# Geotechnical Evaluation Report

**Proposed Mapleton West Meetinghouse**
**Southwest Corner of Spanish Fork Parkway and Heritage Drive**
**Spanish Fork, Utah**
**LDS Property Number: 501-4029**

Prepared for:
The Church of Jesus Christ of Latter-day Saints
% Knell Architects
45 East 300 North
Provo, Utah 84606

GSH

Prepared by
**GSH Geotechnical**
August 2, 2018



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August 2, 2018
Job No. 0153-393-18

The Church of Jesus Christ of Latter-day Saints
% Knell Architects
45 East 300 North
Provo, Utah 84606

Attention: Roger Knell

Mr. Knell:

Re: Geotechnical Evaluation Report
Proposed Mapleton West Meetinghouse
Southwest Corner of Spanish Fork Parkway and Heritage Drive
Spanish Fork, Utah
LDS Property Number: 501-4029

## 1. EXECUTIVE SUMMARY

This report presents the results of the geotechnical study performed at the site of the proposed Mapleton West Meetinghouse to be located at the southwest corner of Spanish Fork Parkway and Heritage Drive in Spanish Fork, Utah.

The soils across the site were generally similar at the boring locations. The borings typically encountered natural silty sand overlying silty clay extending to the maximum depths explored.

Groundwater measurements taken 6 days after drilling indicate that the groundwater is as shallow as 6.0 feet below the surface.

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 topsoil, loose/disturbed soils, or non-engineered fill (if encountered).

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Prior to proceeding with construction, removal of all topsoil, non-engineered fills (if encountered), loose/disturbed soil, 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 undisturbed natural soils.

Based upon our review of available literature, no active faults are known to pass through or immediately adjacent to the site.

## 2. INTRODUCTION

This report presents the results of the geotechnical study performed at the site of the proposed Mapleton West Meetinghouse to be located in Spanish Fork, Utah. The general location of the site with respect to existing roadways, as of 2018, is presented on Figure 1, Vicinity Map. A more detailed 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. 18-0730.

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

The objectives and scope of our study were planned in discussions among Mr. Roger Knell of Knell Architects, Mr. Milan Malkovich of The Church of Jesus Christ of Latter-day Saints, and Mr. Michael S. 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 11 borings, as well as the performance of 2 infiltration tests.

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 4.65-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 120 kips and 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 are anticipated to be minor and less than a foot. Maximum site grading fills are anticipated to be on the order of 2 to 4 feet.

## 7. SITE CONDITIONS

The site consists of a vacant/undeveloped, irregular-shaped, approximately 4.65-acre parcel located at the southwest corner of Spanish Fork Parkway and Heritage Drive (future roadways) in Spanish Fork, Utah. The site slopes downward to the northwest with total relief of approximately 5 feet. Review of historical aerial images indicated that the northern portion of the

site has been used for agricultural purposes. The surface topsoil is loose/disturbed from previous activity at the site.

The site is bounded to the north and south by vacant/undeveloped agricultural land, to the east by a new single-family residential subdivision that is currently under construction, and to the west by vacant/undeveloped land followed by single- and multi-family subdivisions.

## 8. FIELD STUDY

In order to define and evaluate the subsurface soil and groundwater conditions across the site, 11 borings were extended to depths ranging from 5 to 30.5 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, infiltration tests to determine the infiltration rate were performed in Borings B-10 and B-11.

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 3K, 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-1, B-4, B-7, and B-8 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. The borings encountered approximately 6 inches of topsoil at the surface, underlain by undisturbed natural soils. The natural soils primarily consisted of silty sand overlying silty clay extending to the maximum depths explored.

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

The natural clay soils were moist to saturated, soft to very stiff, and brown in color. The natural clay soils are anticipated to exhibit moderate strength and compressibility characteristics under the anticipated load range.

For additional details pertaining to the subsurface conditions encountered, please refer to Figures 3A through 3K, 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.

On August 2, 2018 (6 days following drilling), groundwater was measured within the pipes installed in Borings B-1, B-4, B-7, and B-8 at depths of 6.0, 8.1, 8.0, and 6.2 feet, respectively.

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, density, partial gradation, Atterberg limits, chemical, and topsoil tests. The following paragraphs describe the tests and summarize the test data.

### 10.2 Moisture and Density Tests

To provide index parameters and to correlate other test data, moisture and density tests were performed on selected samples. The results of these tests are presented on the boring logs, Figures 3A through 3K.

### 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 boring logs, Figures 3A through 3K.

| Boring No. | Depth (feet) | Percent Passing No. 200 Sieve | Moisture Content Percent | Soil Classification |
|---|---|---|---|---|
| B-1 | 5.0 | 37.2 | 27.2 | SM |
| B-1 | 10.0 | 61.2 | 26.0 | CL |

### 10.4 Atterberg Limits Test

To aid in classifying the soils, an Atterberg limits test was performed on a sample of the fine-grained cohesive soils. Results of the test are tabulated below and presented on the boring logs, Figures 3A through 3K.

| Boring No. | Depth (feet) | Liquid Limit (percent) | Plastic Limit (percent) | Plasticity Index (percent) | Soil Classification |
|---|---|---|---|---|---|
| B-1 | 20.0 | 24 | 19 | 5 | CL |
| B-1 | 30.0 | 27 | 19 | 8 | CL |

### 10.5 Chemical Tests

A representative soil sample was collected and sent for laboratory analysis for pH and sulfate content. As of the date of this report, results are still pending and will be transmitted when available and with corresponding cement recommendations, if applicable.

### 10.6 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

Due to the shallow groundwater depth, infiltration tests could not be completed at the requested depth of 8.0 feet; therefore, they were performed at depths of 4 feet in Borings B-10 and B-11. Rates were 20 and 23 minutes per inch. We recommend a design rate of 25 minutes per inch.

## 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 soils or granular structural fill extending to suitable natural soils. Under no circumstance shall the footings, floor slabs, or pavements be placed upon topsoil, loose/disturbed soils, or non-engineered fill (if encountered).

Groundwater measurements taken 6 days after drilling indicate that the groundwater is as shallow as 6.0 feet below the surface. It is anticipated that the building pad will be raised 2 to 4 feet to facilitate drainage at the site and this increase in grade will also assist in elevating the foundation excavations above the groundwater.

Prior to proceeding with construction, removal of all topsoil, loose/disturbed soils, non-engineered fills (if encountered), 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 suitable natural soils.

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 topsoil, loose/disturbed soils, surface vegetation, 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.

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 topsoil, loose/disturbed soils, and non-engineered fills have been completely removed.

### 12.2.2 Temporary Excavations

Groundwater was encountered as shallow as 6.0 feet below existing grades. Consideration for dewatering of utility trenches and other excavations below this level should be incorporated into the design and bidding process.

Temporary excavations up to 8 feet deep in fine-grained cohesive soils, above or below the water table, may be constructed with sideslopes no steeper than one-half horizontal to one vertical (0.5H:1.0V). Excavations deeper than 8 feet are not anticipated at the site.

For granular (cohesionless) soils, construction excavations above the water table, not exceeding 4 feet, should be no steeper than one-half horizontal to one vertical (0.5H:1.0V). For excavations up to 8 feet, in granular soils and above the water table, the slopes should be no steeper than one horizontal to one vertical (1H:1V). Excavations encountering saturated cohesionless soils will be very difficult and will require very flat sideslopes and/or shoring, bracing, and dewatering.

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.

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 three-quarter-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] - D1557) compaction criteria in accordance with the following table:

| Location | Total Fill Thickness (feet) | Minimum Percentage of Maximum Dry Density |
|---|---|---|
| Beneath an area extending at least 5 feet beyond the perimeter of the structure | 0 to 10 | 95 |
| Site Grading Fills Outside area defined above | 0 to 5 | 90 |
| Site Grading fills Outside area defined above | 5 to 10 | 95 |
| Utility Trenches | -- | 96 |
| Aggregate base | -- | 96 |

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.

[1] American Association of State Highway and Transportation Officials
[2] American Society for Testing and Materials

### 12.2.5 Utility Trenches

Groundwater was encountered in the borings at depths as shallow as 6.0 feet below existing grades; the utility contractors must be made aware of this condition and be prepared to dewater trenches 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 - D1557) 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 structure may be supported upon conventional spread and continuous wall foundations established upon suitable natural soils and/or structural fill extending to suitable natural 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 | - 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 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 0.35 for footing interface with the natural clay soils, and a coefficient of friction of 0.40 for footing interface with the natural granular soils or granular structural fill may be utilized. 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 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 topsoil, loose/disturbed soils, non-engineered fills, surface vegetation, root systems, 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.

## 12.6 PAVEMENTS

All pavement areas must be prepared as previously discussed (see Section 12.2.1, Site Preparation). Under no circumstances shall pavements be established over topsoil, loose or disturbed soils, non-engineered fills, surface vegetation, root systems, 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 pavement sections on the following pages are recommended.

Parking Areas

(Light Volume of Automobiles and Light Trucks,
Occasional Medium-Weight Trucks,
No Heavyweight Trucks)
[6 equivalent 18-kip axle loads per week]

Flexible:

| | |
|---|---|
| 3.0 inches | Asphalt concrete |
| 7.0 inches | Aggregate base |
| Over | Properly prepared natural subgrade soils and/or structural site grading fill extending to suitable natural subgrade soils |

Rigid:

| | |
|---|---|
| 5.0 inches | Portland cement concrete (non-reinforced) |
| 4.0 inches | Aggregate base |
| Over | Properly prepared natural subgrade soils and/or structural site grading fill extending to suitable natural subgrade soils |

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 natural subgrade soils and/or structural site grading fill extending to suitable natural subgrade soils |
| Rigid: | | |
| | 5.5 inches | Portland cement concrete (non-reinforced) |
| | 4.0 inches | Aggregate base |
| | Over | Properly prepared natural subgrade soils and/or structural site grading fill extending to suitable 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, 6.0 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 12.7, 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 shall conform to applicable sections of the current Utah Department of Transportation (UDOT) Standard Specifications. All asphalt material and paving operations shall 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.

## 12.7 CEMENT TYPES

A representative soil sample was collected and sent for laboratory analysis for pH and sulfate content. As of the date of this report, results are still pending and will be transmitted when available and with corresponding cement recommendations, if applicable.

## 12.8 DOWNSPOUTS

It is recommended that all surface water be directed away from the building with positive drainage measures, including downspouts.

## 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.

### 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 on the following page 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 (40.1232 degrees north and 111.6203 degrees west, respectively), the values for this site are tabulated on the following page.

| Spectral Acceleration Value, T | Site Class B Boundary [mapped values] (% g) | Site Coefficient | Site Class D [adjusted for site class effects] (% g) | Design Values (% g) |
|---|---|---|---|---|
| Peak Ground Acceleration | 48.5 | $F_a$ = 1.015 | 49.2 | 32.8 |
| 0.2 Seconds (Short Period Acceleration) | $S_S$ = 121.3 | $F_a$ = 1.015 | $S_{MS}$ = 123.1 | $S_{DS}$ = 82.1 |
| 1.0 Second (Long Period Acceleration) | $S_1$ = 43.3 | $F_v$ = 1.567 | $S_{M1}$ = 67.9 | $S_{D1}$ = 45.3 |

### 12.9.5 Liquefaction

The site is located in an area that has been identified by U.S. Geological Survey (USGS) as being a "high" liquefaction zone. 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 generally not liquefy during a major seismic event.

Liquefaction of the site soils encountered during this study will not likely liquify during the design seismic event due to their clay content.

## 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.**

Kylie S. Bailey, E.I.T.
Staff Engineer

Reviewed by:

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

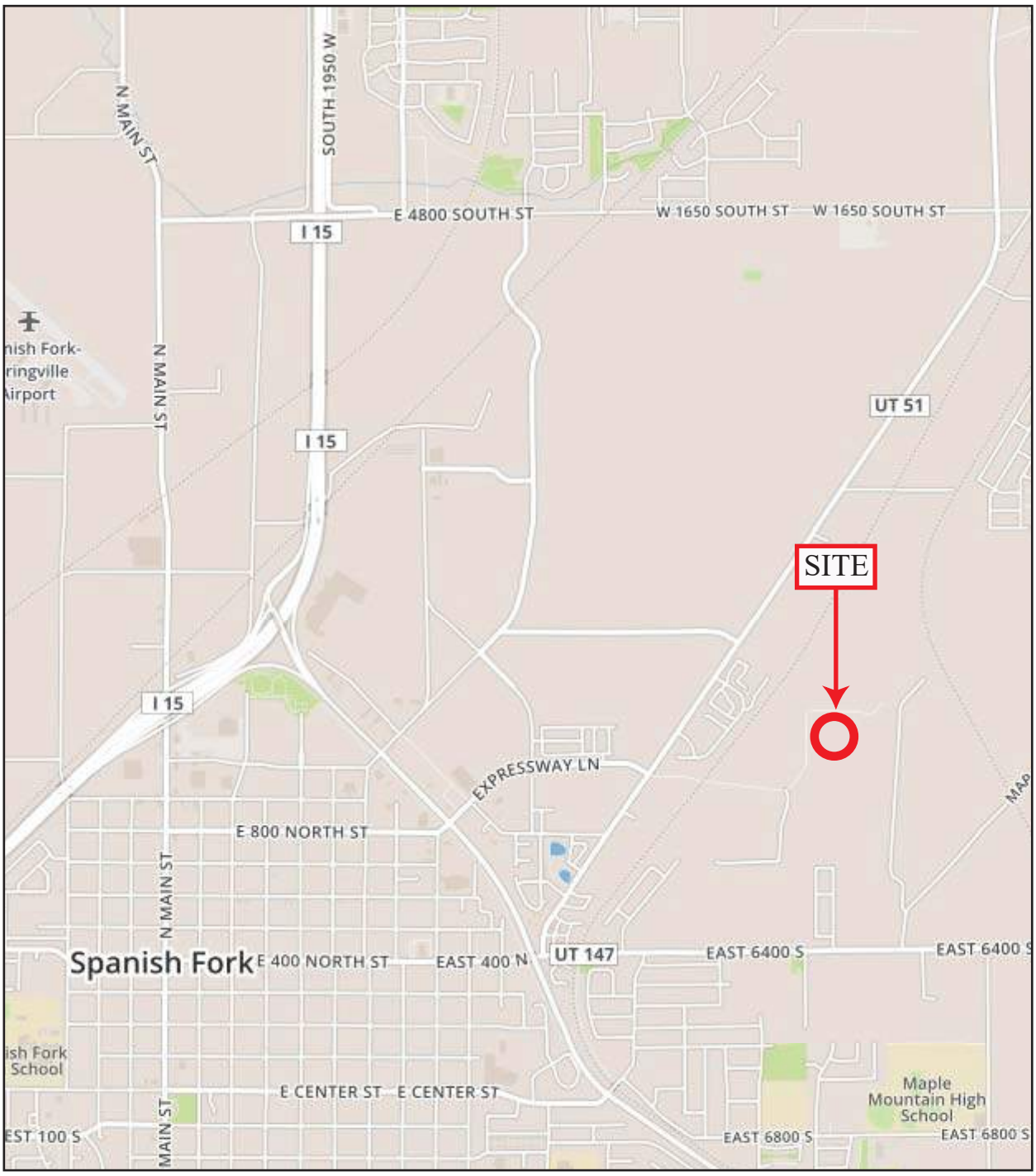
KSB/MSH:jlh

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

Addressee: (email)

cc: Mr. Milan Malkovich (email)
The Church of Jesus Christ of Latter-day Saints

THE CHURCH OF JESUS CHRIST OF LATTER-DAY SAINTS
JOB NO. 0153-393-18




0.5 0 0.5 1 1.5 2 KM 2.5

0.5 0 0.5 MI 1

# FIGURE 1
# VICINITY MAP

REFERENCE:
ALL TRAILS - NATIONAL GEOGRAPHIC TERRAIN
DATED 2018

GSH

THE CHURCH OF JESUS CHRIST OF LATTER-DAY SAINTS
JOB NO. 0153-393-18


REFERENCE:
ADAPTED FROM DRAWING ENTITLED
"SITE PLAN" BY KNELL ARCHITECTS, P.C., DATED 01/16/2018

APPROXIMATE SCALE IN FEET
30 0 30 60

FIGURE 2
SITE PLAN

GSH

# BORING LOG

Page: 1 of 2

## BORING: B-1

CLIENT: The Church of Jesus Christ of Latter-day Saints PROJECT NUMBER: 0153-393-18

PROJECT: Proposed Mapleton West Meetinghouse (Property No. 501-4029) DATE STARTED: 7/26/18 DATE FINISHED: 7/26/18

LOCATION: Southwest Corner of Spanish Fork Parkway and Heritage Drive, Spanish Fork, Utah GSH FIELD REP.: BZ

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

GROUNDWATER DEPTH: 6.0' (8/2/18) ELEVATION: ---

| WATER LEVEL | USCS | DESCRIPTION | DEPTH (FT.) | BLOW COUNT | SAMPLE SYMBOL | MOISTURE (%) | DRY DENSITY (PCF) | % PASSSING 200 | LIQUID LIMIT (%) | PLASTICITY INDEX | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **Ground Surface** | 0 | | | | | | | | |
| | SM | SILTY FINE TO MEDIUM SAND<br>with major roots (topsoil) to 6"; brown with oxidation | | | | | | | | | slightly moist |
| | | | | 11 | | | | | | | medium dense |
| | | | | | | | | | | | |
| | | | | 9 | | 27.2 | | 37.2 | | | loose |
| ▼ | | medium sand grades out | 5 | | | | | | | | |
| | | | | | | | | | | | saturated |
| | CL | FINE SANDY CLAY<br>with occasional layers of silty clay up to 2" thick; brown | | | | | | | | | saturated |
| | | | | 5 | | 26.0 | | 61.2 | | | |
| | | grades to silty clay with some fine sand and occasional layers of silty fine sand up to 2" thick; brown with oxidation | 10 | | | | | | | | |
| | | | | 3 | | | | | | | soft |
| | | | 15 | | | | | | | | |
| | | | | 9 | | | | | 24 | 5 | stiff |
| | | | 20 | | | | | | | | |
| | | | | 8 | | | | | | | |
| | | | 25 | | | | | | | | |

See Subsurface Conditions section in the report for additional information.

FIGURE 3A

# BORING LOG

Page: 2 of 2

**BORING: B-1**

CLIENT: The Church of Jesus Christ of Latter-day Saints PROJECT NUMBER: 0153-393-18

PROJECT: Proposed Mapleton West Meetinghouse (Property No. 501-4029) DATE STARTED: 7/26/18 DATE FINISHED: 7/26/18

| WATER LEVEL | USCS | DESCRIPTION | DEPTH (FT.) | BLOW COUNT | SAMPLE SYMBOL | MOISTURE (%) | DRY DENSITY (PCF) | % PASSING 200 | LIQUID LIMIT (%) | PLASTICITY INDEX | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 25 | 8 | | | | | | | |
| | | | 30 | 7 | | | | | 27 | 8 | medium stiff |
| | | End of Exploration at 30.5'.<br>Installed 1.25" diameter slotted PVC pipe to 30.5'. | 35 | | | | | | | | |
| | | | 40 | | | | | | | | |
| | | | 45 | | | | | | | | |
| | | | 50 | | | | | | | | |

See Subsurface Conditions section in the report for additional information.

FIGURE 3A
(continued)

# BORING LOG

Page: 1 of 1

## BORING: B-2

CLIENT: The Church of Jesus Christ of Latter-day Saints
PROJECT NUMBER: 0153-393-18

PROJECT: Proposed Mapleton West Meetinghouse (Property No. 501-4029)
DATE STARTED: 7/26/18
DATE FINISHED: 7/26/18

LOCATION: Southwest Corner of Spanish Fork Parkway and Heritage Drive, Spanish Fork, Utah
GSH FIELD REP.: BZ

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

GROUNDWATER DEPTH: Not Encountered (7/26/18)
ELEVATION: ---

| WATER LEVEL | USCS | DESCRIPTION | DEPTH (FT.) | BLOW COUNT | SAMPLE SYMBOL | MOISTURE (%) | DRY DENSITY (PCF) | % PASSSING 200 | LIQUID LIMIT (%) | PLASTICITY INDEX | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **Ground Surface** | 0 | | | | | | | | |
| | SM/ SC | SILTY/CLAYEY FINE SAND with occasional layers of silty clay up to 2" thick; major roots (topsoil) to 6"; brown | | | | | | | | | moist medium dense |
| | | | 5 | | | | | | | | very moist |
| | | End of Exploration at 5.0'. No groundwater encountered at time of drilling. | | | | | | | | | |
| | | | 10 | | | | | | | | |
| | | | 15 | | | | | | | | |
| | | | 20 | | | | | | | | |
| | | | 25 | | | | | | | | |

See Subsurface Conditions section in the report for additional information.

FIGURE 3B

# BORING LOG

Page: 1 of 1

## BORING: B-3

CLIENT: The Church of Jesus Christ of Latter-day Saints PROJECT NUMBER: 0153-393-18

PROJECT: Proposed Mapleton West Meetinghouse (Property No. 501-4029) DATE STARTED: 7/26/18 DATE FINISHED: 7/26/18

LOCATION: Southwest Corner of Spanish Fork Parkway and Heritage Drive, Spanish Fork, Utah GSH FIELD REP.: BZ

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

GROUNDWATER DEPTH: Not Encountered (7/26/18) ELEVATION: ---

| WATER LEVEL | USCS | DESCRIPTION | DEPTH (FT.) | BLOW COUNT | SAMPLE SYMBOL | MOISTURE (%) | DRY DENSITY (PCF) | % PASSSING 200 | LIQUID LIMIT (%) | PLASTICITY INDEX | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **Ground Surface** | 0 | | | | | | | | |
| | SM | SILTY FINE SAND<br>with major roots (topsoil) to 6"; brown | | | | | | | | | moist<br>medium stiff |
| | | grades with occasional layers of silty clay up to 2" thick | | | | | | | | | |
| | | | 5 | | | | | | | | very moist |
| | | End of Exploration at 5.0'.<br>No groundwater encountered at time of drilling. | | | | | | | | | |
| | | | 10 | | | | | | | | |
| | | | 15 | | | | | | | | |
| | | | 20 | | | | | | | | |
| | | | 25 | | | | | | | | |

See Subsurface Conditions section in the report for additional information.

FIGURE 3C

# BORING LOG

Page: 1 of 1

## BORING: B-4

CLIENT: The Church of Jesus Christ of Latter-day Saints PROJECT NUMBER: 0153-393-18

PROJECT: Proposed Mapleton West Meetinghouse (Property No. 501-4029) DATE STARTED: 7/26/18 DATE FINISHED: 7/26/18

LOCATION: Southwest Corner of Spanish Fork Parkway and Heritage Drive, Spanish Fork, Utah GSH FIELD REP.: BZ

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

GROUNDWATER DEPTH: 8.1' (8/2/18) ELEVATION: ---

| WATER LEVEL | USCS | DESCRIPTION | DEPTH (FT.) | BLOW COUNT | SAMPLE SYMBOL | MOISTURE (%) | DRY DENSITY (PCF) | % PASSSING 200 | LIQUID LIMIT (%) | PLASTICITY INDEX | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **Ground Surface** | 0 | | | | | | | | |
| | SM | SILTY FINE SAND<br>with major roots (topsoil) to 6"; brown with oxidation | | | | | | | | | slightly moist |
| | | | | 23 | X | 12.4 | 91 | | | | medium dense |
| | | | | | | | | | | | |
| | | | 5 | 18 | X | 22.7 | 93 | | | | moist |
| ▼ | | | | | | | | | | | saturated |
| | CL | SILTY CLAY<br>with some fine sand and occasional layers of silty fine sand up to 2" thick; brown with oxidation | | 9 | ‖ | | | | | | stiff |
| | | | 10 | | | | | | | | |
| | | | | 6 | ‖ | | | | | | medium stiff |
| | | End of Exploration at 15.5'.<br>Installed 1.25" diameter slotted PVC pipe to 15.5'. | 15 | | | | | | | | |
| | | | 20 | | | | | | | | |
| | | | 25 | | | | | | | | |

See Subsurface Conditions section in the report for additional information.

FIGURE 3D

# BORING LOG

Page: 1 of 1

## BORING: B-5

CLIENT: The Church of Jesus Christ of Latter-day Saints PROJECT NUMBER: 0153-393-18

PROJECT: Proposed Mapleton West Meetinghouse (Property No. 501-4029) DATE STARTED: 7/26/18 DATE FINISHED: 7/26/18

LOCATION: Southwest Corner of Spanish Fork Parkway and Heritage Drive, Spanish Fork, Utah GSH FIELD REP.: BZ

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

GROUNDWATER DEPTH: Not Encountered (7/26/18) ELEVATION: ---

| WATER LEVEL | USCS | DESCRIPTION | DEPTH (FT.) | BLOW COUNT | SAMPLE SYMBOL | MOISTURE (%) | DRY DENSITY (PCF) | % PASSSING 200 | LIQUID LIMIT (%) | PLASTICITY INDEX | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **Ground Surface** | 0 | | | | | | | | |
| | SM | SILTY FINE SAND<br>with major roots (topsoil) to 6"; brown | | | | | | | | | slightly moist<br>loose |
| | | grades with oxidation | 5 | | | | | | | | |
| | | End of Exploration at 5.0'. | | | | | | | | | |
| | | | 10 | | | | | | | | |
| | | | 15 | | | | | | | | |
| | | | 20 | | | | | | | | |
| | | | 25 | | | | | | | | |

See Subsurface Conditions section in the report for additional information.

FIGURE 3E

# BORING LOG

Page: 1 of 1

## BORING: B-6

CLIENT: The Church of Jesus Christ of Latter-day Saints PROJECT NUMBER: 0153-393-18

PROJECT: Proposed Mapleton West Meetinghouse (Property No. 501-4029) DATE STARTED: 7/26/18 DATE FINISHED: 7/26/18

LOCATION: Southwest Corner of Spanish Fork Parkway and Heritage Drive, Spanish Fork, Utah GSH FIELD REP.: BZ

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

GROUNDWATER DEPTH: Not Encountered (7/26/18) ELEVATION: ---

| WATER LEVEL | USCS | DESCRIPTION | DEPTH (FT.) | BLOW COUNT | SAMPLE SYMBOL | MOISTURE (%) | DRY DENSITY (PCF) | % PASSSING 200 | LIQUID LIMIT (%) | PLASTICITY INDEX | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **Ground Surface** | 0 | | | | | | | | |
| | SM | SILTY FINE SAND<br>with major roots (topsoil) to 6"; brown | | | | | | | | | dry<br>loose |
| | | grades with oxidation | 5 | | | | | | | | slightly moist |
| | | End of Exploration at 5.0'. | | | | | | | | | |
| | | | 10 | | | | | | | | |
| | | | 15 | | | | | | | | |
| | | | 20 | | | | | | | | |
| | | | 25 | | | | | | | | |

See Subsurface Conditions section in the report for additional information.

FIGURE 3F

# BORING LOG

Page: 1 of 1

## BORING: B-7

CLIENT: The Church of Jesus Christ of Latter-day Saints PROJECT NUMBER: 0153-393-18

PROJECT: Proposed Mapleton West Meetinghouse (Property No. 501-4029) DATE STARTED: 7/26/18 DATE FINISHED: 7/26/18

LOCATION: Southwest Corner of Spanish Fork Parkway and Heritage Drive, Spanish Fork, Utah GSH FIELD REP.: BZ

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

GROUNDWATER DEPTH: 8.0' (8/2/18) ELEVATION: ---

| WATER LEVEL | USCS | DESCRIPTION | DEPTH (FT.) | BLOW COUNT | SAMPLE SYMBOL | MOISTURE (%) | DRY DENSITY (PCF) | % PASSSING 200 | LIQUID LIMIT (%) | PLASTICITY INDEX | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **Ground Surface** | 0 | | | | | | | | |
| | SM | SILTY FINE SAND<br>with major roots (topsoil) to 6"; brown | | | | | | | | | slightly moist |
| | | | | 25 | | 11.6 | 89 | | | | medium dense |
| | | | | | | | | | | | |
| | | | 5 | 16 | | 15.7 | 77 | | | | loose |
| | | | | | | | | | | | |
| ▼ | CL | SILTY CLAY<br>with some fine sand and occasional layers of silty fine sand up to 2" thick; brown with oxidation | | | | | | | | | moist<br>saturated |
| | | | 10 | 15 | | | | | | | very stiff |
| | | End of Exploration at 10.5'.<br>Installed 1.25" diameter slotted PVC pipe to 10.5'. | | | | | | | | | |
| | | | 15 | | | | | | | | |
| | | | 20 | | | | | | | | |
| | | | 25 | | | | | | | | |

See Subsurface Conditions section in the report for additional information.

FIGURE 3G

# BORING LOG

Page: 1 of 1

## BORING: B-8

CLIENT: The Church of Jesus Christ of Latter-day Saints
PROJECT NUMBER: 0153-393-18

PROJECT: Proposed Mapleton West Meetinghouse (Property No. 501-4029)
DATE STARTED: 7/26/18
DATE FINISHED: 7/26/18

LOCATION: Southwest Corner of Spanish Fork Parkway and Heritage Drive, Spanish Fork, Utah
GSH FIELD REP.: BZ

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

GROUNDWATER DEPTH: 6.2' (8/2/18)
ELEVATION: ---

| WATER LEVEL | USCS | DESCRIPTION | DEPTH (FT.) | BLOW COUNT | SAMPLE SYMBOL | MOISTURE (%) | DRY DENSITY (PCF) | % PASSSING 200 | LIQUID LIMIT (%) | PLASTICITY INDEX | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **Ground Surface** | 0 | | | | | | | | |
| | SM | SILTY FINE SAND<br>with major roots (topsoil) to 6"; brown with oxidation | | | | | | | | | moist |
| | | | | 35 | | 20.1 | 88 | | | | medium dense |
| | | | 5 | | | | | | | | |
| ▼ | CL | SILTY CLAY<br>with some fine sand and occasional layers of silty fine sand up to 3" thick; brown with oxidation | | | | | | | | | moist<br>saturated |
| | | | | 10 | | | | | | | stiff |
| | | | 10 | | | | | | | | |
| | | | | 6 | | | | | | | medium stiff |
| | | End of Exploration at 12.5'.<br>Installed 1.25" diameter slotted PVC pipe to 12.5'. | 15 | | | | | | | | |
| | | | 20 | | | | | | | | |
| | | | 25 | | | | | | | | |

See Subsurface Conditions section in the report for additional information.

FIGURE 3H

# BORING LOG

Page: 1 of 1

## BORING: B-9

CLIENT: The Church of Jesus Christ of Latter-day Saints PROJECT NUMBER: 0153-393-18

PROJECT: Proposed Mapleton West Meetinghouse (Property No. 501-4029) DATE STARTED: 7/26/18 DATE FINISHED: 7/26/18

LOCATION: Southwest Corner of Spanish Fork Parkway and Heritage Drive, Spanish Fork, Utah GSH FIELD REP.: BZ

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

GROUNDWATER DEPTH: Not Encountered (7/26/18) ELEVATION: ---

| WATER LEVEL | USCS | DESCRIPTION | DEPTH (FT.) | BLOW COUNT | SAMPLE SYMBOL | MOISTURE (%) | DRY DENSITY (PCF) | % PASSSING 200 | LIQUID LIMIT (%) | PLASTICITY INDEX | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **Ground Surface** | 0 | | | | | | | | |
| | SM | SILTY FINE SAND<br>with major roots (topsoil) to 6"; brown | | | | | | | | | slightly moist<br>loose |
| | | | | | | | | | | | moist |
| | | End of Exploration at 5.0'.<br>No groundwater encountered at time of drilling. | 5 | | | | | | | | |
| | | | 10 | | | | | | | | |
| | | | 15 | | | | | | | | |
| | | | 20 | | | | | | | | |
| | | | 25 | | | | | | | | |

See Subsurface Conditions section in the report for additional information.

FIGURE 3I

# BORING LOG

Page: 1 of 1

## BORING: B-10

CLIENT: The Church of Jesus Christ of Latter-day Saints PROJECT NUMBER: 0153-393-18

PROJECT: Proposed Mapleton West Meetinghouse (Property No. 501-4029) DATE STARTED: 7/26/18 DATE FINISHED: 7/26/18

LOCATION: Southwest Corner of Spanish Fork Parkway and Heritage Drive, Spanish Fork, Utah GSH FIELD REP.: BZ

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

GROUNDWATER DEPTH: Not Encountered (7/26/18) ELEVATION: ---

| WATER LEVEL | USCS | DESCRIPTION | DEPTH (FT.) | BLOW COUNT | SAMPLE SYMBOL | MOISTURE (%) | DRY DENSITY (PCF) | % PASSSING 200 | LIQUID LIMIT (%) | PLASTICITY INDEX | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **Ground Surface** | 0 | | | | | | | | |
| | SM | SILTY FINE SAND<br>with major roots (topsoil) to 6"; brown | | | | | | | | | slightly moist<br>loose |
| | | | | | | | | | | | moist |
| | | | 5 | | | | | | | | very moist to saturated |
| | | End of Exploration at 8.0'.<br>No groundwater encountered at time of drilling. | | | | | | | | | |
| | | | 10 | | | | | | | | |
| | | | 15 | | | | | | | | |
| | | | 20 | | | | | | | | |
| | | | 25 | | | | | | | | |

See Subsurface Conditions section in the report for additional information.

FIGURE 3J

# BORING LOG

Page: 1 of 1

## BORING: B-11

CLIENT: The Church of Jesus Christ of Latter-day Saints PROJECT NUMBER: 0153-393-18

PROJECT: Proposed Mapleton West Meetinghouse (Property No. 501-4029) DATE STARTED: 7/26/18 DATE FINISHED: 7/26/18

LOCATION: Southwest Corner of Spanish Fork Parkway and Heritage Drive, Spanish Fork, Utah GSH FIELD REP.: BZ

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

GROUNDWATER DEPTH: Not Encountered (7/26/18) ELEVATION: ---

| WATER LEVEL | USCS | DESCRIPTION | DEPTH (FT.) | BLOW COUNT | SAMPLE SYMBOL | MOISTURE (%) | DRY DENSITY (PCF) | % PASSSING 200 | LIQUID LIMIT (%) | PLASTICITY INDEX | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **Ground Surface** | 0 | | | | | | | | |
| | SM | SILTY FINE SAND<br>with major roots (topsoil) to 6"; brown | | | | | | | | | slightly moist<br>medium dense |
| | | | | | | | | | | | moist |
| | | | 5 | | | | | | | | very moist to saturated |
| | | End of Exploration at 8.0'.<br>No groundwater encountered at time of drilling. | | | | | | | | | |
| | | | 10 | | | | | | | | |
| | | | 15 | | | | | | | | |
| | | | 20 | | | | | | | | |
| | | | 25 | | | | | | | | |

See Subsurface Conditions section in the report for additional information.

FIGURE 3K

CLIENT: The Church of Jesus Christ of Latter-day Saints
PROJECT: Proposed Mapleton West Meetinghouse (Property No. 501-4029)
PROJECT NUMBER: 0153-393-18

# KEY TO BORING LOG

| WATER LEVEL | USCS | DESCRIPTION | DEPTH (FT.) | BLOW COUNT | SAMPLE SYMBOL | MOISTURE (%) | DRY DENSITY (PCF) | % PASSSING 200 | LIQUID LIMIT (%) | PLASTICITY INDEX | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ① | ② | ③ | ④ | ⑤ | ⑥ | ⑦ | ⑧ | ⑨ | ⑩ | ⑪ | ⑫ |

## COLUMN DESCRIPTIONS

① **Water Level:** Depth to measured groundwater table. See symbol below.

② **USCS:** (Unified Soil Classification System) Description of soils encountered; typical symbols are explained below.

③ **Description:** Description of material encountered; may include color, moisture, grain size, density/consistency,

④ **Depth (ft.):** Depth in feet below the ground surface.

⑤ **Blow Count:** Number of blows to advance sampler 12" beyond first 6", using a 140-lb hammer with 30" drop.

⑥ **Sample Symbol:** Type of soil sample collected at depth interval shown; sampler symbols are explained below.

⑦ **Moisture (%):** Water content of soil sample measured in laboratory; expressed as percentage of dryweight of

⑧ **Dry Density (pcf):** The density of a soil measured in laboratory; expressed in pounds per cubic foot.

⑨ **% Passing 200:** Fines content of soils sample passing a No. 200 sieve; expressed as a percentage.

⑩ **Liquid Limit (%):** Water content at which a soil changes from plastic to liquid behavior.

⑪ **Plasticity Index (%):** Range of water content at which a soil exhibits plastic properties.

⑫ **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:

CEMENTATION:

**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.

MODIFIERS:

**Trace** <5%

**Some** 5-12%

**With** > 12%

MOISTURE CONTENT (FIELD TEST):

**Dry:** Absence of moisture, dusty, dry to the touch.

**Moist:** Damp but no visible water.

**Saturated:** Visible water, usually soil below water table.

Descriptions and stratum lines are interpretive; field descriptions may have been modified to reflect lab test results. Descriptions on the logs apply only at the specific boring locations and at the time the borings were advanced; they are not warranted to be representative of subsurface conditions at other locations or times.

## UNIFIED SOIL CLASSIFICATION SYSTEM (USCS)

| MAJOR DIVISIONS | | | USCS SYMBOLS | TYPICAL DESCRIPTIONS |
|---|---|---|---|---|
| COARSE-GRAINED SOILS More than 50% of material is larger than No. 200 sieve size. | GRAVELS More than 50% of coarse fraction retained on No. 4 sieve. | CLEAN GRAVELS (little or no fines) | GW | Well-Graded Gravels, Gravel-Sand Mixtures, Little or No Fines |
| | | | GP | Poorly-Graded Gravels, Gravel-Sand Mixtures, Little or No Fines |
| | | GRAVELS WITH FINES (appreciable amount of fines) | GM | Silty Gravels, Gravel-Sand-Silt Mixtures |
| | | | GC | Clayey Gravels, Gravel-Sand-Clay Mixtures |
| | SANDS More than 50% of coarse fraction passing through No. 4 sieve. | CLEAN SANDS (little or no fines) | SW | Well-Graded Sands, Gravelly Sands, Little or No Fines |
| | | | SP | Poorly-Graded Sands, Gravelly Sands, Little or No Fines |
| | | SANDS WITH FINES (appreciable amount of fines) | SM | Silty Sands, Sand-Silt Mixtures |
| | | | SC | Clayey Sands, Sand-Clay Mixtures |
| FINE-GRAINED SOILS More than 50% of material is smaller than No. 200 sieve size. | SILTS AND CLAYS Liquid Limit less than 50% | | ML | Inorganic Silts and Very Fine Sands, Rock Flour, Silty or Clayey Fine Sands or Clayey Silts with Slight Plasticity |
| | | | CL | Inorganic Clays of Low to Medium Plasticity, Gravelly Clays, Sandy Clays, Silty Clays, Lean Clays |
| | | | OL | Organic Silts and Organic Silty Clays o f Low Plasticity |
| | SILTS AND CLAYS Liquid Limit greater than 50% | | MH | Inorganic Silts, Micacious or Diatomacious Fine Sand or Silty Soils |
| | | | CH | Inorganic Clays of High Plasticity, Fat Clays |
| | | | OH | Organic Silts and Organic Clays of Medium to High Plasticity |
| HIGHLY ORGANIC SOILS | | | PT | Peat, Humus, Swamp Soils with High Organic Contents |

Note: Dual Symbols are used to indicate borderline soil classifications.

**STRATIFICATION:**

| DESCRIPTION | THICKNESS |
|---|---|
| Seam | up to 1/8" |
| Layer | 1/8" to 12" |

**Occasional:** One or less per 6" of thickness

**Numerous;** More than one per 6" of thickness

**TYPICAL SAMPLER GRAPHIC SYMBOLS**

- 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

**FIGURE 4**

GSH

# APPENDIX A

Topsoil Testing Report