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

Geological Reconnaissance and Geotechnical Study

Phase #9 Eagle Ridge Subdivision

Eden, Weber County, Utah
CMT PROJECT NO. 18262

FOR:

Mr. Tysen Butters
1255 East 2925 North
North Ogden, Utah 84414

May 23, 2022

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Subject: Geotechnical Engineering and Geological Reconnaissance Study
Phase #9 Eagle Ridge Subdivision
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Mr. Butters:

Submitted herewith is the report of our geotechnical engineering and geological reconnaissance study for the Phase #9 Area. This report contains the results of our findings and an 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.

CMT Technical Services (CMT) personnel supervised the excavation of three test pits extending to depths of approximately 8 to 9 feet below the existing ground surface. Soil samples were obtained during the field operations and subsequently transported to our laboratory for further testing. Based on the findings of the subsurface explorations, conventional spread and continuous footings may be utilized to support the proposed residences, provided the recommendations in this report are followed. A detailed discussion of design and construction criteria is presented in this report. A Professional Geologist also visited the site, and conducted a review of the geological and natural hazard conditions for the site.

We appreciate the opportunity to work with you on this project. CMT offers a full range of Geotechnical Engineering, Geological, Material Testing, Special Inspection services, and Phase I and II Environmental Site Assessments. With four offices throughout Northern Utah, and in Arizona, 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) 870-6730. To schedule materials testing please call (801) 908-5859.

Sincerely,

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APPENDIX

1.0 INTRODUCTION

1.1 General

CMT Technical Services (CMT) was authorized by Mr. Tysen Butters to conduct a design level geotechnical engineering study, and a reconnaissance level geological study for the Phase #9 Area within Eagle Ridge Subdivision, which is located in the Eden area of Weber County, Utah. Previous studies have been conducted by our office for adjacent parts of the subdivision, including Lots 49 to 52, 54, 56, 58 to 62, and Lot 69. The Phase #9 site is located on the northeast side of Ogden Valley as shown on **Figure 1, Vicinity Map**, and more detailed aerial coverage of the subdivision site and Phase #9 Area is shown on **Figure 2, Site Plan**. Geological mapping of the Phase #9 Area is included on **Figure 3, Geological Mapping**, and slope-terrain information for the same area is provided on **Figure 4, LiDAR Analysis**. The locations of the test pits excavated for our subsurface evaluation are shown on **Figure 5, Site Evaluation**.

The Phase #9 Area is an approximately 4.1-acre area that is presently undeveloped, and is part of the Eagle Ridge Subdivision development, which is a phased cluster subdivision type project with planned homesite lots, typically three-quarters acre or more in area, and with open space common areas included within the phases. The subject Phase #9 Area and surrounding properties are zoned by Weber County as AV-3 (Agriculture Valley --3), with cluster subdivisions listed as a permitted use for the zone.

1.2 Objectives and Scope

The objectives and scope of our study were planned in discussions between Mr. Butters and Mr. Andrew Harris of CMT Engineering Laboratories (CMT). In general, the objectives of this study were to:

1. Provide geological reconnaissance studies as specified by Weber County Code, Section 108-22 Natural Hazard Areas guidelines and standards (Weber County, 2022). The reconnaissance level geological study was performed to assess whether all or parts of the site are exposed to the hazards that are included in the Weber County Code, Section 108-22 Natural Hazard Areas. These hazards include, but are not limited to: Surface-Fault Ruptures, Landslide, Tectonic Subsidence, Rock Fall, Debris Flows, Liquefaction Areas, Flood, or other Hazardous Areas.
2. Define and evaluate the subsurface soil and groundwater conditions across the site.
3. Provide appropriate foundation and earthwork recommendations as well as geoseismic information to be utilized in the development of the site and design and construction of the proposed residences.

To achieve these objectives our scope of work included the following tasks:

1. A geologic reconnaissance of the subject site, including review of published geologic information.

2. A field program consisting of the excavating, logging, and sampling of three geotechnical test pits, and a laboratory testing program of samples of the subsurface soils collected in the test pits.

3. An office program consisting of the correlation of available data, engineering and geological analyses, and the preparation of this summary report.

1.3 Authorization

Authorization was provided by Mr. Butters by returning a signed copy of our Proposal dated April 4, 2022.

2.0 EXECUTIVE SUMMARY

The following is a brief summary of our findings and conclusions:

The results of our study indicate that the proposed residences may be supported upon conventional spread and/or continuous wall foundations established upon suitable natural granular soil or granular structural replacement fill extending to suitable natural soils utilizing a design, net bearing pressure of 2,000 pounds per square foot.

The most significant geotechnical/geological aspects of the site are:

1. The site is located upon mapped Pleistocene age deposits, with the oldest geologic unit being the by Pleistocene age delta and lacustrine deposits (**Qdl)**, and alluvial (**Qafd**) deposits. The deposits exposed in the test pits appear to be thin, surficial, deposits of coarse alluvium and colluvium that overlie the volcaniclastic deposits at depth. The volcaniclastic deposits at depth will likely present hard (rock) to stiff (soil) excavation conditions, and the coarse alluvial and colluviual deposits may be difficult to excavate where very coarse materials are found.

2. Subsurface soils consisted of a layer of topsoil overlying a thin layer of clay with sand and gravel to about 3 feet below the ground surface underlain by clayey gravel with cobles and some boulders extending to the full depth penetrated, about 9 feet.

3. The natural soils contain highly plastic clay which may in turn be susceptible to volume change (shrink/swell) with change in moisture content. However, the clayey soils encountered at shallow depth consisted primarily of clayey gravel with sand, cobbles and boulders, basically granular soil which reduces the potential for volume change. Foundations may be directly supported on the clayey gravel soils. <u>If only clay soils are encountered at bearing depth and directly below floor slabs, we recommend replacing a minimum 12 inches directly below footings and slabs with non-plastic structural fill soil (clean gravel excluded).</u>

4. Groundwater was not encountered within the depths penetrated, about 9 feet.

Site-specific slope stability studies were not part of the scope of work for this project, because the site slopes are gently sloping and less than 25 percent. However, unbraced slopes at the site must not be steepened to more than four horizontal to one vertical (4H:1V). All retaining walls at the site must be properly engineered. Rockery walls less than 4 feet in height with adjacent tiers separated by at least 2 times the height of the tallest wall, may be considered as landscaping walls.

A geotechnical engineer from CMT will need to verify that all non-engineered fill material (if encountered) and topsoil/disturbed soils have been completely removed and suitable natural soils encountered prior to the placement of structural fills, floor slabs, and footings.

In the following sections, detailed discussions pertaining to proposed construction, field exploration, the geologic setting and mapped hazards, geoseismic setting of the site, earthwork, foundations, lateral pressure and resistance, floor slabs, and subdrains are provided.

3.0 DESCRIPTION OF PROPOSED CONSTRUCTION

The Phase #9 Area is to be developed for the single-family dwelling construction permitted for the Weber County AV-3 land use zone. The intended/proposed structures for the area are likely to be constructed with concrete basement levels supported on conventional spread and strip footings. Above grade levels will consist of wood framed construction, one to three levels in height. Projected maximum column and wall loads will be on the order of about 10,000 to 40,000 pounds and 1,000 to 4,000 pounds per lineal foot, respectively.

Site development will require a moderate amount of earthwork in the form of site grading. We estimate in general that maximum cuts and fills to achieve design grades will be on the order of about 3.0 to 5.0 feet. Larger cuts and fills may be required in isolated areas. In general, the projected site grading activities are anticipated to consist primarily of cutting into the existing ground to construct residences, with very little fill projected for the site. Final cuts and fills must be designed to maintain stability of the slopes on the site and not to steepen un braced slopes greater than four horizontal to one vertical (4H:1V), and all planned retaining walls will need to be properly engineered.

4.0 FIELD EXPLORATION AND SITE CONDITIONS

The site subsurface soil conditions were explored by excavating three test pits on April 8, 2022 at the selected locations shown on **Figure 5**. The test pits were excavated using a 4-ton track-mounted excavator and extended to depths of approximately 8.0 to 9.0 feet below the existing ground surface, at which point excavation was either stopped or refused. During the course of the excavating operations, a continuous log of the subsurface conditions encountered was maintained. Within the test pits disturbed bulk samples of the typical soils encountered were obtained for subsequent laboratory testing and examination. The soil samples were sealed in plastic bags and containers prior to transport to the laboratory.

The soils exposed in the test pits were described, classified, and logged in the field based upon visual and textural examination. These classifications have been supplemented by subsequent inspection and testing in our laboratory. The subsurface conditions encountered in the field exploration are discussed below in **Section 5.4, Subsurface Soil Conditions**, and are illustrated on **Figures 6 through 8, Log of Test Pits**. Sampling information and other pertinent data and observations are also included on the logs. In addition, a Key to Symbols defining the terms and symbols used on the logs is provided as **Figure 9** in this report.

Following completion of excavating and logging, each test pit was backfilled. The backfill was not placed in uniform lifts and compacted to a specific density and therefore must be considered as non-engineered backfill. Settlement of the backfill with time is likely to occur.

5.0 ENGINEERING GEOLOGY

5.1 General Geology

The site is located in Ogden Valley which is a northwest trending fault bounded graben structure, with the Wasatch Range comprising the western flank of the valley and the Bear River Range the eastern flank (Avery, 1994). Topographically the site is located on the valley margin near the lower reaches of Wolf Creek near where the creek joins the North Fork of the Ogden River. The elevation of the Phase #9 Area ranges between 5110 feet on the west side of the site to over 5146 feet on the east side of the site. The Eagle Ridge Subdivision is located on the transition of low gradient piedmont surfaces formed along Wolf Creek, and the gentle valley margin slopes at the base of 7000-foot-high ridgelines that buttress James Peak which rises to 9424 feet approximately 5 miles northeast of the site.

The site is located on the northeastern margin of Ogden Valley, on the east side of the Wasatch Range, which western side the Wasatch Front is marked by the Wasatch fault. The Wasatch fault is approximately 4.7 miles west of the site, and provides the basis of division between the Middle Rocky Mountain Physiographic Province on the east and the Basin and Range Physiographic Province on the west. The Basin and Range Physiographic Province is characterized by approximately north-south trending valleys and mountain ranges that have been formed by extensional tectonics and displacement along normal faults and extends from the Wasatch Range on the east to the Sierra Nevada Range on the west (Hunt, 1967).

The Middle Rocky Mountain province covers parts of Utah, Colorado, Wyoming, Idaho, and Montana. The geology of the province is an assemblage of sedimentary, igneous, and metamorphic rocks that have been folded, faulted, and uplifted. Mountain building (tectonic) activity commenced about 30 million years ago (Cretaceous time) and continues to the present. The province is characterized by mountainous terrain with deep canyons and broad intervening basins, with temperate semi-arid to mesic climatic conditions (Hunt, 1967).

The site is located within a setting of complex geological conditions wherein Pre-Cambrian and Paleozoic rocks were locally rafted over the same during a series of eastward thrust extensions the last of which is named the Willard Thrust sheet, which is believed to have moved onto the vicinity during the Cretaceous Sevier orogeny, and occurred approximately 140 million years ago (ma). The exposure of the present surficial geology of the site vicinity is the result of the uplift and exposure of older pre-Cambrian rocks which forms the crests of Lewis Peak (8,031 feet) west of the valley and James Peak on the east. This exposure was the result of movement along locally high-angle faults (i.e., The Wasatch fault) during late Tertiary and Quaternary age (Bryant, 1988). The present topography was finally shaped by

Quaternary stream deposition and planation by Wolf Creek, which has deposited range-margin coarse alluvium that has been modified by late-Pleistocene lacustrine processes, forming the surface of the Eagle Ridge site vicinity. The current geological mapping drawn from McDonald (2020) of the site is shown on **Figure 3**.

5.2 Site Surface Conditions

The site conditions and site geology were interpreted through an integrated compilation of data, including a review of literature and mapping from previous studies conducted in the area (Sorensen and Crittenden, 1979; Bryant, 1988; King and others, 2008; King and McDonald, 2014; and Coogan and King, 2016); photogeologic analyses of 2012 and 2014 imagery shown on **Figure 2**; historical stereoscopic imagery flown in 1963; GIS analyses of elevation and geoprocessed LiDAR terrain data as shown on **Figure 4**; field reconnaissance of the general site area; and the interpretation of the test pit exposures made on the site as part of our field program. Seismic hazards information was developed from United States Geologic Survey (USGS) databases (Petersen and others, 2014).

The topography of the site vicinity consists of gentle to moderately steep valley-margin foothill slopes. Vegetation at the site is open with a cover of grass, weeds and sage brush. The site slopes developed from our LiDAR analysis were found to range from level to over 30-percent as shown on **Figure 4**.

5.3 Surficial Geology

The surficial geology of the site is presented on **Figure 3**, of this report and has been taken from mapping prepared by McDonald (2020). A summary of the mapping units identified on the site vicinity and described by McDonald (2020) are paraphrased below in relative age sequence (youngest-top to oldest bottom):

Qaly – Stream and alluvium and floodplain deposits (Holocene to upper Pleistocene) – Poorly to moderately sorted, pebble to cobble gravel with a matrix of sand, silt, and clay

Qat1 – Stream terrace deposits (middle Holocene? To upper Pleistocene?) –Poorly to well sorted pebble to cobble gravel In a matrix of sand, silt and clay in terraces above modern streams and/or floodplains; sub-angular to sub-rounded grains; poorly to moderately bedded…

Qafo – Older alluvial-fan deposits, (upper to middle Pleistocene.) Poorly to moderately sorted pebble to cobble gravel with a matrix of silt, sand, and clay; sub-angular to sub-rounded clasts; poorly bedded; fans are typically eroded and incised locally…

Qafoe – Eroded old alluvial-fan deposits (middle to lower Pleistocene?). Poorly sorted cobble gravel with a matrix of sand, silt, and clay; sub-angular to sub-rounded clasts; poorly bedded; surface may be cobble/boulder-armored; deposits are elevated, isolated remnant fan deposits…

Qafd – Alluvial-fan graded to Lake Bonneville and delta deposits, undivided, (upper Pleistocene). Poorly to moderately sorted cobbly gravel in a matrix of sand, silt, and clay; angular to sub-rounded clasts; moderately to well-bedded…deposited upstream from and into Lake Bonneville as the lake transgressed to the Bonneville highstand shoreline…

Qdl – Lake Bonneville delta and lacustrine deposits, (upper Pleistocene). Moderately to well sorted sand, gravelly sand, silty sand, and cobbles deposited in Lake Bonneville deltas and nearshore as the lake transgressed; subrounded to rounded clasts; moderately to well bedded…

The Phase #9 Area is located upon Pleistocene aged Lake Bonneville alluvial (**Qafd**) and deltaic (**Qdl**) deposits. These deposits and formative geological processes are considered presently inactive under the existing site and slope conditions.

5.4 Subsurface Soil Conditions

Topsoil (Soil A-B horizons), dark brown twelve to thirty inches thick were observed on the surfaces of the test pits. Below the topsoil the subsurface conditions encountered in the test pits ranged from Clayey GRAVELS (GC) and Clayey SAND (SC), to Silty Gravels (GM) with varying amounts of sand and gravel. These soils were observed to be brown to yellow and red in color, slightly moist to moist, and estimated to be medium stiff to stiff in consistency (CLAY)., or very dense (GRAVEL) to medium dense (SAND).

Groundwater was not observed in the test pits at the time of our field program. The local static groundwater elevation is projected to be below project depths by about 15 to 20 feet for the site. Future seasonal and longer-term groundwater fluctuations should be anticipated for the site, with the highest seasonal levels generally occurring during the late spring and summer months. Numerous other factors such as heavy precipitation, rapid snow-melt, and other unforeseen factors, may also influence ground water elevations at the site. Groundwater is not anticipated to be encountered during construction

5.6 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, caution should be taken in interpolating or extrapolating subsurface conditions beyond the exploratory locations. Seasonal fluctuations in ground water conditions may also occur.

In addition, once the subsurface explorations were completed the test pits were backfilled with the excavated soils but no effort was made to compact these soils. Test pit backfill soils must be considered non-engineered fill. Settlement of the backfill in the test pits over time should be anticipated and caution should be exercised when constructing over these locations.

5.7 Seismic Setting

5.7.1 General

Utah has adopted the International Building Code (IBC) 2018, which determines the seismic hazard for a site based upon 2014 mapping of bedrock accelerations prepared by the United States Geologic Survey (USGS) and the soil site class. The USGS values are presented on maps incorporated into the IBC code and are also available based on latitude and longitude coordinates (grid points).

5.7.2 Active Earthquake Faults

Based upon our review of available maps and literature, no active faults are known to pass through or immediately adjacent to the site. The nearest active (Holocene) earthquake fault to the site is the Weber segment of the Wasatch fault zone (UT2351E) which is located 4.7 miles west of the site (Black and others, 2004). Accordingly, fault rupture hazards are not considered present on the site. The Ogden Valley North Fork fault (UT2376) is located much closer to the site, approximately 10.7 miles to the southwest, however the most recent movement along this fault is estimated to be pre-Holocene (<750,000 ybp), and is not considered an active risk to the site (Black and others, 1999).

5.7.3 Soil Class

For site class definitions, IBC 2018 Section 1613.2.2 refers to Chapter 20, Site Classification Procedure for Seismic Design, of ASCE[1] 7-16. Given the subsurface soils encountered at the site, which only extended to a depth of about 9.0 feet, and our projection of similar granular soils extending to bedrock within the upper 100 feet it is our opinion the site best fits Site Class D – Stiff Soil Profile (with data,), which we recommend for seismic structural design.

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 at site grid coordinates of 41.3276 degrees north latitude and 111.8431 degrees west longitude, $\mathbf{S_{DS}}$ is 0.729 and the **Seismic Design Category** is D_1.

5.7.4 Strong Ground Motion

Strong ground motion originating from the Wasatch fault or other near-by seismic sources is capable of impacting the site. The Wasatch fault zone is considered active and capable of generating earthquakes as large as magnitude 7.3 (Arabasz and others, 1992). Based on probabilistic estimates (Petersen and others, 2014) queried for the subdivision site (41.3276º N., 111.8431º E.), the expected peak horizontal ground acceleration (PGA) on rock from a large earthquake with a ten-percent probability of exceedance in 50 years is as high as 0.19*g.* For a two-percent probability of exceedance in 50 years, the PGA is as high as 0.44*g* for the site.

[1]American Society of Civil Engineers

The ten-percent probability of exceedance in 50 years event has a return period of 475 years, and the 0.19*g* acceleration for this event corresponds to "strong" perceived shaking with "light" potential damage based on instrument intensity correlations. The two-percent probability of exceedance in 50 years event has a return period of 2475 years, and the 0.44*g* acceleration for this event corresponds to "severe" perceived shaking with "moderate to heavy" potential damage based on instrument intensity correlations (Wald and others, 1999).

Future ground accelerations greater than these are possible at the site but will have a lower probability of occurrence.

5.7.5 Liquefaction

In conjunction with the ground shaking potential of large magnitude seismic events as discussed previously, certain soil units may also possess a potential for liquefaction during a large magnitude event. Liquefaction is a phenomenon whereby loose, saturated, granular soil units lose a significant portion of their shear strength due to excess pore water pressure buildup resulting from dynamic loading, such as that caused by an earthquake. Among other effects, liquefaction can result in densification of such deposits causing settlements of overlying layers after an earthquake as excess pore water pressures are dissipated. Horizontally continuous liquefied layers may also have a potential to spread laterally where sufficient slope or free-face conditions exist. The primary factors affecting liquefaction potential of a soil deposit are: (1) magnitude and duration of seismic ground motions; (2) soil type and consistency; and (3) occurrence and depth to groundwater.

Liquefaction potential hazards have not been studied or mapped for the Ogden Valley area, as has occurred in other parts of northern Utah (Anderson and others 1994). Liquefaction commonly occurs in saturated non-cohesive soils such as stream alluvium, which conditions are not found on the site, consequently the conditions susceptible to liquefaction do not appear to be present at the site within the depths penetrated.

5.7.6 Tectonic Subsidence

Tectonic Subsidence is surface tilting subsidence that occurs along the boundaries of normal faults in response to surface-faulting earthquakes (Keaton, 1986). Because the site is not located in near proximity to active earthquake faults, tectonic subsidence hazards are not considered a risk to the site.

5.8 Landslide and Slump Deposits

The nearest active landslide units are mapped as **Qmsh** deposits by McDonald (2020), and are located over 4000 feet to the east of the site (not included on Figure 3). These deposits should not impact the proposed development.

5.9 Sloping Surfaces

The surface slopes of the site vicinity developed from our LiDAR analysis and shown on **Figure 4** range from near-level to over 30-percent. For the Phase #9 Area the average calculated slope was 8.2-percent for the site. The limiting steep slope gradients for development considerations according to the Weber County Code is 25-percent (Weber County Code, 2022).

5.10 Alluvial Fan - Debris Flow Processes

The site is mapped on "older" alluvial fan deposits that are Pleistocene in age and the deposits and processes are not considered presently active. The nearest potential debris flow process deposits to the site are mapped as **Qafy** by McDonald (2020), and occur approximately 1800 feet to the northeast of the site (not included on Figure 3), and these deposits should not impact the proposed development.

5.11 Flooding Hazards

Mapping by Federal Emergency Management Agency (FEMA, 2015) indicates the Phase #9 Area is outside the FEMA designated 100-year flood zone areas, as shown on **Figure 3**.

Local sheet flow, slope wash, and seasonally perched soil water typical of sloping areas should be anticipated for the site, and site improvements.

5.12 Rockfall and Avalanche Hazards

The site is not located down-slope from steep slope areas where such hazards may originate.

6.0 LABORATORY TESTING

6.1 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

6.2 Lab Summary

Laboratory test results are presented on the Test Pit logs (**Figures 6 through 8**) and in the following **Lab Summary Table**:

LAB SUMMARY TABLE

Test Pit No.	DEPTH (feet)	SOIL CLASS	SAMPLE TYPE	MOISTURE CONTENT(%)	DRY DENSITY (pcf)	GRADATION			ATTERBERG LIMITS		
						GRAV.	SAND	FINES	LL	PL	PI
TP-1	2	GC	Bag			70	8	22			
	4	GC	Bag	15.3				29			
TP-2	3	GC	Bag	8				11	56	26	30
TP-3	2	GC-CH	Bag			42	13	45	62	25	37
	6	GC	Bag	11				32	69	33	36

7.0 SITE PREPARATION AND GRADING

7.1 Site Preparation

Initial site preparation will consist of the removal of surface vegetation, topsoil, non-engineered fill, if encountered, and other deleterious materials from beneath an area extending out at least 3 feet from the perimeter of each proposed residence, and 2 feet beyond pavements, and exterior flatwork areas. Topsoil, although unsuitable for utilization as site grading for or structural fill, may be stockpiled for subsequent landscaping purposes.

The natural soils contain high plastic clay which may in turn be susceptible to volume change (shrink/swell) with change in moisture content. However, the clayey soils encountered at shallow depth consisted primarily of clayey gravel with sand, cobbles and boulders, basically granular soil which reduces the potential for volume change. Foundations may be directly supported on the clayey gravel soils. If only clay soils are encountered at bearing depth and directly below floor slabs, we recommend replacing a minimum 12 inches directly below footings and slabs with non-plastic structural fill soil (clean gravel excluded).

Based on the soil conditions encountered and the geologic history it is recommended that site cuts be limited such that un-braced site grading slopes remain similar to existing slopes (roughly 4H:1V or less).

Subsequent to stripping and prior to the placement of structural site grading fill, pavements, driveway, and garage slabs on grade, If excessively soft or loose soils are encountered, they must be removed to a maximum depth of 2 feet and replaced with structural fill. Beneath footings, all soft, loose, and disturbed soils must be totally removed. If removal depth required is greater than 2 feet, CMT must be informed to provide further recommendations.

7.2 Temporary Excavations

Temporary excavations up to 8 feet deep in fine-grained cohesive soils, above or below the water table, may be constructed with sideslopes no steeper than one-half horizontal to one vertical (0.5H:1V).

For granular (cohesionless) soils, construction excavations above the water table, not exceeding 4 feet, should be no steeper than one-half horizontal to one vertical (0.5H:1V). For excavations up to 8 feet, in granular soils and above the water table, the slopes should be no steeper than one horizontal to one vertical (1H:1V). Excavations encountering saturated cohesionless soils will be very difficult and will require very flat sideslopes and/or shoring, bracing, and dewatering. Excavations deeper than 8 feet are not anticipated at the site.

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.

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

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

Fill Material Type	Description/Recommended Specification
Select Structural Fill/Replacement Fill	Placed below structures, flatwork and pavement. Imported structural fill should consist of 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, and a maximum 40% passing No. 200 sieve.
Non-Structural Fill	Placed below non-structural areas, such as landscaping. On-site soils or imported soils, with a maximum particle size of 8 inches, including silt/clay soils not containing excessive amounts of degradable/organic material.
Stabilization Fill	Placed to stabilize soft areas prior to placing structural fill and/or site grading fill. Coarse angular gravels and cobbles 1 inch to 8 inches in size. May also use 1.5- to 2.0-inch gravel placed on stabilization fabric, such as Mirafi RS280i, or equivalent (see **Section 7.6**).

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

7.4 Utility Trenches

All utility trench backfill material below structurally loaded facilities (flatwork, floor slabs, roads, etc.) shall be placed at the same density requirements established for structural fill. If the surface of the backfill becomes disturbed during the course of construction, the backfill shall be proofrolled and/or properly compacted prior to the construction of any exterior flatwork over a backfilled trench. Proofrolling shall be performed by passing moderately loaded rubber tire-mounted construction equipment uniformly over the surface at least twice. If excessively loose or soft areas are encountered during proofrolling, they shall be removed to a maximum depth of 2 feet below design finish grade and replaced with structural fill.

Most utility companies and City-County governments are now requiring that Type A-1a or A-1b (AASHTO Designation – basically granular soils with limited fines) soils be used as backfill over utilities. These organizations are also requiring that in public roadways the backfill over major utilities be compacted over the full depth of fill to at least 96 percent of the maximum dry density as determined by the AASHTO T-180 (ASTM D-1557) method of compaction.

In private utility areas, natural soils may be re-utilized as trench backfill over the bedding layer provided that they are properly moisture prepared and compacted to the minimum requirements stated in section 7.5 Fill Placement and Compaction below.

7.5 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[2] 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 3 feet beyond the perimeter of structures, and below flatwork and pavement (applies to structural fill and site grading fill)	0 to 5 5 to 8	95 98
Site grading fill outside area defined above	0 to 5 5 to 8	92 95
Utility trenches within structural areas	--	96
Roadbase and subbase	-	96
Non-structural fill	0 to 5 5 to 8	90 92

Structural fills greater than 8 feet thick are not anticipated at the site. For best compaction results, we recommend that the moisture content for structural fill/backfill be within 2% of optimum. Field density tests should be performed on each lift as necessary to verify that proper compaction is being achieved.

[2] American Association of State Highway and Transportation Officials

7.6 Stabilization

To stabilize soft subgrade conditions (if encountered), a mixture of coarse, clean, angular gravels and cobbles and/or 1.5- to 2.0-inch clean gravel should be utilized. 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.

8.0 LATERAL EARTH PRESSURES

The lateral pressure parameters, as presented within this section, are for backfills which will consist of clean, drained on site or imported granular soil placed and compacted in accordance with the recommendations presented herein. The lateral pressures imposed upon subgrade facilities will depend upon the relative rigidity and movement of the backfilled structure. Following are the recommended lateral pressure values, which also assume that the soil surface behind the wall is horizontal and that the backfill within 3 feet of the wall will be compacted with hand-operated compacting equipment.

CONDITION	STATIC (psf/ft)*	SEISMIC (psf)*
Active Pressure (wall is allowed to yield, i.e. move away from the soil, with a minimum 0.001H movement/rotation at the top of the wall, where "H" is the total height of the wall)	42	26
At-Rest Pressure (wall is not allowed to yield)	63	N/A
Passive Pressure (wall moves into the soil)	375	135

*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 FOUNDATION RECOMMENDATIONS

The following recommendations have been developed on the basis of the previously described project characteristics, the subsurface conditions observed in the field, the laboratory test data, as well as common engineering practice.

9.1 Foundation Recommendations

Based on our geotechnical engineering analyses, the proposed structure(s) may be supported upon conventional spread and/or continuous wall foundations placed on suitable, undisturbed natural gravel soils and/or on structural fill extending to suitable natural gravel soils. Footings may be designed using a net bearing pressure of 2,000 psf if placed on suitable, undisturbed, natural soils.

The term “net bearing pressure” refers to the pressure imposed by the portion of the structure located above lowest adjacent final grade, thus the weight of the footing and backfill to lowest adjacent final grade need not be considered. The allowable bearing pressure may be increased by 1/2 for temporary loads such as wind and seismic forces.

We also recommend the following:

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

9.2 Installation

Footings shall not be installed upon soft or disturbed soils, non-engineered fill, construction debris, frozen soil, or within ponded water. Additionally, footings shall not be installed directly on natural clay soils. Where footing would otherwise be established on natural clay soils footing areas must be over excavated a minimum of 12 inches and be returned to bottom of footing grade with granular structural fill meeting the requirements for and properly compacted as stated above in this report. If the granular structural fill upon which the footings are to be established becomes disturbed, it shall be recompacted to the requirements for structural fill or be removed and replaced with new structural fill.

The width of structural fill, where placed below footings, shall extend laterally at least 6 inches beyond the edges of the footings in all directions for each foot of fill thickness beneath the footings.

9.3 Estimated Settlement

Foundations designed and constructed in accordance with our recommendations could experience some settlement, but we anticipate that settlement of footings founded as recommended above will be 1 inch or less. We expect approximately 50 percent of initial settlement to take place during construction.

9.4 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 should be utilized for the natural gravel soils or structural fill. Passive resistance provided by properly placed and compacted granular structural fill above the water table may be considered equivalent to a fluid with a density of 250 pounds per cubic foot.

A combination of passive earth resistance and friction may be utilized provided that the passive component of the total is divided by 1.5.

10.0 FLOOR SLABS

Floor slabs may be established entirely upon natural gravel soils, or where natural clay soils are exposed, over a minimum of 12 inches of granular structural replacement fill extending to suitable natural soils. Under no circumstances shall floor slabs be established directly over native clay soils, non-engineered 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, it is recommended that floor slabs be directly underlain by at least 4 inches of "free-draining" fill, such as "pea" gravel or three-quarters to one-inch minus clean gap-graded gravel. This 4 inches is in addition to the 12 inches of granular fill discussed above.

11.0 DRAINAGE RECOMMENDATIONS

11.1 General Drainage Recommendations

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 structures should be sloped to provide drainage away from the foundations. Where possible we recommend a minimum slope of 6 inches in the first 10 feet away from the structure.

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

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

4. Sprinklers should be aimed away from the foundation walls. The sprinkling systems should be designed with proper drainage and be well-maintained. Over watering should be avoided.

5. Other precautions may become evident during construction.

11.2 Subdrains

11.2.1 General

Due to the potential for random perched groundwater conditions within the predominantly clay soils sequence it is recommended that a foundation drain be installed around subsurface levels deeper than 4 feet below the ground surface for each residence.

11.2.2 Foundation Subdrains

Foundation subdrains should consist of a 4-inch diameter perforated or slotted plastic or PVC pipe enclosed in clean gravel comprised of three-quarter- to one-inch minus gap graded gravel and/or "pea" gravel. The invert of a 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 must be wrapped with a geotextile, such as Mirafi 140N or equivalent.

Above the foundation subdrain, a minimum 12-inch-wide zone of "free-draining" clean sand or gravel (chimney) should be placed adjacent to the foundation walls and extend to within 2 feet of final grade. The sand/gravel fill must be separated from adjacent native or backfill soils with a geotextile fabric (Mirafi 140N or equivalent). The upper 2 feet of soils should consist of a compacted clayey soil cap to reduce surface water infiltration into the drain. As an alternative to the zone of permeable sand or gravel, a prefabricated "drainage board," such as Miradrain or equivalent, may be placed against the exterior below-grade walls. Prior to the installation of the footing subdrain, the below-grade walls should be dampproofed. The slope of the subdrain should be at least 0.3 percent. The foundation subdrains shall be discharged to a down-gradient location well away from the home.

12.0 QUALITY CONTROL

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

<u>12.1 Field Observations</u>

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

<u>12.2 Fill Compaction</u>

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 granular 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.

13.0 LIMITATIONS

The recommendations provided herein were developed from the geologic reconnaissance and by evaluating the information obtained from the test pits and site exploration. The exploration data reflects the subsurface conditions only at the specific locations at the particular time designated on the test pit 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. CMT offers a full range of Geotechnical Engineering, Geological, Material Testing, Special Inspection services, and Phase I and II Environmental Site Assessments. With 4 offices throughout Northern Utah, and in Arizona, 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. To schedule materials testing please call (801) 908-5859.

14.0 REFERENCES

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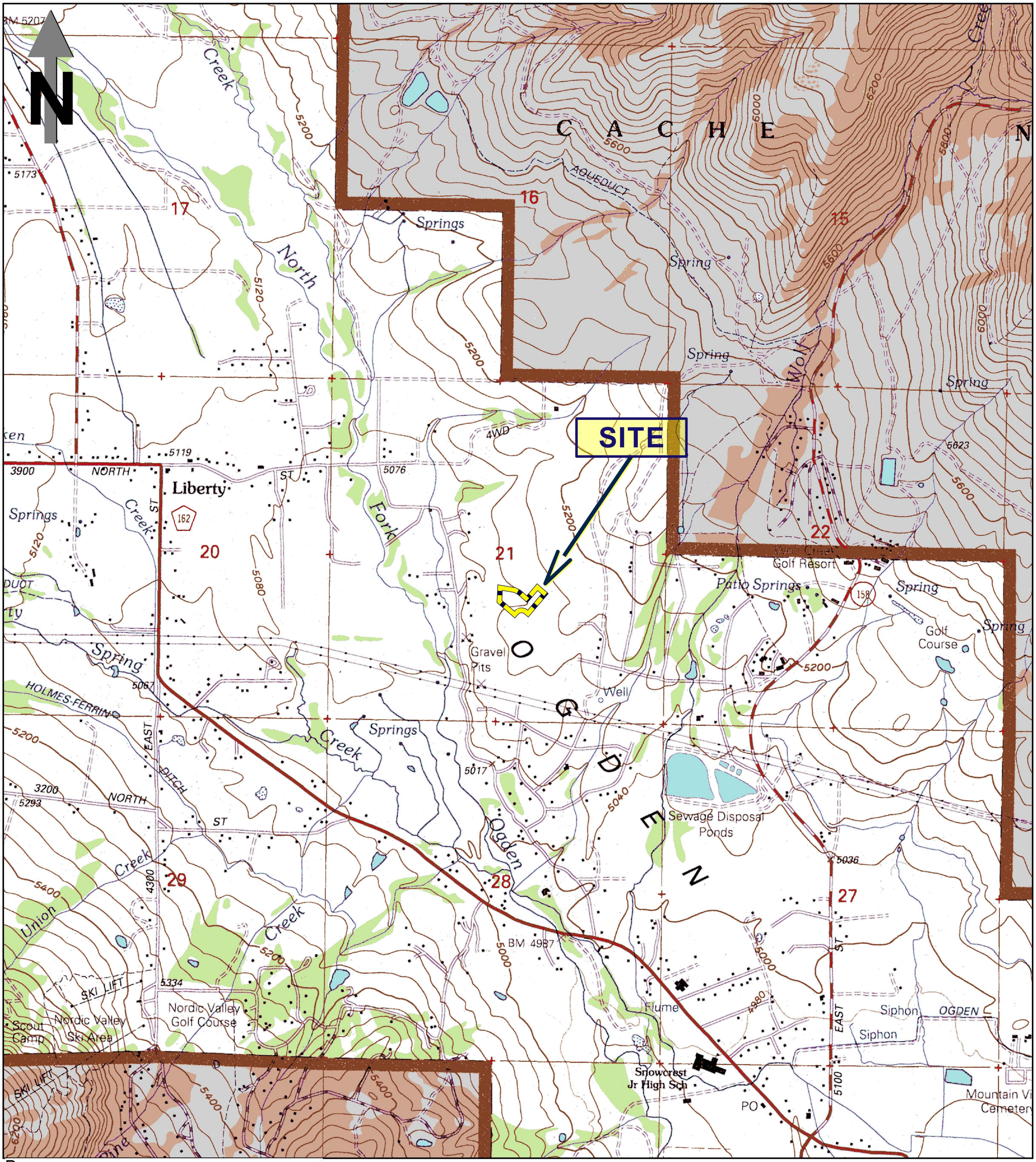
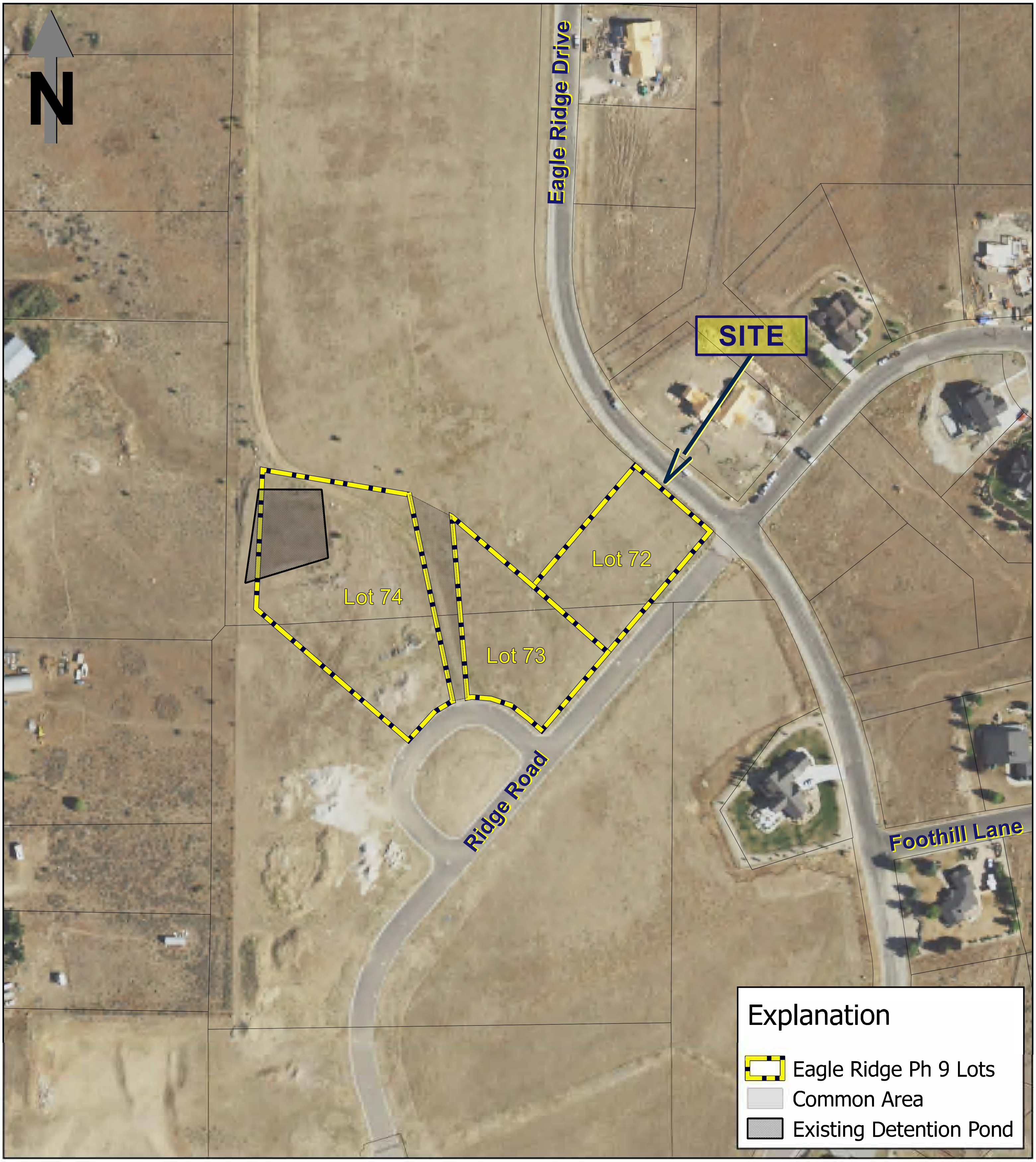
APPENDIX

SUPPORTING DOCUMENTATION



Base:
1998 USGS 7.5 Minute topographic map titled "Huntsville, Utah" from Utah UGRC; http://gis.utah.gov/

Eagle Ridge Subdivision Phase #9 Eden, Utah	CMT TECHNICAL SERVICES		Figure 1
	Vicinity Map	Date: 25 April-22	
		Job #: 18262	

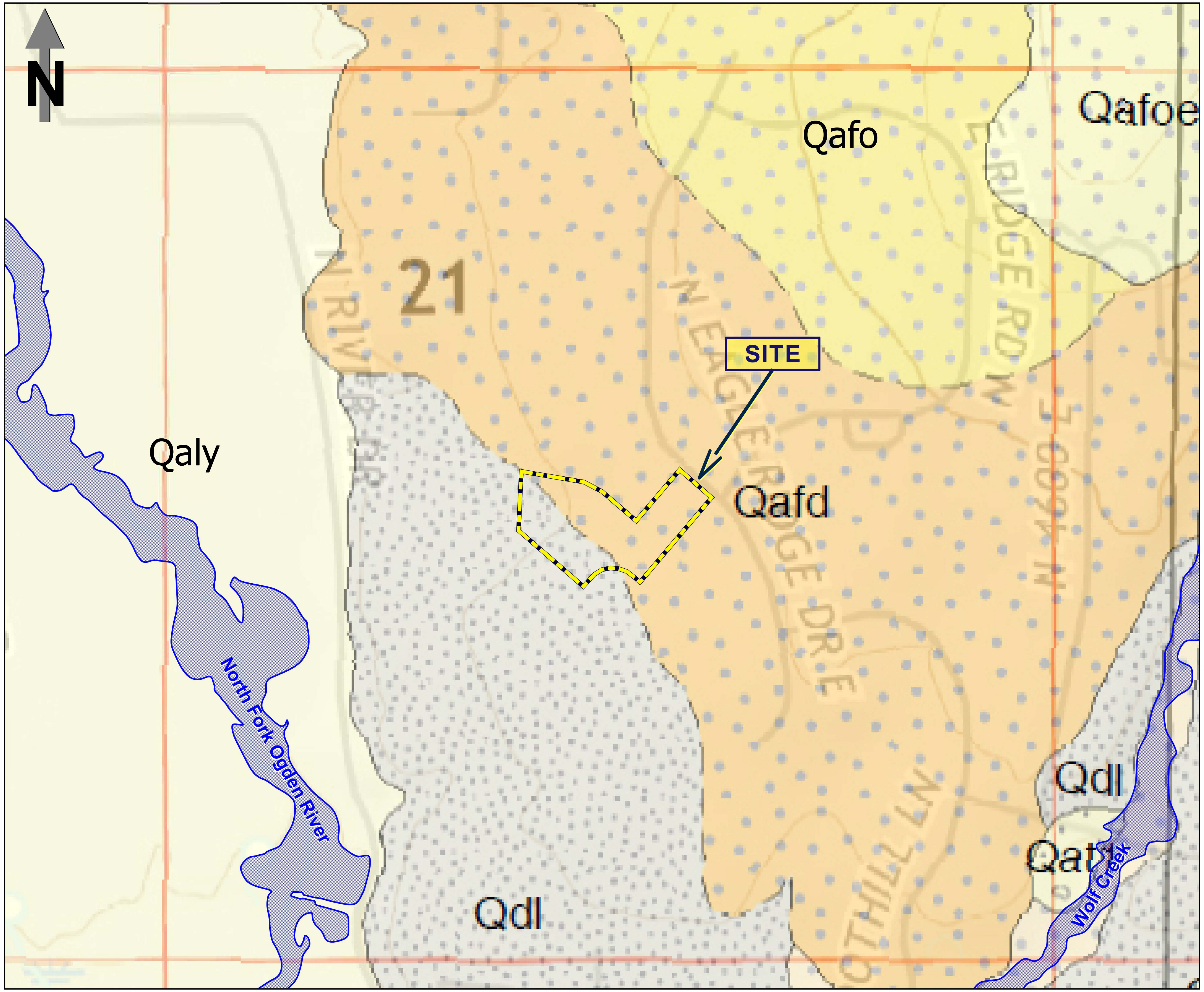


Base:
2021 0.6m NAIP Color Orthoimagery,
from Utah UGRC; http://gis.utah.gov/

0 200 400 ft

1:2,400

Eagle Ridge Subdivision Phase #9 Eden, Utah	CMT TECHNICAL SERVICES Site Plan	Date: 25 April-22 Job # 18262	Figure 2



Base:
McDonald, 2021

0 400 800 ft

1:4,800

GEOLOGCIAL CLASSIFICATION
(after McDonald, 2020)

Qaly – Stream alluvium and floodplain deposits (Holocene to upper Pleistocene) – Poorly to moderately sorted, pebble to cobble gravel with a matrix of sand, silt, and clay…

Qat1 – Stream terrace deposits (middle Holocene? to upper Pleistocene?) – Poorly to well sorted pebble to cobble gravel in a matrix of sand, silt and clay in terraces above modern streams and/or floodplains; subangular to subrounded grains; poorly to moderately bedded…

Qafo – Older alluvial-fan deposits (upper to middle Pleistocene?) – Poorly to moderately sorted pebble to cobble gravel with a matrix of silt, sand and clay; subangular to subrounded clasts; poorly bedded; fans are typically eroded and incised locally…

Qafoe– Eroded old alluvial-fan deposits (middle to lower Pleistocene?) – Poorly sorted cobble gravel with a matrix of sand, silt, and clay; subangular to subrounded clasts; poorly bedded; surface may be cobble/boulder-armored; deposits are elevated, isolated remnant fan deposits that…

Qafd – Alluvial-fan graded to Lake Bonneville and delta deposits, undivided (upper Pleistocene) – Poorly to moderately sorted cobbly gravel in a matrix of sand silt, and clay; angular to subrounded clasts; moderately to well-bedded…deposited upstream from and into Lake Bonneville as the lake transgressed to the Bonneville highstand shoreline…

Qdl – Lake Bonneville delta and lacustrine deposits (upper Pleistocene) – Moderately to well sorted sand, gravelly sand, silty sand, and cobbles deposited in Lake Bonneville deltas and nearshore as the lake transgressed; subrounded to rounded clasts; moderately to well bedded…

FEMA - Flood Insurance Rating Zones (2015) -Zone A - Areas subject to inundation by the 1-percent-annual-chance flood event generally determined using approximate methodologies. Because detailed hydraulic analyses have not been performed, no Base Flood Elevations (BFEs) or flood depths are shown. Mandatory flood insurance purchase requirements and floodplain management standards apply.

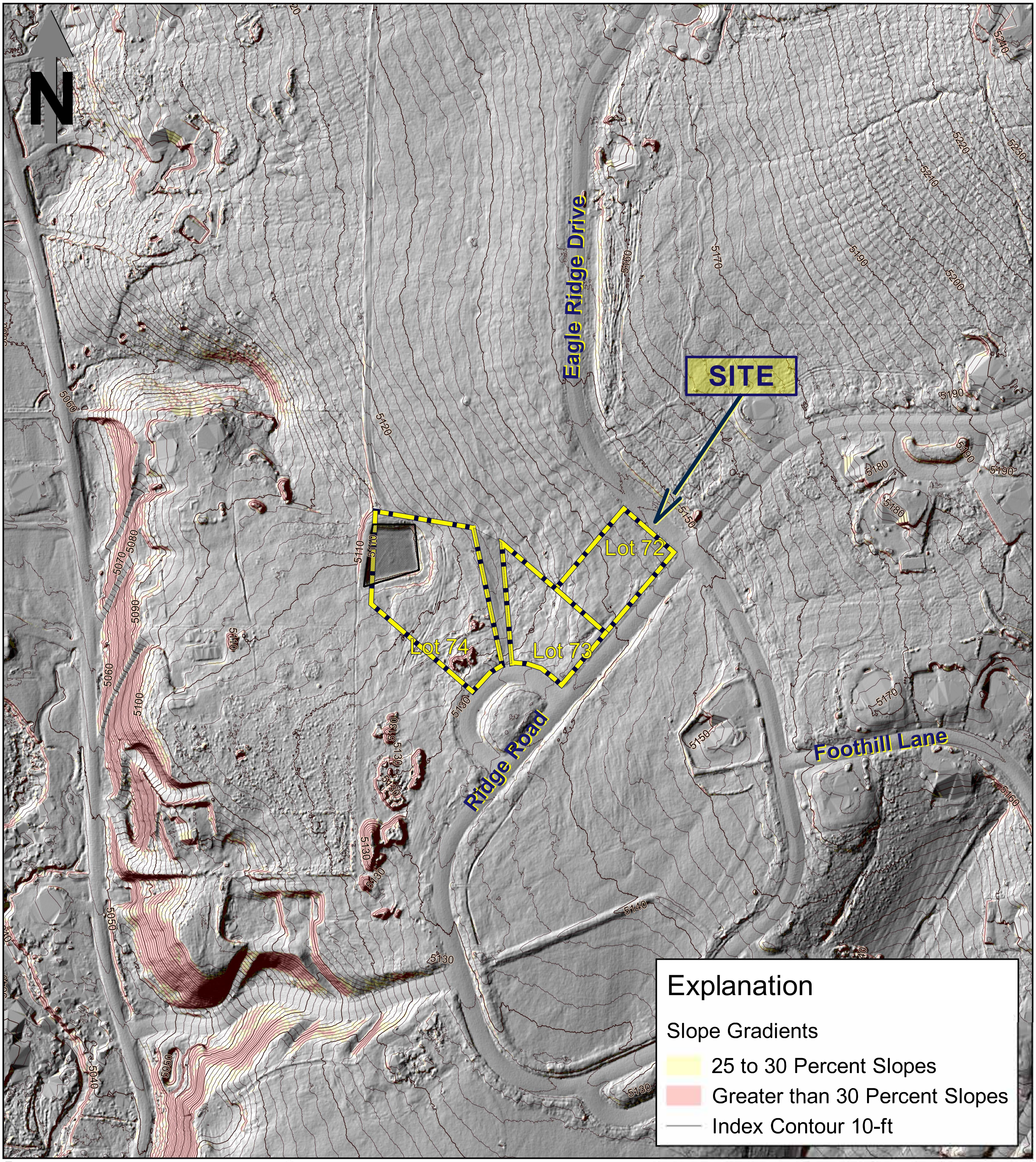
CMT TECHNICAL SERVICES

Eagle Ridge
Subdivision Phase #9
Eden, Utah

GEOLOGIC MAPPING

Date:	25 April-22
Job #	18262

Figure
3

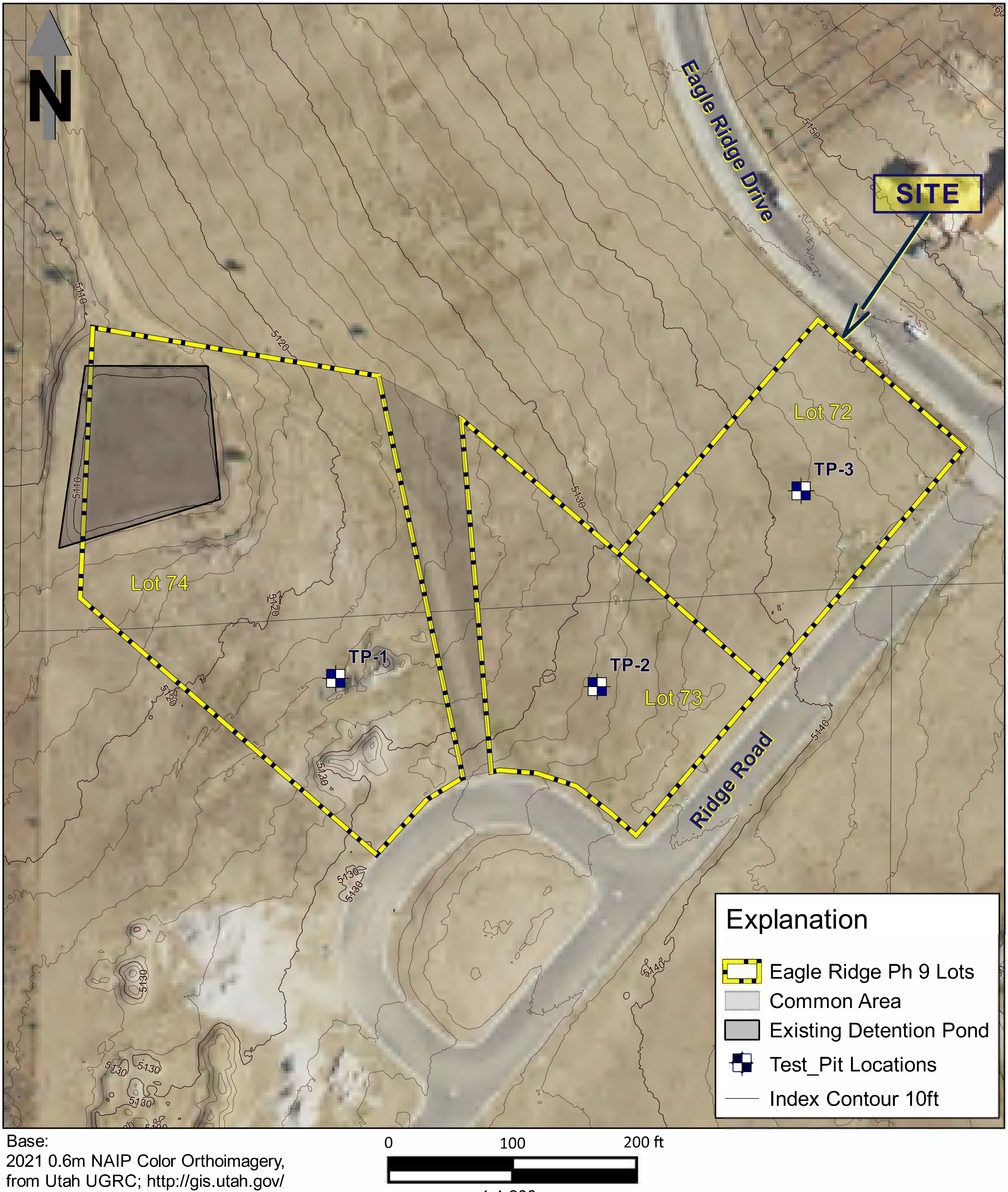


Base:
2020 0.5m LiDAR Imagery,
from Utah UGRC; http://gis.utah.gov/

0 300 600 ft

1:3,600

Eagle Ridge Subdivision Phase #9 Eden, Utah	CMT TECHNICAL SERVICES		Figure 4
	LiDAR Analysis	Date: 25 April-22	
		Job # 18262	



Base:
2021 0.6m NAIP Color Orthoimagery,
from Utah UGRC; http://gis.utah.gov/

Eagle Ridge Subdivision Phase #9 Eden, Utah	CMT TECHNICAL SERVICES		Figure 5
	Site Evaluation	Date: 25 April-22 Job # 18262	

Eagle Ridge Cluster Subdivision Phase 9 — Test Pit Log — TP-1

Near Ridge Road, Eden, Weber County, Utah

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

Date: 4/8/22
Job #: 18262

Depth (ft)	Soil Description	Sample Type	Sample #	Moisture (%)	Dry Density(pcf)	Gradation: Gravel %	Gradation: Sand %	Gradation: Fines %	Atterberg: LL	Atterberg: PL	Atterberg: PI
0	Topsoil; dark brown to brown organic silty to sandy clay with gravel and cobbles										
1	Dark Brown to Brown Organic Silty to Sandy CLAY (CL) with gravel and cobbles — moist, stiff										
2	Clayey GRAVEL (GC) with cobble, sand and some boulders — moist, very dense	◣	1			70	8	22			
4		◣	2	15				29			
6		◣	3								
8		◣	4								
9	END AT 9'										

Remarks: Groundwater not encountered during excavation.

Coordinates: 41.32756°, -111.843713°
Surface Elev. (approx): Not Given

Equipment: Rubber Tire Backhoe
Excavated By: Tysen Butters
Logged By: Christine Underdown

CMT TECHNICAL SERVICES

Figure: 6

Eagle Ridge Cluster Subdivision Phase 9 — Test Pit Log — TP-2

Near Ridge Road, Eden, Weber County, Utah

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

Date: 4/8/22
Job #: 18262

Depth (ft)	Soil Description	Sample Type	Sample #	Moisture (%)	Dry Density(pcf)	Gravel %	Sand %	Fines %	LL	PL	PI
0–1	Topsoil; dark brown to brown organic silty to sandy clay with gravel and cobbles										
1–3	Red and Yellow CLAY (CL) with gravel and cobbles; moist, stiff										
2		◣	5								
3–8	Brown Clayey GRAVEL (GC) with cobble, sand and occasional boulders; moist, very dense	◣	6	8				11	56	26	30
7		◣	7								
8	END AT 8'										

Depth scale: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14

Remarks: Groundwater not encountered during excavation.

Coordinates: 41.327585°, -111.84289°
Surface Elev. (approx): Not Given

Equipment: Rubber Tire Backhoe
Excavated By: Tysen Butters
Logged By: Christine Underdown

CMT TECHNICAL SERVICES

Figure: 7

Eagle Ridge Cluster Subdivision Phase 9 — Test Pit Log — TP-3

Near Ridge Road, Eden, Weber County, Utah

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

Date: 4/8/22
Job #: 18262

Depth (ft)	Soil Description	Sample Type	Sample #	Moisture (%)	Dry Density(pcf)	Gravel %	Sand %	Fines %	LL	PL	PI
0–1	Topsoil; dark brown to brown organic silty to sandy clay with gravel and cobbles										
1–4	Light Brown GravellyCLAY/Clayey Gravel (CL-GC) with cobble and boulders; moist, dense/stiff										
2		◣	8			42	13	45	62	25	37
3	grades dark brown; moist, dense										
4–8	Brown Clayey GRAVEL (GC) with cobble, sand and occasional boulders; moist, dense										
6		◣	9	11				32	69	33	36
8	END AT 8'										

Remarks: Groundwater not encountered during excavation.

Coordinates: 41.328°, -111.842332°
Surface Elev. (approx): Not Given

Equipment: Rubber Tire Backhoe
Excavated By: Tysen Butters
Logged By: Christine Underdown

CMT TECHNICAL SERVICES

Figure: 8

Eagle Ridge Cluster Subdivision Phase 9

Key to Symbols

Near Ridge Road, Eden, Weber County, Utah

Date: 4/8/22
Job #: 18262

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

COLUMN DESCRIPTIONS

① **Depth (ft.):** Depth (feet) below the ground surface (including groundwater depth - see water symbol below).

② **Graphic Log:** Graphic depicting type of soil encountered (see ② below).

③ **Soil Description:** Description of soils encountered, including Unified Soil Classification Symbol (see below).

④ **Sample Type:** Type of soil sample collected at depth interval shown; 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 of sample).

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:
9