



ENGINEERING • GEOTECHNICAL • ENVIRONMENTAL (ESA I & II) •  
MATERIALS TESTING • SPECIAL INSPECTIONS •  
ORGANIC CHEMISTRY • PAVEMENT  
DESIGN • GEOLOGY

## GEOTECHNICAL ENGINEERING STUDY

# JDC Ranch Development

About 3000 West 2800 North  
Plain City, Utah

**CMT PROJECT NO. 21213**

FOR:  
**Nilson Homes**  
1740 Combe Road, Suite 2  
South Ogden, Utah 84403

January 4, 2024

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Mr. Steve Anderson  
Nilson Homes  
1740 Combe Road, Suite 2  
South Ogden, Utah 84403

Subject: Geotechnical Engineering Study  
JDC Ranch Development  
About 3000 West 2800 North  
Plain City, Utah  
CMT Project No. 21213

Mr. Anderson:

Submitted herewith is the report of our geotechnical engineering study for the subject site. This report contains the results of our findings and an engineering interpretation of the results with respect to the available project characteristics. It also contains recommendations to aid in the design and construction of the earth related phases of this project.

On October 28, 2023, a CMT Technical Services (CMT) staff professional was on-site and supervised the excavation of 11 test pits extending to a depth of about 8 feet below the existing ground surface. We obtained soil samples during the field operations that we subsequently transported to our laboratory for further testing and observation.

Conventional spread and/or continuous footings may be utilized to support the proposed structures, provided the recommendations in this report are followed. This report presents detailed discussions of design and construction criteria for this site.

We appreciate the opportunity to work with you at this stage of the project. CMT offers a full range of Geotechnical Engineering, Geological, Material Testing, Special Inspection services, and Phase I and II Environmental Site Assessments. With offices throughout Utah, Idaho, Arizona, Colorado and Texas, our staff is capable of efficiently serving your project needs. If we can be of further assistance or if you have any questions regarding this project, please do not hesitate to contact us at 801-492-4132.

Sincerely,  
CMT Technical Services



William G. Turner, P.E., M. ASCE  
Senior Geotechnical Engineer

Reviewed by:

A handwritten signature in blue ink, appearing to read "Jeffrey J. Egbert".

Jeffrey J. Egbert, P.E., LEED A.P., M. ASCE  
Senior Geotechnical Engineer

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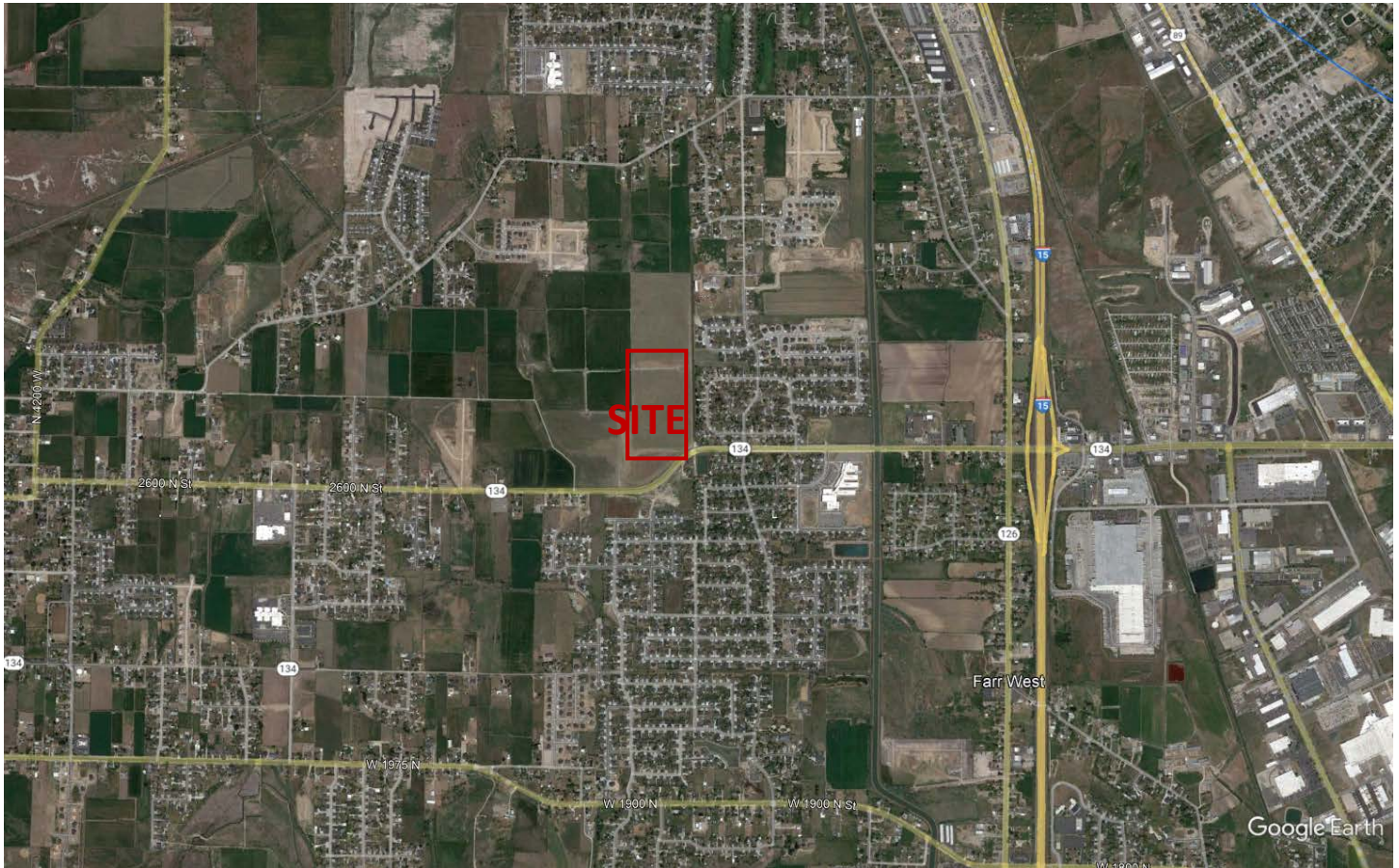
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## 1.0 INTRODUCTION

### 1.1 General

CMT Technical Services (CMT) was retained to conduct a geotechnical subsurface study for the proposed development of the site for single-family and multi-family residences. The parcel is situated on the north side of 2800 North Street at about 3000 West in Plain City, Utah, as shown in the **Vicinity Map** below.



**VICINITY MAP**

### 1.2 Objectives, Scope and Authorization

The objectives and scope of our study were planned in discussions between Mr. Steve Anderson of Nilson Homes, and Mr. Bill Turner of CMT. In general, the objectives of this study were to define and evaluate the subsurface soil and groundwater conditions at the site, and provide appropriate foundation, earthwork, pavement and seismic recommendations to be utilized in the design and construction of the proposed development.

In accomplishing these objectives, our scope of work included performing field exploration, which consisted of the excavating/logging/sampling of 11 test pits, performing laboratory testing on representative samples of

the subsurface soils collected in the test pits, and conducting an office program, which consisted of correlating available data, performing engineering analyses, and preparing this summary report. This scope of work was authorized by returning a signed copy of our proposal dated September 22, 2023, and executed on October 18, 2023.

### **1.3 Description of Proposed Construction**

We understand the project consists of constructing single family and multi-family residences at the site, which will likely have one to two levels of wood frame construction above grade and floor slabs placed close to or a little below existing grade (up to approximately 3 feet below existing ground surface). We project that maximum loads for the residences will be on the order of 6,000 pounds per lineal foot for walls, 60,000 pounds for columns, and relatively light floor slab loads having an average uniform loading not exceeding 100 pounds per square foot. If the loading conditions are different than we have projected, please notify us so that any appropriate modifications to our conclusions and recommendations contained herein can be made.

We anticipate that residential streets and parking areas will be constructed as part of the development and will be paved using asphalt and possibly some concrete surfacing. Traffic is projected to consist of a light volume of automobiles and pickup trucks, up to five daily medium-weight delivery trucks, a weekly garbage truck, and an occasional fire truck.

Site development will require some earthwork in the form of minor cutting and filling. A site grading plan was not available at the time of this report, but we project that maximum cuts and fills may be on the order of 2 to 4 feet. If deeper cuts or fills are planned, CMT should be notified to provide additional recommendations, if needed.

### **1.4 Executive Summary**

Proposed residences can be supported upon conventional spread and continuous wall foundations. The most significant geotechnical aspects regarding site development include the following:

1. Approximately 6 to 12 inches of topsoil blankets the site, which will require removal beneath structures, exterior flatwork and pavements.
2. Subsurface soils encountered below the topsoil consisted of CLAY/ORGANIC CLAY (CL/OH) overlying SAND (SM, SP-SM, SP), while groundwater was encountered at depths of 3 to 5 feet, below the existing ground surface.
3. Foundations and floor slabs may be placed on suitable (non-organic), undisturbed natural soils or on a minimum 18 inches of properly placed and compacted structural fill extending to suitable, undisturbed natural soils.

CMT must assess that topsoil, undocumented fills, debris, disturbed or unsuitable soils have been removed and that suitable soils have been encountered prior to placing site grading fills, footings, slabs, and pavements.

In the following sections, detailed discussions pertaining to the site are provided, including subsurface descriptions, geologic/seismic setting, earthwork, foundations, lateral resistance, lateral pressure, floor slabs, and pavements.

## **2.0 FIELD EXPLORATION**

### **2.1 General**

In order to define and evaluate the subsurface soil and groundwater conditions, 11 test pits were excavated with a backhoe at the site to a depth of approximately 8 feet below the existing ground surface. Locations of the test pits are shown on **Figure 1, Site Plan**, included in the Appendix. The field exploration was performed under the supervision of an experienced member of our geotechnical staff.

Representative soil samples were collected by obtaining disturbed "grab" samples and cutting relatively undisturbed "block" samples from within each test pit. The samples were placed in sealed plastic bags and containers prior to transport to the laboratory.

The subsurface soils encountered in the test pits were classified in the field based upon visual and textural examination, logged and described in general accordance with ASTM<sup>1</sup> D-2488. These field classifications were supplemented by subsequent examination and testing of select samples in our laboratory. Graphical representations of the subsurface conditions encountered are presented on each individual Test Pit Log, **Figures 2 through 12**, included in the Appendix. A Key to Symbols defining the terms and symbols used on the logs, is provided as **Figure 13** in the Appendix.

Following completion of excavating operations, 1.25-inch diameter slotted PVC pipe was installed in test pits TP-2 through TP-11 to allow subsequent water level measurements.

Upon completion of logging and sampling, the test pits were backfilled with the excavated soils. When backfilling, minimal to no effort was made to compact the backfill and no compaction testing was performed. Thus, the test pit backfill is considered undocumented fill and settlement of the backfill in the test pits over time should be anticipated.

### **2.2 Infiltration Testing**

We also performed infiltration testing as part of our field exploration within test pit TP-6 at a depth of about 1 foot below the existing ground surface. The testing consisted of creating and filling a small hole at that depth with water, and measuring the rate of water drop within the small hole over a certain time period (i.e. 15 minutes). We repeated this process multiple times until subsequent readings were the same. The results of this test indicate that the clay soils at this site have an infiltration rate of approximately 30 minutes per inch. This rate could increase (become slower) over time due to siltation, thus we recommend an appropriate factor of safety be applied for design.

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<sup>1</sup>American Society for Testing and Materials

### 3.0 LABORATORY TESTING

Selected samples of the subsurface soils were subjected to various laboratory tests to assess pertinent engineering properties, as follows:

1. Moisture Content, ASTM D-2216, Percent moisture representative of field conditions
2. Dry Density, ASTM D-2937, Dry unit weight representing field conditions
3. Atterberg Limits, ASTM D-4318, Plasticity and workability
4. Gradation Analysis, ASTM D-1140/C-117, Grain Size Analysis
5. One Dimension Consolidation, ASTM D-2435, Consolidation properties

To provide data necessary for our settlement analyses, a consolidation test was performed on each of 3 representative samples of the surficial silt/clay soils encountered across the site. Based upon data obtained from the consolidation testing, the silt/clay soils at this site are moderately over-consolidated, moderately compressible under additional loading, and have a swell potential up to approximately 1.5% at a load of 1,000 psf when water was added (see the **Lab Summary Table** below). Detailed results of the tests are maintained within our files and can be transmitted to you, if so desired.

Laboratory test results are presented on the test pit logs (**Figures 2 through 12**) and in the following **Lab Summary Table**:

**LAB SUMMARY TABLE**

TEST PIT	DEPTH (feet)	SOIL CLASS	SAMPLE TYPE	MOISTURE CONTENT(%)	DRY DENSITY (pcf)	GRADATION			ATTERBERG LIMITS			COLLAPSE (-)/ EXPANSION(+)
						GRAV.	SAND	FINES	LL	PL	PI	
TP-1	3	CM	Bag	23		0	54	46				
TP-2	1.5	SP	Bag	16		22	74	4				
TP-3	3	CL	Block	36	84				49	20	29	+0.2%
TP-4	5	SM	Bag	26		0	71	29				
TP-5	4	SP-SM	Bag	25		0	90	10				
TP-6	4	OH	Block	47	73				74	24	50	+1.5%
TP-7	1.5	CL	Bag	8		0	16	84				
TP-8	2	SM	Bag	14		0	66	34		NP	NP	
TP-9	3	ML	Block	27	92				31	24	7	-0.4%
TP-10	2.5	CL	Bag	28		5	8	87				
TP-11	7	SP-SM	Bag	26		0	94	6				



## 4.0 GEOLOGIC & SEISMIC CONDITIONS

### 4.1 Geologic Setting

The subject site is located in the central portion of Weber County in north-central Utah and sits at an elevation of approximately 4,240 feet above sea level. The site is located in a valley bounded by the Wasatch Mountains on the east and Antelope Island (Great Salt Lake) and the Promontory Mountains to the west. The valley is a deep, sediment-filled basin that is part of the Basin and Range Physiographic Province and was formed by extensional tectonic processes during the Tertiary and Quaternary geologic time periods. The site is located within the Intermountain Seismic Belt, a zone of ongoing tectonism and seismic activity extending from southwestern Montana to southwestern Utah. The active (evidence of movement in the last 10,000 years) Wasatch Fault Zone is part of the Intermountain Seismic Belt and extends from southeastern Idaho to central Utah along the western base of the Wasatch Mountain Range.

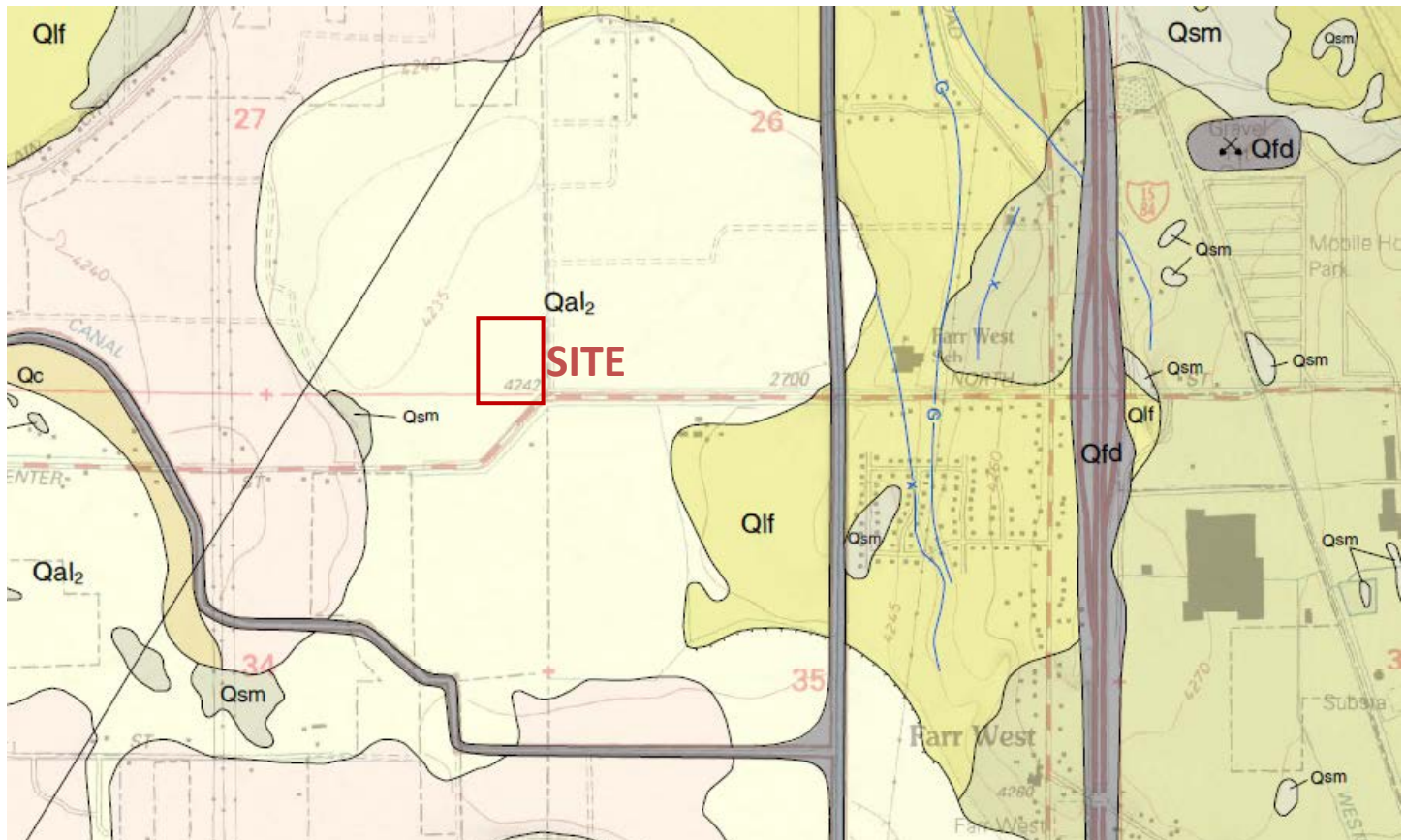
Much of northwestern Utah, including the subject site, was previously covered by the Pleistocene age Lake Bonneville. The Great Salt Lake located to the west of the valley is a remnant of this ancient freshwater lake. Lake Bonneville reached a high-stand elevation of approximately 5,160 and 5,200 feet above sea level between 18,500 and 17,400 years ago. Approximately 17,400 years ago, the lake breached its basin in southeastern Idaho and dropped relatively fast, by almost 300 feet, as water drained into the Snake River. Following this catastrophic release, the lake level continued to drop slowly over time, primarily driven by drier climatic conditions, until reaching the current level of the Great Salt Lake. Shoreline terraces formed at the high-stand elevation of the lake and several subsequent lower lake levels are visible in places on the mountain slopes surrounding the valley. Much of the sediment within the subject valley was deposited as lacustrine sediments during both the transgressive (rise) and regressive (fall) phases of Lake Bonneville and in older pre-Bonneville lakes that previously occupied the basin.

The geology of the Plain City, Utah, 7.5-minute Quadrangle, which includes the location of the subject site, has been mapped by Harty and others<sup>2</sup>. The surficial geology at the location of the subject site and adjacent properties is mapped as “Older stream alluvium” (Map Unit **Qal<sub>2</sub>**) dated to be Holocene in age. Unit **Qal<sub>2</sub>** is described in the referenced map as “Well to poorly sorted silt, sand, and gravel deposited along inactive flood plains 1 to 3 meters (3–10 ft) above modern stream level; mapped where fluvial processes are generally no longer active; thickness generally less than 3 meters (10 ft).” No fill has been mapped at the location of the site on the geologic map. Refer to the **Geologic Map**, shown on the following page.

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<sup>2</sup> Harty, K. M., Lowe, M., and Kirby, S. M., 2012, Geologic Map of the Plain City Quadrangle, Weber, and Box Elder Counties, Utah; Utah Geological Survey, Map Series 253dm, Scale 1:24,000. <https://doi.org/10.34191/M-253dm>





GEOLOGIC MAP

## 4.2 Faulting

No surface fault traces are shown on the referenced geologic map crossing or projecting toward the subject site. The nearest mapped active (Holocene) fault trace is a section of the Brigham City segment of the Wasatch fault located about 1.8 miles north of the site. Seismic design issues are addressed in **Section 4.3** below.

## 4.3 Seismicity

### 4.3.1 Site Class

Utah has adopted the International Building Code (IBC) 2021, which 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). For site class definitions, IBC 2021 Section 1613.2.2 refers to Chapter 20, Site Classification Procedure for Seismic Design, of ASCE<sup>3</sup> 7-16, which stipulates that the average values of shear wave velocity, blow count and/or shear strength within the upper 100 feet (30 meters) be utilized to determine seismic site class. Based on average shear wave velocity data within the

<sup>3</sup>American Society of Civil Engineers

upper 30 meters ( $V_{s,30}$ ) published by McDonald and Ashland<sup>4</sup>, the subject site is located within unit description Q01Wde, which has a log-mean  $V_{s,30}$  of 166 meters per second (545 feet per second). Thus, it is our opinion the site best fits Site Class E – Soft Clay Soil Profile, which we recommend for seismic structural design.

### 4.3.2 Seismic Design Category

The 2014 USGS mapping utilized by the IBC provides values of peak ground, short period and long period spectral accelerations for the Site Class B/C boundary and the Risk-Targeted Maximum Considered Earthquake ( $MCE_R$ ). This Site Class B/C boundary represents average bedrock values for the Western United States and must be corrected for local soil conditions. The Seismic Design Categories in the International Residential Code (IRC 2018 Table R301.2.2.1.1) are based upon the Site Class as addressed in the previous section. For Site Class E at site grid coordinates of 41.3083 degrees north latitude and -112.0465 degrees west longitude,  $S_{DS}$  (using Exception 1 of ASCE 7-16) is 1.133 and the **Seismic Design Category** is D<sub>2</sub>.

### 4.3.3 Liquefaction

The site is located within an area designated by the Utah Geologic Survey<sup>5</sup> as having “High” liquefaction potential. Liquefaction is defined as the condition when saturated, loose, sandy soils lose their support capabilities because of excessive pore water pressure which develops during a seismic event. Clayey soils, even if saturated, will generally not liquefy during a major seismic event.

Subsurface soils encountered consisted of clay, typically not liquefiable, and medium dense (estimated) sand soils, while groundwater was encountered at depths of 3 to 5 feet. These conditions indicate that liquefaction of these soils is not likely to occur. However, the liquefaction susceptibility of the underlying soils (deeper than our explorations) is unknown and would require further investigation to quantify.

## 4.4 Other Geologic Hazards

The site is not located on an active alluvial fan or an observed or mapped rock fall hazard area, and it is not at risk from debris flow or landslide hazards<sup>6</sup>. The site is not located within a known or mapped stream flooding zone<sup>7</sup>.

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<sup>4</sup> McDonald, G.N. and Ashland, F.X., 2008, “Earthquake Site-Conditions Map for the Wasatch Front Urban Corridor, Utah,” Utah Geological Survey Special Study 125, 41 pp.

<sup>5</sup> Utah Geological Survey, “Liquefaction-Potential Map for a Part of Weber County, Utah,” Utah Geological Survey Public Information Series 27, August 1994. [https://ugspub.nr.utah.gov/publications/public\\_information/pi-27.pdf](https://ugspub.nr.utah.gov/publications/public_information/pi-27.pdf)

<sup>6</sup> Utah Geologic Hazards, <https://geology.utah.gov/apps/hazards/>

<sup>7</sup> Federal Emergency Management Agency: <https://msc.fema.gov/portal/search?AddressQuery=-112.048998%2C41.311583>

## 5.0 SITE CONDITIONS

### 5.1 Surface Conditions

At the time the test pits were excavated the site consisted of a field vegetated with grasses and some weeds. Based upon aerial photos dating back to 1993 that are readily available on the internet, it appears the site may have been used for agriculture and/or grazing with very little changed since then. Overall, the site is relatively flat, with a very slight slope downward to the west. The site is bordered on the north and west by similar vacant fields, on the east by existing residences, and on the south by some vacant land and 2600/2700 North Street (see **Vicinity Map** in **Section 1.1** above).

### 5.2 Subsurface Soils

At the locations of the test pits we encountered approximately 6 to 12 inches of topsoil at the surface. We observed natural soils beneath the topsoil, consisting of Silty CLAY with varying amounts of sand (CL), ORGANIC CLAY (OH), Clayey SILT with sand (ML), and SAND with varying amounts of silt and gravel (SM, SP-SM, SP), extending to the maximum depth penetrated of approximately 8 feet.

The silt/clay soils were moist to wet, brown to gray in color, and estimated to be medium stiff to stiff in consistency. They also exhibited moderate over consolidation and strength characteristics, as well as a slight potential (up to 1.5%) for swelling when wetted.

The natural sand soils were moist to wet, brown to whitish/light gray to dark brown/black/dark gray in color, and estimated to be medium dense. They will also exhibit moderately high strength and low compressibility characteristics.

For a more descriptive interpretation of subsurface conditions, please refer to the test pit logs, **Figures 2 through 12**, which graphically represent the subsurface conditions encountered. The lines designating the interface between soil types on the logs generally represent approximate boundaries - in situ, the transition between soil types may be gradual.

### 5.3 Groundwater

We encountered groundwater in the test pits at depths of about 3 to 5 feet below existing grade at the time of our field exploration. These depths to groundwater will likely affect excavations and possibly construction. The following **Groundwater Depths Table** shows the approximate groundwater depths and elevations based on a topographic map you provided and our field explorations:

### GROUNDWATER DEPTHS TABLE

TEST PIT	GROUNDWATER DEPTH (FEET)	APPROXIMATE SURFACE ELEVATION (FEET)	APPROXIMATE GROUNDWATER ELEVATION (FEET)
TP-1	4	4240	4236
TP-2	5	4241	4236
TP-3	3.5	4239.5	4236
TP-4	5	4241	4236
TP-5	4	4240	4236
TP-6	3	4239	4236
TP-7	4	4240	4236
TP-8	4	4241	4237
TP-9	5	4240	4235
TP-10	3	4239.5	4236.5
TP-11	3	4239	4236

Note that groundwater levels can fluctuate seasonally. Numerous other factors such as heavy precipitation, irrigation of neighboring land, and other unforeseen factors, may also influence ground water elevations at the site. The detailed evaluation of these and other factors, which may be responsible for ground water fluctuations, is beyond the scope of this study.

#### **5.4 Site Subsurface Variations**

Based on the results of the subsurface explorations and our experience, variations in the continuity and nature of subsurface conditions should be anticipated. Due to the heterogeneous characteristics of natural soils, care should be taken in interpolating or extrapolating subsurface conditions between or beyond the exploratory locations.

Also, after completing the logging and sampling, the test pits were backfilled with the excavated soils but minimal to no effort was made to compact these soils. Thus, the test pit backfill is considered undocumented fill and settlement of the backfill in the test pits over time should be anticipated.

## **6.0 SITE PREPARATION AND GRADING**

### **6.1 General**

All deleterious materials should be stripped from the site prior to commencement of construction activities. This includes loose and disturbed soils, topsoil, vegetation, etc. Based upon the conditions observed in the



test pits there is topsoil on the surface of the site which we estimated to be about 6 to 12 inches in thickness. When stripping and grubbing, topsoil should be distinguished by the apparent organic content and not solely by color; thus we estimate that topsoil stripping will need to include the upper 4 inches. However, given the past agricultural uses of the site, the upper 12 to 15 inches may have been disturbed during farming.

The site should be observed by a CMT geotechnical engineer to assess that suitable natural soils have been exposed and any deleterious materials, loose and/or disturbed soils have been removed, prior to placing site grading fills, footings, slabs, and pavements.

Fill placed over large areas to raise overall site grades can induce settlements in the underlying natural soils. If more than 3 feet of site grading fill is anticipated over the natural ground surface, we should be notified to assess potential settlements and provide additional recommendations as needed. These recommendations may include placement of the site grading fill far in advance to allow potential settlements to occur prior to construction.

## **6.2 Temporary Excavations**

Excavations deeper than 8 feet are not anticipated at the site. Relatively shallow groundwater was encountered at depths of 3 to 5 feet below the existing ground surface. We anticipate that excavations extending below these depths will likely encounter groundwater, and dewatering of such excavations will likely be required.

In clayey (cohesive) soils, temporary construction excavations not exceeding 4 feet in depth may be constructed with near-vertical side slopes. Temporary excavations up to 8 feet deep, above or below groundwater, may be constructed with side slopes no steeper than one-half horizontal to one vertical (0.5H:1V).

For silty/sandy/gravelly (cohesionless) soils, temporary construction excavations not exceeding 4 feet in depth should be no steeper than one-half horizontal to one vertical (0.5H:1V). For excavations up to 8 feet and above groundwater, side slopes should be no steeper than one horizontal to one vertical (1H:1V). Excavations encountering saturated cohesionless soils will be very difficult to maintain, and will require very flat side slopes and/or shoring, bracing and dewatering.

To reduce disturbance of the natural soils during excavation, we recommend that smooth edge buckets/blades be utilized.

All excavations must be inspected periodically by qualified personnel. If any signs of instability or excessive sloughing are noted, immediate remedial action must be initiated. All excavations should be made following OSHA safety guidelines.

### **6.3 Fill Material**

Following are our recommendations for the various fill types we anticipate will be used at this site:

FILL MATERIAL TYPE	DESCRIPTION   RECOMMENDED SPECIFICATION
Structural Fill	Placed below structures, flatwork and pavement. Well-graded sand/gravel mixture, with maximum particle size of 4 inches, a minimum 70% passing 3/4-inch sieve, a maximum 20% passing the No. 200 sieve, and a maximum Plasticity Index of 10.
Site Grading Fill	Placed over larger areas to raise the site grade. Sandy to gravelly soil, with a maximum particle size of 6 inches, a minimum 70% passing 3/4-inch sieve, a maximum 50% passing No. 200 sieve, and a maximum Plasticity Index of 15.
Non-Structural Fill	Placed below non-structural areas, such as landscaping. On-site soils or imported soils, with a maximum particle size of 8 inches, including silt/clay soils not containing excessive amounts of degradable/organic material (see discussion below).
Stabilization Fill	Placed to stabilize soft areas prior to placing structural fill and/or site grading fill. Coarse angular gravels and cobbles 1 inch to 8 inches in size. May also use 1.5-inch to 2.0-inch gravel placed on stabilization fabric, such as Mirafi RS280i, or equivalent (see <b>Section 6.6</b> ).

On-site sand soils may be suitable for use as structural fill, if processed to meet the requirements given above, and may also be used in site grading fill and non-structural fill situations.

On-site silt/clay soils are not suitable for use as structural fill or site grading fill but may be used as non-structural fill. Note that these silt/clay soils are moisture-sensitive, which means they are inherently more difficult to work with in proper moisture conditioning (they are very sensitive to changes in moisture content), requiring very close moisture control during placement and compaction. This will be very difficult, if not impossible, during wet and cold periods of the year.

All fill material should be approved by a CMT geotechnical engineer prior to placement.

### **6.4 Fill Placement and Compaction**

The various types of compaction equipment available have their limitations as to the maximum lift thickness that can be compacted. For example, hand operated equipment is limited to lifts of about 4 inches and most “trench compactors” have a maximum, consistent compaction depth of about 6 inches. Large rollers, depending on soil and moisture conditions, can achieve compaction at 8 to 12 inches. The full thickness of each lift should be compacted to at least the following percentages of the maximum dry density as determined by ASTM D-1557 (or AASHTO<sup>8</sup> T-180) in accordance with the following recommendations:

<sup>8</sup> American Association of State Highway and Transportation Officials

LOCATION	TOTAL FILL THICKNESS (FEET)	MINIMUM PERCENTAGE OF MAXIMUM DRY DENSITY
Beneath an area extending at least 4 feet beyond the perimeter of structures, and below flatwork and pavement (applies to structural fill and site grading fill) extending at least 2 feet beyond the perimeter	0 to 5	95
Site grading fill outside area defined above	0 to 5	92
Utility trenches within structural areas	--	96
Roadbase and subbase	-	96
Non-structural fill	0 to 5	90

Structural fills greater than 5 feet thick are not anticipated at the site. For best compaction results, we recommend that the moisture content for structural fill/backfill be within 2% of optimum. Field density tests should be performed on each lift as necessary to verify that proper compaction is being achieved.

### **6.5 Utility Trenches**

For the bedding zone around the utility, we recommend utilizing sand bedding fill material that meets current APWA<sup>9</sup> requirements.

All utility trench backfill material below structurally loaded facilities (foundations, floor slabs, flatwork, parking lots/drive areas, etc.) should be placed at the same density requirements established for structural fill in the previous section.

Most utility companies and local governments are requiring Type A-1a or A-1b (AASHTO Designation) soils (sand/gravel soils with limited fines) be used as backfill over utilities within public rights of way, and the backfill be compacted over the full depth above the bedding zone to at least 96% of the maximum dry density as determined by AASHTO T-180 (ASTM D-1557). The natural sand soils at this site may meet these specifications.

Where the utility does not underlie structurally loaded facilities and public rights of way, natural soils may be utilized as trench backfill above the bedding layer, provided they are properly moisture conditioned and compacted to the minimum requirements stated above in **Section 6.4**.

### **6.6 Stabilization**

The natural silt/clay soils at this site will likely be susceptible to rutting and pumping. The likelihood of disturbance or rutting and/or pumping of the existing natural soils is a function of the load applied to the surface, as well as the frequency of the load. Consequently, rutting and pumping can be minimized by avoiding concentrated traffic, minimizing the load applied to the surface by using lighter equipment and/or

<sup>9</sup> American Public Works Association

partial loads, by working in drier times of the year, or by providing a working surface for the equipment. Rubber-tired equipment particularly, because of high pressures, promotes instability in moist/wet, soft soils.

If rutting or pumping occurs, traffic should be stopped and the disturbed soils should be removed and replaced with stabilization material. Typically, a minimum of 18 inches of the disturbed soils must be removed to be effective. However, deeper removal is sometimes required.

To stabilize soft subgrade conditions (if encountered), a mixture of coarse, clean, angular gravels and cobbles and/or 1.5- to 2.0-inch clean gravel should be utilized, as indicated above in **Section 6.3**. Often the amount of gravelly material can be reduced with the use of a geotextile fabric such as Mirafi RS280i or equivalent. Its use will also help avoid mixing of the subgrade soils with the gravelly material. After excavating the soft/disturbed soils, the fabric should be spread across the bottom of the excavation and up the sides a minimum of 18 inches. Otherwise, it should be placed in accordance with the manufacturer's recommendation, including proper overlaps. The gravel material can then be placed over the fabric in compacted lifts as described above.

## **7.0 FOUNDATION RECOMMENDATIONS**

The following recommendations have been developed on the basis of the previously described project characteristics, including the maximum loads discussed in **Section 1.3**, the subsurface conditions observed in the field and the laboratory test data, and standard geotechnical engineering practice.

### **7.1 Foundation Recommendations**

Based on our geotechnical engineering analyses, the proposed residences may be supported upon conventional spread and/or continuous wall foundations placed on suitable, undisturbed natural soils and/or on a minimum 18 inches of structural fill extending to suitable natural soils. Note that footings should be placed on structural fill in the vicinity of TP-6 where organic clay soils were encountered, and stabilization fill or clean gravel may be needed beneath some footings, particularly if groundwater is encountered in footing excavations. Footings may be designed using a net bearing pressure of 2,000 psf if placed on suitable, undisturbed, natural soils or 2,500 psf if placed on a minimum 18 inches of structural fill. The term "net bearing pressure" refers to the pressure imposed by the portion of the structure located above lowest adjacent final grade, thus the weight of the footing and backfill to lowest adjacent final grade need not be considered. The allowable bearing pressure may be increased by 1/3 for temporary loads such as wind and seismic forces.

We also recommend the following:

1. Exterior footings subject to frost should be placed at least 30 inches below final grade.
2. Interior footings not subject to frost should be placed at least 16 inches below grade.
3. Continuous footing widths should be maintained at a minimum of 18 inches.
4. Spot footings should be a minimum of 24 inches wide.



## **7.2 Installation**

Under no circumstances shall foundations be placed on undocumented fill, topsoil with organics, organic soils, sod, rubbish, construction debris, other deleterious materials, frozen soils, or within ponded water.

Deep, large roots may be encountered where trees and larger bushes are located or were previously located at the site; such large roots should be removed. If other unsuitable soils are encountered, they must be completely removed and replaced with properly compacted structural fill. Excavation bottoms should be examined by a CMT geotechnical engineer to confirm that suitable bearing soils have been exposed.

All structural fill should meet the requirements for such, and should be placed and compacted in accordance with **Section 6** above. The width of structural replacement fill below footings should be equal to the width of the footing plus 1 foot for each foot of fill thickness. For instance, if the footing width is 2 feet and the structural fill depth beneath the footing is 2 feet, the fill replacement width should be 4 feet, centered beneath the footing.

The minimum thickness of structural fill below footings should be equivalent to one-third the thickness of structural fill below any other portion of the foundations. For example, if the maximum depth of structural fill is 6 feet, all footings for the new structure should be underlain by a minimum 2 feet of structural fill.

## **7.3 Estimated Settlement**

Foundations designed and constructed in accordance with our recommendations could experience some settlement, but we anticipate that total settlements of footings founded as recommended above will not exceed 1 inch, with differential settlements on the order of 0.5 inches over a distance of 25 feet. We expect approximately 50% of the total settlement to initially take place during construction.

## **7.4 Lateral Resistance**

Lateral loads imposed upon foundations due to wind or seismic forces may be resisted by the development of passive earth pressures and friction between the base of the footings and the supporting soils. In determining frictional resistance, a coefficient of 0.30 for natural silt/clay soils or 0.40 for natural sand soils and structural fill, may be utilized for design. Passive resistance provided by properly placed and compacted structural fill above the water table may be considered equivalent to a fluid with a density of 400 pcf. A combination of passive earth resistance and friction may be utilized if the passive resistance component of the total is divided by 1.5.

## **8.0 LATERAL EARTH PRESSURES**

We anticipate that below-grade walls up to 4 feet tall might be constructed at this site. The lateral earth pressure values given below anticipate that natural sand soils or imported sand/gravel fill will be used as backfill material, placed and compacted in accordance with the recommendations presented herein. If other

soil types will be used as backfill, we should be notified so that appropriate modifications to these values can be provided, as needed.

The lateral pressures imposed upon subgrade facilities will depend upon the relative rigidity and movement of the backfilled structure. Following are the recommended lateral pressure values, which also assume that the soil surface behind the wall is horizontal and that the backfill within 3 feet of the wall will be compacted with hand-operated compacting equipment.

CONDITION	STATIC (psf/ft)*	SEISMIC (psf/ft)**
<b>Active Pressure</b> (wall is allowed to yield, i.e. move away from the soil, with a minimum 0.001H movement/rotation at the top of the wall, where “H” is the total height of the wall)	38	39
<b>At-Rest Pressure</b> (wall is not allowed to yield)	59	N/A
<b>Passive Pressure</b> (wall moves into the soil)	400	215

\*Equivalent Fluid Pressure (applied at 1/3 Height of Wall)

\*\*Equivalent Fluid Pressure (added to static and applied at 1/3 Height of Wall)

## 9.0 FLOOR SLABS

Floor slabs may be established upon suitable, undisturbed, natural soils and/or on structural fill extending to suitable natural soils (same as for foundations), except in the vicinity of TP-6 where we recommend floor slabs be placed on a minimum 12 inches of structural fill (including the 4 inches recommended below). Under no circumstances shall floor slabs be established directly on any topsoil, undocumented fills, loose or disturbed soils, sod, rubbish, construction debris, other deleterious materials, frozen soils, or within ponded water.

In order to facilitate curing of the concrete, we recommend that floor slabs be directly underlain by at least 4 inches of “free-draining” fill, such as “pea” gravel or 3/4-inch to 1-inch minus, clean, gap-graded gravel. To help control normal shrinkage and stress cracking, the floor slabs should have the following features:

1. Adequate reinforcement for the anticipated floor loads with the reinforcement continuous through interior floor joints;
2. Frequent crack control joints; and
3. Non-rigid attachment of the slabs to foundation walls and bearing slabs.

## 10.0 DRAINAGE RECOMMENDATIONS

### 10.1 Surface Drainage

It is important to the long-term performance of foundations and floor slabs that water not be allowed to collect near the foundation walls and infiltrate into the underlying soils. We recommend the following:

1. All areas around each residence should be sloped to provide drainage away from the foundations. We recommend a minimum slope of 4 inches in the first 10 feet away from the structure. This slope should be maintained throughout the lifetime of the structure.
2. All roof drainage should be collected in rain gutters with downspouts designed to discharge at least 10 feet from the foundation walls or well beyond the backfill limits, whichever is greater.
3. Adequate compaction of the foundation backfill should be provided. We suggest a minimum of 90% of the maximum laboratory density as determined by ASTM D-1557. Water consolidation methods should not be used under any circumstances.
4. Landscape sprinklers should be aimed away, and maintained a distance of at least 4 feet, from the foundation walls. The sprinkling systems should be designed with proper drainage and be well-maintained. Over watering should be avoided.
5. Other precautions that may become evident during construction.

## **10.2 Foundation Subdrains**

Groundwater was encountered in the test pits at depths of about 3 to 5 feet below the existing ground surface, which is at approximately elevation 4236 feet (see **Section 5.3** above). If floor slabs will be placed deeper than 6 inches below the existing ground surface, we recommend that perimeter foundation subdrains be installed and that floor slabs be placed at a minimum elevation of about 4238 feet.

Foundation subdrains should consist of a 4-inch diameter perforated or slotted plastic or PVC pipe surrounded by clean gravel. The invert of the subdrain should be at least 2 feet below the top of the lowest adjacent floor slab. The gravel portion of the drain should extend a minimum 2 inches laterally and below the perforated pipe and at least 1 foot above the top of the lowest adjacent floor slab. The gravel zone must be installed immediately adjacent to the perimeter footings and the foundation walls. To reduce the possibility of plugging, the gravel must be wrapped with a geotextile, such as Mirafi 140N or equivalent. Prior to the installation of the footing subdrain, the below-grade walls should be dampproofed. The slope of the subdrain should be at least 0.5%. The gravel placed around the drain pipe should be clean 3/4-inch to 1-inch minus gap-graded gravel and/or "pea" gravel. The foundation subdrains can be discharged into the area subdrains, storm drains, or other suitable down-gradient location.

## **11.0 PAVEMENTS**

All pavement areas must be prepared as discussed above in **Section 6.1**. Under no circumstances shall pavements be established over topsoil, undocumented fills (if encountered), loose or disturbed soils, sod, rubbish, construction debris, other deleterious materials, frozen soils, or within ponded water. In roadway areas, subsequent to stripping and prior to the placement of pavement materials, the exposed subgrade must be proof rolled by passing moderate-weight rubber tire-mounted construction equipment over the surface at

least twice. If excessively soft or otherwise unsuitable soils are encountered, we recommend they be removed to a minimum of 18 inches below the subgrade level and replaced with structural fill.

We anticipate the natural silt/clay soils will exhibit poor pavement support characteristics when saturated or nearly saturated. Based on our laboratory testing experience with similar soils, our pavement design utilized a California Bearing Ratio (CBR) of 3 for the natural silt/clay soils.

Given the projected traffic as discussed above in **Section 1.3**, the following pavement sections for the proposed parking/drive areas are recommended:

MATERIAL	PAVEMENT SECTION THICKNESS (inches)					
	PARKING AREAS (1 ESAL per day)			DRIVE AREAS (3 ESAL'S per day)		
Asphalt	3	3	---	3.5	3.5	---
Concrete	---	--	5	---	---	6
Road-Base	8	4	5	10	6	5
Subbase	0	6	0	0	6	0
Total Thickness	11	13	10	13.5	15.5	11

Given the projected traffic as discussed above in **Section 1.3**, the following pavement sections for the proposed residential streets are recommended for approximately 4 ESAL's (18-kip equivalent single-axle loads) per day:

MATERIAL	PAVEMENT SECTION THICKNESS (inches)	
Asphalt	3	3
Road-Base	10	6
Subbase	0	6
Total Thickness	13	15

Untreated base course (UTBC) should conform to city specifications, or to 1-inch-minus UDOT specifications for A-1-a/NP, and have a minimum CBR value of 70%. Material meeting our specification for structural fill can be used for subbase, as long as the fines content (percent passing No. 200 sieve) does not exceed 15%. Roadbase and subbase material should be compacted as recommended above in **Section 6.4**. Asphalt material generally should conform to APWA requirements, having a ½-inch maximum aggregate size, a 75-gradation Superpave mix containing no more than 15% of recycled asphalt (RAP) and a PG58-28 binder.

Concrete pavement should typically have a minimum 28-day strength of 3,000 psi, and should be saw-cut at appropriate intervals and at the proper time to control the locations of shrinkage cracking. This generally means maximum saw-cut intervals of twice the pavement thickness, in feet (i.e. a 10-foot maximum interval for 5 inches thick concrete), and performing the saw cutting within 24 hours of placement.

For dumpster pads, we recommend a pavement section consisting of 6.5 inches of Portland cement concrete and 6 inches of aggregate base over properly prepared suitable natural subgrade or site grading structural fills



extending to suitable natural soils. Dumpster pads constructed overlying undocumented fills must be avoided or heavily reinforced.

## 12.0 QUALITY CONTROL

We recommend that CMT be retained as part of a comprehensive quality control testing and observation program. With CMT on-site we can help facilitate implementation of our recommendations and address, in a timely manner, any subsurface conditions encountered which vary from those described in this report. Without such a program CMT cannot be responsible for application of our recommendations to subsurface conditions which may vary from those described herein. This program may include, but not necessarily be limited to, the following:

### 12.1 Field Observations

Observations should be completed during all phases of construction such as site preparation, foundation excavation, structural fill placement and concrete placement.

### 12.2 Fill Compaction

Compaction testing by CMT is required for all structural supporting fill materials. Maximum Dry Density (Modified Proctor, ASTM D-1557) tests should be requested by the contractor immediately after delivery of any fill materials. The maximum density information should then be used for field density tests on each lift as necessary to ensure that the required compaction is being achieved.

### 12.3 Excavations

All excavation procedures and processes should be observed by a geotechnical engineer from CMT or their representative. In addition, for the recommendations in this report to be valid, all backfill and structural fill placed in trenches and all pavements should be density tested by CMT. We recommend that freshly mixed concrete be tested by CMT in accordance with ASTM designations.

## 13.0 LIMITATIONS

The recommendations provided herein were developed by evaluating the information obtained from the subsurface explorations and soils encountered therein. The exploration logs reflect the subsurface conditions only at the specific location at the particular time designated on the logs. Soil and ground water conditions may differ from conditions encountered at the actual exploration locations. The nature and extent of any variation in the explorations may not become evident until during the course of construction. If variations do appear, it may become necessary to re-evaluate the recommendations of this report after we have observed the variation.

**Geotechnical Engineering Study**

JDC Ranch Development, Plain City, Utah

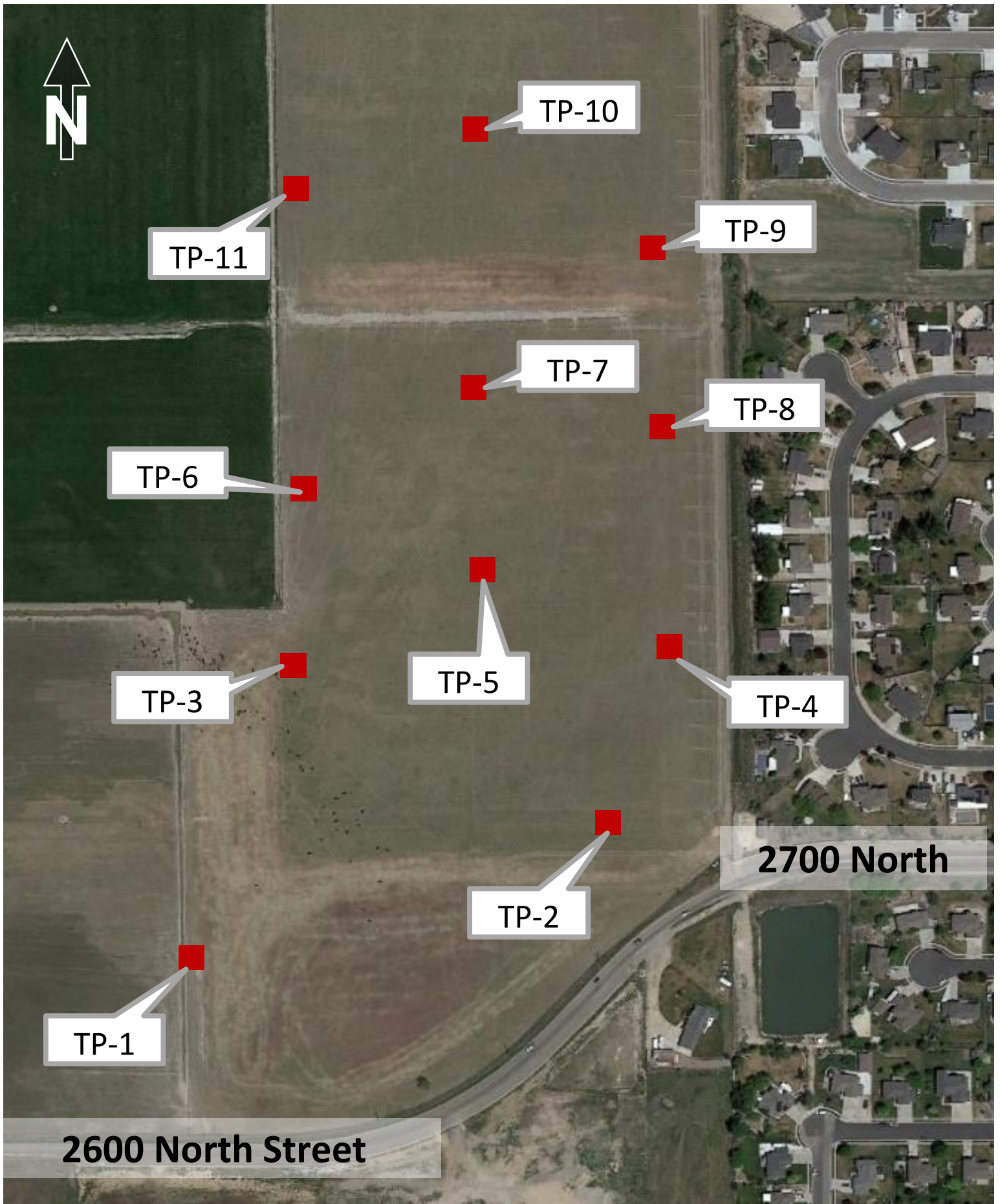
CMT Project No. 21213

Our professional services have been performed, our findings obtained, and our recommendations prepared in accordance with generally accepted geotechnical engineering principles and practices. This warranty is in lieu of all other warranties, either expressed or implied.

We appreciate the opportunity to be of service to you on this project. If we can be of further assistance or if you have any questions regarding this project, please do not hesitate to contact us at (801) 492-4132. To schedule materials testing, please call (801) 381-5141.

**APPENDIX**

SUPPORTING  
DOCUMENTATION



**JDC Ranch Development**  
 About 3000 West 2800 North, Plain City, Utah

**CMT TECHNICAL SERVICES**

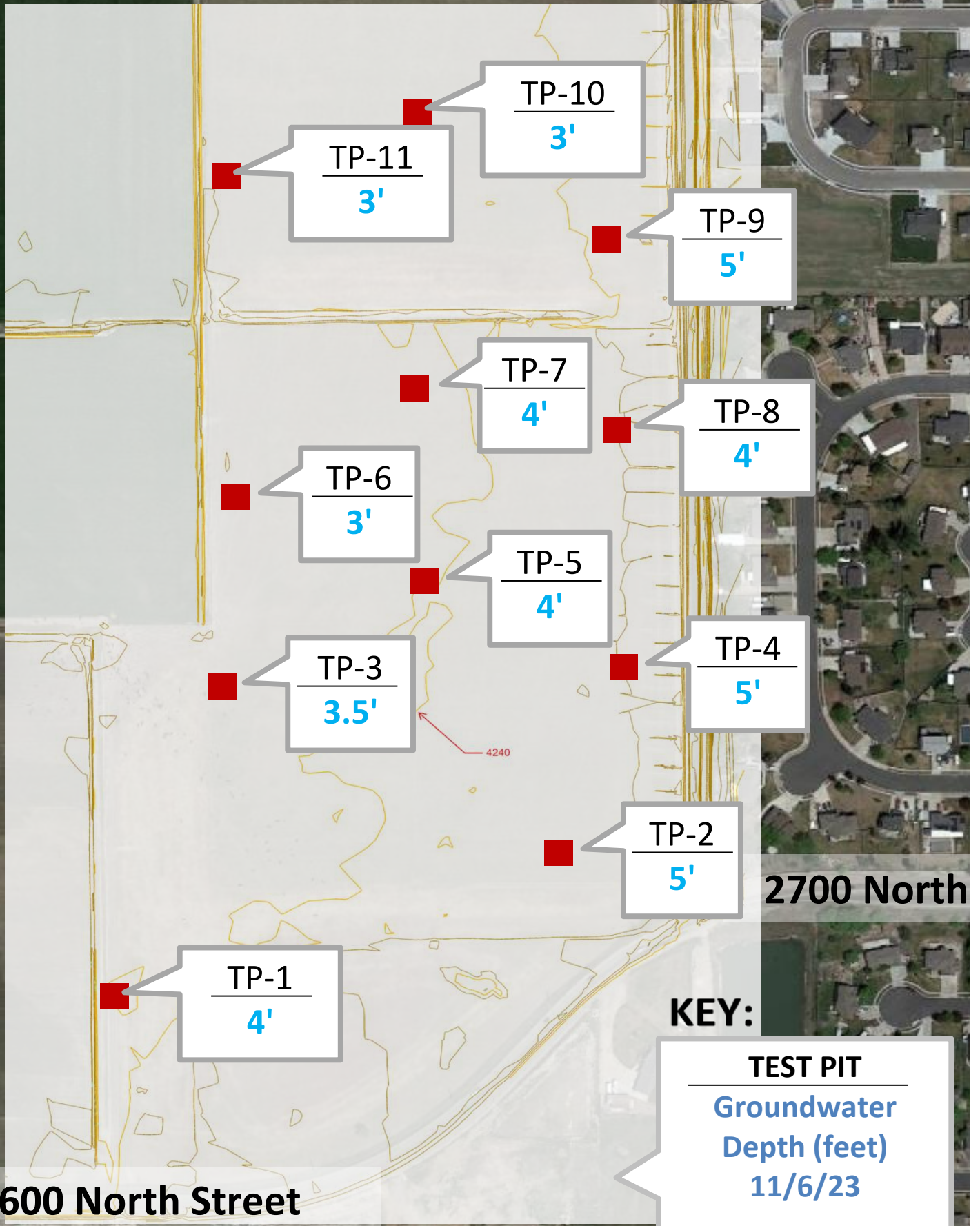
**Site Map**

Date:	6-Nov-23
Job #	21213

Figure:

**1A**





**JDC Ranch Development**

About 3000 West 2800 North, Plain City, Utah



**Site Map**

Date: 6-Nov-23  
Job #: 21213

Figure:

**1B**



# JDC Ranch Development

About 3000 West 2800 North, Plain City, Utah

# Test Pit Log

# TP-1

Total Depth: 8'  
Water Depth: 4'

Date: 11/6/23  
Job #: 21213

Depth (ft)	GRAPHIC LOG	Soil Description	Sample Type	Sample #	Moisture (%)	Dry Density(pcf)	Gradation			Atterberg		
							Gravel %	Sand %	Fines %	LL	PL	PI
0		Topsoil										
1		Light Brown Silty CLAY (CL) moist, medium stiff (estimated)		1								
2		Orange Brown Silty SAND (SM) very moist, medium dense (estimated)										
3				2	23		0	54	46			
4												
5												
6		grades brown		3								
7												
8		END AT 8'										
9												
10												
11												
12												
13												
14												

Remarks: Groundwater encountered during excavation at depth of 4 feet.

Coordinates: 41.30594°, -112.04886°

Surface Elev. (approx): Not Given



Equipment: Mini Excavator  
Excavated By: CMT Technical Services  
Logged By: Steve Laird

Figure:

# 2

# JDC Ranch Development

About 3000 West 2800 North, Plain City, Utah

# Test Pit Log

# TP-2

Total Depth: 8'  
Water Depth: 5'

Date: 11/6/23  
Job #: 21213

Depth (ft)	GRAPHIC LOG	Soil Description	Sample Type	Sample #	Moisture (%)	Dry Density(pcf)	Gradation			Atterberg		
							Gravel %	Sand %	Fines %	LL	PL	PI
0		Topsoil; light brown silty sandy clay										
1		Light Brown Silty CLAY with sand (CL) moist, medium stiff (estimated)		4								
2		Orange Brown Gravelly SAND (SP), trace clay very moist, medium dense (estimated)		5	16		22	74	4			
3												
4												
5		Brown Silty SAND with gravel (SM) medium dense (estimated) wet		6								
6												
7		grades with less gravel										
8		END AT 8'		7								
9												
10												
11												
12												
13												
14												

Remarks: Groundwater encountered during excavation at depth of 5 feet.  
Slotted PVC pipe installed to depth of 8.0 feet to facilitate water level measurements.

Coordinates: 41.30683°, -112.04576°

Surface Elev. (approx): Not Given

Equipment: Mini Excavator

Excavated By: CMT Technical Services

Logged By: Steve Laird

Figure:

# 3



# JDC Ranch Development

About 3000 West 2800 North, Plain City, Utah

# Test Pit Log

# TP-3

Total Depth: 8'  
Water Depth: 3.5'

Date: 11/6/23  
Job #: 21213

Depth (ft)	GRAPHIC LOG	Soil Description	Sample Type	Sample #	Moisture (%)	Dry Density(pcf)	Gradation			Atterberg		
							Gravel %	Sand %	Fines %	LL	PL	PI
0		Topsoil										
1		Light Grayish Brown Silty CLAY (CL), some sand and oxidation very moist, medium stiff (estimated)		8								
2												
3												
4		Brown SAND with silt (SP-SM) wet, medium dense (estimated)										
5												
6				10								
7												
8		END AT 8'										
9												
10												
11												
12												
13												
14												

Remarks: Groundwater encountered during excavation at depth of 3.5 feet.

Slotted PVC pipe installed to depth of 8.0 feet to facilitate water level measurements.

Coordinates: 41.30801°, -112.04813°

Surface Elev. (approx): Not Given

Equipment: Mini Excavator

Excavated By: CMT Technical Services

Logged By: Steve Laird

Figure:

# 4



# JDC Ranch Development

About 3000 West 2800 North, Plain City, Utah

# Test Pit Log

# TP-4

Total Depth: 8'  
Water Depth: 5'

Date: 11/6/23  
Job #: 21213

Depth (ft)	GRAPHIC LOG	Soil Description	Sample Type	Sample #	Moisture (%)	Dry Density(pcf)	Gradation			Atterberg		
							Gravel %	Sand %	Fines %	LL	PL	PI
0		Topsoil; light brown silty sandy clay										
1		Brown Silty SAND (SM), trace clay very moist, medium dense (estimated)		11								
2												
3				12								
4		grades with oxidation										
5			wet	13	26		0	71	29			
6		Brown SAND with silt (SP-SM) wet, medium dense (estimated)										
7				14								
8		END AT 8'										
9												
10												
11												
12												
13												
14												

Remarks: Groundwater encountered during excavation at depth of 5 feet.  
Slotted PVC pipe installed to depth of 8.0 feet to facilitate water level measurements.

Coordinates: 41.308°, -112.04552°

Surface Elev. (approx): Not Given

Equipment: Mini Excavator

Excavated By: CMT Technical Services

Logged By: Steve Laird

Figure:

# 5



# JDC Ranch Development

About 3000 West 2800 North, Plain City, Utah

# Test Pit Log

# TP-5

Total Depth: 8'  
Water Depth: 4'

Date: 11/6/23  
Job #: 21213

Depth (ft)	GRAPHIC LOG	Soil Description	Sample Type	Sample #	Moisture (%)	Dry Density(pcf)	Gradation			Atterberg		
							Gravel %	Sand %	Fines %	LL	PL	PI
0		Topsoil										
1		Gray Silty CLAY with sand (CL) very moist, medium stiff (estimated)		15								
2												
3												
4		Brown SAND with silt (SP-SM) medium dense (estimated) wet		16	25		0	90	10			
5												
6		grades dark brown										
7				17								
8		END AT 8'										
9												
10												
11												
12												
13												
14												

Remarks: Groundwater encountered during excavation at depth of 4 feet.  
Slotted PVC pipe installed to depth of 8.0 feet to facilitate water level measurements.

Coordinates: 41.30845°, -112.04683°

Surface Elev. (approx): Not Given

Equipment: Mini Excavator

Excavated By: CMT Technical Services

Logged By: Steve Laird

Figure:

# 6





# JDC Ranch Development

About 3000 West 2800 North, Plain City, Utah

# Test Pit Log

# TP-6

Total Depth: 8'  
Water Depth: 3'

Date: 11/6/23  
Job #: 21213

Depth (ft)	GRAPHIC LOG	Soil Description	Sample Type	Sample #	Moisture (%)	Dry Density(pcf)	Gradation			Atterberg		
							Gravel %	Sand %	Fines %	LL	PL	PI
0		6" Topsoil										
1		Gray ORGANIC CLAY (OH) Infiltration Test = 30 minutes/inch. very moist, medium stiff (estimated)										
2		grades with oxidation wet		18								
4				19	47	73				74	24	50
5		Black Silty SAND (SM) wet, medium dense (estimated)										
6				20								
8		END AT 8'										
9												
10												
11												
12												
13												
14												

Remarks: Groundwater encountered during excavation at depth of 3 feet.  
Slotted PVC pipe installed to depth of 8.0 feet to facilitate water level measurements.

Coordinates: 41.30892°, -112.04808°

Surface Elev. (approx): Not Given

Equipment: Mini Excavator

Excavated By: CMT Technical Services

Logged By: Steve Laird

Figure:

# 7



# JDC Ranch Development

About 3000 West 2800 North, Plain City, Utah

# Test Pit Log

# TP-7

Total Depth: 8'  
Water Depth: 4'

Date: 11/6/23  
Job #: 21213

Depth (ft)	GRAPHIC LOG	Soil Description	Sample Type	Sample #	Moisture (%)	Dry Density(pcf)	Gradation			Atterberg		
							Gravel %	Sand %	Fines %	LL	PL	PI
0		Topsoil										
1		Gray Silty CLAY with sand (CL), some oxidation moist, medium stiff (estimated)										
2			21	8		0	16	84				
3		Brown Silty Clayey SAND (SC-SM) very moist, medium dense (estimated)										
4		wet	22									
5		Black Silty SAND (SM) wet, medium dense (estimated)										
6			23									
7												
8		END AT 8'										
9												
10												
11												
12												
13												
14												

Remarks: Groundwater encountered during excavation at depth of 4 feet.  
Slotted PVC pipe installed to depth of 8.0 feet to facilitate water level measurements.

Coordinates: 41.30953°, -112.04683°

Surface Elev. (approx): Not Given

Equipment: Mini Excavator

Excavated By: CMT Technical Services

Logged By: Steve Laird

Figure:

# 8



# JDC Ranch Development

About 3000 West 2800 North, Plain City, Utah

# Test Pit Log

# TP-8

Total Depth: 8'  
Water Depth: 4'

Date: 11/6/23  
Job #: 21213

Depth (ft)	GRAPHIC LOG	Soil Description	Sample Type	Sample #	Moisture (%)	Dry Density(pcf)	Gradation			Atterberg		
							Gravel %	Sand %	Fines %	LL	PL	PI
0		Topsoil										
1		Brown Silty SAND (SM) very moist, medium dense (estimated)										
2				24	14		0	66	34		NP	NP
3												
4		Whitish to Gray SAND with silt (SP-SM) wet medium dense (estimated)										
5				25								
6		grades black/dark gray										
7												
8		END AT 8'		26								
9												
10												
11												
12												
13												
14												

Remarks: Groundwater encountered during excavation at depth of 4 feet.  
Slotted PVC pipe installed to depth of 8.0 feet to facilitate water level measurements.

Coordinates: 41.30938°, -112.04548°

Surface Elev. (approx): Not Given

Equipment: Mini Excavator

Excavated By: CMT Technical Services

Logged By: Steve Laird

Figure:

# 9



# JDC Ranch Development

About 3000 West 2800 North, Plain City, Utah

# Test Pit Log

# TP-9

Total Depth: 8'  
Water Depth: 5'

Date: 11/6/23  
Job #: 21213

Depth (ft)	GRAPHIC LOG	Soil Description	Sample Type	Sample #	Moisture (%)	Dry Density(pcf)	Gradation			Atterberg		
							Gravel %	Sand %	Fines %	LL	PL	PI
0		Topsoil; gray silty sandy clay										
1		Brown Clayey SILT with sand (ML), some oxidation very moist, medium stiff (estimated)		27								
2												
3				28	27	92				31	24	7
4		grades with more sand										
5												
6		Dark Brown SAND with silt (SP-SM) wet medium dense (estimated)		29								
7												
8		END AT 8'										
9												
10												
11												
12												
13												
14												

Remarks: Groundwater encountered during excavation at depth of 5 feet.  
Slotted PVC pipe installed to depth of 8.0 feet to facilitate water level measurements.

Coordinates: 41.31035°, -112.0455°

Surface Elev. (approx): Not Given

Equipment: Mini Excavator

Excavated By: CMT Technical Services

Logged By: Steve Laird

Figure:

# 10



# JDC Ranch Development

About 3000 West 2800 North, Plain City, Utah

# Test Pit Log

# TP-10

Total Depth: 8'  
Water Depth: 3'

Date: 11/6/23  
Job #: 21213

Depth (ft)	GRAPHIC LOG	Soil Description	Sample Type	Sample #	Moisture (%)	Dry Density(pcf)	Gradation			Atterberg		
							Gravel %	Sand %	Fines %	LL	PL	PI
0		Topsoil										
1		Gray Silty CLAY (CL)										
		moist, medium stiff (estimated)		30								
2		grades with oxidation										
		very moist										
3												
		wet		31	28	5	8	87				
4		Brown Silty SAND (SM)										
		wet, medium dense (estimated)		32								
5												
		wet, medium dense (estimated)		33								
6		Black Coarse SAND with silt (SP-SM)										
		wet, medium dense (estimated)										
7												
8		END AT 8										
9												
10												
11												
12												
13												
14												

Remarks: Groundwater encountered during excavation at depth of 3 feet.  
Slotted PVC pipe installed to depth of 8.0 feet to facilitate water level measurements.

Coordinates: 41.31134°, -112.04672°

Surface Elev. (approx): Not Given

Equipment: Mini Excavator

Excavated By: CMT Technical Services

Logged By: Steve Laird

Figure:

# 11





# JDC Ranch Development

About 3000 West 2800 North, Plain City, Utah

# Test Pit Log

# TP-11

Total Depth: 8'  
Water Depth: 3'

Date: 11/6/23  
Job #: 21213

Depth (ft)	GRAPHIC LOG	Soil Description	Sample Type	Sample #	Moisture (%)	Dry Density(pcf)	Gradation			Atterberg		
							Gravel %	Sand %	Fines %	LL	PL	PI
0		Topsoil										
1		Gray Silty CLAY (CL), some oxidation moist, medium stiff (estimated)										
2		Brown Silty SAND (SM) with oxidation very moist, medium dense (estimated)		34								
3		wet										
4				35								
5		Black to Dark Gray SAND with silt (SP-SM) wet, medium dense (estimated)										
6												
7				36	26		0	94	6			
8		END AT 8										
9												
10												
11												
12												
13												
14												

Remarks: Groundwater encountered during excavation at depth of 3 feet.  
Slotted PVC pipe installed to depth of 8.0 feet to facilitate water level measurements.

Coordinates: 41.31099°, -112.04821°

Surface Elev. (approx): Not Given

Equipment: Mini Excavator

Excavated By: CMT Technical Services

Logged By: Steve Laird

Figure:

# 12



# JDC Ranch Development

About 3000 West 2800 North, Plain City, Utah

# Key to Symbols

Date: 11/6/23

Job #: 21213

①	②	③	④	⑤	⑥	⑦	⑧	⑨
Depth (ft)	GRAPHIC LOG	Soil Description	Sample Type	Sample #	Moisture (%)	Dry Density(pcf)	Gradation	Atterberg

## COLUMN DESCRIPTIONS

- ① **Depth (ft.):** Depth (feet) below the ground surface (including groundwater depth - see below right).
- ② **Graphic Log:** Graphic depicting type of soil encountered (see ② below).
- ③ **Soil Description:** Description of soils, including Unified Soil Classification Symbol (see below).
- ④ **Sample Type:** Type of soil sample collected; sampler symbols are explained below-right.
- ⑤ **Sample #:** Consecutive numbering of soil samples collected during field exploration.
- ⑥ **Moisture (%):** Water content of soil sample measured in laboratory (percentage of dry weight).
- ⑦ **Dry Density (pcf):** The dry density of a soil measured in laboratory (pounds per cubic foot).
- ⑧ **Gradation:** Percentages of Gravel, Sand and Fines (Silt/Clay), obtained from lab test results of soil passing the No. 4 and No. 200 sieves.
- ⑨ **Atterberg:** Individual descriptions of Atterberg Tests are as follows:  
**LL = Liquid Limit (%):** Water content at which a soil changes from plastic to liquid behavior.  
**PL = Plastic Limit (%):** Water content at which a soil changes from liquid to plastic behavior.  
**PI = Plasticity Index (%):** Range of water content at which a soil exhibits plastic properties (= Liquid Limit - Plastic Limit).

STRATIFICATION		MODIFIERS	MOISTURE CONTENT
Description	Thickness	Trace	
Seam	Up to ½ inch	<5%	<b>Dry:</b> Absence of moisture, dusty, dry to the touch.
Lense	Up to 12 inches	<b>Some</b>	<b>Moist:</b> Damp / moist to the touch, but no visible water.
Layer	Greater than 12 in.	5-12%	<b>Wet:</b> Visible water, usually soil below groundwater.
Occasional	1 or less per foot	<b>With</b>	
Frequent	More than 1 per foot	> 12%	

## UNIFIED SOIL CLASSIFICATION SYSTEM (USCS)

MAJOR DIVISIONS		USCS SYMBOLS	②	TYPICAL DESCRIPTIONS	
<b>COARSE-GRAINED SOILS</b> More than 50% of material is larger than No. 200 sieve size.	<b>GRAVELS</b> The coarse fraction retained on No. 4 sieve.	CLEAN GRAVELS ( < 5% fines)	GW	Well-Graded Gravels, Gravel-Sand Mixtures, Little or No Fines	
		GRAVELS WITH FINES ( ≥ 12% fines)	GP	Poorly-Graded Gravels, Gravel-Sand Mixtures, Little or No Fines	
		<b>SANDS</b> The coarse fraction passing through No. 4 sieve.	CLEAN SANDS ( < 5% fines)	GM	Silty Gravels, Gravel-Sand-Silt Mixtures
			SANDS WITH FINES ( ≥ 12% fines)	GC	Clayey Gravels, Gravel-Sand-Clay Mixtures
	<b>FINE-GRAINED SOILS</b> More than 50% of material is smaller than No. 200 sieve size.	<b>SILTS AND CLAYS</b> Liquid Limit less than 50%	SW	Well-Graded Sands, Gravelly Sands, Little or No Fines	
			SP	Poorly-Graded Sands, Gravelly Sands, Little or No Fines	
SM			Silty Sands, Sand-Silt Mixtures		
<b>SILTS AND CLAYS</b> Liquid Limit greater than 50%		SC	Clayey Sands, Sand-Clay Mixtures		
		ML	Inorganic Silts and Sandy Silts with No Plasticity or Clayey Silts with Slight Plasticity		
		CL	Inorganic Clays of Low to Medium Plasticity, Gravelly Clays, Sandy Clays, Silty Clays, Lean Clays		
<b>SILTS AND CLAYS</b> Liquid Limit greater than 50%	OL	Organic Silts and Organic Silty Clays of Low Plasticity			
	MH	Inorganic Silts, Micaceous or Diatomaceous Fine Sand or Silty Soils			
	CH	Inorganic Clays of High Plasticity, Fat Clays			
<b>HIGHLY ORGANIC SOILS</b>		OH	Organic Silts and Organic Clays of Medium to High Plasticity		
		PT	Peat, Soils with High Organic Contents		

- SAMPLER SYMBOLS**
- Block Sample
  - Bulk/Bag Sample
  - Modified California Sampler 3.5" OD, 2.42" ID
  - D&M Sampler
  - Rock Core
  - Standard
  - Penetration Split Spoon Sampler Thin Wall
  - (Shelby Tube)

- WATER SYMBOL**
- Encountered Water Level
  - Measured Water Level
- (see Remarks on Logs)

Note: Dual Symbols are used to indicate borderline soil classifications (i.e. GP-GM, SC-SM, etc.).

- The results of laboratory tests on the samples collected are shown on the logs at the respective sample depths.
- The subsurface conditions represented on the logs are for the locations specified. Caution should be exercised if interpolating between or extrapolating beyond the exploration locations.
- The information presented on each log is subject to the limitations, conclusions, and recommendations presented in this report.