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## PRELIMINARY GEOTECHNICAL INVESTIGATION

### JDC Ranch Preliminary Geotechnical Investigation

Prepared For:

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Prepared By:

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Job Number: 20-094

**RE: JDC Ranch Preliminary Geotechnical Investigation**

Dear Mr. Bayles,

Per your request this preliminary geotechnical investigation is submitted for the subject property located approximately at 2600 N 2800 W in Weber County, UT. This report contains the findings of the field investigation and the analysis conducted by Civil Solutions Group. This report also contains recommendations pertaining to construction and design of earth related portions of this project.

Civil Solutions Group completed the field investigation on May 26, 2020 at which time seven bore holes were drilled, examined, and recorded in detail. The bore locations were selected to determine the general site soils conditions. Civil Solutions Group recommends the site is suitable for proposed construction within the parameters defined within this report. Thank you for the opportunity to provide these services to you.

Sincerely,

Danny Macfarlane, P.E.  
Civil Solutions Group, Inc.

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NOT FOR CONSTRUCTION

## Executive Summary

A preliminary geotechnical study was performed for the subject property at 2600 N 2800 W in Weber County, UT. Our scope of services included drilling seven bore holes designated B-1 to B-7. The boreholes were drilled with hollow stem augers and advanced to a maximum depth of 15.5-feet below existing site grade. All field work was contained in the proposed development area and was completed on May 26, 2020.

The findings and recommendations generated from this exploration are summarized below:

- Onsite Soil – The site is composed mostly of sandy silt, and silty sand. Some layers with gravel were encountered. Groundwater was encountered at approximately 5 feet below grade at the time of the site investigation.
- Foundations - The planned structure should be supported entirely on continuous spread footings or spot footings. It is anticipated that the bearing capacity of in-situ soil will be between 1,500 and 2,500 pounds per square foot, depending on location within the site.
- Seismic Considerations - The 2018 International Building Code Seismic Design Category for this site is Category D (Risk Category II), with a soil site class of F (soil site class D may be used if the structures fundamental period of vibration is less than, or equal to 0.5 s). The site is located in an area with high liquefaction potential according to the Utah Geological Survey, and the in-situ soils encountered on site. Sandy soils and groundwater were encountered during the field investigation. Liquefaction will be an issue on site, further analysis will be required to determine the liquefaction potential for the site.

This summary should be used in conjunction with the entire report for design purposes. It should be recognized that details were not included or fully developed in this section, and the report must be read in its entirety for a comprehensive understanding of the items contained herein. The entire report should be read for an understanding of the report limitations.

## Introduction

### General

Civil Solutions Group, Inc. (CSG) was contacted by Mr. Bayles and was asked to conduct a preliminary geotechnical investigation on the subject property located at 2600 N 2800 W in Weber County, UT. The general location of the site may be seen in Figure 1, Vicinity Map. A more detailed location of the site showing the proposed development and surrounding improvements is shown in Figure 2, Site Map. It was described that the proposed construction for the JDC Ranch is anticipated to be up to three stories in height and of wood frame construction.

### Objectives and Scope

The objectives and scope of our study were defined between Mr. Bayles and Mr. Dayton Law of Civil Solutions Group. In general, the objectives of this study were to:

- Define and evaluate subsurface soil and groundwater conditions across the site
- Provide foundation, earthwork, and drainage recommendations

To accomplish these objectives, our scope has included the following:

- A field program consisting of the drilling, logging, and sampling of the seven borings
- A laboratory testing program
- An office program consisting of correlating available data, engineering analyses, and report preparation

### Authorization

Civil Solutions Group, Inc. (CSG) was authorized to proceed with this scope of work through an executed contract returned to our office by Mr. Bayles of Nilson Homes. The executed contract was dated April 21, 2020.

### Professional Statements

We at CSG certify that 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. Supporting data upon which our recommendations are based is presented in the subsequent sections of this report. Recommendation made herein are governed by the physical properties of the soils encountered in the exploration borings, observed and projected groundwater conditions, and the layout and design data as summarized in the Proposed Construction section of this report. If subsurface conditions other than those described in this report are encountered and/or if design and layout changes are implemented, CSG must be informed so that our recommendations can be reviewed and amended, if necessary.

### Proposed Construction

The proposed construction is as follows: Structures anticipated to be up to three stories of height of typical wood frame construction and roadways. If structural engineering plans are different than assumed, they should be provided to our office for review.

The site development will likely require minimal earthwork. It is estimated that in certain areas up to 4-foot cuts and/or fills will be required to achieve site grades and tie in-to the adjacent properties.

Column and wall loadings are anticipated to be on the order of 40-80 kips and 2-6 kips per lineal foot respectively.

## **Existing Site Conditions**

### **General**

The site lies approximately at 2600 N 2800 W in Weber County, UT. The existing property is empty fields used for agricultural purposes. The surrounding properties are also currently used for agriculture purposes. The surface and subsurface soils that were explored appeared to be free of hazardous debris and other foreign objects.

### **Site Topography & Drainage Features**

The majority of the site is relatively flat, with some of the west portion of the site being raised up a couple of feet. On-site there were several irrigation ditches and canals, some with water at the time of the site investigation.

### **Site Soils**

The soil conditions encountered in each of the seven borings, to the depths explored, were relatively similar. In bore hole number 2 (B-2), there was approximately 0.5-feet of topsoil with roots extending from vegetation. From approximately 0.5-feet beneath existing grade to 4-feet we encountered brown silt with some sand. From 4-feet to the full depth explored, 15.5-feet, brown silty sand was encountered. The remaining bore holes throughout the site had similar characteristics as B-2. Groundwater was encountered at 30 feet. Soil encountered during the investigation can be referenced in the Soil Logs in the Appendix of this report.

## **Subsurface Exploration and Testing Programs**

### **General**

To define and evaluate the subsurface soil and groundwater conditions across the site, seven borings were drilled to depths of up to 15.5-feet below existing grade. The borings were drilled using a truck mounted drilling rig equipped with 3.25-inch inside diameter hollow stem augers. Soil sampling equipment was advanced through the hollow stem to retrieve disturbed samples of the in-situ soil. Locations of the borings are presented in Figure 2.

### **Field Program**

The field portion of our study was conducted on May 26, 2020. Continuous logs of the subsurface findings were created and maintained as part of the field program. The field portion of our study was under the direct control and continual supervision of an experienced member of our geotechnical staff. Field classifications were logged, and any adjustments made once the laboratory data and analyses were received.

The CSG geotechnical team collected disturbed samples of typical soils that were found in the bore holes. The disturbed samples were taken using bagged grab samples and a SPT split spoon sampler. The SPT split spoon sampler had an outside diameter of 2-inches and an inside diameter of 1.38-inches. The sampler was driven into the undisturbed soil a total of 18-inches utilizing a 140-pound

auto hammer falling a vertical distance of 30-inches. The blow counts recorded on the Soil Logs represent the total number of blows from the safety hammer that were required to drive the sampler a vertical distance of 6-inches.

Graphical depictions of the subsurface findings are shown in the Soil Logs contained within the Appendix of this report.

## Laboratory Program

CSG partnered with RB&G Engineering to conduct a laboratory testing program on the samples retrieved from the sites. This laboratory testing program was conducted to provide data necessary for our engineering analyses. The program included partial gradation (sieve) analysis, and Atterberg limits (if applicable). The following describes the tests and summarize the test data. Samples from the field will be maintained in our office for a period of 90 days at which time they will be disposed of unless a written request is received from Nilson Homes that they should be retained.

### Sieve Analysis

Gradation tests (sieve analysis) were conducted on disturbed samples which were collected from the site. The gradation test aids in classifying the soils and can provide general index parameters. Gradation tests aid the design team in determining the overall composition of the soil and behaviors that the soil may exhibit under certain situations. The results of the tests are shown in Table 1 below:

Table 1 - Gradation & Soil Classifications

Boring Sample No.	Depth (feet)	Percent Passing #200 Sieve	Soil Classification
B-1	4-5.5	85	ML
B-3	9-10.5	7	SP-SM
B-4	2-3.5	91	ML
B-4	9-10.5	4	SP

### Atterberg Limits

Atterberg Limits were performed on relatively undisturbed samples to understand the plastic and liquid limits of the cohesive soil. Atterberg limits allow the design team to understand the potential for the soil to shrink and expand based on water content. The results are presented in Table 2 below:

Table 2 - Atterberg Limits

Boring Sample No.	Depth (feet)	Classification	Liquid Limit (LL)	Plastic Limit (PL)	Plasticity Index (PI)
B-1	4-5.5	ML	24	22	2
B-3	9-10.5	SP-SM	--	--	NP
B-4	2-3.5	ML	37	26	11
B-4	9-10.5	SP	--	--	NP



# Discussions & Recommendations

## Summary of Findings

This is a preliminary geotechnical report, and is not intended to be used for construction purposes. Further investigating and analysis will be required to determine the final geotechnical site recommendations. The recommendations found in this report are preliminary and it is anticipated that the site soils will be capable of withstanding the following recommendations.

Preliminary discussions pertaining to earthwork, structural considerations, and groundwater are included in the following sections:

## Earthwork

### Site Preparation

Initial site preparation will consist of the removal of surface vegetation, topsoil, root balls, sod or any other deleterious materials extending at least three feet beyond the perimeter of all areas to be developed. Non-engineered fills will be completely removed three feet beyond the extents of all spread and continuous footings, rigid pavement areas, floor slabs and other areas that require a stabilized foundation. Stripped materials consisting of vegetation and organic materials should be wasted from the site or used to revegetate landscape areas.

The exposed natural subgrade should be proof-rolled prior to the placement of structural site grading fill, footings, floor slabs, or any other structural improvement made to the site. Soft spots should be completely excavated and removed if they are discovered.

### Drainage

Positive drainage should be provided during construction and maintained throughout the life of the development. Infiltration of water into utility trenches or foundation excavations should be prevented. Planters and other surface features which might retain water in areas adjacent to the buildings or pavements should be sealed, mechanically drained, or eliminated. In areas where sidewalks or paving do not immediately adjoin the structure, we recommend that protective slopes be provided with a minimum grade of approximately five percent for at least 10 feet from perimeter walls. Backfill against footings, exterior walls, and in utility and sprinkler line trenches should be well compacted and free of all construction debris to reduce the possibility of moisture infiltration. Roof runoff should be collected in rain gutters and downspouts. Downspouts, roof drains or scuppers should discharge into extensions when the ground surface beneath such features is not protected by exterior slabs or paving to divert collected water a minimum of 10 feet away from structures. Sprinkler systems should not be installed within five feet of foundation walls. Landscaped irrigation adjacent to the foundation systems should be minimized.

## Structural Considerations

### Spread and Continuous Wall Foundations

It is understood that the proposed structures will be supported on conventional spread and continuous wall foundations. These foundations should be established on undisturbed native soils.

Under no circumstances shall footings be placed overlying non-engineered fills, loose soils, frozen soils, soil containing foreign debris, and any other deleterious material. Unsuitable material must be removed and replaced with an adequate structural fill as discussed in this report. For structural fill replacement beneath footings, the width of the structural fill shall be equal to width of the footing plus one foot on each side for each foot of fill thickness. For example, if the depth of structural fill is three feet then three feet of structural fill needs to extend past the edge of the footing on each side.

For design, the following parameters are provided:

Table 3 - Structural Design Parameters

<b>Design Element</b>	<b>Standard</b>
Recommended minimum depth of embedment for frost conditions	30 inches
Recommended minimum depth of embedment for non-frost conditions	15 inches
Anticipated maximum bearing capacity of in-situ soil	1,500 to 2,500 pounds per square foot*
Anticipated width for continuous wall footings	18 to 30 inches
Anticipated width for isolated spread footings	36 to 72 inches
Recommended bearing pressure increase for seismic loading	33%
Coefficient of friction between footing and native soils	0.45

\*Bearing capacity will vary depending on location within the site. Softer areas will have a lower capacity, while stiffer soil will have a higher capacity.

Settlement of foundation elements are expected to be on the order of 1" or less with approximately 50% occurring during construction. This settlement can be expected if the project is constructed in accordance with recommendations found within this report.

## **Geoseismic Setting**

### **Faulting**

Based on a review of Utah Geological Survey fault maps, the site is approximately 4.5 miles south west of the Wasatch Fault Line Brigham City section.

### **Soil Class**

Due to the liquefaction potential for the site, the soil site class is F. However, if the fundamental period of vibration for the proposed structures is less than, or equal to 0.5 s, then soil site class D may be used ( $S_1 = 0.505 g$  &  $S_5 = 1.507 g$ ). The site is in a Seismic Design Category D (Risk Category II) in accordance with Chapter 20 of ASCE 7 and IBC 2018.

### **Liquefaction**

The site is in an area that has been classified as high liquefaction potential by the Utah Geological Survey. Liquefaction requires water, seismic activity, and loose sandy soils. Sandy soils and water were encountered in the field investigation and therefore are likely to present a risk during a seismic event.

A full liquefaction analysis was not a part of the scope at this time. However, based upon the soils encountered on site, liquefaction will be an issue on site. A deep boring and liquefaction analysis will be required to fully define the liquefaction potential for the site.

## Groundwater

Immediately following drilling operations, the groundwater was measured in each boring. Piezometer pipes were left in several of the boreholes and stabilized conditions were measured on May 11, 2020. Seasonal and longer-term groundwater fluctuations on the order of one and one-half to three feet are projected, with the highest seasonal levels generally occurring during the late spring and early summer months. The groundwater measurements (as measured down from existing grade) are tabulated in Table 4 below:

Table 4 - Groundwater Depth

Bore Hole Number	Time of Drilling (feet)	Stabilized (feet)
B-1	5.0	3.7
B-2	5.0	--
B-3	--	--
B-4	5.5	1.5
B-5	5.5	2.45
B-6	--	--
B-7	5.5	--

## Closure

This is a preliminary geotechnical investigation report, and is not intended for construction use. This report is intended to generally describe the site soils, and the anticipated design elements. These may be used to decide how the project will move forward and what precautions may be needed. Civil Solutions Group should be contacted once the final site layout is determined so a full geotechnical study may be completed for the site.

This preliminary report has been prepared for the exclusive use of our client for specific application to the project discussed and has been prepared in accordance with generally accepted geotechnical engineering practices.

# Appendix

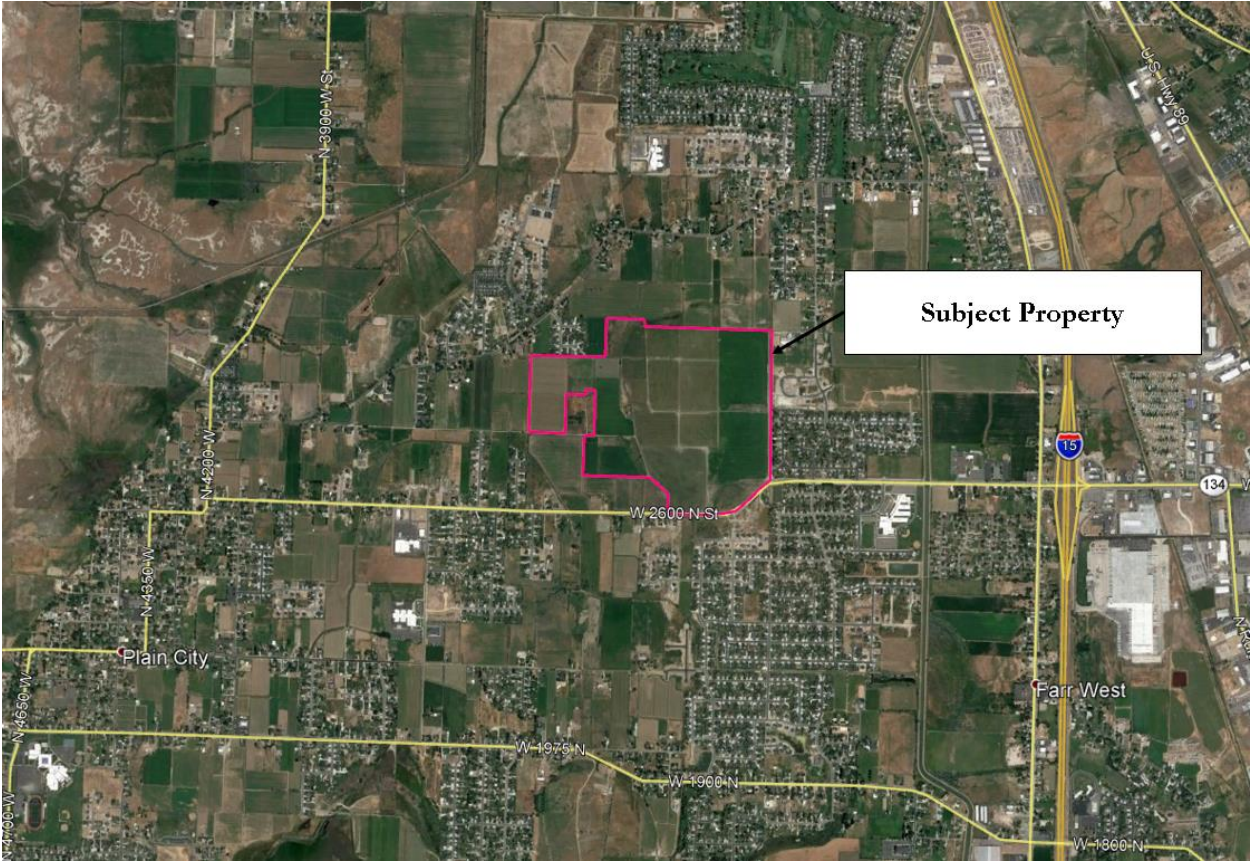


Figure 1 - Vicinity Map



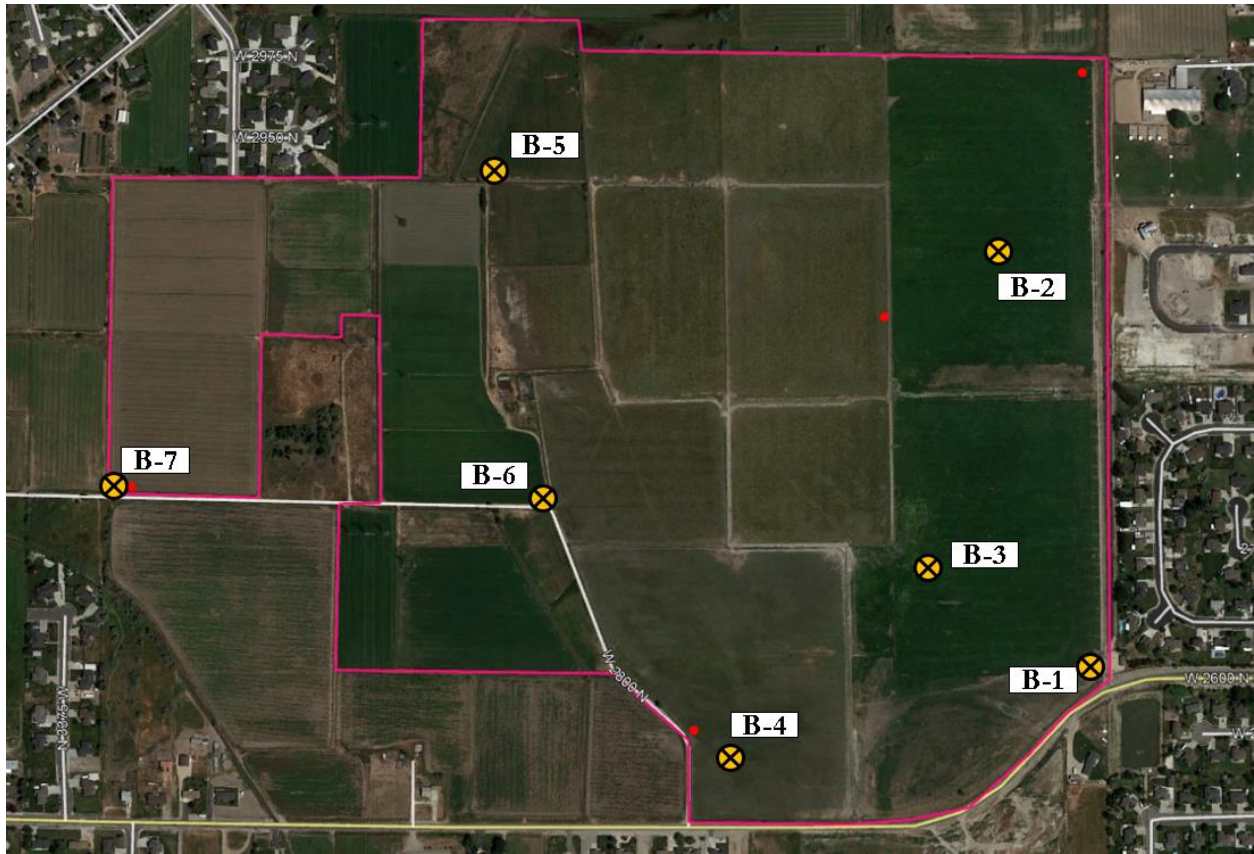


Figure 2 - Site Map





Figure 3 - Looking North



Figure 4 – Looking West



WATER LEVEL	U S C S	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS																																				
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<p><b>1 Water Level:</b> Depth to measure groundwater table. See symbol below.</p> <p><b>2 USCS:</b> Graphic depiction of subsurface material encountered; typical symbols are explained below.</p> <p><b>3 Description:</b> Description of material encountered; may include color, moisture, grain size, and density/consistency.</p> <p><b>4 Depth (ft.):</b> Depth in feet below the ground surface.</p> <p><b>5 Blow Count:</b> Number of blows required to advance SPT sampler (12") beyond first 6" using a 140-lb hammer with a 30 inch drop.</p> <p><b>6 Sample Symbol:</b> Type of soil sample collected at depth interval shown; sampler symbols are explained below.</p> <p><b>7 Moisture (%):</b> Water content of soil sample measured in laboratory; expressed as percentage of dry weight of specimen.</p> <p><b>8 Dry Density (pcf):</b> The density of a soil measured in laboratory; expressed as pounds per cubic foot.</p> <p><b>9 % Passing 200:</b> Fines content of soil sample passing a No. 200 sieve measured in laboratory, expressed as a percentage.</p> <p><b>10 Liquid Limit (%):</b> Water content at which a soil changes from plastic to liquid behavior.</p> <p><b>11 Plasticity Index (%):</b> Range of water content at which a soil exhibits plastic properties.</p> <p><b>12 Remarks:</b> Comments and observations regarding drilling or sampling made by driller or field personnel. Other field and laboratory test results; using the following abbreviations:</p>																																															
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<p><b>STRATIFICATION</b></p> <table border="1"> <thead> <tr> <th>DESCRIPTION</th> <th>THICKNESS</th> </tr> </thead> <tbody> <tr> <td>Seam</td> <td>up to 1/8"</td> </tr> <tr> <td>Layer</td> <td>1/8" - 12"</td> </tr> </tbody> </table> <p><b>STRATIFICATION</b></p> <p>Occasional: One or less per 6" of thickness</p> <p>Numerous: More than one per 6" of thickness.</p> <p><b>TYPICAL SAMPLER GRAPHIC SYMBOLS</b></p> <ul style="list-style-type: none"> <li>Bulk/Bag Sample</li> <li>Standard Penetration Split Spoon Sampler</li> <li>Rock Core</li> <li>No Recovery</li> <li>3.25" OD 2.42" ID D&amp;M Sampler</li> <li>3.0" OD 2.42" ID D&amp;M Sampler</li> <li>California Sampler</li> <li>Thin Wall</li> </ul> <p><b>LOG KEY SYMBOLS</b></p> <ul style="list-style-type: none"> <li>Water Level</li> </ul>												DESCRIPTION	THICKNESS	Seam	up to 1/8"	Layer	1/8" - 12"																														
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<p>Note: Dual Symbols are used to indicate borderline soil classifications</p>																																															

Figure 5 – Key to Soil Logs





# GEOTECHNICAL INVESTIGATION BORE LOG



PROJECT NAME: JDC RANCH  
 PROJECT NUMBER: 20-094  
 DATE DRILLED: 5/26/2020  
 METHOD OF DRILLING: CME 45C W/ 3.25" HSA

LOCATION: 2600 N 2800 W  
 WEBER COUNTY, UT  
 CLIENT: NILSON HOMES  
 LOGGED BY: JP  
 BORE NUMBER: B#2

DEPTH (FT)	DESCRIPTION	GRAPHIC LOG	SAMPLE TYPE	SAMPLE NUMBER	FIELD VALUES			LAB RESULTS					
					COMPRESSIVE STRENGTH (TSF)	SHEAR STRENGTH (TSF)	N-VALUE	N'	DRY DENSITY (PCF)	MOISTURE (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	
	6" TOPSOIL WITH ROOTS												
	SANDY SILT WITH CLAY (ML), BROWN, STIFF												
				2.1			2 5 6	11					
5	SILTY SAND (SP-SM), BROWN, LOOSE			2.2			2 3 5	8					
10	SILTY SAND (SP-SM), GRAY, MEDIUM DENSE			2.3			2 7 8						
15				2.4			2 4 7						

15.5' END OF DRILLING







# GEOTECHNICAL INVESTIGATION BORE LOG



PROJECT NAME: JDC RANCH  
 PROJECT NUMBER: 20-094  
 DATE DRILLED: 5/26/2020  
 METHOD OF DRILLING: CME 45C W/ 3.25" HSA

LOCATION: 2600 N 2800 W  
 WEBER COUNTY, UT  
 CLIENT: NILSON HOMES  
 LOGGED BY: JP  
 BORE NUMBER: B#6

DEPTH (FT)	DESCRIPTION	GRAPHIC LOG	SAMPLE TYPE	SAMPLE NUMBER	FIELD VALUES			LAB RESULTS					
					COMPRESSIVE STRENGTH (TSF)	SHEAR STRENGTH (TSF)	N-VALUE	N'	DRY DENSITY (PCF)	MOISTURE (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	
	6" TOPSOIL WITH ROOTS												
	SANDY SILT WITH CLAY (ML), BROWN, MEDIUM STIFF												
				6.1			2						
							3	5					
							2						
5	SANDY SILT WITH CLAY (ML), BROWN, SOFT			6.2			1						
							1	3					
							2						
	SILTY SAND (SP), BROWN, MEDIUM DENSE												
10				6.3			1						
							6	14					
							8						
	SILTY SAND (SP), GRAY, VERY LOOSE												
15				6.4			1						
							1	3					
							2						

15.5' END OF DRILLING

