Gordon Spilker Huber
Geotechnical Consultants, Inc.

REPORT
GEOTECHNICAL STUDY
PROPOSED SNOW COLLEGE LIBRARY
151 EAST CENTER STREET
SNOW COLLEGE CAMPUS
EPHRAIM, UTAH

Submitted To:

Cooper Roberts Simonsen Associates
700 North 200 West
Salt Lake City, Utah 84103

Submitted By:

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April 22, 2008

Job No. 0661-001-07

GSH
Gordon Spilker Huber
Geotechnical Consultants, Inc.

April 22, 2008
Job No. 0661-001-07

Cooper Roberts Simonsen Associates
700 North 200 West
Salt Lake City, Utah 84103

Attention: Ms. Kathy Wheadon

Ladies and Gentlemen:

Re: Report
Geotechnical Study
Proposed Snow College Library
151 East Center Street
Snow College Campus
Ephraim, Utah

1. INTRODUCTION

1.1 GENERAL

This report presents the results of our geotechnical study performed at the site of the proposed Snow College Library, located at 151 East Center Street in Ephraim, Utah. The general location of the site with respect to major topographic features and existing facilities, as of 2001, is presented on Figure 1, Vicinity Map. A more detailed layout of the site showing the locations of existing roadways and adjacent facilities, as well as the finalized site of the proposed library, is presented on Figure 2, Site Plan.

A geotechnical study for a potential site for the Performing Arts Center, which was ultimately constructed farther to the east, was previously completed in the same general area of the proposed library. The results of the previous geotechnical study are presented in a report dated August 7, 2001[1]. The locations of eight borings advanced in conjunction with the August 7, 2001 study (B-1 through B-8), which are in the general locations of the proposed library, are presented on Figure 2. The seven additional borings drilled in conjunction with this study are also presented on Figure 2. It should be noted that at the time of our field work, various locations for the library within the general site area were being considered. The new

1 "Report, Geotechnical Study, Proposed Performing Arts Center/Classrooms Building, Northeast Corner of 100 East and Center Street, Snow College Campus, Ephraim, Utah," AMEC Earth & Environmental, Inc. Job No. 1-817-003579.

borings were located to assess all of these potential sites. The results of our field explorations and preliminary conclusions were presented in a memorandum dated December 13, 2007[2]. Since the issue of the memorandum, the proposed library site as presented on Figure 2 has been finalized.

1.2 OBJECTIVES AND SCOPE

The objectives and scope of our study were planned in discussions between Ms. Kathy Wheadon of Cooper Roberts Simonsen Associates, and Mr. Mike Huber of Gordon Spilker Huber Geotechnical Consultants, Inc. (GSH).

In general, the objectives of this study were to:

1. Further define and evaluate the subsurface soil and groundwater conditions across the site with regard to geotechnical characteristics.

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

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

1. Review of August 7, 2001 study.

2. A field program consisting of the drilling, logging, and sampling of 7 additional exploration borings extending to depths of 16.0 to 31.5 feet below existing grade.

3. A laboratory testing program.

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

1.3 AUTHORIZATION

Authorization was provided by returning a signed copy of our Proposal No. 07-1128 Revision 1 dated November 19, 2007.

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 previously referenced exploration borings, projected groundwater

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2 "Memorandum, Summary of Site Conditions, Proposed Snow College Library, Northeast Corner of 100 East and Center Streets, Snow College Campus, Ephraim, Utah," Gordon Spilker Huber Geotechnical Consultants, Inc. Job No. 0661-001-07.

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 structure will be three total levels in height with a full-depth basement and will have a footprint of approximately 21,000 square feet. The basement will extend up to 16 feet below final grade. The structure is anticipated to be of steel-frame and masonry construction above grade and reinforced concrete construction below grade.

Structural loads will be transmitted down through columns and bearing walls to the supporting foundations. Based on information provided by the structural engineer, Cameron Empey of Reaveley Engineers + Associates, maximum column and wall loads are anticipated to be on the order of 400 to 500 kips and 2 to 4 kips per lineal foot, respectively. We project that the floor slab loads will be light to moderate (less than an average uniform load of 200 to 250 pounds per square foot).

Traffic in the parking areas associated with the structure will consist of a light volume of automobiles and light trucks and occasional medium-weight trucks. In primary roadway areas, we project that the traffic will consist of a moderate volume of automobiles and light trucks and occasional medium- to heavy-weight trucks.

Maximum site grading cuts and fills are approximately three to four feet.

3. SITE INVESTIGATIONS

3.1 FIELD PROGRAM

In order to define and evaluate the subsurface soil and groundwater conditions across the site, 8 borings (B-1 through B-8) drilled in conjunction with the August 7, 2001 study to depths of 15.0 to 41.5 feet below existing grades were first reviewed. Subsequently, 7 additional borings (B-1A through B-7A) were drilled in conjunction with this study to depths of 16.0 to 31.5 feet. The borings were drilled using rubber tire truck-mounted drill rig equipped with hollow-stem augers. The approximate 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 penetrated were obtained for subsequent laboratory testing and examination. The soils were classified in the field based upon visual and textural examination. These classifications were later supplemented by subsequent inspection and testing in our laboratory. Detailed graphical representation of the subsurface conditions encountered in conjunction with the August 7, 2001 study are presented on Figures 3A through 3H, Log of Borings (August 7, 2001 Study) Figures 4A through 4G, Log of Borings (Current Study) present the conditions encountered in conjunction with this study. Soils were classified in accordance with the nomenclature described on Figure 5, 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. 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 excavating operations, one and one-quarter-inch diameter slotted PVC pipe was installed in Borings B-2A, B-3A, and B-4A 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 completed. The program included moisture, density, partial gradation, collapse-consolidation, sulfate, and pH tests. Laboratory tests from the August 7, 2001 report are also presented in the following sections. The following paragraphs describe the tests and summarize the test data.

3.2.2 Moisture and Density Tests

To provide index parameters and to correlate other test data, moisture and density tests were performed on selected samples. The results of these tests are presented on the boring logs, Figures 3A through 3H and Figures 4A through 4G.

3.2.3 Partial Gradation Test

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

Boring No.	Depth (feet)	Percent Passing No. 200 Sieve	Soil Classification
B-2A	12.5	72.5	ML
B-3A	28.0	7.9	GM/GP
B-7A	15.0	43.2	SM/ML

3.2.4 Collapse-Consolidation Tests

To provide data necessary for our settlement analyses, a collapse-consolidation test was performed on each of 15 representative samples of the clayey soils encountered at the site. The collapse portion of the overall test was performed in accordance with the following procedure:

1. Load sample at in-situ moisture content to specific axial pressure.
2. Measure and record axial deflection.
3. Saturate sample.
4. Measure and record resulting collapse.

The results of the collapse portion of the test are tabulated below:

Boring No.	Depth (feet)	Soil Type	Natural Dry Density (pcf)	Natural Moisture Content (percent)	Axial Load When Saturated (psf)	Collapse (-) Or Swell (+) (percent)
B-2	2.5	CL	91	22.8	1,600	2.4 (-)
B-2	20.5	CL/ML	107	21.4	1,600	1.1 (-)
B-4	5.5	CL/ML	85	13.7	1,600	5.1 (-)
B-4	15.5	CL/ML	92	13.8	1,600	2.3 (-)
B-4	20.5	CL/ML	92	8.9	1,600	3.4 (-)
B-5	8.0	CL/ML	104	24.1	1,600	0.9 (-)
B-6	3.5	CL/ML	91	16.0	1,600	0.7 (-)
B-1A	15.5	CL	108	15.9	1,600	1.2 (-)
B-2A	7.5	CL	101	21.7	1,600	0.6 (-)
B-3A	5.5	CL	101	21.0	1,600	(+)*
B-3A	10.5	CL	99	22.7	1,600	0.1 (-)
B-4A	3.0	CL	93	12.5	1,600	7.1 (-)
B-5A	10.0	CL	96	9.3	1,600	1.0 (-)
B-6A	10.0	CL	113	18.4	1,600	(+)*
B-7A	5.0	CL	103	18.9	1,600	0.2 (-)

* Slight swell

Laboratory data shows that the more layered soils which contain occasional "pinholes" are not or only slightly collapsible (some swelled slightly). When non-collapsible, the soils exhibit relatively high strength and low compressibility characteristics. The non-layered fine-grained soils having a more significant "pinhole" structure were found to be moderately to highly (2.3 to 7.1 percent) collapsible. Detailed results of these tests are maintained within our files and can be transmitted to you, upon your request.

3.2.5 pH and Soluble Sulfates Tests

To determine if the site soils will react detrimentally with concrete, pH and soluble sulfates tests were performed on a representative sample of the natural near-surface soils. The results of those tests are tabulated below:

Boring No.	Depth (feet)	USCS Group Symbol	pH	Water Soluble Sulfate (ppm)
B-5	1.5	ML-CL	7.6	<10

4. SITE CONDITIONS

4.1 SURFACE

The site is located on the Snow College campus on the north side of Center Street at approximately 151 East. The site currently consists of an open lawn area with various large trees and a few sidewalks crossing the site. During the August 7, 2001 study, the site contained four structures which were one to two levels high. Three of these buildings were established near existing grade with the fourth (easternmost) building having a walk-out basement. These facilities were demolished between the time of the August 7, 2001 study and the current study. Some of the fills encountered in the current borings drilled at the site are most likely associated with these previous structures.

The site is bounded by Center Street to the south with one to three-level residential and school buildings beyond. To the west is 100 East Street with the single-level LDS Institute building beyond. To the north are various college buildings which are two to four levels in height. The site is bounded to the east by a similar open area with a parking lot and the Performing Arts Center beyond.

The site slopes gently downhill to the northwest with overall relief on the order of 10 feet. The slope is rather uniform except for a 10 to 20 percent slope, which is approximately 6 feet high in the east-central to northeast portions of the site.

4.2 SUBSURFACE SOIL AND GROUNDWATER

The eight borings drilled during the August 7, 2001 study which are located on the site are included in the soil descriptions and discussions presented in this section.

Non-engineered fills typically consisting of silty clays were encountered from the surface to depths of 1.0 to 5.0 feet in the majority of borings with one of the borings (B-1A) encountering 11.5 feet of non-engineered fills.

Underlying the non-engineered fills are 23.0 to 28.5 feet of silty clays, silty clays/clayey silts, sequences of alternating up to six-inch layers of fine sandy silt, silty clay, and clayey silt. These primarily fine-grained soils contain random deposits of potentially collapsible soils. These soils are discussed in greater detail later in this section. Below the fine-grained soils are very dense sands and gravels. The very dense sands and gravels encountered below 23.0 to 28.5 feet below the ground surface are not collapsible.

The upper fine-grained soils (extending to depths of 23.0 to 28.5 feet) are fairly constant, with the major difference being the increased frequency of soils containing a "pinhole"-type structure in the central and eastern portions of the site (including the proposed building footprint). A "pinhole"-type structure is typically indicative of a moisture sensitive (collapsible) soil. Moisture sensitivity, in this case, is defined as the characteristic of a soil to exhibit moderately high strength and low compressibility characteristics when dry, but to lose strength, become highly compressible, and collapse when saturated. Laboratory data shows that the more layered soils which contain a minimal amount of these "pinholes" are not or only slightly collapsible (some swelled slightly). Where non-collapsible, the soils exhibit relatively high strength and low compressibility characteristics. The non-layered fine-grained soils have a more significant "pinhole" structure and were found to be moderately to highly (2.3 to 7.1 percent) collapsible. The non-collapsible and collapsible soils are variable laterally and vertically in the subsurface sequence. It should be noted that the moderately to highly collapsible soils were only encountered in the borings in the central and eastern portions of the site (including the proposed building pad). Furthermore, the potentially collapsible soils appear to be present in random and isolated pockets and layers in the upper soils which extend from the surface to depths of 23.0 to 28.5 feet below the ground surface. As previously mentioned, at these depths non-collapsible dense sands and gravels were encountered. Within the upper fine-grained soil zones, significant layers of sands and gravels and sands were encountered.

The lines designating the interface between soil types on the boring logs generally represent approximate boundaries. In-situ, the transition between soil types may be gradual.

Groundwater was not encountered in the borings and is anticipated to be at a depth deeper than the extent explored (41.5 feet) during this and the August 7, 2001 study.

5. DISCUSSIONS AND RECOMMENDATIONS

5.1 SUMMARY OF FINDINGS

The geotechnical aspects of the site that will most influence the design and construction of the proposed structure and pavements are the moisture sensitive (potentially collapsible) soils and non-engineered fills, which were encountered at varying depths, thicknesses, and lateral extents.

The two recommended options for supporting the building are as follows:

1. Deep Foundations: Support the structure on deep foundation extending to the very dense sands and gravels encountered at depths ranging from 23.0 to 28.5 feet in the borings at the site.

2. Soil Improvements: Utilize conventional spread and continuous wall foundations established upon suitable natural soils (the very dense sands and gravel encountered at 23.0 to 28.5 feet below existing grades) and/or structural fill extending to the natural granular soil and/or soil improvement systems, such as Geopiers®.

The first option would consist of providing a deep foundation system, such as driven steel piles, drilled concrete shafts, micropiles, or helical piers that extend through the clays into the underlying very dense sands and gravels encountered at depths ranging from 23.0 to 28.5 feet. Helical piers would be the most economical system; however, the helical piers may have some difficulty penetrating some of the harder clays, as well as sand and gravel layers encountered.

As an alternative to deep foundation, soil improvements may be utilized. The first soil improvement would be the removal of the finer-grained soils to the very dense sands and gravels encountered at depths ranging from 23.0 to 28.5 feet. The footings could be placed on these sands and gravels or structural fill extending to the sands and gravels. An alternative to complete removal of the fine-grained soils below the structure are Geopier® soil reinforcement elements.

Specific design details and cost estimates can be provided by the individual installation contractors for each system. With each of the above methods, the structure would no longer be subject to the potential settlement associated with the random potentially collapsible soils encountered at the site.

It should be noted that in our December 13, 2007 memorandum, the partial replacement of the fine-grained potentially collapsible soils with an emphasis on controlling water infiltration into the subsurface was presented as an option. Based on our further review of the subsurface information and the chosen location for the library, this method is not recommended.

It should also be noted that even with the foundations being supported on deep foundations or improved soils, the floor slabs could still see settlements unless they are structurally supported or supported on deep foundations/improved soils.

Pavements and outside flatwork may be established upon properly prepared suitable natural soils and/or upon structural fill extending to properly prepared suitable natural soils. Pavements and outside flatwork may be established overlying potentially properly prepared collapsible soils and/or properly prepared existing non-engineered fills with the understanding that some movements may occur. These movements can be somewhat controlled and delayed by reducing infiltration of water into the subsurface sequence.

The potentially collapsible soils, existing fills, and other natural soils can be re-used as structural site grading fill, if they meet the requirements of such. Fine-grained soils (clays and silts) will require close moisture control during placement and compaction. This will be extremely difficult during wet and cold periods of the year.

Detailed discussions pertaining to earthwork, foundations, floor slabs, lateral resistance, pavements, and the geoseismic setting of the site are discussed in the following sections.

5.2 EARTHWORK

5.2.1 Site Preparation

Initial site preparation will consist of the removal of loose/disturbed surficial soils, surface vegetation, topsoil, non-engineered fills, and other deleterious materials from beneath an area extending out at least five feet from the perimeter the proposed building. The loose/disturbed surficial soils, surface vegetation, topsoil, and other deleterious materials must also be removed from beneath pavement and exterior flatwork areas.

As previously mentioned, the proposed structure may be supported upon conventional spread and continuous wall foundations supported upon suitable non-collapsible natural soils and/or structural fill to suitable granular soils. This will require the removal of the finer-grained soils beneath the building footprint to the very dense sands and gravels encountered at depths ranging from 23.0 to 28.5 feet. As an alternative, the structure can be supported on deep foundations or other soil improvement methods utilized (such as Geopiers®).

Support of the pavements and exterior flatwork on these deep foundations or improved soils is not typically financially feasible. However, the risk of excessive settlements of the pavements is significantly less than the footings since the pavements areas are exerting minimal additional pressure on the potentially collapsible soils.

The potentially collapsible and existing non-engineered fill may remain in pavement and exterior flatwork areas as long as they are properly prepared. Proper preparation will consist of scarification of the upper 9 to 12 inches, moisture preparation, and recompaction to the requirements of structural fill. As an option to proper preparation and recompaction, the upper 12 inches of potentially collapsible and existing non-engineered fills may be removed and replaced with granular subbase over proofrolled subgrade. The fine-grained soils/fills will require that very close moisture control be maintained during placement and compaction. It will be very difficult, if not impossible, to properly compact these soils during wet and cold periods of the year. Even with proper preparation, pavements and exterior flatwork established overlying potentially collapsible soils or existing non-engineered fills may encounter some long-term movements unless the potentially collapsible soils and non-engineered fills are completely removed.

Subsequent to the above operations and prior to the placement of footings, structural site grading fill, or floor slabs, the exposed natural subgrade must be proofrolled by passing moderate-weight rubber tire-mounted construction equipment over the surface at least twice. If any loose, soft, or disturbed zones are encountered, they must be completely removed in footing and floor slab areas and replaced with granular structural fill. In pavement areas, unsuitable soils encountered during recompaction and proofrolling must be removed to a maximum depth of two feet and replaced with compacted granular structural fill.

5.2.2 Temporary Excavations

Temporary construction excavations not exceeding four feet in depth may be constructed with near-vertical sideslopes. Deeper construction excavations up to 10 feet in depth in the natural soils shall be constructed with sideslopes no steeper than one-half horizontal to one vertical in clayey soils and three-quarters horizontal to one vertical in granular soils. Deeper construction excavations up to 15 feet in depth in the natural soils shall be constructed with sideslopes no steeper than three-quarters horizontal to one vertical in clayey soils and one horizontal to one vertical in granular soils. Deeper construction excavations up to 28.5 feet in depth in the natural soils shall be constructed with sideslopes no steeper than one horizontal to one vertical. Excavations deeper than 28.5 feet are not anticipated at the site. If excessive sloughing occurs or where extensive layers of clean granular soils are encountered, the sideslopes must be appropriately flattened.

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

5.2.3 Structural Fill

Structural fill will be required as site grading fill, as backfill over foundations and utilities, and possibly as replacement fill below footings. All structural fill must be free of sod, rubbish, construction debris, frozen soil, and other deleterious materials. Structural site grading fill is defined as fill placed over fairly large open areas to raise the overall site grade.

The maximum particle size within structural site grading fill should generally not exceed four inches; although, occasional particles up to six to eight inches may be incorporated provided that they do not result in "honeycombing" or preclude the obtainment of the desired degree of compaction. In confined areas, the maximum particle size should generally be restricted to two and one-half inches.

On-site soils/fills may be re-utilized as structural site grading fill if they meet the requirements of such. The fine-grained soils/fills will require that very close moisture control be maintained during placement and compaction. It will be very difficult, if not impossible, to properly place and compact these soils/fills during wet and cold periods of the year.

Imported granular materials should consist of mixtures of sand and gravel meeting the general requirements stated herein. To reduce the permeability of fills, it is recommended that structural fill contain a minimum of 20 percent fines (particles passing the No. 200 sieve).

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.

5.2.4 Fill Placement and Compaction

All structural fill should be placed in lifts not exceeding eight inches in loose thickness. Structural fills beneath an area extending out at least 5 feet from all footings and floor slabs, as well as all other fills 5 to 10 feet thick, must be compacted to at least 95 percent of the maximum dry density as determined by the AASHTO[3] T-180 (ASTM[4] D-1557) compaction criteria. Structural fills 10.0 to 28.5 feet thick shall be compacted to 98 percent of the above-defined criteria with moisture contents at or above optimum. Additionally, GSH must review final grading plans for all structural fill areas greater than 10 feet thick to provide additional recommendations as required. Structural fills greater than 28.5 feet thick are not anticipated at the site. Structural fills less than 5 feet thick, which are not beneath an area extending out at least 5 feet from the perimeter of the structure, should be compacted to at least 90 percent of the above-defined criteria.

Prior to the placement of structural site grading fill, pavements, floor slabs, or footings, the exposed subgrade must be prepared as discussed in Section 5.2.1, Site Preparation, of this report. In confined areas, subgrade preparation must 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.

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3 American Association of State Highway and Transportation Officials

4 American Society for Testing and Materials

5.2.5 Utility Trenches

All utility trench backfill material below structurally loaded facilities (flatwork, floor slabs, roads, etc.) should 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 should 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 should 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-1 or A-1a (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 fine-grained soils are not recommended for use as trench backfill.

5.3 FOUNDATIONS

5.3.1 General

Due to the presence of moisture sensitive (potentially collapsible) soils encountered at varying depths, thicknesses, and lateral extents at the site, two recommended options for supporting the building are presented.

The first option would consist of providing a deep foundation system, such as driven steel piles, drilled concrete shafts, micropiles, or helical piers that extend through the clays into the underlying very dense sands and gravels encountered at depths of 23.0 to 28.5 feet. Helical piers would be the most economical system; however, the helical piers may have some difficulty penetrating some of the harder clays, as well as sand and gravel layers encountered. An applicable soil improvement option is Geopier® soil reinforcement elements.

Specific design details and cost estimates can be provided by the individual installation contractors for each system. With each of the above methods, the structure would no longer be subject to the potential settlement associated with the random potentially collapsible soils encountered at the site.

As an alternative to deep foundations and Geopier® soil improvements, the proposed structure may be supported upon conventional spread and continuous wall foundations supported upon suitable non-collapsible natural soils and/or structural fill to suitable granular soils. This will require the removal of the finer-grained soils beneath the building footprint to the very dense sands and gravels encountered at depths ranging from 23.0 to 28.5 feet.

Helical piers, Geopiers®, as well as spread and continuous wall foundations, to be placed overlying the improved site are discussed in the following sections. Additional deep foundation (including drilled concrete piers, micropiles, and driven steel piles) recommendations and design data can be provided at the request of the client.

5.3.2 Helical Piers

Helical piers consist of a single or multiple bearing plates welded to steel shafts. The pier is rotary installed into the soils with extension section being added to reach the bearing depth (approximately 23.0 to 28.5 feet at the site). The top of the helical pier is connected to the rebar reinforcement associated with the concrete footings.

The depth, spacing, and cost of the helical piers will be determined by the pier contractor and the design team. Typically, helical piers are placed every eight feet on-center beneath continuous footings. Generally, two or more are installed beneath spot footings. The helical pier capacity-depth would be determined by the helical pier contractor. It is our recommendation that a test pier be installed so that the contractor can better estimate costs and assess installation through the harder clays and sand and gravel layers at the site.

5.3.3 Geopiers®

Geopier® soil reinforcement elements are constructed by drilling a 24- or 30-inch diameter hole, removing a volume of soil, and then building a bottom bulb of clean, open-graded stone using a beveled, high-energy tamper. The Geopiers® shaft is constructed on top of the bottom bulb using well-graded highway base course stone placed in thin lifts (12 inches compacted thickness). Preliminary data indicates that the Geopiers® would extend to depths of approximately 25 to 30 feet below existing grade. The result of construction is a reinforced zone of soil directly under footings that allows for the construction of shallow spread footings proportioned for a relatively high bearing pressure. One or more Geopiers® will be required under each of the column loads. The spacing of the Geopiers® under wall loads will probably be on the order of eight feet.

We anticipate that with the Geopiers® system that the conventional spread and continuous wall foundations can be proportioned utilizing a net bearing pressure in the range of 4,000 to 4,500 pounds per square foot. Generally, we anticipate that the wall footings will require some additional reinforcing but will not need to be designed as grade beams. With this system, the settlements should be controllable to less than one inch.

Geopiers® soil reinforcement should be designed and constructed by an installer licensed by the Geopiers® Foundation Company, Inc. The installer should provide a Geopiers® layout and detailed design calculations sealed by a professional engineer licensed in the State of Utah. The design calculations should demonstrate that Geopiers® soil reinforcement is designed to control settlement to magnitudes within the criteria for this project.

The Intermountain Regional Engineer for Geopiers® Foundation Company is Mr. David Plehn. Geopiers'® regional office is located in Murray, Utah (801-269-8012). Final design will be provided by Geopiers® or through a licensed installer.

5.3.4 Spread And Continuous Wall Foundations

5.3.4.1 Design Data

Once the Geopiers® systems are installed, the proposed structure can be supported upon conventional spread and continuous wall foundations established directly upon the undisturbed top surface of the Geopiers®. As previously discussed, the structure may also be supported upon deep foundation systems, such as helical pier, drilled shafts or driven piles. Deep foundations design data can be provided by GSH and/or the installer/manufacturer of the specific foundation system. As an alternative to deep foundation and Geopiers® soil improvements, the proposed structure may be supported upon conventional spread and continuous wall foundations supported upon suitable non-collapsible natural soils and/or structural fill to suitable granular soils as previously discussed. For design, the following parameters 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	- 16 inches
Minimum Recommended Width for Isolated Spread Footings	- 30 inches
Recommended Net Bearing Pressure for Real Load Conditions	
Footings Overlying Geopiers®	- Approximately 4,000 pounds per square foot*
Footing Overlying Suitable Natural Sand and Gravel Soils and/or Granular Structural Fill Extending to these Soils	- 3,000 pounds per square foot**
Bearing Pressure Increase for Seismic Loading	- 50 percent

* To be developed by Geopiers®.

** Footings greater than four feet in width may be utilized a bearing pressure of 4,000 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.

5.3.4.2 Installation

If Geopiers® are utilized; foundations must be established directly upon the undisturbed top surface of the pier systems.

If unsuitable soils are encountered at the proposed footing subgrade elevation, they must be totally removed and replaced with compacted granular structural fill. If fine-grained cohesive subgrade soils become disturbed following footing excavation, they shall be completely removed and replaced with granular structural fill. If granular fill soils upon which the footings are to be established become loose or disturbed, they should be recompacted to the requirements for structural fill.

<u>The width of structural replacement fill, as required below footings, shall be extended laterally at least six inches beyond the edges of the footings in all directions for each foot of fill thickness beneath the footings.</u> 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.

5.3.4.3 Settlements

Maximum settlements of foundations designed and installed over Geopiers® or a deep foundation system should be less than one-half inch. However, these estimates will be refined with the design of the system.

Settlements of conventional spread and continuous wall foundations supported upon natural near-surface granular soils (without soil improvements or deep foundations), constructed in accordance with the recommendations presented herein, and supporting the maximum anticipated loads as discussed in Section 2., Proposed Construction, are calculated to be on the order of one-half to five-eighths of an inch. Settlements will occur fairly rapidly with approximately 50 to 60 percent of the quoted total settlement occurring during construction.

5.4 LATERAL RESISTANCE

Lateral loads imposed upon foundations due to wind or seismic forces may be resisted by the development of passive earth pressures and friction between the base of the footings and the supporting soils. In determining frictional resistance, a coefficient of 0.40 should 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.

5.5 LATERAL PRESSURES

The most significant lateral pressures will be imposed by the backfill around the perimeter of the below-grade portions of the building.

The lateral pressure parameters, as presented within this section, project that the backfill will consist of a drained granular soil placed and compacted in accordance with the recommendations presented herein. The lateral pressures imposed upon subgrade facilities will, therefore, be basically dependent upon the relative rigidity and movement of the backfilled structures. For active walls, such as retaining walls which can move outward (away from the backfill), granular backfill may be considered equivalent to a fluid with a density of 35 pounds per cubic foot in computing lateral pressures. For moderately rigid walls, such as the proposed subgrade walls that are generally not more than 12 feet in height, granular backfill may be considered equivalent to a fluid with a density of 45 pounds per cubic foot. For very rigid non-yielding walls, granular backfill should be considered equivalent to a fluid with a density of at least 55 pounds per cubic foot. The above values assume that the surface of the soils slope behind the wall is horizontal, that the granular fill has been placed and lightly compacted, not as a structural fill. To lessen additional lateral pressures, only hand-operated compaction equipment must be utilized within four feet of the walls.

For seismic loading, the lateral load on a 16-foot high wall can be calculated utilizing a uniform pressure of 142 pounds per square foot.

5.6 FLOOR SLABS

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

It should also be noted that even with the foundations being supported on deep foundations or improved soils, the floor slabs could still see settlements unless they are structurally supported or also supported on deep foundations/improved soils.

In order to facilitate curing of the concrete, it is recommended that floor slabs be directly underlain by at least four inches of "free-draining" fill, such as "pea" gravel or three-quarters to one-inch minus clean gap-graded gravel.

5.7 PAVEMENTS

The existing natural soils will exhibit moderately poor to poor pavement support characteristics. All pavement areas must be prepared as previously discussed (see Section 5.2.1, Site Preparation). As previously mentioned, support of the pavements on deep foundations or improved soils are not typically financially feasible. However, the risk of excessive settlements of the pavements is significantly less than the footings, since the pavements areas are exerting minimal additional pressure on the potentially collapsible soils. 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
Over	Properly prepared natural subgrade soils, and/or structural site grading fill extending to 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 natural subgrade soils

Roadway Areas

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

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 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 natural subgrade soils

For dumpster pads, we recommend a pavement section consisting of six and one-half inches of Portland cement concrete, four inches of aggregate base, over properly prepared natural subgrade or site grading structural fills.

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 with the Portland Cement Association (PCA) guidelines. The concrete should have a minimum 28-day unconfined compressive strength of 4,000 pounds per square inch, contain 6 percent ±1 percent air-entrainment, and meet the requirements given below in Section 5.8, Cement Types, of this report.

5.8 CEMENT TYPE

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 on our review of available literature, no active faults pass through or immediately adjacent to the site.

5.9.3 Soil Class

For dynamic structural analysis, the Site Class D - Stiff Soil Profile as defined in Table 1613.5.2, Site Class Definitions, of the IBC 2006 can be utilized.

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 (39.3601 degrees north and 111.5829 degrees west, respectively), the values for this site are tabulated on the following page.

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	27.7	34.5
0.2 Seconds, (Short Period Acceleration)	$S_S = 69.2$	$S_{MS} = 86.2$
1.0 Seconds (Long Period Acceleration)	$S_1 = 22.8$	$S_{M1} = 44.4$

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

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.

Due to the lack of a shallow groundwater table and, therefore, a lack of saturated granular soils at the site, as well as the dense nature of deeper granular soils encountered in the borings, liquefaction is not anticipated to occur at the site during the design seismic event.

5.10 SITE OBSERVATIONS

As previously mentioned, potentially collapsible soils and non-engineered fills are present on the site to varying depths. Therefore, we recommend that a qualified geotechnical engineer observe the foundation excavations to identify that all unsuitable soils and fills have been removed and that suitable soils have been encountered.

Gordon Spilker Huber
Geotechnical Consultants, Inc.

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,

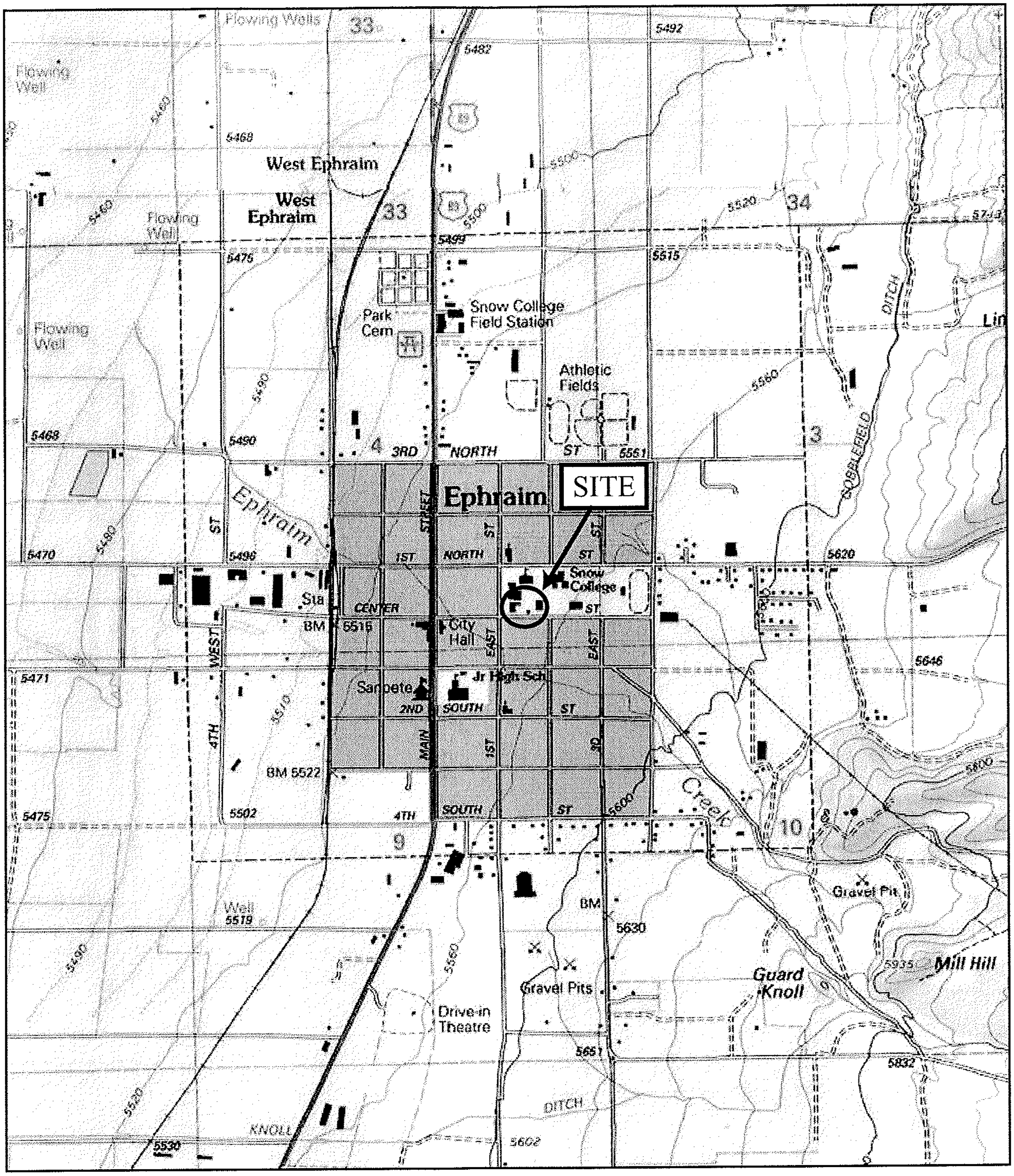
GSH Geotechnical Consultants, Inc.	Reviewed by:
Michael S. Huber, State of Utah 343650	William J. Gordon, State of Utah No. 146417
Professional Engineer	Professional Engineer

MSH/WJG:jlh/sn

Encl.	Figure	1,	Vicinity Map
	Figure	2,	Site Plan
	Figures	3A	through 3H, Log of Borings (August 7, 2001 Study)
	Figures	4A	through 4G, Log of Borings (Current Study)
	Figure	5,	Unified Soil Classification System

Addressee (3 + email)
c: Mr. Cameron Empey (1 + email)
Reaveley Engineers + Associates
675 East 500 South, Suite 400
Salt Lake City, Utah 84102

COOPER ROBERTS SIMONSEN ASSOCIATES
JOB NO. 0661-001-07

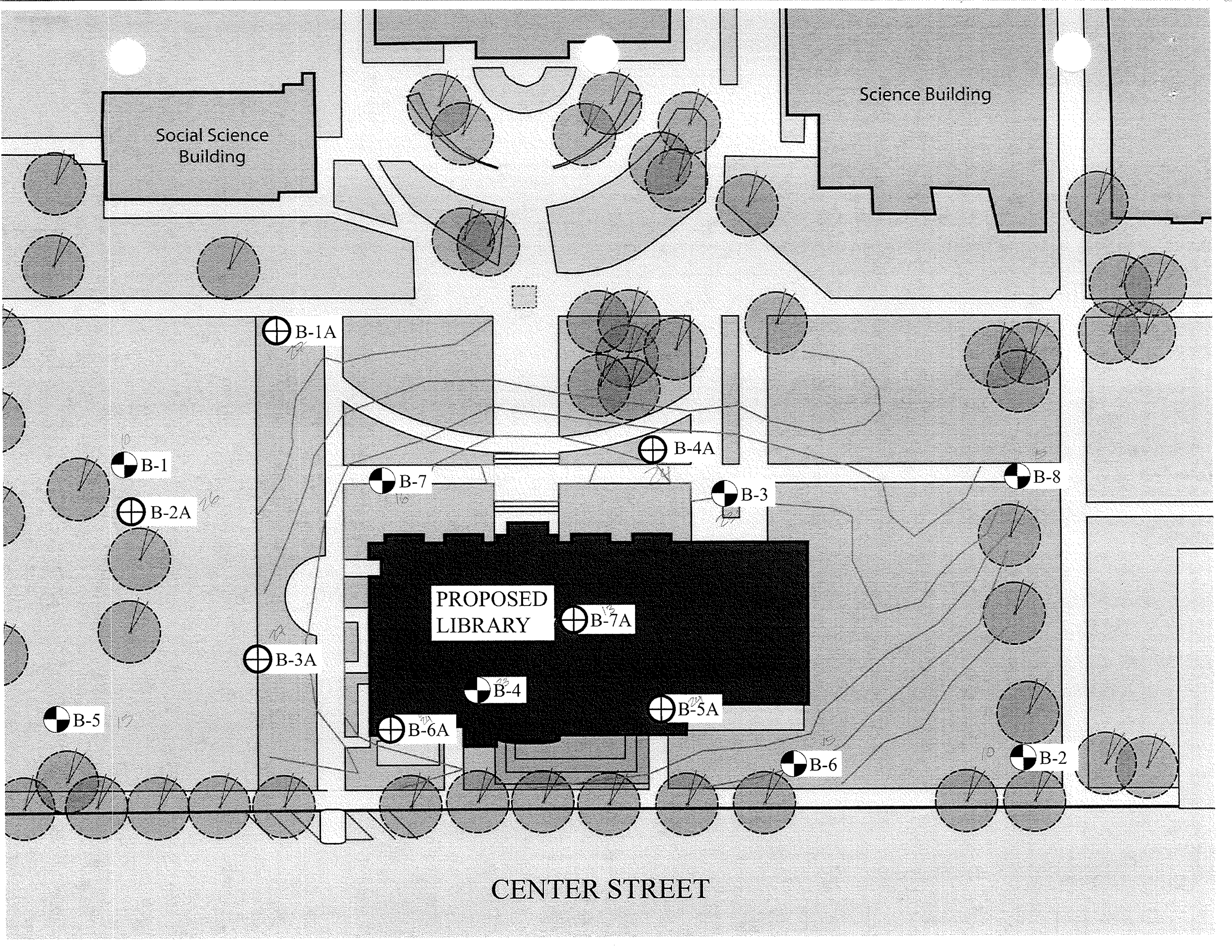


SCALE IN FEET
1000 0 1000 2000

FIGURE 1
VICINITY MAP

GSH
Gordon Spilker Huber
Geotechnical Consultants, Inc.

REFERENCE:
USGS 7.5 MINUTE TOPOGRAPHIC QUADRANGLE MAPS
TITLED "EPHRAIM, UTAH" AND "CHESTER, UTAH"
BOTH DATED 2001


Social Science Building
Science Building
B-1A
B-4A
B-1
B-7
B-8
B-2A
B-3
PROPOSED LIBRARY
B-7A
B-3A
B-4
B-5A
B-5
B-6A
B-6
B-2
CENTER STREET

PROJECT: Performing Arts Center/Classrooms Building, Snow College Campus, Ephraim, Utah

LOG OF TEST BORING NO. B-1

JOB NO. 1-817-003579 DATE 06-21-01

RIG TYPE: CME 550
BORING TYPE: 3-3/4" ID Hollow-Stem Auger
SURFACE ELEV.:
DATUM:

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows/foot 140 lb. 30" free-fall drop hammer	Dry Density lbs. per cubic foot	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0										4" ASPHALT
								GP/GM/FILL		8" ROADBASE; fine to coarse sandy silt and gravel; brown; FILL
								ML/CL	moist medium stiff to stiff	ALTERNATING LAYERS TO 4" OF CLAYEY SILT, SILTY CLAY, AND FINE SANDY SILT; brown with trace black pockets
			X	D	11	97	20.3			
								CL	moist medium stiff	SILTY CLAY with some fine sand; brown with occasional clayey silt layers to 3"; trace fine root/pinholes
5			X	D	8	99	19.7			
10			X	D	27					grades without root/pinholes
								SM/GM	dry medium dense	SILTY FINE TO COARSE SAND AND FINE AND COARSE GRAVEL; brown
15			X	D	28					grades to alternating layers to 6" of silty fine to coarse sandy fine gravel and silty fine to medium sand
20			X	D	23				very moist loose	grades with frequent fine silty sand/silty fine sand layers to 4"
								CL/ML	very moist	ALTERNATING LAYERS TO 6" OF SILTY CLAY, CLAYEY SILT,
25										

GROUNDWATER

DEPTH	HOUR	DATE
	*	

SAMPLE TYPE

A - Auger cuttings
S - 2" O.D. 1.38" I.D. tube sample.
U - 3" O.D. 2.42" I.D. tube sample.
T - 3" O.D. thin-walled Shelby tube.
D - 3 1/4" O.D. 2.42" I.D. tube sample.
C - California Split Spoon Sample

FIGURE 3A

amec

PROJECT Performing Arts Center/Classrooms Building
Snow College Campus, Ephraim, Utah

LOG OF TEST BORING NO. B-1

JOB NO. 1-817-003579 DATE 06-21-01

RIG TYPE CME 550
BORING TYPE 3-3/4" ID Hollow-Stem Auger
SURFACE ELEV.
DATUM

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows/foot 140 lb. 30" free-fall drop hammer	Dry Density lbs. per cubic foot	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
25				D	10					AND FINE SANDY SILT; brown
								GM	very moist very dense	SILTY AND FINE TO COARSE SANDY FINE AND COARSE GRAVEL; brown
30				D	135					
										grades with occasional cobble
35				D	139					
40				D	150					
										Stopped drilling at 40.0'. Stopped sampling at 41.5'. * Groundwater not encountered. Installed 1 1/4" diameter slotted PVC pipe to 40.0'. The discussion in the text under the section titled, SUBSURFACE CONDITIONS, is necessary to a proper understanding of the nature of the subsurface materials.
45										
50										

GROUNDWATER

DEPTH	HOUR	DATE
	*	

SAMPLE TYPE

A - Auger cuttings
S - 2" O.D. 1.38" I.D. tube sample.
U - 3" O.D. 2.42" I.D. tube sample.
T - 3" O.D. thin-walled Shelby tube.
D - 3 1/4" O.D. 2.42" I.D. tube sample.
C - California Split Spoon Sample

FIGURE 3A
(con't)

amec

PROJECT Performing Arts Center/Classrooms Building
Snow College Campus, Ephraim, Utah

LOG OF TEST BORING NO. B-2

JOB NO. 1-817-003579 DATE 06-21-01

RIG TYPE CME 550
BORING TYPE 3-3/4" ID Hollow-Stem Auger
SURFACE ELEV.
DATUM

Depth in Feet	Sample Type	Blows/foot 140 lb. 30" free-fall drop hammer	Dry Density lbs. per cubic foot	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0					ML	moist "loose"/ "medium dense"	**FINE TO MEDIUM SANDY AND CLAYEY SILT**; major roots (topsoil) to 4"; dark brown
	D	6	91	22.8	CL	moist medium dense	**SILTY CLAY** with some fine sand and trace fine gravel; trace pinholes/rootholes; brown
5	D	10			ML	moist medium dense/loose	**ALTERNATING LAYERS TO 1" OF CLAYEY SILT AND FINE SANDY SILT**; brown grades with occasional silty clay layers
10	D	17					
					SM/SP	slightly moist loose	**FINE TO MEDIUM SAND** with sandy silt; brown
					GM/SM	"medium dense"	**SILTY FINE TO COARSE SAND AND FINE GRAVEL**; brown
					CL/ML	moist stiff	**ALTERNATING LAYERS TO 6" SILTY CLAY AND CLAYEY SILT** with occasional fine sandy silt, silty fine to coarse sand, silty fine and coarse gravel, and silty clay layers to 1"; brown
15	D	19	103	19.5			
20	D	14	107	21.4			grades to alternating layers to 6" of silty clay, clayey silt with some fine sand and fine sandy silt; brown
25							

GROUNDWATER

	DEPTH	HOUR	DATE
▽		*	
▼			

SAMPLE TYPE

A - Auger cuttings
S - 2" O.D. 1.38" I.D. tube sample.
U - 3" O.D. 2.42" I.D. tube sample.
T - 3" O.D. thin-walled Shelby tube.
D - 3 1/4" O.D. 2.42" I.D. tube sample.
C - California Split Spoon Sample

FIGURE 3B

amec

LOG OF TEST BORING NO. B-2

PROJECT Performing Arts Center/Classrooms Building
Snow College Campus, Ephraim, Utah

JOB NO. 1-817-003579 DATE 06-21-01

RIG TYPE CME 550
BORING TYPE 3-3/4" ID Hollow-Stem Auger
SURFACE ELEV.
DATUM

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows/foot 140 lb. 30" free-fall drop hammer	Dry Density lbs. per cubic foot	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
25			X	D	92			GM	very dense	SILTY AND FINE TO COARSE SANDY FINE AND COARSE GRAVEL; brown
30			X	D	153					
35			X	D	88					
										Stopped drilling at 35.0'.
										Stopped sampling at 36.5'.
										* Groundwater not encountered.
40										
45										The discussion in the text under the section titled, SUBSURFACE CONDITIONS, is necessary to a proper understanding of the nature of the subsurface materials.
50										

GROUNDWATER

	DEPTH	HOUR	DATE
∇		*	
▼			

SAMPLE TYPE

A - Auger cuttings
S - 2" O.D. 1.38" I.D. tube sample.
U - 3" O.D. 2.42" I.D. tube sample.
T - 3" O.D. thin-walled Shelby tube.
D - 3 1/4" O.D. 2.42" I.D. tube sample.
C - California Split Spoon Sample

FIGURE 3B (con't)

amec

PROJECT Performing Arts Center/Classrooms Building
Snow College Campus, Ephraim, Utah

JOB NO. 1-817-003579 DATE 06-21-01

LOG OF TEST BORING NO. B-3

RIG TYPE CME 550
BORING TYPE 3-3/4" ID Hollow-Stem Auger
SURFACE ELEV.
DATUM

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows/foot 140 lb. 30" free-fall drop hammer	Dry Density lbs. per cubic foot	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0								CL FILL	dry "medium stiff" to "stiff"	SILTY CLAY; major roots (topsoil) to 4"; dark brown; FILL grades with some fine and coarse gravel
			X	D	12					
			X					CL/ ML	moist to very moist stiff	FINE TO MEDIUM SANDY CLAY AND CLAYEY SILT; trace rootholes/pinholes; gray
			X	D	7	82	21.0	ML/ CL	moist medium stiff/ loose	ALTERNATING LAYERS TO 6" OF FINE SANDY SILT, SILTY CLAY, AND CLAYEY SILT
5										
			X	D	11	101	22.8			
10										
								ML/ SM	slightly moist to moist loose	ALTERNATING LAYERS TO 8" SILTY FINE TO MEDIUM SAND AND FINE SANDY SILT with occasional silty clay layers to 5"
			X	D	12					
15										
										grades with occasional layers containing some fine gravel
			X	D	48					
20										
								GM	slightly moist very dense	SILTY FINE TO COARSE SANDY FINE AND COARSE GRAVEL; brown
			X	D	152					
25										

GROUNDWATER

	DEPTH	HOUR	DATE
▽		*	
▼			

SAMPLE TYPE

A - Auger cuttings
S - 2" O.D. 1.38" I.D. tube sample.
U - 3" O.D. 2.42" I.D. tube sample.
T - 3" O.D. thin-walled Shelby tube.
D - 3 1/4" O.D. 2.42" I.D. tube sample.
C - California Split Spoon Sample

FIGURE 3C

amec

LOG OF TEST BORING NO. B-3

PROJECT Performing Arts Center/Classrooms Building
Snow College Campus, Ephraim, Utah

JOB NO. 1-817-003579 DATE 06-21-01

RIG TYPE CME 550
BORING TYPE 3-3/4" ID Hollow-Stem Auger
SURFACE ELEV.
DATUM

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows/foot 140 lb. 30" free-fall drop hammer	Dry Density lbs. per cubic foot	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
25										
										Stopped drilling at 24.0'. Stopped sampling at 25.5'. * Groundwater not encountered.
30										
35										
40										
45										The discussion in the text under the section titled, SUBSURFACE CONDITIONS, is necessary to a proper understanding of the nature of the subsurface materials.
50										

GROUNDWATER

	DEPTH	HOUR	DATE
▽		*	
▼			

SAMPLE TYPE

A - Auger cuttings
S - 2" O.D. 1.38" I.D. tube sample.
U - 3" O.D. 2.42" I.D. tube sample.
T - 3" O.D. thin-walled Shelby tube.
D - 3 1/4" O.D. 2.42" I.D. tube sample.
C - California Split Spoon Sample

FIGURE 3C
(con't)

amec

LOG OF TEST BORING NO. B-4

PROJECT: Performing Arts Center/Classrooms Building, Snow College Campus, Ephraim, Utah

JOB NO. 1-817-003579 DATE 06-21-01

RIG TYPE: CME 550
BORING TYPE: 3-3/4" ID Hollow-Stem Auger
SURFACE ELEV.:
DATUM:

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows/foot, 140 lb. 30" free-fall drop hammer	Dry Density lbs. per cubic foot	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0								ML/ CL FILL	dry "medium stiff"	FINE TO MEDIUM SANDY CLAY AND SILT; major roots (topsoil) to 4"; brown; FILL
			X	D	11			ML/ SM/ CL	slightly moist medium stiff/ loose	ALTERNATING POCKETS AND LAYERS TO 2" OF FINE SANDY SILT, SILTY FINE SAND, CLAYEY SILT, AND SILTY CLAY; brown to red-brown; FILL
5			X	D	17	85	13.7	CL/ ML	dry stiff	SILTY CLAY/CLAYEY SILT with some fine sand; trace to some pinholes/rootholes; light brown
10			X	D	18					
15			X	D	21	92	13.8		slightly moist	grades with frequent silty clay layers to 5"; trace to some rootholes/pinholes
20			X	D	17	92	8.9			grades with trace pinholes and with frequent fine silty sand and silty fine sand layers to 3"
								GM/ ML	slightly moist medium dense	ALTERNATING LAYERS TO 12" OF SILTY FINE TO COARSE SAND, FINE AND COARSE GRAVEL, AND FINE TO
25										

GROUNDWATER

	DEPTH	HOUR	DATE
∇		*	
▼			

SAMPLE TYPE

A - Auger cuttings
S - 2" O.D. 1.38" I.D. tube sample.
U - 3" O.D. 2.42" I.D. tube sample.
T - 3" O.D. thin-walled Shelby tube.
D - 3 1/4" O.D. 2.42" I.D. tube sample.
C - California Split Spoon Sample

FIGURE 3D

amec

LOG OF TEST BORING NO. B-4

PROJECT: Performing Arts Center/Classrooms Building, Snow College Campus, Ephraim, Utah

JOB NO. 1-817-003579 DATE 06-21-01

RIG TYPE: CME 550
BORING TYPE: 3-3/4" ID Hollow-Stem Auger
SURFACE ELEV.:
DATUM:

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows/foot 140 lb. 30" free-fall drop hammer	Dry Density lbs. per cubic foot	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
25				D	25					MEDIUM SANDY AND CLAYEY SILT; brown
								GM	slightly moist to moist very dense	SILTY FINE TO COARSE SANDY FINE AND COARSE GRAVEL; brown
30				D	170					
										Stopped drilling at 30.0'. Stopped sampling at 31.5'.
35										
40										
45										The discussion in the text under the section titled, SUBSURFACE CONDITIONS, is necessary to a proper understanding of the nature of the subsurface materials.
50										

GROUNDWATER

DEPTH	HOUR	DATE
	*	

SAMPLE TYPE

A - Auger cuttings
S - 2" O.D. 1.38" I.D. tube sample.
U - 3" O.D. 2.42" I.D. tube sample.
T - 3" O.D. thin-walled Shelby tube.
D - 3 1/4" O.D. 2.42" I.D. tube sample.
C - California Split Spoon Sample

FIGURE 3D (con't)

amec

PROJECT Performing Arts Center/Classrooms Building
Snow College Campus, Ephraim, Utah

LOG OF TEST BORING NO. B-5

JOB NO. 1-817-003579 DATE 06-22-01

RIG TYPE CME 550
BORING TYPE 3-3/4" ID Hollow-Stem Auger
SURFACE ELEV.
DATUM

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows/foot 140 lb. 30" free-fall drop hammer	Dry Density lbs. per cubic foot	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0								ML/ CL	very moist medium dense	ALTERNATING LAYERS TO 6" OF SILTY CLAY AND CLAYEY SILT with some fine sand; brown
			X	D	6					
5			X	D	7					
			X	D	3	104	24.1			grades with frequent fine sandy silt layers to 6"; trace pinholes/rootholes
10										
								CL/ ML/ SM	slightly moist medium stiff to stiff/loose	ALTERNATING LAYERS TO 6" OF SILTY CLAY, CLAYEY SILT, SILTY FINE SAND, AND FINE SANDY SILT; trace fine pinholes/rootholes; brown
			X	D	11					
15										Stopped drilling at 13.5'. Stopped sampling at 15.0'. * Groundwater not encountered.
20										
25										The discussion in the text under the section titled, SUBSURFACE CONDITIONS, is necessary to a proper understanding of the nature of the subsurface materials.

GROUNDWATER

DEPTH	HOUR	DATE
	*	

SAMPLE TYPE

A - Auger cuttings
S - 2" O.D. 1.38" I.D. tube sample.
U - 3" O.D. 2.42" I.D. tube sample.
T - 3" O.D. thin-walled Shelby tube.
D - 3 1/4" O.D. 2.42" I.D. tube sample.
C - California Split Spoon Sample

FIGURE 3E

amec

LOG OF TEST BORING NO. B-6

PROJECT: Performing Arts Center/Classrooms Building, Snow College Campus, Ephraim, Utah

JOB NO. 1-817-003579 DATE 06-22-01

RIG TYPE: CME 550
BORING TYPE: 3-3/4" ID Hollow-Stem Auger
SURFACE ELEV.:
DATUM:

Depth in Feet	Sample Type	Blows/foot 140 lb. 30" free-fall drop hammer	Dry Density lbs. per cubic foot	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0	D	9	96	21.5	CL FILL	moist medium stiff	**FINE AND COARSE GRAVELLY CLAY** with some fine to coarse sand; major roots (topsoil) to 4"; brown; FILL grades without gravel
	D	19	91	16.0	CL/ML	slightly moist stiff	**ALTERNATING LAYERS TO 4" OF SILTY CLAY WITH TRACE SAND AND CLAYEY SILT WITH SOME SAND**; trace to some rootholes/pinholes with occasional fine sandy silt layers to 1"; brown
5	D	pushed					grades with alternating layers of fine sandy silt, silty clay, and clayey silt with trace fine pinholes
	D	9	99	15.9		medium stiff	grades without pinholes
10							
	D	9				very moist	
15							Stopped drilling at 14.0'. Stopped sampling at 15.5'. * Groundwater not encountered.
20							
25							The discussion in the text under the section titled, SUBSURFACE CONDITIONS, is necessary to a proper understanding of the nature of the subsurface materials.

GROUNDWATER

	DEPTH	HOUR	DATE
∇		*	
▼			

SAMPLE TYPE

A - Auger cuttings
S - 2" O.D. 1.38" I.D. tube sample.
U - 3" O.D. 2.42" I.D. tube sample.
T - 3" O.D. thin-walled Shelby tube.
D - 3 1/4" O.D. 2.42" I.D. tube sample.
C - California Split Spoon Sample

FIGURE 3F

amec

PROJECT Performing Arts Center/Classrooms Building
Snow College Campus, Ephraim, Utah

LOG OF TEST BORING NO. B-7

JOB NO. 1-817-003579 DATE 06-22-01

RIG TYPE CME 550
BORING TYPE 3-3/4" ID Hollow-Stem Auger
SURFACE ELEV.
DATUM

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows/foot 140 lb. 30" free-fall drop hammer	Dry Density lbs. per cubic foot	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0								CL FILL	moist "soft" to "medium stiff"	SILTY CLAY with some fine to medium sand; major roots (topsoil) to 4"; brown; FILL
			X	D	14			CL/ ML FILL	moist stiff	ALTERNATING LAYERS TO 3" OF SILTY CLAY, CLAYEY SILT, AND FINE TO COARSE SANDY SILT with some fine and coarse gravel; brown; FILL
5			X	D	11	100	22.3	CL	very moist medium stiff to stiff	SILTY CLAY with numerous clayey silt and fine sandy silt layers to 1"; brown
10			X	D	12					
15			X	D	34					
			X					SM/ GC	very moist medium dense	ALTERNATING LAYERS TO 12" OF SILTY FINE TO MEDIUM SAND AND CLAYEY AND FINE TO COARSE SANDY FINE AND COARSE GRAVEL; brown
20										Stopped drilling at 15.0'. Stopped sampling at 16.5'. * Groundwater not encountered. The discussion in the text under the section titled, SUBSURFACE CONDITIONS, is necessary to a proper understanding of the nature of the subsurface materials.
25										

GROUNDWATER

	DEPTH	HOUR	DATE
▽		*	
▼			

SAMPLE TYPE

A - Auger cuttings
S - 2" O.D. 1.38" I.D. tube sample.
U - 3" O.D. 2.42" I.D. tube sample.
T - 3" O.D. thin-walled Shelby tube.
D - 3 1/4" O.D. 2.42" I.D. tube sample.
C - California Split Spoon Sample

FIGURE 3G

amec

PROJECT: Performing Arts Center/Classrooms Building, Snow College Campus, Ephraim, Utah

LOG OF TEST BORING NO. B-8

JOB NO. 1-817-003579 DATE 06-22-01

RIG TYPE: CME 550
BORING TYPE: 3-3/4" ID Hollow-Stem Auger
SURFACE ELEV.:
DATUM:

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows/foot 140 lb. 30" free-fall drop hammer	Dry Density lbs. per cubic foot	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0								CL/ML FILL	dry medium stiff to stiff	FINE TO COARSE SANDY AND GRAVELLY CLAY AND SILT; major roots (topsoil) to 4"; dark brown; FILL
			X	D	25					
								CL	moist stiff	SILTY CLAY with some fine sand; brown
			X	D		97	24.0			
5										grades with frequent clayey silt and fine sandy silt layers to 1"; trace fine pinholes; brown
								CL/ML/SM	moist stiff/loose	ALTERNATING LAYERS TO 4" OF SILTY CLAY, CLAYEY SILT, AND SILTY FINE SAND; brown
			X	D	11	97	21.3			
10										
			X	D	16					
15										Stopped drilling at 13.5'. Stopped sampling at 15.0'. * Groundwater not encountered.
20										
25										The discussion in the text under the section titled, SUBSURFACE CONDITIONS, is necessary to a proper understanding of the nature of the subsurface materials.

GROUNDWATER

	DEPTH	HOUR	DATE
▽		*	
▼			

SAMPLE TYPE

A - Auger cuttings
S - 2" O.D. 1.38" I.D. tube sample.
U - 3" O.D. 2.42" I.D. tube sample.
T - 3" O.D. thin-walled Shelby tube.
D - 3 1/4" O.D. 2.42" I.D. tube sample.
C - California Split Spoon Sample

FIGURE 3H

amec

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

Project Name: Proposed Snow College Library
Location: 151 East Center Street, Ephraim, Utah
Drilling Method: 3-3/4" ID Hollow-Stem Auger
Elevation: Overall Site Approximately 5550' +/-
Remarks:

Project No.: 0661-001-07
Client: Cooper Roberts Simonsen Associates
Date Drilled: 11-19-07
Water Level: No groundwater encountered (11-19-07)

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								loose to 5" moist very stiff
		SILTY CLAY, FILL with some fine sand and trace fine gravel; major roots (topsoil) to 3"; brown (CL-FILL)		24							
		SILTY SAND, FILL with some fine gravel; fine sand; brown, FILL (SM)	5	22							moist loose
		At approximately 7.5' to 8.5' drilled through something very hard, possibly concrete, possibly foundation of old building and again at 9.5' to 10.0'									
			10	18							slightly moist
		SILTY CLAY with trace fine sand and seams of fine sand; brown with oxidation mottling (CL)									slightly moist to moist stiff
			15	22		15.9		108			
		ALTERNATING LAYERS UP TO 4" THICK OF SILTY FINE SAND, FINE SANDY SILT, AND SILTY CLAY grading with occasional coarse sand and fine gravel; brown (CL/ML/SM)									moist stiff
			20	13							
											moist stiff
			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.

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

Project Name: Proposed Snow College Library
Project No.: 0661-001-07
Location: 151 East Center Street, Ephraim, Utah
Client: Cooper Roberts Simonsen Associates
Drilling Method: 3-3/4" ID Hollow-Stem Auger
Date Drilled: 11-19-07
Elevation: Overall Site Approximately 5550' +/-
Water Level: No groundwater encountered (11-19-07)
Remarks:

Graphical Log	Water Level	DESCRIPTION	DEPTH FT.	BLOWS/FT	SAMPLE SYMBOL	MOISTURE (%)	% PASSING 200	DRY DENSITY (PCF)	Liquid Limit (%)	Plastic Limit (%)	REMARKS
		SILTY CLAY with numerous silty fine sand layers up to 2" thick and fine sandy silt; brown (CL)		15							
		SILTY GRAVEL with some fine to coarse sand; fine and coarse gravel; brown (GM)	30	100 1"							moist very dense
		Stopped drilling at 30.0'. Stopped sampling at 31.5'. No groundwater encountered at time of drilling.	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 4A (con't)

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

Project Name: Proposed Snow College Library
Location: 151 East Center Street, Ephraim, Utah
Drilling Method: 3-3/4" ID Hollow-Stem Auger
Elevation: Overall Site Approximately 5550' +/-
Remarks:

Project No.: 0661-001-07
Client: Cooper Roberts Simonsen Associates
Date Drilled: 11-19-07
Water Level: No groundwater encountered (11-19-07)

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, FILL with some fine sand; major roots (topsoil) to 2"- 3"; brown (CL-FILL)									loose to 4" moist medium stiff
		SITLY CLAY with trace fine sand; brown (CL)		13							moist stiff
			5								
		grades with numerous layers up to 6" thick of clayey silt		12		21.7		101			
			10								
		SANDY SILT with occasional layers to 1" thick of silty clay; brown with oxidation mottling in clay (ML)		10		21.9	72.5				moist loose
		SILTY CLAY with trace fine sand; brown (CL)	15	18							moist stiff
		ALTERNATING LAYERS UP TO 4" THICK OF SILTY FINE SAND, FINE SANDY SILT, CLAYEY SILT, AND SILTY CLAY; brown (SL/SM/ML)	20	13							moist stiff
			25								moist

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

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

Project Name: Proposed Snow College Library
Location: 151 East Center Street, Ephraim, Utah
Drilling Method: 3-3/4" ID Hollow-Stem Auger
Elevation: Overall Site Approximately 5550' +/-
Remarks:

Project No.: 0661-001-07
Client: Cooper Roberts Simonsen Associates
Date Drilled: 11-19-07
Water Level: No groundwater encountered (11-19-07)

Graphical Log	Water Level	DESCRIPTION	DEPTH FT.	BLOWS/FT	SAMPLE SYMBOL	MOISTURE (%)	% PASSING 200	DRY DENSITY (PCF)	Liquid Limit (%)	Plastic Limit (%)	REMARKS
		SILTY CLAY with numerous silty fine sand and fine sandy silt layers to 2" thick; brown (CL)		39							moist
		SILTY GRAVEL with some fine to coarse sand; fine and coarse gravel; brown (GM)	30	100 5"							very dense
		Stopped drilling at 30.0' Stopped sampling at 31.5'. Installed 1-1/4" diameter slotted PVC pipe to 31.0'. No groundwater encountered at time of drilling.	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.

BOREHOLE B-3A

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

Project Name: Proposed Snow College Library
Location: 151 East Center Street, Ephraim, Utah
Drilling Method: 3-3/4" ID Hollow-Stem Auger
Elevation: Overall Site Approximately 5550' +/-
Remarks:

Project No.: 0661-001-07
Client: Cooper Roberts Simonsen Associates
Date Drilled: 11-19-07
Water Level: No groundwater encountered (11-19-07)

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, FILL with trace fine gravel and fine to coarse sand; major roots (topsoil) to 2"-3"; brown with black mottling (CL-FILL)									loose to 5" moist stiff
				15							
		SITLY CLAY with some fine sand; brown (CL)	5								moist stiff
				14		21.0		101			
		grades with occasional layers to 4" thick of silty fine sand, clayey sand, and clayey silt; brown	10	14		22.7		99			
		grades without layers except occasional silty sand seams	15	11							
		ALTERNATING LAYERS UP TO 4" THICK OF SILTY FINE SAND, FINE SANDY SILT, AND CLAYEY SILT; brown (ML/SM)									moist loose
			20	16							
		SILTY CLAY with numerous fine sandy silt and silty fine sand layers up to 2" thick; brown (CL)									mosit stiff
			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 4C

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

Project Name: Proposed Snow College Library
Location: 151 East Center Street, Ephraim, Utah
Drilling Method: 3-3/4" ID Hollow-Stem Auger
Elevation: Overall Site Approximately 5550' +/-
Remarks:

Project No.: 0661-001-07
Client: Cooper Roberts Simonsen Associates
Date Drilled: 11-19-07
Water Level: No groundwater encountered (11-19-07)

Graphical Log	Water Level	DESCRIPTION	DEPTH FT.	BLOWS/FT	SAMPLE SYMBOL	MOISTURE (%)	% PASSING 200	DRY DENSITY (PCF)	Liquid Limit (%)	Plastic Limit (%)	REMARKS
				14							
		GRAVEL with some silt and fine to coarse sand; fine and coarse gravel; brown (GM/GP)		114		3.6	7.9				moist very dense
		Stopped drilling at 27.5'. Stopped sampling at 29.0'. No groundwater encountered at time of drilling.	30								
			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 4C
(con't)

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

Project Name: Proposed Snow College Library
Location: 151 East Center Street, Ephraim, Utah
Drilling Method: 3-3/4" ID Hollow-Stem Auger
Elevation: Overall Site Approximately 5550' +/-
Remarks:

Project No.: 0661-001-07
Client: Cooper Roberts Simonsen Associates
Date Drilled: 11-26-07
Water Level: No groundwater encountered (11-26-07)

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, FILL with trace fine sand; brown (CL-FILL)									slightly moist to moist medium stiff
		SITLY CLAY with some fine sand; brown (CL)		7		12.5		93			moist medium stiff
		ALTERNATING LAYERS UP TO 4" THICK OF CLAYEY SILT, SILTY CLAY, FINE SANDY SILT, AND SANDY CLAY; brown (ML/CL)	5	7							moist medium stiff
		ALTERNATING LAYERS P TO 6" THICK OF SILTY CLAY, CLAYEY SILT, FINE SANDY SILT, SILTY FINE TO MEDIUM SAND, AND CLAYEY FINE SAND; brown (CL/SM/ML)	10	10							moist medium stiff
		grades with occasional layers up to 1" thick of silty fine to medium sand and clayey fine sand									
		grades with occasional layers with some fine gravel									
			15	25							very stiff
			20	18							stiff
		grades without fine gravel layers									
		SILTY GRAVEL with some fine to coarse sand; fine and coarse gravel; brown (GM)		100 5"							moist very dense no recovery
			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 4D

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

Project Name: Proposed Snow College Library
Location: 151 East Center Street, Ephraim, Utah
Drilling Method: 3-3/4" ID Hollow-Stem Auger
Elevation: Overall Site Approximately 5550' +/-
Remarks:

Project No.: 0661-001-07
Client: Cooper Roberts Simonsen Associates
Date Drilled: 11-26-07
Water Level: No groundwater encountered (11-26-07)

Graphical Log	Water Level	DESCRIPTION	DEPTH FT.	BLOWS/FT	SAMPLE SYMBOL	MOISTURE (%)	% PASSING 200	DRY DENSITY (PCF)	Liquid Limit (%)	Plastic Limit (%)	REMARKS
		Stopped drilling at 24.5'. Stopped sampling at 25.0'. Installed 1-1/4" diameter slotted PVC pipe to 25.0'. No groundwater encountered at time of drilling.	30								
			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 4D (con't)

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

Project Name: Proposed Snow College Library
Location: 151 East Center Street, Ephraim, Utah
Drilling Method: 3-3/4" ID Hollow-Stem Auger
Elevation: Overall Site Approximately 5550' +/-
Remarks:

Project No.: 0661-001-07
Client: Cooper Roberts Simonsen Associates
Date Drilled: 11-26-07
Water Level: No groundwater encountered (11-26-07)

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, FILL with trace fine sand and some to trace fine gravel brown (CL-FILL)									moist very stiff
				36	X						
		SITLY CLAY with trace fine sand and numerous layers up to 1/16" thick of clayey silt; brown (CL)									moist very stiff
			5	24	X						
		grades without layers of silt and with trace fine pinholes/rootholes	10	35	X	9.3		96			
		SILTY CLAY with trace fne sand; slight blocky structure; moderately high plasticity; grayish-brown (CL/CH)									moist hard
			15	79	X	11.2		113			
		SILTY CLAY with numerous layers up to 1/2" thick of silty fine sand and fine sandy silt; brown (CL)									slightly moist to dry very stiff
			20	55	X						
											moist medium dense
			25		X						

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 4E

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

Project Name: Proposed Snow College Library
Location: 151 East Center Street, Ephraim, Utah
Drilling Method: 3-3/4" ID Hollow-Stem Auger
Elevation: Overall Site Approximately 5550' +/-
Remarks:

Project No.: 0661-001-07
Client: Cooper Roberts Simonsen Associates
Date Drilled: 11-26-07
Water Level: No groundwater encountered (11-26-07)

Graphical Log	Water Level	DESCRIPTION	DEPTH FT.	BLOWS/FT	SAMPLE SYMBOL	MOISTURE (%)	% PASSING 200	DRY DENSITY (PCF)	Liquid Limit (%)	Plastic Limit (%)	REMARKS
		SILTY GRAVEL with occasional layers up to 4" thick of silty clay; some fine to coarse sand; fine gravel; brown (GM)		68							
		Stopped drilling at 24.5'.									
		Stopped sampling at 26.0'.									
		No groundwater encountered at time of drilling.									
			30								
			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 4E (con't)

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

Project Name: Proposed Snow College Library
Location: 151 East Center Street, Ephraim, Utah
Drilling Method: 3-3/4" ID Hollow-Stem Auger
Elevation: Overall Site Approximately 5550' +/-
Remarks:

Project No.: 0661-001-07
Client: Cooper Roberts Simonsen Associates
Date Drilled: 11-26-07
Water Level: No groundwater encountered (11-26-07)

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 GRAVEL, FILL with some fine sand; fine to coarse gravel brown, FILL (GM)									
		grades with coal									
			5	10							moist medium stiff
		SITLY CLAY with trace fine sand; brown (CL)									
		grades with medium plasticity	10	38		18.4		113			very stiff
			15	57							slightly moist very stiff
		grades with numerous layers up to 1" of silty fine sand	20	57							
			25	100 3"							

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 4F

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

Project Name: Proposed Snow College Library
Location: 151 East Center Street, Ephraim, Utah
Drilling Method: 3-3/4" ID Hollow-Stem Auger
Elevation: Overall Site Approximately 5550' +/-
Remarks:

Project No.: 0661-001-07
Client: Cooper Roberts Simonsen Associates
Date Drilled: 11-26-07
Water Level: No groundwater encountered (11-26-07)

Graphical Log	Water Level	DESCRIPTION	DEPTH FT.	BLOWS/FT	SAMPLE SYMBOL	MOISTURE (%)	% PASSING 200	DRY DENSITY (PCF)	Liquid Limit (%)	Plastic Limit (%)	REMARKS
		SILTY GRAVEL with some fine to coarse sand; fine and coarse gravel; brown (GM)									
		Stopped drilling at 24.5'. Stopped sampling at 25.0'. No groundwater encountered at time of drilling.	30								
			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 4F
(con't)

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

Project Name: Proposed Snow College Library
Location: 151 East Center Street, Ephraim, Utah
Drilling Method: 3-3/4" ID Hollow-Stem Auger
Elevation: Overall Site Approximately 5550' +/-
Remarks:

Project No.: 0661-001-07
Client: Cooper Roberts Simonsen Associates
Date Drilled: 11-26-07
Water Level: No groundwater encountered (11-26-07)

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, FILL with some fine gravel; some fine sand; brown (CL-FILL)									moist medium stiff
		SITLY CLAY with trace fine sand; brown (CL)		12							moist stiff
			5	11		18.9		103			
			10	12							
		SILTY SAND/SANDY SILT with numerous silty sand, sandy silt and clayey silt layers to 1" thick; fine sand; brown with oxidation mottling (SM/ML)									moist loose
			15	13		7.3	43.2				
		Stopped drilling at 14.5'. Stopped sampling at 16.0'. No groundwater encountered at time of drilling.	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 4G

UNIFIED SOIL CLASSIFICATION SYSTEM

FIELD IDENTIFICATION PROCEDURES							GRAPH SYMBOL	LETTER SYMBOL ‡	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS More than half of material is larger than No. 200 sieve size. ‡‡ (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.
	IDENTIFICATION PROCEDURES ON FRACTION SMALLER THAN No. 40 SIEVE SIZE								
				DRY STRENGTH (CRUSHING CHARACTERISTICS)	DILATANCY (REACTION TO SHAKING)	TOUGHNESS (CONSISTENCY NEAR PLASTIC LIMIT)			
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)	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.

‡ 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.
‡‡ 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
- Standard Penetration Split Spoon Sampler
- Rock Core
- Water Level
- Thin Wall
- No Recovery
- 3-3/4" ID D&M Sampler
- 3" ID D&M Sampler
- California Sampler

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 5

GSH
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