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February 02, 2024

Illinois EPA – Division of Waste Management
1021 N. Grand Avenue
Springfield, IL 62702

Attention: Mr. Derek Rompot

Reference: **Grand Tower Inactive Ash Basin Closure**
Stability Analysis
Grand Tower, Jackson County, Illinois

Mr. Rompot:

Environmental Resources Management, Inc. (ERM) on behalf of Grand Tower Energy Center, LLC, received comments for an operating permit application which was submitted in October 2021. Comments were received in January 2023 and in response to the comment letter, ERM is submitting the attached Stability Analysis.

The Stability Analysis was originally an internal ERM memo, used in the final stages of the design process to confirm that the design of the CCR Inactive Ash Basin Closure was acceptable under multiple conditions and scenarios. The original document was developed in May 2019 and subsequently updated in June 2020 and September 2020. The final document with updates is included with appendices below.

A summary table in the results section of the technical memo shows the results of the four models that were run to address the slope stability of the closed surface impoundment. Models 1 and 2 were run for conditions while under construction and prior to the final cover system being installed over the placed CCR material. Models 3 and 4 include the final cover system. The final technical memo indicates that factors of safety for the closed impoundment for all stages are sufficient for static and dynamic conditions.

If you should have any questions or require additional information concerning this submittal, please contact alan.cork@erm.com or 314 733 4489.

ENGINEER'S SEAL

Sincerely,

Environmental Resources Management, Inc.
IL License #184004359

Chris Mettler, P.E.
IL Registration No. 062-070856
Managing Consultant Engineer

cc: Mrs. Lauren Martin – IEPA – Bureau of Water
Mr. Lynn Dunaway – IEPA – Bureau of Water
Mrs. Tabitha Bernhardt – IEPA –Bureau of Water
Mr. Keith Feemster – Rockland Capital
Mr. John Brodhead – Grand Tower Energy Center

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Memo

To	Chris Mettler
From	Daniel Shnider; Stephen Lindsay, P.E.
Date	September 24, 2020 Updated Sept. 29, 2020
Reference	Grand Tower CCR Final Cover
Subject	Slope Stability Analysis Update - Cover System and Seismic Activity

1. INTRODUCTION

Initial slope stability analysis of the ash basin subgrade of the final cover system under static conditions was documented in a report dated May 23, 2019. That initial slope stability model was then updated in June of 2020 to reflect results of geotechnical laboratory tests of the ash and saturated ash collected in Shelby tubes from the basin and to increase the modelled height of the subgrade crest by 4 feet. This memo documents further updates with the primary objective of testing the slope stability of the final cover system under seismic conditions. The updates include the following:

- Addition to the model of the final cover system of the ash basin, which is comprised of geomembrane, geocomposite, three feet of cover soil, and riprap from the toe of the side slopes up to 372 feet elevation (as detailed in Drawing No. 12 in the drawing set issued for bid in April of 2019). The cover soil for the final cover system is sourced from the compacted levee cap, identified as Silty Clay according to 2007 Hanson Subsurface Investigation Report, appended to the Levee Stability Evaluation and Remedial Alternatives Analysis report dated April 2020 (by ERM). The strength parameters in this model of the materials in the cover system and ash basin are presented in Table I and discussed further in Section 2.
- Addition to the model of the seismic horizontal coefficient to run pseudo-static analysis targeting a factor of safety greater than or equal to 1.0; previous reports analysed static conditions through various flood scenarios. The pseudo-static analysis evaluated normal long-term conditions, or in other words, the seismic stability is calculated as a stand-alone causation event, separate from a flooding failure or rapid drawdown event. This is in consideration of 40 CFR 257.73(e)(iii) which states that initial and periodic factor of safety (FoS) assessments shall be conducted under the following conditions:
    - Static factor of safety under the long-term, maximum storage pool loading condition equal to or greater than 1.5 (previously modelled);
    - Static factor of safety under the maximum surcharge pool loading condition equal to or greater than 1.4 (previously modelled); and
    - Dynamic factor of safety equal to or greater than 1.00.

Table I. Summary Table of Material Properties in Slope Stability Model

Material	Friction Angle	Cohesion	Unit Weight	Saturated Unit Weight
RipRap	40°	0 psf	165 pcf	165 pcf
Silty Clay as Cover Soil	10°	450 psf	133 pcf	153 pcf
Critical Interface*	25°	50 psf	110 pcf	110 pcf
Ash**	30°	100 psf	75 pcf	100 pcf
Silty Clay, Impervious Foundation	10°	500 psf	130 pcf	150 pcf
Sandy Silt, Native Pervious Material	24°	150 psf	115 pcf	135 pcf

*The weakest interface, or the critical interface, of the final cover system is the soil/geocomposite interface, which is modelled as a 4-inch layer between the ash and the cover soil materials. A sensitivity analysis of polygonal slip surface through the critical interface, and targeting a FoS of 1.00 was run to test combinations of the lowest angle of friction and cohesion values.

**The June 2020 report discusses geotechnical testing that yields residual and peak strength values for the ash. The residual values are used in both the static and pseudo-static analyses.

2. MATERIAL STRENGTH PARAMETERS

2.1 Ash Basin

As indicated in the initial report, site-specific explorations and laboratory testing data is limited for the subsurface conditions existing at the site, as well as for the materials of construction. Therefore, the design parameters for these materials are not well defined. Borings with certain field and laboratory classification tests were, however, conducted in assessing the potential for contaminant releases trough the base of the coal combustion residual (CCR) pile after closure. Results of the permeability test allowed for calculation of the unit weight and saturated unit weight of the impervious silty clay immediately beneath the ash. The boring logs indicate the presence of soft clays immediately below the ash within the CCR pile. There is also evidence of soft silts directly beneath the impoundment in some areas as the area is riverine in origin, with silts deposited in laminar lenses and thin layers by flood events. These floods continue and can cause significant variance in the groundwater level, as indicated in the Phase 1 Hydrogeologic Assessment Report prepared in March 2013. Historical investigation in 2007 (by Hanson) indicates that immediately beneath the sandy silt, is the underlying aquifer, consisting of sand and gravel. Consideration of the very soft foundation soils and the potential saturation of the ash during a flood event were critical factors in assessing the stability of the site in the report dated May 23, 2019. Furthermore, direct shear tests were performed on four Shelby Tube samples of the ash in June of 2020, which resulted in the residual strength parameters listed in Table I.

2.2 Final Cover System

The final cover system includes three materials introduced into the model, including the RipRap, Cover Soil and Critical Interface, which represents the soil-to-geocomposite interface. The Cover Soil is silty clay material extracted from the adjacent berm, thus it shares the same material properties. The RipRap material properties are within accepted literature values. An infinite slope

calculation (Attachment A) was previously conducted to evaluate the strength of the critical interface with a friction angle of 26 degrees for the design slope of 4:1 and the resultant FoS was greater than 1.0. However, engineering experience and literature values suggest that a friction angle of less than 26 degrees more closely resembles the performance of the soil-to-geocomposite interface (i.e., the critical interface). Through this slope stability model, a sensitivity analysis was run that tested combinations of friction angle and cohesion values resulting in the lowest possible strength values of this critical interface that yield a passing FoS under dynamic conditions (Model 4 in this analysis). The resultant values are a friction angle of 24 degrees and cohesion of 45 psf. These strength parameters were then input to the critical interface in the cover system for the analyses completed herein.

Soil parameters presented herein, based on the generally accepted strength parameters relating soil classifications to the observations noted during the various investigations and adjusted for experience at similar sites, were therefore applied for purposes of these analyses, and may vary from the parameters that would be derived from actual testing. However, the parameters selected are considered reasonable and provide an indication of the relative adequacy of the closure design configuration.

3. SEISMIC CONDITIONS

A peak ground acceleration (PGA) of 0.4621g was estimated for the Site using the Unified Hazard Tool created by the United States Geological Survey (USGS). This tool functions to generate a Hazard Curve, ultimately identifying the PGA of the bedrock using inputs of Site location, classification of the predominate soil of the top 100 feet below ground surface, and recurrence interval (time period). In accordance with Illinois Title 35, Section 845.120, a seismic probability of exceedance of 2% in 50 years, or a return period of approximately 2,475 years was used to generate the PGA of 0.4621g (see Attachment B for the tool's output). The calculated PGA was then converted to a horizontal seismic coefficient, $k_{h,}$ based on the methods presented in the RCRA Subtitle D Seismic Design Guidance for Municipal Solid Waste Landfill Facilities (258.14) Section 4 - Seismic Impact Zones: Site Specific Seismic Design Ground Motion, and Section 6 - Seismic Impact Zones: Slope Stability and Deformation Analysis (see Attachment C for the calculation of horizontal seismic coefficient). With a series of charts of analytical data (figures 4.5 and 4.6), the resultant upper boundary maximum acceleration at the crest is 0.7g; whereas the lower boundary maximum acceleration at the crest is approximately 0.36g. The maximum acceleration values were converted into lower and upper bound horizontal seismic coefficients (0.175 and 0.35, respectively) using the procedures in the RCRA Seismic Design Guidance. Each of these values were input to the model to evaluate the factor of safety in each seismic condition.

4. RESULTS

The results of the updated slope stability analyses for the Ash Basin in Grand Tower, Illinois are summarized in Table II. Detailed reports of the analyses are presented as output files in Attachment D.

Table II. Summary Table of Slope Stability Model Results

		Static		Pseudo-Static	
	Description	**Circular**	**Polygonal***	**Circular**	**Polygonal***
Model 1	No Cover System – Circular Slip Surface extends through Impervious Foundation	2.54	2.25	0.88 (1.39)**	0.77 (1.30)**
Model 2	No Cover System – Slip Surface extends through Ash/Critical Interface	2.92	2.96	1.13	1.15
Model 3	With Cover System – Circular Slip Surface extends through Impervious Foundation	2.62	2.73	0.87 (1.34)**	1.00
Model 4	With Cover System – Slip Surface through Ash/Critical Interface	3.11	2.73	1.15	1.00

*Polygonal slip surfaces were extended through the critical interface.

**Values in parenthesis indicated the simulation of a seismic condition with the lower boundary coefficient, k_h = 0.175; whereas values not in parenthesis in same cell are results of k_h = 0.35.

Model 1 – This first model simulates the ash basin without a final cover system, under both static and seismic conditions and with the critical slip surface extending through the underlying silty clay layer. Under the seismic condition of a 0.35 horizontal coefficient, the ash basin without final cover yields a FoS of 0.88; however, the model yields an FoS of 1.39 when the horizontal coefficient was reduced to the lower boundary of potential seismic conditions of 0.175. This shows that the weakest layer in the global stability of the ash basin is the underlying silty clay located beneath the ash. In fact, under the optimization feature in the software which generates iterations of critical slip surfaces, the polygonal slip surface extends to the silty clay layer, instead of running parallel to the ash slope of 4:1.

Model 2 – This is the same setup as Model 1, however the slip surface was restricted to only the ash layer to understand if the ash itself was stable. The results indicate the ash material at a 4:1 slope to be stable under both static and seismic (k_h = 0.35) conditions.

Model 3 – This is the first model to include the final cover system of the ash basin. This setup was tested under the same static and seismic conditions as Model 1, where the circular slip surface was unrestricted; in addition, the polygonal slip surface extended through the critical interface in the cover system, or the cover soil/geocomposite interface. This model yielded a FoS of 0.87

under the 0.35 horizontal coefficient, with the circular slip surface through the underlying silty clay layer; however, under the seismic condition with the lower bound horizontal coefficient of 0.175, the system yielded a FoS of 1.34 through the silty clay layer. The critical interface, with an angle of friction set to 25 degrees and cohesion of 50 psf, remained stable under seismic conditions (k_h = 0.35), indicated by the polygonal slip surface through the critical interface with an FoS of 1.00.

Model 4 – This model is similar to Model 3, but with restrictions to not allow the slip surface to extend beneath the ash layer (i.e., similar to Model 2). As expected, and similar to the trend of increasing FoS from Model 1 to Model 2, the FoS for both static and seismic (k_h = 0.35) were greater than or equal to 1.00. The polygonal slip surface through the critical interface under seismic conditions (k_h = 0.35) was 1.00.

5. CONCLUSION

The primary objective of this analysis was to evaluate the performance of the final cover system under both static and seismic conditions. Soil parameters presented herein are based on the generally accepted strength parameters relating soil classifications to the observations noted during the various historical Site investigations and adjusted for experience at similar sites. A peak ground acceleration (PGA) of 0.462 was generated, and then converted to upper boundary (k_h = 0.35) and lower boundary (k_h=0.175) seismic coefficients. Initial sensitivity analysis was conducted to identify the lowest values of shear strength possible under the seismic condition of the upper boundary horizontal coefficient. The sensitivity analysis indicates that shear strength parameters for all materials and interfaces that comprise the final cover system need to have a cohesion of no less than 50 psf and angle of friction no less than 25° or a combination of equal strength. This is similar to the result of the infinite slope analysis, which determined that a passing of factor of safety could be achieved on this slope with a friction angle of 26 ° (Attachment A).

In addition to the performance of the final cover system under seismic conditions, we could have a foundation issue if the upper boundary were to occur. Further analysis of the ash basin without restriction to optimization of the slip surface (Models 1 and 3) shows a failure surface extending beyond the CCR pile and through the silty clay layer, or the impervious foundation of the basin, with a factor of safety less than 1.00 using the upper boundary seismic condition. The factor of safety was greater than 1.00 for the lower boundary coefficient. It appears that depending on what is assumed as the design seismic event and possibly the strength of the foundation layer's shear strength properties, the ash basin is stable. Noting that the guidance document (RCRA 258) suggests a conservative approach and is based on empirical analysis, there is room for adjustment; thus, the coefficient was reduced until a factor of safety of 1.00 was reached. For a seismic coefficient of 0.285, the factor of safety is equal to or greater than 1.00 through the ash basin's foundation layer.

APPENDIX A
INFINITE SLOPE CALCULATION

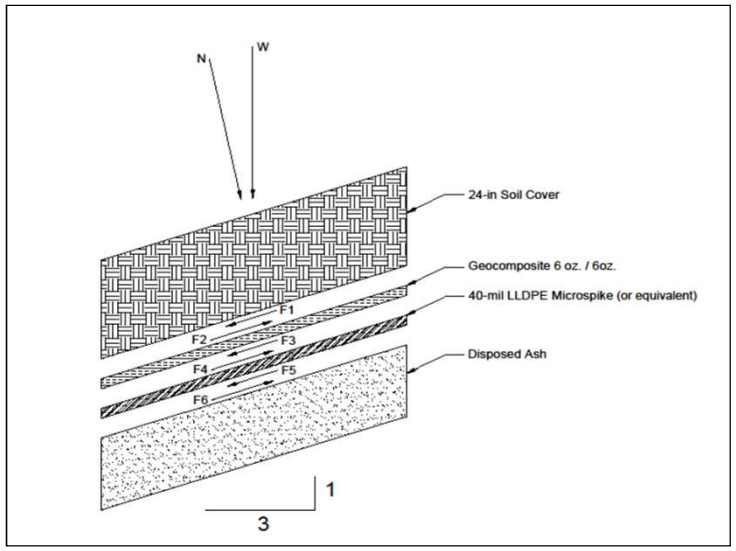
CCB Cap Liner Section Slope Stability of Individual Components - Maximum Slope Length; 50-ft High; Length = 240-ft

Design Conditions:

Maximum Slope = 4H:1V = 14.04 degrees
Minimum Final Cover Soil Thickness = 36-in.
Unit Weight of Cover Soil = 110 pcf
Geocomposite - 6-oz./6-oz. Geotextile on both sides
- Angle of Friction Geotextile to Cover Soil = 26 degrees
- Angle of Friction Geotextile to LLDPE Micro Spike = 28 degrees

Synthetic Liner - Agru America 40-mil LLDPE Micro Spike
- Angle of Friction Geotextile to LLDPE Micro Spike = 28 degrees
- Angle of Friction LLDPE Micro Spike to Ash = 28 degrees

Note: Agru Reported Values for Friction are 32 degrees; Use 28 degrees Conservative



Calculations (Considers a 1-ft X 1-ft block of cap):

W = (3-ft)(240-ft)(1-ft)(110 lb./ft^3) = 79,200.0 lbs.
N = W(cos14.04^o) = 76,834.0 lbs.

F1, Driving Force Down Slope from Cover Soil

F1 = W(sin14.04^o) = 19,213.8 lbs.

F2, Available Resisting Force from Geocomposite Interface with Cover Soil

F2 = N(tan of angle of friction = 26^o) = 37,472.0 lbs.

F2 Available > F1 Driving Force **OK**
Factor of Safety = **2.0**

F3, Driving Force Transferred Through Geocomposite, Cannot Exceed F1 Generated

F3 = F1 = 19,213.8 lbs.

F4, Available Resisting Force from Geocomposite to LLDPE Micro Spike Membrane

F4 = N(tan of angle of friction = 28^o) = 40,852.7 lbs.

F4 Available > F3 Driving Force **OK**
Factor of Safety = **2.1**

F5, Driving Force Transferred Through Geocomposite, Cannot Exceed F3 Generated

F5 = F3 = 19,213.8 lbs.

F6, Available Resisting Force from LLDPE Micro Spike Membrane to Ash

F6 = N(tan of angle of friction = 28^o) = 40,852.7 lbs.

F6 Available > F5 Driving Force **OK**
Factor of Safety = **2.1**

Conclusion: Liner system is stable with no mobilization of components with a minimum factor of safety of 2.0

Reference: Koerner, Robert M., Designing with Geosynthetics, Second Edition, 1990
Agru-America Reported Testing Results for Large Box Shear Testing performed by SGI Testing Services, LLC

Figure - 2

APPENDIX B
UNIFIED HAZARD TOOL

U.S. Geological Survey - Earthquake Hazards Program

Unified Hazard Tool

Please do not use this tool to obtain ground motion parameter values for the design code reference documents covered by the U.S. Seismic Design Maps web tools (e.g., the International Building Code and the ASCE 7 or 41 Standard). The values returned by the two applications are not identical.

Input

Edition

Conterminous U.S. 2014 (v4.0.x)

Spectral Period

Peak Ground Acceleration

Latitude

Decimal degrees

37.653

Time Horizon

Return period in years

2475

Longitude

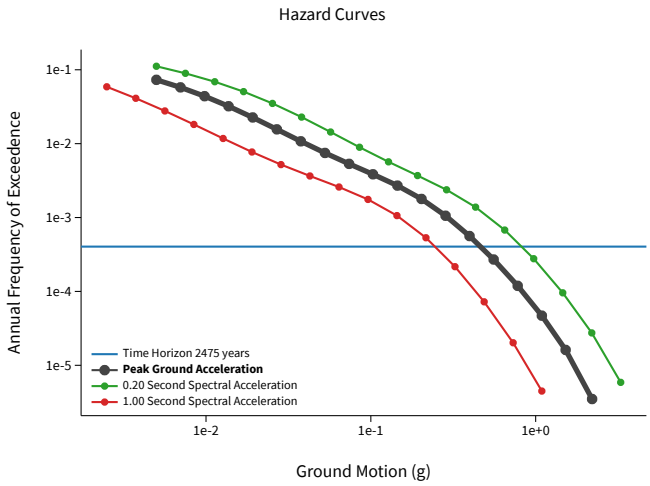
Decimal degrees, negative values for western longitudes

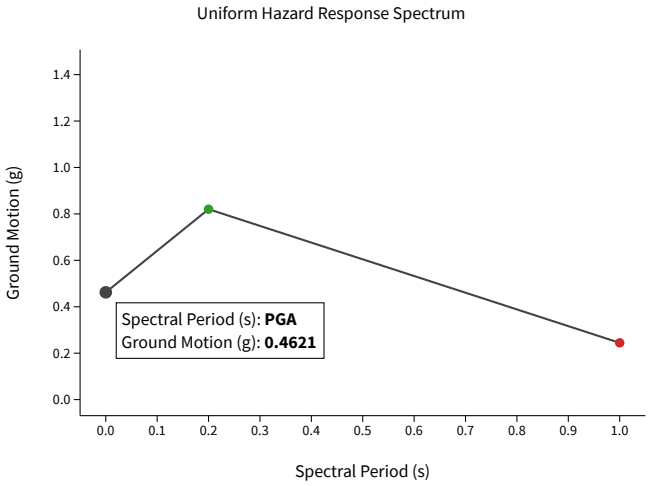
-89.51

Site Class

760 m/s (B/C boundary)

Hazard Curve





View Raw Data

APPENDIX C
CALCULATIONS

Calc By: DS **Date:** 9/23/20 **Project:** 0533442. Ash Basin Closure
√'d By: SL **Date:** **Subject:** Adjusted Ground Acceleration

Reference: "*RCRA Subtitle D Seismic Design Guidance for Municipal Solid Waste Landfill Facilities*"
EPA, April 1995

Objective: Determine the adjusted ground acceleration at the top of the ash basin cover system.

Methodology: Use the design guidelines presented in Section 4 "*RCRA Subtitle D Seismic Design Guidance for Municipal Solid Waste Landfill Facilities*" , EPA, April 1995

Solution: Use the procedure suggested in Section 4.1.1 to determine the adjusted ground acceleration at the top of the landfill.

Step 1: Determine the peak ground acceleration (as a percentage of g) for the site using USGS Unified Hazard Tool, cross-check with 2014 Illinois Hazard Map

a_{max} = 1.25 (Callout on IBC 2003 map)
a_{max} = 0.4-0.8 (Orange shade on map)

https://earthquake.usgs.gov/hazards/interactive/

a_{max} = 0.4621 (Unified Hazard Tool - USGS, input lat., long.

See attached printout for inputs/outputs

Step 2: Classify the site

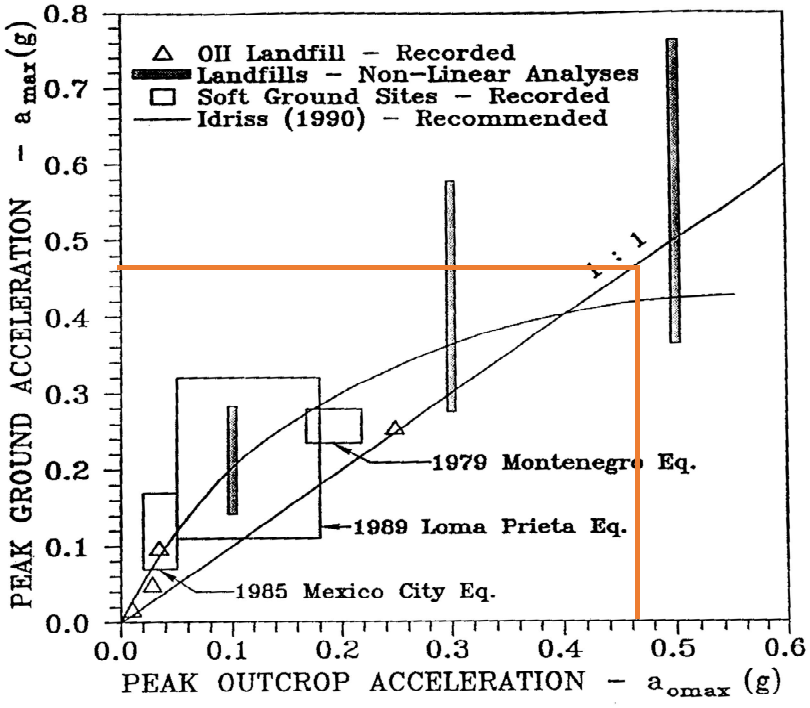
According to USGS Unified Hazard Tool, the Site is classified as 760 m/s (B/C Boundary), which refers to the ASCE 7-02 Standard as soil that has a shear wave veolocity of 760 m/s or (~2,493 ft/sec), or a soil class of rock/very dense soil and soft rock.

Step 3: Estimate free field acceleration

The potential amplification of the bedrock by the local, soft soil deposits on the Site is best estimated by the curve by Idriss (1990). However, the curve does note intersect a PGA of 0.4522; thus, assume a 1:1 amplification as a conservative measure for the

free field peak ground acceleration at the Site.

Figure 4.5



Step 4: Estimate peak acceleration at the top of the ash basin.
Use Figure 4.6 to obtain the maximum acceleration at the peak of the ash basin final cover system (59 feet high).

Figure 4.6

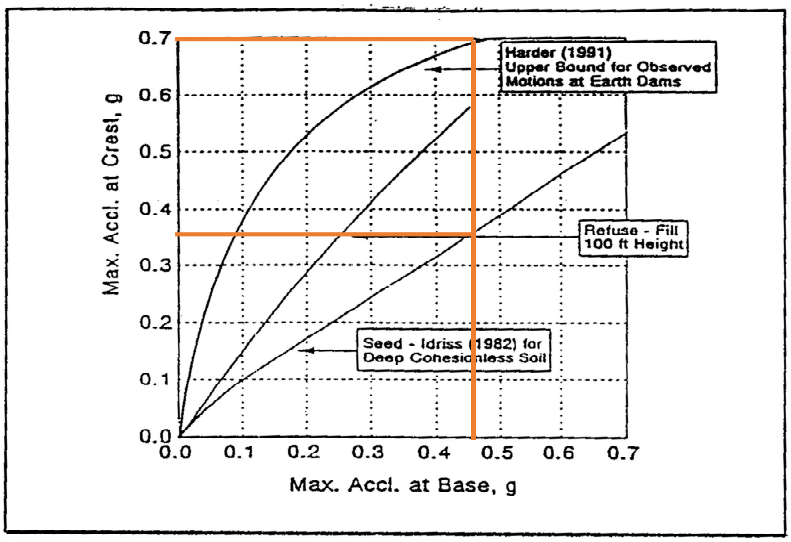


Fig 4.6 Approximate Relationship Between Max. Acceleration at the Base and crest for Various Ground Conditions (Singh and Sun, 1995)

As a general rule (pp. 46 of RCRA 258) if the predominant periods of the bedrock, foundation soil, and ash matches then the amplification is likely determined by the upper boundary.

upper boundary of the Max Acceleration at Crest is approx. 0.7g.
lower boundary of the Max Acceleration at Crest is approx. 0.35g.

Discussion:

According to RCRA Subtitle D (258) Chapter 6 Step 2 in defining the seismic coefficient, k_s, is determined as $0.5*a_{max}/g$

K_s lower boundary = 0.175
K_s upper boundary = 0.35

The horizontal seismic coefficient used in the slope stability analysis will be both boundary limits.

APPENDIX D
SLOPE STABILITY OUTPUT

Slope stability analysis

Input data

Project

Task : Confirmatory Model for Final Closure of the Ash Basin
Description : Slope Stability Analysis of Grand Tower CCR Impoundment Final Closure Plan
Author : ERM - Annapolis
Date : 6/22/2020
Project number : 0533442

Settings

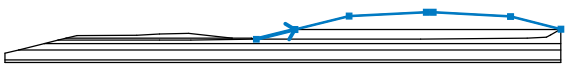
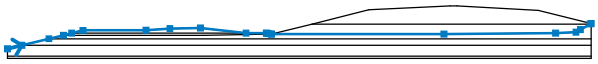
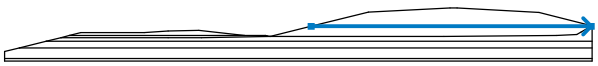
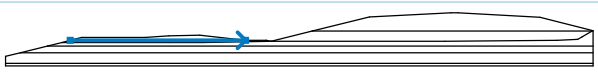
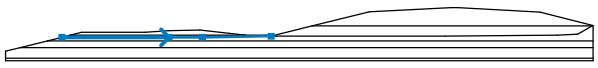
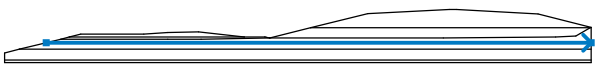
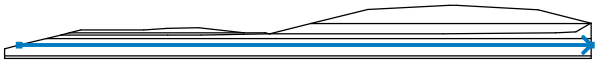
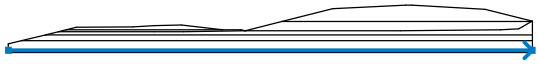
(input for current task)

Stability analysis

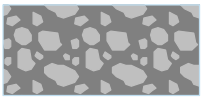
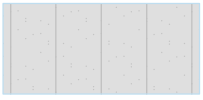
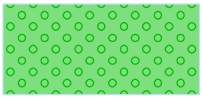
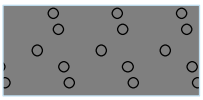
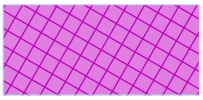
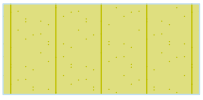
Earthquake analysis : Standard
Verification methodology : Safety factors (ASD)

Safety factors			
Permanent design situation			
Safety factor :	SF_s =	1.50	[–]

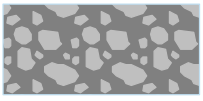
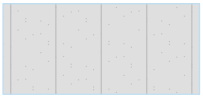
Interface

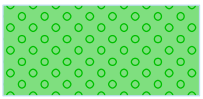
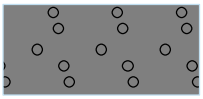
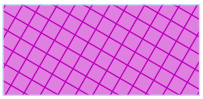
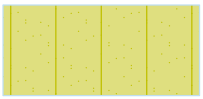
No.	Interface location	Coordinates of interface points [ft]					
		x	z	x	z	x	z
1		200.00	-11.00	279.99	9.00	392.00	37.00
		552.00	45.00	566.00	45.00	726.00	36.00
		830.00	10.00				
2		-320.00	-40.00	-291.43	-33.00	-238.36	-20.00
		-209.79	-13.00	-193.45	-9.00	-171.00	-3.50
		-47.00	-3.00	0.00	0.00	60.00	1.10
		150.00	-9.00	190.00	-9.00	190.64	-9.12
		193.34	-9.67	199.27	-10.85	200.00	-11.00
		540.00	-11.00	760.00	-9.00	800.00	-7.00
		808.86	-1.98	828.24	9.00	830.00	10.00
3		279.99	9.00	828.24	9.00		
4		-193.45	-9.00	150.00	-9.00		
5		-209.79	-13.00	0.00	-13.00	65.00	-13.00
		200.00	-11.00				
6		-238.36	-20.00	830.00	-20.00		
7		-291.43	-33.00	830.00	-33.00		
8		-320.00	-54.00	830.00	-54.00		

Soil parameters - effective stress state

No.	Name	Pattern	φ_{ef} [°]	c_{ef} [psf]	γ [pcf]
1	Ash - Geotech Lab 6/2020		30.00	100.0	75.0
2	Silty Clay (Compacted Levee Cap)		10.00	450.0	133.0
3	Silty Sand (layer in berm, not basin)		28.00	100.0	115.0
4	Silty Clay, impervious fdtn (Updated with 2007 Hanson Report and ERM)		10.00	500.0	130.0
5	Sand & Gravel (Underlying Aquifer)		34.00	0.0	130.0
6	Gravel with trace of fines (G-F), medium dense- RipRap		40.00	0.0	165.0
7	Critical Interface		25.00	50.0	110.0
8	Sandy Silt (Native Pervious Material)		24.00	150.0	115.0

Soil parameters - uplift

No.	Name	Pattern	γ_{sat} [pcf]	γ_s [pcf]	n [–]
1	Ash - Geotech Lab 6/2020		100.0		
2	Silty Clay (Compacted Levee Cap)		153.0		
3	Silty Sand (layer in berm, not basin)		136.0		
4	Silty Clay, impervious fdtn (Updated with 2007 Hanson Report and ERM)		150.0		

No.	Name	Pattern	γ_{sat} [pcf]	γ_s [pcf]	n [–]
5	Sand & Gravel (Underlying Aquifer)		130.0		
6	Gravel with trace of fines (G-F), medium dense- RipRap		165.0		
7	Critical Interface		110.0		
8	Sandy Silt (Native Pervious Material)		135.0		

Soil parameters

Ash - Geotech Lab 6/2020

Unit weight : γ = 75.0 pcf
Stress-state : effective
Angle of internal friction : φ_{ef} = 30.00 °
Cohesion of soil : c_{ef} = 100.0 psf
Saturated unit weight : γ_{sat} = 100.0 pcf

Silty Clay (Compacted Levee Cap)

Unit weight : γ = 133.0 pcf
Stress-state : effective
Angle of internal friction : φ_{ef} = 10.00 °
Cohesion of soil : c_{ef} = 450.0 psf
Saturated unit weight : γ_{sat} = 153.0 pcf

Silty Sand (layer in berm, not basin)

Unit weight : γ = 115.0 pcf
Stress-state : effective
Angle of internal friction : φ_{ef} = 28.00 °
Cohesion of soil : c_{ef} = 100.0 psf
Saturated unit weight : γ_{sat} = 136.0 pcf

Silty Clay, impervious fdtn (Updated with 2007 Hanson Report and ERM)

Unit weight : γ = 130.0 pcf
Stress-state : effective
Angle of internal friction : φ_{ef} = 10.00 °
Cohesion of soil : c_{ef} = 500.0 psf
Saturated unit weight : γ_{sat} = 150.0 pcf

Sand & Gravel (Underlying Aquifer)

Unit weight : γ = 130.0 pcf
Stress-state : effective
Angle of internal friction : φ_{ef} = 34.00 °

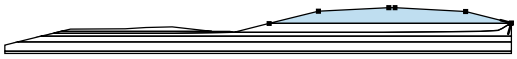
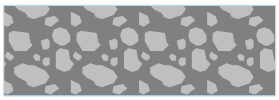
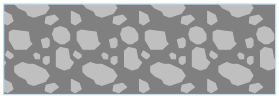
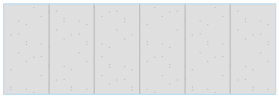
Cohesion of soil : c_{ef} = 0.0 psf
Saturated unit weight : γ_{sat} = 130.0 pcf

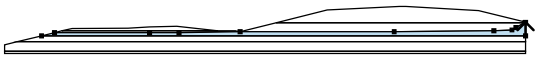
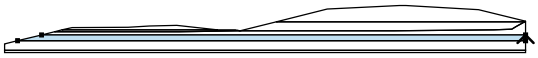
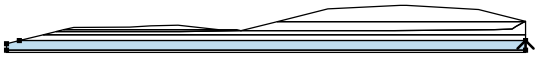
Gravel with trace of fines (G-F), medium dense- RipRap
Unit weight : γ = 165.0 pcf
Stress-state : effective
Angle of internal friction : φ_{ef} = 40.00 °
Cohesion of soil : c_{ef} = 0.0 psf
Saturated unit weight : γ_{sat} = 165.0 pcf

Critical Interface
Unit weight : γ = 110.0 pcf
Stress-state : effective
Angle of internal friction : φ_{ef} = 25.00 °
Cohesion of soil : c_{ef} = 50.0 psf
Saturated unit weight : γ_{sat} = 110.0 pcf

Sandy Silt (Native Pervious Material)
Unit weight : γ = 115.0 pcf
Stress-state : effective
Angle of internal friction : φ_{ef} = 24.00 °
Cohesion of soil : c_{ef} = 150.0 psf
Saturated unit weight : γ_{sat} = 135.0 pcf

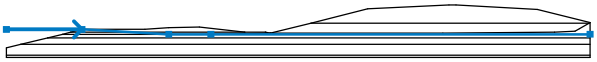
Assigning and surfaces

No.	Surface position	Coordinates of surface points [ft]				Assigned soil
		x	z	x	z	
1		828.24	9.00	830.00	10.00	Ash - Geotech Lab 6/2020
		726.00	36.00	566.00	45.00	
		552.00	45.00	392.00	37.00	
		279.99	9.00			
2		150.00	-9.00	60.00	1.10	Silty Clay (Compacted Levee Cap)
		0.00	0.00	-47.00	-3.00	
		-171.00	-3.50	-193.45	-9.00	
3		279.99	9.00	200.00	-11.00	Ash - Geotech Lab 6/2020
		540.00	-11.00	760.00	-9.00	
		800.00	-7.00	808.86	-1.98	
		828.24	9.00			
4		0.00	-13.00	65.00	-13.00	Silty Sand (layer in berm, not basin)
		200.00	-11.00	199.27	-10.85	
		193.34	-9.67	190.64	-9.12	
		190.00	-9.00	150.00	-9.00	
		-193.45	-9.00	-209.79	-13.00	

No.	Surface position	Coordinates of surface points [ft]				Assigned soil
		x	z	x	z	
5		830.00	-20.00	830.00	10.00	Silty Clay, Impervious fdtn (Updated with 2007 Hanson Report and ERM)
		828.24	9.00	808.86	-1.98	
		800.00	-7.00	760.00	-9.00	
		540.00	-11.00	200.00	-11.00	
		65.00	-13.00	0.00	-13.00	
		-209.79	-13.00	-238.36	-20.00	
6		830.00	-33.00	830.00	-20.00	Sandy Silt (Native Pervious Material)
		-238.36	-20.00	-291.43	-33.00	
7		830.00	-54.00	830.00	-33.00	Sand & Gravel (Underlying Aquifer)
		-291.43	-33.00	-320.00	-40.00	
		-320.00	-54.00			
8		-320.00	-54.00	-320.00	-59.00	Sand & Gravel (Underlying Aquifer)
		830.00	-59.00	830.00	-54.00	

Water

Water type : GWT

No.	GWT location	Coordinates of GWT points [ft]					
		x	z	x	z	x	z
1		-320.00	-3.50	-171.00	-3.50	0.00	-13.00
		83.00	-13.00	830.00	-13.00		

Tensile crack

Tensile crack not input.

Earthquake

Earthquake not included.

Settings of the stage of construction

Design situation : permanent

Results (Stage of construction 1)

Analysis 1 (stage 1)

Circular slip surface

Slip surface parameters							
Center :	x =	282.95	[ft]	Angles :	α_1 =	-23.96	[°]
	z =	137.27	[ft]		α_2 =	50.60	[°]
Radius :	R =	157.01	[ft]				
The slip surface after optimization.							

Segments restricting slip surface

No.	First point		Second point	
	x [ft]	z [ft]	x [ft]	z [ft]
1	-247.18	-19.54	775.42	-19.95

The restrictions of points of circular slip surface

Slope stability verification (Bishop)

Sum of active forces : F_a = 68484.3 lbf/ft
Sum of passive forces : F_p = 173789.3 lbf/ft

Sliding moment : M_a = 10752715.9 lbfft/ft
Resisting moment : M_p = 27286652.3 lbfft/ft

Factor of safety = 2.54 > 1.50

Slope stability ACCEPTABLE

Optimization of circular slip surface (Bishop)

No.	Center		Radius	FS	Verification
	x [ft]	z [ft]	R [ft]		
1	241.42	181.51	193.84	3.12	ACCEPTABLE
2	241.42	181.51	193.84	3.12	ACCEPTABLE
3	241.42	181.51	193.84	3.12	ACCEPTABLE
4	155.79	1773.27	1783.68	6.59	ACCEPTABLE
5	467.68	146.52	160.87	11.94	ACCEPTABLE
6	226.13	4809.90	4817.79	11.08	ACCEPTABLE
7	163.81	1663.81	1675.68	6.91	ACCEPTABLE
8	241.42	181.51	193.84	3.12	ACCEPTABLE
9	198.58	959.16	969.04	3.81	ACCEPTABLE
10	431.91	85.17	92.87	13.02	ACCEPTABLE
11	35.51	1326.73	1337.69	2560.65	ACCEPTABLE
12	184.64	832.69	841.93	3.48	ACCEPTABLE
13	306.53	2738.25	2748.90	9.46	ACCEPTABLE
14	220.96	1400.52	1409.48	4.82	ACCEPTABLE
15	202.90	911.95	923.08	4.81	ACCEPTABLE
16	241.42	181.51	193.84	3.12	ACCEPTABLE
17	182.72	836.77	844.30	3.50	ACCEPTABLE
18	375.83	95.53	103.61	5.45	ACCEPTABLE
19	162.20	395.60	403.63	1240110.62	ACCEPTABLE
20	207.47	637.29	649.38	4.12	ACCEPTABLE
21	241.42	181.51	193.84	3.12	ACCEPTABLE
22	175.52	693.44	702.15	3.25	ACCEPTABLE
23	335.19	108.59	117.38	3.73	ACCEPTABLE
24	176.65	305.98	316.00	5.28	ACCEPTABLE
25	210.86	473.19	486.30	3.71	ACCEPTABLE
26	241.42	181.51	193.84	3.12	ACCEPTABLE
27	190.48	506.62	516.43	3.09	ACCEPTABLE
28	-279.51	3342.03	3382.14	4.34	ACCEPTABLE
29	-57.59	2183.70	2203.50	4.21	ACCEPTABLE

No.	Center		Radius	FS	Verification
	x [ft]	z [ft]	R [ft]		
30	222.65	513.95	526.65	3.54	ACCEPTABLE
31	296.49	311.27	312.83	3.46	ACCEPTABLE
32	160.13	600.27	605.37	5.41	ACCEPTABLE
33	115.44	772.94	783.22	6.12	ACCEPTABLE
34	209.31	280.80	293.92	4.09	ACCEPTABLE
35	274.66	142.13	142.35	3.23	ACCEPTABLE
36	156.06	910.71	919.72	3.46	ACCEPTABLE
37	265.06	476.63	475.08	3.54	ACCEPTABLE
38	190.48	506.62	516.43	3.09	ACCEPTABLE
39	98.09	1181.37	1191.39	3.71	ACCEPTABLE
40	58.91	1357.16	1371.12	3.75	ACCEPTABLE
41	217.84	495.02	505.80	3.10	ACCEPTABLE
42	267.25	356.55	359.94	3.22	ACCEPTABLE
43	193.81	465.53	469.45	3.81	ACCEPTABLE
44	150.24	612.54	622.05	3.97	ACCEPTABLE
45	279.77	121.68	131.25	3.11	ACCEPTABLE
46	209.48	329.82	340.53	3.08	ACCEPTABLE
47	214.29	468.49	471.87	3.22	ACCEPTABLE
48	152.57	702.75	712.00	3.39	ACCEPTABLE
49	228.29	321.00	334.89	3.26	ACCEPTABLE
50	270.94	225.27	231.65	2.98	ACCEPTABLE
51	316.04	191.19	194.33	3.40	ACCEPTABLE
52	165.54	741.19	752.67	6.02	ACCEPTABLE
53	255.13	317.84	332.80	2.95	ACCEPTABLE
54	292.93	323.69	332.42	3.48	ACCEPTABLE
55	228.77	554.98	566.90	3.54	ACCEPTABLE
56	259.82	370.24	389.43	3.00	ACCEPTABLE
57	303.72	265.66	278.18	3.20	ACCEPTABLE
58	279.58	188.17	197.11	3.00	ACCEPTABLE
59	229.38	315.52	329.68	3.25	ACCEPTABLE
60	296.52	115.43	135.01	2.58	ACCEPTABLE
61	296.36	110.87	111.76	3.20	ACCEPTABLE
62	265.21	447.40	442.90	3.51	ACCEPTABLE
63	267.31	260.28	278.76	2.72	ACCEPTABLE
64	333.53	102.98	121.68	2.99	ACCEPTABLE
65	250.01	296.28	292.01	3.74	ACCEPTABLE
66	311.96	48.46	66.51	3.36	ACCEPTABLE
67	333.36	103.85	122.28	2.99	ACCEPTABLE
68	296.52	115.43	135.01	2.58	ACCEPTABLE
69	322.00	103.92	123.67	2.78	ACCEPTABLE
70	295.04	116.15	122.02	3.15	ACCEPTABLE
71	217.46	484.04	492.17	3.10	ACCEPTABLE
72	294.29	235.91	237.72	3.20	ACCEPTABLE
73	278.80	201.91	220.49	2.62	ACCEPTABLE
74	321.41	106.71	125.66	2.80	ACCEPTABLE
75	307.08	68.00	85.99	2.95	ACCEPTABLE
76	240.82	247.31	257.07	2.97	ACCEPTABLE
77	284.40	158.72	160.05	3.08	ACCEPTABLE
78	307.38	66.78	85.26	2.94	ACCEPTABLE

No.	Center		Radius	FS	Verification
	x [ft]	z [ft]	R [ft]		
79	320.41	111.51	129.15	2.82	ACCEPTABLE
80	296.52	115.43	135.01	2.58	ACCEPTABLE
81	312.06	114.73	132.50	2.73	ACCEPTABLE
82	295.11	116.52	126.46	3.15	ACCEPTABLE
83	262.76	271.09	281.03	3.00	ACCEPTABLE
84	298.27	178.12	185.55	3.15	ACCEPTABLE
85	285.36	169.27	188.03	2.58	ACCEPTABLE
86	313.22	109.42	128.56	2.70	ACCEPTABLE
87	303.08	84.36	102.03	2.78	ACCEPTABLE
88	264.75	181.16	193.23	2.87	ACCEPTABLE
89	290.59	134.73	141.86	3.08	ACCEPTABLE
90	303.96	80.82	99.65	2.77	ACCEPTABLE
91	312.11	114.50	132.33	2.73	ACCEPTABLE
92	296.52	115.43	135.01	2.58	ACCEPTABLE
93	306.26	117.80	135.50	2.68	ACCEPTABLE
94	295.46	116.89	129.79	2.86	ACCEPTABLE
95	278.29	198.81	211.50	2.83	ACCEPTABLE
96	298.62	152.11	163.50	3.02	ACCEPTABLE
97	289.34	149.78	168.74	2.56	ACCEPTABLE
98	298.74	154.84	171.50	2.69	ACCEPTABLE
99	287.14	155.72	168.15	2.83	ACCEPTABLE
100	266.02	259.33	271.92	2.90	ACCEPTABLE
101	289.07	199.62	210.61	3.12	ACCEPTABLE
102	280.62	192.61	210.99	2.61	ACCEPTABLE
103	301.08	143.98	162.55	2.63	ACCEPTABLE
104	293.96	126.42	143.63	2.63	ACCEPTABLE
105	266.14	203.84	217.75	2.78	ACCEPTABLE
106	284.03	169.07	179.88	3.03	ACCEPTABLE
107	277.33	156.16	175.57	2.55	ACCEPTABLE
108	286.38	162.95	179.85	2.63	ACCEPTABLE
109	274.62	163.18	176.26	2.79	ACCEPTABLE
110	250.99	275.60	289.07	2.92	ACCEPTABLE
111	275.61	210.75	222.40	2.90	ACCEPTABLE
112	267.64	202.33	221.19	2.61	ACCEPTABLE
113	289.34	149.78	168.74	2.56	ACCEPTABLE
114	282.11	132.38	149.90	2.61	ACCEPTABLE
115	252.41	214.89	229.63	2.84	ACCEPTABLE
116	270.86	178.67	190.13	2.89	ACCEPTABLE
117	283.72	125.76	144.51	2.58	ACCEPTABLE
118	287.66	157.24	174.99	2.61	ACCEPTABLE
119	277.33	156.16	175.57	2.55	ACCEPTABLE
120	283.06	161.97	179.51	2.60	ACCEPTABLE
121	275.55	160.90	175.99	2.69	ACCEPTABLE
122	262.03	225.22	240.43	2.77	ACCEPTABLE
123	276.80	189.37	203.54	2.74	ACCEPTABLE
124	271.04	185.97	204.97	2.58	ACCEPTABLE
125	285.37	151.84	170.94	2.55	ACCEPTABLE
126	280.46	140.46	158.55	2.59	ACCEPTABLE
127	261.62	192.06	208.14	2.72	ACCEPTABLE

No.	Center		Radius	FS	Verification
	x [ft]	z [ft]	R [ft]		
128	273.46	169.60	183.65	2.74	ACCEPTABLE
129	281.67	135.42	154.38	2.57	ACCEPTABLE
130	284.13	157.26	175.50	2.58	ACCEPTABLE
131	277.33	156.16	175.57	2.55	ACCEPTABLE
132	281.02	160.57	178.66	2.58	ACCEPTABLE
133	276.15	159.34	175.83	2.64	ACCEPTABLE
134	267.93	198.46	214.98	2.68	ACCEPTABLE
135	277.21	177.10	192.99	2.67	ACCEPTABLE
136	273.21	175.62	194.74	2.57	ACCEPTABLE
137	282.70	153.25	172.45	2.55	ACCEPTABLE
138	286.47	157.29	175.20	2.59	ACCEPTABLE
139	281.62	156.22	172.46	2.65	ACCEPTABLE
140	273.75	194.15	210.39	2.68	ACCEPTABLE
141	282.82	173.42	189.08	2.68	ACCEPTABLE
142	278.77	172.10	191.00	2.57	ACCEPTABLE
143	288.02	150.46	169.47	2.56	ACCEPTABLE
144	284.73	142.92	161.24	2.58	ACCEPTABLE
145	272.86	175.20	192.03	2.64	ACCEPTABLE
146	280.48	161.10	176.67	2.67	ACCEPTABLE
147	277.33	156.16	175.57	2.55	ACCEPTABLE
148	286.39	135.82	155.41	2.54	ACCEPTABLE
149	290.26	139.15	157.49	2.58	ACCEPTABLE
150	285.57	137.75	154.34	2.63	ACCEPTABLE
151	278.39	171.93	188.46	2.64	ACCEPTABLE
152	287.01	153.33	169.32	2.66	ACCEPTABLE
153	282.80	152.78	172.06	2.55	ACCEPTABLE
154	291.57	133.45	152.87	2.56	ACCEPTABLE
155	288.34	126.12	144.86	2.58	ACCEPTABLE
156	277.23	154.77	171.90	2.62	ACCEPTABLE
157	284.59	141.90	157.81	2.66	ACCEPTABLE
158	289.02	123.26	142.59	2.56	ACCEPTABLE
159	290.88	136.46	155.30	2.57	ACCEPTABLE
160	286.39	135.82	155.41	2.54	ACCEPTABLE
161	288.92	138.26	156.98	2.57	ACCEPTABLE
162	285.84	137.14	154.71	2.60	ACCEPTABLE
163	281.31	158.73	176.25	2.60	ACCEPTABLE
164	286.87	147.12	164.31	2.61	ACCEPTABLE
165	284.02	146.98	166.35	2.54	ACCEPTABLE
166	289.85	134.23	153.70	2.55	ACCEPTABLE
167	287.68	129.38	148.39	2.56	ACCEPTABLE
168	280.39	148.09	166.00	2.59	ACCEPTABLE
169	285.24	139.72	156.84	2.62	ACCEPTABLE
170	282.91	137.46	157.17	2.54	ACCEPTABLE
171	285.40	140.04	158.86	2.56	ACCEPTABLE
172	282.33	138.84	156.55	2.60	ACCEPTABLE
173	277.66	160.84	178.51	2.60	ACCEPTABLE
174	283.30	149.02	166.34	2.61	ACCEPTABLE
175	280.47	148.85	168.34	2.54	ACCEPTABLE
176	282.92	151.75	170.34	2.57	ACCEPTABLE

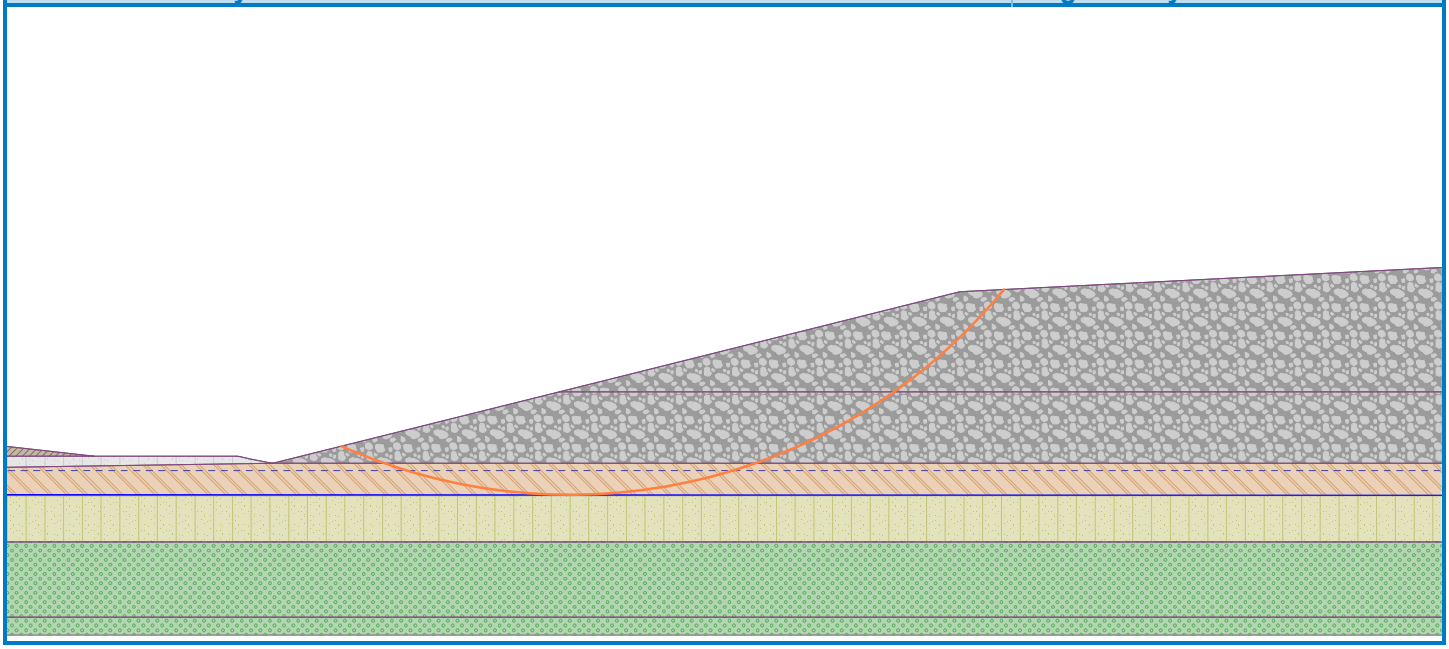
No.	Center		Radius	FS	Verification
	x [ft]	z [ft]	R [ft]		
177	279.78	150.67	168.17	2.60	ACCEPTABLE
178	274.84	174.18	191.67	2.61	ACCEPTABLE
179	280.66	161.52	178.64	2.62	ACCEPTABLE
180	277.88	161.05	180.33	2.55	ACCEPTABLE
181	284.01	147.03	166.39	2.54	ACCEPTABLE
182	281.81	142.11	160.99	2.56	ACCEPTABLE
183	274.08	162.62	180.49	2.60	ACCEPTABLE
184	279.07	153.65	170.71	2.62	ACCEPTABLE
185	276.90	150.72	170.35	2.54	ACCEPTABLE
186	282.95	137.27	157.01	2.54	ACCEPTABLE
187	285.45	139.85	158.69	2.56	ACCEPTABLE
188	282.37	138.64	156.38	2.60	ACCEPTABLE
189	277.71	160.61	178.31	2.60	ACCEPTABLE
190	283.35	148.81	166.16	2.60	ACCEPTABLE
191	280.52	148.64	168.17	2.54	ACCEPTABLE
192	286.43	135.64	155.26	2.54	ACCEPTABLE
193	284.25	130.80	149.95	2.56	ACCEPTABLE
194	276.85	149.77	167.86	2.59	ACCEPTABLE
195	281.73	141.32	158.61	2.61	ACCEPTABLE
196	284.75	128.70	148.26	2.55	ACCEPTABLE
197	285.92	137.81	157.03	2.55	ACCEPTABLE
198	282.95	137.27	157.01	2.54	ACCEPTABLE
199	284.59	139.09	158.21	2.55	ACCEPTABLE
200	282.57	138.20	156.59	2.58	ACCEPTABLE
201	279.56	152.34	170.70	2.58	ACCEPTABLE
202	283.25	144.80	162.94	2.58	ACCEPTABLE
203	281.34	144.79	164.38	2.54	ACCEPTABLE
204	285.27	136.18	155.83	2.54	ACCEPTABLE
205	283.81	132.97	152.31	2.55	ACCEPTABLE
206	278.93	145.45	164.07	2.57	ACCEPTABLE
207	282.16	139.90	158.00	2.58	ACCEPTABLE
208	284.16	131.52	151.13	2.55	ACCEPTABLE
209	284.92	137.66	157.05	2.55	ACCEPTABLE
210	282.95	137.27	157.01	2.54	ACCEPTABLE
211	284.03	138.52	157.85	2.55	ACCEPTABLE
212	282.69	137.89	156.73	2.56	ACCEPTABLE
213	280.74	147.11	165.93	2.56	ACCEPTABLE
214	283.16	142.22	160.90	2.57	ACCEPTABLE
215	281.88	142.25	161.89	2.54	ACCEPTABLE
216	284.50	136.54	156.22	2.54	ACCEPTABLE
217	283.52	134.41	153.88	2.55	ACCEPTABLE
218	280.29	142.65	161.64	2.56	ACCEPTABLE
219	282.43	139.00	157.64	2.57	ACCEPTABLE
220	283.76	133.42	153.07	2.54	ACCEPTABLE
221	284.26	137.54	157.04	2.54	ACCEPTABLE
222	282.95	137.27	157.01	2.54	ACCEPTABLE
223	283.67	138.12	157.58	2.54	ACCEPTABLE
224	282.78	137.69	156.83	2.55	ACCEPTABLE
225	281.49	143.74	162.86	2.55	ACCEPTABLE

No.	Center		Radius	FS	Verification
	x [ft]	z [ft]	R [ft]		
226	283.10	140.54	159.57	2.56	ACCEPTABLE
227	282.24	140.58	160.25	2.54	ACCEPTABLE
228	283.98	136.78	156.48	2.54	ACCEPTABLE
229	283.33	135.36	154.92	2.55	ACCEPTABLE
230	281.19	140.83	160.06	2.56	ACCEPTABLE
231	282.61	138.41	157.42	2.56	ACCEPTABLE
232	283.49	134.69	154.38	2.54	ACCEPTABLE
233	283.82	137.46	157.04	2.54	ACCEPTABLE
234	516.13	125.83	145.14	27.21	ACCEPTABLE
235	282.95	137.27	157.01	2.54	ACCEPTABLE
236	461.43	88.11	105.24	13.99	ACCEPTABLE
237	-1055.31	5750.14	5893.59	3297.83	ACCEPTABLE
238	282.95	137.27	157.01	2.54	ACCEPTABLE
239	240.56	595.66	613.52	3.72	ACCEPTABLE
240	405.44	97.43	114.82	5.93	ACCEPTABLE
241	189.38	193.40	211.45	8.89	ACCEPTABLE
242	282.95	137.27	157.01	2.54	ACCEPTABLE
243	240.09	476.12	493.22	3.36	ACCEPTABLE
244	366.62	106.68	124.46	3.81	ACCEPTABLE
245	214.06	177.96	197.28	4.12	ACCEPTABLE
246	282.95	137.27	157.01	2.54	ACCEPTABLE
247	251.99	352.56	369.92	3.02	ACCEPTABLE
248	339.81	114.70	132.91	3.09	ACCEPTABLE
249	307.29	34.68	51.95	3.92	ACCEPTABLE
250	282.95	137.27	157.01	2.54	ACCEPTABLE
251	276.47	157.98	158.94	3.14	ACCEPTABLE
252	-499.90	4157.14	4222.70	4.48	ACCEPTABLE
253	213.95	647.75	647.37	3.53	ACCEPTABLE
254	260.48	276.58	294.41	2.79	ACCEPTABLE
255	321.40	121.11	139.71	2.79	ACCEPTABLE
256	175.10	563.45	566.99	4.60	ACCEPTABLE
257	300.83	60.54	78.39	3.04	ACCEPTABLE
258	320.32	126.41	143.74	2.83	ACCEPTABLE
259	282.95	137.27	157.01	2.54	ACCEPTABLE
260	307.93	130.22	148.21	2.68	ACCEPTABLE
261	278.85	148.46	154.75	3.05	ACCEPTABLE
262	178.06	623.67	634.81	3.13	ACCEPTABLE
263	272.01	297.38	300.32	3.12	ACCEPTABLE
264	262.44	238.76	257.50	2.68	ACCEPTABLE
265	308.85	125.95	144.87	2.66	ACCEPTABLE
266	294.46	86.02	103.14	2.79	ACCEPTABLE
267	215.60	318.92	330.14	3.33	ACCEPTABLE
268	263.20	211.06	213.56	3.09	ACCEPTABLE
269	295.52	81.76	100.16	2.77	ACCEPTABLE
270	307.07	134.25	151.41	2.71	ACCEPTABLE
271	282.95	137.27	157.01	2.54	ACCEPTABLE
272	297.99	140.08	157.16	2.65	ACCEPTABLE
273	280.15	143.25	153.63	3.04	ACCEPTABLE
274	239.69	333.47	344.72	3.01	ACCEPTABLE

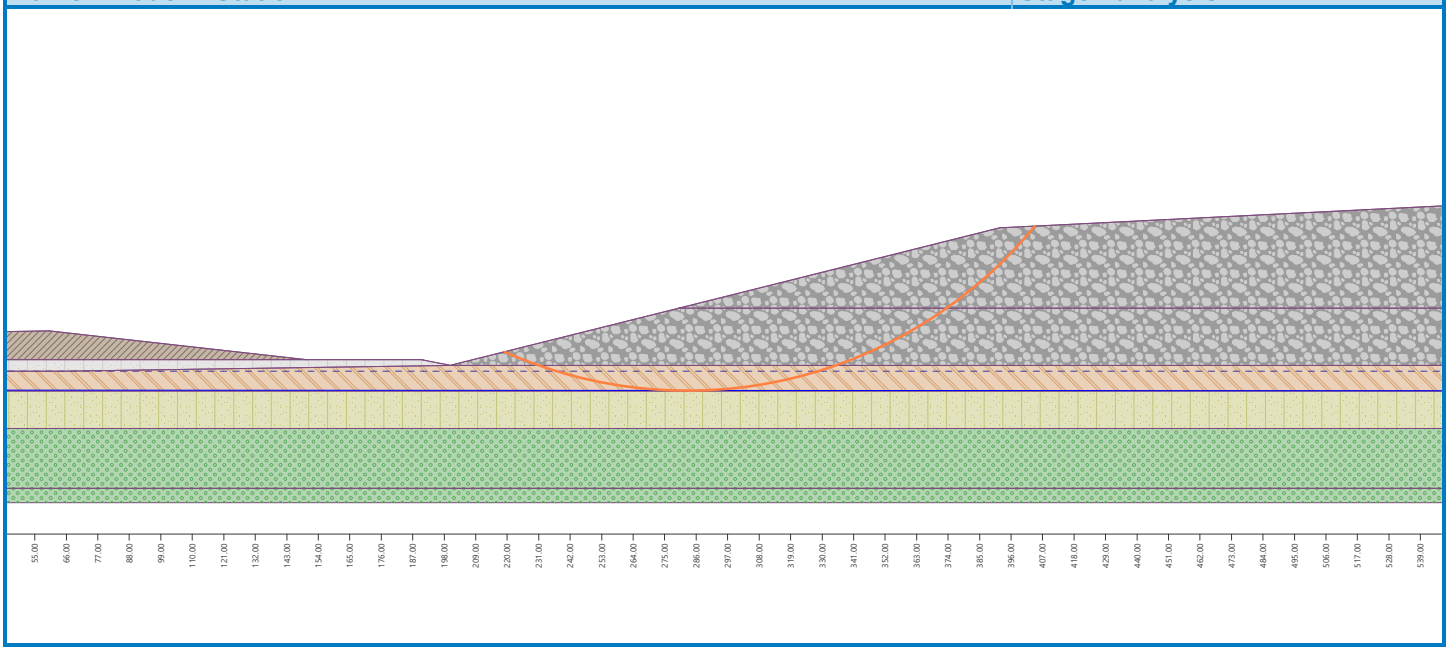
No.	Center		Radius	FS	Verification
	x [ft]	z [ft]	R [ft]		
275	280.78	217.50	225.54	3.04	ACCEPTABLE
276	269.46	201.63	220.60	2.61	ACCEPTABLE
277	300.35	129.46	148.63	2.60	ACCEPTABLE
278	290.07	103.57	120.93	2.69	ACCEPTABLE
279	245.86	223.24	236.24	2.97	ACCEPTABLE
280	273.89	168.29	176.04	3.01	ACCEPTABLE
281	291.55	97.67	116.51	2.66	ACCEPTABLE
282	298.65	137.11	154.75	2.63	ACCEPTABLE
283	282.95	137.27	157.01	2.54	ACCEPTABLE
284	292.29	142.15	159.58	2.61	ACCEPTABLE
285	281.03	141.38	154.66	2.79	ACCEPTABLE
286	260.16	239.91	253.33	2.84	ACCEPTABLE
287	282.92	183.43	195.23	2.88	ACCEPTABLE
288	274.30	178.19	197.33	2.57	ACCEPTABLE
289	294.61	131.94	151.29	2.57	ACCEPTABLE
290	287.52	115.01	132.97	2.62	ACCEPTABLE
291	260.34	186.54	201.32	2.78	ACCEPTABLE
292	277.89	154.13	165.74	2.89	ACCEPTABLE
293	288.81	109.76	128.89	2.60	ACCEPTABLE
294	293.24	137.98	156.16	2.59	ACCEPTABLE
295	282.95	137.27	157.01	2.54	ACCEPTABLE
296	288.88	141.77	159.74	2.59	ACCEPTABLE
297	281.66	140.19	155.53	2.69	ACCEPTABLE
298	269.60	197.11	212.43	2.72	ACCEPTABLE
299	283.41	165.53	179.94	2.72	ACCEPTABLE
300	277.33	163.73	183.03	2.55	ACCEPTABLE
301	290.75	133.66	153.13	2.56	ACCEPTABLE
302	285.93	122.57	141.05	2.59	ACCEPTABLE
303	268.58	167.65	183.89	2.68	ACCEPTABLE
304	279.91	147.40	161.67	2.73	ACCEPTABLE
305	286.93	118.49	137.82	2.57	ACCEPTABLE
306	289.73	138.10	156.73	2.57	ACCEPTABLE
307	282.95	137.27	157.01	2.54	ACCEPTABLE
308	286.78	140.80	159.26	2.57	ACCEPTABLE
309	282.09	139.29	156.05	2.63	ACCEPTABLE
310	274.71	174.08	190.80	2.64	ACCEPTABLE
311	283.44	155.16	171.32	2.65	ACCEPTABLE
312	279.26	154.56	173.98	2.54	ACCEPTABLE
313	288.16	134.84	154.40	2.54	ACCEPTABLE
314	284.92	127.53	146.40	2.57	ACCEPTABLE
315	273.64	156.59	173.91	2.63	ACCEPTABLE
316	281.05	143.60	159.67	2.66	ACCEPTABLE
317	285.63	124.55	144.01	2.56	ACCEPTABLE
318	287.43	137.98	156.95	2.56	ACCEPTABLE
319	282.95	137.27	157.01	2.54	ACCEPTABLE
320	285.45	139.85	158.69	2.56	ACCEPTABLE
321	282.37	138.64	156.38	2.60	ACCEPTABLE
322	277.71	160.61	178.31	2.60	ACCEPTABLE
323	283.35	148.81	166.16	2.60	ACCEPTABLE

No.	Center		Radius	FS	Verification
	x [ft]	z [ft]	R [ft]		
324	280.52	148.64	168.17	2.54	ACCEPTABLE
325	286.43	135.64	155.26	2.54	ACCEPTABLE
326	284.25	130.80	149.95	2.56	ACCEPTABLE
327	276.85	149.77	167.86	2.59	ACCEPTABLE
328	281.73	141.32	158.61	2.61	ACCEPTABLE
329	284.75	128.70	148.26	2.55	ACCEPTABLE
330	285.92	137.81	157.03	2.55	ACCEPTABLE
331	282.95	137.27	157.01	2.54	ACCEPTABLE
332	284.59	139.09	158.21	2.55	ACCEPTABLE
333	282.57	138.20	156.59	2.58	ACCEPTABLE
334	279.56	152.34	170.70	2.58	ACCEPTABLE
335	283.25	144.80	162.94	2.58	ACCEPTABLE
336	281.34	144.79	164.38	2.54	ACCEPTABLE
337	285.27	136.18	155.83	2.54	ACCEPTABLE
338	283.81	132.97	152.31	2.55	ACCEPTABLE
339	278.93	145.45	164.07	2.57	ACCEPTABLE
340	282.16	139.90	158.00	2.58	ACCEPTABLE
341	284.16	131.52	151.13	2.55	ACCEPTABLE
342	284.92	137.66	157.05	2.55	ACCEPTABLE
343	282.95	137.27	157.01	2.54	ACCEPTABLE
344	284.03	138.52	157.85	2.55	ACCEPTABLE
345	282.69	137.89	156.73	2.56	ACCEPTABLE
346	280.74	147.11	165.93	2.56	ACCEPTABLE
347	283.16	142.22	160.90	2.57	ACCEPTABLE
348	281.88	142.25	161.89	2.54	ACCEPTABLE
349	284.50	136.54	156.22	2.54	ACCEPTABLE
350	283.52	134.41	153.88	2.55	ACCEPTABLE
351	280.29	142.65	161.64	2.56	ACCEPTABLE
352	282.43	139.00	157.64	2.57	ACCEPTABLE
353	283.76	133.42	153.07	2.54	ACCEPTABLE
354	284.26	137.54	157.04	2.54	ACCEPTABLE
355	282.95	137.27	157.01	2.54	ACCEPTABLE
356	283.67	138.12	157.58	2.54	ACCEPTABLE
357	282.78	137.69	156.83	2.55	ACCEPTABLE
358	281.49	143.74	162.86	2.55	ACCEPTABLE
359	283.10	140.54	159.57	2.56	ACCEPTABLE
360	282.24	140.58	160.25	2.54	ACCEPTABLE
361	283.98	136.78	156.48	2.54	ACCEPTABLE
362	283.33	135.36	154.92	2.55	ACCEPTABLE
363	281.19	140.83	160.06	2.56	ACCEPTABLE
364	282.61	138.41	157.42	2.56	ACCEPTABLE
365	283.49	134.69	154.38	2.54	ACCEPTABLE
366	283.82	137.46	157.04	2.54	ACCEPTABLE
367	282.95	137.27	157.01	2.54	ACCEPTABLE

Name : Model 4 Dynamic Circular	Stage - analysis : 1 - 1



Name : Model 1 Static	Stage - analysis : 1 - 1



Analysis 3 (stage 1)

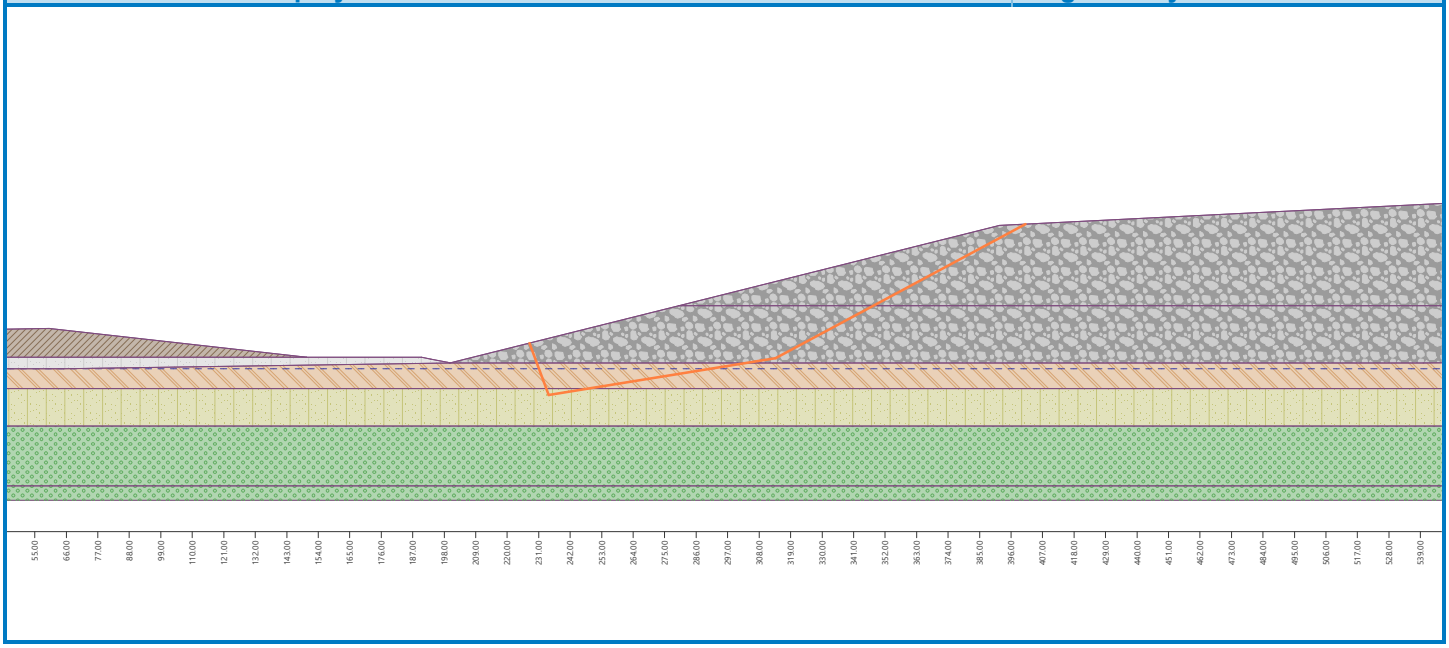
Polygonal slip surface

Coordinates of slip surface points [ft]									
x	z	x	z	x	z	x	z	x	z
227.77	-4.06	234.49	-22.24	313.78	-9.30	401.08	37.45		
The slip surface after optimization.									

Slope stability verification (Janbu)

Factor of safety = 2.25 > 1.50
Slope stability ACCEPTABLE

Name : Model 1 Static poly	Stage - analysis : 1 - 3



Slope stability analysis

Input data

Project

Task : Confirmatory Model for Final Closure of the Ash Basin
Description : Slope Stability Analysis of Grand Tower CCR Impoundment Final Closure Plan
Author : ERM - Annapolis
Date : 6/22/2020
Project number : 0533442

Settings

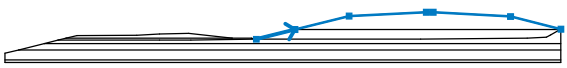
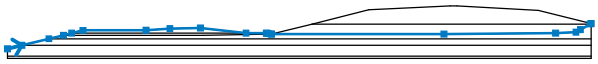
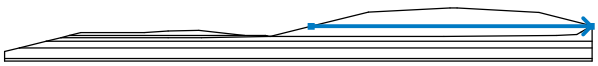
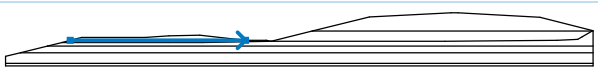
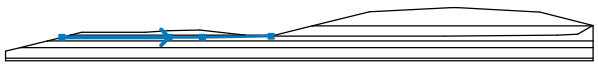
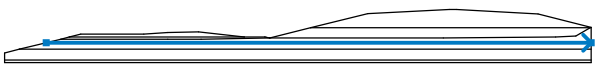
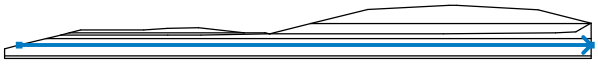
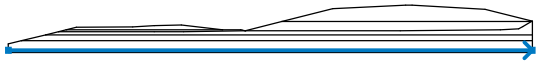
(input for current task)

Stability analysis

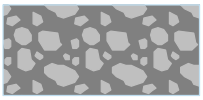
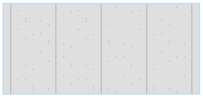
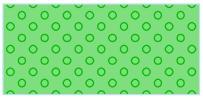
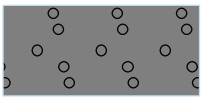
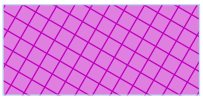
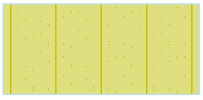
Earthquake analysis : Standard
Verification methodology : Safety factors (ASD)

Safety factors			
Seismic design situation			
Safety factor :	SF_s =	1.00	[–]

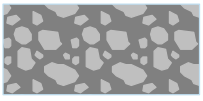
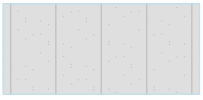
Interface

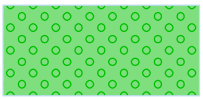
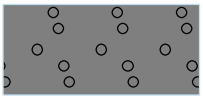
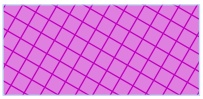
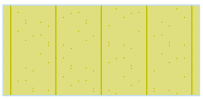
No.	Interface location	Coordinates of interface points [ft]					
		x	z	x	z	x	z
1		200.00	-11.00	279.99	9.00	392.00	37.00
		552.00	45.00	566.00	45.00	726.00	36.00
		830.00	10.00				
2		-320.00	-40.00	-291.43	-33.00	-238.36	-20.00
		-209.79	-13.00	-193.45	-9.00	-171.00	-3.50
		-47.00	-3.00	0.00	0.00	60.00	1.10
		150.00	-9.00	190.00	-9.00	190.64	-9.12
		193.34	-9.67	199.27	-10.85	200.00	-11.00
		540.00	-11.00	760.00	-9.00	800.00	-7.00
		808.86	-1.98	828.24	9.00	830.00	10.00
3		279.99	9.00	828.24	9.00		
4		-193.45	-9.00	150.00	-9.00		
5		-209.79	-13.00	0.00	-13.00	65.00	-13.00
		200.00	-11.00				
6		-238.36	-20.00	830.00	-20.00		
7		-291.43	-33.00	830.00	-33.00		
8		-320.00	-54.00	830.00	-54.00		

Soil parameters - effective stress state

No.	Name	Pattern	φ_{ef} [°]	c_{ef} [psf]	γ [pcf]
1	Ash - Geotech Lab 6/2020		30.00	100.0	75.0
2	Silty Clay (Compacted Levee Cap)		10.00	450.0	133.0
3	Silty Sand (layer in berm, not basin)		28.00	100.0	115.0
4	Silty Clay, impervious fdtn (Updated with 2007 Hanson Report and ERM)		10.00	500.0	130.0
5	Sand & Gravel (Underlying Aquifer)		34.00	0.0	130.0
6	Gravel with trace of fines (G-F), medium dense- RipRap		40.00	0.0	165.0
7	Critical Interface		25.00	50.0	110.0
8	Sandy Silt (Native Pervious Material)		24.00	150.0	115.0

Soil parameters - uplift

No.	Name	Pattern	γ_{sat} [pcf]	γ_s [pcf]	n [–]
1	Ash - Geotech Lab 6/2020		100.0		
2	Silty Clay (Compacted Levee Cap)		153.0		
3	Silty Sand (layer in berm, not basin)		136.0		
4	Silty Clay, impervious fdtn (Updated with 2007 Hanson Report and ERM)		150.0		

No.	Name	Pattern	γ_{sat} [pcf]	γ_s [pcf]	n [–]
5	Sand & Gravel (Underlying Aquifer)		130.0		
6	Gravel with trace of fines (G-F), medium dense- RipRap		165.0		
7	Critical Interface		110.0		
8	Sandy Silt (Native Pervious Material)		135.0		

Soil parameters

Ash - Geotech Lab 6/2020

Unit weight : γ = 75.0 pcf
Stress-state : effective
Angle of internal friction : φ_{ef} = 30.00 °
Cohesion of soil : c_{ef} = 100.0 psf
Saturated unit weight : γ_{sat} = 100.0 pcf

Silty Clay (Compacted Levee Cap)

Unit weight : γ = 133.0 pcf
Stress-state : effective
Angle of internal friction : φ_{ef} = 10.00 °
Cohesion of soil : c_{ef} = 450.0 psf
Saturated unit weight : γ_{sat} = 153.0 pcf

Silty Sand (layer in berm, not basin)

Unit weight : γ = 115.0 pcf
Stress-state : effective
Angle of internal friction : φ_{ef} = 28.00 °
Cohesion of soil : c_{ef} = 100.0 psf
Saturated unit weight : γ_{sat} = 136.0 pcf

Silty Clay, impervious fdtn (Updated with 2007 Hanson Report and ERM)

Unit weight : γ = 130.0 pcf
Stress-state : effective
Angle of internal friction : φ_{ef} = 10.00 °
Cohesion of soil : c_{ef} = 500.0 psf
Saturated unit weight : γ_{sat} = 150.0 pcf

Sand & Gravel (Underlying Aquifer)

Unit weight : γ = 130.0 pcf
Stress-state : effective
Angle of internal friction : φ_{ef} = 34.00 °

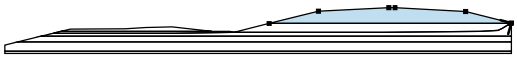
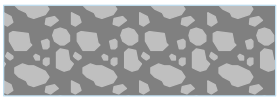
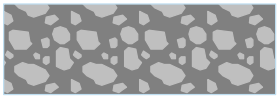
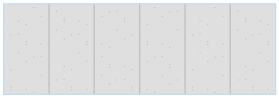
Cohesion of soil : c_{ef} = 0.0 psf
Saturated unit weight : γ_{sat} = 130.0 pcf

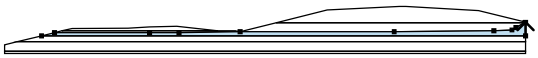
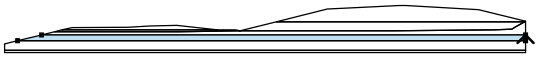
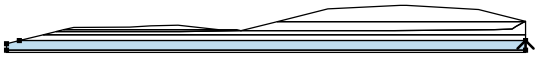
Gravel with trace of fines (G-F), medium dense- RipRap
Unit weight : γ = 165.0 pcf
Stress-state : effective
Angle of internal friction : φ_{ef} = 40.00 °
Cohesion of soil : c_{ef} = 0.0 psf
Saturated unit weight : γ_{sat} = 165.0 pcf

Critical Interface
Unit weight : γ = 110.0 pcf
Stress-state : effective
Angle of internal friction : φ_{ef} = 25.00 °
Cohesion of soil : c_{ef} = 50.0 psf
Saturated unit weight : γ_{sat} = 110.0 pcf

Sandy Silt (Native Pervious Material)
Unit weight : γ = 115.0 pcf
Stress-state : effective
Angle of internal friction : φ_{ef} = 24.00 °
Cohesion of soil : c_{ef} = 150.0 psf
Saturated unit weight : γ_{sat} = 135.0 pcf

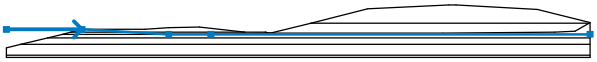
Assigning and surfaces

No.	Surface position	Coordinates of surface points [ft]				Assigned soil
		x	z	x	z	
1		828.24	9.00	830.00	10.00	Ash - Geotech Lab 6/2020
		726.00	36.00	566.00	45.00	
		552.00	45.00	392.00	37.00	
		279.99	9.00			
2		150.00	-9.00	60.00	1.10	Silty Clay (Compacted Levee Cap)
		0.00	0.00	-47.00	-3.00	
		-171.00	-3.50	-193.45	-9.00	
3		279.99	9.00	200.00	-11.00	Ash - Geotech Lab 6/2020
		540.00	-11.00	760.00	-9.00	
		800.00	-7.00	808.86	-1.98	
		828.24	9.00			
4		0.00	-13.00	65.00	-13.00	Silty Sand (layer in berm, not basin)
		200.00	-11.00	199.27	-10.85	
		193.34	-9.67	190.64	-9.12	
		190.00	-9.00	150.00	-9.00	
		-193.45	-9.00	-209.79	-13.00	

No.	Surface position	Coordinates of surface points [ft]				Assigned soil
		x	z	x	z	
5		830.00	-20.00	830.00	10.00	Silty Clay, Impervious fdtn (Updated with 2007 Hanson Report and ERM)
		828.24	9.00	808.86	-1.98	
		800.00	-7.00	760.00	-9.00	
		540.00	-11.00	200.00	-11.00	
		65.00	-13.00	0.00	-13.00	
		-209.79	-13.00	-238.36	-20.00	
6		830.00	-33.00	830.00	-20.00	Sandy Silt (Native Pervious Material)
		-238.36	-20.00	-291.43	-33.00	
7		830.00	-54.00	830.00	-33.00	Sand & Gravel (Underlying Aquifer)
		-291.43	-33.00	-320.00	-40.00	
		-320.00	-54.00			
8		-320.00	-54.00	-320.00	-59.00	Sand & Gravel (Underlying Aquifer)
		830.00	-59.00	830.00	-54.00	

Water

Water type : GWT

No.	GWT location	Coordinates of GWT points [ft]					
		x	z	x	z	x	z
1		-320.00	-3.50	-171.00	-3.50	0.00	-13.00
		83.00	-13.00	830.00	-13.00		

Tensile crack

Tensile crack not input.

Earthquake

Horizontal seismic coefficient : K_h = 0.3500
Vertical seismic coefficient : K_v = 0.0000

Settings of the stage of construction

Design situation : seismic

Results (Stage of construction 1)

Analysis 1 (stage 1)

Circular slip surface

Slip surface parameters							
Center :	x =	318.08	[ft]	Angles :	α_1 =	-16.74	[°]
	z =	314.85	[ft]		α_2 =	35.68	[°]
Radius :	R =	334.60	[ft]				
The slip surface after optimization.							

Segments restricting slip surface

No.	First point		Second point	
	x [ft]	z [ft]	x [ft]	z [ft]
1	-247.18	-19.54	775.42	-19.95

The restrictions of points of circular slip surface

Slope stability verification (Bishop)

Sum of active forces : F_a = 339575.1 lbf/ft
Sum of passive forces : F_p = 298350.4 lbf/ft

Sliding moment : M_a = 113621812.2 lbfft/ft
Resisting moment : M_p = 99828032.4 lbfft/ft

Factor of safety = 0.88 < 1.00

Slope stability NOT ACCEPTABLE

Optimization of circular slip surface (Bishop)

No.	Center		Radius	FS	Verification
	x [ft]	z [ft]	R [ft]		
1	282.95	137.27	157.01	0.89	NOT ACCEPTABLE
2	282.95	137.27	157.01	0.89	NOT ACCEPTABLE
3	282.95	137.27	157.01	0.89	NOT ACCEPTABLE
4	516.13	125.83	145.14	1.69	ACCEPTABLE
5	282.95	137.27	157.01	0.89	NOT ACCEPTABLE
6	461.43	88.11	105.24	1.89	ACCEPTABLE
7	-1055.31	5750.14	5893.59	1373.90	ACCEPTABLE
8	156.91	227.56	244.65	2.72	ACCEPTABLE
9	282.95	137.27	157.01	0.89	NOT ACCEPTABLE
10	240.56	595.66	613.52	1.11	ACCEPTABLE
11	405.44	97.43	114.82	1.41	ACCEPTABLE
12	189.38	193.40	211.45	1.71	ACCEPTABLE
13	282.95	137.27	157.01	0.89	NOT ACCEPTABLE
14	240.09	476.12	493.22	1.08	ACCEPTABLE
15	366.62	106.68	124.46	1.15	ACCEPTABLE
16	214.06	177.96	197.28	1.20	ACCEPTABLE
17	282.95	137.27	157.01	0.89	NOT ACCEPTABLE
18	251.99	352.56	369.92	1.02	ACCEPTABLE
19	339.81	114.70	132.91	1.02	ACCEPTABLE
20	307.29	34.68	51.95	1.47	ACCEPTABLE
21	282.95	137.27	157.01	0.89	NOT ACCEPTABLE
22	276.47	157.98	158.94	1.23	ACCEPTABLE
23	-499.90	4157.14	4222.70	1.59	ACCEPTABLE
24	213.95	647.75	647.37	1.27	ACCEPTABLE
25	260.48	276.58	294.41	0.97	NOT ACCEPTABLE
26	321.40	121.11	139.71	0.96	NOT ACCEPTABLE
27	175.10	563.45	566.99	1.83	ACCEPTABLE
28	300.83	60.54	78.39	1.12	ACCEPTABLE
29	320.32	126.41	143.74	0.99	NOT ACCEPTABLE

No.	Center		Radius	FS	Verification
	x [ft]	z [ft]	R [ft]		
30	282.95	137.27	157.01	0.89	NOT ACCEPTABLE
31	307.93	130.22	148.21	0.94	NOT ACCEPTABLE
32	278.85	148.46	154.75	1.20	ACCEPTABLE
33	178.06	623.67	634.81	1.18	ACCEPTABLE
34	272.01	297.38	300.32	1.16	ACCEPTABLE
35	262.44	238.76	257.50	0.93	NOT ACCEPTABLE
36	308.85	125.95	144.87	0.93	NOT ACCEPTABLE
37	294.46	86.02	103.14	1.03	ACCEPTABLE
38	215.60	318.92	330.14	1.30	ACCEPTABLE
39	263.20	211.06	213.56	1.21	ACCEPTABLE
40	295.52	81.76	100.16	1.01	ACCEPTABLE
41	307.07	134.25	151.41	0.96	NOT ACCEPTABLE
42	282.95	137.27	157.01	0.89	NOT ACCEPTABLE
43	297.99	140.08	157.16	0.95	NOT ACCEPTABLE
44	280.15	143.25	153.63	1.19	ACCEPTABLE
45	239.69	333.47	344.72	1.15	ACCEPTABLE
46	280.78	217.50	225.54	1.16	ACCEPTABLE
47	269.46	201.63	220.60	0.91	NOT ACCEPTABLE
48	300.35	129.46	148.63	0.91	NOT ACCEPTABLE
49	290.07	103.57	120.93	0.99	NOT ACCEPTABLE
50	245.86	223.24	236.24	1.15	ACCEPTABLE
51	273.89	168.29	176.04	1.18	ACCEPTABLE
52	291.55	97.67	116.51	0.96	NOT ACCEPTABLE
53	298.65	137.11	154.75	0.94	NOT ACCEPTABLE
54	282.95	137.27	157.01	0.89	NOT ACCEPTABLE
55	292.29	142.15	159.58	0.94	NOT ACCEPTABLE
56	281.03	141.38	154.66	1.07	ACCEPTABLE
57	260.16	239.91	253.33	1.07	ACCEPTABLE
58	282.92	183.43	195.23	1.10	ACCEPTABLE
59	274.30	178.19	197.33	0.90	NOT ACCEPTABLE
60	294.61	131.94	151.29	0.90	NOT ACCEPTABLE
61	287.52	115.01	132.97	0.95	NOT ACCEPTABLE
62	260.34	186.54	201.32	1.04	ACCEPTABLE
63	277.89	154.13	165.74	1.13	ACCEPTABLE
64	288.81	109.76	128.89	0.93	NOT ACCEPTABLE
65	293.24	137.98	156.16	0.93	NOT ACCEPTABLE
66	282.95	137.27	157.01	0.89	NOT ACCEPTABLE
67	288.88	141.77	159.74	0.93	NOT ACCEPTABLE
68	281.66	140.19	155.53	1.01	ACCEPTABLE
69	269.60	197.11	212.43	1.00	ACCEPTABLE
70	283.41	165.53	179.94	1.02	ACCEPTABLE
71	277.33	163.73	183.03	0.90	NOT ACCEPTABLE
72	290.75	133.66	153.13	0.90	NOT ACCEPTABLE
73	285.93	122.57	141.05	0.93	NOT ACCEPTABLE
74	268.58	167.65	183.89	0.99	NOT ACCEPTABLE
75	279.91	147.40	161.67	1.03	ACCEPTABLE
76	286.93	118.49	137.82	0.92	NOT ACCEPTABLE
77	289.73	138.10	156.73	0.92	NOT ACCEPTABLE
78	282.95	137.27	157.01	0.89	NOT ACCEPTABLE

No.	Center		Radius	FS	Verification
	x [ft]	z [ft]	R [ft]		
79	286.78	140.80	159.26	0.92	NOT ACCEPTABLE
80	282.09	139.29	156.05	0.96	NOT ACCEPTABLE
81	274.71	174.08	190.80	0.96	NOT ACCEPTABLE
82	283.44	155.16	171.32	0.97	NOT ACCEPTABLE
83	279.26	154.56	173.98	0.89	NOT ACCEPTABLE
84	282.98	158.81	176.91	0.92	NOT ACCEPTABLE
85	278.13	157.62	174.10	0.97	NOT ACCEPTABLE
86	270.07	196.14	212.64	0.97	NOT ACCEPTABLE
87	279.25	175.10	191.00	0.98	NOT ACCEPTABLE
88	275.22	173.72	192.85	0.90	NOT ACCEPTABLE
89	284.61	151.71	170.93	0.90	NOT ACCEPTABLE
90	281.31	144.21	162.73	0.92	NOT ACCEPTABLE
91	269.27	176.87	193.95	0.96	NOT ACCEPTABLE
92	276.94	162.67	178.47	0.99	NOT ACCEPTABLE
93	273.85	157.54	177.17	0.90	NOT ACCEPTABLE
94	282.14	140.67	159.80	0.91	NOT ACCEPTABLE
95	276.23	169.32	189.05	0.89	NOT ACCEPTABLE
96	279.88	174.10	192.50	0.91	NOT ACCEPTABLE
97	274.89	173.28	190.10	0.96	NOT ACCEPTABLE
98	266.36	214.53	231.40	0.97	NOT ACCEPTABLE
99	275.85	191.93	208.17	0.97	NOT ACCEPTABLE
100	271.95	189.87	209.32	0.90	NOT ACCEPTABLE
101	281.68	166.14	185.66	0.89	NOT ACCEPTABLE
102	278.34	158.51	177.33	0.91	NOT ACCEPTABLE
103	265.73	193.98	211.43	0.95	NOT ACCEPTABLE
104	273.59	178.86	195.01	0.98	NOT ACCEPTABLE
105	279.26	154.56	173.98	0.89	NOT ACCEPTABLE
106	280.75	170.26	189.19	0.90	NOT ACCEPTABLE
107	276.23	169.32	189.05	0.89	NOT ACCEPTABLE
108	278.61	172.74	191.55	0.90	NOT ACCEPTABLE
109	275.35	171.95	189.72	0.93	NOT ACCEPTABLE
110	269.98	197.90	215.70	0.94	NOT ACCEPTABLE
111	276.08	183.87	201.26	0.94	NOT ACCEPTABLE
112	273.41	182.83	202.37	0.89	NOT ACCEPTABLE
113	279.87	167.19	186.77	0.89	NOT ACCEPTABLE
114	282.29	170.43	189.10	0.91	NOT ACCEPTABLE
115	279.03	169.71	187.31	0.93	NOT ACCEPTABLE
116	273.81	195.16	212.77	0.93	NOT ACCEPTABLE
117	279.83	181.39	198.61	0.94	NOT ACCEPTABLE
118	277.13	180.42	199.80	0.89	NOT ACCEPTABLE
119	283.48	165.12	184.56	0.89	NOT ACCEPTABLE
120	281.25	160.04	179.02	0.90	NOT ACCEPTABLE
121	273.15	182.73	200.72	0.93	NOT ACCEPTABLE
122	278.27	173.04	190.21	0.94	NOT ACCEPTABLE
123	276.23	169.32	189.05	0.89	NOT ACCEPTABLE
124	281.86	157.40	176.78	0.89	NOT ACCEPTABLE
125	282.87	167.84	186.88	0.90	NOT ACCEPTABLE
126	279.87	167.19	186.77	0.89	NOT ACCEPTABLE
127	281.46	169.45	188.41	0.90	NOT ACCEPTABLE

No.	Center		Radius	FS	Verification
	x [ft]	z [ft]	R [ft]		
128	279.32	168.87	187.12	0.92	NOT ACCEPTABLE
129	275.96	185.22	203.48	0.92	NOT ACCEPTABLE
130	279.88	176.44	194.45	0.92	NOT ACCEPTABLE
131	278.06	175.93	195.37	0.89	NOT ACCEPTABLE
132	282.28	165.80	185.29	0.89	NOT ACCEPTABLE
133	280.79	162.44	181.61	0.90	NOT ACCEPTABLE
134	275.45	177.33	195.83	0.91	NOT ACCEPTABLE
135	278.83	170.98	188.95	0.92	NOT ACCEPTABLE
136	277.45	168.61	188.28	0.89	NOT ACCEPTABLE
137	281.63	158.75	178.48	0.89	NOT ACCEPTABLE
138	283.24	160.85	179.97	0.90	NOT ACCEPTABLE
139	281.13	160.19	178.59	0.92	NOT ACCEPTABLE
140	277.90	175.85	194.23	0.91	NOT ACCEPTABLE
141	281.74	167.46	185.60	0.92	NOT ACCEPTABLE
142	279.89	167.10	186.69	0.89	NOT ACCEPTABLE
143	284.01	157.46	177.10	0.89	NOT ACCEPTABLE
144	285.64	159.49	178.52	0.90	NOT ACCEPTABLE
145	283.53	158.86	177.16	0.92	NOT ACCEPTABLE
146	280.36	174.32	192.60	0.92	NOT ACCEPTABLE
147	284.17	166.03	184.08	0.92	NOT ACCEPTABLE
148	282.30	165.70	185.20	0.89	NOT ACCEPTABLE
149	286.38	156.19	175.74	0.89	NOT ACCEPTABLE
150	284.90	152.85	172.09	0.90	NOT ACCEPTABLE
151	279.78	166.85	185.38	0.91	NOT ACCEPTABLE
152	283.09	160.78	178.80	0.92	NOT ACCEPTABLE
153	281.63	158.75	178.48	0.89	NOT ACCEPTABLE
154	285.28	151.20	170.71	0.89	NOT ACCEPTABLE
155	286.00	157.87	177.15	0.89	NOT ACCEPTABLE
156	284.01	157.46	177.10	0.89	NOT ACCEPTABLE
157	285.08	158.86	178.08	0.90	NOT ACCEPTABLE
158	283.69	158.40	177.14	0.91	NOT ACCEPTABLE
159	281.63	168.47	187.20	0.90	NOT ACCEPTABLE
160	284.13	163.09	181.67	0.91	NOT ACCEPTABLE
161	282.88	162.92	182.46	0.89	NOT ACCEPTABLE
162	285.59	156.61	176.19	0.89	NOT ACCEPTABLE
163	284.60	154.39	173.76	0.89	NOT ACCEPTABLE
164	281.21	163.64	182.53	0.90	NOT ACCEPTABLE
165	283.41	159.64	178.19	0.91	NOT ACCEPTABLE
166	282.42	158.32	178.02	0.88	NOT ACCEPTABLE
167	283.49	159.75	179.03	0.89	NOT ACCEPTABLE
168	282.09	159.27	178.08	0.90	NOT ACCEPTABLE
169	280.00	169.43	188.22	0.90	NOT ACCEPTABLE
170	282.52	164.01	182.65	0.91	NOT ACCEPTABLE
171	281.27	163.83	183.43	0.89	NOT ACCEPTABLE
172	284.01	157.46	177.10	0.89	NOT ACCEPTABLE
173	283.02	155.24	174.67	0.89	NOT ACCEPTABLE
174	279.60	164.56	183.52	0.90	NOT ACCEPTABLE
175	281.80	160.54	179.15	0.91	NOT ACCEPTABLE
176	283.28	154.10	173.71	0.89	NOT ACCEPTABLE

No.	Center		Radius	FS	Verification
	x [ft]	z [ft]	R [ft]		
177	283.74	158.62	178.08	0.89	NOT ACCEPTABLE
178	282.42	158.32	178.02	0.88	NOT ACCEPTABLE
179	283.13	159.29	178.71	0.89	NOT ACCEPTABLE
180	282.20	158.96	178.06	0.90	NOT ACCEPTABLE
181	280.83	165.62	184.72	0.90	NOT ACCEPTABLE
182	282.49	162.08	181.07	0.90	NOT ACCEPTABLE
183	281.66	161.98	181.61	0.89	NOT ACCEPTABLE
184	283.48	157.75	177.41	0.89	NOT ACCEPTABLE
185	282.82	156.27	175.79	0.89	NOT ACCEPTABLE
186	280.55	162.44	181.64	0.90	NOT ACCEPTABLE
187	282.01	159.78	178.76	0.90	NOT ACCEPTABLE
188	281.36	158.90	178.64	0.88	NOT ACCEPTABLE
189	282.99	155.50	175.14	0.89	NOT ACCEPTABLE
190	281.84	161.18	180.93	0.88	NOT ACCEPTABLE
191	283.30	158.52	178.06	0.89	NOT ACCEPTABLE
192	525.88	129.39	147.30	1.75	ACCEPTABLE
193	525.88	129.39	147.30	1.75	ACCEPTABLE
194	348.63	174.45	193.99	0.94	NOT ACCEPTABLE
195	525.88	129.39	147.30	1.75	ACCEPTABLE
196	193.23	244.97	264.30	1.44	ACCEPTABLE
197	178.23	8021.48	7986.93	4.70	ACCEPTABLE
198	331.39	8021.48	7986.93	2.31	ACCEPTABLE
199	348.63	174.45	193.99	0.94	NOT ACCEPTABLE
200	277.21	821.29	839.21	1.03	ACCEPTABLE
201	469.65	135.13	153.16	1.53	ACCEPTABLE
202	348.63	174.45	193.99	0.94	NOT ACCEPTABLE
203	292.38	574.46	592.51	0.97	NOT ACCEPTABLE
204	430.16	143.09	161.42	1.30	ACCEPTABLE
205	348.63	174.45	193.99	0.94	NOT ACCEPTABLE
206	-29.45	3570.66	3571.47	1.58	ACCEPTABLE
207	307.58	428.62	447.01	0.92	NOT ACCEPTABLE
208	377.52	353.92	370.65	1.01	ACCEPTABLE
209	270.45	823.44	838.91	1.12	ACCEPTABLE
210	376.37	363.05	378.93	1.03	ACCEPTABLE
211	343.08	207.95	221.89	1.09	ACCEPTABLE
212	260.17	450.35	468.80	0.99	NOT ACCEPTABLE
213	344.75	197.88	213.32	1.04	ACCEPTABLE
214	285.57	705.54	724.39	0.98	NOT ACCEPTABLE
215	372.71	392.03	405.49	1.12	ACCEPTABLE
216	307.58	428.62	447.01	0.92	NOT ACCEPTABLE
217	347.87	422.30	435.78	1.09	ACCEPTABLE
218	224.75	930.72	931.35	1.27	ACCEPTABLE
219	61.75	2459.98	2467.05	1.36	ACCEPTABLE
220	281.48	674.83	691.08	1.05	ACCEPTABLE
221	354.03	378.41	395.05	0.98	NOT ACCEPTABLE
222	330.39	285.96	299.71	1.06	ACCEPTABLE
223	-81.77	2681.89	2703.75	1.33	ACCEPTABLE
224	36.02	2082.68	2093.31	1.34	ACCEPTABLE
225	275.16	445.25	463.78	0.96	NOT ACCEPTABLE

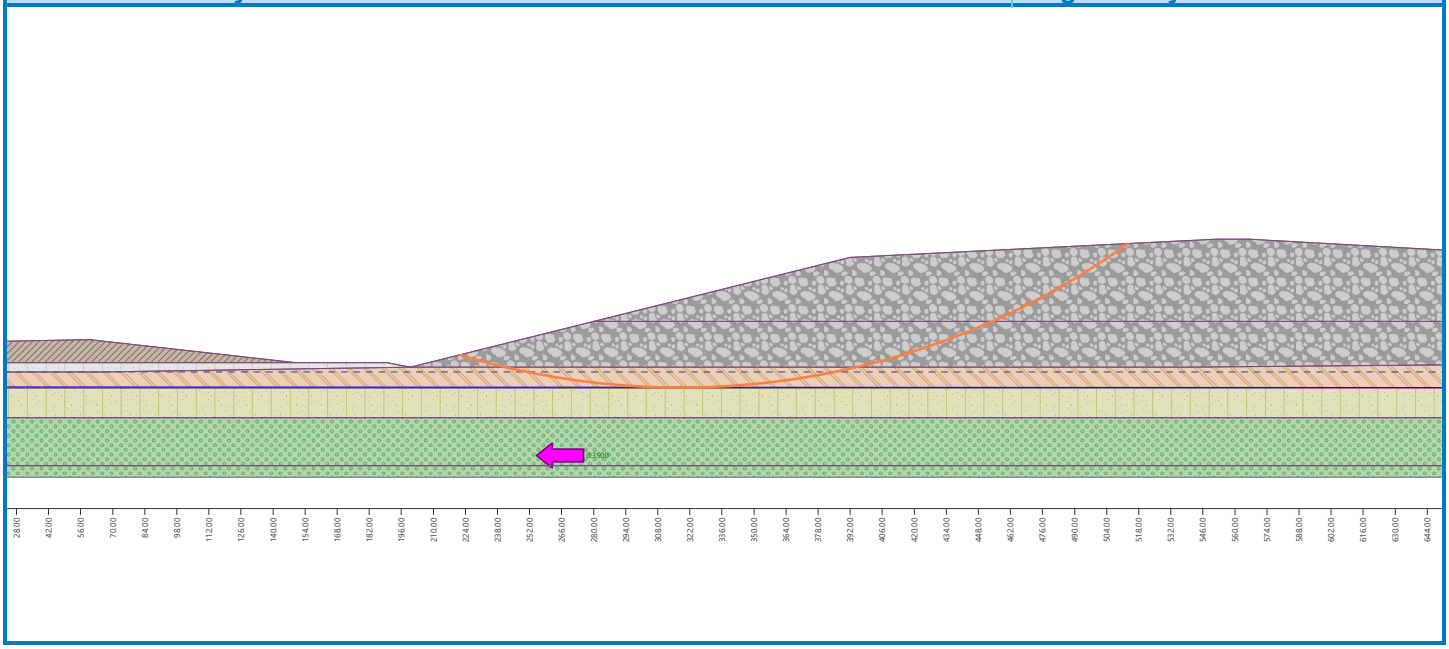
No.	Center		Radius	FS	Verification
	x [ft]	z [ft]	R [ft]		
226	334.44	261.22	277.49	0.98	NOT ACCEPTABLE
227	291.91	600.62	619.51	0.96	NOT ACCEPTABLE
228	349.32	411.93	426.09	1.06	ACCEPTABLE
229	307.58	428.62	447.01	0.92	NOT ACCEPTABLE
230	331.61	441.67	455.66	1.06	ACCEPTABLE
231	275.94	620.89	625.41	1.24	ACCEPTABLE
232	147.27	1535.61	1545.59	1.26	ACCEPTABLE
233	256.21	950.43	953.72	1.28	ACCEPTABLE
234	288.03	592.40	609.40	1.00	ACCEPTABLE
235	338.92	392.32	409.49	0.95	NOT ACCEPTABLE
236	322.44	335.33	350.18	1.02	ACCEPTABLE
237	194.87	995.64	1004.99	1.22	ACCEPTABLE
238	249.46	783.49	786.66	1.25	ACCEPTABLE
239	284.27	444.46	463.14	0.94	NOT ACCEPTABLE
240	326.48	310.54	327.43	0.95	NOT ACCEPTABLE
241	295.31	543.63	562.59	0.94	NOT ACCEPTABLE
242	334.66	421.11	436.33	1.01	ACCEPTABLE
243	307.58	428.62	447.01	0.92	NOT ACCEPTABLE
244	322.36	444.19	459.22	1.02	ACCEPTABLE
245	291.00	529.56	538.25	1.23	ACCEPTABLE
246	229.19	930.02	941.21	1.26	ACCEPTABLE
247	286.77	676.93	684.36	1.25	ACCEPTABLE
248	289.06	552.00	569.94	0.97	NOT ACCEPTABLE
249	328.67	402.98	420.54	0.94	NOT ACCEPTABLE
250	317.35	367.20	383.08	0.98	NOT ACCEPTABLE
251	241.63	725.60	737.55	1.23	ACCEPTABLE
252	280.95	591.48	598.73	1.23	ACCEPTABLE
253	287.35	452.43	471.57	0.93	NOT ACCEPTABLE
254	324.37	323.92	343.18	0.89	NOT ACCEPTABLE
255	339.76	331.22	347.52	0.98	NOT ACCEPTABLE
256	315.41	377.82	386.78	1.25	ACCEPTABLE
257	268.72	669.59	680.00	1.22	ACCEPTABLE
258	316.09	485.76	493.16	1.27	ACCEPTABLE
259	308.54	422.67	441.40	0.92	NOT ACCEPTABLE
260	343.54	306.58	325.21	0.91	NOT ACCEPTABLE
261	332.74	271.82	288.83	0.95	NOT ACCEPTABLE
262	274.03	521.15	532.81	1.16	ACCEPTABLE
263	309.19	415.86	423.06	1.24	ACCEPTABLE
264	334.81	259.16	277.60	0.92	NOT ACCEPTABLE
265	341.37	320.76	338.00	0.95	NOT ACCEPTABLE
266	324.37	323.92	343.18	0.89	NOT ACCEPTABLE
267	334.18	331.61	348.64	0.95	NOT ACCEPTABLE
268	318.98	356.40	368.67	1.12	ACCEPTABLE
269	294.48	509.34	522.12	1.11	ACCEPTABLE
270	320.75	417.57	428.79	1.21	ACCEPTABLE
271	314.18	387.39	406.24	0.91	NOT ACCEPTABLE
272	337.23	312.13	330.96	0.91	NOT ACCEPTABLE
273	329.90	289.44	307.12	0.93	NOT ACCEPTABLE
274	294.56	435.47	449.23	1.07	ACCEPTABLE

No.	Center		Radius	FS	Verification
	x [ft]	z [ft]	R [ft]		
275	315.78	376.05	387.14	1.23	ACCEPTABLE
276	311.19	336.73	356.47	0.88	NOT ACCEPTABLE
277	320.72	346.44	363.83	0.94	NOT ACCEPTABLE
278	304.82	373.02	385.95	1.08	ACCEPTABLE
279	277.71	537.98	551.62	1.10	ACCEPTABLE
280	305.73	438.83	450.72	1.14	ACCEPTABLE
281	300.01	404.65	424.02	0.90	NOT ACCEPTABLE
282	324.37	323.92	343.18	0.89	NOT ACCEPTABLE
283	316.93	301.55	319.61	0.92	NOT ACCEPTABLE
284	278.94	457.88	472.47	1.06	ACCEPTABLE
285	301.00	395.52	407.26	1.14	ACCEPTABLE
286	318.83	290.32	309.44	0.89	NOT ACCEPTABLE
287	322.43	335.89	354.12	0.92	NOT ACCEPTABLE
288	311.19	336.73	356.47	0.88	NOT ACCEPTABLE
289	317.33	344.45	362.52	0.92	NOT ACCEPTABLE
290	307.21	359.44	374.58	1.01	ACCEPTABLE
291	291.55	454.66	470.12	1.02	ACCEPTABLE
292	308.35	399.07	413.52	1.04	ACCEPTABLE
293	303.91	380.89	400.36	0.89	NOT ACCEPTABLE
294	320.02	328.07	347.49	0.89	NOT ACCEPTABLE
295	314.99	313.40	331.99	0.90	NOT ACCEPTABLE
296	291.17	409.88	426.00	0.99	NOT ACCEPTABLE
297	305.05	372.20	386.55	1.03	ACCEPTABLE
298	316.37	305.26	324.58	0.89	NOT ACCEPTABLE
299	318.63	336.55	355.25	0.90	NOT ACCEPTABLE
300	311.19	336.73	356.47	0.88	NOT ACCEPTABLE
301	315.19	342.42	361.00	0.91	NOT ACCEPTABLE
302	308.64	351.29	367.94	0.96	NOT ACCEPTABLE
303	299.07	409.48	426.29	0.97	NOT ACCEPTABLE
304	309.61	376.10	392.29	0.98	NOT ACCEPTABLE
305	306.42	365.69	385.24	0.89	NOT ACCEPTABLE
306	317.09	330.91	350.42	0.88	NOT ACCEPTABLE
307	313.71	321.23	340.20	0.90	NOT ACCEPTABLE
308	298.40	382.65	399.91	0.95	NOT ACCEPTABLE
309	307.34	358.97	375.09	0.97	NOT ACCEPTABLE
310	314.68	315.50	334.96	0.88	NOT ACCEPTABLE
311	316.12	336.78	355.81	0.90	NOT ACCEPTABLE
312	311.19	336.73	356.47	0.88	NOT ACCEPTABLE
313	313.81	340.75	359.70	0.90	NOT ACCEPTABLE
314	309.53	346.19	363.86	0.93	NOT ACCEPTABLE
315	303.49	382.93	400.68	0.94	NOT ACCEPTABLE
316	310.26	362.09	379.46	0.94	NOT ACCEPTABLE
317	308.04	355.83	375.43	0.88	NOT ACCEPTABLE
318	315.13	332.82	352.41	0.88	NOT ACCEPTABLE
319	317.78	336.65	355.45	0.90	NOT ACCEPTABLE
320	313.55	341.99	359.50	0.93	NOT ACCEPTABLE
321	307.66	378.06	395.64	0.94	NOT ACCEPTABLE
322	314.33	357.60	374.80	0.94	NOT ACCEPTABLE
323	312.06	351.55	371.00	0.89	NOT ACCEPTABLE

No.	Center		Radius	FS	Verification
	x [ft]	z [ft]	R [ft]		
324	319.04	329.01	348.46	0.88	NOT ACCEPTABLE
325	316.79	322.57	341.64	0.89	NOT ACCEPTABLE
326	306.99	361.65	379.53	0.93	NOT ACCEPTABLE
327	312.78	346.61	363.77	0.94	NOT ACCEPTABLE
328	311.19	336.73	356.47	0.88	NOT ACCEPTABLE
329	318.08	314.85	334.60	0.88	NOT ACCEPTABLE
330	320.76	318.37	337.34	0.90	NOT ACCEPTABLE
331	316.67	323.02	340.67	0.93	NOT ACCEPTABLE
332	311.06	357.30	375.00	0.93	NOT ACCEPTABLE
333	317.54	337.91	355.25	0.94	NOT ACCEPTABLE
334	315.16	332.63	352.23	0.88	NOT ACCEPTABLE
335	321.92	311.32	330.93	0.88	NOT ACCEPTABLE
336	319.69	304.92	324.16	0.89	NOT ACCEPTABLE
337	310.30	341.65	359.65	0.92	NOT ACCEPTABLE
338	315.95	327.29	344.59	0.94	NOT ACCEPTABLE
339	320.28	301.40	320.98	0.88	NOT ACCEPTABLE
340	321.33	314.90	334.18	0.89	NOT ACCEPTABLE
341	318.08	314.85	334.60	0.88	NOT ACCEPTABLE
342	319.85	317.29	336.52	0.89	NOT ACCEPTABLE
343	317.15	320.22	338.56	0.91	NOT ACCEPTABLE
344	313.53	342.31	360.68	0.91	NOT ACCEPTABLE
345	317.76	329.90	348.04	0.92	NOT ACCEPTABLE
346	316.15	326.62	346.27	0.88	NOT ACCEPTABLE
347	320.65	312.49	332.15	0.88	NOT ACCEPTABLE
348	319.15	308.24	327.65	0.89	NOT ACCEPTABLE
349	312.97	332.31	350.88	0.91	NOT ACCEPTABLE
350	316.70	322.94	341.06	0.92	NOT ACCEPTABLE
351	319.55	305.84	325.47	0.88	NOT ACCEPTABLE
352	320.24	314.92	334.35	0.89	NOT ACCEPTABLE
353	318.08	314.85	334.60	0.88	NOT ACCEPTABLE
354	319.25	316.52	335.92	0.89	NOT ACCEPTABLE
355	317.47	318.39	337.20	0.90	NOT ACCEPTABLE
356	315.11	332.80	351.63	0.90	NOT ACCEPTABLE
357	317.89	324.74	343.42	0.90	NOT ACCEPTABLE
358	316.80	322.66	342.34	0.88	NOT ACCEPTABLE
359	319.79	313.27	332.96	0.88	NOT ACCEPTABLE
360	318.79	310.45	329.97	0.88	NOT ACCEPTABLE
361	314.71	326.31	345.27	0.90	NOT ACCEPTABLE
362	317.17	320.16	338.82	0.91	NOT ACCEPTABLE
363	319.07	308.82	328.49	0.88	NOT ACCEPTABLE
364	319.52	314.91	334.45	0.88	NOT ACCEPTABLE
365	318.08	314.85	334.60	0.88	NOT ACCEPTABLE
366	318.86	315.98	335.50	0.89	NOT ACCEPTABLE
367	317.67	317.20	336.32	0.89	NOT ACCEPTABLE
368	316.12	326.67	345.80	0.89	NOT ACCEPTABLE
369	317.96	321.39	340.42	0.89	NOT ACCEPTABLE
370	317.23	320.04	339.75	0.88	NOT ACCEPTABLE
371	319.22	313.80	333.50	0.88	NOT ACCEPTABLE
372	318.56	311.92	331.51	0.88	NOT ACCEPTABLE

No.	Center x [ft]	Center z [ft]	Radius R [ft]	FS	Verification
373	315.85	322.42	341.64	0.89	NOT ACCEPTABLE
374	317.48	318.35	337.38	0.89	NOT ACCEPTABLE
375	318.74	310.82	330.52	0.88	NOT ACCEPTABLE
376	319.04	314.89	334.50	0.88	NOT ACCEPTABLE
377	318.08	314.85	334.60	0.88	NOT ACCEPTABLE

Name : Model 1 Dyn Circ | **Stage - analysis : 1 - 1**



Analysis 3 (stage 1)

Polygonal slip surface

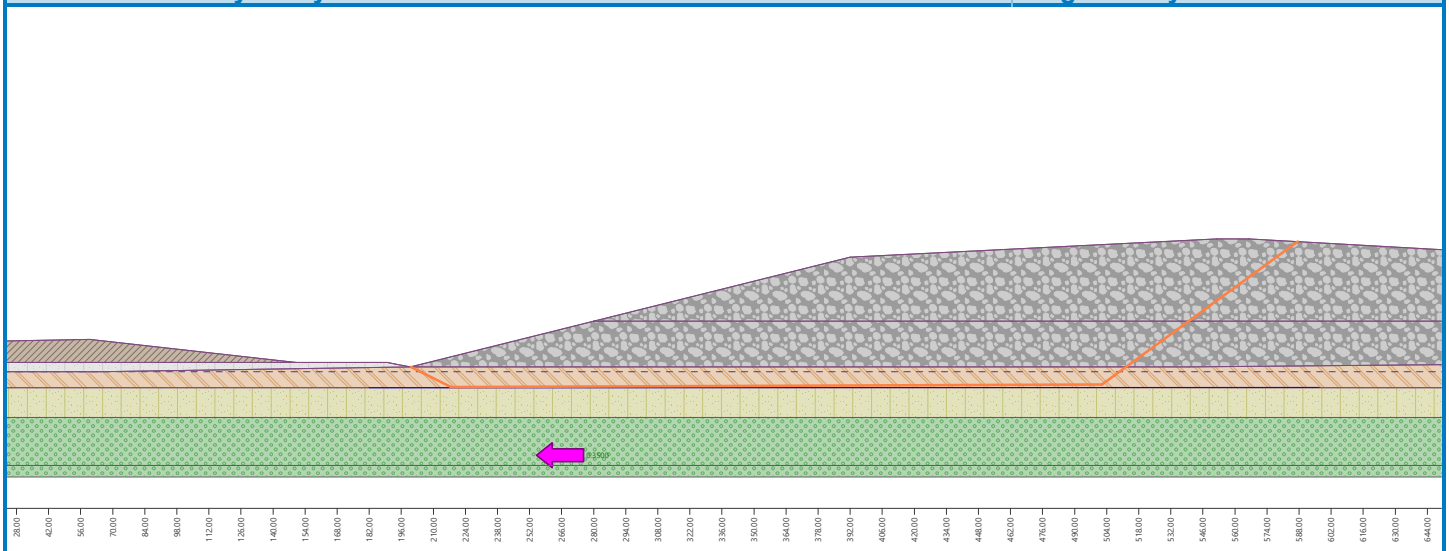
Coordinates of slip surface points [ft]									
x	z	x	z	x	z	x	z	x	z
200.19	-10.95	217.72	-19.81	501.88	-18.62	587.39	43.80		
The slip surface after optimization.									

Segments restricting slip surface

No.	First point x [ft]	First point z [ft]	Second point x [ft]	Second point z [ft]
1	181.92	-19.97	596.86	-19.89

Slope stability verification (Janbu)
Factor of safety = 0.77 < 1.00
Slope stability NOT ACCEPTABLE

Name : Model 1 Dyn Poly	Stage - analysis : 1 - 3



Slope stability analysis

Input data

Project

Task : Confirmatory Model for Final Closure of the Ash Basin
Description : Slope Stability Analysis of Grand Tower CCR Impoundment Final Closure Plan
Author : ERM - Annapolis
Date : 6/22/2020
Project number : 0533442

Settings

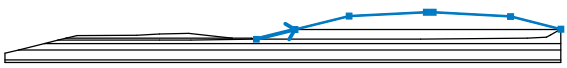
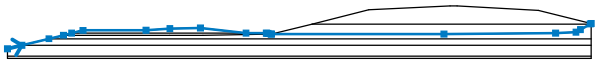
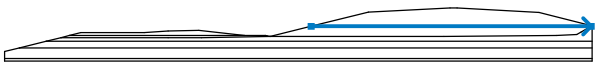
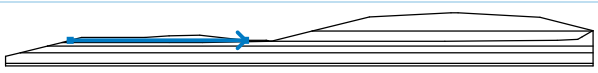
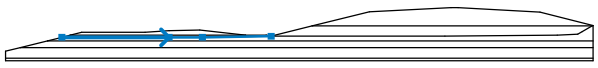
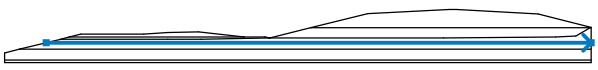
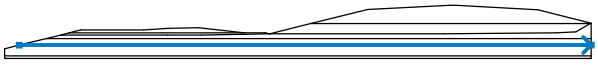
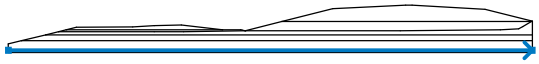
(input for current task)

Stability analysis

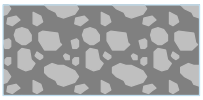
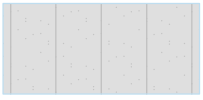
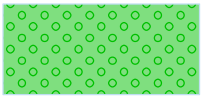
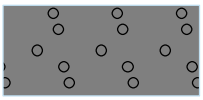
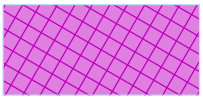
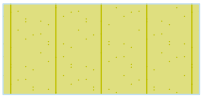
Earthquake analysis : Standard
Verification methodology : Safety factors (ASD)

Safety factors			
Seismic design situation			
Safety factor :	SF_s =	1.00	[–]

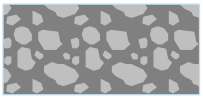
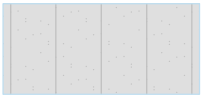
Interface

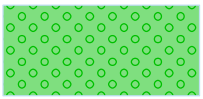
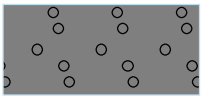
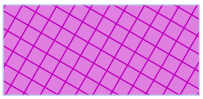
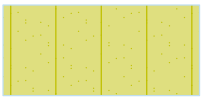
No.	Interface location	Coordinates of interface points [ft]					
		x	z	x	z	x	z
1		200.00	-11.00	279.99	9.00	392.00	37.00
		552.00	45.00	566.00	45.00	726.00	36.00
		830.00	10.00				
2		-320.00	-40.00	-291.43	-33.00	-238.36	-20.00
		-209.79	-13.00	-193.45	-9.00	-171.00	-3.50
		-47.00	-3.00	0.00	0.00	60.00	1.10
		150.00	-9.00	190.00	-9.00	190.64	-9.12
		193.34	-9.67	199.27	-10.85	200.00	-11.00
		540.00	-11.00	760.00	-9.00	800.00	-7.00
		808.86	-1.98	828.24	9.00	830.00	10.00
3		279.99	9.00	828.24	9.00		
4		-193.45	-9.00	150.00	-9.00		
5		-209.79	-13.00	0.00	-13.00	65.00	-13.00
		200.00	-11.00				
6		-238.36	-20.00	830.00	-20.00		
7		-291.43	-33.00	830.00	-33.00		
8		-320.00	-54.00	830.00	-54.00		

Soil parameters - effective stress state

No.	Name	Pattern	φ_{ef} [°]	c_{ef} [psf]	γ [pcf]
1	Ash - Geotech Lab 6/2020		30.00	100.0	75.0
2	Silty Clay (Compacted Levee Cap)		10.00	450.0	133.0
3	Silty Sand (layer in berm, not basin)		28.00	100.0	115.0
4	Silty Clay, impervious fdtn (Updated with 2007 Hanson Report and ERM)		10.00	500.0	130.0
5	Sand & Gravel (Underlying Aquifer)		34.00	0.0	130.0
6	Gravel with trace of fines (G-F), medium dense- RipRap		40.00	0.0	165.0
7	Critical Interface		25.00	50.0	110.0
8	Sandy Silt (Native Pervious Material)		24.00	150.0	115.0

Soil parameters - uplift

No.	Name	Pattern	γ_{sat} [pcf]	γ_s [pcf]	n [–]
1	Ash - Geotech Lab 6/2020		100.0		
2	Silty Clay (Compacted Levee Cap)		153.0		
3	Silty Sand (layer in berm, not basin)		136.0		
4	Silty Clay, impervious fdtn (Updated with 2007 Hanson Report and ERM)		150.0		

No.	Name	Pattern	γ_{sat} [pcf]	γ_s [pcf]	n [–]
5	Sand & Gravel (Underlying Aquifer)		130.0		
6	Gravel with trace of fines (G-F), medium dense- RipRap		165.0		
7	Critical Interface		110.0		
8	Sandy Silt (Native Pervious Material)		135.0		

Soil parameters

Ash - Geotech Lab 6/2020

Unit weight : γ = 75.0 pcf
Stress-state : effective
Angle of internal friction : φ_{ef} = 30.00 °
Cohesion of soil : c_{ef} = 100.0 psf
Saturated unit weight : γ_{sat} = 100.0 pcf

Silty Clay (Compacted Levee Cap)

Unit weight : γ = 133.0 pcf
Stress-state : effective
Angle of internal friction : φ_{ef} = 10.00 °
Cohesion of soil : c_{ef} = 450.0 psf
Saturated unit weight : γ_{sat} = 153.0 pcf

Silty Sand (layer in berm, not basin)

Unit weight : γ = 115.0 pcf
Stress-state : effective
Angle of internal friction : φ_{ef} = 28.00 °
Cohesion of soil : c_{ef} = 100.0 psf
Saturated unit weight : γ_{sat} = 136.0 pcf

Silty Clay, impervious fdtn (Updated with 2007 Hanson Report and ERM)

Unit weight : γ = 130.0 pcf
Stress-state : effective
Angle of internal friction : φ_{ef} = 10.00 °
Cohesion of soil : c_{ef} = 500.0 psf
Saturated unit weight : γ_{sat} = 150.0 pcf

Sand & Gravel (Underlying Aquifer)

Unit weight : γ = 130.0 pcf
Stress-state : effective
Angle of internal friction : φ_{ef} = 34.00 °

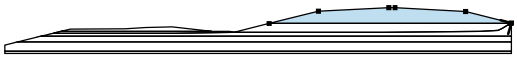
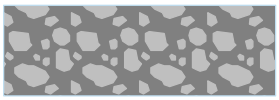
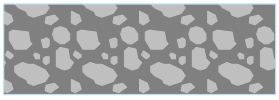
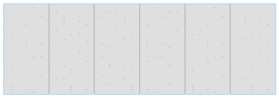
Cohesion of soil : c_{ef} = 0.0 psf
Saturated unit weight : γ_{sat} = 130.0 pcf

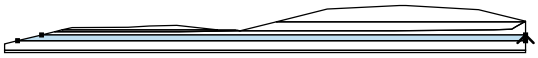
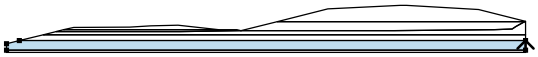
Gravel with trace of fines (G-F), medium dense- RipRap
Unit weight : γ = 165.0 pcf
Stress-state : effective
Angle of internal friction : φ_{ef} = 40.00 °
Cohesion of soil : c_{ef} = 0.0 psf
Saturated unit weight : γ_{sat} = 165.0 pcf

Critical Interface
Unit weight : γ = 110.0 pcf
Stress-state : effective
Angle of internal friction : φ_{ef} = 25.00 °
Cohesion of soil : c_{ef} = 50.0 psf
Saturated unit weight : γ_{sat} = 110.0 pcf

Sandy Silt (Native Pervious Material)
Unit weight : γ = 115.0 pcf
Stress-state : effective
Angle of internal friction : φ_{ef} = 24.00 °
Cohesion of soil : c_{ef} = 150.0 psf
Saturated unit weight : γ_{sat} = 135.0 pcf

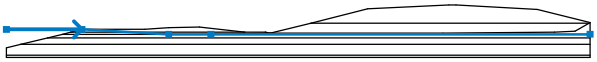
Assigning and surfaces

No.	Surface position	Coordinates of surface points [ft]				Assigned soil
		x	z	x	z	
1		828.24	9.00	830.00	10.00	Ash - Geotech Lab 6/2020
		726.00	36.00	566.00	45.00	
		552.00	45.00	392.00	37.00	
		279.99	9.00			
2		150.00	-9.00	60.00	1.10	Silty Clay (Compacted Levee Cap)
		0.00	0.00	-47.00	-3.00	
		-171.00	-3.50	-193.45	-9.00	
3		279.99	9.00	200.00	-11.00	Ash - Geotech Lab 6/2020
		540.00	-11.00	760.00	-9.00	
		800.00	-7.00	808.86	-1.98	
		828.24	9.00			
4		0.00	-13.00	65.00	-13.00	Silty Sand (layer in berm, not basin)
		200.00	-11.00	199.27	-10.85	
		193.34	-9.67	190.64	-9.12	
		190.00	-9.00	150.00	-9.00	
		-193.45	-9.00	-209.79	-13.00	

No.	Surface position	Coordinates of surface points [ft]				Assigned soil
		x	z	x	z	
5		830.00	-20.00	830.00	10.00	Silty Clay, Impervious fdtn (Updated with 2007 Hanson Report and ERM)
		828.24	9.00	808.86	-1.98	
		800.00	-7.00	760.00	-9.00	
		540.00	-11.00	200.00	-11.00	
		65.00	-13.00	0.00	-13.00	
		-209.79	-13.00	-238.36	-20.00	
6		830.00	-33.00	830.00	-20.00	Sandy Silt (Native Pervious Material)
		-238.36	-20.00	-291.43	-33.00	
7		830.00	-54.00	830.00	-33.00	Sand & Gravel (Underlying Aquifer)
		-291.43	-33.00	-320.00	-40.00	
		-320.00	-54.00			
8		-320.00	-54.00	-320.00	-59.00	Sand & Gravel (Underlying Aquifer)
		830.00	-59.00	830.00	-54.00	

Water

Water type : GWT

No.	GWT location	Coordinates of GWT points [ft]					
		x	z	x	z	x	z
1		-320.00	-3.50	-171.00	-3.50	0.00	-13.00
		83.00	-13.00	830.00	-13.00		

Tensile crack

Tensile crack not input.

Earthquake

Horizontal seismic coefficient : K_h = 0.1750
Vertical seismic coefficient : K_v = 0.0000

Settings of the stage of construction

Design situation : seismic

Results (Stage of construction 1)

Analysis 1 (stage 1)

Circular slip surface

Slip surface parameters							
Center :	x =	318.08	[ft]	Angles :	α_1 =	-16.74	[°]
	z =	314.85	[ft]		α_2 =	35.68	[°]
Radius :	R =	334.60	[ft]				
The slip surface after optimization.							

Segments restricting slip surface

No.	First point		Second point	
	x [ft]	z [ft]	x [ft]	z [ft]
1	-247.18	-19.54	775.42	-19.95

The restrictions of points of circular slip surface

Slope stability verification (Bishop)

Sum of active forces : F_a = 222660.8 lbf/ft
Sum of passive forces : F_p = 308881.7 lbf/ft

Sliding moment : M_a = 74502296.3 lbfft/ft
Resisting moment : M_p = 103351808.1 lbfft/ft

Factor of safety = 1.39 > 1.00

Slope stability ACCEPTABLE

Optimization of circular slip surface (Bishop)

No.	Center		Radius	FS	Verification
	x [ft]	z [ft]	R [ft]		
1	318.08	314.85	334.60	1.39	ACCEPTABLE
2	318.08	314.85	334.60	1.39	ACCEPTABLE
3	318.08	314.85	334.60	1.39	ACCEPTABLE
4	119.85	506.53	522.92	4.78	ACCEPTABLE
5	272.44	2227.55	2245.64	2.08	ACCEPTABLE
6	318.08	314.85	334.60	1.39	ACCEPTABLE
7	284.81	1280.17	1298.17	1.88	ACCEPTABLE
8	516.59	213.92	230.04	2.92	ACCEPTABLE
9	181.18	349.10	366.69	2.82	ACCEPTABLE
10	286.51	1254.14	1272.80	1.84	ACCEPTABLE
11	318.08	314.85	334.60	1.39	ACCEPTABLE
12	268.48	1044.71	1060.80	1.87	ACCEPTABLE
13	454.08	234.03	250.59	2.22	ACCEPTABLE
14	217.51	336.64	355.96	1.73	ACCEPTABLE
15	318.08	314.85	334.60	1.39	ACCEPTABLE
16	267.20	824.58	841.28	1.73	ACCEPTABLE
17	410.51	251.03	268.28	1.81	ACCEPTABLE
18	357.66	79.62	96.20	1.89	ACCEPTABLE
19	318.08	314.85	334.60	1.39	ACCEPTABLE
20	280.59	633.11	650.52	1.61	ACCEPTABLE
21	380.55	265.47	283.40	1.61	ACCEPTABLE
22	348.69	130.98	149.45	1.55	ACCEPTABLE
23	347.91	135.48	152.83	1.59	ACCEPTABLE
24	378.90	277.80	294.10	1.68	ACCEPTABLE
25	318.08	314.85	334.60	1.39	ACCEPTABLE
26	358.28	293.35	310.15	1.57	ACCEPTABLE
27	282.00	520.99	519.86	1.91	ACCEPTABLE
28	224.50	1209.27	1207.59	2.10	ACCEPTABLE
29	289.52	527.20	545.37	1.52	ACCEPTABLE

No.	Center		Radius	FS	Verification
	x [ft]	z [ft]	R [ft]		
30	360.35	279.22	297.66	1.51	ACCEPTABLE
31	337.64	196.01	212.09	1.55	ACCEPTABLE
32	84.54	1465.22	1478.38	1.92	ACCEPTABLE
33	213.44	921.40	920.21	1.98	ACCEPTABLE
34	339.66	184.25	202.26	1.49	ACCEPTABLE
35	357.53	298.49	314.73	1.59	ACCEPTABLE
36	318.08	314.85	334.60	1.39	ACCEPTABLE
37	342.54	316.64	332.76	1.56	ACCEPTABLE
38	301.92	407.48	412.40	1.89	ACCEPTABLE
39	184.21	1128.92	1139.67	2.31	ACCEPTABLE
40	294.95	627.70	630.46	1.98	ACCEPTABLE
41	292.60	471.12	490.27	1.46	ACCEPTABLE
42	346.60	290.06	308.88	1.46	ACCEPTABLE
43	330.80	237.11	253.73	1.51	ACCEPTABLE
44	286.41	498.96	501.47	1.89	ACCEPTABLE
45	333.27	222.55	241.07	1.44	ACCEPTABLE
46	343.85	308.02	324.96	1.53	ACCEPTABLE
47	318.08	314.85	334.60	1.39	ACCEPTABLE
48	333.33	322.75	339.47	1.52	ACCEPTABLE
49	309.12	366.35	375.91	1.89	ACCEPTABLE
50	261.65	657.19	668.26	1.86	ACCEPTABLE
51	309.44	474.35	482.31	1.95	ACCEPTABLE
52	302.03	413.11	432.34	1.43	ACCEPTABLE
53	337.26	297.83	316.94	1.43	ACCEPTABLE
54	326.43	263.64	281.08	1.47	ACCEPTABLE
55	267.56	507.93	520.25	1.75	ACCEPTABLE
56	302.63	404.85	412.61	1.89	ACCEPTABLE
57	328.58	250.88	269.79	1.41	ACCEPTABLE
58	335.00	312.14	329.82	1.48	ACCEPTABLE
59	318.08	314.85	334.60	1.39	ACCEPTABLE
60	327.78	322.95	340.42	1.48	ACCEPTABLE
61	312.69	345.93	358.76	1.68	ACCEPTABLE
62	287.85	497.99	511.34	1.70	ACCEPTABLE
63	314.27	407.01	418.77	1.79	ACCEPTABLE
64	307.75	377.96	397.30	1.42	ACCEPTABLE
65	330.94	303.28	322.58	1.41	ACCEPTABLE
66	323.59	280.98	299.11	1.44	ACCEPTABLE
67	288.18	424.02	438.37	1.62	ACCEPTABLE
68	309.35	365.78	377.40	1.77	ACCEPTABLE
69	325.25	271.09	290.26	1.40	ACCEPTABLE
70	329.24	313.86	332.15	1.45	ACCEPTABLE
71	318.08	314.85	334.60	1.39	ACCEPTABLE
72	324.34	321.46	339.58	1.45	ACCEPTABLE
73	314.70	334.38	349.46	1.57	ACCEPTABLE
74	300.25	422.73	438.03	1.58	ACCEPTABLE
75	316.22	371.33	385.71	1.61	ACCEPTABLE
76	311.35	355.92	375.37	1.41	ACCEPTABLE
77	326.69	307.03	326.48	1.40	ACCEPTABLE
78	321.73	292.38	311.02	1.42	ACCEPTABLE

No.	Center		Radius	FS	Verification
	x [ft]	z [ft]	R [ft]		
79	299.42	381.08	397.06	1.54	ACCEPTABLE
80	312.80	345.69	359.98	1.60	ACCEPTABLE
81	322.94	285.17	304.53	1.39	ACCEPTABLE
82	325.46	314.56	333.30	1.43	ACCEPTABLE
83	318.08	314.85	334.60	1.39	ACCEPTABLE
84	322.16	319.78	338.40	1.43	ACCEPTABLE
85	315.91	327.40	344.01	1.50	ACCEPTABLE
86	307.04	381.59	398.30	1.51	ACCEPTABLE
87	317.11	350.60	366.75	1.53	ACCEPTABLE
88	313.66	341.80	361.34	1.39	ACCEPTABLE
89	323.83	309.59	329.14	1.40	ACCEPTABLE
90	320.50	299.92	318.92	1.41	ACCEPTABLE
91	306.12	356.54	373.71	1.48	ACCEPTABLE
92	314.76	334.23	350.32	1.52	ACCEPTABLE
93	321.36	294.84	314.32	1.40	ACCEPTABLE
94	322.98	314.82	333.88	1.41	ACCEPTABLE
95	318.08	314.85	334.60	1.39	ACCEPTABLE
96	320.76	318.37	337.34	1.42	ACCEPTABLE
97	316.67	323.02	340.67	1.46	ACCEPTABLE
98	311.06	357.30	375.00	1.47	ACCEPTABLE
99	317.54	337.91	355.25	1.47	ACCEPTABLE
100	315.16	332.63	352.23	1.39	ACCEPTABLE
101	321.92	311.32	330.93	1.40	ACCEPTABLE
102	319.69	304.92	324.16	1.40	ACCEPTABLE
103	310.30	341.65	359.65	1.45	ACCEPTABLE
104	315.95	327.29	344.59	1.47	ACCEPTABLE
105	320.28	301.40	320.98	1.39	ACCEPTABLE
106	321.33	314.90	334.18	1.40	ACCEPTABLE
107	318.08	314.85	334.60	1.39	ACCEPTABLE
108	319.85	317.29	336.52	1.41	ACCEPTABLE
109	317.15	320.22	338.56	1.44	ACCEPTABLE
110	313.53	342.31	360.68	1.44	ACCEPTABLE
111	317.76	329.90	348.04	1.44	ACCEPTABLE
112	316.15	326.62	346.27	1.39	ACCEPTABLE
113	320.65	312.49	332.15	1.39	ACCEPTABLE
114	319.15	308.24	327.65	1.40	ACCEPTABLE
115	312.97	332.31	350.88	1.42	ACCEPTABLE
116	316.70	322.94	341.06	1.44	ACCEPTABLE
117	319.55	305.84	325.47	1.39	ACCEPTABLE
118	320.24	314.92	334.35	1.40	ACCEPTABLE
119	318.08	314.85	334.60	1.39	ACCEPTABLE
120	319.25	316.52	335.92	1.40	ACCEPTABLE
121	317.47	318.39	337.20	1.41	ACCEPTABLE
122	315.11	332.80	351.63	1.42	ACCEPTABLE
123	317.89	324.74	343.42	1.42	ACCEPTABLE
124	316.80	322.66	342.34	1.39	ACCEPTABLE
125	319.79	313.27	332.96	1.39	ACCEPTABLE
126	318.79	310.45	329.97	1.40	ACCEPTABLE
127	314.71	326.31	345.27	1.41	ACCEPTABLE

No.	Center		Radius	FS	Verification
	x [ft]	z [ft]	R [ft]		
128	317.17	320.16	338.82	1.43	ACCEPTABLE
129	319.07	308.82	328.49	1.39	ACCEPTABLE
130	319.52	314.91	334.45	1.40	ACCEPTABLE
131	318.08	314.85	334.60	1.39	ACCEPTABLE
132	318.86	315.98	335.50	1.40	ACCEPTABLE
133	317.67	317.20	336.32	1.41	ACCEPTABLE
134	316.12	326.67	345.80	1.41	ACCEPTABLE
135	317.96	321.39	340.42	1.41	ACCEPTABLE
136	317.23	320.04	339.75	1.39	ACCEPTABLE
137	319.22	313.80	333.50	1.39	ACCEPTABLE
138	318.56	311.92	331.51	1.39	ACCEPTABLE
139	315.85	322.42	341.64	1.40	ACCEPTABLE
140	317.48	318.35	337.38	1.41	ACCEPTABLE
141	318.74	310.82	330.52	1.39	ACCEPTABLE
142	319.04	314.89	334.50	1.39	ACCEPTABLE
143	119.85	506.53	522.92	4.78	ACCEPTABLE
144	61.06	2326.33	2327.61	2.30	ACCEPTABLE
145	61.06	2326.33	2327.61	2.30	ACCEPTABLE
146	549.39	450.99	427.94	3.92	ACCEPTABLE
147	61.06	2326.33	2327.61	2.30	ACCEPTABLE
148	484.59	473.10	450.27	3.32	ACCEPTABLE
149	494.85	160.15	168.59	3.77	ACCEPTABLE
150	61.06	2326.33	2327.61	2.30	ACCEPTABLE
151	421.39	595.18	573.77	2.82	ACCEPTABLE
152	380.35	149.73	127.73	2.48	ACCEPTABLE
153	414.08	689.35	666.53	2.85	ACCEPTABLE
154	61.06	2326.33	2327.61	2.30	ACCEPTABLE
155	367.59	738.69	719.51	2.57	ACCEPTABLE
156	187.64	1489.35	1475.41	2.69	ACCEPTABLE
157	381.21	138.92	130.90	2.38	ACCEPTABLE
158	348.27	368.68	349.01	2.34	ACCEPTABLE
159	316.52	1222.50	1202.13	2.65	ACCEPTABLE
160	61.06	2326.33	2327.61	2.30	ACCEPTABLE
161	-1652.16	17362.67	17456.73	2.75	ACCEPTABLE
162	406.94	197.71	205.17	2.57	ACCEPTABLE
163	318.05	938.66	922.07	2.44	ACCEPTABLE
164	345.56	371.66	382.30	2.07	ACCEPTABLE
165	388.40	345.78	353.66	2.31	ACCEPTABLE
166	269.60	897.19	888.19	2.17	ACCEPTABLE
167	75.85	2929.38	2927.47	2.38	ACCEPTABLE
168	298.61	705.25	715.67	2.00	ACCEPTABLE
169	341.65	752.44	756.51	2.20	ACCEPTABLE
170	239.35	1274.62	1284.59	2.05	ACCEPTABLE
171	288.23	884.02	898.46	1.80	ACCEPTABLE
172	331.87	947.64	955.57	2.22	ACCEPTABLE
173	259.55	1339.51	1351.33	2.10	ACCEPTABLE
174	295.31	1010.21	1026.60	1.76	ACCEPTABLE
175	290.57	1340.18	1353.39	2.01	ACCEPTABLE
176	273.75	1437.92	1452.02	2.02	ACCEPTABLE

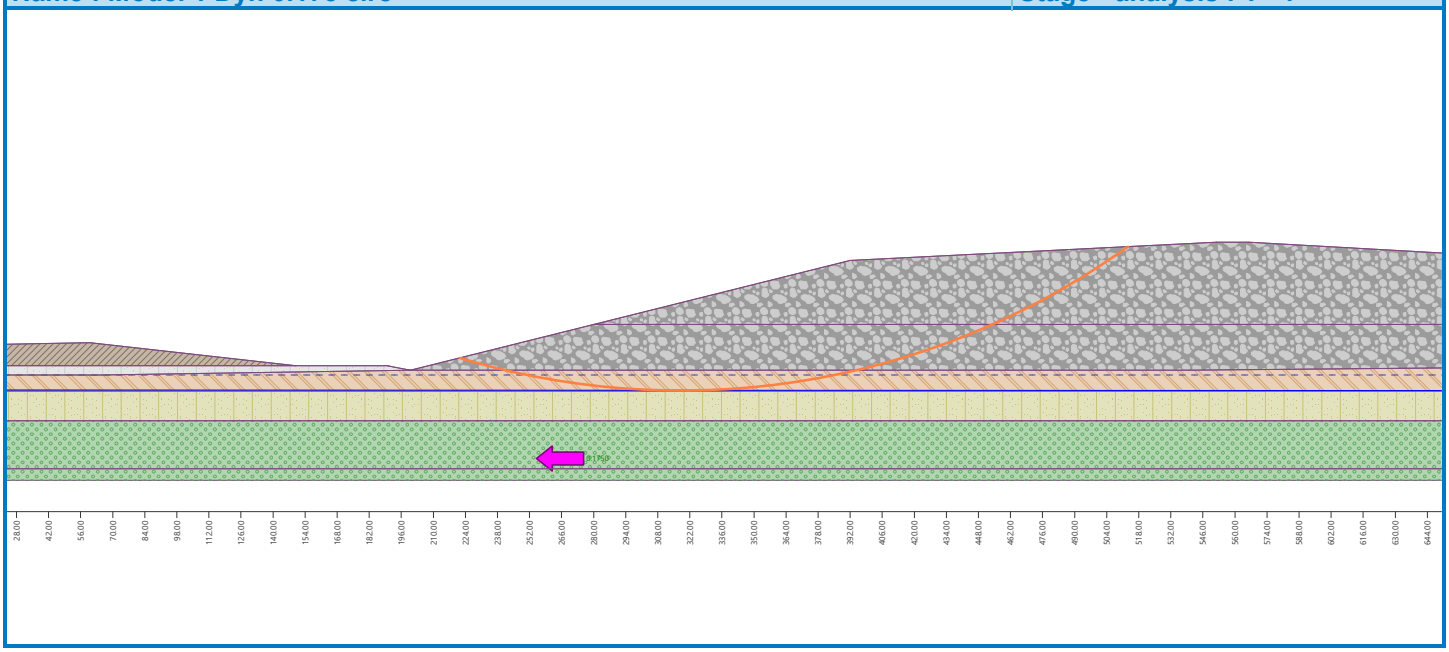
No.	Center		Radius	FS	Verification
	x [ft]	z [ft]	R [ft]		
177	298.26	1168.83	1187.25	1.73	ACCEPTABLE
178	307.08	1427.96	1443.23	1.91	ACCEPTABLE
179	309.63	1301.83	1321.42	1.73	ACCEPTABLE
180	325.66	1220.63	1239.10	1.70	ACCEPTABLE
181	330.05	1522.55	1538.06	1.90	ACCEPTABLE
182	308.78	1659.85	1676.28	1.95	ACCEPTABLE
183	350.93	1287.19	1305.85	1.69	ACCEPTABLE
184	411.05	1396.72	1410.66	2.05	ACCEPTABLE
185	-162.20	7161.91	7175.51	2.46	ACCEPTABLE
186	338.86	1943.46	1959.52	1.94	ACCEPTABLE
187	358.03	1647.28	1666.61	1.72	ACCEPTABLE
188	418.25	1277.03	1293.03	1.89	ACCEPTABLE
189	384.79	921.07	936.11	1.85	ACCEPTABLE
190	325.69	1220.51	1238.99	1.70	ACCEPTABLE
191	397.16	779.90	799.58	1.61	ACCEPTABLE
192	445.03	748.66	765.63	1.89	ACCEPTABLE
193	314.57	1754.33	1750.21	2.47	ACCEPTABLE
194	239.68	3787.63	3782.83	2.67	ACCEPTABLE
195	354.53	1246.59	1265.95	1.65	ACCEPTABLE
196	447.10	717.96	736.35	1.81	ACCEPTABLE
197	418.93	544.43	561.51	1.79	ACCEPTABLE
198	265.75	2320.31	2315.44	2.48	ACCEPTABLE
199	420.93	521.25	539.85	1.72	ACCEPTABLE
200	445.25	745.38	762.50	1.87	ACCEPTABLE
201	397.16	779.90	799.58	1.61	ACCEPTABLE
202	427.86	777.47	794.51	1.82	ACCEPTABLE
203	364.02	1172.69	1175.56	2.44	ACCEPTABLE
204	213.12	2852.49	2860.23	2.39	ACCEPTABLE
205	362.03	1663.90	1665.10	2.57	ACCEPTABLE
206	371.13	1064.89	1084.21	1.63	ACCEPTABLE
207	430.83	737.40	756.17	1.74	ACCEPTABLE
208	411.97	620.11	637.79	1.73	ACCEPTABLE
209	256.14	1873.06	1881.29	2.27	ACCEPTABLE
210	352.91	1300.73	1302.18	2.44	ACCEPTABLE
211	413.92	597.56	616.48	1.67	ACCEPTABLE
212	428.98	762.41	780.08	1.79	ACCEPTABLE
213	397.16	779.90	799.58	1.61	ACCEPTABLE
214	417.00	786.38	803.96	1.76	ACCEPTABLE
215	379.65	988.04	996.29	2.43	ACCEPTABLE
216	324.72	1595.09	1604.58	2.39	ACCEPTABLE
217	383.61	1210.54	1217.59	2.51	ACCEPTABLE
218	380.73	959.81	979.19	1.62	ACCEPTABLE
219	419.79	751.01	770.05	1.69	ACCEPTABLE
220	407.16	672.10	690.35	1.69	ACCEPTABLE
221	328.06	1284.50	1295.09	2.31	ACCEPTABLE
222	375.02	1041.21	1048.43	2.43	ACCEPTABLE
223	408.77	653.63	672.78	1.65	ACCEPTABLE
224	418.23	770.76	788.97	1.73	ACCEPTABLE
225	397.16	779.90	799.58	1.61	ACCEPTABLE

No.	Center		Radius	FS	Verification
	x [ft]	z [ft]	R [ft]		
226	410.09	787.77	805.90	1.71	ACCEPTABLE
227	386.89	902.17	914.15	2.13	ACCEPTABLE
228	359.22	1206.68	1219.11	2.06	ACCEPTABLE
229	390.82	1023.58	1034.76	2.35	ACCEPTABLE
230	386.58	895.74	915.19	1.62	ACCEPTABLE
231	412.32	760.38	779.63	1.66	ACCEPTABLE
232	403.89	707.46	726.14	1.67	ACCEPTABLE
233	357.39	1059.69	1072.92	1.96	ACCEPTABLE
234	384.51	929.43	940.71	2.28	ACCEPTABLE
235	405.10	693.53	712.85	1.64	ACCEPTABLE
236	411.13	774.95	793.59	1.69	ACCEPTABLE
237	397.16	779.90	799.58	1.61	ACCEPTABLE
238	405.64	786.70	805.29	1.68	ACCEPTABLE
239	390.82	855.48	870.00	1.88	ACCEPTABLE
240	375.03	1028.79	1043.50	1.87	ACCEPTABLE
241	393.85	927.54	941.53	1.95	ACCEPTABLE
242	390.27	855.41	874.92	1.62	ACCEPTABLE
243	407.31	766.77	786.16	1.64	ACCEPTABLE
244	401.67	731.35	750.35	1.64	ACCEPTABLE
245	372.73	947.76	963.00	1.81	ACCEPTABLE
246	389.47	870.98	885.03	1.92	ACCEPTABLE
247	402.55	721.31	740.75	1.63	ACCEPTABLE
248	406.44	777.11	796.08	1.66	ACCEPTABLE
249	397.16	779.90	799.58	1.61	ACCEPTABLE
250	402.75	785.12	804.04	1.66	ACCEPTABLE
251	393.13	827.97	844.19	1.77	ACCEPTABLE
252	383.54	933.04	949.36	1.77	ACCEPTABLE
253	395.30	872.71	888.58	1.81	ACCEPTABLE
254	392.63	829.50	849.06	1.61	ACCEPTABLE
255	403.94	771.10	790.58	1.63	ACCEPTABLE
256	400.18	747.41	766.63	1.64	ACCEPTABLE
257	381.65	884.85	901.52	1.73	ACCEPTABLE
258	392.31	837.32	853.23	1.79	ACCEPTABLE
259	400.79	740.38	759.90	1.62	ACCEPTABLE
260	403.33	778.27	797.46	1.65	ACCEPTABLE
261	397.16	779.90	799.58	1.61	ACCEPTABLE
262	400.86	783.68	802.84	1.64	ACCEPTABLE
263	394.56	811.00	828.37	1.71	ACCEPTABLE
264	388.52	877.01	894.42	1.71	ACCEPTABLE
265	396.06	839.51	856.65	1.73	ACCEPTABLE
266	394.17	812.65	832.24	1.61	ACCEPTABLE
267	401.69	774.01	793.55	1.63	ACCEPTABLE
268	399.18	758.19	777.56	1.63	ACCEPTABLE
269	387.13	847.09	864.74	1.69	ACCEPTABLE
270	394.04	816.84	834.00	1.72	ACCEPTABLE
271	400.04	748.37	768.15	1.61	ACCEPTABLE
272	403.72	751.89	771.15	1.64	ACCEPTABLE
273	397.64	777.19	794.65	1.71	ACCEPTABLE
274	391.87	840.32	857.81	1.71	ACCEPTABLE

No.	Center		Radius	FS	Verification
	x [ft]	z [ft]	R [ft]		
275	399.20	804.52	821.75	1.73	ACCEPTABLE
276	397.18	779.71	799.40	1.61	ACCEPTABLE
277	404.50	742.82	762.47	1.62	ACCEPTABLE
278	401.99	727.41	746.88	1.63	ACCEPTABLE
279	390.41	811.66	829.38	1.69	ACCEPTABLE
280	397.16	782.67	799.92	1.73	ACCEPTABLE
281	402.39	722.86	742.54	1.62	ACCEPTABLE
282	404.10	747.42	766.88	1.63	ACCEPTABLE
283	400.04	748.37	768.15	1.61	ACCEPTABLE
284	402.48	750.84	770.28	1.63	ACCEPTABLE
285	398.47	767.22	785.45	1.68	ACCEPTABLE
286	394.76	807.77	826.02	1.67	ACCEPTABLE
287	399.54	784.93	803.01	1.69	ACCEPTABLE
288	398.14	769.13	788.85	1.61	ACCEPTABLE
289	403.01	744.66	764.35	1.62	ACCEPTABLE
290	401.34	734.37	753.95	1.62	ACCEPTABLE
291	393.74	789.50	807.90	1.66	ACCEPTABLE
292	398.16	770.73	788.82	1.69	ACCEPTABLE
293	401.61	731.28	750.99	1.61	ACCEPTABLE
294	402.74	747.78	767.34	1.62	ACCEPTABLE
295	400.04	748.37	768.15	1.61	ACCEPTABLE
296	401.66	750.08	769.62	1.62	ACCEPTABLE
297	399.01	760.78	779.53	1.65	ACCEPTABLE
298	396.59	787.17	805.93	1.65	ACCEPTABLE
299	399.73	772.37	791.02	1.66	ACCEPTABLE
300	398.78	762.15	781.89	1.61	ACCEPTABLE
301	402.02	745.89	765.61	1.61	ACCEPTABLE
302	400.91	739.03	758.67	1.62	ACCEPTABLE
303	395.89	775.34	794.20	1.65	ACCEPTABLE
304	398.81	763.05	781.71	1.66	ACCEPTABLE
305	401.09	736.93	756.67	1.61	ACCEPTABLE
306	401.84	748.00	767.63	1.62	ACCEPTABLE
307	400.04	748.37	768.15	1.61	ACCEPTABLE
308	401.12	749.53	769.16	1.62	ACCEPTABLE
309	399.36	756.58	775.67	1.64	ACCEPTABLE
310	397.77	773.89	792.99	1.64	ACCEPTABLE
311	399.84	764.21	783.23	1.65	ACCEPTABLE
312	399.20	757.53	777.29	1.61	ACCEPTABLE
313	400.28	758.72	778.32	1.62	ACCEPTABLE
314	398.50	765.92	784.99	1.64	ACCEPTABLE
315	396.89	783.45	802.53	1.64	ACCEPTABLE
316	398.98	773.64	792.65	1.64	ACCEPTABLE
317	398.35	766.81	786.54	1.61	ACCEPTABLE
318	400.53	755.85	775.57	1.61	ACCEPTABLE
319	399.79	751.23	770.90	1.61	ACCEPTABLE
320	396.42	775.62	794.77	1.63	ACCEPTABLE
321	398.37	767.43	786.44	1.64	ACCEPTABLE
322	400.04	748.35	768.14	1.61	ACCEPTABLE
323	399.91	749.80	769.53	1.62	ACCEPTABLE

No.	Center x [ft]	Center z [ft]	Radius R [ft]	FS	Verification
324	400.40	757.29	776.95	1.62	ACCEPTABLE
325	318.08	314.85	334.60	1.39	ACCEPTABLE

Name : Model 1 Dyn 0.175 circ | **Stage - analysis : 1 - 1**



Analysis 3 (stage 1)

Polygonal slip surface

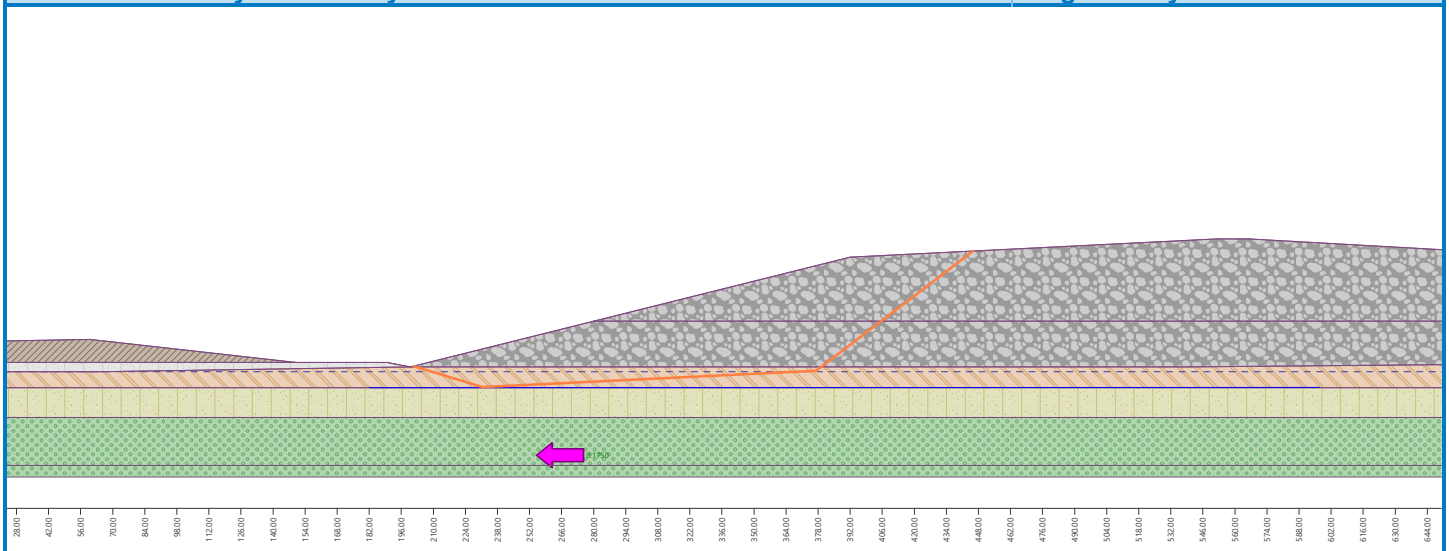
Coordinates of slip surface points [ft]									
x	z	x	z	x	z	x	z	x	z
201.55	-10.61	231.47	-19.81	377.17	-12.56	445.58	39.68		
The slip surface after optimization.									

Segments restricting slip surface

No.	First point x [ft]	First point z [ft]	Second point x [ft]	Second point z [ft]
1	181.92	-19.97	596.86	-19.89

Slope stability verification (Janbu)
Factor of safety = 1.30 > 1.00
Slope stability ACCEPTABLE

Name : Model 1 Dyn 0.175 Poly	Stage - analysis : 1 - 3



Slope stability analysis

Input data

Project

Task : Confirmatory Model for Final Closure of the Ash Basin
Description : Slope Stability Analysis of Grand Tower CCR Impoundment Final Closure Plan
Author : ERM - Annapolis
Date : 6/22/2020
Project number : 0533442

Settings

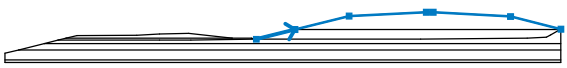
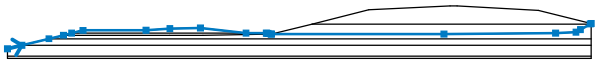
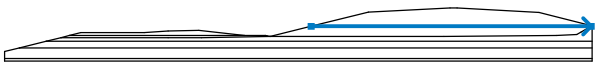
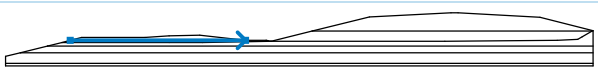
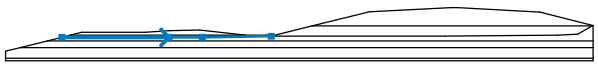
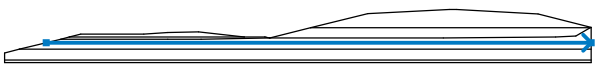
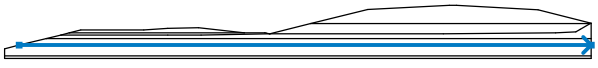
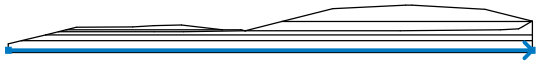
(input for current task)

Stability analysis

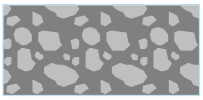
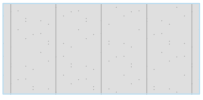
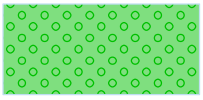
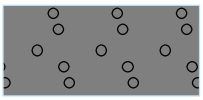
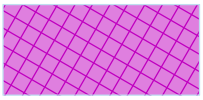
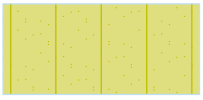
Earthquake analysis : Standard
Verification methodology : Safety factors (ASD)

Safety factors			
Permanent design situation			
Safety factor :	SF_s =	1.50	[–]

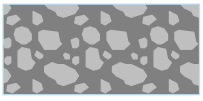
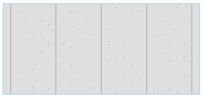
Interface

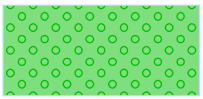
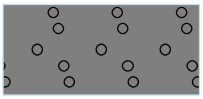
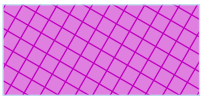
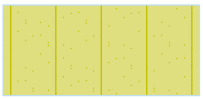
No.	Interface location	Coordinates of interface points [ft]					
		x	z	x	z	x	z
1		200.00	-11.00	279.99	9.00	392.00	37.00
		552.00	45.00	566.00	45.00	726.00	36.00
		830.00	10.00				
2		-320.00	-40.00	-291.43	-33.00	-238.36	-20.00
		-209.79	-13.00	-193.45	-9.00	-171.00	-3.50
		-47.00	-3.00	0.00	0.00	60.00	1.10
		150.00	-9.00	190.00	-9.00	190.64	-9.12
		193.34	-9.67	199.27	-10.85	200.00	-11.00
		540.00	-11.00	760.00	-9.00	800.00	-7.00
		808.86	-1.98	828.24	9.00	830.00	10.00
3		279.99	9.00	828.24	9.00		
4		-193.45	-9.00	150.00	-9.00		
5		-209.79	-13.00	0.00	-13.00	65.00	-13.00
		200.00	-11.00				
6		-238.36	-20.00	830.00	-20.00		
7		-291.43	-33.00	830.00	-33.00		
8		-320.00	-54.00	830.00	-54.00		

Soil parameters - effective stress state

No.	Name	Pattern	φ_{ef} [°]	c_{ef} [psf]	γ [pcf]
1	Ash - Geotech Lab 6/2020		30.00	100.0	75.0
2	Silty Clay (Compacted Levee Cap)		10.00	450.0	133.0
3	Silty Sand (layer in berm, not basin)		28.00	100.0	115.0
4	Silty Clay, impervious fdtn (Updated with 2007 Hanson Report and ERM)		10.00	500.0	130.0
5	Sand & Gravel (Underlying Aquifer)		34.00	0.0	130.0
6	Gravel with trace of fines (G-F), medium dense- RipRap		40.00	0.0	165.0
7	Critical Interface		25.00	50.0	110.0
8	Sandy Silt (Native Pervious Material)		24.00	150.0	115.0

Soil parameters - uplift

No.	Name	Pattern	γ_{sat} [pcf]	γ_s [pcf]	n [–]
1	Ash - Geotech Lab 6/2020		100.0		
2	Silty Clay (Compacted Levee Cap)		153.0		
3	Silty Sand (layer in berm, not basin)		136.0		
4	Silty Clay, impervious fdtn (Updated with 2007 Hanson Report and ERM)		150.0		

No.	Name	Pattern	γ_{sat} [pcf]	γ_s [pcf]	n [–]
5	Sand & Gravel (Underlying Aquifer)		130.0		
6	Gravel with trace of fines (G-F), medium dense- RipRap		165.0		
7	Critical Interface		110.0		
8	Sandy Silt (Native Pervious Material)		135.0		

Soil parameters

Ash - Geotech Lab 6/2020

Unit weight : γ = 75.0 pcf
Stress-state : effective
Angle of internal friction : φ_{ef} = 30.00 °
Cohesion of soil : c_{ef} = 100.0 psf
Saturated unit weight : γ_{sat} = 100.0 pcf

Silty Clay (Compacted Levee Cap)

Unit weight : γ = 133.0 pcf
Stress-state : effective
Angle of internal friction : φ_{ef} = 10.00 °
Cohesion of soil : c_{ef} = 450.0 psf
Saturated unit weight : γ_{sat} = 153.0 pcf

Silty Sand (layer in berm, not basin)

Unit weight : γ = 115.0 pcf
Stress-state : effective
Angle of internal friction : φ_{ef} = 28.00 °
Cohesion of soil : c_{ef} = 100.0 psf
Saturated unit weight : γ_{sat} = 136.0 pcf

Silty Clay, impervious fdtn (Updated with 2007 Hanson Report and ERM)

Unit weight : γ = 130.0 pcf
Stress-state : effective
Angle of internal friction : φ_{ef} = 10.00 °
Cohesion of soil : c_{ef} = 500.0 psf
Saturated unit weight : γ_{sat} = 150.0 pcf

Sand & Gravel (Underlying Aquifer)

Unit weight : γ = 130.0 pcf
Stress-state : effective
Angle of internal friction : φ_{ef} = 34.00 °

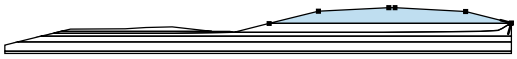
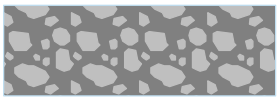
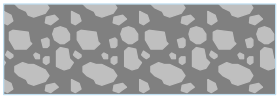
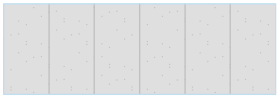
Cohesion of soil : c_{ef} = 0.0 psf
Saturated unit weight : γ_{sat} = 130.0 pcf

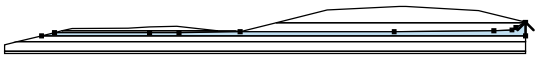
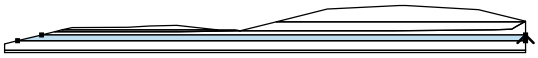
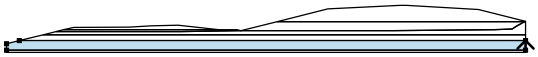
Gravel with trace of fines (G-F), medium dense- RipRap
Unit weight : γ = 165.0 pcf
Stress-state : effective
Angle of internal friction : φ_{ef} = 40.00 °
Cohesion of soil : c_{ef} = 0.0 psf
Saturated unit weight : γ_{sat} = 165.0 pcf

Critical Interface
Unit weight : γ = 110.0 pcf
Stress-state : effective
Angle of internal friction : φ_{ef} = 25.00 °
Cohesion of soil : c_{ef} = 50.0 psf
Saturated unit weight : γ_{sat} = 110.0 pcf

Sandy Silt (Native Pervious Material)
Unit weight : γ = 115.0 pcf
Stress-state : effective
Angle of internal friction : φ_{ef} = 24.00 °
Cohesion of soil : c_{ef} = 150.0 psf
Saturated unit weight : γ_{sat} = 135.0 pcf

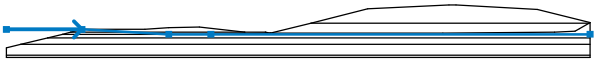
Assigning and surfaces

No.	Surface position	Coordinates of surface points [ft]				Assigned soil
		x	z	x	z	
1		828.24	9.00	830.00	10.00	Ash - Geotech Lab 6/2020
		726.00	36.00	566.00	45.00	
		552.00	45.00	392.00	37.00	
		279.99	9.00			
2		150.00	-9.00	60.00	1.10	Silty Clay (Compacted Levee Cap)
		0.00	0.00	-47.00	-3.00	
		-171.00	-3.50	-193.45	-9.00	
3		279.99	9.00	200.00	-11.00	Ash - Geotech Lab 6/2020
		540.00	-11.00	760.00	-9.00	
		800.00	-7.00	808.86	-1.98	
		828.24	9.00			
4		0.00	-13.00	65.00	-13.00	Silty Sand (layer in berm, not basin)
		200.00	-11.00	199.27	-10.85	
		193.34	-9.67	190.64	-9.12	
		190.00	-9.00	150.00	-9.00	
		-193.45	-9.00	-209.79	-13.00	

No.	Surface position	Coordinates of surface points [ft]				Assigned soil
		x	z	x	z	
5		830.00	-20.00	830.00	10.00	Silty Clay, Impervious fdtn (Updated with 2007 Hanson Report and ERM)
		828.24	9.00	808.86	-1.98	
		800.00	-7.00	760.00	-9.00	
		540.00	-11.00	200.00	-11.00	
		65.00	-13.00	0.00	-13.00	
		-209.79	-13.00	-238.36	-20.00	
6		830.00	-33.00	830.00	-20.00	Sandy Silt (Native Pervious Material)
		-238.36	-20.00	-291.43	-33.00	
7		830.00	-54.00	830.00	-33.00	Sand & Gravel (Underlying Aquifer)
		-291.43	-33.00	-320.00	-40.00	
		-320.00	-54.00			
8		-320.00	-54.00	-320.00	-59.00	Sand & Gravel (Underlying Aquifer)
		830.00	-59.00	830.00	-54.00	

Water

Water type : GWT

No.	GWT location	Coordinates of GWT points [ft]					
		x	z	x	z	x	z
1		-320.00	-3.50	-171.00	-3.50	0.00	-13.00
		83.00	-13.00	830.00	-13.00		

Tensile crack

Tensile crack not input.

Earthquake

Earthquake not included.

Settings of the stage of construction

Design situation : permanent

Results (Stage of construction 1)

Analysis 1 (stage 1)

Circular slip surface

Slip surface parameters							
Center :	x =	244.69	[ft]	Angles :	α_1 =	-7.31	[°]
	z =	265.19	[ft]		α_2 =	34.40	[°]
Radius :	R =	276.04	[ft]				
The slip surface after optimization.							

Segments restricting slip surface

No.	First point		Second point	
	x [ft]	z [ft]	x [ft]	z [ft]
1	200.14	-11.00	631.04	-10.26

The restrictions of points of circular slip surface

Slope stability verification (Bishop)

Sum of active forces : F_a = 43987.5 lbf/ft
Sum of passive forces : F_p = 128553.5 lbf/ft

Sliding moment : M_a = 12142318.3 lbfft/ft
Resisting moment : M_p = 35485908.3 lbfft/ft
Factor of safety = 2.92 > 1.50
Slope stability ACCEPTABLE

Optimization of circular slip surface (Bishop)

No.	Center		Radius	FS	Verification
	x [ft]	z [ft]	R [ft]		
1	260.15	180.04	186.19	3.06	ACCEPTABLE
2	260.15	180.04	186.19	3.06	ACCEPTABLE
3	260.15	180.04	186.19	3.06	ACCEPTABLE
4	95.53	2919.02	2920.61	5.89	ACCEPTABLE
5	480.80	161.09	170.24	17.55	ACCEPTABLE
6	97.63	1129.36	1131.14	620651.53	ACCEPTABLE
7	160.47	2005.68	2012.12	5.14	ACCEPTABLE
8	260.15	180.04	186.19	3.06	ACCEPTABLE
9	130.62	1752.57	1754.15	4.72	ACCEPTABLE
10	444.03	95.51	97.58	14.95	ACCEPTABLE
11	192.71	1123.79	1130.53	4.08	ACCEPTABLE
12	260.15	180.04	186.19	3.06	ACCEPTABLE
13	19.33	2080.05	2089.32	4.49	ACCEPTABLE
14	395.18	94.96	96.82	6.89	ACCEPTABLE
15	93.90	979.91	987.06	2010851.34	ACCEPTABLE
16	56.12	1547.99	1556.09	4.30	ACCEPTABLE
17	190.71	827.51	836.38	3.52	ACCEPTABLE
18	260.15	180.04	186.19	3.06	ACCEPTABLE
19	34.09	1561.06	1575.22	3.93	ACCEPTABLE
20	354.79	108.40	110.88	4.20	ACCEPTABLE
21	137.33	571.35	580.86	14.16	ACCEPTABLE
22	198.46	611.12	621.22	3.19	ACCEPTABLE
23	260.15	180.04	186.19	3.06	ACCEPTABLE
24	128.62	872.35	883.09	3.44	ACCEPTABLE
25	326.05	121.32	124.57	3.41	ACCEPTABLE
26	181.80	362.56	371.57	4.09	ACCEPTABLE
27	297.61	30.21	31.94	4.55	ACCEPTABLE
28	213.70	450.43	460.37	3.03	ACCEPTABLE
29	281.24	437.01	436.63	3.62	ACCEPTABLE

No.	Center		Radius	FS	Verification
	x [ft]	z [ft]	R [ft]		
30	86.64	1400.29	1411.15	3.82	ACCEPTABLE
31	306.00	301.36	305.05	3.59	ACCEPTABLE
32	268.24	191.10	190.48	3.22	ACCEPTABLE
33	163.52	544.41	553.43	3.78	ACCEPTABLE
34	282.73	133.12	135.64	3.13	ACCEPTABLE
35	185.05	795.07	804.49	3.42	ACCEPTABLE
36	286.59	407.71	407.86	3.61	ACCEPTABLE
37	213.70	450.43	460.37	3.03	ACCEPTABLE
38	217.38	652.75	655.27	3.47	ACCEPTABLE
39	138.71	988.99	998.62	3.50	ACCEPTABLE
40	279.22	338.22	343.38	3.31	ACCEPTABLE
41	238.87	308.58	310.89	3.20	ACCEPTABLE
42	185.34	469.98	479.11	3.29	ACCEPTABLE
43	265.65	201.45	206.05	3.02	ACCEPTABLE
44	314.69	149.01	152.04	3.26	ACCEPTABLE
45	130.92	818.57	831.69	3.29	ACCEPTABLE
46	312.90	157.33	159.38	3.24	ACCEPTABLE
47	295.60	81.64	82.22	3.36	ACCEPTABLE
48	192.82	364.17	374.21	3.35	ACCEPTABLE
49	296.09	79.70	80.61	3.37	ACCEPTABLE
50	213.70	450.44	460.38	3.03	ACCEPTABLE
51	306.70	186.18	185.62	3.20	ACCEPTABLE
52	265.65	201.45	206.05	3.02	ACCEPTABLE
53	286.09	221.35	220.79	3.08	ACCEPTABLE
54	202.73	484.03	491.50	3.11	ACCEPTABLE
55	255.69	256.35	266.85	2.94	ACCEPTABLE
56	274.80	288.04	293.06	3.13	ACCEPTABLE
57	196.18	479.34	483.18	3.61	ACCEPTABLE
58	-61.02	1873.22	1898.70	3.98	ACCEPTABLE
59	216.56	472.48	482.89	3.06	ACCEPTABLE
60	288.64	222.68	231.31	3.14	ACCEPTABLE
61	270.58	181.74	187.46	3.01	ACCEPTABLE
62	-285.75	2407.10	2464.99	8.79	ACCEPTABLE
63	277.88	152.53	160.69	3.03	ACCEPTABLE
64	280.99	258.80	265.13	3.13	ACCEPTABLE
65	255.69	256.35	266.85	2.94	ACCEPTABLE
66	265.62	289.70	296.05	3.05	ACCEPTABLE
67	231.53	342.92	346.90	3.13	ACCEPTABLE
68	27.22	1292.38	1314.63	34.97	ACCEPTABLE
69	197.00	603.37	608.13	3.29	ACCEPTABLE
70	278.07	232.80	241.98	3.06	ACCEPTABLE
71	264.95	207.03	214.18	2.97	ACCEPTABLE
72	140.40	654.00	667.47	21.17	ACCEPTABLE
73	194.17	494.87	499.99	3.40	ACCEPTABLE
74	271.22	181.52	190.43	2.98	ACCEPTABLE
75	271.77	261.60	269.13	3.05	ACCEPTABLE
76	255.69	256.35	266.85	2.94	ACCEPTABLE
77	261.23	282.98	290.51	3.01	ACCEPTABLE
78	242.36	304.15	309.80	3.01	ACCEPTABLE

No.	Center		Radius	FS	Verification
	x [ft]	z [ft]	R [ft]		
79	178.67	604.25	614.42	3.14	ACCEPTABLE
80	231.31	416.92	422.08	3.09	ACCEPTABLE
81	235.68	351.60	362.42	2.97	ACCEPTABLE
82	270.81	240.12	249.70	3.01	ACCEPTABLE
83	261.64	224.16	232.37	2.95	ACCEPTABLE
84	201.05	434.66	444.26	3.06	ACCEPTABLE
85	228.75	360.62	365.75	3.08	ACCEPTABLE
86	266.41	204.38	213.79	2.95	ACCEPTABLE
87	266.05	261.41	269.85	3.01	ACCEPTABLE
88	255.69	256.35	266.85	2.94	ACCEPTABLE
89	258.95	275.79	284.22	2.98	ACCEPTABLE
90	247.69	285.08	292.17	2.97	ACCEPTABLE
91	217.01	430.61	439.51	3.03	ACCEPTABLE
92	243.16	345.51	352.06	3.02	ACCEPTABLE
93	242.99	316.57	327.20	2.96	ACCEPTABLE
94	265.86	245.28	255.15	2.98	ACCEPTABLE
95	259.57	235.17	244.12	2.95	ACCEPTABLE
96	224.58	354.48	363.65	2.98	ACCEPTABLE
97	241.07	312.88	319.37	2.99	ACCEPTABLE
98	266.38	206.57	217.27	2.95	ACCEPTABLE
99	263.00	220.74	230.50	2.95	ACCEPTABLE
100	262.44	260.39	269.49	2.98	ACCEPTABLE
101	255.69	256.35	266.85	2.94	ACCEPTABLE
102	257.68	269.99	279.06	2.97	ACCEPTABLE
103	250.68	274.36	282.51	2.95	ACCEPTABLE
104	233.53	356.00	365.04	2.98	ACCEPTABLE
105	248.56	309.89	317.63	2.98	ACCEPTABLE
106	247.48	295.16	305.70	2.95	ACCEPTABLE
107	262.51	248.86	258.93	2.97	ACCEPTABLE
108	258.24	242.34	251.81	2.94	ACCEPTABLE
109	236.67	315.08	324.44	2.95	ACCEPTABLE
110	247.02	289.86	297.55	2.96	ACCEPTABLE
111	263.01	222.16	232.76	2.94	ACCEPTABLE
112	260.64	232.18	242.18	2.94	ACCEPTABLE
113	260.12	259.34	268.88	2.97	ACCEPTABLE
114	255.69	256.35	266.85	2.94	ACCEPTABLE
115	256.94	265.72	275.25	2.96	ACCEPTABLE
116	252.48	267.90	276.81	2.95	ACCEPTABLE
117	242.18	317.03	326.42	2.96	ACCEPTABLE
118	251.40	289.84	298.46	2.97	ACCEPTABLE
119	250.33	281.66	292.17	2.95	ACCEPTABLE
120	260.26	251.30	261.51	2.96	ACCEPTABLE
121	257.37	247.06	256.87	2.94	ACCEPTABLE
122	243.65	293.03	302.68	2.94	ACCEPTABLE
123	244.17	305.89	314.61	2.96	ACCEPTABLE
124	239.00	310.04	318.30	2.96	ACCEPTABLE
125	226.02	371.10	380.12	2.98	ACCEPTABLE
126	236.91	337.08	345.13	2.98	ACCEPTABLE
127	236.95	324.22	334.02	2.95	ACCEPTABLE

No.	Center		Radius	FS	Verification
	x [ft]	z [ft]	R [ft]		
128	255.83	255.76	266.29	2.94	ACCEPTABLE
129	242.00	302.56	312.92	2.94	ACCEPTABLE
130	242.55	315.45	324.87	2.96	ACCEPTABLE
131	237.30	320.03	328.99	2.96	ACCEPTABLE
132	224.36	381.38	391.10	2.98	ACCEPTABLE
133	235.24	347.16	355.91	2.98	ACCEPTABLE
134	235.30	333.98	344.49	2.95	ACCEPTABLE
135	247.06	295.87	305.88	2.95	ACCEPTABLE
136	243.73	292.70	302.36	2.94	ACCEPTABLE
137	226.96	351.45	361.34	2.96	ACCEPTABLE
138	234.30	332.74	341.46	2.97	ACCEPTABLE
139	236.83	309.57	320.30	2.93	ACCEPTABLE
140	237.14	323.41	333.22	2.95	ACCEPTABLE
141	231.78	328.12	337.51	2.96	ACCEPTABLE
142	218.16	392.05	402.28	2.98	ACCEPTABLE
143	229.45	356.41	365.61	2.97	ACCEPTABLE
144	229.78	342.30	353.22	2.94	ACCEPTABLE
145	242.00	302.56	312.91	2.94	ACCEPTABLE
146	238.54	299.75	309.77	2.94	ACCEPTABLE
147	221.08	360.77	371.14	2.96	ACCEPTABLE
148	228.55	341.69	350.86	2.97	ACCEPTABLE
149	243.27	279.88	290.51	2.93	ACCEPTABLE
150	243.95	291.77	301.44	2.94	ACCEPTABLE
151	239.11	294.70	303.89	2.95	ACCEPTABLE
152	226.93	351.57	361.45	2.96	ACCEPTABLE
153	237.29	320.05	329.00	2.96	ACCEPTABLE
154	236.94	309.11	319.85	2.93	ACCEPTABLE
155	248.17	273.85	284.14	2.93	ACCEPTABLE
156	244.95	270.42	280.34	2.93	ACCEPTABLE
157	229.25	323.64	333.72	2.95	ACCEPTABLE
158	236.32	306.28	315.20	2.96	ACCEPTABLE
159	249.08	253.26	263.86	2.93	ACCEPTABLE
160	250.07	263.49	273.12	2.94	ACCEPTABLE
161	245.65	265.05	274.12	2.94	ACCEPTABLE
162	234.70	315.87	325.50	2.95	ACCEPTABLE
163	244.28	287.85	296.65	2.95	ACCEPTABLE
164	243.37	279.45	290.10	2.93	ACCEPTABLE
165	253.74	248.06	258.35	2.93	ACCEPTABLE
166	250.73	244.18	254.07	2.93	ACCEPTABLE
167	236.51	290.82	300.70	2.94	ACCEPTABLE
168	243.24	274.98	283.74	2.95	ACCEPTABLE
169	244.33	258.70	269.62	2.92	ACCEPTABLE
170	245.13	269.66	279.61	2.93	ACCEPTABLE
171	240.66	271.19	280.63	2.95	ACCEPTABLE
172	229.18	323.94	334.01	2.95	ACCEPTABLE
173	239.06	294.88	304.07	2.95	ACCEPTABLE
174	249.08	253.26	263.86	2.93	ACCEPTABLE
175	245.97	249.64	259.84	2.94	ACCEPTABLE
176	231.24	297.87	308.16	2.95	ACCEPTABLE

No.	Center		Radius	FS	Verification
	x [ft]	z [ft]	R [ft]		
177	238.06	281.75	290.90	2.96	ACCEPTABLE
178	247.92	241.68	252.23	2.93	ACCEPTABLE
179	247.13	261.37	271.63	2.93	ACCEPTABLE
180	244.33	258.70	269.62	2.92	ACCEPTABLE
181	244.83	266.11	276.38	2.93	ACCEPTABLE
182	241.95	266.81	276.74	2.94	ACCEPTABLE
183	234.81	299.65	309.93	2.94	ACCEPTABLE
184	241.04	281.80	291.54	2.94	ACCEPTABLE
185	247.51	255.05	265.75	2.92	ACCEPTABLE
186	245.41	252.68	263.12	2.93	ACCEPTABLE
187	235.90	283.71	294.16	2.94	ACCEPTABLE
188	240.35	273.34	283.06	2.94	ACCEPTABLE
189	248.05	241.92	252.83	2.93	ACCEPTABLE
190	246.74	247.26	257.93	2.93	ACCEPTABLE
191	246.18	260.54	271.01	2.93	ACCEPTABLE
192	244.33	258.70	269.62	2.92	ACCEPTABLE
193	244.65	263.69	274.17	2.93	ACCEPTABLE
194	242.77	264.02	274.27	2.93	ACCEPTABLE
195	238.22	284.98	295.45	2.93	ACCEPTABLE
196	242.23	273.68	283.81	2.93	ACCEPTABLE
197	246.45	256.25	267.03	2.92	ACCEPTABLE
198	245.05	254.70	265.30	2.93	ACCEPTABLE
199	238.83	274.92	285.51	2.93	ACCEPTABLE
200	241.75	268.17	278.27	2.94	ACCEPTABLE
201	246.83	247.40	258.31	2.93	ACCEPTABLE
202	245.95	251.03	261.78	2.93	ACCEPTABLE
203	245.56	259.95	270.57	2.93	ACCEPTABLE
204	244.33	258.70	269.62	2.92	ACCEPTABLE
205	244.54	262.05	272.67	2.93	ACCEPTABLE
206	243.30	262.21	272.68	2.93	ACCEPTABLE
207	240.35	275.79	286.40	2.93	ACCEPTABLE
208	242.97	268.51	278.90	2.93	ACCEPTABLE
209	245.75	257.06	267.88	2.92	ACCEPTABLE
210	244.81	256.04	266.74	2.93	ACCEPTABLE
211	240.72	269.32	280.01	2.93	ACCEPTABLE
212	242.65	264.89	275.26	2.93	ACCEPTABLE
213	246.01	251.12	262.03	2.92	ACCEPTABLE
214	245.41	253.57	264.37	2.93	ACCEPTABLE
215	245.14	259.55	270.27	2.92	ACCEPTABLE
216	116.90	2850.36	2854.96	5.92	ACCEPTABLE
217	414.22	275.36	492.60	18.34	ACCEPTABLE
218	116.90	2850.36	2854.96	5.92	ACCEPTABLE
219	420.55	340.42	480.90	11.61	ACCEPTABLE
220	-20.17	2776.02	2779.31	5.67	ACCEPTABLE
221	543.65	286.87	259.44	76.24	ACCEPTABLE
222	-20.17	2776.01	2779.30	5.67	ACCEPTABLE
223	484.65	284.38	257.11	16.31	ACCEPTABLE
224	-20.17	2776.01	2779.30	5.67	ACCEPTABLE
225	440.08	333.17	306.38	13.31	ACCEPTABLE

No.	Center		Radius	FS	Verification
	x [ft]	z [ft]	R [ft]		
226	234.83	1082.06	1058.37	15.14	ACCEPTABLE
227	390.51	45.25	17.87	8.33	ACCEPTABLE
228	449.55	193.68	175.93	13.28	ACCEPTABLE
229	-20.17	2776.01	2779.30	5.67	ACCEPTABLE
230	320.08	1267.01	1239.86	9.82	ACCEPTABLE
231	396.96	459.67	434.12	9.10	ACCEPTABLE
232	342.28	364.46	337.05	6.64	ACCEPTABLE
233	373.91	153.64	127.48	5.67	ACCEPTABLE
234	376.62	673.27	646.02	9.35	ACCEPTABLE
235	-20.17	2776.01	2779.30	5.67	ACCEPTABLE
236	414.00	105.75	110.78	8.70	ACCEPTABLE
237	354.74	627.88	604.23	7.27	ACCEPTABLE
238	359.71	240.77	245.71	4.70	ACCEPTABLE
239	402.41	191.02	198.06	6.54	ACCEPTABLE
240	313.30	553.12	536.84	4.97	ACCEPTABLE
241	135.36	2357.58	2347.73	6.41	ACCEPTABLE
242	322.33	486.89	491.28	4.45	ACCEPTABLE
243	366.16	469.94	469.39	5.52	ACCEPTABLE
244	238.61	1055.09	1061.68	4.42	ACCEPTABLE
245	266.22	1306.81	1305.76	5.44	ACCEPTABLE
246	231.90	1264.20	1273.95	4.70	ACCEPTABLE
247	318.43	876.94	878.54	5.39	ACCEPTABLE
248	282.86	750.01	749.62	4.48	ACCEPTABLE
249	181.62	1193.55	1202.57	4.07	ACCEPTABLE
250	173.98	1637.05	1639.49	4.81	ACCEPTABLE
251	31.43	2458.08	2471.48	4.60	ACCEPTABLE
252	281.77	875.22	877.38	4.70	ACCEPTABLE
253	226.12	907.03	908.27	4.08	ACCEPTABLE
254	140.02	1292.01	1301.59	3.90	ACCEPTABLE
255	43.18	2310.53	2319.17	4.68	ACCEPTABLE
256	182.75	1186.48	1195.48	4.06	ACCEPTABLE
257	265.28	844.39	844.55	4.43	ACCEPTABLE
258	176.63	1047.69	1049.78	3.93	ACCEPTABLE
259	61.62	1569.39	1583.12	3.84	ACCEPTABLE
260	131.65	1326.35	1336.91	3.88	ACCEPTABLE
261	245.18	850.81	848.92	4.23	ACCEPTABLE
262	2.26	1789.83	1805.22	4.10	ACCEPTABLE
263	-256.81	2995.69	3038.13	4.12	ACCEPTABLE
264	231.32	464.05	474.98	3.14	ACCEPTABLE
265	256.68	557.79	560.81	3.62	ACCEPTABLE
266	180.67	878.28	887.31	3.54	ACCEPTABLE
267	291.73	364.48	371.57	3.57	ACCEPTABLE
268	259.93	302.42	306.09	3.05	ACCEPTABLE
269	298.56	313.05	309.97	3.49	ACCEPTABLE
270	54.30	1321.79	1340.24	17.08	ACCEPTABLE
271	313.96	232.70	233.10	3.48	ACCEPTABLE
272	288.88	160.72	157.68	3.18	ACCEPTABLE
273	310.63	73.69	82.99	3.54	ACCEPTABLE
274	297.85	124.82	124.48	3.16	ACCEPTABLE

No.	Center		Radius	FS	Verification
	x [ft]	z [ft]	R [ft]		
275	190.95	659.70	669.94	3.23	ACCEPTABLE
276	303.05	289.64	287.29	3.48	ACCEPTABLE
277	259.93	302.42	306.09	3.05	ACCEPTABLE
278	274.34	365.15	363.23	3.34	ACCEPTABLE
279	170.34	742.41	751.26	3.30	ACCEPTABLE
280	247.91	375.74	384.87	3.09	ACCEPTABLE
281	297.35	251.78	253.04	3.28	ACCEPTABLE
282	276.26	213.34	212.02	3.11	ACCEPTABLE
283	213.31	380.54	388.13	3.10	ACCEPTABLE
284	298.24	124.33	129.63	3.12	ACCEPTABLE
285	243.54	258.45	267.72	2.95	ACCEPTABLE
286	257.68	312.40	315.86	3.06	ACCEPTABLE
287	196.91	508.40	518.10	3.07	ACCEPTABLE
288	278.50	219.97	226.97	3.02	ACCEPTABLE
289	258.07	198.23	202.24	3.10	ACCEPTABLE
290	212.48	316.23	326.48	3.09	ACCEPTABLE
291	278.70	115.71	126.50	3.13	ACCEPTABLE
292	268.45	156.70	162.98	3.06	ACCEPTABLE
293	222.40	390.62	401.35	2.97	ACCEPTABLE
294	268.19	265.77	270.51	3.03	ACCEPTABLE
295	243.54	258.45	267.72	2.95	ACCEPTABLE
296	249.68	307.48	312.53	3.01	ACCEPTABLE
297	199.43	432.78	437.89	3.50	ACCEPTABLE
298	142.94	766.12	774.93	3.52	ACCEPTABLE
299	202.35	445.54	456.50	3.20	ACCEPTABLE
300	267.39	231.37	239.03	2.97	ACCEPTABLE
301	252.18	221.79	227.41	3.05	ACCEPTABLE
302	103.76	815.48	828.93	4.51	ACCEPTABLE
303	268.96	154.67	164.33	3.03	ACCEPTABLE
304	260.89	186.94	194.14	3.02	ACCEPTABLE
305	258.95	267.63	273.73	2.98	ACCEPTABLE
306	243.54	258.45	267.72	2.95	ACCEPTABLE
307	246.46	295.41	301.71	2.99	ACCEPTABLE
308	223.08	338.20	343.56	3.19	ACCEPTABLE
309	134.00	725.27	738.49	3.35	ACCEPTABLE
310	206.51	463.48	469.10	3.18	ACCEPTABLE
311	218.67	370.68	380.77	2.97	ACCEPTABLE
312	259.70	239.71	247.85	2.95	ACCEPTABLE
313	264.99	266.92	272.09	3.01	ACCEPTABLE
314	246.02	287.15	290.62	3.08	ACCEPTABLE
315	175.68	612.20	620.95	3.21	ACCEPTABLE
316	233.20	406.52	409.63	3.13	ACCEPTABLE
317	239.03	336.48	345.01	2.98	ACCEPTABLE
318	254.51	269.10	279.69	2.95	ACCEPTABLE
319	259.87	297.18	304.81	3.03	ACCEPTABLE
320	240.11	322.10	327.91	3.01	ACCEPTABLE
321	173.86	637.12	647.68	3.16	ACCEPTABLE
322	228.41	439.67	445.06	3.11	ACCEPTABLE
323	269.86	251.92	261.57	3.02	ACCEPTABLE

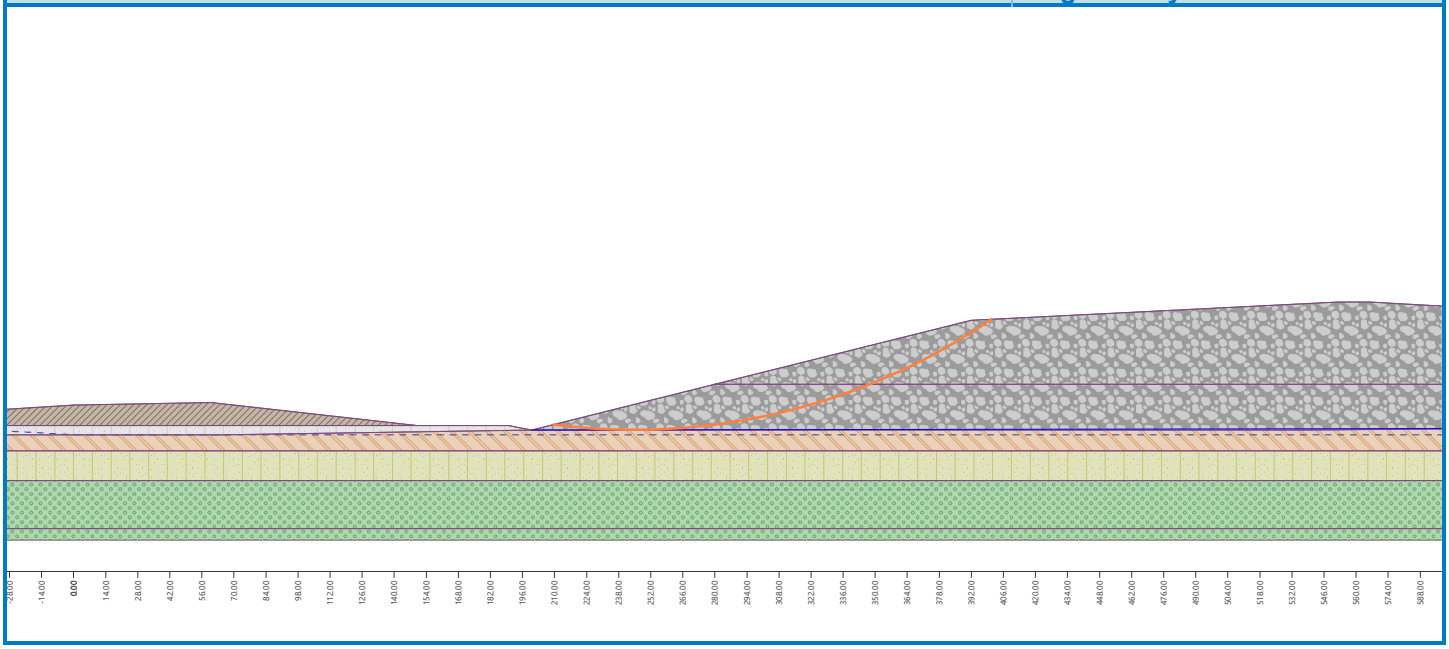
No.	Center		Radius	FS	Verification
	x [ft]	z [ft]	R [ft]		
324	260.55	236.12	244.43	2.95	ACCEPTABLE
325	197.39	459.78	469.66	3.06	ACCEPTABLE
326	225.90	381.88	387.24	3.08	ACCEPTABLE
327	265.51	215.25	224.73	2.95	ACCEPTABLE
328	264.92	274.31	282.84	3.02	ACCEPTABLE
329	254.51	269.10	279.69	2.95	ACCEPTABLE
330	257.65	289.50	298.03	3.00	ACCEPTABLE
331	245.91	300.80	308.02	2.97	ACCEPTABLE
332	214.16	452.73	461.86	3.04	ACCEPTABLE
333	241.08	363.58	370.30	3.03	ACCEPTABLE
334	241.42	331.71	342.46	2.97	ACCEPTABLE
335	264.84	257.38	267.33	2.99	ACCEPTABLE
336	258.45	247.40	256.45	2.95	ACCEPTABLE
337	261.62	267.09	274.07	2.99	ACCEPTABLE
338	250.34	276.11	281.80	2.99	ACCEPTABLE
339	218.63	425.26	432.87	3.05	ACCEPTABLE
340	245.47	337.77	342.95	3.03	ACCEPTABLE
341	245.55	308.09	317.28	2.96	ACCEPTABLE
342	254.89	267.45	278.12	2.95	ACCEPTABLE
343	268.64	236.35	244.76	2.98	ACCEPTABLE
344	262.31	226.37	233.87	2.96	ACCEPTABLE
345	226.83	346.60	354.44	3.00	ACCEPTABLE
346	243.43	304.81	309.92	3.02	ACCEPTABLE
347	247.83	259.61	269.38	2.93	ACCEPTABLE
348	250.07	283.09	290.79	2.96	ACCEPTABLE
349	238.29	292.55	299.23	3.01	ACCEPTABLE
350	202.20	458.25	467.36	3.06	ACCEPTABLE
351	231.81	360.82	367.12	3.03	ACCEPTABLE
352	233.38	325.98	336.05	2.94	ACCEPTABLE
353	258.45	247.40	256.46	2.95	ACCEPTABLE
354	251.64	238.62	246.81	2.96	ACCEPTABLE
355	212.74	369.92	379.04	3.05	ACCEPTABLE
356	229.99	326.10	332.36	3.06	ACCEPTABLE
357	236.71	273.16	283.73	2.94	ACCEPTABLE
358	259.73	205.95	215.81	2.95	ACCEPTABLE
359	255.77	221.95	230.89	2.95	ACCEPTABLE
360	239.05	301.94	312.61	2.93	ACCEPTABLE
361	240.45	330.30	338.96	2.97	ACCEPTABLE
362	226.85	346.56	354.40	3.00	ACCEPTABLE
363	185.31	540.11	550.94	4.35	ACCEPTABLE
364	218.65	425.17	432.79	3.05	ACCEPTABLE
365	250.35	287.22	297.09	2.95	ACCEPTABLE
366	242.98	279.68	288.78	2.94	ACCEPTABLE
367	198.30	437.70	448.30	3.04	ACCEPTABLE
368	217.00	387.37	394.98	3.05	ACCEPTABLE
369	252.40	240.67	251.28	2.93	ACCEPTABLE
370	255.44	260.21	268.72	2.95	ACCEPTABLE
371	244.76	266.45	273.71	2.98	ACCEPTABLE
372	213.88	408.73	417.86	3.01	ACCEPTABLE

No.	Center		Radius	FS	Verification
	x [ft]	z [ft]	R [ft]		
373	240.01	325.93	332.66	2.99	ACCEPTABLE
374	239.62	299.53	310.28	2.93	ACCEPTABLE
375	262.51	230.14	240.11	2.95	ACCEPTABLE
376	256.16	220.37	229.41	2.95	ACCEPTABLE
377	221.80	333.35	342.74	3.00	ACCEPTABLE
378	237.96	293.92	300.58	3.02	ACCEPTABLE
379	263.10	192.33	203.15	2.95	ACCEPTABLE
380	259.67	206.21	216.06	2.95	ACCEPTABLE
381	259.02	245.00	254.18	2.95	ACCEPTABLE
382	252.40	240.67	251.28	2.93	ACCEPTABLE
383	254.25	254.36	263.52	2.94	ACCEPTABLE
384	247.60	256.87	265.18	2.96	ACCEPTABLE
385	230.39	336.50	345.72	2.96	ACCEPTABLE
386	245.38	291.79	299.68	2.96	ACCEPTABLE
387	244.15	278.55	289.21	2.93	ACCEPTABLE
388	245.36	295.68	304.93	2.95	ACCEPTABLE
389	237.75	301.36	309.90	2.96	ACCEPTABLE
390	217.49	395.91	405.68	2.99	ACCEPTABLE
391	234.47	342.33	350.54	2.98	ACCEPTABLE
392	234.56	322.99	333.83	2.94	ACCEPTABLE
393	251.42	269.72	279.88	2.94	ACCEPTABLE
394	246.70	264.29	273.89	2.94	ACCEPTABLE
395	222.11	348.20	358.17	2.97	ACCEPTABLE
396	233.10	320.64	328.81	2.98	ACCEPTABLE
397	252.59	239.88	250.53	2.93	ACCEPTABLE
398	249.69	251.88	261.97	2.93	ACCEPTABLE
399	248.44	282.47	292.15	2.94	ACCEPTABLE
400	244.15	278.55	289.21	2.93	ACCEPTABLE
401	244.88	290.22	299.93	2.94	ACCEPTABLE
402	240.07	293.11	302.32	2.95	ACCEPTABLE
403	228.05	349.35	359.22	2.96	ACCEPTABLE
404	238.32	318.18	327.15	2.96	ACCEPTABLE
405	237.90	307.46	318.22	2.93	ACCEPTABLE
406	249.02	272.60	282.92	2.93	ACCEPTABLE
407	245.83	269.09	279.05	2.93	ACCEPTABLE
408	230.30	321.75	331.83	2.95	ACCEPTABLE
409	237.34	304.50	313.43	2.95	ACCEPTABLE
410	249.89	252.20	262.83	2.93	ACCEPTABLE
411	250.92	262.26	271.91	2.94	ACCEPTABLE
412	246.52	263.80	272.90	2.94	ACCEPTABLE
413	235.70	314.12	323.76	2.95	ACCEPTABLE
414	245.20	286.38	295.20	2.95	ACCEPTABLE
415	244.25	278.13	288.81	2.93	ACCEPTABLE
416	254.53	247.06	257.38	2.93	ACCEPTABLE
417	251.54	243.12	253.05	2.93	ACCEPTABLE
418	237.45	289.34	299.23	2.94	ACCEPTABLE
419	244.15	273.57	282.35	2.95	ACCEPTABLE
420	255.09	228.47	239.13	2.93	ACCEPTABLE
421	253.33	235.74	246.01	2.93	ACCEPTABLE

No.	Center		Radius	FS	Verification
	x [ft]	z [ft]	R [ft]		
422	252.74	254.59	264.57	2.93	ACCEPTABLE
423	249.89	252.20	262.83	2.93	ACCEPTABLE
424	250.54	259.02	268.99	2.93	ACCEPTABLE
425	247.70	259.75	269.34	2.94	ACCEPTABLE
426	240.96	291.14	301.05	2.94	ACCEPTABLE
427	246.96	274.06	283.46	2.94	ACCEPTABLE
428	246.18	269.23	279.88	2.93	ACCEPTABLE
429	246.71	276.73	286.73	2.93	ACCEPTABLE
430	243.70	277.98	287.62	2.94	ACCEPTABLE
431	236.50	311.64	321.65	2.94	ACCEPTABLE
432	242.80	293.27	302.73	2.94	ACCEPTABLE
433	242.22	287.50	298.20	2.93	ACCEPTABLE
434	249.38	265.43	275.86	2.93	ACCEPTABLE
435	247.29	263.03	273.21	2.93	ACCEPTABLE
436	237.60	295.39	305.56	2.93	ACCEPTABLE
437	242.10	284.65	294.09	2.94	ACCEPTABLE
438	242.94	273.15	284.02	2.92	ACCEPTABLE
439	243.38	281.00	291.22	2.93	ACCEPTABLE
440	240.35	282.24	292.13	2.94	ACCEPTABLE
441	232.92	316.73	327.01	2.94	ACCEPTABLE
442	239.35	297.92	307.63	2.94	ACCEPTABLE
443	238.85	291.89	302.82	2.92	ACCEPTABLE
444	246.18	269.23	279.88	2.93	ACCEPTABLE
445	244.04	266.96	277.36	2.93	ACCEPTABLE
446	234.12	300.05	310.49	2.94	ACCEPTABLE
447	238.67	289.19	298.88	2.94	ACCEPTABLE
448	246.81	255.54	266.38	2.92	ACCEPTABLE
449	245.44	261.20	271.82	2.93	ACCEPTABLE
450	244.79	275.06	285.49	2.93	ACCEPTABLE
451	242.94	273.15	284.02	2.92	ACCEPTABLE
452	243.22	278.43	288.86	2.93	ACCEPTABLE
453	241.24	279.10	289.31	2.93	ACCEPTABLE
454	236.51	301.09	311.54	2.93	ACCEPTABLE
455	240.64	289.20	299.29	2.93	ACCEPTABLE
456	240.24	285.51	296.42	2.92	ACCEPTABLE
457	245.11	270.53	281.24	2.92	ACCEPTABLE
458	243.67	269.04	279.59	2.93	ACCEPTABLE
459	237.19	290.58	301.14	2.93	ACCEPTABLE
460	240.18	283.51	293.58	2.93	ACCEPTABLE
461	245.54	261.29	272.14	2.92	ACCEPTABLE
462	244.61	265.14	275.84	2.92	ACCEPTABLE
463	244.17	274.45	285.03	2.93	ACCEPTABLE
464	242.94	273.15	284.02	2.92	ACCEPTABLE
465	243.12	276.69	287.26	2.93	ACCEPTABLE
466	241.82	277.07	287.50	2.93	ACCEPTABLE
467	238.76	291.32	301.89	2.93	ACCEPTABLE
468	241.45	283.66	294.00	2.93	ACCEPTABLE
469	241.15	281.33	292.23	2.92	ACCEPTABLE
470	244.39	271.39	282.16	2.92	ACCEPTABLE

No.	Center x [ft]	Center z [ft]	Radius R [ft]	FS	Verification
471	243.43	270.41	281.07	2.92	ACCEPTABLE
472	239.16	284.56	295.21	2.93	ACCEPTABLE
473	241.14	279.92	290.25	2.93	ACCEPTABLE
474	244.69	265.19	276.04	2.92	ACCEPTABLE
475	244.90	268.58	279.14	2.93	ACCEPTABLE
476	243.63	268.87	279.26	2.93	ACCEPTABLE
477	240.66	282.68	293.22	2.93	ACCEPTABLE
478	243.29	275.26	285.58	2.93	ACCEPTABLE
479	242.95	273.12	283.98	2.92	ACCEPTABLE
480	246.12	263.51	274.26	2.92	ACCEPTABLE
481	245.17	262.48	273.12	2.92	ACCEPTABLE
482	241.03	276.11	286.74	2.93	ACCEPTABLE
483	242.97	271.59	281.89	2.93	ACCEPTABLE
484	246.38	257.48	268.32	2.92	ACCEPTABLE
485	245.78	259.97	270.71	2.92	ACCEPTABLE
486	245.51	266.04	276.69	2.92	ACCEPTABLE
487	244.69	265.19	276.04	2.92	ACCEPTABLE

Name : Model static circ	Stage - analysis : 1 - 1



Analysis 3 (stage 1)

Polygonal slip surface

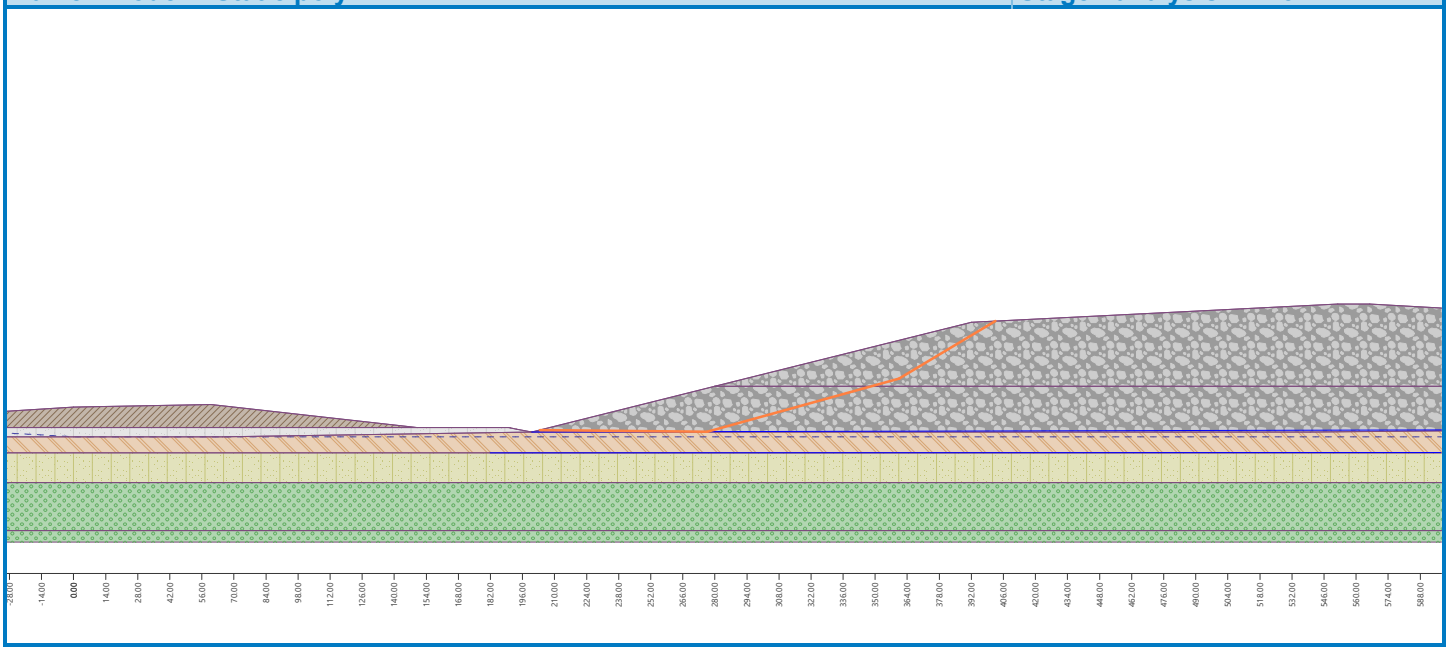
Coordinates of slip surface points [ft]									
x	z	x	z	x	z	x	z	x	z
203.66	-10.09	276.73	-10.78	360.42	12.36	402.55	37.53		
The slip surface after optimization.									

Segments restricting slip surface

No.	First point		Second point	
	x [ft]	z [ft]	x [ft]	z [ft]
1	181.92	-19.97	596.86	-19.89
2	200.04	-10.99	680.07	-9.85

Slope stability verification (Janbu)
Factor of safety = 2.96 > 1.50
Slope stability ACCEPTABLE

Name : Model 2 Static poly	Stage - analysis : 1 - 3



Slope stability analysis

Input data

Project

Task : Confirmatory Model for Final Closure of the Ash Basin
Description : Slope Stability Analysis of Grand Tower CCR Impoundment Final Closure Plan
Author : ERM - Annapolis
Date : 6/22/2020
Project number : 0533442

Settings

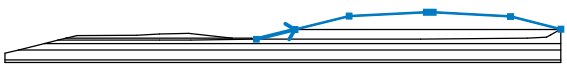
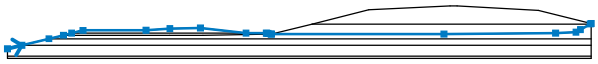
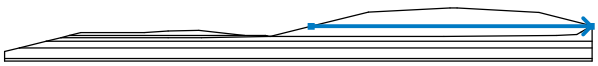
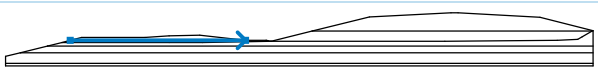
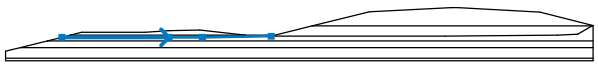
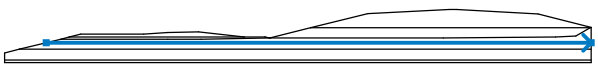
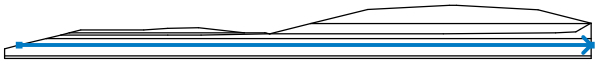
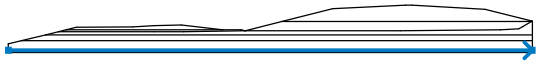
(input for current task)

Stability analysis

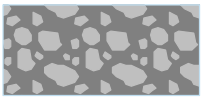
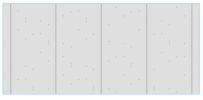
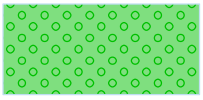
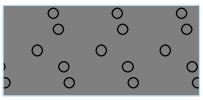
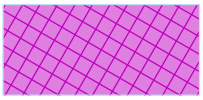
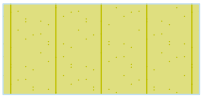
Earthquake analysis : Standard
Verification methodology : Safety factors (ASD)

Safety factors			
Seismic design situation			
Safety factor :	SF_s =	1.00	[–]

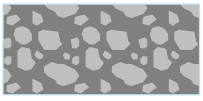
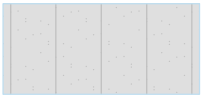
Interface

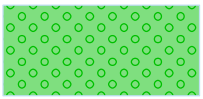
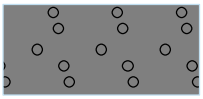
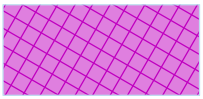
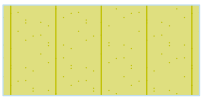
No.	Interface location	Coordinates of interface points [ft]					
		x	z	x	z	x	z
1		200.00	-11.00	279.99	9.00	392.00	37.00
		552.00	45.00	566.00	45.00	726.00	36.00
		830.00	10.00				
2		-320.00	-40.00	-291.43	-33.00	-238.36	-20.00
		-209.79	-13.00	-193.45	-9.00	-171.00	-3.50
		-47.00	-3.00	0.00	0.00	60.00	1.10
		150.00	-9.00	190.00	-9.00	190.64	-9.12
		193.34	-9.67	199.27	-10.85	200.00	-11.00
		540.00	-11.00	760.00	-9.00	800.00	-7.00
		808.86	-1.98	828.24	9.00	830.00	10.00
3		279.99	9.00	828.24	9.00		
4		-193.45	-9.00	150.00	-9.00		
5		-209.79	-13.00	0.00	-13.00	65.00	-13.00
		200.00	-11.00				
6		-238.36	-20.00	830.00	-20.00		
7		-291.43	-33.00	830.00	-33.00		
8		-320.00	-54.00	830.00	-54.00		

Soil parameters - effective stress state

No.	Name	Pattern	φ_{ef} [°]	c_{ef} [psf]	γ [pcf]
1	Ash - Geotech Lab 6/2020		30.00	100.0	75.0
2	Silty Clay (Compacted Levee Cap)		10.00	450.0	133.0
3	Silty Sand (layer in berm, not basin)		28.00	100.0	115.0
4	Silty Clay, impervious fdtn (Updated with 2007 Hanson Report and ERM)		10.00	500.0	130.0
5	Sand & Gravel (Underlying Aquifer)		34.00	0.0	130.0
6	Gravel with trace of fines (G-F), medium dense- RipRap		40.00	0.0	165.0
7	Critical Interface		25.00	50.0	110.0
8	Sandy Silt (Native Pervious Material)		24.00	150.0	115.0

Soil parameters - uplift

No.	Name	Pattern	γ_{sat} [pcf]	γ_s [pcf]	n [–]
1	Ash - Geotech Lab 6/2020		100.0		
2	Silty Clay (Compacted Levee Cap)		153.0		
3	Silty Sand (layer in berm, not basin)		136.0		
4	Silty Clay, impervious fdtn (Updated with 2007 Hanson Report and ERM)		150.0		

No.	Name	Pattern	γ_{sat} [pcf]	γ_s [pcf]	n [–]
5	Sand & Gravel (Underlying Aquifer)		130.0		
6	Gravel with trace of fines (G-F), medium dense- RipRap		165.0		
7	Critical Interface		110.0		
8	Sandy Silt (Native Pervious Material)		135.0		

Soil parameters

Ash - Geotech Lab 6/2020

Unit weight : γ = 75.0 pcf
Stress-state : effective
Angle of internal friction : φ_{ef} = 30.00 °
Cohesion of soil : c_{ef} = 100.0 psf
Saturated unit weight : γ_{sat} = 100.0 pcf

Silty Clay (Compacted Levee Cap)

Unit weight : γ = 133.0 pcf
Stress-state : effective
Angle of internal friction : φ_{ef} = 10.00 °
Cohesion of soil : c_{ef} = 450.0 psf
Saturated unit weight : γ_{sat} = 153.0 pcf

Silty Sand (layer in berm, not basin)

Unit weight : γ = 115.0 pcf
Stress-state : effective
Angle of internal friction : φ_{ef} = 28.00 °
Cohesion of soil : c_{ef} = 100.0 psf
Saturated unit weight : γ_{sat} = 136.0 pcf

Silty Clay, impervious fdtn (Updated with 2007 Hanson Report and ERM)

Unit weight : γ = 130.0 pcf
Stress-state : effective
Angle of internal friction : φ_{ef} = 10.00 °
Cohesion of soil : c_{ef} = 500.0 psf
Saturated unit weight : γ_{sat} = 150.0 pcf

Sand & Gravel (Underlying Aquifer)

Unit weight : γ = 130.0 pcf
Stress-state : effective
Angle of internal friction : φ_{ef} = 34.00 °

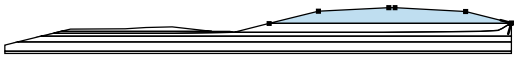
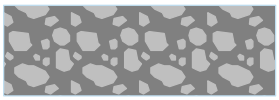
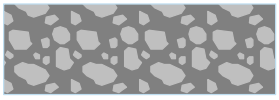
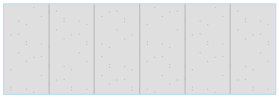
Cohesion of soil : c_{ef} = 0.0 psf
Saturated unit weight : γ_{sat} = 130.0 pcf

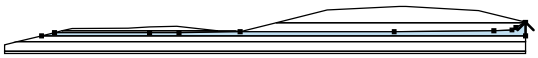
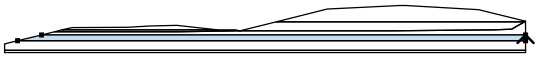
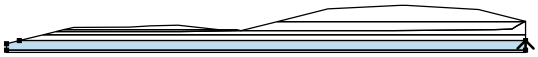
Gravel with trace of fines (G-F), medium dense- RipRap
Unit weight : γ = 165.0 pcf
Stress-state : effective
Angle of internal friction : φ_{ef} = 40.00 °
Cohesion of soil : c_{ef} = 0.0 psf
Saturated unit weight : γ_{sat} = 165.0 pcf

Critical Interface
Unit weight : γ = 110.0 pcf
Stress-state : effective
Angle of internal friction : φ_{ef} = 25.00 °
Cohesion of soil : c_{ef} = 50.0 psf
Saturated unit weight : γ_{sat} = 110.0 pcf

Sandy Silt (Native Pervious Material)
Unit weight : γ = 115.0 pcf
Stress-state : effective
Angle of internal friction : φ_{ef} = 24.00 °
Cohesion of soil : c_{ef} = 150.0 psf
Saturated unit weight : γ_{sat} = 135.0 pcf

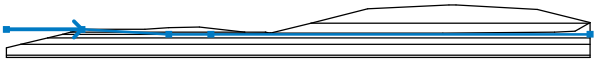
Assigning and surfaces

No.	Surface position	Coordinates of surface points [ft]				Assigned soil
		x	z	x	z	
1		828.24	9.00	830.00	10.00	Ash - Geotech Lab 6/2020
		726.00	36.00	566.00	45.00	
		552.00	45.00	392.00	37.00	
		279.99	9.00			
2		150.00	-9.00	60.00	1.10	Silty Clay (Compacted Levee Cap)
		0.00	0.00	-47.00	-3.00	
		-171.00	-3.50	-193.45	-9.00	
3		279.99	9.00	200.00	-11.00	Ash - Geotech Lab 6/2020
		540.00	-11.00	760.00	-9.00	
		800.00	-7.00	808.86	-1.98	
		828.24	9.00			
4		0.00	-13.00	65.00	-13.00	Silty Sand (layer in berm, not basin)
		200.00	-11.00	199.27	-10.85	
		193.34	-9.67	190.64	-9.12	
		190.00	-9.00	150.00	-9.00	
		-193.45	-9.00	-209.79	-13.00	

No.	Surface position	Coordinates of surface points [ft]				Assigned soil
		x	z	x	z	
5		830.00	-20.00	830.00	10.00	Silty Clay, Impervious fdtn (Updated with 2007 Hanson Report and ERM)
		828.24	9.00	808.86	-1.98	
		800.00	-7.00	760.00	-9.00	
		540.00	-11.00	200.00	-11.00	
		65.00	-13.00	0.00	-13.00	
		-209.79	-13.00	-238.36	-20.00	
6		830.00	-33.00	830.00	-20.00	Sandy Silt (Native Pervious Material)
		-238.36	-20.00	-291.43	-33.00	
7		830.00	-54.00	830.00	-33.00	Sand & Gravel (Underlying Aquifer)
		-291.43	-33.00	-320.00	-40.00	
		-320.00	-54.00			
8		-320.00	-54.00	-320.00	-59.00	Sand & Gravel (Underlying Aquifer)
		830.00	-59.00	830.00	-54.00	

Water

Water type : GWT

No.	GWT location	Coordinates of GWT points [ft]					
		x	z	x	z	x	z
1		-320.00	-3.50	-171.00	-3.50	0.00	-13.00
		83.00	-13.00	830.00	-13.00		

Tensile crack

Tensile crack not input.

Earthquake

Horizontal seismic coefficient : K_h = 0.3500
Vertical seismic coefficient : K_v = 0.0000

Settings of the stage of construction

Design situation : seismic

Results (Stage of construction 1)

Analysis 1 (stage 1)

Circular slip surface

Slip surface parameters							
Center :	x =	238.11	[ft]	Angles :	α_1 =	-5.31	[°]
	z =	331.81	[ft]		α_2 =	31.02	[°]
Radius :	R =	342.68	[ft]				
The slip surface after optimization.							

Segments restricting slip surface

No.	First point		Second point	
	x [ft]	z [ft]	x [ft]	z [ft]
1	200.14	-11.00	631.04	-10.26
2	69.61	-32.88	829.28	-34.89
3	79.68	181.17	276.86	-151.52

The restrictions of points of circular slip surface

Slope stability verification (Bishop)

Sum of active forces : F_a = 119191.4 lbf/ft
Sum of passive forces : F_p = 134421.4 lbf/ft

Sliding moment : M_a = 40844520.3 lbfft/ft
Resisting moment : M_p = 46063538.6 lbfft/ft
Factor of safety = 1.13 > 1.00
Slope stability ACCEPTABLE

Optimization of circular slip surface (Bishop)

No.	Center		Radius	FS	Verification
	x [ft]	z [ft]	R [ft]		
1	249.77	252.91	259.48	1.17	ACCEPTABLE
2	249.77	252.91	259.48	1.17	ACCEPTABLE
3	249.77	252.91	259.48	1.17	ACCEPTABLE
4	4.98	4554.97	4555.40	1.48	ACCEPTABLE
5	503.99	178.73	181.82	2.02	ACCEPTABLE
6	146.45	2441.46	2446.67	1.36	ACCEPTABLE
7	249.77	252.91	259.48	1.17	ACCEPTABLE
8	107.89	2159.40	2159.76	1.41	ACCEPTABLE
9	456.54	113.91	113.86	2.10	ACCEPTABLE
10	188.23	1303.61	1308.99	1.28	ACCEPTABLE
11	249.77	252.91	259.48	1.17	ACCEPTABLE
12	-10.96	2515.64	2524.85	1.44	ACCEPTABLE
13	397.35	134.69	135.18	1.64	ACCEPTABLE
14	76.17	1259.59	1266.15	1.94	ACCEPTABLE
15	183.19	997.86	1005.53	1.23	ACCEPTABLE
16	249.77	252.91	259.48	1.17	ACCEPTABLE
17	-29.28	2109.44	2126.45	1.40	ACCEPTABLE
18	354.56	157.17	158.54	1.37	ACCEPTABLE
19	-234.24	2187.30	2238.05	52.44	ACCEPTABLE
20	124.51	677.63	687.31	4.58	ACCEPTABLE
21	184.79	782.59	792.14	1.19	ACCEPTABLE
22	249.77	252.91	259.48	1.17	ACCEPTABLE
23	93.56	1177.01	1189.00	1.30	ACCEPTABLE
24	323.52	178.72	181.12	1.25	ACCEPTABLE
25	170.96	456.49	465.54	1.59	ACCEPTABLE
26	297.23	61.24	62.11	1.41	ACCEPTABLE
27	201.05	595.99	605.44	1.16	ACCEPTABLE

No.	Center		Radius	FS	Verification
	x [ft]	z [ft]	R [ft]		
28	233.37	812.24	810.53	1.28	ACCEPTABLE
29	17.86	1965.56	1979.74	1.33	ACCEPTABLE
30	306.68	382.24	384.28	1.24	ACCEPTABLE
31	253.02	301.35	299.43	1.28	ACCEPTABLE
32	153.27	641.19	650.24	1.44	ACCEPTABLE
33	284.84	172.73	174.00	1.19	ACCEPTABLE
34	167.27	1010.34	1019.36	1.22	ACCEPTABLE
35	279.73	540.30	539.11	1.25	ACCEPTABLE
36	201.05	595.99	605.44	1.16	ACCEPTABLE
37	184.68	936.91	940.20	1.26	ACCEPTABLE
38	95.80	1351.23	1362.59	1.27	ACCEPTABLE
39	277.03	433.56	437.30	1.20	ACCEPTABLE
40	227.93	429.69	431.64	1.23	ACCEPTABLE
41	170.42	621.37	630.39	1.25	ACCEPTABLE
42	287.85	169.52	178.90	1.18	ACCEPTABLE
43	264.74	269.85	273.18	1.16	ACCEPTABLE
44	307.15	257.38	254.91	1.22	ACCEPTABLE
45	83.20	1158.62	1174.52	1.26	ACCEPTABLE
46	316.54	209.31	209.61	1.22	ACCEPTABLE
47	293.87	135.21	132.32	1.25	ACCEPTABLE
48	186.59	435.71	445.58	1.29	ACCEPTABLE
49	311.81	63.45	73.24	1.49	ACCEPTABLE
50	300.06	110.43	109.90	1.26	ACCEPTABLE
51	201.07	595.87	605.33	1.16	ACCEPTABLE
52	307.35	256.35	253.92	1.22	ACCEPTABLE
53	264.74	269.85	273.18	1.16	ACCEPTABLE
54	281.52	317.74	315.54	1.20	ACCEPTABLE
55	184.05	660.82	668.51	1.21	ACCEPTABLE
56	253.16	339.49	348.35	1.14	ACCEPTABLE
57	269.38	393.92	397.15	1.18	ACCEPTABLE
58	197.99	645.11	655.35	1.16	ACCEPTABLE
59	289.64	290.62	297.27	1.18	ACCEPTABLE
60	269.44	249.43	253.44	1.16	ACCEPTABLE
61	218.42	386.20	397.06	1.14	ACCEPTABLE
62	289.68	161.57	171.87	1.19	ACCEPTABLE
63	279.57	205.47	211.75	1.16	ACCEPTABLE
64	279.52	342.21	346.76	1.18	ACCEPTABLE
65	253.16	339.49	348.35	1.14	ACCEPTABLE
66	261.13	388.73	393.53	1.17	ACCEPTABLE
67	208.81	524.81	528.77	1.23	ACCEPTABLE
68	149.99	937.72	944.65	1.27	ACCEPTABLE
69	212.35	545.90	556.25	1.15	ACCEPTABLE
70	278.05	305.18	312.47	1.16	ACCEPTABLE
71	263.44	281.48	287.00	1.15	ACCEPTABLE
72	145.03	808.88	816.84	1.33	ACCEPTABLE
73	225.27	382.94	393.85	1.13	ACCEPTABLE
74	226.16	464.99	472.01	1.16	ACCEPTABLE
75	154.71	662.19	671.93	1.32	ACCEPTABLE
76	-138.88	2259.57	2292.21	1.50	ACCEPTABLE

No.	Center		Radius	FS	Verification
	x [ft]	z [ft]	R [ft]		
77	31.61	1369.52	1388.77	1.34	ACCEPTABLE
78	206.72	528.67	537.95	1.16	ACCEPTABLE
79	253.16	339.50	348.36	1.14	ACCEPTABLE
80	235.02	326.12	333.55	1.16	ACCEPTABLE
81	67.67	1058.18	1074.10	1.57	ACCEPTABLE
82	14.46	1249.07	1272.10	1.58	ACCEPTABLE
83	217.09	374.61	384.60	1.15	ACCEPTABLE
84	258.47	227.99	238.65	1.14	ACCEPTABLE
85	247.68	273.13	281.79	1.14	ACCEPTABLE
86	222.07	451.82	461.97	1.14	ACCEPTABLE
87	240.97	396.14	403.80	1.15	ACCEPTABLE
88	225.27	382.94	393.85	1.13	ACCEPTABLE
89	224.89	441.09	449.31	1.15	ACCEPTABLE
90	191.36	516.97	525.40	1.21	ACCEPTABLE
91	110.33	962.46	975.84	1.27	ACCEPTABLE
92	160.07	736.63	746.46	1.22	ACCEPTABLE
93	210.44	485.46	495.52	1.15	ACCEPTABLE
94	244.25	352.80	362.29	1.13	ACCEPTABLE
95	231.55	345.87	354.45	1.15	ACCEPTABLE
96	152.04	677.97	689.04	1.27	ACCEPTABLE
97	158.02	658.94	669.15	1.27	ACCEPTABLE
98	218.18	381.80	392.34	1.14	ACCEPTABLE
99	248.97	271.72	282.20	1.13	ACCEPTABLE
100	253.48	303.29	310.80	1.14	ACCEPTABLE
101	233.05	328.92	334.93	1.18	ACCEPTABLE
102	218.92	456.40	462.20	1.18	ACCEPTABLE
103	264.68	253.63	263.10	1.14	ACCEPTABLE
104	254.96	238.94	247.09	1.15	ACCEPTABLE
105	216.65	396.30	402.11	1.22	ACCEPTABLE
106	265.80	194.42	205.20	1.15	ACCEPTABLE
107	260.48	216.25	225.56	1.15	ACCEPTABLE
108	259.21	277.90	286.28	1.14	ACCEPTABLE
109	248.97	271.72	282.20	1.13	ACCEPTABLE
110	251.54	294.41	302.82	1.14	ACCEPTABLE
111	239.51	305.74	313.02	1.16	ACCEPTABLE
112	204.90	468.24	477.77	1.16	ACCEPTABLE
113	233.63	372.69	379.56	1.15	ACCEPTABLE
114	234.92	337.69	348.43	1.13	ACCEPTABLE
115	235.74	369.92	378.71	1.14	ACCEPTABLE
116	220.25	393.99	402.11	1.16	ACCEPTABLE
117	210.65	481.83	489.87	1.17	ACCEPTABLE
118	246.78	320.69	330.57	1.13	ACCEPTABLE
119	238.98	314.24	323.41	1.14	ACCEPTABLE
120	209.10	441.47	449.51	1.18	ACCEPTABLE
121	249.39	269.92	280.47	1.13	ACCEPTABLE
122	244.36	291.32	301.12	1.13	ACCEPTABLE
123	241.46	344.39	353.67	1.13	ACCEPTABLE
124	234.92	337.69	348.43	1.13	ACCEPTABLE
125	235.30	359.73	369.14	1.14	ACCEPTABLE

No.	Center		Radius	FS	Verification
	x [ft]	z [ft]	R [ft]		
126	225.94	372.17	381.04	1.15	ACCEPTABLE
127	201.30	489.64	500.17	1.16	ACCEPTABLE
128	221.20	422.08	430.76	1.15	ACCEPTABLE
129	242.89	326.16	336.31	1.13	ACCEPTABLE
130	237.59	322.19	331.88	1.13	ACCEPTABLE
131	207.74	430.95	441.51	1.15	ACCEPTABLE
132	220.01	397.59	406.25	1.16	ACCEPTABLE
133	244.88	290.95	301.52	1.13	ACCEPTABLE
134	241.32	306.19	316.29	1.13	ACCEPTABLE
135	239.19	342.51	352.27	1.13	ACCEPTABLE
136	234.92	337.69	348.43	1.13	ACCEPTABLE
137	235.10	352.61	362.45	1.13	ACCEPTABLE
138	229.24	359.51	368.96	1.14	ACCEPTABLE
139	214.82	428.45	438.79	1.14	ACCEPTABLE
140	226.66	389.75	399.02	1.14	ACCEPTABLE
141	240.27	329.91	340.26	1.13	ACCEPTABLE
142	236.69	327.41	337.45	1.13	ACCEPTABLE
143	218.02	394.99	405.45	1.14	ACCEPTABLE
144	225.79	374.35	383.60	1.14	ACCEPTABLE
145	241.70	305.79	316.40	1.13	ACCEPTABLE
146	239.24	316.42	326.73	1.13	ACCEPTABLE
147	237.73	341.06	351.14	1.13	ACCEPTABLE
148	234.92	337.69	348.43	1.13	ACCEPTABLE
149	235.01	347.73	357.86	1.13	ACCEPTABLE
150	231.25	351.77	361.62	1.14	ACCEPTABLE
151	222.38	394.27	404.65	1.14	ACCEPTABLE
152	229.76	370.76	380.48	1.14	ACCEPTABLE
153	230.04	360.75	371.63	1.13	ACCEPTABLE
154	238.50	332.46	342.94	1.13	ACCEPTABLE
155	236.09	330.86	341.13	1.13	ACCEPTABLE
156	224.12	374.01	384.50	1.14	ACCEPTABLE
157	229.15	360.86	370.57	1.14	ACCEPTABLE
158	239.51	316.09	326.73	1.13	ACCEPTABLE
159	239.78	325.19	335.21	1.13	ACCEPTABLE
160	236.27	328.31	338.02	1.14	ACCEPTABLE
161	228.01	367.74	377.92	1.14	ACCEPTABLE
162	235.00	346.00	355.56	1.14	ACCEPTABLE
163	234.97	337.49	348.23	1.13	ACCEPTABLE
164	242.95	311.36	321.75	1.13	ACCEPTABLE
165	240.67	309.42	319.59	1.13	ACCEPTABLE
166	229.51	348.89	359.20	1.13	ACCEPTABLE
167	234.36	336.52	346.06	1.14	ACCEPTABLE
168	236.01	320.98	331.87	1.13	ACCEPTABLE
169	243.79	296.01	306.58	1.13	ACCEPTABLE
170	242.25	302.65	313.01	1.13	ACCEPTABLE
171	236.69	329.99	340.91	1.13	ACCEPTABLE
172	236.88	339.55	349.86	1.13	ACCEPTABLE
173	233.23	343.21	353.22	1.13	ACCEPTABLE
174	224.68	384.21	394.71	1.13	ACCEPTABLE

No.	Center		Radius	FS	Verification
	x [ft]	z [ft]	R [ft]		
175	231.86	361.55	371.43	1.13	ACCEPTABLE
176	240.20	324.99	335.66	1.13	ACCEPTABLE
177	237.86	323.21	333.67	1.13	ACCEPTABLE
178	226.29	364.66	375.28	1.13	ACCEPTABLE
179	231.23	351.85	361.70	1.14	ACCEPTABLE
180	241.12	309.11	319.95	1.13	ACCEPTABLE
181	239.51	316.09	326.73	1.13	ACCEPTABLE
182	238.56	332.19	342.67	1.13	ACCEPTABLE
183	236.69	329.99	340.91	1.13	ACCEPTABLE
184	236.80	336.41	346.91	1.13	ACCEPTABLE
185	234.43	338.62	348.93	1.13	ACCEPTABLE
186	229.00	364.67	375.28	1.13	ACCEPTABLE
187	233.60	350.41	360.62	1.13	ACCEPTABLE
188	239.04	326.64	337.39	1.13	ACCEPTABLE
189	237.47	325.48	336.09	1.13	ACCEPTABLE
190	229.93	352.39	363.09	1.13	ACCEPTABLE
191	233.17	344.09	354.28	1.13	ACCEPTABLE
192	239.67	315.92	326.79	1.13	ACCEPTABLE
193	238.58	320.67	331.40	1.13	ACCEPTABLE
194	237.93	331.49	342.11	1.13	ACCEPTABLE
195	236.69	329.99	340.91	1.13	ACCEPTABLE
196	236.76	334.29	344.93	1.13	ACCEPTABLE
197	235.21	335.67	346.17	1.13	ACCEPTABLE
198	231.70	352.50	363.20	1.13	ACCEPTABLE
199	234.68	343.34	353.78	1.13	ACCEPTABLE
200	238.26	327.75	338.56	1.13	ACCEPTABLE
201	237.21	326.99	337.70	1.13	ACCEPTABLE
202	232.26	344.62	355.38	1.13	ACCEPTABLE
203	234.39	339.19	349.62	1.13	ACCEPTABLE
204	238.69	320.55	331.43	1.13	ACCEPTABLE
205	238.79	324.67	335.27	1.13	ACCEPTABLE
206	237.28	325.89	336.35	1.13	ACCEPTABLE
207	233.88	342.21	352.85	1.13	ACCEPTABLE
208	236.80	333.34	343.72	1.13	ACCEPTABLE
209	236.70	329.95	340.88	1.13	ACCEPTABLE
210	236.77	334.24	344.90	1.13	ACCEPTABLE
211	235.22	335.62	346.14	1.13	ACCEPTABLE
212	231.71	352.45	363.16	1.13	ACCEPTABLE
213	234.70	343.29	353.74	1.13	ACCEPTABLE
214	238.27	327.71	338.53	1.13	ACCEPTABLE
215	237.22	326.95	337.67	1.13	ACCEPTABLE
216	232.27	344.57	355.34	1.13	ACCEPTABLE
217	234.41	339.14	349.58	1.13	ACCEPTABLE
218	238.70	320.51	331.40	1.13	ACCEPTABLE
219	237.96	323.72	334.52	1.13	ACCEPTABLE
220	237.52	330.96	341.69	1.13	ACCEPTABLE
221	82.96	3591.58	3594.69	1.42	ACCEPTABLE
222	82.96	3591.58	3594.69	1.42	ACCEPTABLE
223	-203.74	4425.26	4437.84	1.70	ACCEPTABLE

No.	Center		Radius	FS	Verification
	x [ft]	z [ft]	R [ft]		
224	443.00	68.52	53.42	2.51	ACCEPTABLE
225	82.96	3591.58	3594.69	1.42	ACCEPTABLE
226	527.67	1460.05	1445.06	1.80	ACCEPTABLE
227	-569.56	6860.30	6905.66	1.47	ACCEPTABLE
228	423.47	255.36	241.16	1.62	ACCEPTABLE
229	531.20	1192.71	1180.79	1.80	ACCEPTABLE
230	82.96	3591.58	3594.69	1.42	ACCEPTABLE
231	421.78	1894.61	1880.05	1.65	ACCEPTABLE
232	434.13	1640.36	1627.14	1.64	ACCEPTABLE
233	373.78	713.74	698.64	1.49	ACCEPTABLE
234	417.06	295.69	296.37	1.52	ACCEPTABLE
235	175.19	1506.28	1515.28	1.27	ACCEPTABLE
236	350.28	1264.65	1258.34	1.46	ACCEPTABLE
237	378.24	948.78	945.74	1.45	ACCEPTABLE
238	320.30	503.35	496.77	1.32	ACCEPTABLE
239	105.12	1589.78	1598.23	1.29	ACCEPTABLE
240	340.55	368.33	365.38	1.32	ACCEPTABLE
241	76.11	3262.62	3271.32	1.37	ACCEPTABLE
242	354.14	1221.03	1215.03	1.46	ACCEPTABLE
243	175.19	1506.28	1515.28	1.27	ACCEPTABLE
244	211.99	2117.60	2115.30	1.40	ACCEPTABLE
245	-192.39	5239.15	5260.25	1.38	ACCEPTABLE
246	203.79	1698.28	1707.74	1.31	ACCEPTABLE
247	323.41	1081.73	1081.16	1.38	ACCEPTABLE
248	264.20	875.03	872.34	1.31	ACCEPTABLE
249	120.34	1579.27	1588.88	1.27	ACCEPTABLE
250	338.18	381.85	388.14	1.30	ACCEPTABLE
251	214.32	930.46	940.80	1.22	ACCEPTABLE
252	271.30	1073.77	1072.94	1.32	ACCEPTABLE
253	96.61	2115.37	2125.25	1.30	ACCEPTABLE
254	326.23	661.50	665.01	1.31	ACCEPTABLE
255	277.93	532.79	532.54	1.24	ACCEPTABLE
256	174.34	959.06	968.20	1.21	ACCEPTABLE
257	159.29	1577.96	1578.03	1.35	ACCEPTABLE
258	-165.12	3546.28	3570.55	1.37	ACCEPTABLE
259	216.65	914.82	925.28	1.21	ACCEPTABLE
260	309.25	577.07	576.72	1.29	ACCEPTABLE
261	234.56	584.12	581.63	1.26	ACCEPTABLE
262	108.79	1105.99	1116.39	1.30	ACCEPTABLE
263	319.99	155.74	165.93	1.27	ACCEPTABLE
264	289.57	308.28	307.31	1.20	ACCEPTABLE
265	364.16	215.25	210.77	1.38	ACCEPTABLE
266	163.15	569.54	579.92	1.34	ACCEPTABLE
267	334.77	74.25	68.96	1.40	ACCEPTABLE
268	174.32	959.17	968.31	1.21	ACCEPTABLE
269	361.69	231.76	225.89	1.37	ACCEPTABLE
270	289.57	308.28	307.31	1.20	ACCEPTABLE
271	336.05	272.45	266.81	1.29	ACCEPTABLE
272	126.29	1196.70	1205.46	1.26	ACCEPTABLE

No.	Center		Radius	FS	Verification
	x [ft]	z [ft]	R [ft]		
273	270.04	428.48	435.48	1.18	ACCEPTABLE
274	308.27	446.79	447.05	1.26	ACCEPTABLE
275	324.89	344.34	348.45	1.26	ACCEPTABLE
276	299.00	261.00	261.76	1.19	ACCEPTABLE
277	320.15	154.96	165.26	1.27	ACCEPTABLE
278	308.28	214.46	218.07	1.21	ACCEPTABLE
279	223.07	734.46	744.99	1.19	ACCEPTABLE
280	314.71	407.10	408.54	1.26	ACCEPTABLE
281	270.04	428.48	435.48	1.18	ACCEPTABLE
282	289.14	477.69	479.33	1.23	ACCEPTABLE
283	97.84	1300.20	1308.20	1.35	ACCEPTABLE
284	201.32	816.25	825.99	1.19	ACCEPTABLE
285	307.81	368.24	373.14	1.23	ACCEPTABLE
286	288.13	321.92	324.40	1.19	ACCEPTABLE
287	225.12	513.55	523.66	1.15	ACCEPTABLE
288	230.05	642.19	646.90	1.20	ACCEPTABLE
289	186.13	815.72	824.72	1.19	ACCEPTABLE
290	270.05	428.46	435.46	1.18	ACCEPTABLE
291	243.14	406.66	411.74	1.16	ACCEPTABLE
292	207.84	516.81	526.31	1.15	ACCEPTABLE
293	276.67	250.32	260.13	1.15	ACCEPTABLE
294	261.58	320.68	327.38	1.15	ACCEPTABLE
295	279.14	368.18	369.36	1.19	ACCEPTABLE
296	191.24	679.85	689.71	1.17	ACCEPTABLE
297	297.56	273.47	278.04	1.19	ACCEPTABLE
298	277.96	230.55	232.47	1.17	ACCEPTABLE
299	218.67	388.94	398.89	1.15	ACCEPTABLE
300	216.25	532.11	536.86	1.19	ACCEPTABLE
301	176.11	678.13	687.19	1.20	ACCEPTABLE
302	261.58	320.67	327.37	1.15	ACCEPTABLE
303	232.59	311.32	316.08	1.22	ACCEPTABLE
304	200.15	402.46	411.74	1.23	ACCEPTABLE
305	268.38	168.16	178.12	1.17	ACCEPTABLE
306	252.98	229.76	236.06	1.18	ACCEPTABLE
307	207.79	516.98	526.48	1.15	ACCEPTABLE
308	243.14	406.71	411.77	1.16	ACCEPTABLE
309	218.67	388.94	398.89	1.15	ACCEPTABLE
310	214.50	493.13	499.50	1.18	ACCEPTABLE
311	123.50	755.75	768.01	1.49	ACCEPTABLE
312	-812.04	5389.41	5491.25	1.80	ACCEPTABLE
313	-110.57	1963.72	1997.38	1.48	ACCEPTABLE
314	189.95	574.68	584.02	1.18	ACCEPTABLE
315	227.17	395.81	406.69	1.13	ACCEPTABLE
316	228.86	475.94	482.90	1.16	ACCEPTABLE
317	156.08	684.96	694.43	1.29	ACCEPTABLE
318	-125.88	2244.72	2275.72	1.46	ACCEPTABLE
319	40.77	1368.39	1386.42	1.32	ACCEPTABLE
320	208.43	543.65	552.96	1.16	ACCEPTABLE
321	255.10	351.46	360.32	1.14	ACCEPTABLE

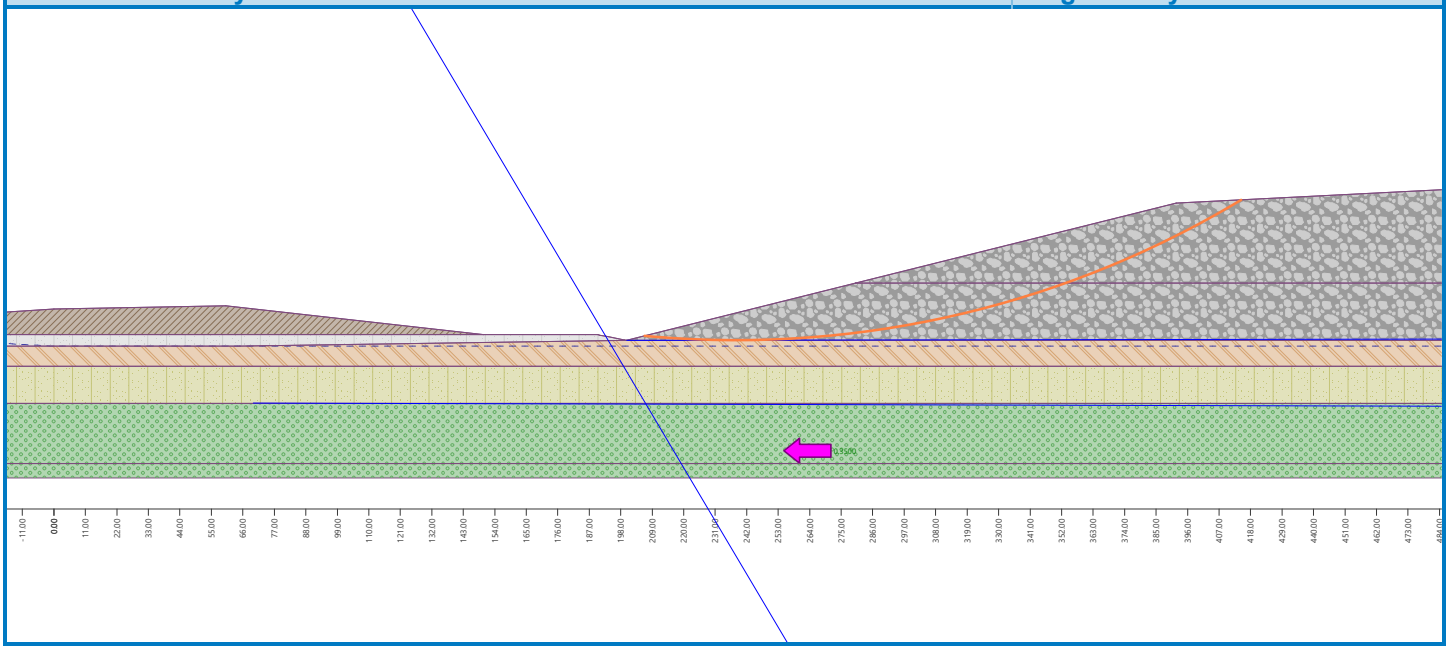
No.	Center		Radius	FS	Verification
	x [ft]	z [ft]	R [ft]		
322	237.22	337.30	344.72	1.15	ACCEPTABLE
323	68.51	1087.81	1103.50	1.48	ACCEPTABLE
324	25.33	1245.27	1266.63	1.49	ACCEPTABLE
325	218.58	388.52	398.56	1.15	ACCEPTABLE
326	260.21	238.75	249.39	1.14	ACCEPTABLE
327	249.58	284.33	292.99	1.14	ACCEPTABLE
328	223.59	466.52	476.71	1.14	ACCEPTABLE
329	243.17	408.04	415.70	1.15	ACCEPTABLE
330	227.17	395.81	406.69	1.13	ACCEPTABLE
331	227.30	452.87	461.05	1.15	ACCEPTABLE
332	192.97	534.76	543.04	1.20	ACCEPTABLE
333	111.09	987.98	1001.31	1.26	ACCEPTABLE
334	162.99	752.19	761.72	1.22	ACCEPTABLE
335	211.60	501.76	511.92	1.15	ACCEPTABLE
336	246.17	365.06	374.53	1.14	ACCEPTABLE
337	233.65	357.62	366.18	1.14	ACCEPTABLE
338	152.04	703.10	714.22	1.25	ACCEPTABLE
339	160.88	674.49	684.35	1.25	ACCEPTABLE
340	219.29	396.86	407.49	1.14	ACCEPTABLE
341	250.72	283.26	293.73	1.13	ACCEPTABLE
342	255.44	314.73	322.25	1.14	ACCEPTABLE
343	234.30	344.46	350.41	1.17	ACCEPTABLE
344	160.68	693.83	705.30	1.20	ACCEPTABLE
345	220.54	472.89	478.59	1.18	ACCEPTABLE
346	266.51	264.56	274.03	1.14	ACCEPTABLE
347	256.83	249.56	257.73	1.14	ACCEPTABLE
348	188.26	496.04	506.45	1.20	ACCEPTABLE
349	218.21	412.23	417.94	1.20	ACCEPTABLE
350	267.57	204.36	215.12	1.15	ACCEPTABLE
351	262.29	226.56	235.87	1.14	ACCEPTABLE
352	261.09	289.13	297.52	1.14	ACCEPTABLE
353	250.72	283.26	293.73	1.13	ACCEPTABLE
354	253.43	305.90	314.33	1.14	ACCEPTABLE
355	240.98	319.57	326.81	1.15	ACCEPTABLE
356	206.50	484.43	493.87	1.16	ACCEPTABLE
357	235.25	387.20	394.02	1.15	ACCEPTABLE
358	236.71	350.24	360.96	1.13	ACCEPTABLE
359	237.77	382.16	390.93	1.14	ACCEPTABLE
360	221.79	409.26	417.31	1.16	ACCEPTABLE
361	212.48	497.36	505.30	1.16	ACCEPTABLE
362	248.60	332.81	342.68	1.13	ACCEPTABLE
363	240.88	326.11	335.27	1.14	ACCEPTABLE
364	190.54	515.30	526.32	1.17	ACCEPTABLE
365	210.89	456.71	464.65	1.17	ACCEPTABLE
366	251.13	281.47	292.01	1.13	ACCEPTABLE
367	246.17	303.07	312.86	1.13	ACCEPTABLE
368	243.38	356.62	365.88	1.14	ACCEPTABLE
369	236.71	350.24	360.96	1.13	ACCEPTABLE
370	237.25	372.10	381.50	1.14	ACCEPTABLE

No.	Center		Radius	FS	Verification
	x [ft]	z [ft]	R [ft]		
371	227.58	386.37	395.19	1.14	ACCEPTABLE
372	222.98	436.54	445.16	1.15	ACCEPTABLE
373	244.71	338.41	348.56	1.13	ACCEPTABLE
374	239.45	334.29	343.97	1.13	ACCEPTABLE
375	209.36	446.19	456.67	1.15	ACCEPTABLE
376	221.77	411.83	420.43	1.15	ACCEPTABLE
377	246.63	302.84	313.40	1.13	ACCEPTABLE
378	243.12	318.20	328.29	1.13	ACCEPTABLE
379	241.07	354.85	364.59	1.13	ACCEPTABLE
380	236.71	350.24	360.96	1.13	ACCEPTABLE
381	237.00	365.05	374.88	1.13	ACCEPTABLE
382	230.93	373.10	382.50	1.14	ACCEPTABLE
383	216.59	442.83	453.11	1.14	ACCEPTABLE
384	228.43	403.53	412.76	1.14	ACCEPTABLE
385	229.32	385.82	396.75	1.13	ACCEPTABLE
386	242.07	342.26	352.60	1.13	ACCEPTABLE
387	238.52	339.66	349.69	1.13	ACCEPTABLE
388	219.70	409.22	419.63	1.14	ACCEPTABLE
389	227.55	387.98	397.18	1.14	ACCEPTABLE
390	243.46	317.92	328.51	1.13	ACCEPTABLE
391	244.11	330.71	340.37	1.13	ACCEPTABLE
392	238.65	336.47	345.64	1.14	ACCEPTABLE
393	225.80	398.67	408.57	1.14	ACCEPTABLE
394	236.68	363.82	372.77	1.14	ACCEPTABLE
395	236.81	349.78	360.51	1.13	ACCEPTABLE
396	248.53	311.02	321.26	1.13	ACCEPTABLE
397	245.24	307.72	317.62	1.13	ACCEPTABLE
398	228.30	368.58	378.65	1.14	ACCEPTABLE
399	235.73	349.23	358.15	1.14	ACCEPTABLE
400	249.57	288.85	299.37	1.13	ACCEPTABLE
401	247.43	298.17	308.36	1.13	ACCEPTABLE
402	246.35	320.73	330.67	1.13	ACCEPTABLE
403	243.46	317.92	328.51	1.13	ACCEPTABLE
404	243.86	326.56	336.52	1.13	ACCEPTABLE
405	240.35	329.92	339.54	1.13	ACCEPTABLE
406	232.40	368.49	378.54	1.13	ACCEPTABLE
407	239.22	347.17	356.64	1.13	ACCEPTABLE
408	239.09	338.83	349.50	1.13	ACCEPTABLE
409	239.34	348.32	358.38	1.13	ACCEPTABLE
410	235.59	352.57	362.32	1.13	ACCEPTABLE
411	227.07	394.00	404.24	1.13	ACCEPTABLE
412	234.25	371.03	380.64	1.13	ACCEPTABLE
413	234.41	361.29	372.08	1.13	ACCEPTABLE
414	242.61	333.73	344.15	1.13	ACCEPTABLE
415	240.29	331.89	342.09	1.13	ACCEPTABLE
416	228.63	374.35	384.70	1.13	ACCEPTABLE
417	233.62	361.24	370.83	1.14	ACCEPTABLE
418	235.52	344.09	355.02	1.13	ACCEPTABLE
419	235.66	354.03	364.35	1.13	ACCEPTABLE

No.	Center		Radius	FS	Verification
	x [ft]	z [ft]	R [ft]		
420	231.85	358.37	368.41	1.13	ACCEPTABLE
421	223.05	400.91	411.46	1.14	ACCEPTABLE
422	230.40	377.33	387.24	1.13	ACCEPTABLE
423	239.09	338.83	349.50	1.13	ACCEPTABLE
424	236.71	337.17	347.63	1.13	ACCEPTABLE
425	224.74	380.70	391.36	1.13	ACCEPTABLE
426	229.79	367.41	377.30	1.14	ACCEPTABLE
427	240.08	322.45	333.28	1.13	ACCEPTABLE
428	240.39	331.48	341.68	1.13	ACCEPTABLE
429	236.83	334.89	344.78	1.13	ACCEPTABLE
430	228.63	374.41	384.76	1.13	ACCEPTABLE
431	235.60	352.58	362.33	1.13	ACCEPTABLE
432	235.57	343.90	354.82	1.13	ACCEPTABLE
433	243.52	317.68	328.26	1.13	ACCEPTABLE
434	241.25	315.69	326.06	1.13	ACCEPTABLE
435	230.08	355.58	366.06	1.13	ACCEPTABLE
436	234.95	343.07	352.79	1.13	ACCEPTABLE
437	244.34	302.30	313.07	1.13	ACCEPTABLE
438	242.81	308.93	319.49	1.13	ACCEPTABLE
439	241.97	324.51	334.90	1.13	ACCEPTABLE
440	240.08	322.45	333.28	1.13	ACCEPTABLE
441	240.27	328.51	338.92	1.13	ACCEPTABLE
442	237.96	330.58	340.77	1.13	ACCEPTABLE
443	232.74	355.72	366.20	1.13	ACCEPTABLE
444	237.21	341.96	352.05	1.13	ACCEPTABLE
445	237.10	336.60	347.49	1.13	ACCEPTABLE
446	242.38	319.25	329.92	1.13	ACCEPTABLE
447	240.86	317.95	328.47	1.13	ACCEPTABLE
448	233.58	343.88	354.45	1.13	ACCEPTABLE
449	236.77	335.76	345.84	1.13	ACCEPTABLE
450	242.94	308.88	319.66	1.13	ACCEPTABLE
451	241.91	313.39	324.04	1.13	ACCEPTABLE
452	241.33	323.85	334.39	1.13	ACCEPTABLE
453	240.08	322.45	333.28	1.13	ACCEPTABLE
454	240.20	326.51	337.06	1.13	ACCEPTABLE
455	238.68	327.80	338.20	1.13	ACCEPTABLE
456	235.31	344.06	354.64	1.13	ACCEPTABLE
457	238.22	335.21	345.54	1.13	ACCEPTABLE
458	238.11	331.81	342.68	1.13	ACCEPTABLE
459	238.20	336.04	346.64	1.13	ACCEPTABLE
460	236.64	337.49	347.94	1.13	ACCEPTABLE
461	233.17	354.26	364.90	1.13	ACCEPTABLE
462	236.14	345.12	355.50	1.13	ACCEPTABLE
463	236.08	341.48	352.39	1.13	ACCEPTABLE
464	239.67	329.58	340.33	1.13	ACCEPTABLE
465	238.63	328.79	339.45	1.13	ACCEPTABLE
466	233.71	346.43	357.13	1.13	ACCEPTABLE
467	235.84	340.98	351.35	1.13	ACCEPTABLE
468	240.09	322.41	333.24	1.13	ACCEPTABLE

No.	Center x [ft]	Center z [ft]	Radius R [ft]	FS	Verification
469	239.36	325.58	336.33	1.13	ACCEPTABLE
470	238.94	332.79	343.47	1.13	ACCEPTABLE
471	238.11	331.81	342.68	1.13	ACCEPTABLE

Name : Model 2 Dyn circ | **Stage - analysis : 1 - 1**



Analysis 3 (stage 1)

Polygonal slip surface

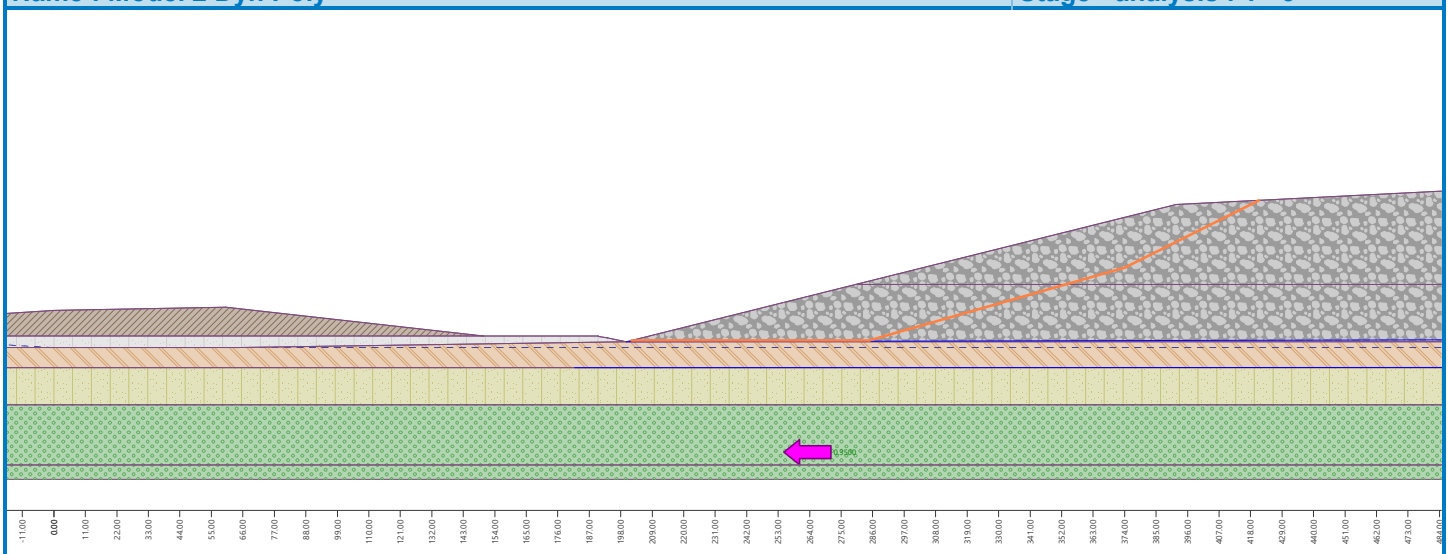
Coordinates of slip surface points [ft]									
x	z	x	z	x	z	x	z	x	z
201.80	-10.55	284.74	-10.50	374.17	14.96	420.99	38.45		
The slip surface after optimization.									

Segments restricting slip surface

No.	First point x [ft]	First point z [ft]	Second point x [ft]	Second point z [ft]
1	181.92	-19.97	596.86	-19.89
2	200.04	-10.99	680.07	-9.85

Slope stability verification (Janbu)
Factor of safety = 1.15 > 1.00
Slope stability ACCEPTABLE

Name : Model 2 Dyn Poly	Stage - analysis : 1 - 3



Slope stability analysis

Input data

Project

Task : Confirmatory Model for Final Closure of the Ash Basin
Description : Slope Stability Analysis of Grand Tower CCR Impoundment Final Closure Plan
Author : ERM - Annapolis
Date : 6/22/2020
Project number : 0533442

Settings

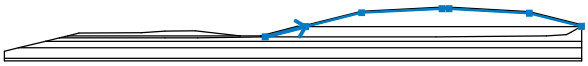
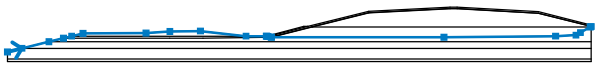
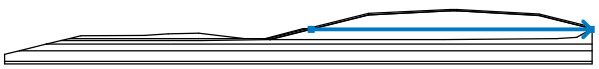
(input for current task)

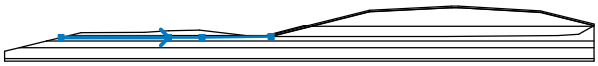
Stability analysis

Earthquake analysis : Standard
Verification methodology : Safety factors (ASD)

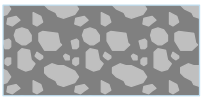
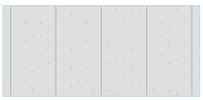
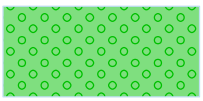
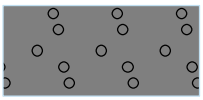
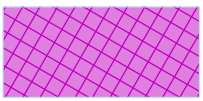
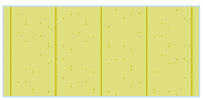
Safety factors			
Permanent design situation			
Safety factor :	SF_s =	1.50	[–]

Interface

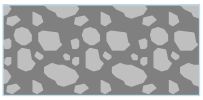
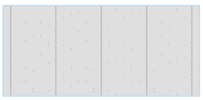
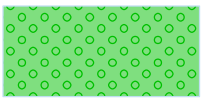
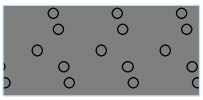
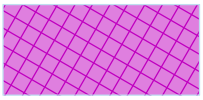
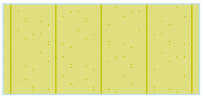
No.	Interface location	Coordinates of interface points [ft]					
		x	z	x	z	x	z
1		193.34	-9.67	194.41	-9.40	200.00	-8.00
		272.00	10.00	392.00	40.00	552.00	48.00
		566.00	48.00	726.00	39.00	830.00	13.00
2		199.27	-10.85	200.00	-10.67	279.99	9.33
		392.00	37.33	552.00	45.33	566.00	45.33
		726.00	36.33	830.00	10.33		
3		200.00	-11.00	279.99	9.00	392.00	37.00
		552.00	45.00	566.00	45.00	726.00	36.00
		830.00	10.00				
4		190.00	-9.00	263.58	10.00	272.00	10.00
5		-320.00	-40.00	-291.43	-33.00	-238.36	-20.00
		-209.79	-13.00	-193.45	-9.00	-171.00	-3.50
		-47.00	-3.00	0.00	0.00	60.00	1.10
		150.00	-9.00	190.00	-9.00	190.64	-9.12
		193.34	-9.67	199.27	-10.85	200.00	-11.00
		540.00	-11.00	760.00	-9.00	800.00	-7.00
		808.86	-1.98	828.24	9.00	830.00	10.00
6		279.99	9.00	828.24	9.00		
7		-193.45	-9.00	150.00	-9.00		

No.	Interface location	Coordinates of interface points [ft]					
		x	z	x	z	x	z
8		-209.79	-13.00	0.00	-13.00	65.00	-13.00
		200.00	-11.00				
9		-238.36	-20.00	830.00	-20.00		
10		-291.43	-33.00	830.00	-33.00		
11		-320.00	-54.00	830.00	-54.00		

Soil parameters - effective stress state

No.	Name	Pattern	φ_{ef} [°]	c_{ef} [psf]	γ [pcf]
1	Ash - Geotech Lab 6/2020		30.00	100.0	75.0
2	Silty Clay (Compacted Levee Cap)		10.00	450.0	133.0
3	Silty Sand (layer in berm, not basin)		28.00	100.0	115.0
4	Silty Clay, impervious fdtn (Updated with 2007 Hanson Report and ERM)		10.00	500.0	130.0
5	Sand & Gravel (Underlying Aquifer)		34.00	0.0	130.0
6	Gravel with trace of fines (G-F), medium dense- RipRap		40.00	0.0	165.0
7	Critical Interface		25.00	50.0	110.0
8	Sandy Silt (Native Pervious Material)		24.00	150.0	115.0

Soil parameters - uplift

No.	Name	Pattern	γ_{sat} [pcf]	γ_s [pcf]	n [–]
1	Ash - Geotech Lab 6/2020		100.0		
2	Silty Clay (Compacted Levee Cap)		153.0		
3	Silty Sand (layer in berm, not basin)		136.0		
4	Silty Clay, impervious fdtn (Updated with 2007 Hanson Report and ERM)		150.0		
5	Sand & Gravel (Underlying Aquifer)		130.0		
6	Gravel with trace of fines (G-F), medium dense- RipRap		165.0		
7	Critical Interface		110.0		
8	Sandy Silt (Native Pervious Material)		135.0		

Soil parameters

Ash - Geotech Lab 6/2020

Unit weight : γ = 75.0 pcf
Stress-state : effective
Angle of internal friction : φ_{ef} = 30.00 °
Cohesion of soil : c_{ef} = 100.0 psf
Saturated unit weight : γ_{sat} = 100.0 pcf

Silty Clay (Compacted Levee Cap)

Unit weight : γ = 133.0 pcf
Stress-state : effective
Angle of internal friction : φ_{ef} = 10.00 °
Cohesion of soil : c_{ef} = 450.0 psf
Saturated unit weight : γ_{sat} = 153.0 pcf

Silty Sand (layer in berm, not basin)

Unit weight : γ = 115.0 pcf
Stress-state : effective

Angle of internal friction : φ_{ef} = 28.00 °
Cohesion of soil : c_{ef} = 100.0 psf
Saturated unit weight : γ_{sat} = 136.0 pcf

Silty Clay, impervious fdtn (Updated with 2007 Hanson Report and ERM)
Unit weight : γ = 130.0 pcf
Stress-state : effective
Angle of internal friction : φ_{ef} = 10.00 °
Cohesion of soil : c_{ef} = 500.0 psf
Saturated unit weight : γ_{sat} = 150.0 pcf

Sand & Gravel (Underlying Aquifer)
Unit weight : γ = 130.0 pcf
Stress-state : effective
Angle of internal friction : φ_{ef} = 34.00 °
Cohesion of soil : c_{ef} = 0.0 psf
Saturated unit weight : γ_{sat} = 130.0 pcf

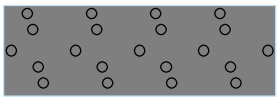
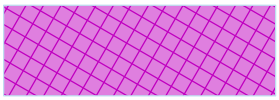
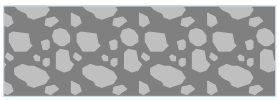
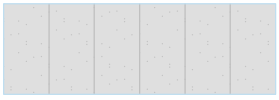
Gravel with trace of fines (G-F), medium dense- RipRap
Unit weight : γ = 165.0 pcf
Stress-state : effective
Angle of internal friction : φ_{ef} = 40.00 °
Cohesion of soil : c_{ef} = 0.0 psf
Saturated unit weight : γ_{sat} = 165.0 pcf

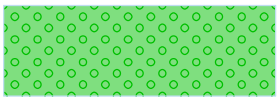
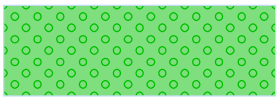
Critical Interface
Unit weight : γ = 110.0 pcf
Stress-state : effective
Angle of internal friction : φ_{ef} = 25.00 °
Cohesion of soil : c_{ef} = 50.0 psf
Saturated unit weight : γ_{sat} = 110.0 pcf

Sandy Silt (Native Pervious Material)
Unit weight : γ = 115.0 pcf
Stress-state : effective
Angle of internal friction : φ_{ef} = 24.00 °
Cohesion of soil : c_{ef} = 150.0 psf
Saturated unit weight : γ_{sat} = 135.0 pcf

Assigning and surfaces

No.	Surface position	Coordinates of surface points [ft]				Assigned soil
		x	z	x	z	
1		828.24	9.00	830.00	10.00	Ash - Geotech Lab 6/2020
		726.00	36.00	566.00	45.00	
		552.00	45.00	392.00	37.00	
		279.99	9.00			

No.	Surface position	Coordinates of surface points [ft]				Assigned soil
		x	z	x	z	
2		150.00	-9.00	60.00	1.10	Silty Clay (Compacted Levee Cap)
		0.00	0.00	-47.00	-3.00	
		-171.00	-3.50	-193.45	-9.00	
3		190.64	-9.12	193.34	-9.67	Gravel with trace of fines (G-F), medium dense-RipRap
		194.41	-9.40	200.00	-8.00	
		272.00	10.00	263.58	10.00	
		190.00	-9.00			
4		199.27	-10.85	200.00	-10.67	Silty Clay (Compacted Levee Cap)
		279.99	9.33	392.00	37.33	
		552.00	45.33	566.00	45.33	
		726.00	36.33	830.00	10.33	
		830.00	13.00	726.00	39.00	
		566.00	48.00	552.00	48.00	
		392.00	40.00	272.00	10.00	
		200.00	-8.00	194.41	-9.40	
		193.34	-9.67			
5		200.00	-11.00	279.99	9.00	Critical Interface
		392.00	37.00	552.00	45.00	
		566.00	45.00	726.00	36.00	
		830.00	10.00	830.00	10.33	
		726.00	36.33	566.00	45.33	
		552.00	45.33	392.00	37.33	
		279.99	9.33	200.00	-10.67	
		199.27	-10.85			
6		279.99	9.00	200.00	-11.00	Ash - Geotech Lab 6/2020
		540.00	-11.00	760.00	-9.00	
		800.00	-7.00	808.86	-1.98	
		828.24	9.00			
7		0.00	-13.00	65.00	-13.00	Silty Sand (layer in berm, not basin)
		200.00	-11.00	199.27	-10.85	
		193.34	-9.67	190.64	-9.12	
		190.00	-9.00	150.00	-9.00	
		-193.45	-9.00	-209.79	-13.00	
8		830.00	-20.00	830.00	10.00	Silty Clay, impervious fdtn (Updated with 2007 Hanson Report and ERM)
		828.24	9.00	808.86	-1.98	
		800.00	-7.00	760.00	-9.00	
		540.00	-11.00	200.00	-11.00	
		65.00	-13.00	0.00	-13.00	
		-209.79	-13.00	-238.36	-20.00	

No.	Surface position	Coordinates of surface points [ft]				Assigned soil
		x	z	x	z	
9		830.00	-33.00	830.00	-20.00	Sandy Silt (Native Pervious Material)
		-238.36	-20.00	-291.43	-33.00	
10		830.00	-54.00	830.00	-33.00	Sand & Gravel (Underlying Aquifer)
		-291.43	-33.00	-320.00	-40.00	
		-320.00	-54.00			
11		-320.00	-54.00	-320.00	-59.00	Sand & Gravel (Underlying Aquifer)
		830.00	-59.00	830.00	-54.00	
						

Water

Water type : GWT

No.	GWT location	Coordinates of GWT points [ft]					
		x	z	x	z	x	z
1		-320.00	-3.50	-171.00	-3.50	0.00	-13.00
		83.00	-13.00	830.00	-13.00		

Tensile crack

Tensile crack not input.

Earthquake

Earthquake not included.

Settings of the stage of construction

Design situation : permanent

Results (Stage of construction 1)

Analysis 1 (stage 1)

Circular slip surface

Slip surface parameters							
Center :	x =	256.05	[ft]	Angles :	α_1 =	-18.09	[°]
	z =	196.14	[ft]		α_2 =	43.92	[°]
Radius :	R =	215.81	[ft]				
The slip surface after optimization.							

Segments restricting slip surface

No.	First point		Second point	
	x [ft]	z [ft]	x [ft]	z [ft]
1	-247.18	-19.54	775.42	-19.95

The restrictions of points of circular slip surface

Slope stability verification (Bishop)

Sum of active forces : F_a = 81958.3 lbf/ft

Sum of passive forces : F_p = 215055.4 lbf/ft

Sliding moment : M_a = 17687424.3 lbfft/ft

Resisting moment : M_p = 46411107.9 lbfft/ft

Factor of safety = 2.62 > 1.50

Slope stability ACCEPTABLE

Optimization of circular slip surface (Bishop)

No.	Center		Radius	FS	Verification
	x [ft]	z [ft]	R [ft]		
1	301.15	370.03	389.78	3.09	ACCEPTABLE
2	301.15	370.03	389.78	3.09	ACCEPTABLE
3	301.15	370.03	389.78	3.09	ACCEPTABLE
4	251.97	2370.69	2389.25	7.55	ACCEPTABLE
5	249.39	2427.26	2445.14	7.68	ACCEPTABLE
6	301.15	370.03	389.78	3.09	ACCEPTABLE
7	269.03	1387.17	1404.00	5.39	ACCEPTABLE
8	504.17	256.05	271.58	19.30	ACCEPTABLE
9	167.53	394.61	411.82	6.94	ACCEPTABLE
10	272.74	1330.94	1349.12	5.20	ACCEPTABLE
11	301.15	370.03	389.78	3.09	ACCEPTABLE
12	261.50	1081.53	1096.95	4.59	ACCEPTABLE
13	439.72	281.26	297.45	6.75	ACCEPTABLE
14	207.20	376.53	395.09	3.45	ACCEPTABLE
15	355.94	44.82	60.32	5.06	ACCEPTABLE
16	273.56	950.47	969.66	4.16	ACCEPTABLE
17	301.15	370.03	389.78	3.09	ACCEPTABLE
18	258.30	871.15	887.17	4.01	ACCEPTABLE
19	395.87	299.12	316.09	4.52	ACCEPTABLE
20	232.78	389.83	409.42	3.01	ACCEPTABLE
21	219.03	740.54	755.98	4.15	ACCEPTABLE
22	181.93	373.58	391.16	4.97	ACCEPTABLE
23	260.60	141.75	160.09	2.79	ACCEPTABLE
24	221.38	462.51	477.93	3.29	ACCEPTABLE
25	344.43	107.78	124.07	3.39	ACCEPTABLE
26	195.81	186.82	204.05	4.01	ACCEPTABLE
27	232.77	389.86	409.44	3.01	ACCEPTABLE
28	260.60	141.75	160.09	2.79	ACCEPTABLE
29	226.57	362.94	378.84	3.01	ACCEPTABLE
30	318.16	114.78	131.47	3.09	ACCEPTABLE
31	213.38	175.74	193.86	3.22	ACCEPTABLE
32	286.56	35.41	51.02	5.05	ACCEPTABLE
33	319.50	108.07	126.72	3.04	ACCEPTABLE
34	260.60	141.75	160.09	2.79	ACCEPTABLE
35	246.92	203.50	202.80	3.73	ACCEPTABLE
36	-1057.42	6557.47	6680.15	8.39	ACCEPTABLE

No.	Center		Radius	FS	Verification
	x [ft]	z [ft]	R [ft]		
37	173.62	699.99	700.89	3.61	ACCEPTABLE
38	236.05	282.81	299.25	2.84	ACCEPTABLE
39	299.49	121.48	138.63	2.93	ACCEPTABLE
40	281.16	57.79	75.98	3.69	ACCEPTABLE
41	-253.29	2332.54	2380.76	130.34	ACCEPTABLE
42	227.75	164.96	183.38	2.96	ACCEPTABLE
43	279.96	62.88	79.08	3.68	ACCEPTABLE
44	243.97	244.42	264.07	2.69	ACCEPTABLE
45	271.33	265.79	281.40	2.88	ACCEPTABLE
46	172.80	505.61	512.76	3.54	ACCEPTABLE
47	-486.44	4698.49	4747.75	5.70	ACCEPTABLE
48	226.35	406.90	423.72	3.11	ACCEPTABLE
49	278.52	230.13	249.25	2.74	ACCEPTABLE
50	255.88	161.33	176.82	2.88	ACCEPTABLE
51	25.03	1276.34	1289.25	26.34	ACCEPTABLE
52	216.61	251.31	270.36	3.06	ACCEPTABLE
53	260.60	141.75	160.09	2.79	ACCEPTABLE
54	233.95	361.14	380.87	2.93	ACCEPTABLE
55	272.35	260.70	276.75	2.87	ACCEPTABLE
56	243.97	244.42	264.07	2.69	ACCEPTABLE
57	254.17	287.81	303.69	2.85	ACCEPTABLE
58	211.21	345.10	354.74	3.19	ACCEPTABLE
59	134.17	887.39	896.48	3.45	ACCEPTABLE
60	175.07	663.95	673.12	3.36	ACCEPTABLE
61	229.86	356.22	373.89	2.95	ACCEPTABLE
62	263.97	241.22	260.95	2.67	ACCEPTABLE
63	287.40	247.48	262.92	2.98	ACCEPTABLE
64	249.92	295.24	301.69	3.21	ACCEPTABLE
65	157.20	854.61	863.71	3.47	ACCEPTABLE
66	233.62	525.98	530.32	3.47	ACCEPTABLE
67	249.65	351.87	369.61	2.90	ACCEPTABLE
68	292.70	220.03	238.61	2.83	ACCEPTABLE
69	276.84	173.77	189.72	2.82	ACCEPTABLE
70	192.02	496.42	505.92	3.23	ACCEPTABLE
71	226.87	399.22	403.38	3.23	ACCEPTABLE
72	243.97	244.42	264.07	2.69	ACCEPTABLE
73	280.03	159.36	177.54	2.74	ACCEPTABLE
74	289.12	238.57	254.95	2.92	ACCEPTABLE
75	263.97	241.22	260.95	2.67	ACCEPTABLE
76	278.08	252.87	269.01	2.89	ACCEPTABLE
77	255.86	272.58	283.04	3.22	ACCEPTABLE
78	217.07	507.71	518.30	3.31	ACCEPTABLE
79	252.66	380.68	389.36	3.37	ACCEPTABLE
80	254.34	313.41	331.68	2.81	ACCEPTABLE
81	283.30	226.65	245.57	2.76	ACCEPTABLE
82	272.26	197.14	214.08	2.76	ACCEPTABLE
83	224.22	370.61	382.60	3.08	ACCEPTABLE
84	246.72	314.60	323.07	3.21	ACCEPTABLE
85	250.64	243.34	263.02	2.66	ACCEPTABLE

No.	Center		Radius	FS	Verification
	x [ft]	z [ft]	R [ft]		
282	216.03	136.03	154.27	3.21	ACCEPTABLE
283	195.74	429.82	449.44	4.03	ACCEPTABLE
284	332.67	80.93	97.66	3.28	ACCEPTABLE
285	194.17	443.82	462.36	4.09	ACCEPTABLE
286	216.03	136.03	154.27	3.21	ACCEPTABLE
287	194.67	346.59	363.29	3.95	ACCEPTABLE
288	292.95	90.86	108.26	3.11	ACCEPTABLE
289	240.45	405.54	421.63	3.05	ACCEPTABLE
290	212.92	860.97	871.80	3.92	ACCEPTABLE
291	331.80	324.21	337.72	3.77	ACCEPTABLE
292	188.73	388.15	402.00	4.21	ACCEPTABLE
293	288.33	110.28	122.52	3.33	ACCEPTABLE
294	228.23	728.31	743.15	3.93	ACCEPTABLE
295	326.60	358.11	368.85	4.38	ACCEPTABLE
296	240.45	405.54	421.63	3.05	ACCEPTABLE
297	285.63	430.60	441.47	3.88	ACCEPTABLE
298	216.00	726.25	738.20	3.88	ACCEPTABLE
299	297.60	360.03	374.83	3.33	ACCEPTABLE
300	262.95	228.01	238.37	3.23	ACCEPTABLE
301	204.79	393.91	408.63	3.45	ACCEPTABLE
302	271.44	189.95	203.93	2.90	ACCEPTABLE
303	220.93	514.91	527.05	3.32	ACCEPTABLE
304	332.36	154.40	166.32	3.64	ACCEPTABLE
305	217.21	237.04	251.84	3.18	ACCEPTABLE
306	301.10	57.79	68.69	4.42	ACCEPTABLE
307	240.44	405.58	421.67	3.04	ACCEPTABLE
308	332.34	154.53	166.42	3.65	ACCEPTABLE
309	271.44	189.95	203.93	2.90	ACCEPTABLE
310	314.52	155.72	169.72	3.21	ACCEPTABLE
311	242.33	305.42	301.76	3.65	ACCEPTABLE
312	19.12	1693.46	1704.04	4.28	ACCEPTABLE
313	234.52	400.30	413.10	3.09	ACCEPTABLE
314	312.86	164.36	176.81	3.32	ACCEPTABLE
315	292.64	92.71	103.90	3.68	ACCEPTABLE
316	232.13	221.39	236.53	2.93	ACCEPTABLE
317	293.10	90.76	102.47	3.57	ACCEPTABLE
318	247.70	333.14	349.05	2.90	ACCEPTABLE
319	276.86	364.35	374.71	3.61	ACCEPTABLE
320	220.62	562.83	576.19	3.42	ACCEPTABLE
321	288.92	298.58	313.13	3.14	ACCEPTABLE
322	264.32	221.84	232.68	3.24	ACCEPTABLE
323	218.02	340.28	355.98	3.06	ACCEPTABLE
324	271.45	189.95	203.93	2.91	ACCEPTABLE
325	233.73	482.65	498.82	3.21	ACCEPTABLE
326	280.85	342.60	354.13	3.45	ACCEPTABLE
327	247.70	333.14	349.05	2.90	ACCEPTABLE
328	259.81	384.78	396.25	3.32	ACCEPTABLE
329	196.42	539.56	546.30	3.26	ACCEPTABLE
330	34.46	1605.69	1619.44	3.84	ACCEPTABLE

No.	Center		Radius	FS	Verification
	x [ft]	z [ft]	R [ft]		
331	130.94	1058.35	1067.24	3.63	ACCEPTABLE
332	229.07	482.77	496.82	3.24	ACCEPTABLE
333	247.22	378.03	397.09	2.91	ACCEPTABLE
334	273.24	314.61	329.87	3.00	ACCEPTABLE
335	255.20	268.74	281.20	2.99	ACCEPTABLE
336	126.90	862.35	871.92	3.43	ACCEPTABLE
337	124.69	870.11	879.97	3.43	ACCEPTABLE
338	227.59	338.67	354.48	2.97	ACCEPTABLE
339	270.09	200.13	218.82	2.69	ACCEPTABLE
340	294.26	200.51	215.63	2.98	ACCEPTABLE
341	260.67	231.96	237.19	3.23	ACCEPTABLE
342	160.12	779.75	788.96	3.38	ACCEPTABLE
343	248.85	429.73	432.29	3.41	ACCEPTABLE
344	251.81	312.22	329.45	2.83	ACCEPTABLE
345	297.74	182.91	200.57	2.87	ACCEPTABLE
346	282.32	138.21	153.45	2.92	ACCEPTABLE
347	198.09	426.66	436.09	3.18	ACCEPTABLE
348	241.46	315.15	317.48	3.24	ACCEPTABLE
349	246.24	210.38	229.58	2.67	ACCEPTABLE
350	262.86	233.39	248.55	2.84	ACCEPTABLE
351	223.20	290.21	297.96	3.27	ACCEPTABLE
352	136.43	812.84	822.14	3.40	ACCEPTABLE
353	196.78	537.89	544.64	3.26	ACCEPTABLE
354	231.87	316.40	333.59	2.89	ACCEPTABLE
355	270.08	200.15	218.85	2.69	ACCEPTABLE
356	254.35	161.15	176.86	2.88	ACCEPTABLE
357	171.71	484.52	493.70	3.42	ACCEPTABLE
358	186.29	443.15	450.06	3.45	ACCEPTABLE
359	226.61	220.17	239.11	2.89	ACCEPTABLE
360	258.40	144.38	162.48	2.81	ACCEPTABLE
361	237.77	285.70	305.20	2.76	ACCEPTABLE
362	265.46	221.43	237.73	2.77	ACCEPTABLE
363	246.24	210.38	229.58	2.67	ACCEPTABLE
364	253.62	237.56	253.64	2.78	ACCEPTABLE
365	231.46	255.09	266.51	3.12	ACCEPTABLE
366	199.60	463.08	473.34	3.19	ACCEPTABLE
367	224.49	367.99	377.86	3.15	ACCEPTABLE
368	236.57	279.41	297.13	2.81	ACCEPTABLE
369	260.50	206.75	225.86	2.66	ACCEPTABLE
370	274.66	216.81	232.36	2.84	ACCEPTABLE
371	253.90	228.69	238.66	3.20	ACCEPTABLE
372	213.50	455.26	465.57	3.21	ACCEPTABLE
373	250.81	330.00	338.06	3.26	ACCEPTABLE
374	249.88	276.94	294.69	2.76	ACCEPTABLE
375	279.47	194.01	212.33	2.74	ACCEPTABLE
376	268.56	165.75	182.04	2.79	ACCEPTABLE
377	221.41	321.93	333.69	3.07	ACCEPTABLE
378	244.86	267.53	275.36	3.19	ACCEPTABLE
379	246.24	210.39	229.59	2.67	ACCEPTABLE

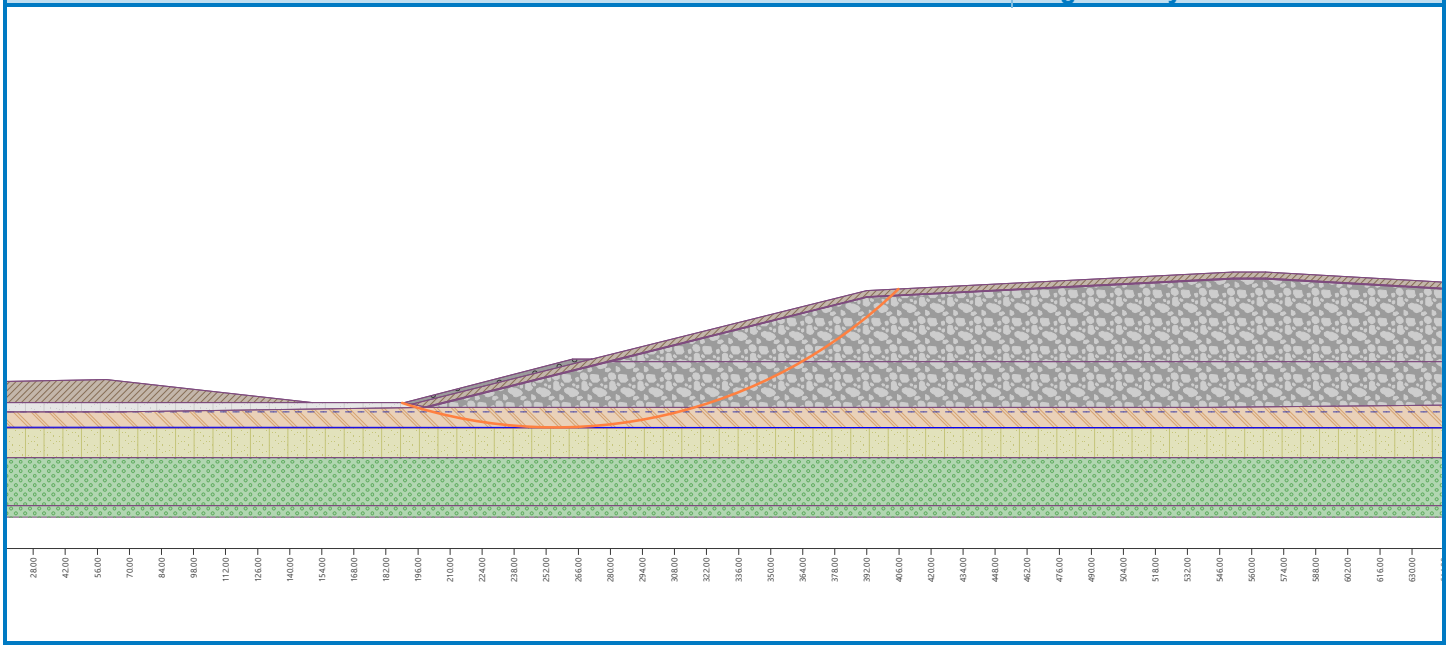
No.	Center		Radius	FS	Verification
	x [ft]	z [ft]	R [ft]		
380	271.21	154.37	172.40	2.74	ACCEPTABLE
381	253.93	257.09	276.56	2.68	ACCEPTABLE
382	276.67	207.31	223.93	2.79	ACCEPTABLE
383	260.50	206.75	225.86	2.66	ACCEPTABLE
384	269.26	216.54	232.93	2.78	ACCEPTABLE
385	256.37	220.64	233.47	2.94	ACCEPTABLE
386	234.64	340.91	353.69	3.00	ACCEPTABLE
387	256.34	276.64	288.17	3.09	ACCEPTABLE
388	253.07	253.39	271.57	2.71	ACCEPTABLE
389	273.23	198.06	216.62	2.70	ACCEPTABLE
390	265.74	179.78	196.90	2.74	ACCEPTABLE
391	236.24	274.37	288.32	2.89	ACCEPTABLE
392	251.87	240.27	251.63	3.07	ACCEPTABLE
393	250.69	209.77	228.99	2.65	ACCEPTABLE
394	255.59	228.74	245.59	2.74	ACCEPTABLE
395	242.40	232.45	246.15	2.90	ACCEPTABLE
396	225.61	343.91	356.65	3.03	ACCEPTABLE
397	241.09	293.66	306.10	2.97	ACCEPTABLE
398	244.19	254.89	273.04	2.73	ACCEPTABLE
399	260.50	206.76	225.88	2.66	ACCEPTABLE
400	252.77	188.96	206.58	2.73	ACCEPTABLE
401	227.22	276.75	290.65	2.97	ACCEPTABLE
402	236.93	255.36	267.64	2.99	ACCEPTABLE
403	241.79	211.01	230.19	2.70	ACCEPTABLE
404	255.31	178.30	197.22	2.68	ACCEPTABLE
405	246.92	241.82	261.18	2.68	ACCEPTABLE
406	257.90	218.37	236.23	2.70	ACCEPTABLE
407	250.69	209.77	228.99	2.65	ACCEPTABLE
408	253.07	224.73	242.35	2.70	ACCEPTABLE
409	244.74	225.63	241.15	2.79	ACCEPTABLE
410	235.82	288.81	303.55	2.88	ACCEPTABLE
411	244.77	261.64	276.32	2.83	ACCEPTABLE
412	246.34	239.51	257.98	2.70	ACCEPTABLE
413	256.62	208.96	228.20	2.64	ACCEPTABLE
414	261.60	218.19	235.51	2.72	ACCEPTABLE
415	253.35	219.26	234.35	2.81	ACCEPTABLE
416	241.79	287.35	302.12	2.86	ACCEPTABLE
417	253.78	253.63	267.87	2.88	ACCEPTABLE
418	252.26	238.57	257.07	2.68	ACCEPTABLE
419	264.78	203.76	222.69	2.67	ACCEPTABLE
420	259.65	191.93	209.84	2.70	ACCEPTABLE
421	241.76	249.71	265.29	2.80	ACCEPTABLE
422	250.68	230.87	244.99	2.87	ACCEPTABLE
423	250.69	209.77	228.99	2.65	ACCEPTABLE
424	261.28	184.84	203.63	2.66	ACCEPTABLE
425	254.11	229.99	249.33	2.65	ACCEPTABLE
426	263.13	211.25	229.31	2.70	ACCEPTABLE
427	256.62	208.96	228.20	2.64	ACCEPTABLE
428	259.66	215.95	233.87	2.70	ACCEPTABLE

No.	Center		Radius	FS	Verification
	x [ft]	z [ft]	R [ft]		
429	254.34	215.99	232.45	2.75	ACCEPTABLE
430	247.40	257.48	273.68	2.78	ACCEPTABLE
431	254.89	237.39	253.29	2.79	ACCEPTABLE
432	253.71	228.55	247.27	2.67	ACCEPTABLE
433	261.93	205.75	224.79	2.66	ACCEPTABLE
434	258.47	197.97	216.33	2.67	ACCEPTABLE
435	246.99	234.84	251.59	2.74	ACCEPTABLE
436	252.75	222.94	238.76	2.79	ACCEPTABLE
437	252.67	209.50	228.73	2.65	ACCEPTABLE
438	260.82	187.69	207.32	2.64	ACCEPTABLE
439	264.45	192.83	211.10	2.69	ACCEPTABLE
440	259.38	192.20	208.93	2.75	ACCEPTABLE
441	250.93	234.28	251.04	2.73	ACCEPTABLE
442	260.23	211.59	227.75	2.76	ACCEPTABLE
443	256.75	208.42	227.72	2.64	ACCEPTABLE
444	259.80	215.36	233.34	2.70	ACCEPTABLE
445	254.49	215.38	231.90	2.75	ACCEPTABLE
446	247.57	256.75	273.00	2.77	ACCEPTABLE
447	255.06	236.70	252.66	2.78	ACCEPTABLE
448	253.85	227.95	246.73	2.66	ACCEPTABLE
449	262.06	205.21	224.32	2.66	ACCEPTABLE
450	258.60	197.43	215.86	2.68	ACCEPTABLE
451	247.14	234.18	250.98	2.74	ACCEPTABLE
452	252.91	222.29	238.16	2.78	ACCEPTABLE
453	252.80	208.96	228.24	2.64	ACCEPTABLE
454	260.94	187.22	206.90	2.64	ACCEPTABLE
455	259.74	192.43	211.45	2.66	ACCEPTABLE
456	255.08	222.31	241.67	2.65	ACCEPTABLE
457	260.91	210.40	228.92	2.67	ACCEPTABLE
458	256.75	208.42	227.72	2.64	ACCEPTABLE
459	258.58	213.57	231.98	2.68	ACCEPTABLE
460	255.12	213.30	230.75	2.71	ACCEPTABLE
461	250.89	239.17	256.42	2.72	ACCEPTABLE
462	255.60	226.91	243.99	2.73	ACCEPTABLE
463	254.81	221.37	240.32	2.66	ACCEPTABLE
464	260.15	206.55	225.75	2.65	ACCEPTABLE
465	257.83	201.42	220.15	2.66	ACCEPTABLE
466	250.46	225.08	242.69	2.70	ACCEPTABLE
467	254.14	217.59	234.62	2.73	ACCEPTABLE
468	254.11	208.78	228.07	2.64	ACCEPTABLE
469	259.43	194.38	213.95	2.65	ACCEPTABLE
470	254.95	205.04	224.75	2.63	ACCEPTABLE
471	256.02	211.64	230.58	2.65	ACCEPTABLE
472	252.58	211.27	229.25	2.69	ACCEPTABLE
473	249.25	235.06	252.70	2.71	ACCEPTABLE
474	253.07	224.77	242.37	2.70	ACCEPTABLE
475	253.06	217.73	237.09	2.64	ACCEPTABLE
476	257.59	204.70	224.42	2.63	ACCEPTABLE
477	255.26	199.58	218.84	2.64	ACCEPTABLE

No.	Center		Radius	FS	Verification
	x [ft]	z [ft]	R [ft]		
478	248.76	221.26	239.26	2.70	ACCEPTABLE
479	251.61	215.52	233.07	2.70	ACCEPTABLE
480	252.31	205.39	225.09	2.64	ACCEPTABLE
481	256.05	196.14	215.81	2.62	ACCEPTABLE
482	257.91	201.01	219.79	2.67	ACCEPTABLE
483	254.54	200.38	218.20	2.70	ACCEPTABLE
484	250.43	225.18	242.78	2.71	ACCEPTABLE
485	255.08	213.44	230.87	2.71	ACCEPTABLE
486	254.16	208.56	227.88	2.64	ACCEPTABLE
487	259.42	194.41	213.98	2.65	ACCEPTABLE
488	257.11	189.35	208.44	2.66	ACCEPTABLE
489	249.94	211.66	229.63	2.69	ACCEPTABLE
490	253.61	204.43	221.81	2.72	ACCEPTABLE
491	253.41	196.47	216.13	2.63	ACCEPTABLE
492	257.87	186.08	205.59	2.64	ACCEPTABLE
493	254.95	205.04	224.75	2.63	ACCEPTABLE
494	258.65	197.76	216.92	2.65	ACCEPTABLE
495	256.05	196.14	215.81	2.62	ACCEPTABLE
496	257.13	199.76	218.84	2.65	ACCEPTABLE
497	254.91	199.23	217.68	2.67	ACCEPTABLE
498	252.40	214.94	233.22	2.67	ACCEPTABLE
499	255.31	207.69	225.89	2.68	ACCEPTABLE
500	254.79	204.39	223.82	2.63	ACCEPTABLE
501	258.16	195.25	214.87	2.63	ACCEPTABLE
502	256.61	191.90	211.20	2.64	ACCEPTABLE
503	252.02	206.29	224.82	2.66	ACCEPTABLE
504	254.31	201.80	219.97	2.68	ACCEPTABLE
505	254.29	196.36	216.02	2.63	ACCEPTABLE
506	257.13	189.66	209.24	2.64	ACCEPTABLE
507	255.32	202.05	221.75	2.63	ACCEPTABLE
508	257.64	197.52	216.87	2.65	ACCEPTABLE
509	256.05	196.14	215.81	2.62	ACCEPTABLE
510	256.61	198.87	218.16	2.64	ACCEPTABLE
511	255.15	198.47	217.34	2.65	ACCEPTABLE
512	253.66	208.43	227.18	2.66	ACCEPTABLE
513	255.44	204.01	222.72	2.66	ACCEPTABLE
514	255.21	201.63	221.14	2.64	ACCEPTABLE
515	257.31	195.82	215.48	2.63	ACCEPTABLE
516	256.28	193.59	213.04	2.64	ACCEPTABLE
517	253.38	202.83	221.73	2.65	ACCEPTABLE
518	254.77	200.13	218.82	2.66	ACCEPTABLE
519	254.88	196.29	215.95	2.63	ACCEPTABLE
520	256.63	192.07	211.71	2.63	ACCEPTABLE
521	255.56	200.07	219.76	2.63	ACCEPTABLE
522	256.96	197.35	216.83	2.64	ACCEPTABLE
523	256.05	196.14	215.81	2.62	ACCEPTABLE
524	256.36	198.09	217.52	2.63	ACCEPTABLE
525	255.39	197.80	216.95	2.65	ACCEPTABLE
526	254.48	204.23	223.28	2.65	ACCEPTABLE

No.	Center x [ft]	Center z [ft]	Radius R [ft]	FS	Verification
527	255.59	201.45	220.49	2.65	ACCEPTABLE
528	255.49	199.79	219.35	2.63	ACCEPTABLE
529	256.83	196.04	215.72	2.63	ACCEPTABLE
530	256.14	194.56	214.09	2.63	ACCEPTABLE
531	254.28	200.56	219.72	2.65	ACCEPTABLE
532	255.14	198.89	217.91	2.65	ACCEPTABLE
533	255.27	196.24	215.90	2.63	ACCEPTABLE
534	256.38	193.54	213.20	2.63	ACCEPTABLE
535	255.72	198.76	218.44	2.63	ACCEPTABLE
536	256.60	197.07	216.62	2.63	ACCEPTABLE
537	256.05	196.14	215.81	2.62	ACCEPTABLE

Name : Model 3 Static circ | **Stage - analysis : 1 - 1**



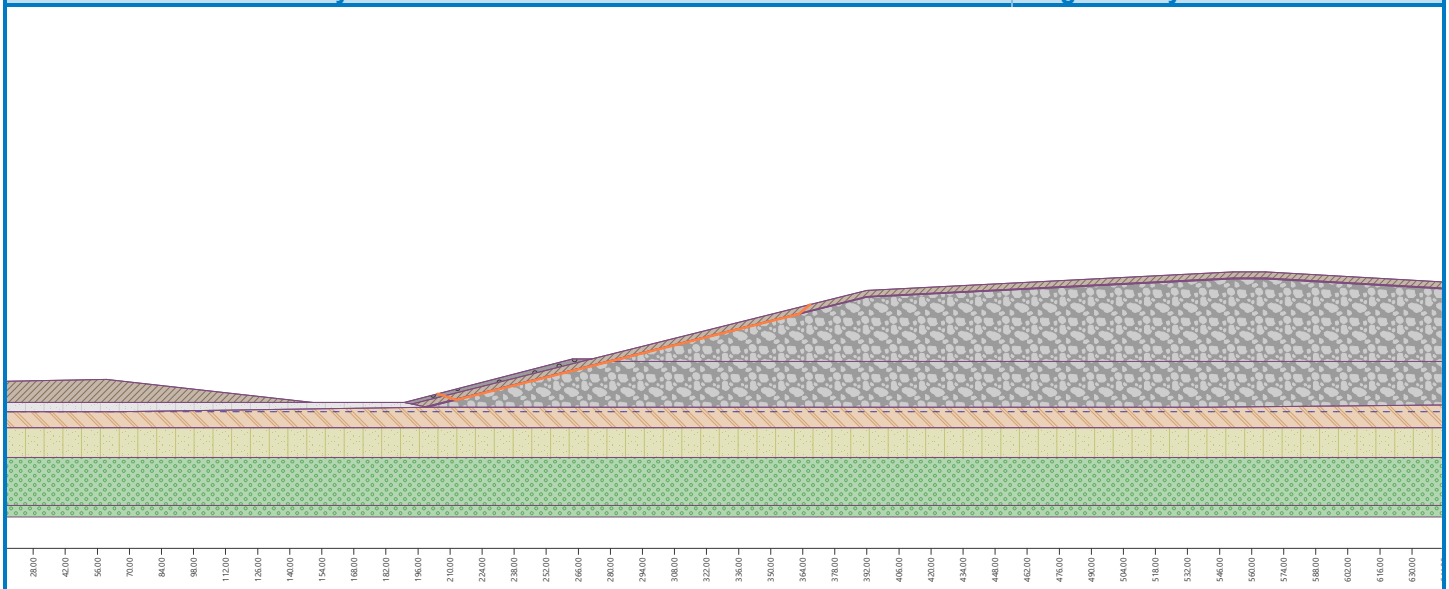
Analysis 3 (stage 1)

Polygonal slip surface

Coordinates of slip surface points [ft]									
x	z	x	z	x	z	x	z	x	z
204.65	-5.22	212.74	-7.80	362.18	29.64	367.23	33.81		
The slip surface after optimization.									

Slope stability verification (Janbu)
Factor of safety = 2.73 > 1.50
Slope stability ACCEPTABLE

Name : Model 3 Static Poly	Stage - analysis : 1 - 3



Slope stability analysis

Input data

Project

Task : Confirmatory Model for Final Closure of the Ash Basin
Description : Slope Stability Analysis of Grand Tower CCR Impoundment Final Closure Plan
Author : ERM - Annapolis
Date : 6/22/2020
Project number : 0533442

Settings

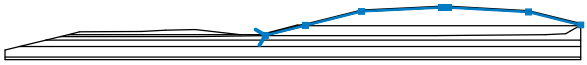
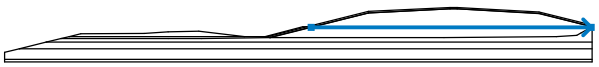
(input for current task)

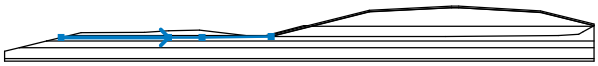
Stability analysis

Earthquake analysis : Standard
Verification methodology : Safety factors (ASD)

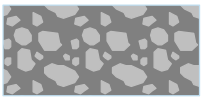
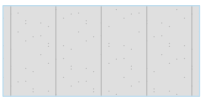
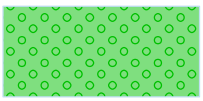
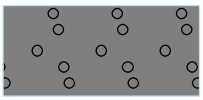
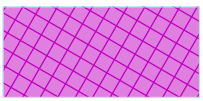
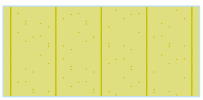
Safety factors			
Seismic design situation			
Safety factor :	SF_s =	1.00	[–]

Interface

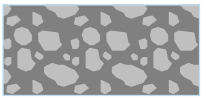
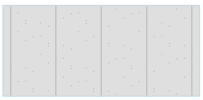
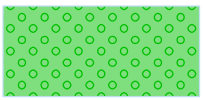
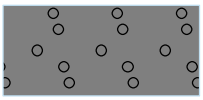
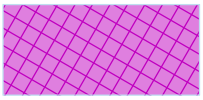
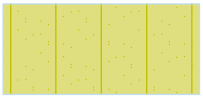
No.	Interface location	Coordinates of interface points [ft]					
		x	z	x	z	x	z
1		193.34	-9.67	194.41	-9.40	200.00	-8.00
		272.00	10.00	392.00	40.00	552.00	48.00
		566.00	48.00	726.00	39.00	830.00	13.00
2		199.27	-10.85	200.00	-10.67	279.99	9.33
		392.00	37.33	552.00	45.33	566.00	45.33
		726.00	36.33	830.00	10.33		
3		200.00	-11.00	279.99	9.00	392.00	37.00
		552.00	45.00	566.00	45.00	726.00	36.00
		830.00	10.00				
4		190.00	-9.00	263.58	10.00	272.00	10.00
5		-320.00	-40.00	-291.43	-33.00	-238.36	-20.00
		-209.79	-13.00	-193.45	-9.00	-171.00	-3.50
		-47.00	-3.00	0.00	0.00	60.00	1.10
		150.00	-9.00	190.00	-9.00	190.64	-9.12
		193.34	-9.67	199.27	-10.85	200.00	-11.00
		540.00	-11.00	760.00	-9.00	800.00	-7.00
		808.86	-1.98	828.24	9.00	830.00	10.00
6		279.99	9.00	828.24	9.00		
7		-193.45	-9.00	150.00	-9.00		

No.	Interface location	Coordinates of interface points [ft]					
		x	z	x	z	x	z
8		-209.79	-13.00	0.00	-13.00	65.00	-13.00
		200.00	-11.00				
9		-238.36	-20.00	830.00	-20.00		
10		-291.43	-33.00	830.00	-33.00		
11		-320.00	-54.00	830.00	-54.00		

Soil parameters - effective stress state

No.	Name	Pattern	φ_{ef} [°]	c_{ef} [psf]	γ [pcf]
1	Ash - Geotech Lab 6/2020		30.00	100.0	75.0
2	Silty Clay (Compacted Levee Cap)		10.00	450.0	133.0
3	Silty Sand (layer in berm, not basin)		28.00	100.0	115.0
4	Silty Clay, impervious fdtn (Updated with 2007 Hanson Report and ERM)		10.00	500.0	130.0
5	Sand & Gravel (Underlying Aquifer)		34.00	0.0	130.0
6	Gravel with trace of fines (G-F), medium dense- RipRap		40.00	0.0	165.0
7	Critical Interface		24.00	45.0	110.0
8	Sandy Silt (Native Pervious Material)		24.00	150.0	115.0

Soil parameters - uplift

No.	Name	Pattern	γ_{sat} [pcf]	γ_s [pcf]	n [–]
1	Ash - Geotech Lab 6/2020		100.0		
2	Silty Clay (Compacted Levee Cap)		153.0		
3	Silty Sand (layer in berm, not basin)		136.0		
4	Silty Clay, impervious fdtn (Updated with 2007 Hanson Report and ERM)		150.0		
5	Sand & Gravel (Underlying Aquifer)		130.0		
6	Gravel with trace of fines (G-F), medium dense- RipRap		165.0		
7	Critical Interface		110.0		
8	Sandy Silt (Native Pervious Material)		135.0		

Soil parameters

Ash - Geotech Lab 6/2020

Unit weight : γ = 75.0 pcf
Stress-state : effective
Angle of internal friction : φ_{ef} = 30.00 °
Cohesion of soil : c_{ef} = 100.0 psf
Saturated unit weight : γ_{sat} = 100.0 pcf

Silty Clay (Compacted Levee Cap)

Unit weight : γ = 133.0 pcf
Stress-state : effective
Angle of internal friction : φ_{ef} = 10.00 °
Cohesion of soil : c_{ef} = 450.0 psf
Saturated unit weight : γ_{sat} = 153.0 pcf

Silty Sand (layer in berm, not basin)

Unit weight : γ = 115.0 pcf
Stress-state : effective

Angle of internal friction : φ_{ef} = 28.00 °
Cohesion of soil : c_{ef} = 100.0 psf
Saturated unit weight : γ_{sat} = 136.0 pcf

Silty Clay, impervious fdtn (Updated with 2007 Hanson Report and ERM)
Unit weight : γ = 130.0 pcf
Stress-state : effective
Angle of internal friction : φ_{ef} = 10.00 °
Cohesion of soil : c_{ef} = 500.0 psf
Saturated unit weight : γ_{sat} = 150.0 pcf

Sand & Gravel (Underlying Aquifer)
Unit weight : γ = 130.0 pcf
Stress-state : effective
Angle of internal friction : φ_{ef} = 34.00 °
Cohesion of soil : c_{ef} = 0.0 psf
Saturated unit weight : γ_{sat} = 130.0 pcf

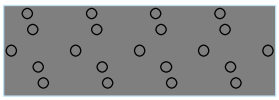
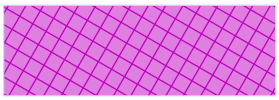
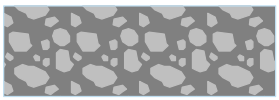
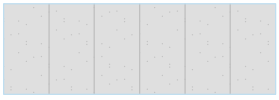
Gravel with trace of fines (G-F), medium dense- RipRap
Unit weight : γ = 165.0 pcf
Stress-state : effective
Angle of internal friction : φ_{ef} = 40.00 °
Cohesion of soil : c_{ef} = 0.0 psf
Saturated unit weight : γ_{sat} = 165.0 pcf

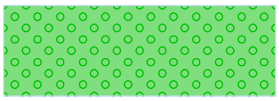
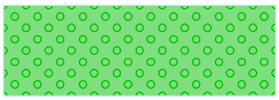
Critical Interface
Unit weight : γ = 110.0 pcf
Stress-state : effective
Angle of internal friction : φ_{ef} = 24.00 °
Cohesion of soil : c_{ef} = 45.0 psf
Saturated unit weight : γ_{sat} = 110.0 pcf

Sandy Silt (Native Pervious Material)
Unit weight : γ = 115.0 pcf
Stress-state : effective
Angle of internal friction : φ_{ef} = 24.00 °
Cohesion of soil : c_{ef} = 150.0 psf
Saturated unit weight : γ_{sat} = 135.0 pcf

Assigning and surfaces

No.	Surface position	Coordinates of surface points [ft]				Assigned soil
		x	z	x	z	
1		828.24	9.00	830.00	10.00	Ash - Geotech Lab 6/2020
		726.00	36.00	566.00	45.00	
		552.00	45.00	392.00	37.00	
		279.99	9.00			

No.	Surface position	Coordinates of surface points [ft]				Assigned soil
		x	z	x	z	
2		150.00	-9.00	60.00	1.10	Silty Clay (Compacted Levee Cap)
		0.00	0.00	-47.00	-3.00	
		-171.00	-3.50	-193.45	-9.00	
3		190.64	-9.12	193.34	-9.67	Gravel with trace of fines (G-F), medium dense-RipRap
		194.41	-9.40	200.00	-8.00	
		272.00	10.00	263.58	10.00	
		190.00	-9.00			
4		199.27	-10.85	200.00	-10.67	Silty Clay (Compacted Levee Cap)
		279.99	9.33	392.00	37.33	
		552.00	45.33	566.00	45.33	
		726.00	36.33	830.00	10.33	
		830.00	13.00	726.00	39.00	
		566.00	48.00	552.00	48.00	
		392.00	40.00	272.00	10.00	
		200.00	-8.00	194.41	-9.40	
		193.34	-9.67			
5		200.00	-11.00	279.99	9.00	Critical Interface
		392.00	37.00	552.00	45.00	
		566.00	45.00	726.00	36.00	
		830.00	10.00	830.00	10.33	
		726.00	36.33	566.00	45.33	
		552.00	45.33	392.00	37.33	
		279.99	9.33	200.00	-10.67	
		199.27	-10.85			
6		279.99	9.00	200.00	-11.00	Ash - Geotech Lab 6/2020
		540.00	-11.00	760.00	-9.00	
		800.00	-7.00	808.86	-1.98	
		828.24	9.00			
7		0.00	-13.00	65.00	-13.00	Silty Sand (layer in berm, not basin)
		200.00	-11.00	199.27	-10.85	
		193.34	-9.67	190.64	-9.12	
		190.00	-9.00	150.00	-9.00	
		-193.45	-9.00	-209.79	-13.00	
8		830.00	-20.00	830.00	10.00	Silty Clay, impervious fdtn (Updated with 2007 Hanson Report and ERM)
		828.24	9.00	808.86	-1.98	
		800.00	-7.00	760.00	-9.00	
		540.00	-11.00	200.00	-11.00	
		65.00	-13.00	0.00	-13.00	
		-209.79	-13.00	-238.36	-20.00	

No.	Surface position	Coordinates of surface points [ft]				Assigned soil
		x	z	x	z	
9		830.00	-33.00	830.00	-20.00	Sandy Silt (Native Pervious Material)
		-238.36	-20.00	-291.43	-33.00	
						
10		830.00	-54.00	830.00	-33.00	Sand & Gravel (Underlying Aquifer)
		-291.43	-33.00	-320.00	-40.00	
		-320.00	-54.00			
						
11		-320.00	-54.00	-320.00	-59.00	Sand & Gravel (Underlying Aquifer)
		830.00	-59.00	830.00	-54.00	
						

Water

Water type : GWT

No.	GWT location	Coordinates of GWT points [ft]					
		x	z	x	z	x	z
1		-320.00	-3.50	-171.00	-3.50	0.00	-13.00
		83.00	-13.00	830.00	-13.00		

Tensile crack

Tensile crack not input.

Earthquake

Horizontal seismic coefficient : K_h = 0.3500
Vertical seismic coefficient : K_v = 0.0000

Settings of the stage of construction

Design situation : seismic

Results (Stage of construction 1)

Analysis 1 (stage 1)

Circular slip surface

Slip surface parameters							
Center :	x =	299.29	[ft]	Angles :	α_1 =	-13.92	[°]
	z =	406.27	[ft]		α_2 =	32.46	[°]
Radius :	R =	426.02	[ft]				
The slip surface after optimization.							

Segments restricting slip surface

No.	First point		Second point	
	x [ft]	z [ft]	x [ft]	z [ft]
1	-247.18	-19.54	775.42	-19.95

The restrictions of points of circular slip surface

Slope stability verification (Bishop)

Sum of active forces : F_a = 421735.2 lbf/ft
Sum of passive forces : F_p = 370051.3 lbf/ft

Sliding moment : M_a = 179667619.2 lbfft/ft
Resisting moment : M_p = 157649259.4 lbfft/ft

Factor of safety = 0.88 < 1.00

Slope stability NOT ACCEPTABLE

Optimization of circular slip surface (Bishop)

No.	Center		Radius	FS	Verification
	x [ft]	z [ft]	R [ft]		
1	230.89	299.12	310.50	1.13	ACCEPTABLE
2	230.89	299.12	310.50	1.13	ACCEPTABLE
3	230.89	299.12	310.50	1.13	ACCEPTABLE
4	70.34	3273.82	3278.13	1.38	ACCEPTABLE
5	513.99	162.99	167.76	2.15	ACCEPTABLE
6	141.19	2256.13	2265.78	1.43	ACCEPTABLE
7	230.89	299.12	310.50	1.13	ACCEPTABLE
8	161.65	1504.87	1509.28	1.29	ACCEPTABLE
9	439.32	150.77	155.44	1.86	ACCEPTABLE
10	124.47	715.85	720.41	1.44	ACCEPTABLE
11	190.24	1191.75	1200.79	1.24	ACCEPTABLE
12	230.89	299.12	310.50	1.13	ACCEPTABLE
13	165.71	1163.84	1168.50	1.26	ACCEPTABLE
14	377.73	178.02	183.55	1.49	ACCEPTABLE
15	27.28	1094.30	1111.29	1039.81	ACCEPTABLE
16	151.66	480.40	486.61	3.22	ACCEPTABLE
17	201.70	850.28	859.86	1.21	ACCEPTABLE
18	230.89	299.12	310.50	1.13	ACCEPTABLE
19	160.67	968.88	975.56	1.22	ACCEPTABLE
20	336.22	199.15	205.46	1.32	ACCEPTABLE
21	169.35	407.88	416.44	1.45	ACCEPTABLE
22	291.40	41.47	46.09	1.83	ACCEPTABLE
23	203.41	670.65	681.38	1.18	ACCEPTABLE
24	339.35	180.26	189.40	1.35	ACCEPTABLE
25	230.89	299.12	310.50	1.13	ACCEPTABLE
26	317.48	154.19	171.71	1.00	ACCEPTABLE
27	271.76	413.97	430.43	0.97	NOT ACCEPTABLE
28	342.27	333.87	347.51	1.10	ACCEPTABLE
29	232.61	791.60	804.82	1.16	ACCEPTABLE
30	342.24	334.08	347.71	1.09	ACCEPTABLE
31	310.41	191.81	202.92	1.25	ACCEPTABLE
32	227.39	426.83	442.96	1.04	ACCEPTABLE
33	312.72	179.50	192.43	1.13	ACCEPTABLE
34	251.21	660.55	677.34	1.03	ACCEPTABLE
35	337.07	369.34	380.03	1.31	ACCEPTABLE
36	271.76	413.97	430.43	0.97	NOT ACCEPTABLE

No.	Center		Radius	FS	Verification
	x [ft]	z [ft]	R [ft]		
37	311.16	412.87	423.53	1.27	ACCEPTABLE
38	161.93	1001.60	1004.32	1.27	ACCEPTABLE
39	-201.04	3672.77	3697.91	1.37	ACCEPTABLE
40	243.63	662.76	676.88	1.10	ACCEPTABLE
41	319.97	356.77	371.15	1.05	ACCEPTABLE
42	296.12	271.84	282.95	1.21	ACCEPTABLE
43	241.03	425.61	441.99	1.01	ACCEPTABLE
44	301.51	242.55	256.45	1.05	ACCEPTABLE
45	256.75	577.07	593.90	1.00	ACCEPTABLE
46	313.79	396.11	407.76	1.18	ACCEPTABLE
47	271.76	413.97	430.43	0.97	NOT ACCEPTABLE
48	294.65	433.95	445.45	1.17	ACCEPTABLE
49	233.38	619.43	623.41	1.20	ACCEPTABLE
50	74.66	1684.57	1696.29	1.26	ACCEPTABLE
51	199.02	1016.90	1020.54	1.25	ACCEPTABLE
52	252.76	575.48	590.21	1.06	ACCEPTABLE
53	270.62	464.27	483.71	0.91	NOT ACCEPTABLE
54	278.58	533.54	549.37	1.00	ACCEPTABLE
55	211.25	754.08	763.14	1.20	ACCEPTABLE
56	131.82	1456.86	1465.98	1.25	ACCEPTABLE
57	175.68	1165.23	1174.11	1.24	ACCEPTABLE
58	254.96	615.30	632.97	0.99	NOT ACCEPTABLE
59	291.14	456.41	475.88	0.89	NOT ACCEPTABLE
60	315.12	470.62	485.48	1.03	ACCEPTABLE
61	260.93	639.56	645.07	1.23	ACCEPTABLE
62	155.65	1409.82	1418.90	1.25	ACCEPTABLE
63	243.76	945.24	949.38	1.26	ACCEPTABLE
64	274.89	607.83	625.57	0.96	NOT ACCEPTABLE
65	323.00	418.15	436.34	0.93	NOT ACCEPTABLE
66	306.41	362.28	378.09	0.99	NOT ACCEPTABLE
67	190.96	960.30	969.51	1.22	ACCEPTABLE
68	236.64	787.57	791.56	1.24	ACCEPTABLE
69	270.61	464.30	483.73	0.91	NOT ACCEPTABLE
70	310.71	336.13	354.03	0.93	NOT ACCEPTABLE
71	281.79	561.39	581.11	0.91	NOT ACCEPTABLE
72	318.50	448.10	464.29	0.98	NOT ACCEPTABLE
73	291.14	456.41	475.88	0.89	NOT ACCEPTABLE
74	305.96	472.67	488.68	0.99	NOT ACCEPTABLE
75	274.94	554.79	564.54	1.23	ACCEPTABLE
76	229.88	882.72	893.26	1.23	ACCEPTABLE
77	271.06	698.24	706.71	1.24	ACCEPTABLE
78	280.06	555.72	573.98	0.94	NOT ACCEPTABLE
79	312.60	429.75	448.34	0.91	NOT ACCEPTABLE
80	301.19	394.37	411.26	0.95	NOT ACCEPTABLE
81	237.83	706.26	717.81	1.17	ACCEPTABLE
82	265.18	614.45	622.74	1.23	ACCEPTABLE
83	277.27	462.16	481.62	0.90	NOT ACCEPTABLE
84	304.65	373.25	391.64	0.91	NOT ACCEPTABLE
85	284.72	525.38	545.05	0.90	NOT ACCEPTABLE

No.	Center		Radius	FS	Verification
	x [ft]	z [ft]	R [ft]		
86	309.07	452.59	469.73	0.95	NOT ACCEPTABLE
87	291.14	456.41	475.88	0.89	NOT ACCEPTABLE
88	300.52	470.26	487.25	0.96	NOT ACCEPTABLE
89	281.56	514.68	527.52	1.10	ACCEPTABLE
90	257.23	690.44	703.49	1.12	ACCEPTABLE
91	280.95	594.58	606.50	1.15	ACCEPTABLE
92	283.55	522.41	541.05	0.92	NOT ACCEPTABLE
93	305.56	438.26	457.13	0.90	NOT ACCEPTABLE
94	297.79	415.36	433.06	0.93	NOT ACCEPTABLE
95	259.16	599.73	613.62	1.07	ACCEPTABLE
96	276.61	544.98	556.76	1.15	ACCEPTABLE
97	281.71	460.74	480.23	0.89	NOT ACCEPTABLE
98	300.36	399.61	418.34	0.90	NOT ACCEPTABLE
99	286.68	502.45	522.07	0.90	NOT ACCEPTABLE
100	302.96	454.79	472.65	0.93	NOT ACCEPTABLE
101	291.14	456.41	475.88	0.89	NOT ACCEPTABLE
102	297.17	466.93	484.67	0.94	NOT ACCEPTABLE
103	285.19	492.62	507.61	1.02	ACCEPTABLE
104	270.66	596.42	611.47	1.03	ACCEPTABLE
105	285.44	540.58	554.94	1.04	ACCEPTABLE
106	285.89	500.60	519.51	0.91	NOT ACCEPTABLE
107	300.80	444.14	463.20	0.90	NOT ACCEPTABLE
108	295.55	429.18	447.44	0.92	NOT ACCEPTABLE
109	270.92	544.36	560.01	1.01	ACCEPTABLE
110	282.39	509.78	524.05	1.05	ACCEPTABLE
111	284.67	459.80	479.31	0.89	NOT ACCEPTABLE
112	299.29	406.27	426.02	0.88	NOT ACCEPTABLE
113	305.49	414.87	432.93	0.92	NOT ACCEPTABLE
114	294.59	434.80	449.96	1.01	ACCEPTABLE
115	277.54	539.91	555.50	1.01	ACCEPTABLE
116	295.47	477.73	492.23	1.04	ACCEPTABLE
117	291.31	455.38	474.91	0.89	NOT ACCEPTABLE
118	308.52	395.86	415.25	0.89	NOT ACCEPTABLE
119	303.42	380.83	399.42	0.91	NOT ACCEPTABLE
120	277.46	491.60	507.83	0.98	NOT ACCEPTABLE
121	292.25	449.14	463.55	1.03	ACCEPTABLE
122	304.96	371.40	390.70	0.89	NOT ACCEPTABLE
123	306.97	405.62	424.31	0.91	NOT ACCEPTABLE
124	299.29	406.27	426.02	0.88	NOT ACCEPTABLE
125	303.33	412.54	431.12	0.91	NOT ACCEPTABLE
126	296.29	424.54	441.21	0.96	NOT ACCEPTABLE
127	285.83	488.92	505.81	0.96	NOT ACCEPTABLE
128	297.08	451.48	467.71	0.98	NOT ACCEPTABLE
129	294.05	438.49	458.08	0.89	NOT ACCEPTABLE
130	305.47	399.27	418.77	0.89	NOT ACCEPTABLE
131	302.03	389.37	408.33	0.90	NOT ACCEPTABLE
132	285.35	459.87	477.19	0.95	NOT ACCEPTABLE
133	294.87	433.21	449.38	0.98	NOT ACCEPTABLE
134	303.11	382.77	402.21	0.89	NOT ACCEPTABLE

No.	Center		Radius	FS	Verification
	x [ft]	z [ft]	R [ft]		
135	304.38	406.01	425.04	0.90	NOT ACCEPTABLE
136	299.29	406.27	426.02	0.88	NOT ACCEPTABLE
137	301.95	410.68	429.64	0.90	NOT ACCEPTABLE
138	297.34	418.14	435.83	0.93	NOT ACCEPTABLE
139	290.73	458.83	476.65	0.93	NOT ACCEPTABLE
140	297.95	435.42	452.82	0.94	NOT ACCEPTABLE
141	295.83	427.52	447.17	0.88	NOT ACCEPTABLE
142	303.42	401.57	421.16	0.88	NOT ACCEPTABLE
143	301.11	395.02	414.24	0.89	NOT ACCEPTABLE
144	290.25	440.69	458.79	0.92	NOT ACCEPTABLE
145	296.45	423.57	440.93	0.94	NOT ACCEPTABLE
146	301.86	390.49	410.03	0.88	NOT ACCEPTABLE
147	302.67	406.17	425.43	0.89	NOT ACCEPTABLE
148	299.29	406.27	426.02	0.88	NOT ACCEPTABLE
149	301.04	409.31	428.52	0.89	NOT ACCEPTABLE
150	298.01	414.05	432.42	0.92	NOT ACCEPTABLE
151	293.75	440.27	458.72	0.91	NOT ACCEPTABLE
152	298.45	425.29	443.47	0.92	NOT ACCEPTABLE
153	297.00	420.34	440.02	0.88	NOT ACCEPTABLE
154	302.04	403.13	422.76	0.88	NOT ACCEPTABLE
155	300.50	398.78	418.18	0.89	NOT ACCEPTABLE
156	293.36	428.67	447.30	0.91	NOT ACCEPTABLE
157	297.44	417.53	435.68	0.92	NOT ACCEPTABLE
158	301.01	395.70	415.31	0.88	NOT ACCEPTABLE
159	301.54	406.24	425.66	0.89	NOT ACCEPTABLE
160	299.29	406.27	426.02	0.88	NOT ACCEPTABLE
161	300.45	408.34	427.73	0.89	NOT ACCEPTABLE
162	298.45	411.40	430.23	0.90	NOT ACCEPTABLE
163	295.67	428.50	447.37	0.90	NOT ACCEPTABLE
164	298.76	418.77	437.47	0.91	NOT ACCEPTABLE
165	297.77	415.61	435.31	0.88	NOT ACCEPTABLE
166	301.13	404.17	423.84	0.88	NOT ACCEPTABLE
167	300.10	401.28	420.80	0.89	NOT ACCEPTABLE
168	295.38	420.97	439.97	0.90	NOT ACCEPTABLE
169	298.08	413.66	432.34	0.91	NOT ACCEPTABLE
170	300.44	399.20	418.86	0.88	NOT ACCEPTABLE
171	300.79	406.26	425.79	0.89	NOT ACCEPTABLE
172	299.29	406.27	426.02	0.88	NOT ACCEPTABLE
173	300.06	407.67	427.18	0.89	NOT ACCEPTABLE
174	298.73	409.67	428.80	0.89	NOT ACCEPTABLE
175	296.91	420.90	440.06	0.90	NOT ACCEPTABLE
176	298.94	414.53	433.58	0.90	NOT ACCEPTABLE
177	298.28	412.48	432.19	0.88	NOT ACCEPTABLE
178	300.52	404.87	424.57	0.88	NOT ACCEPTABLE
179	299.83	402.95	422.54	0.89	NOT ACCEPTABLE
180	296.70	415.97	435.22	0.89	NOT ACCEPTABLE
181	298.49	411.14	430.18	0.90	NOT ACCEPTABLE
182	300.06	401.55	421.24	0.88	NOT ACCEPTABLE
183	300.29	406.27	425.88	0.88	NOT ACCEPTABLE

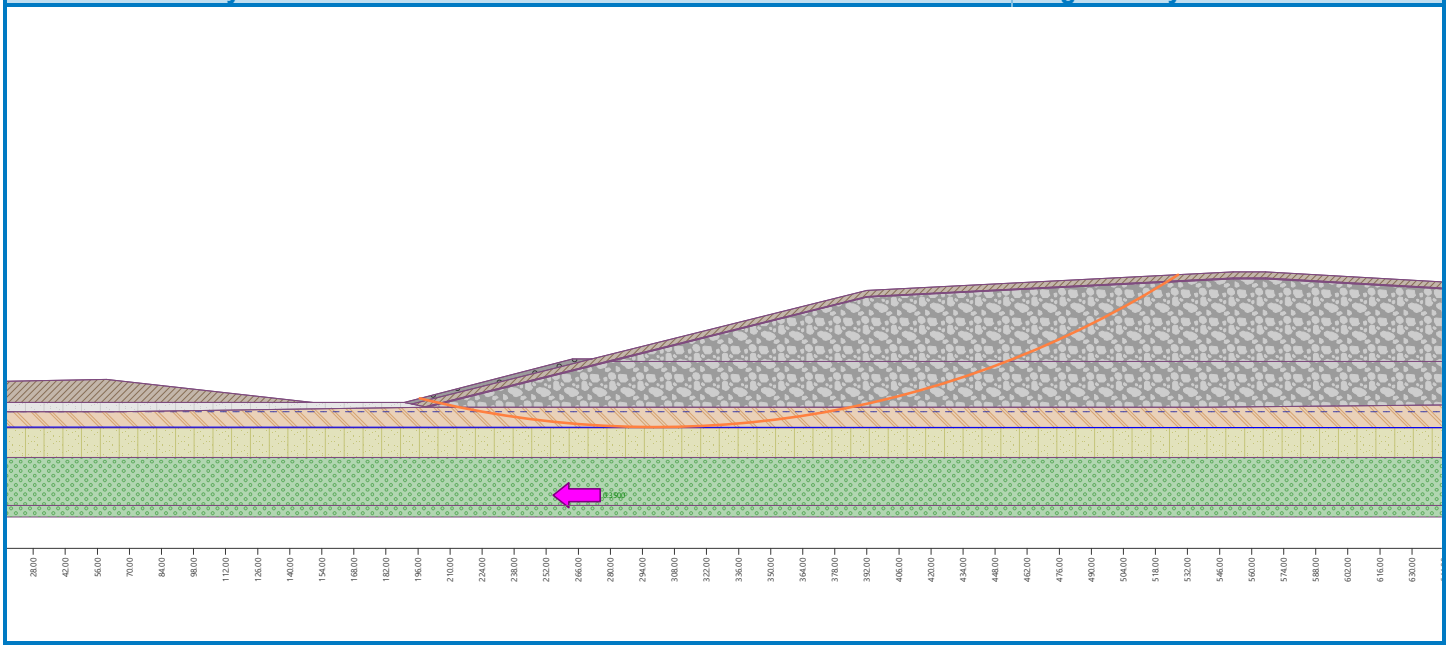
No.	Center		Radius	FS	Verification
	x [ft]	z [ft]	R [ft]		
184	253.87	2599.02	2616.88	1.18	ACCEPTABLE
185	265.94	479.87	731.60	1.40	ACCEPTABLE
186	422.49	2812.45	2828.70	1.02	ACCEPTABLE
187	314.86	4714.41	4729.32	1.26	ACCEPTABLE
188	180.59	1370.32	1388.93	1.20	ACCEPTABLE
189	512.22	78.34	93.15	2.48	ACCEPTABLE
190	330.02	3858.06	3877.18	1.05	ACCEPTABLE
191	422.49	2812.29	2828.54	1.02	ACCEPTABLE
192	379.91	3603.83	3618.68	1.12	ACCEPTABLE
193	270.93	1394.34	1411.95	1.12	ACCEPTABLE
194	504.08	274.44	289.37	1.49	ACCEPTABLE
195	385.85	3226.70	3243.99	1.06	ACCEPTABLE
196	422.49	2812.26	2828.51	1.03	ACCEPTABLE
197	386.07	3501.59	3516.47	1.12	ACCEPTABLE
198	311.45	1535.35	1553.34	1.06	ACCEPTABLE
199	486.46	547.25	562.68	1.25	ACCEPTABLE
200	394.06	3133.80	3150.85	1.01	ACCEPTABLE
201	391.57	3365.23	3380.53	1.09	ACCEPTABLE
202	542.43	1384.31	1400.84	1.15	ACCEPTABLE
203	461.08	629.87	648.34	1.05	ACCEPTABLE
204	306.78	1573.58	1591.43	1.08	ACCEPTABLE
205	458.98	663.28	679.76	1.12	ACCEPTABLE
206	395.82	3113.18	3130.18	1.01	ACCEPTABLE
207	542.26	1414.19	1430.14	1.18	ACCEPTABLE
208	394.06	3133.59	3150.64	1.01	ACCEPTABLE
209	503.33	1774.44	1791.20	1.06	ACCEPTABLE
210	387.66	3393.14	3408.72	1.08	ACCEPTABLE
211	502.93	1798.08	1814.51	1.07	ACCEPTABLE
212	441.87	1127.84	1143.18	1.11	ACCEPTABLE
213	334.53	1907.15	1924.87	1.06	ACCEPTABLE
214	444.42	1078.29	1094.96	1.06	ACCEPTABLE
215	393.42	3140.96	3158.02	1.01	ACCEPTABLE
216	501.41	1888.12	1903.42	1.12	ACCEPTABLE
217	394.06	3133.56	3150.61	1.01	ACCEPTABLE
218	460.26	2391.33	2406.64	1.08	ACCEPTABLE
219	384.20	3395.11	3411.12	1.06	ACCEPTABLE
220	397.90	2891.33	2910.32	0.94	NOT ACCEPTABLE
221	441.73	2452.67	2470.11	0.98	NOT ACCEPTABLE
222	395.10	3034.24	3052.13	0.98	NOT ACCEPTABLE
223	448.21	2238.52	2257.76	0.93	NOT ACCEPTABLE
224	520.17	1480.63	1499.68	1.01	ACCEPTABLE
225	398.60	2870.57	2889.69	0.94	NOT ACCEPTABLE
226	520.00	1494.64	1513.43	1.02	ACCEPTABLE
227	478.39	1094.94	1113.20	1.03	ACCEPTABLE
228	479.08	1074.90	1093.74	1.02	ACCEPTABLE
229	519.62	1525.25	1543.48	1.03	ACCEPTABLE
230	448.21	2238.43	2257.67	0.93	NOT ACCEPTABLE
231	498.61	1737.05	1755.32	1.00	NOT ACCEPTABLE
232	409.19	2716.34	2735.64	0.93	NOT ACCEPTABLE

No.	Center		Radius	FS	Verification
	x [ft]	z [ft]	R [ft]		
233	499.36	1697.09	1715.95	0.98	NOT ACCEPTABLE
234	470.45	1384.72	1403.03	1.00	ACCEPTABLE
235	471.47	1353.77	1372.71	0.98	NOT ACCEPTABLE
236	498.66	1734.55	1752.86	1.00	NOT ACCEPTABLE
237	448.21	2238.43	2257.67	0.93	NOT ACCEPTABLE
238	482.78	1907.90	1926.17	0.98	NOT ACCEPTABLE
239	332.82	5717.23	5718.90	1.61	ACCEPTABLE
240	297.38	10078.99	10079.87	1.65	ACCEPTABLE
241	416.28	2614.76	2634.19	0.92	NOT ACCEPTABLE
242	444.68	2351.51	2369.77	0.95	NOT ACCEPTABLE
243	-353.01	28684.14	28695.35	1.61	ACCEPTABLE
244	401.90	2824.87	2844.01	0.94	NOT ACCEPTABLE
245	448.09	2238.98	2258.23	0.93	NOT ACCEPTABLE
246	428.18	1964.47	1983.21	0.96	NOT ACCEPTABLE
247	430.42	1908.00	1927.38	0.93	NOT ACCEPTABLE
248	404.98	2731.85	2751.61	0.92	NOT ACCEPTABLE
249	413.91	2682.70	2701.67	0.93	NOT ACCEPTABLE
250	396.83	2875.04	2894.37	0.94	NOT ACCEPTABLE
251	399.39	2222.94	2242.50	0.93	NOT ACCEPTABLE
252	-77.03	14040.74	14050.51	1.57	ACCEPTABLE
253	-295.68	18246.45	18261.70	1.55	ACCEPTABLE
254	416.38	2610.49	2629.95	0.92	NOT ACCEPTABLE
255	404.97	2731.61	2751.37	0.92	NOT ACCEPTABLE
256	410.80	2703.20	2722.40	0.93	NOT ACCEPTABLE
257	271.68	5624.07	5633.89	1.56	ACCEPTABLE
258	229.19	8044.28	8053.51	1.67	ACCEPTABLE
259	396.60	2859.96	2879.49	0.98	NOT ACCEPTABLE
260	400.99	2378.59	2398.23	0.93	NOT ACCEPTABLE
261	252.02	6064.37	6074.08	1.63	ACCEPTABLE
262	257.28	5985.43	5994.99	1.56	ACCEPTABLE
263	412.56	2651.01	2670.57	0.92	NOT ACCEPTABLE
264	404.97	2731.61	2751.37	0.92	NOT ACCEPTABLE
265	408.80	2714.49	2733.86	0.93	NOT ACCEPTABLE
266	398.62	2825.50	2845.13	0.93	NOT ACCEPTABLE
267	402.20	2489.66	2509.35	0.93	NOT ACCEPTABLE
268	328.11	4339.74	4352.26	1.39	ACCEPTABLE
269	410.03	2677.95	2697.57	0.92	NOT ACCEPTABLE
270	404.97	2731.61	2751.37	0.92	NOT ACCEPTABLE
271	407.50	2720.99	2740.49	0.92	NOT ACCEPTABLE
272	363.80	3916.31	3930.81	1.23	ACCEPTABLE
273	400.73	2794.11	2813.78	0.93	NOT ACCEPTABLE
274	403.07	2567.27	2586.99	0.92	NOT ACCEPTABLE
275	361.04	3631.40	3646.18	1.21	ACCEPTABLE
276	408.34	2695.86	2715.53	0.92	NOT ACCEPTABLE
277	404.97	2731.61	2751.37	0.92	NOT ACCEPTABLE
278	406.65	2724.88	2744.46	0.92	NOT ACCEPTABLE
279	383.50	3195.54	3211.92	1.04	ACCEPTABLE
280	380.55	3427.44	3443.64	1.06	ACCEPTABLE
281	385.89	3346.35	3362.56	1.05	ACCEPTABLE

No.	Center		Radius	FS	Verification
	x [ft]	z [ft]	R [ft]		
282	402.15	2773.24	2792.94	0.92	NOT ACCEPTABLE
283	403.68	2620.70	2640.43	0.92	NOT ACCEPTABLE
284	378.14	3273.60	3289.98	1.05	ACCEPTABLE
285	382.55	3222.50	3238.75	1.05	ACCEPTABLE
286	407.22	2707.79	2727.49	0.92	NOT ACCEPTABLE
287	408.89	2701.11	2720.63	0.92	NOT ACCEPTABLE
288	385.74	3168.77	3185.09	1.05	ACCEPTABLE
289	382.77	3400.27	3416.42	1.05	ACCEPTABLE
290	388.11	3319.36	3335.51	1.05	ACCEPTABLE
291	404.39	2749.28	2768.92	0.92	NOT ACCEPTABLE
292	410.06	2666.37	2686.13	0.92	NOT ACCEPTABLE
293	411.74	2659.79	2679.37	0.92	NOT ACCEPTABLE
294	388.86	3117.75	3134.13	1.04	ACCEPTABLE
295	385.90	3346.10	3362.30	1.05	ACCEPTABLE
296	391.24	3265.99	3282.19	1.05	ACCEPTABLE
297	407.23	2707.58	2727.28	0.92	NOT ACCEPTABLE
298	408.79	2557.34	2577.07	0.92	NOT ACCEPTABLE
299	383.51	3194.85	3211.23	1.05	ACCEPTABLE
300	387.92	3144.38	3160.64	1.05	ACCEPTABLE
301	412.31	2642.92	2662.61	0.92	NOT ACCEPTABLE
302	410.06	2666.37	2686.13	0.92	NOT ACCEPTABLE
303	411.17	2662.16	2681.80	0.92	NOT ACCEPTABLE
304	396.77	2949.15	2966.64	0.99	NOT ACCEPTABLE
305	395.04	3086.28	3103.65	1.00	NOT ACCEPTABLE
306	398.53	3036.84	3054.21	0.99	NOT ACCEPTABLE
307	408.18	2693.85	2713.57	0.91	NOT ACCEPTABLE
308	409.29	2689.50	2709.10	0.92	NOT ACCEPTABLE
309	394.78	2980.57	2998.02	0.99	NOT ACCEPTABLE
310	393.04	3118.78	3136.12	1.00	NOT ACCEPTABLE
311	396.53	3069.03	3086.36	1.00	NOT ACCEPTABLE
312	406.29	2721.36	2741.04	0.92	NOT ACCEPTABLE
313	410.07	2666.27	2686.03	0.91	NOT ACCEPTABLE
314	411.18	2662.04	2681.68	0.92	NOT ACCEPTABLE
315	396.78	2949.04	2966.53	0.99	NOT ACCEPTABLE
316	395.05	3086.13	3103.51	1.00	NOT ACCEPTABLE
317	398.54	3036.70	3054.07	0.99	NOT ACCEPTABLE
318	408.19	2693.73	2713.45	0.91	NOT ACCEPTABLE
319	411.96	2639.01	2658.81	0.91	NOT ACCEPTABLE
320	409.21	2592.95	2612.69	0.92	NOT ACCEPTABLE
321	393.28	2997.30	3014.79	0.99	NOT ACCEPTABLE
322	396.25	2964.39	2981.79	0.99	NOT ACCEPTABLE
323	411.57	2650.65	2670.36	0.91	NOT ACCEPTABLE
324	410.07	2666.27	2686.03	0.91	NOT ACCEPTABLE
325	410.81	2663.54	2683.22	0.92	NOT ACCEPTABLE
326	401.55	2847.50	2865.74	0.96	NOT ACCEPTABLE
327	400.48	2933.14	2951.30	0.96	NOT ACCEPTABLE
328	402.78	2901.74	2919.90	0.96	NOT ACCEPTABLE
329	408.81	2684.59	2704.32	0.92	NOT ACCEPTABLE
330	411.33	2648.11	2667.89	0.91	NOT ACCEPTABLE

No.	Center		Radius	FS	Verification
	x [ft]	z [ft]	R [ft]		
331	409.49	2617.10	2636.85	0.92	NOT ACCEPTABLE
332	399.25	2878.43	2896.66	0.96	NOT ACCEPTABLE
333	401.23	2856.82	2875.00	0.97	NOT ACCEPTABLE
334	409.76	2609.42	2629.22	0.92	NOT ACCEPTABLE
335	409.08	2676.78	2696.56	0.91	NOT ACCEPTABLE
336	411.07	2655.88	2675.61	0.91	NOT ACCEPTABLE
337	410.07	2666.27	2686.03	0.91	NOT ACCEPTABLE
338	410.56	2664.50	2684.20	0.91	NOT ACCEPTABLE
339	404.53	2784.06	2802.80	0.95	NOT ACCEPTABLE
340	403.85	2838.84	2857.53	0.95	NOT ACCEPTABLE
341	405.38	2818.55	2837.24	0.95	NOT ACCEPTABLE
342	409.23	2678.50	2698.24	0.91	NOT ACCEPTABLE
343	410.91	2654.18	2673.96	0.91	NOT ACCEPTABLE
344	409.68	2633.36	2653.11	0.92	NOT ACCEPTABLE
345	403.01	2804.15	2822.89	0.95	NOT ACCEPTABLE
346	404.33	2789.91	2808.61	0.95	NOT ACCEPTABLE
347	408.35	2647.17	2666.96	0.92	NOT ACCEPTABLE
348	409.86	2628.22	2648.00	0.92	NOT ACCEPTABLE
349	409.41	2673.30	2693.07	0.91	NOT ACCEPTABLE
350	410.74	2659.36	2679.10	0.91	NOT ACCEPTABLE
351	410.07	2666.27	2686.03	0.91	NOT ACCEPTABLE
352	410.40	2665.12	2684.85	0.92	NOT ACCEPTABLE
353	406.44	2743.51	2762.58	0.93	NOT ACCEPTABLE
354	406.00	2779.07	2798.12	0.94	NOT ACCEPTABLE
355	407.01	2765.81	2784.86	0.94	NOT ACCEPTABLE
356	409.51	2674.44	2694.19	0.92	NOT ACCEPTABLE
357	409.75	2667.49	2687.28	0.91	NOT ACCEPTABLE
358	410.09	2666.66	2686.42	0.91	NOT ACCEPTABLE
359	406.12	2744.63	2763.73	0.93	NOT ACCEPTABLE
360	405.70	2780.51	2799.59	0.94	NOT ACCEPTABLE
361	406.71	2767.26	2786.33	0.94	NOT ACCEPTABLE
362	409.20	2675.98	2695.76	0.92	NOT ACCEPTABLE
363	410.32	2659.78	2679.58	0.91	NOT ACCEPTABLE
364	409.49	2645.51	2665.29	0.91	NOT ACCEPTABLE
365	405.11	2757.79	2776.90	0.94	NOT ACCEPTABLE
366	406.00	2748.36	2767.45	0.94	NOT ACCEPTABLE
367	410.20	2663.23	2683.01	0.91	NOT ACCEPTABLE
368	299.29	406.27	426.02	0.88	NOT ACCEPTABLE

Name : Mode 3 Dynamic 0.88	Stage - analysis : 1 - 1



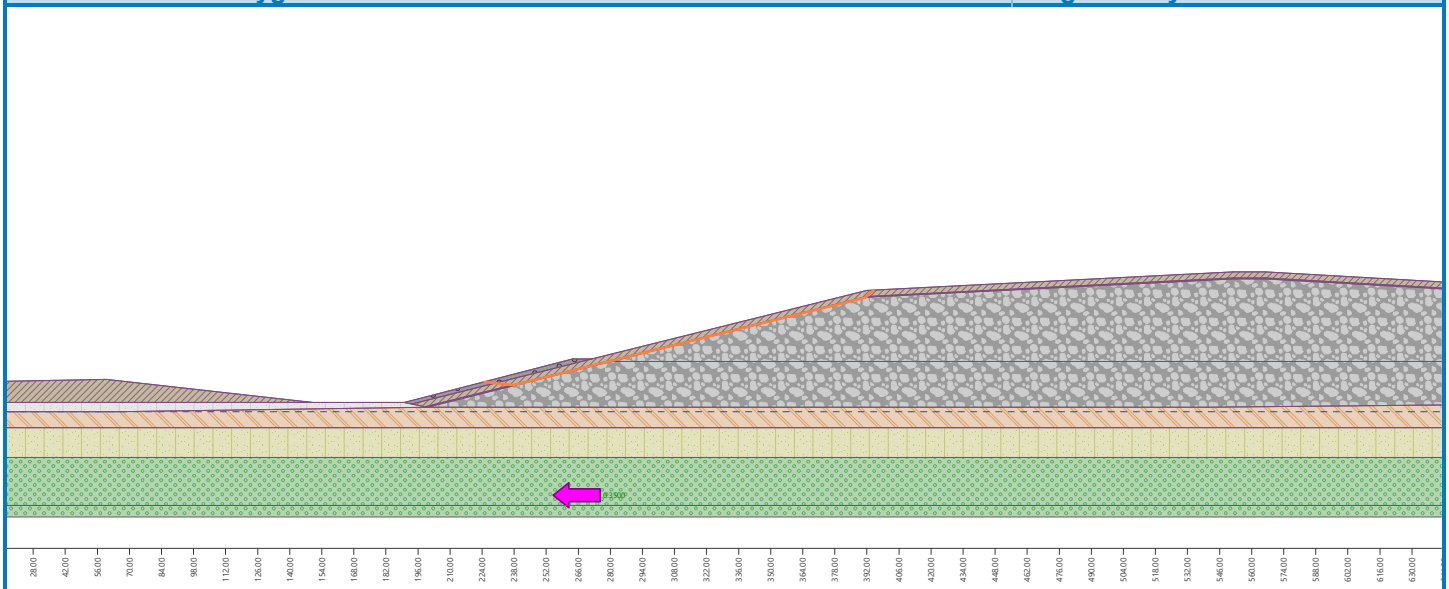
Analysis 3 (stage 1)

Polygonal slip surface

Coordinates of slip surface points [ft]									
x	z	x	z	x	z	x	z	x	z
225.01	0.04	237.74	-1.40	391.40	36.90	394.87	40.14		
The slip surface after optimization.									

Slope stability verification (Janbu)
Factor of safety = 1.01 > 1.00
Slope stability ACCEPTABLE

Name : Model 3 Polygonal	Stage - analysis : 1 - 3



Slope stability analysis

Input data

Project

Task : Confirmatory Model for Final Closure of the Ash Basin
Description : Slope Stability Analysis of Grand Tower CCR Impoundment Final Closure Plan
Author : ERM - Annapolis
Date : 6/22/2020
Project number : 0533442

Settings

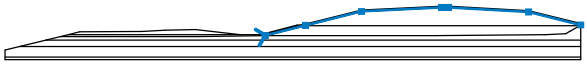
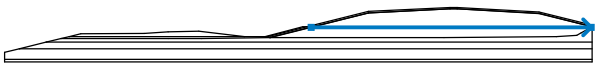
(input for current task)

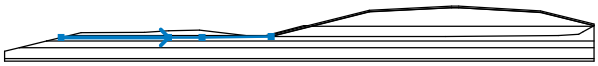
Stability analysis

Earthquake analysis : Standard
Verification methodology : Safety factors (ASD)

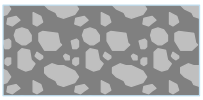
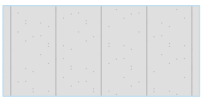
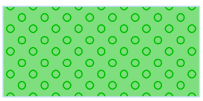
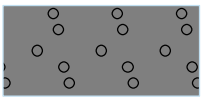
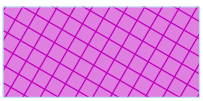
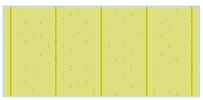
Safety factors			
Seismic design situation			
Safety factor :	SF_s =	1.00	[–]

Interface

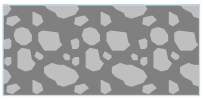
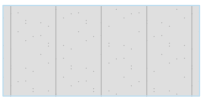
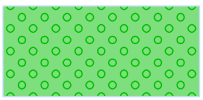
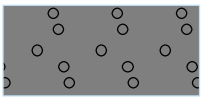
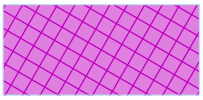
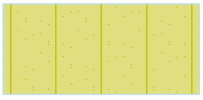
No.	Interface location	Coordinates of interface points [ft]					
		x	z	x	z	x	z
1		193.34	-9.67	194.41	-9.40	200.00	-8.00
		272.00	10.00	392.00	40.00	552.00	48.00
		566.00	48.00	726.00	39.00	830.00	13.00
2		199.27	-10.85	200.00	-10.67	279.99	9.33
		392.00	37.33	552.00	45.33	566.00	45.33
		726.00	36.33	830.00	10.33		
3		200.00	-11.00	279.99	9.00	392.00	37.00
		552.00	45.00	566.00	45.00	726.00	36.00
		830.00	10.00				
4		190.00	-9.00	263.58	10.00	272.00	10.00
5		-320.00	-40.00	-291.43	-33.00	-238.36	-20.00
		-209.79	-13.00	-193.45	-9.00	-171.00	-3.50
		-47.00	-3.00	0.00	0.00	60.00	1.10
		150.00	-9.00	190.00	-9.00	190.64	-9.12
		193.34	-9.67	199.27	-10.85	200.00	-11.00
		540.00	-11.00	760.00	-9.00	800.00	-7.00
		808.86	-1.98	828.24	9.00	830.00	10.00
6		279.99	9.00	828.24	9.00		
7		-193.45	-9.00	150.00	-9.00		

No.	Interface location	Coordinates of interface points [ft]					
		x	z	x	z	x	z
8		-209.79	-13.00	0.00	-13.00	65.00	-13.00
		200.00	-11.00				
9		-238.36	-20.00	830.00	-20.00		
10		-291.43	-33.00	830.00	-33.00		
11		-320.00	-54.00	830.00	-54.00		

Soil parameters - effective stress state

No.	Name	Pattern	φ_{ef} [°]	c_{ef} [psf]	γ [pcf]
1	Ash - Geotech Lab 6/2020		30.00	100.0	75.0
2	Silty Clay (Compacted Levee Cap)		10.00	450.0	133.0
3	Silty Sand (layer in berm, not basin)		28.00	100.0	115.0
4	Silty Clay, impervious fdtn (Updated with 2007 Hanson Report and ERM)		10.00	500.0	130.0
5	Sand & Gravel (Underlying Aquifer)		34.00	0.0	130.0
6	Gravel with trace of fines (G-F), medium dense- RipRap		40.00	0.0	165.0
7	Critical Interface		25.00	50.0	110.0
8	Sandy Silt (Native Pervious Material)		24.00	150.0	115.0

Soil parameters - uplift

No.	Name	Pattern	γ_{sat} [pcf]	γ_s [pcf]	n [–]
1	Ash - Geotech Lab 6/2020		100.0		
2	Silty Clay (Compacted Levee Cap)		153.0		
3	Silty Sand (layer in berm, not basin)		136.0		
4	Silty Clay, impervious fdtn (Updated with 2007 Hanson Report and ERM)		150.0		
5	Sand & Gravel (Underlying Aquifer)		130.0		
6	Gravel with trace of fines (G-F), medium dense- RipRap		165.0		
7	Critical Interface		110.0		
8	Sandy Silt (Native Pervious Material)		135.0		

Soil parameters

Ash - Geotech Lab 6/2020

Unit weight : γ = 75.0 pcf
Stress-state : effective
Angle of internal friction : φ_{ef} = 30.00 °
Cohesion of soil : c_{ef} = 100.0 psf
Saturated unit weight : γ_{sat} = 100.0 pcf

Silty Clay (Compacted Levee Cap)

Unit weight : γ = 133.0 pcf
Stress-state : effective
Angle of internal friction : φ_{ef} = 10.00 °
Cohesion of soil : c_{ef} = 450.0 psf
Saturated unit weight : γ_{sat} = 153.0 pcf

Silty Sand (layer in berm, not basin)

Unit weight : γ = 115.0 pcf
Stress-state : effective

Angle of internal friction : φ_{ef} = 28.00 °
Cohesion of soil : c_{ef} = 100.0 psf
Saturated unit weight : γ_{sat} = 136.0 pcf

Silty Clay, impervious fdtn (Updated with 2007 Hanson Report and ERM)
Unit weight : γ = 130.0 pcf
Stress-state : effective
Angle of internal friction : φ_{ef} = 10.00 °
Cohesion of soil : c_{ef} = 500.0 psf
Saturated unit weight : γ_{sat} = 150.0 pcf

Sand & Gravel (Underlying Aquifer)
Unit weight : γ = 130.0 pcf
Stress-state : effective
Angle of internal friction : φ_{ef} = 34.00 °
Cohesion of soil : c_{ef} = 0.0 psf
Saturated unit weight : γ_{sat} = 130.0 pcf

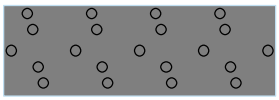
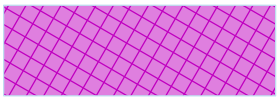
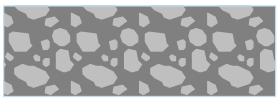
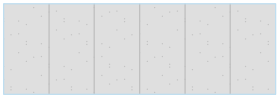
Gravel with trace of fines (G-F), medium dense- RipRap
Unit weight : γ = 165.0 pcf
Stress-state : effective
Angle of internal friction : φ_{ef} = 40.00 °
Cohesion of soil : c_{ef} = 0.0 psf
Saturated unit weight : γ_{sat} = 165.0 pcf

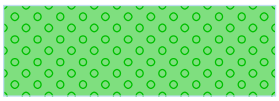
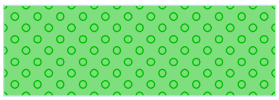
Critical Interface
Unit weight : γ = 110.0 pcf
Stress-state : effective
Angle of internal friction : φ_{ef} = 25.00 °
Cohesion of soil : c_{ef} = 50.0 psf
Saturated unit weight : γ_{sat} = 110.0 pcf

Sandy Silt (Native Pervious Material)
Unit weight : γ = 115.0 pcf
Stress-state : effective
Angle of internal friction : φ_{ef} = 24.00 °
Cohesion of soil : c_{ef} = 150.0 psf
Saturated unit weight : γ_{sat} = 135.0 pcf

Assigning and surfaces

No.	Surface position	Coordinates of surface points [ft]				Assigned soil
		x	z	x	z	
1		828.24	9.00	830.00	10.00	Ash - Geotech Lab 6/2020
		726.00	36.00	566.00	45.00	
		552.00	45.00	392.00	37.00	
		279.99	9.00			

No.	Surface position	Coordinates of surface points [ft]				Assigned soil
		x	z	x	z	
2		150.00	-9.00	60.00	1.10	Silty Clay (Compacted Levee Cap)
		0.00	0.00	-47.00	-3.00	
		-171.00	-3.50	-193.45	-9.00	
3		190.64	-9.12	193.34	-9.67	Gravel with trace of fines (G-F), medium dense-RipRap
		194.41	-9.40	200.00	-8.00	
		272.00	10.00	263.58	10.00	
		190.00	-9.00			
4		199.27	-10.85	200.00	-10.67	Silty Clay (Compacted Levee Cap)
		279.99	9.33	392.00	37.33	
		552.00	45.33	566.00	45.33	
		726.00	36.33	830.00	10.33	
		830.00	13.00	726.00	39.00	
		566.00	48.00	552.00	48.00	
		392.00	40.00	272.00	10.00	
		200.00	-8.00	194.41	-9.40	
		193.34	-9.67			
5		200.00	-11.00	279.99	9.00	Critical Interface
		392.00	37.00	552.00	45.00	
		566.00	45.00	726.00	36.00	
		830.00	10.00	830.00	10.33	
		726.00	36.33	566.00	45.33	
		552.00	45.33	392.00	37.33	
		279.99	9.33	200.00	-10.67	
		199.27	-10.85			
6		279.99	9.00	200.00	-11.00	Ash - Geotech Lab 6/2020
		540.00	-11.00	760.00	-9.00	
		800.00	-7.00	808.86	-1.98	
		828.24	9.00			
7		0.00	-13.00	65.00	-13.00	Silty Sand (layer in berm, not basin)
		200.00	-11.00	199.27	-10.85	
		193.34	-9.67	190.64	-9.12	
		190.00	-9.00	150.00	-9.00	
		-193.45	-9.00	-209.79	-13.00	
8		830.00	-20.00	830.00	10.00	Silty Clay, impervious fdtn (Updated with 2007 Hanson Report and ERM)
		828.24	9.00	808.86	-1.98	
		800.00	-7.00	760.00	-9.00	
		540.00	-11.00	200.00	-11.00	
		65.00	-13.00	0.00	-13.00	
		-209.79	-13.00	-238.36	-20.00	

No.	Surface position	Coordinates of surface points [ft]				Assigned soil
		x	z	x	z	
9		830.00	-33.00	830.00	-20.00	Sandy Silt (Native Pervious Material)
		-238.36	-20.00	-291.43	-33.00	
						
10		830.00	-54.00	830.00	-33.00	Sand & Gravel (Underlying Aquifer)
		-291.43	-33.00	-320.00	-40.00	
		-320.00	-54.00			
						
11		-320.00	-54.00	-320.00	-59.00	Sand & Gravel (Underlying Aquifer)
		830.00	-59.00	830.00	-54.00	
						

Water

Water type : GWT

No.	GWT location	Coordinates of GWT points [ft]					
		x	z	x	z	x	z
1		-320.00	-3.50	-171.00	-3.50	0.00	-13.00
		83.00	-13.00	830.00	-13.00		

Tensile crack

Tensile crack not input.

Earthquake

Horizontal seismic coefficient : K_h = 0.1750
Vertical seismic coefficient : K_v = 0.0000

Settings of the stage of construction

Design situation : seismic

Results (Stage of construction 1)

Analysis 1 (stage 1)

Circular slip surface

Slip surface parameters							
Center :	x =	272.96	[ft]	Angles :	α_1 =	-18.04	[°]
	z =	229.01	[ft]		α_2 =	41.33	[°]
Radius :	R =	248.70	[ft]				
The slip surface after optimization.							

Segments restricting slip surface

No.	First point		Second point	
	x [ft]	z [ft]	x [ft]	z [ft]
1	-247.18	-19.54	775.42	-19.95

The restrictions of points of circular slip surface

Slope stability verification (Bishop)

Sum of active forces : F_a = 187101.8 lbf/ft

Sum of passive forces : F_p = 250863.2 lbf/ft

Sliding moment : M_a = 46532219.6 lbfft/ft

Resisting moment : M_p = 62389674.2 lbfft/ft

Factor of safety = 1.34 > 1.00

Slope stability ACCEPTABLE

Optimization of circular slip surface (Bishop)

No.	Center		Radius	FS	Verification
	x [ft]	z [ft]	R [ft]		
1	240.51	233.36	244.04	1.76	ACCEPTABLE
2	240.51	233.36	244.04	1.76	ACCEPTABLE
3	240.51	233.36	244.04	1.76	ACCEPTABLE
4	98.98	2697.65	2702.85	2.19	ACCEPTABLE
5	497.94	157.61	164.45	3.89	ACCEPTABLE
6	29.30	1467.39	1472.74	2441918.89	ACCEPTABLE
7	148.80	2010.67	2020.78	2.36	ACCEPTABLE
8	240.51	233.36	244.04	1.76	ACCEPTABLE
9	172.15	1311.02	1316.37	1.98	ACCEPTABLE
10	438.51	121.46	126.65	3.42	ACCEPTABLE
11	30.77	1318.17	1327.62	3956981.33	ACCEPTABLE
12	133.54	675.69	680.68	6.56	ACCEPTABLE
13	194.07	1077.76	1087.24	1.93	ACCEPTABLE
14	240.51	233.36	244.04	1.76	ACCEPTABLE
15	166.28	1066.12	1071.37	1.91	ACCEPTABLE
16	378.93	141.55	147.40	2.44	ACCEPTABLE
17	0.97	1220.39	1239.99	6231493.85	ACCEPTABLE
18	152.99	444.54	451.10	4.31	ACCEPTABLE
19	202.42	768.21	778.46	1.83	ACCEPTABLE
20	240.51	233.36	244.04	1.76	ACCEPTABLE
21	160.75	882.46	889.74	1.83	ACCEPTABLE
22	338.10	158.42	164.99	2.03	ACCEPTABLE
23	170.40	368.51	377.43	2.19	ACCEPTABLE
24	291.32	23.79	28.80	3.63	ACCEPTABLE
25	344.76	120.30	135.51	1.74	ACCEPTABLE
26	283.86	490.57	504.87	1.63	ACCEPTABLE
27	223.53	1214.50	1224.83	2.01	ACCEPTABLE
28	390.05	378.00	388.33	2.32	ACCEPTABLE
29	216.65	517.26	531.14	1.75	ACCEPTABLE
30	340.90	142.36	152.06	2.09	ACCEPTABLE
31	252.28	964.88	979.30	1.84	ACCEPTABLE
32	388.71	389.99	399.30	2.31	ACCEPTABLE
33	283.86	490.57	504.87	1.63	ACCEPTABLE
34	355.21	415.34	425.52	2.15	ACCEPTABLE
35	230.25	980.44	992.48	1.90	ACCEPTABLE
36	357.25	399.85	411.16	2.03	ACCEPTABLE

No.	Center		Radius	FS	Verification
	x [ft]	z [ft]	R [ft]		
37	324.20	244.36	252.86	1.97	ACCEPTABLE
38	232.03	529.69	544.52	1.65	ACCEPTABLE
39	327.49	224.74	235.50	2.00	ACCEPTABLE
40	254.34	803.53	818.87	1.71	ACCEPTABLE
41	351.71	441.91	450.36	2.14	ACCEPTABLE
42	283.86	490.57	504.87	1.63	ACCEPTABLE
43	324.00	490.90	499.30	2.04	ACCEPTABLE
44	126.83	1430.91	1433.63	2.03	ACCEPTABLE
45	-382.45	5381.94	5415.61	2.23	ACCEPTABLE
46	246.09	800.12	812.90	1.81	ACCEPTABLE
47	277.83	584.70	603.83	1.48	ACCEPTABLE
48	298.13	689.23	703.35	1.71	ACCEPTABLE
49	86.82	1690.95	1701.53	1.97	ACCEPTABLE
50	-750.92	9141.92	9192.54	2.28	ACCEPTABLE
51	-464.53	6163.66	6206.07	2.12	ACCEPTABLE
52	259.83	850.52	866.79	1.70	ACCEPTABLE
53	314.05	574.99	593.41	1.50	ACCEPTABLE
54	287.48	468.42	483.73	1.58	ACCEPTABLE
55	-49.47	2733.86	2747.82	2.12	ACCEPTABLE
56	251.86	583.31	601.88	1.54	ACCEPTABLE
57	296.23	415.10	433.34	1.46	ACCEPTABLE
58	336.44	404.62	418.01	1.75	ACCEPTABLE
59	232.39	796.43	795.58	1.94	ACCEPTABLE
60	-720.79	7361.76	7424.11	2.17	ACCEPTABLE
61	131.40	1824.12	1825.82	2.11	ACCEPTABLE
62	267.12	657.33	673.71	1.60	ACCEPTABLE
63	342.15	365.13	381.67	1.58	ACCEPTABLE
64	318.80	277.23	290.83	1.67	ACCEPTABLE
65	-24.41	2160.91	2178.40	2.00	ACCEPTABLE
66	113.37	1511.60	1515.09	2.04	ACCEPTABLE
67	261.26	437.82	456.51	1.45	ACCEPTABLE
68	281.45	505.17	518.88	1.67	ACCEPTABLE
69	100.48	1230.08	1240.86	1.89	ACCEPTABLE
70	-692.38	7321.53	7375.95	2.39	ACCEPTABLE
71	242.38	650.87	666.77	1.67	ACCEPTABLE
72	296.23	415.09	433.33	1.46	ACCEPTABLE
73	270.78	334.31	348.94	1.54	ACCEPTABLE
74	-53.12	2273.27	2288.81	2.17	ACCEPTABLE
75	234.84	437.29	455.42	1.52	ACCEPTABLE
76	278.94	291.38	309.12	1.42	ACCEPTABLE
77	319.39	273.68	287.65	1.66	ACCEPTABLE
78	236.30	492.49	491.69	1.82	ACCEPTABLE
79	113.21	1512.56	1516.06	2.04	ACCEPTABLE
80	250.89	500.31	516.06	1.58	ACCEPTABLE
81	322.56	254.59	270.69	1.56	ACCEPTABLE
82	300.02	175.08	188.43	1.65	ACCEPTABLE
83	90.47	1218.99	1225.88	2.05	ACCEPTABLE
84	244.60	307.96	326.16	1.42	ACCEPTABLE
85	302.76	161.43	177.02	1.55	ACCEPTABLE

No.	Center		Radius	FS	Verification
	x [ft]	z [ft]	R [ft]		
86	261.25	437.85	456.53	1.45	ACCEPTABLE
87	318.80	277.22	290.82	1.67	ACCEPTABLE
88	278.94	291.38	309.12	1.42	ACCEPTABLE
89	302.77	298.22	311.67	1.65	ACCEPTABLE
90	260.32	379.23	383.30	1.79	ACCEPTABLE
91	139.28	1112.02	1121.69	1.86	ACCEPTABLE
92	243.74	636.89	639.14	1.87	ACCEPTABLE
93	258.68	430.04	446.43	1.51	ACCEPTABLE
94	308.45	265.65	282.23	1.50	ACCEPTABLE
95	292.44	215.86	229.93	1.58	ACCEPTABLE
96	186.15	658.52	667.58	1.78	ACCEPTABLE
97	236.83	498.77	500.86	1.80	ACCEPTABLE
98	254.61	305.74	323.98	1.41	ACCEPTABLE
99	268.79	344.74	358.74	1.57	ACCEPTABLE
100	218.00	448.03	455.42	1.74	ACCEPTABLE
101	113.81	1163.34	1173.16	1.88	ACCEPTABLE
102	180.71	808.03	815.16	1.82	ACCEPTABLE
103	238.71	436.25	452.58	1.55	ACCEPTABLE
104	278.94	291.38	309.12	1.42	ACCEPTABLE
105	261.84	244.28	259.22	1.49	ACCEPTABLE
106	163.21	685.40	694.42	1.78	ACCEPTABLE
107	175.49	645.55	652.89	1.79	ACCEPTABLE
108	234.59	310.23	328.37	1.45	ACCEPTABLE
109	267.33	218.79	236.15	1.41	ACCEPTABLE
110	245.71	395.52	414.00	1.46	ACCEPTABLE
111	273.17	321.69	337.14	1.51	ACCEPTABLE
112	254.61	305.74	323.98	1.41	ACCEPTABLE
113	259.95	345.76	361.04	1.52	ACCEPTABLE
114	231.65	389.83	400.56	1.72	ACCEPTABLE
115	196.38	657.41	667.18	1.79	ACCEPTABLE
116	221.60	542.03	551.55	1.76	ACCEPTABLE
117	243.95	390.92	407.76	1.50	ACCEPTABLE
118	268.65	301.22	319.43	1.40	ACCEPTABLE
119	282.68	316.29	330.83	1.56	ACCEPTABLE
120	256.86	354.98	363.96	1.76	ACCEPTABLE
121	210.59	645.42	655.24	1.79	ACCEPTABLE
122	251.72	483.82	491.29	1.81	ACCEPTABLE
123	257.28	387.15	404.05	1.48	ACCEPTABLE
124	288.98	282.22	299.54	1.45	ACCEPTABLE
125	277.67	250.95	266.36	1.49	ACCEPTABLE
126	220.89	479.52	490.42	1.74	ACCEPTABLE
127	246.15	408.50	415.78	1.76	ACCEPTABLE
128	254.61	305.72	323.97	1.41	ACCEPTABLE
129	284.86	214.98	234.34	1.36	ACCEPTABLE
130	299.90	220.81	237.10	1.49	ACCEPTABLE
131	279.56	236.55	246.09	1.80	ACCEPTABLE
132	235.97	468.45	479.23	1.76	ACCEPTABLE
133	280.20	325.39	332.97	1.82	ACCEPTABLE
134	269.89	294.88	313.59	1.39	ACCEPTABLE

No.	Center		Radius	FS	Verification
	x [ft]	z [ft]	R [ft]		
135	303.23	203.10	221.82	1.42	ACCEPTABLE
136	292.57	173.38	190.29	1.46	ACCEPTABLE
137	241.76	342.10	354.40	1.62	ACCEPTABLE
138	273.31	266.95	274.30	1.78	ACCEPTABLE
139	294.47	164.14	182.61	1.42	ACCEPTABLE
140	301.19	213.94	231.13	1.46	ACCEPTABLE
141	284.86	214.98	234.34	1.36	ACCEPTABLE
142	294.33	221.68	238.64	1.46	ACCEPTABLE
143	281.55	228.59	241.25	1.62	ACCEPTABLE
144	258.68	350.26	363.28	1.61	ACCEPTABLE
145	283.31	279.02	290.41	1.74	ACCEPTABLE
146	275.25	266.07	284.92	1.38	ACCEPTABLE
147	297.18	206.89	225.81	1.40	ACCEPTABLE
148	289.91	187.53	205.14	1.43	ACCEPTABLE
149	258.89	288.02	302.23	1.53	ACCEPTABLE
150	278.33	244.39	255.61	1.74	ACCEPTABLE
151	291.43	180.06	198.81	1.40	ACCEPTABLE
152	295.60	215.08	232.88	1.43	ACCEPTABLE
153	284.86	214.98	234.34	1.36	ACCEPTABLE
154	290.94	220.64	238.24	1.43	ACCEPTABLE
155	282.73	223.76	238.58	1.52	ACCEPTABLE
156	269.42	294.58	309.52	1.51	ACCEPTABLE
157	284.37	254.33	268.33	1.57	ACCEPTABLE
158	278.61	248.13	267.12	1.37	ACCEPTABLE
159	293.10	209.51	228.57	1.39	ACCEPTABLE
160	288.19	196.80	214.95	1.41	ACCEPTABLE
161	268.50	259.69	275.44	1.47	ACCEPTABLE
162	280.91	232.79	246.68	1.56	ACCEPTABLE
163	276.48	220.79	240.47	1.35	ACCEPTABLE
164	282.40	227.29	245.15	1.41	ACCEPTABLE
165	274.08	230.35	245.57	1.49	ACCEPTABLE
166	259.86	304.54	319.96	1.49	ACCEPTABLE
167	275.38	262.38	276.78	1.53	ACCEPTABLE
168	269.81	255.51	274.84	1.36	ACCEPTABLE
169	284.86	214.98	234.34	1.36	ACCEPTABLE
170	279.89	202.39	220.81	1.39	ACCEPTABLE
171	259.35	267.87	284.09	1.45	ACCEPTABLE
172	272.02	240.23	254.51	1.53	ACCEPTABLE
173	281.16	196.27	215.51	1.37	ACCEPTABLE
174	283.57	221.45	240.00	1.39	ACCEPTABLE
175	276.48	220.79	240.47	1.35	ACCEPTABLE
176	280.31	225.64	244.04	1.39	ACCEPTABLE
177	274.92	227.02	243.70	1.44	ACCEPTABLE
178	266.21	272.44	289.20	1.44	ACCEPTABLE
179	275.98	247.11	263.25	1.46	ACCEPTABLE
180	272.10	243.52	262.95	1.35	ACCEPTABLE
181	282.08	216.88	236.34	1.36	ACCEPTABLE
182	278.74	208.58	227.40	1.37	ACCEPTABLE
183	265.46	250.53	267.83	1.41	ACCEPTABLE

No.	Center		Radius	FS	Verification
	x [ft]	z [ft]	R [ft]		
184	273.68	232.98	249.04	1.46	ACCEPTABLE
185	279.64	204.22	223.61	1.36	ACCEPTABLE
186	281.17	221.39	240.30	1.37	ACCEPTABLE
187	276.48	220.79	240.47	1.35	ACCEPTABLE
188	278.99	224.25	243.05	1.37	ACCEPTABLE
189	275.46	224.89	242.55	1.40	ACCEPTABLE
190	269.95	253.59	271.29	1.40	ACCEPTABLE
191	276.24	237.77	255.07	1.42	ACCEPTABLE
192	273.59	235.76	255.26	1.35	ACCEPTABLE
193	280.22	218.17	237.70	1.35	ACCEPTABLE
194	277.98	212.67	231.77	1.37	ACCEPTABLE
195	269.29	239.96	258.01	1.39	ACCEPTABLE
196	274.69	228.61	245.87	1.42	ACCEPTABLE
197	278.60	209.65	229.13	1.35	ACCEPTABLE
198	279.59	221.26	240.42	1.36	ACCEPTABLE
199	276.48	220.79	240.47	1.35	ACCEPTABLE
200	278.13	223.19	242.27	1.37	ACCEPTABLE
201	275.80	223.50	241.83	1.39	ACCEPTABLE
202	272.26	241.98	260.33	1.38	ACCEPTABLE
203	276.36	231.87	249.96	1.39	ACCEPTABLE
204	274.57	230.69	250.25	1.35	ACCEPTABLE
205	278.98	219.03	238.61	1.35	ACCEPTABLE
206	277.47	215.39	234.68	1.36	ACCEPTABLE
207	271.75	233.29	251.88	1.37	ACCEPTABLE
208	275.31	225.87	243.94	1.39	ACCEPTABLE
209	277.90	213.32	232.86	1.35	ACCEPTABLE
210	278.55	221.14	240.46	1.36	ACCEPTABLE
211	276.48	220.79	240.47	1.35	ACCEPTABLE
212	277.57	222.43	241.71	1.36	ACCEPTABLE
213	276.03	222.58	241.36	1.37	ACCEPTABLE
214	273.72	234.64	253.42	1.37	ACCEPTABLE
215	276.42	228.07	246.70	1.38	ACCEPTABLE
216	275.21	227.36	246.95	1.34	ACCEPTABLE
217	276.29	229.07	248.26	1.36	ACCEPTABLE
218	274.73	229.29	247.98	1.37	ACCEPTABLE
219	272.37	241.65	260.36	1.37	ACCEPTABLE
220	275.10	234.91	253.45	1.38	ACCEPTABLE
221	273.91	234.10	253.61	1.35	ACCEPTABLE
222	276.89	226.14	245.66	1.35	ACCEPTABLE
223	275.88	223.71	243.03	1.36	ACCEPTABLE
224	272.02	235.89	254.75	1.37	ACCEPTABLE
225	274.41	230.89	249.40	1.38	ACCEPTABLE
226	273.52	228.60	248.26	1.34	ACCEPTABLE
227	274.59	230.35	249.60	1.36	ACCEPTABLE
228	273.03	230.56	249.32	1.37	ACCEPTABLE
229	270.64	243.03	261.81	1.37	ACCEPTABLE
230	273.39	236.23	254.84	1.37	ACCEPTABLE
231	272.20	235.41	254.99	1.35	ACCEPTABLE
232	275.21	227.36	246.95	1.34	ACCEPTABLE

No.	Center		Radius	FS	Verification
	x [ft]	z [ft]	R [ft]		
233	274.19	224.94	244.33	1.35	ACCEPTABLE
234	270.31	237.21	256.15	1.36	ACCEPTABLE
235	272.70	232.19	250.78	1.37	ACCEPTABLE
236	271.83	229.85	249.58	1.34	ACCEPTABLE
237	272.90	231.64	250.96	1.35	ACCEPTABLE
238	271.33	231.84	250.68	1.37	ACCEPTABLE
239	268.91	244.41	263.27	1.37	ACCEPTABLE
240	271.68	237.56	256.24	1.37	ACCEPTABLE
241	270.50	236.72	256.37	1.34	ACCEPTABLE
242	273.52	228.60	248.26	1.34	ACCEPTABLE
243	272.51	226.18	245.64	1.35	ACCEPTABLE
244	268.59	238.55	257.56	1.37	ACCEPTABLE
245	270.99	233.50	252.16	1.37	ACCEPTABLE
246	272.82	224.66	244.30	1.34	ACCEPTABLE
247	273.21	230.13	249.61	1.35	ACCEPTABLE
248	271.83	229.85	249.58	1.34	ACCEPTABLE
249	272.54	231.06	250.52	1.35	ACCEPTABLE
250	271.50	231.17	250.31	1.36	ACCEPTABLE
251	269.91	239.43	258.57	1.36	ACCEPTABLE
252	271.74	234.94	253.97	1.36	ACCEPTABLE
253	270.94	234.41	254.09	1.34	ACCEPTABLE
254	272.96	229.01	248.70	1.34	ACCEPTABLE
255	273.67	230.20	249.62	1.35	ACCEPTABLE
256	272.63	230.32	249.41	1.36	ACCEPTABLE
257	271.06	238.53	257.63	1.36	ACCEPTABLE
258	272.88	234.07	253.06	1.36	ACCEPTABLE
259	272.08	233.54	253.18	1.35	ACCEPTABLE
260	274.09	228.18	247.82	1.35	ACCEPTABLE
261	273.41	226.57	246.08	1.35	ACCEPTABLE
262	270.82	234.71	253.92	1.35	ACCEPTABLE
263	272.41	231.39	250.36	1.36	ACCEPTABLE
264	271.83	229.85	249.58	1.34	ACCEPTABLE
265	273.62	225.56	245.19	1.34	ACCEPTABLE
266	273.88	229.20	248.72	1.35	ACCEPTABLE
267	546.06	138.88	154.71	3.71	ACCEPTABLE
268	431.06	2508.16	2526.58	1.76	ACCEPTABLE
269	323.32	4201.23	4218.53	2.10	ACCEPTABLE
270	511.85	75.40	92.50	4.29	ACCEPTABLE
271	431.06	2508.16	2526.58	1.76	ACCEPTABLE
272	385.07	3247.98	3265.18	1.97	ACCEPTABLE
273	275.80	1313.52	1333.25	1.76	ACCEPTABLE
274	270.71	5083.94	5101.45	2.21	ACCEPTABLE
275	431.06	2508.08	2526.50	1.76	ACCEPTABLE
276	272.19	4999.25	5017.11	2.17	ACCEPTABLE
277	429.39	2559.35	2577.40	1.78	ACCEPTABLE
278	275.80	1313.52	1333.25	1.76	ACCEPTABLE
279	354.71	1978.89	1998.36	1.73	ACCEPTABLE
280	387.28	3286.09	3302.64	1.91	ACCEPTABLE
281	525.05	1532.25	1549.26	2.11	ACCEPTABLE

No.	Center		Radius	FS	Verification
	x [ft]	z [ft]	R [ft]		
282	422.83	531.93	551.73	1.69	ACCEPTABLE
283	348.26	2094.96	2113.24	1.86	ACCEPTABLE
284	458.42	116.03	134.40	2.79	ACCEPTABLE
285	422.83	531.93	551.73	1.69	ACCEPTABLE
286	353.69	1438.73	1457.59	1.68	ACCEPTABLE
287	362.39	3139.11	3153.95	2.07	ACCEPTABLE
288	505.94	1453.67	1468.57	2.26	ACCEPTABLE
289	416.79	605.72	620.72	1.92	ACCEPTABLE
290	297.05	1199.35	1218.05	1.70	ACCEPTABLE
291	418.71	582.20	598.60	1.84	ACCEPTABLE
292	506.31	1433.62	1448.88	2.22	ACCEPTABLE
293	353.69	1438.73	1457.59	1.68	ACCEPTABLE
294	451.62	1503.43	1518.43	2.06	ACCEPTABLE
295	364.01	2122.51	2142.13	1.72	ACCEPTABLE
296	453.30	1460.41	1476.14	2.01	ACCEPTABLE
297	395.77	840.51	855.47	1.88	ACCEPTABLE
298	310.58	1272.64	1291.85	1.66	ACCEPTABLE
299	331.08	1730.15	1745.33	1.91	ACCEPTABLE
300	313.66	1861.70	1877.31	1.91	ACCEPTABLE
301	353.68	1438.82	1457.68	1.68	ACCEPTABLE
302	309.37	1004.07	1020.75	1.68	ACCEPTABLE
303	282.52	1134.23	1152.48	1.73	ACCEPTABLE
304	320.66	1738.94	1756.35	1.86	ACCEPTABLE
305	340.70	1606.15	1622.69	1.82	ACCEPTABLE
306	310.58	1272.64	1291.85	1.66	ACCEPTABLE
307	319.36	1554.11	1570.30	1.82	ACCEPTABLE
308	-353.80	7548.93	7576.01	2.30	ACCEPTABLE
309	308.70	1622.76	1639.37	1.86	ACCEPTABLE
310	336.73	1348.20	1367.49	1.65	ACCEPTABLE
311	370.68	1649.49	1664.85	1.91	ACCEPTABLE
312	382.50	1471.65	1489.46	1.75	ACCEPTABLE
313	349.44	1075.51	1092.38	1.71	ACCEPTABLE
314	310.58	1272.64	1291.85	1.66	ACCEPTABLE
315	357.07	994.61	1013.46	1.62	ACCEPTABLE
316	407.98	985.91	1000.63	1.94	ACCEPTABLE
317	201.74	2673.58	2672.45	2.38	ACCEPTABLE
318	-79.22	7571.11	7576.13	2.58	ACCEPTABLE
319	327.42	1458.52	1476.01	1.74	ACCEPTABLE
320	413.35	913.40	930.41	1.80	ACCEPTABLE
321	384.86	711.35	726.80	1.80	ACCEPTABLE
322	-354.38	7554.26	7581.37	2.30	ACCEPTABLE
323	81.24	3964.82	3966.32	2.41	ACCEPTABLE
324	317.22	1008.20	1027.90	1.56	ACCEPTABLE
325	343.46	1138.96	1154.50	1.80	ACCEPTABLE
326	0.57	3656.75	3668.69	2.21	ACCEPTABLE
327	302.00	1371.98	1389.34	1.76	ACCEPTABLE
328	357.06	994.63	1013.48	1.62	ACCEPTABLE
329	328.96	801.19	818.03	1.64	ACCEPTABLE
330	-183.93	5548.59	5565.74	2.28	ACCEPTABLE

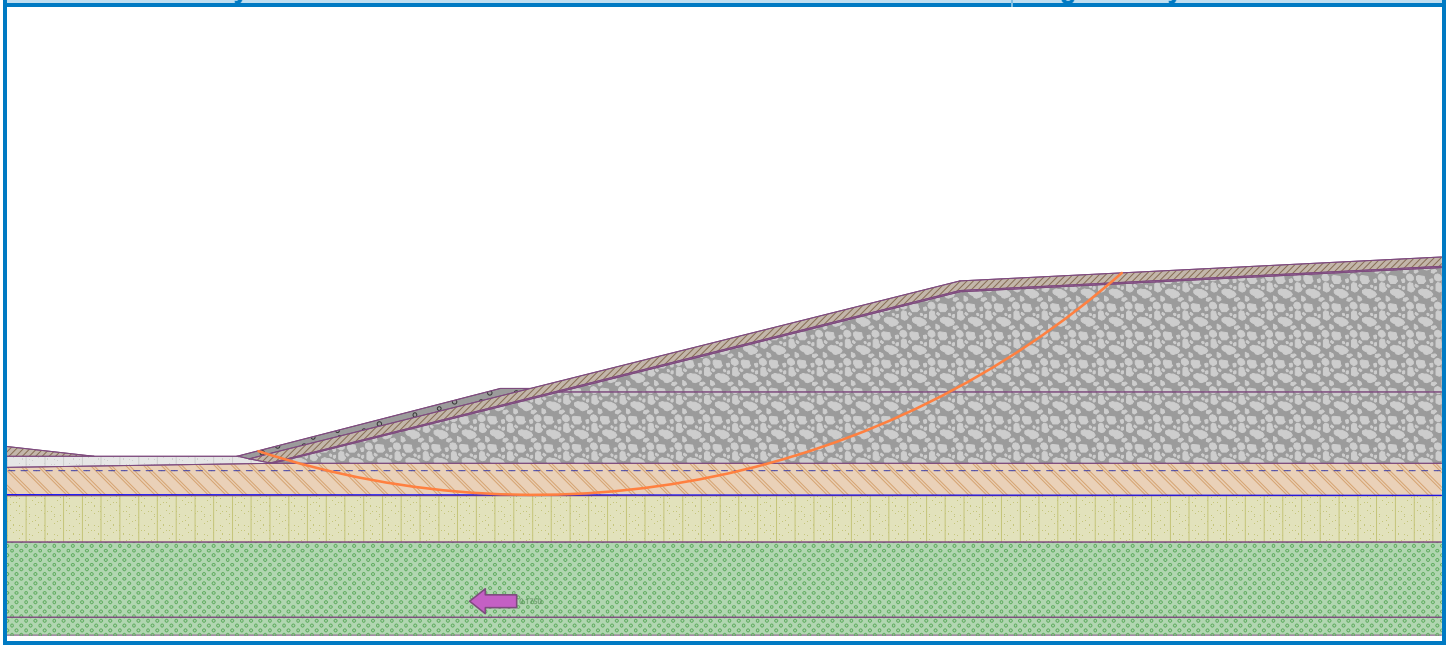
No.	Center		Radius	FS	Verification
	x [ft]	z [ft]	R [ft]		
331	290.76	964.01	983.55	1.58	ACCEPTABLE
332	336.77	733.28	752.43	1.53	ACCEPTABLE
333	383.11	730.03	744.70	1.85	ACCEPTABLE
334	237.45	1571.50	1570.24	2.20	ACCEPTABLE
335	81.06	3966.63	3968.14	2.41	ACCEPTABLE
336	307.66	1101.32	1118.90	1.67	ACCEPTABLE
337	388.67	670.45	687.77	1.70	ACCEPTABLE
338	361.44	513.94	529.29	1.70	ACCEPTABLE
339	-72.17	3719.90	3736.71	2.13	ACCEPTABLE
340	148.61	2329.21	2329.35	2.22	ACCEPTABLE
341	365.39	480.29	497.83	1.60	ACCEPTABLE
342	317.21	1008.26	1027.95	1.57	ACCEPTABLE
343	384.85	711.36	726.81	1.80	ACCEPTABLE
344	336.77	733.28	752.43	1.53	ACCEPTABLE
345	365.71	750.78	766.14	1.77	ACCEPTABLE
346	295.80	1079.61	1083.61	2.17	ACCEPTABLE
347	143.73	2562.79	2572.03	2.21	ACCEPTABLE
348	279.23	1610.90	1613.32	2.29	ACCEPTABLE
349	314.66	981.61	999.80	1.61	ACCEPTABLE
350	371.82	690.09	707.94	1.64	ACCEPTABLE
351	353.38	585.06	601.42	1.65	ACCEPTABLE
352	200.36	1628.39	1637.52	2.09	ACCEPTABLE
353	276.67	1243.96	1246.59	2.17	ACCEPTABLE
354	356.95	554.41	572.43	1.58	ACCEPTABLE
355	321.17	921.38	941.12	1.55	ACCEPTABLE
356	368.34	724.68	741.06	1.71	ACCEPTABLE
357	336.77	733.28	752.43	1.53	ACCEPTABLE
358	355.13	753.33	769.62	1.69	ACCEPTABLE
359	314.90	918.39	927.07	2.16	ACCEPTABLE
360	251.84	1508.67	1519.09	2.17	ACCEPTABLE
361	312.91	1154.07	1161.44	2.24	ACCEPTABLE
362	319.42	905.43	924.10	1.58	ACCEPTABLE
363	360.34	703.88	722.13	1.61	ACCEPTABLE
364	347.92	633.54	650.75	1.61	ACCEPTABLE
365	262.67	1185.28	1196.73	2.02	ACCEPTABLE
366	307.06	986.04	993.57	2.16	ACCEPTABLE
367	350.75	609.16	627.53	1.56	ACCEPTABLE
368	357.56	730.26	747.44	1.65	ACCEPTABLE
369	336.77	733.28	752.43	1.53	ACCEPTABLE
370	348.58	750.23	767.34	1.64	ACCEPTABLE
371	323.88	842.49	854.53	1.96	ACCEPTABLE
372	288.66	1155.60	1168.58	1.92	ACCEPTABLE
373	324.73	969.88	981.00	2.15	ACCEPTABLE
374	323.18	854.03	873.01	1.55	ACCEPTABLE
375	352.58	713.40	731.93	1.58	ACCEPTABLE
376	344.24	666.37	684.19	1.59	ACCEPTABLE
377	290.83	999.05	1012.87	1.83	ACCEPTABLE
378	319.88	877.08	888.31	2.08	ACCEPTABLE
379	348.57	628.95	648.47	1.52	ACCEPTABLE

No.	Center		Radius	FS	Verification
	x [ft]	z [ft]	R [ft]		
380	360.32	641.67	659.24	1.62	ACCEPTABLE
381	339.05	708.86	721.09	1.93	ACCEPTABLE
382	310.11	965.10	977.90	1.90	ACCEPTABLE
383	341.48	814.76	826.02	2.11	ACCEPTABLE
384	337.06	730.78	750.03	1.53	ACCEPTABLE
385	363.44	613.04	632.02	1.57	ACCEPTABLE
386	355.19	570.00	588.24	1.56	ACCEPTABLE
387	310.00	836.78	850.51	1.79	ACCEPTABLE
388	335.93	735.65	747.00	2.05	ACCEPTABLE
389	356.85	555.72	574.77	1.54	ACCEPTABLE
390	361.80	628.09	646.31	1.59	ACCEPTABLE
391	348.57	628.95	648.47	1.52	ACCEPTABLE
392	356.23	638.84	656.98	1.59	ACCEPTABLE
393	342.63	678.84	693.45	1.75	ACCEPTABLE
394	325.98	826.21	841.07	1.74	ACCEPTABLE
395	344.75	742.17	756.15	1.81	ACCEPTABLE
396	341.07	695.23	714.54	1.53	ACCEPTABLE
397	358.52	618.25	637.40	1.55	ACCEPTABLE
398	353.00	589.49	608.15	1.55	ACCEPTABLE
399	324.68	754.89	770.40	1.69	ACCEPTABLE
400	340.84	694.25	708.28	1.78	ACCEPTABLE
401	354.19	579.25	598.46	1.53	ACCEPTABLE
402	357.34	628.85	647.48	1.56	ACCEPTABLE
403	348.57	628.95	648.47	1.52	ACCEPTABLE
404	353.60	636.15	654.73	1.57	ACCEPTABLE
405	344.77	660.87	677.10	1.66	ACCEPTABLE
406	334.62	750.73	767.09	1.65	ACCEPTABLE
407	346.37	700.35	716.16	1.69	ACCEPTABLE
408	343.65	672.45	691.82	1.52	ACCEPTABLE
409	355.22	621.77	641.05	1.54	ACCEPTABLE
410	351.53	602.58	621.51	1.54	ACCEPTABLE
411	333.34	708.14	724.92	1.62	ACCEPTABLE
412	343.69	670.23	686.07	1.68	ACCEPTABLE
413	341.85	636.31	656.08	1.50	ACCEPTABLE
414	346.81	644.12	662.92	1.54	ACCEPTABLE
415	337.82	669.02	685.54	1.64	ACCEPTABLE
416	327.25	760.82	777.48	1.63	ACCEPTABLE
417	339.26	709.44	725.53	1.66	ACCEPTABLE
418	336.72	680.80	700.43	1.50	ACCEPTABLE
419	348.57	628.95	648.46	1.51	ACCEPTABLE
420	344.87	609.79	628.96	1.52	ACCEPTABLE
421	326.15	717.19	734.28	1.60	ACCEPTABLE
422	336.65	678.87	694.99	1.65	ACCEPTABLE
423	345.76	602.26	621.81	1.50	ACCEPTABLE
424	347.68	636.66	655.81	1.53	ACCEPTABLE
425	341.85	636.31	656.08	1.50	ACCEPTABLE
426	345.12	641.79	660.89	1.53	ACCEPTABLE
427	339.24	657.55	675.14	1.58	ACCEPTABLE
428	332.58	715.36	733.04	1.59	ACCEPTABLE

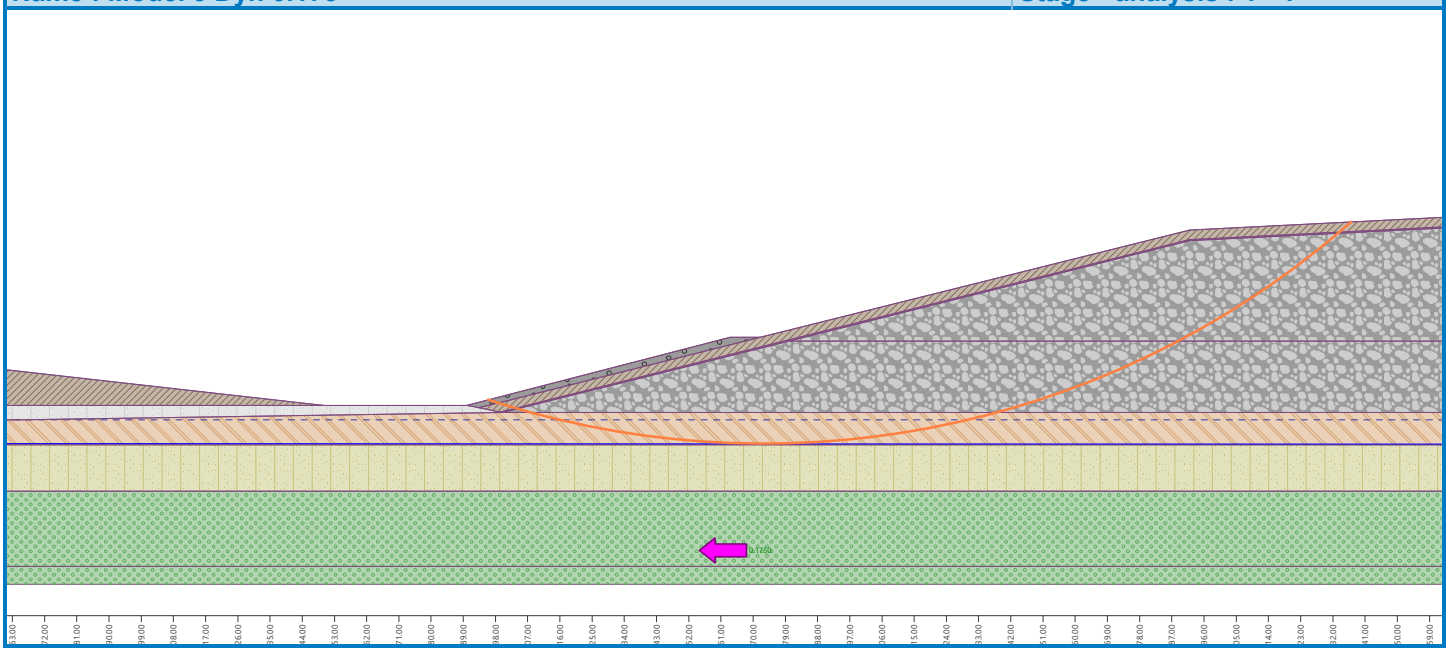
No.	Center		Radius	FS	Verification
	x [ft]	z [ft]	R [ft]		
429	340.28	683.35	700.66	1.61	ACCEPTABLE
430	338.46	665.66	685.33	1.50	ACCEPTABLE
431	346.34	631.38	650.98	1.51	ACCEPTABLE
432	343.86	618.60	637.97	1.51	ACCEPTABLE
433	331.68	688.25	706.21	1.57	ACCEPTABLE
434	338.50	663.72	681.05	1.60	ACCEPTABLE
435	344.48	613.43	633.05	1.50	ACCEPTABLE
436	347.75	618.63	637.59	1.53	ACCEPTABLE
437	342.03	633.32	650.75	1.59	ACCEPTABLE
438	335.59	689.10	706.60	1.59	ACCEPTABLE
439	343.12	658.25	675.40	1.61	ACCEPTABLE
440	341.21	641.75	661.27	1.51	ACCEPTABLE
441	348.91	608.74	628.19	1.51	ACCEPTABLE
442	346.44	596.20	615.42	1.51	ACCEPTABLE
443	334.62	662.91	680.69	1.57	ACCEPTABLE
444	341.33	639.19	656.36	1.60	ACCEPTABLE
445	347.63	586.24	605.98	1.49	ACCEPTABLE
446	350.90	591.09	610.18	1.53	ACCEPTABLE
447	345.38	604.43	621.97	1.58	ACCEPTABLE
448	339.23	657.59	675.18	1.58	ACCEPTABLE
449	346.55	628.25	645.50	1.60	ACCEPTABLE
450	344.50	613.23	632.86	1.50	ACCEPTABLE
451	351.98	581.84	601.42	1.51	ACCEPTABLE
452	349.53	569.63	588.98	1.51	ACCEPTABLE
453	338.18	632.59	650.47	1.56	ACCEPTABLE
454	344.72	609.92	627.20	1.59	ACCEPTABLE
455	350.08	565.02	584.62	1.50	ACCEPTABLE
456	351.44	586.52	605.85	1.52	ACCEPTABLE
457	347.63	586.24	605.98	1.49	ACCEPTABLE
458	349.80	589.59	608.88	1.52	ACCEPTABLE
459	346.15	598.17	616.44	1.56	ACCEPTABLE
460	342.20	632.39	650.69	1.55	ACCEPTABLE
461	346.97	613.63	631.71	1.56	ACCEPTABLE
462	345.56	604.11	623.78	1.50	ACCEPTABLE
463	350.54	583.30	602.93	1.50	ACCEPTABLE
464	348.90	575.16	594.63	1.51	ACCEPTABLE
465	341.43	616.43	634.92	1.54	ACCEPTABLE
466	345.73	601.69	619.79	1.56	ACCEPTABLE
467	349.27	572.02	591.67	1.50	ACCEPTABLE
468	350.16	586.47	605.93	1.51	ACCEPTABLE
469	347.63	586.24	605.98	1.49	ACCEPTABLE
470	349.07	588.52	607.96	1.51	ACCEPTABLE
471	346.66	594.11	612.87	1.53	ACCEPTABLE
472	344.08	616.41	635.19	1.54	ACCEPTABLE
473	347.21	604.23	622.87	1.54	ACCEPTABLE
474	346.26	598.10	617.79	1.50	ACCEPTABLE
475	349.57	584.28	603.95	1.50	ACCEPTABLE
476	348.47	578.85	598.41	1.51	ACCEPTABLE
477	343.55	606.07	624.97	1.52	ACCEPTABLE

No.	Center		Radius	FS	Verification
	x [ft]	z [ft]	R [ft]		
478	346.38	596.40	615.04	1.54	ACCEPTABLE
479	348.73	576.73	596.40	1.50	ACCEPTABLE
480	349.32	586.41	605.96	1.51	ACCEPTABLE
481	347.63	586.24	605.98	1.49	ACCEPTABLE
482	348.58	587.78	607.32	1.51	ACCEPTABLE
483	346.99	591.45	610.53	1.52	ACCEPTABLE
484	345.29	606.10	625.19	1.52	ACCEPTABLE
485	347.36	598.12	617.12	1.53	ACCEPTABLE
486	346.72	594.13	613.83	1.50	ACCEPTABLE
487	348.92	584.93	604.62	1.50	ACCEPTABLE
488	348.19	581.31	600.93	1.50	ACCEPTABLE
489	344.93	599.33	618.51	1.51	ACCEPTABLE
490	346.81	592.95	611.96	1.52	ACCEPTABLE
491	348.53	578.45	598.22	1.50	ACCEPTABLE
492	348.36	579.88	599.58	1.50	ACCEPTABLE
493	348.75	586.36	605.98	1.51	ACCEPTABLE
494	272.96	229.01	248.70	1.34	ACCEPTABLE

Name : Model 4 Dynamic Circular | **Stage - analysis : 1 - 1**



Name : Model 3 Dyn 0.175	Stage - analysis : 1 - 1



Slope stability analysis

Input data

Project

Task : Confirmatory Model for Final Closure of the Ash Basin
Description : Slope Stability Analysis of Grand Tower CCR Impoundment Final Closure Plan
Author : ERM - Annapolis
Date : 6/22/2020
Project number : 0533442

Settings

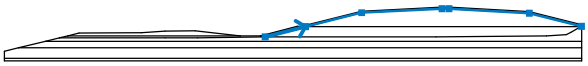
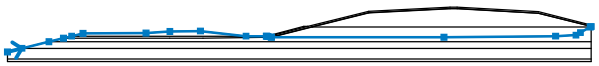
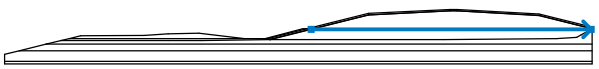
(input for current task)

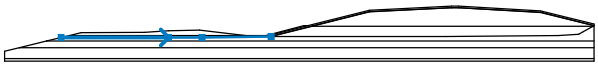
Stability analysis

Earthquake analysis : Standard
Verification methodology : Safety factors (ASD)

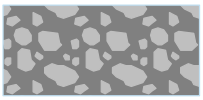
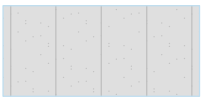
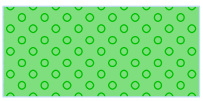
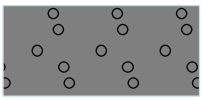
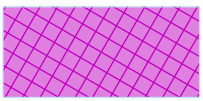
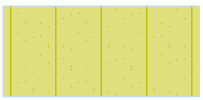
Safety factors			
Permanent design situation			
Safety factor :	SF_s =	1.50	[–]

Interface

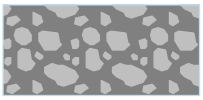
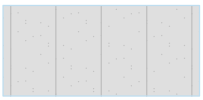
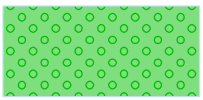
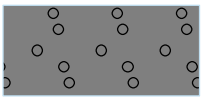
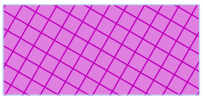
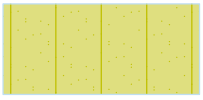
No.	Interface location	Coordinates of interface points [ft]					
		x	z	x	z	x	z
1		193.34	-9.67	194.41	-9.40	200.00	-8.00
		272.00	10.00	392.00	40.00	552.00	48.00
		566.00	48.00	726.00	39.00	830.00	13.00
2		199.27	-10.85	200.00	-10.67	279.99	9.33
		392.00	37.33	552.00	45.33	566.00	45.33
		726.00	36.33	830.00	10.33		
3		200.00	-11.00	279.99	9.00	392.00	37.00
		552.00	45.00	566.00	45.00	726.00	36.00
		830.00	10.00				
4		190.00	-9.00	263.58	10.00	272.00	10.00
5		-320.00	-40.00	-291.43	-33.00	-238.36	-20.00
		-209.79	-13.00	-193.45	-9.00	-171.00	-3.50
		-47.00	-3.00	0.00	0.00	60.00	1.10
		150.00	-9.00	190.00	-9.00	190.64	-9.12
		193.34	-9.67	199.27	-10.85	200.00	-11.00
		540.00	-11.00	760.00	-9.00	800.00	-7.00
		808.86	-1.98	828.24	9.00	830.00	10.00
6		279.99	9.00	828.24	9.00		
7		-193.45	-9.00	150.00	-9.00		

No.	Interface location	Coordinates of interface points [ft]					
		x	z	x	z	x	z
8		-209.79	-13.00	0.00	-13.00	65.00	-13.00
		200.00	-11.00				
9		-238.36	-20.00	830.00	-20.00		
10		-291.43	-33.00	830.00	-33.00		
11		-320.00	-54.00	830.00	-54.00		

Soil parameters - effective stress state

No.	Name	Pattern	φ_{ef} [°]	c_{ef} [psf]	γ [pcf]
1	Ash - Geotech Lab 6/2020		30.00	100.0	75.0
2	Silty Clay (Compacted Levee Cap)		10.00	450.0	133.0
3	Silty Sand (layer in berm, not basin)		28.00	100.0	115.0
4	Silty Clay, impervious fdtn (Updated with 2007 Hanson Report and ERM)		10.00	500.0	130.0
5	Sand & Gravel (Underlying Aquifer)		34.00	0.0	130.0
6	Gravel with trace of fines (G-F), medium dense- RipRap		40.00	0.0	165.0
7	Critical Interface		25.00	50.0	110.0
8	Sandy Silt (Native Pervious Material)		24.00	150.0	115.0

Soil parameters - uplift

No.	Name	Pattern	γ_{sat} [pcf]	γ_s [pcf]	n [–]
1	Ash - Geotech Lab 6/2020		100.0		
2	Silty Clay (Compacted Levee Cap)		153.0		
3	Silty Sand (layer in berm, not basin)		136.0		
4	Silty Clay, impervious fdtn (Updated with 2007 Hanson Report and ERM)		150.0		
5	Sand & Gravel (Underlying Aquifer)		130.0		
6	Gravel with trace of fines (G-F), medium dense- RipRap		165.0		
7	Critical Interface		110.0		
8	Sandy Silt (Native Pervious Material)		135.0		

Soil parameters

Ash - Geotech Lab 6/2020

Unit weight : γ = 75.0 pcf
Stress-state : effective
Angle of internal friction : φ_{ef} = 30.00 °
Cohesion of soil : c_{ef} = 100.0 psf
Saturated unit weight : γ_{sat} = 100.0 pcf

Silty Clay (Compacted Levee Cap)

Unit weight : γ = 133.0 pcf
Stress-state : effective
Angle of internal friction : φ_{ef} = 10.00 °
Cohesion of soil : c_{ef} = 450.0 psf
Saturated unit weight : γ_{sat} = 153.0 pcf

Silty Sand (layer in berm, not basin)

Unit weight : γ = 115.0 pcf
Stress-state : effective

Angle of internal friction : φ_{ef} = 28.00 °
Cohesion of soil : c_{ef} = 100.0 psf
Saturated unit weight : γ_{sat} = 136.0 pcf

Silty Clay, impervious fdtn (Updated with 2007 Hanson Report and ERM)
Unit weight : γ = 130.0 pcf
Stress-state : effective
Angle of internal friction : φ_{ef} = 10.00 °
Cohesion of soil : c_{ef} = 500.0 psf
Saturated unit weight : γ_{sat} = 150.0 pcf

Sand & Gravel (Underlying Aquifer)
Unit weight : γ = 130.0 pcf
Stress-state : effective
Angle of internal friction : φ_{ef} = 34.00 °
Cohesion of soil : c_{ef} = 0.0 psf
Saturated unit weight : γ_{sat} = 130.0 pcf

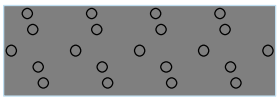
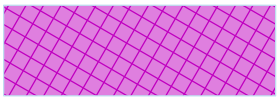
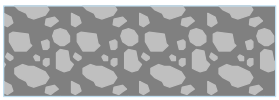
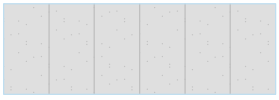
Gravel with trace of fines (G-F), medium dense- RipRap
Unit weight : γ = 165.0 pcf
Stress-state : effective
Angle of internal friction : φ_{ef} = 40.00 °
Cohesion of soil : c_{ef} = 0.0 psf
Saturated unit weight : γ_{sat} = 165.0 pcf

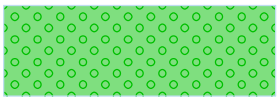
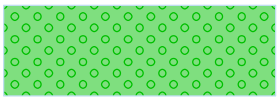
Critical Interface
Unit weight : γ = 110.0 pcf
Stress-state : effective
Angle of internal friction : φ_{ef} = 25.00 °
Cohesion of soil : c_{ef} = 50.0 psf
Saturated unit weight : γ_{sat} = 110.0 pcf

Sandy Silt (Native Pervious Material)
Unit weight : γ = 115.0 pcf
Stress-state : effective
Angle of internal friction : φ_{ef} = 24.00 °
Cohesion of soil : c_{ef} = 150.0 psf
Saturated unit weight : γ_{sat} = 135.0 pcf

Assigning and surfaces

No.	Surface position	Coordinates of surface points [ft]				Assigned soil
		x	z	x	z	
1		828.24	9.00	830.00	10.00	Ash - Geotech Lab 6/2020
		726.00	36.00	566.00	45.00	
		552.00	45.00	392.00	37.00	
		279.99	9.00			

No.	Surface position	Coordinates of surface points [ft]				Assigned soil
		x	z	x	z	
2		150.00	-9.00	60.00	1.10	Silty Clay (Compacted Levee Cap)
		0.00	0.00	-47.00	-3.00	
		-171.00	-3.50	-193.45	-9.00	
3		190.64	-9.12	193.34	-9.67	Gravel with trace of fines (G-F), medium dense-RipRap
		194.41	-9.40	200.00	-8.00	
		272.00	10.00	263.58	10.00	
		190.00	-9.00			
4		199.27	-10.85	200.00	-10.67	Silty Clay (Compacted Levee Cap)
		279.99	9.33	392.00	37.33	
		552.00	45.33	566.00	45.33	
		726.00	36.33	830.00	10.33	
		830.00	13.00	726.00	39.00	
		566.00	48.00	552.00	48.00	
		392.00	40.00	272.00	10.00	
		200.00	-8.00	194.41	-9.40	
		193.34	-9.67			
5		200.00	-11.00	279.99	9.00	Critical Interface
		392.00	37.00	552.00	45.00	
		566.00	45.00	726.00	36.00	
		830.00	10.00	830.00	10.33	
		726.00	36.33	566.00	45.33	
		552.00	45.33	392.00	37.33	
		279.99	9.33	200.00	-10.67	
		199.27	-10.85			
6		279.99	9.00	200.00	-11.00	Ash - Geotech Lab 6/2020
		540.00	-11.00	760.00	-9.00	
		800.00	-7.00	808.86	-1.98	
		828.24	9.00			
7		0.00	-13.00	65.00	-13.00	Silty Sand (layer in berm, not basin)
		200.00	-11.00	199.27	-10.85	
		193.34	-9.67	190.64	-9.12	
		190.00	-9.00	150.00	-9.00	
		-193.45	-9.00	-209.79	-13.00	
8		830.00	-20.00	830.00	10.00	Silty Clay, impervious fdtn (Updated with 2007 Hanson Report and ERM)
		828.24	9.00	808.86	-1.98	
		800.00	-7.00	760.00	-9.00	
		540.00	-11.00	200.00	-11.00	
		65.00	-13.00	0.00	-13.00	
		-209.79	-13.00	-238.36	-20.00	

No.	Surface position	Coordinates of surface points [ft]				Assigned soil
		x	z	x	z	
9		830.00	-33.00	830.00	-20.00	Sandy Silt (Native Pervious Material)
		-238.36	-20.00	-291.43	-33.00	
10		830.00	-54.00	830.00	-33.00	Sand & Gravel (Underlying Aquifer)
		-291.43	-33.00	-320.00	-40.00	
		-320.00	-54.00			
11		-320.00	-54.00	-320.00	-59.00	Sand & Gravel (Underlying Aquifer)
		830.00	-59.00	830.00	-54.00	
						

Water

Water type : GWT

No.	GWT location	Coordinates of GWT points [ft]					
		x	z	x	z	x	z
1		-320.00	-3.50	-171.00	-3.50	0.00	-13.00
		83.00	-13.00	830.00	-13.00		

Tensile crack

Tensile crack not input.

Earthquake

Earthquake not included.

Settings of the stage of construction

Design situation : permanent

Results (Stage of construction 1)

Analysis 1 (stage 1)

Circular slip surface

Slip surface parameters							
Center :	x =	219.05	[ft]	Angles :	α_1 =	-5.81	[°]
	z =	350.89	[ft]		α_2 =	30.95	[°]
Radius :	R =	361.75	[ft]				
The slip surface after optimization.							

Segments restricting slip surface

No.	First point		Second point	
	x [ft]	z [ft]	x [ft]	z [ft]
1	199.34	-10.98	761.49	-9.16

The restrictions of points of circular slip surface

Slope stability verification (Bishop)

Sum of active forces : F_a = 55978.9 lbf/ft
Sum of passive forces : F_p = 174307.1 lbf/ft

Sliding moment : M_a = 20250353.3 lbfft/ft
Resisting moment : M_p = 63055597.2 lbfft/ft

Factor of safety = 3.11 > 1.50

Slope stability ACCEPTABLE

Optimization of circular slip surface (Bishop)

No.	Center		Radius	FS	Verification
	x [ft]	z [ft]	R [ft]		
1	219.05	350.89	361.75	3.11	ACCEPTABLE
2	219.05	350.89	361.75	3.11	ACCEPTABLE
3	219.05	350.89	361.75	3.11	ACCEPTABLE
4	10.56	4119.73	4123.13	6.40	ACCEPTABLE
5	516.36	168.74	171.95	34.70	ACCEPTABLE
6	123.65	2482.79	2491.66	5.44	ACCEPTABLE
7	219.05	350.89	361.75	3.11	ACCEPTABLE
8	140.82	1728.83	1731.89	4.66	ACCEPTABLE
9	433.37	173.42	177.00	9.05	ACCEPTABLE
10	114.34	909.06	912.50	10.84	ACCEPTABLE
11	179.22	1300.91	1309.00	4.29	ACCEPTABLE
12	219.05	350.89	361.75	3.11	ACCEPTABLE
13	157.36	1262.80	1266.33	4.14	ACCEPTABLE
14	369.70	207.99	212.67	5.00	ACCEPTABLE
15	103.78	775.36	783.37	347.92	ACCEPTABLE
16	145.36	552.89	557.87	12.27	ACCEPTABLE
17	195.16	919.07	927.39	3.84	ACCEPTABLE
18	219.05	350.89	361.75	3.11	ACCEPTABLE
19	151.50	1060.10	1065.75	3.78	ACCEPTABLE
20	326.48	235.59	241.25	3.98	ACCEPTABLE
21	161.85	465.47	472.86	4.27	ACCEPTABLE
22	284.51	57.18	60.95	4.47	ACCEPTABLE
23	196.08	734.01	743.51	3.55	ACCEPTABLE
24	325.60	240.86	245.99	3.97	ACCEPTABLE
25	219.05	350.89	361.75	3.11	ACCEPTABLE
26	290.26	280.00	286.15	3.55	ACCEPTABLE
27	157.77	862.30	870.09	3.51	ACCEPTABLE
28	292.68	267.25	274.27	3.56	ACCEPTABLE
29	264.40	140.63	144.58	3.57	ACCEPTABLE
30	175.43	423.71	432.96	3.64	ACCEPTABLE
31	268.08	125.02	130.63	3.62	ACCEPTABLE
32	197.66	614.52	625.02	3.38	ACCEPTABLE
33	280.15	333.39	336.73	3.52	ACCEPTABLE
34	219.05	350.89	361.75	3.11	ACCEPTABLE
35	237.33	445.51	449.33	3.35	ACCEPTABLE
36	170.13	700.84	710.07	4.58	ACCEPTABLE

No.	Center		Radius	FS	Verification
	x [ft]	z [ft]	R [ft]		
37	268.11	294.24	302.51	3.34	ACCEPTABLE
38	237.66	250.43	254.80	3.37	ACCEPTABLE
39	186.29	397.95	408.38	3.43	ACCEPTABLE
40	253.01	186.35	193.74	3.36	ACCEPTABLE
41	252.82	369.39	374.69	3.33	ACCEPTABLE
42	219.05	350.89	361.75	3.11	ACCEPTABLE
43	220.64	456.10	462.20	3.25	ACCEPTABLE
44	187.22	569.44	578.98	3.29	ACCEPTABLE
45	250.52	315.77	325.07	3.23	ACCEPTABLE
46	226.79	293.90	300.63	3.27	ACCEPTABLE
47	197.74	372.21	382.86	3.28	ACCEPTABLE
48	241.12	234.46	243.28	3.24	ACCEPTABLE
49	236.83	380.08	387.35	3.23	ACCEPTABLE
50	219.05	350.89	361.75	3.11	ACCEPTABLE
51	214.84	438.29	446.18	3.20	ACCEPTABLE
52	161.43	562.84	571.36	3.48	ACCEPTABLE
53	11.60	1415.48	1433.15	3.79	ACCEPTABLE
54	90.01	1007.76	1020.75	10.62	ACCEPTABLE
55	198.17	490.20	500.06	3.22	ACCEPTABLE
56	238.12	332.08	342.19	3.18	ACCEPTABLE
57	221.27	315.65	324.14	3.21	ACCEPTABLE
58	105.31	812.21	823.67	4.03	ACCEPTABLE
59	83.78	883.59	898.10	4.00	ACCEPTABLE
60	205.27	357.10	367.89	3.21	ACCEPTABLE
61	232.38	269.77	279.65	3.19	ACCEPTABLE
62	227.33	381.30	390.06	3.18	ACCEPTABLE
63	219.05	350.89	361.75	3.11	ACCEPTABLE
64	212.68	419.33	428.50	3.16	ACCEPTABLE
65	185.55	469.35	478.02	3.24	ACCEPTABLE
66	139.89	755.02	764.76	3.35	ACCEPTABLE
67	163.08	641.32	650.58	3.26	ACCEPTABLE
68	205.28	440.97	451.10	3.17	ACCEPTABLE
69	229.51	343.97	354.67	3.15	ACCEPTABLE
70	217.75	334.38	344.03	3.14	ACCEPTABLE
71	163.46	564.73	573.82	3.32	ACCEPTABLE
72	209.89	354.62	365.44	3.13	ACCEPTABLE
73	225.87	300.35	310.91	3.14	ACCEPTABLE
74	221.55	379.61	389.43	3.15	ACCEPTABLE
75	219.05	350.89	361.75	3.11	ACCEPTABLE
76	213.91	398.59	408.38	3.14	ACCEPTABLE
77	198.57	422.14	431.26	3.17	ACCEPTABLE
78	177.90	560.22	569.22	3.22	ACCEPTABLE
79	189.39	507.91	516.91	3.19	ACCEPTABLE
80	209.94	409.72	420.06	3.15	ACCEPTABLE
81	225.16	348.46	359.34	3.13	ACCEPTABLE
82	217.28	342.25	352.43	3.13	ACCEPTABLE
83	187.03	470.28	479.39	3.22	ACCEPTABLE
84	187.80	468.11	477.11	3.20	ACCEPTABLE
85	212.94	353.36	364.20	3.12	ACCEPTABLE

No.	Center		Radius	FS	Verification
	x [ft]	z [ft]	R [ft]		
86	222.77	318.81	329.61	3.13	ACCEPTABLE
87	215.34	384.35	395.26	3.13	ACCEPTABLE
88	219.73	372.63	382.92	3.14	ACCEPTABLE
89	219.05	350.89	361.75	3.11	ACCEPTABLE
90	215.80	381.98	392.08	3.14	ACCEPTABLE
91	206.58	394.26	403.77	3.15	ACCEPTABLE
92	195.10	472.38	481.67	3.20	ACCEPTABLE
93	202.30	442.28	451.56	3.16	ACCEPTABLE
94	213.00	389.57	400.07	3.15	ACCEPTABLE
95	223.12	349.26	360.14	3.13	ACCEPTABLE
96	217.92	345.01	355.41	3.13	ACCEPTABLE
97	199.37	422.82	432.33	3.18	ACCEPTABLE
98	201.05	418.26	427.51	3.16	ACCEPTABLE
99	214.98	352.54	363.38	3.13	ACCEPTABLE
100	221.53	329.35	340.17	3.13	ACCEPTABLE
101	216.57	373.04	383.94	3.13	ACCEPTABLE
102	219.54	365.25	375.72	3.13	ACCEPTABLE
103	219.05	350.89	361.75	3.11	ACCEPTABLE
104	216.95	371.33	381.66	3.14	ACCEPTABLE
105	211.18	378.24	388.12	3.14	ACCEPTABLE
106	204.33	425.45	435.14	3.17	ACCEPTABLE
107	208.96	407.09	416.77	3.15	ACCEPTABLE
108	215.03	376.44	387.05	3.13	ACCEPTABLE
109	221.76	349.80	360.67	3.13	ACCEPTABLE
110	218.32	346.92	357.47	3.13	ACCEPTABLE
111	206.55	395.99	405.87	3.16	ACCEPTABLE
112	208.04	392.02	401.68	3.15	ACCEPTABLE
113	216.34	351.98	362.83	3.13	ACCEPTABLE
114	220.70	336.46	347.29	3.13	ACCEPTABLE
115	217.40	365.59	376.48	3.13	ACCEPTABLE
116	219.39	360.41	371.00	3.13	ACCEPTABLE
117	219.05	350.89	361.75	3.11	ACCEPTABLE
118	217.68	364.40	374.89	3.14	ACCEPTABLE
119	213.99	368.49	378.66	3.14	ACCEPTABLE
120	209.72	398.10	408.13	3.15	ACCEPTABLE
121	212.74	386.52	396.55	3.13	ACCEPTABLE
122	216.38	367.82	378.51	3.13	ACCEPTABLE
123	220.86	350.16	361.03	3.13	ACCEPTABLE
124	218.57	348.22	358.87	3.12	ACCEPTABLE
125	210.96	379.81	390.00	3.15	ACCEPTABLE
126	212.10	376.85	386.86	3.13	ACCEPTABLE
127	217.24	351.62	362.47	3.12	ACCEPTABLE
128	220.15	341.24	352.08	3.12	ACCEPTABLE
129	217.95	360.66	371.54	3.12	ACCEPTABLE
130	219.29	357.21	367.89	3.13	ACCEPTABLE
131	219.05	350.89	361.75	3.11	ACCEPTABLE
132	218.15	359.84	370.46	3.13	ACCEPTABLE
133	215.75	362.36	372.75	3.13	ACCEPTABLE
134	213.03	381.34	391.63	3.14	ACCEPTABLE

No.	Center		Radius	FS	Verification
	x [ft]	z [ft]	R [ft]		
135	215.01	373.89	384.18	3.13	ACCEPTABLE
136	217.27	362.13	372.87	3.13	ACCEPTABLE
137	220.26	350.41	361.27	3.12	ACCEPTABLE
138	218.74	349.10	359.82	3.12	ACCEPTABLE
139	213.76	369.70	380.09	3.13	ACCEPTABLE
140	214.57	367.61	377.88	3.13	ACCEPTABLE
141	217.84	351.38	362.23	3.11	ACCEPTABLE
142	219.78	344.44	355.29	3.12	ACCEPTABLE
143	218.32	357.39	368.26	3.12	ACCEPTABLE
144	219.21	355.09	365.83	3.12	ACCEPTABLE
145	219.05	350.89	361.75	3.11	ACCEPTABLE
146	218.46	356.84	367.53	3.13	ACCEPTABLE
147	216.88	358.42	368.96	3.13	ACCEPTABLE
148	215.12	370.76	381.23	3.13	ACCEPTABLE
149	216.43	365.91	376.38	3.13	ACCEPTABLE
150	217.86	358.36	369.14	3.13	ACCEPTABLE
151	219.85	350.57	361.43	3.12	ACCEPTABLE
152	218.84	349.69	360.46	3.12	ACCEPTABLE
153	215.57	363.23	373.77	3.13	ACCEPTABLE
154	216.13	361.79	372.25	3.13	ACCEPTABLE
155	218.25	351.21	362.07	3.12	ACCEPTABLE
156	219.54	346.59	357.44	3.12	ACCEPTABLE
157	218.56	355.22	366.09	3.12	ACCEPTABLE
158	219.16	353.69	364.47	3.13	ACCEPTABLE
159	10.56	4119.73	4123.13	6.40	ACCEPTABLE
160	413.10	285.96	497.67	16.81	ACCEPTABLE
161	10.56	4119.73	4123.13	6.40	ACCEPTABLE
162	-485.81	6703.76	6729.19	7.57	ACCEPTABLE
163	433.13	76.75	58.27	19.12	ACCEPTABLE
164	10.56	4119.73	4123.13	6.40	ACCEPTABLE
165	498.88	1581.66	1563.61	30.79	ACCEPTABLE
166	199.12	1007.18	1016.44	4.02	ACCEPTABLE
167	108.15	3117.88	3118.54	6.26	ACCEPTABLE
168	399.52	651.87	651.70	7.37	ACCEPTABLE
169	147.22	904.36	907.79	3.67	ACCEPTABLE
170	-275.27	6237.86	6243.32	8.03	ACCEPTABLE
171	401.08	285.67	272.53	6.82	ACCEPTABLE
172	246.52	349.90	335.94	3891.57	ACCEPTABLE
173	-136.44	3619.88	3634.96	5.09	ACCEPTABLE
174	147.22	904.36	907.79	3.67	ACCEPTABLE
175	263.46	930.71	916.08	5.10	ACCEPTABLE
176	186.75	904.86	914.37	3.79	ACCEPTABLE
177	345.44	371.52	360.38	4.78	ACCEPTABLE
178	272.76	242.49	228.25	6.58	ACCEPTABLE
179	310.83	90.22	77.39	3.69	ACCEPTABLE
180	-347.43	4271.94	4310.46	4.50	ACCEPTABLE
181	316.87	566.40	551.87	4.89	ACCEPTABLE
182	147.22	904.36	907.79	3.67	ACCEPTABLE
183	160.26	951.10	960.28	5.06	ACCEPTABLE

No.	Center		Radius	FS	Verification
	x [ft]	z [ft]	R [ft]		
184	301.12	459.55	450.65	4.09	ACCEPTABLE
185	181.45	453.43	462.44	3.35	ACCEPTABLE
186	164.52	862.19	862.34	3.75	ACCEPTABLE
187	-20.38	1764.85	1780.97	4.23	ACCEPTABLE
188	282.79	273.11	274.39	3.38	ACCEPTABLE
189	208.30	357.37	355.64	5.46	ACCEPTABLE
190	91.72	839.10	849.20	11.84	ACCEPTABLE
191	260.26	133.40	132.90	3.86	ACCEPTABLE
192	150.31	796.47	804.92	3.40	ACCEPTABLE
193	257.28	400.17	397.97	3.43	ACCEPTABLE
194	181.45	453.43	462.44	3.35	ACCEPTABLE
195	133.40	871.03	876.49	3.63	ACCEPTABLE
196	57.62	1187.73	1201.10	3.74	ACCEPTABLE
197	255.04	310.29	313.31	3.25	ACCEPTABLE
198	296.34	305.92	302.67	3.57	ACCEPTABLE
199	101.04	1090.72	1103.26	8.04	ACCEPTABLE
200	307.69	244.43	244.45	3.59	ACCEPTABLE
201	283.90	167.58	164.25	3.34	ACCEPTABLE
202	181.46	453.40	462.42	3.35	ACCEPTABLE
203	302.39	88.93	97.08	3.73	ACCEPTABLE
204	290.95	137.56	136.88	3.36	ACCEPTABLE
205	192.38	638.63	647.56	3.35	ACCEPTABLE
206	298.66	293.35	290.62	3.56	ACCEPTABLE
207	255.04	310.29	313.31	3.25	ACCEPTABLE
208	273.68	353.21	350.67	3.45	ACCEPTABLE
209	181.14	681.83	688.42	3.38	ACCEPTABLE
210	241.95	386.83	395.34	3.28	ACCEPTABLE
211	291.36	262.75	263.57	3.44	ACCEPTABLE
212	271.99	219.34	217.51	3.27	ACCEPTABLE
213	211.09	380.68	387.15	3.23	ACCEPTABLE
214	207.67	528.67	529.94	3.39	ACCEPTABLE
215	121.65	842.26	853.27	3.39	ACCEPTABLE
216	210.73	424.54	434.61	3.17	ACCEPTABLE
217	200.18	589.55	595.86	3.34	ACCEPTABLE
218	242.53	384.16	392.74	3.29	ACCEPTABLE
219	214.91	364.73	371.32	3.21	ACCEPTABLE
220	189.80	436.04	446.03	3.28	ACCEPTABLE
221	234.19	283.88	292.15	3.18	ACCEPTABLE
222	197.28	558.09	568.31	3.30	ACCEPTABLE
223	224.42	471.97	478.89	3.29	ACCEPTABLE
224	210.73	424.54	434.61	3.17	ACCEPTABLE
225	197.09	555.38	563.44	3.27	ACCEPTABLE
226	114.98	800.98	812.85	3.43	ACCEPTABLE
227	-110.97	2123.88	2150.89	4.10	ACCEPTABLE
228	186.27	591.66	600.98	3.30	ACCEPTABLE
229	228.76	406.05	415.58	3.22	ACCEPTABLE
230	208.88	398.06	406.39	3.17	ACCEPTABLE
231	206.51	495.53	500.11	3.28	ACCEPTABLE
232	112.82	785.21	795.39	4.13	ACCEPTABLE

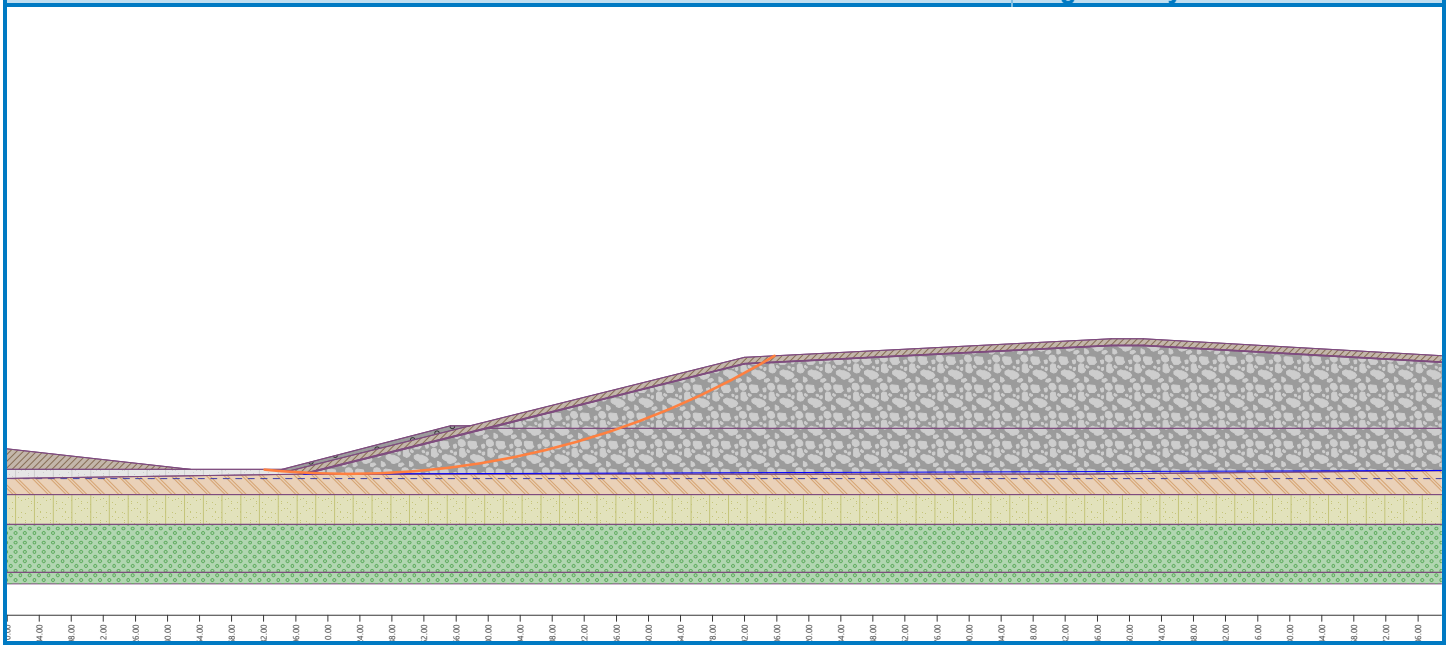
No.	Center		Radius	FS	Verification
	x [ft]	z [ft]	R [ft]		
233	-64.11	1727.91	1753.59	3.94	ACCEPTABLE
234	169.48	617.94	627.03	3.26	ACCEPTABLE
235	211.74	419.81	429.96	3.17	ACCEPTABLE
236	238.68	349.04	355.01	3.21	ACCEPTABLE
237	218.16	348.05	352.79	3.34	ACCEPTABLE
238	-121.40	1771.09	1805.46	10.00	ACCEPTABLE
239	188.45	430.33	439.40	3.32	ACCEPTABLE
240	245.35	235.21	242.81	3.25	ACCEPTABLE
241	207.61	347.39	357.44	3.23	ACCEPTABLE
242	233.17	285.76	291.50	3.26	ACCEPTABLE
243	193.45	505.56	514.73	3.21	ACCEPTABLE
244	224.59	413.17	418.11	3.22	ACCEPTABLE
245	208.88	398.06	406.39	3.17	ACCEPTABLE
246	206.36	465.95	471.70	3.23	ACCEPTABLE
247	168.89	553.48	560.23	3.51	ACCEPTABLE
248	128.17	814.90	824.00	3.46	ACCEPTABLE
249	209.59	415.81	425.53	3.16	ACCEPTABLE
250	201.32	499.75	507.82	3.22	ACCEPTABLE
251	164.02	590.78	599.54	3.29	ACCEPTABLE
252	90.20	1022.06	1034.61	3.51	ACCEPTABLE
253	128.87	831.27	841.79	3.37	ACCEPTABLE
254	192.10	528.59	537.83	3.23	ACCEPTABLE
255	213.27	426.07	436.67	3.17	ACCEPTABLE
256	223.39	398.74	407.83	3.18	ACCEPTABLE
257	209.64	395.03	403.36	3.16	ACCEPTABLE
258	207.37	461.71	467.44	3.23	ACCEPTABLE
259	170.53	546.90	553.54	3.50	ACCEPTABLE
260	32.38	1218.13	1236.56	17.36	ACCEPTABLE
261	130.87	803.15	812.04	3.45	ACCEPTABLE
262	182.46	538.66	547.66	3.21	ACCEPTABLE
263	210.15	413.28	423.04	3.15	ACCEPTABLE
264	202.08	496.15	504.24	3.22	ACCEPTABLE
265	165.33	585.08	593.79	3.28	ACCEPTABLE
266	93.02	1008.50	1020.86	3.50	ACCEPTABLE
267	130.98	821.51	831.91	3.37	ACCEPTABLE
268	192.85	524.97	534.24	3.23	ACCEPTABLE
269	213.74	423.78	434.44	3.17	ACCEPTABLE
270	223.85	396.55	405.69	3.18	ACCEPTABLE
271	210.22	392.47	400.84	3.16	ACCEPTABLE
272	132.97	728.34	738.58	3.40	ACCEPTABLE
273	128.79	741.89	752.73	8.19	ACCEPTABLE
274	200.80	418.40	428.13	3.18	ACCEPTABLE
275	229.61	309.25	319.29	3.14	ACCEPTABLE
276	233.45	345.22	352.27	3.18	ACCEPTABLE
277	211.26	377.42	383.22	3.29	ACCEPTABLE
278	145.71	704.99	715.06	6.03	ACCEPTABLE
279	195.35	515.25	521.02	3.27	ACCEPTABLE
280	211.77	405.89	415.77	3.15	ACCEPTABLE
281	246.22	288.24	297.14	3.19	ACCEPTABLE

No.	Center		Radius	FS	Verification
	x [ft]	z [ft]	R [ft]		
282	235.95	274.77	282.44	3.21	ACCEPTABLE
283	171.68	513.25	522.42	3.33	ACCEPTABLE
284	193.18	452.62	458.43	3.36	ACCEPTABLE
285	216.94	321.10	331.66	3.16	ACCEPTABLE
286	248.10	224.25	234.38	3.22	ACCEPTABLE
287	242.20	248.79	257.54	3.20	ACCEPTABLE
288	220.45	366.61	377.29	3.14	ACCEPTABLE
289	240.04	315.80	323.66	3.18	ACCEPTABLE
290	229.61	309.25	319.29	3.14	ACCEPTABLE
291	231.74	334.80	342.78	3.16	ACCEPTABLE
292	218.74	349.65	356.63	3.19	ACCEPTABLE
293	184.76	516.07	525.08	3.21	ACCEPTABLE
294	211.92	422.12	428.77	3.19	ACCEPTABLE
295	216.64	375.16	385.24	3.13	ACCEPTABLE
296	214.42	417.50	426.02	3.17	ACCEPTABLE
297	197.55	446.87	454.90	3.19	ACCEPTABLE
298	166.68	624.03	633.21	3.25	ACCEPTABLE
299	186.70	541.75	549.82	3.23	ACCEPTABLE
300	206.10	441.39	451.05	3.18	ACCEPTABLE
301	218.73	382.88	393.61	3.14	ACCEPTABLE
302	226.82	361.92	371.41	3.16	ACCEPTABLE
303	218.50	356.97	365.82	3.15	ACCEPTABLE
304	179.15	517.36	526.36	3.22	ACCEPTABLE
305	185.22	499.76	507.85	3.23	ACCEPTABLE
306	210.46	378.07	388.13	3.15	ACCEPTABLE
307	230.11	307.14	317.24	3.14	ACCEPTABLE
308	216.59	350.80	361.48	3.13	ACCEPTABLE
309	210.98	400.18	409.83	3.14	ACCEPTABLE
310	195.41	424.07	433.14	3.20	ACCEPTABLE
311	173.95	565.80	574.80	3.23	ACCEPTABLE
312	185.59	512.46	521.46	3.19	ACCEPTABLE
313	207.21	410.74	420.91	3.16	ACCEPTABLE
314	222.71	348.32	359.02	3.13	ACCEPTABLE
315	214.65	342.62	352.65	3.15	ACCEPTABLE
316	183.72	473.06	482.12	3.27	ACCEPTABLE
317	184.06	472.12	481.13	3.24	ACCEPTABLE
318	210.47	353.33	363.98	3.14	ACCEPTABLE
319	220.36	318.44	329.06	3.14	ACCEPTABLE
320	212.83	384.56	395.30	3.13	ACCEPTABLE
321	217.07	373.25	383.37	3.13	ACCEPTABLE
322	216.59	350.80	361.48	3.13	ACCEPTABLE
323	213.04	382.92	392.87	3.14	ACCEPTABLE
324	203.72	395.30	404.70	3.16	ACCEPTABLE
325	191.88	475.08	484.29	3.20	ACCEPTABLE
326	199.14	444.52	453.72	3.16	ACCEPTABLE
327	210.37	390.19	400.52	3.14	ACCEPTABLE
328	220.67	349.14	359.84	3.13	ACCEPTABLE
329	215.35	345.21	355.44	3.13	ACCEPTABLE
330	196.44	424.27	433.67	3.20	ACCEPTABLE

No.	Center		Radius	FS	Verification
	x [ft]	z [ft]	R [ft]		
331	197.93	420.22	429.39	3.17	ACCEPTABLE
332	212.51	352.48	363.14	3.14	ACCEPTABLE
333	219.10	329.07	339.71	3.13	ACCEPTABLE
334	214.08	373.15	383.87	3.13	ACCEPTABLE
335	216.95	365.62	375.92	3.13	ACCEPTABLE
336	216.59	350.80	361.48	3.13	ACCEPTABLE
337	214.31	371.89	382.06	3.14	ACCEPTABLE
338	208.48	378.82	388.57	3.15	ACCEPTABLE
339	201.43	426.91	436.48	3.18	ACCEPTABLE
340	206.10	408.31	417.87	3.15	ACCEPTABLE
341	212.46	376.81	387.25	3.14	ACCEPTABLE
342	219.31	349.69	360.38	3.13	ACCEPTABLE
343	215.79	347.02	357.40	3.14	ACCEPTABLE
344	203.81	396.80	406.55	3.16	ACCEPTABLE
345	205.21	393.09	402.62	3.16	ACCEPTABLE
346	213.87	351.92	362.59	3.13	ACCEPTABLE
347	218.26	336.24	346.90	3.13	ACCEPTABLE
348	214.92	365.63	376.34	3.13	ACCEPTABLE
349	216.85	360.62	371.04	3.13	ACCEPTABLE
350	216.59	350.80	361.48	3.13	ACCEPTABLE
351	215.10	364.73	375.06	3.13	ACCEPTABLE
352	211.38	368.82	378.84	3.14	ACCEPTABLE
353	206.99	398.93	408.82	3.16	ACCEPTABLE
354	210.04	387.21	397.10	3.14	ACCEPTABLE
355	213.84	368.03	378.54	3.14	ACCEPTABLE
356	217.08	353.43	364.32	3.12	ACCEPTABLE
357	215.73	366.93	377.45	3.13	ACCEPTABLE
358	212.01	371.21	381.41	3.14	ACCEPTABLE
359	207.76	400.87	410.93	3.15	ACCEPTABLE
360	210.77	389.26	399.31	3.15	ACCEPTABLE
361	214.42	370.38	381.10	3.13	ACCEPTABLE
362	218.89	352.70	363.60	3.12	ACCEPTABLE
363	216.61	350.73	361.41	3.12	ACCEPTABLE
364	208.99	382.57	392.77	3.15	ACCEPTABLE
365	210.13	379.57	389.60	3.15	ACCEPTABLE
366	215.27	354.16	365.05	3.13	ACCEPTABLE
367	218.18	343.75	354.62	3.12	ACCEPTABLE
368	216.82	357.10	367.61	3.13	ACCEPTABLE
369	213.20	360.85	371.04	3.14	ACCEPTABLE
370	208.94	390.16	400.21	3.16	ACCEPTABLE
371	211.96	378.70	388.74	3.14	ACCEPTABLE
372	215.51	360.50	371.20	3.13	ACCEPTABLE
373	219.99	343.04	353.92	3.12	ACCEPTABLE
374	217.71	341.09	351.75	3.12	ACCEPTABLE
375	210.18	372.06	382.25	3.15	ACCEPTABLE
376	211.31	369.12	379.13	3.15	ACCEPTABLE
377	216.37	344.46	355.33	3.13	ACCEPTABLE
378	219.28	334.19	345.04	3.12	ACCEPTABLE
379	217.08	353.43	364.32	3.12	ACCEPTABLE

No.	Center		Radius	FS	Verification
	x [ft]	z [ft]	R [ft]		
380	218.42	350.00	360.69	3.12	ACCEPTABLE
381	218.18	343.75	354.62	3.12	ACCEPTABLE
382	217.29	352.60	363.22	3.12	ACCEPTABLE
383	214.93	354.90	365.30	3.13	ACCEPTABLE
384	212.22	373.69	383.99	3.14	ACCEPTABLE
385	214.20	366.31	376.61	3.14	ACCEPTABLE
386	216.41	354.87	365.62	3.12	ACCEPTABLE
387	219.39	343.28	354.15	3.12	ACCEPTABLE
388	217.87	341.97	352.69	3.12	ACCEPTABLE
389	212.95	362.16	372.57	3.14	ACCEPTABLE
390	213.76	360.08	370.36	3.13	ACCEPTABLE
391	216.97	344.23	355.09	3.13	ACCEPTABLE
392	218.91	337.36	348.22	3.12	ACCEPTABLE
393	218.02	346.14	356.75	3.13	ACCEPTABLE
394	215.70	348.22	358.61	3.14	ACCEPTABLE
395	212.99	366.85	377.14	3.13	ACCEPTABLE
396	214.97	359.54	369.83	3.13	ACCEPTABLE
397	217.13	348.38	359.13	3.12	ACCEPTABLE
398	220.12	336.90	347.76	3.12	ACCEPTABLE
399	218.60	335.59	346.31	3.13	ACCEPTABLE
400	213.72	355.41	365.81	3.13	ACCEPTABLE
401	214.53	353.36	363.63	3.14	ACCEPTABLE
402	217.70	337.83	348.68	3.12	ACCEPTABLE
403	219.64	331.03	341.88	3.12	ACCEPTABLE
404	218.18	343.75	354.62	3.12	ACCEPTABLE
405	219.07	341.49	352.22	3.13	ACCEPTABLE
406	218.91	337.36	348.22	3.12	ACCEPTABLE
407	218.32	343.19	353.88	3.12	ACCEPTABLE
408	216.80	344.49	355.03	3.13	ACCEPTABLE
409	215.04	356.60	367.07	3.13	ACCEPTABLE
410	216.35	351.84	362.31	3.13	ACCEPTABLE
411	217.73	344.69	355.47	3.12	ACCEPTABLE
412	219.71	337.05	347.91	3.12	ACCEPTABLE
413	218.70	336.18	346.94	3.12	ACCEPTABLE
414	215.49	349.20	359.75	3.13	ACCEPTABLE
415	216.05	347.79	358.24	3.14	ACCEPTABLE
416	218.11	337.67	348.53	3.12	ACCEPTABLE
417	219.40	333.13	343.98	3.12	ACCEPTABLE
418	218.42	341.61	352.48	3.12	ACCEPTABLE
419	219.02	340.11	350.88	3.12	ACCEPTABLE
420	219.05	350.89	361.75	3.11	ACCEPTABLE

Name : Model 4 Static Circ	Stage - analysis : 1 - 1



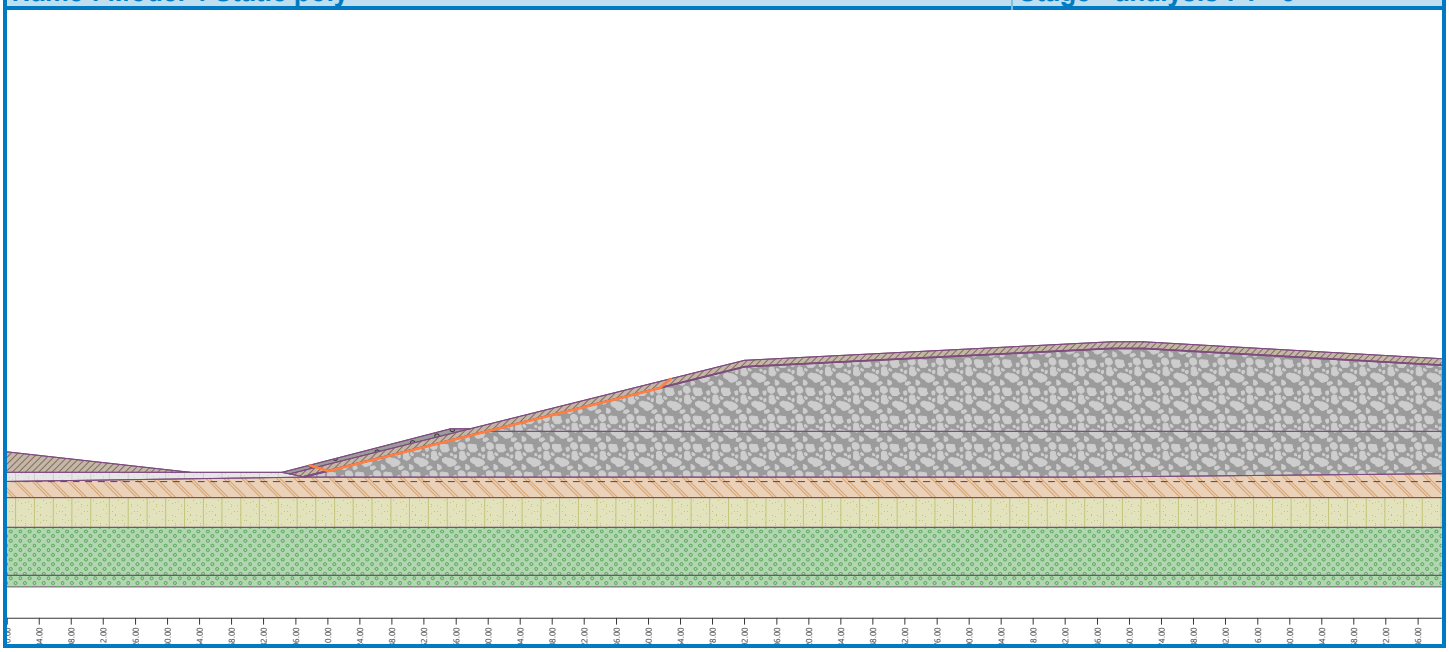
Analysis 3 (stage 1)

Polygonal slip surface

Coordinates of slip surface points [ft]									
x	z	x	z	x	z	x	z	x	z
202.13	-5.87	210.21	-8.33	354.87	27.83	359.61	31.90		
The slip surface after optimization.									

Slope stability verification (Janbu)
Factor of safety = 2.73 > 1.50
Slope stability ACCEPTABLE

Name : Model 4 Static poly	Stage - analysis : 1 - 3



Slope stability analysis

Input data

Project

Task : Confirmatory Model for Final Closure of the Ash Basin
Description : Slope Stability Analysis of Grand Tower CCR Impoundment Final Closure Plan
Author : ERM - Annapolis
Date : 6/22/2020
Project number : 0533442

Settings

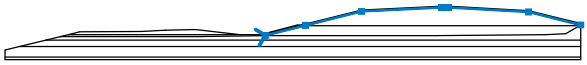
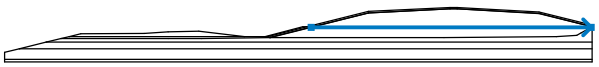
(input for current task)

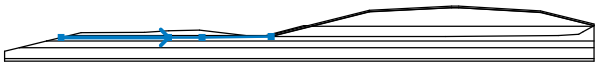
Stability analysis

Earthquake analysis : Standard
Verification methodology : Safety factors (ASD)

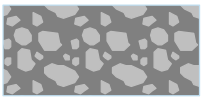
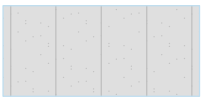
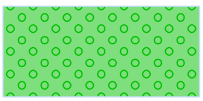
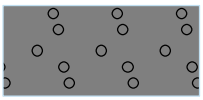
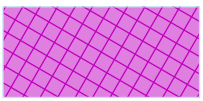
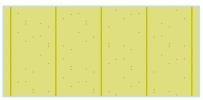
Safety factors			
Seismic design situation			
Safety factor :	SF_s =	1.00	[–]

Interface

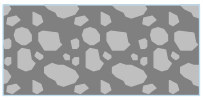
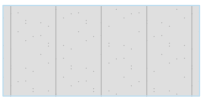
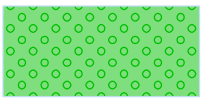
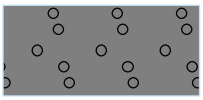
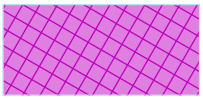
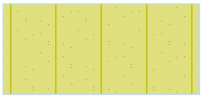
No.	Interface location	Coordinates of interface points [ft]					
		x	z	x	z	x	z
1		193.34	-9.67	194.41	-9.40	200.00	-8.00
		272.00	10.00	392.00	40.00	552.00	48.00
		566.00	48.00	726.00	39.00	830.00	13.00
2		199.27	-10.85	200.00	-10.67	279.99	9.33
		392.00	37.33	552.00	45.33	566.00	45.33
		726.00	36.33	830.00	10.33		
3		200.00	-11.00	279.99	9.00	392.00	37.00
		552.00	45.00	566.00	45.00	726.00	36.00
		830.00	10.00				
4		190.00	-9.00	263.58	10.00	272.00	10.00
5		-320.00	-40.00	-291.43	-33.00	-238.36	-20.00
		-209.79	-13.00	-193.45	-9.00	-171.00	-3.50
		-47.00	-3.00	0.00	0.00	60.00	1.10
		150.00	-9.00	190.00	-9.00	190.64	-9.12
		193.34	-9.67	199.27	-10.85	200.00	-11.00
		540.00	-11.00	760.00	-9.00	800.00	-7.00
		808.86	-1.98	828.24	9.00	830.00	10.00
6		279.99	9.00	828.24	9.00		
7		-193.45	-9.00	150.00	-9.00		

No.	Interface location	Coordinates of interface points [ft]					
		x	z	x	z	x	z
8		-209.79	-13.00	0.00	-13.00	65.00	-13.00
		200.00	-11.00				
9		-238.36	-20.00	830.00	-20.00		
10		-291.43	-33.00	830.00	-33.00		
11		-320.00	-54.00	830.00	-54.00		

Soil parameters - effective stress state

No.	Name	Pattern	φ_{ef} [°]	c_{ef} [psf]	γ [pcf]
1	Ash - Geotech Lab 6/2020		30.00	100.0	75.0
2	Silty Clay (Compacted Levee Cap)		10.00	450.0	133.0
3	Silty Sand (layer in berm, not basin)		28.00	100.0	115.0
4	Silty Clay, impervious fdtn (Updated with 2007 Hanson Report and ERM)		10.00	500.0	130.0
5	Sand & Gravel (Underlying Aquifer)		34.00	0.0	130.0
6	Gravel with trace of fines (G-F), medium dense- RipRap		40.00	0.0	165.0
7	Critical Interface		25.00	50.0	110.0
8	Sandy Silt (Native Pervious Material)		24.00	150.0	115.0

Soil parameters - uplift

No.	Name	Pattern	γ_{sat} [pcf]	γ_s [pcf]	n [–]
1	Ash - Geotech Lab 6/2020		100.0		
2	Silty Clay (Compacted Levee Cap)		153.0		
3	Silty Sand (layer in berm, not basin)		136.0		
4	Silty Clay, impervious fdtn (Updated with 2007 Hanson Report and ERM)		150.0		
5	Sand & Gravel (Underlying Aquifer)		130.0		
6	Gravel with trace of fines (G-F), medium dense- RipRap		165.0		
7	Critical Interface		110.0		
8	Sandy Silt (Native Pervious Material)		135.0		

Soil parameters

Ash - Geotech Lab 6/2020

Unit weight : γ = 75.0 pcf
Stress-state : effective
Angle of internal friction : φ_{ef} = 30.00 °
Cohesion of soil : c_{ef} = 100.0 psf
Saturated unit weight : γ_{sat} = 100.0 pcf

Silty Clay (Compacted Levee Cap)

Unit weight : γ = 133.0 pcf
Stress-state : effective
Angle of internal friction : φ_{ef} = 10.00 °
Cohesion of soil : c_{ef} = 450.0 psf
Saturated unit weight : γ_{sat} = 153.0 pcf

Silty Sand (layer in berm, not basin)

Unit weight : γ = 115.0 pcf
Stress-state : effective

Angle of internal friction : φ_{ef} = 28.00 °
Cohesion of soil : c_{ef} = 100.0 psf
Saturated unit weight : γ_{sat} = 136.0 pcf

Silty Clay, impervious fdtn (Updated with 2007 Hanson Report and ERM)
Unit weight : γ = 130.0 pcf
Stress-state : effective
Angle of internal friction : φ_{ef} = 10.00 °
Cohesion of soil : c_{ef} = 500.0 psf
Saturated unit weight : γ_{sat} = 150.0 pcf

Sand & Gravel (Underlying Aquifer)
Unit weight : γ = 130.0 pcf
Stress-state : effective
Angle of internal friction : φ_{ef} = 34.00 °
Cohesion of soil : c_{ef} = 0.0 psf
Saturated unit weight : γ_{sat} = 130.0 pcf

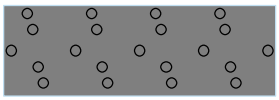
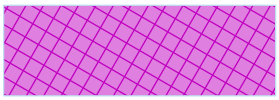
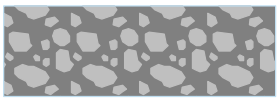
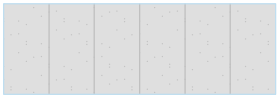
Gravel with trace of fines (G-F), medium dense- RipRap
Unit weight : γ = 165.0 pcf
Stress-state : effective
Angle of internal friction : φ_{ef} = 40.00 °
Cohesion of soil : c_{ef} = 0.0 psf
Saturated unit weight : γ_{sat} = 165.0 pcf

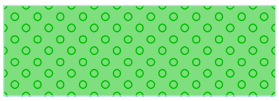
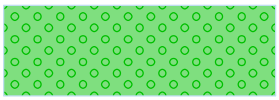
Critical Interface
Unit weight : γ = 110.0 pcf
Stress-state : effective
Angle of internal friction : φ_{ef} = 25.00 °
Cohesion of soil : c_{ef} = 50.0 psf
Saturated unit weight : γ_{sat} = 110.0 pcf

Sandy Silt (Native Pervious Material)
Unit weight : γ = 115.0 pcf
Stress-state : effective
Angle of internal friction : φ_{ef} = 24.00 °
Cohesion of soil : c_{ef} = 150.0 psf
Saturated unit weight : γ_{sat} = 135.0 pcf

Assigning and surfaces

No.	Surface position	Coordinates of surface points [ft]				Assigned soil
		x	z	x	z	
1		828.24	9.00	830.00	10.00	Ash - Geotech Lab 6/2020
		726.00	36.00	566.00	45.00	
		552.00	45.00	392.00	37.00	
		279.99	9.00			

No.	Surface position	Coordinates of surface points [ft]				Assigned soil
		x	z	x	z	
2		150.00	-9.00	60.00	1.10	Silty Clay (Compacted Levee Cap)
		0.00	0.00	-47.00	-3.00	
		-171.00	-3.50	-193.45	-9.00	
3		190.64	-9.12	193.34	-9.67	Gravel with trace of fines (G-F), medium dense-RipRap
		194.41	-9.40	200.00	-8.00	
		272.00	10.00	263.58	10.00	
		190.00	-9.00			
4		199.27	-10.85	200.00	-10.67	Silty Clay (Compacted Levee Cap)
		279.99	9.33	392.00	37.33	
		552.00	45.33	566.00	45.33	
		726.00	36.33	830.00	10.33	
		830.00	13.00	726.00	39.00	
		566.00	48.00	552.00	48.00	
		392.00	40.00	272.00	10.00	
		200.00	-8.00	194.41	-9.40	
		193.34	-9.67			
5		200.00	-11.00	279.99	9.00	Critical Interface
		392.00	37.00	552.00	45.00	
		566.00	45.00	726.00	36.00	
		830.00	10.00	830.00	10.33	
		726.00	36.33	566.00	45.33	
		552.00	45.33	392.00	37.33	
		279.99	9.33	200.00	-10.67	
		199.27	-10.85			
6		279.99	9.00	200.00	-11.00	Ash - Geotech Lab 6/2020
		540.00	-11.00	760.00	-9.00	
		800.00	-7.00	808.86	-1.98	
		828.24	9.00			
7		0.00	-13.00	65.00	-13.00	Silty Sand (layer in berm, not basin)
		200.00	-11.00	199.27	-10.85	
		193.34	-9.67	190.64	-9.12	
		190.00	-9.00	150.00	-9.00	
		-193.45	-9.00	-209.79	-13.00	
8		830.00	-20.00	830.00	10.00	Silty Clay, impervious fdtn (Updated with 2007 Hanson Report and ERM)
		828.24	9.00	808.86	-1.98	
		800.00	-7.00	760.00	-9.00	
		540.00	-11.00	200.00	-11.00	
		65.00	-13.00	0.00	-13.00	
		-209.79	-13.00	-238.36	-20.00	

No.	Surface position	Coordinates of surface points [ft]				Assigned soil
		x	z	x	z	
9		830.00	-33.00	830.00	-20.00	Sandy Silt (Native Pervious Material)
		-238.36	-20.00	-291.43	-33.00	
10		830.00	-54.00	830.00	-33.00	Sand & Gravel (Underlying Aquifer)
		-291.43	-33.00	-320.00	-40.00	
		-320.00	-54.00			
11		-320.00	-54.00	-320.00	-59.00	Sand & Gravel (Underlying Aquifer)
		830.00	-59.00	830.00	-54.00	
						

Water

Water type : GWT

No.	GWT location	Coordinates of GWT points [ft]					
		x	z	x	z	x	z
1		-320.00	-3.50	-171.00	-3.50	0.00	-13.00
		83.00	-13.00	830.00	-13.00		

Tensile crack

Tensile crack not input.

Earthquake

Horizontal seismic coefficient : K_h = 0.3500
Vertical seismic coefficient : K_v = 0.0000

Settings of the stage of construction

Design situation : seismic

Results (Stage of construction 1)

Analysis 1 (stage 1)

Circular slip surface

Slip surface parameters							
Center :	x =	213.26	[ft]	Angles :	α_1 =	-5.39	[°]
	z =	423.23	[ft]		α_2 =	28.42	[°]
Radius :	R =	434.15	[ft]				
The slip surface after optimization.							

Segments restricting slip surface

No.	First point		Second point	
	x [ft]	z [ft]	x [ft]	z [ft]
1	-247.18	-19.54	775.42	-19.95
2	199.16	-10.98	681.21	-9.75

The restrictions of points of circular slip surface

Slope stability verification (Bishop)

Sum of active forces : F_a = 159015.2 lbf/ft
Sum of passive forces : F_p = 182323.1 lbf/ft

Sliding moment : M_a = 69036436.0 lbfft/ft
Resisting moment : M_p = 79155566.6 lbfft/ft
Factor of safety = 1.15 > 1.00
Slope stability ACCEPTABLE

Optimization of circular slip surface (Bishop)

No.	Center		Radius	FS	Verification
	x [ft]	z [ft]	R [ft]		
1	213.26	423.23	434.15	1.15	ACCEPTABLE
2	213.26	423.23	434.15	1.15	ACCEPTABLE
3	213.26	423.23	434.15	1.15	ACCEPTABLE
4	0.48	4530.68	4534.09	1.43	ACCEPTABLE
5	524.24	190.15	193.09	2.10	ACCEPTABLE
6	118.59	2729.05	2737.74	1.35	ACCEPTABLE
7	213.26	423.23	434.15	1.15	ACCEPTABLE
8	132.69	1939.75	1942.70	1.32	ACCEPTABLE
9	431.56	217.24	220.88	1.65	ACCEPTABLE
10	106.32	946.30	949.94	6.47	ACCEPTABLE
11	174.90	1445.12	1453.12	1.26	ACCEPTABLE
12	213.26	423.23	434.15	1.15	ACCEPTABLE
13	162.77	1317.10	1320.40	1.28	ACCEPTABLE
14	364.62	260.78	265.85	1.38	ACCEPTABLE
15	145.46	569.91	574.90	4.16	ACCEPTABLE
16	195.92	995.51	1003.46	1.23	ACCEPTABLE
17	213.26	423.23	434.15	1.15	ACCEPTABLE
18	157.65	1111.78	1116.94	1.25	ACCEPTABLE
19	319.18	298.02	304.30	1.27	ACCEPTABLE
20	162.42	493.29	500.54	1.52	ACCEPTABLE
21	279.44	88.87	93.31	1.41	ACCEPTABLE
22	196.25	807.67	816.74	1.19	ACCEPTABLE
23	311.52	344.51	347.78	1.26	ACCEPTABLE
24	213.26	423.23	434.15	1.15	ACCEPTABLE
25	251.76	509.46	512.39	1.21	ACCEPTABLE
26	162.81	918.89	926.01	1.22	ACCEPTABLE
27	282.81	340.51	348.43	1.21	ACCEPTABLE
28	242.62	241.03	244.09	1.25	ACCEPTABLE
29	175.94	454.97	463.98	1.28	ACCEPTABLE
30	259.49	170.42	177.18	1.24	ACCEPTABLE
31	197.34	685.80	695.78	1.19	ACCEPTABLE
32	263.44	445.94	450.06	1.20	ACCEPTABLE
33	213.26	423.23	434.15	1.15	ACCEPTABLE
34	206.41	629.28	635.00	1.19	ACCEPTABLE
35	171.50	769.57	778.25	1.19	ACCEPTABLE

No.	Center		Radius	FS	Verification
	x [ft]	z [ft]	R [ft]		
36	256.00	376.97	386.37	1.18	ACCEPTABLE
37	219.38	334.95	341.07	1.21	ACCEPTABLE
38	185.62	433.59	443.85	1.25	ACCEPTABLE
39	242.15	240.60	249.45	1.19	ACCEPTABLE
40	198.53	606.47	617.17	1.17	ACCEPTABLE
41	234.89	484.35	491.12	1.18	ACCEPTABLE
42	213.26	423.23	434.15	1.15	ACCEPTABLE
43	194.42	611.73	620.05	1.17	ACCEPTABLE
44	181.56	658.29	667.93	1.45	ACCEPTABLE
45	236.55	406.22	416.86	1.16	ACCEPTABLE
46	208.96	386.82	395.47	1.17	ACCEPTABLE
47	192.58	433.58	444.41	1.19	ACCEPTABLE
48	228.25	304.79	315.12	1.16	ACCEPTABLE
49	218.35	494.99	503.97	1.16	ACCEPTABLE
50	213.26	423.23	434.15	1.15	ACCEPTABLE
51	199.44	550.30	559.46	1.16	ACCEPTABLE
52	127.05	765.86	777.09	1.67	ACCEPTABLE
53	-4.37	1630.80	1647.92	1.38	ACCEPTABLE
54	36.57	1339.32	1356.57	1.40	ACCEPTABLE
55	192.43	573.77	583.73	1.18	ACCEPTABLE
56	208.60	404.22	413.84	1.16	ACCEPTABLE
57	86.53	992.05	1003.67	1.38	ACCEPTABLE
58	199.48	430.07	440.93	1.17	ACCEPTABLE
59	221.65	346.36	357.15	1.15	ACCEPTABLE
60	214.41	477.77	487.60	1.15	ACCEPTABLE
61	213.26	423.23	434.15	1.15	ACCEPTABLE
62	205.10	503.19	512.73	1.16	ACCEPTABLE
63	171.61	588.26	597.35	1.19	ACCEPTABLE
64	128.86	889.56	899.22	1.24	ACCEPTABLE
65	148.43	778.93	788.62	1.21	ACCEPTABLE
66	199.50	520.89	531.12	1.17	ACCEPTABLE
67	210.46	409.74	419.75	1.16	ACCEPTABLE
68	151.92	686.12	695.21	1.23	ACCEPTABLE
69	146.27	704.66	714.53	1.22	ACCEPTABLE
70	204.07	427.76	438.64	1.16	ACCEPTABLE
71	218.85	371.22	382.06	1.15	ACCEPTABLE
72	214.21	458.85	469.00	1.16	ACCEPTABLE
73	213.26	423.23	434.15	1.15	ACCEPTABLE
74	208.20	474.82	484.73	1.16	ACCEPTABLE
75	189.72	516.35	525.47	1.18	ACCEPTABLE
76	169.19	666.01	675.02	1.19	ACCEPTABLE
77	180.69	609.09	618.09	1.18	ACCEPTABLE
78	204.15	487.15	497.58	1.16	ACCEPTABLE
79	211.51	413.94	424.23	1.16	ACCEPTABLE
80	178.17	569.27	578.39	1.20	ACCEPTABLE
81	179.02	566.65	575.65	1.18	ACCEPTABLE
82	207.14	426.24	437.13	1.16	ACCEPTABLE
83	216.98	388.22	399.09	1.15	ACCEPTABLE
84	213.97	446.68	457.07	1.15	ACCEPTABLE

No.	Center		Radius	FS	Verification
	x [ft]	z [ft]	R [ft]		
85	213.26	423.23	434.15	1.15	ACCEPTABLE
86	210.04	456.95	467.16	1.16	ACCEPTABLE
87	199.00	479.60	489.12	1.17	ACCEPTABLE
88	187.57	564.46	573.78	1.18	ACCEPTABLE
89	194.77	531.61	540.92	1.17	ACCEPTABLE
90	207.21	465.32	475.90	1.16	ACCEPTABLE
91	212.14	416.92	427.42	1.15	ACCEPTABLE
92	191.78	510.98	520.50	1.19	ACCEPTABLE
93	193.49	505.87	515.15	1.18	ACCEPTABLE
94	209.18	425.23	436.13	1.15	ACCEPTABLE
95	215.74	399.75	410.63	1.15	ACCEPTABLE
96	213.76	438.74	449.29	1.16	ACCEPTABLE
97	213.26	423.23	434.15	1.15	ACCEPTABLE
98	211.18	445.43	455.86	1.16	ACCEPTABLE
99	204.29	458.66	468.57	1.17	ACCEPTABLE
100	197.45	510.01	519.75	1.17	ACCEPTABLE
101	202.09	489.93	499.66	1.17	ACCEPTABLE
102	209.24	451.06	461.74	1.15	ACCEPTABLE
103	215.98	421.91	432.84	1.15	ACCEPTABLE
104	212.53	418.98	429.61	1.15	ACCEPTABLE
105	199.65	478.15	488.06	1.17	ACCEPTABLE
106	201.16	473.75	483.45	1.17	ACCEPTABLE
107	210.54	424.56	435.47	1.15	ACCEPTABLE
108	214.91	407.51	418.40	1.15	ACCEPTABLE
109	211.61	439.21	450.15	1.15	ACCEPTABLE
110	213.61	433.52	444.19	1.15	ACCEPTABLE
111	213.26	423.23	434.15	1.15	ACCEPTABLE
112	211.90	437.92	448.50	1.15	ACCEPTABLE
113	207.50	445.98	456.20	1.16	ACCEPTABLE
114	203.23	478.21	488.30	1.16	ACCEPTABLE
115	206.26	465.54	475.61	1.16	ACCEPTABLE
116	210.58	441.68	452.44	1.15	ACCEPTABLE
117	215.07	422.35	433.28	1.15	ACCEPTABLE
118	212.78	420.38	431.10	1.15	ACCEPTABLE
119	204.47	458.42	468.63	1.16	ACCEPTABLE
120	205.61	455.14	465.20	1.16	ACCEPTABLE
121	211.45	424.12	435.03	1.15	ACCEPTABLE
122	214.36	412.72	423.62	1.15	ACCEPTABLE
123	212.16	433.86	444.79	1.15	ACCEPTABLE
124	213.50	430.07	440.82	1.15	ACCEPTABLE
125	213.26	423.23	434.15	1.15	ACCEPTABLE
126	212.36	432.97	443.66	1.15	ACCEPTABLE
127	209.51	438.04	448.47	1.15	ACCEPTABLE
128	206.79	458.71	469.06	1.16	ACCEPTABLE
129	208.78	450.55	460.89	1.16	ACCEPTABLE
130	211.48	435.48	446.30	1.15	ACCEPTABLE
131	214.47	422.64	433.57	1.15	ACCEPTABLE
132	212.95	421.32	432.11	1.15	ACCEPTABLE
133	207.52	446.10	456.54	1.16	ACCEPTABLE

No.	Center		Radius	FS	Verification
	x [ft]	z [ft]	R [ft]		
134	208.33	443.79	454.11	1.16	ACCEPTABLE
135	212.05	423.82	434.73	1.15	ACCEPTABLE
136	214.00	416.21	427.12	1.15	ACCEPTABLE
137	212.53	430.30	441.23	1.15	ACCEPTABLE
138	213.42	427.78	438.58	1.15	ACCEPTABLE
139	213.26	423.23	434.15	1.15	ACCEPTABLE
140	212.67	429.70	440.47	1.15	ACCEPTABLE
141	210.80	432.95	443.54	1.15	ACCEPTABLE
142	209.03	446.39	456.92	1.15	ACCEPTABLE
143	210.35	441.07	451.60	1.15	ACCEPTABLE
144	212.07	431.38	442.23	1.15	ACCEPTABLE
145	214.07	422.84	433.76	1.15	ACCEPTABLE
146	213.05	421.95	432.78	1.15	ACCEPTABLE
147	209.48	438.22	448.82	1.15	ACCEPTABLE
148	210.04	436.63	447.15	1.15	ACCEPTABLE
149	212.45	423.62	434.54	1.15	ACCEPTABLE
150	213.75	418.54	429.46	1.15	ACCEPTABLE
151	212.77	427.94	438.87	1.15	ACCEPTABLE
152	213.37	426.26	437.10	1.15	ACCEPTABLE
153	0.48	4530.68	4534.09	1.43	ACCEPTABLE
154	-628.02	8457.72	8481.31	7.50	ACCEPTABLE
155	0.48	4530.68	4534.09	1.43	ACCEPTABLE
156	-362.75	5820.80	5839.13	1.88	ACCEPTABLE
157	439.61	91.28	73.16	2.24	ACCEPTABLE
158	0.48	4530.68	4534.09	1.43	ACCEPTABLE
159	515.87	1929.03	1911.07	1.77	ACCEPTABLE
160	-999.14	10135.42	10205.52	1.55	ACCEPTABLE
161	199.86	1080.86	1090.01	1.23	ACCEPTABLE
162	81.47	3655.63	3656.74	1.42	ACCEPTABLE
163	411.39	695.77	694.60	1.48	ACCEPTABLE
164	146.94	986.53	989.93	1.28	ACCEPTABLE
165	341.53	153.52	151.91	1.33	ACCEPTABLE
166	185.69	2317.92	2321.45	1.37	ACCEPTABLE
167	409.15	722.76	720.76	1.48	ACCEPTABLE
168	199.86	1080.86	1090.01	1.23	ACCEPTABLE
169	335.19	946.12	943.54	1.38	ACCEPTABLE
170	70.46	2964.77	2970.01	1.36	ACCEPTABLE
171	354.11	767.54	768.20	1.38	ACCEPTABLE
172	300.24	415.37	412.01	1.26	ACCEPTABLE
173	157.28	1053.06	1058.89	1.24	ACCEPTABLE
174	315.73	321.56	321.92	1.26	ACCEPTABLE
175	175.99	1908.50	1914.44	1.32	ACCEPTABLE
176	333.02	966.58	963.72	1.38	ACCEPTABLE
177	199.86	1080.86	1090.01	1.23	ACCEPTABLE
178	228.97	1466.38	1465.79	1.33	ACCEPTABLE
179	87.36	2365.18	2373.16	1.31	ACCEPTABLE
180	225.77	1194.34	1205.14	1.27	ACCEPTABLE
181	305.60	855.70	858.70	1.31	ACCEPTABLE
182	251.68	714.66	714.48	1.25	ACCEPTABLE

No.	Center		Radius	FS	Verification
	x [ft]	z [ft]	R [ft]		
183	162.27	1102.73	1110.51	1.23	ACCEPTABLE
184	185.06	1505.49	1502.10	1.35	ACCEPTABLE
185	-219.01	3985.41	4011.55	1.36	ACCEPTABLE
186	196.94	1083.55	1093.50	1.40	ACCEPTABLE
187	302.54	677.08	675.31	1.30	ACCEPTABLE
188	234.82	658.54	654.10	1.27	ACCEPTABLE
189	77.02	1344.40	1355.45	1.27	ACCEPTABLE
190	313.33	223.90	230.67	1.26	ACCEPTABLE
191	192.64	668.54	678.79	1.34	ACCEPTABLE
192	282.70	393.47	391.09	1.22	ACCEPTABLE
193	367.46	215.64	216.98	1.40	ACCEPTABLE
194	249.52	597.70	607.22	1.20	ACCEPTABLE
195	322.58	535.79	537.34	1.30	ACCEPTABLE
196	158.93	1348.47	1357.49	1.25	ACCEPTABLE
197	335.23	446.60	451.79	1.31	ACCEPTABLE
198	300.37	295.69	296.95	1.23	ACCEPTABLE
199	193.90	661.09	671.43	1.33	ACCEPTABLE
200	309.00	247.92	252.43	1.25	ACCEPTABLE
201	211.88	979.13	989.97	1.37	ACCEPTABLE
202	323.87	526.68	528.53	1.30	ACCEPTABLE
203	249.52	597.70	607.22	1.20	ACCEPTABLE
204	285.82	641.12	643.22	1.27	ACCEPTABLE
205	188.08	1072.81	1082.03	1.23	ACCEPTABLE
206	309.22	487.27	493.57	1.27	ACCEPTABLE
207	281.20	407.19	410.19	1.22	ACCEPTABLE
208	209.66	648.62	659.03	1.18	ACCEPTABLE
209	176.03	1023.01	1030.46	1.22	ACCEPTABLE
210	169.54	1052.62	1060.60	1.22	ACCEPTABLE
211	249.49	597.79	607.32	1.20	ACCEPTABLE
212	204.81	580.88	588.17	1.18	ACCEPTABLE
213	215.97	774.89	774.40	1.25	ACCEPTABLE
214	79.75	1396.97	1408.65	1.26	ACCEPTABLE
215	213.51	626.44	637.17	1.17	ACCEPTABLE
216	187.13	958.82	966.10	1.22	ACCEPTABLE
217	175.62	1010.55	1018.78	1.22	ACCEPTABLE
218	252.77	578.88	588.77	1.20	ACCEPTABLE
219	210.68	551.99	559.39	1.17	ACCEPTABLE
220	227.80	708.25	707.67	1.24	ACCEPTABLE
221	98.89	1286.58	1297.35	1.24	ACCEPTABLE
222	279.29	417.97	420.64	1.22	ACCEPTABLE
223	242.19	372.18	371.90	1.21	ACCEPTABLE
224	165.41	621.14	630.14	1.20	ACCEPTABLE
225	284.45	179.38	187.77	1.23	ACCEPTABLE
226	265.59	265.42	267.62	1.19	ACCEPTABLE
227	174.45	851.38	860.41	1.19	ACCEPTABLE
228	257.70	539.65	539.93	1.22	ACCEPTABLE
229	210.68	551.99	559.39	1.17	ACCEPTABLE
230	213.35	698.52	700.55	1.22	ACCEPTABLE
231	136.86	1007.67	1017.45	1.22	ACCEPTABLE

No.	Center		Radius	FS	Verification
	x [ft]	z [ft]	R [ft]		
232	213.27	592.68	602.79	1.17	ACCEPTABLE
233	258.72	454.51	458.43	1.20	ACCEPTABLE
234	229.95	439.23	441.44	1.19	ACCEPTABLE
235	176.62	609.90	618.90	1.18	ACCEPTABLE
236	266.82	265.99	272.60	1.18	ACCEPTABLE
237	208.73	454.18	464.29	1.16	ACCEPTABLE
238	189.61	655.59	662.87	1.18	ACCEPTABLE
239	171.53	722.88	732.03	1.51	ACCEPTABLE
240	237.14	421.60	430.74	1.16	ACCEPTABLE
241	207.71	407.98	415.36	1.18	ACCEPTABLE
242	187.78	466.45	476.48	1.20	ACCEPTABLE
243	229.12	316.21	325.06	1.16	ACCEPTABLE
244	195.31	591.19	601.45	1.18	ACCEPTABLE
245	217.17	519.91	527.55	1.17	ACCEPTABLE
246	208.73	454.18	464.29	1.16	ACCEPTABLE
247	187.70	614.04	623.02	1.17	ACCEPTABLE
248	91.94	922.40	936.54	1.68	ACCEPTABLE
249	-112.12	2200.55	2226.63	1.46	ACCEPTABLE
250	184.44	625.25	634.61	1.19	ACCEPTABLE
251	222.77	446.10	456.25	1.16	ACCEPTABLE
252	228.21	513.60	519.69	1.18	ACCEPTABLE
253	160.89	721.06	727.82	1.23	ACCEPTABLE
254	-74.55	2046.05	2070.34	1.34	ACCEPTABLE
255	88.53	1221.17	1232.05	1.27	ACCEPTABLE
256	198.61	613.90	623.29	1.18	ACCEPTABLE
257	250.69	399.73	407.97	1.18	ACCEPTABLE
258	234.11	381.45	388.16	1.17	ACCEPTABLE
259	65.49	1148.86	1163.18	1.31	ACCEPTABLE
260	81.50	1089.26	1101.55	1.31	ACCEPTABLE
261	208.73	454.16	464.27	1.16	ACCEPTABLE
262	254.64	286.21	296.16	1.17	ACCEPTABLE
263	244.91	331.35	339.39	1.17	ACCEPTABLE
264	213.75	534.54	544.80	1.17	ACCEPTABLE
265	240.15	453.15	460.11	1.17	ACCEPTABLE
266	222.77	446.10	456.25	1.16	ACCEPTABLE
267	225.38	495.33	502.68	1.17	ACCEPTABLE
268	191.63	584.39	591.10	1.19	ACCEPTABLE
269	119.51	999.37	1010.25	1.23	ACCEPTABLE
270	169.41	773.49	780.71	1.21	ACCEPTABLE
271	206.84	554.66	564.25	1.17	ACCEPTABLE
272	241.74	414.04	422.86	1.17	ACCEPTABLE
273	230.13	403.79	411.63	1.16	ACCEPTABLE
274	150.75	753.92	763.53	1.21	ACCEPTABLE
275	167.19	699.06	706.44	1.21	ACCEPTABLE
276	213.38	451.54	461.66	1.16	ACCEPTABLE
277	245.35	332.38	342.19	1.16	ACCEPTABLE
278	238.06	366.59	375.29	1.16	ACCEPTABLE
279	216.71	504.40	514.64	1.16	ACCEPTABLE
280	233.94	452.78	460.77	1.17	ACCEPTABLE

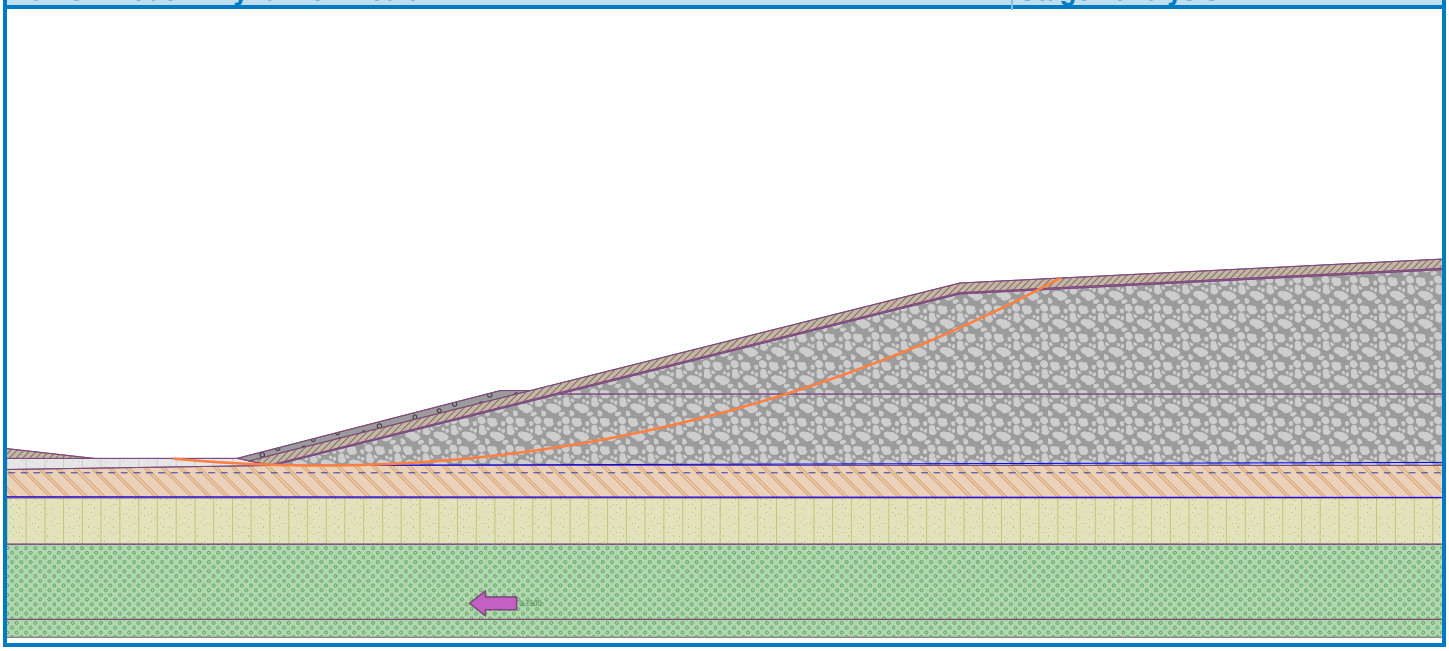
No.	Center		Radius	FS	Verification
	x [ft]	z [ft]	R [ft]		
281	222.77	446.10	456.25	1.16	ACCEPTABLE
282	224.10	480.52	488.76	1.16	ACCEPTABLE
283	204.88	525.54	533.05	1.17	ACCEPTABLE
284	170.46	725.46	734.59	1.51	ACCEPTABLE
285	195.31	621.84	629.28	1.18	ACCEPTABLE
286	212.21	517.08	526.83	1.16	ACCEPTABLE
287	224.74	454.55	465.33	1.16	ACCEPTABLE
288	235.58	424.19	433.43	1.16	ACCEPTABLE
289	227.60	418.22	426.82	1.16	ACCEPTABLE
290	182.40	613.87	622.88	1.18	ACCEPTABLE
291	193.67	578.52	585.96	1.18	ACCEPTABLE
292	216.48	449.80	459.94	1.15	ACCEPTABLE
293	209.15	511.34	520.66	1.16	ACCEPTABLE
294	188.12	561.83	570.80	1.17	ACCEPTABLE
295	163.56	734.09	743.23	1.19	ACCEPTABLE
296	205.98	521.15	530.88	1.17	ACCEPTABLE
297	218.58	457.94	468.69	1.15	ACCEPTABLE
298	222.78	446.07	456.22	1.15	ACCEPTABLE
299	213.95	442.79	452.40	1.15	ACCEPTABLE
300	175.67	620.89	629.90	1.18	ACCEPTABLE
301	174.50	624.61	633.77	1.20	ACCEPTABLE
302	210.28	453.28	463.40	1.16	ACCEPTABLE
303	226.70	384.03	394.71	1.15	ACCEPTABLE
304	228.65	413.25	421.95	1.16	ACCEPTABLE
305	212.74	442.34	450.08	1.16	ACCEPTABLE
306	182.78	612.07	621.08	1.18	ACCEPTABLE
307	205.01	524.93	532.44	1.17	ACCEPTABLE
308	217.18	446.43	456.63	1.15	ACCEPTABLE
309	238.63	366.10	375.96	1.16	ACCEPTABLE
310	231.23	358.44	367.56	1.16	ACCEPTABLE
311	192.46	516.88	525.94	1.17	ACCEPTABLE
312	203.27	485.29	492.78	1.17	ACCEPTABLE
313	220.48	387.01	397.67	1.15	ACCEPTABLE
314	240.78	315.09	325.61	1.16	ACCEPTABLE
315	236.12	336.21	345.98	1.16	ACCEPTABLE
316	222.84	419.21	429.96	1.15	ACCEPTABLE
317	233.78	389.03	398.25	1.16	ACCEPTABLE
318	226.70	384.03	394.71	1.15	ACCEPTABLE
319	227.83	404.15	413.48	1.16	ACCEPTABLE
320	218.09	420.00	428.62	1.16	ACCEPTABLE
321	201.13	516.36	525.58	1.16	ACCEPTABLE
322	214.21	467.96	476.34	1.16	ACCEPTABLE
323	220.36	425.15	435.50	1.15	ACCEPTABLE
324	234.72	371.88	382.00	1.16	ACCEPTABLE
325	229.68	367.10	376.74	1.15	ACCEPTABLE
326	205.68	463.99	473.39	1.16	ACCEPTABLE
327	212.91	443.63	451.97	1.16	ACCEPTABLE
328	222.53	386.09	396.76	1.15	ACCEPTABLE
329	219.10	419.21	429.15	1.15	ACCEPTABLE

No.	Center		Radius	FS	Verification
	x [ft]	z [ft]	R [ft]		
330	208.94	436.03	445.38	1.16	ACCEPTABLE
331	196.85	519.65	528.85	1.17	ACCEPTABLE
332	204.35	487.15	496.32	1.16	ACCEPTABLE
333	216.25	427.23	437.56	1.15	ACCEPTABLE
334	226.77	383.86	394.52	1.15	ACCEPTABLE
335	227.90	403.97	413.28	1.16	ACCEPTABLE
336	218.16	419.82	428.43	1.16	ACCEPTABLE
337	201.09	516.54	525.75	1.16	ACCEPTABLE
338	214.28	467.78	476.14	1.16	ACCEPTABLE
339	220.34	425.22	435.57	1.15	ACCEPTABLE
340	234.79	371.71	381.81	1.16	ACCEPTABLE
341	229.75	366.93	376.55	1.16	ACCEPTABLE
342	205.65	464.10	473.51	1.16	ACCEPTABLE
343	212.98	443.45	451.77	1.16	ACCEPTABLE
344	222.52	386.13	396.79	1.15	ACCEPTABLE
345	236.43	336.49	347.00	1.15	ACCEPTABLE
346	233.15	351.43	361.47	1.15	ACCEPTABLE
347	224.08	407.46	418.18	1.15	ACCEPTABLE
348	231.41	387.53	397.21	1.16	ACCEPTABLE
349	226.77	383.86	394.52	1.15	ACCEPTABLE
350	227.45	397.53	407.28	1.15	ACCEPTABLE
351	221.30	406.71	415.96	1.16	ACCEPTABLE
352	210.93	465.41	474.99	1.16	ACCEPTABLE
353	219.17	436.12	445.17	1.16	ACCEPTABLE
354	222.44	411.33	421.78	1.15	ACCEPTABLE
355	232.14	375.67	385.95	1.15	ACCEPTABLE
356	228.74	372.63	382.59	1.15	ACCEPTABLE
357	213.32	434.26	444.01	1.16	ACCEPTABLE
358	218.24	420.71	429.73	1.16	ACCEPTABLE
359	223.88	385.52	396.19	1.15	ACCEPTABLE
360	233.33	351.62	362.16	1.15	ACCEPTABLE
361	231.07	361.99	372.23	1.15	ACCEPTABLE
362	224.92	399.67	410.38	1.15	ACCEPTABLE
363	229.83	386.46	396.46	1.15	ACCEPTABLE
364	226.77	383.86	394.52	1.15	ACCEPTABLE
365	227.19	393.09	403.13	1.15	ACCEPTABLE
366	223.23	398.64	408.34	1.15	ACCEPTABLE
367	216.67	435.64	445.54	1.15	ACCEPTABLE
368	221.99	417.23	426.79	1.15	ACCEPTABLE
369	223.83	402.21	412.74	1.15	ACCEPTABLE
370	227.10	386.97	397.86	1.15	ACCEPTABLE
371	230.37	378.36	388.77	1.15	ACCEPTABLE
372	228.08	376.40	386.59	1.15	ACCEPTABLE
373	218.02	416.32	426.35	1.15	ACCEPTABLE
374	221.35	407.29	416.83	1.15	ACCEPTABLE
375	224.79	385.11	395.79	1.15	ACCEPTABLE
376	231.20	362.06	372.63	1.15	ACCEPTABLE
377	226.41	377.62	388.49	1.15	ACCEPTABLE
378	229.66	369.16	379.54	1.15	ACCEPTABLE

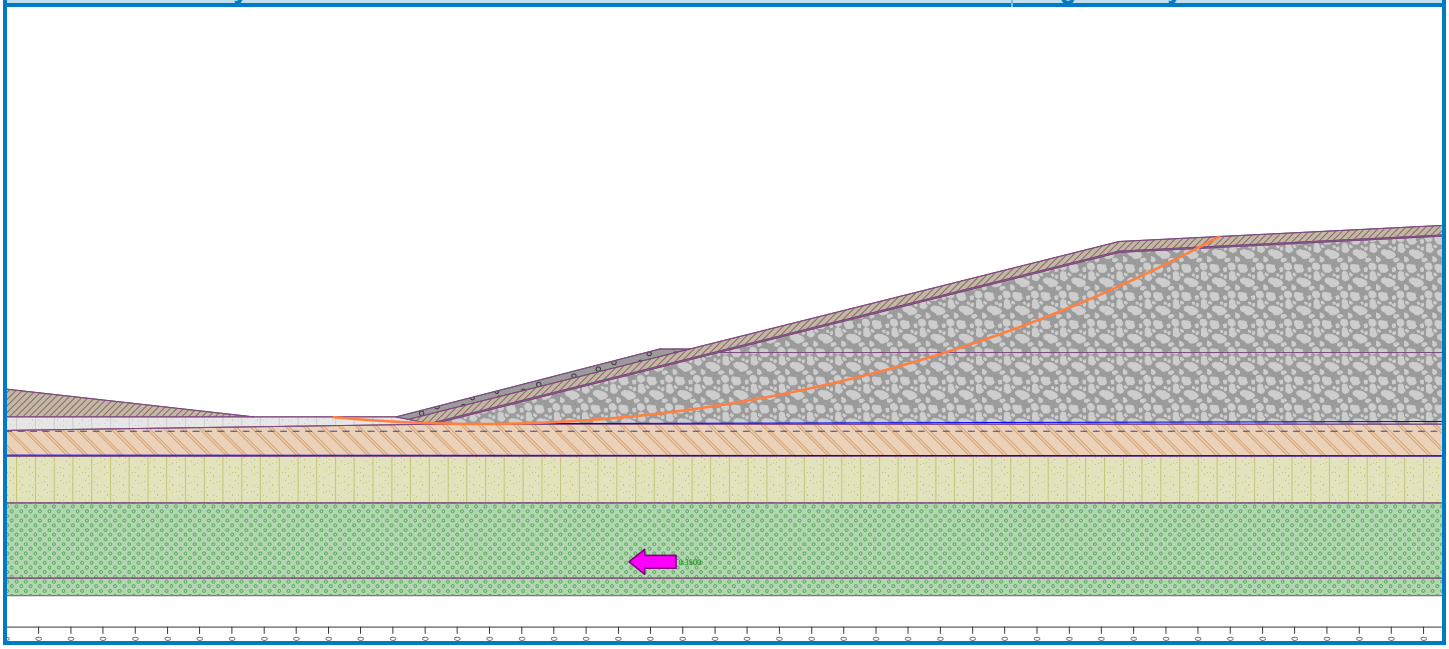
No.	Center		Radius	FS	Verification
	x [ft]	z [ft]	R [ft]		
379	225.48	394.52	405.22	1.15	ACCEPTABLE
380	228.79	385.66	395.88	1.15	ACCEPTABLE
381	226.77	383.86	394.52	1.15	ACCEPTABLE
382	227.04	390.06	400.31	1.15	ACCEPTABLE
383	224.46	393.52	403.53	1.15	ACCEPTABLE
384	220.19	417.41	427.55	1.15	ACCEPTABLE
385	223.70	405.50	415.42	1.15	ACCEPTABLE
386	224.76	396.19	406.77	1.15	ACCEPTABLE
387	226.94	386.07	396.89	1.15	ACCEPTABLE
388	229.17	380.18	390.67	1.15	ACCEPTABLE
389	227.64	378.90	389.24	1.15	ACCEPTABLE
390	221.00	405.11	415.35	1.15	ACCEPTABLE
391	219.89	415.47	425.48	1.15	ACCEPTABLE
392	217.09	419.70	429.52	1.15	ACCEPTABLE
393	213.94	441.48	451.24	1.15	ACCEPTABLE
394	216.12	432.83	442.57	1.15	ACCEPTABLE
395	219.00	417.91	428.05	1.15	ACCEPTABLE
396	226.74	383.91	394.59	1.15	ACCEPTABLE
397	221.42	406.66	417.02	1.15	ACCEPTABLE
398	222.34	404.18	414.41	1.15	ACCEPTABLE
399	225.74	386.55	397.37	1.15	ACCEPTABLE
400	220.68	403.28	413.38	1.15	ACCEPTABLE
401	214.91	428.22	438.06	1.15	ACCEPTABLE
402	215.71	426.00	435.73	1.16	ACCEPTABLE
403	219.78	405.71	415.95	1.15	ACCEPTABLE
404	226.78	374.31	385.17	1.15	ACCEPTABLE
405	227.33	372.86	383.64	1.15	ACCEPTABLE
406	222.17	394.68	405.15	1.15	ACCEPTABLE
407	223.10	392.22	402.55	1.15	ACCEPTABLE
408	220.98	400.16	410.51	1.15	ACCEPTABLE
409	221.90	397.71	407.92	1.15	ACCEPTABLE
410	220.22	412.24	422.49	1.15	ACCEPTABLE
411	221.13	409.78	419.90	1.15	ACCEPTABLE
412	221.00	405.11	415.35	1.15	ACCEPTABLE
413	220.18	412.22	422.32	1.15	ACCEPTABLE
414	218.35	414.91	424.88	1.15	ACCEPTABLE
415	216.40	428.81	438.72	1.15	ACCEPTABLE
416	217.75	423.43	433.34	1.15	ACCEPTABLE
417	219.67	413.62	423.79	1.15	ACCEPTABLE
418	224.80	390.95	401.49	1.15	ACCEPTABLE
419	221.28	406.14	416.46	1.15	ACCEPTABLE
420	221.81	404.71	414.95	1.15	ACCEPTABLE
421	224.23	392.47	403.09	1.15	ACCEPTABLE
422	220.71	404.11	414.27	1.15	ACCEPTABLE
423	216.99	420.25	430.21	1.15	ACCEPTABLE
424	217.47	418.95	428.85	1.15	ACCEPTABLE
425	220.19	405.51	415.75	1.15	ACCEPTABLE
426	224.95	384.12	394.76	1.15	ACCEPTABLE
427	225.23	383.36	393.97	1.15	ACCEPTABLE

No.	Center		Radius	FS	Verification
	x [ft]	z [ft]	R [ft]		
428	221.79	398.13	408.52	1.15	ACCEPTABLE
429	222.32	396.70	407.01	1.15	ACCEPTABLE
430	224.66	384.87	395.56	1.15	ACCEPTABLE
431	220.99	401.80	412.11	1.15	ACCEPTABLE
432	221.52	400.39	410.62	1.15	ACCEPTABLE
433	220.48	409.86	420.10	1.15	ACCEPTABLE
434	221.00	408.44	418.61	1.15	ACCEPTABLE
435	213.26	423.23	434.15	1.15	ACCEPTABLE

Name : Model 4 Dynamic Circular | **Stage - analysis : 1 - 1**



Name : Model 4 Dynamic	Stage - analysis : 1 - 1



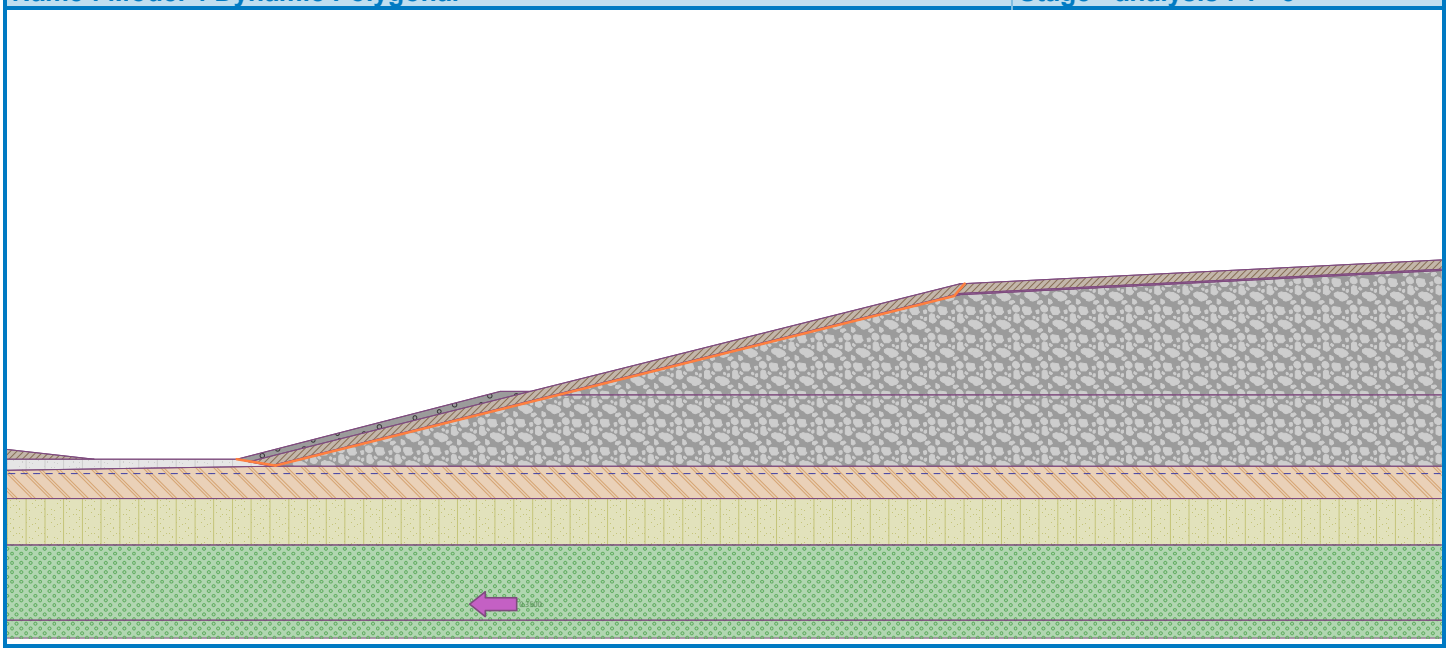
Analysis 3 (stage 1)

Polygonal slip surface

Coordinates of slip surface points [ft]									
x	z	x	z	x	z	x	z	x	z
189.87	-9.00	200.67	-10.78	390.33	36.60	393.34	40.07		
The slip surface after optimization.									

Slope stability verification (Janbu)
Factor of safety = 1.00 > 1.00
Slope stability ACCEPTABLE

Name : Model 4 Dynamic Polygonal	Stage - analysis : 1 - 3



Slope stability analysis

Input data

Project

Task : Confirmatory Model for Final Closure of the Ash Basin
Description : Slope Stability Analysis of Grand Tower CCR Impoundment Final Closure Plan
Author : ERM - Annapolis
Date : 6/22/2020
Project number : 0533442

Settings

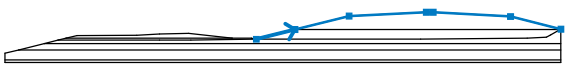
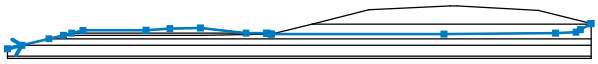
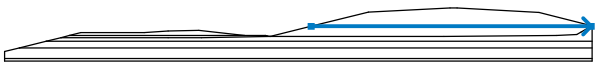
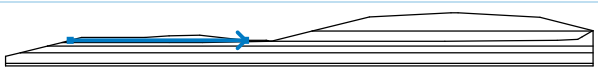
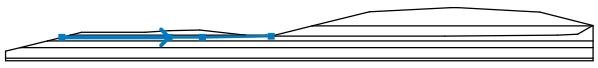
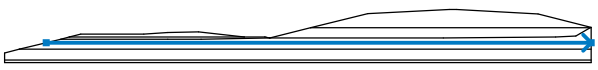
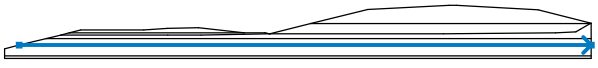
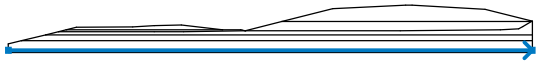
(input for current task)

Stability analysis

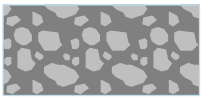
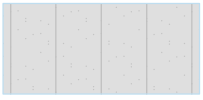
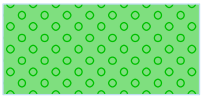
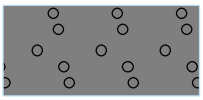
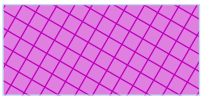
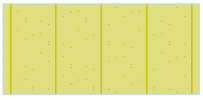
Earthquake analysis : Standard
Verification methodology : Safety factors (ASD)

Safety factors			
Seismic design situation			
Safety factor :	SF_s =	1.00	[–]

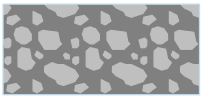
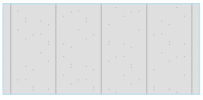
Interface

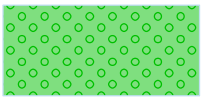
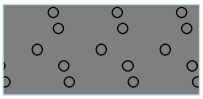
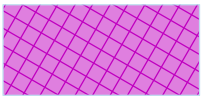
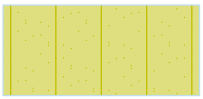
No.	Interface location	Coordinates of interface points [ft]					
		x	z	x	z	x	z
1		200.00	-11.00	279.99	9.00	392.00	37.00
		552.00	45.00	566.00	45.00	726.00	36.00
		830.00	10.00				
2		-320.00	-40.00	-291.43	-33.00	-238.36	-20.00
		-209.79	-13.00	-193.45	-9.00	-171.00	-3.50
		-47.00	-3.00	0.00	0.00	60.00	1.10
		150.00	-9.00	190.00	-9.00	190.64	-9.12
		193.34	-9.67	199.27	-10.85	200.00	-11.00
		540.00	-11.00	760.00	-9.00	800.00	-7.00
		808.86	-1.98	828.24	9.00	830.00	10.00
3		279.99	9.00	828.24	9.00		
4		-193.45	-9.00	150.00	-9.00		
5		-209.79	-13.00	0.00	-13.00	65.00	-13.00
		200.00	-11.00				
6		-238.36	-20.00	830.00	-20.00		
7		-291.43	-33.00	830.00	-33.00		
8		-320.00	-54.00	830.00	-54.00		

Soil parameters - effective stress state

No.	Name	Pattern	φ_{ef} [°]	c_{ef} [psf]	γ [pcf]
1	Ash - Geotech Lab 6/2020		30.00	100.0	75.0
2	Silty Clay (Compacted Levee Cap)		10.00	450.0	133.0
3	Silty Sand (layer in berm, not basin)		28.00	100.0	115.0
4	Silty Clay, impervious fdtn (Updated with 2007 Hanson Report and ERM)		10.00	500.0	130.0
5	Sand & Gravel (Underlying Aquifer)		34.00	0.0	130.0
6	Gravel with trace of fines (G-F), medium dense- RipRap		40.00	0.0	165.0
7	Critical Interface		25.00	50.0	110.0
8	Sandy Silt (Native Pervious Material)		24.00	150.0	115.0

Soil parameters - uplift

No.	Name	Pattern	γ_{sat} [pcf]	γ_s [pcf]	n [–]
1	Ash - Geotech Lab 6/2020		100.0		
2	Silty Clay (Compacted Levee Cap)		153.0		
3	Silty Sand (layer in berm, not basin)		136.0		
4	Silty Clay, impervious fdtn (Updated with 2007 Hanson Report and ERM)		150.0		

No.	Name	Pattern	γ_{sat} [pcf]	γ_s [pcf]	n [–]
5	Sand & Gravel (Underlying Aquifer)		130.0		
6	Gravel with trace of fines (G-F), medium dense- RipRap		165.0		
7	Critical Interface		110.0		
8	Sandy Silt (Native Pervious Material)		135.0		

Soil parameters

Ash - Geotech Lab 6/2020

Unit weight : γ = 75.0 pcf
Stress-state : effective
Angle of internal friction : φ_{ef} = 30.00 °
Cohesion of soil : c_{ef} = 100.0 psf
Saturated unit weight : γ_{sat} = 100.0 pcf

Silty Clay (Compacted Levee Cap)

Unit weight : γ = 133.0 pcf
Stress-state : effective
Angle of internal friction : φ_{ef} = 10.00 °
Cohesion of soil : c_{ef} = 450.0 psf
Saturated unit weight : γ_{sat} = 153.0 pcf

Silty Sand (layer in berm, not basin)

Unit weight : γ = 115.0 pcf
Stress-state : effective
Angle of internal friction : φ_{ef} = 28.00 °
Cohesion of soil : c_{ef} = 100.0 psf
Saturated unit weight : γ_{sat} = 136.0 pcf

Silty Clay, impervious fdtn (Updated with 2007 Hanson Report and ERM)

Unit weight : γ = 130.0 pcf
Stress-state : effective
Angle of internal friction : φ_{ef} = 10.00 °
Cohesion of soil : c_{ef} = 500.0 psf
Saturated unit weight : γ_{sat} = 150.0 pcf

Sand & Gravel (Underlying Aquifer)

Unit weight : γ = 130.0 pcf
Stress-state : effective
Angle of internal friction : φ_{ef} = 34.00 °

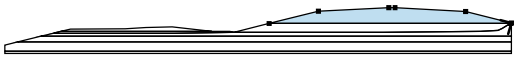
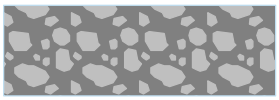
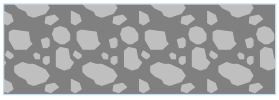
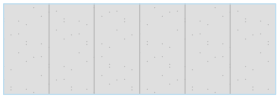
Cohesion of soil : c_{ef} = 0.0 psf
Saturated unit weight : γ_{sat} = 130.0 pcf

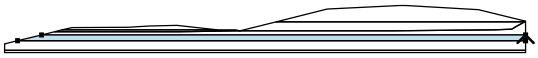
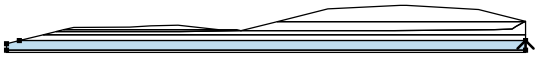
Gravel with trace of fines (G-F), medium dense- RipRap
Unit weight : γ = 165.0 pcf
Stress-state : effective
Angle of internal friction : φ_{ef} = 40.00 °
Cohesion of soil : c_{ef} = 0.0 psf
Saturated unit weight : γ_{sat} = 165.0 pcf

Critical Interface
Unit weight : γ = 110.0 pcf
Stress-state : effective
Angle of internal friction : φ_{ef} = 25.00 °
Cohesion of soil : c_{ef} = 50.0 psf
Saturated unit weight : γ_{sat} = 110.0 pcf

Sandy Silt (Native Pervious Material)
Unit weight : γ = 115.0 pcf
Stress-state : effective
Angle of internal friction : φ_{ef} = 24.00 °
Cohesion of soil : c_{ef} = 150.0 psf
Saturated unit weight : γ_{sat} = 135.0 pcf

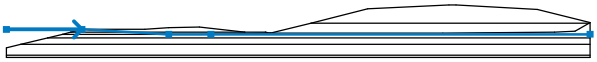
Assigning and surfaces

No.	Surface position	Coordinates of surface points [ft]				Assigned soil
		x	z	x	z	
1		828.24	9.00	830.00	10.00	Ash - Geotech Lab 6/2020
		726.00	36.00	566.00	45.00	
		552.00	45.00	392.00	37.00	
		279.99	9.00			
2		150.00	-9.00	60.00	1.10	Silty Clay (Compacted Levee Cap)
		0.00	0.00	-47.00	-3.00	
		-171.00	-3.50	-193.45	-9.00	
3		279.99	9.00	200.00	-11.00	Ash - Geotech Lab 6/2020
		540.00	-11.00	760.00	-9.00	
		800.00	-7.00	808.86	-1.98	
		828.24	9.00			
4		0.00	-13.00	65.00	-13.00	Silty Sand (layer in berm, not basin)
		200.00	-11.00	199.27	-10.85	
		193.34	-9.67	190.64	-9.12	
		190.00	-9.00	150.00	-9.00	
		-193.45	-9.00	-209.79	-13.00	

No.	Surface position	Coordinates of surface points [ft]				Assigned soil
		x	z	x	z	
5		830.00	-20.00	830.00	10.00	Silty Clay, Impervious fdtn (Updated with 2007 Hanson Report and ERM)
		828.24	9.00	808.86	-1.98	
		800.00	-7.00	760.00	-9.00	
		540.00	-11.00	200.00	-11.00	
		65.00	-13.00	0.00	-13.00	
		-209.79	-13.00	-238.36	-20.00	
6		830.00	-33.00	830.00	-20.00	Sandy Silt (Native Pervious Material)
		-238.36	-20.00	-291.43	-33.00	
7		830.00	-54.00	830.00	-33.00	Sand & Gravel (Underlying Aquifer)
		-291.43	-33.00	-320.00	-40.00	
		-320.00	-54.00			
8		-320.00	-54.00	-320.00	-59.00	Sand & Gravel (Underlying Aquifer)
		830.00	-59.00	830.00	-54.00	

Water

Water type : GWT

No.	GWT location	Coordinates of GWT points [ft]					
		x	z	x	z	x	z
1		-320.00	-3.50	-171.00	-3.50	0.00	-13.00
		83.00	-13.00	830.00	-13.00		

Tensile crack

Tensile crack not input.

Earthquake

Horizontal seismic coefficient : K_h = 0.2870
Vertical seismic coefficient : K_v = 0.0000

Settings of the stage of construction

Design situation : seismic

Results (Stage of construction 1)

Analysis 1 (stage 1)

Circular slip surface

Slip surface parameters							
Center :	x =	289.80	[ft]	Angles :	α_1 =	-20.43	[°]
	z =	188.06	[ft]		α_2 =	44.22	[°]
Radius :	R =	207.81	[ft]				
The slip surface after optimization.							

Segments restricting slip surface

No.	First point		Second point	
	x [ft]	z [ft]	x [ft]	z [ft]
1	-247.18	-19.54	775.42	-19.95

The restrictions of points of circular slip surface

Slope stability verification (Bishop)

Sum of active forces : F_a = 202015.7 lbf/ft

Sum of passive forces : F_p = 202269.8 lbf/ft

Sliding moment : M_a = 41980874.7 lbfft/ft

Resisting moment : M_p = 42033678.8 lbfft/ft

Factor of safety = 1.00 > 1.00

Slope stability ACCEPTABLE

Optimization of circular slip surface (Bishop)

No.	Center		Radius	FS	Verification
	x [ft]	z [ft]	R [ft]		
1	289.80	188.06	207.81	1.00	ACCEPTABLE
2	289.80	188.06	207.81	1.00	ACCEPTABLE
3	289.80	188.06	207.81	1.00	ACCEPTABLE
4	547.77	132.41	149.20	2.22	ACCEPTABLE
5	117.61	513.14	530.14	3.32	ACCEPTABLE
6	231.86	1602.40	1621.71	1.38	ACCEPTABLE
7	289.80	188.06	207.81	1.00	ACCEPTABLE
8	474.57	119.85	136.50	2.00	ACCEPTABLE
9	162.23	268.48	285.24	3.12	ACCEPTABLE
10	254.28	893.23	912.62	1.28	ACCEPTABLE
11	289.80	188.06	207.81	1.00	ACCEPTABLE
12	245.45	708.14	725.03	1.32	ACCEPTABLE
13	416.38	132.02	149.06	1.54	ACCEPTABLE
14	195.50	235.14	253.31	1.75	ACCEPTABLE
15	289.80	188.06	207.81	1.00	ACCEPTABLE
16	244.92	574.10	590.82	1.25	ACCEPTABLE
17	376.46	145.39	162.92	1.27	ACCEPTABLE
18	219.94	219.64	239.24	1.27	ACCEPTABLE
19	289.80	188.06	207.81	1.00	ACCEPTABLE
20	257.46	435.33	452.49	1.18	ACCEPTABLE
21	348.79	156.75	174.78	1.14	ACCEPTABLE
22	316.26	59.48	76.67	1.34	ACCEPTABLE
23	348.82	156.60	174.67	1.14	ACCEPTABLE
24	289.80	188.06	207.81	1.00	ACCEPTABLE
25	274.67	238.57	239.23	1.33	ACCEPTABLE
26	-504.39	4664.95	4724.82	1.65	ACCEPTABLE
27	199.22	879.55	880.00	1.46	ACCEPTABLE
28	266.55	348.67	366.40	1.12	ACCEPTABLE
29	329.75	165.72	184.20	1.08	ACCEPTABLE

No.	Center		Radius	FS	Verification
	x [ft]	z [ft]	R [ft]		
30	308.50	94.02	111.32	1.16	ACCEPTABLE
31	123.27	818.79	830.24	1.57	ACCEPTABLE
32	190.19	599.46	601.31	1.58	ACCEPTABLE
33	308.97	92.01	109.91	1.14	ACCEPTABLE
34	327.77	176.54	193.12	1.13	ACCEPTABLE
35	289.80	188.06	207.81	1.00	ACCEPTABLE
36	314.18	185.75	202.50	1.10	ACCEPTABLE
37	281.41	216.87	222.89	1.31	ACCEPTABLE
38	272.45	402.95	406.10	1.35	ACCEPTABLE
39	269.40	303.44	322.08	1.07	ACCEPTABLE
40	316.74	172.44	191.29	1.04	ACCEPTABLE
41	301.47	127.53	144.17	1.11	ACCEPTABLE
42	215.85	416.96	427.79	1.29	ACCEPTABLE
43	264.51	292.16	295.04	1.32	ACCEPTABLE
44	303.35	119.16	137.61	1.07	ACCEPTABLE
45	314.39	184.66	201.56	1.09	ACCEPTABLE
46	289.80	188.06	207.81	1.00	ACCEPTABLE
47	304.63	193.81	210.53	1.08	ACCEPTABLE
48	284.71	205.91	216.08	1.32	ACCEPTABLE
49	239.76	437.59	449.08	1.32	ACCEPTABLE
50	284.55	295.06	303.20	1.33	ACCEPTABLE
51	274.92	265.29	284.36	1.04	ACCEPTABLE
52	307.90	177.30	196.43	1.03	ACCEPTABLE
53	297.29	148.51	165.79	1.07	ACCEPTABLE
54	247.13	307.54	320.52	1.27	ACCEPTABLE
55	277.87	237.10	245.00	1.31	ACCEPTABLE
56	299.19	139.85	158.71	1.04	ACCEPTABLE
57	305.85	187.69	205.25	1.06	ACCEPTABLE
58	289.80	188.06	207.81	1.00	ACCEPTABLE
59	299.07	194.87	212.20	1.06	ACCEPTABLE
60	286.59	199.49	212.67	1.19	ACCEPTABLE
61	263.50	318.63	332.17	1.22	ACCEPTABLE
62	288.04	249.37	261.23	1.25	ACCEPTABLE
63	280.26	237.30	256.52	1.03	ACCEPTABLE
64	301.94	180.73	200.05	1.02	ACCEPTABLE
65	294.69	162.02	179.98	1.05	ACCEPTABLE
66	264.20	256.23	270.98	1.17	ACCEPTABLE
67	283.15	215.40	227.08	1.25	ACCEPTABLE
68	296.23	154.88	174.02	1.02	ACCEPTABLE
69	300.33	188.64	206.82	1.04	ACCEPTABLE
70	289.80	188.06	207.81	1.00	ACCEPTABLE
71	295.72	193.84	211.81	1.05	ACCEPTABLE
72	287.73	195.49	210.79	1.12	ACCEPTABLE
73	274.42	264.19	279.58	1.14	ACCEPTABLE
74	289.22	225.50	239.94	1.15	ACCEPTABLE
75	283.60	219.95	239.31	1.02	ACCEPTABLE
76	297.92	183.10	202.55	1.01	ACCEPTABLE
77	293.01	170.83	189.34	1.03	ACCEPTABLE
78	273.69	229.66	245.89	1.11	ACCEPTABLE

No.	Center		Radius	FS	Verification
	x [ft]	z [ft]	R [ft]		
79	285.80	204.49	218.81	1.15	ACCEPTABLE
80	294.16	165.47	184.80	1.02	ACCEPTABLE
81	296.75	188.82	207.46	1.03	ACCEPTABLE
82	289.80	188.06	207.81	1.00	ACCEPTABLE
83	293.63	192.44	210.93	1.03	ACCEPTABLE
84	288.45	192.94	209.68	1.08	ACCEPTABLE
85	280.32	234.89	251.66	1.09	ACCEPTABLE
86	289.64	211.71	227.90	1.09	ACCEPTABLE
87	285.73	208.93	228.40	1.01	ACCEPTABLE
88	295.23	184.72	204.27	1.01	ACCEPTABLE
89	291.92	176.63	195.54	1.02	ACCEPTABLE
90	279.42	214.35	231.67	1.07	ACCEPTABLE
91	287.30	198.33	214.44	1.10	ACCEPTABLE
92	292.74	172.78	192.25	1.01	ACCEPTABLE
93	294.40	188.73	207.72	1.02	ACCEPTABLE
94	289.80	188.06	207.81	1.00	ACCEPTABLE
95	292.30	191.21	210.09	1.02	ACCEPTABLE
96	288.91	191.28	209.01	1.05	ACCEPTABLE
97	283.78	217.75	235.49	1.06	ACCEPTABLE
98	289.78	203.30	220.67	1.06	ACCEPTABLE
99	287.12	201.80	221.36	1.01	ACCEPTABLE
100	293.43	185.82	205.43	1.01	ACCEPTABLE
101	291.21	180.47	199.64	1.02	ACCEPTABLE
102	283.03	205.00	223.10	1.04	ACCEPTABLE
103	288.20	194.64	211.95	1.06	ACCEPTABLE
104	291.78	177.78	197.34	1.01	ACCEPTABLE
105	292.85	188.58	207.81	1.02	ACCEPTABLE
106	289.80	188.06	207.81	1.00	ACCEPTABLE
107	291.45	190.26	209.41	1.02	ACCEPTABLE
108	289.21	190.20	208.59	1.04	ACCEPTABLE
109	285.91	207.23	225.62	1.04	ACCEPTABLE
110	289.83	198.00	216.16	1.04	ACCEPTABLE
111	288.02	197.14	216.76	1.01	ACCEPTABLE
112	292.22	186.56	206.22	1.00	ACCEPTABLE
113	290.73	183.01	202.37	1.01	ACCEPTABLE
114	285.35	199.12	217.75	1.03	ACCEPTABLE
115	288.76	192.33	210.46	1.04	ACCEPTABLE
116	291.12	181.16	200.79	1.01	ACCEPTABLE
117	291.83	188.44	207.84	1.01	ACCEPTABLE
118	289.80	188.06	207.81	1.00	ACCEPTABLE
119	290.89	189.57	208.92	1.01	ACCEPTABLE
120	289.41	189.48	208.32	1.03	ACCEPTABLE
121	287.26	200.58	219.42	1.03	ACCEPTABLE
122	289.83	194.59	213.28	1.03	ACCEPTABLE
123	288.62	194.08	213.74	1.00	ACCEPTABLE
124	291.41	187.06	206.75	1.00	ACCEPTABLE
125	290.42	184.70	204.19	1.01	ACCEPTABLE
126	286.86	195.33	214.32	1.02	ACCEPTABLE
127	289.12	190.86	209.52	1.03	ACCEPTABLE

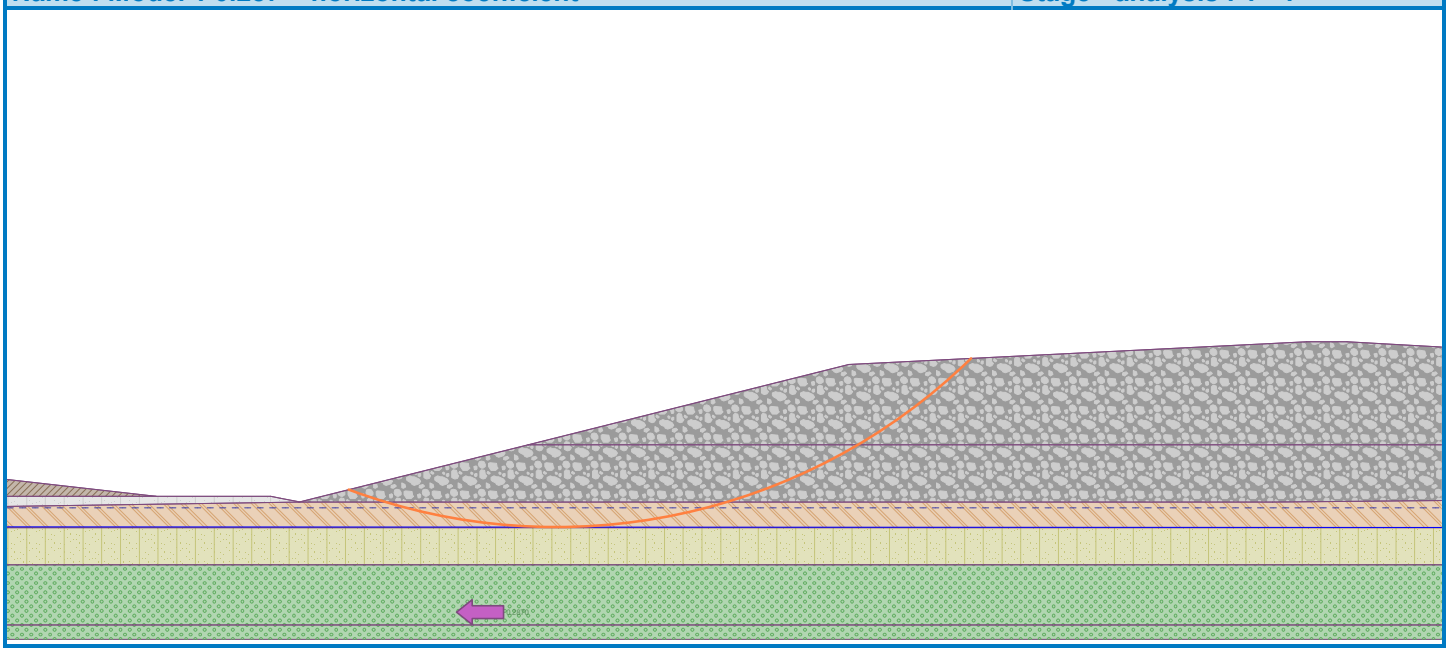
No.	Center		Radius	FS	Verification
	x [ft]	z [ft]	R [ft]		
128	290.69	183.44	203.11	1.00	ACCEPTABLE
129	291.15	188.32	207.84	1.01	ACCEPTABLE
130	289.80	188.06	207.81	1.00	ACCEPTABLE
131	290.52	189.09	208.56	1.01	ACCEPTABLE
132	289.54	189.00	208.15	1.02	ACCEPTABLE
133	288.13	196.29	215.43	1.02	ACCEPTABLE
134	289.83	192.38	211.42	1.02	ACCEPTABLE
135	289.02	192.06	211.75	1.00	ACCEPTABLE
136	290.88	187.39	207.10	1.00	ACCEPTABLE
137	290.21	185.82	205.40	1.01	ACCEPTABLE
138	287.85	192.86	212.11	1.02	ACCEPTABLE
139	289.35	189.91	208.93	1.02	ACCEPTABLE
140	290.39	184.97	204.67	1.00	ACCEPTABLE
141	290.70	188.24	207.84	1.01	ACCEPTABLE
142	547.77	132.41	149.20	2.22	ACCEPTABLE
143	418.09	2949.07	2967.54	1.15	ACCEPTABLE
144	319.87	4705.28	4722.68	1.40	ACCEPTABLE
145	503.95	88.81	106.01	2.39	ACCEPTABLE
146	418.09	2949.07	2967.54	1.15	ACCEPTABLE
147	385.73	3573.15	3590.49	1.31	ACCEPTABLE
148	268.72	1431.30	1450.88	1.30	ACCEPTABLE
149	491.91	312.44	329.90	1.53	ACCEPTABLE
150	389.11	3292.53	3311.76	1.23	ACCEPTABLE
151	418.09	2949.07	2967.54	1.15	ACCEPTABLE
152	405.23	3284.46	3301.64	1.22	ACCEPTABLE
153	555.53	1317.88	1336.07	1.35	ACCEPTABLE
154	317.64	1526.43	1545.98	1.24	ACCEPTABLE
155	470.39	621.51	639.65	1.29	ACCEPTABLE
156	408.55	3062.24	3080.95	1.16	ACCEPTABLE
157	555.52	1320.88	1339.02	1.35	ACCEPTABLE
158	418.09	2949.07	2967.54	1.15	ACCEPTABLE
159	513.21	1717.82	1736.67	1.19	ACCEPTABLE
160	512.50	1763.87	1782.10	1.21	ACCEPTABLE
161	451.08	1087.06	1104.33	1.24	ACCEPTABLE
162	346.10	1853.82	1873.22	1.22	ACCEPTABLE
163	453.29	1043.42	1061.88	1.19	ACCEPTABLE
164	406.55	3085.88	3104.64	1.15	ACCEPTABLE
165	511.26	1845.28	1862.48	1.25	ACCEPTABLE
166	418.09	2949.07	2967.54	1.15	ACCEPTABLE
167	471.95	2328.72	2345.94	1.19	ACCEPTABLE
168	398.46	3321.27	3339.03	1.26	ACCEPTABLE
169	475.48	2182.18	2200.66	1.15	ACCEPTABLE
170	542.73	1397.53	1416.66	1.26	ACCEPTABLE
171	418.50	2935.06	2953.61	1.15	ACCEPTABLE
172	542.45	1448.00	1466.18	1.30	ACCEPTABLE
173	499.21	1028.51	1046.49	1.29	ACCEPTABLE
174	499.45	1019.94	1038.18	1.27	ACCEPTABLE
175	424.60	2728.97	2748.77	1.10	ACCEPTABLE
176	475.95	2161.00	2179.67	1.14	ACCEPTABLE

No.	Center		Radius	FS	Verification
	x [ft]	z [ft]	R [ft]		
177	404.68	3075.83	3094.94	1.20	ACCEPTABLE
178	435.84	1504.51	1523.32	1.15	ACCEPTABLE
179	476.29	2146.66	2165.47	1.13	ACCEPTABLE
180	424.60	2728.80	2748.60	1.11	ACCEPTABLE
181	444.95	2547.05	2565.84	1.12	ACCEPTABLE
182	403.93	3052.08	3071.52	1.20	ACCEPTABLE
183	420.47	1930.94	1950.32	1.12	ACCEPTABLE
184	447.07	2475.78	2495.07	1.10	ACCEPTABLE
185	424.60	2728.80	2748.60	1.11	ACCEPTABLE
186	422.27	2806.13	2825.45	1.11	ACCEPTABLE
187	410.79	2943.37	2962.91	1.12	ACCEPTABLE
188	424.97	2724.58	2744.37	1.10	ACCEPTABLE
189	424.60	2728.80	2748.60	1.11	ACCEPTABLE
190	424.49	2764.61	2784.04	1.11	ACCEPTABLE
191	222.27	9154.09	9164.06	2.03	ACCEPTABLE
192	415.38	2871.42	2891.04	1.12	ACCEPTABLE
193	243.76	6930.57	6940.67	1.98	ACCEPTABLE
194	426.19	2710.85	2730.61	1.10	ACCEPTABLE
195	424.60	2728.80	2748.60	1.11	ACCEPTABLE
196	428.47	2707.69	2727.15	1.11	ACCEPTABLE
197	360.44	4261.07	4273.49	1.58	ACCEPTABLE
198	361.73	4930.72	4942.72	1.62	ACCEPTABLE
199	418.45	2823.69	2843.37	1.12	ACCEPTABLE
200	421.17	2474.78	2494.53	1.11	ACCEPTABLE
201	356.43	4379.08	4391.25	1.60	ACCEPTABLE
202	429.49	2673.67	2693.35	1.10	ACCEPTABLE
203	447.76	2493.03	2512.02	1.12	ACCEPTABLE
204	386.12	3896.28	3908.07	1.63	ACCEPTABLE
205	388.82	4503.50	4514.88	1.73	ACCEPTABLE
206	425.09	2749.69	2769.20	1.11	ACCEPTABLE
207	449.61	2430.08	2449.53	1.10	ACCEPTABLE
208	466.31	2265.35	2284.22	1.12	ACCEPTABLE
209	417.44	3427.31	3438.60	1.75	ACCEPTABLE
210	423.37	3913.06	3923.96	1.96	ACCEPTABLE
211	429.47	2674.70	2694.37	1.10	ACCEPTABLE
212	467.54	2218.30	2237.58	1.11	ACCEPTABLE
213	458.15	2078.97	2098.08	1.12	ACCEPTABLE
214	352.19	4365.94	4378.64	1.56	ACCEPTABLE
215	415.16	3502.79	3513.83	1.87	ACCEPTABLE
216	459.69	2028.01	2047.62	1.11	ACCEPTABLE
217	458.87	2055.02	2074.36	1.11	ACCEPTABLE
218	466.88	2243.52	2262.57	1.12	ACCEPTABLE
219	449.61	2430.00	2449.45	1.10	ACCEPTABLE
220	460.82	2320.85	2339.88	1.12	ACCEPTABLE
221	431.15	3001.92	3015.87	1.38	ACCEPTABLE
222	399.73	3757.44	3771.82	1.36	ACCEPTABLE
223	435.82	3241.52	3255.23	1.39	ACCEPTABLE
224	436.46	2589.00	2608.59	1.10	ACCEPTABLE
225	448.36	2473.01	2492.14	1.11	ACCEPTABLE

No.	Center		Radius	FS	Verification
	x [ft]	z [ft]	R [ft]		
226	414.14	3237.44	3251.64	1.37	ACCEPTABLE
227	377.61	4095.16	4109.90	1.47	ACCEPTABLE
228	417.99	3509.03	3522.96	1.38	ACCEPTABLE
229	422.19	2764.65	2784.42	1.11	ACCEPTABLE
230	449.61	2430.49	2449.93	1.10	ACCEPTABLE
231	460.84	2321.50	2340.53	1.12	ACCEPTABLE
232	431.15	3002.66	3016.60	1.38	ACCEPTABLE
233	399.71	3759.29	3773.66	1.37	ACCEPTABLE
234	435.82	3242.92	3256.62	1.39	ACCEPTABLE
235	436.46	2589.82	2609.40	1.10	ACCEPTABLE
236	461.79	2286.28	2305.60	1.11	ACCEPTABLE
237	455.47	2188.75	2207.95	1.12	ACCEPTABLE
238	396.81	3456.83	3471.48	1.36	ACCEPTABLE
239	430.04	3039.46	3053.24	1.39	ACCEPTABLE
240	431.84	2431.25	2451.06	1.10	ACCEPTABLE
241	448.42	2471.15	2490.29	1.11	ACCEPTABLE
242	410.52	2997.84	3012.28	1.36	ACCEPTABLE
243	377.46	4099.55	4114.27	1.47	ACCEPTABLE
244	417.99	3509.12	3523.04	1.38	ACCEPTABLE
245	422.16	2765.61	2785.36	1.11	ACCEPTABLE
246	449.61	2430.49	2449.93	1.10	ACCEPTABLE
247	438.57	2192.56	2212.08	1.11	ACCEPTABLE
248	374.33	3450.84	3466.11	1.36	ACCEPTABLE
249	409.03	3040.46	3054.72	1.37	ACCEPTABLE
250	439.29	2171.73	2191.43	1.10	ACCEPTABLE
251	448.99	2451.56	2470.84	1.11	ACCEPTABLE
252	431.84	2431.25	2451.06	1.10	ACCEPTABLE
253	442.78	2460.14	2479.48	1.11	ACCEPTABLE
254	418.82	2777.08	2793.29	1.25	ACCEPTABLE
255	401.78	3353.05	3369.37	1.25	ACCEPTABLE
256	424.29	3057.98	3073.85	1.25	ACCEPTABLE
257	425.57	2647.42	2667.18	1.10	ACCEPTABLE
258	443.69	2430.73	2450.29	1.10	ACCEPTABLE
259	436.42	2268.67	2288.28	1.10	ACCEPTABLE
260	397.63	3029.82	3046.49	1.25	ACCEPTABLE
261	418.00	2800.69	2816.78	1.25	ACCEPTABLE
262	436.93	2253.83	2273.57	1.10	ACCEPTABLE
263	443.22	2445.75	2465.19	1.10	ACCEPTABLE
264	431.84	2431.25	2451.06	1.10	ACCEPTABLE
265	439.08	2451.51	2470.99	1.11	ACCEPTABLE
266	423.62	2649.53	2666.93	1.18	ACCEPTABLE
267	413.85	2982.83	3000.28	1.19	ACCEPTABLE
268	427.40	2816.28	2833.46	1.19	ACCEPTABLE
269	427.74	2572.51	2592.29	1.10	ACCEPTABLE
270	439.74	2430.90	2450.54	1.10	ACCEPTABLE
271	434.93	2321.27	2340.95	1.10	ACCEPTABLE
272	410.53	2800.91	2818.59	1.19	ACCEPTABLE
273	423.14	2663.55	2680.86	1.19	ACCEPTABLE
274	435.29	2310.93	2330.69	1.10	ACCEPTABLE

No.	Center		Radius	FS	Verification
	x [ft]	z [ft]	R [ft]		
275	439.40	2441.34	2460.90	1.10	ACCEPTABLE
276	431.84	2431.25	2451.06	1.10	ACCEPTABLE
277	436.64	2445.19	2464.78	1.10	ACCEPTABLE
278	426.55	2571.78	2589.98	1.16	ACCEPTABLE
279	420.61	2775.47	2793.69	1.16	ACCEPTABLE
280	429.12	2675.18	2693.23	1.16	ACCEPTABLE
281	429.14	2524.20	2543.99	1.10	ACCEPTABLE
282	434.03	2539.00	2558.57	1.10	ACCEPTABLE
283	423.51	2675.20	2693.38	1.16	ACCEPTABLE
284	417.22	2891.11	2909.33	1.16	ACCEPTABLE
285	426.03	2784.75	2802.79	1.16	ACCEPTABLE
286	426.30	2622.33	2642.10	1.10	ACCEPTABLE
287	434.52	2523.96	2543.63	1.10	ACCEPTABLE
288	431.33	2446.20	2465.90	1.10	ACCEPTABLE
289	414.89	2775.13	2793.50	1.16	ACCEPTABLE
290	423.19	2684.42	2702.55	1.16	ACCEPTABLE
291	431.58	2438.68	2458.44	1.10	ACCEPTABLE
292	434.27	2531.54	2551.16	1.10	ACCEPTABLE
293	429.14	2524.20	2543.99	1.10	ACCEPTABLE
294	432.39	2534.27	2553.91	1.10	ACCEPTABLE
295	425.47	2622.55	2641.27	1.14	ACCEPTABLE
296	421.53	2758.53	2777.26	1.14	ACCEPTABLE
297	427.18	2692.18	2710.80	1.14	ACCEPTABLE
298	427.26	2589.04	2608.82	1.10	ACCEPTABLE
299	432.73	2524.04	2543.75	1.10	ACCEPTABLE
300	430.61	2471.85	2491.58	1.10	ACCEPTABLE
301	419.90	2686.29	2705.12	1.13	ACCEPTABLE
302	425.27	2628.41	2647.09	1.14	ACCEPTABLE
303	430.96	2461.57	2481.38	1.10	ACCEPTABLE
304	430.78	2466.74	2486.50	1.10	ACCEPTABLE
305	427.45	2583.56	2603.37	1.10	ACCEPTABLE
306	432.56	2529.18	2548.85	1.10	ACCEPTABLE
307	429.14	2524.20	2543.99	1.10	ACCEPTABLE
308	431.30	2531.00	2550.69	1.10	ACCEPTABLE
309	426.73	2588.78	2607.86	1.12	ACCEPTABLE
310	424.20	2676.16	2695.24	1.12	ACCEPTABLE
311	427.88	2633.78	2652.79	1.12	ACCEPTABLE
312	427.89	2567.17	2586.96	1.10	ACCEPTABLE
313	431.53	2524.09	2543.83	1.10	ACCEPTABLE
314	430.12	2489.14	2508.89	1.10	ACCEPTABLE
315	423.09	2630.06	2649.21	1.13	ACCEPTABLE
316	426.60	2592.56	2611.61	1.13	ACCEPTABLE
317	430.36	2482.21	2502.01	1.10	ACCEPTABLE
318	430.24	2485.69	2505.46	1.10	ACCEPTABLE
319	428.02	2563.56	2583.36	1.10	ACCEPTABLE
320	431.42	2527.56	2547.27	1.10	ACCEPTABLE
321	289.80	188.06	207.81	1.00	ACCEPTABLE

Name : Model 1 0.287 = horizontal coefficient	Stage - analysis : 1 - 1



Slope stability analysis

Input data

Project

Task : Confirmatory Model for Final Closure of the Ash Basin
Description : Slope Stability Analysis of Grand Tower CCR Impoundment Final Closure Plan
Author : ERM - Annapolis
Date : 6/22/2020
Project number : 0533442

Settings

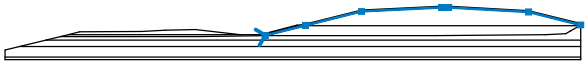
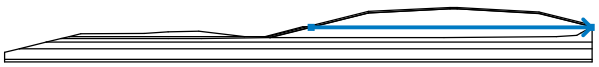
(input for current task)

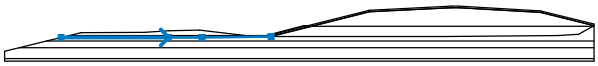
Stability analysis

Earthquake analysis : Standard
Verification methodology : Safety factors (ASD)

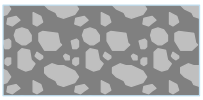
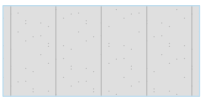
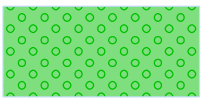
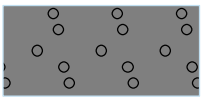
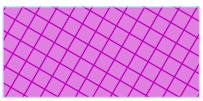
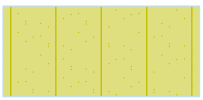
Safety factors			
Seismic design situation			
Safety factor :	SF_s =	1.00	[–]

Interface

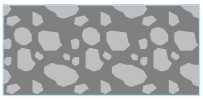
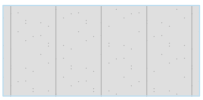
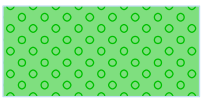
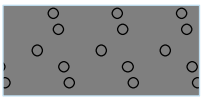
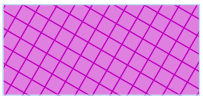
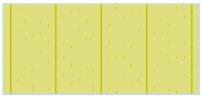
No.	Interface location	Coordinates of interface points [ft]					
		x	z	x	z	x	z
1		193.34	-9.67	194.41	-9.40	200.00	-8.00
		272.00	10.00	392.00	40.00	552.00	48.00
		566.00	48.00	726.00	39.00	830.00	13.00
2		199.27	-10.85	200.00	-10.67	279.99	9.33
		392.00	37.33	552.00	45.33	566.00	45.33
		726.00	36.33	830.00	10.33		
3		200.00	-11.00	279.99	9.00	392.00	37.00
		552.00	45.00	566.00	45.00	726.00	36.00
		830.00	10.00				
4		190.00	-9.00	263.58	10.00	272.00	10.00
5		-320.00	-40.00	-291.43	-33.00	-238.36	-20.00
		-209.79	-13.00	-193.45	-9.00	-171.00	-3.50
		-47.00	-3.00	0.00	0.00	60.00	1.10
		150.00	-9.00	190.00	-9.00	190.64	-9.12
		193.34	-9.67	199.27	-10.85	200.00	-11.00
		540.00	-11.00	760.00	-9.00	800.00	-7.00
		808.86	-1.98	828.24	9.00	830.00	10.00
6		279.99	9.00	828.24	9.00		
7		-193.45	-9.00	150.00	-9.00		

No.	Interface location	Coordinates of interface points [ft]					
		x	z	x	z	x	z
8		-209.79	-13.00	0.00	-13.00	65.00	-13.00
		200.00	-11.00				
9		-238.36	-20.00	830.00	-20.00		
10		-291.43	-33.00	830.00	-33.00		
11		-320.00	-54.00	830.00	-54.00		

Soil parameters - effective stress state

No.	Name	Pattern	φ_{ef} [°]	c_{ef} [psf]	γ [pcf]
1	Ash - Geotech Lab 6/2020		30.00	100.0	75.0
2	Silty Clay (Compacted Levee Cap)		10.00	450.0	133.0
3	Silty Sand (layer in berm, not basin)		28.00	100.0	115.0
4	Silty Clay, impervious fdtn (Updated with 2007 Hanson Report and ERM)		10.00	500.0	130.0
5	Sand & Gravel (Underlying Aquifer)		34.00	0.0	130.0
6	Gravel with trace of fines (G-F), medium dense- RipRap		40.00	0.0	165.0
7	Critical Interface		25.00	50.0	110.0
8	Sandy Silt (Native Pervious Material)		24.00	150.0	115.0

Soil parameters - uplift

No.	Name	Pattern	γ_{sat} [pcf]	γ_s [pcf]	n [–]
1	Ash - Geotech Lab 6/2020		100.0		
2	Silty Clay (Compacted Levee Cap)		153.0		
3	Silty Sand (layer in berm, not basin)		136.0		
4	Silty Clay, impervious fdtn (Updated with 2007 Hanson Report and ERM)		150.0		
5	Sand & Gravel (Underlying Aquifer)		130.0		
6	Gravel with trace of fines (G-F), medium dense- RipRap		165.0		
7	Critical Interface		110.0		
8	Sandy Silt (Native Pervious Material)		135.0		

Soil parameters

Ash - Geotech Lab 6/2020

Unit weight : γ = 75.0 pcf
Stress-state : effective
Angle of internal friction : φ_{ef} = 30.00 °
Cohesion of soil : c_{ef} = 100.0 psf
Saturated unit weight : γ_{sat} = 100.0 pcf

Silty Clay (Compacted Levee Cap)

Unit weight : γ = 133.0 pcf
Stress-state : effective
Angle of internal friction : φ_{ef} = 10.00 °
Cohesion of soil : c_{ef} = 450.0 psf
Saturated unit weight : γ_{sat} = 153.0 pcf

Silty Sand (layer in berm, not basin)

Unit weight : γ = 115.0 pcf
Stress-state : effective

Angle of internal friction : φ_{ef} = 28.00 °
Cohesion of soil : c_{ef} = 100.0 psf
Saturated unit weight : γ_{sat} = 136.0 pcf

Silty Clay, impervious fdtn (Updated with 2007 Hanson Report and ERM)
Unit weight : γ = 130.0 pcf
Stress-state : effective
Angle of internal friction : φ_{ef} = 10.00 °
Cohesion of soil : c_{ef} = 500.0 psf
Saturated unit weight : γ_{sat} = 150.0 pcf

Sand & Gravel (Underlying Aquifer)
Unit weight : γ = 130.0 pcf
Stress-state : effective
Angle of internal friction : φ_{ef} = 34.00 °
Cohesion of soil : c_{ef} = 0.0 psf
Saturated unit weight : γ_{sat} = 130.0 pcf

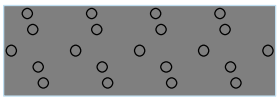
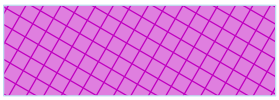
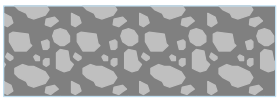
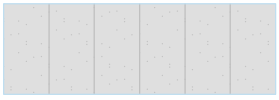
Gravel with trace of fines (G-F), medium dense- RipRap
Unit weight : γ = 165.0 pcf
Stress-state : effective
Angle of internal friction : φ_{ef} = 40.00 °
Cohesion of soil : c_{ef} = 0.0 psf
Saturated unit weight : γ_{sat} = 165.0 pcf

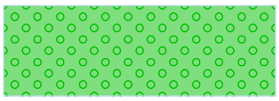
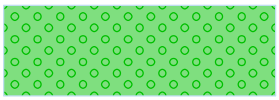
Critical Interface
Unit weight : γ = 110.0 pcf
Stress-state : effective
Angle of internal friction : φ_{ef} = 25.00 °
Cohesion of soil : c_{ef} = 50.0 psf
Saturated unit weight : γ_{sat} = 110.0 pcf

Sandy Silt (Native Pervious Material)
Unit weight : γ = 115.0 pcf
Stress-state : effective
Angle of internal friction : φ_{ef} = 24.00 °
Cohesion of soil : c_{ef} = 150.0 psf
Saturated unit weight : γ_{sat} = 135.0 pcf

Assigning and surfaces

No.	Surface position	Coordinates of surface points [ft]				Assigned soil
		x	z	x	z	
1		828.24	9.00	830.00	10.00	Ash - Geotech Lab 6/2020
		726.00	36.00	566.00	45.00	
		552.00	45.00	392.00	37.00	
		279.99	9.00			

No.	Surface position	Coordinates of surface points [ft]				Assigned soil
		x	z	x	z	
2		150.00	-9.00	60.00	1.10	Silty Clay (Compacted Levee Cap)
		0.00	0.00	-47.00	-3.00	
		-171.00	-3.50	-193.45	-9.00	
3		190.64	-9.12	193.34	-9.67	Gravel with trace of fines (G-F), medium dense-RipRap
		194.41	-9.40	200.00	-8.00	
		272.00	10.00	263.58	10.00	
		190.00	-9.00			
4		199.27	-10.85	200.00	-10.67	Silty Clay (Compacted Levee Cap)
		279.99	9.33	392.00	37.33	
		552.00	45.33	566.00	45.33	
		726.00	36.33	830.00	10.33	
		830.00	13.00	726.00	39.00	
		566.00	48.00	552.00	48.00	
		392.00	40.00	272.00	10.00	
		200.00	-8.00	194.41	-9.40	
		193.34	-9.67			
5		200.00	-11.00	279.99	9.00	Critical Interface
		392.00	37.00	552.00	45.00	
		566.00	45.00	726.00	36.00	
		830.00	10.00	830.00	10.33	
		726.00	36.33	566.00	45.33	
		552.00	45.33	392.00	37.33	
		279.99	9.33	200.00	-10.67	
		199.27	-10.85			
6		279.99	9.00	200.00	-11.00	Ash - Geotech Lab 6/2020
		540.00	-11.00	760.00	-9.00	
		800.00	-7.00	808.86	-1.98	
		828.24	9.00			
7		0.00	-13.00	65.00	-13.00	Silty Sand (layer in berm, not basin)
		200.00	-11.00	199.27	-10.85	
		193.34	-9.67	190.64	-9.12	
		190.00	-9.00	150.00	-9.00	
		-193.45	-9.00	-209.79	-13.00	
8		830.00	-20.00	830.00	10.00	Silty Clay, impervious fdtn (Updated with 2007 Hanson Report and ERM)
		828.24	9.00	808.86	-1.98	
		800.00	-7.00	760.00	-9.00	
		540.00	-11.00	200.00	-11.00	
		65.00	-13.00	0.00	-13.00	
		-209.79	-13.00	-238.36	-20.00	

No.	Surface position	Coordinates of surface points [ft]				Assigned soil
		x	z	x	z	
9		830.00	-33.00	830.00	-20.00	Sandy Silt (Native Pervious Material)
		-238.36	-20.00	-291.43	-33.00	
10		830.00	-54.00	830.00	-33.00	Sand & Gravel (Underlying Aquifer)
		-291.43	-33.00	-320.00	-40.00	
		-320.00	-54.00			
11		-320.00	-54.00	-320.00	-59.00	Sand & Gravel (Underlying Aquifer)
		830.00	-59.00	830.00	-54.00	
						

Water

Water type : GWT

No.	GWT location	Coordinates of GWT points [ft]					
		x	z	x	z	x	z
1		-320.00	-3.50	-171.00	-3.50	0.00	-13.00
		83.00	-13.00	830.00	-13.00		

Tensile crack

Tensile crack not input.

Earthquake

Horizontal seismic coefficient : K_h = 0.2850
Vertical seismic coefficient : K_v = 0.0000

Settings of the stage of construction

Design situation : seismic

Results (Stage of construction 1)

Analysis 1 (stage 1)

Circular slip surface

Slip surface parameters							
Center :	x =	264.45	[ft]	Angles :	α_1 =	-16.57	[°]
	z =	240.90	[ft]		α_2 =	40.30	[°]
Radius :	R =	260.71	[ft]				
The slip surface after optimization.							

Segments restricting slip surface

No.	First point		Second point	
	x [ft]	z [ft]	x [ft]	z [ft]
1	11.60	-19.94	599.18	-19.84
2	173.94	64.88	148.33	-72.97
3	557.89	132.39	569.37	-78.13

The restrictions of points of circular slip surface

Slope stability verification (Bishop)

Sum of active forces : F_a = 240852.0 lbf/ft

Sum of passive forces : F_p = 241047.7 lbf/ft

Sliding moment : M_a = 62792537.9 lbfft/ft

Resisting moment : M_p = 62843557.2 lbfft/ft

Factor of safety = 1.00 > 1.00

Slope stability ACCEPTABLE

Optimization of circular slip surface (Bishop)

No.	Center		Radius	FS	Verification
	x [ft]	z [ft]	R [ft]		
1	264.45	240.90	260.71	1.00	ACCEPTABLE
2	264.45	240.90	260.71	1.00	ACCEPTABLE
3	264.45	240.90	260.71	1.00	ACCEPTABLE
4	305.10	120.86	366.17	2.36	ACCEPTABLE
5	89.78	633.68	649.24	1.49	ACCEPTABLE
6	264.45	240.90	260.71	1.00	ACCEPTABLE
7	264.45	240.90	260.71	1.00	ACCEPTABLE
8	395.47	168.86	185.27	1.38	ACCEPTABLE
9	264.45	240.90	260.71	1.00	ACCEPTABLE
10	355.95	183.21	200.13	1.21	ACCEPTABLE
11	306.26	43.94	59.70	1.75	ACCEPTABLE
12	264.45	240.90	260.71	1.00	ACCEPTABLE
13	327.00	198.54	216.14	1.13	ACCEPTABLE
14	295.88	86.84	103.56	1.29	ACCEPTABLE
15	325.20	209.07	225.00	1.18	ACCEPTABLE
16	264.45	240.90	260.71	1.00	ACCEPTABLE
17	304.93	221.59	238.28	1.12	ACCEPTABLE
18	236.26	349.20	350.72	1.38	ACCEPTABLE
19	-495.11	4674.60	4729.17	1.74	ACCEPTABLE
20	125.06	1198.65	1203.59	1.48	ACCEPTABLE
21	306.95	210.65	228.84	1.08	ACCEPTABLE
22	284.89	136.42	151.98	1.18	ACCEPTABLE
23	76.66	1019.55	1031.91	1.63	ACCEPTABLE
24	109.90	902.01	909.90	1.63	ACCEPTABLE
25	287.16	126.49	144.09	1.13	ACCEPTABLE
26	303.42	229.84	245.49	1.15	ACCEPTABLE
27	264.45	240.90	260.71	1.00	ACCEPTABLE
28	287.95	246.84	262.38	1.13	ACCEPTABLE
29	250.63	294.20	300.70	1.34	ACCEPTABLE
30	158.73	848.81	857.88	1.37	ACCEPTABLE
31	234.79	522.66	527.00	1.36	ACCEPTABLE
32	250.16	351.25	369.08	1.08	ACCEPTABLE
33	293.17	219.74	238.40	1.05	ACCEPTABLE
34	277.33	173.47	189.51	1.12	ACCEPTABLE

No.	Center		Radius	FS	Verification
	x [ft]	z [ft]	R [ft]		
35	192.89	494.32	503.84	1.35	ACCEPTABLE
36	227.97	396.64	400.81	1.35	ACCEPTABLE
37	244.41	244.17	263.91	1.03	ACCEPTABLE
38	280.49	159.20	177.46	1.07	ACCEPTABLE
39	289.63	238.11	254.57	1.10	ACCEPTABLE
40	264.45	240.90	260.71	1.00	ACCEPTABLE
41	278.63	252.28	268.50	1.10	ACCEPTABLE
42	256.48	271.85	282.36	1.33	ACCEPTABLE
43	217.84	505.90	516.55	1.33	ACCEPTABLE
44	253.44	379.19	387.93	1.34	ACCEPTABLE
45	254.82	312.94	331.30	1.05	ACCEPTABLE
46	283.79	226.32	245.33	1.03	ACCEPTABLE
47	272.76	196.79	213.82	1.08	ACCEPTABLE
48	224.84	369.66	381.71	1.27	ACCEPTABLE
49	247.46	313.39	321.91	1.33	ACCEPTABLE
50	251.08	243.10	262.86	1.02	ACCEPTABLE
51	275.56	183.90	202.64	1.04	ACCEPTABLE
52	280.86	241.07	258.42	1.07	ACCEPTABLE
53	264.45	240.90	260.71	1.00	ACCEPTABLE
54	273.27	251.50	268.62	1.07	ACCEPTABLE
55	259.55	260.04	273.48	1.19	ACCEPTABLE
56	238.99	384.48	397.71	1.22	ACCEPTABLE
57	259.49	319.60	331.82	1.24	ACCEPTABLE
58	257.98	288.24	307.02	1.03	ACCEPTABLE
59	277.43	230.96	250.22	1.02	ACCEPTABLE
60	269.88	211.84	229.70	1.05	ACCEPTABLE
61	240.28	315.58	329.93	1.17	ACCEPTABLE
62	255.02	281.12	293.18	1.24	ACCEPTABLE
63	255.52	242.39	262.17	1.01	ACCEPTABLE
64	272.05	201.73	220.81	1.03	ACCEPTABLE
65	275.21	241.91	259.98	1.05	ACCEPTABLE
66	264.45	240.90	260.71	1.00	ACCEPTABLE
67	270.06	249.22	267.11	1.05	ACCEPTABLE
68	261.34	253.10	268.59	1.12	ACCEPTABLE
69	249.26	326.01	341.29	1.14	ACCEPTABLE
70	261.95	288.78	303.45	1.15	ACCEPTABLE
71	260.11	272.17	291.26	1.02	ACCEPTABLE
72	273.14	234.17	253.60	1.01	ACCEPTABLE
73	268.03	221.67	240.15	1.03	ACCEPTABLE
74	249.09	286.87	302.92	1.11	ACCEPTABLE
75	258.80	265.01	279.58	1.15	ACCEPTABLE
76	258.48	241.92	261.71	1.01	ACCEPTABLE
77	269.61	214.26	233.57	1.02	ACCEPTABLE
78	271.55	241.97	260.58	1.03	ACCEPTABLE
79	264.45	240.90	260.71	1.00	ACCEPTABLE
80	268.07	246.98	265.45	1.04	ACCEPTABLE
81	262.44	248.81	265.71	1.08	ACCEPTABLE
82	254.97	293.76	310.50	1.09	ACCEPTABLE
83	263.09	271.08	287.44	1.09	ACCEPTABLE

No.	Center		Radius	FS	Verification
	x [ft]	z [ft]	R [ft]		
84	261.53	261.63	280.94	1.02	ACCEPTABLE
85	270.26	236.37	255.92	1.01	ACCEPTABLE
86	266.82	228.14	247.05	1.03	ACCEPTABLE
87	254.49	270.11	287.37	1.07	ACCEPTABLE
88	260.92	255.96	272.25	1.10	ACCEPTABLE
89	260.46	241.60	261.40	1.01	ACCEPTABLE
90	267.93	222.90	242.37	1.01	ACCEPTABLE
91	262.75	255.67	275.55	1.00	ACCEPTABLE
92	269.14	241.78	260.78	1.02	ACCEPTABLE
93	264.45	240.90	260.71	1.00	ACCEPTABLE
94	266.81	245.18	264.08	1.03	ACCEPTABLE
95	263.13	246.08	263.94	1.05	ACCEPTABLE
96	258.38	274.62	292.36	1.06	ACCEPTABLE
97	263.67	260.32	277.82	1.06	ACCEPTABLE
98	262.49	254.68	274.16	1.01	ACCEPTABLE
99	268.33	237.86	257.50	1.01	ACCEPTABLE
100	266.02	232.42	251.62	1.02	ACCEPTABLE
101	257.92	259.81	277.90	1.05	ACCEPTABLE
102	262.19	250.54	267.99	1.06	ACCEPTABLE
103	261.78	241.40	261.20	1.00	ACCEPTABLE
104	266.79	228.79	248.38	1.01	ACCEPTABLE
105	263.30	250.73	270.59	1.00	ACCEPTABLE
106	267.56	241.57	260.82	1.02	ACCEPTABLE
107	264.45	240.90	260.71	1.00	ACCEPTABLE
108	266.00	243.85	263.04	1.02	ACCEPTABLE
109	263.58	244.32	262.82	1.04	ACCEPTABLE
110	260.50	262.77	281.19	1.03	ACCEPTABLE
111	263.98	253.55	271.82	1.04	ACCEPTABLE
112	263.13	250.09	269.67	1.01	ACCEPTABLE
113	267.04	238.86	258.56	1.01	ACCEPTABLE
114	265.49	235.26	254.66	1.01	ACCEPTABLE
115	260.13	253.29	271.94	1.03	ACCEPTABLE
116	262.98	247.16	265.39	1.04	ACCEPTABLE
117	262.65	241.26	261.07	1.00	ACCEPTABLE
118	266.02	232.78	252.44	1.01	ACCEPTABLE
119	263.67	247.46	267.31	1.00	ACCEPTABLE
120	266.52	241.38	260.82	1.01	ACCEPTABLE
121	264.45	240.90	260.71	1.00	ACCEPTABLE
122	265.47	242.91	262.30	1.02	ACCEPTABLE
123	263.88	243.16	262.09	1.03	ACCEPTABLE
124	261.85	255.24	274.12	1.02	ACCEPTABLE
125	264.16	249.21	267.99	1.03	ACCEPTABLE
126	263.55	247.04	266.70	1.00	ACCEPTABLE
127	266.18	239.54	259.27	1.01	ACCEPTABLE
128	265.14	237.15	256.68	1.01	ACCEPTABLE
129	261.58	249.08	268.12	1.02	ACCEPTABLE
130	263.49	245.00	263.76	1.03	ACCEPTABLE
131	263.24	241.17	260.98	1.00	ACCEPTABLE
132	265.86	233.77	253.65	1.00	ACCEPTABLE

No.	Center		Radius	FS	Verification
	x [ft]	z [ft]	R [ft]		
133	265.50	235.46	255.17	1.01	ACCEPTABLE
134	263.92	245.29	265.13	1.00	ACCEPTABLE
135	265.83	241.23	260.79	1.01	ACCEPTABLE
136	264.45	240.90	260.71	1.00	ACCEPTABLE
137	265.13	242.26	261.79	1.01	ACCEPTABLE
138	264.07	242.40	261.62	1.02	ACCEPTABLE
139	262.72	250.37	269.56	1.02	ACCEPTABLE
140	264.27	246.39	265.51	1.02	ACCEPTABLE
141	263.84	245.02	264.73	1.00	ACCEPTABLE
142	265.60	239.99	259.75	1.00	ACCEPTABLE
143	264.91	238.40	258.03	1.01	ACCEPTABLE
144	262.53	246.34	265.63	1.02	ACCEPTABLE
145	263.82	243.60	262.71	1.02	ACCEPTABLE
146	263.63	241.11	260.92	1.00	ACCEPTABLE
147	265.39	236.13	255.99	1.00	ACCEPTABLE
148	265.15	237.27	257.01	1.01	ACCEPTABLE
149	264.08	243.85	263.68	1.00	ACCEPTABLE
150	265.37	241.13	260.77	1.01	ACCEPTABLE
151	305.10	120.86	366.17	2.36	ACCEPTABLE
152	263.39	439.93	708.83	1.72	ACCEPTABLE
153	391.56	187.44	471.20	2.25	ACCEPTABLE
154	250.51	83.96	583.15	2.94	ACCEPTABLE
155	391.51	190.22	472.28	2.24	ACCEPTABLE
156	263.39	439.92	708.82	1.72	ACCEPTABLE
157	353.46	182.83	505.22	2.32	ACCEPTABLE
158	342.05	839.00	958.89	1.49	ACCEPTABLE
159	232.00	1285.61	1405.68	1.39	ACCEPTABLE
160	345.31	651.36	800.99	1.54	ACCEPTABLE
161	352.11	260.02	537.30	2.04	ACCEPTABLE
162	342.54	810.81	934.46	1.50	ACCEPTABLE
163	185.27	253.91	534.77	1.95	ACCEPTABLE
164	272.91	143.41	415.88	2.31	ACCEPTABLE
165	154.49	292.73	578.90	1.84	ACCEPTABLE
166	342.23	828.28	949.57	1.49	ACCEPTABLE
167	232.00	1285.61	1405.68	1.39	ACCEPTABLE
168	316.62	866.90	995.87	1.48	ACCEPTABLE
169	323.81	436.67	659.49	1.71	ACCEPTABLE
170	315.62	926.81	1048.17	1.47	ACCEPTABLE
171	200.71	429.63	655.80	1.63	ACCEPTABLE
172	265.82	317.63	539.18	1.79	ACCEPTABLE
173	315.41	939.57	1059.41	1.47	ACCEPTABLE
174	232.00	1285.61	1405.68	1.39	ACCEPTABLE
175	290.15	1021.63	1143.57	1.45	ACCEPTABLE
176	299.74	611.45	799.02	1.56	ACCEPTABLE
177	289.88	1033.07	1153.79	1.45	ACCEPTABLE
178	212.14	604.05	794.27	1.50	ACCEPTABLE
179	259.01	500.33	687.97	1.58	ACCEPTABLE
180	289.56	1046.80	1166.10	1.45	ACCEPTABLE
181	232.00	1285.61	1405.68	1.39	ACCEPTABLE

No.	Center		Radius	FS	Verification
	x [ft]	z [ft]	R [ft]		
182	271.13	1118.53	1238.32	1.43	ACCEPTABLE
183	280.94	770.04	934.67	1.49	ACCEPTABLE
184	271.32	1111.75	1232.18	1.43	ACCEPTABLE
185	219.47	762.62	929.22	1.44	ACCEPTABLE
186	252.72	674.03	839.11	1.49	ACCEPTABLE
187	270.98	1123.91	1243.19	1.43	ACCEPTABLE
188	232.00	1285.61	1405.68	1.39	ACCEPTABLE
189	258.20	1178.45	1297.73	1.42	ACCEPTABLE
190	266.76	904.13	1053.71	1.45	ACCEPTABLE
191	258.55	1167.11	1287.40	1.42	ACCEPTABLE
192	218.90	1065.78	1216.82	1.39	ACCEPTABLE
193	243.23	982.85	1133.06	1.42	ACCEPTABLE
194	232.58	1269.91	1391.24	1.39	ACCEPTABLE
195	202.13	1132.54	1283.12	1.37	ACCEPTABLE
196	227.06	1046.89	1196.38	1.40	ACCEPTABLE
197	235.97	828.36	1008.28	1.45	ACCEPTABLE
198	227.56	1034.85	1185.75	1.40	ACCEPTABLE
199	207.73	962.01	1111.63	1.39	ACCEPTABLE
200	217.57	760.41	940.90	1.45	ACCEPTABLE
201	208.69	942.30	1094.47	1.40	ACCEPTABLE
202	208.06	955.24	1105.72	1.39	ACCEPTABLE
203	202.13	1132.57	1283.15	1.37	ACCEPTABLE
204	227.18	1044.10	1193.92	1.40	ACCEPTABLE
205	202.13	1132.54	1283.12	1.37	ACCEPTABLE
206	218.76	1077.09	1226.68	1.39	ACCEPTABLE
207	197.49	1192.09	1323.69	1.36	ACCEPTABLE
208	228.14	1200.49	1330.86	1.39	ACCEPTABLE
209	235.68	1006.75	1157.43	1.41	ACCEPTABLE
210	228.49	1191.60	1322.78	1.39	ACCEPTABLE
211	194.18	943.78	1095.99	1.38	ACCEPTABLE
212	210.29	894.28	1045.76	1.40	ACCEPTABLE
213	228.25	1197.70	1328.32	1.39	ACCEPTABLE
214	197.49	1192.09	1323.69	1.36	ACCEPTABLE
215	217.81	1199.94	1330.50	1.38	ACCEPTABLE
216	193.94	1295.50	1426.64	1.36	ACCEPTABLE
217	210.18	1278.69	1408.87	1.37	ACCEPTABLE
218	216.49	1130.63	1274.49	1.38	ACCEPTABLE
219	210.61	1268.57	1399.59	1.37	ACCEPTABLE
220	192.31	1103.46	1248.31	1.37	ACCEPTABLE
221	203.60	1064.72	1209.09	1.38	ACCEPTABLE
222	197.57	1190.57	1322.30	1.36	ACCEPTABLE
223	210.37	1274.36	1404.91	1.37	ACCEPTABLE
224	193.94	1295.50	1426.64	1.36	ACCEPTABLE
225	206.23	1293.75	1424.14	1.37	ACCEPTABLE
226	210.74	1189.86	1329.39	1.38	ACCEPTABLE
227	195.96	1233.57	1364.32	1.36	ACCEPTABLE
228	192.95	1162.53	1302.81	1.36	ACCEPTABLE
229	200.64	1134.99	1274.94	1.37	ACCEPTABLE
230	196.37	1224.80	1356.32	1.36	ACCEPTABLE

No.	Center		Radius	FS	Verification
	x [ft]	z [ft]	R [ft]		
231	196.15	1229.50	1360.61	1.36	ACCEPTABLE
232	193.94	1295.50	1426.64	1.36	ACCEPTABLE
233	203.10	1300.59	1431.16	1.37	ACCEPTABLE
234	199.99	1371.11	1496.21	1.36	ACCEPTABLE
235	203.33	1295.34	1426.34	1.37	ACCEPTABLE
236	198.53	1185.31	1322.33	1.37	ACCEPTABLE
237	203.21	1298.11	1428.89	1.37	ACCEPTABLE
238	193.94	1295.50	1426.64	1.36	ACCEPTABLE
239	200.03	1299.10	1429.84	1.36	ACCEPTABLE
240	202.21	1250.63	1385.45	1.37	ACCEPTABLE
241	200.20	1295.39	1426.44	1.36	ACCEPTABLE
242	193.56	1233.75	1368.95	1.36	ACCEPTABLE
243	197.06	1220.56	1355.61	1.36	ACCEPTABLE
244	200.11	1297.31	1428.20	1.36	ACCEPTABLE
245	193.94	1295.50	1426.64	1.36	ACCEPTABLE
246	198.00	1297.99	1428.86	1.36	ACCEPTABLE
247	198.11	1295.43	1426.50	1.36	ACCEPTABLE
248	194.54	1276.94	1407.96	1.36	ACCEPTABLE
249	198.05	1296.74	1427.71	1.36	ACCEPTABLE
250	193.94	1295.50	1426.64	1.36	ACCEPTABLE
251	196.64	1297.20	1428.15	1.36	ACCEPTABLE
252	193.42	1302.65	1432.12	1.36	ACCEPTABLE
253	196.13	1304.38	1433.67	1.36	ACCEPTABLE
254	197.15	1282.12	1413.22	1.36	ACCEPTABLE
255	196.21	1302.60	1432.03	1.36	ACCEPTABLE
256	193.98	1294.57	1425.79	1.36	ACCEPTABLE
257	193.83	1290.13	1419.52	1.36	ACCEPTABLE
258	193.91	1288.29	1417.82	1.36	ACCEPTABLE
259	191.69	1280.41	1411.75	1.36	ACCEPTABLE
260	194.38	1282.11	1413.27	1.36	ACCEPTABLE
261	191.17	1287.38	1417.04	1.36	ACCEPTABLE
262	193.87	1289.12	1418.59	1.36	ACCEPTABLE
263	193.95	1287.33	1416.95	1.36	ACCEPTABLE
264	191.73	1279.48	1410.89	1.36	ACCEPTABLE
265	193.91	1288.24	1417.78	1.36	ACCEPTABLE
266	191.17	1287.38	1417.04	1.36	ACCEPTABLE
267	192.97	1288.56	1418.09	1.36	ACCEPTABLE
268	193.66	1273.86	1404.60	1.36	ACCEPTABLE
269	190.90	1295.67	1425.38	1.36	ACCEPTABLE
270	192.70	1296.85	1426.44	1.36	ACCEPTABLE
271	193.40	1282.04	1412.83	1.36	ACCEPTABLE
272	192.76	1295.64	1425.32	1.36	ACCEPTABLE
273	191.28	1290.32	1421.20	1.36	ACCEPTABLE
274	191.17	1287.37	1417.03	1.36	ACCEPTABLE
275	190.82	1276.78	1407.69	1.36	ACCEPTABLE
276	191.88	1272.68	1403.55	1.36	ACCEPTABLE
277	191.23	1286.13	1415.88	1.36	ACCEPTABLE
278	189.76	1280.88	1411.83	1.35	ACCEPTABLE
279	191.55	1282.05	1412.87	1.36	ACCEPTABLE

No.	Center		Radius	FS	Verification
	x [ft]	z [ft]	R [ft]		
280	190.93	1295.03	1424.79	1.36	ACCEPTABLE
281	189.43	1290.34	1421.25	1.35	ACCEPTABLE
282	189.49	1289.09	1420.10	1.35	ACCEPTABLE
283	191.61	1280.85	1411.77	1.36	ACCEPTABLE
284	190.13	1275.68	1407.80	1.36	ACCEPTABLE
285	190.03	1272.70	1403.60	1.36	ACCEPTABLE
286	187.91	1280.92	1411.90	1.35	ACCEPTABLE
287	189.70	1282.10	1412.95	1.35	ACCEPTABLE
288	189.76	1280.88	1411.83	1.35	ACCEPTABLE
289	188.29	1275.72	1407.87	1.35	ACCEPTABLE
290	188.18	1272.75	1403.67	1.35	ACCEPTABLE
291	188.25	1271.50	1402.53	1.35	ACCEPTABLE
292	188.21	1272.13	1403.11	1.35	ACCEPTABLE
293	189.73	1281.50	1412.40	1.35	ACCEPTABLE
294	187.91	1280.92	1411.90	1.35	ACCEPTABLE
295	189.10	1281.72	1412.61	1.35	ACCEPTABLE
296	189.14	1280.90	1411.86	1.35	ACCEPTABLE
297	188.16	1277.45	1409.21	1.35	ACCEPTABLE
298	188.09	1275.47	1406.41	1.35	ACCEPTABLE
299	186.68	1280.94	1411.94	1.35	ACCEPTABLE
300	187.87	1281.74	1412.65	1.35	ACCEPTABLE
301	188.35	1272.02	1403.74	1.35	ACCEPTABLE
302	187.91	1280.92	1411.90	1.35	ACCEPTABLE
303	186.93	1277.47	1409.25	1.35	ACCEPTABLE
304	186.63	1268.53	1400.33	1.35	ACCEPTABLE
305	185.93	1271.24	1403.07	1.35	ACCEPTABLE
306	187.12	1272.04	1403.78	1.35	ACCEPTABLE
307	186.70	1280.52	1411.55	1.35	ACCEPTABLE
308	185.70	1277.49	1409.29	1.35	ACCEPTABLE
309	186.89	1278.29	1410.00	1.35	ACCEPTABLE
310	186.93	1277.47	1409.25	1.35	ACCEPTABLE
311	185.95	1274.05	1406.63	1.35	ACCEPTABLE
312	185.88	1272.07	1403.83	1.35	ACCEPTABLE
313	185.93	1271.23	1403.07	1.35	ACCEPTABLE
314	185.90	1271.65	1403.45	1.35	ACCEPTABLE
315	186.91	1277.88	1409.63	1.35	ACCEPTABLE
316	264.45	240.90	260.71	1.00	ACCEPTABLE

Name : Model 4 seismic coefficient 0.285	Stage - analysis : 1 - 1