

**Geotechnical Investigation  
Grove Cabin PRUD Phase 1 & Future Lots  
Eden, Utah**



**December 13, 2022**

**Prepared by:**



8143 South 2475 East, South Weber, Utah



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Prepared for:

Lewis Homes  
Attn: Taylor Lewis  
3718 North Wolf Creek Drive  
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**Geotechnical Investigation  
Grove Cabins PRUD Phase 1 & Future Lots  
Approximately 4650 North Seven Bridges Road  
Eden, Utah  
CG Project No.: 133-019**

Prepared by:



Mark I. Christensen, P.E.  
Principal

**Christensen Geotechnical**  
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December 13, 2022

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## **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 Grove Cabins PRUD Phase 1 and future lots, which is part of the Bridges Development, and will be located at approximately 4650 North Seven Bridge Road in Eden, 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 for the development by Western Geologic, dated November 21, 2022, was reviewed to assist in our assessments.

The work performed for this report was authorized by Mr. Taylor Lewis and was conducted in accordance with the Christensen Geotechnical proposal dated October 12, 2022.

### **1.2 PROJECT DESCRIPTION**

Based on a concept plan provided to us by Lewis Homes, we understand that the proposed Phase 1 and future lots area are approximately 10 acres in size and are to be developed with 17 single-family residences. The development will also include access roads, associated utilities, and landscaping. The structural loads for the proposed residences are anticipated to be on the order of 3 to 5 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 REVIEW OF PREVIOUS STUDIES

In 2018, GeoStrata completed a geologic/geotechnical report for Phase 1 of the Parkside and Mountainside PRUDs (GeoStrata, 2018). The Parkside, Mountainside, and Grove Cabins PRUDs are all parts of the Bridges Development. GeoStrata's investigation included four borings and three test pits. The explorations completed by GeoStrata were not located within the Grove Cabins development; however, their borings B-2 and B-4 were located within Phase 2 of the Mountainside PRUD, approximately 650 feet to the east. These GeoStrata borings encountered Clayey SAND with gravel (SC), Sandy Lean CLAY with gravel (CL), Lean CLAY (CL), Clayey GRAVEL with sand (GC), Sandy Fat CLAY with gravel (CH), and Sandy SILT (ML). GeoStrata reported encountering perched groundwater in boring B-2 between 20 and 30 feet below existing site grade. Groundwater was not reported in Boring B-4.

GSH Geotechnical Inc. completed an engineering geology study for the eastern portion of the Bridges Development in 2016 (GSH, 2016). The GSH study included the drilling of 5 borings, the excavation of 17 test pits, and the excavation of 2 trenches. Of these explorations, test pit TP-11 was located within the Grove Cabins Phase 1 & future lots, and Clayey GRAVEL with sand (GC) and Silty Sandy Lean CLAY (CL) were encountered within it. Groundwater was not encountered within this test pit.

### 2.2 FIELD INVESTIGATION

The subsurface conditions at the site were explored by excavating five test pits to depths of 5½ to 8 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 7. A key to the symbols and terms used on the Test Pit Logs may be found on Plate 8.

The test pit excavations were 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.

## 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 included moisture content determinations, an Atterberg limits evaluation, and gradation analyses. A summary of our laboratory testing is presented in the table below:

**Table No. 1: Laboratory Test Results**

TEST HOLE NO.	DEPTH (ft.)	NATURAL DRY DENSITY (pcf)	NATURAL MOISTURE (%)	ATTERBERG LIMITS		GRAIN SIZE DISTRIBUTION (%)			SOIL TYPE
				LIQUID LIMIT	PLASTICITY INDEX	GRAVEL (+ #4)	SAND	SILT/CLAY (- #200)	
TP-1	6		1.9			62.9	28.8	8.3	GP-GC
TP-2	3		3.9			33.8	37.7	28.5	GC
TP-3	3		3.3			69.8	19.6	10.6	GP-GC
TP-4	4		13.1	43	24	19.7	21.1	59.3	CL
TP-5	6		3.8			69.0	15.8	15.2	GC

The results of our laboratory tests are also presented on the Test Pit Logs, Plates 3 through 7, and more detailed laboratory results are presented on the laboratory testing plates, Plates 9 and 10.

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, one single-family residence had been constructed within Phase 1 and the roadway within the development had been graded. The remaining portions of the site were undeveloped. The property generally sloped down to the southwest with grades of 5 to 20 percent. The vegetation at the site generally consisted of common grasses and weeds with a few stands of scrub oak.

### **3.2 SUBSURFACE CONDITIONS**

#### **3.2.1 Soils**

Based on the five test pits that were completed for this investigation, the site is covered with approximately 1 foot of topsoil. The native soils below the topsoil generally consist of Clayey GRAVEL with sand (GC) with occasional zones of Poorly Graded GRAVEL with clay and sand (GP-GC) and Sandy Lean CLAY with gravel (CL).

#### **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 GEOLOGIC CONDITIONS

### 4.1 SEISMIC DESIGN CRITERIA

The State of Utah and Utah municipalities have adopted the 2018 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 D, which represents a "stiff soil" profile. The spectral acceleration values obtained from the ATC's web-based application are shown below.

**Table 2: IBC Seismic Response Spectrum Values**

<b>Site Location: 41.343696° N -111.836457° W</b>	
<b>Name</b>	<b>Response Spectral Value</b>
<b>S<sub>s</sub></b>	<b>0.971</b>
<b>S<sub>1</sub></b>	<b>0.346</b>
<b>S<sub>MS</sub></b>	<b>1.08</b>
<b>S<sub>M1</sub></b>	<b>See ASCE Section 11.4.8</b>
<b>S<sub>DS</sub></b>	<b>0.72</b>
<b>S<sub>D1</sub></b>	<b>See ASCE Section 11.4.8</b>
<b>PGA<sub>M</sub></b>	<b>0.503</b>

### 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.

The map "Special Study Areas, Wasatch Front and Nearby Areas, Utah" (Christenson et al., 2008) indicates that the subject site is located in an area designated as having a very low potential for

liquefaction. A site-specific liquefaction assessment was outside the scope of our services for this project. If a liquefaction assessment for this development is desired, Christensen Geotechnical should be contacted to discuss the additional work required.

## **5.0 ENGINEERING ANALYSIS AND RECOMMENDATIONS**

### **5.1 GENERAL CONCLUSIONS**

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 subject site is covered with approximately 1 foot 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. Any localized soft areas identified during the proof rolling 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. The structural fill may consist of the native gravel soils. Due to their potential to swell, the native clay soils should not be used. 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 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

The foundations for the planned structures may consist of conventional continuous and/or spread footings established either on undisturbed native gravel soil or on properly placed and compacted structural fill which extends down to undisturbed native gravel soil. Where foundation excavations expose clay soils, the clay should be over excavated to allow placement of at least 24 inches of properly placed and compacted 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 undisturbed native soils or structural fill may be proportioned for a maximum net allowable bearing capacity of 2,500 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. 3: Lateral Earth Pressures**

Condition	Lateral Pressure Coefficient	Equivalent Fluid Density (pcf)
Active Static	0.26	32
Active Seismic	0.20	24
At Rest	0.46	55
Passive Static	3.39	407
Passive Seismic	-1.62	-194

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 0.40 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

Concrete slabs-on-grade should 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.

## 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 relative high elevation of the subject site, we recommend that all basement walls incorporate a foundation drain. The foundation 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 extend 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 to another free-gravity outfall unless provisions for pumped sumps are made. The gravel which extends up the 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, a slope stability assessment was performed using the Slide computer program and the modified Bishop's method of slices. The location of the profile assessed is shown on Plate 2 and is based on the cross section presented in The Western Geologic report for the development. The alluvial fan and debris flow deposits were assumed to have a strength consisting of an angle of internal friction of 32 degrees and a cohesion of 100 psf. The Maple Canyon Formation bedrock strength was based on the 2018 GeoStrata report and consisted of an angle of internal friction of 26 degrees and 250 psf cohesion.

The profile was 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 0.503g. 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 the profile has safety factors greater than 1.5 and 1.0 for the static and pseudo static conditions and is therefore considered suitable for residential construction.

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 15 feet are planned, 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 11 through 12.

#### 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 10 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 300 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 8 inches of untreated base. 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 and 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.

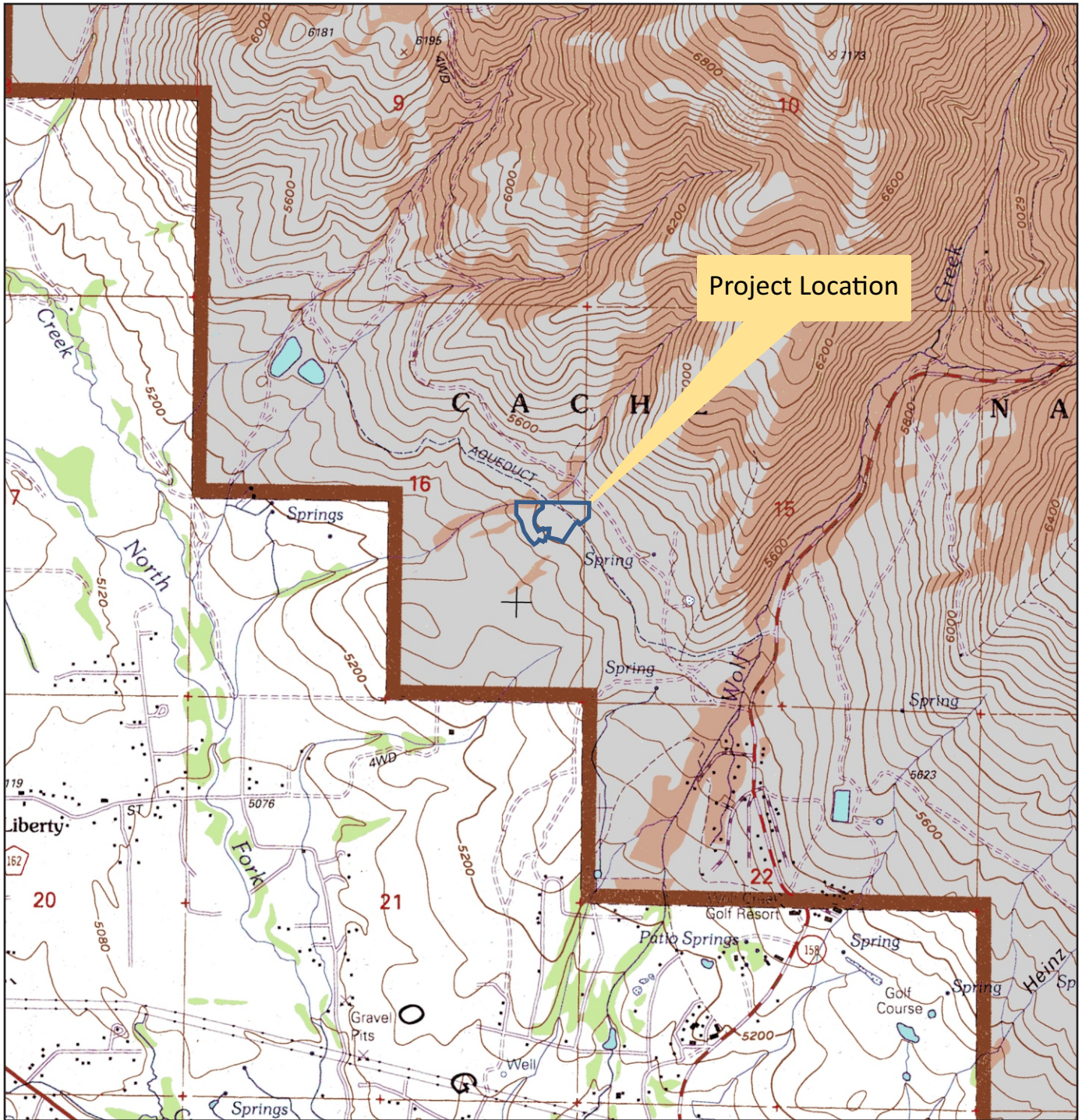
This report was prepared in accordance with the generally accepted standard of practice at the time the report was written. No other warranty, expressed or implied, is made.

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 21, 2022, “Geologic Hazards Evaluation, Proposed Grove Cabins P.R.U.D. Phase 1 and Future Lots, About 4650 North Seven Bridges Road, Eden, Weber County, Utah,” Western Geologic, consultant’s unpublished report.
- Christenson, Gary E. and Shaw, Lucas M., 2008, “Liquefaction Special Study Areas, Wasatch Front and Nearby Areas, Utah,” Utah Geological Survey, Supplement Map to Utah Circular 106.
- Geostrata, February 15, 2018, “Geotechnical Investigation, Phase 1 – Mountainside and Parkside Communities, the Bridges at Wolf Creek Development, Eden, Utah,” unpublished consultant’s report.
- GSH, July 25, 2016, “Report – Engineering Geology Study, The Bridges at Wolf Creek East Phase 1, parts of Sections 15, 16, and 22 Township 7 North, Ranch 1 East, SLBM, Eden, Utah,” unpublished consultant’s report.




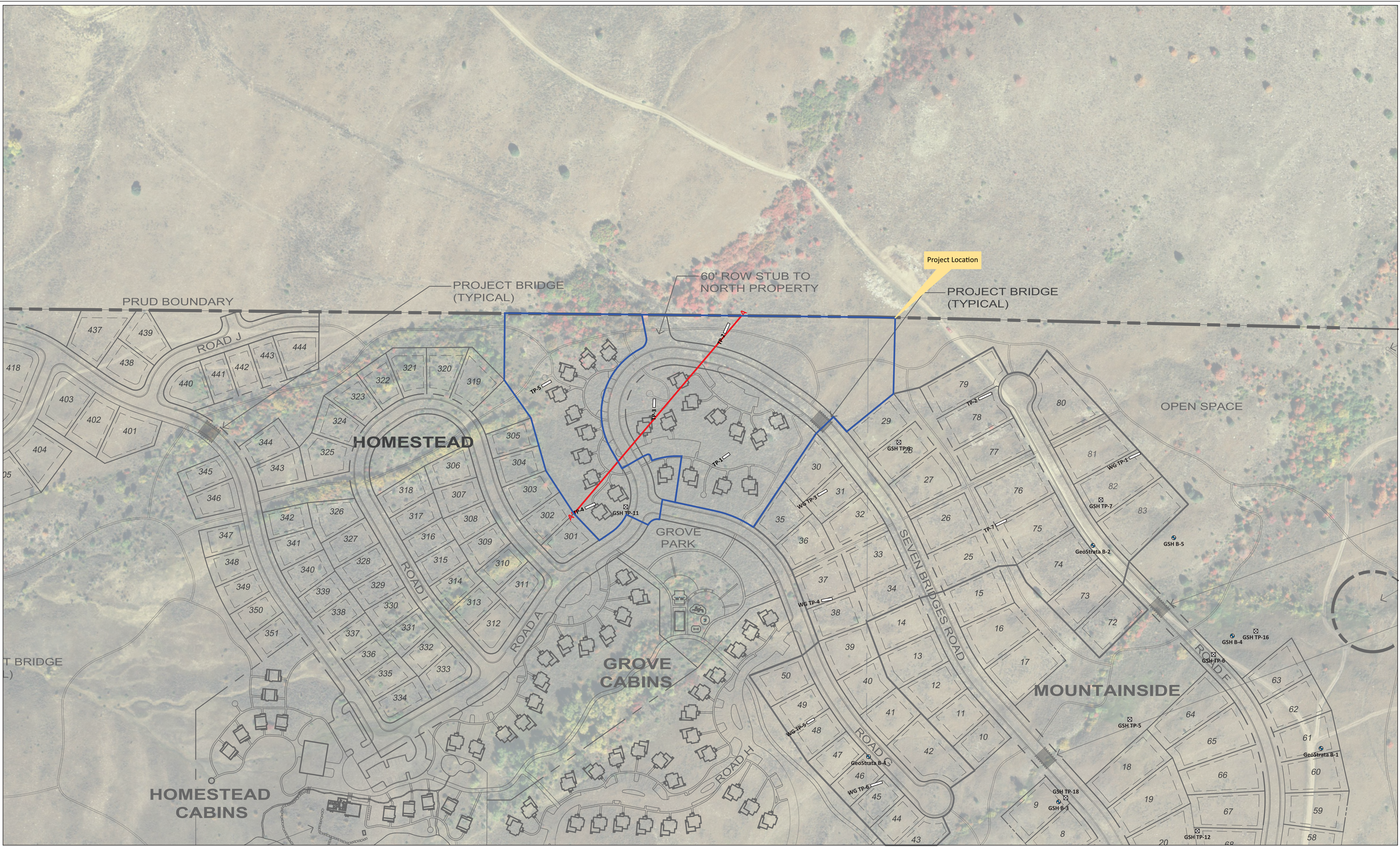
Base: U.S. Geological Survey topographic map, Huntsville quadrangle

 Approximate Project Boundary

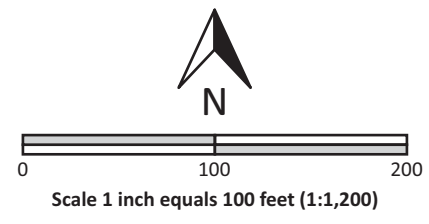


  
Scale 1 inch equals 2,000 feet (1:24,000)



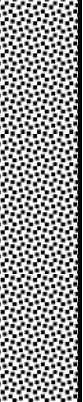

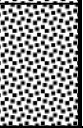
	<p>Lewis Homes Grove Cabins PRUD Phase 1 and Future Lots Eden, Weber County, Utah Project No. 133-019</p>	<p>Plate <b>1</b></p>
<p>Vicinity Map</p>		





Base: Utah Geospatial Resource Center high resolution orthophoto. Site plan modified from Langvardt Design Group overall site plan sheet P1.2 dated June 2019.



Lewis Homes  
 Grove Cabins PRUD Phase 1 and Future Lots  
 Eden, Weber County, Utah,  
 Project No. 133-019  
**Exploration Locations**

Date	Started: 11/7/2022		<b>TEST PIT LOG</b>			Logged By: M Christensen		Test Pit No.		
	Completed: 11/7/2022					Equipment: Trackhoe		<b>TP-1</b>		
Backfilled: 11/7/2022		Location: See Plate 2		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; Clayey GRAVEL with sand - moist, dark brown					
				GC	Clayey GRAVEL with sand - medium dense, slightly moist, brown, with cobbles and boulders up to 2 feet in diameter					
5				GP-GC	Poorly Graded GRAVEL with clay and sand - medium dense, slightly moist, brown, with cobbles and boulders up to 2 feet in diameter		1.9	8.3		
					Bottom of test pit at 7½ feet					
10										
15										


 Bulk/Bag Sample  
 Undisturbed Sample

 Stabilized Groundwater  
 Groundwater At Time of Excavation



**Lewis Homes**  
**Grove Cabins PRUD Phase 1 & Future Lots**  
**Eden, Utah**  
**Project No.: 133-019**

**Plate**  
**3**

Date		TEST PIT LOG			Logged By: M Christensen Equipment: Trackhoe Location: See Plate 2		Test Pit No. <b>TP-2</b>			
Started: 11/7/2022							Sheet 1 of 1			
Completed: 11/7/2022										
Backfilled: 11/7/2022										
Depth (feet)	Sample Type	Groundwater	Graphic Log	Group Symbol	Material Description	Dry Density (pcf)	Moisture Content (%)	Minus #200 (%)	Liquid Limit	Plasticity Index
					Topsoil; Clayey GRAVEL with sand - moist, dark brown					
					Clayey GRAVEL with sand - medium dense, slightly moist, brown, with cobbles and boulders up to 2 feet in diameter					
5	X			GC			3.9	28.5		
	X									
10					Bottom of test pit at 8 feet					
15										
<input checked="" type="checkbox"/> Bulk/Bag Sample <input checked="" type="checkbox"/> Stabilized Groundwater <input type="checkbox"/> Undisturbed Sample <input checked="" type="checkbox"/> Groundwater At Time of Excavation										
					<b>Lewis Homes</b> <b>Grove Cabins PRUD Phase 1 &amp; Future Lots</b> <b>Eden, Utah</b> <b>Project No.: 133-019</b>					
					<b>Plate</b>  <b>4</b>					

Date	Started: 11/7/2022		<b>TEST PIT LOG</b>			Logged By: M Christensen		Test Pit No. <b>TP-3</b>		
	Completed: 11/7/2022					Equipment: Trackhoe				
Backfilled: 11/7/2022					Location: See Plate 2		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; Clayey GRAVEL with sand - moist, dark brown					
				GC	Clayey GRAVEL with sand - medium dense, slightly moist, brown, with cobbles and boulders up to 2 feet in diameter					
5				GP-GC	Poorly Graded GRAVEL with clay and sand - medium dense, slightly moist, brown, with cobbles and boulders up to 2 feet in diameter		3.3	10.6		
10					Bottom of test pit at 8 feet					
15										

Bulk/Bag Sample  
 Undisturbed Sample

Stabilized Groundwater  
 Groundwater At Time of Excavation




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**Plate**  
**5**

Date	Started: 11/7/2022		<b>TEST PIT LOG</b>			Logged By: M Christensen		Test Pit No. <b>TP-4</b>		
	Completed: 11/7/2022					Equipment: Trackhoe				
Backfilled: 11/7/2022					Location: See Plate 2		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; Clayey GRAVEL with sand - moist, dark brown					
				GC	Clayey GRAVEL with sand - medium dense, slightly moist, brown, with cobbles and boulders					
				CL	Sandy Lean CLAY with gravel (Bedrock?) - very stiff, slightly moist, red-brown					
5							13.1	59.3	43	24
					Bottom of test pit at 5½ feet					
10										
15										
<input checked="" type="checkbox"/> Bulk/Bag Sample                       Stabilized Groundwater <input type="checkbox"/> Undisturbed Sample                       Groundwater At Time of Excavation										
					<b>Lewis Homes</b> <b>Grove Cabins PRUD Phase 1 &amp; Future Lots</b> <b>Eden, Utah</b> <b>Project No.: 133-019</b>			<b>Plate</b>  <b>6</b>		



Date		TEST PIT LOG			Logged By: M Christensen Equipment: Trackhoe Location: See Plate 2		Test Pit No. <b>TP-5</b>			
Started: 11/7/2022							Sheet 1 of 1			
Completed: 11/7/2022										
Backfilled: 11/7/2022										
Depth (feet)	Sample Type	Groundwater	Graphic Log	Group Symbol	Material Description	Dry Density (pcf)	Moisture Content (%)	Minus #200 (%)	Liquid Limit	Plasticity Index
					Topsoil; Clayey GRAVEL with sand - moist, dark brown					
	X			GC	Clayey GRAVEL with sand - medium dense, slightly moist, brown, with cobbles and boulders up to 2 feet in diameter					
5							3.8	15.2		
	X									
					Bottom of test pit at 8 feet					
10										
15										
<input checked="" type="checkbox"/> Bulk/Bag Sample <input checked="" type="checkbox"/> Stabilized Groundwater <input type="checkbox"/> Undisturbed Sample <input checked="" type="checkbox"/> Groundwater At Time of Excavation										
					<b>Lewis Homes</b> <b>Grove Cabins PRUD Phase 1 &amp; Future Lots</b> <b>Eden, Utah</b> <b>Project No.: 133-019</b>					<b>Plate</b>  <b>7</b>

**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 Dense	>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"	Thumb to fist
	Fine	#4 – 3"	Pea to thumb
Sand	Coarse	#10 - #4	Rock salt to pea
	Medium	#40 - #10	Sugar to rock salt
	Fine	#200 - #40	Flour to sugar
Silt/Clay	<#200	<0.0029	Flour sized or smaller

**STRATIFICATION**

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

**MODIFIERS**

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

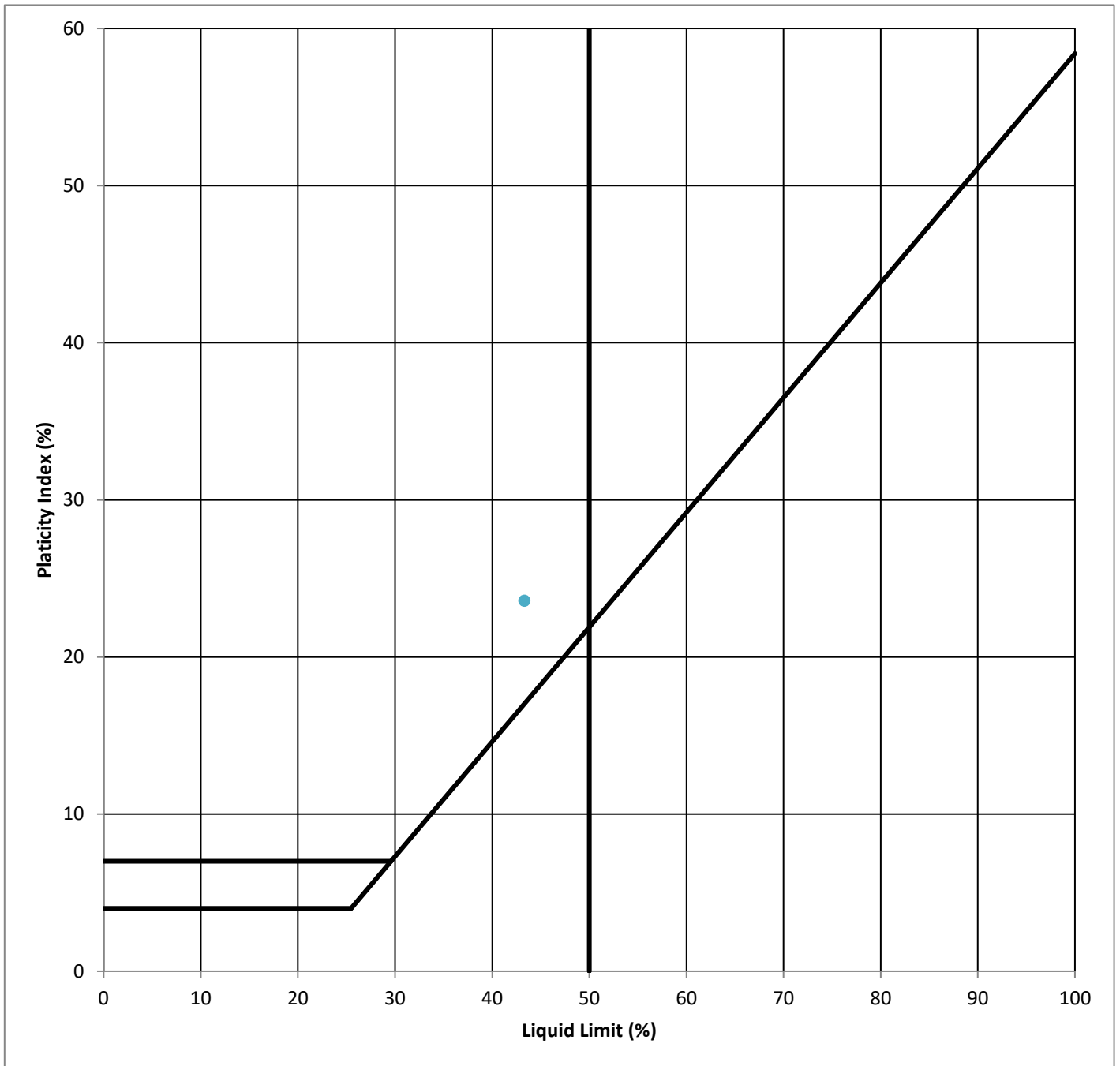
**STRATIFICATION**

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


**NOTES**

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

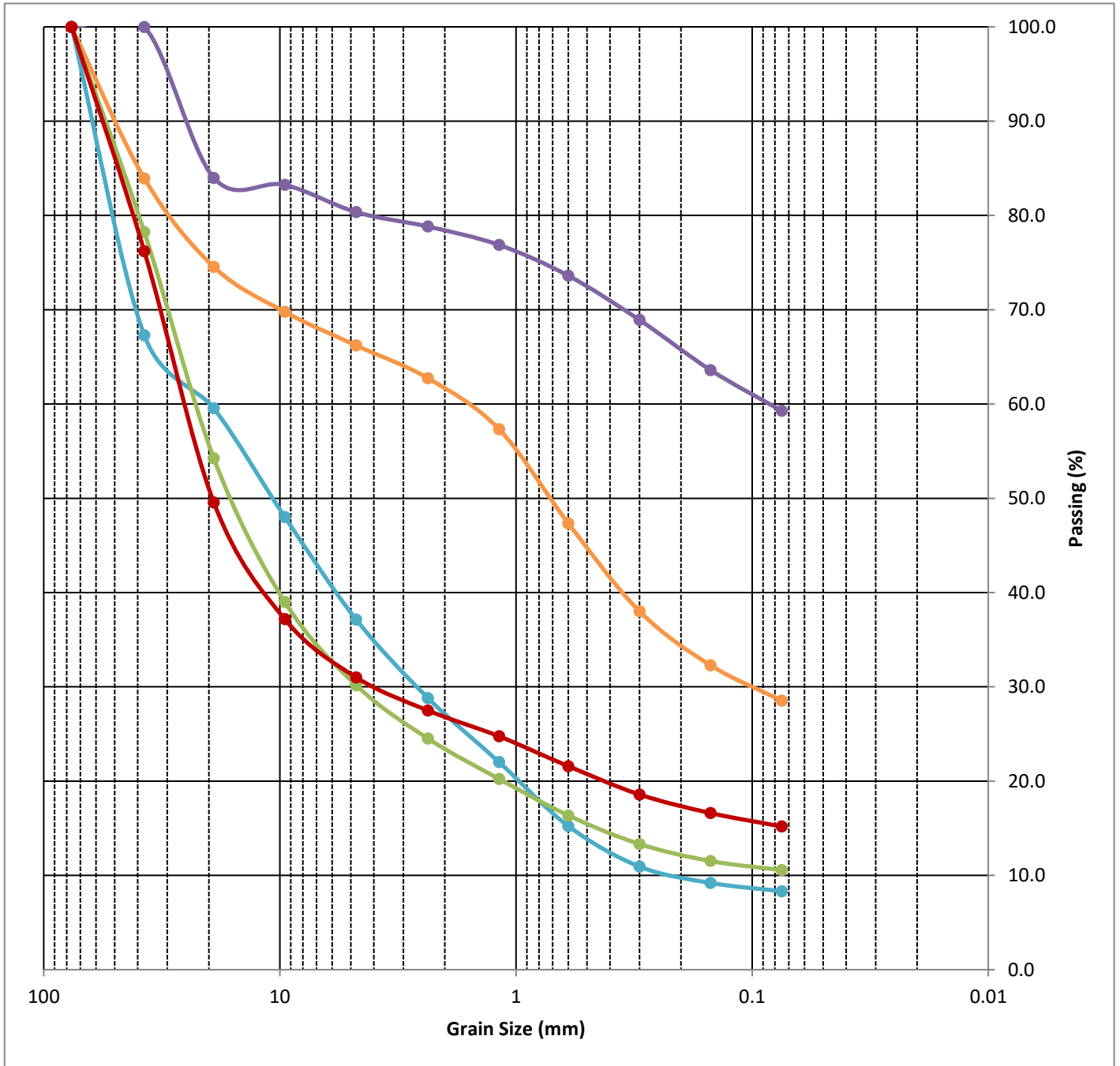
# Atterberg Limits




Location	Depth (ft)		Classification	Liquid Limit	PI
TP-4	4	●	Sandy Lean CLAY with gravel	43	24

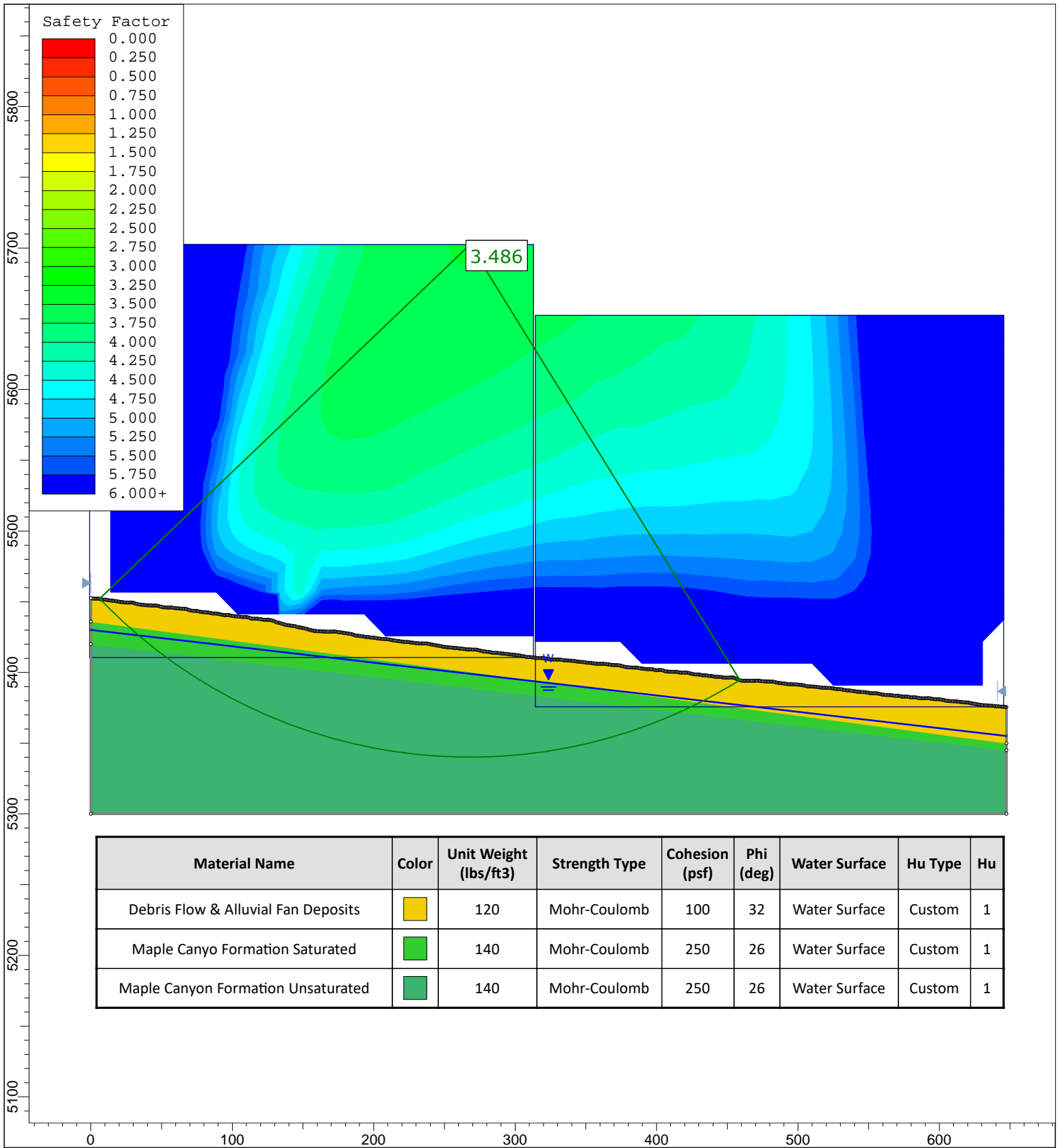
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# Grain Size Distribution



Location	Depth		Classification	% Gravel	% Sand	% Silt and Clay
TP-1	6	●	Poorly Graded GRAVEL with clay & sand	62.9	28.8	8.3
TP-2	3	●	Clayey GRAVEL with sand	33.8	37.7	28.5
TP-3	3	●	Poorly Graded GRAVEL with clay & sand	69.8	19.6	10.6
TP-4	4	●	Sandy Lean CLAY with gravel	19.7	21.1	59.3
TP-5	6	●	Clayey GRAVEL with sand	69.0	15.8	15.2

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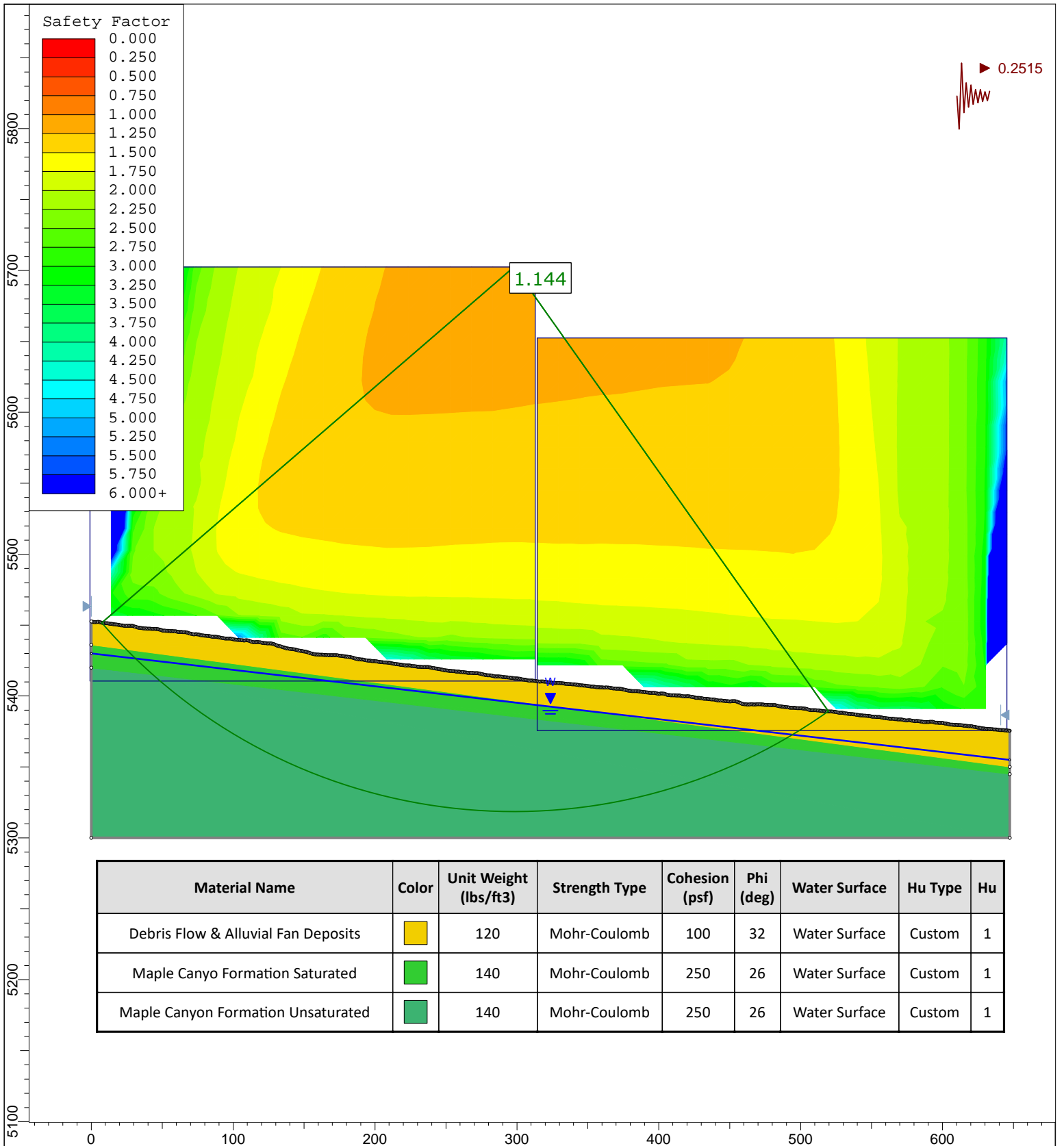


### Global Stability - Static



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Plate  
**11**



### Global Stability - Pseudo Static



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Plate  
**12**