
© 2023 Google
Google Earth

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

# GEOTECHNICAL ENGINEERING STUDY

# East Estates Subdivision

About 1800 South and 3600 West
Ogden, Utah
**CMT PROJECT NO. 21428**

FOR:
**East Estates**
1058 South 3500 West
Ogden, Utah 84404

December 20, 2023

CMT TECHNICAL SERVICES

December 20, 2023

Mr. Tyler East
East Estates
1058 South 3500 West
Ogden, Utah 84404

Subject: Geotechnical Engineering Study
East Estates Subdivision
About 1800 South and 3600 West
Ogden, Utah
CMT Project No. 21428

Mr. East:

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 December 6, 2023, a CMT Technical Services (CMT) staff professional was on-site and supervised the excavation of 4 test pits extending to depths of about 8.5 to 9 feet below the existing ground surface. We obtained soil samples during the field operations that were subsequently transported to our laboratory for further testing and observation.

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

We appreciate the opportunity to work with you at this stage of the project. CMT offers a full range of Geotechnical Engineering, Geological, Material Testing, Special Inspection services, and Phase I and II Environmental Site Assessments. With offices throughout Utah, Idaho, Arizona, Colorado and Texas, our staff is capable of efficiently serving your project needs. If we can be of further assistance or if you have any questions regarding this project, please do not hesitate to contact us at 801-590-0394.

Sincerely,
**CMT Technical Services**

Megan Bolton, E.I.T.
Geotechnical Engineer

**Reviewed by:**

Bryan N Rob

# 276476
BRYAN N. ROBERTS

Bryan N. Roberts P.E.
Senior Geotechnical Engineer

12/20/23

# TABLE OF CONTENTS

# 1.0 INTRODUCTION

## 1.1 General

CMT Technical Services (CMT) was retained to conduct a geotechnical subsurface study for the proposed two-lot, single-family residential development. The parcel is situated on the north side of 1800 South Street at about 3600 West 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. Tyler East of East Estates, and Mr. Bryan Roberts 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, conducting a field infiltration test, 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 and executed on November 27, 2023.

## 1.3 Description of Proposed Construction

We understand a two lot, single-family residential development is planned for the two-acre site. Structures are anticipated to consist of 1 to 3 levels above grade with possible partial depth sublevel if conditions permit. The structures are anticipated to be constructed of light wood framing over concrete spread foundation. We anticipate maximum column loads on the order of 40,000 pounds, with maximum anticipated wall loads on the order of 3,000 pounds per lineal foot, and maximum floor loads of 100 psf. 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.

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 may be supported upon conventional spread and continuous wall foundations established on suitable, undisturbed natural soils or structural fill extending to suitable natural soil. The most significant geotechnical aspects regarding site development include the following:

1. We estimate that topsoil stripping beneath structures will need to include at least the upper about 8 to 10 inches.
2. Static groundwater was measured on December 12, at depths of about 5.1 feet and 7.7 feet below the ground surface within test holes TP-1 and TP-4. we recommend that the top of habitable floor slabs be established at about 3 feet above measured, static groundwater unless the groundwater below the structure can be controlled with subdrains connected to a land drain or other downgradient deposition location. With shallow groundwater, clay subgrade stabilization may be required below footings if placed within 2 feet of local groundwater due to near saturated or saturated soil conditions.
3. Subsurface soils encountered below the topsoil consisted of a relatively thin layer of SILTY SAND (SM) to about 2.5 feet below the ground surface underlain by CLAY/fine sandy CLAY (CL) extending to the full depth penetrated, about 9.0 feet.
4. Foundations and floor slabs may be placed on suitable, stable, undisturbed natural soils or on properly placed and compacted structural fill extending to suitable, undisturbed natural soils.

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

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

# 2.0 FIELD EXPLORATION

## 2.1 General

In order 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 8.5 to 9 feet below the existing ground surface. Locations of the test pits are shown on ***Figure 1, Site Plan***, included in the Appendix. The field exploration was performed under the supervision of an experienced member of our geotechnical staff.

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

The subsurface soils encountered in the test pits were classified in the field based upon visual and textural examination, logged and described in general accordance with ASTM[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/non-engineered fill and settlement of the backfill in the test pits over time should be anticipated.

In addition, an infiltration test was completed at a depth of about 3 feet below the ground surface within natural, unsaturated clay soil.

## 2.2 Infiltration Testing

We also performed infiltration testing as part of our field exploration I-1 in the southwest corner of the site (***Figure 1***) at a depth of about 3 feet below the existing ground surface. The testing consisted of creating and filling a small hole at that depth with water and measuring the rate of water drop within the small hole over a certain time period (i.e. 10 minutes). We repeated this process multiple times until subsequent readings were the same. The results of this test indicate that the silty clay soils at this site have an infiltration rate of approximately 45 minutes per inch. A sample of the encountered soils was collected just below the depth of the infiltration test and returned to the laboratory for index testing to determine the hydrologic soil group

---

[1] American Society for Testing and Materials

(HSG) for the soils. The City of Ogden requires that the tested soil be classified into a Hydrologic Soil Group per the Ogden City Stormwater Design Manual. From laboratory testing and observation, the soil tested would best correlate with the USDA classification of SILTY CLAY LOAM which in turn correlates to the Ogden City Stormwater Design Manual Table "NRCS Hydrologic Soil Group D".

# 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. Hydrometer Analysis, ASTM D-422, Fine Grain Size Analysis

## 3.2 Lab Summary

Laboratory test results are presented on the test pit logs (***Figures 2 through 6***) and in the following **Lab Summary Table**:

**LAB SUMMARY TABLE**

| TEST PIT | DEPTH (feet) | SOIL CLASS | SAMPLE TYPE | MOISTURE CONTENT(%) | DRY DENSITY (pcf) | GRADATION | | | ATTERBERG LIMITS | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | GRAV. | SAND | FINES | LL | PL | PI |
| TP-1 | 2 | CL | Block | 24 | 95 | 0 | 33 | 67 | | | |
| TP-2 | 4.5 | CL | Block | 23 | 100 | 0 | 0 | 100 | 37 | 19 | 18 |
| TP-3 | 8 | CL | Thin Wall | 30 | 92 | 0 | 1 | 99 | 30 | 21 | 9 |
| TP-4 | 5 | CL | Block | 23 | | 0 | 2 | 98 | 39 | 18 | 21 |
| I-1 | 1.5 | SM | Bag | 9 | | 0 | 64 | 36 | | | |
| | 4.5 | CL | Block | 23 | | 0 | 3 | 97 | | | |

## 3.3 One-Dimensional Consolidation Tests

To provide data for an analysis of potential settlement from structural loading, a one-dimensional consolidation test was performed on each of 2 samples of the subsurface soils collected in the test pits. Based upon data obtained from the consolidation testing, the silt/clay soils tested at this site are moderately over-consolidated, exhibiting moderate strength and moderate compressibility characteristic Detailed results of the test are maintained within our files and can be transmitted to you, if so desired.

## 3.4 Hydrometer Test

| Hydrometer | | | |
|---|---|---|---|
| Test No. | Depth (feet) | Millimeter | Percent Passing |
| I-1 | 4.5 | .075 | 96.9 |
| | | 0.0392 | 83.3 |
| | | .0205 | 73.8 |
| | | 0.0059 | 49.1 |
| | | 0.0042 | 43.5 |
| | | 0.0022 | 34.3 |

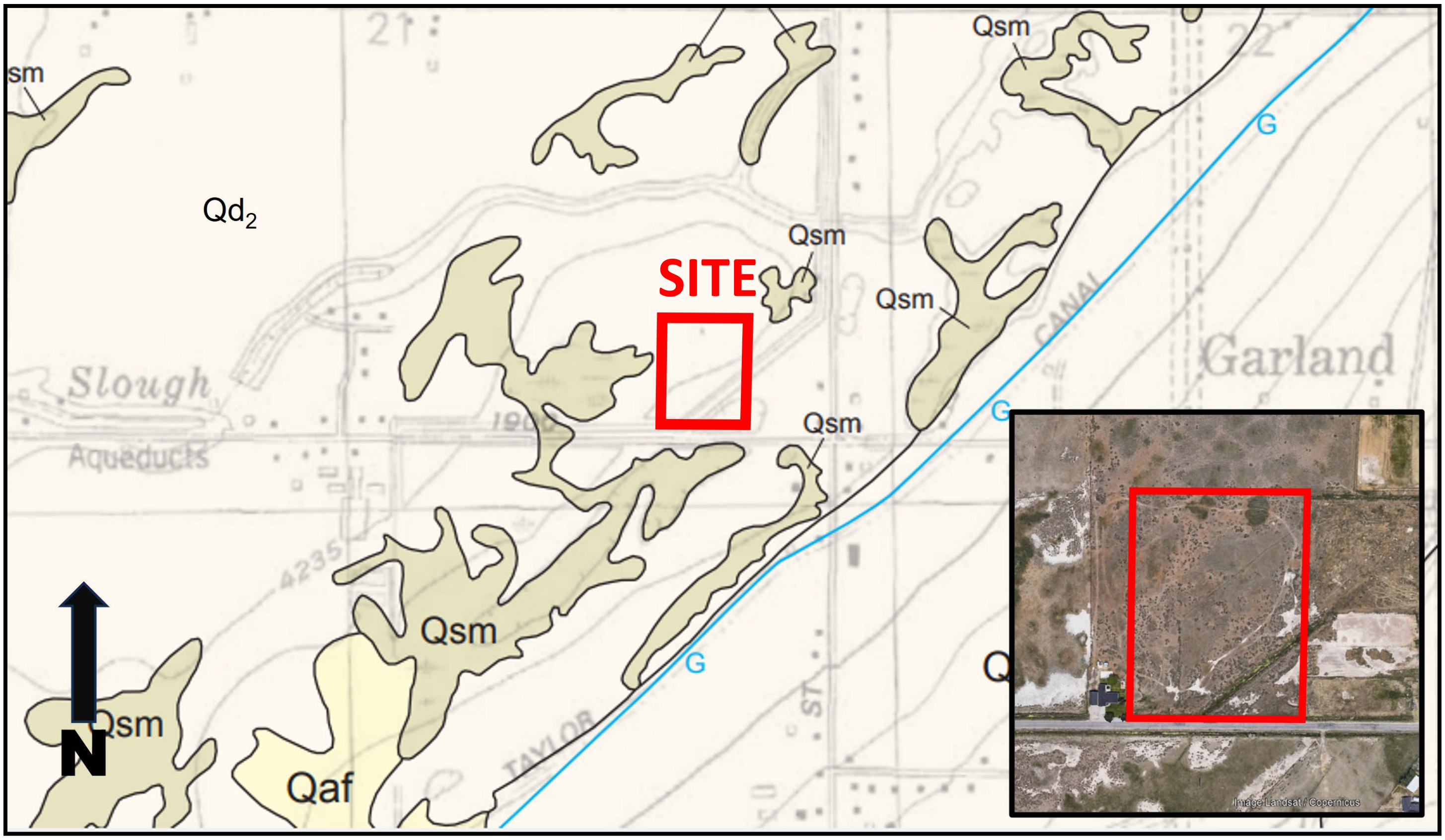
# 4.0 GEOLOGIC & SEISMIC CONDITIONS

## 4.1 Geologic Setting

The subject site is located to the west of the central portion of Weber County in north Utah. The site sits at an elevation of approximately 4,235 feet above sea level. The site is located in a valley bound by the Wasatch Mountains to the east and the 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 freshwater 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 Roy, Utah, 7.5-minute Quadrangle, which includes the location of the subject site, has been mapped by Dorothy Sack[2]. The surficial geology at the subject site and adjacent properties is mapped as "Early Holocene fine-grained deltaic deposits" (Map Unit Qd2) dated to be Holocene in age. Unit Qd2 is described as "Muddy to sandy fines deposited between about 9.7 and 9.4 ka. Estimated thickness 10 to 20 feet (3-6 m)." No fill has been mapped at the site. Refer to the **Geologic Map**, shown below.



GEOLOGIC MAP

## 4.2 Faulting

No active surface fault rupture traces are mapped crossing, adjacent to, or projecting toward the site on the referenced geologic map. The nearest mapped active Holocene fault is the Weber section of the Wasatch Fault Zone approximately 6.77 miles east of the site. Seismic design issues are addressed in **Section 4.3** below.

## 4.3 Seismicity

### 4.3.1 Site Class

Utah has adopted the International Building Code (IBC) 2021, which determines the seismic hazard for a site based upon 2014 mapping of bedrock accelerations prepared by the United States Geologic Survey (USGS) and the soil site class. The USGS values are presented on maps incorporated into the IBC code and are also

---

[2] Sack, D., 2005, Geologic Map of the Roy 7.5' Quadrangle, Weber and Davis Counties, Utah; Utah Geological Survey Miscellaneous Publication, Map MP-05-03, Scale 1:24,000. https://ugspub.nr.utah.gov/publications/misc_pubs/MP-05-3.pdf

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[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. 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 Q01WDe, which has a log-mean $V_{S,30}$ of 166 meters per second (545 feet per second). Thus, it is our opinion the site best fits Site Class E – Soft Clay Soil Profile (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 41.2355 degrees north latitude and -112.0674 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 E soil profile:

---

[3] American Society of Civil Engineers

[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 E [adjusted for site class effects] (g) | MULTI-PLIER | DESIGN VALUES (g) |
|---|---|---|---|---|---|
| Peak Ground Acceleration | PGA = **0.529** | $F_{pga}$ = 1.171 | $PGA_M$ = 0.619 | 1.000 | $PGA_M$ = 0.619 |
| 0.2 Seconds (Long Period Acceleration) | $S_S$ = **1.197** | $F_a$ = N/A | $S_{MS}$ = N/A | 0.667 | $S_{DS}$ = N/A |
|  | (Exception 1:) | $F_a$ = (1.200) | $S_{MS}$ = (1.436) | 0.667 | $S_{DS}$ = (0.958) |
| 1.0 Second (Long Period Acceleration) | $S_1$ = **0.426** | $F_v$ = N/A | $S_{M1}$ = N/A | 0.667 | $S_{D1}$ = N/A |
|  | (Exception 3:) | $F_v$ = (2.348) | $S_{M1}$ = (1.000) | 0.667 | $S_{D1}$ = (0.667) |

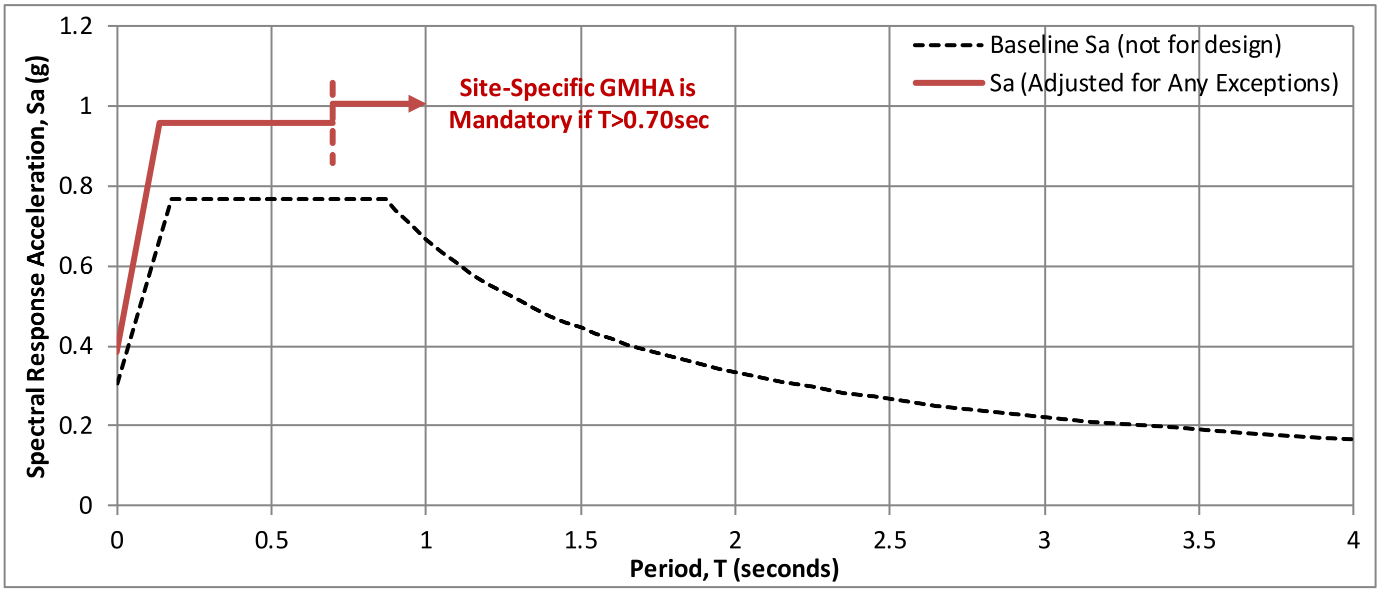
NOTES: 1. TL (seconds): **8**

2. Site Class: **E**

3. Have data to verify?

*** Site Class E**

**4. ASCE 7-16 Requires Site-Specific Ground Motion Hazard Analysis (Since Ss≥1.0 & S1 ≥ 0.2 sec) - OR Can Use Exceptions 1 & 3 up to T=0.70sec (per §11.4.8)**



As shown in the response spectrum above, if the period of the proposed building is greater than 0.7 seconds, a site-specific ground motion hazard analysis (GMHA) is required. If this situation applies, please contact CMT for a proposal to perform the GMHA. Otherwise, the higher exception values may be used for design.

### 4.3.3 Liquefaction

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

A site specific liquefaction study was not performed for this site. However, below about 2.5 feet from the surface we encountered clay soils, typically not liquefiable, extending to the full depth penetrated, about 8.5 to 9 feet. These conditions indicate that liquefaction of the soils encountered is not likely to occur.

---

[5] 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

## 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. The site is not located within a known or mapped stream flooding zone.

# 5.0 SITE CONDITIONS

## 5.1 Surface Conditions

At the time the test pits were excavated the site consisted of an undeveloped vacant lot vegetated with native grasses and weeds. An irrigation canal is present on the southeast portion of the property. A few riding trails also presently cross the lot. Based upon aerial photos dating back to 1997 that are readily available on the internet, the site has remained relatively unchanged. Overall, the site is relatively flat, with a very slight slope downward to the northwest. The site is bordered on the north by an undeveloped vacant lot, on the east by livestock corals and an undeveloped lot, on the south by 1800 South Street, and on the west by a single-family residence and undeveloped land (see **Vicinity Map** in **Section 1.1** above).

## 5.2 Subsurface Soils

At the locations of the test pits we encountered approximately 1 to 1.5 feet of topsoil at the surface. Within test pits TP-1 and TP-2 we observed natural soils beneath the topsoil, consisting of Silty CLAY with varying sand content (CL) extending to the maximum depth penetrated of approximately 9 feet. Within test pits TP-3 TP-4, and I-1 we observed natural soils beneath the topsoil, consisting of Silty SAND (SM) extending to a depth of about 2.5 below the surface underlain by natural Silty CLAY with varying sand content (CL) extending to the maximum depth penetrated of approximately 8.5 feet.

The clay soils were slightly moist to wet, brown to gray in color, and estimated to be medium dense above the groundwater grading to soft below the groundwater in consistency. They also exhibited moderate over consolidation and strength characteristics with moderate compressibility characteristics within the upper about 8 feet tested.

The natural sand soils were moist, brown in color, and estimated to be loose to medium dense. They will also exhibit moderately high strength and low compressibility characteristics.

For a more descriptive interpretation of subsurface conditions, please refer to the test pit logs, ***Figures 2 through 6***, which graphically represent the subsurface conditions encountered. The lines designating the interface between soil types on the logs generally represent approximate boundaries - in situ, the transition between soil types may be gradual.

## 5.3 Groundwater

We encountered groundwater in the test pits and infiltration test pit at depths of about 6.5 to 7.5 feet below existing grade at the time of our field exploration. On December 12, 2023, CMT personnel returned to the site to measure groundwater levels at depths of 5.1 to 7.7 feet, respectively, within slotted PVC pipes installed in test pits TP-1 and TP-4. These depths to groundwater would affect sublevel construction and 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 and magnitudes, is beyond the scope of this study.

## 5.4 Site Subsurface Variations

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

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

# 6.0 SITE PREPARATION AND GRADING

## 6.1 General

Site preparation shall include the removal of surface vegetation, topsoil, any other deleterious materials, loose/disturbed soils and any non-engineered fills, if encountered, from beneath an area extending out at least 4 feet beyond new structures and 2 feet below pavements.
Based upon the conditions observed in the test pits there is topsoil on the surface of the site which we estimated to be about 1 to 1.5 feet in thickness. When stripping and grubbing, topsoil should be distinguished by the apparent organic content and not solely by color; thus we estimate that topsoil stripping will need to include the upper 8 to 10 inches.

Groundwater was measured as shallow as 5.1 feet below the ground surface. Footings installed within about 2 feet or less of groundwater may require some subgrade stabilization prior to pouring concrete.

It is recommended that the top of the lowest habitable slab be kept a minimum of 3.0 feet above the measured groundwater level, or 18 inches above groundwater levels controlled with individual foundations drains tied to a down gradient land drain/storm drain or another acceptable outfall.

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

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

Groundwater was measured on December 12, 2023 within test pits TP-1 and TP-4 at depths of about 5.1 to 7.7 feet below the ground surface. We anticipate that excavations extending below a depth of about 5 feet will likely encounter groundwater, and dewatering of such excavations may be required.

The natural soils encountered at this site predominantly consisted of clay. 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 (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

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

On-site sand soils do not appear suitable for use as select structural fill but may be used as site grading fill and non-structural fill.

On-site clay soils are not suitable for use as select structural fill or site grading fill but may be used as non-structural fill. Note that these clay soils are moisture-sensitive, which means they are inherently more difficult to work with in proper moisture conditioning (they are very sensitive to changes in moisture content), requiring very close moisture control during placement and compaction. This will be very difficult, if not impossible, during wet and cold periods of the year. We also recommend the site grading fill thickness using on-site silt/clay soils be 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[6] T-180) in accordance with the following recommendations:

---

[6] American Association of State Highway and Transportation Officials

| LOCATION | TOTAL FILL THICKNESS (FEET) | MINIMUM PERCENTAGE OF MAXIMUM DRY DENSITY |
|---|---|---|
| Beneath an area extending at least 4 feet beyond the perimeter of structures, and 2 feet beyond flatwork and pavement (applies to structural fill and site grading fill) | 0 to 5<br>5 to 8 | 95<br>98 |
| Site grading fill outside area defined above | 0 to 5<br>5 to 8 | 92<br>95 |
| Utility trenches within structural areas | -- | 96 |
| Roadbase and subbase | - | 96 |
| Non-structural fill | 0 to 5<br>5 to 8 | 90<br>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[7] requirements. All utility trench backfill material below structurally loaded facilities (foundations, floor slabs, flatwork, parking lots/drive areas, etc.) should be placed at the same density requirements established for structural fill in the previous section.

Most utility companies and local governments are requiring Type A-1a or A-1b (AASHTO Designation) soils (sand/gravel soils with limited fines) be used as backfill over utilities within public rights of way, and the backfill be compacted over the full depth above the bedding zone to at least 96% of the maximum dry density as determined by AASHTO T-180 (ASTM D-1557). The natural sand soils at this site will not likely meet these specifications.

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

## 6.6 Stabilization

The natural clay soils at this site will likely be susceptible to rutting and pumping. The likelihood of disturbance or rutting and/or pumping of the existing natural soils is a function of the 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

---

[7] American Public Works Association

equipment. Rubber-tired equipment particularly, because of high pressures, promotes instability in moist/wet, soft soils.

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

To stabilize soft subgrade conditions (if encountered), a mixture of coarse, clean, angular gravels and cobbles and/or 1.5- to 2.0-inch clean gravel should be utilized, as indicated above in **Section 6.3**. 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, including the maximum loads discussed in **Section 1.3**, the subsurface conditions observed in the field and the laboratory test data, and standard geotechnical engineering practice.

## 7.1 Foundation Recommendations

Based on our geotechnical engineering analyses, the proposed residences may be supported upon conventional spread and/or continuous wall foundations placed on suitable, stable, undisturbed natural soils and/or on structural fill extending to suitable natural soils. Footings may be designed using a net bearing pressure of 1,500 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 1/2 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.

## 7.2 Installation

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

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

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

The minimum thickness of structural fill below footings should be equivalent to one-third the thickness of structural fill below any other portion of the foundations for fill placements of 3 feet or more thick. For example, if the maximum depth of structural fill is 6 feet, all footings for the new structure should be underlain by a minimum 2 feet of structural fill.

## 7.3 Estimated Settlement

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

## 7.4 Lateral Resistance

Lateral loads imposed upon foundations due to wind or seismic forces may be resisted by the development of passive earth pressures and friction between the base of the footings and the supporting soils. In determining frictional resistance, a coefficient of 0.30 for natural clay soils or 0.40 for select 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 325 pcf. A combination of passive earth resistance and friction may be utilized if the passive component of the total is divided by 1.5.

# 8.0 LATERAL EARTH PRESSURES

The lateral earth pressure values given below anticipate that existing clay 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.

| 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) | 43 | 35 |
| **At-Rest Pressure** (wall is not allowed to yield) | 64 | N/A |
| **Passive Pressure** (wall moves into the soil) | 325 | 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, 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 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.

It is recommended that the top of the lowest habitable slab be kept a minimum of 3.0 feet above the measured groundwater level, or 18 inches above water level controlled by foundation drains.

## 10.0 DRAINAGE RECOMMENDATIONS

### 10.1 Surface Drainage

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

1. All areas around each residence should be sloped to provide drainage away from the foundations. We recommend a minimum slope of 4 inches in the first 10 feet away from the structure. This slope should be maintained throughout the lifetime of the structure.

2. All roof drainage should be collected in rain gutters with downspouts designed to discharge at least 10 feet from the foundation walls or well beyond the backfill limits, whichever is greater.

3. Adequate compaction of the foundation backfill should be provided. We suggest a minimum of 90% of the maximum laboratory density as determined by ASTM D-1557. Water consolidation methods should not be used under any circumstances.

4. Landscape sprinklers should be aimed away 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

### 10.2.1 General

Groundwater at this site is moderately shallow and variable across the site. If habitable floor slabs are to be placed less than 3.0 feet above measured groundwater, then a foundation drain tied to a suitable down gradient land drain/storm drain or another acceptable outfall.

### 12.2.2 10.3.1 Foundation Subdrains

Foundation subdrains shall at a minimum consist of a 4-inch diameter perforated or slotted plastic or PVC pipe enclosed in clean gravel surrounding the home foundation. The invert of the subdrain should be at least 18 inches below the top of the lowest adjacent habitable floor slab. The gravel portion of the drain should extend 2 inches laterally and below the perforated pipe and at least 1 foot above the top of the lowest adjacent floor slab. The gravel zone must be installed immediately adjacent to the perimeter footings and the foundation walls. To reduce the possibility of plugging, the gravel with drainpipe must be wrapped with a geotextile, such as Mirafi 140N or equivalent.

Above the subdrain, a minimum 12-inch-wide zone of “free-draining” gravel should be placed adjacent to the foundation walls and extend to within 2 feet of final grade and similarly separated from adjacent soils with a geotextile such as Mirafi 140N or equivalent. The upper 2 foot of soils should consist of a compacted low permeable soil where possible to reduce surface water infiltration into the drain. As an alternative to the zone of permeable gravel, a prefabricated “drainage board,” such as Miradrain or equivalent, may be placed adjacent to the exterior below-grade walls. Prior to the installation of the footing subdrain, the below-grade walls should be heavily dampproofed/waterproofed. The slope of the subdrain should be at least 0.3 percent. The gravel placed around the drainpipe should be clean 0.75-inch to 1.0-inch minus gap-graded gravel and/or “pea” gravel. The foundation subdrains can be discharged into the area subdrains, storm drains, or other suitable gravity fed, down-gradient location. Further it is recommended that a minimum 8 inches of gravel be placed below the floor slab which is hydraulically tied to the perimeter foundation drain through either drainpipes or a minimum 6-inch gravel layer extending out and below the foundation and connecting to the perimeter drain.

Proper grading shall be completed around the home as discussed above.

### 10.2 Foundation Subdrains

Groundwater at this site is relatively shallow. If floor slabs will be placed deeper than approximately 4 feet below the existing ground surface, we recommend that perimeter foundation subdrains be installed.

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

## 11.0 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:

### 11.1 Field Observations

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

### 11.2 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.

## 11.3 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.

# 12.0 LIMITATIONS

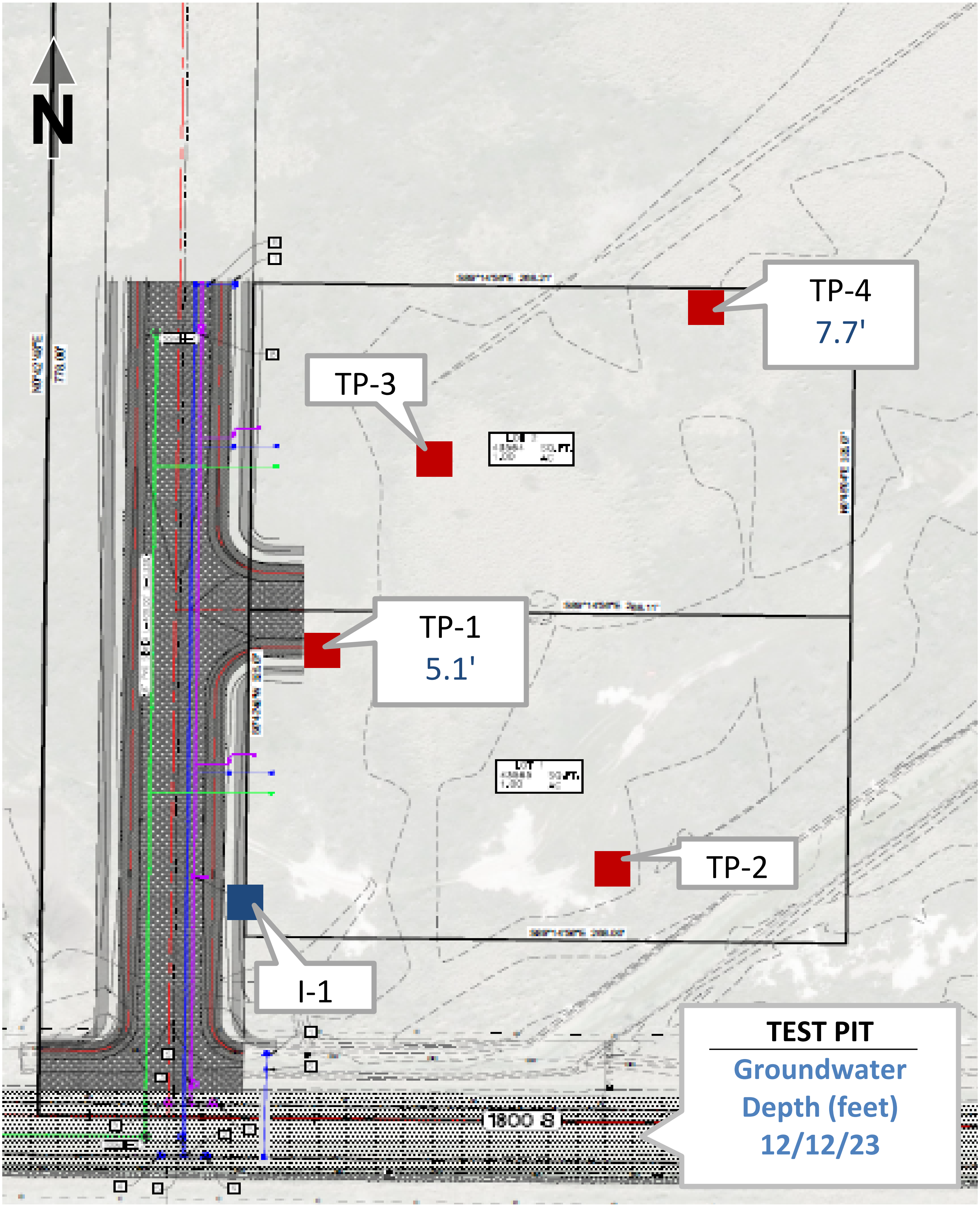
The recommendations provided herein were developed by evaluating the information obtained from the subsurface explorations and soils encountered therein. The exploration logs reflect the subsurface conditions only at the specific location at the particular time designated on the logs. Soil and ground 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



**East Estates Subdivision**

About 1800 South and 3600 West, Ogden, Utah

CMT TECHNICAL SERVICES

**Site Plan**

| | |
|---|---|
| Date: | 6-Dec-23 |
| Job # | 21428 |

Figure:
1

# East Estates Subdivision

About 1800 South and 3600 West, Ogden, Utah

## Test Pit Log TP-1

Total Depth: 9'
Water Depth: 7.5', 5.1'

Date: 12/6/23
Job #: 21428

| Depth (ft) | GRAPHIC LOG | Soil Description | Sample Type | Sample # | Moisture (%) | Dry Density(pcf) | Gradation | | | Atterberg | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Gravel % | Sand % | Fines % | LL | PL | PI |
| 0 | ⁘ | Topsoil; lean clay with silt and sand, dark brown, roots to 8" | | | | | | | | | | |
| 1 | ⁘ | | ▮ | 1 | | | | | | | | |
| | ▨ | Sandy CLAY (CL), gray to brown, bedded/laminated, silt and sand layers/lenses moist, soft to medium stiff (estimated) | | | | | | | | | | |
| 2 | ▨ | | ▮ | 2 | 24 | 95 | 0 | 33 | 67 | | | |
| 3 | ▨ | | | | | | | | | | | |
| 4 | ▨ | | | | | | | | | | | |
| ▼ 5 | ▨ | | ▮ | 3 | | | | | | | | |
| 6 | ▨ | | | | | | | | | | | |
| 7 | ▨ | | | | | | | | | | | |
| ▽ | ▨ | wet | | | | | | | | | | |
| 8 | ▨ | | | | | | | | | | | |
| | ▨ | | ◣ | 4 | | | | | | | | |
| 9 | | END AT 9' | | | | | | | | | | |
| 10 | | | | | | | | | | | | |
| 11 | | | | | | | | | | | | |
| 12 | | | | | | | | | | | | |
| 13 | | | | | | | | | | | | |
| 14 | | | | | | | | | | | | |

Remarks: Groundwater encountered during excavation at depth of 7.5 feet and measured on 12/12/23 at depth of 5.1 feet.
Slotted PVC pipe installed to depth of 9 feet to facilitate water level measurements.

Coordinates: 41.235157°, -112.0677992°
Surface Elev. (approx): Not Given

Equipment: Mini Excavator
Excavated By: CMT Technical Services
Logged By: Sterling Howell

CMT TECHNICAL SERVICES

# East Estates Subdivision

About 1800 South and 3600 West, Ogden, Utah

# Test Pit Log

# TP-2

Total Depth: 9'
Water Depth: 6.5'

Date: 12/6/23
Job #: 21428

| Depth (ft) | GRAPHIC LOG | Soil Description | Sample Type | Sample # | Moisture (%) | Dry Density(pcf) | Gradation | | | Atterberg | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Gravel % | Sand % | Fines % | LL | PL | PI |
| 0 | ▒ | Topsoil | | | | | | | | | | |
| 1 | ▨ | Lean CLAY (CL), brown, laminated<br>moist, soft to medium stiff (estimated) | | | | | | | | | | |
| | ▨ | | ▮ | 5 | | | | | | | | |
| 2 | ▨ | | | | | | | | | | | |
| 3 | ▨ | | | | | | | | | | | |
| 4 | ▨ | | | | | | | | | | | |
| | ▨ | | ▮ | 6 | 23 | 100 | 0 | 0 | 100 | 37 | 19 | 18 |
| 5 | ▨ | | | | | | | | | | | |
| 6 | ▨ | | | | | | | | | | | |
| ▽ | ▨ | wet<br>soft (estimated) | | | | | | | | | | |
| 7 | ▨ | | | | | | | | | | | |
| | ▨ | | ◢ | 7 | | | | | | | | |
| 8 | ▨ | | | | | | | | | | | |
| 9 | | END AT 9' | | | | | | | | | | |
| 10 | | | | | | | | | | | | |
| 11 | | | | | | | | | | | | |
| 12 | | | | | | | | | | | | |
| 13 | | | | | | | | | | | | |
| 14 | | | | | | | | | | | | |

Remarks: Groundwater encountered during excavation at depth of 6.5 feet.

Coordinates: 41.2348078°, -112.067348°
Surface Elev. (approx): Not Given

Equipment: Mini Excavator
Excavated By: CMT Technical Services
Logged By: Sterling Howell

CMT TECHNICAL SERVICES

Figure:
3

# East Estates Subdivision

About 1800 South and 3600 West, Ogden, Utah

# Test Pit Log

# TP-3

Total Depth: 8.5'
Water Depth: 6.5'

Date: 12/6/23
Job #: 21428

| Depth (ft) | GRAPHIC LOG | Soil Description | | Sample Type | Sample # | Moisture (%) | Dry Density(pcf) | Gradation | | | Atterberg | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Gravel % | Sand % | Fines % | LL | PL | PI |
| 0 | ⁙ | Topsoil | | | | | | | | | | | |
| 1 | ● | Silty SAND (SM) | moist, loose to medium dense (estimated) | | | | | | | | | | |
| 1.5–2 | ● | | | ◣ | 8 | | | | | | | | |
| 2.5 | ▨ | Lean CLAY (CL), light brown to brown | soft to medium stiff (estimated) | | | | | | | | | | |
| 5 | ▨ | | | ▮ | 9 | | | | | | | | |
| ▽ 6.5 | ▨ | | wet<br>very soft (estimated) | | | | | | | | | | |
| 8 | ▨ | | | ‖ | 10 | 30 | 92 | 0 | 1 | 99 | 30 | 21 | 9 |
| 8.5 | | END AT 8.5' | | | | | | | | | | | |
| 14 | | | | | | | | | | | | | |

Remarks: Groundwater encountered during excavation at depth of 6.5 feet.

Coordinates: 41.2353151°, -112.0675991°
Surface Elev. (approx): Not Given

Equipment: Mini Excavator
Excavated By: CMT Technical Services
Logged By: Sterling Howell

Figure:
4

# East Estates Subdivision

About 1800 South and 3600 West, Ogden, Utah

## Test Pit Log

## TP-4

Total Depth: 8.5'
Water Depth: 7', 7.7'

Date: 12/6/23
Job #: 21428

| Depth (ft) | GRAPHIC LOG | Soil Description | Sample Type | Sample # | Moisture (%) | Dry Density(pcf) | Gravel % | Sand % | Fines % | LL | PL | PI |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | ⁙ | Topsoil; lean clay with sand | | | | | | | | | | |
| 1 | ⁘ | Silty SAND (SM), brown moist, loose to medium dense (estimated) | ■ | 11 | | | | | | | | |
| 2 | ⁘ | | ◢ | 12 | | | | | | | | |
| 3 | ▨ | Lean CLAY (CL), brown soft to medium stiff (estimated) | | | | | | | | | | |
| 4 | ▨ | | | | | | | | | | | |
| 5 | ▨ | | ■ | 13 | 23 | | 0 | 2 | 98 | 39 | 18 | 21 |
| 6 | ▨ | | | | | | | | | | | |
| ▽ 7 | ▨ | wet | | | | | | | | | | |
| ▼ | ▨ | | | | | | | | | | | |
| 8 | ▨ | | ◢ | 14 | | | | | | | | |
| 9 | | END AT 8.5' | | | | | | | | | | |
| 10 | | | | | | | | | | | | |
| 11 | | | | | | | | | | | | |
| 12 | | | | | | | | | | | | |
| 13 | | | | | | | | | | | | |
| 14 | | | | | | | | | | | | |

Remarks: Groundwater encountered during excavation at depth of 7 feet and measured on 12/12/23 at depth of 7.7 feet.
Slotted PVC pipe installed to depth of 8.5 feet to facilitate water level measurements.

Coordinates: 41.2355463°, -112.0671277°
Surface Elev. (approx): Not Given

Equipment: Mini Excavator
Excavated By: CMT Technical Services
Logged By: Sterling Howell

CMT TECHNICAL SERVICES

Figure:
5

# East Estates Subdivision

About 1800 South and 3600 West, Ogden, Utah

## Test Pit Log

## I-1

Total Depth: 8.5'
Water Depth: 6.5'

Date: 12/6/23
Job #: 21428

| Depth (ft) | GRAPHIC LOG | Soil Description | Sample Type | Sample # | Moisture (%) | Dry Density(pcf) | Gradation<br>Gravel % | Gradation<br>Sand % | Gradation<br>Fines % | Atterberg<br>LL | Atterberg<br>PL | Atterberg<br>PI |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | | Topsoil | | | | | | | | | | |
| 1 | | Silty SAND (SM), light brown moist, loose to medium dense (estimated) | | | | | | | | | | |
| | | | ◢ | 15 | 9 | | 0 | 64 | 36 | | | |
| 2 | | | | | | | | | | | | |
| | | Lean CLAY (CL), light brown to brown, lamintated, silty sand layers soft to medium stiff (estimated)<br>Infiltration = 4.5 min/inch | | | | | | | | | | |
| 3 | | | | | | | | | | | | |
| 4 | | | | | | | | | | | | |
| | | hydrometer results: 63% silt, 34% clay | ▮ | 16 | 23 | | 0 | 3 | 97 | | | |
| 5 | | | | | | | | | | | | |
| 6 | | | | | | | | | | | | |
| ▽ | | wet | | | | | | | | | | |
| 7 | | | | | | | | | | | | |
| 8 | | | ▮ | 17 | | | | | | | | |
| | | END AT 8.5' | | | | | | | | | | |
| 9 | | | | | | | | | | | | |
| 10 | | | | | | | | | | | | |
| 11 | | | | | | | | | | | | |
| 12 | | | | | | | | | | | | |
| 13 | | | | | | | | | | | | |
| 14 | | | | | | | | | | | | |

Remarks: Groundwater encountered during excavation at depth of 6.5 feet.

Coordinates: 41.2347115°, -112.0679417°
Surface Elev. (approx): Not Given

Equipment: Mini Excavator
Excavated By: CMT Technical Services
Logged By: Sterling Howell

CMT TECHNICAL SERVICES

Page: 1 of 1

Figure:
6

# East Estates Subdivision

About 1800 South and 3600 West, Ogden, Utah

# Key to Symbols

Date: 12/6/23
Job #: 21428

| ① | ② | ③ | ④ | ⑤ | ⑥ | ⑦ | ⑧ Gradation | | | Atterberg | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Depth (ft) | GRAPHIC LOG | Soil Description | Sample Type | Sample # | 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.

**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), obtained from lab test results of soil passing the 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. |
| **Wet:** Visible water, usually soil below groundwater. |

## UNIFIED SOIL CLASSIFICATION SYSTEM (USCS)

| MAJOR DIVISIONS | | | USCS SYMBOLS | | TYPICAL DESCRIPTIONS |
|---|---|---|---|---|---|
| **COARSE-GRAINED SOILS**<br>More than 50% of material is larger than No. 200 sieve size. | **GRAVELS**<br>The coarse fraction retained on No. 4 sieve. | **CLEAN GRAVELS**<br>(< 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**<br>( ≥ 12% fines) | GM | ▨ | Silty Gravels, Gravel-Sand-Silt Mixtures |
| | | | GC | ▨ | Clayey Gravels, Gravel-Sand-Clay Mixtures |
| | **SANDS**<br>The coarse fraction passing through No. 4 sieve. | **CLEAN SANDS**<br>(< 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**<br>( ≥ 12% fines) | SM | ▨ | Silty Sands, Sand-Silt Mixtures |
| | | | SC | ▨ | Clayey Sands, Sand-Clay Mixtures |
| **FINE-GRAINED SOILS**<br>More than 50% of material is smaller than No. 200 sieve size. | **SILTS AND CLAYS**<br>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**<br>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<br>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