Geotechnical Evaluation Report

Proposed Morgan Seminary
185 East 100 North
Morgan, Utah (41.0389°, -111.6759°)
LDS Property Number: 502-2348

Prepared for:
The Church of Jesus Christ of Latter-day Saints
Meetinghouse Facilities Department
Salt Lake City, Utah 84150

GSH

Prepared by
GSH Geotechnical
February 28, 2024

LICENSED PROFESSIONAL ENGINEER
No. 348650
MICHAEL S. HUBER
STATE OF UTAH

473 West 4800 South, Murray, UT, Phone (801)-685-9190, Fax (801)-685-2990, Email Address mike@gshgeotech.com

February 28, 2024
Job No. 0153-519-24

The Church of Jesus Christ of Latter-day Saints
Meetinghouse Facilities Department
Mr. Brian Childs
Salt Lake City, Utah

Mr. Childs:

Re: Geotechnical Evaluation Report
Proposed Morgan Seminary
185 East 100 North
Morgan, Utah (41.0389, -111.6759)
Property Number: 502-2348

1. EXECUTIVE SUMMARY

This report presents the results of our geotechnical study performed at the site of the proposed Morgan Seminary to be located at 185 East 100 North in Morgan, Utah.

The soils across the site were generally similar at the test pit locations. Test Pits were completed to depths from 7.5 to 12.0 feet. Test Pits TP-1 and TP-3 encountered 6 inches of crushed gravel. Non-engineered fills were encountered in each test pit to depths ranging from 2.0 to 5.0 feet below the ground surface. The non-engineered fills primarily consisted of clay with varying silt, sand, and gravel content as well as sand with varying clay, silt, and gravel content. Natural soils were encountered below the non-engineered fill in each test pit. The natural soils consisted of sand and gravel with minimal fines content.

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

Groundwater was not encountered at the test pit locations.

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.

The most significant geotechnical aspect of the site are the existing structures and utilities to be demolished/relocated and the non-engineered fills encountered across the site.

Prior to proceeding with construction, removal of all non-engineered fills, 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 is 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. The nearest active fault consists of the Central Section of the Morgan Fault, located approximately 0.64 miles to the northeast of the site.

Due to the density of the granular soils and lack of shallow groundwater, liquefaction-induced settlements are not anticipated to occur during the design seismic event.

2. INTRODUCTION

This report presents the results of the geotechnical study performed at the site of the proposed Morgan Seminary to be located 185 East 100 North in Morgan, Utah. The general location of the site with respect to existing roadways, as of 2024, 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 test pits 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. 23-0908.

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

The objectives and scope of our study were planned in discussions among Mr. Brian Childs 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, 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 excavating, logging, and sampling of 4 test pits.

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 test pits, 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 seminary structure will be constructed on an approximately 1.2-acre parcel. The building will be 1 level in height of wood-frame construction, established slab-on-grade, and supported upon conventional spread and continuous wall footings.

Maximum real column and wall loads are anticipated to be 60 kips and 3 kips per lineal foot, respectively. Real loads are defined as the total of all dead plus frequently applied (reduced) live loads.

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 no medium-weight or heavyweight trucks. In primary drive areas within the seminary parking lot, traffic is projected to consist of a light volume of automobiles and light trucks with occasional medium-weight and heavyweight trucks (mainly garbage trucks).

Maximum site grading cuts and fills are anticipated to be on the order of 1 to 3 feet.

7. SITE CONDITIONS

The site is currently developed with existing commercial structures with associated crush gravel parking areas. The topography of the site is relatively flat, grading down to the south with a total relief of approximately 8 to 10 feet. Vegetation at the site consists of mature trees as well as riparian vegetation along the Weber River on the northern border of the site.

The site is bounded to the north by the Weber River followed by Riverside Park; to the east by an existing commercial structure followed by Trojan Boulevard; to the south by 100 North Street followed by commercial structures and landscaped grass areas; and to the west by single-family residential structures.

8. FIELD STUDY

To define and evaluate the subsurface soil and groundwater conditions across the site, 4 test pits were excavated within the accessible areas. These test pits were completed to depths ranging from 7.5 to 12.0 feet with a moderate-sized rubber track-mounted excavator. The approximate locations of the test pits 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 excavation 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 3D, Test Pit Logs. Soils were classified in accordance with the nomenclature described on Figure 4, Key to Test Pit Log (USCS).

Following completion of excavation operations, 1.25-inch diameter slotted PVC pipe was installed in Test Pit TP-1 to provide a means of monitoring the groundwater fluctuations. The test pits were then backfilled. Although an effort was made to compact the backfill with the excavator, backfill was not placed in uniform lifts and compacted to a specific density. Consequently, settlement of the backfill with time is likely to occur.

9. SUBSURFACE CONDITIONS AND GROUNDWATER

Test Pits TP-1 and TP-3 encountered 6 inches of crushed gravel. Non-engineered fills were encountered in each test pit to depths ranging from 2.0 to 5.0 feet below the ground surface. The non-engineered fills primarily consisted of clay with varying silt, sand, and gravel content as well as sand with varying clay, silt, and gravel content. Natural soils were encountered below the non-engineered fill in each test pit. The natural soils consisted of sand and gravel with minimal fines content.

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

Groundwater was not encountered at the test pit locations.

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

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.

10. LABORATORY TESTING

10.1 General

To provide data necessary for our engineering analysis, a laboratory testing program was performed. This program included moisture, partial gradation, and chemical tests. The following paragraphs describe the tests and summarize the test data.

10.2 Moisture and Partial Gradation Tests

To aid in classifying the granular soils, partial gradation tests were performed. Results of the tests are tabulated below and presented on the test pit logs, Figures 3A through 3D:

Test Pit No.	Depth (feet)	Percent Passing No. 200 Sieve	Moisture Content Percent	Soil Classification
TP-1	5.0	3.5	6.6	GP
TP-2	2.0	16.1	8.6	SM/SC (Fill)
TP-3	2.0	18.9	8.0	SM/SC (Fill)
TP-3	6.0	1.2	3.2	GP
TP-4	1.5	58.9	22.2	CL (Fill)
TP-4	11.0	2.8	4.6	GP

10.7 Chemical Tests

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

Test Pit No.	Depth (feet)	Soil Classification	pH	Total Water-Soluble Sulfate (mg/kg-dry)
TP-4	4.0	GP	8.6	Not Detected

11. RECOMMENDATIONS AND CONCLUSIONS

11.1 SUMMARY OF FINDINGS

The proposed structures may be supported upon conventional spread and continuous wall foundations supported upon suitable natural granular soils and/or structural fill extending to suitable natural granular soils.

The most significant geotechnical aspects at the site are:

1. The existing structures and utilities on the site that are to be demolished/relocated.

2. The existing non-engineered fills across much of the site.

Prior to proceeding with construction, demolition and removal of the existing structures, slabs, foundations, pavements, surface vegetation, root systems, topsoil, non-engineered fill, and any deleterious materials from beneath an area extending out at least 5 feet from the perimeter of the proposed structure footprints and 3 feet beyond pavements and exterior flatwork areas will be required. All existing utility locations should be reviewed to assess their impact on the proposed construction and abandoned and/or relocated as appropriate.

Due to the developed nature of this site and the surrounding area, additional non-engineered fills may exist in unexplored areas of the site. Based on our experience, non-engineered fills are frequently erratic in composition and consistency. All surficial loose/disturbed soils and non-engineered fills must be removed below all footings, floor slabs, and pavements.

On-site granular soils may be re-utilized as structural site grading fill if they meet the criteria for such, as stated later in this report.

Detailed discussions pertaining to earthwork, foundations, pavements, and the geoseismic setting of the site are presented in the following sections.

11.2 EARTHWORK

11.2.1 Site Preparation

It must be noted that from a handling and compaction standpoint, soils containing high amounts of fines (silts and clays) are inherently more difficult to rework and are very sensitive to changes in moisture content, requiring very close moisture control during placement and compaction. This will be very difficult, if not impossible, during wet and cold periods of the year. Additionally, the on-site soils are likely above optimum moisture content for compacting at present and would require some drying prior to re-compacting.

Subsequent to stripping and prior to the placement of floor slabs, foundations, structural site grading fills, exterior flatwork, and pavements, the exposed subgrade must be proof rolled by passing moderate-weight rubber tire-mounted construction equipment over the surface at least twice. If excessively soft or otherwise unsuitable soils are encountered beneath footings, they must be completely removed. 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 natural soils shall be removed to a maximum depth of 2 feet and replaced with compacted granular structural fill.

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

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

11.2.2 Temporary Excavations

Temporary excavations up to 8 feet deep in fine-grained cohesive soils, above or below the water table (not anticipated at the site), 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, 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, the slopes should be no steeper than one horizontal to one vertical (1H:1V). Excavations encountering saturated cohesionless soils (not anticipated at the site) 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.

11.2.3 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 surface vegetation, root systems, 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.

On-site soils, including existing non-engineered fills, may be re-utilized as structural site grading fill if they do not contain construction debris or deleterious material and meet the requirements of structural fill. Fine-grained soils will require very close moisture control and may be very difficult, if not impossible, to properly place and compact during wet and cold periods of the year.

Imported structural fill below foundations and floor slabs shall consist of a well graded sand and gravel mixture with less than 30 percent retained on the three-quarter-inch sieve and less than 20 percent passing the No. 200 Sieve (clays and silts).

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) shall 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.

11.2.4 Fill Placement and Compaction

All 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] T180 (ASTM[2] D1557) compaction criteria in accordance with the table on the following page.

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

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 5	95
Site grading fills outside area defined above	0 to 5	90
Utility trenches within structural areas	--	96
Road base	--	96

Structural fills greater than 5 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 11.2.1, 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.

11.2.5 Utility Trenches

All utility trench backfill material below structurally loaded facilities (footings, floor slabs, flatwork, pavements, 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.

Many utility companies and City-County governments are now requiring that Type A-1a or A-1b (AASHTO Designation – 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 T180 (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 silts and clays, are not recommended for utility trench backfill in structural areas.

11.3 GROUNDWATER

Groundwater was not encountered to the depths explored in the test pits completed at the site.

The groundwater measurements presented are conditions at the time of the field exploration and may not be representative of other times or locations. Groundwater levels may vary seasonally and with precipitation, as well as other factors including irrigation. Evaluation of these factors is beyond the scope of this study. Groundwater levels may, therefore, be at shallower or deeper depths than those measured during this study, including during construction and over the life of the structure.

The extent and nature of any dewatering required during construction will be dependent on the actual groundwater conditions prevalent at the time of construction and the effectiveness of construction drainage to prevent run-off into open excavations.

11.4 SPREAD AND CONTINUOUS WALL FOUNDATIONS

11.4.1 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 granular soils and/or structural fill extending to suitable natural granular soils. For design, the following parameters are provided with respect to the projected loading discussed in Section 6, Design Criteria, of this report:

Minimum Recommended Depth of Embedment for Frost Protection	- 30 inches
Minimum Recommended Depth of Embedment for Non-frost Conditions	- 15 inches
Recommended Minimum Width for Continuous Wall Footings	- 18 inches
Minimum Recommended Width for Isolated Spread Footings	- 24 inches

Recommended Net Bearing Capacity for Real Load Conditions for Footings Established Upon <u>Suitable Natural Granular Soils</u>	-	<u>3,000 pounds per square foot</u>
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.

11.4.2 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.

11.4.3 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.

11.5 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 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.

11.6 FLOOR SLABS

Floor slabs may be established upon suitable natural subgrade soils or structural fill extending to suitable natural soils. Under no circumstances shall floor slabs be established directly over non-engineered fills, loose or disturbed soils, sod, rubbish, construction debris, other deleterious materials, frozen soils, or within ponded water.

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.

11.7 PAVEMENTS

The natural gravel soils will exhibit moderate pavement support characteristics when saturated. All pavement areas must be prepared as previously discussed (see Section 11.2.1, Site Preparation). Under no circumstances shall pavements 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. With the subgrade soils and the projected traffic (40-year design life) as discussed in Section 6, Design Criteria, the following pavement sections are recommended:

<u>Parking Areas</u>

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

<u>Flexible:</u>

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 and associated approach slabs (one 40,000-pound axel load per week), we recommend a pavement section consisting of 8.0 inches of Portland cement concrete, 12.0 inches of aggregate base, over properly prepared natural subgrade or site grading structural fills extending to suitable 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 11.8, Cement Types, of this report. In accordance with the Geotechnical Evaluation Report Template, 25 percent fly ash is required in all concrete exposed to freeze-thaw cycles and deicers.

The crushed stone 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.

11.8 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.

11.9 DOWNSPOUTS

It is recommended that all surface water be directed away from the building with positive drainage measures, including downspouts which must extend a minimum of 20 feet from the structure and flatwork areas.

11.10 GEOSEISMIC SETTING

11.10.1 General

Utah municipalities have adopted the International Building Code (IBC) 2021. The IBC 2021 code refers to ASCE 7-16 Minimum Design Loads and Associated Criteria for Buildings and Other Structures (ASCE 7-16) determines the seismic hazard for a site based upon 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).

11.10.2 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 consists of the Central Section of the Morgan Fault, located approximately 0.64 miles to the northeast of the site.

11.10.3 Site Class

For dynamic structural analysis, the Site Class D – Default Soil Profile as defined in Chapter 20 of ASCE 7-16 (per Section 1613.3.2, Site Class Definitions, of IBC 2021) can be utilized. If a measured site class is desired based on the project structural engineer's evaluation and recommendations, additional testing and analysis can be completed by GSH to determine the measured site class. Please contact GSH for additional information.

11.10.4 Ground Motions

The IBC 2021 code is based on USGS mapping, which provides values of short and long period accelerations for average bedrock values for the Western United States and must be corrected for local soil conditions. The following table summarizes the peak ground and short and long period accelerations for the MCE event and incorporates the appropriate soil amplification factor for a Site Class D – Default* Soil Profile. Based on the site latitude and longitude (41.0388 degrees north and 111.6757 degrees west, respectively), the values for this site are tabulated on the following page.

Spectral Acceleration Value, T	Bedrock Boundary [mapped values] (% g)	Site Coefficient	Site Class D - Default* [adjusted for site class effects] (% g)	Design Values** (% g)
0.2 Seconds (Short Period Acceleration)	S_S = 67.3	F_a = 1.262	S_{MS} = 84.9	S_{DS} = 56.6
1.0 Second (Long Period Acceleration)	S_1 = 23.8	F_v = 2.124	S_{M1} = 50.6	S_{D1} = 33.7

* If a measured site class in accordance with IBC 2021/ASCE 7-16 is beneficial based on the project structural engineer's review, please contact GSH for additional options for obtaining this measured site class.

**IBC 2021/ASCE 7-16 may require a site-specific study based on the project structural engineer's evaluation and recommendations. If needed, GSH can provide additional information and analysis including a complete site-specific study.

11.10.5 Liquefaction

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.

Due to the density of the granular soils and lack of shallow groundwater, liquefaction is not anticipated to occur within the soils encountered in the test pits completed at this site.

11.11 SITE VISITS

GSH must verify that all topsoil/disturbed soils, non-engineered fill, and any other unsuitable soils have been removed, and that suitable soils have been encountered prior to placing site grading fills, footings, slabs, and pavements. Additionally, GSH must observe fill placement and verify in-place moisture content and density of fill materials placed at the site.

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.

LICENSED PROFESSIONAL ENGINEER
No. 343650
MICHAEL S. HUBER
STATE OF UTAH

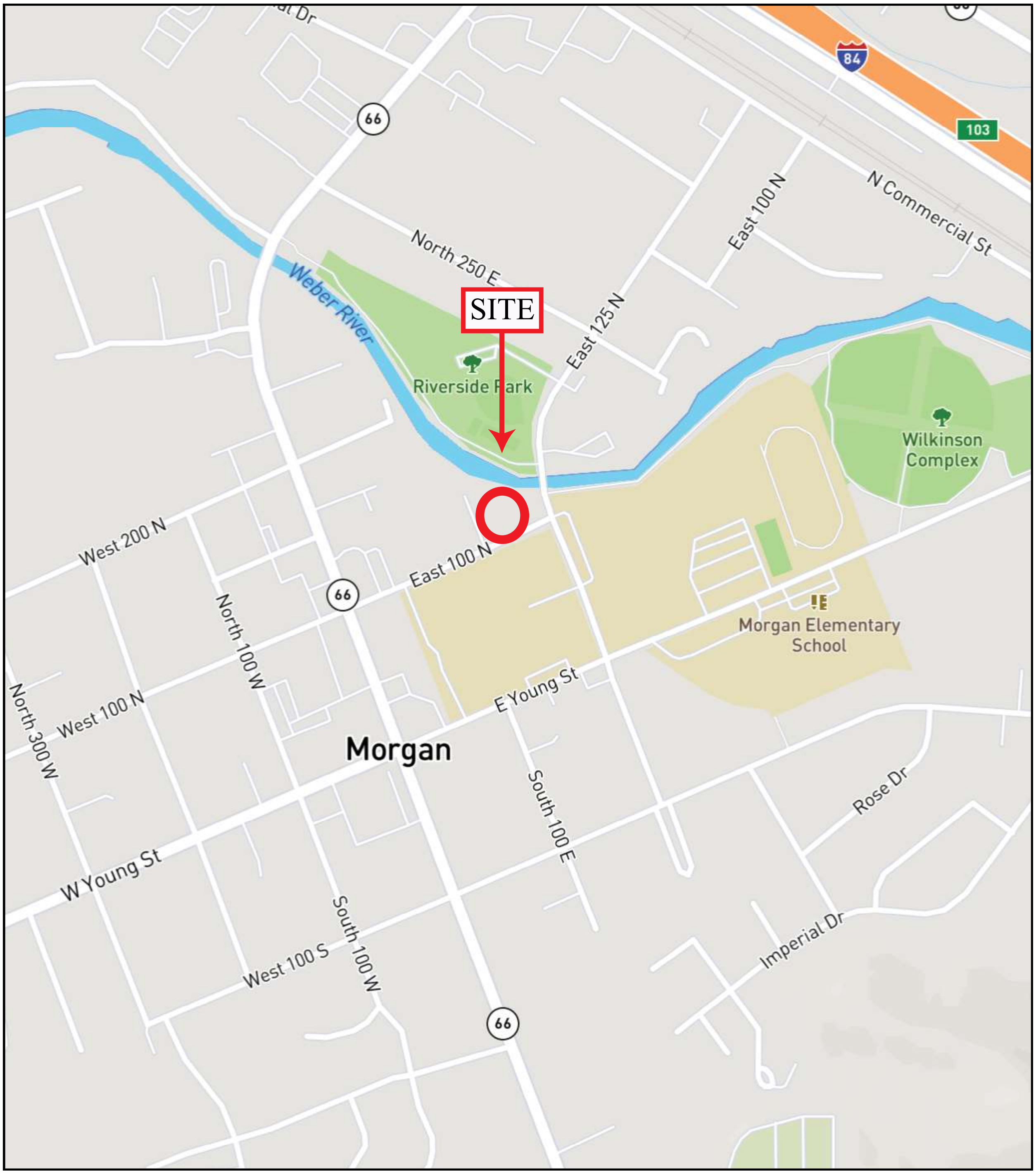
Michael S. Huber, P.E.
State of Utah No. 343650
Vice President/Senior Geotechnical Engineer

MSH:jmt

Encl.	Figure	1,	Vicinity Map
	Figure	2,	Site Plan
	Figures	3A	through 3D, Test Pit Logs
	Figure	4,	Key to Test Pit Log (USCS)

Addressee (email)

THE CHURCH OF JESUS CHRIST OF LATTER-DAY SAINTS
JOB NO. 0153-519-24



0.1 0 0 0 0 0 0.1 MI 0.2

100 0 0 100 200 300 400 M 500

FIGURE 1
VICINITY MAP

GSH

REFERENCE:
ALL TRAILS - NATIONAL GEOGRAPHIC TERRAIN
DATED 2024

THE CHURCH OF JESUS CHRIST OF LATTER-DAY SAINTS
JOB NO. 0153-519-24

FIGURE 2
SITE PLAN

GSH

REFERENCE:
ADAPTED FROM AERIAL PHOTOGRAPH
DOWNLOADED FROM GOOGLE EARTH
IMAGERY DATED 9/2018

TEST PIT LOG

GSH

Page: 1 of 1

TEST PIT: TP-1

CLIENT: The Church of Jesus Christ of Latter-day Saints — PROJECT NUMBER: 0153-519-24

PROJECT: Proposed Morgan Seminary — DATE STARTED: 1/29/24 — DATE FINISHED: 1/29/24

LOCATION: 185 East 100 North, Morgan, Utah (41.0389°, -111.6759°) — GSH FIELD REP.: EC

EXCAVATING METHOD/EQUIPMENT: SY 60C

GROUNDWATER DEPTH: Not Encountered (2/8/24) — ELEVATION: ---

WATER LEVEL	USCS	DESCRIPTION	DEPTH (FT.)	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0							
		6" CRUSHED GRAVEL								
	CL FILL	FINE TO COARSE SANDY CLAY, FILL with fine and coarse gravel; brown								moist medium stiff
				◢						
	GP	FINE TO COARSE SANDY FINE AND COARSE GRAVEL brown								slightly moist medium dense
			5	◢	6.6		3.5			
			10							
				◢						
		End of exploration at 12.0'. No significant sidewall caving. Installed 1.25" diameter slotted PVC pipe to 12.0'.								
			15							
			20							
			25							

See Subsurface Conditions section in the report for additional information.

FIGURE 3A

GSH — TEST PIT LOG

Page: 1 of 1

TEST PIT: TP-2

CLIENT: The Church of Jesus Christ of Latter-day Saints — PROJECT NUMBER: 0153-519-24

PROJECT: Proposed Morgan Seminary — DATE STARTED: 1/29/24 — DATE FINISHED: 1/29/24

LOCATION: 185 East 100 North, Morgan, Utah (41.0389°, -111.6759°) — GSH FIELD REP.: EC

EXCAVATING METHOD/EQUIPMENT: SY 60C

GROUNDWATER DEPTH: Not Encountered (1/29/24) — ELEVATION: ---

WATER LEVEL	USCS	DESCRIPTION	DEPTH (FT.)	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface								
	SM/ SC FILL	SILTY/CLAYEY FINE SAND, FILL with fine and coarse gravel; brown	0							slightly moist loose
				◣	8.6		16.1			
	SP	FINE TO COARSE SAND with fine and coarse gravel; brown	5							dry medium dense
				◣						
		End of exploration at 7.5'. No significant sidewall caving.								
			10							
			15							
			20							
			25							

See Subsurface Conditions section in the report for additional information.

TEST PIT LOG

Page: 1 of 1

TEST PIT: TP-3

CLIENT: The Church of Jesus Christ of Latter-day Saints	PROJECT NUMBER: 0153-519-24
PROJECT: Proposed Morgan Seminary	DATE STARTED: 1/29/24 DATE FINISHED: 1/29/24
LOCATION: 185 East 100 North, Morgan, Utah (41.0389°, -111.6759°)	GSH FIELD REP.: EC
EXCAVATING METHOD/EQUIPMENT: SY 60C	
GROUNDWATER DEPTH: Not Encountered (1/29/24)	ELEVATION: ---

WATER LEVEL	USCS	DESCRIPTION	DEPTH (FT.)	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface								
		6" CRUSHED GRAVEL	0							
	SM/SC FILL	SILTY/CLAYEY FINE SAND, FILL with fine and coarse gravel; brown								slightly moist loose
				sample	8.0		18.9			
	GP	FINE TO COARSE SANDY GRAVEL brown/red								dry medium dense
			5							
				sample	3.2		1.2			
		grades with cobbles		sample						
		End of exploration at 10.0'. No significant sidewall caving.	10							
			15							
			20							
			25							

See Subsurface Conditions section in the report for additional information.

FIGURE 3C

GSH

TEST PIT LOG

TEST PIT: TP-4

CLIENT: The Church of Jesus Christ of Latter-day Saints — PROJECT NUMBER: 0153-519-24

PROJECT: Proposed Morgan Seminary — DATE STARTED: 1/29/24 — DATE FINISHED: 1/29/24

LOCATION: 185 East 100 North, Morgan, Utah (41.0389°, -111.6759°) — GSH FIELD REP.: EC

EXCAVATING METHOD/EQUIPMENT: SY 60C

GROUNDWATER DEPTH: Not Encountered (1/29/24) — ELEVATION: ---

WATER LEVEL	USCS	DESCRIPTION	DEPTH (FT.)	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0							
	CL FILL	SILTY CLAY, FILL with trace fine sand and trace fine and coarse gravel; brown								moist medium stiff
				sample	22.2		58.9			
	GP	FINE TO COARSE SANDY FINE AND COARSE GRAVEL brown								slightly moist medium dense
				sample						
			5							
			10							
				sample	4.6		2.8			
		End of exploration at 11.0'. No significant sidewall caving. No groundwater encountered at time of excavation.								
			15							
			20							
			25							

See Subsurface Conditions section in the report for additional information.

CLIENT: The Church of Jesus Christ of Latter-day Saints PROJECT: Proposed Morgan Seminary PROJECT NUMBER: 0153-519-24	**KEY TO TEST PIT LOG**

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

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

⑥ **Moisture (%):** Water content of soil sample measured in laboratory; expressed as percentage of dryweight of

⑦ **Dry Density (pcf):** The density of a soil measured in laboratory; expressed in pounds per cubic foot.

⑧ **% Passing 200:** Fines content of soils sample passing a No. 200 sieve; expressed as a percentage.

⑨ **Liquid Limit (%):** Water content at which a soil changes from plastic to liquid behavior.

⑩ **Plasticity Index (%):** Range of water content at which a soil exhibits plastic properties.

⑪ **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:	MODIFIERS:	MOISTURE CONTENT (FIELD TEST):
Weakly: Crumbles or breaks with handling or slight finger pressure.	**Trace** <5%	**Dry:** Absence of moisture, dusty, dry to the touch.
Moderately: Crumbles or breaks with considerable finger pressure.	**Some** 5-12%	**Moist:** Damp but no visible water.
Strongly: Will not crumble or break with finger pressure.	**With** > 12%	**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