Geotechnical Evaluation Report

Proposed Elk Ridge Meetinghouse
1120 Rocky Mountain Way
Elk Ridge, Utah
LDS Property Number: 501-2698

Prepared For:
The Church of Jesus Christ of Latter-day Saints
AF PMO
PO Box 268
American Fork, Utah 84003

Prepared by
GSH Geotechnical
August 16, 2017
August 16, 2017
Job No. 0153-353-17

The Church of Jesus Christ of Latter-day Saints
AF PMO
PO Box 268
American Fork, Utah 84003
Attention: Mr. Brent Bigelow

Mr. Bigelow:

Re: Geotechnical Evaluation Report
Proposed Elk Ridge Meetinghouse
1120 Rocky Mountain Way
Elk Ridge, Utah
LDS Property Number: 501-2698

1. EXECUTIVE SUMMARY

This report presents the results of the geotechnical study performed at the site of the proposed Elk Ridge Meetinghouse located at 1120 Rocky Mountain Way in Elk Ridge, Utah.

The soils across the site were generally similar at the boring locations. Borings B-1 through B-4 encountered natural soils primarily consisting of silty clay, sandy silt, or silty sand underlain by fine to coarse gravel to the auger refusal depths of 1.5 to 10.5 feet. Borings B-5 through B-8, B-10, and B-11 encountered natural soils consisting of sandy clay to the termination depths of 5 feet. Boring B-9 encountered natural fine and coarse gravel to the auger refusal depth of approximately 7 inches. Approximately 6 inches of topsoil was encountered at the surface of most of the borings.

The natural clay and silt soils encountered at the site were medium stiff to hard, brown, slightly moist, and are anticipated to exhibit moderate to high compressibility characteristics. The granular soils encountered at the site were medium dense to very dense, brown, slightly moist to moist, and are anticipated to exhibit low compressibility characteristics.

The results of the study indicate that the proposed structure may be supported upon conventional spread and continuous wall foundations established upon suitable natural granular soils or granular structural fill extending to suitable natural granular soils. Under no circumstance shall
footings, floor slabs, or pavements be placed upon the surficial loose/disturbed topsoils or non-engineered fill (if encountered).

The most significant geotechnical aspect of the site is the shallow depth to auger refusal materials encountered in several of the borings.

The dense soils encountered at the refusal depths may require significant effort to excavate and should be considered in the design and bidding process.

Prior to proceeding with construction, removal of all non-engineered fills (if encountered), topsoil, surface vegetation, root systems, and any deleterious materials from beneath an area extending out at least 5 feet from the perimeter of the proposed building foundations and 3 feet beyond pavements and exterior flatwork areas will be required. All existing utility locations should be reviewed to assess their impact on the proposed construction and abandoned and/or relocated as appropriate. All footing excavations must extend to the natural granular soils (sands and gravels).

Based upon our review of available literature, no active faults are known to pass through or immediately adjacent to the site. Due to the density of the granular layers, liquefaction is not anticipated to occur at this site.

2. INTRODUCTION

This report presents the results of the geotechnical study performed at the site of the proposed Elk Ridge Meetinghouse located in Elk Ridge, Utah. The general location of the site with respect to existing roadways, as of 2017, is presented on Figure 1, Vicinity Map. A more detailed overlay site plan showing the proposed construction is presented on Figure 2, Site Plan. The approximate locations of the borings completed in conjunction with this study are also presented on Figure 2.

3. AUTHORIZATION

Authorization was provided by the client returning a signed “Agreement Between Client and Geotechnical Consultant” in accordance with our Professional Services Agreement No. 17-0802.

4. PROJECT DESCRIPTION, PURPOSE OF EVALUATION, & SCOPE OF WORK

The objectives and scope of our study were planned in discussions among Mr. Brent Bigelow of The Church of Jesus Christ of Latter-day Saints, Mr. Roger Knell of Knell Architects, and Mr. Mike Huber of GSH Geotechnical, Inc. (GSH).
In general, the objectives of this study were to:

1. Define and evaluate the subsurface soil and groundwater conditions at the proposed site.

2. Provide appropriate foundation, earthwork, pavement, infiltration, and geoseismic recommendations to be utilized in the design and construction of the proposed facility.

In accomplishing these objectives, our scope has included the following:

1. A field program consisting of the drilling, logging, and sampling of 14 borings, as well as performing an infiltration test.

2. A laboratory testing program.

3. An office program consisting of the correlation of available data, engineering analysis, and the preparation of this summary report.

5. PROFESSIONAL STATEMENTS

Supporting data upon which our recommendations are based are presented in subsequent sections of this report. Recommendations presented herein are governed by the physical properties of the soils encountered in the exploration borings, projected groundwater conditions, and the layout and design data discussed in Section 6, Design Criteria, of this report. If subsurface conditions other than those described in this report are encountered and/or if design and layout changes are implemented, GSH must be informed so that our recommendations can be reviewed and amended, if necessary.

Our professional services have been performed, our findings developed, and our recommendations prepared in accordance with generally accepted engineering principles and practices in this area at this time.

6. DESIGN CRITERIA

The meetinghouse will be constructed on an approximately 3.9-acre parcel. The building will be 1 to 1-extended level in height and of wood-frame construction established slab on grade over conventional spread and continuous wall foundations.

Maximum real column and wall loads are anticipated to be 80 to 120 kips and 4 to 5 kips per lineal foot, respectively. Real loads are defined as the total of all dead plus frequently applied (reduced) live loads.
Extensive at-grade paved parking and roadway areas will be part of the overall site development. Projected traffic in the parking areas is anticipated to consist of a light volume of automobiles and light trucks with occasional medium-weight trucks and no heavyweight trucks. In primary drive areas within the church parking lot, traffic is projected to consist of a moderate volume of automobiles and light trucks, a light volume of medium-weight trucks, and occasional heavyweight trucks (primarily garbage trucks).

Maximum site grading cuts and fills are anticipated to be on the order of 6 to 8 feet.

7. SITE CONDITIONS

The site consists of a rectangular-shaped, approximately 3.9-acre pasture located within a larger pasture in Elk Ridge, Utah. The site slopes downward to the northwest with total relief of approximately 30 to 40 feet. Vegetation at the site primarily consists of cultivated grass hay.

The site is bounded by the remainder of the large pasture land to the north, vacant brush/grassed land to the east, single-family residential structures to the south, and Rocky Mountain Way to the west.

8. FIELD STUDY

In order to define and evaluate the subsurface soil and groundwater conditions across the site, 14 borings were extended to depths ranging from 0.5 to 10.5 feet below existing grades. The borings were drilled using a truck-mounted rotary drill rig equipped with hollow-stem augers. The approximate locations of the borings are presented on Figure 2. Additionally, an infiltration test to determine the infiltration rate was performed in Boring B-10 at a depth of 5 feet.

The field portion of our study was under the direct control and continual supervision of an experienced member of our geotechnical staff. During the course of the drilling operations, a continuous log of the subsurface conditions encountered was maintained. In addition, samples of the typical soils penetrated were obtained for subsequent laboratory testing and examination. The soils were classified in the field based upon visual and textural properties. These classifications were later supplemented by subsequent inspection and testing in our laboratory. Detailed graphical representation of the subsurface conditions encountered is presented on Figures 3A through 3N, Log of Borings. Soils were classified in accordance with the nomenclature described on Figure 4, Key to Boring Log (USCS).

A 3.0-inch outside diameter, 2.42-inch inside diameter drive sampler (Dames & Moore) and a 2.0-inch outside diameter, 1.38-inch inside diameter drive sampler (SPT) were utilized in the subsurface sampling at the site. The blow counts recorded on the boring logs were the number required to drive the sampler 12 inches with a 140-pound hammer dropping 30 inches.
Following completion of drilling operations, 1.25-inch diameter slotted PVC pipe was installed in Borings B-4 and B-5 in order to provide a means of monitoring the groundwater fluctuations. The borings were backfilled with auger cuttings.

9. SUBSURFACE CONDITIONS AND GROUNDWATER

The soils across the site were generally similar at the boring locations. Borings B-1 through B-4 encountered natural soils primarily consisting of silty clay or silty sand underlain by fine and coarse gravel to the auger refusal depths of 1.5 to 10.5 feet. Borings B-5 through B-8, B-10, and B-11 encountered natural soils consisting of sandy clay to the termination depths of 5 feet. Boring B-9 encountered natural fine and coarse gravel to the auger refusal depth of approximately 6 inches. Approximately 6 inches of topsoil was encountered at the surface of each boring.

The natural clay soils at the site were medium stiff to hard, slightly moist, brown in color, and are anticipated to exhibit moderate to low strength and moderate to high compressibility characteristics under the anticipated loading.

The natural sand soils were medium dense to very dense, slightly moist to moist, and brown in color. The natural sand soils are anticipated to exhibit high strength and low compressibility characteristics under the anticipated load range.

For additional details pertaining to the subsurface conditions encountered, please refer to Figures 3A through 3N, Boring Logs. The lines designating the interface between soil types on the boring logs generally represent approximate boundaries. In situ, the transition between soil types may be gradual.

Groundwater was not encountered at this site at the time of drilling. On August 16, 2017 (8 days following drilling), the piezometers installed in Borings B-4 and B-5 were measured for groundwater, and none was encountered.

Seasonal and longer-term groundwater fluctuations on the order of 1 to 2 feet are projected, with the highest seasonal levels generally occurring during the late spring and early summer months. Additional groundwater fluctuations could occur due to snowmelt and/or irrigation on this and surrounding fields.

10. LABORATORY TESTING

10.1 General

In order to provide data necessary for our engineering analysis, a laboratory testing program was completed. The program included moisture and density, partial gradation, chemical, and topsoil tests. The following paragraphs describe the tests and summarize the test data.
10.2 Moisture and Density Tests

To aid in classifying the soils and to help correlate other test data, moisture and density tests were performed on selected samples. The results of these tests are presented on the logs, Figures 3A through 3N.

10.3 Partial Gradation Tests

To aid in classifying the granular soils, partial gradation tests were performed. Results of these tests are presented below and on the logs, Figures 3A through 3N.

<table>
<thead>
<tr>
<th>Boring No.</th>
<th>Depth (feet)</th>
<th>Percent Passing No. 200 Sieve</th>
<th>Moisture Content Percent</th>
<th>Soil Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>B-2</td>
<td>1.5</td>
<td>52.1</td>
<td>3.3</td>
<td>SM/ML</td>
</tr>
<tr>
<td>B-3</td>
<td>1.5</td>
<td>59.2</td>
<td>3.8</td>
<td>ML</td>
</tr>
<tr>
<td>B-4</td>
<td>2.5</td>
<td>72.7</td>
<td>14.3</td>
<td>CL</td>
</tr>
</tbody>
</table>

10.4 Chemical Tests

To determine if the site soils will react detrimentally with concrete, chemical tests were performed on a representative sample of the near-surface soils encountered at the site during each study. The results of the chemical tests are tabulated on the following table:

<table>
<thead>
<tr>
<th>Boring No.</th>
<th>Depth (feet)</th>
<th>Soil Classification</th>
<th>pH</th>
<th>Total Water Soluble Sulfate (mg/kg-dry)</th>
</tr>
</thead>
<tbody>
<tr>
<td>B-1</td>
<td>1.5</td>
<td>CL</td>
<td>8.06</td>
<td>74.3</td>
</tr>
</tbody>
</table>

10.5 Topsoil Tests

A series of topsoil tests were performed on a representative surface sample. The results of these tests are attached to this study as Appendix A, Topsoil Testing Report.

11. INFILTRATION TEST

An infiltration test was performed in Boring B-10 at a depth of approximately 5 feet in the natural clay soils. The field infiltration rate was 20 minutes per inch. The infiltration rates measured during these tests are typical for the site clay soils.
12. RECOMMENDATIONS AND CONCLUSIONS

12.1 SUMMARY OF FINDINGS

The results of the study indicate that the proposed structure may be supported upon conventional spread and continuous wall foundations established upon suitable natural granular soils or granular structural fill extending to suitable natural granular soils. Under no circumstance shall the footing, floor slab, or pavements be placed upon the surficial loose/disturbed soils or non-engineered fill (if encountered).

The most significant geotechnical aspect of the site is the shallow depth to auger refusal materials encountered in several of the borings.

The dense soils encountered at the refusal depths may require significant effort to excavate and should be considered in the design and bidding process.

Prior to proceeding with construction, removal of all non-engineered fills (if encountered), topsoil, surface vegetation, root systems, and any deleterious materials from beneath an area extending out at least 5 feet from the perimeter of the proposed building foundations and 3 feet beyond pavements and exterior flatwork areas will be required. All footing excavations must extend to the natural granular soils (sands and gravels).

In the following sections, detailed discussions pertaining to earthwork, foundations, lateral resistance and pressures, floor slabs, pavements, and the geoseismic setting of the site are provided.

12.2 EARTHWORK

12.2.1 Site Preparation

Initial site preparation will consist of the removal of all surface vegetation, topsoil, root systems, non-engineered fill (if encountered), debris, and any deleterious materials from beneath an area extending out at least 5 feet from the perimeter of the proposed building foundations and 3 feet beyond pavements and exterior flatwork areas. All existing utility locations should be reviewed to assess their impact on the proposed construction and abandoned and/or relocated as appropriate.

It must be noted that from a handling and compaction standpoint, on-site soils containing high amounts of fines (silts and clays) are inherently more difficult to rework and are very sensitive to changes in moisture content. These soils will require very close moisture control during placement and compaction and are, therefore, not recommended for re-use as structural fill. Additionally, the natural sands and gravels may be difficult to test for proper compaction as they contain excessive material over three-quarter-inch in diameter. The material must be screened if testing with a nuclear densometer is required.
Subsequent to the above operations and prior to the placement of footings, structural site grading fill, or floor slabs, the exposed natural subgrade must be proof rolled by passing moderate-weight rubber tire-mounted construction equipment over the surface at least twice. If any loose, soft, or disturbed zones are encountered, they must be completely removed in footing and floor slab areas and replaced with granular structural fill. If removal depth required is greater than 2 feet below footings, GSH must be notified to provide further recommendations. In pavement, floor slab, and outside flatwork areas, unsuitable soils encountered during compaction and proof rolling must be removed to a maximum depth of 2 feet and replaced with compacted granular structural fill.

Subgrade preparation as described must be completed prior to placing overlying structural site grading fills.

GSH must be notified prior to the placement of structural site grading fills, floor slabs, footings, and pavements to verify that all loose/disturbed soils and non-engineered fills have been completely removed and/or properly prepared.

12.2.2 Temporary Excavations

Auger refusal materials were encountered as shallow as 0.5 feet below existing grades. Consideration for difficult excavation, such as utilizing a large toothed ripper, below this level should be incorporated into the design and bidding process.

Temporary construction excavations in clay soils, not exceeding 4 feet in depth, may be constructed with near-vertical sideslopes. Temporary excavations up to 8 feet deep in clay soils shall be constructed with sideslopes no steeper than one-half horizontal to one vertical (0.5H:1V). Temporary excavations up to 8 feet deep in sand and gravel soils shall be constructed with sideslopes no steeper than one horizontal to one vertical (1H:1V). Excavations deeper than 8 feet are not anticipated at the site. If excessive sloughing occurs or where extensive layers of clean granular soils are encountered, the sideslopes should be appropriately flattened and/or shoring/bracing utilized.

Excavations below the groundwater, especially in the sand soils, will be difficult. The sand soils will tend to flow into the excavations. These excavations will, therefore, likely require significantly flatter sideslopes and dewatering and/or shoring/bracing.

All excavations must be inspected periodically by qualified personnel. If any signs of instability are noted, immediate remedial action must be initiated.

Contractors must be made aware of the shallow groundwater conditions and be prepared to dewater excavations as necessary.
12.2.3 Structural Fill

Structural fill is defined as all fill which will ultimately be subjected to structural loadings, such as imposed by footings, floor slabs, pavements, etc. Structural fill will be required as backfill over foundations and utilities, as site grading fill, and as replacement fill below footings. All structural fill must be free of sod, rubbish, topsoil, frozen soil, and other deleterious materials.

Structural site grading fill is defined as structural fill placed over relatively large open areas to raise the overall grade. For structural site grading fill, the maximum particle size shall not exceed 4 inches; although, occasional larger particles, not exceeding 8 inches in diameter, may be incorporated if placed randomly in a manner such that “honeycombing” does not occur and the desired degree of compaction can be achieved. The maximum particle size within structural fill placed within confined areas shall be restricted to 2 inches.

The natural clays are not recommended for re-utilization as structural site grading fill as they will require very close moisture control and may be very difficult, if not impossible, to properly place and compact.

Only granular soils are recommended as structural fill in confined areas, such as around foundations, within utility trenches, and as replacement fill below foundations.

All imported granular structural fill shall consist of a fairly well graded mixture of sand and gravel containing less than 20 percent fines (percent by weight of material passing the U.S. No. 200 sieve) and no more than 30 percent retained on the 0.75-inch sieve.

To stabilize soft subgrade conditions (if encountered) or where structural fill is required to be placed closer than 2.0 feet above the water table at the time of construction, a mixture of coarse angular gravels and cobbles and/or 1.5- to 2.0-inch gravel (stabilizing fill) should be utilized. It may also help to utilize a stabilization fabric, such as Mirafi 600X or equivalent, placed on the natural ground if 1.5- to 2.0-inch gravel is used as stabilizing fill.

Non-structural site grading fill is defined as all fill material not designated as structural fill and may consist of any cohesive or granular soils not containing excessive amounts of degradable material.

12.2.4 Fill Placement and Compaction

Structural fill shall be placed in lifts not exceeding 8 inches in loose thickness. Structural fills shall be compacted in accordance with the percent of the maximum dry density as determined by the AASHTO\(^1\) T-180 (ASTM\(^2\) D-1557) compaction criteria in accordance with the table on the following page.

\(^1\) American Association of State Highway and Transportation Officials
\(^2\) American Society for Testing and Materials
<table>
<thead>
<tr>
<th>Location</th>
<th>Total Fill Thickness (feet)</th>
<th>Minimum Percentage of Maximum Dry Density</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beneath an area extending at least 5 feet beyond the perimeter of the structure</td>
<td>0 to 10</td>
<td>95</td>
</tr>
<tr>
<td>Site Grading Fills Outside area defined above</td>
<td>0 to 5</td>
<td>90</td>
</tr>
<tr>
<td>Site Grading fills Outside area defined above</td>
<td>5 to 10</td>
<td>95</td>
</tr>
<tr>
<td>Utility Trenches</td>
<td>--</td>
<td>96</td>
</tr>
<tr>
<td>Aggregate base</td>
<td>--</td>
<td>96</td>
</tr>
</tbody>
</table>

Structural fills greater than 10 feet thick are not anticipated at the site.

Subsequent to stripping and prior to the placement of structural site grading fill, the subgrade shall be prepared as discussed in Section 12.2.1, Site Preparation, of this report.

Non-structural fill may be placed in lifts not exceeding 12 inches in loose thickness and compacted by passing construction, spreading, or hauling equipment over the surface at least twice.

Coarse gravel and cobble mixtures (stabilizing fill), shall be end-dumped, spread to a maximum loose lift thickness of 15 inches, and compacted by dropping a backhoe bucket onto the surface continuously at least twice. As an alternative, the fill may be compacted by passing moderately heavy construction equipment or large self-propelled compaction equipment at least twice. Subsequent fill material placed over the coarse gravels and cobbles shall be adequately compacted so that the “fines” are “worked into” the voids in the underlying coarser gravels and cobbles.

12.2.5 Utility Trenches

Material causing auger refusal was encountered in the borings at depths as shallow as 7.0 inches below existing grades; the utility contractors must be made aware of this condition and be prepared for difficult excavation as necessary. All utility trench backfill material below structurally loaded facilities (flatwork, floor slabs, roads, etc.) shall be placed at the same density requirements established for structural fill. If the surface of the backfill becomes disturbed during the course of construction, the backfill shall be proof rolled and/or properly compacted prior to the construction of any exterior flatwork over a backfilled trench. Proof rolling shall be performed by passing moderately loaded rubber tire-mounted construction equipment uniformly over the surface at least twice. If excessively loose or soft areas are encountered during proof rolling, they shall be removed to a maximum depth of 2 feet below design finish grade and replaced with structural fill.
Most utility companies and City-County governments are now requiring that Type A-1a or A-1b (AASHTO Designation – basically granular soils with limited fines) soils be used as backfill over utilities. These organizations are also requiring that in public roadways, the backfill over major utilities be compacted over the full depth of fill to at least 96 percent of the maximum dry density as determined by the AASHTO T-180 (ASTM D-1557) method of compaction. GSH recommends that as the major utilities continue onto the site that these compaction specifications are followed.

Fine-grained soils, such as clays and silts, are not recommended for utility trench backfill.

12.3 SPREAD AND CONTINUOUS WALL FOUNDATIONS

12.3.1 Design Data

The results of our analysis indicate that the proposed structures may be supported upon conventional spread and continuous wall foundations established upon suitable natural granular soils and/or structural fill extending to suitable natural granular soils. For design, the following parameters are provided with respect to the projected loading discussed in Section 6, Design Criteria of this report:

- Minimum Recommended Depth of Embedment for Frost Protection: - 30 inches
- Minimum Recommended Depth of Embedment for Non-frost Conditions: - 15 inches
- Recommended Minimum Width for Continuous Wall Footings: - 18 inches
- Minimum Recommended Width for Isolated Spread Footings: - 24 inches
- Recommended Net Bearing Capacity for Real Load Conditions for Footings Placed on Natural Granular Soils: - 3,000 pounds per square foot
- Bearing Capacity Increase for Seismic Loading: - 50 percent

The term “net bearing capacity” refers to the allowable pressure imposed by the portion of the structure located above lowest adjacent final grade. Therefore, the weight of the footing and backfill to lowest adjacent final grade need not be considered. Real loads are defined as the total...
of all dead plus frequently applied live loads. Total load includes all dead and live loads, including seismic and wind.

### 12.3.2 Installation

Under no circumstances shall the footings be established upon the natural fine-grained soils, loose or disturbed soil, surface vegetation, root systems, topsoil, rubbish, construction debris, non-engineered fill, frozen soil, or other deleterious materials. If unsuitable soils are encountered, they must be completely removed and replaced with compacted structural fill.

The width of structural replacement fill below footings shall be equal to the width of the footing plus one foot for each foot of fill thickness.

### 12.3.3 Settlements

Based on column loadings, soil bearing capacities, and the foundation recommendations as discussed above, settlements are anticipated to be less than one inch.

The amount of differential settlement is difficult to predict because the subsurface and foundation loading conditions can vary considerably across the site. However, we anticipate differential settlement between adjacent foundations could vary from one-half to three-quarter-inch. The final deflected shape of the structure will be dependent on actual foundation locations and loading.

### 12.4 LATERAL RESISTANCE

Lateral loads imposed upon foundations due to wind or seismic forces may be resisted by the development of passive earth pressures and friction between the base of the footings and the supporting soils. In determining frictional resistance, a coefficient of friction of 0.30 may be utilized for the footing interface with in situ natural soils and 0.40 for footing interface with granular structural fill. Passive resistance provided by properly placed and compacted granular structural fill above the water table may be considered equivalent to a fluid with a density of 300 pounds per cubic foot. Below the water table, this granular soil should be considered equivalent to a fluid with a density of 150 pounds per cubic foot.

A combination of passive earth resistance and friction may be utilized provided that the friction component of the total is divided by 1.5.

### 12.5 LATERAL PRESSURES

The building is anticipated to be constructed slab on grade. However, for the purpose of potential shallow subgrade structures 4 feet or less below the surface, such as utility boxes, etc., the following lateral pressure discussion is provided.
The lateral pressure parameters, as presented within this section, are for backfills, which will consist of drained granular soil, placed and compacted in accordance with the recommendations presented herein. The lateral pressures imposed upon subgrade facilities will, therefore, be basically dependent upon the relative rigidity and movement of the backfilled structure. For active walls, such as retaining walls which can move outward (away from the backfill), granular backfill may be considered equivalent to a fluid with a density of 35 pounds per cubic foot in computing lateral pressures. For more rigid walls that are not more than 10 inches thick, granular backfill may be considered equivalent to a fluid with a density of 45 pounds per cubic foot. For very rigid non-yielding walls, granular backfill should be considered equivalent to a fluid with a density of at least 55 pounds per cubic foot. The above values assume that the surface of the soils slope behind the wall is horizontal and that the granular fill within 3 feet of the wall will be compacted with hand-operated compacting equipment.

For seismic loading of retaining/below-grade walls, the uniform lateral pressures below, in pounds per square foot (psf), should be added based on wall depth and wall case:

<table>
<thead>
<tr>
<th>Uniform Lateral Pressures</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Wall Height (Feet)</strong></td>
</tr>
<tr>
<td>-------------------------</td>
</tr>
<tr>
<td>4</td>
</tr>
</tbody>
</table>

12.6 FLOOR SLABS

Floor slabs may be established upon suitable stabilized natural soils and/or upon structural fill extending to suitable stabilized natural soils. Under no circumstances shall floor slabs be established over non-engineered fills, loose/disturbed soils, surface vegetation, root systems, topsoil, rubbish, construction debris, other deleterious materials, frozen soils, or within ponded water.

In order to facilitate curing of the concrete and to provide a capillary moisture break, it is recommended that floor slabs be directly underlain by at least 4 inches of “free-draining” fill, such as “pea” gravel or three-quarters to one inch minus clean gap graded gravel.

Settlement of lightly loaded floor slabs designed according to previous recommendations (average uniform pressure of 200 pounds per square foot or less) is anticipated to be less than one-quarter of an inch.

In accordance with the Geotechnical Evaluation Report Template, floor slabs are to be constructed without control or construction joints, are reinforced with No. 4 bars at 18 inches on center each way, and shall include a 15-mil vapor retarder placed directly under the concrete with at least 4 inches of “free-draining” fill, described previously, placed below the vapor retarder.
12.7 PAVEMENTS

The natural surficial clay/silt soils will exhibit moderate to poor pavement support characteristics. All pavement areas must be prepared as previously discussed (see Section 12.2.1, Site Preparation). Under no circumstances shall pavements be established over non-engineered fills, loose or disturbed soils, surface vegetation, root systems, topsoil, rubbish, construction debris, other deleterious materials, frozen soils, or within ponded water. With the subgrade soils and the projected traffic (40-year design life) as discussed in Section 6, Design Criteria, the following pavement sections are recommended:

<table>
<thead>
<tr>
<th>Parking Areas</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Light Volume of Automobiles and Light Trucks, Occasional Medium-Weight Trucks, No Heavyweight Trucks)</td>
</tr>
<tr>
<td>[6 equivalent 18-kip axle loads per week]</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Flexible:</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.0 inches: Asphalt concrete</td>
</tr>
<tr>
<td>7.0 inches: Aggregate base</td>
</tr>
<tr>
<td>Over: Properly prepared and stabilized natural subgrade soils and/or structural site grading fill extending to suitable stabilized natural subgrade soils</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Rigid:</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.0 inches: Portland cement concrete (non-reinforced)</td>
</tr>
<tr>
<td>4.0 inches: Aggregate base</td>
</tr>
<tr>
<td>Over: Properly prepared and stabilized natural subgrade soils and/or structural site grading fill extending to suitable stabilized natural subgrade soils</td>
</tr>
</tbody>
</table>
Parking Lot Drive Lanes and Access Driveways

(Moderate Volume of Automobiles and Light Trucks, Light Volume of Medium-Weight Trucks, and Occasional Heavyweight Trucks)
[15 equivalent 18-kip axle loads per week]

Flexible:

3.0 inches Asphalt concrete
8.0 inches Aggregate base
Over Properly prepared and stabilized natural subgrade soils and/or structural site grading fill extending to suitable stabilized natural subgrade soils

Rigid:

5.5 inches Portland cement concrete (non-reinforced)
4.0 inches Aggregate base
Over Properly prepared and stabilized natural subgrade soils and/or structural site grading fill extending to suitable stabilized natural subgrade soils

For trash enclosure approach slabs (one 40,000-pound axel load per week), we recommend a pavement section consisting of 6.5 inches of Portland cement concrete, 4.0 inches of aggregate base, over properly prepared and stabilized natural subgrade or site grading structural fills extending to suitable stabilized natural soils.

The above rigid pavement sections are for non-reinforced Portland cement concrete. Concrete should be designed in accordance with the American Concrete Institute (ACI) and joint details should conform to the Portland Cement Association (PCA) guidelines. The concrete shall have a minimum 28-day unconfined compressive strength of 4,500 pounds per square inch, contain 6 percent ±1 percent air-entrainment, and meet the requirements given below in Section 12.8, Cement Types, of this report. In accordance with the Geotechnical Evaluation Report Template, 25 percent fly ash is required in all concrete exposed to freeze-thaw cycles and deicers.
The crushed stone should conform to applicable sections of the current UDOT Standard Specifications. All asphalt material and paving operations should meet applicable specifications of the Asphalt Institute and UDOT. A GSH technician shall observe placement and perform density testing of the base course material and asphalt.

Please note that the recommended pavement section is based on estimated post-construction traffic loading. If the pavement is to be constructed and utilized by construction traffic, the above pavement section may prove insufficient for heavy truck traffic, such as concrete trucks or tractor-trailers used for construction delivery. Unexpected distress, reduced pavement life, and/or premature failure of the pavement section could result if subjected to heavy construction traffic and the owner should be made aware of this risk. If the estimated traffic loading stated herein is not correct, GSH must review actual pavement loading conditions to determine if revisions to these recommendations are warranted.

12.8 CEMENT TYPES

The laboratory tests indicate that the natural soils tested contain a negligible amount of water soluble sulfates. Based on our test results, concrete in contact with the on-site soil will have a low potential for sulfate reaction (ACI 318, Table 4.3.1). Therefore, all concrete which will be in contact with the site soils may be prepared using Type I or IA cement.

12.9 GEOSEISMIC SETTING

12.9.1 General

Utah municipalities adopted the International Building Code (IBC) 2015. The IBC 2015 code determines the seismic hazard for a site based upon 2008 mapping of bedrock accelerations prepared by the United States Geologic Survey (USGS) and the soil site class. The USGS values are presented on maps incorporated into the IBC code and are also available based on latitude and longitude coordinates (grid points).

The structure must be designed in accordance with the procedure presented in Section 1613, Earthquake Loads, of the IBC 2015 edition.

12.9.2 Faulting

Based upon our review of available literature, no active faults are known to pass through or immediately adjacent to the site. The nearest mapped active fault is the Provo Section of the Wasatch Fault, approximately 0.6 miles to the east of the site.
12.9.3 Soil Class

For dynamic structural analysis, the Site Class D - Stiff Soil Profile as defined in Chapter 20 of ASCE 7 (per Section 1613.3.2, Site Class Definitions, of IBC 2015) can be utilized.

12.9.4 Ground Motions

The IBC 2015 code is based on 2008 USGS mapping, which provides values of short and long period accelerations for the Site Class B-C boundary for the Maximum Considered Earthquake (MCE). This Site Class B-C boundary represents a hypothetical bedrock surface and must be corrected for local soil conditions. The table below summarizes the peak ground and short and long period accelerations for an MCE event and incorporates a soil amplification factor for a Site Class D soil profile in the fourth column. Based on the site latitude and longitude (40.0208 degrees north and 111.6768 degrees west, respectively), the values for this site are tabulated below:

<table>
<thead>
<tr>
<th>Spectral Acceleration</th>
<th>Site Class B Boundary [mapped values] (%)</th>
<th>Site Class D [adjusted for site class effects] (%)</th>
<th>Design Values (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peak Ground Acceleration</td>
<td>48.1</td>
<td>F$_a$ = 1.019</td>
<td>49.0</td>
</tr>
<tr>
<td>0.2 Seconds (Short Period Acceleration)</td>
<td>S$_S$ = 120.3</td>
<td>F$_a$ = 1.019</td>
<td>S$_{MS}$ = 122.6</td>
</tr>
<tr>
<td>1.0 Second (Long Period Acceleration)</td>
<td>S$_1$ = 44.3</td>
<td>F$_v$ = 1.557</td>
<td>S$_{M1}$ = 69</td>
</tr>
</tbody>
</table>

12.9.5 Liquefaction

The site is located in an area that has been identified by the U.S. Geological Survey (USGS) as having a “very low” liquefaction potential. Liquefaction is defined as the condition when saturated, loose, granular soils lose their support capabilities because of excessive pore water pressure which develops during a seismic event. Clayey soils, even if saturated, will not liquefy during a major seismic event.

Liquefaction of the site soils explored as part of this study is not anticipated during the design seismic event due to the dense nature of the granular soils and lack of groundwater.

12.10 SITE VISITS

Prior to placement of foundations and site grading fills, GSH must verify that suitable natural soils have been encountered below floor slabs, footings, structural fill, and pavements.
If you have any questions or would like to discuss these items further, please feel free to contact us at (801) 685-9190.

Respectfully submitted,

GSH Geotechnical, Inc.

Reviewed by:

Michael S. Huber, P.E.
State of Utah No. 343650
Vice President/Senior Geotechnical Engineer

Alan D. Spilker, P.E.
State of Utah No. 334228
President/Senior Geotechnical Engineer

Encl.

- Figure 1, Vicinity Map
- Figure 2, Site Plan
- Figures 3A through 3N Log of Borings
- Figure 4, Key to Boring Logs (USCS)
- Appendix A Topsoil Testing Report

Addressee (3 + email)

cc: Mr. Roger Knell (email)
Knell Architects
FIGURE 1
VICINITY MAP

REFERENCE:
ALL TRAILS - NATIONAL GEOGRAPHIC TERRAIN
DATED 2017
### BORING LOG

**BORING: B-1**

**CLIENT:** The Church of Jesus Christ of Latter-day Saints  
**PROJECT:** Proposed Elk Ridge Meetinghouse  
**PROJECT NUMBER:** 0153-353-17  
**DATE STARTED:** 8/8/17  
**DATE FINISHED:** 8/8/17

**LOCATION:** 1120 Rocky Mountain Way, Elk Ridge Utah  
**GSH FIELD REP.:** BG

**DRILLING METHOD/EQUIPMENT:** 3-3/4" ID Hollow-Stem Auger  
**HAMMER:** Automatic  
**WEIGHT:** 140 lbs  
**DROP:** 30"

**GROUNDWATER DEPTH:** Not Encountered (8/8/17)  
**ELEVATION:** ---

<table>
<thead>
<tr>
<th>WATER LEVEL</th>
<th>DESCRIPTION</th>
<th>DEPTH (FT)</th>
<th>BLOW COUNT</th>
<th>SAMPLE SYMBOL</th>
<th>MOISTURE (%)</th>
<th>DRY DENSITY (PCF)</th>
<th>% PASSING 200</th>
<th>LIQUID LIMIT (%)</th>
<th>PLASTICITY INDEX</th>
<th>REMARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>USCS CL</td>
<td>SILTY CLAY</td>
<td>0</td>
<td>50</td>
<td>[I]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>slight moist hard</td>
</tr>
<tr>
<td></td>
<td>with major roots (topsoil) to 6&quot;; brown</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>USCS GP</td>
<td>FINE AND COARSE GRAVEL</td>
<td>50</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>slight moist very dense</td>
</tr>
<tr>
<td></td>
<td>with fine to coarse sand; brown</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Auger refusal at 1.5'.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>No groundwater encountered at time of drilling.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

See Subsurface Conditions section in the report for additional information.

FIGURE 3A
See Subsurface Conditions section in the report for additional information.
## Boring Log

**Boring: B-2**

**Project Number:** 0153-353-17  
**Date Started:** 8/8/17  
**Date Finished:** 8/8/17  
**Location:** 1120 Rocky Mountain Way, Elk Ridge Utah  
**GSH Field Rep.:** BG

**Drilling Method/Equipment:** 3-3/4" ID Hollow-Stem Auger  
**Hammer:** Automatic  
**Weight:** 140 lbs  
**Drop:** 30"

**Groundwater Depth:** Not Encountered (8/8/17)  
**Elevation:** ---

### Subsurface Conditions

<table>
<thead>
<tr>
<th>Water Level</th>
<th>Description</th>
<th>Depth (ft)</th>
<th>BLOW COUNT</th>
<th>Sample Symbol</th>
<th>Moisture (%)</th>
<th>Dry Density (pcf)</th>
<th>% Passing 200</th>
<th>Moisture (%)</th>
<th>Plasticity Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>USCS SM</td>
<td>Silty Fine to Medium Sand/Fine to Medium Sandy Silt with trace clay; major roots (topsoil) to 6&quot;; brown</td>
<td>0</td>
<td>30</td>
<td>3.3</td>
<td>52.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>USCS ML</td>
<td>Slightly moist</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>USCS GP</td>
<td>Fine and Coarse Gravel with fine to coarse sand; brown</td>
<td>30</td>
<td>30</td>
<td>3.3</td>
<td>52.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Auger refusal at 2.5'; no groundwater encountered at time of drilling.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

See Subsurface Conditions section in the report for additional information.

**FIGURE 3C**
### Description of Subsurface Conditions

#### Ground Surface

<table>
<thead>
<tr>
<th>Layer</th>
<th>Description</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>SM</td>
<td>Silty fine to medium sand/fine to medium sandy silt with trace clay; major roots (topsoil) to 6&quot;; brown</td>
<td>Slightly moist</td>
</tr>
<tr>
<td>ML</td>
<td>Silty fine to medium sand/fine to medium sandy silt with trace clay; major roots (topsoil) to 6&quot;; brown</td>
<td>Medium dense</td>
</tr>
<tr>
<td>GP</td>
<td>Fine and coarse gravel with fine to coarse sand; brown</td>
<td>Slightly moist</td>
</tr>
<tr>
<td></td>
<td>Auger refusal at 2.5'; No groundwater encountered at time of drilling.</td>
<td>Very dense</td>
</tr>
</tbody>
</table>

See Subsurface Conditions section in the report for additional information.
**BORING LOG**

**BORING: B-3**

**CLIENT:** The Church of Jesus Christ of Latter-day Saints  
**PROJECT:** Proposed Elk Ridge Meetinghouse

**LOCATION:** 1120 Rocky Mountain Way, Elk Ridge Utah  
**GSH FIELD REP.:** BG

**DATE STARTED:** 8/8/17  
**DATE FINISHED:** 8/8/17

**DRILLING METHOD/EQUIPMENT:** 3-3/4" ID Hollow-Stem Auger  
**HAMMER:** Automatic  
**WEIGHT:** 140 lbs  
**DROP:** 30"

**GROUNDWATER DEPTH:** Not Encountered (8/8/17)

---

**WATER LEVEL**

<table>
<thead>
<tr>
<th>WATER LEVEL</th>
<th>DESCRIPTION</th>
<th>DEPTH (FT.)</th>
<th>BLOW COUNT</th>
<th>SAMPLE SYMBOL</th>
<th>% PASSING 200</th>
<th>% PASSING 200</th>
<th>MOISTURE (%)</th>
<th>DRY DENSITY (PCF)</th>
<th>LIQUID LIMIT (%)</th>
<th>PLASTICITY INDEX</th>
</tr>
</thead>
<tbody>
<tr>
<td>ML</td>
<td>FINE SANDY SILT with major roots (topsoil) to 6&quot;; brown</td>
<td>0</td>
<td>16</td>
<td>3.8</td>
<td>59.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>slightly moist</td>
<td>medium dense</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GP</td>
<td>FINE AND COARSE GRAVEL with fine to coarse sand; brown</td>
<td>50/0&quot;</td>
<td>16</td>
<td>3.8</td>
<td>59.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>slightly moist</td>
<td>very dense</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**REMARKS**

No groundwater encountered at time of drilling.

See Subsurface Conditions section in the report for additional information.
 See Subsurface Conditions section in the report for additional information.
<table>
<thead>
<tr>
<th>WATER LEVEL</th>
<th>DESCRIPTION</th>
<th>DEPTH (FT.)</th>
<th>BLOW COUNT</th>
<th>SAMPLE SYMBOL</th>
<th>MOISTURE (%)</th>
<th>DRY DENSITY (pcf)</th>
<th>% PASSING 200</th>
<th>LIQUID LIMIT (%)</th>
<th>PLASTICITY INDEX</th>
<th>REMARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>CL</td>
<td>SILTY CLAY</td>
<td>0</td>
<td>36</td>
<td></td>
<td>14.3</td>
<td>72.7</td>
<td></td>
<td></td>
<td></td>
<td>slightly moist</td>
</tr>
<tr>
<td></td>
<td>with fine sand; major roots (topsoil) to 6”; brown</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>hard</td>
</tr>
<tr>
<td>SM</td>
<td>SILTY FINE SAND</td>
<td>5</td>
<td>60</td>
<td></td>
<td>6.1</td>
<td>92</td>
<td></td>
<td></td>
<td></td>
<td>slightly moist</td>
</tr>
<tr>
<td></td>
<td>brown</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>dense</td>
</tr>
<tr>
<td>GP</td>
<td>FINE TO COARSE GRAVEL</td>
<td>10</td>
<td>50</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>slightly moist</td>
</tr>
<tr>
<td></td>
<td>with fine sand; brown</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>very dense</td>
</tr>
</tbody>
</table>

Auger refusal at 10.0’. No groundwater encountered at time of drilling. Installed 1.25” diameter slotted PVC pipe to 10.5’.

See Subsurface Conditions section in the report for additional information.
### BORING LOG

**BORING: B-5**

**CLIENT:** The Church of Jesus Christ of Latter-day Saints  
**PROJECT:** Proposed Elk Ridge Meetinghouse  
**DATE STARTED:** 8/8/17  
**DATE FINISHED:** 8/8/17  
**LOCATION:** 1120 Rocky Mountain Way, Elk Ridge Utah  
**GSH FIELD REP.:** BG

**GROUNDWATER DEPTH:** Not Encountered (8/8/17)  
**ELEVATION:** ---

**DRILLING METHOD/EQUIPMENT:** 3-3/4" ID Hollow-Stem Auger  
**HAMMER:** Automatic  
**WEIGHT:** 140 lbs  
**DROP:** 30"

---

<table>
<thead>
<tr>
<th>WATER LEVEL</th>
<th>DESCRIPTION</th>
<th>DEPTH (FT.)</th>
<th>BLOW COUNT</th>
<th>SAMPLE SYMBOL</th>
<th>MOISTURE (%)</th>
<th>DRY DENSITY (PCF)</th>
<th>% PASSING 200</th>
<th>LIQUID LIMIT (%)</th>
<th>PLASTICITY INDEX</th>
<th>REMARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ground Surface</td>
<td></td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>slightly moist medium stiff</td>
</tr>
<tr>
<td>FINE SANDY CLAY</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>very stiff</td>
</tr>
<tr>
<td>with major roots (topsoil) to 6''; brown</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>End of Exploration at 5.0'.</td>
<td></td>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>No groundwater encountered at time of drilling. Installed 1.25'' diameter slotted PVC pipe to 5.0'.</td>
</tr>
</tbody>
</table>

See Subsurface Conditions section in the report for additional information.
<table>
<thead>
<tr>
<th>Description</th>
<th>Depth (ft)</th>
<th>Blown Count</th>
<th>Sample Symbol</th>
<th>Moisture (%)</th>
<th>DRY DENSITY (pcf)</th>
<th>% Passing 200</th>
<th>Liquid Limit (%)</th>
<th>Plasticity Index</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ground Surface</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>slightly moist</td>
</tr>
<tr>
<td>FINE SANDY CLAY</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>medium stiff</td>
</tr>
<tr>
<td>with major roots (topsoil) to 6&quot;; brown</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>very stiff</td>
</tr>
<tr>
<td>End of Exploration at 5.0'.</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>No groundwater</td>
</tr>
<tr>
<td>No groundwater encountered at time of drilling.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>encountered at</td>
</tr>
</tbody>
</table>

See Subsurface Conditions section in the report for additional information.
<table>
<thead>
<tr>
<th>WATER LEVEL</th>
<th>DESCRIPTION</th>
<th>DEPTH (FT)</th>
<th>BLOW COUNT</th>
<th>SAMPLE SYMBOL</th>
<th>MOISTURE (%)</th>
<th>DRY DENSITY (pcf)</th>
<th>% PASSING 200</th>
<th>LIQUID LIMIT (%)</th>
<th>PLASTICITY INDEX</th>
<th>REMARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>USCS</td>
<td>Ground Surface</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>USCS</td>
<td>FINE SANDY CLAY</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>slightly moist</td>
</tr>
<tr>
<td>USCS</td>
<td>with major roots (topsoil) to 6'; brown</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>medium stiff</td>
</tr>
<tr>
<td>USCS</td>
<td>End of Exploration at 5.0'. No groundwater encountered at time of drilling.</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>very stiff</td>
</tr>
</tbody>
</table>

See Subsurface Conditions section in the report for additional information.
**Client:** The Church of Jesus Christ of Latter-day Saints  
**Project:** Proposed Elk Ridge Meetinghouse  
**Location:** 1120 Rocky Mountain Way, Elk Ridge Utah  
**GSH Field Rep.:** BG

**Drilling Method/Equipment:** 3-3/4" ID Hollow-Stem Auger  
**Hammer:** Automatic  
**Weight:** 140 lbs  
**Drop:** 30"

**Groundwater Depth:** Not Encountered (8/8/17)

**Elevation:** ---

**Remarks:**
- Slightly moist
- Medium stiff
- Very stiff

---

### Ground Surface

<table>
<thead>
<tr>
<th>Layer</th>
<th>Description</th>
<th>Depth (FT)</th>
<th>BLOW COUNT</th>
<th>SAMPLE SYMBOL</th>
<th>MOISTURE (%)</th>
<th>DRY DENSITY (PCF)</th>
<th>% PASSING 200</th>
<th>LIQUID LIMIT (%)</th>
<th>PLASTICITY INDEX</th>
</tr>
</thead>
<tbody>
<tr>
<td>CL</td>
<td>Fine sandy clay with major roots (topsoil) to 6&quot;; brown</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>

End of Exploration at 5.0'.  
No groundwater encountered at time of drilling.

See Subsurface Conditions section in the report for additional information.
<table>
<thead>
<tr>
<th>Description</th>
<th>U.S.C.S</th>
<th>Blown Count</th>
<th>Sample Symbol</th>
<th>Moisture (%)</th>
<th>Dry Density (pcf)</th>
<th>% Passing 200</th>
<th>Liquid Limit (%)</th>
<th>Plasticity Index</th>
<th>Remarks</th>
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</thead>
<tbody>
<tr>
<td>Ground Surface</td>
<td>GP</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>slightly moist</td>
</tr>
<tr>
<td>Fine to coarse gravel</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>very dense</td>
</tr>
<tr>
<td>with silty fine clay; brown</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Auger refusal at 7.0&quot;.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No groundwater encountered at time of drilling.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>
# BORING LOG

**BORING: B-10**

<table>
<thead>
<tr>
<th>WATER LEVEL</th>
<th>DESCRIPTION</th>
<th>DEPTH (FT.)</th>
<th>BLOW COUNT</th>
<th>SAMPLE SYMBOL</th>
<th>MOISTURE (%)</th>
<th>DRY DENSITY (PCF)</th>
<th>% PASSING 200</th>
<th>LIQUID LIMIT (%)</th>
<th>PLASTICITY INDEX</th>
<th>REMARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>GROUND SURFACE</td>
<td>FINE SANDY CLAY with major roots (topsoil) to 6&quot;; brown</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>slightly moist</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>medium stiff</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>very stiff</td>
</tr>
<tr>
<td></td>
<td>End of Exploration at 5.0'. No groundwater encountered at time of drilling.</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

See Subsurface Conditions section in the report for additional information.
<table>
<thead>
<tr>
<th>WATER LEVEL</th>
<th>DESCRIPTION</th>
<th>DEPTH (FT)</th>
<th>BLOW COUNT</th>
<th>SAMPLE SYMBOL</th>
<th>MOISTURE (%)</th>
<th>DRY DENSITY (PCF)</th>
<th>% PASSING 200</th>
<th>LIQUID LIMIT (%)</th>
<th>PLASTICITY INDEX</th>
<th>REMARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>CL</td>
<td>FINE SANDY CLAY with major roots (topsoil) to 6&quot;; brown</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>slightly moist</td>
</tr>
<tr>
<td></td>
<td>End of Exploration at 5.0'. No groundwater encountered at time of drilling.</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>medium stiff</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>very stiff</td>
</tr>
</tbody>
</table>

See Subsurface Conditions section in the report for additional information.
### Water Level
Depth to measured groundwater table. See symbol below.

### USCS
(Unified Soil Classification System) Description of soils encountered; typical symbols are explained below.

### Description
Description of material encountered; may include color, moisture, grain size, density/consistency, laboratory; expressed as percentage of dryweight of sample.

### Depth (ft.)
Depth in feet below the ground surface.

### Blow Count
Number of blows to advance sampler 12" beyond first 6", using a 140-lb hammer with 30" drop.

### Sample Symbol
Type of soil sample collected at depth interval shown; sampler symbols are explained below.

### Moisture (%)
Water content of soil sample measured in laboratory; expressed as percentage of dryweight of sample.

### Dry Density (pcf)
The density of a soil measured in pounds per cubic foot.

### % Passing 200
Fines content of soils sample passing a No. 200 sieve; expressed as a percentage.

### Remarks
Comments and observations regarding drilling or sampling made by driller or field personnel. May include other field and laboratory test results using the following abbreviations:

#### Remarks: Water content at which a soil changes from plastic to liquid behavior.

#### Plasticity Index (%): Range of water content at which a soil exhibits plastic properties.

### Remarks: Comments and observations regarding drilling or sampling made by driller or field personnel. May include other field and laboratory test results.

### CEMENTATION: MODIFIERS: MOISTURE CONTENT (FIELD TEST):

#### Weakly: 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.

#### Trace: <5%

#### Slight: 5-12%

#### With: >12%

### DRAWN BORING LOG

### WATER SYMBOL

#### Water Level

### FIGURE 4

### TYPICAL SAMPLER

#### Bulk/Bag Sample

#### Standard Penetration Split Spoon Sampler

#### Rock Core

#### No Recovery

#### 3.25" OD, 2.42" ID D&M Sampler

#### 3.0" OD, 2.42" ID D&M Sampler

#### California Sampler

#### Thin Wall

### WATER SYMBOL

#### Water Level
APPENDIX A

Topsoil Testing Report
Topsoil Testing Report

Project
Name Elk Ridge
Site Street Address, City, State/Province 1120 Rocky Mountain Way, Elk Ridge, Utah

Person Submitting Test
Name Mike Huber GSH mike@gshgeotech.com
Address, City, State/Province 473 W 4800 S, SLC, UT 84123

Date Requested 04 Aug 2017
Phone 801 685 9190

Fax 2990

Soil Testing Laboratory
Name QA Consulting and Testing, LLC
Address, City, State/Province 645 South 240 East Salem, UT 84653 vonisaman@comcast.net

Date Submitted 07 Aug 2017
Phone 801 423 1116
Fax 1813

General
1. Owner will pay for pre-bid testing and one (1) final topsoil test.

Landscape Architect Instructions
1. Landscape Architect shall determine by investigation quality and quantity of topsoil on site before landscape design. Add physical and fertility recommendations from laboratory recommendations to relevant Church specifications.

Contractor Instructions
1. Test installed topsoil. Installed topsoil shall comply with Project Specifications.
2. If installed topsoil does not comply. Contractor will enhance and test at no cost to Owner until installed topsoil complies with Project Specifications.

Testing Instructions
1. Collect at least two (2) samples of on-site topsoil and each anticipated topsoil source. If site soil profile or borrow pit are not uniform, additional samples shall be taken. Uniform composite samples may also be used if properly acquired and documented.
2. Submit required soil samples to soil testing laboratory along with all required (for this report and laboratory) information.

Soil Testing Laboratory Instructions
1. This report must be completely filled out and provide soil interpretation and amendment, fertilizer, and soil conditioner recommendations for use by Landscape Architect. These recommendations should consider lawn areas, tree and shrub areas, and native plant areas.
2. Provide appropriate times for fertilizing.
3. Return completed Topsoil Testing Report to person submitting the test.

SOIL SAMPLE LOG

<table>
<thead>
<tr>
<th>Soil Sample No.</th>
<th>Description of location where sample was taken</th>
<th>History of use of the soil</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elk Ridge</td>
<td>Surface</td>
<td>Not given</td>
</tr>
</tbody>
</table>

Existing Conditions Test Report
("Acceptable Levels" refers to the allowable soil specifications prior to being amended)

SOIL TEST DATA

<table>
<thead>
<tr>
<th>Sample No.</th>
<th>pH(1)</th>
<th>EC(1) Mmhos/cm</th>
<th>SAR(1)</th>
<th>% Sand</th>
<th>% Silt</th>
<th>% Clay</th>
<th>Text(2) Class</th>
<th>% OM</th>
<th>NO3-N(4) ppm</th>
<th>P(5) ppm</th>
<th>K(5) ppm</th>
<th>Fe(5) ppm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elk Ridge</td>
<td>7.8</td>
<td>0.4</td>
<td>0.4</td>
<td>53</td>
<td>33</td>
<td>14</td>
<td>Sandy Loam</td>
<td>2.0</td>
<td>3</td>
<td>4</td>
<td>167</td>
<td>18</td>
</tr>
</tbody>
</table>

Acceptable Level(s) 5.5 - 8.4 <3.0 <6.0 15-60 10-60 5-30 (2) >1.0 >20 >11 >130 >10

(1) Saturated soil paste 1:1 soil:water method (please indicate)
(2) Hydrometer method (Acceptable soil- sand:15-60 percent, silt:10-60 percent, clay-5-30 percent)
(3) Potassium dichromate method (Walkey-Black) or loss of ignition
(4) Chromotropic acid method
(5) AB-DTPA method

If other methods are used for NO3-N, P, K, and Fe, then note.

Continued next page.
ROCKS (Coarse Fragments)

<table>
<thead>
<tr>
<th>Sample No.</th>
<th>Percent &gt; 1/4 inch (6.4 mm)</th>
<th>Rocks Present ≥ 1.5 inch (38 mm)</th>
<th>Indicate as present or not present</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elk Ridge</td>
<td>8.3</td>
<td>Not Present</td>
<td></td>
</tr>
</tbody>
</table>

Acceptable Level: ≤ 5.0 percent

< 1.5 inch (38 mm)

Landscape Area Description
Lawn Areas: Receive 5 inch (125 mm) topsoil plus recommended amendments and fertilizers.

Shrub/Tree Areas: Unless otherwise indicated, plant pits are to be backfilled with three (3) parts native soil and one part compost or other recommended amendments. Additionally, contractor will add recommended fertilizer.

Native Grass/Shrub/Tree Areas: Planting to receive minimum recommended amendments and fertilizers for establishment.

Interpretation Summary of Test Results:
Elk Ridge
does not meet Acceptable Levels for: Coarse Fragment % >1/4", NO3N and P.

Soil Amendments, Fertilizer and Soil Conditioner – Recommendations:

Lawn Areas: Amendments: Apply an organic material (compost, etc.) at 5.0 cu yds/1000 sq ft for every 5" of topsoil depth. Incorporate well. See the Compost Quality Guidelines for Landscaping, attached. Or, apply a similar product at label rate following manufacturer’s recommendation for soil preparation and turf maintenance. Fertilizer: Apply an NP fertilizer at label rate. Incorporate well. Conditioner: None.

Shrub/Tree Areas: Amendments: See Landscape Area Description above. Fertilizer: Apply an NP fertilizer at label rate. Conditioner: None.

Native Grass/Shrub/Tree Areas: Amendments: None. Conditioners: None. Fertilizer: Incorporate an NP fertilizer at 1/2 label rate, or per nurseryman's recommendation.

Scarify the subsoil at least 6" before applying topsoil.

Long Term (5 Year) Fertilizer and Soil Conditioner – Recommendations:

Lawn Areas: Core aerate annually and top dress with an organic material 1/8” to ¼”. Fertilizer: Continue with above recommendation as top dress. Conditioner: None.

Shrub/Tree Areas: Amendments: None. Conditioner: None, Fertilizer: As top dress, continue with above recommendation as a top dress.

Native Grass/Shrub/Tree Areas: Amendments: None. Conditioner: None: Fertilizer: See Lawn Areas above and top dress fertilizer at 1/2 label rate, or per nurseryman's recommendation.

GshElkRidgeLdsRpt17.807
## Compost Quality Guidelines for Landscaping*

<table>
<thead>
<tr>
<th>Category</th>
<th>pH**</th>
<th>Soluble Salts**</th>
<th>Sodium Adsorption Ratio** (SAR)</th>
<th>Carbon:Nitrogen Ratio*** (C:N)</th>
<th>% Moisture****</th>
<th>&gt;98% Coarse Material Passing (dry wt basis)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ideal</td>
<td>6 to 8</td>
<td>&lt;5</td>
<td>&lt;10</td>
<td>&lt;20:1</td>
<td>25 to 35</td>
<td>3/8&quot; (9.5 mm)</td>
</tr>
<tr>
<td>Acceptable</td>
<td>5-6, 8-9</td>
<td>&lt;10</td>
<td>&lt;20</td>
<td>21:1 to 30:1</td>
<td>&lt;25, &gt;35</td>
<td>3/4&quot; (19 mm)</td>
</tr>
<tr>
<td>Suspect</td>
<td>&lt;5, &gt;9</td>
<td>&gt;10</td>
<td>&gt;20</td>
<td>&lt;10:1, &gt;30:1</td>
<td>&lt;20, &gt;50</td>
<td>&lt;98% 3/4&quot;</td>
</tr>
</tbody>
</table>

*Von Isaman MS, President of QA Consulting and Testing LLC, Dr. Rich Koenig, USU Cooperative Extension Soils Specialist, and Dr. Teresa Cerny, USU Cooperative Extension Horticulturalist, 3 March 2003.

for composts with biosolid feedstocks, biosolids must meet EPA 503 Class A standards

** 1:5 Compost:Water Slurry on Coarse Material passing 3/8" (9.5 mm)
*** on Coarse Material passing 3/8" (9.5 mm)
**** on total sample

Acceptable level Soluble Salts and/or SAR composts then do not exceed 3 cu yds/1000 sq ft for every 3 inches of soil depth.

CompostGuidelinesTable11.O29