amec

GEOTECHNICAL ENGINEERING REPORT
UNIVERSITY OF UTAH SCHOOL OF BUSINESS
UNIVERSITY OF UTAH CAMPUS
SALT LAKE CITY, UT

Submitted To:

University of Utah
Campus Design & Construction
1795 E. South Campus, RM 201
Salt Lake City, Utah 84112-9403

Submitted By:

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June 29, 2007

Project No. 7-817-005206

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June 29, 2007

University of Utah
Campus Design & Construction
1795 East South Campus Drive, RM 201
Salt Lake City, Utah 84112-9403

Attention: Mr. Bill Billingsly

SUBJECT: Geotechnical Engineering Report
U of U School of Business
University Campus
Salt Lake City, Utah
AMEC Project No. 7-817-005206

1. INTRODUCTION

1.1 Objectives and Scope

This report presents the results of our geotechnical investigation for the new University of Utah School of Business to be located on campus at the site of the Francis Armstrong Madsen Building in Salt Lake City, Utah. The approximate location of the site is shown on Figure 1, Vicinity Map. The objectives of this investigation were to explore and evaluate subsurface materials and conditions and develop recommendations for the design and construction of the new university building. The studies were conducted in accordance with the scope of work outlined in AMEC's proposal PL07-021 dated March 23, 2007 and authorized by Purchase Order No. 0000009088, dated May 5th, 2007. AMEC's scope of work included a site reconnaissance, field explorations, laboratory testing, engineering analyses, and report preparation.

2. PROJECT DESCRIPTION

We understand the proposed construction will consist of demolishing the existing Francis Armstrong Madsen Building and replacing it with a new 4 story building with an approximate 22,000 square foot (sf) footprint. The ground floor of the new building is expected to be at the same approximate elevation as the existing building. A basement mechanical room is planned at the north end of the L-shaped building. Structural loads are expected to be moderate, and we anticipate that the structure will be supported on shallow spread footings. Surrounding areas will be landscaped.

3. SITE DESCRIPTION

3.1 Site Conditions

The site is currently occupied by the existing circular Francis Armstrong Madsen Building and adjacent landscaped and concrete sidewalks. The Francis Armstrong Madsen Building is approximately 10 feet below surrounding grade on the south, and 0 to 5 feet below grade on the north. On the east side of the existing building, the site is a landscaped area with several large trees, the southwest consists primarily of grass, and the northwest is a patio area.

3.2 Geology

The Salt Lake Valley is located near the eastern edge of the Basin and Range physiographic province, which extends from the Sierra Nevada Mountains to the Wasatch Mountains. The Basin and Range

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province is characterized by north-trending mountain ranges and intervening sediment-filled valleys. The mountain ranges are bounded by high-angle normal faults formed in response to regional extension of the earth's crust. A geologic map prepared by Personius and Scott, 1992[1] indicates that the site is underlain by a fan alluvium consisting of clast-supported pebble and cobble gravel, occasional boulders, in a matrix of sand and silty sand. This material is generally poorly sorted and sub angular to round. Deposition is attributed to perennial intermittent streams, debris flows, and debris floods.

4. FIELD EXPLORATIONS & LABORATORY TESTING

4.1 Field Explorations

Subsurface materials and conditions at the project site were investigated on June 5, 6, and 12, 2007 with 3 bore holes designated B-1 through B-3. The approximate locations of the borings are shown on Figure 2, Site Plan. All field operations were observed by a technician provided by our firm, who maintained a detailed log of the materials and conditions encountered in each bore hole and directed the sampling operation. Additional information on the field exploration is presented in Appendix A, Field Explorations.

4.2 Laboratory Testing

Laboratory testing consisted of natural moisture content, dry unit weight, gradations, consolidation testing, and corrosion testing. Details concerning the tests and the laboratory results can be found in Appendix B, Laboratory Testing.

5. SUBSURFACE CONDITIONS

5.1 Fill Conditions

Subsurface investigations encountered approximately 3 feet of fill at the southwest corner of the site. The fill consisted of brown silt with sand and gravel. Fill was typically free from debris.

5.2 Geotechnical Profile

Logs of the borings B-1 through B-3 are presented on Figures 3A through 3C, Log of Borings. The terms used to describe the soils disclosed by the boring logs are defined on Figure 4, Soil Classification Chart & Legend.

The native soil profile is comprised primarily of silty sand with gravel, and silty gravel. The upper 15 feet of the profile consists of approximately 3 to 5 feet of silt with gravel, underlain by silty gravel and silty sand. A sandy clay with gravel layer was encountered in boring B-1 at a depth of approximately 23 feet below grade. The rest of subsurface soils consist of varying amounts of silt, sand, and gravel. The density of the soil profile ranges from dense to very dense in granular soils, while the sandy silts and sandy clays have a hard consistency. Throughout the sampled profile, penetration resistance for the Dames and Moore split barrel sampler ranges from 66 to 196 blows per foot. The results of Atterberg limits testing indicated tested samples to be non-plastic. Moisture contents ranged from 1.6 to 8.4 percent, while available dry unit weights ranged from 116 to 143 pcf.

5.3 Groundwater

At the time of the investigation, a perched groundwater table was encountered at a depth of approximately 30 feet in boring B-3. Boring B-1, which extended to a depth of 45 feet, did not encounter a water table.

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1 Personius, S.F. and Scott, W.E.; 1992; Surficial Geologic Map of the Salt Lake City Segment and Parts of Adjacent Segments of the Wasatch Fault Zone, Davis, Salt Lake and Utah Counties, Utah; U.S. Geological Survey Miscellaneous Investigation Series Map I-2106, Scale 1:50,000

Although, we do not anticipate that groundwater water levels will influence the stability or constructability of the structure, fluctuations in groundwater do occur due to variations in precipitation, runoff, water levels in nearby ditches, drainages and other factors. Longer-term groundwater fluctuations should be anticipated with the highest seasonal levels generally occurring during the late spring and summer months.

6. CONCLUSIONS AND RECOMMENDATIONS

6.1 General

The site is generally favorable to the support of the proposed building on shallow foundations. We anticipate that structural loads can be supported by a shallow spread footing, supported on either native dense soils or structural fill extending down to native dense soils.

The demolition of the existing structure will likely produce disturbed soil that would not be suitable if left in place below footings or floor slabs. After demolition of the existing structure, care should be taken to assure all loose and disturbed material is removed from below the proposed building and backfill zones.

The water table depth is not expected to be an issue during the construction of the project. Water tables are expected to be below planned footing depths, and should not present a problem for planned basements.

6.2 Earthwork

6.2.1 Site Preparation

Demolition of the existing building should include removal of existing floor slabs, footings, walls, fills, and associated disturbed soils. Upon completion of demolition and the excavation to the native subgrade, the resulting subgrade should be observed by a representative of the geotechnical engineer. Any soft areas or areas of unsuitable material should be excavated to firm undisturbed soil and backfilled with structural fill or lean concrete flowable fill, as needed.

We are unaware of the location of underground utilities related to prior structures. If any utilities are located within 5 feet of the proposed foundations, they should be abandoned or relocated. Resulting excavations should be properly backfilled with structural fill.

Granular soils lacking sufficient fines can possibly rut or displace during construction procedures. Disturbed sandy soils should be re-compacted to an even grade before placement of foundations, slabs, or pavement. Compaction can be accomplished by moistening the sandy soils and compacting them with a vibratory plate or other vibratory equipment.

6.2.2 Excavations

Temporary construction excavations in soils not exceeding 4 feet in depth may be constructed with near-vertical side slopes. Temporary excavation slopes up to 20 feet in height and above the water table may be constructed no steeper than one horizontal to one vertical (1H:1V). If excessive sloughing occurs, the excavation slope should be flattened. Excavations encountering the groundwater table or perched groundwater will require much flatter slopes, shoring and bracing, and/or dewatering. Excavation safety and dewatering is the responsibility of the contractor. All excavations should be constructed in conformance with Federal, State and local regulations. All excavations must be inspected periodically by qualified personnel. If any signs of instability are noted, immediate remedial action must be initiated.

6.2.3 Fill Requirements

Fill material should be free from debris, vegetation, roots, other unsuitable material, frozen material, and excess moisture. Structural fill should also conform to the gradation and plasticity requirements shown in the following table, Fill Material Requirements.

FILL MATERIAL REQUIREMENTS

Fill Name	Type	Application	Max Size in.	Max. Percent Passing			Max Liquid Limit
				No.4	No. 10	No. 200	
Structural	S1	Below footings	4	-	50	25	30
Floor Slab	F1	below slabs	6	-	-	35	30
Upper Slab	UF	below slabs, upper 4 inches	2	-	25	5	-
Free Draining	FD	drainage layers or drainage backfill	4	25	5	2	-

Existing site fill may be reused as structural site grading fill if it meets the requirements of structural fill.

6.2.4 Fill Placement and Compaction Requirements

Structural fill and floor slab fill should be compacted to at least 95 percent of the maximum dry density as determined by ASTM D-1557 (modified Proctor). Structural fill should extend out from the edge of footings a distance equal to half the depth of the fill. For example, if the structural fill depth is 4 feet, the fill should extend out at least 2 feet past the outside edge of the footing.

Fill should be placed and compacted in lifts. The lift thickness should be appropriate for the type of equipment being used so that the entire lift thickness is compacted to the required level. With heavy compaction equipment, we recommend that compacted lift thickness be limited to a maximum of 12 inches unless specific arrangements are made with the testing entity to verify compaction in thicker lifts. Fill compaction should be tested frequently. The contractor should have sufficient testing early to verify that compaction methods are adequate to meet compaction requirements and regular additional testing to demonstrate consistent compaction. For column and wall footings we recommend a minimum of 5 tests per lift, or at least one test per 10 column footings per lift and one test per 150 feet of wall footing per lift, whichever is greater. For larger area fills, we recommend a minimum of 5 tests per lift and at least one test per 10,000 square feet of compacted fill.

Where free draining fill is used to collect or drain water, a filter fabric capable of preventing the migration of fines into the free draining fill should be placed between the fill and native soil on all sides.

Fill in landscaped areas should be compacted to a minimum of 85 percent of the maximum dry density as determined by ASTM D-1557.

If pumping of the subgrade occurs when compacting fill, compaction should immediately stop and the geotechnical engineer consulted for appropriate action.

Excess compaction of backfill behind walls can cause significant stresses against walls and should be avoided. The use of moderate to heavy equipment, especially compactors, near walls can also cause significant stresses against walls and should be avoided. Such equipment should not operate within a distance equal to the height of the wall to minimize the potential for excessive lateral pressure.

Compaction close to the walls should be accomplished using hand-operated vibratory plate compactors or small trench compactors.

6.2.5 Fill Placement Considerations

In general, we recommend that the contractor be left to determine the most cost effective and practical means to place and compact fill. However, the following information may be helpful.

When performing compaction testing, the measured degree of compaction is only meaningful if gradation of the soil tested in the field corresponds to the gradation of the samples tested in the lab from which the maximum dry density and optimum moisture was determined. The fill material should be sampled and tested in the laboratory at a frequency appropriate for the variability of the fill. For highly variable soils this can be extremely difficult to ensure and there is a significant risk that field testing may not be representative. Additional measures such as limiting lift thickness may be advised.

Generally the more the moisture content differs from the optimum moisture content, the more difficult it is to achieve the desired compaction. Placing and compacting the fill at a moisture content within 2 percent of the optimum moisture content will generally facilitate compaction. However, in very clean granular soil a wider range of moisture content may be suitable.

The maximum particle size should generally be limited to ½ of the compacted lift thickness. Oversize pieces at the lift surface can carry the weight of the compaction equipment resulting in a poorly compacted zone around the oversized particle. Over a relatively firm subgrade, large pieces extending above the surface of the fill can result in a concentrated foundation load and/or thin section of footing.

Compaction equipment should be suitable for the fill material being placed. Granular material with a relatively small percentage of fines (clay or silt passing the no. 200 sieve), less than approximately 25 to 35 percent, should generally be compacted using vibratory compaction equipment. Sheepsfoot type compactors may be more suitable for soil with more fines, particular clayey soil.

All compaction equipment has a limited depth of influence. For hand operated equipment such as vibratory plate or "jumping jack" compactors, we recommend that the compacted lift thickness be limited to 4 inches. For small "trench" rollers, moderate sized roller compactors and larger roller compactors we recommend that compacted lift thickness be limited to 6, 8 and 12 inches unless it can be demonstrated that the recommended compaction can be achieved throughout the lift with thicker lifts.

6.2.6 Utility Trenches

It should be noted that utility trench excavations have the potential to degrade the engineering properties of the adjacent fill materials. Utility trench walls that are allowed to move laterally can lead to reduced bearing capacity and increased settlement of adjacent structural elements and overlying slabs. Backfill for utility trenches is as important as the original preparation or structural fill placed to support either a foundation or slab. Therefore, it is imperative that the backfill for utility trenches be placed to meet the project specifications for the structural fill of this project.

Most utility companies and municipalities are now requiring that AASHTO Type A-1 or A-1-a soil (granular soil with less than less than 25 or 15 percent fines, respectively) 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 on-site fine-grained soil is not recommended for use as trench backfill.

6.2.7 Finished Grading

Finish grading should be established to convey water away from foundation walls and backfill and to prevent ponding. Down spouts should discharge away from foundation backfill. Irrigation above or near wall backfill should be minimized. We recommend that landscaped surfaces adjacent to buildings be sloped down away from the buildings at a minimum slope of 6 inches down in the first 10 feet (5 percent) away from buildings. Concrete flatwork or pavement adjacent to buildings should slope down away from the buildings at a slope of 1 percent or more.

6.3 Foundations

6.3.1 Design Criteria

Foundation support for the proposed project can be provided by conventional wall and column-type spread footings provided the estimated settlement values presented below are acceptable in terms of structural performance. The following table presents options for footing design:

DESIGN CRITERIA

Footing Location	Foundation Type	Bearing Soils	Foundation Depth (feet)	Allowable Bearing Capacity (psf)	Max Width (feet)	
					Square Column	Wall
At Grade or Basement Level	Spread Foundations	Native Soil or Structural Fill [2]	1.0 [1]	3,000	12	10
		Native Soil or Structural Fill [2]	1.5 [1]	4,000	12	8
		Native Soil or Structural Fill [2]	2.0 [1]	5,000	12	6.5

Notes

1. Bottom of footing elevation below finished floor. For exterior footings, footings should be at the depth listed in this table, or 2.5' below exterior grade, whichever is deeper.
2. Footings should be founded upon undisturbed native soils or upon properly compacted structural fill, which has been placed on undisturbed native soil.

Strip (wall) footings should have a minimum footing width of 1½ feet, and square footings should have a minimum footing width of 2 feet in order to maintain bearing capacity. The allowable bearing pressure applies to the total of real loads, i.e., dead load plus frequently and/or permanently applied live loads. The allowable bearing pressure can be increased by one-third for the total of all loads: dead, live, and wind or seismic.

Soft, loose, or otherwise unsuitable soils, if encountered at footing depth, should be removed to firm subgrade material and replaced with granular structural fill or a lean concrete flowable fill.

6.3.2 Settlements

Settlement of foundations designed and installed in accordance with the above recommendations should not exceed 1 inch.

6.3.3 Installation

Under no circumstances should the footings be installed upon loose or disturbed soil, sod, rubbish, construction debris, topsoil, frozen soil, non-engineered fill, highly expansive clays, other deleterious materials, or within ponded water. If there are unsuitable conditions encountered, the soils must be completely removed and replaced with compacted granular structural fill. If granular soils become loose or disturbed, they must be properly re-compacted before the footings are poured. The width of replacement fill below footings should be equal to the width of the footing plus ½ foot for each foot of fill thickness on either side of the footing. For example, if the width of the footing is 2 feet and the thickness of the structural fill beneath the footing is 2 feet, the width of the structural fill at the base of the footing excavation would be a total of 4 feet.

6.3.4 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, ultimate coefficient of friction values of 0.35 and 0.45 may be utilized for footings established on silt or on granular structural fill, respectively.

Passive resistance provided by properly placed and compacted granular structural fill above the water table may be considered equivalent to a fluid with a density of 300 pounds per cubic foot (pcf). Below the water table, this granular soil should be considered equivalent to a fluid with a density of 150 pcf.

A combination of passive earth resistance and friction may be utilized provided that the friction component of the total is divided by 1.5.

6.4 Lateral Earth Pressures

Design lateral earth pressures for embedded walls depend on the type of construction, i.e., the ability of the wall to yield. The two possible conditions regarding the ability of the wall to yield include the at-rest and the active earth pressure cases. The at-rest earth pressure case applies to walls that are relatively rigid and laterally supported at top and bottom and therefore is unable to yield. The active earth pressure case applies to walls that are capable of yielding slightly away from the backfill by either sliding or rotating about the base. A conventional cantilevered retaining wall is an example of a wall that develops the active earth pressure case by yielding.

Yielding and non-yielding walls can be designed using a lateral earth pressure based on an equivalent fluid having a unit weight of 35 and 55 pcf, respectively. The ground surface should be sloped down at a minimum of 5 percent away from the wall.

6.4.1 Seismic Lateral Earth Pressures

Lateral earth pressure resulting from seismic loading can be calculated based on an equivalent fluid weight of 25 and 55 pounds per cubic foot for active and at-rest cases, respectively. This is assuming an even grade or negative slope at the top of the backfilled wall. For seismic loading the pressure should be inverted increasing from 0 at the base of the wall, to a maximum at the top of the wall equal to the height of the wall times the equivalent fluid weight.

6.5 Floor Support

Floor slabs may be established upon suitable native soils and/or upon structural fill extending to suitable native soils. Slabs may be established upon properly prepared existing near-surface soil, suitable undisturbed natural soils, and/or upon structural fills extending down to suitable natural soils or properly prepared existing near-surface soils. It is recommended that floor slabs are underlain by a minimum thickness of 4-inches of "free-draining" granular material, such as 1-inch to ¾-inch crushed rock. Base course should be installed in a single lift and compacted until well keyed. Settlements of lightly loaded floor slabs are anticipated to be minor.

Under no circumstance should floor slabs be established upon loose or disturbed soils, sod, rubbish, construction debris, non-engineered fill, other deleterious materials, expansive soils, frozen soils, or within ponded water.

6.6 Seismic Hazards

6.6.1 General

The Salt Lake Valley is an area of high seismic activity associated with the Wasatch fault zone, which defines the eastern boundary of the Basin and Range province. The Wasatch fault zone is considered capable of generating earthquakes as large as magnitude 7.3[2].

Utah municipalities have adopted the International Building Code (IBC) 2006. The IBC 2006 code determines the seismic hazard for a site based upon regional acceleration mapping prepared by the United States Geologic Survey (USGS) and the soil site class. The structure must be designed in accordance with the procedures presented in the IBC 2006 edition. The risk from geologic hazards other than those discussed below is low.

6.6.2 IBC Site Class

For dynamic structural analysis, Site Class "C," as defined in Table 1615.1.1, Site Class Definitions of the 2006 IBC, can be utilized.

6.6.3 Earthquake Ground Motions

The IBC 2006 code provides values of ground and structural acceleration for structural design. These design accelerations are based on data collected and interpreted by the US Geological Survey (USGS, 1997) for the maximum considered earthquake (MCE), a level of ground acceleration associated with a 2 percent probability of being exceeded in 50 years (which we abbreviate as 2%PE50yrs). The IBC allows the use of 2/3 of these values. This represents a standard design and risk level, adjusted for local seismicity. Structures could be designed for higher accelerations if the additional costs are out weighed by reduced risk.

Using 40.7625 degrees north latitude and 111.8417 degrees west longitude as the project coordinates; the following table summarizes spectral accelerations for the maximum considered earthquake.

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[2] 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.

DESIGN EARTHQUAKE ACCELERATIONS

Spectral Acceleration Value	MCE Ground Motion Values for Site Class B % g
0.2-Sec Spectral Acceleration (S_S)	158.2
1.0–Sec Spectral Acceleration (S_1)	62.7

MCE – Maximum considered earthquake

For Site Class C and the above-referenced short and long term spectral acceleration values, the amplification factors F_a = 0.9 and F_v = 1.3 values can be used for design.

6.6.4 Surface Fault Rupture

The site is located near the east trace of the East Bench Fault within Salt Lake's County's mapped fault surface rupture special study area. Fault surface ruptures can produce displacements at the ground surface of several feet. Such displacements, if they were to occur beneath a building, could redistribute stresses causing possible collapse of the structure. Surface fault ruptures represent a significant hazard to structures.

It is our understanding that over the course of many years, the university has conducted several trench studies in this area of campus in an attempt to locate the fault. These studies encountered no evidence of the fault. As such, the client has declined to conduct a surface fault rupture study for this specific building, choosing to rely on the results of previous investigations.

6.6.5 Liquefaction & Lateral Spread

Liquefaction is a condition where earthquake ground motion causes a build up of water pressure in the spaces between saturated soil particles causing the soil to behave like a fluid. Liquefaction will generally occur only in relatively loose granular or low-plasticity soil subjected to earthquake ground motion with sufficient intensity and sufficient duration. Damaging settlement may result from liquefaction. Damaging lateral movement known as lateral spread may occur if liquefaction occurs beneath a slope or near a free-face, such as the bank of a river.

The site is located in an area that has been mapped as having a "very low liquefaction potential" on planning maps. In one of our borings, we advanced the hole to a depth of 45 feet below grade and did not encounter a water table. In a second nearby boring, we encountered a perched water table at 30 feet. Due to the general water table being at a depth greater than 45 feet below grade, we do not anticipate liquefaction settlement to be a significant concern to the proposed building.

6.7 Soil Corrosivity and Sulfate Attack on Concrete

Soil corrosivity and sulfate attack was performed on site soils and was found to negligibly corrosive. It is our judgment that site soils can use cement type I or II for concrete placed in contact with the on-site soil.

7. LIMITATIONS

This report has been prepared to aid the architect and engineer in the design of this project. The scope is limited to the specific project and location described herein, and our description of the project represents our understanding of the significant aspects of the project relevant to the design and construction of the earthwork, foundations, and floor slabs. In the event that any changes in the design and location of the building as outlined in this report are planned, we should be given the opportunity to review the changes and to modify or reaffirm the conclusions and recommendations of this report in writing.

The conclusions and recommendations submitted in this report are based on the data obtained from the borings made at the locations indicated on Figure 2, Site Plan, and from other sources of information discussed in this report. In the performance of subsurface investigations, specific information is obtained at specific locations at specific times. However, it is acknowledged that variations in soil conditions may exist between explorations. This report does not reflect any variations that may occur between these explorations. The nature and extent of variation may not become evident until construction. If, during construction, subsurface conditions are different from those encountered in the explorations, we should be advised at once so that we can observe and review these conditions and reconsider our recommendations where necessary.

Our professional services have been performed, our findings obtained, and our recommendations prepared in accordance with generally accepted engineering principles and practices at this time along the Wasatch Front.

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

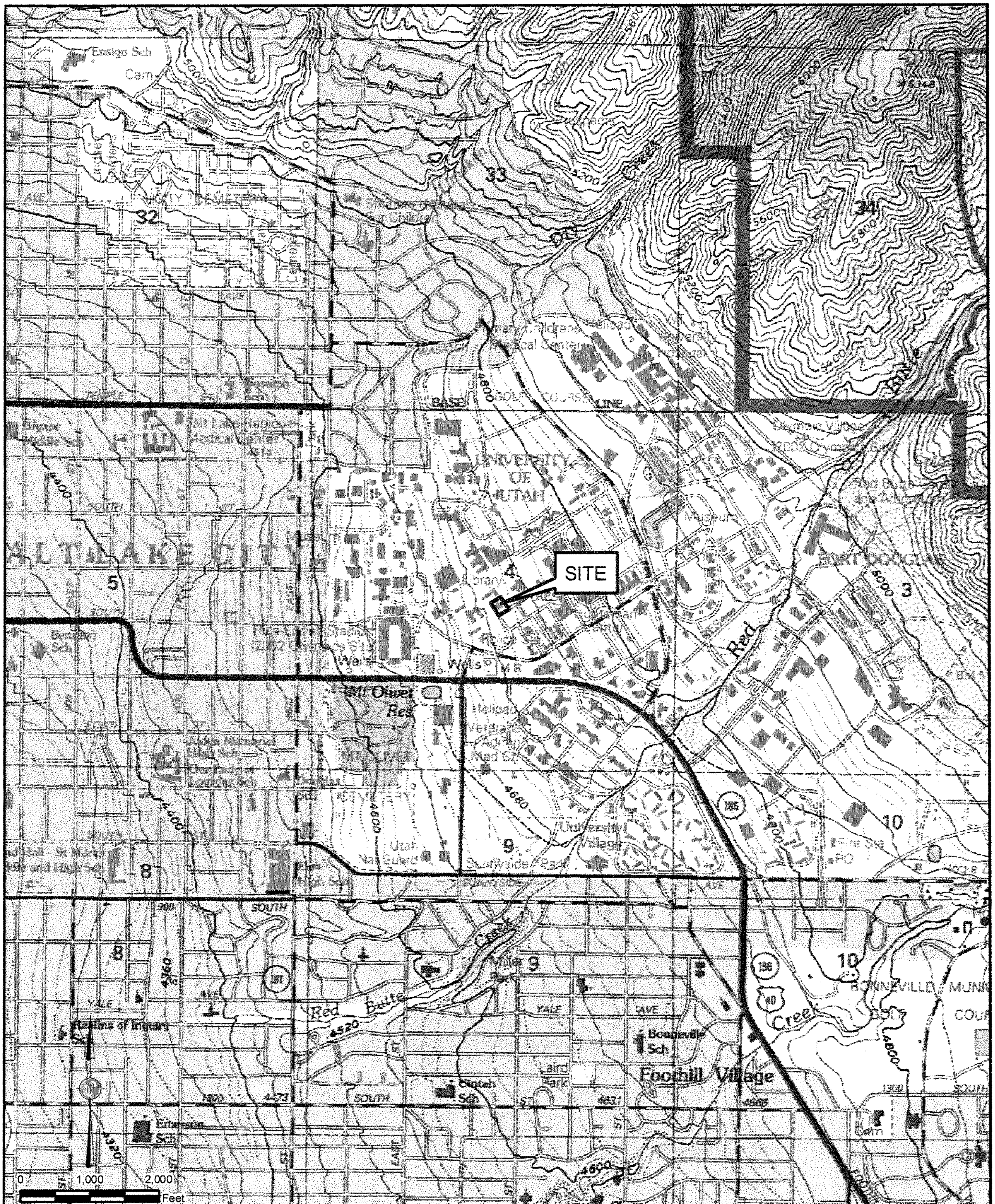
Respectfully submitted,
AMEC Earth & Environmental, Inc.

Daniel W. DeDen, P.E., State of Utah
Professional Engineer

Reviewed by:

David K. Fadling, P.E., State of Utah
Senior Engineer

Addressee (4)



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Fort Douglas Quadrangle, 1998 USGS 7.5 Minute Series (Topographic)

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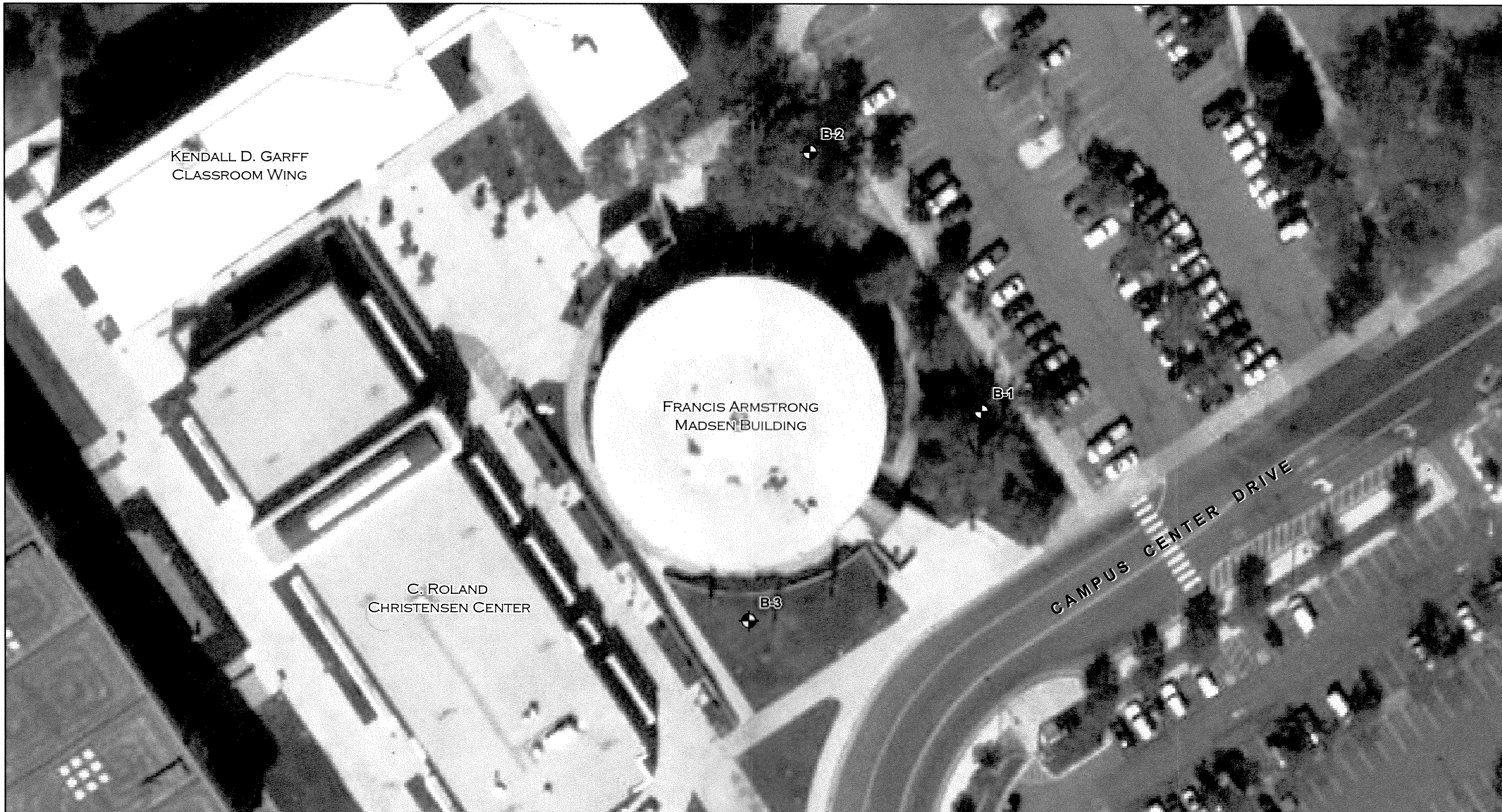
PROJECT: UNIVERSITY OF UTAH SCHOOL OF BUSINESS University of Utah Campus Salt Lake City, Utah 84112	DWN BY: MKW	DATUM: NAD 83	DATE: 06/19/07
	CHK'D BY: DD	P:\Geo\2007\7-817-005206\GIS\Figure1_Vicinity_Map	PROJECT NO: 7-817-005206
TITLE: VICINITY MAP	PROJECTION: UTM 12 North	SCALE: 1 inch equals 2,000 feet	FIGURE NO: 1



NOTE: THIS FIGURE SHOULD BE READ IN CONJUNCTION WITH THE AMEC EARTH & ENVIRONMENTAL REPORT NO. 7-817-005206.

REFERENCE: AERIAL PHOTOGRAPHY PROVIDED BY U.S. GEOLOGICAL SURVEY, DATED 2003. 1-FOOT RESOLUTION.

0 20 40 80 Feet

Legend

Boring Location

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DWN BY:	MKW
CHK'D BY:	DD
DATUM:	NAD 83
PROJECTION:	UTM 12 North
SCALE:	1 inch equals 40 feet

PROJECT
UNIVERSITY OF UTAH SCHOOL OF BUSINESS
University of Utah Campus
Salt Lake City, Utah 84112

TITLE
SITE MAP

P:\Geo\2007\7-817-005206\GIS\Figure2_Site_Map

DATE:	06/19/07
PROJECT NO:	7-817-005206
FIGURE NO:	2

LOG OF BORING NO. B-1

Project Name: **U of U School of Business**
Location: **University of Utah Campus**
Salt Lake City, UT
Project No: **7-817-005206**

Date Drilled: **6/5/07**
Rig Type: **CT-250**
Drilled By: **A Cache**
Logged By: **D. DeDen**

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Surface El.:

Elevation, feet	Depth, feet	Graphic Log	MATERIAL DESCRIPTION	Samples	Penetration Blows / Foot	Recovery, in	Unit Dry Weight, pcf	Water Content, %	% Passing No. 200 Sieve	Liquid Limit	Plasticity Index	REMARKS
	0		**SILT with Sand and Gravel [ML]** medium dense, dark brown, moist, with large roots									
	2.0		**Silty GRAVEL with Sand [GM]** very dense, brown, moist, with occasional cobble									
	5			D-1	100/5"	4/5						
	7.0		**Silty SAND [SM]** very dense, brown, moist									
	10			D-2	126	8/18						
	15		with more sand	D-3	185	14/18						
	20			D	100/4"	0/4						
	21.5		**Sandy Lean CLAY with Gravel [CL]** medium stiff, brown, moist									
	25											

Remarks:

Water Level Observations	
▽	
▼	

The discussion in the report is necessary for a proper understanding of the nature of subsurface materials.

Figure 3A

LOG OF BORING NO. B-1

Project Name:	U of U School of Business	Date Drilled:	6/5/07
Location:	University of Utah Campus Salt Lake City, UT	Rig Type:	CT-250
		Drilled By:	A Cache
Project No:	7-817-005206	Logged By:	D. DeDen

Sheet 2 of 2

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Surface El.:

Elevation, feet	Depth, feet	MATERIAL DESCRIPTION	Samples	Penetration Blows / Foot	Recovery, in	Unit Dry Weight, pcf	Water Content, %	% Passing No. 200 Sieve	Liquid Limit	Plasticity Index	REMARKS
	25.5		D-4	67	15/18						
	25.5–27.5	**Silty GRAVEL with Sand [GM]** dense, brown, moist									
	27.5–32.0	**Sandy SILT with Gravel [ML]** medium stiff to stiff, brown to white, wet									
	30		D-5	66	16/18						
	32.0–37.0	**Silty SAND [SM]** very dense, brown, moist									
	35		D-6	193	15/18						
	37.0–42.0	**Silty GRAVEL with Sand [GM]** very dense, brown, moist									
	40		D-7	78/11"	16/17						
	42.0–46.0	**Silty SAND with Gravel [SM]** very dense, brown, moist, with layers of cleaner sand									
	45		D-8	104	16/18						
	46.0	Stopped augering at 44.5' Stopped sampling at 46' No groundwater encountered									
	50										

Remarks:

Water Level Observations	
∇	
▼	

The discussion in the report is necessary for a proper understanding of the nature of subsurface materials.

Figure 3A

LOG OF BORING NO. B-2

Project Name:	U of U School of Business	Date Drilled:	6/8/07
Location:	University of Utah Campus, Salt Lake City, UT	Rig Type:	CT-250
		Drilled By:	A Cache
Project No:	7-817-005206	Logged By:	D. DeDen

Sheet 1 of 2

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Surface El.:

Elevation, feet	Depth, feet	Graphic Log	MATERIAL DESCRIPTION	Samples	Penetration Blows / Foot	Recovery, in	Unit Dry Weight, pcf	Water Content, %	% Passing No. 200 Sieve	Liquid Limit	Plasticity Index	REMARKS
	0		**SILT with Sand and Gravel [ML]** medium dense, dark brown, moist, with large roots									
	2.0		**Silty GRAVEL with Sand [GM]** very dense, brown, moist, with occasional cobble									
	5			D-1	100/4"	8/10			20	NP	NP	
	10			D-2	96/10"	8/16						
	15			D-3	103	16/18						
	20			D-4	100/4"	6/10						
	25			D	100/6"	0/6						

Remarks:

Water Level Observations	
∇	
▼	

The discussion in the report is necessary for a proper understanding of the nature of subsurface materials.

Figure 3B

LOG OF BORING NO. B-2

Project Name: U of U School of Business
Location: University of Utah Campus
Salt Lake City, UT
Project No: 7-817-005206 Sheet 2 of 2

Date Drilled: 6/8/07
Rig Type: CT-250
Drilled By: A Cache
Logged By: D. DeDen

amec

Elevation, feet	Depth, feet	Graphic Log	Surface El.: MATERIAL DESCRIPTION	Samples	Penetration Blows / Foot	Recovery, in	Unit Dry Weight, pcf	Water Content, %	% Passing No. 200 Sieve	Liquid Limit	Plasticity Index	REMARKS
			29.2	D-5	190/8"	6/14						
	30		Stopped augering at 28.0' Stopped sampling at 29.2' No groundwater encountered									
	35											
	40											
	45											
	50											

Remarks:

Water Level Observations	
∇	
▼	

The discussion in the report is necessary for a proper understanding of the nature of subsurface materials.

Figure 3B

AMEC.SLC.BORING.1.BASE 77-5206.GINT LOGS.U OF U SCHOOL OF BUSINESS.GPJ LAGNNN10.GDT 6/29/07

LOG OF BORING NO. B-3

Project Name: U of U School of Business
Location: University of Utah Campus
Salt Lake City, UT
Project No: 7-817-005206
Sheet 1 of 2

Date Drilled: 6/12/07
Rig Type: CT-250
Drilled By: A Cache
Logged By: D. DeDen

amec

Surface El.:

Elevation, feet	Depth, feet	Graphic Log	MATERIAL DESCRIPTION	Samples	Penetration Blows / Foot	Recovery, in	Unit Dry Weight, pcf	Water Content, %	% Passing No. 200 Sieve	Liquid Limit	Plasticity Index	REMARKS
	0		**SILT with Sand and Gravel [ML]** loose to medium dense, brown, moist, with large roots, topsoil to 3"									
	2.5		**Silty GRAVEL with Sand [GM]** very dense, brown to reddish brown, damp to moist, with occasional cobble									
	5			D-1	87/11"	9/17		8				
	10			D-2	89/10"	10/16		2				
	15		dense, moist	D-3	100	12/18		4	11			
	20		very dense, brown, damp	D-4	143	13/18		6				
	25											

Remarks:

Water Level Observations	
▽	
▼	

The discussion in the report is necessary for a proper understanding of the nature of subsurface materials.

Figure 3C

LOG OF BORING NO. B-3

Project Name: U of U School of Business
Location: University of Utah Campus
Salt Lake City, UT
Project No: 7-817-005206 Sheet 2 of 2

Date Drilled: 6/12/07
Rig Type: CT-250
Drilled By: A Cache
Logged By: D. DeDen

amec

Surface El.:

Elevation, feet	Depth, feet	Graphic Log	MATERIAL DESCRIPTION	Samples	Penetration Blows / Foot	Recovery, in	Unit Dry Weight, pcf	Water Content, %	% Passing No. 200 Sieve	Liquid Limit	Plasticity Index	REMARKS
				D	100/5"	0/5						
	30		wet									
				D-5	122/10"	15/16	128	6				
	35			D-6	100/5"	10/11						
	35.9		Drilling terminated due to dense soils at 35' Stopped sampling at 35.9' Possible perched groundwater table at 31'									
	40											
	45											
	50											

Remarks:

Water Level Observations	
▽	
▼	

The discussion in the report is necessary for a proper understanding of the nature of subsurface materials.

Figure 3C

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APPENDIX A

FIELD EXPLORATIONS

APPENDIX A

FIELD EXPLORATIONS - BORINGS

General

Subsurface materials and conditions at the project site were investigated on June 5, 8, and 12, 2007 with 3 borings designated B-1 through B-3. The approximate locations of the borings are shown on Figure 2, Site Plan. All field operations were observed by a senior technician provided by our firm, who maintained a detailed log of the materials and conditions encountered in each boring and directed the sampling operations.

Borings

The borings were drilled with a truck-mounted SIMCO 2800 drill rig provided and operated by A Cache of Mendon, Utah. The borings were advanced to depths ranging from 29.2 to 46 feet below grade using hollow-stem auger drilling and sampling techniques. Disturbed samples were obtained from the borings at 3 to 5-foot intervals of depth. Disturbed samples were obtained using a 3-inch O.D. Dames & Moore sampler. At the time of sampling, the Standard Penetration Test was conducted. This test consists of driving the split-barrel sampler into the soil a distance of 18 inches using a 140-lb hammer falling from a height of 30 inches. The number of blows required to drive the sampler the last 12 inches is recorded as the penetration resistance. The penetration resistance provides a measure of the relative density of granular soils, such as sand, and the relative consistency, or stiffness, of cohesive soils, such as silt. It should be recognized that penetration resistance values tend to overestimate the relative density of coarse granular soils, such as those containing significant amounts of gravel and cobble-sized particles. The soil samples obtained in the split-spoon sampler were carefully examined in the field, and representative portions were saved in airtight containers for further examination and physical testing in our laboratory.

Logs of the borings are shown on Figures 3A through 3C, Log of Borings. Each log presents a descriptive summary of the various types of material encountered and notes the depth where the materials and/or characteristics of the materials change. To the right of the descriptive summary, the numbers and types of samples taken during the drilling operation are indicated. The terms used to describe the soils are defined on Figure 4, Soil Classification Chart & Legend.

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APPENDIX B

LABORATORY TESTING

APPENDIX B

LABORATORY TESTING

General

All samples obtained from the field were transported to our laboratory for examination and testing. The physical characteristics were noted, and the field classifications were modified where necessary. The laboratory testing program was conducted to provide data for our engineering analyses. The laboratory program included determinations of natural moisture content, unit weight, washed sieve analyses, Atterberg Limits, and consolidation tests. The following sections describe the testing program in more detail.

Natural Moisture Content

Natural moisture content determinations were made in general conformance with ASTM D 2216. The results are presented on Figures 3A through 3C, Log of Borings.

Unit Weight

The dry unit weight, or density, of undisturbed soil samples was determined in the laboratory in general conformance with ASTM D 2937.

Percent Passing the No. 200 Sieve (Washed Sieve Analysis)

The silt and clay content (percent passing the No. 200 sieve) were evaluated for selected soil samples in general conformance with ASTM D 1140. Oven-dried samples were weighed and placed on the No. 200 sieve. The silt and clay were washed through the sieve, and the sample remaining on the sieve was oven-dried and weighed. The change in sample weight is used to calculate the percent of material passing the No. 200 sieve.

Gradation Tests

Gradation tests were preformed on selected samples in general accordance with ASTM C 136 to aid in classifying soils. The oven-dried samples were weighed and vibrated through a series of different size sieves. The individual sieves were then weighed in order to calculate the percentage of gravel, sand and fine grained material.

Atterberg Limits

Atterberg Limit tests were performed in general accordance with ASTM D 4318 on several representative samples of the native soils encountered at the site to verify field classifications.

One-Dimensional Consolidation Tests

Consolidation tests were performed in general accordance with ASTM D 2435 to obtain data on the compressibility characteristics of samples of relatively undisturbed soil.

Chemical Tests

Chemical tests were conducted on selected samples collected from the site. Water Soluble Sulfate tests were performed by TEI Testing Services, Inc. of Salt Lake City, Utah.