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Geotechnical Investigation
Halcyon Lake Estates
Weber County, Utah

GeoStrata Job No. 1459-001

June 5, 2019

Prepared for:

312 Holdings, LLC
Attention: Mr. Tylor Brenchley, and Mr. Keith Ward

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APPENDICES

1.0 EXECUTIVE SUMMARY

This report presents the results of a geotechnical investigation conducted for the proposed Halcyon Lake Estates residential development to be constructed at approximately 4150 West 1800 South in West Haven, Utah. The purposes of this investigation were to assess the nature and engineering properties of the subsurface soils at the site and to provide recommendations for the design and construction of foundations, cut slopes and construction of a ski lake improvement.

Based on the subsurface conditions encountered at the site, it is our opinion that the subject site is suitable for construction of the proposed residential structures provided that the recommendations contained in this report are complied with. However, construction of the proposed ski lake improvement may be cost prohibitive due to several challenges posed by the subsurface conditions at the site.

As a part of this investigation, subsurface soil conditions were explored by completing six boreholes to depths ranging from 21½ to 26½ feet below the existing site grade. Based on our field observations, the site is overlain by 1½ feet of topsoil, composed of fine-grained soils. Underlying the topsoil, we encountered deposits that are mapped as consisting of Holocene-age deltaic deposits composed of sand, silt and clay (Sack, 2005). Groundwater was measured to be at approximately 4 to 5 feet below the existing site grade.

The foundations for the proposed structures may consist of conventional strip and/or spread footings founded on a minimum of 12 inches of properly placed and compacted structural fill. Strip and spread footings should be a minimum of 18 and 36 inches wide, respectively, and exterior shallow footings should be embedded at least 30 inches below final grade for frost protection and confinement. Conventional strip and spread footings founded on undisturbed, native soils may be proportioned for a maximum net allowable bearing capacity of **1,700 psf**.

A laboratory-obtained CBR of 3.3 for near-surface soils was utilized in the pavement design. Based on assumed traffic loads, a pavement section of 3 inches of asphalt over 6 inches of untreated base course over 10 inches of granular borrow is recommended. As an alternative, 3 inches of asphalt over 16 inches of untreated base course could be used.

Recommendations for general site grading, design of foundations, slabs-on-grade, moisture protection, as well as other aspects of construction are included in this report.

NOTE: The scope of services provided within this report are limited to the assessment of the subsurface conditions at the subject site. The executive summary is provided solely for purposes of overview and is not intended to replace the report of which it is part and should not be used separately from the report.

2.0 INTRODUCTION

2.1 PURPOSE AND SCOPE OF WORK

This report presents the results of a geotechnical investigation conducted for the proposed Halcyon Lake Estates development to be constructed at approximately 4150 West 1800 South in West Haven, Utah (see Plate A-1, *Site Vicinity Map*). Based on our understanding of the project, we understand that the project involves a residential development with associated roads and utilities and the construction of a man-made water skiing lake oriented north-south across the development. The purposes of this investigation were to assess the nature and engineering properties of the subsurface soils at the site and to provide recommendations for the design and construction of foundations, cut slopes and construction of the ski lake improvement.

The scope of work completed for this study included a site reconnaissance, subsurface exploration, soil sampling, engineering analyses, and preparation of this report. Our services were performed in accordance with our proposal and your signed authorization dated January 14, 2019.

The recommendations contained in this report are subject to the limitations presented in the "Limitations" section of this report (Section 7.1).

2.1 PROJECT DESCRIPTION

The subject property is located in Weber County, Utah at approximately 4150 West 1800 South in West Haven, Utah (see Plate A-1, *Site Vicinity Map* and Plate A-2, *Exploration Location Map*). Information concerning the nature of the project was provided by the Client as well as in a Preliminary Plat Map of the development prepared by WRB Consulting Services and dated March 29, 2019. Based on this information, we understand that the development will be approximately 47 acres in size and will consist of 28 residential lots and a man-made ski lake which is approximately 2032 feet in length and 263 feet wide with rounded ends. The depth of the lake will be approximately 12 feet deep (16-18 feet below existing site grade).

3.0 METHOD OF STUDY

3.1 FIELD INVESTIGATION

As a part of this investigation, subsurface soil conditions were explored by completing six boreholes to depths ranging from 21½ to 26½ feet below the existing site grade. The approximate locations of the explorations are shown on Plate A-2, *Exploration Location Map* in Appendix A. Exploration points were placed to provide a representative cross section of the subsurface soil conditions. Subsurface soil conditions as encountered in the explorations were logged at the time of our investigation by a staff geotechnical engineer and are presented on the enclosed Borehole Logs, Plates B-1 through B-6 in Appendix B. A *Soils Symbols Description Key* used in the borehole logs is included as Plate B-7.

The boreholes were advanced using a truck-mounted CME-75 drill rig equipped with hollow-stem augers. Soil samples were obtained at regular intervals and/or at noticeable changes in the soil profile. Bulk samples were collected through the use of a 2-inch outside diameter standard split spoon sampler (SPT) (ASTM D1586) and a modified California sampler. Relatively undisturbed samples were collected through the use of Shelby Tubes. All samples were transported to our laboratory to evaluate the engineering properties of the various earth materials observed. The soils were classified according to the Unified Soil Classification System (USCS) by the Geotechnical Engineer. Classifications for the individual soil units are shown on the attached Borehole Logs.

3.2 LABORATORY INVESTIGATION

Representative soil samples were tested in the laboratory to assess the soils' pertinent engineering properties. The following tests were performed for this investigation:

- Percent of Fines by Washing (ASTM D1140)
- Grain Size Distribution Analysis (ASTM D422)
- Atterberg Limits (ASTM D4318)
- In-situ Moisture and Density Test
- 1-D Consolidation Test (ASTM D2435)
- Swell/Collapse Test (ASTM D5333)
- Direct Shear Test (ASTM D3080)

- Consolidated Undrained Triaxial Compression Test (ASTM D4767)
- Laboratory Characteristics of Soil (ASTM D698)
- California Bearing Ratio (CBR) Test (ASTM D1883)

3.3 ENGINEERING ANALYSIS

Engineering analyses were performed using soil data obtained from the laboratory test results and empirical correlations from material density, depositional characteristics and classification. Appropriate factors of safety were applied to the results consistent with industry standards and the accepted standard of care.

4.0 GENERALIZED SITE CONDITIONS

4.1 SURFACE CONDITIONS

At the time of our subsurface investigation, the site of the proposed development largely existed as vacant corn fields or moderately vegetated by grasses and weeds. Evidence of minor site grading was observed largely pertaining to the agricultural use of the land. The surface of the site is relatively flat with several tiers of elevation across the various corn fields that currently exist at the site. The site is bounded on the south by 1800 South, to the east by the DeGiorgio Street community, to the north by an adjacent field and residence, and to the west by additional farm land.

4.2 SUBSURFACE CONDITIONS

As previously discussed, the subsurface soil conditions were explored at the site by advancing six boreholes at representative locations within the subject site. The boreholes extended to depths ranging from 21½ to 26½ feet below existing site grade. The soils encountered in the borehole explorations were visually classified and logged during our field investigation and are included on the Borehole Logs in Appendix B (Plates B-1 through B-6). The subsurface conditions encountered during our investigation are discussed below.

4.2.1 Soils

Based on our field observations and geologic map study, the subject site is overlain by 1½ feet of medium stiff, slightly moist, light brown Silty CLAY topsoil. The soils encountered underlying the topsoil are mapped by the "Geologic Map of the Roy 7.5' Quadrangle" (Sack, 2005) as Early Holocene fine-grained deltaic deposits. The soil units encountered are discussed below.

<u>Early Holocene Fine-Grained Deltaic Deposits [Qd2]</u>: The deposits encountered in our investigation consisted of often rapidly-alternating sand, silt and clay deposits. In general, fine-grained soils persisted to approximately 7 feet below the existing grade. These fine-grained soils consisted of soft to stiff, moist to wet, tan brown to dark gray Lean CLAY (CL), Lean CLAY (CL) with sand, SILT (ML) and Sandy SILT (ML). Sand deposits were encountered at depths ranging from 13 to 21 feet below existing grade. The sand deposits consisted of very loose to medium dense, wet, light brown to dark gray Poorly Graded SAND (SP), Poorly Graded SAND (SP-SM) with silt, and Clayey SAND (SC). It was noted that sandy seams persisted to depths

ranging from 15 to 21½ feet before grading back into fine-grained deposits. These fine-grained deposits persisted to the full depth of our explorations (26½ feet).

4.2.2 Groundwater

Groundwater was encountered in all six boreholes advanced as part of this investigation at a depth of approximately 4 feet below site grade as it existed at the time of our field investigation. A 2-inch PVC pipe was installed in borehole B-3 and measured several days after drilling was completed and groundwater was encountered at 4ft – 11in. Seasonal fluctuations in precipitation, surface runoff from adjacent properties, or other on or off-site sources may increase moisture conditions. Site conditions may require that the contractor install dewatering systems for any excavations extending to depths greater than 4½ feet or possibly shallower depending on the time of year.

Based on our understanding of the project, the man-made lake will be excavated to a depth of approximately 16 to 18 feet below the existing site grade. This depth results in the water level of the lake being at approximately current groundwater levels (4 to 5 feet below existing site grade). According to information provided by the client, the lake will be maintained at the same level and as such do not anticipate the ski lake to have any effect on local and nearby groundwater levels.

4.2.3 Moisture Sensitive Soils

Collapse (often referred to as "hydro-collapse") is a phenomena whereby undisturbed soils exhibit volumetric strain and consolidation upon wetting under increased loading conditions. Collapsible soils can cause differential settling of structures and roadways. Collapsible soils do not necessarily preclude development and can be mitigated by over-excavating porous, potentially collapsible soils and replacing with engineered fill and by controlling surface drainage and runoff. For some structures that are particularly sensitive to differential settlement, or in areas where collapsible soils are identified at great depth, a deep foundation system should be considered.

Soils that have a potential to collapse under increased loading and moisture conditions are typically characterized by a pinhole structure and relatively low unit weights. In general, potentially collapsible soils are observed in fine-grained soils that include clay and silt, although collapsible soils may include sandy soils. Results of our laboratory testing indicated that the subsurface soils have a low collapse potential, with the collapse potential ranging from -0.08 to 0.29 percent.

4.2.3 Strength of Earth Materials

A direct shear test was performed on a relatively "undisturbed" sample obtained from borehole B-1 at a depth of 10 feet that classifies as a Poorly Graded SAND (SP). The test indicated that the sample tested had a cohesion of 40 psf and an internal angle of friction (phi) of 40 degrees (peak strength ≈ ultimate strength). A summary of the test results are presented on Plate C-11.

In addition to the testing described above, a consolidated undrained triaxial test was completed on a relatively "undisturbed" sample obtained from borehole B-1 at a depth of 20 feet that classifies as a Lean CLAY (CL). The test indicated that the sample tested has an effective cohesion of 120 psf and an effective internal angle of friction (phi) of 33 degrees. The total stress conditions indicate an effective cohesion of 220 psf and an internal angle of friction of 25 degrees. Results of our testing may be found on Plates C-12 and C-13 in Appendix C.

Addtionally, vane shear testing and pocket penetrometer testing was completed on relatively undisturbed samples obtained during exploration. Results of this testing can be found in the table below.

Boring No.	Sample Depth (ft)	Vane Shear Strength (psf)	Pocket Pen Shear Strength (psf)
B-1	5	1070	
B-1	20		500
B-2	25	530	
B-3	2.5	500	
B-3	7.5	230	
B-4	5	950	
B-4	10	400	
B-5	7.5		750
B-5	20	1130	

5.0 GEOLOGIC CONDITIONS

5.1 GEOLOGIC SETTING

The site is located in Weber County, Utah at an elevation of 4,240 feet above mean sea level within the northwestern portion of the Salt Lake Basin. The Salt Lake basin is a deep, sediment-filled structural basin of Cenozoic age flanked by the Wasatch Range and Wellsville Mountains to the east and the Promontory Mountains, the Spring Hills, and the West Hills to the west (Hintze, 1980). The southern portion of the Salt Lake Basin is bordered on the west by the east shore of the Great Salt Lake. The Wasatch Range is the easternmost expression of pronounced Basin and Range extension in north-central Utah.

The near-surface geology of the Salt Lake Basin is dominated by sediments, which were deposited within the last 30,000 years due to regression of the Great Salt Lake, formerly Lake Bonneville (Scott and others, 1983; Hintze, 1993). As the lake receded, streams began to incise large deltas that had formed at the mouths of major canyons along the Wasatch Range, and the eroded material was deposited in shallow lakes and marshes in the basin and in a series of recessional deltas and alluvial fans. Sediments toward the center of the valley are predominately deep-water deposits of clay, silt and fine sand. However, these deep-water deposits are in places covered by a thin post-Bonneville alluvial cover. Surface sediments are mapped at the site as consisting of Early Holocene fine-grained deltaic deposits (Sack, 2005).

5.2 SEISMICITY AND FAULTING

The site is located east of the Great Salt Lake and west of the Wasatch Mountain Range. The Weber segment of the Wasatch fault zone is mapped approximately 8 miles east of the subject site along the toe of the steeply west dipping range front. The Weber segment of the Wasatch fault is thought to have most recently experienced a seismic event during the Quaternary Period, and there is evidence that as many as 10 to 15 events have occurred along this segment in the last 15,000 years (Hecker, 1993). A location near Kaysville, Utah indicated that the Weber Segment has a measureable offset of 1.4 to 3.4 meters per event (McCalpin and others, 1994). The Weber Segment may be capable of producing earthquakes as large as magnitude 7.5 (Ms) and has a recurrence interval of approximately 1,200 years. The southern terminus of the Weber Segment occurs at the Salt Lake Salient, a ridge of Paleozoic and Tertiary bedrock that extends west of the Wasatch Front at the northern end of the Salt Lake rupture segment. The geometry of linkage between the main rupture zones in the Weber segment and faults in the interior of the Salt Lake salient is not clear. Surface scarps at the southern margin of the salient are discontinuous but apparently extend into the large normal fault along the eastern boundary of the segment. There is no reported evidence for Quaternary movement on this fault in the interior of the salient, so presumably the Quaternary ruptures have not reactivated most of this fault. The Pleasant View Salient marks the boundary between the Weber Segment and the Brigham City Segment to the north (Personius, 1986).

The site is also located approximately 24 miles east of the East Great Salt Lake fault zone (Hecker, 1993). Evidence suggests that this fault zone has been active during Holocene times (0 to 10,000 years) and has segment lengths comparable to that of the Wasatch fault zone, indicating that it is capable of producing earthquakes of a comparable magnitude (7.5 Ms).

Analysis of the ground shaking hazard along the Wasatch Front suggests that the Wasatch Fault Zone is the single greatest contributor to the seismic hazard in the Salt Lake City region. Each of the faults listed above show evidence of Holocene-aged movement and is therefore considered active.

Seismic hazard maps depicting probabilistic ground motions and spectral response have been developed for the United States by the U.S. Geological Survey as part of NEHRP/NSHMP (Frankel et al, 1996). These maps have been incorporated into both *NEHRP Recommended Provisions for Seismic Regulations for New Buildings and Other Structures* (FEMA, 1997) and the *International Building Code* (IBC) (International Code Council, 2015). Spectral responses for the Maximum Considered Earthquake (MCE) are shown in the table below. These values generally correspond to a two percent probability of exceedance in 50 years (2PE50) for a “firm rock” site. To account for site effects, site coefficients which vary with the magnitude of spectral acceleration are used. Based on our field exploration, it is our opinion that this location is best described as a Site Class E. The spectral accelerations are shown in the table below. The spectral accelerations are calculated based on the site’s approximate latitude and longitude of 41.2371˚ and -112.0791˚ respectively. Based on IBC, the site coefficients are F_a=0.9 and F_v= 2.4. From this procedure the peak ground acceleration (PGA) is estimated to be 0.49g.

MCE_R Seismic Response Spectrum Spectral Acceleration Values for IBC Site Class E[a]

Site Location: **Latitude = 40.4683°N** **Longitude = -111.9127˚ W**	**Site Class E Site Coefficients:** **Fa = 0.90** **Fv = 2.40**
Spectral Period (sec)	**Response Spectrum Spectral Acceleration (g)**
0.2	$\mathbf{S_{MS}}=(F_a*S_s=0.90*1.23) = 2.16$
1.0	$\mathbf{S_{M1}}=(F_v*S_1=2.40*0.41) = 0.98$
a IBC 1613.3.4 recommends scaling the MCE values by 2/3 to obtain the design spectral response acceleration values; values reported in the table above have not been reduced.	

5.3 LIQUEFACTION

Certain areas within the Intermountain region possess a potential for liquefaction during seismic events. Liquefaction is a phenomenon whereby loose, saturated, granular soil deposits lose a significant portion of their shear strength due to excess pore water pressure buildup resulting from dynamic loading, such as that caused by an earthquake. Among other effects, liquefaction can result in densification of such deposits causing settlements of overlying layers after an earthquake as excess pore water pressures are dissipated. The primary factors affecting liquefaction potential of a soil deposit are: (1) level and duration of seismic ground motions; (2) soil type and consistency; and (3) depth to groundwater.

Referring to the map titled "*Liquefaction Special Study Areas, Wasatch Front and Nearby Areas, Utah*" compiled by Gary E. Christensen and Lucas M. Shaw and published by the Utah Geologic Survey, the subject site is located within an area currently designated as "high" for liquefaction potential. "High" liquefaction potential means that there is a 50% probability of having an earthquake within a 100-year period that will be strong enough to cause liquefaction. Furthermore, sandy soils and shallow groundwater were encountered during our subsurface exploration. While a liquefaction potential analysis was outside of the scope of our project, soils that would be considered susceptible to liquefaction were observed within the upper 20 feet of the subject property.

5.4 LATERAL SPREADING

Areas that are subject to liquefaction may also be susceptible to lateral spreading. Lateral spreading occurs as lateral movement in a fractured rock or soil, which results from liquefaction or plastic flow of subjacent materials or from lateral sliding of rock or soils on a gently inclined planar surface, such as a bedding plane or a liquefied sand layer. While lateral spreading may be more prevalent when liquefied, such a state is not necessary and lateral spreading can occur solely due to the increased horizontal forces brought about by ground shaking.

Based on mapping completed by Bartlett and others (2014) for Lateral Spread Displacement Hazards in Weber County, Utah, the site has a 0 to 15% chance of exceeding 0.3 meters of deformation when considering the mean probability of exceedance during a 500-year event. This probability increases to 50 to 75% chance of exceeding 0.3 meters when considering a 2,500 year event. As such, it is considered likely that the site will experience lateral spreading during a maximum credible event. Lateral spread generally occurs in areas of open faces, such open faces would be created by the lake excavation, it is therefore probable that lateral spread could occur on the excavated lake slopes.

6.0 ENGINEERING ANALYSIS AND RECOMMENDATIONS

6.1 GENERAL CONCLUSIONS

Supporting data upon which the following recommendations are based have been presented in the previous sections of this report. The recommendations presented herein are governed by the physical properties of the earth materials encountered as part of our subsurface exploration and the anticipated design data discussed in Section 0, Project Description. If subsurface conditions other than those described herein are encountered in conjunction with construction, and/or if design and layout changes are initiated, GeoStrata must be informed so that our recommendations can be reviewed and revised as changes or conditions may require.

Based on the subsurface conditions encountered at the site, it is our opinion that the subject site is suitable for the proposed development provided that the recommendations contained in this report are incorporated into the design and construction of the project.

The following sub-sections present our recommendations for general site grading, excavation, temporary cut stability, lake construction, foundations and moisture protection.

6.2 EARTHWORK

Prior to the placement of foundations, general site grading is recommended to provide proper support for foundations, exterior concrete flatwork, and concrete slabs-on-grade. Site grading is also recommended to provide proper drainage away from the foundation and moisture control on the subject property and to aid in preventing differential movement in foundation materials as a result of variations in subgrade moisture conditions.

6.2.1 General Site Preparation and Grading

Within areas to be graded (below proposed structures, fill sections, concrete flatwork, or pavement sections), any existing vegetation, debris, topsoil, undocumented fill, or otherwise unsuitable soils should be removed. Any soft, loose, or disturbed soils should also be removed. Following the removal of vegetation, unsuitable soils, and loose or disturbed soils, as described above, site grading may be conducted to bring the site to design elevations.

Based on our observations in the boreholes advanced for the site investigation, there is approximately 1½ to 2 feet of topsoil overlying the subject site. This material should be removed prior to placement of structural fill, structures, concrete flatwork and roadways. If over-excavation is required, the excavation should extend a minimum of one foot laterally for every foot of depth of over-excavation. Excavations should extend laterally at least two feet beyond flatwork, pavements, and slabs-on-grade. If materials are encountered that are not represented in the borehole logs or may present a concern, GeoStrata should be notified so observations and further recommendations as required can be made.

A GeoStrata representative should observe the site preparation and grading operations to assess that the recommendations presented in this report are complied with.

6.2.2 Soft Soil Stabilization

Soft or pumping soils may be exposed in excavations at the site. Once exposed, all subgrade surfaces beneath proposed structure, pavements, and flat work concrete should be proof rolled with a piece of heavy wheeled-construction equipment. If soft or pumping soils are encountered, these soils should be stabilized prior to construction of footings. Stabilization of the subgrade soils can be accomplished using a clean, coarse angular material worked into the soft subgrade. We recommend the material be greater than 2-inch diameter, but less than 6 inches. A locally available pit-run gravel may be suitable but should contain a high percentage of particles larger than 2 inches and have less than 7 percent fines (material passing the No. 200 sieve). A pit-run gravel may not be as effective as a coarse, angular material in stabilizing the soft soils and may require more material and greater effort. The stabilization material should be worked (pushed) into the soft subgrade soils until a firm relatively unyielding surface is established. Once a firm, relatively unyielding surface is achieved, the area may be brought to final design grade using structural fill.

In large areas of soft subgrade soils, stabilization of the subgrade may not be practical using the method outlined above. In these areas it may be more economical to place a woven geotextile fabric against the soft soils covered by 18 inches of coarse, sub-angular to angular material over the woven geotextile. An inexpensive non-woven geotextile “filter” fabric should also be placed over the top of the coarse, sub-angular to angular fill prior to placing structural fill or pavement section soils to reduce infiltration of fines from above. The woven geotextile should be Mirafi RS280i or a proposed alternative approved by GeoStrata. The filter fabric should consist of a Mirafi 140N, or equivalent as approved by the Geotechnical Engineer.

6.2.3 Excavation Stability

Based on Occupational Safety and Health Administration (OSHA) guidelines for excavation safety, trenches with vertical walls up to 5 feet in depth may be occupied, however, the presence of fill soils, loose soils, or wet soils may require that the walls be flattened to maintain safe working conditions. When the trench is deeper than 5 feet, we recommend a trench-shield or shoring be used as a protective system to workers in the trench. Based on our soil observations, laboratory testing, and OSHA guidelines, native soils at the site classify as Type C soils. Due to the near-surface moisture conditions, the contractor should anticipate the use of trench boxes or shields or other shoring as sluffing of excavation sidewalls is considered likely. The contractor is ultimately responsible for trench and site safety. Pertinent OSHA requirements should be met to provide a safe work environment. If site specific conditions arise that require engineering analysis in accordance with OSHA regulations, GeoStrata can respond and provide recommendations as needed.

We recommend that a GeoStrata representative be on-site during all excavations to assess the exposed foundation soils. We also recommend that the Geotechnical Engineer be allowed to review the grading plans when they are prepared in order to evaluate their compatibility with these recommendations.

6.2.4 Slope Stability Analysis – Lake Feature

As mentioned previously, a lake is proposed to be excavated to a depth of approximately 16 to 18 feet below the existing site grade. We assumed an 18 foot excavation to model the temporary cut slope using Slide, a computer program incorporating (among others) Bishop's Simplified Method of analysis. Calculations for stability were developed by searching for the minimum factor of safety for a circular-type failure. Homogeneous earth materials and arcuate failure surfaces were assumed.

Strength parameters used in our analyses were developed based on our laboratory testing, observations of the exposed soils, experience, and engineering judgment. Strength testing was completed on the sands and has been presented in the laboratory testing section of this report (Appendix C). We consider our laboratory direct shear value to be quite high compared to strengths of similar soils and published data. In order to account for variations within the subgrade conditions, our friction angle and cohesion values for the sandy layers has been reduced. The soil strength used in our analysis is presented in the following table;

Soil Type	Friction Angle (ϕ)	Cohesion (psf)
Poorly Graded SAND (SP)	34	0

Strength testing was completed on the clayey soils and has been presented in the laboratory testing section of this report (Appendix C). The effective stress soil strength parameters used in our analysis for these soils is presented in the following table;

Soil Type	Friction Angle (ϕ)	Cohesion (psf)
Lean CLAY (CL)	33	120

The total stress soil strength parameters used in our analysis for these soils is presented in the following table;

Soil Type	Friction Angle (ϕ)	Cohesion (psf)
Lean CLAY (CL)	25	220

Seismic conditions were modeled by application of a horizontal seismic acceleration of 0.25g to the slope stability model. This value is based on an industry standard of practice 50% reduction of the PGA value described in Section 5.2 of this report.

Groundwater was encountered during our investigation and was included in our modeling at a depth of approximately 4 feet below existing site grade.

The modeled geometry of the slope as well as the anticipated residence location was based on information obtained from the client. Based on this information, we modeled the critical state (maximum cut height of 18 feet) although the recommendations made within are applicable for slopes of lesser heights. Results of our stability analysis for temporary slopes are included in Appendix D (Plate D-1).

Results of our slope stability modeling as described above, indicate that the final banks of the lake should be graded at an approximate 3H:1V slope. Results of our slope stability indicate that the resulting 3H:1V slope will have a factor of safety of 1.8 for static conditions and 1.1 for seismic conditions. These slopes meet the industry standard of care (1.5 and 1.0 for static and seismic conditions, respectively).

It should be noted that while the global stability of the slopes modeled above indicate acceptable factors of safety, stability of the exposed soils, particularly the Poorly Graded SAND (SP) soils will likely present additional constructability challenges, particularly if the lake is to be excavated without a dewatering plan (wet excavation). Hydrostatic pressures present in the sandy soils will likely cause these layers heave and spread laterally when exposed in a slope. It will likely be necessary to cover the exposed slope with relatively large (18-inch) diameter, angular boulders as soon as these soils are exposed. Additional discussions concerning the constructability of the lake are provided in the following sections.

6.2.5 Structural Fill and Compaction

All fill placed for the support of structures, flatwork or pavements should consist of structural fill. Due to potential organic content of the fine-grained soils, it is not recommended that the fine-grained soils be used as structural fill for the development. These soils should be stockpiled and be utilized in landscaped areas as necessary. On-site native sandy soils may be utilized as structural fill when compacted as described below.

Imported and locally-sourced structural fill should consist a relatively well-graded granular soil with a maximum of 50 percent passing the No. 4 sieve and a maximum fines content (minus No.200 mesh sieve) of 25 percent. Fill material potion finer than the No. 40 sieve should have a liquid limit (LL) less than 35 and a plasticity index (PI) less than 25.

Grain Size	**Percent Passing**
4-inch	100
2-inch	85 to 100
No. 4	15 to 50
No. 200	< 25
Liquid Limit (LL)	<35
Plasticity Index (PI)	<25

All structural fill should be free of vegetation, debris or frozen material, and should contain no inert materials larger than 4 inches in nominal diameter. All structural fill soils should be approved by the Geotechnical Engineer prior to placement. Earth materials not meeting the aforementioned criteria may be suitable for use as structural fill; however, such material should be evaluated on a case-by-case basis and should be approved by the Geotechnical Engineer prior to use. These requirements for structural fill meet the needs of the site; however, regulating entities including special service districts, cities, counties etc. may require the use of a predefined structural fill for use in their utility corridors/trenches. The contractor should be aware of the special requirements of structural fill by these regulating entities.

All structural fill should be placed in maximum 6-inch loose lifts if compacted by small hand-operated compaction equipment, maximum 8-inch loose lifts if compacted by light-duty rollers, and maximum 10-inch loose lifts if compacted by heavy duty compaction equipment that is capable of efficiently compacting the entire thickness of the lift. We recommend that all structural fill be compacted on a horizontal plane, unless otherwise approved by the geotechnical engineer. Structural fill should be compacted to at least 95% of the maximum dry density, as determined by ASTM D1557. The required compaction should be increased to 98% for fills greater than 5 feet in thickness. The moisture content should be at or slightly above the optimum moisture content at the time of placement and compaction. Also, prior to placing any fill, the excavations should be observed by the geotechnical engineer to observe that any unsuitable materials or loose soils have been removed. In addition, proper grading should precede placement of fill, as described in the **General Site Preparation and Grading** subsection of this report (Section 0).

Fill soils placed for subgrade below exterior flat work and pavements, should be within 3% of the optimum moisture content when placed and compacted to at least 95% of the maximum dry density as determined by ASTM D1557. All utility trenches backfilled below the proposed structure, pavements, and flatwork concrete, should be backfilled with structural fill that is within 3% of the optimum moisture content when placed and compacted to at least 95% of the maximum dry density as determined by ASTM D1557. All other trenches, in landscape areas, should be backfilled and compacted to at least 90% of the maximum dry density (ASTM D1557).

The gradation, placement, moisture, and compaction recommendations contained in this section meet our minimum requirements but may not meet the requirements of other governing agencies such as city, county, or state entities. If their requirements exceed our recommendations, their specifications should override those presented in this report.

6.3 FOUNDATIONS

The foundations for the proposed structures may consist of conventional strip and/or spread footings. Strip and spread footings should be a minimum of 18 and 36 inches wide, respectively, and exterior shallow footings should be embedded at least 30 inches below final grade for frost protection and confinement. Interior shallow footings not susceptible to frost conditions should be embedded at least 18 inches for confinement.

Due to the presence of near-surface groundwater conditions, we recommend that all top of slab elevations be maintained a minimum of 36 inches above the groundwater elevation unless a foundation drain is incorporated into the design of the project. Additional discussions concerning the construction of the drains may be found in Section 6.7 of this report.

6.3.1 Installation and Bearing Material

Footings may be placed entirely on a minimum of 12 inches of structural fill which is bearing on undisturbed native soils. Foundation elements should not be founded on organic-rich topsoil which was observed to extend to a depth of 12 inches across the subject site. If these soils are encountered they should be over-excavated until suitable, native soils are exposed. The site may then be brought back up to design grade using properly placed and compacted structural fill. Structural fill should meet material recommendations and be placed and compacted as recommended in Section 6.2.5.

Soft or pumping soils may be exposed in foundation excavations due to the fine-grained nature of some of the soils observed in our borings. Where soft or pumping soils are exposed, prior to placement of foundations, the soft or pumping soils should be stabilized as recommended in Section 6.2.2 of this report.

All organic material, soft areas, frozen material or other inappropriate material shall be removed from the footing zone to a depth determined by the Geotechnical Engineer and be replaced with structural fill where over excavation is required.

6.3.2 Bearing Pressure

Conventional strip and spread footings founded entirely on a minimum of 12 inches of properly placed and compacted structural fill extending down to undisturbed native soils may be proportioned for a maximum net allowable bearing capacity of **1,500 pounds per square foot (psf).** The recommended net allowable bearing pressure refers to the total dead load and can be increased by 1/3 to include the sum of all loads including wind and seismic.

6.3.3 Frost Depth

All exterior footings are to be constructed at least 30 inches below the ground surface for frost protection and confinement. This includes walk-out areas and may require fill to be placed around buildings. Interior footings not susceptible to frost conditions should be embedded at least 18 inches for confinement. If foundations are constructed through the winter months, all soils on which footings will bear shall be protected from freezing.

6.3.4 Construction Observation

A geotechnical engineer shall periodically monitor excavations prior to installation of footings. Inspection of soil before placement of structural fill or concrete is required to detect any field conditions not encountered in the investigation which would alter the recommendations of this report. All structural fill material shall be tested under the direction of a geotechnical engineer for material and compaction requirements.

6.4 CONCRETE SLAB-ON-GRADE CONSTRUCTION

Concrete slabs-on-grade should be constructed over at least 4 inches of compacted gravel overlying native soils or a zone of structural fill that is at least 12 inches thick. Disturbed native soils should be compacted to at least 95% of the maximum dry density as determined by ASTM D1557 (modified proctor) prior to placement of gravel. The gravel should consist of road base or clean drain rock with a ¾-inch maximum particle size and no more than 12 percent fines passing the No. 200 mesh sieve. The gravel layer should be compacted to at least 95 percent of the maximum dry density of modified proctor or until tight and relatively unyielding if the material is non-proctorable. All concrete slabs should be designed to minimize cracking as a result of shrinkage. Consideration should be given to reinforcing the slab with welded wire, re-bar, or fiber mesh.

6.5 MAN-MADE LAKE RECOMMENDATIONS

As presented earlier in the report, the proposed man-made ski lake feature is to be approximately 16 to 18 feet in depth, with the final water level of the lake existing at approximately the same elevation as the existing groundwater. Construction options include dewatering the lake area or excavating in wet conditions. Both options pose constructability challenges.

6.5.1 Dewatering Lake Area – Separation Liner or Clay Liner

Excavation of the lake can be attempted utilizing a dewatering system used to temporarily draw the existing groundwater table down to an elevation below the bottom of the lake. In order to complete the excavation in dry conditions, we anticipate having to install sheet piles limit the flow of groundwater into the excavation site. The advantages of this technique includes additional stability of the banks of the lake for proper grade establishment as well as dry conditions at the lake bottom for the construction of the lake infrastructure. Although the dewatering effort will reduce the moisture conditions of the excavated slopes, it will still likely be very difficult to safely excavate the sandy material encountered in our boreholes from a depth ranging from 13 to 21 feet below the existing site grade while these soils are saturated. As a result, it may not be feasible to grade the lake bed to a 3H:1V slope when the soils are saturated as recommended in Section 6.2.4 of this report.

The disadvantages of dewatering the site is that the project will require a large scale dewatering plan with numerous well points located along both sides of the proposed lake. Due to the sandy soils encountered at depth, it is likely that a large amount of water will need to be pumped from each well point in order to achieve the desired drop in groundwater elevation. In addition, once the water is removed from the dewatering wells, it will need to be discharged into an approved location that will convey the water off-site so that it will not infiltrate back into the excavation. Challenges for excavated the lake in dry conditions could be cost prohibitive.

Should grading of the bank be possible while the lake bed is dewatered, two options are available for lining the lake. The first would be to install a permeable liner with a woven geotextile purposed for filtration, such as Mirafi FW404, or other approved separation method. This geotextile would provide erosion protection and separation. After installation of the separation method and any necessary gravel and/or rip-rap, the lake will naturally rise to groundwater levels or can be filled with pumped groundwater or irrigation water. However, because this method involves use of a permeable layer at the base of the lake mitigating erosion of the banks, the permanent water level of the lake will approximately correlate to the native groundwater level. This level should be expected to fluctuate throughout the seasons of the years and may vary year-to-year. Any additional water added will infiltrate until the lake is again near groundwater levels.

The second option to line the bottom of the lake would be to use a High Density Polyethylene (HDPE) liner or a layer of high-plasticity low-permeability clay, or a combination of the two. This method of lake construction essentially isolates the lake from the groundwater conditions.

Due to near-surface groundwater levels, the lake will need to be filled with pumped groundwater re-directed into the lake from the dewatering operation at least to the existing groundwater level prior to removal of the dewatering system. Due to hydrostatic pressures (buoyant forces), should the water level in the lake ever be lower than the surrounding groundwater, bank erosion and/or failure of the liner or clay layer could occur.

6.5.2 Construction Without Dewatering

As an alternative, the lake excavation may be attempted without dewatering the site. The advantage of this technique is that no costly dewatering plan will be required. Nor would the excavation require the installation of temporary sheet piles. The disadvantages of this plan are that the sandy soils that will be exposed in the bottom of the lake excavation will be increasingly unstable. Given the relatively clean Poorly Graded SANDs (SP) encountered in our borehole explorations as seen in Appendix B, it is possible that no slope can realistically be retained in the heaving sand layers. Additionally, no liner or separation fabric can be installed by use of this method. The contractor may attempt to stabilize the slope and prevent erosion by dropping riprap and/or gravel into the base of the excavation. This erosion mitigation method may not be as effective and permanent as the options identified in Section 6.5.1. We do not anticipate that this construction method will be feasible.

6.6 EARTH PRESSURE AND LATERAL RESISTANCE

Lateral forces imposed upon conventional foundations due to wind or seismic forces may be resisted by the development of passive earth pressures and friction between the base of the footing and the supporting subgrade.

6.6.1 Imported Granular Backfill Lateral Resistance

In determining the frictional resistance, a coefficient of friction of 0.44 should be used for imported structural fill against concrete.

Ultimate lateral earth pressures from *imported granular* backfill acting against buried walls and structures may be computed from the lateral pressure coefficients or equivalent fluid densities presented in the following table:

Condition	Lateral Pressure Coefficient	Equivalent Fluid Density (pounds per cubic foot)
Active*	0.28	34
At-rest**	0.47	59
Passive*	7.26	907
Seismic Active***	0.62	77
Seismic Passive***	-3.01	-376

* Based on Coulomb's equation

** Based on Jaky

*** Based on Mononobe-Okabe Equation

These coefficients and densities assume level, granular backfill with no buildup of hydrostatic pressures. The force of the water should be added to the presented values if hydrostatic pressures are anticipated. If sloping backfill is present, we recommend the geotechnical engineer be consulted to provide more accurate lateral pressure parameters once the design geometry is established.

6.6.2 Native Backfill Lateral Resistance

In determining the frictional resistance, a coefficient of friction of 0.33 should be used for native soils against concrete.

Ultimate lateral earth pressures from *native* backfill acting against buried walls and structures may be computed from the lateral pressure coefficients or equivalent fluid densities presented in the following table:

Condition	Lateral Pressure Coefficient	Equivalent Fluid Density (pounds per cubic foot)
Active*	0.36	38
At-rest**	0.58	61
Passive*	4.06	426
Seismic Active***	0.92	97
Seismic Passive***	-2.20	-231

* Based on Coulomb's equation

** Based on Jaky

*** Based on Mononobe-Okabe Equation

These coefficients and densities assume level, native backfill similar to soils as presented in our exploration logs in Appendix B with no buildup of hydrostatic pressures. The force of the water should be added to the presented values if hydrostatic pressures are anticipated. If sloping backfill is present, we recommend the geotechnical engineer be consulted to provide more accurate lateral pressure parameters once the design geometry is established.

6.6.3 General Design Recommendations

Walls and structures allowed to rotate slightly should use the active condition. If the element is constrained against rotation, the at-rest condition should be used. These values should be used with an appropriate factor of safety against overturning and sliding. A value of 1.5 is typically used. Additionally, if passive resistance is calculated in conjunction with frictional resistance, the passive resistance should be reduced by ½.

For seismic analyses, the *active* and *passive* earth pressure coefficient provided in the table is based on the Mononobe-Okabe pseudo-static approach and only accounts for the dynamic horizontal thrust produced by ground motion. Hence, the resulting dynamic thrust pressure *should be added* to the static pressure to determine the total pressure on the wall. The pressure distribution of the dynamic horizontal thrust may be closely approximated as an inverted triangle with stress decreasing with depth and the resultant acting at a distance approximately 0.6 times the loaded height of the structure, measured upward from the bottom of the structure.

The coefficients shown assume a vertical wall face. Hydrostatic and surcharge loadings, if any, should be added. Over-compaction behind walls should be avoided. Resisting passive earth pressure from soils subject to frost or heave, or otherwise above prescribed minimum depths of embedment, should usually be neglected in design.

6.7 SUBSURFACE DRAINAGE

As indicated above and in the borehole logs in Appendix B, high moisture contents were measured in soil samples retrieved during the investigation. Groundwater was encountered between 4 and 5-feet below existing site grade. Due to the shallow groundwater and high moisture contents, there is a high risk of water infiltrating subgrade (basement) walls at this site. We therefore recommend construction of foundation drains for all subgrade walls when the foundation depth is within 36 inches of the groundwater level. The foundation drains should consist of a 4-inch diameter perforated pipe placed at or below the footing elevation. The pipe should be covered with at least 12 inches of free-draining gravel (containing less than 5 percent passing the No. 4 sieve) and be graded to a free-gravity out fall or a pumped sump. A separator fabric, such as Mirafi 140N, should separate the free draining gravel and native soil (i.e. the separator fabric should be placed between the gravel and the native soils at the bottom of the gravel, the side of the gravel where the gravel does not lie against the concrete footing or foundation and at the top of the gravel). Consideration should be given to extending the gravel up the foundation wall to within 12 inches of the final ground surface. As an alternative, the gravel extending up the foundation wall may be replaced with a prefabricated drain panel, such as Ecodrain-E.

6.8 MOISTURE PROTECTION AND SURFACE DRAINAGE

Precautions should be taken during and after construction to eliminate saturation of foundation soils. Over-wetting the soils prior to or during construction may result in increased softening and pumping, causing equipment mobility problems and difficulty in achieving compaction.

Moisture should not be allowed to infiltrate the soils in the vicinity of, or upslope from, the structures. We recommend that roof runoff devices be installed to direct all runoff a minimum of 10 feet away from structures. The grade within 10 feet of a structure should be sloped a minimum of 2% away from the structure.

6.9 PAVEMENT SECTION

Based on a laboratory-determined CBR value of 3.3, the near-surface soils are anticipated to provide relatively poor pavement support throughout the proposed pavement area. No traffic information was available at the time this report was prepared, therefore, GeoStrata has assumed traffic counts for community roads and parking areas. We assumed that the vehicle traffic in and out of the development would consist of approximately 200 passenger vehicles/day, 40 pick-up trucks/day, 4 medium-sized trucks/day, and 2 heavy trucks/day. The following pavement design alternatives have been developed for a 20-year design life assuming an annual growth rate of 0% and an estimated single axle load (ESAL) of approximately 48,200 ESALs. Based on the information obtained and the above mentioned assumptions, we recommend that one of the following pavement sections be constructed.

Flexible (Asphalt) Pavement Section – Halcyon Lake Estates

Asphalt Concrete (in.)	Untreated Road Base (in.)	Granular Borrow (in.)
3.0	6	10
3.0	16	0

Asphalt has been assumed to be a high stability plant mix and should be compacted to a minimum density of 96% of the Marshall value. Untreated base course material should be composed of crushed stone with a minimum CBR of 70 and should meet UDOT or Weber County specifications. For design, granular borrow was assumed to have a CBR of at least 30. The base course and granular borrow should be compacted to at least 95% of the maximum dry density of the modified proctor (ASTM D1557).

If traffic conditions vary significantly from our stated assumptions, GeoStrata should be contacted so we can modify our pavement design parameters accordingly. Specifically, if the traffic counts are significantly higher or lower, we should be contacted to revise the pavement section design as necessary. The pavement section thickness above assumes that the majority of the construction traffic including cement trucks, cranes, loaded haulers, etc. has ceased. If a significant volume of construction traffic occurs after the pavement section has been constructed, the owner should anticipate maintenance or a decrease in the design life of the pavement area.

7.0 CLOSURE

7.1 LIMITATIONS

The recommendations contained in this report are based on our limited field exploration, laboratory testing, and understanding of the proposed construction. The subsurface data used in the preparation of this report were obtained from the explorations made 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, GeoStrata should be immediately notified so that we may make any necessary revisions to recommendations contained in this report. In addition, if the scope of the proposed construction changes from that described in this report, GeoStrata 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.

7.2 ADDITIONAL SERVICES

The recommendations made in this report are based on the assumption that an adequate program of tests and observations will be made during construction. GeoStrata staff should be on site to verify compliance with these recommendations. These tests and observations should include, but not necessarily be limited to, the following:

- Observations and testing during site preparation, earthwork and structural fill placement.
- Observation of foundation soils to assess their suitability for footing placement.
- Observation of soft/loose soils over-excavation.
- Observation of temporary excavations and shoring.
- Consultation as may be required during construction.
- Quality control and observation of concrete placement.

We also recommend that project plans and specifications be reviewed by GeoStrata to verify compatibility with our conclusions and recommendations. Additional information concerning the scope and cost of these services can be obtained from our office.

We appreciate the opportunity to be of service on this project. Should you have any questions regarding the report or wish to discuss additional services, please do not hesitate to contact us at your convenience at (801) 501-0583.

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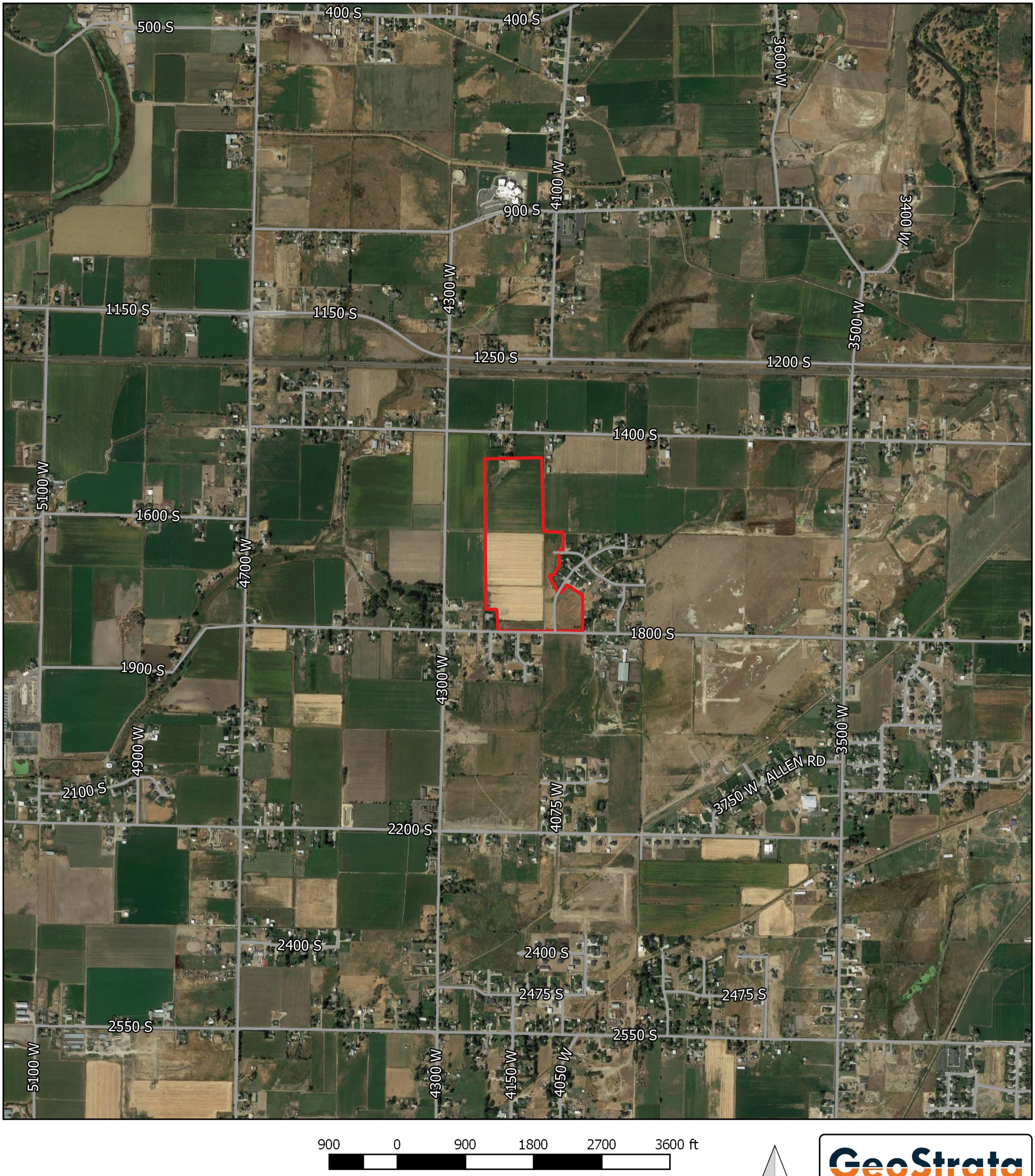
Appendix A



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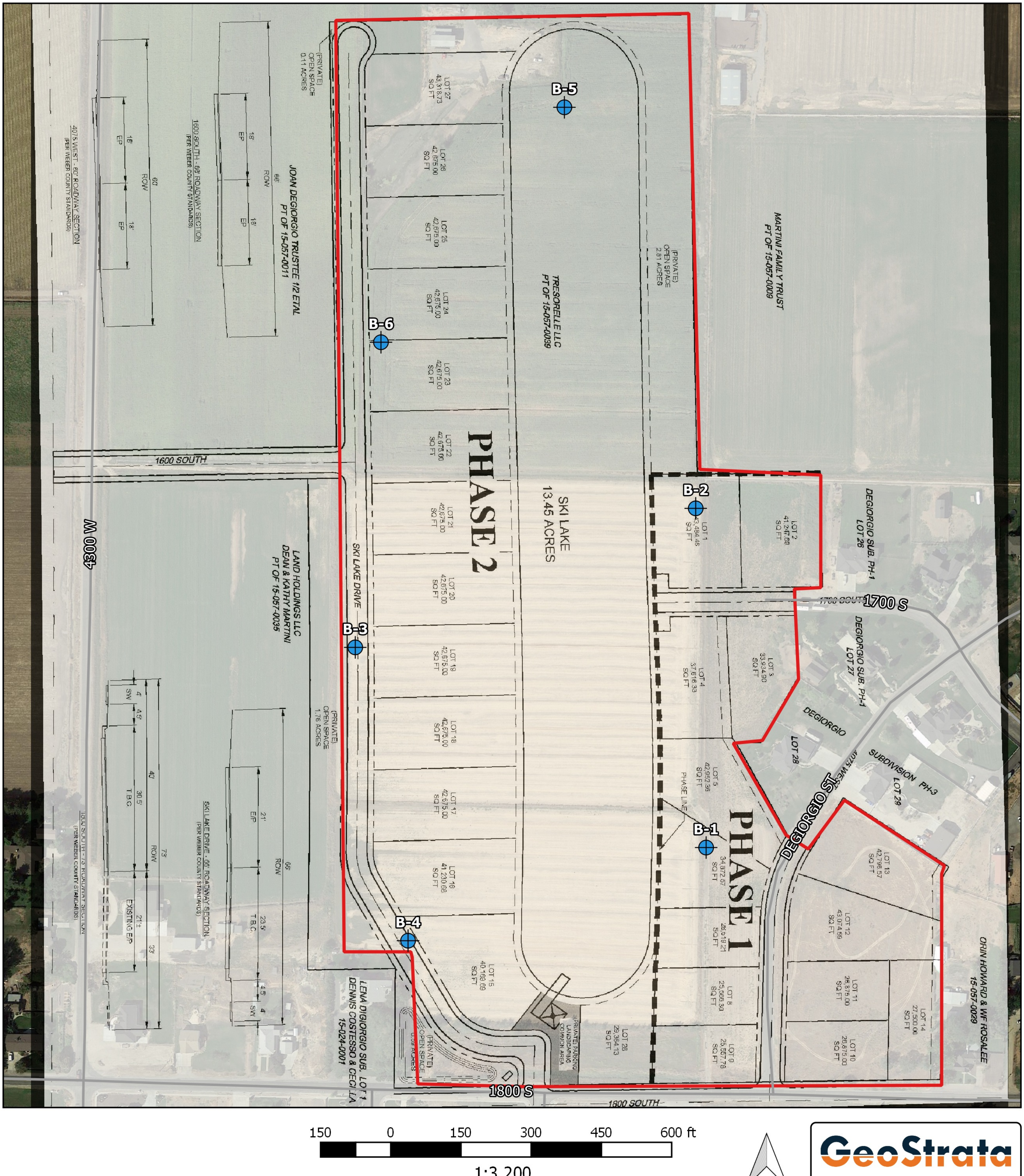
312 Holdings, LLC
Halcyon Lake Estates
Weber County, Utah
Project Number 1459-001

Site Vicinity Map

Plate A-1

Legend

Approximate Site Boundary



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Legend

Approximate Site Boundary

Approximate Exploration Location

312 Holdings, LLC
Halcyon Lake Estates
Weber County, Utah
Project Number 1459-001

Exploration Location Map

Plate A-2

Appendix B

DATE	
STARTED:	5/1/19
COMPLETED:	5/1/19
BACKFILLED:	5/1/19

312 Holdings, LLC
Halcyon Lake Estates
Weber County, Utah
Project Number 1459-001

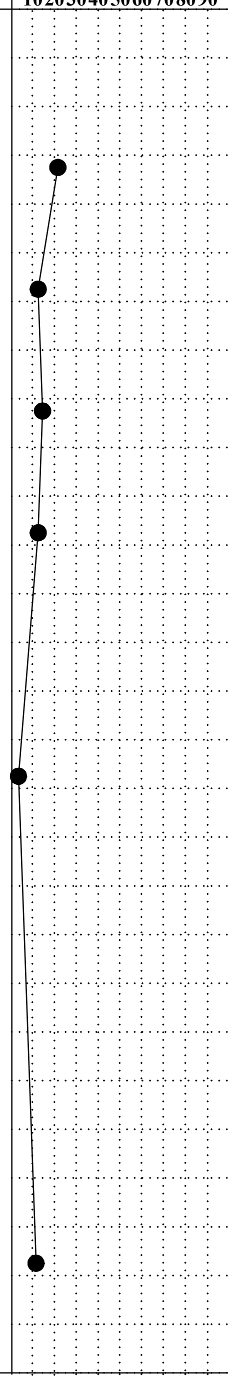
GeoStrata Rep: D. Bliler
Rig Type: CME 75
Boring Type: HSA

Boring ID
B-1
Sheet 1 of 1

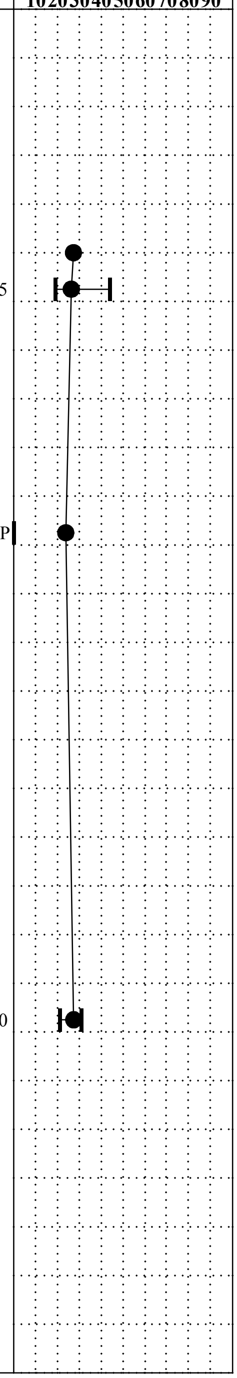
LOCATION
EASTING NORTHING ELEVATION

DEPTH (FEET)	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	N	N*	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index
0		TOPSOIL; Silty CLAY - medium stiff, slightly moist, light brown, organics throughout (existed as a corn field at the time of exploration)							
	CL	Lean CLAY - very stiff, moist, tan-brown, occasional organics	11	21					
4		- groundwater encountered @ 4 ft at the time of exploration							
5					98.0	27.3			
		- stiff, wet, light brown with dark brown mottling, no organics, vane shear UD shear strength = 1070 psf	10	12	94.4	26.3	97.4	44	25
	SP	Poorly Graded SAND - medium dense, wet, dark brown, 1-2 foot layers of heaving sands	14	14					
10			8	12		23.8	4.4	NP	NP
15		- very loose, pocket pen shear strength = 500 psf	3	3					
	CL	Lean CLAY - medium stiff, wet, medium to dark brown							
20		- pocket pen shear strength = 500 psf				27.4	87.6	31	10
25		- stiff, pocket pen shear strength = 500 psf	10	11					
26.5		Bottom of Boring @ 26.5 Feet							

SPT BLOW COUNT



Moisture Content and Atterberg Limits



N - OBSERVED UNCORRECTED BLOW COUNT

N* - CORRECTED N1(60) EQUIVALENT SPT BLOW COUNT

GeoStrata

SAMPLE TYPE
- 2" O.D./1.38" I.D. Split Spoon Sampler
- 2.5" O.D./2" I.D. California Split Spoon Sampler
- 3" O.D. Thin-Walled Shelby Sampler
- Grab Sample
- 2" O.D./1.625" I.D. Liner Sampler

NOTES:

WATER LEVEL
▼ - MEASURED ▽ - ESTIMATED

Plate

B - 1

DATE	
STARTED:	5/1/19
COMPLETED:	5/1/19
BACKFILLED:	5/1/19

312 Holdings, LLC
Halcyon Lake Estates
Weber County, Utah

Project Number 1459-001

GeoStrata Rep: D. Bliler
Rig Type: CME 75
Boring Type: HSA

Boring ID
B-2
Sheet 1 of 1

LOCATION: EASTING NORTHING ELEVATION

Depth (ft)	USCS	MATERIAL DESCRIPTION	N	N*	Dry Density (pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index
0		TOPSOIL; Silty CLAY - medium stiff, slightly moist, light brown, organics throughout (existed as a corn field at the time of exploration)							
	CL	Lean CLAY - medium stiff, moist, tan-brown with iron staining, occasional organics - torvane UD shear strength = 530 psf - groundwater encountered @ 4 ft at the time of exploration	4	5					
5	ML	SILT - medium stiff, wet, tan-brown, no organics	2	4		31.4	91.4	28	2
	SP-SM	Poorly Graded SAND with silt - very loose, wet, dark brown, heaving sands throughout	2	3					
10			12	12	88.4	23.7			
	ML	SILT - stiff, wet, dark gray							
15						34.4	97.0	NP	NP
20			13	14					
25	CL	Lean CLAY - soft, wet, tan-brown	2	3	81.2	39.5	99.3	44	22
		Bottom of Boring @ 26.5 Feet							

N - OBSERVED UNCORRECTED BLOW COUNT
N* - CORRECTED N1(60) EQUIVALENT SPT BLOW COUNT

SAMPLE TYPE
- 2" O.D./1.38" I.D. Split Spoon Sampler
- 2.5" O.D./2" I.D. California Split Spoon Sampler
- 3" O.D. Thin-Walled Shelby Sampler
- Grab Sample
- 2" O.D./1.625" I.D. Liner Sampler

NOTES:

WATER LEVEL
▼ - MEASURED ▽ - ESTIMATED

Plate
B - 2

DATE	
STARTED:	5/1/19
COMPLETED:	5/1/19
BACKFILLED:	5/1/19

312 Holdings, LLC
Halcyon Lake Estates
Weber County, Utah
Project Number 1459-001

GeoStrata Rep: D. Bliler
Rig Type: CME 75
Boring Type: HSA

Boring ID
B-3
Sheet 1 of 1

LOCATION
EASTING NORTHING ELEVATION

DEPTH (FEET)	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	N	N*	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index
0		TOPSOIL; Silty CLAY - medium stiff, slightly moist, light brown, organics throughout (existed as a corn field at the time of exploration)							
	ML	SILT - stiff, moist, tan-brown with iron staining							
		- wet, torvane UD shear strength = 500 psf	7	9	89.6	25.4	95.4	NP	NP
5		- groundwater encountered @ 4ft-11in in a piezometer read 4 days after exploration	2	4					
		- soft							
	SC	Clayey SAND - medium dense, wet, light brown, 3-4 inch seams of black poorly graded sand							
		- torvane UD shear strength = 230 psf	16	16		24.4	35.3		
10	ML	Sandy SILT - medium stiff, wet, light brown	5	8		23.7	66.4	NP	NP
	SP-SM	Poorly Graded SAND with silt - loose, wet, dark gray	5	7					
15	CL	Lean CLAY - soft, wet, dark gray	2	3					
20	SP	Poorly Graded SAND - loose, wet, dark gray	5	8		22.4	4.3	NP	NP
21.5		Bottom of Boring @ 21.5 Feet							

SPT BLOW COUNT 10 20 30 40 50 60 70 80 90

Moisture Content and Atterberg Limits
Plastic Limit — Moisture Content — Liquid Limit
10 20 30 40 50 60 70 80 90

N - OBSERVED UNCORRECTED BLOW COUNT N* - CORRECTED N1(60) EQUIVALENT SPT BLOW COUNT

GeoStrata

SAMPLE TYPE
- 2" O.D./1.38" I.D. Split Spoon Sampler
- 2.5" O.D./2" I.D. California Split Spoon Sampler
- 3" O.D. Thin-Walled Shelby Sampler
- Grab Sample
- 2" O.D./1.625" I.D. Liner Sampler

NOTES:

WATER LEVEL
▼ - MEASURED ▽ - ESTIMATED

Plate
B - 3

DATE	
STARTED:	5/1/19
COMPLETED:	5/1/19
BACKFILLED:	5/1/19

312 Holdings, LLC
Halcyon Lake Estates
Weber County, Utah
Project Number 1459-001

GeoStrata Rep: D. Bliler
Rig Type: CME 75
Boring Type: HSA

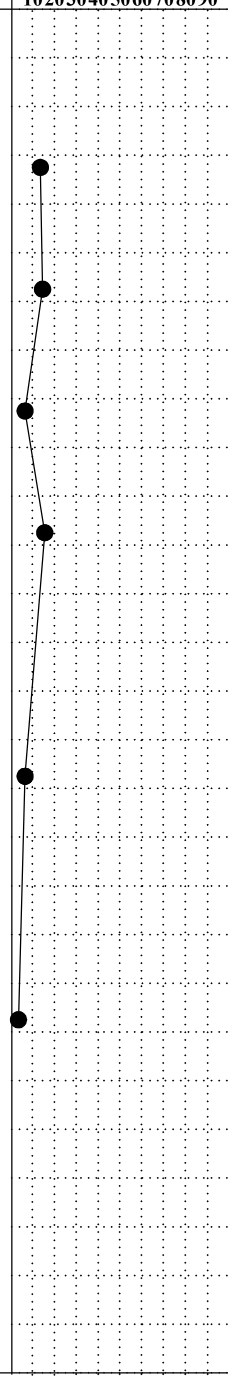
Boring ID
B-4
Sheet 1 of 1

LOCATION
EASTING NORTHING ELEVATION

DEPTH (FEET)	SAMPLES	WATER LEVEL	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	N	N*	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index
0				TOPSOIL; Silty CLAY - medium stiff, slightly moist, light brown, organics throughout (existed as a corn field at the time of exploration)							
			CL	Lean CLAY - stiff, moist, tan-brown with iron staining, occasional organics							
	Split Spoon				7	13					
		▽		- groundwater encountered @ 4 ft at the time of exploration							
5			SM	Silty SAND - medium dense, wet, light brown, torvane UD shear strength = 950 psf							
	California Split Spoon				11	14	105.2	16.0	32.6	NP	NP
			SP-SM	Poorly Graded SAND with silt - loose, wet, dark brown							
	Split Spoon				4	6					
10				- medium dense, dark gray							
	California Split Spoon				15	15	99.0	22.8	7.2		
15	Split Spoon				4	6					
20				- medium brown							
	Split Spoon				2	3					
				Bottom of Boring @ 21.5 Feet							
25											

SPT BLOW COUNT

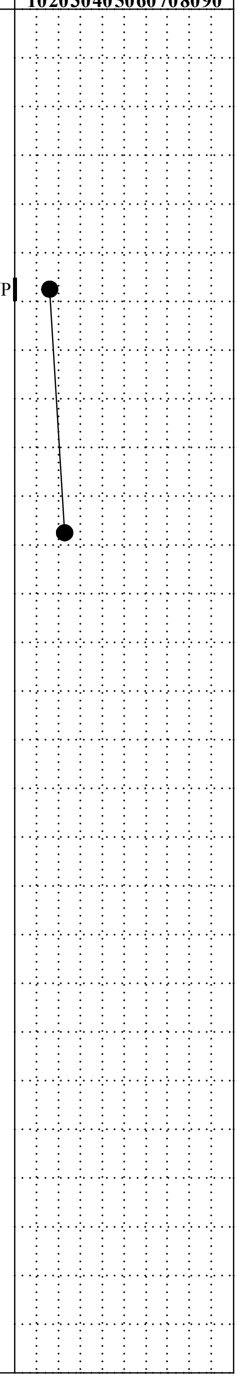
10 20 30 40 50 60 70 80 90



Moisture Content and Atterberg Limits

Plastic Limit — Moisture Content — Liquid Limit

10 20 30 40 50 60 70 80 90



N - OBSERVED UNCORRECTED BLOW COUNT N* - CORRECTED N1(60) EQUIVALENT SPT BLOW COUNT

GeoStrata

SAMPLE TYPE
- 2" O.D./1.38" I.D. Split Spoon Sampler
- 2.5" O.D./2" I.D. California Split Spoon Sampler
- 3" O.D. Thin-Walled Shelby Sampler
- Grab Sample
- 2" O.D./1.625" I.D. Liner Sampler

NOTES:

WATER LEVEL
▼ - MEASURED ▽ - ESTIMATED

Plate
B - 4

DATE	
STARTED:	5/1/19
COMPLETED:	5/1/19
BACKFILLED:	5/1/19

312 Holdings, LLC
Halcyon Lake Estates
Weber County, Utah
Project Number 1459-001

GeoStrata Rep: D. Bliler
Rig Type: CME 75
Boring Type: HSA

Boring ID
B-5
Sheet 1 of 1

LOCATION
EASTING NORTHING ELEVATION

DEPTH (FEET)	SAMPLES	WATER LEVEL	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	N	N*	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index
0				TOPSOIL; Silty CLAY - medium stiff, slightly moist, light brown, organics throughout (existed as a corn field at the time of exploration)							
			CL	Lean CLAY - soft, moist, tan-brown with iron staining, occasional organics - torvane UD shear strength = 400 psf - groundwater encountered @ 4 ft at the time of exploration	2	3	95.1	29.4			
5				- soft	1	2					
			SM	Silty SAND - medium dense, wet, dark brown - pocket pen shear strength = 750 psf	13	13	98.4	23.4	14.2	NP	NP
10			SP	Poorly Graded SAND with silt - loose, wet, dark gray	4	6					
15				- medium dense	9	14		23.2	5.8		
20			CL	Lean CLAY - medium dense, wet, gray-brown, torvane UD shear strength = 1130 psf	13	15		26.9	93.6	39	18
				Bottom of Boring @ 21.5 Feet							

SPT BLOW COUNT: 10 20 30 40 50 60 70 80 90

Moisture Content and Atterberg Limits: Plastic Limit, Moisture Content, Liquid Limit — 10 20 30 40 50 60 70 80 90

N - OBSERVED UNCORRECTED BLOW COUNT N* - CORRECTED N1(60) EQUIVALENT SPT BLOW COUNT

GeoStrata

SAMPLE TYPE
- 2" O.D./1.38" I.D. Split Spoon Sampler
- 2.5" O.D./2" I.D. California Split Spoon Sampler
- 3" O.D. Thin-Walled Shelby Sampler
- Grab Sample
- 2" O.D./1.625" I.D. Liner Sampler

NOTES:

WATER LEVEL
▼ - MEASURED ▽ - ESTIMATED

Plate
B - 5

DATE		
STARTED:	5/1/19	
COMPLETED:	5/1/19	
BACKFILLED:	5/1/19	

312 Holdings, LLC
Halcyon Lake Estates
Weber County, Utah

Project Number 1459-001

GeoStrata Rep: D. Bliler
Rig Type: CME 75
Boring Type: HSA

Boring ID
B-6

LOCATION

EASTING NORTHING ELEVATION

DEPTH (FEET)	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	N	N*	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index
0	CL	TOPSOIL; Silty CLAY - medium stiff, slightly moist, light brown, organics throughout (existed as a corn field at the time of exploration)							
		Lean CLAY with sand - stiff, moist, medium brown, occasional organics					77.3	26	7
		- very moist	5	10					
		- no organics, groundwater encountered @ 4 ft at the time of exploration							
5		- medium stiff, wet	4	7					
	SM	Silty SAND - medium dense, wet, tan-brown	13	13					
10	SP-SM	Poorly Graded SAND with silt - medium dense, wet, dark gray	10	15		26.0	13.4		
15		- black	8	13					
20	CL	Lean CLAY - stiff, wet, gray-brown	8	9		32.5	92.8	31	9
		Bottom of Boring @ 21.5 Feet							

SPT BLOW COUNT 10 20 30 40 50 60 70 80 90

Moisture Content and Atterberg Limits — Plastic Limit, Moisture Content, Liquid Limit — 10 20 30 40 50 60 70 80 90

N - OBSERVED UNCORRECTED BLOW COUNT   N* - CORRECTED N1(60) EQUIVALENT SPT BLOW COUNT

GeoStrata

SAMPLE TYPE
- 2" O.D./1.38" I.D. Split Spoon Sampler
- 2.5" O.D./2" I.D. California Split Spoon Sampler
- 3" O.D. Thin-Walled Shelby Sampler
- Grab Sample
- 2" O.D./1.625" I.D. Liner Sampler

NOTES:

WATER LEVEL
- MEASURED
- ESTIMATED

Plate
B - 6

UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS			USCS SYMBOL	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS (More than half of material is larger than the #200 sieve)	GRAVELS (More than half of coarse fraction is larger than the #4 sieve)	CLEAN GRAVELS WITH LITTLE OR NO FINES	GW	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE OR NO FINES
			GP	POORLY-GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE OR NO FINES
		GRAVELS WITH OVER 12% FINES	GM	SILTY GRAVELS, GRAVEL-SILT-SAND MIXTURES
			GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES
	SANDS (More than half of coarse fraction is smaller than the #4 sieve)	CLEAN SANDS WITH LITTLE OR NO FINES	SW	WELL-GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE OR NO FINES
			SP	POORLY-GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE OR NO FINES
		SANDS WITH OVER 12% FINES	SM	SILTY SANDS, SAND-GRAVEL-SILT MIXTURES
			SC	CLAYEY SANDS SAND-GRAVEL-CLAY MIXTURES
FINE GRAINED SOILS (More than half of material is smaller than the #200 sieve)	SILTS AND CLAYS (Liquid limit less than 50)		ML	INORGANIC SILTS & VERY FINE SANDS, SILTY OR CLAYEY FINE SANDS, CLAYEY SILTS WITH SLIGHT PLASTICITY
			CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
			OL	ORGANIC SILTS & ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS (Liquid limit greater than 50)		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILT
			CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
			OH	ORGANIC CLAYS & ORGANIC SILTS OF MEDIUM-TO-HIGH PLASTICITY
HIGHLY ORGANIC SOILS			PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

LOG KEY SYMBOLS

BORING SAMPLE LOCATION

TEST-PIT SAMPLE LOCATION

WATER LEVEL (level after completion)

WATER LEVEL (level where first encountered)

CEMENTATION

DESCRIPTION	DESCRIPTION
WEAKELY	CRUMBLES OR BREAKS WITH HANDLING OR SLIGHT FINGER PRESSURE
MODERATELY	CRUMBLES OR BREAKS WITH CONSIDERABLE FINGER PRESSURE
STRONGLY	WILL NOT CRUMBLE OR BREAK WITH FINGER PRESSURE

OTHER TESTS KEY

C	CONSOLIDATION	SA	SIEVE ANALYSIS
AL	ATTERBERG LIMITS	DS	DIRECT SHEAR
UC	UNCONFINED COMPRESSION	T	TRIAXIAL
S	SOLUBILITY	R	RESISTIVITY
O	ORGANIC CONTENT	RV	R-VALUE
CBR	CALIFORNIA BEARING RATIO	SU	SOLUBLE SULFATES
COMP	MOISTURE/DENSITY RELATIONSHIP	PM	PERMEABILITY
CI	CALIFORNIA IMPACT	-200	% FINER THAN #200
COL	COLLAPSE POTENTIAL	Gs	SPECIFIC GRAVITY
SS	SHRINK SWELL	SL	SWELL LOAD

MODIFIERS

DESCRIPTION	%
TRACE	<5
SOME	5 - 12
WITH	>12

MOISTURE CONTENT

DESCRIPTION	FIELD TEST
DRY	ABSENCE OF MOISTURE, DUSTY, DRY TO THE TOUCH
MOIST	DAMP BUT NO VISIBLE WATER
WET	VISIBLE FREE WATER, USUALLY SOIL BELOW WATER TABLE

STRATIFICATION

DESCRIPTION	THICKNESS	DESCRIPTION	THICKNESS
SEAM	1/16 - 1/2"	OCCASIONAL	ONE OR LESS PER FOOT OF THICKNESS
LAYER	1/2 - 12"	FREQUENT	MORE THAN ONE PER FOOT OF THICKNESS

GENERAL NOTES

1. Lines separating strata on the logs represent approximate boundaries only. Actual transitions may be gradual.
2. No warranty is provided as to the continuity of soil conditions between individual sample locations.
3. Logs represent general soil conditions observed at the point of exploration on the date indicated.
4. In general, Unified Soil Classification designations presented on the logs were evaluated by visual methods only. Therefore, actual designations (based on laboratory tests) may vary.

APPARENT / RELATIVE DENSITY - COARSE-GRAINED SOIL

APPARENT DENSITY	SPT (blows/ft)	MODIFIED CA. SAMPLER (blows/ft)	CALIFORNIA SAMPLER (blows/ft)	RELATIVE DENSITY (%)	FIELD TEST
VERY LOOSE	<4	<4	<5	0 - 15	EASILY PENETRATED WITH 1/2-INCH REINFORCING ROD PUSHED BY HAND
LOOSE	4 - 10	5 - 12	5 - 15	15 - 35	DIFFICULT TO PENETRATE WITH 1/2-INCH REINFORCING ROD PUSHED BY HAND
MEDIUM DENSE	10 - 30	12 - 35	15 - 40	35 - 65	EASILY PENETRATED A FOOT WITH 1/2-INCH REINFORCING ROD DRIVEN WITH 5-LB HAMMER
DENSE	30 - 50	35 - 60	40 - 70	65 - 85	DIFFICULT TO PENETRATED A FOOT WITH 1/2-INCH REINFORCING ROD DRIVEN WITH 5-LB HAMMER
VERY DENSE	>50	>60	>70	85 - 100	PENETRATED ONLY A FEW INCHES WITH 1/2-INCH REINFORCING ROD DRIVEN WITH 5-LB HAMMER

CONSISTENCY - FINE-GRAINED SOIL

CONSISTENCY	SPT (blows/ft)	TORVANE UNTRAINED SHEAR STRENGTH (tsf)	POCKET PENETROMETER UNCONFINED COMPRESSIVE STRENGTH (tsf)	FIELD TEST
VERY SOFT	<2	<0.125	<0.25	EASILY PENETRATED SEVERAL INCHES BY THUMB. EXUDES BETWEEN THUMB AND FINGERS WHEN SQUEEZED BY HAND.
SOFT	2 - 4	0.125 - 0.25	0.25 - 0.5	EASILY PENETRATED ONE INCH BY THUMB. MOLDED BY LIGHT FINGER PRESSURE.
MEDIUM STIFF	4 - 8	0.25 - 0.5	0.5 - 1.0	PENETRATED OVER 1/2 INCH BY THUMB WITH MODERATE EFFORT. MOLDED BY STRONG FINGER PRESSURE.
STIFF	8 - 15	0.5 - 1.0	1.0 - 2.0	INDENTED ABOUT 1/2 INCH BY THUMB BUT PENETRATED ONLY WITH GREAT EFFORT.
VERY STIFF	15 - 30	1.0 - 2.0	2.0 - 4.0	READILY INDENTED BY THUMBNAIL.
HARD	>30	>2.0	>4.0	INDENTED WITH DIFFICULTY BY THUMBNAIL.

GeoStrata

Soil Symbols Description Key

312 Holdings, LLC
Halcyon Lake Estates
Weber County, UT
Project Number: 1459-001

Plate B-7

Appendix C

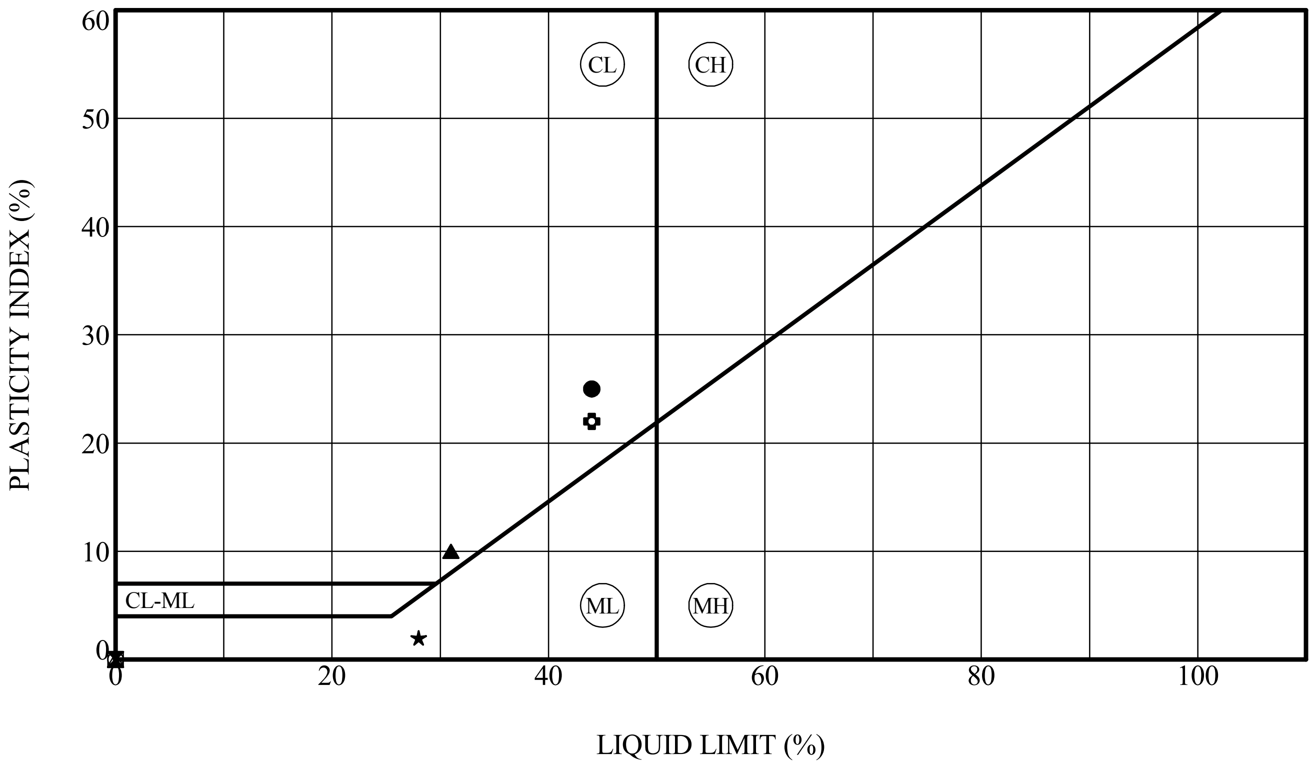
Boring No.	Sample Depth (feet)	USCS Soil Classification	Natural Moisture Content (%)	Natural Dry Density (pcf)	Optimum Moisture Content (%)	Maximum Dry Density (pcf)	Gradation			Atterberg		Consolidation			Collapse (%)	Swell (%)	Vane Shear Strength (psf)	Pocket Pen Shear Strength (psf)	Direct Shear Test		Effective Stress - Triaxial		Total Stress - Triaxial		CBR (%)
							Gravel (%)	Sand (%)	Fines (%)	LL	PI	Cc	Cr	OCR					Apparent Cohesion (psf)	Internal Friction Angle (^{0})	Effective Cohesion (psf)	Internal Friction Angle (^{0})	Effective Cohesion (psf)	Internal Friction Angle (^{0})	
B-1	5	CL	26.3	94.4					97.4	44	25					0.08	1070								
B-1	5	CL	27.3	98								0.115	0.023	3.2											
B-1	10	SP	23.8						4.4	NP	NP								40	40					
B-1	20	CL	27.4						87.6	31	10							500			120	33	220	25	
B-2	5	ML	31.4						91.4	28	2														
B-2	10	SP-SM	23.7	88.4																					
B-2	15	ML	34.4				0.0	3.0	97.0	NP	NP														
B-2	25	CL	39.5	81.2					99.3	44	22	0.147	0.033	1			530								
B-3	2.5	ML	25.4	89.6					95.4	NP	NP				0.04		500								
B-3	7.5	SC	24.4						35.3								230								
B-3	10	ML	23.7						66.4	NP	NP														
B-3	20	SP	22.4				0.6	95.1	4.3	NP	NP														
B-4	5	SM	16	105.2					32.6	NP	NP	0.074	0.014	4.1			950								
B-4	10	SP-SM	22.8	99			0.0	92.8	7.2								400								
B-5	2.5	CL	29.4	95.1																					
B-5	7.5	SM	23.4	98.4					14.2	NP	NP				0.29			750							
B-5	15	SP-SM	23.2				1.3	92.9	5.8																
B-5	20	CL	26.9						93.6	39	18						1130								
B-6	1.5	CL			16.3	110.7	0.0	22.7	77.3	26	7														3.3
B-6	10	SM	26				0.0	86.6	13.4																
B-6	20	CL	32.5						92.8	31	9														

GeoStrata

Lab Summary Report

312 Holdings, LLC
Halcyon Lake Estates
Weber County, UT
Project Number: 1459-001

Plate C - 1



	Sample Location	Depth (ft)	LL (%)	PL (%)	PI (%)	Fines (%)	Classification
●	**B-1**	**5.0**	**44**	**19**	**25**	**97.4**	**Lean CLAY**
⊠	**B-1**	**10.0**	**NP**	**NP**	**NP**	**4.4**	**Poorly Graded SAND**
▲	**B-1**	**20.0**	**31**	**21**	**10**	**87.6**	**Lean CLAY**
★	**B-2**	**5.0**	**28**	**26**	**2**	**91.4**	**SILT**
⊙	**B-2**	**15.0**	**NP**	**NP**	**NP**	**97.0**	**SILT**
✿	**B-2**	**25.0**	**44**	**22**	**22**	**99.3**	**Lean CLAY**
○	**B-3**	**2.5**	**NP**	**NP**	**NP**	**95.4**	**SILT**
△	**B-3**	**10.0**	**NP**	**NP**	**NP**	**66.4**	**Sandy SILT**

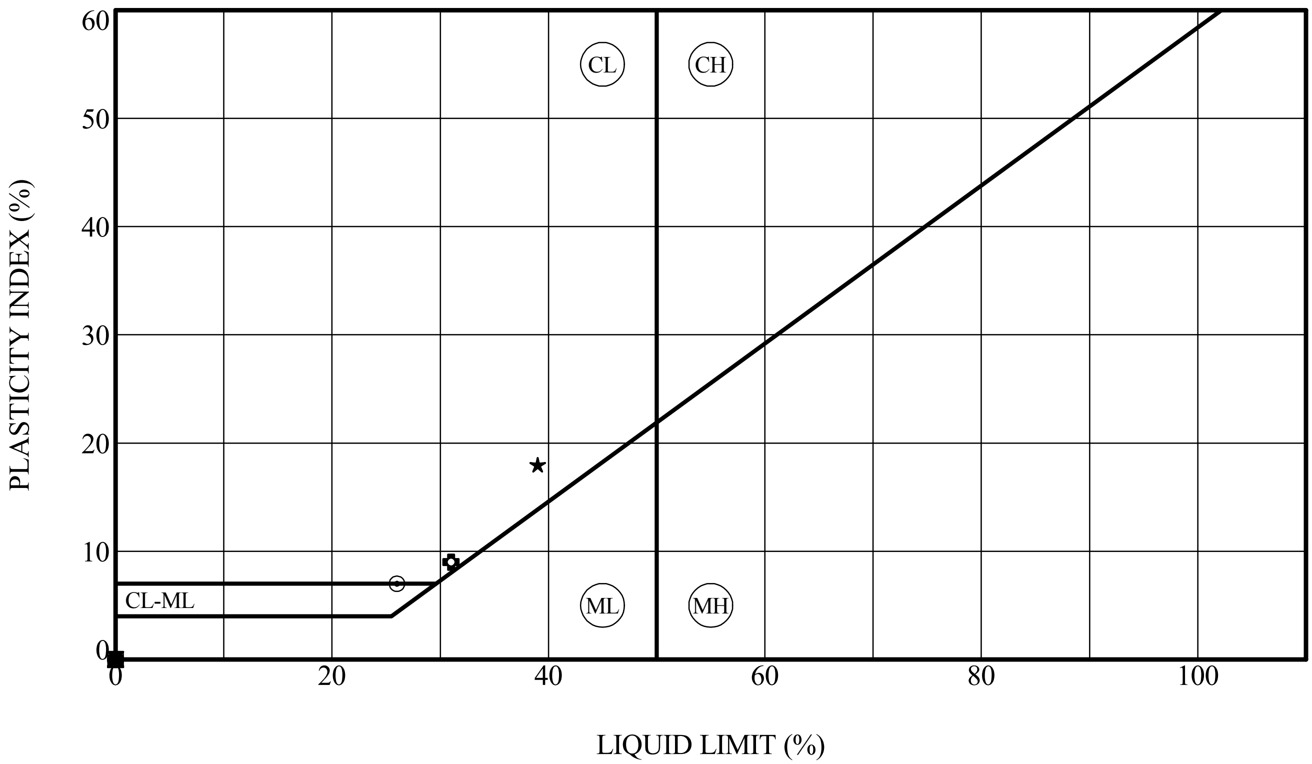
GeoStrata

ATTERBERG LIMITS' RESULTS - ASTM D 4318

312 Holdings, LLC
Halcyon Lake Estates
Weber County, Utah
Project Number: 1459-001

Plate

C - 2



	Sample Location	Depth (ft)	LL (%)	PL (%)	PI (%)	Fines (%)	Classification
●	**B-3**	**20.0**	**NP**	**NP**	**NP**	**4.3**	**Poorly Graded SAND**
⊠	**B-4**	**5.0**	**NP**	**NP**	**NP**	**32.6**	**Silty SAND**
▲	**B-5**	**7.5**	**NP**	**NP**	**NP**	**14.2**	**Silty SAND**
★	**B-5**	**20.0**	**39**	**21**	**18**	**93.6**	**Lean CLAY**
⊙	**B-6**	**1.5**	**26**	**19**	**7**	**77.3**	**Lean CLAY with sand**
✿	**B-6**	**20.0**	**31**	**22**	**9**	**92.8**	**Lean CLAY**

C_ATTERBERG EXPLORATION LOGS.GPJ GEOSTRATA.GDT 5/27/19

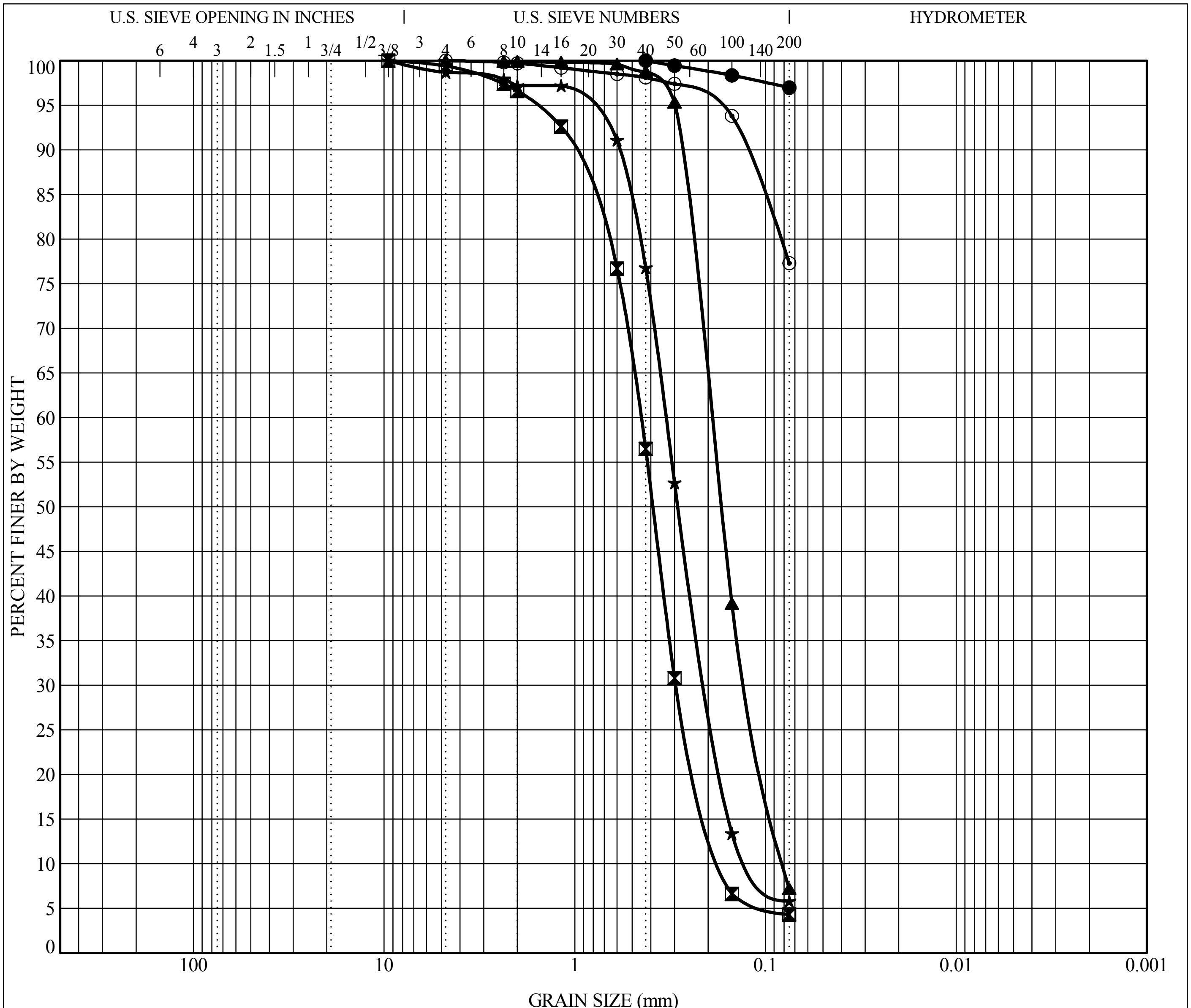
GeoStrata

ATTERBERG LIMITS' RESULTS - ASTM D 4318

312 Holdings, LLC
Halcyon Lake Estates
Weber County, Utah
Project Number: 1459-001

Plate

C - 3



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Sample Location	Depth	Classification	LL	PL	PI	Cc	Cu
●	**B-2**	**15.0**	**SILT**	**NP**	**NP**	**NP**		
⊠	**B-3**	**20.0**	**Poorly Graded SAND**	**NP**	**NP**	**NP**	**1.15**	**2.73**
▲	**B-4**	**10.0**	**Poorly Graded SAND with silt**				**0.98**	**2.43**
★	**B-5**	**15.0**	**Poorly Graded SAND with silt**				**1.10**	**3.03**
⊙	**B-6**	**1.5**	**Lean CLAY with sand**	**26**	**19**	**7**		

	Sample Loctaion	Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**B-2**	**15.0**	**0.425**				**0.0**	**3.0**	**97.0**	
⊠	**B-3**	**20.0**	**9.5**	**0.451**	**0.293**	**0.165**	**0.6**	**95.1**	**4.3**	
▲	**B-4**	**10.0**	**4.75**	**0.194**	**0.123**	**0.08**	**0.0**	**92.8**	**7.2**	
★	**B-5**	**15.0**	**9.5**	**0.333**	**0.201**	**0.11**	**1.3**	**92.9**	**5.8**	
⊙	**B-6**	**1.5**	**4.75**				**0.0**	**22.7**	**77.3**	

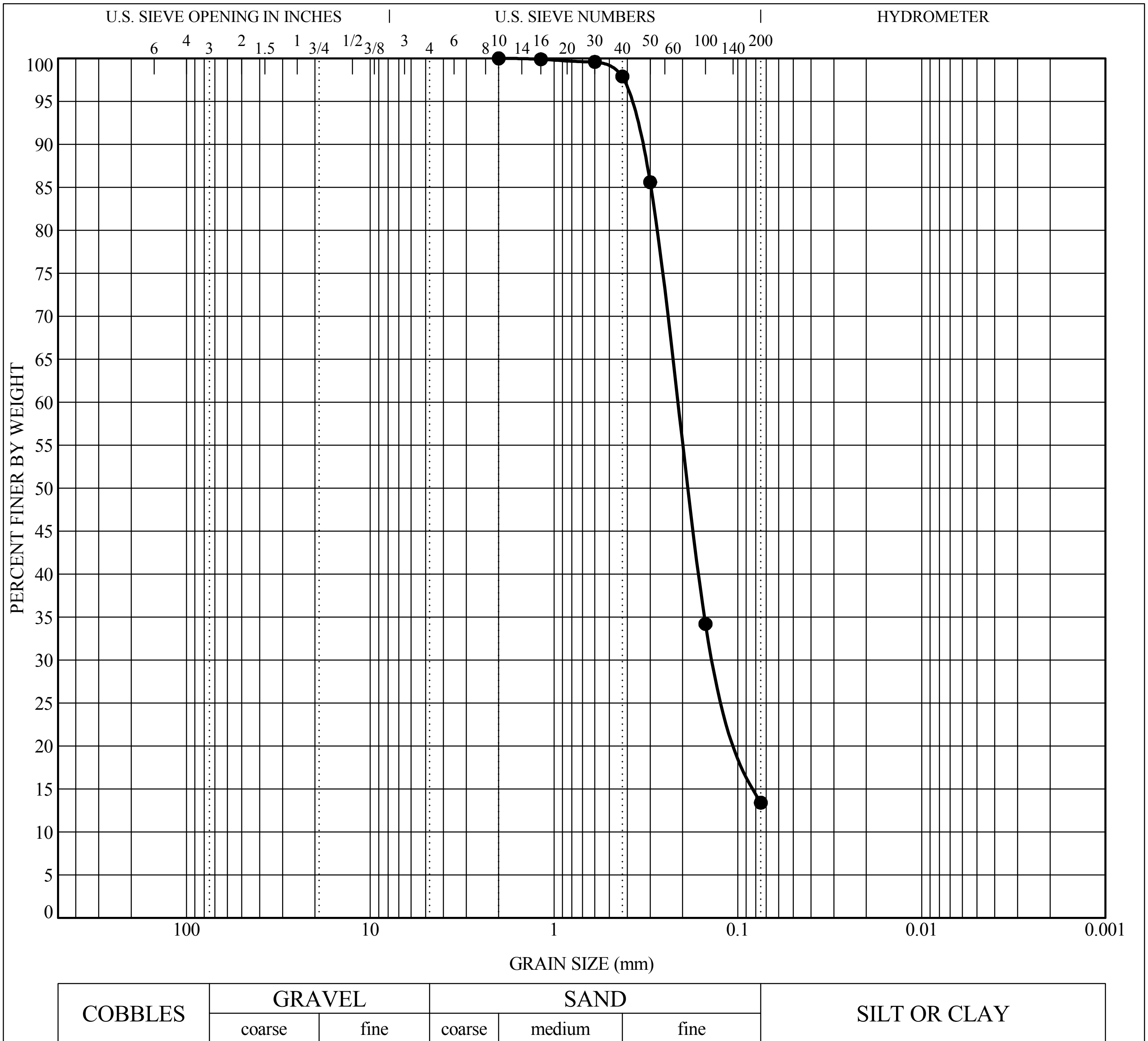
GeoStrata

GRAIN SIZE DISTRIBUTION - ASTM D422

312 Holdings, LLC
Halcyon Lake Estates
Weber County, Utah
Project Number: 1459-001

Plate

C - 4



Sample Location	Depth	Classification	LL	PL	PI	Cc	Cu
● **B-6**	**10.0**	**Silty SAND**					

Sample Loctaion	Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● **B-6**	**10.0**	**2**	**0.212**	**0.13**		**0.0**	**86.6**	**13.4**	

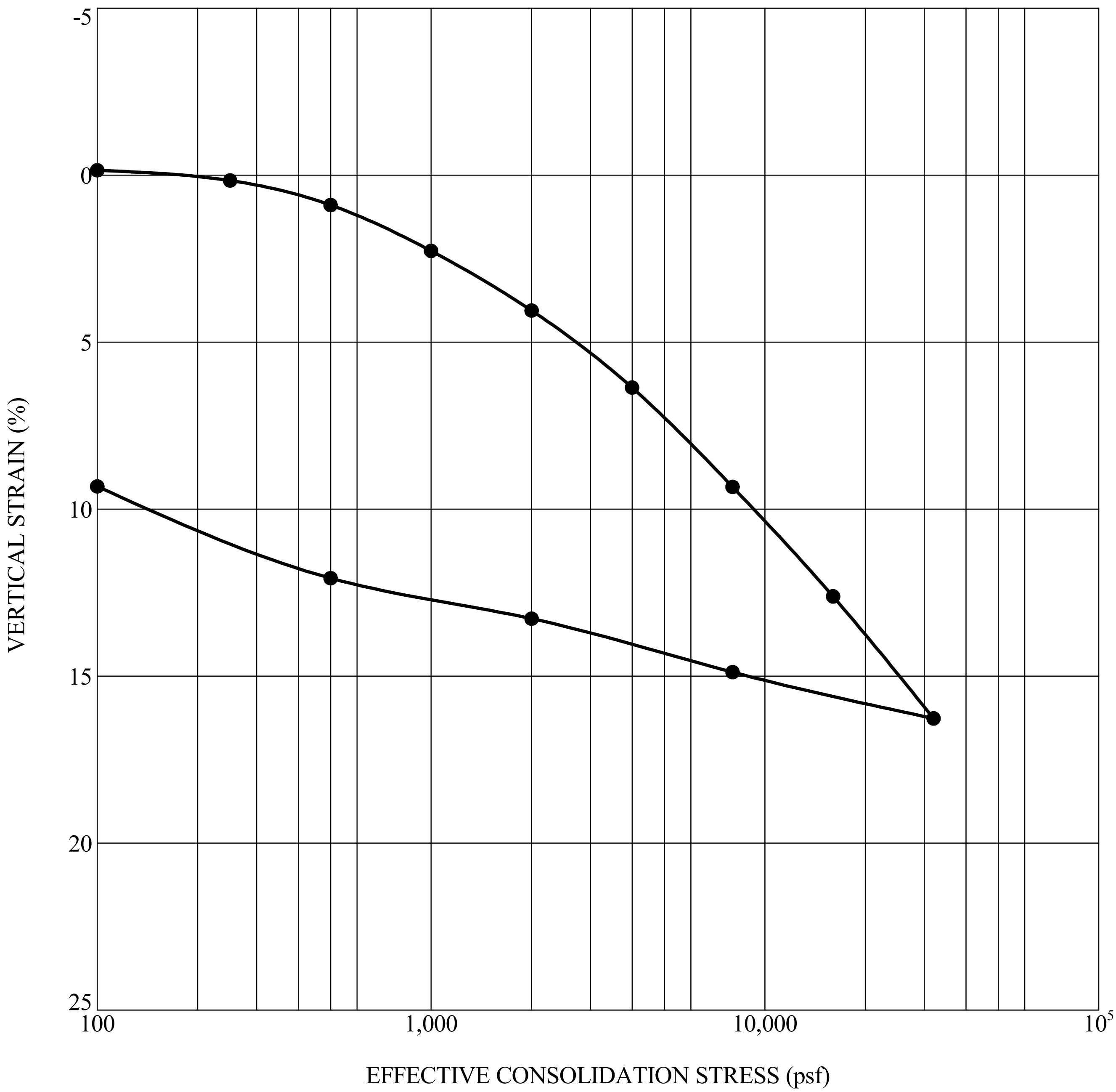
GeoStrata

GRAIN SIZE DISTRIBUTION - ASTM D422

312 Holdings, LLC
Halcyon Lake Estates
Weber County, Utah
Project Number: 1459-001

Plate

C - 5



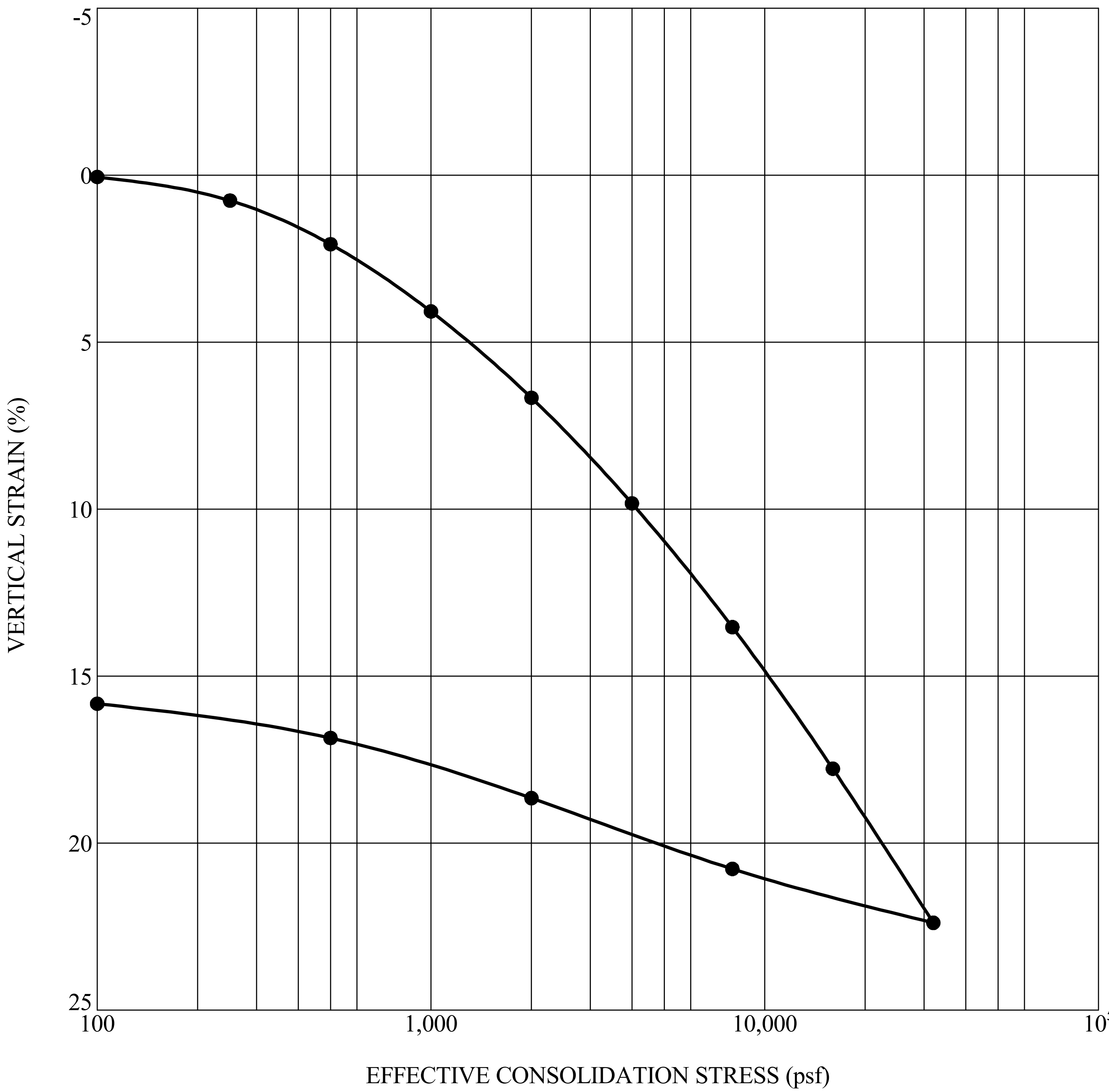
	Sample Location	Depth (ft)	Classification	γ_d (pcf)	MC (%)	C'_c	C'_r	OCR
●	**B-1**	**5.0**	**Lean CLAY**	**98**	**27**	**0.115**	**0.023**	**3.2**

1-D CONSOLIDATION TEST - ASTM D 2435

312 Holdings, LLC
Halcyon Lake Estates
Weber County, Utah
Project Number: 1459-001

Plate
C - 6

C_CONSOL EXPLORATION LOGS.GPJ GEOSTRATA.GDT 5/27/19



	Sample Location	Depth (ft)	Classification	γ_d (pcf)	MC (%)	C'_c	C'_r	OCR
●	**B-2**	**25.0**	**Lean CLAY**	**81**	**40**	**0.147**	**0.033**	**1.0**

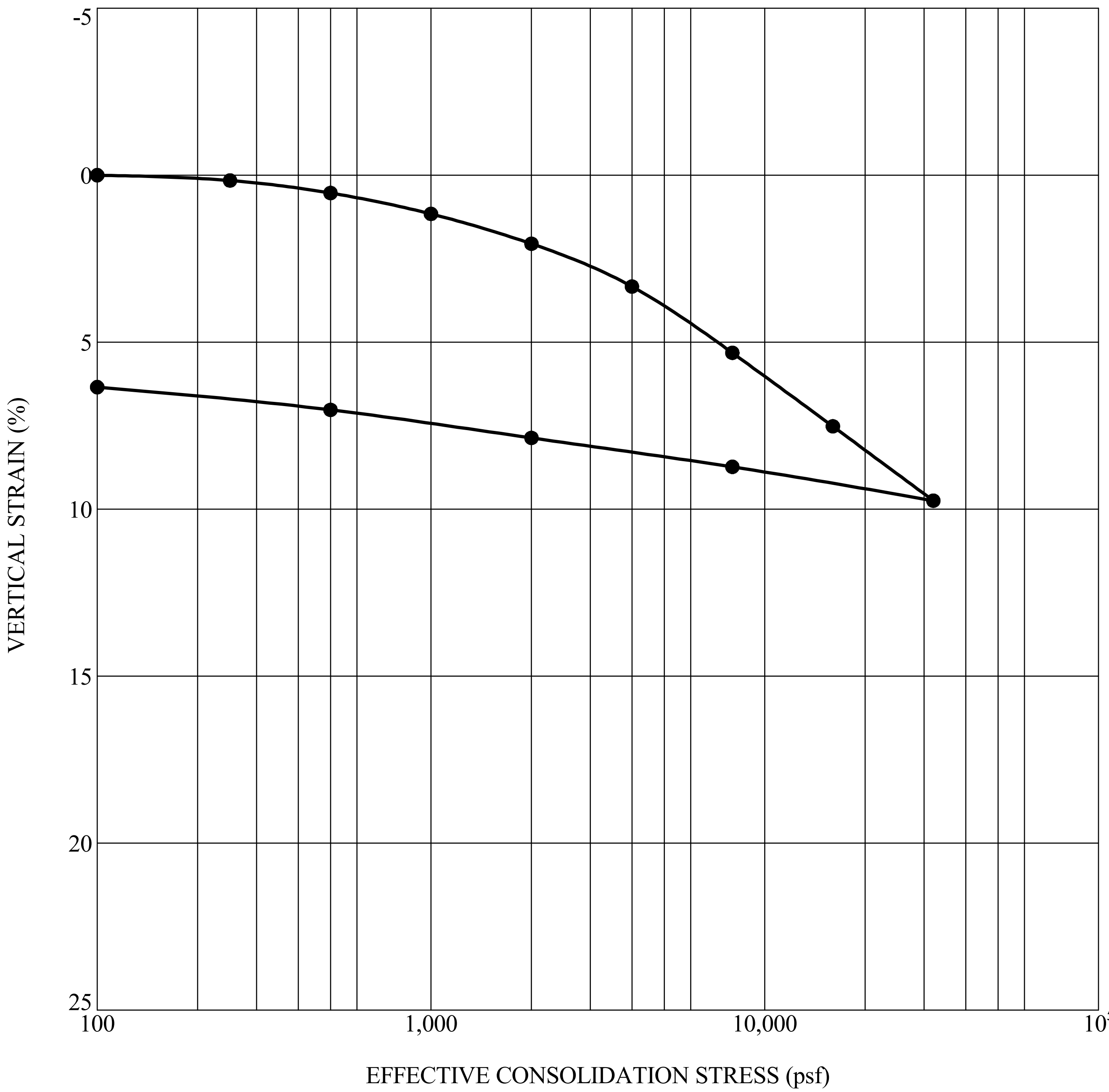
GeoStrata

1-D CONSOLIDATION TEST - ASTM D 2435

312 Holdings, LLC
Halcyon Lake Estates
Weber County, Utah
Project Number: 1459-001

Plate

C - 7



	Sample Location	Depth (ft)	Classification	γ_d (pcf)	MC (%)	C'_c	C'_r	OCR
●	**B-4**	**5.0**	**Silty SAND**	**105**	**21**	**0.074**	**0.014**	**4.1**

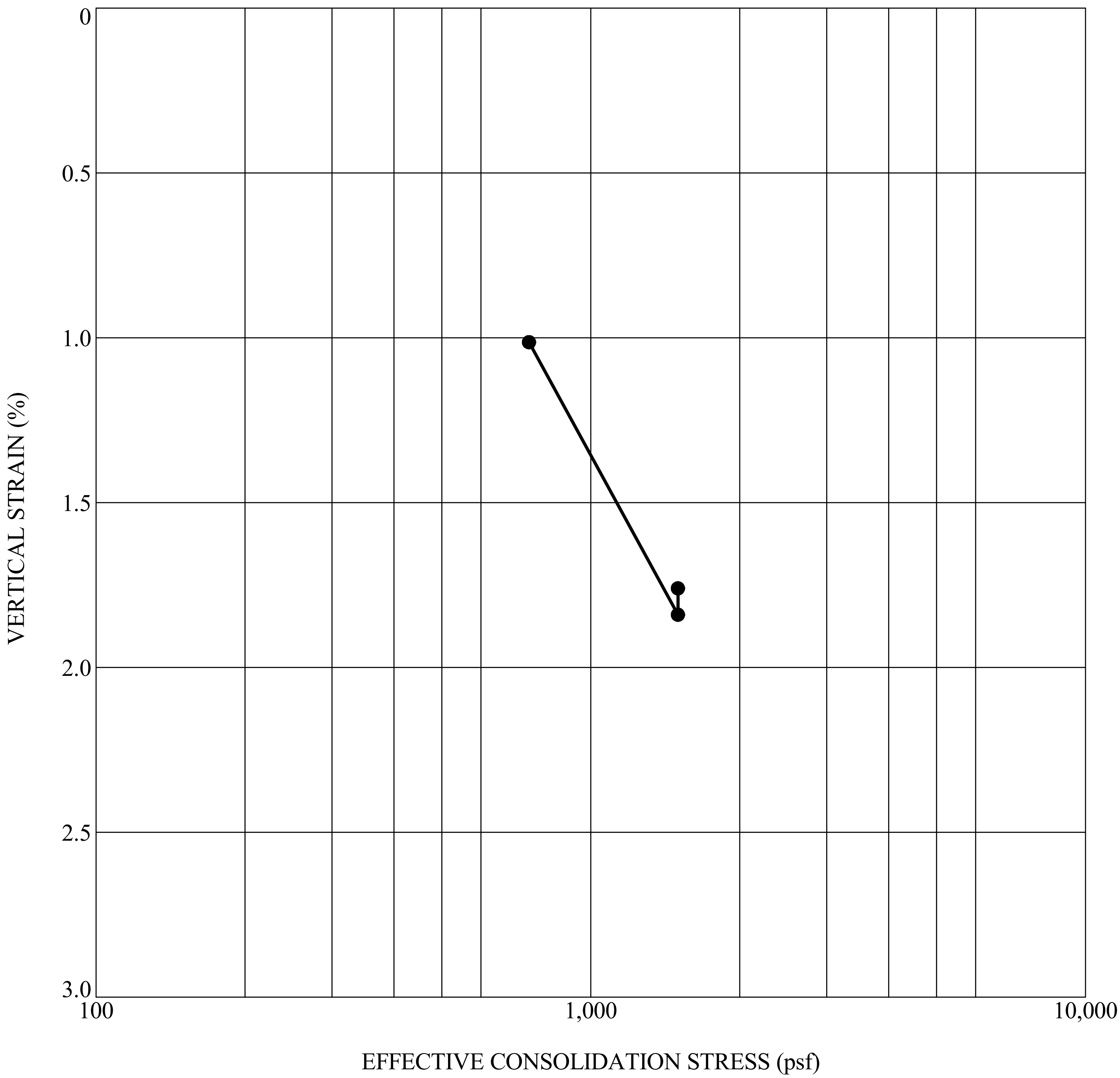
GeoStrata

1-D CONSOLIDATION TEST - ASTM D 2435

312 Holdings, LLC
Halcyon Lake Estates
Weber County, Utah
Project Number: 1459-001

Plate
C - 8

C_CONSOL EXPLORATION LOGS.GPJ GEOSTRATA.GDT 5/27/19



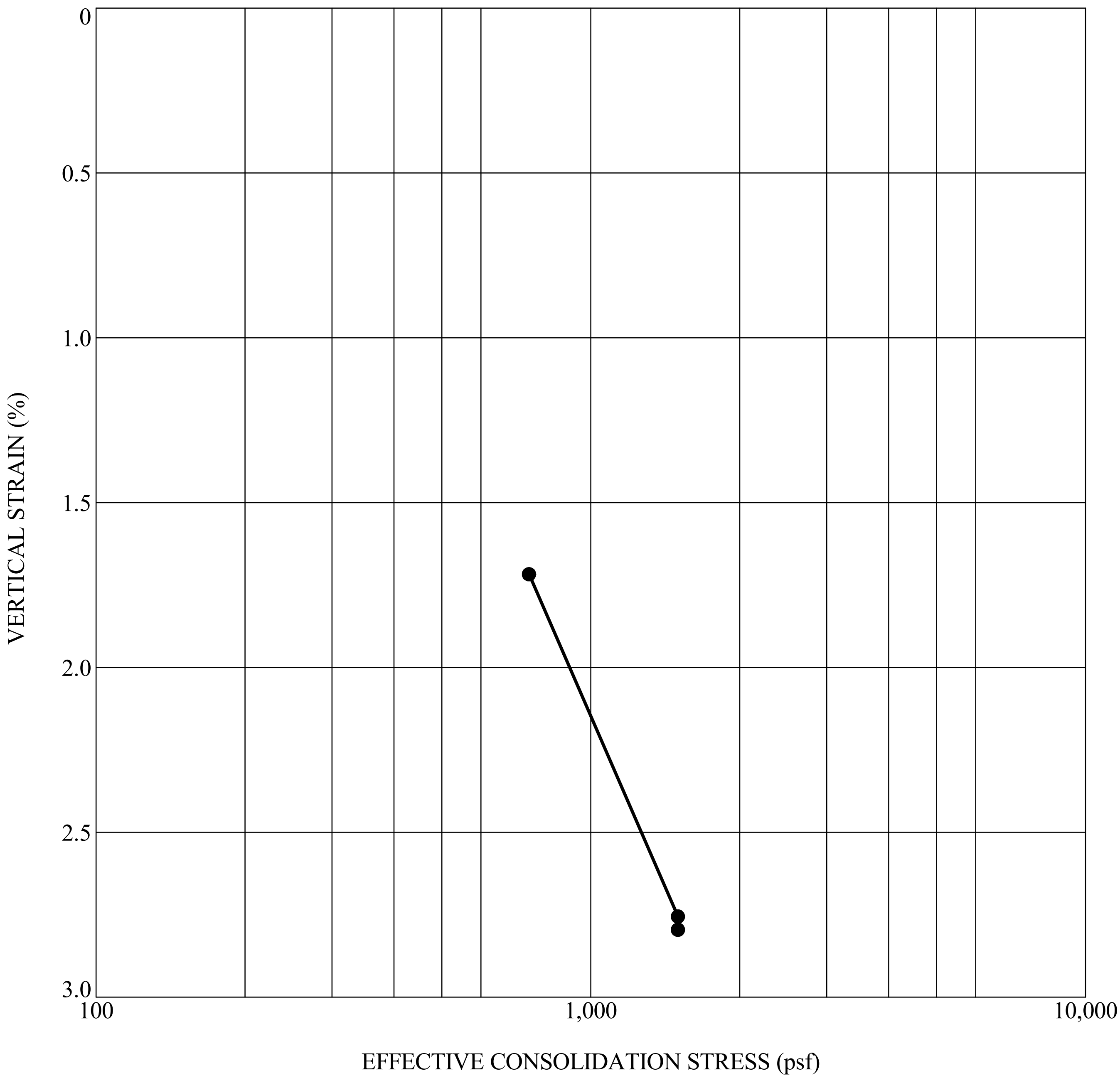
	Sample Location	Depth (ft)	Classification	γ_d (pcf)	MC (%)	Inundation Load (psf)	Swell (%)	Collapse (%)
●	**B-1**	**5.0**	**Lean CLAY**	**94**	**29**	**1500**	**0.08**	

GeoStrata

1-D SWELL/COLLAPSE TEST

312 Holdings, LLC
Halcyon Lake Estates
Weber County, Utah
Project Number: 1459-001

Plate
C - 9



	Sample Location	Depth (ft)	Classification	γ_d (pcf)	MC (%)	Inundation Load (psf)	Swell (%)	Collapse (%)
●	**B-3**	**2.5**	**SILT**	**90**	**33**	**1500**		**0.04**

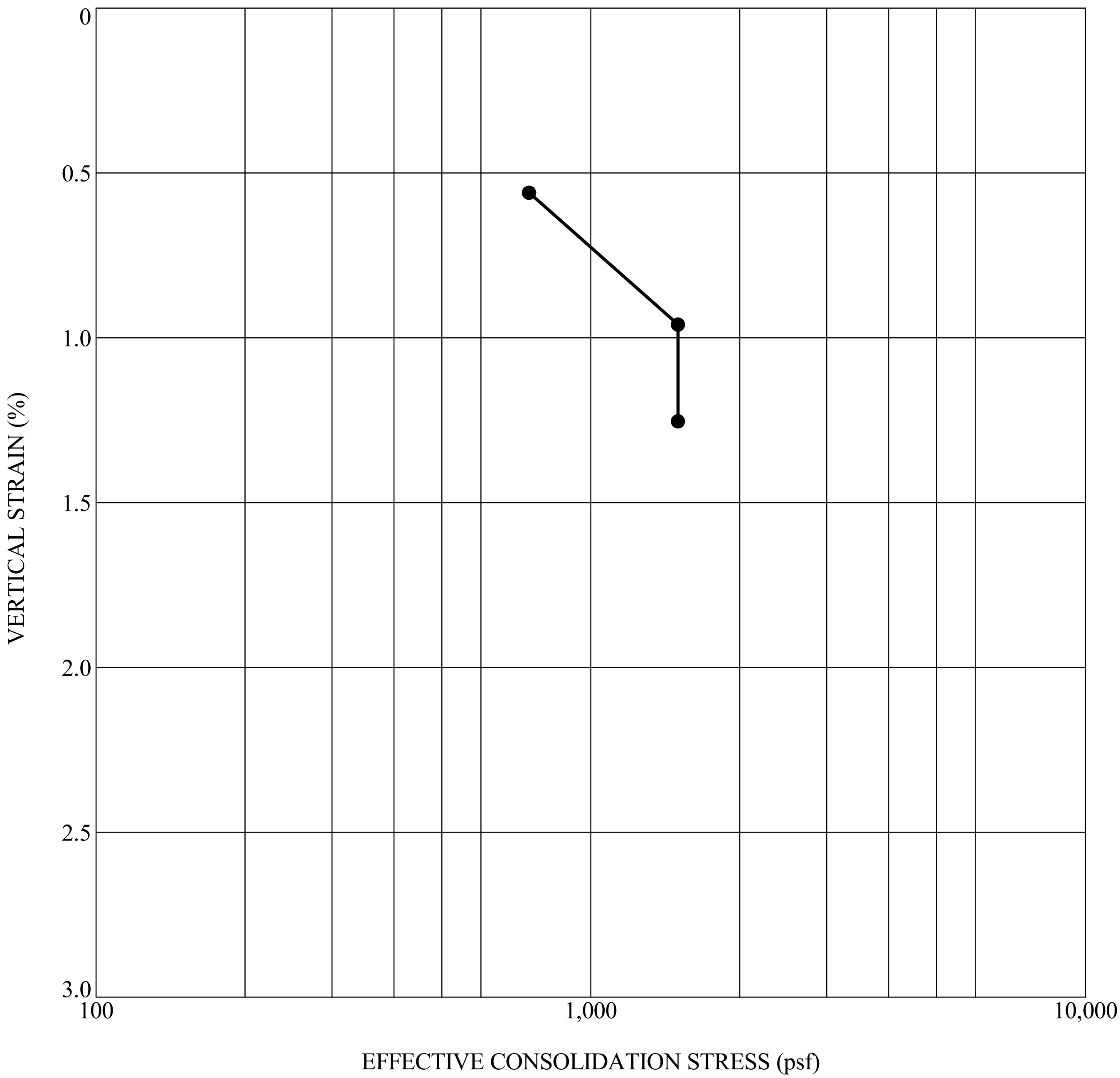
1-D SWELL/COLLAPSE TEST

GeoStrata

312 Holdings, LLC
Halcyon Lake Estates
Weber County, Utah
Project Number: 1459-001

Plate

C - 10



	Sample Location	Depth (ft)	Classification	γ_d (pcf)	MC (%)	Inundation Load (psf)	Swell (%)	Collapse (%)
●	**B-5**	**7.5**	**Silty SAND**	**98**	**26**	**1500**		**0.29**

GeoStrata

1-D SWELL/COLLAPSE TEST

312 Holdings, LLC
Halcyon Lake Estates
Weber County, Utah
Project Number: 1459-001

Plate

C - 11

Source of Material **B-6 1.5 ft.**

Material Description **Lean CLAY with sand**

Test Method **ASTM D698 Method C**

ATTERBERG LIMITS		
LL	PL	PI
26	**19**	**7**

Percent Passing # 4 Sieve **100.0**

Percent Passing # 200 Sieve **77.3**

TEST RESULTS

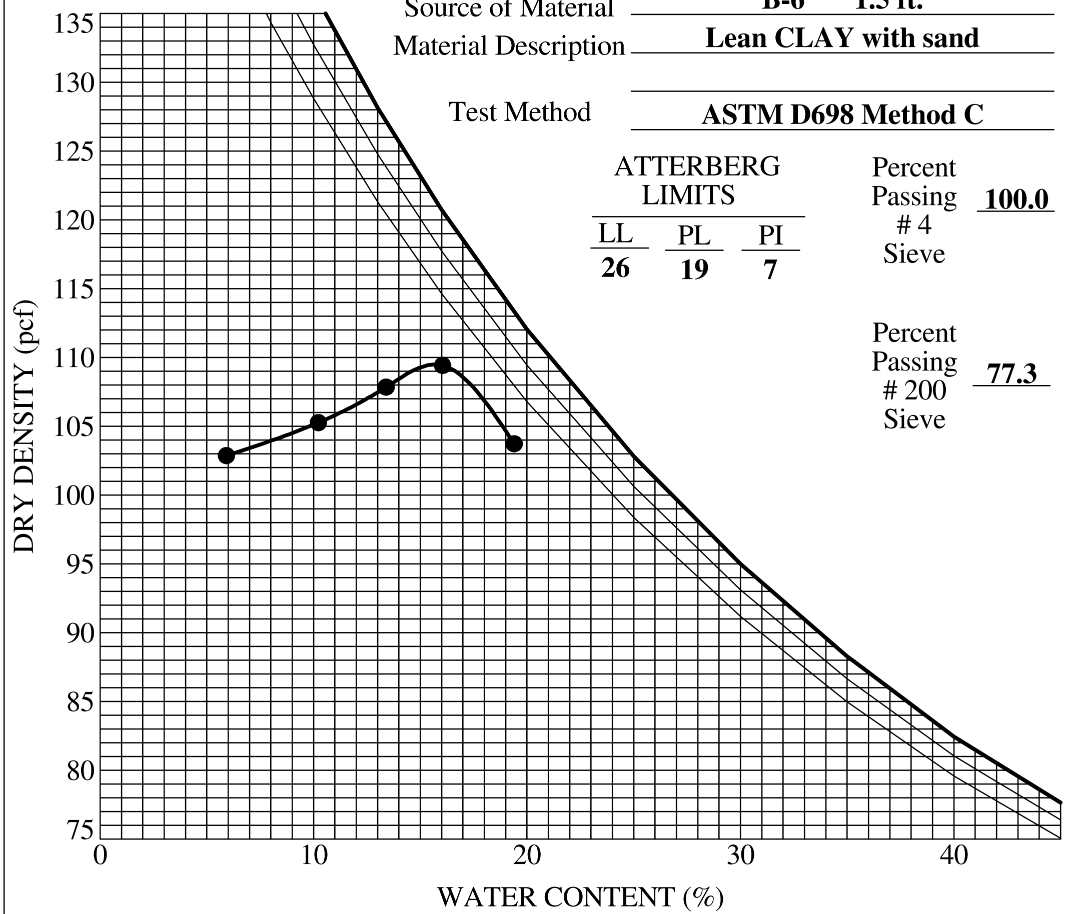
Maximum Dry Density **110.7** (pcf)

Optimum Water Content **16.3** (%)

Percent Rock ______ (%)

Corrected Maximum Dry Density ______ (pcf)

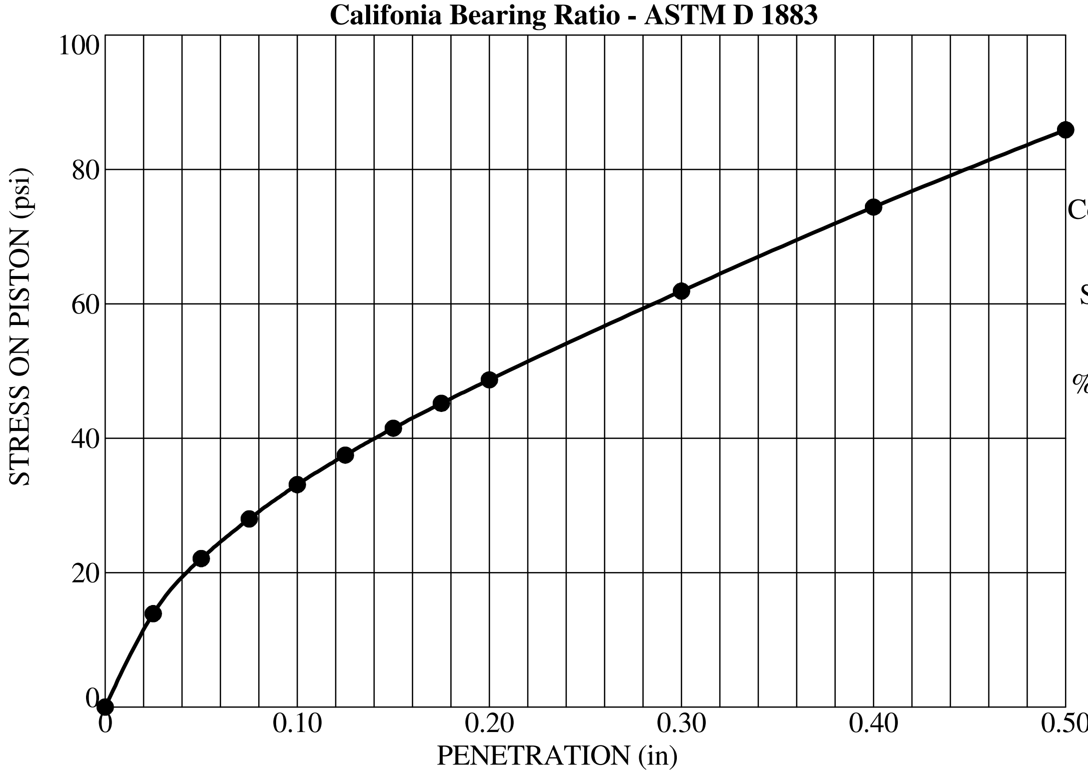
Corrected Optimum Water Content ______ (%)



Curves of 100% Saturation for Specific Gravity Equal to:

2.60, 2.70, 2.80

Califonia Bearing Ratio - ASTM D 1883



Dry Density **108.2** (pcf)

Relative Compaction **98** (%)

Surcharge **50** (psf)

% Standard CBR **3.30**

Swell **0.00** (%)

GeoStrata

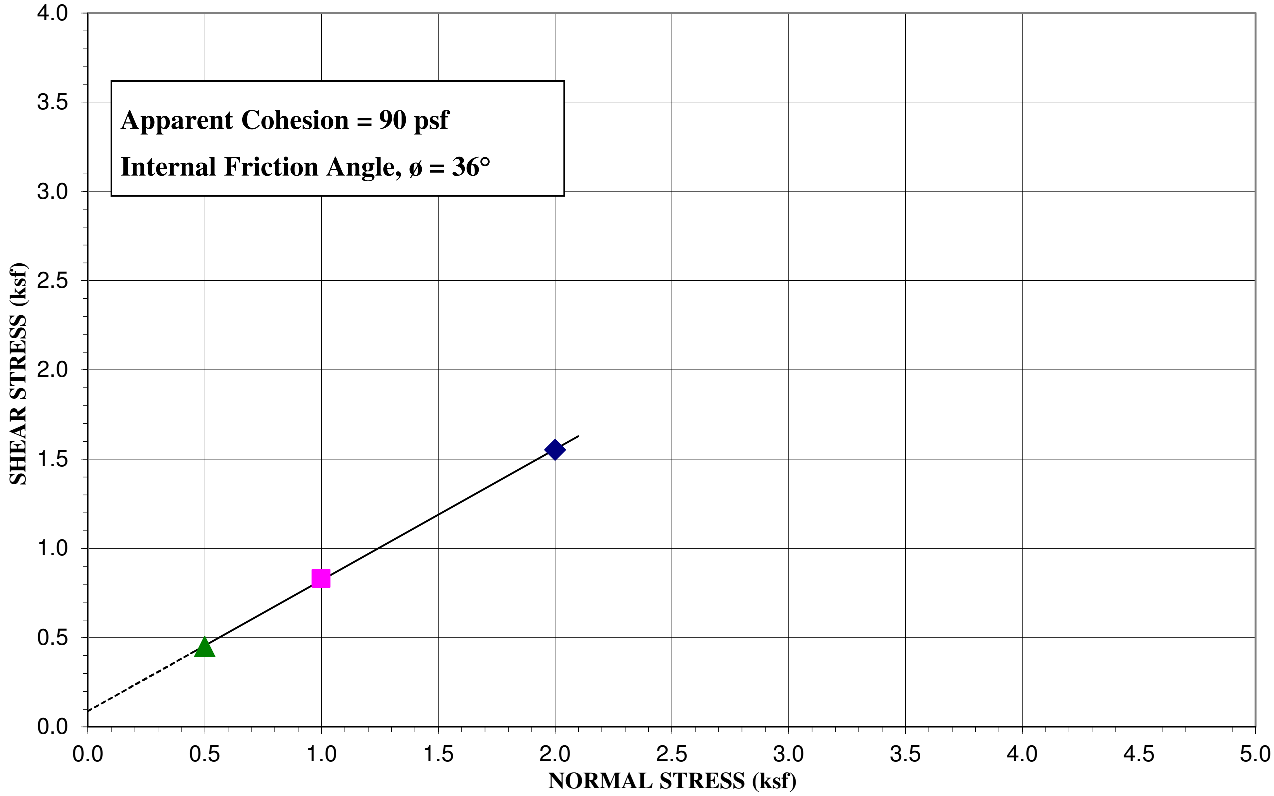
COMPACTION AND CBR TEST

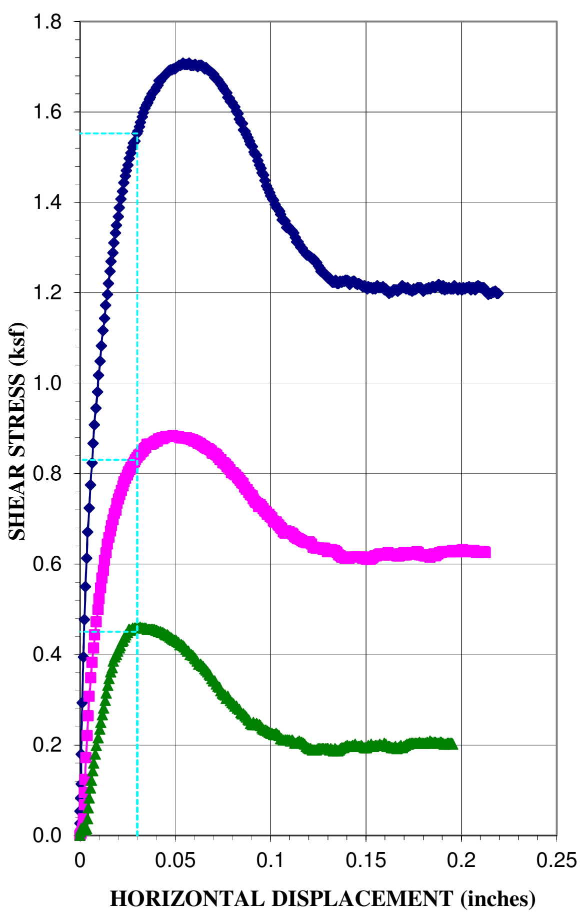
312 Holdings, LLC
Halcyon Lake Estates
Weber County, Utah
Project Number: 1459-001

Plate

C - 12

DIRECT SHEAR TEST





Sample Location:	B-1 @ 10
Type of Test:	Consolidated Drained/Saturated

Test No. (Symbol)	**1 (◆)**	**2 (■)**	**3 (▲)**
Sample Type	Remolded		
Initial Height, in.	0.931	0.929	0.931
Diameter, in.	2.5	2.5	2.5
Dry Density Before, pcf	98.8	100.5	100.2
Dry Density After, pcf	100.9	102.6	102.3
Moisture % Before	22.0	20.5	20.7
Moisture % After	22.2	21.1	21.1
Saturation, % Before	86.5	84.0	84.3
Saturation, % After	92.1	91.4	90.7
Normal Load, ksf	2.0	1.0	0.5
Shear Stress, ksf	1.55	0.83	0.45
Strain Rate	0.001507 IN/MIN		

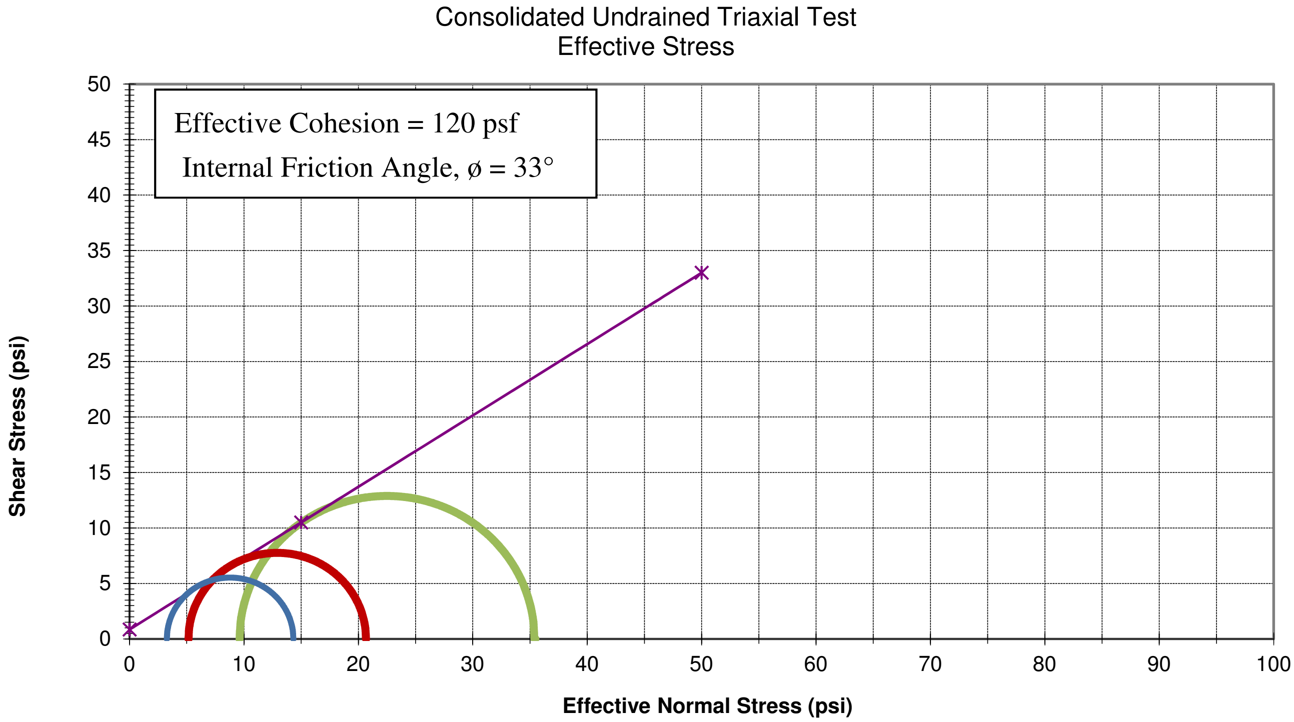
Sample Properties	
Cohesion, psf	90
Friction Angle, ϕ	36
Liquid Limit, %	0
Plasticity Index, %	0
Percent Gravel	
Percent Sand	
Percent Passing No. 200 sieve	4.4
Classification	SP

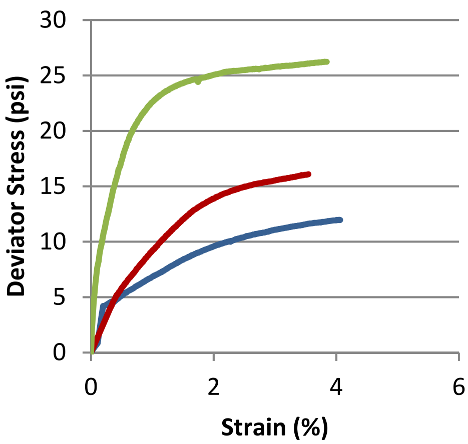
PROJECT: Halcyon Lake Estates

PROJECT NO.: **1459-001**

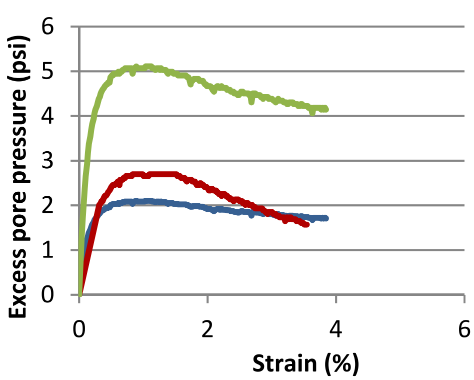
GeoStrata

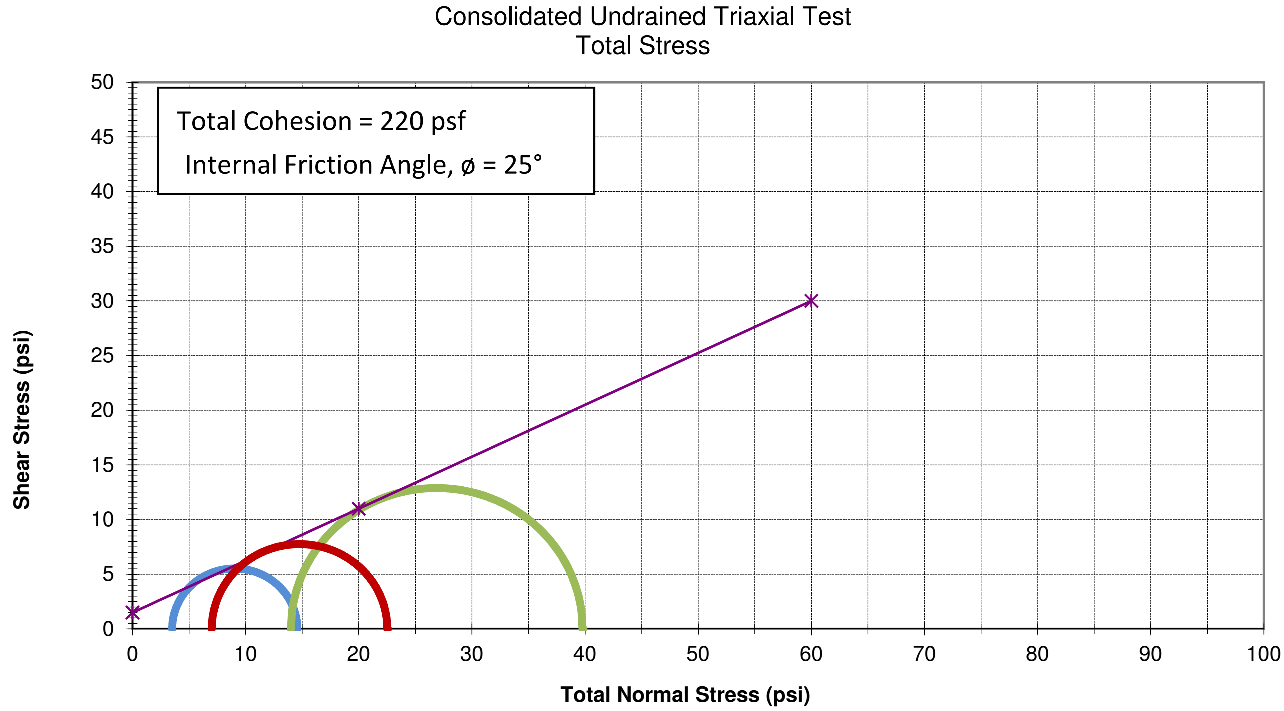
Plate C-13

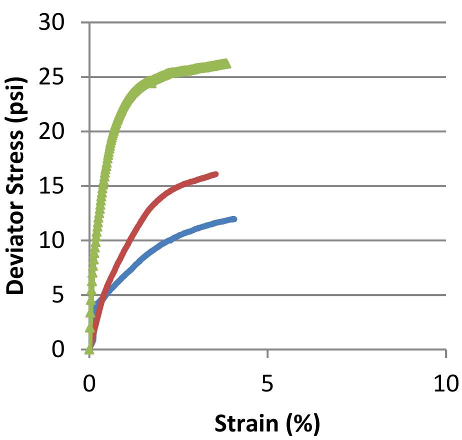


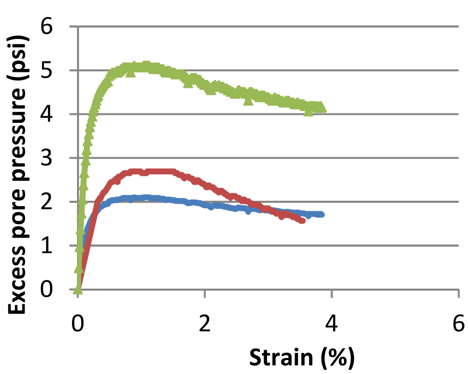


Sample Location	B-1 @ 20		
Sample Type	Undisturbed		
Test Type	Consolidated Undrained		
Length (in)	5.68	NA	NA
Diameter (in)	2.83	NA	NA
Dry Density (pcf)	90.4	NA	NA
Moisture (%)	33.1	NA	NA
Consolidation Press (psf)	504	1008	2016
"B" Parameter	0.95	0.95	0.95
Total Confining Stress σ_3 (psi)	3.5	7.0	14.0
Total Axial Stress σ_1 (psi)	14.6	22.5	39.8
Deviator Stress σ_1-σ_3 (psi)	11.1	15.5	25.8
Effective Confining Stress σ_3' (psi)	3.3	5.1	9.6
Effective Axial Stress σ_1' (psi)	14.3	20.7	35.4
Pore Pressure μ (psi)	0.2	1.9	4.4
Strain (%)	5.0	5.0	5.0



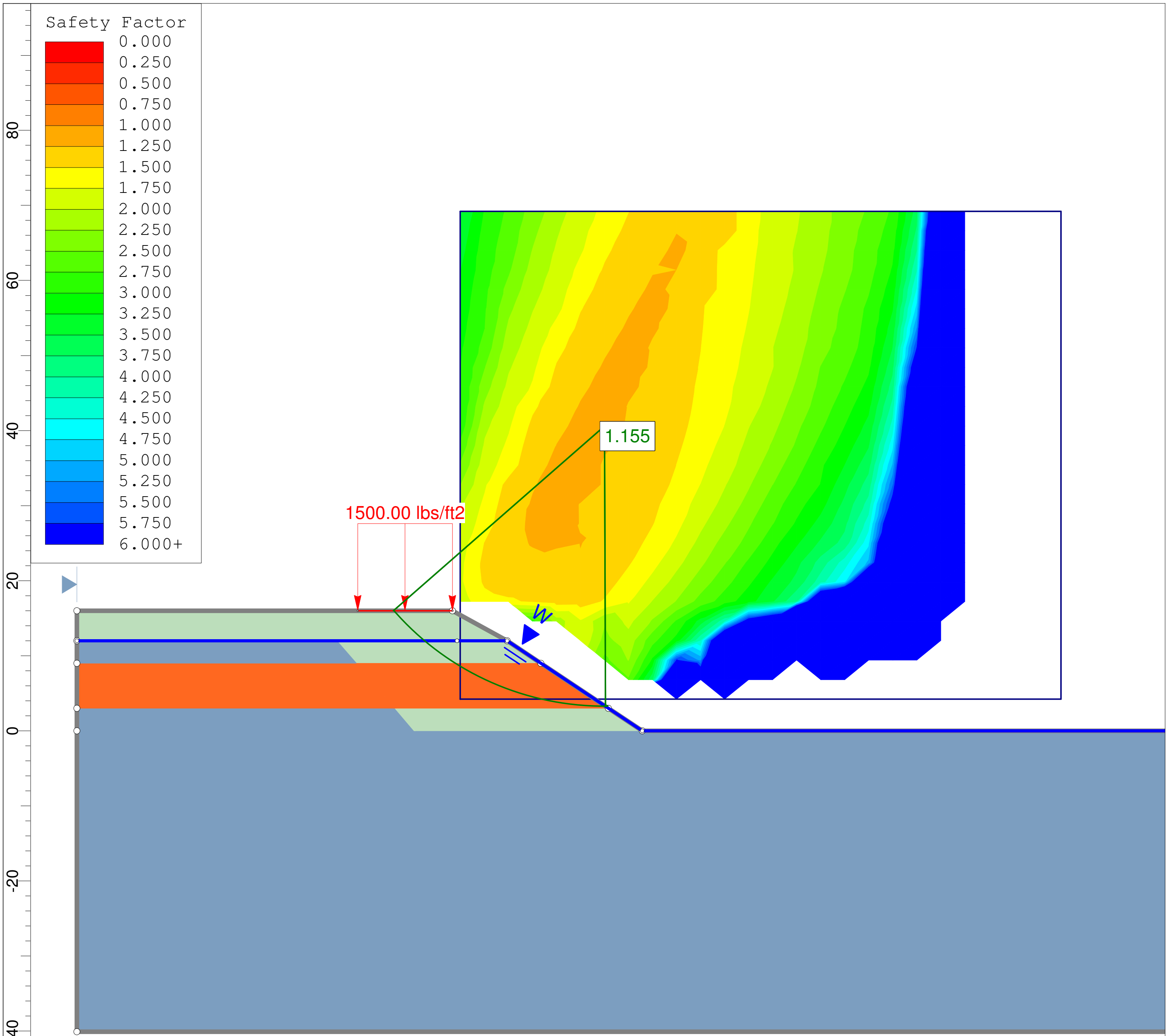






Sample Location	B-1 @ 20		
Sample Type	Undisturbed		
Test Type	Consolidated Undrained		
Length (in)	5.68	NA	NA
Diameter (in)	2.83	NA	NA
Dry Density (pcf)	90.4	NA	NA
Moisture (%)	33.1	NA	NA
Consolidation Press (psf)	504	1008	2016
"B" Parameter	0.95	0.95	0.95
Total Confining Stress σ_3 (psi)	3.5	7.0	14.0
Total Axial Stress σ_1 (psi)	14.6	22.5	39.8
Deviator Stress σ_1-σ_3 (psi)	11.1	15.5	25.8
Effective Confining Stress σ_3' (psi)	3.3	5.1	9.6
Effective Axial Stress σ_1' (psi)	14.3	20.7	35.4
Pore Pressure μ (psi)	0.2	1.9	4.4
Strain (%)	5.0	5.0	5.0

Appendix D



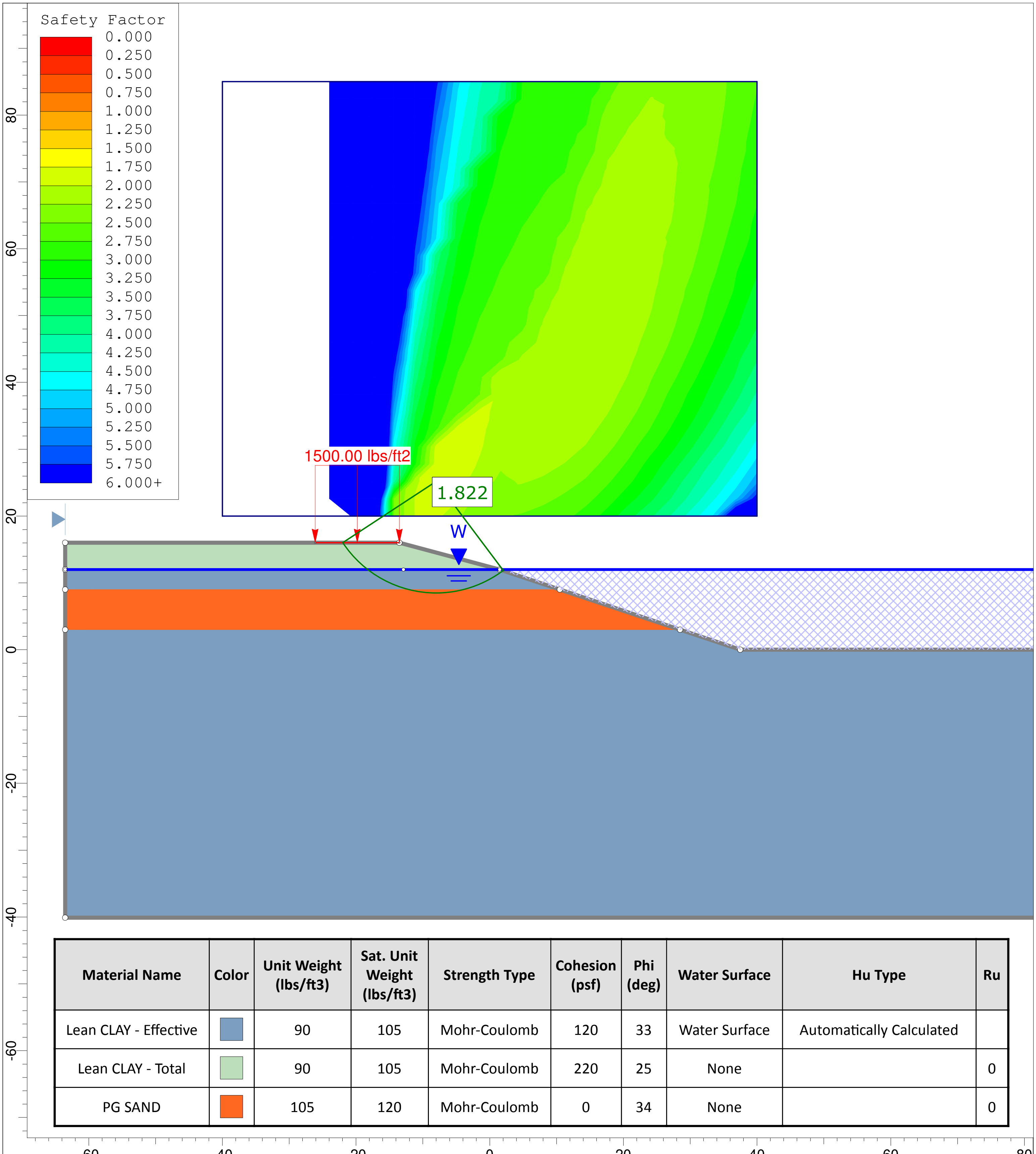
Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Hu Type	Ru
Lean CLAY - Effective		90	105	Mohr-Coulomb	120	33	Water Surface	Automatically Calculated	
Lean CLAY - Total		90	105	Mohr-Coulomb	220	25	None		0
PG SAND		105	120	Mohr-Coulomb	0	34	None		0

GeoStrata

Global Stability - Temporary 1.5H:1V Static

312 Holdings, LLC
Halcyon Lake Estates
Weber County, Utah
Project Number: 1459-001

Plate D-1



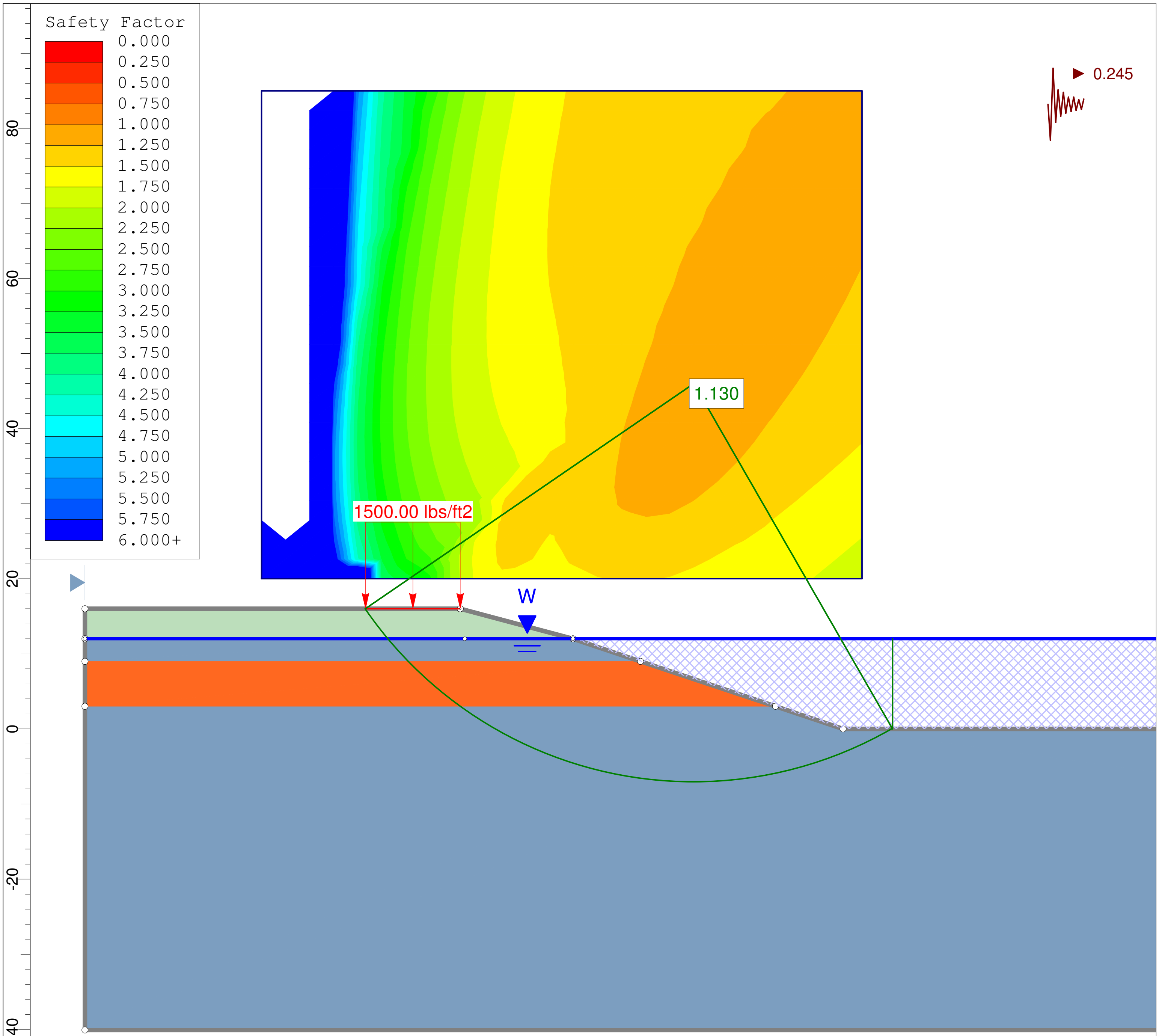
Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Hu Type	Ru
Lean CLAY - Effective		90	105	Mohr-Coulomb	120	33	Water Surface	Automatically Calculated	
Lean CLAY - Total		90	105	Mohr-Coulomb	220	25	None		0
PG SAND		105	120	Mohr-Coulomb	0	34	None		0

GeoStrata

Global Stability - Permanent 3H:1V Static

312 Holdings, LLC
Halcyon Lake Estates
Weber County, Utah
Project Number: 1459-001

Plate D-2



Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Hu Type	Ru
Lean CLAY - Effective		90	105	Mohr-Coulomb	120	33	Water Surface	Automatically Calculated	
Lean CLAY - Total		90	105	Mohr-Coulomb	220	25	None		0
PG SAND		105	120	Mohr-Coulomb	0	34	None		0

GeoStrata

Global Stability - Permanent 3H:1V Pseudo-Static

312 Holdings, LLC
Halcyon Lake Estates
Weber County, Utah
Project Number: 1459-001

Plate D-3