GEOTECHNICAL INVESTIGATION
WATERLOO MORADA FIRE STATION 2
4946 East Eight Mile Road
Stockton, California

File No. 4694-007

Raney Geotechnical Inc

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October 14, 2020

Waterloo Morada Fire District
C/O Dillon & Murphy Engineering
Attention: Cesar Palacios
Post Office Box 2180
Lodi, CA 95421

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INTRODUCTION

Our firm has completed a Geotechnical Investigation for a fire station proposed for construction on East Eight Mile Road in Stockton. The purpose of our investigation has been to provide data pertinent to earthwork construction, foundation design, slab-on-grade thickness and support, flatwork, and pavements. This report presents the results of our investigation.

Field exploration for this investigation has included the drilling of two borings extending to depths of about ten feet using a truck mounted drill rig. Relatively undisturbed samples from the borings and disturbed samples from other locations were obtained and returned to our laboratory for further review and testing. The locations of the borings and sampling sites are shown relative to the existing and proposed construction over an aerial photo base on Plate 1, *Plot Plan*. Descriptions of the soils encountered in the borings are presented on Plates 2 and 3, *Log of Boring*. The nomenclature used to describe the soils on the logs is defined on Plate 4, *Unified Soil Classification System*. The results of moisture, density, and unconfined compressive strength tests are included on the logs at the depths of each sample tested. Atterberg limits tests were performed on a selected sample for soil classification purposes; the test results are graphed on Plate 5, *Atterberg Limit Data*. The results of testing performed to assess the pavement subgrade properties are presented on Plate 6, *Resistance Value Data*.

PROPOSED CONSTRUCTION

We understand it is planned to demolish a detached garage and carport in order to construct an approximate 2,400 square foot metal building for use as a fire station apparatus room. The building will have a concrete slab-on-grade floor. Foundation loads are expected to be relatively light and common to metal frame construction. New asphalt concrete (AC) paved driveways will be provided for access to the building. The AC pavements and building slab must be capable of sustaining fire trucks weighing up to 80,000 pounds. We understand that the station will have one two-axle truck, and another with a single axle in the front and a tandem axle in the rear.

For purposes of this report, we have assumed that the finished floor level and the finished pavement level will be at or slightly above the current site grades. Grading of the building pad is expected to require nominal cuts and fills. Grading of the pavement areas is expected to require on the order of two feet of cuts, and on the order of three to five feet of over-excavation and replacement with engineered fill within the area of an existing leach field that crosses the proposed driveway, as discussed herein.

SITE CONDITIONS

SURFACE

The approximate 7.3-acre property fronts on the southerly side of East Eight Mile Road. The property is bound by a residence addressed as 5020 East Eight Mile Road on the east, a residence addressed as 4874 East Eight Mile Road on the west, and a subdivision on the south. A house, carport, detached garage, and metal building are on about the northerly 250 feet of the property. AC pavements are at the central portion of about the northerly 160 feet of the property between the detached garage and house. Low concrete masonry unit (CMU) walls are around the northerly 160 feet of the property. Chain link fences are at the southerly limits of the AC pavements. The remainder of the property consists of undeveloped land that has been disced recently. The ground surface is relatively flat with an average elevation on the order of +39 feet.

SUBSURFACE

We measured pavement sections consisting of three and one-half inches of AC over three inches of aggregate base (AB) in Test Boring 1, and one inch of AC over a woven geotextile fabric over six inches of AB in Test Boring 2. Below the pavements and extending to a depth of about three and one-half feet in Test Boring 1, and a depth of about four and one-quarter feet in Test Boring 2, stiff, high plasticity, dark gray-brown clays were encountered. Below the high plasticity clays and extending to a depth of about four and one-half feet in Test Boring 1, stiff, lower plasticity, brown slightly silty slightly fine sandy clays were found. Below the clays and extending to depths of near nine feet in both test borings, medium dense, brown, silty very fine to fine sands and silty fine to coarse sands were encountered. Below the silty sands and extending to the maximum ten-foot-depth drilled, medium dense, moist to very moist, brown and light brown, fine to coarse sands were encountered.

For better understanding of the subsurface conditions, reference should be made to Plates 2 and 3, *Log of Boring*.

CONCLUSIONS

GROUNDWATER

Free groundwater was not encountered in our exploration. A boring log obtained by the State Department of Water Resources (DWR) for a well about 1,000 feet to the north indicates that the groundwater level was measured to be about 90 feet below the ground surface on May 2, 2016. This depth is consistent with groundwater maps prepared by San Joaquin County. Based on this information and experience in the area, we conclude that the permanent groundwater table will not have a significant effect on the proposed construction.

During the wet season, infiltrating water through cracks in the pavements as well as lateral migration from unpaved areaswill increase soil moisture contents. The pavements will also reduce normal soil moisture evaporation. This may result in high soil moisture contents that persist year round. High moisture content soils can be unstable under earthwork equipment and may require considerable aeration in order to achieve a moisture content which will allow compaction. The prospect of high moisture conditions and unstable surface soils should be considered in scheduling earthwork construction. Allowing as long of an aeration period as possible after existing pavements are removed can reduce instability problems during preparation of the new building pad and new pavement areas.

BEARING CAPACITY

The immediate surface soils generally exhibit stiff and medium dense consistencies. The undisturbed native soils, properly reworked native soils and engineered fill materials are expected to provide adequate support for the proposed improvements.

EXPANSIVE SOILS

The near surface soils consist of high plasticity clays that are capable of developing significant swelling pressures with variations in moisture content. Shrinking and swelling of these clays will cause movements and possible distress to floor slabs, foundations, flatwork, and pavements. Related sticking of doors as well as cracking of drywall and rigid siding may occur. Expansion effects on foundations can be reduced by use of reinforcement and increasing foundation depths to bear in soils where moisture content variations are lower.

Procedures commonly used to reduce expansive soil effects on floor slabs include treatment of soils with lime and cement to alter expansive tendencies; over-excavation and replacement of expansive clays with non-expansive fill materials; and reinforcement of floor slabs together with saturation and preswelling of soils prior to concrete slab placement. Chemical treatment and over-excavation of the expansive clays can provide adequate performance. Presaturation is less effective than the other methods and is not considered compatible with the performance requirements of a fire station. However, given the relatively small footprint of the building, chemical treatment may not be cost effective. Recommendations are presented below for over-excavation and replacement of expansive clays beneath the floor slab. We can provide recommendations for lime treatment upon request.

SEISMIC DESIGN

In design using the Equivalent Lateral Force or Modal Response Spectrum Analysis procedures of the 2019 California Building Code/ASCE 7-16, the parameters in Table 1 are considered appropriate for this site. With Site Class D and a Mapped Spectral Response Acceleration S_1 equal to or greater than 0.2g, the Seismic Response Coefficient C_S used to scale base shear must be increased as indicated in the following paragraph. Otherwise, a site specific ground motion hazard analysis is required.

When using the Equivalent Lateral Force or Modal Response Spectrum Analysis procedures, the calculated maximum value of C_S (Equation 12.8-2) should be used for structures with fundamental periods of up to $1.5*(S_{D1}/S_{DS}) = 0.992$ seconds. For structures with greater periods, the calculated limitations on values of C_S (Equations 12.8-3 and 12.8-4) should be increased by 50 percent.

TABLE 1
2019 CBC/ASCE 7-16 SEISMIC DESIGN PARAMETERS

Period (seconds)	Mapped Spectral Response Accelerations (g)		Site Class	Site Coefficients		Maximum Considered Earthquake Spectral Response Accelerations (g)		Design Spectral Response Accelerations (g)	
0.2	S_S	0.639	D	F_a	1.289	S_{MS}	0.824	S_{DS}	0.549
1.0	S_1	0.262		F_v	2.076*	S_{M1}	0.544*	S_{D1}	0.363*

*To be used only for calculation of T_s

LIQUEFACTION POTENTIAL

Soil liquefaction is the loss of strength of low-cohesion soils (usually sands) that occurs when pore water pressure exceeds the intergranular stress of the soils. Liquefaction normally occurs only under saturated conditions and in soils with low relative density. Liquefaction can occur during earthquakes as vibrations induce soils to readjust to a more compacted state. Research has shown that earthquake induced liquefaction normally occurs only within about the upper 50 to 60 feet of the soil profile. Given the depth of the free groundwater table and the low levels of shaking anticipated for this site, we conclude that seismic induced liquefaction at this site is unlikely.

RECOMMENDATIONS

EARTHWORK

Site clearance should include the removal of unwanted pavements, planters, CMU walls, unwanted structures, foundations, slabs, and flatwork. Surface vegetation, rubble, rubbish, and any other unwanted construction or debris also should be removed. Any small diameter (2" or less) underground pipes within two feet (2') of the original or final soil grade, whichever is lower, should be removed from new construction areas. Larger diameter pipes should be removed from the new building pad regardless of depth. Existing septic and leach field areas within new construction areas should be over-excavated to expose firm, undisturbed native soils. This is expected to require on the order of three to five feet of over-excavation. These areas should be restored to grade with engineered fill. Care should be taken to avoid undermining adjacent construction.

Deep excavations required for the removal of the above items should be sloped back to a dish-shaped configuration to allow through passage of compaction equipment, and then restored to grade with engineered fill placed and compacted in accordance with the following recommendations.

The building pad area should be over-excavated so that a non-expansive fill layer may be constructed on the surface of the building pad. The over-excavation and non-expansive fill should extend to a depth of at least 24 inches below the bottom of the apparatus room floor slab. The over-excavation should extend at least five feet beyond building wall lines in pavement areas, should extend at least one foot beyond wall lines in landscaping areas, and should be extended to the outer edges of any patio or flatwork that are attached to the building. Following over-excavation grades should be restored with non-expansive fill placed in accordance with the following recommendations.

Areas designated to receive engineered fill as well as the building pad, flatwork, and pavement areas that are completed in excavation or left at existing grade should be scarified to a depth of eight inches, brought to a minimum three percent over the optimum moisture content and re-compacted in place to at least 90 percent of the maximum dry density determined by ASTM D1557 test procedure. Engineered fill should be placed in lifts not exceeding six inches in compacted thickness, brought to a uniform moisture content, and compacted to at least 90 percent of the maximum dry density, as defined above. Fills composed of on-site clays should be placed at a moisture content of at least three percent over optimum. Fills composed of sands, silts or gravels should be placed at a moisture content of at least optimum. Fills composed of aggregate base should be compacted to at least 95 percent of the maximum dry density.

On-site soils are suitable for use as engineered fill provided the soils do not contain significant vegetable matter, rubble, rubbish, or other undesirable substances. Only imported non-expansive materials should be used for fill within the upper two feet of the new building pad. Beneath floor slabs supporting fire fighting apparatus, the fill should consist of Caltrans Class 2 AB. In other floor areas, the non-expansive fill may consist of AB; or it may consist of sands, silts, or gravels with a plasticity index of ten or less. Proposed imported soils should be approved by our firm prior to importation to the site.

The upper eight inches of the building pad, flatwork and pavement subgrades should be compacted to at least 90 percent of the ASTM D1557 maximum dry density, at a minimum three percent over the optimum moisture content, regardless of whether the final grade is achieved by cutting, by filling, or is left at existing grade. AB materials should be compacted to at least 95 percent of the ASTM D1557 maximum dry density.

A representative of this firm should be present during grading to test and observe earthwork construction.

FOUNDATIONS

The near surface soils consist of high plasticity clays and will be subject to seasonal moisture variations and related shrinking and swelling. Recommendations are presented below for use of conventional continuous and isolated spread foundations. The following recommendations include minimum depth and reinforcing intended to reduce the effects of the expansive soil movements. However, it should be noted that expansive soil movements will still occur, and expectations of foundation/slab performance should be realistic. If greater assurance against expansive soil effects is desired, foundation depths can be increased. Our firm can provide further discussion on increasing foundation depths upon request.

The proposed building may be supported on conventional continuous and isolated spread foundations based within undisturbed or recompacted native soils, engineered fill placed in accordance with the recommendations of this report, or a combination of these materials. Foundations should extend to a minimum depth of 36 inches below the building pad or lowest surrounding subgrade levels. A minimum foundation width of 12 inches should be maintained. Foundations based as recommended may be sized using maximum bearing capacities of 3,000 pounds per square foot (psf) for dead plus live load or 4,000 psf for total load, including the effects of seismic and wind forces. The weight of foundation concrete below grade may be neglected in sizing computations. Continuous foundations should contain minimum reinforcement equivalent to or greater than six No. 5 bars – three each top and bottom. Actual reinforcement should be detailed by the project Structural Engineer.

Resistance to lateral forces may be computed using friction and passive earth pressure, but not both, except, as recommended below. A coefficient of friction of 0.30 may be utilized in design. Passive earth pressure may be assumed to be equivalent to the stress exerted by a fluid weighing 300 pounds per cubic foot. A combination of friction and passive earth pressure may be used in design, provided that the larger mode of resistance is reduced by 50 percent. The recommended friction coefficient and passive earth pressure have been modified by appropriate factors of safety and may be applied directly in design.

Foundation excavations should be clean and free of all loose and/or soft materials, and the bearing materials should be in a firm, moist condition when foundation concrete is placed.

SLAB-ON-GRADE

Floor slabs may be supported on the building pad prepared as recommended above. Living/office area concrete slab-on-grade floors should be at least four inches thick and underlain by a minimum four-inch thick blanket of free draining crushed rock to serve as a capillary moisture break. The crushed rock should be graded such that 100 percent will pass a one-inch sieve and none will pass a No. 4 sieve. To reduce moisture vapor penetration, the crushed rock should be covered with a plastic membrane at least ten mils thick. The membrane may be protected by one to two inches of clean sand, if desired. As an alternative the membrane may be placed directly on the building pad beneath the crushed rock, and the protective sand eliminated. Care should be taken to avoid puncture of the membrane during the construction process.

With the use of water-based floor adhesives, impervious floor coverings are extremely sensitive to slab moisture. Under some conditions, the small amount of moisture vapor which bypasses the vapor membrane, or even the excess water remaining in the slab from placement, can be sufficient to cause debonding and discoloration problems. To minimize sub-slab moisture vapor problems, the capillary break gravel must be present to the minimum recommended thickness and the membrane must be continuous throughout the slab area. Any membrane seams should overlap by at least one foot. The membrane should be cut tight to penetrations and tape sealed. Tears and punctures should be sealed with membrane manufacturer-approved tape, or overlain by a patching membrane. Slab concrete should be placed at as low a water to cement ratio as practical. The under-slab gravel layer should be protected from precipitation and other moisture; wetting of the sand over the membrane prior to concrete placement should be minimized. The edges of the slab at the building perimeter should be thickened to form a cutoff between the building exterior and under-slab gravel layers. If impervious floor coverings are planned and greater assurance against moisture problems is desired, consideration should be given to waterproofing of slabs with a quality commercial concrete sealant. A sealant or other waterproofing system may be necessary for the satisfactory performance of wood laminates, sheet vinyl, and other impervious flooring.

Apparatus room slabs must be capable of sustaining fire trucks weighing up to 80,000 pounds. We understand that the station will have one two-axle truck, and another with a single axle in the front and a tandem axle in the rear. We used fire truck axle weight limits based on the Fire Apparatus Manufacturers' Association and the Caltrans fire truck exemptions in slab design. Assuming each truck will enter and exit the building on average six times a day, seven days a week, and a 20-year design life, our calculations indicate that at least nine inches of Portland cement concrete (PCC), placed directly over the minimum 24-inch-thick AB building pad, would be appropriate for this level of traffic. The slabs should be waterproofed with a quality commercial sealant. If the apparatus room floors are not placed continuously with an exterior concrete driveway, if used, or meets the exterior AC driveway, then the floor slab edges at the truck doorways should be thickened. The thickened edges should be achieved by tapering the slabs from nine to 11 inches over the outer five feet of the slab edges.

PCC placed for the apparatus room floors should have a minimum unconfined compressive strength (f'c) of 4,000 pounds per square inch (psi) or higher at 28 days. Slab concrete should be placed at a slump of no more than three inches. The slabs should have shrinkage crack control joints spaced on maximum 20-foot centers in both directions. Each slab section formed by the joints should be kept as near to equal dimensions in each direction as possible.

We suggest floor slabs include at least nominal reinforcement, such as No. 4 bars on 24-inch-centers each way, to aid in crack control.

Shrinkage crack control joints may consist of saw-cut grooves penetrating to a depth of at least one-quarter of the slab thickness. With the recommended joint spacing, load transfer devices such as dowels are not considered necessary for a monolithically poured slab. Construction cold joints, however, should include dowels to provide load transfer. American Concrete Institute (ACI) suggests use of at least one and one-quarter inch diameter dowels, at least 18 inches long, and spaced no more than 12-inch centers, for nine inch-thick slabs. Since it is likely that construction joints would also serve as shrinkage crack control joints, one end of each dowel should be greased or wrapped to allow lateral movement. All reinforcement and dowels should be chaired at or above the mid-depth of the slabs.

EXTERIOR FLATWORK

Exterior flatwork subgrades should be moisture conditioned. We suggest that all flatwork should contain reinforcement as well as use of thickened exterior flatwork edges to reduce the effects of expansive soil movements. We also suggest use of frequent control joints and recommend limiting control joint spacing to six feet or less. Consideration also should be given to providing eight inches or more of Caltrans Class 2 AB beneath flatwork.

Expansive soil movements will cause exterior flatwork to move differentially relative to the building floor slab. At doorways, a joint between exterior flatwork and the foundation as well as a step would allow differential movement. Where the exterior flatwork must meet the interior floor level at doorways, we have recommended the expansive clay soils beneath the flatwork be over-excavated to at least 24 inches below the flatwork soil subgrade level and replaced with non-expansive materials such as Caltrans Class 2 AB or crushed rock.

PAVEMENTS

Resistance (R) value tests are used to assess pavement support properties of soils. R values can range from 5 for the poorest quality clays to 70 or more for high quality sands and gravels. The R value test we performed on a sample of the near surface soils resulted in an R value of 11. Experience in this area have shown that the R value for the native high plasticity clays can be as low as 3. We used a reduced R value of 8 in the Caltrans Design Method for Flexible Pavements to calculate alternative pavement sections. The Caltrans Design Method uses traffic indices (TI's) to account for anticipated pavement loads, usage, and design life. It is common to use a design life of 20 years for commercial pavements.

The Asphalt Institute has suggested that a TI of 4.5 may be reasonably representative of automobile parking lot wheel loads. As indicated above, driveway pavements must be capable of sustaining fire trucks weighing up to 80,000 pounds. We understand that the station will have one two-axle truck, and another with a single axle in the front and a tandem axle in the rear. We used fire truck axle weight limits based on the Fire Apparatus Manufacturers' Association and the Caltrans fire truck exemptions in flexible pavement design. Assuming the flexible pavement will be used by each truck on average six times a day, seven days a week, and a 20-year design life, our calculations indicate a TI of 9.0 is representative of this usage. Recommended pavement section alternatives for these TI's are presented in Table 2. We can provide additional pavement sections for other TI's and loading frequencies upon request. Decisions regarding pavement sections should be made on the basis of economics and the desired level of future maintenance.

TABLE 2
PAVEMENT SECTION ALTERNATIVES

	Design Traffic Index	Type B Asphalt Concrete (inches)	Portland Cement Concrete (inches)	Class 2 Aggregate Base (inches)
Automobile Parking	4.5	2.5 3.0	-- --	9 8
Fire Truck Driveways, including Entry Aprons	9.0	4.0 5.0 --	-- -- 9.0	22 20 12

PCC driveways should have a minimum unconfined compressive strength (f'c) of 4,000 pounds per square inch (psi) or higher at 28 days. Slab concrete should be placed at a slump of no more than three inches.

We recommend the outside edges of driveway slabs be thickened to at least 11 inches. The transition to the thickened edge can be achieved by tapering from the nine inch interior slab thickness to the 11 inch thick edge over a distance of at least five feet. The taper can be accomplished by thinning the gravel layer under the slab.

PCC pavements should have shrinkage crack control joints spaced on maximum 20-foot centers. Each slab section formed by the joints should be kept as near to equal dimensions in each direction as possible. We suggest driveway slabs include at least nominal reinforcement, such as No. 4 bars on 24-inch-centers each way, to aid in crack control.

Shrinkage crack control joints may consist of saw-cut grooves penetrating to a depth of at least one-quarter of the slab thickness. With the recommended joint spacing, load transfer devices such as dowels are not considered necessary for a monolithically poured slab. Construction cold joints, however, should include dowels to provide load transfer. ACI suggests use of at least one and one-quarter inch diameter dowels, at least 18 inches long, and spaced no more than 12-inch centers, for nine inch-thick slabs. Since it is likely that construction joints would also serve as shrinkage crack control joints, one end of each dowel should be greased or wrapped to allow lateral movement. All reinforcement and dowels should be chaired at or above the mid-depth of the slabs.

Pavement subgrades should be prepared in accordance with the *Earthwork* section of this report. Materials and construction within structural pavement sections should conform to the applicable provisions of the 2018 Caltrans Standard Specifications. AB should be compacted to at least 95 percent of the ASTM D1557 maximum dry density.

LIMITATIONS

This report necessarily assumes uniform variation of soils between our borings and sampling locations. Our recommendations are based upon this assumed uniformity and the information provided regarding the proposed construction. If unusual conditions are encountered during construction, the contractor or his representative should notify this firm immediately so that alternate recommendations can be made.

This report is applicable only to the proposed construction, as described herein, and should not be utilized for design or construction on any other site.

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The following Plates are attached and complete this report:

- Plate 1 - Plot Plan
- Plate 2 - Log of Boring, Boring 1
- Plate 3 - Log of Boring, Boring 2
- Plate 4 - Unified Soil Classification System
- Plate 5 - Atterberg Limit Data
- Plate 6 - Resistance Value Data

Very truly yours,

RANEY GEOTECHNICAL, INC

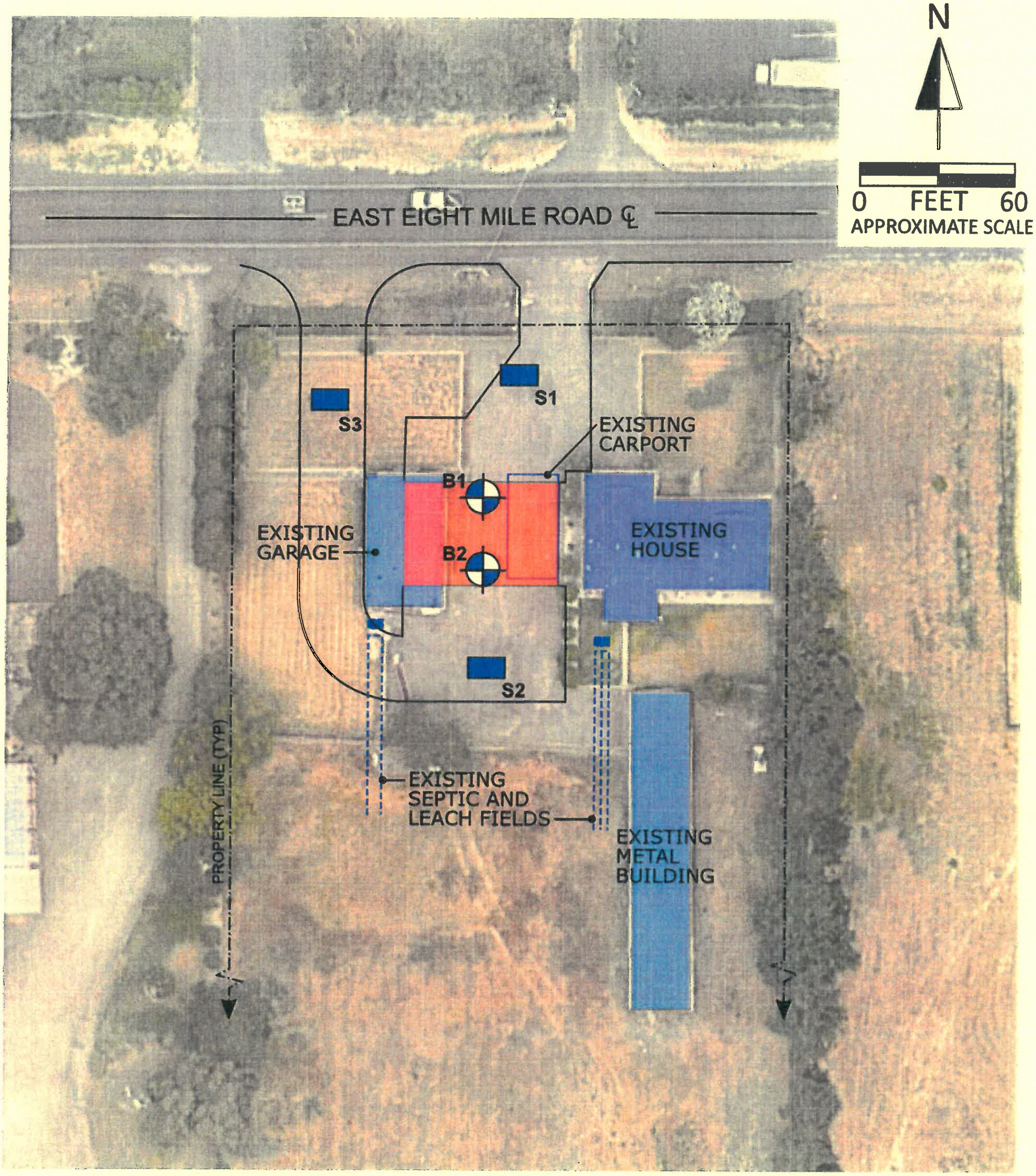
REGISTERED PROFESSIONAL ENGINEER
TONY Y.G. LEI
C89262
CIVIL
STATE OF CALIFORNIA

10/14/20

Tony Y.G. Lei
Registered Civil Engineer No. C89262

TYGL/WCB

PROJECT NUMBER: 4694-007



NOTES:

1. BORING AND SAMPLING LOCATIONS SHOWN ARE APPROXIMATE.
2. PREPARED FROM A SITE PLAN BY DILLON & MURPHY ENGINEERING AND A 8/3/19 GOOGLE EARTH IMAGE.

KEY:

B1 — BORING LOCATION AND NUMBER

S1 — SURFACE SAMPLING LOCATION AND NUMBER

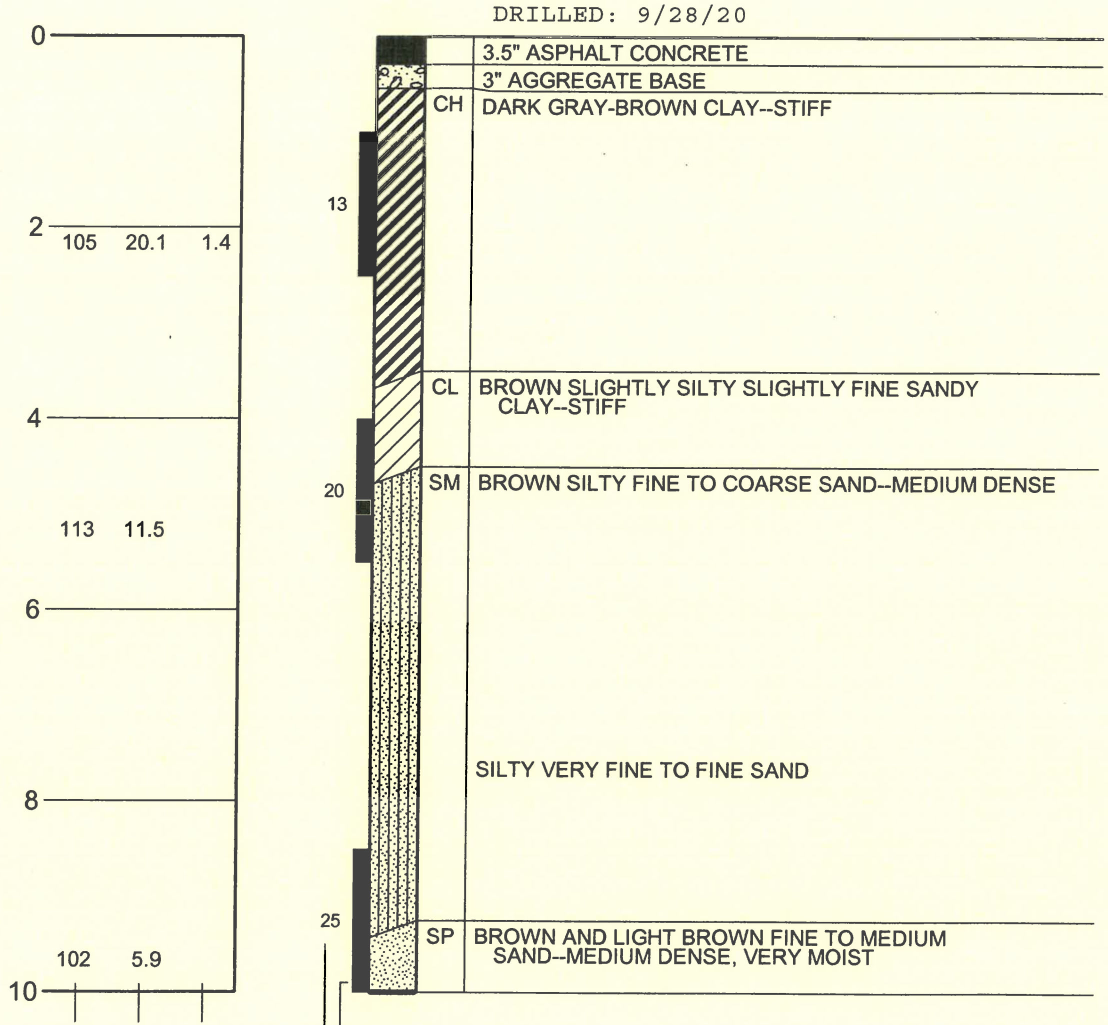
PLOT PLAN

Raney Geotechnical Inc

PLATE 1

BORING 1

DRILLED: 9/28/20



NOTES:

1. THE BORING LOG DEPICTS SUBSURFACE CONDITIONS ONLY AT THE BORING LOCATION AND TIME DESIGNATED.
2. NOMENCLATURE USED TO DESCRIBE SOILS DEFINED ON PLATE 4.
3. UNDISTURBED SAMPLE OBTAINED WITH 2" I.D. MODIFIED CALIFORNIA SAMPLER.
4. SAMPLER PENETRATION RESISTANCE IN BLOWS PER FOOT OR FRACTION THEREOF; 140-POUND HAMMER, 30" DROP.
5. FREE GROUNDWATER NOT ENCOUNTERED IN BORINGS.

PROJECT NUMBER: 4694-007
PLATE NUMBER: 2
DRAWN BY: TL
DATE: 10/8/20

LOG OF BORING

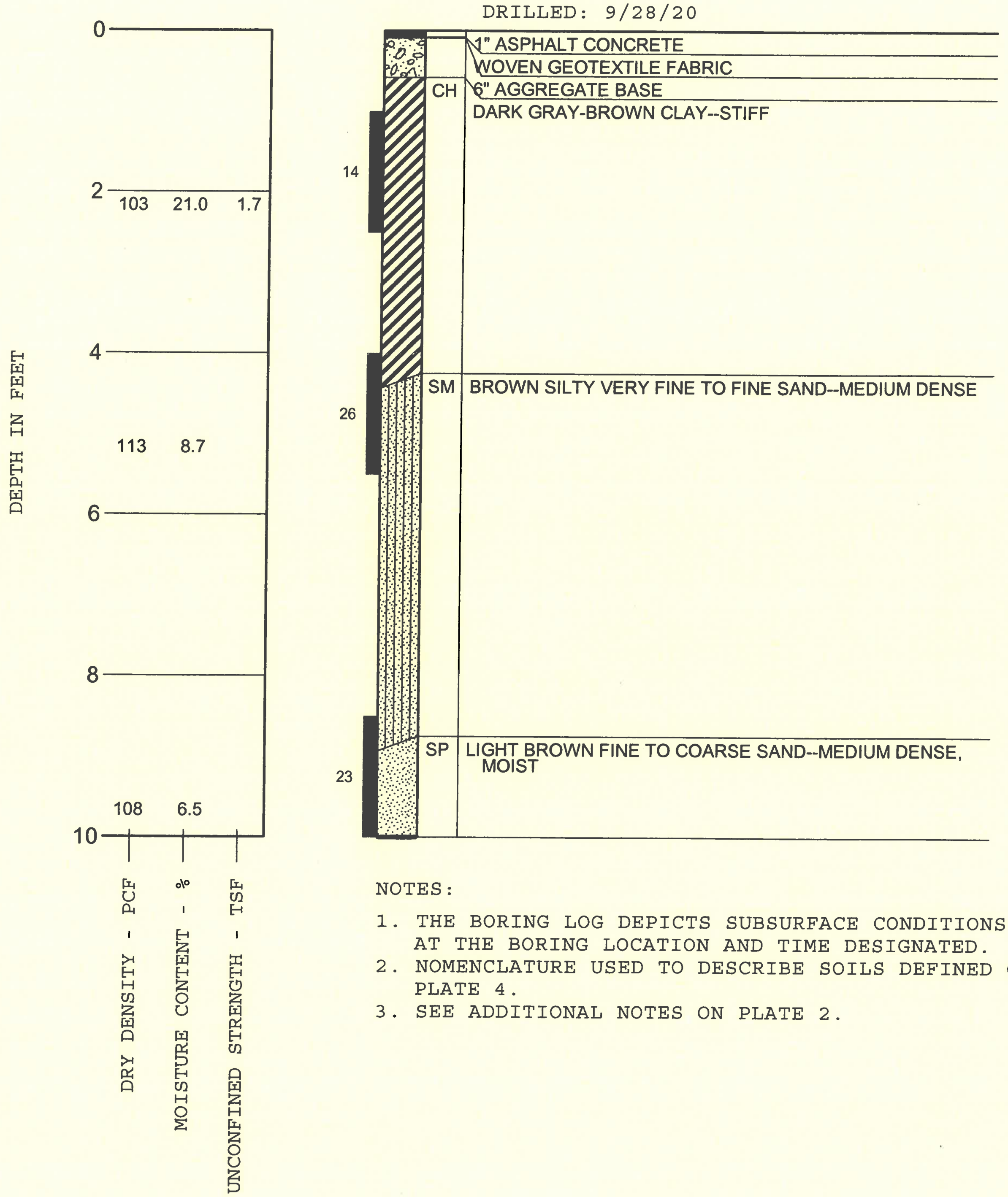
Raney Geotechnical Inc

PROJECT NUMBER: 4694-007
PLATE NUMBER: 3

DRAWN BY: TL
DATE: 10/8/20

BORING 2

DRILLED: 9/28/20



NOTES:

1. THE BORING LOG DEPICTS SUBSURFACE CONDITIONS ONLY AT THE BORING LOCATION AND TIME DESIGNATED.
2. NOMENCLATURE USED TO DESCRIBE SOILS DEFINED ON PLATE 4.
3. SEE ADDITIONAL NOTES ON PLATE 2.

LOG OF BORING

Raney Geotechnical Inc

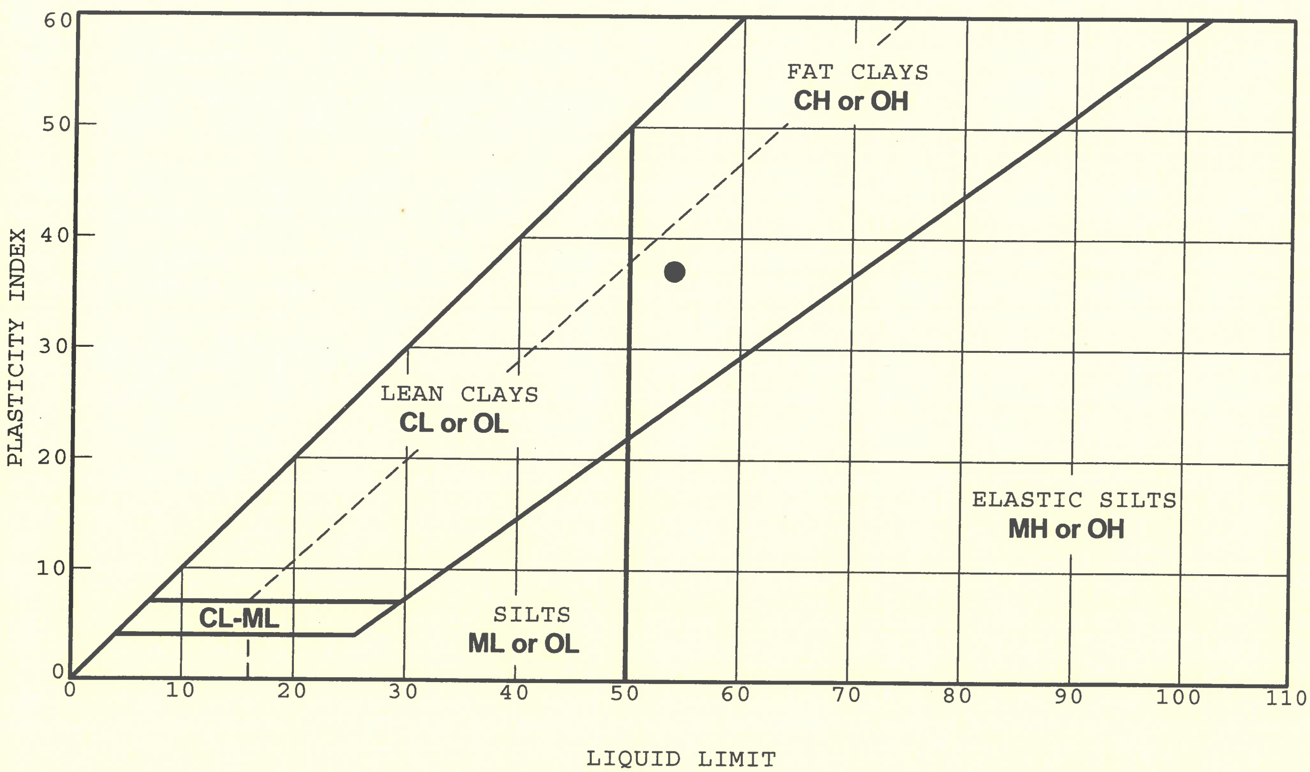
PROJECT NUMBER: 4694-007
PLATE NUMBER: 4

SYMBOL	DESCRIPTION	MAJOR DIVISIONS		
GW	WELL GRADED GRAVELS, GRAVEL-SAND MIXTURES	CLEAN GRAVELS WITH LESS THAN 5% FINES	GRAVEL AND GRAVELLY SOILS	COARSE GRAINED SOILS MORE THAN 50% LARGER THAN NO. 200 SIEVE
GP	POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES			
GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES	GRAVELS WITH MORE THAN 12% FINES	MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	
GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES			
SW	WELL GRADED SANDS, GRAVELLY SANDS	CLEAN SANDS WITH LESS THAN 5% FINES	SANDS AND SANDY SOILS	
SP	POORLY GRADED SANDS, GRAVELLY SANDS			
SM	SILTY SANDS, SAND-SILT MIXTURES	SANDS WITH MORE THAN 12% FINES	MORE THAN 50% OF COARSE FRACTION PASSING NO. 4 SIEVE	
SC	CLAYEY SANDS, SAND-CLAY MIXTURES			
ML	INORGANIC SILTS, ROCK FLOUR, OR CLAYEY SILTS WITH SLIGHT PLASTICITY	LIQUID LIMIT LESS THAN 50	SILTS AND CLAYS	FINE GRAINED SOILS MORE THAN 50% SMALLER THAN NO. 200 SIEVE
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			
MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS SILTS, ELASTIC SILTS	LIQUID LIMIT GREATER THAN 50	SILTS AND CLAYS	
CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS			
OH	ORGANIC CLAYS AND ORGANIC SILTS OF MEDIUM TO HIGH PLASTICITY			
PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENT	HIGHLY ORGANIC SOILS		

UNIFIED SOIL CLASSIFICATION SYSTEM

Raney Geotechnical Inc

PROJECT NUMBER: 4694-007
PLATE NUMBER: 5



CLASSIFICATION TEST RESULTS						
SYMBOL	SAMPLE LOCATION	DEPTH FEET	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	SOIL CLASSIFICATION
●	BORING 1	1.5	54	17	37	CH

ATTERBERG LIMIT DATA

Raney Geotechnical Inc

Project Number: 4694-007

RESISTANCE VALUE TEST
CALIFORNIA TEST METHOD 301G

SAMPLE LOCATION: SAMPLE S2
DEPTH: 1 – 2'
MATERIAL DESCRIPTION: DARK GRAY-BROWN CLAY

TEST NUMBER	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	EXUDATION PRESSURE (PSI)	EXPANSION PRESSURE (PSF)	RESISTANCE VALUE
1	106.3	19.8	179	39	5
2	112.0	17.7	294	65	10
3	118.0	15.6	449	104	16

Resistance value at 300 psi exudation pressure = 11

RESISTANCE VALUE DATA

Raney Geotechnical Inc