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

GEOTECHNICAL ENGINEERING STUDY

Clearfield Municipal Operation Center Expansion

About 497 South Main Street
Clearfield, Utah
CMT PROJECT NO. 19654

FOR:
Jones & Associates Consulting Engineers
6080 Fashion Point Drive
South Ogden, Utah 84403

March 6, 2023

CMT TECHNICAL SERVICES

March 6, 2023

Mr. Brandon Jones
Jones & Associates Consulting Engineers
6080 Fashion Point Drive
South Ogden, Utah 84403

Subject: Geotechnical Engineering Study
Clearfield Municipal Operation Center Expansion
About 497 South Main Street
Clearfield, Utah
CMT Project Number: 19654

Mr. Jones:

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 January 11, 2023, a CMT Technical Services (CMT) staff professional was on-site and supervised the drilling of 6 bore holes extending to depths of about 6.5 to 46.5 feet below the existing ground surface. Soil samples were obtained during the field operations and subsequently transported to our laboratory for further testing and observation.

Conventional spread and/or continuous footings may be utilized to support the proposed structure(s), 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 801-590-0394.

Sincerely,
CMT Technical Services

Bryan N Roberts

LICENSED PROFESSIONAL ENGINEER
276476
BRYAN N. ROBERTS
3/6/2023
STATE OF UTAH

Bryan N. Roberts, P.E.
Senior Geotechnical Engineer

Reviewed by:

Andrew M. Harris, P.E.
Geotechnical Division Manager

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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 Clearfield Municipal Operation Center Expansion project. The site is situated on the east side of Main Street at about 497 South in Clearfield, 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. Brandon K. Jones of Jones & Associates Consulting Engineers, and Mr. Andrew Harris 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 has included performing field exploration, which consisted of the drilling/logging/sampling of 6 bore holes, performing laboratory testing on representative samples of the subsurface soils collected in the bore holes, 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 December 14, 2022 and executed on January 3, 2023.

1.3 Description of Proposed Construction

We understand that the proposed construction consists of a new public works building and an addition to the existing truck shop. The structures will likely consist of 1 to 2 levels of steel post/beam, reinforced masonry, and/or reinforced concrete construction placed on spread footings with slab on grade floors established at or near existing site grades. Maximum continuous wall and column loads are anticipated to be 2 to 5 kips per lineal foot and 50 to 100 kips, respectively. 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 also understand that pavements at the site will include light-duty and heavy-duty parking areas and internal drive lanes. We further anticipate the majority of the paved areas will utilize asphalt pavement, with some areas of rigid paved aprons and loading areas. Concrete paved equipment storage areas and a gravel surfaced parking lot is also planned.

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 1 to 3 feet. Shallow groundwater was encountered during our field study. Therefore, limiting cuts to removal of demolition materials and unsuitable soils where possible is recommended.

1.4 Executive Summary

Proposed structures can be supported upon conventional spread and continuous wall foundations utilizing a bearing pressure of 2,000 pounds per square foot (psf). The most significant geotechnical aspects regarding site development include the following:

1. Asphalt and/or surface fills blanketed the site at the bore hole locations. These fills were generally granular and roughly up to 18 inches thick. Unless compaction data is available indicating the fills have been properly compacted as structural fill (see section **6.4 Fill Placement and Compaction** of this report) the fill must be considered to be undocumented/non-engineered fill. Variation in the thickness and lateral extent of the fill material must be anticipated across the site.
2. Below the pavement and surface fills, natural soils were encountered comprised generally of fine-grained CLAY/SILT (CL/ML) with varying fine sandy content extending to depth of about 8.5 to 14 feet underlain by SAND with varying silt content (SM, SP) extending to the full depth penetrated, about 46.5 feet below the ground surface.

3. Groundwater was observed in the bore holes at depths of about 4 to 5 feet below existing grade at the time of our field exploration. On January 19, 2023, CMT personnel returned to the site to measure groundwater level at depth of 6.6 feet, within slotted PVC pipe installed in bore hole B-4.
4. Our evaluation indicates isolated zones of the saturated sandy soils could liquefy under a major seismic event. Maximum anticipated settlement resulting from the liquefaction is in the range of 1.0 inch or less. This amount of settlement is considered tolerable for structures to provide life safety egress, although some relatively minor structural damage would be possible. Lateral spreading due to liquefaction is not anticipated to occur.

During construction CMT must observe that any debris, deleterious materials, disturbed or unsuitable soils have been removed and that suitable soils have been exposed and/or fills properly prepared, 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 setting, seismicity, 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, 6 bore holes were drilled at the site to depths of approximately 6.5 to 46.5 feet below the existing ground surface. Locations of the bore holes 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.

Samples of the subsurface soils encountered in the bore holes were collected at varying depths through the hollow stem drill augers. Relatively undisturbed samples of the subsurface soils were obtained by hydraulically pushing a 3-inch diameter (Shelby) tube and driving a split-spoon sampler with 2.5-inch outside diameter rings/liners into the undisturbed soils below the drill augers. Disturbed samples were collected utilizing a standard split spoon sampler. This standard split spoon sampler was driven 18 inches into the soils below the drill augers using a 140-pound hammer free-falling a distance of 30 inches. The number of hammer blows needed for each 6-inch interval was recorded. The sum of the hammer blows for the final 12 inches of penetration is known as a standard penetration test and this 'blow count' was recorded on the bore hole logs.

The subsurface soils encountered in the bore holes were classified in the field based upon visual and textural examination, logged and described in general accordance with ASTM[1] D-2488. These field classifications were supplemented by subsequent examination and testing of select samples in our laboratory. Logs of the bore holes, including a description of the soil strata encountered, is presented on each individual Bore Hole Log, ***Figures 2 through 7***, included in the Appendix. Sampling information and other pertinent data and observations

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[1] American Society for Testing and Materials

are also included on the logs. In addition, a Key to Symbols defining the terms and symbols used on the logs is provided as ***Figure 8*** in the Appendix.

Following completion of drilling operations, 1.25-inch diameter slotted PVC pipe was installed in bore hole B-4 to allow subsequent water level measurements. The bore holes were backfilled with auger cuttings.

3.0 LABORATORY TESTING

3.1 General

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

3.2 Lab Summary

Laboratory test results are presented on the bore hole logs (***Figures 2 through 7***) and in the following **Lab Summary Table**:

LAB SUMMARY TABLE

BORE	DEPTH	SOIL	SAMPLE	MOISTURE	DRY DENSITY	GRADATION			ATTERBERG LIMITS		
HOLE	(feet)	CLASS	TYPE	CONTENT(%)	(pcf)	GRAV.	SAND	FINES	LL	PL	PI
B-1	2.5	CL	Shelby	20.6	102			56.7			
	5	CL-ML	SPT	28.9				75.9	25	20	5
	7.5	CL-ML	Shelby	30.6	91						
	10	SP-SM	Rings	24.5	97	0	91	8.9			
B-2	2.5	ML	Rings	20.6	100			50.9	20	18	2
	7.5	CL-ML	SPT					26	20	6	
	10	CL-ML	SPT	30.7				84.2			
B-3	2.5	SC-CL	Shelby	18.4	99			51			
	5	SC-CL	SPT	28				51.5			
	7.5	SC-CL	SPT	28.5				69.1	27	22	5
	10	CL	Shelby	29.1	92.9			89.1			
	15	SP	SPT	27.7				5.1			
B-4	2.5	SM-ML	SPT	16.3				53.2			
	5	CL	SPT	28.2				64.5			
	7.5	SM	SPT	24.2				26.1			
	15	SP	Rings	22.4	100			2.6			
	25	SM	SPT	24.4				30.3			
	40	SM	SPT	25.5				16.3			
	45	SP-SM	SPT	21.7				9.7			

3.3 One-Dimensional Consolidation Tests

To provide data necessary for our settlement analysis, a consolidation test was performed on each of three near surface clay/silt samples between depths of about 2.5 and 8.0 feet. The results of the tests indicate that the samples tested were moderately over-consolidated and exhibit moderate strength and moderately high compressibility characteristic under estimated loading conditions. The clay/silt soils will govern foundation design. Detailed results of the tests are maintained within our files and can be transmitted to you, upon your request.

4.0 GEOLOGIC & SEISMIC CONDITIONS

4.1 Geologic Setting

The subject site is located in the north-central portion of Davis County in north-central Utah. The site sits at an elevation of approximately 4,447 feet above sea level. The site is located in a valley bound 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. The valley was formed by extensional tectonic processes during the Tertiary and Quaternary geologic time periods. The Valley 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 valley in which the subject site is located, was also previously covered by the Pleistocene age Lake Bonneville. The Great Salt Lake, located along the western margin of the valley and beyond, is a remnant of this ancient fresh water lake. Lake Bonneville reached a high-stand elevation of between approximately 5,160 and 5,200 feet above sea level at 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 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 USGS Clearfield, Utah 7.5 Minute Quadrangle, that includes the location of the subject site, has been mapped by Sack[2]. The surficial geology at the location of the subject site and adjacent properties is mapped as a combination of “Undifferentiated lacustrine and alluvial deposits” (Map Unit Qla) dated to be Holocene to uppermost Pleistocene and “Older Deltaic Deposits” (Map Unit Qd2) dated to be Holocene to upper Pleistocene. No fill has been mapped at the location of the site on the geologic map.

Unit Qla is described on the referenced geologic map as “Fluvially reworked lake sediments and intermingled lake and alluvial-fan deposits. Poorly sorted fine-grained sediment deposited from about 12.6 ka to present. Thickness probably less than 10 feet (3 m).” Unit Qd2 is described on the referenced geologic map as “…sand-dominated sediments and an irregular surface topography that includes meander-like curves. These curves are interpreted as channel remnants from the subaerial component of the transgressive-phase Weber River delta, perhaps partially covered by subaqueous deposits of the same transgressive delta sequence… Maximum thickness of the Qd2 unit may be as much as 50 feet (15 m).” Refer to the **Geologic Map**., shown below.

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[2] Sack, D., 2005, Geologic Map of the Clearfield 7.5’ Quadrangle, Davis County, Utah; Utah Geological Survey Miscellaneous Publication MP-05-4, Scale 1:24,000.

GEOLOGIC MAP

4.2 Faulting

No active surface fault traces are shown on the referenced geologic map crossing, adjacent to, or projecting toward the subject site. The nearest mapped active fault is the Weber Segment of the Wasatch Fault Zone approximately 6.0 miles to the east. 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) 2018, 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 2018 Section 1613.2.2 refers to Chapter 20, Site Classification Procedure for Seismic Design, of ASCE[3] 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.

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[3] American Society of Civil Engineers

Based on average shear wave velocity data within the upper 30 meters ($V_{S,30}$) published by McDonald and Ashland[4], the subject site is located within unit description Q02WD, which has a log-mean $V_{S,30}$ of 256 meters per second (840 feet per second). Further, based on the blow counts obtained in bore hole B-4 which extended to the maximum depth explored of 46.5 feet, and considering that similar soils are anticipated to a depth of 100 feet, it is our opinion the site best fits Site Class D – Stiff Soil Profile (with data), which we recommend for seismic structural design.

4.3.2 Ground Motions

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 at site grid coordinates of 41.105933 degrees north latitude and -112.024988 degrees west longitude. The following table and response spectra summarizes the peak ground, short period and long period accelerations for the MCE_R event, and incorporates appropriate soil correction factors for a Site Class D (with data) soil profile:

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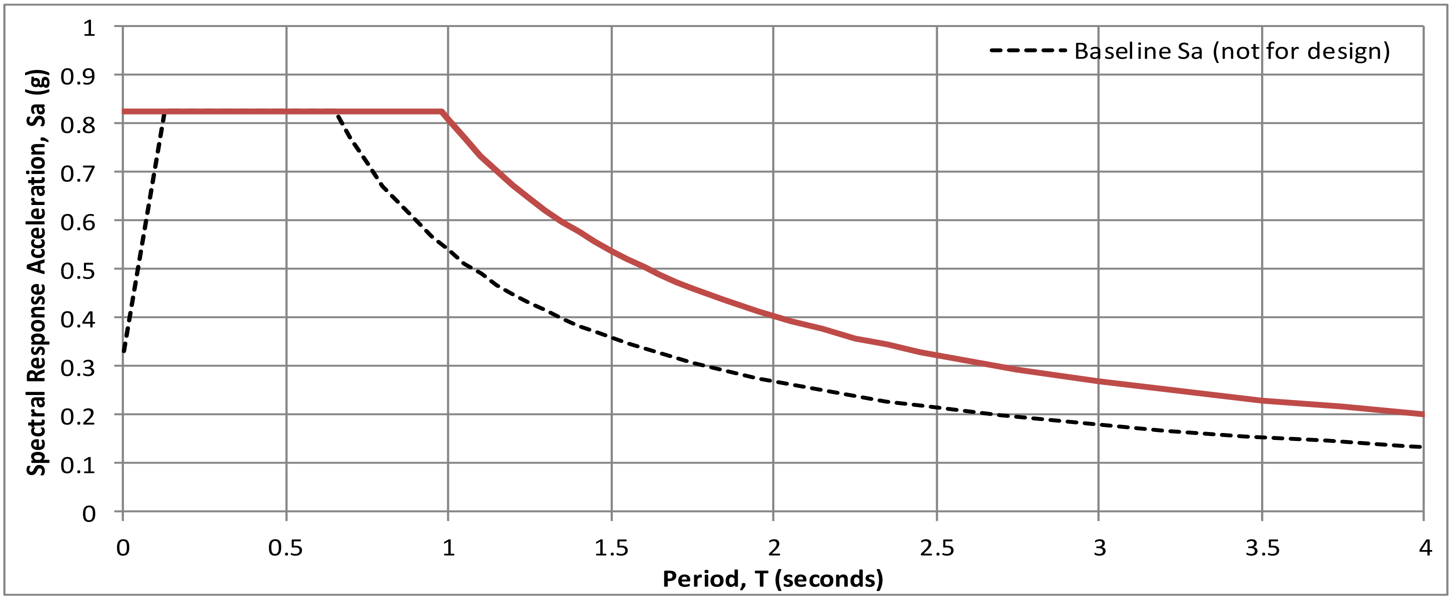
[4] McDonald, G.N. and Ashland, F.X., 2008, "Earthquake Site-Conditions Map for the Wasatch Front Urban Corridor, Utah," Utah Geological Survey Special Study 125, 41 pp.

SPECTRAL ACCELERATION PERIOD, T	SITE CLASS B/C BOUNDARY [mapped values] (g)	SITE COEFFICIENT	SITE CLASS D* [adjusted for site class effects] (g)	MULTI-PLIER	DESIGN VALUES (g)
Peak Ground Acceleration	PGA = **0.549**	F_{pga} = 1.100	PGA_M = 0.604	1.000	PGA_M = 0.604
0.2 Seconds (Long Period Acceleration)	S_S = **1.233**	F_a = 1.007	S_{MS} = 1.241	0.667	S_{DS} = 0.828
	(no exceptions needed)	F_a = (N/A)	S_{MS} = (N/A)	0.667	S_{DS} = (N/A)
1.0 Second (Long Period Acceleration)	S_1 = **0.433**	F_v = N/A	S_{M1} = N/A	0.667	S_{D1} = N/A
	(Exception 2:)	F_v = (1.867)	S_{M1} = (0.808)	0.667	S_{D1} = (0.539)

NOTES: 1. TL (seconds): **8**
2. Site Class: **D**
3. Have data to verify? **yes**

*** Site Class D With Data**

4. ASCE 7-16 Requires Site-Specific Ground Motion Hazard Analysis (Since S1≥0.2 sec) - OR Can Use Exception 2 (per §11.4.8) (Sa/Cs Plot Assumes R=Ie=1.0)



As indicated in the above table, S_1 is greater than 0.2 seconds and a site-specific ground motion hazard analysis (GMHA) is required for the site, unless the Exception 2 values shown are used for seismic design. If a site-specific GMHA is desired instead of using the higher exception values for design, please contact CMT for a proposal to perform the GMHA.

4.3.3 Liquefaction

The site is located within an area designated by the Utah Geologic Survey (Davis County) [5] as having "moderate" 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.

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[5] Utah Geological Survey, "Liquefaction-Potential Map for a Part of Davis County, Utah," Utah Geological Survey Public Information Series 24, August 1994. https://ugspub.nr.utah.gov/publications/public_information/pi-24.pdf

We evaluated the liquefaction potential of the site using the procedures described in Youd et al[6] and Idriss & Boulanger[7], and only apply to the saturated silty/sandy deposits. Our evaluation indicates isolated zones of the saturated sandy soils could liquefy under a major seismic event. Maximum anticipated settlement resulting from the liquefaction is on the order of 1.0 inch or less. This amount of settlement is generally considered tolerable for structures to provide life safety egress, although some relatively minor structural damage would be possible. Lateral spreading due to liquefaction is not anticipated to occur.

4.4 Other Geologic Hazards

No landslide deposits or features, including lateral spread deposits, are mapped on or adjacent to the site. The site is not located within a known or mapped debris flow, stream flooding[8], or rock fall hazard area.

5.0 SITE CONDITIONS

5.1 Surface Conditions

The site is currently occupied by the Clearfield Municipal Operations Center with associated buildings, parking areas, and storage areas. Based upon aerial photos dating back to 1997 that are readily available on the internet, a prior structure was present at the south end of the proposed new building up until about 2019. The current roadway along the south side of the property (575 South) was constructed around 2016. Overall, the site is relatively flat, with a very slight slope downward to the west. The site is bordered on the north by a commercial building with associated parking, on the east by train tracks and an industrial building with associated parking, on the south by 575 South Street followed by two single-family homes and a storage area for a commercial business, and on the east by Main Street followed by commercial buildings with associated parking (see **Vicinity Map** in **Section 1.1** above).

5.2 Subsurface Soils

Bore holes B-1 and B-2 were located within asphalt pavement areas. At bore holes B-3 through B-6, the surface was blanketed with a silty gravel with sand fill on the order of about 18 inches thick. The depth and lateral extent of onsite surface fill could vary both laterally and with depth across the site.

Below the pavement and surface fills, natural soils we encountered comprised generally of fine-grained CLAY/SILT (CL/ML) with varying fine sandy content extending to depth of about 8.5 to 14 feet underlain by SAND

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[6] Youd, T.L.; Idriss, I.M.; Andrus, R.D.; Arango, I.; Castro, G.; Christian, J.T.; Dobry, R.; Finn, W.D.L.; Harder, L.F. Jr.; Hynes, M.E.; Ishihara, K.; Koester, J.P.; Liao, S.C.; Marcuson, W.F. III; Martin, G.R.; Mitchell, J.K.; Moriwaki, Y.; Power, M.S.; Robertson, P.K.; Seed, R.B.; and Stokoe, K.H. II; October 2001, "Liquefaction Resistance of Soils: Summary Report from the 1996 NCEER and 1998 NCEER/NSF Workshops on Evaluation of Liquefaction Resistance of Soils," ASCE Journal of Geotechnical and Geoenvironmental Engineering, p 817-833.

[7] Idriss, I.M. and Boulanger, R.W., December 2010, "SPT-Based Liquefaction Triggering Procedures," Department of Civil & Environmental Engineering, University of California at Davis, Report No. UCD/CGM 10/02, 259 p.

[8] https://msc.fema.gov/portal/search?AddressQuery=749%20S%20Main%20Street%2C%20Clearfield%2C%20UT#searchresultsanchor

with varying silt content (SM, SP) extending to the full depth penetrated, about 46.5 feet below the ground surface.

The silt/clay soils were moist to wet, generally brown in color, very soft to medium stiff in consistency based on SPT blow counts and based on laboratory testing, exhibit moderate pre-consolidation, moderate strength and moderately high compressibility characteristics.

The natural sand soils were wet, brown to gray in color, and loose to dense based on the blow counts in the bore holes. They will also exhibit moderately high strength and low compressibility characteristics under static loading.

For a more descriptive interpretation of subsurface conditions, please refer to the bore hole logs, ***Figures 2 through 7***, 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

Groundwater was observed in the bore holes at depths of about 4 to 5 feet below existing grade at the time of our field exploration. On January 19, 2023, CMT personnel returned to the site to measure groundwater level at depth of 6.6 feet, within slotted PVC pipe installed in bore hole B-4. These depths to groundwater could affect utility and foundation installation and other deeper excavations.

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.

6.0 SITE PREPARATION AND GRADING

6.1 General

All deleterious materials should be stripped from the site prior to commencement of construction activities. Where existing asphalt is to remain, we recommend saw cutting to provide a clean edge for new abutting construction transitions.

At the bore hole locations, the site surface is blanketed with asphalt pavement and granular fill. Unless documentation is made available proving otherwise, these surface fills would be considered as undocumented/non-engineered fill and must either be removed below structures or properly prepared over the entire fill thickness in order to remain below new structures and pavements. Building foundations and floor slabs must be directly supported by suitable, stable, undisturbed natural soils or structural fill extending to suitable natural soils.

Proper preparation would include moisture conditioning and recompacting to the requirements for structural fill (see section **6.4 Fill Placement and Compaction** below).

The on-site granular fills, free of debris and any deleterious material may be removed and reutilized as general site grading fill if processed to meet the requirements as outlined below in sections **6.3 Fill Material** and **6.4 Fill Placement and Compaction** below.

Following subgrade preparations, the exposed subgrade must be proofrolled by passing moderate-weight rubber tire-mounted construction equipment over the surface at least twice. An exception to this would be where the rolled surface is within 2 feet or less of groundwater. If excessively soft or loose soils are encountered, they must be removed (up to a maximum depth of 2 feet) and replaced with structural fill.

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/properly prepared, prior to placing site grading fills, footings, slabs, and pavements.

6.2 Temporary Excavations

Relatively shallow groundwater was encountered at the time of drilling between about 4.0 and 5.0 feet below the ground surface with subsequent static groundwater depth measured at about 6.6 feet below the ground surface in bore hole B-4 on January 19, 2023. We anticipate that excavations extending below a depth of about 4 to 5 feet may likely encounter groundwater, and dewatering of such excavations may be required.

Temporary excavations in clayey (cohesive) soils, 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, without bracing, may be constructed with side slopes no steeper than one-half horizontal to one vertical (0.5H:1V).

For 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) with out bracing. 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

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 possibly as replacement fill below footings. All structural fill must be free of sod, rubbish, topsoil, frozen soil, and other deleterious materials.

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

Fill Material Type	Description/Recommended Specification
Select Structural Fill/Replacement 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.
General 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, and a maximum 30% passing No. 200 sieve.
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- to 2.0-inch gravel placed on stabilization fabric, such as Mirafi RS280i or equivalent (see **Section 6.6**).

On-site surficial sand and gravel soils appear suitable for use as general site grading fill, if processed to meet the requirements given above, and compacted as outlined below in section **6.4 Fill Placement and Compaction** below. These soils may also be used in non-structural fill situations.

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[9] T-180) in accordance with the following recommendations:

LOCATION	TOTAL FILL THICKNESS (FEET)	MINIMUM PERCENTAGE OF MAXIMUM DRY DENSITY
Beneath an area extending at least 5 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 5 to 8	95 98
Site grading fill outside area defined above	0 to 5 5 to 8	92 95
Utility trenches within structural areas	--	96
Roadbase and subbase	-	96
Non-structural fill	0 to 5 5 to 8	90 92

Structural fills greater than 8 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[10] 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).

Where the utility does not underlie structurally loaded facilities and public rights of way, on-site fill and 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**.

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[9] American Association of State Highway and Transportation Officials
[10] American Public Works Association

6.6 Stabilization

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**. This coarse material may be placed and worked into the soft soils until firm and non-yielding or the soft soils removed an additional, minimum of 18 inches, and backfilled with the clean stabilizing fill. A test area should be implemented to achieve a proper stabilization strategy. 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, the subsurface conditions observed in the field and the laboratory test data, as well as common geotechnical engineering practice.

7.1 Foundation Recommendations

Based on our geotechnical engineering analyses and the projected loading discussed in section **1.3 Description of Proposed Construction**, the proposed structure(s) may be supported upon conventional spread and/or continuous wall foundations placed on suitable, undisturbed natural soils and/or on structural fill extending to suitable natural soils. Footings may be designed using a net bearing pressure of 2,000 if placed on suitable, stable, undisturbed, natural soils or on structural fill extending to suitable natural soils.

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 1/2 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.

With shallow groundwater present and depending on the planned footing depth, some dewatering and/or wet subgrade stabilization may be required.

7.2 Installation

Under no circumstances shall the footings be established upon non-engineered fills, loose or disturbed soils, topsoil, sod, 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.

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.

If other unsuitable soils are encountered, they must be completely removed and replaced with properly compacted structural fill. Excavation bottoms should be observed by a CMT geotechnical engineer to confirm that suitable bearing materials soils have been exposed.

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 select granular 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 300 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 high might be constructed at this site for utility boxes etc. The lateral earth pressure values given below are for a backfill material that will consist of drained soils, free of debris and deleterious materials, placed and compacted in accordance with the recommendations presented herein.

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)*
Active Pressure (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	31
At-Rest Pressure (wall is not allowed to yield)	58	N/A
Passive Pressure (wall moves into the soil)	300	165

*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). 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 quarters 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

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

1. All areas around structures should be sloped to provide drainage away from the foundations. Where possible we recommend a minimum slope of 6 inches in the first 10 feet away from 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. Sprinklers should be aimed away 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 may become evident during construction.

11.0 PAVEMENTS

All pavement areas must be prepared as discussed above in **Section 6.1**. We anticipate the natural fine sandy 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 is based upon a California Bearing Ratio (CBR) of 4 for the natural fine sandy silt/clay soils. Given the projected traffic as discussed above in **Section 1.3**, the following pavement sections are recommended for the given ESAL's (18-kip equivalent single-axle loads) per day:

Pavement for site parking areas and internal drives at the site is anticipated to consist primarily of asphalt paved. However, for loading/unloading zones and aprons we recommend rigid (Portland cement concrete-PCC) pavements. We understand that a gravel surfaced parking, storage areas will also be constructed.

The following recommended pavement sections are for projected traffic scenario loading. If the projected loading conditions are significantly different from that presented, then CMT must be informed to provide further and more appropriate recommendations.

<u>Gravel Surface Equipment Parking and Storage Area</u>

MATERIAL	PAVEMENT SECTION THICKNESS (inches)	
Asphalt	---	---
Road-Base	**18**	**8**
Subbase	---	**13**
Total Thickness	**18**	**21**

Internal Light Vehicle Parking and Drive Lanes

MATERIAL	PARKING/DRIVE AREAS PAVEMENT SECTION THICKNESS (inches)					
	LIGHT VEHICLE PARKING AREAS (1-3 ESAL per day)			Light Vehicle Internal Drives (UP TO 6 ESAL'S per day)		
Asphalt	3	3	---	3	3	---
Concrete	---	--	5	---	---	5.5
Road-Base	9	5	6	11	6	6
Subbase	---	6	---	---	7	---
Total Thickness	12	14	11	14	16	11.5

Internal Drive with Moderate Volume of Trucks

Material	Pavement Section Thickness (inches)			
	Internal Drive Areas/Loading Zone Aprons 40 medium Trucks and 2 tractor-Trailer Combinations (52 ESAL's per day)			
Asphalt	4	4	4.5	---
Concrete	---	---	---	6
Road-Base	11	6	9	6
Subbase	---	7	---	---
Total Thickness	15	17	13.5	12

If more heavy traffic is planned, CMT must be notified to adjust the pavement design as needed.

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%. Subbases shall consist of a low plastic, granular soil with a minimum CBR of 30 percent. Roadbase and subbase material should be compacted as recommended above in **Section 6.4** Fill Placement and Compaction of this report. Asphalt material generally should conform to APWA requirements, having a ½-inch maximum aggregate size, a 75-gyration Superpave mix containing no more than 15% of recycled asphalt (RAP) and a PG58-28 binder. The asphalt pavement should be compacted to 93% of the maximum density for the asphalt material.

For dumpster pads, we recommend a pavement section consisting of 6.5 inches of Portland cement concrete, 6.0 inches of aggregate base, over properly prepared suitable natural subgrade or site grading structural fills extending to suitable natural soils. Dumpster pads shall not be constructed overlying non-engineered fills unless heavily reinforced.

Exterior Portland cement concrete elements should be designed in accordance with the American Concrete Institute (ACI). 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.

12.0 QUALITY CONTROL

We recommend that CMT be retained as part of a comprehensive quality control testing and observation program. With CMT onsite 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 his 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.

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) 590-0394. To schedule materials testing, please call (801) 381-5141.

APPENDIX

SUPPORTING DOCUMENTATION

CMT TECHNICAL SERVICES

Clearfield Municipal Operation Center

About 497 South Main Street, Clearfield, Utah

SITE PLAN

Date:	17-Jan-2023	Figure:
CMT No.:	19654	1

Clearfield Municipal Operation Center Bore Hole Log B-1

About 497 South Main Street, Clearfield, Utah

Total Depth: 11.5'
Water Depth: 4.5'

Date: 1/11/23
Job #: 19654

Depth (ft)	GRAPHIC LOG	Soil Description	Sample Type	Sample #	Blows (N)	Total	Moisture (%)	Dry Density(pcf)	Gravel %	Sand %	Fines %	LL	PL	PI
0	■	Asphalt/Roadbase Mix												
	▨	Brown Silty CLAY (CL) with fine sand very moist, soft grades with fine sand layers and oxidation												
	▨		‖	1			20.6	102			56.7			
4 ▽	▨	wet												
	▥	Brown Sandy Clay/Silt (CL-ML) very soft	◣	2	1 0 2	2	28.9				75.9	25	20	5
8	▥		‖	3			30.6	91						
	⁘	Poorly Graded SAND (SP-SM) with some silt wet, medium dense												
	⁘		⧗	4	0 9 17	26	24.5	97	0	91	8.9			
12		END AT 11.5'												
16														
20														
24														
28														

Remarks: Groundwater encountered during drilling at depth of 4.5 feet.

Coordinates: 41.106713°, -112.025413°
Surface Elev. (approx): Not Given

Equipment: Hollow-Stem Auger
Automatic Hammer, Wt=140 lbs, Drop=30"
Excavated By: Direct Push
Logged By: Carolina & Sterling
Page: 1 of 1

CMT TECHNICAL SERVICES

Figure:
2

Clearfield Municipal Operation Center Bore Hole Log B-2

About 497 South Main Street, Clearfield, Utah

Total Depth: 11.5'
Water Depth: 4.5'

Date: 1/11/23
Job #: 19654

Depth (ft)	GRAPHIC LOG	Soil Description	Sample Type	Sample #	Blows (N)	Blows (N) Total	Moisture (%)	Dry Density(pcf)	Gradation Gravel %	Gradation Sand %	Gradation Fines %	Atterberg LL	Atterberg PL	Atterberg PI
0		Asphalt/Roadbase Mix												
		Light Brown Fine Sandy SILT ML) very moist, soft												
		very soft		5	3 1 3	4	20.6	100			50.9	20	18	2
4 ▽		Light Brown Silty Clay/Clayey Silt (CL-ML) with some fine sand wet												
				6	1 0 0	0								
8				7	1 1 1	2						26	20	6
				8	1 2 1	3	30.7				84.2			
		END AT 11.5'												
12														
16														
20														
24														
28														

Remarks: Groundwater encountered during drilling at depth of 4.5 feet.

Coordinates: 41.106652°, -112.024709°
Surface Elev. (approx): Not Given

Equipment: Hollow-Stem Auger
Automatic Hammer, Wt=140 lbs, Drop=30"
Excavated By: Direct Push
Logged By: Carolina & Sterling

CMT TECHNICAL SERVICES

Page: 1 of 1

Figure: 3

Clearfield Municipal Operation Center Bore Hole Log B-3

About 497 South Main Street, Clearfield, Utah

Total Depth: 16.5'
Water Depth: 4'

Date: 1/11/23
Job #: 19654

Depth (ft)	GRAPHIC LOG	Soil Description	Sample Type	Sample #	Blows (N)	Total	Moisture (%)	Dry Density(pcf)	Gravel %	Sand %	Fines %	LL	PL	PI
0	▩	Fill; silty gravel with sand moist												
	▨	Light Brown Clayey Sand/Sandy Clay (SC-CL) very moist, soft/very loose												
			‖	9			18.4	99			51			
▽ 4		wet												
			◥	10	1 3 1	4	28				51.5			
		grades highly interbedded with fine sand layers												
8			◥	11	2 2 0	2	28.5				69.1	27	22	5
	▨	Fine Sandy CLAY (CL) wet, soft												
			‖	12			29.1	92.9			89.1			
12														
	⁚	Poorly Graded SAND (SP) with some fines wet, very loose												
16			◥	13	2 1 3	4	27.7				5.1			
		END AT 16.5'												
20														
24														
28														

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

Coordinates: 41.106227°, -112.02479°
Surface Elev. (approx): Not Given

Equipment: Hollow-Stem Auger
Automatic Hammer, Wt=140 lbs, Drop=30"
Excavated By: Direct Push
Logged By: Carolina & Sterling
Page: 1 of 1

CMT TECHNICAL SERVICES

Figure:
4

Clearfield Municipal Operation Center Bore Hole Log

B-4

About 497 South Main Street, Clearfield, Utah

Total Depth: 46.5'
Water Depth: 5', 6.6'

Date: 1/11/23
Job #: 19654

Depth (ft)	GRAPHIC LOG	Soil Description	Sample Type	Sample #	Blows (N)	Total	Moisture (%)	Dry Density(pcf)	Gradation Gravel %	Gradation Sand %	Gradation Fines %	Atterberg LL	Atterberg PL	Atterberg PI
0		Fill; silty gravel with sand												
		Light Brown Silty Sand/Sandy Silt (SM-ML) moist, loose/soft		14	3 3 1	4	16.3				53.2			
4														
▽		Fine Sandy CLAY (CL) with silt wet		15	0 0 3	3	28.2				64.5			
▼														
8		Silty SAND (SM) with trace clay layers and trace oxidation wet, loose		16	4 5 3	8	24.2				26.1			
				17	3 6 4	10								
12														
		Brown Poorly Graded SAND (SP) with some fines wet, medium dense												
16				18	3 6 17	23	22.4	100			2.6			
		Brown Silty SAND (SM) wet, medium dense												
20		grades with 4" clay layers		19	4 11 16	27								
24		grades with oxidation												
				20	1 6 11	17	24.4				30.3			
28														

Remarks: Groundwater encountered during drilling at depth of 5 feet and measured on 1/19/23 at depth of 6.6 feet.
Slotted PVC pipe installed to depth of 46.5 feet to facilitate water level measurements.

Coordinates: 41.10594°, -112.024847°
Surface Elev. (approx): Not Given

Equipment: Hollow-Stem Auger
Automatic Hammer, Wt=140 lbs, Drop=30"
Excavated By: Direct Push
Logged By: Carolina & Sterling

CMT TECHNICAL SERVICES

Figure:
5

Clearfield Municipal Operation Center Bore Hole Log

B-4

About 497 South Main Street, Clearfield, Utah

Total Depth: 46.5'
Water Depth: 5', 6.6'

Date: 1/11/23
Job #: 19654

Depth (ft)	GRAPHIC LOG	Soil Description	Sample Type	Sample #	Blows (N)		Moisture (%)	Dry Density(pcf)	Gradation			Atterberg		
						Total			Gravel %	Sand %	Fines %	LL	PL	PI
28	▨													
	▨		◣	21	12 16 21	37								
32	▨													
36	▨		◣	22	10 18 23	41								
40	▨		◣	23	0 4 8	12	25.5				16.3			
44	░	Brown Sand (SP) with silt wet, dense												
	░		◣	24	2 8 24	32	21.7				9.7			
		END AT 46.5'												
48														
52														
56														

Remarks: Groundwater encountered during drilling at depth of 5 feet and measured on 1/19/23 at depth of 6.6 feet.
Slotted PVC pipe installed to depth of 46.5 feet to facilitate water level measurements.

Coordinates: 41.10594°, -112.024847°
Surface Elev. (approx): Not Given

Equipment: Hollow-Stem Auger
Automatic Hammer, Wt=140 lbs, Drop=30"
Excavated By: Direct Push
Logged By: Carolina & Sterling

CMT TECHNICAL SERVICES

Figure:
5

Clearfield Municipal Operation Center Bore Hole Log

B-5

About 497 South Main Street, Clearfield, Utah

Total Depth: 11.5'
Water Depth: 4'

Date: 1/11/23
Job #: 19654

Depth (ft)	GRAPHIC LOG	Soil Description	Sample Type	Sample #	Blows (N)	Total	Moisture (%)	Dry Density(pcf)	Gravel %	Sand %	Fines %	LL	PL	PI
0	▨	Fill; silty gravel with sand												
	⁚	Light Brown Silty Fine SAND (SM) very moist, loose												
	⁚		◣	25	5 4 4	8	18.2				39			
∇ 4	⁚	wet												
	⁚		◣	26	2 2 2	4								
8	⁚		◣	27	3 5 7	12								
	⁚		◣	28	4 6 7	13	30.1				36.5			
12		END AT 11.5'												
16														
20														
24														
28														

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

Coordinates: 41.10541°, -112.024716°
Surface Elev. (approx): Not Given

Equipment: Hollow-Stem Auger
Automatic Hammer, Wt=140 lbs, Drop=30"
Excavated By: Direct Push
Logged By: Carolina & Sterling

CMT TECHNICAL SERVICES

Clearfield Municipal Operation Center Bore Hole Log B-6

About 497 South Main Street, Clearfield, Utah

Total Depth: 6.5'
Water Depth: 4'

Date: 1/11/23
Job #: 19654

Depth (ft)	GRAPHIC LOG	Soil Description	Sample Type	Sample #	Blows (N)		Moisture (%)	Dry Density(pcf)	Gradation			Atterberg		
						Total			Gravel %	Sand %	Fines %	LL	PL	PI
0	▩	Fill; silty gravel with sand												
	▥	SILT (ML) with fine sand slightly moist, soft												
	▥		◢	29	5 2 2	4								
▽ 4	▨	Fine Sandy CLAY (CL) with silt wet												
	▨		◢	30	2 1 1	2	24.4				69.9			
		END AT 6.5'												
8														
12														
16														
20														
24														
28														

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

Coordinates: 41.106235°, -112.025039°
Surface Elev. (approx): Not Given

Equipment: Hollow-Stem Auger
Automatic Hammer, Wt=140 lbs, Drop=30"
Excavated By: Direct Push
Logged By: Carolina & Sterling
Page: 1 of 1

CMT TECHNICAL SERVICES

Figure: 7

Clearfield Municipal Operation Center

Key to Symbols

About 497 South Main Street, Clearfield, Utah

Date: 1/11/23

Job #: 19654

①	②	③	④	⑤	⑥ Blows(N)	⑦	⑧	⑨	⑩ Gradation			Atterberg		
Depth (ft)	GRAPHIC LOG	Soil Description	Sample Type	Sample #		Total	Moisture (%)	Dry Density(pcf)	Gravel %	Sand %	Fines %	LL	PL	PI

COLUMN DESCRIPTIONS

Depth (ft.): Depth (feet) below the ground surface (including groundwater depth - see below right).

Graphic Log: Graphic depicting type of soil encountered (see below).

Soil Description: Description of soils, including Unified Soil Classification Symbol (see below).

Sample Type: Type of soil sample collected; sampler symbols are explained below-right.

Sample #: Consecutive numbering of soil samples collected during field exploration.

Blows: Number of blows to advance sampler in 6" increments, using a 140-lb hammer with 30" drop.

Total Blows: Number of blows to advance sampler the 2nd and 3rd 6" increments.

Moisture (%): Water content of soil sample measured in laboratory (percentage of dry weight).

Dry Density (pcf): The dry density of a soil measured in laboratory (pounds per cubic foot).

Gradation: Percentages of Gravel, Sand and Fines (Silt/Clay), from lab test results of soil passing No. 4 and No. 200 sieves.

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	
Description	**Thickness**
Seam	Up to ½ inch
Lense	Up to 12 inches
Layer	Greater than 12 in.
Occasional	1 or less per foot
Frequent	More than 1 per foot

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

MOISTURE CONTENT
Dry: Absence of moisture, dusty, dry to the touch.
Moist: Damp / moist to the touch, but no visible water.
Saturated: Visible water, usually soil below groundwater.

UNIFIED SOIL CLASSIFICATION SYSTEM (USCS)

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

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

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)

1. The results of laboratory tests on the samples collected are shown on the logs at the respective sample depths.
2. 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.
3. The information presented on each log is subject to the limitations, conclusions, and recommendations presented in this report.

Figure:
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