GEOTECHNICAL ENGINEERING STUDY

Proposed Maverik Store

NWC of Sheldon Road & Stockton Boulevard
Elk Grove, California

CMT PROJECT NO. 14937

FOR:
Cardno, Inc.
1142 West 2320 South, Suite A
West Valley City, Utah 84119

August 4, 2020

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

CMT ENGINEERING LABORATORIES

August 4, 2020

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Subject: Geotechnical Engineering Study
Proposed Maverik Store
NWC of Sheldon Road & Stockton Boulevard
Elk Grove, California
CMT Project Number: 14937

Mr. Hamblin:

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 July 16 and 17, 2020, a total of 6 bore holes were augered/drilled at the site extending to depths between about 5.5 and 71.5 feet below the existing ground surface. Soil samples were obtained in the bore holes during the field operations and subsequently transported to our laboratory for further testing and observation.

Natural soils consisted of silty clay, silt and silty/clayey sand layers. Groundwater was encountered at a depth of about 55 feet below the surface. Based upon the results of our study the proposed structures may be supported on conventional strip and spread footings founded on suitable, undisturbed natural soils or engineered fill placed on suitable, undisturbed natural soils. A detailed discussion of design and construction criteria is presented in this report.

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, and 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) 492-4132.

Sincerely,
CMT Engineering Laboratories

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1.0 INTRODUCTION

1.1 General

CMT Engineering Laboratories (CMT) was retained to conduct a geotechnical subsurface study for a proposed Maverik Store. The site is situated at the northwest corner of the intersection of Sheldon Road and Stockton Boulevard in Elk Grove, California 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 communications between Mr. Russ Hamblin of Cardno, Inc., and Mr. Jeffrey Egbert of CMT Engineering Laboratories (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, field explorations were performed on the site by Cardno, which consisted of the drilling/logging/sampling of 6 bore holes. Our scope of work included performing laboratory testing on samples of the subsurface soils collected in the bore holes as provided to us, and conducting an office program which included correlating available data, performing engineering analyses, and preparing this summary report.

1.3 Description of Proposed Construction

We understand that the proposed construction consists of a new Maverik convenience store and fuel station with accompanying fuel islands and canopies, truck scales and underground fuel storage tanks. We project that wall loads for the store building will not exceed 4,000 pounds per linear foot. Floor slab loads are anticipated to be relatively light, with an average uniform loading not exceeding 150 pounds per square foot.

The fuel island canopies will be supported by steel frames and columns extending to the foundation system. It is projected that the maximum canopy downward column loads will be on the order of 60,000 pounds. In addition, uplift and lateral loads will be imposed upon these foundations.

If the loading conditions are different than we have projected, please notify us so that any appropriate modifications to our conclusions and recommendations contained herein can be made.

We also understand the parking/drive paved areas will utilize both asphalt and concrete pavement. Concrete pavement will likely be installed in front of the proposed store structure, as well as in the canopy fuel islands and over the underground storage tank area. In other areas, asphalt concrete sections will likely be used. Traffic is projected to consist of mostly automobiles and light trucks, a few daily medium-weight delivery trucks, multiple fuel delivery trucks, a weekly garbage truck, and an occasional fire truck.

1.4 Executive Summary

The most significant geotechnical aspects regarding site development include the following:

1. Subsurface natural soils consisted of CLAY (CL), SILT (ML) and SAND (SC, SM), extending to the bottom of the bore holes.
3. Groundwater was observed at a depth of approximately 55 feet below the surface, which will not affect construction.
4. The potential for liquefaction to occur in the soils we encountered is low.
5. Foundations and floor slabs may be constructed on suitable undisturbed natural soils or on structural/engineered fill which extends to natural soils.

A qualified geotechnical engineer must assess that non-engineered fill (if encountered), topsoil, debris, disturbed or unsuitable soils have been removed and that suitable soils have been encountered prior to placing structural/site grading fills, footings, slabs, and pavements.

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

2.0 FIELD EXPLORATION

2.1 General

In order to define and evaluate the subsurface soil and groundwater conditions, 6 bore holes were hand augered and/or drilled at the site to depths of approximately 5.5 to 71.5 feet below the existing ground surface. Locations of the bore holes are presented on **Figure 1**.

Samples of the subsurface soils encountered in the bore holes were collected at varying depths through the hollow stem drill augers. Relatively undisturbed samples of the subsurface soils were obtained by driving a split-spoon sampler with 2.5-inch outside diameter rings/liners into the undisturbed soils below the drill augers. Disturbed samples were collected utilizing a standard split spoon sampler. This standard split spoon sampler was driven 18 inches into the soils below the drill augers using a 140 pound hammer free-falling a distance of 30 inches. The number of hammer blows needed for each 6 inch interval was recorded. The sum of the hammer blows for the final 12 inches of penetration is known as a standard penetration test (SPT) and this 'blow count' was recorded on the bore hole logs. Where more than 50 blows occurred before the 6-inch interval was achieved, the sampling was terminated and the number of blows and inches penetrated by the sampler were recorded. The blow count provides a reasonable approximation of the relative density of granular soils, but only a limited indication of the relative consistency of fine grained soils because the consistency of these soils is significantly influenced by the moisture content.

The subsurface soil samples retrieved in the bore holes were classified in the field based upon visual and textural examination in general accordance with ASTM[1] D-2488. These field classifications were supplemented by subsequent examination and testing of select samples in our laboratory. Graphic logs of the bore holes, including a description of the soil strata encountered, are presented on the Bore Hole Logs, **Figures 2 through 7**, included in the Appendix. 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 8** in the Appendix.

2.2 Infiltration Testing

Infiltration testing was also performed in bore hole B-2 within natural clay soils. The testing consisted of drilling to 5 feet below the surface, removing the auger, filling the hole with water and measuring the rate of water drop over a certain time period (i.e. every 10 minutes). The final measured rate was approximately 7 minutes per inch.

3.0 LABORATORY TESTING

Selected samples of the subsurface soils were subjected to various laboratory tests to assess pertinent engineering properties, as follows:

[1]American Society for Testing and Materials

1. Moisture Content, ASTM D-2216, Percent moisture representative of field conditions
2. Dry Density, ASTM D-2937, Dry unit weight representing field conditions
3. Atterberg Limits, ASTM D-4318, Plasticity and workability
4. Gradation Analysis, ASTM D-1140/C-117, Grain Size Analysis
5. One-Dimensional Consolidation, ASTM-2435-11, Settlement Characteristics

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

LAB SUMMARY TABLE

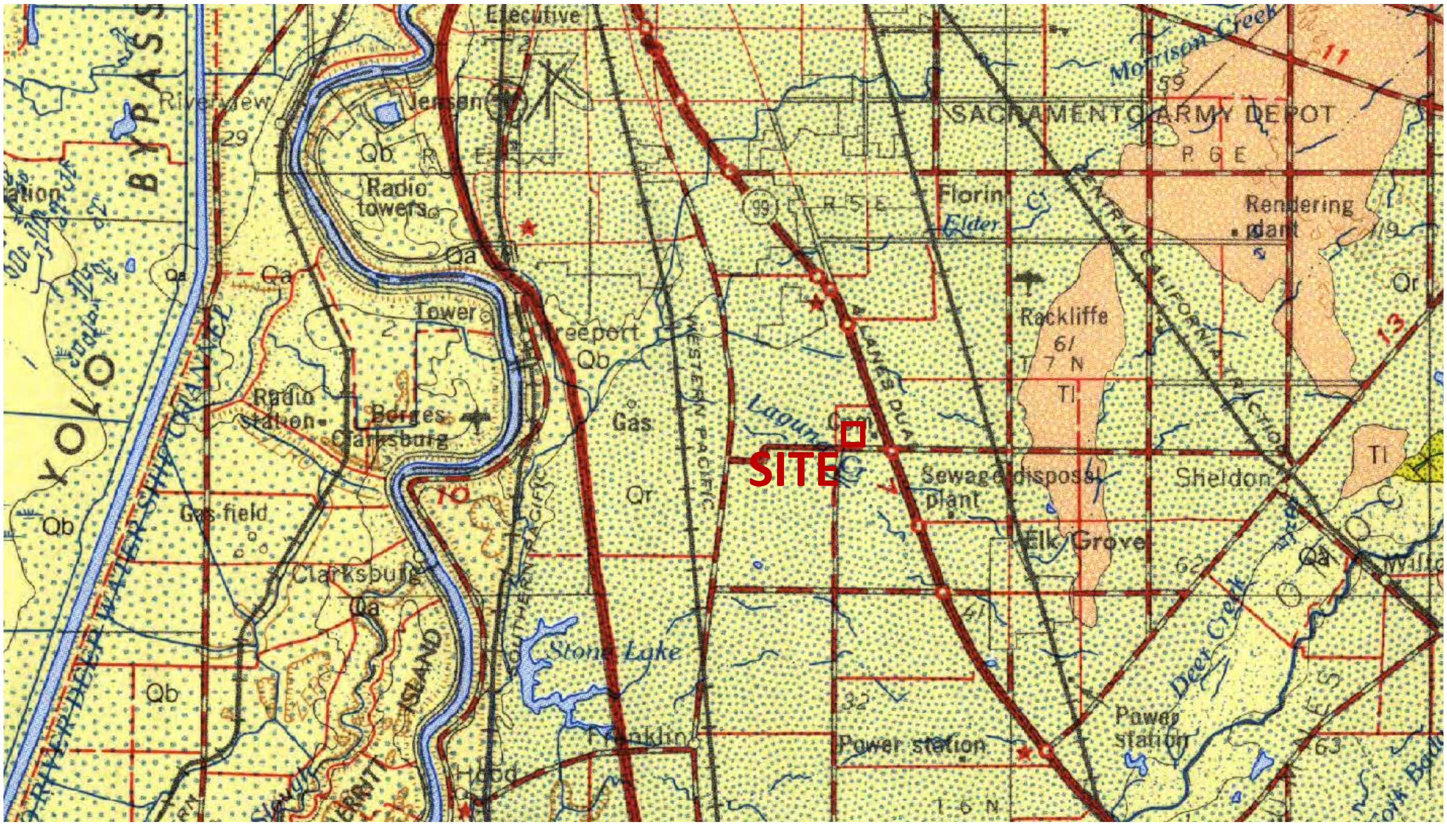
Bore Hole	Depth (feet)	Sample Type	Soil Class	Moisture Content (%)	Dry Denstiy (pcf)	Gradation			Atterberg Limits			Collapse (-) or Expansion (+)
						Grav	Sand	Fines	LL	PL	PI	
B-2	7.5	CL	Rings	12	109				29	15	14	+0%
	15	CL	Rings	21				69				
B-3	5	SC	Bag	16				35				
	9.5	CL	SPT	16					36	24	12	
B-4	10	ML	Rings	17	81					NP	NP	+0%
B-5	5	CL	Bag	12				68				
B-6	20	CL	Rings	13					39	14	25	
	30	CL	Rings	14					31	17	14	
	45	ML	SPT	26						NP	NP	
	55	ML	SPT	25						NP	NP	
	65	ML	SPT	22						NP	NP	

4.0 GEOLOGIC & SEISMIC CONDITIONS

4.1 Geologic Setting

The subject site is located within the northern half of the Central Valley in north-central California at an elevation of approximately 31 feet above sea level. The Central Valley is a large, flat valley approximately 450 miles long and up to 60 miles wide that dominates the geography of central California. The valley is bounded on the east by the Sierra Nevada Mountains and on the west by the Coast Range and is thought to have originated below sea level as an offshore area depressed by subduction of the Farallon Plate into a trench further offshore. The San Joaquin Fault is a notable seismic feature of the Central Valley that is located along the western margin of the central portion of the valley. The valley was enclosed by the uplift of the Coast Ranges, with its original drainage outlet into Monterey Bay. Over time, faulting moved the Coast Ranges, and a new drainage outlet developed near what is now San Francisco Bay. Over the millennia, the valley was filled by the sediments of these same ranges, as well as the rising Sierra Nevada to the east.

The geology of the Sacramento Quadrangle, that includes the location of the subject site, has been mapped by Wagner and others[2]. The geology at the location of the site and adjacent properties is mapped as "Riverbank Formation (Alluvium)" (Map Unit Qr) loosely dated as early to middle Quaternary. The referenced map only describes Unit Qr as "Alluvium". Refer to the **Geologic Map**., shown below.



GEOLOGIC MAP

4.2 Faulting

An interactive hazards map from the California Geological Survey[3] was reviewed. No fault traces are shown on the referenced geologic map crossing, adjacent to, or projecting toward the subject site. The nearest mapped active (Holocene) fault appears to be the Dunnigan Hills Fault approximately 33 miles to the northwest.

4.3 Seismicity

4.3.1 Site Class

We understand that the State of California Building Code (SCBC) 2019 was adopted on January 1, 2020, which we anticipate will be the code for design of the structures at this site. SCBC 2019 refers to Chapter 20, Site

[2] Wagner, D.L., Jennings, C.W., Bedrossian, T.L., and Bortugno, E.J., 1981, Geologic Map of the Sacramento Quadrangle, California; California Division of Mines and Geology, Regional Geologic Map Series, Map No. 1A, Sheet 1 of 4, Scale 1:250,000.
[3] https://maps.conservation.ca.gov/cgs/DataViewer/

Classification Procedure for Seismic Design, of ASCE[4] 7-16, which stipulates that the average values of shear wave velocity, blow count and/or shear strength within the upper 100 feet (30 meters) be utilized to determine seismic site class. Based on average blow counts and subsurface soils encountered within the maximum depth explored of 71.5 feet at the site, and presuming similar soils extend from 71.5 to 100 feet, it is our opinion the site best fits Site Class D – Stiff Soil (with data), which we recommend for seismic structural design.

4.3.2 Ground Motions

The seismic mapping utilized by the California Building Code 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 38.4385 degrees north latitude and -121.4041 degrees west longitude. The following table summarizes the peak ground, short period and long period accelerations for the MCE_R event, and incorporates appropriate soil correction factors for a Site Class D (with data) soil profile:

SPECTRAL ACCELERATION PERIOD, T	SITE CLASS B/C BOUNDARY [mapped values] (g)	SITE COEFFICIENT	SITE CLASS D* [adjusted for site class effects] (g)	MULTI-PLIER	DESIGN VALUES (g)
Peak Ground Acceleration	PGA = **0.232**	F_{pga} = 1.368	PGA_M = 0.317	1.000	PGA_M = 0.317
0.2 Seconds (Long Period Acceleration)	S_S = **0.553**	F_a = 1.358	S_{MS} = 0.751	0.667	S_{DS} = 0.501
	(no exceptions needed)	F_a = (N/A)	S_{MS} = (N/A)	0.667	S_{DS} = (N/A)
1.0 Second (Long Period Acceleration)	S_1 = **0.247**	F_v = N/A	S_{M1} = N/A	0.667	S_{D1} = N/A
	(Exception 2:)	F_v = (2.106)	S_{M1} = (0.520)	0.667	S_{D1} = (0.347)

NOTES: 1. TL (seconds): **8** — *** Site Class D With Data**
2. Site Class: **D** — **4. ASCE 7-16 Requires Site-Specific Ground Motion Hazard Analysis (Since S1≥0.2 sec) - OR Can Use Exception 2 (per §11.4.8)**
3. Have data to verify? **yes**

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

4.3.3 Liquefaction

Liquefaction is defined as the condition when saturated, loose, sandy soils lose their support capabilities because of excessive pore water pressure which develops during a seismic event. Clayey soils, even if saturated, will generally not liquefy during a major seismic event.

Groundwater was encountered at a depth of about 55 feet below the surface. Saturated soils below these depths consisted of hard to very hard silt and very dense sand lenses. Given these conditions, saturated sandy deposits will not liquefy due to a major seismic event.

[4] American Society of Civil Engineers

4.4 Other Geologic Hazards

No landslide deposits or features, including lateral spread deposits, are mapped on or adjacent to the site. The site is not located within a known or mapped potential debris flow or rock fall hazard area. A Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map[5] (FIRM) for the site and surrounding area indicates that the site is located in a "Zone X" flood hazard potential area defined as "minimal flood hazard."

5.0 SITE CONDITIONS

5.1 Surface Conditions

At the time the bore holes were drilled, the site was undeveloped land vegetated with weeds. The site grade was relatively flat with a very slight slope downward to the south. Based on aerial photos dating back to 1993 that are readily available on the internet, the site has remained relatively unchanged since that time but may have been used for agricultural purposes. The site was bordered on the north by multi-family residences, on the east by Stockton Boulevard, on the south by Sheldon Road, and on the west by similar undeveloped land (see **Vicinity Map** in **Section 1.1** above).

5.2 Subsurface Soils

Approximately 6 inches of topsoil or 6 to 12 inches of fill soils were encountered at the surface across the site. The fill soils, considered to be non-engineered fill, may be deeper at some locations and consisted of clay/sand/gravel with some concrete debris. The natural soils encountered below the topsoil/fill soils consisted of Silty CLAY with varying amounts of sand (CL), SILT with fine sand (ML), and Clayey to Silty SAND (SC to SM), extending to the maximum depth explored of 71.5 feet below the surface.

The clay and silt soils were slightly moist to wet, light to dark yellowish brown to grayish orange in color, and of very stiff to very hard consistency based upon the SPT blow counts. They also exhibited moderate over-consolidation and compressibility characteristics.

The natural sand soils were moist to wet, brown in color, and appear to be medium dense near the surface but at depth vary in relative density from dense to very dense based upon the SPT blow counts.

For a more descriptive interpretation of subsurface conditions, please refer to the bore hole logs, **Figures 2 through 7**, which graphically represent the subsurface conditions encountered. The lines designating the interface between soil types on the log generally represent approximate boundaries; in situ, the transition between soil types may be gradual.

[5] https://msc.fema.gov/portal/search?AddressQuery=elk%20grove%20ca#searchresultsanchor

5.3 Groundwater

Groundwater was encountered only within the deepest bore hole, B-6, at a depth of about 55 feet below the surface. This depth to groundwater will not affect construction or tank excavations.

Groundwater levels can fluctuate seasonally. Numerous factors such as heavy precipitation, irrigation of neighboring land, and other unforeseen factors, may influence ground water elevations at the site. The detailed evaluation of these and other factors, which may be responsible for ground water fluctuations, is beyond the scope of this study.

5.4 Site Subsurface Variations

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

6.0 SITE PREPARATION AND GRADING

6.1 General

All deleterious materials should be stripped from the site prior to commencement of construction activities. This includes loose and disturbed soils, topsoil, vegetation, etc. Based upon the conditions observed in the borings there is topsoil on the surface of the site which we estimated to be about 6 inches 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 at least the upper 4 inches. However, given the past agricultural uses of the site, the upper 12 to 15 inches may have been disturbed during farming.

In addition, approximately 6 to 12 inches of undocumented fill is present on the surface of the site, but locally could be deeper. Variation in the depth and lateral extent of non-engineered fill must be anticipated. All undocumented fill shall be removed from beneath structures. Outside of building footprints, proper preparation of undocumented fill and disturbed soils shall consist of removing the upper 6 inches, scarifying to a minimum depth of 8 inches and compacting the soils in place. The exposed subgrade must then be proofrolled by passing moderate-weight rubber tire-mounted construction equipment over the surface at least twice. If excessively soft or loose soils are encountered, they must be removed (up to a maximum depth of 2 feet) and replaced with structural fill.

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 existing ground surface, we should be notified to assess potential settlements and provide additional recommendations as needed. These recommendations may include placement of the site grading fill far in advance to allow potential settlements to occur prior to construction.

6.2 Temporary Excavations

Excavations up to 16 feet deep for tank excavations are anticipated at the site. 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 16 feet deep, above or below groundwater, may be constructed with side slopes no steeper than one horizontal to one vertical (1H: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 16 feet and above groundwater, side slopes should be no steeper than one horizontal to one vertical (1H:1V). Excavations encountering saturated cohesionless soils, though not anticipated, will be very difficult to maintain, and will require very flat side slopes and/or shoring, bracing and dewatering.

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

The table below contains our recommendations for the various fill types we anticipate will be used at this site:

FILL MATERIAL TYPE	DESCRIPTION | RECOMMENDED SPECIFICATION
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- to 2.0-inch gravel placed on stabilization fabric, such as Mirafi RS280i or equivalent (see **Section 6.6**).

The natural soils at this site are not suitable for use as structural fill or site grading fill. All on-site soils could be used as non-structural fill but could also be more difficult to work with given their plasticity. If utilized, these soils should be compacted to the same requirements as imported engineered fill as recommended below.

All fill material should be approved by a 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:

LOCATION	TOTAL FILL THICKNESS (FEET)	MINIMUM PERCENTAGE OF MAXIMUM DRY DENSITY
Beneath an area extending at least 4 feet beyond the perimeter of structures, and below flatwork and pavement (applies to structural fill and site grading fill) extending at least 2 feet beyond the perimeter	0 to 5	95
Site grading fill outside area defined above	0 to 5	92
Utility trenches within structural areas	--	96
Roadbase and subbase	-	96
Non-structural fill	0 to 5	90

Structural fills greater than 5 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 local or 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).

[6] American Association of State Highway and Transportation Officials
[7] American Public Works Association

6.6 Stabilization

The natural clayey soils, which predominated in the near surface soil profile, may be susceptible to rutting and pumping. The likelihood of disturbance or rutting and/or pumping 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 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 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.

7.0 FOUNDATION RECOMMENDATIONS

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

7.1 Foundation Recommendations

Based on our geotechnical engineering analyses, the proposed structures may be supported upon conventional spread and/or continuous wall foundations placed on suitable, undisturbed natural soils and/or on structural fill extending to suitable natural soils. Footings may be designed using a net bearing pressure of 2,000 psf if placed on suitable, undisturbed, natural soils or 2,500 psf if placed on a minimum 18 inches of structural fill. The term "net bearing pressure" refers to the pressure imposed by the portion of the structure located above lowest adjacent final grade, thus the weight of the footing and backfill to lowest adjacent final grade need not be considered. The allowable bearing pressure may be increased by 1/3 for temporary loads such as wind and seismic forces.

We also recommend the following:

1. Exterior footings subject to frost should be placed at least 12 inches below final grade.
2. Interior footings not subject to frost should be placed at least 8 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 non-engineered fill (if encountered), topsoil with organics, sod, rubbish, construction debris, other deleterious materials, frozen soils, or within ponded water. If unsuitable soils are encountered, they must be completely removed and replaced with properly compacted structural fill. The base of footing excavations and floor slab sub grades should be examined by a qualified 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 4 feet, the fill replacement width should be 6 feet, centered beneath the footing.

The minimum thickness of structural fill below footings should be equivalent to one-third the thickness of structural fill below any other portion of the foundations. For example, if 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 clayey soils and 0.40 for 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 400 pcf. A combination of passive earth resistance and friction may be utilized if the friction component of the total is divided by 1.5.

8.0 LATERAL EARTH PRESSURES

We anticipate that below-grade walls up to 4 feet high may be constructed at this site. The lateral earth pressure values given in the table below are for a backfill material that will consist of drained sand/gravel soils (less than 10% passing No. 200 sieve) 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)	35	30
At-Rest Pressure (wall is not allowed to yield)	55	80
Passive Pressure (wall moves into the soil)	425	575

*Equivalent Fluid Pressure (applied at 1/3 Height of 4-foot High Wall)
**Uniform Pressure, Seismic Only (applied at 1/2 Height of 4-foot High Wall)

9.0 BOUYANT FORCES

Groundwater was encountered at a depth of approximately 55 feet below the surface at the proposed tank locations (B-6). Based upon this condition we anticipate that underground tanks will not need to be designed to resist buoyant forces.

10.0 FLOOR SLABS

Floor slabs may be established upon suitable, undisturbed natural soils and/or on structural fill extending to suitable, undisturbed natural soils (same as for foundations). Under no circumstances shall floor slabs be established directly on any topsoil, 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, we recommend that floor slabs placed on structural fill be directly underlain by at least 4 inches of "free-draining" fill, such as "pea" gravel or 3/4-inch quarters to 1-inch minus, clean, gap-graded gravel. To help control normal shrinkage and stress cracking, the floor slabs should have the following features:

1. Adequate reinforcement for the anticipated floor loads with the reinforcement continuous through interior floor joints;
2. Frequent crack control joints; and
3. Non-rigid attachment of the slabs to foundation walls and bearing slabs.

11.0 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 the structures 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.

12.0 PAVEMENTS

All pavement areas must be prepared as discussed above in **Section 6.1**, which will provide 2 feet of prepared subgrade beneath pavement areas. Under no circumstances shall pavements be established over topsoil, un-prepared existing fill soils, loose or disturbed soils, sod, rubbish, construction debris, other deleterious materials, frozen soils, or within ponded water.

We anticipate the near surface clayey soils will exhibit poor pavement support characteristics when saturated or nearly saturated. Based on our laboratory testing experience with similar soils, our pavement design is based upon a Resistance (R) value of about 5 (approximate California Bearing Ratio of 3).

Given the projected traffic as discussed above in **Section 1.3**, the following pavement sections are recommended for the estimated Traffic Indices (TI):

MATERIAL	PAVEMENT SECTION THICKNESS (INCHES)					
	PARKING AREAS (T.I. = 5.0)			DRIVE AREAS (T.I. = 5.5)		
Asphalt	**3**	**3**	**---**	**3**	**3**	**---**
Concrete	**---**	**--**	**5**	**---**	**---**	**6**
Road-Base	**8**	**4**	**6**	**10**	**6**	**6**
Subbase	**0**	**6**	**0**	**0**	**6**	**0**
Total Thickness	**11**	**13**	**11**	**13**	**15**	**12**

Untreated base course (UTBC) should conform to city or Caltrans specifications. Material meeting our specification for structural fill can be used for subbase, as long as the fines content (percent passing No. 200 sieve) does not exceed 15%. Roadbase and subbase material should be compacted as recommended above in **Section 6.4**. Asphalt material generally should conform to Caltrans or APWA requirements.

Concrete pavement should be designed in accordance with the American Concrete Institute (ACI) and joint details should conform to the Portland Cement Association (PCA) guidelines. The concrete should have a minimum 28-day unconfined compressive strength of 4,000 pounds per square inch.

13.0 QUALITY CONTROL

We recommend that a comprehensive quality control testing and observation program be established during construction to 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:

13.1 Field Observations

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

13.2 Fill Compaction

Compaction testing 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.

13.3 Excavations

All excavation procedures and processes should be observed by a geotechnical engineer. 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. We recommend that freshly mixed concrete be tested in accordance with ASTM designations.

14.0 LIMITATIONS

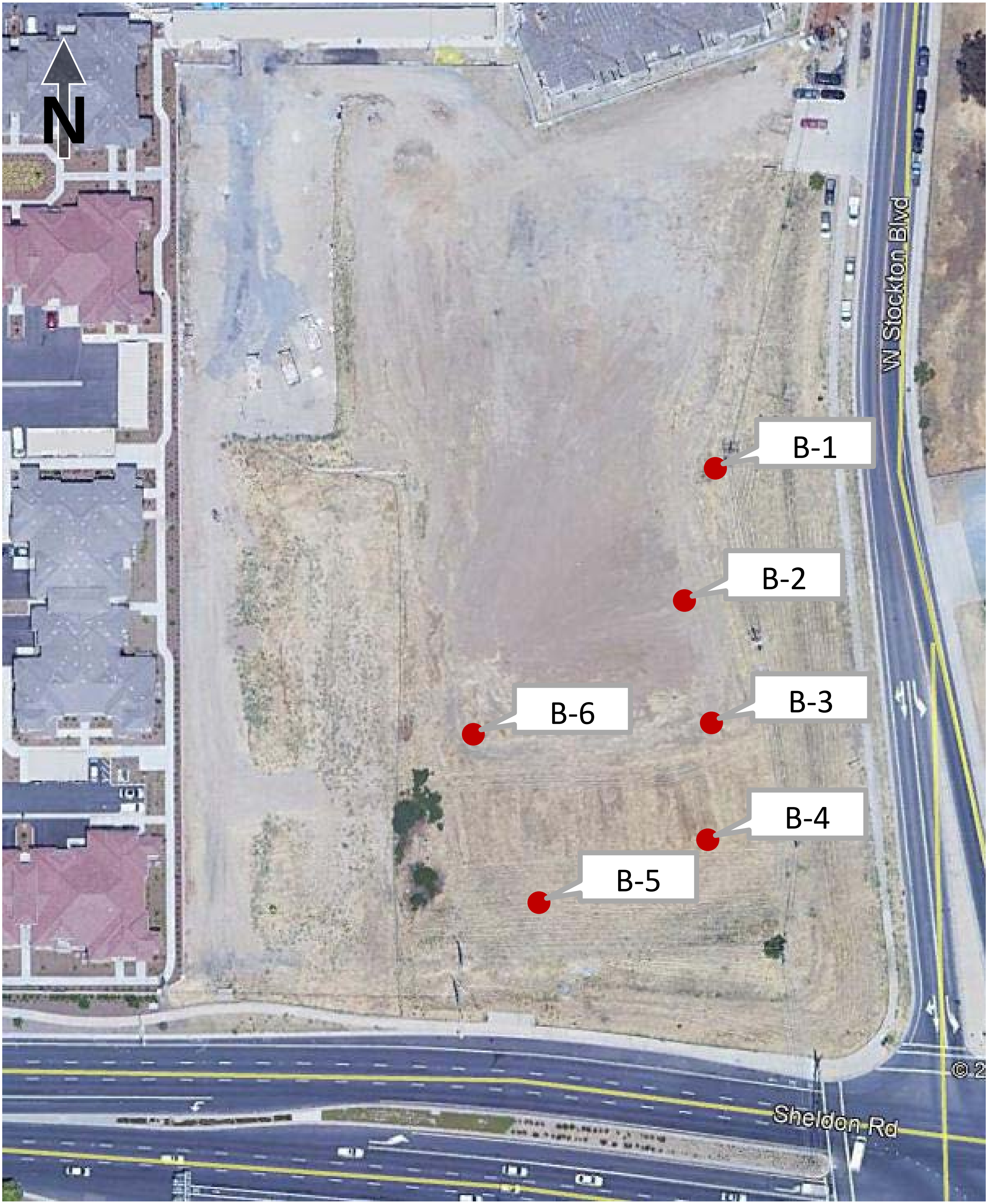
The recommendations provided herein were developed by evaluating the information obtained from the subsurface explorations and soils encountered therein. The exploration logs reflect the subsurface conditions only at the specific location at the particular time designated on the logs. Soil and ground 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) 492-4132.

APPENDIX

SUPPORTING
DOCUMENTATION



Maverik Store NWC of Sheldon Road & Stockton Blvd, Elk Grove, CA	CMT ENGINEERING LABORATORIES		Figure: 1
	Site Plan	Date: 31-Jul-20 Job # 14937	

Maverik, Elk Grove CA

NWC of Sheldon Road & Stockton Blvd, Elk Grove, CA

Bore Hole Log

B-1

Boring Type:	Hand Auger	Total Depth:	5.5'	Date:	7/16/20
Surface Elev. (approx):	N/A	Water Depth:	(see Remarks)	Job #:	14937

Depth (ft)	GRAPHIC LOG	Soil Description	Sample Type	Sample #	Blows (N)	Total	Moisture (%)	Dry Density(pcf)	Gradation Gravel %	Sand %	Fines %	Atterberg LL	PL	PI
0		FILL: sand/clay/gravel												
		Yellowish Brown Silty CLAY with fine sand (CL) slightly moist, medium stiff (estimated)												
				1										
4		Dark Yellowish-Orange Clayey SAND (SC), some calcification slightly moist, medium dense (estimated)												
				2										
		END AT 5.5'												
8														
12														
16														
20														
24														
28														

Remarks: Groundwater not encountered during drilling.

CMT ENGINEERING LABORATORIES

Drilled By: (Hand Auger)

Logged By: Michelle Bostrum

Figure: 2

Maverik, Elk Grove CA

NWC of Sheldon Road & Stockton Blvd, Elk Grove, CA

Bore Hole Log

B-2

Boring Type: Hand Auger/Hollow-Stem Auger
Surface Elev. (approx): N/A
Total Depth: 16.5'
Water Depth: (see Remarks)
Date: 7/17/20
Job #: 14937

Depth (ft)	Soil Description	Sample Type	Sample #	Blows (N)	Total	Moisture (%)	Dry Density (pcf)	Gravel %	Sand %	Fines %	LL	PL	PI
0	FILL: sand/clay/gravel, some concrete debris												
	Yellowish Brown Silty CLAY with fine sand (CL) slightly moist, medium stiff (estimated)												
			3										
4			4										
	Grayish-Orange Sandy CLAY (CL) slightly moist, very stiff												
8			5	8 11 17	28	12	109				29	15	14
			6	6 7 18	25								
12													
16	grades yellowish brown		7	8 26 31	57	21				69			
	END AT 16.5'												
20													
24													
28													

Remarks: Groundwater not encountered during drilling.

CMT ENGINEERING LABORATORIES

Drilled By: Cascade
Logged By: Michelle Bostrum
Page: 1 of 1

Figure: 3

Maverik, Elk Grove CA

NWC of Sheldon Road & Stockton Blvd, Elk Grove, CA

Bore Hole Log

B-3

Boring Type: Hand Auger/Hollow-Stem Auger
Surface Elev. (approx): N/A
Total Depth: 11'
Water Depth: (see Remarks)
Date: 7/17/20
Job #: 14937

Depth (ft)	Soil Description	Sample #	Blows (N)	Total	Moisture (%)	Dry Density(pcf)	Gravel %	Sand %	Fines %	LL	PL	PI
0	FILL: sand/clay/gravel											
	Dark Yellowish Brown Silty CLAY with fine sand (CL) slightly moist, medium stiff (estimated)	8										
4	Dark Yellowish-Orange Clayey SAND (SC), with calcified agglomerates moist, medium dense (estimated)	9			16				35			
8	Yellowish Brown Silty CLAY with fine sand (CL) moist, very stiff	10	17 25 33	58								
	hard	11	17 32 36	68	16					36	24	12
	END AT 11'											
12												
16												
20												
24												
28												

Remarks: Groundwater not encountered during drilling.

CMT ENGINEERING LABORATORIES

Drilled By: Cascade
Logged By: Michelle Bostrum

Figure: 4

Maverik, Elk Grove CA

NWC of Sheldon Road & Stockton Blvd, Elk Grove, CA

Bore Hole Log

B-4

Boring Type: Hand Auger/Hollow-Stem Auger	Total Depth: 16.5'	Date: 7/17/20	
Surface Elev. (approx): N/A	Water Depth: (see Remarks)	Job #: 14937	

Depth (ft)	Soil Description	Sample #	Blows (N)	Total	Moisture (%)	Dry Density (pcf)	Gravel %	Sand %	Fines %	LL	PL	PI
0	TOPSOIL											
	Dark Yellowish-Orange Clayey SAND (SC), with calcified agglomerates; slightly moist, medium dense (estimated)											
		12										
4												
		13										
	Yellowish Brown SILT with fine sand (ML), some calcification; moist, very hard											
8		14	8 26 44	70								
		15	19 27 42	69	17	81					NP	NP
12												
16		16	18 25 39	64								
	END AT 16.5'											
20												
24												
28												

Remarks: Groundwater not encountered during drilling.

Figure: 5

CMT ENGINEERING LABORATORIES

Drilled By: Cascade

Logged By: Michelle Bostrum

Maverik, Elk Grove CA

NWC of Sheldon Road & Stockton Blvd, Elk Grove, CA

Bore Hole Log

B-5

Boring Type: Hand Auger	Total Depth: 5.5'	Date: 7/16/20	
Surface Elev. (approx): N/A	Water Depth: (see Remarks)	Job #: 14937	

Depth (ft)	GRAPHIC LOG	Soil Description	Sample Type	Sample #	Blows (N)	Total	Moisture (%)	Dry Density(pcf)	Gradation: Gravel %	Sand %	Fines %	Atterberg: LL	PL	PI
0		TOPSOIL												
		Dark Yellowish-Orange Fine Sandy CLAY (CL) slightly moist, medium stiff (estimated)												
			◣	17										
4														
			◣	18			12				68			
		END AT 5.5'												
8														
12														
16														
20														
24														
28														

Remarks: Groundwater not encountered during drilling.

CMT ENGINEERING LABORATORIES

Drilled By: (Hand Auger)
Logged By: Michelle Bostrum

Figure: 6

Maverik, Elk Grove CA

NWC of Sheldon Road & Stockton Blvd, Elk Grove, CA

Bore Hole Log

B-6

Boring Type: Hand Auger/Hollow-Stem Auger | Total Depth: 71.5' | Date: 7/17/20

Surface Elev. (approx): N/A | Water Depth: 55' | Job #: 14937

Depth (ft)	Soil Description	Sample Type	Sample #	Blows (N)	Total	Moisture (%)	Dry Density(pcf)	Gravel %	Sand %	Fines %	LL	PL	PI
0	TOPSOIL												
	Dark Yellowish-Orange Fine Sandy CLAY (CL) slightly moist, stiff (estimated)												
			19										
4	Dark Yellowish-Orange Silty SAND (SM) slightly moist, medium dense (estimated)												
			20										
8	Grayish-Orange Sandy CLAY (CL) moist, hard		21	14 16 26	42								
			22	22 42 32	74								
12													
			23	13 18 27	45								
16	Dark Yellowish-Orange Silty SAND (SM) moist, medium dense												
20	Light Yellowish Brown Silty CLAY with fine sand (CL), some calcified agglomerates up to 3/4" size moist, hard		24	18 25 37	62	13					39	14	25
24													
	grades with frequent seams of Silt and Fine Sand and oxidation staining		25	10 19 32	51								
28													

Remarks: Groundwater encountered during drilling at depth of 55 feet.

CMT ENGINEERING LABORATORIES

Drilled By: Cascade

Logged By: Michelle Bostrum

Figure: 7

Maverik, Elk Grove CA

NWC of Sheldon Road & Stockton Blvd, Elk Grove, CA

Bore Hole Log

B-6

Boring Type: Hand Auger/Hollow-Stem Auger | Total Depth: 71.5' | Date: 7/17/20

Surface Elev. (approx): N/A | Water Depth: 55' | Job #: 11/22/40

Depth (ft)	GRAPHIC LOG	Soil Description	Sample Type	Sample #	Blows (N)	Total	Moisture (%)	Dry Density(pcf)	Gravel %	Sand %	Fines %	LL	PL	PI
28		Light Yellowish Brown Silty CLAY with fine sand (CL) (Continued)												
		hard		26	12 23 41	64	14					31	17	14
36		very hard		27	8 25 42	67								
		Dark Yellowish Brown SILT with fine sand (ML), occasional 4" to 6" thick lenses of sand; moist, very hard												
40				28	13 24 50/4"									
				29	19 39 41	80	26						NP	NP
		hard		30	15 18 34	52								
		grades with fequent oxidation staining below 51'												
56		wet		31	11 29	65	25						NP	NP

Remarks: Groundwater encountered during drilling at depth of 55 feet.

Figure: 7

CMT ENGINEERING LABORATORIES

Drilled By: Cascade

Logged By: Michelle Bostrum

Maverik, Elk Grove CA

NWC of Sheldon Road & Stockton Blvd, Elk Grove, CA

Bore Hole Log

B-6

Boring Type: Hand Auger/Hollow-Stem Auger	Total Depth: 71.5'	Date: 7/17/20	
Surface Elev. (approx): N/A	Water Depth: 55'	Job #: 11/22/40	

Depth (ft)	GRAPHIC LOG	Soil Description	Sample Type	Sample #	Blows (N)	Blows (N) Total	Moisture (%)	Dry Density(pcf)	Gravel %	Sand %	Fines %	LL	PL	PI
56		Dark Yellowish Brown SILT with fine sand (ML) (Continued)			36									
		Thinly Laminated Seams of SILT (ML) and Fine Silty SAND (SM), oxidation staining wet, very hard/dense												
60				32	24 40 45	85								
64				33	20 37 41	78	22						NP	NP
68				34	15 31 50/5"									
72		END AT 71.5'												
76														
80														
84														

Remarks: Groundwater encountered during drilling at depth of 55 feet.

CMT ENGINEERING LABORATORIES

Drilled By: Cascade

Logged By: Michelle Bostrum

Figure: 7

Maverik, Elk Grove CA

NWC of Sheldon Road & Stockton Blvd, Elk Grove, CA

Key to Symbols

Date: 7/16/20
Job #: 14937

Depth (ft)	GRAPHIC LOG	Soil Description	Sample Type	Sample #	Blows(N)	Total	Moisture (%)	Dry Density(pcf)	Gradation ⑩ Gravel %	Sand %	Fines %	Atterberg ⑪ LL	PL	PI
①	②	③	④	⑤	⑥	⑦	⑧	⑨						

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

⑦ **Total Blows:** Number of blows to advance sampler the 2nd and 3rd 6" increments.

⑧ **Moisture (%):** Water content of soil sample measured in laboratory (percentage of dry weight of sample).

⑨ **Dry Density (pcf):** The dry density of a soil measured in laboratory (pounds per cubic foot).

⑩ **Gradation:** Percentages of Gravel, Sand and Fines (Silt/Clay), obtained from lab test results of soil passing the No. 4 and No. 200 sieves.

⑪ **Atterberg:** Individual descriptions of Atterberg Tests are as follows:

LL = Liquid Limit (%): Water content at which a soil changes from plastic to liquid behavior.

PL = Plastic Limit (%): Water content at which a soil changes from liquid to plastic behavior.

PI = Plasticity Index (%): Range of water content at which a soil exhibits plastic properties (= Liquid Limit - Plastic Limit).

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

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

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

UNIFIED SOIL CLASSIFICATION SYSTEM (USCS)

MAJOR DIVISIONS			USCS SYMBOLS	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 Very Fine Sands, Silty or Clayey Fine Sands 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 o f Low Plasticity
	SILTS AND CLAYS Liquid Limit greater than 50%		MH		Inorganic Silts, Micacious or Diatomacious Fine Sand or Silty Soils with Plasticity (Elastic Silts)
			CH		Inorganic Clays of High Plasticity, Fat Clays
			OH		Organic Silts and Organic Clays of Medium to High Plasticity
HIGHLY ORGANIC SOILS			PT		Peat, Humus, Swamp Soils with High Organic Contents

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

SAMPLER SYMBOLS

- Block Sample
- Bulk/Bag Sample
- Modified California Sampler 3.5" OD, 2.42" ID
- D&M Sampler
- Rock Core
- Standard Penetration Split Spoon Sampler
- Thin Wall (Shelby Tube)

WATER SYMBOL

- Encountered Water Level
- Measured Water Level

(see Remarks on Logs)

1. The results of laboratory tests on the samples collected are shown on the logs at the respective sample depths.
2. The subsurface conditions represented on the logs are for the locations specified. Caution should be exercised if interpolating between or extrapolating beyond the exploration locations.
3. The information presented on each log is subject to the limitations, conclusions, and recommendations presented in this report.

CMT ENGINEERING LABORATORIES