Gordon Spilker Huber
Geotechnical Consultants, Inc.

REPORT
GEOTECHNICAL STUDY
PROPOSED STAKE CENTER MEETINGHOUSE
APPROXIMATELY 1970 SOUTH 3000 WEST
SYRACUSE, UTAH
LDS PROPERTY NUMBER: 500-1632

Submitted To:

Report
Geotechnical Study
Proposed Stake Center Meetinghouse
Approximately 1970 South 3000 West
Syracuse, Utah
LDS Property Number: 500-1632

Submitted By:

Gordon Spilker Huber Geotechnical Consultants, Inc.
4426 South Century Drive, Suite 100
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May 7, 2009

Job No. 0153-080-09

GSH
Gordon Spilker Huber
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May 7, 2009
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The Church of Jesus Christ of Latter-Day Saints
% Richards Bott Architects
620 24th Street
Ogden, Utah 84401

Attention: Mr. G. Brian Bott, AIA

Gentlemen:

Re: Report
Geotechnical Study
Proposed Stake Center Meetinghouse
Approximately 1970 South 3000 West
Syracuse, Utah
LDS Property Number: 500-1632

1. INTRODUCTION

1.1 GENERAL

This report presents the results of our geotechnical study performed at the site of the proposed meetinghouse, which is located at approximately 1970 South 3000 West in Syracuse, Utah. The general location of the site with respect to major topographic features and existing facilities, as of 1999, is presented on Figure 1, Vicinity Map. A more detailed layout of the site showing the proposed facilities and adjacent roadways is presented on Figure 2, Site Plan. The locations of the borings drilled in conjunction with this study are also presented on Figure 2.

1.2 OBJECTIVES AND SCOPE

The objectives and scope of our study were planned in discussions between Mr. G. Brian Bott of Richards Bott Architects, and Mr. Mike Huber of Gordon Spilker Huber Geotechnical Consultants, Inc. (GSH).

In general, the objectives of this study were to:

1. Define and evaluate the subsurface soil and groundwater conditions across the site.

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

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

1. A field program consisting of the drilling, logging, and sampling of 12 borings.

2. A laboratory testing program.

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

1.3 AUTHORIZATION

Authorization was provided by the client.

1.4 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 2., Proposed Construction, 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.

2. PROPOSED CONSTRUCTION

The approximately 26,000 square foot meetinghouse is planned for the approximate 4.85-acre site. The structure will be one- to one-extended-level in height. The structure will be of wood-frame construction established slab-on-grade.

Maximum real column and wall loads, as provided in the "Geo-Technical Information Guideline", will be 20 to 70 kips and 1.8 to 5.2 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 improvement. Projected traffic in the parking areas is anticipated to consist of a light volume of automobiles and light trucks and occasional medium-weight trucks. In primary roadway areas,

traffic is projected to consist of a moderate volume of automobiles and light trucks, a light volume of medium-weight trucks, and occasional heavy-weight trucks.

Maximum site grading cuts are anticipated to be minimal across the site and on the order of less than one foot. Fills are anticipated to be on the order of two to three feet. It is anticipated that the overall site will be raised approximately two to three feet to facilitate drainage and access off the adjacent roadways. Many of the recommendations presented in this report are based on this projection; therefore, if additional site grading fills are planned for the site, GSH must be contacted immediately.

3. SITE INVESTIGATIONS

3.1 FIELD PROGRAM

In order to define and evaluate the subsurface soil and groundwater conditions at the site, 12 borings were explored to depths ranging from 5.0 to 31.5 feet below existing grade. The borings were drilled using a truck-mounted drill rig equipped with hollow-stem augers. Locations of the borings are presented on Figure 2.

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 encountered were obtained for subsequent laboratory testing and examination. The soils were classified in the field based upon visual and textural examination. These classifications have been supplemented by subsequent inspection and testing in our laboratory. Detailed graphical representation of the subsurface conditions encountered is presented on Figures 3A through 3L, Log of Borings. Soils were classified in accordance with the nomenclature described on Figure 4, Unified Soil Classification System.

A 3.25-inch outside diameter, 2.42-inch inside diameter drive sampler (Dames & Moore) was utilized in the subsurface sampling at the site. Additionally, a 2.0-inch outside diameter, 1.38-inch inside diameter drive sampler (SPT) was also utilized. The blow-counts recorded on the boring logs were those required to drive the sampler 12 inches with a 140-pound hammer dropping 30 inches.

Following completion of drilling operations, one and one-quarter-inch diameter slotted PVC pipe was installed in Borings B-1 through B-6 in order to provide a means of monitoring the groundwater fluctuations.

3.2 LABORATORY TESTING

3.2.1 General

In order to provide data necessary for our engineering analyses, a laboratory testing program was performed. The program included moisture, density, partial gradation, consolidation, chemical, and topsoil tests. The following paragraphs describe the tests and summarize the test data.

3.2.2 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 boring logs, Figures 3A through 3L.

3.2.3 Partial Gradation Tests

To aid in classifying the granular soils, partial gradation tests were performed. Results of the tests are tabulated below:

Boring No.	Depth (feet)	Percent Passing No. 200 Sieve	Soil Classification
B-1	4.5	24.5	SC
B-1	8.5	33.4	SM
B-4	5.5	21.3	SM
B-5	2.5	14.3	SM
B-5	5.5	17.1	SM

3.2.4 Consolidation Test

To provide data necessary for our settlement analyses, a consolidation test was performed upon a representative sample of the near-surface silty clay soils encountered at the site. The results of the test indicated that the soil tested is moderately over-consolidated and, when loaded below the over-consolidation pressure, will exhibit moderate compressibility characteristics. Detailed results of the test are maintained within our files and can be transmitted to you, upon your request.

3.2.5 Chemical Tests

To determine if the site soils will react detrimentally with concrete, chemical tests were performed on a representative sample of the clayey soils encountered at the site. The results of the chemical tests are tabulated below:

Boring No.	Depth (feet)	pH	Total Water Soluble Sulfate (mg/kg-dry)
B-9	1.5	7.5	33

3.2.6 Topsoil Tests

A series of topsoil tests were performed on a combined surface sample from three locations across the site. The results of these tests are attached to this study as Appendix A, Topsoil Testing Report.

4. SITE CONDITIONS

4.1 SURFACE

The site consists of a rectangular-shaped 4.85-acre parcel of open, undeveloped agricultural land on the west side of 3000 West Street. The site is located in a single-family residential and agricultural area. The site is surrounded mainly by open, vacant agricultural fields with some residential subdivisions beyond. An elementary school and a fire station are also located to the east of 3000 West Street. A three-foot-wide by two-foot-deep concrete-lined irrigation canal is located along the east property line. A series of shallow ditches extend approximately 50 feet west from the canal.

Vegetation at the site consists of grasses and a few scattered weeds. Natural site topography slopes gently downward to the southwest with an estimated overall relief on the order of one to two feet across the site. The site is approximately one foot below the surface of 3000 West Street.

4.2 SUBSURFACE SOIL

The soil conditions encountered in each of the borings, to the depths penetrated, were relatively similar. In general, silty clays and clayey sands were encountered from the surface to depths of 2.0 to 5.5 feet underlain by silty sands to the depths penetrated, 5.0 to 31.5 feet. The clays and clayey sands are typically stiff/medium dense; moist to saturated; brown to light brown; and, based on laboratory tests, are anticipated to exhibit moderate strength and compressibility characteristics under the proposed loadings. The underlying silty sands are typically medium

dense to dense; saturated; gray, brown, and light brown; and are anticipated to exhibit moderately high strength and moderately low compressibility characteristics.

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.

4.3 GROUNDWATER

Groundwater was encountered during drilling at the site. On April 7, 2009, groundwater was measured in the piezometers placed in Borings B-1 through B-5. The piezometer in Boring B-6 had been destroyed. The following table summarizes groundwater measurements:

Boring No.	Groundwater Depth (feet)	
	April 21/23, 2009	**April 30, 2009**
B-1	6.0*	3.6
B-2	4.0*	3.9
B-3	3.0*	3.2
B-4	5.0*	2.9
B-5	5.0*	2.7
B-6	4.0*	Pipe Destroyed
B-7	4.0*	No pipe installed
B-8	5.0*	No pipe installed
B-9	5.0*	No pipe installed
B-10	3.5*	No pipe installed
B-11	4.0*	No pipe installed
B-12	4.0*	No pipe installed

* During drilling, not stabilized.

Seasonal and longer-term groundwater fluctuations of one to two feet should be anticipated. The highest seasonal levels will generally occur during the late spring and summer months. Irrigation on this and surrounding fields may also create seasonal groundwater fluctuations.

5. DISCUSSIONS AND RECOMMENDATIONS

5.1 SUMMARY OF FINDINGS

The results of our study indicate that the proposed structure may be supported upon conventional spread and continuous wall foundations established upon suitable undisturbed natural soils and/or structural fill extending to suitable undisturbed natural soils.

The most significant geotechnical aspects of the site are the high groundwater level and the easily disturbed near-surface clays.

Groundwater measurements taken at the site indicate that the groundwater is as shallow as 2.7 feet below the surface. The minimum depth for frost protection for footings is 30 inches. To meet this minimum embedment depth, footing elevations will extend near or below the groundwater elevation. This will create significant construction issues with the easily disturbed clay soils and may require stabilization and/or dewatering. It is anticipated that the building pad will be raised approximately two to three feet to facilitate drainage at the site. This rise will also assist in elevating the foundation excavations above the groundwater and the easily disturbed clays. It is strongly recommended that site grading cuts be kept to as minimal as possible.

To facilitate construction and improve long-term performance, it is recommended that a means of lowering the groundwater table across the site be considered. An effective system is dependent on finding a point of suitable gravity discharge. As an alternate to an area subdrain, the site can be raised, as previously mentioned. Subdrains and/or site grading fills should be installed as far in advance of other construction as possible. Even with these precautions, extensive stabilization of the natural clays prior to placement of footing, floor slabs, pavements, or structural site grading fill, will likely be required. This will be especially true during the wetter months and during times of precipitation.

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

5.2 SUBDRAIN

As previously discussed, if area subdrains are used, they should be installed as far in advance of other construction as possible. Even lowering the groundwater table only two feet would be beneficial.

Once a suitable point of gravity discharge and its elevation is determined, GSH can provide subdrain details and layout recommendations.

5.3 EARTHWORK

5.3.1 Site Preparation

Site preparation is to consist of the removal of all surface vegetation, root bulbs, sod, rubbish, non-engineered fills, loose surficial soils, and any other deleterious materials from an area extending at least three feet beyond the perimeter of the building, and exterior flatwork. We estimate that approximately two inches of stripping will be necessary to remove the majority of roots, vegetation, and organics. Due to the high groundwater table and easily disturbed near-surface clay, it is recommended that in pavement areas, the vegetation be removed but the topsoil remain. The topsoil will act as a "mat" and will be a more stable surface for pavements than if this topsoil were to be removed. Vegetation and other deleterious materials should be removed from the site. Stripped topsoil will be unsuitable for structural fill but may be stockpiled for subsequent landscaping purposes. Due to the high groundwater level, it is recommended that cuts be kept as minimal as possible and generally be less than one foot. As previously mentioned, even with these precautions extensive stabilization of the subgrade will likely be required prior to the placement of footings, floor slabs, pavements, and structural fills.

Due to the high groundwater and easily disturbed nature of the near-surface clays, proofrolling of the natural soils is not recommended. If excessively soft or loose soils are encountered, they must be stabilized and/or replaced with structural fill.

5.3.2 Temporary Excavations

The groundwater table should be anticipated as shallow as approximately two and one-half feet, and possibly shallower. Temporary construction excavations in cohesive (clayey) soil, not exceeding four feet in depth above or below the groundwater table, may be constructed with sideslopes no steeper than one-quarter horizontal to one vertical. Temporary excavations up to eight feet deep in fine-grained cohesive soils may be constructed with sideslopes no steeper than three-quarters horizontal to one vertical. Temporary excavations up to eight feet deep in the sand soils may be constructed with sideslopes no steeper than one horizontal to one vertical. Additionally, excavations below the groundwater in sand layers will be extremely difficult since these soils will tend to "flow" into the excavations. This condition will require significant effort to stabilize and will likely include significantly flatter sideslopes, dewatering, and/or the use of shoring/bracing. Excavations deeper than eight feet are not anticipated at the site. If excessive sloughing occurs, the sideslopes must be flattened and dewatering and/or shoring provided.

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

5.3.3 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 possibly as replacement fill below footings. It is recommended that all structural fill must be free of sod, rubbish, topsoil, frozen soil, and other deleterious materials. Structural site grading fill is defined as fill placed over relatively large open areas to raise the overall grade. For structural site grading fill, the maximum particle size should generally not exceed four inches or half the thickness of the fill; although, occasional larger particles, not exceeding eight 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 should generally be restricted to two inches.

The on-site soils may be utilized as structural site grading fill. However, it should be noted that unless moisture control is maintained near optimum, utilization of fine-grained soils (clays and silts) as structural site grading fill will be very difficult, if not impossible, during wet and cold periods of the year. Additionally, the fine-grained silty clay soils encountered in the borings were above optimum moisture content and would require substantial drying prior to compacting. Only granular soils are recommended as structural fill in confined areas, such as under foundations, within backfill wedges, and within utility trenches.

To stabilize soft subgrade conditions or where structural fill is required to be placed below a level one foot above the water table at the time of construction, a mixture of coarse gravels and cobbles (stabilizing fill) should be utilized.

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.

5.3.4 Fill Placement and Compaction

Coarse gravel and cobble mixtures (stabilizing fill), if utilized, 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.

All structural fill shall be placed in lifts not exceeding eight inches in loose thickness. Structural fills beneath an area extending at least 3 feet beyond the perimeter of the structure must be compacted to at least 95 percent of the maximum dry density as determined by the AASHTO[1] T-180 (ASTM[2] D-1557) compaction criteria. All structural fills 5 to 10 feet thick must be compacted to 95 percent of the above criteria. Structural fills less than 5 feet thick, which are not beneath an area extending out at least 3 feet from the perimeter of the structure, must be

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

compacted to at least 90 percent of the above-defined criteria. 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 should be prepared as discussed in Section 5.3.1, Site Preparation, of this report. In confined areas, subgrade preparation shall consist of the removal of all loose or disturbed soils.

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.

5.3.5 Utility Trenches

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 proofrolled and/or properly compacted prior to the construction of any exterior flatwork over a backfilled trench. Proofrolling may 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 proofrolling, they shall be removed to a maximum depth of two 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. We recommend that as the major utilities continue onto the site that these compaction specifications are followed.

The natural fine-grained cohesive soils are not recommended for use as trench backfill.

5.4 SPREAD AND CONTINUOUS WALL FOUNDATIONS

5.4.1 Design Data

The proposed structure may be supported upon conventional spread and continuous wall foundations established upon suitable undisturbed natural soils or structural fill extending to suitable undisturbed natural soils. A slightly higher bearing pressure may be utilized if the footings are underlain by granular structural fill as defined later in this section. For design, the parameters on the following page are provided.

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 Pressure for Real Load Conditions	- 2,500 pounds per square foot*
Bearing Pressure Increase for Seismic Loading	- 50 percent

* Footings underlain by a minimum of 12 inches of granular structural fill extending to suitable natural soils may utilize a slightly higher bearing pressure of 3,000 pounds per square foot.

The term "net bearing pressure" refers to the 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.

5.4.2 Installation

Groundwater was measured as shallow as 2.7 feet below the surface. Dewatering and stabilization of the bearing subgrade will likely be required to construct foundations.

Once the building pad construction is completed, we recommend footing trenches be excavated with a smooth-edged bucket to reduce disturbance of the bearing soils. All loose/disturbed soils within the footing trench shall be removed.

If structural fill is utilized below foundations, the fill shall extend to suitable natural soils and be placed such that the width of fill extends laterally at least six inches beyond the edges of the footings in all directions for each foot of fill thickness beneath footings. For example, if the width of the footing is two feet and the thickness of the structural fill beneath the footing is one foot, the width of the structural fill at the base of the footing excavation would be a total of three feet.

Under no circumstances shall the footings be installed overlying soft or disturbed soils, construction debris, frozen soil, sod, rubbish, topsoil, non-engineered fill, or within ponded water.

5.4.3 Settlements

Settlements of foundations designed and installed in accordance with above recommendations, and supporting maximum projected structural loads, are anticipated to be approximately one-half to five-eighths of an inch. Settlements are expected to occur rapidly with approximately 50 to 60 percent of the settlements occurring during construction.

5.5 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 structural fills. In determining frictional resistance, a coefficient of 0.40 or 0.45 should be utilized for footings poured directly upon natural soil and upon a minimum of 12 inches of granular structural fills, respectively. 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.

5.6 FLOOR SLABS

To facilitate construction and to provide a capillary moisture break, we recommend that all at-grade slabs be immediately underlain by a minimum of four inches of “free-draining” granular material, such as three-quarter to one-inch minus clean gap-graded gravel. The gravel may be placed directly upon properly prepared suitable natural soils and/or granular structural fill. Settlements of lightly loaded floor slabs (less than 200 pounds per square foot) will be less than one-quarter of an inch.

The tops of all floor slabs in habitable areas must be established at least four feet above the measured groundwater levels or those levels controlled by subdrains. This places the top of floor slabs a minimum of approximately one and one-half feet above the existing ground surface.

5.7 PAVEMENTS

The existing natural silty clay soils encountered at the site will exhibit poor pavement support characteristics when saturated or near saturated. All pavement areas must be prepared as

previously discussed. With the subgrade soils and the projected traffic, as discussed in Section 2., Proposed Construction, the following pavement sections are recommended:

Parking Areas

(Light Volume of Automobiles and Light Trucks,
Occasional Medium-Weight Trucks,
and No Heavy-Weight Trucks)
[1 equivalent 18-kip axle loads per day]

Flexible:

2.5 inches	Asphalt concrete
7.0 inches	Aggregate base course
8.0 inches	Granular subbase*
Over	Properly prepared natural subgrade soils, and/or structural site grading fill extending to natural subgrade soils

* Granular site grading fills or stabilizing fills greater than eight inches thick will meet this requirement.

Rigid:

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

* Granular site grading fills or stabilizing fills greater than eight inches thick will meet this requirement.

Primary Roadway Areas

(Moderate Volume of Automobiles and Light Trucks,
Light Volume of Medium-Weight Trucks,
and Occasional Heavy-Weight Trucks)
[5 equivalent 18-kip axle loads per day]

Flexible:

3.0 inches	Asphalt concrete
8.0 inches	Aggregate base course
9.0 inches	Granular subbase*
Over	Properly prepared natural subgrade soils, and/or structural site grading fill extending to natural subgrade soils

* Granular site grading fills or stabilizing fills greater than nine inches thick will meet this requirement.

Rigid:

6.0 inches	Portland cement concrete (non-reinforced)
4.0 inches	Aggregate base course
9.0 inches	Granular subbase*
Over	Properly prepared natural soils and/or structural site grading fill extending to suitable natural soils

* Granular site grading fills or stabilizing fills greater than nine inches thick will meet this requirement.

For dumpster pads, we recommend a pavement section consisting of 6.5 inches of Portland cement concrete, 4.0 inches of aggregate base course and 9.0 inches of granular subbase over properly prepared natural subgrade or site grading structural fills.

These 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 with the Portland Cement Association (PCA) guidelines. The concrete shall have a minimum 28-day unconfined compressive strength of 4,000 pounds per square inch and contain 6 percent ±1 percent air-entrainment.

5.8 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.

5.9 GEOSEISMIC SETTING

5.9.1 General

Utah municipalities adopted the International Building Code (IBC) 2006 on January 1, 2007. The IBC 2006 code determines the seismic hazard for a site based upon 2002 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 2006 edition.

5.9.2 Faulting

Based upon our review of available literature, no active faults are known to pass through or immediately adjacent to the site. The nearest active fault is the Wasatch fault approximately nine miles east of the site. The Wasatch fault zone is considered capable of generating earthquakes as large as magnitude 7.4.

5.9.3 Soil Class

Our analysis shows that some of the deeper saturated soils could liquefy during the design seismic event (see Section 5.8.5, Liquefaction). According to the IBC 2006 Table 1613.5.2, "Soils vulnerable to potential failure or collapse under seismic loading such as liquefiable soils..." are designated under site Class F. However, the potential settlements due to liquefaction are anticipated to be up to approximately one-half of an inch. This magnitude of settlement can typically be tolerated by an adequately designed structure to protect life safety. Additionally, surface rupture and lateral spreading are not anticipated to occur. Therefore, we recommend the site be designated under Site Class D - Stiff Soil Profile for design.

5.9.4 Ground Motions

The IBC 2006 code is based on 2002 USGS (United States Geologic Survey) 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 following table summarizes the peak ground and short and long period accelerations for a MCE event and incorporates a soil amplification factor for a Site Class D soil profile in the second column. Based on the site latitude and longitude (41.0853 degrees north and 112.0850 degrees west, respectively), the values for this site are tabulated below:

Spectral Acceleration Value, T Seconds	Site Class B-C Boundary [mapped values] (% g)	Site Class D [adjusted for site class effects] (% g)
Peak Ground Acceleration	40.3	44.2
0.2 Seconds, (Short Period Acceleration)	$S_S = 100.8$	$S_{MS} = 110.5$
1.0 Seconds (Long Period Acceleration)	$S_1 = 40.2$	$S_{M1} = 64.3$

The IBC 2006 code design accelerations (S_{DS} and S_{D1}) are based on multiplying the above accelerations (adjusted for site class effects) for the MCE event by two-thirds (⅔).

5.9.5 Liquefaction

The site is located in an area that has been identified by Davis County as having a "high" liquefaction potential. Liquefaction is defined as the condition when saturated, loose, finer-grained sand-type soils lose their support capabilities because of excessive pore water pressure which develops during a seismic event.

Our analysis indicates that the sand layers encountered at depths of eight to nine feet in Borings B-2 and B-6 could liquefy during the design seismic event. If this isolated layer was to completely liquefy, settlements on the order of one-half of an inch could occur. The other saturated soils encountered at the site are not anticipated to liquefy during the design seismic event. Due to the depth of the potentially liquefiable layers and the thickness of overlying non-liquefiable soils, ground rupture is not anticipated during the design seismic event. Due to the depth of the potentially liquefiable layers, the isolated nature of the potentially liquefiable layers, as well as the relatively level nature of the site, lateral spread is not anticipated to occur at the site during the design seismic event.

Calculations were performed using the procedures described in NCEER-97-0022 entitled, "Proceedings of the NCEER Workshop on Evaluation of Liquefaction Resistance of Soils," and only apply to the saturated cohesionless deposits.

We appreciate the opportunity of providing this service for you. If you have any questions or require additional information, please do not hesitate to contact us.

Respectfully submitted,

GSH Geotechnical Consultants, Inc.

Michael S. Huber, State of Utah No. 343650
Professional Engineer

Reviewed by:

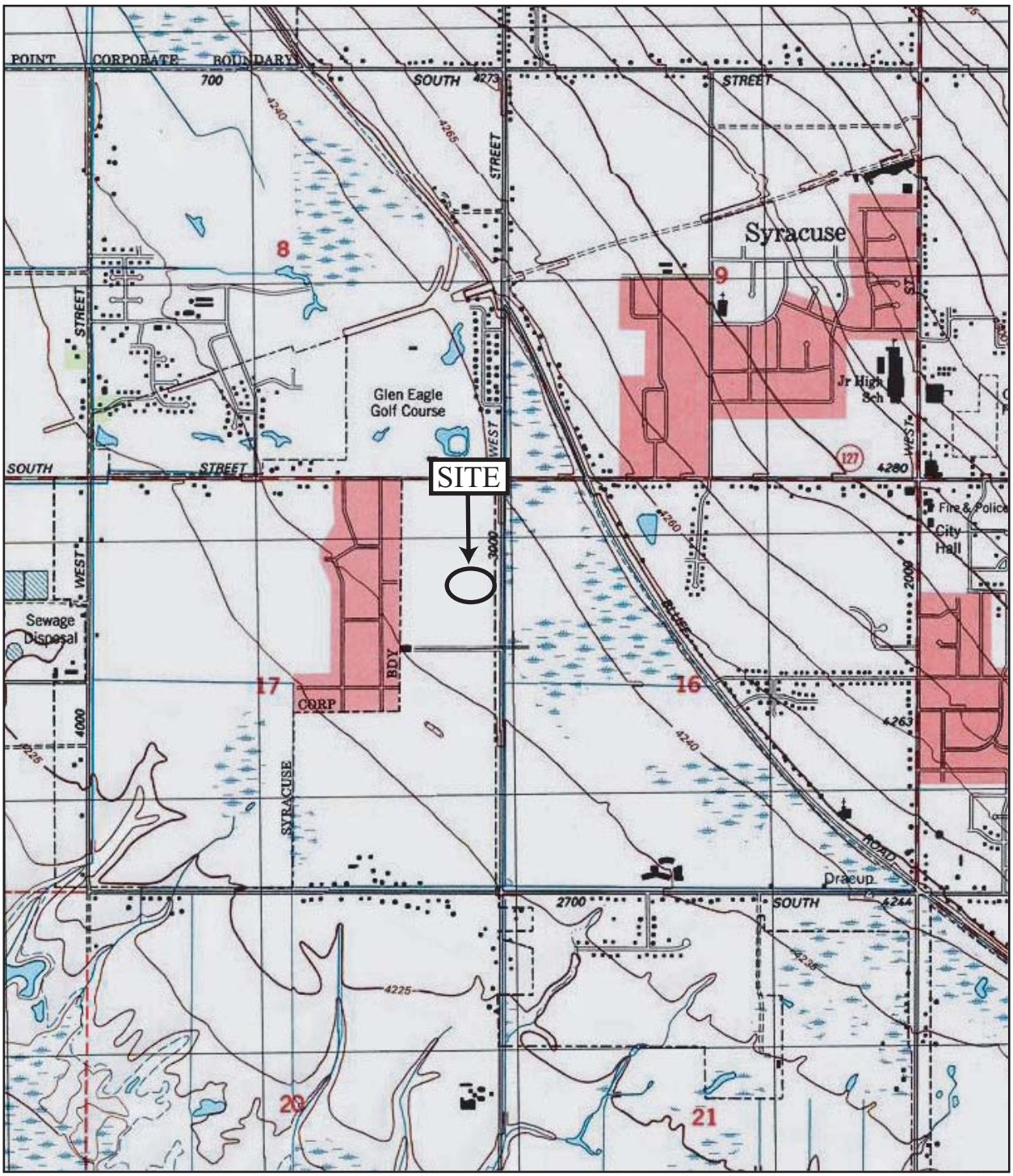
Bryan N. Roberts, State of Utah No. 276476
Professional Engineer

MSH/BNR:jal/jlh

Encl. Figure 1, Vicinity Map
Figure 2, Site Plan
Figures 3A through 3L, Log of Borings
Figure 4, Unified Soil Classification System
Appendix A Topsoil Testing Report

Addressee (5 + email)

THE CHURCH OF JESUS CHRIST OF LATTER-DAY SAINTS
JOB NO. 0153-080-09



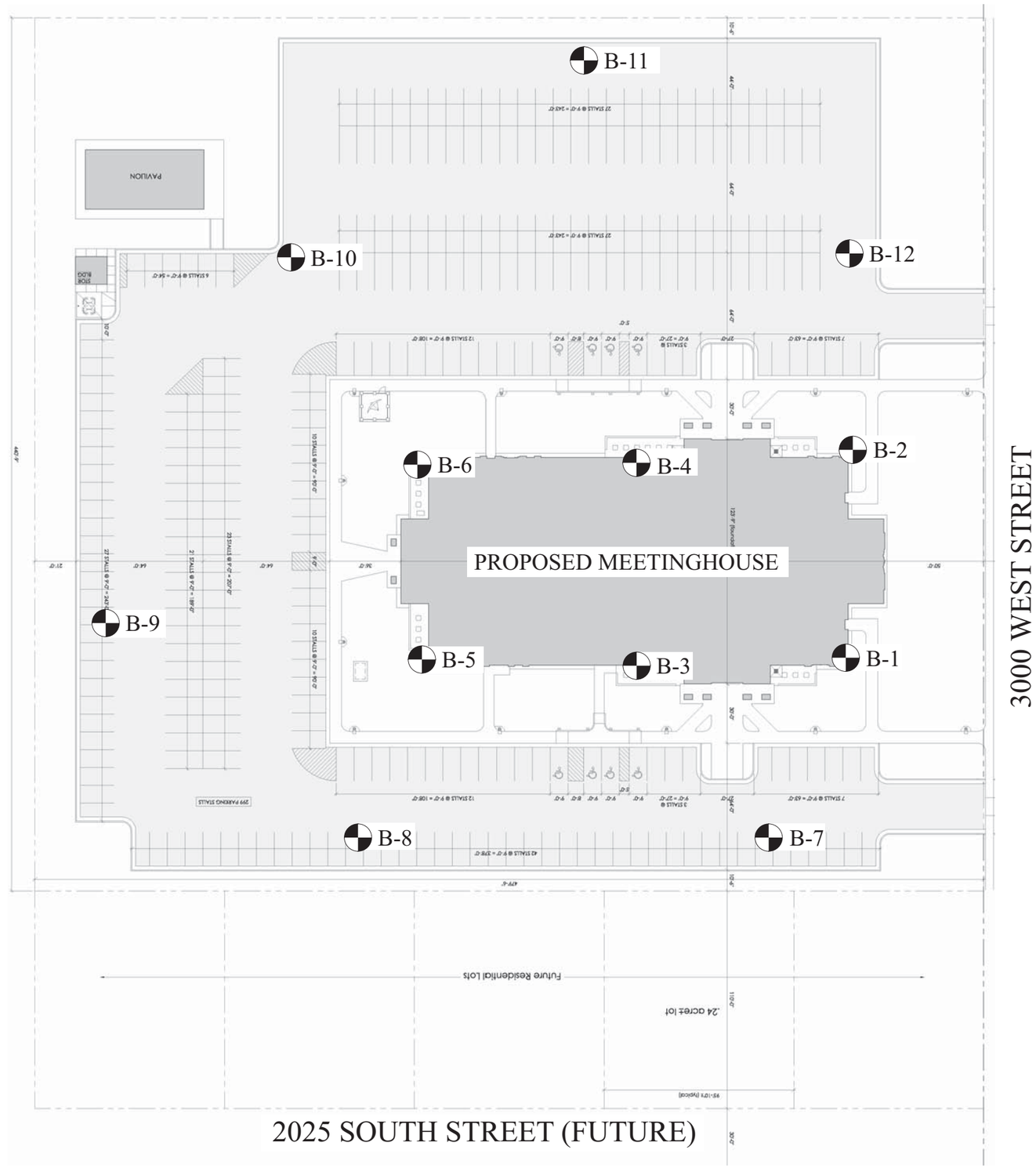
SCALE IN FEET
1000 0 1000 2000

FIGURE 1
VICINITY MAP

REFERENCE:
USGS 7.5 MINUTE TOPOGRAPHIC QUADRANGLE MAP
TITLED "CLEARFIELD, UTAH"
DATED 1999

GSH
Gordon Spilker Huber
Geotechnical Consultants, Inc.

THE CHURCH OF JESUS CHRIST OF LATTER-DAY SAINTS
JOB NO. 0153-080-09



SCALE IN FEET
30 0 30 60

REFERENCE:
ADAPTED FROM DRAWING ENTITLED
"SYRACUSE WEST LEGACY, SHEET SD1.1"
BY RICHARDS BOTT, NOT DATED

FIGURE 2
SITE PLAN

GSH
Gordon Spilker Huber
Geotechnical Consultants, Inc.

Gordon Spilker Huber Geotechnical Consultants, Inc.
Salt Lake City, Utah 84123

Project Name: Proposed Syracuse Meetinghouse
Project No.: 0153-080-09
Location: 2025 S 3000 W, Syracuse, Utah
Client: The Church of Jesus Christ of Latter-Day Saints
Drilling Method: 3-3/4" ID Hollow-Stem Auger
Date Drilled: 04-21-09
GSH Field Rep.: RJG
Elevation: Overall site approximately 4241' +/-
Water Level: 6.0' (04-21-09) 3.6' (04-30-09)
Remarks:

Graphical Log	Water Level	DESCRIPTION	DEPTH FT.	BLOWS/FT	SAMPLE SYMBOL	MOISTURE (%)	% PASSING 200	DRY DENSITY (PCF)	Liquid Limit (%)	Plastic Limit (%)	REMARKS
		Ground Surface									
		CLAYEY FINE SAND major roots (topsoil) to 3"; light brown (SC)	0								loose to 4" moist
				44		32.6		88			medium dense
		grades with occasional layers up to 8" thick of fine sandy clay									
			5	11		26.2	24.5				saturated
		SILTY FINE SAND gray (SM)									saturated
				48		33.3	33.4				medium dense
			10								
		grades with occasional layers up to 1/4" thick of silty clay; brown		38							dense
		Stopped drilling at 13.0'.	15								
		Stopped sampling at 14.5'.									
		Installed 1-1/4" diameter slotted PVC pipe to 14.5'.									
			20								
			25								

The discussion in the text under the section titled, SUBSURFACE CONDITIONS, is necessary for a proper understanding of the nature of the subsurface material.

FIGURE 3A

Gordon Spilker Huber Geotechnical Consultants, Inc.
Salt Lake City, Utah 84123

Project Name: Proposed Syracuse Meetinghouse
Project No.: 0153-080-09
Location: 2025 S 3000 W, Syracuse, Utah
Client: The Church of Jesus Christ of Latter-Day Saints
Drilling Method: 3-3/4" ID Hollow-Stem Auger
Date Drilled: 04-23-09
GSH Field Rep.: RJG
Elevation: Overall site approximately 4241' +/-
Water Level: 4.0' (04-23-09) 3.9' (04-30-09)
Remarks:

Graphical Log	Water Level	DESCRIPTION	DEPTH FT.	BLOWS/FT	SAMPLE SYMBOL	MOISTURE (%)	% PASSING 200	DRY DENSITY (PCF)	Liquid Limit (%)	Plastic Limit (%)	REMARKS
		Ground Surface	0								
		SILTY CLAY with some fine sand; major roots (topsoil) to 2"; brown (CL)		13							loose to 3" moist
		SILTY FINE SAND gray (SM)									stiff moist
				69							saturated medium dense
			5								
		grades with numerous fine sandy silt and silty clay layers up to 3" thick; brown and gray	10	7							loose
		Stopped drilling at 9.0'. Stopped sampling at 11.5'. Installed 1-1/4" diameter slotted PVC pipe to 10.5'.	15								
			20								
			25								

The discussion in the text under the section titled, SUBSURFACE CONDITIONS, is necessary for a proper understanding of the nature of the subsurface material.

FIGURE 3B

Gordon Spilker Huber Geotechnical Consultants, Inc.
Salt Lake City, Utah 84123

Project Name: Proposed Syracuse Meetinghouse
Project No.: 0153-080-09
Location: 2025 S 3000 W, Syracuse, Utah
Client: The Church of Jesus Christ of Latter-Day Saints
Drilling Method: 3-3/4" ID Hollow-Stem Auger
Date Drilled: 04-23-09
GSH Field Rep.: RJG
Elevation: Overall site approximately 4241' +/-
Water Level: 3.0' (04-23-09) 3.2' (04-30-09)
Remarks:

Graphical Log	Water Level	DESCRIPTION	DEPTH FT.	BLOWS/FT	SAMPLE SYMBOL	MOISTURE (%)	% PASSING 200	DRY DENSITY (PCF)	Liquid Limit (%)	Plastic Limit (%)	REMARKS
		Ground Surface									
		CLAYEY FINE SAND major roots (topsoil) to 3"; brown (SC)	0								loose to 5" moist
				48		27.3		94			medium dense
		SILTY FINE SAND brown (SM)									
											saturated
		grades gray	5								medium dense
				19							
		grades with occasional layers up to 6" thick of silty clay	10								
				16							
		Stopped drilling at 10.0'.									
		Stopped sampling at 11.5'.									
		Installed 1-1/4" diameter slotted PVC pipe to 5.0'.									
			15								
			20								
			25								

The discussion in the text under the section titled, SUBSURFACE CONDITIONS, is necessary for a proper understanding of the nature of the subsurface material.

FIGURE 3C

Gordon Spilker Huber Geotechnical Consultants, Inc.
Salt Lake City, Utah 84123

Project Name: Proposed Syracuse Meetinghouse
Project No.: 0153-080-09
Location: 2025 S 3000 W, Syracuse, Utah
Client: The Church of Jesus Christ of Latter-Day Saints
Drilling Method: 3-3/4" ID Hollow-Stem Auger
Date Drilled: 04-21-09
GSH Field Rep.: RJG
Elevation: Overall site approximately 4241' +/-
Water Level: 5.0' (04-21-09) 2.9' (04-30-09)
Remarks:

Graphical Log	Water Level	DESCRIPTION	DEPTH FT.	BLOWS/FT	SAMPLE SYMBOL	MOISTURE (%)	% PASSING 200	DRY DENSITY (PCF)	Liquid Limit (%)	Plastic Limit (%)	REMARKS
		Ground Surface	0								
		SILTY CLAY with some fine sand; major roots (topsoil) to 3"; grayish-brown (CL)									loose to 5" moist
											"stiff" moist
		FINE SANDY CLAY light brown (SC)									dense
				98		26.8		95			saturated
		SILTY FINE SAND brown and light brown (SM)									dense
		grades brown to gray with numerous layers up to 1/2" thick of silty clay	5	12		28.3	21.3				medium dense
		grades without layers; light brown	10	35							dense
			15	95							
			20	51							very dense
			25								

The discussion in the text under the section titled, SUBSURFACE CONDITIONS, is necessary for a proper understanding of the nature of the subsurface material.

FIGURE 3D

Gordon Spilker Huber Geotechnical Consultants, Inc.
Salt Lake City, Utah 84123

Project Name: Proposed Syracuse Meetinghouse
Project No.: 0153-080-09
Location: 2025 S 3000 W, Syracuse, Utah
Client: The Church of Jesus Christ of Latter-Day Saints
Drilling Method: 3-3/4" ID Hollow-Stem Auger
Date Drilled: 04-21-09
GSH Field Rep.: RJG
Elevation: Overall site approximately 4241' +/-
Water Level: 5.0' (04-21-09) 2.9' (04-30-09)
Remarks:

Graphical Log	Water Level	DESCRIPTION	DEPTH FT.	BLOWS/FT	SAMPLE SYMBOL	MOISTURE (%)	% PASSING 200	DRY DENSITY (PCF)	Liquid Limit (%)	Plastic Limit (%)	REMARKS
				38							saturated dense
			30	12							medium dense
		Stopped drilling at 30.0'. Stopped sampling at 31.5'. Installed 1-1/4" diameter slotted PVC pipe to 31.5'.	35								
			40								
			45								
			50								

The discussion in the text under the section titled, SUBSURFACE CONDITIONS, is necessary for a proper understanding of the nature of the subsurface material.

FIGURE 3D
(con't)

Gordon Spilker Huber Geotechnical Consultants, Inc.
Salt Lake City, Utah 84123

Project Name: Proposed Syracuse Meetinghouse
Project No.: 0153-080-09
Location: 2025 S 3000 W, Syracuse, Utah
Client: The Church of Jesus Christ of Latter-Day Saints
Drilling Method: 3-3/4" ID Hollow-Stem Auger
Date Drilled: 04-21-09
GSH Field Rep.: RJG
Elevation: Overall site approximately 4241' +/-
Water Level: 5.0' (04-21-09) 2.7' (04-30-09)
Remarks:

Graphical Log	Water Level	DESCRIPTION	DEPTH FT.	BLOWS/FT	SAMPLE SYMBOL	MOISTURE (%)	% PASSING 200	DRY DENSITY (PCF)	Liquid Limit (%)	Plastic Limit (%)	REMARKS
		Ground Surface									
		SILTY CLAY with some fine sand; major roots (topsoil) to 4"; brown (CL)	0								loose to 5" moist "stiff"
		SILTY FINE SAND light brown with oxidation (SM)		94		23.2	14.3				moist dense saturated
			5	12		28.2	12.1				saturated medium dense
		grades with numerous layers up to 1/2" thick of silty clay; brown and grayish-brown (SM)									
		grades without layers	10	22							
		grades brown	15	23							
		Stopped drilling at 15.0'. Stopped sampling at 16.5'. Installed 1-1/4" diameter slotted PVC pipe to 16.5'.	20								
			25								

The discussion in the text under the section titled, SUBSURFACE CONDITIONS, is necessary for a proper understanding of the nature of the subsurface material.

FIGURE 3E

Gordon Spilker Huber Geotechnical Consultants, Inc.
Salt Lake City, Utah 84123

Project Name: Proposed Syracuse Meetinghouse
Project No.: 0153-080-09
Location: 2025 S 3000 W, Syracuse, Utah
Client: The Church of Jesus Christ of Latter-Day Saints
Drilling Method: 3-3/4" ID Hollow-Stem Auger
Date Drilled: 04-23-09
GSH Field Rep.: RJG
Elevation: Overall site approximately 4241' +/-
Water Level: 4.0' (04-23-09) (Pipe Destroyed 04-30-09)
Remarks:

Graphical Log	Water Level	DESCRIPTION	DEPTH FT.	BLOWS/FT	SAMPLE SYMBOL	MOISTURE (%)	% PASSING 200	DRY DENSITY (PCF)	Liquid Limit (%)	Plastic Limit (%)	REMARKS
		Ground Surface									
		SILTY CLAY with some fine sand; major roots (topsoil) to 3"; light brown (CL)	0								loose to 3" moist stiff
		CLAYEY SAND with numerous silty clay layers up to 1" thick; light brown (SC)		27		33.3		87.0			moist very stiff
											saturated
		SILTY FINE SAND with numerous silty clay layers up to 1/2" thick; light brown to brown (SM)	5	23							saturated medium dense
		grades without layers; gray	10	11							
		Stopped drilling at 10.0'.									
		Stopped sampling at 11.5'.									
		Installed 1-1/4" diameter slotted PVC pipe to 11.5'.	15								
			20								
			25								

The discussion in the text under the section titled, SUBSURFACE CONDITIONS, is necessary for a proper understanding of the nature of the subsurface material.

FIGURE 3F

Gordon Spilker Huber Geotechnical Consultants, Inc.
Salt Lake City, Utah 84123

Project Name: Proposed Syracuse Meetinghouse
Project No.: 0153-080-09
Location: 2025 S 3000 W, Syracuse, Utah
Client: The Church of Jesus Christ of Latter-Day Saints
Drilling Method: 3-3/4" ID Hollow-Stem Auger
Date Drilled: 04-23-09
GSH Field Rep.: RJG
Elevation: Overall site approximately 4241' +/-
Water Level: 4.0' (04-23-09)
Remarks:

Graphical Log	Water Level	DESCRIPTION	DEPTH FT.	BLOWS/FT	SAMPLE SYMBOL	MOISTURE (%)	% PASSING 200	DRY DENSITY (PCF)	Liquid Limit (%)	Plastic Limit (%)	REMARKS
		Ground Surface	0								
		SILTY CLAY with some fine sand; major roots (topsoil) to 3"; brown (CL)									loose to 4" moist "stiff"
		CLAYEY FINE SAND with numerous silty clay layers up to 1/2" thick; light brown (SC)									moist "medium dense" saturated
			5								
		Stopped drilling at 5.0'.									
		Stopped sampling at 5.0'.									
			10								
			15								
			20								
			25								

The discussion in the text under the section titled, SUBSURFACE CONDITIONS, is necessary for a proper understanding of the nature of the subsurface material.

FIGURE 3G

Gordon Spilker Huber Geotechnical Consultants, Inc.
Salt Lake City, Utah 84123

Project Name: Proposed Syracuse Meetinghouse
Project No.: 0153-080-09
Location: 2025 S 3000 W, Syracuse, Utah
Client: The Church of Jesus Christ of Latter-Day Saints
Drilling Method: 3-3/4" ID Hollow-Stem Auger
Date Drilled: 04-21-09
GSH Field Rep.: RJG
Elevation: Overall site approximately 4241' +/-
Water Level: 5.0' (04-21-09)
Remarks:

Graphical Log	Water Level	DESCRIPTION	DEPTH FT.	BLOWS/FT	SAMPLE SYMBOL	MOISTURE (%)	% PASSING 200	DRY DENSITY (PCF)	Liquid Limit (%)	Plastic Limit (%)	REMARKS
		Ground Surface									
		FINE SANDY CLAY major roots (topsoil) to 4"; brown (CL)	0								loose to 3" moist stiff
		SILTY FINE SAND with numerous silty clay layers up to 1/2" thick; light brown (SM)									moist "medium dense"
	▼		5								saturated
		Stopped drilling at 5.0'. Stopped sampling at 5.0'.									
			10								
			15								
			20								
			25								

The discussion in the text under the section titled, SUBSURFACE CONDITIONS, is necessary for a proper understanding of the nature of the subsurface material.

FIGURE 3H

Gordon Spilker Huber Geotechnical Consultants, Inc.
Salt Lake City, Utah 84123

Project Name: Proposed Syracuse Meetinghouse
Project No.: 0153-080-09
Location: 2025 S 3000 W, Syracuse, Utah
Client: The Church of Jesus Christ of Latter-Day Saints
Drilling Method: 3-3/4" ID Hollow-Stem Auger
Date Drilled: 04-23-09
GSH Field Rep.: RJG
Elevation: Overall site approximately 4241' +/-
Water Level: 5.0' (04-23-09)
Remarks:

Graphical Log	Water Level	DESCRIPTION	DEPTH FT.	BLOWS/FT	SAMPLE SYMBOL	MOISTURE (%)	% PASSING 200	DRY DENSITY (PCF)	Liquid Limit (%)	Plastic Limit (%)	REMARKS
		Ground Surface	0								
		SILTY CLAY with some fine sand; major roots (topsoil) to 3"; brown (CL)									loose to 4" moist stiff
		CLAYEY FINE SAND with numerous silty clay layers up to 1/2" thick; light brown (SM)									very moist "medium dense"
	▼		5								saturated
		Stopped drilling at 5.0'. Stopped sampling at 5.0'.	10								
			15								
			20								
			25								

The discussion in the text under the section titled, SUBSURFACE CONDITIONS, is necessary for a proper understanding of the nature of the subsurface material.

FIGURE 3I

Gordon Spilker Huber Geotechnical Consultants, Inc.
Salt Lake City, Utah 84123

Project Name: Proposed Syracuse Meetinghouse
Project No.: 0153-080-09
Location: 2025 S 3000 W, Syracuse, Utah
Client: The Church of Jesus Christ of Latter-Day Saints
Drilling Method: 3-3/4" ID Hollow-Stem Auger
Date Drilled: 04-23-09
GSH Field Rep.: RJG
Elevation: Overall site approximately 4241' +/-
Water Level: 3.5' (04-23-09)
Remarks:

Graphical Log	Water Level	DESCRIPTION	DEPTH FT.	BLOWS/FT	SAMPLE SYMBOL	MOISTURE (%)	% PASSING 200	DRY DENSITY (PCF)	Liquid Limit (%)	Plastic Limit (%)	REMARKS
		Ground Surface	0								
		SILTY CLAY with some fine sand; major roots (topsoil) to 3"; brown (CL)									loose to 3" moist
											"stiff"
		SILTY FINE SAND with numerous silty clay layers up to 1/2" thick; grayish-brown (SM)									moist "medium dense" saturated
			5								
		Stopped drilling at 5.0'. Stopped sampling at 5.0'.	10								
			15								
			20								
			25								

The discussion in the text under the section titled, SUBSURFACE CONDITIONS, is necessary for a proper understanding of the nature of the subsurface material.

FIGURE 3J

Gordon Spilker Huber Geotechnical Consultants, Inc.
Salt Lake City, Utah 84123

Project Name: Proposed Syracuse Meetinghouse
Project No.: 0153-080-09
Location: 2025 S 3000 W, Syracuse, Utah
Client: The Church of Jesus Christ of Latter-Day Saints
Drilling Method: 3-3/4" ID Hollow-Stem Auger
Date Drilled: 04-23-09
GSH Field Rep.: RJG
Elevation: Overall site approximately 4241' +/-
Water Level: 4.0' (04-23-09)
Remarks:

Graphical Log	Water Level	DESCRIPTION	DEPTH FT.	BLOWS/FT	SAMPLE SYMBOL	MOISTURE (%)	% PASSING 200	DRY DENSITY (PCF)	Liquid Limit (%)	Plastic Limit (%)	REMARKS
		Ground Surface	0								
		SILTY CLAY with some fine sand; major roots (topsoil) to 3"; brown (CL)									"loose to 4" moist
											"stiff"
		CLAYEY TO SILTY FINE SAND with occasional silty clayey layers up to 1/2" thick; light brown (SC)									moist "medium dense"
											saturated
			5								
		Stopped drilling at 5.0'.									
		Stopped sampling at 5.0'.									
			10								
			15								
			20								
			25								

The discussion in the text under the section titled, SUBSURFACE CONDITIONS, is necessary for a proper understanding of the nature of the subsurface material.

FIGURE 3K

Gordon Spilker Huber Geotechnical Consultants, Inc.
Salt Lake City, Utah 84123

Project Name: Proposed Syracuse Meetinghouse
Project No.: 0153-080-09
Location: 2025 S 3000 W, Syracuse, Utah
Client: The Church of Jesus Christ of Latter-Day Saints
Drilling Method: 3-3/4" ID Hollow-Stem Auger
Date Drilled: 04-23-09
GSH Field Rep.: RJG
Elevation: Overall site approximately 4241' +/-
Water Level: 4.0' (04-23-09)
Remarks:

Graphical Log	Water Level	DESCRIPTION	DEPTH FT.	BLOWS/FT	SAMPLE SYMBOL	MOISTURE (%)	% PASSING 200	DRY DENSITY (PCF)	Liquid Limit (%)	Plastic Limit (%)	REMARKS
		Ground Surface	0								
		SILTY CLAY with some fine sand; major roots (topsoil) to 3"; brown (CL)									loose to 5" moist "stiff"
		CLAYEY FINE SAND with occasional silty clay layers up to 1/2" thick; light brown (SC)									saturated "medium dense"
			5								
		Stopped drilling at 5.0'. Stopped sampling at 5.0'.									
			10								
			15								
			20								
			25								

The discussion in the text under the section titled, SUBSURFACE CONDITIONS, is necessary for a proper understanding of the nature of the subsurface material.

FIGURE 3L

UNIFIED SOIL CLASSIFICATION SYSTEM

FIELD IDENTIFICATION PROCEDURES				GRAPH SYMBOL	LETTER SYMBOL [1]	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS More than half of material is larger than No. 200 sieve size. [2] (The No. 200 sieve size is about the smallest particle visible to the naked eye)	GRAVELS More than half of coarse fraction is larger than No. 4 sieve size. (For visual classifications, the 1/4" size may be used as equivalent to the No. 4 sieve size.)	CLEAN GRAVELS (Little or no fines)	Wide range in grain size and substantial amounts of all intermediate particle sizes.		GW	Well graded gravels, gravel-sand mixtures, little or no fines.
			Predominantly one size or a range of sizes with some intermediate sizes missing.		GP	Poorly graded gravels, gravel-sand mixtures, little or no fines.
		GRAVELS WITH FINES (Appreciable amount of fines)	Non-plastic fines (for identification procedures see ML below).		GM	Silty gravels, poorly graded gravel-sand-silt mixtures.
			Plastic fines (for identification procedures see CL below).		GC	Clayey gravels, poorly graded gravel-sand-clay mixtures.
	SANDS More than half of coarse fraction is smaller than No. 4 sieve size. (For visual classifications, the 1/4" size may be used as equivalent to the No. 4 sieve size.)	CLEAN SANDS (Little or no fines)	Wide range in grain sizes and substantial amounts of all intermediate particle sizes.		SW	Well graded sands, gravelly sands, little or no fines.
			Predominantly one size or a range of sizes with some intermediate sizes missing.		SP	Poorly graded sands, gravelly sands, little or no fines.
		SANDS WITH FINES (Appreciable amount of fines)	Non-plastic fines (for identification procedures see ML below).		SM	Silty sands, poorly graded sand-silt mixtures.
			Plastic fines (for identification procedures see CL below).		SC	Clayey sands, poorly graded sand-clay mixtures.

FINE GRAINED SOILS More than half of material is smaller than No. 200 sieve size. (The No. 200 sieve size is about the smallest particle visible to the naked eye)	IDENTIFICATION PROCEDURES ON FRACTION SMALLER THAN No. 40 SIEVE SIZE	DRY STRENGTH (CRUSHING CHARACTERISTICS)	DILATANCY (REACTION TO SHAKING)	TOUGHNESS (CONSISTENCY NEAR PLASTIC LIMIT)	GRAPH SYMBOL	LETTER SYMBOL [1]	TYPICAL DESCRIPTIONS
	SILTS AND CLAYS Liquid limit less than 50	None to slight	Quick to slow	None		ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sand with slight plasticity.
		Medium to high	None to very slow	Medium		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
		Slight to medium	Slow	Slight		OL	Organic silts and organic silt-clays of low plasticity.
	SILTS AND CLAYS Liquid limit greater than 50	Slight to medium	Slow to none	Slight to medium		MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.
		High to very high	None	High		CH	Inorganic clays of high plasticity, fat clays.
		Medium to high	None to very slow	Slight to medium		OH	Organic clays of medium to high plasticity.
HIGHLY ORGANIC SOILS		Readily identified by color, odor, spongy feel and frequently by fibrous texture.				Pt	Peat and other highly organic soils.

[1] Boundary classifications: –Soils possessing characteristics of two groups are designated by combinations of group symbols. For example GW–GC, well graded gravel–sand mixture with clay binder.
[2] All sieve sizes on this chart are U.S. standard.

GENERAL NOTES

1. In general, Unified Soil Classification Designations presented on the logs were evaluated by visual methods only. There rore, actual designations (based on laboratory testing) may differ.

2. Lines seperating strata on the logs represent approximate boundaries only Actual transitions may be gradual.

3. Logs represent general soil conditions observed at teh point of exploration onthe date indicated.

4. No warranty is provided as to the continuity of soil conditions between individual sample locations.

FINE - GRAINED SOIL

CONSISTENCY	SPT (blows/ft)	TORVANE UNDRAINED SHEAR STRENGTH (tsf)	POCKET PENETROMETER UNCONFINED COMPRESSIVE STRENGTH (tsf)	FIELD TEST
Very Soft	<2	<0.125	<0.25	Easily penetrated several inches by Thumb. Squeezes through fingers.
Soft	2 - 4	0.125 - 0.25	0.25 - 0.5	Easily penetrated 1 " by Thumb . Molded by light finger pressure.
Medium Stiff	4 - 8	0.25 - 0.5	0.5 - 1.0	Penetrated over 1/2 " by Thumb with moerate effort. Molded by strong finger pressure.
Stiff	8 - 15	0.5 - 1.0	1.0 - 2.0	Indented about 1/2 " by Thumb but penetrated only with great effort
Very Stiff	15 - 30	1.0 - 2.0	2.0 - 4.0	Readily Indented by Thumbnail
Hard	>30	>2.0	>4.0	Indented with difficulty by Thumbnail

LOG KEY SYMBOLS

- Bulk / Bag Sample
- Rock Core
- Standard Penetration Split Spoon Sampler
- No Recovery
- Thin Wall
- D&M Sampler
- Water Level (level after completion)
- Water Level (level where first encountered)

COARSE -GRAINDE SOIL

APPERENT DENSITY	SPT (blows/ft)	RELATIVE DENSITY (%)	FIELD TEST
Very Loose	<4	0 - 15	Easily penetrated with 1/2 " reinforcing rod pushed by hand
Loose	4 - 10	15 - 35	Difficult to penetrated with 1/2 " reinforcing rod pushed by hand
Medium Dense	10 - 30	35 - 65	Easily penetrated a foot with 1/2 " reinforcing rod driven with 5-lb hammer
Dense	30 - 50	65 - 85	Difficult to penetrated a foot with 1/2 " reinforcing rod driven with 5-lb hammer
Very Dense	>50	85 - 100	Penetrated only a few inches with 1/2 " reinforcing rod driven with 5-lb hammer

STRATIFICATION

DESCRIPTION	THICKNESS
SEAM	1/16 - 1/2 "
LAYER	1/2 - 12 "

DESCRIPTION	THICKNESS
Occasional	One or less per foot of thickness
Frequent	More than on per foot of thichness

CEMENTATION

DESCRIPTION	DESCRIPTION
Weakely	Crumbles or breaks with handling of slight finger pressure
Moderately	Crumbles or breaks with considerable finger pressure
Strongly	Will not crumbles or breaks with finger pressure

MODIFIERS

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

MOISTURE CONTENT

DESCRIPTION	FIELD TEST
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible water, usually soil below Water Table

FIGURE 4

GSH
Gordon Spilker Huber Geotechnical Consultants, Inc.

APPENDIX A

Topsoil Testing Report

Topsoil Testing Report

Syracuse 0153-080-09

DTA Area Office	This form should be given to the person or lab doing the testing each time a soils test is requested.
Ward/Branch	Date Requested: 20 Apr 09
City: Syracuse / State: UT	By Whom: ESH Contact Phone # 801 605 9190 Fax # 2990
Stake/Mission	Property Number
Site Street Address	

Instructions to Architect

1. The architect is to determine, by investigation, the quality and quantity of topsoil on a site before the Owner's review. All information on this form must be provided.
2. A horticultural topsoil test is recommended at each site.
3. The costs for the testing and report will be paid by the Owner.
4. Copies of the report shall be made available to the landscape architect and the DTA Area Office.
5. Report location where soil is from and a history of its use on the back of this form.

Instructions to the Soil Testing Laboratory Firm

1. At least two test samples shall be made of the topsoil on the project site and each anticipated topsoil source. If the 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. The soil report must provide interpretation and recommendations for soil amendments, fertilizers, and soil conditioners for use by the architect and the landscape architect.

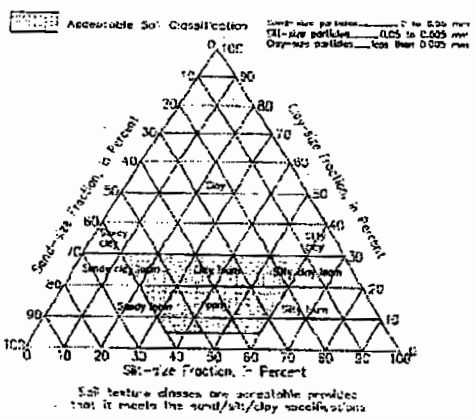
Test Report on Existing Conditions ("Acceptable Levels" refers to the allowable soil specifications prior to being amended)

Soil Test Data

Sample No.	pH(1)	EC(1) Mmhos/cm	SAR(1)	% Sand	% Silt	% Clay	Text(2) Class	%(3) OM	NO3-N(4) ppm	P(5) ppm	K(5) ppm	Fe(5) Ppm
0-6"	7.5	0.5	1.0	50	31	19	Loam	5.8	2	21	448	27
Acceptable Level(s)	5.5-8.0	<3.0	<6.0	15-60	10-60	5-30	(2)	>1.0	>20	>11	>130	>10

IMPORTED TOPSOIL – DEFINED (Specification Section 32-9113 – Finish Grading and Soil Preparation)

- Fertile, loose, friable soil, capable of sustaining vigorous plant growth.
- Clean and free from toxic minerals & chemicals, noxious weeds, weed seeds and rock (coarse fragments) or other objectionable/construction materials. Remove any such objects. No more than 2% by volume of soil measuring over 2.0mm.



Soil texture classes are acceptable provided that it meets the sand/silt/clay specifications

Texture Classification Chart

ACCEPTABLE COMPOSITION

	Composition in Percent		
	Sand	Silt	Clay
Acceptable %	15-60	10-60	5-30

Syracuse

Soil Sample No.	Description of location where sample was taken	History of Use of the soil
0-6"		

Documented infiltration rate of test sample(s) based on texture at 90% relative density *To the nearest 1/10 of an inch.

(1)saturated soil paste 1:1 soil:water method (please indicate)
(2)hydrometer method (Acceptable soil- sand:15-60%, silt:10-60%, clay-5-30%)
(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. Changes in acceptable levels shall also be made by the testing laboratory.

Sample No. 0-6" _____ - 2.3 inches/hour*
Sample No. _____ _____ - _____ inches/hour*
Sample No. _____ _____ - _____ inches/hour*
Sample No. _____ _____ - _____ inches/hour*

Name of Soil Lab performing the analysis

QA CONSULTING AND TESTING
VON ISAMAN
PO BOX 627
SALEM, UT 84653
Phone # (801) 423-1116
Fax # FAX (801) 423-1813

Interpretation Summary of Test Results: 0-6" soil does not meet Acceptable levels for NO3N. Soil has 0.2% of soil measuring over 2 mm. Soil has no coarse fragments (rocks) ≥ 1.5" in diameter.

Soil Amendments, Fertilizer and Soil Conditioner – Recommendations: No amendments are necessary. No additional organic material is necessary. Apply a 20-0-0 ammonium sulfate or similar fertilizer at label rate. Scarify the sub-soil to 6" depth before applying topsoil.

Long Term (5 Year) Fertilizer and Soil Conditioner – Recommendations: Continue with above fertilizer schedule indefinately. Core aerate turf areas where possible yearly at the minimum.

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COMPOST QUALITY GUIDELINES FOR LANDSCAPING*

Category	pH**	Soluble Salts** dS/m or mmho/cm	Sodium Adsorption Ratio** (SAR)	Carbon:Nitrogen Ratio*** (C:N)	% Moisture****	≥98% Coarse Material Passing (dry wt basis)
Ideal	6 to 8	≤5	<10	≤20:1	25 to 35	3/8" (9.5 mm)
Acceptable	5-6, 8-9	≤10	≤20	21:1 to 30:1	<25, >35	3/4" (19 mm)
Suspect	<5, >9	>10	>20	<10:1, >30:1	<20, >50	<98% 3/4"

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

*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.

** 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.

CompostGuidelines06.126