REPORT
GEOTECHNICAL STUDY
PROPOSED WELDING BUILDING
550 EAST 300 SOUTH
KAYSVILLE, UTAH

February 28, 2024

Job No. 003-053-24

Prepared for:
State of Utah – DFCM
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February 28, 2024
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State of Utah – DFCM
P.O. Box 141160
Salt Lake City, Utah 84114

Attention: Mr. Tim Parkinson

Ladies and Gentlemen:

Re: Report
Geotechnical Study
Proposed Welding Building
550 East 300 South
Kaysville, Utah

1. INTRODUCTION

1.1 GENERAL

This report presents the results of our geotechnical study performed at the site of the proposed Welding Building, which is located at 550 East 300 South in Kaysville, Utah. The general location of the site with respect to major topographic features and existing facilities, as of 1998, is presented on Figure 1, Vicinity Map. A detailed location of the site showing existing roadways, surrounding facilities, and proposed structure, on an air photograph base, is presented on Figure 2, Area Map. The boring locations drilled 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. Tim Parkinson of State of Utah – DFCM and Mr. Patrick Emery of Gordon Geotechnical Engineering, Inc. (G^2).

In general, the objectives of this study were to:

1. Accurately define and evaluate the subsurface soil and groundwater conditions across the site.

2. Provide appropriate foundation, earthwork, pavement, and geoseismic recommendations and parameters 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 four 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 returning a Purchase Order Summary Report 220187 dated January 25, 2024, DFCM Project No. 23369220 for our Professional Services Agreement No. 24-0106 dated January 10, 2024.

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, measured and 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, G² 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

A welding building is planned for the east side of the Davis Technical College campus. The structure is anticipated to be one-extended level in height and of masonry or wood-frame construction established slab-on-grade.

Maximum column and wall loads are projected to be on the order of 90 to 120 kips and 3 to 5 kips per lineal foot, respectively.

Site development will require a minor amount of earthwork in the form of site grading. It is estimated that maximum cuts and fills to achieve design grades will be on the order of one to two feet.

Paved surface parking areas will also be part of the overall development. Traffic over the pavements will consist of a light to moderately light volume of automobiles and light trucks, and some medium-weight trucks. In roadways, the traffic will be somewhat higher.

3. INVESTIGATIONS

3.1 FIELD PROGRAM

In order to define and evaluate the subsurface soil and groundwater conditions across the site, 4 borings were drilled to depths ranging from 3.0 to 46.5 feet below existing grade. Locations of the borings are presented on Figure 2.

The field portion of our study was under the direct control and continual supervision of an experienced member of our geotechnical staff. During the course of the drilling operations, a continuous log of the subsurface conditions encountered was maintained. In addition, samples of the typical soils encountered were obtained 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 Figures 3A through 3D, Log of Borings. Soils were classified in accordance with the nomenclature described on Figure 4, Unified Soil Classification System.

A 3.25-inch outside diameter, 2.42-inch inside diameter drive sampler (Dames & Moore) and a 2.0-inch outside diameter, 1.38-inch inside diameter drive sampler (SPT) were utilized in the subsurface sampling at the site. 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 Boring B-2 in order to provide a means of monitoring the groundwater fluctuations.

3.2 MASW

3.2.1 General

A MASW, Multichannel Analysis of Surface Waves is a surface geophysical analysis developed by Park et al. and explained in detail in his document "Multichannel Analysis of Surface Waves"[1]. During a MASW, surface waves are measured using geophones. The waves can be used to graphically display vibrations transmitted through various materials. Changes in the velocity of the waves, as a function of depth, can be used to model the earth's interior.

Seismic wave vibrations were measured and recorded at 8 offsets using 2-second-long shots using *Vibrascope* software. The data recording interval during each shot was 0.5 milliseconds. Three shots were stacked at each offset, with 4 forward offsets and 4 reverse offsets.

3.2.2 Data Evaluation

Following the acquisition of the data, using ParkSEIS (PS) 3.0 Auto software, a wavefield transformation of the records reveals the shear-wave dispersion curve. This dispersion curve plots frequency, in hertz, against slowness, in seconds per meter. The shear-wave dispersion curve from the wavefield transformation is then automatically picked and the picks modeled to determine the subsurface shear-wave velocity profile (see Appendix A).

The results of the testing indicate that the average shear wave velocity (Vs_{100}) of the upper 100 feet is 748 fts (228 m/s).

3.3 LABORATORY TESTING

3.3.1 General

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

3.3.2 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 undisturbed samples. The results of these tests are presented on the boring logs, Figures 3A through 3D.

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1 Choon B. Park, Richard D. Miller, and Jianghai Xia, 1999, "Multichannel Analysis of Surface Waves," GeoPhysics, Col. 64, NC3 (May-June 1999); p 800-808, 7FIGS.

3.3.3 Partial Gradation Tests

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

Boring No.	Depth (feet)	Percent Passing No. 40 Sieve	Percent Passing No. 200 Sieve	Soil Classification
B-1	2.5	---	39.0	SM
B-1	7.5	---	56.0	SM/ML
B-2	2.5	---	16.2	SM
B-2	15.0	---	3.0	SP
B-2	25.0	---	6.7	SP/SM
B-2	30.0	87.7	8.1	SP/SM
B-2	40.0	70.2	36.1	SM/GM
B-2	45.0	---	94.8	CL

3.3.4 Consolidation Tests

To provide data necessary for our settlement analyses, a consolidation test was performed on two representative samples of the fine-grained soils encountered in the exploration borings. The data available indicates that the soils are moderately to over-consolidated and when loaded below the over-consolidated pressure the soils will exhibit moderate compressibility characteristics.

3.4 INFILTRATION TEST

An infiltration test was conducted in general accordance with the Utah Department of Environmental Quality's wastewater disposal system percolation test regulations. However, the test hole was not saturated nor allowed to swell. Results of the infiltration test are summarized in the chart below:

Test No.	Depth (feet)	Measured Infiltration Rate (min./in.)	Recommended Design Infiltration Rate (min./in.)
I-1	3.0	1.6	15

The measured infiltration rate reflects current natural site conditions at the test location. The measured rate is fast for this type of soil. It is our experience that infiltration rate will decrease over the lifetime of the system due to siltation and the introduction of other materials. Accordingly, we recommend a reduced design infiltration rate of at least 15 minutes per inch be used in design for a system installed in the natural, non-saturated, silts.

4. SITE CONDITIONS

4.1 SURFACE

The site consists of a rectangular-shaped parcel of mostly vacant land. A review of historical photographs indicate that earthwork and agricultural operations have previously occurred at the site. The remainder of the site is covered by scattered grasses and weeds.

The site is bordered by similar mostly vacant land to the east and south, a Davis Tech Main Building road to the west, and an existing Davis Tech Main Building to the north.

The topography of the site slopes gently down to the west/southwest with an overall relief on the order of two to five feet across the site. The site grade is at approximately the same elevation as the grade of the adjacent streets.

4.2 SUBSURFACE SOIL

The soil conditions encountered in each of the borings, to the depths penetrated, were relatively similar.

In general, from the ground surface and extending to depths of 3.0 to 41.5 feet, natural sands with varying amounts of silts were encountered. The sands are loose to dense, slightly moist to saturated, brown in color and projected to exhibit relatively high strength and low compressibility characteristics under the anticipated loading range.

In Boring B-2, the sands are, in turn, underlain by natural silty clays that extended to the depth explored of 46.5 feet. The clay is very stiff, saturated, brown in color, and are projected to exhibit moderate strength and compressibility characteristics under the anticipated loading range.

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

4.3 GROUNDWATER

Immediately following drilling operations, the groundwater was measured in each boring. On February 14, 2024, we returned to the site and measured the groundwater within the piezometers placed in the borings. Groundwater measurements are tabulated below:

Boring No.	Groundwater Depth (feet)	
	February 9, 2024	February 14, 2024
B-1	NGWE*	No PVC installed.
B-2	39.0*	40.5
B-3	NGWE*	No PVC installed.
B-4	NGWE*	No PVC installed.

* Not stabilized, during drilling.

NGWE No groundwater encountered.

Seasonal and longer-term groundwater fluctuations on the order of one to two feet are projected, with the highest seasonal levels generally occurring during the late spring and early summer months.

5. DISCUSSIONS AND RECOMMENDATIONS

5.1 SUMMARY OF FINDINGS

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

Although not encountered at the boring locations, non-engineered fills may be encountered at the site due to the potential for previous earthwork at the site.

Non-engineered fills, if encountered, must be completely removed from beneath the building footprint and rigid pavement areas.

Due to the potential for encountering non-engineered fills, a qualified geotechnical engineer from our staff must aid in verifying that all non-engineered fills have been completely removed prior to the placement of structural site grading fills, footings, or foundations.

Detailed discussions pertaining to earthwork, foundations, floor slabs, lateral resistance, pavement, 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 must consist of the removal of any existing structures and pavements, slab, debris, and any associated non-engineered fills (if encountered). In proposed flexible pavement areas, the existing asphalt concrete and fills may remain provided that they do not interfere with the final grade. The asphalt concrete should be perforated to facilitate drainage and proofrolled.

Further preparation of the site must consist of the removal of all non-engineered fills (if encountered), loose surficial soils, topsoil, debris, and other deleterious materials from beneath an area extending at least three feet beyond the perimeter of the proposed building, rigid pavement, and exterior flatwork areas.

The non-engineered fills may remain in flexible pavement areas as long as they are properly prepared. Proper preparation will consist of scarifying and moisture conditioning the upper eight inches and recompacting to the requirements of structural fill. However, it should be noted that compaction of fine-grained soils (clays and silts, if utilized) as structural site grading fill will be very difficult, if not impossible, during wet and cold periods of the year. As an option for proper preparation and recompaction, the upper eight inches of the non-engineered fills may be removed and replaced with granular subbase over proofrolled subgrade. Even with proper preparation, flexible pavements established on non-engineered fills may experience some long-term movements. If the possibility of these movements is not acceptable, these non-engineered fills must be completely removed.

Subsequent to the above operations and prior to the placement of footings, structural site grading fill, or floor slabs, the exposed natural subgrade must be proofrolled by passing moderate-weight rubber tire-mounted construction equipment over the surface at least twice. If any loose, soft, or disturbed zones are encountered, they must be completely removed in footing and floor slab areas and replaced with granular structural fill. If removal depth required is greater than two feet, G^2 must be notified to provide further recommendations. In pavement areas, unsuitable soils encountered during recompaction and proofrolling must be removed to a maximum depth of two feet and replaced with compacted granular structural fill.

5.2.2 Excavations

Temporary construction excavations up to four feet in the site soils shall be constructed with near-vertical sideslopes. Temporary construction excavations up to eight feet in granular soils shall be constructed with sideslopes no steeper than one horizontal to one vertical (1.0H:1.0V).

Temporary construction excavations up to eight feet in fine-grained cohesive soils may be constructed with sideslopes no steeper than one-half horizontal to one vertical (0.5H:1.0V). Deeper excavations are not anticipated. Loose and raveling soils are anticipated. Therefore, the face of the deeper-steeper slopes must be protected.

Utility trench excavations must conform within Occupational Safety and Health (OSHA) guidelines for trench safety.

To minimize disturbance to the underlying soils, it is our recommendation that footings be excavated with a backhoe equipped with a smooth-lip bucket.

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 is defined as all fill which will ultimately be subjected to structural loadings, such as imposed by footings, floor slabs, pavements, etc. Structural fill will be required as backfill over foundations and utilities, as site grading fill, and in some areas, as replacement fill below footings. All structural fill must be free of sod, rubbish, topsoil, 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. For structural site grading fill, the maximum particle size should generally not exceed four inches; although, occasional larger particles, not exceeding six inches in diameter may be incorporated if placed randomly in a manner such that “honeycombing” does not occur, and the desired degree of compaction can be achieved. The maximum particle size within structural fill placed within confined areas should generally be restricted to two inches.

The non-engineered fills and underlying natural soils may be utilized as structural site grading fill. It should be noted that unless moisture control is maintained, utilization of natural on-site fine-grained soils as structural site grading fill will be very difficult, if not impossible, during wet and cold periods of the year. Only granular soils are recommended as structural fill in confined areas, such as around foundations and within utility trenches.

To stabilize soft subgrade conditions or where structural fill is required to be placed below a level one foot above the water table at the time of construction, a mixture of coarse gravels and cobbles and/or one and one-half- to two-inch gravel (stabilizing fill) should be utilized.

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

Structural fill shall be placed in lifts not exceeding eight inches in loose thickness. Structural fills shall be compacted in accordance with the percent of the maximum dry density as determined by the AASHTO[2] T-180 (ASTM[3] 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 3 feet beyond the perimeter of the structure	0 to 8	95
Outside area defined above	0 to 6	90
Outside area defined above	6 to 8	92
Road base	-	96

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

Subsequent to stripping and prior to the placement of structural site grading fill, the subgrade must 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.

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

Coarse gravel and cobble mixtures (stabilizing fill), if utilized, shall be end-dumped, spread to a maximum loose lift thickness of 15 inches, and compacted by dropping a backhoe bucket onto the surface continuously at least twice. As an alternative, the fill may be compacted by passing moderately heavy construction equipment or large self-propelled compaction equipment over the surface at least twice. Subsequent fill material placed over the coarse gravels and cobbles shall be adequately placed so that the “fines” are “worked into” the voids in the underlying coarser gravels and cobbles.

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

5.2.5 Utility Trenches

All utility trench backfill material below structurally loaded facilities (flatwork, floor slabs, roads, etc.) should be placed at the same density requirements established for structural fill. If the surface of the backfill becomes disturbed during the course of construction, the backfill should be proofrolled and/or properly compacted prior to the construction of any exterior flatwork over a backfilled trench. Proofrolling may be performed by passing moderately loaded rubber tire-mounted construction equipment uniformly over the surface at least twice. If excessively loose or soft areas are encountered during proofrolling, they should be removed to a maximum depth of two feet below design finish grade and replaced with structural fill.

Most utility companies and City-County governments are now requiring that Type A-1 or A-1-a (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.

Natural fine-grained cohesive soils are not recommended for use as trench backfill. Some of the natural sand soils and surficial granular fills (if encountered) may be suitable for use as trench backfill.

5.2.6 Areal Settlements

Areal settlements resulting from site grading fills as much as one to two feet should be less than one-half of an inch. These settlements are in addition to settlements induced by foundation and floor slab loads. To reduce the total settlement that the structure will realize, site grading fill must be placed as far in advance of other construction as possible. The majority of this settlement will occur during placement.

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. <u>Under no circumstances shall footings be placed overlying non-engineered fills (if encountered)</u>.

For design, the following parameters are provided with respect to the projected loading discussed in Section 2., Proposed Construction, of this report:

Minimum Recommended Depth of Embedment for Frost Protection	- 30 inches
Minimum Recommended Depth of Embedment for Non-frost Conditions	- 15 inches
Recommended Minimum Width for Continuous Wall Footings	- 18 inches
Minimum Recommended Width for Isolated Spread Footings	- 24 inches
Recommended Net Bearing Pressure for Real Load Conditions	
For footings on suitable natural soils and/or structural fill extending to suitable natural soils	- 2,500 pounds per square foot
Bearing Pressure Increase for Seismic Loading	- 50 percent*

* Not applicable for edge bearing pressure when the footings are established upon granular soil. Use 25 percent for overturning or other inclined loading.

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 the 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 shall the footings be established upon non-engineered fills, loose or disturbed soils, rubbish, construction debris, other deleterious materials, frozen soils, or within ponded water. If unsuitable soils are encountered, they must be completely removed and replaced with compacted structural fill.

The width of structural replacement fill below footings should be equal to the width of the footing plus one foot for each foot of fill thickness.

5.3.3 Settlements

Settlements of foundations designed and installed in accordance with the above recommendations and supporting maximum projected structural loads are anticipated to be less than one inch. Settlements are expected to occur rapidly with approximately 60 to 70 percent of the 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. In determining frictional resistance on fine-grained soils, a coefficient of 0.40 should be utilized. In determining frictional resistance on granular soils, a coefficient of 0.45 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, assume that the backfill extending at least five feet from the back of the wall be properly placed and compacted granular soil. The lateral pressures imposed upon subgrade facilities will, therefore, be basically dependent upon the relative rigidity and movement of the backfilled structure. For active walls, such as retaining walls which can move outward (away from the backfill), granular backfill may be considered equivalent to a fluid with a density of 35 pounds per cubic foot in computing lateral pressures. For more rigid basement walls, granular backfill may be considered equivalent to a fluid with a density of 45 pounds per cubic foot. For very rigid non-yielding walls, granular backfill should be considered equivalent to a fluid with a density with at least 55 pounds per cubic foot. The above values assume that the surface of the soils slope behind the wall is horizontal, that the granular fill has been placed and lightly compacted, not as structural fill. If the fill is placed as a structural fill the values should be increased to 45 pounds per cubic foot, 60 pounds per cubic foot, and 120 pounds per cubic foot, respectively.

Recommended average lateral uniform pressure for various height walls are tabulated on the following page and assume a granular wall backfill with a horizontal grade above the wall. It should be noted that the lateral pressures as quoted assume that the backfill materials will not become saturated. If the backfill becomes saturated, the above values may be decreased by one-half; however, full hydrostatic water pressures will have to be included.

Wall Height (feet)	Uniform Seismic Lateral Pressure* (psf)
4	75

* Maximum short-term pressures, they are not sustained loads.

Note that the pressures presented in this section do not include surcharge loadings, such as floor slabs, etc.

5.6 FLOOR SLABS

Floor slabs may be susceptible to vertical movement due to the slight expanse potential of the natural silty clay soil. Therefore, floor slabs may be established upon a minimum of 18 inches of structural fill extending to suitable natural soils. To provide a capillary break, it is recommended that floor slabs be directly underlain by at least four inches of "free-draining" fill, such as "pea" gravel or three-quarters- to one-inch minus clean gravel. Settlements of lightly to moderately loaded floor slabs are anticipated to be minor.

5.7 PAVEMENTS

The properly prepared non-engineered fills will exhibit poor engineering characteristics when saturated or nearly saturated. Non-engineered fills (if encountered) may remain in flexible pavement areas if properly prepared, as stated previously in this report. Rigid pavements shall not be placed overlying non-engineered fills, even if properly prepared. Considering the existing non-engineered soils as the subgrade soils and the projected traffic, the pavement sections on the following pages are recommended.

Parking Areas

(Light Volume of Automobiles and Light Trucks,
Occasional Medium-Weight Trucks,
and No Heavy-Weight Trucks)
[1 equivalent 18-kip axle load per day]

Flexible:

2.5 inches	Asphalt concrete
8.0 inches	Aggregate base
Over	Properly prepared natural soils, properly prepared existing non-engineered fill, and/or structural site grading fill extending to suitable stabilized natural soils.

Rigid:

5.0 inches	Portland cement concrete (non-reinforced)
4.0 inches	Aggregate base
Over	Properly prepared natural soils, and/or structural site grading fill extending to suitable stabilized natural soils.*

* Rigid pavements shall not be placed over non-engineered fills, even if properly prepared.

Primary Roadway Areas

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

Flexible:

3.0 inches	Asphalt concrete
8.0 inches	Aggregate base
Over	Properly prepared natural soils, properly prepared existing non-engineered fill, and/or structural site grading fill extending to suitable stabilized natural soils.

Rigid:

5.5 inches	Portland cement concrete (non-reinforced)
5.0 inches	Aggregate base
Over	Properly prepared natural soils, and/or structural site grading fill extending to suitable stabilized natural soils.*

* Rigid pavements shall not be placed over non-engineered fills, even if properly prepared.

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

These above rigid pavement sections are for non-reinforced Portland cement concrete. Concrete should be designed in accordance with the American Concrete Institute (ACI) and joint details should conform to the Portland Cement Association (PCA) guidelines. The concrete should have a minimum 28-day unconfined compressive strength of 4,000 pounds per square inch and contain 6 percent ±1 percent air-entrainment.

5.8 GEOSEISMIC SETTING

5.8.1 General

In July 2023, the State of Utah adopted the 2021 International Building Code (IBC). The IBC 2021 code determines the seismic hazard for a site based upon 2014 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 2021 edition.

5.8.2 Faulting

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

5.8.3 Soil Class

A Vs_{100} value of 228 m/sec (748 ft/sec) was calculated from the MASW. Based on the shear wave velocity profile and on the soils encountered in our exploration boring, we recommend that “Site Class D – Stiff Soil” be utilized for the design of structure at the site. The average shear-wave velocity profile can be seen in Appendix A.

5.8.4 Ground Motions

The IBC 2021 code is based on 2014 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 a hypothetical sandstone 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 (41.0292 degrees north and -111.9224 degrees west, respectively), the values for this site are tabulated on the following page.

Spectral Acceleration Value, T Seconds	Site Class B-C Boundary [mapped values] (% g)	Site Class D [adjusted for site class effects] (% g)
Peak Ground Acceleration (Geo-Mean)	60.0	66.0
0.2 Seconds (Short Period Acceleration)	S_S = 131.1	S_{MS} = 131.1
1.0 Seconds (Long Period Acceleration)	S_1 = 48.3	S_{M1} = *

* See Section 11.4.8 for requirements on site-specific ground motion studies. Please contact us for a proposal, if needed.

5.8.5 Liquefaction

The site is located in an area that has been identified by the Utah Geological Survey as having "moderate" 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.

Due to the fine-grained and cohesive nature of the saturated soils, liquefaction is not projected to occur within the soils encountered at the boring locations.

Calculations were performed using the procedures described in the 2008 Soil Liquefaction During Earthquakes Monograph by Idriss and Boulanger[4].

5.9 SITE OBSERVATIONS

Due to the potential for non-engineered fills to be encountered, a qualified geotechnical engineer from our staff must aid in verifying that all non-engineered fills have been completely removed and that suitable natural soils have been encountered prior to the placement of structural site grading fills, footings, or foundations.

4 Idriss, I. M., and Boulanger, R. W. (2008), Soil liquefaction during earthquakes: Monograph MNO-12, Earthquake Engineering Research Institute, Oakland, CA, 261 pp.

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

Respectfully submitted,

Gordon Geotechnical Engineering, Inc.

Joshua M. Whitney, State of Utah No. 6252902
Senior Engineer

Reviewed by:

Patrick R. Emery, State of Utah No. 7941710
Senior Engineer

JMW/PRE:sn

Encl. Figure 1, Vicinity Map
Figure 2, Area Map
Figures 3A through 3D, Log of Borings
Figure 4, Unified Soil Classification System
Figure 5, Photographs
Appendix A, MASW Survey Results

Addressee (email only)
c: Matt Wallace (email only)
Method Studio

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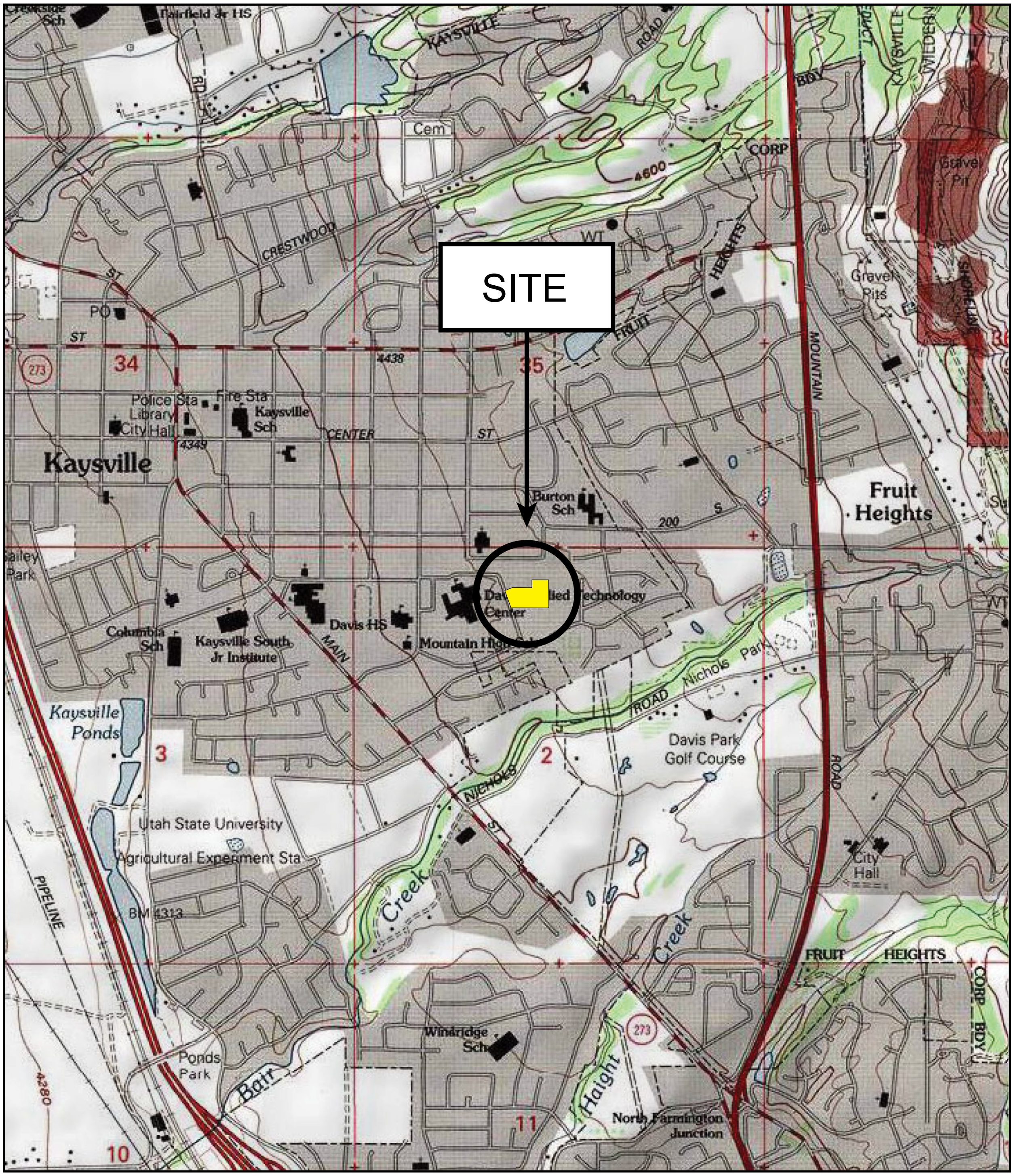
JOB NO. 003-053-24

GORDON GEOTECHNICAL ENGINEERING, INC.



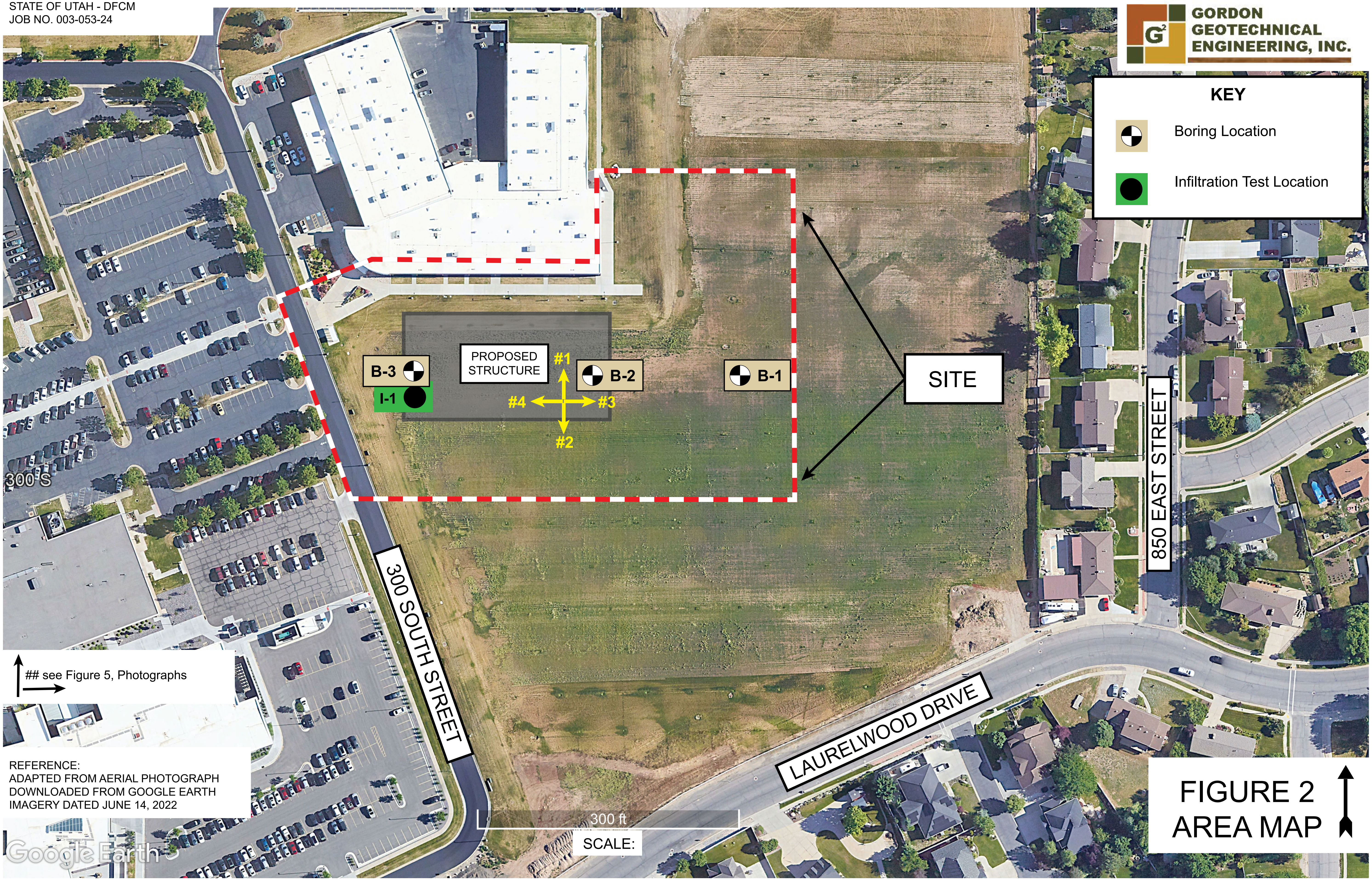
SCALE IN FEET

1000 0 1000 2000

FIGURE 1
VICINITY MAP

REFERENCE:
USGS 7.5 MINUTE TOPOGRAPHIC QUADRANGLE MAP
TITLED "KAYSVILLE, UTAH", DATED 1998

STATE OF UTAH - DFCM
JOB NO. 003-053-24



see Figure 5, Photographs

REFERENCE:
ADAPTED FROM AERIAL PHOTOGRAPH
DOWNLOADED FROM GOOGLE EARTH
IMAGERY DATED JUNE 14, 2022

FIGURE 2
AREA MAP

Gordon Geotechnical Engineering, Inc.
4426 South Century Drive, Suite 100
Salt Lake City, Utah 84123

Project Name: Proposed Welding Building

Project No.: 003-053-24

Location: 550 East 300 South, Kaysville, Utah

Client: State of Utah - DFCM

Drilling Method: 3.75" ID Hollow-Stem Auger

Date Drilled: 02-09-24

Elevation: ---

Water Level: No groundwater encountered.

Remarks:

DESCRIPTION	GRAPHIC LOG	WATER LEVEL	DEPTH (FT.)	SAMPLE SYMBOL	SAMPLE TYPE	BLOWS/FT.	MOISTURE (%)	DRY DENSITY (PCF)	%PASSING 200	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	REMARKS
Ground Surface			0									
FINE TO COARSE SAND with some silt; 2" turf; major roots (topsoil) to 6"; brown (SM)												slightly moist loose
					U	13	13.8		39.0			
			5		U	15	14.4	87				
SILTY FINE TO COARSE SAND brown (SM)												slightly moist loose
					U	17	20.2		56.0			
grades with 1" thick layers of clay												
			10		U	20						medium dense
grades with 1/2" thick layers of clay												
			15		U	17						loose
Stopped drilling at 15.0'.												
Stopped sampling at 16.5'.												
No groundwater encountered at time of drilling.			20									
			25									

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

Gordon Geotechnical Engineering, Inc.
4426 South Century Drive, Suite 100
Salt Lake City, Utah 84123

Project Name: Proposed Welding Building
Location: 550 East 300 South, Kaysville, Utah
Drilling Method: 3.75" ID Hollow-Stem Auger
Elevation: ---
Remarks:

Project No.: 003-053-24
Client: State of Utah - DFCM
Date Drilled: 02-09-24
Water Level: 39.0' (02-09-24), 40.5' (02-14-24)

DEPTH (FT.)	DESCRIPTION	SAMPLE TYPE	BLOWS/FT.	MOISTURE (%)	DRY DENSITY (PCF)	%PASSING 200	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	REMARKS
	Ground Surface								
0	**FINE TO MEDIUM SAND** with some silt; 2" turf; major roots (topsoil) to 6"; orange/light brown (SM)								slightly moist loose
		U	12	9.7		16.2			
5									medium dense
		U	21						
									loose
		U	14						
10		U	17						
	grades with thin (1/8" thick) clay layers								
15	grades with trace silt	U	15	5.2		3.0			
20									medium dense
		SPT	22						
25									

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Project Name: Proposed Welding Building
Project No.: 003-053-24
Location: 550 East 300 South, Kaysville, Utah
Client: State of Utah - DFCM
Drilling Method: 3.75" ID Hollow-Stem Auger
Date Drilled: 02-09-24
Elevation: ---
Water Level: 39.0' (02-09-24), 40.5' (02-14-24)
Remarks:

DESCRIPTION	GRAPHIC LOG	WATER LEVEL	DEPTH (FT.)	SAMPLE SYMBOL	SAMPLE TYPE	BLOWS/FT.	MOISTURE (%)	DRY DENSITY (PCF)	%PASSING 200	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	REMARKS
FINE TO MEDIUM SAND with some silt; 2" turf; major roots (topsoil) to 6"; orange/light brown (SM)					SPT	20	4.5		6.7			
			30		SPT	29	2.8		8.1			
grades with some fine gravel and trace silt; light brown/tan												moist dense
			35		SPT	37						
FINE AND COARSE GRAVEL/FINE TO COARSE SAND brown (GM/SM) grades with fine to medium sandy clay layer 2" thick												moist medium dense saturated
		▼	40		SPT	11	14.1		36.1			
SILTY CLAY with very thin lenses of fine to coarse sand; brown/orange (CL)												saturated medium stiff
			45		SPT	7	28.2		94.8			
Stopped drilling at 45.0'. Stopped sampling at 46.5'. Installed slotted PVC to 45.0'.			50									

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

FIGURE 3B
(con't)

Gordon Geotechnical Engineering, Inc.
4426 South Century Drive, Suite 100
Salt Lake City, Utah 84123

Project Name: Proposed Welding Building
Location: 550 East 300 South, Kaysville, Utah
Drilling Method: 3.75" ID Hollow-Stem Auger
Elevation: ---
Remarks:

Project No.: 003-053-24
Client: State of Utah - DFCM
Date Drilled: 02-09-24
Water Level: No groundwater encountered.

DESCRIPTION	GRAPHIC LOG	WATER LEVEL	DEPTH (FT.)	SAMPLE SYMBOL	SAMPLE TYPE	BLOWS/FT.	MOISTURE (%)	DRY DENSITY (PCF)	%PASSING 200	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	REMARKS
Ground Surface												
FINE TO MEDIUM SAND with some silt; 2" turf; major roots (topsoil) to 6"; orange/brown (SM)			0									slightly moist loose
					U	11						
			5		U	13						
grades with thin layers of clay					U	13						
			10		U	16	10.4	84				
			15		U	20						medium dense
			20		U	14						
Stopped drilling at 20.0'. Stopped sampling at 21.5'. No groundwater encountered at time of drilling.			25									

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

FIGURE 3C

Gordon Geotechnical Engineering, Inc.
4426 South Century Drive, Suite 100
Salt Lake City, Utah 84123

BORING B-4

Project Name: Proposed Welding Building

Project No.: 003-053-24

Location: 550 East 300 South, Kaysville, Utah

Client: State of Utah - DFCM

Drilling Method: 3.75" ID Hollow-Stem Auger

Date Drilled: 02-09-24

Elevation: ---

Water Level: No groundwater encountered.

Remarks:

DESCRIPTION	GRAPHIC LOG	WATER LEVEL	DEPTH (FT.)	SAMPLE SYMBOL	SAMPLE TYPE	BLOWS/FT.	MOISTURE (%)	DRY DENSITY (PCF)	%PASSING 200	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	REMARKS
Ground Surface												
FINE TO MEDIUM SAND with some silt; 2" turf; major roots (topsoil) to 6"; brown (SM)			0									slightly moist "medium dense"
Stopped drilling at 3.0'. No groundwater encountered at time of drilling.			5									
			10									
			15									
			20									
			25									

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

FIGURE 3D

UNIFIED SOIL CLASSIFICATION SYSTEM

FIELD IDENTIFICATION PROCEDURES				GRAPH SYMBOL	LETTER SYMBOL [1]	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS More than half of material is larger than No. 200 sieve size. [2] (The No. 200 sieve size is about the smallest particle visible to the naked eye)	GRAVELS More than half of coarse fraction is larger than No. 4 sieve size. (For visual classifications, the 1/4" size may be used as equivalent to the No. 4 sieve size.)	CLEAN GRAVELS (Little or no fines)	Wide range in grain size and substantial amounts of all intermediate particle sizes.		GW	Well graded gravels, gravel-sand mixtures, little or no fines.
			Predominantly one size or a range of sizes with some intermediate sizes missing.		GP	Poorly graded gravels, gravel-sand mixtures, little or no fines.
		GRAVELS WITH FINES (Appreciable amount of fines)	Non-plastic fines (for identification procedures see ML below).		GM	Silty gravels, poorly graded gravel-sand-silt mixtures.
			Plastic fines (for identification procedures see CL below).		GC	Clayey gravels, poorly graded gravel-sand-clay mixtures.
	SANDS More than half of coarse fraction is smaller than No. 4 sieve size. (For visual classifications, the 1/4" size may be used as equivalent to the No. 4 sieve size.)	CLEAN SANDS (Little or no fines)	Wide range in grain sizes and substantial amounts of all intermediate particle sizes.		SW	Well graded sands, gravelly sands, little or no fines.
			Predominantly one size or a range of sizes with some intermediate sizes missing.		SP	Poorly graded sands, gravelly sands, little or no fines.
		SANDS WITH FINES (Appreciable amount of fines)	Non-plastic fines (for identification procedures see ML below).		SM	Silty sands, poorly graded sand-silt mixtures.
			Plastic fines (for identification procedures see CL below).		SC	Clayey sands, poorly graded sand-clay mixtures.

IDENTIFICATION PROCEDURES ON FRACTION SMALLER THAN No. 40 SIEVE SIZE

		DRY STRENGTH (CRUSHING CHARACTERISTICS)	DILATANCY (REACTION TO SHAKING)	TOUGHNESS (CONSISTENCY NEAR PLASTIC LIMIT)	GRAPH SYMBOL	LETTER SYMBOL	TYPICAL DESCRIPTIONS
FINE GRAINED SOILS More than half of material is smaller than No. 200 sieve size. (The No. 200 sieve size is about the smallest particle visible to the naked eye)	SILTS AND CLAYS Liquid limit less than 50	None to slight	Quick to slow	None		ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sand with slight plasticity.
		Medium to high	None to very slow	Medium		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
		Slight to medium	Slow	Slight		OL	Organic silts and organic silt-clays of low plasticity.
	SILTS AND CLAYS Liquid limit greater than 50	Slight to medium	Slow to none	Slight to medium		MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.
		High to very high	None	High		CH	Inorganic clays of high plasticity, fat clays.
		Medium to high	None to very slow	Slight to medium		OH	Organic clays of medium to high plasticity.
HIGHLY ORGANIC SOILS		Readily identified by color, odor, spongy feel and frequently by fibrous texture.				Pt	Peat and other highly organic soils.

[1] Boundary classifications: —Soils possessing characteristics of two groups are designated by combinations of group symbols. For example GW—GC, well graded gravel—sand mixture with clay binder.
[2] All sieve sizes on this chart are U.S. standard.

GENERAL NOTES

1. In general, Unified Soil Classification Designations presented on the logs were evaluated by visual methods only. There rore, actual designations (based on laboratory testing) may differ.

2. Lines seperating strata on the logs represent approximate boundaries only Actual transitions may be gradual.

3. Logs represent general soil conditions observed at teh point of exploration onthe date indicated.

4. No warranty is provided as to the continuity of soil conditions between individual sample locations.

FINE - GRAINED SOIL

CONSISTENCY	SPT (blows/ft)	TORVANE UNDRAINED SHEAR STRENGTH (tsf)	POCKET PENETROMETER UNCONFINED COMPRESSIVE STRENGTH (tsf)	FIELD TEST
Very Soft	<2	<0.125	<0.25	Easily penetrated several inches by Thumb. Squeezes through fingers.
Soft	2 - 4	0.125 - 0.25	0.25 - 0.5	Easily penetrated 1 " by Thumb . Molded by light finger pressure.
Medium Stiff	4 - 8	0.25 - 0.5	0.5 - 1.0	Penetrated over 1/2 " by Thumb with moerate effort. Molded by strong finger pressure.
Stiff	8 - 15	0.5 - 1.0	1.0 - 2.0	Indented about 1/2 " by Thumb but penetrated only with great effort
Very Stiff	15 - 30	1.0 - 2.0	2.0 - 4.0	Readily indented by Thumbnail
Hard	>30	>2.0	>4.0	Indented with difficulty by Thumbnail

LOG KEY SYMBOLS

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

COARSE -GRAINDE SOIL

APPERENT DENSITY	SPT (blows/ft)	RELATIVE DENSITY (%)	FIELD TEST
Very Loose	<4	0 - 15	Easily penetrated with 1/2 " reinforcing rod pushed by hand
Loose	4 - 10	15 - 35	Difficult to penetrated with 1/2 " reinforcing rod pushed by hand
Medium Dense	10 - 30	35 - 65	Easily penetrated a foot with 1/2 " reinforcing rod driven with 5-lb hammer
Dense	30 - 50	65 - 85	Difficult to penetrated a foot with 1/2 " reinforcing rod driven with 5-lb hammer
Very Dense	>50	85 - 100	Penetrated only a few inches with 1/2 " reinforcing rod driven with 5-lb hammer

STRATIFICATION

DESCRIPTION	THICKNESS
SEAM	1/16 - 1/2 "
LAYER	1/2 - 12 "

DESCRIPTION	THICKNESS
Occasional	One or less per foot of thickness
Frequent	More than on per foot of thichness

CEMENTATION

DESCRIPTION	DESCRIPTION
Weakely	Crumbles or breaks with handling of slight finger pressure
Moderately	Crumbles or breaks with considerable finger pressure
Strongly	Will not crumbles or breaks with finger pressure

MODIFIERS

DESCRIPTION	%
Trace	<5
Some	5 - 12
With	>12

MOISTURE CONTENT

DESCRIPTION	FIELD TEST
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible water, usually soil below Water Table

FIGURE 4

STATE OF UTAH - DFCM
JOB NO. 003-053-24

GORDON GEOTECHNICAL ENGINEERING, INC.

#1 Looking north.

#2 Looking south.

#3 Looking east.

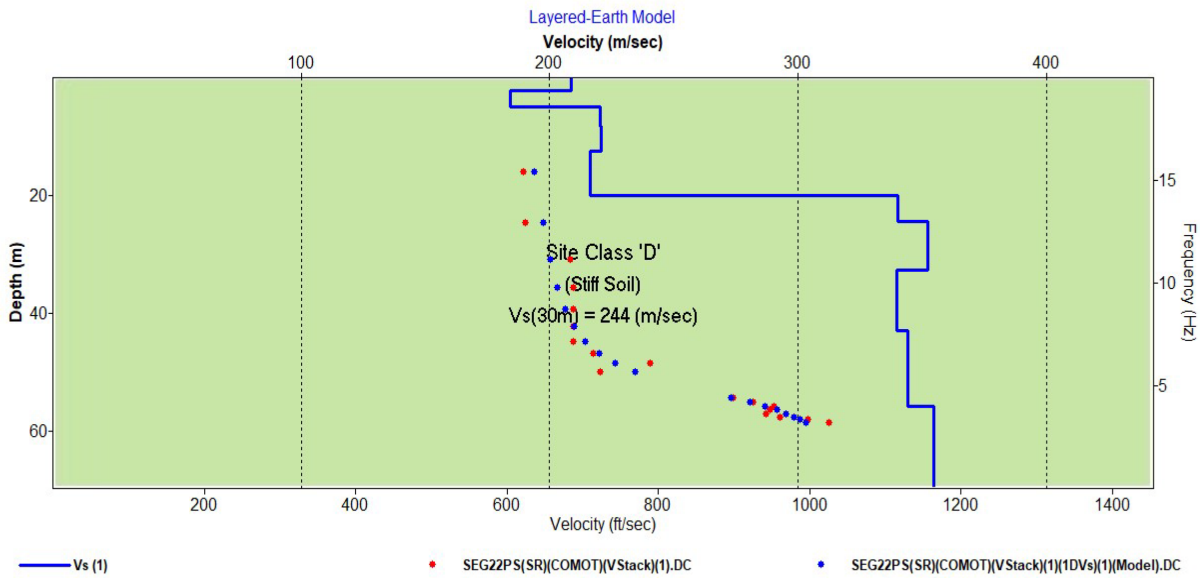
#4 Looking west.

FIGURE 5
PHOTOGRAPHS

Locations and direction, see Figure 2, Area Map

APPENDIX A

MASW Survey Results


Layered-Earth Model
Velocity (m/sec)
100
200
300
400
Depth (m)
20
40
60
Frequency (Hz)
15
10
5
Site Class 'D'
(Stiff Soil)
Vs(30m) = 244 (m/sec)
200
400
600
800
1000
1200
1400
Velocity (ft/sec)
Vs (1)
SEG22PS(SR)(COMOT)(VStack)(1).DC
SEG22PS(SR)(COMOT)(VStack)(1)(1DVs)(1)(Model).DC