REPORT
GEOTECHNICAL STUDY
PROPOSED DAVIS MEATS BUILDING
2069 SOUTH 7500 WEST STREET
OGDEN, UTAH

Submitted To:

Lakeside Holdings
Attention: Mr. Joann Balay
1402 South 4700 West
Ogden, Utah

Submitted By:

GSH Geotechnical, Inc.
1596 West 2650 South
Ogden, Utah 84401

August 8, 2016

Job No. 2196-01N-16

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Ms. Joann Balay
Lakeside Holdings
1402 South 4700 West
Ogden, Utah 84401

Ms. Davis:

Re: Report
Geotechnical Study
Proposed Davis Meats Building
2069 South 7500 West Street
Ogden, Utah
(41.2304° N; 112.1645° W)

1. INTRODUCTION

1.1 GENERAL

This report presents the results of our geotechnical study performed for the proposed Davis Meats commercial building to be located at 2069 South 7500 West Street in Ogden, Utah. The general location of the site with respect to major roadways, as of 2014, is presented on Figure 1, Vicinity Map. A more detailed layout of the site showing the locations of proposed and existing facilities and roadways is presented on Figure 2, Site Plan. The locations of the boring drilled and test pits excavated in conjunction with this study are also presented on Figure 2.

1.2 OBJECTIVES AND SCOPE

The objectives and scope of our study were planned in discussions between Mr. Brent Davis and Ms. Joann Balay of Lakeside Holdings and Mr. Andrew Harris 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.

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

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

1. A field program consisting of the drilling, logging, and sampling of 1 boring and the logging and sampling 2 test pits.

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 returning a signed copy of our Professional Services Agreement No. 16-0670N dated June 27, 2016.

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 boring and test pits, projected groundwater conditions, and the layout and design data discussed in Section 2, Proposed Construction, of this report. If subsurface conditions other than those described in this report are encountered and/or if design and layout changes are implemented, GSH must be informed so that our recommendations can be reviewed and amended, if necessary.

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

2. PROPOSED CONSTRUCTION

The subject property is located at 2069 South 7500 West Street in Ogden, Utah. The proposed 3,375 square foot commercial building will consist of steel post and beam construction supported on conventional spread footings, with slab on grade concrete floors established at or near existing site grades. Maximum projected loads are 100,000 pounds for columns and 5,000 pounds per lineal foot for walls.

Associated parking/drive areas around the building will be constructed of gravel pavement with moderate projected traffic that includes primarily passenger vehicles and daily medium-weight trucks as well as daily semi-tractor/trailer.

Site development will require a moderate amount of earthwork in the form of site grading. We estimate in general that maximum cuts and fills to achieve design grades will be on the order of 1 to 3 feet.

3. INVESTIGATIONS

3.1 FIELD PROGRAM

In order to define and evaluate the subsurface soil and groundwater conditions at the site, 1 boring was drilled to a depth of about 31.5 feet below existing grade. Additionally 2 test pits were excavated to depths of about 8.5 to 9.0 feet below the existing grade within the proposed development area. The boring was drilled using a truck-mounted drill rig and hollow-stem augers. The test pits were excavated using a rubber tire mounted backhoe. Locations of the boring and test pits are presented on Figure 2.

The field portion of our study was under the direct control and continual supervision of an experienced member of our geotechnical staff. During the course of the excavating and drilling operations, a continuous log of the subsurface soil conditions encountered was maintained. In addition, samples of the typical soils encountered were obtained and placed in sealed bags and plastic containers for subsequent laboratory testing and examination. The soils were classified in the field based upon visual and textural examination. These classifications have been supplemented by subsequent inspection and testing in our laboratory. Detailed graphical representation of the subsurface conditions encountered is presented on Figure 3A, Boring Log, and on Figures 4A and 4B, Test Pit Log. Soils were classified in accordance with the nomenclature described on Figure 5, Key to Boring Log (USCS) and on Figure 6, Key to Test Pit Log (USCS).

A 2.0-inch outside diameter, 1.38-inch inside diameter drive sampler (SPT) was utilized in the subsurface soil sampling at select locations within the boring. 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.

Bulk soil samples were recovered from the excavated material at various depths from the test pits.

Following completion of drilling and excavation operations, one and one-quarter-inch diameter slotted PVC pipe was installed in boring B-1 in order to provide a means of monitoring the groundwater fluctuations. The boring was backfilled with auger cuttings. Following completion of excavating and logging, each test pit was backfilled. Although an effort was made to compact the backfill with the trackhoe, backfill was not placed in uniform lifts and compacted to a specific density. Consequently, the backfill soils must be considered as non-engineered and settlement of the backfill with time is likely to occur.

3.2 LABORATORY TESTING

3.2.1 General

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

3.2.2 Partial Gradation Test

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

Boring/Test Pit No.	Depth (feet)	Percent Passing No. 200 Sieve	Soil Classification
B-1	2.5	46	SM/ML
B-1	5.0	76	ML
B-1	7.5	9	SP-SM
B-1	10.0	25	SM
B-1	15.0	67	CL
B-3	25	55	CL/SC
TP-1	6.5	54	SM/ML
TP-2	4.0	98	ML

3.2.3 Atterberg Limit Tests

To aid in classifying the soils, Atterberg limit tests were performed on a sample of the silty-sand soils. Results of the test are tabulated below:

Boring No.	Depth (feet)	Liquid Limit (percent)	Plastic Limit (percent)	Plasticity Index (percent)	Soil Classification
B-1	15.0	55	23	32	CH
B-1	25.0	44	23	21	CL

4. SITE CONDITIONS

4.1 SURFACE

The subject property is a rectangular shaped parcel located at 2069 South 7500 West Street in Ogden, Utah. The surface of the site is vegetated with various grasses and weeds. The topography of the site is relatively flat with a slight slope to the west with a total elevation change of about 4 feet over the site. The site is bound by undeveloped property to the north, south, and west, and by undeveloped property and rural residences followed by 7500 West to the east.

4.2 SUBSURFACE SOIL AND GROUNDWATER

Subsurface conditions encountered at the boring and test pit locations within the proposed development area varied slightly across the site. At boring and test pit locations, topsoil and disturbed soils were encountered at the surface of the site extending to about 6 inches below existing grades. Natural soils were encountered beneath the topsoil and disturbed soils to the full depth penetrated, about 8.5 to 31.5 feet, and consisted of fine to medium sands with varying silt content to a depth of about 12 feet, and a silty clay with traces of fine to medium sand to the full depth of the boring, about 31.5 feet.

The sand soils encountered were loose to medium dense, dry to saturated, brown to grey in color, and will generally exhibit moderate strength and moderate compressibility characteristics under the anticipated static loading.

The fine grained silty clay soils encountered were very soft to medium stiff, saturated, dark grey in color, and will exhibit slightly moderate to moderate strength and moderate to moderately high compressibility characteristics.

For a more detailed description of the subsurface soils encountered, please refer to Figures 3A, Boring Log, and Figures 4A and 4B, Test Pit Log. The lines designating the interface between soil types on the boring and test pit logs generally represent approximate boundaries. In-situ, the transition between soil types may be gradual.

4.3 Groundwater

Groundwater was encountered at about 7.0 to 8.0 feet below existing site grades at the boring and test pit locations at the time of our field exploration. Static groundwater measurements were taken on Monday July 18, 2016, (about 10 days following the drilling of individual borings). The results of these measurements are tabulated on the following page.

Boring No.	Static Groundwater Level Below Existing Grade (feet) July 18, 2016
B-1	6.4

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. The contractor should be prepared to dewater excavations as needed. Depending on the time of year construction occurs, the relatively shallow groundwater levels could affect construction of deeper utilities.

5. DISCUSSIONS AND RECOMMENDATIONS

5.1 SUMMARY OF FINDINGS

The results of our analyses indicate that the proposed building may be supported upon conventional spread and/or continuous wall foundations established upon suitable natural soils or granular structural fill extending to suitable natural soils. The most significant geotechnical aspects of the site are the moderate strength characteristics of the near surface soils encountered at the site, the relatively shallow groundwater, and the liquefaction potential of the loose, saturated sands encountered at the site.

Static groundwater was measured at 6.4 feet below the surface at Boring B-1. This depth to groundwater encountered at the boring locations may affect the installation of deeper utilities. Due to the relatively shallow groundwater, site grading cuts should be kept to the minimum necessary to remove non-engineered soils/un-suitable soils and no deeper than 1.5 feet above measured groundwater, without incorporating a land drain. Additionally, subgrade stabilization of very moist to saturated soils must be anticipated for foundation excavations within 2 feet of the measured groundwater.

Our calculations indicate that there are layers of silty sand soils encountered at Borings B-1 at depths of about 6.5 to 12.5 feet below existing site grades which could liquefy during the design seismic event. Associated settlements were calculated on the order of less than 1 inch. This magnitude of settlement should be tolerable to design for life safety. Ground rupture and lateral spread are not expected to occur.

The on-site soils may be re-utilized as structural site grading fill if they meet the requirements for such, as stated herein. However, it must be noted that from a handling and compaction standpoint, soils containing high amounts of fines (silts and clays) are very sensitive to changes in moisture content and will require very close moisture control during placement and compaction and are inherently more difficult to compact. <u>This will be very difficult, if not impossible, during wet and cold periods of the year.</u>

A geotechnical engineer from GSH will need to verify that all topsoil/disturbed soils have been completely removed prior to the placement of structural site grading fills, floor slabs, footings, foundations, or rigid pavements.

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

5.2 EARTHWORK

5.2.1 Site Preparation

Initial site preparation will consist of the removal of surface vegetation, topsoil, and other deleterious materials from beneath an area extending out at least 3 feet from the perimeter of the proposed buildings, pavements, and exterior flatwork areas. Surface vegetation and other deleterious materials should generally be removed from the site. Topsoil, although unsuitable for utilization as structural fill, may be stockpiled for subsequent landscaping purposes.

Additional site preparation will consist of the removal of non-engineered fills (if encountered) from an area extending out at least 3 feet from the perimeter of the proposed structure.

The non-engineered fills may remain in asphalt pavement and sidewalk areas as long as they are properly prepared. Rigid pavements are not recommended to be placed over the non-engineered fill soils.

Proper preparation shall consist of scarifying, moisture conditioning, and re-compacting the upper 12 inches to the requirements for structural fill. As an option to proper preparation and recompaction, the upper 12 inches of non-engineered fill (where encountered) may be removed and replaced with granular subbase containing a maximum 20 percent fines over proofrolled subgrade. Even with proper preparation, pavements established overlying non-engineered fills may encounter some long-term movements unless the non-engineered fills are completely removed.

Subsequent to stripping and prior to the placement of structural site grading fill, pavements, driveway and garage slabs on grade, the prepared subgrade must be proofrolled by passing moderate-weight rubber tire-mounted construction equipment over the surface at least twice. If excessively soft or loose soils are encountered, they must be removed to a maximum depth of 2 feet and replaced with structural fill. Beneath footings, all loose and disturbed soils must be totally removed. Where the subgrade is within 2 feet of measured groundwater, proofrolling is not recommended and the exposed subgrade must be visually inspected for loose/soft/ un-suitable soils.

Subgrade stabilization of very moist to saturated soils must be anticipated for foundation excavations within 2 feet of the measured groundwater.

5.2.2 Excavations

Temporary excavations up to 8 feet deep in fine-grained cohesive soils, above or below the water table, may be constructed with sideslopes no steeper than one-half horizontal to one vertical (½H:1V). Excavations deeper than 8 feet are not anticipated at the site.

For granular (cohesionless) soils, construction excavations above the water table, not exceeding 4 feet, should be no steeper than one-half horizontal to one vertical (½H:1V). For excavations up to 8 feet, in granular soils and above the water table, the slopes should be no steeper than one horizontal to one vertical (1H:1V). Excavations encountering saturated cohesionless soils will be very difficult and will require very flat sideslopes and/or shoring, bracing and dewatering.

To reduce disturbance of the natural soils during excavation, it is recommended that smooth edge buckets/blades be utilized.

All excavations must be inspected periodically by qualified personnel. If any signs of instability or excessive sloughing 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 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. 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. In confined areas, the maximum particle size should generally be restricted to 2.5 inches.

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

Only granular soils are recommended in confined areas such as utility trenches, footing excavations, etc. Generally, we recommend that all imported granular structural fill consist of a well-graded mixture of sands and gravels with no more than 20 percent fines (material passing the No. 200 sieve) and less than 30 percent retained on the 3/4 inch sieve. The plasticity index of import fine-grained soil should not exceed 18 percent.

To stabilize soft subgrade conditions or where structural fill is required to be placed closer than 1.0 to 2.0 feet above the water table at the time of construction, a mixture of coarse gravels and cobbles and/or 1.5- to 2.0-inch gravel (stabilizing fill) should be utilized. It may also help to

utilize a stabilization fabric, such as Mirafi 600X or equivalent, placed on the native ground if 1.5- to 2.0-inch gravel is used as stabilizing fill.

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 ASTM[1] D-1557 (AASHTO[2] T-180) 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 8	95
Site Grading Fills outside area defined above	0 to 5	90
Site Grading Fills outside area defined above	5 to 8	95
Trench Backfill	--	96
Pavement granular base/subbase	--	96

Structural fills greater than 8 feet thick are not anticipated at the site.

Subsequent to stripping and prior to the placement of structural site grading fill, the subgrade should be prepared as discussed in Section 5.2.1, Site Preparation, of this report. In confined areas, subgrade preparation should consist of the removal of all loose or disturbed soils.

Site grading fills must be placed on relatively flat surfaces. Proper benching of slopes will be required to facilitate fill placement.

If utilized for stabilizing fill, coarse gravel and cobble mixtures should be end-dumped, spread to a maximum loose lift thickness of 15 inches, and compacted by dropping a backhoe bucket onto the surface continuously at least twice. As an alternative, the fill may be compacted by passing moderately heavy construction equipment or large self-propelled compaction equipment at least twice. Subsequent fill material placed over the coarse gravels and cobbles should be adequately

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

compacted so that the "fines" are "worked into" the voids in the underlying coarser gravels and cobbles.

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 2 feet below design finish grade) and replaced with structural fill.

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

The natural or imported silt/clay soils are not recommended for use as trench backfill, particularly in structurally loaded areas.

5.3 SPREAD AND CONTINUOUS WALL FOUNDATIONS

5.3.1 Design Data

The proposed structure may be supported upon conventional spread and continuous wall foundations established upon suitable natural soils and/or structural fill extending to suitable natural soils. 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	- 24 inches

Recommended Net Bearing Pressure for Real Load Conditions	- 2,000 pounds per square foot
Bearing Pressure Increase for Seismic Loading	- 50 percent

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

Footings shall not be installed upon soft or disturbed soils, non-engineered fill, construction debris, frozen soil, or within ponded water. If the granular structural fill upon which the footings are to be established become disturbed, it shall be recompacted to the requirements for structural fill or be removed and replaced with structural fill.

The width of structural fill, where placed below footings, shall extend laterally at least 6 inches beyond the edges of the footings in all directions for each foot of fill thickness beneath the footings. For example, if the width of the footing is 2 feet and the thickness of the structural fill beneath the footing is 1.5 feet, the width of the structural fill at the base of the footing excavation would be a total of 3.5 feet, centered below the footing.

5.3.3 Settlements

Maximum settlements of foundations designed and installed in accordance with recommendations presented herein and supporting maximum anticipated loads as discussed in Section 2, Proposed Construction, are anticipated to be 1 inch or less.

Approximately 40 percent of the quoted settlement should occur 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..35 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 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, loose or disturbed soils, sod, rubbish, construction debris, other deleterious materials, frozen soils, or within ponded water. In order to facilitate construction and curing of the concrete, it is recommended that floor slabs be directly underlain by 4 inches of "free-draining" fill, such as "pea" gravel or three-quarters- to one-inch minus clean gap-graded gravel.

Settlement of lightly loaded floor slabs (average uniform pressure of 200 pounds per square foot or less) is anticipated to be less than 1/2 inch.

The tops of all floor slabs in habitable areas must be established no deeper than 1.5 feet below the existing ground surface, or at least 2 feet above the highest anticipated normal water level or the maximum groundwater level controlled by subdrains.

Construction of floor slabs should be in sections 10 to 12 feet in width with construction or expansion joints or 0.25 depth saw-cuts on no more than 12-foot centers. Saw-cuts must be completed within 24 hours of the "initial set" of the concrete and should be performed under the direction of the concrete paving contractor. The concrete should have a minimum 28-day unconfined compressive strength of 4,000 pounds per square inch and contain 6 percent ±1 percent air-entrainment.

5.6 GEOSEISMIC SETTING

5.6.1 General

Utah municipalities have adopted the International Building Code (IBC) 2015. The IBC 2015 code determines the seismic hazard for a site based upon 2008 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 2015 edition.

5.6.2 Faulting

Based upon our review of available literature, no active faults are known to pass through or immediately adjacent to the site. The nearest active fault is the Wasatch Fault, approximately 11.6 miles east of the site.

5.6.3 Soil Class

Static groundwater was measured 10 days after drilling at depths 6.4 feet below the existing ground surface. Loose to medium dense, saturated silty sand soils were encountered in boring B-

1 completed at the site between depths of about 6.5 to 12.5 feet below the existing ground surface.

Our analysis shows that layers of these saturated sand soils could liquefy during the design seismic event (see Section 5.10.5, Liquefaction). According to the IBC 2015, which references ASCE-7-10, Chapter 20, "Soils vulnerable to potential failure or collapse under seismic loading such as liquefiable soils..." are designated under site Class F. However, the potential settlements due to liquefaction are anticipated to be less than 1 inch at the top of the layer. This magnitude of settlement can typically be tolerated by an adequately designed structure to protect life safety. Therefore, we recommend the site be designated under Site Class D - Stiff Soil Profile for design.

5.6.4 Ground Motions

The IBC 2012 code is based on 2008 USGS mapping, which provides values of short and long period accelerations for the Site Class B boundary for the Maximum Considered Earthquake (MCE). This Site Class B boundary represents average bedrock values for the Western United States and must be corrected for local soil conditions. The following table summarizes the peak ground and short and long period accelerations for the MCE event and incorporates the appropriate soil amplification factor for a Site Class D soil profile. Based on the site latitude and longitude (41.2304 degrees north and 112.1645 degrees west, respectively), the values for this site are tabulated below:

Spectral Acceleration Value, T	Site Class B Boundary [mapped values] (% g)	Site Coefficient	Site Class D [adjusted for site class effects] (% g)	Design Values (% g)
Peak Ground Acceleration	38.9	F_a = 1.111	43.2	28.8
0.2 Seconds (Short Period Acceleration)	S_S = 97.3	F_a = 1.111	S_{MS} = 108.1	S_{DS} = 72.1
1.0 Second (Long Period Acceleration)	S_1 = 32.9	F_v = 1.742	S_{M1} = 57.3	S_{D1} = 38.2

5.6.5 Liquefaction

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

Calculations performed used the procedures described in NCEER-97-0022 entitled, "Proceedings of the NCEER Workshop on Evaluation of Liquefaction Resistance of Soils," and only apply to the saturated cohesionless deposits. Analyses indicate that the saturated silty sand soils encountered between depths of about 6.5 to 12.5 feet below the existing ground surface could

liquefy under a major seismic event. A threshold acceleration of 0.32g is required for liquefaction to occur. Maximum anticipated settlement resulting from the liquefaction is less than 1 inch. This magnitude of settlement can typically be tolerated by an adequately designed structure to protect life safety. If such movements cannot be handled by the structural components of the building, ground improvement may be necessary. GSH can provide ground improvement recommendations if desired.

5.7 SITE OBSERVATIONS

As stated previously, prior to placement of foundations, floor slabs, pavements, and site grading fills, a geotechnical engineer from GSH must verify that all fill material, topsoil and disturbed soils have been removed and suitable subgrade conditions have been encountered. Additionally, GSH must observe fill placement and verify in-place moisture content and density of fill materials placed at the site.

5.8 CLOSURE

If you have any questions or would like to discuss these items further, please feel free to contact us at (801) 393-2012.

Respectfully submitted,

GSH Geotechnical, Inc.

Jed McFarlane, E.I.T.
Staff Geotechnical Engineer

Reviewed by:

LICENSED PROFESSIONAL ENGINEER
ANDREW MICHAEL HARRIS
No. 7420456
STATE OF UTAH

Andrew M. Harris, P.E.
State of Utah No. 7420456
Senior Geotechnical Engineer

JM/BNR:mmh

Encl. Figure 1, Vicinity Map
Figure 2, Site Plan
Figures 3A Boring Log
Figures 4A and 4B, Test Pit Log
Figure 5, Key to Boring Log (USCS)
Figure 6, Key to Test Pit Log (USCS)

Addressee (email)

LAKESIDE HOLDINGS
JOB NO. 2196-01N-16

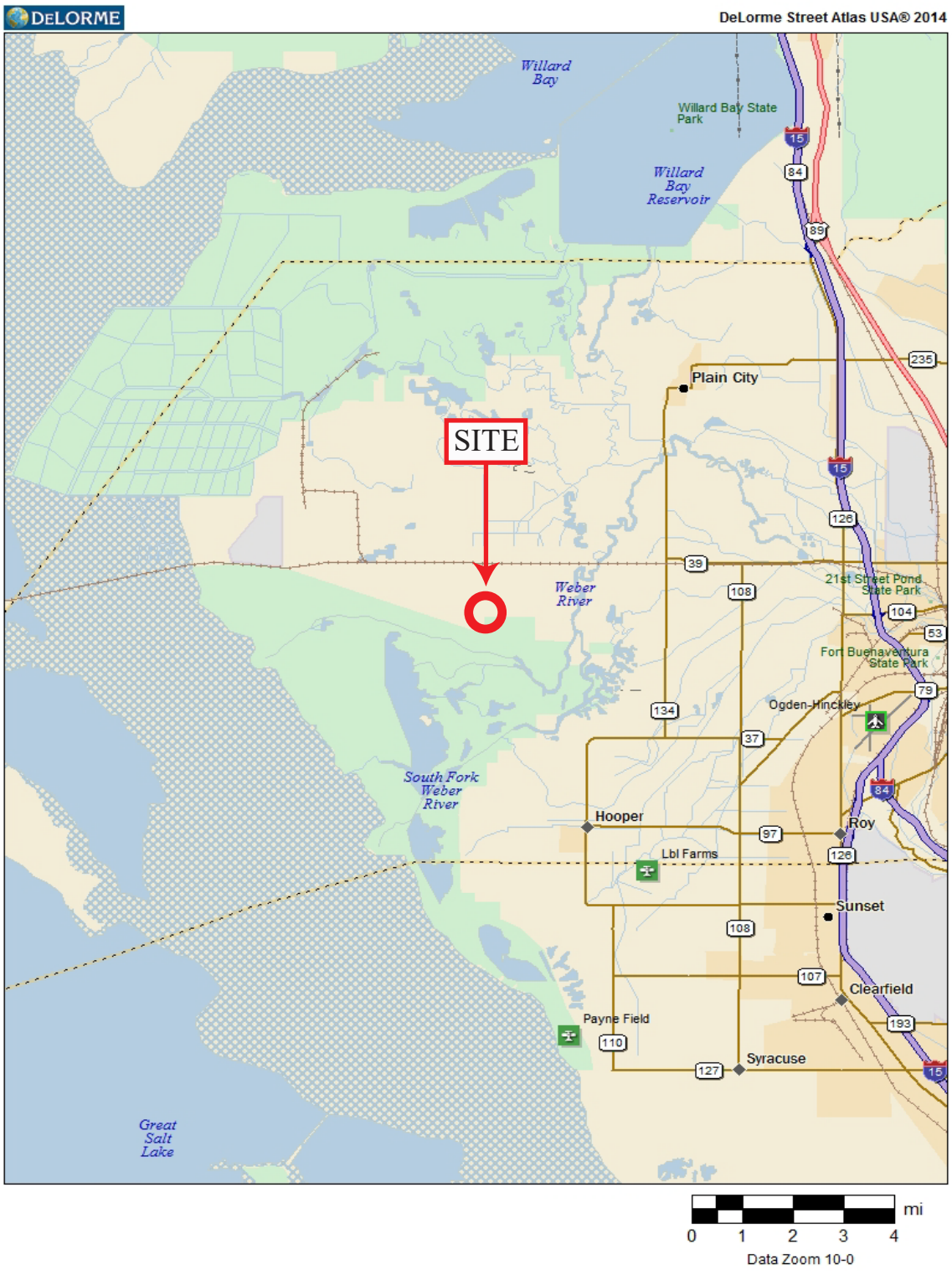

FIGURE 1
VICINITY MAP

REFERENCE:
DELORME STREET ATLAS

GSH

LAKESIDE HOLDINGS
JOB NO. 2196-01N-16

Scale ~ 1" =20'

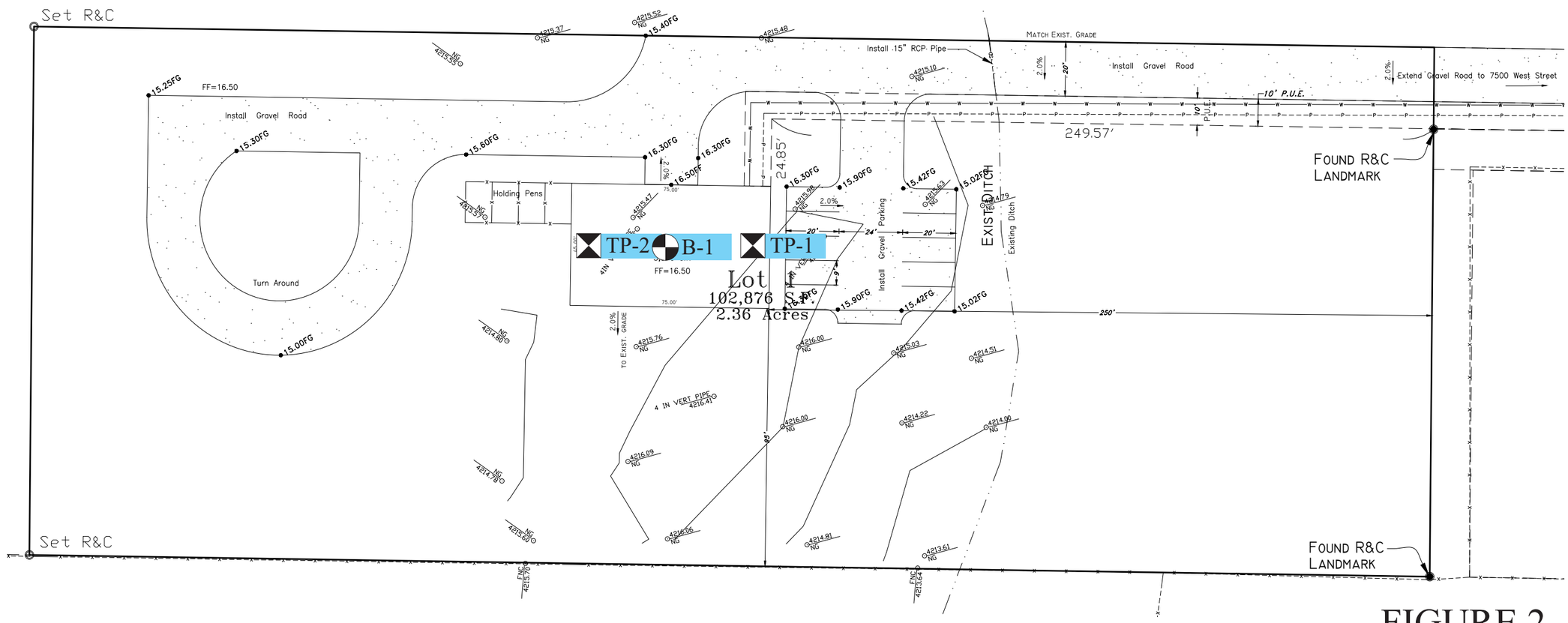

FIGURE 2
SITE PLAN

REFERENCE:
ADAPTED FROM DRAWING ENTITLED SITE PLAN
BY LANDMARK SURVERYING, INC., DATED MAY 20, 2016

GSH

BORING LOG

Page: 1 of 2

BORING: B-1

CLIENT: Lakeside Holdings | PROJECT NUMBER: 2196-01N-16

PROJECT: Proposed Davis Meats Building | DATE STARTED: 7/8/16 | DATE FINISHED: 7/8/16

LOCATION: About 2069 South 7500 West, Ogden, Utah | GSH FIELD REP.: JM

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

GROUNDWATER DEPTH: 7.5' (7/8/16), 6.4' (7/18/16) | 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								
	SP/SM	FINE SAND with some silt; trace organics; light brown		10							dry loose
				8				46			slightly moist
			5								
		grades with interbedded layers of silt		10				76			moist
▼											
		grades gray		14				9			saturated dense
			10								
				8				25			loose
	CL	SILTY CLAY with trace fine to medium sand; dark gray									saturated very soft
			15								
				1				67	55	32	
			20								
				5							medium stiff
			25								

See Subsurface Conditions section in the report for additional information.

FIGURE 3A

GSH

BORING LOG

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BORING: B-1

CLIENT: Lakeside Holdings | PROJECT NUMBER: 2196-01N-16

PROJECT: Proposed Davis Meats Building | DATE STARTED: 7/8/16 | DATE FINISHED: 7/8/16

WATER LEVEL	USCS	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
			25								
				1				55	44	21	very soft
			30								
				3							
		End of Exploration at 31.5' Installed 1.25" diameter slotted PVC pipe to 30.0'	35								
			40								
			45								
			50								

See Subsurface Conditions section in the report for additional information.

FIGURE 3A
(continued)

TEST PIT LOG

Page: 1 of 1

TEST PIT: TP-1

CLIENT: Lakeside Holdings | PROJECT NUMBER: 2196-01N-16

PROJECT: Proposed Davis Meats Building | DATE STARTED: 7/8/16 | DATE FINISHED: 7/8/16

LOCATION: About 2069 South 7500 West, Ogden, Utah | GSH FIELD REP.: JM

EXCAVATING METHOD/EQUIPMENT: CAT 430D - Backhoe

GROUNDWATER DEPTH: 8.0' (7/8/16) | ELEVATION: ---

WATER LEVEL	USCS	DESCRIPTION	DEPTH (FT.)	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0							
	SM/ ML	SILTY FINE TO MEDIUM SAND/SANDY SILT with trace roots; brown								moist medium dense
			5							
							54			very moist
▼		grades gray								saturated
		End of Exploration at 8.5' No significant sidewall caving	10							
			15							
			20							
			25							

See Subsurface Conditions section in the report for additional information.

FIGURE 4A

TEST PIT LOG

Page: 1 of 1

TEST PIT: TP-2

CLIENT: Lakeside Holdings
PROJECT NUMBER: 2196-01N-16
PROJECT: Proposed Davis Meats Building
DATE STARTED: 7/8/16
DATE FINISHED: 7/8/16
LOCATION: About 2069 South 7500 West, Ogden, Utah
GSH FIELD REP.: JM
EXCAVATING METHOD/EQUIPMENT: CAT 430D - Backhoe
GROUNDWATER DEPTH: 7.0' (7/8/16)
ELEVATION: ---

WATER LEVEL	USCS	DESCRIPTION	DEPTH (FT.)	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0							
	SM	SILTY FINE TO MEDIUM SAND with trace roots; light brown								dry medium dense
										moist
			5							
▼		grades gray								saturated
		End of Exploration at 7.5' No significant sidewall caving								
			10							
			15							
			20							
			25							

See Subsurface Conditions section in the report for additional information.

FIGURE 4B

CLIENT: Lakeside Holdings
PROJECT: Proposed Davis Meats Building
PROJECT NUMBER: 2196-01N-16

KEY TO BORING LOG

WATER LEVEL	USCS	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSSING 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 measured groundwater table. See symbol below.

② **USCS:** (Unified Soil Classification System) Description of soils encountered; typical symbols are explained below.

③ **Description:** Description of material encountered; may include color, moisture, grain size, density/consistency,

④ **Depth (ft.):** Depth in feet below the ground surface.

⑤ **Blow Count:** Number of blows to advance sampler 12" beyond first 6", using a 140-lb hammer with 30" 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 dryweight of

⑧ **Dry Density (pcf):** The density of a soil measured in laboratory; expressed in pounds per cubic foot.

⑨ **% Passing 200:** Fines content of soils sample passing a No. 200 sieve; expressed as a percentage.

⑩ **Liquid Limit (%):** Water content at which a soil changes from plastic to liquid behavior.

⑪ **Plasticity 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. May include other field and laboratory test results using the following abbreviations:

CEMENTATION:

Weakly: Crumbles or breaks with handling or slight finger pressure.

Moderately: Crumbles or breaks with considerable finger pressure.

Strongly: Will not crumble or break with finger pressure.

MODIFIERS:

Trace <5%

Some 5-12%

With > 12%

MOISTURE CONTENT (FIELD TEST):

Dry: Absence of moisture, dusty, dry to the touch.

Moist: Damp but no visible water.

Saturated: Visible water, usually soil below water table.

Descriptions and stratum lines are interpretive; field descriptions may have been modified to reflect lab test results. Descriptions on the logs apply only at the specific boring locations and at the time the borings were advanced; they are not warranted to be representative of subsurface conditions at other locations or times.

UNIFIED SOIL CLASSIFICATION SYSTEM (USCS)

MAJOR DIVISIONS			USCS SYMBOLS	TYPICAL DESCRIPTIONS
COARSE-GRAINED SOILS More than 50% of material is larger than No. 200 sieve size.	GRAVELS More than 50% of coarse fraction retained on No. 4 sieve.	CLEAN GRAVELS (little or no fines)	GW	Well-Graded Gravels, Gravel-Sand Mixtures, Little or No Fines
			GP	Poorly-Graded Gravels, Gravel-Sand Mixtures, Little or No Fines
		GRAVELS WITH FINES (appreciable amount of fines)	GM	Silty Gravels, Gravel-Sand-Silt Mixtures
			GC	Clayey Gravels, Gravel-Sand-Clay Mixtures
	SANDS More than 50% of coarse fraction passing through No. 4 sieve.	CLEAN SANDS (little or no fines)	SW	Well-Graded Sands, Gravelly Sands, Little or No Fines
			SP	Poorly-Graded Sands, Gravelly Sands, Little or No Fines
		SANDS WITH FINES (appreciable amount of fines)	SM	Silty Sands, Sand-Silt Mixtures
			SC	Clayey Sands, Sand-Clay Mixtures
FINE-GRAINED SOILS More than 50% of material is smaller than No. 200 sieve size.	SILTS AND CLAYS Liquid Limit less than 50%		ML	Inorganic Silts and Very Fine Sands, Rock Flour, Silty or Clayey Fine Sands or Clayey Silts with Slight Plasticity
			CL	Inorganic Clays of Low to Medium Plasticity, Gravelly Clays, Sandy Clays, Silty Clays, Lean Clays
			OL	Organic Silts and Organic Silty Clays o f Low Plasticity
	SILTS AND CLAYS Liquid Limit greater than 50%		MH	Inorganic Silts, Micacious or Diatomacious Fine Sand or Silty Soils
			CH	Inorganic Clays of High Plasticity, Fat Clays
			OH	Organic Silts and Organic Clays of Medium to High Plasticity
HIGHLY ORGANIC SOILS			PT	Peat, Humus, Swamp Soils with High Organic Contents

Note: Dual Symbols are used to indicate borderline soil classifications.

STRATIFICATION:

DESCRIPTION	THICKNESS
Seam	up to 1/8"
Layer	1/8" to 12"
Occasional:	One or less per 6" of thickness
Numerous;	More than one per 6" of thickness

TYPICAL SAMPLER GRAPHIC SYMBOLS

- Bulk/Bag Sample
- Standard Penetration Split Spoon Sampler
- Rock Core
- No Recovery
- 3.25" OD, 2.42" ID D&M Sampler
- 3.0" OD, 2.42" ID D&M Sampler
- California Sampler
- Thin Wall

WATER SYMBOL

Water Level

FIGURE 5

GSH

CLIENT: Lakeside Holdings
PROJECT: Proposed Davis Meats Building
PROJECT NUMBER: 2196-01N-16

KEY TO TEST PIT LOG

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

COLUMN DESCRIPTIONS

① **Water Level:** Depth to measured groundwater table. See symbol below.

② **USCS:** (Unified Soil Classification System) Description of soils encountered; typical symbols are explained below.

③ **Description:** Description of material encountered; may include color, moisture, grain size, density/consistency,

④ **Depth (ft.):** Depth in feet below the ground surface.

⑤ **Sample Symbol:** Type of soil sample collected at depth interval shown; sampler symbols are explained below.

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

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

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

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

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

⑪ **Remarks:** Comments and observations regarding drilling or sampling made by driller or field personnel. May include other field and laboratory test results using the following abbreviations:

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

Descriptions and stratum lines are interpretive; field descriptions may have been modified to reflect lab test results. Descriptions on the logs apply only at the specific boring locations and at the time the borings were advanced; they are not warranted to be representative of subsurface conditions at other locations or times.

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			GP	Poorly-Graded Gravels, Gravel-Sand Mixtures, Little or No Fines
		GRAVELS WITH FINES (appreciable amount of fines)	GM	Silty Gravels, Gravel-Sand-Silt Mixtures
			GC	Clayey Gravels, Gravel-Sand-Clay Mixtures
	SANDS More than 50% of coarse fraction passing through No. 4 sieve.	**CLEAN SANDS** (little or no fines)	SW	Well-Graded Sands, Gravelly Sands, Little or No Fines
			SP	Poorly-Graded Sands, Gravelly Sands, Little or No Fines
		SANDS WITH FINES (appreciable amount of fines)	SM	Silty Sands, Sand-Silt Mixtures
			SC	Clayey Sands, Sand-Clay Mixtures
FINE-GRAINED SOILS More than 50% of material is smaller than No. 200 sieve size.	**SILTS AND CLAYS** Liquid Limit less than 50%		ML	Inorganic Silts and Very Fine Sands, Rock Flour, Silty or Clayey Fine Sands or Clayey Silts with Slight Plasticity
			CL	Inorganic Clays of Low to Medium Plasticity, Gravelly Clays, Sandy Clays, Silty Clays, Lean Clays
			OL	Organic Silts and Organic Silty Clays o f Low Plasticity
	SILTS AND CLAYS Liquid Limit greater than 50%		MH	Inorganic Silts, Micacious or Diatomacious Fine Sand or Silty Soils
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- 3.0" OD, 2.42" ID D&M Sampler
- California Sampler
- Thin Wall

WATER SYMBOL

Water Level

FIGURE 6

GSH