Geotechnical Investigation
Legacy Mountain Development
Huntsville, Weber County, Utah

January 8, 2021

Prepared by:

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Geotechnical Investigation
Legacy Mountain Development
Approximately 6000 East Nighthawk Lane
Huntsville, Weber County, Utah
CG Project No.: 133-009

Prepared by:

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Principal

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January 8, 2021

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ATTACHED PLATES

1.0 INTRODUCTION

1.1 PURPOSE AND SCOPE OF WORK

This report presents the results of a geotechnical investigation that was performed for the proposed Legacy Mountain Development which is to be located at approximately 6000 East Nighthawk Lane in Huntsville, Weber County, Utah. The general location of the project is indicated on the Project Vicinity Map, Plate 1. In general, the purposes of this investigation were to evaluate the subsurface conditions and the nature and engineering properties of the subsurface soils, and to provide recommendations for general site grading and for the design and construction of floor slabs, pavements, and foundations. This investigation included subsurface exploration, representative soil sampling, field and laboratory testing, engineering analysis, and preparation of this report. Prior to the completion of our report, the Geologic Hazards Evaluation report for the development by Western Geologic, dated November 20, 2020, was reviewed to assist in our assessments.

The work performed for this report was authorized by Mr. John Lewis and was conducted in accordance with the Christensen Geotechnical proposal dated September 24, 2020.

1.2 PROJECT DESCRIPTION

Based on a concept plan provided to us by Lewis Homes, we understand that the proposed development is to consist of a residential subdivision approximately 240 acres in size. Approximately 140 acres of the subdivision is to remain open space. The remaining 100 acres is to be developed with residential lots. The proposed structures within the development are to consist of single-family residences that are one to two stories in height, with basements. The development will also include an access road, associated utilities, and landscaping. The footing loads for the proposed structures are anticipated to be on the order of 3 to 4 klf for walls and 150 psf for floors. If the actual structural loads are different from those anticipated, Christensen Geotechnical should be notified in order to reevaluate our recommendations.

2.0 METHODS OF STUDY

2.1 FIELD INVESTIGATION

The subsurface conditions at the site were explored by excavating 25 test pits to depths of 7 to 10½ feet below the existing site grade. The approximate test pit locations are shown on the Exploration Location Map, Plate 2. The subsurface conditions as encountered in the test pits were recorded at the time of excavation and are presented on the attached Test Pit Logs, Plates 3 to 27. A key to the symbols and terms used on the Test Pit Logs may be found on Plate 28.

The test pit excavation was accomplished with a tracked excavator. Disturbed and undisturbed soil samples were collected from the test pit sidewalls at the time of excavation. The disturbed samples were collected and placed in bags and buckets. The undisturbed samples consisted of block samples which were placed in bags. The samples were visually classified in the field and portions of each sample were packaged and transported to our laboratory for testing. The classifications for the individual soil units are shown on the attached Test Pit Logs.

During the logging of the test pits, a Schmitt rebound hammer was used to estimate the compressive strength of the bedrock exposed within several of the test pits. The results of the rebound hammer testing are as follows:

Table No. 1: Schmitt Rebound Hammer Test Results

Test Pit	Depth (ft)	Compressive Strength (psf)
TP-2	8	300,000
TP-3	6	575,000
TP-7	8	260,000
TP-8	8	140,000
TP-9	6	350,000
TP-11	7	350,000
TP-13	8	200,000
TP-14	8	200,000
TP-16	7	140,000
TP-21	6	140,000
TP-22	7	260,000
TP-24	8	140,000
TP-25	7	350,000

2.2 LABORATORY TESTING

Of the soils collected during the field investigation, representative samples were selected for testing in the laboratory in order to evaluate the pertinent engineering properties. The laboratory testing performed included moisture content and density determinations, Atterberg limits evaluations, partial gradation analyses, one-dimensional consolidation/swell tests, and direct shear tests. A summary of our laboratory testing is presented in the table below:

Table No. 2: Laboratory Test Results

Test Pit No.	Depth (ft.)	Dry Density (pcf)	Moisture Content (%)	Atterberg Limits		Silt/Clay (- #200)	% Swell	Direct Shear		CBR	Soil Type
				LL	PI			Friction Angle	Cohesion (psf)		
TP-1	2		28.6	52	21	72.7					MH
TP-2	4		17.8	48	31	82.5		25	140		CL
TP-4	8	90.5	26.1	57	23	54.2	0.5				MH
TP-7	2		20.5	65	42	90.6					CH
TP-10	7		15.4	49	28	81.9					CL
TP-12	3		16.5	52	32	79.1					CH
TP-14	3		14.7	63	37	90.7					CH
TP-15	4		15.2	51	25	79.4					CH
TP-16	2	106.2	13.1	41	25	52.5	1.0	28	105		CL
TP-17	8		17.6	45	28	71.9					CL
TP-18	8		19.7	55	37	79.6		26	120		CH
TP-19	3		13.1	57	40	51.3					CH
TP-21	3	109.9	13.7	59	39	80.2	5.3	23	75		CH
TP-22	2	107.5	19.0	58	37	90.1	4.0				CH
TP-23	4		27.5	61	35	73.6					CH
TP-24	3		18.3	50	25	76.3					CH

The results of our laboratory tests are also presented on the Test Pit Logs, Plates 3 through 27, and more detailed laboratory results are presented on the laboratory testing plates, Plates 29 through 40.

The samples will be retained in our laboratory for 30 days following the date of this report, at which time they will be disposed of unless a written request for additional holding time is received prior to the disposal date.

3.0 GENERAL SITE CONDITIONS

3.1 SURFACE CONDITIONS

At the time of our investigation, the subject site was undeveloped land located in the mountain foothills above Pineview Reservoir in the southwest end of the Ogden Valley. The property is located on generally northeast-facing slopes which vary in orientation and steepness. The elevation of the property varies from approximately 4,980 to 5,815 feet above sea level. The vegetation at the site generally consisted of pockets of dense trees and brush with common grasses and weeds.

3.2 SUBSURFACE CONDITIONS

3.2.1 Soils

Based on the 25 test pits that were completed for this investigation, the site is covered with 1 to 3 feet of topsoil. Below the topsoil, 0 to more than 10 feet of soil cover tuffaceous siltstone, sandstone, and conglomerate bedrock. The soils above the bedrock generally consist of Lean CLAY (CL), Lean CLAY with sand (CL), Sandy Lean CLAY (CL), Elastic SILT (ML), Fat CLAY (CH), Fat CLAY with sand (CH), and Sandy Fat CLAY (CH). The bedrock was encountered at depths of ½ to 8½ feet below site grade. Bedrock was not encountered in test pits TP-18 and TP-23. Excavator refusal was encountered on bedrock in test pits TP-1, TP-3, TP-9, TP-11, TP-12, TP-13, TP-14, TP-16, TP-20, TP-21, TP-22, and TP-25 at depths of 7 to 9 feet below existing site grade.

3.2.2 Groundwater

Groundwater was not encountered within our test pits at the time of excavation. It should be understood that groundwater is likely below its seasonal high and may fluctuate in response to seasonal changes, precipitation, and irrigation.

4.0 SEISMIC CONSIDERATIONS

4.1 SEISMIC DESIGN CRITERIA

The State of Utah and Utah municipalities have adopted the 2015 International Building Code (IBC) for seismic design. The IBC seismic design is based on seismic hazard maps which depict probabilistic ground motions and spectral response; the maps, ground motions, and spectral response having been developed by the United States Geological Survey (USGS). Seismic design values, including the design spectral response, may be calculated for a specific site using the web-based application by the Applied Technology Council (ATC), the project site's approximate latitude and longitude, and its Site Class. Based on our field exploration, it is our opinion that this location is best described as a Site Class B, which represents a "rock" profile. The spectral acceleration values obtained from the ATC's web-based application are shown below.

Table 3: IBC Seismic Response Spectrum Values

Site Location: 41.247579º N -111.807261º W	
Name	**Response Spectral Value**
S_S	**0.873**
S_1	**0.308**
S_{MS}	**0.785**
S_{M1}	**0.247**
S_{DS}	**0.524**
S_{D1}	**0.164**
PGA	**0.386**
PGA_M	**0.347**

4.2 LIQUEFACTION

Certain areas in the intermountain west possess a potential for liquefaction. Liquefaction is a phenomenon in which soils lose their intergranular strength due to an increase of pore pressures during a dynamic event such as an earthquake. The potential for liquefaction is based on several factors, including 1) the grain-size distribution of the soil, 2) the plasticity of the fine fraction of the soil (material passing the No. 200 sieve), 3) the relative density of the soils, 4) earthquake strength (magnitude) and duration, 5) overburden pressures, and 6) the depth to groundwater. Due to the shallow bedrock at this site, we assess the liquefaction potential to be very low.

5.0 ENGINEERING ANALYSIS AND RECOMMENDATIONS

5.1 GENERAL CONLUSIONS

Based on the results of our field and laboratory investigations, it is our opinion that the subject site is suitable for the proposed construction provided that the recommendations contained in this report are incorporated into the design and construction of the project.

5.2 EARTHWORK

5.2.1 General Site Preparation and Grading

Prior to site grading operations, all vegetation, topsoil, undocumented fill soils, and loose or disturbed soils should be stripped (removed) from the building pad and flatwork concrete areas. Following the stripping operations, the exposed soils should be proof rolled to a firm, unyielding condition. Site grading may then be conducted to bring the site to design grade.

Based on the test pits excavated at the site, the site is covered with ½ to 3 feet of topsoil. This topsoil should be removed from below footings, concrete flatwork, and pavements. Where over-excavation is required, the excavation should extend at least 1 foot laterally for every foot of over-excavation. A Christensen Geotechnical representative should observe the site grading operations.

5.2.2 Soft Soil Stabilization

Once exposed through excavation, all subgrade soils should be proof rolled with a relatively large, wheeled vehicle to a firm, unyielding condition. Due to the fine-grained nature of the near-surface soil at the site, soft soils are likely to be encountered. Where encountered, these localized soft areas should be removed and replaced with granular structural fill. If soft areas extend more than 18 inches deep, or where large areas are encountered, stabilization may be considered. The use of stabilization should be approved by the geotechnical engineer, but would likely consist of over-excavating the area by at least 18 inches and then placing a geofabric (such as Mirafi RS280i) at the bottom of the excavation. Over this, a stabilizing fill, consisting of angular coarse gravel with cobbles, would be placed to the design subgrade.

5.2.3 Temporary Construction Excavations

Based on OSHA requirements and the soil conditions encountered during our field investigation, we anticipate that temporary construction excavations at the site that have vertical walls that

extend to depths of up to 5 feet may be occupied without shoring; however, where groundwater or fill soils are encountered, flatter slopes may be required. Excavations that extend to more than 5 feet in depth should be sloped or shored in accordance with OSHA regulations for a type C soil. The stability of construction excavations is the contractor's responsibility. If the stability of an excavation becomes questionable, the excavation should be evaluated immediately by qualified personnel.

5.2.4 Structural Fill and Compaction

All fill that is placed for the support of structures, concrete flatwork, and pavements should consist of structural fill. Due to their swell potential, the native clay soils should not be used as structural fill below structures, but may be used below the exterior flatwork concrete and roadways. The sandstone bedrock may also be used as structural fill below any exterior flatwork concrete and pavements if it is crushed to a maximum particle size of 4 inches. All structural fill placed below the proposed residences should consist of an imported material. Imported structural fill, if required, should consist of a relatively well-graded granular soil with a maximum particle size of 4 inches, with a maximum of 50 percent passing the No. 4 sieve and with a maximum of 30 percent passing the No. 200 sieve. The liquid limit of the fines (material passing the No. 200 sieve) should not exceed 35 and the plasticity index should be less than 15. Additionally, all structural fill, whether native soils or imported material, should be free of topsoil, vegetation, frozen material, particles larger than 4 inches in diameter, and any other deleterious materials. Any imported materials should be approved by the geotechnical engineer prior to importing.

The structural fill should be placed in loose lifts that are a maximum of 8 inches thick. The moisture content should be within 3 percent of optimum and the fill should be compacted to at least 95 percent of the maximum density as determined by ASTM D 1557. Where the fill heights exceed 5 feet, the level of compaction should be increased to 98 percent.

5.2.5 Excavatability

As indicated earlier, with the exception of TP-18 and TP-23, bedrock was encountered within all of the Test Pits at depths of ½ to 8½ feet. This bedrock was generally in a weak to moderately strong condition. We anticipate that the minimum equipment required for excavations within the bedrock will be the use of a heavy excavator with a ripper tooth or a hoe-ram. Prior to bidding, the contractor should be provided this report in order to be made aware of the subsurface conditions so that they can assess the type of equipment that will be best suited for these conditions.

5.2.6 Permanent Cut and Fill Slopes

The existing slopes on the property should not be over-steepened by cutting or filling. We recommend that all non-retained cut and fill slopes be graded no steeper than a 3 to 1 (horizontal to vertical) grade. If steeper grades are required, additional slope stability assessments may be required.

5.3 FOUNDATIONS

Due to the presence of swelling soils and landslide deposits (see Section 5.9), the foundations for the planned structures may consist of conventional continuous and/or spread footings established either entirely on properly placed and compacted structural fill or entirely on bedrock. Where clay soils are exposed, the clay should be over excavated to allow placement of at least 24 inches of structural fill below the footings. Where structures are located on landslide deposits, these deposits should be completely removed from below the structure down to undeformed bedrock (see Section 5.9). The building pad may then be brought to finish grade with imported structural fill. The footings for the proposed structures should be a minimum of 20 inches and 30 inches wide for continuous and spot footings, respectively. The exterior footings should be established at a minimum of 30 inches below the lowest adjacent grade to provide frost protection and confinement. Interior footings that are not subject to frost should be embedded a minimum of 18 inches for confinement.

Continuous and spread footings that are established on imported structural fill or bedrock may be proportioned for a maximum net allowable bearing capacity of 3,000 psf. A one-third increase may be used for transient wind or seismic loads. All footing excavations should be observed by the geotechnical engineer prior to the construction of footings.

5.4 ESTIMATED SETTLEMENT

If the foundations are designed and constructed in accordance with the recommendations presented in this report, there is a low risk that total settlement will exceed 1 inch and a low risk that differential settlement will exceed ½ inch for a 30-foot span.

5.5 LATERAL EARTH PRESSURES

Buried structures, such as basement walls, should be designed to resist the lateral loads imposed by the soils retained. The lateral earth pressures on the below-grade walls and the distribution of those pressures will depend upon the type of structure, hydrostatic pressures, in-situ soils, backfill, and tolerable movements. Basement and retaining walls are usually designed with

triangular stress distributions, which are based on an equivalent fluid pressure and calculated from lateral earth pressure coefficients. If soils similar to the native soils are used to backfill the basement walls, then the walls may be designed using the following ultimate values:

Table No. 4: Lateral Earth Pressures

Condition	Lateral Pressure Coefficient	Equivalent Fluid Density (pcf)
Active Static	0.36	42
Active Seismic	0.14	16
At-Rest	0.53	61
Passive Static	2.77	319
Passive Seismic	-0.30	-35

We recommend that walls which are allowed little or no wall movement be designed using "at rest" conditions. Walls that are allowed to rotate at least 0.4 percent of the wall height may be designed with "active" pressures. The coefficients and densities that are presented above assume a level backfill with no buildup of hydrostatic pressures. If anticipated, hydrostatic pressures and any surcharge loads should be added to the presented values. If sloping backfill is present, we recommend that the geotechnical engineer be consulted to provide more appropriate lateral pressure parameters once the design geometry is established.

The seismic active and passive earth pressure coefficients provided in the table above are based on the Mononobe-Okabe method and only account for the dynamic horizontal force produced by a seismic event. The resulting dynamic pressure should therefore be added to the static pressure to determine the total pressure on the wall. The dynamic pressure distribution can be represented as an inverted triangle, with stress decreasing with depth, and the resultant force acting approximately 0.6 times the height of the retaining wall, measured upward from the bottom of the wall.

Lateral building loads will be resisted by frictional resistance between the footings and the foundation soils and by passive pressure developed by backfill against the wall. For footings on native soils, we recommend that an ultimate coefficient of friction of 0.35 be used. If passive resistance is used in conjunction with frictional resistance, the passive resistance should be reduced by ½. The passive earth pressure from soils subject to frost or heave should usually be neglected in design.

The coefficients and equivalent fluid densities presented above are ultimate values and should be used with an appropriate factor of safety against overturning and sliding. A value of 1.5 is typically used.

5.6 CONCRETE SLAB-ON-GRADE CONSTRUCTION

The laboratory testing completed for this investigation indicates that the native clay soils at the site have some risk for expansion. Concrete slabs, including basement floor slabs and exterior flatwork, have a high risk of movement due to their light loading. To reduce the risk of expansion and slab movement, consideration should be given to placing 24 inches of structural fill below any concrete slabs where clay soils are encountered. At a minimum, we recommend that concrete slabs-on-grade be constructed over at least 4 inches of compacted gravel to help distribute floor loads, break the rise of capillary water, and to aid in the curing process. The gravel should consist of free-draining gravel compacted to a firm, unyielding condition. To help control normal shrinkage and stress cracking, the floor slab should have adequate reinforcement for the anticipated floor loads with the reinforcement continuous through the interior joints. In addition, we recommend adequate crack control joints to control crack propagation. Prior to the construction of slabs-on-grade, the site grading recommendations presented in Section 5.2.1 should be followed.

5.7 MOISTURE PROTECTION AND SURFACE DRAINAGE

Any wetting of the foundation soils will likely cause some degree of volume change within the soil and should be prevented both during and after construction. We recommend that the following precautions be taken at this site:

1. The ground surface should be graded to drain away from the structures in all directions, with a minimum fall of 8 inches in the first 10 feet.
2. Roof runoff should be collected in rain gutters with downspouts that are designed to discharge well outside of the backfill limits.
3. Sprinkler heads should be aimed away from and placed at least 12 inches from foundation walls.
4. There should be adequate compaction of backfill around foundation walls, to a minimum of 90% density (ASTM D 1557). Water consolidation methods should not be used.

5.8 SUBSURFACE DRAINAGE

Due to the high alpine setting of the subject site, we recommend that all basement and retaining walls incorporate a foundation drain. The foundations drain should consist of a 4-inch-diameter

slotted pipe placed at or below the bottom of footings and encased in at least 12 inches of free-draining gravel. The gravel should be extended up the foundation wall to within 2 feet of the final ground surface, and a filter fabric, such as Mirafi 140N, should separate the gravel from the native soils. The pipe should be graded to drain to the land drains, a storm drain or another free-gravity outfall unless provisions for pumped sumps are made. The gravel which is to extend up the foundation wall may be replaced by a fabricated drain panel such as Mirafi G200N or equivalent.

5.9 SLOPE STABILITY

As recommended in the Geologic Hazards Evaluation by Western Geologic, the stability of the slopes at the site was assessed using the Slide computer program and the modified Bishop's method of slices. Eight profiles were used to assess the slopes. The locations of the profiles are shown on Plate 2 and are based on the cross sections presented in the Western Geologic report. For our analyses, we assumed that the top 5 feet of the bedrock was highly weathered. The strength of this highly weathered portion of the bedrock that was used in our analyses was based on a direct shear test. This test indicated a strength consisting of an angle of internal friction of 25 degrees and a cohesion of 140 psf. The strength of the remaining, less weathered bedrock was based on Schmitt rebound hammer testing that was performed in our test pits at the time of excavation. As indicated in Section 2.1, the results of these tests indicated compressive strength values of 140,000 to 575,00 psf. For our analyses, we reduced these strength values to 28,000 psf (cohesion value of 14,000 psf). The strength value of the near-surface colluvial clay soil was based on direct shear testing. The lowest value of these tests indicates a strength value consisting of an angle of internal friction of 23 degrees and a cohesion of 75 psf. The strength value used for the landslide deposits was based on the Stark method (Stark et al., 2005) which indicated a residual strength of 17 degrees.

The profiles were assessed under static and pseudo static conditions. The pseudo static condition is used to assess the slope during a seismic event. As indicated in Section 4.1, the peak ground acceleration at this site is estimated to be 0.347g. As is common practice, half of this value was used in our pseudo static assessments. Minimum factors of safety of 1.5 and 1.0 for static and seismic conditions, respectively, were considered acceptable. Our analyses indicate that Profiles B and E have safety factors greater than 1.5 and 1.0 for the static and pseudo static conditions. Our analyses of profiles A, C, D, F, G, and H indicate that the slopes at these locations are statically either marginally stable (has a static factor of safety greater than 1.0 but less than 1.5) or unstable (has a static safety factor less than 1.0). Further analyses of Profiles C and D indicate

that the slopes at these locations have safety factors greater than 1.5 and 1.0 when outside the landslide deposits and outside the areas with steep slopes (steep meaning slopes steeper than 25 percent). Our analyses of Profiles A, F, G, and H indicate that adequate factors of safety for a home site is achieved when the landslide soils in the vicinity of the proposed home is removed and replaced with a gravel structural fill.

Based on the results of our stability assessments, it is our opinion that most of the slopes at the site are stable; however, areas where slopes are greater than 25 percent and areas with landslide deposits pose a high risk of slope failure. Due to the high risk in these areas, we recommend that no structures be constructed on slopes steeper than 25 percent. We further recommend that the landslide areas be avoided. If construction is to occur within landslide areas, all landslide deposits should be removed from below structures and roadways and replaced with gravel structural fill. The gravel fill should extend down to non-deformed bedrock and extend at least 20 feet beyond the edge of the structures and roadways. The structural fill should be a gravel material with a strength value consisting of an angel of internal friction of at least 36 degrees. A qualified engineer or geologist should observe the building excavation prior to placement of the gravel fill to assess whether the landslide deposits have been removed. If landslide deposits extend more than 15 feet below the ground's surface, the engineer may recommend that the gravel needs to extend more than 20 feet laterally beyond the edge of the structure or that other measures are required. It should be understood that this process will only reduce the risk of slope failure within the area that the gravel is placed. A high risk of slope failure will still be present in the landslide deposits around the gravel pad.

The slope stability analysis presented above is based on the assumption that no significant cuts or fills will occur during the development of the site. Significant changes to the site grade, such as the steepening of slopes with cuts or fills, may adversely affect the stability of the slopes and increase the risk of slope failures. If cuts or fills over 5 feet are planned in areas mapped as landslide deposits by Western Geologic, additional slope stability assessments may be necessary and Christensen Geotechnical should be contacted to provide the additional assessments. The results of our slope stability assessments may be found on Plates 41 through 62.

5.10 PAVEMENT DESIGN

Pavement sections for roadways within the proposed development were assessed using the PAS computer program (prepared by the American Concrete Pavement Association) and an assumed CBR value of 3 percent. No traffic information was available at the time this report was

prepared; Christensen Geotechnical has therefore assumed a traffic load for the roadways based on our experience with similar projects. We have assumed that traffic will consist of 100 passenger cars per day, 4 medium trucks per day and 4 heavy trucks per day. We have further assumed no increase in traffic over the life of the pavement. Based on this information, we recommend a pavement section consisting of 3 inches of asphalt over 14 inches of untreated base. As an alternative, a pavement section of 3 inches of asphalt, 6 inches of untreated base, and 9 inches of granular borrow may be used. The asphalt should consist of a high-stability plant mix and should be compacted to at least 96 percent of the Marshall maximum density. The untreated base should meet the material requirements for Weber County or UDOT. The granular borrow should meet the recommendations for imported structural fill as presented in Section 5.2.4 of this report. The untreated base and granular borrow should be compacted to at least 95 percent of the maximum dry density as determined by ASTM D 1557.

6.0 LIMITATIONS

The recommendations contained in this report are based on limited field exploration, laboratory testing, and our understanding of the proposed construction. The subsurface data used in this report was obtained from the explorations that were made specifically for this investigation. It is possible that variations in the soil and groundwater conditions could exist between and beyond the points explored. The nature and extent of variations may not be evident until construction occurs. If any conditions are encountered at this site that are different from those described in this report, Christensen Geotechnical should be immediately notified so that we may make any necessary revisions to the recommendations contained in this report. In addition, if the scope of the proposed construction changes from that described in this report, Christensen Geotechnical should be notified.

This report was prepared in accordance with the generally accepted standard of practice at the time the report was written. No other warranty, expressed or implied, is made.

It is the client's responsibility to see that all parties to the project, including the designer, contractor, subcontractors, etc., are made aware of this report in its entirety. The use of information contained in this report for bidding purposes should be done at the contractor's option and risk.

The recommendations presented within this report are based on the assumption that an adequate program of tests and observations will be followed during construction to verify compliance with our recommendations. We also assume that we will review the project plans and specifications to verify that our conclusions and recommendations are incorporated and remain appropriate (based on the actual design).

7.0 REFERENCES

Black, Bill, November 20, 2020, "Geologic Hazards Evaluation, Proposed Legacy Mountain Development, Sections 14 and 23, Township 6 North, Range 1 East, Huntsville, Weber County, Utah," Western Geologic, consultant's unpublished report.

Stark, Timothy D., Choi, Hangseok, and McCone, Sean, 2005, "Drained Shear Strength Parameters of Analysis of Landslides," ASCE, Journal of Geotechnical and Environmental Engineering, May 2005, pages 575-588.

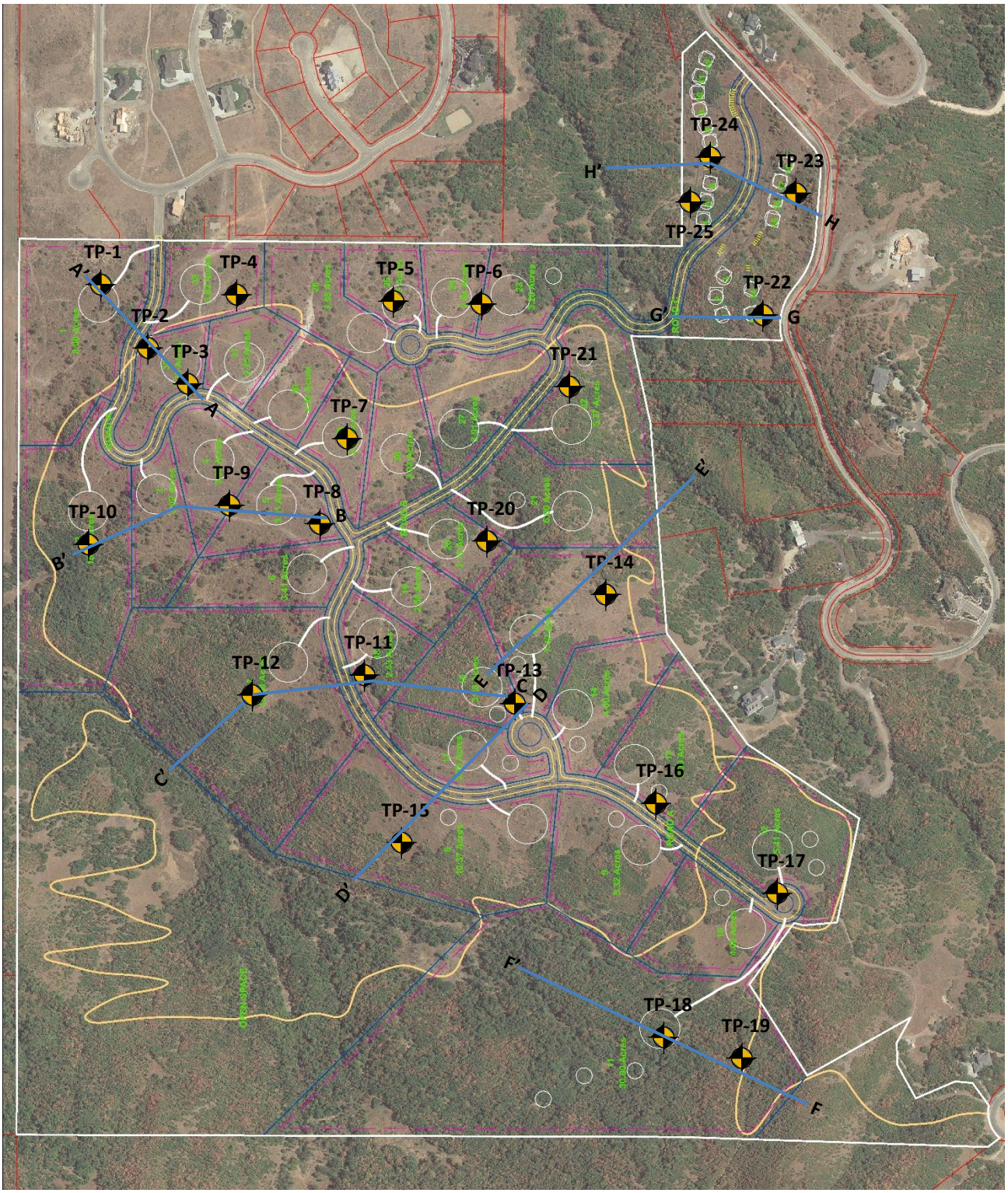
Base Photo: Utah AGRC

Drawing Not to Scale

N

Approximate Project Boundary

Christensen Geotechnical	Lewis Homes Legacy Mountain Development Huntsville, Weber County, Utah Project No. 133-009 **Vicinity Map**	Plate 1



Approximate Test Pit Location

Slope Stability Profile

Base Map: Great Basin Engineering

Drawing Not to Scale

N

Christensen Geotechnical

Lewis Homes
Legacy Mountain Development
Huntsville, Weber County, Utah
Project No. 133-009

Exploration Location Map

Plate
2

Date		
Started:	10/12/2021	
Completed:	10/12/2021	
Backfilled:	---	

TEST PIT LOG

Logged By: M Christensen
Equipment: Trackhoe
Location: See Plate 2

Test Pit No.
TP-1

Sheet 1 of 1

Depth (feet)	Sample Type	Groundwater	Graphic Log	Group Symbol	Material Description	Dry Density (pcf)	Moisture Content (%)	Minus #200 (%)	Liquid Limit	Plasticity Index
					Topsoil; Lean CLAY - moist, dark brown					
				MH	Elastic SILT with sand - very stiff, slightly moist, brown		28.6	82.5	52	21
5					Siltstone Bedrock - weathered, weak, light gray					
					Refusal at 7 feet on bedrock					
10										
15										

☒ Bulk/Bag Sample
▥ Undisturbed Sample

▼ Stabllized Groundwater
▽ Groundwater At Time of Excavation

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Legacy Mountain Development
Huntsville, Weber County, Utah
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Plate
3

Date			TEST PIT LOG	Logged By: M Christensen	Test Pit No.
Started:	10/14/2020			Equipment: Trackhoe	TP-2
Completed:	10/14/2020			Location: See Plate 2	Sheet 1 of 1
Backfilled:	---				

Depth (feet)	Sample Type	Groundwater	Graphic Log	Group Symbol	Material Description	Dry Density (pcf)	Moisture Content (%)	Minus #200 (%)	Liquid Limit	Plasticity Index
					Topsoil; Lean CLAY - moist, dark brown					
					Lean CLAY with sand - very stiff, slightly moist, brown					
					Sandstone and Claystone Bedrock - weathered, weak, light gray					
							17.8	82.5	48	31
5										
					- moderatly strong below 8 feet					
10					Bottom of test pit at 10 feet					
15										

☒ Bulk/Bag Sample
▥ Undisturbed Sample
▼ Stabllized Groundwater
▽ Groundwater At Time of Excavation

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Plate
4

Date			TEST PIT LOG	Logged By: M Christensen	Test Pit No.
	Started:	10/14/2020		Equipment: Trackhoe	TP-3
	Completed:	10/14/2020		Location: See Plate 2	
	Backfilled:	---			Sheet 1 of 1

Depth (feet)	Sample Type	Groundwater	Graphic Log	Group Symbol	Material Description	Dry Density (pcf)	Moisture Content (%)	Minus #200 (%)	Liquid Limit	Plasticity Index
					Topsoil; Lean CLAY - moist, dark brown					
					Sandstone and Claystone Bedrock - weathered, weak, light gray					
					- moderatly strong below 3 feet					
5					- strong below 5 feet					
					Refusal at 8 feet on bedrock					
10										
15										

☒ Bulk/Bag Sample
▥ Undisturbed Sample
▼ Stabllized Groundwater
▽ Groundwater At Time of Excavation

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Project No.: 133-009

Plate
5

Date		
Started:	10/12/2020	
Completed:	10/12/2020	
Backfilled:	---	

TEST PIT LOG

Logged By: M Christensen
Equipment: Trackhoe
Location: See Plate 2

Test Pit No.
TP-4

Sheet 1 of 1

Depth (feet)	Sample Type	Groundwater	Graphic Log	Group Symbol	Material Description	Dry Density (pcf)	Moisture Content (%)	Minus #200 (%)	Liquid Limit	Plasticity Index
					Topsoil; Lean CLAY - moist, dark brown					
5				CL	Lean CLAY - very stiff, slightly moist, brown					
10	☒				Siltstone to Sandstone Bedrock - weathered, weak, light gray	90.5	26.1	54.2	57	23
15					Bottom of test pit at 10½ feet					

☒ Bulk/Bag Sample
▥ Undisturbed Sample
▼ Stabllized Groundwater
▽ Groundwater At Time of Excavation

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Project No.: 133-009

Plate
6

Date			TEST PIT LOG	Logged By: M Christensen	Test Pit No.
	Started:	10/12/2020		Equipment: Trackhoe	TP-5
	Completed:	10/12/2020		Location: See Plate 2	Sheet 1 of 1
	Backfilled:	---			

Depth (feet)	Sample Type	Groundwater	Graphic Log	Group Symbol	Material Description	Dry Density (pcf)	Moisture Content (%)	Minus #200 (%)	Liquid Limit	Plasticity Index
					Topsoil; Lean CLAY - moist, dark brown					
					Siltstone to Sandstone Bedrock - weathered, weak, light gray					
					- moderately strong					
5										
10										
					Bottom of test pit at 10½ feet					
15										

☒ Bulk/Bag Sample
▥ Undisturbed Sample

▼ Stabllized Groundwater
▽ Groundwater At Time of Excavation

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Plate
7

Date			TEST PIT LOG	Logged By: M Christensen	Test Pit No.
Started:	10/12/2020			Equipment: Trackhoe	TP-6
Completed:	10/12/2020			Location: See Plate 2	Sheet 1 of 1
Backfilled:	---				

Depth (feet)	Sample Type	Groundwater	Graphic Log	Group Symbol	Material Description	Dry Density (pcf)	Moisture Content (%)	Minus #200 (%)	Liquid Limit	Plasticity Index
					Topsoil; Lean CLAY - moist, dark brown					
					Siltstone to Sandstone Bedrock - weathered, weak, light gray					
5					- moderately strong					
10					Bottom of test pit at 10 feet					
15										

☒ Bulk/Bag Sample
▥ Undisturbed Sample
▼ Stabllized Groundwater
▽ Groundwater At Time of Excavation

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Plate
8

Date			TEST PIT LOG	Logged By: M Christensen	Test Pit No.
Started:	10/12/2020			Equipment: Trackhoe	TP-7
Completed:	10/12/2020			Location: See Plate 2	Sheet 1 of 1
Backfilled:	---				

Depth (feet)	Sample Type	Groundwater	Graphic Log	Group Symbol	Material Description	Dry Density (pcf)	Moisture Content (%)	Minus #200 (%)	Liquid Limit	Plasticity Index
					Topsoil; Lean CLAY - moist, dark brown					
				CL	Fat CLAY - very stiff, slightly moist, light brown		20.5	90.6	65	42
5					Siltstone to Sandstone Bedrock - weathered, weak, light gray - strong and fractured below 7 feet					
10					Bottom of test pit at 9 feet					
15										

☒ Bulk/Bag Sample
▥ Undisturbed Sample
▼ Stabllized Groundwater
▽ Groundwater At Time of Excavation

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Plate
9

Date			TEST PIT LOG	Logged By: M Christensen	Test Pit No.
Started:	10/12/2020			Equipment: Trackhoe	TP-8
Completed:	10/12/2020			Location: See Plate 2	Sheet 1 of 1
Backfilled:	---				

Depth (feet)	Sample Type	Groundwater	Graphic Log	Group Symbol	Material Description	Dry Density (pcf)	Moisture Content (%)	Minus #200 (%)	Liquid Limit	Plasticity Index
					Topsoil; Lean CLAY - moist, dark brown					
					Siltstone to Sandstone Bedrock - weathered, weak, light gray					
5					- strong below 5 feet					
10					Bottom of test pit at 9½ feet					
15										

☒ Bulk/Bag Sample
▥ Undisturbed Sample
▼ Stabllized Groundwater
▽ Groundwater At Time of Excavation

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Plate
10

Date		
Started:	10/13/2020	
Completed:	10/13/2020	
Backfilled:	---	

TEST PIT LOG

Logged By: M Christensen
Equipment: Trackhoe
Location: See Plate 2

Test Pit No.
TP-9

Sheet 1 of 1

Depth (feet)	Sample Type	Groundwater	Graphic Log	Group Symbol	Material Description	Dry Density (pcf)	Moisture Content (%)	Minus #200 (%)	Liquid Limit	Plasticity Index
					Topsoil; Lean CLAY - moist, dark brown					
					Siltstone to Sandstone Bedrock - weathered, weak, light gray					
5					- strong below 4 feet					
					Refusal at 7½ feet on bedrock					
10										
15										

☒ Bulk/Bag Sample
▥ Undisturbed Sample

▼ Stabllized Groundwater
▽ Groundwater At Time of Excavation

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Plate
11

Date		
Started:	10/13/2020	
Completed:	10/13/2020	
Backfilled:	---	

TEST PIT LOG

Logged By: M Christensen
Equipment: Trackhoe
Location: See Plate 2

Test Pit No.
TP-10

Sheet 1 of 1

Depth (feet)	Sample Type	Groundwater	Graphic Log	Group Symbol	Material Description	Dry Density (pcf)	Moisture Content (%)	Minus #200 (%)	Liquid Limit	Plasticity Index
					Topsoil; Lean CLAY - moist, dark brown					
5				CL	Lean CLAY with sand - very stiff, slighlty moist, brown		15.4	81.9	49	28
10					Claystone to Sandstone Bedrock - weathered, weak, light gray					
					Bottom of test pit at 10 feet					
15										

☒ Bulk/Bag Sample
▥ Undisturbed Sample

▼ Stabllized Groundwater
▽ Groundwater At Time of Excavation

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Plate
12

Date			TEST PIT LOG	Logged By: M Christensen	Test Pit No.
Started:	10/12/2020			Equipment: Trackhoe	TP-11
Completed:	10/12/2020			Location: See Plate 2	Sheet 1 of 1
Backfilled:	---				

Depth (feet)	Sample Type	Groundwater	Graphic Log	Group Symbol	Material Description	Dry Density (pcf)	Moisture Content (%)	Minus #200 (%)	Liquid Limit	Plasticity Index
					Topsoil; Lean CLAY - moist, dark brown					
					Siltstone to Sandstone Bedrock - weathered, weak, light gray					
5					- strong below 4 feet					
					Refusal at 8 feet on bedrock					
10										
15										

☒ Bulk/Bag Sample
▥ Undisturbed Sample

▼ Stabllized Groundwater
▽ Groundwater At Time of Excavation

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Plate
13

Date			TEST PIT LOG	Logged By: M Christensen	Test Pit No.
Started:	10/13/2020			Equipment: Trackhoe	TP-12
Completed:	10/13/2020			Location: See Plate 2	Sheet 1 of 1
Backfilled:	---				

Depth (feet)	Sample Type	Groundwater	Graphic Log	Group Symbol	Material Description	Dry Density (pcf)	Moisture Content (%)	Minus #200 (%)	Liquid Limit	Plasticity Index
					Topsoil; Lean CLAY - moist, dark brown					
				CH	Fat CLAY with sand - very stiff, slightly moist, light gray		16.5	79.1	52	32
5					Siltstone to Sandstone Bedrock - weathered, weak, light gray - moderatly strong					
10					Refusal at 8 feet on bedrock					
15										

☒ Bulk/Bag Sample
▥ Undisturbed Sample

▼ Stabllized Groundwater
▽ Groundwater At Time of Excavation

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Plate
14

Date		
Started:	10/13/2020	
Completed:	10/13/2020	
Backfilled:	---	

TEST PIT LOG

Logged By: M Christensen
Equipment: Trackhoe
Location: See Plate 2

Test Pit No.
TP-13

Sheet 1 of 1

Depth (feet)	Sample Type	Groundwater	Graphic Log	Group Symbol	Material Description	Dry Density (pcf)	Moisture Content (%)	Minus #200 (%)	Liquid Limit	Plasticity Index
					Topsoil; Lean CLAY - moist, dark brown					
					Siltstone to Sandstone Bedrock - weathered, weak, light gray					
					- moderatly strong below 4 feet					
5										
					Refusal at 9 feet on bedrock					
10										
15										

☒ Bulk/Bag Sample
▥ Undisturbed Sample

▼ Stabllized Groundwater
▽ Groundwater At Time of Excavation

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Plate
15

Date			TEST PIT LOG	Logged By: M Christensen	Test Pit No.
Started:	10/14/2020			Equipment: Trackhoe	TP-14
Completed:	10/14/2020			Location: See Plate 2	Sheet 1 of 1
Backfilled:	---				

Depth (feet)	Sample Type	Groundwater	Graphic Log	Group Symbol	Material Description	Dry Density (pcf)	Moisture Content (%)	Minus #200 (%)	Liquid Limit	Plasticity Index
					Topsoil; Lean CLAY - moist, dark brown					
				CH	Fat CLAY - very stiff, slightly moist, light gray		14.7	90.7	63	37
5					Siltstone to Sandstone Bedrock - weathered, weak, light gray					
10					Refusal at 9 feet on bedrock					
15										

☒ Bulk/Bag Sample
▥ Undisturbed Sample
▼ Stabllized Groundwater
▽ Groundwater At Time of Excavation

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Plate
16

Date		
Started:	10/14/2020	
Completed:	10/14/2020	
Backfilled:	---	

TEST PIT LOG

Logged By: M Christensen
Equipment: Trackhoe
Location: See Plate 2

Test Pit No.
TP-15
Sheet 1 of 1

Depth (feet)	Sample Type	Groundwater	Graphic Log	Group Symbol	Material Description	Dry Density (pcf)	Moisture Content (%)	Minus #200 (%)	Liquid Limit	Plasticity Index
					Topsoil; Lean CLAY - moist, dark brown					
				CH	Fat CLAY with sand - very stiff, slightly moist, light gray		15.2	79.4	51	25
5					Siltstone to Sandstone Bedrock - weathered, weak, light gray					
10					Bottom of test pit at 10 feet					
15										

☒ Bulk/Bag Sample
▥ Undisturbed Sample

▼ Stabllized Groundwater
▽ Groundwater At Time of Excavation

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Plate
17

Date		
Started:	10/14/2020	
Completed:	10/14/2020	
Backfilled:	---	

TEST PIT LOG

Logged By: M Christensen
Equipment: Trackhoe
Location: See Plate 2

Test Pit No.
TP-16
Sheet 1 of 1

Depth (feet)	Sample Type	Groundwater	Graphic Log	Group Symbol	Material Description	Dry Density (pcf)	Moisture Content (%)	Minus #200 (%)	Liquid Limit	Plasticity Index
					Topsoil; Lean CLAY - moist, dark brown					
				CL	Sandy Lean CLAY - very stiff, slightly moist, brown	106.2	13.1	52.5	41	25
5					Claystone to Sandstone Bedrock - weathered, weak, light gray					
10					Refusal at 8½ feet					
15										

☒ Bulk/Bag Sample
▥ Undisturbed Sample

▼ Stabllized Groundwater
▽ Groundwater At Time of Excavation

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Plate
18

Date		
Started:	10/14/2020	
Completed:	10/14/2020	
Backfilled:	---	

TEST PIT LOG

Logged By: M Christensen
Equipment: Trackhoe
Location: See Plate 2

Test Pit No.
TP-17
Sheet 1 of 1

Depth (feet)	Sample Type	Groundwater	Graphic Log	Group Symbol	Material Description	Dry Density (pcf)	Moisture Content (%)	Minus #200 (%)	Liquid Limit	Plasticity Index
					Topsoil; Lean CLAY - moist, dark brown					
					Claystone, Sandstone, and Conglomerate Bedrock - weathered, friable, brown					
5					- weak below 4 feet		17.6	71.9	45	28
					Bottom of test pit at 9 feet					
10										
15										

☒ Bulk/Bag Sample
▥ Undisturbed Sample

▼ Stabllized Groundwater
▽ Groundwater At Time of Excavation

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Plate
19

Date		
Started:	10/14/2020	
Completed:	10/14/2020	
Backfilled:	---	

TEST PIT LOG

Logged By: M Christensen
Equipment: Trackhoe
Location: See Plate 2

Test Pit No.
TP-18
Sheet 1 of 1

Depth (feet)	Sample Type	Groundwater	Graphic Log	Group Symbol	Material Description	Dry Density (pcf)	Moisture Content (%)	Minus #200 (%)	Liquid Limit	Plasticity Index
					Topsoil; Lean CLAY - moist, dark brown					
5				CH	Fat CLAY with sand - very stiff, slightly moist, brown		19.7	79.6	55	37
10					Bottom of test pit at 9 feet					
15										

☒ Bulk/Bag Sample
▥ Undisturbed Sample

▼ Stabllized Groundwater
▽ Groundwater At Time of Excavation

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Plate
20

Date		
Started:	10/14/2020	
Completed:	10/14/2020	
Backfilled:	---	

TEST PIT LOG

Logged By: M Christensen
Equipment: Trackhoe
Location: See Plate 2

Test Pit No.
TP-19

Sheet 1 of 1

Depth (feet)	Sample Type	Groundwater	Graphic Log	Group Symbol	Material Description	Dry Density (pcf)	Moisture Content (%)	Minus #200 (%)	Liquid Limit	Plasticity Index
					Topsoil; Lean CLAY - moist, dark brown					
				CH	Sandy Fat CLAY - very stiff, slightly moist, brown		13.1	51.3	57	40
5					Siltstone to Sandstone Bedrock - weathered, weak, brown					
					Bottom of test pit at 9 feet					
10										
15										

☒ Bulk/Bag Sample
▥ Undisturbed Sample

▼ Stabllized Groundwater
▽ Groundwater At Time of Excavation

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Plate
21

Date		
Started:	10/13/2021	
Completed:	10/13/2021	
Backfilled:	---	

TEST PIT LOG

Logged By: M Christensen
Equipment: Trackhoe
Location: See Plate 2

Test Pit No.
TP-20

Sheet 1 of 1

Depth (feet)	Sample Type	Groundwater	Graphic Log	Group Symbol	Material Description	Dry Density (pcf)	Moisture Content (%)	Minus #200 (%)	Liquid Limit	Plasticity Index
					Topsoil; Lean CLAY - moist, dark brown					
				CL	Lean CLAY with sand - very stiff, slightly moist, light gray					
5					Siltstone to Sandstone Bedrock - weathered, weak, light gray					
10					Refusal at 8 feet on bedrock					
15										

☒ Bulk/Bag Sample
▥ Undisturbed Sample

▼ Stabllized Groundwater
▽ Groundwater At Time of Excavation

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Plate
22

Date		
Started:	10/13/2021	
Completed:	10/13/2021	
Backfilled:	---	

TEST PIT LOG

Logged By: M Christensen
Equipment: Trackhoe
Location: See Plate 2

Test Pit No.
TP-21
Sheet 1 of 1

Depth (feet)	Sample Type	Groundwater	Graphic Log	Group Symbol	Material Description	Dry Density (pcf)	Moisture Content (%)	Minus #200 (%)	Liquid Limit	Plasticity Index
					Topsoil; Lean CLAY - moist, dark brown					
				CH	Fat CLAY with sand - very stiff, slightly moist, light gray	109.9	13.7	80.2	59	37
5					Siltstone to Sandstone Bedrock - weathered, weak, light gray - moderately strong below 5 feet					
10					Refusal at 8 feet on bedrock					
15										

☒ Bulk/Bag Sample
▥ Undisturbed Sample

▼ Stabllized Groundwater
▽ Groundwater At Time of Excavation

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Plate
23

Date			TEST PIT LOG	Logged By: M Christensen	Test Pit No.
Started:	10/14/2021			Equipment: Trackhoe	TP-22
Completed:	10/14/2021			Location: See Plate 2	Sheet 1 of 1
Backfilled:	---				

Depth (feet)	Sample Type	Groundwater	Graphic Log	Group Symbol	Material Description	Dry Density (pcf)	Moisture Content (%)	Minus #200 (%)	Liquid Limit	Plasticity Index
					Topsoil; Lean CLAY - moist, dark brown					
				CH	Fat CLAY - very stiff, slightly moist, brown	107.5	190.0	90.1	58	37
5					Siltstone to Sandstone Bedrock - weathered, weak, light gray - moderately strong below 5 feet					
10					Refusal at 8 feet on bedrock					
15										

☒ Bulk/Bag Sample
▥ Undisturbed Sample

▼ Stabllized Groundwater
▽ Groundwater At Time of Excavation

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Plate
24

Date		
Started:	10/14/2021	
Completed:	10/14/2021	
Backfilled:	---	

TEST PIT LOG

Logged By: M Christensen
Equipment: Trackhoe
Location: See Plate 2

Test Pit No.
TP-23
Sheet 1 of 1

Depth (feet)	Sample Type	Groundwater	Graphic Log	Group Symbol	Material Description	Dry Density (pcf)	Moisture Content (%)	Minus #200 (%)	Liquid Limit	Plasticity Index
					Topsoil; Lean CLAY - moist, dark brown					
5				CH	Fat CLAY with sand - very stiff, slightly moist, brown		27.5	73.6	61	35
10					Bottom of test pit at 10 feet					
15										

☒ Bulk/Bag Sample
▥ Undisturbed Sample

▼ Stabllized Groundwater
▽ Groundwater At Time of Excavation

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Plate
25

Date		
Started:	10/14/2021	
Completed:	10/14/2021	
Backfilled:	---	

TEST PIT LOG

Logged By: M Christensen
Equipment: Trackhoe
Location: See Plate 2

Test Pit No.
TP-24
Sheet 1 of 1

Depth (feet)	Sample Type	Groundwater	Graphic Log	Group Symbol	Material Description	Dry Density (pcf)	Moisture Content (%)	Minus #200 (%)	Liquid Limit	Plasticity Index
					Topsoil; Lean CLAY - moist, dark brown					
				CH	Fat CLAY with sand - very stiff, slightly moist, brown		18.3	76.3	50	25
5					Siltstone to Sandstone Bedrock - weathered, weak, light gray					
10					Bottom of test pit at 10 feet					
15										

☒ Bulk/Bag Sample
▥ Undisturbed Sample

▼ Stabllized Groundwater
▽ Groundwater At Time of Excavation

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Plate
26

Date		
Started:	10/14/2021	
Completed:	10/14/2021	
Backfilled:	---	

TEST PIT LOG

Logged By: M Christensen
Equipment: Trackhoe
Location: See Plate 2

Test Pit No.
TP-25
Sheet 1 of 1

Depth (feet)	Sample Type	Groundwater	Graphic Log	Group Symbol	Material Description	Dry Density (pcf)	Moisture Content (%)	Minus #200 (%)	Liquid Limit	Plasticity Index
					Topsoil; Silty GRAVEL with sand - moist, dark brown					
					Sandstone Bedrock - slightly weathered, moderately strong to strong, light gray					
5										
					Refusal at 8 feet on bedrock					
10										
15										

☒ Bulk/Bag Sample
▥ Undisturbed Sample

▼ Stabllized Groundwater
▽ Groundwater At Time of Excavation

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Plate
27

RELATIVE DENSITY – COURSE GRAINED SOILS

Relative Density	SPT (blows/ft.)	3 In OD California Sampler (blows/ft.)	Relative Density (%)	Field Test
Very Loose	<4	<5	0 – 15	Easily penetrated with a ½ inch steel rod pushed by hand
Loose	4 – 10	5 – 15	15 – 35	Difficult to penetrate with a ½ inch steel rod pushed by hand
Medium Dense	10 – 30	15 – 40	35 – 65	Easily penetrated 1-foot with a steel rod driven by a 5 pound hammer
Dense	30 – 50	40 – 70	65 – 85	Difficult to penetrate 1-foot with a steel rod driven by a 5 pound hammer
Very Dese	>50	>70	85 - 100	Penetrate only a few inches with a steel rod driven by a 5 pound hammer

CONSISTENCY – FINE GRAINED SOILS

Consistency	SPT (blows/ft)	Torvane Undrained Shear Strength (tsf)	Pocket Penetrometer Undrained Shear Strength (tsf)	Field Test
Very Soft	<2	<0.125	<0.25	Easily penetrated several inches with thumb
Soft	2 – 14	0.125 – 0.25	0.25 – 0.5	Easily penetrated one inch with thumb
Medium Stiff	4 – 8	0.25 – 0.5	0.5 – 1.0	Penetrated over ½ inch by thumb with moderate effort. Molded by strong finger pressure
Stiff	8 – 15	0.5 – 1.0	1.0 – 2.0	Indented ½ inch by thumb with great effort
Very Stiff	15 – 30	1.0 – 2.0	2.0 – 4.0	Readily indented with thumbnail
Hard	>30	>2.0	>4.0	Indented with difficulty with thumbnail

CEMENTATION

Weakly	Crumbles or breaks with handling or little finger pressure
Moderately	Crumbles or breaks with considerable finger pressure
Strongly	Will not crumble or break with finger pressure

MOISTURE

Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible water, usually below water table

GRAIN SIZE

Description		Sieve Size	Grain Size (in)	Approximate Size
Boulders		>12”	>12”	Larger than basketball
Cobbles		3” – 12”	3” – 12”	Fist to basketball
Gravel	Coarse	3/4” - 3”	3/4” - 3”	Thumb to fist
	Fine	#4 – 3”	0.19 – 0.75	Pea to thumb
Sand	Coarse	#10 - #4	0.079 – 0.19	Rock salt to pea
	Medium	#40 - #10	0.017 – 0.079	Sugar to rock salt
	Fine	#200 - #40	0.0029 – 0.017	Flour to sugar
Silt/Clay		<#200	<0.0029	Flour sized or smaller

STRATAFICATION

Occasional	One or less per foot of thickness
Frequent	More than one per foot of thickness

MODIFIERS

Trace	<5%
Some	5-12%
With	>12%

STRATIFICATION

Seam	1/16 to 1/2 inch
Layer	1/2 to 12 inch

NOTES

1. The logs are subject to the limitations and conclusions presented in the report.
2. Lines separating strata represent approximate boundaries only. Actual transitions may be gradual.
3. Logs represent the soil conditions at the points explored at the time of our investigation.
4. Soils classifications shown on logs are based on visual methods . Actual designations (based on laboratory testing)may vary.

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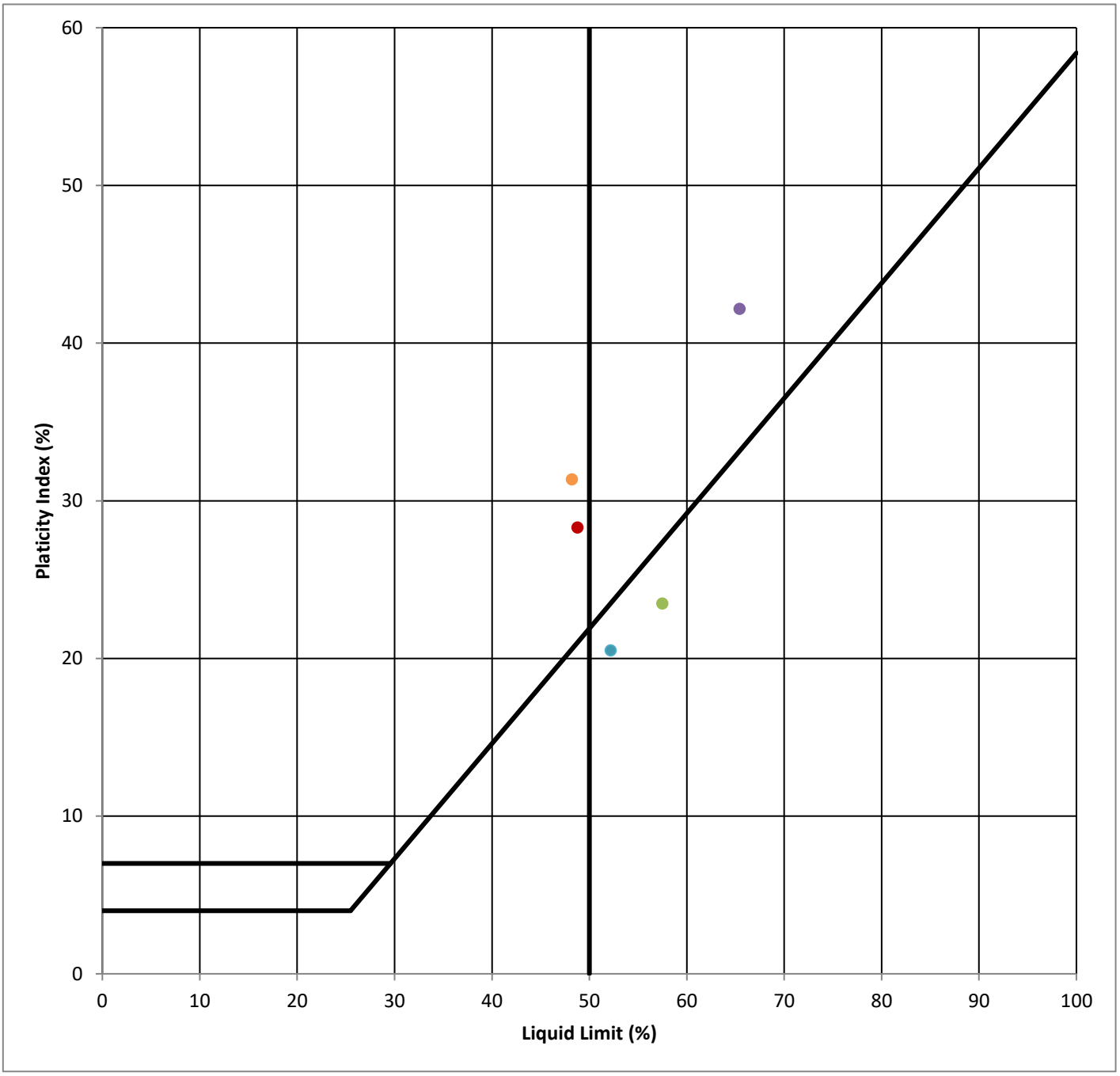
Soil Terms Key

Plate 28

Atterberg Limits



Location	Depth (ft)		Classification	Liquid Limit	PI
TP-1	2	●	Elastic SILT with sand	52	21
TP-2	4	●	Bedrock (Lean CLAY with sand)	48	31
TP-4	8	●	Bedrock (Sandy Elastic SILT)	57	23
TP-7	2	●	Fat CLAY	65	42
TP-10	7	●	Lean CLAY with sand	49	28

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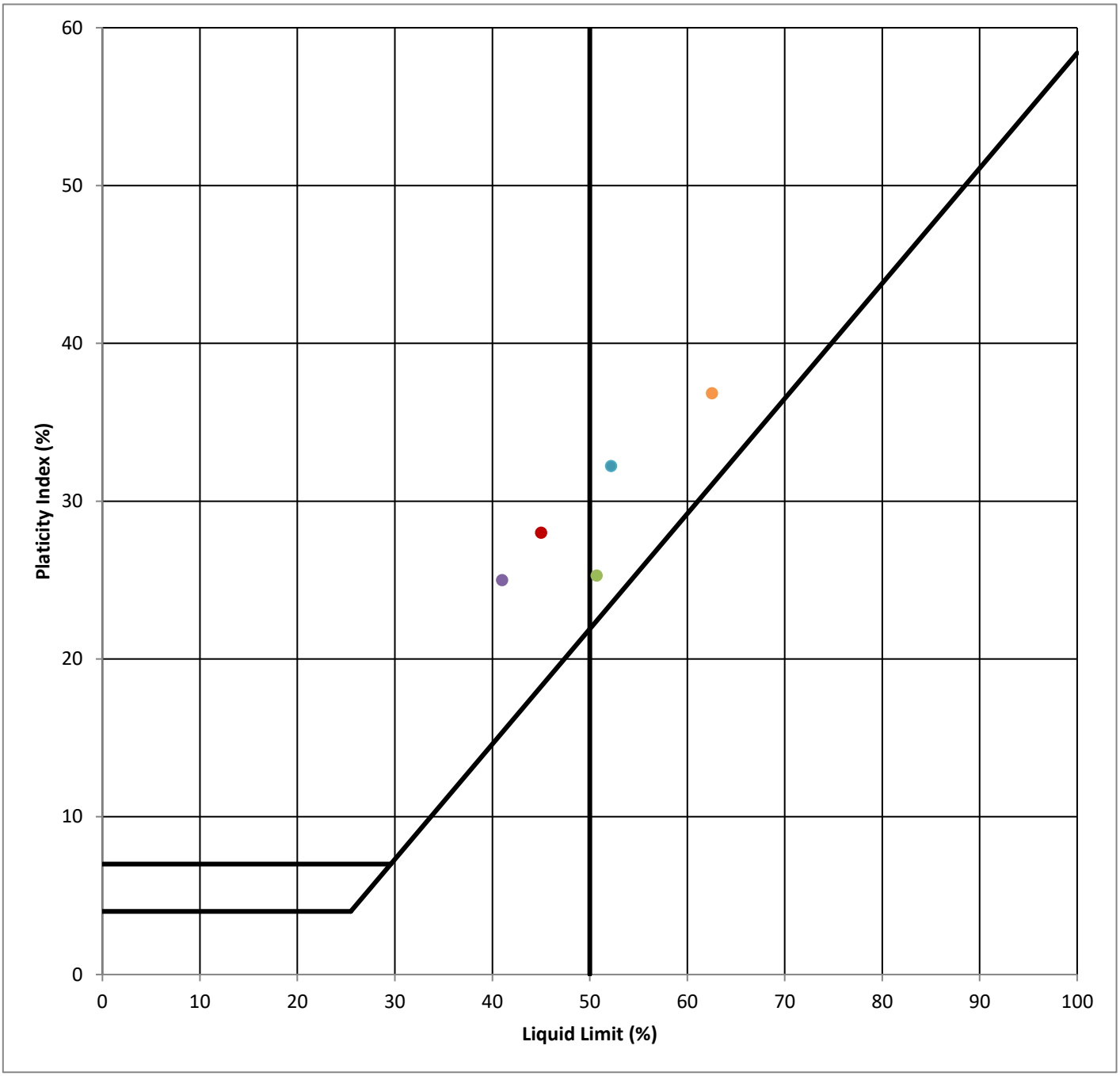
29

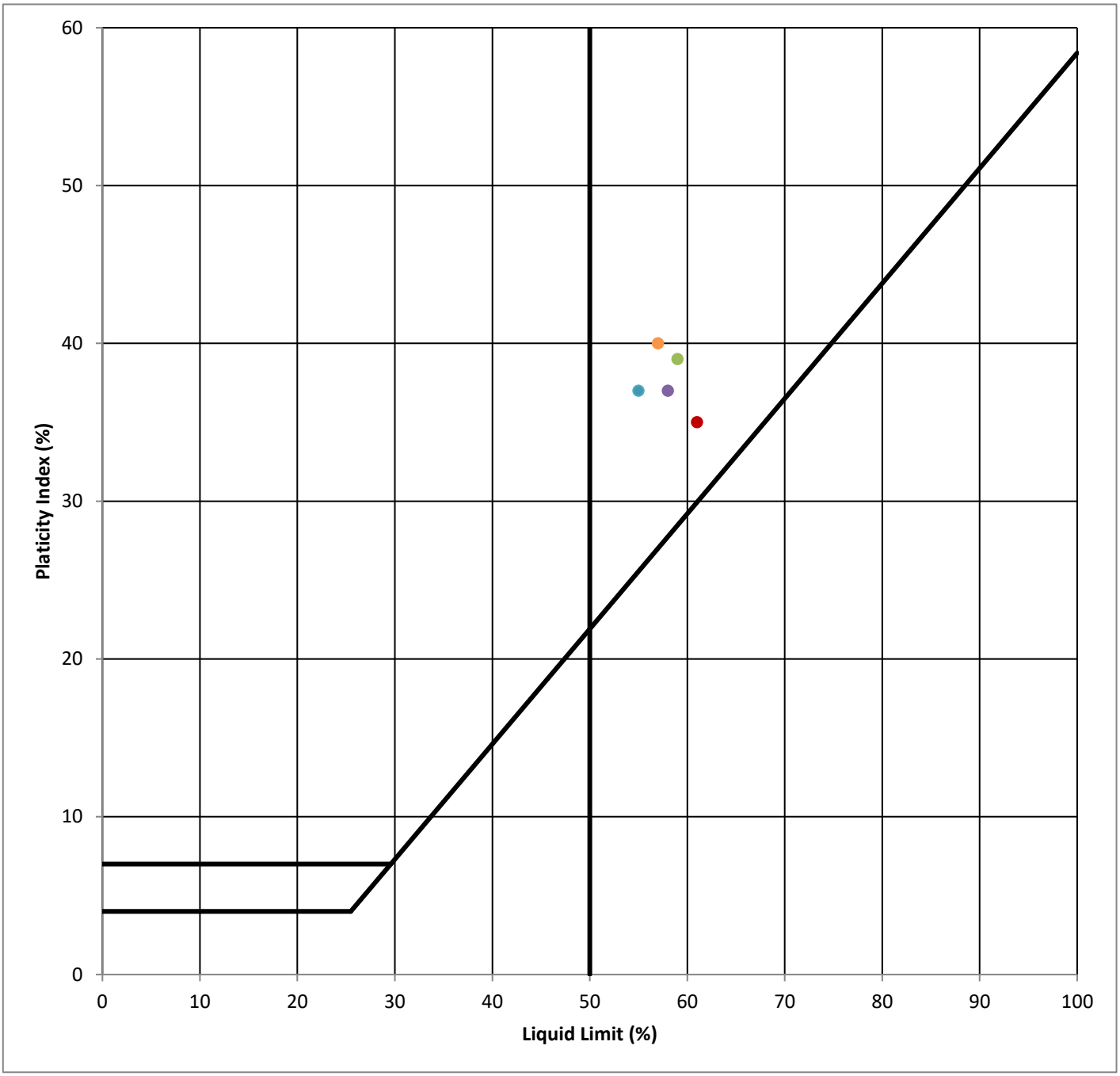
Atterberg Limits



Location	Depth (ft)		Classification	Liquid Limit	PI
TP-12	3	●	Fat CLAY with sand	52	32
TP-14	3	●	Fat CLAY	63	37
TP-15	4	●	Fat CLAY with sand	51	25
TP-16	2	●	Sandy Lean CLAY	41	25
TP-17	8	●	Bedrock (Lean CLAY with sand)	45	28

Christensen Geotechnical	Lewis Homes Legacy Mountain Development Huntsville, Weber County, Utah Project No.: 133-009	Plate 30

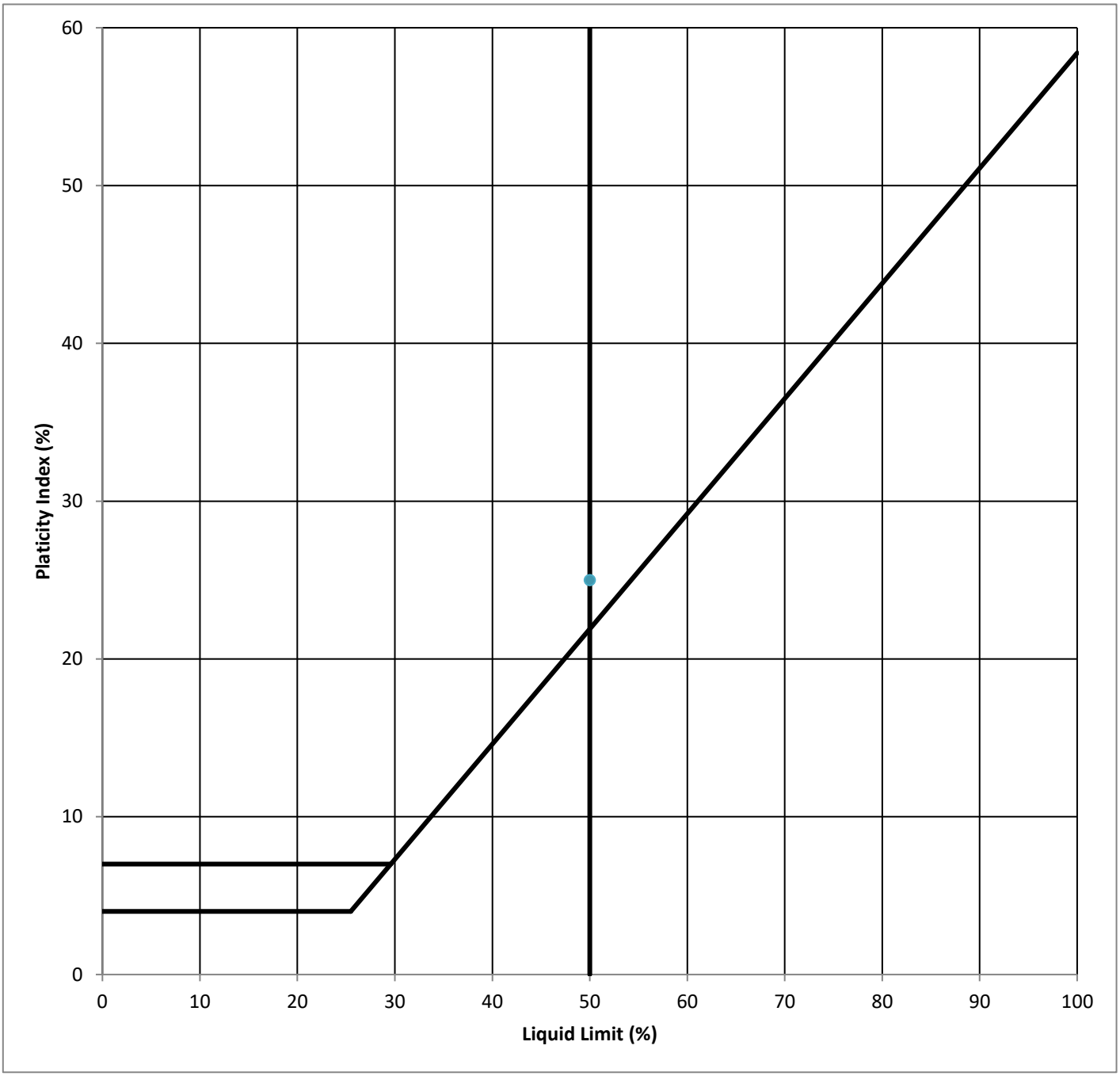
Atterberg Limits



Location	Depth (ft)		Classification	Liquid Limit	PI
TP-18	8	●	Fat CLAY with sand	55	37
TP-19	3	●	Sandy Fat CLAY	57	40
TP-21	3	●	Fat CLAY with sand	59	39
TP-22	2	●	Fat CLAY	58	37
TP-23	4	●	Fat CLAY with sand	61	35

Christensen Geotechnical	Lewis Homes Legacy Mountain Development Huntsville, Weber County, Utah Project No.: 133-009	Plate 31

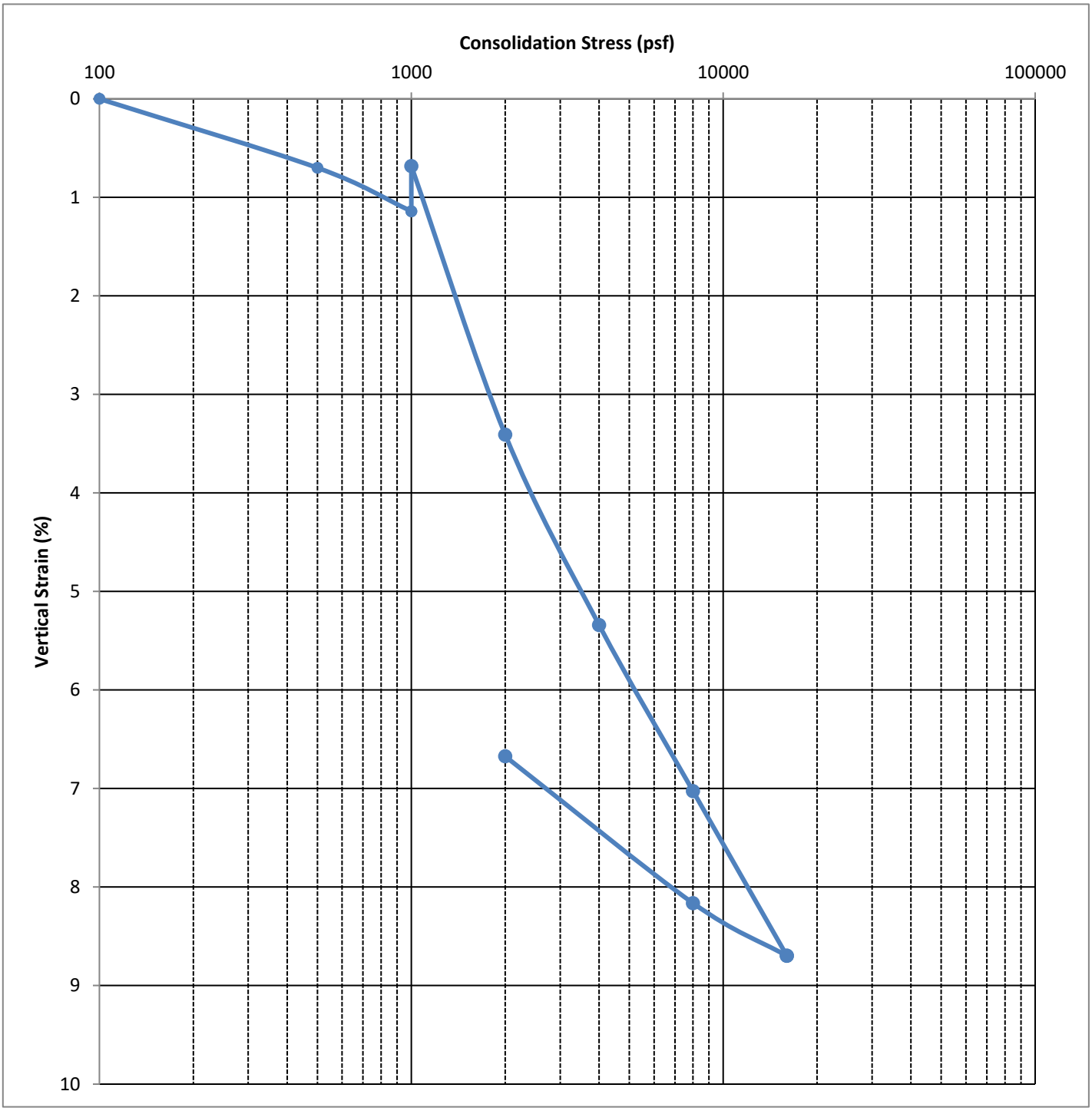
Atterberg Limits



Location	Depth (ft)		Classification	Liquid Limit	PI
TP-24	3	●	Fat CLAY with sand	50	25

Christensen Geotechnical	Lewis Homes Legacy Mountain Development Huntsville, Weber County, Utah Project No.: 133-009	Plate 32

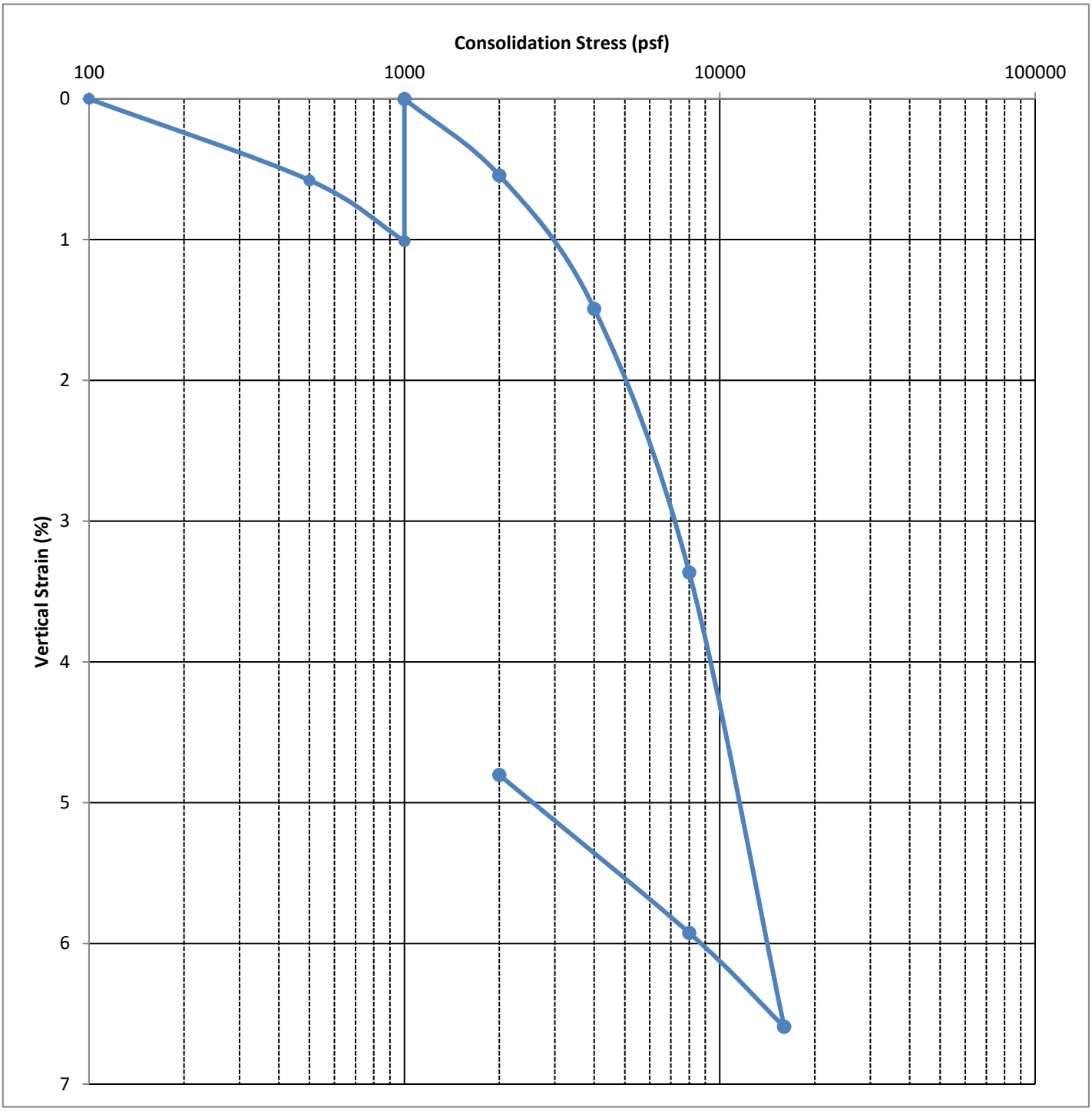
1-D Consolidation



Location	Depth (ft)	Dry Density (pcf)	Moisture Content (%)	σ_o (psf)	σ_p (psf)	C_c	C_r	OCR
TP-4	8	90.5	26.1	900	1,100	0.056	0.022	1.2

Christensen Geotechnical	Lewis Homes Legacy Mountain Development Huntsville, Weber County, Utah Project No.: 133-009	Plate 33

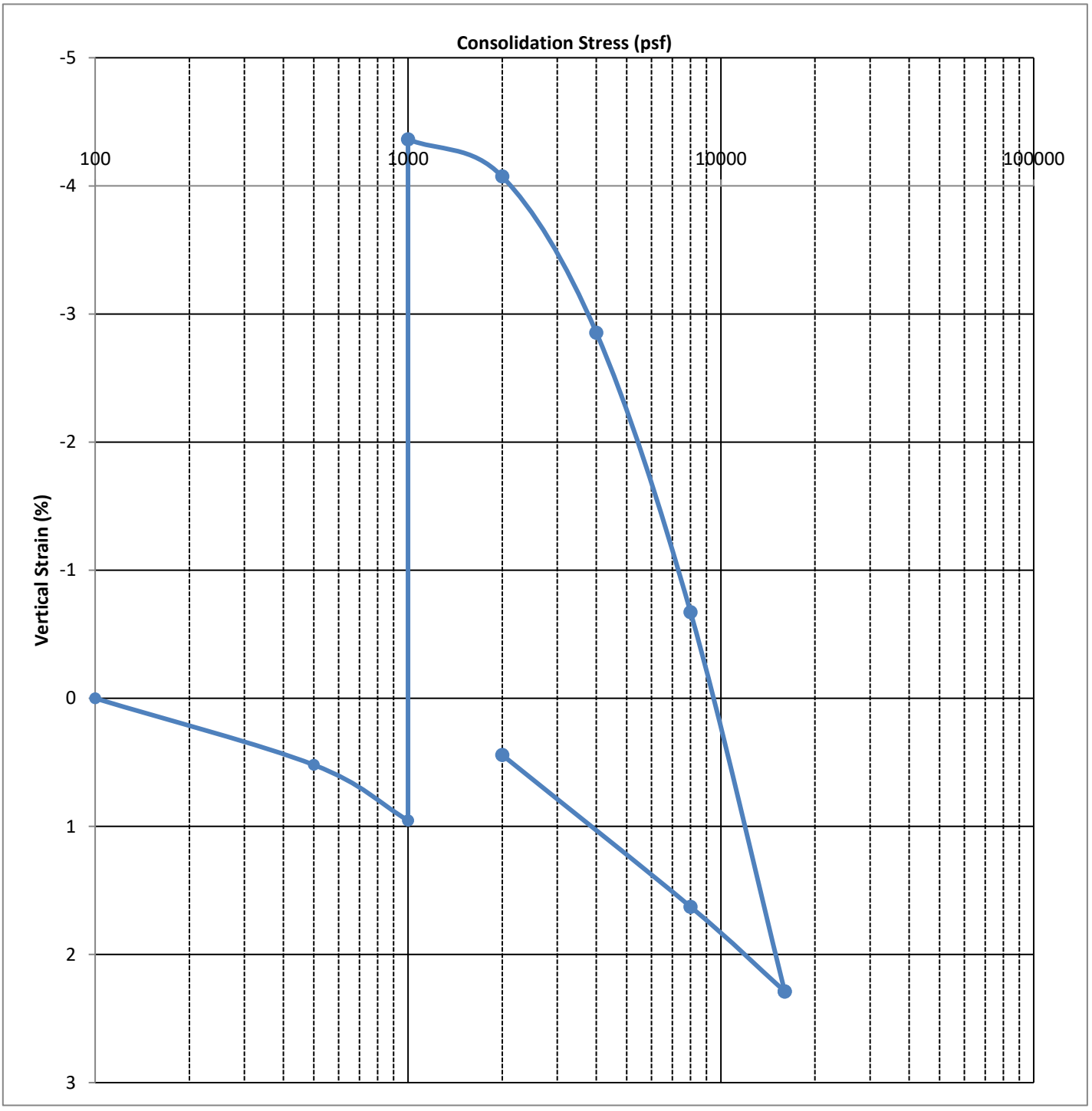
1-D Consolidation



Location	Depth (ft)	Dry Density (pcf)	Moisture Content (%)	σ_o (psf)	σ_p (psf)	C_c	C_r	OCR
TP-16	2	106.2	13.1	200	4,000	0.085	0.020	20.0

Christensen Geotechnical	Lewis Homes Legacy Mountain Development Huntsville, Weber County, Utah Project No.: 133-009	Plate 34

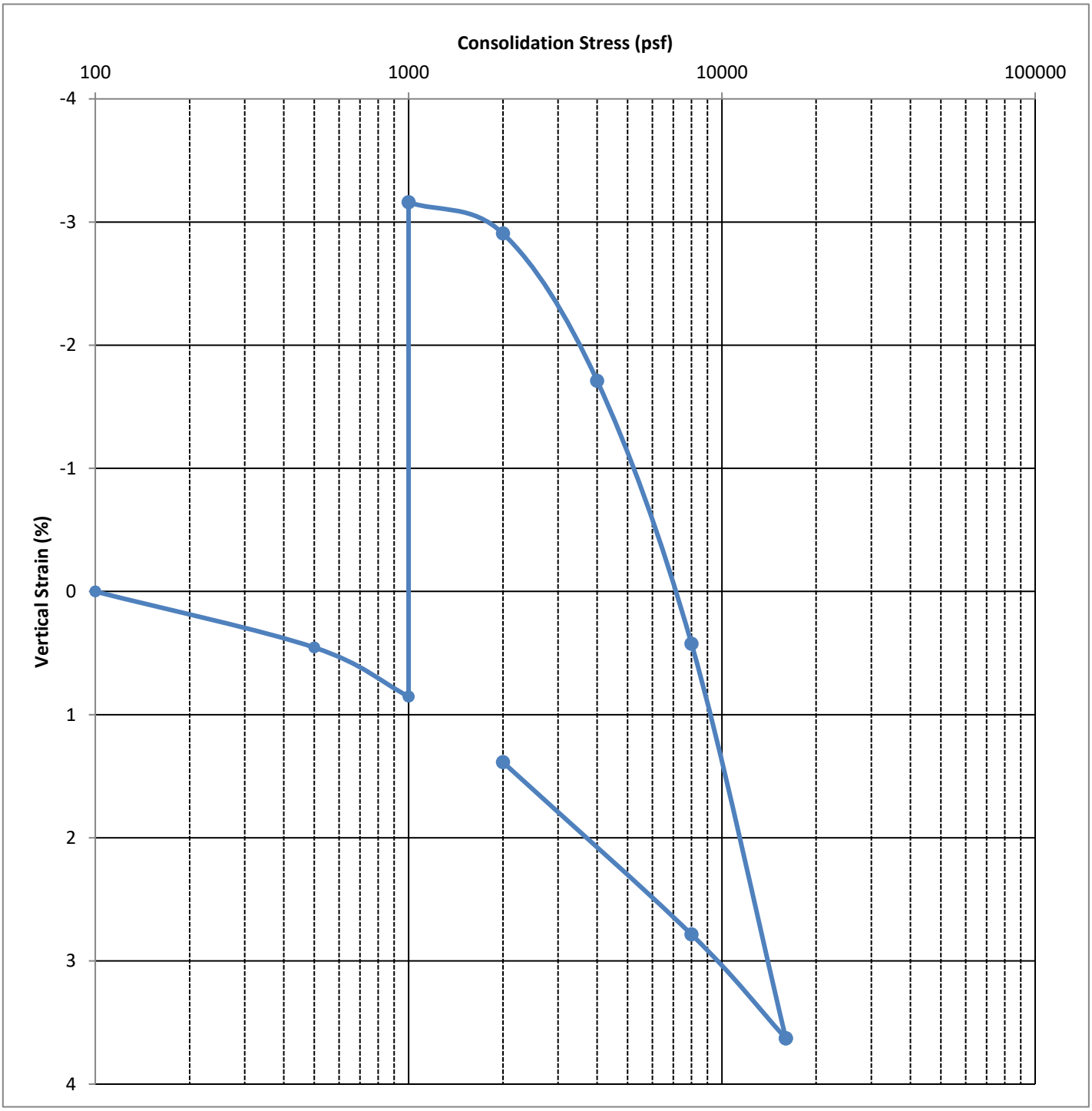
1-D Consolidation



Location	Depth (ft)	Dry Density (pcf)	Moisture Content (%)	σ_o (psf)	σ_p (psf)	C_c	C_r	OCR
TP-21	3	109.9	13.7	400	3,900	0.085	0.020	9.8

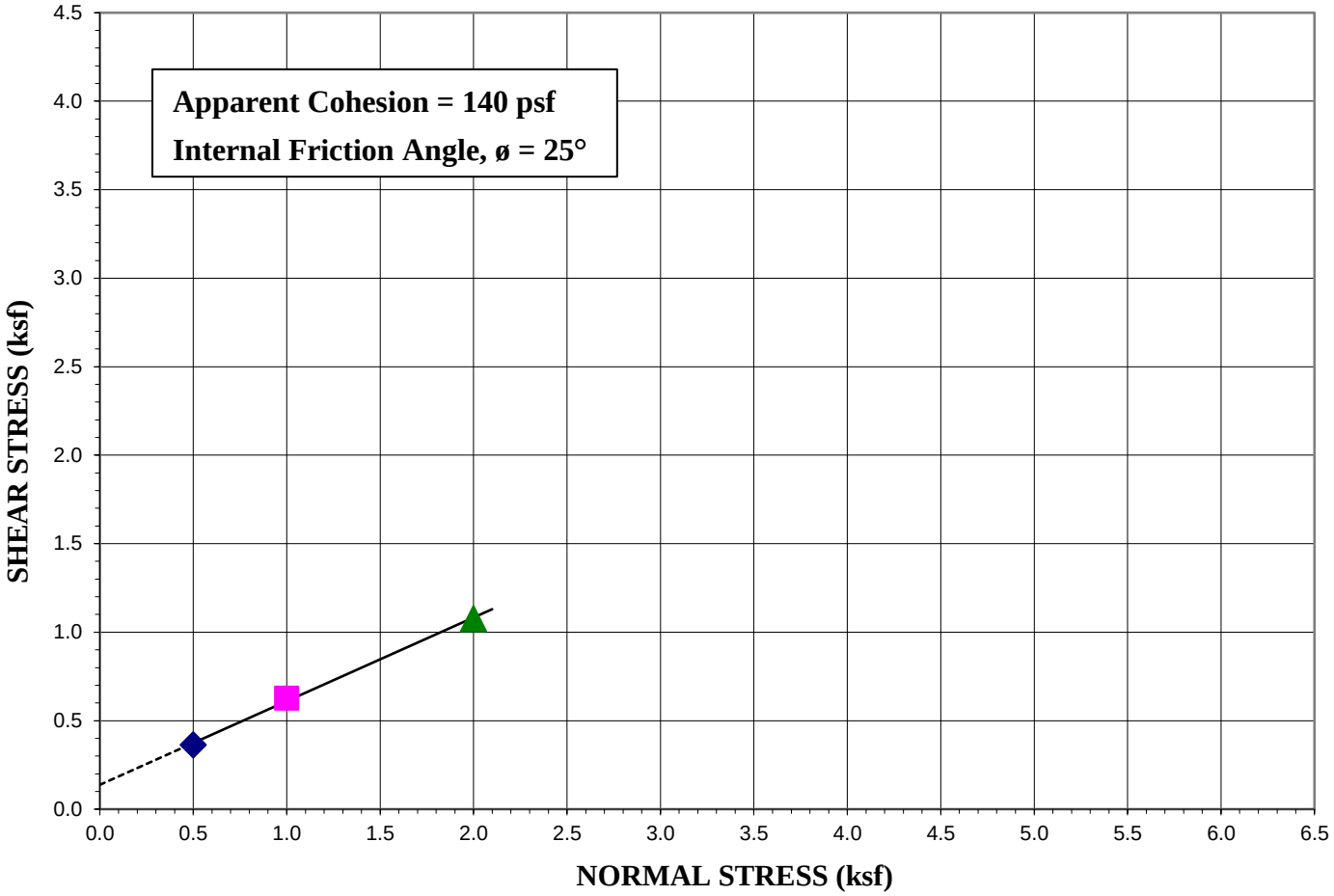
Christensen Geotechnical	Lewis Homes Legacy Mountain Development Huntsville, Weber County, Utah Project No.: 133-009	Plate 35

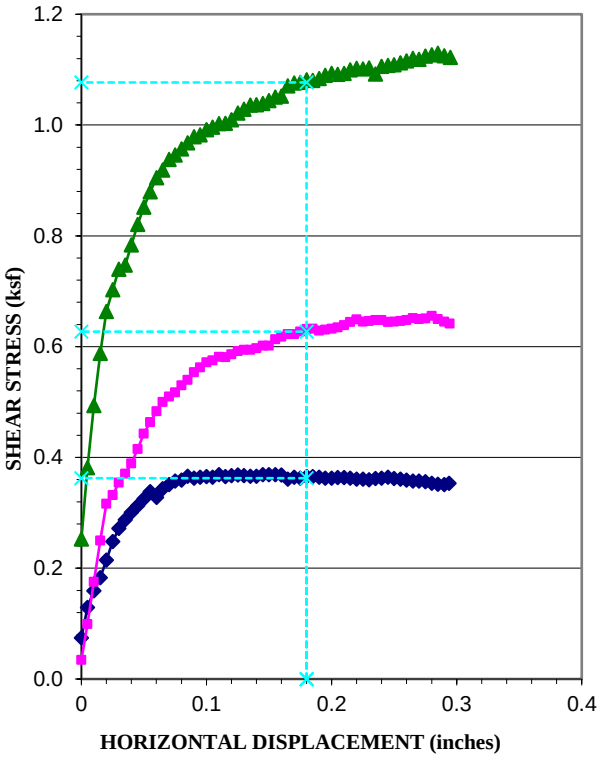
1-D Consolidation



Location	Depth (ft)	Dry Density (pcf)	Moisture Content (%)	σ_o (psf)	σ_p (psf)	C_c	C_r	OCR
TP-22	2	107.5	13.7	200	4,000	0.089	0.025	20.0

Christensen Geotechnical	Lewis Homes Legacy Mountain Development Huntsville, Weber County, Utah Project No.: 133-009	Plate 36





Location: TP-2	**Depth:**	4.0 ft	
Type of Test:	Consolidated Drained/Saturated		
Test No. (Symbol)	**1 (◆)**	**2 (■)**	**3 (▲)**
Sample Type:	Fully Softened		
Initial Height, in.	1	1	1
Diameter, in.	2.4	2.4	2.4
Dry Density Before, pcf	81.1	81.5	81.2
Moisture % Before	39.2	39.2	39.2
Normal Load, ksf	0.5	1.0	2.0
Shear Stress, ksf	0.36	0.63	1.08
Strain Rate	0.0006 in/min		

Sample Properties	
Cohesion, psf	140
Friction Angle, ϕ	25
Liquid Limit, %	48
Plasticity Index, %	31
Percent Gravel	---
Percent Sand	---
Percent Passing No. 200 sieve	82.5
Classification	Lean CLAY w/ sand (CL)

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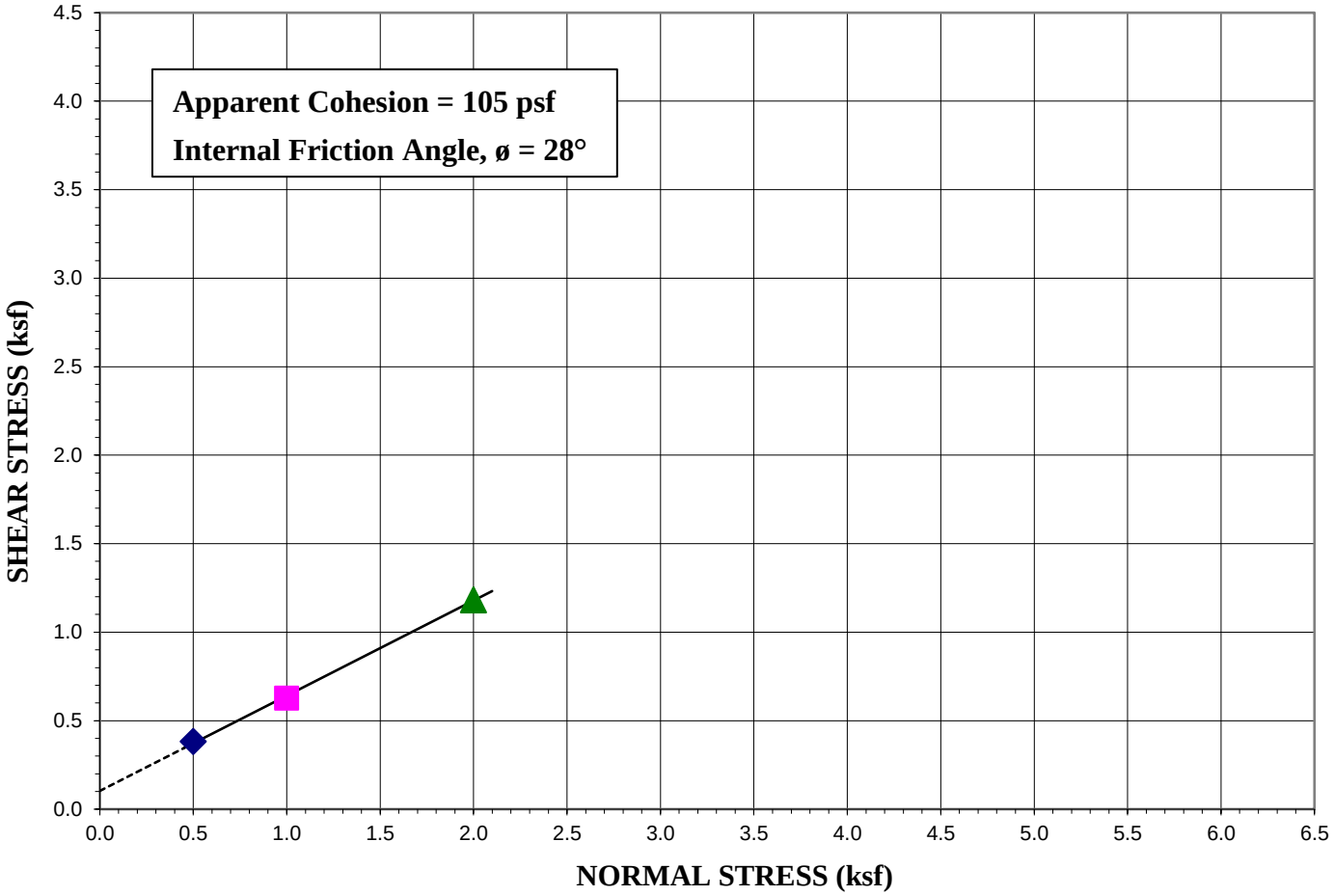

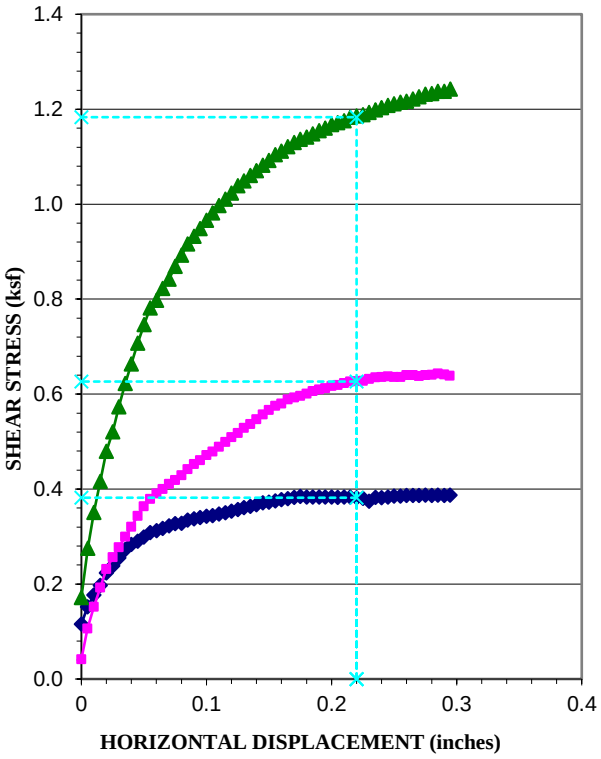

Location: TP-16	Depth: 2.0 ft		
Type of Test:	Consolidated Drained/Saturated		
Test No. (Symbol)	1 (◆)	2 (■)	3 (▲)
Sample Type:	Fully Softened		
Initial Height, in.	1	1	1
Diameter, in.	2.4	2.4	2.4
Dry Density Before, pcf	81.1	81.5	81.2
Moisture % Before	39.2	39.2	39.2
Normal Load, ksf	0.5	1.0	2.0
Shear Stress, ksf	0.38	0.63	1.18
Strain Rate	0.0006 in/min		

Sample Properties	
Cohesion, psf	105
Friction Angle, ϕ	28
Liquid Limit, %	41
Plasticity Index, %	25
Percent Gravel	---
Percent Sand	---
Percent Passing No. 200 sieve	52.5
Classification	Sandy Lean CLAY

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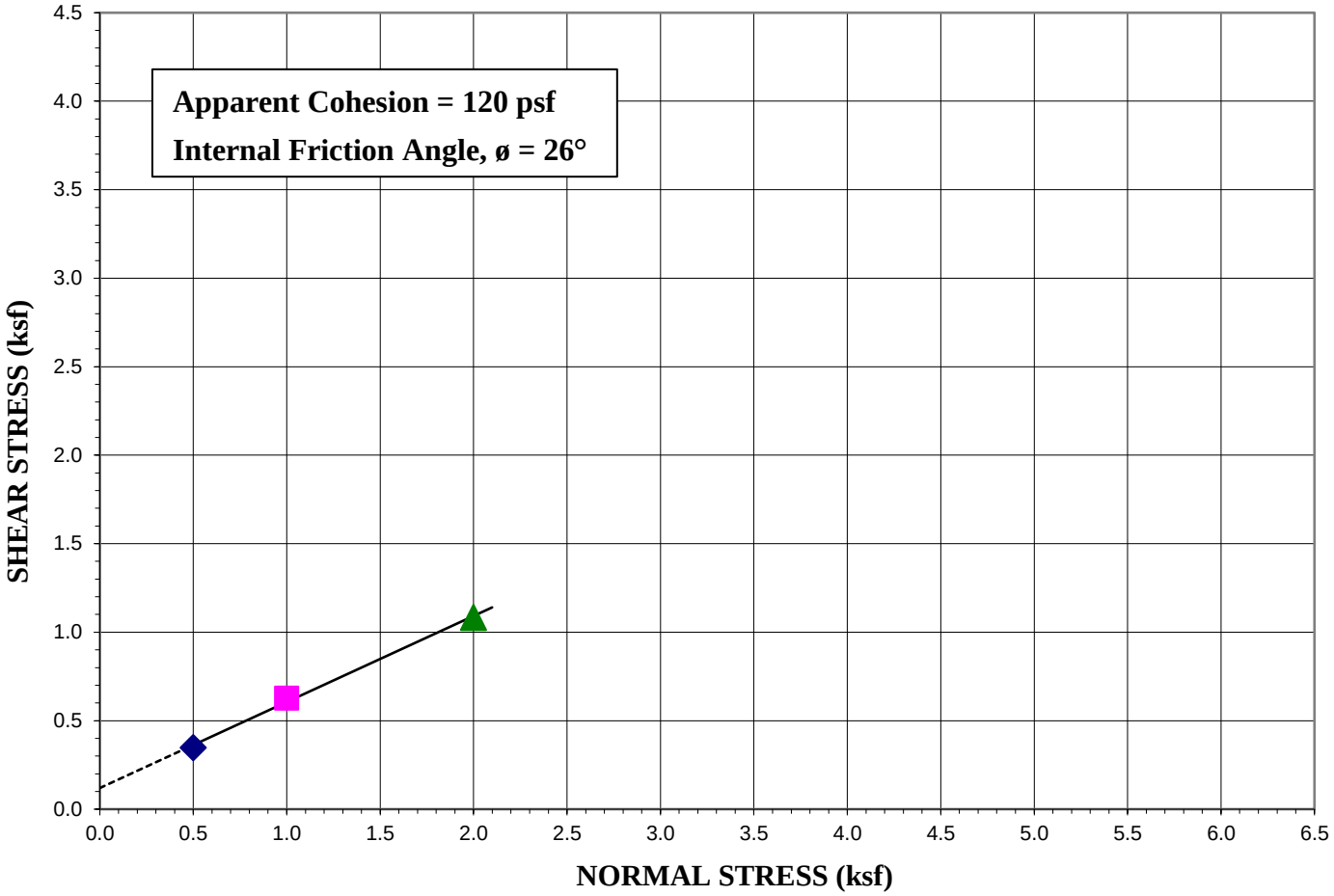
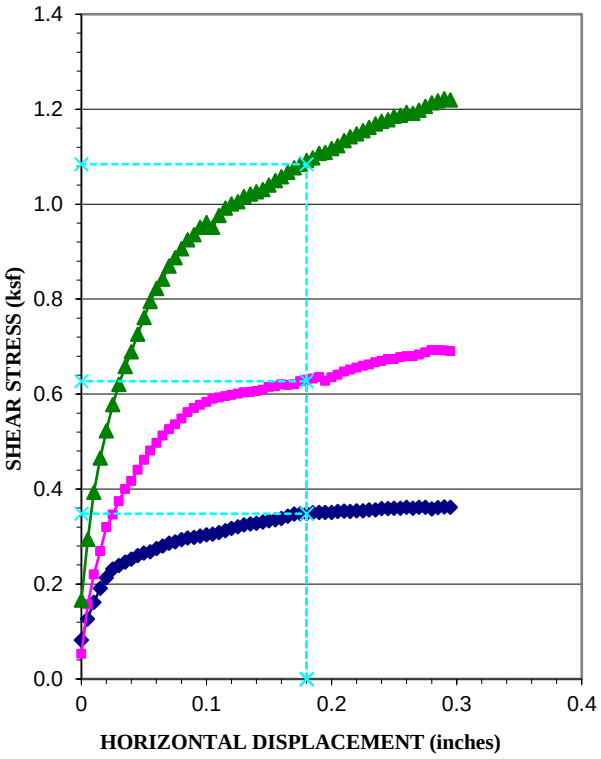
38





Location: TP-18	Depth: 8.0 ft		
Type of Test:	Consolidated Drained/Saturated		
Test No. (Symbol)	1 (◆)	2 (■)	3 (▲)
Sample Type:	Fully Softened		
Initial Height, in.	1	1	1
Diameter, in.	2.4	2.4	2.4
Dry Density Before, pcf	82.7	83.6	82.9
Moisture % Before	37.7	37.7	37.7
Normal Load, ksf	0.5	1.0	2.0
Shear Stress, ksf	0.35	0.63	1.08
Strain Rate	0.0006 in/min		

Sample Properties	
Cohesion, psf	120
Friction Angle, ϕ	26
Liquid Limit, %	55
Plasticity Index, %	37
Percent Gravel	---
Percent Sand	---
Percent Passing No. 200 sieve	79.6
Classification	Fat CLAY with sand

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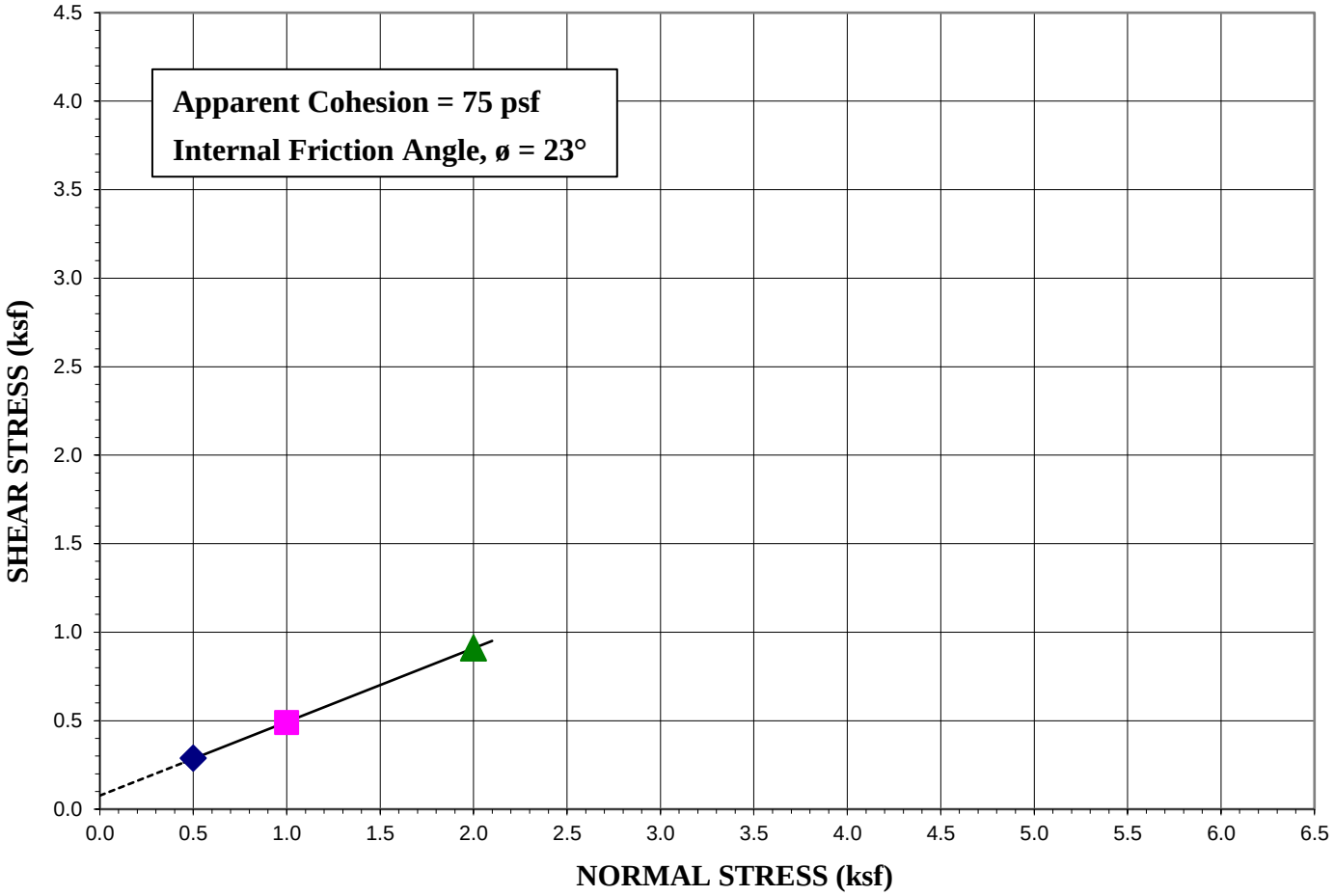
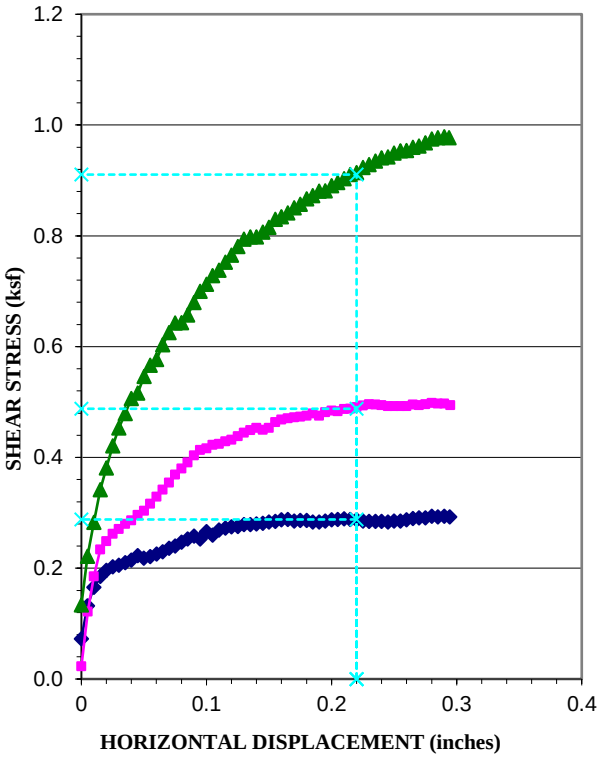
39





Location: TP-21	**Depth:**	3.0 ft	
Type of Test:	Consolidated Drained/Saturated		
Test No. (Symbol)	**1 (◆)**	**2 (■)**	**3 (▲)**
Sample Type:	Fully Softened		
Initial Height, in.	1	1	1
Diameter, in.	2.4	2.4	2.4
Dry Density Before, pcf	75.7	74.9	74.5
Moisture % Before	45.1	45.1	45.1
Normal Load, ksf	0.5	1.0	2.0
Shear Stress, ksf	0.29	0.49	0.91
Strain Rate	0.0006 in/min		

Sample Properties	
Cohesion, psf	75
Friction Angle, ϕ	23
Liquid Limit, %	59
Plasticity Index, %	39
Percent Gravel	---
Percent Sand	---
Percent Passing No. 200 sieve	80.2
Classification	Fat CLAY with sand

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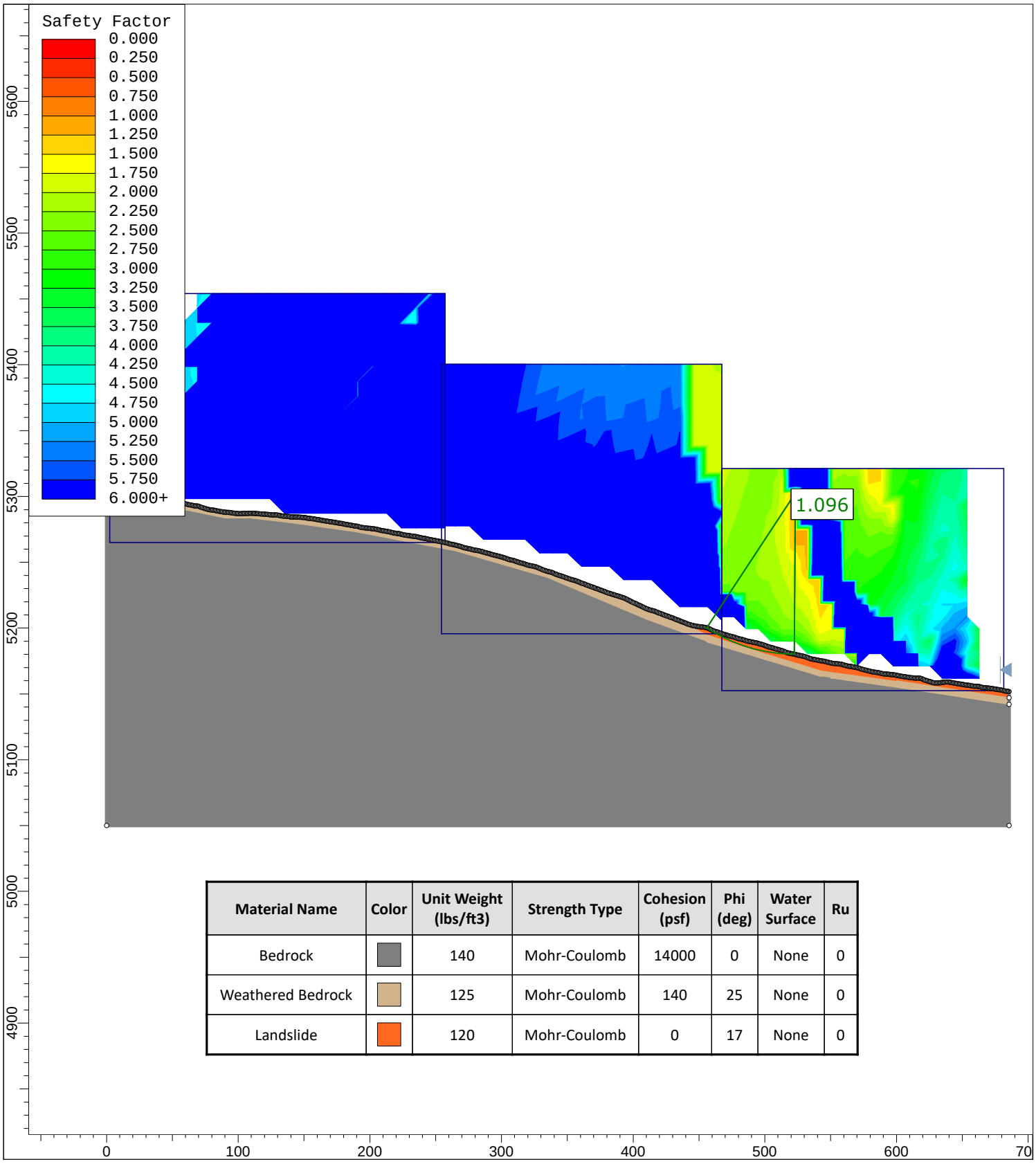
40



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru
Bedrock		140	Mohr-Coulomb	14000	0	None	0
Weathered Bedrock		125	Mohr-Coulomb	140	25	None	0
Landslide		120	Mohr-Coulomb	0	17	None	0

Profile A - Static

Christensen Geotechnical

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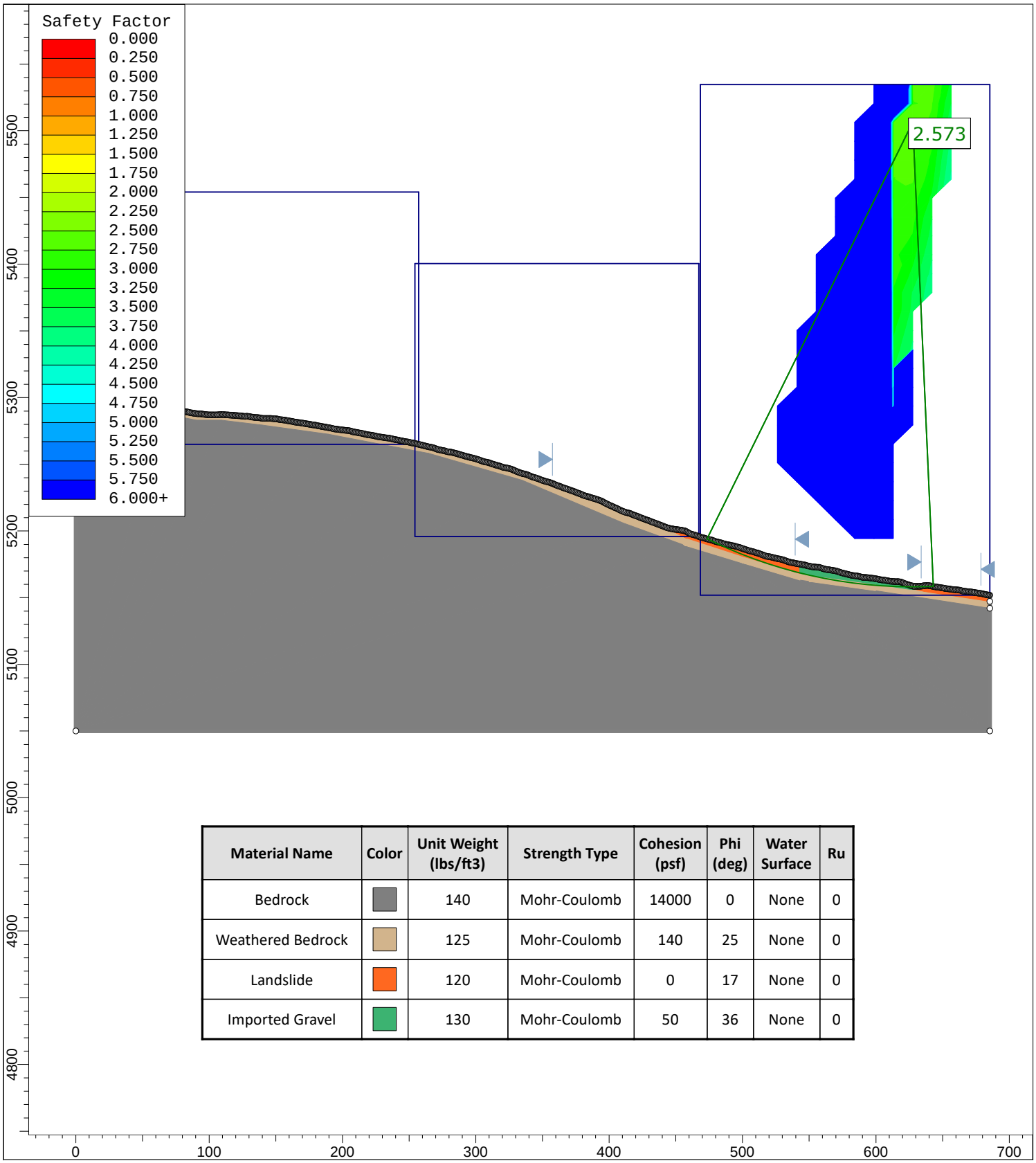
41



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru
Bedrock		140	Mohr-Coulomb	14000	0	None	0
Weathered Bedrock		125	Mohr-Coulomb	140	25	None	0
Landslide		120	Mohr-Coulomb	0	17	None	0
Imported Gravel		130	Mohr-Coulomb	50	36	None	0

Profile A with Gravel Fill - Static

Christensen Geotechnical

Legacy Mountain Development
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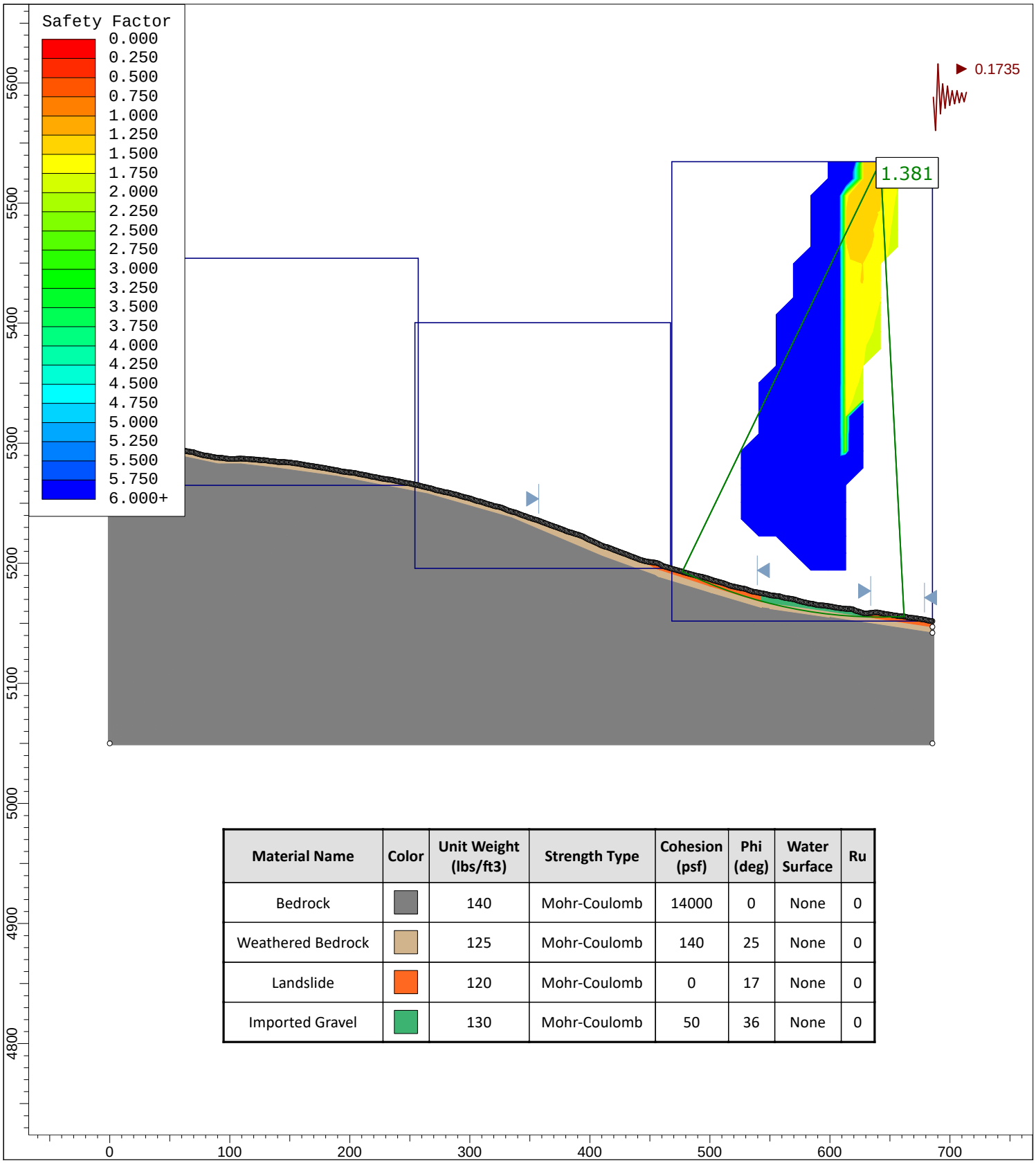
Plate
42



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru
Bedrock		140	Mohr-Coulomb	14000	0	None	0
Weathered Bedrock		125	Mohr-Coulomb	140	25	None	0
Landslide		120	Mohr-Coulomb	0	17	None	0
Imported Gravel		130	Mohr-Coulomb	50	36	None	0

Profile A with Gravel Fill - Pseudo Static

Christensen Geotechnical

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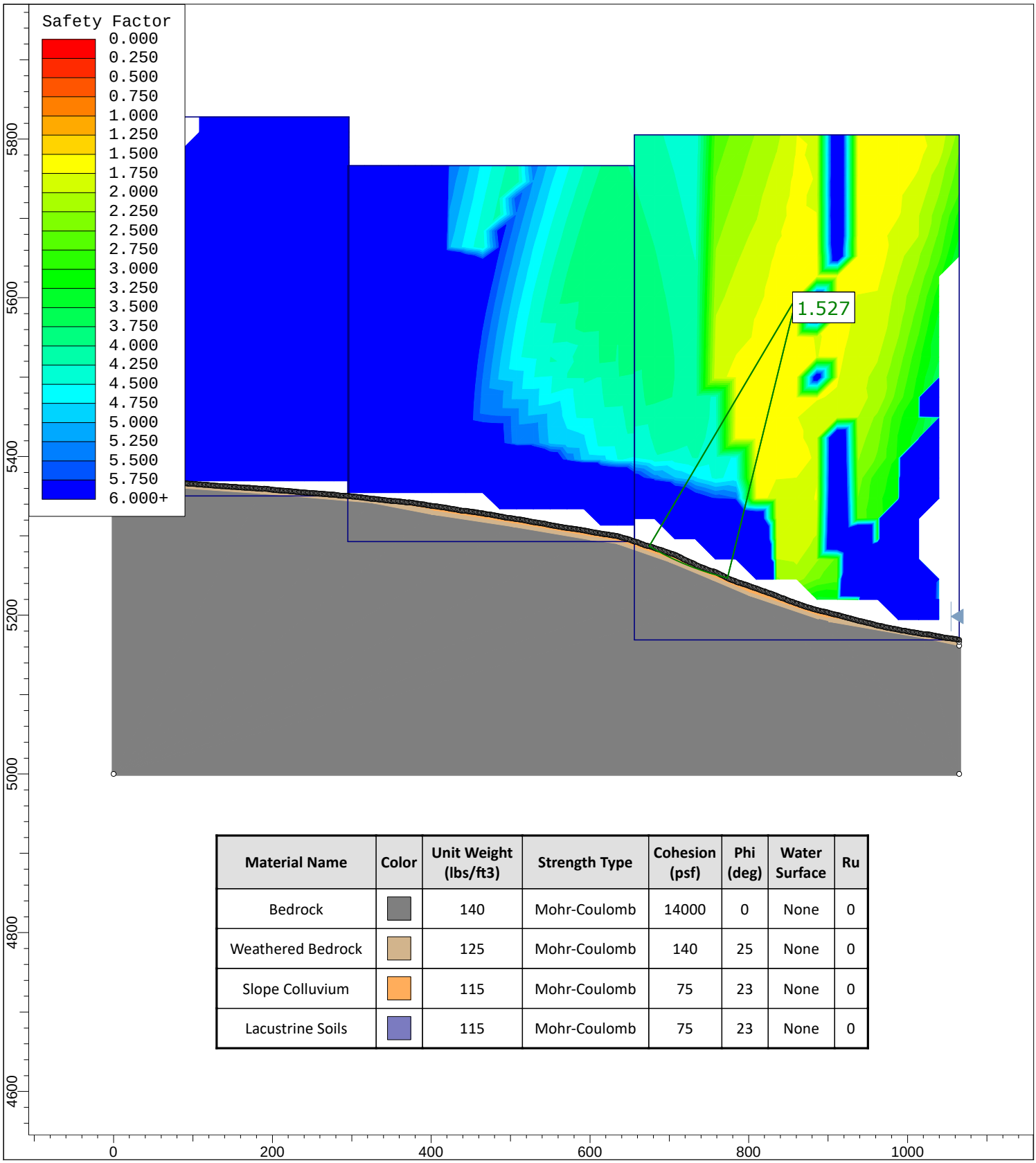
Plate
43



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru
Bedrock		140	Mohr-Coulomb	14000	0	None	0
Weathered Bedrock		125	Mohr-Coulomb	140	25	None	0
Slope Colluvium		115	Mohr-Coulomb	75	23	None	0
Lacustrine Soils		115	Mohr-Coulomb	75	23	None	0

Profile B - Static

Christensen Geotechnical

Legacy Mountain Development
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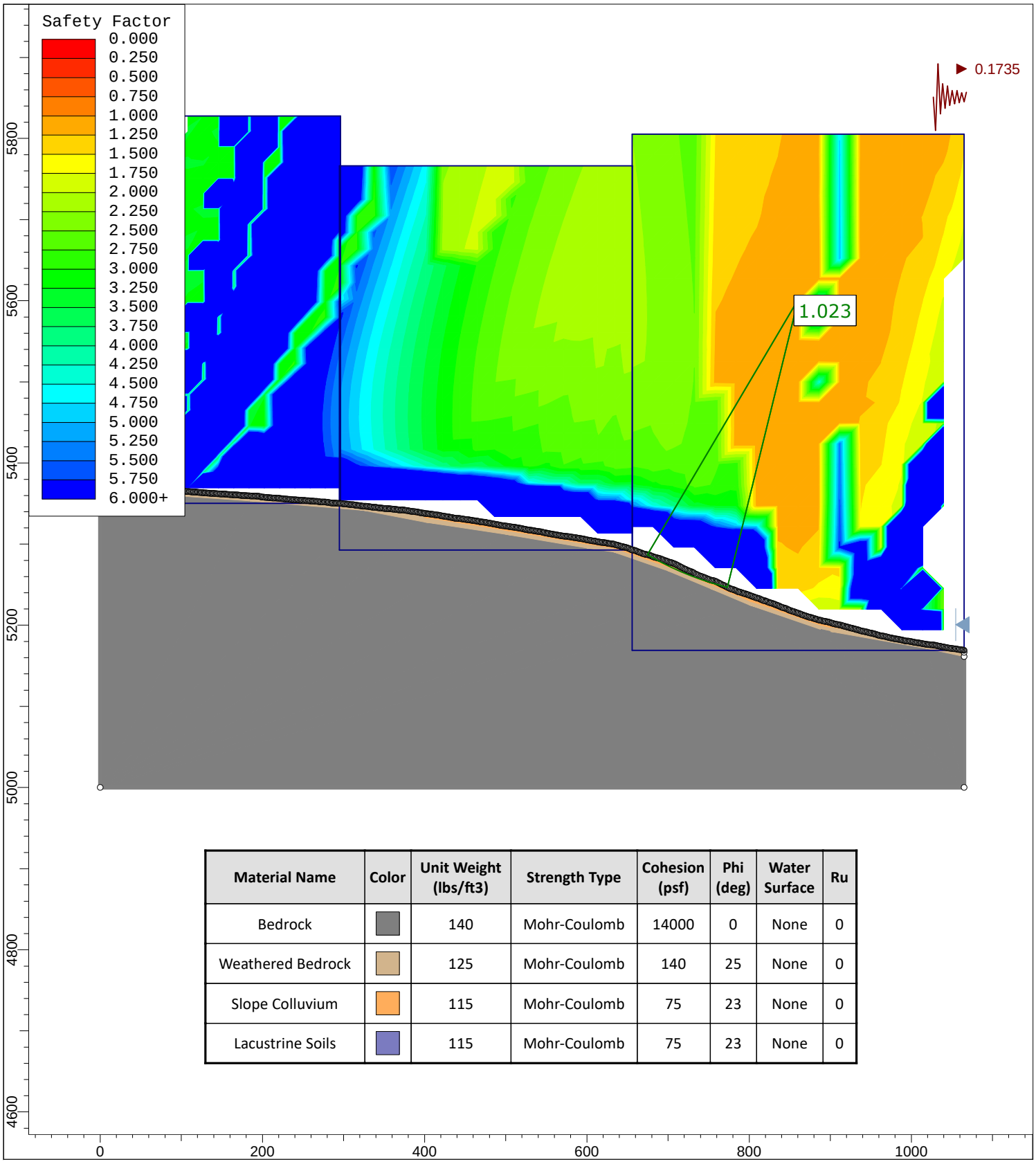
Plate
44



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru
Bedrock		140	Mohr-Coulomb	14000	0	None	0
Weathered Bedrock		125	Mohr-Coulomb	140	25	None	0
Slope Colluvium		115	Mohr-Coulomb	75	23	None	0
Lacustrine Soils		115	Mohr-Coulomb	75	23	None	0

Profile B - Pseudo Static

Christensen Geotechnical

Legacy Mountain Development
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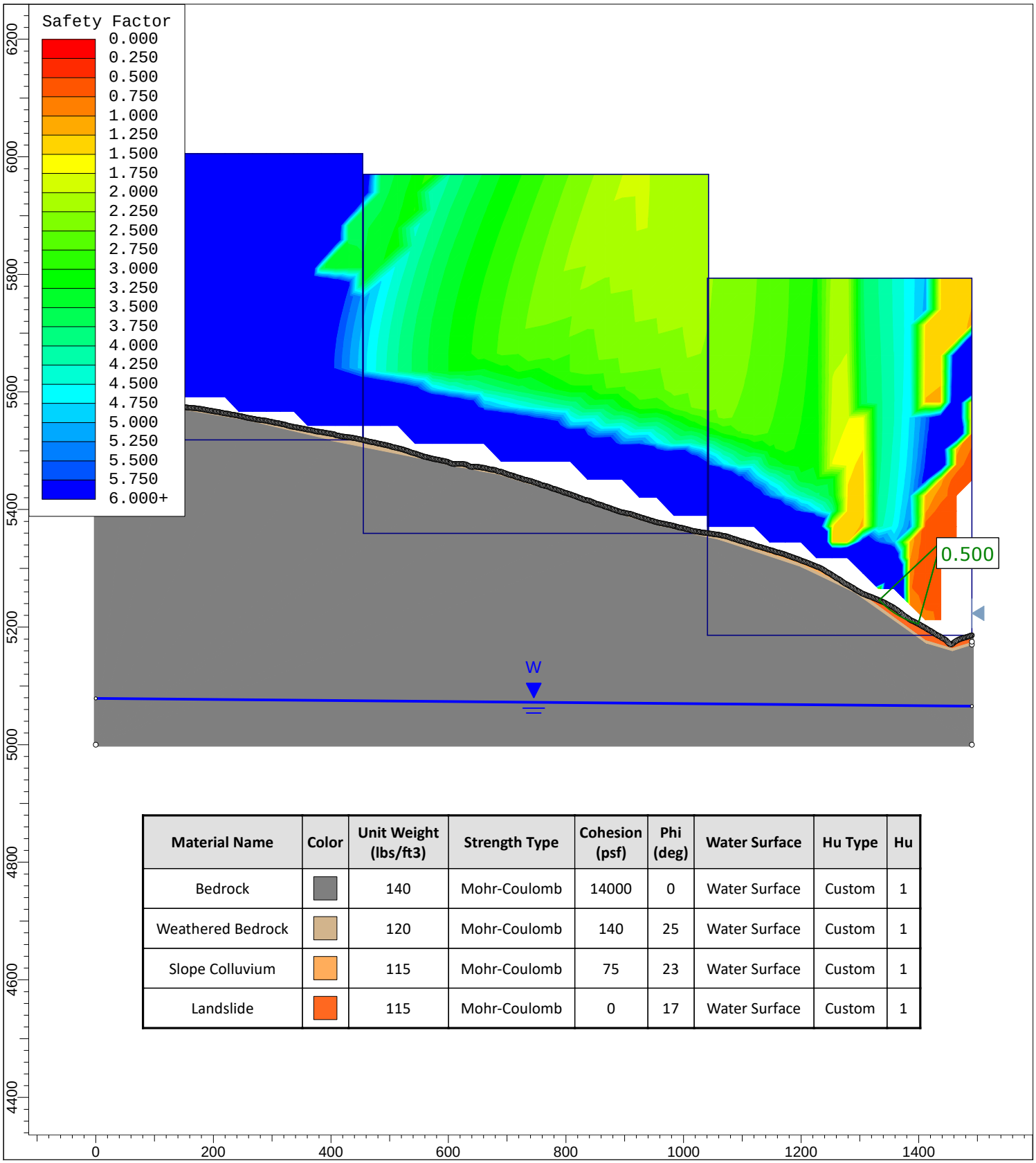
Plate
45



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Hu Type	Hu
Bedrock		140	Mohr-Coulomb	14000	0	Water Surface	Custom	1
Weathered Bedrock		120	Mohr-Coulomb	140	25	Water Surface	Custom	1
Slope Colluvium		115	Mohr-Coulomb	75	23	Water Surface	Custom	1
Landslide		115	Mohr-Coulomb	0	17	Water Surface	Custom	1

Profile C - Static

Christensen Geotechnical

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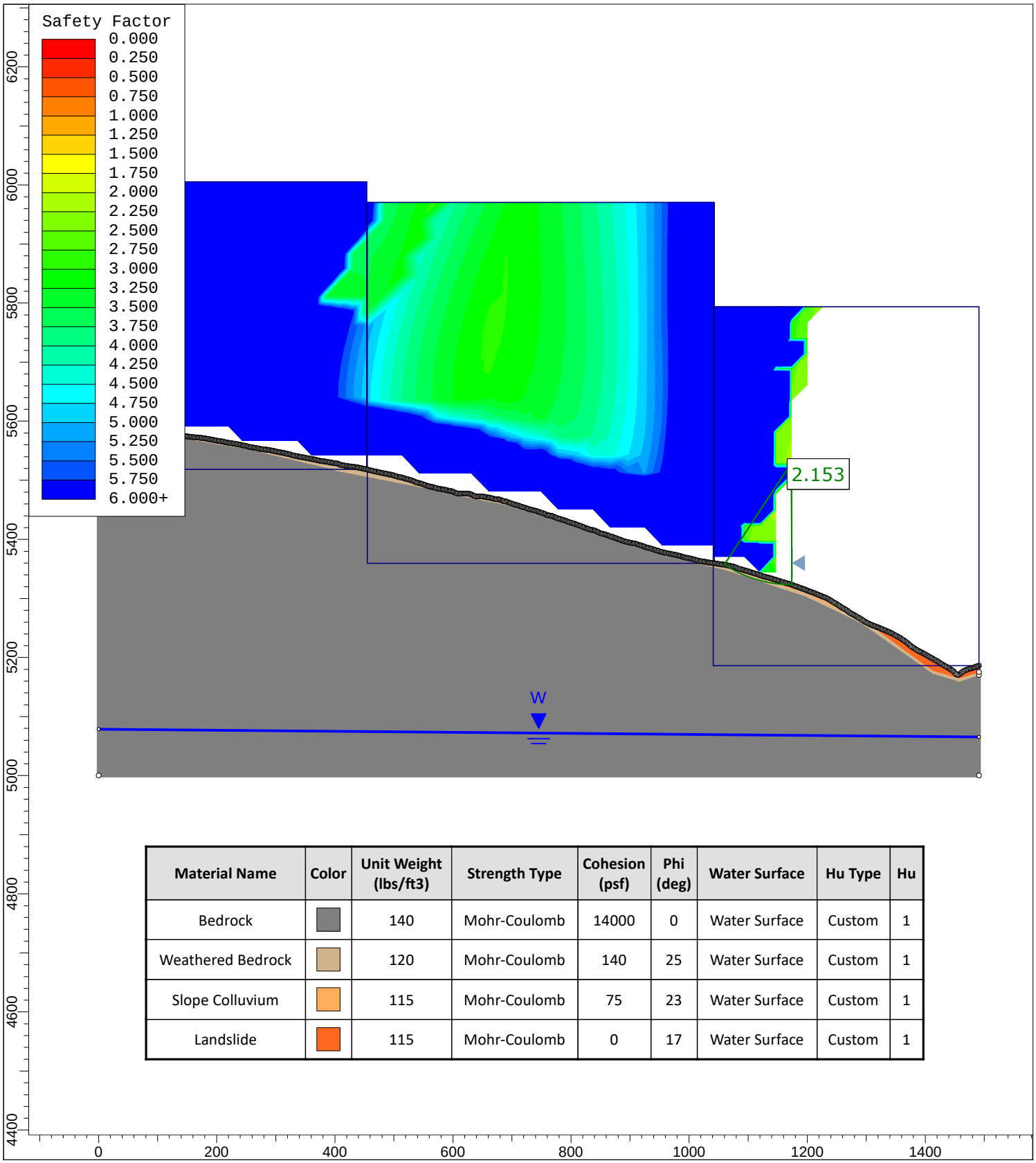
46



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Hu Type	Hu
Bedrock		140	Mohr-Coulomb	14000	0	Water Surface	Custom	1
Weathered Bedrock		120	Mohr-Coulomb	140	25	Water Surface	Custom	1
Slope Colluvium		115	Mohr-Coulomb	75	23	Water Surface	Custom	1
Landslide		115	Mohr-Coulomb	0	17	Water Surface	Custom	1

Profile C Excluding Landslide - Static

Christensen Geotechnical

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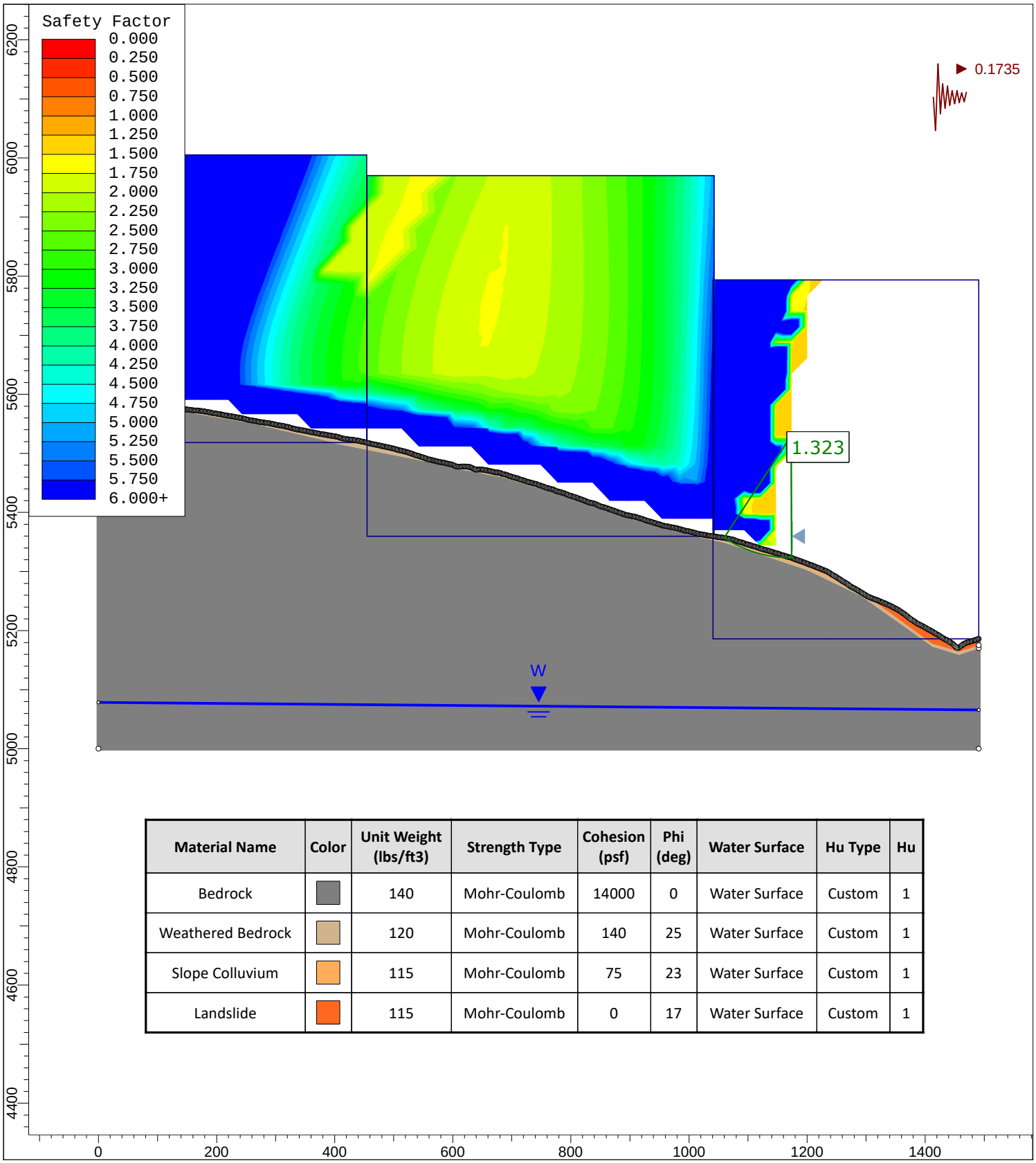
Plate
47



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Hu Type	Hu
Bedrock		140	Mohr-Coulomb	14000	0	Water Surface	Custom	1
Weathered Bedrock		120	Mohr-Coulomb	140	25	Water Surface	Custom	1
Slope Colluvium		115	Mohr-Coulomb	75	23	Water Surface	Custom	1
Landslide		115	Mohr-Coulomb	0	17	Water Surface	Custom	1

Profile C Excluding Landslide - Pseudo Static

Christensen Geotechnical

Legacy Mountain Development
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Huntsville, Weber County, Utah
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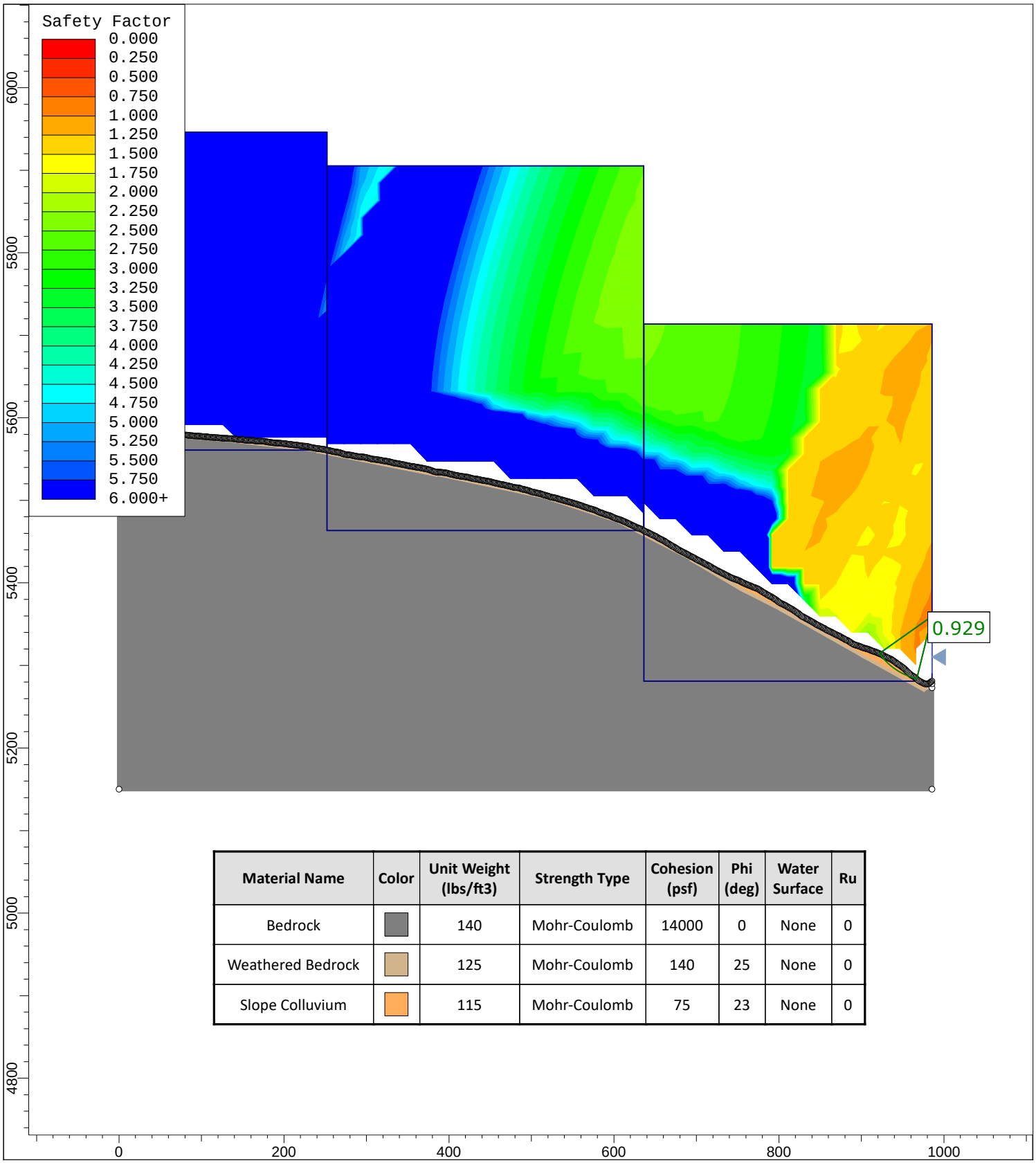
Plate
48



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru
Bedrock		140	Mohr-Coulomb	14000	0	None	0
Weathered Bedrock		125	Mohr-Coulomb	140	25	None	0
Slope Colluvium		115	Mohr-Coulomb	75	23	None	0

Profile D - Static

Christensen Geotechnical

Legacy Mountain Development
Lewis Homes
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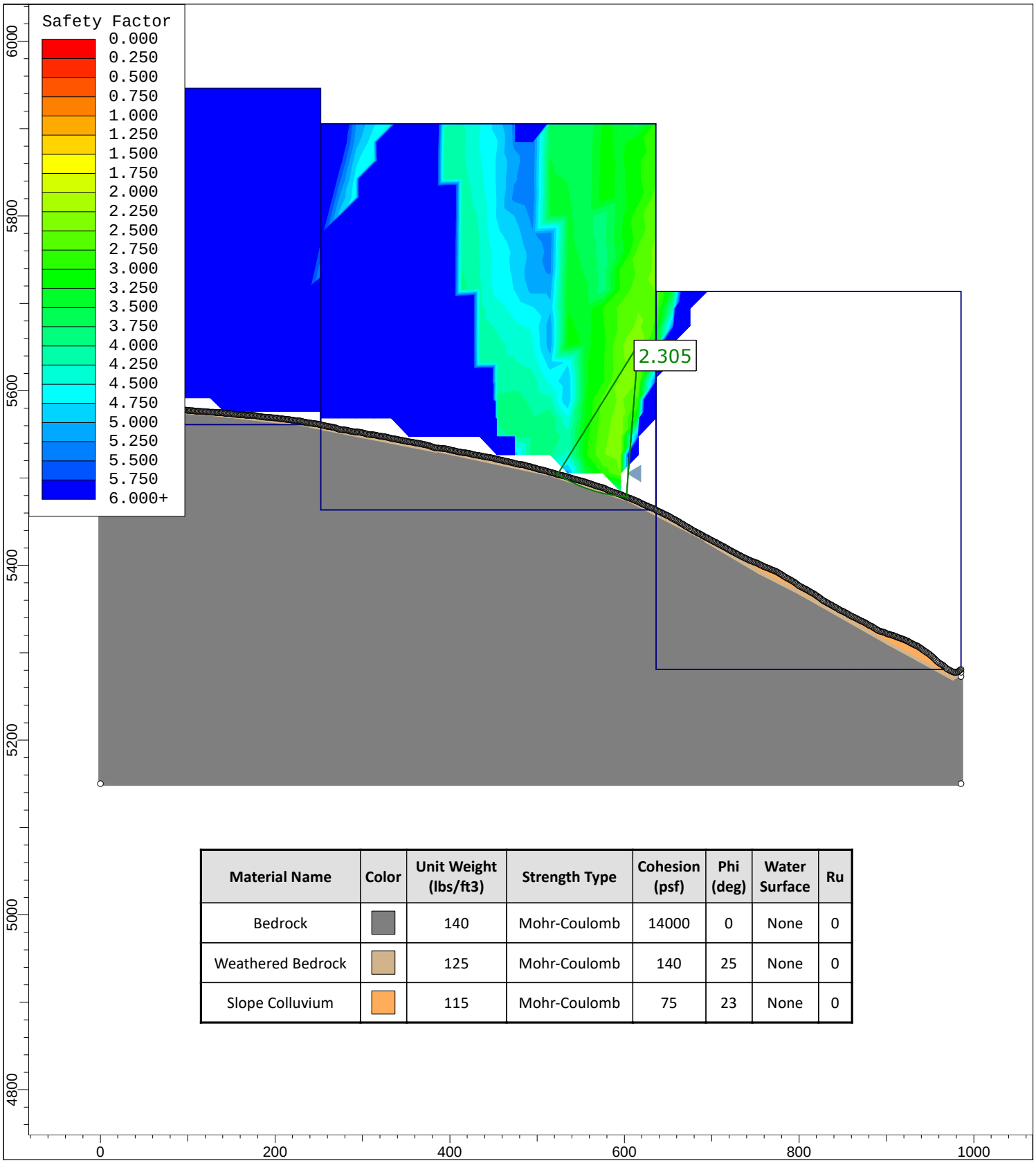
Plate
49



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru
Bedrock		140	Mohr-Coulomb	14000	0	None	0
Weathered Bedrock		125	Mohr-Coulomb	140	25	None	0
Slope Colluvium		115	Mohr-Coulomb	75	23	None	0

Profile D Excluding Steep Slope - Static

Christensen Geotechnical

Legacy Mountain Development
Lewis Homes
Huntsville, Weber County, Utah
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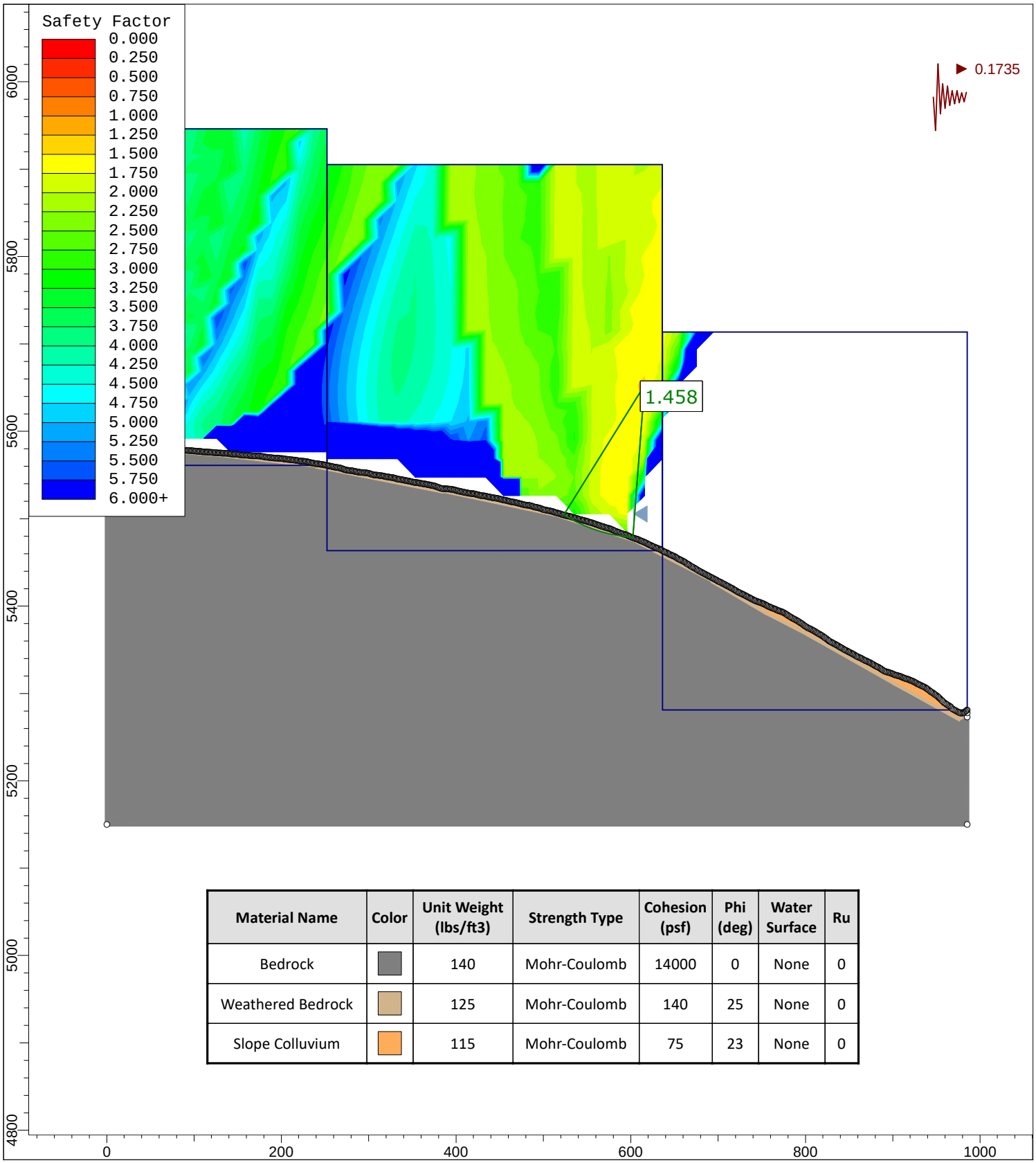
Plate
50



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru
Bedrock		140	Mohr-Coulomb	14000	0	None	0
Weathered Bedrock		125	Mohr-Coulomb	140	25	None	0
Slope Colluvium		115	Mohr-Coulomb	75	23	None	0

Profile D Excluding Steep Slope - Pseudo Static

Christensen Geotechnical

Legacy Mountain Development
Lewis Homes
Huntsville, Weber County, Utah
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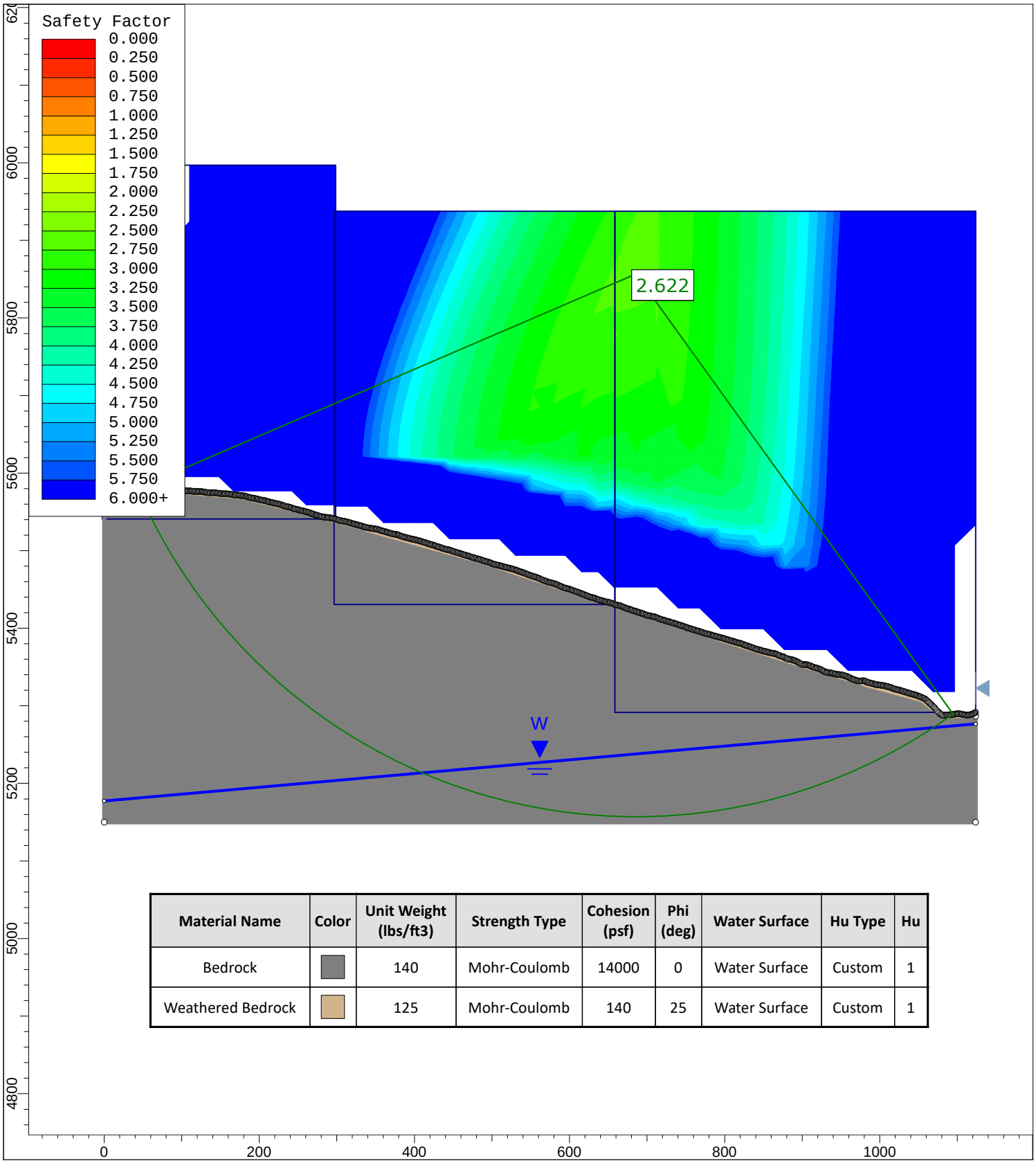
Plate
51



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Hu Type	Hu
Bedrock		140	Mohr-Coulomb	14000	0	Water Surface	Custom	1
Weathered Bedrock		125	Mohr-Coulomb	140	25	Water Surface	Custom	1

Profile E - Static

Christensen Geotechnical

Legacy Mountain Development
Lewis Homes
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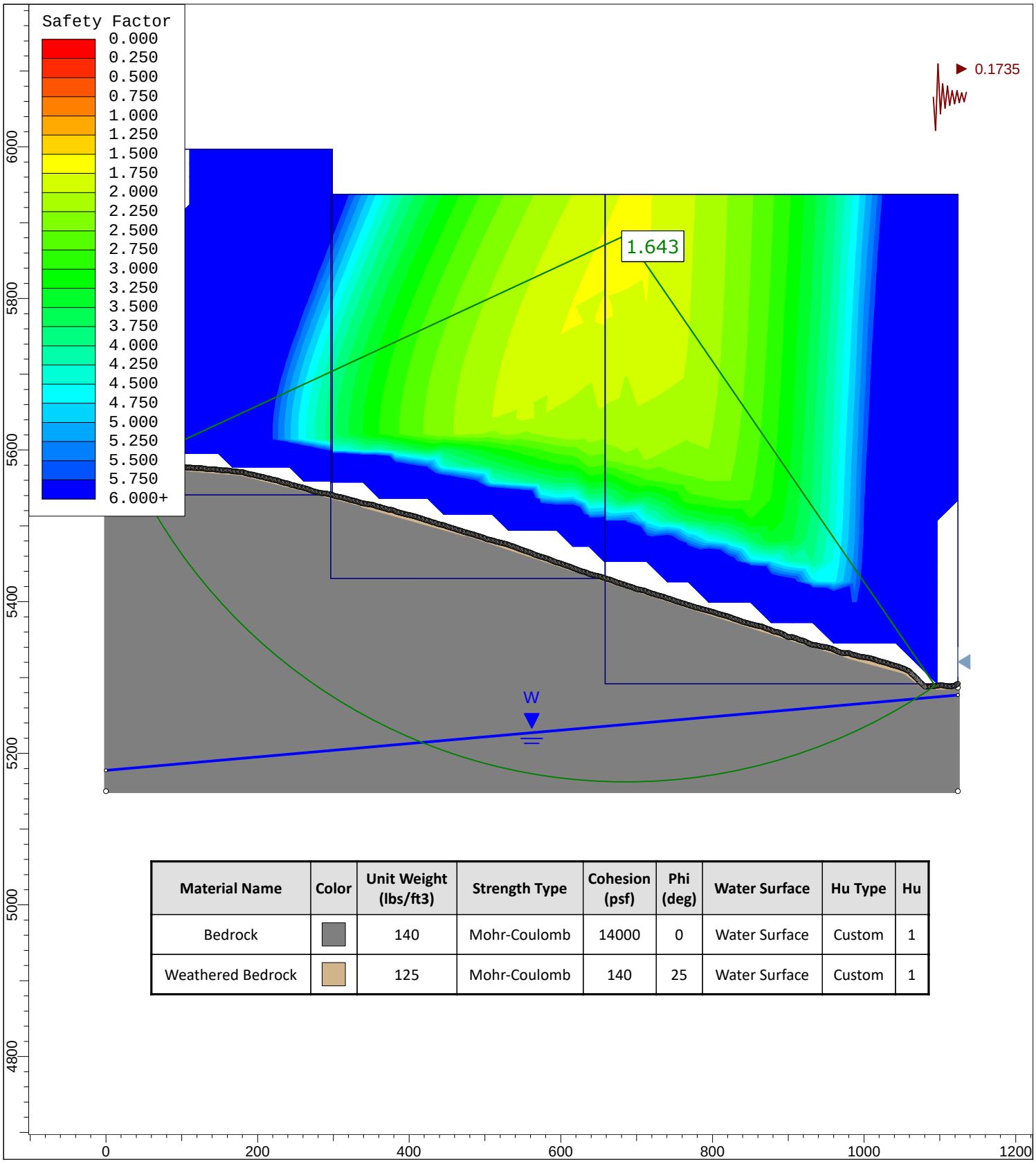
113-009

Plate
52



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Hu Type	Hu
Bedrock		140	Mohr-Coulomb	14000	0	Water Surface	Custom	1
Weathered Bedrock		125	Mohr-Coulomb	140	25	Water Surface	Custom	1

Profile E - Pseudo Static

Christensen Geotechnical

Legacy Mountain Development
Lewis Homes
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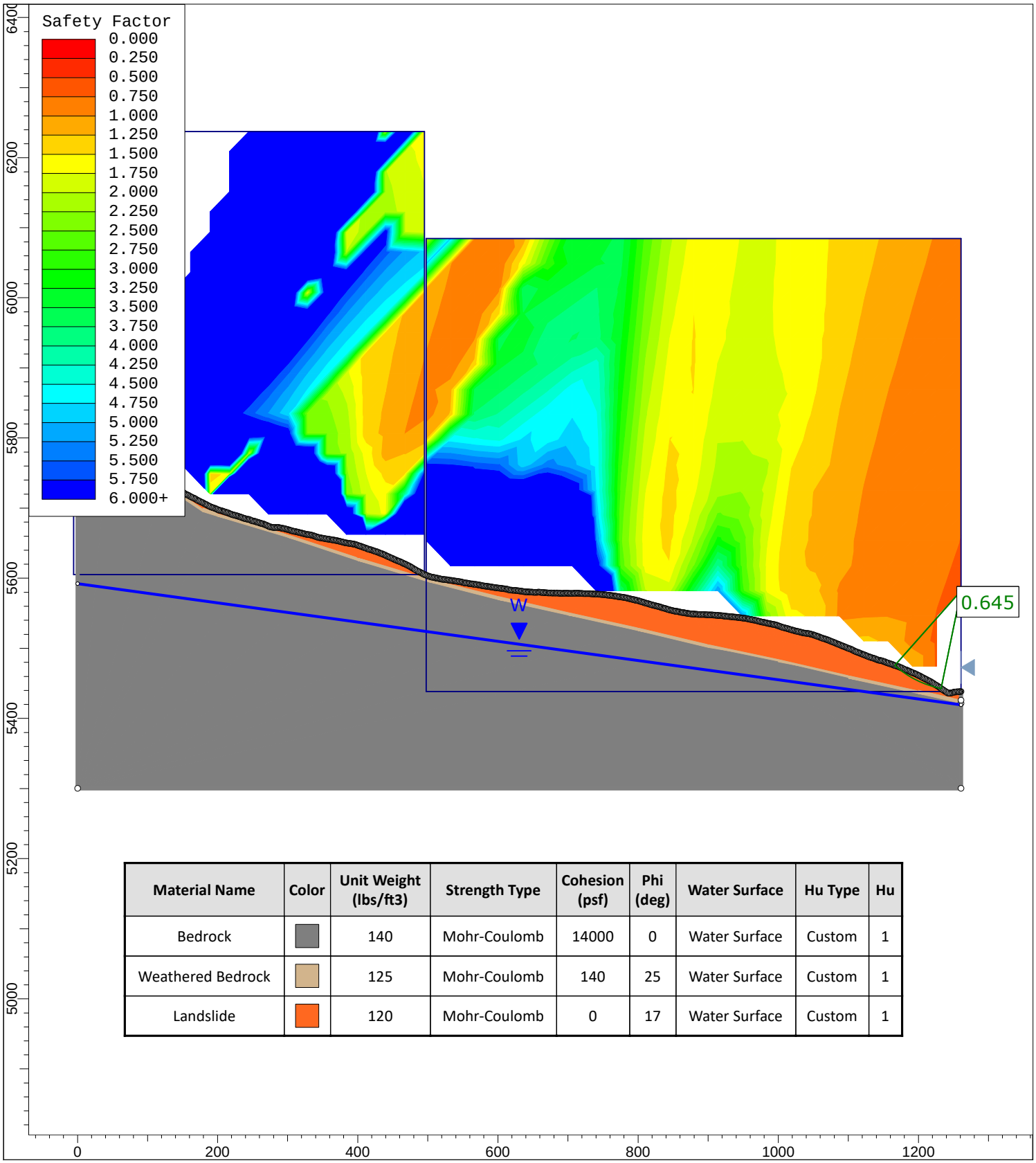
Plate
53



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Hu Type	Hu
Bedrock		140	Mohr-Coulomb	14000	0	Water Surface	Custom	1
Weathered Bedrock		125	Mohr-Coulomb	140	25	Water Surface	Custom	1
Landslide		120	Mohr-Coulomb	0	17	Water Surface	Custom	1

Profile F - Static

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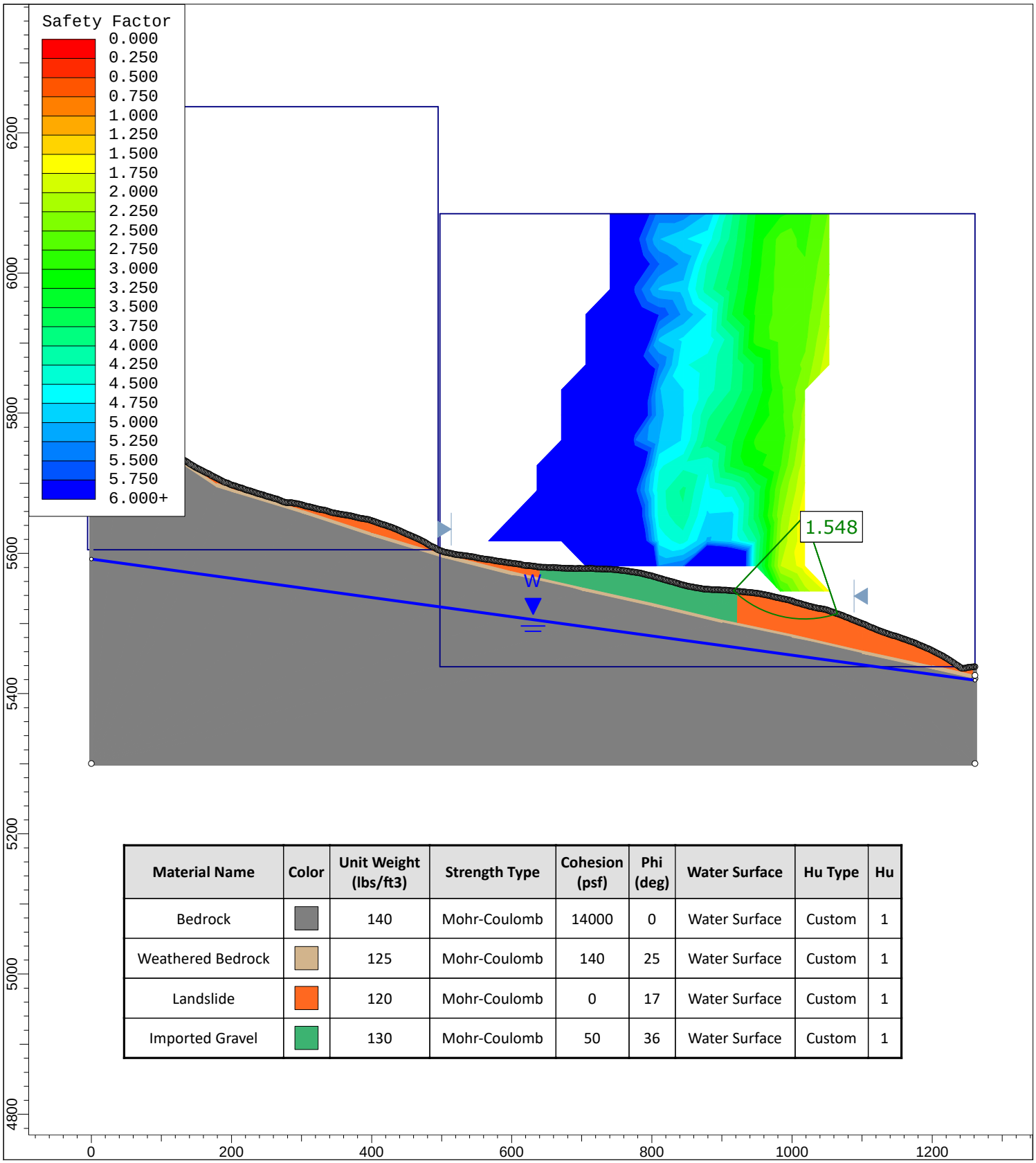

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Hu Type	Hu
Bedrock		140	Mohr-Coulomb	14000	0	Water Surface	Custom	1
Weathered Bedrock		125	Mohr-Coulomb	140	25	Water Surface	Custom	1
Landslide		120	Mohr-Coulomb	0	17	Water Surface	Custom	1
Imported Gravel		130	Mohr-Coulomb	50	36	Water Surface	Custom	1

Profile F with Gravel Fil - Static

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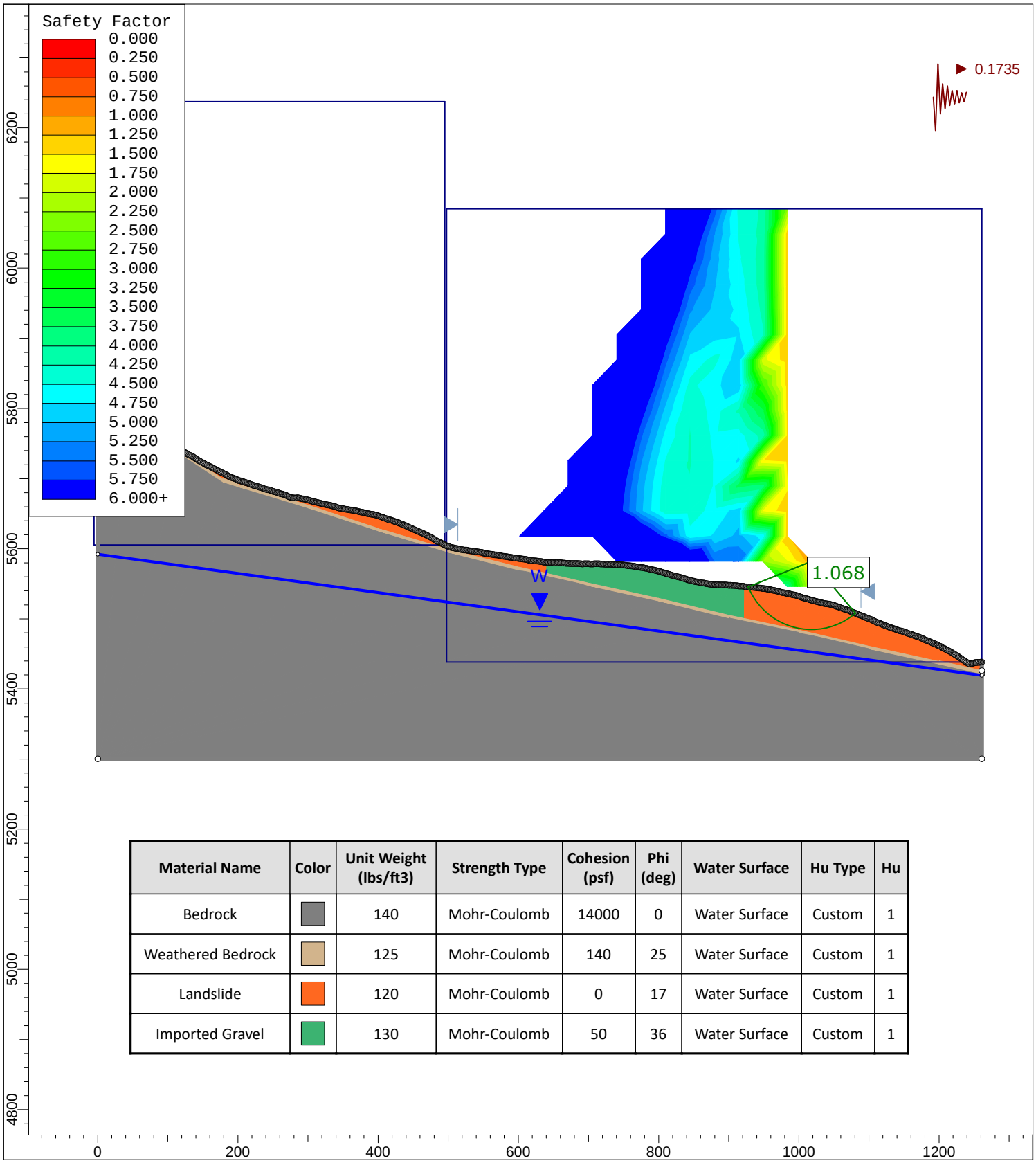
55



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Hu Type	Hu
Bedrock		140	Mohr-Coulomb	14000	0	Water Surface	Custom	1
Weathered Bedrock		125	Mohr-Coulomb	140	25	Water Surface	Custom	1
Landslide		120	Mohr-Coulomb	0	17	Water Surface	Custom	1
Imported Gravel		130	Mohr-Coulomb	50	36	Water Surface	Custom	1

Profile F with Gravel Fil - Pseudo Static

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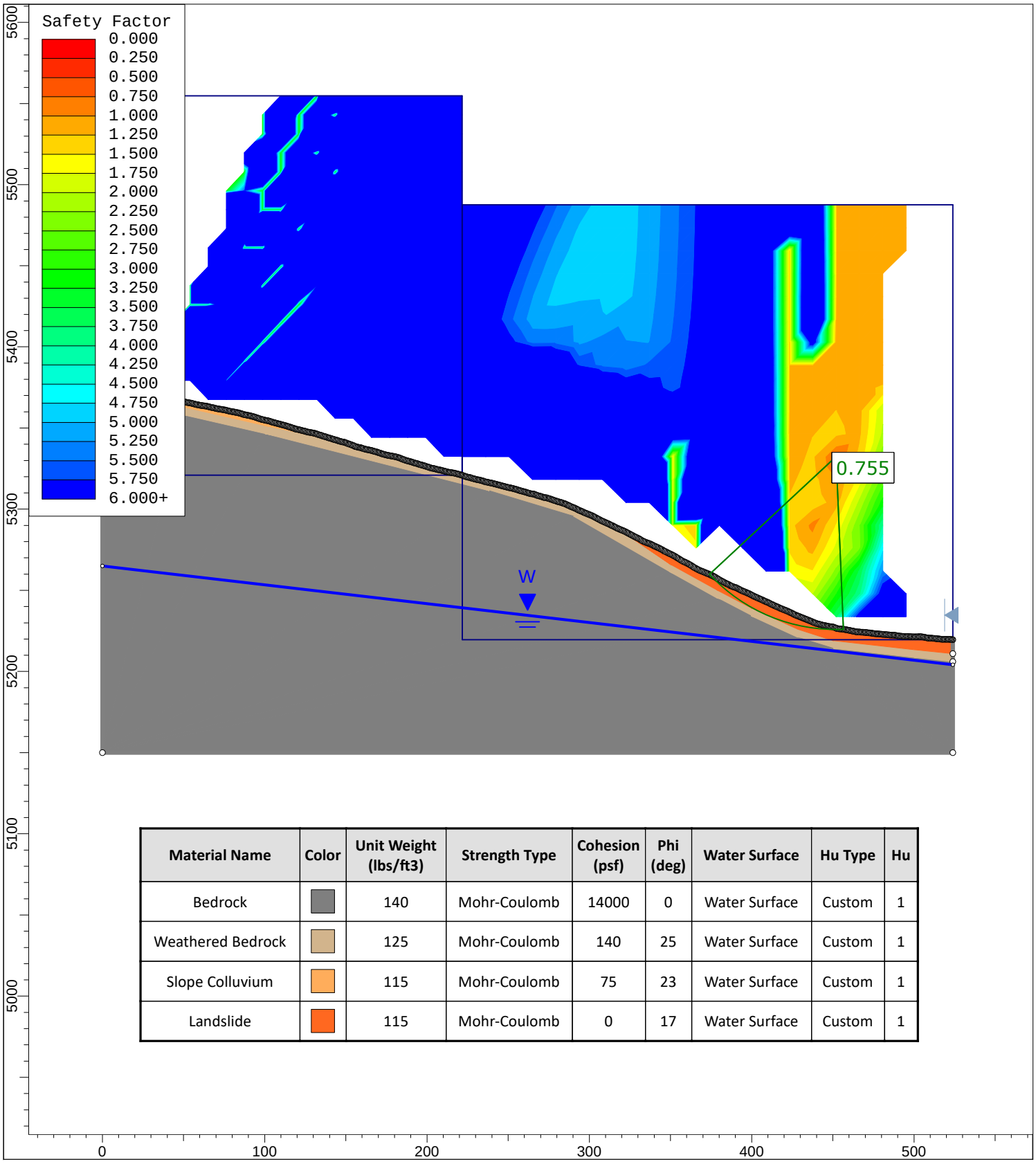

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Hu Type	Hu
Bedrock		140	Mohr-Coulomb	14000	0	Water Surface	Custom	1
Weathered Bedrock		125	Mohr-Coulomb	140	25	Water Surface	Custom	1
Slope Colluvium		115	Mohr-Coulomb	75	23	Water Surface	Custom	1
Landslide		115	Mohr-Coulomb	0	17	Water Surface	Custom	1

Profile G - Static

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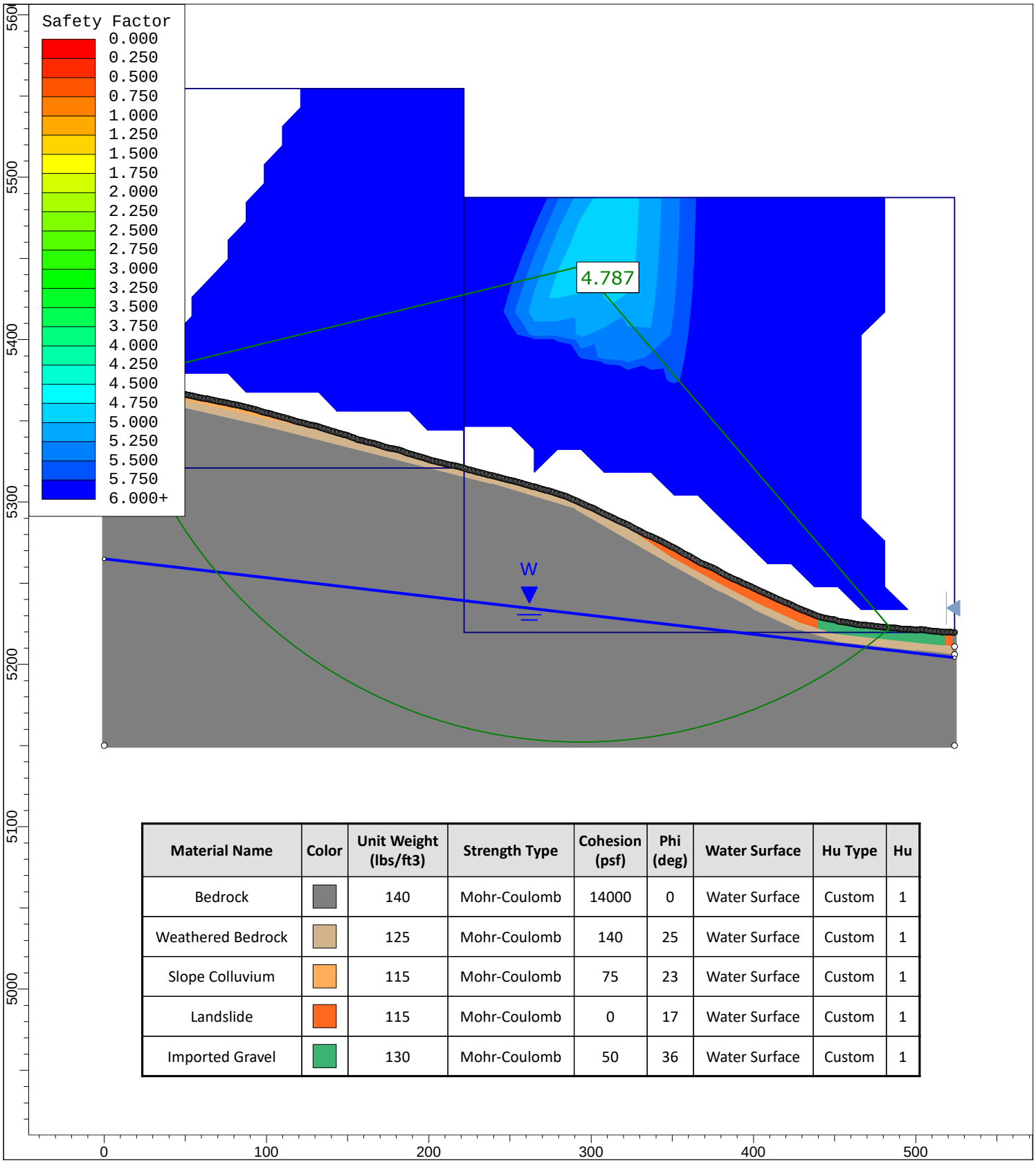

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Hu Type	Hu
Bedrock		140	Mohr-Coulomb	14000	0	Water Surface	Custom	1
Weathered Bedrock		125	Mohr-Coulomb	140	25	Water Surface	Custom	1
Slope Colluvium		115	Mohr-Coulomb	75	23	Water Surface	Custom	1
Landslide		115	Mohr-Coulomb	0	17	Water Surface	Custom	1
Imported Gravel		130	Mohr-Coulomb	50	36	Water Surface	Custom	1

Profile G with Gravel Fill- Static

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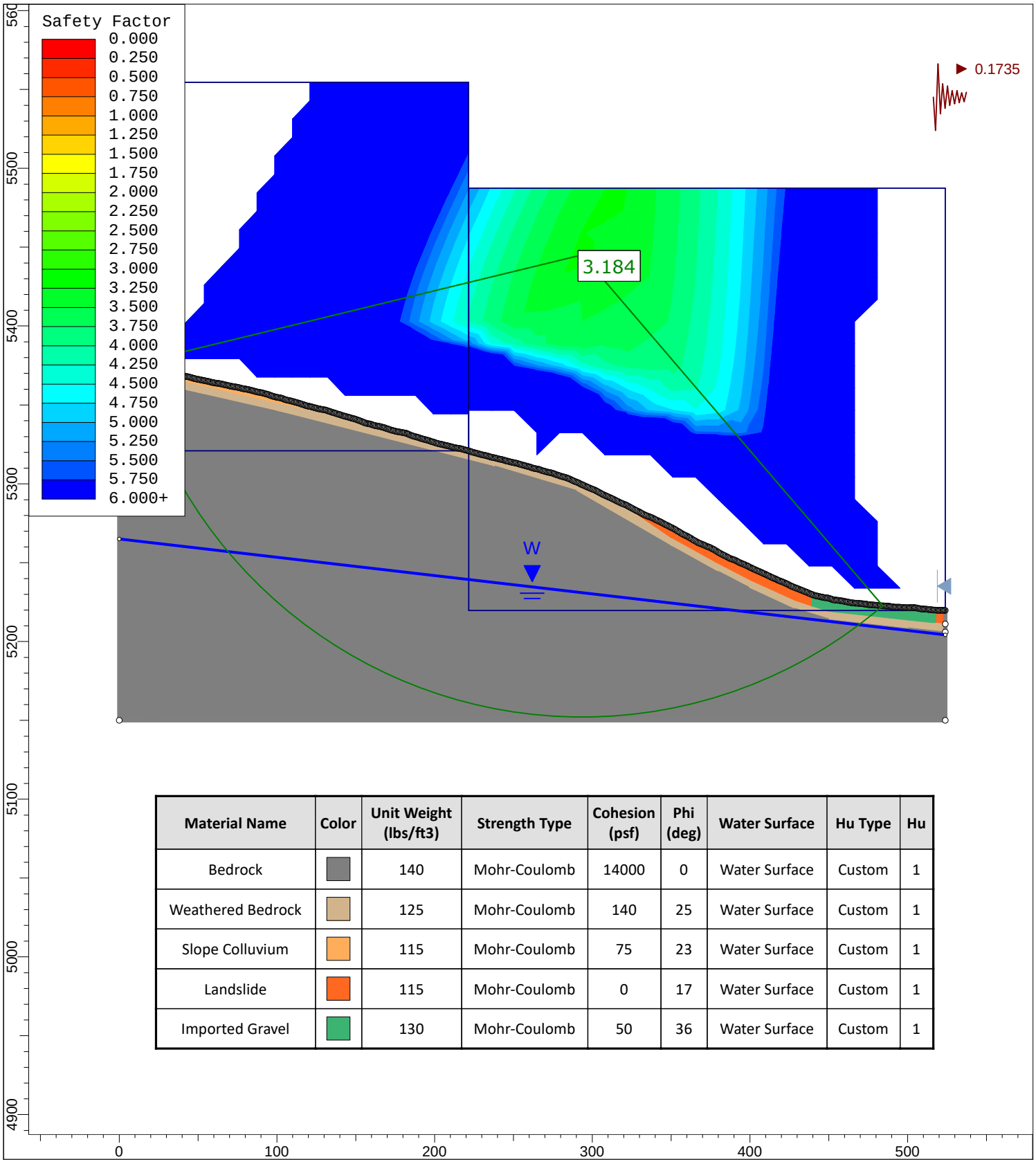

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Hu Type	Hu
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Weathered Bedrock		125	Mohr-Coulomb	140	25	Water Surface	Custom	1
Slope Colluvium		115	Mohr-Coulomb	75	23	Water Surface	Custom	1
Landslide		115	Mohr-Coulomb	0	17	Water Surface	Custom	1
Imported Gravel		130	Mohr-Coulomb	50	36	Water Surface	Custom	1

Profile G with Gravel Fill- Pseudo Static

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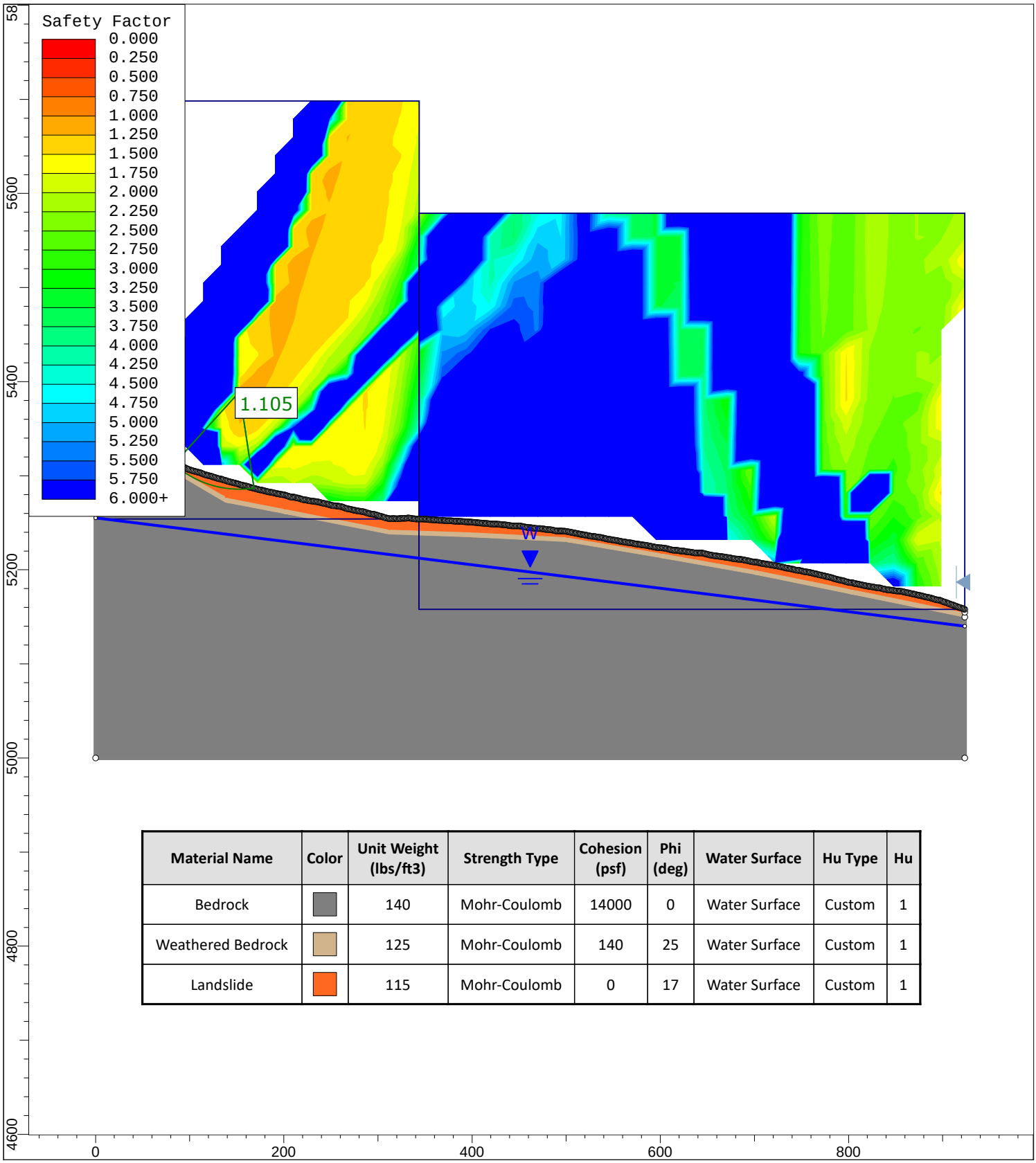

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Hu Type	Hu
Bedrock		140	Mohr-Coulomb	14000	0	Water Surface	Custom	1
Weathered Bedrock		125	Mohr-Coulomb	140	25	Water Surface	Custom	1
Landslide		115	Mohr-Coulomb	0	17	Water Surface	Custom	1

Profile H - Static

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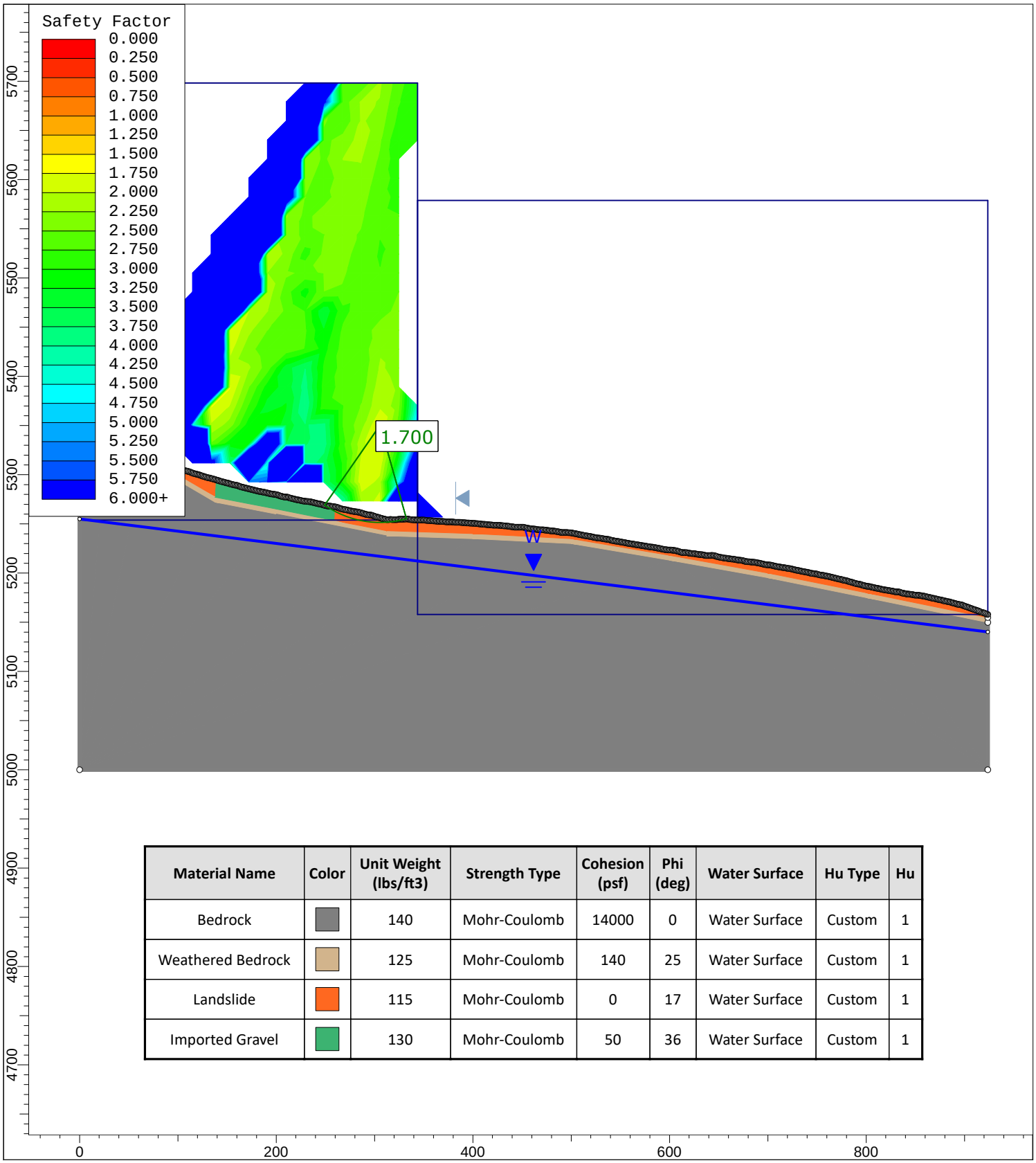

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Hu Type	Hu
Bedrock		140	Mohr-Coulomb	14000	0	Water Surface	Custom	1
Weathered Bedrock		125	Mohr-Coulomb	140	25	Water Surface	Custom	1
Landslide		115	Mohr-Coulomb	0	17	Water Surface	Custom	1
Imported Gravel		130	Mohr-Coulomb	50	36	Water Surface	Custom	1

Profile H with Gravel Fill - Static

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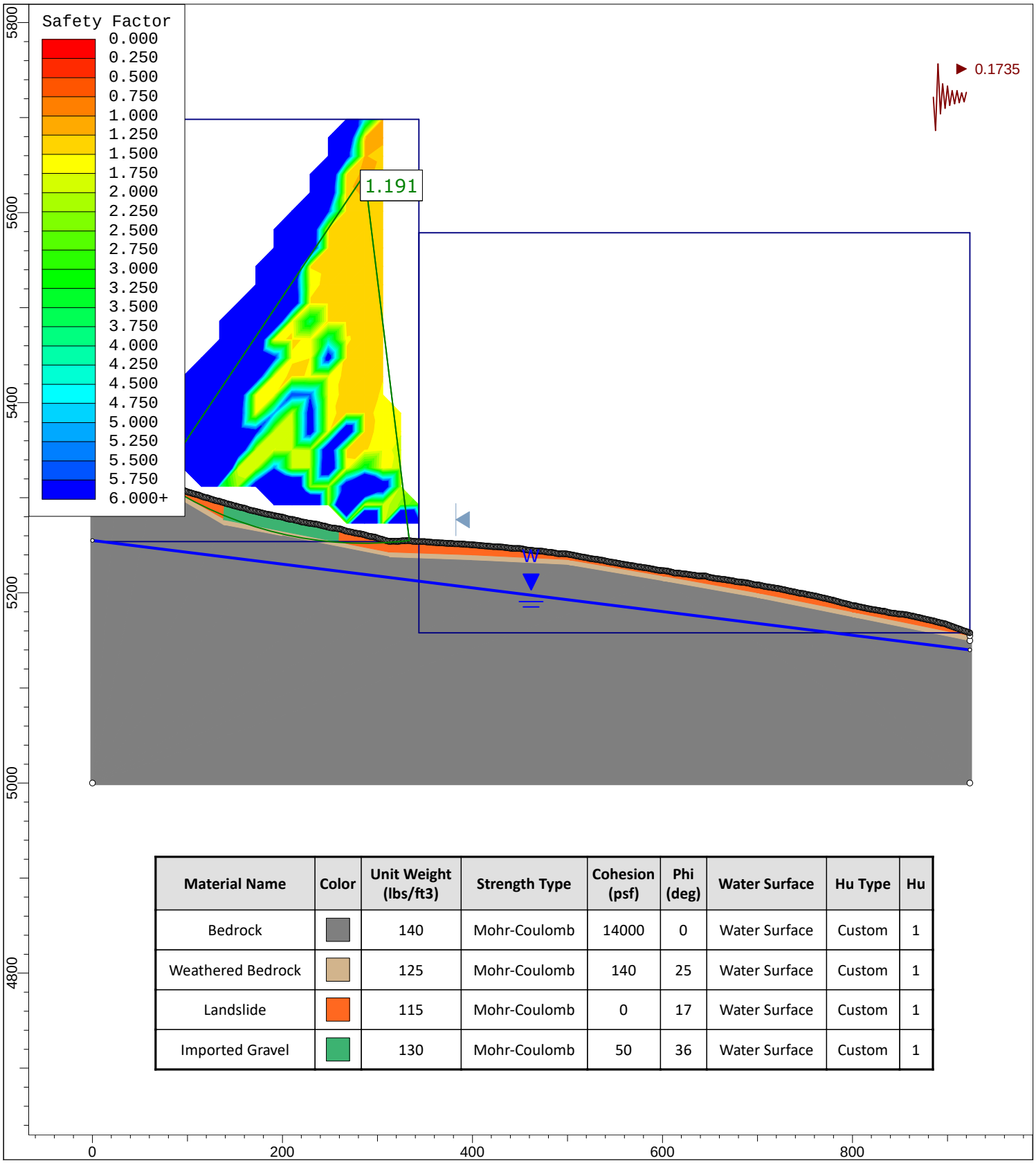

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Landslide		115	Mohr-Coulomb	0	17	Water Surface	Custom	1
Imported Gravel		130	Mohr-Coulomb	50	36	Water Surface	Custom	1

Profile H with Gravel Fill - Pseudo Static

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