NOTICE OF MEETING
HILLSIDE REVIEW BOARD
CITY OF ST. GEORGE
WASHINGTON COUNTY, UTAH

Public Notice

Notice is hereby given that the Hillside Review Board of the City of St. George, Washington County, Utah, will hold a meeting at the referenced site on Wednesday, August 07, 2024, commencing on-site at 8:30 a.m.

The agenda for the meeting is as follows:

Call to Order

1. **Consider a request for a Hillside Development Permit to allow disturbance of areas in the 20-30%, 30-40%, and 40% and above slope areas and review possible construction in a possible landslide area. Applicant – American Land Consulting, LLC, representative, Adam Allen. Case No. 2024-HS-011.**

   BACKGROUND AND RECOMMENDATION: In 2019, the Hillside Review Board heard a request on this property for a hotel and associated parking structure. That application was ultimately approved by the City Council but had a number of conditions associated with the construction, such as 15-18 feet of over-excavation and imported/structural fill, deep foundations, and a decant wall (intended to increase slope stability). The current application is to review two buildings that would be restaurants on two lots. **Meeting time is approximately 8:30 am at the North-East corner of Black Ridge Drive and 250 West**.

2. **Consider a request for a Hillside Development Permit to adjust the location of the ridgeline and ridgeline setback on lot 44 of the Foremaster Ridge subdivision in anticipation of the construction of a a residential home. Applicant – Jack de Ryk. Case No. 2024-HS-010.**

   BACKGROUND AND RECOMMENDATION: This is a request to obtain a hillside development for the property located at 1856 E. Joe Cir. (Lot 44, Foremaster Ridge). This location is a residential neighborhood, and the applicant would like to build a house on this lot. The rear of the applicant's property abuts the ridge line of Foremaster Ridge. The applicant is requesting to review the location of the 30-foot ridgeline setback as shown on the final plat for Foremaster Ridge lot 44 and establish a ridgeline which the applicant feels is more indicative of the actual ridgeline. **Meeting time is approximately 9:30 am at 1856 E Joe Cir.**

3. **Minutes**

   Consider a request to approve the meeting minutes from the July 10, 2024 meeting.

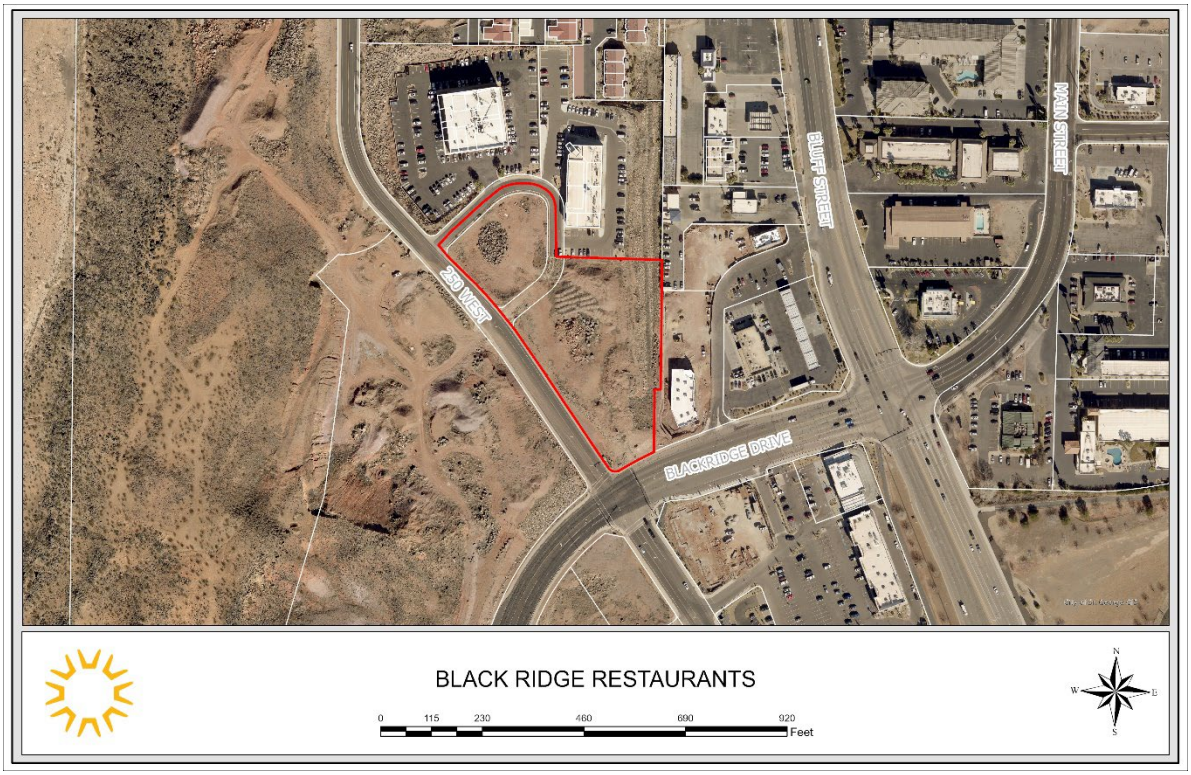
Monica Smith

Monica Smith – Development Office Supervisor

REASONABLE ACCOMMODATION: The City of St. George will make efforts to provide reasonable accommodations to disabled members of the public in accessing City programs. Please contact the City Human Resources Office at (435) 627-4674 at least 24 hours in advance if you have special needs.

Item # 1 Meeting Location

North-East Corner of Black Ridge Dr. & 250 W



Item #2 Meeting Location

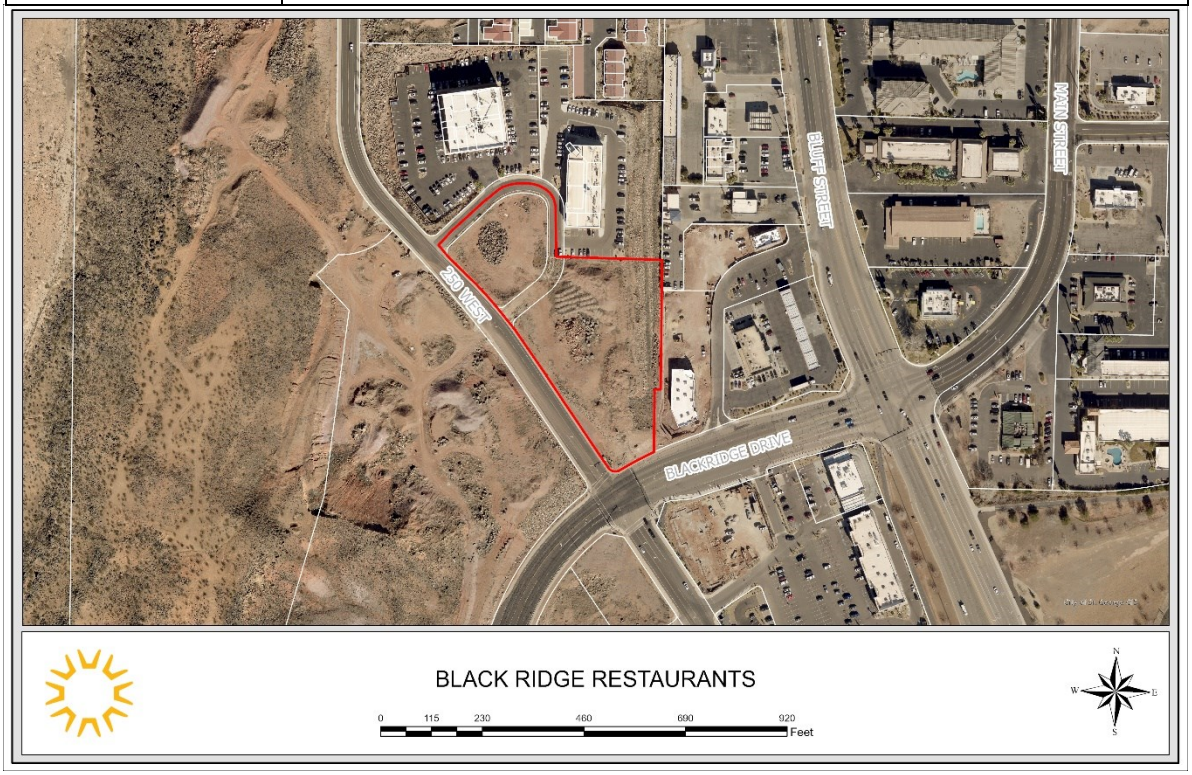
1856 E Joe Cir.

St.George
Community Development

ITEM 1
Hillside Permit

HILLSIDE REVIEW BOARD AGENDA REPORT: **08/07/2024**

Black Ridge Restaurants Hillside Development Permit (Case No. 2024-HS-011)		
Request:	A Hillside Development Permit to allow disturbance of areas in the 20-30%, 30-40% and 40% and above slope areas and review possible construction in a possible landslide area.	
Applicant:	American Land Consulting, LLC	
Representative:	Adam Allen	
Location:	North-East corner or Black Ridge Drive & 250 West	
General Plan:	DTCC (Downtown Connected Corridor)	
Existing Zoning:	PD-C (Planned Development Commercial)	
Surrounding Zoning:	North	PD-C (Planned Development Commercial)
	South	C-2 (Highway Commercial)
	East	PD-C (Planned Development Commercial)
	West	PD-C (Planned Development Commercial)
Land Area:	Approximately 164,473 ft² (3.77 acres)	



BACKGROUND

In 2019, the Hillside Review Board heard a request on this property for a hotel and associated parking structure. That application was ultimately approved by the City Council but had a number of conditions associate with the construction such as 15-18 feet of over-excavation and imported/structural fill, deep foundations, and a secant wall (intended to increase slope stability) to name a few. Additionally, restrictions on surface water were also imposed in order to limit the amount of water that soaks into the hillside soil. In the end, the hotel moved across the street and in 2021, received approval for a hillside permit. It appears that the hotel concept has been abandoned at this point.

The current application is to review two buildings that would be restaurants on the two lots. The lots were created in 2006 through the Black Ridge Commercial Center plat. The Hillside Review Board must weigh in and make a recommendation to Planning Commission and City Council on all applications in hillside overlay areas.

This particular request still will need to address the items listed above. Those items include, 1) slopes that are in excess of 40% on the site. It appears that some of those slopes were created by piling dirt and other materials on the site through the years. 2) Landscaping on the site. The previously approved hotel required limiting the landscaping quantities and types in order to contain the water on site and limit the amount of water that accumulated in soil. This will need to be considered here as well. 3) The property is in a designated landslide area identified by the Utah Geological Society (UGS). The applicant will need to identify how they intend to deal with this potential issue and the Hillside Review Board must carefully consider those measures and any other conditions needed to make this site compatible with development.

APPLICABLE ORDINANCE(S) *(Selected portions)*

10-13A-1: Density and Disturbance Standards

A. The hillside development overlay zone (HDOZ) limits development densities and provides specific development incentives to transfer underlying zone densities from hillsides (sending areas) to less steep slopes or more safe development areas (receiving areas), within a development.

B. For those portions of a proposed development with natural slopes twenty percent (20%) or less, development density follows the density and development standards in the underlying zone.

C. For those portions of a proposed development with natural slopes from twenty-one percent (21%) to thirty percent (30%), development activity shall not disturb more than thirty percent (30%) of the parcel within this slope category.

D. For those portions of a proposed development with natural slopes from thirty-one percent (31%) to forty percent (40%), development activity shall not disturb more than five percent (5%) of the area within this slope category.

E. A proposed development may not disturb slopes in excess of forty percent (40%).

10-13A-2: Slope and Slope Areas Determined

A. Slope shall be determined for each significant portion of development parcel.

B. *Procedure:* The applicant shall map the location of the natural slope by using the following procedure:

1. *Preparation of Contour Maps:* The applicant shall submit an accurate, current contour map, prepared and certified by a licensed professional engineer or surveyor, which shows all land contours at intervals no greater than five feet (5'), drawn at a one inch equals one hundred feet (1" = 100') scale maximum.

2. *Verification through Field Surveys:* The city engineer, or designee may require the applicant to submit a field survey to verify the accuracy of the contour map.

C. *Determination of Slope Areas:* Using the contour map, natural slopes shall be calculated using points identified as natural slopes of twenty percent (20%), thirty percent (30%), and forty percent (40%), and shall be located on the contour map and connected by a continuous line. That area bounded by said lines and intersecting property lines shall be used for determining project density. Small washes or outcrops, which have slopes distinctly different from surrounding property, and are not part of the contiguous topography, may be excluded from the slope determination.

10-13B-2: Development in Geologic Hazard Areas

A. *Geologic Hazard Areas (UGS 1 – 4: subsections A1 through A4 of this section):* For any development in the city with a geologic hazard listed below, applicant shall submit a report prepared by a qualified, licensed geologist specializing in engineering geology, or a licensed civil engineer, trained and experienced in the practice of geotechnical engineering. Development in the geologic hazard overlay for high category rockfall areas shall be reviewed by the hillside review board.

1. Surface fault rupture and earthquake: well-defined Holocene, and well-defined fault areas, red and purple lines/categories (extending five hundred feet (500') on the downthrown side and two hundred fifty feet (250') on the upthrown side of each red/purple fault line).
2. Liquefaction: Very High category.
3. Landslide: Very High category.
4. Rockfall: High category.

B. *General Requirements for Development in a Geologic Hazard Area:*

1. Submit a site-specific report prepared by a qualified, licensed geologist specializing in engineering geology, or a licensed civil engineer, trained and experienced in the practice of geotechnical engineering with the following minimum requirements:

a. Identify all geologic hazard areas (UGS 1 – 4: subsections A1 through A4 of this section);

b. Identify any other geologic hazards, not listed above (UGS 1 – 4: subsections A1 through A4 of this section), which present an unacceptable risk to development;

c. Demonstrate which areas of the development are suitable for the proposed use;

d. Recommend specific measures necessary to make the land suitable for the proposed use;

e. Recommend the optimal placement of all structures, roadways, utilities, trails and infrastructure in relation to the geologic hazard area;

f. Slope stability analysis: conclusions and recommendations concerning the effects of material removal, introduction of water, both on and off site, including, where applicable, on mesa tops, seismic activity, and erosion on slope stability;

g. Foundation investigation: conclusions and recommendations concerning the effects of soil conditions on foundation and structural stability, including bearing capacity, sheer strength, and shrink/swell potential of soils;

h. Spring location: the location and yield of springs and seeps which shall be shown on the site plan;

i. Structural features: structural features including any geological limitations;

j. Surface hazards: existence of surface hazards including potential for rockfalls and toppling failures to cliffs, slopes and overhangs above the subject property; and

k. Effect of geologic conditions: conclusions and recommendations regarding the effect of geologic conditions on the proposed development, together with recommendations identifying the means proposed to minimize any hazard to life or property, or adverse impact on the natural environment.

2. The city shall review the applicant's report. If the applicant's report is deemed adequate by the city engineer or designee, development may proceed if the report recommendations are followed. If the report is deemed incomplete or inadequate by the city engineer or designee, the development application shall be denied. If denied, the applicant may request an independent review, and the city engineer or designee may order a review by independent, qualified professionals. The professionals selected by the city shall review and prepare written findings and comments on the applicant's report. The cost of the independent, qualified professionals shall be paid to the city by applicant. Applicant may develop if the independent review and written findings and comments are implemented, in addition to any nonconflicting recommendations in the initial report of applicant. The city engineer or designee is the land use authority for the decision. The reports shall be specifically identified on the plat and available to all owners and interested parties.

3. All development shall be outside the geologic hazard areas in subsections A1 through A4 of this section, unless:

a. The city has accepted applicant's report, prepared by a qualified, licensed geologist specializing in engineering geology or a licensed professional engineer trained and practicing in the field of geotechnical engineering, and it recommends development, and shows hazards can be adequately mitigated for the proposed land use;

b. If the city has not accepted applicant's report, the applicant also adopts and implements the independent review and writing findings and comments, in addition to any nonconflicting recommendations in applicant's report;

c. All report recommendations, and HDOZ permit conditions (when required), are adopted by the city and are conditions of development.

4. Hold the city harmless from all claims resulting from any damage related to development within a geologic hazard area by executing a "geologic hazard disclaimer of liability and agreement" and by placing a "notice of hazard" on the final plat.

5. The applicant may appeal a decision in accordance with chapter 3 of this title.

C. *Compliance:* No structure or land shall be constructed, located, extended, converted or altered without full compliance with the terms of this chapter and other applicable regulations.

D. *Abrogation and Greater Restrictions:* This chapter is not intended to repeal, abrogate or impair any existing easement, covenant or deed restriction; however, where this chapter and another ordinance, easement, covenant or deed restriction conflict or overlap, the more stringent restriction shall prevail.

E. *Interpretation:* In the interpretation and application of this chapter, all provisions are minimum requirements in addition to applicable provisions of this title.

EXHIBITS PROVIDED

1. Exhibit A – Site Plan
   "Exhibit A" in the packet shows the site plan as proposed.

2. Exhibit B – Grading Plan
   This is the proposed grading plan for the site.

3. Exhibit C – Landscape & Vegetation Plan
   Exhibit C shows proposed areas to be landscaped though not specific plantings. This may need to be updated to show plant and tree details.

4. Exhibit D – Slope Analysis
   Exhibit D shows the slopes on the site.

5. Exhibit E – Drainage Plan
   "Exhibit B" shows how the applicant intends to drain water on the property.

6. Exhibit F – 2018 AGEC Geotechnical Investigation
   This is the Geotech report for the original hotel project. See Exhibits G & H for updates.

7. Exhibit G – 2021 AGEC Geotechnical Investigation
   This was an update to the Geotech report conducted in 2021.

8. Exhibit H – 2024 AGEC Hillside Report
   This is another update to the previous two investigations. HSRB needs to determine if this updated report, at three years old, adequately addresses the needs of the site.

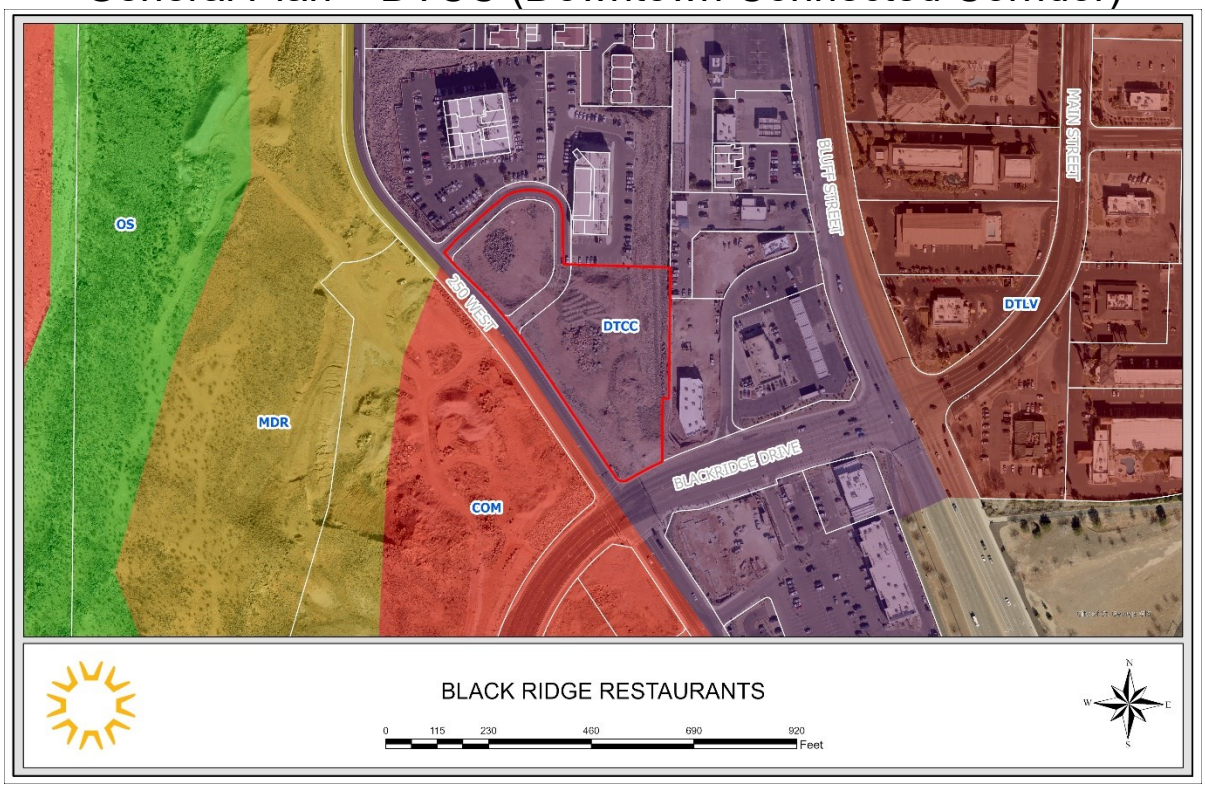
9. Exhibit I – 2019 AGEC Slope Stability Report
   As with the Geotechnical Investigation, the slope stability is several years old but has an update conducted in 2021.

10. Exhibit J – 2021 AGEC Slope Stability Update
    The HSRB should study and determine if this investigation adequately addresses the needs of the site.

RECOMMENDATION

Section 10-13A-8(B)(1) of the "Hillside Review Board Powers and Duties" states that the Hillside Board can make recommendations to "adopt, modify or reject a proposal" to the Planning Commission (PC).

General Plan – DTCC (Downtown Connected Corridor)



Zoning – PD-C (Planned Development Commercial)

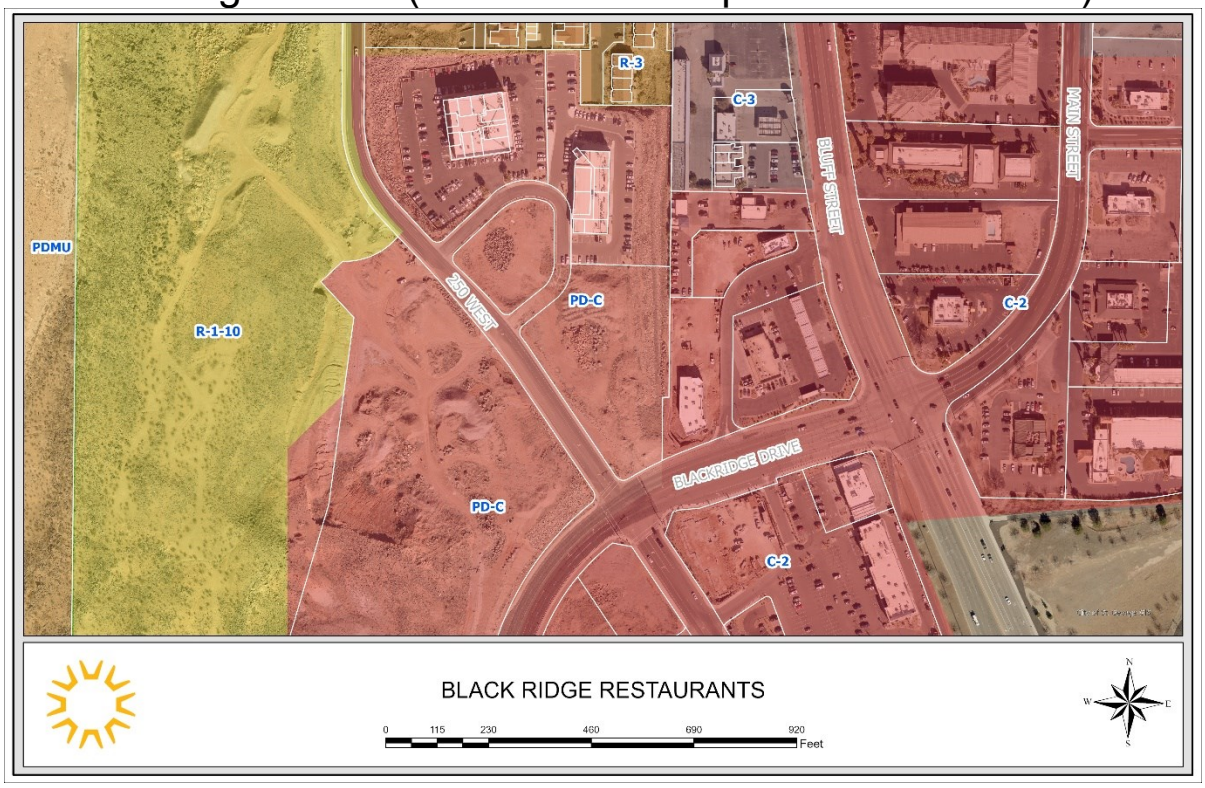
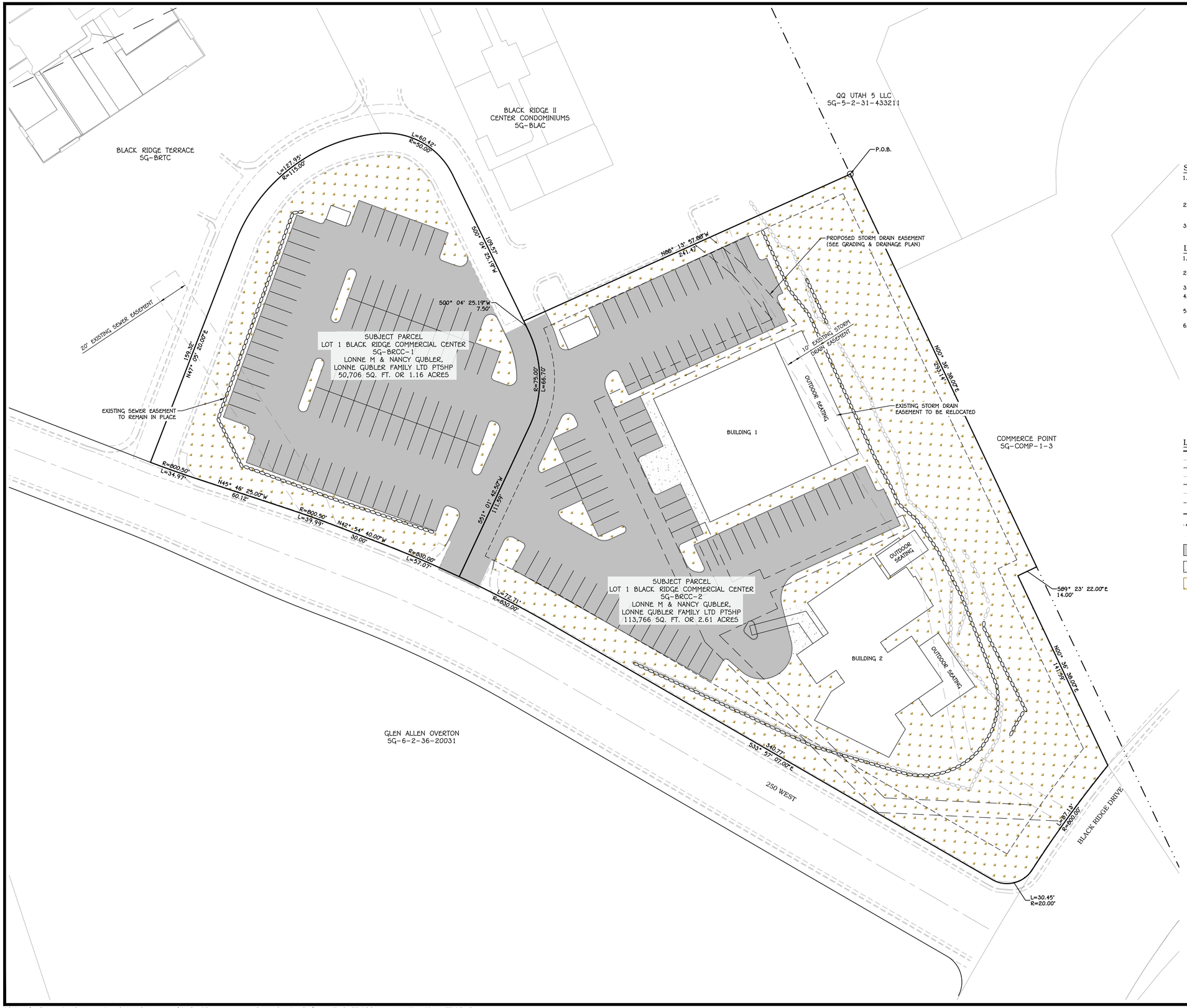


EXHIBIT A

Site Plan



0 30' 60'

SCALE: 1" = 30'

SITE PLAN NOTES:

1. CONTRACTOR TO MATCH EXISTING CONDITIONS AT ALL TIE IN LOCATIONS. PROTECT IN PLACE ALL INFRASTRUCTURE TO REMAIN. SAWCUT EXISTING C&G AND ASPHALT WHERE APPROPRIATE TO PROVIDE A SMOOTH TRANSITION FROM EXISTING TO NEW.
2. CLASS 1 AND/OR CLASS II SURVEY MONUMENTS SHOWN ON THIS PLAN ARE FOR INFORMATION ONLY. FINAL LOCATIONS FOR ALL SURVEY MONUMENTS TO BE PROVIDED BY THE LICENSED SURVEYOR.
3. ALL FIELD DESIGN CHANGES MUST BE APPROVED BY THE ENGINEER AND CITY PRIOR TO PROCEEDING WITH PROPOSED FIELD DESIGN CHANGES.

LANDSCAPE & VEGETATION NOTES:

1. ALL LANDSCAPING TO CONFORM TO ST GEORGE CITY CODE, WITH THE FOLLOWING RECOMMENDATIONS.
2. DUE TO THE SOIL RESTRICTIONS ON THIS SITE, IT IS RECOMMENDED THAT THE LANDSCAPING AND VEGETATION BE MINIMAL ON THIS SITE.
3. GROUND COVER SHOULD BE NON-IRRIGATED AND MOSTLY ROCK MULCH
4. THE LANDSCAPING SHALL DRIP IRRIGATED ONLY. NO OPEN SPRAY SPRINKLER HEADS SHALL BE ALLOWED.
5. IT IS RECOMMENDED THAT A LINER IS PLACED AROUND ANY PLANTINGS TO PREVENT WATER FROM INFILTRATING THE GROUND.
6. RE-VEGETATING IS NOT PLANNED DUE TO THIS ENTIRE SITE BEING PREVIOUSLY DISTURBED.

LEGEND:

	DETAIL
PROPOSED PARCEL BOUNDARY	
EXISTING/ADJACENT PARCEL BOUNDARY	
PROPOSED EASEMENT	
EXISTING EASEMENT	
PROPOSED CENTERLINE ALIGNMENT	
EXISTING CENTERLINE ALIGNMENT	
PROPOSED SETBACK LINE	
SURVEY SECTION LINE	
PROPOSED ROCK WALL (SEE GRADING PLANS)	
EXISTING ROCK RETAINING WALL	
PAVEMENT SECTION PER GEOTECHNICAL REPORT	
CONCRETE SURFACE	
LANDSCAPE AREA	

REV.	DATE:	REVISION

PRELIMINARY
NOT FOR
CONSTRUCTION

AMERICAN
CONSULTING & ENGINEERING
1173 S. 250 W. #504
ST. GEORGE, UT 84770

DATE:	07/10/2024
JOB #:	24-013
DRAWN BY:	SSA
CHECKED BY:	ARC

BLACK RIDGE RESTAURANTS

SECTION 36 TOWNSHIP 42 S, RANGE 16 W SLB&M
ST.GEORGE, UTAH

SITE & LANDSCAPE PLAN

HILLSIDE

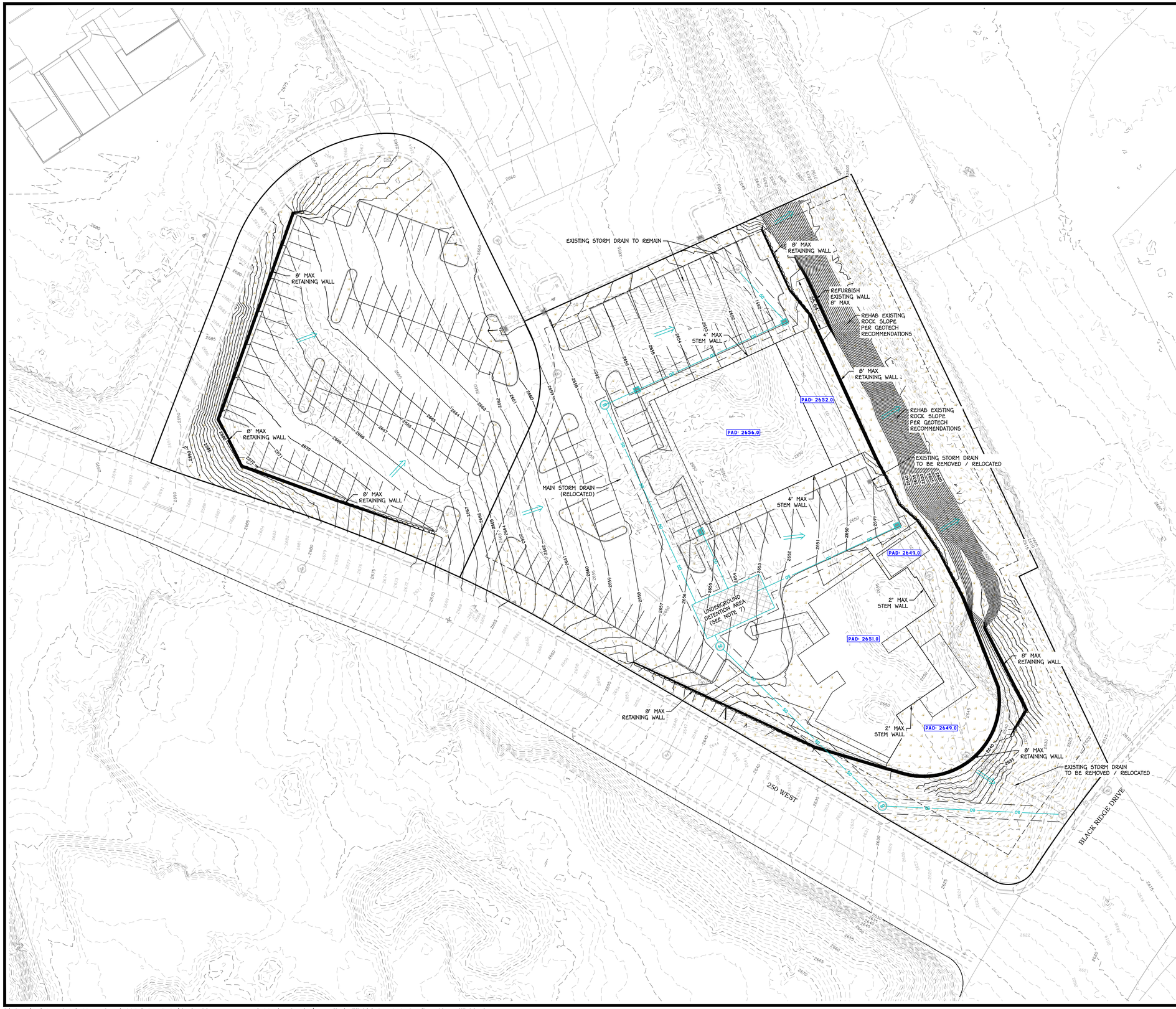
C.3.1

SHEET: 3 of 6

C:\Dropbox\American\03 projects\2024\24-013 black ridge restaurants\03 drawings\sheet files\Hillside\24-013 Site Plan Hillside.dwg

EXHIBIT B

Grading Plan



0 30' 60'

SCALE: 1" = 30'

Blue Stakes of UTAH811 Bluestakes.org

Call Before You Dig!

GRADING PLAN NOTES:

1. THE CONTRACTOR SHALL PROVIDE APPROPRIATE EQUIPMENT TO CONTROL DUST AND AIR POLLUTION CAUSED BY CONSTRUCTION OPERATIONS. THE CONTRACTOR SHALL ALSO PROVIDE APPROPRIATE MUD AND DIRT CONTAINMENT TO MAINTAIN THE WORK SITE, ACCESS ROADWAYS, AND ADJACENT PROPERTIES IN A CLEAN CONDITION.
2. ALL EXCAVATION AND GRADING SHALL BE IN ACCORDANCE WITH CITY STANDARDS AND SPECIFICATIONS ALONG WITH APPENDIX J STANDARDS OF THE INTERNATIONAL BUILDING CODE 2018 EDITION OR NEWER AS ADOPTED BY THE STATE OF UTAH AND CITY.
3. CONTRACTOR TO NOTIFY ENGINEER IMMEDIATELY IF THERE ARE ANY CONFLICTS BETWEEN THE REQUIREMENTS OF THE PLANS AND GEOTECHNICAL REPORT AND/OR GEOTECHNICAL FIELD OBSERVATIONS.
4. GEOTECHNICAL ENGINEER TO PROVIDE GRADING COMPLETION REPORT TO CONFIRM THAT WORK HAS BEEN PERFORMED IN CONFORMANCE WITH GEOTECHNICAL RECOMMENDATIONS.
5. RETAINING WALLS GREATER THAN 3' IN HEIGHT REQUIRE A PERMIT FROM THE CITY BUILDING DEPARTMENT. ALL ROCK RETAINING WALLS MUST BE CERTIFIED AND INSPECTED BY THE GEOTECHNICAL ENGINEER PRIOR TO THE CITY'S FINAL ACCEPTANCE.
6. IT IS THE PROPERTY OWNER'S RESPONSIBILITY (DEVELOPER, HOMEOWNER, HOA, ETC.) TO COMPLETE AND MAINTAIN THE FINAL GRADING ON THEIR PROPETY IN ACCORDANCE WITH THE GRADING AND DRAINAGE PLAN ALONG WITH ALL RECOMMENDATIONS FROM THE GEOTECHNICAL ENGINEER. THE PROPERTY OWNER IS RESPONSIBLE IN PERPETUITY, FOR INSPECTING AND MAINTAINING PROPER DRAINAGE FOR THEIR PROPERTY.
7. ON-SITE DETENTION IS NOT RECOMMENDED DUE TO EXISTING SOILS AND GEOLOGICAL CONDITIONS, HOWEVER, IF ON-SITE DETENTION IS DETERMINED TO BE NECESSARY ALL STORM WATER RUNOFF WILL NEED TO BE STORED IN AN IMPERMEABLE UNDERGROUND DETENTION BASIN WITH AN APPROPRIATE LEAK DETECTION SYSTEM.

NOTICE TO CONTRACTORS:

ENGINEER CAN NOT GUARANTEE THE ACCURACY OF THE EXISTING UNDERGROUND UTILITIES DEPICTED IN THESE PLANS. LOCATIONS SHOWN FOR ALL EXISTING UNDERGROUND UTILITIES IS BASED ON EXTERNAL INFORMATION FROM GIS MAPPING, PREVIOUS AS-BUILT RECORD DRAWINGS, BLUE STAKES SURFACE MARKINGS IN THE FIELD, OR COMBINATION THEREOF. THE ENGINEER HAS MADE EVERY EFFORT TO ACCURATELY DEPICT THE LOCATIONS OF EXISTING UNDERGROUND UTILITIES, HOWEVER, IT IS THE CONTRACTOR'S RESPONSIBILITY TO CONTACT BLUE STAKES OF UTAH AT LEAST TWO (2) BUSINESS DAYS PRIOR TO COMMENCING WITH EXCAVATION TO VERIFY BOTH HORIZONTAL AND VERTICAL LOCATIONS OF ALL UTILITIES. CONTRACTOR ALSO REQUIRED TO TAKE ALL NECESSARY PRECAUTIONS TO PROTECT ALL EXISTING UNDERGROUND UTILITIES BOTH SHOWN, AND NOT SHOWN, IN THESE PLANS. IF ANY UTILITY LOCATION DISCREPANCIES ARE FOUND IN THE FIELD, CONTRACTOR SHOULD NOTIFY THE ENGINEER IMMEDIATELY.

EARTHWORK QUANTITIES:

EARTHWORK QUANTITIES PROVIDED BELOW ARE APPROXIMATED BASED ON COMPARISON OF EXISTING GROUND AND FINISH GROUND SURFACE DATA USING A (SHRINK/SWELL) FACTOR OF X.XX. QUANTITIES SHOWN DO NOT ACCOUNT FOR ADDITIONAL CUT/FILL GENERATED BY BACKOUT VOLUMES FROM PAVEMENT SECTIONS, SIDEWALKS, FOOTINGS/FOUNDATIONS, CURB AND GUTTER, ETC. CONTRACTOR RESPONSIBLE TO INDEPENDENTLY VERIFY ALL EARTHWORK QUANTITIES REQUIRED TO COMPLETE CONSTRUCTION.

6,280	CU. YDS. CUT
10,204	CU. YDS. FILL
3,924	CU. YDS. (NET FILL)

LEGEND:

	DETAIL
PROPOSED PARCEL BOUNDARY	
EXISTING/ADJACENT PARCEL BOUNDARY	
PROPOSED CENTERLINE ALIGNMENT	
EXISTING CENTERLINE ALIGNMENT	
PROPOSED ROCK RETAINING WALL	
EXISTING ROCK RETAINING WALL	
GRADING LIMITS OF DISTURBANCE	
3000 EXISTING GROUND MAJOR CONTOUR	
3001 EXISTING GROUND MINOR CONTOUR	
3000 FINISH GROUND MAJOR CONTOUR	
3001 FINISH GROUND MINOR CONTOUR	
50 PROPOSED STORM PIPE (SIZE PER PLAN)	
50 EXISTING STORM PIPE (SIZE PER PLAN)	
CURB INLET SINGLE CATCH BASIN	205
50 STANDARD STORM DRAIN MANHOLE	220
SURFACE FLOW DIRECTION	

REV.	DATE:	REVISION

PRELIMINARY
NOT FOR
CONSTRUCTION

AMERICAN CONSULTING & ENGINEERING
1173 S. 250 W. #504 ST. GEORGE, UT 84770

DATE:	07/10/2024
JOB #:	24-013
DRAWN BY:	SSA
CHECKED BY:	ARC

BLACK RIDGE RESTAURANTS

SECTION 36 TOWNSHIP 42 S, RANGE 16 W SLB&M
ST.GEORGE, UTAH

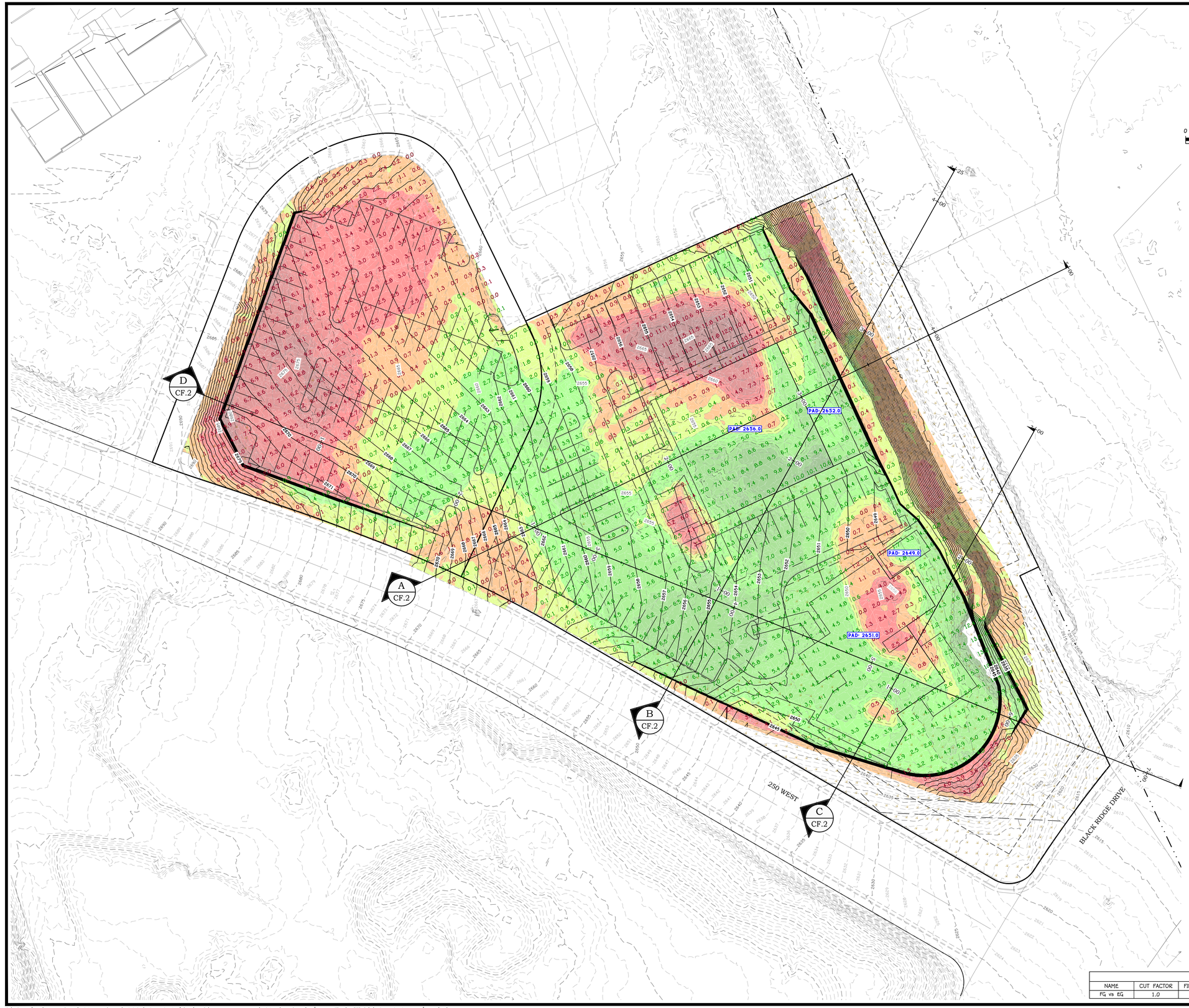
GRADING & DRAINAGE PLAN

HILLSIDE

C.4.1

SHEET: 4 of 6

C:\Dropbox\American\03 projects\2024\24-013 black ridge restaurants\03 drawings\sheet files\Hillside\24-013 Grading Plan Hillside.dwg



Blue Stakes of UTAH811
Bluestakes.org
Call Before You Dig!

ELEVATIONS TABLE		
MINIMUM ELEVATION	MAXIMUM ELEVATION	COLOR
-14	-12	
-12	-10	
-10	-8	
-8	-6	
-6	-4	
-4	-2	
-2	0	
0	2	
2	4	
4	6	
6	8	
8	10	
10	12	

CUT / FILL SUMMARY						
NAME	CUT FACTOR	FILL FACTOR	2D AREA (s.f.)	CUT (cu.yds.)	FILL (cu.yds.)	NET (cu.yds.)
FG vs EG	1.0	1.0	126,821	6,280	10,204	3,924.0

REV.	DATE:	REVISION

PRELIMINARY
NOT FOR
CONSTRUCTION

AMERICAN
CONSULTING & ENGINEERING
1173 S. 250 W. #504 ST. GEORGE, UT 84770

DATE:	07/10/2024
JOB #:	24-013
DRAWN BY:	SSA
CHECKED BY:	ARC

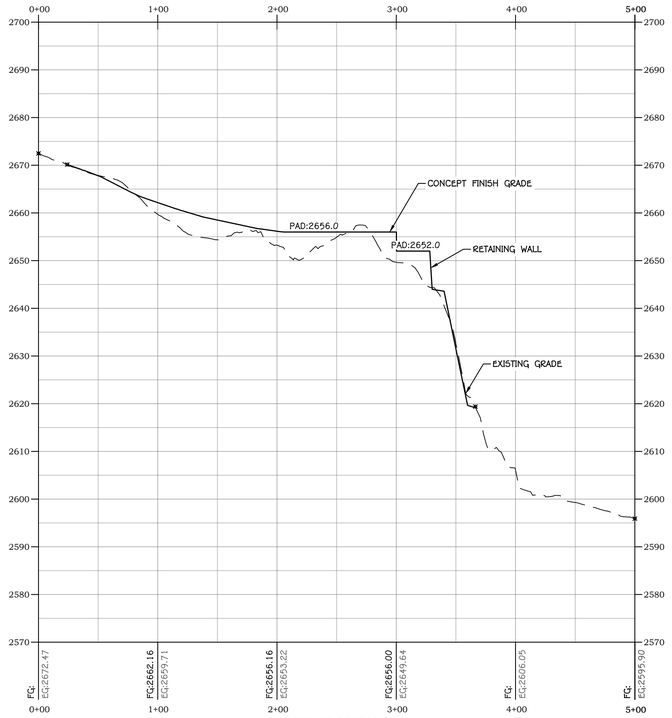
BLACK RIDGE RESTAURANTS
SECTION 36 TOWNSHIP 42 S, RANGE 16 W SLB&M
ST.GEORGE, UTAH

EARTH MOVING PLAN
HILLSIDE

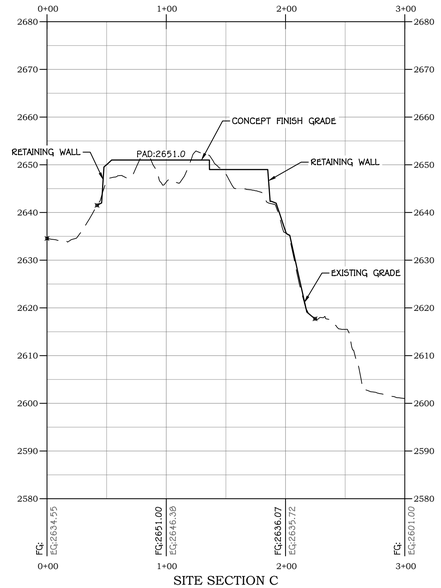
C.4.2

SHEET: 5 of 6

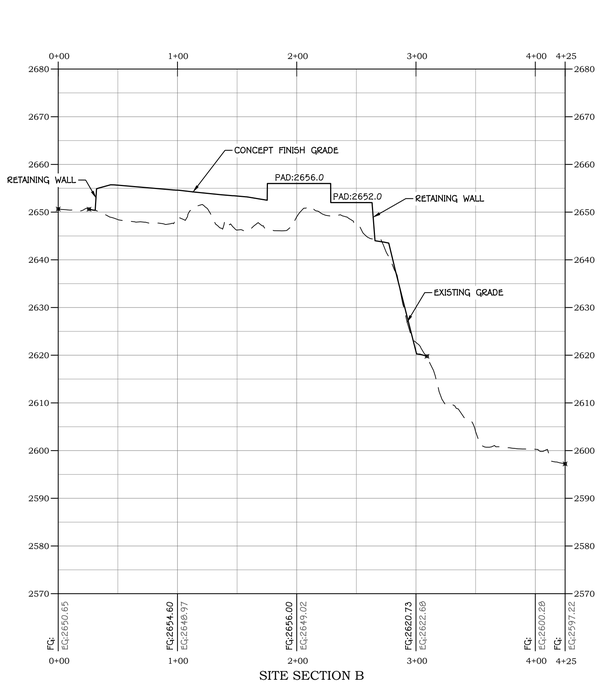
C:\Dropbox\American\03 projects\2024\24-013 black ridge restaurants\03 drawings\sheet files\Hillside\24-013 Earthwork.dwg



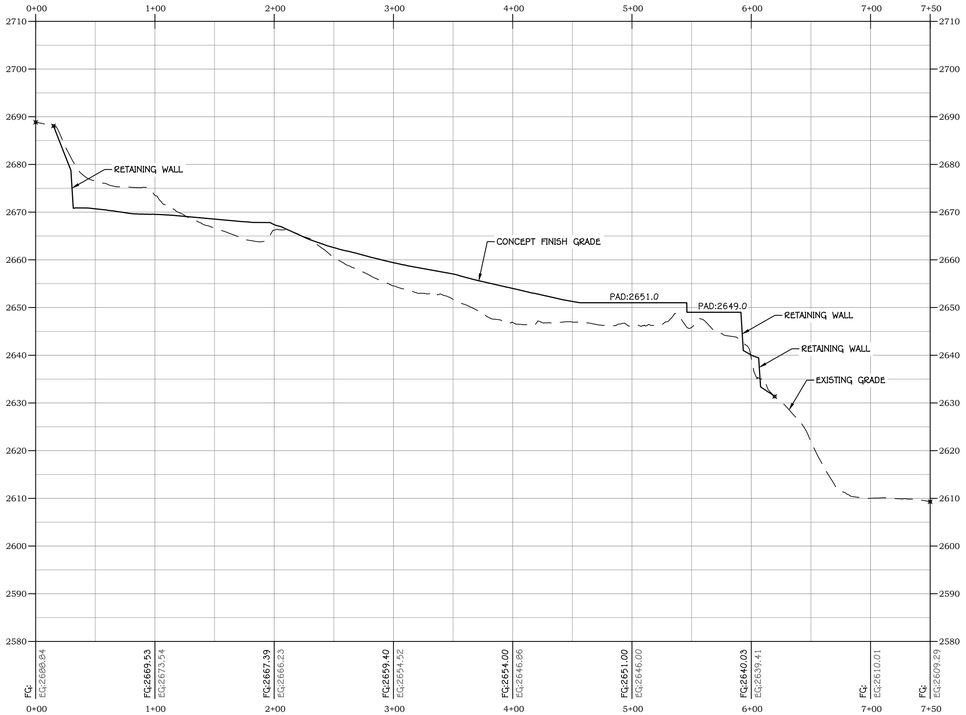
SITE SECTION A



SITE SECTION C



SITE SECTION B



SITE SECTION D

0 60' 120'

HORIZ. SCALE: 1" = 60'
VERT. SCALE: 1" = 15'

REV.	DATE:	REVISION

PRELIMINARY
NOT FOR
CONSTRUCTION

AMERICAN
CONSULTING & ENGINEERING
1173 S. 250 W. #450
ST. GEORGE, UT 84770

DATE:	07/10/2024
JOB #	24-013
DRAWN BY:	SSA
CHECKED BY:	ARC

BLACK RIDGE RESTAURANTS
SECTION 36 TOWNSHIP 42 S, RANGE 16 W SLB&M
ST.GEORGE, UTAH

SITE SECTIONS
HILLSIDE

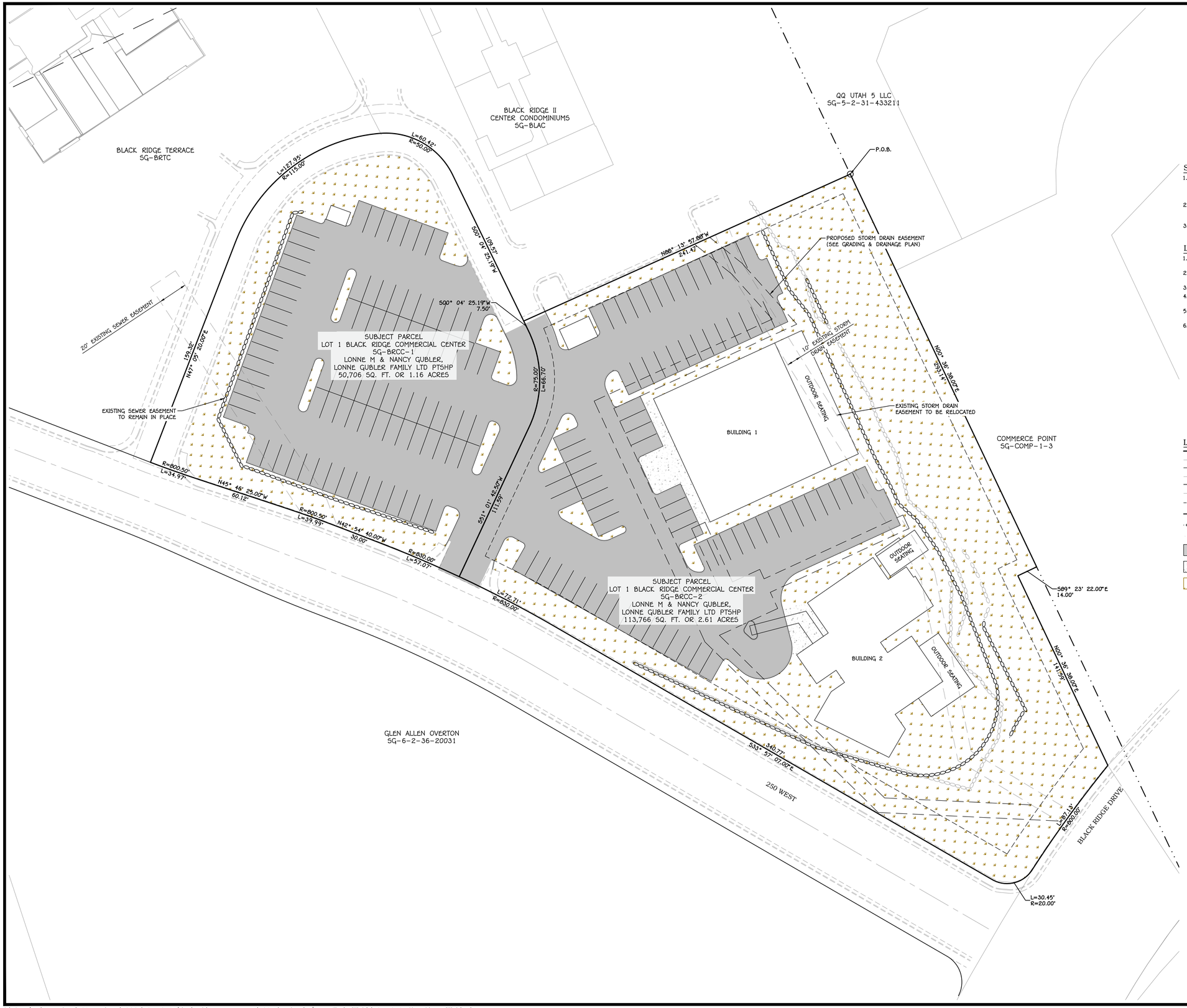
C.4.3

SHEET: 6 of 6

C:\Dropbox\American\03 projects\2024\24-013 black ridge restaurants\03 drawings\sheet files\Hillside\24-013 Earthwork.dwg

EXHIBIT C

Landscape & Vegetation Plan



0 30' 60'

SCALE: 1" = 30'

SITE PLAN NOTES:

1. CONTRACTOR TO MATCH EXISTING CONDITIONS AT ALL TIE IN LOCATIONS. PROTECT IN PLACE ALL INFRASTRUCTURE TO REMAIN. SAWCUT EXISTING C&G AND ASPHALT WHERE APPROPRIATE TO PROVIDE A SMOOTH TRANSITION FROM EXISTING TO NEW.
2. CLASS 1 AND/OR CLASS II SURVEY MONUMENTS SHOWN ON THIS PLAN ARE FOR INFORMATION ONLY. FINAL LOCATIONS FOR ALL SURVEY MONUMENTS TO BE PROVIDED BY THE LICENSED SURVEYOR.
3. ALL FIELD DESIGN CHANGES MUST BE APPROVED BY THE ENGINEER AND CITY PRIOR TO PROCEEDING WITH PROPOSED FIELD DESIGN CHANGES.

LANDSCAPE & VEGETATION NOTES:

1. ALL LANDSCAPING TO CONFORM TO ST GEORGE CITY CODE, WITH THE FOLLOWING RECOMMENDATIONS.
2. DUE TO THE SOIL RESTRICTIONS ON THIS SITE, IT IS RECOMMENDED THAT THE LANDSCAPING AND VEGETATION BE MINIMAL ON THIS SITE.
3. GROUND COVER SHOULD BE NON-IRRIGATED AND MOSTLY ROCK MULCH
4. THE LANDSCAPING SHALL DRIP IRRIGATED ONLY. NO OPEN SPRAY SPRINKLER HEADS SHALL BE ALLOWED.
5. IT IS RECOMMENDED THAT A LINER IS PLACED AROUND ANY PLANTINGS TO PREVENT WATER FROM INFILTRATING THE GROUND.
6. RE-VEGETATING IS NOT PLANNED DUE TO THIS ENTIRE SITE BEING PREVIOUSLY DISTURBED.

LEGEND:

	DETAIL
PROPOSED PARCEL BOUNDARY	
EXISTING/ADJACENT PARCEL BOUNDARY	
PROPOSED EASEMENT	
EXISTING EASEMENT	
PROPOSED CENTERLINE ALIGNMENT	
EXISTING CENTERLINE ALIGNMENT	
PROPOSED SETBACK LINE	
SURVEY SECTION LINE	
PROPOSED ROCK WALL (SEE GRADING PLANS)	
EXISTING ROCK RETAINING WALL	
PAVEMENT SECTION PER GEOTECHNICAL REPORT	
CONCRETE SURFACE	
LANDSCAPE AREA	

REV.	DATE:	REVISION

PRELIMINARY
NOT FOR
CONSTRUCTION

AMERICAN
CONSULTING & ENGINEERING
1173 S. 250 W. #504
ST. GEORGE, UT 84770

DATE:	07/10/2024
JOB #:	24-013
DRAWN BY:	SSA
CHECKED BY:	ARC

BLACK RIDGE RESTAURANTS

SECTION 36 TOWNSHIP 42 S, RANGE 16 W SLB&M
ST.GEORGE, UTAH

SITE & LANDSCAPE PLAN

HILLSIDE

C.3.1

SHEET: 3 of 6

C:\Dropbox\American\03 projects\2024\24-013 black ridge restaurants\03 drawings\sheet files\Hillside\24-013 Site Plan Hillside.dwg

EXHIBIT D

Slope Analysis

HILLSIDE NOTES:

1. THE PROPOSED PROJECT PROPERTY HAS BEEN PREVIOUSLY GRADED. NATURAL GRADE / UNDISTURBED TERRAIN NOT ENCOUNTERED.

LEGEND

- EXISTING HILLSIDE SLOPE 20.01%~30%
- EXISTING HILLSIDE SLOPE 30.01%~40%
- EXISTING HILLSIDE SLOPE >40%

REV.	DATE:	REVISION

PRELIMINARY
NOT FOR
CONSTRUCTION

AMERICAN
CONSULTING & ENGINEERING
1173 S. 250 W. #504 ST. GEORGE, UT 84770

DATE:	07/10/2024
JOB #	24-013
DRAWN BY:	SSA
CHECKED BY:	ARC

BLACK RIDGE RESTAURANTS
SECTION 36 TOWNSHIP 42 S, RANGE 16 W SLB&M
ST.GEORGE, UTAH

SLOPE MAP PLAN
HILLSIDE

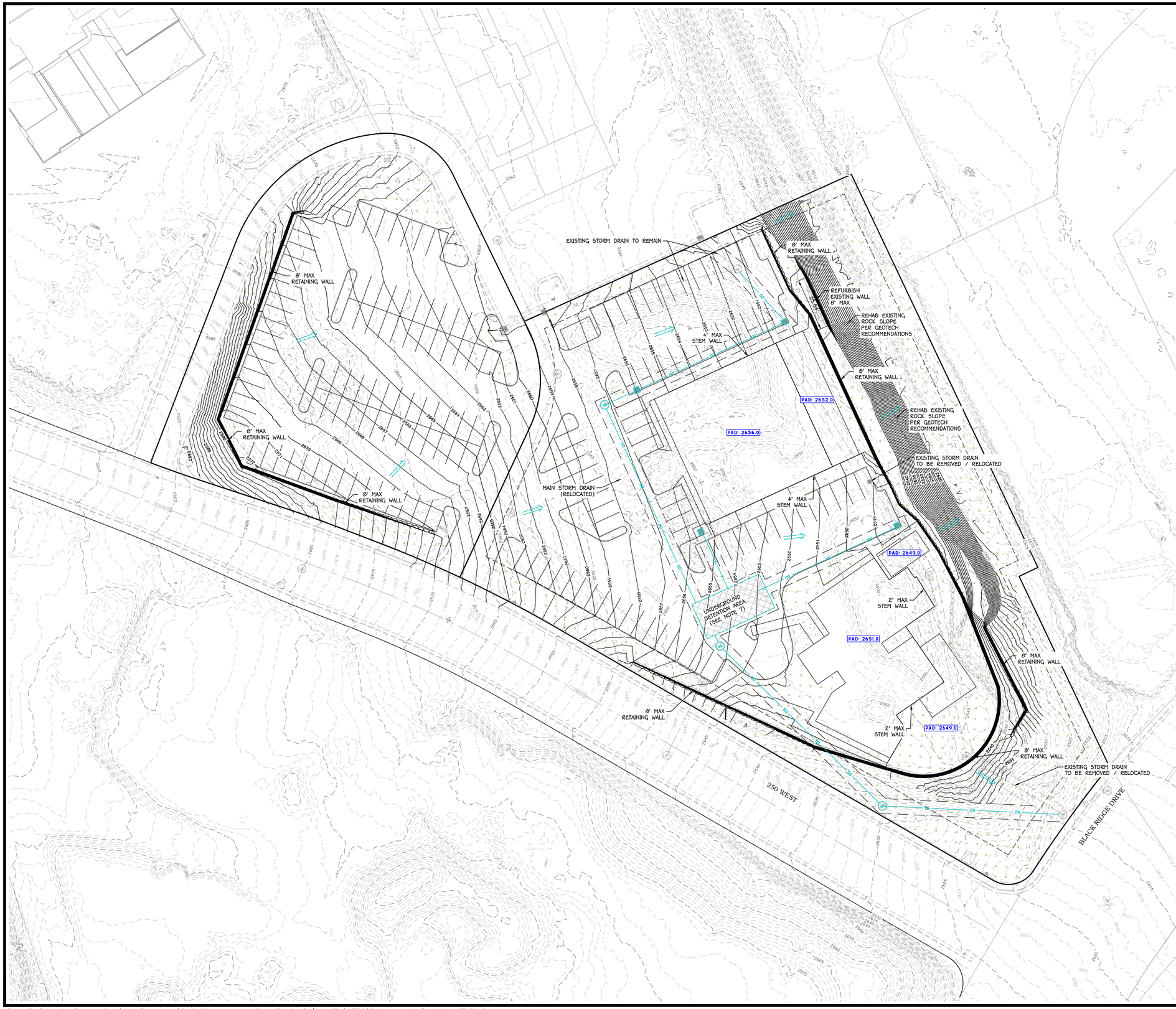
C.2.1

SHEET: 2 of 6

C:\Dropbox\American\03 projects\2024\24-013 black ridge restaurants\03 drawings\sheet files\Hillside\24-013 Existing Conditions.dwg

EXHBIT E

Drainage Plan



0 30' 60'

SCALE: 1" = 30'

Blue Stakes of UTAH811 Bluestakes.org

Call Before You Dig!

GRADING PLAN NOTES:

1. THE CONTRACTOR SHALL PROVIDE APPROPRIATE EQUIPMENT TO CONTROL DUST AND AIR POLLUTION CAUSED BY CONSTRUCTION OPERATIONS. THE CONTRACTOR SHALL ALSO PROVIDE APPROPRIATE MUD AND DIRT CONTAINMENT TO MAINTAIN THE WORK SITE, ACCESS ROADWAYS, AND ADJACENT PROPERTIES IN A CLEAN CONDITION.
2. ALL EXCAVATION AND GRADING SHALL BE IN ACCORDANCE WITH CITY STANDARDS AND SPECIFICATIONS ALONG WITH APPENDIX J STANDARDS OF THE INTERNATIONAL BUILDING CODE 2018 EDITION OR NEWER AS ADOPTED BY THE STATE OF UTAH AND CITY.
3. CONTRACTOR TO NOTIFY ENGINEER IMMEDIATELY IF THERE ARE ANY CONFLICTS BETWEEN THE REQUIREMENTS OF THE PLANS AND GEOTECHNICAL REPORT AND/OR GEOTECHNICAL FIELD OBSERVATIONS.
4. GEOTECHNICAL ENGINEER TO PROVIDE GRADING COMPLETION REPORT TO CONFIRM THAT WORK HAS BEEN PERFORMED IN CONFORMANCE WITH GEOTECHNICAL RECOMMENDATIONS.
5. RETAINING WALLS GREATER THAN 3' IN HEIGHT REQUIRE A PERMIT FROM THE CITY BUILDING DEPARTMENT. ALL ROCK RETAINING WALLS MUST BE CERTIFIED AND INSPECTED BY THE GEOTECHNICAL ENGINEER PRIOR TO THE CITY'S FINAL ACCEPTANCE.
6. IT IS THE PROPERTY OWNER'S RESPONSIBILITY (DEVELOPER, HOMEOWNER, HOA, ETC.) TO COMPLETE AND MAINTAIN THE FINAL GRADING ON THEIR PROPETY IN ACCORDANCE WITH THE GRADING AND DRAINAGE PLAN ALONG WITH ALL RECOMMENDATIONS FROM THE GEOTECHNICAL ENGINEER. THE PROPERTY OWNER IS RESPONSIBLE IN PERPETUITY, FOR INSPECTING AND MAINTAINING PROPER DRAINAGE FOR THEIR PROPERTY.
7. ON-SITE DETENTION IS NOT RECOMMENDED DUE TO EXISTING SOILS AND GEOLOGICAL CONDITIONS, HOWEVER, IF ON-SITE DETENTION IS DETERMINED TO BE NECESSARY ALL STORM WATER RUNOFF WILL NEED TO BE STORED IN AN IMPERMEABLE UNDERGROUND DETENTION BASIN WITH AN APPROPRIATE LEAK DETECTION SYSTEM.

NOTICE TO CONTRACTORS:

ENGINEER CAN NOT GUARANTEE THE ACCURACY OF THE EXISTING UNDERGROUND UTILITIES DEPICTED IN THESE PLANS. LOCATIONS SHOWN FOR ALL EXISTING UNDERGROUND UTILITIES IS BASED ON EXTERNAL INFORMATION FROM GIS MAPPING, PREVIOUS AS-BUILT RECORD DRAWINGS, BLUE STAKES SURFACE MARKINGS IN THE FIELD, OR COMBINATION THEREOF. THE ENGINEER HAS MADE EVERY EFFORT TO ACCURATELY DEPICT THE LOCATIONS OF EXISTING UNDERGROUND UTILITIES, HOWEVER, IT IS THE CONTRACTOR'S RESPONSIBILITY TO CONTACT BLUE STAKES OF UTAH AT LEAST TWO (2) BUSINESS DAYS PRIOR TO COMMENCING WITH EXCAVATION TO VERIFY BOTH HORIZONTAL AND VERTICAL LOCATIONS OF ALL UTILITIES. CONTRACTOR ALSO REQUIRED TO TAKE ALL NECESSARY PRECAUTIONS TO PROTECT ALL EXISTING UNDERGROUND UTILITIES BOTH SHOWN, AND NOT SHOWN, IN THESE PLANS. IF ANY UTILITY LOCATION DISCREPANCIES ARE FOUND IN THE FIELD, CONTRACTOR SHOULD NOTIFY THE ENGINEER IMMEDIATELY.

EARTHWORK QUANTITIES:

EARTHWORK QUANTITIES PROVIDED BELOW ARE APPROXIMATED BASED ON COMPARISON OF EXISTING GROUND AND FINISH GROUND SURFACE DATA USING A (SHRINK/SWELL) FACTOR OF X.XX. QUANTITIES SHOWN DO NOT ACCOUNT FOR ADDITIONAL CUT/FILL GENERATED BY BACKOUT VOLUMES FROM PAVEMENT SECTIONS, SIDEWALKS, FOOTINGS/FOUNDATIONS, CURB AND GUTTER, ETC. CONTRACTOR RESPONSIBLE TO INDEPENDENTLY VERIFY ALL EARTHWORK QUANTITIES REQUIRED TO COMPLETE CONSTRUCTION.

6,280	CU. YDS. CUT
10,204	CU. YDS. FILL
3,924	CU. YDS. (NET FILL)

LEGEND:

	DETAIL
PROPOSED PARCEL BOUNDARY	
EXISTING/ADJACENT PARCEL BOUNDARY	
PROPOSED CENTERLINE ALIGNMENT	
EXISTING CENTERLINE ALIGNMENT	
PROPOSED ROCK RETAINING WALL	
EXISTING ROCK RETAINING WALL	
GRADING LIMITS OF DISTURBANCE	
3000 EXISTING GROUND MAJOR CONTOUR	
3001 EXISTING GROUND MINOR CONTOUR	
3000 FINISH GROUND MAJOR CONTOUR	
3001 FINISH GROUND MINOR CONTOUR	
50 PROPOSED STORM PIPE (SIZE PER PLAN)	
50 EXISTING STORM PIPE (SIZE PER PLAN)	
CURB INLET SINGLE CATCH BASIN	205
50 STANDARD STORM DRAIN MANHOLE	220
SURFACE FLOW DIRECTION	

REV.	DATE:	REVISION

PRELIMINARY
NOT FOR
CONSTRUCTION

AMERICAN CONSULTING & ENGINEERING
1173 S. 250 W. #504 ST. GEORGE, UT 84770

DATE:	07/10/2024
JOB #:	24-013
DRAWN BY:	SSA
CHECKED BY:	ARC

BLACK RIDGE RESTAURANTS

SECTION 36 TOWNSHIP 42 S, RANGE 16 W SLB&M
ST.GEORGE, UTAH

GRADING & DRAINAGE PLAN

HILLSIDE

C.4.1

SHEET: 4 of 6

C:\Dropbox\American\03 projects\2024\24-013 black ridge restaurants\03 drawings\sheet files\Hillside\24-013 Grading Plan Hillside.dwg

EXHIBIT F

2018 AGEC Geotechnical Investigation

AGEC

Applied GeoTech

GEOTECHNICAL INVESTIGATION

BLACKSTONE HOTEL SITE

250 WEST BLACKRIDGE DRIVE

ST. GEORGE, UTAH

PREPARED FOR:

BLACK RIDGE DEVELOPMENT, LLC
2001 PARK AVENUE
PARK CITY, UTAH 84060

ATTENTION: GLEN OVERTON

PROJECT NO. 2180187

DECEMBER 14, 2018

1420 South 270 East • St. George, Utah 84790 • (435) 673-6850 • FAX (435) 673-1044

TABLE OF CONTENTS

SUMMARY . . . . . Page 1

SCOPE OF WORK . . . . . Page 2

SITE CONDITIONS . . . . . Page 2

FIELD STUDY . . . . . Page 3

SUBSURFACE CONDITIONS . . . . . Page 3

SUBSURFACE WATER . . . . . Page 5

PROPOSED CONSTRUCTION . . . . . Page 6

GEOLOGIC HAZARDS . . . . . Page 7
- A. Landslide . . . . . Page 7
- B. Expansive Soil and Bedrock . . . . . Page 7

SLOPE STABILITY . . . . . Page 8
- A. Earlier Evaluations . . . . . Page 8
- B. Site Specific Stability . . . . . Page 8

RECOMMENDATIONS . . . . . Page 11
- A. Site Grading . . . . . Page 11
- B. Foundations . . . . . Page 19
- C. Floor Systems and Construction Details . . . . . Page 23
- D. Pool Construction Details . . . . . Page 25
- E. Lateral Earth Pressures . . . . . Page 27
- F. Seismicity, Liquefaction, and Faulting . . . . . Page 29
- G. Soil Corrosion . . . . . Page 29
- H. Pavement . . . . . Page 30
- I. Design Review/Construction Observation . . . . . Page 31

LIMITATIONS . . . . . Page 33

GEOLOGIC LITERATURE REFERENCES . . . . . Page 34

FIGURES AND TABLES

Vicinity Map	Figure 1
Site Plan	Figure 2
Landslide Hazard Map	Figure 2a
Expansive Soil and Rock Susceptibility Map	Figure 2b
Logs of Exploratory Borings	Figures 3-7
Legend and Notes of Exploratory Borings	Figure 8
Consolidation/Swell Test Results	Figures 9-13
Summary of Laboratory Testing	Table 1
Deep Foundation Element Design Parameters	Table 2
Core Logs and Legend and Notes to Core Logs	Appendix

SUMMARY

1. Two geologic hazards exist at the site which could impact the project. The hazards include highly expansive soil and bedrock and the potential for landslide movement.

   The ancient landslide is not moving currently, but factors of safety against future movement do not meet industry standards. If the site is to be developed, the developer should be aware of this condition and accept the risk of future movement if the landslide reactivates. If movement occurs, significant distress to the development could be experienced.

2. Due to the expansive characteristics of the on site clay and bedrock, there is the potential for up to approximately 5 inches of heave without properly designing for this condition. Therefore, the recommendations contained in this report should be implemented to properly support the proposed improvements.

3. The subsurface profile observed in the borings drilled generally consists of fill overlying bedrock to the maximum depth investigated, approximately 93 feet. Talus (cobbles infilled gravel, sand and clay) and landslide deposits were encountered beneath the fill.

4. Groundwater levels were measured at elevations of approximately 2,595½ and 2,581 feet, which is about 42 feet below the proposed "0" level of the hotel.

5. Drainage of surface water away from structures and desert landscaping are critical for acceptable performance of the site. The storm drain system should be water tight. Water ways should be lined to prevent to seepage into the ground.

6. Detailed recommendations for subgrade preparation, grading, materials, foundations, pavement and drainage are included in the report.

7. The information provided in this summary should not be used independent of that provided within the body of this report.

SCOPE OF WORK

This report presents the results of a geotechnical investigation for the proposed Blackstone Hotel site to be located in St. George, Utah, as shown on Figure 1. This report presents the subsurface conditions encountered and recommendations for the geotechnical aspects of the project.

Field exploration was conducted to obtain information on the subsurface conditions and to obtain samples for laboratory testing. Results of the field exploration and laboratory testing were analyzed to develop conclusions, professional opinions and recommendations for the proposed development.

This report has been prepared to summarize the data obtained during the study and to present our conclusions and recommendations based on the proposed construction and the subsurface conditions encountered. Design parameters and a discussion of geotechnical engineering considerations related to construction are included in the report.

SITE CONDITIONS

The site consists of a partially developed and graded parcel of property in the Black Ridge Development in St. George, Utah. The site was previously rough graded. The grading generally appears to consist of cut on the south and west with increasing fill depth to the north and east. The east edge of the site consists of a tall fill slope which is graded at an approximate 1:1 (Horizontal:Vertical) slope. It is faced with basalt boulders. Comparison of existing elevations to previous topography indicates the site has received up to on the order of 41 feet of fill on the east tapering to less than 5 feet on the west.

A vacant parcel is located below the fill slope to the east with a new Maverik Gas Station further to the east. Black Ridge Drive is to the south, 250 West Street is to the west and existing commercial buildings are to the north.

The site is elevated above Black Ridge Drive on the south and the topography generally slopes down to the south and southeast. The site has only sparse vegetation and scattered large piles of boulders and fill.

FIELD STUDY

An engineer from AGEC visited the site on August 7, 2007, June 6, 7, August 16, September 17, 18, 20, 21, 24, and October 5, 2018 and observed the drilling of 11 borings as shown on Figure 2. The borings were drilled utilizing a truck mounted rill rig equipped with hollow stem augers and a 2½ inch HQ core barrel with a carbide and carbonado bit using mud rotary techniques. The subsurface conditions were logged and samples were obtained to conduct laboratory testing.

SUBSURFACE CONDITIONS

The subsurface profile observed in the borings drilled generally consists of fill overlying bedrock to the maximum depth investigated, approximately 93 feet. Talus (cobbles infilled gravel, sand and clay) and landslide deposits were encountered beneath the fill. The transition of landslide altered bedrock to undisturbed bedrock occurs at a depth of approximately 37 to 80 feet below the ground surface.

Descriptions of each soil and bedrock type observed follow.

> Fill 1 - The fill consists of lean to fat clay with sand and gravel. It contains occasional cobbles and boulders. Consistency and moisture appears variable (poorly to well compacted) and is red to purple in color. The clay varies from low to high plasticity. The cobbles and boulders are basalt and sandstone.

Laboratory tests conducted on samples of the fill indicate in-place moisture contents ranging from 7 to 21 percent, in-place dry densities ranging from 94 to 117 pounds per cubic foot (pcf), gravel content (percent retained on the No. 4 sieve) of 10 percent, and fines contents (percent passing the No. 200 sieve) ranging from 62 to 88 percent. Atterberg Limits tests indicate liquid limits ranging from 29 to 54 percent and plasticity indexes ranging from 17 to 40 percent. A water soluble sulfate test indicates a water soluble sulfate concentration of 3,075 parts per million (ppm).

A one-dimensional consolidation test conducted on a sample of the fill indicates the fill is slightly expansive when wetted under a constant pressure of approximately 1,000 pounds per square foot (psf). A swell percentage of approximately 1.3 percent was measured with a swell pressure of approximately 2,800 pounds per square foot (psf).

Fill 2 - The fill contains basalt boulders with voids between the boulders.

Basalt Boulder - The basalt boulder is hard, dry and is grey in color.

Talus - The talus contains cobbles infilled with gravel, sand and clay and occasional boulders. It is typically stiff/dense, slightly moist to moist, gypsiferous, and is purple to red in color. The clay is low to high plastic.

Laboratory tests conducted on one sample indicates a gravel content of 32 percent and a fines content of 39 percent. An Atterberg Limits test indicates a liquid limit of 39 percent and a plasticity index of 28 percent.

Mudstone Bedrock - The mudstone bedrock is soft to moderately hard, slightly moist to very moist, medium to high plastic, and is purple to red to grey in color. The altered mudstone (above the landslide surface) contains sand and small basalt gravels. The mudstone changes to dark grey/black to yellow below the landslide and is red in boring B-10.

Laboratory tests conducted on samples of the mudstone bedrock indicate in-place moisture contents ranging from 2 to 25 percent, in-place dry densities ranging from 88 to 146 pcf, gravel contents ranging from 4 to 10 percent, and fines contents ranging from 34 to 97 percent. Atterberg Limits tests indicate liquid limits ranging from 25 to 64 percent and plasticity indexes ranging from non plastic to 51 percent. Water soluble sulfate tests indicate water soluble sulfate concentrations ranging from 270 to 4,770 ppm. Unconfined compressive strength tests indicate unconfined compressive strengths ranging from 4.0 to 40.7 kips per square foot (ksf).

One-dimensional consolidation tests conducted on samples of the mudstone indicate it is slightly to moderately expansive when wetted under a constant pressure of 1,000 psf. Swell percentages ranging from ½ to 2¼ percent were measured. Swell pressures ranging from approximately 1,600 to 5,000 pounds per square foot (psf) were also measured. The Atterberg limit tests and swell tests on nearby properties also indicate portions of the mudstone are highly expansive.

The Logs of Exploratory Borings are shown on Figures 3-7. Legend and Notes of the Exploratory Borings are shown on Figure 8. The laboratory test results are also shown on Figures 3-7 and are summarized in the Summary of Laboratory Testing, Table 1. The consolidation/collapse/swell test results are shown graphically on Figure 9-13.

SUBSURFACE WATER

Groundwater levels were measured on October 29, 2019. Groundwater was measured within Borings B-2 and B-5 at elevations of approximately 2,595½ and 2,581 feet, respectively. Groundwater was not encountered within the other borings drilled at the site. Our experience has shown that surface water may infiltrate and perch on, or within, the underlying mudstone.

PROPOSED CONSTRUCTION

It is currently proposed to develop a hotel resort on the site. The hotel will include a conference center, a restaurant, a gym as well as other amenities. There will also be a swimming pool/spa.

Architectural drawings of the development indicate the hotel will consist of a 4 story structure with an adjacent 2 story parking structure. The hotel will require excavation on the order of 20 to 30 feet below the existing grade to facilitate the "daylight" exposure of the east facing side of the hotel. The west side will include 2 to 4 stories of exposed building which will follow the topography of the site.

We understand the expose portion of the hotel will consist of conventional wood framing and we anticipate the below grade portions will utilize reinforced concrete construction. The parking structure will include one below grade level and will also be a reinforced concrete structure. The pool will use a reinforced gunnite shell.

Due to the presence of the underlying expansive soil and bedrock, the buildings and pool will be supported on deep foundation elements consisting of micropiles or drilled concrete piers in conjunction with grade beams and structural floors.

The development will also include underground utilities, asphalt concrete pavement and concrete retaining wall to support the east side of the property.

Additional details regarding the design, site improvements and building loads are currently not available. If the proposed construction, loading conditions, or grading are significantly different from what is described above, we should be notified so we may reevaluate our recommendations.

GEOLOGIC HAZARDS

Review of geologic hazard mapping by Lund et. al. (2008) and our experience in the area indicate the following potential conditions that could adversely impact the site:

A. Landslide

The site for the proposed new hotel is located above the toe of a 300 foot high slope. The lower ⅔ of the slope has been mapped as a landslide deposit. The ground surface of the landslide deposit slopes on average approximately 8.2:1 H:V (horizontal to vertical). The landslide deposit extends up to a depth of 83 feet below the existing ground surface at the site.

Old landslides are often barely stable and may reactivate with new loadings or other changes in condition that tend to reduce their stability. With the site located on a landslide deposit, the subsurface conditions need to be carefully investigated and the stability of the slope evaluated under static and seismic conditions. The risk of future movement needs to be recognized, potential impact of ground movement identified, appropriate consideration given to remedial measures and then a decision made if the benefit is worth the risk.

B. Expansive Soil and Bedrock

The Chinle formation is mapped at the site which consists of highlt expansive bedrock. It is high plastic and also has a high shrink/swell susceptibility.

Geologic hazard maps are shown on Figures 2a and 2b.

SLOPE STABILITY

A. Earlier Evaluations

Earlier studies by AGEC on the stability of the east slope of Black Ridge (slope on which the hotel is proposed) indicate that the stability of the slope is marginal.

In order to determine if movement is occurring on the slope, five inclinometers were installed in 2007 on the east slope of Black Ridge extending to depths of 92 to 250 feet. Four of the five indicate that there has been no movement since 2007. Ground movement was measured at multiple depths in the inclinometer installed immediately west of the vacant restaurant located at 1090 South Bluff Street, prior to 2011.

With the lack of measured movement in the four inclinometers over the past 10½ years along with the lack of surficial evidence of movement, it is apparent that the portion of the slope for this project is currently maintaining its stability. Using the information available from our subsurface exploration, the laboratory test results and our experience in the area, it is our professional opinion that the stability of the slope is marginal even with the lack of apparent movement.

B. Site Specific Stability

Based on our experience in the area along with the information that we have gathered from studies on this landslide, we have analyzed the stability of the slope in the area of the proposed hotel.

1. Prior Slope Modifications

A number of years ago, a relatively large amount of soil was removed from properties west of (up-slope from) the hotel site and placed on the hotel site. Up to 41 feet of fill was encountered during this study.

Our stability analysis of the slope indicates that the placement of fill at the toe of the slope has resulted in a 7 percent improvement of the stability.

2. **Proposed Site Grading**

The ground surface profile proposed for the hotel, does not change the improved stability resulting from the major grading that was accomplished a number of years ago.

3. **Stability Analysis**

The stability analysis indicates the following:

a. A calculated factor of safety using the parameters selected to characterize the materials in the slope and the existing configuration is near 1.1. A factor of safety on the order of 1.5 is typically desired for slopes upon which human occupied improvements are constructed. Lower factors of safety could be considered when using conservative soil strengths and with increased knowledge of the subsurface characteristics.

b. Changes in the internal conditions and the surficial geometry modifications may improve or reduce the ability of the slope to maintain its stability.

c. We anticipate that it is a matter of time before movement of the east slope of Black Ridge occurs. Determining a location and/or timing of such an event is not possible with the information currently available.

4. **Possible Impact of Current Conditions**

Assuming that strength characteristics of the landslide mass have improved (soils behaving as if they are unsaturated) since the ancient landslide movements occurred, overall calculated stability of the slope is estimated to increase approximately 30 percent.

The stability under a seismic event, assuming the improved strength characteristics described above, is estimated to have a safety factor of less than 1. A major seismic event could potentially result in displacement of approximately 10 inches. If the development proceeds, this potential increase in soil strength would need to be further evaluated and substantiated in order to quantify this improvement.

5. **Other Mitigating Factors**

If the decision is made to continue with further design and potential construction of the hotel at this location, we recommend that the following items be considered:

a. Evaluate options to strengthen the overall slope stability by increasing the resisting forces and/or by lowering the water level on the slope.

b. Minimize, if not eliminate the introduction of moisture into the subgrade. This could be accomplished by,

   i. Collecting and transporting surface drainage off of the site in water tight storm drainage systems. This type of construction is not standard and therefore it would require specific attention to verify that the improvements are water tight.

   ii. Water ways should be lined to prevent to seepage into the ground.

iii. Measures need to be taken to eliminate the potential for water to pond on the slope.

c. Positive steps would need to be taken on other improvements on the landslide mass to help maintain the overall stability of the slope.

RECOMMENDATIONS

Based on our experience in the area, subsurface conditions encountered, laboratory test results, and proposed construction, the following recommendations are provided:

A. Site Grading

Based on the subsurface conditions observed and the proposed grading, the following recommendations are provided.

1. Subgrade Preparation

General: Prior to placing site grading fill or concrete, the existing sparse vegetation should be removed. The piles of fill and boulders should also be removed.

Flatwork and Pavement Support: Portions of the existing fill exhibit expansive characteristics. Settlement of the ground surface could also occur due to due to the variable consistency and density of the fill. We anticipate improvements (pool and decking) will be supported on deep foundation elements where the fill is relatively deep (the east portion of the site). Thus, the condition of the fill will not affect their performance.

The fill is relatively shallow on the west portion of the site where pavement and flatwork are proposed to be supported on the ground surface. Our borings indicate the fill in this area is likely less than 10 feet deep in this area. Due to the variable consistency and density of the fill, the full depth of this fill should be removed from areas which will support pavement and flatwork.

We recommend flatwork and pavement be supported on an appropriate thickness of non-expansive, low permeable fill. The thickness of low permeable fill should be based on the acceptable magnitude of potential differential vertical movement. The low permeable fill layer is intended to reduce the risk of wetting. Strict site drainage is critical to the satisfactory performance of flatwork, pavement or other surface supported features. The estimated potential surface heave associated with corresponding overexcavation depths are provided in the following table.

Thickness of Non-Expansive Low Permeable Fill (feet)	Estimated Potential Differential Vertical Slab Movement (inches)	
	Fill Subgrade	Mudstone Subgrade
0	2 to 3½	3½ to 5
2	1½ to 2¼	2½ to 3¾
4	1 to 1½	2 to 3
6	¾ to 1	1½ to 2½
8	½ to ¾	1¼ to 2
10	< ½	1 to 1½
12	--	¾ to 1¼
14	--	¾ to 1
16	--	½ to ¾

As a minimum, we recommend at least 5 feet of non-expansive, low permeable fill be placed above the mudstone bedrock in areas which will support flatwork or pavement. The risk of heave potential may also be reduced by increasing the overexcavation depth and providing strict drainage.

Buildings: Buildings will be supported on deep foundation elements with raised structural floors. Therefore, removal of fill or mudstone is not critical under building areas unless slab on grade floors will be considered.

Lateral Extent: All overexcavation and subgrade preparation procedures should extend at least 5 feet beyond the perimeter of the proposed construction. Excavations should be located by survey.

2. Excavation/Earthwork

Excavation of the on-site soil and soft bedrock at the site may be accomplished with typical excavation equipment. The drilling of the soil and bedrock encountered to the depths investigated may be performed with typical rotary drilling equipment. Difficulty may be encountered when drilling through cobbles and boulders which are present in the fill and talus. Loss of drilling fluid may also occur due to the presence of voids in the fill.

3. Grading Slopes and Trenches

Permanent cut slopes excavated into the overburden soils should be cut no steeper than 2:1 (Horizontal:Vertical). Permanent cut slopes into the soft mudstone bedrock should be cut no steeper than 1:1 (Horizontal:Vertical).

It has been our experience that the mudstone surface will dry to a "pop corn" texture and ravel resulting in deposition of material at the toe until an approximate 2½:1 slope is achieved over time. To improve performance of steeper cut slopes in mudstone, slope facing should be considered along with

strict site drainage away from the slope and implementation of desert landscaping.

Facing could consist of large stacked boulders, precast concrete blocks or reinforced gunnite facing attached with soil nails. A drain should also be constructed behind the facing to reduce the potential for water accumulation and buildup of hydro-static pressure. If these options will be considered, AGEC should be contacted to provide further consultation.

Unretained fill slopes constructed with properly compacted on-site soil should be graded no steeper than 2:1 (horizontal to vertical). Slopes should include benches in accordance with the 2015 IBC. The cut and fill slopes will be highly susceptible to erosion, particularly resulting from run off from the adjacent slopes. Water should be directed around slopes using drainage swales to reduce potential erosion.

Fill slopes should be graded by overbuilding and then cutting them back to the desired grade to provide a compacted slope face. Fill placed on existing slopes steeper than 4:1 (horizontal to vertical) should be placed using a benching procedure. Benches should be of sufficient width to allow adequate area for the compaction equipment.

Utility trenches excavated in the on-site soils should be excavated in accordance with OSHA requirements using a OSHA Soil Class C (1½:1 Horizontal:Vertical) for overburden soils and soft mudstone. Steeper trenches may require the use of shoring or a trench box to provide as safe work environment. Safe trench excavation is the responsibility of the contractor.

4. Compaction

Compaction of fill materials placed at the site should equal or exceed the following percentages when compared to the maximum dry density as determined by ASTM D-698 or ASTM D-1557:

Area	Percent Compaction ASTM D-698*	Percent Compaction ASTM D-1557**
Subgrade	95	90
Site grading	95	90
Slabs (base course)	Does not apply	95
Utility trench backfill	95	90
Wall Backfill	95	90

* Fine-grained low permeable fill/processed mudstone.
** Granular site grading fill/granular low permeable fill/structural fill.

Prior to placing approved fill, the exposed subgrade should be moisture conditioned and compacted as recommended above. Fill should be placed in lifts which do not exceed the capability of the equipment used. Generally 6 to 8 inch lifts are adequate for heavy rubber tire equipment. Lift thicknesses should be reduced to 4 inches for hand compaction equipment.

Fill materials should be properly moisture conditioned prior to placement. Fine-grained soil, low permeable fill and processed mudstone or mudstone/sand mixture should be moisture conditioned to 2 to 4 percentage points over the optimum moisture content as determined by ASTM D-698. Granular soil should be moisture conditioned to within 2 percentage points of the optimum moisture content as determined by ASTM D-1557. Each lift of fill placed should be tested to verify moisture content and compaction are appropriate.

5. Materials

Recommendations for imported fill types follow. If structural floors are used, the type of fill placed under the buildings is not critical. Imported fill should be non-expansive and meet the following recommendations.

Area	Fill Type	Recommendations
Footings/pads/site	Structural and site grading fill	**-200** <35%, **LL** <30% Maximum size: 4 inches Solubility < 1%
Under slabs/flatwork	Base course	**-200** <12% Maximum size: 1 inch
Drains	Gravel	1 inch max size **-200** <5%

-200 = Percent Passing the No. 200 Sieve

LL = Liquid Limit

The existing site grading fill is variable in plasticity and portions are expansive. The on site fill is suitable for use as site grading fill, wall backfill and utility trench backfill in areas which will support hard surfaces and pavement at depths greater than 5 feet below the finished grade.

If portions of the onsite fill appear low plastic, it may also be suitable for use as fill extending to the surface, but observation and additional testing would be necessary. Alternatively, the fill may be mixed with imported, non-expansive fill or imported soil would be placed to support in the upper 5 feet of the profile.

The on-site mudstone is not suitable for use wall backfill or as fill in structural areas or areas which will support hard surfaces and pavement. It may be used as fill in landscape areas or it should be disposed of offsite.

The potential impact of the expansive characteristics of the underlying mudstone bedrock can be reduced by protecting the bedrock from becoming wet. Placement of relatively low permeable fill above the bedrock can help reduce the possibility of water coming in contact with the bedrock. The low permeable fill supporting these areas is intended to provide a low permeable

zone to reduce the potential for water to infiltrate and wet the underlying subgrade. If the expansive subgrade below the low permeable fill is wetted, surface heave will occur. This will result in reduced flatwork and pavement life.

Low permeable fill used to replace removed mudstone should meet one of the following set of criteria.

Liquid Limit (%)	Percent Passing the No. 200 Sieve
45 +	15-20
30-45	20-40
0-30	30-100

The onsite fill soil mixed with some imported, non-expansive, granular fill will likely meet the low permeable fill requirements at a ratio of 1 part granular soil to one part of the onsite fill. The mixture should be tested by AGEC to verify its engineering characteristics prior to use as fill.

6. Drainage

The following drainage recommendations should be implemented to reduce the potential for wetting of the underlying expansive soils and bedrock.

a. Positive site drainage away from foundations should be maintained during the course of construction.

b. After construction has been completed, positive drainage of surface water away from the buildings should be maintained throughout the life of the structure. We recommend a minimum slope of 6 inches in the first 10 feet from the perimeter of the structure. In no case should water be allowed to pond adjacent to foundations.

c. Desert landscaping, which requires no water, should be implemented. Grass should not be used. Rock mulch and turf are recommended.

d. Rain gutters should be utilized and roof down spouts should be piped to discharge to the storm drain system. This will require design of buried discharge pipes with flexible watertight connections.

e. If planters are used, they should be underlined by a impermeable membrane which is sloped to a discharge pipe which discharges water to storm drain.

f. We also recommend that desert landscaping, which requires no water, be used adjacent to concrete walls and masonry walls or other cement containing elements which will be backfilled. Further, the below grade portions of walls/fences which are backfilled with soil should be protected with an impermeable membrane and a subsurface drain. A gravel covered, perforated PVC pipe should also be placed at the base of the wall to carry water to a discharge point. This is intended to reduce the potential for salt weathering on concrete/masonry.

7. Subsurface Drainage Protection

As a precautionary measure, the crawl space and below grade portions of the hotel and parking structure should be protected from potential infiltration of surface water by constructing a perimeter subsurface drain around the crawl space of the building.

The drain system should consist of a 1 foot wide trench excavated around the outside perimeter of the grade beam/walls supporting the buildings. The trench should be excavated to a depth of at least 2 feet below the crawl space depth. A 4 inch perforated PVC pipe should be placed in the bottom of the trench and covered with free-draining gravel to within 2 feet of the ground surface. Prior to backfilling, Mirafi 140N filter fabric should be placed over the gravel. The perimeter drain trench and the grade beams should be backfilled with properly compacted, low permeable fill above the gravel to reduce the potential for surface water infiltration directly to the crawl space between the beams and the trench.

The drain pipe should be placed in the bottom of the drain trench and sloped at a 2% grade (minimum) to drain by gravity or to a sump and discharge to the storm drain system.

B. Foundations

We recommend the proposed hotel, parking structure, pool and pool decking be supported on deep foundation elements which will extend support of the structures through the existing fill down to the underlying "non-active" mudstone. The deep foundation elements should extend at least 45 feet into the underlying expansive mudstone and be designed by a structural engineer according to the parameters provided in Table 2 of this report. Grade beams should be utilized to span the distance between piers and support a structural floor with a crawl space below. The following recommendations should be followed for the design and construction of the deep foundation system.

1. Micropile Design

a. Minimum length = 45 feet.

b. End bearing should not be considered for micropile capacity. Capacity of micropiles will be developed through skin friction.

c. The micropiles should be structurally reinforced to resist tensile forces on the pile due to upward skin friction (uplift) which could result if the mudstone is wetted and swells. The tensile force may be calculated utilizing at least 20 feet of pile length with an ultimate skin friction of 1,000 psf. A "greased PVC bond breaker" may also be considered to reduce uplift forces on the micropiles.

d. Micropile capacity should be reduced to account for a downdrag of 250 psf which could result if the existing fill densifies adjacent to the deep foundation element resulting in downward force on the deep foundation element. A greased bond breaker may also be considered to address down drag forces.

e. The micropile should be designed for a minimum dead load of 3,000 pounds. If the minimum dead load cannot be met and piles are spaced as far apart as practical, the length should extend beyond the minimum penetration to make up the dead load deficit. This can be accomplished by using the appropriate resisting ultimate skin friction as given in Table 2.

f. Care should be taken to assure the micropiles are not over-sized (mushroomed) at the ground surface, which could provide an area where swelling soil/rock could exert uplift forces on the piles.

g. The water cement ratio of the grout should be on the order of 0.45 to 0.50. This should be verified during construction using a grout scale to verify the grout has a specific gravity on the order of 1.8 to 1.9. The grout volume should be recorded for each micropile constructed to ensure the appropriate volume is placed.

h. Grout should be placed in the micropiles the same day they are drilled using a tremmie pipe which extends to the bottom of the drill hole. The tremmie pipe should be raised as the grout is placed to ensure the element is free of voids. If water enters the drill holes, it would be necessary to place grout immediately after the drill hole is completed using a tremmie. The tremmie will also displace water out of the hole as grout is placed. Failure to place grout the day of drilling may require re-drilling for additional bedrock penetration.

i. Micropile holes should be observed during drilling to verify depth. If air rotary methods are used, they can also be inspected to verify caving does not occur below the ground surface which could also result in additional uplift forces.

j. "Centralizers" should be used on the micropile steel reinforcing bar at approximately a 5 to 7 foot spacing to ensure the appropriate grout cover on the reinforcing.

2. Drill Pier Design

a. Minimum length = 45 feet.

b. Capacity of drilled piers may consider end bearing and skin friction to determine capacity. The end bearing capacities provided in Table 2 are allowable and include a factor of safety of 2.0.

c. The drilled piers should be structurally reinforced to resist tensile forces on the pier due to upward skin friction (uplift) which could result if the mudstone is wetted and swells. The tensile force may be calculated utilizing at least 20 feet of pier length with an ultimate skin friction of 1,000 psf.

d. Drilled piers should also be designed for down drag of 250 psf which could result if the existing fill densifies adjacent to the deep foundation element resulting in downward force on the deep foundation element.

e. The foundation elements should be designed for a minimum dead load of 10,000 psf. If the minimum dead load cannot be met and piers are spaced as far apart as practical, the length should extend beyond the minimum penetration to make up the dead load deficit. This can be accomplished by assuming an appropriate resisting ultimate skin friction as given in Table 2.

g. Care should be taken to assure the drilled piers are not over-sized (mushroomed) at the ground surface, which could provide an area where swelling soil/rock could exert uplift forces on the piers.

h. The concrete volume should be recorded for each pier constructed to ensure the appropriate volume is placed.

i. Concrete should be placed in the piers the same day they are drilled using a tremmie pipe which extends to the bottom of the drill hole. The tremmie pipe should be raised as the concrete is placed to ensure the element is free of voids. If water enters the drill holes, it would be necessary to place concrete immediately after the drill hole is completed using a tremmie. The tremmie will also displace water out of the hole

as concrete is placed. Failure to place concrete the day of drilling may require re-drilling for additional bedrock penetration.

j. Drilled pier holes should also be inspected to verify caving does not occur below the ground surface which could also result in additional uplift forces. Casing the drill hole may be necessary if the caving occurs to ensure a straight shaft with a consistent diameter. Pier holes must also be inspected to ensure they are cleaned and free of loose or disturbed soil.

k. Concrete coverage should be verified on reinforcing cages by placing spacers on the outside of the reinforcing cage to ensure it is not touching the drill hole side wall.

C. Floor System and Construction Details

1. Structural Floor/Beams/Crawl Space

Structural floors (including entries, porches and patios), supported on grade beams should be supported on deep foundation systems.

We recommend that a minimum 24 inch crawl space be provided below structural floors. Proper ventilation of the crawl space is critical and the ventilation system should be designed by the appropriate design professional.

A minimum 12-inch void space should be provided below the grade beams to allow the expansive mudstone to swell without exerting uplift forces on the grade beams. The void space should be protected prior to backfilling the grade beams to ensure the void space is not compromised. We also recommend low permeable fill be used as backfill around the beams to reduce the potential for infiltration and migration of water to the crawl space. Proper compaction and moisture conditioning of the backfill is critical.

2. Vapor Barrier

A vapor barrier should be placed on the bottom of the crawl space, attached to the grade beams using a water resistant attachment system to reduce moisture in the crawl space.

3. Plumbing and Utility Lines

Plumbing lines and utility lines should be hung from the floor when a pier/pile foundation system is utilized. Plumbing lines should have flexible joints where connections are made. A 12-inch void space should also be provided below plumbing where it crosses below grade beams.

4. Exterior Flatwork

The owners should be aware that exterior flatwork may move where expansive materials are present. To reduce concerns for flatwork movement causing distress to the structures, the flatwork should be separated from the main structure and allow for unrestrained vertical movement. This generally is accomplished by providing a construction joint between the concrete flatwork and the wall/slab with a heavy felt board.

A 4-inch layer of properly compacted base course should be placed below slabs to provide a firm and consistent subgrade and to promote even curing of the concrete.

Use of pavers or compacted decorative gravel in lieu of concrete flatwork may also be considered. Pavers or gravel will allow for some movement if the supporting subgrade heaves.

5. Exterior Porches

Exterior porches, patios and overhangs that are structurally tied to the remainder of the building should be supported by the same foundation system as the building.

D. Pool Construction Details

1. Pool Structural Floor

The shell of the pool should be structurally reinforced to span the distance between the piers. We recommend a minimum 24 inch void be provided below the pool to prevent expansive materials from exerting uplift forces on the pool. A void box should be placed in the bottom of the pool excavation prior to placing plumbing and rebar, or spraying gunnite to allow for construction above the void below the pool.

As an alternative, the bottom of the pool may be constructed as a structural floor supported on the piers using V-decking with a crawl space (This is the preferred method). The raised structural floor should be supported on grade beams. We recommend that a minimum 24 inch crawl space and access be provided below the structural floor. A 12-inch void space should be provided below the grade beams to allow the expansive materials to swell without exerting uplift forces on the grade beams. Subsequent to removing concrete forms from grade beams, the void should be inspected by AGEC to ensure the proper void space is provided.

2. Pool Plumbing and Utility Lines

Plumbing lines and utility lines should be hung from the floor when a pier foundation and structural floor system is utilized or placed above the void box (if used) to prevent crushing of the piping or connections.

Plumbing lines should have flexible joints where connections are made. A 12-inch void space should also be provided below plumbing where it crosses below grade beams. Exterior plumbing lines may be run inside a larger pipe conduit to allow for some movement without negatively affecting the plumbing lines. Plumbing lines should be tested prior to operation.

3. Pool Decking

Due to the presence of the underlying fill and expansive materials, we recommend the pool decking consist of a raised structural slab supported on deep foundation elements.

If slab on grade pool decking will be considered, the subgrade supporting the decking should be prepared as recommended in the Subgrade Preparation section of this report for "Flatwork". The owner should be aware that exterior flatwork will likely heave (as stated in the Subgrade Preparation section of this report).

Slab on grade pool decking should be separated (free vertical movement) from the main structure of the pool and should not be tied directly to the pool shell or to adjacent buildings. This is recommended to allow for unrestrained uplift of the pool decking so as not to affect the main structure of the pool. This generally is accomplished by providing a construction joint between the concrete flatwork and pool or building with a heavy felt board.

The pool decking should be sloped away from the pool to provide adequate drainage. We also recommend constructing a water-tight concrete gutter system (depression) or drain around the pool decking to catch runoff water, divert it around the pool, and discharge off site. Joints or seams in the pool decking should be sealed to reduce infiltration of surface water.

A 4-inch layer of properly compacted base course should be placed below slabs to provide a firm and consistent subgrade and to promote even curing of the concrete.

E. Lateral Earth Pressures

1. Retaining Structures

The following equivalent fluid weights are given for design of subgrade walls and retaining structures. The active condition is where the wall moves away from the soil. The passive condition is where the wall moves into the soil and the at-rest condition is where the wall does not move. We recommend basement walls or below grade beams be designed in an at-rest condition. Walls where lateral movement is not tolerable should also be designed in the at-rest condition.

The values listed below assume a horizontal surface adjacent the top and bottom of the wall.

Soil Type	**Active Condition**		**At-Rest Condition**		**Passive Condition**
	Equivalent Fluid Weight	Earth Pressure Coefficient	Equivalent Fluid Weight	Earth Pressure Coefficient	Equivalent Fluid Weight
Imported Granular Backfill	35 pcf	0.28	55 pcf	0.44	325 pcf
On-site Clayey Fill Soil	45 pcf	0.38	65pcf	0.54	225 pcf

The above values account for the lateral earth pressures due to the soil and level backfill conditions and do not account for hydrostatic pressures or surcharge loads.

Lateral loading should be increased to account for surcharge loading using the appropriate earth pressure coefficient and a rectangular distribution if structures are placed above the wall and are within a horizontal distance equal to the height of the wall. If the ground surface slopes up away from the wall, the equivalent fluid weights should also be increased.

Care should be taken to prevent percolation of surface water into the backfill material adjacent to the retaining walls. The risk of hydrostatic buildup can be reduced by placing a subdrain behind the walls consisting of free-draining gravel wrapped in a filter fabric.

2. Seismic Conditions

Under seismic conditions, the equivalent fluid weights should be modified as follows according to the Mononobe-Okabe method assuming a level backfill condition:

Lateral Earth Pressure Condition	**Seismic Modification (2% PE in 50 yrs)**
Active	9 pcf increase
At-rest	no increase
Passive	18 pcf decrease

The seismic increases and decrease assume a peak ground acceleration (PGA) of 0.21g and a 1 second period ground acceleration (S_1) of 0.14g using the Mononobe-Okabe pressure distribution.

3. Safety Factors

The values recommended assume mobilization of the soil to achieve the assumed soil strength. Conventional safety factors used for structural analysis for such items as overturning and sliding resistance should be used in design.

F. Seismicity, Liquefaction and Faulting

1. Seismicity

Listed below is a summary of the seismic site parameters.

Description	Value - Seismic Event - 2% PE in 50 yrs
2015 IBC Seismic Site Class	C
PGA	0.21g
S_s	0.50g
S_1	0.15g
F_a	1.20
F_v	1.65
F_{PGA}	1.19

2. Liquefaction

Based on subsurface conditions encountered in the boring, the subsurface soils observed are non-liquefiable during a severe seismic event.

3. Faults

Based on review of available geologic literature, there are no mapped faults extending through the site.

G. Soil Corrosion

Our experience in the area and laboratory test results indicates the on-site soil and bedrock contain sulfate concentration corresponding to a "moderate" to "severe" potential sulfate attack on concrete exposed to these materials. Therefore, we recommend concrete elements that will be exposed to the on-site soils be designed in accordance with provisions provided in the American Concrete Institute Manual of Concrete Practice (ACI) 318-11. Tables 4.2.1 and 4.3.1 of ACI 318-11 should be

referenced for design of concrete elements utilizing a Sulfate Exposure Class of S2, and a sulfate exposure severity of "severe".

Consideration should also be given to cathodic protection of buried metal pipes. We recommend utilizing PVC pipes where local building codes allow.

H. Pavement

Based on the subsoil conditions encountered and the laboratory test results, the following recommendations are given:

1. Analysis

   The flexible pavement analysis is based on AASHTO design methods and a 20 year design lifeThe rigid pavement is based on AASHTO and PCCA design methods and a 20 year design life.

2. Subgrade Support

   Our design assumes a properly prepared subgrade as recommended in the Subgrade Preparation section of this report. The subgrade preparation varies depending on the location on the site. Prior to base course or pavement or grading fill, the subgrade should be prepared as recommended in the Subgrade Preparation section of this report.

3. Pavement Thickness

   Based on the anticipated traffic, the following pavement sections are recommended.

	Rigid Pavement		Flexible Pavement	
Area	Portland Cement (inches)	Base Course (inches)	Asphaltic concrete (inches)	Base Course (inches)
Light Duty Parking	--	--	2½	8
Entrances and dumpster pad	4	4	3	12

4. Pavement Materials

a. *Flexible Pavement (Asphaltic Concrete)*

The pavement materials should meet AASHTO, St. George City specifications for gradation and quality. The pavement thicknesses indicated above assume that the base course is a high quality material with a CBR value of at least 80 percent. Asphalt material should have a Marshal stability of at least 1,800 pounds.

b. *Rigid Pavement (Portland Cement Concrete)*

The pavement thicknesses indicated assumes that the concrete will have a 28-day compressive strength of at least 4,500 psi.

5. Jointing

Joints for concrete (rigid) pavement should be laid out in a square or rectangular pattern. Joint spacings should not exceed 30 times the thickness of the slab. The depth of joints should be at least one-quarter of the slab thickness.

6. Drainage

The collection and diversion of drainage away from the pavement surface is extremely important to the satisfactory performance of the pavement section. Proper drainage should be provided. We further recommend proper pavement maintenance to extend the pavement life.

I. Design Review/Construction Observation

Design review and construction observations are recommended to verify the recommendations in this report are properly implemented and followed. In order to provide a foundation compliance report as required by the St. George City, we recommend the following be done as a minimum:

1. Review the foundation plan and design to verify the geotechnical aspects of the design were correctly and properly included.

2. Observe on a full time basis the drilling and construction of the micropiles and piers including reinforcement and concrete placement.

3. Observe the reinforcing steel in the grade beams.

4. Verify the proper void space is provided below the grade beams.

5. Conduct special inspections as required by the St. George City, the 2015 International Building Code and the Structural engineer.

The above observations will be conducted by qualified individuals and according to standard test methods (ASTM, ICBO, ICC, etc.).

LIMITATIONS

This report has been prepared in accordance with generally accepted soil and foundation engineering practices in the area for the use of the client for design purposes. The conclusions and recommendations included within the report are based on the information obtained from the borings drilled, geologic literature, laboratory test results, engineering analysis and our experience in the area. Variations in the subsurface conditions may not become evident until additional exploration or excavation is conducted. If the subsurface soil or groundwater conditions are found to be different from what is described in this report, we should be notified to reevaluate the recommendations given.

If you have any questions or we can be of further service, please call.

APPLIED GEOTECHNICAL ENGINEERING CONSULTANTS, INC.

Arnold DeCastro, P.E.

Reviewed By: James E Nordquist, P.E., D.G.E.

AD/sd P:\2018 Project Files\2180100\2180187 - GT Blackridge Hotel Site\2180187.rep.wpd

GEOLOGIC LITERATURE REFERENCES

"Geologic map of the St. George quadrangle, Washington County, Utah", Hayden, J.M., Willis, G.C., 2011, Utah Geological Survey map, 251DM.

"Geologic hazards and adverse construction conditions, St. George-Hurricane Metropolitan Area, Washington County, Utah", Lund, W.R., Knudsen, T.R., Vice, G.S., and Shaw, L.M., 2008, Utah Geological Survey Special Study 127, variously paginated, 14 plates, scale 1:24,000.

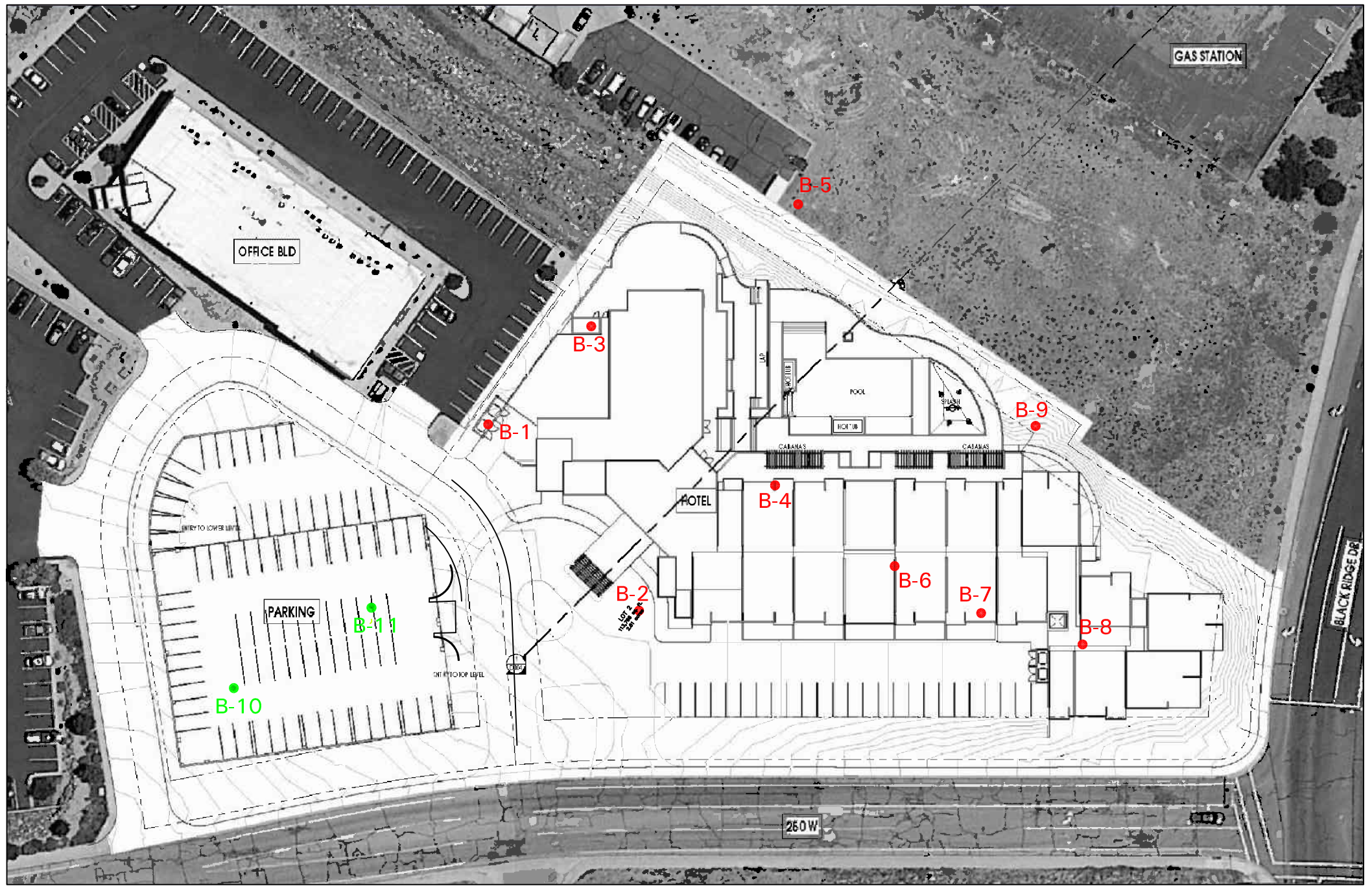
N

Not to Scale

BLACKSTONE HOTEL SITE
ST. GEORGE, UTAH

2180187	AGEC	Vicinity Map	Figure 1

BLACKSTONE HOTEL SITE
ST. GEORGE, UTAH



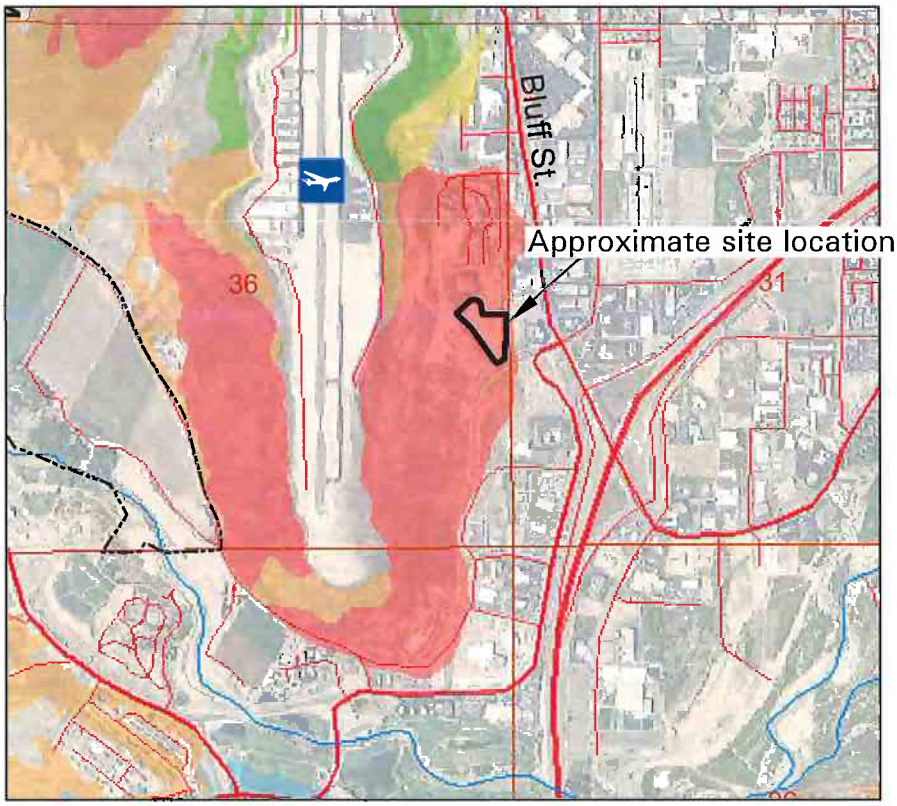
- Approximate boring location (current study)
- Approximate boring location (previous study by AGEC under Project No. 2061672)

N

0 80 160 feet

Approximate Scale

2180187	AGEC	Site Plan	Figure 2



Landslide-Hazard Map for the St. George-Hurricane Metropolitan Area, Washington County, Utah, UGS Special Study 127 2008, W.R. Lund, T.R. Knudson, G.S. Vice and L.M. Shaw

EXPLANATION

VH	Very High: Existing landslides (Category A).
H	High: Areas where Category B geologic units crop out on slopes greater than 15 percent (8.5°).
M_C	Moderate C: Areas where Category C geologic units crop out on slopes greater than 20 percent (11.3°).
M_B	Moderate B: Areas where Category B geologic units crop out on slopes less than 15 percent (8.5°).
L	Low: Areas where Category D geologic units crop out on slopes greater than 30 percent (16.7°).

Landslide Susceptibility of Geologic Units

Susceptibility Category	Geologic Units[1]	Comments
A	Existing landslides	Existing slope failures are considered the most likely units in which landsliding may initiate.
B	Petrified Forest Mbr., Chinle Fm.	This rock unit consists chiefly of bentonitic clay, which is highly expansive and has low shear strength especially when wet. This unit includes the greatest number of landslides mapped in the study area.
C	Woods Ranch Mbr., Toroweap Fm.; Harrisburg Mbr., Kaibab Fm.; Shnabkaib Mbr. and red members, Moenkopi Fm.; Whitmore Point Mbr., Moenave Fm.; Temple Cap Fm.; Carmel Fm.; Cretaceous bentonitic beds; Iron Springs Fm.	These bedrock units contain varying amounts of gypsum, shale, claystone, mudstone, siltstone, or a combination of the above that imparts weak shear strength characteristics to the units, at least locally, and makes them susceptible to slope failure. These units contain the second greatest number of landslides in the study area.
D	Remaining bedrock and unconsolidated geologic units in the study area.	These geologic units either contain a higher percentage of stronger rock types, crop out on slopes too low to generate slope failures, or generate failures that are too small to map at 1:24,000-scale. As a result, they exhibit few or no mapped landslides. Some landslides identified within these units are likely the result of failures in underlying, weaker geologic units.

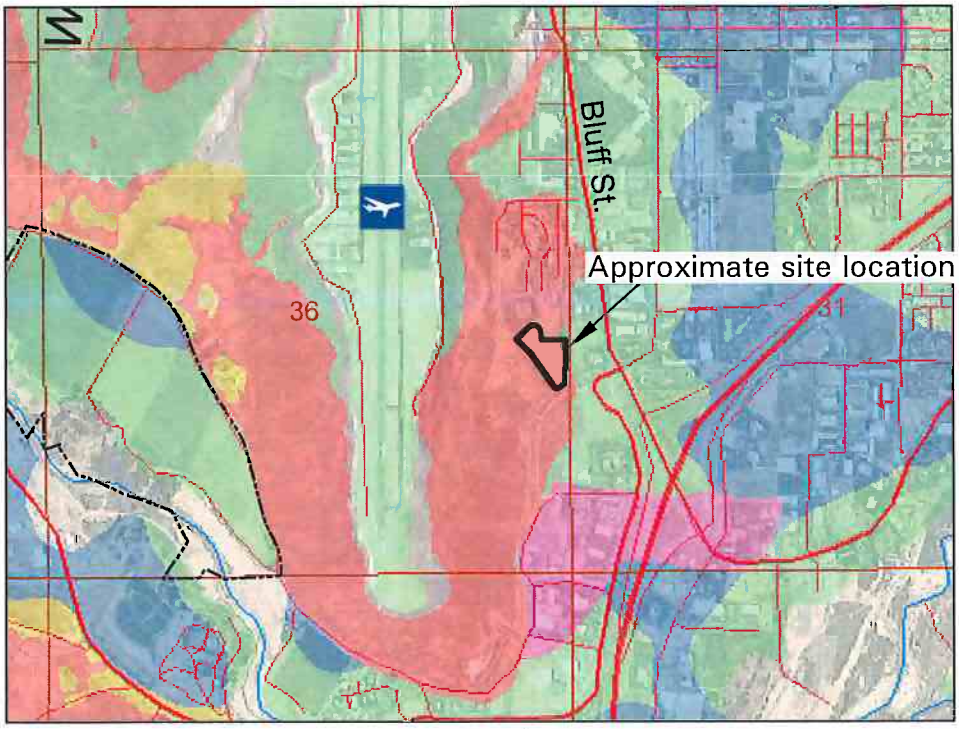
[1]Refer to UGS 1:24,000-scale geologic maps (see SOURCES OF DATA and REFERENCES in accompanying text) for a description of map units.

BLACKSTONE HOTEL SITE
ST. GEORGE, UTAH

N

Approximate Scale 1 = 24,000'

2180187	AGEC	Landslide Hazard Map	Figure 2a



Expansive-Soil-and Rock-Susceptibility Map for the St. George-Hurricane Metropolitan Area, Washington County, Utah, UGS Special Study 127 2008, W.R. Lund, T.R. Knudson, G.S. Vice and L.M. Shaw

ROCK

ERH — Bedrock units with high shrink/swell susceptibility include claystone horizons in the Virgin Limestone Member of the Moenkopi Formation; the Petrified Forest Member of the Chinle Formation, known locally as the "Blue Clay;" the lower red beds of the Dinosaur Canyon Member and the Whitmore Point Member of the Moenave Formation; the Iron Springs Formation, which contains abundant clay-rich strata in its lower part; and a thin interval (maximum thickness 90 feet) of montmorillonitic clay that lies between the Carmel Formation and the overlying Iron Springs Formation. Landslides mapped within these rock units were also included in the high-susceptibility category. These bedrock units contain an abundance of expansive clay minerals and are commonly associated with expansive rock problems in the study area.

ERM — Bedrock units with moderate shrink/swell susceptibility include the Shnabkaib and lower, middle, and upper red members of the Moenkopi Formation; the Co-op Creek and Crystal Creek Members of the Carmel Formation; and the Temple Cap Formation. These rock units are chiefly fine grained and contain alternating strata of shale, claystone, mudstone, siltstone, sandstone, and limestone. Not all or necessarily the majority of these strata contain expansive clay minerals, but past experience in the study area has shown that a sufficiently high percentage of strata do contain expansive clays that foundation problems are often associated with these rock units. Where mapped as undivided, we assigned a moderate susceptibility to the Moenkopi Formation, Carmel Formation, and grouped Triassic, Triassic/Jurassic, and Jurassic/Cretaceous rocks. Landslides mapped within moderate-susceptibility units are also included in this category.

ERL — Bedrock units with low shrink/swell susceptibility include the Timpoweap Member of the Moenkopi Formation and the the Kayenta Formation. Although we consider these units to have a low susceptibility relative to the bedrock units identified above, they contain some fine-grained, clay-rich strata that may cause shrink/swell problems locally.

CONCEALED

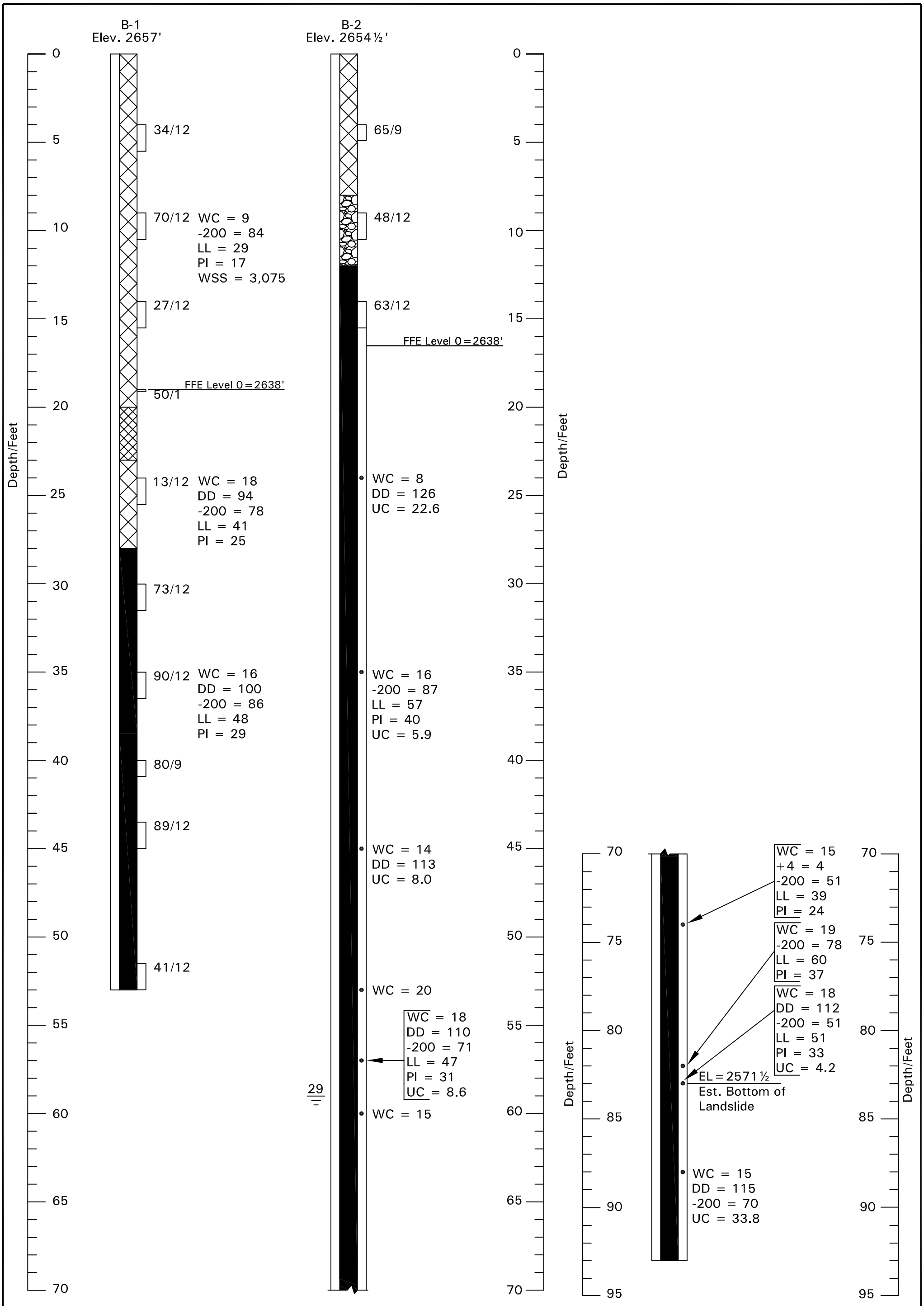
CHESR — Area of highly expansive soil or rock (≥5 percent swell) in the shallow subsurface (≤20 feet), but with little or no evidence of such material at the ground surface. Based on past engineering experience, such highly expansive soil or rock can cause differential displacements at the ground surface even when overlain by as much as 20 feet of nonexpansive material, and these areas are considered to have a high potential for expansive soil and rock problems.

BLACKSTONE HOTEL SITE
ST. GEORGE, UTAH

N

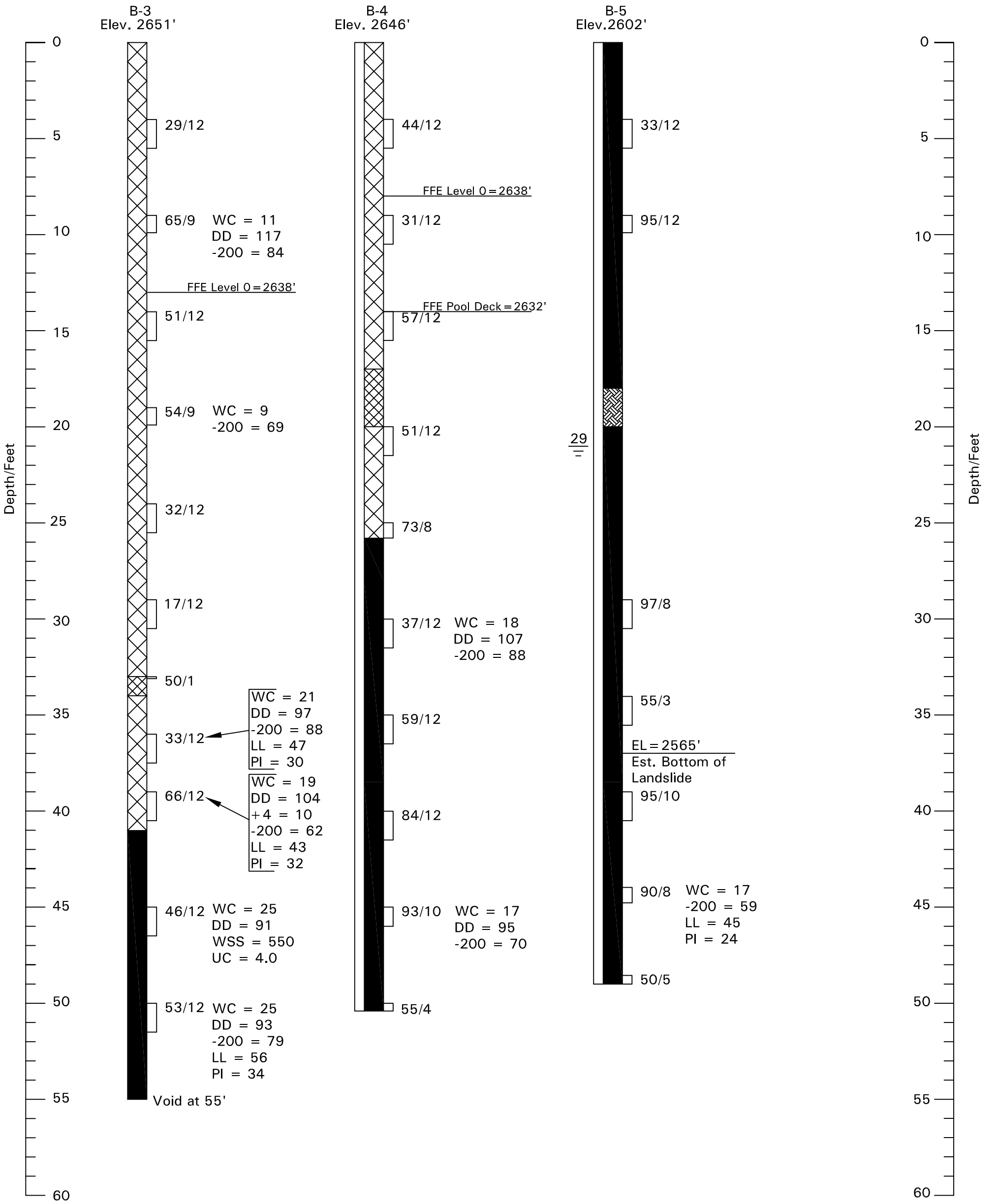
Approximate Scale 1 = 24,000'

2180187	AGEC	Expansive Soil and Rock Susceptibility Map	Figure 2b

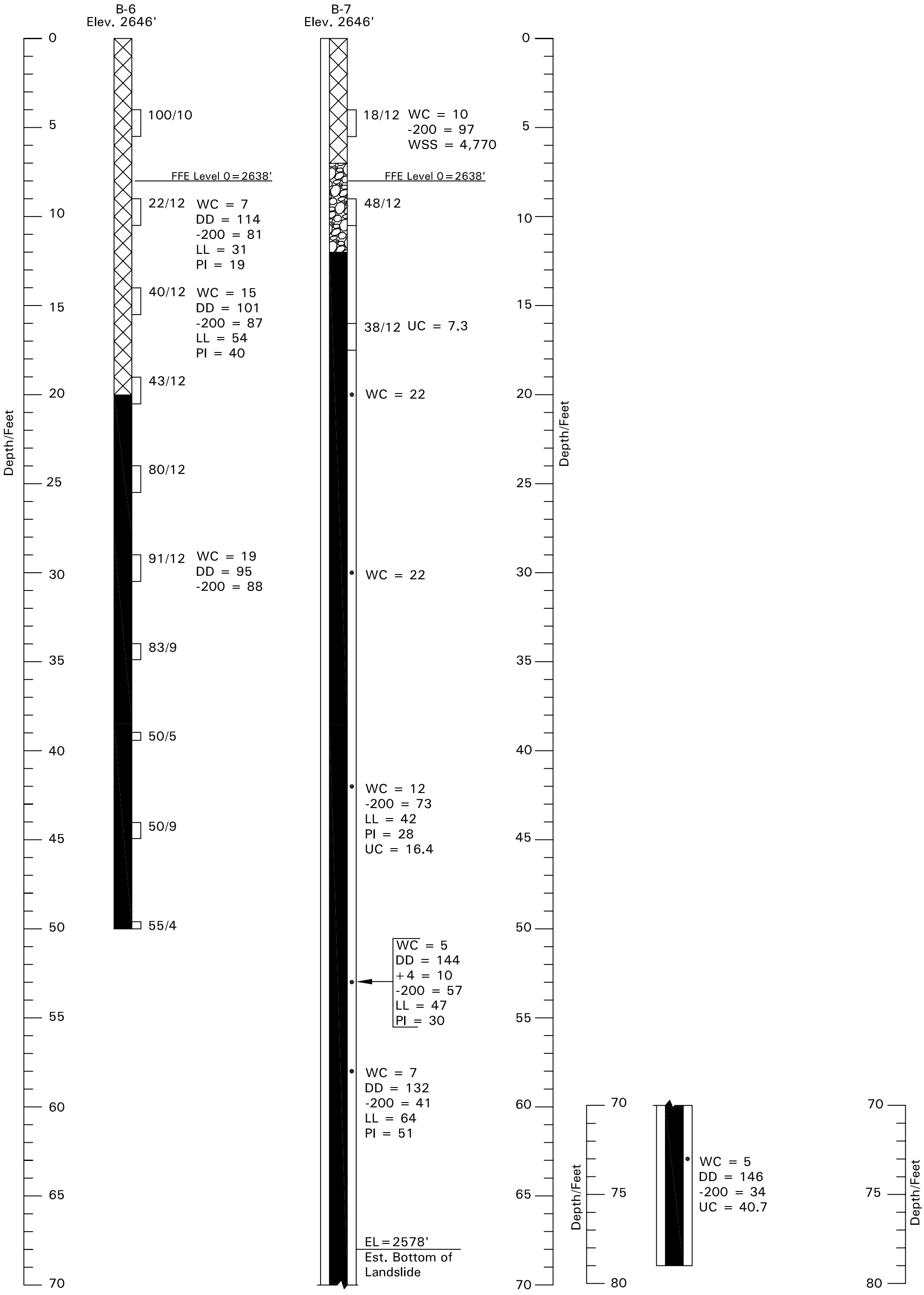


See Figure 8 for Legend and Notes

2180187	AGEC	Logs of Exploratory Borings	Figure 3

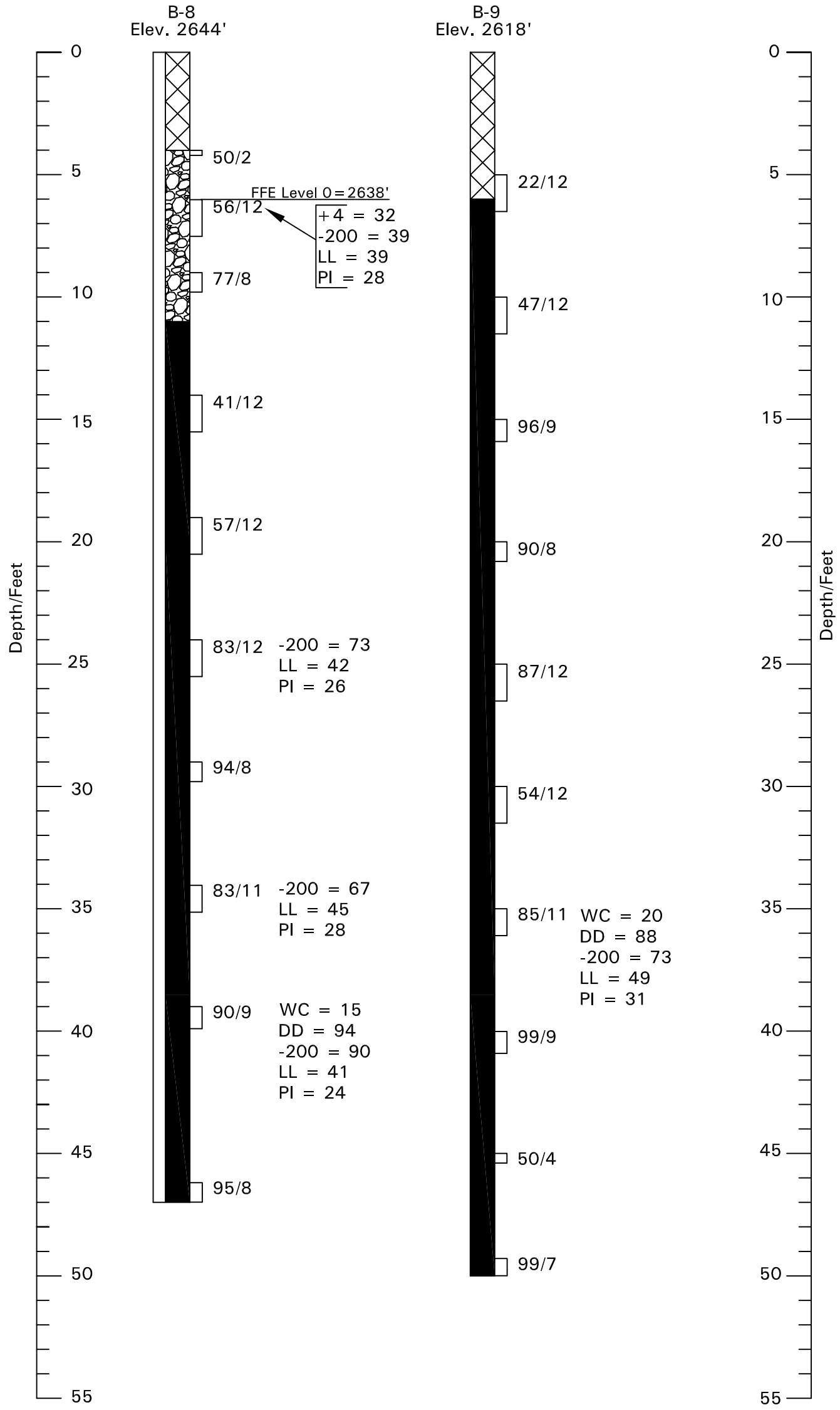


See Figure 8 for Legend and Notes



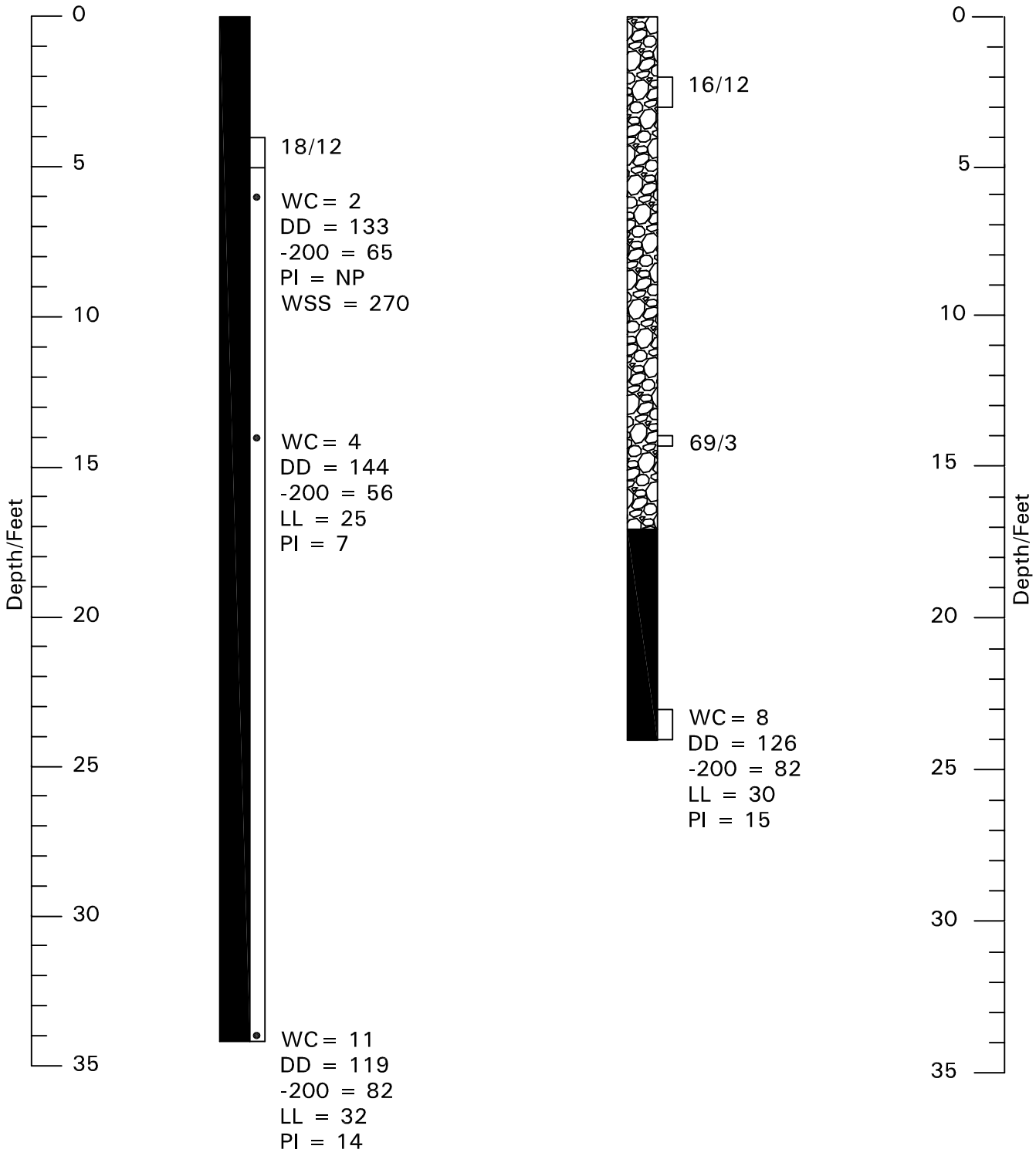
See Figure 8 for Legend and Notes

2180187	AGEC	Logs of Exploratory Borings	Figure 5



See Figure 8 for Legend and Notes

2180187	AGEC	Logs of Exploratory Borings	Figure 6



See Figure 8 for Legend and Notes

2180187	AGEC	Logs of Exploratory Borings	Figure 7

LEGEND:

Fill 1; lean to fat clay with sand and gravel, contains occasional cobbles and boulders. Consistency appears inconsistent (poorly to well compacted), slightly moist to moist, red to purple. Clay varies from low to high plasticity. Cobbles and boulders are basalt and sandstone.

Fill 2; basalt boulders, contains voids.

Basalt Boulder; hard, dry, grey.

Talus; cobbles infilled with gravel, sand and clay, occasional boulders, typically stiff/dense, slightly moist to moist, gypsiferous, purple to red. Clay is low to high plastic.

Mudstone Bedrock; soft to moderately hard, slightly moist to very moist, medium to high plastic, purple to red to grey. Altered mudstone (above the landslide slop surface) contains sand, clay and small basalt gravels. Changes to dark grey/black to yellow below the landslide. Red in boring B-10.

10/12 California drive sample taken. The symbol 10/12 indicates that 10 blows from a 140 pound automatic hammer falling 30 inches were required to drive the sampler 12 inches.

Indicates core sample taken.

Indicates slotted 1 inch PVC pipe installed in the boring to the depth shown.

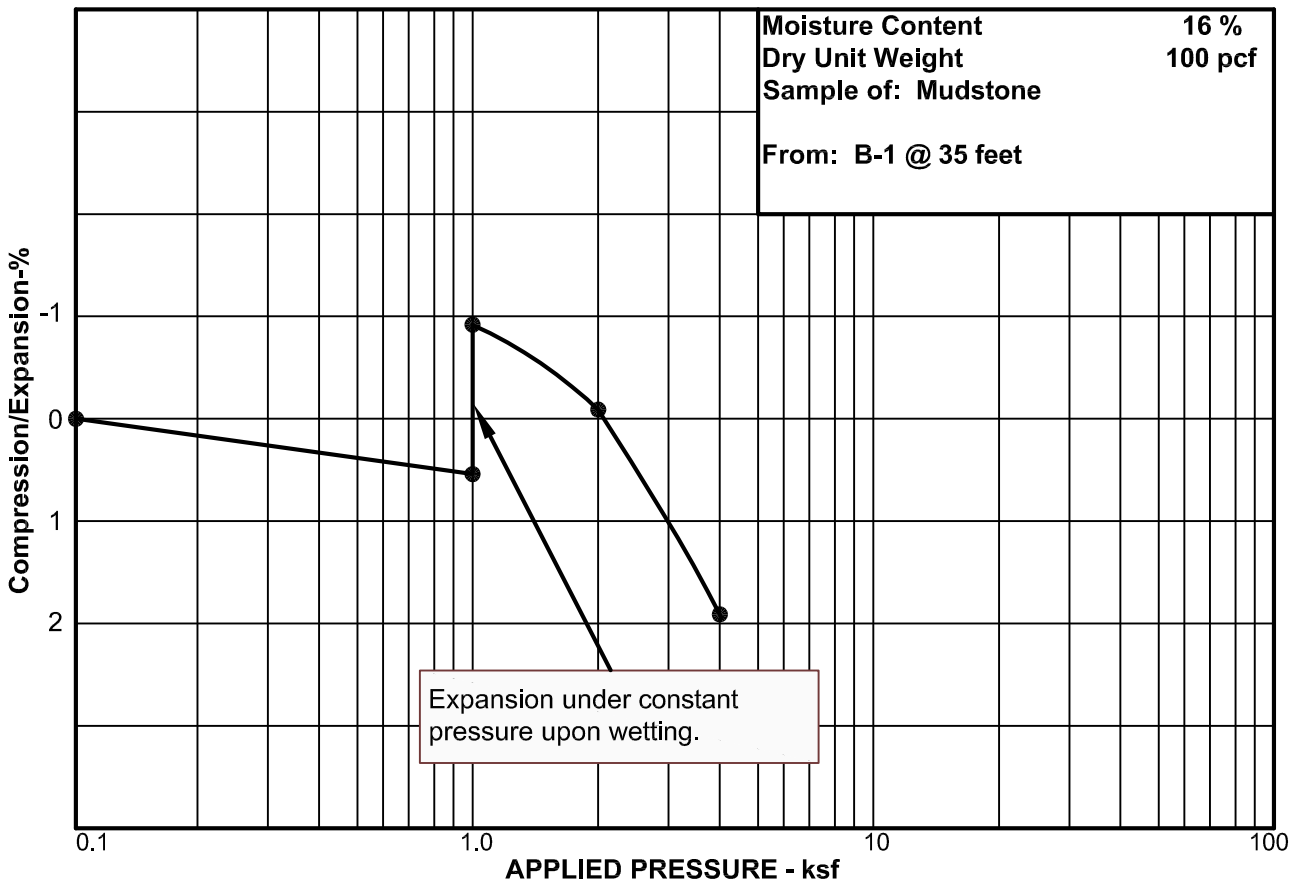
0 Indicates the depth to free water and the number days after drilling the measurement was taken.

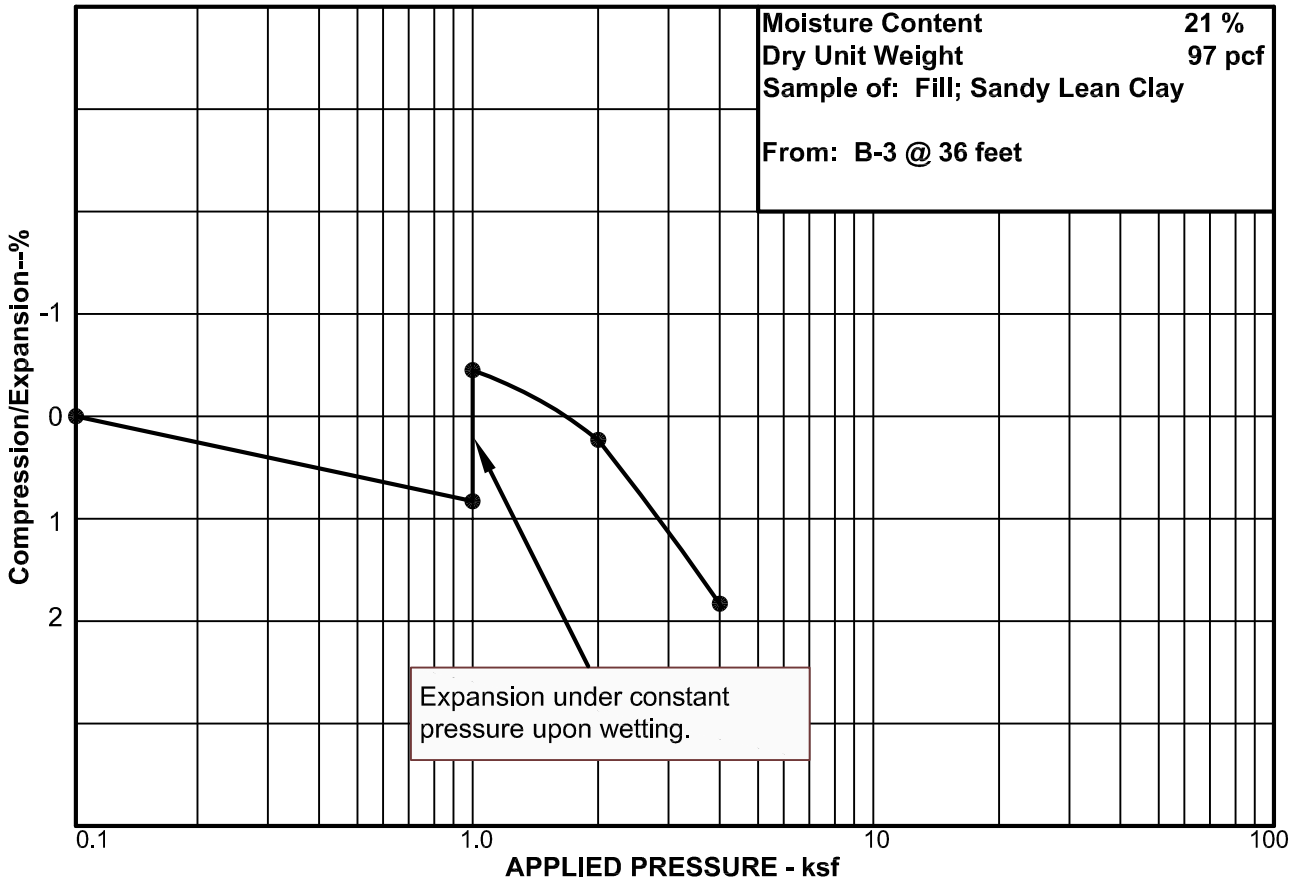
FFE Finished Floor Elevation

NOTES:

1. The borings were drilled on August 7, 2007, June 6, 7, August 16, September 17, 18, 20, 21, 24, and October 5, 2018 with a truck-mounted drill rig equipped with 8-inch hollow-stem augers and 2½ inch HQ core barrel with a carbide bit using mud rotary techniques.
2. The locations and elevations of the borings B-1 to B-9 were measured by Bush & Gudgell using GPS methods. The locations of borings B-10 and B-11 (2061672) were measured by pacing from features shown on Figure 2. The elevations were determined by interpolating between contours shown on the site plan for this report.
3. The boring locations and elevations should be considered accurate only to the degree implied by the method used.
4. The lines between the materials shown on the boring logs represent the approximate boundaries between material types and the transitions may be gradual.
5. Free water was not encountered in the borings B-1 to B-4 and B-6 to B-11 at the time of drilling.
6. WC = water content (%);
   DD = dry density (pcf);
   +4 = percent retained on the No. 4 sieve;
   -200 = percent passing No. 200 sieve;
   LL = liquid limit (%);
   PI = plasticity index (%);
   NP = non-plastic;
   UCC = unconfined compressive strength (ksf);
   WSS = water soluble sulfates (ppm).

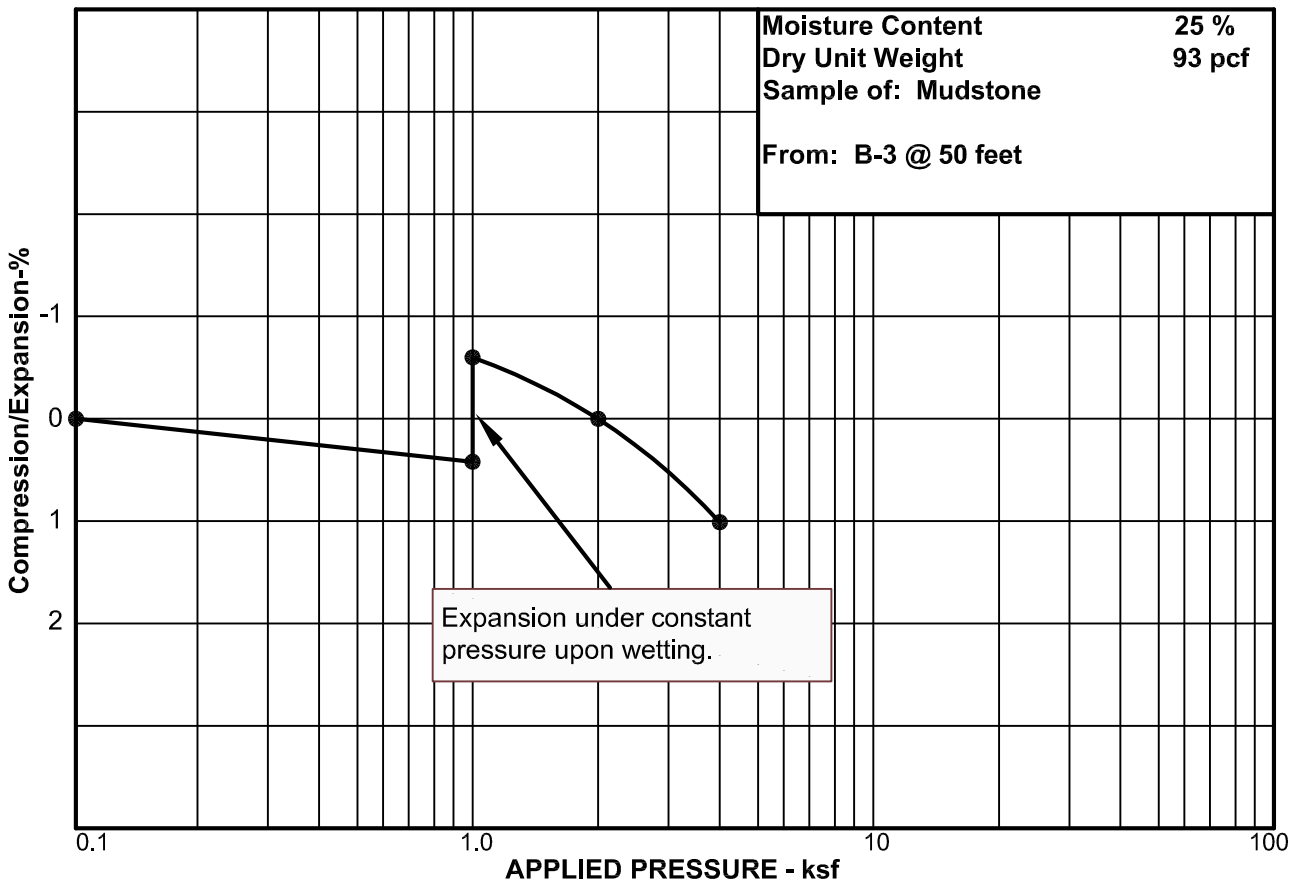
Applied Geotechnical Engineering Consultants, Inc.

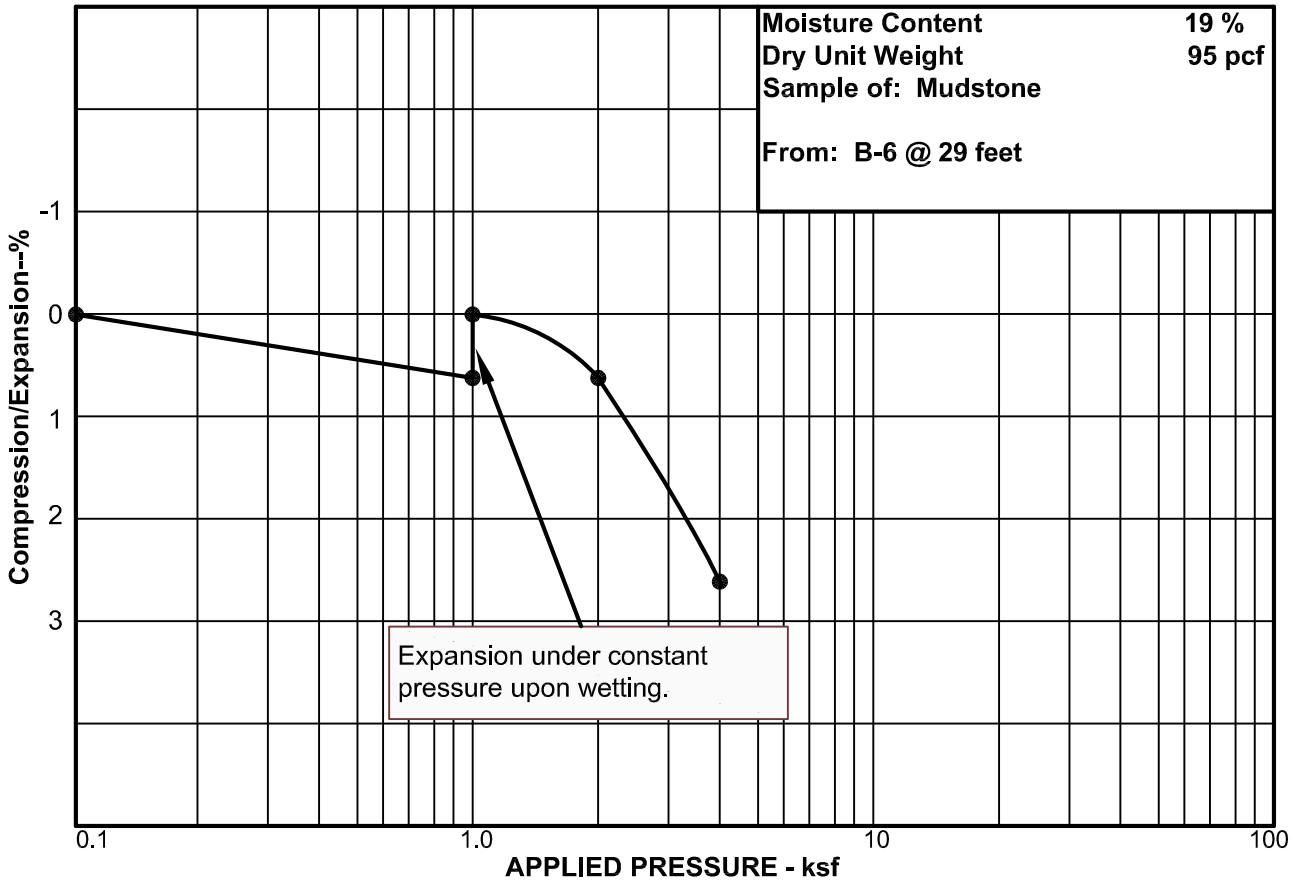




Project No. 2180187 **CONSOLIDATION TEST RESULTS** **Figure 9**

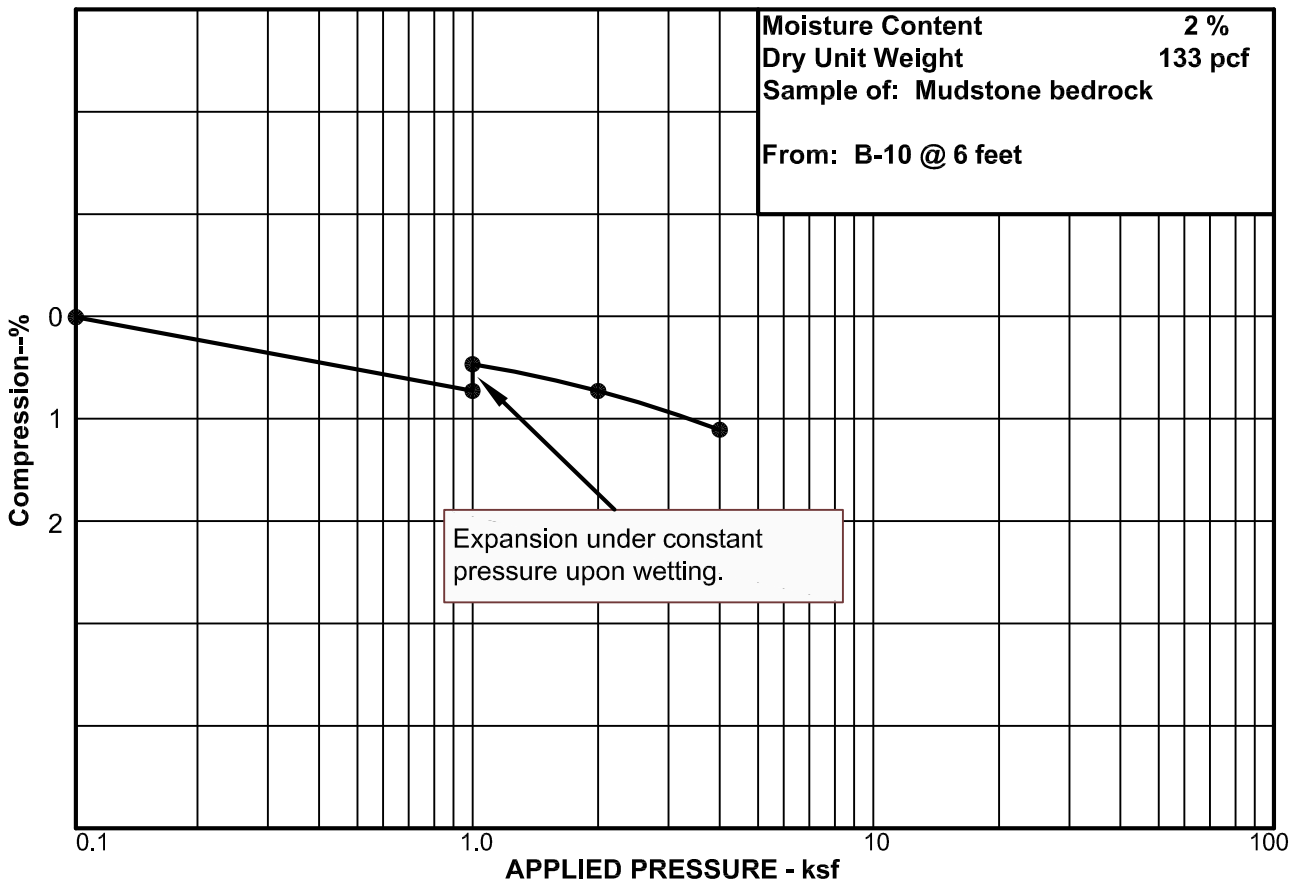
Applied Geotechnical Engineering Consultants, Inc.

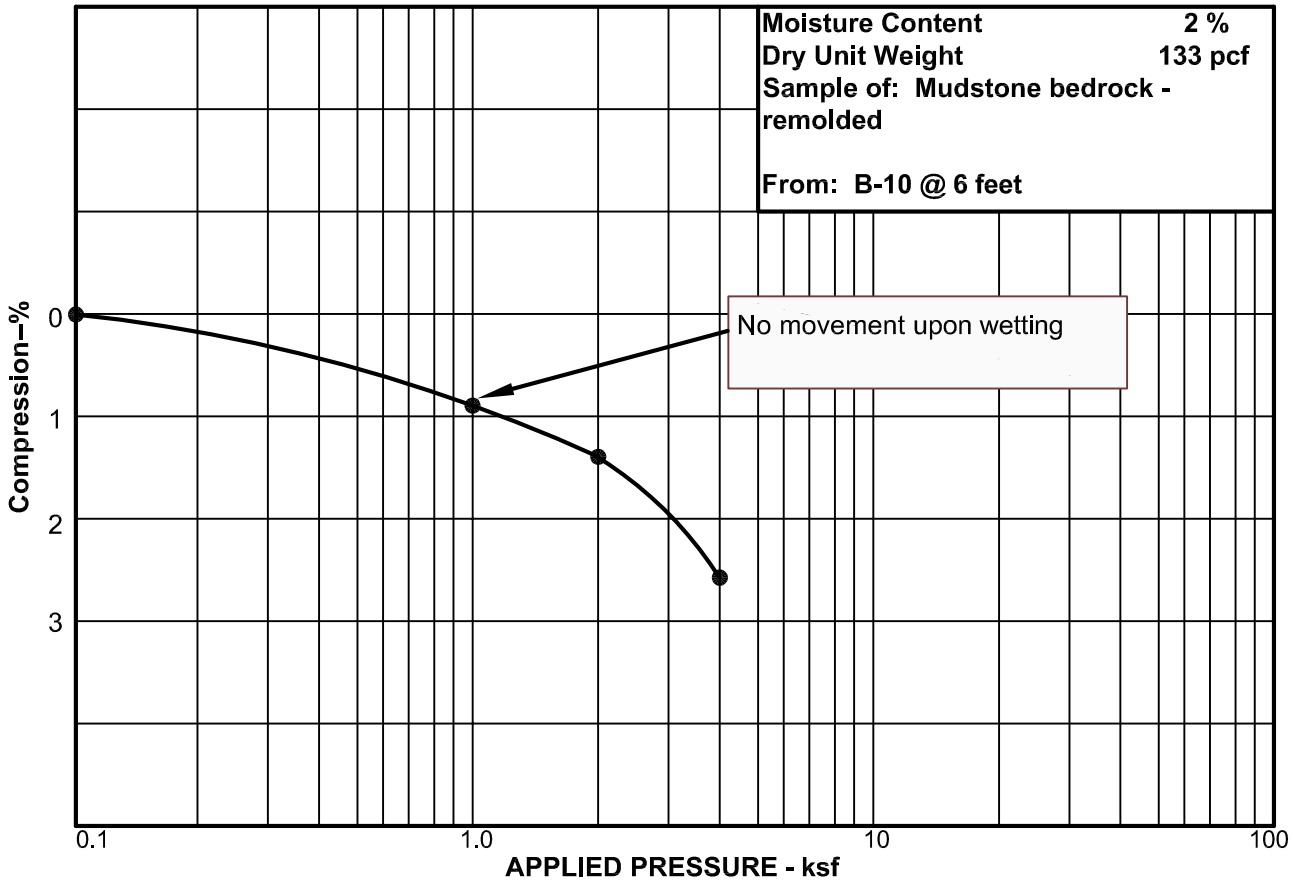




Project No. 2180187 **CONSOLIDATION TEST RESULTS** **Figure 10**

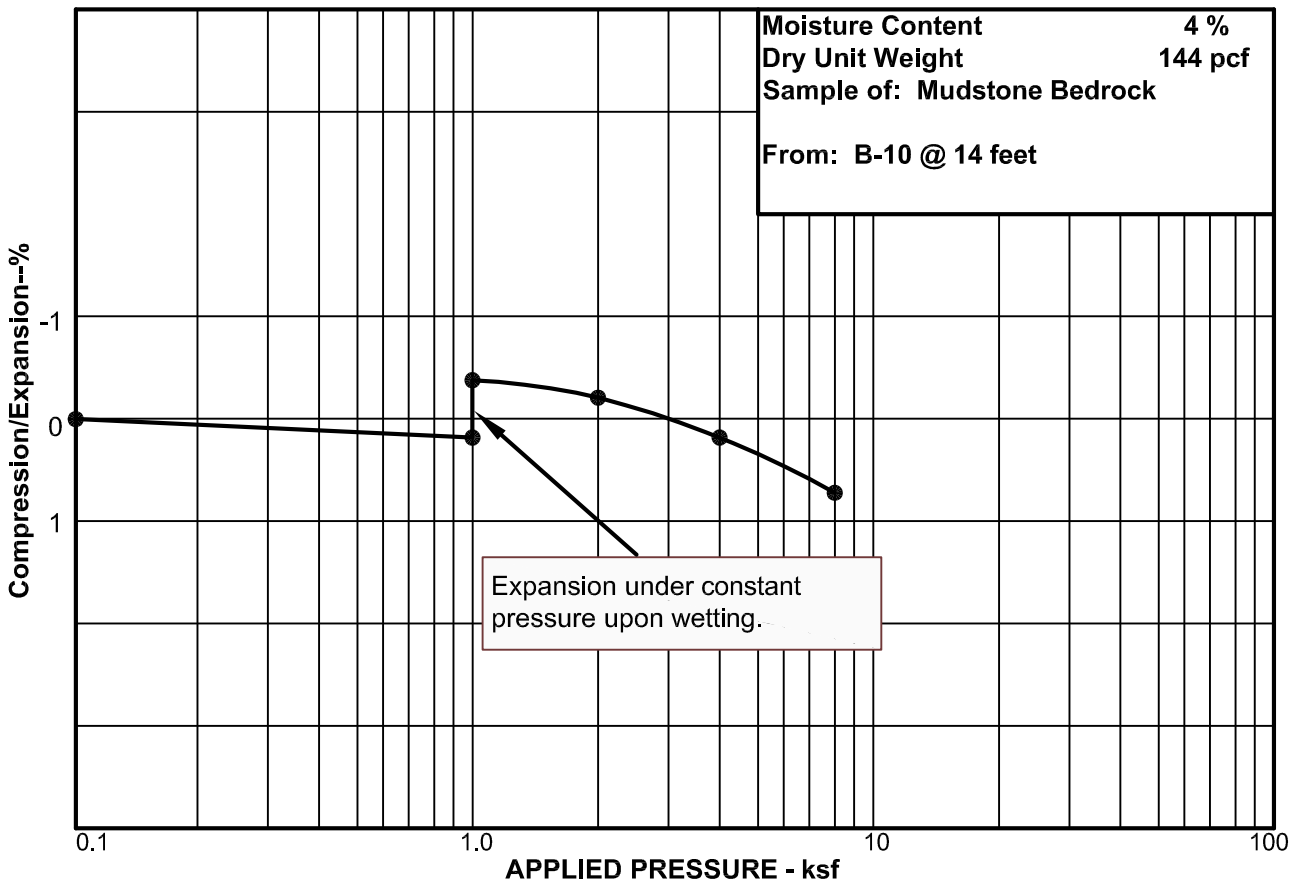
Applied Geotechnical Engineering Consultants, Inc.

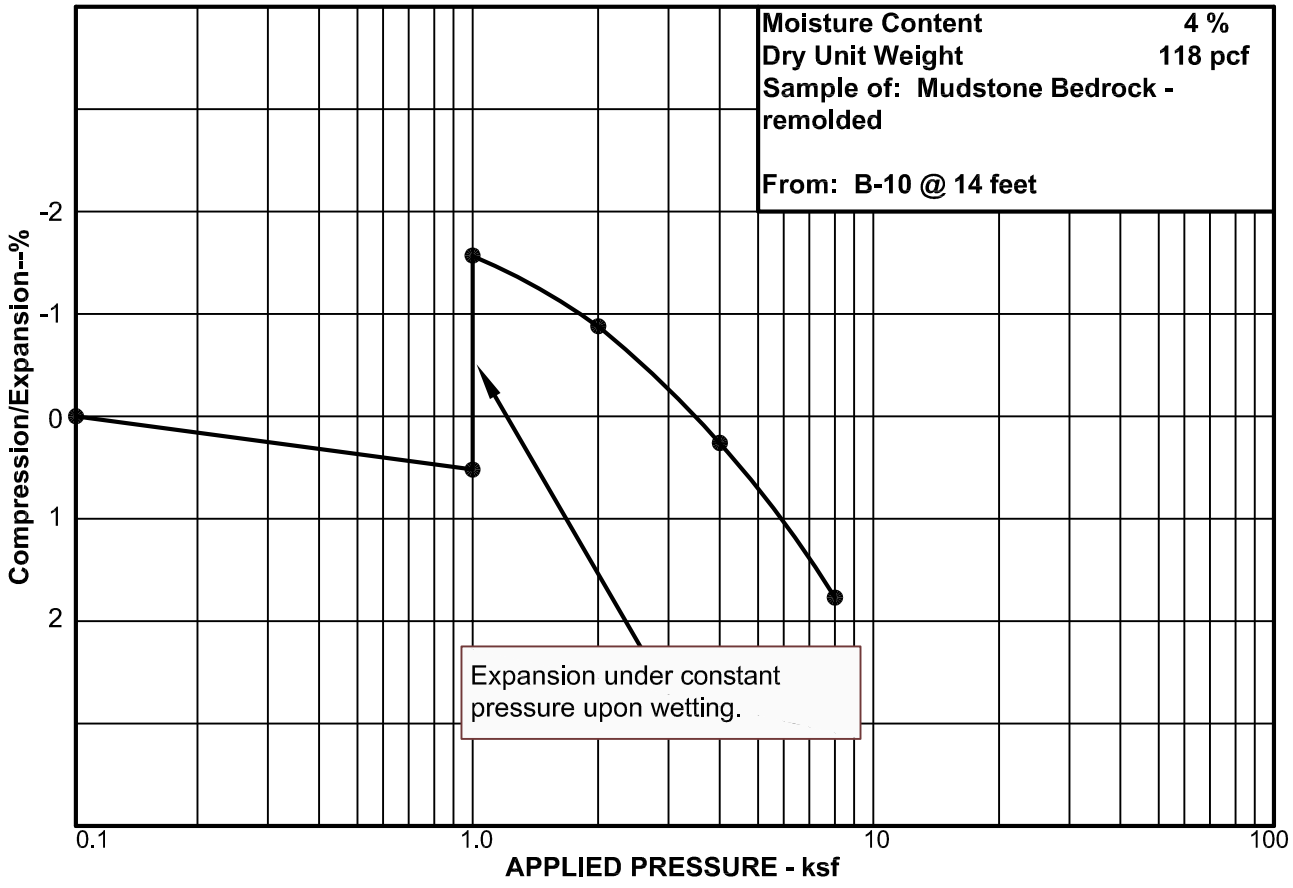




Project No. 2180187 **CONSOLIDATION TEST RESULTS** **Figure 11**

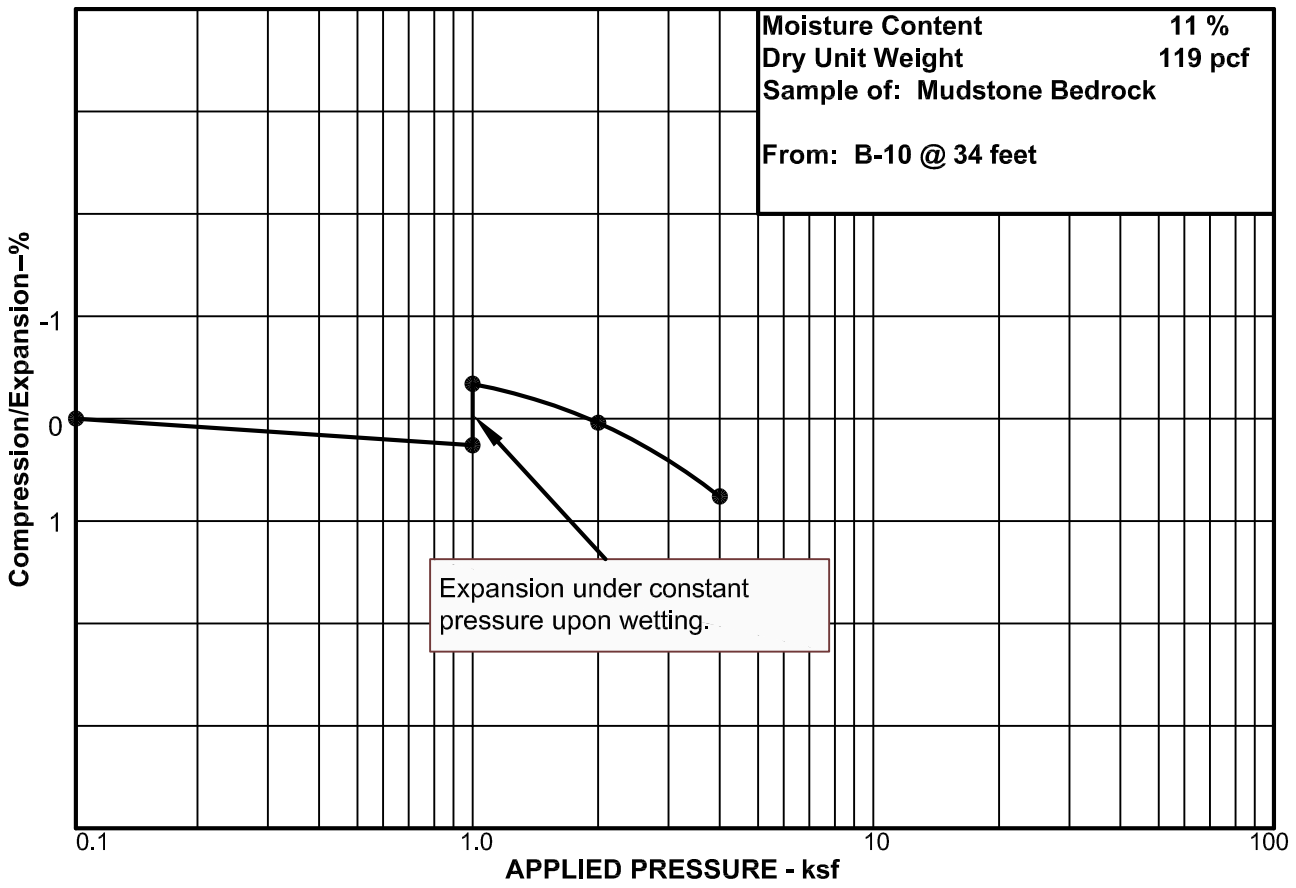
Applied Geotechnical Engineering Consultants, Inc.

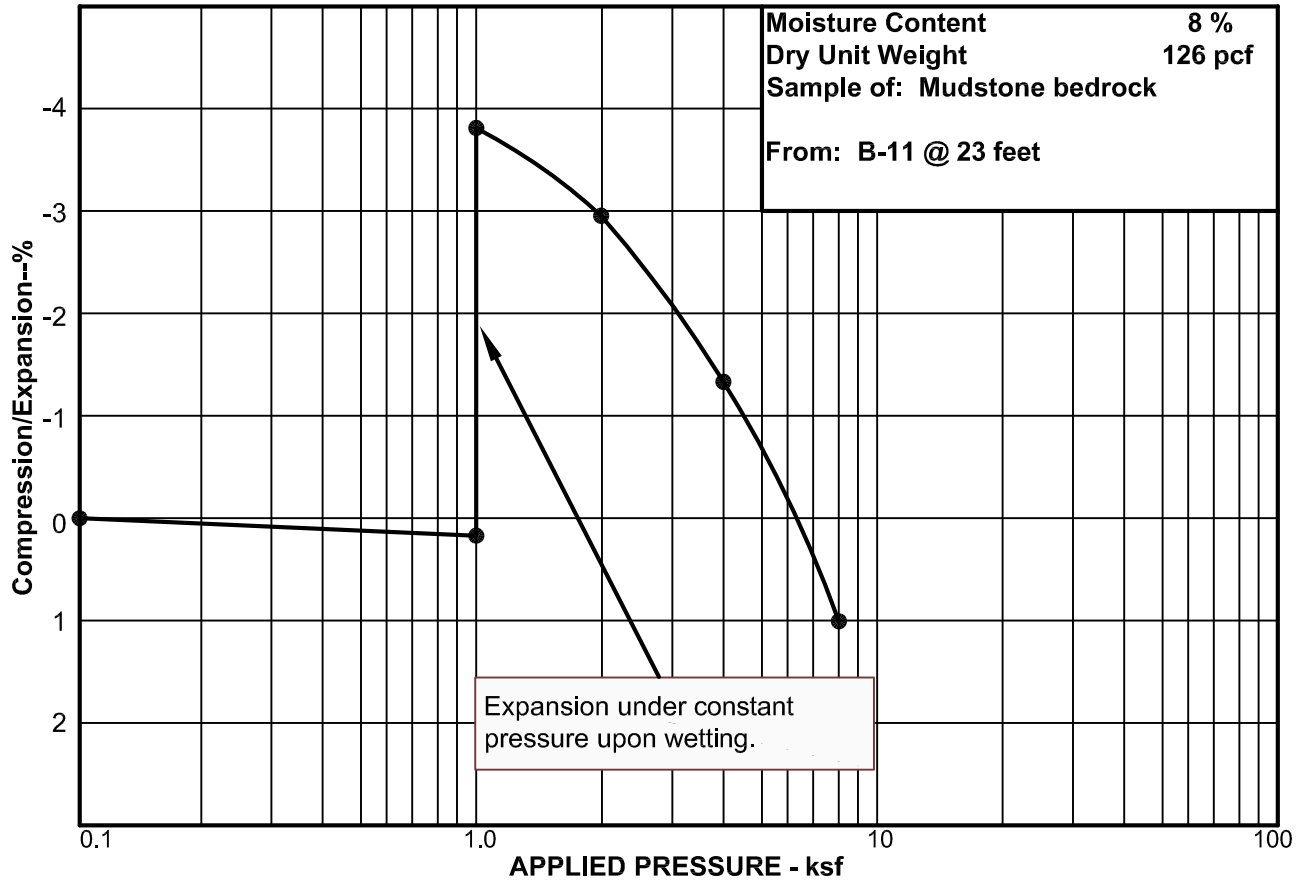




Project No. 2180187 **CONSOLIDATION TEST RESULTS** **Figure 12**

Applied Geotechnical Engineering Consultants, Inc.





Project No. 2180187 **CONSOLIDATION TEST RESULTS** **Figure 13**

Applied Geotechnical Engineering Consultants, Inc.

Table 1 - Summary of Laboratory Test Results

Blackstone Hotel

Project No. 2180187

Sample Location				Gradation			Atterberg Limits				
Boring No.	Depth (ft)	Natural Moisture Content (%)	Natural Dry Density (pcf)	Gravel (%)	Sand (%)	Silt/Clay (%)	Liquid Limit (%)	Plastic Index (%)	Unconfined Compressive Strength (ksf)	Water Soluble Sulfates (ppm)	Soil Type
B-1	9	9				84	29	17		3,075	Fill; Lean Clay with Sand (CL)
B-1	24	18	94			78	41	25			Fill; Lean Clay with Sand (CL)
B-1	35	16	100			86	48	29			Mudstone Bedrock
B-2	24	8	126						22.6		Mudstone Bedrock
B-2	35	16				87	57	40	5.9		Mudstone Bedrock
B-2	45	14	113						8.0		Mudstone Bedrock
B-2	53	20									Mudstone Bedrock
B-2	57	18	110			71	47	31	8.6		Mudstone Bedrock
B-2	60	15									Mudstone Bedrock
B-2	74	15		4	45	51	39	24			Mudstone Bedrock
B-2	82	19				78	60	37			Mudstone Bedrock
B-2	83	18	112			51	51	33	4.2		Mudstone Bedrock
B-2	88	15	115			70			33.8		Mudstone Bedrock
B-3	9	11	117			84					Fill; Lean Clay with Sand (CL)
B-3	19	9				69					Fill; Lean Clay with Sand (CL)

Applied Geotechnical Engineering Consultants, Inc.

Table 1 - Summary of Laboratory Test Results

Blackstone Hotel

Project No. 2180187

Sample Location				Gradation			Atterberg Limits				
Boring No.	Depth (ft)	Natural Moisture Content (%)	Natural Dry Density (pcf)	Gravel (%)	Sand (%)	Silt/Clay (%)	Liquid Limit (%)	Plastic Index (%)	Unconfined Compressive Strength (ksf)	Water Soluble Sulfates (ppm)	Soil Type
B-3	36	21	97			88	47	30			Fill; Sandy Lean Clay (CL)
B-3	39	19	104	10	28	62	43	32			Fill; Sandy Lean Clay (CL)
B-3	45	25	91						4.0	550	Mudstone Bedrock
B-3	50	25	93			79	56	34			Mudstone Bedrock
B-4	30	18	107			88					Mudstone Bedrock
B-4	45	17	95			70					Mudstone Bedrock
B-5	44	17				59	45	24			Mudstone Bedrock
B-6	9	7	114			81	31	19			Fill; Lean Clay with Sand (CL)
B-6	14	15	101			87	54	40			Fill; Lean Clay with Sand (CL)
B-6	29	19	95			88					Mudstone Bedrock
B-7	4	10				97				4,770	Mudstone Bedrock
B-7	16								7.3		Mudstone Bedrock
B-7	20	22									Mudstone Bedrock
B-7	30	22									Mudstone Bedrock
B-7	42	12				73	42	28	16.4		Mudstone Bedrock
B-7	53	5	144	10	33	57	47	30			Mudstone Bedrock

Applied Geotechnical Engineering Consultants, Inc.

Table 1 - Summary of Laboratory Test Results

Blackstone Hotel

Project No. 2180187

Sample Location				Gradation			Atterberg Limits				
Boring No.	Depth (ft)	Natural Moisture Content (%)	Natural Dry Density (pcf)	Gravel (%)	Sand (%)	Silt/Clay (%)	Liquid Limit (%)	Plastic Index (%)	Unconfined Compressive Strength (ksf)	Water Soluble Sulfates (ppm)	Soil Type
B-7	58	7	132			41	64	51			Mudstone Bedrock
B-7	73	5	146			34			40.7		Mudstone Bedrock
B-8	6			32	29	39	39	28			Clayey Sand with Gravel (SC)
B-8	24					73	42	26			Mudstone Bedrock
B-8	34					67	45	28			Mudstone Bedrock
B-8	39	15	94			90	41	24			Mudstone Bedrock
B-9	35	20	88			73	49	31			Mudstone Bedrock
B-10	6	2	133			65		NP		270	Mudstone Bedrock
B-10	14	4	144			56	25	7			Mudstone Bedrock
B-10	34	11	119			82	32	14			Mudstone Bedrock
B-11	23	8	126			82	30	15			Mudstone Bedrock

Applied Geotechnical Engineering Consultants, Inc.

Table 2

Deep Foundation Element Design Parameters

Blackstone Hotel Project No. 2180187

Soil Type	Soil Properties			Lateral Design Parameters			Axial Design Parameters		
	Total Unit Weight (pcf)	Cohesion (psf)	Friction Angle (Degrees)	Horizontal Modulus (pci)	Ultimate Passive Resistance (psf)	Strain @ 50% Yield (k_{rm})	Ultimate Skin Friction (psf)	Ultimate Uplift Skin Friction (psf)	Net Allowable** Bearing Capacity (ksf)
Fill (Thickness varies)	100	500	0	30	4,500*	0.04	250	167	--
Active Mudstone (upper 20 feet)	100	2,000	0	500	18,000	0.006	1,000	750	--
Mudstone (>20 to 40 feet)	110	4,000	0	1,400	36,000	0.006	2,000	1,333	--
Mudstone (>40 to 60 feet)	120	6,000	0	2,000	54,000	0.005	3,000	2,000	35
Mudstone (>60 to 70 feet)	130	7,500	0	2,500	67,500	0.004	3,750	2,500	40
Hard Mudstone (>70 feet)	140	12,500	0	3,000	112,500	0.003	6,250	4,167	60

* Ignore the upper 2 feet

** Minimum embedment of 45 feet into the mudstone.

APPENDIX

PROJECT NO. 2180187

AGEC FIELD CORE LOG

PROJECT Blackridge Hotel Site

CORE SIZE 2½" HQ

DATE 08/16/2018

LOCATION See Figure 2

ELEVATION 2654½'

PAGE 1 of 5

FIELD ENG. HA

DRILLER AGEC

BORING NO. B-2

DEPTH (ft)	ALTERATION	HARDNESS	CORE DESCRIPTION	WATER	PACKER TESTS	GRAPHIC LOG	DISCONTINUITY LOG: ORIENT.	TYPE	ROUGH.	PLAN.	FILLING	CORE RUN (FT)	RECOVERY (FT)	RQD (%)	FRAC./FT.	PROGRESS	DRILLING COMMENTS
0–8			Fill; Silty Sand with Gravel, poorly compacted, slightly moist, fine to medium grained with gravel, cobbles and boulders, red-brown.														Boring cased with 8" HSA to 14'.
8–12			Talus; Lean to Fat Clay, stiff to very stiff, moist to slightly moist, fine to medium grained, gypsiferous, medium to high plastic, red/brown.														
12–19			Landslide, mudstone, weathered, altered, soft, moist to slightly moist, fine to medium grained, with varied amounts of sand with silt, red/purple to grey to red/purple.				0° 0° 0° 0°					5	4	75	1 2 0 0 2	2.8 2.8 2.8 2.8 2.8	Boring advanced with 2½" HQ Core and carbide bit using mud.
												6	4	80	0	5	

PROJECT NO. 2180187

AGEC FIELD CORE LOG

PROJECT Blackrock Hotel Site

CORE SIZE 2½" HQ

DATE 08/16/2018

LOCATION See Figure 2

ELEVATION 2654½'

PAGE Page 2 of 5

FIELD ENG. H.A.

DRILLER AGEC

BORING NO. B-2

DEPTH (ft)	ALTERATION	HARDNESS	CORE DESCRIPTION	WATER	PACKER TESTS	GRAPHIC LOG	DISCONTINUITY LOG: ORIENT.	DISCONTINUITY LOG: TYPE	DISCONTINUITY LOG: ROUGH.	DISCONTINUITY LOG: PLAN.	DISCONTINUITY LOG: FILLING	CORE RUN (FT)	RECOVERY (FT)	RQD (%)	FRAC./FT.	PROGRESS	DRILLING COMMENTS
20			Landslide, mudstone, weathered, extremely to moderately altered, soft, moist to slightly moist, fine to medium grained, with varied amounts of sand with silt, red/purple to grey to red/purple.														Boring advanced with 2½" HQ core barrel with carbide bit using mud.
21							0°								0	5	
															0	5	
22							0°					5	4	80			Loss of mud.
							0°								I	5	
23																	
							0°								I	5	
24							0°										Grey
															I	6	Red/Purple
25															0	6	
26												5	4	75			Grey
															0	6	
27															0	5	
28							0°										
															2	7	Red/Purple
29							0°								0	4	
30															0	4	
31												5	5	100			
							0°								0	5	
32																	
							0°								0	6	
33															0	6	
34							0°										
															0	7	
35							0°								0	12	Red/Purple Grey
36							0°					4	4	100			Speed change.
							0°								1	3	
37							0°										
							0°								2	8	
38							0°										
															1	8	
39												4	5	100			
															0	3	

PROJECT NO. 2180187

AGEC FIELD CORE LOG

PROJECT Blackrock Hotel Site

CORE SIZE 2½" HQ

DATE 08/16/18

LOCATION See Figure 2

ELEVATION 2654½'

FIELD ENG. H.A.

DRILLER AGEC

BORING NO. B-2

DEPTH (ft)	ALTERATION	HARDNESS	CORE DESCRIPTION	WATER	PACKER TESTS	GRAPHIC LOG	DISCONTINUITY LOG: ORIENT.	TYPE	ROUGH.	PLAN.	FILLING	CORE RUN (FT)	RECOVERY (FT)	RQD (%)	FRAC./FT.	PROGRESS	DRILLING COMMENTS
41			Landslide, mudstone, weathered, extremely to moderately altered, soft, moist to slightly moist, fine to medium grained, with varied amounts of sand, silt, red clay and basalt gravels, red/purple to grey to purple.				30°					4	5	100	1	5	Boring advanced with 2½" HQ core barrel with carbide bit using mud.
42							0°								2	5	Grey
43							0°					2	2	100	1	4	Purple
44															I	5	
45							0°								2	10	
46							0°					3	3	100	1	5	
47							0°								1	3	
48												½	½	100	0	5	
49															0	5	
50												5½	5	100	0	4	
51															0	5	
52							0°								0	19	
53							0°					2	3	100	1	8	
54							0°								1	10	
55							0°								1	14	
56							0°					4	5	100	2	14	
57							0°				B				1	11	
58							0°								2	10	Gravel, red, clay dots.
59							0°					3½	4½	100	0	11	
															1	11	

PROJECT NO. 2180187

AGEC FIELD CORE LOG

PROJECT Blackridge Hotel Site

CORE SIZE 2½" HQ

DATE 08/16/2018

LOCATION See Figure 2

ELEVATION 2654½'

PAGE 4 of 5

FIELD ENG. H.A.

DRILLER AGEC

BORING NO. B-2

DEPTH (ft)	ALTERATION	HARDNESS	CORE DESCRIPTION	WATER	PACKER TESTS	GRAPHIC LOG	DISCONTINUITY LOG: ORIENT.	DISCONTINUITY LOG: TYPE	DISCONTINUITY LOG: ROUGH.	DISCONTINUITY LOG: PLAN.	DISCONTINUITY LOG: FILLING	CORE RUN (FT)	RECOVERY (FT)	RQD (%)	FRAC./FT.	PROGRESS	DRILLING COMMENTS
60																	
61			Landslide, mudstone, weathered, extremely to moderately altered, soft, moist to slightly moist, fine to medium grained, with varied amounts of sand, silt, red clay and basalt gravels, red/purple to grey to red/purple.									3½	4½	100	I	11	Boring advanced with 2½" HQ Core and carbide bit using mud.
															0	8	
62												2½	4	100	0	4	
															I	10	
63																	
															2	10	
64											B						Gravel
											B				2	12	
65											B						
															2	10	Basalt piece Loss mud
66											B	4½	5	66			
															1	10	
67															0		
																8	
68											B				2		Gravels
											B					9	
69											B				0	1	
															1		
70																4	
												4½	5	95	1	8	
71											B						
											B				1	8	
72																	
															1	7	
73											B						
											B				2	7	
74											B						
															1	8	
75												4	5	65			
											B				1	7	Red/Purple Grey
76																	
															0	9	
77																	
															3	6	
78												2	2	67			
															2	10	
79											B						Pebbles
												2	2½	21	I	16	Change to carbonado bit

PROJECT NO. 2180187

AGEC FIELD CORE LOG

PROJECT Blackrock Hotel Site

CORE SIZE 2½" HQ

DATE 08/20/2018

LOCATION See Figure 2

ELEVATION 2654½'

PAGE 5 of 5

FIELD ENG. H.A.

DRILLER AGEC

BORING NO. B-2

DEPTH (ft)	ALTERATION	HARDNESS	CORE DESCRIPTION	WATER	PACKER TESTS	GRAPHIC LOG	DISCONTINUITY LOG: ORIENT.	TYPE	ROUGH.	PLAN.	FILLING	CORE RUN (FT)	RECOVERY (FT)	RQD (%)	FRAC./FT.	PROGRESS	DRILLING COMMENTS
80																8	Boring advanced with 2½" HQ Core and carbide bit using air.
81			Landslide, mudstone, weathered, extremely to moderately altered, soft, moist to slightly moist, fine to medium grained, with varied amounts of sand, silt, red clay and basalt gravels, red/purple to grey to red/purple.				0°				Fe	2	2½	21	I	10	
82							0°				Fe	5	5	93	I	20	
83			Bottom of Landslide				0°					2½	2½	63	I	4	
84			Mudstone, soft to moderately hard, slightly altered, slightly moist, high plastic, iron oxide deposits, grey to yellow to purple.				0°					1½	1½	60	I	9	
85							0°								3	17	Grey/Yellow
86							0°				Fe	4	5	95	2	12	
87							0°								1	10	
88							0°								0	12	
89							0°								2	13	
90							0°					1	1½	0	I	16	
91							0°				Fe	4	4½	56	2	18	
92							0°								I	17	
93							0°								0	10	Change speed Pueple/Yellow
94															0	11	
95																	End of boring at 93'.
96																	
97																	
98																	
99																	

PROJECT NO. 2180187

AGEC FIELD CORE LOG

PROJECT Blackridge Hotel Site

CORE SIZE 2½" HQ

DATE 06/06/2018

LOCATION See Figure 2

ELEVATION 2646'

PAGE 1 of 4

FIELD ENG. HA

DRILLER AGEC

BORING NO. B-7

DEPTH (ft)	ALTERATION	HARDNESS	CORE DESCRIPTION	WATER	PACKER TESTS	GRAPHIC LOG	DISCONTINUITY LOG: ORIENT.	DISCONTINUITY LOG: TYPE	DISCONTINUITY LOG: ROUGH.	DISCONTINUITY LOG: PLAN.	DISCONTINUITY LOG: FILLING	CORE RUN (FT)	RECOVERY (FT)	RQD (%)	FRAC./FT.	PROGRESS	DRILLING COMMENTS
0–7			Fill; Silty Sand with Gravel, poorly compacted, slightly moist, fine to medium grained with gravel, highly plastic, purple/red.														Boring cased with 8" HSA to 9'.
7–12			Talus; Lean to Fat Clay with gravel, cobbles and occasional boulders, very stiff, moist, fine to medium grained, gypsiferous, medium to high plastic, purple/red.														Boring advanced with 2" diameter NWJ using Tricone bit with mud.
12–19			Landslide Mudstone, altered, soft to moderately hard, slightly moist to moist to wet, layers of siltstone, purple.														
16–17												3	1½	36	I	3	Boring advanced with 2½" HQ Core and carbonado bit using mud.
17–18															I	3	
18–19															2	3	
19												5	4½	88	I	5	

PROJECT NO. 2180187

AGEC FIELD CORE LOG

PROJECT Blackrock Hotel Site

CORE SIZE 2½" HQ

DATE 06/06/2018

LOCATION See Figure 2

ELEVATION 2646'

FIELD ENG. H.A.

DRILLER AGEC

BORING NO. B-7

DEPTH (ft)	ALTERATION	HARDNESS	CORE DESCRIPTION	WATER	PACKER TESTS	GRAPHIC LOG	DISCONTINUITY LOG: ORIENT.	TYPE	ROUGH.	PLAN.	FILLING	CORE RUN (FT)	RECOVERY (FT)	RQD (%)	FRAC./FT.	PROGRESS	DRILLING COMMENTS
20																20	
21			Landslide Mudstone, weathered, altered, soft, slightly moist to moist to wet, occasional layers of low plastic siltstone, with varied amounts of sand, silt, basalt pebbles, purple to grey to dark grey.												1	5	Boring advanced with 2½" HQ core barrel with diamond embedded bit using air.
21															0	5	
22												5	4½	88		22	
22															0	5	
23																23	
23															0	5	
24							0°									24	
24							0°								2	7	
25							0°									25	
25															0	7	
26							0°					5	5	85		26	
26															1	7	
27																27	
27															0	7	
28																28	
28															0	7	
29							0°									29	
29							0°								2	9	
30							0°									30	
30							0°								0	9	
31							15	0	SR	PL	Fe	5	5	75		31	
31															0	9	
32							13°									32	
32															1	9	
33																33	
33															0	9	
34							0°									34	
34							0°				G				2	8	
35							45	0	SR	PL	Fe					35	
35															1	8	
36												5	5	93		36	
36															0	8	
37							0°									37	
37															2	8	
38							15	0	SR	PL	Fe					38	
38															1	8	
39							0°									39	
												5	5	80	2	2	

PROJECT NO. 2180187

AGEC FIELD CORE LOG

PROJECT Blackrock Hotel Site

CORE SIZE 2½" HQ

DATE 06/07/18

LOCATION See Figure 2

ELEVATION 2646'

PAGE Page 3 of 4

FIELD ENG. H.A.

DRILLER AGEC

BORING NO. B-7

DEPTH (ft)	ALTERATION	HARDNESS	CORE DESCRIPTION	WATER	PACKER TESTS	GRAPHIC LOG	DISCONTINUITY LOG: ORIENT.	DISCONTINUITY LOG: TYPE	DISCONTINUITY LOG: ROUGH.	DISCONTINUITY LOG: PLAN.	DISCONTINUITY LOG: FILLING	CORE RUN (FT)	RECOVERY (FT)	RQD (%)	FRAC./FT.	PROGRESS	DRILLING COMMENTS
41			Landslide, mudstone, weathered, altered, hard to soft, slightly moist to moist to wet, fine to medium grained, with varied amounts of sand, silt, red clay, pebbles, purple to grey to dark grey.									5	5	80	2	9	Boring advanced with 2½" HQ core barrel with diamond embedded bit using mud.
42															2	9	
43															0	9	
44															0	9	
45												5	5	85	1	8	
46															0	8	
47															2	8	
48															1	8	
49															2	8	
50												5	5	96	1	8	
51															2	8	
52															0	8	
53															0	8	
54															1	8	
55											B	5	5	92	I	5.6	Wet
56															0	5.6	Purple ↕ Grey (slightly moist)
57											B				I	5.6	
58															0	5.6	
59											Fe				0	5.6	
												5	3	60	0	10	

PROJECT NO. 2180187

AGEC FIELD CORE LOG

PROJECT Blackridge Hotel Site

CORE SIZE 2½" HQ

DATE 06/07/2018

LOCATION See Figure 2

ELEVATION 2646'

PAGE 4 of 4

FIELD ENG. H.A.

DRILLER AGEC

BORING NO. B-7

DEPTH (ft)	ALTERATION	HARDNESS	CORE DESCRIPTION	WATER	PACKER TESTS	GRAPHIC LOG	DISCONTINUITY LOG: ORIENT.	DISCONTINUITY LOG: TYPE	DISCONTINUITY LOG: ROUGH.	DISCONTINUITY LOG: PLAN.	DISCONTINUITY LOG: FILLING	CORE RUN (FT)	RECOVERY (FT)	RQD (%)	FRAC./FT.	PROGRESS	DRILLING COMMENTS
60			Landslide, mudstone, weathered, altered, hard to soft, slightly moist to moist to wet, fine to medium grained, purple to grey to dark grey to black to grey.												0	10	Boring advanced with 2½" HQ Core and carbide bit using air.
61							30°				Fe				0	10	
62							0°					5	3	60		10	
63															I	10	
64							0°								I	10	
65															1	13	Black Mudstone
66							20°				Fe	5	5	90	0	17	
67							0°								3	12	
68			Bottom of Landslide				0°				Fe				2	8	Grey
			Mudstone, moderately hard, slightly altered, medium plastic, iron oxide, dark grey to yellow.												0	5	Speed ↓
69							0°										Speed ↑
70							0°								0	18	
71							0°				Fe	5	5	98	1	11	
72											Fe				2	8	
73							0°				Fe				0	8	
74							0°				Fe				1	8	Speed ↓
75							0° 0°					5	5	92	2	20	
76							0°				Fe Fe				2	20	Speed ↑
77							0° 0°								2	9	
78							0° 0°				Fe				2	9	
79							0°								3	9	Purple
																	End of Boring at 79'.

LEGEND AND NOTES TO CORE LOG

Alteration

Log Symbol	Description	Field Identification
E	Extremely altered	The material is discolored and the original minerals of the rock have been almost entirely altered to secondary minerals, even though the original fabric may be intact.
H	Highly altered	The rock is weakened to such an extent that a 2-inch diameter core can be broken readily by hand across the rock fabric.
M	Moderately altered	Rock is discolored and noticeably weakened, but a 2-inch diameter core cannot usually be broken by hand across the rock fabric.
S	Slightly altered	Rock is slightly discolored but not noticeably lower in strength than fresh rock.
U	Unaltered	Rock shows no discoloration, loss of strength, or any other effect of weathering or alteration.

Hardness

Log Symbol	Description	Field Identification
S	Soft	Fingernail: Can be scratched with a fingernail.
M	Moderately hard	Knife: Can be readily scratched with a pocket knife blade. The scratch leaves a trace of dust and is readily visible after the dust is blown away. Pick: Shallow indentation under a firm blow from the point of a geology pick.
H	Hard	Knife: Can be scratched with difficulty with a pocket knife blade. The scratch leaves little dust and is often only faintly visible. Pick: A hand-held sample breaks with one firm blow with the hammer end of a geology pick.
V	Very hard	Knife: Cannot be scratched with a pocket knife blade. Pick: Requires many blows from the hammer end of a geology pick.

Joint Type

Log Symbol	Description	Field Identification
B	Bedding	Joint associated with bedding plane.
H	Healed	Joint is healed closed.
O	Open	Joint is open and sides do not fit together.
S	Shear	Joint is due to shear.

Joint Surface Roughness

Log Symbol	Description	Field Identification
VR	Very rough	Near vertical steps and ridges occur on the discontinuity surface.
R	Rough	Some ridges and side-angle steps are evident. Asperities are clearly visible, and discontinuity surface feels very abrasive.
SR	Slightly rough	Asperities on the discontinuity surface are distinguishable and can be felt.
S	Smooth	Surface appears smooth and feels smooth to the touch.
SLK	Slickensided	Visual evidence of polishing exists.

LEGEND AND NOTES TO CORE LOG

Joint Surface Planarity

Log Symbol	Description	Field Identification
W	Wavy	A moderately undulating surface.
PL	Planar	A flat surface.
ST	Stepped	A surface with asperities or steps.

Joint Filling Material

Log Symbol	Description	Field Identification
CL	Clay	Joint filled with clay-sized particles.
Sd	Sand	Joint filled with sand-sized particles.
G	Gypsum	Joint filled with gypsum.
Ca	Calcite	Joint filled with calcite.
Fe	Iron oxide	Joint surfaces coated with iron oxide stains.
C	Clean	No surface coating or joint filling.
Q	Quartz	Joint filled with quartz
B	Basalt pebbles	Joint filled with basalt pebbles

Other

Log Symbol	Description
RQD (Rock Quality Designation)	Percent of intact core which is 4 inches or greater in length.
Fractures Per Foot	Number of fractures per foot of core. "I" indicates intensely fractured.
Progress	Time to advance boring (minutes per foot).

EXHIBIT G

2021 AGEC Geotechnical Investigation

GEOTECHNICAL INVESTIGATION

BLACKSTONE HOTEL SITE
WEST PARCEL

250 WEST BLACKRIDGE DRIVE

ST. GEORGE, UTAH

PREPARED FOR:

BLACK RIDGE DEVELOPMENT, LLC
2001 PARK AVENUE
PARK CITY, UTAH 84060

ATTENTION: OSCAR COVARRUBIAS

PROJECT NO. 2211175 **SEPTEMBER 8, 2021**

TABLE OF CONTENTS

EXECUTIVE SUMMARY. . . . . Page 1

SCOPE OF WORK. . . . . Page 2

PREVIOUS STUDIES. . . . . Page 2

SITE CONDITIONS. . . . . Page 3

FIELD STUDY. . . . . Page 4

SUBSURFACE CONDITIONS. . . . . Page 5

SUBSURFACE WATER. . . . . Page 6

PROPOSED CONSTRUCTION. . . . . Page 6

GEOLOGIC HAZARDS. . . . . Page 7
- A. Landslide. . . . . Page 7
- B. Expansive Soil and Bedrock. . . . . Page 8

SLOPE STABILITY. . . . . Page 8
- A. Earlier Evaluations. . . . . Page 8
- B. Site Specific Stability. . . . . Page 9

RECOMMENDATIONS. . . . . Page 11
- A. Site Grading. . . . . Page 11
- B. Foundations. . . . . Page 19
- C. Floor System and Construction Details. . . . . Page 23
- D. Pool Construction Details. . . . . Page 24
- E. Lateral Earth Pressures. . . . . Page 26
- F. Seismicity, Liquefaction and Faulting. . . . . Page 28
- G. Soil Corrosion. . . . . Page 29
- H. Pavement. . . . . Page 30
- I. Design Review/Construction Observation. . . . . Page 31

LIMITATIONS. . . . . Page 33

GEOLOGIC LITERATURE REFERENCES. . . . . Page 34

FIGURES AND TABLES

Vicinity Map	Figure 1
Site Plan	Figure 2
Logs of Exploratory Borings	Figures 3-5
Logs of Test Pits	Figure 6
Exploratory Borings Legend and Notes	Figure 7
Consolidation Test Results	Figures 8-12
Summary of Laboratory Testing	Table 1
Deep Foundation Element Design Parameters	Table 2
Photos - Core Logs and Legend and Notes to Core Logs	Appendix

EXECUTIVE SUMMARY

1. Two geologic hazards exist at the site which could impact the project. The hazards include the potential for landslide movement and heave due to the highly expansive soil and bedrock.

2. The stability of the slope, upon which the hotel is planned does not meet the minimum standard criteria for stability using saturated soil strengths. AGEC is conducting additional studies to evaluate the stability of the slope incorporating unsaturated strengths of the landslide and undisturbed materials.

3. Due to the expansive characteristics of the on site clay and bedrock, there is the potential for significant heave up wetting of the subgrade soil and bedrock. We understand that the foundation system is planned to be a deep foundation system consisting of caissons or micropiles to address this issue.

4. The subsurface investigation include the drilling of Six borings were drilled at the locations shown on Figure 2. The borings were drilled to depths of 24 to 124 feet below the existing ground surface. The borings were drilled entirely in the landslide deposit. The subsurface profile observed in the borings drilled generally consists clay mixed with rock (talus) overlying mudstone bedrock to the maximum depth investigated. There were layers of sandstone within the mudstone.

5. Groundwater was measured at an elevation of approximately 2,576½ feet, which is approximately 113 feet below the proposed “0" level of the hotel.

6. Detailed recommendations for subgrade preparation, grading, materials, foundations, pavement and drainage are included in the report.

SCOPE OF WORK

This report presents the results of a geotechnical investigation for the proposed Blackstone Hotel to be located in St. George, Utah, as shown on Figure 1. This report presents the subsurface conditions encountered and recommendations for the geotechnical aspects of the project.

Field exploration was conducted to obtain information on the subsurface conditions and to obtain samples for laboratory testing. Results of the field exploration and laboratory testing were analyzed to develop conclusions, professional opinions and recommendations for the proposed development.

This report has been prepared to summarize the data obtained during the study and to present our conclusions and recommendations based on the proposed construction and the subsurface conditions encountered. Design parameters and a discussion of geotechnical engineering considerations related to construction are included in the report. Our scope of work was conducted in general accordance with our proposal dated April 19, 2021 and signed May 19, 2021.

An additional slope stability report will be provided that will address the landslide hazard.

PREVIOUS STUDIES

AGEC has conducted various levels of studies on the property and adjacent properties since 1998. The following studies were referenced as a part of our study.

1. Blackridge Development, Geologic Hazard Assessment and Preliminary Geotechnical Recommendations, AGEC Project No. 980473, dated March 5, 1999.

2. Blackridge Drive Special Improvement District, AGEC Project No. 981307, dated April 25, 2000.

3. Grading Recommendations and West Slope Grading Recommendations, AGEC Project No. 2991121, dated September 15, 1999 and November 15,1999.

4. Tech Ridge South Access Road, AGEC Project No. 2180187, dated October 19, 2018.

5. Black Stone Hotel, (east parcel), AGEC Project No. 2180187, dated December 14, 2018.

6. Black Stone Hotel Slope Stability Consultation, AGEC Project No. 2180187, dated September 23, 2019.

SITE CONDITIONS

The site consists of a previously graded parcel of undeveloped property in the Black Ridge Development in St. George, Utah. A large amount of soil and bedrock was removed from the site resulting in a relatively level site with a few stockpiles of soil.

The graded area has a significant cut slope along the west side of the property and a moderately steep cut slope along the south portion of the property. The graded area is generally lower through the center of the site with several piles of fill. Due to the lower area, storm water has not been allowed to drain off the property and is generally retained on the site.

A containment area of deposited pieces of asbestos pipe is also located on the property. The area is shown on a recorded survey map included in Appendix A of this report. The asbestos removal and disposal is not included in our scope of work.

There is a roadway, (250 West Street) located along the eastern portion of the site which slopes down from the north to the south to the intersection with Blackridge Drive. The slope, which was cut to grade the roadway is partially lined with stacked basalt boulders.

The property to the south consists of additional hillside and slopes from the top of Tech Ridge to the west down to Blackridge Drive.

The property immediately to the west, above the graded slopes up to the top of Tech Ridge (the previous airport property). The top of the ridge is a basalt capped ridge with talus or littered rocks along the upper slope.

The area to the north is relatively level with additional small knolls and bench areas.

Across 250 West Street to the east is vacant, previously graded property along with two office buildings.

Several photos of the site conditions are included in the appendix.

FIELD STUDY

An engineer from AGEC visited the site on June 14-16, 2021 and observed the drilling of six borings as shown on Figure 2. The borings were drilled utilizing a truck-mounted rill rig equipped with augers and coring tools. Boring B-4 was drilled using a 2½ inch HQ core barrel with a carbide and carbonado bit using mud rotary techniques. The other borings were drilled with auger. The subsurface conditions were logged and samples were obtained.

In addition, five test pits were excavated on July 6, 2021 with a track excavator at the approximate locations shown on Figure 2.

SUBSURFACE CONDITIONS

The subsurface profile observed in the borings drilled and test pits excavated generally consists lean clay mixed with rock (talus) overlying mudstone bedrock, all within the landslide deposit. There were layers of sandstone within the mudstone.

Descriptions of each soil and bedrock type observed follow.

Fill - The fill varies from clayey gravel to lean/fat clay. It contains occasional cobbles and boulders. Consistency appears poorly compacted and is red to brown to purple in color. The clay varies from low to high plasticity. The cobbles and boulders are mixed with basalt and sandstone/shale bedrock chunks.

Lean/Fat Clay (CL/CH) - The lean clay is medium stiff to very stiff and is slightly moist. It is generally medium to highly plastic an red to brown to purple in color.

Clayey Gravel GC) - The clayey gravel is dense and generally dry. The gravel is angular and generally contains cobbles and boulder size particles. It is brown to red in color. The basalt gravel is gray and black in color.

Mudstone Bedrock - The mudstone consists of lean to fat clay with varied amounts of sand. It is soft to moderately hard, slightly moist to very moist to wet, medium to high plastic, and is purple to red to grey in color.

Laboratory tests conducted on samples of the mudstone bedrock indicate in-place moisture contents ranging from 7 to 24 percent, in-place dry densities ranging from 93 to 126 pounds per cubic foot (pcf) and percent passing the No. 200 sieve (fines contents) ranging from 60 to 94 percent. Atterberg Limits tests indicate liquid limits ranging from 53 to 77 percent and plasticity indexes ranging from 37 to 54 percent. Water soluble sulfate tests indicate water soluble sulfate concentrations ranging from

370 to 11,707 ppm. Unconfined compressive strength tests indicate unconfined compressive strengths ranging from 1,540 to 6,900 psf.

Relatively undisturbed, one-dimensional consolidation tests conducted on samples of the mudstone indicate it is non to highly expansive when wetted under a constant pressure of 1,000 psf. Swell percentages up to 7½ percent were measured. Swell pressures ranging from approximately 3 to 13 kips per square foot (ksf) were also measured.

The Logs of Exploratory Borings are shown on Figures 3 to 6. Legend and Notes of the Exploratory Borings are shown on Figure 7. The laboratory test results are also shown on Figures 3 to 6 and are summarized in the Summary of Laboratory Testing, Table 1. The consolidation/swell test results are shown graphically on Figures 8 to 12.

SUBSURFACE WATER

The depth to groundwater was measured on August 11, 2021 (in deeper borings in the area) and found to be approximately 113 feet below the proposed "0" level of the hotel.

PROPOSED CONSTRUCTION

It is currently proposed to develop the site for a resort style hotel. The resort hotel will include a conference center, a restaurant, a gym as well as other amenities. There will also be a below grade swimming pool/spa on the east side of the hotel.

Architectural drawings of the development indicate the hotel will consist of a four-story structure with perimeter parking. The hotel will require excavation on the order of 10 to 15 feet below the existing grade. The front or east side of the hotel will expose the lower level, while the back or west side will be backfilled up to the main or 2nd level.

We understand the upper levels of the hotel will consist of conventional wood framing and we anticipate the below grade portions will utilize reinforced concrete construction. The swimming pool will use a reinforced gunnite shell.

Due to the presence of the underlying expansive soil and bedrock, the buildings and pool will be supported on deep foundation elements consisting of micropiles or drilled concrete piers in conjunction with grade beams and structural floors.

The development will also include underground utilities, asphalt concrete pavement and concrete retaining walls.

Additional details regarding the design, site improvements and building loads are currently not available. If the proposed construction, loading conditions, or grading are significantly different from what is described above, we should be notified so we may reevaluate our recommendations.

GEOLOGIC HAZARDS

Review of geologic hazard mapping by Lund et. al. (2008) and our experience in the area indicate the following conditions that could adversely impact the site:

A. Landslide

The site for the proposed new hotel is located in the lower section of a 300-foot high slope. The lower ⅔ of the slope has been mapped as a landslide deposit. The ground surface of the landslide deposit slopes on average approximately 7:1 H:V (horizontal to vertical). The landslide deposit is estimated to extend up to a depth of approximately 200 feet below the existing ground surface at the site.

Old landslides are often marginally stable and may reactivate with new loadings or other changes in condition that tend to reduce their stability. With the site located on a landslide deposit, the subsurface conditions need to be carefully investigated and the stability of the slope evaluated under static and seismic conditions in order to estimate the risk. The risk of future movement needs to then be recognized, potential impact of ground movement identified, appropriate consideration given to remedial measures and then a decision made if the benefit is worth the risk.

B. Expansive Soil and Bedrock

Geologic mapping indicates that the site is situated where the Chinle Formation, which consists of highly expansive bedrock, is present. It is high plastic and also has a high shrink/swell susceptibility.

SLOPE STABILITY

A. Earlier Evaluations

Earlier studies by AGEC on the stability of the east slope of Tech Ridge (slope on which the hotel is proposed) indicate that the stability of the slope is marginal.

Previous studies included the installment of five inclinometers. The inclinometers were installed in order to determine if movement is occurring on the slope, five inclinometers were installed in 2007 on the east slope of Tech Ridge extending to depths of 92 to 250 feet. When measured in 2018, four of the five inclinometer measurements indicated that there had been no movement since 2007. Ground movement was measured in 2011 at multiple depths in the inclinometer north of the proposed hotel site. The inclinometer was located immediately west of the vacant fast food restaurant located at 1090 South Bluff Street.

With the lack of measured movement in the four inclinometers over a time period of 10½ years, along with the lack of surficial evidence of movement, it appears that the portion of the slope, for this project, is currently maintaining its stability. Using the information available from our subsurface exploration, the laboratory test results and our experience in the area, it is our professional opinion that the stability of the slope is marginal even with the lack of apparent movement.

B. Site Specific Stability

Based on our experience in the area along with the information that we have gathered from studies on this landslide, we have analyzed the stability of the slope in the area of the proposed hotel.

1. Prior Slope Modifications

   A number of years ago, a relatively large amount of soil and bedrock was removed from the area currently proposed for the hotel and placed on the lower portions of the slope (east of the hotel site). These changes have not significantly changed the stability of the slope.

2. Proposed Site Grading

   The ground surface profile proposed for the hotel, does not change the stability of the slope.

3. Stability Analysis

   The stability analysis indicates the following:

   a. A calculated factor of safety using saturated soil and bedrock strengths is near 1. A factor of safety on the order of 1.5 is typically desired for slopes upon which human occupied improvements are constructed when using saturated soil and bedrock strengths. Lower factors of

safety can be considered appropriate when weaker strengths are included in the analysis.

b. Changes in the internal conditions and the surficial geometry modifications may improve or reduce the ability of the slope to maintain its stability.

4. Possible Impact of Current Conditions

Assuming that strength characteristics of the landslide mass have improved (soils behaving as if they are unsaturated) since the ancient landslide movements occurred, overall calculated stability of the slope is estimated to increase approximately 20 to 30 percent.

The stability under a seismic event, assuming the improved strength characteristics described above, is estimated to have a safety factor of less than 1. A major seismic event could potentially result in displacement of the slope.

The potential increase in the calculated safety factor using un-saturated soil strength needs further evaluation and substantiation in order to quantify this improvement.

5. Other Mitigating Factors

If the decision is made to continue with further design and potential construction of the hotel at this location, we recommend that the following items be considered:

a. Minimize, if not eliminate the introduction of moisture into the subgrade. This could be accomplished by,

i. Collecting and transporting surface drainage off of the site in water tight storm drainage systems. This type of construction is not standard and therefore it would require specific attention to verify that the improvements are water tight.

ii. Water ways should be lined to prevent seepage into the ground.

iii. Measures need to be taken to eliminate the potential for water to pond on the slope.

b. Positive steps would need to be taken on other improvements on the landslide mass to help maintain the overall stability of the slope.

RECOMMENDATIONS

Based on our experience in the area, subsurface conditions encountered, laboratory test results, and proposed construction, the following recommendations are provided:

A. Site Grading

Based on the subsurface conditions observed and the proposed grading, the following recommendations are provided.

1. Subgrade Preparation

a. General: Prior to placing site grading fill or concrete, the existing sparse vegetation should be removed. The piles of fill and boulders should also be removed.

b. Flatwork and Pavement Support: We recommend removing the existing fill, which appears to vary from 1 to 4 feet prior to placing additional fill in

these areas. We anticipate improvements (pool and decking) will be supported on deep foundation elements.

The Asbestos Deposit area subgrade preparation will be addressed by others.

We recommend flatwork and pavement be supported on an appropriate thickness of non-expansive, low permeable fill. The thickness of low permeable fill should be based on the acceptable magnitude of potential differential vertical movement.

The low permeable fill layer is intended to reduce the risk of wetting the expansive soil/bedrock. Strict site drainage is critical to the satisfactory performance of flatwork, pavement and other movement sensitive surface supported features. The estimated potential surface heave associated with corresponding overexcavation depths are provided in the following table.

Thickness of Non-Expansive Low Permeable Fill (feet)	Estimated Potential Differential Vertical Slab Movement (inches)
0	3½ to 5
2	2½ to 3¾
4	2 to 3
6	1½ to 2½
8	1¼ to 2
10	1 to 1½
12	¾ to 1¼
14	¾ to 1
16	½ to ¾

As a minimum, we recommend at least 5 feet of non-expansive, low permeable fill be placed above the mudstone bedrock in areas which will support flatwork or pavement. The risk of heave potential may also be reduced by increasing the overexcavation depth and providing strict drainage.

Buildings: Buildings will be supported on deep foundation elements with raised structural floors. Therefore, removal of fill or mudstone is not critical under building areas unless slab-on-grade floors will be considered.

Lateral Extent: All overexcavation and subgrade preparation procedures should extend at least 5 feet beyond the perimeter of the proposed construction. Excavations should be located by survey.

2. Excavation/Earthwork

Excavation of the on-site soil and soft bedrock at the site may be accomplished with typical excavation equipment. The drilling of the soil and bedrock encountered to the depths investigated may be performed with typical rotary drilling equipment. Difficulty may be encountered when drilling through cobbles and boulders which are present in the fill and talus. Loss of drilling fluid may also occur due to the presence of voids in the fill.

3. Grading Slopes and Trenches

Permanent cut slopes excavated into the overburden soils should be cut no steeper than 2:1 (Horizontal:Vertical). Permanent cut slopes into the soft mudstone bedrock should be cut no steeper than 1:1 (Horizontal:Vertical).

It has been our experience that the mudstone surface will dry to a “pop corn” texture and ravel resulting in deposition of material at the toe until an approximate 2½:1 slope is achieved over time. To improve performance of steeper cut slopes in the mudstone, slope facing should be considered along

with strict site drainage away from the slope and implementation of desert landscaping.

Facing could consist of large stacked boulders, precast concrete blocks or reinforced gunnite facing attached with soil nails. A drain should also be constructed behind the facing to reduce the potential for water accumulation and buildup of hydro-static pressure. If these options will be considered, AGEC should be contacted to provide further consultation.

Unretained fill slopes constructed with properly compacted on-site soil should be graded no steeper than 2:1 (horizontal to vertical). Slopes should include benches in accordance with the 2018 IBC. The cut and fill slopes will be highly susceptible to erosion, particularly resulting from run off from the adjacent slopes. Water should be directed around slopes using drainage swales to reduce potential erosion.

Fill slopes should be graded by overbuilding and then cutting them back to the desired grade to provide a compacted slope face. Fill placed on existing slopes steeper than 4:1 (horizontal to vertical) should be placed using a benching procedure. Benches should be of sufficient width to allow adequate area for the compaction equipment.

Utility trenches excavated in the on-site soils should be excavated in accordance with OSHA requirements using a OSHA Soil Class C (1½:1 Horizontal:Vertical) for overburden soils and soft mudstone. Steeper trenches may require the use of shoring or a trench box to provide as safe work environment. Safe trench excavation is the responsibility of the contractor.

4. Compaction

Compaction of fill materials placed at the site should equal or exceed the following percentages when compared to the maximum dry density as determined by ASTM D-698 or ASTM D-1557:

Area	Percent Compaction ASTM D-698*	Percent Compaction ASTM D-1557**
Subgrade	95	90
Site grading	95	90
Slabs (base course)	Does not apply	95
Utility trench backfill	95	90
Wall Backfill	95	90

* Fine-grained low permeable fill/processed mudstone.
** Granular site grading fill/granular low permeable fill/structural fill.

Prior to placing approved fill, the exposed subgrade should be moisture conditioned and compacted as recommended above. Fill should be placed in lifts which do not exceed the capability of the equipment used. Generally 6 to 8 inch lifts are adequate for heavy rubber tire equipment. Lift thicknesses should be reduced to 4 inches for hand compaction equipment.

Fill materials should be properly moisture conditioned prior to placement. Fine-grained soil, low permeable fill and processed mudstone or mudstone/sand mixture should be moisture conditioned to 2 to 4 percentage points over the optimum moisture content as determined by ASTM D-698. Granular soil should be moisture conditioned to within 2 percentage points of the optimum moisture content as determined by ASTM D-1557. Each lift of fill placed should be tested to verify moisture content and compaction are appropriate.

5. Materials

Recommendations for imported fill types follow. If structural floors are used, the type of fill placed under the buildings is not critical. Imported fill should be non-expansive and meet the following recommendations.

Area	Fill Type	Recommendations
Footings/pads/site	Structural and site grading fill	-200 <35%, **LL** <30% Maximum size: 4 inches Solubility < 1%
Under slabs/flatwork	Base course	-200 <12% Maximum size: 1 inch
Drains	Gravel	1 inch max size -200 <5%

-200 = Percent Passing the No. 200 Sieve
LL = Liquid Limit

The existing site grading fill is variable in plasticity and portions are expansive. The on site fill is suitable for use as site grading fill, wall backfill and utility trench backfill in areas which will support hard surfaces and pavement at depths greater than 5 feet below the finished grade.

If portions of the onsite fill appear low plastic, it may also be suitable for use as fill extending to the surface, but observation and additional testing would be necessary. Alternatively, the fill may be mixed with imported, non-expansive fill or imported soil would be placed to support in the upper 5 feet of the profile.

The on-site mudstone is not suitable for use wall backfill or as fill in structural areas or areas which will support hard surfaces and pavement. It may be used as fill in landscape areas or it should be disposed of offsite.

The potential impact of the expansive characteristics of the underlying clay and mudstone can be reduced by protecting the soil and bedrock from becoming wet. Placement of relatively low permeable fill above the expansive materials can help reduce the possibility of water coming in contact with the expansive materials. The low permeable fill supporting these areas is intended to provide a low permeable zone to reduce the potential for water to infiltrate and wet the underlying subgrade. If the expansive subgrade below the low permeable fill is wetted, surface heave will occur. This will result in reduced flatwork and pavement life.

Low permeable fill used to replace removed mudstone should meet one of the following set of criteria.

Liquid Limit (%)	Percent Passing the No. 200 Sieve
45 +	15-20
30-45	20-40
0-30	30-100

The onsite fill soil mixed with some imported, non-expansive, granular fill will likely meet the low permeable fill requirements at a ratio of 1 part granular soil to one part of the onsite fill. The mixture should be tested by AGEC to verify its engineering characteristics prior to use as fill.

6. Drainage

The following drainage recommendations should be implemented to reduce the potential for wetting of the underlying expansive soil and bedrock.

a. Positive site drainage away from foundations should be maintained during the course of construction.

b. After construction has been completed, positive drainage of surface water away from the buildings should be maintained throughout the life of the structure. We recommend a minimum slope of 6 inches in the first 10 feet from the perimeter of the structure. In no case should water be allowed to pond adjacent to foundations.

c. Desert landscaping, which requires no water, should be implemented. Grass should not be used. Rock mulch and turf are recommended.

d. Rain gutters should be utilized and roof down spouts should be piped to discharge to the storm drain system. This will require design of buried discharge pipes with flexible watertight connections.

e. If planters are used, they should be underlined by a impermeable membrane which is sloped to a discharge pipe which discharges water to storm drain.

f. We also recommend that desert landscaping, which requires no water, be used adjacent to concrete walls and masonry walls or other cement containing elements which will be backfilled. Further, the below grade portions of walls/fences which are backfilled with soil should be protected with an impermeable membrane and a subsurface drain. A gravel covered, perforated PVC pipe should also be placed at the base of the wall to carry water to a discharge point. This is intended to reduce the potential for salt weathering on concrete/masonry.

7. Subsurface Drainage Protection

As a precautionary measure, the crawl space and below grade portions of the hotel and parking structure should be protected from potential infiltration of surface water by constructing a perimeter subsurface drain around the crawl space of the building.

The drain system should consist of a 1 foot wide trench excavated around the outside perimeter of the grade beam/walls supporting the buildings. The trench should be excavated to a depth of at least 2 feet below the crawl space depth. A 4-inch perforated PVC pipe should be placed in the bottom of the trench and covered with free-draining gravel to within 2 feet of the ground surface. Prior to backfilling, Mirafi 140N filter fabric should be placed over the gravel. The perimeter drain trench and the grade beams should be backfilled with properly compacted, low permeable fill above the gravel to reduce the potential for surface water infiltration directly to the crawl space between the beams and the trench.

The drain pipe should be placed in the bottom of the drain trench and sloped at a 2 percent grade (minimum) to drain by gravity or to a sump and discharge to the storm drain system.

B. Foundations

We recommend the proposed hotel, parking structure, pool and pool decking be supported on deep foundation elements which will extend support of the structures through any existing fill and the active zone of the expansive materials down to the underlying "non-active" mudstone. The deep foundation elements should extend at least 30 feet into the underlying expansive mudstone and be designed by a structural engineer according to the parameters provided in Table 2 of this report. Grade beams should be utilized to span the distance between piers and support a structural floor with a crawl space below. The following recommendations should be followed for the design and construction of the deep foundation system.

1. <u>Micropile Design</u>
   a. Minimum length = 30 feet.

   b. End bearing should not be considered for micropile capacity. Capacity of micropiles will be developed through skin friction.

c. The micropiles should be structurally reinforced to resist tensile forces on the pile due to upward skin friction (uplift) which could result if the mudstone is wetted and swells. The tensile force may be calculated utilizing at least 10 feet of pile length with an ultimate skin friction of 1,000 psf. A "greased PVC bond breaker" may also be considered to reduce uplift forces on the micropiles.

d. The micropile should be designed for a minimum dead load of 3,000 pounds. If the minimum dead load cannot be met and piles are spaced as far apart as practical, the length should extend beyond the minimum penetration to make up the dead load deficit. This can be accomplished by using the appropriate resisting ultimate skin friction as given in Table 2.

e. Care should be taken to assure the micropiles are not over-sized (mushroomed) at the ground surface, which could provide an area where swelling soil/rock could exert uplift forces on the piles.

f. The water cement ratio of the grout should be on the order of 0.45 to 0.50. This should be verified during construction using a grout scale to verify the grout has a specific gravity on the order of 1.8 to 1.9. The grout volume should be recorded for each micropile constructed to ensure the appropriate volume is placed.

g. Grout should be placed in the micropiles the same day they are drilled using a tremmie pipe which extends to the bottom of the drill hole. The tremmie pipe should be raised as the grout is placed to ensure the element is free of voids. If water enters the drill holes, it would be necessary to place grout immediately after the drill hole is completed using a tremmie. The tremmie will also displace water out of the hole

as grout is placed. Failure to place grout the day of drilling may require re-drilling for additional bedrock penetration.

h. Micropile holes should be observed during drilling to verify depth. If air rotary methods are used, they can also be inspected to verify caving does not occur below the ground surface which could also result in additional uplift forces.

j. "Centralizers" should be used on the micropile steel reinforcing bar at approximately a 5 to 7 foot spacing to ensure the appropriate grout cover on the reinforcing.

2. Drill Pier Design

a. Minimum length = 30 feet.

b. Capacity of drilled piers may consider end bearing and skin friction to determine capacity. The end bearing capacities provided in Table 2 are allowable and include a factor of safety of 2.0.

c. The drilled piers should be structurally reinforced to resist tensile forces on the pier due to upward skin friction (uplift) which could result if the mudstone is wetted and swells. The tensile force may be calculated utilizing at least 20 feet of pier length with an ultimate skin friction of 1,000 psf.

d. The foundation elements should be designed for a minimum dead load of 10,000 psf. If the minimum dead load cannot be met and piers are spaced as far apart as practical, the length should extend beyond the minimum penetration to make up the dead load deficit. This can be accomplished by assuming an appropriate resisting ultimate skin friction as given in Table 2.

e. Care should be taken to assure the drilled piers are not over-sized (mushroomed) at the ground surface, which could provide an area where swelling soil/rock could exert uplift forces on the piers.

f. The concrete volume should be recorded for each pier constructed to ensure the appropriate volume is placed.

g. Concrete should be placed in the piers the same day they are drilled using a tremmie pipe which extends to the bottom of the drill hole. The tremmie pipe should be raised as the concrete is placed to ensure the element is free of voids. If water enters the drill holes, it would be necessary to place concrete immediately after the drill hole is completed using a tremmie. The tremmie will also displace water out of the hole as concrete is placed. Failure to place concrete the day of drilling may require re-drilling for additional bedrock penetration.

h. Drilled pier holes should also be inspected to verify caving does not occur below the ground surface which could also result in additional uplift forces. Casing the drill hole may be necessary if the caving occurs to ensure a straight shaft with a consistent diameter. Pier holes must also be inspected to ensure they are cleaned and free of loose or disturbed soil.

i. Concrete coverage should be verified on reinforcing cages by placing spacers on the outside of the reinforcing cage to ensure it is not touching the drill hole side wall.

C. Floor System and Construction Details

1. Structural Floor/Beams/Crawl Space

Structural floors (including entries, porches and patios), supported on grade beams should be supported on deep foundation systems.

We recommend that a minimum 24-inch crawl space be provided below structural floors. Proper ventilation of the crawl space is critical and the ventilation system should be designed by the appropriate design professional.

A minimum 12-inch void space should be provided below the grade beams to allow the expansive mudstone to swell without exerting uplift forces on the grade beams. The void space should be protected prior to backfilling the exterior grade beams to ensure the void space is not compromised. We also recommend low permeable fill be used as backfill adjacent to the beams to reduce the potential for infiltration and migration of water to the crawl space. Proper compaction and moisture conditioning of the backfill is critical.

2. Vapor Barrier

A vapor barrier should be placed on the bottom of the crawl space, attached to the exterior grade beams using a water resistant attachment system to reduce moisture in the crawl space.

3. Plumbing and Utility Lines

Plumbing lines and utility lines should be hung from the floor when a pier/pile foundation system is utilized. Plumbing lines should have flexible joints where connections are made. A 12-inch void space should also be provided below plumbing where it crosses below grade beams.

4. Exterior Flatwork

The owners should be aware that exterior flatwork may move where expansive materials are present. To reduce concerns for flatwork movement causing distress to the structures, the flatwork should be separated from the main structure and allow for unrestrained vertical movement. This generally is accomplished by providing a construction joint between the concrete flatwork and the wall/slab with a heavy felt board.

A 4-inch layer of properly compacted base course should be placed below slabs to provide a firm and consistent subgrade and to promote even curing of the concrete.

Use of pavers or compacted decorative gravel in lieu of concrete flatwork may also be considered. Pavers or gravel will allow for some movement if the supporting subgrade heaves.

5. Exterior Porches

Exterior porches, patios and overhangs that are structurally tied to the remainder of the building should be supported by the same foundation system as the building.

D. Pool Construction Details

1. Pool Structural Floor

The shell of the pool should be structurally reinforced to span the distance between the piers. We recommend a minimum 2- inch void be provided below the pool to prevent expansive materials from exerting uplift forces on the pool. A void box should be placed in the bottom of the pool excavation prior to placing plumbing and rebar, or spraying gunnite to allow for construction above the void below the pool.

As an alternative, the bottom of the pool may be constructed as a structural floor supported on the piers using V-decking with a crawl space (This is the preferred method). The raised structural floor should be supported on grade beams. We recommend that a minimum 24-inch crawl space and access be provided below the structural floor. A 12-inch void space should be provided below the grade beams to allow the expansive materials to swell without exerting uplift forces on the grade beams. Subsequent to removing concrete forms from grade beams, the void should be inspected by AGEC to ensure the proper void space is provided.

2. Pool Plumbing and Utility Lines

Plumbing lines and utility lines should be hung from the floor when a pier foundation and structural floor system is utilized or placed above the void box (if used) to prevent crushing of the piping or connections.

Plumbing lines should have flexible joints where connections are made. A 12-inch void space should also be provided below plumbing where it crosses below grade beams. Exterior plumbing lines may be run inside a larger pipe conduit to allow for some movement without negatively affecting the plumbing lines. Plumbing lines should be tested prior to operation.

3. Pool Decking

Due to the presence of the underlying fill and expansive materials, we recommend the pool decking consist of a raised structural slab supported on deep foundation elements.

If slab-on-grade pool decking will be considered, the subgrade supporting the decking should be prepared as recommended in the Subgrade Preparation section of this report for "Flatwork". The owner should be aware that exterior

flatwork will likely heave (as stated in the Subgrade Preparation section of this report).

Slab-on- grade pool decking should be separated (free vertical movement) from the main structure of the pool and should not be tied directly to the pool shell or to adjacent buildings. This is recommended to allow for unrestrained uplift of the pool decking so as not to affect the main structure of the pool. This generally is accomplished by providing a construction joint between the concrete flatwork and pool or building with a heavy felt board.

The pool decking should be sloped away from the pool to provide adequate drainage. We also recommend constructing a water-tight concrete gutter system (depression) or drain around the pool decking to catch runoff water, divert it around the pool, and discharge off site. Joints or seams in the pool decking should be sealed to reduce infiltration of surface water.

A 4-inch layer of properly compacted base course should be placed below slabs to provide a firm and consistent subgrade and to promote even curing of the concrete.

E. Lateral Earth Pressures

1. Retaining Structures

The following equivalent fluid weights are given for design of subgrade walls and retaining structures. The active condition is where the wall moves away from the soil. The passive condition is where the wall moves into the soil and the at-rest condition is where the wall does not move. We recommend basement walls or below grade beams be designed in an at-rest condition. Walls where lateral movement is not tolerable should also be designed in the at-rest condition.

The values listed below assume a horizontal surface adjacent the top and bottom of the wall.

	Active Condition		At-Rest Condition		Passive Condition
Soil Type	Equivalent Fluid Weight	Earth Pressure Coefficient	Equivalent Fluid Weight	Earth Pressure Coefficient	Equivalent Fluid Weight
Imported Granular Backfill	35 pcf	0.28	55 pcf	0.44	325 pcf
On-site Clayey Fill Soil	45 pcf	0.38	65pcf	0.54	225 pcf

The above values account for the lateral earth pressures due to the soil and level backfill conditions and do not account for hydrostatic pressures or surcharge loads.

Lateral loading should be increased to account for surcharge loading using the appropriate earth pressure coefficient and a rectangular distribution if structures are placed above the wall and are within a horizontal distance equal to the height of the wall. If the ground surface slopes up away from the wall, the equivalent fluid weights should also be increased.

Care should be taken to prevent percolation of surface water into the backfill material adjacent to the retaining walls. The risk of hydrostatic buildup can be reduced by placing a subdrain behind the walls consisting of free-draining gravel wrapped in a filter fabric.

2. Seismic Conditions

Under seismic conditions, the equivalent fluid weights should be modified as follows according to the Mononobe-Okabe method assuming a level backfill condition:

Lateral Earth Pressure Condition	Seismic Modification (2% PE in 50 yrs)
Active	9 pcf increase
At-rest	no increase
Passive	18 pcf decrease

The seismic increases and decrease assume a peak ground acceleration (PGA) of 0.23g and a 1 second period ground acceleration (S_1) of 0.17g using the Mononobe-Okabe pressure distribution.

3. Safety Factors

The values recommended assume mobilization of the soil to achieve the assumed soil strength. Conventional safety factors used for structural analysis for such items as overturning and sliding resistance should be used in design.

F. Seismicity, Liquefaction and Faulting

1. Seismicity

Listed below is a summary of the seismic site parameters.

Description	Value - Seismic Event (2% PE in 50 yrs)
2018 IBC Seismic Site Class	C
PGA	0.23g
S_s	0.51g
S_1	0.17g
F_a	1.38
F_v	2.27
F_{PGA}	1.37

2. Seismic Design Considerations

Based on the subsurface conditions anticipated, a ground motion hazard analysis as per ASCE 7-16 is not required by the 2018 International Building Code. A 10 percent decrease in design seismic load might be achieved if shear wave velocities are measured on site. If this is requested, we propose to perform a Refraction Microtremor (ReMi) survey to measure subsurface shear wave velocity

3. Liquefaction

Based on subsurface conditions encountered in the boring, the subsurface soils observed are non-liquefiable during a severe seismic event.

4. Faults

Based on review of available geologic literature, there are no mapped faults extending through the site.

G. Soil Corrosion

Our experience in the area and laboratory test results indicates the on-site soil and bedrock contain sulfate concentration corresponding to a "moderate" to "severe" potential sulfate attack on concrete exposed to these materials. Therefore, we recommend concrete elements that will be exposed to the on-site soils be designed in accordance with provisions provided in the American Concrete Institute Manual of Concrete Practice (ACI) 318-11. Tables 4.2.1 and 4.3.1 of ACI 318-11 should be referenced for design of concrete elements utilizing a Sulfate Exposure Class of S2, and a sulfate exposure severity of "severe".

Consideration should also be given to cathodic protection of buried metal pipes. We recommend utilizing PVC pipes where local building codes allow.

H. Pavement

Based on the subsoil conditions encountered and the laboratory test results, the following recommendations are given:

1. Analysis

The flexible pavement analysis is based on AASHTO design methods and a 20-year design life. The rigid pavement is based on AASHTO and PCCA design methods and a 20-year design life.

2. Subgrade Support

Our design assumes a properly prepared subgrade as recommended in the Subgrade Preparation section of this report. The subgrade preparation varies depending on the location on the site. Prior to base course or pavement or grading fill, the subgrade should be prepared as recommended in the Subgrade Preparation section of this report.

3. Pavement Thickness

Based on the anticipated traffic, the following pavement sections are recommended.

	Rigid Pavement		Flexible Pavement	
Area	Portland Cement (inches)	Base Course (inches)	Asphaltic concrete (inches)	Base Course (inches)
Light Duty Parking	--	--	2½	8
Entrances and dumpster pad	4	4	3	12

4. Pavement Materials

a. *Flexible Pavement (Asphaltic Concrete)*

The pavement materials should meet AASHTO, St. George City specifications for gradation and quality. The pavement thicknesses indicated above assume that the base course is a high quality material with a CBR value of at least 80 percent. Asphalt material should have a Marshal stability of at least 1,800 pounds.

b. *Rigid Pavement (Portland Cement Concrete)*

The pavement thicknesses indicated assumes that the concrete will have a 28-day compressive strength of at least 4,500 psi.

5. Jointing

Joints for concrete (rigid) pavement should be laid out in a square or rectangular pattern. Joint spacings should not exceed 30 times the thickness of the slab. The depth of joints should be at least one-quarter of the slab thickness.

6. Drainage

The collection and diversion of drainage away from the pavement surface is extremely important to the satisfactory performance of the pavement section. Proper drainage should be provided. We further recommend proper pavement maintenance to extend the pavement life.

I. Design Review/Construction Observation

Design review and construction observations are recommended to verify the recommendations in this report are properly implemented and followed. In order to provide a foundation compliance report as required by the St. George City, we recommend the following be done as a minimum:

1. Review the foundation plan and design to verify the geotechnical aspects of the design were correctly and properly included.

2. Observe on a full time basis the drilling and construction of the micropiles and piers including reinforcement and concrete placement.

3. Observe the reinforcing steel in the grade beams.

4. Verify the proper void space is provided below the grade beams.

5. Conduct special inspections as required by the St. George City, the 2018 International Building Code and the Structural engineer.

The above observations will be conducted by qualified individuals and according to standard test methods (ASTM, ICBO, ICC, etc.).

LIMITATIONS

This report has been prepared in accordance with generally accepted soil and foundation engineering practices in the area for the use of the client for design purposes. The conclusions and recommendations included within the report are based on the information obtained from the borings drilled, geologic literature, laboratory test results, engineering analysis and our experience in the area. Variations in the subsurface conditions may not become evident until additional exploration or excavation is conducted. If the subsurface soil or groundwater conditions are found to be different from what is described in this report, we should be notified to reevaluate the recommendations given.

If you have any questions or we can be of further service, please call.

APPLIED GEOTECHNICAL ENGINEERING CONSULTANTS, INC.

G. Wayne Rogers, P.E.

Reviewed by: Arnold DeCastro, P.E.

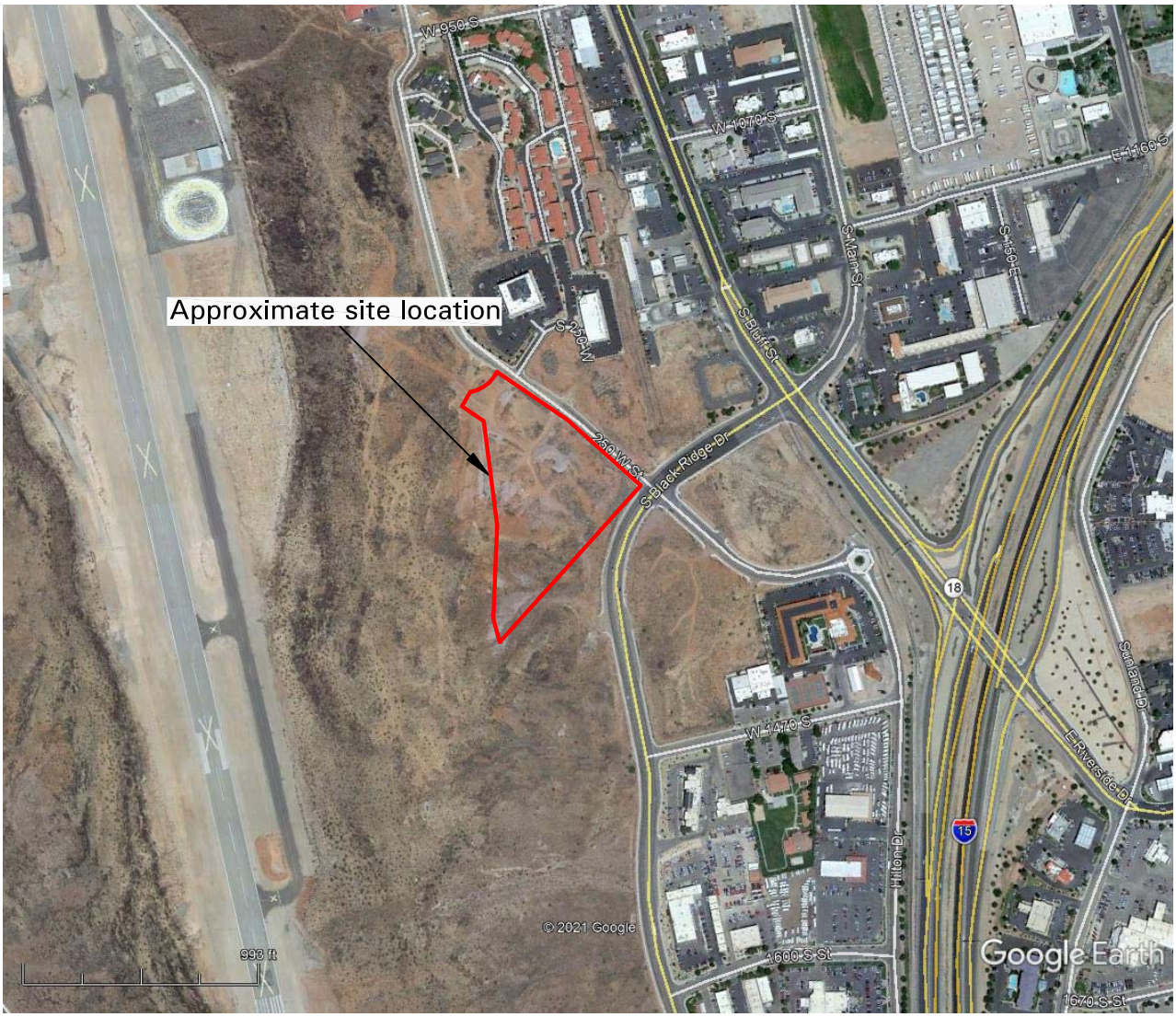
Reviewed By: James E Nordquist, P.E., D.G.E.

AD/sd P:\2021 Project Files\2211100\2211175 - Blackstone Hotel (West Blackridge Parcel)\FINAL DRAFT REPORT.wpd

GEOLOGIC LITERATURE REFERENCES

"Geologic map of the St. George quadrangle, Washington County, Utah", Hayden, J.M., Willis, G.C., 2011, Utah Geological Survey map, 251DM.

"Geologic hazards and adverse construction conditions, St. George-Hurricane Metropolitan Area, Washington County, Utah", Lund, W.R., Knudsen, T.R., Vice, G.S., and Shaw, L.M., 2008, Utah Geological Survey Special Study 127, variously paginated, 14 plates, scale 1:24,000.



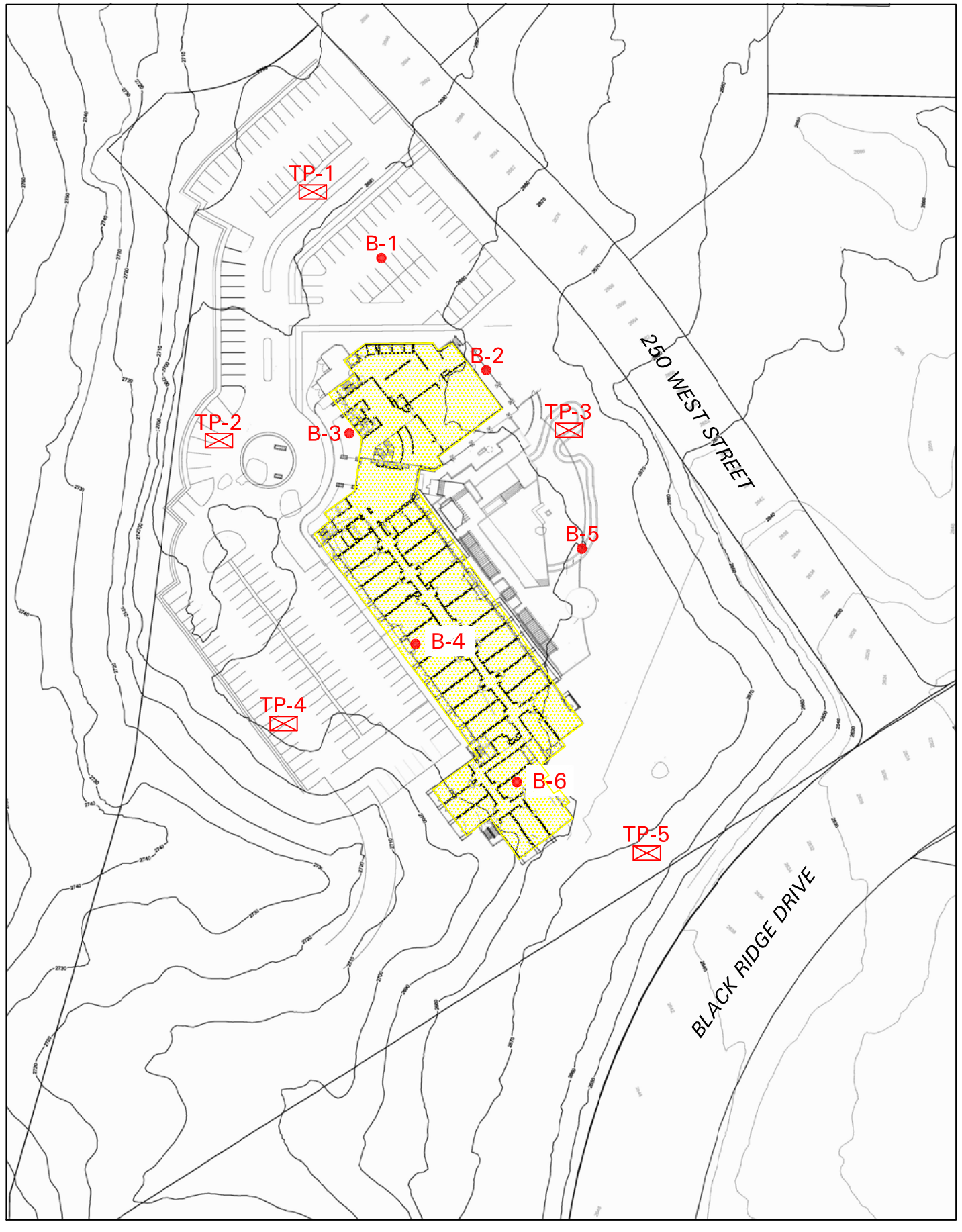
N

Not to Scale

BLACKSTONE HOTEL
WEST PARCEL
ST. GEORGE, UTAH

2211175	AGEC	Vicinity Map	Figure 1

BLACKSTONE HOTEL WEST PARCEL
ST. GEORGE, UTAH



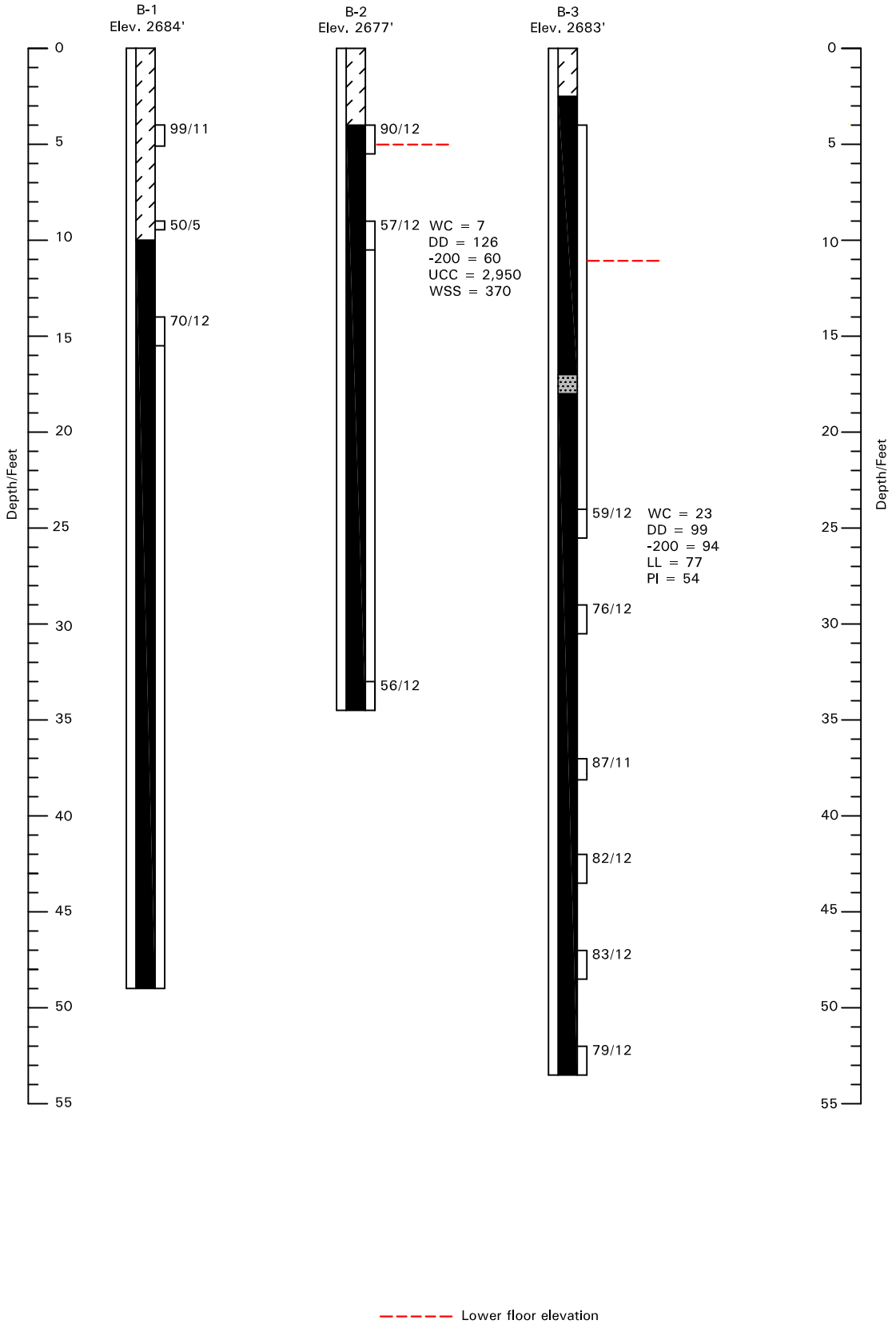
- Approximate boring location
- Approximate test pit location
- Proposed Hotel

N

0 80 160 feet

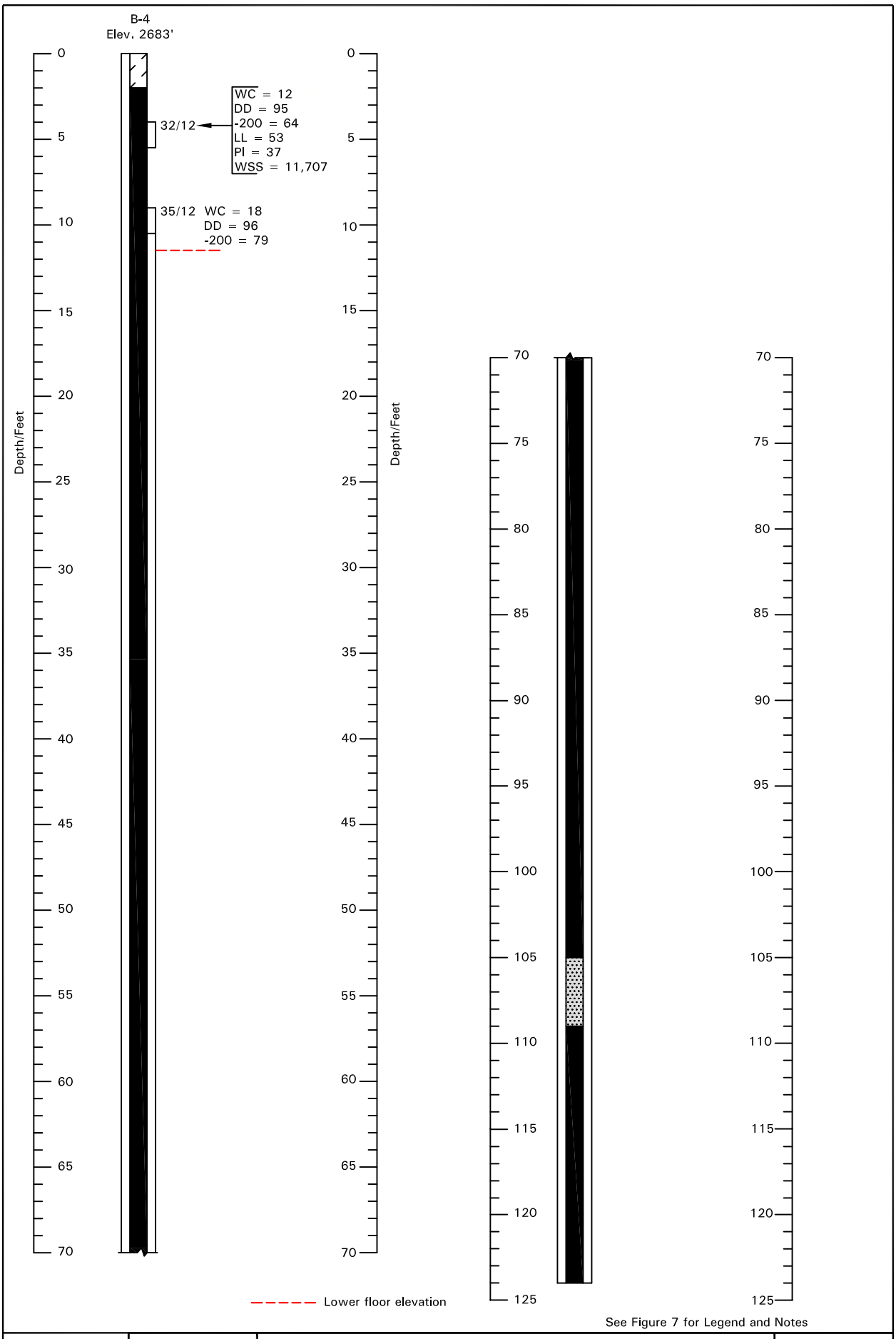
Approximate Scale

2211175	AGEC	Site Plan	Figure 2

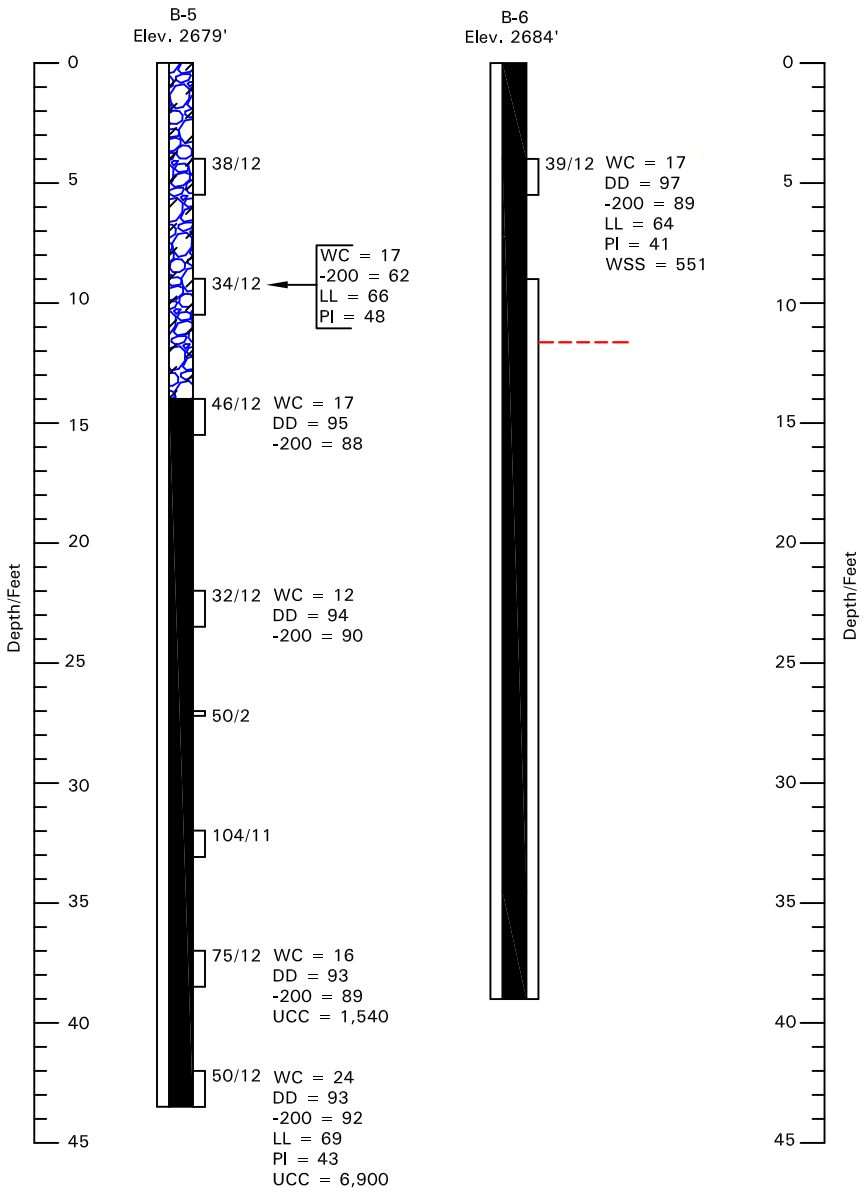


See Figure 7 for Legend and Notes

2211175	AGES	Logs of Exploratory Borings	Figure 3



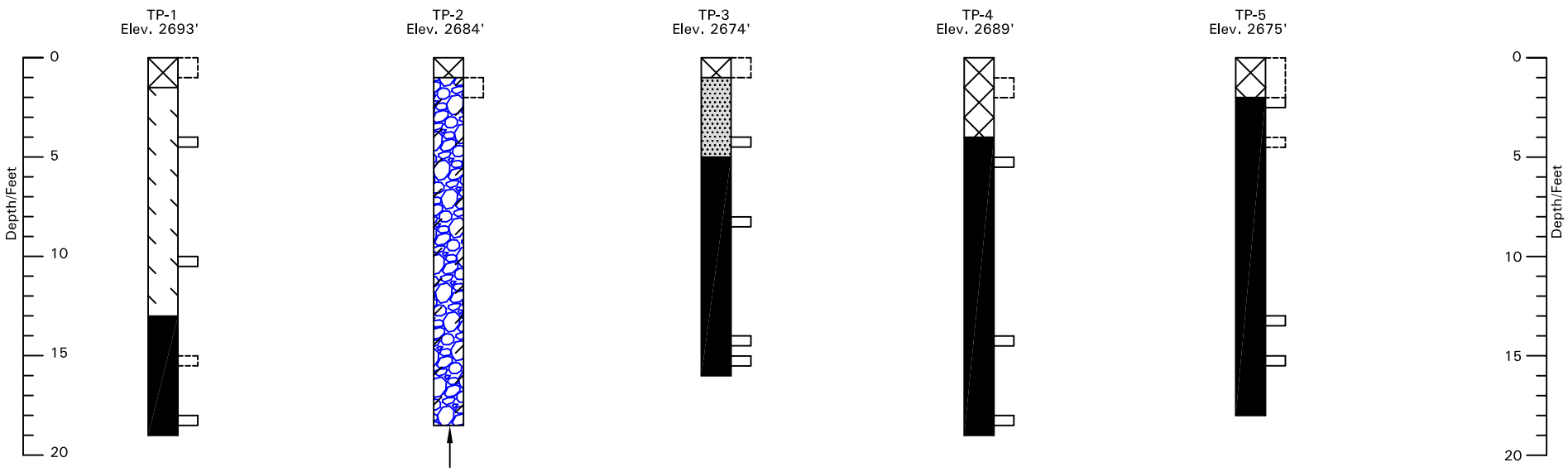
2211175	AGES	Logs of Exploratory Borings	Figure 4



Lower Floor Elevation.

See Figure 7 for Legend and Notes

2211175	AGES	Logs of Exploratory Borings	Figure 5



See Figure 7 for Legend and Notes

2211175	AGEC	Logs of Test Pits	Figure 6

LEGEND:

Fill; varies from clayey gravel to lean/fat clay, poorly compacted, dry, and red-brown to purple in color.

Landslide deposit - Lean/Fat Clay (CL/CH); medium stiff to very stiff, weathered mudstone, slightly moist, medium to highly plastic, and brown, red to slightly purple in color.

Landslide deposit - Clayey Gravel (GC); dense, dry, contains angular gravel up to boulder size, and and brown to red in color. The gravel is slightly gray to black basalt.

Landslide deposit - Mudstone Bedrock; consists of lean to fat clay with varied amounts of sand. It is soft to moderately hard, slightly moist to wet, and purple, grey, red-brown in color.

Landslide deposit - Sandstone Bedrock; moderately hard, contains layers of clay, dry to wet and grey to brown to red in color.

10/12 California drive sample taken. The symbol 10/12 indicates that 10 blows from a 140 pound hammer falling 30 inches were required to drive the sampler 12 inches.

Indicates slotted 1 inch PVC pipe installed in the boring to the depth shown.

Indicates core sample taken.

Indicates practical excavator refusal.

Lower floor elevation (Elevation 2671 feet)

NOTES:

1. The borings were drilled on June 14, 15, and 16, 2021 with a truck mounted drill rig equipped with 8-inch hollow-stem augers. The test pits were excavated on July 6, 2021with a track excavator (CAT 336).
2. The locations of the borings and test pits were located by a hand held GPS.
3. The elevations of the borings and test pits were determined by interpolations of the contours on the site plan provided.
4. The boring locations and elevations should be considered accurate only to the degree implied by the method used.
5. The lines between the materials shown on the logs represent the approximate boundaries between material types and the transitions may be gradual.
6. Free water was not encountered in the borings or test pits at the time of drilling/ excavation.
7. WC = water content (%);
   DD = dry density (pcf);
   +4 = percent retained on the No. 4 sieve;
   -200 = percent passing No. 200 sieve;
   LL = liquid limit (%);
   PI = plasticity index (%).

Applied Geotechnical Engineering Consultants, Inc.

Table 1 - Summary of Laboratory Test Results

Blackstone Hotel

Project No. 2211175

Sample Location				Gradation			Atterberg Limits		Moisture-Density Relationship				
Boring No.	Depth (ft)	Natural Moisture Content (%)	Natural Dry Density (pcf)	Gravel (%)	Sand (%)	Silt/Clay (%)	Liquid Limit (%)	Plastic Index (%)	Maximum Dry Density (pcf)	Optimum Moisture Content (%)	Unconfined Compressive Strength (psf)	Water Soluble Sulfate (ppm)	Soil Type
B-2	9	7	126			60					2,950	370	Landslide Deposit - Mudstone Bedrock, Sandy Fat Clay (CH)
B-3	24	23	99			94	77	54					Landslide Deposit - Mudstone Bedrock, Fat Clay (CH)
B-4	4	12	95			64	53	37				11,707	Landslide Deposit - Mudstone Bedrock, Sandy Fat Clay (CH)
B-4	9	18	96			79							Landslide Deposit - Mudstone Bedrock, Fat Clay with Sand (CH)
B-5	9	17				62	66	48					Landslide Deposit - Mudstone Bedrock, Sandy Fat Clay (CH)
B-5	14	17	95			88							Landslide Deposit - Mudstone Bedrock, Fat Clay (CH)
B-5	22	12	94			90							Landslide Deposit - Mudstone Bedrock, Fat Clay (CH)
B-5	37	16	93			89					1,540		Landslide Deposit - Mudstone Bedrock, Fat Clay (CH)
B-5	42	24	93			92	69	43			6,900		Landslide Deposit - Mudstone Bedrock, Fat Clay (CH)
B-6	4	17	97			89	64	41				551	Landslide Deposit - Mudstone Bedrock, Fat Clay (CH)

Applied Geotechnical Engineering Consultants, Inc.

Table 2

Deep Foundation Element Design Parameters

Blackstone Hotel Project No. 2211175

Soil Type	Soil Properties			Lateral Design Parameters			Axial Design Parameters		
	Total Unit Weight (pcf)	Cohesion (psf)	Friction Angle (Degrees)	Horizontal Modulus (pci)	Ultimate Passive Resistance (psf)	Strain @ 50% Yield (k_{rm})	Ultimate Skin Friction (psf)	Ultimate Uplift Skin Friction (psf)	Net Allowable** Bearing Capacity (ksf)
Mudstone (upper 10 feet)	100	2,000	0	500	18,000	0.006	1,000	750	--
Mudstone (10 to 20 feet)	110	4,000	0	1,400	36,000	0.006	2,000	1,333	--
Mudstone (>20 feet)	120	6,000	0	2,000	54,000	0.005	3,000	2,000	35

* Ignore the upper 2 feet

** Minimum embedment of 20 feet into the mudstone.

APPENDIX

SITE PHOTOS, CORE LOGS
AND ASBESTOS LOCATION MAP

Photo No. 1, View of property to right or west of 250 West, looking south.

Photo No. 2, View of property from west of SWC property looking north

Photo No. 3, View of property from Near SWC, looking NE.

Photo No. 4, View of property from near SEC corner at top of slope, looking NW

Photo No. 5, View of property from above and west of property, looking west

Photo No. 6, View of property from above and west of property, looking south to southeast.

PROJECT NO. 2211175

AGEC FIELD CORE LOG

PROJECT Blackstone Hotel West Parcel

CORE SIZE 2½"

DATE June 14, 2021

LOCATION

ELEVATION 2684'

PAGE Page 1 of 3

FIELD ENG. T.R.A.

DRILLER B.L.

BORING NO. B-1

DEPTH (ft)	ALTERATION	HARDNESS	CORE DESCRIPTION	WATER	PACKER TESTS	GRAPHIC LOG	DISCONTINUITY LOG: ORIENT.	DISCONTINUITY LOG: TYPE	DISCONTINUITY LOG: ROUGH.	DISCONTINUITY LOG: PLAN.	DISCONTINUITY LOG: FILLING	CORE RUN (FT)	RECOVERY (FT)	RQD (%)	FRAC./FT.	PROGRESS	DRILLING COMMENTS
0			Landslide deposit - Lean Clay with sand and gravel, hard, slightly moist, red/mottled.														Boring cased with 8" diameter HSA to 14'.
1																	
2			Boulder														
3																	
4																	
5																	
6																	
7																	
8			Boulder														
9																	
10			Boulder														
11																	
12																	
13																	
14			Landslide deposit - Mudstone Bedrock, moderately hard slightly moist to moist, purple.									5	2½	40		0.8	Boring advanced with 2½" HQ Core and carbide bit using air.
15																	
16																	
17																	
18																	
19												5	3½	30		1.8	

PROJECT NO. 2211175

AGEC FIELD CORE LOG

PROJECT Blackstone Hotel West Parcel

CORE SIZE 2½"

DATE June 14, 2021

LOCATION

ELEVATION 2684'

PAGE Page 2 of 3

FIELD ENG. T.R.A.

DRILLER B.L.

BORING NO. B-1

DEPTH (ft)	ALTERATION	HARDNESS	CORE DESCRIPTION	WATER	PACKER TESTS	GRAPHIC LOG	DISCONTINUITY LOG: ORIENT.	TYPE	ROUGH.	PLAN.	FILLING	CORE RUN (FT)	RECOVERY (FT)	RQD (%)	FRAC./FT.	PROGRESS	DRILLING COMMENTS
20–21			Landslide deposit - Mudstone Bedrock, moderately hard slightly moist to moist, purple.														
21–22																1.8	
22–23												5	3½	30			
23–24																	
24–25																	
25–26																	
26–27												5	3½	30		2.6	
27–28																	
28–29																	
29–30																	
30–31																	
31–32												5	3½	30		3.2	
32–33																	
33–34																	
34–35																	Switch to carbide bit
35–36																	
36–37												5	3½	30		0.4	
37–38																	
38–39																	
39–												5				1.2	

PROJECT NO. 2211175

AGEC FIELD CORE LOG

PROJECT Blackstone Hotel West Parcel

CORE SIZE 2½"

DATE June 14, 2021

LOCATION

ELEVATION 2684'

PAGE 3 of 3

FIELD ENG. T.R.A.

DRILLER B.L.

BORING NO. B-1

DEPTH (ft)	ALTERATION	HARDNESS	CORE DESCRIPTION	WATER	PACKER TESTS	GRAPHIC LOG	DISCONTINUITY LOG: ORIENT.	TYPE	ROUGH.	PLAN.	FILLING	CORE RUN (FT)	RECOVERY (FT)	RQD (%)	FRAC./FT.	PROGRESS	DRILLING COMMENTS
40			Landslide deposit - Mudstone Bedrock, moderately hard slightly moist to moist, purple.														
41																	
42												5	5	70		1.2	
43																	
44																	
45																	
46												5	5	40		0.8	
47																	
48																	
49																	End of boring at 49'.
50																	
51																	
52																	
53																	
54																	
55																	
56																	
57																	
58																	
59																	

PROJECT NO. 2211175

AGEC FIELD CORE LOG

PROJECT Blackstone Hotel West Parcel

CORE SIZE 2½"

DATE June 14, 2021

LOCATION

ELEVATION 2677'

PAGE Page 1 of 2

FIELD ENG. T.R.A.

DRILLER B.L.

BORING NO. B-2

DEPTH (ft)	ALTERATION	HARDNESS	CORE DESCRIPTION	WATER	PACKER TESTS	GRAPHIC LOG	DISCONTINUITY LOG: ORIENT.	TYPE	ROUGH.	PLAN.	FILLING	CORE RUN (FT)	RECOVERY (FT)	RQD (%)	FRAC./FT.	PROGRESS	DRILLING COMMENTS
0			Landslide deposit - Lean Clay with sand and gravel, hard, slightly moist, red/mottled.														Boring cased with 8" diameter HSA to 14'.
4			Landslide deposit - Mudstone Bedrock, soft to moderately hard, grey to purple to red.														
9																	Boring advanced with 2½" HQ Core and carbide bit using air.
10												5	2	25		0.4	
14												5	5			1.0	
17			Landslide deposit - Sandstone Bedrock, soft, grey to brown.														
18			Landslide deposit - Mudstone Bedrock, red to grey.														
19												5	3				

PROJECT NO. 2211175

AGEC FIELD CORE LOG

PROJECT Blackstone Hotel West Parcel

CORE SIZE 2½"

DATE June 14, 2021

LOCATION

ELEVATION 2677'

PAGE Page 2 of 2

FIELD ENG. T.R.A.

DRILLER B.L.

BORING NO. B-2

DEPTH (ft)	ALTERATION	HARDNESS	CORE DESCRIPTION	WATER	PACKER TESTS	GRAPHIC LOG	DISCONTINUITY LOG: ORIENT.	DISCONTINUITY LOG: TYPE	DISCONTINUITY LOG: ROUGH.	DISCONTINUITY LOG: PLAN.	DISCONTINUITY LOG: FILLING	CORE RUN (FT)	RECOVERY (FT)	RQD (%)	FRAC./FT.	PROGRESS	DRILLING COMMENTS
21			Landslide deposit - Mudstone Bedrock, soft to moderately hard, grey to purple to red.													1.8	
22												5	3				
23																	
24																	
25												5					
26																	
27																	
28																	
29			Landslide deposit - Shale/Sandstone, hard, moist to wet, red to grey.														
30																	
31												4	4			2.5	
32																	
33																	
34																	
35																	End of boring at 34½'.
36																	
37																	
38																	
39																	

PROJECT NO. 2211175

AGEC FIELD CORE LOG

PROJECT Blackstone Hotel West Parcel

CORE SIZE 2½"

DATE June 15, 2021

LOCATION

ELEVATION 2683'

PAGE Page 1 of 2

FIELD ENG. T.R.A.

DRILLER B.L.

BORING NO. B-3

DEPTH (ft)	ALTERATION	HARDNESS	CORE DESCRIPTION	WATER	PACKER TESTS	GRAPHIC LOG	DISCONTINUITY LOG: ORIENT.	DISCONTINUITY LOG: TYPE	DISCONTINUITY LOG: ROUGH.	DISCONTINUITY LOG: PLAN.	DISCONTINUITY LOG: FILLING	CORE RUN (FT)	RECOVERY (FT)	RQD (%)	FRAC./FT.	PROGRESS	DRILLING COMMENTS
0			Landslide deposit - Lean Clay with sand and gravel, hard, slightly moist, red/mottled.														Boring cased with 8" diameter HSA to 4'.
4			Landslide deposit - Mudstone Bedrock, soft to moderately hard, grey to purple to red.									5	1½	60		1.2	Boring advanced with 2½" HQ Core and carbide bit using air.
9												5	3	20		3.8	
14												5	1½	20		1.2	
17			Landslide deposit - Sandstone Bedrock, soft, grey to brown.														
18			Landslide deposit - Mudstone Bedrock, red to grey.									5	1½	0		0.8	

PROJECT NO. 2211175

AGEC FIELD CORE LOG

PROJECT Blackstone Hotel West Parcel

CORE SIZE 2½"

DATE June 15, 2021

LOCATION

ELEVATION

PAGE Page 2 of 2

FIELD ENG. T.R.A.

DRILLER B.L.

BORING NO. B-3

DEPTH (ft)	ALTERATION	HARDNESS	CORE DESCRIPTION	WATER	PACKER TESTS	GRAPHIC LOG	DISCONTINUITY LOG: ORIENT.	DISCONTINUITY LOG: TYPE	DISCONTINUITY LOG: ROUGH.	DISCONTINUITY LOG: PLAN.	DISCONTINUITY LOG: FILLING	CORE RUN (FT)	RECOVERY (FT)	RQD (%)	FRAC./FT.	PROGRESS	DRILLING COMMENTS
21–24			Landslide deposit - Mudstone Bedrock, soft, moist, grey to purple to red.									5	1½	0		0.8	
24																	End of coring at 24'.

PROJECT NO. 2211175

AGEC FIELD CORE LOG

PROJECT Blackstone Hotel West Parcel

CORE SIZE 2½"

DATE June 16, 2021

LOCATION

ELEVATION 2683'

PAGE Page 1 of 7

FIELD ENG. T.R.A.

DRILLER B.L.

BORING NO. B-4

DEPTH (ft)	ALTERATION	HARDNESS	CORE DESCRIPTION	WATER	PACKER TESTS	GRAPHIC LOG	DISCONTINUITY LOG: ORIENT.	DISCONTINUITY LOG: TYPE	DISCONTINUITY LOG: ROUGH.	DISCONTINUITY LOG: PLAN.	DISCONTINUITY LOG: FILLING	CORE RUN (FT)	RECOVERY (FT)	RQD (%)	FRAC./FT.	PROGRESS	DRILLING COMMENTS
0			Landslide deposit - Lean Clay with sand and gravel, hard, slightly moist, red/mottled.														Boring cased with 8" diameter HSA to 9'.
2			Landslide deposit - Mudstone Bedrock, moderately hard slightly moist to moist, purple.														
9																	Boring advanced with 2½" HQ Core and carbide bit using air.
11												5	3½	70		0.6	
14																	
15												2				2.0	
17												3	2½	80			
19												5	5	80		4.8	

PROJECT NO. 2211175

AGEC FIELD CORE LOG

PROJECT Blackstone Hotel West Parcel

CORE SIZE 2½"

DATE June 16, 2021

LOCATION

ELEVATION 2683'

PAGE Page 2 of 7

FIELD ENG. T.R.A.

DRILLER B.L.

BORING NO. B-4

DEPTH (ft)	ALTERATION	HARDNESS	CORE DESCRIPTION	WATER	PACKER TESTS	GRAPHIC LOG	DISCONTINUITY LOG: ORIENT.	TYPE	ROUGH.	PLAN.	FILLING	CORE RUN (FT)	RECOVERY (FT)	RQD (%)	FRAC./FT.	PROGRESS	DRILLING COMMENTS
20–21			Landslide deposit - Mudstone Bedrock, moderately hard slightly moist to moist, purple.		0–1												
21–22					1–2							5	5	80		4.8	
22–23					2–3												
23–24					3–4												
24–25					4–5							5	5	90		5.6	
25–26					5–6												
26–27					6–7												
27–28					7–8												
28–29					8–9												
29–30					9–10							5	5	90		5.6	
30–31					10–11												
31–32					11–12												
32–33					12–13												
33–34					13–14												
34–35					14–15							5	5	90		7.6	Switch to carbide bit
35–36					15–16												
36–37					16–17												
37–38					17–18												
38–39					18–19												
39–					19–							5	5	90		5.6	

PROJECT NO. 2211175 **AGEC FIELD CORE LOG**

PROJECT Blackstone Hotel West Parcel | CORE SIZE 2½" | DATE June 16/17, 2021

LOCATION | ELEVATION 2683' | PAGE 3 of 7

FIELD ENG. T.R.A. | DRILLER B.L. | BORING NO. B-4

DEPTH (ft)	ALTERATION	HARDNESS	CORE DESCRIPTION	WATER	PACKER TESTS	GRAPHIC LOG	DISCONTINUITY LOG: ORIENT.	TYPE	ROUGH.	PLAN.	FILLING	CORE RUN (FT)	RECOVERY (FT)	RQD (%)	FRAC./FT.	PROGRESS	DRILLING COMMENTS
40			Landslide deposit - Mudstone Bedrock, moderately hard slightly moist to moist, purple.														
41																	
42												5	5	90		5.6	
43																	
44																	
45																	
46												5	5	80		7.8	
47																	
48																	
49																	
50																	
51												5	5	50		10.6	
52																	
53																	
54																	
55																	
56												5	5	70		5.8	
57																	
58																	
59												5	5	60			

PROJECT NO. 2211175

AGEC FIELD CORE LOG

PROJECT Blackstone Hotel West Parcel

CORE SIZE 2½"

DATE June 17, 2021

LOCATION

ELEVATION 2683'

PAGE 4 of 7

FIELD ENG. T.R.A.

DRILLER B.L.

BORING NO. B-4

DEPTH (ft)	ALTERATION	HARDNESS	CORE DESCRIPTION	WATER	PACKER TESTS	GRAPHIC LOG	DISCONTINUITY LOG: ORIENT.	TYPE	ROUGH.	PLAN.	FILLING	CORE RUN (FT)	RECOVERY (FT)	RQD (%)	FRAC./FT.	PROGRESS	DRILLING COMMENTS
60			Landslide deposit - Mudstone Bedrock, moderately hard slightly moist to moist, purple.														Boring advanced with 2½" HQ Core and carbide bit using air.
61																	
62												5	5	60		7.4	
63																	
64																	
65												5	5	80			
66																6.4	
67																	
68																	
69																	
70												5	5	95			
71																7.0	
72																	
73																	
74																	
75												5	4½	70			
76																	
77																9.6	
78																	
79																	
												5	5	40		6.6	

PROJECT NO. 2211175

AGEC FIELD CORE LOG

PROJECT Blackstone Hotel West Parcel

CORE SIZE 2½"

DATE June 17/18, 2021

LOCATION

ELEVATION 2683'

PAGE 5 of 7

FIELD ENG. T.R.A.

DRILLER B.L.

BORING NO. B-4

DEPTH (ft)	ALTERATION	HARDNESS	CORE DESCRIPTION	WATER	PACKER TESTS	GRAPHIC LOG	DISCONTINUITY LOG: ORIENT.	TYPE	ROUGH.	PLAN.	FILLING	CORE RUN (FT)	RECOVERY (FT)	RQD (%)	FRAC./FT.	PROGRESS	DRILLING COMMENTS
80			Landslide deposit - Mudstone Bedrock, moderately hard slightly moist to moist, purple.														Boring advanced with 2½" HQ Core and carbide bit using air.
81																	
82												5	5	90		6.6	
83																	
84																	
85																	
86																6.0	
87												5	5	90			
88																	
89																	
90																	
91																7.2	
92												5	5	90			
93																	
94																	
95																	
96																6.4	
97												5	5	90			
98																	
99																	
												5	5	95		7.0	

PROJECT NO. 2211175

AGEC FIELD CORE LOG

PROJECT Blackstone Hotel West Parcel

CORE SIZE 2½"

DATE June 18, 2021

LOCATION

ELEVATION 2683'

PAGE 6 of 7

FIELD ENG. T.R.A.

DRILLER B.L.

BORING NO. B-4

DEPTH (ft)	ALTERATION	HARDNESS	CORE DESCRIPTION	WATER	PACKER TESTS	GRAPHIC LOG	DISCONTINUITY LOG: ORIENT.	DISCONTINUITY LOG: TYPE	DISCONTINUITY LOG: ROUGH.	DISCONTINUITY LOG: PLAN.	DISCONTINUITY LOG: FILLING	CORE RUN (FT)	RECOVERY (FT)	RQD (%)	FRAC./FT.	PROGRESS	DRILLING COMMENTS
100–101			Landslide deposit - Mudstone Bedrock, moderately hard slightly moist to moist, purple.														Boring advanced with 2½" HQ Core and carbide bit using air.
101–102																	
102–103												5	5	95		7.0	
103–104																	
104–105																	
105–106			Landslide deposit - Sandstone Bedrock; moderately hard, grey to purple.														
106–107												5	5	95		6.2	
107–108																	
108–109																	
109–110			Landslide deposit - Mudstone Bedrock, moderately hard slightly moist to moist, purple.														
110–111																	
111–112												5	5	90		8.0	
112–113																	
113–114																	
114–115																	
115–116																	
116–117												5	5	95		10	
117–118																	
118–119																	
119–												5	5	95		2.8	

PROJECT NO. 2211175

AGEC FIELD CORE LOG

PROJECT Blackstone Hotel West Parcel

CORE SIZE 2½"

DATE June 18, 2021

LOCATION

ELEVATION 2683'

PAGE 7 of 7

FIELD ENG. T.R.A.

DRILLER B.L.

BORING NO. B-4

DEPTH (ft)	ALTERATION	HARDNESS	CORE DESCRIPTION	WATER	PACKER TESTS	GRAPHIC LOG	DISCONTINUITY LOG: ORIENT.	DISCONTINUITY LOG: TYPE	DISCONTINUITY LOG: ROUGH.	DISCONTINUITY LOG: PLAN.	DISCONTINUITY LOG: FILLING	CORE RUN (FT)	RECOVERY (FT)	RQD (%)	FRAC./FT.	PROGRESS	DRILLING COMMENTS
120					120							120				120		
121			Landslide deposit - Mudstone Bedrock, moderately hard slightly moist to moist, purple.		121		121					121				121		Boring advanced with 2½" HQ Core and carbide bit using air.
122					122		122					122	5	5	95	122	7.8	
123					123		123					123				123		
124					124		124					124				124		End of boring at 124'.

PROJECT NO. 2211175

AGEC FIELD CORE LOG

PROJECT Blackstone Hotel West Parcel

CORE SIZE 2½"

DATE June 15, 2021

LOCATION

ELEVATION 2784'

PAGE Page 1 of 2

FIELD ENG. T.R.A.

DRILLER B.L.

BORING NO. B-6

DEPTH (ft)	ALTERATION	HARDNESS	CORE DESCRIPTION	WATER	PACKER TESTS	GRAPHIC LOG	DISCONTINUITY LOG: ORIENT.	TYPE	ROUGH.	PLAN.	FILLING	CORE RUN (FT)	RECOVERY (FT)	RQD (%)	FRAC./FT.	PROGRESS	DRILLING COMMENTS
0			Landslide deposit - Mudstone Bedrock, soft to moderately hard, grey to purple to red.														Boring cased with 8" diameter HSA to 9'.
9																	
9												5	2	0		0.4	Boring advanced with 2½" HQ Core and carbide bit using air.
14																	
14												5	2	20		0.6	
19																	
19												5	4½	40		0.6	

PROJECT NO. 2211175

AGEC FIELD CORE LOG

PROJECT Blackstone Hotel West Parcel

CORE SIZE 2½"

DATE June 15, 2021

LOCATION

ELEVATION 2784'

PAGE Page 2 of 2

FIELD ENG. T.R.A.

DRILLER B.L.

BORING NO. B-6

DEPTH (ft)	ALTERATION	HARDNESS	CORE DESCRIPTION	WATER	PACKER TESTS	GRAPHIC LOG	DISCONTINUITY LOG: ORIENT.	DISCONTINUITY LOG: TYPE	DISCONTINUITY LOG: ROUGH.	DISCONTINUITY LOG: PLAN.	DISCONTINUITY LOG: FILLING	CORE RUN (FT)	RECOVERY (FT)	RQD (%)	FRAC./FT.	PROGRESS	DRILLING COMMENTS
20			Landslide deposit - Mudstone Bedrock, soft to moderately hard, grey to purple to red.														
21																	
22												5	4½	40		0.6	
23																	
24																	
25																	
26												5	3½	0			
27																0.8	
28																	
29																	
30																	
31																	
32												5	2½	0		2.5	
33																	
34																	
35																	
36												5	3	60			
37																2.0	
38																	
39																	End of boring at 39'.

BCE
BROWN CONSULTING ENGINEERS
CIVIL ENGINEERING * LAND SURVEYING * LAND PLANNING

MAY 3, 2004

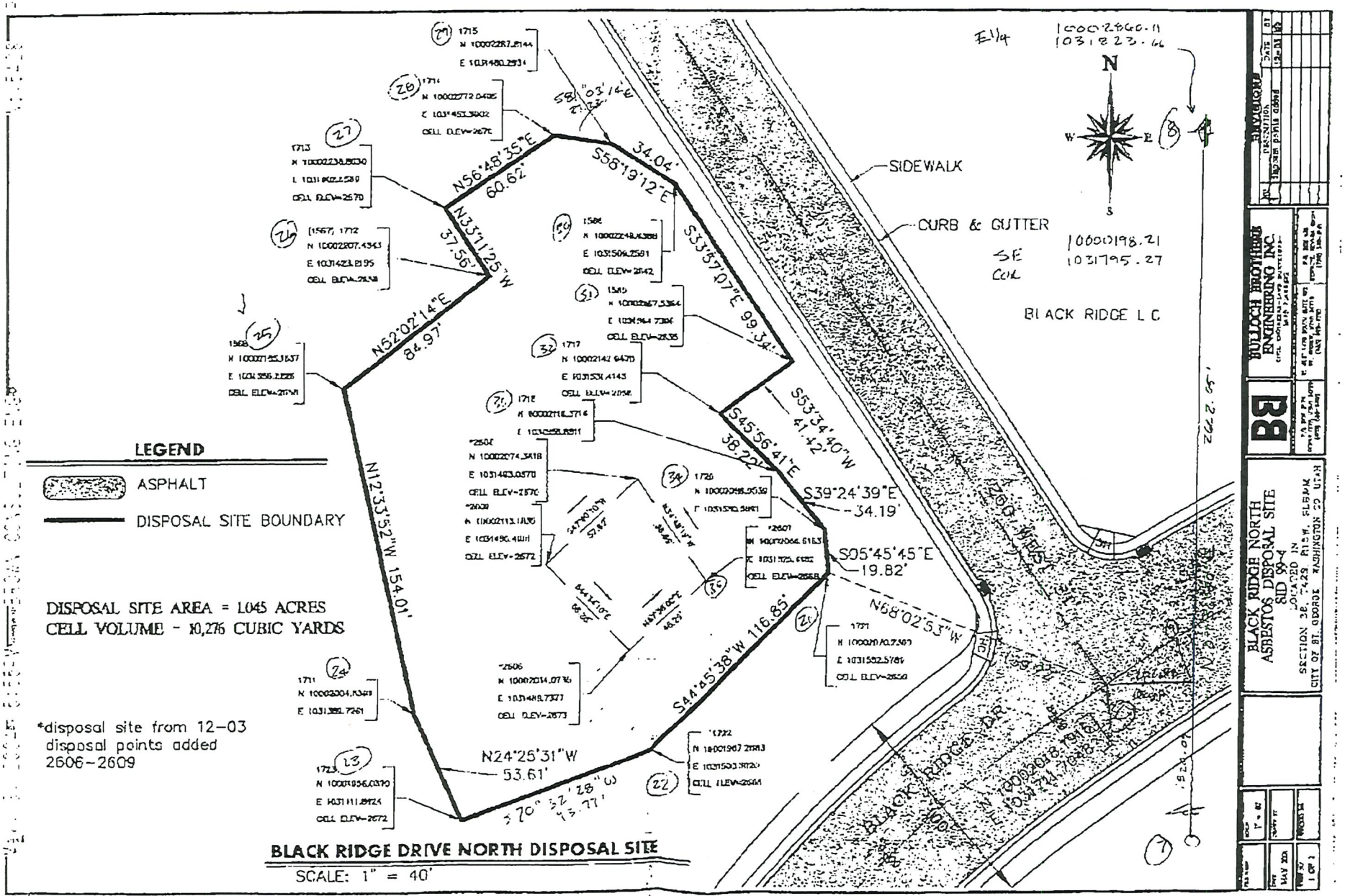
BLACK RIDGE NORTH ASBESTOS DISPOSAL SITE

BEGINNING AT THE SOUTHEAST CORNER OF SECTION 36, T42S, R16W, SLB&M THENCE N0°36'40"E, 1820.09 FEET ALONG THE SECTION LINE AND WEST 102.98 FEET TO THE CENTERLINE OF 250 WEST STREET AND BLACKRIDGE DRIVE; THENCE N68°02'53"W, 139.22 FEET TO THE TRUE POINT OF BEGINNING; THENCE S44°45'38"W, 116.85 FEET; THENCE S70°32'28"W, 93.77 FEET; THENCE N24°25'31"W, 53.61 FEET; THENCE N12°33'52"W, 154.01 FEET; THENCE N52°02'14"E, 84.97 FEET; THENCE N33°11'25"W, 37.56 FEET; THENCE N56°48'35"E, 60.62 FEET; THENCE S81°03'14"E, 27.23 FEET; THENCE S58°19'12"E, 34.04 FEET; THENCE S33°57'07"E, 99.34; THENCE S53°34'40"W, 41.42 FEET; THENCE S45°56'41"E, 38.22 FEET; THENCE S39°24'39"E, 34.19 FEET; THENCE S5°45'45"E, 19.82 FEET TO THE TRUE POINT OF BEGINNING.

CONTAINS 1.0455 ACRES

REGISTERED LAND SURVEYOR
MARC. L. BROWN
170223
5-3-04
STATE OF UTAH

163 WEST 1600 SOUTH #5 * ST. GEORGE UT 84770
PHONE 435.628.4700 * FAX 435.628.4725 * WWW.BROWNCE.COM


LEGEND
ASPHALT
DISPOSAL SITE BOUNDARY
DISPOSAL SITE AREA = 1.045 ACRES
CELL VOLUME - 10,276 CUBIC YARDS
*disposal site from 12-03 disposal points added 2606-2609
BLACK RIDGE DRIVE NORTH DISPOSAL SITE
SCALE: 1" = 40'
N
S
E
W
SIDEWALK
CURB & GUTTER
BLACK RIDGE L C
BLACK RIDGE NORTH
ASBESTOS DISPOSAL SITE
BID 99-4
SECTION 36, T.7S., R.3W.
CITY OF ST. GEORGE, WASHINGTON CO., UTAH
BUTLER HOLLOWAY
ENGINEERING INC

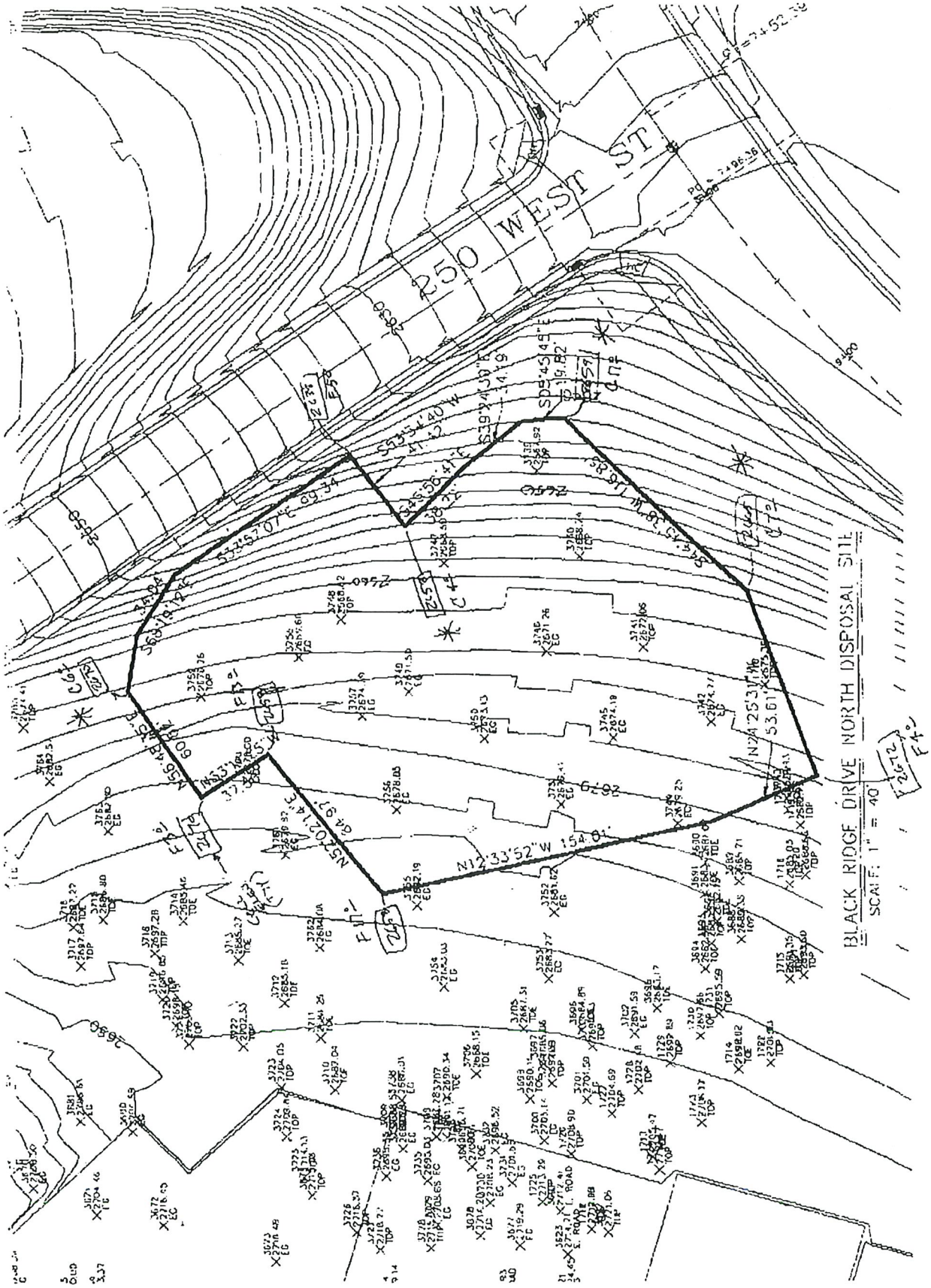

250 WEST ST
BLACK RIDGE DRIVE NORTH DISPOSAL SITE
SCALE: 1" = 40'
S39°45'49"E 119.82'
S53°54'40"W 417.19'
S36°56'42"E 256.42'
S53°25'07"W 69.34'
S68°19'12"W 149.84'
N53°10'48"W 150.00'
N36°49'12"E 240.00'
N53°10'48"W 64.97'
N12°33'52"W 154.01'
N12°25'13"W 53.61'
S38°51'11"E 381.38'
C41
C42
C43
C44
F41
F42
F43
F44
F45
F46
F47
F48
F49
F50
F51
F52
F53
F54
F55
F56
F57
F58
F59
F60
F61
F62
F63
F64
F65
F66
F67
F68
F69
F70
F71
F72
F73
F74
F75
F76
F77
F78
F79
F80
F81
F82
F83
F84
F85
F86
F87
F88
F89
F90
F91
F92
F93
F94
F95
F96
F97
F98
F99
F100
F101
F102
F103
F104
F105
F106
F107
F108
F109
F110
F111
F112
F113
F114
F115
F116
F117
F118
F119
F120
F121
F122
F123
F124
F125
F126
F127
F128
F129
F130
F131
F132
F133
F134
F135
F136
F137
F138
F139
F140
F141
F142
F143
F144
F145
F146
F147
F148
F149
F150
F151
F152
F153
F154
F155
F156
F157
F158
F159
F160
F161
F162
F163
F164
F165
F166
F167
F168
F169
F170
F171
F172
F173
F174
F175
F176
F177
F178
F179
F180
F181
F182
F183
F184
F185
F186
F187
F188
F189
F190
F191
F192
F193
F194
F195
F196
F197
F198
F199
F200
F201
F202
F203
F204
F205
F206
F207
F208
F209
F210
F211
F212
F213
F214
F215
F216
F217
F218
F219
F220
F221
F222
F223
F224
F225
F226
F227
F228
F229
F230
F231
F232
F233
F234
F235
F236
F237
F238
F239
F240
F241
F242
F243
F244
F245
F246
F247
F248
F249
F250
F251
F252
F253
F254
F255
F256
F257
F258
F259
F260
F261
F262
F263
F264
F265
F266
F267
F268
F269
F270
F271
F272
F273
F274
F275
F276
F277
F278
F279
F280
F281
F282
F283
F284
F285
F286
F287
F288
F289
F290
F291
F292
F293
F294
F295
F296
F297
F298
F299
F300
F301
F302
F303
F304
F305
F306
F307
F308
F309
F310
F311
F312
F313
F314
F315
F316
F317
F318
F319
F320
F321
F322
F323
F324
F325
F326
F327
F328
F329
F330
F331
F332
F333
F334
F335
F336
F337
F338
F339
F340
F341
F342
F343
F344
F345
F346
F347
F348
F349
F350
F351
F352
F353
F354
F355
F356
F357
F358
F359
F360
F361
F362
F363
F364
F365
F366
F367
F368
F369
F370
F371
F372
F373
F374
F375
F376
F377
F378
F379
F380
F381
F382
F383
F384
F385
F386
F387
F388
F389
F390
F391
F392
F393
F394
F395
F396
F397
F398
F399
F400
F401
F402
F403
F404
F405
F406
F407
F408
F409
F410
F411
F412
F413
F414
F415
F416
F417
F418
F419
F420
F421
F422
F423
F424
F425
F426
F427
F428
F429
F430
F431
F432
F433
F434
F435
F436
F437
F438
F439
F440
F441
F442
F443
F444
F445
F446
F447
F448
F449
F450
F451
F452
F453
F454
F455
F456
F457
F458
F459
F460
F461
F462
F463
F464
F465
F466
F467
F468
F469
F470
F471
F472
F473
F474
F475
F476
F477
F478
F479
F480
F481
F482
F483
F484
F485
F486
F487
F488
F489
F490
F491
F492
F493
F494
F495
F496
F497
F498
F499
F500
F501
F502
F503
F504
F505
F506
F507
F508
F509
F510
F511
F512
F513
F514
F515
F516
F517
F518
F519
F520
F521
F522
F523
F524
F525
F526
F527
F528
F529
F530
F531
F532
F533
F534
F535
F536
F537
F538
F539
F540
F541
F542
F543
F544
F545
F546
F547
F548
F549
F550
F551
F552
F553
F554
F555
F556
F557
F558
F559
F560
F561
F562
F563
F564
F565
F566
F567
F568
F569
F570
F571
F572
F573
F574
F575
F576
F577
F578
F579
F580
F581
F582
F583
F584
F585
F586
F587
F588
F589
F590
F591
F592
F593
F594
F595
F596
F597
F598
F599
F600
F601
F602
F603
F604
F605
F606
F607
F608
F609
F610
F611
F612
F613
F614
F615
F616
F617
F618
F619
F620
F621
F622
F623
F624
F625
F626
F627
F628
F629
F630
F631
F632
F633
F634
F635
F636
F637
F638
F639
F640
F641
F642
F643
F644
F645
F646
F647
F648
F649
F650
F651
F652
F653
F654
F655
F656
F657
F658
F659
F660
F661
F662
F663
F664
F665
F666
F667
F668
F669
F670
F671
F672
F673
F674
F675
F676
F677
F678
F679
F680
F681
F682
F683
F684
F685
F686
F687
F688
F689
F690
F691
F692
F693
F694
F695
F696
F697
F698
F699
F700
F701
F702
F703
F704
F705
F706
F707
F708
F709
F710
F711
F712
F713
F714
F715
F716
F717
F718
F719
F720
F721
F722
F723
F724
F725
F726
F727
F728
F729
F730
F731
F732
F733
F734
F735
F736
F737
F738
F739
F740
F741
F742
F743
F744
F745
F746
F747
F748
F749
F750
F751
F752
F753
F754
F755
F756
F757
F758
F759
F760
F761
F762
F763
F764
F765
F766
F767
F768
F769
F770
F771
F772
F773
F774
F775
F776
F777
F778
F779
F780
F781
F782
F783
F784
F785
F786
F787
F788
F789
F790
F791
F792
F793
F794
F795
F796
F797
F798
F799
F800
F801
F802
F803
F804
F805
F806
F807
F808
F809
F810
F811
F812
F813
F814
F815
F816
F817
F818
F819
F820
F821
F822
F823
F824
F825
F826
F827
F828
F829
F830
F831
F832
F833
F834
F835
F836
F837
F838
F839
F840
F841
F842
F843
F844
F845
F846
F847
F848
F849
F850
F851
F852
F853
F854
F855
F856
F857
F858
F859
F860
F861
F862
F863
F864
F865
F866
F867
F868
F869
F870
F871
F872
F873
F874
F875
F876
F877
F878
F879
F880
F881
F882
F883
F884
F885
F886
F887
F888
F889
F890
F891
F892
F893
F894
F895
F896
F897
F898
F899
F900
F901
F902
F903
F904
F905
F906
F907
F908
F909
F910
F911
F912
F913
F914
F915
F916
F917
F918
F919
F920
F921
F922
F923
F924
F925
F926
F927
F928
F929
F930
F931
F932
F933
F934
F935
F936
F937
F938
F939
F940
F941
F942
F943
F944
F945
F946
F947
F948
F949
F950
F951
F952
F953
F954
F955
F956
F957
F958
F959
F960
F961
F962
F963
F964
F965
F966
F967
F968
F969
F970
F971
F972
F973
F974
F975
F976
F977
F978
F979
F980
F981
F982
F983
F984
F985
F986
F987
F988
F989
F990
F991
F992
F993
F994
F995
F996
F997
F998
F999
F1000

EXHIBIT H

2024 AGEC Geotechnical Investigation

Applied GeoTech

July 13, 2024

Cross L Holidings
2805 Cottonwood Circle
Santa Clara, Utah 84765

Attention: Lonne Gubler

Subject: Geologic Hazard Hillside Report
Blackridge Restaurants
St. George, Utah
Project Nos. 2240674

REFERENCES

1. 1. "Geotechnical Investigation, Blackstone Hotel" (current parcel), prepared by AGEC under Project No. 2180187, dated December 14, 2018.

2. "Slope Stability Consultation", Blackstone Hotel (current parcel), prepared by AGEC, Project No. 2180187

3. "Geotechnical Investigation", Blackstone Hotel, West Parcel, prepared by AGEC, Project No. 2211175, dated September 8, 2021.

4. "Stability Consultation", Blackstone Hotel, West Parcel, prepared by AGEC, Project No. 2211175, dated September 28, 2021.

5. "Preliminary Grading Plan", prepared by American Consulting and Engineering under Job #24-013 dated July 3, 2024.

BACKGROUND INFORMATION

AGEC has previously conducted a geotechnical study for the property (Ref No. 1) for a previously planned hotel site. Subsequently, the hotel site was moved across 250 West to the west. AGEC conducted by AGEC for the property to the west (Ref No. 3 and 4). The information from these references was used to evaluate the site and provide our conclusions and recommendations for the proposed new construction as shown on the attached site plan (Ref No. 5).

AGEC has used the proposed construction/grading plan (Ref No. 4) and evaluated

the slope stability of the property. Reference No.'s 1, 3 and 4 are attached for reference.

GENERAL SUMMARY-CONCLUSIONS

The following are the significant items that exist at the site;

1. There are basically 2 geologic hazards that exist at the site which could impact the project. The hazards include the potential for landslide movement, highly expansive soil and bedrock.

2. AGEC has evaluated the stability of the slope, upon which the restaurants are planned. Based on profiles and material strengths from previous work noted in References 1-4, the overall site does not meet the minimum standard for stability assuming that the soil and bedrock is saturated. As a part of AGEC's previous study has conducted additional investigation on this site to evaluate the factors of safety and for ground improvement at this location. During Reference No.'s 2-4, AGEC conducted additional laboratory testing for the analysis to determine the strengths and moisture characteristics for our evaluation. Additional evaluation in a partially saturated slope in the upper portion of the slope. The results of this evaluation are discussed in the stability section below.

3. Due to the expansive characteristics of the on-site clay and bedrock, there is the potential for significant heave up wetting of the subgrade soils. AGEC will provide foundation recommendations using an overexcavation and replacement method for the building areas.

SITE CONDITIONS

The site is located on a sloping hillside located north of Blackridge Drive and east of 250 West Street. The site consists of two parcels that are approximately 3.8 acres. There are retail buildings below and to the east of the property. The eastern portion of the property consists of a rock slope that varies with steeper sections up to approximately 1:1 (horizontal to vertical) with several benches within the slope. The slope height varies from approximately 30 to 55 feet in height increasing to the north. The base of the slope (retail project) has a reinforced concrete wall along the eastern property line.

The south edge of the property has limited rock facing along the top of the slope with exposed soil and rock below. The slope through this area is approximately 30 feet in height.

The western edge of the property borders 250 West Street, which slopes up to the north and slightly west with approximately 40 feet of elevation change along the roadway. There is an exposed soil/mudstone slope down to the 250 west at the southwest corner and decreases in height to the north to a point where the site is lower than 250 west and there is a slope down to the property of approximately 10 to 12 feet.

To the north of the property are two office buildings. These buildings are accessed off of 250 west along the north edge of the property with a roadway that slopes down to the northeast. The roadway extends along the edge of the property to near the north central portion of the property that will eventually extend southwest to connect to the planned entrance of the property along 250 West.

The northeast portion of the site is generally lower by several feet from the property to the north. There is a small retaining wall along the eastern portion of the north property line.

There are several stockpiles of materials that vary from rock to soil to mudstone. There is also a buried storm drain that extends along the crest of the slope on the eastern portion of the site and extends south to Blackridge drive.

Aerial Photo of the property.

SUBSURFACE CONDITIONS

AGEC investigated the subsurface conditions during the previous studies noted in Reference No.'s 1-3. The study for the overall slope was initiated in 2007 where several deep borings were drilled and inclinometers and piezometers were installed. During the 2018 study, AGEC observed the drilling of 6 borings and excavation of 5 test pits across the property.

The subsurface profile observed in the borings drilled generally consists of fill overlying bedrock to the maximum depth investigated, approximately 93 feet. Talus (cobbles infilled gravel, sand and clay) and landslide deposits were encountered beneath the fill. The transition of landslide altered bedrock to undisturbed bedrock occurs at a depth of approximately 37 to 80 feet below the ground surface.

Details of the various types of materials encountered along with laboratory testing are included in the referenced documents.

OVERALL HILLSIDE STABILITY

The area for the proposed restaurants is located on the lower section of a 300-foot-high slope. The lower two-thirds of the slope has been identified and mapped as a landslide deposit, which has the potential for landslide movement if environmental conditions change. The area has also received a significant amount of fill that is retained by a rockery slope on the eastern edge of the property.

The ground surface of the landslide deposit slopes down at an average slope of approximately 7.3 horizontal to 1 vertical. Earlier studies (Ref No.'s 1-3) of the landslide deposit has revealed that the depth of the landslide extends approximately 200 feet below the existing ground surface.

Previous studies have also included measurement of inclinometers that were installed in 2007 that extended 79 to 259 feet below the existing ground surface. Four of the five inclinometers have indicated that there has been no movement from the initial measurements in 2007 through measurements taken in 2018.

Ground movement was experienced at multiple depths prior to 2011 on a portion of the slope located on and west of a vacant restaurant located at 1090 South Bluff Street (Dairy Queen site).

PROPOSED CONSTRUCTION

There will be two restaurant pads as shown on the attached site plan. The restaurant pads are planned to be at elevations 2656.0 feet (north pad) and 2651.0 feet (south pad). Each pad will a portion of the pad on the east side that will be 2 feet lower than the main pad.

There are retaining walls planned around the east, south, southwest portion and northwest portion of the site. The walls are planned to be rock retaining and will be approximately 8 feet in height. In addition, portions of the existing slope along the east, south and southwest portions of the site will be rehabilitated. The existing storm drain along the east side to the west side of the property.

We understand that the grading will include adding fill on the eastern portion of the site up to the building pad, that will result in placement of approximately 9 to 10 feet of fill on the east end of the proposed building pad.

The site will include public improvements and parking lot as shown on the provided site/grading plan.

Additional details for the buildings and types of structures will likely be provided as the design proceeds.

STABILITY ANALYSES

Stability studies conducted in 2007 assumed that the soil and bedrock were wet. The strengths of the soil and bedrock were estimated by back calculating stability assuming a static factor of safety of 1.0 for the pre graded profile.

In 2021, AGEC was requested to evaluate the overall slope stability for proposed improvements to be located at the restaurant site and across Blackridge Drive to the west. A letter, addressed to Blackridge Development, LLC dated September 28, 2021, summarizes our the analysis and the results therefrom.

The soil and bedrock strength characteristics are included on the attached calculation sheets and summary calculation report.

A common factor of safety used in designing earth slopes and retainage systems within undisturbed ground conditions is 1.5. This value is used because of the uncertainty of the subsurface conditions.

Acceptable factors of safety for existing landslides is typically between 1.2 and 1.5.

Due to the large number of landslides in the state of Washington, the Washington State Highway Department assesses the stability of landslides. Their target factor of safety for landslide repairs is 1.25 (WSDOT Geotechnical Design Manual M46-03.08, October,2013).

Utah Department of Transportation accepts a safety factor of 1.3 for long-term static conditions for embankments and cut slopes located where failure or excessive deformation impacts adjacent bridges or critical facilities (Figure 12.1 – minimum acceptable factors of safety – global stability UDOT Geotechnical Manual of Instruction, September, 20217).

The stakeholders of this project may consider accepting factors of safety at or above 1.3 due to the following aspects of the analysis conducted.

a. The back calculated values are considered residual strengths which are the weakest strengths of the material. This approach significantly reduces the likelihood of lower values being experienced.

b. The laboratory strength test results of the weak layer materials are reasonably consistent with back calculated strength values. This increases our confidence that the values used in the analysis are representative.

c. The lack of hillside movement is a good indicator that the strength of the hillside is sufficient to prevent creep.

d. There could be an improvement in the stability of the slope if the development reduces the amount of water available to seep into the subgrade.

With the proposed grading along with the grading that has already been accomplished at the site and using the unsaturated strengths of the materials at the site above the water level and the saturated strengths below the water level result in a calculated factor safety of 1.3.

Using the same strengths and the seismic acceleration of 0.16g (which would reflect an event with a 2 percent probability of exceedance in 50 years). Results in a factor of safety of less than 1.0. Using these same parameters, we estimate that approximately 8 inches of movement would occur under a seismic event using unsaturated conditions.

CONSIDERATIONS

We anticipate that proper water management in conjunction with development should provide an opportunity for the strength of the slope to improvement and therefore, improve the stability of the slope. If the proposed improvements are constructed, we recommend that at least two inclinometers, two piezometers be installed and monitored over the lifetime of the facility. This would allow the stakeholders to know how the landslide mass is behaving. This would also allow steps to be taken if needed to improve the integrity of the slope.

LONG-TERM SLOPE RECOMMENDATIONS

The soil and bedrock strengths in the hillside need to remain similar to that used in this analysis in order to maintain the level of stability. This can be achieved by keeping the moisture conditions as they currently are and drier if possible.

There is also the opportunity to improve the existing conditions with strict adherence to the recommendations presented below.

Recommendations to maintain if not improve the current moisture conditions include:

a. Monitoring the landslide would be prudent to confirm that the acceptability of the approach being taken is providing the safety anticipated. Monitoring would also provide a warning if the conditions are changing.

b. Collect and remove surface drainage off the site in watertight storm drainage systems. This type of construction is not standard and therefore requires specific attention to verify that the improvements are watertight. This would also include not storing storm water on site without positive methods to eliminate and verify that water is not seeping into the subgrade.

c. Water ways should be lined to prevent seepage into the ground.

d. Positive measures need to be taken to eliminate the potential for water to ever pond on the site and on the hillside.

e. Eliminate as much as possible landscaping that requires irrigation.

f. Positive steps need to be taken with other improvements on the hillside and up on the bluff on the hillside the location of the restaurants, west of the restaurants and up on the bluff to help maintain the overall integrity of the slope.

FOUNDATIONS

AGEC understands that it is planned to support the restaurants on conventional spread and spot footing footings bearing on a properly prepared subgrade.

Based upon the proposed locations and preliminary plans, the estimates, at least 17 feet of properly compacted fill to reduce heave to within tolerable limits. Undocumented fill should also be removed the full depth.

FURTHER EVALUATION

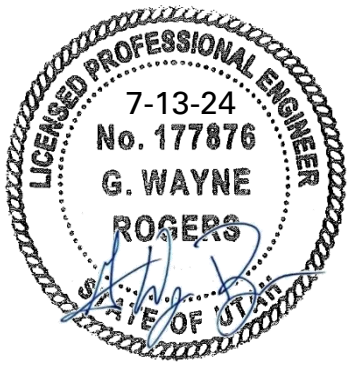
AGEC will provide further details that will include building foundation recommendations and detailed site grading recommendations including rockery wall details.

LIMITATIONS

This report has been prepared in accordance with generally accepted soil and foundation engineering practices in the area for the use of the client for design purposes. The conclusions and recommendations included within the report are based on the information obtained from the referenced documents that included field and laboratory testing. In addition, our conclusions and recommendations are based on our experience in the area. Variations in the subsurface conditions may not become evident until excavation is conducted. If the subsurface conditions are found to be significantly different from those described above, we should be notified to reevaluate our recommendations.

If you have any questions or if we can be of further service please call.

APPLIED GEOTECHNICAL ENGINEERING CONSULTANTS, INC.

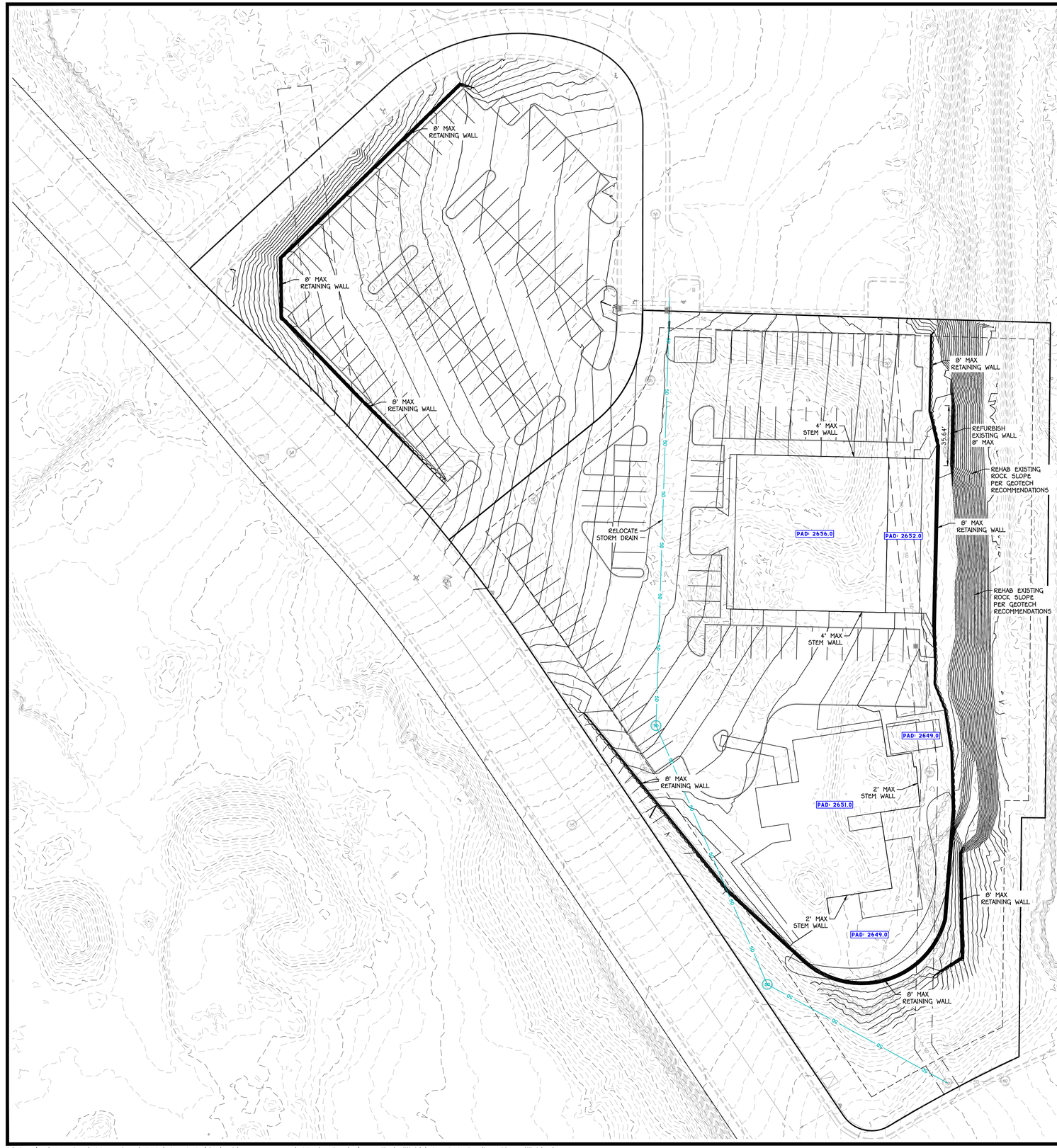


G. Wayne Rogers, P.E.

James E. Nordquist, P.E.

P:\2024 Project Files\2240600\2240674 - GT Black Ridge Restaurants\AGEC Hillside Report- Blackridge Restaurants #2240674.docx

SITE/GRADING PLAN



0 30' 60'

SCALE: 1" = 30'

Blue Stakes of UTAH811 Bluestakes.org

Call Before You Dig!

GRADING PLAN NOTES:

1. THE CONTRACTOR SHALL PROVIDE APPROPRIATE EQUIPMENT TO CONTROL DUST AND AIR POLLUTION CAUSED BY CONSTRUCTION OPERATIONS. THE CONTRACTOR SHALL ALSO PROVIDE APPROPRIATE MUD AND DIRT CONTAINMENT TO MAINTAIN THE WORK SITE, ACCESS ROADWAYS, AND ADJACENT PROPERTIES IN A CLEAN CONDITION.
2. ALL EXCAVATION AND GRADING SHALL BE IN ACCORDANCE WITH CITY STANDARDS AND SPECIFICATIONS ALONG WITH APPENDIX J STANDARDS OF THE INTERNATIONAL BUILDING CODE 2018 EDITION OR NEWER AS ADOPTED BY THE STATE OF UTAH AND CITY.
3. CONTRACTOR TO NOTIFY ENGINEER IMMEDIATELY IF THERE ARE ANY CONFLICTS BETWEEN THE REQUIREMENTS OF THE PLANS AND GEOTECHNICAL REPORT AND/OR GEOTECHNICAL FIELD OBSERVATIONS.
4. GEOTECHNICAL ENGINEER TO PROVIDE GRADING COMPLETION REPORT TO CONFRIM THAT WORK HAS BEEN PERFORMED IN CONFORMANCE WITH GEOTECHNICAL RECOMMENDATIONS.
5. RETAINING WALLS GREATER THAN 3' IN HEIGHT REQUIRE A PERMIT FROM THE CITY BUILDING DEPARTMENT. ALL ROCK RETAINING WALLS MUST BE CERTIFIED AND INSPECTED BY THE GEOTECHNICAL ENGINEER PRIOR TO THE CITY'S FINAL ACCEPTANCE.
6. IT IS THE PROPERTY OWNER'S RESPONSIBILITY (DEVELOPER, HOMEOWNER, HOA, ETC.) TO COMPLETE AND MAINTAIN THE FINAL GRADING ON THEIR PROPESTY IN ACCORDANCE WITH THE GRADING AND DRAINAGE PLAN ALONG WITH ALL RECOMMENDATIONS FROM THE GEOTECHNICAL ENGINEER. THE PROPERTY OWNER IS RESPONSIBLE IN PERPETUITY, FOR INSPECTING AND MAINTAINING PROPER DRAINAGE FOR THEIR PROPERTY.
7. ALL STORM DRAIN PIPE LENGTHS ARE GIVEN FROM AND TO THE CENTER OF EACH STRUCTURE. CONTRACTOR SHALL VERIFY THE ACTUAL LENGTHS REQUIRED PRIOR TO ORDERING PIPE MATERIALS.

NOTICE TO CONTRACTORS:

ENGINEER CAN NOT GUARANTEE THE ACCURACY OF THE EXISTING UNDERGROUND UTILITIES DEPICTED IN THESE PLANS. LOCATIONS SHOWN FOR ALL EXISTING UNDERGROUND UTILITIES IS BASED ON EXTERNAL INFORMATION FROM GIS MAPPING, PREVIOUS AS-BUILT RECORD DRAWINGS, BLUE STAKES SURFACE MARKINGS IN THE FIELD, OR COMBINATION THEREOF. THE ENGINEER HAS MADE EVERY EFFORT TO ACCURATELY DEPICT THE LOCATIONS OF EXISTING UNDERGROUND UTILITIES, HOWEVER, IT IS THE CONTRACTOR'S RESPONSIBILITY TO CONTACT BLUE STAKES OF UTAH AT LEAST TWO (2) BUSINESS DAYS PRIOR TO COMMENCING WITH EXCAVATION TO VERIFY BOTH HORIZONTAL AND VERTICAL LOCATIONS OF ALL UTILITIES. CONTRACTOR ALSO REQUIRED TO TAKE ALL NECESSARY PRECAUTIONS TO PROTECT ALL EXISTING UNDERGROUND UTILITIES BOTH SHOWN, AND NOT SHOWN, IN THESE PLANS. IF ANY UTILITY LOCATION DISCREPANCIES ARE FOUND IN THE FIELD, CONTRACTOR SHOULD NOTIFY THE ENGINEER IMMEDIATELY.

EARTHWORK QUANTITIES:

EARTHWORK QUANTITIES PROVIDED BELOW ARE APPROXIMATED BASED ON COMPARISON OF EXISTING GROUND AND FINISH GROUND SURFACE DATA USING A (SHRINK/SWELL) FACTOR OF X.XX. QUANTITIES SHOWN DO NOT ACCOUNT FOR ADDITIONAL CUT/FILL GENERATED BY BACKOUT VOLUMES FROM PAVEMENT SECTIONS, SIDEWALKS, FOOTINGS/FOUNDATIONS, CURB AND GUTTER, ETC. CONTRACTOR RESPONSIBLE TO INDEPENDENTLY VERIFY ALL EARTHWORK QUANTITIES REQUIRED TO COMPLETE CONSTRUCTION.

XXX,XXX CU. YDS. CUT
XXX,XXX CU. YDS. FILL
X,XXX CU. YDS. (CUT/FILL)

KEY NOTES:

		DETAIL
00	SIDEWALK DRAINAGE STRUCTURE	204

LEGEND:

	DETAIL
PROPOSED PARCEL BOUNDARY	
EXISTING/ADJACENT PARCEL BOUNDARY	
PROPOSED CENTERLINE ALIGNMENT	
EXISTING CENTERLINE ALIGNMENT	
PHASE LINE	
SHEET MATCH LINE	
PROPOSED RETAINING WALL	
EXISTING RETAINING WALL	
PROPOSED ROCK RETAINING WALL	
EXISTING ROCK RETAINING WALL	
GRADING LIMITS OF DISTURBANCE	
3000 EXISTING GROUND MAJOR CONTOUR	
3001 EXISTING GROUND MINOR CONTOUR	
3000 FINISH GROUND MAJOR CONTOUR	
3001 FINISH GROUND MINOR CONTOUR	
50 PROPOSED STORM PIPE (SIZE PER PLAN)	
50 EXISTING STORM PIPE (SIZE PER PLAN)	
CURB INLET SINGLE CATCH BASIN	205
CURB INLET DOUBLE CATCH BASIN	206
STANDARD STORM DRAIN MANHOLE	220
FLARED END SECTION	
GRATE INLET AREA DRAIN BOX	
PROPOSED DRAINAGE SWALE/DITCH (SEE SECTIONS)	
EXISTING DRAINAGE SWALE/DITCH	

REV.	DATE:	REVISION

PRELIMINARY
NOT FOR
CONSTRUCTION

AMERICAN CONSULTING & ENGINEERING
1173 S. 250 W. #504 ST. GEORGE, UT 84770

DATE:	07/03/2024
JOB #:	24-013
DRAWN BY:	SSA
CHECKED BY:	ARC

BLACK RIDGE RESTAURANTS
SECTION 36 TOWNSHIP 42 S, RANGE 16 W SLB&M
ST.GEORGE, UTAH

GRADING PLAN
HILLSIDE

H.4.1

SHEET: 4 of 5

C:\Dropbox\American\03 projects\2024\24-013 black ridge restaurants\03 drawings\sheet files\Hillside\24-013 Grading Plan Hillside.dwg

EXHIBIT I

2019 AGEC Slope Stability Report

AGEC
Applied GeoTech

September 23, 2019

Blackridge Development, LLC
2001 Park Avenue
Park City, Utah 84060

Attention: Glen Overton
EMAIL: glenaoverton@gmail.com

Subject: Slope Stability Consultation
Blackstone Hotel Project
250 West Blackridge Drive
St. George, Utah
Project No. 2180187

Gentlemen:

Applied Geotechnical Engineering Consultants, Inc. was requested to conduct additional geotechnical analyses on the stability of the hillside upon which the Blackstone Hotel is proposed to be constructed. A geotechnical investigation for the proposed hotel, located at 250 West Blackridge Drive in St. George, was conducted and the findings and recommendations were presented in a report dated December 14, 2018 under Project No. 2180187.

The report indicates that the site is located on an ancient landslide deposit, which has the potential, if environmental conditions change, for landslide movement. The initial analysis conducted during the original study assumes that the hillside is wet, reflecting a most adverse moisture condition. The factor of safety against landslide movement, using the saturated material strengths, does not meet minimum standards.

AGEC has been requested to conduct further analysis to estimate the stability of the slope using a moisture condition that reflects the groundwater and seepage conditions anticipated during the life of the facility.

I. BACKGROUND

The geotechnical report provided the following comments with regards to the hillside stability.

A. Landslide Deposit

"The site for the proposed hotel is located above the toe of a 300-foot high slope. The lower two-thirds of the slope has been mapped as a landslide deposit. The ground surface of the landslide deposit slopes on average of approximately 8.2 horizontal to 1 vertical. The landslide deposit extends up to a depth of 83 feet below the existing ground surface at the site.

B. Slope Movement

"In order to determine if movement is occurring on the slope, five inclinometers were installed in 2007 on the east slope of Blackridge extending to depths of 92 to 250 feet. Four of the five indicate that there has been no movement since 2007. Ground movement was measured at multiple depths in the inclinometer installed immediately west of the vacant restaurant located at 1090 South Bluff Street prior to 2011.

With the lack of measured movement in the four inclinometers over the past 10½ years, along with the lack of surficial evidence of movement, it is apparent that the portion of the slope for this project is currently maintaining its stability."

C. Earlier Stability Analysis

1. The calculated static factor of safety using saturated material strengths in the slope and the existing configuration is near 1.1.

2. Changes in the internal conditions and the surficial geometry modifications may improve or reduce the ability of the slope to maintain its stability.

3. We anticipate that it is a matter of time before movement, somewhere on the east slope, occurs. Determining a location and/or timing of such an event is not possible with the information currently available.

D. Possible Impact of Current Conditions

Assuming that strength characteristics of the soil and bedrock in the hillside behave as unsaturated materials the stability of the slope is estimated to increase approximately 30 percent.

II. CURRENT STUDY

In order to model the slope with unsaturated conditions in the hillside, AGEC was requested to conduct additional testing and analyses in order to further understand the characteristics of unsaturated, on-site soil and bedrock. Unsaturated conditions would likely result in higher sod/bedrock strengths than were used in our original analysis.

In order to develop this additional understanding, samples of soil (weathered bedrock) from the hillside were obtained and tested in the laboratory to define the index properties and to measure strength characteristics with different moisture contents. Stability analyses have been conducted using this additional information.

A. Existing Moisture Conditions

Based on laboratory testing on soil and bedrock samples obtained in the hillside, the following moisture contents, dry densities and relative degree of saturation have been obtained.

Characteristic	Range		Average
	Low	High	
Moisture Content (%)	2	27	12.8
Dry Density (pcf)	88	146	111.2
Degree of Saturation (%)	10	100	65.6

The upper 10 feet has a wide range of moisture contents, likely due to the samples being obtained during differing times of the year. The moisture content trends from a depth of 10 at approximately 10% and increases to approximately 15% with depth.

B. Laboratory Testing

The predominant material in the hillside is mudstone. Disturbed, weathered samples of the mudstone were obtained for testing. The samples obtained have distinct colors of “blue”, “red”, and “gray”. A fourth sample, obtained from between basalt blocks in the debris portion of the landslide deposit was also obtained. These colors were used to identify the samples tested.

1. Index Properties

The disturb bulk samples were tested in the laboratory to determine their index properties. Listed below is a table summarizing the test results.

Index Property	Blue Clay	Red Clay	Gray Clay	Debris Clay
Moisture Content (%)	9.1	5.3	3.3	1.3
Grain-size Distribution				
+ #4 sieve (%) (gravel size)	0	0	0	17
- #4, + #200 sieves (%) (sand size)	33	21	6	31
- #200 sieve (%) (silt and clay size)	67	79	94	52
Atterberg Limits				
Liquid Limit (%)	55	46	47	38
Plasticity Index (%)	31	24	26	12
Moisture/density Relationship (standard Proctor)				
Maximum Dry Density (pcf)	98.0	104.5	104.2	108.2
Optimum Moisture Content (%)	22.0	17.6	19.2	15.1
Specific Gravity	2.64	2.64	2.71	2.65

These test results are projected on Figure 1-4.

2. Strength Testing

Testing for this study was conducted on disturbed samples that were remolded prior to strength testing. Testing included using the triaxial shear apparatus and the direct shear apparatus.

After reviewing the index properties of the four samples obtained, it was decided to focus the testing on the two mudstone sample colors which represent the predominant materials in the hillside. We therefore proceeded to conduct the testing using blue and red clay.

a. Fully Softened Strength

Samples of the blue and red clay were remolded at 38 and 36 percent moisture with densities of 73 and 84 pounds per cubic foot (pcf), respectively. The remolded moisture contents are 16 and 18.4 percent above the soil's optimum moisture contents and the remolded densities are approximately 74 and 80 percent compaction. Once the samples were remolded, they were placed in a triaxial shear apparatus and consolidated under a confining pressures of 2, 6 and 10 kips per square foot (ksf). The consolidated samples were then sheared with pore pressure measurements. Test results are presented on Figures 8 through 13 and the table below.

b. Unsaturated Strengths

Samples of the blue and red clay were also remolded at moisture contents between 12 and 24 percent with densities near 95 or 103.5 pcf (97 to 99 percent compaction) and tested in consolidated, undrained tests with confining pressures of 2, 6 and 10 ksf. The test results are included on Figures 7 through 12 and summarized in the table below.

c. Pre-sheared strength

Samples of the two materials were remolded at 10 and 13 percent moisture with densities of 95 and 101 pcf (97 percent compaction) and placed in a shear testing apparatus. The samples were then sheared and then reset and sheared at 2, 6 and 10 ksf normal load. The tests were conducted at an undrained shear rate. Test results are presented on Figures 14 and 15 and the table below.

d. Test Results

Listed below is a table summarizing the results of the tests conducted.

Blue Clay Strength Test Results

Moisture Content (%)	Dry Density (pcf)	Φ (°)	c (ksf)	Test Type
13.0	95.0	23.8	0.7	Direct Shear, pre-sheared with no water added
14.4	95.5	18.5	2.6	Triaxial, unsaturated
19.6	94.6	9.9	3.4	Triaxial, unsaturated
23.8	94.9	7.3	2.7	Triaxial, unsaturated
38.0	73.0	23.0	0.2	Triaxial, saturated

Red Clay Strength Test Results

Moisture Content (%)	Dry Density (pcf)	Φ (°)	c (ksf)	Test Type
10.0	101.0	14.5	0.9	Direct Shear, pre-sheared with no water added
12.6	103.5	20.1	2.2	Triaxial, unsaturated
14.9	102.0	16.2	3.3	Triaxial, unsaturated
17.9	105.1	12.7	3.3	Triaxial, unsaturated
36.0	84.0	24.0	0	Triaxial, saturated

C. Stability Model

1. Surface Conditions

The model of the hillside used in this analysis include the following characteristics.

Characteristics	Value
Top Elevation (feet)	2893
Toe Elevation (feet)	2593
Slope Height (feet)	301
Upper Intact Slope (Horizontal to Vertical)	1.2:1 (upper 100')
Mid- Landslide Slope (Horizontal to Vertical)	7.8:1 (middle 130')
Lower Landslide Slope (Horizontal to Vertical)	5.4:1 (lower 60')
Average overall Slope (Horizontal to Vertical)	4.4:1

2. Subsurface Profile

A subsurface profile has been developed from the deep borings drilled during earlier studies, geologic maps along with the results of the this and earlier analyses. The first figure of each stability condition (in the appendix) presents the profile used for our analysis.

The upper portion of the hillside consists of a basalt cap. It is estimated that the cap is from 20 to 30 feet thick.

The mudstone (referred to as "parent" material) in the slope extends from the basalt cap, down to sandstone.

The bedrock in the area dips down to the north east. The interface between the mudstone and the sandstone dips down to the east at 7.6 degrees.

Based on our prior studies and evaluation of other landslide events in the area, there is a weak plane within the mudstone deposit. Measurements obtained by us and others indicate that this weak plane dips at approximately 8 to 9 degrees towards the northeast. With this orientation, the weak plane has been modeled dipping down towards the east, following the slope at an angle of 5 to 10 degrees.

Also based on the subsurface conditions encountered during our earlier studies, we have estimated the thickness of the landslide to be up to approximately 125 feet thick.

3. Water & Moisture Conditions

Ground water has been measured in the deep borings drilled on the slope. Using this information, along with the water level measures obtained during this study, a groundwater elevation of 2605 feet (approximately 288 feet below the bluff) dropping down to elevation 2586 feet (approximately 6 feet below grade) near the toe of the slope was used in the model.

For the unsaturated model, the moisture contents measured in the borings were used with the water content characteristic curves (Figure 5) determined in the laboratory in order to estimate a suction profile below the ground surface down to the ground water level.

Using the values obtained along with the moisture contents of samples measured in this hillside, we have estimated two potential suction profiles with depth. These profiles are presented below.

Landslide Deposit

Depth for the ground surface (feet)	Suction (ksf)	(pF)
0 to 30	13.0	4.4
30 to 60	26.5	3.4
60 to 90	19.0	3.8
90 to 120	11.0	4.9
120 to 150 or to the water level	5.0	6.2

Natural, Undisturbed Hillside

Depth for the ground surface (feet)	Suction (ksf)	(pF)
0 to 50	14.0	4.3
50 to 100	33.0	3.2
100 to 150	21.0	3.6
150 to 200	11.0	4.9
200 to water level or to the water level	5.0	6.2

The suction value used in the analysis was based on the depth below the ground surface to the ground water level.

4. Material Strengths

a. Saturated Strengths

The stability analysis conducted for our 2018 report, was based on saturated soil strengths. Listed below is a table summarizing the strengths used in that study.

Material	Unit Weight (psf)	Φ (°)	c (psf)
Landslide	125	15	200
Parent	125	28	535
Parent Weak Plane	125	8.5	0
Sandstone	125	44	3,000
Basalt	165	45	30,000

b. Unsaturated Strengths

The unsaturated strength of the on-site material (soil / weathered bedrock) was investigated by remolding the two soil samples at different moisture contents, compressing the samples and then shearing the samples in a triaxial shear apparatus. The testing allowed us to estimate the anticipated increase in soil strength as the moisture content decreases.

The literature indicates that this increase in strength can be modeled as a friction angle used in conjunction with the soil suction presented earlier. This friction angle is indicated to be less than the normal friction angle, often times is around 0.6 times the normal friction angle and has been measured to be on the order of 17 degrees for the type of material on this site. With these considerations and the test results, we have selected a 7 degree angle for the unsaturated aspect of the materials on site for the landslide and parent materials. We have selected a value of 4.5 degrees to use along the weak plane of the undisturbed deposits.

D. Results

The stability of the hillside was evaluated assuming a number of conditions using the profile, strength and pore water pressures described above. The original profile stability was verified using saturated soil strengths for what we anticipate the original profile was before significant grading occurred on the site. A static safety factor of 1.0 was obtained using the existing water level and saturated soil strengths.

With the grading that has occurred (removal of material upslope from the hotel site and placement on the hotel site) has resulted in an increase of factor of safety to approximately 1.1.

Using the proposed grading of the hotel site, the unsaturated strengths of the materials at the site above the water level and the saturated strengths below the water level, results in a calculated factor of safety of 1.4.

Our analysis also indicates that in order to increase the factor of safety for the hotel site to 1.5, reinforcement could be placed at the toe of the slope, along the east side of the site. We envision this reinforcement would consist in drilled concrete piers. Preliminary estimates indicate that piers drilled to a depth of approximately 105 feet with sufficient strength could increase the factor of safety to 1.5. Preliminary calculations indicate that 2½ foot diameter piers, spaced at approximately 15 feet (center-to-center), would provide the estimated reinforcement. The design of the reinforcement needs to be verified during design of the facility.

Using the same strengths (including reinforcement) and a seismic acceleration of 0.16g (which would reflect an event with a 2% probability of accedence in 50 years) results in a safety factor of less than 1.0. Using these same parameters, we estimate that approximately 4 inches of movement would occur under a major seismic event using the unsaturated conditions.

We recommend that the design of the hotel include slope reinforcement along with the retaining wall proposed for the east side of the development.

III. LONG-TERM RECOMMENDATIONS

The soil and bedrock strengths in the hillside need to remain similar to that used in this analysis in order to maintain the desired level of stability. This can be achieved by keeping the moisture conditions as they currently are.

Recommendations to maintain the current moisture conditions are included in our 2018 report. The recommendations include:

A. Collect and remove surface drainage off the site in water tight storm drainage systems. This type of construction is not standard and therefore, would require specific attention to verify that the improvements are water tight. This would also include not storing storm water onsite without positive methods to eliminate and verify that water is not seeping into the subgrade.

B. Water ways should be lined to prevent seepage into the ground.

C. Positive measures need to be taken to eliminate the potential for water to ever pond on the site and on the hillside.

D. Eliminate, as much as possible, landscaping that requires irrigation.

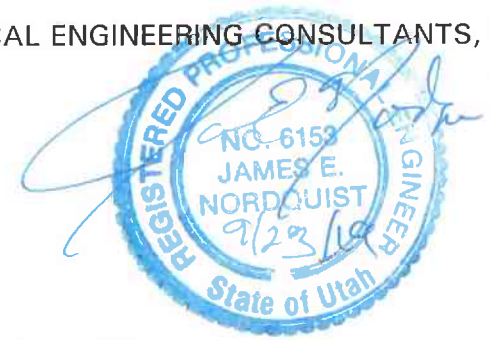
E. Positive steps need to be taken with other improvements on the hillside and up on the bluff to help maintain the overall integrity of the slope.

IV. LIMITATIONS

This letter has been prepared in accordance with generally accepted soil and foundation engineering practices in the area for the use of the client. The conclusions and recommendations included in the letter are based on conditions defined by our earlier studies and the testing conducted during this study. Variations in the subsurface conditions may not become evident until additional exploration or excavation is conducted. If the subsurface and/or surface drainage or proposed construction is found to be significantly different from what is described in this letter, we should be notified to reevaluate the recommendations given.

Sincerely,

APPLIED GEOTECHNICAL ENGINEERING CONSULTANTS, INC.



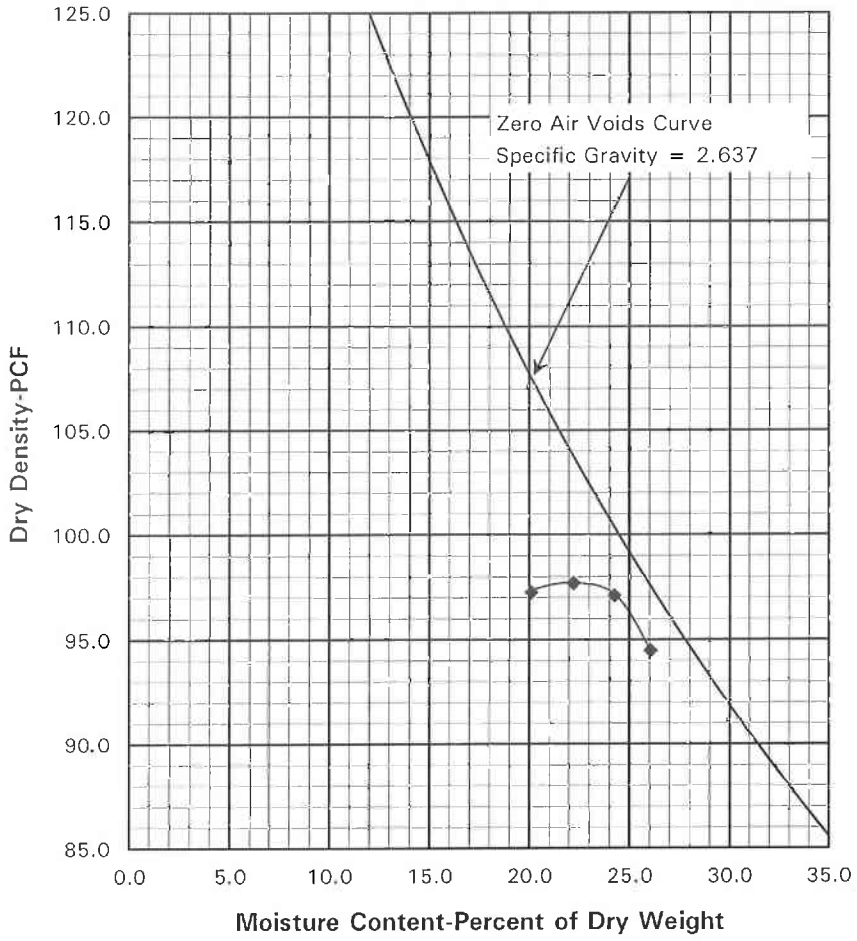
James E. Nordquist, P.E., D. G.E.

Reviewed by AD, P.E.
JEN/rs

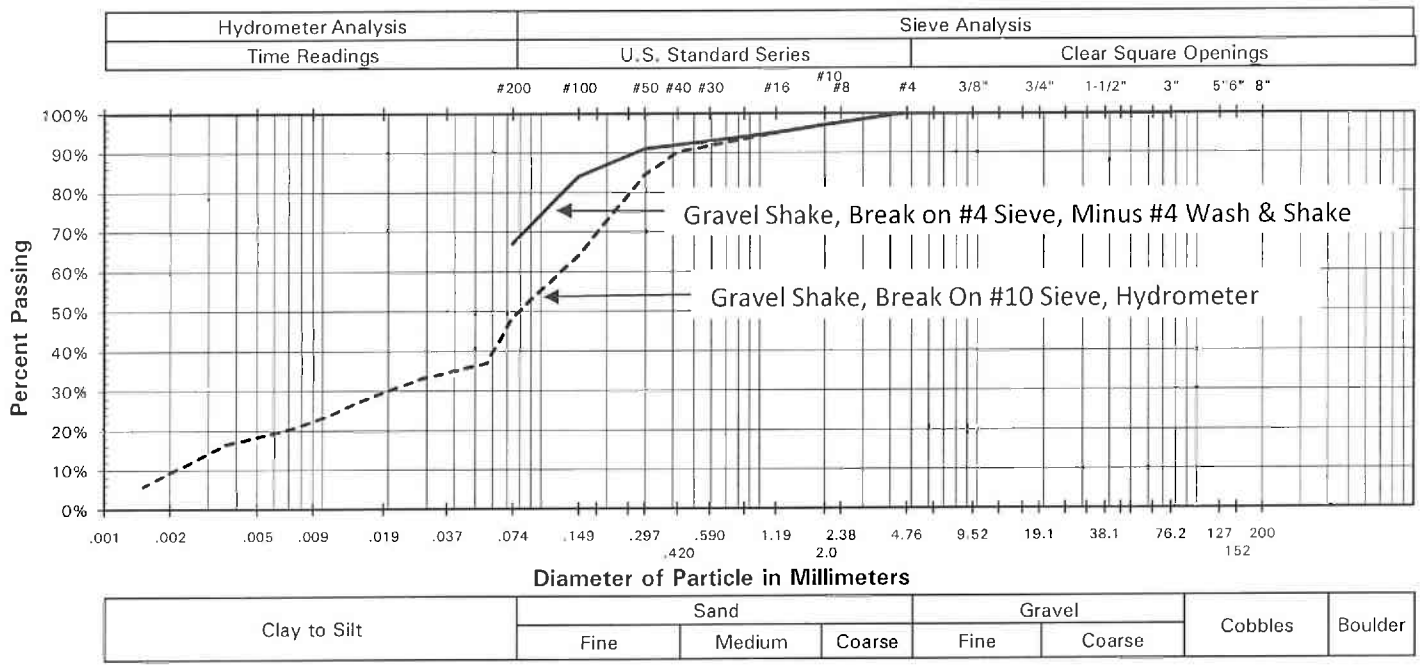
Enclosures

cc: Tyler Hoskins, EMAIL: tylerhoskins69@gmail.com

APPLIED GEOTECHNICAL ENGINEERING CONSULTANTS, Inc.



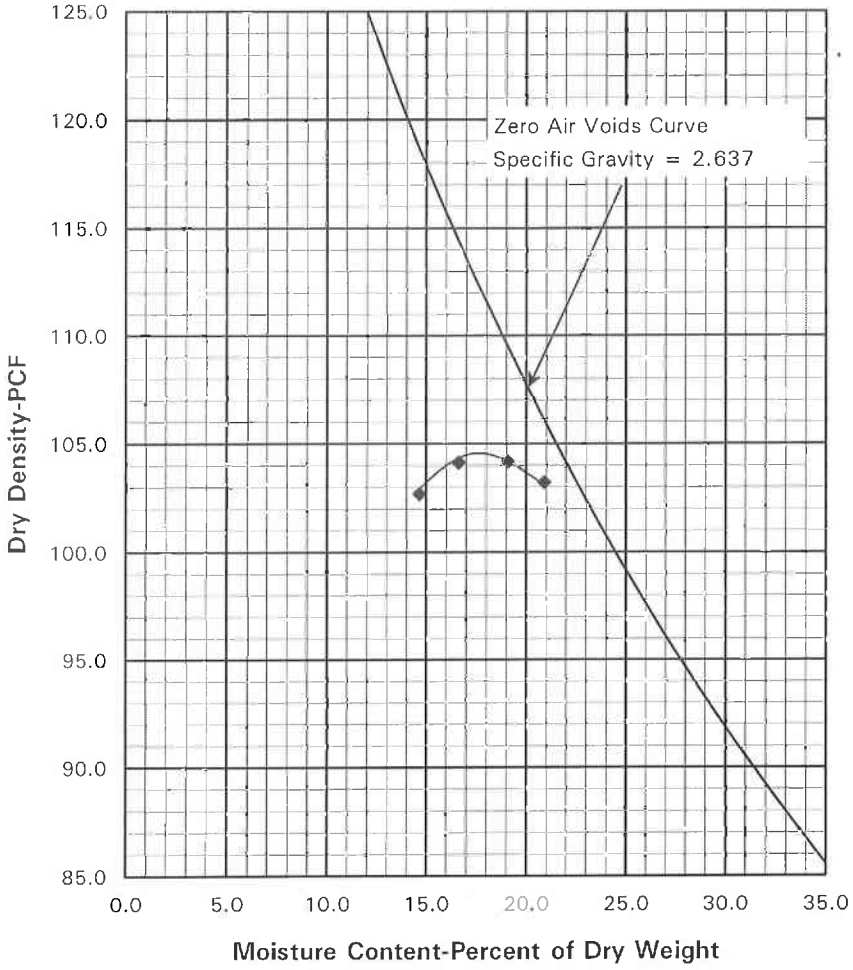
Project	Blackridge Hotel
Project No.	2180187
Sample No.	16527
Maximum Dry Density	97.7 pcf
Optimum Moisture	22.2%
Atterberg Limits	
Liquid Limit	55
Plasticity Index	31
Gradation	
Gravel	0%
Sand	33%
Silt & Clay	67%
Reviewed By:	KBB
Test Procedure:	ASTM D698 A
Sample Location:	Blue Clay
Soil Description:	Sandy Fat Clay
Date Sampled	-
Sampled By	AGEC
Date Tested	08/13/19
Tested By	AGEC



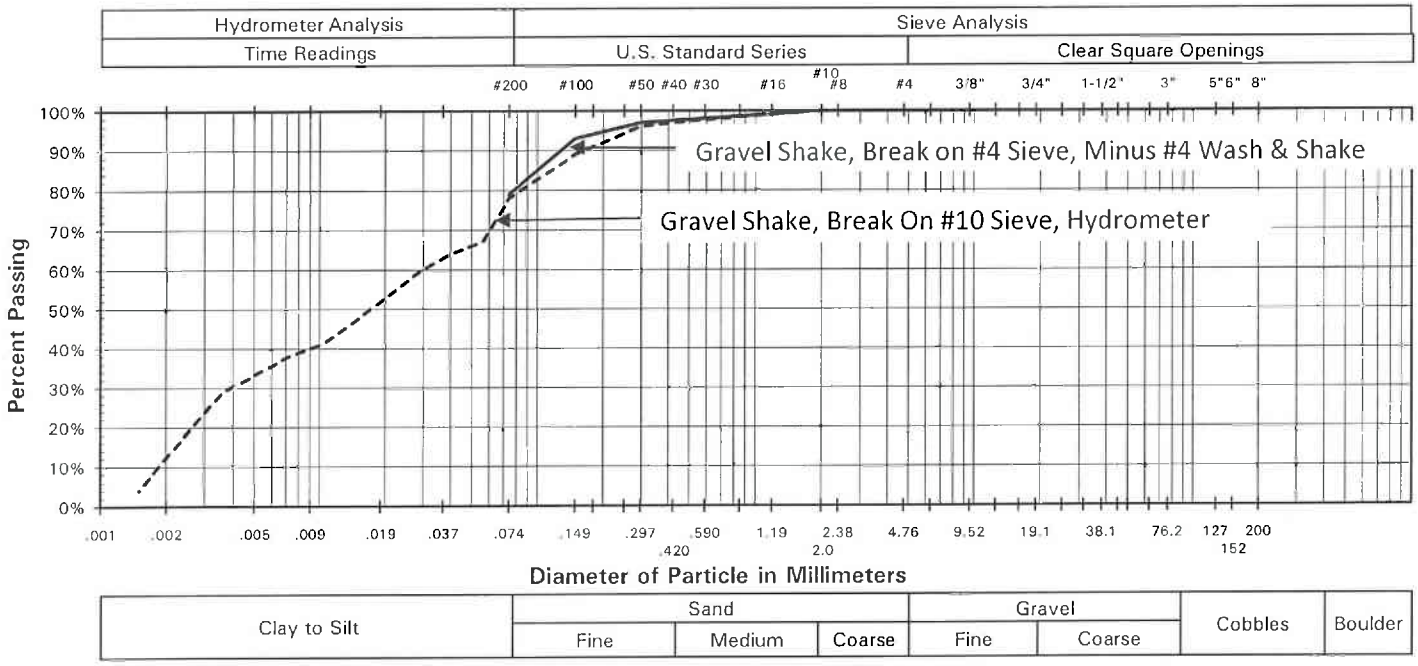
GRADATION & MOISTURE-DENSITY RELATIONSHIP

Figure 1

APPLIED GEOTECHNICAL ENGINEERING CONSULTANTS, Inc.



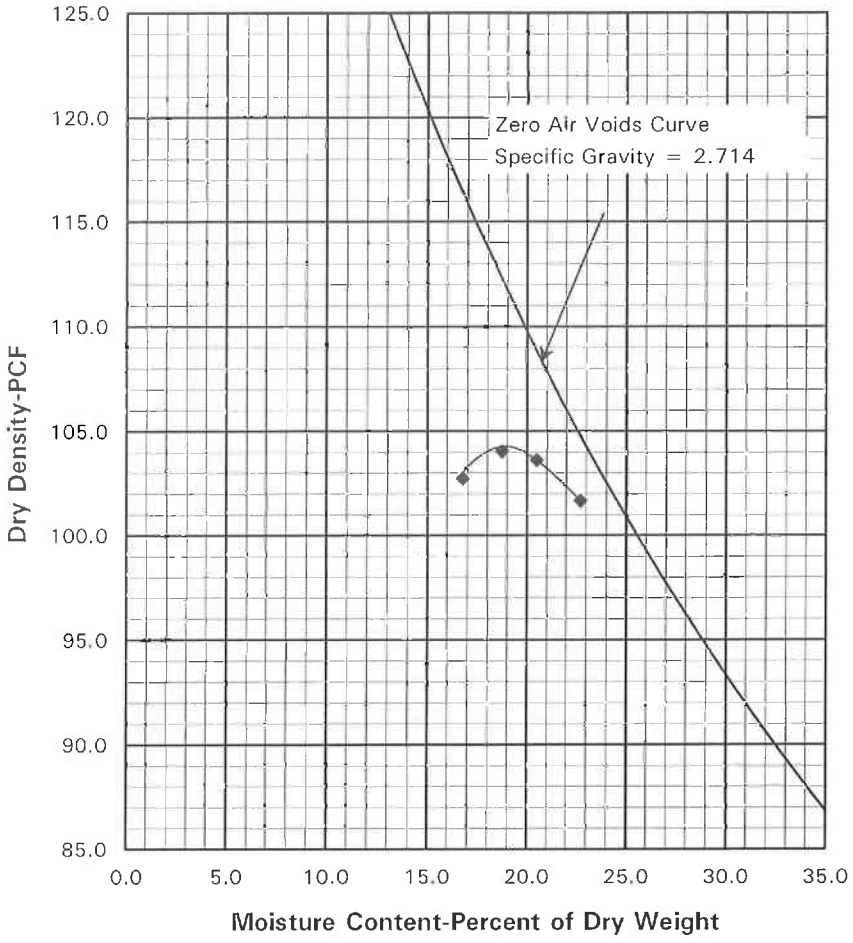
Project	Blackridge Hotel
Project No.	2180187
Sample No.	16528
Maximum Dry Density	104.5 pcf
Optimum Moisture	17.6%
Atterberg Limits	
Liquid Limit	46
Plasticity Index	24
Gradation	
Gravel	0%
Sand	21%
Silt & Clay	79%
Reviewed By:	KBB
Test Procedure:	ASTM D698 A
Sample Location:	Red Clay
Soil Description:	Lean Clay with Sand
Date Sampled	-
Sampled By	AGEC
Date Tested	08/13/19
Tested By	AGEC



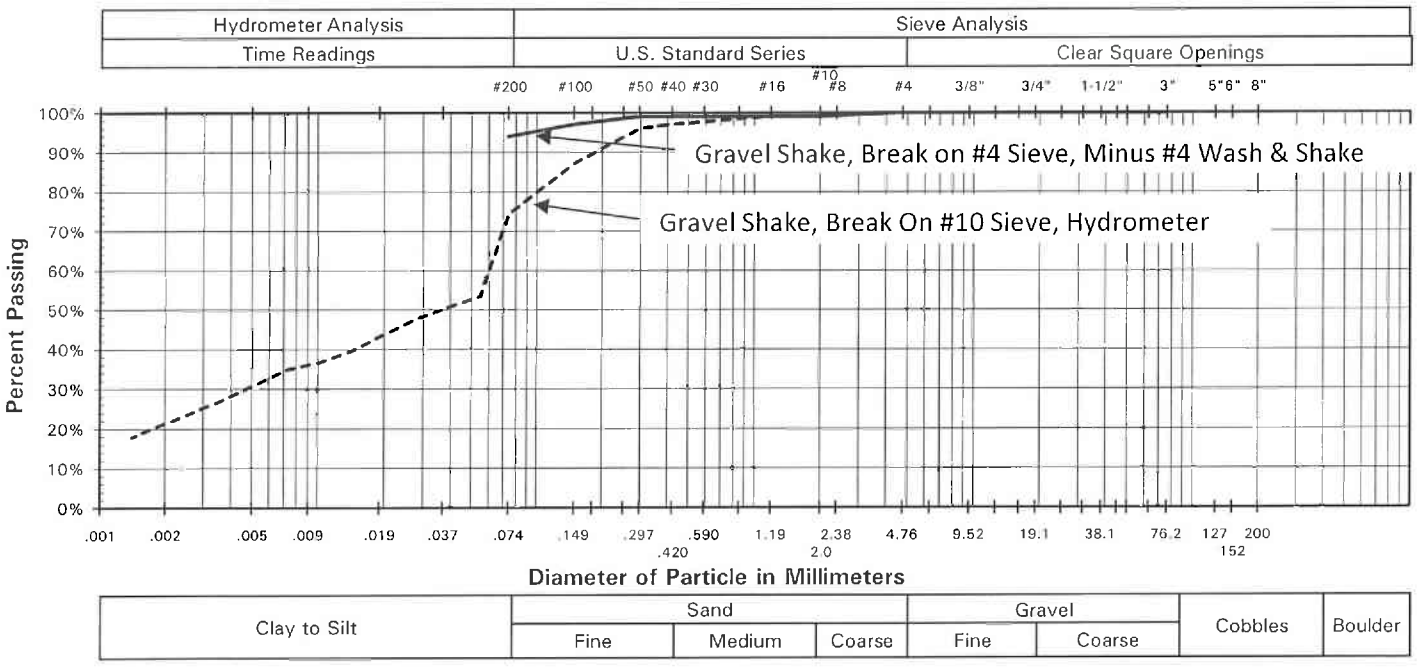
GRADATION & MOISTURE-DENSITY RELATIONSHIP

Figure 2

APPLIED GEOTECHNICAL ENGINEERING CONSULTANTS, Inc.



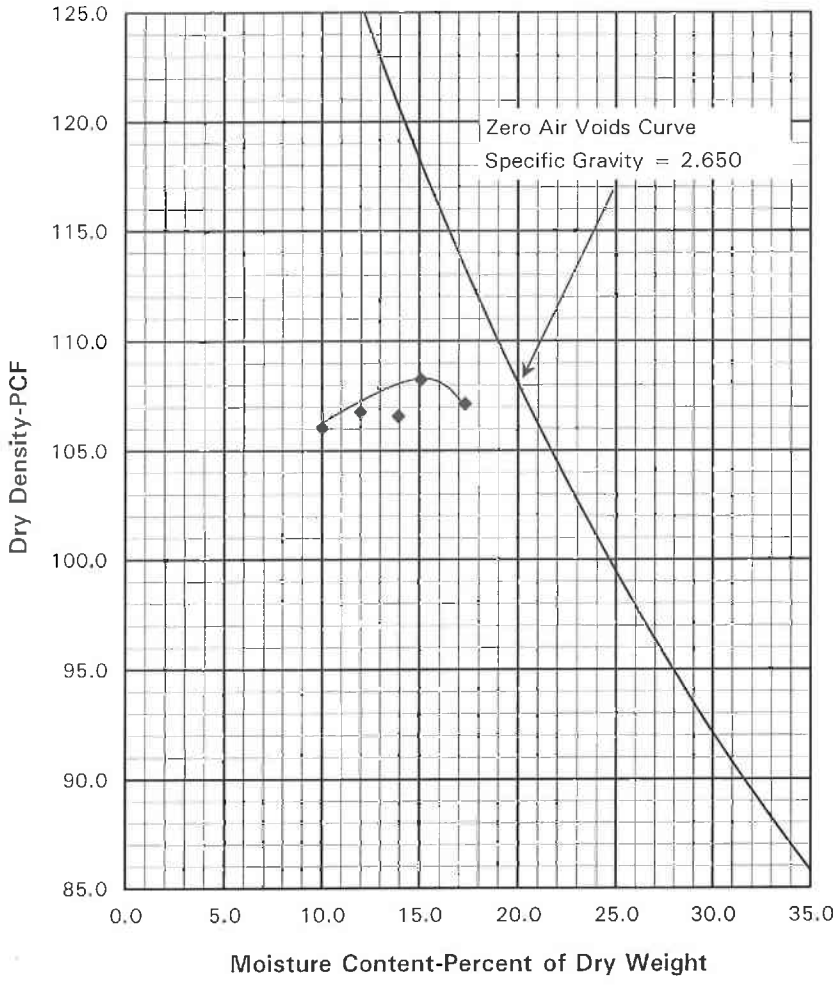
Project	Blackridge Hotel
Project No.	2180187
Sample No.	16529
Maximum Dry Density	104.2 pcf
Optimum Moisture	19.2%
Atterberg Limits	
Liquid Limit	47
Plasticity Index	26
Gradation	
Gravel	0%
Sand	6%
Silt & Clay	94%
Reviewed By:	KBB
Test Procedure:	ASTM D698 A
Sample Location:	Gray Clay
Soil Description:	Lean Clay
Date Sampled	-
Sampled By	AGEC
Date Tested	08/13/19
Tested By	AGEC



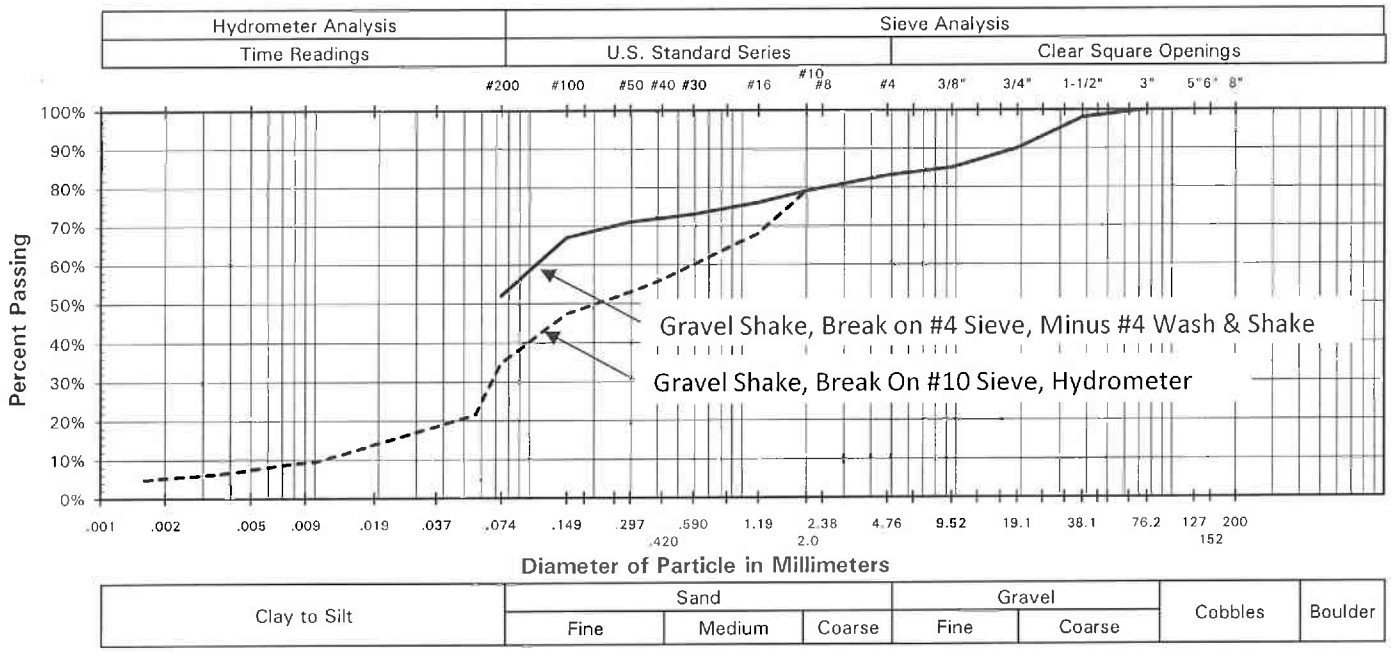
GRADATION & MOISTURE-DENSITY RELATIONSHIP

Figure 3

APPLIED GEOTECHNICAL ENGINEERING CONSULTANTS, Inc.



Project	Blackridge Hotel
Project No.	2180187
Sample No.	16530
Maximum Dry Density	108.2 pcf
Optimum Moisture	15.1%
Atterberg Limits	
Liquid Limit	38
Plasticity Index	12
Gradation	
Gravel	17%
Sand	31%
Silt & Clay	52%
Reviewed By:	KBB
Test Procedure:	ASTM D698 C
Sample Location:	Debris
Soil Description:	Sandy Lean Clay with Gravel
Date Sampled	-
Sampled By	AGEC
Date Tested	08/13/19
Tested By	AGEC



GRADATION & MOISTURE-DENSITY RELATIONSHIP

Figure 4

APPLIED GEOTECHNICAL ENGINEERING CONSULTANTS, Inc.

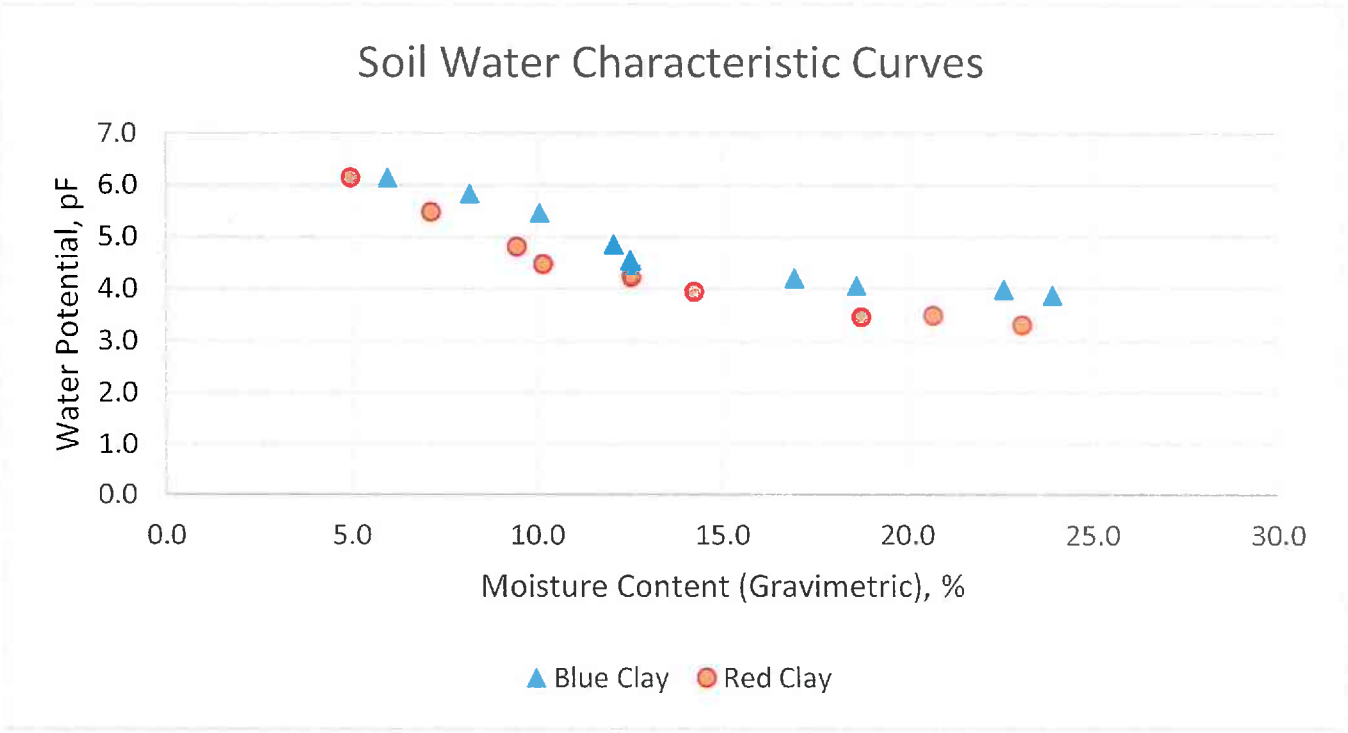
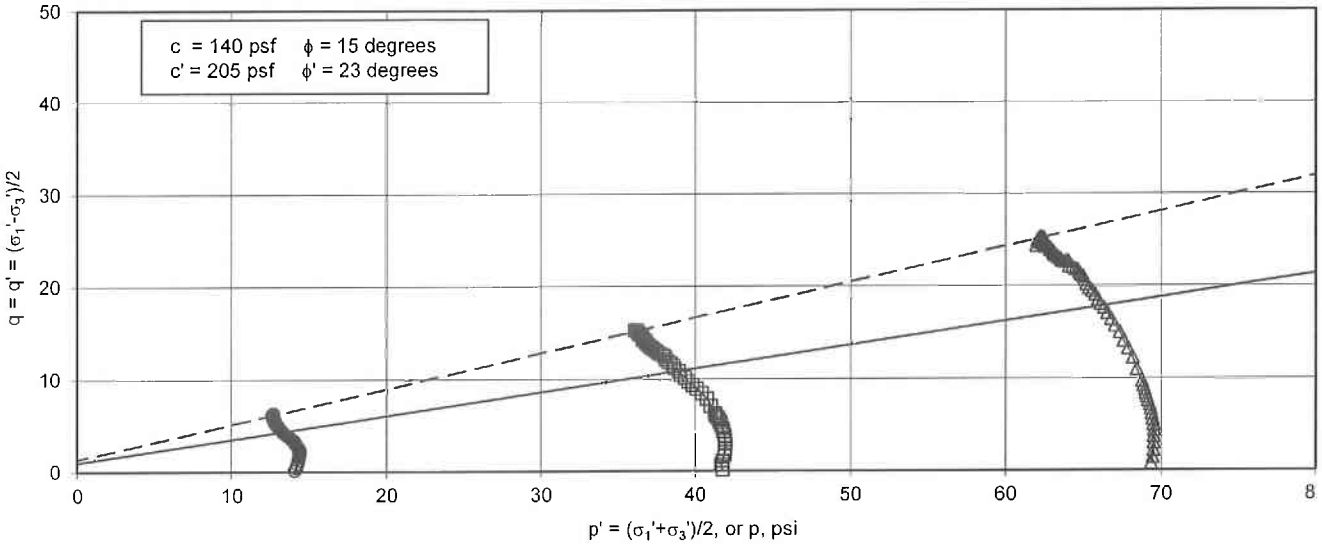
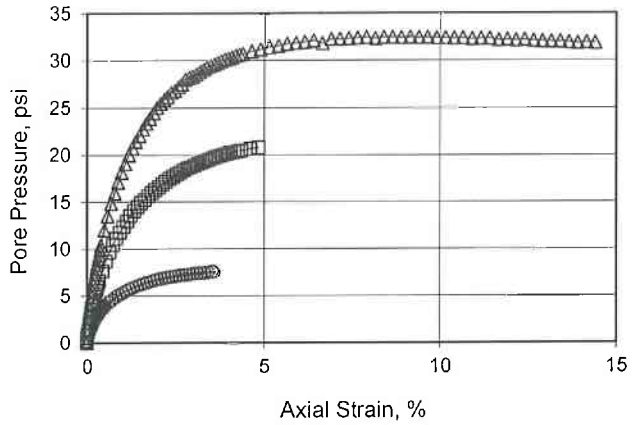
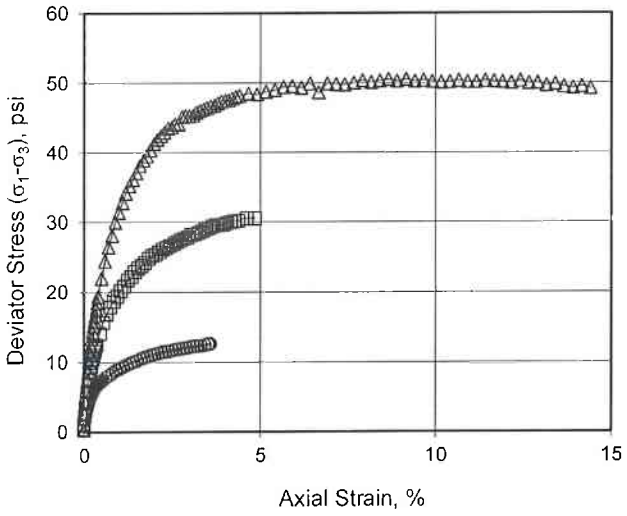


Figure 5

Applied Geotechnical Engineering Consultants, Inc.







Test No. (Symbol)	O	□	△
Sample Type	Remolded		
Length, in.	4.03	3.81	3.25
Diameter, in.	1.93	NM	NM
Dry Density, pcf	73	NM	NM
Moisture Content, %	38	NM	NM
Consolidation Pressure, psi	13.9	41.6	69.4
"B" Parameter	99	NA	NA
Total Confining Stress (σ_3), psi	13.9	41.6	69.4
Total Axial Stress (σ_1), psi	26.1	72.3	119.5
Deviator Stress (σ_1-σ_3), psi	12.2	30.5	50.0
Effective Lateral Stress (σ_3'), psi	6.6	20.8	37.1
Effective Axial Stress (σ_1'), psi	18.7	51.4	87.1
Pore Pressure (μ), psi	7.3	20.8	32.4
Strain, %	3.0	4.8	7.7

Remarks	Multistage Test (CU) Consolidated
Undrained with pore pressure measurements.	
Sample saturated with back pressure saturation.	
Sample pulverized to minus No. 40 sieve material	
and moisture-cured to a liquidity index of 45%.	

Sample Index Properties	
Remold Dry Density, pcf	73
Reold Moisture Content, %	38
Liquid Limit, %	55
Plasticity Index, %	31
Percent Gravel	0
Percent Sand	46
Percent Passing No. 200 Sieve	54

Sample Description
Sandy Fat Clay

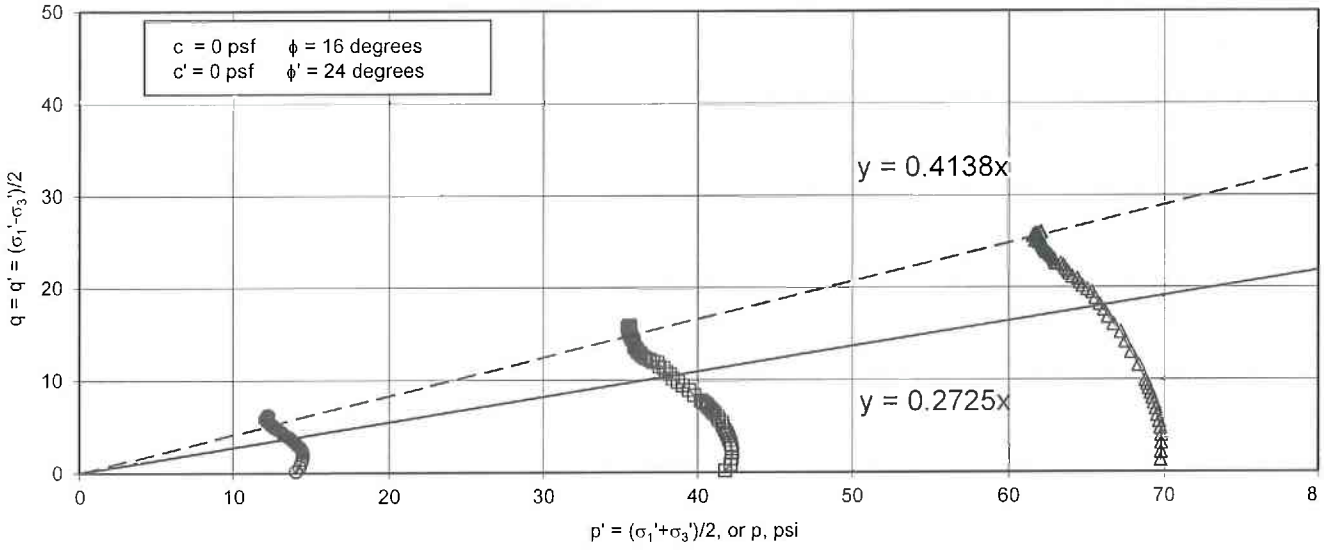
Test Description: Multi-Stage Triaxial Compression Test
Test Sample Location: Blue Clay
Project Name: Blackridge Hotel

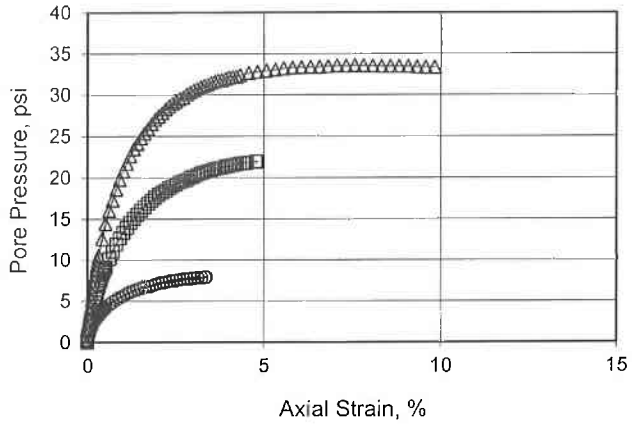
Project No. 2180187

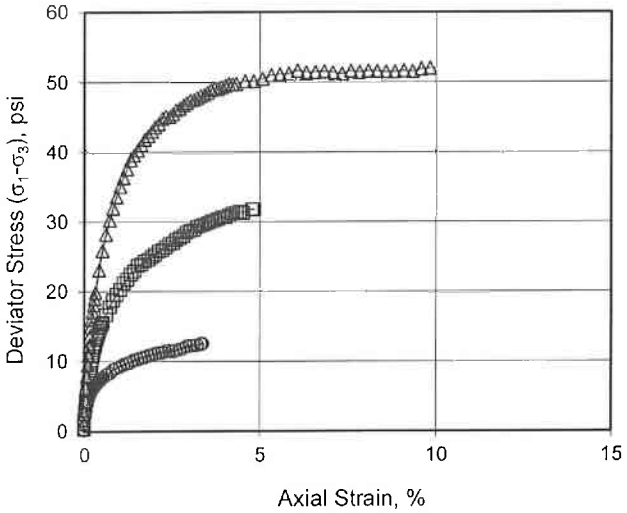
Triaxial Compression Test

Figure 6

Applied Geotechnical Engineering Consultants, Inc.







Test No. (Symbol)	○	□	△
Sample Type	Remolded		
Length, in.	3.96	3.61	3.39
Diameter, in.	1.93	NM	NM
Dry Density, pcf	84	NM	NM
Moisture Content, %	36	NM	NM
Consolidation Pressure, psi	13.9	41.6	69.4
"B" Parameter	99	NA	NA
Total Confining Stress (σ_3), psi	13.9	41.6	69.4
Total Axial Stress (σ_1), psi	26.4	73.4	120.5
Deviator Stress (σ_1-σ_3), psi	12.5	31.8	51.2
Effective Lateral Stress (σ_3'), psi	5.9	19.7	36.2
Effective Axial Stress (σ_1'), psi	18.5	51.5	87.4
Pore Pressure (μ), psi	7.9	21.9	33.2
Strain, %	3.4	4.8	5.6

Remarks	Multistage Test (CU) Consolidated
Undrained with pore pressure measurements.	
Sample saturated with back pressure saturation.	
Sample pulverized to minus No. 40 sieve material	
and moisture-cured to a liquidity index of 58%.	

Sample Index Properties	
Remold Dry Density, pcf	84
Reold Moisture Content, %	36
Liquid Limit, %	46
Plasticity Index, %	24
Percent Gravel	0
Percent Sand	20
Percent Passing No. 200 Sieve	80

Sample Description
Lean Clay with Sand

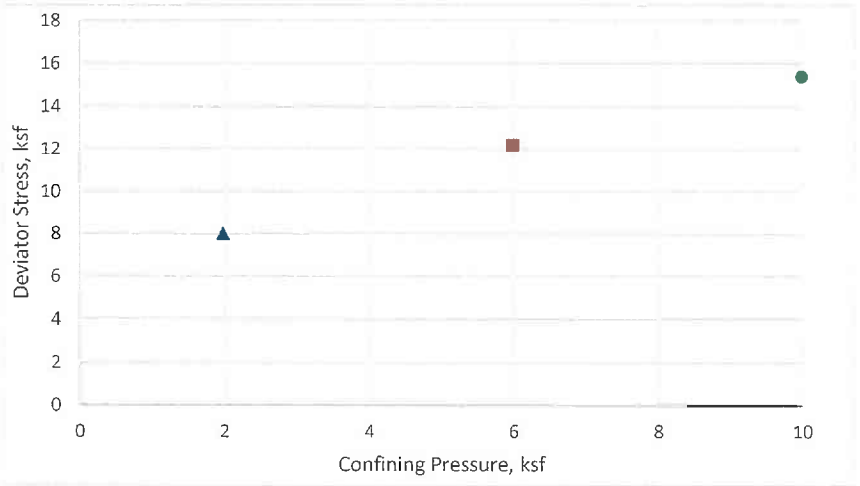
Test Description: Multi-Stage Triaxial Compression Test
Test Sample Location: Red Clay
Project Name: Blackridge Hotel

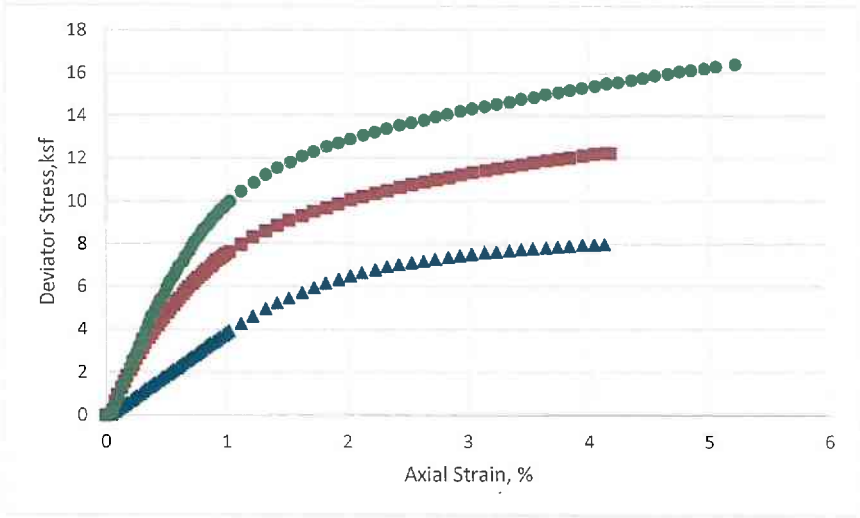
Project No. 2180187

Triaxial Compression Test

Figure 7

Applied Geotechnical Engineering Consultants, Inc.





Multi-Stage Undrained Test

Project and Sample Information			
Project Number		2180187	
Project Name		Blackridge Hotel	
Sample Identification		Blue Clay	
Sample Description		Sandy Fat Clay	
Test No. (Symbol)	1 (▲)	2 (■)	3 (●)
Sample Type	Remolded		
Length, in.			
Diameter, in.	1.93	1.93	1.93
Dry Density, pcf	95.5	-	-
Moisture Content, %	14.4	-	-
Confining Pressure, ksf	2.0	6.0	10.0
Deviator Stress, ksf	8.0	12.2	15.4
Axial Strian, %	4.0	4.0	4.0
Rate of Strain, %/min	1.0	1.0	1.0

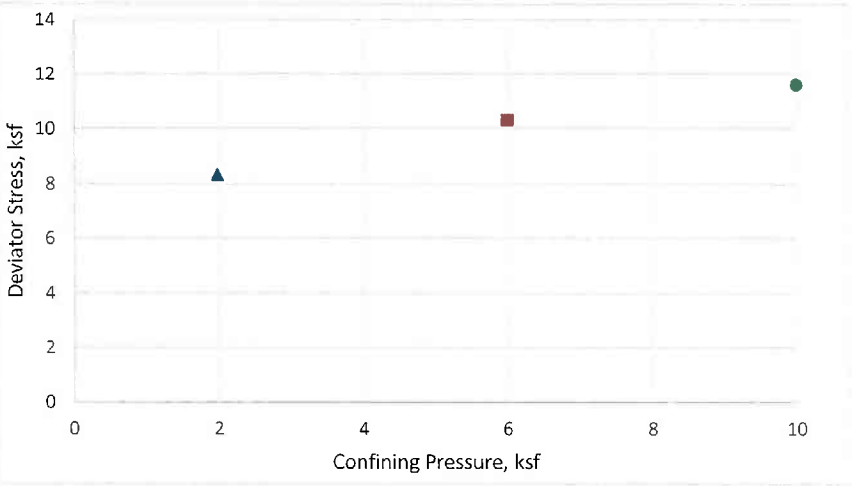
Remold Sample Properties	
Dry Density, pcf	95.5
Moisture Content, %	14.4
Liquid Limit, %	55
Plasticity Index, %	31
Percent Gravel, >4.750mm	0
Percent Coarse Sand, 2.000mm-4.750mm	0
Percent Medium Sand, 0.425mm-2.000mm	7
Percent Fine Sand, 0.075mm-0.425mm	43
Percent Silt, 0.005mm-0.075mm	13
Percent Clay, 0.001mm-0.005mm	37
Percent Colloidals, <0.001mm	0
Percent Clay Fraction, <0.002mm	

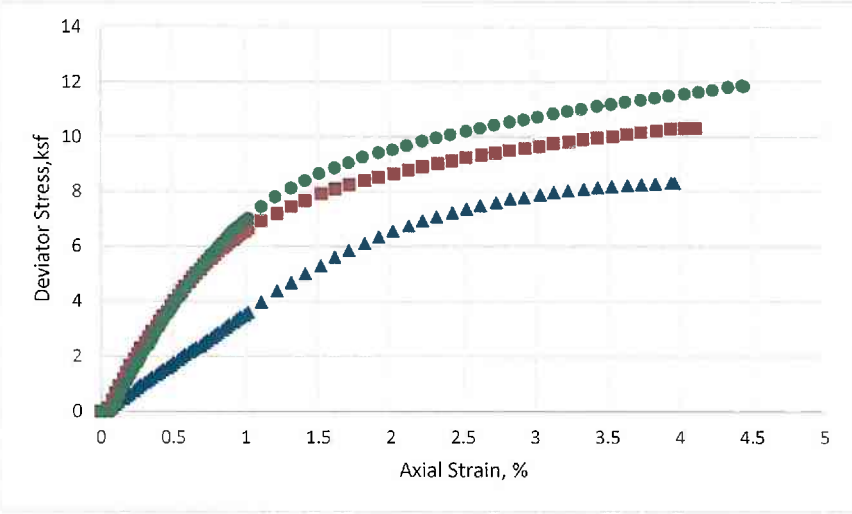
Notes

The Sigma 1 Trautwein Automated Load Test System and the Sigma-1 UU Triaxial Test Software was used for the three-stage undrained shear test. A cyclic loading procedure was employed to perform the multi-stage test.

The deviator stress was released to zero once a maximum value was reached. Each stage commenced from a condition of zero deviator stress. Material passing the # 10 seive was remolded to the approximate moisture content and dry density indicated above.

Applied Geotechnical Engineering Consultants, Inc.





Multi-Stage Undrained Test

Project and Sample Information			
Project Number		2180187	
Project Name		Blackridge Hotel	
Sample Identification		Blue Clay	
Sample Description		Sandy Fat Clay	
Test No. (Symbol)	1 (▲)	2 (■)	3 (●)
Sample Type	Remolded		
Length, in.			
Diameter, in.	1.93	1.93	1.93
Dry Density, pcf	94.6	-	-
Moisture Content, %	19.6	-	-
Confining Pressure, ksf	2.0	6.0	10.0
Deviator Stress, ksf	8.30	10.30	11.60
Axial Strian, %	4.0	4.0	4.0
Rate of Strain, %/min	1.0	1.0	1.0

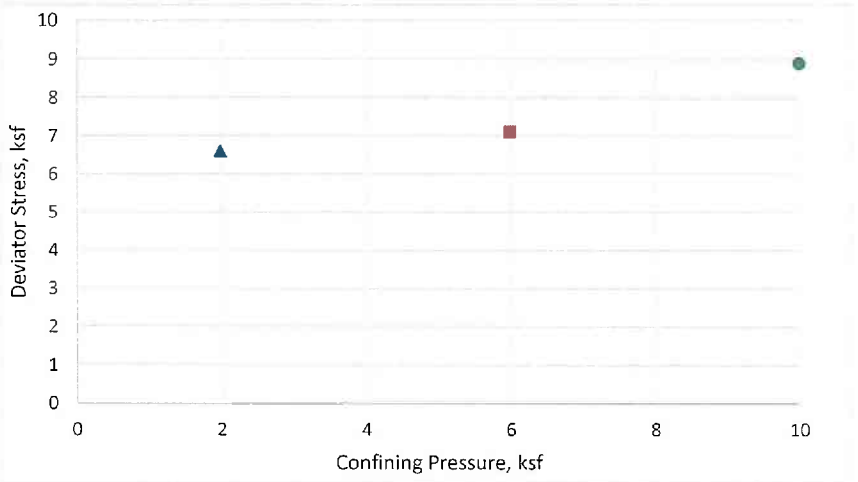
Remold Sample Properties	
Dry Density, pcf	94.6
Moisture Content, %	19.6
Liquid Limit, %	55
Plasticity Index, %	31
Percent Gravel, >4.750mm	0
Percent Coarse Sand, 2.000mm-4.750mm	0
Percent Medium Sand, 0.425mm-2.000mm	7
Percent Fine Sand, 0.075mm-0.425mm	43
Percent Silt, 0.005mm-0.075mm	13
Percent Clay, 0.001mm-0.005mm	37
Percent Colloidals, <0.001mm	0
Percent Clay Fraction, <0.002mm	

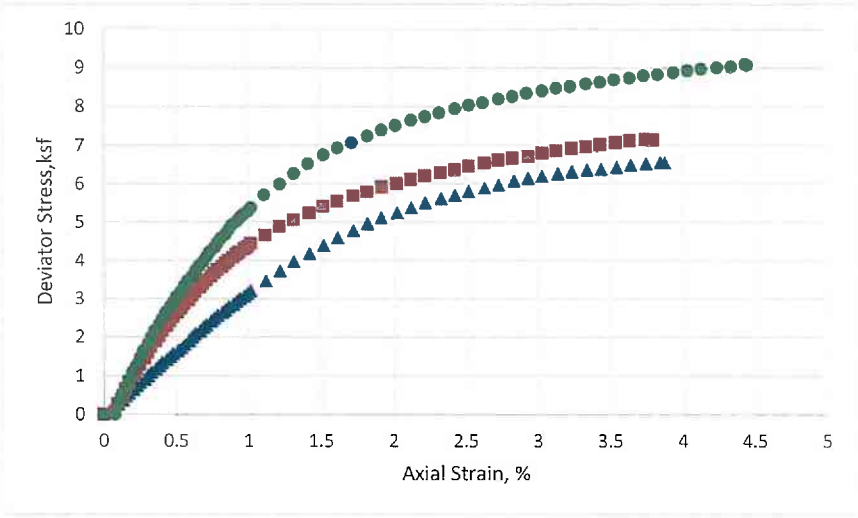
Notes

The Sigma 1 Trautwein Automated Load Test System and the Sigma-1 UU Triaxial Test Software was used for the three-stage undrained shear test. A cyclic loading procedure was employed to perform the multi-stage test.

The deviator stress was released to zero once a maximum value was reached. Each stage commenced from a condition of zero deviator stress. Material passing the # 10 seive was remolded to the approximate moisture content and dry density indicated above.

Applied Geotechnical Engineering Consultants, Inc.





Multi-Stage Undrained Test

Project and Sample Information			
Project Number		2180187	
Project Name		Blackridge Hotel	
Sample Identification		Blue Clay	
Sample Description		Sandy Fat Clay	
Test No. (Symbol)	1 (▲)	2 (■)	3 (●)
Sample Type	Remolded		
Length, in.			
Diameter, in.	1.93	1.93	1.93
Dry Density, pcf	94.9		
Moisture Content, %	23.8		
Confining Pressure, ksf	2.0	6.0	10.0
Deviator Stress, ksf	6.60	7.10	8.90
Axial Strian, %	3.9	3.8	4.0
Rate of Strain, %/min	1.0	1.0	1.0

Remold Sample Properties	
Dry Density, pcf	94.9
Moisture Content, %	23.8
Liquid Limit, %	55
Plasticity Index, %	31
Percent Gravel, >4.750mm	0
Percent Coarse Sand, 2.000mm-4.750mm	0
Percent Medium Sand, 0.425mm-2.000mm	7
Percent Fine Sand, 0.075mm-0.425mm	43
Percent Silt, 0.005mm-0.075mm	13
Percent Clay, 0.001mm-0.005mm	37
Percent Colloidals, <0.001mm	0
Percent Clay Fraction, <0.002mm	

Notes

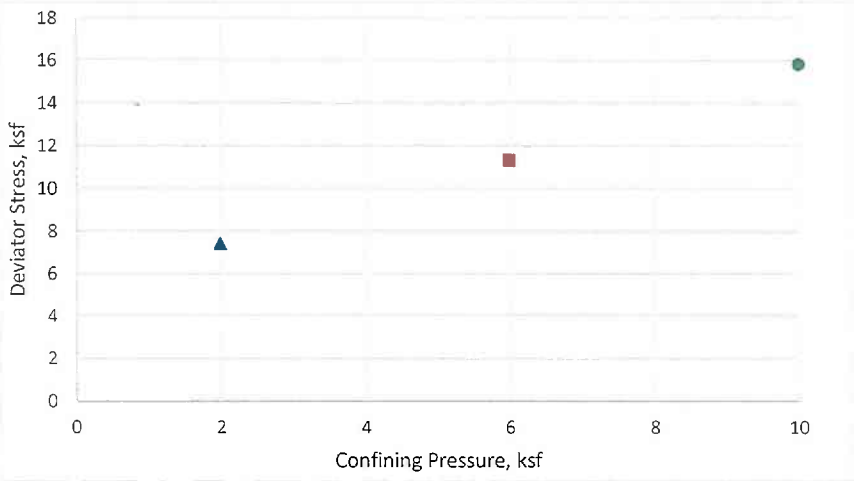
The Sigma 1 Trautwein Automated Load Test System and the Sigma-1 UU Triaxial Test Software was used for the three-stage undrained shear test. A cyclic loading procedure was employed to perform the multi-stage test.

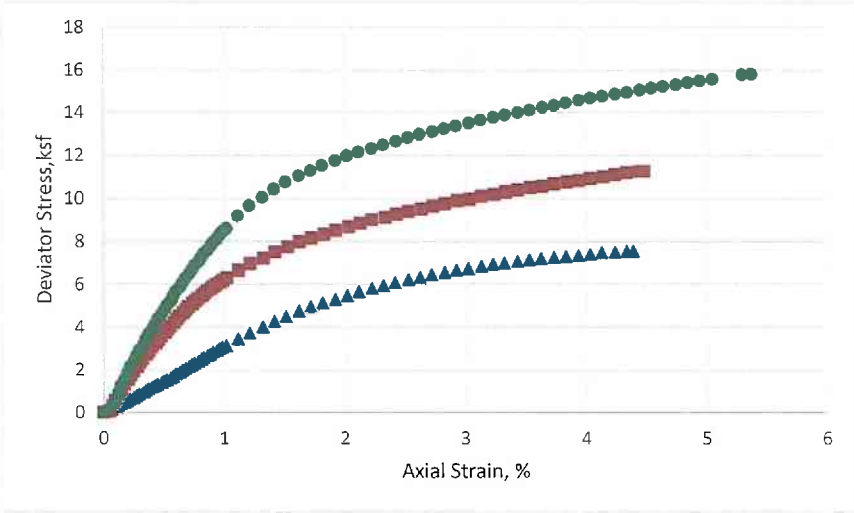
The deviator stress was released to zero once a maximum value was reached. Each stage commenced from a condition of zero deviator stress. Material passing the # 10 seive was remolded to the approximate moisture content and dry density indicated above.

Project No. 2180187

Figure 10

Applied Geotechnical Engineering Consultants, Inc.





Multi-Stage Undrained Test

Project and Sample Information			
Project Number		2180187	
Project Name		Blackridge Hotel	
Sample Identification		Red Clay	
Sample Description		Lean Clay with Sand	
Test No. (Symbol)	1 (▲)	2 (■)	3 (●)
Sample Type	Remolded		
Length, in.			
Diameter, in.	1.93	1.93	1.93
Dry Density, pcf	103.5	-	-
Moisture Content, %	12.6	-	-
Confining Pressure, ksf	2.0	6.0	10.0
Deviator Stress, ksf	7.40	11.30	15.80
Axial Strian, %	4.0	4.5	5.4
Rate of Strain, %/min	1.0	1.0	1.0

Remold Sample Properties	
Dry Density, pcf	103.5
Moisture Content, %	12.5
Liquid Limit, %	46
Plasticity Index, %	24
Percent Gravel, >4.750mm	0
Percent Coarse Sand, 2.000mm-4.750mm	0
Percent Medium Sand, 0.425mm-2.000mm	3
Percent Fine Sand, 0.075mm-0.425mm	19
Percent Silt, 0.005mm-0.075mm	44
Percent Clay, 0.001mm-0.005mm	34
Percent Colloidals, <0.001mm	0
Percent Clay Fraction, <0.002mm	

Notes

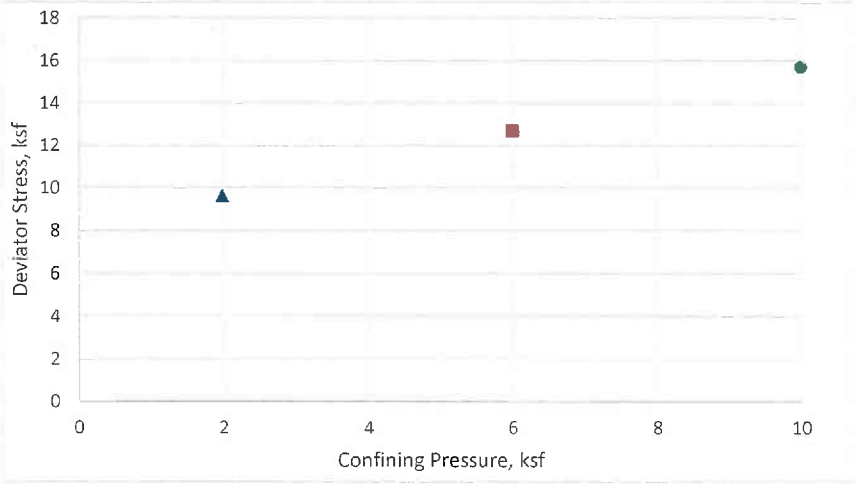
The Sigma 1 Trautwein Automated Load Test System and the Sigma-1 UU Triaxial Test Software was used for the three-stage undrained shear test. A cyclic loading procedure was employed to perform the multi-stage test.

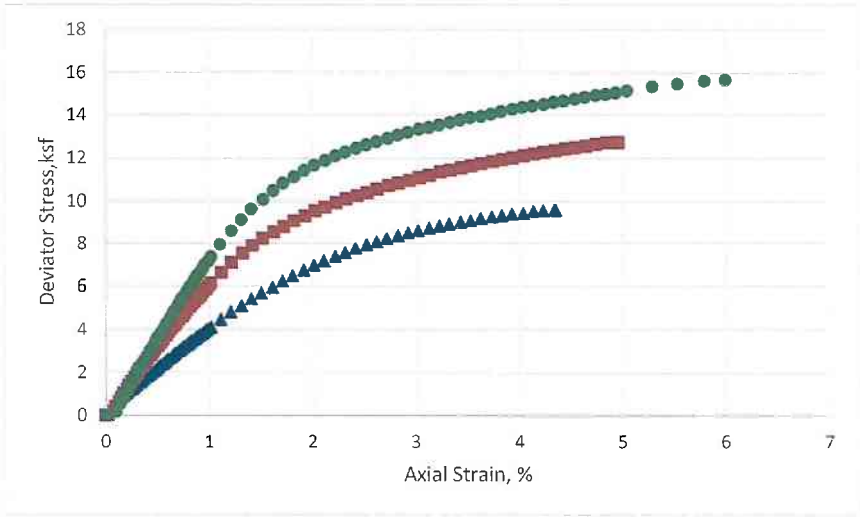
The deviator stress was released to zero once a maximum value was reached. Each stage commenced from a condition of zero deviator stress. Material passing the # 10 seive was remolded to the approximate moisture content and dry density indicated above.

Project No. 2180187

Figure 11

Applied Geotechnical Engineering Consultants, Inc.





Multi-Stage Undrained Test

Project and Sample Information			
Project Number		2180187	
Project Name		Blackridge Hotel	
Sample Identification		Red Clay	
Sample Description		Lean Clay with Sand	
Test No. (Symbol)	1 (▲)	2 (■)	3 (●)
Sample Type	Remolded		
Length, in.			
Diameter, in.	1.93	1.93	1.93
Dry Density, pcf	102	-	-
Moisture Content, %	14.9	-	-
Confining Pressure, ksf	2.0	6.0	10.0
Deviator Stress, ksf	9.60	12.70	15.70
Axial Strian, %	4.4	5.0	6.0
Rate of Strain, %/min	1.0	1.0	1.0

Remold Sample Properties	
Dry Density, pcf	102.0
Moisture Content, %	14.9
Liquid Limit, %	46
Plasticity Index, %	24
Percent Gravel, >4.750mm	0
Percent Coarse Sand, 2.000mm-4.750mm	0
Percent Medium Sand, 0.425mm-2.000mm	3
Percent Fine Sand, 0.075mm-0.425mm	19
Percent Silt, 0.005mm-0.075mm	44
Percent Clay, 0.001mm-0.005mm	34
Percent Colloidals, <0.001mm	0
Percent Clay Fraction, <0.002mm	

Notes

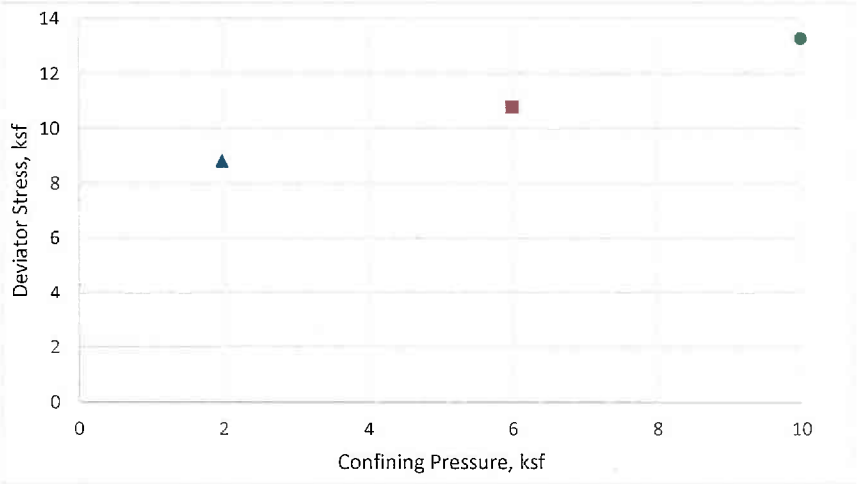
The Sigma 1 Trautwein Automated Load Test System and the Sigma-1 UU Triaxial Test Software was used for the three-stage undrained shear test. A cyclic loading procedure was employed to perform the multi-stage test.

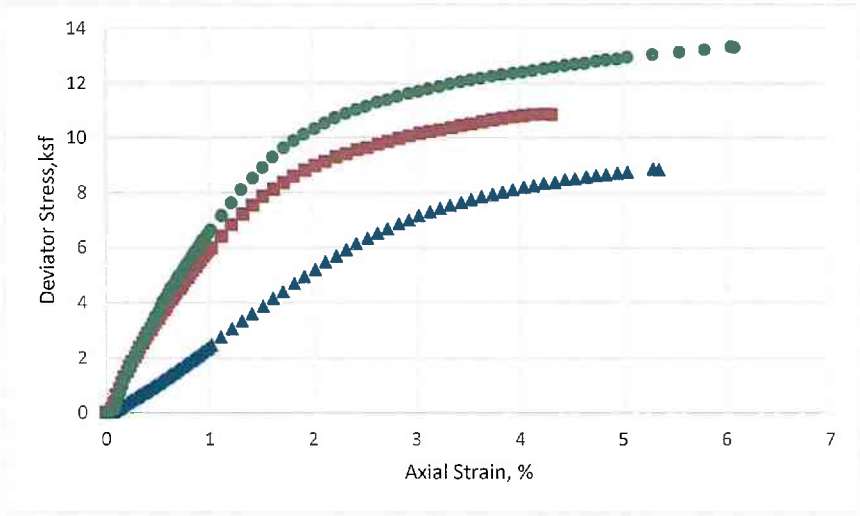
The deviator stress was released to zero once a maximum value was reached. Each stage commenced from a condition of zero deviator stress. Material passing the # 10 seive was remolded to the approximate moisture content and dry density indicated above.

Project No. 2180187

Figure 12

Applied Geotechnical Engineering Consultants, Inc.





Multi-Stage Undrained Test

Project and Sample Information			
Project Number		2180187	
Project Name		Blackridge Hotel	
Sample Identification		Red Clay	
Sample Description		Lean Clay with Sand	
Test No. (Symbol)	1 (▲)	2 (■)	3 (●)
Sample Type	Remolded		
Length, in.			
Diameter, in.	1.93	1.93	1.93
Dry Density, pcf	105.1	-	-
Moisture Content, %	17.9	-	-
Confining Pressure, ksf	2.0	6.0	10.0
Deviator Stress, ksf	8.80	10.80	13.30
Axial Strian, %	5.4	4.3	6.0
Rate of Strain, %/min	1.0	1.0	1.0

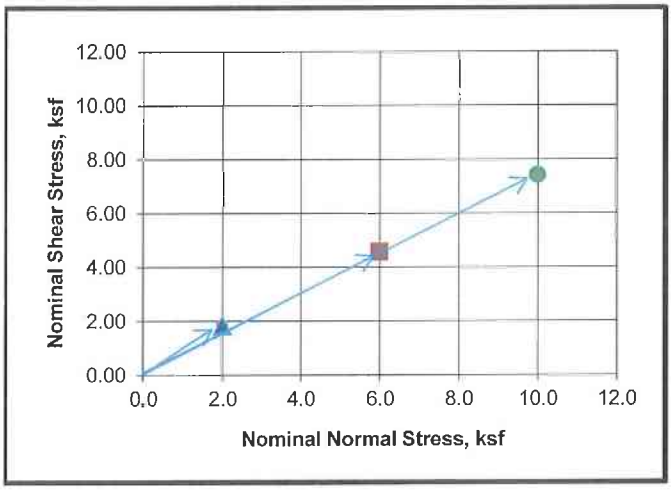
Remold Sample Properties	
Dry Density, pcf	105.1
Moisture Content, %	17.9
Liquid Limit, %	46
Plasticity Index, %	24
Percent Gravel, >4.750mm	0
Percent Coarse Sand, 2.000mm-4.750mm	0
Percent Medium Sand, 0.425mm-2.000mm	3
Percent Fine Sand, 0.075mm-0.425mm	19
Percent Silt, 0.005mm-0.075mm	44
Percent Clay, 0.001mm-0.005mm	34
Percent Colloidals, <0.001mm	0
Percent Clay Fraction, <0.002mm	

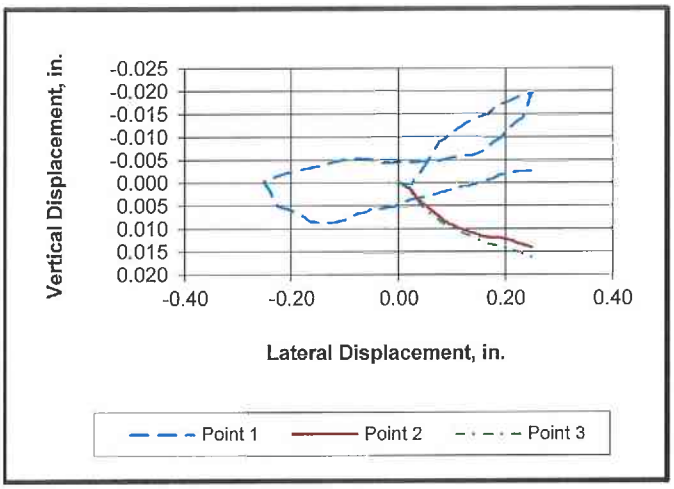
Notes

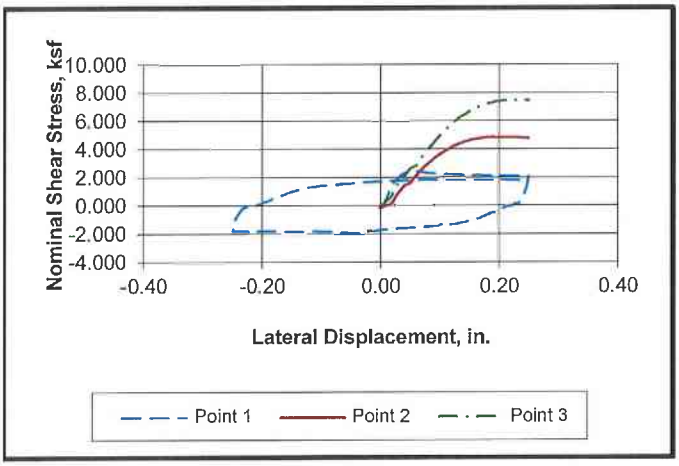
The Sigma 1 Trautwein Automated Load Test System and the Sigma-1 UU Triaxial Test Software was used for the three-stage undrained shear test. A cyclic loading procedure was employed to perform the multi-stage test.

The deviator stress was released to zero once a maximum value was reached. Each stage commenced from a condition of zero deviator stress. Material passing the # 10 seive was remolded to the approximate moisture content and dry density indicated above.

Applied Geotechnical Engineering Consultants, Inc.







DIRECT SHEAR TEST

Project and Sample Information			
Project Number		2180187	
Project Name		Blackridge Hotel	
Sample Identification		Blue Clay	
Sample Description		Sandy Fat Clay	
Test No. (Symbol)	1 (▲)	2 (■)	3 (●)
Test Type	Consolidated Unsaturated		
Sample Type	Remolded		
Length, in.	1.00	-	-
Diameter, in.	2.42	2.42	2.42
Dry Density, pcf	95	-	-
Moisture Content, %	13	-	-
Consol. Load, ksf	2.0	6.0	10.0
Normal Load, ksf	2.0	6.0	10.0
Shear Stress, ksf	1.86	4.58	7.44
Secant Friction Angle	43	37	37
Lateral Displacement, in	0.200	0.200	0.200
Relative Lateral Displacement, %	8.26	8.26	8.26
Rate of Strain, in/min	0.04	0.04	0.040
Gap Width, in	0.075	0.080	0.070

Material passing the #10 sieve remolded to:
a dry density of approximately 95pcf
at a moisture content of approximately 13%.
A three-stage direct shear test was performed.
A pre-shear cycle was performed before the 1st shear stage.

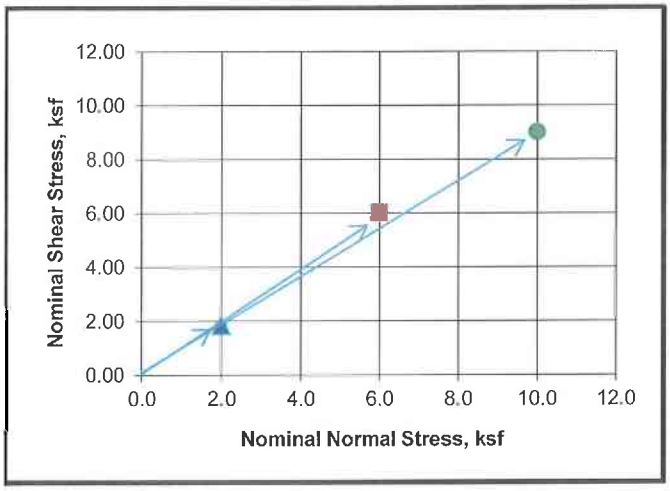
Sample Properties	
Dry Density, pcf	95
Moisture Content, %	13
Liquid Limit, %	55
Plasticity Index, %	31
Percent Gravel, >4.750mm	0
Percent Coarse Sand, 2.000mm-4.750mm	0
Percent Medium Sand, 0.425mm-2.000mm	7
Percent Fine Sand, 0.075mm-0.425mm	43
Percent Silt, 0.005mm-0.075mm	13
Percent Clay, 0.001mm-0.005mm	37
Percent Colloidals, <0.001mm	0

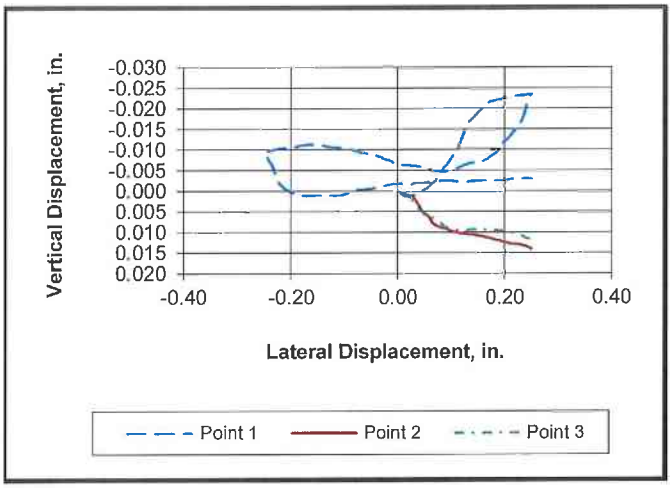
Project No. 2180187

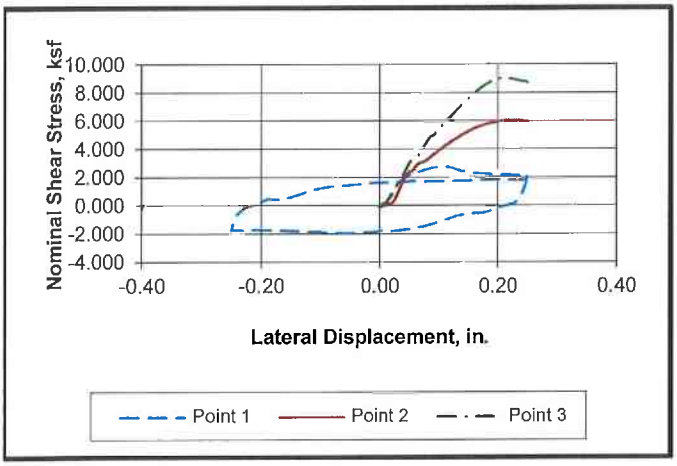
Direct Shear Results

Figure 14

Applied Geotechnical Engineering Consultants, Inc.







DIRECT SHEAR TEST

Project and Sample Information			
Project Number		2180187	
Project Name		Blackridge Hotel	
Sample Identification		Red Clay	
Sample Description		Lean Clay w Sand	
Test No. (Symbol)	1 (▲)	2 (■)	3 (●)
Test Type	Consolidated Unsaturated		
Sample Type	Remolded		
Length, in.	1.00	-	-
Diameter, in.	2.42	2.42	2.42
Dry Density, pcf	101	-	-
Moisture Content, %	10	-	-
Consol. Load, ksf	2.0	6.0	10.0
Normal Load, ksf	2.0	6.0	10.0
Shear Stress, ksf	1.86	6.02	9.03
Secant Friction Angle	43	45	42
Lateral Displacement, in	0.202	0.203	0.202
Relative Lateral Displacement, %	8.35	8.39	8.35
Rate of Strain, in/min	0.04	0.04	0.040
Gap Width, in	0.075	0.080	0.070

Material passing the #10 sieve remolded to:
a dry density of approximately 105pcf
at a moisture content of approximately 10%.
A three-stage direct shear test was performed.
A pre-shear cycle was performed before the 1st shear stage.

Sample Properties	
Dry Density, pcf	105
Moisture Content, %	10
Liquid Limit, %	46
Plasticity Index, %	24
Percent Gravel, >4.750mm	0
Percent Coarse Sand, 2.000mm-4.750mm	0
Percent Medium Sand, 0.425mm-2.000mm	3
Percent Fine Sand, 0.075mm-0.425mm	19
Percent Silt, 0.005mm-0.075mm	44
Percent Clay, 0.001mm-0.005mm	34
Percent Colloidals, <0.001mm	0

Project No. 2180187

Direct Shear Results

Figure 15

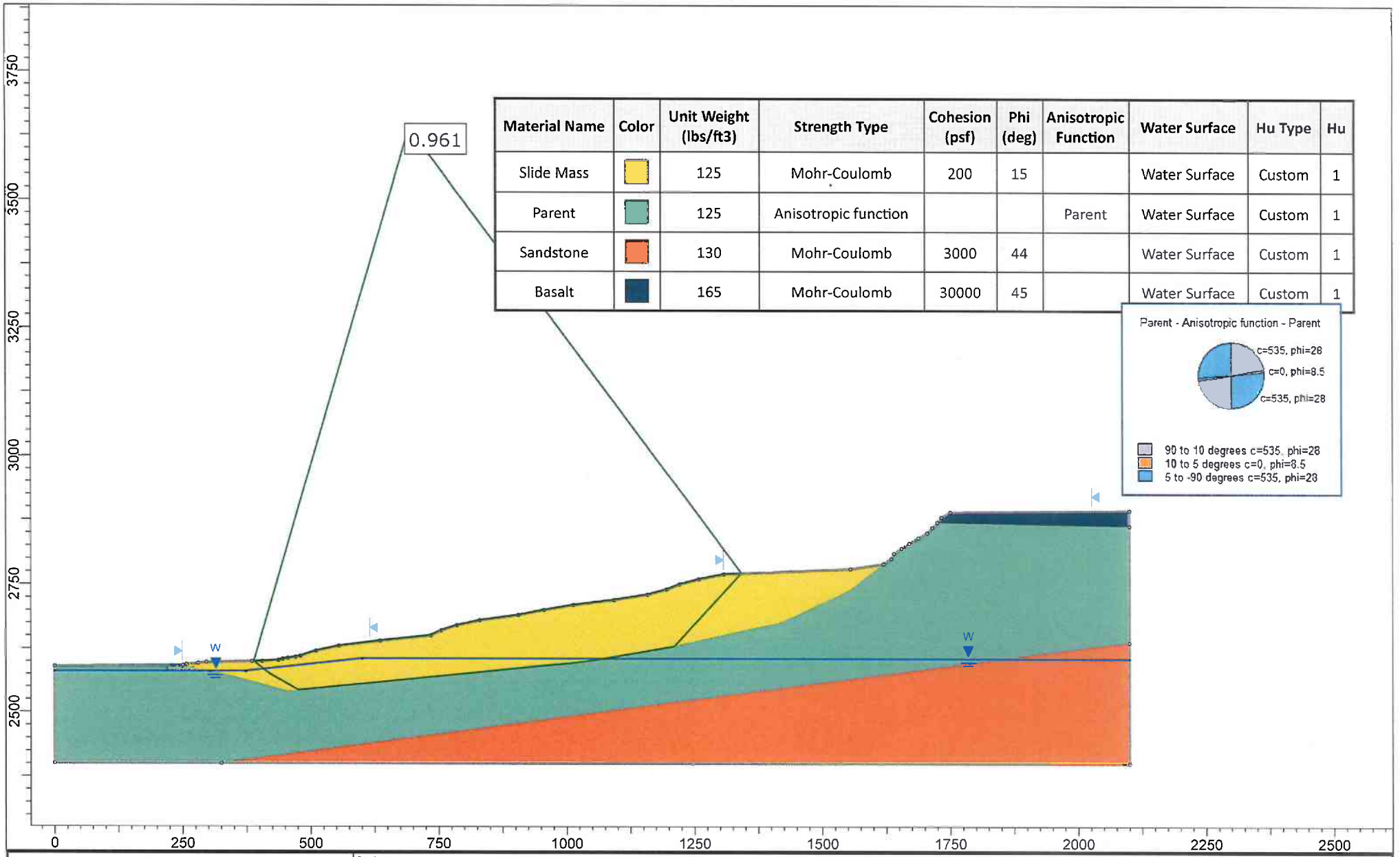
APPENDIX

A-1 Condition Before Grading
A-2 Proposed Profile - Static
A-3 Proposed Profile with Reinforcement - Static
A-4 Proposed Profile with Reinforcement - Seismic

APPENDIX

A-1 Condition Before Grading

Project No. 2180187



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Anisotropic Function	Water Surface	Hu Type	Hu
Slide Mass		125	Mohr-Coulomb	200	15		Water Surface	Custom	1
Parent		125	Anisotropic function			Parent	Water Surface	Custom	1
Sandstone		130	Mohr-Coulomb	3000	44		Water Surface	Custom	1
Basalt		165	Mohr-Coulomb	30000	45		Water Surface	Custom	1

AGEC
Applied GeoTech

SLIDEINTERPRET 8.014

Project	Blackstone Hotel - original profile, static, saturated soil		
Analysis Description			
Drawn By		Scale 1:3098	Company
Date	9/20/2019 5:01:59 PM		File Name Blackridge Original Profile.slmd

Slide Analysis Information

Blackridge Original Profile

Project Summary

File Name:	Blackridge Original Profile.slmd
Slide Modeler Version:	8.014
Compute Time:	00h:00m:04.739s
Project Title:	SLIDE - An Interactive Slope Stability Program
Date Created:	10/19/2018, 3:12:08 PM

General Settings

Units of Measurement:	Imperial Units
Time Units:	days
Permeability Units:	feet/second
Data Output:	Standard
Failure Direction:	Right to Left

Analysis Options

Slices Type:	Vertical

Analysis Methods Used

Bishop simplified
Janbu simplified

Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Groundwater Analysis

Groundwater Method:	Water Surfaces
Pore Fluid Unit Weight [lbs/ft3]:	62.4
Use negative pore pressure cutoff:	Yes
Maximum negative pore pressure [psf]:	0
Advanced Groundwater Method:	None

Random Numbers

Pseudo-random Seed:	10116
Random Number Generation Method:	Park and Miller v.3

Surface Options

Search Method:	Particle Swarm Search
Initial # of Surface Vertices:	8
Maximum Iterations:	200
Number of Particles:	50
Minimum Elevation:	Not Defined
Minimum Depth:	Not Defined
Minimum Area:	Not Defined
Minimum Weight:	Not Defined
Convex Surfaces Only:	Enabled

Seismic Loading

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No

Materials

Property	Slide Mass	Parent	Sandstone	Basalt
Color				
Strength Type	Mohr-Coulomb	Anisotropic function	Mohr-Coulomb	Mohr-Coulomb
Unit Weight [lbs/ft3]	125	125	130	165
Cohesion [psf]	200		3000	30000
Friction Angle [°]	15		44	45
Water Surface	Water Table	Water Table	Water Table	Water Table
Hu Value	1	1	1	1

Anisotropic Functions

Name: Parent

Angle From	Angle To	c	phi
-90	5	535	28
5	10	0	8.5
10	90	535	28

Global Minimums

Method: bishop simplified

FS	0.961382
Axis Location:	693.829, 3638.837
Left Slip Surface Endpoint:	388.665, 2600.000
Right Slip Surface Endpoint:	1341.800, 2771.403
Resisting Moment:	1.73224e+09 lb-ft
Driving Moment:	1.80182e+09 lb-ft
Total Slice Area:	82220.1 ft2
Surface Horizontal Width:	953.135 ft
Surface Average Height:	86.2628 ft

Method: janbu simplified

FS	0.929838
Axis Location:	693.829, 3638.837
Left Slip Surface Endpoint:	388.665, 2600.000
Right Slip Surface Endpoint:	1341.800, 2771.403
Resisting Horizontal Force:	1.47714e+06 lb
Driving Horizontal Force:	1.5886e+06 lb
Total Slice Area:	82220.1 ft2
Surface Horizontal Width:	953.135 ft
Surface Average Height:	86.2628 ft

Global Minimum Coordinates

Method: bishop simplified

X	Y
388.665	2600
405.303	2586.03
421.941	2573.42
475.948	2542.48
524.332	2547.35
552.78	2550.22
580.242	2552.99
610.913	2556.08
641.307	2559.14
668.326	2561.87
696.111	2564.67
722.899	2567.38
749.687	2570.08
779.284	2573.07
809.723	2576.14
840.161	2579.21
869.219	2582.14
915.483	2586.81
961.747	2591.48
1008.01	2596.15
1054.27	2602.2
1097.77	2609.16
1143.38	2617.03
1176.92	2622.87
1210.04	2628.71
1230.8	2651.19
1248.41	2670.26
1265.96	2689.27
1283.51	2708.28
1312.66	2739.84
1341.8	2771.4

Method: janbu simplified

X	Y
388.665	2600
405.303	2586.03
421.941	2573.42
475.948	2542.48
524.332	2547.35
552.78	2550.22
580.242	2552.99
610.913	2556.08
641.307	2559.14
668.326	2561.87
696.111	2564.67
722.899	2567.38
749.687	2570.08
779.284	2573.07
809.723	2576.14
840.161	2579.21
869.219	2582.14
915.483	2586.81
961.747	2591.48
1008.01	2596.15
1054.27	2602.2
1097.77	2609.16
1143.38	2617.03
1176.92	2622.87
1210.04	2628.71
1230.8	2651.19
1248.41	2670.26
1265.96	2689.27
1283.51	2708.28
1312.66	2739.84
1341.8	2771.4

Valid/Invalid Surfaces

Method: bishop simplified

Number of Valid Surfaces: 8410
Number of Invalid Surfaces: 11712

Error Codes:

Error Code -108 reported for 1 surface
Error Code -112 reported for 12 surfaces
Error Code -113 reported for 3012 surfaces
Error Code -121 reported for 109 surfaces
Error Code -124 reported for 1 surface
Error Code -1000 reported for 8577 surfaces

Method: janbu simplified

Number of Valid Surfaces: 7954
Number of Invalid Surfaces: 12168

Error Codes:

Error Code -112 reported for 3 surfaces
Error Code -113 reported for 3012 surfaces
Error Code -121 reported for 109 surfaces
Error Code -124 reported for 1 surface
Error Code -1000 reported for 9043 surfaces

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).
-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.
-113 = Surface intersects outside slope limits.
-121 = Concave failure surface, only convex surfaces have been defined as being allowed.
-124 = A slice has a width less than the minimum acceptable value.
-1000 = No valid slip surface is generated

Slice Data

Global Minimum Query (bishop simplified) - Safety Factor: 0.961382

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [degrees]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	16.6382	14529	-40.0208	Slide Mass	200	15	589.345	566.586	1368.12	0	1368.12	873.232	873.232
2	2.85674	5414.27	-37.1577	Slide Mass	200	15	933.439	897.391	2602.7	0	2602.7	1895.26	1895.26
3	13.7815	37876.5	-37.1577	Slide Mass	200	15	1103	1060.41	3584.31	373.221	3211.09	2748.37	2375.14
4	17.8414	74374.6	-29.8103	Slide Mass	200	15	1256.5	1207.98	4888.56	1126.73	3761.83	4168.65	3041.92
5	17.8414	103935	-29.8103	Slide Mass	200	15	1553.79	1493.79	6715.74	1887.25	4828.49	5825.5	3938.25
6	17.8414	133212	-29.8103	Slide Mass	200	15	1845.81	1774.53	8524	2647.77	5876.23	7466.46	4818.69
7	0.482768	4014.65	-29.8103	Parent	535	28	5087.44	4890.97	11230.7	3038.32	8192.4	8315.9	5277.58
8	16.1279	137322	5.75436	Parent	0	8.5	835.88	803.6	8430.38	3053.35	5377.03	8514.62	5461.27
9	16.1279	144747	5.75436	Parent	0	8.5	904.892	869.947	8883.76	3062.81	5820.95	8974.94	5912.13
10	16.1279	150882	5.75436	Parent	0	8.5	961.666	924.528	9258.41	3072.28	6186.13	9355.32	6283.04
11	28.4481	275807	5.75436	Parent	0	8.5	1011.66	972.596	9593.14	3085.36	6507.78	9695.08	6609.72
12	27.4622	274032	5.75436	Parent	0	8.5	1052.54	1011.89	9872.45	3101.77	6770.68	9978.52	6876.75
13	30.6714	308788	5.75436	Parent	0	8.5	1063.56	1022.49	9960.45	3118.83	6841.62	10067.6	6948.8
14	15.1966	154048	5.75994	Parent	0	8.5	1091.58	1049.43	10026.9	3004.97	7021.93	10137	7132.04
15	15.1966	154682	5.75994	Parent	0	8.5	1112.62	1069.65	10066.5	2909.32	7157.19	10178.7	7269.42
16	27.0195	275180	5.76212	Parent	0	8.5	1133.84	1090.05	10070.1	2776.43	7293.68	10184.5	7408.09
17	27.7848	282888	5.76317	Parent	0	8.5	1159.76	1114.97	10064.3	2603.87	7460.44	10181.4	7577.49
18	26.7881	272655	5.76317	Parent	0	8.5	1185.57	1139.79	10058.6	2432.02	7626.54	10178.2	7746.2
19	26.7881	277965	5.76317	Parent	0	8.5	1241.73	1193.78	10251.1	2263.31	7987.79	10376.4	8113.11
20	14.7984	165945	5.76317	Parent	0	8.5	1389.93	1336.25	11073.4	2132.36	8941.02	11213.7	9081.3
21	14.7984	172601	5.76317	Parent	0	8.5	1473.03	1416.14	11514.8	2039.16	9475.6	11663.4	9624.27
22	30.4385	370774	5.76317	Parent	0	8.5	1574.06	1513.27	12022.2	1896.72	10125.5	12181.1	10284.4
23	15.2194	190770	5.76317	Parent	0	8.5	1650.18	1586.45	12368.2	1752.94	10615.2	12534.7	10781.8
24	15.2194	193708	5.76317	Parent	0	8.5	1694.39	1628.96	12556.8	1657.09	10899.7	12727.8	11070.7
25	14.5288	185930	5.76317	Parent	0	8.5	1719.39	1652.99	12623.8	1563.42	11060.4	12797.4	11233.9
26	14.5288	186785	5.76317	Parent	0	8.5	1742.4	1675.11	12680.3	1471.92	11208.4	12856.2	11384.3
27	23.132	299154	5.76317	Parent	0	8.5	1772.22	1703.78	12753.6	1353.33	11400.3	12932.5	11579.1
28	23.132	301779	5.76317	Parent	0	8.5	1811.89	1741.92	12863.1	1207.65	11655.4	13046	11838.3
29	23.132	307739	5.76317	Parent	0	8.5	1873.63	1801.27	13114.5	1061.96	12052.6	13303.6	12241.7
30	23.132	314287	5.76317	Parent	0	8.5	1939.24	1864.35	13391	916.283	12474.7	13586.7	12670.4
31	23.1319	319531	5.76317	Parent	0	8.5	1996.24	1919.15	13611.9	770.602	12841.3	13813.4	13042.8
32	23.1319	324312	5.76317	Parent	0	8.5	2050.17	1971	13813.2	624.92	13188.3	14020.1	13395.2
33	23.132	327126	7.44354	Parent	0	8.5	2084.87	2004.36	13869.3	457.787	13411.5	14141.7	13683.9
34	23.132	326821	7.44354	Parent	0	8.5	2111.61	2030.06	13852.6	269.201	13583.4	14128.5	13859.3
35	17.5029	246474	9.09982	Parent	0	8.5	2122.64	2040.67	13741.9	87.4407	13654.5	14081.9	13994.4

36	25.9967	363637	9.09982	Parent	0	8.5	2121.64	2039.71	13648	0	13648	13987.8	13987.8
37	22.8026	317410	9.78033	Parent	0	8.5	2107.43	2026.05	13556.7	0	13556.7	13919.9	13919.9
38	22.8026	316206	9.78033	Parent	0	8.5	2099.45	2018.37	13505.2	0	13505.2	13867.1	13867.1
39	16.771	231797	9.88827	Parent	0	8.5	2091.88	2011.1	13456.6	0	13456.6	13821.2	13821.2
40	16.771	233615	9.88827	Parent	0	8.5	2108.3	2026.88	13562.1	0	13562.1	13929.6	13929.6
41	16.5606	233960	9.9973	Parent	0	8.5	2137.61	2055.06	13750.7	0	13750.7	14127.5	14127.5
42	16.5606	239017	9.9973	Parent	0	8.5	2183.81	2099.48	14047.9	0	14047.9	14432.9	14432.9
43	2.71714	39527.1	47.2804	Parent	535	28	5379.9	5172.14	8721.2	0	8721.2	14547.3	14547.3
44	18.0437	245499	47.2804	Slide Mass	200	15	3072.72	2954.06	10278.3	0	10278.3	13605.8	13605.8
45	17.607	207834	47.2804	Slide Mass	200	15	2686.97	2583.2	8894.23	0	8894.23	11804.1	11804.1
46	17.5517	175330	47.2804	Slide Mass	200	15	2298.44	2209.68	7500.24	0	7500.24	9989.33	9989.33
47	17.5517	141826	47.2804	Slide Mass	200	15	1889.77	1816.79	6033.95	0	6033.95	8080.47	8080.47
48	14.5715	92033.6	47.2804	Slide Mass	200	15	1512.01	1453.62	4678.54	0	4678.54	6315.96	6315.96
49	14.5715	68379.9	47.2804	Slide Mass	200	15	1164.47	1119.51	3431.64	0	3431.64	4692.7	4692.7
50	29.1428	55356.4	47.2866	Slide Mass	200	15	566.44	544.565	1285.93	0	1285.93	1899.49	1899.49

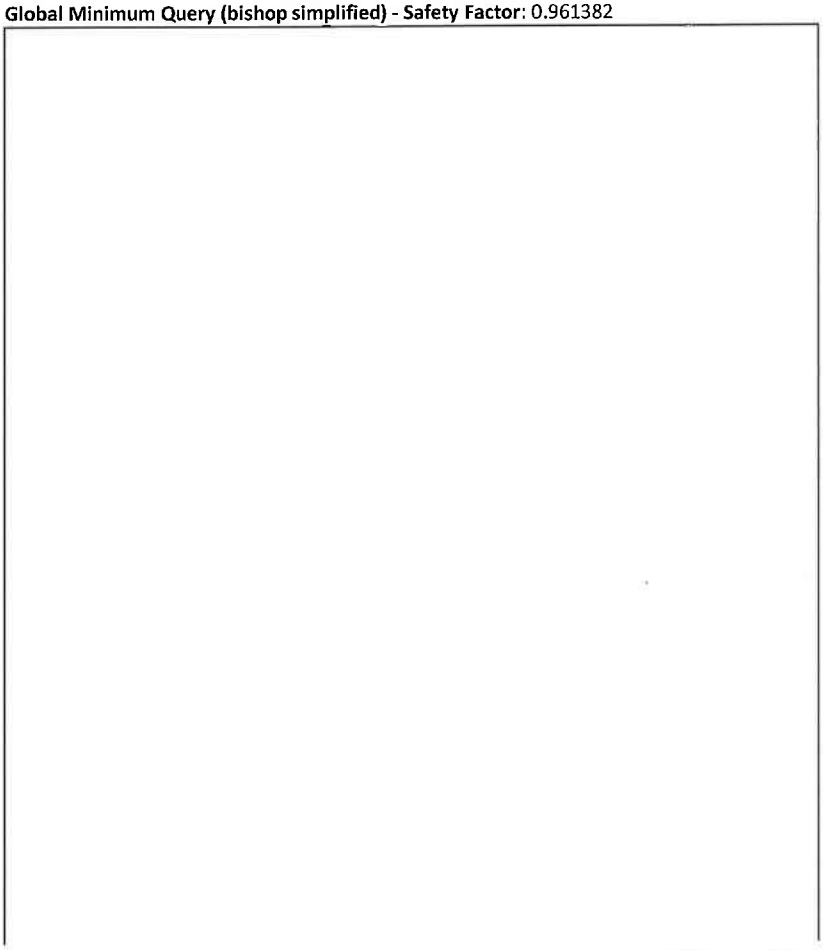
Global Minimum Query (janbu simplified) - Safety Factor: 0.929838

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [degrees]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	16.6382	14529	-40.0208	Slide Mass	200	15	615.695	572.497	1390.18	0	1390.18	873.167	873.167
2	2.85674	5414.27	-37.1577	Slide Mass	200	15	973.918	905.586	2633.28	0	2633.28	1895.17	1895.17
3	13.7815	37876.5	-37.1577	Slide Mass	200	15	1150.84	1070.09	3620.45	373.221	3247.23	2748.26	2375.04
4	17.8414	74374.6	-29.8103	Slide Mass	200	15	1307.53	1215.79	4917.69	1126.73	3790.96	4168.55	3041.82
5	17.8414	103935	-29.8103	Slide Mass	200	15	1616.88	1503.44	6751.78	1887.25	4864.53	5825.39	3938.14
6	17.8414	133212	-29.8103	Slide Mass	200	15	1920.76	1786	8566.8	2647.77	5919.03	7466.31	4818.54
7	0.482768	4014.65	-29.8103	Parent	535	28	5343.79	4968.86	11377.2	3038.32	8338.88	8315.5	5277.18
8	16.1279	137322	5.75436	Parent	0	8.5	863.786	803.181	8427.55	3053.35	5374.2	8514.59	5461.24
9	16.1279	144747	5.75436	Parent	0	8.5	935.103	869.494	8880.73	3062.81	5817.92	8974.97	5912.16
10	16.1279	150882	5.75436	Parent	0	8.5	993.771	924.046	9255.2	3072.28	6182.92	9355.35	6283.07
11	28.4481	275807	5.75436	Parent	0	8.5	1045.44	972.089	9589.74	3085.36	6504.38	9695.09	6609.73
12	27.4622	274032	5.75436	Parent	0	8.5	1087.67	1011.36	9868.94	3101.77	6767.17	9978.54	6876.77
13	30.6714	308788	5.75436	Parent	0	8.5	1099.07	1021.96	9956.89	3118.83	6838.06	10067.6	6948.81
14	15.1966	154048	5.75994	Parent	0	8.5	1128.04	1048.89	10023.2	3004.97	7018.27	10137	7132.05
15	15.1966	154682	5.75994	Parent	0	8.5	1149.76	1069.09	10062.8	2909.32	7153.46	10178.8	7269.44
16	27.0195	275180	5.76212	Parent	0	8.5	1171.69	1089.48	10066.3	2776.43	7289.85	10184.5	7408.08
17	27.7848	282888	5.76317	Parent	0	8.5	1198.48	1114.39	10060.4	2603.87	7456.54	10181.4	7577.5
18	26.7881	272655	5.76317	Parent	0	8.5	1225.16	1139.2	10054.6	2432.02	7622.57	10178.2	7746.22
19	26.7881	277965	5.76317	Parent	0	8.5	1283.19	1193.16	10246.9	2263.31	7983.63	10376.4	8113.14
20	14.7984	165945	5.76317	Parent	0	8.5	1436.33	1335.55	11068.7	2132.36	8936.38	11213.7	9081.34
21	14.7984	172601	5.76317	Parent	0	8.5	1522.2	1415.4	11509.9	2039.16	9470.69	11663.5	9624.32
22	30.4385	370774	5.76317	Parent	0	8.5	1626.61	1512.48	12016.9	1896.72	10120.2	12181.1	10284.4
23	15.2194	190770	5.76317	Parent	0	8.5	1705.26	1585.62	12362.6	1752.94	10609.7	12534.7	10781.8
24	15.2194	193708	5.76317	Parent	0	8.5	1750.96	1628.11	12551.1	1657.09	10894	12727.8	11070.7
25	14.5288	185930	5.76317	Parent	0	8.5	1776.78	1652.12	12618	1563.42	11054.6	12797.3	11233.9
26	14.5288	186785	5.76317	Parent	0	8.5	1800.56	1674.23	12674.5	1471.92	11202.6	12856.2	11384.3
27	23.132	299154	5.76317	Parent	0	8.5	1831.38	1702.89	12747.7	1353.33	11394.3	12932.5	11579.2
28	23.132	301779	5.76317	Parent	0	8.5	1872.38	1741.01	12857	1207.65	11649.4	13046	11838.4
29	23.132	307739	5.76317	Parent	0	8.5	1936.18	1800.33	13108.2	1061.96	12046.2	13303.6	12241.7
30	23.132	314287	5.76317	Parent	0	8.5	2003.98	1863.38	13384.5	916.283	12468.2	13586.7	12670.4

31	23.1319	319531	5.76317	Parent	0	8.5	2062.89	1918.15	13605.2	770.602	12834.6	13813.4	13042.8
32	23.1319	324312	5.76317	Parent	0	8.5	2118.62	1969.97	13806.3	624.92	13181.4	14020.1	13395.2
33	23.132	327126	7.44354	Parent	0	8.5	2154.15	2003.01	13860.3	457.787	13402.5	14141.7	13683.9
34	23.132	326821	7.44354	Parent	0	8.5	2181.77	2028.69	13843.5	269.201	13574.3	14128.6	13859.4
35	17.5029	246474	9.09982	Parent	0	8.5	2192.86	2039	13730.7	87.4407	13643.2	14081.9	13994.5
36	25.9967	363637	9.09982	Parent	0	8.5	2191.82	2038.04	13636.8	0	13636.8	13987.9	13987.9
37	22.8026	317410	9.78033	Parent	0	8.5	2177.01	2024.27	13544.7	0	13544.7	13920	13920
38	22.8026	316206	9.78033	Parent	0	8.5	2168.75	2016.59	13493.3	0	13493.3	13867.2	13867.2
39	16.771	231797	9.88827	Parent	0	8.5	2160.92	2009.31	13444.6	0	13444.6	13821.3	13821.3
40	16.771	233615	9.88827	Parent	0	8.5	2177.87	2025.07	13550.1	0	13550.1	13929.7	13929.7
41	16.5606	233960	9.9973	Parent	0	8.5	2208.14	2053.21	13738.3	0	13738.3	14127.6	14127.6
42	16.5606	239017	9.9973	Parent	0	8.5	2255.87	2097.59	14035.3	0	14035.3	14432.9	14432.9
43	2.71714	39527.1	47.2804	Parent	535	28	5492.88	5107.49	8599.61	0	8599.61	14548.1	14548.1
44	18.0437	245499	47.2804	Slide Mass	200	15	3152.26	2931.09	10192.6	0	10192.6	13606.3	13606.3
45	17.607	207834	47.2804	Slide Mass	200	15	2756.52	2563.12	8819.29	0	8819.29	11804.4	11804.4
46	17.5517	175330	47.2804	Slide Mass	200	15	2357.94	2192.5	7436.12	0	7436.12	9989.64	9989.64
47	17.5517	141826	47.2804	Slide Mass	200	15	1938.69	1802.67	5981.23	0	5981.23	8080.73	8080.73
48	14.5715	92033.6	47.2804	Slide Mass	200	15	1551.15	1442.32	4636.39	0	4636.39	6316.2	6316.2
49	14.5715	68379.9	47.2804	Slide Mass	200	15	1194.62	1110.8	3399.16	0	3399.16	4692.87	4692.87
50	29.1428	55356.4	47.2866	Slide Mass	200	15	581.101	540.33	1270.13	0	1270.13	1899.57	1899.57

Interslice Data

Global Minimum Query (bishop simplified) - Safety Factor: 0.961382



Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	388.665	2600	0	0	0
2	405.303	2586.03	28920.1	0	0
3	408.16	2583.86	37221.7	0	0
4	421.941	2573.42	89859.6	0	0
5	439.783	2563.2	162249	0	0
6	457.624	2552.97	258620	0	0
7	475.465	2542.75	378685	0	0
8	475.948	2542.48	384247	0	0
9	492.076	2544.1	384027	0	0
10	508.204	2545.73	384183	0	0
11	524.332	2547.35	384645	0	0
12	552.78	2550.22	385924	0	0
13	580.242	2552.99	387508	0	0
14	610.913	2556.08	389343	0	0
15	626.11	2557.61	390561	0	0
16	641.307	2559.14	392038	0	0
17	668.326	2561.87	395218	0	0
18	696.111	2564.67	399219	0	0
19	722.899	2567.38	403784	0	0
20	749.687	2570.08	409332	0	0
21	764.486	2571.57	413362	0	0
22	779.284	2573.07	417962	0	0
23	809.723	2576.14	428941	0	0
24	824.942	2577.68	435058	0	0
25	840.161	2579.21	441558	0	0
26	854.69	2580.68	448027	0	0
27	869.219	2582.14	454749	0	0
28	892.351	2584.48	465969	0	0
29	915.483	2586.81	477850	0	0
30	938.615	2589.15	490573	0	0
31	961.747	2591.48	504169	0	0
32	984.879	2593.82	518567	0	0
33	1008.01	2596.15	533742	0	0
34	1031.14	2599.17	540054	0	0
35	1054.27	2602.2	547034	0	0
36	1071.78	2605	545662	0	0
37	1097.77	2609.16	543988	0	0
38	1120.58	2613.09	538757	0	0
39	1143.38	2617.03	533546	0	0
40	1160.15	2619.95	529289	0	0
41	1176.92	2622.87	524999	0	0
42	1193.48	2625.79	520257	0	0
43	1210.04	2628.71	515412	0	0
44	1212.76	2631.65	504368	0	0
45	1230.8	2651.19	358970	0	0
46	1248.41	2670.26	236690	0	0
47	1265.96	2689.27	134470	0	0
48	1283.51	2708.28	52948.4	0	0
49	1298.09	2724.06	1152.1	0	0
50	1312.66	2739.84	-36031.6	0	0
51	1341.8	2771.4	0	0	0

Global Minimum Query (janbu simplified) - Safety Factor: 0.929838

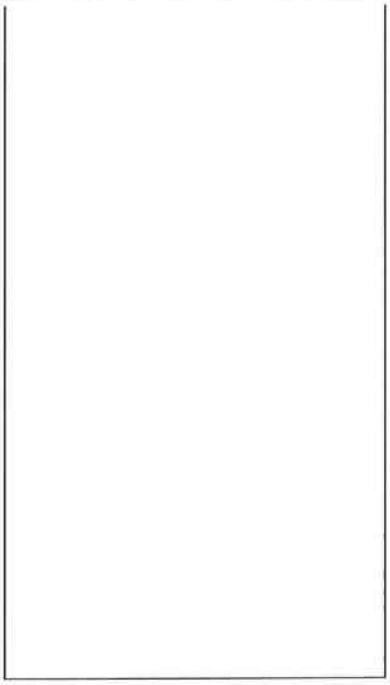
Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	388.665	2600	0	0	0
2	405.303	2586.03	29665.5	0	0
3	408.16	2583.86	38148.6	0	0
4	421.941	2573.42	91821.2	0	0
5	439.783	2563.2	165416	0	0
6	457.624	2552.97	263277	0	0
7	475.465	2542.75	385113	0	0
8	475.948	2542.48	390839	0	0
9	492.076	2544.1	391071	0	0
10	508.204	2545.73	391718	0	0
11	524.332	2547.35	392701	0	0
12	552.78	2550.22	394947	0	0
13	580.242	2552.99	397501	0	0
14	610.913	2556.08	400432	0	0
15	626.11	2557.61	402208	0	0
16	641.307	2559.14	404253	0	0
17	668.326	2561.87	408462	0	0
18	696.111	2564.67	413545	0	0
19	722.899	2567.38	419177	0	0
20	749.687	2570.08	425842	0	0
21	764.486	2571.57	430563	0	0
22	779.284	2573.07	435896	0	0
23	809.723	2576.14	448484	0	0
24	824.942	2577.68	455445	0	0
25	840.161	2579.21	462811	0	0
26	854.69	2580.68	470120	0	0
27	869.219	2582.14	477691	0	0
28	892.351	2584.48	490288	0	0
29	915.483	2586.81	503578	0	0
30	938.615	2589.15	517757	0	0
31	961.747	2591.48	532859	0	0
32	984.879	2593.82	548809	0	0
33	1008.01	2596.15	565577	0	0
34	1031.14	2599.17	573512	0	0
35	1054.27	2602.2	582137	0	0
36	1071.78	2605	582020	0	0
37	1097.77	2609.16	582210	0	0
38	1120.58	2613.09	578606	0	0
39	1143.38	2617.03	575016	0	0
40	1160.15	2619.95	571947	0	0
41	1176.92	2622.87	568855	0	0
42	1193.48	2625.79	565312	0	0
43	1210.04	2628.71	561693	0	0
44	1212.76	2631.65	551311	0	0
45	1230.8	2651.19	409017	0	0
46	1248.41	2670.26	289384	0	0
47	1265.96	2689.27	189422	0	0
48	1283.51	2708.28	109756	0	0
49	1298.09	2724.06	59193	0	0
50	1312.66	2739.84	22958.9	0	0
51	1341.8	2771.4	0	0	0

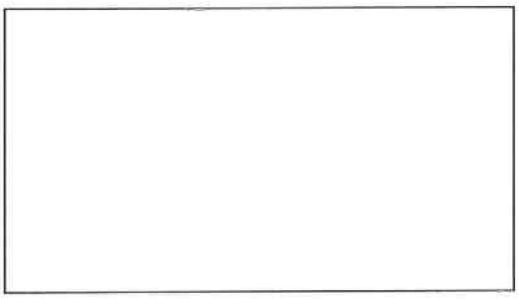
Entity Information

Group: Group 1

Shared Entities

Type	Coordinates	
	X	Y
External Boundary	0	2400
	325	2400
	2100	2400
	2100	2637
	2100	2863
	2100	2893
	1750	2890
	1733	2880
	1725	2870
	1715	2860
	1705	2850
	1688	2840
	1670	2830
	1655	2820
	1640	2810
	1635	2800
	1620	2790
	1555	2780
	1307	2770
	1258	2760
	1220	2750
	1195	2740
	1158	2730
	1093	2720
	1013	2710
	955	2700
	905	2690
	830	2680
	785	2670
	755	2660
	735	2650
	635	2640
	555	2630
	510	2620
	480	2610
	470	2608
	455	2606
	445	2604
	437	2602
	405	2600
	385	2600
	296	2598
	280	2596
	257	2594
	250	2592
	0	2590





Material Boundary

X	Y
250	2592
343.173	2571.24
456.053	2540.97
506.217	2545.57
625.989	2559.08
779.187	2574.58
929.108	2591.46
1070.69	2604.83
1238.02	2636.42
1419.39	2676.21
1552.78	2738.22
1620	2790

Material Boundary

X	Y
325	2400
2100	2637

Material Boundary

X	Y
1725	2870
2100	2863

Scenario-based Entities

Type	Coordinates	Master Scenario
Water Table	X: 0, 373.093, 600, 2100 / Y: 2580, 2580, 2605, 2605	Assigned to materials: Slide Mass, Parent, Sandstone, Basalt

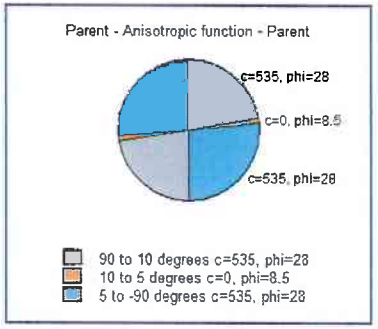
APPENDIX

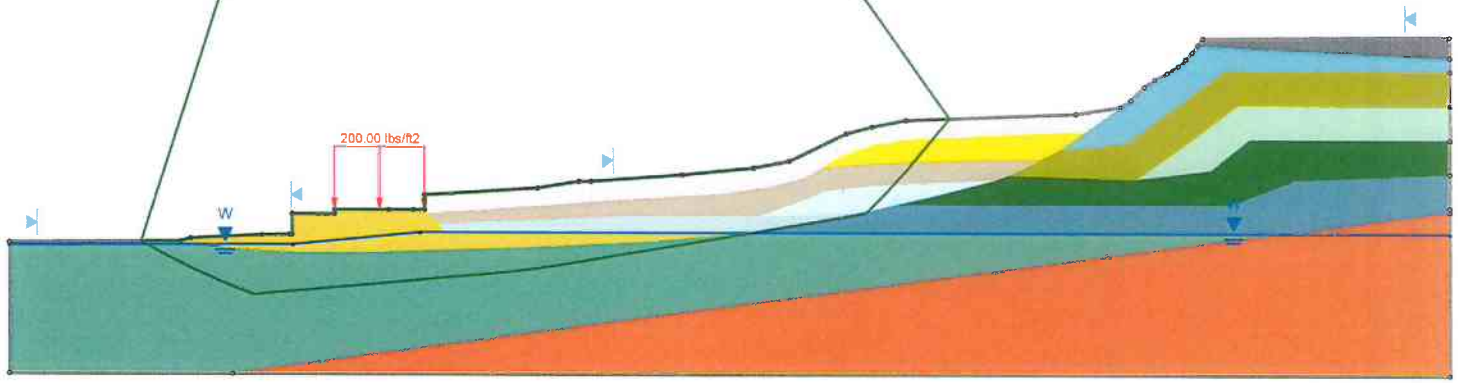
A-2 Proposed Profile - Static

Project No. 2180187

1.410 Spencer

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Anisotropic Function	Water Surface	Ru
Basalt Cap		165	Mohr-Coulomb	75000	45		None	0
Slide Mass		125	Mohr-Coulomb	200	15		Water Surface	
Slide Mass 1		125	Mohr-Coulomb	1750	15		Water Surface	
Slide Mass 2		125	Mohr-Coulomb	3500	15		Water Surface	
Slide Mass 3		125	Mohr-Coulomb	2500	15		Water Surface	
Slide Mass 4		125	Mohr-Coulomb	1500	15		Water Surface	
Slide Mass 5		125	Mohr-Coulomb	750	15		Water Surface	
Parent		125	Anisotropic function			Parent	Water Surface	
Parent 1		125	Anisotropic function			Parent 1	Water Surface	
Parent 2		125	Anisotropic function			Parent 2	Water Surface	
Parent 3		125	Anisotropic function			Parent 3	Water Surface	
Parent 4		125	Anisotropic function			Parent 4	Water Surface	
Parent 5		125	Anisotropic function			Parent 5	Water Surface	
Sandstone		130	Mohr-Coulomb	3000	44		Water Surface	





3750
3500
3250
3000
2750
2500
2250

-500 -250 0 250 500 750 1000 1250 1500 1750 2000 2250

AGEC Applied GeoTech

SLIDEINTERPRET 8.014

Project: Blackstone Hotel - proposed profile, static, un-saturated soil,			
Analysis Description:			
Drawn By:	Scale: 1:3357	Company:	
Date: 9/21/2019 9:35:00 AM		File Name:	Unsaturated Building Profile A.slmd

Slide Analysis Information

Unsaturated Building Profile A

Project Summary

File Name:	Unsaturated Building Profile A.slmd
Slide Modeler Version:	8.014
Compute Time:	00h:00m:14.871s
Project Title:	SLIDE - An Interactive Slope Stability Program
Date Created:	10/19/2018, 3:12:08 PM

General Settings

Units of Measurement:	Imperial Units
Time Units:	days
Permeability Units:	feet/second
Data Output:	Standard
Failure Direction:	Right to Left

Analysis Options

Slices Type:	Vertical
Analysis Methods Used	
	Bishop simplified
	Janbu simplified
	Spencer
Number of slices:	100
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Groundwater Analysis

Groundwater Method:	Water Surfaces
Pore Fluid Unit Weight [lbs/ft3]:	62.4
Use negative pore pressure cutoff:	Yes
Maximum negative pore pressure [psf]:	0
Advanced Groundwater Method:	None

Random Numbers

Pseudo-random Seed:	10116
Random Number Generation Method:	Park and Miller v.3

Surface Options

Search Method:	Simulated Annealing Search
Minimum Elevation:	Not Defined
Minimum Depth:	Not Defined
Minimum Area:	Not Defined
Minimum Weight:	Not Defined
Convex Surfaces Only:	Enabled

Seismic Loading

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No

Loading

1 Distributed Load present

Distributed Load 1

Distribution:	Constant
Magnitude [psf]:	200
Orientation:	Vertical

Materials

Property	Basalt Cap	Slide Mass	Slide Mass 1	Slide Mass 2	Slide Mass 3	Slide Mass 4	Slide Mass 5	Parent
Color								
Strength Type	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Anisotropic function
Unit Weight [lbs/ft3]	165	125	125	125	125	125	125	125
Cohesion [psf]	75000	200	1750	3500	2500	1500	750	
Friction Angle [°]	45	15	15	15	15	15	15	
Water Surface	None	Water Table	Water Table	Water Table	Water Table	Water Table	Water Table	Water Table
Hu Value		1	1	1	1	1	1	1
Ru Value	0							

Anisotropic Functions

Name: Parent 5

Angle From	Angle To	c	phi
-90	5	1100	28
5	10	285	8.5
10	90	1100	28

Name: Parent 4

Angle From	Angle To	c	phi
-90	5	1850	28
5	10	750	8.5
10	90	1850	28

Name: Parent 3

Angle From	Angle To	c	phi
-90	5	3100	28
5	10	1600	8.5
10	90	3100	28

Name: Parent 2

Angle From	Angle To	c	phi
-90	5	4600	28
5	10	2500	8.5
10	90	4600	28

Name: Parent 1

Angle From	Angle To	c	phi
-90	5	2200	28
5	10	1140	8.5
10	90	2200	28

Name: Parent

Angle From	Angle To	c	phi
-90	5	535	28
5	10	0	8.5
10	90	535	28

Property	Parent 1	Parent 2	Parent 3	Parent 4	Parent 5	Sandstone
Color						
Strength Type	Anisotropic function	Anisotropic function	Anisotropic function	Anisotropic function	Anisotropic function	Mohr-Coulomb
Unit Weight [lbs/ft3]	125	125	125	125	125	130
Cohesion [psf]						3000
Friction Angle [°]						44
Water Surface	Water Table	Water Table	Water Table	Water Table	Water Table	Water Table
Hu Value	1	1	1	1	1	1

Anisotropic Functions

Name: Parent 5

Angle From	Angle To	c	phi
-90	5	1100	28
5	10	285	8.5
10	90	1100	28

Name: Parent 4

Angle From	Angle To	c	phi
-90	5	1850	28
5	10	750	8.5
10	90	1850	28

Name: Parent 3

Angle From	Angle To	c	phi
-90	5	3100	28
5	10	1600	8.5
10	90	3100	28

Name: Parent 2

Angle From	Angle To	c	phi
-90	5	4600	28
5	10	2500	8.5
10	90	4600	28

Name: Parent 1

Angle From	Angle To	c	phi
-90	5	2200	28
5	10	1140	8.5
10	90	2200	28

Name: Parent

Angle From	Angle To	c	phi
-90	5	535	28
5	10	0	8.5
10	90	535	28

Global Minimums

Method: bishop simplified

FS	1.351020
Axis Location:	659.778, 3753.008
Left Slip Surface Endpoint:	300.553, 2597.757
Right Slip Surface Endpoint:	1368.444, 2772.478
Resisting Moment:	2.97295e+09 lb-ft
Driving Moment:	2.2011e+09 lb-ft
Total Slice Area:	101799 ft2
Surface Horizontal Width:	1067.89 ft
Surface Average Height:	95.3268 ft

Method: janbu simplified

FS	1.325190
Axis Location:	659.778, 3753.008
Left Slip Surface Endpoint:	300.553, 2597.757
Right Slip Surface Endpoint:	1368.444, 2772.478
Resisting Horizontal Force:	2.19353e+06 lb
Driving Horizontal Force:	1.65526e+06 lb
Total Slice Area:	101799 ft2
Surface Horizontal Width:	1067.89 ft
Surface Average Height:	95.3268 ft

Method: spencer

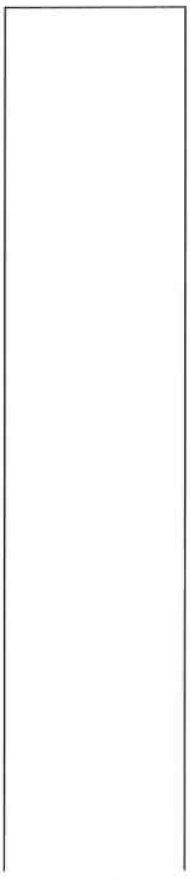
FS	1.410030
Axis Location:	600.730, 3861.001
Left Slip Surface Endpoint:	192.315, 2591.539
Right Slip Surface Endpoint:	1371.251, 2772.591
Resisting Moment:	3.64608e+09 lb-ft
Driving Moment:	2.58582e+09 lb-ft
Resisting Horizontal Force:	2.47215e+06 lb
Driving Horizontal Force:	1.75326e+06 lb
Total Slice Area:	112598 ft2
Surface Horizontal Width:	1178.94 ft
Surface Average Height:	95.5081 ft

Global Minimum Coordinates

Method: bishop simplified

X	Y
300.553	2597.76
324.495	2579.4
348.437	2563.02
379.615	2543.13
411.939	2523.29
450.756	2526.95
489.548	2530.6
528.558	2534.05
567.752	2537.52
599.899	2540.35
632.114	2543.61
681.965	2550.55
731.816	2555.89
781.667	2560.76
831.518	2565.63
867.922	2571.41
904.327	2576.63
940.732	2582.55
977.136	2587.92
1023.09	2596.02
1068.94	2604.1
1114.8	2612.15
1160.23	2620.14
1206.54	2628.29
1252.92	2636.46
1280.12	2666.53
1309.56	2700.88
1339	2736.97
1368.44	2772.48

Method: janbu simplified



X	Y
300.553	2597.76
324.495	2579.4
348.437	2563.02
379.615	2543.13
411.939	2523.29
450.756	2526.95
489.548	2530.6
528.558	2534.05
567.752	2537.52
599.899	2540.35
632.114	2543.61
681.965	2550.55
731.816	2555.89
781.667	2560.76
831.518	2565.63
867.922	2571.41
904.327	2576.63
940.732	2582.55
977.136	2587.92
1023.09	2596.02
1068.94	2604.1
1114.8	2612.15
1160.23	2620.14
1206.54	2628.29
1252.92	2636.46
1280.12	2666.53
1309.56	2700.88
1339	2736.97
1368.44	2772.48

Method: spencer

X	Y
192.315	2591.54
227.728	2571.54
263.142	2553.32
309.562	2532.42
355.983	2514.18
409.689	2518.95
464.787	2523.84
517.913	2528.55
571.038	2533.27
630.331	2538.53
686.962	2543.55
740.177	2548.45
794.221	2556.19
843.512	2564.55
892.804	2572.92
942.095	2581.29
991.385	2589.66
1034.56	2596.99
1080.63	2604.83
1126.7	2612.67
1167.86	2619.69
1209.07	2626.84
1249.33	2633.92
1279.81	2665.51
1310.29	2699.48
1340.77	2736.03
1371.25	2772.59

Valid/Invalid Surfaces

Method: bishop simplified

Number of Valid Surfaces: 7178
Number of Invalid Surfaces: 15932

Error Codes:

Error Code -1000 reported for 15932 surfaces

Method: janbu simplified

Number of Valid Surfaces: 8761
Number of Invalid Surfaces: 14349

Error Codes:

Error Code -1000 reported for 14349 surfaces

Method: spencer

Number of Valid Surfaces: 7177
Number of Invalid Surfaces: 15933

Error Codes:

Error Code -1000 reported for 15933 surfaces

Error Codes

The following errors were encountered during the computation:

-1000 = No valid slip surface is generated

Slice Data

Global Minimum Query (bishop simplified) - Safety Factor: 1.35102

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [degrees]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	14.7345	11054	-37.4726	Slide Mass	200	15	349.902	472.724	1017.82	0	1017.82	749.596	749.596
2	5.31502	9413.13	-37.4726	Slide Mass	200	15	558.795	754.943	2198.41	127.335	2071.07	1770.05	1642.72
3	3.89243	8718.42	-37.4726	Parent	535	28	1631.7	2204.46	3487.78	347.97	3139.81	2236.97	1889
4	11.9711	35747.3	-34.3923	Parent	535	28	1773.39	2395.88	4197.27	697.456	3499.81	2983.36	2285.9
5	11.9711	48870.5	-34.3923	Parent	535	28	2087.62	2820.41	5508.11	1209.88	4298.23	4079.1	2869.22
6	10.3928	52754.8	-32.5341	Parent	535	28	2315.02	3127.64	6549.46	1673.42	4876.04	5072.69	3399.27
7	10.3928	62014.3	-32.5341	Parent	535	28	2565.12	3465.53	7599.59	2088.06	5511.53	5963.28	3875.22
8	10.3928	71085.6	-32.5341	Parent	535	28	2805.72	3790.59	8625.57	2502.7	6122.87	6835.78	4333.08
9	10.7746	82970	-31.5332	Parent	535	28	3001.97	4055.72	9538.32	2916.78	6621.54	7696.31	4779.53
10	10.7746	92237	-31.5332	Parent	535	28	3233.5	4368.52	10540.1	3330.31	7209.81	8556.05	5225.74
11	10.7746	101480	-31.5332	Parent	535	28	3463.86	4679.74	11539	3743.84	7795.15	9413.58	5669.74
12	9.70422	131083	5.37997	Parent	0	8.5	1047.22	1414.82	13409.4	3942.61	9466.83	13508.1	9565.46
13	9.70422	130202	5.37997	Parent	0	8.5	1037.02	1401.03	13319.6	3945.09	9374.48	13417.2	9472.14
14	9.70422	129094	5.37997	Parent	0	8.5	1024.24	1383.77	13206.6	3947.56	9259.06	13303.1	9355.51
15	9.70422	127985	5.37997	Parent	0	8.5	1011.47	1366.51	13093.6	3950.03	9143.53	13188.8	9238.78

16	9.69803	126796	5.37896	Parent	0	8.5	998.69	1349.25	12980.6	3952.51	9028.08	13074.6	9122.12
17	9.69803	125689	5.37896	Parent	0	8.5	985.922	1332	12867.7	3954.99	8912.68	12960.5	9005.51
18	9.69803	128970	5.37896	Parent	0	8.5	1035.9	1399.52	13321.8	3957.47	9364.36	13419.4	9461.9
19	9.69803	130749	5.37896	Parent	0	8.5	1064.4	1438.02	13582	3959.95	9622.02	13682.2	9722.24
20	9.75245	130400	5.04908	Parent	0	8.5	1052.46	1421.89	13478.3	3964.2	9514.06	13571.2	9607.04
21	9.75245	129350	5.04908	Parent	0	8.5	1039.99	1405.05	13371.6	3970.23	9401.39	13463.5	9493.28
22	9.75245	128300	5.04908	Parent	0	8.5	1027.53	1388.22	13265.1	3976.26	9288.83	13355.9	9379.61
23	9.75245	127249	5.04908	Parent	0	8.5	1015.08	1371.39	13158.5	3982.29	9176.16	13248.1	9265.85
24	9.79845	126791	5.05594	Parent	0	8.5	1002.57	1354.49	13051.4	3988.29	9063.11	13140.1	9151.81
25	9.79845	125729	5.05594	Parent	0	8.5	990.045	1337.57	12944.1	3994.28	8949.87	13031.7	9037.46
26	9.79845	124667	5.05594	Parent	0	8.5	977.513	1320.64	12836.9	4000.26	8836.64	12923.4	8923.12
27	9.79845	123606	5.05594	Parent	0	8.5	964.989	1303.72	12729.6	4006.24	8723.4	12815	8808.78
28	10.7157	133962	5.04761	Parent	0	8.5	951.896	1286.03	12617.6	4012.55	8605.03	12701.7	8689.1
29	10.7157	132695	5.04761	Parent	0	8.5	938.21	1267.54	12500.4	4019.19	8481.26	12583.3	8564.13
30	10.7157	131427	5.04761	Parent	0	8.5	924.516	1249.04	12383.4	4025.83	8357.58	12465.1	8439.24
31	10.7384	145964	5.77752	Parent	0	8.5	1061.01	1433.44	13580.6	3989.22	9591.36	13687.9	9698.71
32	10.7384	159308	5.77752	Parent	0	8.5	1193.97	1613.08	14714.8	3921.43	10793.4	14835.6	10914.2
33	10.7384	158723	5.77752	Parent	0	8.5	1195.44	1615.06	14660.2	3853.63	10806.6	14781.2	10927.6
34	9.97019	146610	7.91541	Parent	0	8.5	1190.63	1608.56	14539.6	3776.48	10763.1	14705.1	10928.7
35	9.97019	145635	7.91541	Parent	0	8.5	1189.41	1606.91	14442	3689.98	10752.1	14607.4	10917.4
36	9.97019	144661	7.91541	Parent	0	8.5	1188.18	1605.25	14344.5	3603.48	10741	14509.7	10906.2
37	9.97019	143686	7.91541	Parent	0	8.5	1186.96	1603.6	14246.9	3516.98	10729.9	14412	10895
38	9.97019	142712	7.91541	Parent	0	8.5	1185.73	1601.94	14149.4	3430.48	10718.9	14314.2	10883.8
39	12.4627	177327	6.1203	Parent	0	8.5	1189.82	1607.47	14101.3	3345.54	10755.8	14228.9	10883.3
40	12.4627	176422	6.1203	Parent	0	8.5	1190.99	1609.05	14028.6	3262.15	10766.5	14156.3	10894.2
41	12.4627	175517	6.1203	Parent	0	8.5	1192.17	1610.64	13955.9	3178.76	10777.1	14083.7	10904.9
42	12.4627	174612	6.1203	Parent	0	8.5	1193.34	1612.23	13883.1	3095.37	10787.7	14011.1	10915.7
43	12.4627	173800	5.57729	Parent	0	8.5	1196.18	1616.06	13829	3015.71	10813.3	13945.8	10930.1
44	12.4627	173080	5.57729	Parent	0	8.5	1198.18	1618.76	13771.1	2939.77	10831.4	13888.1	10948.4
45	12.4627	172361	5.57729	Parent	0	8.5	1200.17	1621.45	13713.2	2863.83	10849.4	13830.4	10966.6
46	12.4627	172544	5.57729	Parent	0	8.5	1210.09	1634.85	13727	2787.89	10939.1	13845.1	11057.2
47	9.97017	138997	5.57729	Parent	0	8.5	1228.12	1659.22	13821.6	2719.54	11102	13941.5	11222
48	9.97017	139854	5.57729	Parent	0	8.5	1244.19	1680.92	13906	2658.79	11247.2	14027.5	11368.7
49	9.97017	140712	5.57729	Parent	0	8.5	1260.25	1702.62	13990.5	2598.04	11392.4	14113.6	11515.5
50	9.97017	141569	5.57729	Parent	0	8.5	1276.31	1724.32	14074.9	2537.28	11537.7	14199.6	11662.3
51	9.97017	142403	5.57729	Parent	0	8.5	1292.11	1745.66	14157	2476.53	11680.5	14283.2	11806.6
52	12.1349	172027	9.02445	Parent	0	8.5	1281.78	1731.71	13973.2	2386.02	11587.1	14176.7	11790.7
53	12.1349	169389	9.02445	Parent	0	8.5	1271.22	1717.44	13757.4	2265.76	11491.7	13959.3	11693.5
54	12.1349	167760	9.02445	Parent	0	8.5	1269.7	1715.39	13623.4	2145.5	11477.9	13825.1	11679.6
55	12.1349	166363	8.16154	Parent	0	8.5	1271.74	1718.15	13527.5	2031.07	11496.4	13709.9	11678.8
56	12.1349	165107	8.16154	Parent	0	8.5	1272.3	1718.9	13423.9	1922.47	11501.4	13606.4	11683.9
57	12.1349	163851	8.16154	Parent	0	8.5	1272.85	1719.65	13320.4	1813.87	11506.5	13502.9	11689
58	12.1349	162417	9.24441	Parent	0	8.5	1269.94	1715.72	13178.1	1697.95	11480.2	13384.8	11686.9
59	12.1349	160805	9.24441	Parent	0	8.5	1268.9	1714.31	13045.4	1574.71	11470.7	13252	11677.3
60	12.1349	159193	9.24441	Parent	0	8.5	1267.86	1712.9	12912.8	1451.46	11461.3	13119.1	11667.7
61	12.1349	157723	8.38252	Parent	0	8.5	1269.57	1715.22	12810.9	1334.05	11476.8	12997.9	11663.9
62	12.1349	156395	8.38252	Parent	0	8.5	1269.8	1715.53	12701.4	1222.47	11478.9	12888.5	11666
63	12.1349	155066	8.38252	Parent	0	8.5	1270.03	1715.84	12591.8	1110.89	11480.9	12779	11668.1
64	11.4876	145409	9.99321	Parent	0	8.5	1265.88	1710.23	12435.4	991.946	11443.4	12658.4	11666.5
65	11.4876	144069	9.99321	Parent	0	8.5	1266.93	1711.65	12318.6	865.638	11453	12541.8	11676.2
66	11.4876	142749	9.99321	Parent	0	8.5	1268.16	1713.31	12203.4	739.329	11464	12426.8	11687.5
67	11.4876	141428	9.99321	Parent	0	8.5	1269.4	1714.98	12088.2	613.021	11475.2	12311.9	11698.9
68	11.464	139821	9.99617	Parent	0	8.5	1270.62	1716.63	11973	486.824	11486.2	12197	11710.2
69	11.464	138505	9.99617	Parent	0	8.5	1271.85	1718.29	11858.1	360.737	11497.4	12082.3	11721.5
70	11.464	137189	9.99617	Parent	0	8.5	1273.07	1719.94	11743.1	234.649	11508.4	11967.5	11732.8
71	11.464	135873	9.99617	Parent	0	8.5	1274.3	1721.6	11628	108.562	11519.5	11852.6	11744.1
72	4.15928	48971.8	9.95334	Parent	0	8.5	1275.25	1722.89	11550.8	22.7458	11528.1	11774.6	11751.9
73	10.4242	121982	9.95334	Parent 5	285	8.5	1476.81	1995.2	11443.3	0	11443.3	11702.4	11702.4
74	10.4242	121386	9.95334	Parent 5	285	8.5	1470.61	1986.82	11387.2	0	11387.2	11645.2	11645.2
75	10.4242	121601	9.95334	Parent 5	285	8.5	1472.85	1989.85	11407.4	0	11407.4	11665.8	11665.8
76	10.4242	121830	9.95334	Parent 5	285	8.5	1475.23	1993.06	11428.9	0	11428.9	11687.8	11687.8

77	11.3582	133001	9.9852	Parent 5	285	8.5	1477.58	1996.24	11450.2	0	11450.2	11710.3	11710.3
78	11.3582	133268	9.9852	Parent 5	285	8.5	1480.13	1999.68	11473.2	0	11473.2	11733.8	11733.8
79	11.3582	136073	9.9852	Parent 5	285	8.5	1506.92	2035.88	11715.4	0	11715.4	11980.7	11980.7
80	11.3582	141005	9.9852	Parent 5	285	8.5	1554.04	2099.54	12141.4	0	12141.4	12415	12415
81	11.5778	148808	9.97941	Parent 5	285	8.5	1601.65	2163.86	12571.7	0	12571.7	12853.5	12853.5
82	11.5778	153935	9.97941	Parent 5	285	8.5	1649.69	2228.77	13006.1	0	13006.1	13296.3	13296.3
83	11.5778	159062	9.97941	Parent 5	285	8.5	1697.75	2293.69	13440.5	0	13440.5	13739.2	13739.2
84	11.5778	164189	9.97941	Parent 5	285	8.5	1745.8	2358.61	13874.8	0	13874.8	14182	14182
85	11.5943	169560	9.98559	Parent 5	285	8.5	1793.85	2423.53	14309.3	0	14309.3	14625.1	14625.1
86	11.5943	173404	9.98559	Parent 5	285	8.5	1829.83	2472.14	14634.5	0	14634.5	14956.7	14956.7
87	11.5943	174915	9.98559	Parent 5	285	8.5	1843.98	2491.25	14762.3	0	14762.3	15087	15087
88	11.5943	176378	9.98559	Parent 5	285	8.5	1857.67	2509.75	14886.2	0	14886.2	15213.3	15213.3
89	1.1209	17056.3	47.8771	Parent 5	1100	28	4743.27	6408.25	9983.38	0	9983.38	15228.6	15228.6
90	13.0374	188358	47.8771	Slide Mass 4	1500	15	3261.91	4406.91	10848.7	0	10848.7	14455.9	14455.9
91	13.0374	169256	47.8771	Slide Mass 4	1500	15	3023.5	4084.81	9646.65	0	9646.65	12990.1	12990.1
92	7.71887	90953.4	49.3993	Slide Mass 4	1500	15	2800.69	3783.79	8523.22	0	8523.22	11790.8	11790.8
93	10.8618	115845	49.3993	Slide Mass 3	2500	15	3221.92	4352.88	6915.07	0	6915.07	10674.1	10674.1
94	10.8618	101582	49.3993	Slide Mass 3	2500	15	3010.33	4067.02	5848.2	0	5848.2	9360.34	9360.34
95	5.80829	47757.2	50.7905	Slide Mass 3	2500	15	2801.68	3785.12	4796.12	0	4796.12	8230.16	8230.16
96	11.8171	81732.5	50.7905	Slide Mass 2	3500	15	3188.95	4308.33	3016.73	0	3016.73	6925.45	6925.45
97	11.8171	61041	50.7905	Slide Mass 2	3500	15	2909.46	3930.74	1607.54	0	1607.54	5173.68	5173.68
98	5.99034	23084.2	50.3344	Slide Mass 2	3500	15	2708.57	3659.33	594.612	0	594.612	3861.08	3861.08
99	11.7261	30052.3	50.3344	Slide Mass 1	1750	15	1456.13	1967.26	810.837	0	810.837	2566.9	2566.9
100	11.7261	10017.4	50.3344	Slide Mass 1	1750	15	1182.55	1597.65	-568.564	0	-568.564	857.57	857.57

Global Minimum Query (janbu simplified) - Safety Factor: 1.32519

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [degrees]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	14.7345	11054	-37.4726	Slide Mass	200	15	358.119	474.576	1024.73	0	1024.73	750.207	750.207
2	5.31502	9413.13	-37.4726	Slide Mass	200	15	571.919	757.901	2209.44	127.335	2082.11	1771.03	1643.69
3	3.89243	8718.42	-37.4726	Parent	535	28	1679.29	2225.38	3527.11	347.97	3179.14	2239.82	1891.85
4	11.9711	35747.3	-34.3923	Parent	535	28	1822.58	2415.26	4233.71	697.456	3536.26	2986.13	2288.67
5	11.9711	48870.5	-34.3923	Parent	535	28	2145.52	2843.22	5551.01	1209.88	4341.13	4082.36	2872.48
6	10.3928	52754.8	-32.5341	Parent	535	28	2377.49	3150.62	6592.68	1673.42	4919.26	5076.06	3402.64
7	10.3928	62014.3	-32.5341	Parent	535	28	2634.34	3491	7647.48	2088.06	5559.42	5967.01	3878.95
8	10.3928	71085.6	-32.5341	Parent	535	28	2881.43	3818.44	8677.98	2502.7	6175.28	6839.89	4337.19
9	10.7746	82970	-31.5332	Parent	535	28	3081.83	4084.01	9591.48	2916.78	6674.7	7700.47	4783.69
10	10.7746	92237	-31.5332	Parent	535	28	3319.52	4398.99	10597.4	3330.31	7267.08	8560.54	5230.23
11	10.7746	101480	-31.5332	Parent	535	28	3556	4712.38	11600.4	3743.84	7856.54	9418.42	5674.58
12	9.70422	131083	5.37997	Parent	0	8.5	1067.4	1414.51	13407.3	3942.61	9464.68	13507.8	9565.2
13	9.70422	130202	5.37997	Parent	0	8.5	1057	1400.72	13317.5	3945.09	9372.43	13417.1	9471.97
14	9.70422	129094	5.37997	Parent	0	8.5	1043.97	1383.46	13204.5	3947.56	9256.9	13302.8	9355.22
15	9.70422	127985	5.37997	Parent	0	8.5	1030.95	1366.2	13091.5	3950.03	9141.47	13188.6	9238.56
16	9.69803	126796	5.37896	Parent	0	8.5	1017.93	1348.95	12978.5	3952.51	9026.03	13074.4	9121.87
17	9.69803	125689	5.37896	Parent	0	8.5	1004.91	1331.7	12865.6	3954.99	8910.62	12960.2	9005.24
18	9.69803	128970	5.37896	Parent	0	8.5	1055.86	1399.21	13319.8	3957.47	9362.31	13419.2	9461.73
19	9.69803	130749	5.37896	Parent	0	8.5	1084.9	1437.7	13579.8	3959.95	9619.87	13682	9722.02
20	9.75245	130400	5.04908	Parent	0	8.5	1072.74	1421.59	13476.3	3964.2	9512.11	13571.1	9606.89

21	9.75245	129350	5.04908	Parent	0	8.5	1060.04	1404.76	13369.7	3970.23	9399.45	13463.3	9493.11
22	9.75245	128300	5.04908	Parent	0	8.5	1047.34	1387.93	13263.1	3976.26	9286.89	13355.7	9379.42
23	9.75245	127249	5.04908	Parent	0	8.5	1034.64	1371.1	13156.5	3982.29	9174.22	13247.9	9265.64
24	9.79845	126791	5.05594	Parent	0	8.5	1021.89	1354.2	13049.5	3988.29	9061.18	13139.9	9151.59
25	9.79845	125729	5.05594	Parent	0	8.5	1009.12	1337.28	12942.2	3994.28	8947.93	13031.5	9037.21
26	9.79845	124667	5.05594	Parent	0	8.5	996.355	1320.36	12835.1	4000.26	8834.81	12923.2	8922.96
27	9.79845	123606	5.05594	Parent	0	8.5	983.587	1303.44	12727.8	4006.24	8721.57	12814.8	8808.59
28	10.7157	133962	5.04761	Parent	0	8.5	970.246	1285.76	12615.8	4012.55	8603.26	12701.5	8688.96
29	10.7157	132695	5.04761	Parent	0	8.5	956.293	1267.27	12498.7	4019.19	8479.49	12583.1	8563.96
30	10.7157	131427	5.04761	Parent	0	8.5	942.34	1248.78	12381.6	4025.83	8355.82	12464.9	8439.05
31	10.7384	145964	5.77752	Parent	0	8.5	1081.42	1433.09	13578.3	3989.22	9589.04	13687.7	9698.46
32	10.7384	159308	5.77752	Parent	0	8.5	1216.96	1612.7	14712.2	3921.43	10790.8	14835.3	10913.9
33	10.7384	158723	5.77752	Parent	0	8.5	1218.44	1614.67	14657.6	3853.63	10804	14780.9	10927.3
34	9.97019	146610	7.91541	Parent	0	8.5	1213.43	1608.03	14536.1	3776.48	10759.6	14704.8	10928.3
35	9.97019	145635	7.91541	Parent	0	8.5	1212.19	1606.38	14438.6	3689.98	10748.6	14607.1	10917.1
36	9.97019	144661	7.91541	Parent	0	8.5	1210.94	1604.72	14340.9	3603.48	10737.4	14509.3	10905.8
37	9.97019	143686	7.91541	Parent	0	8.5	1209.69	1603.07	14243.4	3516.98	10726.4	14411.5	10894.6
38	9.97019	142712	7.91541	Parent	0	8.5	1208.45	1601.42	14145.8	3430.48	10715.3	14313.8	10883.3
39	12.4627	177327	6.1203	Parent	0	8.5	1212.7	1607.06	14098.6	3345.54	10753	14228.6	10883.1
40	12.4627	176422	6.1203	Parent	0	8.5	1213.89	1608.64	14025.8	3262.15	10763.7	14156	10893.8
41	12.4627	175517	6.1203	Parent	0	8.5	1215.09	1610.23	13953.1	3178.76	10774.3	14083.4	10904.6
42	12.4627	174612	6.1203	Parent	0	8.5	1216.29	1611.82	13880.3	3095.37	10784.9	14010.7	10915.4
43	12.4627	173800	5.57729	Parent	0	8.5	1219.21	1615.69	13826.6	3015.71	10810.8	13945.6	10929.9
44	12.4627	173080	5.57729	Parent	0	8.5	1221.24	1618.38	13768.6	2939.77	10828.8	13887.8	10948.1
45	12.4627	172361	5.57729	Parent	0	8.5	1223.28	1621.08	13710.7	2863.83	10846.8	13830.1	10966.3
46	12.4627	172544	5.57729	Parent	0	8.5	1233.39	1634.47	13724.4	2787.89	10936.5	13844.9	11057
47	9.97017	138997	5.57729	Parent	0	8.5	1251.77	1658.83	13819	2719.54	11099.4	13941.2	11221.7
48	9.97017	139854	5.57729	Parent	0	8.5	1268.14	1680.53	13903.4	2658.79	11244.6	14027.3	11368.5
49	9.97017	140712	5.57729	Parent	0	8.5	1284.51	1702.22	13987.9	2598.04	11389.9	14113.3	11515.3
50	9.97017	141569	5.57729	Parent	0	8.5	1300.89	1723.92	14072.2	2537.28	11535	14199.3	11662
51	9.97017	142403	5.57729	Parent	0	8.5	1316.99	1745.26	14154.3	2476.53	11677.8	14282.9	11806.4
52	12.1349	172027	9.02445	Parent	0	8.5	1306.27	1731.06	13968.8	2386.02	11582.8	14176.2	11790.2
53	12.1349	169389	9.02445	Parent	0	8.5	1295.5	1716.79	13753.1	2265.76	11487.3	13958.9	11693.1
54	12.1349	167760	9.02445	Parent	0	8.5	1293.97	1714.75	13619.1	2145.5	11473.6	13824.6	11679.1
55	12.1349	166363	8.16154	Parent	0	8.5	1296.09	1717.57	13523.6	2031.07	11492.5	13709.4	11678.4
56	12.1349	165107	8.16154	Parent	0	8.5	1296.66	1718.32	13420	1922.47	11497.6	13606	11683.5
57	12.1349	163851	8.16154	Parent	0	8.5	1297.23	1719.07	13316.5	1813.87	11502.6	13502.5	11688.6
58	12.1349	162417	9.24441	Parent	0	8.5	1294.2	1715.06	13173.6	1697.95	11475.7	13384.3	11686.3
59	12.1349	160805	9.24441	Parent	0	8.5	1293.14	1713.65	13041	1574.71	11466.3	13251.4	11676.7
60	12.1349	159193	9.24441	Parent	0	8.5	1292.07	1712.24	12908.3	1451.46	11456.9	13118.6	11667.2
61	12.1349	157723	8.38252	Parent	0	8.5	1293.87	1714.62	12806.9	1334.05	11472.8	12997.5	11663.5
62	12.1349	156395	8.38252	Parent	0	8.5	1294.1	1714.93	12697.3	1222.47	11474.8	12888	11665.5
63	12.1349	155066	8.38252	Parent	0	8.5	1294.34	1715.24	12587.8	1110.89	11476.9	12778.5	11667.6
64	11.4876	145409	9.99321	Parent	0	8.5	1290.02	1709.52	12430.6	991.946	11438.7	12657.9	11666
65	11.4876	144069	9.99321	Parent	0	8.5	1291.09	1710.94	12313.8	865.638	11448.1	12541.3	11675.6
66	11.4876	142749	9.99321	Parent	0	8.5	1292.34	1712.6	12198.7	739.329	11459.3	12426.4	11687
67	11.4876	141428	9.99321	Parent	0	8.5	1293.6	1714.27	12083.4	613.021	11470.4	12311.4	11698.4
68	11.464	139821	9.99617	Parent	0	8.5	1294.85	1715.92	11968.3	486.824	11481.5	12196.5	11709.7
69	11.464	138505	9.99617	Parent	0	8.5	1296.09	1717.57	11853.3	360.737	11492.5	12081.7	11721
70	11.464	137189	9.99617	Parent	0	8.5	1297.35	1719.23	11738.3	234.649	11503.6	11966.9	11732.3
71	11.464	135873	9.99617	Parent	0	8.5	1298.59	1720.88	11623.2	108.562	11514.7	11852.1	11743.6
72	4.15928	48971.8	9.95334	Parent	0	8.5	1299.56	1722.17	11546.1	22.7458	11523.3	11774.1	11751.4
73	10.4242	121982	9.95334	Parent 5	285	8.5	1504.98	1994.38	11437.7	0	11437.7	11701.8	11701.8
74	10.4242	121386	9.95334	Parent 5	285	8.5	1498.65	1986	11381.6	0	11381.6	11644.6	11644.6
75	10.4242	121601	9.95334	Parent 5	285	8.5	1500.93	1989.02	11401.9	0	11401.9	11665.3	11665.3
76	10.4242	121830	9.95334	Parent 5	285	8.5	1503.36	1992.24	11423.3	0	11423.3	11687.2	11687.2
77	11.3582	133001	9.9852	Parent 5	285	8.5	1505.75	1995.41	11444.6	0	11444.6	11709.7	11709.7
78	11.3582	133268	9.9852	Parent 5	285	8.5	1508.35	1998.85	11467.6	0	11467.6	11733.2	11733.2
79	11.3582	136073	9.9852	Parent 5	285	8.5	1535.65	2035.03	11709.7	0	11709.7	11980.1	11980.1
80	11.3582	141005	9.9852	Parent 5	285	8.5	1583.67	2098.67	12135.5	0	12135.5	12414.3	12414.3
81	11.5778	148808	9.97941	Parent 5	285	8.5	1632.19	2162.96	12565.7	0	12565.7	12852.9	12852.9

82	11.5778	153935	9.97941	Parent 5	285	8.5	1681.16	2227.85	12999.8	0	12999.8	13295.7	13295.7
83	11.5778	159062	9.97941	Parent 5	285	8.5	1730.12	2292.74	13434.1	0	13434.1	13738.5	13738.5
84	11.5778	164189	9.97941	Parent 5	285	8.5	1779.09	2357.63	13868.3	0	13868.3	14181.3	14181.3
85	11.5943	169560	9.98559	Parent 5	285	8.5	1828.05	2422.52	14302.5	0	14302.5	14624.4	14624.4
86	11.5943	173404	9.98559	Parent 5	285	8.5	1864.73	2471.12	14627.6	0	14627.6	14955.9	14955.9
87	11.5943	174915	9.98559	Parent 5	285	8.5	1879.13	2490.21	14755.4	0	14755.4	15086.2	15086.2
88	11.5943	176378	9.98559	Parent 5	285	8.5	1893.09	2508.71	14879.1	0	14879.1	15212.4	15212.4
89	1.1209	17056.3	47.8771	Parent 5	1100	28	4803.98	6366.19	9904.28	0	9904.28	15216.7	15216.7
90	13.0374	188358	47.8771	Slide Mass 4	1500	15	3312.51	4389.7	10784.5	0	10784.5	14447.6	14447.6
91	13.0374	169256	47.8771	Slide Mass 4	1500	15	3070.4	4068.87	9587.12	0	9587.12	12982.5	12982.5
92	7.71887	90953.4	49.3993	Slide Mass 4	1500	15	2843.65	3768.37	8465.63	0	8465.63	11783.3	11783.3
93	10.8618	115845	49.3993	Slide Mass 3	2500	15	3271.33	4335.13	6848.8	0	6848.8	10665.4	10665.4
94	10.8618	101582	49.3993	Slide Mass 3	2500	15	3056.5	4050.44	5786.32	0	5786.32	9352.32	9352.32
95	5.80829	47757.2	50.7905	Slide Mass 3	2500	15	2844.17	3769.06	4736.2	0	4736.2	8222.31	8222.31
96	11.8171	81732.5	50.7905	Slide Mass 2	3500	15	3237.31	4290.05	2948.52	0	2948.52	6916.52	6916.52
97	11.8171	61041	50.7905	Slide Mass 2	3500	15	2953.59	3914.06	1545.3	0	1545.3	5165.53	5165.53
98	5.99034	23084.2	50.3344	Slide Mass 2	3500	15	2749.8	3644	537.425	0	537.425	3853.62	3853.62
99	11.7261	30052.3	50.3344	Slide Mass 1	1750	15	1478.3	1959.03	780.097	0	780.097	2562.89	2562.89
100	11.7261	10017.4	50.3344	Slide Mass 1	1750	15	1200.55	1590.96	-593.534	0	-593.534	854.31	854.31

Global Minimum Query (spencer) - Safety Factor: 1.41003

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [degrees]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	9.28297	3084.94	-29.4572	Parent	535	28	691.188	974.596	826.76	0	826.76	436.387	436.387
2	13.065	14794.4	-29.4572	Parent	535	28	1003.09	1414.38	1884.67	230.794	1653.87	1318.14	1087.35
3	13.065	27015.9	-29.4572	Parent	535	28	1270.02	1790.77	3054.21	692.437	2361.77	2336.91	1644.48
4	11.8049	34481.6	-27.2224	Parent	535	28	1464.31	2064.72	3990.25	1113.27	2876.98	3236.98	2123.71
5	11.8049	43612.9	-27.2224	Parent	535	28	1677.85	2365.82	4936.56	1493.28	3443.28	4073.43	2580.15
6	11.8049	55649	-27.2224	Parent	535	28	2019.22	2847.16	6221.83	1873.3	4348.53	5183.1	3309.8
7	11.6049	66037	-24.2424	Parent	535	28	2254.59	3179.04	7199.6	2226.88	4972.72	6184.34	3957.46
8	11.6049	74437.9	-24.2424	Parent	535	28	2459.13	3467.45	8069.15	2554.04	5515.11	6961.78	4407.74
9	11.6049	82827.8	-24.2424	Parent	535	28	2663.21	3755.2	8937.52	2881.19	6056.33	7738.26	4857.07
10	11.6049	91217.7	-24.2424	Parent	535	28	2867.28	4042.95	9805.82	3208.34	6597.48	8514.66	5306.32
11	11.6054	99127.6	-21.4435	Parent	535	28	2949.21	4158.48	10329.4	3514.66	6814.75	9171.04	5656.38
12	11.6054	106550	-21.4435	Parent	535	28	3124.63	4405.82	11080.1	3800.16	7279.95	9852.84	6052.68
13	11.6054	113972	-21.4435	Parent	535	28	3300.04	4653.16	11830.8	4085.66	7745.14	10534.6	6448.97
14	11.6054	121393	-21.4435	Parent	535	28	3475.47	4900.51	12581.5	4371.15	8210.34	11216.4	6845.28
15	10.7411	115494	5.07054	Parent	0	8.5	655.407	924.144	10668.3	4484.66	6183.64	10726.5	6241.79
16	10.7411	114779	5.07054	Parent	0	8.5	654.602	923.009	10602.2	4426.17	6176.01	10660.3	6234.09
17	10.7411	113862	5.07054	Parent	0	8.5	651.827	919.095	10517.5	4367.69	6149.82	10575.3	6207.66
18	10.7411	112943	5.07054	Parent	0	8.5	649.028	915.149	10432.6	4309.2	6123.36	10490.2	6180.95
19	10.7411	112019	5.07054	Parent	0	8.5	646.186	911.141	10347.3	4250.71	6096.63	10404.7	6153.96
20	11.0197	146384	5.07054	Parent	0	8.5	951.575	1341.75	13179.7	4201.93	8977.81	13264.2	9062.24
21	11.0197	153704	5.07054	Parent	0	8.5	1020.74	1439.28	13838.9	4208.48	9630.39	13929.4	9720.96
22	11.0197	152358	5.07054	Parent	0	8.5	1007.19	1420.17	13717.7	4215.03	9502.63	13807	9591.99
23	11.0197	151011	5.07054	Parent	0	8.5	993.646	1401.07	13596.4	4221.58	9374.77	13684.5	9462.94
24	11.0197	149664	5.07054	Parent	0	8.5	980.1	1381.97	13475.1	4228.13	9247.01	13562.1	9333.97
25	10.6251	144088	5.07054	Parent	0	8.5	980.071	1381.93	13481.3	4234.57	9246.77	13568.3	9333.73
26	10.6251	149745	5.07054	Parent	0	8.5	1053.64	1485.66	14181.6	4240.88	9940.76	14275.1	10034.2
27	10.6251	148493	5.07054	Parent	0	8.5	1040.57	1467.24	14064.7	4247.2	9817.53	14157.1	9909.86

28	10.6251	147241	5.07054	Parent	0	8.5	1027.51	1448.82	13947.8	4253.52	9694.31	14039	9785.48
29	10.6251	145989	5.07054	Parent	0	8.5	1014.45	1430.4	13830.9	4259.84	9571.09	13920.9	9661.1
30	13.2813	180725	5.07054	Parent	0	8.5	999.752	1409.68	13699.3	4266.94	9432.37	13788	9521.07
31	13.2813	178769	5.07054	Parent	0	8.5	983.426	1386.66	13553.2	4274.84	9278.37	13640.5	9365.63
32	13.2813	176812	5.07054	Parent	0	8.5	967.093	1363.63	13407	4282.73	9124.31	13492.8	9210.11
33	13.2813	174856	5.07054	Parent	0	8.5	950.767	1340.61	13260.9	4290.63	8970.23	13345.2	9054.59
34	11.8585	154470	5.07054	Parent	0	8.5	935.313	1318.82	13122.5	4298.1	8824.41	13205.5	8907.4
35	11.8585	152911	5.07054	Parent	0	8.5	920.732	1298.26	12992.1	4305.15	8686.91	13073.8	8768.61
36	11.8585	155799	5.07054	Parent	0	8.5	943.888	1330.91	13206.7	4301.36	8905.32	13290.4	8989.07
37	11.8585	183080	5.07054	Parent	0	8.5	1174.61	1656.24	15317.9	4235.7	11082.2	15422.1	11186.4
38	11.8585	182586	5.07054	Parent	0	8.5	1177.19	1659.87	15276.5	4170.04	11106.5	15381	11211
39	14.1577	217339	5.07054	Parent	0	8.5	1180.02	1663.86	15231.2	4098.02	11133.2	15335.9	11237.9
40	14.1577	216634	5.07054	Parent	0	8.5	1183.09	1668.19	15181.8	4019.63	11162.2	15286.8	11267.1
41	14.1577	215930	5.07054	Parent	0	8.5	1186.17	1672.53	15132.4	3941.25	11191.1	15237.6	11296.4
42	14.1577	215225	5.07054	Parent	0	8.5	1189.24	1676.87	15083	3862.86	11220.1	15188.5	11325.7
43	13.3039	201565	5.26273	Parent	0	8.5	1191.17	1679.59	15023.8	3785.43	11238.4	15133.6	11348.1
44	13.3039	200868	5.26273	Parent	0	8.5	1193.77	1683.25	14971.9	3708.96	11262.9	15081.8	11372.9
45	13.3039	200171	5.26273	Parent	0	8.5	1196.36	1686.91	14919.9	3632.5	11287.4	15030.1	11397.6
46	13.3039	199474	5.26273	Parent	0	8.5	1198.96	1690.57	14867.9	3556.03	11311.9	14978.4	11422.3
47	10.8088	161178	8.14482	Parent	0	8.5	1186.1	1672.43	14660	3469.53	11190.5	14829.8	11360.2
48	10.8088	159973	8.14482	Parent	0	8.5	1184.67	1670.42	14550	3373	11177	14719.6	11346.6
49	10.8088	158813	8.14482	Parent	0	8.5	1183.68	1669.02	14444.1	3276.47	11167.7	14613.6	11337.1
50	10.8088	158711	8.14482	Parent	0	8.5	1192.87	1681.98	14434.3	3179.94	11254.4	14605.1	11425.1
51	10.8088	159055	8.14482	Parent	0	8.5	1206.35	1700.99	14465	3083.41	11381.6	14637.7	11554.3
52	12.3228	181500	9.63455	Parent	0	8.5	1212.78	1710.05	14412.1	2969.88	11442.2	14618	11648.1
53	12.3228	181442	9.63455	Parent	0	8.5	1226	1728.7	14406.3	2839.35	11567	14614.4	11775.1
54	12.3228	181368	9.63455	Parent	0	8.5	1239.11	1747.18	14399.4	2708.81	11690.6	14609.8	11901
55	12.3228	179437	9.63455	Parent	0	8.5	1236.6	1743.64	14245.3	2578.28	11667	14455.2	11876.9
56	12.3228	176503	9.63455	Parent	0	8.5	1225.68	1728.24	14011.6	2447.75	11563.9	14219.7	11772
57	12.3228	174614	9.63455	Parent	0	8.5	1223.52	1725.2	13860.8	2317.21	11543.5	14068.5	11751.2
58	12.3228	172819	9.63455	Parent	0	8.5	1222.16	1723.28	13717.4	2186.68	11530.7	13924.9	11738.2
59	12.3228	171023	9.63455	Parent	0	8.5	1220.8	1721.36	13574	2056.14	11517.9	13781.3	11725.1
60	12.3227	169227	9.63455	Parent	0	8.5	1219.44	1719.44	13430.7	1925.61	11505	13637.7	11712.1
61	12.3227	167432	9.63455	Parent	0	8.5	1218.07	1717.52	13287.3	1795.08	11492.2	13494.1	11699
62	12.3227	165637	9.63455	Parent	0	8.5	1216.71	1715.6	13143.9	1664.54	11479.4	13350.5	11685.9
63	12.3227	163842	9.63455	Parent	0	8.5	1215.35	1713.68	13000.5	1534.01	11466.5	13206.9	11672.8
64	12.3227	162047	9.63455	Parent	0	8.5	1213.99	1711.76	12857.2	1403.48	11453.7	13063.3	11659.8
65	12.3227	160252	9.63455	Parent	0	8.5	1212.63	1709.84	12713.8	1272.95	11440.9	12919.7	11646.7
66	12.3227	158457	9.63455	Parent	0	8.5	1211.27	1707.92	12570.4	1142.41	11428	12776.1	11633.6
67	12.3227	156803	9.63455	Parent	0	8.5	1211.09	1707.68	12438.3	1011.88	11426.4	12643.9	11632
68	10.7939	136197	9.63455	Parent	0	8.5	1212.91	1710.24	12332.9	889.443	11443.5	12538.8	11649.4
69	10.7939	135125	9.63455	Parent	0	8.5	1214.65	1712.69	12235	775.105	11459.9	12441.2	11666.1
70	10.7939	134053	9.63455	Parent	0	8.5	1216.39	1715.14	12137	660.767	11476.3	12343.5	11682.7
71	10.7939	132981	9.63455	Parent	0	8.5	1218.12	1717.59	12039.1	546.428	11492.7	12245.9	11699.5
72	11.5174	140709	9.66072	Parent	0	8.5	1219.79	1719.94	11936.4	428.089	11508.3	12144.1	11716
73	11.5174	139480	9.66072	Parent	0	8.5	1221.61	1722.5	11831.3	305.749	11525.6	12039.3	11733.5
74	11.5174	138252	9.66072	Parent	0	8.5	1223.43	1725.07	11726.1	183.409	11542.7	11934.4	11751
75	11.5174	137024	9.66072	Parent	0	8.5	1225.24	1727.63	11620.9	61.0694	11559.9	11829.5	11768.4
76	11.5174	136103	9.66072	Parent 5	285	8.5	1423.83	2007.64	11526.4	0	11526.4	11768.8	11768.8
77	11.5174	136354	9.66072	Parent 5	285	8.5	1426.08	2010.82	11547.7	0	11547.7	11790.5	11790.5
78	11.5174	136720	9.66072	Parent 5	285	8.5	1429.37	2015.46	11578.8	0	11578.8	11822.1	11822.1
79	11.5174	137086	9.66072	Parent 5	285	8.5	1432.66	2020.1	11609.9	0	11609.9	11853.8	11853.8
80	13.7208	163999	9.68003	Parent 5	285	8.5	1437.75	2027.27	11657.8	0	11657.8	11903.1	11903.1
81	13.7208	169405	9.68003	Parent 5	285	8.5	1478.54	2084.79	12042.7	0	12042.7	12294.9	12294.9
82	13.7208	176732	9.68003	Parent 5	285	8.5	1533.82	2162.73	12564.2	0	12564.2	12825.8	12825.8
83	13.7344	184210	9.84523	Parent 5	285	8.5	1588.02	2239.15	13075.5	0	13075.5	13351.1	13351.1
84	13.7344	191482	9.84523	Parent 5	285	8.5	1642.79	2316.38	13592.3	0	13592.3	13877.4	13877.4
85	13.7344	198753	9.84523	Parent 5	285	8.5	1697.57	2393.62	14109.1	0	14109.1	14403.7	14403.7
86	13.4215	201139	9.97223	Parent 5	285	8.5	1750.15	2467.76	14605.2	0	14605.2	14912.9	14912.9
87	13.4215	204740	9.97223	Parent 5	285	8.5	1777.89	2506.88	14866.9	0	14866.9	15179.5	15179.5
88	13.4215	206707	9.97223	Parent 5	285	8.5	1793.04	2528.24	15009.9	0	15009.9	15325.1	15325.1

89	3.37525	51679.5	46.0225	Parent 5	1100	28	4569.92	6443.72	10050.1	0	10050.1	14786.1	14786.1
90	13.5507	196144	46.0225	Slide Mass 4	1500	15	3074.3	4334.86	10579.8	0	10579.8	13765.9	13765.9
91	13.5507	177145	46.0225	Slide Mass 4	1500	15	2865	4039.74	9478.44	0	9478.44	12447.6	12447.6
92	9.05199	107291	48.1013	Slide Mass 4	1500	15	2643.3	3727.13	8311.78	0	8311.78	11257.9	11257.9
93	10.7134	114933	48.1013	Slide Mass 3	2500	15	3080.79	4344	6881.89	0	6881.89	10315.6	10315.6
94	10.7134	101760	48.1013	Slide Mass 3	2500	15	2900.33	4089.55	5932.3	0	5932.3	9164.91	9164.91
95	7.1744	59634.9	50.177	Slide Mass 3	2500	15	2687.47	3789.41	4812.13	0	4812.13	8035.1	8035.1
96	11.6541	80976.9	50.177	Slide Mass 2	3500	15	3086.73	4352.38	3181.13	0	3181.13	6882.91	6882.91
97	11.6541	61301.3	50.177	Slide Mass 2	3500	15	2843.42	4009.3	1900.74	0	1900.74	5310.72	5310.72
98	6.90576	27040.9	50.177	Slide Mass 2	3500	15	2649.67	3736.11	881.19	0	881.19	4058.83	4058.83
99	11.7884	30197.5	50.177	Slide Mass 1	1750	15	1411.85	1990.75	898.493	0	898.493	2591.66	2591.66
100	11.7884	10065.8	50.177	Slide Mass 1	1750	15	1165.74	1643.73	-396.615	0	-396.615	1001.41	1001.41

Interslice Data

Global Minimum Query (bishop simplified) - Safety Factor: 1.35102

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	300.553	2597.76	0	0	0
2	315.288	2586.46	16640.1	0	0
3	320.603	2582.39	28560.3	0	0
4	324.495	2579.4	45303.8	0	0
5	336.466	2571.21	100878	0	0
6	348.437	2563.02	170947	0	0
7	358.83	2556.39	238372	0	0
8	369.223	2549.76	315352	0	0
9	379.615	2543.13	401629	0	0
10	390.39	2536.52	496959	0	0
11	401.165	2529.9	601402	0	0
12	411.939	2523.29	714925	0	0
13	421.643	2524.21	712809	0	0
14	431.348	2525.12	710677	0	0
15	441.052	2526.03	708524	0	0
16	450.756	2526.95	706351	0	0
17	460.454	2527.86	704161	0	0
18	470.152	2528.77	701950	0	0
19	479.85	2529.69	699808	0	0
20	489.548	2530.6	697705	0	0
21	499.301	2531.46	696332	0	0
22	509.053	2532.32	694929	0	0
23	518.806	2533.19	693497	0	0
24	528.558	2534.05	692036	0	0
25	538.356	2534.91	690523	0	0
26	548.155	2535.78	688980	0	0
27	557.953	2536.65	687408	0	0
28	567.752	2537.52	685807	0	0
29	578.468	2538.46	684041	0	0
30	589.183	2539.41	682240	0	0
31	599.899	2540.35	680404	0	0

32	610.637	2541.44	677015	0	0
33	621.376	2542.53	673820	0	0
34	632.114	2543.61	670699	0	0
35	642.084	2545	662387	0	0
36	652.055	2546.39	654199	0	0
37	662.025	2547.77	646133	0	0
38	671.995	2549.16	638191	0	0
39	681.965	2550.55	630372	0	0
40	694.428	2551.88	626322	0	0
41	706.891	2553.22	622383	0	0
42	719.353	2554.55	618557	0	0
43	731.816	2555.89	614843	0	0
44	744.279	2557.11	612886	0	0
45	756.741	2558.32	611025	0	0
46	769.204	2559.54	609259	0	0
47	781.667	2560.76	607599	0	0
48	791.637	2561.73	606359	0	0
49	801.607	2562.71	605197	0	0
50	811.577	2563.68	604111	0	0
51	821.548	2564.65	603104	0	0
52	831.518	2565.63	602173	0	0
53	843.653	2567.55	590762	0	0
54	855.788	2569.48	579638	0	0
55	867.922	2571.41	568754	0	0
56	880.057	2573.15	560608	0	0
57	892.192	2574.89	552649	0	0
58	904.327	2576.63	544878	0	0
59	916.462	2578.6	534225	0	0
60	928.597	2580.58	523822	0	0
61	940.732	2582.55	513668	0	0
62	952.867	2584.34	506131	0	0
63	965.001	2586.13	498793	0	0
64	977.136	2587.92	491653	0	0
65	988.624	2589.94	480990	0	0
66	1000.11	2591.97	470576	0	0
67	1011.6	2593.99	460409	0	0
68	1023.09	2596.02	450489	0	0
69	1034.55	2598.04	440829	0	0
70	1046.01	2600.06	431415	0	0
71	1057.48	2602.08	422248	0	0
72	1068.94	2604.1	413327	0	0
73	1073.1	2604.83	410187	0	0
74	1083.53	2606.66	404613	0	0
75	1093.95	2608.49	399077	0	0
76	1104.37	2610.32	393527	0	0
77	1114.8	2612.15	387963	0	0
78	1126.16	2614.15	381810	0	0
79	1137.52	2616.14	375639	0	0
80	1148.87	2618.14	369288	0	0
81	1160.23	2620.14	362619	0	0
82	1171.81	2622.18	355509	0	0
83	1183.39	2624.22	348069	0	0
84	1194.97	2626.26	340299	0	0
85	1206.54	2628.29	332200	0	0
86	1218.14	2630.33	323739	0	0
87	1229.73	2632.38	315032	0	0
88	1241.33	2634.42	306226	0	0
89	1252.92	2636.46	297327	0	0
90	1254.04	2637.7	290257	0	0
91	1267.08	2652.12	176278	0	0
92	1280.12	2666.53	76529.3	0	0

93	1287.83	2675.54	21341.4	0	0
94	1298.7	2688.21	-31373.4	0	0
95	1309.56	2700.88	-72861.7	0	0
96	1315.37	2708	-90771.1	0	0
97	1327.18	2722.49	-96869	0	0
98	1339	2736.97	-85850.8	0	0
99	1344.99	2744.19	-73958.5	0	0
100	1356.72	2758.34	-68389.5	0	0
101	1368.44	2772.48	0	0	0

Global Minimum Query (janbu simplified) - Safety Factor: 1.32519

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	300.553	2597.76	0	0	0
2	315.288	2586.46	16851	0	0
3	320.603	2582.39	28892.7	0	0
4	324.495	2579.4	45953.3	0	0
5	336.466	2571.21	102464	0	0
6	348.437	2563.02	173635	0	0
7	358.83	2556.39	242050	0	0
8	369.223	2549.76	320128	0	0
9	379.615	2543.13	407605	0	0
10	390.39	2536.52	504222	0	0
11	401.165	2529.9	610050	0	0
12	411.939	2523.29	725057	0	0
13	421.643	2524.21	723162	0	0
14	431.348	2525.12	721249	0	0
15	441.052	2526.03	719312	0	0
16	450.756	2526.95	717352	0	0
17	460.454	2527.86	715372	0	0
18	470.152	2528.77	713370	0	0
19	479.85	2529.69	711446	0	0
20	489.548	2530.6	709567	0	0
21	499.301	2531.46	708417	0	0
22	509.053	2532.32	707235	0	0
23	518.806	2533.19	706021	0	0
24	528.558	2534.05	704775	0	0
25	538.356	2534.91	703475	0	0
26	548.155	2535.78	702143	0	0
27	557.953	2536.65	700779	0	0
28	567.752	2537.52	699383	0	0
29	578.468	2538.46	697839	0	0
30	589.183	2539.41	696257	0	0
31	599.899	2540.35	694636	0	0
32	610.637	2541.44	691495	0	0
33	621.376	2542.53	688578	0	0
34	632.114	2543.61	685736	0	0
35	642.084	2545	677684	0	0
36	652.055	2546.39	669755	0	0
37	662.025	2547.77	661949	0	0
38	671.995	2549.16	654265	0	0
39	681.965	2550.55	646704	0	0
40	694.428	2551.88	642977	0	0
41	706.891	2553.22	639361	0	0
42	719.353	2554.55	635858	0	0
43	731.816	2555.89	632468	0	0
44	744.279	2557.11	630835	0	0
45	756.741	2558.32	629299	0	0
46	769.204	2559.54	627858	0	0
47	781.667	2560.76	626527	0	0
48	791.637	2561.73	625553	0	0

49	801.607	2562.71	624660	0	0
50	811.577	2563.68	623848	0	0
51	821.548	2564.65	623117	0	0
52	831.518	2565.63	622467	0	0
53	843.653	2567.55	611396	0	0
54	855.788	2569.48	600610	0	0
55	867.922	2571.41	590064	0	0
56	880.057	2573.15	582256	0	0
57	892.192	2574.89	574635	0	0
58	904.327	2576.63	567201	0	0
59	916.462	2578.6	556887	0	0
60	928.597	2580.58	546822	0	0
61	940.732	2582.55	537006	0	0
62	952.867	2584.34	529806	0	0
63	965.001	2586.13	522805	0	0
64	977.136	2587.92	516002	0	0
65	988.624	2589.94	505660	0	0
66	1000.11	2591.97	495566	0	0
67	1011.6	2593.99	485719	0	0
68	1023.09	2596.02	476121	0	0
69	1034.55	2598.04	466781	0	0
70	1046.01	2600.06	457688	0	0
71	1057.48	2602.08	448842	0	0
72	1068.94	2604.1	440243	0	0
73	1073.1	2604.83	437220	0	0
74	1083.53	2606.66	431985	0	0
75	1093.95	2608.49	426786	0	0
76	1104.37	2610.32	421574	0	0
77	1114.8	2612.15	416348	0	0
78	1126.16	2614.15	410565	0	0
79	1137.52	2616.14	404764	0	0
80	1148.87	2618.14	398790	0	0
81	1160.23	2620.14	392510	0	0
82	1171.81	2622.18	385808	0	0
83	1183.39	2624.22	378788	0	0
84	1194.97	2626.26	371451	0	0
85	1206.54	2628.29	363796	0	0
86	1218.14	2630.33	355794	0	0
87	1229.73	2632.38	347553	0	0
88	1241.33	2634.42	339219	0	0
89	1252.92	2636.46	330793	0	0
90	1254.04	2637.7	323902	0	0
91	1267.08	2652.12	211605	0	0
92	1280.12	2666.53	113416	0	0
93	1287.83	2675.54	59127.3	0	0
94	1298.7	2688.21	7868.44	0	0
95	1309.56	2700.88	-32259.5	0	0
96	1315.37	2708	-49458.3	0	0
97	1327.18	2722.49	-53910.5	0	0
98	1339	2736.97	-41390.9	0	0
99	1344.99	2744.19	-28801.4	0	0
100	1356.72	2758.34	-22498.7	0	0
101	1368.44	2772.48	0	0	0

Global Minimum Query (spencer) - Safety Factor: 1.41003

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	192.315	2591.54	0	0	0
2	201.598	2586.3	10750.9	966.014	5.13448
3	214.663	2578.92	37763.2	3393.18	5.13447
4	227.728	2571.54	76893.1	6909.16	5.13447

5	239.532	2565.46	118411	10639.7	5.13447
6	251.337	2559.39	168196	15113.1	5.13447
7	263.142	2553.32	229816	20649.9	5.13447
8	274.747	2548.09	293604	26381.5	5.13447
9	286.352	2542.87	364310	32734.7	5.13446
10	297.957	2537.64	441921	39708.5	5.13448
11	309.562	2532.42	526439	47302.7	5.13447
12	321.167	2527.86	607750	54608.9	5.13448
13	332.773	2523.3	694519	62405.4	5.13447
14	344.378	2518.74	786746	70692.3	5.13447
15	355.983	2514.18	884430	79469.6	5.13447
16	366.724	2515.14	881302	79188.6	5.13447
17	377.466	2516.09	878229	78912.5	5.13447
18	388.207	2517.04	875207	78640.9	5.13447
19	398.948	2518	872235	78373.9	5.13447
20	409.689	2518.95	869314	78111.5	5.13448
21	420.708	2519.93	866914	77895.8	5.13447
22	431.728	2520.9	864631	77690.6	5.13447
23	442.748	2521.88	862317	77482.7	5.13447
24	453.768	2522.86	859973	77272.1	5.13447
25	464.787	2523.84	857597	77058.7	5.13448
26	475.413	2524.78	855301	76852.3	5.13447
27	486.038	2525.72	853126	76656.9	5.13447
28	496.663	2526.67	850923	76458.9	5.13447
29	507.288	2527.61	848691	76258.4	5.13447
30	517.913	2528.55	846431	76055.3	5.13447
31	531.194	2529.73	843565	75797.8	5.13447
32	544.476	2530.91	840654	75536.2	5.13447
33	557.757	2532.09	837699	75270.7	5.13447
34	571.038	2533.27	834700	75001.2	5.13447
35	582.897	2534.32	831983	74757.1	5.13447
36	594.755	2535.37	829232	74509.9	5.13447
37	606.614	2536.42	826529	74267	5.13447
38	618.472	2537.47	824341	74070.4	5.13447
39	630.331	2538.53	822227	73880.4	5.13447
40	644.489	2539.78	819800	73662.4	5.13447
41	658.646	2541.04	817478	73453.8	5.13448
42	672.804	2542.29	815262	73254.6	5.13447
43	686.962	2543.55	813152	73065	5.13447
44	700.266	2544.78	810588	72834.7	5.13448
45	713.569	2546	808123	72613.2	5.13447
46	726.873	2547.23	805756	72400.5	5.13447
47	740.177	2548.45	803487	72196.6	5.13447
48	750.986	2550	793629	71310.9	5.13448
49	761.795	2551.55	783926	70439	5.13447
50	772.604	2553.09	774376	69580.9	5.13448
51	783.412	2554.64	764940	68733	5.13447
52	794.221	2556.19	755603	67894	5.13447
53	806.544	2558.28	740399	66527.9	5.13447
54	818.867	2560.37	725371	65177.5	5.13447
55	831.19	2562.46	710518	63842.9	5.13447
56	843.512	2564.55	695957	62534.6	5.13447
57	855.835	2566.65	681750	61258	5.13447
58	868.158	2568.74	667832	60007.4	5.13447
59	880.481	2570.83	654197	58782.3	5.13447
60	892.804	2572.92	640845	57582.6	5.13448
61	905.126	2575.01	627777	56408.3	5.13447
62	917.449	2577.11	614991	55259.5	5.13448
63	929.772	2579.2	602489	54136.1	5.13447
64	942.095	2581.29	590270	53038.2	5.13447
65	954.417	2583.38	578334	51965.7	5.13447

66	966.74	2585.47	566682	50918.7	5.13447
67	979.063	2587.57	555312	49897.1	5.13448
68	991.385	2589.66	544217	48900.1	5.13447
69	1002.18	2591.49	534711	48046	5.13447
70	1012.97	2593.32	525403	47209.6	5.13447
71	1023.77	2595.15	516293	46391.1	5.13448
72	1034.56	2596.99	507382	45590.3	5.13447
73	1046.08	2598.95	498028	44749.9	5.13448
74	1057.6	2600.91	488902	43929.8	5.13447
75	1069.11	2602.87	480003	43130.2	5.13447
76	1080.63	2604.83	471331	42351	5.13447
77	1092.15	2606.79	465131	41793.9	5.13447
78	1103.67	2608.75	458916	41235.5	5.13447
79	1115.18	2610.71	452677	40674.9	5.13447
80	1126.7	2612.67	446416	40112.3	5.13447
81	1140.42	2615.01	438859	39433.3	5.13447
82	1154.14	2617.35	430961	38723.6	5.13447
83	1167.86	2619.69	422601	37972.4	5.13447
84	1181.6	2622.08	413246	37131.8	5.13447
85	1195.33	2624.46	403411	36248.1	5.13447
86	1209.07	2626.84	393097	35321.4	5.13448
87	1222.49	2629.2	382120	34335.1	5.13448
88	1235.91	2631.56	370898	33326.8	5.13449
89	1249.33	2633.92	359543	32306.4	5.13447
90	1252.71	2637.42	339813	30533.6	5.13447
91	1266.26	2651.46	232897	20926.8	5.13448
92	1279.81	2665.51	138613	12454.9	5.13445
93	1288.86	2675.6	78682.3	7069.93	5.13447
94	1299.57	2687.54	29512.9	2651.85	5.13446
95	1310.29	2699.48	-10251	-921.091	5.13445
96	1317.46	2708.08	-32373.3	-2908.87	5.13447
97	1329.11	2722.06	-40860.4	-3671.47	5.13447
98	1340.77	2736.03	-34288.1	-3080.92	5.13446
99	1347.67	2744.32	-23287.8	-2092.51	5.13449
100	1359.46	2758.45	-19346.6	-1738.37	5.13447
101	1371.25	2772.59	0	0	0

Entity Information

Group: Group 1

Shared Entities

Type	Coordinates

X	Y
0	2400
325	2400
2100	2400
2100	2637
2100	2643
2100	2693
2100	2743
2100	2793
2100	2843
2100	2863
2100	2893
1740	2890
1733	2880
1725	2870
1715	2860
1705	2850
1688	2840
1670	2830
1655	2820
1635	2800
1620	2790
1555	2780
1307	2770
1258	2760
1220	2750
1137	2710
1085	2700
981	2690
848	2680
848	2680.01
848.017	2680.01
848	2680
830	2680
770	2670
605	2660
605	2638
588.901	2638
552.82	2638
474	2638
474	2632
412	2632
412	2602
408	2602
368	2601
264	2596
250	2592
0	2590

	X	Y
	250	2592
	336.843	2580.18
	408	2575.83
	410.443	2575.83
	412	2575.83
	426.415	2575
	520	2575
	639.276	2579.23
	748.665	2582.59
	929.108	2591.46
	1070.69	2604.83
	1153.89	2619.43
	1184.94	2624.6
	1232.69	2633.27
	1269.97	2641.01
	1295.65	2647.01
	1331.37	2655.36
	1352.55	2660.31
	1436.77	2682.3
	1456.52	2690.28
	1501.45	2711.7
	1533.28	2726.88
	1538.15	2730.43
	1571.12	2754.42
	1620	2790

	X	Y
	325	2400
Material Boundary	1859.05	2604.83
	2100	2637

	X	Y
	1533.28	2726.88
Material Boundary	1628.48	2735.95
	1772.43	2843
	2100	2843

	X	Y
	1456.52	2690.28
	1643.59	2684.57
Material Boundary	1725.74	2743
	1790.67	2793
	2100	2793

	X	Y
	1070.69	2604.83
Material Boundary	1142.96	2604.83
	1796.72	2604.83
	1859.05	2604.83

	X	Y
Material Boundary	625.172	2617.99
	635.144	2604.99

	X	Y
	605	2638
Material Boundary	608.98	2632.63
	625.172	2617.99

Material Boundary

X	Y
1751.38	2697.67
1807.8	2743

Material Boundary

X	Y
1807.8	2743
2100	2743

Material Boundary

X	Y
1733	2880
2100	2863

Material Boundary

X	Y
1643.59	2684.57
1671.74	2687.99
1751.38	2697.67

Material Boundary

X	Y
1295.65	2647.01
1778.84	2647.01
1872.68	2683.69
2100	2693

Material Boundary

X	Y
635.144	2604.99
1070.69	2604.83

Material Boundary

X	Y
608.98	2632.63
771.118	2643.71
889.239	2652.93
1040.2	2662.15
1107.04	2671.94
1160.05	2685.77
1183.23	2698.93
1210.76	2717.23
1263.67	2735.82

Material Boundary

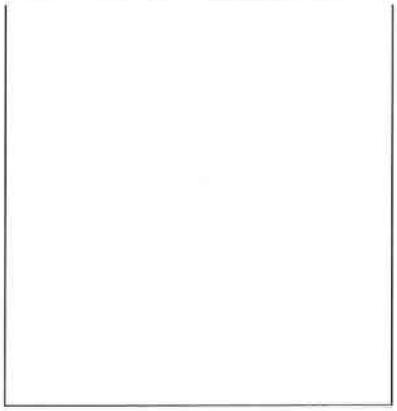
X	Y
1263.67	2735.82
1311.94	2742.7
1571.12	2754.42

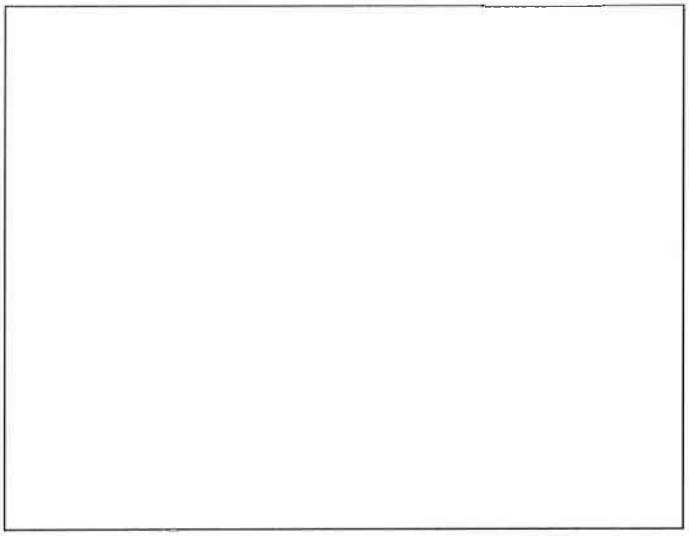
Material Boundary

X	Y
1183.23	2698.93
1254.6	2705.68

Material Boundary

X	Y
625.172	2617.99
903.806	2628.93
1042.92	2628.93
1089.74	2628.93
1232.69	2633.27





	X	Y
Material Boundary	1089.74	2628.93
	1150.23	2649.7
	1191.06	2667.09
	1259.1	2673.9
	1340.76	2678.55
	1436.77	2682.3

	X	Y
Material Boundary	1254.6	2705.68
	1412.45	2711.7
	1501.45	2711.7

Scenario-based Entities

Type	Coordinates	Master Scenario
		Assigned to materials:
Water Table	X: 0, Y: 2586 X: 413.466, Y: 2586.61 X: 598.915, Y: 2604.83 X: 2100, Y: 2604.83	Slide Mass Slide Mass 1 Slide Mass 2 Slide Mass 3 Slide Mass 4 Slide Mass 5 *... and 7 more*
Distributed Load	X: 474, Y: 2638 X: 605, Y: 2638	Constant Distribution Orientation: Vertical Magnitude: 200 lbs/ft2 Creates Excess Pore Pressure: No

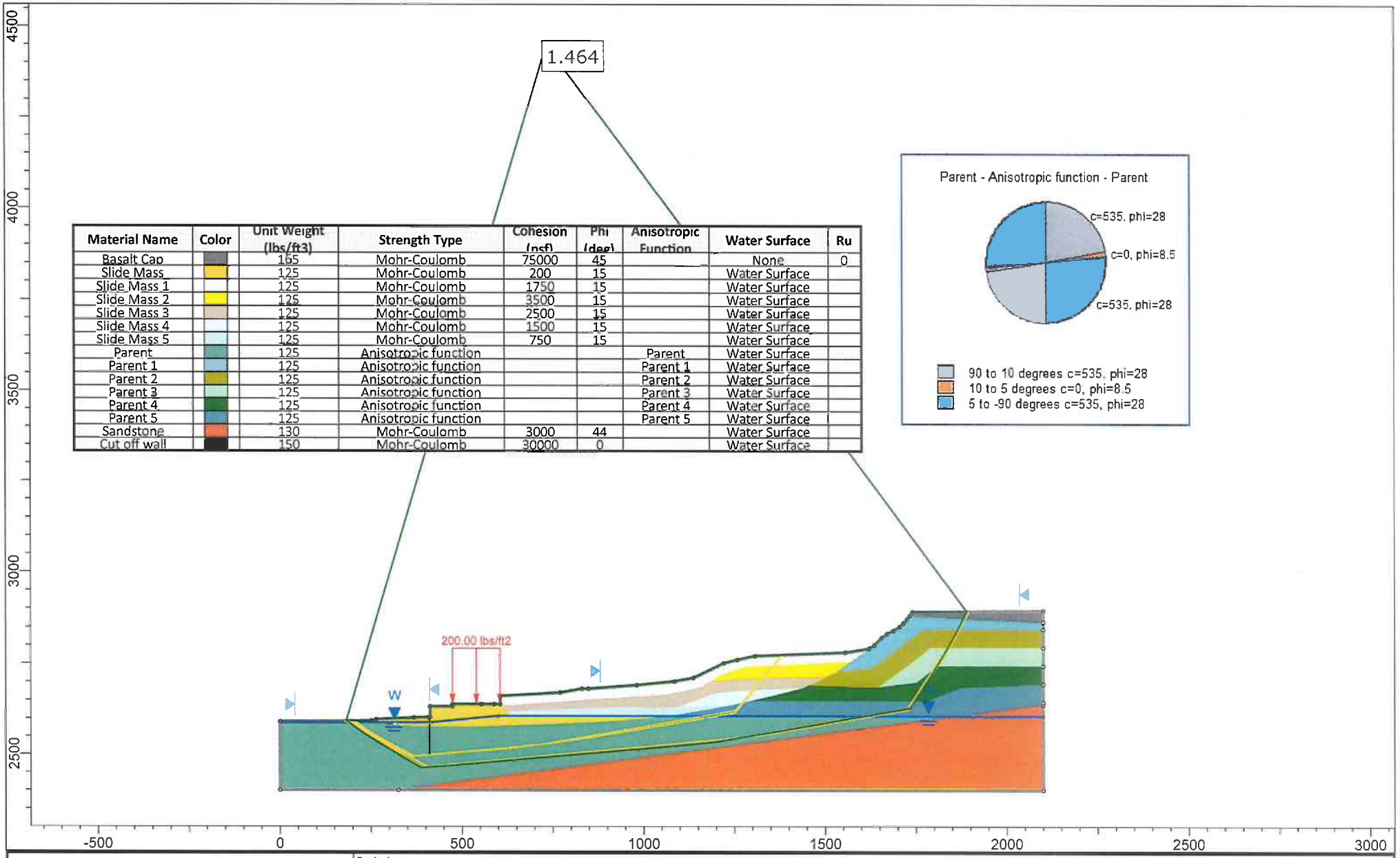
APPENDIX

A-3 Proposed Profile with Reinforcement - Static

Project No. 2180187

1.464

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Anisotropic Function	Water Surface	Ru
Basalt Cap		165	Mohr-Coulomb	75000	45		None	0
Slide Mass		125	Mohr-Coulomb	200	15		Water Surface	
Slide Mass 1		125	Mohr-Coulomb	1750	15		Water Surface	
Slide Mass 2		125	Mohr-Coulomb	3500	15		Water Surface	
Slide Mass 3		125	Mohr-Coulomb	2500	15		Water Surface	
Slide Mass 4		125	Mohr-Coulomb	1500	15		Water Surface	
Slide Mass 5		125	Mohr-Coulomb	750	15		Water Surface	
Parent		125	Anisotropic function			Parent	Water Surface	
Parent 1		125	Anisotropic function			Parent 1	Water Surface	
Parent 2		125	Anisotropic function			Parent 2	Water Surface	
Parent 3		125	Anisotropic function			Parent 3	Water Surface	
Parent 4		125	Anisotropic function			Parent 4	Water Surface	
Parent 5		125	Anisotropic function			Parent 5	Water Surface	
Sandstone		130	Mohr-Coulomb	3000	44		Water Surface	
Cut off wall		150	Mohr-Coulomb	30000	0		Water Surface	



AGEC Applied GeoTech

SLIDEINTERPRET 8.014

Project	Blackstone Hotel - proposed profile, static, un-saturated soil, with reinforcement		
Analysis Description			
Drawn By		Scale 1:4368	Company
Date	9/21/2019 9:30:55 AM		File Name Unsaturated Building Profile A with reinforcement.slmd

Slide Analysis Information

Unsaturated Building Profile A with reinforcement

Project Summary

File Name:	Unsaturated Building Profile A with reinforcement.slmd
Slide Modeler Version:	8.014
Compute Time:	00h:00m:35.483s
Project Title:	SLIDE - An Interactive Slope Stability Program
Date Created:	10/19/2018, 3:12:08 PM

General Settings

Units of Measurement:	Imperial Units
Time Units:	days
Permeability Units:	feet/second
Data Output:	Standard
Failure Direction:	Right to Left

Analysis Options

Slices Type:	Vertical
Analysis Methods Used	
	Bishop simplified
	Janbu simplified
	Spencer
Number of slices:	100
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Groundwater Analysis

Groundwater Method:	Water Surfaces
Pore Fluid Unit Weight [lbs/ft3]:	62.4
Use negative pore pressure cutoff:	Yes
Maximum negative pore pressure [psf]:	0
Advanced Groundwater Method:	None

Random Numbers

Pseudo-random Seed:	10116
Random Number Generation Method:	Park and Miller v.3

Surface Options

Search Method:	Simulated Annealing Search
Minimum Elevation:	Not Defined
Minimum Depth:	Not Defined
Minimum Area:	Not Defined
Minimum Weight:	Not Defined
Convex Surfaces Only:	Enabled

Seismic Loading

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No

Loading

1 Distributed Load present

Distributed Load 1

Distribution:	Constant
Magnitude [psf]:	200
Orientation:	Vertical

Materials

Property	Basalt Cap	Slide Mass	Slide Mass 1	Slide Mass 2	Slide Mass 3	Slide Mass 4	Slide Mass 5	Parent
Color								
Strength Type	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Anisotropic function
Unit Weight [lbs/ft3]	165	125	125	125	125	125	125	125
Cohesion [psf]	75000	200	1750	3500	2500	1500	750	
Friction Angle [°]	45	15	15	15	15	15	15	
Water Surface	None	Water Table	Water Table	Water Table	Water Table	Water Table	Water Table	Water Table
Hu Value		1	1	1	1	1	1	1
Ru Value	0							

Anisotropic Functions

Name: Parent 5

Angle From	Angle To	c	phi
-90	5	1100	28
5	10	285	8.5
10	90	1100	28

Name: Parent 4

Angle From	Angle To	c	phi
-90	5	1850	28
5	10	750	8.5
10	90	1850	28

Name: Parent 3

Angle From	Angle To	c	phi
-90	5	3100	28
5	10	1600	8.5
10	90	3100	28

Name: Parent 2

Angle From	Angle To	c	phi
-90	5	4600	28
5	10	2500	8.5
10	90	4600	28

Name: Parent 1

Angle From	Angle To	c	phi
-90	5	2200	28
5	10	1140	8.5
10	90	2200	28

Name: Parent

Angle From	Angle To	c	phi
-90	5	535	28
5	10	0	8.5
10	90	535	28

Property	Parent 1	Parent 2	Parent 3	Parent 4	Parent 5	Sandstone	Cut off wall
Color							
Strength Type	Anisotropic function	Anisotropic function	Anisotropic function	Anisotropic function	Anisotropic function	Mohr-Coulomb	Mohr-Coulomb
Unit Weight [lbs/ft3]	125	125	125	125	125	130	150
Cohesion [psf]						3000	30000
Friction Angle [°]						44	0
Water Surface	Water Table	Water Table	Water Table	Water Table	Water Table	Water Table	Water Table
Hu Value	1	1	1	1	1	1	1

Anisotropic Functions

Name: Parent 5

Angle From	Angle To	c	phi
-90	5	1100	28
5	10	285	8.5
10	90	1100	28

Name: Parent 4

Angle From	Angle To	c	phi
-90	5	1850	28
5	10	750	8.5
10	90	1850	28

Name: Parent 3

Angle From	Angle To	c	phi
-90	5	3100	28
5	10	1600	8.5
10	90	3100	28

Name: Parent 2

Angle From	Angle To	c	phi
-90	5	4600	28
5	10	2500	8.5
10	90	4600	28

Name: Parent 1

Angle From	Angle To	c	phi
-90	5	2200	28
5	10	1140	8.5
10	90	2200	28

Name: Parent

Angle From	Angle To	c	phi
-90	5	535	28
5	10	0	8.5
10	90	535	28

Global Minimums

Method: bishop simplified

FS	1.395260
Axis Location:	603.712, 3871.603
Left Slip Surface Endpoint:	190.438, 2591.524
Right Slip Surface Endpoint:	1379.811, 2772.936
Resisting Moment:	4.19513e+09 lb-ft
Driving Moment:	3.00669e+09 lb-ft
Total Slice Area:	131682 ft2
Surface Horizontal Width:	1189.37 ft
Surface Average Height:	110.715 ft

Method: janbu simplified

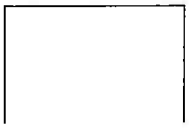
FS	1.363340
Axis Location:	603.712, 3871.603
Left Slip Surface Endpoint:	190.438, 2591.524
Right Slip Surface Endpoint:	1379.811, 2772.936
Resisting Horizontal Force:	2.76218e+06 lb
Driving Horizontal Force:	2.02605e+06 lb
Total Slice Area:	131682 ft2
Surface Horizontal Width:	1189.37 ft
Surface Average Height:	110.715 ft

Method: spencer

FS	1.464150
Axis Location:	736.044, 4449.873
Left Slip Surface Endpoint:	181.582, 2591.453
Right Slip Surface Endpoint:	1890.103, 2891.251
Resisting Moment:	1.44868e+10 lb-ft
Driving Moment:	9.89434e+09 lb-ft
Resisting Horizontal Force:	6.07724e+06 lb
Driving Horizontal Force:	4.1507e+06 lb
Total Slice Area:	287468 ft2
Surface Horizontal Width:	1708.52 ft
Surface Average Height:	168.256 ft

Global Minimum Coordinates

Method: bishop simplified

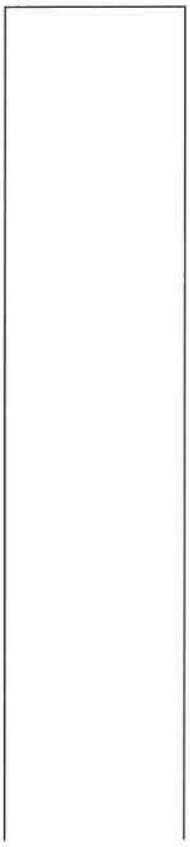


X	Y
190.438	2591.52
226.658	2568.88
262.878	2547.34
299.1	2527.84
335.321	2508.34
365.178	2492.26
409.845	2496.18
454.507	2500.1
499.164	2504.02
543.822	2507.94
588.48	2511.85
635.781	2516.01
686.864	2522.84
737.946	2529.78
789.115	2538.77
840.284	2547.79
885.783	2555.81
931.281	2563.82
976.78	2571.84
1022.28	2579.85
1062.02	2586.86
1101.77	2593.86
1139.99	2600.6
1178.1	2607.32
1215.71	2613.95
1253.33	2620.58
1291.96	2667.11
1330.59	2713.65
1355.2	2743.29
1379.81	2772.94

Method: janbu simplified

X	Y
190.438	2591.52
226.658	2568.88
262.878	2547.34
299.1	2527.84
335.321	2508.34
365.178	2492.26
409.845	2496.18
454.507	2500.1
499.164	2504.02
543.822	2507.94
588.48	2511.85
635.781	2516.01
686.864	2522.84
737.946	2529.78
789.115	2538.77
840.284	2547.79
885.783	2555.81
931.281	2563.82
976.78	2571.84
1022.28	2579.85
1062.02	2586.86
1101.77	2593.86
1139.99	2600.6
1178.1	2607.32
1215.71	2613.95
1253.33	2620.58
1291.96	2667.11
1330.59	2713.65
1355.2	2743.29
1379.81	2772.94

Method: spencer



X	Y
181.582	2591.45
234.069	2555.17
286.555	2522.29
339.042	2490.53
388.568	2460.95
477.718	2468.77
545.692	2474.73
612.39	2480.64
678.687	2486.52
729.439	2491.05
773.048	2494.93
818.688	2499.01
864.385	2503.09
907.963	2506.98
951.54	2510.87
996.992	2514.93
1042.44	2518.99
1118.39	2525.77
1194.33	2532.55
1270.27	2545.9
1316.33	2554.01
1361.94	2562.04
1427.74	2573.64
1493.6	2585.26
1553.28	2595.78
1613.33	2606.37
1673.78	2617.02
1734.33	2627.7
1764.12	2673.82
1793.91	2720.18
1824.97	2771.65
1856.03	2825.07
1890.1	2891.25

Valid/Invalid Surfaces

Method: bishop simplified

Number of Valid Surfaces: 7708
Number of Invalid Surfaces: 15283

Error Codes:

Error Code -1000 reported for 15283 surfaces

Method: janbu simplified

Number of Valid Surfaces: 8758
Number of Invalid Surfaces: 14233

Error Codes:

Error Code -1000 reported for 14233 surfaces

Method: spencer

Number of Valid Surfaces: 6531
Number of Invalid Surfaces: 16460

Error Codes:

Error Code -1000 reported for 16460 surfaces

Error Codes

The following errors were encountered during the computation:

-1000 = No valid slip surface is generated

Slice Data

Global Minimum Query (bishop simplified) - Safety Factor: 1.39526

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [degrees]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	8.36864	2771.55	-32.0131	Parent	535	28	668.366	932.545	747.674	0	747.674	329.819	329.819
2	13.9257	16898.4	-32.0131	Parent	535	28	973.241	1357.92	1819.94	272.243	1547.69	1211.48	939.236
3	13.9257	32247.3	-32.0131	Parent	535	28	1251.94	1746.78	3095.81	816.784	2279.02	2313.11	1496.32
4	12.0733	40101.2	-30.735	Parent	535	28	1483.7	2070.15	4200.77	1313.58	2887.19	3318.59	2005.01
5	12.0733	51091.9	-30.735	Parent	535	28	1710.77	2386.97	5245.67	1762.63	3483.04	4228.47	2465.84
6	12.0733	64927.5	-30.735	Parent	535	28	2053.83	2865.62	6594.94	2211.68	4383.26	5373.77	3162.09
7	12.0739	78678.2	-28.3007	Parent	535	28	2339.27	3263.89	7771.92	2639.6	5132.32	6512.32	3872.72
8	12.0739	89384.9	-28.3007	Parent	535	28	2569.21	3584.72	8782.07	3046.38	5735.69	7398.65	4352.27
9	12.0739	100073	-28.3007	Parent	535	28	2798.42	3904.52	9790.31	3453.17	6337.14	8283.47	4830.3
10	12.0738	110761	-28.3007	Parent	535	28	3027.61	4224.31	10798.5	3859.95	6938.56	9168.26	5308.31
11	12.0738	121449	-28.3007	Parent	535	28	3256.82	4544.11	11806.8	4266.74	7540.02	10053.1	5786.35
12	12.0738	132137	-28.3007	Parent	535	28	3486.02	4863.9	12815	4673.52	8141.49	10937.9	6264.41
13	14.9285	178155	-28.3007	Parent	535	28	3742.31	5221.5	13942.4	5128.39	8814.03	11927.3	6798.94
14	14.9285	194495	-28.3007	Parent	535	28	4025.71	5616.91	15189	5631.36	9557.65	13021.3	7389.96
15	11.1668	151188	5.01506	Parent	0	8.5	815.654	1138.05	13467.6	5852.77	7614.87	13539.2	7686.45
16	11.1668	150221	5.01506	Parent	0	8.5	812.852	1134.14	13381.4	5792.65	7588.73	13452.7	7660.06
17	11.1668	149243	5.01506	Parent	0	8.5	809.935	1130.07	13294	5732.52	7561.44	13365	7632.51
18	11.1668	153058	5.01506	Parent	0	8.5	852.565	1189.55	13631.9	5672.4	7959.48	13706.7	8034.29
19	11.1653	186399	5.01506	Parent	0	8.5	1174.78	1639.13	16591.8	5624.12	10967.7	16694.9	11070.8
20	11.1653	187510	5.01506	Parent	0	8.5	1184.56	1652.77	16690.4	5631.44	11058.9	16794.3	11162.9
21	11.1653	186142	5.01506	Parent	0	8.5	1170.79	1633.55	16569.1	5638.76	10930.4	16671.9	11033.1
22	11.1653	184775	5.01506	Parent	0	8.5	1157.01	1614.33	16447.8	5646.08	10801.7	16549.3	10903.2
23	11.1645	183394	5.01506	Parent	0	8.5	1143.23	1595.11	16326.6	5653.39	10673.2	16426.9	10773.5
24	11.1645	184153	5.01506	Parent	0	8.5	1155.07	1611.62	16444.4	5660.71	10783.7	16545.7	10885
25	11.1645	189032	5.01506	Parent	0	8.5	1216.5	1697.34	17025.2	5668.03	11357.2	17132	11464
26	11.1645	187665	5.01506	Parent	0	8.5	1202.74	1678.13	16904	5675.35	11228.6	17009.5	11334.2
27	11.1645	186298	5.01506	Parent	0	8.5	1188.96	1658.91	16782.7	5682.66	11100.1	16887	11204.4
28	11.1645	184931	5.01506	Parent	0	8.5	1175.19	1639.69	16661.5	5689.98	10971.5	16764.6	11074.6
29	11.1645	183563	5.01506	Parent	0	8.5	1161.42	1620.48	16540.2	5697.3	10842.9	16642.1	10944.8
30	11.1645	182196	5.01506	Parent	0	8.5	1147.64	1601.26	16418.9	5704.62	10714.3	16519.6	10815
31	11.1645	180829	5.01506	Parent	0	8.5	1133.87	1582.05	16297.7	5711.93	10585.7	16397.2	10685.2
32	11.1645	179462	5.01506	Parent	0	8.5	1120.1	1562.83	16176.4	5719.25	10457.2	16274.7	10555.5
33	11.1645	178094	5.01506	Parent	0	8.5	1106.32	1543.61	16055.2	5726.57	10328.6	16152.2	10425.7
34	11.1645	176727	5.01506	Parent	0	8.5	1092.56	1524.4	15933.9	5733.89	10200	16029.8	10295.9
35	11.8252	185695	5.01506	Parent	0	8.5	1078.37	1504.61	15809	5741.42	10067.6	15903.6	10162.2
36	11.8252	203963	5.01506	Parent	0	8.5	1233.44	1720.97	17219.7	5704.4	11515.3	17327.9	11623.5
37	11.8252	216315	5.01506	Parent	0	8.5	1342.73	1873.46	18175.2	5639.64	12535.6	18293.1	12653.4
38	11.8252	215841	5.01506	Parent	0	8.5	1345.35	1877.11	18134.9	5574.89	12560	18253	12678.1
39	12.7707	232096	7.61758	Parent	0	8.5	1339.6	1869.09	17995.6	5489.23	12506.4	18174.8	12685.5
40	12.7707	230605	7.61758	Parent	0	8.5	1338.52	1867.59	17879	5382.65	12496.3	18058	12675.3
41	12.7707	229114	7.61758	Parent	0	8.5	1337.45	1866.09	17762.4	5276.07	12486.3	17941.2	12665.2
42	12.7707	227623	7.61758	Parent	0	8.5	1336.37	1864.59	17645.8	5169.5	12476.3	17824.5	12655
43	12.7707	226111	7.73754	Parent	0	8.5	1334.91	1862.55	17524.7	5062.07	12462.6	17706	12644
44	12.7707	224576	7.73754	Parent	0	8.5	1333.66	1860.8	17404.7	4953.79	12450.9	17585.9	12632.1

45	12.7707	223042	7.73754	Parent	0	8.5	1332.4	1859.05	17284.8	4845.52	12439.2	17465.8	12620.3
46	12.7707	221507	7.73754	Parent	0	8.5	1331.15	1857.3	17164.7	4737.24	12427.5	17345.6	12608.3
47	12.7922	219934	9.97183	Parent	0	8.5	1322.65	1845.44	16961	4612.93	12348.1	17193.6	12580.6
48	12.7922	217578	9.97183	Parent	0	8.5	1318.03	1839	16777.6	4472.59	12305	17009.4	12536.8
49	12.7922	215486	9.97183	Parent	0	8.5	1315.6	1835.6	16614.6	4332.24	12282.3	16845.9	12513.6
50	12.7922	215021	9.97183	Parent	0	8.5	1326.53	1850.86	16576.3	4191.9	12384.4	16809.5	12617.6
51	12.7922	214830	9.9919	Parent	0	8.5	1339.69	1869.21	16558.6	4051.41	12507.2	16794.6	12743.2
52	12.7922	214636	9.9919	Parent	0	8.5	1352.87	1887.61	16541	3910.77	12630.2	16779.4	12868.6
53	12.7922	214441	9.9919	Parent	0	8.5	1366.06	1906.01	16523.5	3770.14	12753.4	16764.2	12994.1
54	12.7922	213145	9.9919	Parent	0	8.5	1370.19	1911.77	16421.5	3629.51	12791.9	16662.9	13033.3
55	11.3747	186620	9.9919	Parent	0	8.5	1357.3	1893.78	16168.3	3496.66	12671.6	16407.4	12910.7
56	11.3747	184707	9.9919	Parent	0	8.5	1352.77	1887.46	16000.9	3371.61	12629.3	16239.2	12867.6
57	11.3747	183073	9.9919	Parent	0	8.5	1350.82	1884.74	15857.6	3246.57	12611	16095.6	12849
58	11.3747	181440	9.9919	Parent	0	8.5	1348.86	1882.01	15714.3	3121.52	12592.8	15952	12830.5
59	11.3747	179807	9.9919	Parent	0	8.5	1346.91	1879.29	15571.1	2996.47	12574.7	15808.4	12812
60	11.3747	178173	9.9919	Parent	0	8.5	1344.96	1876.57	15427.8	2871.42	12556.4	15664.8	12793.4
61	11.3747	176540	9.9919	Parent	0	8.5	1343.01	1873.85	15284.6	2746.37	12538.3	15521.2	12774.9
62	11.3747	174906	9.9919	Parent	0	8.5	1341.06	1871.13	15141.3	2621.32	12520	15377.6	12756.3
63	11.3747	173273	9.9919	Parent	0	8.5	1339.11	1868.41	14998.1	2496.27	12501.9	15234.1	12737.8
64	11.3747	171640	9.9919	Parent	0	8.5	1337.16	1865.69	14854.8	2371.22	12483.6	15090.4	12719.2
65	11.3747	170006	9.9919	Parent	0	8.5	1335.21	1862.97	14711.6	2246.17	12465.5	14946.9	12700.7
66	11.3747	168373	9.9919	Parent	0	8.5	1333.26	1860.25	14568.3	2121.12	12447.2	14803.2	12682.1
67	11.3746	166807	9.9919	Parent	0	8.5	1331.93	1858.39	14430.9	1996.07	12434.8	14665.5	12669.4
68	11.3746	165489	9.9919	Parent	0	8.5	1332.91	1859.75	14314.8	1871.02	12443.8	14549.7	12678.7
69	11.3746	164195	9.9919	Parent	0	8.5	1334.09	1861.4	14200.9	1745.97	12454.9	14435.9	12690
70	11.3746	162901	9.9919	Parent	0	8.5	1335.27	1863.05	14086.9	1620.92	12465.9	14322.1	12701.2
71	13.2482	188100	9.99611	Parent	0	8.5	1336.54	1864.82	13963.3	1485.54	12477.8	14198.9	12713.4
72	13.2482	186343	9.99611	Parent	0	8.5	1337.92	1866.74	13830.4	1339.83	12490.6	14066.2	12726.4
73	13.2482	184586	9.99611	Parent	0	8.5	1339.28	1868.65	13697.6	1194.12	12503.5	13933.6	12739.5
74	13.2482	182828	9.99611	Parent	0	8.5	1340.66	1870.57	13564.7	1048.41	12516.3	13801	12752.6
75	13.2482	181145	9.99611	Parent	0	8.5	1342.62	1873.31	13437.3	902.701	12534.6	13673.9	12771.2
76	13.2482	180929	9.99611	Parent	0	8.5	1356.22	1892.28	13418.5	756.991	12661.5	13657.6	12900.6
77	12.741	174333	9.99611	Parent	0	8.5	1373.99	1917.07	13441.5	614.07	12827.4	13683.6	13069.6
78	12.741	174659	9.99611	Parent	0	8.5	1391.41	1941.38	13464	473.94	12990	13709.2	13235.3
79	12.741	175146	9.99611	Parent	0	8.5	1410.17	1967.55	13499	333.809	13165.2	13747.5	13413.7
80	11.9893	168858	9.99776	Parent	0	8.5	1459.93	2036.98	13827.6	197.801	13629.8	14085	13887.2
81	11.9893	174350	9.99776	Parent	0	8.5	1521.95	2123.52	14274.7	65.9156	14208.8	14543	14477.1
82	14.1347	212602	9.99776	Parent 5	285	8.5	1781.84	2486.13	14728.1	0	14728.1	15042.2	15042.2
83	12.5369	194957	9.99776	Parent 5	285	8.5	1835.4	2560.86	15228.1	0	15228.1	15551.7	15551.7
84	12.5369	200961	9.99776	Parent 5	285	8.5	1885.76	2631.12	15698.3	0	15698.3	16030.7	16030.7
85	12.5369	206966	9.99776	Parent 5	285	8.5	1936.11	2701.38	16168.4	0	16168.4	16509.7	16509.7
86	12.5369	212040	9.99776	Parent 5	285	8.5	1978.66	2760.75	16565.7	0	16565.7	16914.5	16914.5
87	12.5369	213998	9.99776	Parent 5	285	8.5	1995.08	2783.66	16718.9	0	16718.9	17070.6	17070.6
88	12.5369	215705	9.99776	Parent 5	285	8.5	2009.4	2803.63	16852.5	0	16852.5	17206.8	17206.8
89	17.0317	276571	50.2996	Parent 5	1100	28	4786.66	6678.64	10491.9	0	10491.9	16257.4	16257.4
90	10.8005	156640	50.2996	Slide Mass 4	1500	15	3137.01	4376.95	10736.9	0	10736.9	14515.4	14515.4
91	10.8005	142053	50.2996	Slide Mass 4	1500	15	2926.24	4082.86	9639.33	0	9639.33	13164	13164
92	7.54666	90599.8	50.3008	Slide Mass 4	1500	15	2747.18	3833.03	8707.02	0	8707.02	12016.1	12016.1
93	13.3719	142689	50.3008	Slide Mass 3	2500	15	3121.35	4355.1	6923.32	0	6923.32	10683.1	10683.1
94	13.3719	117243	50.3008	Slide Mass 3	2500	15	2824.38	3940.74	5376.9	0	5376.9	8778.98	8778.98
95	4.34115	32467.5	50.3008	Slide Mass 2	3500	15	3205.66	4472.73	3630.29	0	3630.29	7491.63	7491.63
96	12.3055	77127.9	50.3008	Slide Mass 2	3500	15	3016.63	4208.98	2645.96	0	2645.96	6279.61	6279.61
97	12.3055	55091.4	50.3008	Slide Mass 2	3500	15	2737.16	3819.05	1190.71	0	1190.71	4487.73	4487.73
98	1.17781	4117.48	50.3008	Slide	3500	15	2584.05	3605.42	393.441	0	393.441	3506.03	3506.03

99	11.7166	29966.7	50.3008	Mass 2 Slide	1750	15	1418.39	1979.02	854.705	0	854.705	2563.21	2563.21
100	11.7166	9988.9	50.3008	Mass 1 Slide	1750	15	1152.29	1607.74	-530.906	0	-530.906	857.073	857.073

Global Minimum Query (janbu simplified) - Safety Factor: 1.36334

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [degrees]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	8.36864	2771.55	-32.0131	Parent	535	28	689.76	940.378	762.405	0	762.405	331.175	331.175
2	13.9257	16898.4	-32.0131	Parent	535	28	1004.39	1369.33	1841.39	272.243	1569.15	1213.45	941.211
3	13.9257	32247.3	-32.0131	Parent	535	28	1292.01	1761.45	3123.4	816.784	2306.62	2315.65	1498.87
4	12.0733	40101.2	-30.735	Parent	535	28	1530.38	2086.43	4231.39	1313.58	2917.81	3321.45	2007.87
5	12.0733	51091.9	-30.735	Parent	535	28	1764.59	2405.74	5280.97	1762.63	3518.34	4231.78	2469.15
6	12.0733	64927.5	-30.735	Parent	535	28	2118.44	2888.16	6637.33	2211.68	4425.65	5377.73	3166.05
7	12.0739	78678.2	-28.3007	Parent	535	28	2410.62	3286.49	7814.44	2639.6	5174.84	6516.42	3876.82
8	12.0739	89384.9	-28.3007	Parent	535	28	2647.58	3609.55	8828.74	3046.38	5782.36	7403.12	4356.74
9	12.0739	100073	-28.3007	Parent	535	28	2883.77	3931.56	9841.14	3453.17	6387.97	8288.34	4835.17
10	12.0738	110761	-28.3007	Parent	535	28	3119.96	4253.57	10853.6	3859.95	6993.62	9173.59	5313.64
11	12.0738	121449	-28.3007	Parent	535	28	3356.15	4575.57	11866	4266.74	7599.23	10058.8	5792.08
12	12.0738	132137	-28.3007	Parent	535	28	3592.34	4897.58	12878.4	4673.52	8204.86	10944	6270.53
13	14.9285	178155	-28.3007	Parent	535	28	3856.46	5257.66	14010.4	5128.39	8882.03	11933.9	6805.49
14	14.9285	194495	-28.3007	Parent	535	28	4148.49	5655.8	15262.2	5631.36	9630.84	13028.4	7397.05
15	11.1668	151188	5.01506	Parent	0	8.5	834.546	1137.77	13465.8	5852.77	7613	13539	7686.24
16	11.1668	150221	5.01506	Parent	0	8.5	831.678	1133.86	13379.4	5792.65	7586.77	13452.4	7659.75
17	11.1668	149243	5.01506	Parent	0	8.5	828.693	1129.79	13292.1	5732.52	7559.56	13364.8	7632.28
18	11.1668	153058	5.01506	Parent	0	8.5	872.314	1189.26	13629.9	5672.4	7957.51	13706.5	8034.06
19	11.1653	186399	5.01506	Parent	0	8.5	1201.99	1638.72	16589	5624.12	10964.9	16694.5	11070.4
20	11.1653	187510	5.01506	Parent	0	8.5	1211.99	1652.36	16687.6	5631.44	11056.2	16794	11162.5
21	11.1653	186142	5.01506	Parent	0	8.5	1197.9	1633.14	16566.4	5638.76	10927.6	16671.5	11032.7
22	11.1653	184775	5.01506	Parent	0	8.5	1183.81	1613.93	16445.1	5646.08	10799	16549	10902.9
23	11.1645	183394	5.01506	Parent	0	8.5	1169.72	1594.72	16323.9	5653.39	10670.5	16426.6	10773.2
24	11.1645	184153	5.01506	Parent	0	8.5	1181.82	1611.22	16441.7	5660.71	10781	16545.4	10884.7
25	11.1645	189032	5.01506	Parent	0	8.5	1244.68	1696.92	17022.4	5668.03	11354.3	17131.6	11463.6
26	11.1645	187665	5.01506	Parent	0	8.5	1230.59	1677.71	16901.2	5675.35	11225.9	17009.2	11333.8
27	11.1645	186298	5.01506	Parent	0	8.5	1216.5	1658.5	16779.9	5682.66	11097.3	16886.7	11204
28	11.1645	184931	5.01506	Parent	0	8.5	1202.41	1639.29	16658.7	5689.98	10968.7	16764.2	11074.2
29	11.1645	183563	5.01506	Parent	0	8.5	1188.32	1620.08	16537.5	5697.3	10840.2	16641.8	10944.5
30	11.1645	182196	5.01506	Parent	0	8.5	1174.22	1600.86	16416.3	5704.62	10711.6	16519.3	10814.7
31	11.1645	180829	5.01506	Parent	0	8.5	1160.13	1581.65	16295	5711.93	10583.1	16396.8	10684.9
32	11.1645	179462	5.01506	Parent	0	8.5	1146.04	1562.44	16173.8	5719.25	10454.6	16274.4	10555.1
33	11.1645	178094	5.01506	Parent	0	8.5	1131.95	1543.23	16052.6	5726.57	10326	16151.9	10425.3
34	11.1645	176727	5.01506	Parent	0	8.5	1117.86	1524.02	15931.3	5733.89	10197.4	16029.4	10295.5
35	11.8252	185695	5.01506	Parent	0	8.5	1103.35	1504.24	15806.6	5741.42	10065.1	15903.4	10162
36	11.8252	203963	5.01506	Parent	0	8.5	1262	1720.54	17216.8	5704.4	11512.4	17327.6	11623.2
37	11.8252	216315	5.01506	Parent	0	8.5	1373.83	1873	18172.1	5639.64	12532.5	18292.7	12653.1
38	11.8252	215841	5.01506	Parent	0	8.5	1376.5	1876.64	18131.8	5574.89	12556.9	18252.6	12677.7
39	12.7707	232096	7.61758	Parent	0	8.5	1370.44	1868.38	17990.9	5489.23	12501.6	18174.2	12684.9
40	12.7707	230605	7.61758	Parent	0	8.5	1369.35	1866.89	17874.3	5382.65	12491.6	18057.4	12674.8
41	12.7707	229114	7.61758	Parent	0	8.5	1368.25	1865.39	17757.7	5276.07	12481.6	17940.7	12664.6
42	12.7707	227623	7.61758	Parent	0	8.5	1367.15	1863.89	17641.1	5169.5	12471.6	17823.9	12654.4
43	12.7707	226111	7.73754	Parent	0	8.5	1365.65	1861.84	17519.9	5062.07	12457.9	17705.5	12643.4
44	12.7707	224576	7.73754	Parent	0	8.5	1364.36	1860.09	17400	4953.79	12446.2	17585.4	12631.6
45	12.7707	223042	7.73754	Parent	0	8.5	1363.08	1858.34	17279.9	4845.52	12434.4	17465.1	12619.6
46	12.7707	221507	7.73754	Parent	0	8.5	1361.8	1856.59	17160	4737.24	12422.7	17345	12607.8
47	12.7922	219934	9.97183	Parent	0	8.5	1352.95	1844.53	16954.9	4612.93	12342	17192.8	12579.9
48	12.7922	217578	9.97183	Parent	0	8.5	1348.23	1838.09	16771.5	4472.59	12299	17008.6	12536
49	12.7922	215486	9.97183	Parent	0	8.5	1345.74	1834.7	16608.5	4332.24	12276.2	16845.1	12512.8
50	12.7922	215021	9.97183	Parent	0	8.5	1356.92	1849.95	16570.2	4191.9	12378.3	16808.8	12616.9
51	12.7922	214830	9.9919	Parent	0	8.5	1370.38	1868.29	16552.4	4051.41	12501	16793.8	12742.4

52	12.7922	214636	9.9919	Parent	0	8.5	1383.87	1886.68	16534.8	3910.77	12624	16778.6	12867.8
53	12.7922	214441	9.9919	Parent	0	8.5	1397.36	1905.07	16517.2	3770.14	12747.1	16763.4	12993.3
54	12.7922	213145	9.9919	Parent	0	8.5	1401.58	1910.83	16415.1	3629.51	12785.6	16662.1	13032.6
55	11.3747	186620	9.9919	Parent	0	8.5	1388.39	1892.85	16162	3496.66	12665.4	16406.6	12910
56	11.3747	184707	9.9919	Parent	0	8.5	1383.75	1886.52	15994.7	3371.61	12623.1	16238.5	12866.9
57	11.3747	183073	9.9919	Parent	0	8.5	1381.75	1883.8	15851.4	3246.57	12604.8	16094.8	12848.3
58	11.3747	181440	9.9919	Parent	0	8.5	1379.77	1881.09	15708.2	3121.52	12586.7	15951.3	12829.7
59	11.3747	179807	9.9919	Parent	0	8.5	1377.77	1878.37	15564.9	2996.47	12568.4	15807.6	12811.2
60	11.3747	178173	9.9919	Parent	0	8.5	1375.78	1875.65	15421.7	2871.42	12550.3	15664.1	12792.6
61	11.3747	176540	9.9919	Parent	0	8.5	1373.78	1872.93	15278.4	2746.37	12532	15520.4	12774.1
62	11.3747	174906	9.9919	Parent	0	8.5	1371.79	1870.21	15135.2	2621.32	12513.9	15376.9	12755.5
63	11.3747	173273	9.9919	Parent	0	8.5	1369.79	1867.49	14991.9	2496.27	12495.6	15233.2	12737
64	11.3747	171640	9.9919	Parent	0	8.5	1367.8	1864.77	14848.7	2371.22	12477.5	15089.7	12718.4
65	11.3747	170006	9.9919	Parent	0	8.5	1365.8	1862.05	14705.5	2246.17	12459.3	14946.1	12699.9
66	11.3747	168373	9.9919	Parent	0	8.5	1363.81	1859.33	14562.2	2121.12	12441.1	14802.5	12681.3
67	11.3746	166807	9.9919	Parent	0	8.5	1362.45	1857.48	14424.7	1996.07	12428.6	14664.7	12668.7
68	11.3746	165489	9.9919	Parent	0	8.5	1363.44	1858.83	14308.7	1871.02	12437.7	14548.9	12677.9
69	11.3746	164195	9.9919	Parent	0	8.5	1364.65	1860.48	14194.7	1745.97	12448.8	14435.2	12689.2
70	11.3746	162901	9.9919	Parent	0	8.5	1365.86	1862.13	14080.7	1620.92	12459.8	14321.4	12700.4
71	13.2482	188100	9.99611	Parent	0	8.5	1367.16	1863.9	13957.2	1485.54	12471.6	14198.1	12712.6
72	13.2482	186343	9.99611	Parent	0	8.5	1368.56	1865.81	13824.2	1339.83	12484.4	14065.5	12725.6
73	13.2482	184586	9.99611	Parent	0	8.5	1369.97	1867.73	13691.4	1194.12	12497.3	13932.9	12738.8
74	13.2482	182828	9.99611	Parent	0	8.5	1371.37	1869.64	13558.5	1048.41	12510.1	13800.2	12751.8
75	13.2482	181145	9.99611	Parent	0	8.5	1373.38	1872.38	13431.1	902.701	12528.4	13673.2	12770.4
76	13.2482	180929	9.99611	Parent	0	8.5	1387.29	1891.35	13412.3	756.991	12655.3	13656.8	12899.8
77	12.741	174333	9.99611	Parent	0	8.5	1405.46	1916.12	13435.1	614.07	12821.1	13682.9	13068.8
78	12.741	174659	9.99611	Parent	0	8.5	1423.28	1940.42	13457.5	473.94	12983.6	13708.4	13234.5
79	12.741	175146	9.99611	Parent	0	8.5	1442.46	1966.57	13492.5	333.809	13158.7	13746.7	13412.9
80	11.9893	168858	9.99776	Parent	0	8.5	1493.37	2035.97	13820.9	197.801	13623	14084.1	13886.3
81	11.9893	174350	9.99776	Parent	0	8.5	1556.82	2122.47	14267.7	65.9156	14201.8	14542.1	14476.2
82	14.1347	212602	9.99776	Parent 5	285	8.5	1822.66	2484.9	14719.9	0	14719.9	15041.2	15041.2
83	12.5369	194957	9.99776	Parent 5	285	8.5	1877.45	2559.6	15219.7	0	15219.7	15550.7	15550.7
84	12.5369	200961	9.99776	Parent 5	285	8.5	1928.95	2629.82	15689.6	0	15689.6	16029.6	16029.6
85	12.5369	206966	9.99776	Parent 5	285	8.5	1980.47	2700.05	16159.5	0	16159.5	16508.6	16508.6
86	12.5369	212040	9.99776	Parent 5	285	8.5	2023.99	2759.39	16556.6	0	16556.6	16913.4	16913.4
87	12.5369	213998	9.99776	Parent 5	285	8.5	2040.79	2782.29	16709.7	0	16709.7	17069.5	17069.5
88	12.5369	215705	9.99776	Parent 5	285	8.5	2055.43	2802.25	16843.3	0	16843.3	17205.6	17205.6
89	17.0317	276571	50.2996	Parent 5	1100	28	4857.95	6623.04	10387.3	0	10387.3	16238.7	16238.7
90	10.8005	156640	50.2996	Slide Mass 4	1500	15	3194.45	4355.12	10655.5	0	10655.5	14503.1	14503.1
91	10.8005	142053	50.2996	Slide Mass 4	1500	15	2979.81	4062.5	9563.39	0	9563.39	13152.5	13152.5
92	7.54666	90599.8	50.3008	Slide Mass 4	1500	15	2797.48	3813.92	8635.67	0	8635.67	12005.3	12005.3
93	13.3719	142689	50.3008	Slide Mass 3	2500	15	3178.5	4333.38	6842.3	0	6842.3	10670.9	10670.9
94	13.3719	117243	50.3008	Slide Mass 3	2500	15	2876.09	3921.09	5303.58	0	5303.58	8767.94	8767.94
95	4.34115	32467.5	50.3008	Slide Mass 2	3500	15	3264.36	4450.43	3547.05	0	3547.05	7479.1	7479.1
96	12.3055	77127.9	50.3008	Slide Mass 2	3500	15	3071.86	4188	2567.64	0	2567.64	6267.82	6267.82
97	12.3055	55091.4	50.3008	Slide Mass 2	3500	15	2787.28	3800.01	1119.64	0	1119.64	4477.03	4477.03
98	1.17781	4117.48	50.3008	Slide Mass 2	3500	15	2631.36	3587.44	326.346	0	326.346	3495.93	3495.93
99	11.7166	29966.7	50.3008	Slide Mass 1	1750	15	1444.36	1969.15	817.873	0	817.873	2557.66	2557.66
100	11.7166	9988.9	50.3008	Slide Mass 1	1750	15	1173.39	1599.73	-560.824	0	-560.824	852.568	852.568

Global Minimum Query (spencer) - Safety Factor: 1.46415

	Angle	Base	Base	Shear	Shear	Base	Pore	Effective	Base	Effective

Number	[ft]	[lbs]	of Slice Base [degrees]	Material	Cohesion [psf]	Friction Angle [degrees]	Stress [psf]	Strength [psf]	Normal Stress [psf]	Pressure [psf]	Normal Stress [psf]	Vertical Stress [psf]	Vertical Stress [psf]
1	7.48751	2449.96	-34.6524	Parent	535	28	644.978	944.344	769.864	0	769.864	324.052	324.052
2	14.9998	19648.3	-34.6524	Parent	535	28	962.796	1409.68	1969.17	324.138	1645.03	1303.68	979.54
3	14.9998	39312.8	-34.6524	Parent	535	28	1282.3	1877.48	3497.31	972.468	2524.84	2610.98	1638.51
4	14.9998	58977.3	-34.6524	Parent	535	28	1601.81	2345.29	5025.46	1620.8	3404.66	3918.28	2297.48
5	17.4956	92442	-32.0714	Parent	535	28	1874.07	2743.92	6442.2	2287.8	4154.4	5267.9	2980.1
6	17.4956	122563	-32.0714	Parent	535	28	2358.91	3453.8	8462.93	2973.48	5489.45	6984.82	4011.34
7	17.4956	150675	-32.0714	Parent	535	28	2789.93	4084.87	10335.5	3659.16	6676.33	8587.31	4928.15
8	17.4957	176076	-31.1716	Parent	535	28	3122.52	4571.84	11925.2	4333.02	7592.2	10036.3	5703.24
9	17.4957	201062	-31.1716	Parent	535	28	3477.38	5091.4	13564.4	4995.06	8569.34	11460.8	6465.72
10	17.4957	226048	-31.1716	Parent	535	28	3832.23	5610.96	15203.6	5657.1	9546.49	12885.3	7228.2
11	16.5087	236078	-30.8507	Parent	535	28	4160.69	6091.88	16747.5	6296.53	10451	14262.2	7965.7
12	16.5087	258041	-30.8507	Parent	535	28	4490.07	6574.13	18271.3	6913.37	11358	15589.3	8675.97
13	16.5087	279466	-30.8507	Parent	535	28	4804.34	7034.28	19753.6	7530.21	12223.4	16883.9	9353.65
14	22.2873	397065	5.01038	Parent	0	8.5	1015.58	1486.96	17728.1	7778.68	9949.47	17817.2	10038.5
15	22.2873	467048	5.01038	Parent	0	8.5	1340.15	1962.18	20839.6	7710.33	13129.3	20957.1	13246.8
16	22.2873	462920	5.01038	Parent	0	8.5	1319.93	1932.57	20656.2	7725.05	12931.1	20771.9	13046.8
17	22.2873	460265	5.01038	Parent	0	8.5	1309.76	1917.69	20571.3	7739.77	12831.5	20686.1	12946.3
18	16.9937	357906	5.01038	Parent	0	8.5	1366.75	2001.12	21142.6	7752.75	13389.8	21262.4	13509.7
19	16.9937	354741	5.01038	Parent	0	8.5	1346.77	1971.88	20958.1	7763.97	13194.1	21076.2	13312.2
20	16.9937	351577	5.01038	Parent	0	8.5	1326.8	1942.63	20773.6	7775.2	12998.4	20890	13114.8
21	16.9937	348412	5.01038	Parent	0	8.5	1306.82	1913.38	20589.2	7786.42	12802.7	20703.7	12917.3
22	16.6744	338773	5.06376	Parent	0	8.5	1286.87	1884.17	20404.3	7797.05	12607.3	20518.4	12721.3
23	16.6744	335693	5.06376	Parent	0	8.5	1267.17	1855.33	20221.4	7807.09	12414.3	20333.6	12526.6
24	16.6744	332614	5.06376	Parent	0	8.5	1247.47	1826.49	20038.4	7817.13	12221.3	20149	12331.8
25	16.6744	350064	5.06376	Parent	0	8.5	1346.54	1971.53	20987.5	7795.67	13191.8	21106.8	13311.1
26	16.5742	372046	5.07121	Parent	0	8.5	1491.56	2183.87	22316.3	7703.68	14612.6	22448.7	14745
27	16.5742	371080	5.07121	Parent	0	8.5	1494.95	2188.83	22257.7	7611.9	14645.8	22390.4	14778.5
28	16.5742	370114	5.07121	Parent	0	8.5	1498.34	2193.79	22199.1	7520.12	14679	22332	14811.9
29	16.5742	369148	5.07121	Parent	0	8.5	1501.72	2198.74	22140.5	7428.35	14712.1	22273.7	14845.4
30	16.9175	375790	5.0967	Parent	0	8.5	1505.05	2203.62	22080.1	7335.38	14744.8	22214.4	14879
31	16.9175	374768	5.0967	Parent	0	8.5	1508.46	2208.61	22019.4	7241.23	14778.2	22153.9	14912.7
32	16.9175	373745	5.0967	Parent	0	8.5	1511.87	2213.6	21958.6	7147.07	14811.6	22093.5	14946.4
33	21.8043	480199	5.0967	Parent	0	8.5	1515.77	2219.31	21889.1	7039.32	14849.7	22024.3	14984.9
34	21.8043	478561	5.0967	Parent	0	8.5	1520.45	2226.16	21813.5	6917.97	14895.5	21949.1	15031.1
35	15.2134	335003	5.0967	Parent	0	8.5	1538.17	2252.11	21884.2	6814.96	15069.3	22021.4	15206.5
36	15.2134	337245	5.0967	Parent	0	8.5	1561.64	2286.47	22029.4	6730.29	15299.1	22168.7	15438.4
37	15.2134	339486	5.0967	Parent	0	8.5	1585.1	2320.83	22174.7	6645.62	15529	22316	15670.4
38	15.2325	341997	5.10277	Parent	0	8.5	1607.5	2353.62	22309.3	6560.85	15748.4	22452.8	15892
39	15.2325	340746	5.10277	Parent	0	8.5	1607.77	2354.02	22227.1	6475.97	15751.2	22370.7	15894.7
40	15.2325	339405	5.10277	Parent	0	8.5	1607.45	2353.55	22139.1	6391.1	15748	22282.7	15891.6
41	21.7885	484773	5.10277	Parent	0	8.5	1614.58	2363.99	22105.8	6287.95	15817.8	22250	15962
42	21.7885	483936	5.10277	Parent	0	8.5	1622.98	2376.28	22066.6	6166.55	15900	22211.5	16045
43	21.7886	483100	5.10277	Parent	0	8.5	1631.36	2388.56	22027.4	6045.14	15982.3	22173.1	16127.9
44	21.7886	482262	5.10277	Parent	0	8.5	1639.76	2400.85	21988.2	5923.73	16064.4	22134.6	16210.9
45	15.1508	334849	5.10277	Parent	0	8.5	1646.87	2411.26	21954.9	5820.82	16134.1	22102	16281.2
46	15.1508	334445	5.10277	Parent	0	8.5	1652.71	2419.81	21927.8	5736.4	16191.4	22075.3	16338.9
47	15.1508	334374	5.10277	Parent	0	8.5	1660.77	2431.61	21922.2	5651.97	16270.3	22070.5	16418.6
48	15.1507	334570	5.10277	Parent	0	8.5	1670.62	2446.04	21934.4	5567.55	16366.8	22083.6	16516
49	15.1507	334767	5.10277	Parent	0	8.5	1680.47	2460.46	21946.4	5483.13	16463.3	22096.5	16613.3
50	15.1507	334963	5.10277	Parent	0	8.5	1690.32	2474.88	21958.5	5398.71	16559.8	22109.5	16710.7
51	18.9853	420019	5.10277	Parent	0	8.5	1701.42	2491.13	21972.1	5303.61	16668.5	22124.1	16820.4
52	18.9853	420328	5.10277	Parent	0	8.5	1713.76	2509.2	21987.3	5197.82	16789.5	22140.3	16942.5
53	18.9853	421883	5.10277	Parent	0	8.5	1732.75	2537	22067.5	5092.03	16975.4	22222.2	17130.1
54	18.9853	426398	5.10277	Parent	0	8.5	1767.5	2587.88	22302.1	4986.24	17315.9	22460	17473.7
55	18.9853	431041	5.10277	Parent	0	8.5	1802.93	2639.76	22543.5	4880.46	17663	22704.5	17824
56	18.9853	442459	5.10277	Parent	0	8.5	1874.46	2744.49	23138.5	4774.67	18363.8	23305.9	18531.2
57	18.9853	460149	5.10277	Parent	0	8.5	1979.41	2898.15	24060.9	4668.88	19392	24237.6	19568.7
58	18.9853	477839	5.10277	Parent	0	8.5	2084.35	3051.8	24983.2	4563.09	20420.1	25169.3	20606.2
59	18.9855	493585	9.97058	Parent	0	8.5	2165.75	3170.98	25623.6	4406.07	21217.5	26004.4	21598.3

60	18.9855	505310	9.97058	Parent	0	8.5	2248.57	3292.24	26226.7	4197.8	22028.9	26622	22424.2
61	18.9855	509858	9.97058	Parent	0	8.5	2293.47	3357.98	26458.3	3989.53	22468.8	26861.5	22872
62	18.9855	513238	9.97058	Parent	0	8.5	2332.21	3414.7	26629.6	3781.27	22848.3	27039.5	23258.3
63	15.3552	416163	9.98704	Parent	0	8.5	2357.98	3452.43	26693.5	3592.77	23100.7	27108.7	23515.9
64	15.3552	416988	9.98704	Parent	0	8.5	2380.28	3485.08	26743.2	3424.04	23319.2	27162.4	23738.4
65	15.3552	416921	9.98704	Parent	0	8.5	2396.75	3509.2	26735.9	3255.32	23480.6	27158	23902.7
66	15.2031	409217	9.98704	Parent	0	8.5	2390	3499.32	26501.9	3087.43	23414.5	26922.8	23835.3
67	15.2031	405295	9.98704	Parent	0	8.5	2380.87	3485.95	26245.4	2920.37	23325	26664.6	23744.3
68	15.2031	401372	9.98704	Parent	0	8.5	2371.74	3472.58	25988.9	2753.31	23235.6	26406.6	23653.3
69	16.4492	429847	9.9994	Parent	0	8.5	2362.17	3458.57	25721.1	2579.3	23141.8	26137.6	23558.3
70	16.4492	425248	9.9994	Parent	0	8.5	2352.27	3444.07	25443.2	2398.32	23044.8	25857.9	23459.6
71	16.4492	420648	9.9994	Parent	0	8.5	2342.37	3429.58	25165.2	2217.35	22947.8	25578.2	23360.8
72	16.4492	416049	9.9994	Parent	0	8.5	2332.47	3415.08	24887.2	2036.37	22850.8	25298.5	23262.1
73	16.4658	411861	9.9994	Parent	0	8.5	2322.56	3400.57	24609.1	1855.3	22753.8	25018.6	23163.3
74	16.4658	407252	9.9994	Parent	0	8.5	2312.65	3386.06	24330.8	1674.14	22656.7	24738.6	23064.4
75	16.4658	402643	9.9994	Parent	0	8.5	2302.74	3371.55	24052.5	1492.99	22559.5	24458.5	22965.6
76	16.4658	398034	9.9994	Parent	0	8.5	2292.83	3357.04	23774.3	1311.83	22462.5	24178.6	22866.7
77	19.8935	474748	9.9994	Parent	0	8.5	2281.88	3341.01	23467.1	1111.81	22355.3	23869.4	22757.6
78	19.8935	468020	9.9994	Parent	0	8.5	2269.9	3323.48	23130.8	892.941	22237.9	23531.1	22638.1
79	19.8935	461293	9.9994	Parent	0	8.5	2257.93	3305.95	22794.7	674.07	22120.6	23192.8	22518.7
80	17.1076	392993	9.9994	Parent	0	8.5	2256.65	3304.07	22578.6	470.524	22108.1	22976.5	22505.9
81	17.1076	392150	9.9994	Parent	0	8.5	2270.57	3324.46	22526.8	282.303	22244.5	22927.1	22644.8
82	17.1076	391328	9.9994	Parent	0	8.5	2284.62	3345.03	22476.2	94.0831	22382.1	22879	22784.9
83	8.72123	199177	9.9994	Parent 5	285	8.5	2481.57	3633.39	22404.6	0	22404.6	22842.2	22842.2
84	20.1514	465229	9.9994	Parent 5	285	8.5	2506.48	3669.87	22648.7	0	22648.7	23090.6	23090.6
85	20.1514	495924	9.9994	Parent 5	285	8.5	2659.24	3893.53	24145.3	0	24145.3	24614.1	24614.1
86	20.1514	530237	9.9994	Parent 5	285	8.5	2830.02	4143.57	25818.3	0	25818.3	26317.2	26317.2
87	20.1835	552351	9.9994	Parent 5	285	8.5	2935.71	4298.32	26853.8	0	26853.8	27371.4	27371.4
88	20.1835	575068	9.9994	Parent 5	285	8.5	3048.59	4463.59	27959.6	0	27959.6	28497.1	28497.1
89	20.1835	615311	9.9994	Parent 5	285	8.5	3248.55	4756.36	29918.5	0	29918.5	30491.3	30491.3
90	12.4727	395306	57.1397	Parent 5	1100	28	7862.45	11511.8	19581.8	0	19581.8	31753.8	31753.8
91	17.3178	505005	57.1397	Parent 4	1850	28	7599.73	11127.1	17447.8	0	17447.8	29213	29213
92	14.8959	388615	57.2729	Parent 4	1850	28	6871.47	10060.9	15442.4	0	15442.4	26134.7	26134.7
93	14.8959	346173	57.2729	Parent 4	1850	28	6209	9090.91	13618.2	0	13618.2	23279.6	23279.6
94	13.6652	279063	58.8931	Parent 4	1850	28	5426.79	7945.63	11464.2	0	11464.2	20457.8	20457.8
95	17.3921	300097	58.8931	Parent 3	3100	28	5239.05	7670.75	8596.33	0	8596.33	17278.8	17278.8
96	12.4127	175849	59.8297	Parent 3	3100	28	4473.73	6550.21	6488.92	0	6488.92	14184.7	14184.7
97	18.6449	202816	59.8297	Parent 2	4600	28	4365.99	6392.47	3371.15	0	3371.15	10881.6	10881.6
98	9.23008	71974.4	62.757	Parent 2	4600	28	3501.99	5127.44	991.974	0	991.974	7793.54	7793.54
99	15.5259	75031.9	62.757	Parent 1	2200	28	1910.4	2797.12	1123.02	0	1123.02	4833.41	4833.41
100	9.31753	13851	62.757	Basalt Cap	75000	45	22371.8	32755.7	-42244.4	0	-42244.4	1206.21	1206.21

Interslice Data

Global Minimum Query (bishop simplified) - Safety Factor: 1.39526

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	190.438	2591.52	0	0	0
2	198.807	2586.29	9486.87	0	0
3	212.732	2577.59	38840.4	0	0
4	226.658	2568.88	83170.3	0	0
5	238.731	2561.7	131181	0	0
6	250.805	2554.52	189425	0	0
7	262.878	2547.34	261483	0	0
8	274.952	2540.84	340162	0	0
9	287.026	2534.34	428176	0	0
10	299.1	2527.84	525503	0	0
11	311.174	2521.34	632143	0	0

12	323.247	2514.84	748096	0	0
13	335.321	2508.34	873362	0	0
14	350.25	2500.3	1.04112e+06	0	0
15	365.178	2492.26	1.22312e+06	0	0
16	376.345	2493.24	1.219e+06	0	0
17	387.512	2494.22	1.21493e+06	0	0
18	398.679	2495.2	1.21092e+06	0	0
19	409.845	2496.18	1.20705e+06	0	0
20	421.011	2497.16	1.20387e+06	0	0
21	432.176	2498.14	1.2007e+06	0	0
22	443.341	2499.12	1.19749e+06	0	0
23	454.507	2500.1	1.19426e+06	0	0
24	465.671	2501.08	1.19098e+06	0	0
25	476.836	2502.06	1.18772e+06	0	0
26	488	2503.04	1.18458e+06	0	0
27	499.164	2504.02	1.1814e+06	0	0
28	510.329	2505	1.17819e+06	0	0
29	521.493	2505.98	1.17495e+06	0	0
30	532.658	2506.96	1.17167e+06	0	0
31	543.822	2507.94	1.16835e+06	0	0
32	554.987	2508.92	1.165e+06	0	0
33	566.151	2509.89	1.16162e+06	0	0
34	577.316	2510.87	1.1582e+06	0	0
35	588.48	2511.85	1.15475e+06	0	0
36	600.305	2512.89	1.15105e+06	0	0
37	612.131	2513.93	1.14772e+06	0	0
38	623.956	2514.97	1.14469e+06	0	0
39	635.781	2516.01	1.14173e+06	0	0
40	648.552	2517.71	1.12804e+06	0	0
41	661.322	2519.42	1.11454e+06	0	0
42	674.093	2521.13	1.10123e+06	0	0
43	686.864	2522.84	1.0881e+06	0	0
44	699.634	2524.57	1.07469e+06	0	0
45	712.405	2526.31	1.06146e+06	0	0
46	725.176	2528.04	1.04843e+06	0	0
47	737.946	2529.78	1.03559e+06	0	0
48	750.739	2532.03	1.01431e+06	0	0
49	763.531	2534.28	993378	0	0
50	776.323	2536.53	972784	0	0
51	789.115	2538.77	952416	0	0
52	801.907	2541.03	932178	0	0
53	814.7	2543.28	912149	0	0
54	827.492	2545.54	892327	0	0
55	840.284	2547.79	872788	0	0
56	851.659	2549.79	855775	0	0
57	863.033	2551.8	839046	0	0
58	874.408	2553.8	822582	0	0
59	885.783	2555.81	806383	0	0
60	897.157	2557.81	790449	0	0
61	908.532	2559.81	774781	0	0
62	919.907	2561.82	759377	0	0
63	931.281	2563.82	744238	0	0
64	942.656	2565.83	729364	0	0
65	954.031	2567.83	714755	0	0
66	965.405	2569.83	700411	0	0
67	976.78	2571.84	686332	0	0
68	988.155	2573.84	672513	0	0
69	999.529	2575.85	658938	0	0
70	1010.9	2577.85	645604	0	0
71	1022.28	2579.85	632513	0	0
72	1035.53	2582.19	617556	0	0

73	1048.77	2584.52	602928	0	0
74	1062.02	2586.86	588628	0	0
75	1075.27	2589.19	574657	0	0
76	1088.52	2591.53	561009	0	0
77	1101.77	2593.86	547584	0	0
78	1114.51	2596.11	534847	0	0
79	1127.25	2598.36	522282	0	0
80	1139.99	2600.6	509875	0	0
81	1151.98	2602.71	498096	0	0
82	1163.97	2604.83	486114	0	0
83	1178.1	2607.32	474518	0	0
84	1190.64	2609.53	463798	0	0
85	1203.18	2611.74	452668	0	0
86	1215.71	2613.95	441128	0	0
87	1228.25	2616.16	429242	0	0
88	1240.79	2618.37	417222	0	0
89	1253.33	2620.58	405086	0	0
90	1270.36	2641.09	271108	0	0
91	1281.16	2654.1	165202	0	0
92	1291.96	2667.11	71305	0	0
93	1299.5	2676.2	12820.6	0	0
94	1312.88	2692.31	-57091	0	0
95	1326.25	2708.42	-106053	0	0
96	1330.59	2713.65	-111165	0	0
97	1342.89	2728.47	-113385	0	0
98	1355.2	2743.29	-97461.8	0	0
99	1356.38	2744.71	-94986.4	0	0
100	1368.09	2758.82	-90484.5	0	0
101	1379.81	2772.94	0	0	0

Global Minimum Query (janbu simplified) - Safety Factor: 1.36334

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	190.438	2591.52	0	0	0
2	198.807	2586.29	9761.13	0	0
3	212.732	2577.59	39779.3	0	0
4	226.658	2568.88	84964	0	0
5	238.731	2561.7	133816	0	0
6	250.805	2554.52	193030	0	0
7	262.878	2547.34	266253	0	0
8	274.952	2540.84	346162	0	0
9	287.026	2534.34	435526	0	0
10	299.1	2527.84	534324	0	0
11	311.174	2521.34	642555	0	0
12	323.247	2514.84	760220	0	0
13	335.321	2508.34	887318	0	0
14	350.25	2500.3	1.05751e+06	0	0
15	365.178	2492.26	1.24212e+06	0	0
16	376.345	2493.24	1.23825e+06	0	0
17	387.512	2494.22	1.23442e+06	0	0
18	398.679	2495.2	1.23065e+06	0	0
19	409.845	2496.18	1.22703e+06	0	0
20	421.011	2497.16	1.2242e+06	0	0
21	432.176	2498.14	1.22138e+06	0	0
22	443.341	2499.12	1.21853e+06	0	0
23	454.507	2500.1	1.21563e+06	0	0
24	465.671	2501.08	1.2127e+06	0	0
25	476.836	2502.06	1.20978e+06	0	0
26	488	2503.04	1.207e+06	0	0
27	499.164	2504.02	1.20418e+06	0	0
28	510.329	2505	1.20132e+06	0	0

29	521.493	2505.98	1.19843e+06	0	0
30	532.658	2506.96	1.19549e+06	0	0
31	543.822	2507.94	1.19252e+06	0	0
32	554.987	2508.92	1.1895e+06	0	0
33	566.151	2509.89	1.18645e+06	0	0
34	577.316	2510.87	1.18336e+06	0	0
35	588.48	2511.85	1.18023e+06	0	0
36	600.305	2512.89	1.17688e+06	0	0
37	612.131	2513.93	1.17394e+06	0	0
38	623.956	2514.97	1.17132e+06	0	0
39	635.781	2516.01	1.16879e+06	0	0
40	648.552	2517.71	1.15556e+06	0	0
41	661.322	2519.42	1.14252e+06	0	0
42	674.093	2521.13	1.12966e+06	0	0
43	686.864	2522.84	1.11699e+06	0	0
44	699.634	2524.57	1.10403e+06	0	0
45	712.405	2526.31	1.09126e+06	0	0
46	725.176	2528.04	1.07868e+06	0	0
47	737.946	2529.78	1.0663e+06	0	0
48	750.739	2532.03	1.04547e+06	0	0
49	763.531	2534.28	1.025e+06	0	0
50	776.323	2536.53	1.00486e+06	0	0
51	789.115	2538.77	984947	0	0
52	801.907	2541.03	965172	0	0
53	814.7	2543.28	945609	0	0
54	827.492	2545.54	926258	0	0
55	840.284	2547.79	907192	0	0
56	851.659	2549.79	890595	0	0
57	863.033	2551.8	874281	0	0
58	874.408	2553.8	858232	0	0
59	885.783	2555.81	842447	0	0
60	897.157	2557.81	826926	0	0
61	908.532	2559.81	811670	0	0
62	919.907	2561.82	796678	0	0
63	931.281	2563.82	781950	0	0
64	942.656	2565.83	767487	0	0
65	954.031	2567.83	753288	0	0
66	965.405	2569.83	739354	0	0
67	976.78	2571.84	725683	0	0
68	988.155	2573.84	712273	0	0
69	999.529	2575.85	699107	0	0
70	1010.9	2577.85	686183	0	0
71	1022.28	2579.85	673501	0	0
72	1035.53	2582.19	659022	0	0
73	1048.77	2584.52	644871	0	0
74	1062.02	2586.86	631050	0	0
75	1075.27	2589.19	617558	0	0
76	1088.52	2591.53	604389	0	0
77	1101.77	2593.86	591449	0	0
78	1114.51	2596.11	579185	0	0
79	1127.25	2598.36	567097	0	0
80	1139.99	2600.6	555175	0	0
81	1151.98	2602.71	543868	0	0
82	1163.97	2604.83	532377	0	0
83	1178.1	2607.32	521461	0	0
84	1190.64	2609.53	511361	0	0
85	1203.18	2611.74	500869	0	0
86	1215.71	2613.95	489983	0	0
87	1228.25	2616.16	478766	0	0
88	1240.79	2618.37	467421	0	0
89	1253.33	2620.58	455964	0	0

90	1270.36	2641.09	325611	0	0
91	1281.16	2654.1	221494	0	0
92	1291.96	2667.11	129267	0	0
93	1299.5	2676.2	71877.7	0	0
94	1312.88	2692.31	4171.28	0	0
95	1326.25	2708.42	-42795.2	0	0
96	1330.59	2713.65	-47172.2	0	0
97	1342.89	2728.47	-47430.7	0	0
98	1355.2	2743.29	-29728.4	0	0
99	1356.38	2744.71	-27092.1	0	0
100	1368.09	2758.82	-21712.3	0	0
101	1379.81	2772.94	0	0	0

Global Minimum Query (spencer) - Safety Factor: 1.46415

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	181.582	2591.45	0	0	0
2	189.069	2586.28	8813.66	-23.6428	-0.153697
3	204.069	2575.91	43671.6	-117.15	-0.153697
4	219.069	2565.54	99165.7	-266.014	-0.153697
5	234.069	2555.17	175296	-470.235	-0.153697
6	251.564	2544.21	278709	-747.641	-0.153696
7	269.06	2533.25	412757	-1107.23	-0.153697
8	286.555	2522.29	574875	-1542.11	-0.153696
9	304.051	2511.7	755722	-2027.24	-0.153697
10	321.547	2501.12	960126	-2575.55	-0.153696
11	339.042	2490.53	1.18809e+06	-3187.06	-0.153696
12	355.551	2480.67	1.42192e+06	-3814.33	-0.153697
13	372.06	2470.81	1.67622e+06	-4496.49	-0.153697
14	388.568	2460.95	1.95032e+06	-5231.78	-0.153697
15	410.856	2462.9	1.93832e+06	-5199.57	-0.153696
16	433.143	2464.86	1.92747e+06	-5170.46	-0.153696
17	455.43	2466.81	1.91652e+06	-5141.11	-0.153697
18	477.718	2468.77	1.90552e+06	-5111.59	-0.153697
19	494.711	2470.26	1.89725e+06	-5089.39	-0.153696
20	511.705	2471.75	1.88891e+06	-5067.03	-0.153696
21	528.699	2473.24	1.88051e+06	-5044.49	-0.153696
22	545.692	2474.73	1.87204e+06	-5021.78	-0.153697
23	562.367	2476.2	1.86335e+06	-4998.47	-0.153697
24	579.041	2477.68	1.8546e+06	-4975	-0.153697
25	595.716	2479.16	1.8458e+06	-4951.38	-0.153696
26	612.39	2480.64	1.83724e+06	-4928.42	-0.153696
27	628.964	2482.11	1.82914e+06	-4906.69	-0.153696
28	645.538	2483.58	1.82118e+06	-4885.34	-0.153696
29	662.113	2485.05	1.81336e+06	-4864.37	-0.153697
30	678.687	2486.52	1.80569e+06	-4843.78	-0.153696
31	695.604	2488.03	1.79783e+06	-4822.71	-0.153697
32	712.522	2489.54	1.79013e+06	-4802.05	-0.153696
33	729.439	2491.05	1.78257e+06	-4781.78	-0.153697
34	751.243	2492.99	1.77305e+06	-4756.25	-0.153697
35	773.048	2494.93	1.76379e+06	-4731.38	-0.153696
36	788.261	2496.29	1.75749e+06	-4714.5	-0.153697
37	803.475	2497.65	1.75136e+06	-4698.05	-0.153696
38	818.688	2499.01	1.74539e+06	-4682.03	-0.153696
39	833.921	2500.37	1.73953e+06	-4666.31	-0.153696
40	849.153	2501.73	1.73378e+06	-4650.9	-0.153697
41	864.385	2503.09	1.72816e+06	-4635.81	-0.153696
42	886.174	2505.03	1.72033e+06	-4614.8	-0.153696
43	907.963	2506.98	1.71276e+06	-4594.49	-0.153696
44	929.751	2508.92	1.70544e+06	-4574.88	-0.153697
45	951.54	2510.87	1.69839e+06	-4555.96	-0.153697

46	966.69	2512.22	1.69364e+06	-4543.21	-0.153696
47	981.841	2513.57	1.68901e+06	-4530.8	-0.153697
48	996.992	2514.93	1.68452e+06	-4518.74	-0.153696
49	1012.14	2516.28	1.68015e+06	-4507.03	-0.153697
50	1027.29	2517.63	1.67592e+06	-4495.68	-0.153696
51	1042.44	2518.99	1.67182e+06	-4484.69	-0.153697
52	1061.43	2520.68	1.66688e+06	-4471.42	-0.153696
53	1080.41	2522.38	1.66214e+06	-4458.71	-0.153696
54	1099.4	2524.07	1.65762e+06	-4446.6	-0.153697
55	1118.39	2525.77	1.65337e+06	-4435.19	-0.153696
56	1137.37	2527.46	1.64938e+06	-4424.49	-0.153697
57	1156.36	2529.16	1.64574e+06	-4414.73	-0.153697
58	1175.34	2530.85	1.64253e+06	-4406.11	-0.153696
59	1194.33	2532.55	1.63975e+06	-4398.65	-0.153696
60	1213.31	2535.89	1.59534e+06	-4279.54	-0.153697
61	1232.3	2539.22	1.5505e+06	-4159.24	-0.153696
62	1251.28	2542.56	1.50574e+06	-4039.16	-0.153696
63	1270.27	2545.9	1.46114e+06	-3919.52	-0.153696
64	1285.62	2548.6	1.42517e+06	-3823.03	-0.153696
65	1300.98	2551.31	1.3894e+06	-3727.09	-0.153697
66	1316.33	2554.01	1.35391e+06	-3631.89	-0.153697
67	1331.54	2556.69	1.3193e+06	-3539.04	-0.153696
68	1346.74	2559.37	1.28523e+06	-3447.65	-0.153696
69	1361.94	2562.04	1.25171e+06	-3357.74	-0.153697
70	1378.39	2564.94	1.21597e+06	-3261.86	-0.153697
71	1394.84	2567.84	1.18087e+06	-3167.71	-0.153697
72	1411.29	2570.74	1.14642e+06	-3075.28	-0.153696
73	1427.74	2573.64	1.1126e+06	-2984.58	-0.153697
74	1444.21	2576.55	1.0794e+06	-2895.52	-0.153697
75	1460.67	2579.45	1.04685e+06	-2808.18	-0.153696
76	1477.14	2582.35	1.01493e+06	-2722.58	-0.153697
77	1493.6	2585.26	983666	-2638.7	-0.153696
78	1513.5	2588.76	946749	-2539.67	-0.153697
79	1533.39	2592.27	910773	-2443.16	-0.153696
80	1553.28	2595.78	875738	-2349.18	-0.153696
81	1570.39	2598.8	846239	-2270.05	-0.153696
82	1587.5	2601.81	817134	-2191.98	-0.153697
83	1604.61	2604.83	788423	-2114.96	-0.153697
84	1613.33	2606.37	775614	-2080.6	-0.153697
85	1633.48	2609.92	745652	-2000.22	-0.153696
86	1653.63	2613.47	713451	-1913.84	-0.153696
87	1673.78	2617.02	678748	-1820.75	-0.153696
88	1693.97	2620.58	642437	-1723.35	-0.153697
89	1714.15	2624.14	604470	-1621.5	-0.153696
90	1734.33	2627.7	563567	-1511.78	-0.153697
91	1746.81	2647.01	283524	-760.559	-0.153697
92	1764.12	2673.82	-52637.8	141.202	-0.153697
93	1779.02	2697	-308214	826.788	-0.153696
94	1793.91	2720.18	-531375	1425.42	-0.153696
95	1807.58	2742.82	-716844	1922.95	-0.153697
96	1824.97	2771.65	-873501	2343.18	-0.153696
97	1837.38	2793	-956524	2565.89	-0.153696
98	1856.03	2825.07	-983244	2637.57	-0.153697
99	1865.26	2843	-968703	2598.56	-0.153696
100	1880.79	2873.15	-972906	2609.84	-0.153697
101	1890.1	2891.25	0	0	0

Entity Information

Group: Group 1

Shared Entities

Type	Coordinates	
	X	Y
External Boundary	0	2400
	325	2400
	2100	2400
	2100	2637
	2100	2643
	2100	2693
	2100	2743
	2100	2793
	2100	2843
	2100	2863
	2100	2893
	1740	2890
	1733	2880
	1725	2870
	1715	2860
	1705	2850
	1688	2840
	1670	2830
	1655	2820
	1635	2800
	1620	2790
	1555	2780
	1307	2770
	1258	2760
	1220	2750
	1137	2710
	1085	2700
	981	2690
	848	2680
	848	2680.01
	848.017	2680.01
	848	2680
	830	2680
	770	2670
	605	2660
	605	2638
	588.901	2638
	552.82	2638
	474	2638
	474	2632
	412	2632
	412	2602
	408	2602
	368	2601
	264	2596
	250	2592
	0	2590

X	Y
250	2592
336.843	2580.18
408	2575.83
410.443	2575.83
412	2575.83
426.415	2575
520	2575
639.276	2579.23
748.665	2582.59
929.108	2591.46
1070.69	2604.83
1153.89	2619.43
1184.94	2624.6
1232.69	2633.27
1269.97	2641.01
1295.65	2647.01
1331.37	2655.36
1352.55	2660.31
1436.77	2682.3
1456.52	2690.28
1501.45	2711.7
1533.28	2726.88
1538.15	2730.43
1571.12	2754.42
1620	2790

Material Boundary

X	Y
325	2400
1859.05	2604.83
2100	2637

Material Boundary

X	Y
1533.28	2726.88
1628.48	2735.95
1772.43	2843
2100	2843

Material Boundary

X	Y
1456.52	2690.28
1643.59	2684.57
1725.74	2743
1790.67	2793
2100	2793

Material Boundary

X	Y
1070.69	2604.83
1142.96	2604.83
1796.72	2604.83
1859.05	2604.83

Material Boundary

X	Y
625.172	2617.99
635.144	2604.99

Material Boundary

X	Y
605	2638
608.98	2632.63
625.172	2617.99

Material Boundary

X	Y
1751.38	2697.67
1807.8	2743

Material Boundary

X	Y
1807.8	2743
2100	2743

Material Boundary

X	Y
1733	2880
2100	2863

Material Boundary

X	Y
1643.59	2684.57
1671.74	2687.99
1751.38	2697.67

Material Boundary

X	Y
1295.65	2647.01
1778.84	2647.01
1872.68	2683.69
2100	2693

Material Boundary

X	Y
635.144	2604.99
1070.69	2604.83

Material Boundary

X	Y
608.98	2632.63
771.118	2643.71
889.239	2652.93
1040.2	2662.15
1107.04	2671.94
1160.05	2685.77
1183.23	2698.93
1210.76	2717.23
1263.67	2735.82

Material Boundary

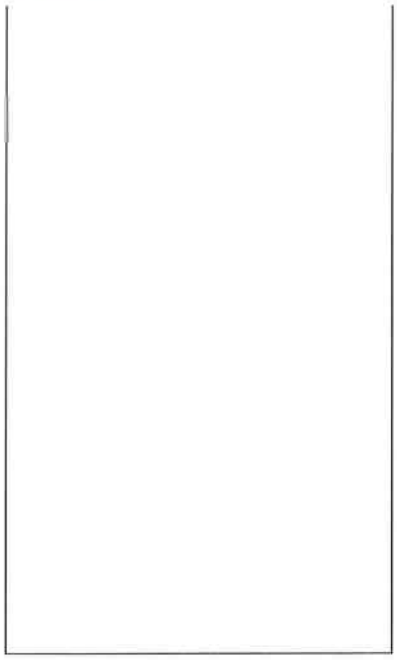
X	Y
1263.67	2735.82
1311.94	2742.7
1571.12	2754.42

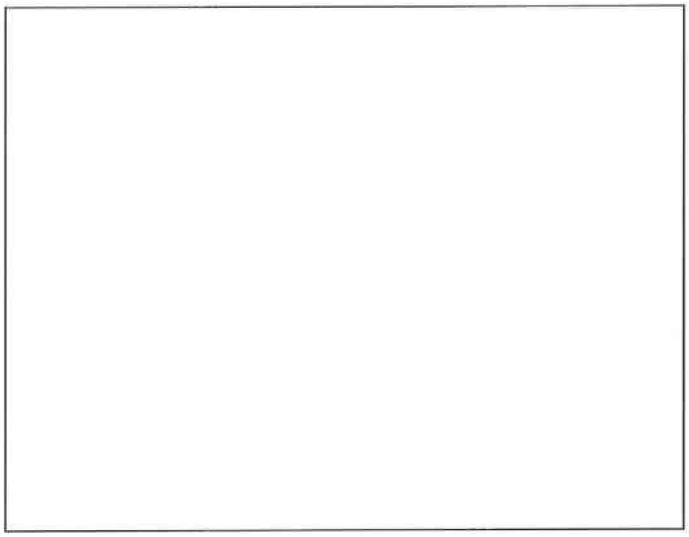
Material Boundary

X	Y
1183.23	2698.93
1254.6	2705.68

Material Boundary

X	Y
625.172	2617.99
903.806	2628.93
1042.92	2628.93
1089.74	2628.93
1232.69	2633.27





Material Boundary

X	Y
1089.74	2628.93
1150.23	2649.7
1191.06	2667.09
1259.1	2673.9
1340.76	2678.55
1436.77	2682.3

Material Boundary

X	Y
1254.6	2705.68
1412.45	2711.7
1501.45	2711.7

Material Boundary

X	Y
408	2602
408	2575.83
408	2498
412	2498
412	2575.83
412	2602

Scenario-based Entities

Type	Coordinates	Master Scenario
		Assigned to materials:
Water Table	X: 0, 413.466, 598.915, 2100 Y: 2586, 2586.61, 2604.83, 2604.83	Slide Mass Slide Mass 1 Slide Mass 2 Slide Mass 3 Slide Mass 4 Slide Mass 5 *... and 8 more*
Distributed Load	X: 474, 605 Y: 2638, 2638	Constant Distribution Orientation: Vertical Magnitude: 200 lbs/ft2 Creates Excess Pore Pressure: No

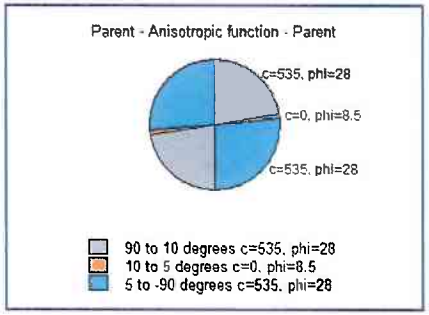
APPENDIX

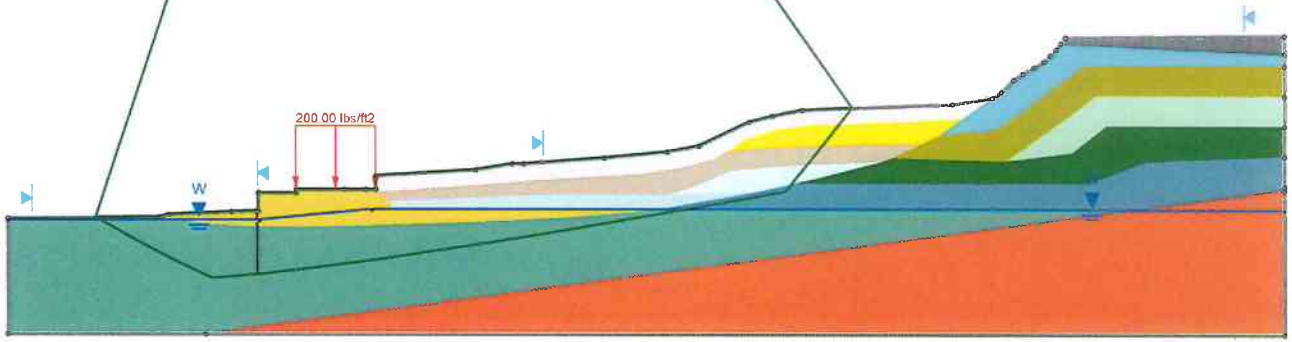
A-4 Proposed Profile with Reinforcement - Seismic

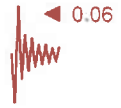
Project No. 2180187

1.021

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Anisotropic Function	Water Surface
Basalt Cap		165	Mohr-Coulomb	75000	45		None
Slide Mass		125	Mohr-Coulomb	200	15		Water Surface
Slide Mass 1		125	Mohr-Coulomb	1750	15		Water Surface
Slide Mass 2		125	Mohr-Coulomb	3500	15		Water Surface
Slide Mass 3		125	Mohr-Coulomb	2500	15		Water Surface
Slide Mass 4		125	Mohr-Coulomb	1500	15		Water Surface
Slide Mass 5		125	Mohr-Coulomb	750	15		Water Surface
Parent		125	Anisotropic function			Parent	Water Surface
Parent 1		125	Anisotropic function			Parent 1	Water Surface
Parent 2		125	Anisotropic function			Parent 2	Water Surface
Parent 3		125	Anisotropic function			Parent 3	Water Surface
Parent 4		125	Anisotropic function			Parent 4	Water Surface
Parent 5		125	Anisotropic function			Parent 5	Water Surface
Sandstone		130	Mohr-Coulomb	3000	44		Water Surface
Cut off wall		150	Mohr-Coulomb	30000	0		Water Surface







4000
3500
3000
2500

-500 -250 0 250 500 750 1000 1250 1500 1750 2000 2250 2500

AGEC Applied GeoTech

SLIDEINTERPRET 8.014

Project: Blackstone Hotel - proposed profile, static, un-saturated soil, with reinforcement and earthquake			
Analysis Description:			
Drawn By:	Scale: 1:3789	Company:	
Date: 9/21/2019 9:46:10 AM		File Name: Unsaturated Building Profile A with reinforcement eq.slmd	

Slide Analysis Information

Unsaturated Building Profile A with reinforcement eq

Project Summary

File Name:	Unsaturated Building Profile A with reinforcement eq.slmd
Slide Modeler Version:	8.014
Compute Time:	00h:00m:17.461s
Project Title:	SLIDE - An Interactive Slope Stability Program
Date Created:	10/19/2018, 3:12:08 PM

General Settings

Units of Measurement:	Imperial Units
Time Units:	days
Permeability Units:	feet/second
Data Output:	Standard
Failure Direction:	Right to Left

Analysis Options

Slices Type:	Vertical
Analysis Methods Used	
	Bishop simplified
	Janbu simplified
	Spencer
Number of slices:	100
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Groundwater Analysis

Groundwater Method:	Water Surfaces
Pore Fluid Unit Weight [lbs/ft3]:	62.4
Use negative pore pressure cutoff:	Yes
Maximum negative pore pressure [psf]:	0
Advanced Groundwater Method:	None

Random Numbers

Pseudo-random Seed:	10116
Random Number Generation Method:	Park and Miller v.3

Surface Options

Search Method:	Simulated Annealing Search
Minimum Elevation:	Not Defined
Minimum Depth:	Not Defined
Minimum Area:	Not Defined
Minimum Weight:	Not Defined
Convex Surfaces Only:	Enabled

Seismic Loading

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No

Seismic Load Coefficient (Horizontal): 0.06

Loading

1 Distributed Load present

Distributed Load 1

Distribution:	Constant
Magnitude [psf]:	200
Orientation:	Vertical

Materials

Property	Basalt Cap	Slide Mass	Slide Mass 1	Slide Mass 2	Slide Mass 3	Slide Mass 4	Slide Mass 5	Parent
Color								
Strength Type	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Anisotropic function
Unit Weight [lbs/ft3]	165	125	125	125	125	125	125	125
Cohesion [psf]	75000	200	1750	3500	2500	1500	750	
Friction Angle [°]	45	15	15	15	15	15	15	
Water Surface	None	Water Table	Water Table	Water Table	Water Table	Water Table	Water Table	Water Table
Hu Value		1	1	1	1	1	1	1
Ru Value	0							

Anisotropic Functions

Name: Parent 5

Angle From	Angle To	c	phi
-90	5	1100	28
5	10	285	8.5
10	90	1100	28

Name: Parent 4

Angle From	Angle To	c	phi
-90	5	1850	28
5	10	750	8.5
10	90	1850	28

Name: Parent 3

Angle From	Angle To	c	phi
-90	5	3100	28
5	10	1600	8.5
10	90	3100	28

Name: Parent 2

Angle From	Angle To	c	phi
-90	5	4600	28
5	10	2500	8.5
10	90	4600	28

Name: Parent 1

Angle From	Angle To	c	phi
-90	5	2200	28
5	10	1140	8.5
10	90	2200	28

Name: Parent

Angle From	Angle To	c	phi
-90	5	535	28
5	10	0	8.5
10	90	535	28

Property	Parent 1	Parent 2	Parent 3	Parent 4	Parent 5	Sandstone	Cut off wall
Color							
Strength Type	Anisotropic function	Anisotropic function	Anisotropic function	Anisotropic function	Anisotropic function	Mohr-Coulomb	Mohr-Coulomb
Unit Weight [lbs/ft3]	125	125	125	125	125	130	150
Cohesion [psf]						3000	30000
Friction Angle [°]						44	0
Water Surface	Water Table	Water Table	Water Table	Water Table	Water Table	Water Table	Water Table
Hu Value	1	1	1	1	1	1	1

Anisotropic Functions

Name: Parent 5

Angle From	Angle To	c	phi
-90	5	1100	28
5	10	285	8.5
10	90	1100	28

Name: Parent 4

Angle From	Angle To	c	phi
-90	5	1850	28
5	10	750	8.5
10	90	1850	28

Name: Parent 3

Angle From	Angle To	c	phi
-90	5	3100	28
5	10	1600	8.5
10	90	3100	28

Name: Parent 2

Angle From	Angle To	c	phi
-90	5	4600	28
5	10	2500	8.5
10	90	4600	28

Name: Parent 1

Angle From	Angle To	c	phi
-90	5	2200	28
5	10	1140	8.5
10	90	2200	28

Name: Parent

Angle From	Angle To	c	phi
-90	5	535	28
5	10	0	8.5
10	90	535	28

Global Minimums

Method: bishop simplified

FS	1.020540
Axis Location:	585.489, 3926.827
Left Slip Surface Endpoint:	145.384, 2591.163
Right Slip Surface Endpoint:	1389.957, 2773.345
Resisting Moment:	4.28715e+09 lb-ft
Driving Moment:	4.20237e+09 lb-ft
Total Slice Area:	130013 ft2
Surface Horizontal Width:	1244.57 ft
Surface Average Height:	104.464 ft

Method: janbu simplified

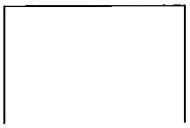
FS	0.996810
Axis Location:	585.489, 3926.827
Left Slip Surface Endpoint:	145.384, 2591.163
Right Slip Surface Endpoint:	1389.957, 2773.345
Resisting Horizontal Force:	2.75708e+06 lb
Driving Horizontal Force:	2.76591e+06 lb
Total Slice Area:	130013 ft2
Surface Horizontal Width:	1244.57 ft
Surface Average Height:	104.464 ft

Method: spencer

FS	1.066850
Axis Location:	593.236, 3923.925
Left Slip Surface Endpoint:	154.848, 2591.239
Right Slip Surface Endpoint:	1396.352, 2773.603
Resisting Moment:	3.87449e+09 lb-ft
Driving Moment:	3.6317e+09 lb-ft
Resisting Horizontal Force:	2.55283e+06 lb
Driving Horizontal Force:	2.39286e+06 lb
Total Slice Area:	110656 ft2
Surface Horizontal Width:	1241.5 ft
Surface Average Height:	89.1303 ft

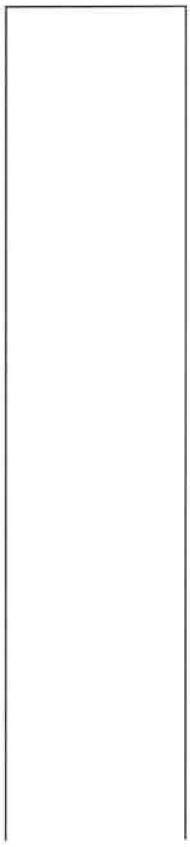
Global Minimum Coordinates

Method: bishop simplified



X	Y
145.384	2591.16
192.163	2564.72
238.942	2538.74
285.726	2515.29
336.498	2490.86
375.382	2494.27
415.984	2497.82
450.113	2501.96
484.165	2506.24
518.859	2510.69
553.554	2515.13
607.99	2522.14
665.576	2530.89
723.161	2539.66
774.447	2547.48
825.733	2555.68
877.019	2564.04
928.306	2572.63
979.593	2581.58
1030.88	2590.53
1081.64	2599.45
1124.42	2606.97
1168.02	2614.65
1218.65	2623.58
1250.4	2629.18
1280.28	2634.45
1301.19	2660.66
1322.1	2686.88
1356.03	2729.43
1389.96	2773.35

Method: janbu simplified



X	Y
145.384	2591.16
192.163	2564.72
238.942	2538.74
285.726	2515.29
336.498	2490.86
375.382	2494.27
415.984	2497.82
450.113	2501.96
484.165	2506.24
518.859	2510.69
553.554	2515.13
607.99	2522.14
665.576	2530.89
723.161	2539.66
774.447	2547.48
825.733	2555.68
877.019	2564.04
928.306	2572.63
979.593	2581.58
1030.88	2590.53
1081.64	2599.45
1124.42	2606.97
1168.02	2614.65
1218.65	2623.58
1250.4	2629.18
1280.28	2634.45
1301.19	2660.66
1322.1	2686.88
1356.03	2729.43
1389.96	2773.35

Method: spencer

X	Y
154.848	2591.24
330.455	2524.25
538.743	2542.72
717.997	2559.79
970.205	2586
1111	2608.55
1284.53	2638.89
1396.35	2773.6

Valid/Invalid Surfaces

Method: bishop simplified

Number of Valid Surfaces: 7712
Number of Invalid Surfaces: 16212

Error Codes:

Error Code -1000 reported for 16212 surfaces

Method: janbu simplified

Number of Valid Surfaces: 7458
Number of Invalid Surfaces: 16466

Error Codes:

Error Code -1000 reported for 16466 surfaces

Method: spencer

Number of Valid Surfaces: 8760
Number of Invalid Surfaces: 15164

Error Codes:

Error Code -1000 reported for 15164 surfaces

Error Codes

The following errors were encountered during the computation:

-1000 = No valid slip surface is generated

Slice Data

Global Minimum Query (bishop simplified) - Safety Factor: 1.02054

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [degrees]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	8.73337	2732.97	-29.48	Parent	535	28	973.107	993.095	861.551	0	861.551	311.442	311.442
2	12.6817	13699.8	-29.48	Parent	535	28	1373.76	1401.98	1854.78	224.23	1630.55	1078.18	853.946
3	12.6817	25225.3	-29.48	Parent	535	28	1713.33	1748.52	2955.04	672.745	2282.3	1986.48	1313.73
4	12.6817	36750.8	-29.48	Parent	535	28	2052.89	2095.06	4055.3	1121.26	2934.04	2894.78	1773.52
5	11.6947	44020.8	-29.0501	Parent	535	28	2359.47	2407.93	5071.19	1548.72	3522.47	3760.62	2211.9
6	11.6947	53653.3	-29.0501	Parent	535	28	2665.06	2719.8	6064.15	1955.13	4109.02	4583.84	2628.71
7	11.6947	63285.9	-29.0501	Parent	535	28	2970.66	3031.68	7057.11	2361.54	4695.57	5407.05	3045.51
8	11.6947	72918.5	-29.0501	Parent	535	28	3276.26	3343.55	8050.09	2767.95	5282.14	6230.28	3462.33
9	11.696	82103.8	-26.6173	Parent	535	28	3431.62	3502.11	8734.87	3154.56	5580.31	7015.14	3860.58
10	11.696	93436.1	-26.6173	Parent	535	28	3855.75	3934.95	9915.76	3521.38	6394.38	7983.48	4462.1
11	11.696	105397	-26.6173	Parent	535	28	4317.73	4406.42	11169.3	3888.2	7281.06	9005.47	5117.27
12	11.696	114830	-26.6173	Parent	535	28	4627.45	4722.5	12130.5	4255.02	7875.53	9811.54	5556.52
13	12.693	135043	-25.6928	Parent	535	28	4873.61	4973.71	12977.5	4629.54	8347.98	10632.8	6003.22
14	12.693	145700	-25.6928	Parent	535	28	5191.35	5297.98	13969.6	5011.77	8957.82	11472	6460.19
15	12.693	156358	-25.6928	Parent	535	28	5509.08	5622.24	14961.7	5393.99	9567.74	12311.2	6917.25
16	12.693	167015	-25.6928	Parent	535	28	5826.83	5946.51	15953.8	5776.22	10177.6	13150.4	7374.22
17	12.9614	175574	5.0035	Parent	0	8.5	1100.85	1123.46	13449.8	5932.52	7517.24	13546.1	7613.62
18	12.9614	174745	5.0035	Parent	0	8.5	1101.66	1124.29	13385.7	5862.89	7522.85	13482.2	7619.3
19	12.9614	173837	5.0035	Parent	0	8.5	1101.61	1124.24	13315.7	5793.27	7522.45	13412.2	7618.9
20	13.534	180162	5.0035	Parent	0	8.5	1097.42	1119.96	13216	5722.11	7493.85	13312	7589.93
21	13.534	178729	5.0035	Parent	0	8.5	1092.64	1115.08	13110.6	5649.41	7461.15	13206.2	7556.81
22	13.534	202538	5.0035	Parent	0	8.5	1357.51	1385.39	14846.6	5576.71	9269.85	14965.4	9388.7
23	11.3762	189825	6.90536	Parent	0	8.5	1602.84	1635.76	16492.6	5547.45	10945.1	16686.7	11139.2
24	11.3762	187865	6.90536	Parent	0	8.5	1580.39	1612.85	16323.1	5531.23	10791.9	16514.5	10983.3
25	11.3762	185906	6.90536	Parent	0	8.5	1557.94	1589.94	16153.5	5515.01	10638.5	16342.2	10827.2
26	11.3508	183501	7.17316	Parent	0	8.5	1534.24	1565.75	15973.7	5497.13	10476.6	16166.8	10669.7
27	11.3508	181474	7.17316	Parent	0	8.5	1511.37	1542.41	15798.1	5477.58	10320.5	15988.3	10510.7
28	11.3508	187071	7.17316	Parent	0	8.5	1610.83	1643.92	16457.7	5458.03	10999.7	16660.5	11202.4
29	11.5648	189400	7.30024	Parent	0	8.5	1601.39	1634.28	16372.8	5437.49	10935.3	16577.9	11140.4
30	11.5648	187259	7.30024	Parent	0	8.5	1577.86	1610.27	16190.5	5415.95	10774.6	16392.6	10976.7
31	11.5648	185117	7.30024	Parent	0	8.5	1554.34	1586.27	16008.3	5394.41	10613.9	16207.5	10813.1
32	11.5648	182975	7.30024	Parent	0	8.5	1530.82	1562.26	15826.2	5372.87	10453.3	16022.3	10649.4
33	11.5648	180833	7.30024	Parent	0	8.5	1507.29	1538.25	15644	5351.32	10292.7	15837.1	10485.8
34	11.5648	178692	7.30024	Parent	0	8.5	1483.76	1514.24	15461.8	5329.78	10132	15651.9	10322.1
35	13.6092	207529	7.34073	Parent	0	8.5	1457.96	1487.91	15261.9	5306.03	9955.87	15449.7	10143.7

36	13.6092	204546	7.34073	Parent	0	8.5	1430.19	1459.57	15046.3	5280.07	9766.26	15230.6	9950.51
37	13.6092	201564	7.34073	Parent	0	8.5	1402.42	1431.23	14830.7	5254.12	9576.57	15011.4	9757.23
38	13.6092	206838	7.34073	Parent	0	8.5	1457.55	1487.49	15167.2	5214.24	9953	15355	10140.8
39	11.5171	197969	8.64022	Parent	0	8.5	1731.22	1766.78	16926.7	5104.94	11821.7	17189.8	12084.8
40	11.5171	196454	8.64022	Parent	0	8.5	1728.03	1763.52	16795.7	4995.73	11800	17058.3	12062.5
41	11.5171	194940	8.64022	Parent	0	8.5	1724.82	1760.25	16664.7	4886.53	11778.2	16926.8	12040.3
42	11.5171	193425	8.64022	Parent	0	8.5	1721.63	1756.99	16533.6	4777.32	11756.3	16795.2	12017.9
43	11.5171	191911	8.64022	Parent	0	8.5	1718.43	1753.73	16402.6	4668.12	11734.5	16663.7	11995.6
44	11.517	190390	8.66056	Parent	0	8.5	1715.13	1750.36	16270.8	4558.78	11712	16532	11973.2
45	11.517	188869	8.66056	Parent	0	8.5	1711.9	1747.06	16139.2	4449.32	11689.9	16399.9	11950.6
46	11.517	187349	8.66056	Parent	0	8.5	1708.66	1743.76	16007.7	4339.85	11667.8	16267.9	11928.1
47	11.517	185828	8.66056	Parent	0	8.5	1705.43	1740.46	15876.1	4230.39	11645.7	16135.8	11905.5
48	11.517	184308	8.66056	Parent	0	8.5	1702.21	1737.17	15744.6	4120.93	11623.6	16003.9	11882.9
49	12.8215	203394	8.66801	Parent	0	8.5	1698.75	1733.64	15605.3	4005.21	11600.1	15864.3	11859.1
50	12.8215	201507	8.66801	Parent	0	8.5	1695.13	1729.95	15458.6	3883.24	11575.4	15717.1	11833.8
51	12.8215	199620	8.66801	Parent	0	8.5	1691.52	1726.26	15312	3761.27	11550.7	15569.9	11808.6
52	12.8215	197864	8.66801	Parent	0	8.5	1689.37	1724.07	15175.3	3639.3	11536	15432.8	11793.5
53	12.8216	197615	9.08541	Parent	0	8.5	1702.67	1737.64	15141.2	3514.35	11626.8	15413.4	11899.1
54	12.8216	197754	9.08541	Parent	0	8.5	1722.53	1757.91	15148.8	3386.4	11762.4	15424.2	12037.8
55	12.8216	197893	9.08541	Parent	0	8.5	1742.38	1778.17	15156.5	3258.46	11898	15435.1	12176.7
56	12.8216	198031	9.08541	Parent	0	8.5	1762.24	1798.44	15164.1	3130.52	12033.6	15445.9	12315.4
57	12.8216	197377	9.25369	Parent	0	8.5	1772.65	1809.06	15106.1	3001.38	12104.7	15394.9	12393.5
58	12.8216	194273	9.25369	Parent	0	8.5	1756.66	1792.74	14866.5	2871.02	11995.5	15152.7	12281.7
59	12.8216	192050	9.25369	Parent	0	8.5	1750.51	1786.47	14694.3	2740.67	11953.6	14979.5	12238.8
60	12.8216	190247	9.25369	Parent	0	8.5	1749.04	1784.97	14553.9	2610.32	11943.5	14838.8	12228.5
61	12.8217	188400	9.50379	Parent	0	8.5	1746.2	1782.07	14402.3	2478.17	11924.1	14694.6	12216.5
62	12.8217	186505	9.50379	Parent	0	8.5	1744.22	1780.05	14254.9	2344.23	11910.6	14546.9	12202.6
63	12.8217	184610	9.50379	Parent	0	8.5	1742.24	1778.03	14107.3	2210.29	11897	14399	12188.7
64	12.8217	182715	9.50379	Parent	0	8.5	1740.26	1776	13959.9	2076.35	11883.5	14251.2	12174.8
65	12.8217	180746	9.90158	Parent	0	8.5	1736.1	1771.76	13794.6	1939.55	11855.1	14097.7	12158.1
66	12.8217	178704	9.90158	Parent	0	8.5	1733.3	1768.9	13635.9	1799.89	11836	13938.4	12138.6
67	12.8217	176662	9.90158	Parent	0	8.5	1730.5	1766.04	13477.1	1660.23	11816.8	13779.1	12118.9
68	12.8217	174620	9.90158	Parent	0	8.5	1727.7	1763.19	13318.3	1520.58	11797.8	13619.9	12099.3
69	12.8217	172749	9.90158	Parent	0	8.5	1726.8	1762.27	13172.5	1380.92	11791.6	13473.9	12093
70	12.8217	171135	9.90158	Parent	0	8.5	1728.77	1764.28	13046.4	1241.26	11805.1	13348.1	12106.9
71	12.8217	169524	9.90158	Parent	0	8.5	1730.77	1766.32	12920.4	1101.6	11818.8	13222.5	12120.9
72	12.8217	167913	9.90158	Parent	0	8.5	1732.77	1768.36	12794.4	961.944	11832.4	13096.8	12134.9
73	12.6911	164603	9.97	Parent	0	8.5	1734.39	1770.01	12665.9	822.509	11843.4	12970.8	12148.3
74	12.6911	163000	9.97	Parent	0	8.5	1736.23	1771.89	12539.3	683.299	11856	12844.5	12161.2
75	12.6911	161397	9.97	Parent	0	8.5	1738.07	1773.77	12412.6	544.089	11868.5	12718.1	12174.1
76	12.6911	159794	9.97	Parent	0	8.5	1739.9	1775.64	12286	404.879	11881.1	12591.8	12186.9
77	15.2839	191166	9.97	Parent	0	8.5	1749.92	1785.86	12200.9	251.449	11949.5	12508.6	12257.1
78	15.2839	191581	9.97	Parent	0	8.5	1777.74	1814.25	12223.2	83.7982	12139.4	12535.7	12451.9
79	12.2076	153367	9.97	Parent 5	285	8.5	2066.02	2108.46	12201	0	12201	12564.2	12564.2
80	14.5319	183034	9.98834	Parent 5	285	8.5	2070.5	2113.03	12231.7	0	12231.7	12596.3	12596.3
81	14.5319	188242	9.98834	Parent 5	285	8.5	2121.66	2165.24	12581	0	12581	12954.7	12954.7
82	14.5319	196314	9.98834	Parent 5	285	8.5	2200.97	2246.18	13122.6	0	13122.6	13510.2	13510.2
83	12.6588	177587	9.99898	Parent 5	285	8.5	2275.09	2321.82	13628.7	0	13628.7	14029.8	14029.8
84	12.6588	183709	9.99898	Parent 5	285	8.5	2344.13	2392.28	14100.1	0	14100.1	14513.4	14513.4
85	12.6588	189831	9.99898	Parent 5	285	8.5	2413.17	2462.74	14571.6	0	14571.6	14997	14997
86	12.6588	195952	9.99898	Parent 5	285	8.5	2482.22	2533.2	15043	0	15043	15480.7	15480.7
87	10.5833	167357	9.9999	Parent 5	285	8.5	2529.86	2581.82	15368.4	0	15368.4	15814.5	15814.5
88	10.5833	168598	9.9999	Parent 5	285	8.5	2546.59	2598.9	15482.7	0	15482.7	15931.7	15931.7
89	10.5833	169813	9.9999	Parent 5	285	8.5	2563	2615.64	15594.7	0	15594.7	16046.6	16046.6
90	14.9394	241578	9.9999	Parent 5	285	8.5	2580.87	2633.88	15716.7	0	15716.7	16171.8	16171.8
91	14.9394	242566	9.9999	Parent 5	285	8.5	2590.31	2643.51	15781.2	0	15781.2	16237.9	16237.9
92	8.79238	137915	51.4272	Parent 5	1100	28	5601.04	5716.09	8681.58	0	8681.58	15704.7	15704.7
93	12.1174	173445	51.4272	Slide Mass 4	1500	15	3935.76	4016.6	9392.07	0	9392.07	14327.1	14327.1
94	13.0624	164853	51.4272	Slide Mass 4	1500	15	3601.05	3675.02	8117.28	0	8117.28	12632.6	12632.6
95	7.84717	86796.7	51.4272	Slide	2500	15	4030.47	4113.26	6020.78	0	6020.78	11074.6	11074.6

96	17.5819	160560	51.4272	Mass 3 Slide	2500	15	3649.23	3724.19	4568.74	0	4568.74	9144.51	9144.51
97	16.3463	107211	51.4272	Mass 3 Slide	3500	15	3878.25	3957.91	1708.96	0	1708.96	6571.9	6571.9
98	12.2223	53300.2	52.312	Mass 2 Slide	3500	15	3416.55	3486.73	-49.5326	0	-49.5326	4372.88	4372.88
99	10.8538	27700.7	52.312	Mass 2 Slide	1750	15	1781.17	1817.75	252.864	0	252.864	2558.42	2558.42
100	10.8538	9233.57	52.312	Mass 1 Slide	1750	15	1447.53	1477.26	-1017.89	0	-1017.89	855.803	855.803
				Mass 1									

Global Minimum Query (janbu simplified) - Safety Factor: 0.99681

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [degrees]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	8.73337	2732.97	-29.48	Parent	535	28	1006.03	1002.82	879.839	0	879.839	311.12	311.12
2	12.6817	13699.8	-29.48	Parent	535	28	1420.23	1415.7	1880.6	224.23	1656.37	1077.72	853.49
3	12.6817	25225.3	-29.48	Parent	535	28	1771.29	1765.64	2987.24	672.745	2314.5	1985.91	1313.17
4	12.6817	36750.8	-29.48	Parent	535	28	2122.34	2115.57	4093.89	1121.26	2972.63	2894.1	1772.84
5	11.6947	44020.8	-29.0501	Parent	535	28	2438.71	2430.93	5114.44	1548.72	3565.72	3759.85	2211.13
6	11.6947	53653.3	-29.0501	Parent	535	28	2754.57	2745.78	6112.99	1955.13	4157.86	4582.96	2627.83
7	11.6947	63285.9	-29.0501	Parent	535	28	3070.42	3060.63	7111.55	2361.54	4750.01	5406.08	3044.54
8	11.6947	72918.5	-29.0501	Parent	535	28	3386.28	3375.48	8110.11	2767.95	5342.16	6229.19	3461.24
9	11.696	82103.8	-26.6173	Parent	535	28	3542.39	3531.09	8789.37	3154.56	5634.81	7014.13	3859.57
10	11.696	93436.1	-26.6173	Parent	535	28	3980.21	3967.51	9976.98	3521.38	6455.6	7982.34	4460.96
11	11.696	105397	-26.6173	Parent	535	28	4457.11	4442.89	11237.9	3888.2	7349.71	9004.27	5116.07
12	11.696	114830	-26.6173	Parent	535	28	4776.83	4761.59	12204.1	4255.02	7949.06	9810.22	5555.2
13	12.693	135043	-25.6928	Parent	535	28	5028.7	5012.66	13050.8	4629.54	8421.24	10631.4	6001.87
14	12.693	145700	-25.6928	Parent	535	28	5356.56	5339.47	14047.7	5011.77	9035.91	11470.6	6458.8
15	12.693	156358	-25.6928	Parent	535	28	5684.41	5666.28	15044.5	5393.99	9650.52	12309.7	6915.67
16	12.693	167015	-25.6928	Parent	535	28	6012.26	5993.08	16041.4	5776.22	10265.2	13148.8	7372.61
17	12.9614	175574	5.0035	Parent	0	8.5	1126.72	1123.13	13447.5	5932.52	7515.01	13546.2	7613.66
18	12.9614	174745	5.0035	Parent	0	8.5	1127.56	1123.96	13383.5	5862.89	7520.62	13482.2	7619.34
19	12.9614	173837	5.0035	Parent	0	8.5	1127.51	1123.91	13313.5	5793.27	7520.22	13412.2	7618.93
20	13.534	180162	5.0035	Parent	0	8.5	1123.21	1119.63	13213.8	5722.11	7491.64	13312.1	7589.98
21	13.534	178729	5.0035	Parent	0	8.5	1118.32	1114.75	13108.3	5649.41	7458.94	13206.3	7556.85
22	13.534	202538	5.0035	Parent	0	8.5	1389.41	1384.98	14843.8	5576.71	9267.13	14965.5	9388.77
23	11.3762	189825	6.90536	Parent	0	8.5	1640.33	1635.1	16488.1	5547.45	10940.7	16686.8	11139.3
24	11.3762	187865	6.90536	Parent	0	8.5	1617.36	1612.2	16318.7	5531.23	10787.5	16514.6	10983.4
25	11.3762	185906	6.90536	Parent	0	8.5	1594.39	1589.3	16149.3	5515.01	10634.2	16342.3	10827.3
26	11.3508	183501	7.17316	Parent	0	8.5	1570.1	1565.09	15969.4	5497.13	10472.2	16167	10669.8
27	11.3508	181474	7.17316	Parent	0	8.5	1546.69	1541.76	15793.8	5477.58	10316.2	15988.4	10510.8
28	11.3508	187071	7.17316	Parent	0	8.5	1648.49	1643.23	16453.1	5458.03	10995.1	16660.6	11202.5
29	11.5648	189400	7.30024	Parent	0	8.5	1638.81	1633.58	16368.1	5437.49	10930.6	16578	11140.5
30	11.5648	187259	7.30024	Parent	0	8.5	1614.73	1609.58	16186	5415.95	10770	16392.8	10976.9
31	11.5648	185117	7.30024	Parent	0	8.5	1590.66	1585.59	16003.8	5394.41	10609.4	16207.6	10813.2
32	11.5648	182975	7.30024	Parent	0	8.5	1566.59	1561.59	15821.7	5372.87	10448.8	16022.4	10649.5
33	11.5648	180833	7.30024	Parent	0	8.5	1542.51	1537.59	15639.6	5351.32	10288.3	15837.2	10485.9
34	11.5648	178692	7.30024	Parent	0	8.5	1518.43	1513.59	15457.4	5329.78	10127.7	15652	10322.2
35	13.6092	207529	7.34073	Parent	0	8.5	1492.03	1487.27	15257.6	5306.03	9951.57	15449.8	10143.8
36	13.6092	204546	7.34073	Parent	0	8.5	1463.61	1458.94	15042.1	5280.07	9762.04	15230.7	9950.59
37	13.6092	201564	7.34073	Parent	0	8.5	1435.2	1430.62	14826.6	5254.12	9572.49	15011.5	9757.38
38	13.6092	206838	7.34073	Parent	0	8.5	1491.61	1486.85	15163	5214.24	9948.77	15355.2	10140.9
39	11.5171	197969	8.64022	Parent	0	8.5	1771.53	1765.88	16920.8	5104.94	11815.8	17190	12085
40	11.5171	196454	8.64022	Parent	0	8.5	1768.26	1762.62	16789.7	4995.73	11794	17058.4	12062.6
41	11.5171	194940	8.64022	Parent	0	8.5	1764.99	1759.36	16658.7	4886.53	11772.2	16926.9	12040.4
42	11.5171	193425	8.64022	Parent	0	8.5	1761.72	1756.1	16527.7	4777.32	11750.4	16795.4	12018.1
43	11.5171	191911	8.64022	Parent	0	8.5	1758.46	1752.85	16396.7	4668.12	11728.6	16663.9	11995.8
44	11.517	190390	8.66056	Parent	0	8.5	1755.07	1749.47	16264.8	4558.78	11706	16532.1	11973.3
45	11.517	188869	8.66056	Parent	0	8.5	1751.77	1746.18	16133.3	4449.32	11683.9	16400.1	11950.8

46	11.517	187349	8.66056	Parent	0	8.5	1748.46	1742.88	16001.7	4339.85	11661.9	16268.1	11928.2
47	11.517	185828	8.66056	Parent	0	8.5	1745.15	1739.58	15870.2	4230.39	11639.9	16136.1	11905.7
48	11.517	184308	8.66056	Parent	0	8.5	1741.85	1736.29	15738.7	4120.93	11617.7	16004	11883
49	12.8215	203394	8.66801	Parent	0	8.5	1738.31	1732.76	15599.4	4005.21	11594.1	15864.4	11859.1
50	12.8215	201507	8.66801	Parent	0	8.5	1734.6	1729.07	15452.7	3883.24	11569.5	15717.1	11833.9
51	12.8215	199620	8.66801	Parent	0	8.5	1730.91	1725.39	15306.1	3761.27	11544.9	15570	11808.7
52	12.8215	197864	8.66801	Parent	0	8.5	1728.7	1723.19	15169.4	3639.3	11530.1	15433	11793.7
53	12.8216	197615	9.08541	Parent	0	8.5	1742.28	1736.72	15135	3514.35	11620.7	15413.6	11899.3
54	12.8216	197754	9.08541	Parent	0	8.5	1762.59	1756.97	15142.6	3386.4	11756.2	15424.4	12038
55	12.8216	197893	9.08541	Parent	0	8.5	1782.92	1777.23	15150.2	3258.46	11891.7	15435.3	12176.8
56	12.8216	198031	9.08541	Parent	0	8.5	1803.23	1797.48	15157.7	3130.52	12027.2	15446.1	12315.6
57	12.8216	197377	9.25369	Parent	0	8.5	1813.87	1808.08	15099.6	3001.38	12098.2	15395.1	12393.7
58	12.8216	194273	9.25369	Parent	0	8.5	1797.5	1791.77	14860.1	2871.02	11989.1	15152.9	12281.9
59	12.8216	192050	9.25369	Parent	0	8.5	1791.21	1785.5	14687.8	2740.67	11947.1	14979.6	12239
60	12.8216	190247	9.25369	Parent	0	8.5	1789.72	1784.01	14547.4	2610.32	11937.1	14839	12228.7
61	12.8217	188400	9.50379	Parent	0	8.5	1786.78	1781.08	14395.7	2478.17	11917.5	14694.8	12216.7
62	12.8217	186505	9.50379	Parent	0	8.5	1784.75	1779.06	14248.2	2344.23	11903.9	14546.9	12202.7
63	12.8217	184610	9.50379	Parent	0	8.5	1782.73	1777.04	14100.7	2210.29	11890.4	14399.1	12188.9
64	12.8217	182715	9.50379	Parent	0	8.5	1780.7	1775.02	13953.2	2076.35	11876.9	14251.3	12175
65	12.8217	180746	9.90158	Parent	0	8.5	1776.4	1770.73	13787.8	1939.55	11848.2	14097.9	12158.3
66	12.8217	178704	9.90158	Parent	0	8.5	1773.54	1767.88	13629.1	1799.89	11829.2	13938.6	12138.7
67	12.8217	176662	9.90158	Parent	0	8.5	1770.67	1765.02	13470.2	1660.23	11810	13779.3	12119.1
68	12.8217	174620	9.90158	Parent	0	8.5	1767.81	1762.17	13311.5	1520.58	11790.9	13620.1	12099.5
69	12.8217	172749	9.90158	Parent	0	8.5	1766.89	1761.25	13165.8	1380.92	11784.8	13474.2	12093.3
70	12.8217	171135	9.90158	Parent	0	8.5	1768.9	1763.26	13039.5	1241.26	11798.3	13348.3	12107
71	12.8217	169524	9.90158	Parent	0	8.5	1770.95	1765.3	12913.5	1101.6	11811.9	13222.7	12121.1
72	12.8217	167913	9.90158	Parent	0	8.5	1773	1767.34	12787.5	961.944	11825.6	13097	12135.1
73	12.6911	164603	9.97	Parent	0	8.5	1774.64	1768.98	12659	822.509	11836.5	12971	12148.5
74	12.6911	163000	9.97	Parent	0	8.5	1776.53	1770.86	12532.4	683.299	11849.1	12844.6	12161.3
75	12.6911	161397	9.97	Parent	0	8.5	1778.4	1772.73	12405.7	544.089	11861.6	12718.3	12174.2
76	12.6911	159794	9.97	Parent	0	8.5	1780.29	1774.61	12279.1	404.879	11874.2	12592	12187.1
77	15.2839	191166	9.97	Parent	0	8.5	1790.53	1784.82	12194	251.449	11942.5	12508.7	12257.3
78	15.2839	191581	9.97	Parent	0	8.5	1818.99	1813.19	12216.1	83.7982	12132.3	12535.8	12452
79	12.2076	153367	9.97	Parent 5	285	8.5	2113.97	2107.23	12192.8	0	12192.8	12564.4	12564.4
80	14.5319	183034	9.98834	Parent 5	285	8.5	2118.55	2111.79	12223.4	0	12223.4	12596.5	12596.5
81	14.5319	188242	9.98834	Parent 5	285	8.5	2170.91	2163.98	12572.5	0	12572.5	12954.9	12954.9
82	14.5319	196314	9.98834	Parent 5	285	8.5	2252.05	2244.87	13113.8	0	13113.8	13510.5	13510.5
83	12.6588	177587	9.99898	Parent 5	285	8.5	2327.89	2320.46	13619.6	0	13619.6	14030	14030
84	12.6588	183709	9.99898	Parent 5	285	8.5	2398.53	2390.88	14090.8	0	14090.8	14513.7	14513.7
85	12.6588	189831	9.99898	Parent 5	285	8.5	2469.18	2461.3	14561.9	0	14561.9	14997.3	14997.3
86	12.6588	195952	9.99898	Parent 5	285	8.5	2539.82	2531.72	15033.1	0	15033.1	15480.9	15480.9
87	10.5833	167357	9.9999	Parent 5	285	8.5	2588.57	2580.31	15358.3	0	15358.3	15814.7	15814.7
88	10.5833	168598	9.9999	Parent 5	285	8.5	2605.69	2597.38	15472.5	0	15472.5	15932	15932
89	10.5833	169813	9.9999	Parent 5	285	8.5	2622.48	2614.11	15584.5	0	15584.5	16046.9	16046.9
90	14.9394	241578	9.9999	Parent 5	285	8.5	2640.76	2632.34	15706.4	0	15706.4	16172.1	16172.1
91	14.9394	242566	9.9999	Parent 5	285	8.5	2650.42	2641.97	15770.8	0	15770.8	16238.2	16238.2
92	8.79238	137915	51.4272	Parent 5	1100	28	5682.12	5663.99	8583.65	0	8583.65	15708.5	15708.5
93	12.1174	173445	51.4272	Slide Mass 4	1500	15	4006.36	3993.58	9306.19	0	9306.19	14329.8	14329.8
94	13.0624	164853	51.4272	Slide Mass 4	1500	15	3665.65	3653.96	8038.71	0	8038.71	12635.1	12635.1
95	7.84717	86796.7	51.4272	Slide Mass 3	2500	15	4102.78	4089.69	5932.82	0	5932.82	11077.3	11077.3
96	17.5819	160560	51.4272	Slide Mass 3	2500	15	3714.7	3702.85	4489.12	0	4489.12	9146.99	9146.99
97	16.3463	107211	51.4272	Slide Mass 2	3500	15	3947.83	3935.24	1624.32	0	1624.32	6574.51	6574.51
98	12.2223	53300.2	52.312	Slide Mass 2	3500	15	3477.36	3466.27	-125.881	0	-125.881	4375.24	4375.24
99	10.8538	27700.7	52.312	Slide Mass 1	1750	15	1812.87	1807.09	213.06	0	213.06	2559.66	2559.66
100	10.8538	9233.57	52.312	Slide	1750	15	1473.29	1468.59	-1050.23	0	-1050.23	856.804	856.804

Mass 1

Global Minimum Query (spencer) - Safety Factor: 1.06685

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [degrees]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	13.0872	4169.28	-20.8809	Parent	535	28	905.401	965.927	810.457	0	810.457	465.064	465.064
2	12.5016	11769.9	-20.8809	Parent	535	28	1243.18	1326.29	1637.53	149.341	1488.19	1163.28	1013.94
3	12.5016	19378.8	-20.8809	Parent	535	28	1469.8	1568.06	2390.99	448.077	1942.91	1830.29	1382.21
4	12.5016	26987.7	-20.8809	Parent	535	28	1696.43	1809.84	3144.45	746.813	2397.63	2497.29	1750.48
5	12.5016	34596.7	-20.8809	Parent	535	28	1923.06	2051.62	3897.89	1045.55	2852.34	3164.28	2118.73
6	12.5016	42205.6	-20.8809	Parent	535	28	2149.69	2293.4	4651.35	1344.28	3307.07	3831.29	2487.01
7	12.5016	49814.5	-20.8809	Parent	535	28	2376.32	2535.18	5404.81	1643.02	3761.79	4498.29	2855.27
8	12.5016	57938.3	-20.8809	Parent	535	28	2631.96	2807.91	6216.47	1941.76	4274.71	5212.43	3270.67
9	12.5016	69877.1	-20.8809	Parent	535	28	3102.6	3310.01	7459.53	2240.49	5219.04	6275.95	4035.46
10	12.5016	79355.8	-20.8809	Parent	535	28	3434.6	3664.2	8424.38	2539.23	5885.15	7114.15	4574.92
11	12.5016	87747.7	-20.8809	Parent	535	28	3705.35	3953.05	9266.37	2837.96	6428.41	7852.85	5014.89
12	12.5016	96139.6	-20.8809	Parent	535	28	3976.11	4241.91	10108.3	3136.7	6971.65	8591.54	5454.84
13	12.5016	104531	-20.8809	Parent	535	28	4246.86	4530.76	10950.3	3435.44	7514.89	9330.24	5894.8
14	12.5016	112923	-20.8809	Parent	535	28	4517.61	4819.61	11792.3	3734.17	8058.14	10068.9	6334.76
15	12.9241	120654	5.06695	Parent	0	8.5	748.589	798.632	9192.19	3848.38	5343.81	9258.56	5410.18
16	12.9241	119807	5.06695	Parent	0	8.5	749.426	799.525	9127.83	3778.05	5349.78	9194.28	5416.23
17	12.9241	118957	5.06695	Parent	0	8.5	750.239	800.392	9063.24	3707.73	5355.51	9129.76	5422.03
18	12.9241	117825	5.06695	Parent	0	8.5	748.033	798.039	8977.23	3637.41	5339.82	9043.56	5406.15
19	12.9241	116496	5.06695	Parent	0	8.5	743.717	793.434	8876.11	3567.08	5309.03	8942.05	5374.97
20	12.9241	115167	5.06695	Parent	0	8.5	739.4	788.829	8774.92	3496.76	5278.16	8840.48	5343.72
21	4	42419.5	5.06695	Cut off wall	30000	0	28120.2	30000	11399	3450.72	7948.31	13892.3	10441.6
22	12.6743	158365	5.06695	Parent	0	8.5	1243.51	1326.64	12311.5	3434.77	8876.75	12421.8	8987.01
23	12.6743	156585	5.06695	Parent	0	8.5	1223.02	1304.78	12172.9	3442.35	8730.54	12281.3	8838.98
24	12.6743	154804	5.06695	Parent	0	8.5	1202.54	1282.93	12034.3	3449.94	8584.31	12140.9	8690.94
25	12.6743	153024	5.06695	Parent	0	8.5	1182.06	1261.08	11895.6	3457.52	8438.1	12000.4	8542.91
26	12.6743	152272	5.06695	Parent	0	8.5	1175.81	1254.41	11858.5	3465.11	8393.41	11962.8	8497.67
27	12.6743	158969	5.06695	Parent	0	8.5	1272.61	1357.68	12557.1	3472.69	9084.43	12670	9197.27
28	12.6743	157188	5.06695	Parent	0	8.5	1252.12	1335.82	12418.5	3480.28	8938.21	12529.5	9049.23
29	12.6743	155408	5.06695	Parent	0	8.5	1231.64	1313.97	12279.9	3487.87	8791.98	12389.1	8901.19
30	12.6743	153628	5.06695	Parent	0	8.5	1211.15	1292.12	12141.2	3495.45	8645.77	12248.6	8753.15
31	12.6743	151847	5.06695	Parent	0	8.5	1190.66	1270.26	12002.6	3503.04	8499.54	12108.2	8605.11
32	11.9503	141484	5.43983	Parent	0	8.5	1168.03	1246.11	11845.9	3507.96	8337.91	11957.1	8449.14
33	11.9503	139784	5.43983	Parent	0	8.5	1148.08	1224.83	11705.8	3510.22	8195.54	11815.1	8304.87
34	11.9503	138084	5.43983	Parent	0	8.5	1128.13	1203.55	11565.6	3512.47	8053.17	11673.1	8160.6
35	11.9503	136384	5.43983	Parent	0	8.5	1108.19	1182.27	11425.5	3514.73	7910.79	11531.1	8016.33
36	11.9503	134684	5.43983	Parent	0	8.5	1088.25	1161	11285.4	3516.99	7768.42	11389	7872.05
37	11.9503	148069	5.43983	Parent	0	8.5	1234.6	1317.13	12298.4	3485.19	8813.18	12415.9	8930.75
38	11.9503	165181	5.43983	Parent	0	8.5	1427.03	1522.43	13601	3414.18	10186.8	13736.9	10322.7
39	11.9503	164563	5.43983	Parent	0	8.5	1429.89	1525.48	13550.3	3343.17	10207.2	13686.5	10343.3
40	11.9503	163945	5.43983	Parent	0	8.5	1432.74	1528.52	13499.7	3272.16	10227.5	13636.1	10364
41	11.9503	163327	5.43983	Parent	0	8.5	1435.59	1531.56	13449	3201.14	10247.9	13585.8	10384.6
42	11.9503	162709	5.43983	Parent	0	8.5	1438.44	1534.6	13398.4	3130.13	10268.3	13535.4	10405.2
43	11.9503	162091	5.43983	Parent	0	8.5	1441.29	1537.64	13347.7	3059.12	10288.6	13485	10425.9
44	11.9503	161473	5.43983	Parent	0	8.5	1444.15	1540.69	13297.1	2988.11	10309	13434.6	10446.5
45	11.9503	160855	5.43983	Parent	0	8.5	1447	1543.73	13246.4	2917.1	10329.3	13384.2	10467.1
46	11.9503	160237	5.43983	Parent	0	8.5	1449.85	1546.77	13195.8	2846.08	10349.7	13333.9	10487.8
47	12.6104	168331	5.93372	Parent	0	8.5	1448.6	1545.44	13110.5	2769.68	10340.8	13261	10491.4
48	12.6104	167470	5.93372	Parent	0	8.5	1450.68	1547.66	13043.6	2687.9	10355.7	13194.4	10506.5
49	12.6104	166609	5.93372	Parent	0	8.5	1452.77	1549.89	12976.6	2606.11	10370.5	13127.6	10521.5
50	12.6104	165747	5.93372	Parent	0	8.5	1454.86	1552.12	12909.7	2524.33	10385.4	13061	10536.6
51	12.6104	165695	5.93372	Parent	0	8.5	1465.78	1563.77	12906	2442.54	10463.4	13058.3	10615.8
52	12.6104	166926	5.93372	Parent	0	8.5	1490.71	1590.36	13002.1	2360.76	10641.4	13157	10796.3
53	12.6104	168173	5.93372	Parent	0	8.5	1515.81	1617.14	13099.5	2278.97	10820.6	13257.1	10978.1
54	12.6104	169420	5.93372	Parent	0	8.5	1540.91	1643.92	13196.9	2197.19	10999.7	13357.1	11159.9

55	12.6104	170644	5.93372	Parent	0	8.5	1565.76	1670.43	13292.5	2115.4	11177.1	13455.3	11339.9
56	12.6104	169866	5.93372	Parent	0	8.5	1568.76	1673.63	13232.1	2033.62	11198.5	13395.2	11361.5
57	12.6104	168157	5.93372	Parent	0	8.5	1561.59	1665.98	13099.1	1951.83	11147.3	13261.4	11309.6
58	12.6104	167514	5.93372	Parent	0	8.5	1566.06	1670.75	13049.3	1870.05	11179.2	13212	11342
59	12.6104	166942	5.93372	Parent	0	8.5	1571.31	1676.35	13005	1788.26	11216.7	13168.3	11380
60	12.6104	166371	5.93372	Parent	0	8.5	1576.56	1681.95	12960.7	1706.48	11254.2	13124.6	11418.1
61	12.6104	165799	5.93372	Parent	0	8.5	1581.81	1687.55	12916.4	1624.69	11291.7	13080.8	11456.1
62	12.6104	165228	5.93372	Parent	0	8.5	1587.06	1693.16	12872	1542.91	11329.1	13037	11494.1
63	12.6104	164657	5.93372	Parent	0	8.5	1592.31	1698.76	12827.8	1461.12	11366.7	12993.3	11532.2
64	12.6104	164085	5.93372	Parent	0	8.5	1597.56	1704.36	12783.5	1379.34	11404.1	12949.5	11570.2
65	12.6104	163514	5.93372	Parent	0	8.5	1602.81	1709.96	12739.1	1297.55	11441.6	12905.7	11608.2
66	12.6104	162942	5.93372	Parent	0	8.5	1608.06	1715.56	12694.9	1215.77	11479.1	12862	11646.3
67	13.0629	167594	9.0988	Parent	0	8.5	1586.03	1692.06	12431.4	1109.6	11321.8	12685.4	11575.8
68	13.0629	166076	9.0988	Parent	0	8.5	1588.46	1694.65	12318.3	979.057	11339.2	12572.7	11593.6
69	13.0629	164711	9.0988	Parent	0	8.5	1592.48	1698.94	12216.4	848.513	11367.9	12471.4	11622.9
70	13.0629	163346	9.0988	Parent	0	8.5	1596.5	1703.23	12114.5	717.968	11396.6	12370.2	11652.3
71	13.0629	161981	9.0988	Parent	0	8.5	1600.52	1707.52	12012.7	587.423	11425.2	12269	11681.6
72	13.0629	160616	9.0988	Parent	0	8.5	1604.54	1711.8	11910.8	456.879	11454	12167.8	11710.9
73	13.0629	159251	9.0988	Parent	0	8.5	1608.56	1716.09	11808.9	326.334	11482.6	12066.6	11740.2
74	13.0629	157886	9.0988	Parent	0	8.5	1612.58	1720.38	11707.1	195.79	11511.3	11965.4	11769.6
75	13.0629	156567	9.0988	Parent	0	8.5	1617.08	1725.18	11608.7	65.2452	11543.5	11867.7	11802.4
76	11.6166	139242	9.0988	Parent 5	285	8.5	1892.12	2018.61	11599.8	0	11599.8	11902.9	11902.9
77	11.6166	139785	9.0988	Parent 5	285	8.5	1898.46	2025.37	11645.1	0	11645.1	11949.1	11949.1
78	12.3948	149605	9.91923	Parent 5	285	8.5	1896.75	2023.55	11632.8	0	11632.8	11964.5	11964.5
79	12.3948	149940	9.91923	Parent 5	285	8.5	1900.4	2027.44	11658.9	0	11658.9	11991.2	11991.2
80	12.3948	152541	9.91923	Parent 5	285	8.5	1928.76	2057.7	11861.4	0	11861.4	12198.7	12198.7
81	12.3948	158412	9.91923	Parent 5	285	8.5	1992.78	2126	12318.4	0	12318.4	12666.9	12666.9
82	12.3948	164308	9.91923	Parent 5	285	8.5	2057.08	2194.6	12777.4	0	12777.4	13137.1	13137.1
83	12.3948	170205	9.91923	Parent 5	285	8.5	2121.39	2263.2	13236.5	0	13236.5	13607.4	13607.4
84	12.3948	176101	9.91923	Parent 5	285	8.5	2185.69	2331.8	13695.5	0	13695.5	14077.7	14077.7
85	12.3948	181998	9.91923	Parent 5	285	8.5	2249.99	2400.4	14154.5	0	14154.5	14548	14548
86	12.3948	187805	9.91923	Parent 5	285	8.5	2313.31	2467.96	14606.6	0	14606.6	15011.1	15011.1
87	12.3948	190824	9.91923	Parent 5	285	8.5	2346.23	2503.08	14841.5	0	14841.5	15251.8	15251.8
88	12.3948	192519	9.91923	Parent 5	285	8.5	2364.72	2522.8	14973.5	0	14973.5	15387	15387
89	12.3948	194203	9.91923	Parent 5	285	8.5	2383.09	2542.4	15104.6	0	15104.6	15521.4	15521.4
90	12.3948	195183	9.91923	Parent 5	285	8.5	2393.78	2553.8	15180.9	0	15180.9	15599.5	15599.5
91	12.3948	195744	9.91923	Parent 5	285	8.5	2399.89	2560.32	15224.5	0	15224.5	15644.2	15644.2
92	5.68052	87819.7	50.3043	Parent 5	1100	28	5236.27	5586.31	8437.52	0	8437.52	14745.6	14745.6
93	13.0418	186354	50.3043	Slide Mass 4	1500	15	3647.25	3891.07	8923.59	0	8923.59	13317.4	13317.4
94	13.0418	164195	50.3043	Slide Mass 4	1500	15	3348.77	3572.64	7735.18	0	7735.18	11769.4	11769.4
95	13.2344	141458	50.3043	Slide Mass 3	2500	15	3772.82	4025.03	5691.52	0	5691.52	10236.6	10236.6
96	13.2344	115966	50.3043	Slide Mass 3	2500	15	3434.44	3664.03	4344.21	0	4344.21	8481.65	8481.65
97	15.1135	101253	50.3043	Slide Mass 2	3500	15	3830.06	4086.1	2187.36	0	2187.36	6801.41	6801.41
98	15.1135	68008.1	50.3043	Slide Mass 2	3500	15	3443.63	3673.84	648.773	0	648.773	4797.29	4797.29
99	11.6801	29784.1	50.3043	Slide Mass 1	1750	15	1774.53	1893.16	534.272	0	534.272	2672.03	2672.03
100	11.6801	9928.04	50.3043	Slide Mass 1	1750	15	1476.29	1574.98	-653.173	0	-653.173	1125.3	1125.3

Interslice Data

Global Minimum Query (bishop simplified) - Safety Factor: 1.02054

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]

1	145.384	2591.16	0	0	0
2	154.118	2586.23	12565	0	0
3	166.799	2579.06	42414.6	0	0
4	179.481	2571.89	83755.3	0	0
5	192.163	2564.72	136587	0	0
6	203.858	2558.22	194406	0	0
7	215.552	2551.73	261661	0	0
8	227.247	2545.23	338352	0	0
9	238.942	2538.74	424479	0	0
10	250.638	2532.87	510778	0	0
11	262.334	2527.01	608267	0	0
12	274.03	2521.15	717773	0	0
13	285.726	2515.29	835961	0	0
14	298.419	2509.18	968802	0	0
15	311.112	2503.08	1.11109e+06	0	0
16	323.805	2496.97	1.26281e+06	0	0
17	336.498	2490.86	1.42397e+06	0	0
18	349.459	2492	1.41241e+06	0	0
19	362.421	2493.13	1.40097e+06	0	0
20	375.382	2494.27	1.38967e+06	0	0
21	388.916	2495.45	1.37801e+06	0	0
22	402.45	2496.64	1.3665e+06	0	0
23	415.984	2497.82	1.35508e+06	0	0
24	427.36	2499.2	1.33916e+06	0	0
25	438.736	2500.58	1.32332e+06	0	0
26	450.113	2501.96	1.30759e+06	0	0
27	461.463	2503.38	1.29113e+06	0	0
28	472.814	2504.81	1.27478e+06	0	0
29	484.165	2506.24	1.25828e+06	0	0
30	495.73	2507.72	1.24113e+06	0	0
31	507.294	2509.2	1.2241e+06	0	0
32	518.859	2510.69	1.20721e+06	0	0
33	530.424	2512.17	1.19044e+06	0	0
34	541.989	2513.65	1.17379e+06	0	0
35	553.554	2515.13	1.15728e+06	0	0
36	567.163	2516.88	1.13786e+06	0	0
37	580.772	2518.64	1.11862e+06	0	0
38	594.381	2520.39	1.09956e+06	0	0
39	607.99	2522.14	1.08034e+06	0	0
40	619.507	2523.89	1.05872e+06	0	0
41	631.025	2525.64	1.03739e+06	0	0
42	642.542	2527.39	1.01634e+06	0	0
43	654.059	2529.14	995571	0	0
44	665.576	2530.89	975088	0	0
45	677.093	2532.65	954822	0	0
46	688.61	2534.4	934840	0	0
47	700.127	2536.16	915144	0	0
48	711.644	2537.91	895732	0	0
49	723.161	2539.66	876605	0	0
50	735.982	2541.62	855620	0	0
51	748.804	2543.57	834989	0	0
52	761.625	2545.53	814711	0	0
53	774.447	2547.48	794778	0	0
54	787.268	2549.53	773649	0	0
55	800.09	2551.58	752749	0	0
56	812.911	2553.63	732079	0	0
57	825.733	2555.68	711639	0	0
58	838.555	2557.77	690907	0	0
59	851.376	2559.86	670657	0	0
60	864.198	2561.95	650821	0	0
61	877.019	2564.04	631368	0	0

62	889.841	2566.19	611479	0	0
63	902.663	2568.33	591994	0	0
64	915.485	2570.48	572914	0	0
65	928.306	2572.63	554239	0	0
66	941.128	2574.86	534719	0	0
67	953.95	2577.1	515642	0	0
68	966.771	2579.34	497007	0	0
69	979.593	2581.58	478814	0	0
70	992.415	2583.82	461048	0	0
71	1005.24	2586.05	443686	0	0
72	1018.06	2588.29	426729	0	0
73	1030.88	2590.53	410176	0	0
74	1043.57	2592.76	393994	0	0
75	1056.26	2594.99	378215	0	0
76	1068.95	2597.22	362837	0	0
77	1081.64	2599.45	347862	0	0
78	1096.93	2602.14	330285	0	0
79	1112.21	2604.83	313047	0	0
80	1124.42	2606.97	302815	0	0
81	1138.95	2609.53	290535	0	0
82	1153.48	2612.09	277790	0	0
83	1168.02	2614.65	264324	0	0
84	1180.67	2616.88	251973	0	0
85	1193.33	2619.12	239074	0	0
86	1205.99	2621.35	225628	0	0
87	1218.65	2623.58	211633	0	0
88	1229.23	2625.45	199615	0	0
89	1239.82	2627.31	187485	0	0
90	1250.4	2629.18	175246	0	0
91	1265.34	2631.81	157803	0	0
92	1280.28	2634.45	140271	0	0
93	1289.07	2645.47	85396.2	0	0
94	1301.19	2660.66	-20151.6	0	0
95	1314.25	2677.04	-116085	0	0
96	1322.1	2686.88	-148992	0	0
97	1339.68	2708.93	-195362	0	0
98	1356.03	2729.43	-173599	0	0
99	1368.25	2745.25	-134368	0	0
100	1379.1	2759.3	-120303	0	0
101	1389.96	2773.35	0	0	0

Global Minimum Query (janbu simplified) - Safety Factor: 0.99681

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	145.384	2591.16	0	0	0
2	154.118	2586.23	12937.8	0	0
3	166.799	2579.06	43551.7	0	0
4	179.481	2571.89	85845.5	0	0
5	192.163	2564.72	139819	0	0
6	203.858	2558.22	198829	0	0
7	215.552	2551.73	267430	0	0
8	227.247	2545.23	345621	0	0
9	238.942	2538.74	433403	0	0
10	250.638	2532.87	521294	0	0
11	262.334	2527.01	620571	0	0
12	274.03	2521.15	732080	0	0
13	285.726	2515.29	852414	0	0
14	298.419	2509.18	987636	0	0
15	311.112	2503.08	1.13245e+06	0	0
16	323.805	2496.97	1.28687e+06	0	0
17	336.498	2490.86	1.45088e+06	0	0

18	349.459	2492	1.43964e+06	0	0
19	362.421	2493.13	1.42854e+06	0	0
20	375.382	2494.27	1.41757e+06	0	0
21	388.916	2495.45	1.40625e+06	0	0
22	402.45	2496.64	1.39509e+06	0	0
23	415.984	2497.82	1.38409e+06	0	0
24	427.36	2499.2	1.36858e+06	0	0
25	438.736	2500.58	1.35317e+06	0	0
26	450.113	2501.96	1.33785e+06	0	0
27	461.463	2503.38	1.32179e+06	0	0
28	472.814	2504.81	1.30584e+06	0	0
29	484.165	2506.24	1.28976e+06	0	0
30	495.73	2507.72	1.27304e+06	0	0
31	507.294	2509.2	1.25644e+06	0	0
32	518.859	2510.69	1.23996e+06	0	0
33	530.424	2512.17	1.2236e+06	0	0
34	541.989	2513.65	1.20736e+06	0	0
35	553.554	2515.13	1.19124e+06	0	0
36	567.163	2516.88	1.17228e+06	0	0
37	580.772	2518.64	1.15349e+06	0	0
38	594.381	2520.39	1.13487e+06	0	0
39	607.99	2522.14	1.11611e+06	0	0
40	619.507	2523.89	1.09496e+06	0	0
41	631.025	2525.64	1.07409e+06	0	0
42	642.542	2527.39	1.0535e+06	0	0
43	654.059	2529.14	1.0332e+06	0	0
44	665.576	2530.89	1.01318e+06	0	0
45	677.093	2532.65	993370	0	0
46	688.61	2534.4	973847	0	0
47	700.127	2536.16	954608	0	0
48	711.644	2537.91	935653	0	0
49	723.161	2539.66	916982	0	0
50	735.982	2541.62	896503	0	0
51	748.804	2543.57	876378	0	0
52	761.625	2545.53	856605	0	0
53	774.447	2547.48	837176	0	0
54	787.268	2549.53	816555	0	0
55	800.09	2551.58	796169	0	0
56	812.911	2553.63	776020	0	0
57	825.733	2555.68	756106	0	0
58	838.555	2557.77	735903	0	0
59	851.376	2559.86	716178	0	0
60	864.198	2561.95	696865	0	0
61	877.019	2564.04	677935	0	0
62	889.841	2566.19	658568	0	0
63	902.663	2568.33	639604	0	0
64	915.485	2570.48	621045	0	0
65	928.306	2572.63	602891	0	0
66	941.128	2574.86	583891	0	0
67	953.95	2577.1	565333	0	0
68	966.771	2579.34	547216	0	0
69	979.593	2581.58	529540	0	0
70	992.415	2583.82	512291	0	0
71	1005.24	2586.05	495447	0	0
72	1018.06	2588.29	479007	0	0
73	1030.88	2590.53	462973	0	0
74	1043.57	2592.76	447306	0	0
75	1056.26	2594.99	432041	0	0
76	1068.95	2597.22	417179	0	0
77	1081.64	2599.45	402719	0	0
78	1096.93	2602.14	385767	0	0

79	1112.21	2604.83	369163	0	0
80	1124.42	2606.97	359520	0	0
81	1138.95	2609.53	347943	0	0
82	1153.48	2612.09	335918	0	0
83	1168.02	2614.65	323199	0	0
84	1180.67	2616.88	311521	0	0
85	1193.33	2619.12	299316	0	0
86	1205.99	2621.35	286583	0	0
87	1218.65	2623.58	273323	0	0
88	1229.23	2625.45	261929	0	0
89	1239.82	2627.31	250429	0	0
90	1250.4	2629.18	238824	0	0
91	1265.34	2631.81	222281	0	0
92	1280.28	2634.45	205653	0	0
93	1289.07	2645.47	152546	0	0
94	1301.19	2660.66	49133	0	0
95	1314.25	2677.04	-44694.1	0	0
96	1322.1	2686.88	-76185.7	0	0
97	1339.68	2708.93	-119683	0	0
98	1356.03	2729.43	-95082.2	0	0
99	1368.25	2745.25	-53922.8	0	0
100	1379.1	2759.3	-38964.4	0	0
101	1389.96	2773.35	0	0	0

Global Minimum Query (spencer) - Safety Factor: 1.06685

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	154.848	2591.24	0	0	0
2	167.935	2586.25	15633.5	1933.57	7.0506
3	180.437	2581.48	38263	4732.44	7.05064
4	192.938	2576.71	66859.7	8269.33	7.05064
5	205.44	2571.94	101424	12544.2	7.05058
6	217.941	2567.17	141955	17557.2	7.05062
7	230.443	2562.4	188453	23308.2	7.05064
8	242.944	2557.63	240918	29797.2	7.05065
9	255.446	2552.86	299960	37099.5	7.05062
10	267.948	2548.09	370091	45773.5	7.05064
11	280.449	2543.32	448401	55459.1	7.05065
12	292.951	2538.56	533605	65997.3	7.05065
13	305.452	2533.79	625703	77388	7.05063
14	317.954	2529.02	724694	89631.4	7.05063
15	330.455	2524.25	830578	102727	7.05061
16	343.379	2525.39	822470	101725	7.05067
17	356.304	2526.54	814498	100739	7.05067
18	369.228	2527.69	806661	99769.3	7.05064
19	382.152	2528.83	798963	98817.1	7.05063
20	395.076	2529.98	791404	97882.2	7.05063
21	408	2531.12	783985	96964.6	7.05063
22	412	2531.48	889765	110048	7.05066
23	424.674	2532.6	882173	109109	7.05066
24	437.349	2533.73	874584	108170	7.05063
25	450.023	2534.85	866998	107232	7.05065
26	462.697	2535.97	859415	106294	7.05064
27	475.371	2537.1	851840	105357	7.05063
28	488.046	2538.22	844304	104425	7.05064
29	500.72	2539.34	836771	103493	7.05062
30	513.394	2540.47	829241	102562	7.05064
31	526.069	2541.59	821714	101631	7.05063
32	538.743	2542.72	814191	100701	7.05067
33	550.693	2543.85	806166	99708	7.05063
34	562.643	2544.99	798164	98718.3	7.05063

35	574.594	2546.13	790185	97731.4	7.05063
36	586.544	2547.27	782229	96747.5	7.05064
37	598.494	2548.41	774297	95766.4	7.05064
38	610.445	2549.54	766156	94759.6	7.05064
39	622.395	2550.68	757804	93726.5	7.05063
40	634.345	2551.82	749580	92709.4	7.05064
41	646.295	2552.96	741485	91708.2	7.05064
42	658.246	2554.1	733519	90722.9	7.05064
43	670.196	2555.23	725681	89753.6	7.05064
44	682.146	2556.37	717973	88800.1	7.05063
45	694.097	2557.51	710393	87862.6	7.05063
46	706.047	2558.65	702942	86941.1	7.05064
47	717.997	2559.79	695619	86035.4	7.05064
48	730.608	2561.1	686585	84918.1	7.05064
49	743.218	2562.41	677717	83821.2	7.05063
50	755.828	2563.72	669014	82744.9	7.05064
51	768.439	2565.03	660477	81689	7.05064
52	781.049	2566.34	652086	80651.1	7.05063
53	793.66	2567.65	643808	79627.4	7.05064
54	806.27	2568.96	635645	78617.7	7.05064
55	818.88	2570.27	627595	77622.1	7.05064
56	831.491	2571.58	619660	76640.6	7.05063
57	844.101	2572.89	611888	75679.4	7.05064
58	856.712	2574.2	604303	74741.2	7.05063
59	869.322	2575.51	596878	73822.9	7.05063
60	881.932	2576.82	589611	72924.1	7.05063
61	894.543	2578.14	582503	72045	7.05064
62	907.153	2579.45	575553	71185.5	7.05065
63	919.764	2580.76	568762	70345.5	7.05064
64	932.374	2582.07	562130	69525.2	7.05063
65	944.984	2583.38	555656	68724.5	7.05064
66	957.595	2584.69	549340	67943.4	7.05064
67	970.205	2586	543183	67181.8	7.05063
68	983.268	2588.09	527818	65281.4	7.05063
69	996.331	2590.18	512812	63425.5	7.05064
70	1009.39	2592.28	498154	61612.5	7.05063
71	1022.46	2594.37	483843	59842.5	7.05063
72	1035.52	2596.46	469879	58115.5	7.05064
73	1048.58	2598.55	456263	56431.4	7.05064
74	1061.65	2600.64	442995	54790.4	7.05064
75	1074.71	2602.74	430073	53192.2	7.05064
76	1087.77	2604.83	417496	51636.6	7.05063
77	1099.39	2606.69	409519	50650	7.05063
78	1111	2608.55	401499	49658.1	7.05064
79	1123.4	2610.72	390794	48334.1	7.05064
80	1135.79	2612.88	380058	47006.3	7.05065
81	1148.19	2615.05	369079	45648.3	7.05063
82	1160.58	2617.22	357549	44222.3	7.05064
83	1172.98	2619.39	345467	42728	7.05064
84	1185.37	2621.55	332832	41165.3	7.05065
85	1197.77	2623.72	319645	39534.3	7.05064
86	1210.16	2625.89	305905	37834.9	7.05064
87	1222.56	2628.06	291621	36068.3	7.05066
88	1234.95	2630.22	277055	34266.6	7.05063
89	1247.35	2632.39	262329	32445.3	7.05063
90	1259.74	2634.56	247446	30604.5	7.05062
91	1272.14	2636.73	232471	28752.4	7.05063
92	1284.53	2638.89	217443	26893.7	7.05063
93	1290.21	2645.74	184149	22775.8	7.05061
94	1303.25	2661.45	80284.8	9929.76	7.05063
95	1316.3	2677.16	-7466.98	-923.53	7.05064

96	1329.53	2693.1	-56814.8	-7026.96	7.05064
97	1342.76	2709.05	-87626.7	-10837.8	7.05062
98	1357.88	2727.25	-75699.5	-9362.65	7.05064
99	1372.99	2745.46	-39598.9	-4897.67	7.05065
100	1384.67	2759.53	-28197.6	-3487.53	7.05064
101	1396.35	2773.6	0	0	0

Entity Information

Group: Group 1

Shared Entities

Type	Coordinates
External Boundary	

X	Y
0	2400
325	2400
2100	2400
2100	2637
2100	2643
2100	2693
2100	2743
2100	2793
2100	2843
2100	2863
2100	2893
1740	2890
1733	2880
1725	2870
1715	2860
1705	2850
1688	2840
1670	2830
1655	2820
1635	2800
1620	2790
1555	2780
1307	2770
1258	2760
1220	2750
1137	2710
1085	2700
981	2690
848	2680
848	2680.01
848.017	2680.01
848	2680
830	2680
770	2670
605	2660
605	2638
588.901	2638
552.82	2638
474	2638
474	2632
412	2632
412	2602
408	2602
368	2601
264	2596
250	2592
0	2590

X	Y
250	2592
336.843	2580.18
408	2575.83
410.443	2575.83
412	2575.83
426.415	2575
520	2575
639.276	2579.23
748.665	2582.59
929.108	2591.46
1070.69	2604.83
1153.89	2619.43
1184.94	2624.6
1232.69	2633.27
1269.97	2641.01
1295.65	2647.01
1331.37	2655.36
1352.55	2660.31
1436.77	2682.3
1456.52	2690.28
1501.45	2711.7
1533.28	2726.88
1538.15	2730.43
1571.12	2754.42
1620	2790

Material Boundary

X	Y
325	2400
1859.05	2604.83
2100	2637

Material Boundary

X	Y
1533.28	2726.88
1628.48	2735.95
1772.43	2843
2100	2843

Material Boundary

X	Y
1456.52	2690.28
1643.59	2684.57
1725.74	2743
1790.67	2793
2100	2793

Material Boundary

X	Y
1070.69	2604.83
1142.96	2604.83
1796.72	2604.83
1859.05	2604.83

Material Boundary

X	Y
625.172	2617.99
635.144	2604.99

Material Boundary

X	Y
605	2638
608.98	2632.63
625.172	2617.99

	X	Y
Material Boundary	1751.38	2697.67
	1807.8	2743

	X	Y
Material Boundary	1807.8	2743
	2100	2743

	X	Y
Material Boundary	1733	2880
	2100	2863

	X	Y
Material Boundary	1643.59	2684.57
	1671.74	2687.99
	1751.38	2697.67

	X	Y
Material Boundary	1295.65	2647.01
	1778.84	2647.01
	1872.68	2683.69
	2100	2693

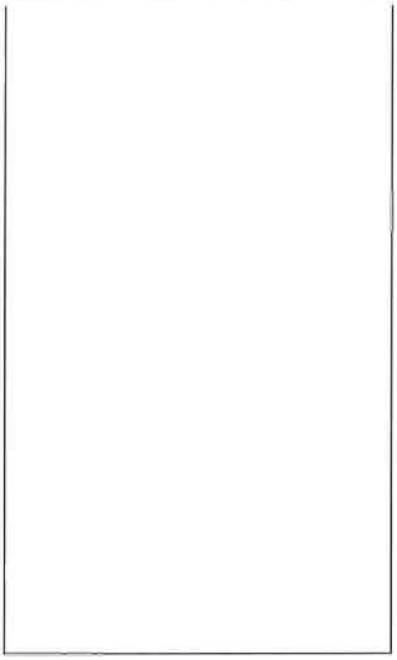
	X	Y
Material Boundary	635.144	2604.99
	1070.69	2604.83

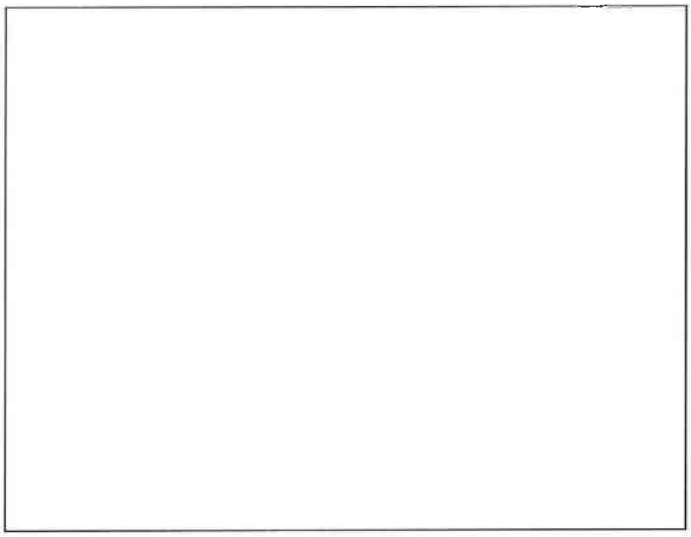
	X	Y
Material Boundary	608.98	2632.63
	771.118	2643.71
	889.239	2652.93
	1040.2	2662.15
	1107.04	2671.94
	1160.05	2685.77
	1183.23	2698.93
	1210.76	2717.23
	1263.67	2735.82

	X	Y
Material Boundary	1263.67	2735.82
	1311.94	2742.7
	1571.12	2754.42

	X	Y
Material Boundary	1183.23	2698.93
	1254.6	2705.68

	X	Y
Material Boundary	625.172	2617.99
	903.806	2628.93
	1042.92	2628.93
	1089.74	2628.93
	1232.69	2633.27





Material Boundary

X	Y
1089.74	2628.93
1150.23	2649.7
1191.06	2667.09
1259.1	2673.9
1340.76	2678.55
1436.77	2682.3

Material Boundary

X	Y
1254.6	2705.68
1412.45	2711.7
1501.45	2711.7

Material Boundary

X	Y
408	2602
408	2575.83
408	2498
412	2498
412	2575.83
412	2602

Scenario-based Entities

Type	Coordinates	Master Scenario
		Assigned to materials:
Water Table	X: 0, 413.466, 598.915, 2100 Y: 2586, 2586.61, 2604.83, 2604.83	Slide Mass Slide Mass 1 Slide Mass 2 Slide Mass 3 Slide Mass 4 Slide Mass 5 *... and 8 more*
Distributed Load	X: 474, 605 Y: 2638, 2638	Constant Distribution Orientation: Vertical Magnitude: 200 lbs/ft2 Creates Excess Pore Pressure: No

EXHIBIT J

2021 AGEC Slope Stability Report

AGEC
Applied GeoTech

September 28, 2021

Blackridge Development, LLC
2001 Park Avenue
Park City, Utah 84060

Attention: Glen Overton
EMAIL: glenaoverton@gmail.com

Subject: Slope Stability Consultation
Blackstone, West Hotel Project
250 West Blackridge Drive
St. George, Utah
Project No. 2-21-1175

Gentlemen:

Applied Geotechnical Engineering Consultants, Inc. was requested to conduct geotechnical analyses to evaluate the stability of the hillside upon which the Blackstone Hotel is proposed to be constructed. A geotechnical investigation for the proposed hotel, located on the west side of 250 West along Blackridge Drive in St. George, was conducted and the findings and recommendations were presented in a report dated September 8, 2021 under Project No. 2-21-1175. The hotel site was originally planned to be constructed on the east side of Blackridge Drive. A geotechnical investigation for the hotel on the east side of the road was presented in a report dated December 14, 2018 under project number 2-18-0187.

The reports indicate that both sites are located on an ancient landslide deposit, which has the potential, if environmental conditions change, for landslide movement. Our initial analyses, conducted for both sites, assume that the hillside is wet, reflecting a most adverse moisture condition. Our initial evaluation indicates the calculated factor of safety against landslide movement, using the saturated material strengths, does not meet minimum standards.

I. BACKGROUND

A. Landslide Deposit

The site for the proposed hotel is located in the lower section of a 300-foot high slope. The lower two-thirds of the slope has been identified and mapped

as a landslide deposit. The ground surface of the landslide deposit slopes down at average slope of approximately 7.3 horizontal to 1 vertical. During our earlier studies the landslide deposit has been logged to extend up to a depth of approximately 200 feet below the existing ground surface at the site.

B. Slope Movement

In order to determine if movement is occurring on the slope, five inclinometers were installed in 2007 on the east slope of Blackridge extending to depths of 79 to 259 feet below grade. Four of the five inclinometers indicate that there has been no movement since 2007 compared to measurements taken in 2018. Ground movement was measured at multiple depths prior to 2011 in the inclinometer installed immediately west of the vacant restaurant (Dairy Queen) located at 1090 South Bluff Street.

With the lack of measured movement in the four inclinometers over 10½ years (between 2007 and 2018), along with the lack of surficial evidence of movement, it is apparent that the portion of the slope for this project is currently maintaining its stability and is not showing evidence of creep (slow lateral movement).

C. Earlier Stability Analysis

1. The previously back-calculated saturated material strengths of the landslide materials were verified by calculating a static factor of safety of 1.0 for the pre-graded profile.

2. Changes in the internal conditions and the surficial geometry modifications may improve or reduce the ability of the slope to maintain its stability.

II. CURRENT STUDY

In order to understand the likelihood of future slope movement, the stability of the slope has been evaluated taking advantage of the desert environment and the resulting un-saturated condition of the soil and bedrock above the groundwater table.

In order to develop this additional understanding, samples of soil (weathered bedrock) from the hillside were obtained and tested in the laboratory to define the index properties and to measure strength characteristics with different moisture contents. Stability analyses have been conducted using this additional information.

A. Weak Layers

Samples of the subsurface materials were obtained during our subsurface exploration in June, 2021. Boring B-4 was cored, and weak zones were identified at the following depths, associated elevations and approximate thickness:

Weak Layers		
Depth (feet)	Elevation (feet)	Estimated Thickness (feet)
50	2633	5
77	2606	2
97	2589	1
114	2569	1
117	2566	2

Samples from the weak layers were testing in the laboratory for their index properties and their strength characteristics.

B. Existing Moisture Conditions

Based on laboratory testing completed on soil and bedrock samples obtained in the hillside, the following moisture contents, dry densities and relative degrees of saturation have been obtained.

Characteristic	Range		Average
	Low	High	
Moisture Content (%)	0.3	39.5	16.3
Dry Density (pcf)	88.0	147.0	106.2
Degree of Saturation (%)	10	100	71.9

C. Laboratory Testing

The predominant material in the hillside is mudstone bedrock.

Disturbed, weathered samples of the mudstone were obtained for testing. The samples obtained have distinct colors of "blue", "red", and "gray". A fourth sample, obtained from between basalt blocks in the debris portion of the landslide deposit was also obtained. These colors were used to identify the samples tested.

1. Index Properties

The disturb bulk samples were tested in the laboratory to determine their index properties. Listed below is a table summarizing the test results.

Index Property	Blue Clay	Red Clay	Gray Clay	Debris Clay
Moisture Content (%)	9.1	5.3	3.3	1.3
Grain-size Distribution				
+ #4 sieve (%) (gravel size)	0	0	0	17
- #4, + #200 sieves (%) (sand size)	33	21	6	31
- #200 sieve (%) (silt and clay size)	67	79	94	52
Atterberg Limits				
Liquid Limit (%)	55	46	47	38
Plasticity Index (%)	31	24	26	12
Moisture/density Relationship (standard Proctor)				
Maximum Dry Density (pcf)	98.0	104.5	104.2	108.2
Optimum Moisture Content (%)	22.0	17.6	19.2	15.1
Specific Gravity	2.64	2.64	2.71	2.65

These test results are presented on Figures 1-4.

The index properties of the samples tested for this project are presented below:

Index Property	Low	High	Average	Number of samples tested
Moisture Content (%)	0.3	39.5	16.2	45
Dry Density (pcf)	91.5	140.6	104.4	15
Degree of Saturation (%)	41	100	74	15
Grain-size Distribution				
- #200 sieve (%) (silt and clay size)	74	97	79	15
Atterberg Limits				
Liquid Limit (%)	43	77	60	10
Plasticity Index (%)	24	54	40	10

2. Strength Testing

Testing for the 2018 and this current study was conducted on disturbed samples that were remolded prior to strength testing. Testing was completed using the triaxial shear apparatus, the direct shear apparatus and the ring shear apparatus.

After reviewing the index properties of the four samples obtained in 2018, it was decided to focus the testing on the two mudstone sampled with colors which represent the predominant materials in the hillside. Two samples from boring B-4 were tested in the 2021 study.

a. Fully Softened and Residual Strength

i. 2018 Study

Samples of the blue and red clay were remolded at 38 and 36 percent moisture with densities of 73 and 84 pounds per cubic foot (pcf), respectively. The remolded moisture contents are 16 and 18.4 percent above the soil's optimum moisture contents and the remolded densities are approximately 74 and 80 percent compaction. Once the samples were remolded, they were placed in a triaxial shear apparatus and consolidated under a confining pressures of 2, 6 and 10 kips per square foot (ksf). The consolidated samples were then

sheared with pore pressure measurements. Test results are presented on Figures 6 and 7.

ii. 2021 Study

Two samples obtained from boring B-4 were tested for their fully softened and residual strengths. The soil properties and strength test results are presented below:

Sample Characteristic	B-4 @ 50 feet	B-4 @ 114 feet
Remolded Moisture Content (%)	44.2	50.1
Remolded Dry Density (pcf)	75.8 to 79.2	74.3 to 75.9
Liquid Limit (%)	58	65
Plasticity Index (%)	35	45
Specific Gravity	2.76	2.75
Grain Size Distribution (%)		
Coarse Sand (2.000 to 4.750 mm)	0	0
Medium Sand (0.425 to 2.000 mm)	0	0
Fine Sand (0.075 to 0.425 mm)	53	27
Silt (0.005 to 0.075 mm)	5	26
Clay (0.001 to 0.005 mm)	12	11
Colloidals (<0.001 mm)	30	36
Fully Softened Strength		
Friction (degrees)	18.3	17.0
Cohesion (psf)	240	180
Residual Strength - Friction (degrees)	8.9	11.5

Strength test results are presented on Figures 16 and 17.

b. Unsaturated Strengths

Samples of the blue and red clay were remolded at moisture contents between 12 and 24 percent with densities near 95 or 103.5 pcf (97 to 99 percent compaction) and tested in consolidated, undrained tests with confining pressures of 2, 6 and 10 ksf. The test results are included on Figures 8 through 13 and summarized in the table below.

c. Pre-sheared strength

Samples of the two materials were remolded at 10 and 13 percent moisture with densities of 95 and 101 pcf (97 percent compaction) and placed in a shear testing apparatus. The samples were then sheared and then reset and sheared at 2, 6 and 10 ksf normal load. The tests were conducted at an undrained shear rate. Test results are presented on Figures 14 and 15 and the table below.

d. Test Results

Listed below is a table summarizing the results of the tests conducted.

Blue Clay Strength Test Results

Moisture Content (%)	Dry Density (pcf)	Φ (°)	c (ksf)	Test Type
13.0	95.0	23.8	0.7	Direct Shear, pre-sheared with no water added
14.4	95.5	18.5	2.6	Triaxial, unsaturated
19.6	94.6	9.9	3.4	Triaxial, unsaturated
23.8	94.9	7.3	2.7	Triaxial, unsaturated
38.0	73.0	23.0	0.2	Triaxial, saturated

Red Clay Strength Test Results

Moisture Content (%)	Dry Density (pcf)	Φ (°)	c (ksf)	Test Type
10.0	101.0	14.5	0.9	Direct Shear, pre-sheared with no water added
12.6	103.5	20.1	2.2	Triaxial, unsaturated
14.9	102.0	16.2	3.3	Triaxial, unsaturated
17.9	105.1	12.7	3.3	Triaxial, unsaturated
36.0	84.0	24.0	0	Triaxial, saturated

Values of the shear strength at a confining pressure of 10,000 psf versus suction are presented on Figure 18.

e. Suction

Samples of the bulk mudstone were tested in the laboratory to define a soil-water characteristic curve (SWCC) for each of the blue and red clay samples. The suction was measured using a WP4C measuring device. A "best fit" relationship was visually estimated. The test results are presented on Figure 5.

Samples obtained during the 2021 study were also tested to measure their suction values. A plot of suction versus depth is presented on Figure 19.

D. Stability Model

1. Surface Conditions

The model of the hillside used in this analysis include the following characteristics.

Characteristics	Value
Top Elevation (feet)	2884
Toe Elevation (feet)	2584
Slope Height (feet)	300
Upper Intact Slope (Horizontal to Vertical)	2.5:1 (upper ~80')
Landslide Slope (Horizontal to Vertical)	7.3:1
Average overall Slope (Horizontal to Vertical)	5.8:1

2. Subsurface Profile

A subsurface profile has been developed from the deep borings drilled during earlier studies, geologic maps along with the results of the this and earlier analyses. The first figure of each stability condition (in the appendix) presents the profile used for our analysis.

The upper portion of the hillside consists of a basalt cap. It is estimated that the cap is from 20 to 30 feet thick.

The mudstone (referred to as "parent" material) in the slope extends from the basalt cap, down to sandstone.

The bedrock bedding planes in the area dips down to the north east. The interface between the mudstone and the sandstone is estimated to dip down to the east at 7.6 degrees.

Based on our prior studies and evaluation of other landslide events in the area, there are weak planes within the mudstone deposit. Measurements obtained by us and others indicate that this weak plane dips at approximately 8 to 9 degrees towards the northeast. With this orientation, the weak plane has been modeled dipping down towards the east, following the slope at an angle of 5 to 10 degrees.

Also based on the subsurface conditions encountered during our earlier studies, we have estimated the thickness of the landslide to be up to approximately 200 feet thick under the site.

3. Water & Moisture Conditions

Ground water has been measured in the deep borings drilled on the slope. Using this information, a groundwater elevation of 2605 feet (approximately 280 feet below the bluff) dropping down to elevation 2580 feet (approximately 5 feet below grade) near the toe of the slope was used in the model.

For the unsaturated model, the suction and moisture contents measured in the laboratory were used.

Using the values obtained along with the moisture contents of samples measured in this hillside, we have estimated a suction profile with depth. This profile is described below.

Landslide Deposit and Natural, Undisturbed Hillside

Depth	Suction (ksf)	(pF)
0 to15 feet	0.0	0
15 feet below grade to 10 feet above water	15.0	3.9
10' above water to water	7.5	3.6

4. Material Strengths

a. Saturated Strengths

The stability analysis conducted for our 2018 report, was based on saturated soil strengths. Listed below is a table summarizing the strengths used in that study.

Material	Unit Weight (psf)	Φ′ (°)	c′ (psf)
Landslide (residual)	125	13.5	0
Landslide - weak plane (residual)	125	8.5	0
Parent	125	25	470
Parent Weak Plane	125	17.0	180
Sandstone	125	44	3,000
Basalt	165	45	30,000

b. Unsaturated Strengths

The unsaturated strength of the on-site material (soil / weathered bedrock) was investigated by remolding the two soil samples at different moisture contents, compressing the samples and then shearing the samples in a triaxial shear apparatus. The testing allowed us to estimate the anticipated increase in soil strength as the moisture content decreases.

The unsaturated component of strength is modeled as friction in conjunction with the amount of suction. With the relatively high moisture contents and low suction values at depths from 15 to 80 feet below grade in B-4, a suction strength factor (Φ^b) slightly below the effective friction (Φ′) has been used.

E. Results

1. Factor of Safety

A common factor of safety used when designing earth slopes and retainage systems within undisturbed ground conditions is 1.5. This value is used because soil properties cannot be back-analyzed and greater uncertainties exist in the subsurface conditions and the strength values used in an analysis. The use of back-analyzed values allow the use of lower (less conservative) factors of safety.

Acceptable factors of safety for existing landslides is typically between 1.2 and 1.5 when back-calculated strengths can be determined.

Due to the large number of landslides in the state of Washington, the Washington State Highway Department assesses the stability of landslides through back-analysis. Their factor of safety for landslide repair is 1.25 (WSDOT Geotechnical Design Manual M 46-03.08 October 2013).

The Utah Department of Transportation accepts a safety factor of 1.3 for long-term static conditions for embankments and cut slopes located where failure or excessive deformation impacts adjacent bridges or critical facilities (Figure 12.1 - Minimum Acceptable Factors of Safety - Global Stability, UDOT Geotechnical Manual of Instruction, September 2017).

The stakeholders of this project may consider accepting factors of safety between 1.2 and 1.5 due to the following aspects of the analysis conducted:

a. Landslide strengths were back-calculated. The back-calculated values are considered "residual" strengths which are the weakest strengths of the material. This approach significantly reduces the likelihood of lower values being experienced.

b. The laboratory strength test results of the weak layer materials are reasonably consistent with the back-calculated strength values. This increases our confidence that the values used in the analysis are representative.

c. The lack of hillside movement over 10½ years is a good indicator that the strength of the hillside is sufficient to prevent creep.

d. There could be an improvement in the stability of the slope if the development reduces the amount of water available to seep into the subgrade.

2. Calculated Values

The stability of the hillside was evaluated assuming a number of conditions using the profile, strength and pore water pressures described above. The original profile stability (Safety Factor of 1.0) was verified using saturated soil strengths for what we anticipate the original profile was before significant grading occurred on the site.

With the grading that has occurred (removal of material from the hotel site and placement west of the hotel site) has resulted in essentially the same factor of safety.

Using the proposed grading of the hotel site, the unsaturated strengths of the materials at the site above the water level and the saturated strengths below the water level, result in a calculated factor of safety of 1.39 when using a suction of 15,000 psf. Extending tension cracks down below the existing scarp reduce the factor of safety to 1.38.

Using the same strengths and a seismic acceleration of 0.16g (which would reflect an event with a 2% probability of accedence in 50 years) results in a safety factor of less than 1.0. Using these same parameters, we estimate that approximately 7 inches of movement would occur under a major seismic event using the unsaturated conditions.

3. Considerations

With the regrading that was conducted years ago in the area proposed for the hotel, water has been allowed to pond in the area where boring B-4 was drilled. Therefore, the moisture condition of the below grade materials, in the area of B-4, were found to be higher than what has been found in other areas of the blackridge slope.

With other areas being drier, higher suction related strengths would be expected. These higher strengths would result in higher calculated stability factors of safety.

We anticipate that proper water management in conjunction with development should provide an opportunity for the strength of the slope to improve, and therefore improve the stability of the slope.

4. Recommendations

If the proposed improvements are constructed, we recommend that at least two inclinometers and two piezometers be installed and monitored over the lifetime of the facility. This would allow the stakeholders to know how the landslide mass is behaving and would also allow steps to be taken, if needed, to maintain the integrity of the slope.

III. LONG-TERM RECOMMENDATIONS

The soil and bedrock strengths in the hillside need to remain similar to that used in this analysis in order to maintain the level of stability. This can be achieved by keeping the moisture conditions as they currently are, and drier if possible.

There is also the opportunity to improve the existing conditions with strict adherence to the recommendations presented below.

Recommendations to maintain, if not to improve the current moisture conditions include:

A. Monitoring the landslide would be prudent to confirm that the acceptability of the approach being taken is providing the safety expected. The monitoring would also provide a warning if the conditions are changing.

B. Collect and remove surface drainage off the site in water tight storm drainage systems. This type of construction is not standard and therefore, would require specific attention to verify that the improvements are water tight. This would also include not storing storm water onsite without positive methods to eliminate and verify that water is not seeping into the subgrade.

C. Water ways should be lined to prevent seepage into the ground.

D. Positive measures need to be taken to eliminate the potential for water to ever pond on the site and on the hillside.

E. Eliminate, as much as possible, landscaping that requires irrigation.

F. Positive steps need to be taken with other improvements on the hillside and up on the bluff to help maintain the overall integrity of the slope.

Page 14

IV. LIMITATIONS

This letter has been prepared in accordance with generally accepted soil and foundation engineering practices in the area for the use of the client. The conclusions and recommendations included in the letter are based on conditions defined by our earlier studies and the testing conducted during this study. Variations in the subsurface conditions may not become evident until additional exploration or excavation is conducted. If the subsurface and/or surface drainage or proposed construction is found to be significantly different from what is described in this letter, we should be notified to reevaluate the recommendations given.

Sincerely,

APPLIED GEOTECHNICAL ENGINEERING CONSULTANTS, INC.

James E. Nordquist, P.E., D. G.E.

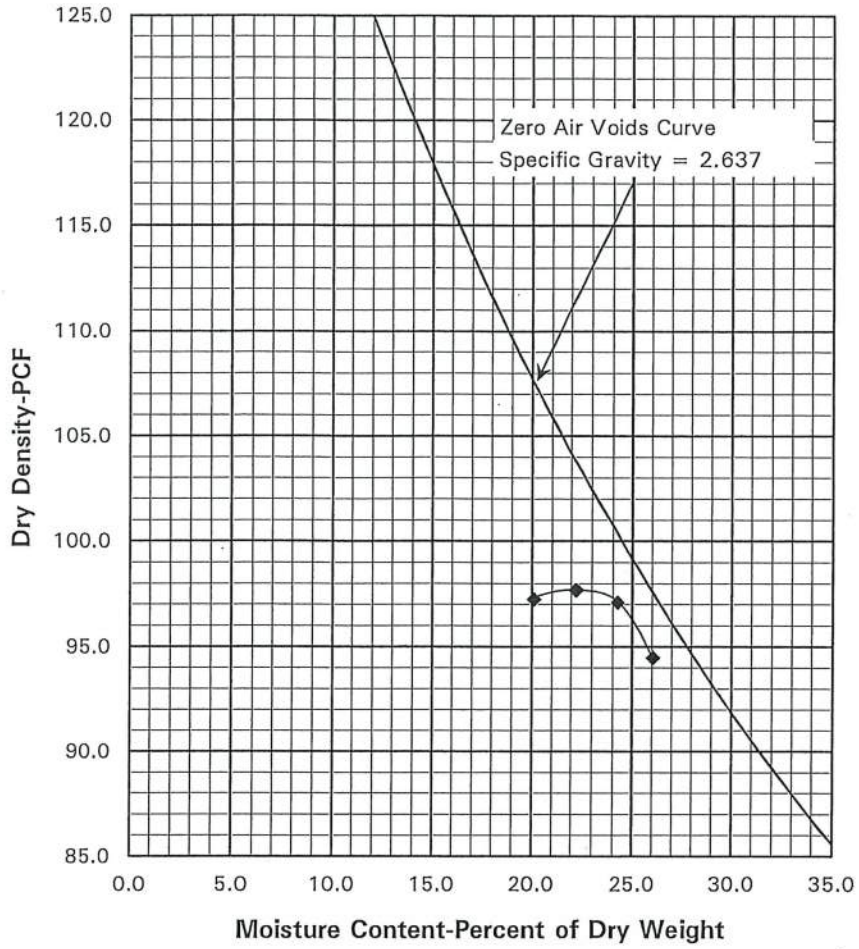
In consultation with Sandra Houston - Professor of Arizona State University
Chair - Soil Properties and Modeling
Committee, ASCE Geo-Institute

Reviewed by WR, P.E., AD, P.E.
JEN/bw

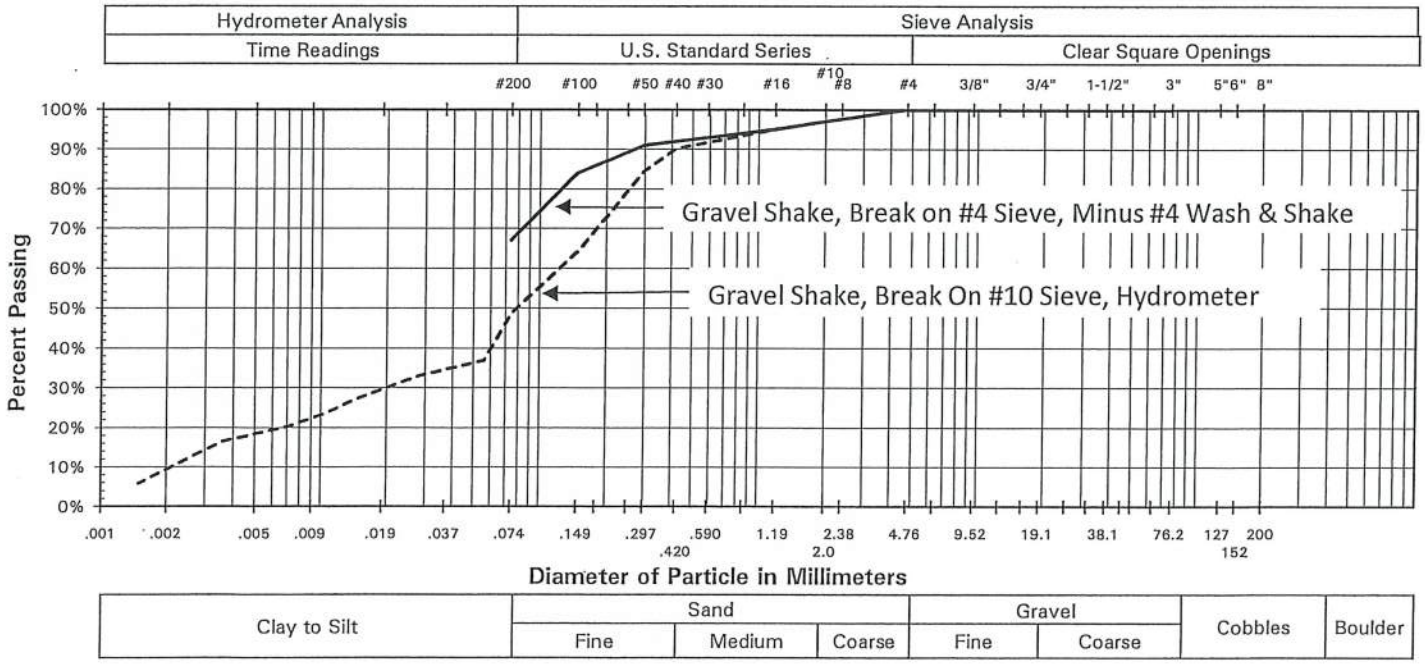
Enclosures

cc: Oscar Covarrubias, EMAIL: oscar@lodgingandhospitality.com

APPLIED GEOTECHNICAL ENGINEERING CONSULTANTS, Inc.



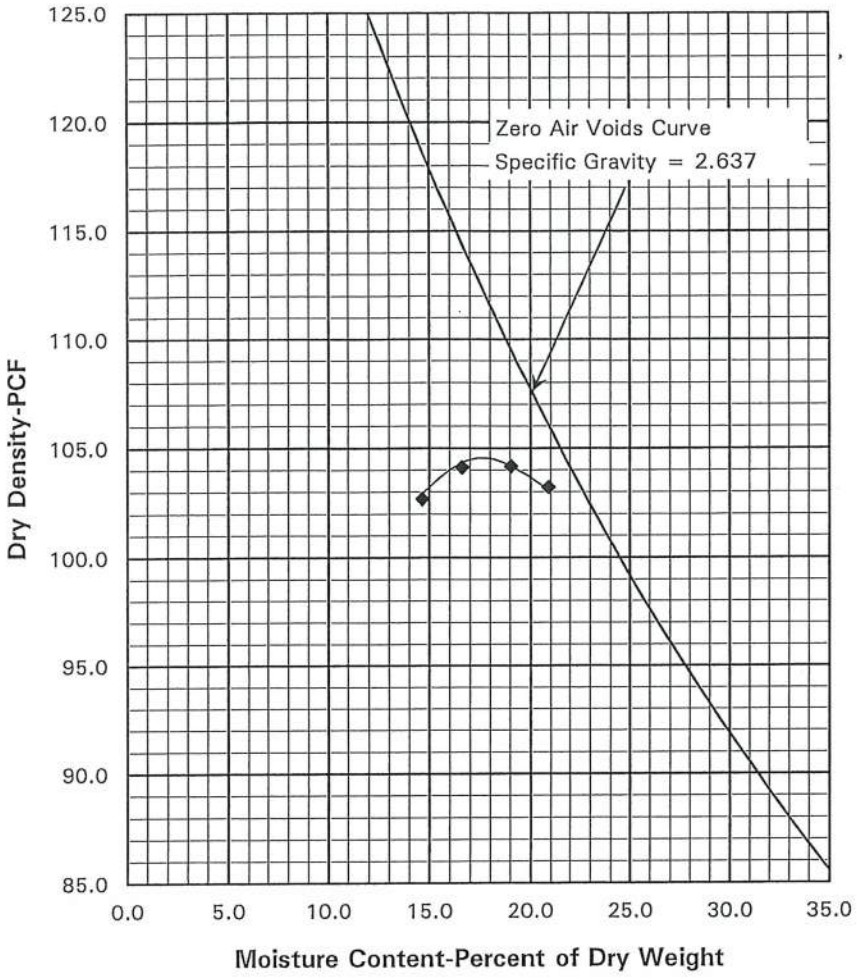
Project	Blackridge Hotel
Project No.	2180187
Sample No.	16527
Maximum Dry Density	97.7 pcf
Optimum Moisture	22.2%
Atterberg Limits	
Liquid Limit	55
Plasticity Index	31
Gradation	
Gravel	0%
Sand	33%
Silt & Clay	67%
Reviewed By:	KBB
Test Procedure:	ASTM D698 A
Sample Location:	Blue Clay
Soil Description:	Sandy Fat Clay
Date Sampled	-
Sampled By	AGEC
Date Tested	08/13/19
Tested By	AGEC



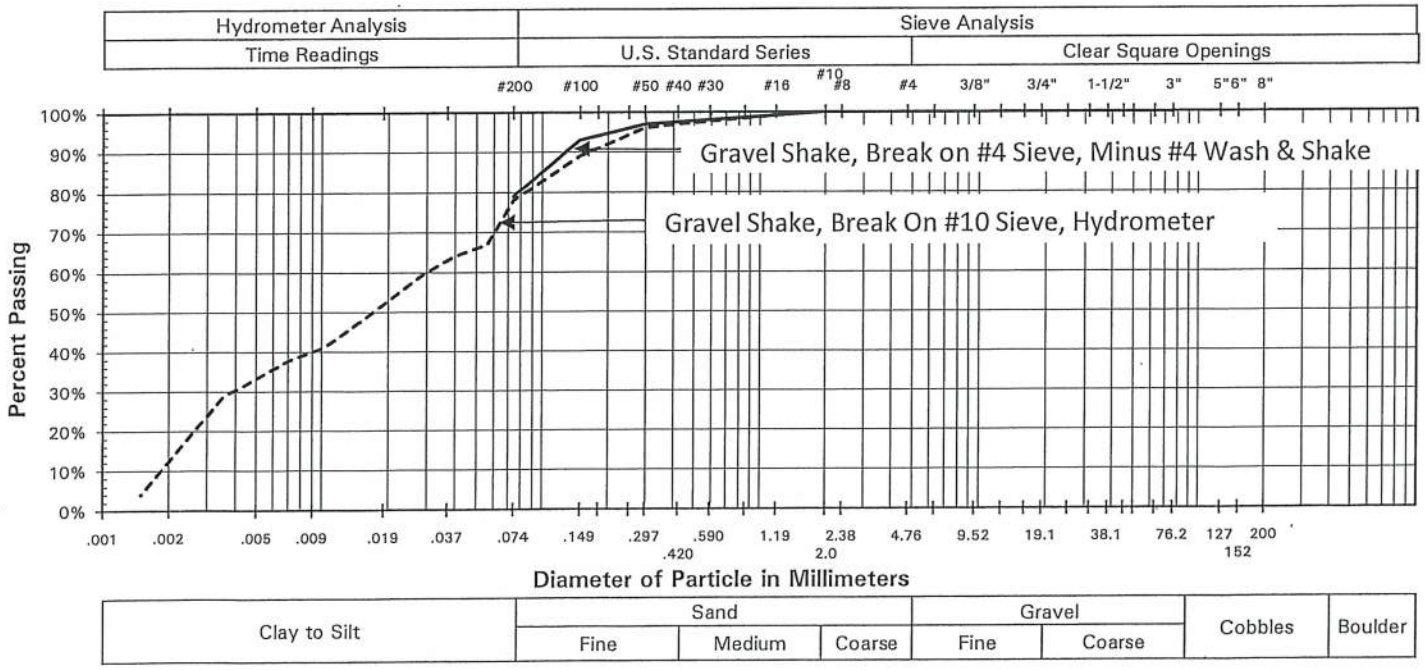
GRADATION & MOISTURE-DENSITY RELATIONSHIP

Figure 1

APPLIED GEOTECHNICAL ENGINEERING CONSULTANTS, Inc.



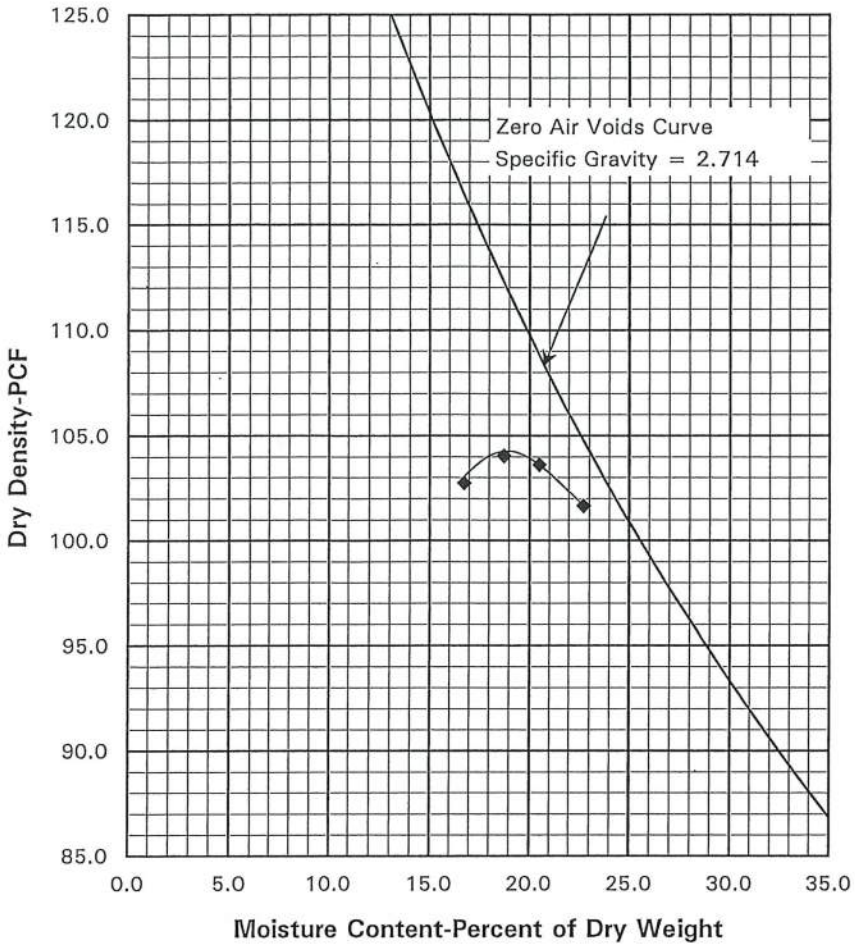
Project	Blackridge Hotel
Project No.	2180187
Sample No.	16528
Maximum Dry Density	104.5 pcf
Optimum Moisture	17.6%
Atterberg Limits	
Liquid Limit	46
Plasticity Index	24
Gradation	
Gravel	0%
Sand	21%
Silt & Clay	79%
Reviewed By:	KBB
Test Procedure:	ASTM D698 A
Sample Location:	Red Clay
Soil Description:	Lean Clay with Sand
Date Sampled	-
Sampled By	AGEC
Date Tested	08/13/19
Tested By	AGEC



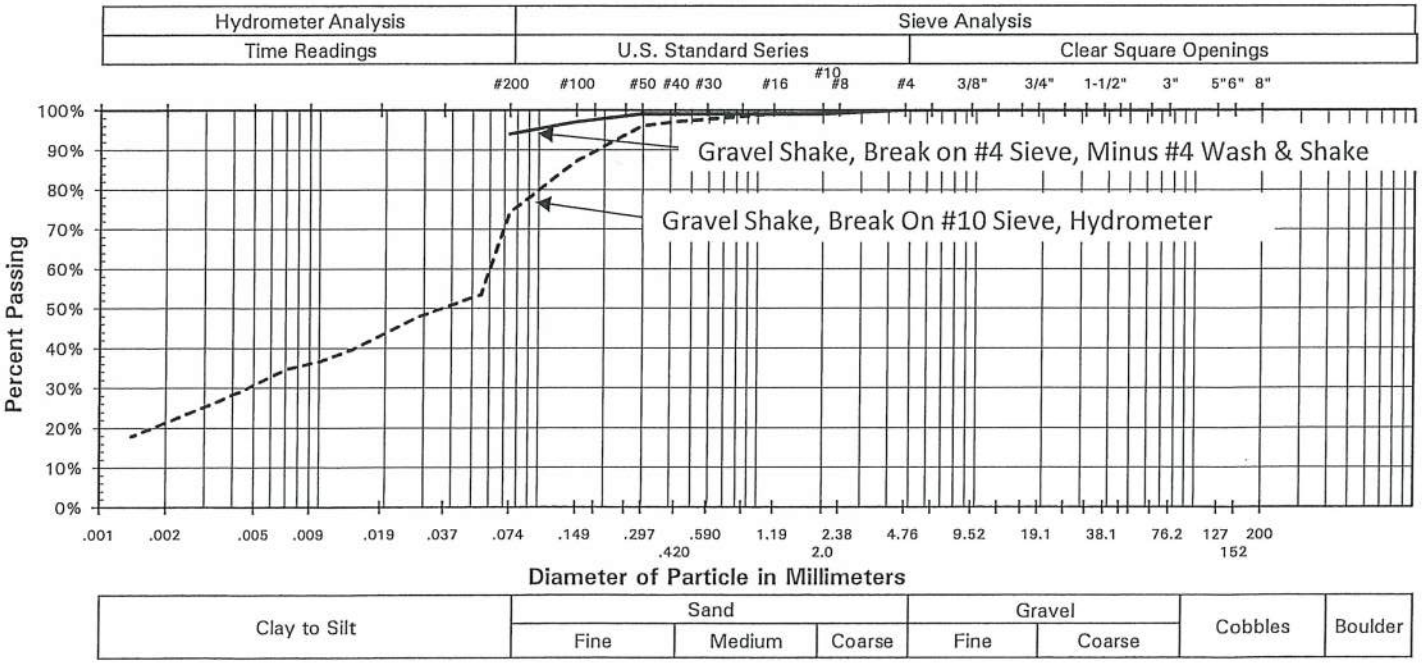
GRADATION & MOISTURE-DENSITY RELATIONSHIP

Figure 2

APPLIED GEOTECHNICAL ENGINEERING CONSULTANTS, Inc.



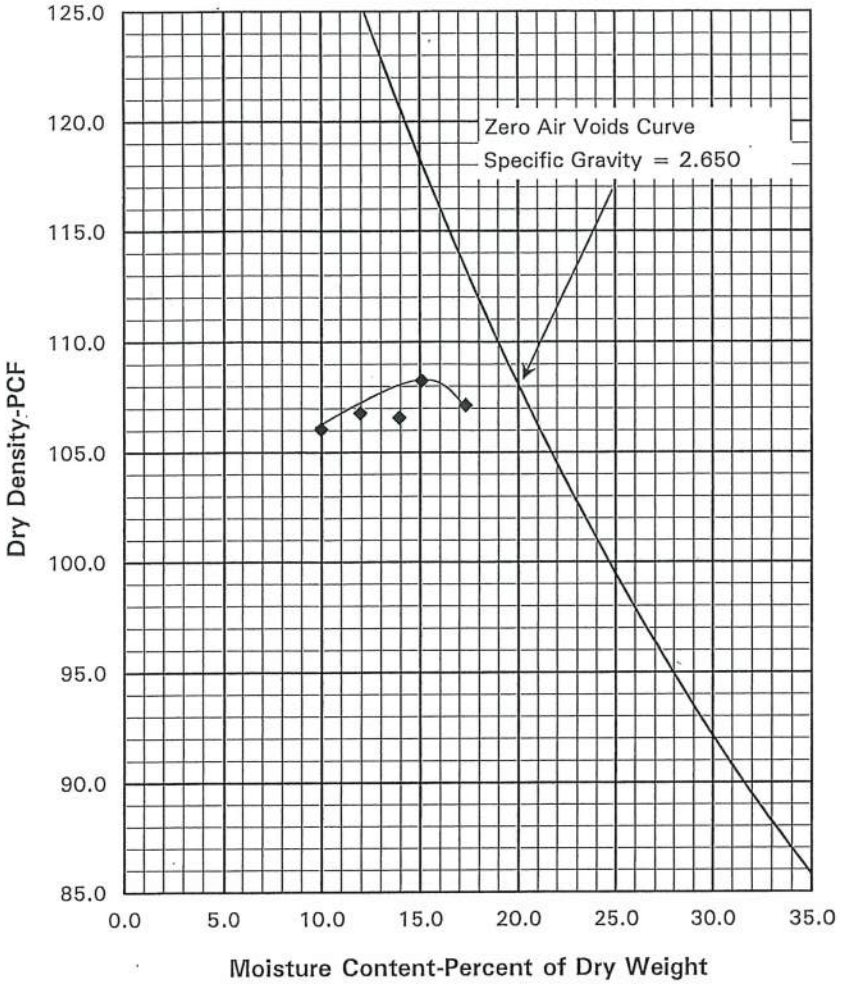
Project	Blackridge Hotel
Project No.	2180187
Sample No.	16529
Maximum Dry Density	104.2 pcf
Optimum Moisture	19.2%
Atterberg Limits	
Liquid Limit	47
Plasticity Index	26
Gradation	
Gravel	0%
Sand	6%
Silt & Clay	94%
Reviewed By:	KBB
Test Procedure:	ASTM D698 A
Sample Location:	Gray Clay
Soil Description:	Lean Clay
Date Sampled	-
Sampled By	AGEC
Date Tested	08/13/19
Tested By	AGEC



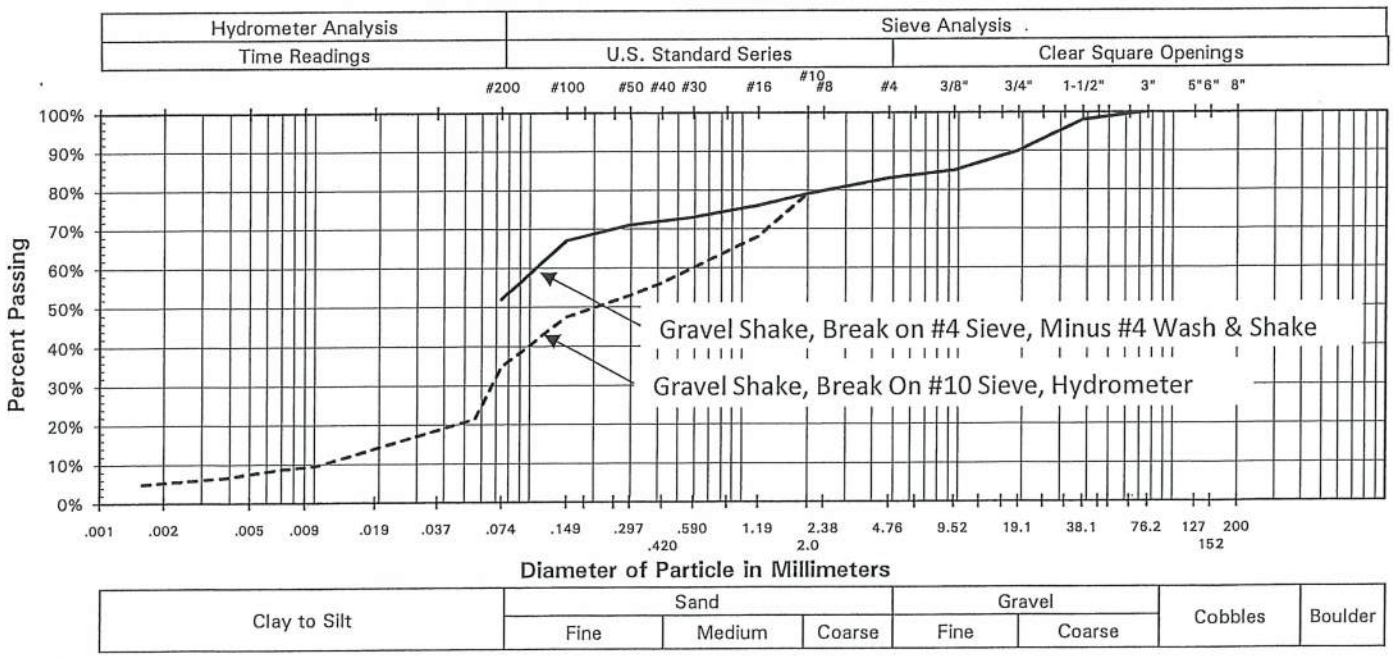
GRADATION & MOISTURE-DENSITY RELATIONSHIP

Figure 3

APPLIED GEOTECHNICAL ENGINEERING CONSULTANTS, Inc.



Project	Blackridge Hotel
Project No.	2180187
Sample No.	16530
Maximum Dry Density	108.2 pcf
Optimum Moisture	15.1%
Atterberg Limits	
Liquid Limit	38
Plasticity Index	12
Gradation	
Gravel	17%
Sand	31%
Silt & Clay	52%
Reviewed By:	KBB
Test Procedure:	ASTM D698 C
Sample Location:	Debris
Soil Description:	Sandy Lean Clay with Gravel
Date Sampled	-
Sampled By	AGEC
Date Tested	08/13/19
Tested By	AGEC



GRADATION & MOISTURE-DENSITY RELATIONSHIP

Figure 4

APPLIED GEOTECHNICAL ENGINEERING CONSULTANTS, Inc.

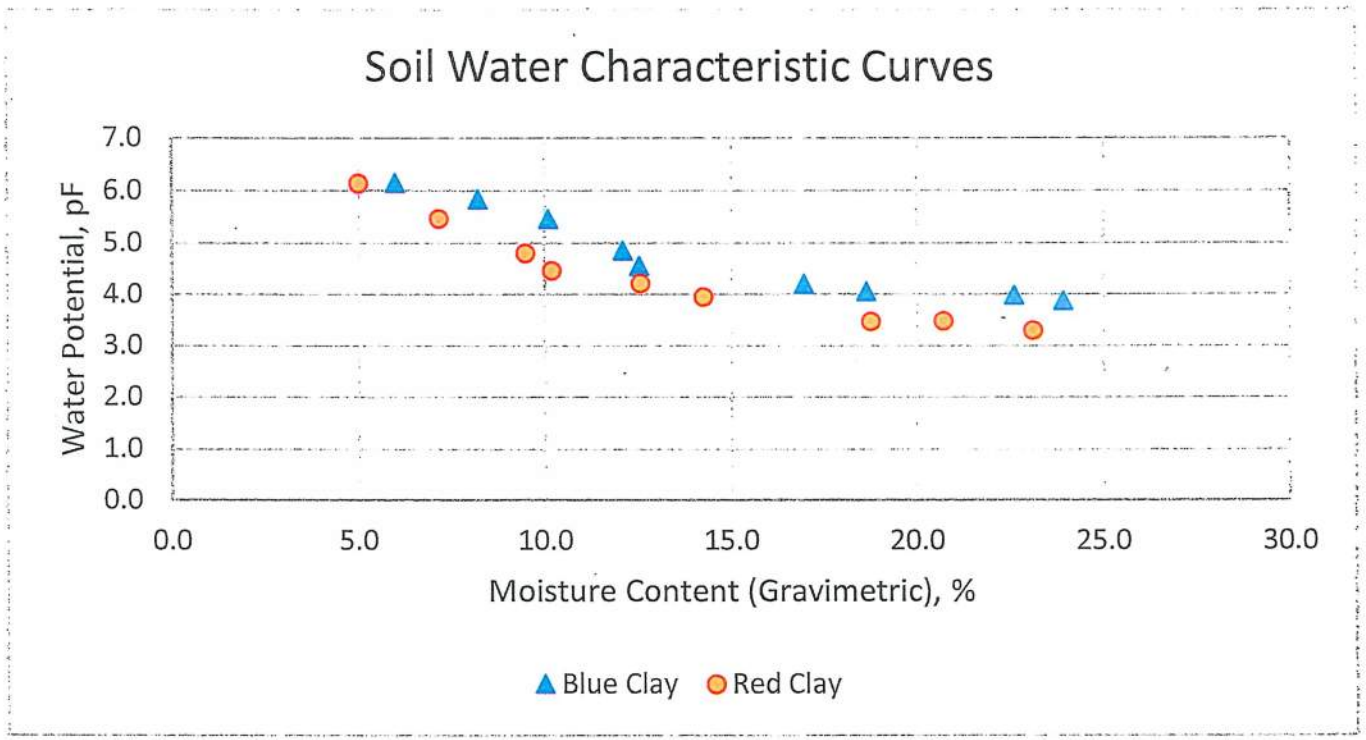
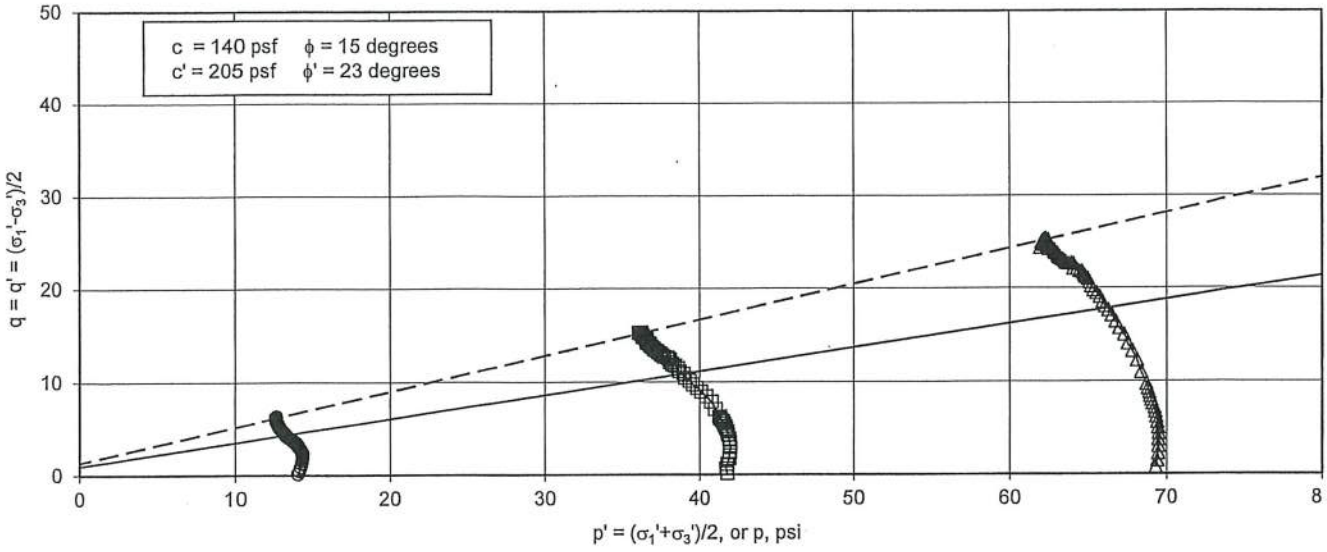
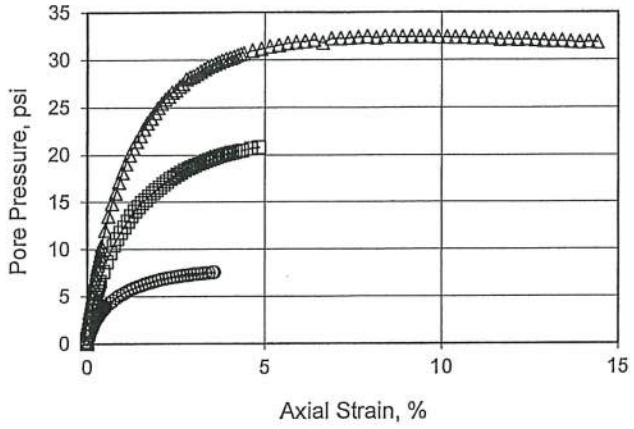
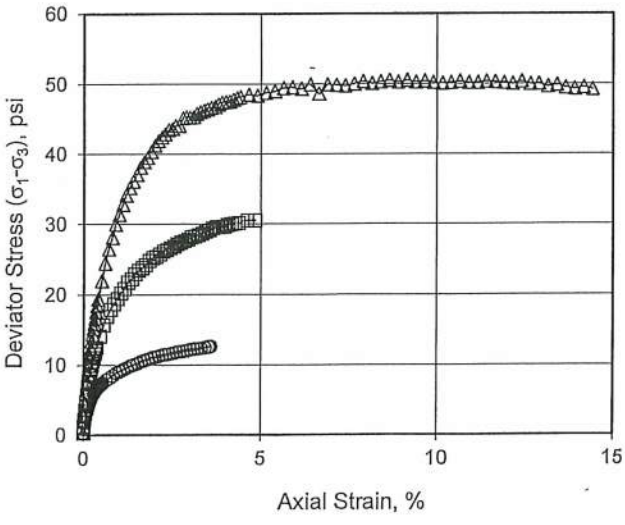


Figure 5

Applied Geotechnical Engineering Consultants, Inc.







Test No. (Symbol)	○	□	△
Sample Type	Remolded		
Length, in.	4.03	3.81	3.25
Diameter, in.	1.93	NM	NM
Dry Density, pcf	73	NM	NM
Moisture Content, %	38	NM	NM
Consolidation Pressure, psi	13.9	41.6	69.4
"B" Parameter	99	NA	NA
Total Confining Stress (σ_3), psi	13.9	41.6	69.4
Total Axial Stress (σ_1), psi	26.1	72.3	119.5
Deviator Stress (σ_1-σ_3), psi	12.2	30.5	50.0
Effective Lateral Stress (σ_3'), psi	6.6	20.8	37.1
Effective Axial Stress (σ_1'), psi	18.7	51.4	87.1
Pore Pressure (μ), psi	7.3	20.8	32.4
Strain, %	3.0	4.8	7.7

Remarks	Multistage Test (CU) Consolidated
Undrained with pore pressure measurements.	
Sample saturated with back pressure saturation.	
Sample pulverized to minus No. 40 sieve material	
and moisture-cured to a liquidity index of 45%.	

Sample Index Properties	
Remold Dry Density, pcf	73
Reold Moisture Content, %	38
Liquid Limit, %	55
Plasticity Index, %	31
Percent Gravel	0
Percent Sand	46
Percent Passing No. 200 Sieve	54

Sample Description
Sandy Fat Clay

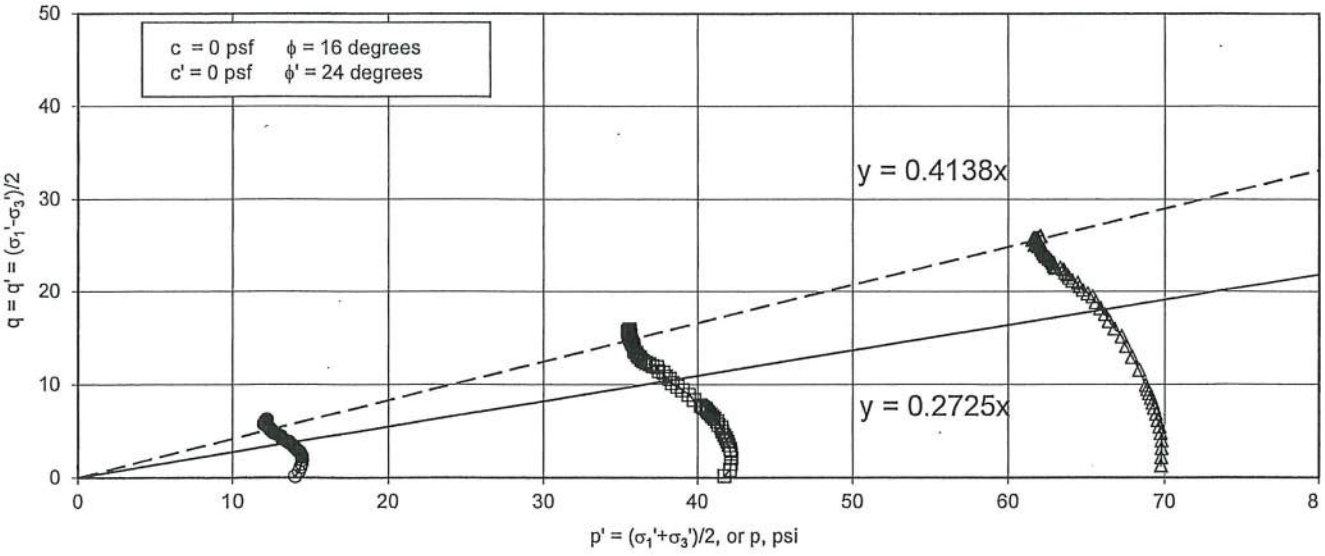
Test Description: Multi-Stage Triaxial Compression Test
Test Sample Location: Blue Clay
Project Name: Blackridge Hotel

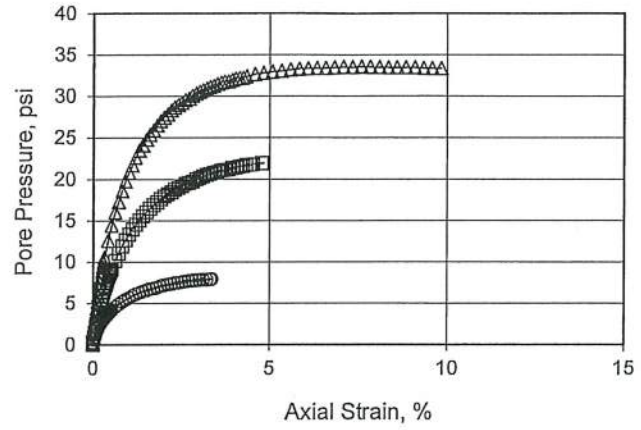
Project No. 2180187

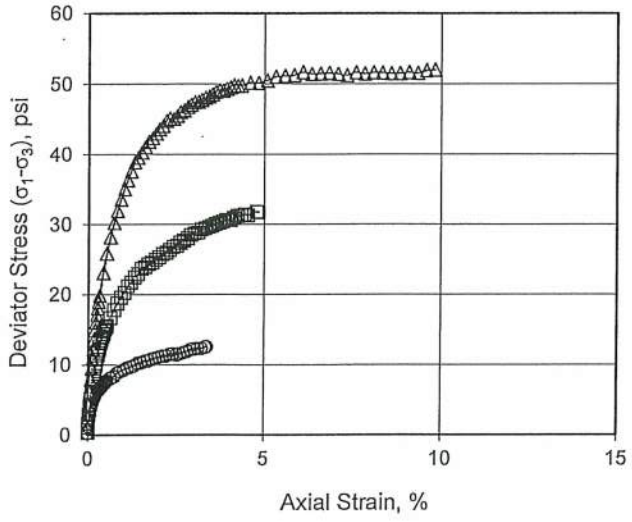
Triaxial Compression Test

Figure 6

Applied Geotechnical Engineering Consultants, Inc.







Test No. (Symbol)	○	□	△
Sample Type	Remolded		
Length, in.	3.96	3.61	3.39
Diameter, in.	1.93	NM	NM
Dry Density, pcf	84	NM	NM
Moisture Content, %	36	NM	NM
Consolidation Pressure, psi	13.9	41.6	69.4
"B" Parameter	99	NA	NA
Total Confining Stress (σ_3), psi	13.9	41.6	69.4
Total Axial Stress (σ_1), psi	26.4	73.4	120.5
Deviator Stress (σ_1-σ_3), psi	12.5	31.8	51.2
Effective Lateral Stress (σ_3'), psi	5.9	19.7	36.2
Effective Axial Stress (σ_1'), psi	18.5	51.5	87.4
Pore Pressure (μ), psi	7.9	21.9	33.2
Strain, %	3.4	4.8	5.6

Remarks	Multistage Test (CU) Consolidated
Undrained with pore pressure measurements.	
Sample saturated with back pressure saturation.	
Sample pulverized to minus No. 40 sieve material	
and moisture-cured to a liquidity index of 58%.	

Sample Index Properties	
Remold Dry Density, pcf	84
Reold Moisture Content, %	36
Liquid Limit, %	46
Plasticity Index, %	24
Percent Gravel	0
Percent Sand	20
Percent Passing No. 200 Sieve	80

Sample Description
Lean Clay with Sand

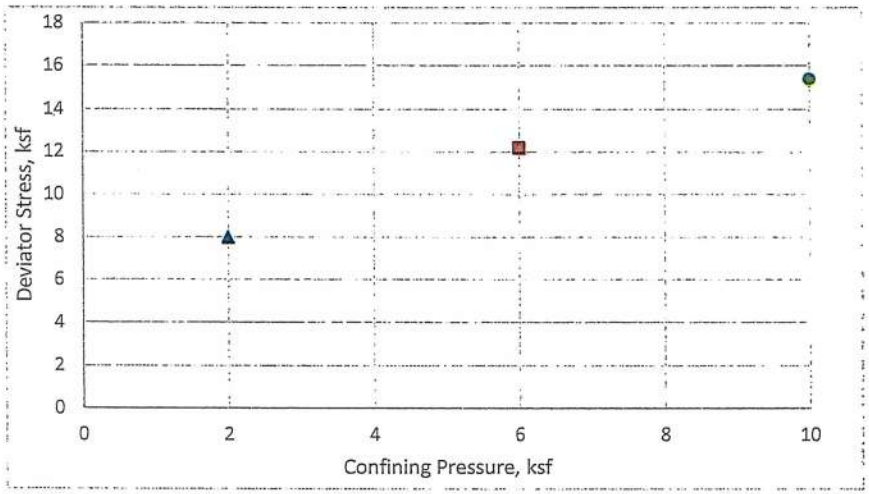
Test Description: Multi-Stage Triaxial Compression Test
Test Sample Location: Red Clay
Project Name: Blackridge Hotel

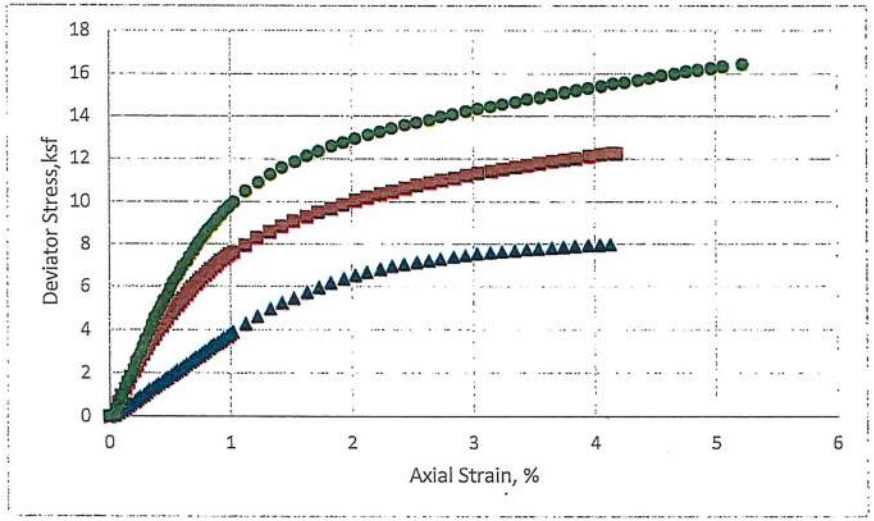
Project No. 2180187

Triaxial Compression Test

Figure 7

Applied Geotechnical Engineering Consultants, Inc.





Multi-Stage Undrained Test

Project and Sample Information			
Project Number		2180187	
Project Name		Blackridge Hotel	
Sample Identification		Blue Clay	
Sample Description		Sandy Fat Clay	
Test No. (Symbol)	1 (▲)	2 (■)	3 (●)
Sample Type	Remolded		
Length, in.			
Diameter, in.	1.93	1.93	1.93
Dry Density, pcf	95.5	-	-
Moisture Content, %	14.4	-	-
Confining Pressure, ksf	2.0	6.0	10.0
Deviator Stress, ksf	8.0	12.2	15.4
Axial Strian, %	4.0	4.0	4.0
Rate of Strain, %/min	1.0	1.0	1.0

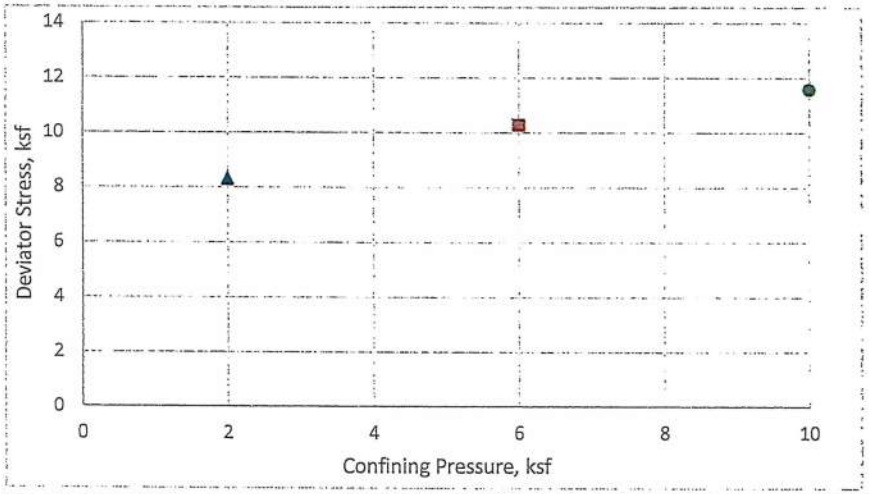
Remold Sample Properties	
Dry Density, pcf	95.5
Moisture Content, %	14.4
Liquid Limit, %	55
Plasticity Index, %	31
Percent Gravel, >4.750mm	0
Percent Coarse Sand, 2.000mm-4.750mm	0
Percent Medium Sand, 0.425mm-2.000mm	7
Percent Fine Sand, 0.075mm-0.425mm	43
Percent Silt, 0.005mm-0.075mm	13
Percent Clay, 0.001mm-0.005mm	37
Percent Colloidals, <0.001mm	0
Percent Clay Fraction, <0.002mm	

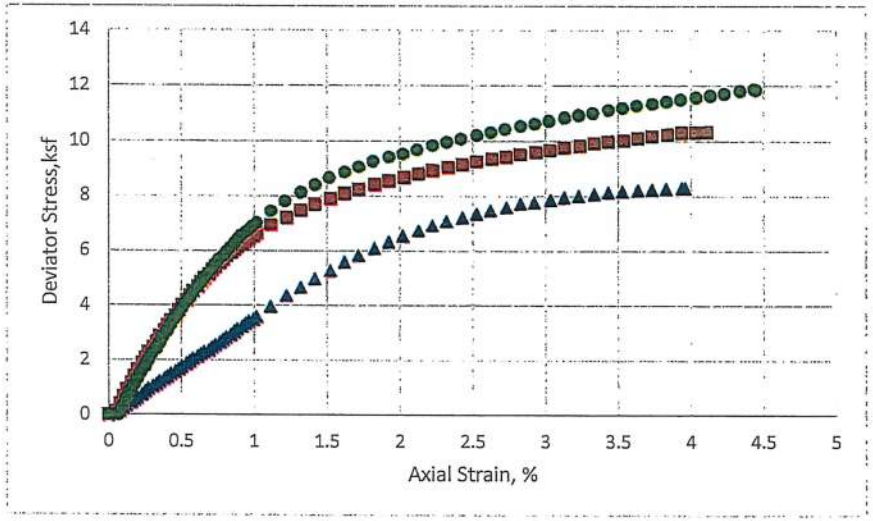
Notes

The Sigma 1 Trautwein Automated Load Test System and the Sigma-1 UU Triaxial Test Software was used for the three-stage undrained shear test. A cyclic loading procedure was employed to perform the multi-stage test.

The deviator stress was released to zero once a maximum value was reached. Each stage commenced from a condition of zero deviator stress. Material passing the # 10 seive was remolded to the approximate moisture content and dry density indicated above.

Applied Geotechnical Engineering Consultants, Inc.





Multi-Stage Undrained Test

Project and Sample Information			
Project Number		2180187	
Project Name		Blackridge Hotel	
Sample Identification		Blue Clay	
Sample Description		Sandy Fat Clay	
Test No. (Symbol)	1 (▲)	2 (■)	3 (●)
Sample Type	Remolded		
Length, in.			
Diameter, in.	1.93	1.93	1.93
Dry Density, pcf	94.6	-	-
Moisture Content, %	19.6	-	-
Confining Pressure, ksf	2.0	6.0	10.0
Deviator Stress, ksf	8.30	10.30	11.60
Axial Strian, %	4.0	4.0	4.0
Rate of Strain, %/min	1.0	1.0	1.0

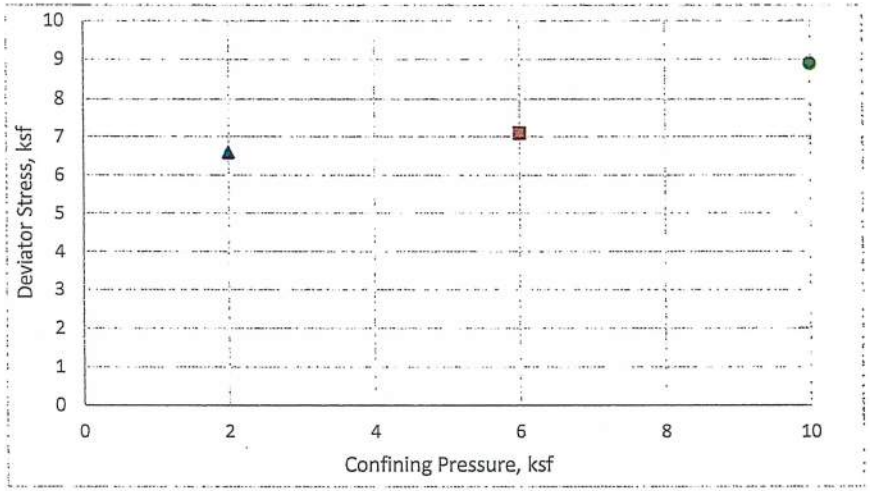
Remold Sample Properties	
Dry Density, pcf	94.6
Moisture Content, %	19.6
Liquid Limit, %	55
Plasticity Index, %	31
Percent Gravel, >4.750mm	0
Percent Coarse Sand, 2.000mm-4.750mm	0
Percent Medium Sand, 0.425mm-2.000mm	7
Percent Fine Sand, 0.075mm-0.425mm	43
Percent Silt, 0.005mm-0.075mm	13
Percent Clay, 0.001mm-0.005mm	37
Percent Colloidals, <0.001mm	0
Percent Clay Fraction, <0.002mm	

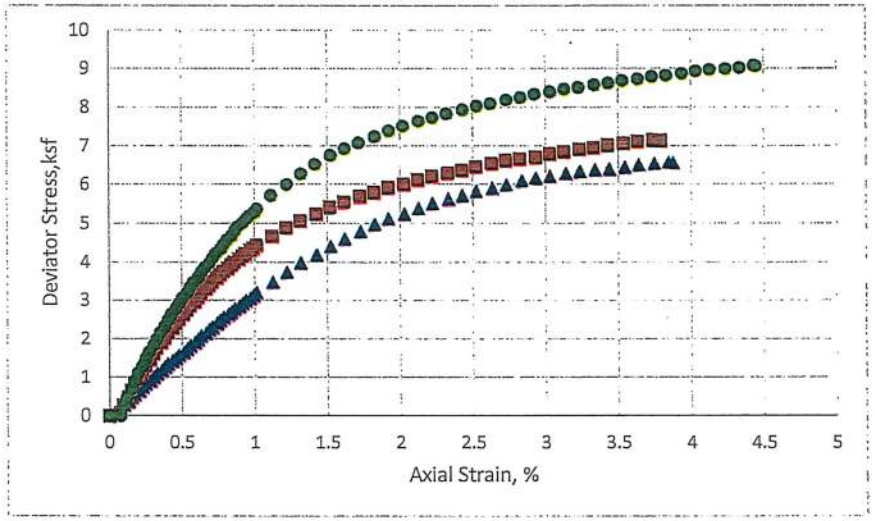
Notes

The Sigma 1 Trautwein Automated Load Test System and the Sigma-1 UU Triaxial Test Software was used for the three-stage undrained shear test. A cyclic loading procedure was employed to perform the multi-stage test.

The deviator stress was released to zero once a maximum value was reached. Each stage commenced from a condition of zero deviator stress. Material passing the # 10 seive was remolded to the approximate moisture content and dry density indicated above.

Applied Geotechnical Engineering Consultants, Inc.





Multi-Stage Undrained Test

Project and Sample Information			
Project Number		2180187	
Project Name		Blackridge Hotel	
Sample Identification		Blue Clay	
Sample Description		Sandy Fat Clay	
Test No. (Symbol)	1 (▲)	2 (■)	3 (●)
Sample Type	Remolded		
Length, in.			
Diameter, in.	1.93	1.93	1.93
Dry Density, pcf	94.9		
Moisture Content, %	23.8		
Confining Pressure, ksf	2.0	6.0	10.0
Deviator Stress, ksf	6.60	7.10	8.90
Axial Strian, %	3.9	3.8	4.0
Rate of Strain, %/min	1.0	1.0	1.0

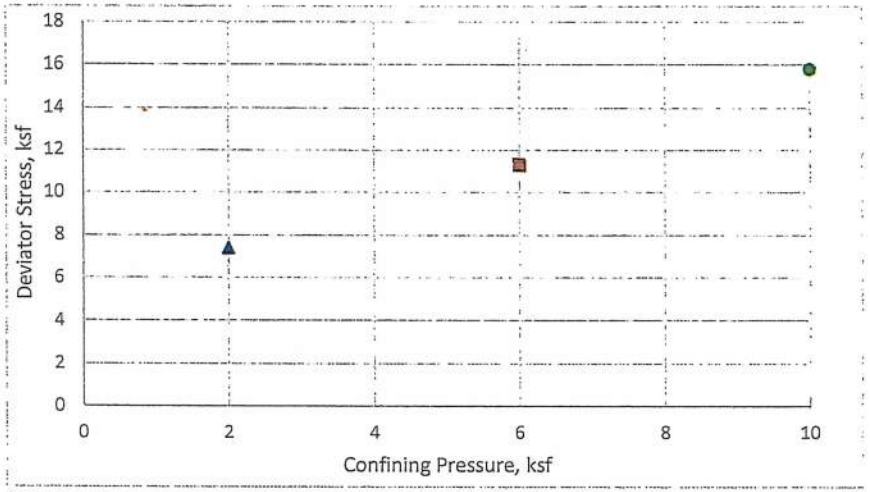
Remold Sample Properties	
Dry Density, pcf	94.9
Moisture Content, %	23.8
Liquid Limit, %	55
Plasticity Index, %	31
Percent Gravel, >4.750mm	0
Percent Coarse Sand, 2.000mm-4.750mm	0
Percent Medium Sand, 0.425mm-2.000mm	7
Percent Fine Sand, 0.075mm-0.425mm	43
Percent Silt, 0.005mm-0.075mm	13
Percent Clay, 0.001mm-0.005mm	37
Percent Colloidals, <0.001mm	0
Percent Clay Fraction, <0.002mm	

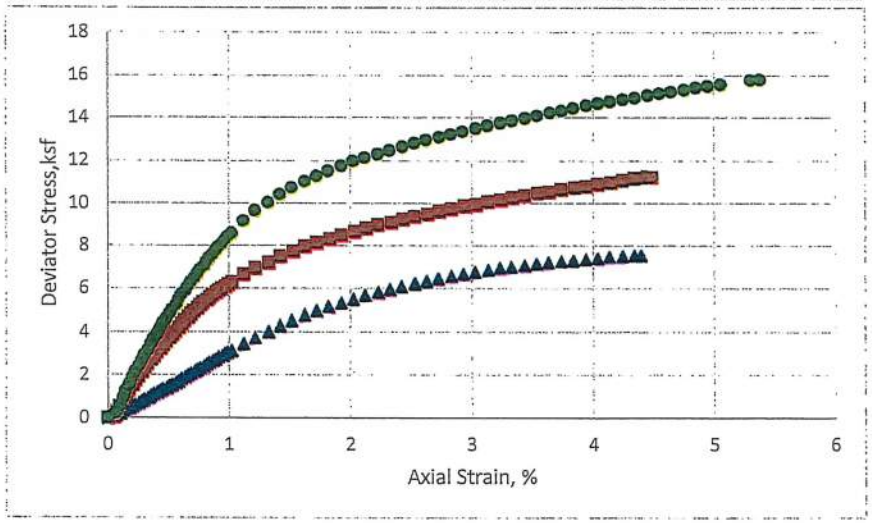
Notes

The Sigma 1 Trautwein Automated Load Test System and the Sigma-1 UU Triaxial Test Software was used for the three-stage undrained shear test. A cyclic loading procedure was employed to perform the multi-stage test.

The deviator stress was released to zero once a maximum value was reached. Each stage commenced from a condition of zero deviator stress. Material passing the # 10 seive was remolded to the approximate moisture content and dry density indicated above.

Applied Geotechnical Engineering Consultants, Inc.





Multi-Stage Undrained Test

Project and Sample Information			
Project Number		2180187	
Project Name		Blackridge Hotel	
Sample Identification		Red Clay	
Sample Description		Lean Clay with Sand	
Test No. (Symbol)	1 (▲)	2 (■)	3 (●)
Sample Type	Remolded		
Length, in.			
Diameter, in.	1.93	1.93	1.93
Dry Density, pcf	103.5	-	-
Moisture Content, %	12.6	-	-
Confining Pressure, ksf	2.0	6.0	10.0
Deviator Stress, ksf	7.40	11.30	15.80
Axial Strian, %	4.0	4.5	5.4
Rate of Strain, %/min	1.0	1.0	1.0

Remold Sample Properties	
Dry Density, pcf	103.5
Moisture Content, %	12.5
Liquid Limit, %	46
Plasticity Index, %	24
Percent Gravel, >4.750mm	0
Percent Coarse Sand, 2.000mm-4.750mm	0
Percent Medium Sand, 0.425mm-2.000mm	3
Percent Fine Sand, 0.075mm-0.425mm	19
Percent Silt, 0.005mm-0.075mm	44
Percent Clay, 0.001mm-0.005mm	34
Percent Colloidals, <0.001mm	0
Percent Clay Fraction, <0.002mm	

Notes

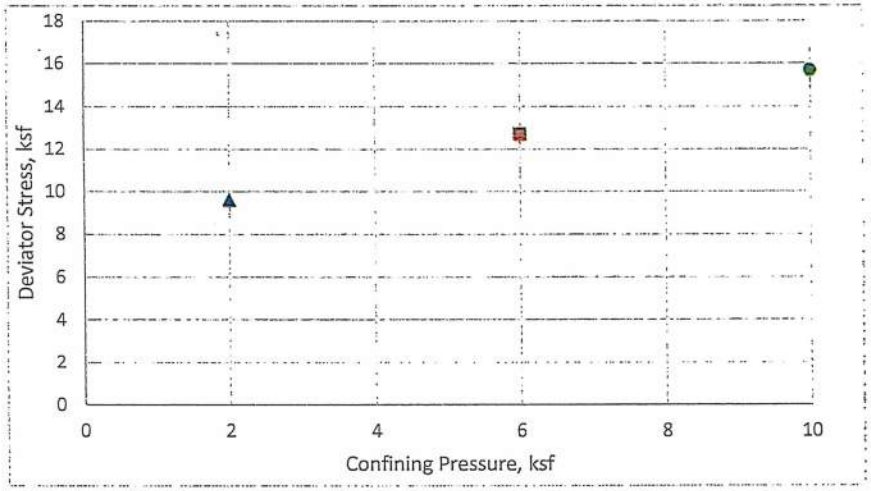
The Sigma 1 Trautwein Automated Load Test System and the Sigma-1 UU Triaxial Test Software was used for the three-stage undrained shear test. A cyclic loading procedure was employed to perform the multi-stage test.

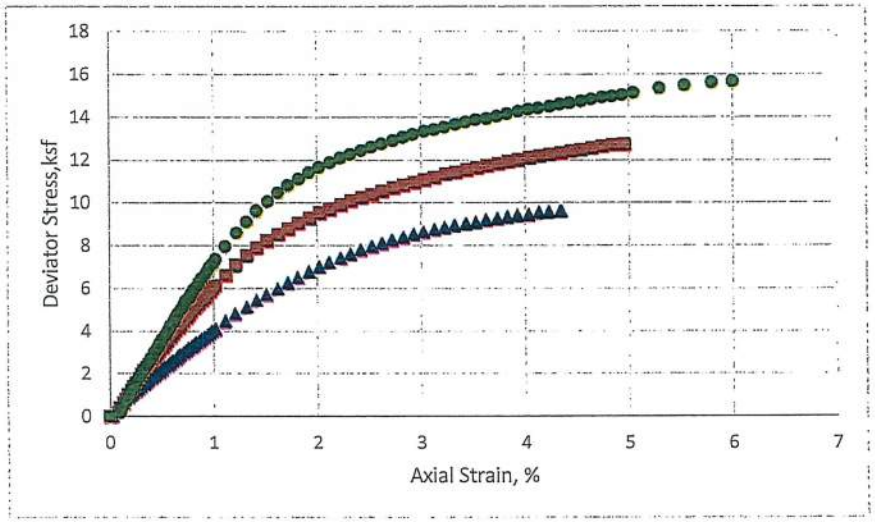
The deviator stress was released to zero once a maximum value was reached. Each stage commenced from a condition of zero deviator stress. Material passing the # 10 seive was remolded to the approximate moisture content and dry density indicated above.

Project No. 2180187

Figure 11

Applied Geotechnical Engineering Consultants, Inc.





Multi-Stage Undrained Test

Project and Sample Information			
Project Number		2180187	
Project Name		Blackridge Hotel	
Sample Identification		Red Clay	
Sample Description		Lean Clay with Sand	
Test No. (Symbol)	1 (▲)	2 (■)	3 (●)
Sample Type	Remolded		
Length, in.			
Diameter, in.	1.93	1.93	1.93
Dry Density, pcf	102	-	-
Moisture Content, %	14.9	-	-
Confining Pressure, ksf	2.0	6.0	10.0
Deviator Stress, ksf	9.60	12.70	15.70
Axial Strian, %	4.4	5.0	6.0
Rate of Strain, %/min	1.0	1.0	1.0

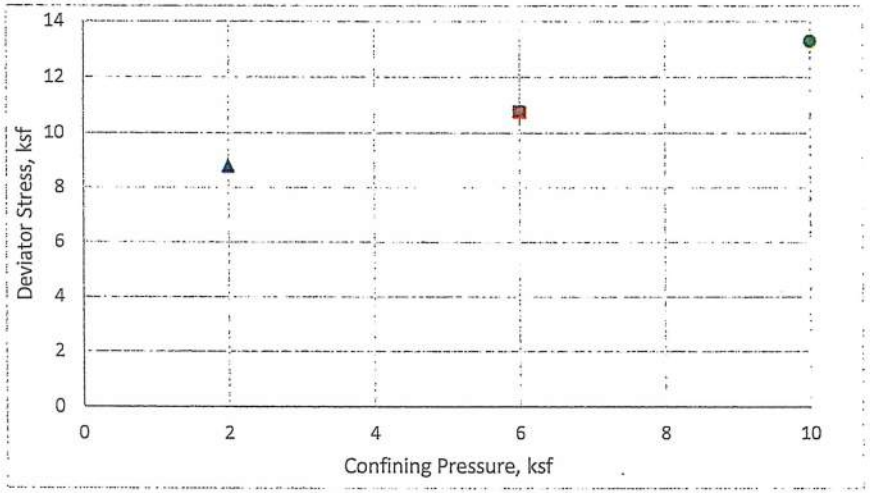
Remold Sample Properties	
Dry Density, pcf	102.0
Moisture Content, %	14.9
Liquid Limit, %	46
Plasticity Index, %	24
Percent Gravel, >4.750mm	0
Percent Coarse Sand, 2.000mm-4.750mm	0
Percent Medium Sand, 0.425mm-2.000mm	3
Percent Fine Sand, 0.075mm-0.425mm	19
Percent Silt, 0.005mm-0.075mm	44
Percent Clay, 0.001mm-0.005mm	34
Percent Colloidals, <0.001mm	0
Percent Clay Fraction, <0.002mm	

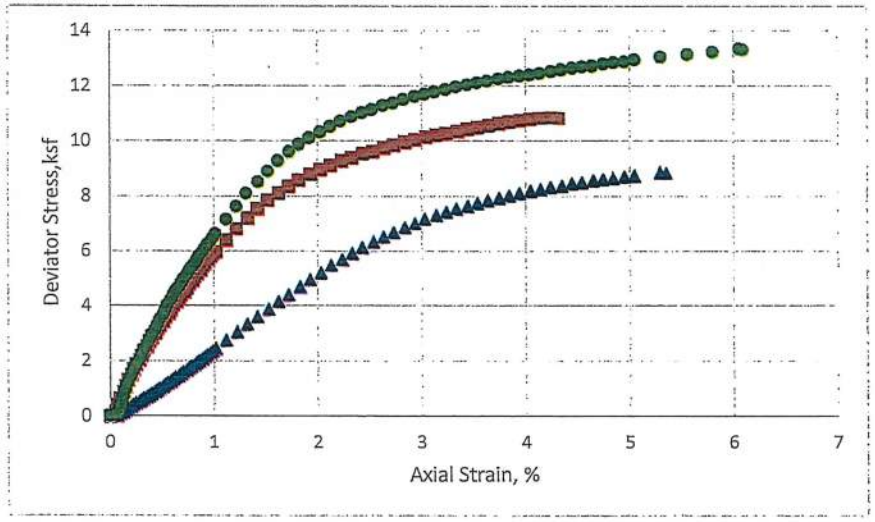
Notes

The Sigma 1 Trautwein Automated Load Test System and the Sigma-1 UU Triaxial Test Software was used for the three-stage undrained shear test. A cyclic loading procedure was employed to perform the multi-stage test.

The deviator stress was released to zero once a maximum value was reached. Each stage commenced from a condition of zero deviator stress. Material passing the # 10 seive was remolded to the approximate moisture content and dry density indicated above.

Applied Geotechnical Engineering Consultants, Inc.





Multi-Stage Undrained Test

Project and Sample Information			
Project Number		2180187	
Project Name		Blackridge Hotel	
Sample Identification		Red Clay	
Sample Description		Lean Clay with Sand	
Test No. (Symbol)	1 (▲)	2 (■)	3 (●)
Sample Type	Remolded		
Length, in.			
Diameter, in.	1.93	1.93	1.93
Dry Density, pcf	105.1	-	-
Moisture Content, %	17.9	-	-
Confining Pressure, ksf	2.0	6.0	10.0
Deviator Stress, ksf	8.80	10.80	13.30
Axial Strian, %	5.4	4.3	6.0
Rate of Strain, %/min	1.0	1.0	1.0

Remold Sample Properties	
Dry Density, pcf	105.1
Moisture Content, %	17.9
Liquid Limit, %	46
Plasticity Index, %	24
Percent Gravel, >4.750mm	0
Percent Coarse Sand, 2.000mm-4.750mm	0
Percent Medium Sand, 0.425mm-2.000mm	3
Percent Fine Sand, 0.075mm-0.425mm	19
Percent Silt, 0.005mm-0.075mm	44
Percent Clay, 0.001mm-0.005mm	34
Percent Colloidals, <0.001mm	0
Percent Clay Fraction, <0.002mm	

Notes

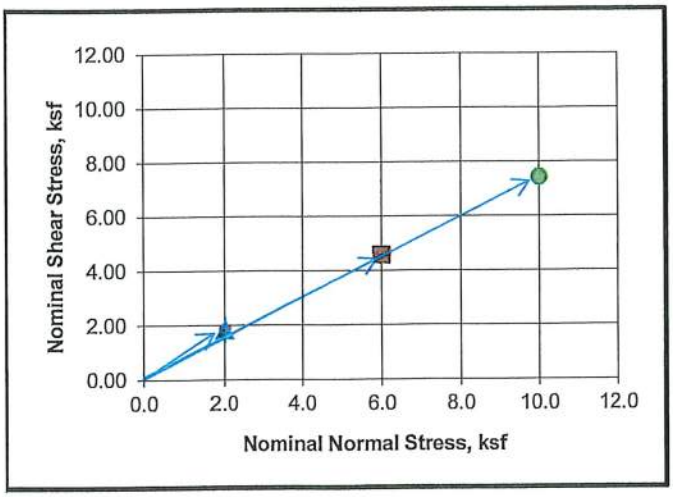
The Sigma 1 Trautwein Automated Load Test System and the Sigma-1 UU Triaxial Test Software was used for the three-stage undrained shear test. A cyclic loading procedure was employed to perform the multi-stage test.

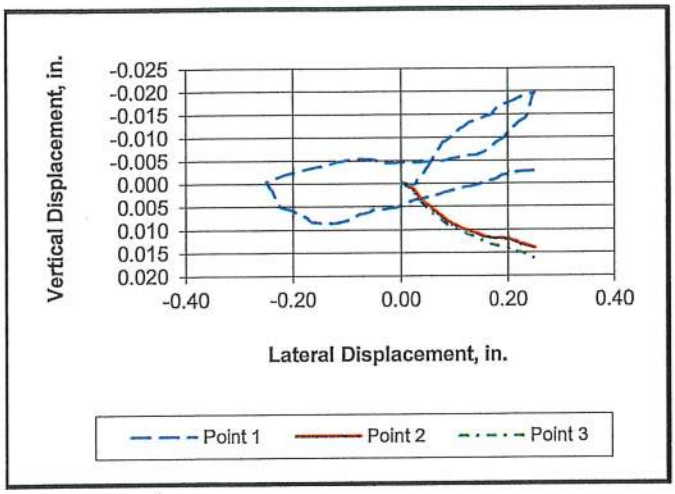
The deviator stress was released to zero once a maximum value was reached. Each stage commenced from a condition of zero deviator stress. Material passing the # 10 seive was remolded to the approximate moisture content and dry density indicated above.

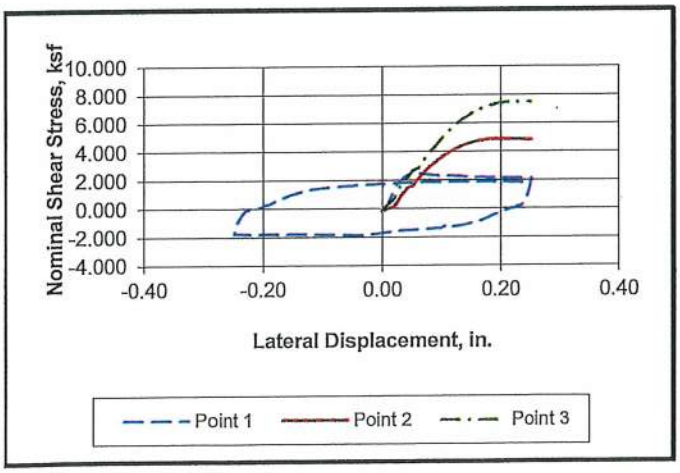
Project No. 2180187

Figure 13

Applied Geotechnical Engineering Consultants, Inc.







DIRECT SHEAR TEST

Project and Sample Information			
Project Number			2180187
Project Name			Blackridge Hotel
Sample Identification			Blue Clay
Sample Description			Sandy Fat Clay
Test No. (Symbol)	1 (▲)	2 (■)	3 (●)
Test Type	Consolidated Unsaturated		
Sample Type	Remolded		
Length, in.	1.00	-	-
Diameter, in.	2.42	2.42	2.42
Dry Density, pcf	95	-	-
Moisture Content, %	13	-	-
Consol. Load, ksf	2.0	6.0	10.0
Normal Load, ksf	2.0	6.0	10.0
Shear Stress, ksf	1.86	4.58	7.44
Secant Friction Angle	43	37	37
Lateral Displacement, in	0.200	0.200	0.200
Relative Lateral Displacement, %	8.26	8.26	8.26
Rate of Strain, in/min	0.04	0.04	0.040
Gap Width, in	0.075	0.080	0.070

Material passing the #10 sieve remolded to:
a dry density of approximately 95pcf
at a moisture content of approximately 13%.
A three-stage direct shear test was performed.
A pre-shear cycle was performed before the 1st shear stage.

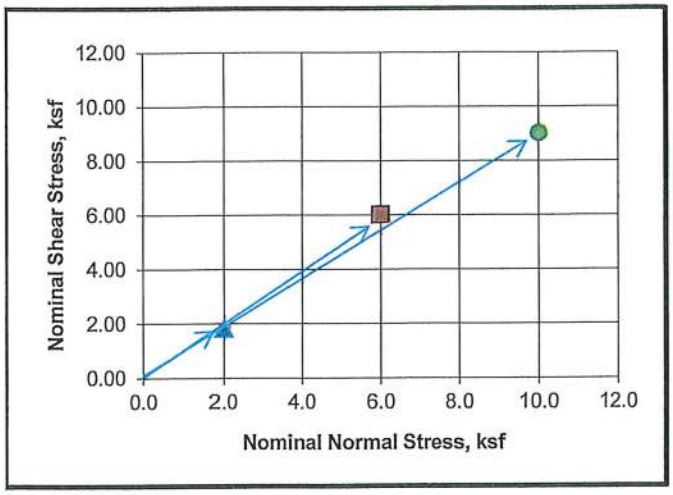
Sample Properties	
Dry Density, pcf	95
Moisture Content, %	13
Liquid Limit, %	55
Plasticity Index, %	31
Percent Gravel, >4.750mm	0
Percent Coarse Sand, 2.000mm-4.750mm	0
Percent Medium Sand, 0.425mm-2.000mm	7
Percent Fine Sand, 0.075mm-0.425mm	43
Percent Silt, 0.005mm-0.075mm	13
Percent Clay, 0.001mm-0.005mm	37
Percent Colloidals, <0.001mm	0

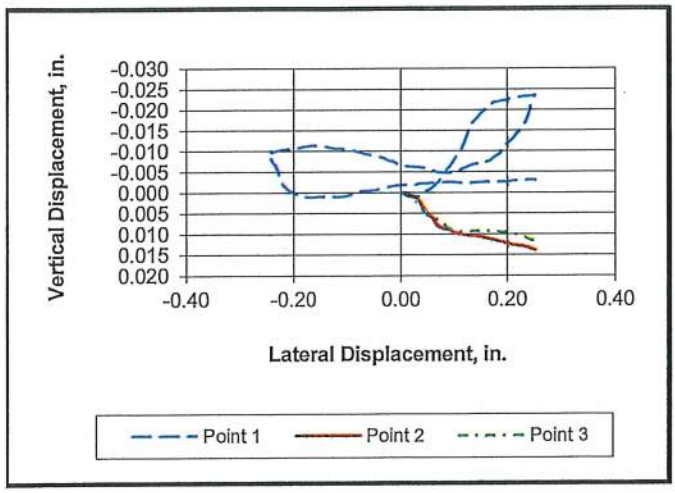
Project No. 2180187

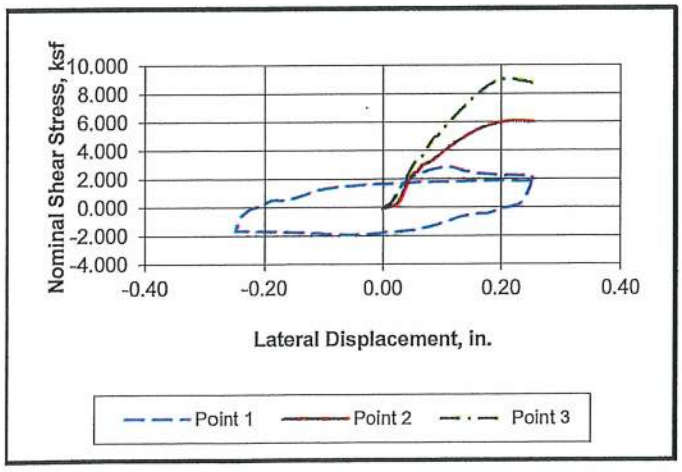
Direct Shear Results

Figure 14

Applied Geotechnical Engineering Consultants, Inc.







DIRECT SHEAR TEST

Project and Sample Information			
Project Number			2180187
Project Name			Blackridge Hotel
Sample Identification			Red Clay
Sample Description			Lean Clay w Sand
Test No. (Symbol)	1 (▲)	2 (■)	3 (●)
Test Type	Consolidated Unsaturated		
Sample Type	Remolded		
Length, in.	1.00	-	-
Diameter, in.	2.42	2.42	2.42
Dry Density, pcf	101	-	-
Moisture Content, %	10	-	-
Consol. Load, ksf	2.0	6.0	10.0
Normal Load, ksf	2.0	6.0	10.0
Shear Stress, ksf	1.86	6.02	9.03
Secant Friction Angle	43	45	42
Lateral Displacement, in	0.202	0.203	0.202
Relative Lateral Displacement, %	8.35	8.39	8.35
Rate of Strain, in/min	0.04	0.04	0.040
Gap Width, in	0.075	0.080	0.070

Material passing the #10 sieve remolded to:
a dry density of approximately 105pcf
at a moisture content of approximately 10%.
A three-stage direct shear test was performed.
A pre-shear cycle was performed before the 1st shear stage.

Sample Properties	
Dry Density, pcf	105
Moisture Content, %	10
Liquid Limit, %	46
Plasticity Index, %	24
Percent Gravel, >4.750mm	0
Percent Coarse Sand, 2.000mm-4.750mm	0
Percent Medium Sand, 0.425mm-2.000mm	3
Percent Fine Sand, 0.075mm-0.425mm	19
Percent Silt, 0.005mm-0.075mm	44
Percent Clay, 0.001mm-0.005mm	34
Percent Colloidals, <0.001mm	0

Project No. 2180187

Direct Shear Results

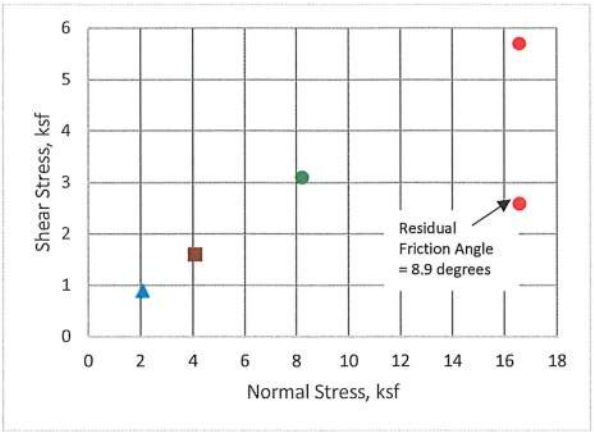
Figure 15

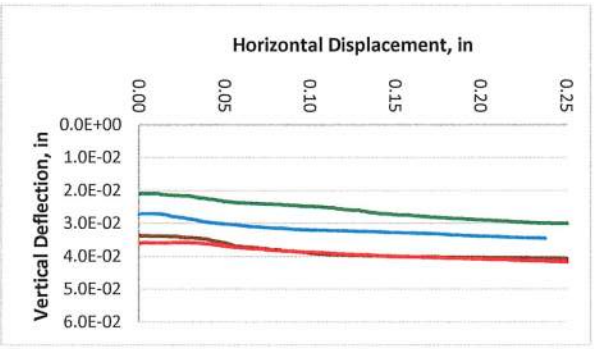
Applied Geotechnical Engineering Consultants, Inc.

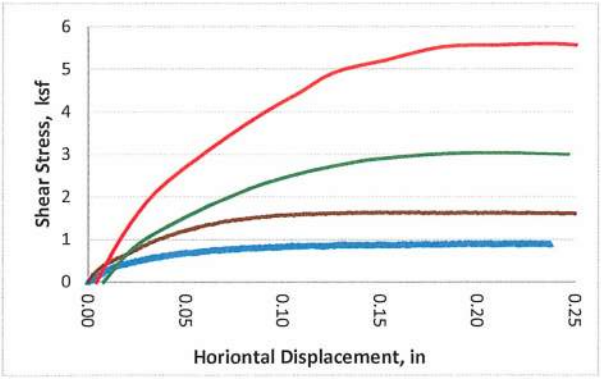
All Testing Completed Using a Wykeham Farrance Torshear Device

Project Number 2211175

Project Name Blackstone Hotel West







Sample and Test Information				
Sample Identification	B-4 at 50'			
Sample Description	Claystone (Fat Clay)			
Test Type	Fully Softened Shear Strength			
Sampe Type	Remolded			
Test Equipment and Procedures				
Specimen Container	Adjustable Modified Bromhead			
Porous Disc Construction	Serrated Stainless Steel			
	Manufactured by Illinois University			
Test Procedure	Consolidated by Incremental Loading,			
	Unloaded and Flushed by Lifting (Pts 3 & 4),			
	ReConsolidated by Incremental Loading (Pts 3 & 4),			
	and Sheared			
Test Data				
Test No. (Symbol)	1 (▲)	2 (■)	3 (●)	4 (●)
Dry Density, pcf	78.8	76.3	75.8	79.2
Moisture Content, %	44.2	44.2	44.2	44.2
Initial Height of Sample, in	0.1815	0.1815	0.1815	0.1815
Radii of Sample, in	1.378-1.9685			
Initial Saturation, %	100.0	100.0	100.0	100.0
Final Saturation, %	100.0	100.0	100.0	100.0
Consol. Load, ksf	2.084	4.084	8.209	16.584
Normal Load, ksf	2.084	4.084	8.209	16.584
Shear Stress, ksf	0.9	1.6	3.1	5.7
Secant Friction Angle	23.4	21.4	20.7	19.0
Displacement, in	0.20	0.16	0.27	0.24
Shear Rate, in/min	0.0008	0.0008	0.0008	0.0008

Samples were pulverized using a mortar and pestle when wet and passed thru a No. 40 sieve with water. The samples were dried in a low-temperature oven and rolled on a glass plate to a moisture content approximately 76% of the liquid limit.

Sample Index Properties on Minus #40 Sieve Material		
Liquid Limit, %		57
Plasticity Index, %		31
Percent Clay Fraction, <0.002mm		37
Specific Gravity of Soil	Measured	2.763

Hydrometer Results on Minus #40 Sieve Material	
Percent Coarse Sand, 2.000mm-4.750mm	0
Percent Medium Sand, 0.425mm-2.000mm	0
Percent Fine Sand, 0.075mm-0.425mm	53
Percent Silt, 0.005mm-0.075mm	5
Percent Clay, 0.001mm-0.005mm	12
Percent Colloidals, <0.001mm	30

Project No. 2211175

Ring Shear Results

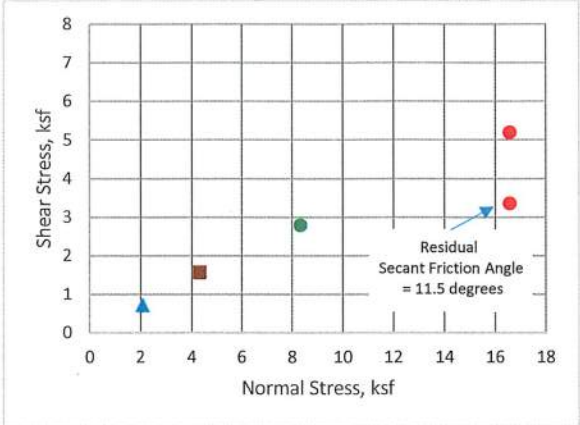
Figure 16

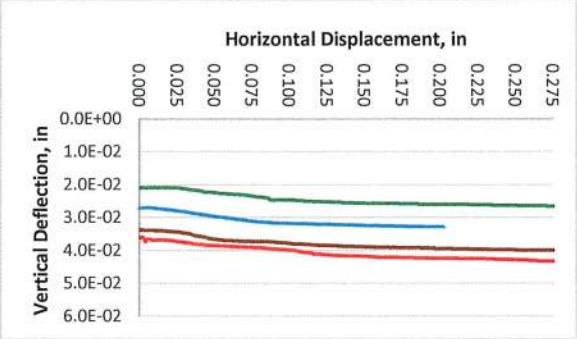
Applied Geotechnical Engineering Consultants, Inc.

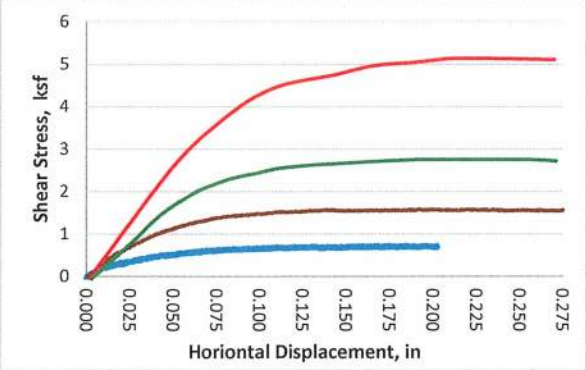
All Testing Completed Using a Wykeham Farrance Torshear Device

Project Number 2211175

Project Name Blackstone Hotel West







Sample and Test Information				
Sample Identification	B-4 at 114'			
Sample Description	Claystone (Fat Clay)			
Test Type	Fully Softened Shear Strength			
Sampe Type	Remolded			
Test Equipment and Procedures				
Specimen Container	Adjustable Modified Bromhead			
Porous Disc Construction	Serrated Stainless Steel			
	Manufactured by Illinois University			
Test Procedure	Consolidated by Incremental Loading,			
	Unloaded and Flushed by Lifting (Pts 2 ,3 & 4),			
	ReConsolidated by Incremental Loading (Pts 2,3,&4),			
	and Sheared			
Test Data				
Test No. (Symbol)	1 (▲)	2 (■)	3 (●)	4 (●)
Dry Density, pcf	74.8	75.0	75.9	74.3
Moisture Content, %	50.1	50.1	50.1	50.1
Initial Height of Sample, in	0.1815	0.1815	0.1815	0.1815
Radii of Sample, in	1.378-1.9685			
Initial Saturation, %	100.0	100.0	100.0	100.0
Final Saturation, %	100.0	100.0	100.0	100.0
Consol. Load, ksf	2.084	4.334	8.334	16.584
Normal Load, ksf	2.084	4.334	8.334	16.584
Shear Stress, ksf	0.726	1.564	2.799	5.199
Secant Friction Angle	19.2	19.8	18.6	17.4
Displacement, in	0.20	0.20	0.20	0.20
Rate of Strain, in/min	0.0008	0.0008	0.0008	0.0008

Samples were pulverized using a mortar and pestle when wet and passed thru a No. 40 sieve with water. The samples were dried in a low-temperature oven and rolled on a glass plate to a moisture content approximately 77% of the liquid limit.

Sample Index Properties on Minus #40 Sieve Material		
Liquid Limit, %		60
Plasticity Index, %		38
Percent Clay Fraction, <0.002mm		40
Specific Gravity of Soil	Measured	2.748

Hydrometer Results on Minus #40 Sieve Material	
Percent Coarse Sand, 2.000mm-4.750mm	0
Percent Medium Sand, 0.425mm-2.000mm	0
Percent Fine Sand, 0.075mm-0.425mm	27
Percent Silt, 0.005mm-0.075mm	26
Percent Clay, 0.001mm-0.005mm	11
Percent Colloidals, <0.001mm	36

Project No. 2211175

Ring Shear Results

Figure 17

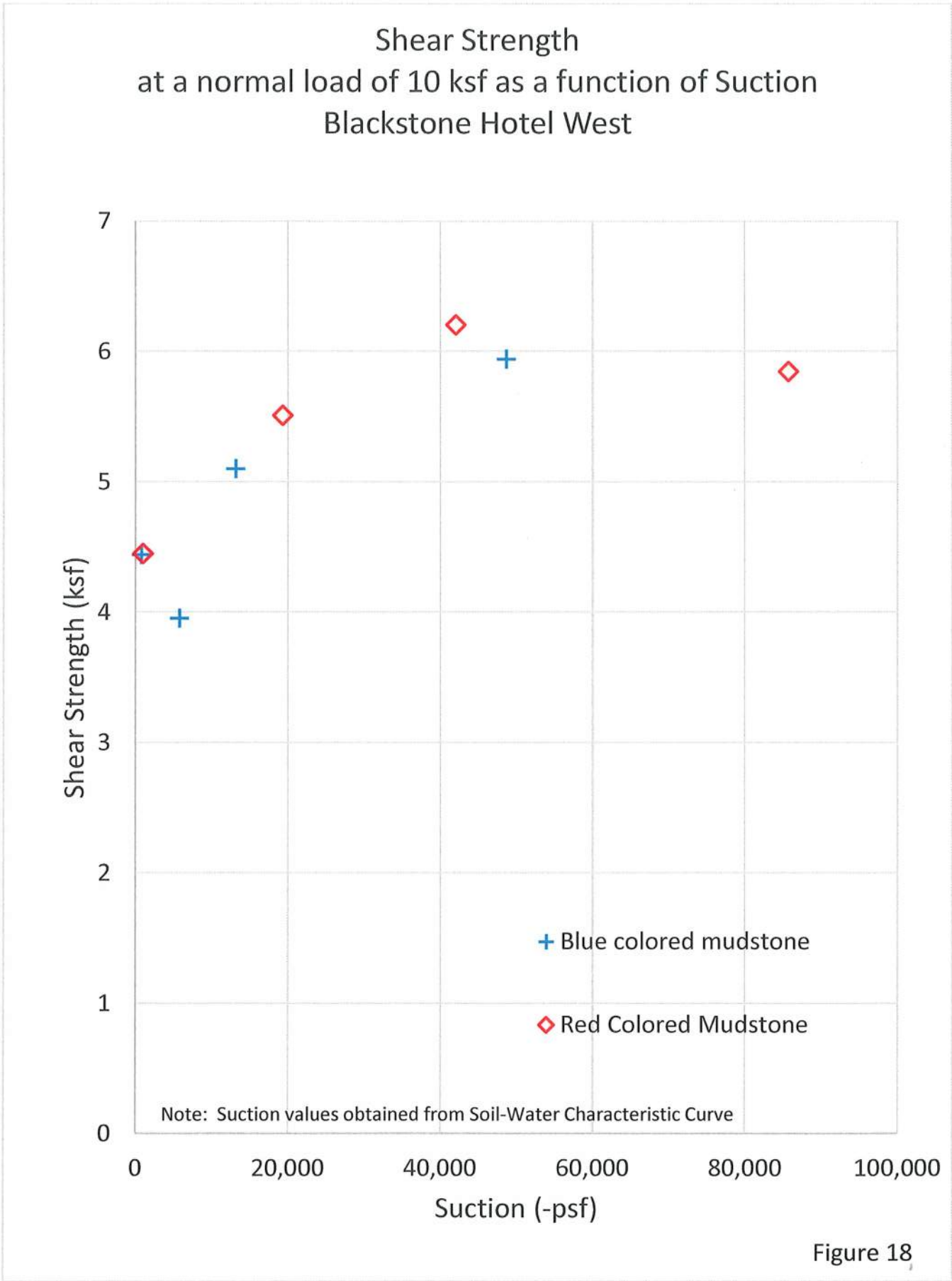
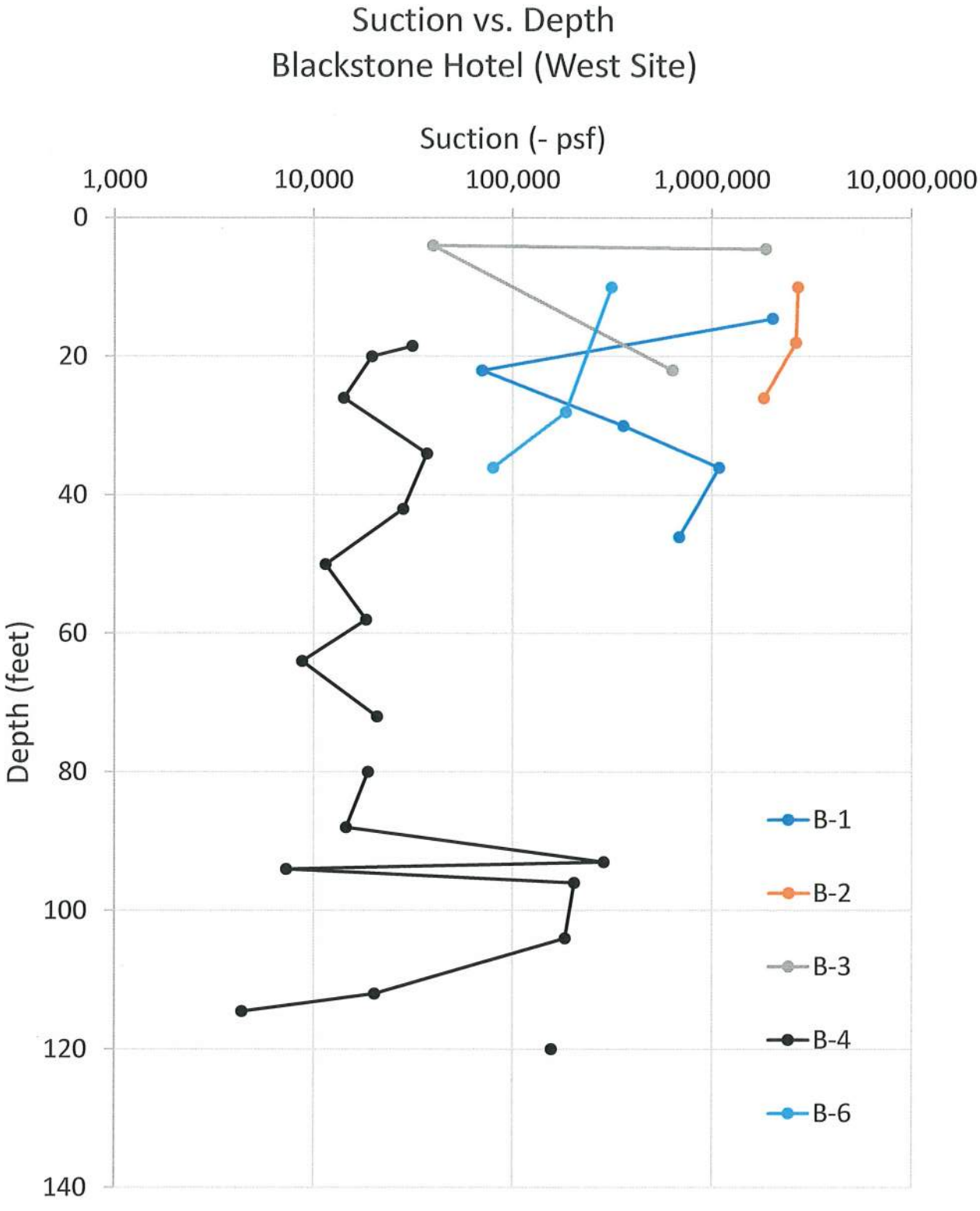

Shear Strength
at a normal load of 10 ksf as a function of Suction
Blackstone Hotel West
Shear Strength (ksf)
0
1
2
3
4
5
6
7
0
20,000
40,000
60,000
80,000
100,000
Suction (-psf)
Blue colored mudstone
Red Colored Mudstone
Note: Suction values obtained from Soil-Water Characteristic Curve

Figure 18



Project # 2-21-1175

Figure 19

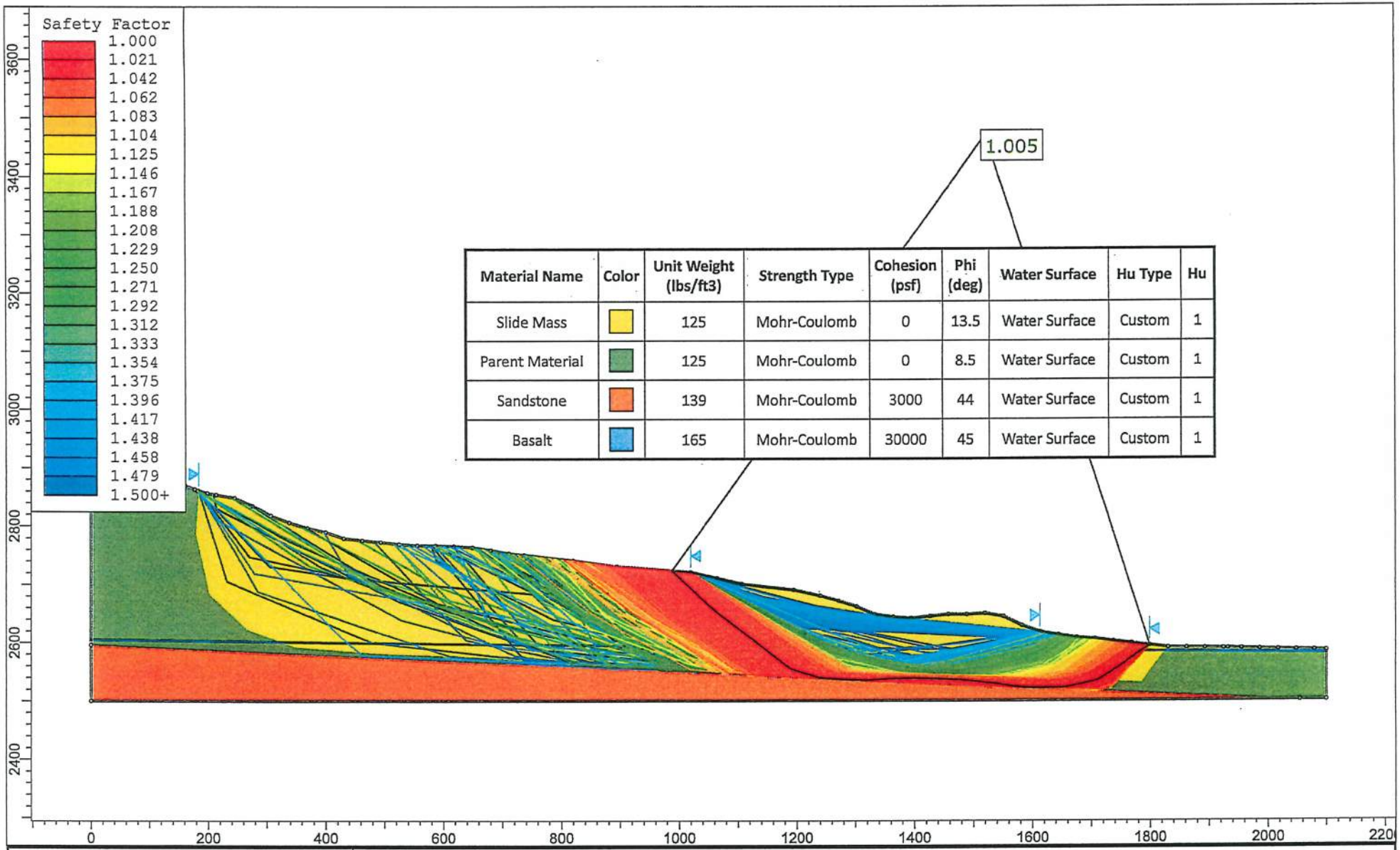
APPENDIX

A-1 Condition Before Grading
A-2 Proposed Profile - Static
A-3 Proposed Profile - Seismic (Yield Acceleration)

APPENDIX

A-1 Condition Before Grading

Project No. 2-21-1175



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Hu Type	Hu
Slide Mass		125	Mohr-Coulomb	0	13.5	Water Surface	Custom	1
Parent Material		125	Mohr-Coulomb	0	8.5	Water Surface	Custom	1
Sandstone		139	Mohr-Coulomb	3000	44	Water Surface	Custom	1
Basalt		165	Mohr-Coulomb	30000	45	Water Surface	Custom	1

AGEC
Applied GeoTech

SLIDEINTERPRET 8.032

Project	Blackstone Hotel (west)		
Analysis Description	Pre-excavation condtions - static residual strengths		
Drawn By		Scale 1:2702	Company
Date	1:24:26 PM9/16/2021		File Name Pre excavation conditions shallow 9 15 21.slmd

Slide Analysis Information

Pre excavation conditions shallow 9 15 21

Project Summary

File Name:	Pre excavation conditions shallow 9 15 21.slmd
Slide Modeler Version:	8.032
Compute Time:	00h:00m:04.331s
Project Title:	SLIDE - An Interactive Slope Stability Program
Date Created:	8/24/2021, 2:35:12 PM

General Settings

Units of Measurement:	Imperial Units
Time Units:	days
Permeability Units:	feet/second
Data Output:	Standard
Failure Direction:	Left to Right

Analysis Options

Analysis Methods Used	
Slices Type:	Vertical
	Bishop simplified
Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Groundwater Analysis

Groundwater Method:	Water Surfaces
Pore Fluid Unit Weight [lbs/ft3]:	62.4
Use negative pore pressure cutoff:	Yes
Maximum negative pore pressure [psf]:	0
Advanced Groundwater Method:	None

Random Numbers

Pseudo-random Seed:	10116

Random Number Generation Method: Park and Miller v.3

Surface Options

Search Method:	Cuckoo Search
Initial # of Surface Vertices:	8
Maximum Iterations:	500
Number of Nests:	50
Minimum Elevation:	Not Defined
Minimum Depth:	Not Defined
Minimum Area:	Not Defined
Minimum Weight:	Not Defined
Convex Surfaces Only:	Enabled

Seismic Loading

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No

Materials

Property	Slide Mass	Parent Material	Sandstone	Basalt
Color				
Strength Type	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb
Unit Weight [lbs/ft3]	125	125	139	165
Cohesion [psf]	0	0	3000	30000
Friction Angle [°]	13.5	8.5	44	45
Water Surface	Water Table	Water Table	Water Table	Water Table
Hu Value	1	1	1	1

Global Minimums

Method: bishop simplified

FS	1.004870
Axis Location:	1522.516, 3470.628
Left Slip Surface Endpoint:	987.608, 2722.591
Right Slip Surface Endpoint:	1800.000, 2593.879
Resisting Moment:	1.27247e+09 lb-ft
Driving Moment:	1.2663e+09 lb-ft
Total Slice Area:	75540.3 ft2
Surface Horizontal Width:	812.392 ft
Surface Average Height:	92.985 ft

Global Minimum Coordinates

Method: bishop simplified

X	Y
987.608	2722.59
1006.92	2705.02
1026.23	2686.77
1045.54	2667.84
1064.85	2650.76
1096.71	2626.7
1128.6	2602.01
1159.5	2577.14
1190.44	2553.71
1214.71	2546.04
1238.99	2538.96
1279.34	2536.3
1319.69	2534.97
1360.04	2537
1400.39	2537.63
1440.74	2536.85
1481.09	2534.66
1511.13	2531.98
1541.18	2528.25
1571.06	2523.63
1601.22	2521.42
1628.68	2521.77
1656.13	2522.01
1683.58	2527.85
1711.28	2533.96
1733.45	2547.23
1755.61	2562.04
1777.81	2578.34
1800	2593.88

Valid/Invalid Surfaces

Method: bishop simplified

Number of Valid Surfaces: 24096
Number of Invalid Surfaces: 961

Error Codes:

Error Code -112 reported for 209 surfaces
Error Code -114 reported for 111 surfaces
Error Code -121 reported for 59 surfaces
Error Code -124 reported for 14 surfaces
Error Code -1000 reported for 568 surfaces

Error Codes

The following errors were encountered during the computation:

-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.
-114 = Surface with Reverse Curvature.

-121 = Concave failure surface, only convex surfaces have been defined as being allowed.
-124 = A slice has a width less than the minimum acceptable value.
-1000 = No valid slip surface is generated

Slice Data

- **Global Minimum Query (bishop simplified) - Safety Factor: 1.00487**

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [degrees]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	19.3098	19347.2	-42.3086	Slide Mass	0	13.5	196.621	197.579	822.976	0	822.976	1001.94	1001.94
2	19.3098	58510.8	-43.384	Slide Mass	0	13.5	590.584	593.46	2471.94	0	2471.94	3030.12	3030.12
3	19.3097	94539.2	-44.4226	Slide Mass	0	13.5	947.789	952.405	3967.04	0	3967.04	4895.92	4895.92
4	19.3097	127639	-41.5008	Slide Mass	0	13.5	1303.68	1310.03	5456.68	0	5456.68	6610.11	6610.11
5	15.9321	126254	-37.0481	Slide Mass	0	13.5	1604.01	1611.82	6713.75	0	6713.75	7924.57	7924.57
6	15.9321	142651	-37.0481	Slide Mass	0	13.5	1812.32	1821.15	7585.67	0	7585.67	8953.74	8953.74
7	15.9426	159719	-37.7577	Slide Mass	0	13.5	2019.8	2029.64	8454.06	0	8454.06	10018.4	10018.4
8	15.9426	179891	-37.7577	Slide Mass	0	13.5	2274.9	2285.98	9521.8	0	9521.8	11283.7	11283.7
9	13.1749	164833	-38.8213	Slide Mass	0	13.5	2507.14	2519.35	10493.8	0	10493.8	12511.1	12511.1
10	17.7338	245543	-38.8213	Slide Mass	0	13.5	2686.75	2699.83	11684.2	438.585	11245.6	13846	13407.5
11	15.3348	233530	-37.1365	Slide Mass	0	13.5	2831.34	2845.13	13084.7	1233.83	11850.8	15228.8	13995
12	15.3348	252450	-37.1365	Slide Mass	0	13.5	2936.65	2950.95	14238.7	1947.08	12291.6	16462.6	14515.5
13	0.267269	4567.69	-37.1365	Parent Material	0	8.5	1975.71	1985.33	15594.1	2309.93	13284.1	17090.3	14780.3
14	24.2684	419824	-17.534	Parent Material	0	8.5	2095.67	2105.88	16637.1	2546.36	14090.8	17299.2	14752.9
15	24.2822	426223	-16.2692	Parent Material	0	8.5	2075.98	2086.09	16947	2988.65	13958.3	17552.8	14564.2
16	20.1749	350764	-3.76698	Parent Material	0	8.5	2084.29	2094.44	17248.9	3234.68	14014.2	17386.1	14151.5
17	20.1749	339306	-3.76698	Parent Material	0	8.5	1990.65	2000.34	16687.2	3302.58	13384.6	16818.3	13515.7
18	20.175	325695	-1.89096	Parent Material	0	8.5	1893.47	1902.69	16081	3349.82	12731.2	16143.6	12793.7
19	20.175	308885	-1.89096	Parent Material	0	8.5	1766.22	1774.82	15252	3376.4	11875.6	15310.4	11934
20	13.45	193754	2.88958	Parent Material	0	8.5	1654.65	1662.71	14488.9	3363.51	11125.4	14405.4	11041.9
21	13.45	185958	2.88958	Parent Material	0	8.5	1575.64	1583.31	13905.4	3311.15	10594.2	13825.8	10514.7
22	13.45	181509	2.88958	Parent Material	0	8.5	1533.91	1541.38	13572.4	3258.8	10313.6	13495	10236.2
23	20.175	265921	0.89115	Parent Material	0	8.5	1485.55	1492.78	13203.8	3215.34	9988.44	13180.7	9965.34

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [degrees]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
24	20.175	261523	0.89115	Parent Material	0	8.5	1458.21	1465.31	12985.4	3180.77	9804.6	12962.7	9781.92
25	20.175	264471	-1.10945	Parent Material	0	8.5	1474.2	1481.38	13080.3	3168.18	9912.16	13108.9	9940.71
26	20.175	270939	-1.10945	Parent Material	0	8.5	1520.36	1527.76	13400	3177.57	10222.5	13429.5	10251.9
27	20.1749	277971	-3.10735	Parent Material	0	8.5	1559.32	1566.91	13693.4	3208.95	10484.4	13778	10569.1
28	20.1749	282408	-3.10735	Parent Material	0	8.5	1583.9	1591.61	13912	3262.3	10649.7	13998	10735.7
29	15.0212	212553	-5.09772	Parent Material	0	8.5	1588.88	1596.62	14008.4	3325.21	10683.2	14150.1	10824.9
30	15.0212	216317	-5.09772	Parent Material	0	8.5	1615.02	1622.89	14256.7	3397.67	10859	14400.7	11003.1
31	15.0212	220271	-7.07584	Parent Material	0	8.5	1632.26	1640.21	14461.4	3486.49	10974.9	14664	11177.5
32	15.0212	220102	-7.07584	Parent Material	0	8.5	1615.26	1623.13	14452.3	3591.68	10860.6	14652.8	11061.1
33	14.9439	217671	-8.79093	Parent Material	0	8.5	1578.14	1585.83	14321.8	3710.83	10611	14565.9	10855.1
34	14.9439	210395	-8.79093	Parent Material	0	8.5	1488	1495.25	13848.9	3843.93	10005	14079	10235.1
35	15.0782	201860	-4.19265	Parent Material	0	8.5	1390.03	1396.8	13285.6	3939.37	9346.25	13387.5	9448.15
36	15.0782	192993	-4.19265	Parent Material	0	8.5	1295.02	1301.33	12704.6	3997.15	8707.4	12799.5	8802.34
37	13.7278	167975	0.73102	Parent Material	0	8.5	1224.95	1230.92	12251.7	4015.47	8236.28	12236.1	8220.65
38	13.7278	161970	0.73102	Parent Material	0	8.5	1162.93	1168.59	11813.5	3994.34	7819.21	11798.7	7804.37
39	13.7277	157602	0.502822	Parent Material	0	8.5	1117.75	1123.19	11490.3	3974.92	7515.41	11480.5	7505.6
40	13.7277	153471	0.502822	Parent Material	0	8.5	1075.57	1080.81	11189.1	3957.2	7231.85	11179.6	7222.41
41	13.7242	147232	12.0151	Parent Material	0	8.5	1056.05	1061.19	10952.7	3852.11	7100.59	10727.9	6875.83
42	13.7242	138926	12.0151	Parent Material	0	8.5	992.65	997.484	10334	3659.65	6674.3	10122.7	6463.04
43	13.5609	130272	12.433	Parent Material	0	8.5	944.349	948.948	9814.68	3465.1	6349.58	9606.48	6141.38
44	13.5609	123316	12.433	Parent Material	0	8.5	895.708	900.07	9291.01	3268.47	6022.54	9093.54	5825.07
45	0.579103	5097.49	12.433	Slide Mass	0	13.5	1421.51	1428.43	9115.8	3165.95	5949.85	8802.4	5636.45
46	22.1651	172273	30.9125	Slide Mass	0	13.5	1403.15	1409.98	8612.43	2739.43	5873	7772.25	5032.82
47	22.1652	125788	33.7418	Slide Mass	0	13.5	1088.26	1093.56	6401.95	1846.94	4555.01	5675.02	3828.08
48	22.1943	76580.4	36.3096	Slide Mass	0	13.5	750.786	754.442	4002.15	859.678	3142.47	3450.45	2590.77
49	7.71363	14500.3	34.9886	Slide Mass	0	13.5	490.163	492.55	2222.91	171.282	2051.62	1879.84	1708.55
50	14.4807	10748	34.9886	Slide Mass	0	13.5	212.937	213.974	891.267	0	891.267	742.23	742.23

Interslice Data

- Global Minimum Query (bishop simplified) - Safety Factor: 1.00487

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	987.608	2722.59	0	0	0
2	1006.92	2705.02	10667.7	0	0
3	1026.23	2686.77	44376.9	0	0
4	1045.54	2667.84	101150	0	0
5	1064.85	2650.76	169199	0	0
6	1080.78	2638.73	224387	0	0
7	1096.71	2626.7	286743	0	0
8	1112.65	2614.36	358928	0	0
9	1128.6	2602.01	440231	0	0
10	1141.77	2591.41	518444	0	0
11	1159.5	2577.14	637522	0	0
12	1174.84	2565.53	746055	0	0
13	1190.17	2553.91	866376	0	0
14	1190.44	2553.71	869004	0	0
15	1214.71	2546.04	945712	0	0
16	1238.99	2538.96	1.0154e+06	0	0
17	1259.17	2537.63	996259	0	0
18	1279.34	2536.3	978264	0	0
19	1299.52	2535.63	950774	0	0
20	1319.69	2534.97	925300	0	0
21	1333.14	2535.65	893208	0	0
22	1346.59	2536.32	862575	0	0
23	1360.04	2537	832730	0	0
24	1380.22	2537.32	798615	0	0
25	1400.39	2537.63	765121	0	0
26	1420.57	2537.24	740489	0	0
27	1440.74	2536.85	715052	0	0
28	1460.92	2535.75	698590	0	0
29	1481.09	2534.66	681872	0	0
30	1496.11	2533.32	676776	0	0
31	1511.13	2531.98	671621	0	0
32	1526.16	2530.11	674066	0	0
33	1541.18	2528.25	676750	0	0
34	1556.12	2525.94	686264	0	0
35	1571.06	2523.63	696033	0	0
36	1586.14	2522.52	689758	0	0
37	1601.22	2521.42	684274	0	0
38	1614.95	2521.59	665313	0	0
39	1628.68	2521.77	647279	0	0
40	1642.4	2521.89	630550	0	0
41	1656.13	2522.01	614437	0	0
42	1669.86	2524.93	567952	0	0
43	1683.58	2527.85	524143	0	0
44	1697.14	2530.84	481994	0	0
45	1710.7	2533.83	442069	0	0

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
46	1711.28	2533.96	440082	0	0
47	1733.45	2547.23	294676	0	0
48	1755.61	2562.04	175769	0	0
49	1777.81	2578.34	93834.2	0	0
50	1785.52	2583.74	78052.2	0	0
51	1800	2593.88	0	0	0

Entity Information

Group: Group 1

Shared Entities

Type	Coordinates	
External Boundary	X	Y
	0	2500
	2055	2500
	2100	2500
	2100	2582.57
	2100	2584
	2080	2584.86
	2048.8	2585.5
	2017.7	2586.12
	1986.6	2586.79
	1955.5	2587.95
	1931.9	2588.35
	1924.4	2588.47
	1893.3	2589.04
	1862.2	2589.45
	1831.1	2589.87
	1800	2593.88
	1768.9	2597.62
	1737.8	2600.68
	1706.7	2604.89
	1675.6	2607.37
	1644.5	2612.11
	1613.4	2617.54
	1582.3	2628.31
	1551.2	2643.45
	1520	2648.71
	1488.9	2647.09
	1457.8	2647.27
	1426.7	2644.08
	1395.6	2640.68
	1364.5	2642.99
	1333.4	2647.54
	1302.3	2660.95
	1271.2	2671.01
	1240	2680

Type	Coordinates	
	X	Y
	1195	2690
	1107	2700
	1065	2710
	1020	2720
	895	2730
	820	2740
	737	2750
	711.29	2752.81
	680.18	2758.49
	649.08	2763.35
	617.97	2765.31
	586.87	2766.13
	555.76	2766.66
	524.65	2769.07
	493.55	2772.29
	462.44	2775.32
	431.34	2779.05
	400.23	2789.67
	369.12	2796.46
	338.02	2805.78
	306.91	2817.8
	275.81	2834.28
	244.7	2848.45
	213.59	2853.8
	199.1	2856.2
	182.731	2860.95
	182.49	2861.02
	177.484	2863
	161.8	2869.2
	151.38	2874.05
	141	2878.9
	130.65	2883.4
	120.28	2884.98
	89.171	2885.5
	58.065	2885.13
	26.959	2884.32
	0	2883.71
	0	2863
	0	2596

Type	Coordinates

X	Y
182.731	2860.95
177.592	2787.91
200.955	2683.46
265.548	2622.99
347.29	2592.75
480.335	2581.3
567.939	2569.47
801.122	2558.58
998.653	2549.35
1253.03	2537.46
1706.31	2516.29
1787.1	2530.88
1802.74	2552.08
1831.1	2589.87

Material Boundary

X	Y
1931.9	2588.35
2100	2582.57

Material Boundary

X	Y
0	2596
567.939	2569.47

Material Boundary

X	Y
0	2863
177.484	2863

Material Boundary

X	Y
1706.31	2516.29
2055	2500

Material Boundary

X	Y
480.335	2581.3
1787.1	2530.88

Scenario-based Entities

Type	Coordinates	Master Scenario

X	Y
0	2605
2100	2580

Water Table

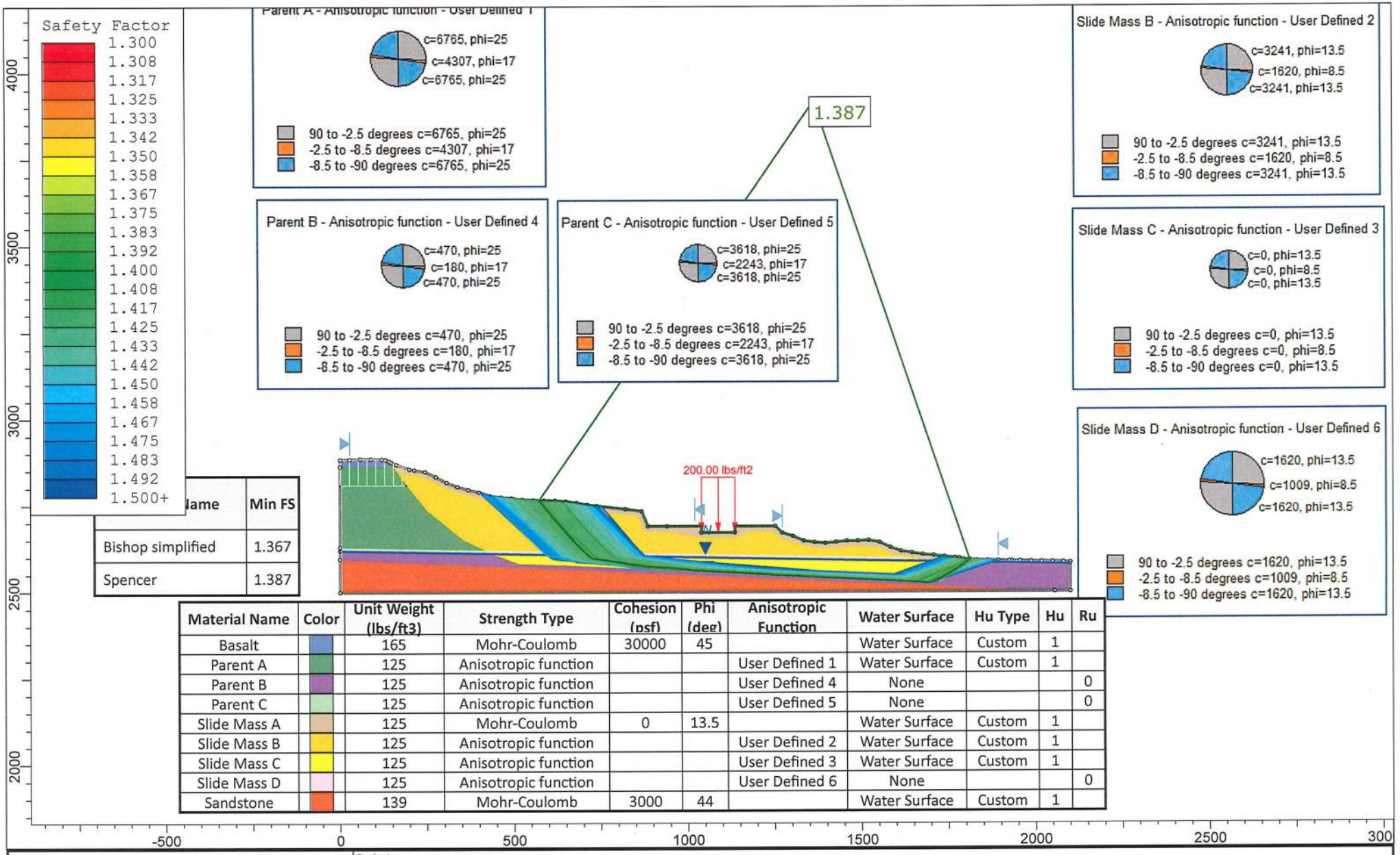
Assigned to materials:

- Slide Mass
- Parent Material
- Sandstone
- Basalt

APPENDIX

A-2 Proposed Profile - Static

Project No. 2-21-1175



lame	Min FS
Bishop simplified	1.367
Spencer	1.387

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Anisotropic Function	Water Surface	Hu Type	Hu	Ru
Basalt		165	Mohr-Coulomb	30000	45		Water Surface	Custom	1	
Parent A		125	Anisotropic function			User Defined 1	Water Surface	Custom	1	
Parent B		125	Anisotropic function			User Defined 4	None			0
Parent C		125	Anisotropic function			User Defined 5	None			0
Slide Mass A		125	Mohr-Coulomb	0	13.5		Water Surface	Custom	1	
Slide Mass B		125	Anisotropic function			User Defined 2	Water Surface	Custom	1	
Slide Mass C		125	Anisotropic function			User Defined 3	Water Surface	Custom	1	
Slide Mass D		125	Anisotropic function			User Defined 6	None			0
Sandstone		139	Mohr-Coulomb	3000	44		Water Surface	Custom	1	

AGEC Applied GeoTech

SLIDEINTERPRET 8.032

Project	Blackstone Hotel (west)		
Analysis Description	Proposed Construction - Static with unsaturated strengths		
Drawn By		Scale 1:4562	Company
Date	3:30:21 PM9/22/2021		File Name Unsaturated with Hotel 9 22 21.slmd

Slide Analysis Information

Unsaturated with Hotel 9 22 21

Project Summary

File Name:	Unsaturated with Hotel 9 22 21.slmd
Slide Modeler Version:	8.032
Compute Time:	00h:02m:35.982s
Project Title:	SLIDE - An Interactive Slope Stability Program
Date Created:	8/24/2021, 2:35:12 PM

General Settings

Units of Measurement:	Imperial Units
Time Units:	days
Permeability Units:	feet/second
Data Output:	Standard
Failure Direction:	Left to Right

Analysis Options

Analysis Methods Used	
Slices Type:	Vertical
	Bishop simplified
	Spencer
Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Groundwater Analysis

Groundwater Method:	Water Surfaces
Pore Fluid Unit Weight [lbs/ft3]:	62.4
Use negative pore pressure cutoff:	Yes
Maximum negative pore pressure [psf]:	0
Advanced Groundwater Method:	None

Random Numbers

Pseudo-random Seed: 10116
Random Number Generation Method: Park and Miller v.3

Surface Options

Search Method:	Cuckoo Search
Initial # of Surface Vertices:	8
Maximum Iterations:	5000
Number of Nests:	50
Minimum Elevation:	Not Defined
Minimum Depth:	Not Defined
Minimum Area:	Not Defined
Minimum Weight:	Not Defined
Convex Surfaces Only:	Enabled

Seismic Loading

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No

Loading

- 1 Distributed Load present

Distributed Load 1

Distribution:	Constant
Magnitude [psf]:	200
Orientation:	Normal to boundary

Tension Crack

-
- Water level: dry

Materials

Property	Basalt	Parent A	Parent B	Parent C	Slide Mass A	Slide Mass B	Slide Mass C	Slide Mass D
Color								
Strength Type	Mohr-Coulomb	Anisotropic function	Anisotropic function	Anisotropic function	Mohr-Coulomb	Anisotropic function	Anisotropic function	Anisotropic function
Unit Weight [lbs/ft3]	165	125	125	125	125	125	125	125
Cohesion [psf]	30000				0			
Friction Angle [°]	45				13.5			
Water Surface	Water Table	Water Table	None	None	Water Table	Water Table	Water Table	None

Property	Basalt	Parent A	Parent B	Parent C	Slide Mass A	Slide Mass B	Slide Mass C	Slide Mass D
Hu Value	1	1			1	1	1	
Ru Value			0	0				0

Anisotropic Functions

Name: User Defined 1

Angle From	Angle To	c	phi
-90	-8.5	6765	25
-8.5	-2.5	4307	17
-2.5	90	6765	25

Name: User Defined 2

Angle From	Angle To	c	phi
-90	-8.5	3241	13.5
-8.5	-2.5	1620	8.5
-2.5	90	3241	13.5

Name: User Defined 3

Angle From	Angle To	c	phi
-90	-8.5	0	13.5
-8.5	-2.5	0	8.5
-2.5	90	0	13.5

Name: User Defined 4

Angle From	Angle To	c	phi
-90	-8.5	470	25
-8.5	-2.5	180	17
-2.5	90	470	25

Name: User Defined 5

Angle From	Angle To	c	phi
-90	-8.5	3618	25
-8.5	-2.5	2243	17
-2.5	90	3618	25

Name: User Defined 6

Angle From	Angle To	c	phi
-90	-8.5	1620	13.5
-8.5	-2.5	1009	8.5
-2.5	90	1620	13.5

Property	Sandstone
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	139
Cohesion [psf]	3000
Friction Angle [°]	44
Water Surface	Water Table
Hu Value	1

Global Minimums

Method: bishop simplified

FS	1.367310
Axis Location:	1395.082, 3852.534
Left Slip Surface Endpoint:	636.348, 2764.155
Right Slip Surface Endpoint:	1810.545, 2592.519
Resisting Moment:	3.55915e+09 lb-ft
Driving Moment:	2.60305e+09 lb-ft
Total Slice Area:	123466 ft2
Surface Horizontal Width:	1174.2 ft
Surface Average Height:	105.149 ft

Method: spencer

FS	1.387420
Axis Location:	1364.971, 3918.343
Left Slip Surface Endpoint:	571.656, 2766.390
Right Slip Surface Endpoint:	1810.545, 2592.519
Resisting Moment:	3.94983e+09 lb-ft
Driving Moment:	2.8469e+09 lb-ft
Resisting Horizontal Force:	2.53402e+06 lb
Driving Horizontal Force:	1.82643e+06 lb
Total Slice Area:	134250 ft2
Surface Horizontal Width:	1238.89 ft
Surface Average Height:	108.363 ft

Global Minimum Coordinates

Method: bishop simplified

X	Y
636.348	2764.15
666.875	2726.92
706.146	2682.42
745.413	2641.76
782.983	2605.14
818.076	2577.82
868.307	2570.35
920.2	2567.9
973.587	2565.49
1026.98	2562.31
1085.33	2559.11
1127.72	2557.23
1162.55	2555.57
1197.38	2553.49
1233	2550.12
1268.62	2548.03
1308.49	2546.21
1348.37	2544.21

X	Y
1383.24	2542.61
1422.89	2540.3
1473.47	2537.31
1523.67	2534.7
1555.42	2533.04
1586.71	2531.46
1645.89	2528.77
1700.83	2526.28
1728.27	2537.29
1755.51	2549.93
1782.57	2565.99
1810.55	2592.52

Method: spencer

X	Y
571.656	2766.39
606.353	2722.34
641.051	2681.71
680.866	2637.6
720.681	2598.13
776.597	2589.78
830.603	2581.71
884.72	2573.88
944.372	2570.4
981.178	2566.96
1016.46	2562.44
1073.35	2559.16
1130.24	2556.25
1187.13	2552.73
1221.83	2550.6
1256.53	2548.48
1313.99	2545.42
1359.16	2542.97
1404.34	2540.73
1448.81	2538.53
1493.25	2536.33
1537.8	2534.08
1581.87	2531.52
1626.09	2528.95
1661.45	2527.32
1696.87	2525.69
1725.62	2538.93
1754.38	2553.82
1783.1	2572
1810.55	2592.52

Valid/Invalid Surfaces

Method: bishop simplified

Number of Valid Surfaces: 226498
Number of Invalid Surfaces: 273630

Error Codes:

Error Code -108 reported for 168 surfaces
Error Code -109 reported for 2 surfaces
Error Code -111 reported for 197 surfaces
Error Code -112 reported for 2593 surfaces
Error Code -114 reported for 1306 surfaces
Error Code -121 reported for 3456 surfaces
Error Code -124 reported for 268 surfaces
Error Code -1000 reported for 265640 surfaces

Method: spencer

Number of Valid Surfaces: 225642
Number of Invalid Surfaces: 274486

Error Codes:

Error Code -108 reported for 1237 surfaces
Error Code -109 reported for 2 surfaces
Error Code -111 reported for 1201 surfaces
Error Code -112 reported for 2473 surfaces
Error Code -114 reported for 1306 surfaces
Error Code -121 reported for 3456 surfaces
Error Code -124 reported for 268 surfaces
Error Code -1000 reported for 264543 surfaces

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).
-109 = Soiltype for slice base not located. This error should occur very rarely, if at all. It may occur if a very low number of slices is combined with certain soil geometries, such that the midpoint of a slice base is actually outside the soil region,even though the slip surface is wholly within the soil region.
-111 = safety factor equation did not converge
-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.
-114 = Surface with Reverse Curvature.
-121 = Concave failure surface, only convex surfaces have been defined as being allowed.
-124 = A slice has a width less than the minimum acceptable value.
-1000 = No valid slip surface is generated

Slice Data

- **Global Minimum Query (bishop simplified) - Safety Factor: 1.36731**

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [degrees]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	15.5561	17448.6	-50.6545	Slide Mass A	0	13.5	162.213	221.795	923.843	0	923.843	1121.71	1121.71

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [degrees]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
2	14.9717	48079.8	-50.6545	Slide Mass B	3241	13.5	2416.74	3304.43	264.207	0	264.207	3212.1	3212.1
3	19.6353	106061	-48.5679	Slide Mass B	3241	13.5	2768.21	3785.01	2265.95	0	2265.95	5402.33	5402.33
4	19.6353	152154	-48.5679	Slide Mass B	3241	13.5	3112.01	4255.08	4223.93	0	4223.93	7749.83	7749.83
5	19.6336	196553	-46.0006	Slide Mass B	3241	13.5	3493.14	4776.2	6394.56	0	6394.56	10011.9	10011.9
6	19.6336	241018	-46.0006	Slide Mass B	3241	13.5	3829.63	5236.29	8310.99	0	8310.99	12276.8	12276.8
7	27.1237	402818	-44.2629	Slide Mass B	3241	13.5	4250.75	5812.09	10709.4	0	10709.4	14852.1	14852.1
8	10.4464	176092	-44.2629	Slide Mass D	1620	13.5	3539.11	4839.06	13408.3	0	13408.3	16857.5	16857.5
9	17.5464	318224	-37.9068	Slide Mass C	0	13.5	2737.84	3743.47	16004.8	412.147	15592.6	18136.7	17724.5
10	17.5464	343553	-37.9068	Slide Mass C	0	13.5	2832.35	3872.7	17374.8	1243.85	16131	19580.3	18336.4
11	25.1156	510567	-8.45763	Slide Mass C	0	8.5	1997.02	2730.54	20031.8	1761.3	18270.5	20328.7	18567.4
12	25.1156	511532	-8.45763	Slide Mass C	0	8.5	1979.3	2706.31	20072.8	1964.48	18108.4	20367.2	18402.7
13	25.9461	432334	-2.70143	Slide Mass C	0	8.5	1584.8	2166.91	16588	2088.85	14499.1	16662.8	14573.9
14	25.9461	394012	-2.70143	Slide Mass C	0	8.5	1419.23	1940.53	15118.8	2134.4	12984.4	15185.8	13051.4
15	26.694	409424	-2.58793	Slide Mass C	0	8.5	1431.22	1956.92	15273	2178.96	13094.1	15337.7	13158.8
16	26.694	413450	-2.58793	Slide Mass C	0	8.5	1442.88	1972.87	15423.3	2222.52	13200.8	15488.5	13266
17	26.6941	418118	-3.40903	Slide Mass C	0	8.5	1453.58	1987.5	15576.7	2278.05	13298.7	15663.3	13385.3
18	26.6941	423424	-3.40903	Slide Mass C	0	8.5	1467.84	2006.99	15774.7	2345.55	13429.1	15862.1	13516.5
19	29.1787	430057	-3.14109	Slide Mass C	0	8.5	1352.1	1848.74	14782.1	2411.91	12370.2	14856.3	12444.4
20	29.1787	408842	-3.14109	Slide Mass C	0	8.5	1274.97	1743.28	14141.7	2477.15	11664.6	14211.7	11734.6
21	21.1928	300312	-2.5374	Slide Mass C	0	8.5	1288.34	1761.56	14313.4	2526.48	11786.9	14370.5	11844
22	21.1928	302800	-2.5374	Slide Mass C	0	8.5	1297.48	1774.06	14430.3	2559.89	11870.5	14487.8	11928
23	34.8324	565319	-2.72153	Slide Mass C	0	8.5	1485.79	2031.54	16200.9	2607.56	13593.3	16271.5	13664
24	34.8311	589818	-3.42175	Slide Mass C	0	8.5	1547.55	2115.98	16841.2	2682.79	14158.4	16933.7	14250.9
25	17.8095	305776	-5.40986	Slide Mass C	0	8.5	1557.85	2130.07	17021.8	2769.11	14252.7	17169.3	14400.2
26	17.8095	309531	-5.40986	Slide Mass C	0	8.5	1571.57	2148.82	17231.3	2853.18	14378.1	17380.1	14526.9
27	17.81	312580	-3.35815	Slide Mass C	0	8.5	1589.3	2173.07	17457.6	2917.24	14540.3	17550.8	14633.6
28	17.81	297825	-3.35815	Slide Mass C	0	8.5	1494.54	2043.5	16634.7	2961.29	13673.4	16722.4	13761.1

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [degrees]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
29	19.9362	301928	-2.61145	Slide Mass C	0	8.5	1320.89	1806.06	15084.5	2999.83	12084.7	15144.7	12144.9
30	19.9362	287601	-2.61145	Slide Mass C	0	8.5	1239.13	1694.28	14369.6	3032.87	11336.7	14426.1	11393.2
31	19.9362	269823	-2.87078	Slide Mass C	0	8.5	1137.69	1555.57	13477.3	3068.74	10408.5	13534.3	10465.6
32	19.9362	254872	-2.87078	Slide Mass C	0	8.5	1051.96	1438.35	12731.6	3107.43	9624.19	12784.4	9676.94
33	34.8701	434791	-2.62027	Slide Mass C	0	8.5	1012.87	1384.91	12422.5	3155.84	9266.67	12468.9	9313.03
34	19.8257	245550	-3.33401	Slide Mass C	0	8.5	996.65	1362.73	12327.4	3209.16	9118.23	12385.5	9176.29
35	19.8257	252035	-3.33401	Slide Mass C	0	8.5	1026.91	1404.11	12652.8	3257.66	9395.12	12712.6	9454.94
36	25.2927	333330	-3.38679	Slide Mass C	0	8.5	1071.38	1464.91	13115.5	3313.58	9801.93	13178.9	9865.33
37	25.2927	344595	-3.38679	Slide Mass C	0	8.5	1112.87	1521.64	13558.4	3376.92	10181.5	13624.3	10247.4
38	25.0997	346865	-2.97084	Slide Mass C	0	8.5	1128.73	1543.32	13760.9	3434.32	10326.6	13819.5	10385.2
39	25.0997	354006	-2.97084	Slide Mass C	0	8.5	1154.06	1577.96	14044.1	3485.77	10558.4	14104	10618.2
40	31.7439	442237	-2.99078	Slide Mass C	0	8.5	1128.89	1543.54	13872.4	3544.37	10328.1	13931.4	10387
41	31.2976	397363	-2.90307	Slide Mass C	0	8.5	987.881	1350.74	12646.2	3608.17	9038	12696.3	9088.1
42	29.5887	336185	-2.60251	Slide Mass C	0	8.5	837.308	1144.86	11323.9	3663.47	7660.43	11362	7698.49
43	29.5887	314413	-2.60251	Slide Mass C	0	8.5	751.973	1028.18	10591.9	3712.22	6879.72	10626.1	6913.9
44	27.468	280382	-2.59754	Slide Mass C	0	8.5	701.358	958.974	10175.8	3759.16	6416.64	10207.6	6448.46
45	27.468	273189	-2.59754	Slide Mass C	0	8.5	667.968	913.32	9915.44	3804.27	6111.17	9945.74	6141.47
46	27.4418	247029	21.8626	Slide Mass C	0	13.5	1045.49	1429.51	9421.31	3466.98	5954.33	9001.82	5534.84
47	27.2443	193198	24.8955	Slide Mass C	0	13.5	840.117	1148.7	7481.13	2696.46	4784.67	7091.24	4394.78
48	27.0522	133769	30.7019	Slide Mass C	0	13.5	622.614	851.306	5314.46	1768.52	3545.94	4944.75	3176.23
49	20.7356	48864.3	43.4714	Slide Mass C	0	13.5	364.601	498.522	2702.11	625.614	2076.5	2356.46	1730.85
50	7.24415	3510.86	43.4714	Slide Mass A	0	13.5	102.085	139.582	581.402	0	581.402	484.624	484.624

- **Global Minimum Query (spencer) - Safety Factor: 1.38742**

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [degrees]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	12.8945	13014.6	-51.7742	Slide Mass A	0	13.5	132.524	183.867	765.862	0	765.862	934.115	934.115
2	21.8026	81005.9	-51.7742	Slide Mass B	3241	13.5	2461.88	3415.66	727.523	0	727.523	3853.12	3853.12

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [degrees]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
3	34.6977	272628	-49.5046	Slide Mass B	3241	13.5	3049.96	4231.57	4126.02	0	4126.02	7697.64	7697.64
4	19.9073	229482	-47.9272	Slide Mass B	3241	13.5	3577.27	4963.18	7173.39	0	7173.39	11136.2	11136.2
5	19.9073	276986	-47.9272	Slide Mass B	3241	13.5	3901.04	5412.38	9044.44	0	9044.44	13365.9	13365.9
6	21.1163	341297	-44.7517	Slide Mass B	3241	13.5	4289.88	5951.86	11291.6	0	11291.6	15544.4	15544.4
7	10.3229	183256	-44.7517	Slide Mass D	1620	13.5	3488.97	4840.66	13415	0	13415	16873.8	16873.8
8	8.37593	157005	-44.7517	Slide Mass C	0	13.5	2567.21	3561.8	15090	254.069	14836	17635.1	17381
9	27.958	538845	-8.49326	Slide Mass C	0	8.5	1969.21	2732.12	18902.9	621.81	18281.1	19196.9	18575.1
10	27.958	541851	-8.49326	Slide Mass C	0	8.5	1956.24	2714.13	19009.8	849.099	18160.7	19301.9	18452.8
11	27.0034	526029	-8.4966	Slide Mass C	0	8.5	1942.78	2695.45	19108.3	1072.56	18035.7	19398.5	18325.9
12	27.0034	528573	-8.4966	Slide Mass C	0	8.5	1929.22	2676.64	19202	1292.19	17909.8	19490.2	18198
13	27.0581	531111	-8.22925	Slide Mass C	0	8.5	1913.68	2655.08	19273.6	1508.01	17765.5	19550.3	18042.3
14	27.0581	487058	-8.22925	Slide Mass C	0	8.5	1718.85	2384.77	17676.9	1720.04	15956.8	17925.4	16205.4
15	19.884	290062	-3.34398	Slide Mass C	0	8.5	1368.42	1898.57	14554.1	1850.48	12703.6	14634.1	12783.6
16	19.884	292938	-3.34398	Slide Mass C	0	8.5	1378.69	1912.82	14698.3	1899.35	12799	14778.9	12879.5
17	19.884	295826	-3.34398	Slide Mass C	0	8.5	1389.02	1927.16	14843.1	1948.21	12894.9	14924.3	12976.1
18	36.8069	558173	-5.33314	Slide Mass C	0	8.5	1397.75	1939.27	15033.9	2057.97	12975.9	15164.4	13106.4
19	35.2861	552671	-7.30949	Slide Mass C	0	8.5	1418.32	1967.8	15430.4	2263.55	13166.8	15612.3	13348.8
20	28.4435	443160	-3.29224	Slide Mass C	0	8.5	1418.55	1968.13	15587	2417.94	13169.1	15668.6	13250.7
21	28.4435	398273	-3.29224	Slide Mass C	0	8.5	1258.51	1746.08	14169.5	2486.23	11683.3	14241.9	11755.7
22	28.4436	403768	-2.92757	Slide Mass C	0	8.5	1274.27	1767.95	14378.5	2548.85	11829.6	14443.7	11894.8
23	28.4436	408939	-2.92757	Slide Mass C	0	8.5	1287.69	1786.56	14560	2605.81	11954.2	14625.8	12020
24	28.4435	467946	-3.54858	Slide Mass C	0	8.5	1482.46	2056.8	16434.8	2672.42	13762.4	16526.7	13854.3
25	28.4435	484930	-3.54858	Slide Mass C	0	8.5	1534.78	2129.39	16996.7	2748.68	14248.1	17091.9	14343.2
26	34.7003	600031	-3.50107	Slide Mass C	0	8.5	1552.11	2153.43	17241.4	2832.43	14408.9	17336.3	14503.9
27	34.7003	607973	-3.50107	Slide Mass C	0	8.5	1566.84	2173.87	17469.4	2923.66	14545.7	17565.3	14641.6
28	28.731	452101	-3.04725	Slide Mass C	0	8.5	1369.16	1899.6	15710.4	2999.92	12710.5	15783.3	12783.4
29	28.731	414358	-3.04725	Slide Mass C	0	8.5	1221.15	1694.25	14397.7	3061.22	11336.5	14462.7	11401.5

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [degrees]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
30	22.5882	300122	-3.10513	Slide Mass C	0	8.5	1092.72	1516.06	13260.8	3116.67	10144.2	13320.1	10203.4
31	22.5882	287538	-3.10513	Slide Mass C	0	8.5	1027.4	1425.44	12704.1	3166.28	9537.86	12759.9	9593.59
32	22.5882	282864	-2.84532	Slide Mass C	0	8.5	1001.16	1389.03	12506.9	3212.69	9294.22	12556.7	9343.98
33	22.5882	282045	-2.84532	Slide Mass C	0	8.5	992.576	1377.12	12470.4	3255.9	9214.54	12519.8	9263.87
34	22.2328	285344	-2.82843	Slide Mass C	0	8.5	1025.51	1422.82	12818.8	3298.56	9520.29	12869.5	9570.96
35	22.2328	294944	-2.82843	Slide Mass C	0	8.5	1067.46	1481.02	13250.4	3340.68	9909.71	13303.1	9962.45
36	22.2239	303015	-2.82867	Slide Mass C	0	8.5	1102.59	1529.76	13618.6	3382.79	10235.8	13673.1	10290.3
37	22.2239	306328	-2.82867	Slide Mass C	0	8.5	1114.1	1545.72	13767.6	3424.89	10342.7	13822.6	10397.7
38	22.2744	312192	-2.89558	Slide Mass C	0	8.5	1134.13	1573.52	13996.5	3467.86	10528.6	14053.9	10586
39	22.2744	314187	-2.89558	Slide Mass C	0	8.5	1139.04	1580.32	14085.9	3511.69	10574.2	14143.5	10631.8
40	22.0344	302620	-3.32256	Slide Mass C	0	8.5	1091.91	1514.94	13697.2	3560.42	10136.7	13760.5	10200.1
41	22.0344	280164	-3.32256	Slide Mass C	0	8.5	976.539	1354.87	12679.7	3614.05	9065.64	12736.4	9122.33
42	22.1078	259078	-3.33428	Slide Mass C	0	8.5	863.581	1198.15	11684.9	3667.92	8017	11735.2	8067.32
43	22.1078	243210	-3.33428	Slide Mass C	0	8.5	780.557	1082.96	10968.3	3722.01	7246.28	11013.8	7291.76
44	35.3597	372137	-2.6332	Slide Mass C	0	8.5	725.361	1006.38	10512.6	3778.78	6733.83	10546	6767.19
45	35.4245	357752	-2.63753	Slide Mass C	0	8.5	673.056	933.812	10086.7	3838.37	6248.29	10117.7	6279.29
46	28.752	258321	24.7315	Slide Mass C	0	13.5	1139.83	1581.42	10025	3437.94	6587.1	9500.02	6062.08
47	28.7524	194740	27.3745	Slide Mass C	0	13.5	889.94	1234.72	7669.09	2526.08	5143.01	7208.29	4682.21
48	28.726	124387	32.3268	Slide Mass C	0	13.5	624.34	866.222	5068.33	1460.25	3608.08	4673.22	3212.97
49	18.3072	36421.1	36.7893	Slide Mass C	0	13.5	347.064	481.524	2443.68	437.988	2005.69	2184.14	1746.16
50	9.13545	4539.1	36.7893	Slide Mass A	0	13.5	109.088	151.351	630.424	0	630.424	548.847	548.847

Interslice Data

- **Global Minimum Query (bishop simplified) - Safety Factor: 1.36731**

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	636.348	2764.15	0	0	0
2	651.904	2745.18	15007.2	0	0
3	666.875	2726.92	-16341.7	0	0

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
4	686.511	2704.67	-20273.3	0	0
5	706.146	2682.42	12605.2	0	0
6	725.78	2662.09	74051	0	0
7	745.413	2641.76	167856	0	0
8	772.537	2615.33	335686	0	0
9	782.983	2605.14	435234	0	0
10	800.53	2591.48	605878	0	0
11	818.076	2577.82	793581	0	0
12	843.192	2574.08	818247	0	0
13	868.307	2570.35	843511	0	0
14	894.253	2569.13	822709	0	0
15	920.2	2567.9	804403	0	0
16	946.893	2566.7	784635	0	0
17	973.587	2565.49	764737	0	0
18	1000.28	2563.9	750713	0	0
19	1026.98	2562.31	736624	0	0
20	1056.15	2560.71	720851	0	0
21	1085.33	2559.11	706302	0	0
22	1106.53	2558.17	692448	0	0
23	1127.72	2557.23	678509	0	0
24	1162.55	2555.57	653593	0	0
25	1197.38	2553.49	634777	0	0
26	1215.19	2551.8	635748	0	0
27	1233	2550.12	636828	0	0
28	1250.81	2549.07	626773	0	0
29	1268.62	2548.03	617546	0	0
30	1288.56	2547.12	604935	0	0
31	1308.49	2546.21	593303	0	0
32	1328.43	2545.21	584101	0	0
33	1348.37	2544.21	575863	0	0
34	1383.24	2542.61	560376	0	0
35	1403.06	2541.46	554859	0	0
36	1422.89	2540.3	549118	0	0
37	1448.18	2538.81	541658	0	0
38	1473.47	2537.31	533812	0	0
39	1498.57	2536.01	523413	0	0
40	1523.67	2534.7	512747	0	0
41	1555.42	2533.04	499928	0	0
42	1586.71	2531.46	489089	0	0
43	1616.3	2530.11	479550	0	0
44	1645.89	2528.77	471550	0	0
45	1673.36	2527.52	464971	0	0
46	1700.83	2526.28	458983	0	0
47	1728.27	2537.29	326565	0	0
48	1755.51	2549.93	209092	0	0
49	1782.57	2565.99	106883	0	0
50	1803.3	2585.65	46207.9	0	0
51	1810.55	2592.52	0	0	0

- **Global Minimum Query (spencer) - Safety Factor: 1.38742**

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	571.656	2766.39	0	0	0
2	584.551	2750.02	10828.9	969.675	5.11691
3	606.353	2722.34	-22708.8	-2033.46	5.1169
4	641.051	2681.71	39113.9	3502.46	5.11691
5	660.958	2659.65	126094	11291.1	5.11691
6	680.866	2637.6	247890	22197.4	5.11692
7	701.982	2616.67	393681	35252.3	5.11692
8	712.305	2606.43	494952	44320.6	5.11692
9	720.681	2598.13	598751	53615.3	5.11692
10	748.639	2593.95	622615	55752.2	5.11692
11	776.597	2589.78	647287	57961.5	5.11692
12	803.6	2585.74	671909	60166.2	5.11691
13	830.603	2581.71	697275	62437.6	5.11691
14	857.661	2577.8	720915	64554.5	5.11692
15	884.72	2573.88	743580	66584	5.11691
16	904.604	2572.72	733279	65661.6	5.11691
17	924.488	2571.56	722942	64736	5.11692
18	944.372	2570.4	712567	63807	5.11692
19	981.178	2566.96	712776	63825.6	5.11691
20	1016.46	2562.44	732569	65598.1	5.11692
21	1044.91	2560.8	717723	64268.7	5.11692
22	1073.35	2559.16	705111	63139.3	5.11691
23	1101.8	2557.71	689780	61766.5	5.11692
24	1130.24	2556.25	674333	60383.3	5.11692
25	1158.68	2554.49	661155	59203.3	5.11692
26	1187.13	2552.73	647480	57978.8	5.11692
27	1221.83	2550.6	630225	56433.6	5.11691
28	1256.53	2548.48	612942	54886	5.11691
29	1285.26	2546.95	597633	53515.2	5.11692
30	1313.99	2545.42	584569	52345.4	5.11692
31	1336.58	2544.2	576136	51590.2	5.11691
32	1359.16	2542.97	568495	50906	5.11691
33	1381.75	2541.85	559922	50138.3	5.11691
34	1404.34	2540.73	551501	49384.3	5.11692
35	1426.57	2539.63	542781	48603.5	5.11692
36	1448.81	2538.53	533603	47781.6	5.11692
37	1471.03	2537.43	524053	46926.5	5.11692
38	1493.25	2536.33	514411	46063.1	5.11692
39	1515.53	2535.21	504918	45213	5.11692
40	1537.8	2534.08	495416	44362.2	5.11692
41	1559.84	2532.8	488878	43776.7	5.11692
42	1581.87	2531.52	483580	43302.3	5.11692
43	1603.98	2530.23	479538	42940.3	5.11691
44	1626.09	2528.95	476409	42660.1	5.11691
45	1661.45	2527.32	467856	41894.2	5.11691
46	1696.87	2525.69	460473	41233.1	5.11691
47	1725.62	2538.93	294933	26409.8	5.11691
48	1754.38	2553.82	155171	13894.8	5.11691
49	1783.1	2572	45100	4038.49	5.11692

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
50	1801.41	2585.69	5291.64	473.841	5.11692
51	1810.55	2592.52	0	0	0

Entity Information

Group: Group 1

Shared Entities

Type	Coordinates	
External Boundary	X	Y
	0	2500
	2055	2500
	2100	2500
	2100	2582.57
	2100	2584
	2080	2584.86
	2048.8	2585.5
	2017.7	2586.12
	1986.6	2586.79
	1955.5	2587.95
	1931.9	2588.35
	1924.4	2588.47
	1893.3	2589.04
	1862.2	2589.45
	1831.1	2589.87
	1810.55	2592.52
	1780.66	2596.18
	1768.9	2597.62
	1737.8	2600.68
	1706.7	2604.89
	1675.6	2607.37
	1644.5	2612.11
	1613.4	2617.54
	1582.3	2628.31
	1551.2	2643.45
	1520	2648.71
	1488.9	2647.09
	1457.8	2647.27
	1426.7	2644.08
	1395.6	2640.68
	1364.5	2642.99
	1333.4	2647.54
	1302.3	2660.95
	1271.2	2671.01
	1252	2690
	1135	2690
	1135	2672
	1039	2672

Type	Coordinates	
	X	Y
	1039	2690
	940	2690
	885	2690
	866.991	2733.73
	820	2740
	737	2750
	711.29	2752.81
	680.18	2758.49
	649.08	2763.35
	617.97	2765.31
	586.87	2766.13
	555.76	2766.66
	524.65	2769.07
	493.55	2772.29
	462.44	2775.32
	431.34	2779.05
	400.23	2789.67
	369.12	2796.46
	338.02	2805.78
	306.91	2817.8
	275.81	2834.28
	244.7	2848.45
	213.59	2853.8
	199.1	2856.2
	161.8	2869.2
	147.608	2875.56
	141	2878.9
	130.65	2883.4
	120.28	2884.98
	89.171	2885.5
	58.065	2885.13
	26.959	2884.32
	0	2883.71
	0	2863
	0	2630
	0	2620
	0	2596

Type	Coordinates

Material Boundary

X	Y
182.308	2821.95
212.393	2783.59
248.409	2737.67
312.568	2685.31
353.568	2651.85
385.121	2636.75
415.734	2622.1
437.544	2611.67
514.019	2582.3
645.613	2578.18
908.026	2565.54
1119.06	2556.05
1374.9	2541.87
1584.25	2530.99
1691.6	2524.98
1728.07	2530.13
1761.29	2545.83
1803.3	2585.65
1803.5	2585.84
1810.55	2592.52

Material Boundary

X	Y
1931.9	2588.35
2100	2582.57

Material Boundary

X	Y
0	2596
2055	2500

Material Boundary

X	Y
0	2863
154.397	2863

Material Boundary

X	Y
147.608	2875.56
154.397	2863
162.358	2849
182.308	2821.95

Material Boundary

X	Y
437.544	2611.67
542.546	2609.67

Type	Coordinates	
	X	Y
Material Boundary	162.358	2849
	243.869	2833.47
	305.541	2802.42
	337.886	2790.78
	431.904	2764.9
	525.922	2754.12
	X	Y
Material Boundary	542.546	2609.67
	890.643	2603.04
	X	Y
	525.922	2754.12
Material Boundary	649.267	2745.49
	710.939	2738.16
	820.914	2725.22
	X	Y
	820.914	2725.22
	854.554	2720.05
	874.392	2674.33
	884.743	2674.76
Material Boundary	940.377	2674.76
	1038.71	2657.51
	1137.04	2657.51
	1182.32	2674.76
	1245.29	2674.33
	X	Y
	890.643	2603.04
	1645.59	2588.66
	1615.3	2599.32
	1594.04	2606.8
	1632.88	2598.98
Material Boundary	1644.22	2596.7
	1706.29	2589.83
	1769.26	2586.3
	1803.3	2585.65
	1803.58	2585.65
	1803.5	2585.84
	X	Y
	1332.84	2632.5
	1364.32	2627.32
	1395.8	2624.74
Material Boundary	1489.39	2632.07
	1550.2	2627.76
	1594.04	2606.8

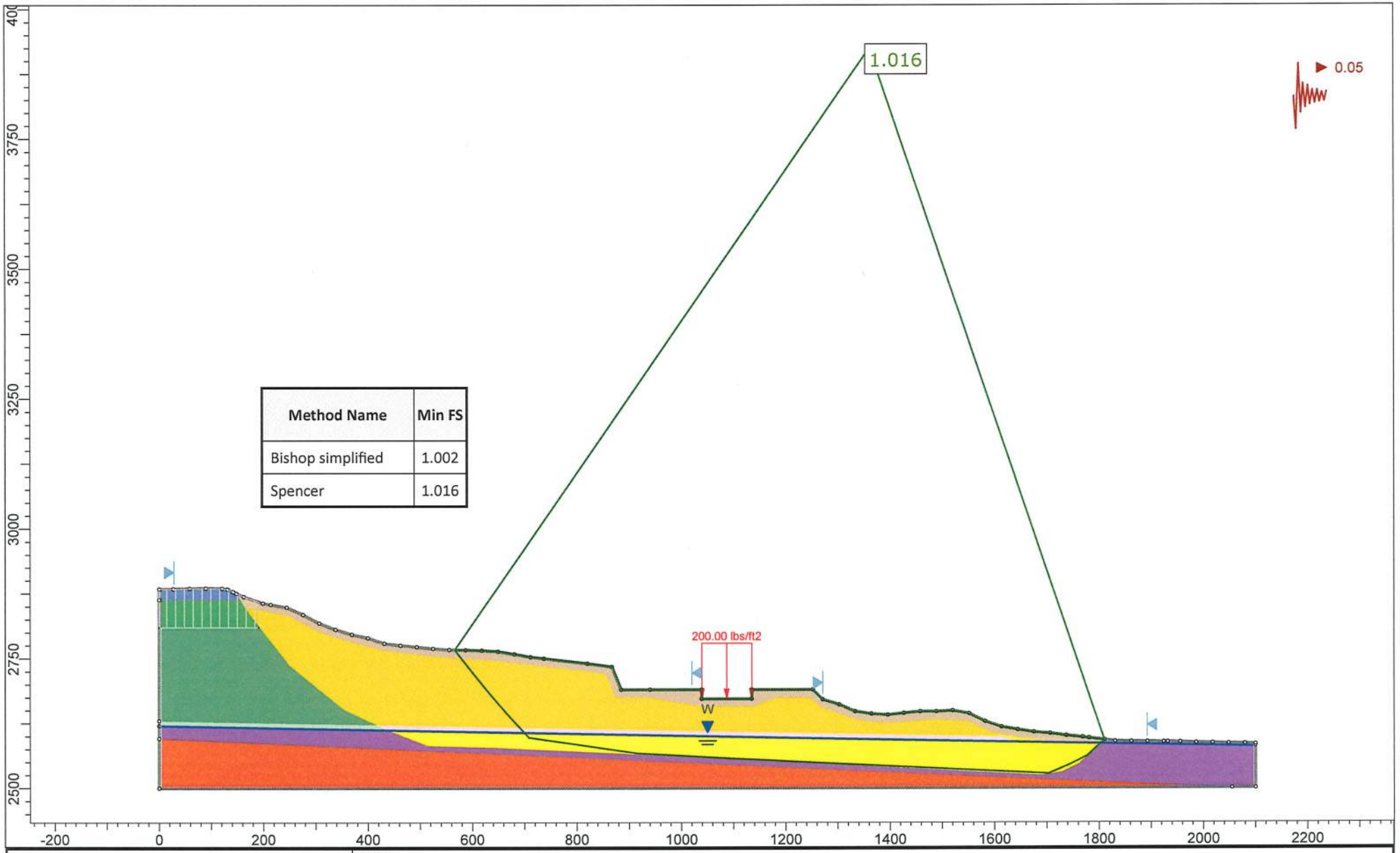
Type	Coordinates
Material Boundary	X: 1245.29, 1269.01, 1332.84 Y: 2674.33, 2655.36, 2632.5
Material Boundary	X: 0, 437.544 Y: 2620, 2611.67
Material Boundary	X: 0, 415.734, 1615.3, 1632.88, 1780.66 Y: 2630, 2622.1, 2599.32, 2598.98, 2596.18

Scenario-based Entities

Type	Coordinates	Master Scenario
Water Table	X: 0, 2100 Y: 2620, 2580	Assigned to materials: Basalt Parent A Slide Mass A Slide Mass B Slide Mass C Sandstone
Distributed Load	X: 1135, 1039 Y: 2672, 2672	Constant Distribution Orientation: Normal to boundary Magnitude: 200 lbs/ft2 Creates Excess Pore Pressure: No
Tension Crack	X: 0, 191 Y: 2810, 2810	Water level: dry

A-3 Proposed Profile - Seismic (Yield Acceleration)

Project No. 2-21-1175



AGEC Applied GeoTech

SLIDEINTERPRET 8.032

Project	Blackstone Hotel (west)		
Analysis Description	Proposed Construction - Yield Acceleration with unsaturated strengths		
Drawn By		*Scale* 1:3043	*Company*
Date	4:06:16 PM9/22/2021		*File Name* Unsaturated with Hotel 9 22 21 eq.slmd

Slide Analysis Information

Unsaturated with Hotel 9 22 21 eq

Project Summary

File Name:	Unsaturated with Hotel 9 22 21 eq.slmd
Slide Modeler Version:	8.032
Compute Time:	00h:02m:29.293s
Project Title:	SLIDE - An Interactive Slope Stability Program
Date Created:	8/24/2021, 2:35:12 PM

General Settings

Units of Measurement:	Imperial Units
Time Units:	days
Permeability Units:	feet/second
Data Output:	Standard
Failure Direction:	Left to Right

Analysis Options

Analysis Methods Used	
Slices Type:	Vertical
	Bishop simplified
	Spencer
Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Groundwater Analysis

Groundwater Method:	Water Surfaces
Pore Fluid Unit Weight [lbs/ft3]:	62.4
Use negative pore pressure cutoff:	Yes
Maximum negative pore pressure [psf]:	0
Advanced Groundwater Method:	None

Random Numbers

Pseudo-random Seed:	10116
Random Number Generation Method:	Park and Miller v.3

Surface Options

Search Method:	Cuckoo Search
Initial # of Surface Vertices:	8
Maximum Iterations:	5000
Number of Nests:	50
Minimum Elevation:	Not Defined
Minimum Depth:	Not Defined
Minimum Area:	Not Defined
Minimum Weight:	Not Defined
Convex Surfaces Only:	Enabled

Seismic Loading

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No
Seismic Load Coefficient (Horizontal):	0.05

Loading

- 1 Distributed Load present

Distributed Load 1

Distribution:	Constant
Magnitude [psf]:	200
Orientation:	Normal to boundary

Tension Crack

-
- Water level: dry

Materials

Property	Basalt	Parent A	Parent B	Parent C	Slide Mass A	Slide Mass B	Slide Mass C	Slide Mass D
Color								
Strength Type	Mohr-Coulomb	Anisotropic function	Anisotropic function	Anisotropic function	Mohr-Coulomb	Anisotropic function	Anisotropic function	Anisotropic function
Unit Weight [lbs/ft3]	165	125	125	125	125	125	125	125
Cohesion [psf]	30000				0			
Friction Angle [°]	45				13.5			

Property	Basalt	Parent A	Parent B	Parent C	Slide Mass A	Slide Mass B	Slide Mass C	Slide Mass D
Water Surface	Water Table	Water Table	None	None	Water Table	Water Table	Water Table	None
Hu Value	1	1			1	1	1	
Ru Value			0	0				0

Anisotropic Functions

Name: User Defined 1

Angle From	Angle To	c	phi
-90	-8.5	6765	25
-8.5	-2.5	4307	17
-2.5	90	6765	25

Name: User Defined 2

Angle From	Angle To	c	phi
-90	-8.5	3241	13.5
-8.5	-2.5	1620	8.5
-2.5	90	3241	13.5

Name: User Defined 3

Angle From	Angle To	c	phi
-90	-8.5	0	13.5
-8.5	-2.5	0	8.5
-2.5	90	0	13.5

Name: User Defined 4

Angle From	Angle To	c	phi
-90	-8.5	470	25
-8.5	-2.5	180	17
-2.5	90	470	25

Name: User Defined 5

Angle From	Angle To	c	phi
-90	-8.5	3618	25
-8.5	-2.5	2243	17
-2.5	90	3618	25

Name: User Defined 6

Angle From	Angle To	c	phi
-90	-8.5	1620	13.5
-8.5	-2.5	1009	8.5
-2.5	90	1620	13.5

Property	Sandstone
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	139
Cohesion [psf]	3000
Friction Angle [°]	44
Water Surface	Water Table
Hu Value	1

Global Minimums

Method: bishop simplified

FS	1.002440
Axis Location:	1361.958, 3924.638
Left Slip Surface Endpoint:	565.415, 2766.497
Right Slip Surface Endpoint:	1810.545, 2592.519
Resisting Moment:	3.90003e+09 lb-ft
Driving Moment:	3.89052e+09 lb-ft
Total Slice Area:	136335 ft2
Surface Horizontal Width:	1245.13 ft
Surface Average Height:	109.494 ft

Method: spencer

FS	1.016480
Axis Location:	1361.958, 3924.638
Left Slip Surface Endpoint:	565.415, 2766.497
Right Slip Surface Endpoint:	1810.545, 2592.519
Resisting Moment:	3.90506e+09 lb-ft
Driving Moment:	3.84175e+09 lb-ft
Resisting Horizontal Force:	2.50336e+06 lb
Driving Horizontal Force:	2.46277e+06 lb
Total Slice Area:	136335 ft2
Surface Horizontal Width:	1245.13 ft
Surface Average Height:	109.494 ft

Global Minimum Coordinates

Method: bishop simplified

X	Y
565.415	2766.5
600.507	2721.72
635.599	2678.61
670.691	2637.5
707.138	2597.85
756.05	2590.54
805.058	2583.26
858.068	2575.41
915.268	2567.04
979.271	2563.43
1016.94	2561.31
1054.7	2559.19
1092.46	2557.35
1130.21	2555.51
1167.97	2553.67
1205.73	2551.83
1240.39	2550.14

X	Y
1275.06	2548.45
1318.94	2546.31
1362.82	2544.17
1406.43	2542.04
1450.04	2539.92
1493.67	2537.79
1545.09	2535.29
1581.19	2533.57
1617.28	2531.84
1663.52	2529.64
1704.01	2527.71
1744.51	2544.75
1777.98	2561.66
1810.55	2592.52

Method: spencer

X	Y
565.415	2766.5
600.507	2721.72
635.599	2678.61
670.691	2637.5
707.138	2597.85
756.05	2590.54
805.058	2583.26
858.068	2575.41
915.268	2567.04
979.271	2563.43
1016.94	2561.31
1054.7	2559.19
1092.46	2557.35
1130.21	2555.51
1167.97	2553.67
1205.73	2551.83
1240.39	2550.14
1275.06	2548.45
1318.94	2546.31
1362.82	2544.17
1406.43	2542.04
1450.04	2539.92
1493.67	2537.79
1545.09	2535.29
1581.19	2533.57
1617.28	2531.84
1663.52	2529.64
1704.01	2527.71
1744.51	2544.75
1777.98	2561.66
1810.55	2592.52

Valid/Invalid Surfaces

Method: bishop simplified

Number of Valid Surfaces: 227255
Number of Invalid Surfaces: 272865

Error Codes:

Error Code -108 reported for 77 surfaces
Error Code -109 reported for 3 surfaces
Error Code -111 reported for 62 surfaces
Error Code -112 reported for 2697 surfaces
Error Code -114 reported for 1329 surfaces
Error Code -121 reported for 3442 surfaces
Error Code -124 reported for 248 surfaces
Error Code -1000 reported for 265007 surfaces

Method: spencer

Number of Valid Surfaces: 227251
Number of Invalid Surfaces: 272869

Error Codes:

Error Code -108 reported for 615 surfaces
Error Code -109 reported for 3 surfaces
Error Code -111 reported for 1391 surfaces
Error Code -112 reported for 2414 surfaces
Error Code -114 reported for 1329 surfaces
Error Code -121 reported for 3442 surfaces
Error Code -124 reported for 248 surfaces
Error Code -1000 reported for 263427 surfaces

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).
-109 = Soiltype for slice base not located. This error should occur very rarely, if at all. It may occur if a very low number of slices is combined with certain soil geometries, such that the midpoint of a slice base is actually outside the soil region,even though the slip surface is wholly within the soil region.
-111 = safety factor equation did not converge
-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.
-114 = Surface with Reverse Curvature.
-121 = Concave failure surface, only convex surfaces have been defined as being allowed.
-124 = A slice has a width less than the minimum acceptable value.
-1000 = No valid slip surface is generated

Slice Data

- **Global Minimum Query (bishop simplified) - Safety Factor: 1.00244**

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [degrees]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	12.5539	12398.5	-51.9127	Slide Mass A	0	13.5	181.169	181.611	756.463	0	756.463	987.621	987.621
2	22.5378	84374	-51.9127	Slide Mass B	3241	13.5	3163.12	3170.84	-292.239	0	-292.239	3743.68	3743.68
3	35.0918	285039	-50.8558	Slide Mass B	3241	13.5	4001.17	4010.94	3207.01	0	3207.01	8122.71	8122.71
4	35.0919	458032	-49.5146	Slide Mass B	3241	13.5	4965.87	4977.99	7235.08	0	7235.08	13052.4	13052.4
5	18.935	310602	-47.4124	Slide Mass B	3241	13.5	5681.34	5695.2	10222.5	0	10222.5	16403.6	16403.6
6	9.38947	169143	-47.4124	Slide Mass D	1620	13.5	4704.52	4716	12895.7	0	12895.7	18014.1	18014.1
7	8.12223	154363	-47.4124	Slide Mass C	0	13.5	3559.31	3567.99	15132.6	270.851	14861.8	19005	18734.2
8	24.456	476678	-8.49942	Slide Mass C	0	8.5	2749.05	2755.76	19080.4	641.223	18439.2	19491.3	18850
9	24.456	479352	-8.49942	Slide Mass C	0	8.5	2735.97	2742.65	19191.7	840.21	18351.5	19600.6	18760.4
10	24.504	482447	-8.44308	Slide Mass C	0	8.5	2720.26	2726.9	19284.7	1038.62	18246.1	19688.5	18649.9
11	24.504	484546	-8.44308	Slide Mass C	0	8.5	2703.89	2710.49	19372.8	1236.46	18136.3	19774.1	18537.7
12	26.5051	526359	-8.42872	Slide Mass C	0	8.5	2686.34	2692.89	19460.7	1442.17	18018.5	19858.8	18416.6
13	26.5051	527842	-8.42872	Slide Mass C	0	8.5	2663.34	2669.84	19520.1	1655.74	17864.3	19914.7	18259
14	57.1999	947928	-8.32927	Slide Mass C	0	8.5	2127.61	2132.8	16260.7	1989.82	14270.9	16572.2	14582.4
15	32.0017	495488	-3.22211	Slide Mass C	0	8.5	1955.84	1960.61	15373.1	2254.3	13118.8	15483.2	13228.9
16	32.0017	502695	-3.22211	Slide Mass C	0	8.5	1978.14	1982.97	15597	2328.68	13268.3	15708.4	13379.7
17	18.8362	299254	-3.21899	Slide Mass C	0	8.5	1995.86	2000.73	15774.9	2387.73	13387.2	15887.2	13499.5
18	18.8362	301748	-3.21899	Slide Mass C	0	8.5	2008.98	2013.88	15906.6	2431.44	13475.2	16019.6	13588.1
19	37.7571	577037	-3.21813	Slide Mass C	0	8.5	1902.65	1907.29	15259.1	2497.1	12762	15366	12868.9
20	18.8786	267296	-2.79113	Slide Mass C	0	8.5	1746.58	1750.84	14273.5	2558.39	11715.1	14358.7	11800.3
21	18.8786	269468	-2.79113	Slide Mass C	0	8.5	1758.43	1762.72	14388	2593.39	11794.6	14473.8	11880.4
22	37.7571	545452	-2.79113	Slide Mass C	0	8.5	1776.21	1780.54	14559.7	2645.88	11913.9	14646.3	12000.5
23	18.8786	307694	-2.79113	Slide Mass C	0	8.5	2020.49	2025.42	16250.8	2698.37	13552.4	16349.3	13650.9
24	18.8786	320633	-2.79113	Slide Mass C	0	8.5	2109.25	2114.4	16881.1	2733.36	14147.8	16984	14250.6
25	37.7571	647781	-2.79113	Slide Mass C	0	8.5	2127.02	2132.21	17052.8	2785.85	14267	17156.5	14370.7
26	34.6633	602351	-2.79113	Slide Mass C	0	8.5	2149.75	2155	17272.4	2852.97	14419.4	17377.2	14524.2
27	34.6633	577426	-2.79113	Slide Mass C	0	8.5	2033.81	2038.77	16559	2917.22	13641.8	16658.1	13740.9

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [degrees]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
28	21.9417	324467	-2.79113	Slide Mass C	0	8.5	1749.2	1753.47	14702.4	2969.69	11732.7	14787.7	11818
29	21.9417	306079	-2.79113	Slide Mass C	0	8.5	1619.14	1623.09	13870.7	3010.36	10860.3	13949.6	10939.3
30	21.9417	284236	-2.79113	Slide Mass C	0	8.5	1465.77	1469.35	12882.7	3051.03	9831.66	12954.2	9903.12
31	21.9417	274642	-2.79113	Slide Mass C	0	8.5	1395.04	1398.44	12448.9	3091.7	9357.17	12516.9	9425.19
32	21.8049	268938	-2.79094	Slide Mass C	0	8.5	1361.95	1365.27	12267.5	3132.24	9135.22	12333.8	9201.61
33	21.8049	268755	-2.79094	Slide Mass C	0	8.5	1354.71	1358.02	12259.4	3172.66	9086.73	12325.4	9152.78
34	21.8049	276775	-2.79094	Slide Mass C	0	8.5	1403.18	1406.6	12624.8	3213.07	9411.77	12693.2	9480.17
35	21.8049	285938	-2.79094	Slide Mass C	0	8.5	1459.4	1462.96	13042.3	3253.48	9788.84	13113.5	9859.99
36	21.8161	293738	-2.79094	Slide Mass C	0	8.5	1505.33	1509	13390.9	3293.91	10097	13464.3	10170.4
37	21.8161	296788	-2.79094	Slide Mass C	0	8.5	1520.04	1523.75	13530	3334.34	10195.6	13604.1	10269.7
38	25.7088	356204	-2.78687	Slide Mass C	0	8.5	1550.74	1554.52	13779.9	3378.32	10401.5	13855.3	10477
39	25.7088	355847	-2.78687	Slide Mass C	0	8.5	1541.64	1545.4	13766.4	3425.86	10340.6	13841.5	10415.6
40	36.0959	464940	-2.72994	Slide Mass C	0	8.5	1391.36	1394.75	12814.4	3481.87	9332.5	12880.7	9398.84
41	36.0959	405070	-2.72994	Slide Mass C	0	8.5	1136.27	1139.04	11167.9	3546.37	7621.51	11222.1	7675.69
42	23.1177	241433	-2.72994	Slide Mass C	0	8.5	1013.2	1015.67	10395.3	3599.27	6796.05	10443.6	6844.36
43	23.1177	233459	-2.72994	Slide Mass C	0	8.5	956.026	958.359	10053.1	3640.58	6412.53	10098.7	6458.12
44	20.2475	199018	-2.72994	Slide Mass C	0	8.5	910.408	912.629	9785.85	3679.32	6106.53	9829.26	6149.94
45	20.2475	196715	-2.72994	Slide Mass C	0	8.5	888.216	890.383	9673.17	3715.5	5957.67	9715.53	6000.03
46	20.2483	182002	22.8208	Slide Mass C	0	13.5	1473.56	1477.16	9608.52	3455.73	6152.79	8988.46	5532.73
47	20.2483	153620	22.8208	Slide Mass C	0	13.5	1248.26	1251.31	8112.06	2900	5212.06	7586.81	4686.81
48	33.4657	188809	26.8136	Slide Mass C	0	13.5	972.021	974.393	6133.15	2074.5	4058.65	5641.86	3567.36
49	25.3199	67408.8	43.4519	Slide Mass C	0	13.5	588.229	589.664	3219.55	763.423	2456.13	2662.28	1898.86
50	7.24899	3513.43	43.4519	Slide Mass A	0	13.5	150.144	150.51	626.92	0	626.92	484.678	484.678

- **Global Minimum Query (spencer) - Safety Factor: 1.01648**

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [degrees]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	12.5539	12398.5	-51.9127	Slide Mass A	0	13.5	160.163	162.802	678.118	0	678.118	882.474	882.474

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [degrees]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
2	22.5378	84374	-51.9127	Slide Mass B	3241	13.5	3200.37	3253.11	50.4474	0	50.4474	4133.89	4133.89
3	35.0918	285039	-50.8558	Slide Mass B	3241	13.5	3944.61	4009.62	3201.53	0	3201.53	8047.73	8047.73
4	35.0919	458032	-49.5146	Slide Mass B	3241	13.5	4808.42	4887.66	6858.85	0	6858.85	12491.7	12491.7
5	18.935	310602	-47.4124	Slide Mass B	3241	13.5	5462.32	5552.34	9627.41	0	9627.41	15570.2	15570.2
6	9.38947	169143	-47.4124	Slide Mass D	1620	13.5	4403.07	4475.63	11894.6	0	11894.6	16685	16685
7	8.12223	154363	-47.4124	Slide Mass C	0	13.5	3185.53	3238.03	13758.2	270.851	13487.4	17224	16953.1
8	24.456	476678	-8.49942	Slide Mass C	0	8.5	2689.41	2733.73	18933	641.223	18291.8	19334.9	18693.7
9	24.456	479352	-8.49942	Slide Mass C	0	8.5	2675.81	2719.91	19039.5	840.21	18199.3	19439.4	18599.2
10	24.504	482447	-8.44308	Slide Mass C	0	8.5	2660	2703.84	19130.5	1038.62	18091.8	19525.3	18486.7
11	24.504	484546	-8.44308	Slide Mass C	0	8.5	2643.18	2686.74	19213.9	1236.46	17977.4	19606.2	18369.8
12	26.5051	526359	-8.42872	Slide Mass C	0	8.5	2625.27	2668.53	19297.7	1442.17	17855.5	19686.7	18244.5
13	26.5051	527842	-8.42872	Slide Mass C	0	8.5	2601.89	2644.77	19352.3	1655.74	17696.6	19737.9	18082.1
14	57.1999	947928	-8.32927	Slide Mass C	0	8.5	2076.42	2110.64	16112.4	1989.82	14122.6	16416.4	14426.6
15	32.0017	495488	-3.22211	Slide Mass C	0	8.5	1935.14	1967.03	15416	2254.3	13161.7	15525	13270.7
16	32.0017	502695	-3.22211	Slide Mass C	0	8.5	1957.1	1989.35	15639.7	2328.68	13311	15749.9	13421.2
17	18.8362	299254	-3.21899	Slide Mass C	0	8.5	1974.56	2007.1	15817.6	2387.73	13429.8	15928.6	13540.9
18	18.8362	301748	-3.21899	Slide Mass C	0	8.5	1987.48	2020.23	15949.1	2431.44	13517.7	16060.9	13629.5
19	37.7571	577037	-3.21813	Slide Mass C	0	8.5	1881.95	1912.96	15297	2497.1	12799.9	15402.9	12905.8
20	18.8786	267296	-2.79113	Slide Mass C	0	8.5	1729.34	1757.84	14320.4	2558.39	11762	14404.7	11846.3
21	18.8786	269468	-2.79113	Slide Mass C	0	8.5	1741.04	1769.73	14434.9	2593.39	11841.5	14519.8	11926.4
22	37.7571	545452	-2.79113	Slide Mass C	0	8.5	1758.58	1787.56	14606.7	2645.88	11960.8	14692.4	12046.5
23	18.8786	307694	-2.79113	Slide Mass C	0	8.5	2000.9	2033.87	16307.3	2698.37	13608.9	16404.8	13706.5
24	18.8786	320633	-2.79113	Slide Mass C	0	8.5	2088.9	2123.33	16940.9	2733.36	14207.6	17042.8	14309.4
25	37.7571	647781	-2.79113	Slide Mass C	0	8.5	2106.45	2141.16	17112.7	2785.85	14326.9	17215.4	14429.5
26	34.6633	602351	-2.79113	Slide Mass C	0	8.5	2128.88	2163.96	17332.4	2852.97	14479.4	17436.2	14583.2
27	34.6633	577426	-2.79113	Slide Mass C	0	8.5	2013.62	2046.8	16612.7	2917.22	13695.5	16710.9	13793.6
28	21.9417	324467	-2.79113	Slide Mass C	0	8.5	1730.89	1759.42	14742.2	2969.69	11772.5	14826.6	11856.9

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [degrees]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
29	21.9417	306079	-2.79113	Slide Mass C	0	8.5	1601.65	1628.05	13903.9	3010.36	10893.5	13982	10971.6
30	21.9417	284236	-2.79113	Slide Mass C	0	8.5	1449.28	1473.16	12908.2	3051.03	9857.15	12978.8	9927.81
31	21.9417	274642	-2.79113	Slide Mass C	0	8.5	1378.95	1401.68	12470.5	3091.7	9378.84	12537.8	9446.07
32	21.8049	268938	-2.79094	Slide Mass C	0	8.5	1346.01	1368.19	12287.1	3132.24	9154.82	12352.7	9220.44
33	21.8049	268755	-2.79094	Slide Mass C	0	8.5	1338.75	1360.81	12278.1	3172.66	9105.42	12343.3	9170.69
34	21.8049	276775	-2.79094	Slide Mass C	0	8.5	1386.79	1409.64	12645.2	3213.07	9432.15	12712.8	9499.76
35	21.8049	285938	-2.79094	Slide Mass C	0	8.5	1442.53	1466.3	13064.8	3253.48	9811.29	13135.1	9881.61
36	21.8161	293738	-2.79094	Slide Mass C	0	8.5	1488.06	1512.58	13414.8	3293.91	10120.9	13487.4	10193.5
37	21.8161	296788	-2.79094	Slide Mass C	0	8.5	1502.59	1527.35	13554.1	3334.34	10219.7	13627.3	10293
38	25.7088	356204	-2.78687	Slide Mass C	0	8.5	1533	1558.26	13804.9	3378.32	10426.6	13879.5	10501.2
39	25.7088	355847	-2.78687	Slide Mass C	0	8.5	1523.87	1548.98	13790.3	3425.86	10364.5	13864.5	10438.7
40	36.0959	464940	-2.72994	Slide Mass C	0	8.5	1374.78	1397.44	12832.4	3481.87	9350.48	12897.9	9416.04
41	36.0959	405070	-2.72994	Slide Mass C	0	8.5	1121.31	1139.79	11172.9	3546.37	7626.51	11226.4	7679.98
42	23.1177	241433	-2.72994	Slide Mass C	0	8.5	998.977	1015.44	10393.8	3599.27	6794.49	10441.4	6842.12
43	23.1177	233459	-2.72994	Slide Mass C	0	8.5	942.11	957.636	10048.3	3640.58	6407.69	10093.2	6452.61
44	20.2475	199018	-2.72994	Slide Mass C	0	8.5	896.725	911.503	9778.35	3679.32	6099.03	9821.11	6141.79
45	20.2475	196715	-2.72994	Slide Mass C	0	8.5	874.612	889.026	9664.1	3715.5	5948.6	9705.8	5990.3
46	20.2483	182002	22.8208	Slide Mass C	0	13.5	1656.38	1683.68	10468.7	3455.73	7013	9771.74	6316.01
47	20.2483	153620	22.8208	Slide Mass C	0	13.5	1402.71	1425.83	8838.99	2900	5938.99	8248.74	5348.74
48	33.4657	188809	26.8136	Slide Mass C	0	13.5	1116.22	1134.62	6800.53	2074.5	4726.03	6236.35	4161.85
49	25.3199	67408.8	43.4519	Slide Mass C	0	13.5	759.707	772.227	3979.97	763.423	3216.54	3260.24	2496.82
50	7.24899	3513.43	43.4519	Slide Mass A	0	13.5	170.899	173.715	723.577	0	723.577	561.673	561.673

Interslice Data

- **Global Minimum Query (bishop simplified) - Safety Factor: 1.00244**

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	565.415	2766.5	0	0	0

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
2	577.969	2750.48	10462.5	0	0
3	600.507	2721.72	-65012.1	0	0
4	635.599	2678.61	-52905.6	0	0
5	670.691	2637.5	93158.4	0	0
6	689.626	2616.9	211703	0	0
7	699.015	2606.69	307723	0	0
8	707.138	2597.85	420254	0	0
9	731.594	2594.19	446591	0	0
10	756.05	2590.54	473788	0	0
11	780.554	2586.9	501397	0	0
12	805.058	2583.26	529832	0	0
13	831.563	2579.34	561381	0	0
14	858.068	2575.41	593846	0	0
15	915.268	2567.04	655718	0	0
16	947.269	2565.23	645598	0	0
17	979.271	2563.43	635528	0	0
18	998.107	2562.37	629608	0	0
19	1016.94	2561.31	623705	0	0
20	1054.7	2559.19	613113	0	0
21	1073.58	2558.27	606642	0	0
22	1092.46	2557.35	600162	0	0
23	1130.21	2555.51	587171	0	0
24	1149.09	2554.59	579369	0	0
25	1167.97	2553.67	571119	0	0
26	1205.73	2551.83	554588	0	0
27	1240.39	2550.14	539378	0	0
28	1275.06	2548.45	525734	0	0
29	1297	2547.38	519305	0	0
30	1318.94	2546.31	513920	0	0
31	1340.88	2545.24	509752	0	0
32	1362.82	2544.17	506191	0	0
33	1384.63	2543.11	502981	0	0
34	1406.43	2542.04	499911	0	0
35	1428.24	2540.98	496574	0	0
36	1450.04	2539.92	492913	0	0
37	1471.86	2538.85	489001	0	0
38	1493.67	2537.79	485069	0	0
39	1519.38	2536.54	480257	0	0
40	1545.09	2535.29	475643	0	0
41	1581.19	2533.57	470724	0	0
42	1617.28	2531.84	469184	0	0
43	1640.4	2530.74	469292	0	0
44	1663.52	2529.64	469946	0	0
45	1683.77	2528.67	470911	0	0
46	1704.01	2527.71	472102	0	0
47	1724.26	2536.23	369498	0	0
48	1744.51	2544.75	282787	0	0
49	1777.98	2561.66	155957	0	0
50	1803.3	2585.65	67205.6	0	0

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
51	1810.55	2592.52	0	0	0

- **Global Minimum Query (spencer) - Safety Factor: 1.01648**

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	565.415	2766.5	0	0	0
2	577.969	2750.48	9463.86	1326.18	7.97697
3	600.507	2721.72	-57261.5	-8024.1	7.97696
4	635.599	2678.61	-43916.8	-6154.09	7.97695
5	670.691	2637.5	91584.7	12833.8	7.97694
6	689.626	2616.9	201636	28255.4	7.97696
7	699.015	2606.69	290107	40652.9	7.97696
8	707.138	2597.85	393433	55132.1	7.97696
9	731.594	2594.19	420448	58917.7	7.97696
10	756.05	2590.54	448319	62823.3	7.97696
11	780.554	2586.9	476603	66786.8	7.97697
12	805.058	2583.26	505710	70865.5	7.97696
13	831.563	2579.34	537980	75387.6	7.97696
14	858.068	2575.41	571162	80037.3	7.97695
15	915.268	2567.04	634282	88882.5	7.97697
16	947.269	2565.23	624674	87536	7.97695
17	979.271	2563.43	615123	86197.7	7.97696
18	998.107	2562.37	609513	85411.5	7.97696
19	1016.94	2561.31	603922	84628	7.97695
20	1054.7	2559.19	593930	83227.9	7.97696
21	1073.58	2558.27	587707	82355.9	7.97697
22	1092.46	2557.35	581477	81482.9	7.97697
23	1130.21	2555.51	568994	79733.6	7.97696
24	1149.09	2554.59	561475	78679.9	7.97696
25	1167.97	2553.67	553518	77564.9	7.97696
26	1205.73	2551.83	537581	75331.7	7.97697
27	1240.39	2550.14	522924	73277.8	7.97696
28	1275.06	2548.45	509814	71440.7	7.97697
29	1297	2547.38	503689	70582.4	7.97697
30	1318.94	2546.31	498594	69868.4	7.97696
31	1340.88	2545.24	494697	69322.3	7.97696
32	1362.82	2544.17	491402	68860.5	7.97695
33	1384.63	2543.11	488452	68447.1	7.97695
34	1406.43	2542.04	485642	68053.4	7.97696
35	1428.24	2540.98	482572	67623.2	7.97696
36	1450.04	2539.92	479187	67148.8	7.97695
37	1471.86	2538.85	475558	66640.3	7.97696
38	1493.67	2537.79	471911	66129.3	7.97696
39	1519.38	2536.54	467441	65502.9	7.97696
40	1545.09	2535.29	463170	64904.4	7.97696
41	1581.19	2533.57	458697	64277.6	7.97696
42	1617.28	2531.84	457557	64117.8	7.97696
43	1640.4	2530.74	457907	64166.8	7.97695
44	1663.52	2529.64	458796	64291.5	7.97697

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
45	1683.77	2528.67	459965	64455.2	7.97695
46	1704.01	2527.71	461357	64650.3	7.97696
47	1724.26	2536.23	347598	48709.2	7.97696
48	1744.51	2544.75	251462	35237.5	7.97694
49	1777.98	2561.66	108380	15187.4	7.97697
50	1803.3	2585.65	-3024.83	-423.872	7.97696
51	1810.55	2592.52	0	0	0

Entity Information

Group: Group 1

Shared Entities

Type	Coordinates	
External Boundary	X	Y
	0	2500
	2055	2500
	2100	2500
	2100	2582.57
	2100	2584
	2080	2584.86
	2048.8	2585.5
	2017.7	2586.12
	1986.6	2586.79
	1955.5	2587.95
	1931.9	2588.35
	1924.4	2588.47
	1893.3	2589.04
	1862.2	2589.45
	1831.1	2589.87
	1810.55	2592.52
	1780.66	2596.18
	1768.9	2597.62
	1737.8	2600.68
	1706.7	2604.89
	1675.6	2607.37
	1644.5	2612.11
	1613.4	2617.54
	1582.3	2628.31
	1551.2	2643.45
	1520	2648.71
	1488.9	2647.09
	1457.8	2647.27
	1426.7	2644.08
	1395.6	2640.68
	1364.5	2642.99
	1333.4	2647.54
	1302.3	2660.95

Type	Coordinates	
	X	Y
	1271.2	2671.01
	1252	2690
	1135	2690
	1135	2672
	1039	2672
	1039	2690
	940	2690
	885	2690
	866.991	2733.73
	820	2740
	737	2750
	711.29	2752.81
	680.18	2758.49
	649.08	2763.35
	617.97	2765.31
	586.87	2766.13
	555.76	2766.66
	524.65	2769.07
	493.55	2772.29
	462.44	2775.32
	431.34	2779.05
	400.23	2789.67
	369.12	2796.46
	338.02	2805.78
	306.91	2817.8
	275.81	2834.28
	244.7	2848.45
	213.59	2853.8
	199.1	2856.2
	161.8	2869.2
	147.608	2875.56
	141	2878.9
	130.65	2883.4
	120.28	2884.98
	89.171	2885.5
	58.065	2885.13
	26.959	2884.32
	0	2883.71
	0	2863
	0	2630
	0	2620
	0	2596

Type	Coordinates	
	X	Y
Material Boundary	182.308	2821.95
	212.393	2783.59
	248.409	2737.67
	312.568	2685.31
	353.568	2651.85
	385.121	2636.75
	415.734	2622.1
	437.544	2611.67
	514.019	2582.3
	645.613	2578.18
	908.026	2565.54
	1119.06	2556.05
	1374.9	2541.87
	1584.25	2530.99
	1691.6	2524.98
	1728.07	2530.13
	1761.29	2545.83
	1803.3	2585.65
	1803.5	2585.84
	1810.55	2592.52

Type	X	Y
Material Boundary	1931.9	2588.35
	2100	2582.57

Type	X	Y
Material Boundary	0	2596
	2055	2500

Type	X	Y
Material Boundary	0	2863
	154.397	2863

Type	X	Y
Material Boundary	147.608	2875.56
	154.397	2863
	162.358	2849
	182.308	2821.95

Type	X	Y
Material Boundary	437.544	2611.67
	542.546	2609.67

Type	Coordinates	
	X	Y
Material Boundary	162.358	2849
	243.869	2833.47
	305.541	2802.42
	337.886	2790.78
	431.904	2764.9
	525.922	2754.12
	X	Y
Material Boundary	542.546	2609.67
	890.643	2603.04
	X	Y
	525.922	2754.12
Material Boundary	649.267	2745.49
	710.939	2738.16
	820.914	2725.22
	X	Y
	820.914	2725.22
	854.554	2720.05
	874.392	2674.33
	884.743	2674.76
Material Boundary	940.377	2674.76
	1038.71	2657.51
	1137.04	2657.51
	1182.32	2674.76
	1245.29	2674.33
	X	Y
	890.643	2603.04
	1645.59	2588.66
	1615.3	2599.32
	1594.04	2606.8
	1632.88	2598.98
Material Boundary	1644.22	2596.7
	1706.29	2589.83
	1769.26	2586.3
	1803.3	2585.65
	1803.58	2585.65
	1803.5	2585.84
	X	Y
	1332.84	2632.5
	1364.32	2627.32
Material Boundary	1395.8	2624.74
	1489.39	2632.07
	1550.2	2627.76
	1594.04	2606.8

Type	Coordinates
Material Boundary	X: 1245.29, 1269.01, 1332.84 Y: 2674.33, 2655.36, 2632.5
Material Boundary	X: 0, 437.544 Y: 2620, 2611.67
Material Boundary	X: 0, 415.734, 1615.3, 1632.88, 1780.66 Y: 2630, 2622.1, 2599.32, 2598.98, 2596.18

Scenario-based Entities

Type	Coordinates	Master Scenario
Water Table	X: 0, 2100 Y: 2620, 2580	Assigned to materials: Basalt Parent A Slide Mass A Slide Mass B Slide Mass C Sandstone
Distributed Load	X: 1135, 1039 Y: 2672, 2672	Constant Distribution Orientation: Normal to boundary Magnitude: 200 lbs/ft2 Creates Excess Pore Pressure: No
Tension Crack	X: 0, 191 Y: 2810, 2810	Water level: dry

St.George
Community Development

Hillside Permit

HILLSIDE REVIEW BOARD AGENDA REPORT: **08/07/2024**

Foremaster Ridge Lot 44 Hillside Development Permit (Case No. 2024-HS-010)		
Request:	A Hillside Development Permit to adjust the location of the ridgeline and ridgeline setback on lot 44 of the Foremaster Ridge subdivision in anticipation of the construction of a residential home.	
Applicant:	Jack de Ryk/Floyd Jackson	
Location:	1856 E Joe Cir	
General Plan:	Low Density Residential (LDR)	
Existing Zoning:	Single Family Residential, minimum lot size 10,000 sf (R-1-10)	
Surrounding Zoning:	North	R-1-10
	South	R-1-10
	East	R-1-10
	West	R-1-10
Land Area:	Approximately 0.47 acres	

BACKGROUND

This is a request to obtain a hillside permit for the property located at 1856 E. Joe Cir (Lot 44, Foremaster Ridge). (See Exhibit A, Foremaster Ridge final plat.) This location is a residential neighborhood, and the applicant would like to build a house on this lot. The rear of the applicant's property abuts the ridge line of Foremaster Ridge. The plat identifies this ridge line as having a 30' ridge line setback area and states, "*No structures, walls, or solid fences are allowed within the 30' foot ridge line setback area*."

The applicant is requesting to review the location of the 30-foot ridgeline setback as shown on the final plat for Foremaster Ridge lot 44 and establish a ridgeline which the applicant feels is more indicative of the actual ridgeline.

APPLICABLE ORDINANCE(S) *(Selected portions)*

10-13A-6: Building Setbacks and Additional Design Standards:

A. *Front Setback along Streets:* Along streets where the slope of the adjacent property to the street is over fifteen percent (15%), the minimum setback is twenty feet (20').

B. *Setbacks:* All setbacks shall conform to the underlying zone criteria except as provided herein. No structure or accessory structure shall be constructed within the setback area as defined below. However, a see-through wrought iron fence with at least fifty percent (50%) of the fence open, landscaping, and a nonvertical swimming pool are permitted in the setback area.

1. *Ridgelines:* All ridgelines as shown on the ridgeline map shall be subject to the setback provisions contained herein. Setbacks from ridgelines not identified on the ridgeline map shall be a minimum of thirty feet (30'), or greater if recommended in the geotechnical reports.

2. *Plateaus:* On plateaus, the setback from the ridgeline shall be a minimum of fifty feet (50') unless a greater setback is recommended in the geotechnical reports.

C. *Cuesta:* Where a ridgeline occurs on a cuesta, the minimum setback shall be one hundred feet (100') measured normal (perpendicular) to the closest point of the ridge, unless a greater setback is recommended in the geotechnical report.

D. *Additional Design Standards:*

1. Retaining walls shall be colored to blend into the surrounding natural geology.

2. Retaining wall height is limited to the heights set forth in chapter 18 of this title and the standards for rock wall construction.

3. Building exterior colors shall be earth tone and blend with the surrounding natural landscape.

4. In residential zones, “no disturbance” areas shall be held as the “common area” of a project. Common areas shall be owned and maintained by the homeowners’ association or may be deeded to the city when accepted by the city.

5. In nonresidential zones, any “no disturbance” area shall be identified on the final site plan or final plat.

6. Any required no disturbance area shall be identified on the ground with temporary fencing or other approved means to prevent accidental disturbance of the area during construction and such fencing shall be installed prior to issuance of a grading permit.

7. The building site shall be located on the flattest portion of the parcel.

8. No structure shall extend over any natural ridgeline. The structure shall be in contact with the ground at all edges. (Ord. 2019-10-002, 10-10-2019)

EXHIBITS PROVIDED

1. Exhibit A – Foremaster Ridge Plat
   “Exhibit A” in the packet shows the plat of Foremaster Ridge.

2. Exhibit B – Aerial of Existing Project Area
   “Exhibit B” is an aerial map of the project site for Foremaster Ridge Lot 44.

3. Exhibit C – Site Plan Map of Lot 44
   “Exhibit D” is a map showing the site and ridgeline setback of Lot 44.

4. Exhibit D – Slope Map for Foremaster Ridge Lot 44
   “Exhibit D” is the slope analysis map of lot 44.

RECOMMENDATION

Section 10-13A-8(B)(1) of the “Hillside Review Board Powers and Duties” states that the hillside board can make recommendations to “adopt, modify or reject a proposal” to the Planning Commission (PC).

General Plan – LDR (Low Density Residential)

Zoning - R-1-10

EXHIBIT A
FOREMASTER RIDGE

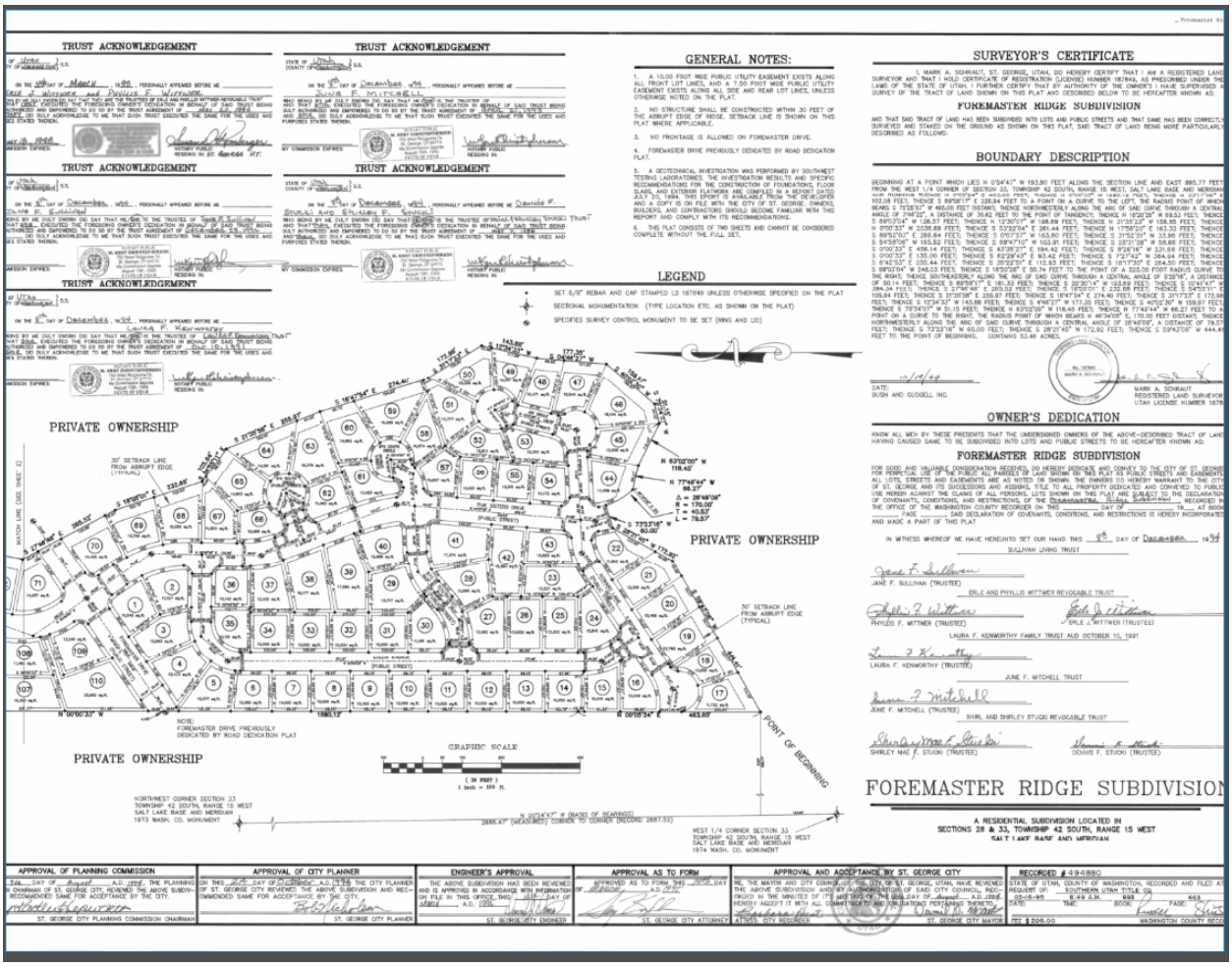


EXHIBIT B
AERIAL IMAGE OF LOT 44

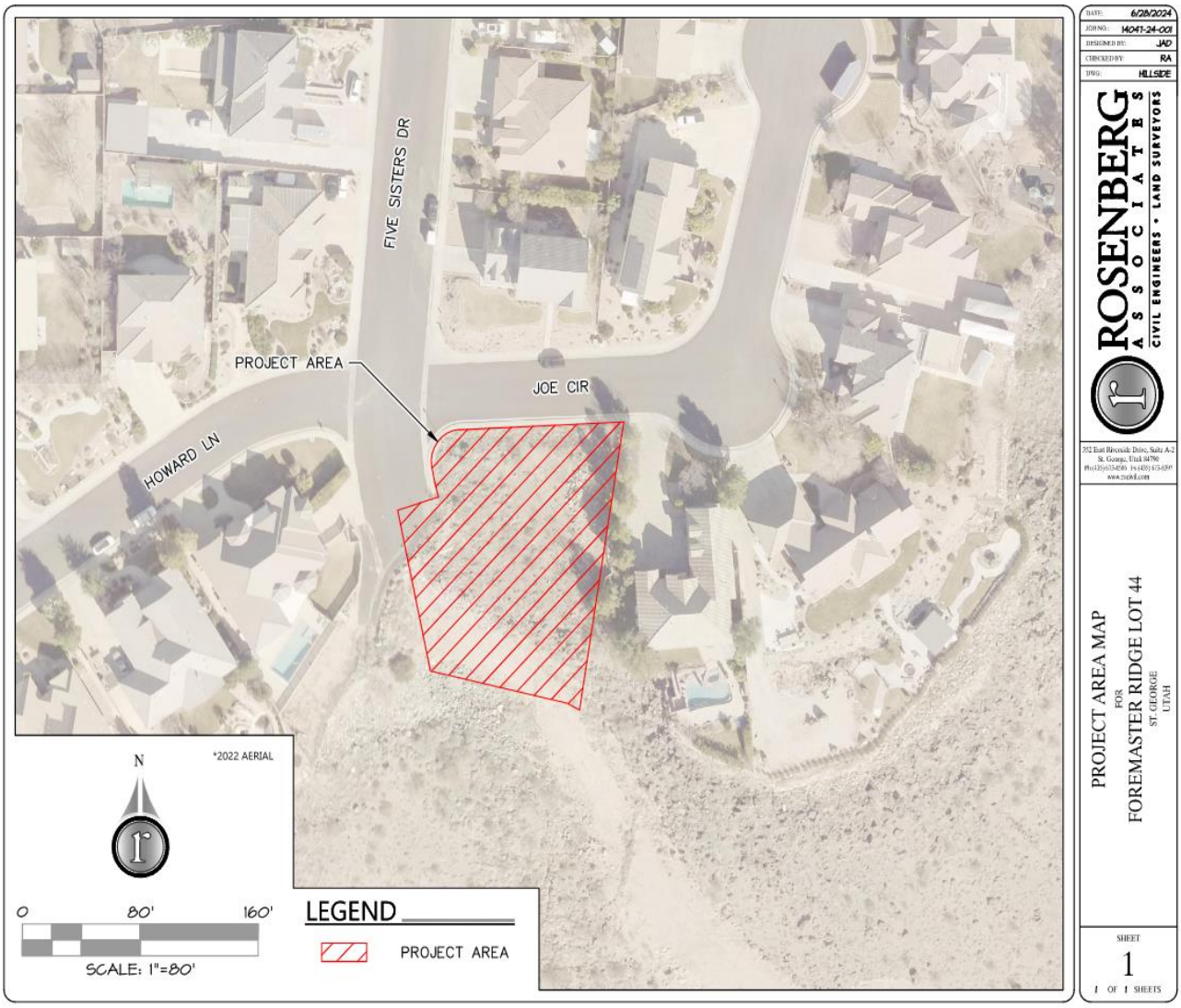


EXHIBIT C
SITE PLAN

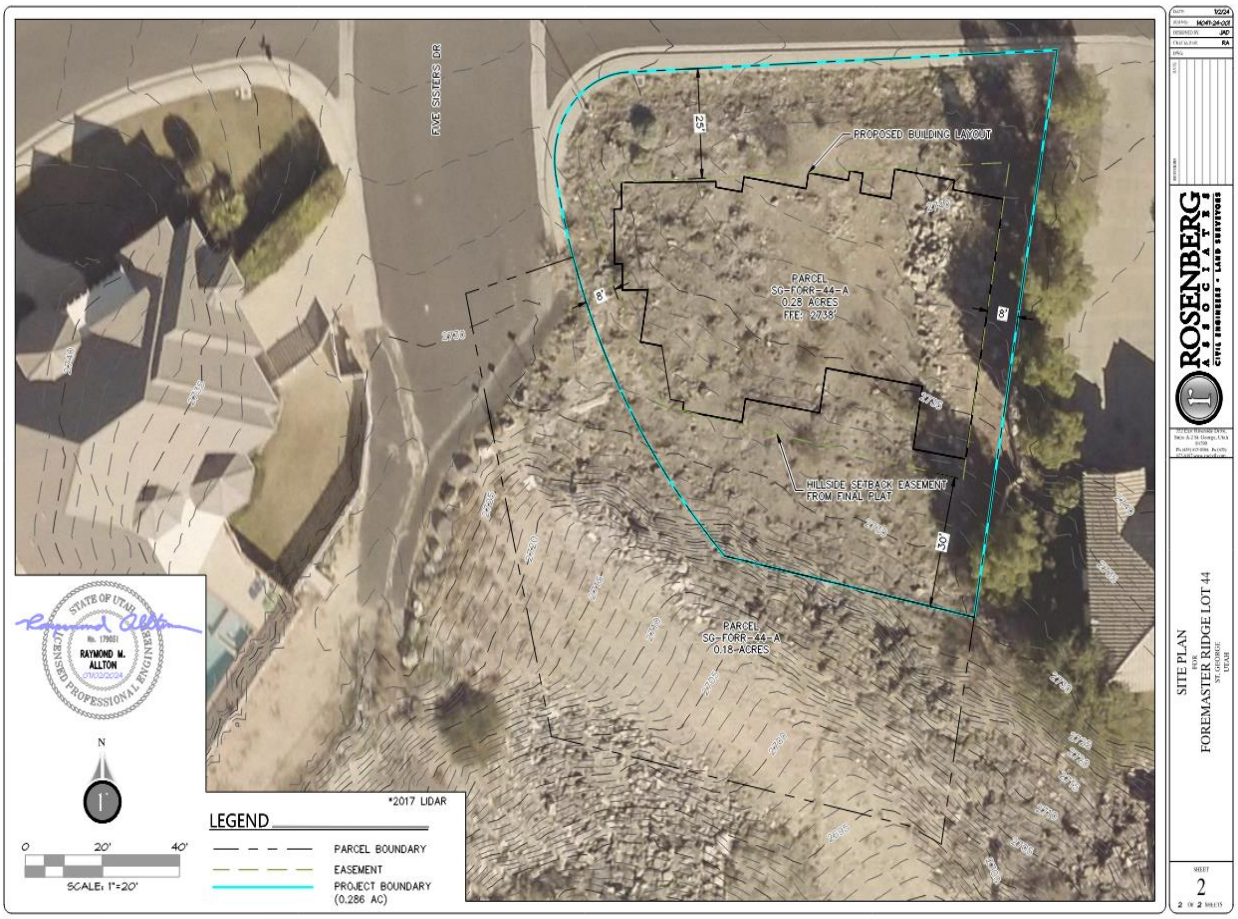
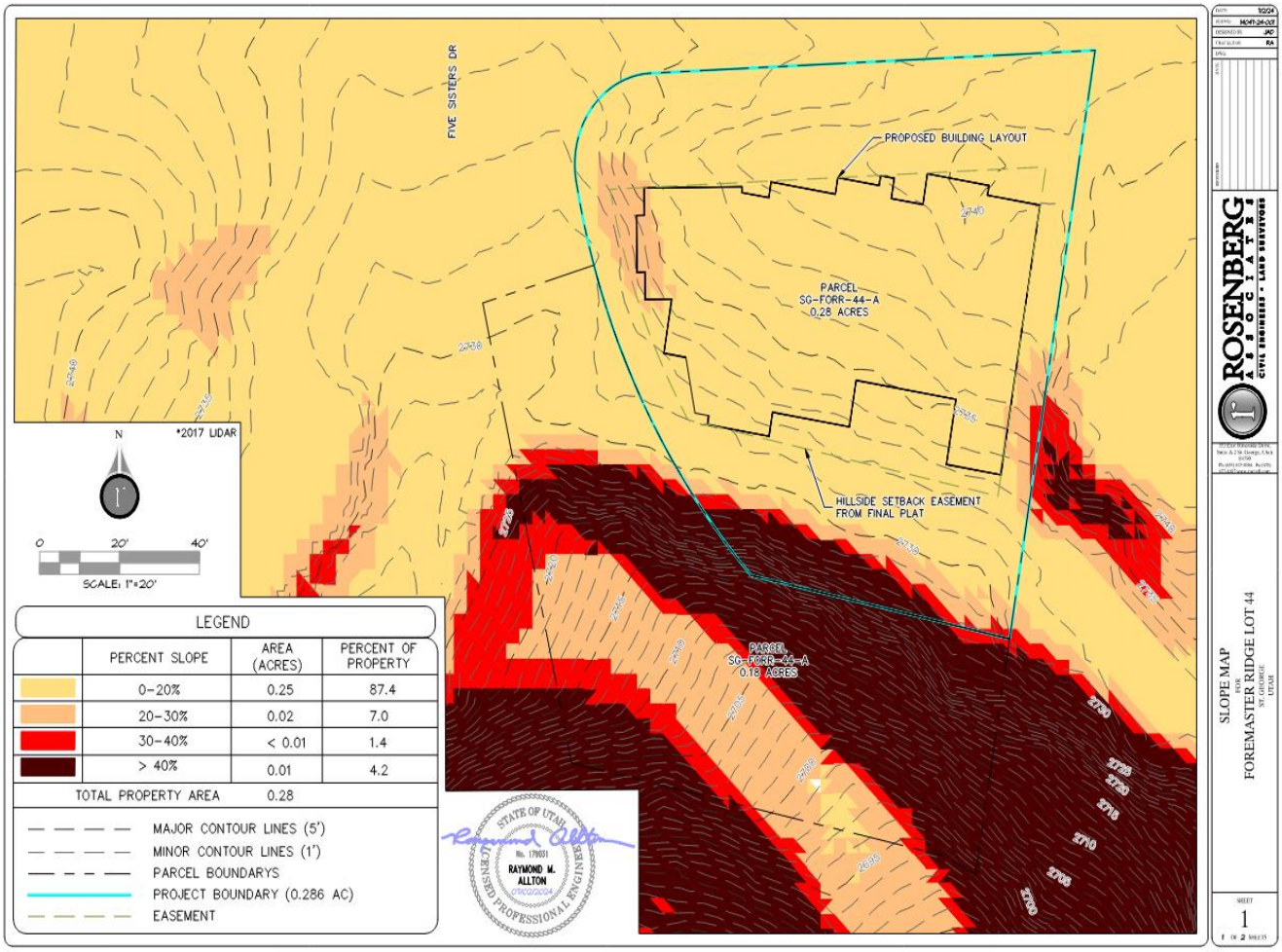


EXHIBIT D
SLOPE MAP



ST. GEORGE HILLSIDE REVIEW BOARD MINUTES
July 10, 2024, 8:30 A.M.
ON SITE

PRESENT:

Board Member Chair, James Sullivan
Board Member, Kevin Holyoak
Board Member, Jeff Mathis
Board Member, Russ Owens
Board Member, Dave Black

EXCUSED:

STAFF MEMBERS PRESENT:

Assistant Public Works Director, Wes Jenkins
Planner III, Mike Hadley
City Landscape Architect, Mark Goble
Development Office Supervisor, Monica Smith
Water Services Assistant Director, Kade Bringhurst
Assistant City Attorney, Daniel Baldwin

OTHERS PRESENT:

Alpha Engineering, Rhett Beazer

Link to Call to Order by Chair Sullivan: 00:00:00

HILLSIDE DEVELOPMENT PERMIT:

Consider a request for a Hillside Development Permit to allow disturbance of areas in the 20-30%, 30-40%, and 40% and above slope areas. This application is required in order to replace the water tank on the property. Applicant – St. George Water Department, representative, Rhett Beazer – Case No. 2024-HS-009 – ON SITE

BACKGROUND AND RECOMMENDATION: The Water Division of St. George City is proposing to replace an existing 2MG water tank which will include a new access road to be constructed to ensure there is no encroachment on the existing BLM property. Case No. **2024-HS-009** (Staff – Mike Hadley).

Link to comment by applicant, Rhett Beazer, describing the project, including discussion between Board Members and Mr. Beazer: 00:00:27

Link to comment by Assistant Water Services Director, Kade Bringhurst, including discussion between Board Members and Mr. Bringhurst: 00:00:56

Link to question by Assistant Public Works Director, Wes Jenkins, including discussion between Assistant Water Services Director, Kade Bringhurst, applicant, Rhett Beazer, and Mr. Jenkins: 00:03:23

Link to question by Board Member Owens, including discussion between Board Members and Assistant Water Services Director, Kade Bringhurst: 00:03:41

DRAFT

Link to question by Board Member Black, including discussion between Board Members and Mr. Bringhurst: 00:03:50

Link to question by Assistant Public Works Director, including discussion between Board Members, Mr. Bringhurst, and Mr. Jenkins: 00:04:57

Link to question by Chair Sullivan, including discussion between Board Members and Mr. Bringhurst: 00:05:20

Link to comment by applicant, Rhett Beazer, including discussion between Board Members, Mr. Bringhurst, and Mr. Beazer: 00:05:36

Link to question by Board Member Black, including discussion between Board Members and Mr. Bringhurst: 00:06:37

Link to question by Board Member Black, including discussion between Board Members, applicant, Rhett Beazer, and Mr. Bringhurst: 00:06:50

Link to comment by Board Member Black, including discussion between Board Members and Mr. Bringhurst: 00:08:03

Link to question by Board Member Owens, including discussion between Board Members and Mr. Bringhurst: 00:10:47

Link to comment by Chair Sullivan, including discussion between Board Members and Mr. Bringhurst: 00:11:29

Agenda packet [Page 3]

Link to motion: 00:13:07

MOTION:

A motion was made by Board Member Black to recommend for approval the construction of the new water tank to be constructed at 1023 N Cottonwood Springs Rd, with the following comments, one, that the cut slope for the new proposed access road be evaluated during construction to see that can be steepened up to minimize impact, second, evaluation further if access can be provided by the existing access or not, and third, that the risk of rockfall to the structures below the ridgetop be addressed by their geotechnical engineer, and that those risks be considered in the construction of the tank.

Link to discussion on the motion: 00:14:18

Link to amended motion: 00:14:20

DRAFT

AMENDED
MOTION:

Board Member Black amended his motion to include that any blasting that's required for the project be done in accordance with the draft blasting ordinance that the City of St. George is working on now.

SECOND:

The motion was seconded by Board Member Owens.

VOTE:

Chair Sullivan called for a vote, as follows:

Board Member Sullivan – aye
Board Member Holyoak – aye
Board Member Mathis – aye
Board Member Black – aye
Board Member Owens – aye

The vote was unanimous and the motion carried

APPROVAL OF MINUTES:

Approval of the meeting minutes from the May 22, 2024 meeting.

Agenda packet [Page 82]

Link to motion: 00:15:07

MOTION:

A motion was made by Board Member Mathis to approve the minutes from the last meeting.

SECOND:

The motion was seconded by Board Member Holyoak.

VOTE:

Chair Sullivan called for a vote, as follows:

Board Member Sullivan – aye
Board Member Holyoak – aye
Board Member Mathis – aye
Board Member Black – aye
Board Member Owens – aye

DRAFT

ADJOURN:

Link to move to adjourn: 00:15:18

MOTION:

A motion was made by Board Member Holyoak to adjourn.

SECOND:

The motion was seconded by Board Member Owens.

VOTE:

Chair Sullivan called for a vote, as follows:

Board Member Sullivan – aye
Board Member Holyoak – aye
Board Member Mathis – aye
Board Member Black – aye
Board Member Owens – aye

The vote was unanimous and the motion carried.

/s/Monica Smith
_____
Monica Smith, Secretary

DRAFT