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 meetings at the referenced site on **Wednesday, March 13, 2024,** commencing on-site at approximately 8:30 a.m.

The estimated site times are in bold. The agenda for the meeting is as follows:

1. Consider a request for a hillside development permit in the hillside overlay zone and in areas exceeding 20% slope and in a rockfall study zone for a potential hotel at approximately 300 South 1470 East (see map below). The property is approximately 2.17 acres. **Meeting time is approximately 8:30 am at City Hall Community Development Department conference room, 175 East 200 North.**

2. Discussion on a proposed amendment to Title 10-18A regarding rockery and segmental block walls. **Meeting time is approximately 8:30 am at City Hall Community Development Department conference room, 175 East 200 North.**

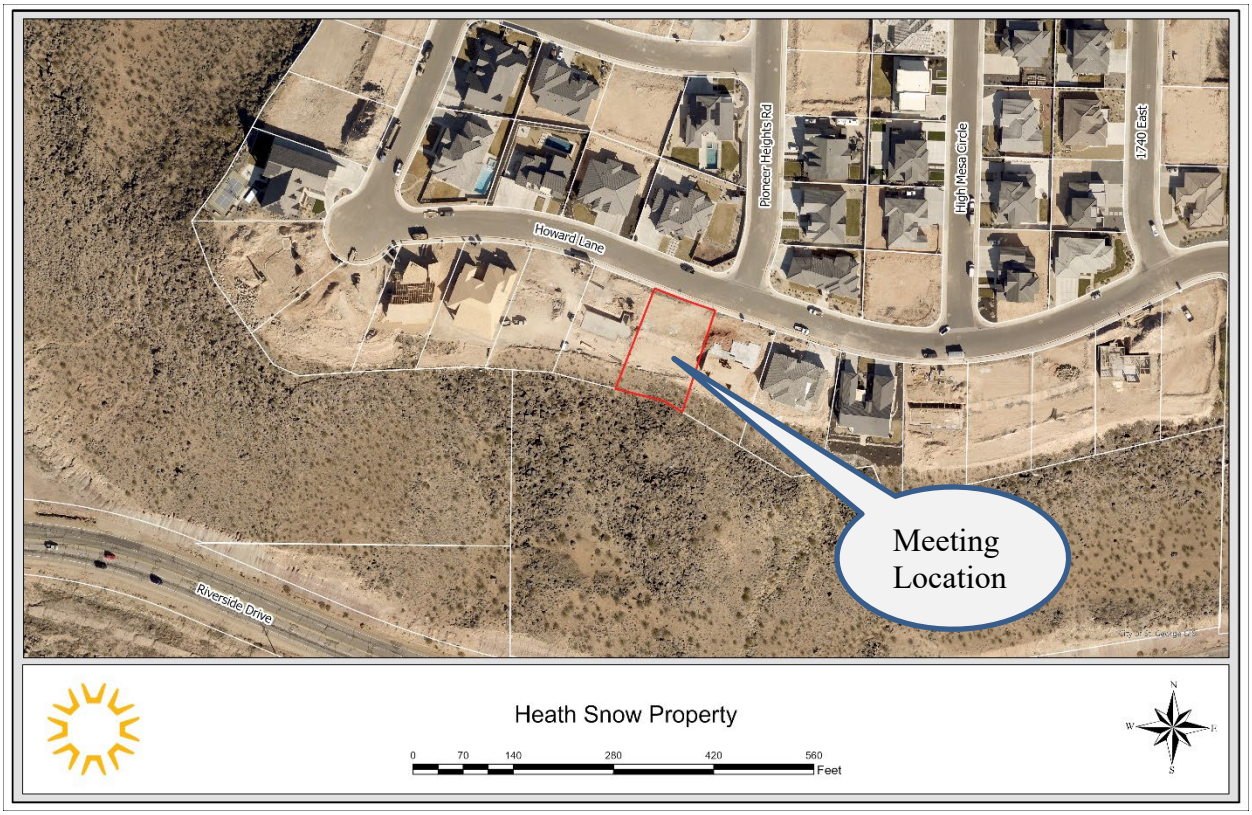
3. Consider a request for a hillside development permit at the South Rim at Foremaster Ridge Phase 2 development. The applicant is proposing to adjust the location of the ridgeline as identified on the plat. The property is generally located at 1636 Howard Lane and is currently zoned Single Family Residential, minimum lot size 10,000 sf (R-1-10). The applicant is Heath Snow. **Meeting time approx. 10:00 am at 1636 East Howard Lane.**

Brenda Hatch
Planner II – CDBG and Housing

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.

Items #1 & 2 Meeting Location – City Hall 175 East 200 North

Item #3 Meeting Location



St.George
Community Development

ITEM 1
Hillside Permit

HILLSIDE REVIEW BOARD AGENDA REPORT: **02/28/2024**
HILLSIDE REVIEW BOARD AGENDA REPORT: **03/13/2024**

@Home Best Western Hillside Development Permit (Case No. 2024-HS-005)		
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 rockfall hazard overlay area.	
Applicant:	Nick Ence	
Representative:	Rhett Beazer	
Location:	Approximately 300 South and 1470 East (See map)	
General Plan:	COM (Commercial)	
Existing Zoning:	PD-C (Planned Development Commercial)	
Surrounding Zoning:	North	PD-C (Planned Development Commercial)
	South	PD-C (Planned Development Commercial)
	East	OS (Open Space)
	West	PD-C (Planned Development Commercial)
Land Area:	Approximately 94,647 ft² (2.17 acres)	

BACKGROUND

On February 28, 2024, the Hillside Review Board convened on the subject property and discussed the proposed hotel and the hillside issues related to such construction. From that discussion, concerns were raised concerning proposed 1:1 slopes. The Board requested additional documentation either revising the 1:1 slopes or justifying them. The geotechnical report and Grading plan have been revised and are attached as "Exhibit H".

In 2011, the southern extension of 1470 East was constructed making the connection between the existing 1470 East termination and Medical Center Drive. This opened the land along that corridor available to develop. The city hasn't seen any development along that stretch of road yet until now. The applicant for this hillside permit is requesting to build on slope that exceeds 20% and area that is in a rockfall study zone. The application is for a proposed hotel. Specifics like room numbers, height of the building, etc. are not yet known but, will be forthcoming with a PD (Planned Development) amendment.

The Hillside Review Board must weigh in and make a recommendation to Planning Commission and City Council on all applications in hillside overlay areas.

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 – Hillside Slope Map
   "Exhibit A" in the packet shows the location of the new road extension.

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

3. Exhibit C – Landscape & Vegetation Plan

4. Exhibit D – Street Design
   Cross sections of the proposed streets

5. Exhibit E – Earth moving Plan
   "Exhibit B" in the packet is the earth moving plan.

6. Exhibit F – Geotechnical Engineering Report (Rockfall Study is included at the end of this report)
   Exhibit C is a geotechnical report and rockfall study.

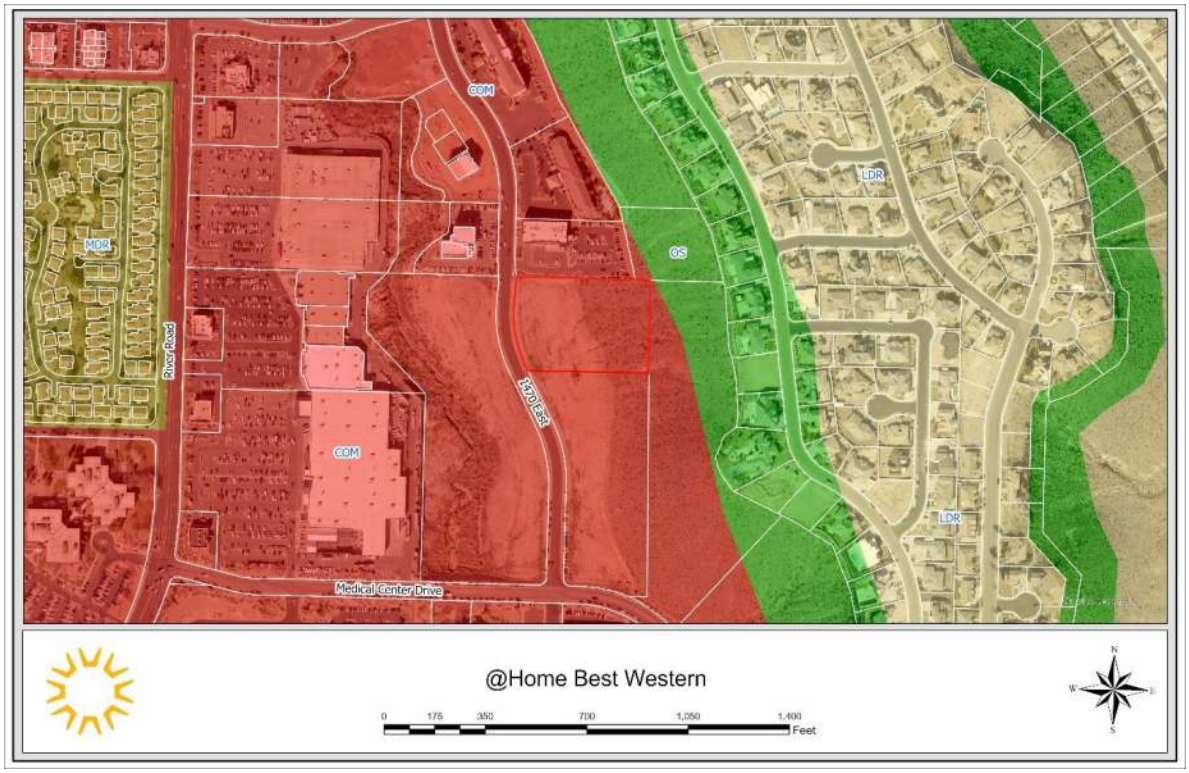
7. Exhibit G – Drainage Control Plan
   This is a letter from Alpha Engineering which describes the plan for controlling drainage.

8. **Exhibit H – Revised Geotechnical Engineering Report & Preliminary Grading Plan**

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 – COM – Commercial



Zoning – PD-C (Planned Development Commercial)

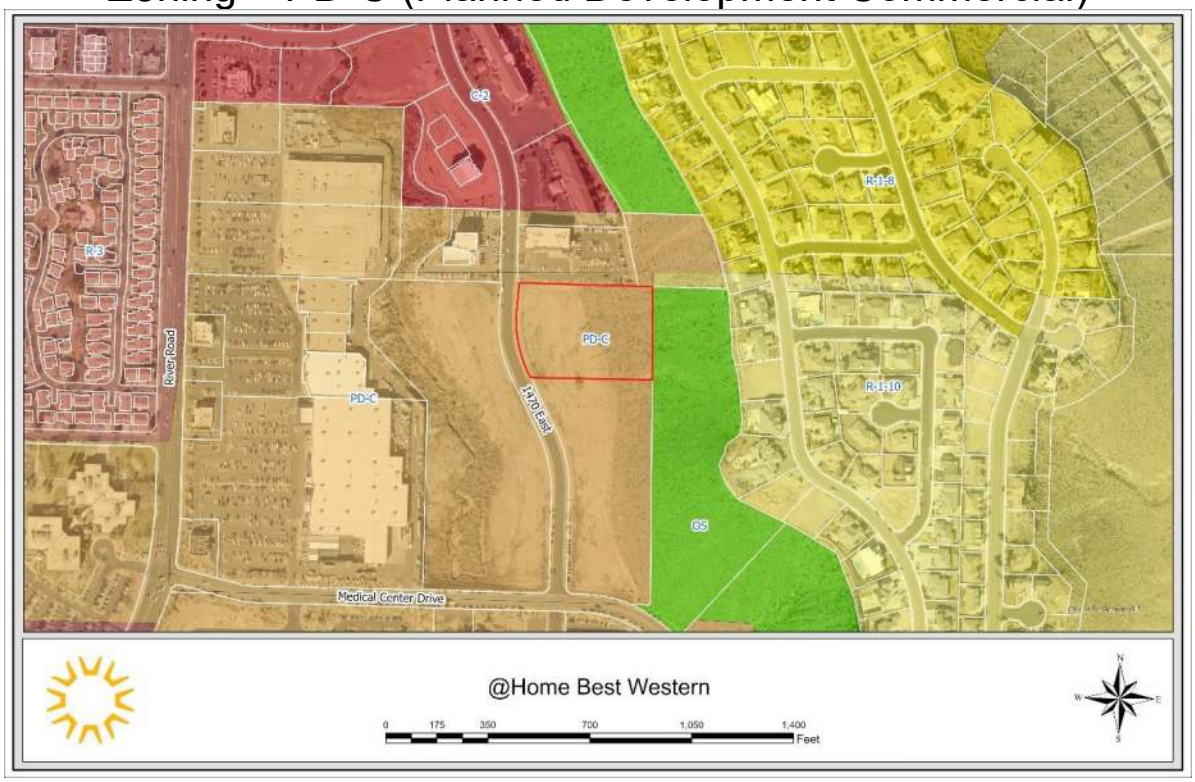
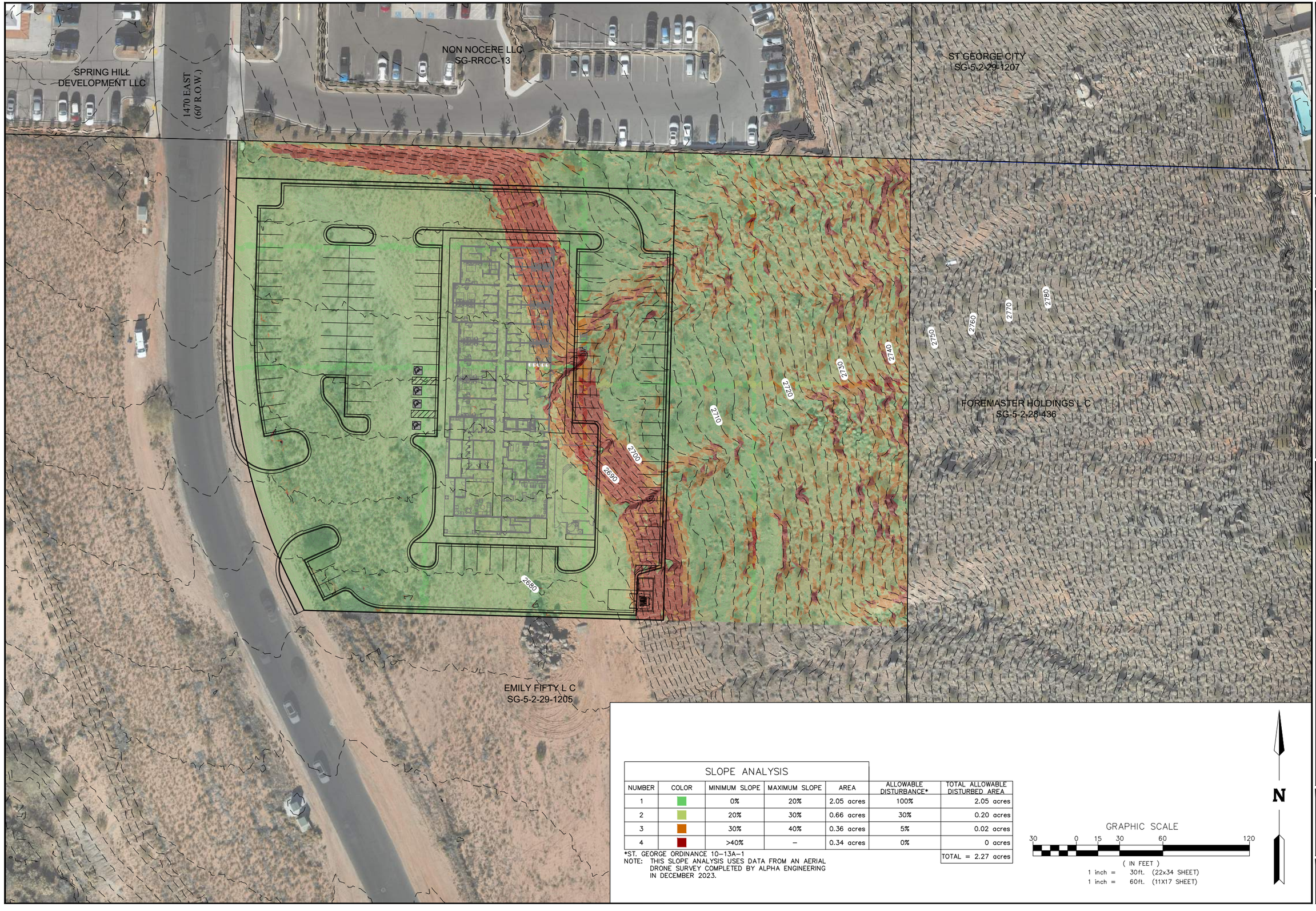


EXHIBIT A

Hillside Slope Map



SLOPE ANALYSIS						
NUMBER	COLOR	MINIMUM SLOPE	MAXIMUM SLOPE	AREA	ALLOWABLE DISTURBANCE*	TOTAL ALLOWABLE DISTURBED AREA
1		0%	20%	2.05 acres	100%	2.05 acres
2		20%	30%	0.66 acres	30%	0.20 acres
3		30%	40%	0.36 acres	5%	0.02 acres
4		>40%	–	0.34 acres	0%	0 acres
						TOTAL = 2.27 acres

*ST. GEORGE ORDINANCE 10-13A-1
NOTE: THIS SLOPE ANALYSIS USES DATA FROM AN AERIAL DRONE SURVEY COMPLETED BY ALPHA ENGINEERING IN DECEMBER 2023.

GRAPHIC SCALE
30 0 15 30 60 120
(IN FEET)
1 inch = 30ft. (22x34 SHEET)
1 inch = 60ft. (11X17 SHEET)

N

NO.	DATE	BY	DESCRIPTION

REVISIONS

PRELIMINARY
NOT FOR CONSTRUCTION

ALPHA ENGINEERING
43 South 100 East, Suite 100 • St George, Utah 84770
T: 435.628.6500 • F: 435.628.6553 • alphaengineering.com

TITLE: SLOPE ANALYSIS
PROJECT: @ HOME BEST WESTERN
ST. GEORGE, UTAH

PROJECT # 2043-01
NAME RKB
DATE FEBRUARY 6, 2024
SCALE AS NOTED

SHEET 1
1 OF 1
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EXHIBIT B

Site Plan

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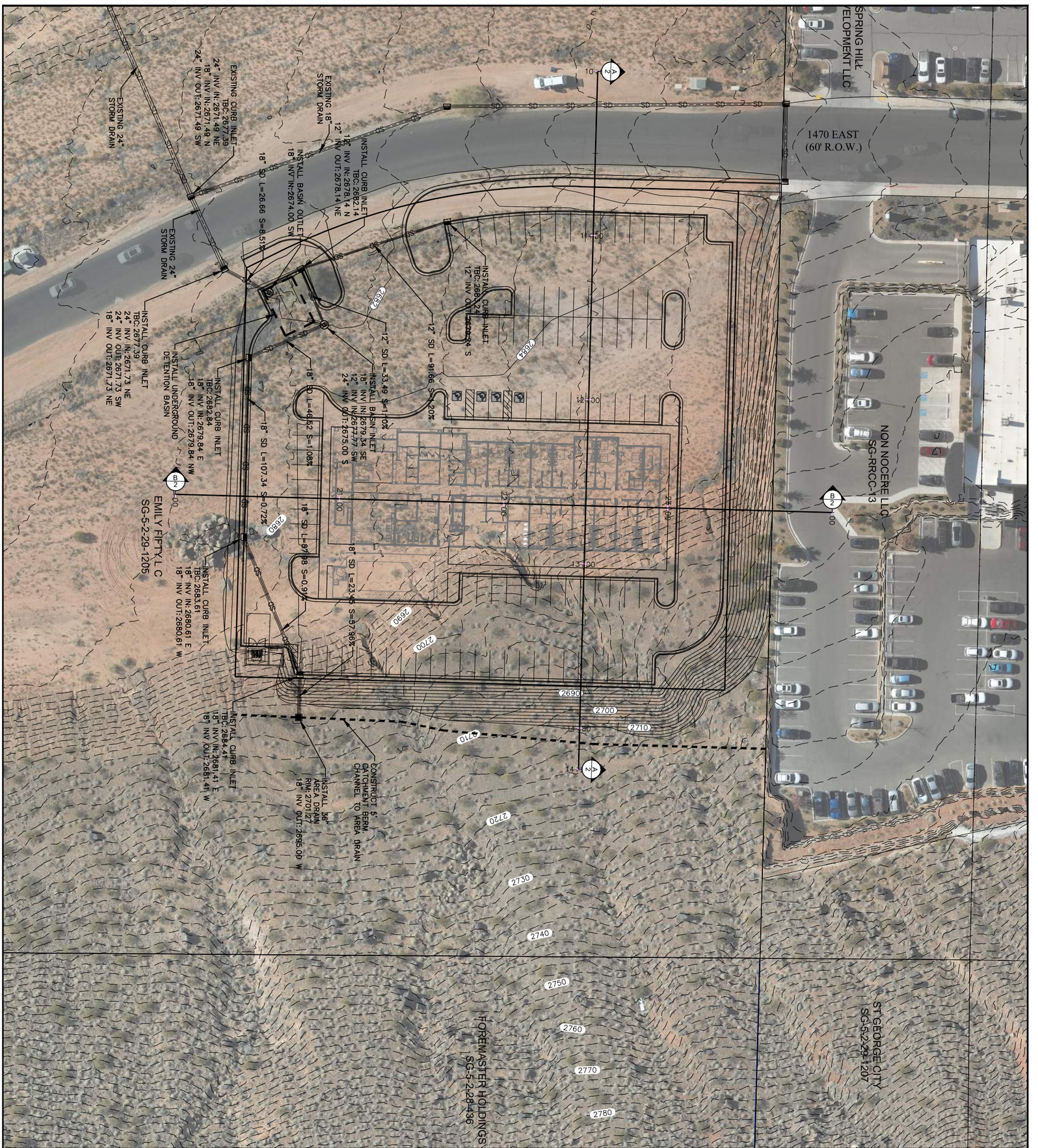

GRAPHIC SCALE
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1 inch = (IN FEET)
1 inch = 30ft. (22x34 SHEET)
60ft. (11X17 SHEET)

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SITE PLAN

@ HOME BEST WESTERN
ST. GEORGE, UTAH

ALPHA ENGINEERING
43 South 100 East, Suite 100 • St George, Utah 84770
T: 435.628.6500 • F: 435.628.6553 • alphaengineering.com

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REVISIONS	NO.	DATE	BY	DESCRIPTION

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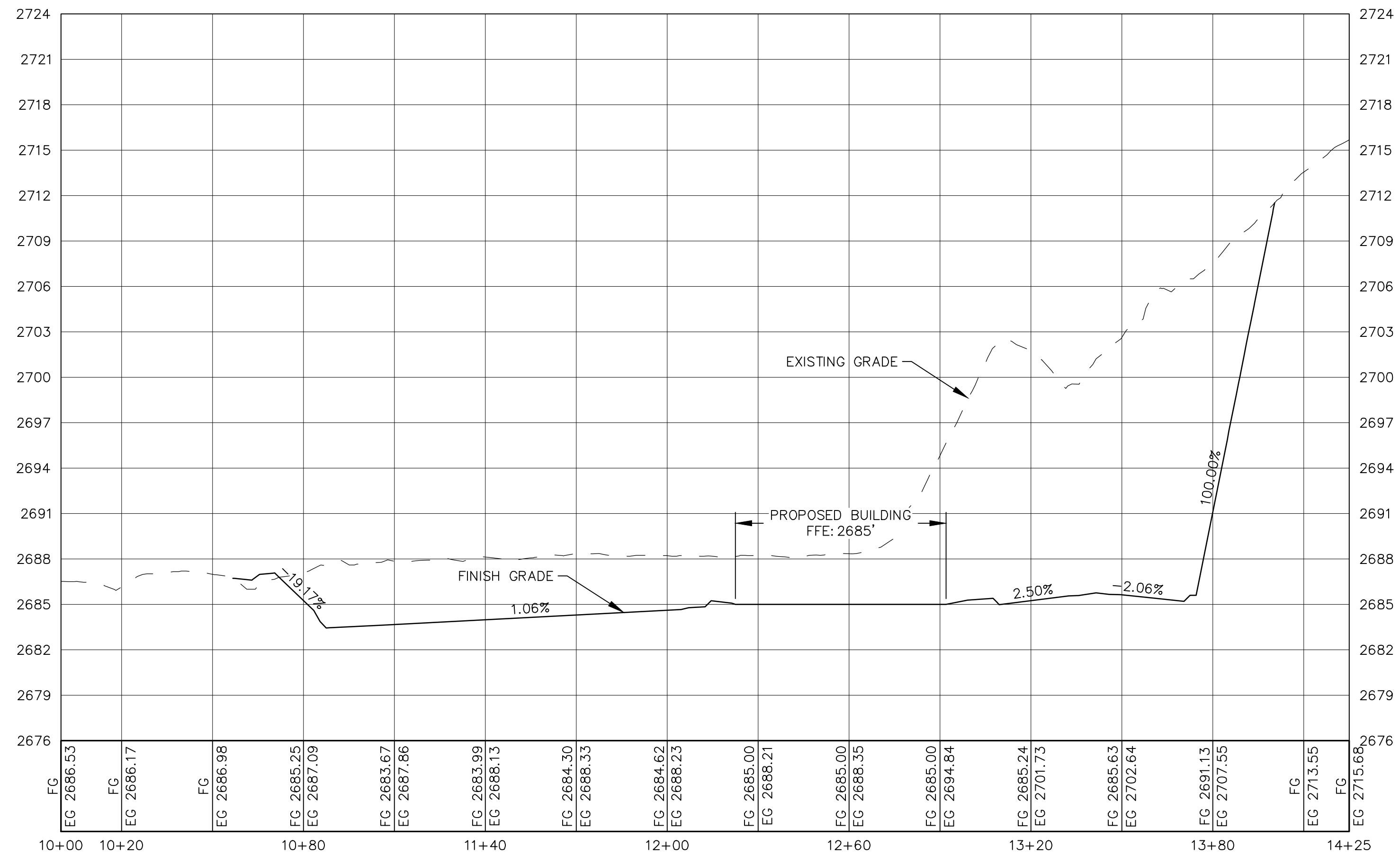
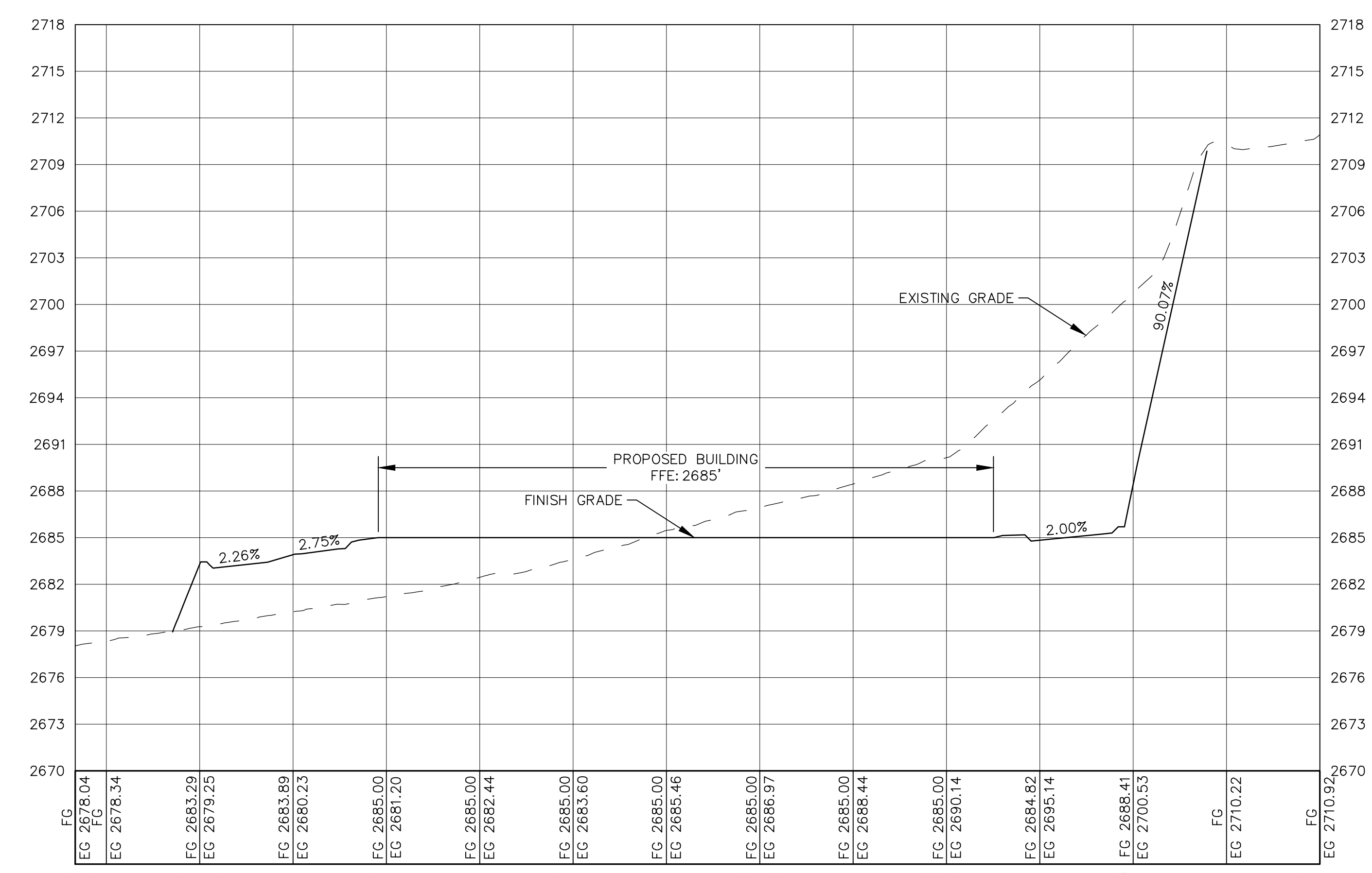
SHEET: 1 OF 2
PROJECT #: 2043-01
NAME: RKB
DATE: FEBRUARY 7, 2024
SCALE: AS NOTED





NO.	DATE	BY	DESCRIPTION

REVISIONS

PRELIMINARY
NOT FOR CONSTRUCTION

ALPHA ENGINEERING
43 South 100 East, Suite 100 • St George, Utah 84770
T: 435.628.6500 • F: 435.628.6553 • alphaengineering.com

TITLE
CROSS SECTIONS

PROJECT
@ HOME BEST WESTERN
ST. GEORGE, UTAH

PROJECT # 2043-01
NAME RKB
DATE FEBRUARY 7, 2024
SCALE AS NOTED

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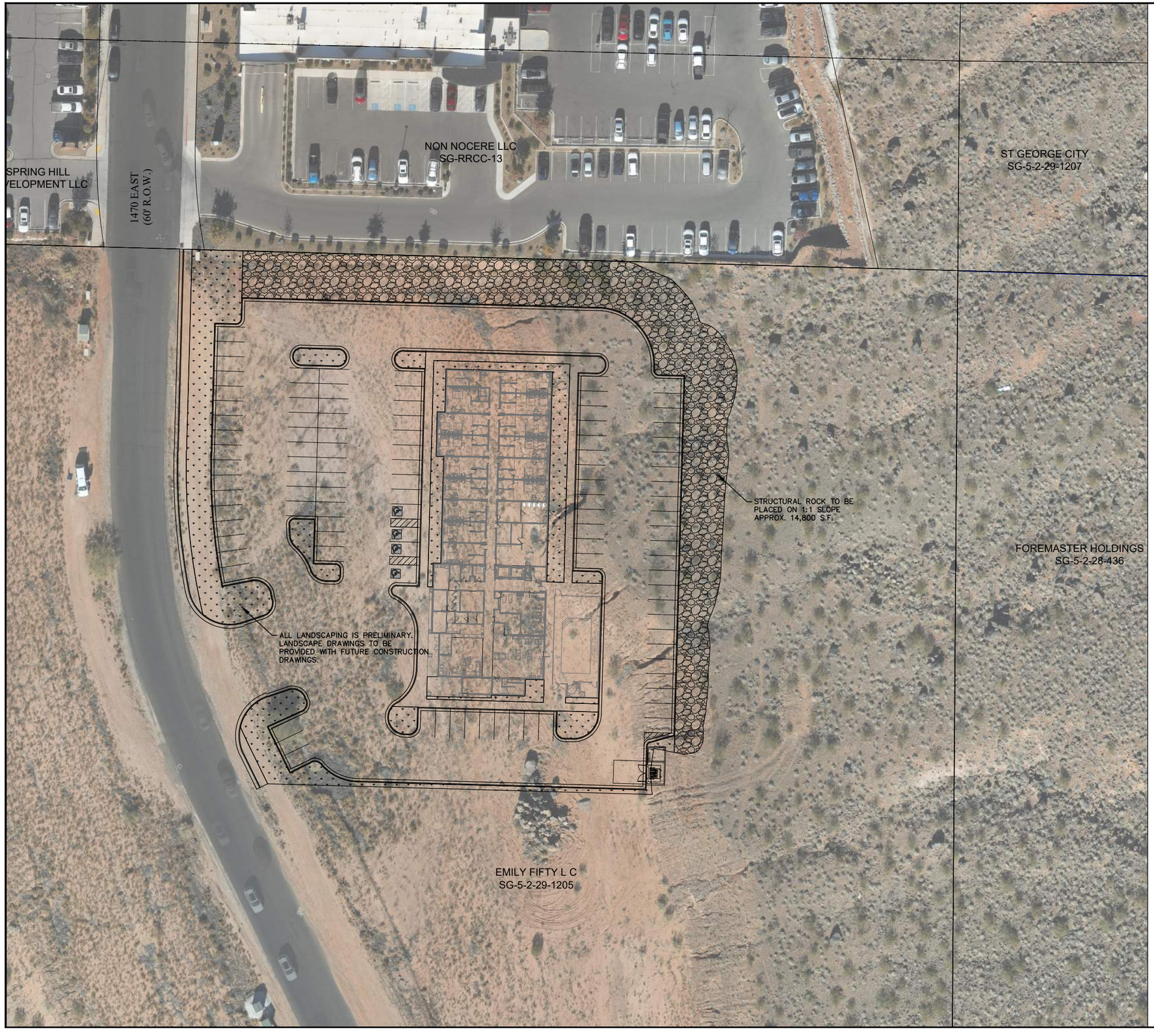
EXHIBIT C

Landscape & Vegetation Plan



LANDSCAPE NOTES

1. DISTURBED SLOPES TO BE LINED WITH ROCK FOR STRUCTURAL PURPOSES.
2. IRRIGATION WILL NOT BE PLACED ON THE DISTURBED 1:1 SLOPES.
3. LANDSCAPE & IRRIGATION PLANS WILL BE PROVIDED WITH FUTURE CONSTRUCTION DRAWINGS. ALL LANDSCAPING AND IRRIGATION WILL CONFORM TO ST. GEORGE CITY STANDARDS AND REQUIREMENTS.

GRAPHIC SCALE

30 0 15 30 60 120

(IN FEET)

1 inch = 30ft. (22x34 SHEET)

1 inch = 60ft. (11X17 SHEET)

N

NO.	DATE	BY	DESCRIPTION

REVISIONS

PRELIMINARY
NOT FOR CONSTRUCTION

ALPHA ENGINEERING
43 South 100 East, Suite 100 • St George, Utah 84770
T: 435.628.6500 • F: 435.628.6553 • alphaengineering.com

TITLE: LANDSCAPE & VEGETATION PLAN

PROJECT: @ HOME BEST WESTERN
ST. GEORGE, UTAH

PROJECT #	2043-01
NAME	RKB
DATE	FEBRUARY 7, 2024
SCALE	AS NOTED
SHEET	1 OF 1
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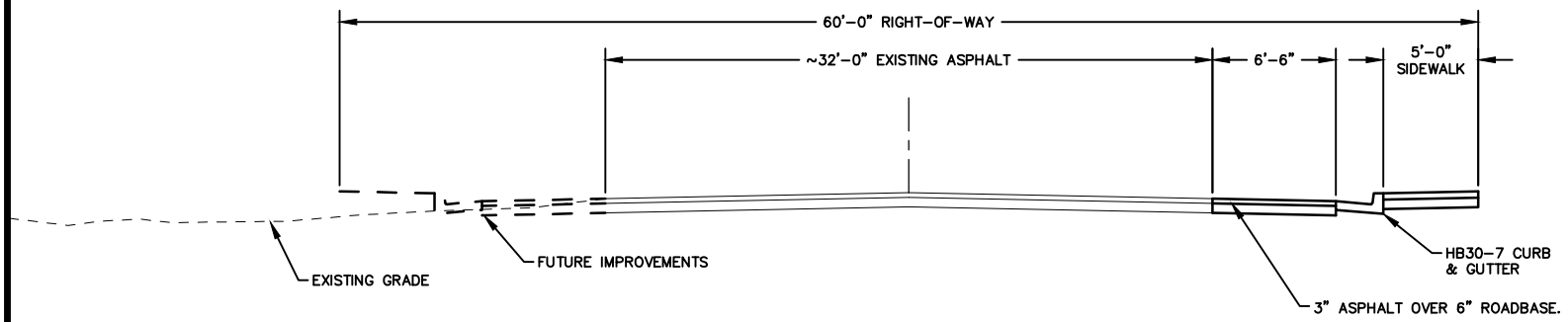
EXHIBIT D

Street Design



1470 EAST ROAD
NTS

STREET DESIGN - @ HOME BEST WESTERN

	RKB	ST. GEORGE, UTAH

ALPHA ENGINEERING
43 South 100 East, Suite 100 • St George, Utah 84770
T: 435.628.6500 • F: 435.628.6553 • alphaengineering.com

EXHBIT E

Earth Moving Plan

EARTH MOVING NOTES

1. SUITABLE EXISTING MATERIAL WILL BE USED FOR FILL ON-SITE.
2. EXCESS AND UNSUITABLE MATERIAL WILL BE REMOVED FROM THE SITE.
3. ANTICIPATED OPERATIONS MAY INCLUDE:
   - CAT D-6 DOZERS
   - CAT 980 SIZE LOADERS
   - CAT 345 SIZE EXCAVATORS

ANTICIPATED SCHEDULE:

BEGIN GRADING BY: OCTOBER 1, 2024

FINISH GRADING BY: DECEMBER 31, 2024

FINISH ROCK STACKING BY: JANUARY 31, 2025

TERRAIN DESCRIPTION

THE EAST PORTION ADJACENT TO 1470 EAST HAS BEEN ROUGH GRADED FOR FUTURE DEVELOPMENT. TOPOGRAPHY EXTENDS UPWARD ROUGHLY 200 FEET FROM THE PROPOSED BUILDING ELEVATION OVER ROUGHLY 400 FEET HORIZONTALLY, GIVING AN AVERAGE GRADE OF 2 HORIZONTAL TO 1 VERTICAL. THE GRADE IS NOT CONSISTENT AND STEEPENS SIGNIFICANTLY TOWARDS THE TOP WITH LOCALIZED GRADES APPROACHING 1H:1V AND IS CAPPED WITH COLUMNAR BASALT. VEGETATION ON SITE IS SPARSE WITH SOME DESERT SHRUBS AND GRASSES PRESENT. THE MAJORITY OF THE GROUND SURFACE IN THE DEVELOPMENT AREA IS BARE EARTH AND ROCK FIELDS.

GRAPHIC SCALE

30 0 15 30 60 120

(IN FEET)

1 inch = 30ft. (22x34 SHEET)

1 inch = 60ft. (11X17 SHEET)

N

NO.	DATE	BY	DESCRIPTION

REVISIONS

PRELIMINARY
NOT FOR CONSTRUCTION

ALPHA ENGINEERING
43 South 100 East, Suite 100 • St George, Utah 84770
T: 435.628.6500 • F: 435.628.6553 • alphaengineering.com

TITLE: EARTH MOVING PLAN

PROJECT: BEST WESTERN @ HOME
ST. GEORGE, UTAH

PROJECT # 2043-01

NAME RKB

DATE FEBRUARY 7, 2024

SCALE AS NOTED

SHEET 1

1 OF 1

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EXHIBIT F

Geotechnical Report (Rockfall Study)

GEOTECHNICAL ENGINEERING REPORT

Prepared for:

Home Hospitality Group

Attn: Nick Ence

107 South 1470 East Suite #302

St. George, Utah 84790

February 6, 2024

(Edited: February 7, 2024

@Home Best Western

PROFESSIONAL ENGINEER
2/7/24
No. 13760330
CHAD S. HARDMAN
STATE OF UTAH

Prepared by:

LANDMARK TESTING & ENGINEERING

795 EAST FACTORY DRIVE
ST. GEORGE, UT 84790

Landmark Project No: 240016

February 6, 2024 (Edited: February 7, 2024)

Home Hospitality Group
Nick Ence
107 South 1470 East, Suite 302
St. George, Utah 84790

Subject: Geotechnical Engineering Report
@Home Best Western
St. George, Utah
Landmark Project No.: 240016

Mr. Nick Ence,

Landmark Testing and Engineering (Landmark) has completed a Geotechnical Engineering Report for the proposed hotel development located at approximately 335 South 1470 East in St. George, Utah. The geotechnical recommendations, including foundation design, pavement design, slope stability analysis, and rockfall analysis, along with our field and laboratory data are presented in this report. This work has been done in general accordance with Landmark proposal YP4756 dated December 1, 2023 and your subsequent authorization of the work.

The field investigation consisted of eight test pits excavated to a maximum depth of 15 feet below ground surface (bgs) and one trench to 8 feet bgs. Additionally, Landmark performed one refraction microtremor (ReMi) array proximate to the proposed structure, and rockfall and slope stability reconnaissance.

Conventional spread footings bearing on structural fill are recommended for structural support of the proposed structures. Over-excavation and recompaction, as detailed in Section 6.0 of this report, will be required. The existing soils, free from organics and other debris are suitable for use as structural fill.

To reduce the risk to life and property against potential rockfall hazards, we also recommend the construction of a rockfall protection method. We have provided parameters and analysis assuming an earthen berm will be constructed along the eastern property line above the top of the proposed 1 horizontal to 1 vertical (1H:1V) to be cut in that area.

Landmark has great interest in providing materials testing and special inspection services during the construction phase of this project. If you advise us of the appropriate time to discuss these engineering services, we will be pleased to meet with you at your convenience.

Please feel free to contact our office at (435) 986-0566 if you have any questions.

Sincerely,
LANDMARK TESTING AND ENGINEERING

Steven Wells, P.E.
Geotechnical Manager

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@HOME BEST WESTERN
ST. GEORGE, UTAH

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@HOME BEST WESTERN
ST. GEORGE, UTAH

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FIGURE A-3:	**Critical Cross Section S-S'**
FIGURES A-4 through A-11:	**Test Pit Logs**
FIGURE A-12:	**Trench Profile**
FIGURE A-13:	**Unified Soil Classification System**

APPENDIX B – Laboratory Test Results

TABLE B-1:	**Summary of Laboratory Test Results**
FIGURE B-1:	**Consolidation Curve**
FIGURE B-2:	**Modified Proctor Curve**
FIGURE B-3:	**CBR Curve**
FIGURES B-4 and B-5:	**Soil Classification Reports**
FIGURE B-6:	**Water-Soluble Sulfate Report**

APPENDIX C – Shear Wave Velocity Analysis

FIGURE C-1:	**Shear Wave Velocity Report (2 Pages)**
FIGURE C-2:	**ASCE Hazard Tool Seismic Output (3 Pages)**

APPENDIX D – Slope Stability Analysis

FIGURE D-1:	**Slope Stability Profiles for Static and Seismic**
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APPENDIX E – Rockfall Study

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FIGURE E-2:	**RocFall2 – Round Rock Paths**
FIGURE E-3:	**RocFall2 – Rock Paths with Berm**
FIGURE E-4:	**Typical Berm Detail**
FIGURE E-5:	**RocFall2 – Rockfall Report**

1.0 INTRODUCTION

This report presents the results of Landmark Testing & Engineering's geotechnical investigation and analysis for the proposed @Home Best Western development in St. George, Utah. Figure A-1 is a Vicinity Map showing the project location relative to surrounding features. Figure A-2 is a Site Map showing the proposed project layout and the approximate locations of the test pits completed for this investigation. Figure A-3 shows the critical cross section line used for slope stability and rockfall analysis.

This investigation was completed to assist in developing opinions and recommendations concerning site earthwork and foundation design.

2.0 PROPOSED CONSTRUCTION

A preliminary site layout and grading plan has been provided to us and reviewed in preparation of this Geotechnical Engineering Report. We understand that development of the 2.27-acre project site will include construction of a three- to four-story hotel, associated asphalt paved parking and driveways, and dumpster pad. It is anticipated that the east side of the property will be cut as much as 30 feet down to the parking lot elevation. The south end of the development area will be filled roughly 10 feet to meet the proposed design grades.

Building loads are expected to be on the order of 3,500 to 4,500 pounds per linear foot along strip footings, with point loads on pad footings up to 100 kips. Traffic loads are anticipated to be equivalent to residential average daily traffic with heavy use drive aisles providing access to the garbage enclosure.

Any significant changes to the anticipated development should be reviewed by Landmark to evaluate the continued applicability of the recommendations contained in this report.

3.0 SITE SETTING

3.1 SURFACE CONDITIONS

The project is located at approximately 335 South 1470 East on Parcel SG-5-2-29-1205. The entire lot is roughly 21 acres, with the proposed development being in the northernmost 2.27 acres. This lot is immediately South of the Mesa Medical Center located at 295 South 1470 East. The southern majority of the property has been rough graded for future development, and the property has frontage onto 1470 East to the west. Historical imagery shows that the western portion of the lot has been roughly graded around 2013.

Foremaster Ridge extends upward immediately east of the property. Topography extends upward roughly 200 feet from the proposed building elevation over roughly 400 feet horizontally giving an average grade of 2 horizontal to 1 vertical (2H:1V). The grade is not consistent and steepens significantly towards the top with localized grades approaching 1H:1V and is capped with columnar basalt, which is a known source for rock fall. Storm water has cut channels into the slope, and the landscape is scattered with rocks ranging from 10 feet to 2 feet.

Vegetation on site is sparse with some desert shrubs and grasses present. The majority of the ground surface in the development area is bare earth and rock fields.

3.2 GEOLOGIC SETTING

According to the Utah Geological Survey,[1] the project site is mapped as located on:

Qmt: Talus (Holocene to upper Pleistocene)
Poorly sorted, angular boulders and finer-grained interstitial sediment deposited principally by rock fall on and at the base of steep slopes; typically grades downslope into colluvial deposits and may include colluvial deposits where impractical to differentiate the two; also includes alluvial deposits in the bottom of washes, and, in the Smith Mesa quadrangle, locally includes small landslide deposits along the outcrop belt of the Petrified Forest Member of the Chinle Formation; generally less than 30 feet (9 m) thick.

This colluvial Talus layer is likely underlain by:

Jks: Springdale Sandstone Member of Kayenta Formation (Lower Jurassic)
Medium- to thick-bedded, fine- to medium-grained sandstone with planar and low-angle cross-stratification, and minor, thin, discontinuous lenses of intraformational conglomerate and thin interbeds of moderate-reddish-brown or greenish-gray mudstone and siltstone; contains locally abundant petrified and carbonized fossil plants.

Materials encountered during the subsurface exploration of the property coincide with geologic mapping by the UGS.

3.3 GEOLOGIC HAZARDS

The St. George basin lies within the physiographical transitional zone between the Colorado Plateau to the east and the Basin and Range Province to the west. Southwestern Utah is located on a structural block proximate to the southern segment of the Intermountain Seismic belt, which is characterized by high-angle normal faults that tend to step down to the west. The Hurricane fault with an offset of 6,000 to 8,000 feet forms the eastern edge of the transition zone. The Grand Wash-Reef Reservoir-Gunlock fault system with displacement of about 1,500 to 3,000 feet forms the western edge.

Fault Rupture

The trace of the Washington Fault Zone is located approximately 3 miles east of the site with the Hurricane Fault roughly 13 miles to the east. The Utah Geologic Survey indicates that these faults displace late Quaternary sediments and are considered active. Strong ground motion associated with movement along these, or other faults associated with the Intermountain Seismic Belt is possible, however, the potential for surface fault rupture is considered low.

Although the potential for surface rupture caused by activity from either of these faults is low, there is potential for strong ground motion at the site due to possible fault rupture at these or other localized faulting zones. These ground motions are considered by the ASCE 7-16 seismic design parameters given in Section 3.4. Shear wave velocity analysis was performed to assist in seismic classification of the site as outlined in Section 3.4.

1 Utah Geological Survey (UGS), Interactive Geologic Map Portal, Accessed February 5, 2024

Liquefaction

Liquefaction is the sudden loss of shear strength in the soil due to the build-up of excess pore water pressure.[2] This can occur when the soil is subjected to intense shaking such as during a seismic event. The soils that are most susceptible to liquefaction are loose, saturated sandy soils with a low fines content (material passing the #200 sieve).

According to the Utah Geological Survey,[3] the soils in the project area are mapped as being low liquefaction-susceptibility zone. Soils encountered in the test pits are Silty Sands with minor Clayey Sands. Groundwater was not encountered in our test pits during our investigation and therefore liquefaction potential may be considered low. A liquefaction study is beyond the scope of this report.

Slope Stability

Global slope stability is a concern when a native or constructed slope is steep enough that the resisting forces in the soil may be overcome by the mobilization forces acting downward on a section of soil. Different soil types and slope geometry can greatly impact the stability of a given slope grade. In general, a soil slope of 2H:1V is considered stable and does not require additional analysis.

The preliminary grading plan shows that in order to establish the desired parking lot and building grades for the development, a slope of 1H:1V will need to be cut in the eastern portion of the project. Beyond the proposed cut, the slope continues upward in a relatively steep manner. Slope stability analysis has been performed as described in Section 4.3 and Section 5.1.

Rockfall

The proposed development is shown on the UGS geologic hazards map as being located within a high rockfall hazard area. The project area and the slope further east exhibit signs of rockfall including the presence of geologically young basalt which has become detached from the Lava Ridge Lava Flow source which is present east of the property as shown in Figure A-3. Landmark has performed rockfall analysis as outlined in Section 4.3 and 5.2

Expansive soils

The site is shown on the UGS geologic hazards map as being partially located in a low expansive soil hazard area. Expansive soils are clays and claystone which changes volume due to moisture content changes. Expansive soils were not encountered in our test pits.

It is possible for expansive soil to be present in areas beyond our exploration locations. As such, excavating contractors should be vigilant in observation of soil conditions. If highly plastic soils which are unusual in color are found on site, Landmark should be contacted for further evaluation and recommendations.

Collapsible Soils

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2 Coduto, Donald P. (1999), Geotechnical Engineering: Principles and Practices, Prentice Hall, Upper Saddle River, NJ

3 St. George-Hurricane Metropolitan Area Geologic-Hazard Study, Knudsen, Tyler R., Utah Geologic Survey Special Study 127.

The site is shown on the UGS geologic hazards map as being located in Type 2 Collapsible Soil hazard area. Collapsible soils are considered to have considerable strength when in a dry, natural state, but significantly settle due to hydro compaction, reduction of air space when the soil is wetted. Soils encountered on site exhibited signs of collapsibility which were confirmed by laboratory testing.

Collapsible soils pose significant hazard to the development. For recommendations related to collapsible soils, refer to Section 6.0.

3.4 SEISMICITY

Seismicity at the site was determined using ASCE Hazard Tool from ASCEhazardtool.org website. Consideration should be given to the risk category of the building. It is assumed in this report that the building is risk category II as determined by International Building Code (IBC) Table 1604.5. It is possible that risk category III is more appropriate, depending on the intended use and capacity of the structure. If this is the case, applicable design considerations should be followed.

A Shear Wave Velocity Study was conducted on the project site as shown on the site map in Figure A-2. Landmark determined the average shear wave velocity of the upper 100 ft (Vs,100) of the site soil profile on the project according to the refraction microtremor method (ReMi). The ReMi data showed that the Vs,100 of the site soils is 1,756 ft/sec, which classifies the site as "C." The ReMi data is included as Figure C-1. This correlates well with soils encountered in the test pits. Bedrock was found in the ReMi data, although it is difficult to define as the near surface rock is heavily weathered in places. There are significant strength increases seen at roughly 8 feet and 16 feet bgs, with another increase at roughly 36 feet bgs as shown in Figure C-1.

The following values are presented to assist with seismic design:

- Latitude = 37.102952° North, Longitude = 113.551219° West
- V_s = 1,756 ft./sec.
- Site Class = C – Very Dense Soil and Soft Rock, based on ASCE 7 as referenced in 2021 IBC

Period (sec)	Sa (g)	Site Class
0.2	S_S = 0.521	B/C
1.0	S_1 = 0.169	B/C
0.2	S_{DS} = 0.448	C
1.0	S_{D1} = 0.169	C

The complete ASCE Hazard Tool output is attached as Figure C-2.

4.0 INVESTIGATION

4.1 FIELD INVESTIGATION

To investigate the subsurface conditions, 8 test pits and a trench were excavated to a maximum depth of 15 feet. Test pits were excavated using a CAT 336F mid-sized trackhoe with a 4-foot

toothed bucket. Depending on subsurface conditions, bag or block samples of soil were obtained from the test pit excavations. Test pit and trench designations and approximate locations are shown on Figure A-2.

Landmark geologist Michael Meyers supervised the excavation. A log of the subsurface conditions was prepared, samples were collected and sealed for transport, and relevant site photographs were taken. Groundwater was not encountered in the test pits at the time of investigation.

Soil conditions were variable across the property. Near surface soils especially up on the slope along the eastern portion of the development area consisted of silty sand to lean clay with various amounts of fines and gravels as well as basalt boulders in some locations. Underlaying these colluvial deposits at various depths, materials transitioned to mudstone or sandstone which was difficult to excavate, and in many cases, the test pits were terminated due to refusal.

Complete test pit logs are presented on Figures A-4 through A-11 with the trench profile as Figure A-12. A key to the soil classifications used on the logs is presented as Figure A-13.

4.2 LABORATORY TESTING

Soil samples from the test pits were taken to our St. George, Utah laboratory for testing. Tests performed on the samples included:

- Moisture content and unit weight for density determination
- Sieve analysis and Atterberg Limits for soil classification
- One-Dimension Consolidation for earthwork design
- Modified Proctor for construction testing
- California Bearing Ratio (CBR) for pavement section design
- Soluble Sulfate Content for concrete mix design selection

A sample from TP-4 at 12 feet bgs was tested for soil classification. The sample had a moisture content of 3.7 percent. Atterberg Limit testing showed that the sample had a liquid limit of 20 with a plasticity index of 4 indicating low plasticity. Mechanical sieve analysis showed that the sample was 11 percent gravel, 47 percent sand, and 42 percent silt and clay. According to the USCS, this soil is classified as Silty Clayey Sand (SC-SM).

Another sample from TP-5 at 3 feet bgs was tested for soil classification. The sample had a moisture content of 3.7 percent. Atterberg Limit testing showed that the sample was non-plastic. Mechanical sieve analysis showed that the sample was 19 percent gravel, 58 percent sand, and 32 percent silt and clay. According to the USCS, this soil is classified as Silty Sand with Gravel (SM).

A sample taken from TP-6 at 2 feet bgs was tested for consolidation. The sample had a density of 89.4 pcf with a moisture content of 4.4 percent. This sample collapsed 4.1 percent under a 1.5 ksf load in a saturated condition. This is considered highly collapsible. For recommendations related to collapsible soil see Section 6.

A sample taken from TP-7 at 1.5 feet bgs was tested for water soluble sulfate content. The sample tested had 1.89 percent soluble sulfate which is considered highly corrosive according to the American Concrete Institute (ACI) Section 318. For recommendations related to corrosive soils, refer to Section 12.0.

A bulk sample taken from TP-2 was tested for maximum dry density, optimum moisture, and CBR.

According to modified Proctor testing, the sample has a maximum dry density of 123.2 at an optimum moisture of 10.2 percent with a CBR of 38.

The results of the laboratory tests are shown on the test pit logs as well as on the attached Summary of Laboratory Test Results on Table B-1. Individual test results are also included in Appendix B.

4.3 ROCKFALL AND SLOPE STABILITY RECONNAISANCE

To determine the rockfall and slope stability hazard present on the site, a Landmark engineer visited the property to document the surface conditions of the slopes, their characteristic roughness, approximate grade, and the typical boulder size. The general direction of the slope, and the likely path if rockfall or slope failure were to occur.

The basalt cap of Foremaster Ridge is considered the main source of rockfall in the area. The parking lot is roughly 430 horizontal feet west of the rock source and the structure is approximately 500 feet west. Critically, the proposed 1H:1V cut slope is roughly 390 horizontal feet from the rock source. The area between the proposed structure and the top of the slope is mapped by UGS as talus deposits.

In general, the topography of the slope steepens towards the top, with grades near the bottom of 3H:1V and steepening to nearly 1H:1V at the top. The rock source zone is nearly vertical with severely fractured columnar basalt from the Lava Ridge lava flow being exposed. The topography of the slope is moderately hummocky as is common in areas of colluvial activity. Stormwater has scoured out canals and channels of various sizes trending generally parallel to the grade of the slope.

The slope is lightly vegetated with desert shrubs and grasses. Boulders of various sizes and shapes are scattered across the slope and into the development area. There is evidence of a significant rockfall event that occurred relatively recently above the proposed development, the separated rock segment was very large and blocky.

As previously mentioned, the proposed development includes cutting a 1H:1V slope at the toe of the existing grade. This increases the potential acceleration zone of potential rockfall and may be a detriment to the global stability of the natural slope. As such, Landmark has performed analysis of the global slope stability and rockfall analysis as outlined in Section 5.0. Recommendations for site grading and earthwork pertaining to this analysis are given in Section 6.0.

5.0 ANALYSIS AND CONCLUSIONS

Our field and laboratory tests results indicate that near surface soils on site consist of colluvial silty sand which is intermixed with gravel, cobbles, and boulders especially along the western portion of the project area. These sands are underlain by mudstone and sandstone which was difficult to excavate with the mid-sized trackhoe used for the exploration. Several of the test pits reached refusal as shallow as 7 feet bgs.

Near surface sands exhibited signs of collapsibility in the field. In addition, a consolidation test performed on a sample from TP-6 collapsed 4 percent under 1.5 ksf loading under saturated condition which is highly collapsible. Therefore, we recommend that loose soils beneath footings and floor slabs of the hotel structure be excavated prior to construction. General recommendations for the earthwork and the foundation system are outlined in Sections 6.0 and 7.0 of the report.

Slope stability and rockfall analysis was performed along a critical cross section S – S' shown on Figure A-3. This section was selected as the most critical due to it being the tallest section of the 1H:1V cut as well as due to the steepness of the natural slope above the proposed cut. The selection of this critical cross section is based on the preliminary grading plan provided to Landmark. Should the grading plan change, Landmark should be contacted to evaluate the continued efficacy of the design.

5.1 SLOPE STABILITY ANALYSIS

Slope stability analysis is the quantitative and qualitative analysis of the condition of a man-made or natural slope. In the case of this project, the slope analyzed is both the man-made cut as well as the natural slope above the proposed cut.

To perform the analysis, appropriate soil properties, slope geometry and other conditions were established. Calculations were then performed to ensure that resisting forces are sufficiently greater than the forces tending to cause a slope to fail.[4] Ultimately, a factor of safety (FS) is determined by comparing the resisting forces to the sliding forces along a potential failure surface.

To assist with analysis, RocScience Slide2 software was used to perform the calculations. Both the static and seismic conditions for the geometry and condition as shown in Figures D-1 and D-2 were analyzed using a variety of methods. For the conditions analyzed, the slope, cut at a 1H:1V as shown in the preliminary grading plan is stable for the static and seismic condition.

This assumes that the lower 20 feet of the cut will be comprised of competent sandstone material and the remaining soil consists of sandy colluvial material as encountered in TP-1. The slope stability output provided by RocScience is attached as Figure D-2. This report contains assumptions and limitations used in the analysis.

Landmark should be called on site to assess the soil conditions as the slope is being cut. Should soil conditions encountered during construction vary somewhat from the conditions found during the investigation, Landmark should perform further analysis of the "as-built" condition.

5.2 ROCKFALL ANALYSIS

A two-dimensional model of the natural slope, and then the design critical cross section S-S' was modeled in the Colorado Rock-Fall Simulation Program (CRSP) as well as in RocScience Rocfall2 software to evaluate the potential runout zone below the rock source. Firstly, analysis was done on the natural slope to verify the parameters of the model. Modeling of various rock shapes and sizes in Rocfall2 show relatively similar distribution as found in the field.

Based on the geometry provided in the preliminary grading plan, a variety of rock shapes and sizes were simulated in Rocfall2 and CRSP. Across several iterations, roughly 5 to 10 percent of the rocks analyzed reached the 1H:1V cut slope and then accelerated into the parking lot. Some rocks approached the proposed hotel site as shown in Figures E-1 and E-2.

4 Duncan, M.J. et al (2014), *Soil Strength and Slope Stability Second Edition*, Wiley Publishing, Pg. 81-101

Rockfall Recommendations

Based on our site evaluation and rockfall simulations, it appears that there is a risk of rockfall reaching the parking lot area, and a slight risk of falling rocks reaching the proposed structure footprint.

To reduce the risk of rockfall and damage to property and life, mitigation measures are recommended. We reviewed several mitigation options including concrete barriers, catchment fences, and an earth fill catch berm. The least invasive mitigation measure is the construction of a catch berm along the eastern property line of the lot. This berm should extend across the entirety of the proposed 1H:1V cut slope. A proposed berm detail is included in Figure E-4. Rocfall2 simulations indicate that the berm would be successful at reducing the risk of rocks reaching the cut slope and accelerating into the parking area. Concrete barriers and catchment fences would need to be designed for the potential rockfall energy.

6.0 SITE GRADING AND EARTHWORK

6.1 GENERAL GRADING

Site preparation should initially consist of grubbing and removal of vegetation. Grubbing is expected to be minimal, as most of the development area is bare earth.

The preliminary grading plan shows that the development area will be cut some 30 feet from the existing grades in the north and western portions of the site and roughly 10 feet of fill in the south and eastern portions of the site.

Near surface soils consisted of silty sand to lean clay with gravel, cobbles, and boulders intermixed. These soils exhibited high potential for collapse under loaded, saturated conditions.

Building Pad

In the area of the hotel building pad, we recommend that at least 4 feet of material be over-excavated from the existing ground surface. This excavation should extend 5 feet horizontally beyond the building envelope in all directions. Consideration should be given to over-excavating hardscaped areas around the perimeter of the building as well. If at any point sandstone bedrock is reached, the over-excavation may be considered complete at that point.

Once the over-excavation is complete, the bottom of the excavation should be scarified, moisture conditioned to within 2 percent of the optimum moisture, and recompacted to 90% of maximum dry density as determined by ASTM D1557 Modified Proctor testing. If the bottom of the excavation is into bedrock, scarification is not required.

Following over-excavation, a Landmark engineer or geologist should observe the excavation to document the depth of the excavation and determine if subsurface conditions match those found in our filed investigation. Alterations to our recommendations may be required if substantially different conditions are encountered.

Once the over-excavation is complete, the contractor may begin placing structural fill as outlined in Section 6.2. On site soils which are free of over-sized material exceeding 6 inches may be used as structural fill on site. Shrinkage of the on-site soils should be expected on the order of 25 percent volume reduction. Imported material may be required to establish desired grades. Foundations

should be established on a minimum of 1 foot of structural fill, and not established directly on bedrock to limit the potential for differential settlement.

Landmark does not determine the location of the over-excavation or the location of the structures to be constructed. The builder is responsible to ensure that the building footprint is entirely within the over-excavated and recompacted building pad.

Pavement Area

Based on observation of the preliminary grading plan provided to Landmark, much of the portions of the project to be paved will be in areas of mass grading. The parking lot in the northeast will be significantly cut below existing grade, and the parking lot to the southwest will be on fill. In areas where the grading transitions from cut to fill, the contractor should ensure that at least 1 foot of structurally placed fill material is installed under pavement areas, curbs, and sidewalk to reduce the risk of settlement due to collapsible soils.

Catchment Berm

To reduce the risk of damage to life and property from rockfall hazard, Landmark recommends that a catchment berm be constructed along the top of the 1H:1V cut slope proposed along the eastern portion of the property. A typical detail for this berm is provided as Figure E-4. This berm should be constructed such that the total height of the berm is at least 5 feet high relative to the uppermost existing grade. This berm should be setback at least 5 feet from the top of the cut slope. The core of the berm should be constructed out of onsite sandy soils which have been compacted to 95% of ASTM D-1557. There should be roughly 3 feet of loose screened fill placed on the uphill side of the berm.

This berm should extend roughly the entire length of the cut slope. Modifications to this design maybe made in the field by a Landmark engineer should grading of the site warrant such a change.

6.2 FILL PLACEMENT AND COMPACTION

All fill to be placed for support of footings and slabs-on-grade should be considered structural fill. On-site soils with over-sized material removed are suitable for use as structural fill. However, we recommend that the floor slabs and footings be established on at least 12 inches of aggregate base course material or imported granular fill.

Imported, granular fill, if required, should be well-graded, non-expansive, and free of organics and all deleterious materials. Soils used for imported, granular fill should meet the following specifications and preferably would classify as gravel.

GRADATION	PERCENT PASSING
6- inch	100
3-inch	80-100
No. 200 sieve	10-25
ATTERBERG LIMITS	
Liquid Limit	30 or less

Plasticity Index	9 or less

Material not meeting the above requirements may be suitable for use as structural fill at the discretion of the geotechnical engineer. Samples of structural fill should be submitted for testing prior to transporting to the site.

Any on-site soils used as structural fill or imported, granular fill should be compacted to the following specifications.

FILL PLACEMENT AND COMPACTION	
Maximum lift thickness	8-inch (loose)
Minimum compaction	95% ASTM D-1557
Compacted Moisture Content	within 2% of optimum

Compaction of structural fill should be completed with equipment suitable for the conditions encountered in the field such that compaction requirements are met, including those areas that may be inaccessible to large rolling compactors. All structural fill should be evenly spread on a horizontal plane in eight-inch loose lifts. Each eight-inch lift of structural fill material placed at the site should be tested for compliance with the required relative compaction and moisture content prior to proceeding with additional lifts.

6.3 LIGHTLY LOADED ELEMENTS

Exterior concrete slabs on grade (sidewalks, curbs, gutters, and misc.) should be established on a minimum of 12-inches of structurally placed soils with a maximum particle size of 6-inches. Sidewalks adjacent to public right of ways will need to be underlain by approved road base as per City of St. George Standards.

Structural fill, including road base, should be compacted to a minimum of 95 percent of the maximum dry density as determined by ASTM D-1557.

6.4 CUT AND FILL SLOPES

It is recommended that permanent cut or fill slopes in silty sand soil be maintained at a slope of two horizontal to one vertical (2H:1V) or flatter unless structurally retained. The 1H:1V slope has been analyzed and is stable as shown in Section 5.0. The majority of the exposed cut face should be into competent sandstone material with less than 10 vertical feet of colluvium making up the slope.

Steeply cut slopes are subject to erosion and degradation over time. Consideration should be given to drainage and erosion control methods to limit the amount of maintenance required.

Grading of both cut and fill slopes should be such that surface water is directed away from the slopes and not concentrated on slopes or in unprotected channels. Construction procedures should ensure adequate compaction of slope faces. All excavations should conform to OSHA standards.

7.0 FOUNDATION & CONSTRUCTION CONSIDERATIONS

The proposed structures may be supported on conventional spread or continuous footings established on a minimum of 12 inches of aggregate base course or imported granular fill

overlaying structurally places silty sand. Foundation excavations should be visually observed and tested by qualified personnel prior to placement of reinforcing steel or concrete. Additional foundation recommendations are subsequently presented.

DESCRIPTION	VALUE
Foundation Type	Continuous or spread footings
Bearing Material	Aggregate Base Course or Granular Fill
Allowable Bearing Capacity	3,000 psf on Aggregate Base Course 2,800 psf on Granular Fill
Minimum embedment depth below finished grade	12 inches (for frost and confinement)
Minimum footing width	12 inches (continuous) for single-story 18-inches for two stories 24-inches (isolated spread)
Total estimated settlement	1-inch
Total differential settlement	less than 3/4 inch

The allowable bearing capacity is based upon dead load plus long-term live load. A one-third increase in allowable bearing capacity for short duration loads such as wind or seismic loads is permitted with the alternative load combinations given in Section 1605.3.2 of the IBC.

8.0 FLOOR SLABS

It is recommended that concrete floor slabs be constructed on a pad that has been prepared as previously indicated. A minimum of 4-inches of relatively free-draining material should be used beneath the slab in order to help distribute floor loads, break the rise of capillary water, and aid in the concrete curing process. Alternatively, 6 inches of road base may be used in place of the free draining-material. The thickness of the free-draining material may be included in the 12-inches of granular, structural fill.

Concrete slabs should be designed using rebar reinforcement and frequent crack control joints to help control normal shrinkage and stress cracking. Concrete placement and curing should meet ACI[5] requirements including following hot or cold weather placement recommendations, when appropriate. If a moisture-sensitive floor covering will be installed, we recommend that a vapor barrier be installed beneath the concrete slab. The moisture sensitivity of floor finishes, anticipated project conditions, and the potential effects of slab curling and cracking should be considered in determining if the barrier should be placed directly beneath the slab or beneath the free-draining gravel (see ACI 302.IR-96 for more information regarding vapor barrier location). If the vapor barrier is installed directly beneath the slab, measures should be taken to minimize excessive slab curl such as reduced joint spacing and use of a low shrinkage (low water-cement ratio) mix.

5 American Concrete Institute

9.0 LATERAL EARTH PRESSURES

Lateral loads imposed on footings may be resisted by the development of passive earth pressures against the sides of footings and friction between the base of the footing and the supporting soils. Lateral earth pressure values are presented in the following table.

Case Evaluated	Soil Type	Value
Active	Structurally placed Silty Sand	38 psf/ft
		56 psf/ft (with seismic)
At-Rest	Structurally placed Silty Sand	59 psf/ft
Passive	Structurally placed Silty Sand	407 psf/ft
		357 psf/ft (with seismic)
Seismic Coefficient	IBC 1610.1.1	0.179
Coefficient of friction tan(φ*0.6) where φ = 32°	Structurally placed Silty Sand	0.35

The lateral earth pressures presented do not include any safety factors except where the friction angle (φ) used to determine the coefficient of friction has been multiplied by 0.6 to account for smooth contact conditions. The pressures also assume horizontal backfill and that the backfill is in a drained condition with no build-up of hydrostatic pressure. The additional effects of sloping backfill, surcharge, structural loads and groundwater conditions should be included in calculating lateral earth pressures. Backfill should be placed in accordance with the requirements of structural fill except that backfill in landscape and areas that will not be subject to structural loadings may be reduced to 90 percent of the maximum dry density as determined by ASTM D-1557.

10.0 PAVEMENT DESIGN RECOMMENDATIONS

10.1 ASPHALT PAVEMENT

Design of the pavement sections are based on the procedures outlined in the 1993 Guidelines for Design of Pavement Structures by the American Association of State Highway and Transportation Officials (AASHTO). A Traffic Index of 5.5 was used for design of the parking areas and typical use drive aisles planned for the development. A heavy use section should be considered along the path to the garbage enclosure and any loading areas. A CBR value of 10 was used based on the soil encountered in our investigation and laboratory testing performed.

For pavement design, the following design parameters have been assumed:

Pavement Design Life	20 years
Subgrade CBR	10
Structural Layer Coefficients	Asphalt = 0.42
	Road Base = 0.12

Based on design parameters, the following pavement sections are provided.

Location	Asphalt Thickness (inches)	Base Course (inches)	Scarified and Compacted Subgrade (inches)
Typical Use (T.I = 5.5)	2.5	6	12
Heavy Use (T.I = 7.0)	3.5	8	12

Recompacted on-site soils should be compacted to a minimum of 95 percent of the maximum dry density as determined by ASTM D-1557 and base course soils should be compacted to a minimum of 95 percent of the maximum dry density (ASTM D-1557). Asphalt should be compacted to at least 96 percent of the Marshall maximum density. Asphaltic concrete and base should be tested prior to site delivery and during placement for conformance with project specifications.

10.2 CONCRETE PAVEMENT

We anticipate that a concrete pad may be installed by the dumpster or other areas with heavy truck traffic. Procedures outlined in the Portland Cement Association's guide "Thickness Design for Concrete Highway and Street Pavements" were utilized for concrete pavement design.

The following design parameters were used:

Average daily truck traffic = 0.5 (Axle -load category 1)
Subgrade-subbase support = moderate (based on site soils)
Concrete modulus of rupture = 600 psi (with fiber reinforcement)

Based on input parameters, a minimum of 5.5 inches of concrete and 6 inches of base over a properly prepared subgrade will be adequate. The design recommendations are based on the following assumptions:

Subgrade soils should be compacted to a minimum of 95 percent of the maximum dry density (ASTM D-1557). Concrete and base coarse materials and construction should meet the City of St. George specifications.

As a rough guide, the joint spacing in feet for plain concrete pavement should not generally exceed twice the slab thickness in inches. Thus, for a 5.5-inch-thick slab, joint spacing would be on the order of 11.0 feet as a maximum. Also, as a general guideline, the ratio of slab width to length should not exceed 1.25.

Joint depth should be 1/4 of the slab thickness and continuous across the slab. If sawn joints are used, the joints should be sawn as soon as possible following concrete set.

11.0 MOISTURE CONTROL

This soils report provides recommendations for site preparation and foundation design. Inadequate surface drainage or failure to control moisture will result in excessive differential movement of slabs, walkways, porches, or patios and structural damage, regardless of the site preparation. The following moisture control measures are recommended:

(1) Once the finish floor elevation has been established, the site grades should be constructed and maintained to drain surface and roof runoff away from the building

foundation at a slope of five percent for at least ten feet beyond the structure. The ground surface should be graded to drain away from the building in all directions. Water should not be allowed to pond adjacent to foundations or on-site.

(2) Grass should not be placed within 5 feet of the foundation. Grass, if planted, should have a minimum slope of 5% away from the foundation.

(3) Xeriscape (landscaping that eliminates the need for supplemental irrigation of plants) is recommended within 10 feet of the building foundation. Bubblers, although more efficient than sprinkler irrigation, still have a significant potential of introducing excessive water into the ground and saturating foundation soils. Bubblers are not recommended in the 10 feet buffer zone area. As an alternative, sealed bottom planter boxes may be used.

(4) Inadequate compaction of utility trench backfill provides a conduit for water migration. All utility trenches within the building footprint and extending 5 feet beyond the footprint should be backfilled with structural fill similar to that approved for the foundations. Backfill adjacent to structures should be compacted to at least 90 percent of the maximum dry density as determined by ASTM D-1557 and the minimum slope requirements should be followed. Backfill beneath structures should be compacted to at least 95 percent of the maximum dry density.

(5) Grading should be such that surface water is directed away from all cut and fill slopes and collected only in channels protected against erosion. Water should not be allowed to pond on-site.

(6) Unless roof runoff falls on impervious surfaces such as asphalt or concrete that are sloped away from the building for a distance of 10 feet, roof runoff should be collected and discharged well outside of the foundation backfill limits.

It should be emphasized that final grading and landscaping generally occurs after construction of the structure and observation of these features is outside of normal geotechnical inspection and observation. The owner/contractor is responsible to ensure that these surface drainage and moisture control recommendations are followed throughout the life of the structure.

12.0 SOIL CORROSIVITY

Soils from the project site were tested for water-soluble sulfates content. The percent of water-soluble sulfates in the sample tested was 1.89 percent which is considered highly corrosive according to ACI 318. We recommend that concrete mixes used on the project be designed in accordance with ACI 318 Table 19.3.1.1 for Sulfate Exposure Class S2. We recommend that buried pipes be plastic (PVC or HDPE) instead of metal, where possible.

13.0 FOUNDATION REVIEW AND TESTING

This report has been prepared to assist in project design and construction. Variations from the conditions portrayed in the exploratory investigations may occur which are sometimes sufficient to require modifications to the design. In order to incorporate recommendations provided into actual field conditions and to confirm that the project specifications are implemented, we recommend that observation and testing be performed during construction to monitor over-excavation, grading, and preparation of soils upon which foundations elements or structural loads may be established.

14.0 LIMITATIONS

The exploratory data presented in this report were collected to provide geotechnical design recommendations for this project and subsurface site descriptions represent conditions observed at the time and at the locations explored. The investigations may not be indicative of subsurface conditions beyond the investigation location and conditions may change with passage of time. If subsurface conditions are encountered that are significantly different than those reported herein, Landmark should be contacted immediately for the continued applicability of the recommendations. In the event changes to the project are made that differ from those presented in this report, Landmark should be made aware of the changes. Landmark will provide written verification that the recommendations and conclusions remain valid or that modifications are required.

This report has been prepared to assist in project design and construction. We respectfully request the opportunity to review the final design drawings and specifications in order to determine whether the assumptions and recommendations presented herein are applicable to the anticipated designs.

This report is not intended to be used as the sole bid document. Any information concerning the environmental conditions of the site is beyond the scope of this geotechnical study. This geotechnical report has been prepared to meet the specific needs of our client and may not be appropriate to satisfy the needs of other users.

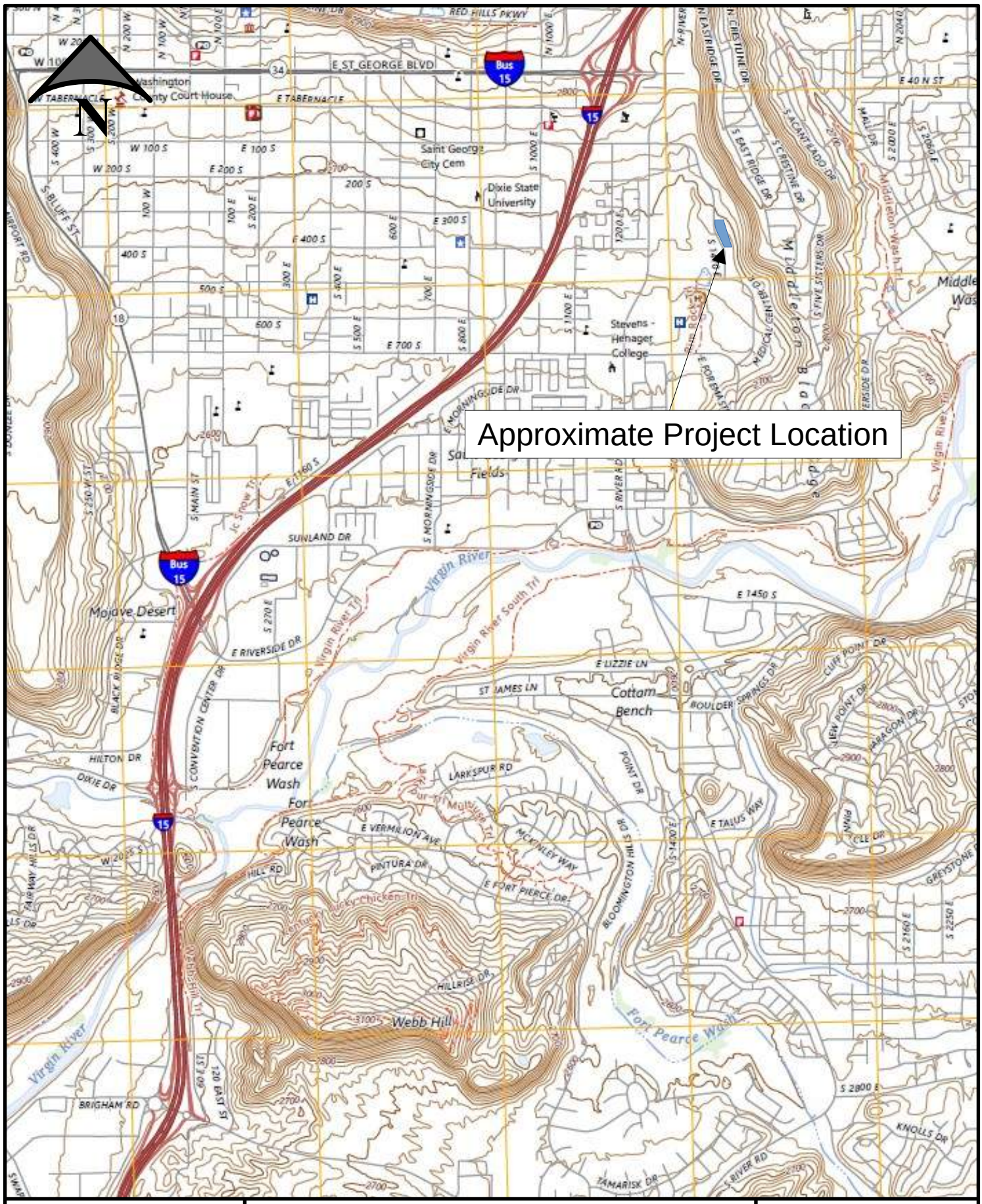
Site conditions and standards of practice change, therefore, we should be notified to review and update the report and its recommendations if construction is not commenced within 3 years of the date it was issued.

We appreciate this opportunity to be of service.

LANDMARK TESTING & ENGINEERING

Chad S. Hardman, P.E.
Professional Engineer

Reviewed By:
John M. Anderson, P.E.
Project Engineer

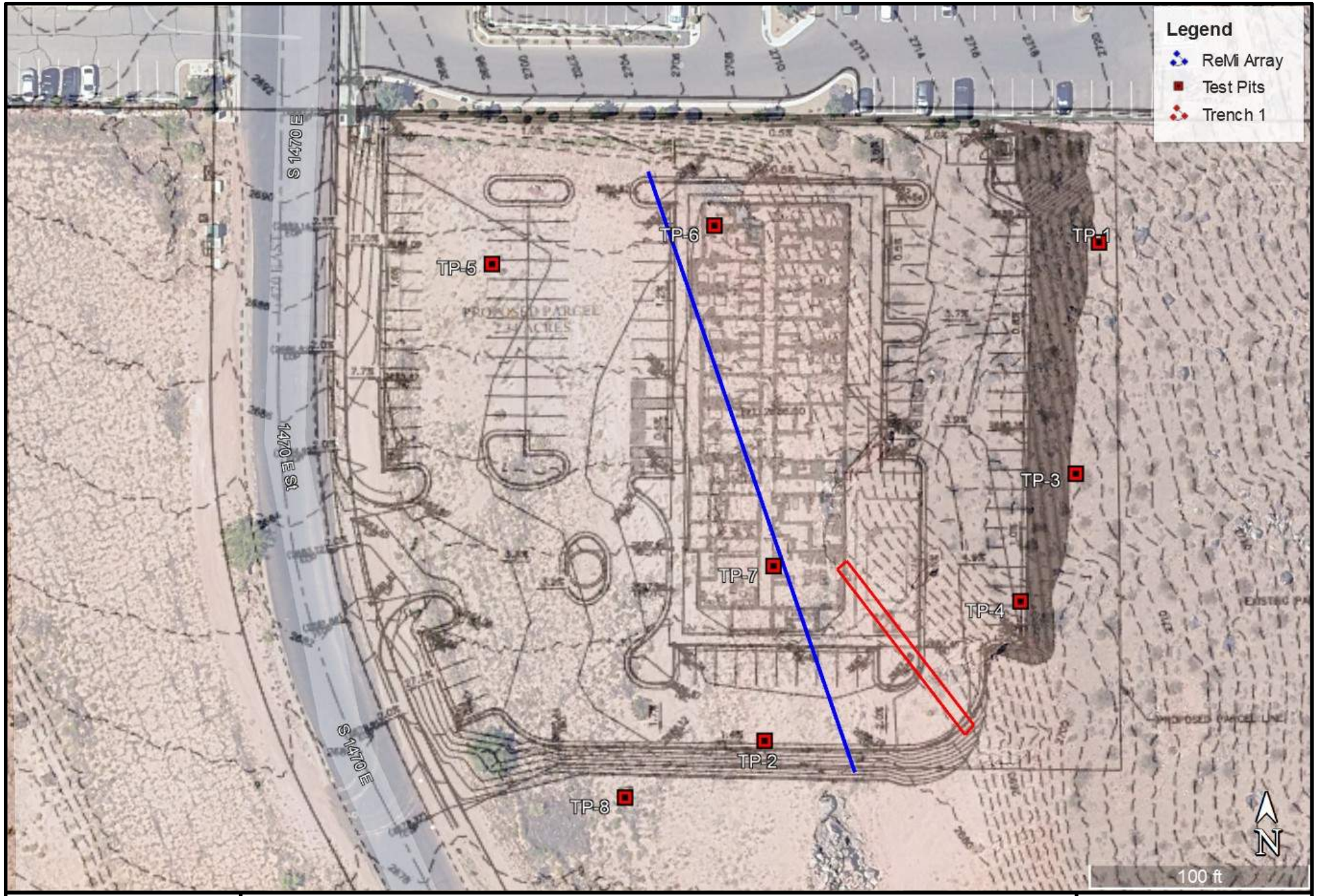


LANDMARK TESTING & ENGINEERING

Vicinity Map

Landmark Project No 240016

Figure A-1

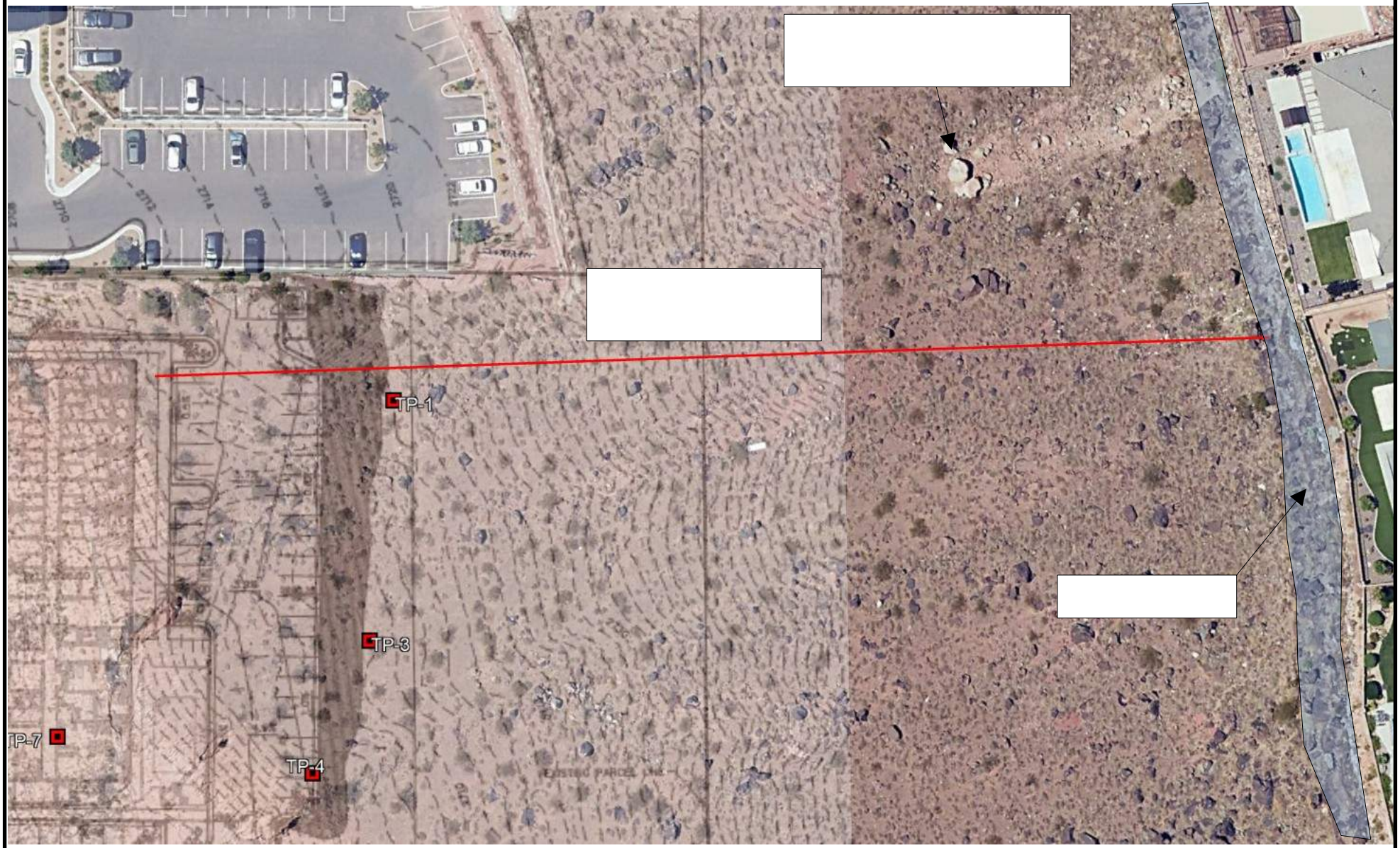


LANDMARK TESTING & ENGINEERING

Site Plan

Landmark Project No 240016

Figure A-2



LANDMARK
TESTING & ENGINEERING

TEST PIT NUMBER TP-1

DATE: 2024-01-23
LOGGED BY: Micheal Meyers
REVIEWED BY: Chad Hardman
NOTES:

EXCAVATOR: Quality Excavation
EQUIPMENT: CAT 336F
LATITUDE/LONGITUDE: 37.10027 -113.55046
GROUNDWATER: _____ feet below surface

Depth (ft)	Soil Symbol	Samples	Lithologic Description	Sample Dry Density (pcf)	Moisture (%)	Atterberg Limits LL (%)	Atterberg Limits PI (%)	Gravel (%)	Sand (%)	Fines (%)	Consolidation	Modified Proctor Max. Dry Density (pcf)	Optimum Moisture (%)	Water-Soluble Sulfate (%)	CBR
			Ground Surface												
0			**NATIVE: Silty SAND (SM)** Medium dense to dense, wet, reddish brown												
1			Slightly moist, scattered gravel cobbles and boulders, fine roots down to 2 feet, brown to reddish brown												
2			Dense, slightly moist, abundant gravel cobble and boulders, carbonate cementation weak to moderate, pinkish brown and white												
3															
4			Dense, slightly moist, abundant gravel cobbles and boulders, reddish brown to black												
5															
6		BG													
7															
8															
9															
10															
11															
12		BG	**Sandstone** Weathered to firm, dry to slightly moist, pinkish, springdale member												
13															
14															
15			TP-1 Terminated at 15'												
16															
17															
18															
19															
20															

LANDMARK TESTING & ENGINEERING EST 1998

PROJECT NAME: Hilton Home 2
Project Location: St. George, Utah
Project No.: 240016
Client: Home Hospitality Group

Figure A-4

RSLog / Landmark Test Pit - With Lab Results - NO ELEVATIONS / landmark-testing-and-engineering / admin / February 05, 2024 11:45 AM

TEST PIT NUMBER TP-2

DATE: 2024-01-23
LOGGED BY: Micheal Meyers
REVIEWED BY: Chad Hardman
NOTES:

EXCAVATOR: Quality Excavation
EQUIPMENT: CAT 336F
LATITUDE/LONGITUDE: 37.10208 -113.55098
GROUNDWATER: _____ feet below surface

Depth (ft)	Soil Symbol	Samples	Lithologic Description	Sample Dry Density (pcf)	Moisture (%)	Atterberg Limits LL (%)	Atterberg Limits PI (%)	Gravel (%)	Sand (%)	Fines (%)	Consolidation	Modified Proctor Max. Dry Density (pcf)	Optimum Moisture (%)	Water-Soluble Sulfate (%)	CBR
			Ground Surface												
0			**NATIVE: Silty SAND (SM)**												
			Medium dense, slightly moist to moist, brown												
1			Slightly moist, brown to reddish brown												
			Silty Clayey SAND (SC-SM)												
2			Medium stiff/dense, slightly moist, brown to reddish brown												
3															
4		B										123.2	10.2		38.3
5															
6			**Sandstone**												
			Weathered to firm, dry to slightly moist, pinkish, springdale member												
7															
8			TP-2 Terminated at 8'												
			Practical Refusal on Sandstone Bedrock												
9															
10															
11															
12															
13															
14															
15															
16															
17															
18															
19															
20															

LANDMARK TESTING & ENGINEERING EST 1998

PROJECT NAME: Hilton Home 2
Project Location: St. George, Utah
Project No.: 240016
Client: Home Hospitality Group

Figure A-5

RSLog / Landmark Test Pit - With Lab Results - NO ELEVATIONS / landmark-testing-and-engineering / admin / February 05, 2024 11:45 AM

TEST PIT NUMBER TP-3

DATE: 2024-01-23
LOGGED BY: Micheal Meyers
REVIEWED BY: Chad Hardman
NOTES:

EXCAVATOR: Quality Excavation
EQUIPMENT: CAT 336F
LATITUDE/LONGITUDE: 37.10241 -113.5505
GROUNDWATER: _____ feet below surface

Depth (ft)	Soil Symbol	Samples	Lithologic Description	Sample Dry Density (pcf)	Moisture (%)	Atterberg Limits LL (%)	Atterberg Limits PI (%)	Gravel (%)	Sand (%)	Fines (%)	Consolidation	Modified Proctor Max. Dry Density (pcf)	Optimum Moisture (%)	Water-Soluble Sulfate (%)	CBR
			Ground Surface												
0			**NATIVE: Silty SAND (SM)**												
1			Medium dense, moist, brown Slightly moist, fine roots down to 2.5 feet, gravel, brown to reddish brown												
2			**Lean CLAY (CL)** Medium stiff, slightly moist, weakly cemented carbonates, gravel cobbles and rare boulders, brown and light pink,												
3															
4			**Silty SAND with Gravel (SM)**												
5			Dense, slightly moist, fine to medium grained sand with gravel cobbles and boulders, brown to reddish brown, basalt boulders												
6															
7															
8															
9															
10		BLK	**Mudstone** Stiff, slightly moist, purple												
11			**Sandstone** Weathered to firm, slightly moist, pink												
12			TP-3 Terminated at 12' Practical Refusal on Sandstone Bedrock												
13															
14															
15															
16															
17															
18															
19															
20															

LANDMARK TESTING & ENGINEERING EST 1998

PROJECT NAME: Hilton Home 2
Project Location: St. George, Utah
Project No.: 240016
Client: Home Hospitality Group

Figure A-6

RSLog / Landmark Test Pit - With Lab Results - NO ELEVATIONS / landmark-testing-and-engineering / admin / February 05, 2024 11:45 AM

TEST PIT NUMBER TP-4

DATE: 2024-01-23
LOGGED BY: Micheal Meyers
REVIEWED BY: Chad Hardman
NOTES:

EXCAVATOR: Quality Excavation
EQUIPMENT: CAT 336F
LATITUDE/LONGITUDE: 37.10225 -113.55058
GROUNDWATER: _____ feet below surface

Depth (ft)	Soil Symbol	Samples	Lithologic Description	Sample Dry Density (pcf)	Moisture (%)	Atterberg Limits LL (%)	Atterberg Limits PI (%)	Gravel (%)	Sand (%)	Fines (%)	Consolidation	Modified Proctor Max. Dry Density (pcf)	Optimum Moisture (%)	Water-Soluble Sulfate (%)	CBR
			Ground Surface												
0			**NATIVE: Silty SAND (SM)**												
1			Medium dense, moist to wet, brown Slightly moist, with gravel and cobbles, fine roots down to 4 feet, brown to reddish brown												
2			**Lean CLAY (CL)**												
3		BG	Medium stiff, slightly moist, with gravel and cobble, pinholes down to at least 5 feet, weakly cemented carbonate pockets, brown to white												
4															
5															
6		BLK													
7			**Silty SAND (SM)**												
8			Medium dense, slightly moist, with gravel and cobbles, brown to reddish brown												
9			Basalt boulders												
10															
11															
12		BG			3.7	20	4	11	47						
13			**Sandstone**												
14		BLK	Weathered to firm, dry to slightly moist, pink, springdale member												
15			TP-4 Terminated at 15'												
16															
17															
18															
19															
20															

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PROJECT NAME: Hilton Home 2
Project Location: St. George, Utah
Project No.: 240016
Client: Home Hospitality Group

Figure A-7

TEST PIT NUMBER TP-5

DATE: 2024-01-23
LOGGED BY: Micheal Meyers
REVIEWED BY: Chad Hardman
NOTES:

EXCAVATOR: Quality Excavation
EQUIPMENT: CAT 336F
LATITUDE/LONGITUDE: 37.10268 -113.5514
GROUNDWATER: _____ feet below surface

Depth (ft)	Soil Symbol	Samples	Lithologic Description	Sample Dry Density (pcf)	Moisture (%)	Atterberg Limits LL (%)	Atterberg Limits PI (%)	Gravel (%)	Sand (%)	Fines (%)	Consolidation	Modified Proctor Max. Dry Density (pcf)	Optimum Moisture (%)	Water-Soluble Sulfate (%)	CBR
			Ground Surface												
0			**NATIVE: Silty SAND (SM)**												
1		BLK	Medium dense to dense, dry to slightly moist, yellow and white, pink sandstone, springdale member												
2															
3		BG	**Silty SAND (SM)**		5.3	0	0	19	58						
4			Dense, slightly moist, pink to light purple, sandstone springdale member												
5			Dense, slightly moist, light purple, sandstone sprindale member												
6															
7			TP-5 Terminated at 7' Practical Refusal on Sandstone Bedrock												
8															
9															
10															
11															
12															
13															
14															
15															
16															
17															
18															
19															
20															

LANDMARK TESTING & ENGINEERING EST 1998

PROJECT NAME: Hilton Home 2
Project Location: St. George, Utah
Project No.: 240016
Client: Home Hospitality Group

Figure A-8

TEST PIT NUMBER TP-6

DATE: 2024-01-23
LOGGED BY: Micheal Meyers
REVIEWED BY: Chad Hardman
NOTES:

EXCAVATOR: Quality Excavation
EQUIPMENT: CAT 336F
LATITUDE/LONGITUDE: 37.10272 -113.55106
GROUNDWATER: _____ feet below surface

Depth (ft)	Soil Symbol	Samples	Lithologic Description	Sample Dry Density (pcf)	Moisture (%)	Atterberg Limits LL (%)	Atterberg Limits PI (%)	Gravel (%)	Sand (%)	Fines (%)	Consolidation	Modified Proctor Max. Dry Density (pcf)	Optimum Moisture (%)	Water-Soluble Sulfate (%)	CBR
			Ground Surface												
0			**NATIVE: Silty SAND (SM)** Medium dense, slightly moist, some gravel cobbles and weathered sandstone, brown to reddish brown												
2		M		89.4	4.4						4.1% C @ 1540				
6		BLK	**Sandstone** Weathered to firm, dry to slightly moist, light pink to white, springdale member												
7			TP-6 Terminated at 7' Practical Refusal on Sandstone Bedrock												

PROJECT NAME: Hilton Home 2
Project Location: St. George, Utah
Project No.: 240016
Client: Home Hospitality Group

Figure A-9

RSLog / Landmark Test Pit - With Lab Results - NO ELEVATIONS / landmark-testing-and-engineering / admin / February 05, 2024 11:45 AM

TEST PIT NUMBER TP-7

DATE: 2024-01-23
LOGGED BY: Micheal Meyers
REVIEWED BY: Chad Hardman
NOTES:

EXCAVATOR: Quality Excavation
EQUIPMENT: CAT 336F
LATITUDE/LONGITUDE: 37.10229 -113.55096
GROUNDWATER: _____ feet below surface

Depth (ft)	Soil Symbol	Samples	Lithologic Description	Sample Dry Density (pcf)	Moisture (%)	Atterberg Limits LL (%)	Atterberg Limits PI (%)	Gravel (%)	Sand (%)	Fines (%)	Consolidation	Modified Proctor Max. Dry Density (pcf)	Optimum Moisture (%)	Water-Soluble Sulfate (%)	CBR
			Ground Surface												
0		BLK	**NATIVE: Silty SAND (SM)** Medium dense, slightly moist, interbedded silts and clays, abundant pinholes in fines down to 5 feet, minor basalt boulders 5 feet wide, reddish brown to grey to dark purple											1.89	
6		BG	**Sandstone** Firm, dry to slightly moist, light pink and purple												
9			TP-7 Terminated at 8.5' Practical Refusal on Bedrock												

PROJECT NAME: Hilton Home 2
Project Location: St. George, Utah
Project No.: 240016
Client: Home Hospitality Group

Figure A-10

RSLog / Landmark Test Pit - With Lab Results - NO ELEVATIONS / landmark-testing-and-engineering / admin / February 05, 2024 11:45 AM

TEST PIT NUMBER TP-8

DATE: 2024-01-23
LOGGED BY: Micheal Meyers
REVIEWED BY: Chad Hardman
NOTES:

EXCAVATOR: Quality Excavation
EQUIPMENT: CAT 336F
LATITUDE/LONGITUDE: 37.10201 -113.5512
GROUNDWATER: _____ feet below surface

Depth (ft)	Soil Symbol	Samples	Lithologic Description	Sample Dry Density (pcf)	Moisture (%)	Atterberg Limits LL (%)	Atterberg Limits PI (%)	Gravel (%)	Sand (%)	Fines (%)	Consolidation	Modified Proctor Max. Dry Density (pcf)	Optimum Moisture (%)	Water-Soluble Sulfate (%)	CBR
			Ground Surface												
0			**NATIVE: Silty SAND with Gravel (SM)**												
1			Medium dense, moist, brown Slightly moist, fine roots down to 2 feet, brown to reddish brown												
2			**Sandstone**												
3			Weathered to firm, dry to slightly moist, light pink, springdale member												
4			Weathered to firm, dry to slightly moist, purple												
5		BG													
6															
7															
8															
9			TP-8 Terminated at 9' Practical Refusal on Bedrock												
10															
11															
12															
13															
14															
15															
16															
17															
18															
19															
20															

LANDMARK TESTING & ENGINEERING EST 1998

PROJECT NAME: Hilton Home 2
Project Location: St. George, Utah
Project No.: 240016
Client: Home Hospitality Group

Figure A-11

RSLog / Landmark Test Pit - With Lab Results - NO ELEVATIONS / landmark-testing-and-engineering / admin / February 05, 2024 11:45 AM

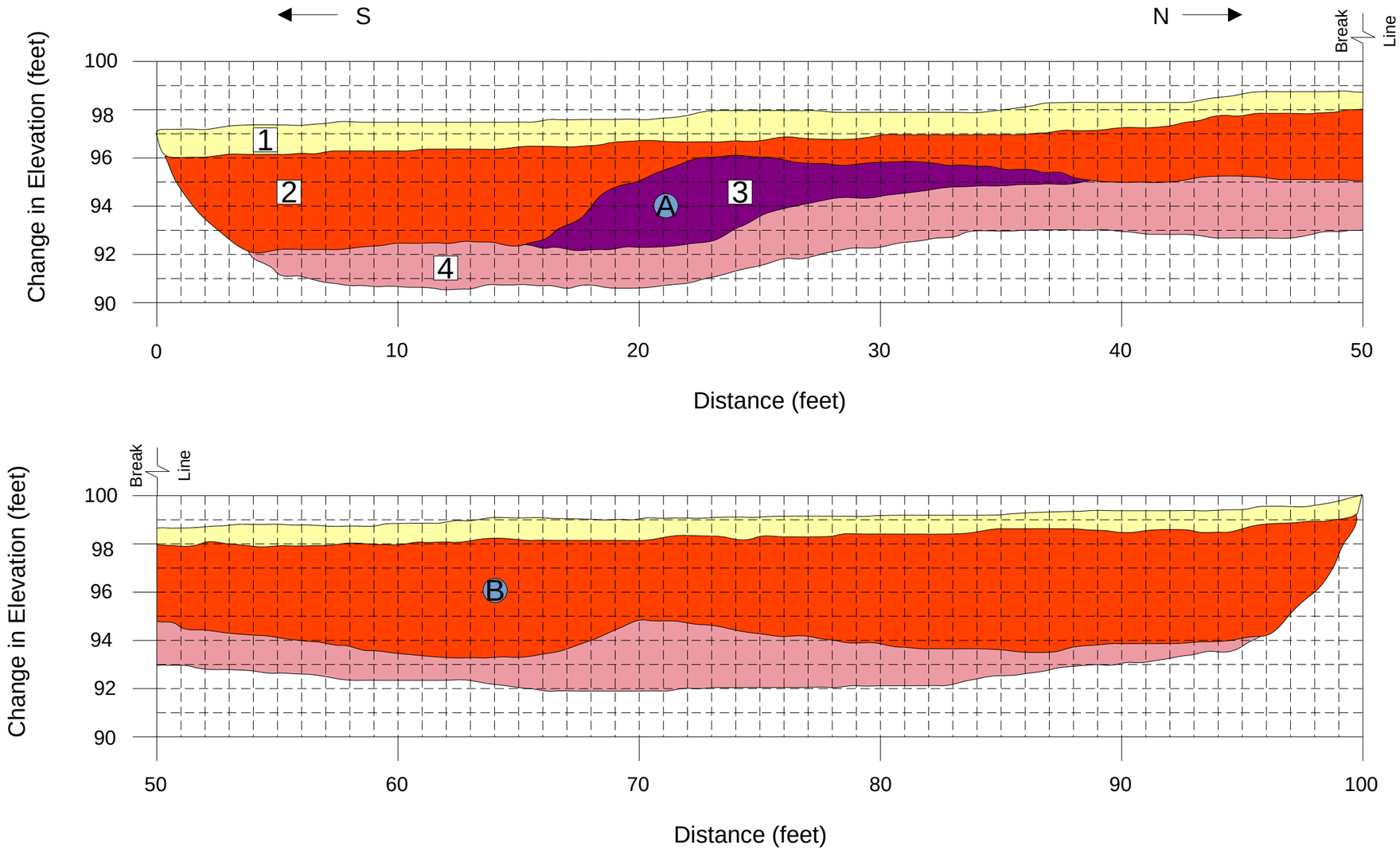


Image 1: Photograph of trench wall from approximately 0+15 to 0+25.

Soil Types

1. Fill: Silty Sand (SM), medium dense, slightly moist, fine to medium grained sand, brown to red brown
2. Native: Silty Sand (SM), medium dense, slightly moist, fine to medium grained, brown to red brown
3. Lean Clay (CL), medium stiff, slightly moist, fine to medium grained, purple and gray
4. Sandstone, weathered to firm, dry to slightly moist, fine to medium grained, light pink and white

Sample Locations

A. 0+21 at 3.5 ft
B. 0+64 at 3.0 ft

LANDMARK TESTING & ENGINEERING

Trench 1

Landmark Project No 240016

Figure A-12

UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS		SYMBOLS	TYPICAL NAMES
COARSE-GRAINED SOILS (More than 50% of soil Retained on No. 200 sieve size)	GRAVELS More than 1/2 of coarse fraction > No.4 sieve size	GW	Well graded gravels or gravel-sand mixtures little or no fines.
		GP	Poorly graded gravels or gravel-sand mixtures little or no fines.
		GM	Silty gravels, gravel-sand-silt mixtures
		GC	Clayey gravels, gravel-sand-clay mixtures
	SANDS More than 1/2 of coarse fraction < No.4 sieve size	SW	Well graded sands or gravelly sand mixtures little or no fines.
		SP	Poorly graded sands or gravelly sand mixtures little or no fines.
		SM	Silty sands, sand-silt mixtures
		SC	Clayey sands, sand-clay mixtures
FINE-GRAINED SOILS (Less than 50% of soil Retained on No. 200 sieve size)	SILTS & CLAYS Liquid Limit < 50	ML	Inorganic silts and very fine sands, rock flour, silty fine sands or clayey silts with slight plasticity
		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
		OL	Organic silts and organic silty clays of low plasticity
	SILTS & CLAYS Liquid Limit > 50	MH	Inorganic silts, micaceous of diatomaceous fine sand or silty soils, elastic silts
		CH	Inorganic clays of high plasticity, fat clays
		OH	Organic clays of medium to high plasticity, organic silty clays, organic silts
HIGHLY ORGANIC SOILS		PT	Peat and other highly organic soils

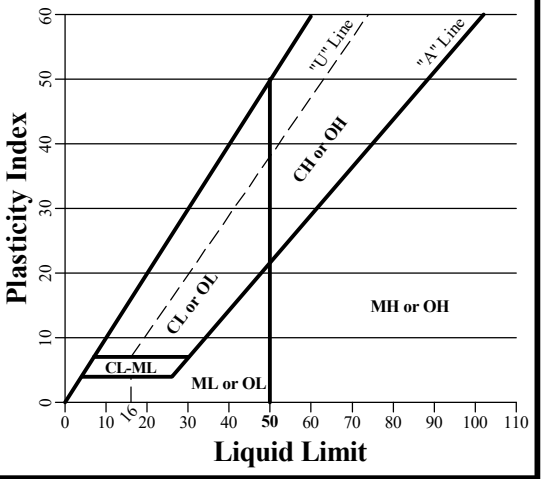
GRAIN SIZE CHART

CLASSIFICATION	Range of Grain Size	
	U.S. Standard Sieve Size	Grain Size in Millimeters
BOULDERS	**Above 12"**	**Above 305**
COBBLES	**12" to 3"**	**305 to 76.2**
GRAVEL	**3" to No. 4**	**76.2 to 4.76**
Coarse	3" to 3/4"	76.2 to 19.1
Fine	3/4" to No. 4	19.1 to 4.76
SAND	**No. 4 to No. 200**	**4.76 to 0.074**
Coarse	No. 4 to No. 10	4.76 to 2.00
Medium	No. 10 to No. 40	2.00 to 0.42
Fine	No. 40 to No. 200	0.420 to 0.074
SILT & CLAY	Below No. 200	Below 0.074

SAMPLES

- Relatively Undisturbed Sample
- Block Sample
- Bag Sample
- Auger Cuttings
- B — Bucket Sample
- Core
- No Recovery

PLASTICITY CURVE



Landmark Testing & Engineering
795 Factory Drive
St. George, UT 84790
Telephone: 435-986-0566
Website: www.landmarktesting.com

Figure A-13

LANDMARK TESTING & ENGINEERING

SUMMARY OF LABORATORY TEST RESULTS

Client: Home Hospitality Group
107 S 1470 E, Ste 302
St George, UT 84790

Date of Report: 2/2/2024

Project: Hilton Home 2

Project #: 240016

Location: St. George, Utah

Boring / Test Pit Number	Depth Below Ground Surface (ft)	Moisture Content (%)	In-Place Dry Desnity (pcf)	Mechanical Gradation			Atterberg Limits		Swell-Consolidation Swell/Collapse @ Wetting Load (S/C @ ksf)	Modified Proctor / CBR			Percent Finer Than 0.02 mm (%)	Unconfined Compressive Strength (psf)	Soluble Sulfate Content (%)	USCS Group Symbol	AASHTO Soil Classification
				Gravel (%)	Sand (%)	Fines (%)	Liquid Limit	Plasticity Index		Maximum Dry Density (pcf)	Optimum Moisture Content (%)	CBR Value					
TP-4	12.0	3.7		11	47	42	20	4								SC-SM	A-4(0)
TP-5	3.0	5.3		19	58	23	NP	NP								SM	A-2-4(0)
TP-6	2.0	4.4	89.4						4.1% C @ 1.5 ksf								
TP-7	1.5														1.89		
TP-2	Bulk									123.2	10.2	38.3					

TABLE B-1

LANDMARK TESTING & ENGINEERING

CONSOLIDATION REPORT

Client: Home Hospitality Group
107 S 1470 E, Ste 302
St George, UT 84790

Date of Report: 2/1/2024
Reviewed By: Z. Girsberger
Lab#: 24SG0570

Project: Hilton Home 2 **Project #:** 240016
Location: St George **Sampled By:** M. Meyers **Date:** 1/23/2024
Type of Sample: SM **Tested By:** J. Bracken **Date:** 1/26/2023
Location of Sample: Test Pit 6 at 2 **Authorized By:** Client **Date:** 1/23/2024

COLLAPSE/SWELL CURVE

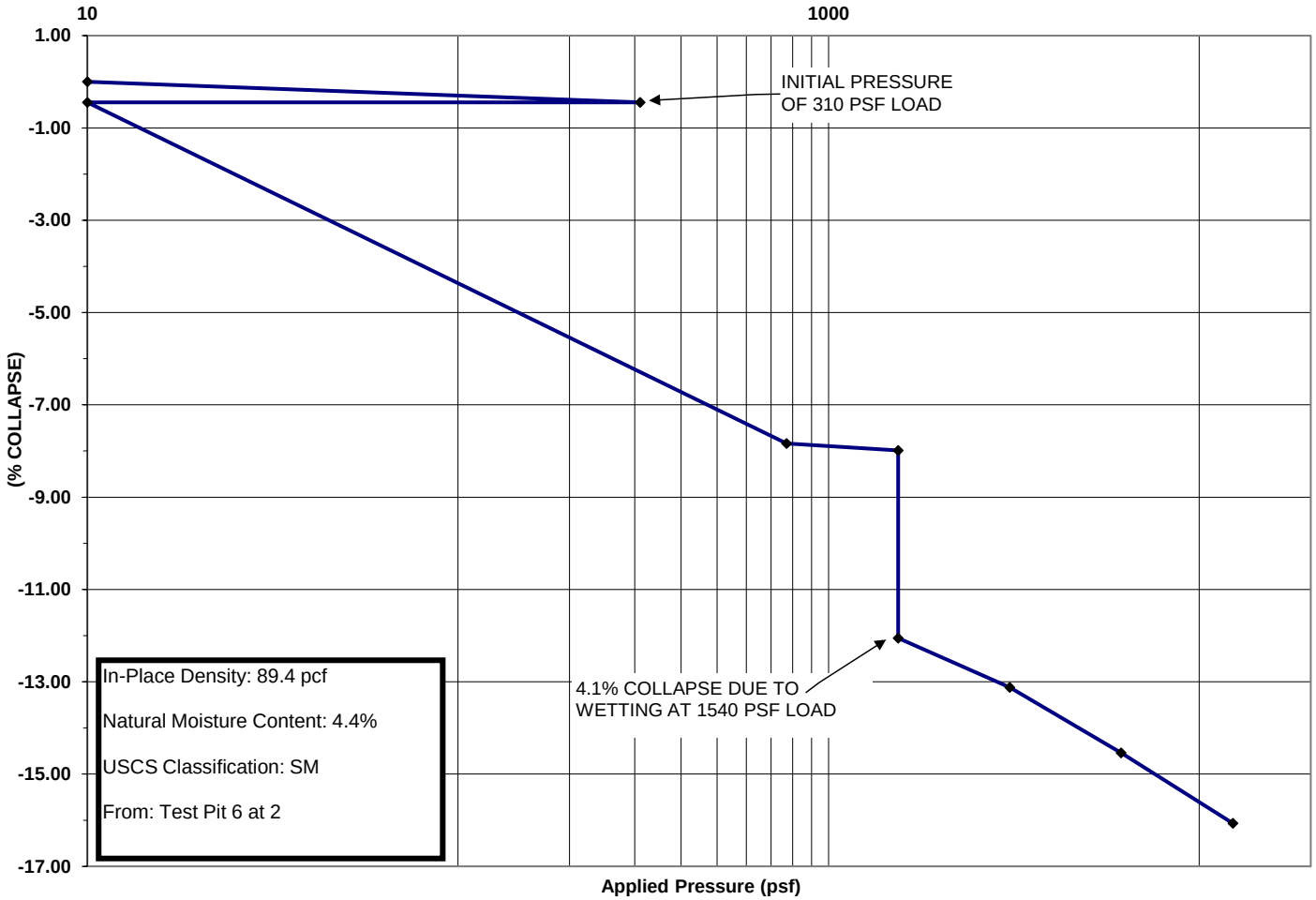


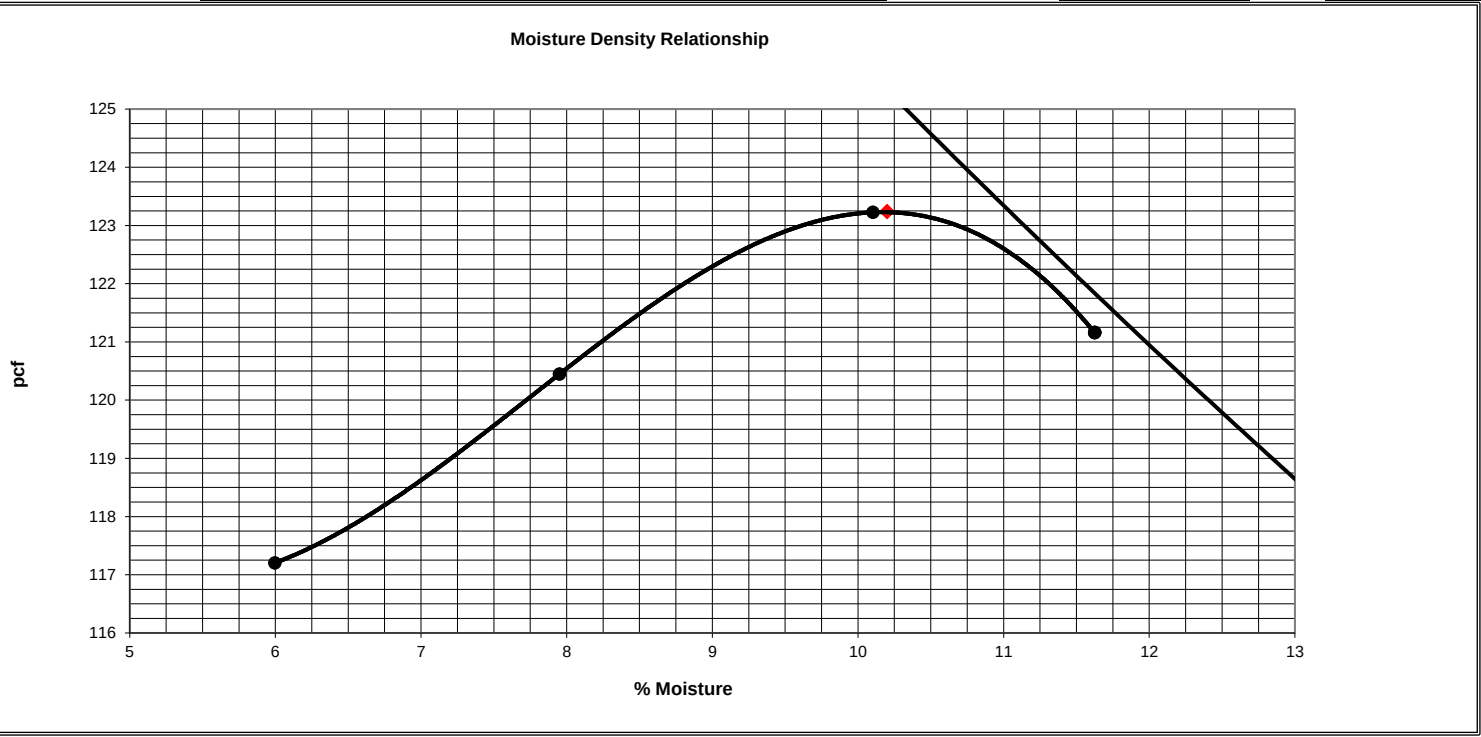
Figure B-1

PROCTOR REPORT

Client: Home Hospitality Group
107 S 1470 E, Ste 302
St George, UT 84790

Date of Report: 1/29/2024
Reviewed By: Z. Girsberger
Lab#: 24SG0572

Project: Hilton Home 2 **Project #:** 240016
Location: St George **Sampled By:** M. Meyers **Date:** 1/23/2024
Type of Sample: Red Brown Silty Sand with Sandstone Gravel **Tested By:** J. Wells **Date:** 1/29/2024
Location of Sample: Test Pit 2 at Bulk **Authorized By:** Client **Date:** 1/23/2024



Proctor Data	
Hammer Weight:	10 pounds
Hammer Drop:	18 inches
Number of Layers:	5 layers
Blows per Layer:	56 blows
Mold Size (cu. Ft.):	0.075
% Oversized:	2.0
Oversize Sp. G.:	N/A
ZAV Sp. G.:	2.53
Test Performed on Material Passing:	3/4 in.Sieve

Point	1	2	3	4	5	6
% Moisture	6.0	7.9	10.1	11.6		
Dry Density	117.2	120.4	123.2	121.2		

Test Results	
Maximum Dry Density, Lbs/ft^3	**123.2**
Optimum Moisture, %	**10.2**
Test Standard	**ASTM D 1557**
Method	**Method C**

Figure B-2

LANDMARK TESTING & ENGINEERING

CALIFORNIA BEARING RATIO

Client: Home Hospitality Group
107 S 1470 E, Ste 302
St George, UT 84790

Date of Report: 2/2/2024
Reviewed By: Z. Girsberger
Lab#: 24SG0572

Project: Hilton Home 2 **Project #:** 240016
Location: St George **Sampled By:** M. Meyers **Date:** 1/23/2024
Type of Sample: Red Brown Silty Sand with Sandstone Gravel **Tested By:** J. Wells **Date:** 1/29/2024
Location of Sample: Test Pit 2 at Bulk **Authorized By:** Client **Date:** 1/23/2024

SOIL DATA		
Max. Dry Density:	123.2	<
Optimum Moisture:	10.2	<
Test Standard	ASTM D 1557	
% +3/4" Replaced	2.0	<

CBR RESULTS	
0.10 in. penetration:	36.2
0.20 in. penetration:	38.3

SPECIFICATION	
0.20 in penetration:	

CALIFORNIA BEARING RATIO, ASTM D 1883			
MOLDED		SOAKED	
% Moisture Before:	9.1	Average % Moisture:	11.8
% Moisture After:	9.1	Top 1" % Moisture:	11.8
Dry Density:	123.0	Dry Density:	121.6
% of Max. Density:	99.9	% of Max. Density:	98.7
# Blows / Lift:	56 / 5	Percent Swell:	0.5
Surcharge, lbs:	10	Linearity Correction:	0.008

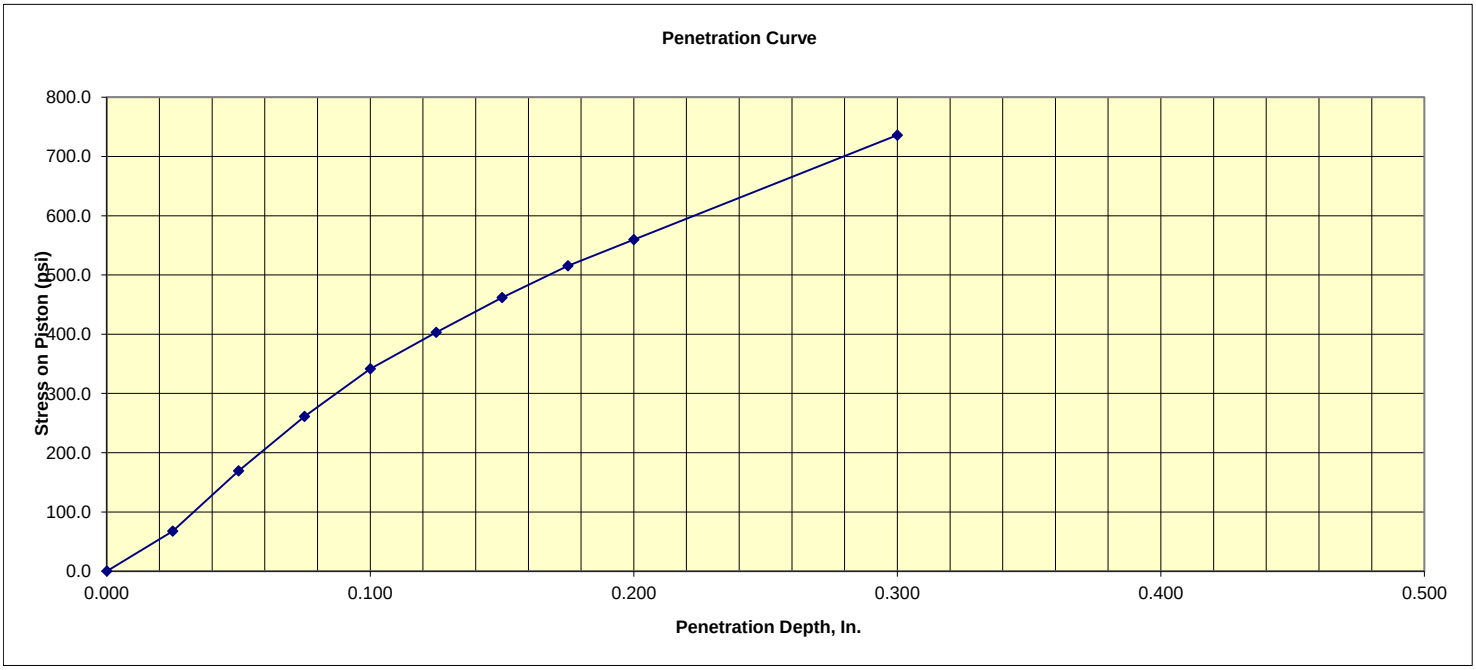


Figure B-3

SOIL CLASSIFICATION REPORT

Client: Home Hospitality Group
107 S 1470 E, Ste 302
St George, UT 84790

Date of Report: 2/1/2024
Reviewed By: Z. Girsberger
Lab#: 24SG0568

Project: Hilton Home 2 **Project #:** 240016
Location: St George **Sampled By:** M. Meyers **Date:** 1/23/2024
Type of Sample: Brown Silty, Clayey Sand **Tested By:** A. Pay **Date:** 1/31/2024
Location of Sample: Test Pit 4 at 12.0 **Authorized By:** Client **Date:** 1/23/2024

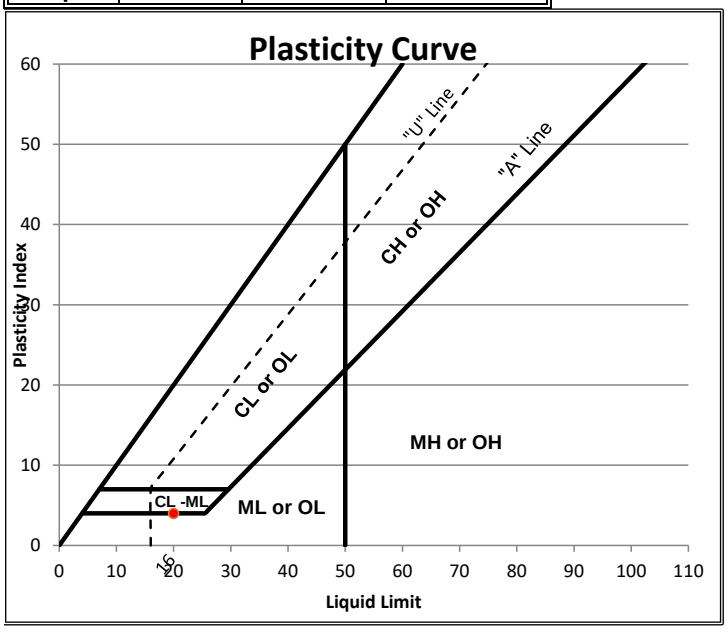
Sieve Analysis , ASTM C136 and C117

Sieve Size		% Passing Cumulative	Specification
150 mm	6"		
75 mm	3"		
50 mm	2"		
37.5 mm	1-1/2"	100	
25 mm	1"	99	
19 mm	3/4"	95	
12.5 mm	1/2"	94	
9.5 mm	3/8"	92	
4.75 mm	#4	89	
2.00 mm	#10	86	
1.18 mm	#16	85	
425 µm	#40	83	
300 µm	#50	82	
75 µm	#200	42.2	

Test	Result	Specification	Test Standard
Natural Moisture Content, %	3.7		ASTM D 2216
Liquid Limit	20		ASTM D 4318
Plasticity Index	4		ASTM D 4318
Unified Classification System	SC-SM		ASTM D 2487
AASHTO Classification System	A-4(0)		AASHTO M145

% Cobble > 3"	% Gravel < 3" - #4	% Sand < #4 - #200	% Silt-Clay < #200
0.0	11.0	46.8	42.2

Diameter D_{60}	Diameter D_{30}	Diameter D_{10}	Coefficient of Uniformity, C_U	Coefficient of Concavity, C_C



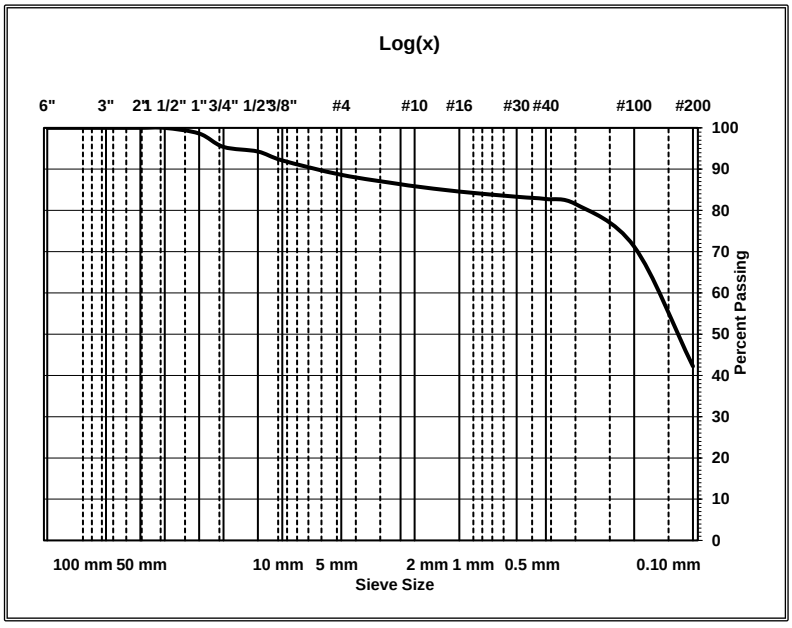


Figure B-4

SOIL CLASSIFICATION REPORT

Client: Home Hospitality Group
107 S 1470 E, Ste 302
St George, UT 84790

Date of Report: 1/30/2024
Reviewed By: Z. Girsberger
Lab#: 24SG0569

Project: Hilton Home 2 **Project #:** 240016
Location: St George **Sampled By:** M. Meyers **Date:** 1/23/2024
Type of Sample: Purple Silty Sand with Gravel **Tested By:** A. Pay **Date:** 1/30/2024
Location of Sample: Test Pit 5 at 3.0 **Authorized By:** Client **Date:** 1/23/2024

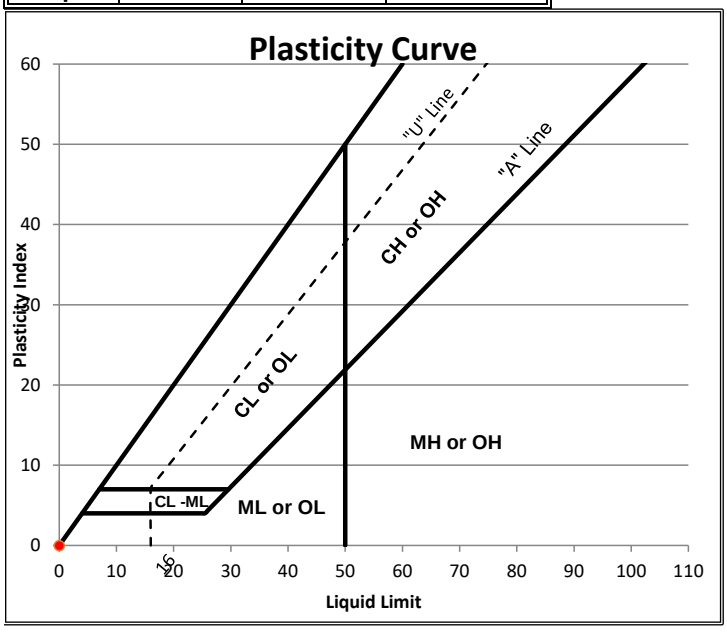
Sieve Analysis , ASTM C136 and C117

Sieve Size		% Passing Cumulative	Specification
150 mm	6"		
75 mm	3"		
50 mm	2"		
37.5 mm	1-1/2"		
25 mm	1"	100	
19 mm	3/4"	97	
12.5 mm	1/2"	94	
9.5 mm	3/8"	90	
4.75 mm	#4	81	
2.00 mm	#10	72	
1.18 mm	#16	68	
425 µm	#40	62	
300 µm	#50	59	
75 µm	#200	22.9	

Test	Result	Specification	Test Standard
Natural Moisture Content, %	5.3		ASTM D 2216
Liquid Limit	NP		ASTM D 4318
Plasticity Index	NP		ASTM D 4318
Unified Classification System	SM		ASTM D 2487
AASHTO Classification System	A-2-4(0)		AASHTO M145

% Cobble > 3"	% Gravel < 3" - #4	% Sand < #4 - #200	% Silt-Clay < #200
0.0	19.0	58.1	22.9

Diameter D_{60}	Diameter D_{30}	Diameter D_{10}	Coefficient of Uniformity, C_U	Coefficient of Concavity, C_C



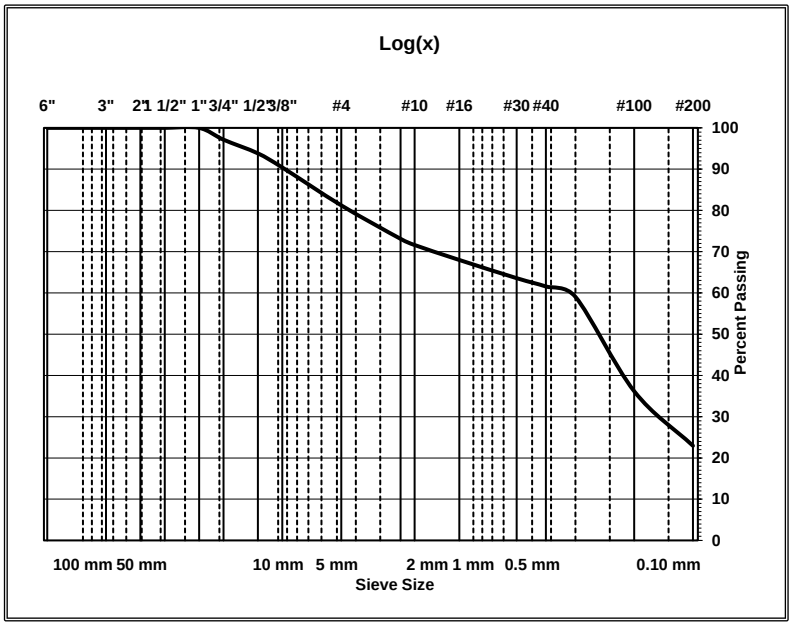


Figure B-5

LANDMARK TESTING & ENGINEERING

WATER-SOLUBLE SULFATE IN SOIL

Client: Home Hospitality Group
107 S 1470 E, Ste 302
St George, UT 84790

Date of Report: 1/31/2024
Reviewed By: Z. Girsberger
Lab#: 24SG0571

Project: Hilton Home 2 **Project #:** 240016
Location: St George **Sampled By:** M. Meyers **Date:** 1/23/2024
Type of Sample: Red-Brown Silty Sand **Tested By:** A. pay **Date:** 1/30/2024
Location of Sample: Test Pit 7 at 1.5' **Authorized By:** Client **Date:** 1/23/2024

Test	Result %	Exposure Class	Test Standard
Percent Water-Soluble Sulfate in Soil	1.89	S2	ASTM C1580

Figure B-6

Hilton Home2 Suites - North Line Shear-Wave Velocity Report
Hilton Home2 Suites Terēan VsSurf ReMi™ 2.1 Software

Array Location

Datum:	UTM Zone 12N NAD83
Site Name:	**Hilton Home2 Suites - North Line**
Center:	4109275.0, -273346.0
Geophone 1:	4109264.0, -273308.0
Geophone6:	4109287.0, -273391.0

Results

Vs100:	**1,756 ft/s**
IBC Site Class:	C
IBC Version:	IBC 2018
ASCE:	ASCE 7-16
Depth:	**65.6 feet**

Survey Parameters

Geophone Count:	6
Geophone Spacing:	26.25 feet
Array Length:	131 feet
Survey Date:	Jan 19, 2024
Performed By:	Landmark Testing & Engineering
Analysis By:	SteveW
Analysis Date:	Mon Jan 22 20:13:20 MST 2024

Narrative

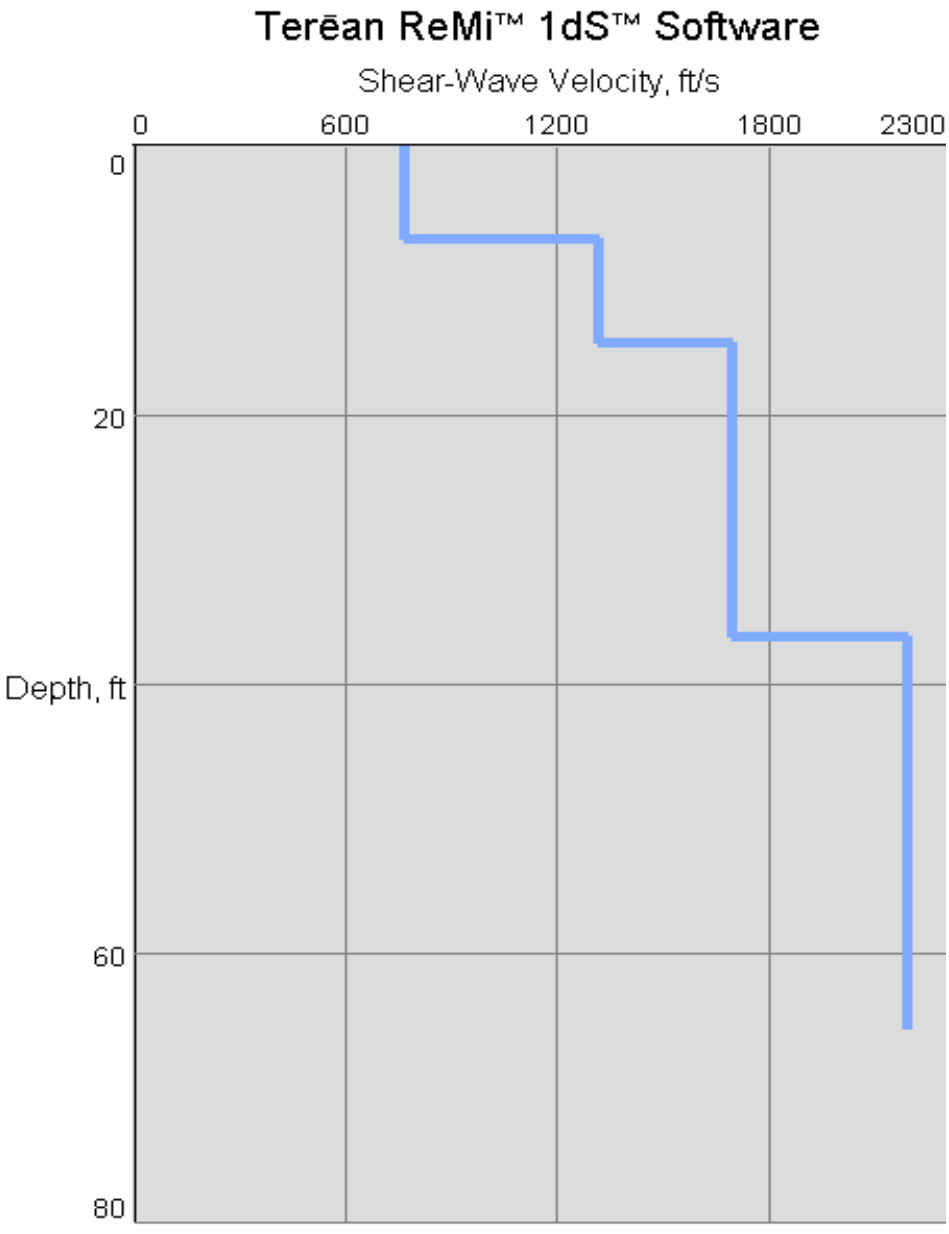
SHEAR WAVE VELOCITIES AND SEISMIC SITE CLASS

Landmark Testing & Engineering's geophysical site evaluation included subsurface seismic imaging and earthquake ground shaking potential evaluation using Terēan's VsSurf ReMi™ seismic data processing software. Seismic surveys were performed to evaluate depth to bedrock and the seismic site class per IBC 2018 and ASCE 7-16 using the weighted-average soil shear wave velocity for the upper 100 feet (Vs100). The surveys were performed by recording active and/or ambient (passive) seismic sources. The seismic recording array for these surveys consisted of 6, 4.5-Hz geophones at a 26.25 feet (8 m, 26.25 ft) spacing for a total survey length of 131 feet. Noise generated by walking and hammer hits along the survey line during data acquisition while ambient noise was generated from traffic along the nearby roads. The seismic data were acquired using a ReMiDAQ™ 4-12 seismograph (terean.com/products), while data was processed using Terēan's ReMi™ software. Survey results indicate a weighted-average soil shear wave velocity of the upper 100 feet (Vs100) of 1,756 ft/s. This results in a designation of a Seismic Site Class C according to Table ASCE 7-16.

Hilton Home2 Suites - North Line
Hilton Home2 Suites

Shear-Wave Velocity Report
Terēan VsSurf ReMi™ 2.1 Software

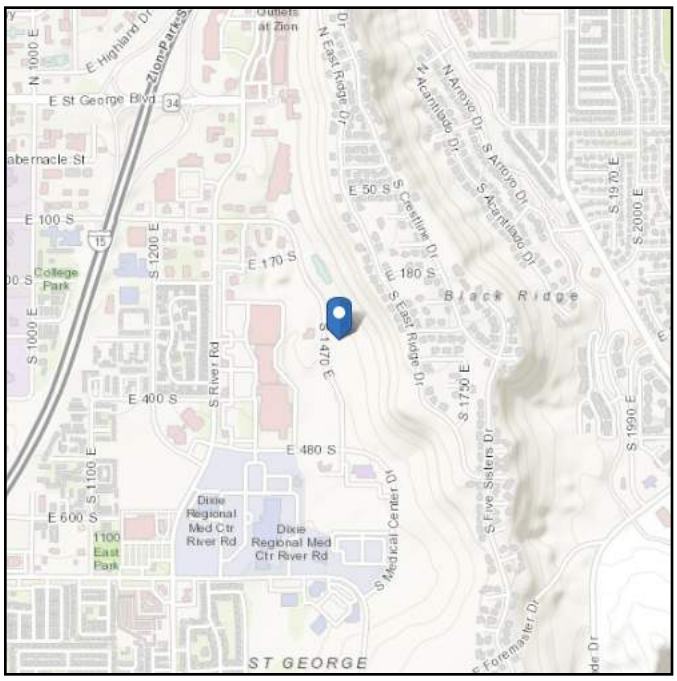
Depth (ft)	Vs (ft/s)
0.0	765
6.8	765
6.8	1,314
14.6	1,314
14.6	1,694
36.4	1,694
36.4	2,187
364.5	2,187



ASCE Hazards Report

Address:
No Address at This Location

Standard:	ASCE/SEI 7-16	**Latitude:**	37.102952
Risk Category:	II	**Longitude:**	-113.551219
Soil Class:	C - Very Dense Soil and Soft Rock	**Elevation:**	0 ft (NAVD 88)



Seismic

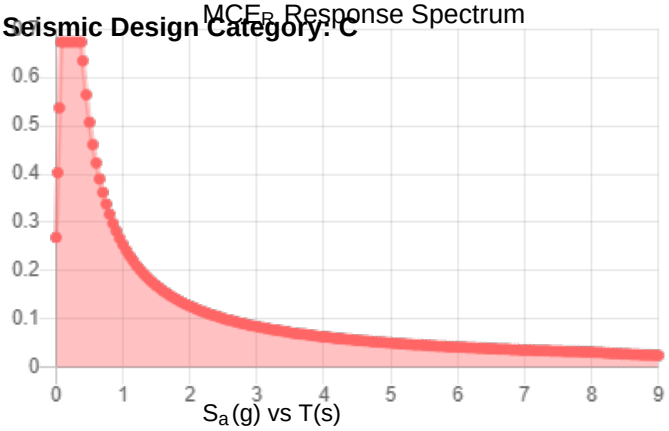
Site Soil Class: C - Very Dense Soil and Soft Rock

Results:

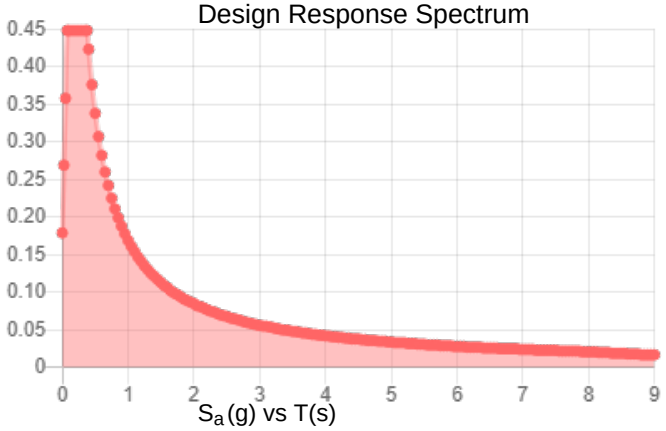
S_S :	0.521	S_{D1} :	0.169
S_1 :	0.169	T_L :	8
F_a :	1.292	PGA :	0.229
F_v :	1.5	PGA_M :	0.275
S_{MS} :	0.673	F_{PGA} :	1.2
S_{M1} :	0.254	I_e :	1
S_{DS} :	0.448	C_v :	0.947

Seismic Design Category: C

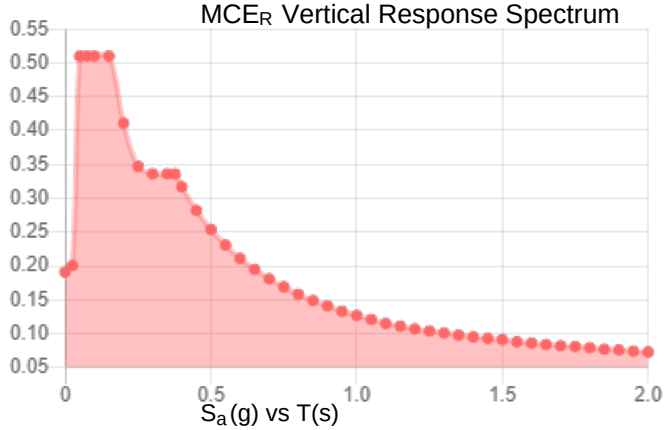
MCE_R Response Spectrum



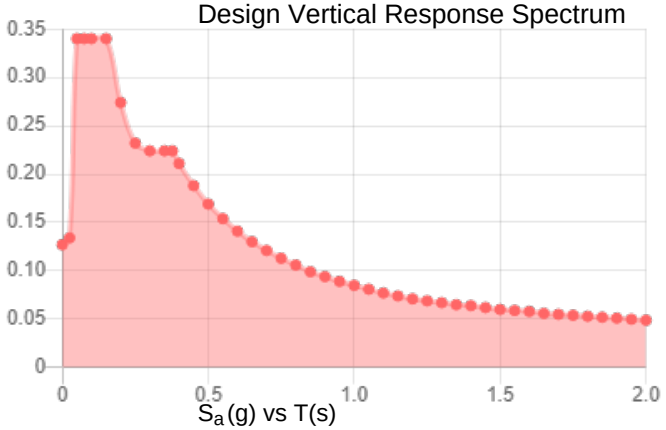
Design Response Spectrum



MCE_R Vertical Response Spectrum



Design Vertical Response Spectrum



Data Accessed: Mon Feb 05 2024

Date Source:

USGS Seismic Design Maps based on ASCE/SEI 7-16 and ASCE/SEI 7-16 Table 1.5-2. Additional data for site-specific ground motion procedures in accordance with ASCE/SEI 7-16 Ch. 21 are available from USGS.

The ASCE Hazard Tool is provided for your convenience, for informational purposes only, and is provided “as is” and without warranties of any kind. The location data included herein has been obtained from information developed, produced, and maintained by third party providers; or has been extrapolated from maps incorporated in the ASCE standard. While ASCE has made every effort to use data obtained from reliable sources or methodologies, ASCE does not make any representations or warranties as to the accuracy, completeness, reliability, currency, or quality of any data provided herein. Any third-party links provided by this Tool should not be construed as an endorsement, affiliation, relationship, or sponsorship of such third-party content by or from ASCE.

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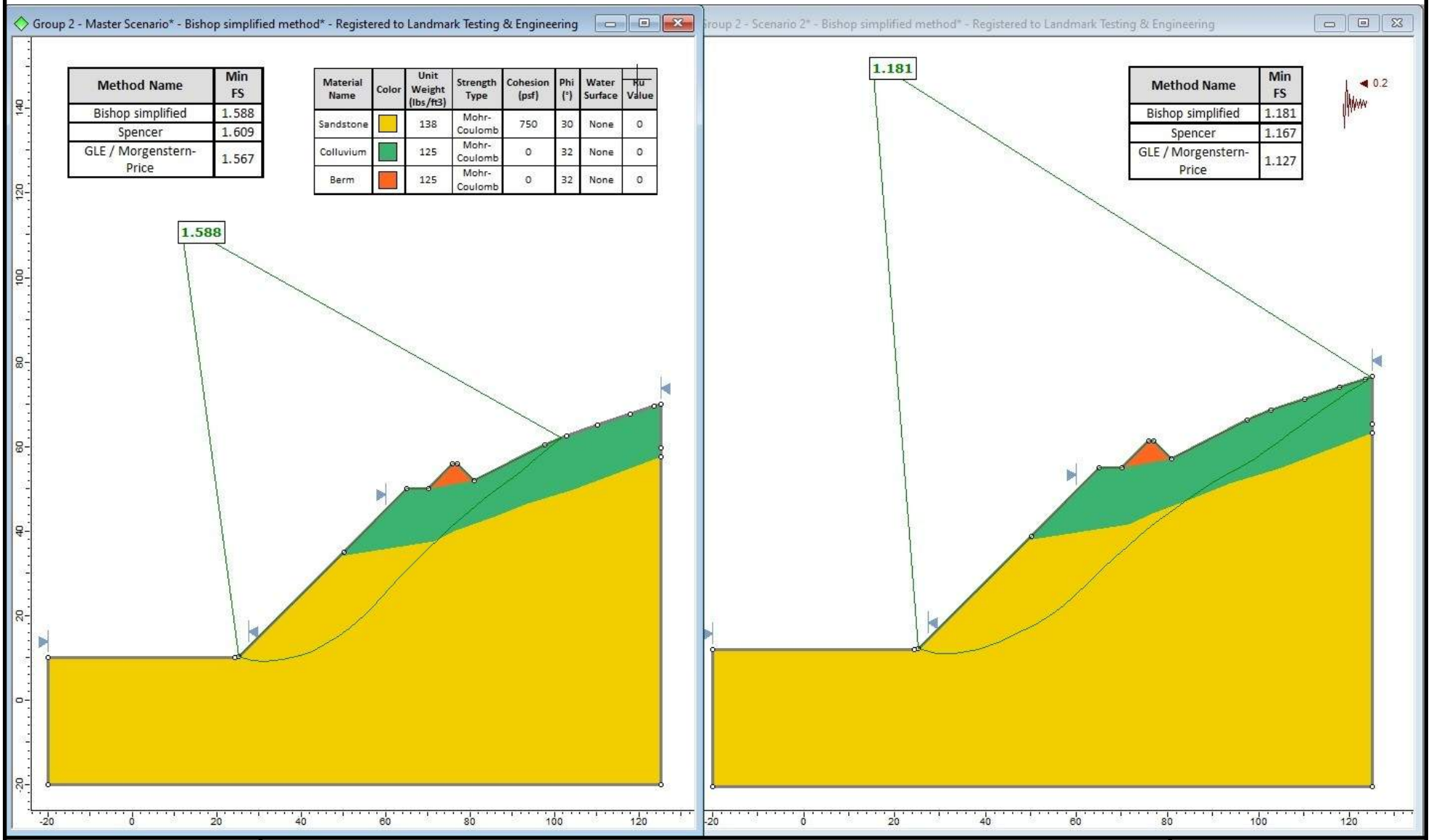
The allowable factor of safety for the static condition is 1.5. All methods show FS greater than 1.5. The condition as analyzed is stable.

The allowable factor of safety for the seismic condition is 1.1. All methods show FS greater than 1.1. The condition as analyzed is stable.



LANDMARK TESTING & ENGINEERING

Slope Stability Output – Static and Seismic Condition

Landmark Project No 240016

Figure D-1

rocscience

LANDMARK TESTING & ENGINEERING

240016 Hilton Home 2
Slide2 - An Interactive Slope Stability Program
Date Created: 1/25/2024, 2:24:19 PM
Software Version: 9.031

FIGURE D-2 (35 Pages)

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Slide2 Analysis Information

240016 Hilton Home 2

Project Summary

File Name:	240016 Hilton Home 2.slmd
Slide2 Modeler Version:	9.031
Project Title:	Slide2 - An Interactive Slope Stability Program
Date Created:	1/25/2024, 2:24:19 PM

Currently Open Scenarios

Group Name	Scenario Name	Global Minimum	Compute Time
Group 2	Master Scenario	Bishop Simplified: 1.588080 Spencer: 1.608550 Gle/morgenstern-price: 1.566820	00h:00m:06.984s
	Scenario 2	Bishop Simplified: 1.180800 Spencer: 1.166840 Gle/morgenstern-price: 1.126630	00h:00m:06.810s

General Settings

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

Analysis Options

All Open Scenarios

Slices Type:	Vertical
Analysis Methods Used	
	Bishop simplified
	GLE/Morgenstern-Price with interslice force function (Half Sine)
	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
Eliminate vertical segments in non-circular search	Yes

Groundwater Analysis

All Open Scenarios

Groundwater Method:	Water Surfaces
Pore Fluid Unit Weight [lbs/ft3]:	62.4
Advanced Groundwater Method:	None

Random Numbers

All Open Scenarios

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

Surface Options

All Open Scenarios

Search Method:	Particle Swarm Search
Initial # of Surface Vertices:	8
Maximum Iterations:	500
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

Group 2 - Master Scenario

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No

Group 2 - Scenario 2

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No
Seismic Load Coefficient (Horizontal):	0.2

Materials

Sandstone	
Color	
Strength Type	Mohr-Coulomb
Unit Weight	138 lbs/ft3
Cohesion	750 psf
Phi	30 °
Water Surface	Assigned per scenario
Ru Value	0

Colluvium	
Color	
Strength Type	Mohr-Coulomb
Unit Weight	125 lbs/ft3
Cohesion	0 psf
Phi	32 °
Water Surface	Assigned per scenario
Ru Value	0

Berm	
Color	
Strength Type	Mohr-Coulomb
Unit Weight	125 lbs/ft3
Cohesion	0 psf
Phi	32 °
Water Surface	Assigned per scenario
Ru Value	0

Materials In Use

Material	Group 2	Scenario 2
Sandstone	✓	✓
Colluvium	✓	✓
Berm	✓	✓

Global Minimums

Group 2 - Master Scenario

Method: bishop simplified

FS	1.588080
Axis Location:	11.480, 112.568
Left Slip Surface Endpoint:	25.191, 10.190
Right Slip Surface Endpoint:	101.609, 62.110
Resisting Moment:	1.01864e+07 lb-ft
Driving Moment:	6.41429e+06 lb-ft
Total Slice Area:	869.076 ft2
Surface Horizontal Width:	76.4174 ft
Surface Average Height:	11.3727 ft

Method: spencer

FS	1.608550
Axis Location:	12.653, 121.477
Left Slip Surface Endpoint:	25.191, 10.190
Right Slip Surface Endpoint:	109.205, 64.735
Resisting Moment:	1.00113e+07 lb-ft
Driving Moment:	6.2238e+06 lb-ft
Resisting Horizontal Force:	79215.4 lb
Driving Horizontal Force:	49246.6 lb
Total Slice Area:	812.285 ft2
Surface Horizontal Width:	84.0144 ft
Surface Average Height:	9.66841 ft

Method: gle/morgenstern-price

FS	1.566820
Axis Location:	13.741, 129.092
Left Slip Surface Endpoint:	25.191, 10.190
Right Slip Surface Endpoint:	115.733, 66.911
Resisting Moment:	1.09768e+07 lb-ft
Driving Moment:	7.00579e+06 lb-ft
Resisting Horizontal Force:	82577.7 lb
Driving Horizontal Force:	52703.9 lb
Total Slice Area:	870.217 ft2
Surface Horizontal Width:	90.5415 ft
Surface Average Height:	9.61124 ft

Group 2 - Scenario 2

Method: bishop simplified

FS	1.180800
Axis Location:	15.227, 139.492
Left Slip Surface Endpoint:	25.191, 10.190
Right Slip Surface Endpoint:	124.647, 69.882
Resisting Moment:	1.54646e+07 lb-ft
Driving Moment:	1.30967e+07 lb-ft
Total Slice Area:	1209.1 ft2
Surface Horizontal Width:	99.4554 ft
Surface Average Height:	12.1572 ft

Method: spencer

FS	1.166840
Axis Location:	17.458, 137.691
Left Slip Surface Endpoint:	26.779, 11.771
Right Slip Surface Endpoint:	123.787, 69.596
Resisting Moment:	1.02878e+07 lb-ft
Driving Moment:	8.8168e+06 lb-ft
Resisting Horizontal Force:	76229.6 lb
Driving Horizontal Force:	65330.2 lb
Total Slice Area:	852.331 ft2
Surface Horizontal Width:	97.0079 ft
Surface Average Height:	8.7862 ft

Method: gle/morgenstern-price

FS	1.126630
Axis Location:	14.709, 128.766
Left Slip Surface Endpoint:	25.839, 10.835
Right Slip Surface Endpoint:	115.732, 66.911
Resisting Moment:	1.01487e+07 lb-ft
Driving Moment:	9.00805e+06 lb-ft
Resisting Horizontal Force:	78291.2 lb
Driving Horizontal Force:	69491.6 lb
Total Slice Area:	894.986 ft2
Surface Horizontal Width:	89.8936 ft
Surface Average Height:	9.95606 ft

Global Minimum Coordinates

Group 2 - Master Scenario

Method: bishop simplified

X	Y
25.1911	10.1902
28.2356	9.30606
31.2801	9.10939
35.4965	9.54779
39.7129	10.4867
42.5789	11.5381
45.4449	13.0094
48.3109	14.8567
51.1769	16.9126
53.1063	18.6303
55.0357	20.2805
56.9651	22.0644
58.8945	24.2244
61.1343	26.7336
63.3742	29.1647
65.614	31.5175
67.8538	33.7921
70.0936	35.9884
72.3334	38.1066
75.3171	40.824
78.3007	43.4372
81.2844	45.9462
84.268	48.351
86.8312	50.3274
89.3944	52.2143
91.9577	54.0117
94.5209	56.2695
97.0841	58.4637
99.6473	60.5683
101.609	62.1102

Method: spencer

X	Y
25.1911	10.1902
28.0357	10.4313
30.8803	10.8515
35.4008	11.7493
39.8562	13.3164
42.7582	15.0604
45.6602	16.7235
48.5396	18.5674
51.419	20.4324
54.7553	23.0995
58.0916	25.7688
61.4279	28.7091
64.7642	31.8162
68.1004	34.8068
71.4367	37.6809
73.8213	39.6518
76.2058	41.5395
79.015	43.6652
81.8242	45.6929
85.1043	47.9459
88.3844	50.0843
91.6635	52.1076
94.9426	54.6125
98.2217	57.0029
101.883	59.7055
105.544	62.2802
109.205	64.7352

Method: gle/morgenstern-price

X	Y
25.1911	10.1902
29.7557	9.5602
33.711	10.3361
36.9619	11.6136
39.4972	12.9352
42.099	14.528
44.6281	16.074
46.8308	17.6492
49.1963	19.3996
51.5389	21.1212
54.9836	23.7703
57.0694	25.3266
59.1551	27.0605
61.2408	28.8587
63.4057	30.852
65.6732	32.8606
67.5604	34.4664
69.3158	35.8988
71.1935	37.3654
73.0711	38.7663
75.8505	40.7431
78.6298	42.6227
82.1908	44.9066
86.0386	47.2402
90.2958	49.6733
94.6213	52.785
96.8316	54.2979
99.0419	55.8688
103.462	59.0772
106.526	61.1934
109.589	63.2027
112.655	65.107
115.733	66.9109

Group 2 - Scenario 2

Method: bishop simplified

X	Y
25.1911	10.1902
29.1923	9.12644
33.2152	9.0967
38.2385	10.1152
43.2624	11.8162
45.99	13.0673
48.5551	14.3561
50.8973	15.5232
54.595	17.9582
57.0175	19.6727
59.44	21.763
62.4191	24.7041
65.3985	27.5416
68.3779	30.275
71.0282	32.6139
73.6784	34.8602
76.3286	37.0139
78.9787	39.075
81.7026	41.0985
84.4265	43.0267
87.2235	44.909
89.9123	46.6247
92.8045	48.3691
96.0492	50.2128
99.294	51.9433
101.829	53.8248
104.365	55.625
106.9	57.5287
109.435	59.4031
111.97	61.2458
114.506	63.0608
117.041	64.8545
119.576	66.5597
122.111	68.2086
124.647	69.8822

Method: spencer

X	Y
26.7794	11.7707
30.1542	12.603
32.9321	13.4538
35.71	14.6087
38.3789	15.7555
41.0478	16.9625
45.6264	19.3922
49.0413	21.4697
51.6338	23.1801
53.8262	24.6534
56.0186	26.1126
58.2172	27.6038
60.2577	29.1534
62.4692	30.9781
64.6807	32.7255
66.8922	34.3957
69.1037	35.9886
71.5522	37.6668
74.0007	39.2595
76.4492	40.7667
80.9218	43.3636
85.3945	45.8044
89.8671	48.7231
94.3398	51.4856
98.8124	54.0919
103.285	56.5538
106.537	58.3388
109.13	60.0981
112.377	62.1872
116.561	64.7879
118.97	66.3587
121.379	67.9831
123.787	69.5958

Method: gle/morgenstern-price

X	Y
25.8388	10.8347
28.0313	10.6489
30.2635	10.6379
34.0107	11.806
37.7599	13.4409
40.6088	14.8721
43.4576	16.5559
45.7855	18.1333
48.3199	19.9658
50.5403	21.5739
52.7607	23.1931
55.1885	24.9606
57.6186	26.9677
60.046	28.9982
62.9769	31.3476
65.9079	33.5947
69.1104	35.9381
72.313	38.1697
75.0938	40.0103
77.8715	41.7519
80.6464	43.3948
83.8181	45.1619
86.5769	46.6943
89.1644	48.1278
91.7488	49.5558
95.3451	51.5361
98.9245	53.5007
102.503	55.4585
105.814	57.2654
109.121	59.0653
112.426	62.2922
114.079	63.9026
115.732	66.9108

Global Minimum Support Data

All Open Scenarios

No Supports Present

Valid and Invalid Surfaces

Group 2 - Master Scenario

Method: bishop simplified

Number of Valid Surfaces:	34560
Number of Invalid Surfaces:	69147

Error Codes

Error Code -111 reported for 2 surfaces
Error Code -112 reported for 3 surfaces
Error Code -121 reported for 1 surface
Error Code -1000 reported for 69141 surfaces

Method: spencer

Number of Valid Surfaces:	34548
Number of Invalid Surfaces:	69159

Error Codes

Error Code -111 reported for 12 surfaces
Error Code -112 reported for 5 surfaces
Error Code -121 reported for 1 surface
Error Code -1000 reported for 69141 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces:	34562
Number of Invalid Surfaces:	69145

Error Codes

Error Code -111 reported for 4 surfaces
Error Code -112 reported for 1 surface
Error Code -121 reported for 1 surface
Error Code -1000 reported for 69139 surfaces

Group 2 - Scenario 2

Method: bishop simplified

Number of Valid Surfaces:	34552
Number of Invalid Surfaces:	69149

Error Codes

Error Code -112 reported for 4 surfaces
Error Code -121 reported for 4 surfaces
Error Code -1000 reported for 69141 surfaces

Method: spencer

Number of Valid Surfaces:	34510
Number of Invalid Surfaces:	69191

Error Codes

Error Code -111 reported for 19 surfaces
Error Code -112 reported for 10 surfaces
Error Code -121 reported for 4 surfaces
Error Code -1000 reported for 69158 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces:	34536
Number of Invalid Surfaces:	69165

Error Codes

Error Code -111 reported for 5 surfaces
Error Code -112 reported for 10 surfaces
Error Code -121 reported for 4 surfaces
Error Code -1000 reported for 69146 surfaces

Error Code Descriptions

The following errors were encountered during the computation:

-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.

-121 = Concave failure surface, only convex surfaces have been defined as being allowed.

-1000 = No valid slip surface is generated

Slice Data

Group 2 - Master Scenario

Global Minimum Query (bishop simplified) - Safety Factor: 1.58808

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [deg]	Base Material	Base Cohesion [psf]	Base Friction Angle [deg]	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	1.52225	205.528	-16.1936	Sandstone	750	30	582.895	925.684	304.293	0	304.293	135.017	135.017
2	1.52225	616.585	-16.1936	Sandstone	750	30	692.654	1099.99	606.201	0	606.201	405.049	405.049
3	1.52225	991.537	-3.69613	Sandstone	750	30	726.127	1153.15	698.273	0	698.273	651.366	651.366
4	1.52225	1330.38	-3.69613	Sandstone	750	30	808.998	1284.75	926.224	0	926.224	873.963	873.963
5	2.10819	2350.37	5.93609	Sandstone	750	30	845.619	1342.91	1026.95	0	1026.95	1114.88	1114.88
6	2.10819	2896.89	5.93609	Sandstone	750	30	936.432	1487.13	1276.75	0	1276.75	1374.11	1374.11
7	2.10819	3407	12.5542	Sandstone	750	30	980.424	1556.99	1397.75	0	1397.75	1616.08	1616.08
8	2.10819	3880.7	12.5542	Sandstone	750	30	1056	1677.01	1605.62	0	1605.62	1840.78	1840.78
9	1.43301	2887.85	20.1446	Sandstone	750	30	1063.13	1688.34	1625.25	0	1625.25	2015.24	2015.24
10	1.43301	3065.87	20.1446	Sandstone	750	30	1102.98	1751.62	1734.86	0	1734.86	2139.47	2139.47
11	1.43301	3223.13	27.1749	Sandstone	750	30	1087.08	1726.37	1691.13	0	1691.13	2249.21	2249.21
12	1.43301	3359.62	27.1749	Sandstone	750	30	1116.27	1772.72	1771.4	0	1771.4	2344.46	2344.46
13	1.43301	3477.53	32.8045	Sandstone	750	30	1097.37	1742.7	1719.41	0	1719.41	2426.74	2426.74
14	1.43301	3576.85	32.8045	Sandstone	750	30	1117.78	1775.12	1775.56	0	1775.56	2496.05	2496.05
15	1.43301	3663.56	35.653	Sandstone	750	30	1111.78	1765.59	1759.05	0	1759.05	2556.56	2556.56
16	1.43301	3724.23	35.653	Sandstone	750	30	1123.98	1784.97	1792.62	0	1792.62	2598.89	2598.89
17	1.9294	5064.28	41.6771	Sandstone	750	30	1077.71	1711.5	1665.36	0	1665.36	2624.79	2624.79
18	1.9294	5092.95	40.5413	Sandstone	750	30	1092.27	1734.62	1705.4	0	1705.4	2639.66	2639.66
19	1.9294	5112.81	42.756	Sandstone	750	30	1074.49	1706.38	1656.49	0	1656.49	2649.94	2649.94
20	1.9294	5064.8	48.2272	Sandstone	750	30	1013.94	1610.22	1489.95	0	1489.95	2625.07	2625.07
21	1.11991	2894.79	48.2469	Sandstone	750	30	1003.35	1593.4	1460.8	0	1460.8	2584.84	2584.84
22	1.11991	2861.61	48.2469	Sandstone	750	30	995.695	1581.24	1439.75	0	1439.75	2555.22	2555.22
23	2.23982	5635.79	47.3441	Sandstone	750	30	994.582	1579.48	1436.69	0	1436.69	2516.18	2516.18
24	2.23982	5515.59	46.4092	Sandstone	750	30	989.601	1571.57	1423	0	1423	2462.51	2462.51
25	1.11991	2575.37	45.4412	Sandstone	750	30	955.524	1517.45	1329.26	0	1329.26	2299.62	2299.62
26	1.11991	2402.25	45.4412	Sandstone	750	30	914.48	1452.27	1216.36	0	1216.36	2145.03	2145.03
27	2.23982	4297.62	44.4388	Sandstone	750	30	862.388	1369.54	1073.08	0	1073.08	1918.73	1918.73
28	2.02817	3604.4	43.4008	Sandstone	750	30	832.235	1321.66	990.136	0	990.136	1777.16	1777.16
29	0.211648	376.24	43.4008	Colluvium	0	32	509.777	809.567	1295.58	0	1295.58	1777.67	1777.67
30	1.49182	2666.55	42.326	Colluvium	0	32	517.767	822.255	1315.88	0	1315.88	1787.44	1787.44
31	1.49182	2693.31	42.326	Colluvium	0	32	522.964	830.508	1329.09	0	1329.09	1805.38	1805.38
32	1.49182	2659.34	41.2131	Colluvium	0	32	521.643	828.411	1325.74	0	1325.74	1782.61	1782.61
33	1.49182	2322	41.2131	Colluvium	0	32	455.473	723.327	1157.57	0	1157.57	1556.49	1556.49
34	1.49182	1804.36	40.0611	Colluvium	0	32	357.589	567.88	908.797	0	908.797	1209.5	1209.5
35	1.49182	1302.53	40.0611	Colluvium	0	32	258.136	409.94	656.04	0	656.04	873.11	873.11
36	1.49182	1096.82	38.8687	Colluvium	0	32	219.636	348.8	558.195	0	558.195	735.222	735.222
37	1.49182	1015.56	38.8687	Colluvium	0	32	203.363	322.957	516.839	0	516.839	680.749	680.749
38	1.28161	811.143	37.635	Colluvium	0	32	191.065	303.427	485.585	0	485.585	632.91	632.91
39	1.28161	758.336	37.635	Colluvium	0	32	178.626	283.673	453.972	0	453.972	591.707	591.707
40	1.28161	709.114	36.3589	Colluvium	0	32	168.812	268.087	429.029	0	429.029	553.301	553.301
41	1.28161	663.477	36.3589	Colluvium	0	32	157.947	250.833	401.417	0	401.417	517.691	517.691
42	1.28161	621.425	35.0395	Colluvium	0	32	149.53	237.465	380.024	0	380.024	484.879	484.879
43	1.28161	582.958	35.0395	Colluvium	0	32	140.274	222.766	356.499	0	356.499	454.864	454.864
44	1.28161	526.054	41.3746	Colluvium	0	32	119.939	190.472	304.818	0	304.818	410.464	410.464
45	1.28161	450.713	41.3746	Colluvium	0	32	102.761	163.192	261.163	0	261.163	351.677	351.677
46	1.28161	377.919	40.5643	Colluvium	0	32	86.7935	137.835	220.581	0	220.581	294.878	294.878
47	1.28161	307.671	40.5643	Colluvium	0	32	70.6602	112.214	179.58	0	179.58	240.067	240.067
48	1.28161	236.562	39.3895	Colluvium	0	32	54.8933	87.1749	139.509	0	139.509	184.582	184.582
49	1.28161	155.502	39.3895	Colluvium	0	32	36.0836	57.3037	91.7048	0	91.7048	121.333	121.333
50	1.96124	87.6129	38.1738	Colluvium	0	32	13.4246	21.3193	34.118	0	34.118	44.6722	44.6722

Global Minimum Query (spencer) - Safety Factor: 1.60855

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [deg]	Base Material	Base Cohesion [psf]	Base Friction Angle [deg]	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	1.4223	127.058	4.84463	Sandstone	750	30	621.935	1000.41	433.729	0	433.729	486.443	486.443
2	1.4223	381.174	4.84463	Sandstone	750	30	697.883	1122.58	645.328	0	645.328	704.478	704.478
3	1.4223	626.502	8.40303	Sandstone	750	30	737.725	1186.67	756.331	0	756.331	865.309	865.309
4	1.4223	863.04	8.40303	Sandstone	750	30	803.343	1292.22	939.147	0	939.147	1057.82	1057.82
5	2.26022	1840.17	11.2332	Sandstone	750	30	853.333	1372.63	1078.42	0	1078.42	1247.9	1247.9
6	2.26022	2401.64	11.2332	Sandstone	750	30	945.97	1521.64	1336.52	0	1336.52	1524.39	1524.39
7	2.22772	2864.09	19.3781	Sandstone	750	30	926.562	1490.42	1282.45	0	1282.45	1608.34	1608.34
8	2.22772	3304.66	19.3781	Sandstone	750	30	989.864	1592.25	1458.81	0	1458.81	1806.97	1806.97
9	1.451	2353.18	31.0047	Sandstone	750	30	897.493	1443.66	1201.46	0	1201.46	1740.83	1740.83
10	1.451	2467.68	31.0047	Sandstone	750	30	918.017	1476.68	1258.64	0	1258.64	1810.34	1810.34
11	1.451	2586.22	29.816	Sandstone	750	30	952.856	1532.72	1355.7	0	1355.7	1901.76	1901.76
12	1.451	2708.82	29.816	Sandstone	750	30	975.303	1568.82	1418.24	0	1418.24	1977.17	1977.17
13	1.43971	2799.29	32.6348	Sandstone	750	30	961.927	1547.31	1380.98	0	1380.98	1996.98	1996.98
14	1.43971	2900.73	32.6348	Sandstone	750	30	979.726	1575.94	1430.57	0	1430.57	2057.97	2057.97
15	1.43971	2996.88	32.931	Sandstone	750	30	992.923	1597.17	1467.34	0	1467.34	2110.45	2110.45
16	1.43971	3076.8	32.931	Sandstone	750	30	1006.87	1619.6	1506.19	0	1506.19	2158.34	2158.34
17	1.66814	3636.3	38.6399	Sandstone	750	30	946.866	1523.08	1339.02	0	1339.02	2095.97	2095.97
18	1.66814	3685.91	38.6399	Sandstone	750	30	953.597	1533.91	1357.77	0	1357.77	2120.1	2120.1
19	1.66814	3735.39	38.6626	Sandstone	750	30	960.032	1544.26	1375.7	0	1375.7	2143.8	2143.8
20	1.66814	3784.74	38.6626	Sandstone	750	30	966.725	1555.03	1394.34	0	1394.34	2167.8	2167.8
21	1.66814	3818.51	41.3894	Sandstone	750	30	937.703	1508.34	1313.49	0	1313.49	2139.87	2139.87
22	1.66814	3836.67	41.3894	Sandstone	750	30	940.043	1512.11	1320.01	0	1320.01	2148.46	2148.46
23	1.66814	3845.24	42.9631	Sandstone	750	30	921.985	1483.06	1269.69	0	1269.69	2128.35	2128.35
24	1.66814	3844.2	42.9631	Sandstone	750	30	921.855	1482.85	1269.33	0	1269.33	2127.87	2127.87
25	1.66814	3720.59	41.8727	Sandstone	750	30	919.332	1478.79	1262.3	0	1262.3	2086.38	2086.38
26	1.66814	3385.74	41.8727	Sandstone	750	30	876.608	1410.07	1143.27	0	1143.27	1929.05	1929.05
27	1.6003	2936.24	40.7439	Sandstone	750	30	846.776	1362.08	1060.16	0	1060.16	1789.63	1789.63
28	1.6003	2741.25	40.7439	Sandstone	750	30	820.274	1319.45	986.315	0	986.315	1692.96	1692.96
29	0.135675	233.033	40.7439	Colluvium	0	32	403.015	648.269	1037.45	0	1037.45	1384.63	1384.63
30	2.38455	4162.73	39.5754	Colluvium	0	32	419.039	674.045	1078.7	0	1078.7	1425.05	1425.05
31	2.38455	4292.38	38.3661	Colluvium	0	32	442.27	711.413	1138.5	0	1138.5	1488.61	1488.61
32	1.4046	2388.85	37.1151	Colluvium	0	32	427.944	688.37	1101.62	0	1101.62	1425.45	1425.45
33	1.4046	1992.43	37.1151	Colluvium	0	32	356.928	574.137	918.81	0	918.81	1188.9	1188.9
34	1.4046	1560.99	35.8212	Colluvium	0	32	286.555	460.938	737.654	0	737.654	944.485	944.485
35	1.4046	1212.95	35.8212	Colluvium	0	32	222.665	358.167	573.187	0	573.187	733.903	733.903
36	1.64004	1330.18	34.4838	Colluvium	0	32	214.433	344.927	551.997	0	551.997	699.284	699.284
37	1.64004	1272.02	34.4838	Colluvium	0	32	205.057	329.845	527.862	0	527.862	668.709	668.709
38	1.64004	1219.72	33.1021	Colluvium	0	32	201.744	324.515	519.335	0	519.335	650.861	650.861
39	1.64004	1173.3	33.1021	Colluvium	0	32	194.066	312.165	499.568	0	499.568	626.088	626.088
40	1.63956	1132.43	31.6756	Colluvium	0	32	192.365	309.429	495.19	0	495.19	613.884	613.884
41	1.63956	1097.77	31.6756	Colluvium	0	32	186.478	299.959	480.034	0	480.034	595.095	595.095
42	1.63956	1038.43	37.3761	Colluvium	0	32	158.581	255.085	408.221	0	408.221	529.361	529.361
43	1.63956	954.421	37.3761	Colluvium	0	32	145.751	234.448	375.195	0	375.195	486.534	486.534
44	1.63956	876.277	36.0911	Colluvium	0	32	137.11	220.549	352.952	0	352.952	452.902	452.902
45	1.63956	800.892	36.0911	Colluvium	0	32	125.315	201.575	322.588	0	322.588	413.939	413.939
46	1.83063	775.583	36.4333	Colluvium	0	32	107.989	173.706	277.989	0	277.989	357.702	357.702
47	1.83063	643.035	36.4333	Colluvium	0	32	89.5341	144.02	230.48	0	230.48	296.57	296.57
48	1.83063	511.623	35.1164	Colluvium	0	32	73.0217	117.459	187.974	0	187.974	239.326	239.326
49	1.83063	359.973	35.1164	Colluvium	0	32	51.3775	82.6432	132.257	0	132.257	168.387	168.387
50	3.66126	282.496	33.8427	Colluvium	0	32	20.646	33.2101	53.1473	0	53.1473	66.9908	66.9908

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.56682

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [deg]	Base Material	Base Cohesion [psf]	Base Friction Angle [deg]	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	1.52151	180.988	-7.85832	Sandstone	750	30	561.472	879.725	224.69	0	224.69	147.196	147.196
2	1.52151	542.963	-7.85832	Sandstone	750	30	681.816	1068.28	551.282	0	551.282	457.178	457.178
3	1.52151	904.939	-7.85832	Sandstone	750	30	811.819	1271.97	904.088	0	904.088	792.041	792.041
4	1.97767	1627.09	11.0985	Sandstone	750	30	810.189	1269.42	899.664	0	899.664	1058.6	1058.6
5	1.97767	2058.27	11.0985	Sandstone	750	30	915.046	1433.71	1184.22	0	1184.22	1363.72	1363.72
6	1.62545	1978.65	21.4531	Sandstone	750	30	913.221	1430.85	1179.27	0	1179.27	1538.14	1538.14
7	1.62545	2198.17	21.4531	Sandstone	750	30	968.769	1517.89	1330.02	0	1330.02	1710.71	1710.71
8	2.53528	3809.87	27.5331	Sandstone	750	30	968.382	1517.28	1328.97	0	1328.97	1833.79	1833.79
9	1.30089	2107.42	31.4739	Sandstone	750	30	966.865	1514.9	1324.85	0	1324.85	1916.74	1916.74
10	1.30089	2196.83	31.4739	Sandstone	750	30	986.955	1546.38	1379.37	0	1379.37	1983.56	1983.56
11	2.52908	4527.17	31.4367	Sandstone	750	30	1015.84	1591.64	1457.77	0	1457.77	2078.74	2078.74
12	2.20275	4184.26	35.5687	Sandstone	750	30	993.634	1556.85	1397.5	0	1397.5	2108.05	2108.05
13	2.36553	4692.53	36.501	Sandstone	750	30	998.581	1564.6	1410.92	0	1410.92	2149.86	2149.86
14	2.34255	4812.31	36.3125	Sandstone	750	30	1012.9	1587.03	1449.78	0	1449.78	2194.17	2194.17
15	1.72236	3624.28	37.562	Sandstone	750	30	1003.37	1572.11	1423.93	0	1423.93	2195.57	2195.57
16	1.72236	3689.6	37.562	Sandstone	750	30	1007.79	1579.03	1435.92	0	1435.92	2210.96	2210.96
17	2.08577	4562.43	36.7277	Sandstone	750	30	1025.08	1606.12	1482.85	0	1482.85	2247.69	2247.69
18	2.0857	4646.25	39.7374	Sandstone	750	30	987.216	1546.79	1380.08	0	1380.08	2200.77	2200.77
19	2.0857	4695.4	40.766	Sandstone	750	30	972.866	1524.31	1341.14	0	1341.14	2179.89	2179.89
20	2.1649	4896.94	42.6371	Sandstone	750	30	944.763	1480.27	1264.87	0	1264.87	2134.76	2134.76
21	2.26753	5118.37	41.5352	Sandstone	750	30	953.812	1494.45	1289.43	0	1289.43	2134.34	2134.34
22	1.8872	3930.8	40.3945	Sandstone	750	30	928.6	1454.95	1221.01	0	1221.01	2011.15	2011.15
23	1.75541	3295.06	39.2138	Sandstone	750	30	896.437	1404.56	1133.72	0	1133.72	1865.2	1865.2
24	1.87765	3243.51	37.992	Sandstone	750	30	875.308	1371.45	1076.38	0	1076.38	1760.05	1760.05
25	0.399389	692.997	36.7281	Sandstone	750	30	889.975	1394.43	1116.19	0	1116.19	1780.23	1780.23
26	1.47826	2608.78	36.7281	Colluvium	0	32	433.932	679.894	1088.06	0	1088.06	1411.83	1411.83
27	1.38969	2521.66	35.4211	Colluvium	0	32	457.614	716.998	1147.44	0	1147.44	1472.9	1472.9
28	1.38969	2592.81	35.4211	Colluvium	0	32	469.749	736.012	1177.86	0	1177.86	1511.96	1511.96
29	1.38965	2532.32	34.0704	Colluvium	0	32	471.804	739.232	1183.02	0	1183.02	1502.1	1502.1
30	1.38965	2207.91	34.0704	Colluvium	0	32	410.218	642.738	1028.6	0	1028.6	1306.03	1306.03
31	1.78047	2240.83	32.6752	Colluvium	0	32	332.771	521.392	834.4	0	834.4	1047.83	1047.83
32	1.78047	1741.89	32.6752	Colluvium	0	32	256.345	401.647	642.77	0	642.77	807.184	807.184
33	1.9239	1807.48	31.235	Colluvium	0	32	253.275	396.836	635.07	0	635.07	788.67	788.67
34	1.9239	1764.65	31.235	Colluvium	0	32	247.364	387.575	620.248	0	620.248	770.263	770.263
35	2.1286	1912.38	29.7495	Colluvium	0	32	249.983	391.678	626.815	0	626.815	769.689	769.689
36	2.1286	1879.72	29.7495	Colluvium	0	32	246.439	386.125	617.927	0	617.927	758.776	758.776
37	2.16277	1833.23	35.7307	Colluvium	0	32	212.662	333.203	533.237	0	533.237	686.223	686.223
38	2.16277	1713.07	35.7307	Colluvium	0	32	201.079	315.054	504.193	0	504.193	648.846	648.846
39	2.21031	1637.24	34.3902	Colluvium	0	32	195.273	305.957	489.635	0	489.635	623.292	623.292
40	2.21031	1511.13	35.401	Colluvium	0	32	179.964	281.971	451.249	0	451.249	579.148	579.148
41	2.21026	1332.51	35.9722	Colluvium	0	32	160.027	250.733	401.257	0	401.257	517.404	517.404
42	2.21026	1143.24	35.9722	Colluvium	0	32	140.077	219.476	351.236	0	351.236	452.904	452.904
43	1.53157	664.287	34.6398	Colluvium	0	32	121.807	190.85	305.424	0	305.424	389.579	389.579
44	1.53157	559.449	34.6398	Colluvium	0	32	103.985	162.925	260.735	0	260.735	332.576	332.576
45	1.53157	459.731	33.2633	Colluvium	0	32	88.1524	138.119	221.037	0	221.037	278.862	278.862
46	1.53157	365.132	33.2633	Colluvium	0	32	70.938	111.147	177.872	0	177.872	224.404	224.404
47	1.5331	275.887	31.8419	Colluvium	0	32	55.0982	86.329	138.156	0	138.156	172.374	172.374
48	1.5331	191.359	31.8419	Colluvium	0	32	38.682	60.6078	96.993	0	96.993	121.016	121.016
49	1.53887	112.242	30.3753	Colluvium	0	32	23.18	36.3189	58.1225	0	58.1225	71.7088	71.7088
50	1.53887	37.4139	30.3753	Colluvium	0	32	7.80045	12.2219	19.5592	0	19.5592	24.1312	24.1312

Group 2 - Scenario 2

Global Minimum Query (bishop simplified) - Safety Factor: 1.1808

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [deg]	Base Material	Base Cohesion [psf]	Base Friction Angle [deg]	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	2.00061	348.217	-14.8883	Sandstone	750	30	827.885	977.567	394.158	0	394.158	174.056	174.056
2	2.00061	1044.65	-14.8883	Sandstone	750	30	1023.53	1208.58	794.285	0	794.285	522.169	522.169
3	2.01141	1680.23	-0.423477	Sandstone	750	30	1047.39	1236.76	843.092	0	843.092	835.351	835.351
4	2.01141	2239.9	-0.423477	Sandstone	750	30	1183.93	1397.99	1122.35	0	1122.35	1113.6	1113.6
5	2.51169	3491.31	11.4617	Sandstone	750	30	1196.22	1412.5	1147.48	0	1147.48	1390.03	1390.03
6	2.51169	4181.06	11.4617	Sandstone	750	30	1318.38	1556.75	1397.33	0	1397.33	1664.64	1664.64
7	2.51192	4812.14	18.7055	Sandstone	750	30	1348.59	1592.42	1459.11	0	1459.11	1915.72	1915.72
8	2.51192	5383.73	18.7055	Sandstone	750	30	1444.05	1705.13	1654.34	0	1654.34	2143.28	2143.28
9	2.72764	6431.79	24.639	Sandstone	750	30	1460.56	1724.63	1688.1	0	1688.1	2358	2358
10	2.56508	6531.04	26.6768	Sandstone	750	30	1509.31	1782.19	1787.8	0	1787.8	2546.14	2546.14
11	2.34225	6338.79	26.4869	Sandstone	750	30	1574.73	1859.44	1921.6	0	1921.6	2706.29	2706.29
12	1.84885	5195.37	33.3654	Sandstone	750	30	1519.79	1794.57	1809.26	0	1809.26	2810.06	2810.06
13	1.84885	5322.77	33.3654	Sandstone	750	30	1545.28	1824.67	1861.38	0	1861.38	2878.97	2878.97
14	2.4225	7147.2	35.2886	Sandstone	750	30	1543.57	1822.65	1857.89	0	1857.89	2950.34	2950.34
15	2.4225	7263.26	40.7897	Sandstone	750	30	1477.71	1744.88	1723.19	0	1723.19	2998.25	2998.25
16	1.48953	4473.38	44.6331	Sandstone	750	30	1418.72	1675.23	1602.54	0	1602.54	3003.21	3003.21
17	1.48953	4455.41	44.6331	Sandstone	750	30	1414.75	1670.53	1594.41	0	1594.41	2991.15	2991.15
18	1.48972	4443.34	43.602	Sandstone	750	30	1428.4	1686.66	1622.34	0	1622.34	2982.68	2982.68
19	1.48972	4426.06	43.602	Sandstone	750	30	1424.53	1682.09	1614.42	0	1614.42	2971.08	2971.08
20	1.48968	4219.36	42.5343	Sandstone	750	30	1394.51	1646.64	1553.02	0	1553.02	2832.4	2832.4
21	1.48968	3943.09	42.5343	Sandstone	750	30	1331.91	1572.72	1425	0	1425	2646.94	2646.94
22	2.6503	6413.71	41.4288	Sandstone	750	30	1270.28	1499.95	1298.95	0	1298.95	2420	2420
23	1.32512	3144.66	40.2843	Sandstone	750	30	1269.41	1498.92	1297.18	0	1297.18	2373.12	2373.12
24	1.32512	3170.49	40.2843	Sandstone	750	30	1276.15	1506.88	1310.96	0	1310.96	2392.62	2392.62
25	2.65017	6417.72	39.0997	Sandstone	750	30	1301.9	1537.28	1363.61	0	1363.61	2421.63	2421.63
26	2.6501	5717.69	37.874	Sandstone	750	30	1224.45	1445.83	1205.22	0	1205.22	2157.54	2157.54
27	1.36198	2332.45	36.606	Sandstone	750	30	1080.18	1275.48	910.159	0	910.159	1712.55	1712.55
28	1.36198	1976.45	36.606	Sandstone	750	30	986.431	1164.78	718.414	0	718.414	1451.16	1451.16
29	2.34447	3216.53	35.295	Sandstone	750	30	970.174	1145.58	685.167	0	685.167	1371.96	1371.96
30	0.379409	506.066	35.295	Colluvium	0	32	513.488	606.327	970.325	0	970.325	1333.83	1333.83
31	1.39847	1839.43	33.94	Colluvium	0	32	513.263	606.061	969.9	0	969.9	1315.32	1315.32
32	1.39847	1800.54	33.94	Colluvium	0	32	502.409	593.245	949.392	0	949.392	1287.51	1287.51
33	1.34443	1698.24	32.5406	Colluvium	0	32	499.721	590.07	944.307	0	944.307	1263.16	1263.16
34	1.34443	1670.18	32.5406	Colluvium	0	32	491.463	580.32	928.706	0	928.706	1242.29	1242.29
35	1.44606	1769.67	31.0961	Colluvium	0	32	490.926	579.685	927.687	0	927.687	1223.79	1223.79
36	1.44606	1746.34	31.0961	Colluvium	0	32	484.453	572.042	915.459	0	915.459	1207.65	1207.65
37	1.6224	1937.27	29.6063	Colluvium	0	32	485.811	573.646	918.026	0	918.026	1194.08	1194.08
38	1.6224	1919.38	29.6063	Colluvium	0	32	481.327	568.351	909.553	0	909.553	1183.06	1183.06
39	1.62236	1907.01	28.0712	Colluvium	0	32	485.127	572.838	916.731	0	916.731	1175.45	1175.45
40	1.62236	1882.21	28.0712	Colluvium	0	32	478.818	565.388	904.809	0	904.809	1160.16	1160.16
41	2.53531	2783.98	36.5804	Colluvium	0	32	417.236	492.672	788.439	0	788.439	1098.08	1098.08
42	2.53531	2523.33	35.376	Colluvium	0	32	382.84	452.058	723.445	0	723.445	995.274	995.274
43	2.5353	2208.01	36.9023	Colluvium	0	32	329.82	389.451	623.253	0	623.253	870.909	870.909
44	2.5353	1877.17	36.4766	Colluvium	0	32	281.633	332.552	532.195	0	532.195	740.414	740.414
45	2.53525	1555.95	36.0112	Colluvium	0	32	234.56	276.968	443.241	0	443.241	613.729	613.729
46	2.53525	1244.19	35.5991	Colluvium	0	32	188.348	222.401	355.918	0	355.918	490.757	490.757
47	2.53522	940.177	35.2801	Colluvium	0	32	142.787	168.603	269.821	0	269.821	370.846	370.846
48	2.53522	653.577	33.9247	Colluvium	0	32	100.613	118.804	190.126	0	190.126	257.799	257.799
49	2.53522	389.922	33.04	Colluvium	0	32	60.5503	71.4978	114.42	0	114.42	153.802	153.802
50	2.53522	131.277	33.43	Colluvium	0	32	20.308	23.9797	38.3756	0	38.3756	51.7815	51.7815

Global Minimum Query (spencer) - Safety Factor: 1.16684

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [deg]	Base Material	Base Cohesion [psf]	Base Friction Angle [deg]	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	1.68739	147.012	13.8526	Sandstone	750	30	886.88	1034.85	493.37	0	493.37	712.073	712.073
2	1.68739	441.092	13.8526	Sandstone	750	30	965.409	1126.48	652.082	0	652.082	890.15	890.15
3	1.38895	575.795	17.0294	Sandstone	750	30	984.053	1148.23	689.755	0	689.755	991.163	991.163
4	1.38895	759.157	17.0294	Sandstone	750	30	1038.78	1212.09	800.367	0	800.367	1118.54	1118.54
5	1.38895	927.95	22.5741	Sandstone	750	30	1001.59	1168.69	725.191	0	725.191	1141.58	1141.58
6	1.38895	1082.18	22.5741	Sandstone	750	30	1041.74	1215.54	806.337	0	806.337	1239.42	1239.42
7	2.66885	2505.41	23.253	Sandstone	750	30	1088.29	1269.87	900.435	0	900.435	1368.07	1368.07
8	2.66886	3050.02	24.3361	Sandstone	750	30	1141.75	1332.24	1008.48	0	1008.48	1524.86	1524.86
9	1.52622	1971.37	27.9525	Sandstone	750	30	1129.67	1318.14	984.048	0	984.048	1583.5	1583.5
10	1.52622	2120.65	27.9525	Sandstone	750	30	1160.85	1354.53	1047.07	0	1047.07	1663.07	1663.07
11	1.52622	2269.93	27.9525	Sandstone	750	30	1192.03	1390.91	1110.09	0	1110.09	1742.64	1742.64
12	1.70743	2700.72	31.3158	Sandstone	750	30	1161.5	1355.29	1048.39	0	1048.39	1755.03	1755.03
13	1.70743	2856.28	31.3158	Sandstone	750	30	1188.4	1386.67	1102.74	0	1102.74	1825.75	1825.75
14	2.59249	4577.33	33.4147	Sandstone	750	30	1177.88	1374.4	1081.49	0	1081.49	1858.59	1858.59
15	2.19239	4060.61	33.9003	Sandstone	750	30	1193.45	1392.57	1112.96	0	1112.96	1914.94	1914.94
16	2.1924	4232.98	33.6469	Sandstone	750	30	1220.03	1423.58	1166.67	0	1166.67	1978.7	1978.7
17	2.19859	4415.91	34.1476	Sandstone	750	30	1232.3	1437.89	1191.47	0	1191.47	2027.29	2027.29
18	2.04056	4224.62	37.2129	Sandstone	750	30	1192.23	1391.14	1110.5	0	1110.5	2015.87	2015.87
19	2.2115	4666.13	39.5252	Sandstone	750	30	1161.01	1354.71	1047.39	0	1047.39	2005.31	2005.31
20	2.21149	4747.76	38.3142	Sandstone	750	30	1191.79	1390.62	1109.59	0	1109.59	2051.29	2051.29
21	2.21148	4627.34	37.0613	Sandstone	750	30	1200.7	1401.02	1127.61	0	1127.61	2034.42	2034.42
22	2.21147	4146.15	35.7657	Sandstone	750	30	1166.63	1361.28	1058.76	0	1058.76	1899.1	1899.1
23	2.35042	4028.69	34.4264	Sandstone	750	30	1146.07	1337.28	1017.19	0	1017.19	1802.69	1802.69
24	0.0980942	170.011	34.4264	Colluvium	0	32	517.976	604.395	967.237	0	967.237	1322.25	1322.25
25	2.44851	4382	33.0429	Colluvium	0	32	552.604	644.8	1031.89	0	1031.89	1391.35	1391.35
26	2.44849	4634.7	31.6144	Colluvium	0	32	604.516	705.374	1128.83	0	1128.83	1500.95	1500.95
27	2.23633	3844.14	30.1407	Colluvium	0	32	568.464	663.307	1061.51	0	1061.51	1391.58	1391.58
28	2.23633	2868.45	30.1407	Colluvium	0	32	424.182	494.952	792.088	0	792.088	1038.38	1038.38
29	2.23633	2365	28.6217	Colluvium	0	32	362.608	423.106	677.112	0	677.112	874.991	874.991
30	2.23633	2345.1	28.6217	Colluvium	0	32	359.557	419.546	671.413	0	671.413	867.626	867.626
31	1.49088	1537.5	33.1271	Colluvium	0	32	317.798	370.82	593.436	0	593.436	800.82	800.82
32	1.49088	1498.97	33.1271	Colluvium	0	32	309.833	361.526	578.561	0	578.561	780.748	780.748
33	1.49088	1460.44	33.1271	Colluvium	0	32	301.869	352.233	563.693	0	563.693	760.682	760.682
34	2.23632	2129.31	31.7013	Colluvium	0	32	303.458	354.087	566.659	0	566.659	754.089	754.089
35	2.23632	2064.44	31.7013	Colluvium	0	32	294.213	343.3	549.395	0	549.395	731.114	731.114
36	2.23632	2010.49	30.2304	Colluvium	0	32	296.677	346.175	553.995	0	553.995	726.876	726.876
37	2.23632	1957.33	30.2304	Colluvium	0	32	288.833	337.022	539.349	0	539.349	707.658	707.658
38	1.49088	1256.65	28.83	Colluvium	0	32	287.578	335.557	537.003	0	537.003	695.296	695.296
39	1.49088	1220.89	28.83	Colluvium	0	32	279.395	326.009	521.724	0	521.724	675.513	675.513
40	1.49088	1182.95	28.83	Colluvium	0	32	270.712	315.878	505.51	0	505.51	654.52	654.52
41	1.62587	1226.03	28.7647	Colluvium	0	32	257.675	300.666	481.167	0	481.167	622.618	622.618
42	1.62587	1154.78	28.7647	Colluvium	0	32	242.702	283.194	453.205	0	453.205	586.436	586.436
43	2.59347	1640.17	34.1503	Colluvium	0	32	190.244	221.984	355.25	0	355.25	484.299	484.299
44	1.62345	884.845	32.7576	Colluvium	0	32	169.43	197.698	316.383	0	316.383	425.396	425.396
45	1.62345	782.69	32.7576	Colluvium	0	32	149.87	174.874	279.856	0	279.856	376.284	376.284
46	2.09184	863.842	31.867	Colluvium	0	32	131.099	152.971	244.805	0	244.805	326.302	326.302
47	2.09184	706.141	31.867	Colluvium	0	32	107.166	125.045	200.114	0	200.114	266.733	266.733
48	2.40884	606.752	33.1079	Colluvium	0	32	77.6567	90.613	145.011	0	145.011	195.65	195.65
49	2.40885	367.492	33.9926	Colluvium	0	32	46.0634	53.7486	86.0159	0	86.0159	117.077	117.077
50	2.40885	121.914	33.8024	Colluvium	0	32	15.371	17.9355	28.7028	0	28.7028	38.9938	38.9938

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.12663

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [deg]	Base Material	Base Cohesion [psf]	Base Friction Angle [deg]	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	2.19249	358.119	-4.84216	Sandstone	750	30	822.179	926.291	305.345	0	305.345	235.696	235.696
2	2.23224	1073.05	-0.283189	Sandstone	750	30	1038.04	1169.49	726.579	0	726.579	721.448	721.448
3	3.74719	3040.48	17.3129	Sandstone	750	30	1097.67	1236.67	842.939	0	842.939	1185.1	1185.1
4	1.87458	1987.77	23.5618	Sandstone	750	30	1180.24	1329.69	1004.06	0	1004.06	1518.75	1518.75
5	1.87458	2258.82	23.5618	Sandstone	750	30	1266.47	1426.84	1172.32	0	1172.32	1724.63	1724.63
6	1.42447	1888.41	26.6725	Sandstone	750	30	1282.41	1444.8	1203.44	0	1203.44	1847.65	1847.65
7	1.42447	2026.37	26.6725	Sandstone	750	30	1331.61	1500.24	1299.45	0	1299.45	1968.38	1968.38
8	1.42438	2151.78	30.5861	Sandstone	750	30	1300.32	1464.97	1238.37	0	1238.37	2006.95	2006.95
9	1.42438	2264.88	30.5861	Sandstone	750	30	1332.06	1500.74	1300.33	0	1300.33	2087.67	2087.67
10	2.32797	3912.79	34.1198	Sandstone	750	30	1294.57	1458.5	1227.15	0	1227.15	2104.3	2104.3
11	2.5344	4509.54	35.8689	Sandstone	750	30	1285.75	1448.56	1209.95	0	1209.95	2139.61	2139.61
12	2.22034	4137.23	35.9156	Sandstone	750	30	1301.69	1466.52	1241.06	0	1241.06	2183.86	2183.86
13	2.2204	4275.14	36.0998	Sandstone	750	30	1306.94	1472.44	1251.3	0	1251.3	2204.34	2204.34
14	2.42778	4830.17	36.0556	Sandstone	750	30	1315.6	1482.19	1268.19	0	1268.19	2225.97	2225.97
15	2.43012	4958.33	39.5543	Sandstone	750	30	1242.44	1399.77	1125.43	0	1125.43	2151.59	2151.59
16	2.4274	5032.01	39.9126	Sandstone	750	30	1230.58	1386.41	1102.3	0	1102.3	2131.69	2131.69
17	1.46548	3079.37	38.7151	Sandstone	750	30	1252.73	1411.36	1145.51	0	1145.51	2149.68	2149.68
18	1.46548	3117.02	38.7151	Sandstone	750	30	1251.76	1410.27	1143.62	0	1143.62	2147.02	2147.02
19	2.93096	6315.72	37.476	Sandstone	750	30	1275.13	1436.6	1189.22	0	1189.22	2166.81	2166.81
20	1.60128	3221.32	36.1945	Sandstone	750	30	1259.03	1418.46	1157.81	0	1157.81	2079.1	2079.1
21	1.60128	2967.82	36.1945	Sandstone	750	30	1213.83	1367.54	1069.6	0	1069.6	1957.81	1957.81
22	2.46328	4238.06	34.8696	Sandstone	750	30	1199.3	1351.17	1041.25	0	1041.25	1876.95	1876.95
23	0.739271	1296.45	34.8696	Colluvium	0	32	475.884	536.145	858.011	0	858.011	1189.62	1189.62
24	1.39038	2499.9	33.5006	Colluvium	0	32	503.049	566.75	906.988	0	906.988	1239.96	1239.96
25	1.39038	2583.29	33.5006	Colluvium	0	32	515.451	580.722	929.353	0	929.353	1270.53	1270.53
26	1.38889	2637.61	32.0869	Colluvium	0	32	545.648	614.743	983.793	0	983.793	1325.9	1325.9
27	1.38889	2468.25	32.0869	Colluvium	0	32	506.882	571.068	913.898	0	913.898	1231.7	1231.7
28	1.3874	2092.22	30.628	Colluvium	0	32	442.574	498.617	797.953	0	797.953	1059.98	1059.98
29	1.3874	1706.7	30.628	Colluvium	0	32	353.699	398.488	637.714	0	637.714	847.125	847.125
30	1.58587	1649.91	29.1239	Colluvium	0	32	305.069	343.7	550.034	0	550.034	720	720
31	1.58587	1629.54	29.1239	Colluvium	0	32	299.749	337.706	540.443	0	540.443	707.444	707.444
32	1.37942	1406.54	29.0512	Colluvium	0	32	297.562	335.242	536.499	0	536.499	701.787	701.787
33	1.37942	1396.65	29.0512	Colluvium	0	32	295.718	333.165	533.175	0	533.175	697.439	697.439
34	1.29375	1301.08	28.986	Colluvium	0	32	295.106	332.475	532.071	0	532.071	695.557	695.557
35	1.29375	1292.68	28.986	Colluvium	0	32	294.618	331.925	531.19	0	531.19	694.405	694.405
36	1.29216	1282.87	28.9235	Colluvium	0	32	295.177	332.555	532.199	0	532.199	695.303	695.303
37	1.29216	1274.79	28.9235	Colluvium	0	32	295.807	333.265	533.335	0	533.335	696.788	696.788
38	1.79818	1760.96	28.8398	Colluvium	0	32	297.898	335.621	537.104	0	537.104	701.144	701.144
39	1.79818	1746.09	28.8398	Colluvium	0	32	300.48	338.53	541.761	0	541.761	707.223	707.223
40	3.57934	3420.94	28.7606	Colluvium	0	32	305.387	344.058	550.608	0	550.608	718.223	718.223
41	1.78905	1647.13	28.6853	Colluvium	0	32	304.071	342.576	548.235	0	548.235	714.608	714.608
42	1.78905	1596.95	28.6853	Colluvium	0	32	301.55	339.735	543.69	0	543.69	708.683	708.683
43	1.65577	1421.06	28.6187	Colluvium	0	32	296.774	334.354	535.077	0	535.077	697.009	697.009
44	1.65577	1348.43	28.6187	Colluvium	0	32	287.5	323.906	518.357	0	518.357	675.229	675.229
45	1.6537	1274.37	28.5549	Colluvium	0	32	278.236	313.469	501.655	0	501.655	653.071	653.071
46	1.6537	1202.29	28.5549	Colluvium	0	32	268.338	302.318	483.81	0	483.81	629.839	629.839
47	1.65232	1055.54	44.318	Colluvium	0	32	191.623	215.888	345.493	0	345.493	532.607	532.607
48	1.65232	836.054	44.318	Colluvium	0	32	159.144	179.296	286.934	0	286.934	442.333	442.333
49	1.65312	617.203	44.251	Colluvium	0	32	123.416	139.044	222.517	0	222.517	342.748	342.748
50	1.65312	253.872	61.2094	Colluvium	0	32	40.1341	45.2163	72.3612	0	72.3612	145.393	145.393

Interslice Data

Group 2 - Master Scenario

Global Minimum Query (bishop simplified) - Safety Factor: 1.58808

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [deg]
1	25.1911	10.1902	0	0	0
2	26.7134	9.74813	1021.83	0	0
3	28.2356	9.30606	2344.21	0	0
4	29.7579	9.20772	3518.22	0	0
5	31.2801	9.10939	4840.8	0	0
6	33.3883	9.32859	6398.42	0	0
7	35.4965	9.54779	8092.73	0	0
8	37.6047	10.0173	9503.45	0	0
9	39.7129	10.4867	10975.9	0	0
10	41.1459	11.0124	11645	0	0
11	42.5789	11.5381	12313.6	0	0
12	44.0119	12.2737	12627.3	0	0
13	45.4449	13.0094	12923.8	0	0
14	46.8779	13.9331	12908.1	0	0
15	48.3109	14.8567	12869.9	0	0
16	49.7439	15.8847	12654.9	0	0
17	51.1769	16.9126	12422.9	0	0
18	53.1063	18.6303	11641.7	0	0
19	55.0357	20.2805	10934.8	0	0
20	56.9651	22.0644	10052.9	0	0
21	58.8945	24.2244	8790.93	0	0
22	60.0144	25.479	8081.84	0	0
23	61.1343	26.7336	7390.59	0	0
24	63.3742	29.1647	6125.65	0	0
25	65.614	31.5175	4994.16	0	0
26	66.7339	32.6548	4552.5	0	0
27	67.8538	33.7921	4193.28	0	0
28	70.0936	35.9884	3768.01	0	0
29	72.1218	37.9064	3556.84	0	0
30	72.3334	38.1066	3405.42	0	0
31	73.8253	39.4653	2389.96	0	0
32	75.3171	40.824	1364.31	0	0
33	76.8089	42.1306	410.307	0	0
34	78.3007	43.4372	-422.677	0	0
35	79.7925	44.6917	-1029.3	0	0
36	81.2844	45.9462	-1467.21	0	0
37	82.7762	47.1486	-1810.73	0	0
38	84.268	48.351	-2128.8	0	0
39	85.5496	49.3392	-2363.79	0	0
40	86.8312	50.3274	-2583.49	0	0
41	88.1128	51.2709	-2771.91	0	0
42	89.3944	52.2143	-2948.2	0	0
43	90.6761	53.113	-3098.09	0	0
44	91.9577	54.0117	-3238.71	0	0
45	93.2393	55.1406	-3429.1	0	0
46	94.5209	56.2695	-3592.22	0	0
47	95.8025	57.3666	-3722.98	0	0
48	97.0841	58.4637	-3829.44	0	0
49	98.3657	59.516	-3905.89	0	0
50	99.6473	60.5683	-3956.15	0	0
51	101.609	62.1102	0	0	0

Global Minimum Query (spencer) - Safety Factor: 1.60855

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [deg]
1	25.1911	10.1902	0	0	0
2	26.6134	10.3107	832.293	564.818	34.1619
3	28.0357	10.4313	1747.1	1185.63	34.1619
4	29.458	10.6414	2637.46	1789.85	34.1619
5	30.8803	10.8515	3582.74	2431.35	34.1619
6	33.1405	11.3004	5027.37	3411.71	34.1619
7	35.4008	11.7493	6565.52	4455.54	34.1619
8	37.6285	12.5328	7624.79	5174.4	34.1619
9	39.8562	13.3164	8686.89	5895.17	34.1619
10	41.3072	14.1884	8941.47	6067.93	34.1619
11	42.7582	15.0604	9175.97	6227.07	34.1619
12	44.2092	15.8919	9431.26	6400.31	34.1619
13	45.6602	16.7235	9667.11	6560.37	34.1619
14	47.0999	17.6454	9778.8	6636.17	34.1619
15	48.5396	18.5674	9870.39	6698.32	34.1619
16	49.9793	19.4999	9931.63	6739.88	34.1619
17	51.419	20.4324	9976.72	6770.48	34.1619
18	53.0872	21.766	9770.57	6630.58	34.1619
19	54.7553	23.0995	9550.64	6481.33	34.1619
20	56.4235	24.4342	9316.05	6322.13	34.1619
21	58.0916	25.7688	9067.73	6153.62	34.1619
22	59.7597	27.2389	8700.98	5904.73	34.1619
23	61.4279	28.7091	8328.55	5651.99	34.1619
24	63.096	30.2626	7894.01	5357.1	34.1619
25	64.7642	31.8162	7459.82	5062.44	34.1619
26	66.4323	33.3115	7105.87	4822.24	34.1619
27	68.1004	34.8068	6858.65	4654.47	34.1619
28	69.7007	36.1854	6752.21	4582.24	34.1619
29	71.301	37.564	6705.15	4550.3	34.1619
30	71.4367	37.6809	6638.57	4505.12	34.1619
31	73.8213	39.6518	5511.74	3740.42	34.1619
32	76.2058	41.5395	4417.24	2997.67	34.162
33	77.6104	42.6024	3847.45	2610.99	34.1619
34	79.015	43.6652	3372.22	2288.48	34.1619
35	80.4196	44.6791	3026.87	2054.12	34.1619
36	81.8242	45.6929	2758.51	1872	34.1619
37	83.4643	46.8194	2488.38	1688.68	34.1618
38	85.1043	47.9459	2230.05	1513.37	34.1618
39	86.7443	49.0151	2005.64	1361.08	34.1618
40	88.3844	50.0843	1789.77	1214.59	34.162
41	90.0239	51.0959	1604.21	1088.66	34.1619
42	91.6635	52.1076	1424.33	966.588	34.1619
43	93.303	53.36	1173.05	796.067	34.162
44	94.9426	54.6125	942.107	639.34	34.1619
45	96.5822	55.8077	745.061	505.619	34.1619
46	98.2217	57.0029	564.967	383.403	34.162
47	100.052	58.3542	387.011	262.637	34.162
48	101.883	59.7055	239.468	162.51	34.162
49	103.714	60.9928	131.152	89.0036	34.162
50	105.544	62.2802	54.9422	37.2853	34.1619
51	109.205	64.7352	0	0	0

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.56682

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [deg]
1	25.1911	10.1902	0	0	0
2	26.7126	9.9802	901.469	42.9716	2.72913
3	28.2342	9.7702	2054.63	195.609	5.4384
4	29.7557	9.5602	3479.68	495.765	8.10861
5	31.7333	9.94815	4732.94	962.225	11.4918
6	33.711	10.3361	6083.18	1600.95	14.7446
7	35.3365	10.9748	6814.32	2122.46	17.3003
8	36.9619	11.6136	7539.46	2704.96	19.7367
9	39.4972	12.9352	8238.16	3544.24	23.2785
10	40.7981	13.7316	8440.87	3930.29	24.9679
11	42.099	14.528	8626.29	4313.85	26.5688
12	44.6281	16.074	8941.76	5043.96	29.4269
13	46.8308	17.6492	8929.15	5503.21	31.6463
14	49.1963	19.3996	8821.56	5896.26	33.7585
15	51.5389	21.1212	8698.44	6223.96	35.5847
16	53.2612	22.4458	8540.51	6381.32	36.7664
17	54.9836	23.7703	8374.3	6499.9	37.8176
18	57.0694	25.3266	8204.71	6625.78	38.9229
19	59.1551	27.0605	7870.85	6569.92	39.8523
20	61.2408	28.8587	7488.36	6421.31	40.6133
21	63.4057	30.852	7012.39	6145.72	41.2316
22	65.6732	32.8606	6585.2	5866.81	41.6981
23	67.5604	34.4664	6376.94	5731.43	41.9484
24	69.3158	35.8988	6326.63	5710.64	42.0705
25	71.1935	37.3654	6391.57	5771.96	42.0839
26	71.5929	37.6634	6414.4	5789.98	42.0711
27	73.0711	38.7663	5855.75	5268.12	41.9761
28	74.4608	39.7547	5357.59	4793.26	41.818
29	75.8505	40.7431	4846.22	4301.53	41.5924
30	77.2402	41.6829	4390.04	3856.57	41.2987
31	78.6298	42.6227	3993.41	3463.54	40.9356
32	80.4103	43.7647	3633.05	3088.32	40.3666
33	82.1908	44.9066	3355.45	2783.58	39.6781
34	84.1147	46.0734	3101.75	2493.41	38.7948
35	86.0386	47.2402	2853.97	2210.66	37.761
36	88.1672	48.4567	2623.52	1936.63	36.434
37	90.2958	49.6733	2396.34	1672.03	34.9051
38	92.4585	51.2292	2026.63	1322.91	33.135
39	94.6213	52.785	1677.07	1013.13	31.1365
40	96.8316	54.2979	1367.92	753.555	28.8493
41	99.0419	55.8688	1056.86	522.512	26.3078
42	101.252	57.473	766.859	333.601	23.5101
43	103.462	59.0772	513.012	191.398	20.4599
44	104.994	60.1353	376.389	123.779	18.2039
45	106.526	61.1934	259.757	73.6944	15.8389
46	108.057	62.1981	172.704	41.0603	13.3738
47	109.589	63.2027	102.652	19.619	10.82
48	111.122	64.1549	55.5832	7.99883	8.18906
49	112.655	65.107	22.5383	2.17012	5.49982
50	114.194	66.0089	5.78533	0.27892	2.76018
51	115.733	66.9109	0	0	0

Group 2 - Scenario 2

Global Minimum Query (bishop simplified) - Safety Factor: 1.1808

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [deg]
1	25.1911	10.1902	0	0	0
2	27.1917	9.65832	1796.27	0	0
3	29.1923	9.12644	4057.48	0	0
4	31.2038	9.11157	5840.69	0	0
5	33.2152	9.0967	7790.77	0	0
6	35.7269	9.60596	9512.67	0	0
7	38.2385	10.1152	11276.2	0	0
8	40.7505	10.9657	12460.4	0	0
9	43.2624	11.8162	13603.9	0	0
10	45.99	13.0673	14189.5	0	0
11	48.5551	14.3561	14450.7	0	0
12	50.8973	15.5232	14628.6	0	0
13	52.7462	16.7407	14196.6	0	0
14	54.595	17.9582	13722.8	0	0
15	57.0175	19.6727	12847.3	0	0
16	59.44	21.763	11372.5	0	0
17	60.9296	23.2336	10234.4	0	0
18	62.4191	24.7041	9105.91	0	0
19	63.9088	26.1229	8043.48	0	0
20	65.3985	27.5416	6989.98	0	0
21	66.8882	28.9083	6100.99	0	0
22	68.3779	30.275	5348.98	0	0
23	71.0282	32.6139	4394.72	0	0
24	72.3533	33.737	3990.97	0	0
25	73.6784	34.8602	3575.51	0	0
26	76.3286	37.0139	2805.39	0	0
27	78.9787	39.075	2422.67	0	0
28	80.3407	40.0867	2506.54	0	0
29	81.7026	41.0985	2727.92	0	0
30	84.0471	42.7581	3222	0	0
31	84.4265	43.0267	3054.99	0	0
32	85.825	43.9679	2492.07	0	0
33	87.2235	44.909	1941.04	0	0
34	88.5679	45.7669	1463.17	0	0
35	89.9123	46.6247	993.195	0	0
36	91.3584	47.4969	540.051	0	0
37	92.8045	48.3691	92.8815	0	0
38	94.4269	49.2909	-352.709	0	0
39	96.0492	50.2128	-794.186	0	0
40	97.6716	51.078	-1181.7	0	0
41	99.294	51.9433	-1564.18	0	0
42	101.829	53.8248	-2546.64	0	0
43	104.365	55.625	-3383	0	0
44	106.9	57.5287	-4174.9	0	0
45	109.435	59.4031	-4833.87	0	0
46	111.97	61.2458	-5367.17	0	0
47	114.506	63.0608	-5784.48	0	0
48	117.041	64.8545	-6094.5	0	0
49	119.576	66.5597	-6294.34	0	0
50	122.111	68.2086	-6407.49	0	0
51	124.647	69.8822	0	0	0

Global Minimum Query (spencer) - Safety Factor: 1.16684

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [deg]
1	26.7794	11.7707	0	0	0
2	28.4668	12.1868	1261.83	1054.68	39.89
3	30.1542	12.603	2531.32	2115.75	39.8898
4	31.5432	13.0284	3489.54	2916.66	39.8899
5	32.9321	13.4538	4440.05	3711.12	39.8898
6	34.3211	14.0312	5226.88	4368.78	39.8899
7	35.71	14.6087	5991.77	5008.11	39.8899
8	38.3789	15.7555	7362.6	6153.89	39.8899
9	41.0478	16.9625	8582.52	7173.53	39.8899
10	42.574	17.7724	9115.42	7618.95	39.8899
11	44.1002	18.5823	9615.02	8036.52	39.8899
12	45.6264	19.3922	10081.3	8426.26	39.8899
13	47.3338	20.431	10435.3	8722.16	39.89
14	49.0413	21.4697	10747.7	8983.25	39.8899
15	51.6338	23.1801	11036.1	9224.34	39.89
16	53.8262	24.6534	11200.9	9362.04	39.8899
17	56.0186	26.1126	11326.7	9467.19	39.8899
18	58.2172	27.6038	11376.1	9508.49	39.8899
19	60.2577	29.1534	11243.2	9397.42	39.8899
20	62.4692	30.9781	10966.5	9166.1	39.8898
21	64.6807	32.7255	10713.6	8954.78	39.89
22	66.8922	34.3957	10560.2	8826.54	39.8899
23	69.1037	35.9886	10624.4	8880.21	39.8899
24	71.4541	37.5996	10873.8	9088.65	39.8899
25	71.5522	37.6668	10825.6	9048.34	39.8898
26	74.0007	39.2595	9658.76	8073.08	39.8899
27	76.4492	40.7667	8510.64	7113.45	39.8899
28	78.6855	42.0651	7634.75	6381.35	39.8899
29	80.9218	43.3636	6981.16	5835.07	39.8899
30	83.1581	44.584	6492.75	5426.83	39.8899
31	85.3945	45.8044	6008.44	5022.03	39.8899
32	86.8854	46.7773	5597.39	4678.47	39.8899
33	88.3762	47.7502	5196.64	4343.51	39.8899
34	89.8671	48.7231	4806.2	4017.17	39.8899
35	92.1034	50.1043	4276.28	3574.24	39.8899
36	94.3398	51.4856	3762.5	3144.81	39.8899
37	96.5761	52.7887	3301.93	2759.85	39.8899
38	98.8124	54.0919	2853.54	2385.07	39.8898
39	100.303	54.9125	2590.27	2165.03	39.8899
40	101.794	55.7332	2334.5	1951.25	39.89
41	103.285	56.5538	2086.67	1744.11	39.89
42	104.911	57.4463	1830.97	1530.38	39.8899
43	106.537	58.3388	1590.12	1329.07	39.8899
44	109.13	60.0981	1130.52	944.921	39.8898
45	110.754	61.1426	898.137	750.69	39.8899
46	112.377	62.1872	692.585	578.883	39.8899
47	114.469	63.4876	475.716	397.617	39.8898
48	116.561	64.7879	298.437	249.443	39.8899
49	118.97	66.3587	136.371	113.983	39.8899
50	121.379	67.9831	34.1151	28.5144	39.8899
51	123.787	69.5958	0	0	0

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.12663

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [deg]
1	25.8388	10.8347	0	0	0
2	28.0313	10.6489	1787.71	158.641	5.07113
3	30.2635	10.6379	3898.28	696.041	10.1235
4	34.0107	11.806	6418.77	2096.35	18.0869
5	35.8853	12.6235	7412.86	2955.62	21.7379
6	37.7599	13.4409	8376.83	3929.76	25.1323
7	39.1843	14.1565	8964.75	4673.27	27.5328
8	40.6088	14.8721	9526.47	5450.8	29.7771
9	42.0332	15.714	9905.66	6157.69	31.8665
10	43.4576	16.5559	10255.3	6866.47	33.8044
11	45.7855	18.1333	10550.8	7852.43	36.6585
12	48.3199	19.9658	10690.3	8765.53	39.3501
13	50.5403	21.5739	10757.2	9477.22	41.3804
14	52.7607	23.1931	10778.1	10096.6	43.1301
15	55.1885	24.9606	10764.5	10670.6	44.749
16	57.6186	26.9677	10533.3	10940.8	46.0871
17	60.046	28.9982	10275.7	11083.1	47.1648
18	61.5115	30.1729	10150.1	11154.1	47.6982
19	62.9769	31.3476	10017.7	11183.5	48.1474
20	65.9079	33.5947	9819.62	11218.6	48.8044
21	67.5092	34.7664	9834.78	11326.5	49.0323
22	69.1104	35.9381	9931.61	11493.7	49.17
23	71.5737	37.6546	10250.9	11879.1	49.2079
24	72.313	38.1697	9901.46	11462.2	49.1784
25	73.7034	39.09	9266.21	10686.3	49.0711
26	75.0938	40.0103	8610.95	9869.52	48.896
27	76.4827	40.8811	7984.58	9073.45	48.6524
28	77.8715	41.7519	7399.1	8315.91	48.3388
29	79.259	42.5733	6939.22	7694.32	47.9539
30	80.6464	43.3948	6564.77	7162.93	47.495
31	82.2322	44.2783	6232.61	6654.84	46.8765
32	83.8181	45.1619	5904.55	6147.21	46.1535
33	85.1975	45.9281	5622.62	5708.73	45.4354
34	86.5769	46.6943	5342.68	5274.14	44.6301
35	87.8707	47.411	5082.91	4872.94	43.7918
36	89.1644	48.1278	4824.81	4478.65	42.8691
37	90.4566	48.8418	4569.66	4094.22	41.859
38	91.7488	49.5558	4316.13	3719.79	40.7559
39	93.5469	50.546	3967.78	3219.62	39.0573
40	95.3451	51.5361	3622.44	2745.24	37.1564
41	98.9245	53.5007	2949.63	1895.05	32.7195
42	100.714	54.4796	2627.55	1526.4	30.1532
43	102.503	55.4585	2315.44	1197.32	27.3436
44	104.158	56.3619	2039.19	930.344	24.524
45	105.814	57.2654	1777.23	699.93	21.4961
46	107.468	58.1653	1531.01	505.535	18.2731
47	109.121	59.0653	1298.9	344.805	14.8668
48	110.774	60.6787	846.983	169.302	11.3038
49	112.426	62.2922	479.775	64.1229	7.61258
50	114.079	63.9026	202.002	13.5216	3.82955
51	115.732	66.9108	0	0	0

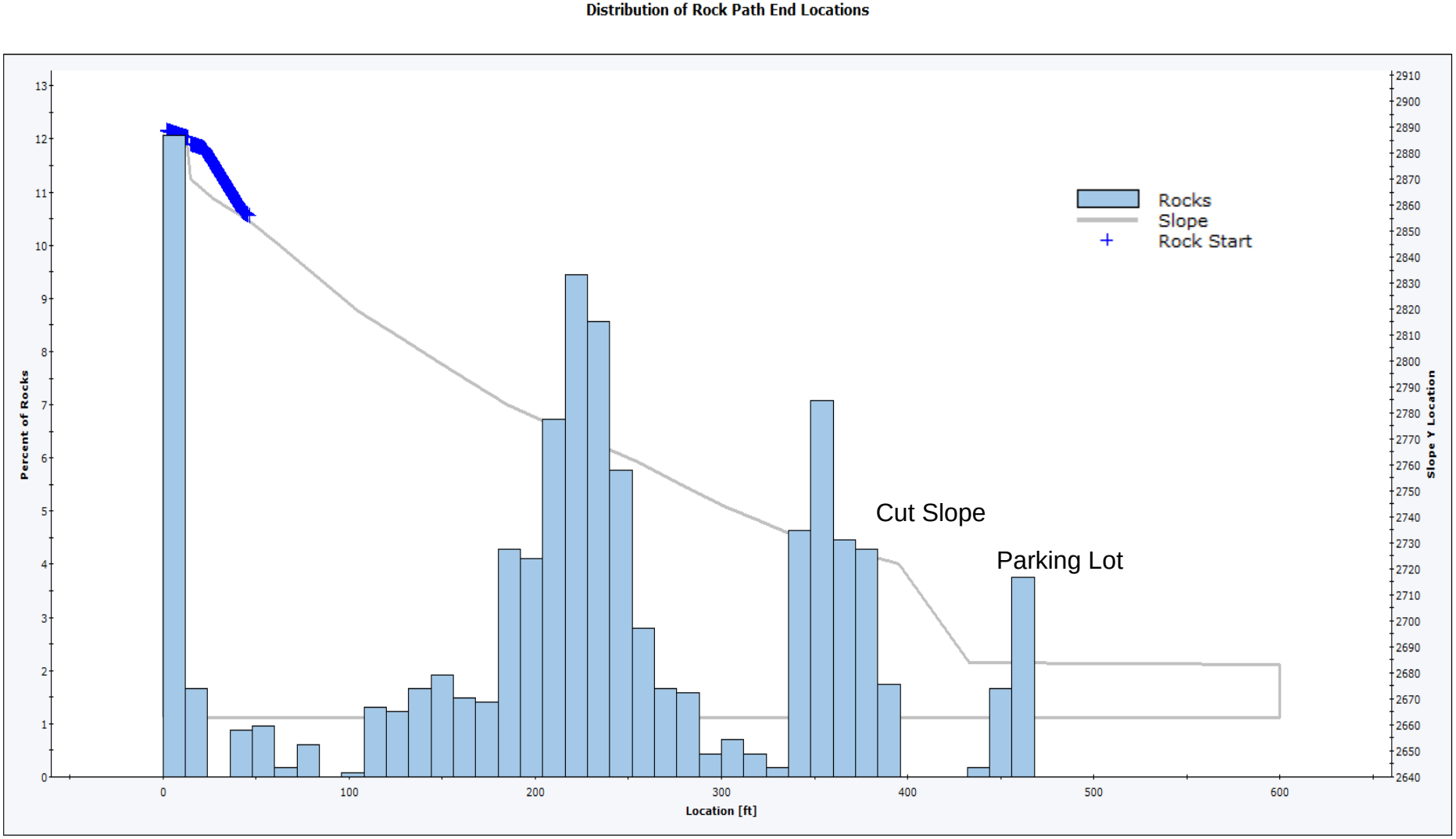
Discharge Sections

Entity Information

Group 2

Shared Entities

Type	Coordinates (x,y)
External Boundary	-20, -20 125, -20 125, 57.6703 125, 59.6053 125, 70 123.448, 69.4825 117.796, 67.5988 110.163, 65.0544 102.656, 62.5521 97.487, 60.372 80.913, 51.855 76.995, 55.813 75.788, 55.813 70.0205, 50.0054 70.017, 50 70, 50 65, 50 50.15, 35.027 25.1911, 10.1902 24.2836, 10 -20, 10
Material Boundary	25.1911, 10.1902 49.093, 33.956 71.418, 37.583 76.771, 40.043 86.464, 43.66 93.565, 46.455 104.446, 49.744 125, 57.6703
Material Boundary	70.0205, 50.0054 80.913, 51.855



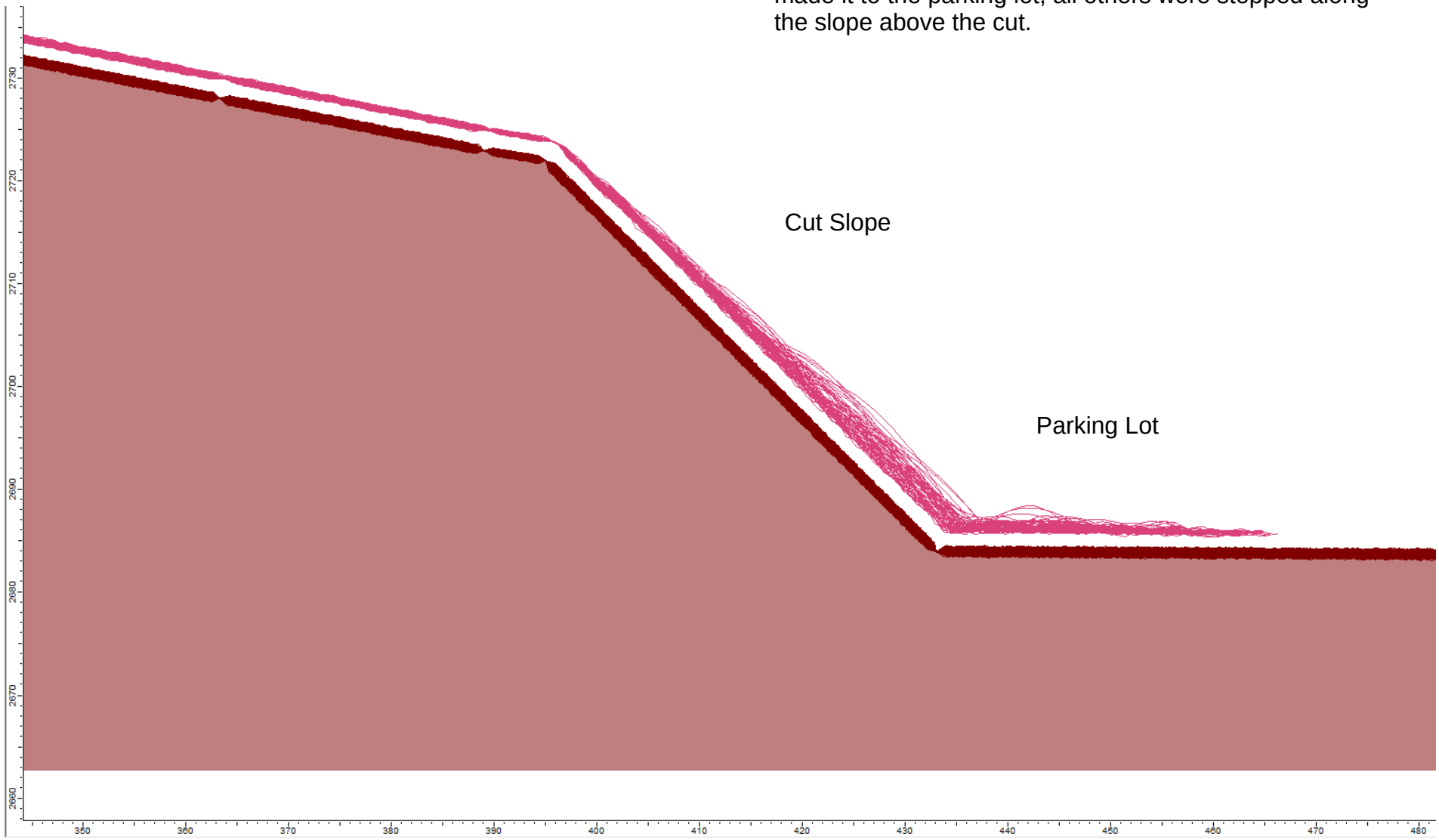
LANDMARK TESTING & ENGINEERING

Rocfall2 Rock Endpoint Distribution

Landmark Project No 240016

Figure E-1

Pink lines show rock paths accelerating down the 1H:1V slope into the parking lot area and approaching the proposed structure location. Roughly 5% of the rock paths analyzed made it to the parking lot, all others were stopped along the slope above the cut.

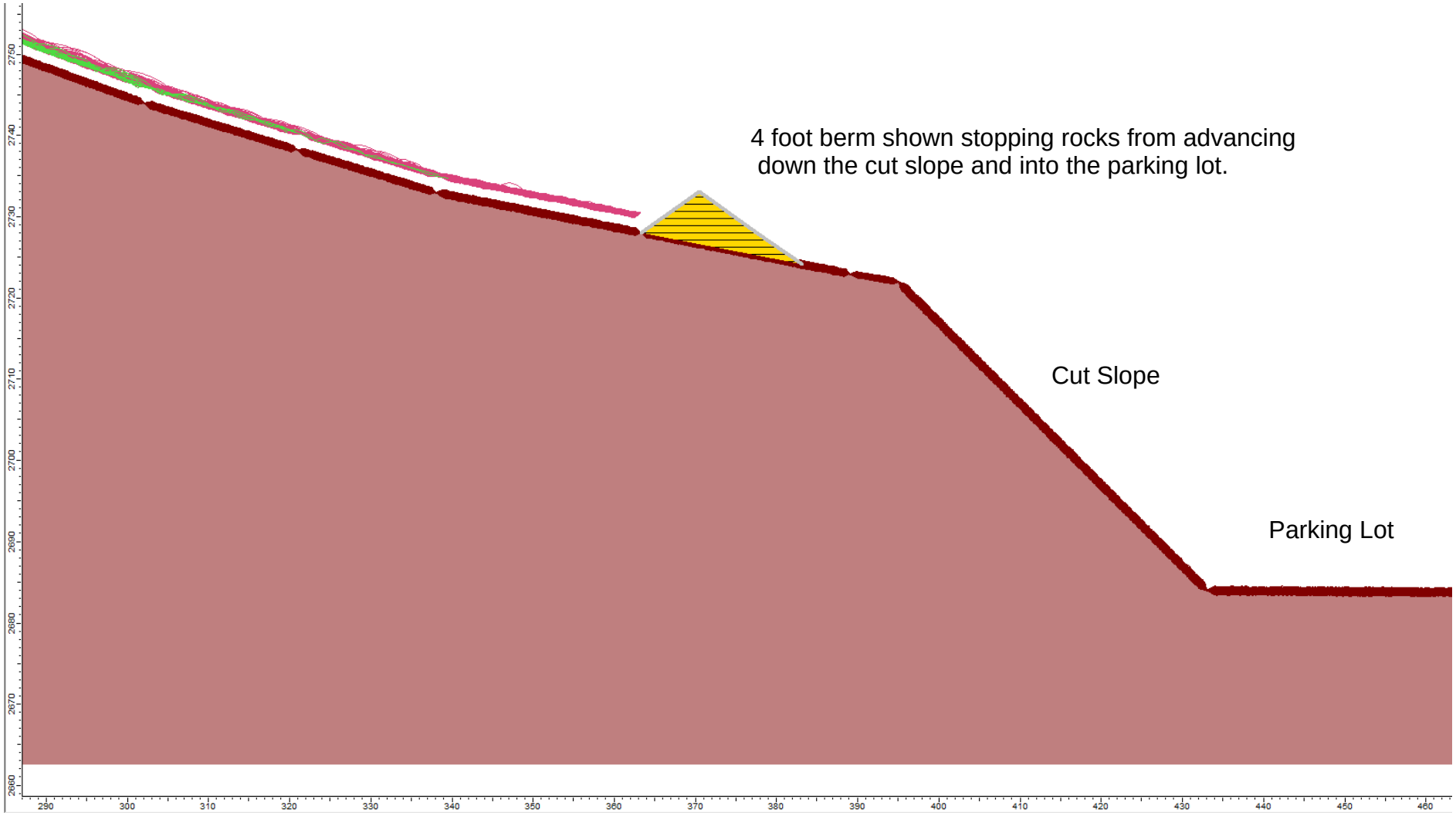


LANDMARK TESTING & ENGINEERING

Rocfall2 Round Rock Paths

Landmark Project No 240016

Figure E-2

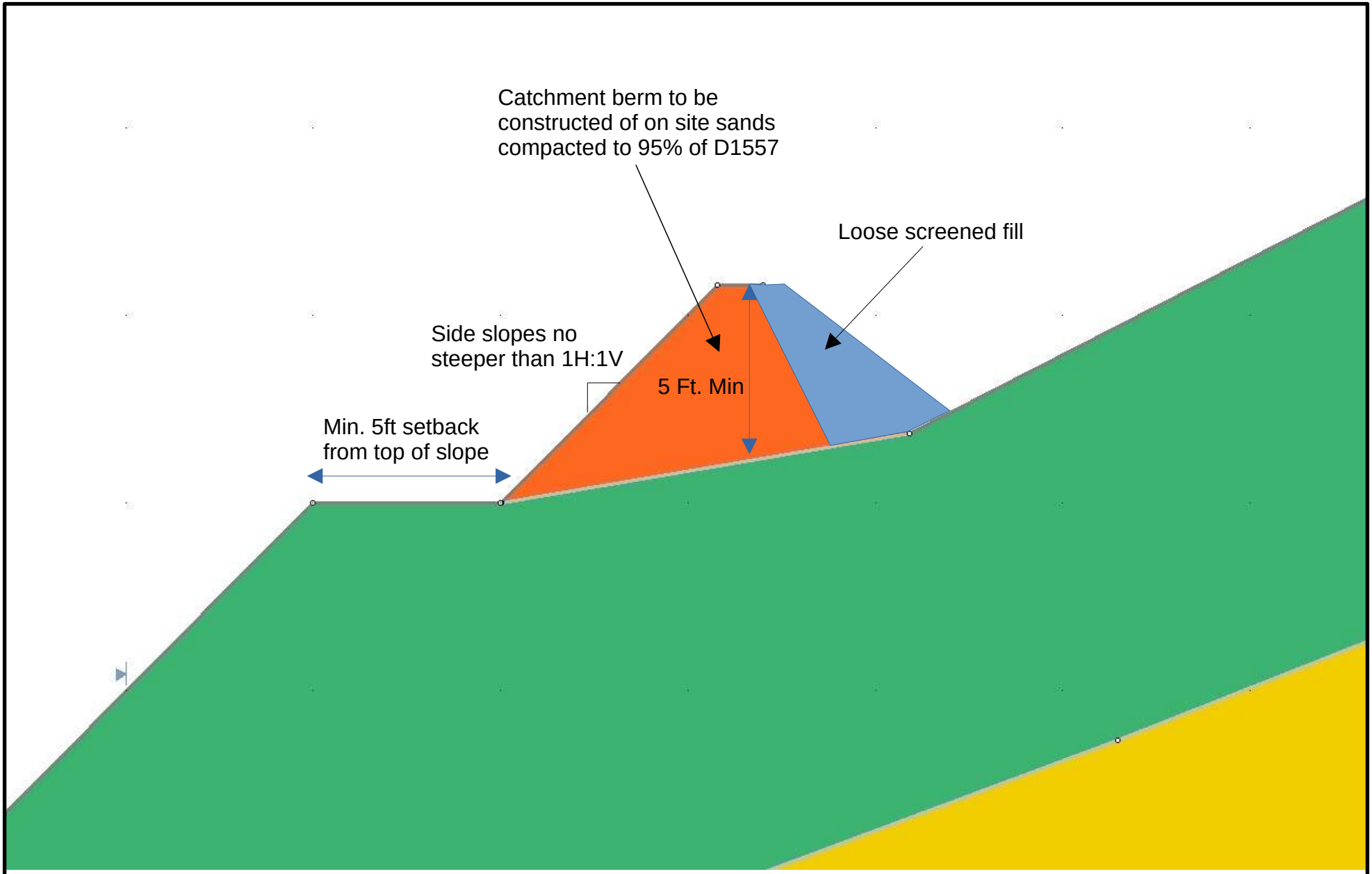


LANDMARK TESTING & ENGINEERING

Rocfall2 Round Rock Paths with Berm

Landmark Project No 240016

Figure E-3



LANDMARK TESTING & ENGINEERING

Typical Rockfall Catchment Berm Detail

Landmark Project No 240016

Figure E-4

CSH CRSP A-A' Rocfall Two Roc Types
Software Version: 8.024

FIGURE E-5 (14 Pages)

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CSH CRSP A-A' Rocfall Two Roc Types

RocFall2 Analysis Information

Project Summary

File Name	CSH CRSP A-A' Rocfall Two Roc Types
File Version	8.024

Project Settings

General Settings

Engine	Rigid Body
Units	Imperial Foot-Pounds (ft, lbm, ft-lbf)
Rock throw mode	2000 rocks thrown overall
Use tangential CRSP damping	Yes

Engine Conditions

Maximum steps per rock	30000
Normal velocity cutoff (ft/s)	0.1
Stopped velocity cutoff (ft/s)	0.33
Maximum timestep (s)	0.01
Switch velocity (ft/s)	-1e-09

Random Number Generation

Sampling method	Latin-Hypercube
Material Properties Sampling	Per simulation
Random seed	Pseudo-random seed: 12345234

Slope Geometry

Vertex	X	Y	X Std.Dev.	Y Std.Dev.
1	0	2887		
2	12.8278	2884.08		
3	14.722	2870.04		
4	26.934	2862.25		
5	46	2854		
6	62.1623	2844.69		
7	79	2835		
8	105	2819		
9	127.842	2808.62		
10	149	2799		
11	165.95	2791.47		
12	185	2783		
13	201.228	2777.9		
14	218.125	2772.59		
15	240.925	2765.42		
16	255	2761		
17	280.713	2751.7		
18	302	2744		
19	320.839	2738.24		
20	338	2733		
21	363.274	2728.04		
22	389	2723		
23	395	2722		
24	433	2684		
25	600	2683		

Slope Material Assignment

Material	From Vertex	To Vertex
Bedrock Outcrops	1	5
Cell 0001	5	25

Material Properties

Bedrock Outcrops

"Bedrock Outcrops" Properties					
Color					
	Mean	Distribution	Std.Dev.	Rel. Min	Rel. Max
Normal Restitution	0.35	Normal	0.04	0.12	0.12
Tangential Restitution	0.85	Normal	0.04	0.12	0.12
Dynamic Friction	0.5	Normal	0.04	0.12	0.12
Rolling Friction	0.15	Normal	0.02	0.06	0.06
"Bedrock Outcrops" Advanced Properties					
Forest and Vegetation Damping		Disabled			
Scarring		Disabled			
Viscoplastic Damping		Disabled			

Cell 0001

"Cell 0001" Properties					
Color					
	Mean	Distribution	Std.Dev.	Rel. Min	Rel. Max
Normal Restitution	0.28	None			
Tangential Restitution	0.88	None			
Dynamic Friction	0.55	None			
Rolling Friction	0.1	None			
Slope Roughness Spacing	1.2	Normal	0.2	0.6	0.6
Slope Roughness Amplitude	0	Normal	0.2	0.6	0.6
"Cell 0001" Advanced Properties					
Forest and Vegetation Damping		Disabled			
Scarring		Disabled			
Viscoplastic Damping		Disabled			

Berm(s) Geometry

Berm 1

Assigned Berm Property: Default Berm		
Vertex	X	Y
1	363.274	2728.04
2	370.415	2733.04
3	377.556	2728.04
4	383.11	2724.15

Berm Properties

Default Berm

"Default Berm" Properties

Berm Property	Mean	Distribution	Calculate Impact Std.Dev.	Rel. Min	Rel. Max
Normal Restitution	0.1	None			
Tangential Restitution	0.85	None			
Dynamic Friction	0.5	None			
Rolling Friction	0.15	None			

Seeders

Seeder 1

Seeder Properties					
Name	Seeder 1				
Location	(0, 2887), (12.8278, 2884.08), (14.722, 2870.04)				
Rocks to Throw					
Number of Rocks	Set in Project Settings				
Rock Types	Circles,	Squares			
Initial Conditions					
	Mean	Distribution	Std.Dev.	Rel. Min	Rel. Max
Horizontal Velocity (ft/s)	1	None			
Vertical Velocity (ft/s)	-1	None			
Rotational Velocity (deg/s)	0	None			
Initial Rotation (deg/s)	0	Uniform		0	360

Rock Types

Circles

Properties					
Name	Circles				
Color					
Smooth Shapes	Sphere				
Polygons	None				
	Mean	Distribution	Std.Dev.	Rel. Min	Rel. Max
Mass (lbm)	5529	None			
Density (lbm/ft3)	165	None			

Squares

Properties					
Name	Squares				
Color					
Smooth Shapes	Square				
Polygons	None				
	Mean	Distribution	Std.Dev.	Rel. Min	Rel. Max
Mass (lbm)	8100	None			
Density (lbm/ft3)	168.56	None			

Collectors

Record paths' first impacts only?	No
Analysis Point 1	
Name	Analysis Point 1
Location	(1, 2876.57) to (1, 2927.57)

Summary Results

Run Properties			
Simulation Time (s)	19.75		
Envelope data:			
	Max	Mean	95%
Envelope Bounce Height (ft)	14.99	14.18	14.78
Envelope Total Kinetic Energy (ft-lbf)	1.269e+05	7.004e+04	1.269e+05
Envelope Translational Kinetic Energy (ft-lbf)	9.801e+04	5.289e+04	9.801e+04
Envelope Rotational Kinetic Energy (ft-lbf)	3.222e+04	1.723e+04	3.222e+04
Envelope Translational Kinetic Velocity (ft/s)	32.13	21.64	32.13
Envelope Rotational Kinetic Velocity (rad/s)	13.26	9.401	13.26

Stopping Reason	
CONTINUE	0
Invalid Start Location	0
Invalid Slope Geometry	0
Invalid bad crest loss definition	0
Invalid relative size between rock and slope	0
Max Steps	0
Edge Model	0
Stopped	1261
Stopped (wedged)	0
Stopped (chattering)	0
Hit Barrier	0
Hit Berm with infinite capacity	0
No collision found	0
Bad Collision Geometry (location before)	739
Rock is freefalling onto a spike or a trough	0
END_ERROR_UNKNOWN	0
END_ERROR_POSITIVE_GAP	0
Bad collision calculation	0
Bad Collision Geometry (0 intersection)	0
Bad Collision Geometry (location after)	0
Bad Collision Geometry (missing intersection)	0
Error during results reading	0
Total Rocks	2000

Collector(s) Impact Results

Berm(s) Impact Results

Berm 1			
Berm Name	Berm 1		
Hits	405 / 2000 rocks		
Impact Statistics			
Based on actual values for all impacted rocks.			
	Mean	Min	Max
Impact Along Height (ft)	0.63	0.21	1.29
Translational Velocity (ft/s)	3.47	1.04	6.21
Translation Energy (ft-lbf)	1133.86	92.15	3316.51

EXHIBIT G

Drainage Control Plan

ALPHA ENGINEERING

43 South 100 East, Suite 100 T 435.628.6500
St George, Utah 84770 F 435.628.6553
alphaengineering.com

February 7, 2024

St. George City
175 East 200 North
St. George, UT 84770

Re: @Home Best Western – Drainage Control Plan

To Whom It May Concern,

The proposed plans for the @Home Best Western located on 1470 East (Parcel SG-5-2-29-1205) includes the construction of one building with associated parking and landscaping on a vacant lot. To find preliminary conservative flow rates between the existing and proposed storm runoff for the Hillside Development Permit, the Rational Method was used as outlined in the St. George Drainage Manual. The Rational Formula is shown below:

$$Q = CIA$$

Where,

Q = Runoff volume, cubic feet per second (cfs)
C = Land use coefficient; Table 2-6 in the St. George City Drainage Manual
I = Rainfall intensity, in/hr; Interpolated from Table 2-1 in the St. George City Drainage Manual
A = Area, acres

The project consists of 2.43 acres. The flat portion of the site consists of Badland (Ba) soil with a hydrologic soil group of "D" while the slopes consist of Stony Colluvial Land (SY) with a hydrologic soil group of "D". The rainfall intensity was determined by taking the average of the 100-year, 3-hour storm (1.64 inches) over the storm duration.

The existing site contains 0.45 acres of Desert Shrub: < 30% Ground Cover and 1.98 acres of Bare Soil: Newly Graded Areas. This corresponds to land use coefficients of 0.20 and 0.50 for a weighted coefficient of 0.44. The runoff volume for the existing conditions is 0.6 cfs.

The proposed site will consist of business land cover with an assumed coefficient of 0.90. The estimated runoff for the proposed conditions is 1.2 cfs. Due to the anticipated increase in storm water runoff, detention will be required. A detailed Drainage Study will be provided with the construction drawings and will detail the size of the detention basin and will provide a more in-depth determination of storm water runoff.

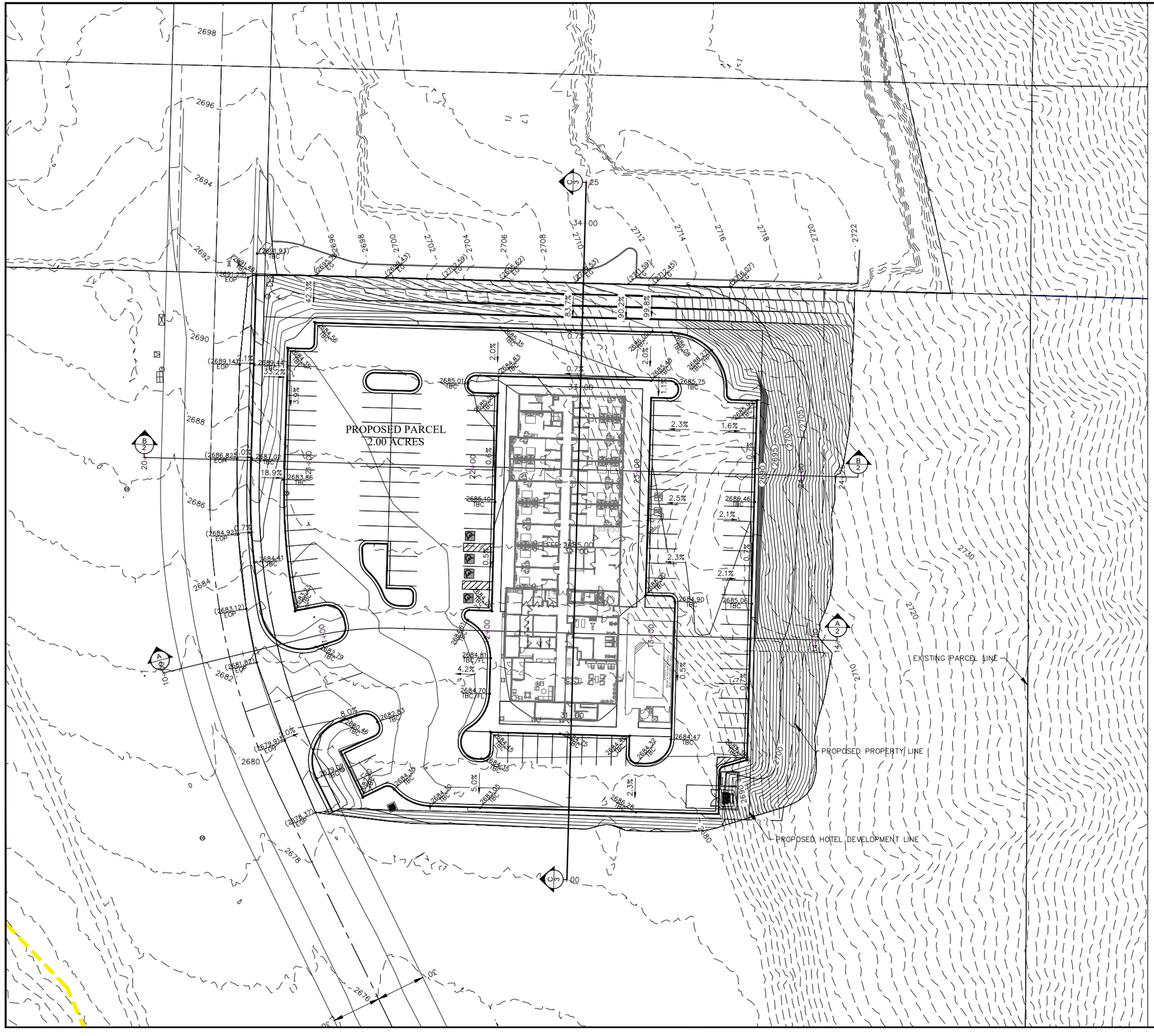
If you have any questions concerning the above or need us to modify any of the information, please feel free to call.

Sincerely,

Rhett Beazer, P.E.
ALPHA ENGINEERING COMPANY

EXHIBIT H

Revised Geotechnical Report & Preliminary Grading Plan



GRADING NOTES

ROUGH GRADING QUANTITIES:
CUT: 21,600 C.Y.
FILL: 2,700 C.Y.
NET: 18,900 C.Y. (CUT)

*GRADING QUANTITIES COMPARE TOP OF EXISTING GRADE TO TOP OF FINISH GRADE

CUT/FILL SLOPES:
CUT SLOPES – 2H:1V IN COLUVIUM (UPPERMOST 12 TO 15 FEET)
0.5H:1V IN SANDSTONE (BELOW COLLUVIUM)
FILL SLOPES – 2H:1V

PROPERTY AREA: 2.00 ACRES

TOTAL PARCEL: 2.43 ACRES

GRAPHIC SCALE
30 0 15 30 60 120
(IN FEET)
1 inch = 30ft. (22x34 SHEET)
1 inch = 60ft. (11X17 SHEET)

N

NO.	DATE	BY	DESCRIPTION

REVISIONS

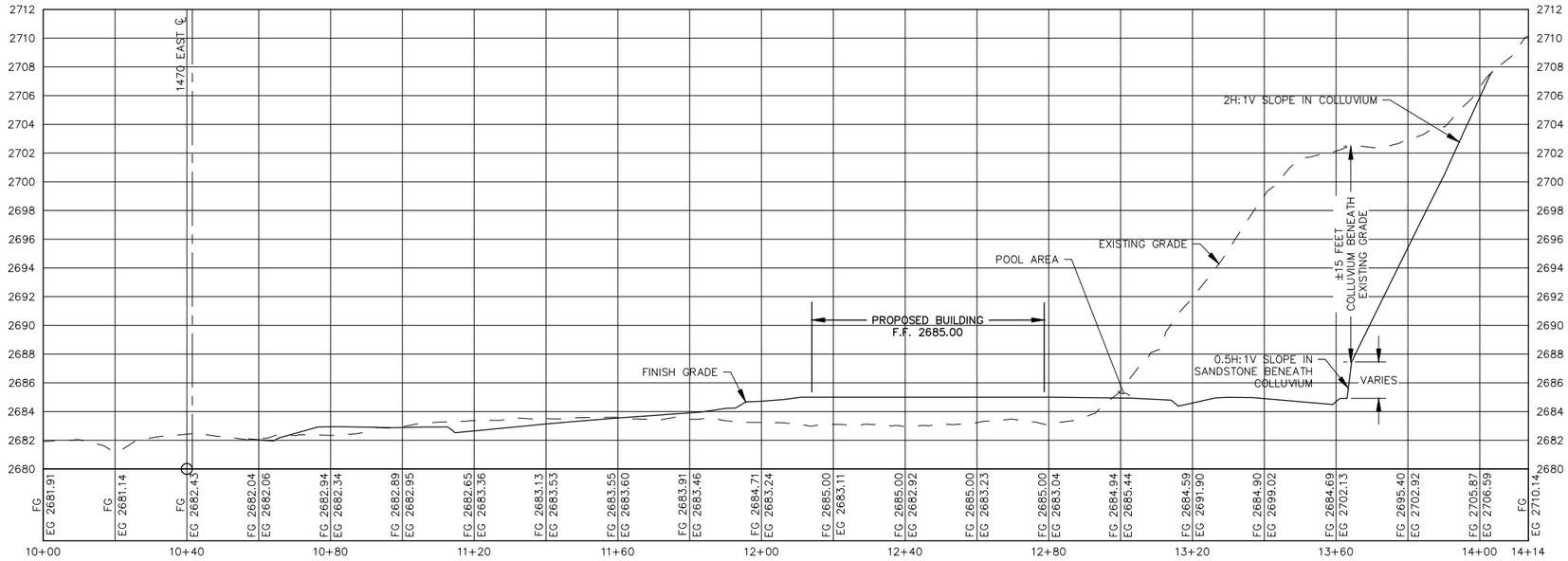
PRELIMINARY
NOT FOR CONSTRUCTION

ALPHA ENGINEERING
43 South 100 East, Suite 100 • St George, Utah 84770
T: 435.628.6500 • F: 435.628.6553 • alphaengineering.com

TITLE: ROUGH GRADE
PROJECT: BEST WESTERN @ HOME
ST. GEORGE, UTAH

PROJECT #	2043-01
NAME	RKB
DATE	MARCH 6, 2024
SCALE	AS NOTED
SHEET	1 OF 3
FILE	2043-01 Preliminary Grading Plan.dwg

P:\2043-01 Best Western @ Home\Drawings\Exhibit Drawings\2043-01 Preliminary Grading Plan.dwg, ROUGH GRAD, 3/6/2024 2:56:45 PM, jheward



SECTION A-A PROFILE

HORIZONTAL SCALE: 1" = 40' (11x17)
VERTICAL SCALE: 1" = 10' (11x17)

SECTION B-B PROFILE

HORIZONTAL SCALE: 1" = 40' (11x17)
VERTICAL SCALE: 1" = 10' (11x17)

NO.	DATE	BY	DESCRIPTION

REVISIONS

PRELIMINARY
NOT FOR CONSTRUCTION

ALPHA ENGINEERING
43 South 100 East, Suite 100 • St George, Utah 84770
T: 435.628.6500 • F: 435.628.6553 • alphaengineering.com

GRADING SECTIONS (A & B)

BEST WESTERN @ HOME
ST. GEORGE, UTAH

PROJECT #	2043-01
NAME	JMD
DATE	MARCH 6, 2024
SCALE	AS NOTED
SHEET	2
	2 OF 3
FILE	2043-01 Preliminary Grading Plan.dwg

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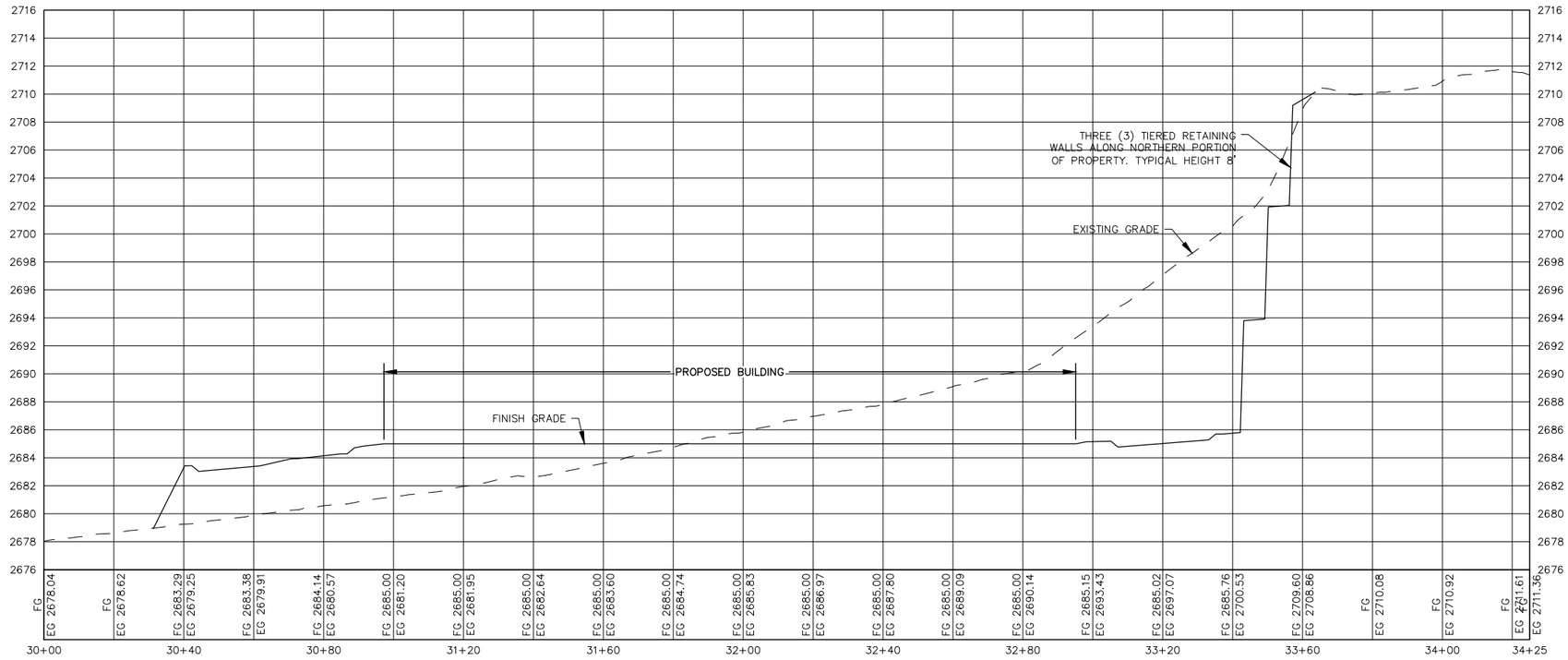

SECTION C-C PROFILE

HORIZONTAL SCALE: 1" = 40' (11x17)
VERTICAL SCALE: 1" = 10' (11x17)

NO.	DATE	BY	DESCRIPTION

REVISIONS

PRELIMINARY
NOT FOR CONSTRUCTION

ALPHA ENGINEERING
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TITLE: GRADING SECTION (C)

PROJECT: BEST WESTERN @ HOME
ST. GEORGE, UTAH

PROJECT # 2043-01
NAME JMD
DATE MARCH 6, 2024
SCALE AS NOTED

SHEET 3
3 OF 3
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GEOTECHNICAL ENGINEERING REPORT

Prepared for:

Home Hospitality Group

Attn: Nick Ence

107 South 1470 East Suite #302

St. George, Utah 84790

February 6, 2024

Revised: March 5, 2024

@Home Best Western

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Prepared by:

LANDMARK TESTING & ENGINEERING

795 EAST FACTORY DRIVE
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Landmark Project No: 240016

February 6, 2024
Revised: March 5, 2024

Home Hospitality Group
Nick Ence
107 South 1470 East, Suite 302
St. George, Utah 84790

Subject: Geotechnical Engineering Report
@Home Best Western
St. George, Utah
Landmark Project No.: 240016

Mr. Nick Ence,

Landmark Testing and Engineering (Landmark) has completed a Geotechnical Engineering Report for the proposed hotel development located at approximately 335 South 1470 East in St. George, Utah. The geotechnical recommendations, including foundation design, pavement design, slope stability analysis, and rockfall analysis, along with our field and laboratory data are presented in this report. This work has been done in general accordance with Landmark proposal YP4756 dated December 1, 2023 and your subsequent authorization of the work.

The field exploration consisted of eight test pits excavated to a maximum depth of 15 feet below ground surface (bgs) and one trench to 8 feet bgs. Additionally, Landmark performed one refraction microtremor (ReMi) array proximate to the proposed structure, and rockfall and slope stability reconnaissance. Subsurface soils encountered on site consisted primarily of silty sand with gravel and cobbles overlaying sandstone bedrock.

Conventional spread footings bearing on structural fill are recommended for structural support of the proposed structures. Over-excavation and recompaction, as detailed in Section 6.0 of this report, will be required. The existing soils, free from organics and other debris are suitable for use as structural fill.

The grading plan as drafted shows a 1 horizontal to 1 vertical (1H:1V) slope to be cut at constant grade along the eastern property boundary. This geometry was analyzed and determined to be unstable as designed. We recommend revising the geometry to include a 1H:2V in the sandstone strata, and a 2H:1V in the colluvial strata as indicated in Section 5.1. This recommended geometry was analyzed and considered globally stable.

To reduce the risk to life and property against potential rockfall hazards, we also recommend the construction of a rockfall protection method. We have provided parameters and analysis assuming an earthen berm will be constructed along the eastern property line above the top of the proposed cut slope to be constructed in that area.

Landmark has great interest in providing materials testing and special inspection services during the construction phase of this project. If you advise us of the appropriate time to discuss these engineering services, we will be pleased to meet with you at your convenience.

Please feel free to contact our office at (435) 986-0566 if you have any questions.

Sincerely,
LANDMARK TESTING AND ENGINEERING

Steven Wells, P.E.
Geotechnical Manager

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ST. GEORGE, UTAH

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1.0 INTRODUCTION

This report presents the results of Landmark Testing & Engineering's geotechnical exploration and analysis for the proposed @Home Best Western development in St. George, Utah. Figure A-1 is a Vicinity Map showing the project location relative to surrounding features. Figure A-2 is a Site Map showing the proposed project layout and the approximate locations of the test pits completed for this exploration. Figure A-3 shows the critical cross section line used for slope stability and rockfall analysis.

This exploration was completed to assist in developing opinions and recommendations concerning site earthwork and foundation design.

2.0 PROPOSED CONSTRUCTION

A preliminary site layout and grading plan has been provided to us and reviewed in preparation of this Geotechnical Engineering Report. We understand that development of the 2.27-acre project site will include construction of a three- to four-story hotel, associated asphalt paved parking and driveways, and dumpster pad. It is anticipated that the east side of the property will be cut as much as 30 feet down to the parking lot elevation. The south end of the development area will be filled roughly 10 feet to meet the proposed design grades.

Building loads are expected to be on the order of 3,500 to 4,500 pounds per linear foot along strip footings, with point loads on pad footings up to 100 kips. Traffic loads are anticipated to be equivalent to residential average daily traffic with heavy use drive aisles providing access to the garbage enclosure.

Any significant changes to the anticipated development should be reviewed by Landmark to evaluate the continued applicability of the recommendations contained in this report.

3.0 SITE SETTING

3.1 SURFACE CONDITIONS

The project is located at approximately 335 South 1470 East on Parcel SG-5-2-29-1205. The entire lot is roughly 21 acres, with the proposed development being in the northernmost 2.27 acres. This lot is immediately South of the Mesa Medical Center located at 295 South 1470 East. The southern majority of the property has been rough graded for future development, and the property has frontage onto 1470 East to the west. Historical imagery shows that the western portion of the lot has been roughly graded around 2013.

Foremaster Ridge extends upward immediately east of the property. Topography extends upward roughly 200 feet from the proposed building elevation over roughly 400 feet horizontally giving an average grade of 2 horizontal to 1 vertical (2H:1V). The grade is not consistent and steepens significantly towards the top with localized grades approaching 1H:1V and is capped with columnar basalt, which is a known source for rock fall. Storm water has cut channels into the slope, and the landscape is scattered with rocks ranging from 2 feet to 10 feet.

Vegetation on site is sparse with some desert shrubs and grasses present. The majority of the ground surface in the development area is bare earth and rock fields.

3.2 GEOLOGIC SETTING

According to the Utah Geological Survey,[1] the project site is mapped as located on:

Qmt: Talus (Holocene to upper Pleistocene)
Poorly sorted, angular boulders and finer-grained interstitial sediment deposited principally by rock fall on and at the base of steep slopes; typically grades downslope into colluvial deposits and may include colluvial deposits where impractical to differentiate the two; also includes alluvial deposits in the bottom of washes, and, in the Smith Mesa quadrangle, locally includes small landslide deposits along the outcrop belt of the Petrified Forest Member of the Chinle Formation; generally less than 30 feet (9 m) thick.

This colluvial Talus layer is likely underlain by:

Jks: Springdale Sandstone Member of Kayenta Formation (Lower Jurassic)
Medium- to thick-bedded, fine- to medium-grained sandstone with planar and low-angle cross-stratification, and minor, thin, discontinuous lenses of intraformational conglomerate and thin interbeds of moderate-reddish-brown or greenish-gray mudstone and siltstone; contains locally abundant petrified and carbonized fossil plants.

Materials encountered during the subsurface exploration of the property coincide with geologic mapping by the UGS.

3.3 GEOLOGIC HAZARDS

The St. George basin lies within the physiographical transitional zone between the Colorado Plateau to the east and the Basin and Range Province to the west. Southwestern Utah is located on a structural block proximate to the southern segment of the Intermountain Seismic belt, which is characterized by high-angle normal faults that tend to step down to the west. The Hurricane fault with an offset of 6,000 to 8,000 feet forms the eastern edge of the transition zone. The Grand Wash-Reef Reservoir-Gunlock fault system with displacement of about 1,500 to 3,000 feet forms the western edge.

Fault Rupture

The trace of the Washington Fault Zone is located approximately 3 miles east of the site with the Hurricane Fault roughly 13 miles to the east. The Utah Geologic Survey indicates that these faults displace late Quaternary sediments and are considered active. Strong ground motion associated with movement along these, or other faults associated with the Intermountain Seismic Belt is possible, however, the potential for surface fault rupture is considered low.

Although the potential for surface rupture caused by activity from either of these faults is low, there is potential for strong ground motion at the site due to possible fault rupture at these or other localized faulting zones. These ground motions are considered by the ASCE 7-16 seismic design parameters given in Section 3.4. Shear wave velocity analysis was performed to assist in seismic classification of the site as outlined in Section 3.4.

1 Utah Geological Survey (UGS), Interactive Geologic Map Portal, Accessed February 5, 2024

Liquefaction

Liquefaction is the sudden loss of shear strength in the soil due to the build-up of excess pore water pressure.[2] This can occur when the soil is subjected to intense shaking such as during a seismic event. The soils that are most susceptible to liquefaction are loose, saturated sandy soils with a low fines content (material passing the #200 sieve).

According to the Utah Geological Survey,[3] the soils in the project area are mapped as being low liquefaction-susceptibility zone. Soils encountered in the test pits are Silty Sands with minor Clayey Sands. Groundwater was not encountered in our test pits during our exploration and therefore liquefaction potential may be considered low. A liquefaction study is beyond the scope of this report.

Slope Stability

Global slope stability is a concern when a native or constructed slope is steep enough that the resisting forces in the soil may be overcome by the mobilization forces acting downward on a section of soil. Different soil types and slope geometry can greatly impact the stability of a given slope grade. In general, a soil slope of 2H:1V is considered stable and does not require additional analysis.

The preliminary grading plan shows that in order to establish the desired parking lot and building grades for the development, a slope of 1H:1V is proposed in the eastern portion of the project. Beyond the proposed cut, the slope continues upward in a relatively steep manner. Slope stability analysis has been performed as described in Section 4.3 and Section 5.1. The slope is not globally stable as designed; we recommend revising the geometry as described in Section 5.1.

Rockfall

The proposed development is shown on the UGS geologic hazards map as being located within a high rockfall hazard area. The project area and the slope further east exhibit signs of rockfall including the presence of geologically young basalt which has become detached from the Lava Ridge Lava Flow source which is present east of the property as shown in Figure A-3. Landmark has performed rockfall analysis as outlined in Sections 4.3 and 5.2. Rockfall does pose a risk to the proposed development. For this reason, we are recommending an earthen berm be constructed uphill of the proposed cut along the eastern property boundary.

Expansive Soils

The site is shown on the UGS geologic hazards map as being partially located in a low expansive soil hazard area. Expansive soils are clays and claystone which changes volume due to moisture content changes. Expansive soils were not encountered in our test pits.

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2 Coduto, Donald P. (1999), Geotechnical Engineering: Principles and Practices, Prentice Hall, Upper Saddle River, NJ

3 St. George-Hurricane Metropolitan Area Geologic-Hazard Study, Knudsen, Tyler R., Utah Geologic Survey Special Study 127.

It is possible for expansive soil to be present in areas beyond our exploration locations. As such, excavating contractors should be vigilant in observation of soil conditions. If highly plastic soils are found on site, Landmark should be contacted for further evaluation and recommendations.

Collapsible Soils

The site is shown on the UGS geologic hazards map as being located in Type 2 Collapsible Soil hazard area. Collapsible soils are considered to have considerable strength when in a dry, natural state, but significantly settle due to hydro compaction, reduction of air space when the soil is wetted. Soils encountered on site exhibited signs of collapsibility which were confirmed by laboratory testing.

Collapsible soils pose significant hazard to the development. For recommendations related to collapsible soils, refer to Section 6.0.

3.4 SEISMICITY

Seismicity at the site was determined using ASCE Hazard Tool from ASCEhazardtool.org website. Consideration should be given to the risk category of the building. It is assumed in this report that the building is risk category II as determined by International Building Code (IBC) Table 1604.5. It is possible that risk category III is more appropriate, depending on the intended use and capacity of the structure. If this is the case, applicable design considerations should be followed.

A Shear Wave Velocity Study was conducted on the project site as shown on the site map in Figure A-2. Landmark determined the average shear wave velocity of the upper 100 ft (Vs,100) of the site soil profile on the project according to the refraction microtremor method (ReMi). The ReMi data showed that the Vs,100 of the site soils is 1,756 ft/sec, which classifies the site as "C." The ReMi data is included as Figure C-1. This correlates well with soils encountered in the test pits. Bedrock was found in the ReMi data, although it is difficult to define as the near surface rock is heavily weathered in places. There are significant strength increases seen at roughly 8 feet and 16 feet bgs, with another increase at roughly 36 feet bgs as shown in Figure C-1.

The following values are presented to assist with seismic design:

- Latitude = 37.102952° North, Longitude = 113.551219° West
- V_s = 1,756 ft./sec.
- Site Class = C – Very Dense Soil and Soft Rock, based on ASCE 7 as referenced in 2021 IBC

Period (sec)	Sa (g)	Site Class
0.2	S_S = 0.521	B/C
1.0	S_1 = 0.169	B/C
0.2	S_{DS} = 0.448	C
1.0	S_{D1} = 0.169	C

The complete ASCE Hazard Tool output is attached as Figure C-2.

4.0 EXPLORATION

4.1 FIELD EXPLORATION

To investigate the subsurface conditions, 8 test pits and a trench were excavated to a maximum depth of 15 feet. Test pits were excavated using a CAT 336F mid-sized trackhoe with a 4-foot toothed bucket. Depending on subsurface conditions, bag or block samples of soil were obtained from the test pit excavations. Test pit and trench designations and approximate locations are shown on Figure A-2.

Landmark geologist Michael Meyers supervised the excavation. A log of the subsurface conditions was prepared, samples were collected and sealed for transport, and relevant site photographs were taken. Groundwater was not encountered in the test pits at the time of exploration.

Soil conditions were variable across the property. Near surface soils especially up on the slope along the eastern portion of the development area consisted of silty sand to lean clay with various amounts of fines and gravels as well as basalt boulders in some locations. Underlaying these colluvial deposits at various depths, materials transitioned to sandstone which was difficult to excavate, and in many cases, the test pits were terminated due to refusal.

Complete test pit logs are presented on Figures A-4 through A-11 with the trench profile as Figure A-12. A key to the soil classifications used on the logs is presented as Figure A-13.

4.2 LABORATORY TESTING

Soil samples from the test pits were taken to our St. George, Utah laboratory for testing. Tests performed on the samples included:

- Moisture content and unit weight for density determination
- Sieve analysis and Atterberg Limits for soil classification
- One-Dimension Consolidation for earthwork design
- Modified Proctor for construction testing
- California Bearing Ratio (CBR) for pavement section design
- Soluble Sulfate Content for concrete mix design selection

A sample from TP-4 at 12 feet bgs was tested for soil classification. The sample had a moisture content of 3.7 percent. Atterberg Limit testing showed that the sample had a liquid limit of 20 with a plasticity index of 4 indicating low plasticity. Mechanical sieve analysis showed that the sample was 11 percent gravel, 47 percent sand, and 42 percent silt and clay. According to the USCS, this soil is classified as Silty Clayey Sand (SC-SM).

Another sample from TP-5 at 3 feet bgs was tested for soil classification. The sample had a moisture content of 3.7 percent. Atterberg Limit testing showed that the sample was non-plastic. Mechanical sieve analysis showed that the sample was 19 percent gravel, 58 percent sand, and 32 percent silt and clay. According to the USCS, this soil is classified as Silty Sand with Gravel (SM).

A sample taken from TP-6 at 2 feet bgs was tested for consolidation. The sample had a density of 89.4 pcf with a moisture content of 4.4 percent. This sample collapsed 4.1 percent under a 1.5 ksf load in a saturated condition. This is considered highly collapsible. For recommendations related to collapsible soil see Section 6.

A sample taken from TP-7 at 1.5 feet bgs was tested for water soluble sulfate content. The sample tested had 1.89 percent soluble sulfate which is considered highly corrosive according to the American Concrete Institute (ACI) Section 318. For recommendations related to corrosive soils, refer to Section 12.0.

A bulk sample taken from TP-2 was tested for maximum dry density, optimum moisture, and CBR. According to modified Proctor testing, the sample has a maximum dry density of 123.2 at an optimum moisture of 10.2 percent with a CBR of 38.

The results of the laboratory tests are shown on the test pit logs as well as on the attached Summary of Laboratory Test Results on Table B-1. Individual test results are also included in Appendix B.

4.3 ROCKFALL AND SLOPE STABILITY RECONNAISANCE

To determine the rockfall and slope stability hazard present on the site, a Landmark engineer visited the property to document the surface conditions of the slopes, their characteristic roughness, approximate grade, and the typical boulder size. The general direction of the slope, and the likely path if rockfall or slope failure were to occur.

The basalt cap of Foremaster Ridge is considered the main source of rockfall in the area. The parking lot is roughly 430 horizontal feet west of the rock source and the structure is approximately 500 feet west. Critically, the proposed cut slope is roughly 390 horizontal feet from the rock source. The area between the proposed structure and the top of the slope is mapped by UGS as talus deposits.

In general, the topography of the slope steepens towards the top, with grades near the bottom of 3H:1V and steepening to nearly vertical at the top. The rock source zone is nearly vertical with severely fractured columnar basalt from the Lava Ridge lava flow being exposed. The topography of the slope is moderately hummocky as is common in areas of colluvial activity. Stormwater has scoured out canals and channels of various sizes trending generally parallel to the grade of the slope.

The slope is lightly vegetated with desert shrubs and grasses. Boulders of various sizes and shapes are scattered across the slope and into the development area. There is evidence of a significant rockfall event that occurred relatively recently above the proposed development, the separated rock segment was very large and blocky.

As previously mentioned, the proposed development includes cutting a slope at the toe of the existing grade. This increases the potential acceleration zone of potential rockfall and may be a detriment to the global stability of the natural slope. As such, Landmark has performed analysis of the global slope stability and rockfall analysis as outlined in Section 5.0. Recommendations for site grading and earthwork pertaining to this analysis are given in Section 6.0.

5.0 ANALYSIS AND CONCLUSIONS

Our field and laboratory tests results indicate that near surface soils on site consist of colluvial silty sand which is intermixed with gravel, cobbles, and boulders especially along the eastern portion of the project area. These sands are underlain by mudstone and sandstone which was difficult to excavate with the mid-sized trackhoe used for the exploration. Several of the test pits reached refusal as shallow as 7 feet bgs.

Near surface sands exhibited signs of collapsibility in the field. In addition, a consolidation test performed on a sample from TP-6 collapsed 4 percent under 1.5 ksf loading under saturated condition which is highly collapsible. Therefore, we recommend that loose soils beneath footings and floor slabs of the hotel structure be excavated prior to construction. General recommendations for the earthwork and the foundation system are outlined in Sections 6.0 and 7.0 of the report.

Slope stability and rockfall analysis was performed along a critical cross section S – S' shown on Figure A-3. This section was selected as the most critical due to it being the tallest section of the cut as well as due to the steepness of the natural slope above the proposed cut. The selection of this critical cross section is based on the preliminary grading plan provided to Landmark. Should the grading plan change, Landmark should be contacted to evaluate the continued efficacy of the design.

5.1 SLOPE STABILITY ANALYSIS

Slope stability analysis is the quantitative and qualitative analysis of the condition of a man-made or natural slope. In the case of this project, the slope analyzed is both the man-made cut as well as the natural slope above the proposed cut.

To perform the analysis, appropriate soil properties, slope geometry and other conditions were established. Calculations using limit equilibrium methods were then performed to ensure that resisting forces are sufficiently greater than the forces tending to cause a slope to fail.[4] Ultimately, a factor of safety (FS) is determined by comparing the resisting forces to the sliding forces along a potential failure surface.

To assist with analysis, RocScience Slide2 software was used to perform the calculations. Both the static and seismic conditions for the geometry and condition as shown in Figures D-1 and D-2 were analyzed using a variety of methods. Groundwater was not encountered and is not expected. The underlying sandstone is not impermeable, and saturated soil conditions are not likely. Stormwater will runoff readily due to the steepness of the slopes. For these reasons the slope was analyzed under total stress condition as saturated conditions are not warranted.

For the conditions analyzed, the slope, cut at a 1H:1V as shown in the preliminary grading plan is **not stable** for the static or seismic condition. Factors of safety for both the static and seismic condition in the proposed geometry are less than 1. The target factor of safety for static conditions is 1.5, and the target factor of safety for seismic conditions is 1.1.

Slope Stability Recommendations

Several alternative geometries and soil parameters were considered. Ultimately, Landmark recommends that where there is not bedrock, the slope be cut at 2H:1V. We expect the upper 12 to 15 feet of material will require this shallower grade. The sandstone bedrock may be cut at a 1H:2V. This steeper grade is expected to be in the lower 15 to 18 feet of the cut face. It is possible for this sandstone to be interbedded with mudstones and other sedimentary facies, if this is encountered in the field, Landmark should be contacted to reevaluate the soil conditions.

There were three soil types used in the analysis: sandstone, colluvium, and compacted colluvium

4 Duncan, M.J. et al (2014), *Soil Strength and Slope Stability Second Edition*, Wiley Publishing, Pg. 81-101

(berm). In all cases, Mohr-Coulomb soil parameters were assigned using conservative values for unit weight, effective friction angle, and cohesion used in the analysis.

Material	Unit Weight (pcf)	Cohesion (psf)	Phi (°)
Berm	130	50	34
Colluvium	125	10	34
Sandstone	138	2000	25

Due to the moderate cementation and fines encountered in the material, a small amount of cohesion was assigned to the colluvial material. Models which were run without cohesion show only superficial surface failures along the berm. Duncan (referenced above) suggests that material classified as SM-SC have cohesion of approximately 300 psf when compacted to 100% of relative dry density as determined by ASTMD-698. Our values of 10 psf for in place colluvium and 50 psf for compacted colluvium are conservative based on the literature. Additionally, the effective friction angle increases with relative density, however, to maintain conservative soil parameters, the friction angle has not been increased between the in place colluvium and the compacted colluvium.

Limit equilibrium analysis was performed based on the geometry recommended assuming depths outlined above. Four methods were used to perform the analysis, Bishop, Janbu, Spencer, and Morgenstern-Price. For the seismic condition an acceleration of one half of the peak ground acceleration (0.12g) as given by the ASCE 7-16 was assumed in the downhill direction. The following are the provided factors of safety for each method and condition:

Method Name	FS Static	FS Seismic (0.12g)
Bishop Simplified	1.57	1.21
Janbu Simplified	1.53	1.16
Spencer	1.57	1.19
Morgenstern-Price	1.57	1.18

In all methods analyzed the target factor of safety was exceeded for the given geometry. Figure D-1 shows the critical failure surface analyzed for both static and seismic. Figure D-2 shows all surfaces analyzed for the static condition. For complete analysis refer to the Rocscience output attached as Figure D-3.

Landmark should be called on site to assess the soil conditions as the slope is being cut. Should soil conditions encountered during construction vary somewhat from the conditions found during the exploration, Landmark should perform further analysis of the “as-built” condition.

5.2 ROCKFALL ANALYSIS

A two-dimensional model of the natural slope, and then the design critical cross section S-S’ was modeled in the Colorado Rock-Fall Simulation Program (CRSP) as well as in RocScience Rocfall2 software to evaluate the potential runout zone below the rock source. Firstly, analysis was done on the natural slope to verify the parameters of the model. Modeling of various rock shapes and sizes

in Rocfall2 show relatively similar distribution as found in the field. Landmark performed this analysis based on the proposed 1H:1V. This is a conservative geometry compared to the geometry recommended in Section 5.1.

Based on the geometry provided in the preliminary grading plan, a variety of rock shapes and sizes were simulated in Rocfall2 and CRSP. Across several iterations, roughly 5 to 10 percent of the rocks analyzed reached the cut slope and then accelerated into the parking lot. Some rocks approached the proposed hotel site as shown in Figures E-1 and E-2.

Rockfall Recommendations

Based on our site evaluation and rockfall simulations, it appears that there is a risk of rockfall reaching the parking lot area, and a slight risk of falling rocks reaching the proposed structure footprint.

To reduce the risk of rockfall and damage to property and life, mitigation measures are recommended. We reviewed several mitigation options including concrete barriers, catchment fences, and an earth fill catch berm. The least invasive mitigation measure is the construction of a catch berm along the eastern property line of the lot. This berm should extend across the entirety of the proposed cut slope. A proposed berm detail is included in Figure E-4. Rocfall2 simulations indicate that the berm would be successful at reducing the risk of rocks reaching the cut slope and accelerating into the parking area. Concrete barriers and catchment fences would need to be designed for the potential rockfall energy.

6.0 SITE GRADING AND EARTHWORK

6.1 GENERAL GRADING

Site preparation should initially consist of grubbing and removal of vegetation. Grubbing is expected to be minimal, as most of the development area is bare earth.

The preliminary grading plan shows that the development area will be cut some 30 feet from the existing grades in the north and western portions of the site and roughly 10 feet of fill in the south and eastern portions of the site.

Near surface soils consisted of silty sand to lean clay with gravel, cobbles, and boulders intermixed. These soils exhibited high potential for collapse under loaded, saturated conditions.

Building Pad

In the area of the hotel building pad, we recommend that at least 4 feet of material be over-excavated from the existing ground surface. This excavation should extend 5 feet horizontally beyond the building envelope in all directions. Consideration should be given to over-excavating hardscaped areas around the perimeter of the building as well. If at any point sandstone bedrock is reached, the over-excavation may be considered complete at that point.

Once the over-excavation is complete, the bottom of the excavation should be scarified, moisture conditioned to within 2 percent of the optimum moisture, and recompacted to 90% of maximum dry density as determined by ASTM D1557 Modified Proctor testing. If the bottom of the excavation is into bedrock, scarification is not required.

Following over-excavation, a Landmark engineer or geologist should observe the excavation to

document the depth of the excavation and determine if subsurface conditions match those found in our filed exploration. Alterations to our recommendations may be required if substantially different conditions are encountered.

Once the over-excavation is complete, the contractor may begin placing structural fill as outlined in Section 6.2. On site soils which are free of over-sized material exceeding 6 inches may be used as structural fill on site. Shrinkage of the on-site soils should be expected on the order of 25 percent volume reduction. Imported material may be required to establish desired grades. Foundations should be established on a minimum of 1 foot of structural fill, and not established directly on bedrock to limit the potential for differential settlement.

Landmark does not determine the location of the over-excavation or the location of the structures to be constructed. The builder is responsible to ensure that the building footprint is entirely within the over-excavated and recompacted building pad.

Pavement Area

Based on observation of the preliminary grading plan provided to Landmark, much of the portions of the project to be paved will be in areas of mass grading. The parking lot in the northeast will be significantly cut below existing grade, and the parking lot to the southwest will be on fill. In areas where the grading transitions from cut to fill, the contractor should ensure that at least 1 foot of structurally placed fill material is installed under pavement areas, curbs, and sidewalk to reduce the risk of settlement due to collapsible soils.

Catchment Berm

To reduce the risk of damage to life and property from rockfall hazard, Landmark recommends that a catchment berm be constructed along the top of the cut slope proposed along the eastern portion of the property. A typical detail for this berm is provided as Figure E-4. This berm should be constructed such that the total height of the berm is at least 5 feet high relative to the uppermost existing grade. This berm should be setback at least 5 feet from the top of the cut slope. The core of the berm should be constructed out of onsite soils which have been compacted to 95% of ASTM D-1557. There should be roughly 3 feet of loose screened fill placed on the uphill side of the berm.

Stormwater should be directed away from the face of the berm and not allowed to saturate the soils of the slope. We recommend the uphill side of the berm be graded as a drainage swale, or other stormwater mitigation method implemented.

This berm should extend roughly the entire length of the cut slope. Modifications to this design maybe made in the field by a Landmark engineer should grading of the site warrant such a change.

6.2 FILL PLACEMENT AND COMPACTION

All fill to be placed for support of footings and slabs-on-grade should be considered structural fill. On-site soils with over-sized material removed are suitable for use as structural fill. However, we recommend that the floor slabs and footings be established on at least 12 inches of aggregate base course material or imported granular fill.

Imported, granular fill, if required, should be well-graded, non-expansive, and free of organics and all deleterious materials. Soils used for imported, granular fill should meet the following specifications and preferably would classify as gravel.

GRADATION	PERCENT PASSING
6- inch	100
3-inch	80-100
No. 200 sieve	10-25
ATTERBERG LIMITS	
Liquid Limit	30 or less
Plasticity Index	9 or less

Material not meeting the above requirements may be suitable for use as structural fill at the discretion of the geotechnical engineer. Samples of structural fill should be submitted for testing prior to transporting to the site.

Any on-site soils used as structural fill or imported, granular fill should be compacted to the following specifications.

FILL PLACEMENT AND COMPACTION	
Maximum lift thickness	8-inch (loose)
Minimum compaction	95% ASTM D-1557
Compacted Moisture Content	within 2% of optimum

Compaction of structural fill should be completed with equipment suitable for the conditions encountered in the field such that compaction requirements are met, including those areas that may be inaccessible to large rolling compactors. All structural fill should be evenly spread on a horizontal plane in eight-inch loose lifts. Each eight-inch lift of structural fill material placed at the site should be tested for compliance with the required relative compaction and moisture content prior to proceeding with additional lifts.

6.3 LIGHTLY LOADED ELEMENTS

Exterior concrete slabs on grade (sidewalks, curbs, gutters, and misc.) should be established on a minimum of 12-inches of structurally placed soils with a maximum particle size of 6-inches. Sidewalks adjacent to public right of ways will need to be underlain by approved road base as per City of St. George Standards.

Structural fill, including road base, should be compacted to a minimum of 95 percent of the maximum dry density as determined by ASTM D-1557.

6.4 CUT AND FILL SLOPES

It is recommended that permanent cut or fill slopes in silty sand soil be maintained at a slope of two horizontal to one vertical (2H:1V) or flatter unless structurally retained. The cut slope along the eastern portion of the property should be constructed in accordance with the recommendations outlined in Section 5.1. Where the project boundary and soil conditions do not allow for the recommended geometries outlined in Section 5.1, structural retention may be required in accordance with St. George City Standards. No retaining wall designs have been provided at this

time, but can be done at your request.

Steeply cut slopes are subject to erosion and degradation over time. Consideration should be given to drainage and erosion control methods to limit the amount of maintenance required.

Grading of both cut and fill slopes should be such that surface water is directed away from the slopes and not concentrated on slopes or in unprotected channels. Construction procedures should ensure adequate compaction of slope faces. All excavations should conform to OSHA standards.

7.0 FOUNDATION & CONSTRUCTION CONSIDERATIONS

The proposed structures may be supported on conventional spread or continuous footings established on a minimum of 12 inches of aggregate base course or imported granular fill overlaying structurally places silty sand. Foundation excavations should be visually observed and tested by qualified personnel prior to placement of reinforcing steel or concrete. Additional foundation recommendations are subsequently presented.

DESCRIPTION	VALUE
Foundation Type	Continuous or spread footings
Bearing Material	Aggregate Base Course or Granular Fill
Allowable Bearing Capacity	3,000 psf on Aggregate Base Course 2,800 psf on Granular Fill
Minimum embedment depth below finished grade	12 inches (for frost and confinement)
Minimum footing width	12 inches (continuous) for single-story 18-inches for two stories 24-inches (isolated spread)
Total estimated settlement	1-inch
Total differential settlement	less than 3/4 inch

The allowable bearing capacity is based upon dead load plus long-term live load. A one-third increase in allowable bearing capacity for short duration loads such as wind or seismic loads is permitted with the alternative load combinations given in Section 1605.3.2 of the IBC.

8.0 FLOOR SLABS

It is recommended that concrete floor slabs be constructed on a pad that has been prepared as previously indicated. A minimum of 4-inches of relatively free-draining material should be used beneath the slab in order to help distribute floor loads, break the rise of capillary water, and aid in the concrete curing process. Alternatively, 6 inches of road base may be used in place of the free draining-material. The thickness of the free-draining material may be included in the 12-inches of granular, structural fill.

Concrete slabs should be designed using rebar reinforcement and frequent crack control joints to help control normal shrinkage and stress cracking. Concrete placement and curing should meet

ACI[5] requirements including following hot or cold weather placement recommendations, when appropriate. If a moisture-sensitive floor covering will be installed, we recommend that a vapor barrier be installed beneath the concrete slab. The moisture sensitivity of floor finishes, anticipated project conditions, and the potential effects of slab curling and cracking should be considered in determining if the barrier should be placed directly beneath the slab or beneath the free-draining gravel (see ACI 302.IR-96 for more information regarding vapor barrier location). If the vapor barrier is installed directly beneath the slab, measures should be taken to minimize excessive slab curl such as reduced joint spacing and use of a low shrinkage (low water-cement ratio) mix.

9.0 LATERAL EARTH PRESSURES

Lateral loads imposed on footings may be resisted by the development of passive earth pressures against the sides of footings and friction between the base of the footing and the supporting soils. Lateral earth pressure values are presented in the following table.

Case Evaluated	Soil Type	Value
Active	Structurally placed Silty Sand	38 psf/ft
		56 psf/ft (with seismic)
At-Rest	Structurally placed Silty Sand	59 psf/ft
Passive	Structurally placed Silty Sand	407 psf/ft
		357 psf/ft (with seismic)
Seismic Coefficient	IBC 1610.1.1	0.179
Coefficient of friction tan(φ*0.6) where φ = 32°	Structurally placed Silty Sand	0.35

The lateral earth pressures presented do not include any safety factors except where the friction angle (φ) used to determine the coefficient of friction has been multiplied by 0.6 to account for smooth contact conditions. The pressures also assume horizontal backfill and that the backfill is in a drained condition with no build-up of hydrostatic pressure. The additional effects of sloping backfill, surcharge, structural loads and groundwater conditions should be included in calculating lateral earth pressures. Backfill should be placed in accordance with the requirements of structural fill except that backfill in landscape and areas that will not be subject to structural loadings may be reduced to 90 percent of the maximum dry density as determined by ASTM D-1557.

10.0 PAVEMENT DESIGN RECOMMENDATIONS

10.1 ASPHALT PAVEMENT

Design of the pavement sections are based on the procedures outlined in the 1993 Guidelines for Design of Pavement Structures by the American Association of State Highway and Transportation Officials (AASHTO). A Traffic Index of 5.5 was used for design of the parking areas and typical use drive aisles planned for the development. A heavy use section should be considered along the

5 American Concrete Institute

path to the garbage enclosure and any loading areas. A CBR value of 10 was used based on the soil encountered in our exploration and laboratory testing performed.

For pavement design, the following design parameters have been assumed:

Pavement Design Life	20 years
Subgrade CBR	10
Structural Layer Coefficients	Asphalt = 0.42
	Road Base = 0.12

Based on design parameters, the following pavement sections are provided.

Location	Asphalt Thickness (inches)	Base Course (inches)	Scarified and Compacted Subgrade (inches)
Typical Use (T.I = 5.5)	2.5	6	12
Heavy Use (T.I = 7.0)	3.5	8	12

Recompacted on-site soils should be compacted to a minimum of 95 percent of the maximum dry density as determined by ASTM D-1557 and base course soils should be compacted to a minimum of 95 percent of the maximum dry density (ASTM D-1557). Asphalt should be compacted to at least 96 percent of the Marshall maximum density. Asphaltic concrete and base should be tested prior to site delivery and during placement for conformance with project specifications.

10.2 CONCRETE PAVEMENT

We anticipate that a concrete pad may be installed by the dumpster or other areas with heavy truck traffic. Procedures outlined in the Portland Cement Association's guide "Thickness Design for Concrete Highway and Street Pavements" were utilized for concrete pavement design.

The following design parameters were used:

Average daily truck traffic = 0.5 (Axle -load category 1)
Subgrade-subbase support = moderate (based on site soils)
Concrete modulus of rupture = 600 psi (with fiber reinforcement)

Based on input parameters, a minimum of 5.5 inches of concrete and 6 inches of base over a properly prepared subgrade will be adequate. The design recommendations are based on the following assumptions:

Subgrade soils should be compacted to a minimum of 95 percent of the maximum dry density (ASTM D-1557). Concrete and base coarse materials and construction should meet the City of St. George specifications.

As a rough guide, the joint spacing in feet for plain concrete pavement should not generally exceed twice the slab thickness in inches. Thus, for a 5.5-inch-thick slab, joint spacing would be on the order of 11.0 feet as a maximum. Also, as a general guideline, the ratio of slab width to length should not exceed 1.25.

Joint depth should be 1/4 of the slab thickness and continuous across the slab. If sawn joints are

used, the joints should be sawn as soon as possible following concrete set.

11.0 MOISTURE CONTROL

This soils report provides recommendations for site preparation and foundation design. Inadequate surface drainage or failure to control moisture will result in excessive differential movement of slabs, walkways, porches, or patios and structural damage, regardless of the site preparation. The following moisture control measures are recommended:

(1) Once the finish floor elevation has been established, the site grades should be constructed and maintained to drain surface and roof runoff away from the building foundation at a slope of five percent for at least ten feet beyond the structure. The ground surface should be graded to drain away from the building in all directions. Water should not be allowed to pond adjacent to foundations or on-site.

(2) Grass should not be placed within 5 feet of the foundation. Grass, if planted, should have a minimum slope of 5% away from the foundation.

(3) Xeriscape (landscaping that eliminates the need for supplemental irrigation of plants) is recommended within 10 feet of the building foundation. Bubblers, although more efficient than sprinkler irrigation, still have a significant potential of introducing excessive water into the ground and saturating foundation soils. Bubblers are not recommended in the 10 feet buffer zone area. As an alternative, sealed bottom planter boxes may be used.

(4) Inadequate compaction of utility trench backfill provides a conduit for water migration. All utility trenches within the building footprint and extending 5 feet beyond the footprint should be backfilled with structural fill similar to that approved for the foundations. Backfill adjacent to structures should be compacted to at least 90 percent of the maximum dry density as determined by ASTM D-1557 and the minimum slope requirements should be followed. Backfill beneath structures should be compacted to at least 95 percent of the maximum dry density.

(5) Grading should be such that surface water is directed away from all cut and fill slopes and collected only in channels protected against erosion. Water should not be allowed to pond on-site.

(6) Unless roof runoff falls on impervious surfaces such as asphalt or concrete that are sloped away from the building for a distance of 10 feet, roof runoff should be collected and discharged well outside of the foundation backfill limits.

It should be emphasized that final grading and landscaping generally occurs after construction of the structure and observation of these features is outside of normal geotechnical inspection and observation. The owner/contractor is responsible to ensure that these surface drainage and moisture control recommendations are followed throughout the life of the structure.

12.0 SOIL CORROSIVITY

Soils from the project site were tested for water-soluble sulfates content. The percent of water-soluble sulfates in the sample tested was 1.89 percent which is considered highly corrosive according to ACI 318. We recommend that concrete mixes used on the project be designed in accordance with ACI 318 Table 19.3.1.1 for Sulfate Exposure Class S2. We recommend that buried pipes be plastic (PVC or HDPE) instead of metal, where possible.

13.0 FOUNDATION REVIEW AND TESTING

This report has been prepared to assist in project design and construction. Variations from the conditions portrayed in the exploratory explorations may occur which are sometimes sufficient to require modifications to the design. In order to incorporate recommendations provided into actual field conditions and to confirm that the project specifications are implemented, we recommend that observation and testing be performed during construction to monitor over-excavation, grading, and preparation of soils upon which foundations elements or structural loads may be established.

14.0 LIMITATIONS

The exploratory data presented in this report were collected to provide geotechnical design recommendations for this project and subsurface site descriptions represent conditions observed at the time and at the locations explored. The explorations may not be indicative of subsurface conditions beyond the exploration location and conditions may change with passage of time. If subsurface conditions are encountered that are significantly different than those reported herein, Landmark should be contacted immediately for the continued applicability of the recommendations. In the event changes to the project are made that differ from those presented in this report, Landmark should be made aware of the changes. Landmark will provide written verification that the recommendations and conclusions remain valid or that modifications are required.

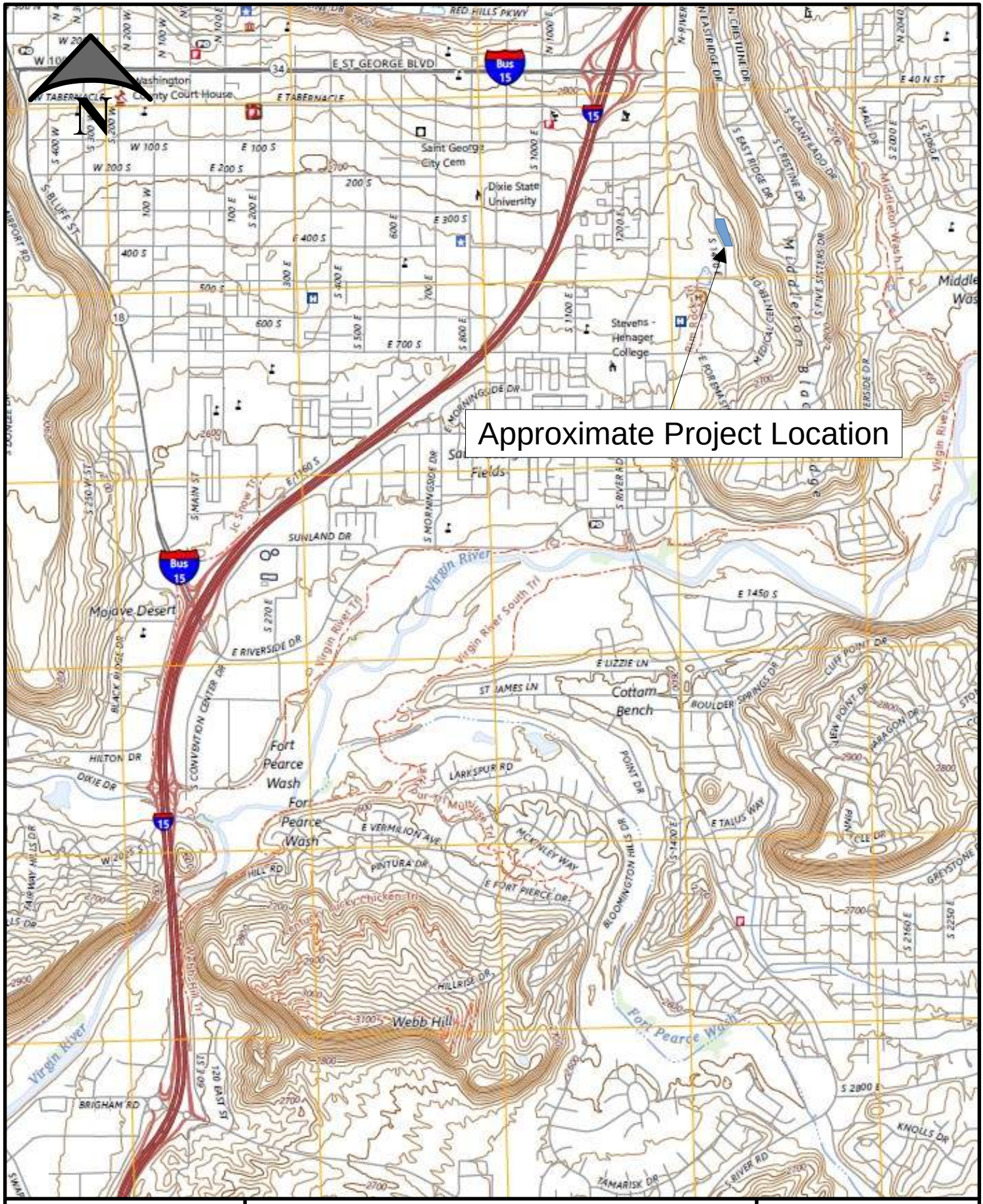
This report has been prepared to assist in project design and construction. We respectfully request the opportunity to review the final design drawings and specifications in order to determine whether the assumptions and recommendations presented herein are applicable to the anticipated designs.

This report is not intended to be used as the sole bid document. Any information concerning the environmental conditions of the site is beyond the scope of this geotechnical study. This geotechnical report has been prepared to meet the specific needs of our client and may not be appropriate to satisfy the needs of other users.
Site conditions and standards of practice change, therefore, we should be notified to review and update the report and its recommendations if construction does not commence within 3 years of the date it was issued.

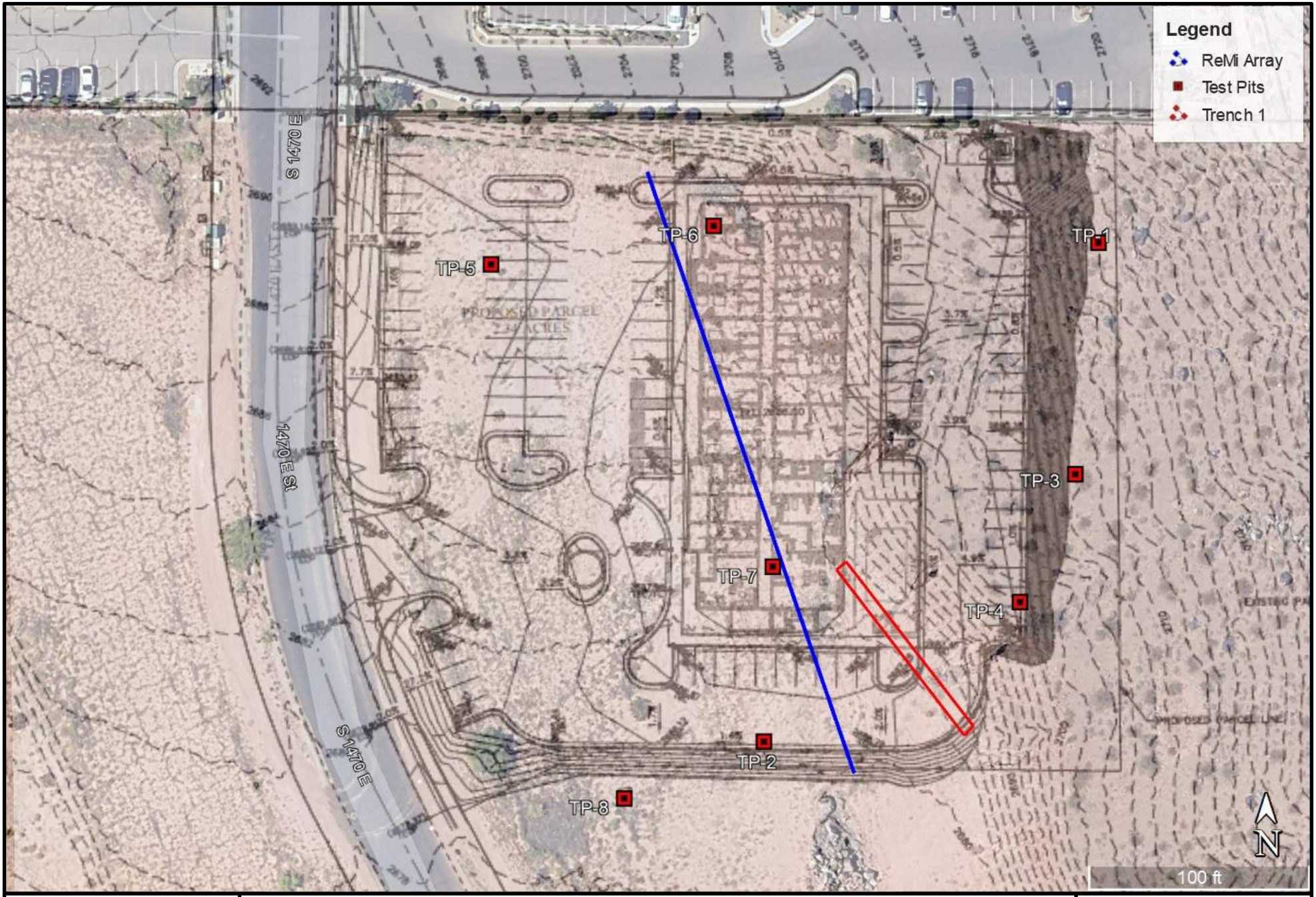
LANDMARK TESTING & ENGINEERING

Chad S. Hardman, P.E.
Project Engineer

Reviewed by:
John M. Anderson
Project Engineer



LANDMARK TESTING & ENGINEERING	**Vicinity Map** Landmark Project No 240016	Figure A-1

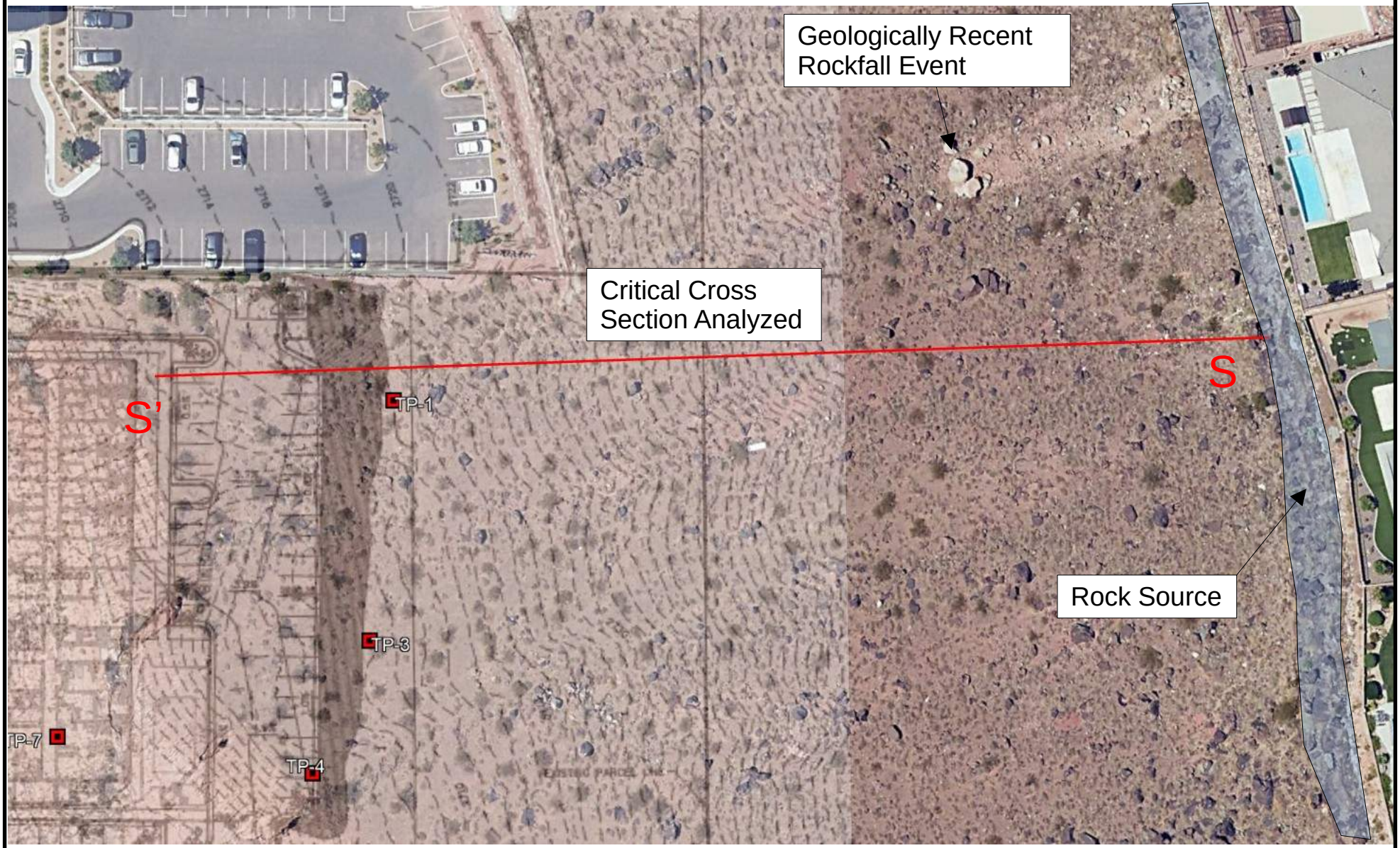


LANDMARK TESTING & ENGINEERING

Site Plan

Landmark Project No 240016

Figure A-2



LANDMARK TESTING & ENGINEERING

Rockfall and Slope Stability Site Map

Landmark Project No 240016

Figure A-3

TEST PIT NUMBER TP-1

DATE: 2024-01-23
LOGGED BY: Micheal Meyers
REVIEWED BY: Chad Hardman
NOTES:

EXCAVATOR: Quality Excavation
EQUIPMENT: CAT 336F
LATITUDE/LONGITUDE: 37.10027 -113.55046
GROUNDWATER: _____ feet below surface

Depth (ft)	Soil Symbol	Samples	Lithologic Description	Sample Dry Density (pcf)	Moisture (%)	Atterberg Limits LL (%)	Atterberg Limits PI (%)	Gravel (%)	Sand (%)	Fines (%)	Consolidation	Modified Proctor Max. Dry Density (pcf)	Optimum Moisture (%)	Water-Soluble Sulfate (%)	CBR
			Ground Surface												
0			**NATIVE: Clayey Gravel with Sand (GC)** Medium dense to dense, wet, reddish brown												
1			Slightly moist, scattered gravel cobbles and boulders, fine roots down to 2 feet, brown to reddish brown												
2			Dense, slightly moist, abundant gravel cobble and boulders, carbonate cementation weak to moderate, pinkish brown and white												
3															
4			Dense, slightly moist, abundant gravel cobbles and boulders, reddish brown to black												
5															
6		BG			5.6	36	18	57	21	22					
7															
8															
9															
10															
11															
12		BG	**Sandstone** Weathered to firm, dry to slightly moist, pinkish, springdale member												
13															
14															
15			TP-1 Terminated at 15'												
16															
17															
18															
19															
20															

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PROJECT NAME: @Home Best Western
Project Location: St. George, Utah
Project No.: 240016
Client: Home Hospitality Group

Figure A-4

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TEST PIT NUMBER TP-2

DATE: 2024-01-23
LOGGED BY: Micheal Meyers
REVIEWED BY: Chad Hardman
NOTES:

EXCAVATOR: Quality Excavation
EQUIPMENT: CAT 336F
LATITUDE/LONGITUDE: 37.10208 -113.55098
GROUNDWATER: _____ feet below surface

Depth (ft)	Soil Symbol	Samples	Lithologic Description	Sample Dry Density (pcf)	Moisture (%)	Atterberg Limits LL (%)	Atterberg Limits PI (%)	Gravel (%)	Sand (%)	Fines (%)	Consolidation	Modified Proctor Max. Dry Density (pcf)	Optimum Moisture (%)	Water-Soluble Sulfate (%)	CBR
			Ground Surface												
0			**NATIVE: Silty SAND (SM)**												
			Medium dense, slightly moist to moist, brown												
1			Slightly moist, brown to reddish brown												
			Silty Clayey SAND (SC-SM)												
2			Medium stiff/dense, slightly moist, brown to reddish brown												
3															
4		B										123.2	10.2		38.3
5															
6			**Sandstone**												
			Weathered to firm, dry to slightly moist, pinkish, springdale member												
7															
8			TP-2 Terminated at 8'												
			Practical Refusal on Sandstone Bedrock												
9															
10															
11															
12															
13															
14															
15															
16															
17															
18															
19															
20															

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PROJECT NAME: @Home Best Western
Project Location: St. George, Utah
Project No.: 240016
Client: Home Hospitality Group

Figure A-5

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TEST PIT NUMBER TP-3

DATE: 2024-01-23
LOGGED BY: Micheal Meyers
REVIEWED BY: Chad Hardman
NOTES:

EXCAVATOR: Quality Excavation
EQUIPMENT: CAT 336F
LATITUDE/LONGITUDE: 37.10241 -113.5505
GROUNDWATER: _____ feet below surface

Depth (ft)	Soil Symbol	Samples	Lithologic Description	Sample Dry Density (pcf)	Moisture (%)	Atterberg Limits LL (%)	Atterberg Limits PI (%)	Gravel (%)	Sand (%)	Fines (%)	Consolidation	Modified Proctor Max. Dry Density (pcf)	Optimum Moisture (%)	Water-Soluble Sulfate (%)	CBR
			Ground Surface												
0			**NATIVE: Silty SAND (SM)**												
1			Medium dense, moist, brown Slightly moist, fine roots down to 2.5 feet, gravel, brown to reddish brown												
2			**Lean CLAY (CL)** Medium stiff, slightly moist, weakly cemented carbonates, gravel cobbles and rare boulders, brown and light pink,												
3															
4			**Silty SAND with Gravel (SM)**												
5			Dense, slightly moist, fine to medium grained sand with gravel cobbles and boulders, brown to reddish brown, basalt boulders												
6															
7															
8															
9															
10		BLK	**Mudstone** Stiff, slightly moist, purple												
11			**Sandstone** Weathered to firm, slightly moist, pink												
12			TP-3 Terminated at 12' Practical Refusal on Sandstone Bedrock												
13															
14															
15															
16															
17															
18															
19															
20															

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PROJECT NAME: @Home Best Western
Project Location: St. George, Utah
Project No.: 240016
Client: Home Hospitality Group

Figure A-6

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TEST PIT NUMBER TP-4

DATE: 2024-01-23
LOGGED BY: Micheal Meyers
REVIEWED BY: Chad Hardman
NOTES:

EXCAVATOR: Quality Excavation
EQUIPMENT: CAT 336F
LATITUDE/LONGITUDE: 37.10225 -113.55058
GROUNDWATER: _____ feet below surface

Depth (ft)	Soil Symbol	Samples	Lithologic Description	Sample Dry Density (pcf)	Moisture (%)	Atterberg Limits LL (%)	Atterberg Limits PI (%)	Gravel (%)	Sand (%)	Fines (%)	Consolidation	Modified Proctor Max. Dry Density (pcf)	Optimum Moisture (%)	Water-Soluble Sulfate (%)	CBR
			Ground Surface												
0			**NATIVE: Silty SAND (SM)**												
1			Medium dense, moist to wet, brown Slightly moist, with gravel and cobbles, fine roots down to 4 feet, brown to reddish brown												
2			**Lean CLAY (CL)**												
3		BG	Medium stiff, slightly moist, with gravel and cobble, pinholes down to at least 5 feet, weakly cemented carbonate pockets, brown to white												
4															
5															
6		BLK													
7			**Silty SAND (SM)**												
8			Medium dense, slightly moist, with gravel and cobbles, brown to reddish brown												
9			Basalt boulders												
10															
11															
12		BG			3.7	20	4	11	47	42					
13			**Sandstone**												
14		BLK	Weathered to firm, dry to slightly moist, pink, springdale member												
15			TP-4 Terminated at 15'												
16															
17															
18															
19															
20															

LANDMARK TESTING & ENGINEERING EST 1998

PROJECT NAME: @Home Best Western
Project Location: St. George, Utah
Project No.: 240016
Client: Home Hospitality Group

Figure A-7

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TEST PIT NUMBER TP-5

DATE: 2024-01-23
LOGGED BY: Micheal Meyers
REVIEWED BY: Chad Hardman
NOTES:

EXCAVATOR: Quality Excavation
EQUIPMENT: CAT 336F
LATITUDE/LONGITUDE: 37.10268 -113.5514
GROUNDWATER: _____ feet below surface

Depth (ft)	Soil Symbol	Samples	Lithologic Description	Sample Dry Density (pcf)	Moisture (%)	Atterberg Limits LL (%)	Atterberg Limits PI (%)	Gravel (%)	Sand (%)	Fines (%)	Consolidation	Modified Proctor Max. Dry Density (pcf)	Optimum Moisture (%)	Water-Soluble Sulfate (%)	CBR
			Ground Surface												
0			**NATIVE: Silty SAND (SM)**												
1		BLK	Medium dense to dense, dry to slightly moist, yellow and white, pink sandstone, springdale member												
2															
3		BG			5.3	NP	NP	19	58	23					
			Silty SAND (SM)												
4			Dense, slightly moist, pink to light purple, sandstone springdale member												
5															
			Dense, slightly moist, light purple, sandstone sprindale member												
6															
7			TP-5 Terminated at 7' Practical Refusal on Sandstone Bedrock												
8															
9															
10															
11															
12															
13															
14															
15															
16															
17															
18															
19															
20															

LANDMARK TESTING & ENGINEERING EST 1998

PROJECT NAME: @Home Best Western
Project Location: St. George, Utah
Project No.: 240016
Client: Home Hospitality Group

Figure A-8

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TEST PIT NUMBER TP-6

DATE: 2024-01-23
LOGGED BY: Micheal Meyers
REVIEWED BY: Chad Hardman
NOTES:

EXCAVATOR: Quality Excavation
EQUIPMENT: CAT 336F
LATITUDE/LONGITUDE: 37.10272 -113.55106
GROUNDWATER: _____ feet below surface

Depth (ft)	Soil Symbol	Samples	Lithologic Description	Sample Dry Density (pcf)	Moisture (%)	Atterberg Limits LL (%)	Atterberg Limits PI (%)	Gravel (%)	Sand (%)	Fines (%)	Consolidation	Modified Proctor Max. Dry Density (pcf)	Optimum Moisture (%)	Water-Soluble Sulfate (%)	CBR
			Ground Surface												
0			**NATIVE: Silty SAND (SM)** Medium dense, slightly moist, some gravel cobbles and weathered sandstone, brown to reddish brown												
2		M		89.4	4.4						4.1% C @ 1540				
6		BLK	**Sandstone** Weathered to firm, dry to slightly moist, light pink to white, springdale member												
7			TP-6 Terminated at 7' Practical Refusal on Sandstone Bedrock												

PROJECT NAME: @Home Best Western
Project Location: St. George, Utah
Project No.: 240016
Client: Home Hospitality Group

Figure A-9

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TEST PIT NUMBER TP-7

DATE: 2024-01-23
LOGGED BY: Micheal Meyers
REVIEWED BY: Chad Hardman
NOTES:

EXCAVATOR: Quality Excavation
EQUIPMENT: CAT 336F
LATITUDE/LONGITUDE: 37.10229 -113.55096
GROUNDWATER: _____ feet below surface

Depth (ft)	Soil Symbol	Samples	Lithologic Description	Sample Dry Density (pcf)	Moisture (%)	Atterberg Limits LL (%)	Atterberg Limits PI (%)	Gravel (%)	Sand (%)	Fines (%)	Consolidation	Modified Proctor Max. Dry Density (pcf)	Optimum Moisture (%)	Water-Soluble Sulfate (%)	CBR
			Ground Surface												
0		BLK	**NATIVE: Silty SAND (SM)** Medium dense, slightly moist, interbedded silts and clays, abundant pinholes in fines down to 5 feet, minor basalt boulders 5 feet wide, reddish brown to grey to dark purple											1.89	
5		BG	**Sandstone** Firm, dry to slightly moist, light pink and purple												
8			TP-7 Terminated at 8.5' Practical Refusal on Bedrock												
20															

PROJECT NAME: @Home Best Western
Project Location: St. George, Utah
Project No.: 240016
Client: Home Hospitality Group

Figure A-10

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TEST PIT NUMBER TP-8

DATE: 2024-01-23
LOGGED BY: Micheal Meyers
REVIEWED BY: Chad Hardman
NOTES:

EXCAVATOR: Quality Excavation
EQUIPMENT: CAT 336F
LATITUDE/LONGITUDE: 37.10201 -113.5512
GROUNDWATER: _____ feet below surface

Depth (ft)	Soil Symbol	Samples	Lithologic Description	Sample Dry Density (pcf)	Moisture (%)	Atterberg Limits LL (%)	Atterberg Limits PI (%)	Gravel (%)	Sand (%)	Fines (%)	Consolidation	Modified Proctor Max. Dry Density (pcf)	Optimum Moisture (%)	Water-Soluble Sulfate (%)	CBR
			Ground Surface												
0			**NATIVE: Silty SAND with Gravel (SM)**												
1			Medium dense, moist, brown Slightly moist, fine roots down to 2 feet, brown to reddish brown												
2			**Sandstone**												
3			Weathered to firm, dry to slightly moist, light pink, springdale member												
4			Weathered to firm, dry to slightly moist, purple												
5		BG													
6															
7															
8															
9			TP-8 Terminated at 9' Practical Refusal on Bedrock												
10															
11															
12															
13															
14															
15															
16															
17															
18															
19															
20															

LANDMARK TESTING & ENGINEERING EST 1998

PROJECT NAME: @Home Best Western
Project Location: St. George, Utah
Project No.: 240016
Client: Home Hospitality Group

Figure A-11

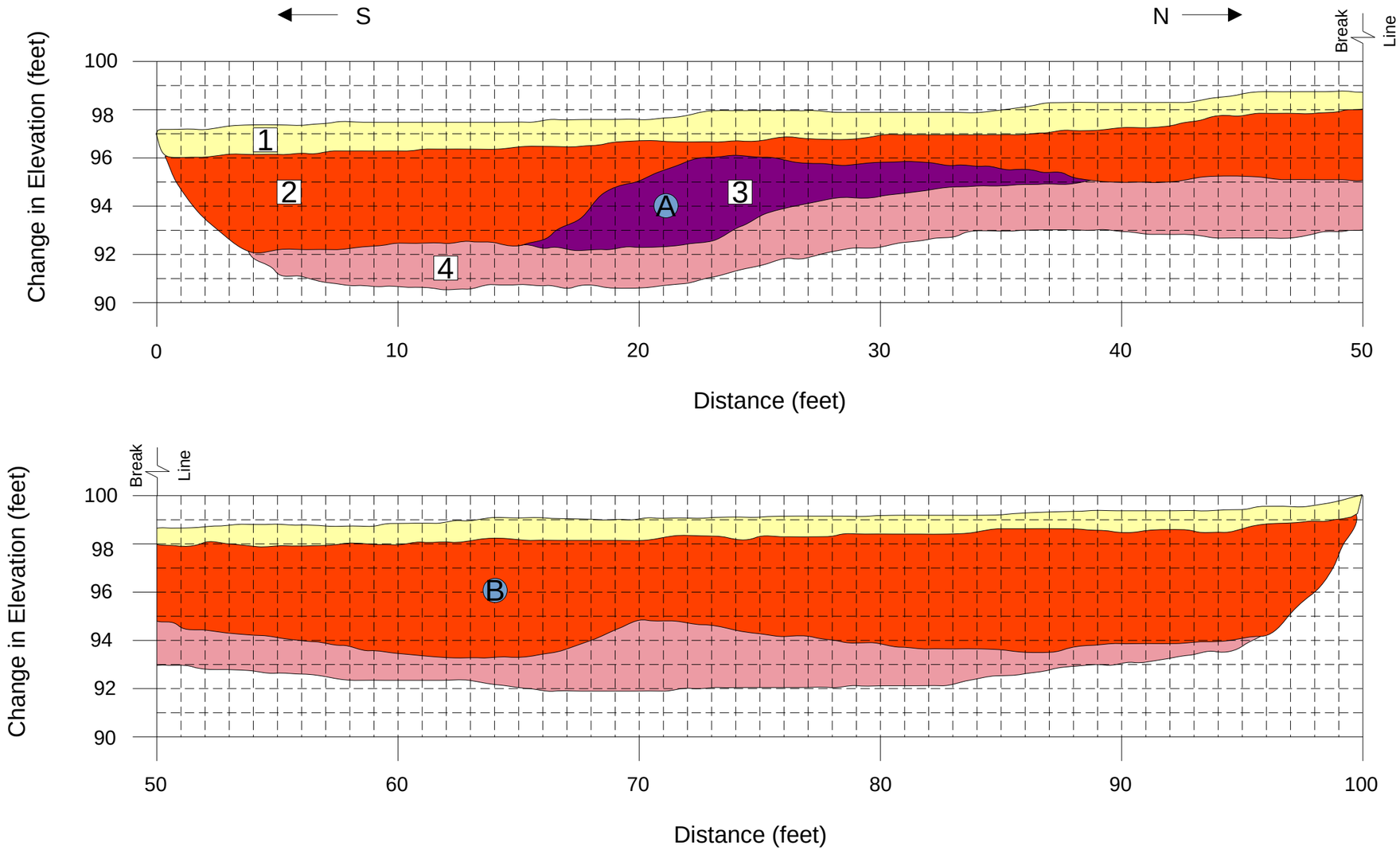

Image 1: Photograph of trench wall from approximately 0+15 to 0+25.

Soil Types

1. Fill: Silty Sand (SM), medium dense, slightly moist, fine to medium grained sand, brown to red brown
2. Native: Silty Sand (SM), medium dense, slightly moist, fine to medium grained, brown to red brown
3. Lean Clay (CL), medium stiff, slightly moist, fine to medium grained, purple and gray
4. Sandstone, weathered to firm, dry to slightly moist, fine to medium grained, light pink and white

Sample Locations

A. 0+21 at 3.5 ft
B. 0+64 at 3.0 ft

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Trench 1

Landmark Project No 240016

Figure A-12

UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS		SYMBOLS	TYPICAL NAMES
COARSE-GRAINED SOILS (More than 50% of soil Retained on No. 200 sieve size)	GRAVELS More than 1/2 of coarse fraction > No.4 sieve size	GW	Well graded gravels or gravel-sand mixtures little or no fines.
		GP	Poorly graded gravels or gravel-sand mixtures little or no fines.
		GM	Silty gravels, gravel-sand-silt mixtures
		GC	Clayey gravels, gravel-sand-clay mixtures
	SANDS More than 1/2 of coarse fraction < No.4 sieve size	SW	Well graded sands or gravelly sand mixtures little or no fines.
		SP	Poorly graded sands or gravelly sand mixtures little or no fines.
		SM	Silty sands, sand-silt mixtures
		SC	Clayey sands, sand-clay mixtures
FINE-GRAINED SOILS (Less than 50% of soil Retained on No. 200 sieve size)	SILTS & CLAYS Liquid Limit < 50	ML	Inorganic silts and very fine sands, rock flour, silty fine sands or clayey silts with slight plasticity
		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
		OL	Organic silts and organic silty clays of low plasticity
	SILTS & CLAYS Liquid Limit > 50	MH	Inorganic silts, micaceous of diatomaceous fine sand or silty soils, elastic silts
		CH	Inorganic clays of high plasticity, fat clays
		OH	Organic clays of medium to high plasticity, organic silty clays, organic silts
HIGHLY ORGANIC SOILS		PT	Peat and other highly organic soils

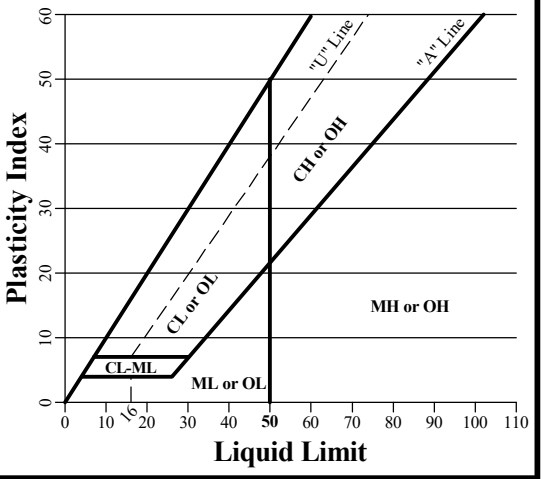
GRAIN SIZE CHART

CLASSIFICATION	Range of Grain Size	
	U.S. Standard Sieve Size	Grain Size in Millimeters
BOULDERS	**Above 12"**	**Above 305**
COBBLES	**12" to 3"**	**305 to 76.2**
GRAVEL	**3" to No. 4**	**76.2 to 4.76**
Coarse	3" to 3/4"	76.2 to 19.1
Fine	3/4" to No. 4	19.1 to 4.76
SAND	**No. 4 to No. 200**	**4.76 to 0.074**
Coarse	No. 4 to No. 10	4.76 to 2.00
Medium	No. 10 to No. 40	2.00 to 0.42
Fine	No. 40 to No. 200	0.420 to 0.074
SILT & CLAY	Below No. 200	Below 0.074

SAMPLES

- Relatively Undisturbed Sample
- Block Sample
- Bag Sample
- Auger Cuttings
- B — Bucket Sample
- Core
- No Recovery

PLASTICITY CURVE



Landmark Testing & Engineering
795 Factory Drive
St. George, UT 84790
Telephone: 435-986-0566
Website: www.landmarktesting.com

Figure A-13

LANDMARK TESTING & ENGINEERING

SUMMARY OF LABORATORY TEST RESULTS

Client: Home Hospitality Group
107 S 1470 E, Ste 302
St George, UT 84790

Date of Report: 3/5/2024

Project: @Home Best Western

Project #: 240016

Location: St. George, Utah

Boring / Test Pit Number	Depth Below Ground Surface (ft)	Moisture Content (%)	In-Place Dry Desnity (pcf)	Mechanical Gradation			Atterberg Limits		Swell-Consolidation Swell/Collapse @ Wetting Load (S/C @ ksf)	Modified Proctor / CBR			Percent Finer Than 0.02 mm (%)	Unconfined Compressive Strength (psf)	Soluble Sulfate Content (%)	USCS Group Symbol	AASHTO Soil Classification
				Gravel (%)	Sand (%)	Fines (%)	Liquid Limit	Plasticity Index		Maximum Dry Density (pcf)	Optimum Moisture Content (%)	CBR Value					
TP-1	6.0	5.6		57	21	22	36	18								GC	A-2-6(0)
TP-2	Bulk									123.2	10.2	38					
TP-4	12.0	3.7		11	47	42	20	4								SC-SM	A-4(0)
TP-5	3.0	5.3		19	58	23	NP	NP								SM	A-2-4(0)
TP-6	2.0	4.4	89.4						4.1%C @ 1.5ksf								
TP-7	1.5														1.89		

TABLE B-1

PROCTOR REPORT

Client: Home Hospitality Group
107 S 1470 E, Ste 302
St George, UT 84790

Date of Report: 1/29/2024
Reviewed By: Z. Girsberger
Lab#: 24SG0572

Project: @Home Best Western **Project #:** 240016
Location: St George **Sampled By:** M. Meyers **Date:** 1/23/2024
Type of Sample: Red Brown Silty Sand with Sandstone Gravel **Tested By:** J. Wells **Date:** 1/29/2024
Location of Sample: Test Pit 2 at Bulk **Authorized By:** Client **Date:** 1/23/2024

Proctor Data	
Hammer Weight:	10 pounds
Hammer Drop:	18 inches
Number of Layers:	5 layers
Blows per Layer:	56 blows
Mold Size (cu. Ft.):	0.075
% Oversized:	2.0
Oversize Sp. G.:	N/A
ZAV Sp. G.:	2.53
Test Performed on Material Passing:	3/4 in.Sieve

Point	1	2	3	4	5	6
% Moisture	6.0	7.9	10.1	11.6		
Dry Density	117.2	120.4	123.2	121.2		

Test Results	
Maximum Dry Density, Lbs/ft^3	**123.2**
Optimum Moisture, %	**10.2**
Test Standard	**ASTM D 1557**
Method	**Method C**

SOIL CLASSIFICATION REPORT

Client: Home Hospitality Group
107 S 1470 E, Ste 302
St George, UT 84790

Date of Report: 2/1/2024
Reviewed By: Z. Girsberger
Lab#: 24SG0568

Project: @Home Best Western **Project #:** 240016
Location: St George **Sampled By:** M. Meyers **Date:** 1/23/2024
Type of Sample: Brown Silty, Clayey Sand **Tested By:** A. Pay **Date:** 1/31/2024
Location of Sample: Test Pit 4 at 12.0 **Authorized By:** Client **Date:** 1/23/2024

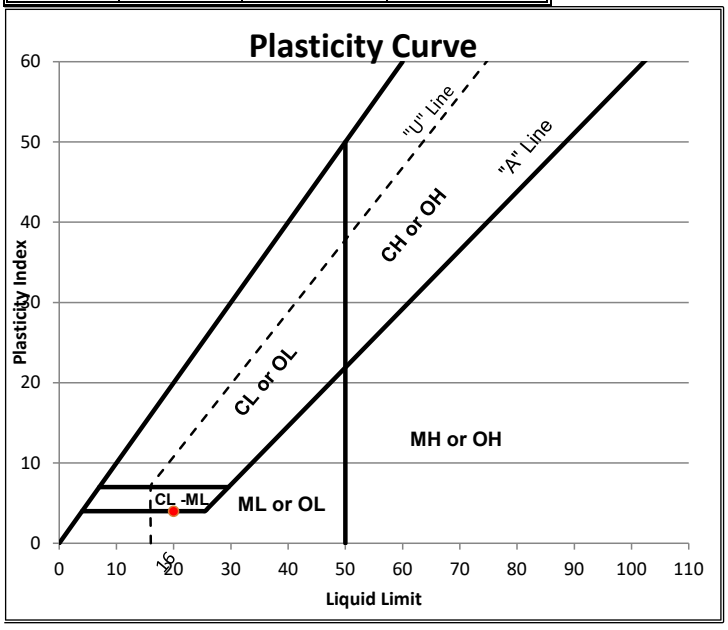
Sieve Analysis , ASTM C136 and C117

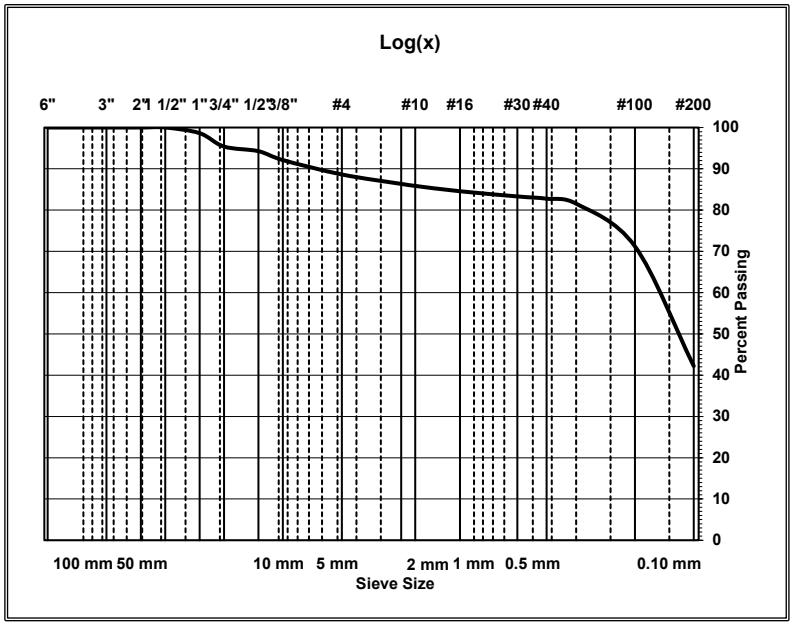
Sieve Size		% Passing Cumulative	Specification
150 mm	6"		
75 mm	3"		
50 mm	2"		
37.5 mm	1-1/2"	100	
25 mm	1"	99	
19 mm	3/4"	95	
12.5 mm	1/2"	94	
9.5 mm	3/8"	92	
4.75 mm	#4	89	
2.00 mm	#10	86	
1.18 mm	#16	85	
425 µm	#40	83	
300 µm	#50	82	
75 µm	#200	42.2	

Test	Result	Specification	Test Standard
Natural Moisture Content, %	3.7		ASTM D 2216
Liquid Limit	20		ASTM D 4318
Plasticity Index	4		ASTM D 4318
Unified Classification System	SC-SM		ASTM D 2487
AASHTO Classification System	A-4(0)		AASHTO M145

% Cobble > 3"	% Gravel < 3" - #4	% Sand < #4 - #200	% Silt-Clay < #200
0.0	11.0	46.8	42.2

Diameter D_{60}	Diameter D_{30}	Diameter D_{10}	Coefficient of Uniformity, C_U	Coefficient of Concavity, C_C





SOIL CLASSIFICATION REPORT

Client: Home Hospitality Group
107 S 1470 E, Ste 302
St George, UT 84790

Date of Report: 1/30/2024
Reviewed By: Z. Girsberger
Lab#: 24SG0569

Project: @Home Best Western **Project #:** 240016
Location: St George **Sampled By:** M. Meyers **Date:** 1/23/2024
Type of Sample: Purple Silty Sand with Gravel **Tested By:** A. Pay **Date:** 1/30/2024
Location of Sample: Test Pit 5 at 3.0 **Authorized By:** Client **Date:** 1/23/2024

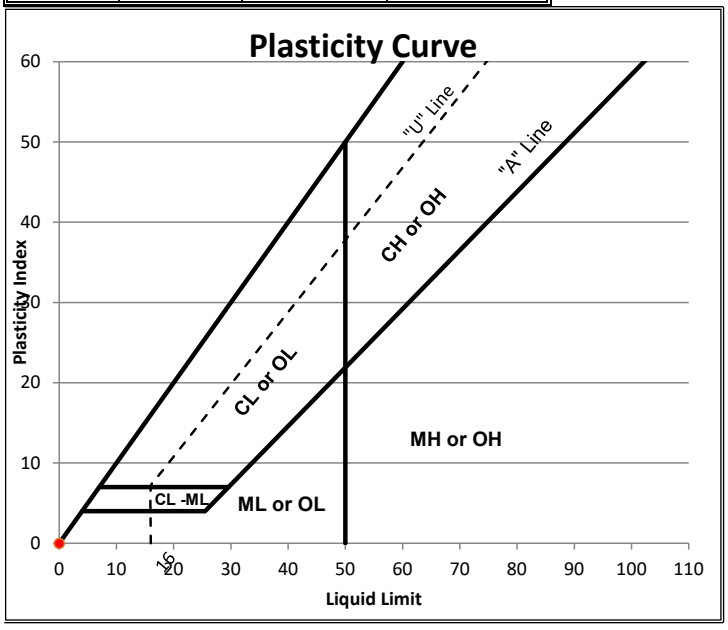
Sieve Analysis , ASTM C136 and C117

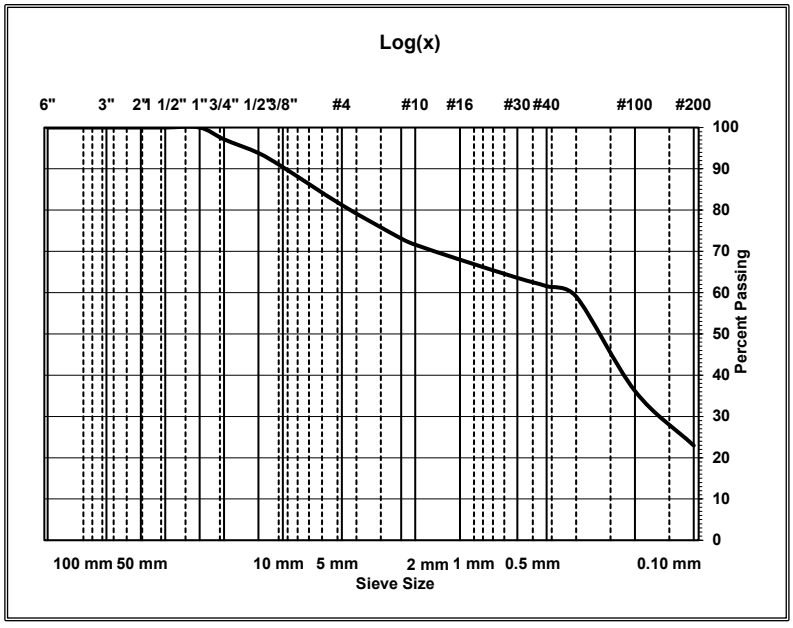
Sieve Size		% Passing Cumulative	Specification
150 mm	6"		
75 mm	3"		
50 mm	2"		
37.5 mm	1-1/2"		
25 mm	1"	100	
19 mm	3/4"	97	
12.5 mm	1/2"	94	
9.5 mm	3/8"	90	
4.75 mm	#4	81	
2.00 mm	#10	72	
1.18 mm	#16	68	
425 µm	#40	62	
300 µm	#50	59	
75 µm	#200	22.9	

Test	Result	Specification	Test Standard
Natural Moisture Content, %	5.3		ASTM D 2216
Liquid Limit	NP		ASTM D 4318
Plasticity Index	NP		ASTM D 4318
Unified Classification System	SM		ASTM D 2487
AASHTO Classification System	A-2-4(0)		AASHTO M145

% Cobble > 3"	% Gravel < 3" - #4	% Sand < #4 - #200	% Silt-Clay < #200
0.0	19.0	58.1	22.9

Diameter D_{60}	Diameter D_{30}	Diameter D_{10}	Coefficient of Uniformity, C_U	Coefficient of Concavity, C_C





SOIL CLASSIFICATION REPORT

Client: Home Hospitality Group
107 S 1470 E, Ste 302
St George, UT 84790

Date of Report: 3/4/2024
Reviewed By: Chad Hardman
Lab#: 24SG1305

Project: @Home Best Western **Project #:** 240016
Location: St George **Sampled By:** M. Meyers **Date:** 1/23/2024
Type of Sample: Red-Brown Clayey Gravel with Sand **Tested By:** A. Pay **Date:** 3/4/2024
Location of Sample: Test Pit 1 at 6' **Authorized By:** Client **Date:** 1/23/2024

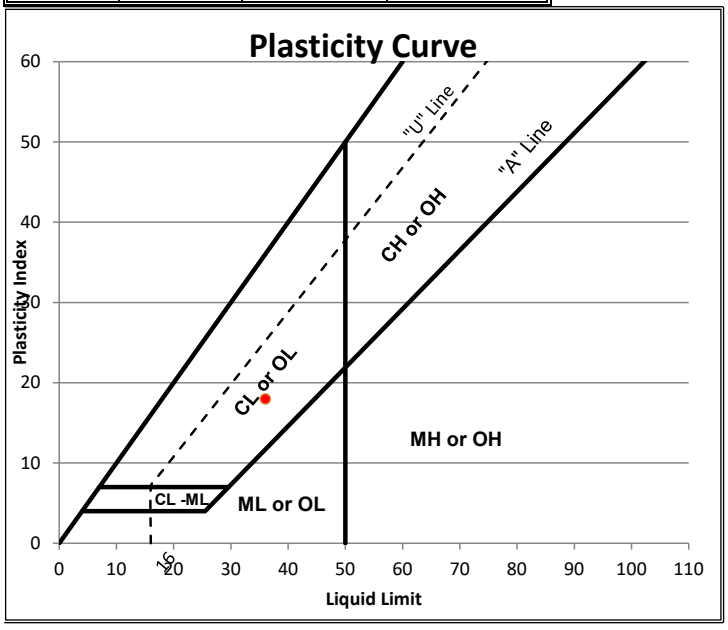
Sieve Analysis , ASTM C136 and C117

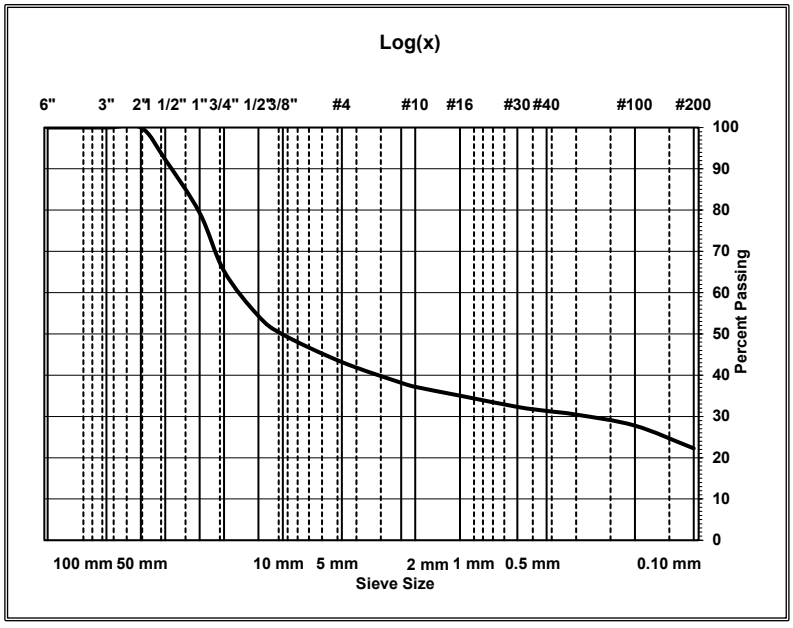
Sieve Size		% Passing Cumulative	Specification
150 mm	6"		
75 mm	3"		
50 mm	2"	100	
37.5 mm	1-1/2"	92	
25 mm	1"	79	
19 mm	3/4"	65	
12.5 mm	1/2"	54	
9.5 mm	3/8"	50	
4.75 mm	#4	43	
2.00 mm	#10	37	
1.18 mm	#16	35	
425 µm	#40	31	
300 µm	#50	30	
75 µm	#200	22.3	

Test	Result	Specification	Test Standard
Natural Moisture Content, %	5.6		ASTM D 2216
Liquid Limit	36		ASTM D 4318
Plasticity Index	18		ASTM D 4318
Unified Classification System	GC		ASTM D 2487
AASHTO Classification System	A-2-6(0)		AASHTO M145

% Cobble > 3"	% Gravel < 3" - #4	% Sand < #4 - #200	% Silt-Clay < #200
0.0	57.0	20.7	22.3

Diameter D_{60}	Diameter D_{30}	Diameter D_{10}	Coefficient of Uniformity, C_U	Coefficient of Concavity, C_C





LANDMARK TESTING & ENGINEERING

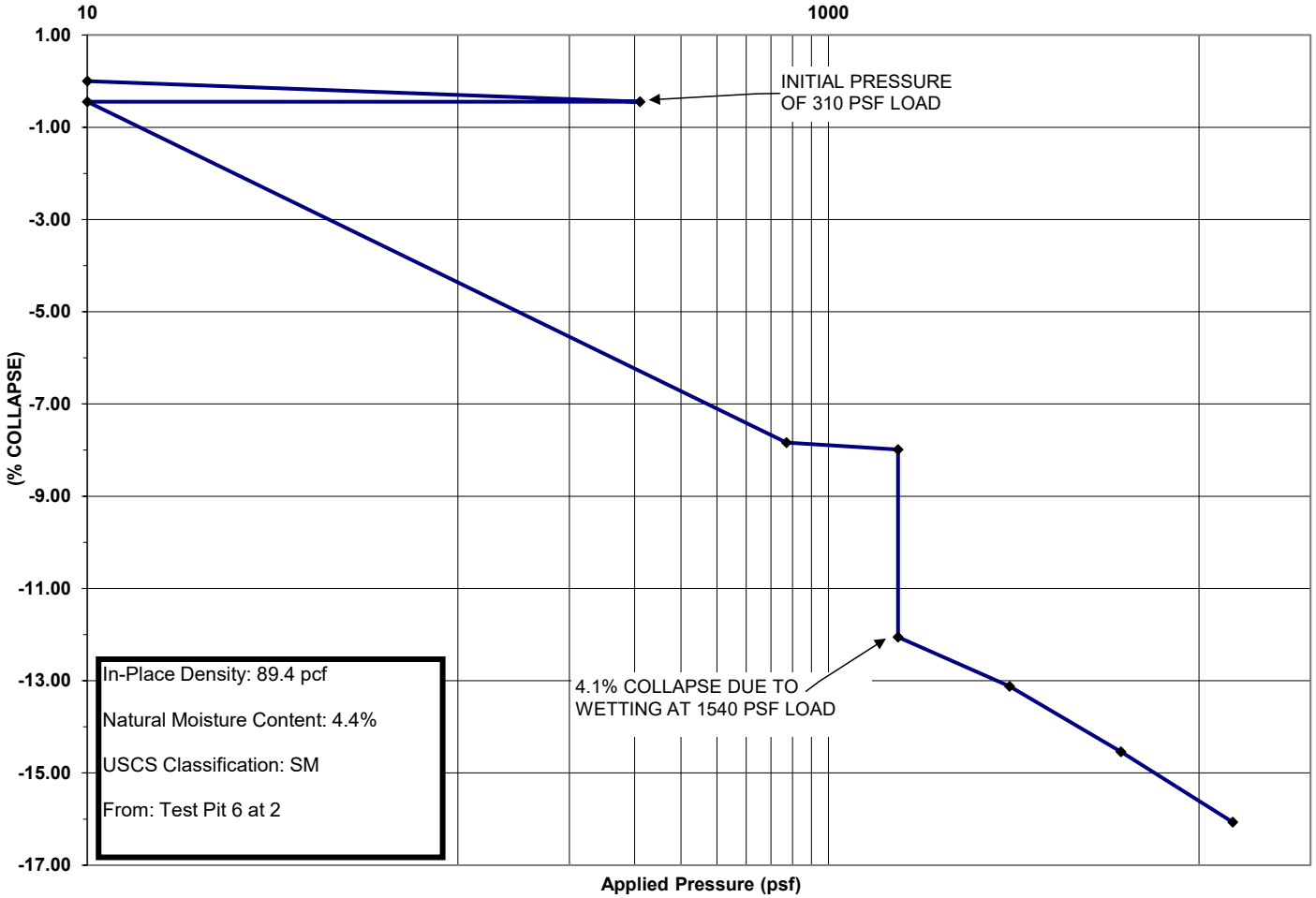
CONSOLIDATION REPORT

Client: Home Hospitality Group
107 S 1470 E, Ste 302
St George, UT 84790

Date of Report: 2/1/2024
Reviewed By: Z. Girsberger
Lab#: 24SG0570

Project: @Home Best Western **Project #:** 240016
Location: St George **Sampled By:** M. Meyers **Date:** 1/23/2024
Type of Sample: SM **Tested By:** J. Bracken **Date:** 1/26/2023
Location of Sample: Test Pit 6 at 2 **Authorized By:** Client **Date:** 1/23/2024

COLLAPSE/SWELL CURVE



CALIFORNIA BEARING RATIO

Client: Home Hospitality Group
107 S 1470 E, Ste 302
St George, UT 84790

Date of Report: 2/2/2024
Reviewed By: Z. Girsberger
Lab#: 24SG0572

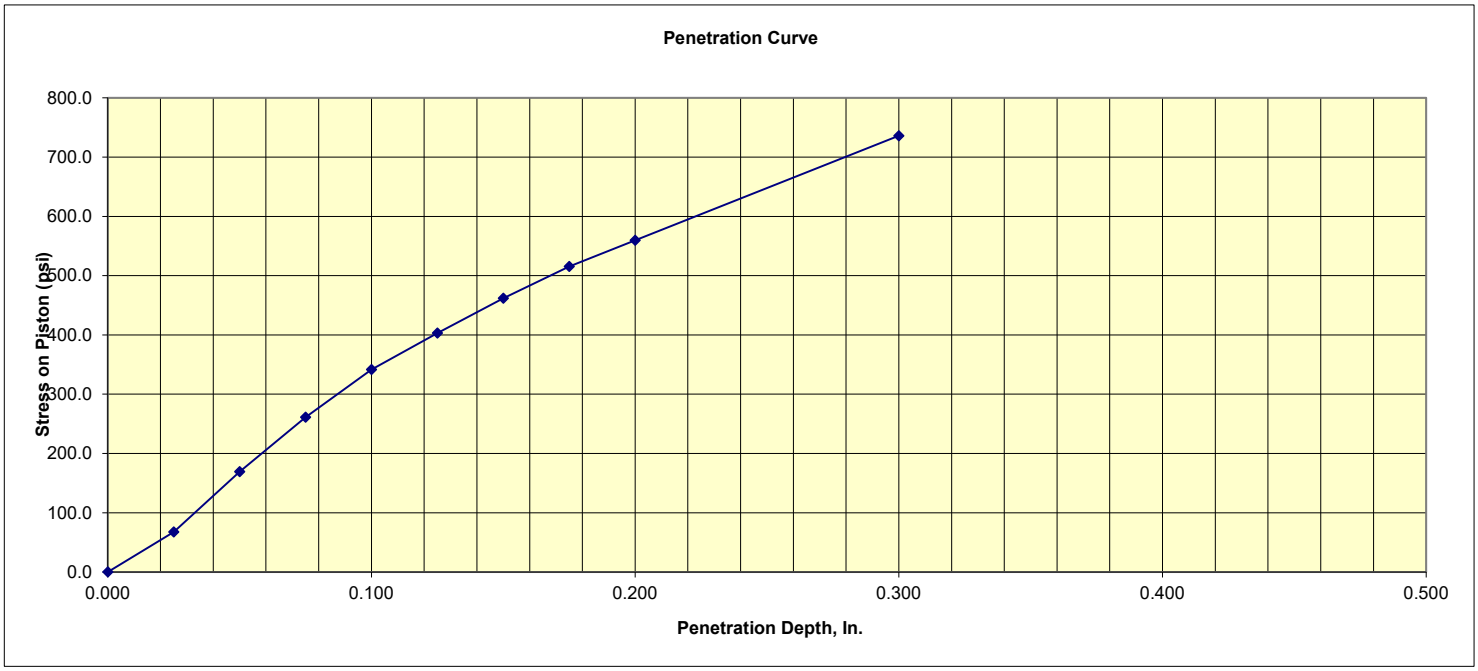
Project: @Home Best Western **Project #:** 240016
Location: St George **Sampled By:** M. Meyers **Date:** 1/23/2024
Type of Sample: Red Brown Silty Sand with Sandstone Gravel **Tested By:** J. Wells **Date:** 1/29/2024
Location of Sample: Test Pit 2 at Bulk **Authorized By:** Client **Date:** 1/23/2024

SOIL DATA		
Max. Dry Density:	123.2	<
Optimum Moisture:	10.2	<
Test Standard	ASTM D 1557	
% +3/4" Replaced	2.0	<

CBR RESULTS	
0.10 in. penetration:	36.2
0.20 in. penetration:	38.3

SPECIFICATION	
0.20 in penetration:	

CALIFORNIA BEARING RATIO, ASTM D 1883			
MOLDED		**SOAKED**	
% Moisture Before:	9.1	**Average % Moisture:**	11.8
% Moisture After:	9.1	**Top 1" % Moisture:**	11.8
Dry Density:	123.0	**Dry Density:**	121.6
% of Max. Density:	99.9	**% of Max. Density:**	98.7
# Blows / Lift:	56 / 5	**Percent Swell:**	0.5
Surcharge, lbs:	10	**Linearity Correction:**	0.008



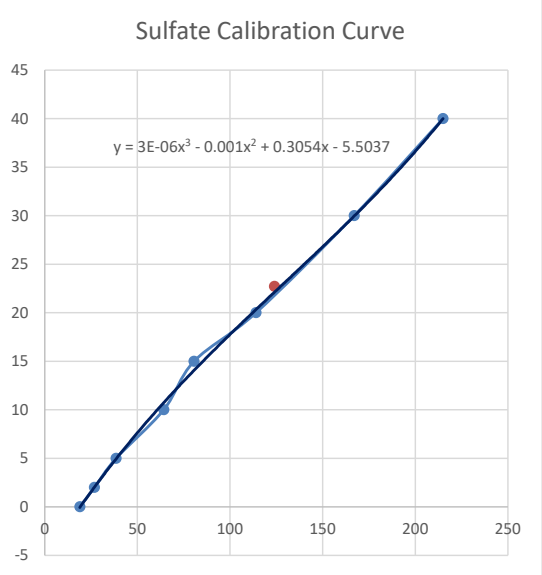
WATER-SOLUBLE SULFATE IN SOIL

Client: Home Hospitality Group
107 S 1470 E, Ste 302
St George, UT 84790

Date of Report: 1/31/2024
Reviewed By: Z. Girsberger
Lab#: 24SG0571

Project: @Home Best Western **Project #:** 240016
Location: St George **Sampled By:** M. Meyers **Date:** 1/23/2024
Type of Sample: Red-Brown Silty Sand **Tested By:** A. pay **Date:** 1/30/2024
Location of Sample: Test Pit 7 at 1.5' **Authorized By:** Client **Date:** 1/23/2024

Test	Result %	Exposure Class	Test Standard
Percent Water-Soluble Sulfate in Soil	1.89	S2	ASTM C1580



Hilton Home2 Suites - North Line Shear-Wave Velocity Report
Hilton Home2 Suites Terēan VsSurf ReMi™ 2.1 Software

Array Location

Datum:	UTM Zone 12N NAD83
Site Name:	**Hilton Home2 Suites - North Line**
Center:	4109275.0, -273346.0
Geophone 1:	4109264.0, -273308.0
Geophone6:	4109287.0, -273391.0

Results

Vs100:	**1,756 ft/s**
IBC Site Class:	C
IBC Version:	IBC 2018
ASCE:	ASCE 7-16
Depth:	**65.6 feet**

Survey Parameters

Geophone Count:	6
Geophone Spacing:	26.25 feet
Array Length:	131 feet
Survey Date:	Jan 19, 2024
Performed By:	Landmark Testing & Engineering
Analysis By:	SteveW
Analysis Date:	Mon Jan 22 20:13:20 MST 2024

Narrative

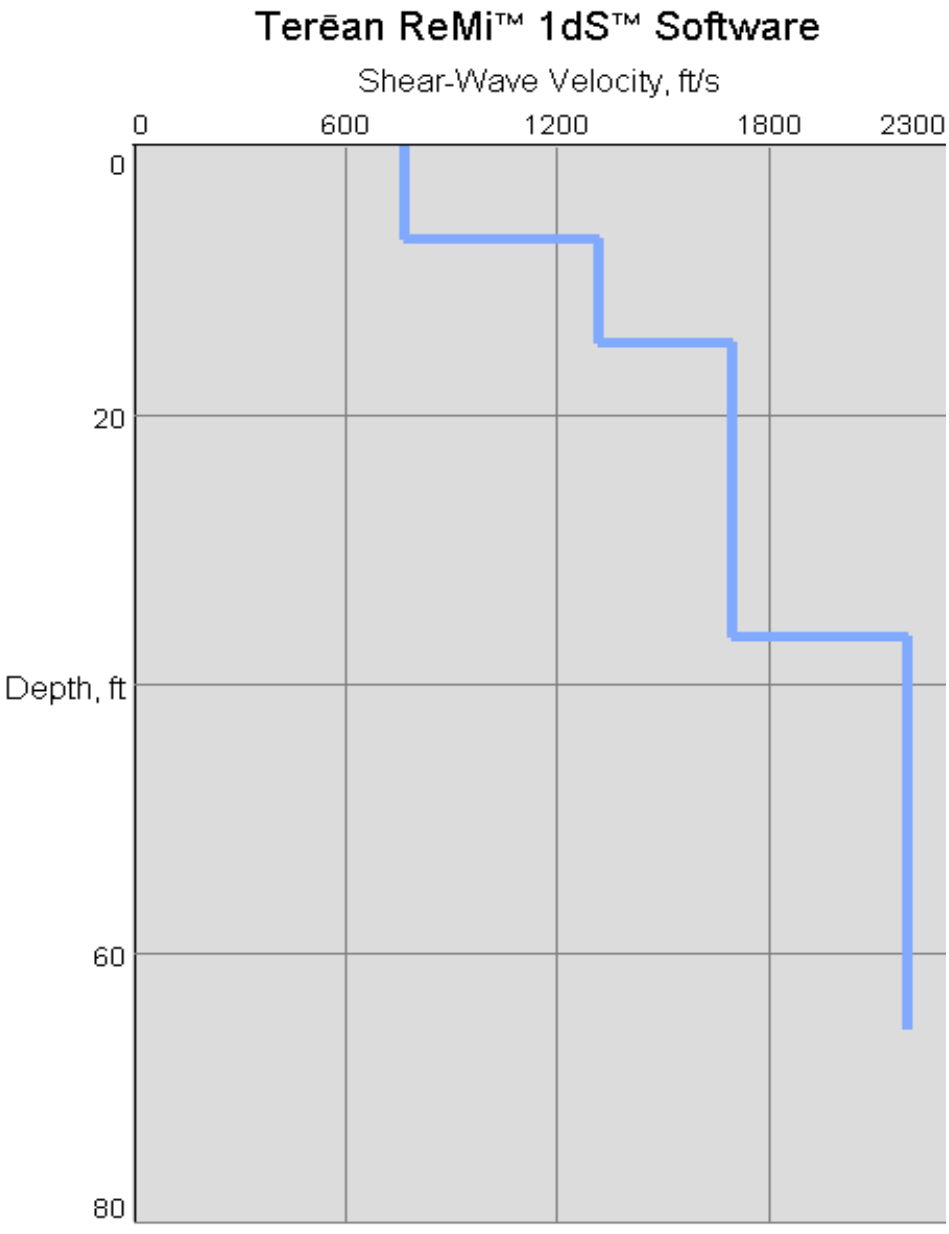
SHEAR WAVE VELOCITIES AND SEISMIC SITE CLASS

Landmark Testing & Engineering's geophysical site evaluation included subsurface seismic imaging and earthquake ground shaking potential evaluation using Terēan's VsSurf ReMi™ seismic data processing software. Seismic surveys were performed to evaluate depth to bedrock and the seismic site class per IBC 2018 and ASCE 7-16 using the weighted-average soil shear wave velocity for the upper 100 feet (Vs100). The surveys were performed by recording active and/or ambient (passive) seismic sources. The seismic recording array for these surveys consisted of 6, 4.5-Hz geophones at a 26.25 feet (8 m, 26.25 ft) spacing for a total survey length of 131 feet. Noise generated by walking and hammer hits along the survey line during data acquisition while ambient noise was generated from traffic along the nearby roads. The seismic data were acquired using a ReMiDAQ™ 4-12 seismograph (terean.com/products), while data was processed using Terēan's ReMi™ software. Survey results indicate a weighted-average soil shear wave velocity of the upper 100 feet (Vs100) of 1,756 ft/s. This results in a designation of a Seismic Site Class C according to Table ASCE 7-16.

Hilton Home2 Suites - North Line
Hilton Home2 Suites

Shear-Wave Velocity Report
Terēan VsSurf ReMi™ 2.1 Software

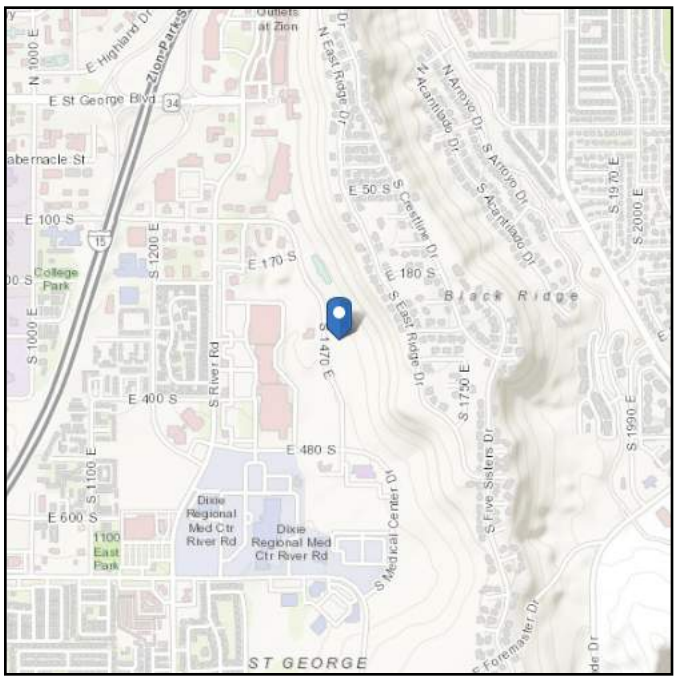
Depth (ft)	Vs (ft/s)
0.0	765
6.8	765
6.8	1,314
14.6	1,314
14.6	1,694
36.4	1,694
36.4	2,187
364.5	2,187



ASCE Hazards Report

Address:
No Address at This Location

Standard:	ASCE/SEI 7-16	**Latitude:**	37.102952
Risk Category:	II	**Longitude:**	-113.551219
Soil Class:	C - Very Dense Soil and Soft Rock	**Elevation:**	0 ft (NAVD 88)



Seismic

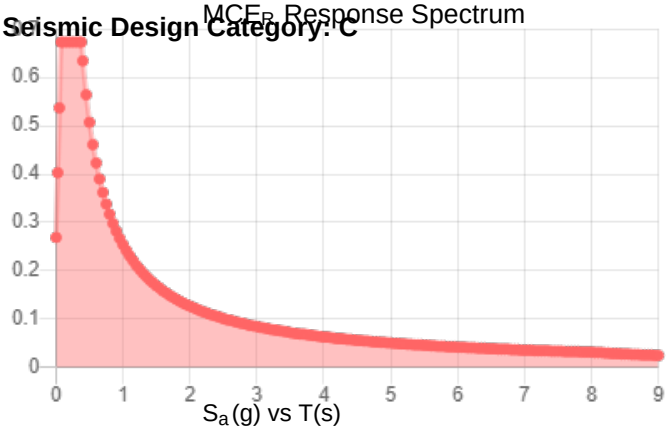
Site Soil Class: C - Very Dense Soil and Soft Rock

Results:

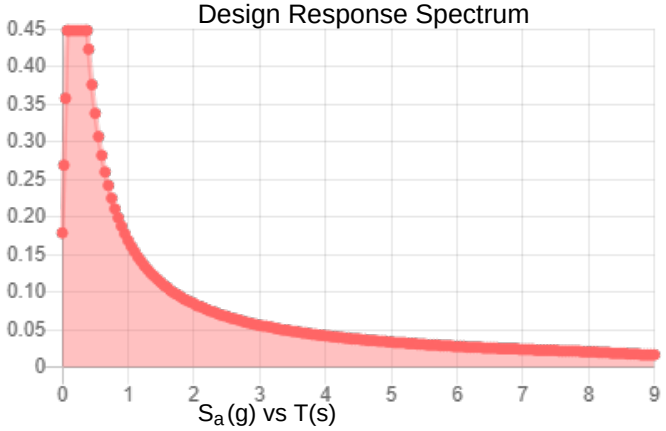
S_S :	0.521	S_{D1} :	0.169
S_1 :	0.169	T_L :	8
F_a :	1.292	PGA :	0.229
F_v :	1.5	PGA_M :	0.275
S_{MS} :	0.673	F_{PGA} :	1.2
S_{M1} :	0.254	I_e :	1
S_{DS} :	0.448	C_v :	0.947

Seismic Design Category: C

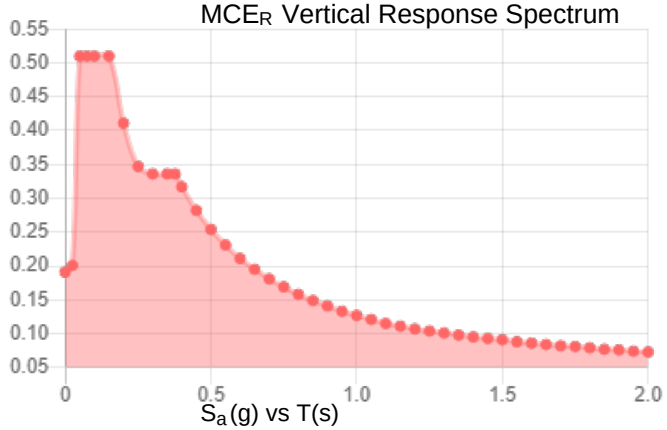
MCE_R Response Spectrum



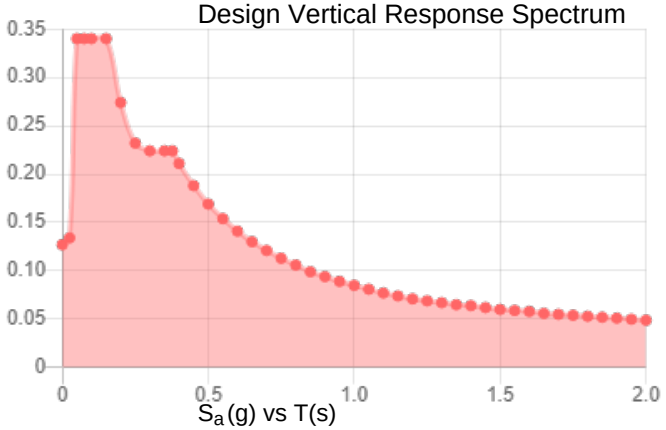
Design Response Spectrum



MCE_R Vertical Response Spectrum



Design Vertical Response Spectrum



Data Accessed: Mon Feb 05 2024

Date Source:

USGS Seismic Design Maps based on ASCE/SEI 7-16 and ASCE/SEI 7-16 Table 1.5-2. Additional data for site-specific ground motion procedures in accordance with ASCE/SEI 7-16 Ch. 21 are available from USGS.

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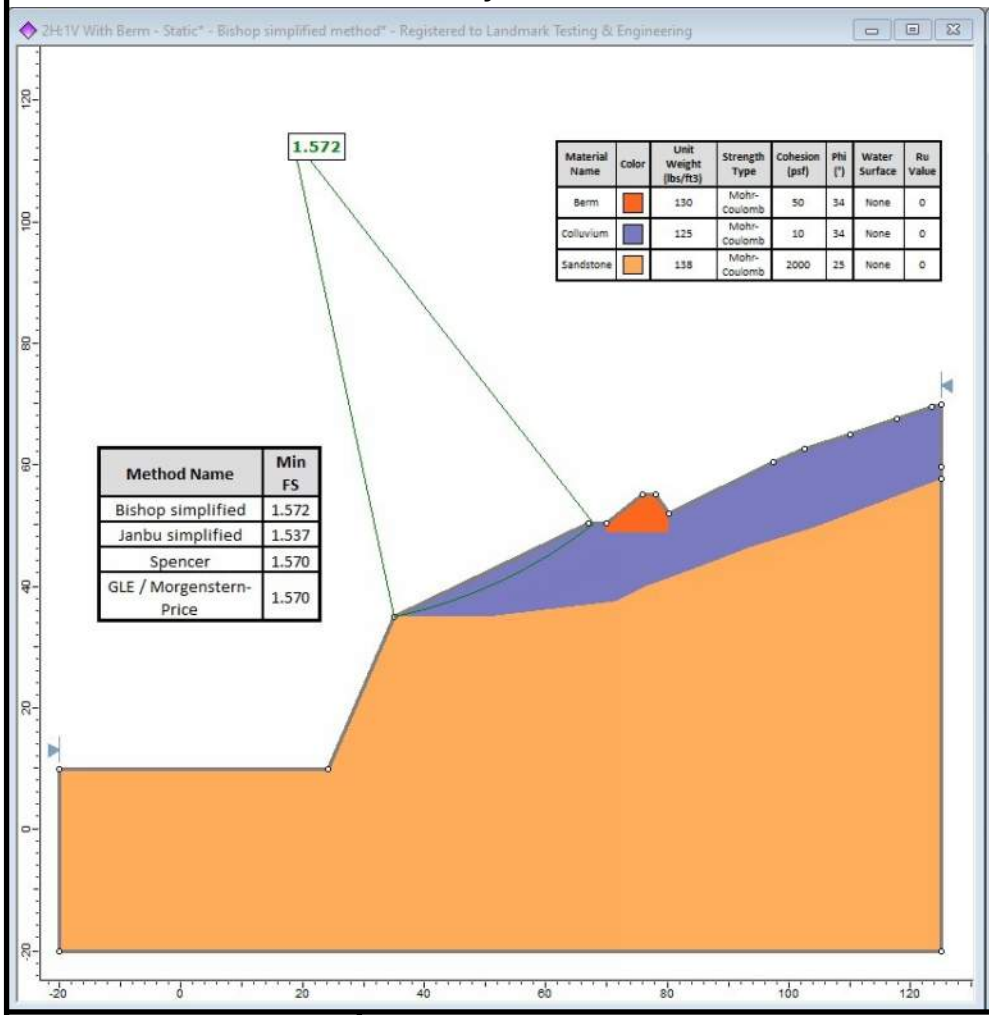
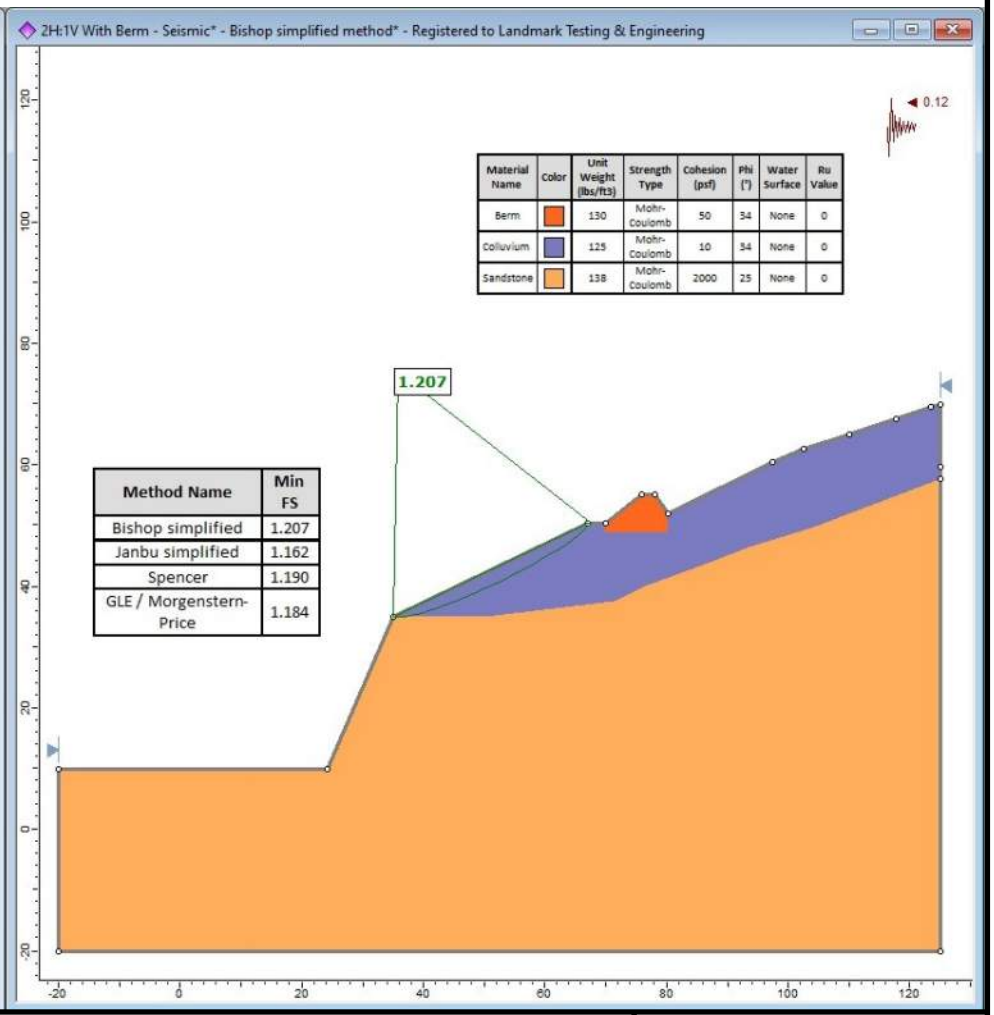
The allowable factor of safety for the static condition is 1.5. All methods show FS greater than 1.5. The most critical surface and factor of safety according to Bishop is shown.

The condition as analyzed is stable.

The allowable factor of safety for the seismic condition is 1.1. All methods show FS greater than 1.1.

The condition as analyzed is stable for horizontal acceleration of 0.12 g (0.5*PGA).



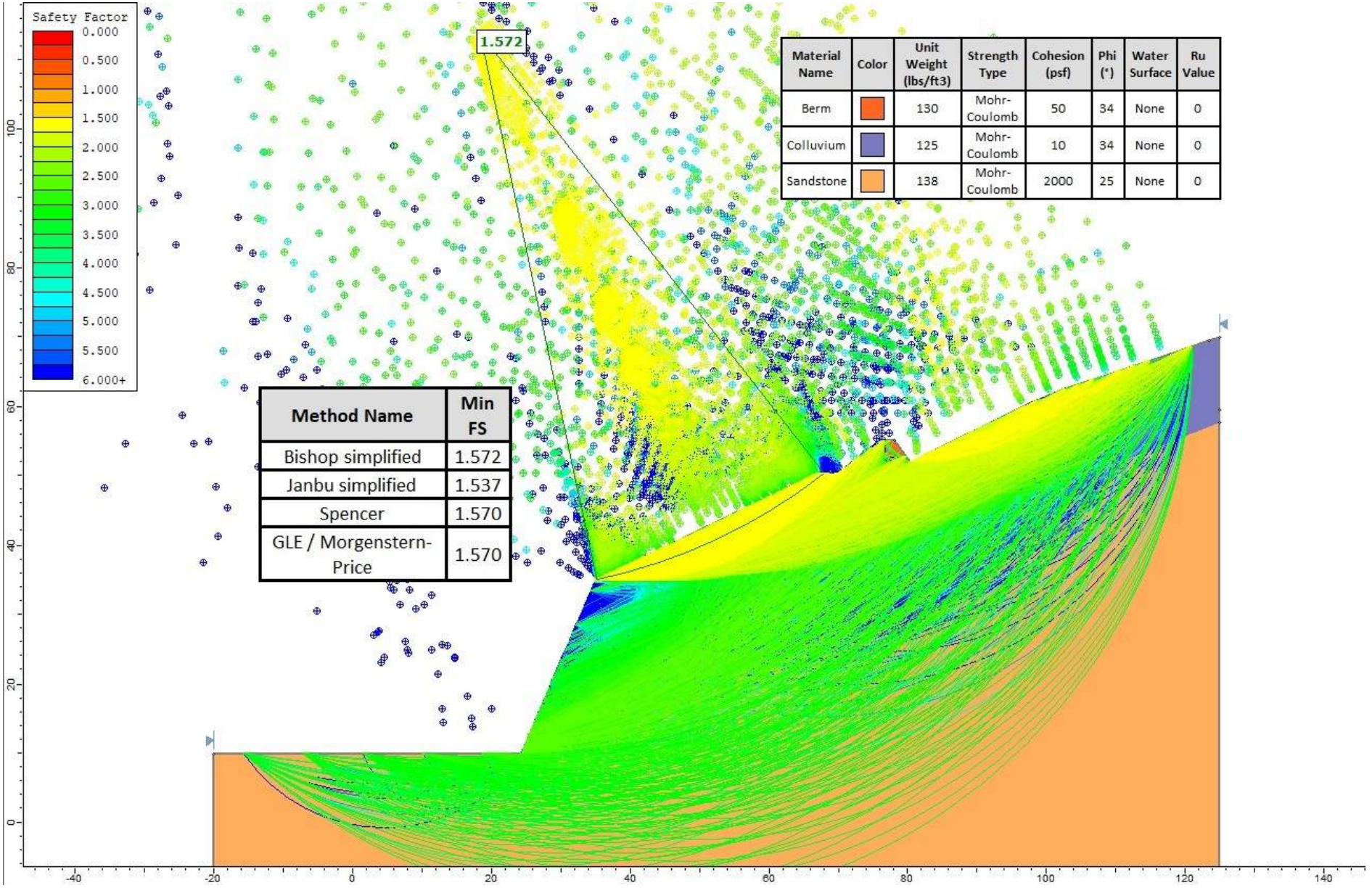


LANDMARK TESTING & ENGINEERING

Slope Stability Profiles

Landmark Project No. 240016

Figure D-1



LANDMARK TESTING & ENGINEERING

Slope Stability Profiles – All Failure Surfaces Analyzed

Landmark Project No. 240016

Figure D-2

240016 @Home Best Western
Slide2 - An Interactive Slope Stability Program
Date Created: 1/25/2024, 2:24:19 PM
Software Version: 9.031

Figure D-3 (53 Pages)

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Slide2 Analysis Information

240016 Hilton Home 2

Project Summary

File Name:	240016 Hilton Home 2.slmd
Slide2 Modeler Version:	9.031
Project Title:	Slide2 - An Interactive Slope Stability Program
Date Created:	1/25/2024, 2:24:19 PM

Currently Open Scenarios

Group Name	Scenario Name	Global Minimum	Compute Time
2H:1V With Berm	Master Scenario	Bishop Simplified: 1.586940 Janbu Simplified: 1.533590 Spencer: 1.564860 Gle/morgenstern-price: 1.559370	00h:00m:04.556s
	Seismic	Bishop Simplified: 1.206820 Janbu Simplified: 1.162200 Spencer: 1.189760 Gle/morgenstern-price: 1.184180	00h:00m:05.240s
	Static	Bishop Simplified: 1.572060 Janbu Simplified: 1.537160 Spencer: 1.569270 Gle/morgenstern-price: 1.569700	00h:00m:01.755s

General Settings

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

Analysis Options

All Open Scenarios

Slices Type:	Vertical
Analysis Methods Used	
	Bishop simplified
	GLE/Morgenstern-Price with interslice force function (Half Sine)
	Janbu 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
Eliminate vertical segments in non-circular search	Yes

Groundwater Analysis

All Open Scenarios

Groundwater Method:	Water Surfaces
Pore Fluid Unit Weight [lbs/ft3]:	62.4
Advanced Groundwater Method:	None

Random Numbers

All Open Scenarios

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

Surface Options

2H:1V With Berm - Static

Surface Type:	Circular
Search Method:	Auto Refine Search
Divisions along slope:	20
Circles per division:	10
Number of iterations:	10
Divisions to use in next iteration:	50%
Composite Surfaces:	Disabled
Minimum Elevation:	Not Defined
Minimum Depth:	Not Defined
Minimum Area:	Not Defined
Minimum Weight:	Not Defined

All other Scenarios

Search Method:	Particle Swarm Search
Initial # of Surface Vertices:	8
Maximum Iterations:	500
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

2H:1V With Berm - Seismic

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No
Seismic Load Coefficient (Horizontal):	0.12

All other Scenarios

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No

Materials

SSS	
Color	
Strength Type	Mohr-Coulomb
Unit Weight	138 lbs/ft3
Cohesion	700 psf
Phi	30 °
Water Surface	Assigned per scenario
Ru Value	0

Collu	
Color	
Strength Type	Mohr-Coulomb
Unit Weight	125 lbs/ft3
Cohesion	0 psf
Phi	32 °
Water Surface	Assigned per scenario
Ru Value	0

Berm	
Color	
Strength Type	Mohr-Coulomb
Unit Weight	130 lbs/ft3
Cohesion	50 psf
Phi	34 °
Water Surface	Assigned per scenario
Ru Value	0

Colluvium	
Color	
Strength Type	Mohr-Coulomb
Unit Weight	125 lbs/ft3
Cohesion	10 psf
Phi	34 °
Water Surface	Assigned per scenario
Ru Value	0

Sandstone	
Color	
Strength Type	Mohr-Coulomb
Unit Weight	138 lbs/ft3
Cohesion	2000 psf
Phi	25 °
Water Surface	Assigned per scenario
Ru Value	0

Materials In Use

Material	2H:1V With Berm	Seismic	Static
Berm	✓	✓	✓
Colluvium	✓	✓	✓
Sandstone	✓	✓	✓

Global Minimums

2H:1V With Berm - Master Scenario

Method: bishop simplified

FS	1.586940
Axis Location:	35.813, 75.089
Left Slip Surface Endpoint:	35.000, 35.000
Right Slip Surface Endpoint:	67.397, 50.385
Resisting Moment:	206577 lb-ft
Driving Moment:	130173 lb-ft
Total Slice Area:	64.6898 ft2
Surface Horizontal Width:	32.3965 ft
Surface Average Height:	1.99682 ft

Method: janbu simplified

FS	1.533590
Axis Location:	35.815, 75.093
Left Slip Surface Endpoint:	35.000, 35.000
Right Slip Surface Endpoint:	67.400, 50.385
Resisting Horizontal Force:	5748.39 lb
Driving Horizontal Force:	3748.32 lb
Total Slice Area:	78.3272 ft2
Surface Horizontal Width:	32.4001 ft
Surface Average Height:	2.4175 ft

Method: spencer

FS	1.564860
Axis Location:	35.798, 75.061
Left Slip Surface Endpoint:	35.000, 34.999
Right Slip Surface Endpoint:	67.368, 50.385
Resisting Moment:	190442 lb-ft
Driving Moment:	121699 lb-ft
Resisting Horizontal Force:	4481.58 lb
Driving Horizontal Force:	2863.89 lb
Total Slice Area:	59.9753 ft2
Surface Horizontal Width:	32.3686 ft
Surface Average Height:	1.85289 ft

Method: gle/morgenstern-price

FS	1.559370
Axis Location:	35.836, 75.134
Left Slip Surface Endpoint:	35.000, 35.000
Right Slip Surface Endpoint:	67.441, 50.385
Resisting Moment:	209862 lb-ft
Driving Moment:	134582 lb-ft
Resisting Horizontal Force:	4897.64 lb
Driving Horizontal Force:	3140.78 lb
Total Slice Area:	65.8984 ft2
Surface Horizontal Width:	32.4412 ft
Surface Average Height:	2.03132 ft

2H:1V With Berm - Seismic

Method: bishop simplified

FS	1.206820
Axis Location:	35.888, 75.239
Left Slip Surface Endpoint:	35.000, 35.000
Right Slip Surface Endpoint:	67.546, 50.385
Resisting Moment:	193827 lb-ft
Driving Moment:	160609 lb-ft
Total Slice Area:	63.7413 ft2
Surface Horizontal Width:	32.5464 ft
Surface Average Height:	1.95848 ft

Method: janbu simplified

FS	1.162200
Axis Location:	35.880, 75.223
Left Slip Surface Endpoint:	35.000, 35.000
Right Slip Surface Endpoint:	67.531, 50.385
Resisting Horizontal Force:	5502.01 lb
Driving Horizontal Force:	4734.13 lb
Total Slice Area:	78.94 ft2
Surface Horizontal Width:	32.5306 ft
Surface Average Height:	2.42664 ft

Method: spencer

FS	1.189760
Axis Location:	35.899, 75.260
Left Slip Surface Endpoint:	35.000, 35.000
Right Slip Surface Endpoint:	67.567, 50.385
Resisting Moment:	191054 lb-ft
Driving Moment:	160583 lb-ft
Resisting Horizontal Force:	4470.89 lb
Driving Horizontal Force:	3757.82 lb
Total Slice Area:	62.959 ft2
Surface Horizontal Width:	32.5675 ft
Surface Average Height:	1.93319 ft

Method: gle/morgenstern-price

FS	1.184180
Axis Location:	35.892, 75.247
Left Slip Surface Endpoint:	35.000, 35.000
Right Slip Surface Endpoint:	67.555, 50.385
Resisting Moment:	194748 lb-ft
Driving Moment:	164458 lb-ft
Resisting Horizontal Force:	4554.71 lb
Driving Horizontal Force:	3846.28 lb
Total Slice Area:	64.329 ft2
Surface Horizontal Width:	32.5547 ft
Surface Average Height:	1.97603 ft

2H:1V With Berm - Static

Method: bishop simplified

FS	1.572060
Center:	18.159, 114.021
Radius:	80.791
Left Slip Surface Endpoint:	35.021, 35.010
Right Slip Surface Endpoint:	67.933, 50.385
Resisting Moment:	384408 lb-ft
Driving Moment:	244525 lb-ft
Total Slice Area:	57.1085 ft2
Surface Horizontal Width:	32.9121 ft
Surface Average Height:	1.73518 ft

Method: janbu simplified

FS	1.537160
Center:	29.568, 88.921
Radius:	54.179
Left Slip Surface Endpoint:	35.041, 35.020
Right Slip Surface Endpoint:	67.650, 50.385
Resisting Horizontal Force:	5823.49 lb
Driving Horizontal Force:	3788.48 lb
Total Slice Area:	79.2966 ft2
Surface Horizontal Width:	32.609 ft
Surface Average Height:	2.43174 ft

Method: spencer

FS	1.569270
Center:	18.184, 114.063
Radius:	80.826
Left Slip Surface Endpoint:	35.021, 35.010
Right Slip Surface Endpoint:	67.963, 50.385
Resisting Moment:	385927 lb-ft
Driving Moment:	245927 lb-ft
Resisting Horizontal Force:	4309.24 lb
Driving Horizontal Force:	2746.01 lb
Total Slice Area:	57.4277 ft2
Surface Horizontal Width:	32.9419 ft
Surface Average Height:	1.7433 ft

Method: gle/morgenstern-price

FS	1.569700
Center:	18.184, 114.063
Radius:	80.826
Left Slip Surface Endpoint:	35.021, 35.010
Right Slip Surface Endpoint:	67.963, 50.385
Resisting Moment:	386031 lb-ft
Driving Moment:	245927 lb-ft
Resisting Horizontal Force:	4309.61 lb
Driving Horizontal Force:	2745.5 lb
Total Slice Area:	57.4277 ft2
Surface Horizontal Width:	32.9419 ft
Surface Average Height:	1.7433 ft

Global Minimum Coordinates

2H:1V With Berm - Master Scenario

Method: bishop simplified

X	Y
35	35
35.9515	35.0005
36.9031	35.0013
37.8446	35.1771
38.7861	35.3674
39.7277	35.6285
40.6701	35.8899
42.1039	36.3445
43.5393	36.8116
44.9749	37.4012
46.4125	37.9918
47.7665	38.6173
49.1205	39.2427
50.4745	39.8682
51.8284	40.4937
53.1824	41.1191
54.0117	41.5082
54.841	41.8977
56.3565	42.7209
57.5316	43.3721
58.6027	43.9733
59.6698	44.5727
60.7369	45.172
61.7998	45.7693
62.7647	46.4525
63.7247	47.1333
64.6847	47.8255
65.6447	48.5302
66.5206	49.4576
67.3965	50.385

Method: janbu simplified

X	Y
35	35
36.2767	35.0189
37.5533	35.0378
38.6651	35.1828
39.7769	35.3974
40.8878	35.6772
41.9996	35.9765
43.5838	36.4903
45.1679	37.0151
46.8289	37.6364
47.8131	38.0284
48.7973	38.4581
50.2424	39.1239
51.4218	39.6782
52.6013	40.2325
53.7807	40.7869
54.9601	41.3412
56.1396	41.9063
57.6726	42.7814
59.2114	43.6834
60.6	44.5712
61.9887	45.4707
62.9094	46.141
63.8254	46.8095
64.7472	47.5777
65.6691	48.4963
66.5346	49.3656
67.4001	50.385

Method: spencer

X	Y
34.9997	34.9992
37.8251	35.3338
42.6479	36.7684
48.9688	39.2261
56.0526	42.5987
61.7035	45.8276
65.6988	48.6588
67.3682	50.385

Method: gle/morgenstern-price

X	Y
35	35
36.0395	35
37.0796	35.0012
37.9823	35.1885
38.8851	35.3759
39.795	35.6281
40.7056	35.8807
42.2105	36.4635
43.7154	37.0568
45.2997	37.6815
46.1574	38.0196
47.015	38.3578
48.6426	39.0438
50.2702	39.7455
51.8978	40.5106
53.5254	41.2757
55.1398	42.0407
56.7542	42.8058
57.5812	43.2542
58.4083	43.7027
59.811	44.4838
61.0169	45.1704
62.2228	45.8763
63.191	46.5347
64.1536	47.1893
64.9843	47.8148
65.815	48.6286
66.6281	49.4252
67.4412	50.385

2H:1V With Berm - Seismic

Method: bishop simplified

X	Y
35	35
35.9138	35.0117
36.8302	35.0235
37.8231	35.2023
38.816	35.4444
39.8089	35.6866
40.7979	35.9669
42.2075	36.4751
43.6171	36.9832
45.0267	37.4914
46.4967	38.1043
47.7485	38.6765
49.0002	39.2487
50.2519	39.8209
51.5036	40.3931
52.9133	41.0375
54.323	41.6819
55.6608	42.375
56.9986	43.0774
58.2001	43.745
59.3025	44.3575
60.405	44.9701
61.5035	45.5834
62.5147	46.2642
63.5465	46.9588
64.5783	47.6827
65.5453	48.5125
66.5458	49.3742
67.5464	50.385

Method: janbu simplified

X	Y
35	35
36.1834	35.0001
37.3667	35.0007
38.463	35.195
39.5594	35.4092
40.6548	35.6964
41.9398	36.0398
42.8675	36.3354
43.7951	36.6309
45.3447	37.1312
46.9706	37.7281
48.6671	38.3973
49.8249	38.9288
50.9826	39.4603
52.1404	39.9919
53.2981	40.5234
54.5809	41.1123
55.8637	41.7299
56.9909	42.3622
58.1181	42.9944
59.1475	43.5805
60.5413	44.4615
61.9329	45.3423
62.8619	46.0101
63.7957	46.6813
64.7353	47.4862
65.6749	48.2923
66.6027	49.3387
67.5306	50.385

Method: spencer

X	Y
35	35
36.0307	35.0818
37.0769	35.2
38.231	35.4756
39.3851	35.7513
40.5643	36.1089
41.7429	36.4663
43.279	37.0261
44.8229	37.5889
46.4166	38.1804
48.0163	38.7882
49.327	39.3871
50.6378	39.9939
51.9485	40.6008
53.2593	41.2077
54.57	41.8145
55.8808	42.4214
56.965	42.9975
58.0493	43.5898
59.1315	44.1811
60.6068	45.0235
62.064	45.8678
63.4868	46.8471
64.9096	47.8265
65.5644	48.3177
66.2193	48.9572
66.8934	49.6155
67.5675	50.385

Method: gle/morgenstern-price

X	Y
35	35
35.9864	35.0084
36.9727	35.1281
37.9073	35.2416
38.8419	35.4762
39.7766	35.7397
40.7112	36.0031
42.1986	36.5368
43.6859	37.1356
45.2244	37.7549
46.7628	38.3743
48.3922	39.0921
50.0216	39.8099
51.651	40.5278
53.2803	41.2456
54.9354	42.0059
56.5904	42.7661
58.1155	43.5508
59.6406	44.3772
60.9724	45.0989
62.3042	45.8546
63.1669	46.4292
64.0296	47.0481
64.8811	47.7021
65.7326	48.356
66.6436	49.2771
67.5547	50.385

Global Minimum Support Data

All Open Scenarios

No Supports Present

Valid and Invalid Surfaces

2H:1V With Berm - Master Scenario

Method: bishop simplified

Number of Valid Surfaces:	34520
Number of Invalid Surfaces:	103696

Error Codes

Error Code -106 reported for 4 surfaces
Error Code -111 reported for 8 surfaces
Error Code -112 reported for 13 surfaces
Error Code -121 reported for 30 surfaces
Error Code -1000 reported for 103641 surfaces

Method: janbu simplified

Number of Valid Surfaces:	34527
Number of Invalid Surfaces:	103689

Error Codes

Error Code -106 reported for 4 surfaces
Error Code -111 reported for 9 surfaces
Error Code -112 reported for 1 surface
Error Code -121 reported for 30 surfaces
Error Code -1000 reported for 103645 surfaces

Method: spencer

Number of Valid Surfaces:	34467
Number of Invalid Surfaces:	103749

Error Codes

Error Code -106 reported for 4 surfaces
Error Code -108 reported for 1 surface
Error Code -111 reported for 41 surfaces
Error Code -112 reported for 8 surfaces
Error Code -121 reported for 30 surfaces
Error Code -1000 reported for 103665 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces:	34516
Number of Invalid Surfaces:	103700

Error Codes

Error Code -106 reported for 4 surfaces
Error Code -111 reported for 14 surfaces
Error Code -112 reported for 4 surfaces
Error Code -121 reported for 30 surfaces
Error Code -1000 reported for 103648 surfaces

2H:1V With Berm - Seismic

Method: bishop simplified

Number of Valid Surfaces:	34529
Number of Invalid Surfaces:	103687

Error Codes

Error Code -106 reported for 10 surfaces
Error Code -109 reported for 1 surface
Error Code -111 reported for 3 surfaces
Error Code -112 reported for 4 surfaces
Error Code -121 reported for 52 surfaces
Error Code -1000 reported for 103617 surfaces

Method: janbu simplified

Number of Valid Surfaces:	34505
Number of Invalid Surfaces:	103711

Error Codes

Error Code -106 reported for 10 surfaces
Error Code -109 reported for 1 surface
Error Code -111 reported for 22 surfaces
Error Code -112 reported for 1 surface
Error Code -121 reported for 52 surfaces
Error Code -1000 reported for 103625 surfaces

Method: spencer

Number of Valid Surfaces:	34343
Number of Invalid Surfaces:	103873

Error Codes

Error Code -106 reported for 10 surfaces
Error Code -108 reported for 5 surfaces
Error Code -109 reported for 1 surface
Error Code -111 reported for 115 surfaces
Error Code -112 reported for 6 surfaces
Error Code -121 reported for 52 surfaces
Error Code -1000 reported for 103684 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces:	34447
Number of Invalid Surfaces:	103769

Error Codes

Error Code -106 reported for 10 surfaces
Error Code -108 reported for 1 surface
Error Code -109 reported for 1 surface
Error Code -111 reported for 54 surfaces
Error Code -112 reported for 4 surfaces
Error Code -121 reported for 52 surfaces
Error Code -1000 reported for 103647 surfaces

2H:1V With Berm - Static

Method: bishop simplified

Number of Valid Surfaces:	12962
Number of Invalid Surfaces:	27

Error Codes

Error Code -112 reported for 27 surfaces

Method: janbu simplified

Number of Valid Surfaces:	12736
Number of Invalid Surfaces:	253

Error Codes

Error Code -108 reported for 59 surfaces
Error Code -111 reported for 194 surfaces

Method: spencer

Number of Valid Surfaces:	10170
Number of Invalid Surfaces:	2819

Error Codes

Error Code -108 reported for 89 surfaces
Error Code -111 reported for 2702 surfaces
Error Code -112 reported for 28 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces:	12617
Number of Invalid Surfaces:	372

Error Codes

Error Code -108 reported for 66 surfaces
Error Code -111 reported for 278 surfaces
Error Code -112 reported for 28 surfaces

Error Code Descriptions

The following errors were encountered during the computation:

-106 = Average slice width is less than 0.0001 * (maximum horizontal extent of soil region). This limitation is imposed to avoid numerical errors which may result from too many slices, or too small a slip region.

-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. It may occur for circular slip surfaces 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. It can also occur if the midpoint of a slice is above or too close to the external boundary.

-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.

-121 = Concave failure surface, only convex surfaces have been defined as being allowed.

-1000 = No valid slip surface is generated

Slice Data

2H:1V With Berm - Master Scenario

Global Minimum Query (bishop simplified) - Safety Factor: 1.58694

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [deg]	Base Material	Base Cohesion [psf]	Base Friction Angle [deg]	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	0.475761	6.78627	0.0324169	Colluvium	10	34	12.3612	19.6165	14.2571	0	14.2571	14.2641	14.2641
2	0.475761	20.3588	0.0324169	Colluvium	10	34	24.4838	38.8543	42.7782	0	42.7782	42.7921	42.7921
3	0.951606	81.4332	0.0442578	Colluvium	10	34	42.6598	67.6985	85.5416	0	85.5416	85.5746	85.5746
4	0.941498	123.681	10.5769	Colluvium	10	34	57.568	91.3569	120.616	0	120.616	131.366	131.366
5	0.470751	73.824	11.4291	Colluvium	10	34	67.1836	106.616	143.24	0	143.24	156.822	156.822
6	0.470751	81.5278	11.4291	Colluvium	10	34	73.5888	116.781	158.31	0	158.31	173.187	173.187
7	0.94155	182.017	15.4963	Colluvium	10	34	79.1416	125.593	171.374	0	171.374	193.316	193.316
8	0.471196	99.5337	15.5055	Colluvium	10	34	85.9497	136.397	187.391	0	187.391	211.236	211.236
9	0.471196	105.163	15.5055	Colluvium	10	34	90.4924	143.606	198.079	0	198.079	223.184	223.184
10	0.71692	169.531	17.591	Colluvium	10	34	94.1264	149.373	206.629	0	206.629	236.471	236.471
11	0.71692	180.017	17.591	Colluvium	10	34	99.6055	158.068	219.519	0	219.519	251.099	251.099
12	0.717717	190.453	18.025	Colluvium	10	34	104.62	166.025	231.316	0	231.316	265.359	265.359
13	0.717717	200.425	18.025	Colluvium	10	34	109.807	174.257	243.521	0	243.521	279.253	279.253
14	0.717757	207.662	22.3284	Colluvium	10	34	110.061	174.66	244.118	0	244.118	289.321	289.321
15	0.717757	212.142	22.3284	Colluvium	10	34	112.319	178.244	249.432	0	249.432	295.562	295.562
16	0.718842	216.949	22.3336	Colluvium	10	34	114.573	181.821	254.735	0	254.735	301.803	301.803
17	0.718842	221.435	22.3336	Colluvium	10	34	116.832	185.405	260.048	0	260.048	308.044	308.044
18	0.676988	211.179	24.7945	Colluvium	10	34	116.093	184.233	258.31	0	258.31	311.939	311.939
19	0.676988	212.229	24.7945	Colluvium	10	34	116.644	185.107	259.607	0	259.607	313.491	313.491
20	0.676988	213.279	24.7945	Colluvium	10	34	117.195	185.981	260.902	0	260.902	315.04	315.04
21	0.676988	214.328	24.7945	Colluvium	10	34	117.745	186.855	262.199	0	262.199	316.591	316.591
22	0.676988	215.378	24.7945	Colluvium	10	34	118.296	187.729	263.494	0	263.494	318.141	318.141
23	0.676988	216.428	24.7945	Colluvium	10	34	118.848	188.604	264.791	0	264.791	319.693	319.693
24	0.676988	217.477	24.7945	Colluvium	10	34	119.398	189.478	266.087	0	266.087	321.242	321.242
25	0.676988	218.527	24.7945	Colluvium	10	34	119.949	190.352	267.383	0	267.383	322.794	322.794
26	0.676988	219.577	24.7945	Colluvium	10	34	120.5	191.226	268.679	0	268.679	324.343	324.343
27	0.676988	220.626	24.7945	Colluvium	10	34	121.051	192.1	269.975	0	269.975	325.895	325.895
28	0.829312	271.389	25.1335	Colluvium	10	34	121.221	192.371	270.375	0	270.375	327.246	327.246
29	0.829312	272.321	25.16	Colluvium	10	34	121.595	192.964	271.255	0	271.255	328.37	328.37
30	0.757742	246.978	28.5079	Colluvium	10	34	117.673	186.74	262.028	0	262.028	325.94	325.94
31	0.757742	242.466	28.5079	Colluvium	10	34	115.617	183.477	257.19	0	257.19	319.985	319.985
32	0.587544	184.66	28.997	Colluvium	10	34	113.217	179.668	251.542	0	251.542	314.292	314.292
33	0.587544	181.469	28.997	Colluvium	10	34	111.348	176.702	247.146	0	247.146	308.86	308.86
34	0.535518	162.493	29.3063	Colluvium	10	34	109.214	173.316	242.127	0	242.127	303.431	303.431
35	0.535518	159.587	29.3063	Colluvium	10	34	107.353	170.362	237.747	0	237.747	298.006	298.006
36	0.53357	156.112	29.3192	Colluvium	10	34	105.48	167.39	233.341	0	233.341	292.58	292.58
37	0.53357	153.217	29.3192	Colluvium	10	34	103.618	164.436	228.961	0	228.961	287.155	287.155
38	0.53357	150.322	29.3192	Colluvium	10	34	101.757	161.482	224.58	0	224.58	281.728	281.728
39	0.53357	147.428	29.3192	Colluvium	10	34	99.8954	158.528	220.201	0	220.201	276.304	276.304
40	0.531452	143.958	29.3349	Colluvium	10	34	98.0213	155.554	215.792	0	215.792	270.878	270.878
41	0.531452	141.074	29.3349	Colluvium	10	34	96.1586	152.598	211.411	0	211.411	265.45	265.45
42	0.48243	123.438	35.2999	Colluvium	10	34	88.44	140.349	193.249	0	193.249	255.868	255.868
43	0.48243	116.812	35.2999	Colluvium	10	34	83.9521	133.227	182.691	0	182.691	242.132	242.132
44	0.479995	109.629	35.3464	Colluvium	10	34	79.4327	126.055	172.059	0	172.059	228.397	228.397
45	0.479995	103.034	35.3464	Colluvium	10	34	74.9455	118.934	161.502	0	161.502	214.657	214.657
46	0.480001	96.2722	35.7903	Colluvium	10	34	70.0757	111.206	150.045	0	150.045	200.567	200.567
47	0.480001	89.3402	35.7903	Colluvium	10	34	65.3775	103.75	138.99	0	138.99	186.125	186.125
48	0.960002	157.126	36.2835	Colluvium	10	34	57.8252	91.7651	121.222	0	121.222	163.673	163.673
49	0.875911	102.282	46.6351	Colluvium	10	34	38.5746	61.2155	75.9302	0	75.9302	116.772	116.772
50	0.875911	42.8575	46.6351	Colluvium	10	34	18.6881	29.6569	29.1426	0	29.1426	48.929	48.929

Global Minimum Query (janbu simplified) - Safety Factor: 1.53359

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [deg]	Base Material	Base Cohesion [psf]	Base Friction Angle [deg]	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	0.638329	11.8536	0.848628	Colluvium	10	34	14.5929	22.3796	18.3536	0	18.3536	18.5697	18.5697
2	0.638329	35.5608	0.848628	Colluvium	10	34	30.8221	47.2684	55.2526	0	55.2526	55.7091	55.7091
3	0.638334	59.2685	0.848628	Colluvium	10	34	47.0512	72.1572	92.1519	0	92.1519	92.8488	92.8488
4	0.638334	82.976	0.848628	Colluvium	10	34	63.2803	97.0461	129.051	0	129.051	129.988	129.988
5	0.555899	89.3414	7.42751	Colluvium	10	34	73.0202	111.983	151.196	0	151.196	160.715	160.715
6	0.555899	102.858	7.42751	Colluvium	10	34	83.1343	127.494	174.192	0	174.192	185.029	185.029
7	0.555899	115.164	10.9244	Colluvium	10	34	89.9973	138.019	189.797	0	189.797	207.167	207.167
8	0.555899	126.26	10.9244	Colluvium	10	34	98.0895	150.429	208.194	0	208.194	227.127	227.127
9	0.555432	136.101	14.1383	Colluvium	10	34	102.894	157.797	219.118	0	219.118	245.037	245.037
10	0.555432	144.908	14.1383	Colluvium	10	34	109.172	167.425	233.393	0	233.393	260.892	260.892
11	0.555931	153.522	15.069	Colluvium	10	34	114.429	175.487	245.343	0	245.343	276.152	276.152
12	0.555931	161.674	15.069	Colluvium	10	34	120.196	184.331	258.455	0	258.455	290.817	290.817
13	0.792057	242.267	17.9684	Colluvium	10	34	123.442	189.309	265.837	0	265.837	305.87	305.87
14	0.792057	254.497	17.9684	Colluvium	10	34	129.386	198.425	279.351	0	279.351	321.312	321.312
15	0.528038	176.337	18.3315	Colluvium	10	34	133.888	205.329	289.587	0	289.587	333.948	333.948
16	0.528038	181.528	18.3315	Colluvium	10	34	137.662	211.117	298.168	0	298.168	343.779	343.779
17	0.528038	186.719	18.3315	Colluvium	10	34	141.435	216.904	306.748	0	306.748	353.61	353.61
18	0.553666	200.539	20.5069	Colluvium	10	34	142.4	218.383	308.941	0	308.941	362.202	362.202
19	0.553666	204.61	20.5069	Colluvium	10	34	145.178	222.643	315.256	0	315.256	369.556	369.556
20	0.553666	208.681	20.5069	Colluvium	10	34	147.955	226.902	321.57	0	321.57	376.908	376.908
21	0.492104	188.528	21.719	Colluvium	10	34	148.928	228.394	323.782	0	323.782	383.105	383.105
22	0.492104	191.008	21.719	Colluvium	10	34	150.814	231.287	328.071	0	328.071	388.145	388.145
23	0.492104	192.909	23.5853	Colluvium	10	34	150.111	230.209	326.474	0	326.474	392.01	392.01
24	0.492104	194.232	23.5853	Colluvium	10	34	151.103	231.73	328.727	0	328.727	394.696	394.696
25	0.722543	286.795	24.7352	Colluvium	10	34	150.585	230.936	327.551	0	327.551	396.924	396.924
26	0.722543	288.073	24.7352	Colluvium	10	34	151.232	231.928	329.021	0	329.021	398.693	398.693
27	0.58972	235.861	25.1739	Colluvium	10	34	151.179	231.846	328.9	0	328.9	399.955	399.955
28	0.58972	236.308	25.1739	Colluvium	10	34	151.454	232.269	329.527	0	329.527	400.712	400.712
29	0.58972	236.754	25.1739	Colluvium	10	34	151.73	232.692	330.154	0	330.154	401.468	401.468
30	0.58972	237.2	25.1739	Colluvium	10	34	152.006	233.115	330.781	0	330.781	402.225	402.225
31	0.58972	237.646	25.1739	Colluvium	10	34	152.281	233.537	331.407	0	331.407	402.981	402.981
32	0.58972	238.092	25.1739	Colluvium	10	34	152.557	233.96	332.035	0	332.035	403.738	403.738
33	0.58972	238.538	25.1739	Colluvium	10	34	152.833	234.383	332.661	0	332.661	404.494	404.494
34	0.58972	238.985	25.1739	Colluvium	10	34	153.109	234.806	333.289	0	333.289	405.251	405.251
35	0.58972	239.232	25.6005	Colluvium	10	34	152.754	234.262	332.482	0	332.482	405.671	405.671
36	0.58972	239.282	25.6005	Colluvium	10	34	152.785	234.309	332.552	0	332.552	405.756	405.756
37	0.766522	307.729	29.7166	Colluvium	10	34	146.353	224.445	317.928	0	317.928	401.462	401.462
38	0.766522	301.082	29.7166	Colluvium	10	34	143.304	219.769	310.996	0	310.996	392.79	392.79
39	0.769378	294.949	30.379	Colluvium	10	34	139.233	213.527	301.741	0	301.741	383.36	383.36
40	0.769378	287.111	30.379	Colluvium	10	34	135.671	208.064	293.641	0	293.641	373.172	373.172
41	0.69433	250.775	32.5933	Colluvium	10	34	129.076	197.95	278.648	0	278.648	361.174	361.174
42	0.69433	241.187	32.5933	Colluvium	10	34	124.336	190.681	267.871	0	267.871	347.367	347.367
43	0.69433	231.349	32.9305	Colluvium	10	34	119.132	182.7	256.038	0	256.038	333.198	333.198
44	0.69433	221.261	32.9305	Colluvium	10	34	114.158	175.072	244.73	0	244.73	318.668	318.668
45	0.920696	273.58	36.0568	Colluvium	10	34	103.931	159.388	221.476	0	221.476	297.144	297.144
46	0.915987	246.031	36.1247	Colluvium	10	34	94.3636	144.715	199.723	0	199.723	268.596	268.596
47	0.921847	215.682	39.8044	Colluvium	10	34	80.0762	122.804	167.24	0	167.24	233.967	233.967
48	0.921847	169.514	44.899	Colluvium	10	34	60.7657	93.1897	123.334	0	123.334	183.886	183.886
49	0.86554	108.881	45.1231	Colluvium	10	34	42.8991	65.7897	82.7115	0	82.7115	125.795	125.795
50	0.86554	47.6608	49.667	Colluvium	10	34	20.2497	31.0548	31.215	0	31.215	55.0648	55.0648

Global Minimum Query (spencer) - Safety Factor: 1.56486

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [deg]	Base Material	Base Cohesion [psf]	Base Friction Angle [deg]	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	0.70635	11.3372	6.75263	Colluvium	10	34	14.7669	23.1082	19.4337	0	19.4337	21.1822	21.1822
2	0.70635	33.9054	6.75263	Colluvium	10	34	29.6988	46.4745	54.0756	0	54.0756	57.5921	57.5921
3	0.70635	56.4737	6.75263	Colluvium	10	34	44.6306	69.8407	88.7176	0	88.7176	94.002	94.002
4	0.70635	79.042	6.75263	Colluvium	10	34	59.5625	93.207	123.359	0	123.359	130.412	130.412
5	0.688977	93.5282	16.5655	Colluvium	10	34	61.2458	95.8411	127.265	0	127.265	145.483	145.483
6	0.688977	104.376	16.5655	Colluvium	10	34	67.5727	105.742	141.943	0	141.943	162.043	162.043
7	0.688977	115.223	16.5655	Colluvium	10	34	73.8993	115.642	156.621	0	156.621	178.603	178.603
8	0.688977	126.071	16.5655	Colluvium	10	34	80.2263	125.543	171.299	0	171.299	195.163	195.163
9	0.688977	136.918	16.5655	Colluvium	10	34	86.5534	135.444	185.978	0	185.978	211.724	211.724
10	0.688977	147.766	16.5655	Colluvium	10	34	92.8805	145.345	200.656	0	200.656	228.284	228.284
11	0.688977	158.613	16.5655	Colluvium	10	34	99.207	155.245	215.335	0	215.335	244.844	244.844
12	0.632089	152.776	21.2473	Colluvium	10	34	97.0464	151.864	210.322	0	210.322	248.056	248.056
13	0.632089	157.343	21.2473	Colluvium	10	34	99.754	156.101	216.603	0	216.603	255.39	255.39
14	0.632089	161.91	21.2473	Colluvium	10	34	102.462	160.339	222.886	0	222.886	262.726	262.726
15	0.632089	166.477	21.2473	Colluvium	10	34	105.17	164.577	229.169	0	229.169	270.062	270.062
16	0.632089	171.044	21.2473	Colluvium	10	34	107.878	168.814	235.452	0	235.452	277.398	277.398
17	0.632089	175.611	21.2473	Colluvium	10	34	110.586	173.052	241.735	0	241.735	284.734	284.734
18	0.632089	180.178	21.2473	Colluvium	10	34	113.294	177.29	248.017	0	248.017	292.068	292.068
19	0.632089	184.745	21.2473	Colluvium	10	34	116.002	181.527	254.299	0	254.299	299.404	299.404
20	0.632089	189.312	21.2473	Colluvium	10	34	118.71	185.765	260.582	0	260.582	306.74	306.74
21	0.632089	193.879	21.2473	Colluvium	10	34	121.419	190.003	266.865	0	266.865	314.076	314.076
22	0.643979	199.96	25.4596	Colluvium	10	34	115.591	180.884	253.347	0	253.347	308.381	308.381
23	0.643979	200.176	25.4596	Colluvium	10	34	115.709	181.069	253.62	0	253.62	308.711	308.711
24	0.643979	200.392	25.4596	Colluvium	10	34	115.828	181.254	253.894	0	253.894	309.04	309.04
25	0.643979	200.608	25.4596	Colluvium	10	34	115.945	181.438	254.167	0	254.167	309.37	309.37
26	0.643979	200.823	25.4596	Colluvium	10	34	116.063	181.623	254.44	0	254.44	309.699	309.699
27	0.643979	201.039	25.4596	Colluvium	10	34	116.181	181.807	254.715	0	254.715	310.03	310.03
28	0.643979	201.255	25.4596	Colluvium	10	34	116.299	181.992	254.989	0	254.989	310.36	310.36
29	0.643979	201.47	25.4596	Colluvium	10	34	116.417	182.176	255.262	0	255.262	310.689	310.689
30	0.643979	201.686	25.4596	Colluvium	10	34	116.535	182.361	255.535	0	255.535	311.019	311.019
31	0.643979	201.902	25.4596	Colluvium	10	34	116.653	182.545	255.809	0	255.809	311.348	311.348
32	0.643979	202.117	25.4596	Colluvium	10	34	116.771	182.73	256.082	0	256.082	311.678	311.678
33	0.627882	194.925	29.7428	Colluvium	10	34	108.611	169.961	237.152	0	237.152	299.21	299.21
34	0.627882	190.435	29.7428	Colluvium	10	34	106.249	166.265	231.672	0	231.672	292.38	292.38
35	0.627882	185.946	29.7428	Colluvium	10	34	103.887	162.569	226.193	0	226.193	285.552	285.552
36	0.627882	181.456	29.7428	Colluvium	10	34	101.525	158.872	220.713	0	220.713	278.722	278.722
37	0.627882	176.966	29.7428	Colluvium	10	34	99.1629	155.176	215.232	0	215.232	271.892	271.892
38	0.627882	172.476	29.7428	Colluvium	10	34	96.8004	151.479	209.752	0	209.752	265.062	265.062
39	0.627882	167.986	29.7428	Colluvium	10	34	94.4385	147.783	204.272	0	204.272	258.232	258.232
40	0.627882	163.496	29.7428	Colluvium	10	34	92.0766	144.087	198.792	0	198.792	251.403	251.403
41	0.627882	159.006	29.7428	Colluvium	10	34	89.7141	140.39	193.312	0	193.312	244.572	244.572
42	0.665877	159.919	35.3229	Colluvium	10	34	78.6876	123.135	167.729	0	167.729	223.49	223.49
43	0.665877	147.262	35.3229	Colluvium	10	34	72.9203	114.11	154.349	0	154.349	206.023	206.023
44	0.665877	134.605	35.3229	Colluvium	10	34	67.1525	105.084	140.968	0	140.968	188.555	188.555
45	0.665877	121.948	35.3229	Colluvium	10	34	61.385	96.0589	127.588	0	127.588	171.088	171.088
46	0.665877	109.291	35.3229	Colluvium	10	34	55.6174	87.0335	114.207	0	114.207	153.62	153.62
47	0.665877	96.6335	35.3229	Colluvium	10	34	49.8499	78.0081	100.826	0	100.826	136.152	136.152
48	0.556489	64.7527	45.9574	Colluvium	10	34	35.0503	54.8488	66.4911	0	66.4911	102.733	102.733
49	0.556489	43.3182	45.9574	Colluvium	10	34	25.2212	39.4677	43.6877	0	43.6877	69.7662	69.7662
50	0.556489	18.5302	45.9574	Colluvium	10	34	14.094	22.0552	17.8726	0	17.8726	32.4457	32.4457

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.55937

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [deg]	Base Material	Base Cohesion [psf]	Base Friction Angle [deg]	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	0.519762	8.10873	0.00143433	Colluvium	10	34	13.3329	20.7909	15.9982	0	15.9982	15.9985	15.9985
2	0.519762	24.3262	0.00143433	Colluvium	10	34	27.5383	42.9424	48.8391	0	48.8391	48.8398	48.8398
3	0.520016	40.5481	0.0670775	Colluvium	10	34	42.2698	65.9142	82.8964	0	82.8964	82.9459	82.9459
4	0.520016	56.7427	0.0670775	Colluvium	10	34	57.5843	89.7953	118.301	0	118.301	118.369	118.369
5	0.902776	126.461	11.7212	Colluvium	10	34	65.5946	102.286	136.82	0	136.82	150.429	150.429
6	0.902776	154.252	11.7212	Colluvium	10	34	79.8605	124.532	169.801	0	169.801	186.37	186.37
7	0.454932	87.3605	15.495	Colluvium	10	34	86.1726	134.375	184.393	0	184.393	208.282	208.282
8	0.454932	92.6132	15.495	Colluvium	10	34	91.4049	142.534	196.49	0	196.49	221.83	221.83
9	0.455335	97.9527	15.5039	Colluvium	10	34	96.6525	150.717	208.621	0	208.621	235.432	235.432
10	0.455335	103.21	15.5039	Colluvium	10	34	101.929	158.945	220.82	0	220.82	249.095	249.095
11	0.752431	178.189	21.1689	Colluvium	10	34	99.1214	154.567	214.329	0	214.329	252.714	252.714
12	0.752431	184.772	21.1689	Colluvium	10	34	102.626	160.032	222.431	0	222.431	262.173	262.173
13	0.752431	191.106	21.5183	Colluvium	10	34	105.434	164.41	228.922	0	228.922	270.492	270.492
14	0.752431	197.191	21.5183	Colluvium	10	34	108.543	169.259	236.111	0	236.111	278.908	278.908
15	0.528117	142.04	21.5183	Colluvium	10	34	111.151	173.325	242.14	0	242.14	285.964	285.964
16	0.528117	145.038	21.5183	Colluvium	10	34	113.271	176.632	247.042	0	247.042	291.703	291.703
17	0.528117	148.036	21.5183	Colluvium	10	34	115.365	179.896	251.881	0	251.881	297.367	297.367
18	0.857654	246.795	21.5183	Colluvium	10	34	118.065	184.107	258.124	0	258.124	304.674	304.674
19	0.857654	254.701	21.5183	Colluvium	10	34	121.339	189.212	265.693	0	265.693	313.534	313.534
20	0.813793	247.86	22.8544	Colluvium	10	34	121.165	188.941	265.291	0	265.291	316.359	316.359
21	0.813793	252.727	22.8544	Colluvium	10	34	122.957	191.736	269.435	0	269.435	321.259	321.259
22	0.542528	171.011	23.3238	Colluvium	10	34	123.297	192.265	270.218	0	270.218	323.379	323.379
23	0.542528	172.818	23.3238	Colluvium	10	34	124.18	193.642	272.259	0	272.259	325.801	325.801
24	0.542528	174.624	23.3238	Colluvium	10	34	125.047	194.995	274.267	0	274.267	328.182	328.182
25	0.542528	175.715	25.1769	Colluvium	10	34	121.459	189.399	265.971	0	265.971	323.065	323.065
26	0.542528	176.091	25.1769	Colluvium	10	34	121.337	189.209	265.689	0	265.689	322.726	322.726
27	0.542528	176.466	25.1769	Colluvium	10	34	121.221	189.029	265.42	0	265.42	322.403	322.403
28	0.813785	265.4	25.1769	Colluvium	10	34	121.087	188.819	265.11	0	265.11	322.029	322.029
29	0.813785	266.245	25.1769	Colluvium	10	34	120.941	188.592	264.774	0	264.774	321.625	321.625
30	0.807206	264.771	25.3554	Colluvium	10	34	120.387	187.728	263.492	0	263.492	320.541	320.541
31	0.807206	265.292	25.3554	Colluvium	10	34	120.163	187.378	262.973	0	262.973	319.916	319.916
32	0.538146	177.153	25.3558	Colluvium	10	34	119.996	187.118	262.588	0	262.588	319.453	319.453
33	0.538146	177.384	25.3558	Colluvium	10	34	119.88	186.937	262.319	0	262.319	319.129	319.129
34	0.538146	177.615	25.3558	Colluvium	10	34	119.777	186.777	262.083	0	262.083	318.844	318.844
35	0.82704	270.493	28.4681	Colluvium	10	34	112.827	175.939	246.015	0	246.015	307.194	307.194
36	0.82704	265.195	28.4681	Colluvium	10	34	110.67	172.576	241.029	0	241.029	301.038	301.038
37	0.701338	220.288	29.1106	Colluvium	10	34	107.498	167.629	233.694	0	233.694	293.553	293.553
38	0.701338	215.58	29.1106	Colluvium	10	34	105.418	164.385	228.885	0	228.885	287.586	287.586
39	0.602949	181.289	29.6555	Colluvium	10	34	102.581	159.962	222.327	0	222.327	280.733	280.733
40	0.602949	177.24	29.6555	Colluvium	10	34	100.6	156.872	217.746	0	217.746	275.024	275.024
41	0.602949	172.828	30.3442	Colluvium	10	34	97.5561	152.126	210.71	0	210.71	267.818	267.818
42	0.602949	168.051	30.3442	Colluvium	10	34	95.2923	148.596	205.477	0	205.477	261.26	261.26
43	0.484104	130.083	34.2169	Colluvium	10	34	87.956	137.156	188.517	0	188.517	248.329	248.329
44	0.484104	124.232	34.2169	Colluvium	10	34	84.6662	132.026	180.91	0	180.91	238.486	238.486
45	0.481333	117.719	34.2169	Colluvium	10	34	81.3662	126.88	173.281	0	173.281	228.613	228.613
46	0.481333	111.934	34.2169	Colluvium	10	34	78.052	121.712	165.62	0	165.62	218.698	218.698
47	0.830679	176.422	36.9783	Colluvium	10	34	70.0998	109.312	147.235	0	147.235	200.018	200.018
48	0.830679	143.123	44.4122	Colluvium	10	34	53.8483	83.9695	109.664	0	109.664	162.419	162.419
49	0.813113	98.3767	44.4122	Colluvium	10	34	40.0144	62.3973	77.6822	0	77.6822	116.884	116.884
50	0.813113	43.8313	49.7298	Colluvium	10	34	19.4653	30.3536	30.1754	0	30.1754	53.1523	53.1523

2H:1V With Berm - Seismic

Global Minimum Query (bishop simplified) - Safety Factor: 1.20682

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [deg]	Base Material	Base Cohesion [psf]	Base Friction Angle [deg]	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	0.913826	24.396	0.735969	Colluvium	10	34	23.0419	27.8074	26.4006	0	26.4006	26.6965	26.6965
2	0.916352	73.458	0.735969	Colluvium	10	34	52.7123	63.6142	79.4864	0	79.4864	80.1635	80.1635
3	0.992918	124.675	10.207	Colluvium	10	34	71.2917	86.0362	112.728	0	112.728	125.565	125.565
4	0.496459	75.2286	13.7056	Colluvium	10	34	81.8253	98.7484	131.575	0	131.575	151.53	151.53
5	0.496459	82.5116	13.7056	Colluvium	10	34	89.041	107.457	144.485	0	144.485	166.2	166.2
6	0.496458	89.7945	13.7056	Colluvium	10	34	96.2571	116.165	157.395	0	157.395	180.87	180.87
7	0.496458	97.0775	13.7056	Colluvium	10	34	103.473	124.873	170.306	0	170.306	195.54	195.54
8	0.494467	103.322	15.8279	Colluvium	10	34	107.967	130.297	178.348	0	178.348	208.956	208.956
9	0.494467	109.336	15.8279	Colluvium	10	34	113.836	137.379	188.847	0	188.847	221.119	221.119
10	0.704806	163.851	19.8234	Colluvium	10	34	115.042	138.835	191.006	0	191.006	232.477	232.477
11	0.704806	171.289	19.8234	Colluvium	10	34	119.952	144.76	199.79	0	199.79	243.03	243.03
12	1.40963	364.895	19.8234	Colluvium	10	34	127.316	153.647	212.965	0	212.965	258.86	258.86
13	0.704811	193.604	19.8234	Colluvium	10	34	134.68	162.534	226.14	0	226.14	274.69	274.69
14	0.704811	201.043	19.8234	Colluvium	10	34	139.588	168.458	234.924	0	234.924	285.244	285.244
15	0.735012	215.674	22.6332	Colluvium	10	34	139.727	168.625	235.172	0	235.172	293.43	293.43
16	0.735012	219.951	22.6332	Colluvium	10	34	142.364	171.808	239.891	0	239.891	299.249	299.249
17	0.625857	189.674	24.5664	Colluvium	10	34	141.516	170.784	238.372	0	238.372	303.062	303.062
18	0.625857	190.807	24.5664	Colluvium	10	34	142.322	171.757	239.815	0	239.815	304.874	304.874
19	0.625857	191.94	24.5664	Colluvium	10	34	143.128	172.73	241.256	0	241.256	306.684	306.684
20	0.625857	193.073	24.5664	Colluvium	10	34	143.934	173.702	242.699	0	242.699	308.495	308.495
21	0.625857	194.207	24.5664	Colluvium	10	34	144.74	174.675	244.141	0	244.141	310.305	310.305
22	0.625857	195.34	24.5664	Colluvium	10	34	145.546	175.648	245.584	0	245.584	312.117	312.117
23	0.625857	196.473	24.5664	Colluvium	10	34	146.352	176.621	247.025	0	247.025	313.927	313.927
24	0.625857	197.606	24.5664	Colluvium	10	34	147.158	177.593	248.467	0	248.467	315.737	315.737
25	1.40972	449.252	24.5664	Colluvium	10	34	148.469	179.175	250.813	0	250.813	318.682	318.682
26	0.704861	226.782	24.5664	Colluvium	10	34	149.83	180.818	253.249	0	253.249	321.741	321.741
27	0.704861	228.219	24.5664	Colluvium	10	34	150.738	181.914	254.872	0	254.872	323.779	323.779
28	0.66889	216.198	27.3876	Colluvium	10	34	146.513	176.815	247.314	0	247.314	323.219	323.219
29	0.66889	214.083	27.3876	Colluvium	10	34	145.143	175.162	244.862	0	244.862	320.057	320.057
30	0.66889	211.774	27.702	Colluvium	10	34	143.214	172.833	241.41	0	241.41	316.605	316.605
31	0.66889	209.269	27.702	Colluvium	10	34	141.595	170.88	238.515	0	238.515	312.861	312.861
32	0.600736	185.122	29.0581	Colluvium	10	34	137.744	166.232	231.623	0	231.623	308.159	308.159
33	0.600736	181.722	29.0581	Colluvium	10	34	135.33	163.319	227.305	0	227.305	302.499	302.499
34	0.551226	163.754	29.0581	Colluvium	10	34	133.016	160.526	223.165	0	223.165	297.073	297.073
35	0.551226	160.892	29.0581	Colluvium	10	34	130.802	157.854	219.202	0	219.202	291.88	291.88
36	0.551226	158.029	29.0581	Colluvium	10	34	128.587	155.181	215.241	0	215.241	286.688	286.688
37	0.551226	155.167	29.0581	Colluvium	10	34	126.372	152.508	211.278	0	211.278	281.494	281.494
38	0.54925	151.713	29.1752	Colluvium	10	34	123.98	149.622	206.999	0	206.999	276.219	276.219
39	0.54925	148.77	29.1752	Colluvium	10	34	121.698	146.868	202.915	0	202.915	270.861	270.861
40	0.505596	132.509	33.9498	Colluvium	10	34	112.454	135.712	186.376	0	186.376	262.084	262.084
41	0.505596	126.343	33.9498	Colluvium	10	34	107.502	129.735	177.515	0	177.515	249.888	249.888
42	0.515898	122.561	33.9498	Colluvium	10	34	102.499	123.698	168.564	0	168.564	237.57	237.57
43	0.515898	116.142	33.9498	Colluvium	10	34	97.4454	117.599	159.522	0	159.522	225.126	225.126
44	0.515897	109.25	35.0537	Colluvium	10	34	90.9724	109.787	147.941	0	147.941	211.767	211.767
45	0.515897	101.887	35.0537	Colluvium	10	34	85.242	102.872	137.688	0	137.688	197.494	197.494
46	0.483539	86.5248	40.631	Colluvium	10	34	73.1961	88.3345	116.136	0	116.136	178.941	178.941
47	0.483539	75.484	40.631	Colluvium	10	34	64.5707	77.9252	100.703	0	100.703	156.108	156.108
48	1.00051	120.932	40.7351	Colluvium	10	34	51.1987	61.7876	76.7781	0	76.7781	120.87	120.87
49	0.500253	40.2546	45.2946	Colluvium	10	34	34.0395	41.0796	46.0774	0	46.0774	80.4688	80.4688
50	0.500253	15.8025	45.2946	Colluvium	10	34	16.5795	20.0085	14.8382	0	14.8382	31.5891	31.5891

Global Minimum Query (janbu simplified) - Safety Factor: 1.1622

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [deg]	Base Material	Base Cohesion [psf]	Base Friction Angle [deg]	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	0.591708	10.5077	0.0046577	Colluvium	10	34	18.9099	21.9771	17.7567	0	17.7567	17.7583	17.7583
2	0.591708	31.5231	0.0046577	Colluvium	10	34	39.5217	45.9321	53.2716	0	53.2716	53.2748	53.2748
3	0.59165	52.5225	0.030321	Colluvium	10	34	60.1072	69.8566	88.741	0	88.741	88.7728	88.7728
4	0.59165	73.5141	0.030321	Colluvium	10	34	80.6925	93.7808	124.21	0	124.21	124.253	124.253
5	0.548165	83.5278	10.0469	Colluvium	10	34	87.992	102.264	136.787	0	136.787	152.377	152.377
6	0.548165	94.9124	10.0469	Colluvium	10	34	98.9219	114.967	155.62	0	155.62	173.146	173.146
7	0.548165	105.954	11.058	Colluvium	10	34	108.48	126.075	172.088	0	172.088	193.289	193.289
8	0.548165	116.653	11.058	Colluvium	10	34	118.653	137.899	189.617	0	189.617	212.806	212.806
9	0.547697	125.988	14.6885	Colluvium	10	34	123.344	143.35	197.7	0	197.7	230.032	230.032
10	0.547697	134.167	14.6885	Colluvium	10	34	130.866	152.093	210.662	0	210.662	244.966	244.966
11	0.642537	167.695	14.9616	Colluvium	10	34	138.582	161.06	223.955	0	223.955	260.989	260.989
12	0.642537	178.689	14.9616	Colluvium	10	34	147.179	171.051	238.768	0	238.768	278.099	278.099
13	0.927634	274.603	17.6742	Colluvium	10	34	152.253	176.948	247.511	0	247.511	296.026	296.026
14	0.927634	291.988	17.6742	Colluvium	10	34	161.433	187.617	263.328	0	263.328	314.767	314.767
15	0.774808	257.051	17.8929	Colluvium	10	34	169.406	196.884	277.067	0	277.067	331.761	331.761
16	0.774808	268.863	17.8929	Colluvium	10	34	176.859	205.545	289.907	0	289.907	347.007	347.007
17	0.812943	292.967	20.1588	Colluvium	10	34	179.511	208.628	294.478	0	294.478	360.379	360.379
18	0.812943	302.315	20.1588	Colluvium	10	34	185.013	215.022	303.957	0	303.957	371.878	371.878
19	0.848261	324.186	21.5269	Colluvium	10	34	187.488	217.898	308.222	0	308.222	382.177	382.177
20	0.848261	331.905	21.5269	Colluvium	10	34	191.785	222.893	315.626	0	315.626	391.276	391.276
21	0.57887	229.575	24.6595	Colluvium	10	34	188.54	219.121	310.034	0	310.034	396.592	396.592
22	0.57887	230.462	24.6595	Colluvium	10	34	189.242	219.937	311.245	0	311.245	398.124	398.124
23	0.57887	231.349	24.6595	Colluvium	10	34	189.944	220.753	312.455	0	312.455	399.657	399.657
24	0.57887	232.237	24.6595	Colluvium	10	34	190.647	221.57	313.666	0	313.666	401.19	401.19
25	0.57887	233.124	24.6595	Colluvium	10	34	191.349	222.386	314.874	0	314.874	402.721	402.721
26	0.57887	234.011	24.6595	Colluvium	10	34	192.051	223.202	316.085	0	316.085	404.254	404.254
27	0.57887	234.898	24.6595	Colluvium	10	34	192.753	224.018	317.295	0	317.295	405.787	405.787
28	0.57887	235.785	24.6595	Colluvium	10	34	193.456	224.834	318.504	0	318.504	407.318	407.318
29	0.641406	262.293	24.6595	Colluvium	10	34	194.195	225.694	319.78	0	319.78	408.933	408.933
30	0.641406	263.382	24.6595	Colluvium	10	34	194.974	226.599	321.121	0	321.121	410.633	410.633
31	0.641406	263.896	25.7087	Colluvium	10	34	193.36	224.723	318.34	0	318.34	411.434	411.434
32	0.641406	263.835	25.7087	Colluvium	10	34	193.317	224.673	318.266	0	318.266	411.339	411.339
33	0.563585	230.196	29.2895	Colluvium	10	34	185.325	215.385	304.495	0	304.495	408.45	408.45
34	0.563585	226.994	29.2895	Colluvium	10	34	182.837	212.493	300.208	0	300.208	402.767	402.767
35	0.563585	223.791	29.2895	Colluvium	10	34	180.348	209.601	295.921	0	295.921	397.085	397.085
36	0.563585	220.589	29.2895	Colluvium	10	34	177.861	206.71	291.635	0	291.635	391.403	391.403
37	0.514712	198.522	29.6545	Colluvium	10	34	174.719	203.059	286.221	0	286.221	385.695	385.695
38	0.514712	195.573	29.6545	Colluvium	10	34	172.22	200.154	281.914	0	281.914	379.965	379.965
39	0.696889	258.19	32.2949	Colluvium	10	34	163.61	190.148	267.08	0	267.08	370.49	370.49
40	0.696889	248.976	32.2949	Colluvium	10	34	157.996	183.623	257.407	0	257.407	357.268	357.268
41	0.695799	239.367	32.3322	Colluvium	10	34	152.31	177.015	247.61	0	247.61	344.017	344.017
42	0.695799	230.126	32.3322	Colluvium	10	34	146.674	170.464	237.899	0	237.899	330.737	330.737
43	0.929066	288.24	35.7082	Colluvium	10	34	133.127	154.72	214.556	0	214.556	310.247	310.247
44	0.466901	135.138	35.7082	Colluvium	10	34	124.604	144.815	199.873	0	199.873	289.437	289.437
45	0.466901	128.639	35.7082	Colluvium	10	34	118.904	138.19	190.05	0	190.05	275.517	275.517
46	0.469784	120.971	40.5859	Colluvium	10	34	105.566	122.689	167.068	0	167.068	257.504	257.504
47	0.469784	110.587	40.5859	Colluvium	10	34	96.9979	112.731	152.305	0	152.305	235.4	235.4
48	0.939569	189.953	40.6274	Colluvium	10	34	84.0756	97.7127	130.04	0	130.04	202.171	202.171
49	0.927844	132.169	48.4352	Colluvium	10	34	55.1689	64.1173	80.2322	0	80.2322	142.447	142.447
50	0.927844	55.0945	48.4352	Colluvium	10	34	26.0299	30.2519	30.0247	0	30.0247	59.3791	59.3791

Global Minimum Query (spencer) - Safety Factor: 1.18976

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [deg]	Base Material	Base Cohesion [psf]	Base Friction Angle [deg]	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	0.515334	6.65478	4.53598	Colluvium	10	34	20.6293	24.5439	21.5621	0	21.5621	23.1987	23.1987
2	0.515334	19.9643	4.53598	Colluvium	10	34	38.6151	45.9427	53.2873	0	53.2873	56.3507	56.3507
3	0.52313	33.3038	6.44675	Colluvium	10	34	53.4372	63.5774	79.4318	0	79.4318	85.4699	85.4699
4	0.52313	45.8676	6.44675	Colluvium	10	34	69.3423	82.5007	107.487	0	107.487	115.322	115.322
5	0.577034	62.5474	13.433	Colluvium	10	34	70.8534	84.2986	110.152	0	110.152	127.075	127.075
6	0.577034	72.5959	13.433	Colluvium	10	34	80.5985	95.8929	127.341	0	127.341	146.592	146.592
7	0.577034	82.6445	13.433	Colluvium	10	34	90.3436	107.487	144.531	0	144.531	166.108	166.108
8	0.577034	92.693	13.433	Colluvium	10	34	100.089	119.082	161.72	0	161.72	185.625	185.625
9	0.589598	103.691	16.8705	Colluvium	10	34	100.942	120.097	163.226	0	163.226	193.838	193.838
10	0.589598	111.383	16.8705	Colluvium	10	34	107.706	128.144	175.156	0	175.156	207.819	207.819
11	0.589341	119.021	16.8705	Colluvium	10	34	114.468	136.19	187.084	0	187.084	221.798	221.798
12	0.589341	126.705	16.8705	Colluvium	10	34	121.229	144.233	199.009	0	199.009	235.773	235.773
13	0.768048	174.404	20.0243	Colluvium	10	34	119.45	142.117	195.871	0	195.871	239.405	239.405
14	0.768048	182.945	20.0243	Colluvium	10	34	124.839	148.528	205.376	0	205.376	250.874	250.874
15	0.771941	192.476	20.0256	Colluvium	10	34	130.237	154.951	214.898	0	214.898	262.367	262.367
16	0.771941	201.102	20.0256	Colluvium	10	34	135.652	161.393	224.449	0	224.449	273.891	273.891
17	0.79684	216.37	20.3631	Colluvium	10	34	140.024	166.595	232.161	0	232.161	284.133	284.133
18	0.79684	225.029	20.3631	Colluvium	10	34	145.253	172.816	241.385	0	241.385	295.298	295.298
19	0.799828	234.23	20.8049	Colluvium	10	34	148.933	177.194	247.876	0	247.876	304.464	304.464
20	0.799828	242.251	20.8049	Colluvium	10	34	153.713	182.882	256.309	0	256.309	314.715	314.715
21	0.655377	202.413	24.5562	Colluvium	10	34	145.183	172.733	241.262	0	241.262	307.598	307.598
22	0.655377	203.667	24.5562	Colluvium	10	34	146.028	173.738	242.751	0	242.751	309.473	309.473
23	0.655377	204.759	24.8434	Colluvium	10	34	145.927	173.618	242.573	0	242.573	310.135	310.135
24	0.655377	205.687	24.8434	Colluvium	10	34	146.547	174.356	243.668	0	243.668	311.518	311.518
25	0.655377	206.615	24.8434	Colluvium	10	34	147.168	175.095	244.764	0	244.764	312.9	312.9
26	0.655377	207.543	24.8434	Colluvium	10	34	147.789	175.834	245.859	0	245.859	314.283	314.283
27	0.655377	208.471	24.8434	Colluvium	10	34	148.411	176.573	246.954	0	246.954	315.666	315.666
28	0.655377	209.399	24.8434	Colluvium	10	34	149.032	177.312	248.049	0	248.049	317.049	317.049
29	0.655377	210.327	24.8434	Colluvium	10	34	149.653	178.051	249.145	0	249.145	318.432	318.432
30	0.655377	211.255	24.8434	Colluvium	10	34	150.273	178.789	250.241	0	250.241	319.815	319.815
31	0.655377	212.183	24.8434	Colluvium	10	34	150.894	179.528	251.336	0	251.336	321.198	321.198
32	0.655377	213.111	24.8434	Colluvium	10	34	151.515	180.267	252.432	0	252.432	322.581	322.581
33	0.542125	175.73	27.9849	Colluvium	10	34	141.977	168.919	235.608	0	235.608	311.051	311.051
34	0.542125	173.853	27.9849	Colluvium	10	34	140.553	167.224	233.095	0	233.095	307.781	307.781
35	0.542125	171.702	28.6459	Colluvium	10	34	137.13	163.152	227.058	0	227.058	301.966	301.966
36	0.542125	169.278	28.6459	Colluvium	10	34	135.316	160.993	223.856	0	223.856	297.773	297.773
37	0.541118	166.543	28.6525	Colluvium	10	34	133.482	158.812	220.624	0	220.624	293.56	293.56
38	0.541118	164.122	28.6525	Colluvium	10	34	131.667	156.652	217.421	0	217.421	289.365	289.365
39	0.737622	218.987	29.7269	Colluvium	10	34	126.378	150.36	208.092	0	208.092	280.255	280.255
40	0.737622	212.815	29.7269	Colluvium	10	34	123.056	146.407	202.231	0	202.231	272.498	272.498
41	0.728629	203.885	30.0855	Colluvium	10	34	118.769	141.307	194.67	0	194.67	263.478	263.478
42	0.728629	197.311	30.0855	Colluvium	10	34	115.211	137.074	188.395	0	188.395	255.142	255.142
43	0.711383	182.85	34.5412	Colluvium	10	34	100.67	119.773	162.745	0	162.745	232.04	232.04
44	0.711383	169.688	34.5412	Colluvium	10	34	94.0055	111.844	150.989	0	150.989	215.697	215.697
45	0.711383	156.526	34.5412	Colluvium	10	34	87.3415	103.915	139.235	0	139.235	199.356	199.356
46	0.711383	143.364	34.5412	Colluvium	10	34	80.6775	95.9869	127.48	0	127.48	183.014	183.014
47	0.654879	118.688	36.8711	Colluvium	10	34	70.1478	83.459	108.907	0	108.907	161.52	161.52
48	0.654868	98.1525	44.3209	Colluvium	10	34	51.3276	61.0675	75.7107	0	75.7107	125.836	125.836
49	0.674092	73.2457	44.3209	Colluvium	10	34	39.2419	46.6885	54.393	0	54.393	92.7156	92.7156
50	0.674081	31.8265	48.7823	Colluvium	10	34	19.5979	23.3168	19.743	0	19.743	42.1156	42.1156

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.18418

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [deg]	Base Material	Base Cohesion [psf]	Base Friction Angle [deg]	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	0.493177	7.17189	0.485957	Colluvium	10	34	16.9598	20.0835	14.9494	0	14.9494	15.0933	15.0933
2	0.493177	21.5157	0.485957	Colluvium	10	34	34.6463	41.0275	46.0003	0	46.0003	46.2941	46.2941
3	0.493177	34.1427	6.92262	Colluvium	10	34	47.4267	56.1618	68.4378	0	68.4378	74.196	74.196
4	0.493177	45.053	6.92262	Colluvium	10	34	61.0114	72.2485	92.2871	0	92.2871	99.6947	99.6947
5	0.467307	52.7565	6.92262	Colluvium	10	34	74.6952	88.4526	116.311	0	116.311	125.38	125.38
6	0.467307	62.5522	6.92262	Colluvium	10	34	88.4578	104.75	140.473	0	140.473	151.213	151.213
7	0.934613	147.418	14.0893	Colluvium	10	34	94.8775	112.352	151.743	0	151.743	175.556	175.556
8	0.934657	170.773	15.7436	Colluvium	10	34	107.727	127.568	174.301	0	174.301	204.67	204.67
9	0.467328	93.5095	15.7436	Colluvium	10	34	118.364	140.164	192.976	0	192.976	226.344	226.344
10	0.467328	98.9246	15.7436	Colluvium	10	34	125.523	148.642	205.546	0	205.546	240.932	240.932
11	0.743663	165.926	19.7394	Colluvium	10	34	123.88	146.696	202.659	0	202.659	247.111	247.111
12	0.743663	174.321	19.7394	Colluvium	10	34	130.135	154.103	213.643	0	213.643	260.339	260.339
13	0.743663	181.204	21.9282	Colluvium	10	34	129.783	153.686	213.023	0	213.023	265.269	265.269
14	0.743663	186.576	21.9282	Colluvium	10	34	133.269	157.815	219.145	0	219.145	272.795	272.795
15	0.512819	131.789	21.9282	Colluvium	10	34	136.147	161.223	224.197	0	224.197	279.006	279.006
16	0.512819	134.343	21.9282	Colluvium	10	34	138.444	163.943	228.229	0	228.229	283.962	283.962
17	0.512819	136.897	21.9282	Colluvium	10	34	140.693	166.606	232.178	0	232.178	288.817	288.817
18	0.769228	210.135	21.9282	Colluvium	10	34	143.433	169.851	236.989	0	236.989	294.731	294.731
19	0.769228	215.882	21.9282	Colluvium	10	34	146.62	173.624	242.582	0	242.582	301.607	301.607
20	0.543127	155.189	23.7762	Colluvium	10	34	142.597	168.861	235.52	0	235.52	298.343	298.343
21	0.543127	156.653	23.7762	Colluvium	10	34	143.308	169.703	236.769	0	236.769	299.904	299.904
22	0.543127	158.117	23.7762	Colluvium	10	34	143.992	170.513	237.97	0	237.97	301.407	301.407
23	0.543127	159.582	23.7762	Colluvium	10	34	144.651	171.293	239.126	0	239.126	302.853	302.853
24	0.543127	161.046	23.7762	Colluvium	10	34	145.287	172.046	240.243	0	240.243	304.25	304.25
25	0.543127	162.511	23.7762	Colluvium	10	34	145.902	172.774	241.323	0	241.323	305.601	305.601
26	0.543127	163.975	23.7762	Colluvium	10	34	146.5	173.482	242.371	0	242.371	306.913	306.913
27	0.543127	165.44	23.7762	Colluvium	10	34	147.082	174.171	243.394	0	243.394	308.192	308.192
28	0.543127	166.904	23.7762	Colluvium	10	34	147.652	174.846	244.393	0	244.393	309.442	309.442
29	0.81469	253.102	23.7762	Colluvium	10	34	148.351	175.674	245.622	0	245.622	310.978	310.978
30	0.81469	256.397	23.7762	Colluvium	10	34	149.18	176.656	247.077	0	247.077	312.799	312.799
31	0.827521	263.003	24.6721	Colluvium	10	34	146.557	173.55	242.472	0	242.472	309.794	309.794
32	0.827521	264.793	24.6721	Colluvium	10	34	146.627	173.633	242.596	0	242.596	309.951	309.951
33	0.551681	177.523	24.6721	Colluvium	10	34	146.723	173.747	242.765	0	242.765	310.164	310.164
34	0.551681	178.319	24.6721	Colluvium	10	34	146.831	173.874	242.953	0	242.953	310.401	310.401
35	0.551681	179.115	24.6721	Colluvium	10	34	146.966	174.034	243.19	0	243.19	310.7	310.7
36	0.762544	246.88	27.2276	Colluvium	10	34	138.498	164.006	228.323	0	228.323	299.585	299.585
37	0.762544	244.39	27.2276	Colluvium	10	34	136.983	162.212	225.663	0	225.663	296.146	296.146
38	0.508363	161.101	28.4518	Colluvium	10	34	132.235	156.59	217.328	0	217.328	288.982	288.982
39	0.508363	159.111	28.4518	Colluvium	10	34	130.782	154.869	214.776	0	214.776	285.642	285.642
40	0.508363	157.122	28.4518	Colluvium	10	34	129.371	153.199	212.301	0	212.301	282.403	282.403
41	0.665897	202.801	28.4518	Colluvium	10	34	127.794	151.331	209.532	0	209.532	278.779	278.779
42	0.665897	199.387	28.4518	Colluvium	10	34	126.062	149.28	206.491	0	206.491	274.8	274.8
43	0.665897	195.263	29.5736	Colluvium	10	34	121.646	144.051	198.739	0	198.739	267.769	267.769
44	0.665897	190.43	29.5736	Colluvium	10	34	119.356	141.339	194.717	0	194.717	262.448	262.448
45	0.862695	234.938	33.6647	Colluvium	10	34	107.659	127.488	174.184	0	174.184	245.888	245.888
46	0.862695	215.267	35.6561	Colluvium	10	34	97.5882	115.562	156.502	0	156.502	226.513	226.513
47	0.851506	188.548	37.5244	Colluvium	10	34	86.4545	102.378	136.956	0	136.956	203.354	203.354
48	0.851506	162.47	37.5244	Colluvium	10	34	76.824	90.9735	120.048	0	120.048	179.05	179.05
49	0.91106	132.349	45.3134	Colluvium	10	34	55.2031	65.3704	82.0902	0	82.0902	137.9	137.9
50	0.91106	58.5097	50.5678	Colluvium	10	34	26.1609	30.9792	31.103	0	31.103	62.9153	62.9153

2H:1V With Berm - Static

Global Minimum Query (bishop simplified) - Safety Factor: 1.57206

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [deg]	Base Material	Base Cohesion [psf]	Base Friction Angle [deg]	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	0.658242	7.1082	12.2862	Colluvium	10	34	10.0559	15.8085	8.61151	0	8.61151	10.8015	10.8015
2	0.658242	21.0874	12.7644	Colluvium	10	34	18.3273	28.8116	27.8893	0	27.8893	32.0412	32.0412
3	0.658242	34.591	13.2436	Colluvium	10	34	26.2601	41.2824	46.3781	0	46.3781	52.5584	52.5584
4	0.658242	47.616	13.7236	Colluvium	10	34	33.8556	53.223	64.0807	0	64.0807	72.3486	72.3486
5	0.658242	60.1597	14.2047	Colluvium	10	34	41.1152	64.6355	81.0004	0	81.0004	91.4077	91.4077
6	0.658242	72.219	14.6867	Colluvium	10	34	48.0399	75.5216	97.1398	0	97.1398	109.731	109.731
7	0.658242	83.7908	15.1698	Colluvium	10	34	54.6311	85.8833	112.502	0	112.502	127.314	127.314
8	0.658242	94.8718	15.6541	Colluvium	10	34	60.8895	95.7219	127.088	0	127.088	144.151	144.151
9	0.658242	105.458	16.1395	Colluvium	10	34	66.8162	105.039	140.901	0	140.901	160.237	160.237
10	0.658242	115.547	16.6261	Colluvium	10	34	72.412	113.836	153.943	0	153.943	175.566	175.566
11	0.658242	125.134	17.1139	Colluvium	10	34	77.6783	122.115	166.217	0	166.217	190.135	190.135
12	0.658242	134.216	17.603	Colluvium	10	34	82.6145	129.875	177.722	0	177.722	203.934	203.934
13	0.658242	142.788	18.0934	Colluvium	10	34	87.2225	137.119	188.462	0	188.462	216.96	216.96
14	0.658242	150.846	18.5852	Colluvium	10	34	91.5022	143.847	198.437	0	198.437	229.204	229.204
15	0.658242	158.386	19.0784	Colluvium	10	34	95.4544	150.06	207.648	0	207.648	240.662	240.662
16	0.658242	165.403	19.5731	Colluvium	10	34	99.0796	155.759	216.097	0	216.097	251.325	251.325
17	0.658242	171.893	20.0694	Colluvium	10	34	102.378	160.944	223.784	0	223.784	261.187	261.187
18	0.658242	177.85	20.5672	Colluvium	10	34	105.35	165.616	230.711	0	230.711	270.24	270.24
19	0.658242	183.27	21.0666	Colluvium	10	34	107.995	169.775	236.875	0	236.875	278.475	278.475
20	0.658242	188.146	21.5677	Colluvium	10	34	110.314	173.421	242.282	0	242.282	285.887	285.887
21	0.658242	192.473	22.0705	Colluvium	10	34	112.307	176.554	246.927	0	246.927	292.463	292.463
22	0.658242	196.247	22.5752	Colluvium	10	34	113.975	179.175	250.812	0	250.812	298.197	298.197
23	0.658242	199.459	23.0817	Colluvium	10	34	115.316	181.283	253.938	0	253.938	303.08	303.08
24	0.658242	202.105	23.5901	Colluvium	10	34	116.33	182.878	256.302	0	256.302	307.101	307.101
25	0.658242	204.177	24.1005	Colluvium	10	34	117.018	183.96	257.906	0	257.906	310.252	310.252
26	0.658242	205.669	24.6129	Colluvium	10	34	117.38	184.528	258.748	0	258.748	312.52	312.52
27	0.658242	206.574	25.1275	Colluvium	10	34	117.413	184.581	258.828	0	258.828	313.897	313.897
28	0.658242	206.884	25.6442	Colluvium	10	34	117.12	184.12	258.143	0	258.143	314.369	314.369
29	0.658242	206.592	26.1632	Colluvium	10	34	116.499	183.143	256.695	0	256.695	313.927	313.927
30	0.658242	205.69	26.6844	Colluvium	10	34	115.549	181.65	254.481	0	254.481	312.557	312.557
31	0.658242	204.169	27.2081	Colluvium	10	34	114.27	179.639	251.499	0	251.499	310.246	310.246
32	0.658242	202.02	27.7343	Colluvium	10	34	112.66	177.109	247.749	0	247.749	306.983	306.983
33	0.658242	199.235	28.263	Colluvium	10	34	110.72	174.059	243.228	0	243.228	302.752	302.752
34	0.658242	195.804	28.7943	Colluvium	10	34	108.449	170.489	237.935	0	237.935	297.541	297.541
35	0.658242	191.717	29.3284	Colluvium	10	34	105.845	166.395	231.866	0	231.866	291.332	291.332
36	0.658242	186.965	29.8653	Colluvium	10	34	102.908	161.778	225.02	0	225.02	284.112	284.112
37	0.658242	181.535	30.4051	Colluvium	10	34	99.6361	156.634	217.395	0	217.395	275.863	275.863
38	0.658242	175.418	30.9478	Colluvium	10	34	96.0288	150.963	208.987	0	208.987	266.568	266.568
39	0.658242	168.601	31.4937	Colluvium	10	34	92.0849	144.763	199.795	0	199.795	256.21	256.21
40	0.658242	161.072	32.0428	Colluvium	10	34	87.8026	138.031	189.814	0	189.814	244.771	244.771
41	0.658242	152.819	32.5952	Colluvium	10	34	83.1813	130.766	179.043	0	179.043	232.23	232.23
42	0.658242	143.827	33.1511	Colluvium	10	34	78.219	122.965	167.478	0	167.478	218.567	218.567
43	0.658242	134.084	33.7104	Colluvium	10	34	72.9145	114.626	155.115	0	155.115	203.762	203.762
44	0.658242	123.574	34.2735	Colluvium	10	34	67.2665	105.747	141.951	0	141.951	187.791	187.791
45	0.658242	112.281	34.8403	Colluvium	10	34	61.273	96.3249	127.982	0	127.982	170.632	170.632
46	0.658242	100.191	35.4111	Colluvium	10	34	54.9326	86.3574	113.205	0	113.205	152.259	152.259
47	0.658242	87.2849	35.9859	Colluvium	10	34	48.2436	75.8418	97.6146	0	97.6146	132.647	132.647
48	0.658242	73.5459	36.565	Colluvium	10	34	41.2041	64.7753	81.2077	0	81.2077	111.77	111.77
49	0.658242	57.2096	37.1485	Colluvium	10	34	32.9534	51.8047	61.978	0	61.978	86.9443	86.9443
50	0.658242	20.9575	37.7364	Colluvium	10	34	15.0355	23.6367	20.2172	0	20.2172	31.8533	31.8533

Global Minimum Query (janbu simplified) - Safety Factor: 1.53716

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [deg]	Base Material	Base Cohesion [psf]	Base Friction Angle [deg]	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	0.652179	9.90516	6.14517	Colluvium	10	34	12.576	19.3313	13.8342	0	13.8342	15.1882	15.1882
2	0.652179	29.3892	6.83934	Colluvium	10	34	24.9657	38.3763	42.0697	0	42.0697	45.064	45.064
3	0.652179	48.2194	7.53453	Colluvium	10	34	36.8127	56.587	69.0681	0	69.0681	73.9372	73.9372
4	0.652179	66.3926	8.23083	Colluvium	10	34	48.1224	73.9718	94.8421	0	94.8421	101.803	101.803
5	0.652179	83.9055	8.92835	Colluvium	10	34	58.8999	90.5386	119.403	0	119.403	128.657	128.657
6	0.652179	100.755	9.62721	Colluvium	10	34	69.1501	106.295	142.763	0	142.763	154.492	154.492
7	0.652179	116.936	10.3275	Colluvium	10	34	78.8773	121.247	164.931	0	164.931	179.305	179.305
8	0.652179	132.445	11.0294	Colluvium	10	34	88.0858	135.402	185.916	0	185.916	203.085	203.085
9	0.652179	147.277	11.733	Colluvium	10	34	96.7791	148.765	205.728	0	205.728	225.829	225.829
10	0.652179	161.427	12.4383	Colluvium	10	34	104.962	161.343	224.375	0	224.375	247.526	247.526
11	0.652179	174.889	13.1456	Colluvium	10	34	112.636	173.139	241.863	0	241.863	268.169	268.169
12	0.652179	187.659	13.8549	Colluvium	10	34	119.805	184.159	258.202	0	258.202	287.75	287.75
13	0.652179	199.729	14.5664	Colluvium	10	34	126.472	194.407	273.395	0	273.395	306.259	306.259
14	0.652179	211.093	15.2802	Colluvium	10	34	132.638	203.886	287.448	0	287.448	323.685	323.685
15	0.652179	221.745	15.9964	Colluvium	10	34	138.307	212.6	300.367	0	300.367	340.017	340.017
16	0.652179	231.675	16.7152	Colluvium	10	34	143.48	220.552	312.157	0	312.157	355.245	355.245
17	0.652179	240.877	17.4368	Colluvium	10	34	148.16	227.745	322.82	0	322.82	369.355	369.355
18	0.652179	249.342	18.1612	Colluvium	10	34	152.346	234.18	332.361	0	332.361	382.335	382.335
19	0.652179	257.061	18.8886	Colluvium	10	34	156.041	239.86	340.782	0	340.782	394.172	394.172
20	0.652179	264.024	19.6192	Colluvium	10	34	159.246	244.786	348.085	0	348.085	404.849	404.849
21	0.652179	270.221	20.3531	Colluvium	10	34	161.96	248.959	354.27	0	354.27	414.352	414.352
22	0.652179	275.641	21.0905	Colluvium	10	34	164.185	252.379	359.342	0	359.342	422.664	422.664
23	0.652179	280.273	21.8316	Colluvium	10	34	165.921	255.047	363.298	0	363.298	429.768	429.768
24	0.652179	284.105	22.5766	Colluvium	10	34	167.168	256.964	366.139	0	366.139	435.644	435.644
25	0.652179	287.124	23.3256	Colluvium	10	34	167.925	258.128	367.864	0	367.864	440.274	440.274
26	0.652179	289.316	24.0789	Colluvium	10	34	168.193	258.539	368.474	0	368.474	443.636	443.636
27	0.652179	290.667	24.8366	Colluvium	10	34	167.97	258.196	367.965	0	367.965	445.708	445.708
28	0.652179	291.162	25.599	Colluvium	10	34	167.255	257.097	366.336	0	366.336	446.467	446.467
29	0.652179	290.784	26.3663	Colluvium	10	34	166.046	255.24	363.584	0	363.584	445.889	445.889
30	0.652179	289.515	27.1387	Colluvium	10	34	164.345	252.624	359.704	0	359.704	443.943	443.943
31	0.652179	287.339	27.9165	Colluvium	10	34	162.146	249.245	354.695	0	354.695	440.607	440.607
32	0.652179	284.234	28.6999	Colluvium	10	34	159.451	245.101	348.551	0	348.551	435.848	435.848
33	0.652179	280.181	29.4893	Colluvium	10	34	156.254	240.188	341.267	0	341.267	429.633	429.633
34	0.652179	275.157	30.2848	Colluvium	10	34	152.555	234.502	332.838	0	332.838	421.929	421.929
35	0.652179	269.139	31.0868	Colluvium	10	34	148.352	228.04	323.257	0	323.257	412.702	412.702
36	0.652179	262.102	31.8957	Colluvium	10	34	143.64	220.797	312.52	0	312.52	401.912	401.912
37	0.652179	254.019	32.7117	Colluvium	10	34	138.416	212.768	300.616	0	300.616	389.518	389.518
38	0.652179	244.86	33.5353	Colluvium	10	34	132.678	203.948	287.539	0	287.539	375.475	375.475
39	0.652179	234.597	34.3668	Colluvium	10	34	126.421	194.33	273.281	0	273.281	359.736	359.736
40	0.652179	223.194	35.2067	Colluvium	10	34	119.643	183.911	257.833	0	257.833	342.253	342.253
41	0.652179	210.618	36.0553	Colluvium	10	34	112.338	172.681	241.185	0	241.185	322.969	322.969
42	0.652179	196.831	36.9132	Colluvium	10	34	104.502	160.636	223.327	0	223.327	301.827	301.827
43	0.652179	181.79	37.7808	Colluvium	10	34	96.1305	147.768	204.25	0	204.25	278.765	278.765
44	0.652179	165.453	38.6587	Colluvium	10	34	87.2186	134.069	183.94	0	183.94	253.712	253.712
45	0.652179	147.77	39.5476	Colluvium	10	34	77.7616	119.532	162.387	0	162.387	226.597	226.597
46	0.652179	128.691	40.448	Colluvium	10	34	67.7537	104.148	139.581	0	139.581	197.342	197.342
47	0.652179	108.159	41.3606	Colluvium	10	34	57.1901	87.9103	115.507	0	115.507	165.857	165.857
48	0.652179	86.112	42.2862	Colluvium	10	34	46.065	70.8093	90.1535	0	90.1535	132.049	132.049
49	0.652179	62.4831	43.2256	Colluvium	10	34	34.3731	52.8369	63.5084	0	63.5084	95.8158	95.8158
50	0.652179	25.7947	44.1798	Colluvium	10	34	16.7292	25.7155	23.2992	0	23.2992	39.5562	39.5562

Global Minimum Query (spencer) - Safety Factor: 1.56927

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [deg]	Base Material	Base Cohesion [psf]	Base Friction Angle [deg]	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	0.658838	7.13286	12.2625	Colluvium	10	34	11.517	18.0733	11.9692	0	11.9692	14.4724	14.4724
2	0.658838	21.1609	12.7409	Colluvium	10	34	20.484	32.1449	32.8311	0	32.8311	37.4627	37.4627
3	0.658838	34.7123	13.2202	Colluvium	10	34	29.0168	45.5352	52.6831	0	52.6831	59.4997	59.4997
4	0.658838	47.7843	13.7004	Colluvium	10	34	37.1218	58.2542	71.5398	0	71.5398	80.5894	80.5894
5	0.658838	60.374	14.1816	Colluvium	10	34	44.8053	70.3116	89.4156	0	89.4156	100.738	100.738
6	0.658838	72.4784	14.6638	Colluvium	10	34	52.073	81.7166	106.324	0	106.324	119.95	119.95
7	0.658838	84.0943	15.1471	Colluvium	10	34	58.9308	92.4783	122.279	0	122.279	138.232	138.232
8	0.658838	95.2183	15.6315	Colluvium	10	34	65.3842	102.605	137.293	0	137.293	155.588	155.588
9	0.658838	105.847	16.1171	Colluvium	10	34	71.4383	112.106	151.38	0	151.38	172.022	172.022
10	0.658838	115.977	16.6039	Colluvium	10	34	77.0995	120.99	164.549	0	164.549	187.539	187.539
11	0.658838	125.604	17.0918	Colluvium	10	34	82.3714	129.263	176.815	0	176.815	202.143	202.143
12	0.658838	134.725	17.5811	Colluvium	10	34	87.2597	136.934	188.187	0	188.187	215.836	215.836
13	0.658838	143.336	18.0717	Colluvium	10	34	91.7688	144.01	198.678	0	198.678	228.623	228.623
14	0.658838	151.431	18.5637	Colluvium	10	34	95.9038	150.499	208.298	0	208.298	240.506	240.506
15	0.658838	159.008	19.0571	Colluvium	10	34	99.6686	156.407	217.058	0	217.058	251.488	251.488
16	0.658838	166.06	19.5519	Colluvium	10	34	103.068	161.742	224.967	0	224.967	261.57	261.57
17	0.658838	172.584	20.0483	Colluvium	10	34	106.107	166.51	232.036	0	232.036	270.757	270.757
18	0.658838	178.575	20.5463	Colluvium	10	34	108.788	170.717	238.274	0	238.274	279.048	279.048
19	0.658838	184.026	21.0459	Colluvium	10	34	111.115	174.37	243.689	0	243.689	286.444	286.444
20	0.658838	188.934	21.5471	Colluvium	10	34	113.094	177.475	248.292	0	248.292	292.948	292.948
21	0.658838	193.292	22.0501	Colluvium	10	34	114.727	180.038	252.091	0	252.091	298.56	298.56
22	0.658838	197.094	22.555	Colluvium	10	34	116.018	182.064	255.095	0	255.095	303.282	303.282
23	0.658838	200.335	23.0616	Colluvium	10	34	116.971	183.559	257.311	0	257.311	307.111	307.111
24	0.658838	203.008	23.5702	Colluvium	10	34	117.588	184.528	258.748	0	258.748	310.048	310.048
25	0.658838	205.107	24.0807	Colluvium	10	34	117.875	184.977	259.414	0	259.414	312.094	312.094
26	0.658838	206.624	24.5933	Colluvium	10	34	117.832	184.911	259.316	0	259.316	313.247	313.247
27	0.658838	207.553	25.108	Colluvium	10	34	117.465	184.334	258.461	0	258.461	313.505	313.505
28	0.658838	207.886	25.6249	Colluvium	10	34	116.775	183.252	256.857	0	256.857	312.868	312.868
29	0.658838	207.616	26.144	Colluvium	10	34	115.767	181.669	254.51	0	254.51	311.334	311.334
30	0.658838	206.734	26.6655	Colluvium	10	34	114.442	179.59	251.427	0	251.427	308.899	308.899
31	0.658838	205.233	27.1893	Colluvium	10	34	112.803	177.019	247.616	0	247.616	305.563	305.563
32	0.658838	203.103	27.7156	Colluvium	10	34	110.855	173.961	243.082	0	243.082	301.321	301.321
33	0.658838	200.335	28.2445	Colluvium	10	34	108.598	170.42	237.832	0	237.832	296.171	296.171
34	0.658838	196.921	28.776	Colluvium	10	34	106.037	166.4	231.872	0	231.872	290.108	290.108
35	0.658838	192.849	29.3102	Colluvium	10	34	103.172	161.905	225.208	0	225.208	283.13	283.13
36	0.658838	188.111	29.8472	Colluvium	10	34	100.007	156.938	217.845	0	217.845	275.229	275.229
37	0.658838	182.694	30.3872	Colluvium	10	34	96.5449	151.505	209.79	0	209.79	266.404	266.404
38	0.658838	176.589	30.9301	Colluvium	10	34	92.7871	145.608	201.048	0	201.048	256.646	256.646
39	0.658838	169.782	31.4761	Colluvium	10	34	88.7368	139.252	191.624	0	191.624	245.951	245.951
40	0.658838	162.263	32.0254	Colluvium	10	34	84.3959	132.44	181.526	0	181.526	234.314	234.314
41	0.658838	154.018	32.5779	Colluvium	10	34	79.767	125.176	170.755	0	170.755	221.725	221.725
42	0.658838	145.033	33.1339	Colluvium	10	34	74.8514	117.462	159.32	0	159.32	208.178	208.178
43	0.658838	135.295	33.6934	Colluvium	10	34	69.6524	109.303	147.224	0	147.224	193.665	193.665
44	0.658838	124.789	34.2566	Colluvium	10	34	64.1719	100.703	134.473	0	134.473	178.177	178.177
45	0.658838	113.5	34.8236	Colluvium	10	34	58.4119	91.664	121.072	0	121.072	161.705	161.705
46	0.658838	101.411	35.3945	Colluvium	10	34	52.3746	82.1899	107.026	0	107.026	144.239	144.239
47	0.658838	88.5052	35.9695	Colluvium	10	34	46.0623	72.2842	92.3402	0	92.3402	125.769	125.769
48	0.658838	74.7652	36.5487	Colluvium	10	34	39.4771	61.9502	77.0193	0	77.0193	106.283	106.283
49	0.658838	57.978	37.1323	Colluvium	10	34	31.64	49.6517	58.7862	0	58.7862	82.7434	82.7434
50	0.658838	20.9833	37.7205	Colluvium	10	34	15.1435	23.7643	20.4065	0	20.4065	32.1194	32.1194

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.5697

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [deg]	Base Material	Base Cohesion [psf]	Base Friction Angle [deg]	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	0.658838	7.13286	12.2625	Colluvium	10	34	10.1854	15.9881	8.87767	0	8.87767	11.0915	11.0915
2	0.658838	21.1609	12.7409	Colluvium	10	34	18.7966	29.5051	28.9175	0	28.9175	33.1676	33.1676
3	0.658838	34.7123	13.2202	Colluvium	10	34	27.1953	42.6884	48.4626	0	48.4626	54.8513	54.8513
4	0.658838	47.7843	13.7004	Colluvium	10	34	35.3541	55.4953	67.4496	0	67.4496	76.0683	76.0683
5	0.658838	60.374	14.1816	Colluvium	10	34	43.2452	67.882	85.8137	0	85.8137	96.7416	96.7416
6	0.658838	72.4784	14.6638	Colluvium	10	34	50.8407	79.8047	103.49	0	103.49	116.793	116.793
7	0.658838	84.0943	15.1471	Colluvium	10	34	58.1134	91.2206	120.414	0	120.414	136.146	136.146
8	0.658838	95.2183	15.6315	Colluvium	10	34	65.0373	102.089	136.528	0	136.528	154.725	154.725
9	0.658838	105.847	16.1171	Colluvium	10	34	71.5888	112.373	151.773	0	151.773	172.46	172.46
10	0.658838	115.977	16.6039	Colluvium	10	34	77.7454	122.037	166.102	0	166.102	189.285	189.285
11	0.658838	125.604	17.0918	Colluvium	10	34	83.4892	131.053	179.468	0	179.468	205.14	205.14
12	0.658838	134.725	17.5811	Colluvium	10	34	88.8049	139.397	191.839	0	191.839	219.978	219.978
13	0.658838	143.336	18.0717	Colluvium	10	34	93.6797	147.049	203.184	0	203.184	233.752	233.752
14	0.658838	151.431	18.5637	Colluvium	10	34	98.106	153.997	213.484	0	213.484	246.431	246.431
15	0.658838	159.008	19.0571	Colluvium	10	34	102.078	160.232	222.727	0	222.727	257.99	257.99
16	0.658838	166.06	19.5519	Colluvium	10	34	105.595	165.753	230.914	0	230.914	268.415	268.415
17	0.658838	172.584	20.0483	Colluvium	10	34	108.66	170.564	238.046	0	238.046	277.698	277.698
18	0.658838	178.575	20.5463	Colluvium	10	34	111.278	174.673	244.138	0	244.138	285.845	285.845
19	0.658838	184.026	21.0459	Colluvium	10	34	113.457	178.094	249.209	0	249.209	292.866	292.866
20	0.658838	188.934	21.5471	Colluvium	10	34	115.209	180.844	253.287	0	253.287	298.778	298.778
21	0.658838	193.292	22.0501	Colluvium	10	34	116.547	182.944	256.4	0	256.4	303.607	303.607
22	0.658838	197.094	22.555	Colluvium	10	34	117.486	184.418	258.585	0	258.585	307.382	307.382
23	0.658838	200.335	23.0616	Colluvium	10	34	118.044	185.293	259.882	0	259.882	310.139	310.139
24	0.658838	203.008	23.5702	Colluvium	10	34	118.235	185.594	260.328	0	260.328	311.911	311.911
25	0.658838	205.107	24.0807	Colluvium	10	34	118.08	185.35	259.967	0	259.967	312.739	312.739
26	0.658838	206.624	24.5933	Colluvium	10	34	117.596	184.59	258.84	0	258.84	312.663	312.663
27	0.658838	207.553	25.108	Colluvium	10	34	116.799	183.339	256.986	0	256.986	311.718	311.718
28	0.658838	207.886	25.6249	Colluvium	10	34	115.707	181.625	254.445	0	254.445	309.945	309.945
29	0.658838	207.616	26.144	Colluvium	10	34	114.335	179.472	251.253	0	251.253	307.374	307.374
30	0.658838	206.734	26.6655	Colluvium	10	34	112.697	176.901	247.441	0	247.441	304.037	304.037
31	0.658838	205.233	27.1893	Colluvium	10	34	110.806	173.932	243.039	0	243.039	299.96	299.96
32	0.658838	203.103	27.7156	Colluvium	10	34	108.671	170.581	238.072	0	238.072	295.163	295.163
33	0.658838	200.335	28.2445	Colluvium	10	34	106.302	166.862	232.557	0	232.557	289.662	289.662
34	0.658838	196.921	28.776	Colluvium	10	34	103.705	162.785	226.513	0	226.513	283.468	283.468
35	0.658838	192.849	29.3102	Colluvium	10	34	100.883	158.356	219.946	0	219.946	276.582	276.582
36	0.658838	188.111	29.8472	Colluvium	10	34	97.8384	153.577	212.861	0	212.861	269.001	269.001
37	0.658838	182.694	30.3872	Colluvium	10	34	94.5703	148.447	205.256	0	205.256	260.712	260.712
38	0.658838	176.589	30.9301	Colluvium	10	34	91.076	142.962	197.124	0	197.124	251.697	251.697
39	0.658838	169.782	31.4761	Colluvium	10	34	87.3492	137.112	188.452	0	188.452	241.929	241.929
40	0.658838	162.263	32.0254	Colluvium	10	34	83.3822	130.885	179.22	0	179.22	231.374	231.374
41	0.658838	154.018	32.5779	Colluvium	10	34	79.1635	124.263	169.402	0	169.402	219.986	219.986
42	0.658838	145.033	33.1339	Colluvium	10	34	74.6805	117.226	158.969	0	158.969	207.715	207.715
43	0.658838	135.295	33.6934	Colluvium	10	34	69.9154	109.746	147.88	0	147.88	194.497	194.497
44	0.658838	124.789	34.2566	Colluvium	10	34	64.8498	101.795	136.091	0	136.091	180.257	180.257
45	0.658838	113.5	34.8236	Colluvium	10	34	59.4615	93.3367	123.552	0	123.552	164.915	164.915
46	0.658838	101.411	35.3945	Colluvium	10	34	53.7249	84.332	110.202	0	110.202	148.374	148.374
47	0.658838	88.5052	35.9695	Colluvium	10	34	47.6118	74.7363	95.9755	0	95.9755	130.529	130.529
48	0.658838	74.7652	36.5487	Colluvium	10	34	41.0907	64.5	80.7996	0	80.7996	111.259	111.259
49	0.658838	57.978	37.1323	Colluvium	10	34	33.0556	51.8874	62.1006	0	62.1006	87.1297	87.1297
50	0.658838	20.9833	37.7205	Colluvium	10	34	15.061	23.6412	20.224	0	20.224	31.873	31.873

Interslice Data

2H:1V With Berm - Master Scenario

Global Minimum Query (bishop simplified) - Safety Factor: 1.58694

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [deg]
1	35	35	0	0	0
2	35.4758	35.0003	5.87714	0	0
3	35.9515	35.0005	17.514	0	0
4	36.9031	35.0013	58.0464	0	0
5	37.8446	35.1771	91.0416	0	0
6	38.3154	35.2722	109.036	0	0
7	38.7861	35.3674	128.612	0	0
8	39.7277	35.6285	158.391	0	0
9	40.1989	35.7592	174.394	0	0
10	40.6701	35.8899	191.14	0	0
11	41.387	36.1172	211.655	0	0
12	42.1039	36.3445	233.168	0	0
13	42.8216	36.5781	254.232	0	0
14	43.5393	36.8116	276.168	0	0
15	44.2571	37.1064	283.202	0	0
16	44.9749	37.4012	290.29	0	0
17	45.6937	37.6965	297.424	0	0
18	46.4125	37.9918	304.612	0	0
19	47.0895	38.3045	302.423	0	0
20	47.7665	38.6173	300.202	0	0
21	48.4435	38.93	297.948	0	0
22	49.1205	39.2427	295.662	0	0
23	49.7975	39.5555	293.344	0	0
24	50.4745	39.8682	290.993	0	0
25	51.1515	40.1809	288.609	0	0
26	51.8284	40.4937	286.194	0	0
27	52.5054	40.8064	283.746	0	0
28	53.1824	41.1191	281.265	0	0
29	54.0117	41.5082	276.601	0	0
30	54.841	41.8977	271.776	0	0
31	55.5988	42.3093	253.103	0	0
32	56.3565	42.7209	234.863	0	0
33	56.9441	43.0465	219.47	0	0
34	57.5316	43.3721	204.41	0	0
35	58.0671	43.6727	190.114	0	0
36	58.6027	43.9733	176.138	0	0
37	59.1362	44.273	162.495	0	0
38	59.6698	44.5727	149.172	0	0
39	60.2034	44.8723	136.168	0	0
40	60.7369	45.172	123.484	0	0
41	61.2684	45.4706	111.128	0	0
42	61.7998	45.7693	99.0914	0	0
43	62.2823	46.1109	75.7476	0	0
44	62.7647	46.4525	53.8451	0	0
45	63.2447	46.7929	33.3969	0	0
46	63.7247	47.1333	14.3889	0	0
47	64.2047	47.4794	-3.89952	0	0
48	64.6847	47.8255	-20.6178	0	0
49	65.6447	48.5302	-50.5384	0	0
50	66.5206	49.4576	-87.1673	0	0
51	67.3965	50.385	0	0	0

Global Minimum Query (janbu simplified) - Safety Factor: 1.53359

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [deg]
1	35	35	0	0	0
2	35.6383	35.0095	9.14157	0	0
3	36.2767	35.0189	28.2937	0	0
4	36.915	35.0284	57.4567	0	0
5	37.5533	35.0378	96.6305	0	0
6	38.1092	35.1103	126.265	0	0
7	38.6651	35.1828	159.855	0	0
8	39.221	35.2901	189.521	0	0
9	39.7769	35.3974	221.71	0	0
10	40.3324	35.5373	248.204	0	0
11	40.8878	35.6772	276.188	0	0
12	41.4437	35.8268	303.08	0	0
13	41.9996	35.9765	331.215	0	0
14	42.7917	36.2334	360.702	0	0
15	43.5838	36.4903	391.425	0	0
16	44.1118	36.6652	411.458	0	0
17	44.6398	36.8402	431.983	0	0
18	45.1679	37.0151	453	0	0
19	45.7215	37.2222	467.865	0	0
20	46.2752	37.4293	482.961	0	0
21	46.8289	37.6364	498.287	0	0
22	47.321	37.8324	508.106	0	0
23	47.8131	38.0284	518.013	0	0
24	48.3052	38.2433	521.743	0	0
25	48.7973	38.4581	525.476	0	0
26	49.5198	38.791	525.248	0	0
27	50.2424	39.1239	524.998	0	0
28	50.8321	39.401	522.989	0	0
29	51.4218	39.6782	520.968	0	0
30	52.0115	39.9554	518.937	0	0
31	52.6013	40.2325	516.894	0	0
32	53.191	40.5097	514.84	0	0
33	53.7807	40.7869	512.775	0	0
34	54.3704	41.0641	510.698	0	0
35	54.9601	41.3412	508.611	0	0
36	55.5499	41.6238	504.749	0	0
37	56.1396	41.9063	500.886	0	0
38	56.9061	42.3439	473.972	0	0
39	57.6726	42.7814	447.753	0	0
40	58.442	43.2324	418.787	0	0
41	59.2114	43.6834	390.733	0	0
42	59.9057	44.1273	356.655	0	0
43	60.6	44.5712	324.07	0	0
44	61.2944	45.021	291.645	0	0
45	61.9887	45.4707	260.852	0	0
46	62.9094	46.141	208.081	0	0
47	63.8254	46.8095	160.991	0	0
48	64.7472	47.5777	106.34	0	0
49	65.6691	48.4963	49.062	0	0
50	66.5346	49.3656	14.2943	0	0
51	67.4001	50.385	0	0	0

Global Minimum Query (spencer) - Safety Factor: 1.56486

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [deg]
1	34.9997	34.9992	0	0	0
2	35.706	35.0829	8.80389	3.67023	22.6306
3	36.4124	35.1665	25.2562	10.529	22.6307
4	37.1187	35.2501	49.3569	20.5763	22.6307
5	37.8251	35.3338	81.1061	33.8121	22.6306
6	38.5141	35.5387	97.2156	40.5279	22.6306
7	39.203	35.7437	114.675	47.8067	22.6307
8	39.892	35.9486	133.485	55.6483	22.6307
9	40.581	36.1535	153.646	64.0529	22.6306
10	41.27	36.3585	175.157	73.0204	22.6305
11	41.9589	36.5634	198.018	82.5509	22.6306
12	42.6479	36.7684	222.229	92.6442	22.6306
13	43.28	37.0141	231.871	96.664	22.6306
14	43.9121	37.2599	241.681	100.754	22.6307
15	44.5442	37.5057	251.658	104.913	22.6306
16	45.1763	37.7515	261.803	109.142	22.6306
17	45.8084	37.9972	272.115	113.441	22.6306
18	46.4404	38.243	282.594	117.81	22.6307
19	47.0725	38.4888	293.241	122.248	22.6306
20	47.7046	38.7345	304.055	126.756	22.6305
21	48.3367	38.9803	315.036	131.334	22.6306
22	48.9688	39.2261	326.185	135.982	22.6306
23	49.6128	39.5327	322.936	134.628	22.6306
24	50.2568	39.8393	319.679	133.27	22.6306
25	50.9007	40.1459	316.414	131.909	22.6306
26	51.5447	40.4525	313.142	130.545	22.6306
27	52.1887	40.7591	309.861	129.177	22.6306
28	52.8327	41.0657	306.572	127.806	22.6306
29	53.4767	41.3723	303.276	126.432	22.6306
30	54.1206	41.6789	299.971	125.054	22.6306
31	54.7646	41.9855	296.659	123.673	22.6306
32	55.4086	42.2921	293.338	122.289	22.6307
33	56.0526	42.5987	290.01	120.901	22.6306
34	56.6805	42.9575	273.115	113.858	22.6306
35	57.3083	43.3163	256.703	107.016	22.6306
36	57.9362	43.675	240.774	100.376	22.6307
37	58.5641	44.0338	225.329	93.9365	22.6306
38	59.192	44.3925	210.366	87.6988	22.6306
39	59.8199	44.7513	195.887	81.6625	22.6306
40	60.4477	45.1101	181.89	75.8277	22.6307
41	61.0756	45.4688	168.377	70.1942	22.6306
42	61.7035	45.8276	155.347	64.7621	22.6306
43	62.3694	46.2995	128.59	53.6076	22.6307
44	63.0353	46.7713	104.307	43.4843	22.6307
45	63.7011	47.2432	82.4983	34.3925	22.6306
46	64.367	47.7151	63.1633	26.3319	22.6306
47	65.0329	48.1869	46.3022	19.3028	22.6306
48	65.6988	48.6588	31.9151	13.305	22.6306
49	66.2553	49.2342	13.1583	5.48552	22.6306
50	66.8118	49.8096	2.05364	0.856134	22.6306
51	67.3682	50.385	0	0	0

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.55937

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [deg]
1	35	35	0	0	0
2	35.5198	35	6.92973	0.206685	1.70839
3	36.0395	35	21.2425	1.26555	3.40944
4	36.5595	35.0006	43.173	3.85061	5.09674
5	37.0796	35.0012	73.0458	8.66162	6.76244
6	37.9823	35.1885	106.636	18.0044	9.58343
7	38.8851	35.3759	146.928	32.0026	12.2878
8	39.34	35.502	162.875	39.3966	13.5977
9	39.795	35.6281	179.676	47.7012	14.8682
10	40.2503	35.7544	197.335	56.9489	16.0976
11	40.7056	35.8807	215.855	67.1603	17.2828
12	41.4581	36.1721	227.986	79.1216	19.1391
13	42.2105	36.4635	240.393	91.6172	20.8626
14	42.9629	36.7601	251.811	104.038	22.4484
15	43.7154	37.0568	263.436	116.705	23.8939
16	44.2435	37.265	271.716	125.688	24.8239
17	44.7716	37.4733	280.097	134.704	25.6838
18	45.2997	37.6815	288.574	143.713	26.4738
19	46.1574	38.0196	302.547	158.223	27.6082
20	47.015	38.3578	316.768	172.426	28.5607
21	47.8288	38.7008	324.378	182.016	29.2978
22	48.6426	39.0438	332.025	190.727	29.8746
23	49.1851	39.2777	335.708	195.159	30.171
24	49.7277	39.5116	339.393	199.098	30.3972
25	50.2702	39.7455	343.079	202.522	30.5537
26	50.8127	40.0006	341.144	202.078	30.6405
27	51.3553	40.2556	339.215	201.075	30.658
28	51.8978	40.5106	337.292	199.522	30.606
29	52.7116	40.8932	334.416	196.184	30.3979
30	53.5254	41.2757	331.551	191.673	30.0326
31	54.3326	41.6582	327.937	185.645	29.5142
32	55.1398	42.0407	324.341	178.592	28.8385
33	55.6779	42.2958	321.95	173.352	28.3
34	56.2161	42.5508	319.566	167.706	27.6902
35	56.7542	42.8058	317.187	161.676	27.0088
36	57.5812	43.2542	300.174	145.244	25.8208
37	58.4083	43.7027	283.613	129.02	24.4615
38	59.1096	44.0932	267.741	114.612	23.1743
39	59.811	44.4838	252.288	100.726	21.7644
40	60.4139	44.8271	237.815	88.7045	20.4554
41	61.0169	45.1704	223.72	77.2894	19.0587
42	61.6198	45.5233	208.169	65.9422	17.5768
43	62.2228	45.8763	193.1	55.4182	16.0131
44	62.7069	46.2055	173.619	45.5521	14.7012
45	63.191	46.5347	155.05	36.7728	13.3422
46	63.6723	46.862	137.495	29.0932	11.9473
47	64.1536	47.1893	120.854	22.4258	10.5123
48	64.9843	47.8148	86.993	12.1546	7.95384
49	65.815	48.6286	42.478	3.94931	5.31169
50	66.6281	49.4252	13.1327	0.612393	2.66983
51	67.4412	50.385	0	0	0

2H:1V With Berm - Seismic

Global Minimum Query (bishop simplified) - Safety Factor: 1.20682

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [deg]
1	35	35	0	0	0
2	35.9138	35.0117	17.8188	0	0
3	36.8302	35.0235	56.3709	0	0
4	37.8231	35.2023	92.043	0	0
5	38.3196	35.3234	107.708	0	0
6	38.816	35.4444	124.518	0	0
7	39.3125	35.5655	142.473	0	0
8	39.8089	35.6866	161.574	0	0
9	40.3034	35.8268	177.56	0	0
10	40.7979	35.9669	194.255	0	0
11	41.5027	36.221	207.146	0	0
12	42.2075	36.4751	220.372	0	0
13	43.6171	36.9832	247.834	0	0
14	44.3219	37.2373	262.068	0	0
15	45.0267	37.4914	276.638	0	0
16	45.7617	37.7978	281.388	0	0
17	46.4967	38.1043	286.117	0	0
18	47.1226	38.3904	283.728	0	0
19	47.7485	38.6765	281.294	0	0
20	48.3743	38.9626	278.815	0	0
21	49.0002	39.2487	276.293	0	0
22	49.626	39.5348	273.727	0	0
23	50.2519	39.8209	271.116	0	0
24	50.8777	40.107	268.462	0	0
25	51.5036	40.3931	265.763	0	0
26	52.9133	41.0375	259.523	0	0
27	53.6182	41.3597	256.319	0	0
28	54.323	41.6819	253.059	0	0
29	54.9919	42.0284	239.412	0	0
30	55.6608	42.375	225.953	0	0
31	56.3297	42.7262	211.55	0	0
32	56.9986	43.0774	197.382	0	0
33	57.5993	43.4112	180.601	0	0
34	58.2001	43.745	164.219	0	0
35	58.7513	44.0513	149.539	0	0
36	59.3025	44.3575	135.196	0	0
37	59.8538	44.6638	121.188	0	0
38	60.405	44.9701	107.517	0	0
39	60.9542	45.2767	93.931	0	0
40	61.5035	45.5834	80.6965	0	0
41	62.0091	45.9238	58.2122	0	0
42	62.5147	46.2642	36.9799	0	0
43	63.0306	46.6115	16.6057	0	0
44	63.5465	46.9588	-2.46495	0	0
45	64.0624	47.3208	-22.1908	0	0
46	64.5783	47.6827	-40.2782	0	0
47	65.0618	48.0976	-63.4525	0	0
48	65.5453	48.5125	-83.0697	0	0
49	66.5458	49.3742	-112.512	0	0
50	67.0461	49.8796	-123.603	0	0
51	67.5464	50.385	0	0	0

Global Minimum Query (janbu simplified) - Safety Factor: 1.1622

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [deg]
1	35	35	0	0	0
2	35.5917	35	9.92734	0	0
3	36.1834	35.0001	29.5273	0	0
4	36.7751	35.0004	58.7592	0	0
5	37.3667	35.0007	97.6403	0	0
6	37.9149	35.0978	122.566	0	0
7	38.463	35.195	150.289	0	0
8	39.0112	35.3021	178.603	0	0
9	39.5594	35.4092	209.333	0	0
10	40.1071	35.5528	233.386	0	0
11	40.6548	35.6964	258.717	0	0
12	41.2973	35.8681	289.183	0	0
13	41.9398	36.0398	321.31	0	0
14	42.8675	36.3354	356.432	0	0
15	43.7951	36.6309	393.308	0	0
16	44.5699	36.8811	424.411	0	0
17	45.3447	37.1312	456.658	0	0
18	46.1577	37.4297	479.55	0	0
19	46.9706	37.7281	502.963	0	0
20	47.8189	38.0627	519.968	0	0
21	48.6671	38.3973	537.215	0	0
22	49.246	38.6631	536.413	0	0
23	49.8249	38.9288	535.589	0	0
24	50.4037	39.1946	534.744	0	0
25	50.9826	39.4603	533.877	0	0
26	51.5615	39.7261	532.988	0	0
27	52.1404	39.9919	532.079	0	0
28	52.7192	40.2576	531.147	0	0
29	53.2981	40.5234	530.194	0	0
30	53.9395	40.8178	529.113	0	0
31	54.5809	41.1123	528.006	0	0
32	55.2223	41.4211	522.055	0	0
33	55.8637	41.7299	516.107	0	0
34	56.4273	42.046	496.668	0	0
35	56.9909	42.3622	477.567	0	0
36	57.5545	42.6783	458.804	0	0
37	58.1181	42.9944	440.377	0	0
38	58.6328	43.2875	422.609	0	0
39	59.1475	43.5805	405.17	0	0
40	59.8444	44.021	370.565	0	0
41	60.5413	44.4615	337.414	0	0
42	61.2371	44.9019	305.617	0	0
43	61.9329	45.3423	275.284	0	0
44	62.8619	46.0101	221.097	0	0
45	63.3288	46.3457	195.981	0	0
46	63.7957	46.6813	172.279	0	0
47	64.2655	47.0838	140.119	0	0
48	64.7353	47.4862	111.121	0	0
49	65.6749	48.2923	62.4979	0	0
50	66.6027	49.3387	13.8747	0	0
51	67.5306	50.385	0	0	0

Global Minimum Query (spencer) - Safety Factor: 1.18976

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [deg]
1	35	35	0	0	0
2	35.5153	35.0409	8.95091	5.30184	30.6393
3	36.0307	35.0818	24.2764	14.3795	30.6393
4	36.5538	35.1409	43.5395	25.7895	30.6393
5	37.0769	35.2	67.957	40.2526	30.6393
6	37.654	35.3378	86.1553	51.0318	30.6393
7	38.231	35.4756	106.402	63.0244	30.6393
8	38.808	35.6134	128.697	76.2304	30.6393
9	39.3851	35.7513	153.041	90.6497	30.6392
10	39.9747	35.9301	170.928	101.245	30.6393
11	40.5643	36.1089	189.748	112.392	30.6392
12	41.1536	36.2876	209.49	124.086	30.6393
13	41.7429	36.4663	230.164	136.331	30.6392
14	42.511	36.7462	246.152	145.801	30.6391
15	43.279	37.0261	262.593	155.54	30.6393
16	44.051	37.3075	279.569	165.596	30.6394
17	44.8229	37.5889	297.003	175.922	30.6393
18	45.6198	37.8846	313.952	185.961	30.6392
19	46.4166	38.1804	331.301	196.238	30.6393
20	47.2164	38.4843	346.984	205.527	30.6393
21	48.0163	38.7882	362.966	214.993	30.6392
22	48.6716	39.0876	361.581	214.173	30.6393
23	49.327	39.3871	360.153	213.327	30.6392
24	49.9824	39.6905	357.615	211.824	30.6393
25	50.6378	39.9939	355.041	210.299	30.6392
26	51.2931	40.2974	352.43	208.753	30.6393
27	51.9485	40.6008	349.783	207.185	30.6393
28	52.6039	40.9042	347.098	205.595	30.6393
29	53.2593	41.2077	344.377	203.983	30.6393
30	53.9147	41.5111	341.619	202.349	30.6393
31	54.57	41.8145	338.824	200.694	30.6393
32	55.2254	42.118	335.993	199.017	30.6393
33	55.8808	42.4214	333.125	197.318	30.6393
34	56.4229	42.7095	321.136	190.216	30.6392
35	56.965	42.9975	309.324	183.22	30.6393
36	57.5072	43.2937	295.821	175.222	30.6393
37	58.0493	43.5898	282.573	167.375	30.6393
38	58.5904	43.8855	269.586	159.683	30.6394
39	59.1315	44.1811	256.855	152.141	30.6392
40	59.8691	44.6023	236.15	139.877	30.6392
41	60.6068	45.0235	216.203	128.062	30.6392
42	61.3354	45.4457	196.1	116.155	30.6393
43	62.064	45.8678	176.844	104.749	30.6393
44	62.7754	46.3575	146.825	86.968	30.6393
45	63.4868	46.8471	119.401	70.7241	30.6393
46	64.1982	47.3368	94.5717	56.0171	30.6393
47	64.9096	47.8265	72.337	42.8469	30.6393
48	65.5644	48.3177	50.5399	29.936	30.6393
49	66.2193	48.9572	23.9556	14.1895	30.6393
50	66.8934	49.6155	5.81204	3.44261	30.6393
51	67.5675	50.385	0	0	0

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.18418

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [deg]
1	35	35	0	0	0
2	35.4932	35.0042	7.44108	0.271778	2.09174
3	35.9864	35.0084	21.7536	1.58726	4.17321
4	36.4795	35.0682	36.9484	4.03629	6.23434
5	36.9727	35.1281	56.1055	8.15045	8.26554
6	37.44	35.1849	78.0812	13.9848	10.1543
7	37.9073	35.2416	103.942	22.0958	12.0012
8	38.8419	35.4762	139.331	38.7563	15.5444
9	39.7766	35.7397	173.6	59.2811	18.8541
10	40.2439	35.8714	192.27	71.55	20.4119
11	40.7112	36.0031	211.98	85.222	21.9015
12	41.4549	36.27	230.115	103.066	24.1271
13	42.1986	36.5368	248.964	122.352	26.1716
14	42.9422	36.8362	259.96	138.422	28.0342
15	43.6859	37.1356	271.072	154.716	29.7158
16	44.1987	37.342	278.792	166.009	30.772
17	44.7115	37.5485	286.551	177.289	31.7451
18	45.2244	37.7549	294.341	188.505	32.6367
19	45.9936	38.0646	306.071	205.087	33.8246
20	46.7628	38.3743	317.829	221.212	34.8383
21	47.3059	38.6135	320.3	228.062	35.4519
22	47.8491	38.8528	322.683	234.296	35.9829
23	48.3922	39.0921	324.974	239.881	36.4331
24	48.9353	39.3314	327.171	244.788	36.8037
25	49.4784	39.5707	329.27	248.988	37.0959
26	50.0216	39.8099	331.269	252.457	37.3107
27	50.5647	40.0492	333.166	255.174	37.4487
28	51.1078	40.2885	334.959	257.12	37.5104
29	51.651	40.5278	336.646	258.282	37.4962
30	52.4656	40.8867	338.976	258.53	37.332
31	53.2803	41.2456	341.064	256.965	36.9952
32	54.1079	41.6257	338.612	250.322	36.474
33	54.9354	42.0059	335.957	242.017	35.7683
34	55.4871	42.2593	334.077	235.603	35.1929
35	56.0387	42.5127	332.114	228.526	34.5317
36	56.5904	42.7661	330.069	220.817	33.7826
37	57.353	43.1585	316.47	202.383	32.599
38	58.1155	43.5508	303.058	183.817	31.2385
39	58.6239	43.8263	291.083	169.624	30.2308
40	59.1322	44.1018	279.31	155.722	29.1407
41	59.6406	44.3772	267.742	142.163	27.967
42	60.3065	44.7381	252.899	124.999	26.3016
43	60.9724	45.0989	238.409	108.601	24.4904
44	61.6383	45.4768	220.883	91.6438	22.5334
45	62.3042	45.8546	203.931	75.9767	20.4334
46	63.1669	46.4292	168.534	53.1642	17.5079
47	64.0296	47.0481	130.031	33.3082	14.3677
48	64.8811	47.7021	91.458	17.9156	11.0833
49	65.7326	48.356	58.8711	7.90639	7.64906
50	66.6436	49.2771	17.6712	1.19122	3.85649
51	67.5547	50.385	0	0	0

2H:1V With Berm - Static

Global Minimum Query (bishop simplified) - Safety Factor: 1.57206

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [deg]
1	35.0213	35.0102	0	0	0
2	35.6795	35.1536	5.37635	0	0
3	36.3378	35.3027	13.266	0	0
4	36.996	35.4576	23.3448	0	0
5	37.6542	35.6184	35.3007	0	0
6	38.3125	35.785	48.834	0	0
7	38.9707	35.9575	63.6569	0	0
8	39.629	36.136	79.4937	0	0
9	40.2872	36.3204	96.081	0	0
10	40.9455	36.5109	113.167	0	0
11	41.6037	36.7075	130.513	0	0
12	42.2619	36.9101	147.891	0	0
13	42.9202	37.119	165.086	0	0
14	43.5784	37.334	181.896	0	0
15	44.2367	37.5554	198.129	0	0
16	44.8949	37.783	213.609	0	0
17	45.5532	38.0171	228.169	0	0
18	46.2114	38.2576	241.656	0	0
19	46.8696	38.5046	253.932	0	0
20	47.5279	38.7581	264.868	0	0
21	48.1861	39.0183	274.351	0	0
22	48.8444	39.2852	282.28	0	0
23	49.5026	39.5588	288.569	0	0
24	50.1608	39.8394	293.145	0	0
25	50.8191	40.1268	295.949	0	0
26	51.4773	40.4213	296.937	0	0
27	52.1356	40.7228	296.078	0	0
28	52.7938	41.0315	293.36	0	0
29	53.4521	41.3475	288.782	0	0
30	54.1103	41.6709	282.361	0	0
31	54.7685	42.0017	274.132	0	0
32	55.4268	42.3402	264.144	0	0
33	56.085	42.6862	252.465	0	0
34	56.7433	43.0401	239.18	0	0
35	57.4015	43.4019	224.394	0	0
36	58.0598	43.7717	208.23	0	0
37	58.718	44.1497	190.83	0	0
38	59.3762	44.536	172.36	0	0
39	60.0345	44.9307	153.004	0	0
40	60.6927	45.3339	132.969	0	0
41	61.351	45.7459	112.488	0	0
42	62.0092	46.1668	91.8155	0	0
43	62.6675	46.5968	71.2322	0	0
44	63.3257	47.0359	51.0456	0	0
45	63.9839	47.4845	31.5914	0	0
46	64.6422	47.9427	13.2343	0	0
47	65.3004	48.4107	-3.63009	0	0
48	65.9587	48.8887	-18.5736	0	0
49	66.6169	49.3769	-31.1338	0	0
50	67.2751	49.8756	-40.3785	0	0
51	67.9334	50.385	0	0	0

Global Minimum Query (janbu simplified) - Safety Factor: 1.53716

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [deg]
1	35.0414	35.0199	0	0	0
2	35.6936	35.0901	7.22804	0	0
3	36.3458	35.1683	20.2148	0	0
4	36.998	35.2546	38.2586	0	0
5	37.6501	35.3489	60.6868	0	0
6	38.3023	35.4514	86.8552	0	0
7	38.9545	35.562	116.147	0	0
8	39.6067	35.6809	147.974	0	0
9	40.2589	35.808	181.772	0	0
10	40.911	35.9434	217.005	0	0
11	41.5632	36.0873	253.163	0	0
12	42.2154	36.2396	289.762	0	0
13	42.8676	36.4004	326.341	0	0
14	43.5197	36.5699	362.467	0	0
15	44.1719	36.7481	397.731	0	0
16	44.8241	36.9351	431.748	0	0
17	45.4763	37.1309	464.16	0	0
18	46.1285	37.3357	494.632	0	0
19	46.7806	37.5497	522.857	0	0
20	47.4328	37.7728	548.551	0	0
21	48.085	38.0053	571.456	0	0
22	48.7372	38.2472	591.343	0	0
23	49.3894	38.4988	608.005	0	0
24	50.0415	38.76	621.265	0	0
25	50.6937	39.0312	630.974	0	0
26	51.3459	39.3124	637.01	0	0
27	51.9981	39.6039	639.28	0	0
28	52.6503	39.9057	637.723	0	0
29	53.3024	40.2182	632.307	0	0
30	53.9546	40.5415	623.034	0	0
31	54.6068	40.8757	609.939	0	0
32	55.259	41.2213	593.092	0	0
33	55.9111	41.5784	572.6	0	0
34	56.5633	41.9472	548.609	0	0
35	57.2155	42.328	521.306	0	0
36	57.8677	42.7213	490.92	0	0
37	58.5199	43.1271	457.728	0	0
38	59.172	43.546	422.052	0	0
39	59.8242	43.9783	384.27	0	0
40	60.4764	44.4243	344.812	0	0
41	61.1286	44.8844	304.17	0	0
42	61.7808	45.3592	262.9	0	0
43	62.4329	45.8491	221.626	0	0
44	63.0851	46.3547	181.048	0	0
45	63.7373	46.8764	141.948	0	0
46	64.3895	47.4149	105.198	0	0
47	65.0417	47.9709	71.7675	0	0
48	65.6938	48.5451	42.7338	0	0
49	66.346	49.1382	19.2933	0	0
50	66.9982	49.7512	2.77455	0	0
51	67.6504	50.385	0	0	0

Global Minimum Query (spencer) - Safety Factor: 1.56927

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [deg]
1	35.0213	35.0102	0	0	0
2	35.6801	35.1534	5.87313	2.41473	22.35
3	36.339	35.3024	14.4766	5.95203	22.3499
4	36.9978	35.4572	25.4381	10.4588	22.3499
5	37.6566	35.6178	38.4028	15.7893	22.35
6	38.3155	35.7843	53.0328	21.8044	22.35
7	38.9743	35.9567	69.0069	28.3721	22.35
8	39.6331	36.135	86.0204	35.3672	22.35
9	40.292	36.3193	103.785	42.671	22.3499
10	40.9508	36.5097	122.027	50.1715	22.3501
11	41.6097	36.7062	140.492	57.7631	22.3499
12	42.2685	36.9088	158.936	65.3465	22.35
13	42.9273	37.1175	177.135	72.8289	22.35
14	43.5862	37.3325	194.878	80.1238	22.3499
15	44.245	37.5538	211.969	87.1508	22.35
16	44.9038	37.7814	228.227	93.8356	22.35
17	45.5627	38.0153	243.488	100.11	22.35
18	46.2215	38.2558	257.601	105.912	22.3499
19	46.8804	38.5027	270.429	111.187	22.35
20	47.5392	38.7562	281.851	115.883	22.35
21	48.198	39.0164	291.762	119.958	22.35
22	48.8569	39.2832	300.068	123.373	22.35
23	49.5157	39.5569	306.693	126.097	22.35
24	50.1746	39.8373	311.575	128.104	22.35
25	50.8334	40.1248	314.667	129.375	22.35
26	51.4922	40.4192	315.936	129.897	22.35
27	52.1511	40.7208	315.365	129.662	22.35
28	52.8099	41.0295	312.951	128.67	22.35
29	53.4687	41.3455	308.709	126.926	22.3501
30	54.1276	41.6689	302.667	124.441	22.3499
31	54.7864	41.9998	294.87	121.236	22.35
32	55.4453	42.3382	285.378	117.333	22.35
33	56.1041	42.6843	274.269	112.766	22.3501
34	56.7629	43.0383	261.636	107.571	22.3499
35	57.4218	43.4001	247.589	101.796	22.35
36	58.0806	43.77	232.257	95.4922	22.35
37	58.7394	44.148	215.784	88.7196	22.35
38	59.3983	44.5344	198.335	81.5454	22.35
39	60.0571	44.9291	180.092	74.0447	22.35
40	60.716	45.3325	161.256	66.3003	22.35
41	61.3748	45.7446	142.049	58.4032	22.3499
42	62.0336	46.1656	122.711	50.4526	22.35
43	62.6925	46.5956	103.506	42.5566	22.3501
44	63.3513	47.0349	84.719	34.8322	22.35
45	64.0102	47.4836	66.656	27.4056	22.35
46	64.669	47.9419	49.648	20.4127	22.3499
47	65.3278	48.41	34.0502	13.9997	22.35
48	65.9867	48.8882	20.2434	8.32307	22.35
49	66.6455	49.3766	8.63492	3.55024	22.35
50	67.3043	49.8754	0.152438	0.0626747	22.35
51	67.9632	50.385	0	0	0

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.5697

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [deg]
1	35.0213	35.0102	0	0	0
2	35.6801	35.1534	5.43869	0.174557	1.8383
3	36.339	35.3024	13.5137	0.865744	3.6656
4	36.9978	35.4572	23.9287	2.29189	5.4711
5	37.6566	35.6178	36.3861	4.62531	7.24444
6	38.3155	35.7843	50.5884	7.99063	8.97593
7	38.9743	35.9567	66.2397	12.4641	10.6565
8	39.6331	36.135	83.0478	18.0743	12.2782
9	40.292	36.3193	100.725	24.8034	13.8338
10	40.9508	36.5097	118.992	32.5905	15.317
11	41.6097	36.7062	137.578	41.3347	16.7227
12	42.2685	36.9088	156.222	50.9	18.0466
13	42.9273	37.1175	174.677	61.1204	19.2852
14	43.5862	37.3325	192.711	71.8062	20.4359
15	44.245	37.5538	210.106	82.7495	21.4968
16	44.9038	37.7814	226.662	93.7311	22.4665
17	45.5627	38.0153	242.197	104.527	23.344
18	46.2215	38.2558	256.548	114.914	24.1288
19	46.8804	38.5027	269.569	124.676	24.8206
20	47.5392	38.7562	281.135	133.611	25.4197
21	48.198	39.0164	291.141	141.533	25.9259
22	48.8569	39.2832	299.497	148.278	26.3396
23	49.5157	39.5569	306.135	153.709	26.661
24	50.1746	39.8373	311.004	157.716	26.8904
25	50.8334	40.1248	314.068	160.219	27.028
26	51.4922	40.4192	315.31	161.171	27.0739
27	52.1511	40.7208	314.728	160.555	27.0279
28	52.8099	41.0295	312.332	158.389	26.8904
29	53.4687	41.3455	308.149	154.72	26.661
30	54.1276	41.6689	302.218	149.626	26.3397
31	54.7864	41.9998	294.592	143.211	25.9259
32	55.4453	42.3382	285.334	135.606	25.4196
33	56.1041	42.6843	274.522	126.967	24.8206
34	56.7629	43.0383	262.244	117.465	24.1287
35	57.4218	43.4001	248.601	107.29	23.3438
36	58.0806	43.77	233.707	96.6446	22.4665
37	58.7394	44.148	217.691	85.7369	21.4968
38	59.3983	44.5344	200.693	74.7807	20.436
39	60.0571	44.9291	182.872	63.988	19.2852
40	60.716	45.3325	164.402	53.5654	18.0466
41	61.3748	45.7446	145.478	43.7082	16.7227
42	62.0336	46.1656	126.313	34.5956	15.317
43	62.6925	46.5956	107.147	26.3848	13.8338
44	63.3513	47.0349	88.2451	19.2054	12.2782
45	64.0102	47.4836	69.9029	13.1534	10.6566
46	64.669	47.9419	52.4503	8.28472	8.97592
47	65.3278	48.41	36.2558	4.60876	7.24446
48	65.9867	48.8882	21.732	2.08148	5.47107
49	66.6455	49.3766	9.34056	0.598393	3.66558
50	67.3043	49.8754	0.137423	0.00441064	1.8383
51	67.9632	50.385	0	0	0

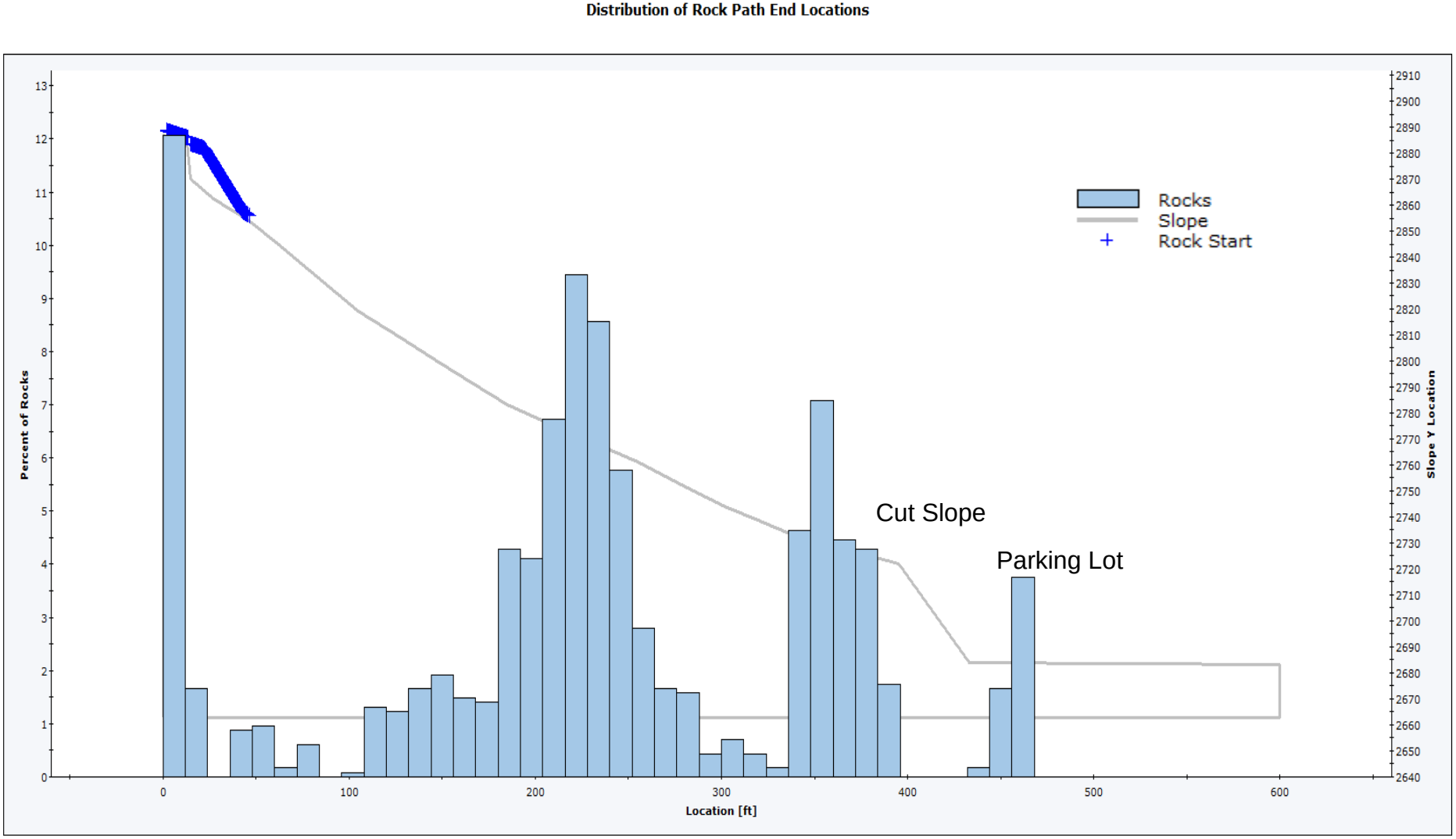
Discharge Sections

Entity Information

2H:1V With Berm

Shared Entities

Type	Coordinates (x,y)
External Boundary	-20, -20 125, -20 125, 57.6703 125, 59.6053 125, 70 123.448, 69.4825 117.796, 67.5988 110.163, 65.0544 102.656, 62.5521 97.487, 60.372 80.353, 51.955 77.299, 55.128 75.976, 55.128 70.019, 50.385 67.034, 50.385 35, 35 24.2836, 10 -20, 10
Material Boundary	35, 35 50, 35 71.418, 37.583 76.771, 40.043 86.464, 43.66 93.565, 46.455 104.446, 49.744 125, 57.6703
Material Boundary	70.019, 50.385 70.019, 48.889 80.345, 48.889 80.353, 51.955



LANDMARK TESTING & ENGINEERING

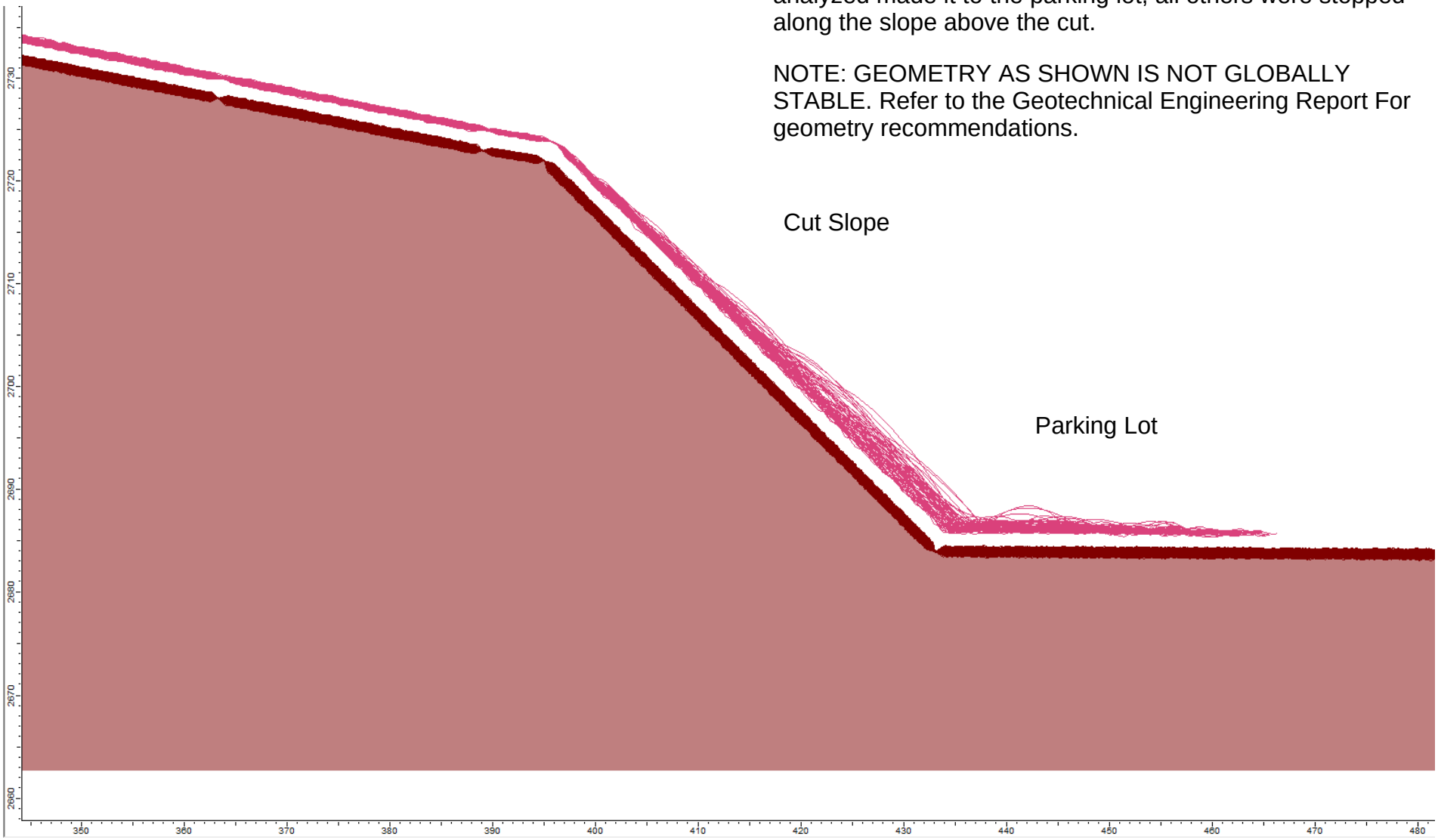
Rocfall2 Rock Endpoint Distribution

Landmark Project No 240016

Figure E-1

Pink lines show rock paths accelerating down the proposed 1H:1V slope into the parking lot area and approaching the proposed structure location. Roughly 5% of the rock paths analyzed made it to the parking lot, all others were stopped along the slope above the cut.

NOTE: GEOMETRY AS SHOWN IS NOT GLOBALLY STABLE. Refer to the Geotechnical Engineering Report For geometry recommendations.

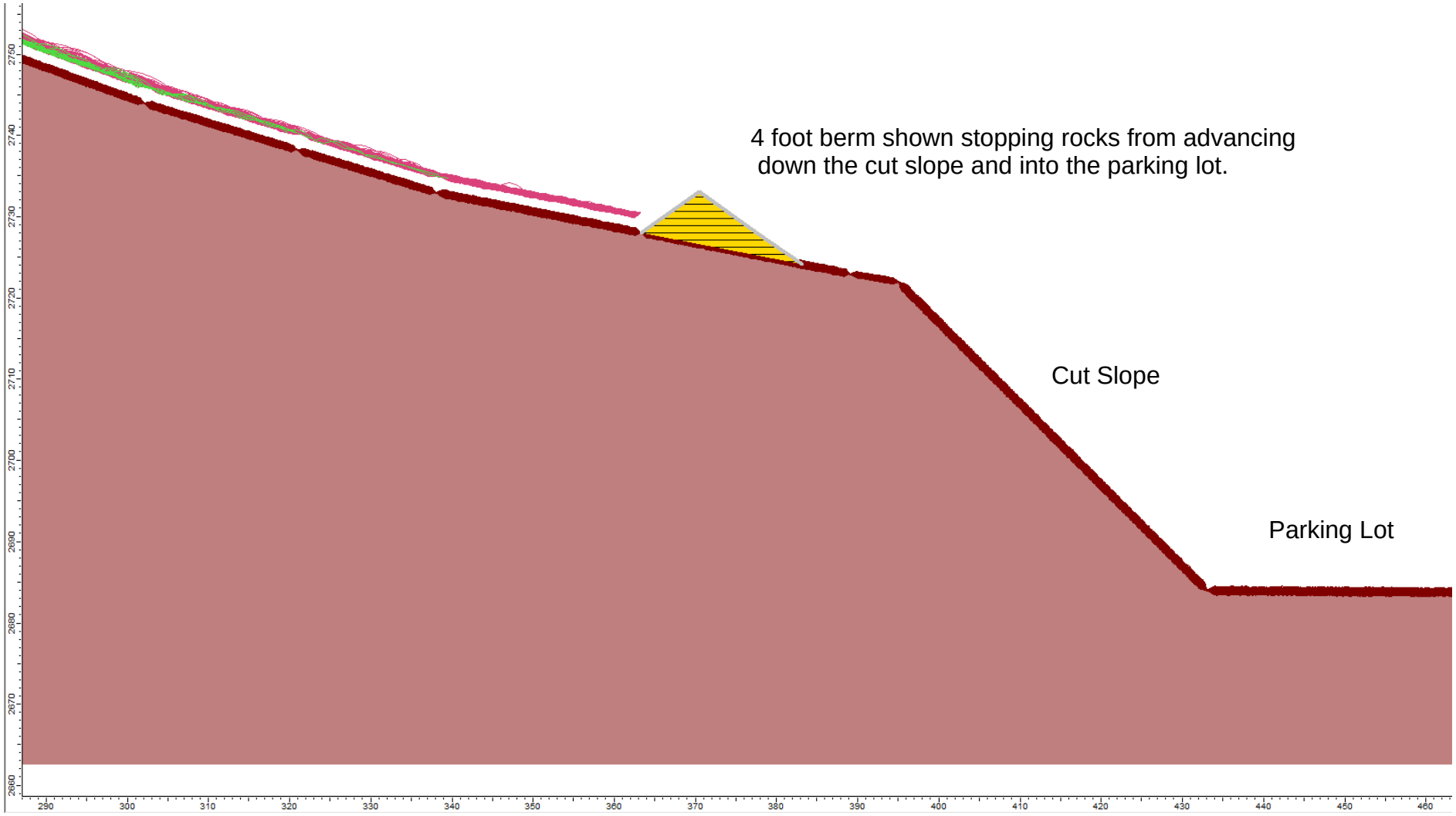


LANDMARK TESTING & ENGINEERING

Rocfall2 Round Rock Paths

Landmark Project No 240016

Figure E-2

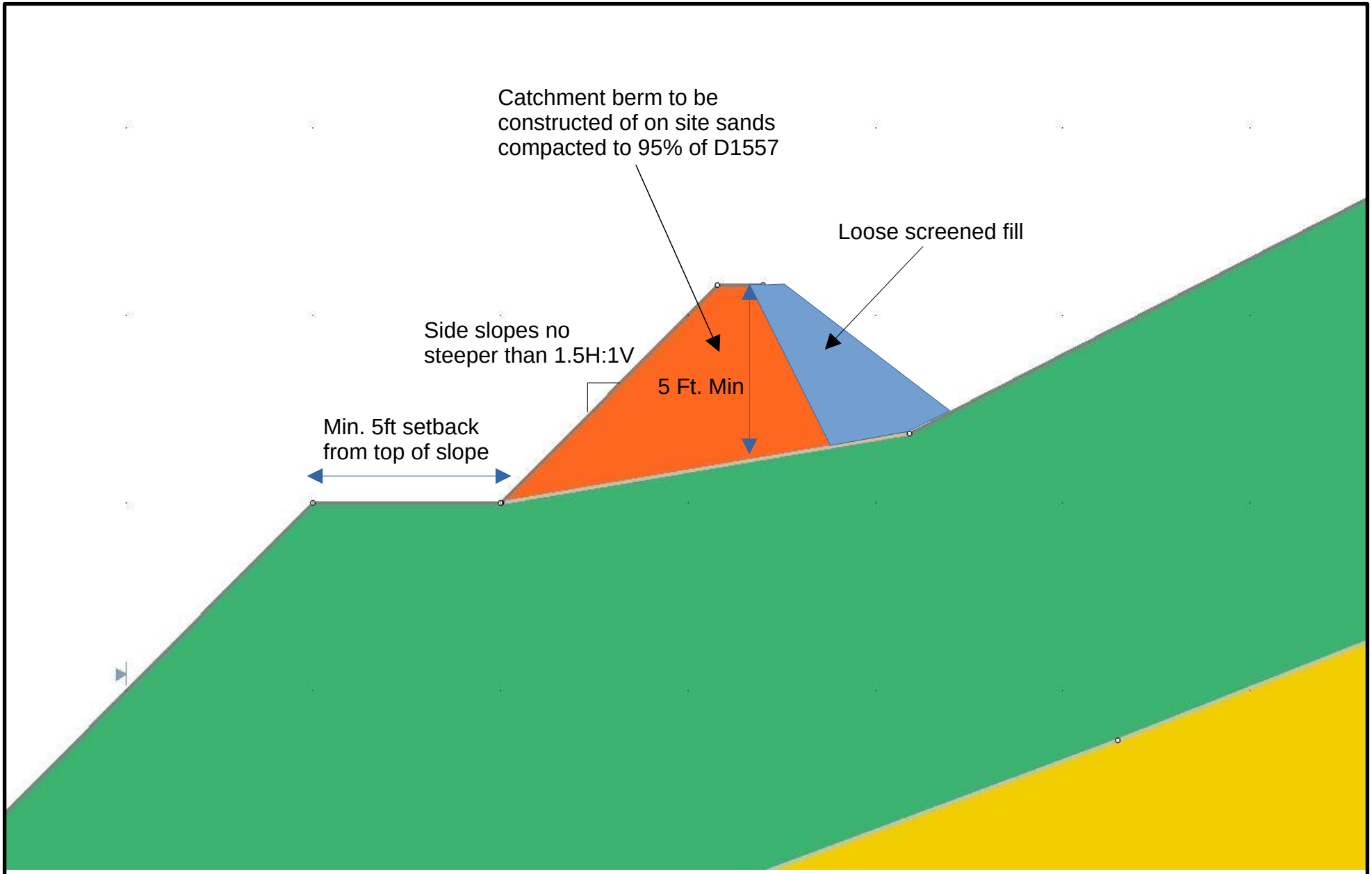


LANDMARK TESTING & ENGINEERING

Rocfall2 Round Rock Paths with Berm

Landmark Project No 240016

Figure E-3



LANDMARK TESTING & ENGINEERING

Typical Rockfall Catchment Berm Detail

Landmark Project No 240016

Figure E-4

rocscience

LANDMARK TESTING & ENGINEERING

CSH CRSP A-A' Rocfall Two Roc Types
Software Version: 8.024

FIGURE E-5 (14 Pages)

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CSH CRSP A-A' Rocfall Two Roc Types

RocFall2 Analysis Information

Project Summary

File Name	CSH CRSP A-A' Rocfall Two Roc Types
File Version	8.024

Project Settings

General Settings

Engine	Rigid Body
Units	Imperial Foot-Pounds (ft, lbm, ft-lbf)
Rock throw mode	2000 rocks thrown overall
Use tangential CRSP damping	Yes

Engine Conditions

Maximum steps per rock	30000
Normal velocity cutoff (ft/s)	0.1
Stopped velocity cutoff (ft/s)	0.33
Maximum timestep (s)	0.01
Switch velocity (ft/s)	-1e-09

Random Number Generation

Sampling method	Latin-Hypercube
Material Properties Sampling	Per simulation
Random seed	Pseudo-random seed: 12345234

Slope Geometry

Vertex	X	Y	X Std.Dev.	Y Std.Dev.
1	0	2887		
2	12.8278	2884.08		
3	14.722	2870.04		
4	26.934	2862.25		
5	46	2854		
6	62.1623	2844.69		
7	79	2835		
8	105	2819		
9	127.842	2808.62		
10	149	2799		
11	165.95	2791.47		
12	185	2783		
13	201.228	2777.9		
14	218.125	2772.59		
15	240.925	2765.42		
16	255	2761		
17	280.713	2751.7		
18	302	2744		
19	320.839	2738.24		
20	338	2733		
21	363.274	2728.04		
22	389	2723		
23	395	2722		
24	433	2684		
25	600	2683		

Slope Material Assignment

Material	From Vertex	To Vertex
Bedrock Outcrops	1	5
Cell 0001	5	25

Material Properties

Bedrock Outcrops

"Bedrock Outcrops" Properties					
Color					
	Mean	Distribution	Std.Dev.	Rel. Min	Rel. Max
Normal Restitution	0.35	Normal	0.04	0.12	0.12
Tangential Restitution	0.85	Normal	0.04	0.12	0.12
Dynamic Friction	0.5	Normal	0.04	0.12	0.12
Rolling Friction	0.15	Normal	0.02	0.06	0.06
"Bedrock Outcrops" Advanced Properties					
Forest and Vegetation Damping		Disabled			
Scarring		Disabled			
Viscoplastic Damping		Disabled			

Cell 0001

"Cell 0001" Properties					
Color					
	Mean	Distribution	Std.Dev.	Rel. Min	Rel. Max
Normal Restitution	0.28	None			
Tangential Restitution	0.88	None			
Dynamic Friction	0.55	None			
Rolling Friction	0.1	None			
Slope Roughness Spacing	1.2	Normal	0.2	0.6	0.6
Slope Roughness Amplitude	0	Normal	0.2	0.6	0.6
"Cell 0001" Advanced Properties					
Forest and Vegetation Damping		Disabled			
Scarring		Disabled			
Viscoplastic Damping		Disabled			

Berm(s) Geometry

Berm 1

Assigned Berm Property: Default Berm		
Vertex	X	Y
1	363.274	2728.04
2	370.415	2733.04
3	377.556	2728.04
4	383.11	2724.15

Berm Properties

Default Berm

"Default Berm" Properties

Berm Property	Mean	Distribution	Calculate Impact Std.Dev.	Rel. Min	Rel. Max
Normal Restitution	0.1	None			
Tangential Restitution	0.85	None			
Dynamic Friction	0.5	None			
Rolling Friction	0.15	None			

Seeders

Seeder 1

Seeder Properties					
Name	Seeder 1				
Location	(0, 2887), (12.8278, 2884.08), (14.722, 2870.04)				
Rocks to Throw					
Number of Rocks	Set in Project Settings				
Rock Types	Circles,	Squares			
Initial Conditions					
	Mean	Distribution	Std.Dev.	Rel. Min	Rel. Max
Horizontal Velocity (ft/s)	1	None			
Vertical Velocity (ft/s)	-1	None			
Rotational Velocity (deg/s)	0	None			
Initial Rotation (deg/s)	0	Uniform		0	360

Rock Types

Circles

Properties					
Name	Circles				
Color					
Smooth Shapes	Sphere				
Polygons	None				
	Mean	Distribution	Std.Dev.	Rel. Min	Rel. Max
Mass (lbm)	5529	None			
Density (lbm/ft3)	165	None			

Squares

Properties					
Name	Squares				
Color					
Smooth Shapes	Square				
Polygons	None				
	Mean	Distribution	Std.Dev.	Rel. Min	Rel. Max
Mass (lbm)	8100	None			
Density (lbm/ft3)	168.56	None			

Collectors

Record paths' first impacts only?	No
Analysis Point 1	
Name	Analysis Point 1
Location	(1, 2876.57) to (1, 2927.57)

Summary Results

Run Properties			
Simulation Time (s)	19.75		
Envelope data:			
	Max	Mean	95%
Envelope Bounce Height (ft)	14.99	14.18	14.78
Envelope Total Kinetic Energy (ft-lbf)	1.269e+05	7.004e+04	1.269e+05
Envelope Translational Kinetic Energy (ft-lbf)	9.801e+04	5.289e+04	9.801e+04
Envelope Rotational Kinetic Energy (ft-lbf)	3.222e+04	1.723e+04	3.222e+04
Envelope Translational Kinetic Velocity (ft/s)	32.13	21.64	32.13
Envelope Rotational Kinetic Velocity (rad/s)	13.26	9.401	13.26

Stopping Reason	
CONTINUE	0
Invalid Start Location	0
Invalid Slope Geometry	0
Invalid bad crest loss definition	0
Invalid relative size between rock and slope	0
Max Steps	0
Edge Model	0
Stopped	1261
Stopped (wedged)	0
Stopped (chattering)	0
Hit Barrier	0
Hit Berm with infinite capacity	0
No collision found	0
Bad Collision Geometry (location before)	739
Rock is freefalling onto a spike or a trough	0
END_ERROR_UNKNOWN	0
END_ERROR_POSITIVE_GAP	0
Bad collision calculation	0
Bad Collision Geometry (0 intersection)	0
Bad Collision Geometry (location after)	0
Bad Collision Geometry (missing intersection)	0
Error during results reading	0
Total Rocks	2000

Collector(s) Impact Results

Berm(s) Impact Results

Berm 1			
Berm Name	Berm 1		
Hits	405 / 2000 rocks		
Impact Statistics			
Based on actual values for all impacted rocks.			
	Mean	Min	Max
Impact Along Height (ft)	0.63	0.21	1.29
Translational Velocity (ft/s)	3.47	1.04	6.21
Translation Energy (ft-lbf)	1133.86	92.15	3316.51

St.George
Community Development

ITEM 2
Zoning Regulation Amendment

HILLSIDE REVIEW BOARD AGENDA REPORT: 03/13/2024

ZONING REGULATION AMENDMENT
Rock Walls
(2024-ZRA-006)

Amendment to Title 10-18A
Changes to the rock walls portion of the zoning code.

REQUEST:
Consider a request to amend Title 10-18A, Rockery Walls, of the St. George City Code, to make various changes to the rock wall portion of the zoning ordinance (see proposed language below). The applicant is The City of St. George.

BACKGROUND:
The original hillside ordinance was approved in 2007. Staff has been looking at revising the ordinance for the past couple of years. Staff has been working with local geotechnical engineers to revise the ordinance to reflect current construction practices and amendments that the development community has been requesting.

Proposed Changes:
The following is a summary of the proposed changes to chapter 10-18A:

Old Rockery Wall vs. New Rockery/Segmental Block Wall Ordinance - Highlights

Old Ordinance	New Ordinance
Rockery walls 4’ and greater require engineering analysis and design.	Rockery walls greater than 3’ require engineering analysis and design.
Maximum single-tier height = 8’	Maximum single-tier height = 10’ except for manufacturing zoning where the maximum height shall not exceed 12’.
Maximum two-tier Height = 16’	Maximum two-tier Height = 16’ (same)
The setback from the backs of rockery walls to a building or structure footing shall be at least the height of the wall.	The setback from the face of rockery walls to a building or structure footing shall be at least 10’.
Terraced rockery walls are considered one (1)wall, unless separated by a horizontal	Terraced rockery walls are considered one (1)wall, unless separated by a horizontal

distance greater than the vertical height of the lower wall.	distance greater than 1½ times the vertical height of the tallest wall.
Terraced rockery walls shall be separated a minimum distance of one-half (½) the height of the lower wall. The distance shall be measured from the back of the rocks on the lower wall to the face of the rocks on the upper wall.	Terraced rockery walls shall be separated a minimum distance of one-half (½) the height of the greatest exposed height of the tallest wall. The distance shall be measured from top of the exposed face of the lower wall to base of the exposed face of the upper wall.
The height of the upper wall shall not exceed the height of the lower wall.	The height of the upper wall shall may exceed the height of the lower wall.
	Retaining walls shall be installed between lots where there is an elevation change greater than 3.5' in height, unless special circumstances require an alternative design.
	Retaining walls shall be installed at the time of development; unless bonded for; and if bonded for, then all walls shall be installed before the issuance of building permits for the homes.
The separation distance between terraced rock retaining walls shall be measured from back of lower wall to face of upper wall.	The separation distance between terraced rock retaining walls shall be measured from face of upper wall to base of lower wall.
The minimum separation distance between a structure and a rock retaining wall is the height of the retaining wall	If the minimum separation distance of 10 feet from a structure to a rock wall exceeds the required setback to a building per the zone, an engineering analysis can be performed to reduce the minimum separation distance of 10 feet.

RECOMMENDATION:

Staff recommends approval of the amendment to Title 10-18A, Rock Walls, of the City Code, in order to make various changes to the rock wall standards as shown in the proposed language.

ALTERNATIVES:

1. Recommend approval as presented.
2. Recommend approval with changes.
3. Recommend denial.
4. Continue the proposed zoning regulation amendment to a specific date.

POSSIBLE MOTION:

"I move that the Hillside Review Board recommend approval of the zoning regulations amendment as proposed and presented by the City of St. George and based on the findings listed in the staff report."

FINDINGS:

1. It is in the best interest of the city to update city zoning regulations periodically.
2. The proposed revisions is more in line with current construction practices and eliminates other antiquated practices.
3. The proposed changes are in the best interest of the health, safety, and general welfare of the city and residents of St. George.

EXHIBIT A
Proposed Zoning Regulation Amendment

ARTICLE A. ROCKERY AND SEGMENTAL BLOCK WALLS

10-18A-1: Rockery Walls Subject to This Article – Permit Required
10-18A-2: Documents Required for Permit
10-18A-3: Site Conditions
10-18A-4: Construction
10-18A-5: Limitations
10-18A-6: Setbacks
10-18A-7: Structural Analysis
10-18A-8: Materials
10-18A-9: Inspections

10-18A-1: Rockery and Segmental Block Walls Subject to This Article – Permit Required
10-18A-2: Documents Required for Permit
10-18A-3: Site Conditions
10-18A-4: Construction
10-18A-5: Limitations
10-18A-6: Separations
10-18A-7: Structural Analysis
10-18A-8: Materials
10-18A-9: Inspections

10-18A-1:

ROCKERY AND SEGMENTAL BLOCK WALLS SUBJECT TO THIS ARTICLE – PERMIT REQUIRED:

A. Rockery and segmental block retaining walls greater than four feet (4') high and greater4') in height, as measured from the ground surface to the top of the uppermost rock layerexposed face to finished grade adjacent to the base of the retaining wall, shall be subject to the provisions of this article and shall require a permit issued by the city of St. George community development departmentCity prior to construction or alteration unless the wall was included and approved on the engineered construction drawings for the subdivision. or development site plans. (Ord. 2019-10-002, 10-10-2019)

B. The following do not require a building permit:

1. Non-tiered retaining walls less than four feet (4') in exposed height and have no steeper than 10H:1V (Horizontal:Vertical) front and back slopes within ten feet (10') of the wall.

2. Double-tiered retaining walls less than four feet (4') in exposed height per wall, have front slopes and back slopes of each wall no steeper than or equal to 10H:1V within ten feet (10') of the walls, and have a separation greater than 1.5 times the height of the tallest exposed face of the two walls. The distance shall be measured from top of exposed face of the lower wall to base of exposed face of the upper wall from face of wall to face of wall.

10-18A-2:

DOCUMENTS REQUIRED FOR PERMIT:

The following documentation shall be submitted to the ~~city~~City at the time of application for a permit under this article:

A~~.~~. A completed Pre-Wall Geotechnical Data Sheet from the geotechnical engineer responsible for observation and testing of the wall construction.

B. A dimensioned ~~drawing~~grading plan that identifies the location of each rockery or segmental block wall with respect to the property lines, easements, streets, and other rights-of-way. ~~Existing construction required setbacks, as noted below, and drainage features shall clearly be identified on~~

C. Cross sectional drawings~~.~~

~~B. A cross section of the wall~~ of the retaining wall(s) including surface grade and structures located in front and behind the retaining wall(s) showing the minimum rock or block size, for each lift, maximum wall height, reinforcing, backfill specifications, wall and surface drainage details, slope of adjacent ground, minimum embedment, cuts, and wall batter.

~~C.~~ D. All rockery and segmental block retaining walls four feet (~~4') and~~4') or greater in exposed height shall require engineering analysis.

~~D.~~ E. All rockery and segmental block retaining walls four feet (~~4') and~~4') or greater in exposed height shall require an engineering design. (Ord. 2019-10-002, 10-10-2019)

F. A copy of the site-specific geotechnical recommendations for design and construction of retaining walls including subgrade preparation, backfill placement and compaction, and the

engineering properties of anticipated construction materials. Documents shall also include a reference to the source/geotechnical report of the data.

G. When applicable, landscape and drainage plans in accordance with or adhering to City Standards and Specifications section 4.4.2B .

10-18A-3:

SITE CONDITIONS:

A. The following specific site conditions shall be considered for each wall design and shown on the drawings submitted:

1. Future structures and landscaping.

2. Location of utilities, utility easements, and written permission in a form acceptable to City from each affected utility to construct the wall. Notwithstanding any written permission, City reserves the right to deny a permit for a wall within, or over, a utility easement.

3. Location of existing or future utility installations within ten feet (10') of the base and top of wall.

4. Data showing the subgrade soil conditions within ten feet (10') of the wall.

5. The type of fill material to be replaced or removed.

6. The drawings shall show the drainage for surface water within sixteen feet (16') of the wall, and all walls shall be designed assuming wet conditions.

7. The drawings shall note the subsurface water conditions within eight feet (8') of the wall.

8. The drawings shall noteshow the keyway/foundation depth and width.

9. 8. The drawings shall noteshow the slope conditions and surcharge loads.

10. Maintenance and service access10. Site geometry including surface grades in front and behind the retaining walls, maximum retained height requirements, site access, structures located in front and behind the retaining walls, location of property lines and utility easements, and minimum setback requirements.

11. Anticipated construction parameters including wall type (i.e., rock, segmental block, gravity, and/or MSE options), anticipated surcharge loading conditions, wall batter, minimum keyway embedment, behind wall drainage, surface drainage, and future landscaping.

12. Soils information including anticipated subgrade soil and groundwater conditions, subgrade preparation requirements, recommended backfill materials and the suitability of on-site soils for use as backfill material, soil strength parameters for design of the retaining walls, and the presence of potential geologic hazards or construction constraints.

13. Rockery and segmental block wall construction according to St. George Standard Specifications 4.4.

. (Ord. 2019-10-002, 10-10-2019)

10-18A-4:

CONSTRUCTION:

A. *Monitoring:* All phases of rockery-wall construction shall be monitored by the geotechnical engineer employed by the owner/contractor to verify that the nature and quality of the materials being used are appropriate and that the construction is in accordance with the engineered design. The geotechnical engineer shall verify to the city in writing that the materials and construction of the rockery wall as-built is in accordance with the engineered design after construction is complete.

B. *Fill Compaction:* Where the rockery walls are constructed in front of a fill, the fill shall be placed and compacted in a manner that will provide a competent fill mass as noted in the drawings. All fills shall consist of quality fill meeting the geotechnical engineer's recommendations as noted on the drawings or report.

C. *Compaction Testing:* Density tests to verify compaction shall be taken at random locations. At least two (2) tests per one hundred feet (100') of wall length per two feet (2') of backfill shall be taken. In critical locations, the geotechnical engineer may request additional monitoring. The testing shall be conducted by a certified technician under the direction of the geotechnical engineer.

D. *Fill Construction Reinforcement:* All fill placed behind rockery walls shall be reinforced as recommended by the geotechnical engineer.

E. *Rock Selection:* The contractor shall have sufficient space and stockpile material available to select from among a number of rocks for each space in the rockery wall to be filled. Rock should be of a generally cubical, tabular or rectangular shape. Rounded rocks should not be used and internal void spaces in the facing should be kept to a minimum. Prior to being placed, all rock shall be inspected and approved by the geotechnical engineer. The rock source shall be preapproved by the geotechnical engineer. Rocks shall be placed to decrease in size with increasing wall height. Rocks shall be placed to bear on good flat-to-flat surfaces. The long dimension of the rocks shall extend back toward the cut/fill face. Rocks shall bear on at least two (2) or more other rocks.

F. *Rock Placement:* Rock shall be placed as recommended by the geotechnical engineer. A keyway (one-foot (1') minimum) as recommended by the geotechnical engineer shall be constructed into unyielding soil.

G. *Drainage:* A rock drainage filter or geosynthetic filter fabric shall be installed between the rear face of the rock wall and soil face being protected. The drainage design shall consider adjacent conditions and potential for water and erosion and shall be constructed as directed by the engineer.

H. *Surface Drainage:* Surface drainage shall be directed away from the rockery-wall face to a positive and permanent discharge well away and beyond the rock wall. The surrounding site shall be graded such that water cannot flow over the top of the wall.

I. *Steepness of Walls:* The steepness of the wall shall not exceed one horizontal to six vertical (1:6). Specific recommendations from the engineer are required and shall be noted on the drawings.

J. *Slopes:* Slopes above and below walls shall not exceed two horizontal to one vertical (2:1). (Ord. 2019-10-002, 10-10-2019)

Rockery and segmental block wall construction including:

a. Height Limitations
b. Terracing
c. Separation Requirements
d. Site Preparation
e. Monitoring
f. Backfill
g. Backfill Compaction and Testing

h. Geogrid Reinforcement
i. Rock Selection and Placement
j. Segmental Block Retaining Wall Units
k. Wall Drainage
l. Surface Drainage
m. Batter
n. Slopes
o. Structural Analysis
p. Inspections

shall be constructed in accordance with St. George City Standard Specifications 4.4 or as amended.

10-18A-5:

LIMITATIONS:

A. *Height*: The height of any single rockery or segmental block wall shall not exceed eighten feet (8'), or as limited by10').

Terracing of retaining walls is permitted where the International Building Code, foundation clearancecombined height of all walls shall not exceed maximum height of sixteen feet (16').

Walls with a separation greater than 1.5h (h of tallest exposed height of the two (2) walls), from slopes,face of wall to face of wall, shall be considered as separate walls for analysis purposes and these standards, whichever is most restrictive.applicability to this ordinance. If walls are within 1.5h, then the combined height of the terrace shall be used for limitations of height.

B. *Alignment*: Walls shall be in a continuous alignment without. Any abrupt changes in direction shall be considered and shown in the design.

C. *Terminations, Intersections, and Radii*: Terminations, intersections, and radii of rockery and segmental block retaining walls shall be included in the engineering analysis. (Ord. 2019-10-002, 10-10-2019)

10-18A-6:

SETBACKSSEPARATION:

A. *Minimum Setbacks**Separations*: The setbackseparation from a rockery or segmental block retaining wall to a building or structure shall meet all setbackseparation requirements as outlined in the International Building Code. Foundation clearance from slopes or the setback from a rockery wall shall be a minimum of the height of the rockeryin accordance with the St. George Standard Specification section 4.4.3 or as amended. The distance shall be measured from the

outside of the structure foundation to the exposed face of the retaining wall. This provision applies to buildings or structures at the top of the wall.

B. *Separate Rockery and Segmental Block Retaining Walls Considered One (1) Wall*: For height and setbackseparation restrictions separate rockery and segmental block retaining walls shall be considered one (1) wall, unless separated by a horizontal distance greater than one and one-half (1.5) the vertical height of the lowertaller wall. The distance shall be measured from the outside of the structure foundation of the structure to the exposed face of the rockery and segmental block retaining wall. This provision applies to buildingbuildings or structures at the low and hightop side of the wall.

C. *Terraced Rockery and Segmental Block Retaining Walls*: Multiple rockery and segmental block retaining walls, designed as terraced retaining walls, shall be separated a minimum distance of one-half (½)in accordance with the heightSt. George Standard Specifications section 4.4.3. The distance shall be measured from top of exposed face of the lower rockery wall to another rockery wall. The heightbase of anexposed face of the upper wall shall not exceed the height of a lower wall. The total combined height of all rockery walls shall not exceed sixteen feet (16').

D. *Rockery Walls in Utility Easements:* Rockery walls shall not be constructed within utility easements without prior written permission in a form acceptable to the city from each affected utility. Notwithstanding any written permission, the city reserves the right to deny a permit for a wall within, or over, a utility easement. Rock walls shall be limited to a height of three feet (3') within the street-frontage utility easement. (Ord. 2019-10-002, 10-10-2019)

D. *Property Lines*: The rockery or segmental block retaining wall shall be constructed on the property it is retaining. No retaining wall component shall extend beyond the property line.

10-18A-7:

STRUCTURAL ANALYSIS:

A. *Adherence to Requirements*: All structural analysis shall be in accordance with adopted building code of the jurisdiction having authority, the local amendment adopted by the authority having jurisdiction, and this article.

B. *Factor of Safety – Seismic Forces*: The minimum factorfactors of safety used for sliding and overturning of each rock in a rockery wall structural analysis shall be two (2). This shall include load combinationsin general accordance with the current Federal Highway

Administration (FHWA) Guidelines for Rockery Walls, and the current National Concrete Masonry Association (NCMA) Design Manual for Segmental Block Retaining Walls, for both static and seismic forces.

C. *Analysis Provisions*: The following analysis provisions provided in St. George Standard Specifications 4.4.17 shall apply:

1. The maximum unit weight of the rocks used in the design of a rockery wall shall be one hundred fifty-five (155) pcf unless field verified by special inspection.

2. The maximum coefficient of friction between rocks in a rockery wall shall be one-half (½).

3. Surcharge load shall be taken into consideration in the analysis.

4. Specifications shall be provided to clearly define acceptance criteria for rock materials. (Ord. 2019-10-002, 10-10-2019)

D. *Design Details*: The geotechnical engineer shall provide the design details specific to the location and conditions with a professional stamp. The geotechnical engineer shall provide upon request a printout of the input and output of the files with factors of safety within the applicable design standard used according to St. George Standard Specifications 4.4.

10-18A-8:

MATERIALS:

Rock and block material shall meet the minimum requirements of the "Rock Wall Construction Guidelines," by the Associated Rockery Contractors, August 15, 2000, Edition, unless other materials are specifically preapproved by the geotechnical engineer.St. George City Standard Specifications section 4.4.10 and 4.4.11. (Ord. 2019-10-002, 10-10-2019)

10-18A-9:

INSPECTIONS:

A. *Qualified Geotechnical Engineer Required*: Construction of rockery and segmental block retaining walls shall be supervised and inspectedobserved by a qualified geotechnical engineer employed by the owner/contractor. Supervision and testing and shall include all phases of wall construction. Testing shall be at the frequency specified by the geotechnical engineer, and shall include all phases of construction.

B. *Schedule Required*: A schedule for the continuous or periodic observation of construction shall be specified on the construction documents and all such observations shall be verified in writing. (Ord. 2019-10-002, 10-10-2019)

. C. *Final Compliance Report Required*: Upon completion of the wall, the geotechnicalGeotechnical engineer shall submit a final compliance report to the authority having jurisdiction.. The report shall include a description of the rock wall, including type of rock, size of rock, rock placement, embedment, summary of testing and inclination, property line setback, separations, and height of wall.observations per the Pre-Wall Geotechnical Data Sheet as part of the construction permit. The report shall provide a professional opinion as to the compliance with allthat the construction observed meets the intent of the design recommendations and acceptance of the construction.

C. *Schedule Required:* A schedule for the continuous or periodic supervision and inspection of construction shall be specified on the construction documents and all such supervision and inspection shall be verified in writing. (Ord. 2019-10-002, 10-10-2019)

The St. George City Code is current through Ordinance 2023-041, passed December 7, 2023.

Disclaimer: The city recorder has the official version of the St. George City Code. Users should contact the city recorder for ordinances passed subsequent to the ordinance cited above.

City Website: www.sgcity.org
City Telephone: (435) 627-4000

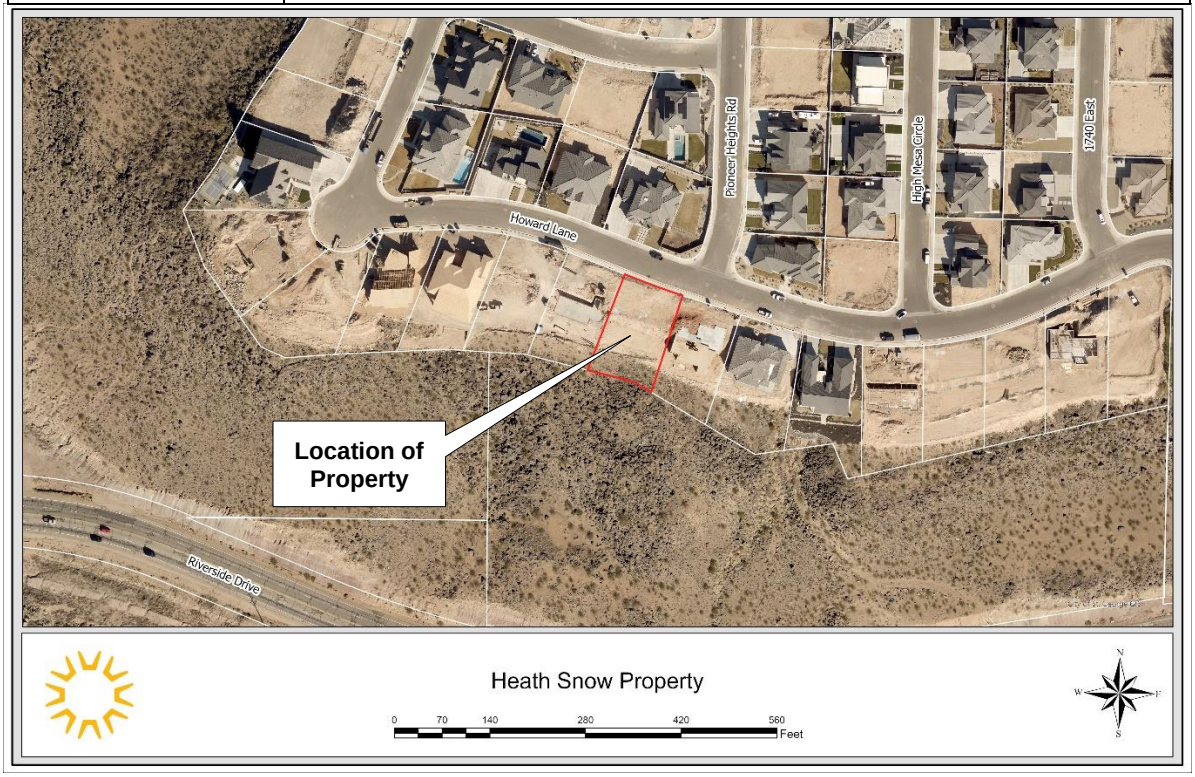
Hosted by Code Publishing Company, A General Code Company.. Final summary shall include documentation of items on Pre-Wall Geotechnical Data Sheet, compaction testing results, and photos.

St.George
Community Development

ITEM 3
Hillside Permit

HILLSIDE REVIEW BOARD AGENDA REPORT: **03/13/2024**

Heath Snow Property – South Rim at Foremaster Ridge Phase 2 Lot 32 Hillside Development Permit (Case No. 2024-HS-006)		
Request:	A Hillside Development Permit to adjust the location of the ridgeline and ridgeline setback on lot 32 of the South Rim at Foremaster Ridge Phase 2 subdivision in anticipation of the construction of a residential home.	
Applicant:	Heath Snow	
Location:	1636 East Howard Lane	
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 0.32 acres	



BACKGROUND

This is a request to obtain a hillside permit for the property located at 1636 E. Howard Lane (Lot 32, South Rim at Foremaster Ridge Phase 2). (See Exhibit A, South Rim at Foremaster Ridge Phase 2 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 meet with the hillside committee and review the location of the 30-foot ridgeline setback as shown on the final plat for South Rim at Foremaster Ridge Phase 2 lot 32 and propose a new ridgeline which the owner 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 – South Rim at Foremaster Ridge Phase 2 Plat
   “Exhibit A” in the packet shows the plat of South Rim at Foremaster Ridge Phase 2.

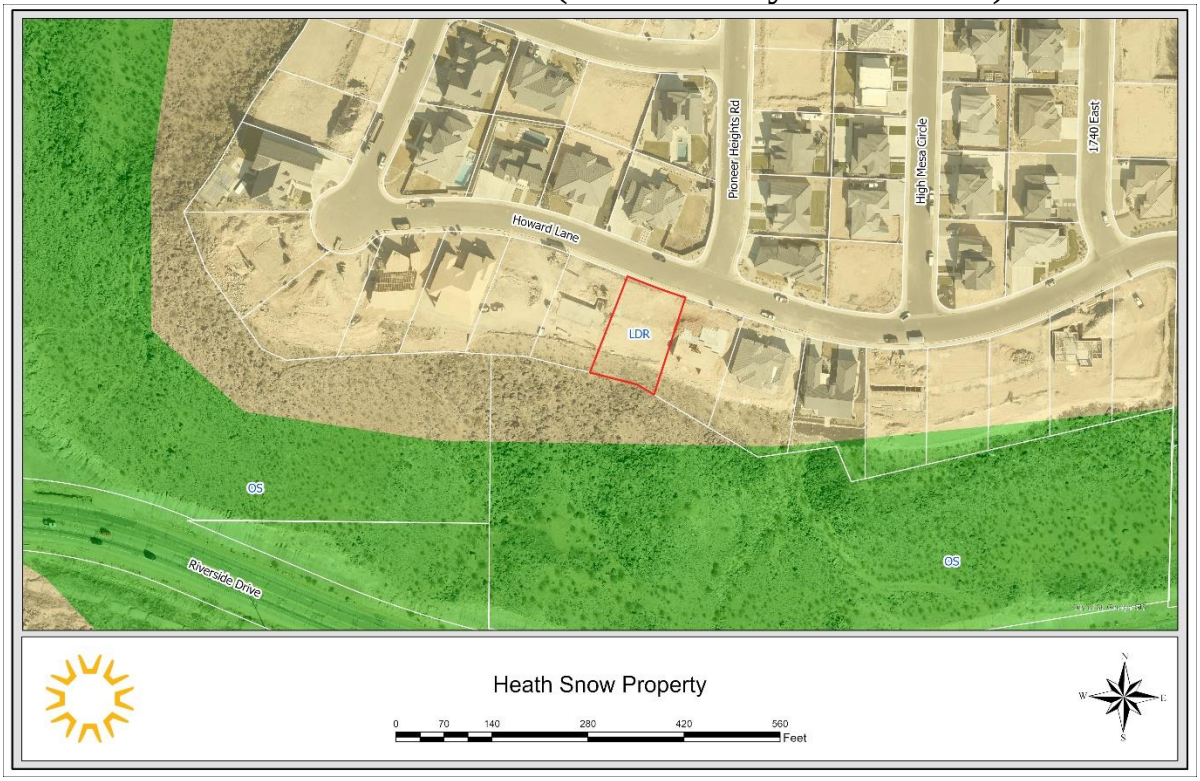
2. Exhibit B – Aerial of Existing Ridgeline with Plat Overlay
   “Exhibit B” is an aerial map with the South Rim at Foremaster Ridge Phase 2 Plat overlayed.

3. Exhibit C – Map of Proposed Ridgeline
   “Exhibit D” is a map showing the location of the proposed ridgeline designation with the proposed ridgeline and ridgeline setback of Lot 32.

RECOMMENDATION

The applicant is requesting that the ridgeline and the ridgeline setback be adjusted for Lot 32 of the South Rim at Foremaster Ridge Phase 2 plat. 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

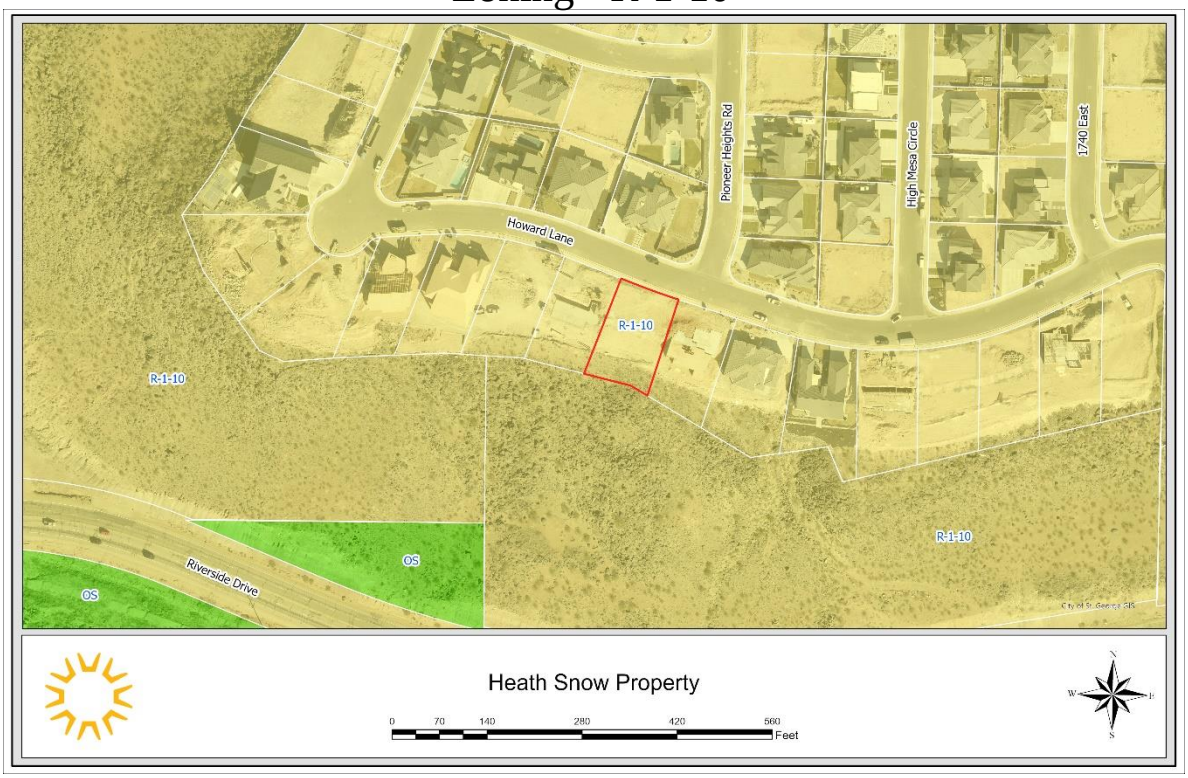


EXHIBIT A
SOUTH RIM AT FOREMASTER RIDGE PHASE 2

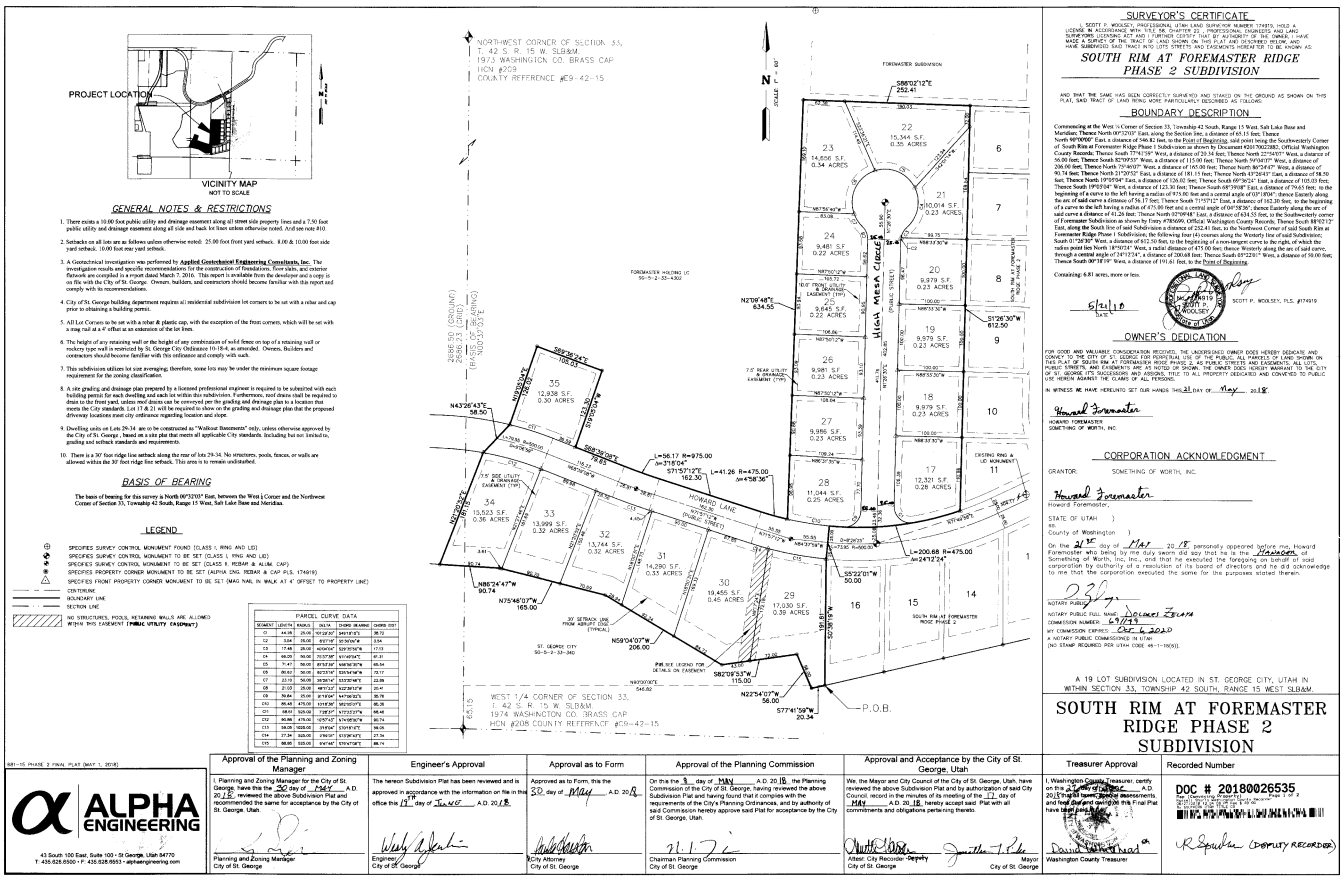
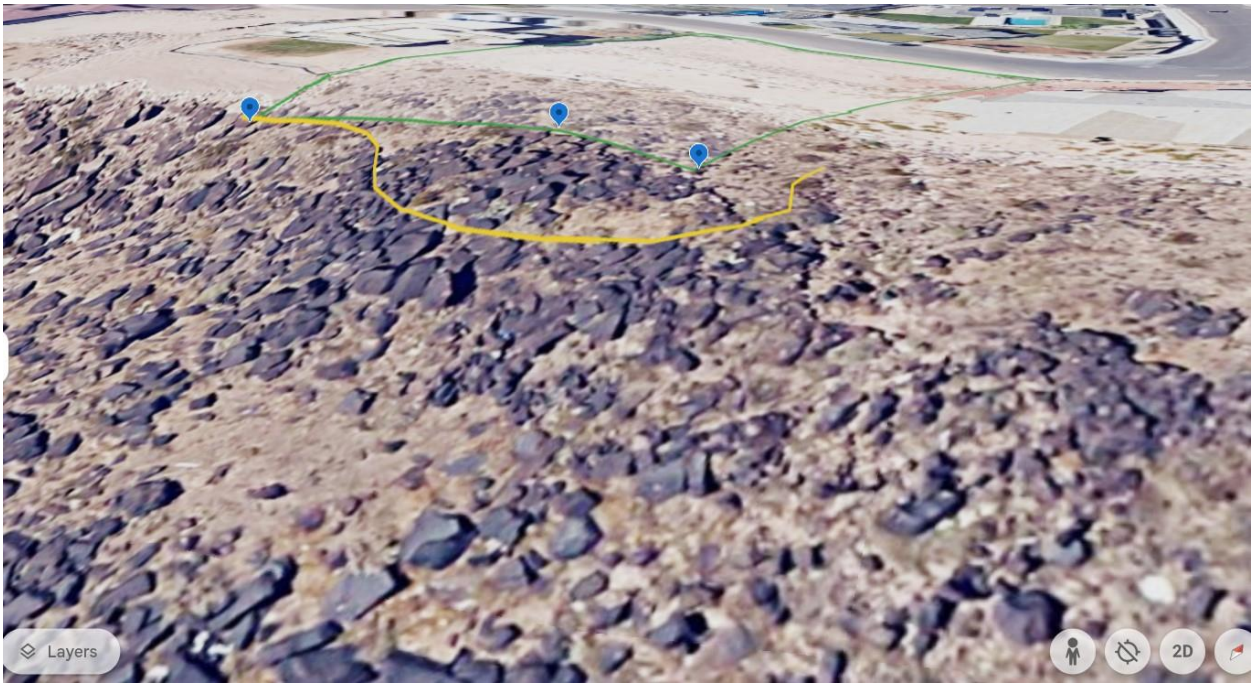
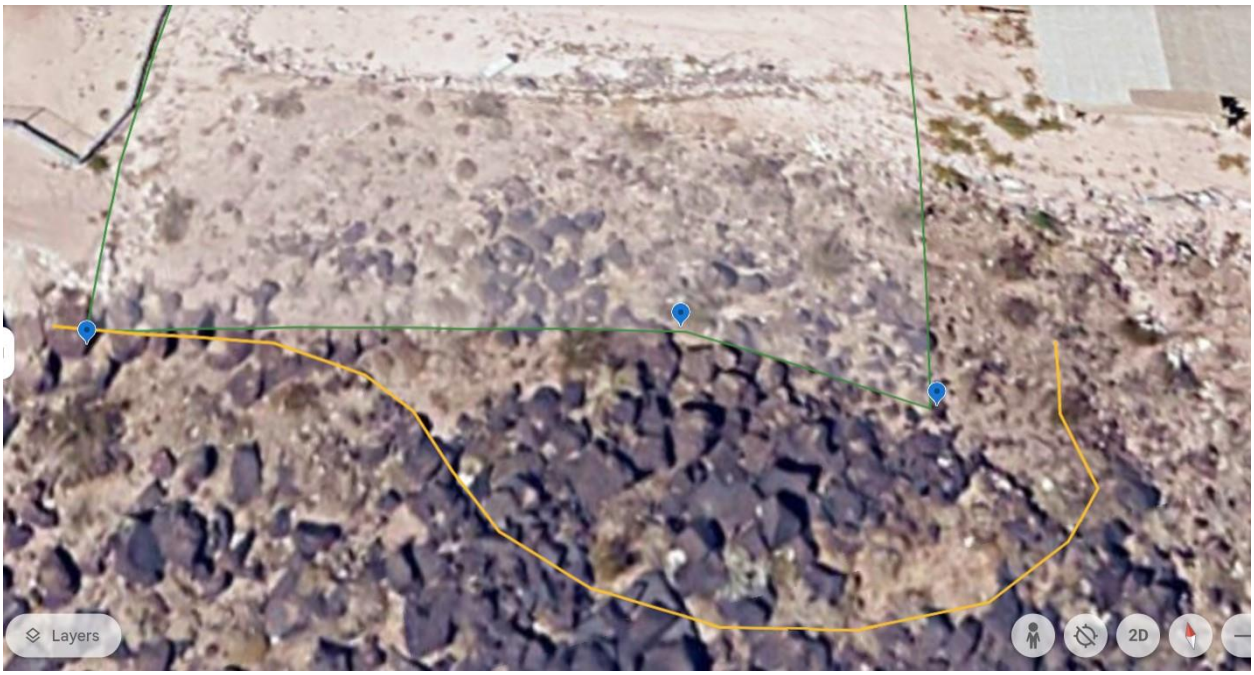


EXHIBIT B
AERIAL IMAGES OF LOT 32


2223 George Washington Blvd
St. George, Utah
View on Google Maps
Google

EXHIBIT C
PROPOSED RIDGELINE




Layers
2D


Layers