GSH

REPORT
GEOTECHNICAL STUDY
PROPOSED VETERANS AFFAIRS HOSPITAL CENTER EXPANSION
500 SOUTH FOOTHILL BOULEVARD
SALT LAKE CITY, UTAH

Submitted To:

EFT Architects, Inc.
265 East 100 South, Suite 350
Salt Lake City, Utah 84111

Submitted By:

GSH Geotechnical, Inc.
473 West 4800 South
Salt Lake City, Utah 84123

September 7, 2012

Job No. 0461-015-12

GSH

September 7, 2012
Job No. 0461-015-12

EFT Architects, Inc.
265 East 100 South, Suite 350
Salt Lake City, Utah 84111

Attention: Mr. Eric Tholen, AIA, LEED

Gentlemen:

Re: Report
Geotechnical Study
Proposed Veterans Affairs Hospital
Center Expansion
500 South Foothill Boulevard
Salt Lake City, Utah

1. INTRODUCTION

1.1 GENERAL

This report presents the results of our geotechnical study performed at the site of the proposed Veterans Affairs Hospital Center expansion located at 500 South Foothill Boulevard in Salt Lake City, Utah. The general location of the site with respect to major topographic features and existing facilities, as of 1998 and 1999, is presented on Figure 1, Vicinity Map. A more detailed layout of the site showing the site with existing facilities and roadways is presented on Figure 2, Site Plan. The locations of the 7 borings drilled in conjunction with this study are also presented on Figure 2.

1.2 OBJECTIVES AND SCOPE

The objectives and scope of the study were planned in discussions between Mr. Eric Tholen of EFT Architects and Mr. Alan Spilker of GSH Geotechnical, Inc. (GSH).

In general, the objectives of this study were to:

1. Define and evaluate the subsurface soil and groundwater conditions across the site of the proposed medical center expansion.

GSH Geotechnical, Inc.
473 West 4800 South
Salt Lake City, Utah 84123
Tel: (801) 685-9190 Fax: (801) 685-2990
www.gshgeo.com

2. Provide appropriate foundation, earthwork, and geoseismic recommendations to be utilized in the design and construction of the proposed medical center expansion.

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

1. A field program consisting of the drilling, logging, and sampling of 7 exploration borings.

2. A laboratory testing program.

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

1.3 AUTHORIZATION

Authorization was provided by a signed copy of our Professional Services Agreement No. 12-0609 dated June 13, 2012.

1.4 PROFESSIONAL STATEMENTS

Supporting data upon which our recommendations are based are presented in subsequent sections of this report. Recommendations presented herein are governed by the physical properties of the soils encountered in the exploration borings, projected groundwater conditions, and the layout and design data discussed in Section 2, Proposed Construction, of this report. If subsurface conditions other than those described in this report are encountered and/or if design and layout changes are implemented, GSH must be informed so that our recommendations can be reviewed and amended, if necessary.

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

2. PROPOSED CONSTRUCTION

Preliminary plans for the proposed Veterans Hospital Medical Center expansion are unknown at this time. The expansion structure is projected to be constructed of reinforced concrete and steel-frame construction. The expansion will likely tie into the existing hospital building but it is anticipated that shared loading between the new expansion and existing structure will be minimal. Projected maximum real column and wall loads will be on the order of 300 to 800 kips and 4 to 8 kips per lineal foot, respectively. Floor slab loads are projected to range from 150 to 200 pounds per square foot. Real loads are defined as the total of all dead plus frequently applied (reduced) live loads.

With the existing elevated helicopter pad, maximum site grading cuts may be up to as much as 15 to 20 feet. Maximum site grading fills are anticipated to be less than 5 feet.

3. SITE INVESTIGATIONS

3.1 FIELD PROGRAM

In order to define and evaluate the subsurface soil and groundwater conditions in the area of the parking structure, 7 borings were drilled to depths ranging from 11.5 to 31.5 feet with a truck-mounted drill rig equipped with hollow-stem augers. The locations of the 7 borings drilled in conjunction with this study are presented on Figure 2. Auger refusal was encountered on dense soils/gravels/cobbles within some borings at depths between 11.5 and 26.0 feet below the surface.

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 representations of the subsurface conditions encountered are presented on Figures 3A through 3G, Log of Borings. Soils were classified in accordance with the nomenclature described on Figure 4, Key to Boring Log.

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

Following completion of drilling operations, one and one-quarter-inch diameter slotted PVC pipe was installed in Borings B-1, B-3, B-6, and B-7 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, consolidation, and chemical tests. The following paragraphs describe the tests and summarize the test data.

3.2.2 Moisture and Density Tests

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

3.2.3 Consolidation Tests

To provide data necessary for our settlement analyses, a consolidation test was performed on each of 5 representative samples of the fine-grained cohesive soils encountered in the exploration borings at the site. The results of these tests indicate that the natural, undisturbed clays are moderately to highly over-consolidated and will exhibit moderate compressibility characteristics when loaded above the consolidation pressure. Tests completed on existing clay fills encountered in the borings indicate slight/moderate over-consolidation. Detailed results of the tests are maintained within our files and can be transmitted to you, upon your request.

3.2.4 Chemical Tests

To provide data used in determining whether the site soils will react detrimentally with concrete, pH and water soluble sulfate tests were performed. The results of the tests are tabulated below:

Boring No.	Depth (feet)	Soil Classification	pH	Total Water Soluble Sulfate (mg/kg-dry)
B-1	5.5	CL	8.69	8.4

4. SITE CONDITIONS

4.1 SURFACE

The site encompasses an area including the existing helicopter pad, extending north up to the existing hospital building (Building No. 14), while extending west and east into an existing parking lot and roadway. A new multi-level parking structure is located to the northwest of the site.

The existing helicopter pad is raised roughly 15 feet above surrounding grades with a raised concrete walkway running east to the existing hospital. The overall site slopes downhill to the southwest.

4.2 SUBSURFACE SOIL AND GROUNDWATER

Borings B-2 through B-4 were completed across the elevated helicopter pad. Boring B-7 was completed to the north of the helicopter pad in an area that also appears to have been elevated. Borings B-1, B-5, and B-6 were completed at lower elevations within the existing parking lot and roadways.

The surface at each boring location was blanketed with asphalt concrete ranging in thickness from 2.5 to 5.0 inches over highly variable thicknesses of base course. Below the pavement, fills were encountered in Borings B-2 through B-7 ranging from 5 to 24 feet thick. These fills consist primarily of clays with varying silt, sand, and gravel content, and occasional clayey sands and gravels. Based on laboratory testing, blow counts, and observations, the fills are under-compacted and will exhibit variable and, in most cases, poor engineering characteristics for supporting building structures. Therefore, these fills will be considered as non-engineered.

Below the pavement section in Boring B-1 extending to a depth of 13.5 feet and below the fills in Borings B-2 and B-4 to B-7 extending to the full depth penetrated 11.5 to 26.0 feet, natural clay soils were encountered. These natural clay soils encountered contain varying amounts of sands and gravels and are stiff to very stiff, moist, brown, and moderately to highly over-consolidated.

From 13.5 feet to the full depth penetrated, 15.5 feet, in Boring B-1, and from 24.0 to 30.5 feet in Boring B-3, natural silty sand with some gravel and occasional sandy clay layers up to one inch thick was encountered. The natural silty sands are medium dense to very dense, moist, brown, and will exhibit high strength and low compressibility characteristics.

Auger refusal was encountered in dense soils/gravel/cobbles at Borings B-1 and B-4 through B-7 between depths of 11.5 and 26.0 feet. Auger refusal and non-engineered fill depths are shown on the boring logs, Figures 3 A through 3G, as well as depicted on Figure 2.

Groundwater/saturated soils were not encountered within the depths penetrated, 11.5 to 31.5 feet, at the time of drilling. Seasonal and longer-term groundwater fluctuations of 1 to 2 feet should be anticipated. The highest seasonal levels will generally occur during the late spring and summer months. Groundwater is not expected to affect construction of a slab-on-grade structure.

5. DISCUSSIONS AND RECOMMENDATIONS

5.1 SUMMARY OF FINDINGS

The results of our analysis indicate that the proposed structure can be supported upon conventional spread and continuous wall foundations established upon suitable natural soils and/or granular structural fill extending to suitable natural soils. More heavily loaded footings must be underlain by granular structural fill to control settlements.

The geotechnical aspect of the site that will most influence the design and construction of the proposed structure is the existing non-engineered fills, which range from 5 to 24 feet thick at the boring locations with the thicker fills associated with the existing helicopter pad extending northeast toward the existing hospital structure.

As previously indicated, these fills appear to be under-compacted and exhibit variable engineering characteristics. GSH recommends that non-engineered fills be removed below the building expansion. The existing fills may be re-used as structural site grading fills as long as they meet the requirements of such.

Where the non-engineered fills are significantly thick and should final design grading conflict with the large removal depths required, these fills may be left in place below the structure if deep foundations or in-situ ground modification methods are implemented. Due to the likelihood that the elevated helicopter pad will be removed, deep foundations and ground modification methods are not discussed in detail within this report. However, recommendations for such may be provided upon request.

Due to the presence of fills at the site, we recommend that a qualified geotechnical engineer observe the foundation excavations to identify that all non-engineered fills have been removed and that suitable soils have been encountered.

Detailed discussions pertaining to foundation, earthwork, and the geoseismic setting of the site are discussed in the following sections.

5.2 EARTHWORK

5.2.1 Site Preparation

Initial preparation of the site for major construction will include demolition of existing pavements, as well as abandonment or relocation of existing utilities running beneath the footprint of the proposed structure.

Further site preparation will consist of the stripping of all non-engineered fills, surface vegetation, topsoil, and other deleterious materials from beneath an area extending out at least 5 feet beyond the perimeter of the proposed building and settlement sensitive exterior flatwork.

Prior to the placement of structural site grading fill, pavements, floor slabs, or footings, the exposed natural subgrade should be proofrolled by running moderate-weight rubber tire-mounted construction equipment uniformly over the surface at least 3 times. 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, GSH must be notified to provide additional recommendations. In floor slab, outside flatwork, and pavement areas, unsuitable natural soils should be removed to a maximum depth of 2 feet and replaced with granular structural fill.

Existing fills may be re-utilized as structural site grading fill if they meet the requirements for such stated later in this report. However, 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 control moisture content and recompact these fine-grained soils/fills during wet and cold periods of the year.

Surface vegetation and other deleterious materials, where encountered, should generally be removed from the site. Topsoil, although unsuitable for utilization as structural fill, may be stockpiled for subsequent landscaping purposes.

5.2.2 Temporary Excavations

Shallow temporary construction excavations, not exceeding 4 feet in depth in cohesive (clay) soils, may be constructed with near vertical sideslopes. In clay soils, deeper excavations of up to 10 feet may be constructed with sideslopes no steeper than one-half horizontal to one vertical. In clay soils, temporary excavations of up to 20 feet may be constructed with sideslopes no steeper than three-quarters horizontal to one vertical. In silty sands and gravels, excavations of up to 20 feet may be constructed with sideslopes no steeper than one horizontal to one vertical. Excavations deeper 20 feet are not anticipated.

Cut slope considerations may change based on exposed soils, perched groundwater seepage, and/or equipment loading along the upper banks. All excavations must be observed periodically by qualified personnel. If any signs of instability or excessive sloughing are noted during or following excavation, 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 as replacement fill beneath some 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 and may consist of on-site or import soils provided they meet the requirements stated herein. The maximum particle size within structural site grading fill should generally not exceed 4 inches; although, occasional particles up to 6 to 8 inches may be incorporated provided that they do not result in "honeycombing" or preclude the obtainment of the desired degree of compaction. Fine-grained soils if utilized as structural site grading fill will require very close moisture control and may be very difficult, if not impossible, to control moisture content, properly place, and compact during wet and cold periods of the year.

Only granular soils are recommended in confined areas such as backfill around structures and within utility trenches. In confined areas, the maximum particle size should generally be restricted to 2.5 inches.

Structural replacement fill below footings must consist of granular soils. Generally, we recommend that all imported granular structural fill consist of a well-graded mixture of sands and gravels with no more than 18 percent fines (material 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 shall be placed in lifts not exceeding 8 inches in loose thickness. Structural fills shall be compacted in accordance with the percent of the maximum dry density as determined by the AASHTO[1] T-180 (ASTM[2] D-1557) compaction criteria in accordance with the table below:

Location	Total Fill Thickness (feet)	Minimum Percentage of Maximum Dry Density
Beneath an area extending at least 5 feet beyond the perimeter of the structure	0 to 10	95
Beneath an area extending at least 5 feet beyond the perimeter of the structure	10+	98*
Outside area defined above	0 to 5	90
Outside area defined above	5 +	95

* Must be compacted at optimum or above moisture content.

Structural fills greater than 15 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 5.2.1, Site Preparation, of this report. In confined areas, subgrade preparation shall consist of the removal of all loose or disturbed soils.

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

---

1 American Association of State Highway and Transportation Officials

2 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.) shall be placed at the same density requirements established for structural fill. If the surface of the backfill becomes disturbed during the course of construction, the backfill shall be proofrolled and/or properly compacted prior to the construction of any exterior flatwork over a backfilled trench. Proofrolling 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 proofrolling, they shall be removed to a maximum depth of 2 feet below design finish grade and replaced with structural fill.

Most utility companies and City-County governments are now requiring that Type A-1a or A-1b (AASHTO Designation – basically granular soils with limited fines) soils be used as backfill over utilities. These organizations are also requiring that in public roadways, the backfill over major utilities be compacted over the full depth of fill to at least 96 percent of the maximum dry density as determined by the AASHTO T-180 (ASTM D-1557) method of compaction.

The on-site fine-grained cohesive soils/fills are not recommended for use as trench backfill.

5.3 SPREAD AND CONTINUOUS WALL FOUNDATIONS

5.3.1 Design Data

The proposed 3-level structure may be supported upon conventional spread and continuous wall foundations established on suitable undisturbed natural soils and/or granular structural fill extending to suitable soils. Where final design may incorporate additional levels, a higher foundation loading range was also considered as outlined in Section 2, Proposed Construction. For highly loaded footings, varying thicknesses of replacement fills will be required, as presented in Section 5.3.3, Settlements.

Under no circumstances should the footings be established upon existing non-engineered fills. 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	- 18 inches
Minimum Recommended Width for Isolated Spread Footings	- 24 inches

Recommended Net Bearing Pressure for Real Load Conditions

Footing with Minimum Recommended Widths	- 3,000 pounds per square foot*
Footings with Minimum Widths of Four Feet or Greater and Underlain with a Minimum of 24 Inches of Granular Structural Replacement Fill	- 4,000 pounds per square foot*
Bearing Pressure Increase for Seismic Loading	- 50 percent

* See Section 5.3.3, Settlements, of this report for thickness of granular structural fill required under footings.

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.

5.3.2 Installation

Under no circumstances should the footings be installed upon non-engineered fills, loose or disturbed soils, sod, rubbish, frozen soil, or other deleterious materials. If unsuitable soils are encountered, they must be removed and replaced with suitable granular fill. The width of replacement fill should be equal to the width of the footing plus one foot for each foot of fill thickness. If granular soils become loose, they must be recompacted to the requirements of structural fill before the footings are poured.

5.3.3 Settlements

Calculated settlements of foundations designed and installed in accordance with the above recommendations and supporting various loads are tabulated on the following page.

Footing Type	Load (kips)	Recommended Minimum Thickness of Granular Structural Fill Below Footings (feet)	Bearing Pressure (psf)	Projected Ultimate Settlement (inches)
Spread	50 to 200	0.0	3,000	¼ to ¾
	200+ to 400	1.5	3,000	⅜ to ¾
	400+ to 500	2.0	4,000	½ to 1
	500+ to 700	2.5	4,000	¾ to 1
	700+ to 800	3.0	4,000	¾ to 1
Wall	0 to 8 kip/ft	0.0	3,000	¼ to ⅝

Settlements will occur rapidly with 50 to 60 percent of the projected settlements 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. For estimated frictional resistance, a coefficient of friction 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 lateral pressure parameters, as presented within this section, are for backfills which will consist of drained granular soil placed and compacted in accordance with the recommendations presented herein. The lateral pressures imposed upon subgrade facilities will, therefore, be basically dependent upon the relative rigidity and movement of the backfilled structure. Wall heights of approximately 8t feet were used for this analysis. For active walls, such as retaining walls which can move outward (away from the backfill), granular backfill shall be considered equivalent to a fluid with a density of 35 pounds per cubic foot in computing lateral pressures.

For more rigid walls, an equivalent fluid pressure of 45 pounds per cubic foot is recommended. The above values assume that the surface of the soils slope behind the wall is horizontal and that the granular fill within 3 feet of the wall will be compacted with hand-operated compacting equipment. If final grades slope up from the backfilled subgrade walls, higher equivalent fluid pressure will be imposed.

To lessen additional lateral pressures, only hand-operated compaction equipment should be utilized within 3 feet of the walls.

For seismic loading and below-grade walls up to 4 feet tall, a uniform pressure of 50 and 80 pounds per square foot should be added for active and more rigid walls, respectively.

5.6 FLOOR SLABS

To facilitate construction and curing, we recommend that all at-grade floor slabs be immediately underlain by a minimum of 4 inches of "free-draining" granular material, such as "pea" gravel or three-quarter to one-inch minus clean gap-graded gravel. The gravel may be placed directly upon properly prepared suitable natural soils and/or granular structural fill. Settlements of lightly loaded floor slabs will be negligible.

5.7 CEMENT TYPES

Laboratory tests indicate that the site soils contain negligible amounts of water soluble sulfates. Therefore, all concrete which will be in contact with the site soils may be prepared using Type I or IA cement.

5.8 GEOSEISMIC SETTING

5.8.1 General

Utah municipalities adopted the International Building Code (IBC) 2009 on July 1, 2010. The IBC 2009 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 2009 edition.

5.8.2 Faulting

Based upon our review of available literature, no active faults are known to pass through or immediately adjacent to the site. The site is located outside fault investigation zones identified

by Salt Lake County. The nearest active fault is the East Bench portion of the Wasatch Fault, approximately one-quarter of a mile northwest of the site. The Wasatch Fault zone is considered capable of generating earthquakes as large as magnitude 7.3[3].

5.8.3 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 2009 can be utilized.

5.8.4 Ground Motions

The IBC 2009 code is based on 2002 USGS mapping, which provides values of short and long period accelerations for the Site Class B-C boundary for the Maximum Considered Earthquake (MCE). This Site Class B-C boundary represents a hypothetical bedrock surface and must be corrected for local soil conditions. The 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 (40.7569 degrees north and -111.8421 degrees west, respectively), the values for this site are tabulated below:

Spectral Acceleration Value, T Seconds	Site Class B-C Boundary [mapped values] (% g)	Site Class D [adjusted for site class effects] (% g)
Peak Ground Acceleration	63.7	63.7
0.2 Seconds, (Short Period Acceleration)	$S_S = 159.4$	$S_{MS} = 159.4$
1.0 Seconds (Long Period Acceleration)	$S_1 = 63.4$	$S_{M1} = 95.1$

The IBC 2009 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.

---

[3] Arabasz, W.J., Pechmann, J.C., and Brown, E.D., 1992, Observational seismology and the evaluation of earthquake hazards and risk in the Wasatch Front area, Utah, in Gori, P.L., and Hays, W.W., eds., Assessment of regional earthquake hazards and risk along the Wasatch Front, Utah: U.S. Geological Survey Professional Paper 1500-D, 36 p.

GSH

5.8.5 Liquefaction

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

Groundwater was not encountered during this study to maximum depth penetrated of 31.5 feet. The soils encountered in the borings are not saturated and, therefore, not susceptible to liquefaction, even during a major seismic event.

5.9 SITE OBSERVATIONS

As previously mentioned, non-engineered fills are present across much of the site to varying depths. Therefore, we recommend that a qualified geotechnical engineer observe the foundation excavations to identify that all non-engineered fills have been removed and that suitable soils have been encountered prior to the placement of structural fills and footings.

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.

Bryan N. Roberts, P.E.
State of Utah No. 276476
Project Geotechnical Engineer

Reviewed by:

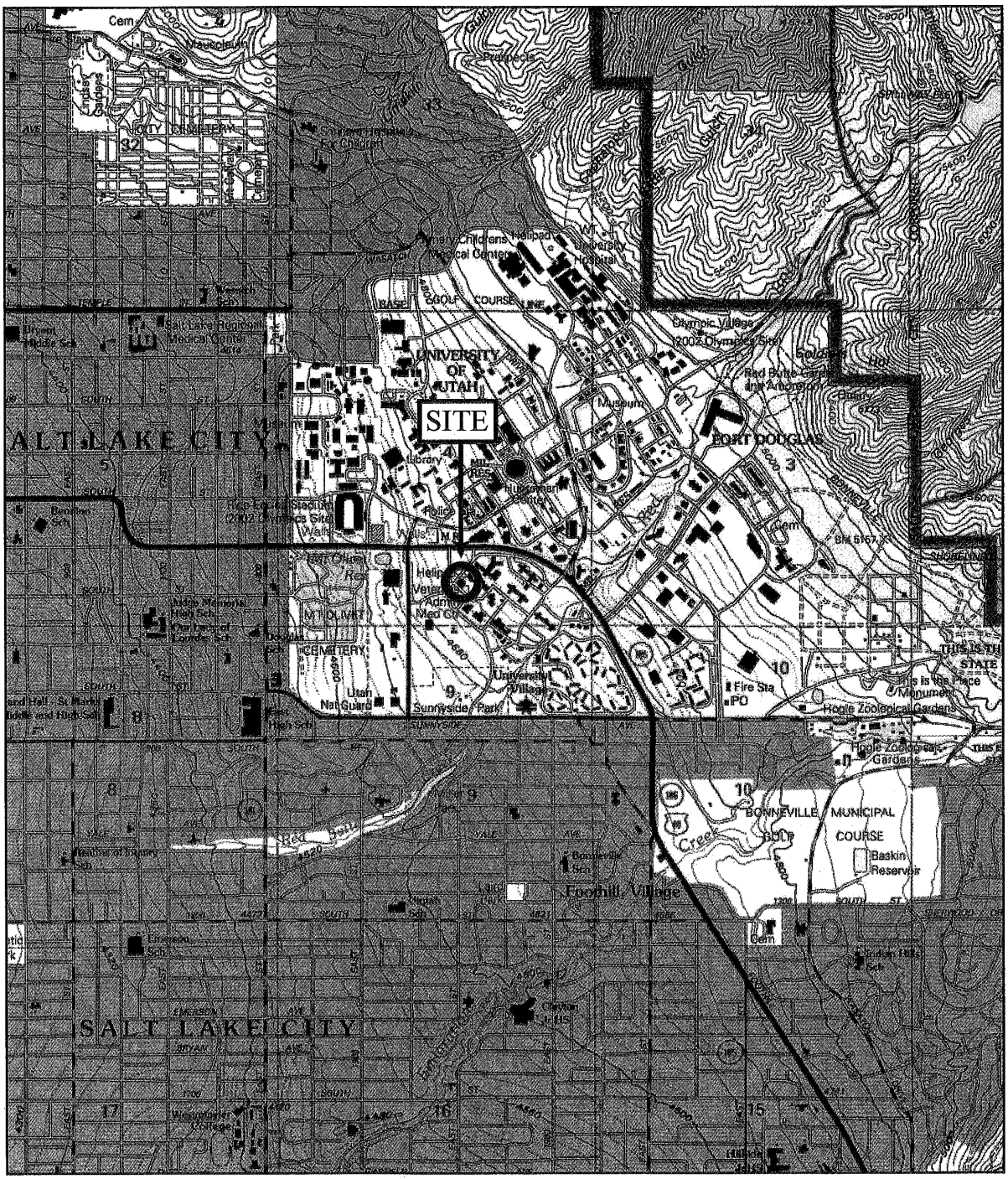
Alan D. Spilker, P.E.
State of Utah No. 334228
President/Senior Geotechnical Engineer

BNR/ADS:jlh

Encl. Figure 1, Vicinity Map
Figure 2, Site Plan
Figures 3A through 3G, Log of Borings
Figure 4, Key to Boring Log

Addressee (3 + email)

EFT ARCHITECTS, INC.
JOB NO. 0461-015-12



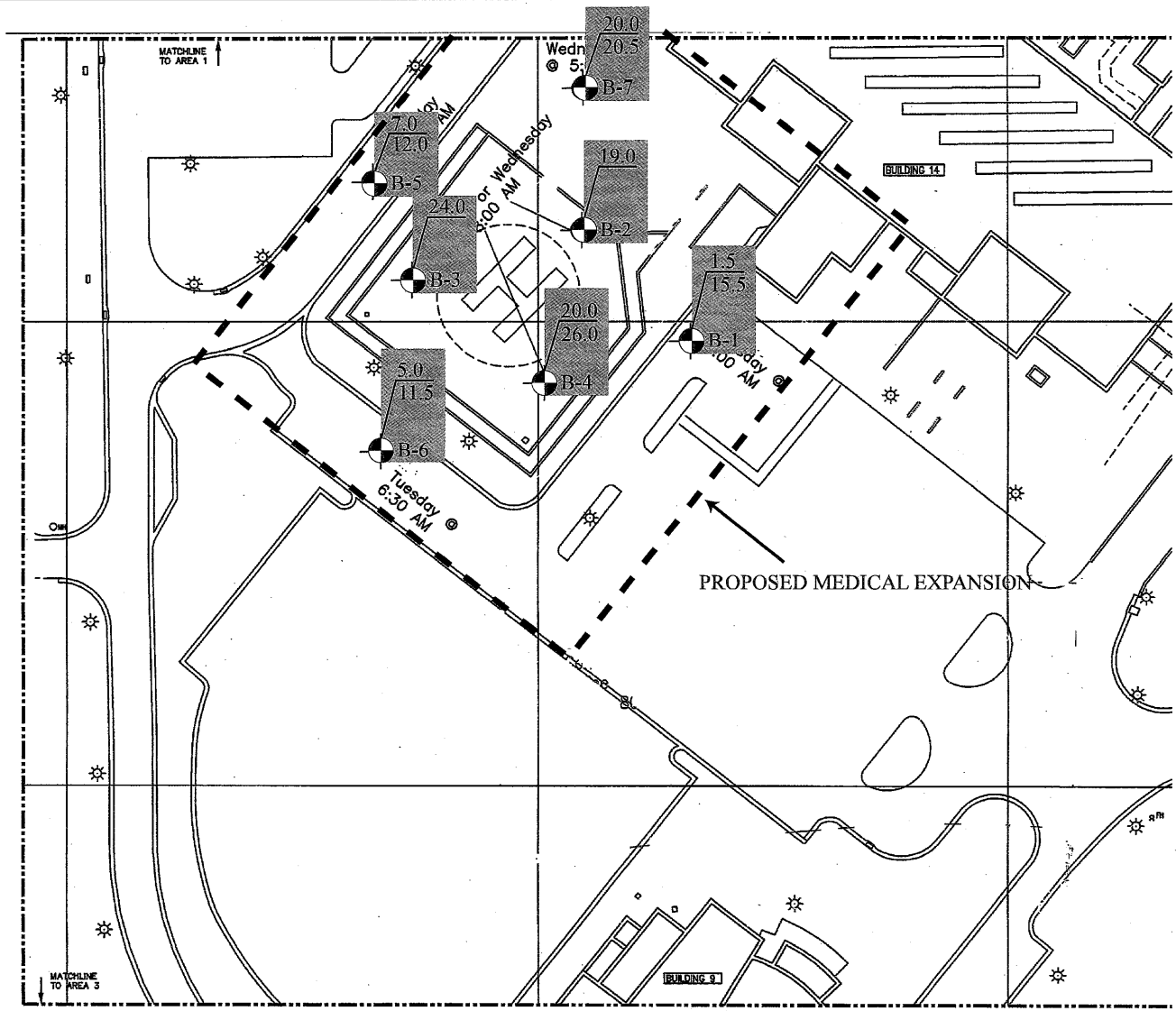
SCALE IN FEET
1000 0 1000 2000

REFERENCE:
USGS 7.5 MINUTE TOPOGRAPHIC QUADRANGLE MAPS
"FORT DOUGLAS, UTAH", SALT LAKE CITY NORTH, UTAH"
"SUGAR HOUSE, UTAH" ALL DATED 1998 AND
"SALT LAKE CITY SOUTH, UTAH" DATED 1999

FIGURE 1
VICINITY MAP

GSH

EFT ARCHITECTS
JOB NO. 0461-015-12



REFERENCE:
ADAPTED FROM DRAWING ENTITLED
"GEOTECHNICAL SCHEDULE FOR HELIPAD"
PROVIDED BY CLIENT, NOT DATED

NOT TO SCALE

FIGURE 2
SITE PLAN

GSH

GSH BORING LOG

Page: 1 of 1

BORING: B-1

CLIENT: EFT Architects, Inc.
PROJECT NUMBER: 0461-015-12
PROJECT: Proposed VA Hospital Center Expansion
DATE STARTED: 8/14/12
LOCATION: 500 Foothill Drive, Salt Lake City, Utah
DATE FINISHED: 8/14/12 **GSH Field Rep.:** HRW
DRILLING METHOD/EQUIPMENT: 3-3/4" ID Hollow-Stem Auger
HAMMER: Automatic **WEIGHT:** 140 lbs **DROP:** 30"
GROUNDWATER DEPTH: No groundwater encountered (8/14/12)
ELEVATION: ---

WATER LEVEL	USCS	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0								
		5" ASPHALT									
		10" BASE COURSE									
	CL	**SILTY CLAY** with some fine sand, fine and coarse gravel; reddish-brown		42		22.4	101				slightly moist very stiff
		grades tan	5	34		24.1	100				moist
		grades with some oxidation mottling		27							
		grades with trace fine gravel	10	38		29.3	92				
	SM	**SILTY FINE TO COARSE SAND** with some fine and coarse gravel and silt; brown	15	50/1"							slightly moist
		Refusal at 15.5'. No groundwater encountered at time of drilling. Installed 1-1/4" diameter slotted PVC pipe to 15.5'.	20 25								

See Subsurface Conditions section in the report for additional information.

FIGURE 3A

GSH BORING LOG

Page: 1 of 1

BORING: B-2

CLIENT: EFT Architects, Inc.
PROJECT NUMBER: 0461-015-12
PROJECT: Proposed VA Hospital Center Expansion
DATE STARTED: 8/14/12
LOCATION: 500 Foothill Drive, Salt Lake City, Utah
DATE FINISHED: 8/14/12 **GSH Field Rep.:** HRW
DRILLING METHOD/EQUIPMENT: 3-3/4" ID Hollow-Stem Auger
HAMMER: Automatic **WEIGHT:** 140 lbs **DROP:** 30"
GROUNDWATER DEPTH: No groundwater encountered (8/14/12)
ELEVATION: ---

WATER LEVEL	USCS	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0								
		2.5" ASPHALT									
	CL	**SILTY CLAY, FILL** with some fine sand, trace fine and coarse gravel; grayish-brown									slightly moist stiff
				14							
		grades with some coarse sand and gravel; reddish-brown	5								
				18							
				17							moist
		grades with coarse gravel/cobble-sized rock	10								
				55							
		grades with fine to coarse sand, fine and coarse gravel; blackish-brown	15								hard
				80							
	CL	**SILTY CLAY** with trace fine sand; brown	20								moist very stiff
				30							
		Stopped drilling at 20.0'. No groundwater encountered at time of drilling.	25								

See Subsurface Conditions section in the report for additional information.

FIGURE 3B

GSH BORING LOG

Page: 1 of 2

BORING: B-3

CLIENT: EFT Architects, Inc.
PROJECT NUMBER: 0461-015-12
PROJECT: Proposed VA Hospital Center Expansion
DATE STARTED: 8/14/12
LOCATION: 500 Foothill Drive, Salt Lake City, Utah
DATE FINISHED: 8/14/12 **GSH Field Rep.:** HRW
DRILLING METHOD/EQUIPMENT: 3-3/4" ID Hollow-Stem Auger
HAMMER: Automatic **WEIGHT:** 140 lbs **DROP:** 30"
GROUNDWATER DEPTH: No groundwater encountered (8/14/12)
ELEVATION: ---

WATER LEVEL	USCS	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0								
		2.5" ASPHALT									
	SM	**FINE TO MEDIUM SAND, FILL** with some silt; brown									
	CL	**SILTY CLAY, FILL** with trace fine sand and gravel; reddish-brown		24		17.0	109				slightly moist very stiff
		grades with trace to some fine gravel	5	19							
				29							moist
		grades brown with some fine gravel	10	16		13.3	109				stiff
		grades with some coarse gravel; trace cobbles possible	15	18							
			20	39							
	SM	**SILTY FINE TO MEDIUM SAND** with some clay and sandy clay layers up to 1" thick; brown	25								

See Subsurface Conditions section in the report for additional information.

FIGURE 3C

GSH	BORING LOG Page: 2 of 2	BORING: B-3

CLIENT: EFT Architects, Inc. **PROJECT NUMBER:** 0146-015-12

PROJECT: Proposed VA Hospital Center Expansion **DATE STARTED:** 8/14/12

WATER LEVEL	USCS	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
			25								
				32							moist medium dense
		grades with some fine to coarse sand and fine and coarse gravel	30	50 /5"							
		Stopped drilling at 30.0'. No groundwater encountered at time of drilling. Installed 1-1/4" diameter slotted PVC pipe to 30.0'.	35								
			40								
			45								
			50								

See Subsurface Conditions section in the report for additional information.

FIGURE 3C
(cont'd)

GSH	BORING LOG Page: 1 of 2	BORING: B-4

CLIENT: EFT Architects, Inc. **PROJECT NUMBER:** 0461-015-12

PROJECT: Proposed VA Hospital Center Expansion **DATE STARTED:** 8/14/12

LOCATION: 500 Foothill Drive, Salt Lake City, Utah **DATE FINISHED:** 8/14/12 **GSH Field Rep.:** HRW

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

GROUNDWATER DEPTH: No groundwater encountered (8/14/12) **ELEVATION:** ---

WATER LEVEL	USCS	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0								
		2.75" ASPHALT									
	CL	**SILTY CLAY, FILL** with trace to some sand and gravel; dark brown to reddish-brown									slightly moist stiff
				14							
		grades reddish-brown	5								
				19		14.9	119				
		grades with trace to some gravel; brown		21		15.4	108				moist
		grades brown to dark brown	10	19		16.9	108				
		grades with some fine to coarse sands and fine and coarse gravel; occasional silty sand layers up to 1" thick; brown and gray	15	61							
	CL	**SILTY CLAY** with some fine sand and trace coarse gravel; brown with white mottling	20	50/ 5"							slightly moist very stiff
			25								

See Subsurface Conditions section in the report for additional information.

FIGURE 3D

GSH	BORING LOG Page: 2 of 2	BORING: B-4

CLIENT: EFT Architects, Inc. **PROJECT NUMBER:** 0146-015-12

PROJECT: Proposed VA Hospital Center Expansion **DATE STARTED:** 8/14/12

WATER LEVEL	USCS	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
	SM	**CLAYEY FINE TO COARSE SAND** with with fine and coarse gravel; brown	25	50/ 4"							moist very dense
		Refusal at 26.0'. No groundwater encountered at time of drilling.	30 35 40 45 50								

See Subsurface Conditions section in the report for additional information.

FIGURE 3D
(cont'd)

GSH

BORING LOG

Page: 1 of 1

BORING: B-5

CLIENT: EFT Architects, Inc.
PROJECT NUMBER: 0461-015-12
PROJECT: Proposed VA Hospital Center Expansion
DATE STARTED: 8/14/12
LOCATION: 500 Foothill Drive, Salt Lake City, Utah
DATE FINISHED: 8/14/12 **GSH Field Rep.:** HRW
DRILLING METHOD/EQUIPMENT: 3-3/4" ID Hollow-Stem Auger
HAMMER: Automatic **WEIGHT:** 140 lbs **DROP:** 30"
GROUNDWATER DEPTH: No groundwater encountered (8/14/12)
ELEVATION: ---

WATER LEVEL	USCS	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0								
		2.75" ASPHALT									
	CL	**SILTY CLAY, FILL** with trace to some fine sand and trace to some gravel; brown		38		13.6	120				slightly moist very stiff
		grades gravelly clay	5	14							loose
	CL/GC	**GRAVELLY CLAY/CLAYEY GRAVEL** with some fine to coarse sand and fine and coarse gravel; brown		52							slightly moist medium dense
	CL	**SILTY CLAY** with some fine to coarse sand; reddish-brown	10	22		12.9	117				moist stiff
		Refusal at 12.0'. No groundwater encountered at time of drilling.	15 20 25								

See Subsurface Conditions section in the report for additional information.

FIGURE 3E

GSH BORING LOG

Page: 1 of 1

BORING: B-6

CLIENT: EFT Architects, Inc.
PROJECT NUMBER: 0461-015-12
PROJECT: Proposed VA Hospital Center Expansion
DATE STARTED: 8/14/12
LOCATION: 500 Foothill Drive, Salt Lake City, Utah
DATE FINISHED: 8/14/12 **GSH Field Rep.:** HRW
DRILLING METHOD/EQUIPMENT: 3-3/4" ID Hollow-Stem Auger
HAMMER: Automatic **WEIGHT:** 140 lbs **DROP:** 30"
GROUNDWATER DEPTH: No groundwater encountered (8/14/12)
ELEVATION: ---

WATER LEVEL	USCS	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0								
		2.75" ASPHALT									
	SC	**CLAYEY FINE TO COARSE SAND, FILL** with some fine and coarse gravel; reddish brown		50/5"							slightly moist very dense
	CL	**SILTY CLAY** with trace fine sand; tan to light brown with oxidation mottling	5	31		22.8	103				moist to very moist very stiff
				18		28.4	94				
			10	17		28.3	94				
		Refusal at 11.5'. No groundwater encountered at time of drilling. Installed 1-1/4" diameter slotted PVC pipe to 12.0'.	15 20 25								

See Subsurface Conditions section in the report for additional information.

FIGURE 3F

GSH BORING LOG

Page: 1 of 1

BORING: B-7

CLIENT: EFT Architects, Inc.
PROJECT NUMBER: 0461-015-12
PROJECT: Proposed VA Hospital Center Expansion
DATE STARTED: 8/14/12
LOCATION: 500 Foothill Drive, Salt Lake City, Utah
DATE FINISHED: 8/14/12 **GSH Field Rep.:** HRW
DRILLING METHOD/EQUIPMENT: 3-3/4" ID Hollow-Stem Auger
HAMMER: Automatic **WEIGHT:** 140 lbs **DROP:** 30"
GROUNDWATER DEPTH: No groundwater encountered (8/14/12)
ELEVATION: ---

WATER LEVEL	USCS	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0								
		4.5" ASPHALT									
	SC	**CLAYEY FINE TO COARSE SAND, FILL** with some fine and coarse gravel with some silty clay; reddish-brown		43							slightly moist medium dense
	CL	**SANDY CLAY, FILL** with some fine and coarse gravel and some fine to coarse sand; brown	5	91							slightly moist very stiff
	GC	**CLAYEY GRAVEL, FILL** with some sand and fine and coarse gravels with possible cobbles; reddish-brown		50/ 2"							slightly moist dense
	CL	**SILTY CLAY, FILL** with some fine gravel; brown	10	51		16.3	107				moist very stiff
			15	80/ 4"							
	CL	**SILTY CLAY** with some sand and trace gravel; brown	20	50/ 5"							hard
		Refusal at 20.5'. No groundwater encountered at time of drilling. Installed 1-1/4" diameter slotted PVC pipe to 20.5'.	25								

See Subsurface Conditions section in the report for additional information.

FIGURE 3G

PROJECT: EFT Architects, Inc.
PROJECT LOCATION: 500 Foothill Drive, Salt Lake City, Utah
PROJECT NUMBER: 0461-015-12

KEY TO BORING LOG

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

COLUMN DESCRIPTIONS

1. **Water Level:** Depth to measure groundwater table. See symbol below.
2. **USCS:** Graphic depiction of subsurface material encountered; typical symbols are explaned below.
3. **Description:** Description of material encountered; may include color, moisture, grain size, and density/consistency.
4. **Depth (ft.):** Depth in feet below the ground surface.
5. **Blow Count:** Number of blows required to advance sampler (12 inches) beyond first. using a 140-lb hammer with a 30 inch drop.
6. **Sample Symbol:** Type of soil sample collected at depth interval shown; sampler symbols are explained below.
7. **Moisture (%):** Water content of soil sample measured in laboratory; expressed as percentage of dry weight of specimen.
8. **Dry Density (pcf):** The density of a soil measured in laboratory; expressed as pounds per cubic foot.
9. **% Passing 200:** Fines content of soil sample passing a No. 200 sieve measured in laboratory, expressed as a percentage.
10. **Liquid Limit (%):** Water content at which a soil changes from plastic to liquid behavior.
11. **Placsticity Index (%):** Range of water content at which a soil exhibits plastic properties.
12. **Remarks:** Comments and observations regarding drilling or sampling made by driller or field personnel. Other field and laboratory test results; using the following abbreviations:

CEMENTATION	MODIFIERS	MOISTURE CONTENT (FIELD TEST)
Weakly: Crumbles or breaks with handling of 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

MAJOR DIVISIONS			SYMBOLS Graph	SYMBOLS Letter	TYPICAL DESCRIPTIONS
COARSE-GRAINED SOILS: More than 50% of No. 200 sieve size.	GRAVELS: More than 50% of coarse fraction retained in No. 4 sieve.	CLEAN GRAVELS (little or no fines)		GW	Well-Graded Gravels, Gravel-Sand Mixtures, Little or No Fines
				GP	Poorly-Graded Gravel, 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-Clay 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 of 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 Clays of Medium to High Plasticity, Organic Silts
HIGHLY ORGANIC SOILS				PT	Peat, Humus, Swamp Soils with High Organic Contents

Note: Dual Symbols are used to indicate borderline soil classifications

STRATIFACTION

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

STRATIFACTION

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
- 3-3/4" ID D&M Sampler
- 3" ID D&M Sampler
- California Sampler
- Thin Wall

LOG KEY SYMBOLS

- Water Level

FIGURE 4

GSH