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

GEOTECHNICAL ENGINEERING STUDY

605 Jackson Development

About 605 North Jackson Avenue
Ogden, Utah

CMT PROJECT NO. 21200

FOR:
Ogden City
2549 Washington Boulevard, Suite 120
Ogden, Utah 84401

November 17, 2023

CMT TECHNICAL SERVICES

November 17, 2023

Mr. Jeremy Smith
Ogden City
2549 Washington Boulevard, Suite 120
Ogden, Utah 84401

Subject: Geotechnical Engineering Study
605 Jackson Development
About 605 North Jackson Avenue
Ogden, Utah
CMT Project No. 21200

Mr. Smith:

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 26, 2023, a CMT Technical Services (CMT) staff professional was on-site and supervised the excavation of 5 test pits extending to depths of about 8 to 10.5 feet below the existing ground surface. Samples of the subsurface soils were collected in the test pits during the field operations and subsequently transported to our laboratory for further observation and testing of select samples.

Conventional spread and/or continuous footings may be utilized to support the proposed residences, 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

374995
JEFFREY J. EGBERT
11/17/23

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

Reviewed by:

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

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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 approximately 6.5 acres as a residential subdivision. The parcel is situated on the west side of Jackson Avenue at about 605 North in Ogden, 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. Jeremy Smith of Ogden City, 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 included performing field exploration, which consisted of the excavating/logging/sampling of 5 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 October 13, 2023, and executed on October 17, 2023.

1.3 Description of Proposed Construction

We understand that a residential subdivision and associated infrastructure are planned for the approximately 6.5-acre site. Proposed residences will likely be 1 to 2 levels of wood-framed construction above grade, founded on spread footings with basements. Maximum continuous wall and column loads are anticipated to be 3,000 pounds per lineal foot and 25,000 pounds, respectively. If the structural 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 residential streets which we anticipate will be surfaced with asphalt concrete. Traffic is projected to consist of mostly automobiles and light trucks, a few 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 3 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. Up to 1 foot of topsoil encountered on the surface, which will require removal beneath structures, flat work, and pavements;
2. Subsurface soils encountered consisted of natural CLAY (CL), SILT (ML), and SAND (SC, SC-SM, SM) layers to the maximum depth explored of approximately 8.5 feet below the existing ground surface;
3. Laboratory consolidation testing indicates potentially collapsible soils are present on the site to depths of at least 5 feet. Observed collapse ranged from about 4% to 8%, which is considered moderately high to high. Foundations and floor slabs should not be placed directly on potentially collapsible soils;
4. Foundations and floor slabs should be placed suitable, undisturbed, natural non-collapsible soils at least 6 feet below the existing site grades, or on at least 36 inches of properly placed and compacted structural fill;
5. Strict control of surface moisture is recommended to minimize the potential for adverse settlements by allowing subsurface potentially collapsible soils to become wetted after construction.

CMT must assess that topsoil, undocumented fills (if encountered), potentially collapsible soils, 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

To define and evaluate the subsurface soil and groundwater conditions, 5 test pits were excavated with a backhoe at the site to depths of approximately 8.0 to 10.5 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 sealed in plastic bags 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[1] 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 6***, included in the Appendix. A Key to Symbols defining the terms and symbols used on the logs, is provided as ***Figure 7*** in the Appendix.

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.

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
6. California Bearing Ratio, ASTM D-2937, Subgrade support properties

To provide data necessary for an assessment of potential settlement from structural loading, a consolidation test was performed on each of 3 representative samples of the subsurface natural soils encountered across the

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[1] American Society for Testing and Materials

site. Based upon data obtained from the consolidation testing, collapse of approximately 4% to 8% was observed at a load of 1,000 psf when water was added (see the **Lab Summary Table** below). Some of this observed collapse in granular soils may be the result of sample disturbance during collection and handling. However, the collapse potential will govern foundation and floor slab support recommendations. Detailed results of the consolidation 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 6***) and in the following **Lab Summary Table.** CBR test results are presented and discussed in **Section 11.0, Pavements.**

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	1.5	ML	BULK			8	15	77	34	24	10	
TP-1	8	ML	GRAB	26				89				-0.6%
TP-2	1	CL	GRAB	7		11	14	75				
TP-2	10	CL	GRAB	23				99	33	18	15	
TP-3	1	CL	BLOCK	11	88	8	18	74				
TP-3	4	CL	BLOCK	12	80	4	20	76	32	22	10	-4%
TP-4	4	SC-SM	BLOCK	4	95	29	37	34				-6%
TP-4	7	SC-SM	BLOCK	4	92	26	41	34	23	19	4	
TP-5	3	CL	BLOCK	7	82	14	26	60				-8%

4.0 GEOLOGIC & SEISMIC CONDITIONS

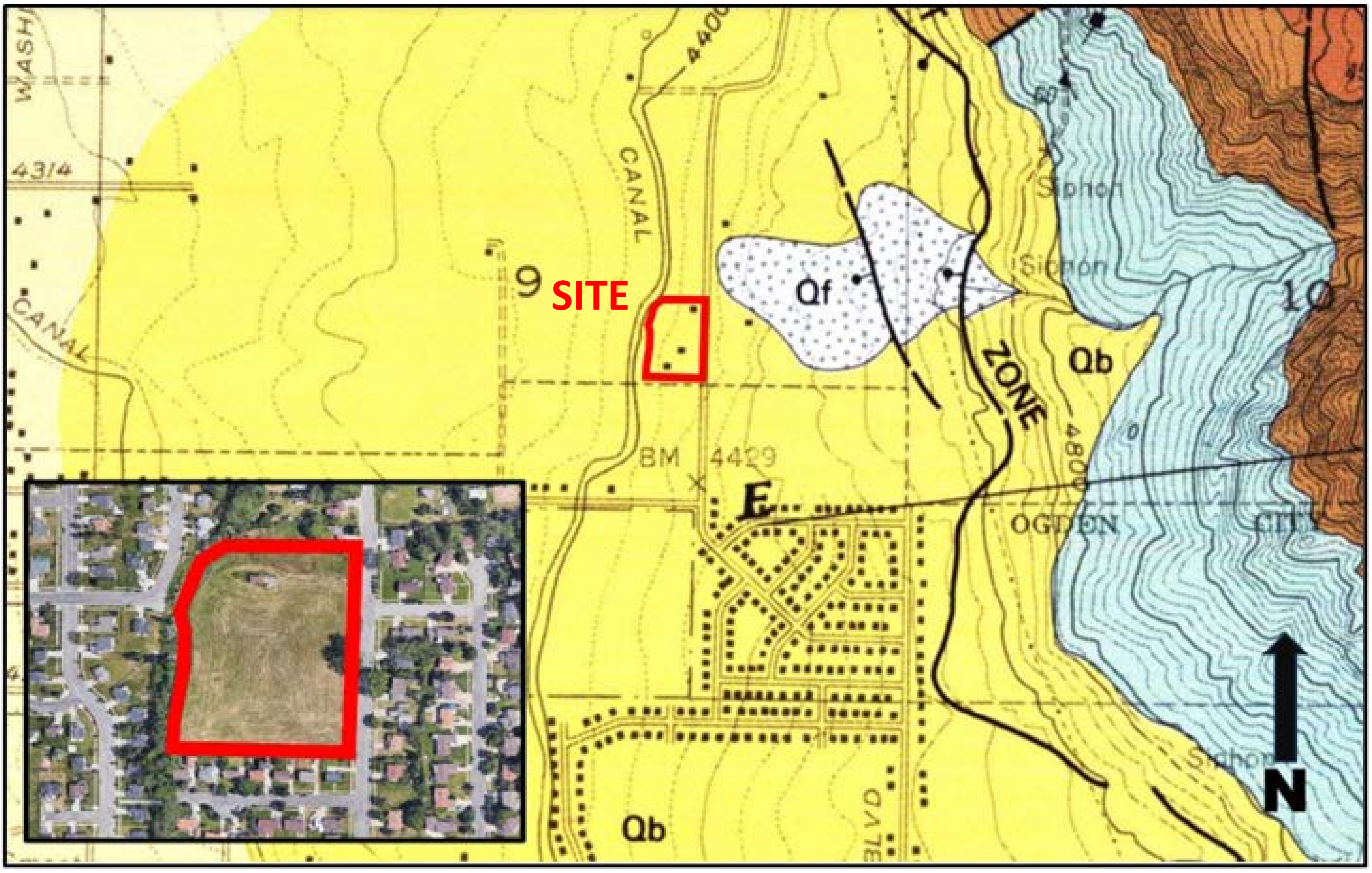
4.1 Geologic Setting

The subject site is located in the central portion of Weber County in north-central Utah and ranges in elevation from approximately 4,399 to 4,413 feet above sea level. The site is 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, was formed by extensional tectonic processes during the Tertiary and Quaternary geologic time periods, and is 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 at 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 by almost 300 feet relatively fast 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 North Ogden and Plain City, Utah, 7.5-minute Quadrangle, which include the location of the subject site, has been mapped by Max D. Crittenden and Martin L. Sorensen[2]. The surficial geology at the location of the subject site and adjacent properties is mapped as "Lake Bonneville Deposits" (Map Unit **Qb**) dated to be Pleistocene in age. Unit **Qb** is described in the referenced map as "Gravel, sand, and silt deposited mainly during high stands of Lake Bonneville; thickness 0-60 m. Locally, includes silt deposits." No fill or disturbed ground is mapped at the location. Refer to the **Geologic Map**, shown below.



GEOLOGIC MAP

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[2] Crittenden, M.D., and Sorensen, M.L., 1985, Geologic Map of the North Ogden Quadrangle and part of the Ogden and Plain City Quadrangles, Box Elder and Weber Counties, Utah; Utah Geological Survey, Miscellaneous Investigations Series Map 1606, Scale 1:24,000. https://ugspub.nr.utah.gov/publications/united_states_geological_survey/geologic_maps/i/i-1606.pdf

4.2 Faulting

No active surface fault rupture traces are mapped crossing, adjacent to, or projecting toward the site on the referenced geologic map. However, the nearest mapped active Holocene faults is the Weber section of the Wasatch Fault Zone (WFZ) approximately 0.31 miles east of the site[3]. Should this segment of the fault rupture, producing an earthquake, ground shaking at this site could be severe.

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[4] 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 upper 30 meters ($V_{S,30}$) published by McDonald and Ashland[5], the subject site is located within unit description Q02W, which has a log-mean $V_{S,30}$ of 233 meters per second (764 feet per second). Thus, 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 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 D (with data) at site grid coordinates of 41.2693 degrees north latitude and -111.9534 degrees west longitude, $\mathbf{S_{DS}}$ is 0.945 and the **Seismic Design Category** is D_2.

4.3.3 Liquefaction

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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[3] USGS, Faults: https://www.usgs.gov/programs/earthquake-hazards/faults

[4] American Society of Civil Engineers

[5] 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.

The site is located within an area designated by the Utah Geologic Survey[6] as having "Very Low" liquefaction potential. This is defined as having a less than 5% probability that within a 100-year period an earthquake strong enough to cause liquefaction will occur.

A special liquefaction study was not performed for this site. We encountered unsaturated soils within the depths we explored. In our opinion, the soils we encountered support the mapped very low liquefaction potential designation.

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[7]. The site is not located within a known or mapped stream flooding zone[8].

5.0 SITE CONDITIONS

5.1 Surface Conditions

At the time the test pits were excavated the site consisted of a field vegetated by grasses and weeds. The site grade slopes downward to the west with an overall relief of approximately 15 feet. Based upon aerial photos dating back to 1993 that are readily available on the internet, three residences occupied the site at that time and were demolished between 2007 and 2009. If the previous residences had basements that were backfilled, the backfill soils used should be considered undocumented fill if encountered. There were several trees around these residences as well which were also removed previously. A single small structure remains on the northwest portion of the site. Since removal of the previous residences the site appears to have been cultivated at times. The site is bordered on the north, south, and west by residential development, and on the east by Jackson Avenue (see **Vicinity Map** in **Section 1.1** above).

5.2 Subsurface Soils

At the locations of test pits TP-1, TP-2, and TP-4 we encountered approximately 8 to 12 inches of topsoil at the surface. Natural soils encountered beneath the topsoil at the locations of the referenced test pits , and from the surface at the remaining test pit locations, consisted of light brown to brown, slightly moist to very moist, Lean CLAY (CL) and SILT (ML) layers, with varying amounts of sand and gravel, and layers of light brown to brown, slightly moist, Clayey SAND (SC), Silty-Clayey SAND (SC-SM), and Silty SAND (SM), with varying amounts of gravel. The clay and silt soils were estimated to have medium stiff consistency, and the sand soils to be in a medium dense state.

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[6] 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

[7] Utah Geologic Hazards, https://geology.utah.gov/apps/hazards/

[8] Federal Emergency Management Agency: https://msc.fema.gov/portal/search?AddressQuery=-111.953439%2C41.269487

Relatively undisturbed samples of the subsurface soils tested in the laboratory displayed a potential for these soils to experience significant, additional settlement (collapse) upon wetting when subjected to additional loading such as from footings. Collapse amounts observed ranged from approximately 4% to 8% which is considered moderately high to high. Footings and foundation should not be placed on potentially collapsible soils.

For a more descriptive interpretation of subsurface conditions, please refer to the test pit logs, ***Figures 2 through 5***, 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 did not encounter groundwater at the time of our field explorations within the maximum depth explored of about 10.5 feet below the existing ground surface. Therefore, we do not anticipate that groundwater will be encountered during the proposed construction.

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, and the magnitude of potential 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. Backfill soils could potentially be encountered when previous residences were located. Such soils should be considered undocumented fill.

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 vegetation, topsoil, loose and disturbed soils, etc. Topsoil, estimated to be about 8 to 12 inches in thickness, was noted on the surface at the locations of test pits TP-1, TP-2, and TP-4. Though not noted at the other test pit locations, there is likely topsoil and/or soils disturbed by past cultivation present across the entire site. These soils should be expected to vary in depth.

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 6 to 8 inches. However, given the past agricultural uses of the site, the upper 12 to 15 inches may have been disturbed during farming.

Laboratory testing indicates potentially collapsible soils are present across the site and appear to often have rootholes/pinholes, are dry and light weight and generally have very limited to no visible bedding. Potentially collapsible soils must be removed/replaced below all foundations. In addition to potential differential settlement and distress to floor slabs and footings, potentially collapsible soils can result in settlement and distress to pavements and exterior concrete flatwork. However, the potentially collapsible soils may remain in pavement and exterior concrete flatwork areas if:

1. They are properly prepared/partially replaced as outlined below;
2. No more than 3 feet of subsequent overlying site grading fills are installed above any remaining sequence of potentially collapsible soils;
3. Any planned subsurface detention systems are installed well away and down gradient from nearby structures, and preferably below any remaining sequence of potentially collapsible soils; and
4. Adequate site drainage is maintained to reduce the potential for subsurface soil saturation.
5. The owner accepts the risk that some settlement of pavement and exterior concrete flatwork areas could occur if the underlying potentially collapsible soils become wetted, which could result in minor to significant damage and resulting maintenance/reconstruction.

Proper preparation of potentially collapsible soils in pavement areas shall consist of removing the upper 18 inches, scarifying the exposed surface to a minimum depth of 8 inches, and moisture conditioning as needed, and recompacting the scarified soils in place to the requirements presented in **Section 6.4**. The removed soils may then be placed and compacted to the appropriate moisture content and density as indicated below in **Section 6.4**. Clods should be broken down to no more than 2 inches in nominal size. For an additional reduction in the risk from potentially collapsible soils, the removed 24 inches should be replaced with imported structural fill meeting our recommendations below in **Section 6.3**, that is placed, moisture conditioned and compacted as recommended below in **Section 6.4**.

After subgrade preparation, pavement areas must then be proof rolled by passing moderate-weight rubber tire-mounted construction equipment over the surface at least twice. 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 subgrade should be observed by a CMT geotechnical engineer to assess that suitable soils have been exposed and/or properly prepared, 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. Groundwater was not encountered within the maximum depth explored, about 8.5 feet at the time of our field explorations, and thus is not anticipated to be encountered in excavations.

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 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 immediately below footings, floor slabs, exterior flatwork, and as pavement subbase. Well-graded sand/gravel mixture, with maximum particle size of 4 inches, a minimum 70% passing 3/4-inch sieve, a minimum 15% passing and a maximum 30% 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.

FILL MATERIAL TYPE	DESCRIPTION | RECOMMENDED SPECIFICATION
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 **Section 6.6**).

On-site soils are not suitable for use as structural fill. On-site soils could potentially be used as site grading fill if reworked by carefully breaking down clods (max particle size about 2 inches), proper moisture conditioning, and re-compaction to the requirements specified herein. Naturals soils can be used as non-structural fill. Note that the natural fine grained soils, in addition to being potentially collapsible, 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. We also recommend the site grading fill thickness using on-site soils not exceed a maximum of 3 feet below structures, to minimize potential settlements.

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 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 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
Reworked native soils below exterior pavement and flatwork	--	93
Roadbase and subbase	-	96
Non-structural fill	0 to 5	90

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[9] American Association of State Highway and Transportation Officials

LOCATION	TOTAL FILL THICKNESS (FEET)	MINIMUM PERCENTAGE OF MAXIMUM DRY DENSITY
	5 to 8	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. Above the bedding zone, we recommend that utility trench backfill have a minimum 15% fines, to reduce permeability (refer to **Section 6.3** above). In addition, utilities should be installed as close to the bottom of the potentially collapsible soils as reasonably possible. For gravity fed utilities consideration should be given to preparation of the trench base as recommended below pavements to reduce the potential for collapse related settlement if utility lines leak.

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, 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 soils, particularly clay/silt 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 soil moisture content, 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 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.

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[10] American Public Works Association

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**. 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 based on 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 suitable, undisturbed, non-collapsible natural soils at least 6 feet below the existing site grades, or on a minimum of 36 inches of structural fill extending to suitable natural soils. Footings may be designed using a net bearing pressure of 2,000 psf.

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 directly on potentially collapsible soils, on undocumented fill, topsoil with organics, sod, rubbish, construction debris, other deleterious materials, frozen soils, or within ponded water. Where footings would otherwise be placed on potentially collapsible soils, we recommend the collapsible soils be completely removed or over-excavated a minimum 36 inches and replaced with properly compacted structural fill. If other unsuitable soils are encountered, they must be completely removed and replaced with properly compacted structural fill.

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. The base of footing excavations should be observed by a CMT geotechnical engineer to assess if 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 footings will cross over an area where an old basement was backfilled, and the maximum depth of structural fill used for the backfill 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.

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 0.40 for structural fill, may be utilized for design. Passive resistance provided by properly placed and compacted natural soils above the water table may be considered equivalent to a fluid with a density of 275 pcf. A combination of passive earth resistance and friction may be utilized if the friction component of the total is divided by 1.5.

8.0 LATERAL EARTH PRESSURES

We project that basement walls up to 8 feet tall will be constructed at this site. The lateral earth pressure values given below anticipate that existing soils 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. Subgrade walls less than 12 feet high do not require designing for a seismic at-rest lateral earth pressure.

CONDITION	STATIC (psf/ft)*	SEISMIC (psf/ft)**
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)	32	31
At-Rest Pressure (wall is not allowed to yield)	48	N/A
Passive Pressure (wall moves into the soil)	275	145

*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, non-collapsible natural soils at least 6 feet below the existing grades, or a minimum of 36 inches of structural fill extending to undisturbed natural soils (same as for foundations). Under no circumstances shall floor slabs be established directly on potentially collapsible soils, or any topsoil, undocumented fills (if encountered), 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;
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

The on-site soils are potentially collapsible when subjected to water, thus it is very 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 each residence should be sloped to provide drainage away from the foundations. We recommend a minimum slope of 6 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

The soils encountered at this site are generally not Group 1 soils per IRC[11] 2018. However, groundwater was not encountered in our exploration to a maximum depth of 8.5 feet below the existing site grade. In addition, it is our opinion that concentrating water into a foundation drain, unless the drain is very carefully and properly constructed, would be detrimental considering the potentially collapsible soils.

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.

To provide data to aid in pavement design a California Bearing Ratio (CBR) test was performed on a bulk sample of the near surface SILT (ML) soils collected from TP-1. Results are presented in the following table:

SAMPLE TYPE	SOIL CLASS	OPTIMUM MOISTURE(%)	MAX DRY DENSITY (pcf)	CBR (%)
Bulk	ML	15.3	113.7	5

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[11] International Residential Code

Given the projected traffic as discussed above in **Section 1.3**, the following pavement sections 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	**12**	**6**
Subbase	**0**	**6**
Total Thickness	**15**	**15**

*We recommend this section be utilized for the connecting road through the proposed development

The above pavement sections provided assume that proper subgrade preparation as outlined in section 6.0 Site Preparation and Grading has been completed. In particular with respect to potentially collapsible soils.

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%. Subbase shall consist of a granular soils meeting a minimum CBR of 30%. 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-gyration Superpave mix containing no more than 15% of recycled asphalt (RAP) and a PG58-28 binder.

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.

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

605 Jackson Development

About 605 North Jackson Avenue, Ogden, Utah

SITE PLAN

Date:	31-Oct-2023
CMT No.:	21200

Figure: 1

605 Jackson Development

About 605 North Jackson Avenue, Ogden, Utah

Test Pit Log

TP-1

Total Depth: 9'
Water Depth: (see Remarks)

Date: 10/26/23
Job #: 21200

Depth (ft)	GRAPHIC LOG	Soil Description	Sample Type	Sample #	Moisture (%)	Dry Density(pcf)	Gradation			Atterberg		
							Gravel %	Sand %	Fines %	LL	PL	PI
0	▨	Topsoil: Dark brown silty clay with roots and some gravel										
	▥	Brown SILT (ML) with sand and gravel, some roots, slightly moist medium stiff (estimated)										
1			◢	1								
			◢	2			8	15	77	34	24	10
2												
3												
4												
5												
6												
7												
8		moist to very moist	▮	3	26				89			
9		END AT 9'										
10												
11												
12												
13												
14												

Remarks: Groundwater not encountered during excavation.

Coordinates: 41.2697176°, -111.9539193°
Surface Elev. (approx): Not Given

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

Figure:
2

605 Jackson Development

About 605 North Jackson Avenue, Ogden, Utah

Test Pit Log

TP-2

Total Depth: 10.5'
Water Depth: (see Remarks)

Date: 10/26/23
Job #: 21200

Depth (ft)	GRAPHIC LOG	Soil Description	Sample Type	Sample #	Moisture (%)	Dry Density(pcf)	Gradation			Atterberg		
							Gravel %	Sand %	Fines %	LL	PL	PI
0		Topsoil: Dark brown silty clay, roots, and organics										
1		Light brown Lean CLAY (CL), trace gravel, slightly moist medium stiff (estimated)	◣	4	7		11	14	75			
2		grades brown, sandy, slight bedding, moist										
3												
4												
5		bedding becomes more defined with depth	◣	5								
6												
7												
8												
9												
10		very moist	◣	6	23				99	33	18	15
		END AT 10.5'										
11												
12												
13												
14												

Remarks: Groundwater not encountered during excavation.

Coordinates: 41.2700306°, -111.9532528°
Surface Elev. (approx): Not Given

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

CMT TECHNICAL SERVICES

Figure:
3

605 Jackson Development

About 605 North Jackson Avenue, Ogden, Utah

Test Pit Log

TP-3

Total Depth: 8'
Water Depth: (see Remarks)

Date: 10/26/23
Job #: 21200

Depth (ft)	GRAPHIC LOG	Soil Description	Sample Type	Sample #	Moisture (%)	Dry Density(pcf)	Gradation			Atterberg		
							Gravel %	Sand %	Fines %	LL	PL	PI
0	▨	Brown Lean CLAY (CL) with sand, some gravel, roots/rootholes, slightly moist medium stiff (estimated)										
1	▨		◢	7	11	88	8	18	74			
2	▨											
3	▨											
4	▨	grades trace gravel	▮	8	12	80	4	20	76	32	22	10
5	▨											
6	▨											
7	▨		◢	9								
8		END AT 8'										
9												
10												
11												
12												
13												
14												

Remarks: Groundwater not encountered during excavation.

Coordinates: 41.269013°, -111.9538556°
Surface Elev. (approx): Not Given

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

Figure: 4

605 Jackson Development

About 605 North Jackson Avenue, Ogden, Utah

Test Pit Log TP-4

Total Depth: 8'
Water Depth: (see Remarks)

Date: 10/26/23
Job #: 21200

Depth (ft)	GRAPHIC LOG	Soil Description	Sample Type	Sample #	Moisture (%)	Dry Density(pcf)	Gradation			Atterberg		
							Gravel %	Sand %	Fines %	LL	PL	PI
0		Topsoil: Dark brown silty clay, roots, and organics										
1		Light brown Silty SAND (SM) with roots, some gravel, some rootholes, slightly moist medium dense (estimated)	◢	10								
2												
3												
4		Light brown Silty-Clayey SAND (SC-SM) with gravel, some rootholes, slightly moist medium stiff (estimated)	▮	11	4	95	29	37	34			
5												
6												
7		grades brown	▮	12	4	92	25	41	34	23	19	4
8		END AT 8'										
9												
10												
11												
12												
13												
14												

Remarks: Groundwater not encountered during excavation.

Coordinates: 41.2687703°, -111.9532987°
Surface Elev. (approx): Not Given

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

CMT TECHNICAL SERVICES

Figure: 5

605 Jackson Development

About 605 North Jackson Avenue, Ogden, Utah

Test Pit Log

TP-5

Total Depth: 8'
Water Depth: (see Remarks)

Date: 10/26/23
Job #: 21200

Depth (ft)	GRAPHIC LOG	Soil Description	Sample Type	Sample #	Moisture (%)	Dry Density(pcf)	Gradation			Atterberg		
							Gravel %	Sand %	Fines %	LL	PL	PI
0	▨	Brown Clayey SAND (SC) with gravel, slightly moist medium dense (estimated)										
1	▨		◣	13								
2	▨											
3	▨	Brown Sandy CLAY (CL) with gravel, slightly moist medium stiff (estimated)	▮	14	7	82	14	26	60			
4	▨											
5	▨											
6	▨											
	▨	Brown Clayey SAND (SC), slightly moist medium dense (estimated)										
7	▨		◣	15								
8		END AT 8'										
9												
10												
11												
12												
13												
14												

Remarks: Groundwater not encountered during excavation.

Coordinates: 41.2693318°, -111.9530446°
Surface Elev. (approx): Not Given

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

CMT TECHNICAL SERVICES

Page: 1 of 1

Figure:
6

605 Jackson Development

Key to Symbols

About 605 North Jackson Avenue, Ogden, Utah

Date: 10/26/23
Job #: 21200

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

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	
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.
Wet: Visible water, usually soil below groundwater.

UNIFIED SOIL CLASSIFICATION SYSTEM (USCS)

MAJOR DIVISIONS			USCS SYMBOLS	②	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 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
			OL	▨	Organic Silts and Organic Silty Clays of Low Plasticity
	SILTS AND CLAYS Liquid Limit greater than 50%		MH	▨	Inorganic Silts, Micacious or Diatomacious Fine Sand or Silty Soils
			CH	▨	Inorganic Clays of High Plasticity, Fat Clays
			OH	▨	Organic Silts and Organic Clays of Medium to High Plasticity
HIGHLY ORGANIC SOILS			PT	▨	Peat, 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.

CMT TECHNICAL SERVICES

Figure:
7