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Geotechnical Investigation
Madyson Place
4472 West Maegan Nicole Lane
Riverton, Utah

GeoStrata Job No. 1012-007

October 29, 2015

Prepared for:

Keystone Construction
8679 South Sandy Parkway, Suite A
Sandy, UT 84070

Attn: Mr. Grant Lefgren

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APPENDICES

1.0 EXECUTIVE SUMMARY

This report presents the results of a geotechnical investigation conducted for the proposed Madyson Place subdivision located at 4472 West Maegan Nicole Lane in Riverton, 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 general site grading and the design and construction of foundations, slab-on-grades, and exterior concrete flatwork.

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.

Based on our observations and geologic literature review, the subject site is overlain by ½ to 2½ feet of undocumented fill soils composed of silt and gravel. Underlying the undocumented fill soils are clay deposits which are mapped as being Pleistocene-age silt and clay deposits associated with the regressive phase of Lake Bonneville. It is anticipated that topsoil and additional fill soils associated with the demolition of existing structures will be encountered during construction. Groundwater was not encountered in the test pits completed for this investigation, and is not expected to impact the development.

Conventional spread and strip footings may be used to support the proposed structure. Due to the presence of potentially collapsible silty/clayey soils located at the site, all foundations should be advanced until granular gravel soils are encountered. The footings may then be either established upon these soils or the site may be brought back up to design grade using properly compacted structural fill. Alternatively, the potentially collapsible soils may be left in place as long as the foundations are founded entirely on a minimum of 24 inches of structural fill. In addition, foundation elements should not be placed on combination soils, i.e. partially on silt and partially on gravel. If combination soils are encountered, then a minimum of 12-inches of these soils should be over-excavated, blended and replaced as structural fill. Under no circumstances should footings be placed directly on potentially collapsible native soils. Conventional strip and spread footings founded on undisturbed, uniform, non-disturbed native soils or on structural fill may be proportioned for a maximum net allowable bearing capacity of 1.500 psf.

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 Madyson Place subdivision located at 4472 West Maegan Nicole Lane in Riverton, 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 general site grading and the design and construction of foundations, slab-on-grades, and exterior concrete flatwork.

The scope of work completed for this study included a site reconnaissance, subsurface exploration, soil sampling, laboratory testing, engineering analyses, and preparation of this report. Our services were performed in accordance with our proposal, dated September 1, 2015 and your signed authorization.

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

2.2 PROJECT DESCRIPTION

The subject property is located at 4472 West Maegan Nicole Lane in Riverton, Utah (see Plate A-1, *Site Vicinity Map*). Our understanding of the proposed development is based on information provided by the client. We understand that the development will consist of two residential building lots having a combined area of approximately 1.03 acres. We anticipate that the improvements will consist of 1 to 2 story single-family residential structures with basements with associated landscaping and pavements. We anticipated footing loads on the order of 3 to 5 klf. This report provides design parameters for construction of buildings and associated infrastructure.

3.0 METHODS OF STUDY

3.1 FIELD INVESTIGATION

As a part of this investigation, subsurface soil conditions were explored by excavating five test pits to depths of 5½ to 10 feet below existing site grade. The approximate locations of the explorations are shown on the *Exploration Location Map*, Plate A-2 in Appendix A. Subsurface soil conditions as encountered in the explorations were logged at the time of our investigation by a geotechnical engineer and are presented on the enclosed Test Pit Logs, Plates B-1 to B-5 in Appendix B. A *Key to Soil Symbols and Terminology* is presented on Plate B-6.

The test pits were excavated with the aid of a mini trackhoe. Bulk and undisturbed soil samples were obtained in the test pit explorations which were transported to our laboratory for testing to evaluate 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 Test Pit Logs.

3.2 LABORATORY INVESTIGATION

Geotechnical laboratory tests were conducted on selected soil samples obtained during our field investigation. The laboratory testing program was designed to evaluate the engineering characteristics of onsite earth materials. Laboratory tests conducted during this investigation include:

- Grain Size Distribution Analysis (ASTM D422)
- Atterberg Limits Test (ASTM D4318)
- 1-D Consolidation Test (ASTM D2435)
- Collapse Potential Test (ASTM D5333)

The results of laboratory tests are presented on the test pit logs in Appendix B (Plates B-1 to B-5), the Lab Summary Report (Plate C-1) and on the test result plates presented in Appendix C (Plates C-2 through C-5).

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.

Excavation stability was evaluated based on the field conditions encountered, laboratory test results, and soil type. Occupational Safety and Health (OSHA) minimum requirements are typically prescribed unless conditions warrant further flattening of excavation walls.

4.0 GENERALIZED SITE CONDITIONS

4.1 SURFACE CONDITIONS

The subject property is located at 4472 West Maegan Nicole Lane in Riverton, Utah. The site is currently vacant, although we understand that a structure was previously present on the site. The site is moderately vegetated with native weeds and grasses, and contains occasional piles of undocumented fill soils and other debris. The property is relatively flat at an elevation of 4,724 feet above mean sea level with a total topographic relief across the site of approximately 3 feet.

4.2 SUBSURFACE CONDITIONS

As previously discussed, the subsurface soil conditions were explored at the site by excavating five test pits at representative locations within the property. The test pits extended to depths of 5½ to 10 feet below existing site grade. The soils encountered in the test pit explorations were visually classified and logged during our field investigation and are included on the test pit logs in Appendix B (Plates B-1 and B-5). The subsurface conditions encountered during our investigation are discussed below.

4.2.1 Soils

Based on our observations and geologic literature review, the subject site is overlain by ½ to 2½ feet of undocumented fill soils composed of silt and gravel. This fill unit may be thicker than observed depending on the original topography of the site. Underlying the undocumented fill soils we encountered Pleistocene-age silt and clay deposits associated with the regressive phase of Lake Bonneville. It is anticipated that topsoil and additional fill soils associated with the demolition of existing structures will be encountered during construction. Descriptions of the soil units encountered are provided below:

<u>Undocumented Fill Soil:</u> Generally consists of brown Silty GRAVEL (GM) with sand. It is likely that this material was derived from the demolition of the pre-existing structure. Undocumented fill soils were encountered in each of the test pits excavated as part of this investigation, and likely overlay the majority of the site.

<u>Pleistocene-age Silt and Clay Deposits of Regressive Phase of Lake Bonneville:</u> This geologic unit is mapped as being sandy clay to clayey silt and silty clay. The soils observed in our test pits

consisted of alternating seams of fine-grained and coarse-grained sediments. Coarse-grained sediments consisted of dense, brown, Silty GRAVEL (GM) with sand, Poorly Graded GRAVEL (GP) with sand, and Silty SAND (SM). Fine-grained sediments consisted of stiff, moist, brown, Silty CLAY (CL-ML) with sand and gravel, SILT (ML), SILT (ML) with sand, and Sandy SILT (ML). Occasional fine pinholes were observed throughout the fine-grained soil units. These deposits extended to the full depth of our investigation.

The stratification lines shown on the enclosed test pit logs represent the approximate boundary between soil types (Plates B-1 and B-5). The actual in-situ transition may be gradual. Due to the nature and depositional characteristics of the native soils, care should be taken in interpolating subsurface conditions between and beyond the exploration locations.

4.2.2 Groundwater

Groundwater was not encountered in the test pits excavated as part of our investigation. It is likewise not anticipated that groundwater will impact the proposed improvements. It is our experience that during snowmelt, runoff, irrigation on the property and surrounding properties, high precipitation events, and other activities, the groundwater level can rise several feet. Fluctuations in the groundwater level should be expected over time.

4.2.3 Hydro-Collapsible 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. A total of four collapse potential tests were completed on relatively "undisturbed" samples retrieved from depths ranging from 2 to 6 feet below the existing ground surface. The samples tested exhibited volumetric strain ranging from 0.60 to 4.58 percent upon wetting, indicating that the fine-grained soils at the site have a low to high potential to collapse upon wetting. The results of these tests are presented in Appendix C. Recommendations for construction if these soils are present is included in Section 6 of this report.

5.0 GEOLOGIC CONDITIONS

5.1 GEOLOGIC SETTING

The site is located in Riverton, Utah at an elevation of approximately 4,725 feet in the southern portion of the Salt Lake Valley. The Salt Lake Valley is a deep, sediment-filled structural basin of Cenozoic age flanked by the Wasatch Range to the east and the Oquirrh Mountains, the Promontory Mountains, and the West Hills to the west (Hintze, 1980). A portion of western boundary of the Salt Lake Valley is bordered by the eastern 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 Valley is dominated by sediments, which were deposited within the last 30,000 years by 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 at the site are mapped as upper Pleistocene-aged lacustrine silt and clay deposits associated with the Provo phase of the Bonneville Lake cycle (Davis, 2000).

5.2 SEISMICITY AND FAULTING

The site lies within the north-south trending belt of seismicity known as the Intermountain Seismic Belt (ISB) (Hecker, 1993). The ISB extends from northwestern Montana through southwestern Utah. An active fault is defined as a fault that has had activity within the Holocene (<11ka). No active faults are mapped through or immediately adjacent to the site (Black and others, 2003, and Solomon and others, 2006). The site is located approximately 8½ miles west of the nearest mapped portion of the of the Salt Lake City segment of the Wasatch Fault Zone, which is mapped along the western flank of the Wasatch Mountains and the Salt Lake Salient. The Salt Lake City segment of the Wasatch Fault Zone was reportedly last active approximately 1,800 years ago and has a recurrence interval of approximately 2,400 years (Black et. al., 1996, Black et. al., 2003). The site is also located approximately 10¼ miles south of the mapped Taylorsville fault. The Taylorsville fault is one of two main splays of the West Valley fault zone (Keaton and Curry, 1993). The West Valley fault zone trends in a north-south orientation and is located in the central portion of the Salt Lake Valley. While the West Valley fault zone is reported to be active and probably seismically independent of the Wasatch fault zone, sympathetic movement on the West Valley fault zone resulting from major earthquakes on the Wasatch fault zone Salt Lake City segment of the Wasatch fault zone is a possibility. Finally, the site is also located approximately 11 miles east of the Oquirrh Fault Zone. The Oquirrh Fault Zone consists of a normal fault located along the western base of the Oquirrh Mountains in the eastern Tooele Valley. This fault was reportedly last active approximately 4,300 and 6,900 years ago, and appears to be seismically independent of the Wasatch Fault Zone (Black and others, 2004). Analyses of 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, 2009). 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 D which represents a "stiff soil" profile. The spectral accelerations are shown in the table below. The spectral accelerations are calculated based on the site's approximate latitude and longitude of 40.5173° and –111.9974 respectively and the United States Geological Survey 2012 ground motion calculator version 5.1.0 (USGS, 2011). Based on the IBC, the site coefficients are F_a=1.01 and F_v=1.72. From this procedure the peak ground acceleration (PGA) is estimated to be 0.49g.

MCE Seismic Response Spectrum Spectral Acceleration Values for IBC Site Class D[a]

Site Location: **Latitude = 40.5172 N** **Longitude = -111.9974 W**	**Site Class D Site Coefficients:** **Fa = 1.01** **Fv = 1.72**
Spectral Period (sec)	**Response Spectrum Spectral Acceleration (g)**
0.2	$S_{MS}=(F_a * S_s=1.01*1.22) = 1.23$
1.0	$S_{M1}=(F_v * S_1=1.72*0.34) = 0.59$
[a] IBC 1615.1.3 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.

Based on our review of the *Surface Rupture Liquefaction Potential Special Study Areas, Salt Lake County, Utah*, map, the site is located in an area currently designated as having a "Very Low" liquefaction potential. "Very Low" liquefaction potential indicates that there is a less than 5% probability of having an earthquake within a 100-year period that will be strong enough to cause liquefaction. Groundwater was not encountered in any of our investigations, and as such, these soils are typically not considered susceptible to liquefaction. However, it is possible that liquefiable soils exist at greater depths not investigated as part of this study. A liquefaction analysis was beyond the scope of the project; however, if the owner wishes to have greater understanding of the liquefaction potential of the soils at greater depths, a liquefaction analysis should be completed at the site.

6.0 ENGINEERING CONCLUSIONS AND RECOMMENDATIONS

6.1 GENERAL CONCLUSIONS

Based on the subsurface conditions encountered at the site, it is our opinion that the subject site is suitable for the proposed construction provided that the recommendations contained in this report are complied with. The recommendations presented in this report are based on our understanding of the proposed project, the subsurface conditions observed during field exploration, the results of laboratory testing, and our engineering analyses. If subsurface conditions other than those described herein are encountered in conjunction with construction, and/or if design and layout changes are initiated, we must be informed so that the recommendations herein can be reviewed and revised as changes or conditions may require.

6.2 EARTHWORK

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

6.2.1 General Site Preparation and Grading

In areas beneath footings, pavements, and concrete flat work, topsoil should be stripped and stockpiled for use in landscape areas or disposal. Debris, undocumented fill, vegetation, roots, loose, soft or other deleterious materials should also be removed and replaced with structural fill. 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 test pit logs or may present a concern, GeoStrata should be notified so observations and further recommendations as required can be made. The exposed native soils should then be proof-rolled with heavy rubber-tired equipment. If soft soils are observed, they should be stabilized in accordance with our recommendations in Section 6.2.3; if loose soils are observed, they should be compacted as recommended in Section 6.2.4.

6.2.2 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. Deeper excavations, if required, should be constructed with side slopes no steeper than one and one-half horizontal to one vertical (1.5H:1V). If wet conditions are encountered, side slopes should be further flattened to maintain slope stability. Alternatively shoring or trench boxes may be used to improve safe work conditions in trenches. 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.

6.2.3 Soft Soil Stabilization

Soft or pumping soils may be exposed in excavations at the site. Once exposed, all subgrade surfaces beneath proposed structure and flat work concrete should be proof rolled with 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-rounded to rounded material over the woven geotextile. An inexpensive non-woven geotextile "filter" fabric should also be placed over the top of the coarse, sub-rounded to rounded fill prior to placing structural fill or pavement section soils to reduce infiltration of fines from above. The woven geotextile should be Tencate Mirafi RS280i or prior approved equivalent. The filter fabric should consist of Tencate Mirafi 160N or equivalent as approved by the Geotechnical Engineer.

6.2.4 Structural Fill and Compaction

All fill placed for the support of structures, concrete flatwork or pavements should consist of structural fill. Structural fill may consist of native granular soils if material exceeding 4-inches in nominal diameter are first screened out. Structural fill may also consist of reworked, native fine-grained soils, although the contractor should be aware that these soils can be difficult to moisture condition and compact. Onsite undocumented fill soils may be suitable for structural fill provided that they are free of debris and clasts larger than 4-inches in nominal diameter. The contractor should have confidence that the anticipated method of compaction will be suitable for the type of structural fill used. All structural fill should be free of vegetation, debris or frozen material, and should contain no inert materials larger than 4 inches nominal size. Alternatively, an imported structural fill meeting the specifications below may be used. If soil is imported for use as structural fill, we recommend that it be a relatively well graded granular soil with a maximum of 50 percent passing the No. 4 mesh sieve and a maximum fines content (minus No.200 mesh sieve) of 25 percent. All structural fill soils should be approved by the Geotechnical Engineer prior to placement. Clay and silt particles in imported structural fill should have a liquid limit less than 35 and a plasticity index less than 15 based on the Atterberg Limit's test (ASTM D-4318). The contractor should anticipate testing all soils used as structural fill frequently to assess the maximum dry density, fines content, and moisture content, etc.

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 12-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 with an overall thickness of 6 feet or less should be compacted to at least

95% of the maximum dry density, as determined by ASTM D-1557 (modified proctor). The moisture content should be within 3% of 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 6.2.1).

Fill soils placed for subgrade below exterior pavements and flat work 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 D-1557. 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 D-1557. All other trenches, in landscape areas, should be backfilled and compacted to at least 90% of the maximum dry density (ASTM D-1557).

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 founded on undisturbed, uniform, granular, native soils. If combination (non-uniform) soils are exposed in the foundation excavation, a minimum of 12 inches of the combination soils should be removed and replaced with structural fill. Due to the presence of potentially collapsible silty/clayey soils, all foundation excavations should be advanced until granular gravel/sand soils are encountered. The footings may then be either established upon these soils, or the site may be brought back up to design grade using properly compacted structural fill. Alternatively, the potentially collapsible clayey soils may be left in place as long as the foundations are founded entirely on a minimum of 24 inches of structural fill. Under no circumstances should footings be placed directly on potentially collapsible native soils. Strip and spread footings should be a minimum of 20 and 36 inches wide, respectively, and exterior shallow footings should be embedded at least 36-inches below final grade for frost protection and confinement. Interior footings not subject to frost should be embedded at least 18 inches below final grade to provide confinement.

Conventional strip footings founded entirely on undisturbed, uniform, non-collapsible, native soils or on properly placed and compacted structural fill may be proportioned for a maximum net allowable bearing capacity of **1,500 psf**. The net allowable bearing capacity may be increased (typically by one-third) for temporary loading conditions such as transient wind and seismic loads. All footing excavations should be observed by the Geotechnical Engineer prior to footing placement.

Settlements of properly designed and constructed conventional footings, founded as described above, are anticipated to be less than 1 inch. Differential settlements should be on the order of half the total settlement over 30 feet.

If recommendations are not followed to provide drainage away from the structure, downspouts are not discharged away from foundations as discussed in Section 6.7 of this report, and/or excessive irrigation occurs next to the foundation, the total and/or differential settlements may increase significantly due to wetting induced collapse. It should be noted that by placing the footings on a zone of structural fill over native soils, soils with a potential for hydro-collapse may still be left in place beneath the structure. The Owner should be aware that should these soils become saturated, there is a risk that excessive settlement could occur. If the Owner is unwilling to accept this risk, then all of the soils with a potential for collapse that exist beneath the footings should be removed.

6.4 CONCRETE SLAB-ON-GRADE CONSTRUCTION

Concrete slabs-on-grade should be constructed over at least 4 inches of compacted gravel overlying undisturbed native soil 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 D-1557 (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. The maximum load on the floor slab should not exceed 300 psf; greater loads would require additional subgrade preparation and additional structural fill. 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 EARTH PRESSURES 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 soils. In determining the frictional resistance against concrete, a coefficient of friction of 0.37 for native soils or structural fill should be used.

Ultimate lateral earth pressures from native soils and granular backfill acting against retaining walls and buried 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*	0.35	42
At-rest**	0.52	62
Passive*	2.88	346
Seismic Active***	0.85	102
Seismic Passive***	-1.26	-151

* 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.

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.

6.6 MOISTURE PROTECTION AND SURFACE DRAINAGE

As mentioned previously, due to moderate collapse potential of the on-site soils, it is critical that planning and care be implemented in the site drainage and design of surface water conveyance. Moisture should not be allowed to infiltrate the soils in the vicinity of the foundations. We recommend the following mitigation measures be implemented at the building location;

- The ground surface within 10 feet of the entire perimeter of the building should slope a minimum of five percent away from the structure. Alternatively, a slope of 5% is acceptable if the water is conveyed to a concrete ditch that will convey the water to a point of discharge that is at least 10 feet from the structures.
- Roof runoff devices (rain gutters) should be installed to direct all runoff a minimum of 10 feet away from the structure and preferably day-lighted to the curb where it can be transferred to the storm drain system. Rain gutters discharging roof runoff adjacent to or within the near vicinity of the structure may result in excessive differential settlement.
- We do not recommend storm drain collection sumps be used as part of this development. However, if necessary, sumps should not be located adjacent to foundations or within roadway pavements due to the presence of potentially collapsible soils.
- We recommend irrigation around foundations be minimized by selective landscaping and that irrigation valves be constructed at least 5 feet away from foundations.
- Jetting (injecting water beneath the surface) to compact backfill against foundation soils may result in excessive settlement beneath the building and should not be allowed.

- Backfill against foundations walls should consist of on-site native fine-grained soils and should be placed in lifts and compacted to 90% modified proctor to create a moisture barrier.

Failure to comply with these recommendations could result in excessive total and differential settlements causing structural damage.

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 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, we 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 us 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.

8.0 REFERENCES CITED

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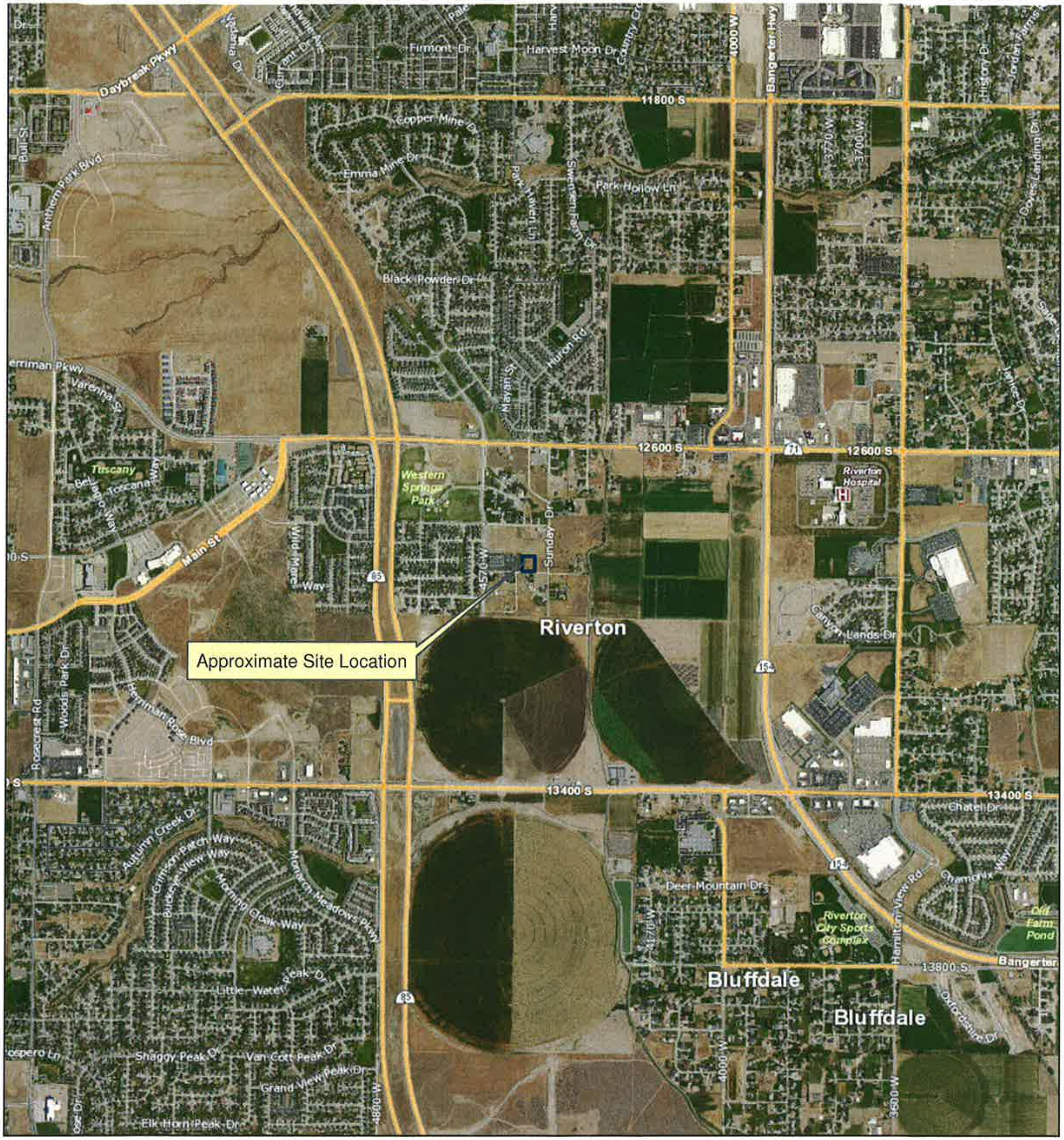

0 750 1,500 3,000 4,500 6,000 Feet

1:24,000

Base Map: Utah AGRC Hybrid Base Map

N

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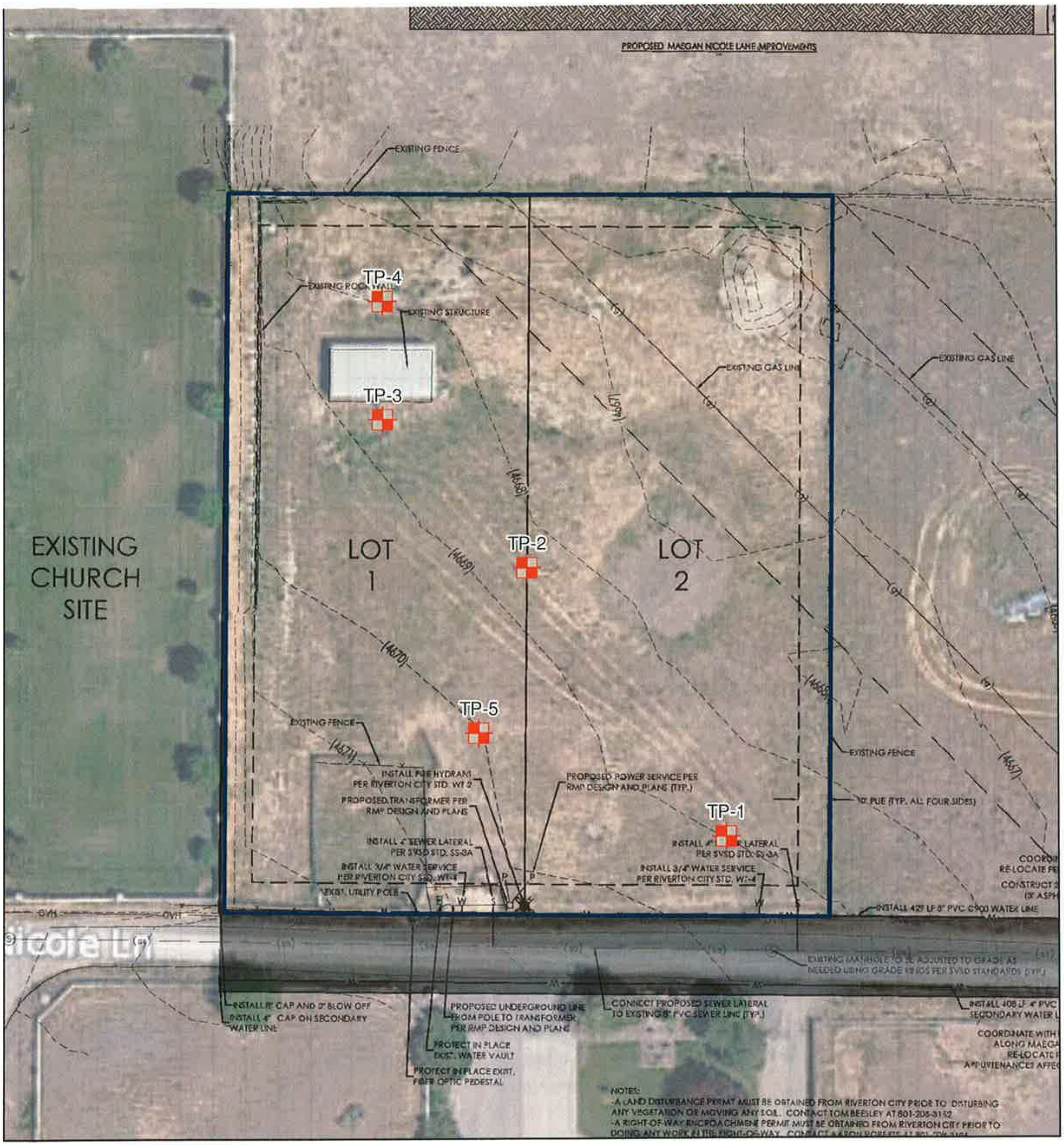
Keystone Construction
Madyson Place
Riverton, UT
Project Number: 1012-007

Site Vicinity Map

Plate A-1



0 15 30 60 90 120 Feet

1:500

Base Map: Utah AGRC Hybrid Base Map
Madyson Place Improvement Plan, Stantec, 7/29/15

N

GeoStrata

Legend

Approximate Test Pit Location

Approximate Site Boundary

Keystone Construction
Madyson Place
Riverton, UT
Project Number: 1012-007

Exploration Location Map

Plate A-2

DATE		
STARTED:	9/3/15	
COMPLETED:	9/3/15	
BACKFILLED:	9/3/15	

Keystone Construction
Madyson Place
Riverton, UT
Project Number 1012-007

GeoStrata Rep: J. Mattson
Rig Type: mini trackhoe

TEST PIT NO: **TP-1**
Sheet 1 of 1

LOCATION
NORTHING EASTING ELEVATION

Depth (feet)	USCS	MATERIAL DESCRIPTION	Dry Density (pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index
0		FILL; Silty GRAVEL with sand - brown, moist					
		TOPSOIL; Silty GRAVEL with sand - dark brown, moist					
	GM	Silty GRAVEL with sand - dense, brown, moist					
	ML	SILT - stiff, brown, moist					
			81.6	10.6	86.4	31	3
10		Bottom of Test Pit @ 10 Feet					

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

DEPTH: METERS 0, 1, 2, 3; FEET 0, 5, 10
SAMPLES | WATER LEVEL | GRAPHICAL LOG | UNIFIED SOIL CLASSIFICATION

GeoStrata

SAMPLE TYPE
- GRAB SAMPLE
- 3" O.D. THIN-WALLED HAND SAMPLER

WATER LEVEL
- MEASURED
- ESTIMATED

NOTES:

Plate B-1

DATE	
STARTED:	9/3/15
COMPLETED:	9/3/15
BACKFILLED:	9/3/15

Keystone Construction
Madyson Place
Riverton, UT
Project Number 1012-007

GeoStrata Rep: J. Mattson
Rig Type: mini trackhoe

TEST PIT NO: **TP-2**
Sheet 1 of 1

LOCATION
NORTHING EASTING ELEVATION

DEPTH (Meters)	DEPTH (Feet)	SAMPLES	WATER LEVEL	GRAPHICAL LOG	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index
0	0					FILL; Silty GRAVEL with sand - brown, moist					
						TOPSOIL; Silty GRAVEL with sand - dark brown, moist					
					CL-ML	Silty CLAY with sand and gravel - stiff, brown, moist					
1					CL-ML	Silty CLAY with sand - stiff, brown, moist, pinholes					
		Grab sample					84.9	8.1	71.7	26	4
	5	Grab sample									
2					GM	Silty GRAVEL with sand - dense, brown, moist					
		Grab sample						5.8	13.9		
						Bottom of Test Pit @ 8.5 Feet					
3	10										

Moisture Content and Atterberg Limits

Plastic Limit — Moisture Content — Liquid Limit

10 20 30 40 50 60 70 80 90

GeoStrata

SAMPLE TYPE
- GRAB SAMPLE
- 3" O.D. THIN-WALLED HAND SAMPLER

WATER LEVEL
- MEASURED
- ESTIMATED

NOTES:

Plate B-2

DATE	
STARTED:	9/3/15
COMPLETED:	9/3/15
BACKFILLED:	9/3/15

Keystone Construction
Madyson Place
Riverton, UT
Project Number 1012-007

GeoStrata Rep: J. Mattson
Rig Type: mini trackhoe

TEST PIT NO: **TP-3**
Sheet 1 of 1

LOCATION
NORTHING | EASTING | ELEVATION

Depth (Meters)	Depth (Feet)	Samples	Water Level	Graphical Log	Unified Soil Classification	Material Description	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index	Moisture Content and Atterberg Limits (Plastic Limit / Moisture Content / Liquid Limit; 10 20 30 40 50 60 70 80 90)
0	0					FILL; Silty GRAVEL with sand - brown						
						TOPSOIL; Silty GRAVEL with sant - dark brown, moist						
					GP	Poorly Graded GRAVEL with sand - dense, brown, moist						
					ML	SILT - stiff, brown, moist						
1												
	5											
2						- Fe staining						
3	10					Bottom of Test Pit @ 9.5 Feet						

SAMPLE TYPE
- GRAB SAMPLE
- 3" O.D. THIN-WALLED HAND SAMPLER

WATER LEVEL
- ▼ - MEASURED
- ▽ - ESTIMATED

NOTES:

Plate
B-3

DATE	
STARTED:	9/3/15
COMPLETED:	9/3/15
BACKFILLED:	9/3/15

Keystone Construction
Madyson Place
Riverton, UT
Project Number 1012-007

GeoStrata Rep: J. Mattson
Rig Type: mini trackhoe

TEST PIT NO:
TP-4
Sheet 1 of 1

LOCATION
NORTHING EASTING ELEVATION

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

DEPTH METERS	DEPTH FEET	SAMPLES	WATER LEVEL	GRAPHICAL LOG	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index
0	0					FILL; Silty GRAVEL with sand - brown, moist					
						TOPSOIL; Sandy SILT - brown, moist					
					ML	Sandy SILT - stiff, brown, slightly moist, pinholes					
1		Grab sample						5.8	81.4	33	11
					ML	SILT with gravel - stiff, brown, moist, pinholes					
	5	Grab sample									
						Bottom of Test Pit @ 5.5 Feet					
2											
3	10										

LOG OF TEST PITS (B) TEST PIT LOGS.GPJ GEOSTRATA.GDT 10/23/15

SAMPLE TYPE
- GRAB SAMPLE
- 3" O.D. THIN-WALLED HAND SAMPLER

WATER LEVEL
- MEASURED
- ESTIMATED

NOTES:

Plate B-4

DATE		
STARTED:	9/3/15	
COMPLETED:	9/3/15	
BACKFILLED:	9/3/15	

Keystone Construction
Madyson Place
Riverton, UT
Project Number 1012-007

GeoStrata Rep: J. Mattson
Rig Type: mini trackhoe

TEST PIT NO:
TP-5
Sheet 1 of 1

LOCATION
NORTHING EASTING ELEVATION

DEPTH METERS	DEPTH FEET	SAMPLES	WATER LEVEL	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index
0	0				FILL; Silty GRAVEL with sand - brown					
					TOPSOIL; Silty GRAVEL with sand - dark brown, moist					
1				GP	Poorly Graded GRAVEL with sand - dense, brown, slightly moist		0.8	3.7		
	5			ML	Silty SAND - stiff, brown, moist, with occasional gravel					
2					Bottom of Test Pit @ 6.5 Feet					
3	10									

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

LOG OF TEST PITS (B) TEST PIT LOGS.GPJ GEOSTRATA.GDT 10/23/15

GeoStrata

SAMPLE TYPE
- GRAB SAMPLE
- 3" O.D. THIN-WALLED HAND SAMPLER

WATER LEVEL
- MEASURED
- ESTIMATED

NOTES:

Plate B-5

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.

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Soil Symbols Description Key

Keystone Construction
Madyson Place
Riverton, UT
Project Number: 1012-007

Plate B-6

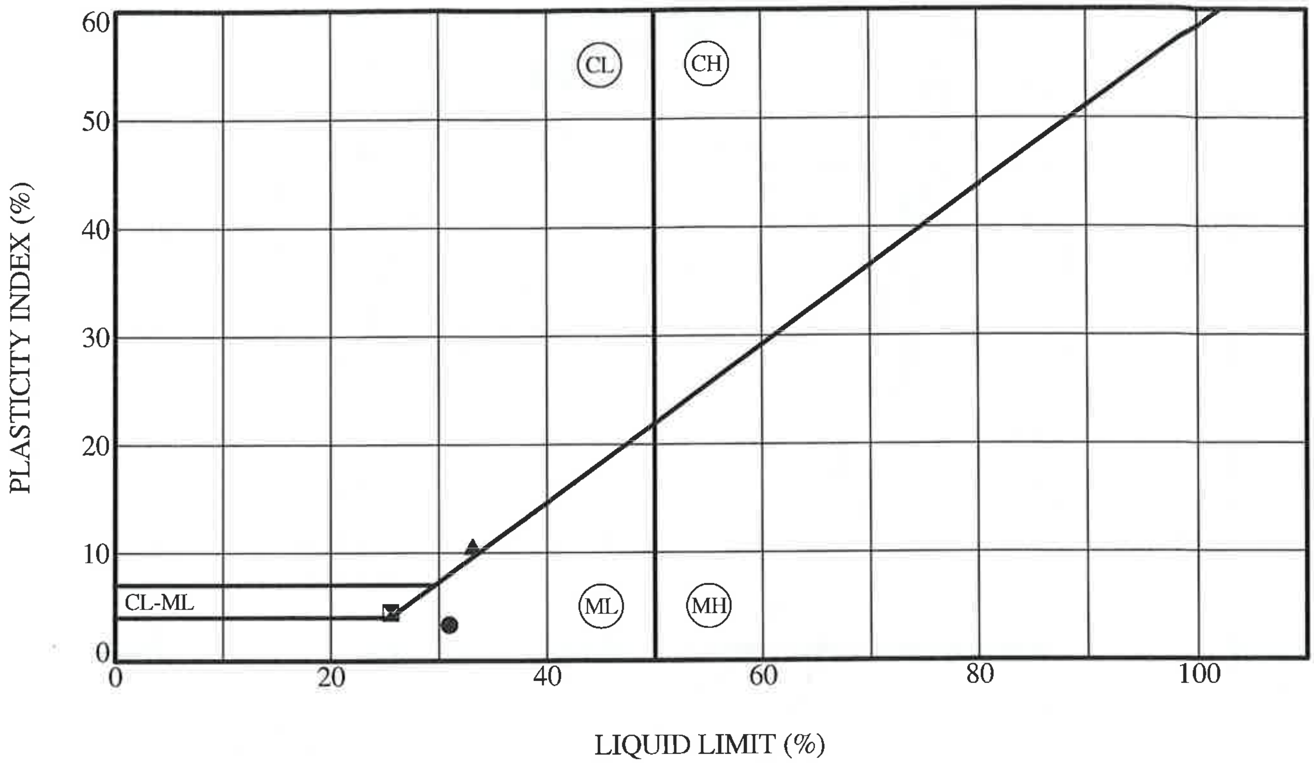
Test Pit No.	Sample Depth (feet)	USCS Soil Classification	Natural Moisture Content (%)	Natural Dry Density (pcf)	Gradation			Atterberg		Consolidation			Collapse (%)
					Gravel (%)	Sand (%)	Fines (%)	LL	PI	Cc	Cr	OCR	
TP-1	6	ML	10.6	81.6	0.0	13.6	86.4	31	3	0.194	0.02	5	0.6
TP-2	4	CL-ML	8.1	84.9	1.0	27.3	71.7	26	5	0.14	0.014	1.8	1.45
TP-2	8	GM	5.8		57.3	28.8	13.9						
TP-4	3	CL	5.8		0.6	18.0	81.4	33	10				
TP-5	4	GP	0.8		69.9	26.4	3.7						
Lot 1 Footings	6	ML	4.0	70.0									4.58
Lot 1 Garage	2	ML	2.0	94.0									2.81

GeoStrata

Lab Summary Report

Keystone Construction
Madyson Place
Riverton, UT
Project Number: 1012-007

Plate C - 1



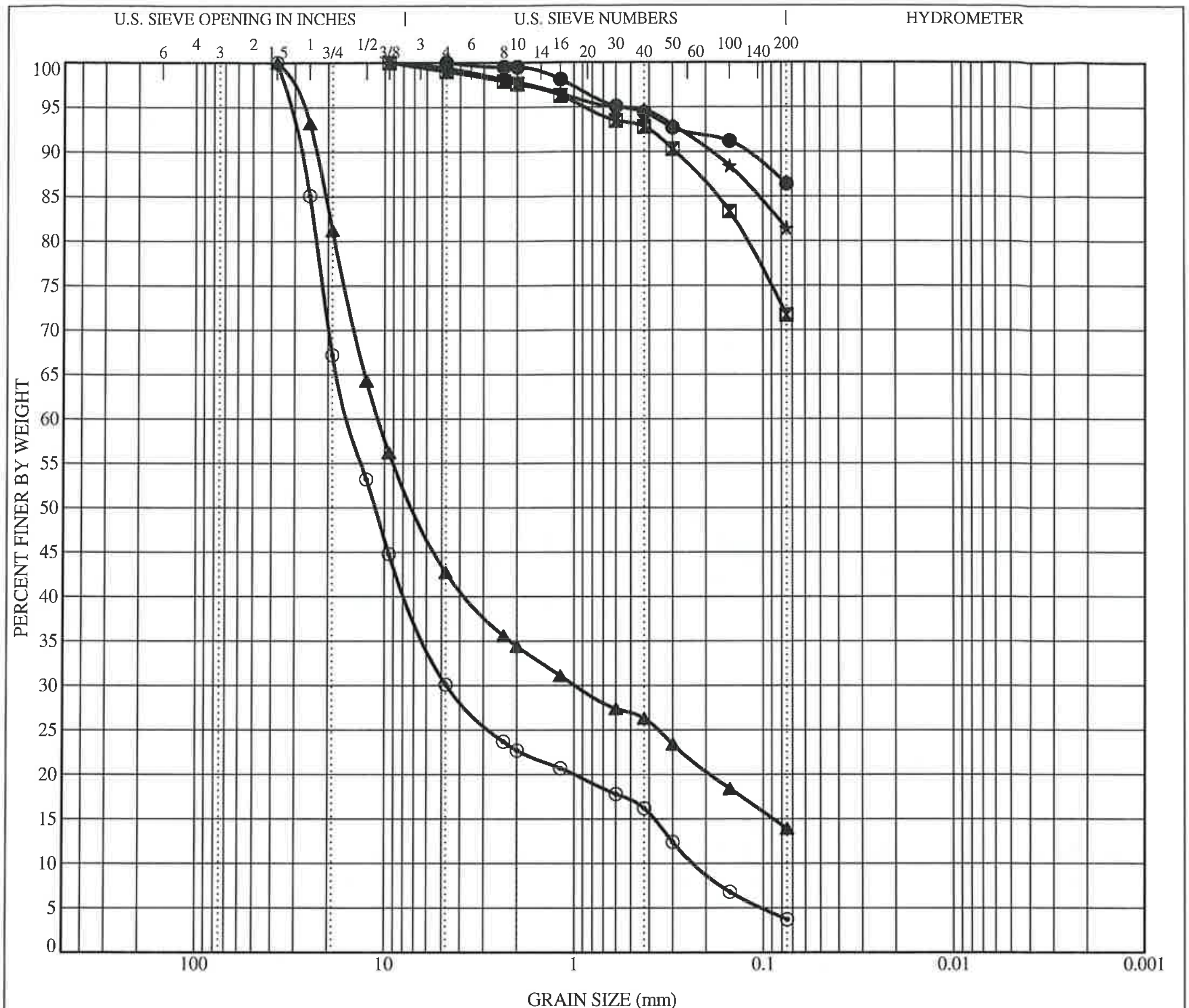
	Sample Location	Depth (ft)	LL (%)	PL (%)	PI (%)	Fines (%)	Classification
●	**TP-1**	**6.0**	**31**	**28**	**3**	**86.4**	**SILT**
⊠	**TP-2**	**4.0**	**26**	**21**	**5**	**71.7**	**Silty CLAY with sand**
▲	**TP-4**	**3.0**	**33**	**23**	**10**	**81.4**	**Lean CLAY with sand**

GeoStrata

ATTERBERG LIMITS' RESULTS - ASTM D 4318

Keystone Construction
Madyson Place
Riverton, UT
Project Number: 1012-007

Plate C - 2



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Sample Location	Depth	Classification	LL	PL	PI	Cc	Cu
●	**TP-1**	**6.0**	**SILT**	**31**	**28**	**3**		
⊠	**TP-2**	**4.0**	**Silty CLAY with sand**	**26**	**21**	**5**		
▲	**TP-2**	**8.0**	**Silty GRAVEL with sand**					
★	**TP-4**	**3.0**	**Lean CLAY with sand**	**33**	**23**	**10**		
⊙	**TP-5**	**4.0**	**Poorly Graded GRAVEL with sand**				**6.46**	**68.73**

	Sample Loctaion	Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**TP-1**	**6.0**	**4.75**				**0.0**	**13.6**	**86.4**	
⊠	**TP-2**	**4.0**	**9.5**				**1.0**	**27.3**	**71.7**	
▲	**TP-2**	**8.0**	**37.5**	**10.805**	**0.965**		**57.3**	**28.8**	**13.9**	
★	**TP-4**	**3.0**	**9.5**				**0.6**	**18.0**	**81.4**	
⊙	**TP-5**	**4.0**	**37.5**	**15.319**	**4.698**	**0.223**	**69.9**	**26.4**	**3.7**	

GeoStrata

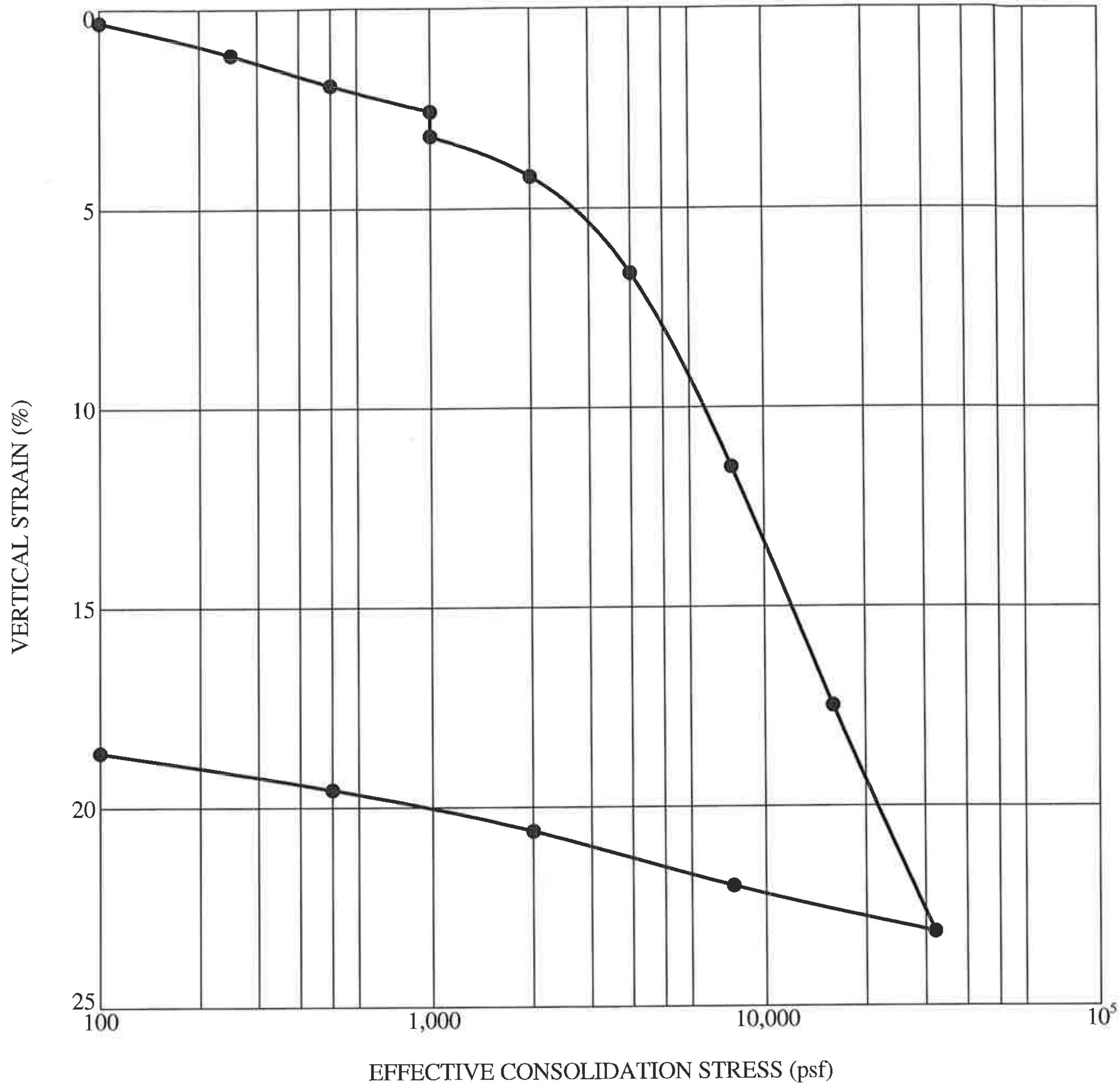
GRAIN SIZE DISTRIBUTION - ASTM D422

Keystone Construction
Madyson Place
Riverton, UT
Project Number: 1012-007

Plate

C - 3

C_GSD TEST PIT LOGS.GPJ GEOSTRATA.GDT 10/23/15



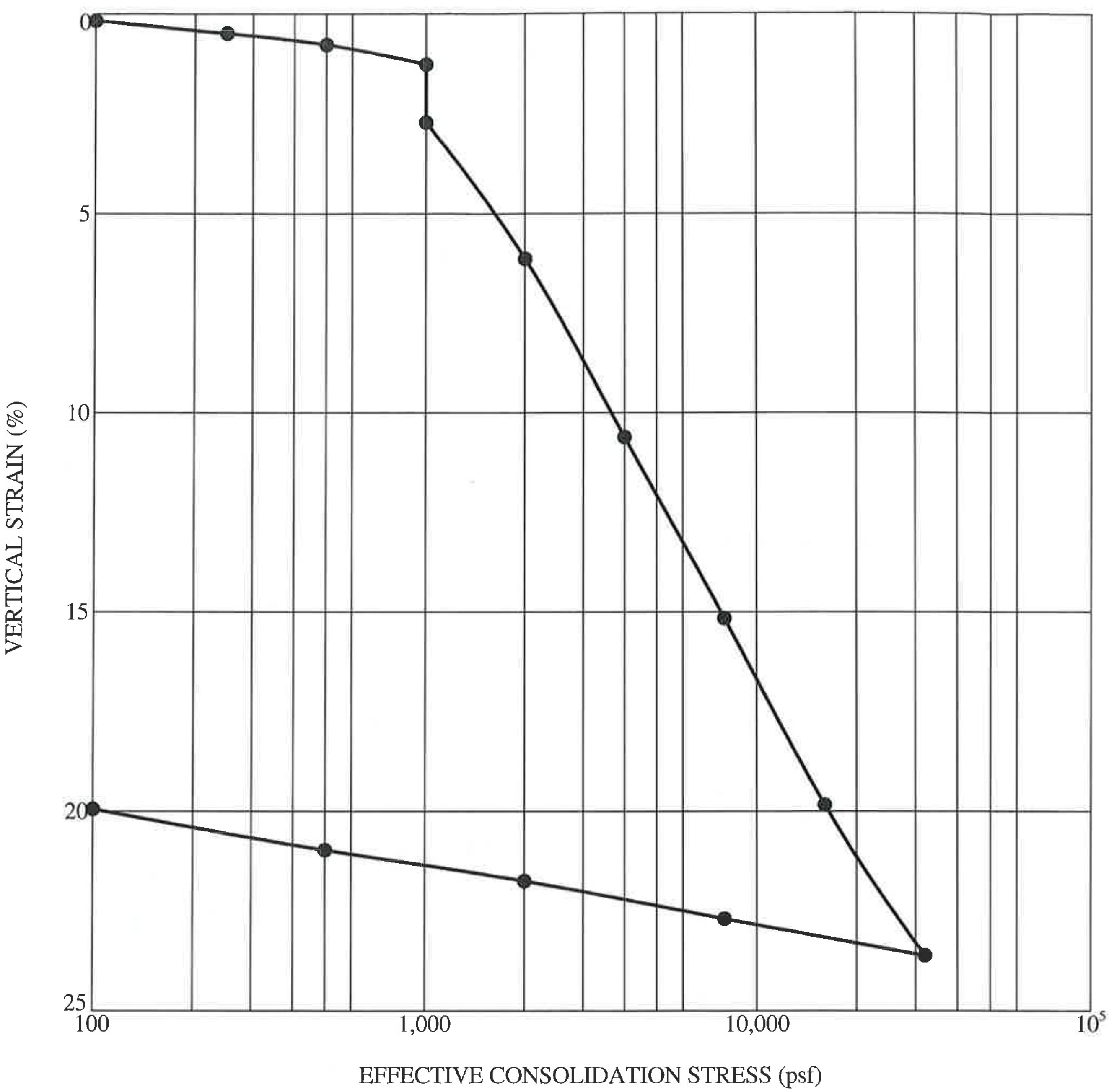
	Sample Location	Depth (ft)	Classification	γ_d (pcf)	MC (%)	C'_c	C'_r	OCR	Inundation Load (psf)	Swell (%)	Collapse (%)
●	**TP-1**	**6.0**	**SILT**	**82**	**13**	**0.194**	**0.020**	**5.0**	**1000**	**---**	**0.60**
⊠											
▲											
★											
⊙											

1-D CONSOLIDATION/SWELL/COLLAPSE TEST

GeoStrata

Keystone Construction
Madyson Place
Riverton, UT
Project Number: 1012-007

Plate
C - 4



	Sample Location	Depth (ft)	Classification	γ_d (pcf)	MC (%)	C'_c	C'_r	OCR	Inundation Load (psf)	Swell (%)	Collapse (%)
●	**TP-2**	**4.0**	**Silty CLAY with sand**	**85**	**8**	**0.140**	**0.014**	**1.8**	**1000**	**---**	**1.45**
⧗											
▲											
★											
⊙											

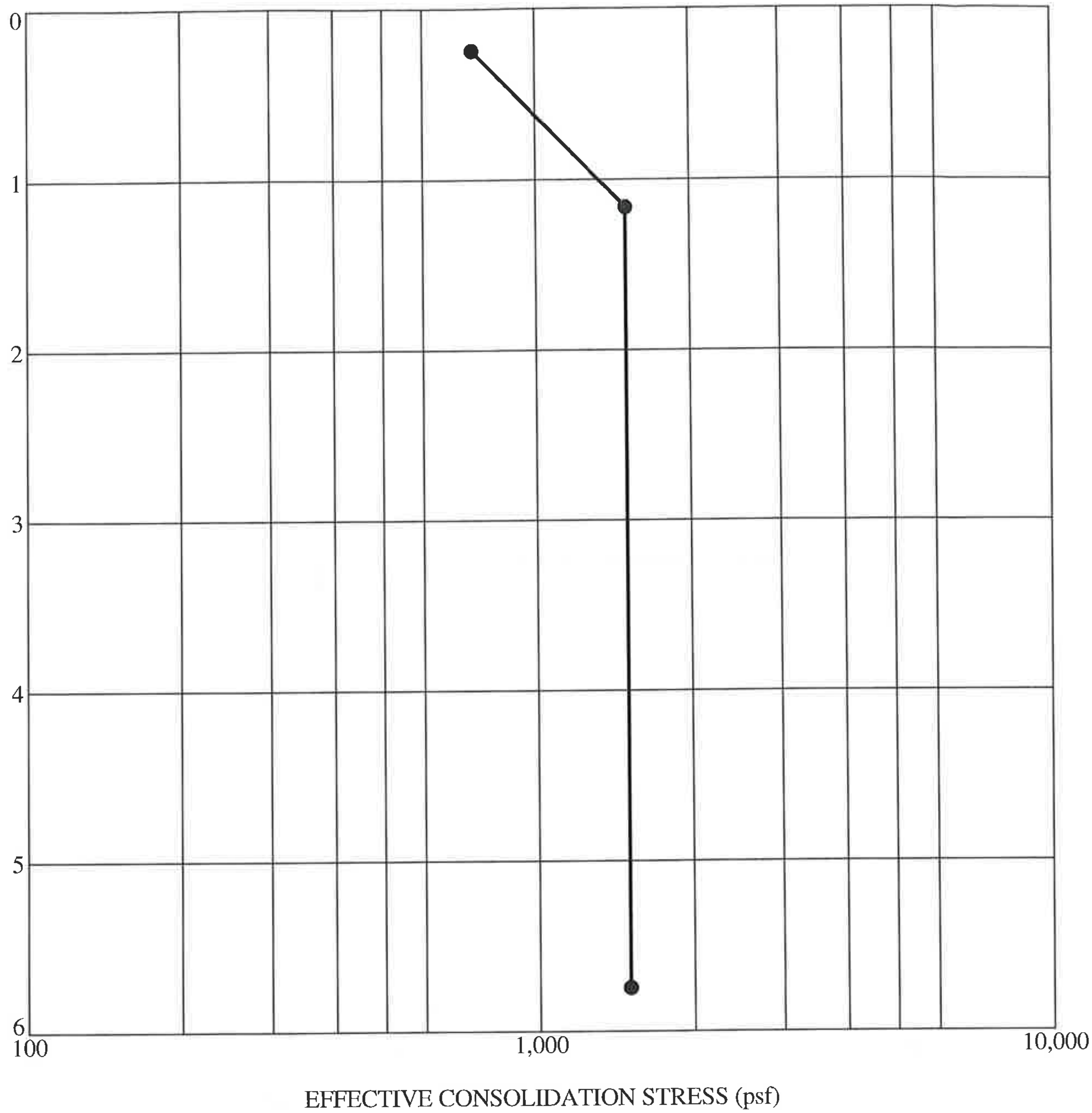
GeoStrata

1-D CONSOLIDATION/SWELL/COLLAPSE TEST

Keystone Construction
Madyson Place
Riverton, UT
Project Number: 1012-007

Plate
C - 5

C_CONSOL SWELL/COLLAPSE TEST PIT LOGS.GPJ GEOSTRATA.GDT 10/23/15



	Sample Location	Depth (ft)	Classification	γ_d (pcf)	MC (%)	Inundation Load (psf)	Swell (%)	Collapse (%)
●	**Lot 1 Footings**	**6.0**	**SILT**	**70**	**4**	**1500**	**---**	**4.58**
⊠								
▲								
★								
⊙								

1-D SWELL/COLLAPSE TEST

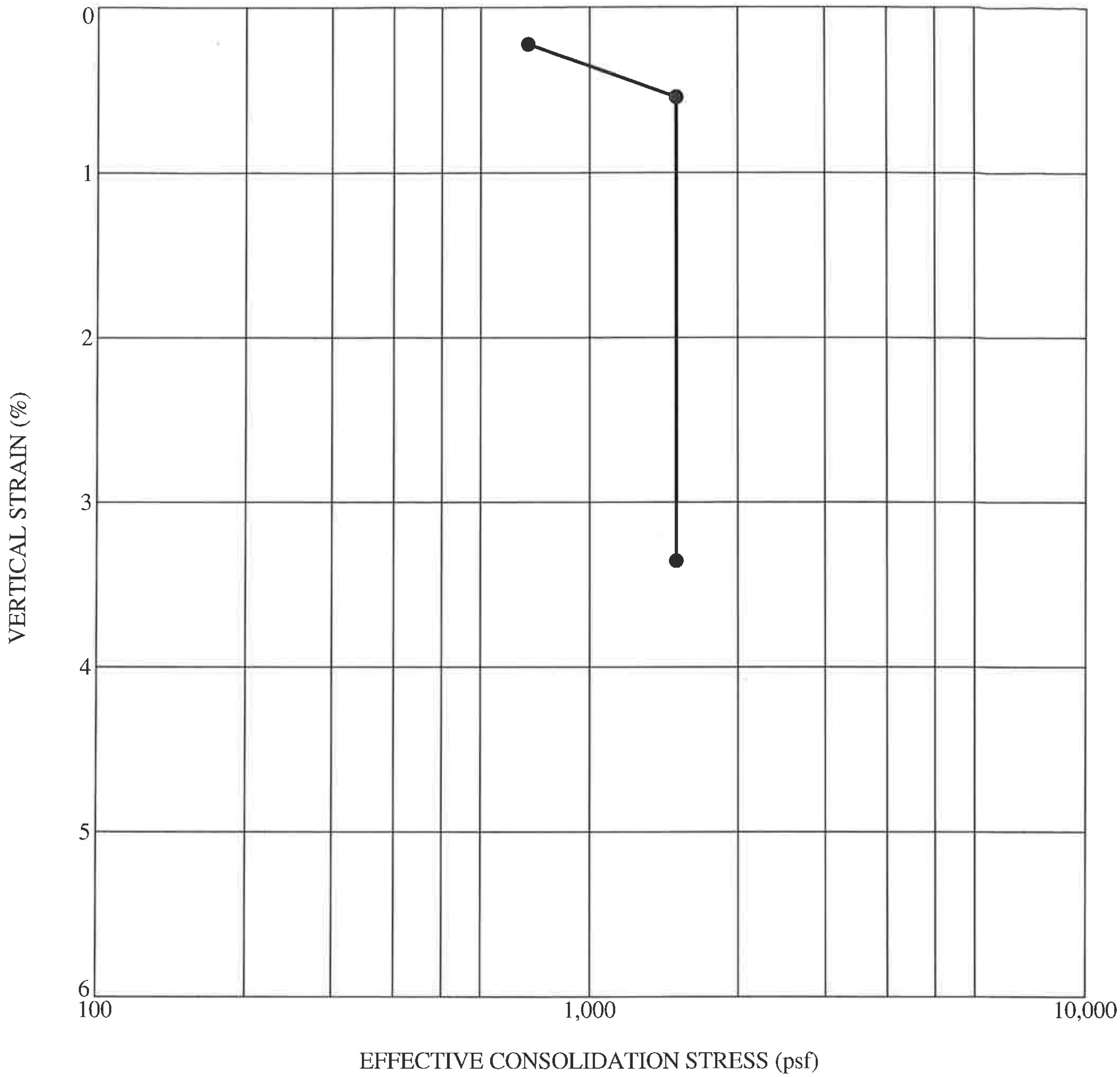
GeoStrata

Keystone Construction
Madyson Place
Riverton, UT
Project Number: 1012-007

Plate

C - 6

C_SWELL/COLLAPSE LAB TESTING.GPJ GEOSTRATA.GDT 10/27/15



	Sample Location	Depth (ft)	Classification	γ_d (pcf)	MC (%)	Inundation Load (psf)	Swell (%)	Collapse (%)
●	**Lot 1 Garage**	**2.0**	**Sandy SILT**	**94**	**2**	**1500**	**---**	**2.81**
⊠								
▲								
★								
⊙								

GeoStrata

1-D SWELL/COLLAPSE TEST

Keystone Construction
Madyson Place
Riverton, UT
Project Number: 1012-007

Plate

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