GORDON GEOTECHNICAL ENGINEERING, INC.

REPORT
GEOTECHNICAL STUDY
PROPOSED TOWNE STORAGE RIVERTON
13658 SOUTH REDWOOD ROAD
RIVERTON, UTAH

February 8, 2017

Job No. 035-012-17

Prepared for:
Menlove Construction
4243 Nike Drive
West Jordan, Utah 84088

Prepared by:
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February 8, 2017
Job No. 035-012-17

Menlove Construction
4243 Nike Drive
West Jordan, Utah 84088

Attention: Mr. Ken Menlove

Ladies and Gentlemen:

Re: Report
Geotechnical Study
Proposed Towne Storage Riverton
13658 South Redwood Road
Riverton, Utah

1. INTRODUCTION

1.1 GENERAL

This report presents the results of our geotechnical study performed at the site of the proposed Towne Storage Riverton which is located at 13658 South Redwood Road in Riverton, Utah. The general location of the site with respect to major topographic features and existing facilities, as of 1999, is presented on Figure 1, Vicinity Map. A detailed location of the site showing existing roadways and surrounding facilities, on an air photograph base, is presented on Figure 2, Area Map. A more detailed layout of the site showing the proposed development and approximate location of existing structures is presented on Figure 3, Site Plan. The test pit locations excavated in conjunction with this study are also presented on Figure 3.

1.2 OBJECTIVES AND SCOPE

The objectives and scope of our study were planned in discussions between Mr. Ken Menlove of Menlove Construction 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 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 excavating, logging, and sampling of seven 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. 17-0121 executed on January 24, 2017.

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 test pits, 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, G^2 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 self-storage facility is planned for the approximately 2.8-acre site. A total of five structures with footprints ranging from 5,700 to 29,250 square feet will cover the majority of the site. The structures will be one to one-extended level in height and of wood-frame/masonry construction established slab-on-grade.

Structural loads will be transmitted down through bearing walls and columns to the supporting foundations. Maximum anticipated wall and column loads are projected to be on the order 1 to 2 kips per lineal foot and 40 to 60 kips, respectively. At-grade floor slab loads will be light.

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, 7 test pits were excavated to depths ranging from 11 to 18 feet below existing grade. Locations of the test pits are presented on Figure 3.

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 excavation operations, a continuous log of the subsurface conditions encountered was maintained. In addition, relatively undisturbed and small disturbed 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 4A through 4G, Log of Test Pits. Soils were classified in accordance with the nomenclature described on Figure 5, Unified Soil Classification System.

Relatively undisturbed samples of the subsurface soils were collected utilizing a 2.42-inch inside diameter thin-wall hand sampler. Disturbed bag samples were also collected from the soils brought up by the backhoe bucket.

Following completion of excavating and logging, each test pit was backfilled. Although an effort was made to compact the backfill with the backhoe, backfill was not placed in uniform lifts and compacted to a specific density. Consequently, 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 and density, partial gradation, and chemical tests. The following paragraphs describe the tests and summarize the test data.

3.2.2 Moisture and Density Tests

To aid in classifying the soils and to help correlate other test data, moisture and density tests were performed on selected undisturbed samples. The results of these tests are presented on the test pits logs, Figures 4A through 4G.

3.2.3 Partial Gradation Test

To aid in classifying the soils and to provide general index parameters, a partial gradation test was performed upon five representative samples of the soils encountered in the exploration test pits. The results of the test are tabulated below:

Test Pit No.	Depth (feet)	Sieve Percent Passing		Soil Classification
		No. 4	No. 200	
TP-1	3.0	36.7	1.2	GP
TP-2	1.0	89.5	31.1	SM-FILL
TP-4	3.5	100.0	5.1	SP/SM
TP-5	2.0	53.1	2.8	SP/GP
TP-7	2.5	91.4	2.4	SP

3.2.4 Chemical Tests

To determine if the site soils will react detrimentally with concrete, chemical tests were performed on a representative sample of the soils encountered at the site. The results of the chemical tests are tabulated below:

Test Pit No.	Depth (feet)	Soil Classification	pH	Total Water Soluble Sulfate (mg/kg-dry)
TP-7	2.5	SP	9.6	11.4

4. SITE CONDITIONS

4.1 SURFACE

The site consists of a rectangular-shaped parcel containing approximately 2.8-acres of land. At the time of the field work, two residential structures were observed on the eastern portion of the site. One of the structures appeared to contain a below-grade level and the other structure appeared to be established slab-on-grade. The middle to western portions of the site contain several small outbuildings and remnant concrete foundations/floor slabs associated with a previous structure which had been demolished.

The site is bordered by single-family residential structures to the north, Redwood Road to the east, commercial and multi-family structures to the south, and single-family residential structures to the west.

The topography of the site is relatively flat with an overall relief on the order of one to two feet across the site. The site grade is at approximately the same elevation as the grade of the adjacent roadways.

4.2 SUBSURFACE SOIL AND GROUNDWATER

The soil conditions encountered in each of the test pits, to the depths excavated, were relatively similar. In each of the test pits, non-engineered fill consisting of sandy clay and silty fine and coarse gravel was encountered at the surface and extending to depths of one to two feet. The fills are loose to dense, slightly moist, brown, and will exhibit variable, and most likely poor engineering characteristics.

Underlying the fills in each of the test pits and extending to the maximum explored depths of 11 to 18 feet, natural granular soils were encountered. The granular soils consisted primarily of fine to coarse sand/gravel with trace silt grading to fine sand and silty fine sand with depth. The natural granular soils are loose to medium dense, slightly moist, light brown, and will exhibit high strength and low compressibility characteristics under the anticipated loading range.

Groundwater was not encountered in the test pits to the depths explored, 11 to 18 feet, during excavation operations. Groundwater is anticipated to be at a depth greater than 20 feet at the site.

5. DISCUSSIONS AND RECOMMENDATIONS

5.1 SUMMARY OF FINDINGS

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

The most significant geotechnical aspect of the site are:

1. Non-engineered fills encountered in each of the test pits to depths of one to two feet.

2. Potential for deeper non-engineered fills associated with the demolition and backfill of basement-containing structures.

Non-engineered fills must be completely removed from beneath the building footprint and rigid pavement areas. Non-engineered fills may remain below flexible pavements provided that they are properly prepared as described in Section 5.2.1, Site Preparation.

Due to the variable nature of the non-engineered fills encountered, a qualified geotechnical engineer 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

Preparation of the site must consist of the removal of all non-engineered fills, 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) 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 not exceeding four feet in depth may be constructed with near-vertical sideslopes. Excavations up to 10 feet in the finer-grained soils can be constructed with sideslopes no steeper than three-quarters horizontal to one vertical (0.75H:1.0V). Excavations up to 10 feet in the granular soils can be constructed with sideslopes no steeper than one horizontal to one vertical (1.0H:1.0V). If saturated granular soils are encountered (not anticipated at the site), flatter sideslopes, shoring and bracing, and/or dewatering will be required.

To reduce disturbance, we recommend that excavations for footings be accomplished utilizing a backhoe 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, 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 on-site natural soils (including non-engineered fills) may be utilized as structural site grading fill. It should be noted that unless moisture control is maintained, utilization of natural on-site clayey 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

All other 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[1] T-180 (ASTM[2] D-1557) compaction criteria in accordance with the table below:

Location	Total Fill Thickness (feet)	Minimum Percentage of Maximum Dry Density
Beneath an area extending at least 3 feet beyond the perimeter of the structures	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.

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

5.2.5 Utility Trenches

All utility trench backfill material below structurally loaded facilities (flatwork, floor slabs, roads, etc.) 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.

The fine-grained non-engineered fill soils are not recommended for use as trench backfill. Much of the natural sand and gravel may be suitable for use as trench backfill.

5.2.6 Areal Settlements

Areal settlements resulting from site grading fills as much as two to three 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 structures 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 structures may be supported upon conventional spread and continuous wall foundations established upon suitable natural soils and/or structural fill extending to suitable natural soils. Under no circumstances shall footings be placed overlying non-engineered fills.

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	- 3,000 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 on the order of three-eighths to five-eighths of an 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 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 FLOOR SLABS

Floor slabs may be established upon suitable undisturbed natural soils, and/or upon structural fill extending to suitable natural soils or properly prepared existing surface soils. Non-engineered fills, and topsoil are not considered suitable. 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 gap-graded gravel. Settlements of lightly to moderately loaded floor slabs are anticipated to be minor.

5.6 PAVEMENTS

The properly prepared non-engineered fills will exhibit poor engineering characteristics when saturated or nearly saturated. Non-engineered fills 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 following pavement sections are recommended:

Parking Areas

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

Flexible:

2.5 inches	Asphalt concrete
8.0 inches	Aggregate base
Over	Properly prepared natural soils, properly prepared non-engineered fills, 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 non-engineered fills, 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.

5.7 GEOSEISMIC SETTING

5.7.1 General

As of July 2016, the State of Utah has 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 structures must be designed in accordance with the procedure presented in Section 1613, Earthquake Loads, of the IBC 2015 edition.

5.7.2 Faulting

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

5.7.3 Soil Class

For dynamic structural analysis, the Site Class D - Stiff Soil Profile as defined in Table 20.3-1, Site Classification, of ASCE 7-10 April 6, 2011 can be utilized.

5.7.4 Ground Motions

The IBC 2015 code is based on 2008 USGS mapping, which provides peak values of short and long period accelerations (S_S, S_1) for the Site Class B-C boundary for the Maximum Considered Earthquake (MCE). This Site Class B-C boundary represents a hypothetical bedrock surface and must be corrected for local soil conditions. The following table summarizes the peak ground and short and long period accelerations for this site for a MCE event and incorporates a soil amplification factor for a Site Class D soil profile in the second column. Based on the site latitude and longitude (40.5578 degrees north and -112.2937 degrees west, respectively), the values for this site are tabulated below:

Spectral Acceleration Value, T Seconds	Site Class B-C Boundary [mapped values] (% g)	Site Class D [adjusted for site class effects] (% g)
Peak Ground Acceleration	55.4	55.4
0.2 Seconds, (Short Period Acceleration)	S_S = 138.4	S_{MS} = 138.4
1.0 Seconds (Long Period Acceleration)	S_1 = 46.4	S_{M1} = 71.2

The IBC 2015 code design accelerations (S_{DS} and S_{D1}) are based on multiplying the above accelerations (S_{MS} and S_{M1}) for the MCE event by two-thirds (⅔).

5.7.5 Liquefaction

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

Due to absence of groundwater to the depths explored, our analysis indicates liquefaction is not anticipated during the design seismic event.

Calculations were performed using the procedures described in the 2008 Soil Liquefaction During Earthquakes Monograph by Idriss and Boulanger[3].

5.8 SITE OBSERVATIONS

As stated previously, due to the variable nature of the non-engineered fills encountered, a qualified geotechnical engineer 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.

5.9 CEMENT TYPES

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

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

GORDON GEOTECHNICAL ENGINEERING, INC.

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

Respectfully submitted,

Gordon Geotechnical Engineering, Inc.

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

PRE:sn

Encl. Figure 1, Vicinity Map
Figure 2, Area Map
Figure 3, Site Plan
Figures 4A through 4G, Log of Test Pits
Figure 5, Unified Soil Classification System
Figure 6, Photographs

Addressee (3 + email)

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.

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

PRE:sn

Encl. Figure 1, Vicinity Map
Figure 2, Area Map
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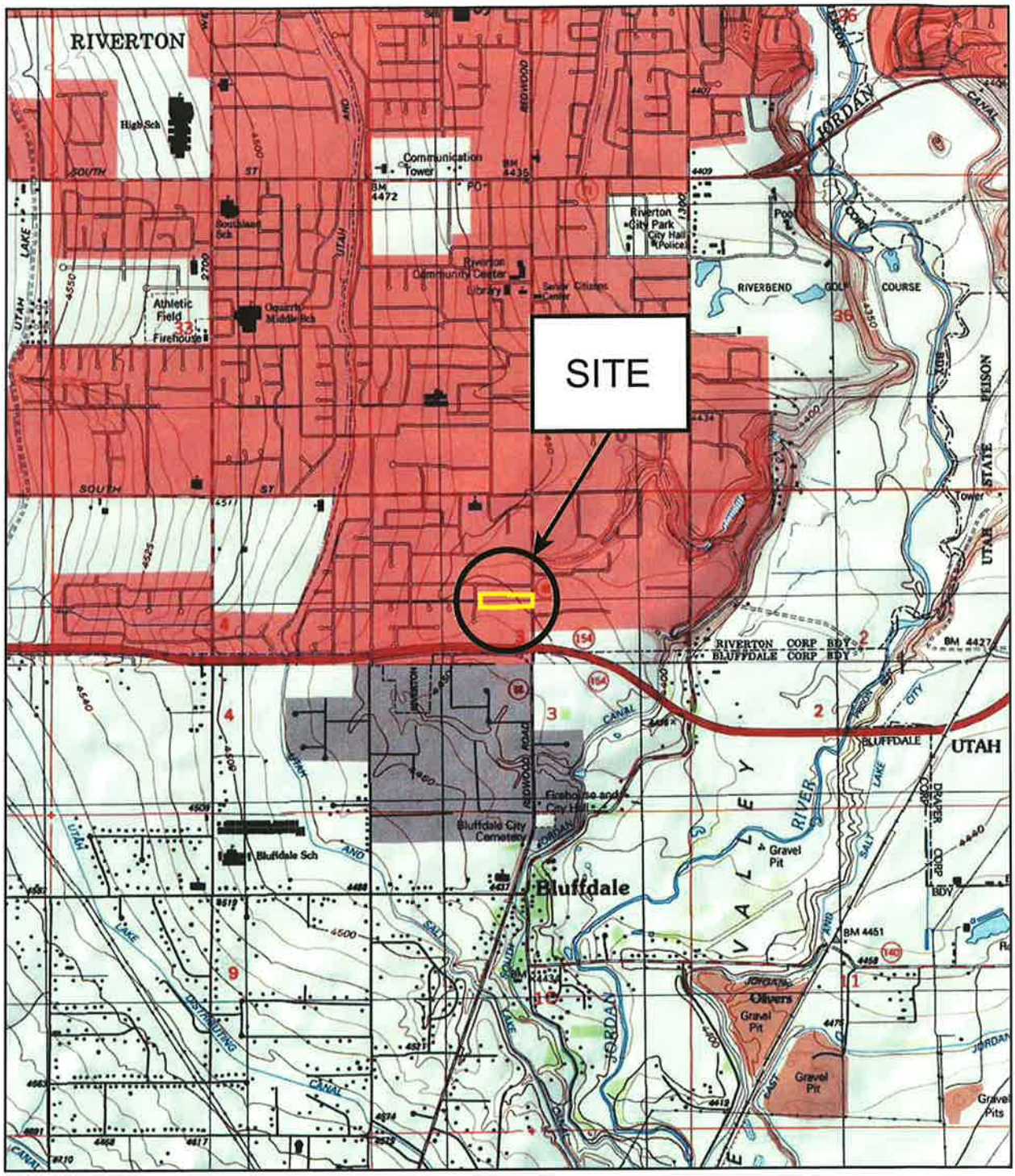
Figures 4A through 4G, Log of Test Pits
Figure 5, Unified Soil Classification System
Figure 6, Photographs

Addressee (3 + email)

MENLOVE CONSTRUCTION
JOB NO. 035-012-17

GORDON GEOTECHNICAL ENGINEERING, INC.



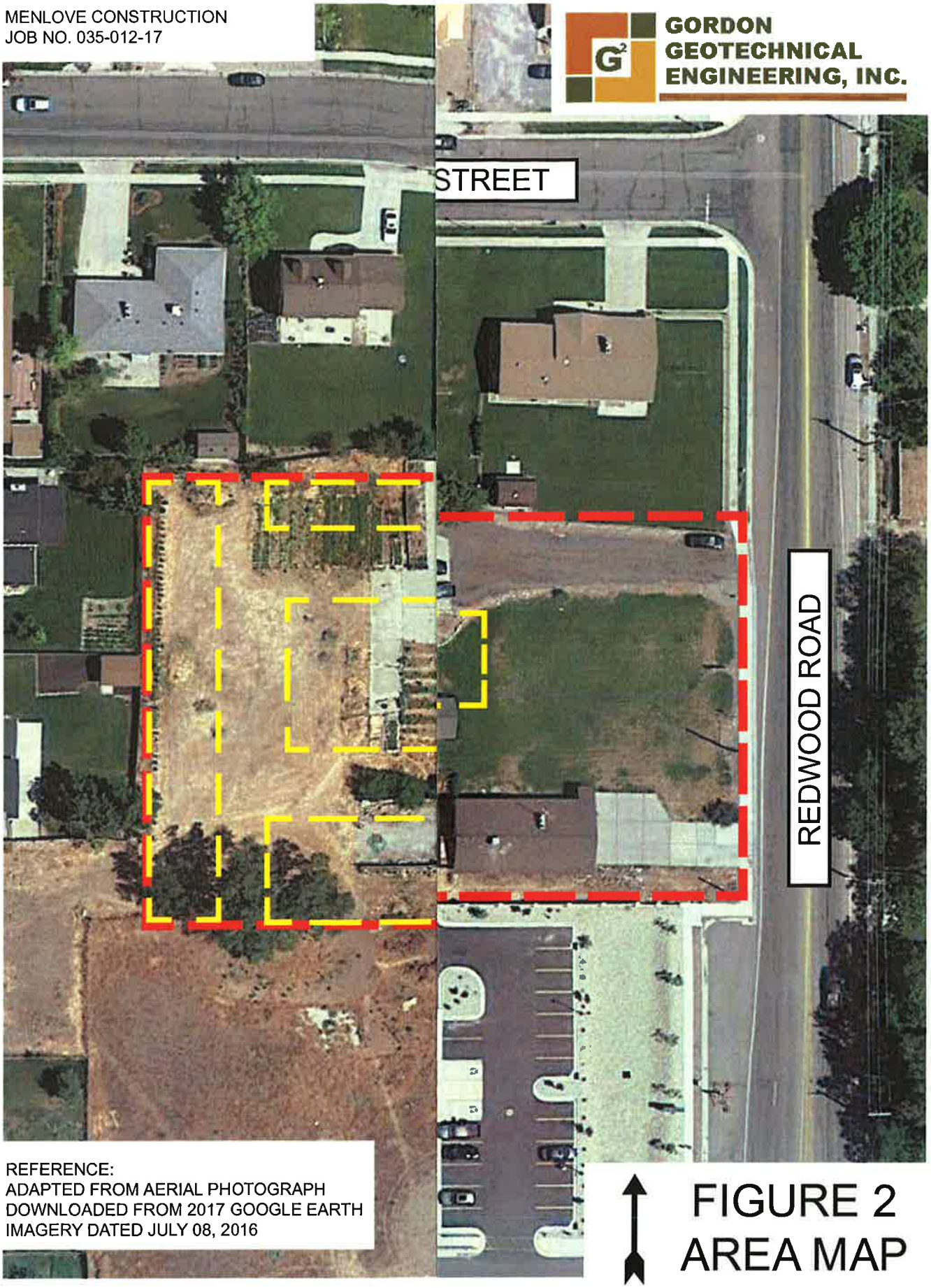
SCALE IN FEET
1000 0 1000 2000

REFERENCE:
USGS 7.5 MINUTE TOPOGRAPHIC QUADRANGLE MAPS TITLED "MIDVALE, UTAH", AND "JORDAN NARROWS, UTAH", BOTH DATED 1999

FIGURE 1
VICINITY MAP

MENLOVE CONSTRUCTION
JOB NO. 035-012-17

GORDON GEOTECHNICAL ENGINEERING, INC.



REFERENCE:
ADAPTED FROM AERIAL PHOTOGRAPH
DOWNLOADED FROM 2017 GOOGLE EARTH
IMAGERY DATED JULY 08, 2016

FIGURE 2
AREA MAP

SCALE:
feet 0 700
meters 0 200

MENLOVE CONSTRUCTION
JOB NO. 035-012-17

GORDON GEOTECHNICAL ENGINEERING, INC.

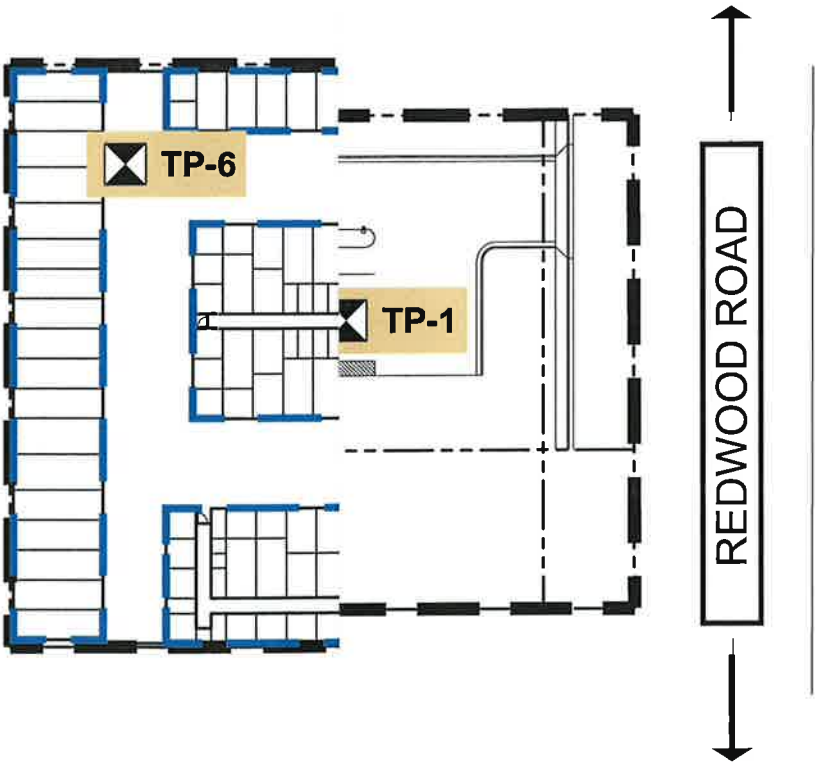


FIGURE 3
SITE PLAN

REFERENCE:
ADAPTED FROM DRAWING ENTITLED "STORAGE LAY
BY BARNETT STRUCTURES, LC., DATED DECEMBER

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

TEST PIT TP-1

Project Name: Proposed Towne Storage Riverton
Project No.: 035-012-17
Location: 13658 South Redwood Road, Riverton, Utah
Client: Menlove Construction
Excavating Method: JCB 4CX Backhoe
Date Excavated: 01-30-17
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
SANDY CLAY, FILL dark brown (SC-FILL)												moist "medium stiff"
SANDY FINE GRAVEL with trace silt; light brown (GP)					B				1.2			slightly moist "loose" to "medium dense"
			5									
FINE SAND with some silt; light brown (SP/SM)					B							slightly moist "loose" to "medium dense"
			10									
SILTY FINE SAND with occasional layers up to 2" thick of silty clay; light brown (SM)					B							slightly moist "medium dense"
			15									
Stopped excavating at 15.0'. Stopped sampling at 13.5'. No groundwater encountered at time of excavating. No signficant sidewall caving.			20									
			25									

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

FIGURE 4A

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

TEST PIT TP-2

Project Name: Proposed Towne Storage Riverton
Project No.: 035-012-17
Location: 13658 South Redwood Road, Riverton, Utah
Client: Menlove Construction
Excavating Method: JCB 4CX Backhoe
Date Excavated: 01-30-17
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
SILTY FINE SAND, FILL with some fine gravel; dark brown (SM-FILL)					B				31.1			slightly moist "medium stiff"
FINE TO COARSE SAND AND FINE GRAVEL with trace silt; light brown (SP/GP)			5		B							slightly moist "medium dense"
FINE SAND with trace silt; light brown (SP/SM)			10		B							moist "medium dense"
grades with some silt												
Stopped excavating at 14.0'. Stopped sampling at 13.5'. No groundwater encountered at time of excavating. No signficant sidewall caving.			15 20 25									

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

FIGURE 4B

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

TEST PIT TP-3

Project Name: Proposed Towne Storage Riverton
Project No.: 035-012-17
Location: 13658 South Redwood Road, Riverton, Utah
Client: Menlove Construction
Excavating Method: JCB 4CX Backhoe
Date Excavated: 01-30-17
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
CLAYEY FINE TO COARSE SAND AND GRAVEL, FILL dark brown (CL/GC-FILL)					B							moist "loose"
SANDY FINE GRAVEL light brown (GP)			5									slightly moist "loose"
FINE SAND with trace silt; light brown (SP)			10		B							slightly moist "medium dense"
grades with some silt												
SILTY FINE SAND light brown (SM)			15		B							slightly moist "medium dense"
Stopped excavating at 18.0'. Stopped sampling at 17.5'. No groundwater encountered at time of excavating. No signficant sidewall caving.			20 25									

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

FIGURE 4C

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

TEST PIT TP-4

Project Name: Proposed Towne Storage Riverton
Project No.: 035-012-17
Location: 13658 South Redwood Road, Riverton, Utah
Client: Menlove Construction
Excavating Method: JCB 4CX Backhoe
Date Excavated: 01-30-17
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
SANDY CLAY, FILL dark brown (CL/SC-FILL)												
FINE TO MEDIUM SAND with some silt; light brown (SP/SM)												slightly moist "loose"
					TW				5.1			
grades without medium sand			5									
grades with some silt			10									
Stopped excavating at 11.0'. Stopped sampling at 4.0'. No groundwater encountered at time of excavating. No signficant sidewall caving.			15 20 25									

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

FIGURE 4D

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

TEST PIT TP-5

Project Name: Proposed Towne Storage Riverton
Project No.: 035-012-17
Location: 13658 South Redwood Road, Riverton, Utah
Client: Menlove Construction
Excavating Method: JCB 4CX Backhoe
Date Excavated: 01-30-17
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
SANDY CLAY, FILL dark brown (CL/SC-FILL)												moist "medium stiff"
FINE TO COARSE SAND/FINE GRAVEL with trace silt; light brown (SP/GP)					B				2.8			slightly moist "medium dense"
FINE SAND with trace silt; light brown (SP)			5									slightly moist "loose" to "medium dense"
SILTY FINE SAND light brown (SM)			10		B							slightly moist "medium dense"
Stopped excavating at 15.0'. Stopped sampling at 13.5'. No groundwater encountered at time of excavating. No signficant sidewall caving.			15 20 25									

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

FIGURE 4E

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

TEST PIT TP-6

Project Name: Proposed Towne Storage Riverton
Project No.: 035-012-17
Location: 13658 South Redwood Road, Riverton, Utah
Client: Menlove Construction
Excavating Method: JCB 4CX Backhoe
Date Excavated: 01-30-17
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
CLAYEY FINE TO COARSE SAND, FILL dark brown (SC-FILL)					TW							moist "medium dense"
FINE TO COARSE SAND with some fine gravel and trace silt; light brown (SP)			5		B							moist "loose"
FINE SAND with trace silt; light brown (SP)			10		B							slightly moist "loose" to "medium dense"
SILTY FINE SAND light brown (SM)			15		B							slightly moist "medium dense"
FINE SANDY SILT light brown (ML)					B							very moist "stiff"
Stopped excavating at 17.5'. Stopped sampling at 16.5'. No groundwater encountered at time of excavating. Some sidewall caving above 10.0'. Installled slotted PVC pipe to 17.5'.			20 25									

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

FIGURE 4F

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

TEST PIT TP-7

Project Name: Proposed Towne Storage Riverton
Project No.: 035-012-17
Location: 13658 South Redwood Road, Riverton, Utah
Client: Menlove Construction
Excavating Method: JCB 4CX Backhoe
Date Excavated: 01-30-17
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
SILTY FINE TO COARSE SAND, FILL dark brown (SC-FILL)												slightly moist "loose"
FINE TO COARSE SAND with some fine and coarse gravel and trace silt; light brown (SP)					B				2.4			slightly moist "loose"
FINE SAND with trace silt; light brown (SP)			5									slightly moist "loose"
FINE TO COARSE SAND with trace silt; light brown (SP)					B							slightly moist "loose"
FINE SAND with some silt; light brown (SP)			10									slightly moist "medium dense"
Stopped excavating at 12.0'. Stopped sampling at 9.5'. No groundwater encountered at time of excavating. Some sidewall caving above 10.5'.			15 20 25									

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

FIGURE 4G

GORDON GEOTECHNICAL ENGINEERING, INC.

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)	Nonplastic 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)	Nonplastic 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
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)	IDENTIFICATION PROCEDURES ON FRACTION SMALLER THAN No. 40 SIEVE SIZE					
	SILTS AND CLAYS: Liquid limit less than 50	DRY STRENGTH (CRUSHING CHARACTERISTICS)	DILATANCY (REACTION TO SHAKING)	TOUGHNESS (CONSISTENCY NEAR PLASTIC LIMIT)		
		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 fore, actual designations (based on laboratory testing) may differ.
2. Lines separating 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
- 3.25" ID D&M Sampler
- 3" ID D&M Sampler
- California Sampler

COARSE - GRAINDE SOIL

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

STRATIFICATION

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

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

CEMENTATION

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

MODIFIERS

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

MOISTURE CONTENT

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

FIGURE 5