APPENDIX F

Geotechnical Engineering Report

Lodi Police Shooting Range
Lodi, California
December 9, 2019
Terracon Project No. NA195023

Prepared for:
Petralogix Engineering, Inc.
Galt, CA

Prepared by:
Terracon Consultants, Inc.
Lodi, California

December 9, 2019

Terracon GeoReport

Petralogix Engineering, Inc.
26675 Bruella Road
Galt, CA 95632

Attn: Daniel Kramer
P: (209) 400-5729
E: dkramer@petralogix.com

Re: Geotechnical Engineering Report
Lodi Police Shooting Range
12751 N. Thornton Road
Lodi, California
Terracon Project No. NA195023

Dear Mr. Daniel Kramer:

We have completed the Geotechnical Engineering services for the above referenced project. This study was performed in general accordance with Terracon Proposal No. PNA195023 dated August 16, 2019. This report presents the findings of the subsurface exploration and provides geotechnical recommendations concerning earthwork and the design and construction of foundations and floor slabs for the proposed project.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report or if we may be of further service, please contact us.

Sincerely,
Terracon Consultants, Inc.

Patrick C. Dell, Senior Associate
Geotechnical Engineer 2186
Geotechnical Department Manager

REGISTERED PROFESSIONAL ENGINEER PATRICK CRAIG DELL No. 2186 GEOTECHNICAL STATE OF CALIFORNIA

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REPORT TOPICS

Note: This report was originally delivered in a web-based format. **Orange Bold** text in the report indicates a referenced section heading. The PDF version also includes hyperlinks which direct the reader to that section and clicking on the ***GeoReport*** logo will bring you back to this page. For more interactive features, please view your project online at client.terracon.com.

ATTACHMENTS

Note: Refer to each individual Attachment for a listing of contents.

Terracon GeoReport

REPORT SUMMARY

Topic [1]	Overview Statement [2]
Project Description	At this time the proposed project will include 300-yard, 200-yard, 100-yard, 75-yard, and 25-yard shooting ranges surrounded by 10-foot high Hesco™ walls; an explosive ordinance demolition bunker; a 15-foot high earthen embankment; a 40-foot by 24-foot classroom training building, mobile restroom, multiple storage containers, an access road, and a defensive driving course area.
Geotechnical Characterization	Interbedded layers of loose to dense sand with varying amounts of silt, stiff to hard silt with varying amounts of sand, and very stiff to hard lean clay with varying amounts of sand were encountered in our field explorations. Groundwater was encountered between depths of about 4 to 7 feet below the existing ground surface.
Earthwork	Native soils may be used for engineered fill.
Shallow Foundations	Shallow foundations will be sufficient Allowable bearing pressure = 2,500 psf for the classroom building Expected settlements: < 1-inch total, < ½ inch differential Detect and remove zones of fill as noted in **Earthwork**.
Maximum Loads (assumed)	■ Walls: 1 to 2 kips per linear foot (klf) ■ Slabs: 100 pounds per square foot (psf)
Grading/Slopes	Up to 2 feet of cut and up to 15 feet of fill will be required to develop final grades. Final slope angles for the embankment berm will be approximately 2H:1V (Horizontal: Vertical).
Free-Standing Retaining Walls	Concrete or block retaining walls are not anticipated to be constructed as part of this project. However, walls separating the various ranges are planned to be constructed using the Hesco™ wall system. This system consists of wire frames with a geotextile material to retain soil placed within the wire frames. These walls are planned to be 10-feet high.
Below-Grade Structures	Retaining walls: None anticipated.
Pavements	With subgrade prepared as noted in **Earthwork**. We assume flexible (asphalt) and graveled surface pavement sections should be considered. Please confirm this assumption. A portion of the pavement will be constructed as a gravel access road and parking area for the facility. The defensive driving training area will be constructed with asphalt concrete pavement. The design section of this pavement will be designed in consultation with the course designers. The pavement design period is 20 years.
General Comments	This section contains important information about the limitations of this geotechnical engineering report.

1. If the reader is reviewing this report as a pdf, the topics above can be used to access the appropriate section of the report by simply clicking on the topic itself.
2. This summary is for convenience only. It should be used in conjunction with the entire report for design purposes.

Geotechnical Engineering Report

Lodi Police Shooting Range
12751 N. Thornton Road
Lodi, California
Terracon Project No. NA195023
December 9, 2019

INTRODUCTION

This report presents the results of our subsurface exploration and geotechnical engineering services performed for the proposed Police Shooting Range, demolitions bunker and detonations area, classroom training facility, and defensive driving course to be located at 12751 N. Thornton Road in Lodi, California. The purpose of these services is to provide information and geotechnical engineering recommendations relative to:

- Subsurface soil conditions
- Groundwater conditions
- Site preparation and earthwork
- Excavation considerations
- Seismic site classification per 2016 CBC
- Foundation design and construction
- Floor slab design and construction
- Lateral earth pressures
- Pavement design and construction

The geotechnical engineering Scope of Services for this project included the advancement of 5 test borings to depths ranging from approximately 11½ to 51½ feet below existing site grades (bgs).

Maps showing the site and boring locations are shown in the **Site Location** and **Exploration Plan** sections, respectively. The results of the laboratory testing performed on soil samples obtained from the site during the field exploration are included on the boring logs and/or as separate graphs in the **Exploration Results** section.

SITE CONDITIONS

The following description of site conditions is derived from our site visit in association with the field exploration and our review of publicly available geologic and topographic maps.

Item	Description
Parcel Information	The project is located at 12751 N. Thornton Road in Lodi, California. The approximate coordinates of the project are 38.0936°N and 121.3977°W See **Site Location**

Item	Description
Existing Improvements	The project site is currently an open field.
Current Ground Cover	Minor weeds and grasses, bare ground.
Existing Topography	The site is relatively flat with a slight slope down towards the west.
Geology	The surficial soils are identified as Pleistocene-aged deposits of the Lower Member of the Modesto Formation, which is classified as undivided alluvium. This description is consistent with the soils encountered in our field explorations.

PROJECT DESCRIPTION

Our initial understanding of the project was provided in our proposal and was discussed during project planning. A period of collaboration has transpired since the project was initiated, and our final understanding of the project conditions is as follows:

Item	Description
Information Provided	We received several emails from Petrologix regarding the scope of the project. We also participated in several meetings with City of Lodi personnel, Petrologix, and the project civil design team to discuss various aspects of the project. The scope of the project has evolved through the discussions.
Project Description	The project will consist of developing the site with multiple distances shooting ranges, an explosive ordinance demolition bunker and detonation area, a classroom training facility, and a defensive driving course. The plans were conceptual at the time our report was prepared and may change prior to construction. The project will likely be developed in phases depending on funding.
Proposed Structures	At this time the proposed project will include 300-yard, 200-yard, 100-yard, 75-yard, and 25-yard shooting ranges surrounded by 10-foot high Hesco™ walls; an explosive ordinance demolition bunker; a 15-foot high earthen embankment; a 40-foot by 24-foot classroom training building, mobile restroom, multiple storage containers, an access road, and a defensive driving course area.
Building Construction	The classroom training facility may be a pre-manufactured/modular type building supported on a shallow spread footing foundation system with a concrete slab-on-grade floor.
Finished Floor Elevation	Unknown
Maximum Loads	■ Walls: 1 to 2 kips per linear foot (klf) ■ Slabs: 100 pounds per square foot (psf)
Grading/Slopes	Up to 2 feet of cut and up to 15 feet of fill will be required to develop final grades. Final slope angles for the embankment berm will be approximately 2H:1V (Horizontal: Vertical).

Item	Description
Free-Standing Retaining Walls	Concrete or block retaining walls are not anticipated to be constructed as part of this project. However, walls separating the various ranges are planned to be constructed using the Hesco™ wall system. This system consists of wire frames with a geotextile material to retain soil placed within the wire frames. These walls are planned to be 10-feet high.
Pavements	We assume flexible (asphalt) and graveled surface pavement sections will be used. Please confirm this assumption. A portion of the pavement will be constructed as a gravel access road and parking area for the facility. The defensive driving training area will be constructed with asphalt concrete pavement. The design section of this pavement will be designed in consultation with the course designers. The pavement design period is 20 years.
Estimated Start of Construction	Unknown

GEOTECHNICAL CHARACTERIZATION

The near surface soils consisted of medium dense to dense silty sand and stiff sandy silt soils that extended to depth of between 2½ and 4 feet bgs. These soils were underlain by interbedded layers of loose to dense sands with varying amounts of silt, very stiff to hard silts with varying amounts of sand, and very stiff to hard lean clay with varying amounts of sand that extended to the maximum depths explored. The silts varied from non-plastic to low plasticity. The lean clay soils were encountered below a depth of about 5 feet bgs and are therefore the potential for seasonal volume changes from varying moisture contents (shrink/swell) is low and should not affect the support of structures. These soil conditions are consistent with previous field explorations Terracon has performed in this area for the tertiary pond project located south of the proposed shooting range.

Groundwater

The boreholes were observed while drilling and after completion for the presence and level of groundwater. Groundwater was encountered at depths of between approximately 4 and 7 feet bgs. This is typical for this site based on our previous explorations for the adjacent tertiary treatment ponds.

Groundwater level fluctuations occur due to seasonal variations in the amount of rainfall, water in the adjacent slough, irrigation of adjacent fields, runoff and other factors not evident at the time the borings were drilled. Therefore, groundwater levels during construction or at other times in the life of the project may be higher or lower than the levels indicated on the boring logs. The possibility of groundwater level fluctuations should be considered when developing the design and construction plans for the project.

GEOTECHNICAL OVERVIEW

The near surface sandy silts and silty sands could become unstable with typical earthwork and construction traffic, especially after precipitation events. Effective drainage should be completed early in the construction sequence and maintained after construction to avoid potential issues. If possible, the grading should be performed during the warmer and drier times of the year. If grading is performed during the winter months, an increased risk for possible undercutting and replacement of unstable subgrade will persist. Additional site preparation recommendations, including subgrade improvement and fill placement, are provided in the **Earthwork** section.

The proposed classroom building may be supported on shallow spread foundations bearing on compacted native soil or a minimum of 12 inches of engineered fill. The **Shallow Foundations** section addresses support of the building bearing on compacted native soils or engineered fill. The **Floor Slabs** section addresses support of the slab-on-grade floor.

The **Earthwork** section addresses support of the Hesco™ walls bearing on compacted native soils or engineered fill.

Flexible and graveled surface pavement may be constructed for this project. The **Pavements** section addresses the design of pavement systems.

The **General Comments** section provides an understanding of the report limitations.

EARTHWORK

Earthwork is anticipated to include clearing and grubbing, excavations, and fill placement. The following sections provide recommendations for use in the preparation of specifications for the work. Recommendations include critical quality criteria, as necessary, to render the site in the state considered in our geotechnical engineering evaluation for foundations, floor slabs, and pavements.

Site Preparation

Prior to placing fill, existing vegetation and root mat should be removed. Complete stripping of the topsoil should be performed in the proposed building and parking/driveway areas.

Underground facilities such as irrigation pipes may be encountered during construction. If underground facilities are encountered, such materials and features should be completely removed and the excavation thoroughly cleaned prior to backfill placement and/or construction.

Once cuts have been made and prior to placing any engineered fill, the subgrade should be proofrolled with an adequately loaded vehicle such as a fully-loaded tandem-axle dump truck or water truck. The proofrolling should be performed under the direction of the Geotechnical Engineer. Areas excessively deflecting under the proofroll should be delineated and subsequently addressed by the Geotechnical Engineer. Such areas should either be removed or moisture conditioned and recompacted. Such areas may also be modified by stabilizing with lime/cement or aggregate base with geogrids.

The exposed subgrade soil should be scarified, moisture conditioned, and compacted. The depth of scarification of subgrade soils and moisture conditioning of the subgrade is highly dependent upon the time of year of construction and the site conditions that exist immediately prior to construction. If construction occurs during the winter or spring, when the subgrade soils are typically already in a moist condition, scarification and compaction may only be 8 inches. If construction occurs during the summer or fall when the subgrade soils have been allowed to dry out deeper, the depth of scarification and moisture conditioning may be as much as 18 inches. A representative of our office should be present to observe the exposed subgrade and specify the depth of scarification and moisture conditioning required subsequent to grading cuts and prior to placing fill.

The area beneath the proposed 15-foot high embankment should be overexcavated to a depth of 2 feet below the existing ground surface. The exposed subgrade should then be scarified to a depth of 12 inches and compacted to the relative density specified in this section. The overexcavated soil should then be placed and compacted as engineered fill. The side slopes of the embankment should be constructed at a slope no steeper than 2H:1V (2 horizontal to 1 vertical). All grading for the embankment should incorporate the limits of the proposed embankment plus a lateral distance of at least five feet beyond the outside edges of the slopes. Since most fill slopes are constructed with a loosely or poorly compacted surface, the fill slopes should be slightly overbuilt and trimmed back to firm, compacted soil, hence embankment slopes shall not be cat tracked for surface compaction.

The embankment slopes should be covered with some type of erosion control measure immediately after construction. Erosion control measures can consist of erosion resistant vegetation, jute netting, or rip rap. These should be installed per the manufacturer's specifications. Some minor, relatively shallow erosion should be anticipated and planned for. Routine maintenance will be required on all embankment slopes. Any detected problems should be repaired immediately. It is important that the bottom of all embankments be protected from erosion or undercutting that could jeopardize the integrity of the slope. Substantial slope failure could occur if the bottoms of the slopes are not protected. A rigorous program of reducing the amount of animal burrows should be in place to reduce the potential for seepage-related problems. If less risk is desired for erosion of the embankment slopes and associated maintenance, the angle of the slopes can be lessened.

The surface soils at the site primarily consist of silty sands and sandy silts which are typically subject to significant wind/water erosion. The project civil engineer, while developing the plans, should plan to limit wind/water erosion during and after construction to a level acceptable to the owner. Rip rap or other erosion control measures should be implemented to reduce the potential for wave damage to the waterside slope of the embankments.

We anticipate there will be some settlement beneath the embankment. This settlement could be in the range of 1 to 2 inches.

The subgrade beneath the Hesco™ walls should be overexcavated to a depth of at least 12 inches below existing site grades. The exposed subgrade should then be scarified to a depth of 12 inches and compacted to the relative density specified in this section. The overexcavated soil should then be placed and compacted as engineered fill. All grading for the walls should incorporate the limits of the proposed embankment plus a lateral distance of at least three feet beyond the outside edges of the walls.

Fill Material Types

All fill materials should be inorganic soils free of vegetation, debris, and fragments larger than three inches in size. Pea gravel or other similar non-cementitious, poorly-graded materials should not be used as fill or backfill without the prior approval of the geotechnical engineer.

Imported earth materials for use as engineered fill should be pre-approved by our representative prior to construction. Imported non-expansive soils may be used as fill material for the following:

- general site grading
- foundation areas
- slab-on-grade floor
- pavement subgrade
- foundation backfill
- trench backfill
- exterior slabs-on-grade
- embankment fill

Soils for use as compacted engineered fill material within the proposed building pad area should conform to non-expansive materials as indicated in the following recommendations:

Percent Finer by Weight Gradation	(ASTM C 136)
3"	100
No. 4 Sieve	50 - 100
No. 200 Sieve	15 - 50

■ Liquid Limit	30 (max)
■ Plasticity Index	10 (max)
■ Maximum Expansive Index*	20 (max)

*ASTM D 4829

The on-site near surface silty sand soils should meet the specifications above. Although the near surface native silty soils may not meet the above specifications, in our opinion they may be used as engineered fill for this project. Near surface native soils should be compacted using equipment and procedures that will produce recommended moisture contents and densities throughout. Fill lifts should not exceed ten inches in loose thickness.

Fill Compaction Requirements

Recommended compaction and moisture content criteria for engineered fill materials are as follows:

Material Type and Location	Per the Modified Proctor Test (ASTM D 1557)		
	Minimum Compaction Requirement (%)	Range of Moisture Contents for Compaction Above Optimum	
		Minimum	Maximum
On-site sandy and silt soils and Low volume change (non-expansive) imported fill:			
Beneath foundations:	90	0%	+3%
Beneath slabs:	90	0%	+3%
Embankment fill:	90	0%	+3%
Miscellaneous backfill:	90	0%	+3%
Beneath pavement*:	95	0%	+3%
Utility Trenches*:	90	0%	+3%
Bottom of native soil excavation receiving fill:	90	+0%	+3%

*The upper 12 inches of subgrade soils beneath pavement should be compacted to 95% of the maximum dry density as determined in the ASTM D1557 test method.

We recommend that compacted native soil or any engineered fill be tested for moisture content and relative compaction during placement. Should the results of the in-place density tests indicate the specified moisture content or compaction requirements have not been met, the area represented by the test should be reworked and retested as required until the specified moisture content and relative compaction requirements are achieved.

Utility Trench Backfill

Utility trenches are a common source of water infiltration and migration. Utility trenches penetrating beneath the building should be effectively sealed to restrict water intrusion and flow through the trenches, which could migrate below the building. The trench should provide an effective trench plug that extends at least 5 feet from the face of the building exterior. The plug material should consist of cementitious flowable fill or low permeability clay. The trench plug material should be placed to surround the utility line. If used, the clay trench plug material should be placed and compacted to comply with the water content and compaction recommendations for structural fill stated previously in this report.

Grading and Drainage

All grades must provide effective drainage away from the building during and after construction and should be maintained throughout the life of the structure. Water retained next to the building can result in soil movements greater than those discussed in this report. Greater movements can result in unacceptable differential floor slab and/or foundation movements, cracked slabs and walls, and roof leaks. The roof should have gutters/drains with downspouts that discharge onto pavements or tied to tight lines that discharge into the storm drain system or be discharged a minimum of 20 feet from the structure.

Exposed ground should be sloped and maintained at a minimum 5% away from the building for at least 10 feet beyond the perimeter of the building. Locally, flatter grades may be necessary to transition ADA access requirements for flatwork. After building construction and landscaping have been completed, final grades should be verified to document effective drainage has been achieved. Grades around the structure should also be periodically inspected and adjusted, as necessary, as part of the structure's maintenance program. Where paving or flatwork abuts the structure, a maintenance program should be established to effectively seal and maintain joints and prevent surface water infiltration.

Earthwork Construction Considerations

Shallow excavations for the proposed structure are anticipated to be accomplished with conventional construction equipment. Upon completion of filling and grading, care should be taken to maintain the subgrade water content prior to construction of floor slabs. Construction traffic over the completed subgrades should be avoided. The site should also be graded to prevent ponding of surface water on the prepared subgrades or in excavations. Water collecting over or adjacent to construction areas should be removed. If the subgrade freezes, desiccates, saturates, or is disturbed, the affected material should be removed, or the materials should be scarified, moisture conditioned, and recompacted prior to floor slab construction.

As a minimum, excavations should be performed in accordance with OSHA 29 CFR, Part 1926, Subpart P, "Excavations" and its appendices, and in accordance with any applicable local, and/or state regulations.

Construction site safety is the sole responsibility of the contractor who controls the means, methods, and sequencing of construction operations. Under no circumstances shall the information provided herein be interpreted to mean Terracon is assuming responsibility for construction site safety, or the contractor's activities; such responsibility shall neither be implied nor inferred.

Construction Observation and Testing

The earthwork efforts should be monitored under the direction of the Geotechnical Engineer. Monitoring should include documentation of adequate removal of vegetation and topsoil, proofrolling, and mitigation of areas delineated by the proofroll to require mitigation.

Each lift of compacted fill should be tested, evaluated, and reworked, as necessary, until approved by the Geotechnical Engineer prior to placement of additional lifts. Each lift of fill should be tested for density and water content at a frequency of at least one test for every 1,000 square feet of compacted fill in the building areas and 5,000 square feet in pavement areas. One density and water content test should be performed for every 50 to 100 linear feet of compacted utility trench backfill.

In areas of foundation excavations, the bearing subgrade should be evaluated under the direction of the Geotechnical Engineer. If unanticipated conditions are encountered, the Geotechnical Engineer should prescribe mitigation options.

In addition to the documentation of the essential parameters necessary for construction, the continuation of the Geotechnical Engineer into the construction phase of the project provides the continuity to maintain the Geotechnical Engineer's evaluation of subsurface conditions, including assessing variations and associated design changes.

SHALLOW FOUNDATIONS

If the site has been prepared in accordance with the requirements noted in Earthwork, the following design parameters are applicable for shallow foundations. In order to provide uniform support for the foundations, we recommend the bottom of all foundation excavations be compacted with jumping jack or similar hand-operated equipment.

Design Parameters – Compressive Loads

Item	Description
Maximum Net Allowable Bearing pressure [1, 2]	2,500 pounds per square foot
Required Bearing Stratum [3]	12 inches of compacted native soil or minimum of 12 inches of engineered fill
Minimum Foundation Dimensions	Columns: 24 inches Continuous: 12 inches
Maximum Foundation Dimensions	Columns: 72 inches Continuous: 36 inches
Ultimate Passive Resistance [4] **(equivalent fluid pressures)**	350 pcf

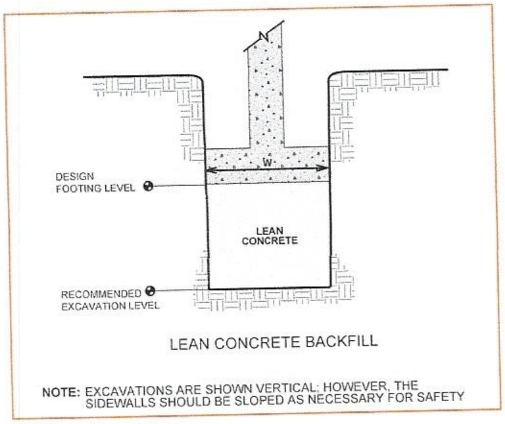
Item	Description
Ultimate Coefficient of Sliding Friction [5]	0.40
Minimum Embedment below Finished Grade [6]	12 inches
Estimated Total Settlement from Structural Loads [2]	Less than about 1 inch
Estimated Differential Settlement [2, 7]	About ½ of total settlement

1. The maximum net allowable bearing pressure is the pressure in excess of the minimum surrounding overburden pressure at the footing base elevation. An appropriate factor of safety has been applied. These bearing pressures can be increased by 1/3 for transient loads unless those loads have been factored to account for transient conditions. Values assume that exterior grades are relatively flat around the structure.
2. Values provided are for maximum loads noted in **Project Description**.
3. Unsuitable or soft soils should be over-excavated and replaced per the recommendations presented in the **Earthwork**.
4. Use of passive earth pressures require the sides of the excavation for the spread footing foundation to be nearly vertical and the concrete placed neat against these vertical faces or that the footing forms be removed and compacted structural fill be placed against the vertical footing face. If passive resistance is used to resist lateral loads, the base friction should be reduced by 25 percent.
5. Can be used to compute sliding resistance where foundations are placed on suitable soil/materials. Should be neglected for foundations subject to net uplift conditions.
6. Embedment necessary to minimize the effects of seasonal water content variations. Finished grade is defined as the lowest adjacent grade within five feet of the foundation for perimeter (exterior) footings.
7. Differential settlements are as measured over a span of 50 feet.

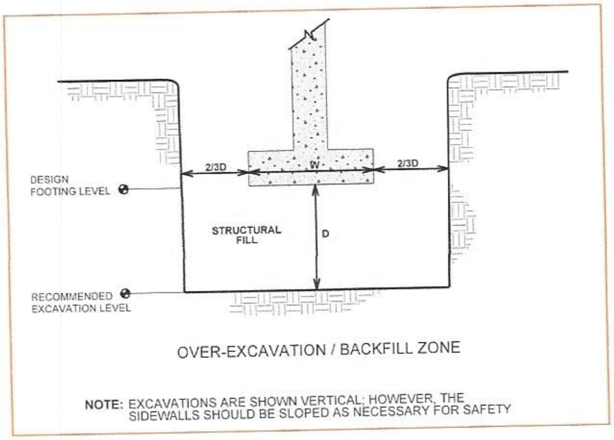
Foundation Construction Considerations

As noted in **Earthwork**, the footing excavations should be evaluated under the direction of the Geotechnical Engineer. The base of all foundation excavations should be free of water and loose soil, prior to placing concrete. Concrete should be placed soon after excavating to reduce bearing soil disturbance. Care should be taken to prevent wetting or drying of the bearing materials during construction. Excessively wet or dry material or any loose/disturbed material in the bottom of the footing excavations should be removed/reconditioned before foundation concrete is placed.

If unsuitable bearing soils are encountered at the base of the planned footing excavation, the excavation should be extended deeper to suitable soils, and the footings could bear directly on these soils at the lower level or on lean concrete backfill placed in the excavations. This is illustrated on the sketch below.



Over-excavation for structural fill placement below footings should be conducted as shown below. The over-excavation should be backfilled up to the footing base elevation, with engineered fill placed, as recommended in the **Earthwork** section.



To ensure foundations have adequate support, special care should be taken when footings are located adjacent to trenches. The bottom of such footings should be at least 1 foot below an imaginary plane with an inclination of 1.5 horizontal to 1.0 vertical extending upward from the nearest edge of the adjacent trench.

SEISMIC CONSIDERATIONS

The seismic design requirements for the project are based on Seismic Design Category. Site Classification is required to determine the Seismic Design Category for a structure. The Site Classification is based on the upper 100 feet of the site profile defined by a weighted average value of either shear wave velocity, standard penetration resistance, or undrained shear strength in accordance with Section 20.4 of ASCE 7-10.

	Value
2016 California Building Code Site Classification (CBC) [1]	D [2]
Site Latitude	38.0936° N
Site Longitude	121.3977° W
S_s Spectral Acceleration for a Short Period	0.880g
S_1 Spectral Acceleration for a 1-Second Period	0.333g
F_a Site Coefficient for a Short Period	1.148
F_v Site Coefficient for a 1-Second Period	1.734
S_{MS} Maximum Considered Spectral Response Acceleration for a Short Period	1.010g
S_{M1} Maximum Considered Spectral Response Acceleration for a 1-Second Period	0.578g
S_{DS} Design Spectral Acceleration for a Short Period [3]	0.673g
S_{D1} Spectral Acceleration for a 1-Second Period [3]	0.385g
PGA_M Peak Ground Acceleration	0.367g

1. Seismic site classification in general accordance with the *2016 California Building Code*, which refers to ASCE 7-10 with March 2013 errata.
2. The 2016 California Building Code (CBC) uses a site profile extending to a depth of 100 feet for seismic site classification. Borings at this site were extended to a maximum depth of 51½ feet. The site properties below the boring depth to 100 feet were estimated based on our experience and knowledge of geologic conditions of the general area. Additional deeper borings or geophysical testing may be performed to confirm the conditions below the current boring depth.
3. These values were obtained using online seismic design maps and tools provided by the USGS (http://earthquake.usgs.gov/hazards/designmaps/).

LIQUEFACTION

Liquefaction is a mode of ground failure that results from the generation of high pore water pressures during earthquake ground shaking, causing loss of shear strength. Liquefaction is typically a hazard where loose sandy soils or non-plastic fine-grained soils exist below groundwater. The California Geologic Survey (CGS) has designated certain areas within California as potential liquefaction hazard zones. These are areas considered at a risk of liquefaction-related ground failure during a seismic event, based upon mapped surficial deposits and the presence of a relatively shallow water table. The project site is not located within a liquefaction hazard zone mapped by the CGS.

An analysis of the potential for liquefaction to occur at this site was not included in our scope of services.

FLOOR SLABS

Design parameters for floor slabs assume the requirements for **Earthwork** have been followed. Specific attention should be given to positive drainage away from the structure and positive drainage of the aggregate base beneath the floor slab.

Floor Slab Design Parameters

Item	Description
Floor Slab Support [1]	Minimum 4 inches of free-draining crushed aggregate [2] At least 12 inches compacted non-expansive native soils or engineered fill

1. Floor slabs should be structurally independent of building footings or walls to reduce the possibility of floor slab cracking caused by differential movements between the slab and foundation.
2. Free-draining granular material should have less than 5% fines (material passing the No. 200 sieve). Other design considerations such as condensation development could warrant more extensive design provisions.

The use of a vapor retarder should be considered beneath concrete slabs on grade covered with wood, tile, carpet, or other moisture sensitive or impervious coverings, or when the slab will support equipment sensitive to moisture. When conditions warrant the use of a vapor retarder, the slab designer should refer to ACI 302 and/or ACI 360 for procedures and cautions regarding the use and placement of a vapor retarder.

Saw-cut control joints should be placed in the slab to help control the location and extent of cracking. For additional recommendations refer to the ACI Design Manual. Joints or cracks should be sealed with a water-proof, non-extruding compressible compound specifically recommended for heavy duty concrete pavement and wet environments.

Where floor slabs are tied to perimeter walls or turn-down slabs to meet structural or other construction objectives, our experience indicates differential movement between the walls and slabs will likely be observed in adjacent slab expansion joints or floor slab cracks beyond the length of the structural dowels. The Structural Engineer should account for potential differential settlement through use of sufficient control joints, appropriate reinforcing or other means.

Floor Slab Construction Considerations

Finished subgrade, within and for at least 10 feet beyond the floor slab, should be protected from traffic, rutting, or other disturbance and maintained in a relatively moist condition until floor slabs are constructed. If the subgrade should become damaged or desiccated prior to construction of floor slabs, the affected material should be removed and structural fill should be added to replace the resulting excavation. Final conditioning of the finished subgrade should be performed immediately prior to placement of the floor slab support course.

The Geotechnical Engineer should approve the condition of the floor slab subgrades immediately prior to placement of the floor slab support course, reinforcing steel, and concrete. Attention should be paid to high traffic areas that were rutted and disturbed earlier, and to areas where backfilled trenches are located.

PAVEMENTS

General Pavement Comments

Pavement designs are provided for the traffic conditions and pavement life conditions as noted in **Project Description** and in the following sections of this report. A critical aspect of pavement performance is site preparation. Pavement designs noted in this section must be applied to the site which has been prepared as recommended in the **Earthwork** section.

Design of Asphaltic Concrete (AC) pavements are based on the procedures in the Caltrans Highway Design Manual, 2018 edition.

As part of our geotechnical engineering services for the adjacent tertiary ponds projects, we performed several Resistance value (R-value) tests on samples of the near surface subgrade soils. One sample was taken just to the east of the proposed shooting range site. The test produced an R-value of 59. In our opinion, this sample is representative of the soils within the proposed shooting range site. The Caltrans design method allows the use of a maximum R-value of 50 in design. Therefore, a design R-value of 50 was used for the AC and PCC pavement designs.

We have provided pavement sections for the defensive driving course for traffic indices (TI) of 4.0 and 5.0 although the actual pavement section should be determined by collaboration of the design team. If additional pavement sections are required, we should be contacted to provide the additional recommendations.

Pavement Section Thicknesses

The following table provides options for AC pavement sections:

Asphaltic Concrete (AC) Design		
Layer	Thickness (inches)	
	TI=4.0	TI= 5.0
AC [1]	2.5	3.0
Aggregate Base	4.0	4.0

Asphaltic Concrete (AC) Design		
Layer	Thickness (inches)	
	TI=4.0	TI= 5.0

1. All materials should meet the current Caltrans Standard Specifications, latest edition

The access road and parking lot will not be covered with asphalt concrete but will have an exposed gravel surface. For the access road and parking lot we recommend the pavement section consist of 6 inches of compacted aggregate base over compacted subgrade. We recommend consideration be given to applying a bitumen oil seal coat to the gravel surface for the first several years in order to reduce the amount of dust and to try and seal the aggregate surface from moisture intrusion. If water penetrates into the gravel, the pavement section may become unstable and lead to premature road failure. Periodic maintenance of the gravel road sections should be anticipated. We also recommend that a stockpile of aggregate base be kept on site to repair any potholes as they appear. The gravel road surface should be sealed prior to the beginning of the rainy season. The ground adjacent to the pavement should be sloped in order to drain water away from the road section.

The estimated pavement sections provided in this report are minimums for the assumed design criteria, and as such, periodic maintenance should be expected. Areas for parking of heavy vehicles, concentrated turn areas, and start/stop maneuvers could require thicker pavement sections. Edge restraints (i.e. concrete curbs or aggregate shoulders) should be planned along curves and areas of maneuvering vehicles. A maintenance program including surface sealing, joint cleaning and sealing, and timely repair of cracks and deteriorated areas will increase the pavement's service life. As an option, thicker sections could be constructed to decrease future maintenance.

Pavement design methods are intended to provide structural sections with adequate thickness over a subgrade such that wheel loads are reduced to a level the subgrade can support.

Openings in pavements, such as decorative landscaped areas, are sources for water infiltration into surrounding pavement systems. Water can collect in the islands and migrate into the surrounding subgrade soils thereby degrading support of the pavement. This is especially applicable for islands with raised concrete curbs, irrigated foliage, and low permeability near-surface soils. The civil design for the pavements with these conditions should include features to restrict or to collect and discharge excess water from the islands. Examples of features are edge drains connected to the storm water collection system, longitudinal subdrains, or other suitable outlet and impermeable barriers preventing lateral migration of water such as a cutoff wall installed to a depth below the pavement structure.

Dishing in parking lots surfaced with AC is usually observed in frequently-used parking stalls (such as near the front of buildings) and occurs under the wheel footprint in these stalls. The use of higher-grade asphaltic cement, or surfacing these areas with PCC, should be considered. The dishing is exacerbated by factors such as irrigated islands or planter areas, and sheet surface drainage to the front of structures.

Rigid PCC pavements will perform better than AC in areas where short-radii turning and braking are expected (i.e. entrance/exit aprons) due to better resistance to rutting and shoving. In addition, PCC pavement will perform better in areas subject to large or sustained loads. An adequate number of longitudinal and transverse control joints should be placed in the rigid pavement in accordance with ACI and/or AASHTO requirements. Expansion (isolation) joints must be full depth and should only be used to isolate fixed objects abutting or within the paved area.

Pavement Drainage

Pavements should be sloped to provide rapid drainage of surface water. Water allowed to pond on or adjacent to the pavements could saturate the subgrade and contribute to premature pavement deterioration. In addition, the pavement subgrade should be graded to provide positive drainage within the granular base section.

The pavement surfacing and adjacent sidewalks should be sloped to provide rapid drainage of surface water. Water should not be allowed to pond on or adjacent to slabs, since it could saturate the subgrade and contribute to premature pavement or slab deterioration.

Pavement Maintenance

The pavement sections represent minimum recommended thicknesses and, as such, periodic maintenance should be anticipated. Therefore, preventive maintenance should be planned and provided for through an on-going pavement management program. Maintenance activities are intended to slow the rate of pavement deterioration and to preserve the pavement investment. Maintenance consists of both localized maintenance (e.g. crack and joint sealing and patching) and global maintenance (e.g. surface sealing). Preventive maintenance is usually the priority when implementing a pavement maintenance program. Additional engineering observation is recommended to determine the type and extent of a cost-effective program. Even with periodic maintenance, some movements and related cracking may still occur and repairs may be required.

Pavement performance is affected by its surroundings. In addition to providing preventive maintenance, the civil engineer should consider the following recommendations in the design and layout of pavements:

1. Final grade adjacent to paved areas should slope down from the edges at a minimum 2%.

2. Subgrade and pavement surfaces should have a minimum 2% slope to promote proper surface drainage.
3. Install below pavement drainage systems surrounding areas anticipated for frequent wetting.
4. Install joint sealant and seal cracks immediately.
5. Seal all landscaped areas in or adjacent to pavements to reduce moisture migration to subgrade soils.
6. Place compacted, low permeability backfill against the exterior side of curb and gutter.
7. Place curb, gutter and/or sidewalk directly on subgrade soils rather than on unbound granular base course materials.

CORROSIVITY

The table below lists the results of laboratory soluble sulfate, soluble chloride, electrical resistivity, and pH testing. The values may be used to estimate potential corrosive characteristics of the on-site soils with respect to contact with the various underground materials which will be used for project construction.

Corrosivity Test Results Summary						
Boring	Sample Depth (feet)	Soil Description	Soluble Sulfate (%)	Soluble Chloride (%)	Electrical Resistivity (Ω-cm)	pH
B4	1.0 – 2.5	SILTY SAND (SM)	0.02	<0.01	2522	8.37

The sulfate test results indicate that the soil from boring B4 classifies as Class S0 according to Table 19.3.1.1 of ACI 318-14. This indicates that the sulfate level is negligible when considering corrosion to concrete. Based on the results of the sulfate content test results, ACI 318-14, Section 19.3 does not specify the type of cement or a maximum water-cement ratio for concrete for sulfate Class S0. For further information, see ACI 318-14, Section 19.3.

GENERAL COMMENTS

Our analysis and opinions are based upon our understanding of the project, the geotechnical conditions in the area, and the data obtained from our site exploration. Natural variations will occur between exploration point locations or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction. Terracon should be retained as the Geotechnical Engineer, where noted in this report, to provide observation and testing services during pertinent construction phases. If variations appear, we can provide further evaluation and supplemental recommendations. If variations are noted in the absence of our observation and testing services on-site, we should be immediately notified so that we can provide evaluation and supplemental recommendations.

Our Scope of Services does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If the owner is concerned about the potential for such contamination or pollution, other studies should be undertaken.

Our services and any correspondence or collaboration through this system are intended for the sole benefit and exclusive use of our client for specific application to the project discussed and are accomplished in accordance with generally accepted geotechnical engineering practices with no third-party beneficiaries intended. Any third-party access to services or correspondence is solely for information purposes to support the services provided by Terracon to our client. Reliance upon the services and any work product is limited to our client and is not intended for third parties. Any use or reliance of the provided information by third parties is done solely at their own risk. No warranties, either express or implied, are intended or made.

Site characteristics as provided are for design purposes and not to estimate excavation cost. Any use of our report in that regard is done at the sole risk of the excavating cost estimator as there may be variations on the site that are not apparent in the data that could significantly impact excavation cost. Any parties charged with estimating excavation costs should seek their own site characterization for specific purposes to obtain the specific level of detail necessary for costing. Site safety, and cost estimating including, excavation support, and dewatering requirements/design are the responsibility of others. If changes in the nature, design, or location of the project are planned, our conclusions and recommendations shall not be considered valid unless we review the changes and either verify or modify our conclusions in writing.

ATTACHMENTS

EXPLORATION AND TESTING PROCEDURES

Field Exploration

Number of Borings	Boring Depth (feet)	Planned Location
1	50	Planned 15-foot high embankment
2	20	Planned shooting range wall areas
1	15	Planned classroom training facility
1	10	Planned defensive driving course area

Boring Layout and Elevations: Unless otherwise noted, Terracon personnel provided the boring layout. Coordinates were obtained with a handheld GPS unit (estimated horizontal accuracy of about ±10 feet). If elevations and a more precise boring layout are desired, we recommend borings be surveyed.

Subsurface Exploration Procedures: We advanced the borings with a track-mounted rotary drill rig using continuous hollow stem flight augers. We obtained samples at depths of 1 foot, 2½ feet, 5 feet, 10 feet and at intervals of 5 feet thereafter. In the split-barrel sampling procedure, a standard 2-inch outer diameter split-barrel sampling spoon was driven into the ground by a 140-pound automatic hammer falling a distance of 30 inches. The number of blows required to advance the sampling spoon the last 12 inches of a normal 18-inch penetration is recorded as the Standard Penetration Test (SPT) resistance value. The SPT resistance values, also referred to as N-values, are indicated on the boring logs at the test depths. A 2.5-inch O.D. split-barrel Modified California sampling spoon with 2.0-inch I.D. tube lined sampler was also used for sampling. Tube-lined, split-barrel sampling procedures are similar to standard split spoon sampling procedure; however, blow counts are not equivalent to the SPT blow counts. We observed and recorded groundwater levels during drilling and sampling. For safety purposes, all borings were backfilled with neat cement after their completion.

The sampling depths, penetration distances, and other sampling information was recorded on the field boring logs. The samples were placed in appropriate containers and taken to our soil laboratory for testing and classification by a Geotechnical Engineer. Our exploration team prepared field boring logs as part of the drilling operations. These field logs included visual classifications of the materials encountered during drilling and our interpretation of the subsurface conditions between samples. Final boring logs were prepared from the field logs. The final boring logs represent the Geotechnical Engineer's interpretation of the field logs and include modifications based on observations and tests of the samples in our laboratory.

Laboratory Testing

The project engineer reviewed the field data and assigned laboratory tests to understand the engineering properties of the various soil strata, as necessary, for this project. Procedural standards noted below are for reference to methodology in general. In some cases, variations to methods were applied because of local practice or professional judgment. Standards noted below include reference to other, related standards. Such references are not necessarily applicable to describe the specific test performed.

- ASTM D2216 Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
- ASTM D422 Standard Test Method for Particle-Size Analysis of Soils
- ASTM D1140 Standard Test Method for Determining the Amount of Material Finer than No. 200 Sieve by Soil Washing
- Corrosivity

The laboratory testing program included examination of soil samples by an engineer. Based on the material's texture and plasticity, we described and classified the soil samples in accordance with the Unified Soil Classification System.

SITE LOCATION AND EXPLORATION PLANS

Contents:

Note: All attachments are one page unless noted above.

SITE LOCATION

Lodi Police Shooting Range ▪ Lodi, California

December 9, 2019 ▪ Terracon Project No. NA195023

Terracon GeoReport

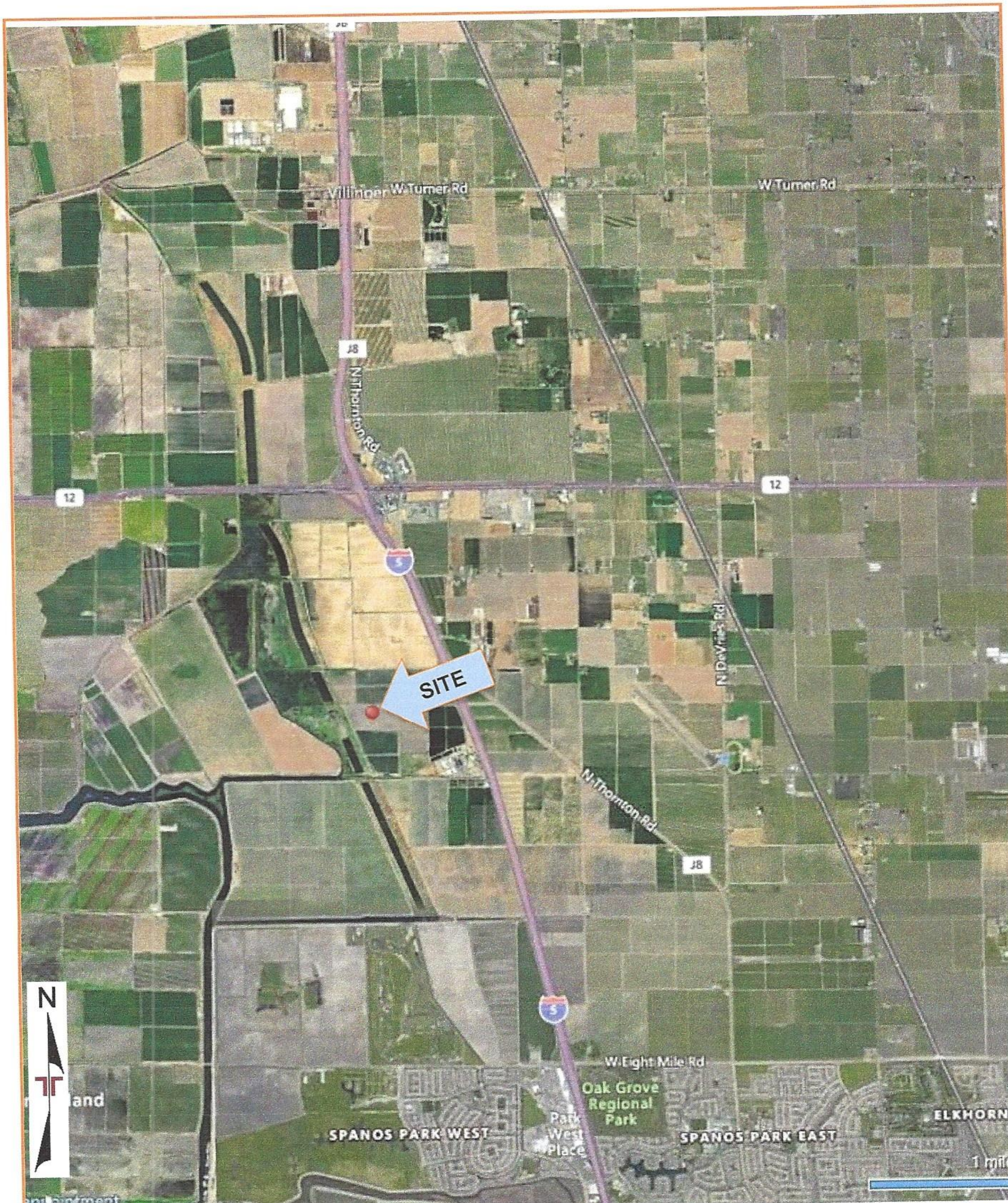
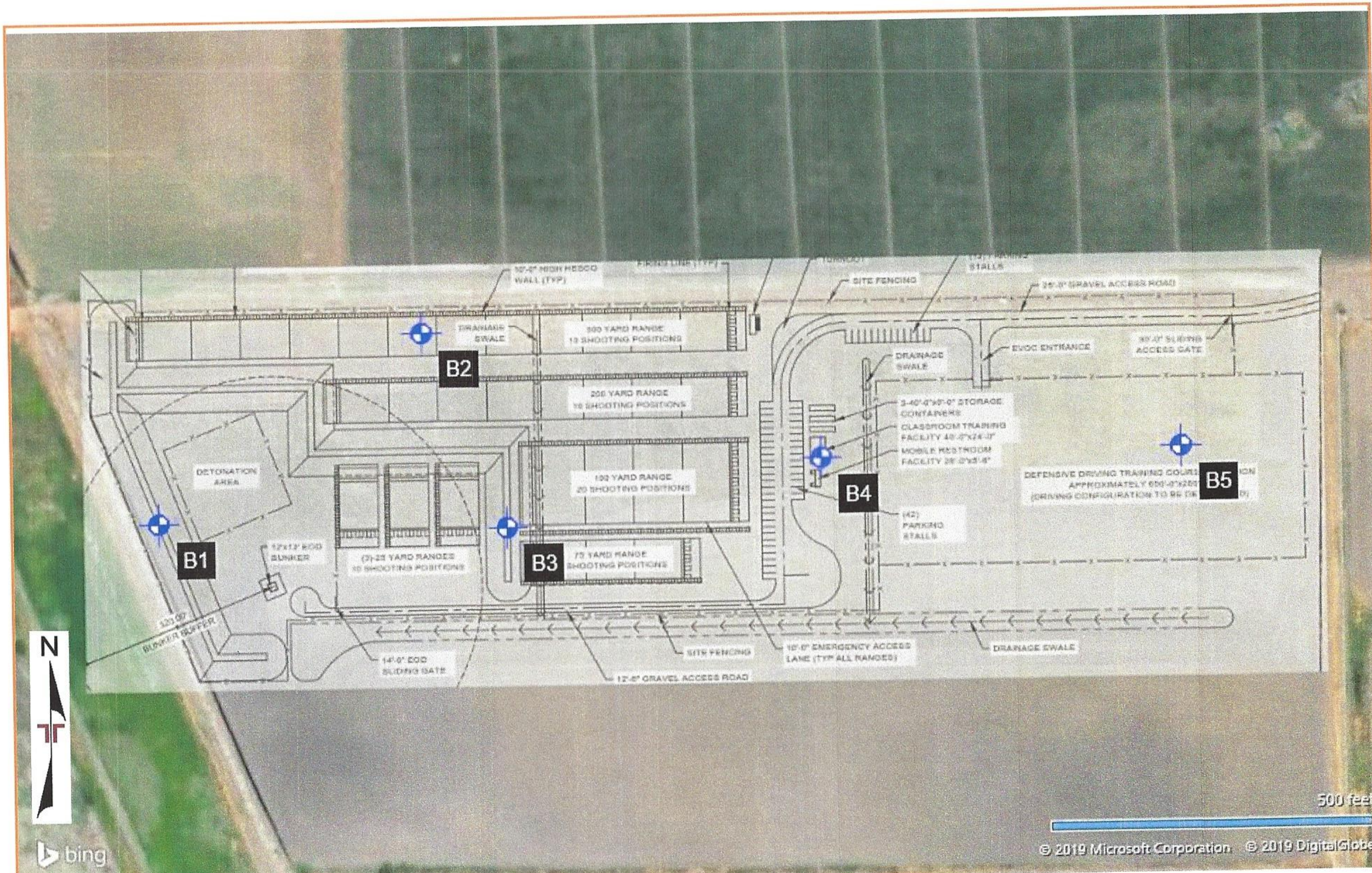


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP PROVIDED BY MICROSOFT BING MAPS

SITE LOCATION

Lodi Police Shooting Range ■ Lodi, California
December 9, 2019 ■ Terracon Project No. NA195023



MAP PROVIDED BY MICROSOFT BING MAPS

DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

EXPLORATION RESULTS

Contents:

Boring Logs (B-1 through B-5)
Corrosivity

Note: All attachments are one page unless noted above.

BORING LOG NO. B1

PROJECT: Lodi Police Shooting Range

CLIENT: Petralogix Engineering, Inc.
Galt, CA

SITE: 12751 N Thornton Road
Lodi, CA

LOCATION See Exploration Plan

Latitude: 38.0933° Longitude: -121.3999°

DEPTH	Description	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	PERCENT FINES
	SANDY SILT (ML), fine grained, low plasticity, dark brown							
	stiff				2-2-5 N=7	18		
2.5	**SILTY SAND (SM)**, fine grained, low plasticity, brown to light brown, medium dense				4-4-7 N=11	21		44
	tan, very loose	5			1-1-1 N=2	24		
	reddish brown, dense	10			8-17-30 N=47	16		43
14.0	**SANDY SILT (ML)**, fine grained, tan							
	very stiff	15			6-6-6 N=12	32 27		
16.0	**LEAN CLAY (CL)**, medium plasticity, tan, very stiff							
18.0	**SILTY SAND (SM)**, fine to coarse grained, brown							
	medium dense	20			3-6-9 N=15	30 34		26
	fine grained, brown, medium dense							
	fine grained, nonplastic, reddish tan, medium dense	25			7-9-13 N=22	31 38		
25.5	**SILT WITH SAND (ML)**, fine grained, nonplastic, tan, very stiff							

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Mud Rotary

Abandonment Method:
Boring backfilled with cement grout upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations estimated using Google Earth

Notes:

WATER LEVEL OBSERVATIONS

Water level not determined

Terracon
902 Industrial Way
Lodi, CA

Boring Started: 09-04-2019	Boring Completed: 09-04-2019
Drill Rig: D-50	Driller: R. Anderson
Project No.: NA195023	

BORING LOG NO. B1

PROJECT: Lodi Police Shooting Range

CLIENT: Petralogix Engineering, Inc.
Galt, CA

SITE: 12751 N Thornton Road
Lodi, CA

LOCATION See Exploration Plan

Latitude: 38.0933° Longitude: -121.3999°

DEPTH	Description	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	PERCENT FINES
28.0	**SILTY SAND (SM)**, fine to medium grained, brown							
	medium dense	30		X	4-4-5 N=9	31		
	medium dense	35		X	3-3-6 N=9	37		
38.0	**LEAN CLAY (CL)**, medium plasticity, tan with rust mottlling							
	very stiff	40		X	3-6-12 N=18	28		
43.0	**POORLY GRADED SAND WITH SILT (SP-SM)**, fine to coarse grained, light brown, medium dense							
		45		X	9-8-10 N=18	14 20		
45.5	**SANDY SILT (ML)**, fine grained, light brown, very stiff							
48.0	**LEAN CLAY (CL)**, medium plasticity, gray with rust mottlling, hard							
		50		X	9-16-18 N=34	30		
51.5	***Boring Terminated at 51.5 Feet***							

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Mud Rotary

Abandonment Method:
Boring backfilled with cement grout upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations estimated using Google Earth

Notes:

WATER LEVEL OBSERVATIONS

Water level not determined

Terracon
902 Industrial Way
Lodi, CA

Boring Started: 09-04-2019	Boring Completed: 09-04-2019
Drill Rig: D-50	Driller: R. Anderson
Project No.: NA195023	

BORING LOG NO. B2

PROJECT: Lodi Police Shooting Range

CLIENT: Petralogix Engineering, Inc.
Galt, CA

SITE: 12751 N Thornton Road
Lodi, CA

LOCATION See Exploration Plan

Latitude: 38.0941° Longitude: -121.3985°

GRAPHIC LOG / DEPTH	Description	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	PERCENT FINES
	SILTY SAND (SM), fine grained, dark brown, medium dense				2-3-5	15	99	28
4.0	dark brown, dense		▽		5-8-11	18	65	
	SANDY SILT (ML), fine grained, light brown, hard	5			17-22-32 N=54	20	108	
	nonplastic, light brown, hard				5-9-7 N=16	20		
	low plasticity, light brown, hard	10			7-10-12 N=22	14		
	light brown with red, hard	15			6-8-12 N=20	25		
21.5	fine grained, light brown, hard	20			7-12-13 N=25	38 27		58
	Boring Terminated at 21.5 Feet							

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
6" Hollow Stem Auger

Abandonment Method:
Boring backfilled with cement grout upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations estimated using Google Earth

Notes:

WATER LEVEL OBSERVATIONS

▽ *While drilling*

Terracon
902 Industrial Way
Lodi, CA

Boring Started: 08-23-2019	Boring Completed: 08-23-2019
Drill Rig: D-50	Driller: R. Anderson
Project No.: NA195023	

BORING LOG NO. B3

PROJECT: Lodi Police Shooting Range

CLIENT: Petralogix Engineering, Inc.
Galt, CA

SITE: 12751 N Thornton Road
Lodi, CA

LOCATION See Exploration Plan

Latitude: 38.0933° Longitude: -121.398°

DEPTH	Description	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	PERCENT FINES
	SILTY SAND (SM), fine grained, dark brown, medium dense				2-3-7	14	109	
4.0	dense				3-6-12	15	116	28
	SANDY SILT (ML), fine grained, nonplastic, reddish brown, hard	5	▽		2-9-16 N=25	22	106	
	fine grained, tan with red, hard				13-20-25 N=45	13	123	
12.5	fine to medium grained, reddish orange, hard	10			13-18-24 N=42	20	110	60
18.0	**LEAN CLAY (CL)**, low plasticity, tan very stiff	15			3-5-8 N=13	34 35		
21.5	**SILT WITH SAND (ML)**, fine grained, tan, very stiff	20			4-6-9 N=15	37		
	Boring Terminated at 21.5 Feet							

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
6" Hollow Stem Auger

Abandonment Method:
Boring backfilled with cement grout upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations estimated using Google Earth

Notes:

WATER LEVEL OBSERVATIONS

▽ *While drilling*

Terracon
902 Industrial Way
Lodi, CA

Boring Started: 08-23-2019	Boring Completed: 08-23-2019
Drill Rig: D-50	Driller: R. Anderson
Project No.: NA195023	

BORING LOG NO. B4

PROJECT: Lodi Police Shooting Range

CLIENT: Petralogix Engineering, Inc. Galt, CA

SITE: 12751 N Thornton Road Lodi, CA

LOCATION See Exploration Plan

Latitude: 38.0936° Longitude: -121.3963°

DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	PERCENT FINES
SILTY SAND (SM), fine grained, dark brown, medium dense				3-4-6	11	97	
2.5 **SANDY SILT (ML)**, fine grained, nonplastic, brown, hard				10-11-21	15	114	
light brown, stiff	5			4-6-7	21	99	
		▽					
light brown, hard				6-8-9 N=17	17	111	
light brown to tan, hard	10			5-7-14 N=21	29	96	
15.0 **SILTY SAND (SM)**, fine grained, light brown with orange, dense	15			12-12-12 N=24	18	113	20
16.5 ***Boring Terminated at 16.5 Feet***							

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
6" Hollow Stem Auger

Abandonment Method:
Boring backfilled with cement grout upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations estimated using Google Earth

Notes:

WATER LEVEL OBSERVATIONS

▽ *While drilling*

Terracon
902 Industrial Way
Lodi, CA

Boring Started: 08-23-2019	Boring Completed: 08-23-2019
Drill Rig: D-50	Driller: R. Anderson
Project No.: NA195023	

BORING LOG NO. B5

PROJECT: Lodi Police Shooting Range

CLIENT: Petralogix Engineering, Inc.
Galt, CA

SITE: 12751 N Thornton Road
Lodi, CA

LOCATION See Exploration Plan

Latitude: 38.0936° Longitude: -121.3944°

GRAPHIC LOG / DEPTH	Description	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	PERCENT FINES
	SILTY SAND (SM), fine grained, dark brown, medium dense				5-5-6	8	98	37
2.5	**SANDY SILT (ML)**, fine to medium grained, nonplastic, brown, stiff				4-5-5	13	107	
5.0	**SANDY LEAN CLAY (CL)**, fine grained, low plasticity, tan, medium stiff	5			3-2-3	28	95	
7.5	**SILT (ML)**, nonplastic, brown with orange, hard				11-14-14	17	108	
9.5	**SANDY SILT (ML)**, fine grained, nonplastic, brown, hard	10			9-14-16	17	105	
11.5	***Boring Terminated at 11.5 Feet***							

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
6" Hollow Stem Auger

Abandonment Method:
Boring backfilled with cement grout upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations estimated using Google Earth

Notes:

WATER LEVEL OBSERVATIONS

Terracon
902 Industrial Way
Lodi, CA

Boring Started: 08-23-2019	Boring Completed: 08-23-2019
Drill Rig: D-50	Driller: R. Anderson
Project No.: NA195023	

CHEMICAL LABORATORY TEST REPORT

Project Number: NA195023
Service Date: 09/27/19
Report Date: 10/03/19
Task:

Terracon

750 Pilot Road, Suite F
Las Vegas, Nevada 89119
(702) 597-9393

Client

Petralogix Engineering, Inc.
Galt, CA

Project

Lodi Police Shooting Range

Sample Submitted By: Terracon (NA) **Date Received:** 1/10/1900 **Lab No.: 19-1068**

Results of Corrosion Analysis

Sample Number	1
Sample Location	B4
Sample Depth (ft.)	1.0-2.5
pH Analysis, AWWA 4500 H	8.37
Water Soluble Sulfate (SO4), ASTM C 1580 (percent %)	0.02
Sulfides, AWWA 4500-S D, (mg/kg)	Nil
Chlorides, ASTM D 512, (percent %)	<0.01
Red-Ox, AWWA 2580, (mV)	+688
Total Salts, AWWA 2540, (mg/kg)	1034
Resistivity, ASTM G 57, (ohm-cm)	2522

Analyzed By: Trisha Campo

Trisha Campo
Chemist

SUPPORTING INFORMATION

Contents:

Note: All attachments are one page unless noted above.

GENERAL NOTES

DESCRIPTION OF SYMBOLS AND ABBREVIATIONS

Lodi Police Shooting Range ■ Lodi, CA

December 7, 2019 ■ Terracon Project No. NA195023

Terracon GeoReport

SAMPLING	WATER LEVEL	FIELD TESTS
Modified California Ring Sampler	Water Initially Encountered	**N** — Standard Penetration Test Resistance (Blows/Ft.)
Shelby Tube	Water Level After a Specified Period of Time	**(HP)** — Hand Penetrometer
Standard Penetration Test	Water Level After a Specified Period of Time	**(T)** — Torvane
	Cave In Encountered	**(DCP)** — Dynamic Cone Penetrometer
	Water levels indicated on the soil boring logs are the levels measured in the borehole at the times indicated. Groundwater level variations will occur over time. In low permeability soils, accurate determination of groundwater levels is not possible with short term water level observations.	**UC** — Unconfined Compressive Strength
		(PID) — Photo-Ionization Detector
		(OVA) — Organic Vapor Analyzer

DESCRIPTIVE SOIL CLASSIFICATION

Soil classification as noted on the soil boring logs is based Unified Soil Classification System. Where sufficient laboratory data exist to classify the soils consistent with ASTM D2487 "Classification of Soils for Engineering Purposes" this procedure is used. ASTM D2488 "Description and Identification of Soils (Visual-Manual Procedure)" is also used to classify the soils, particularly where insufficient laboratory data exist to classify the soils in accordance with ASTM D2487. In addition to USCS classification, coarse grained soils are classified on the basis of their in-place relative density, and fine-grained soils are classified on the basis of their consistency. See "Strength Terms" table below for details. The ASTM standards noted above are for reference to methodology in general. In some cases, variations to methods are applied as a result of local practice or professional judgment.

LOCATION AND ELEVATION NOTES

Exploration point locations as shown on the Exploration Plan and as noted on the soil boring logs in the form of Latitude and Longitude are approximate. See Exploration and Testing Procedures in the report for the methods used to locate the exploration points for this project. Surface elevation data annotated with +/- indicates that no actual topographical survey was conducted to confirm the surface elevation. Instead, the surface elevation was approximately determined from topographic maps of the area.

STRENGTH TERMS

RELATIVE DENSITY OF COARSE-GRAINED SOILS (More than 50% retained on No. 200 sieve.) Density determined by Standard Penetration Resistance		CONSISTENCY OF FINE-GRAINED SOILS (50% or more passing the No. 200 sieve.) Consistency determined by laboratory shear strength testing, field visual-manual procedures or standard penetration resistance			
Descriptive Term (Density)	**Standard Penetration or N-Value Blows/Ft.**	**Descriptive Term (Consistency)**	**Unconfined Compressive Strength Qu, (tsf)**	**Standard Penetration or N-Value Blows/Ft.**	**Ring Sampler Blows/Ft.**
Very Loose	0 - 3	Very Soft	less than 0.25		< 3
Loose	4 - 9	Soft	0.25 to 0.50	2 - 4	3 - 4
Medium Dense	10 - 29	Medium Stiff	0.50 to 1.00		5 - 9
Dense	30 - 50	Stiff	1.00 to 2.00	8 - 15	10 - 18
Very Dense	> 50	Very Stiff	2.00 to 4.00	15 - 30	19 - 42
		Hard	> 4.00	> 30	> 42

RELEVANCE OF SOIL BORING LOG

The soil boring logs contained within this document are intended for application to the project as described in this document. Use of these soil boring logs for any other purpose may not be appropriate.

UNIFIED SOIL CLASSIFICATION SYSTEM

Terracon GeoReport

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests [A]				Soil Classification: Group Symbol	Soil Classification: Group Name [B]
Coarse-Grained Soils: More than 50% retained on No. 200 sieve	**Gravels:** More than 50% of coarse fraction retained on No. 4 sieve	**Clean Gravels:** Less than 5% fines [C]	$Cu \geq 4$ and $1 \leq Cc \leq 3$ [E]	GW	Well-graded gravel [F]
			$Cu < 4$ and/or [Cc<1 or Cc>3.0] [E]	GP	Poorly graded gravel [F]
		Gravels with Fines: More than 12% fines [C]	Fines classify as ML or MH	GM	Silty gravel [F, G, H]
			Fines classify as CL or CH	GC	Clayey gravel [F, G, H]
	Sands: 50% or more of coarse fraction passes No. 4 sieve	**Clean Sands:** Less than 5% fines [D]	$Cu \geq 6$ and $1 \leq Cc \leq 3$ [E]	SW	Well-graded sand [I]
			$Cu < 6$ and/or [Cc<1 or Cc>3.0] [E]	SP	Poorly graded sand [I]
		Sands with Fines: More than 12% fines [D]	Fines classify as ML or MH	SM	Silty sand [G, H, I]
			Fines classify as CL or CH	SC	Clayey sand [G, H, I]
Fine-Grained Soils: 50% or more passes the No. 200 sieve	**Silts and Clays:** Liquid limit less than 50	**Inorganic:**	PI > 7 and plots on or above "A" line [J]	CL	Lean clay [K, L, M]
			PI < 4 or plots below "A" line [J]	ML	Silt [K, L, M]
		Organic:	(Liquid limit - oven dried) / (Liquid limit - not dried) < 0.75	OL	Organic clay [K, L, M, N]
					Organic silt [K, L, M, O]
	Silts and Clays: Liquid limit 50 or more	**Inorganic:**	PI plots on or above "A" line	CH	Fat clay [K, L, M]
			PI plots below "A" line	MH	Elastic Silt [K, L, M]
		Organic:	(Liquid limit - oven dried) / (Liquid limit - not dried) < 0.75	OH	Organic clay [K, L, M, P]
					Organic silt [K, L, M, Q]
Highly organic soils:	Primarily organic matter, dark in color, and organic odor			PT	Peat

[A] Based on the material passing the 3-inch (75-mm) sieve.

[B] If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

[C] Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.

[D] Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay.

[E] $Cu = D_{60}/D_{10}$ $\quad Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}}$

[F] If soil contains ≥ 15% sand, add "with sand" to group name.

[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

[H] If fines are organic, add "with organic fines" to group name.

[I] If soil contains ≥ 15% gravel, add "with gravel" to group name.

[J] If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.

[K] If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.

[L] If soil contains ≥ 30% plus No. 200 predominantly sand, add "sandy" to group name.

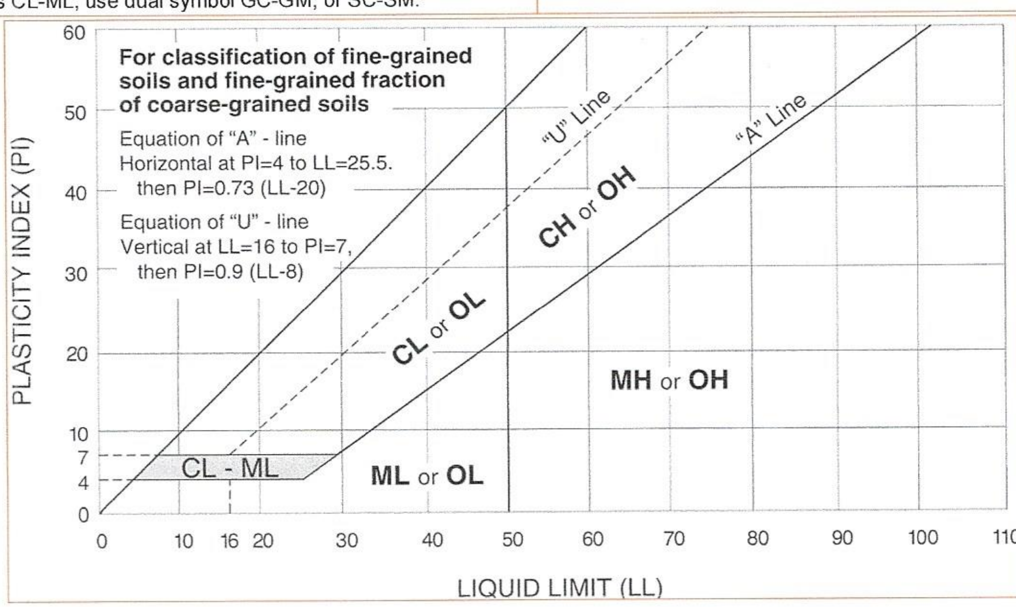
[M] If soil contains ≥ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.

[N] PI ≥ 4 and plots on or above "A" line.

[O] PI < 4 or plots below "A" line.

[P] PI plots on or above "A" line.

[Q] PI plots below "A" line.



Asphaltic Concrete (AC) Design		
Layer	Thickness (inches)	
	TI=4.0	TI= 5.0

1. All materials should meet the current Caltrans Standard Specifications, latest edition

The access road and parking lot will not be covered with asphalt concrete but will have an exposed gravel surface. For the access road and parking lot we recommend the pavement section consist of 6 inches of compacted aggregate base over compacted subgrade. We recommend consideration be given to applying a bitumen oil seal coat to the gravel surface for the first several years in order to reduce the amount of dust and to try and seal the aggregate surface from moisture intrusion. If water penetrates into the gravel, the pavement section may become unstable and lead to premature road failure. Periodic maintenance of the gravel road sections should be anticipated. We also recommend that a stockpile of aggregate base be kept on site to repair any potholes as they appear. The gravel road surface should be sealed prior to the beginning of the rainy season. The ground adjacent to the pavement should be sloped in order to drain water away from the road section.

The estimated pavement sections provided in this report are minimums for the assumed design criteria, and as such, periodic maintenance should be expected. Areas for parking of heavy vehicles, concentrated turn areas, and start/stop maneuvers could require thicker pavement sections. Edge restraints (i.e. concrete curbs or aggregate shoulders) should be planned along curves and areas of maneuvering vehicles. A maintenance program including surface sealing, joint cleaning and sealing, and timely repair of cracks and deteriorated areas will increase the pavement's service life. As an option, thicker sections could be constructed to decrease future maintenance.

Pavement design methods are intended to provide structural sections with adequate thickness

Dishing in parking lots surfaced with AC is usually observed in frequently-used parking stalls (such as near the front of buildings) and occurs under the wheel footprint in these stalls. The use of higher-grade asphaltic cement, or surfacing these areas with PCC, should be considered. The dishing is exacerbated by factors such as irrigated islands or planter areas, and sheet surface drainage to the front of structures.

Rigid PCC pavements will perform better than AC in areas where short-radii turning and braking are expected (i.e. entrance/exit aprons) due to better resistance to rutting and shoving. In addition, PCC pavement will perform better in areas subject to large or sustained loads. An adequate number of longitudinal and transverse control joints should be placed in the rigid pavement in accordance with ACI and/or AASHTO requirements. Expansion (isolation) joints must be full depth and should only be used to isolate fixed objects abutting or within the paved area.

Pavement Drainage

Pavements should be sloped to provide rapid drainage of surface water. Water allowed to pond on or adjacent to the pavements could saturate the subgrade and contribute to premature pavement deterioration. In addition, the pavement subgrade should be graded to provide positive drainage within the granular base section.

The pavement surfacing and adjacent sidewalks should be sloped to provide rapid drainage of surface water. Water should not be allowed to pond on or adjacent to slabs, since it could saturate the subgrade and contribute to premature pavement or slab deterioration.

Pavement Maintenance

The pavement sections represent minimum recommended thicknesses and, as such, periodic maintenance should be anticipated. Therefore, preventive maintenance should be planned and provided for through an on-going pavement management program. Maintenance activities are intended to slow the rate of pavement deterioration and to preserve the pavement investment. Maintenance consists of both localized maintenance (e.g. crack and joint sealing and patching) and global maintenance (e.g. surface sealing). Preventive maintenance is usually the priority when implementing a pavement maintenance program. Additional engineering observation is recommended to determine the type and extent of a cost-effective program. Even with periodic maintenance, some movements and related cracking may still occur and repairs may be required.

Pavement performance is affected by its surroundings. In addition to providing preventive maintenance, the civil engineer should consider the following recommendations in the design and layout of pavements:

1. Final grade adjacent to paved areas should slope down from the edges at a minimum 2%.

2. Subgrade and pavement surfaces should have a minimum 2% slope to promote proper surface drainage.
3. Install below pavement drainage systems surrounding areas anticipated for frequent wetting.
4. Install joint sealant and seal cracks immediately.
5. Seal all landscaped areas in or adjacent to pavements to reduce moisture migration to subgrade soils.
6. Place compacted, low permeability backfill against the exterior side of curb and gutter.
7. Place curb, gutter and/or sidewalk directly on subgrade soils rather than on unbound granular base course materials.

CORROSIVITY

The table below lists the results of laboratory soluble sulfate, soluble chloride, electrical resistivity, and pH testing. The values may be used to estimate potential corrosive characteristics of the on-site soils with respect to contact with the various underground materials which will be used for project construction.

Corrosivity Test Results Summary						
Boring	Sample Depth (feet)	Soil Description	Soluble Sulfate (%)	Soluble Chloride (%)	Electrical Resistivity (Ω-cm)	pH
B4	1.0 – 2.5	SILTY SAND (SM)	0.02	<0.01	2522	8.37

The sulfate test results indicate that the soil from boring B4 classifies as Class S0 according to Table 19.3.1.1 of ACI 318-14. This indicates that the sulfate level is negligible when considering corrosion to concrete. Based on the results of the sulfate content test results, ACI 318-14, Section 19.3 does not specify the type of cement or a maximum water-cement ratio for concrete for sulfate Class S0. For further information, see ACI 318-14, Section 19.3.

GENERAL COMMENTS

Our analysis and opinions are based upon our understanding of the project, the geotechnical conditions in the area, and the data obtained from our site exploration. Natural variations will occur between exploration point locations or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction. Terracon should be retained as the Geotechnical Engineer, where noted in this report, to provide observation and testing services during pertinent construction phases. If variations appear, we can provide further evaluation and supplemental recommendations. If variations are noted in the absence of our observation and testing services on-site, we should be immediately notified so that we can provide evaluation and supplemental recommendations.

Our Scope of Services does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If the owner is concerned about the potential for such contamination or pollution, other studies should be undertaken.

Our services and any correspondence or collaboration through this system are intended for the sole benefit and exclusive use of our client for specific application to the project discussed and are accomplished in accordance with generally accepted geotechnical engineering practices with no third-party beneficiaries intended. Any third-party access to services or correspondence is solely for information purposes to support the services provided by Terracon to our client. Reliance upon the services and any work product is limited to our client and is not intended for third parties. Any use or reliance of the provided information by third parties is done solely at their own risk. No warranties, either express or implied, are intended or made.

Site characteristics as provided are for design purposes and not to estimate excavation cost. Any use of our report in that regard is done at the sole risk of the excavating cost estimator as there may be variations on the site that are not apparent in the data that could significantly impact excavation cost. Any parties charged with estimating excavation costs should seek their own site characterization for specific purposes to obtain the specific level of detail necessary for costing. Site safety, and cost estimating including, excavation support, and dewatering requirements/design are the responsibility of others. If changes in the nature, design, or location of the project are planned, our conclusions and recommendations shall not be considered valid unless we review the changes and either verify or modify our conclusions in writing.

ATTACHMENTS

EXPLORATION AND TESTING PROCEDURES

Field Exploration

Number of Borings	Boring Depth (feet)	Planned Location
1	50	Planned 15-foot high embankment
2	20	Planned shooting range wall areas
1	15	Planned classroom training facility
1	10	Planned defensive driving course area

Boring Layout and Elevations: Unless otherwise noted, Terracon personnel provided the boring layout. Coordinates were obtained with a handheld GPS unit (estimated horizontal accuracy of about ±10 feet). If elevations and a more precise boring layout are desired, we recommend borings be surveyed.

Subsurface Exploration Procedures: We advanced the borings with a track-mounted rotary drill rig using continuous hollow stem flight augers. We obtained samples at depths of 1 foot, 2½ feet, 5 feet, 10 feet and at intervals of 5 feet thereafter. In the split-barrel sampling procedure, a standard 2-inch outer diameter split-barrel sampling spoon was driven into the ground by a 140-pound automatic hammer falling a distance of 30 inches. The number of blows required to advance the sampling spoon the last 12 inches of a normal 18-inch penetration is recorded as the Standard Penetration Test (SPT) resistance value. The SPT resistance values, also referred to as N-values, are indicated on the boring logs at the test depths. A 2.5-inch O.D. split-barrel Modified California sampling spoon with 2.0-inch I.D. tube lined sampler was also used for sampling. Tube-lined, split-barrel sampling procedures are similar to standard split spoon sampling procedure; however, blow counts are not equivalent to the SPT blow counts. We observed and recorded groundwater levels during drilling and sampling. For safety purposes, all borings were backfilled with neat cement after their completion.

The sampling depths, penetration distances, and other sampling information was recorded on the field boring logs. The samples were placed in appropriate containers and taken to our soil laboratory for testing and classification by a Geotechnical Engineer. Our exploration team prepared field boring logs as part of the drilling operations. These field logs included visual classifications of the materials encountered during drilling and our interpretation of the subsurface conditions between samples. Final boring logs were prepared from the field logs. The final boring logs represent the Geotechnical Engineer's interpretation of the field logs and include modifications based on observations and tests of the samples in our laboratory.

Laboratory Testing

The project engineer reviewed the field data and assigned laboratory tests to understand the engineering properties of the various soil strata, as necessary, for this project. Procedural standards noted below are for reference to methodology in general. In some cases, variations to methods were applied because of local practice or professional judgment. Standards noted below include reference to other, related standards. Such references are not necessarily applicable to describe the specific test performed.

- ASTM D2216 Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
- ASTM D422 Standard Test Method for Particle-Size Analysis of Soils
- ASTM D1140 Standard Test Method for Determining the Amount of Material Finer than No. 200 Sieve by Soil Washing
- Corrosivity

The laboratory testing program included examination of soil samples by an engineer. Based on the material's texture and plasticity, we described and classified the soil samples in accordance with the Unified Soil Classification System.

SITE LOCATION AND EXPLORATION PLANS

Contents:

Site Location Plan
Exploration Plan with Project Overlay

Note: All attachments are one page unless noted above.

SITE LOCATION

Lodi Police Shooting Range ■ Lodi, California

December 9, 2019 ■ Terracon Project No. NA195023

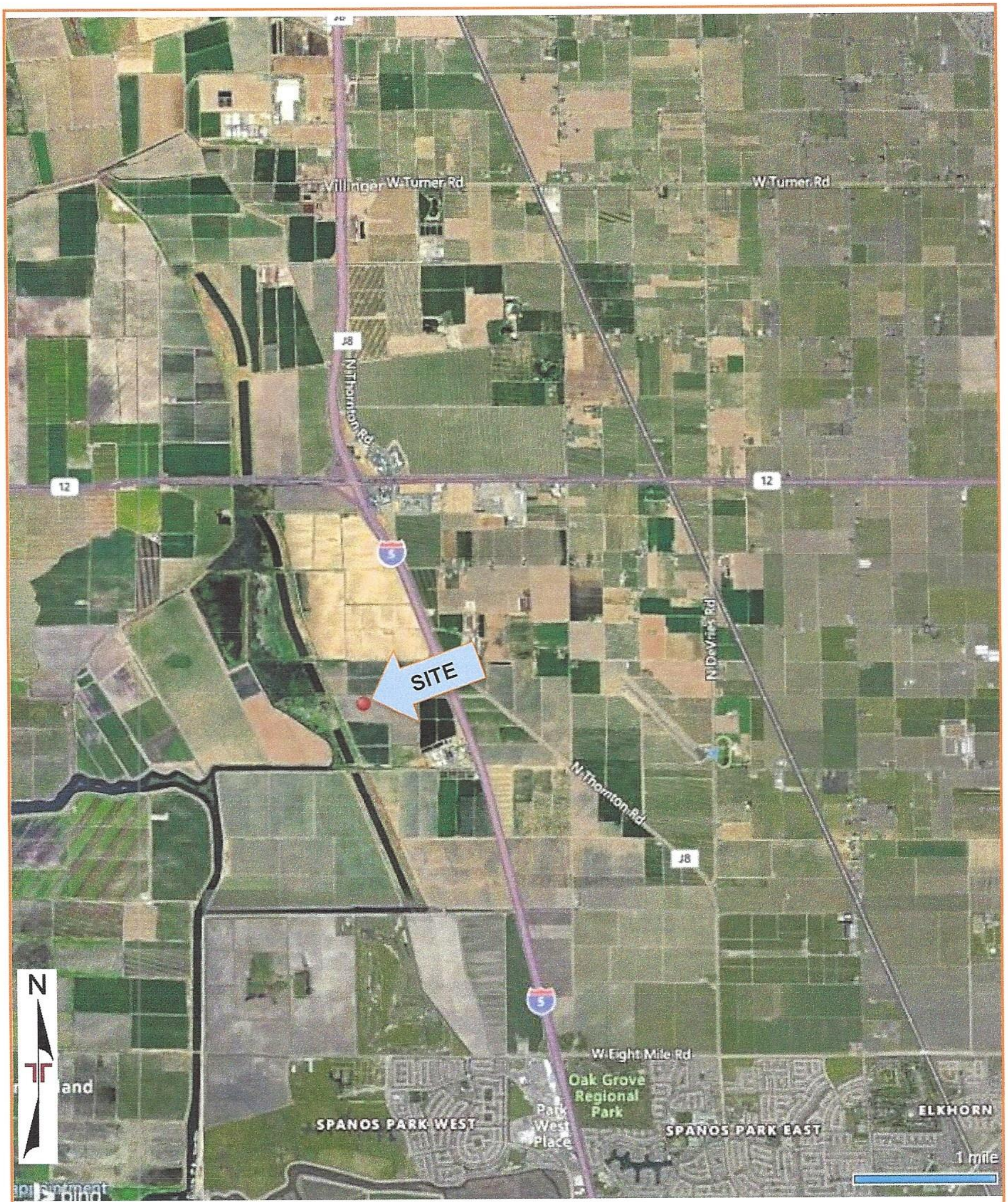


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP PROVIDED BY MICROSOFT BING MAPS

SITE LOCATION

Lodi Police Shooting Range ■ Lodi, California

December 9, 2019 ■ Terracon Project No. NA195023

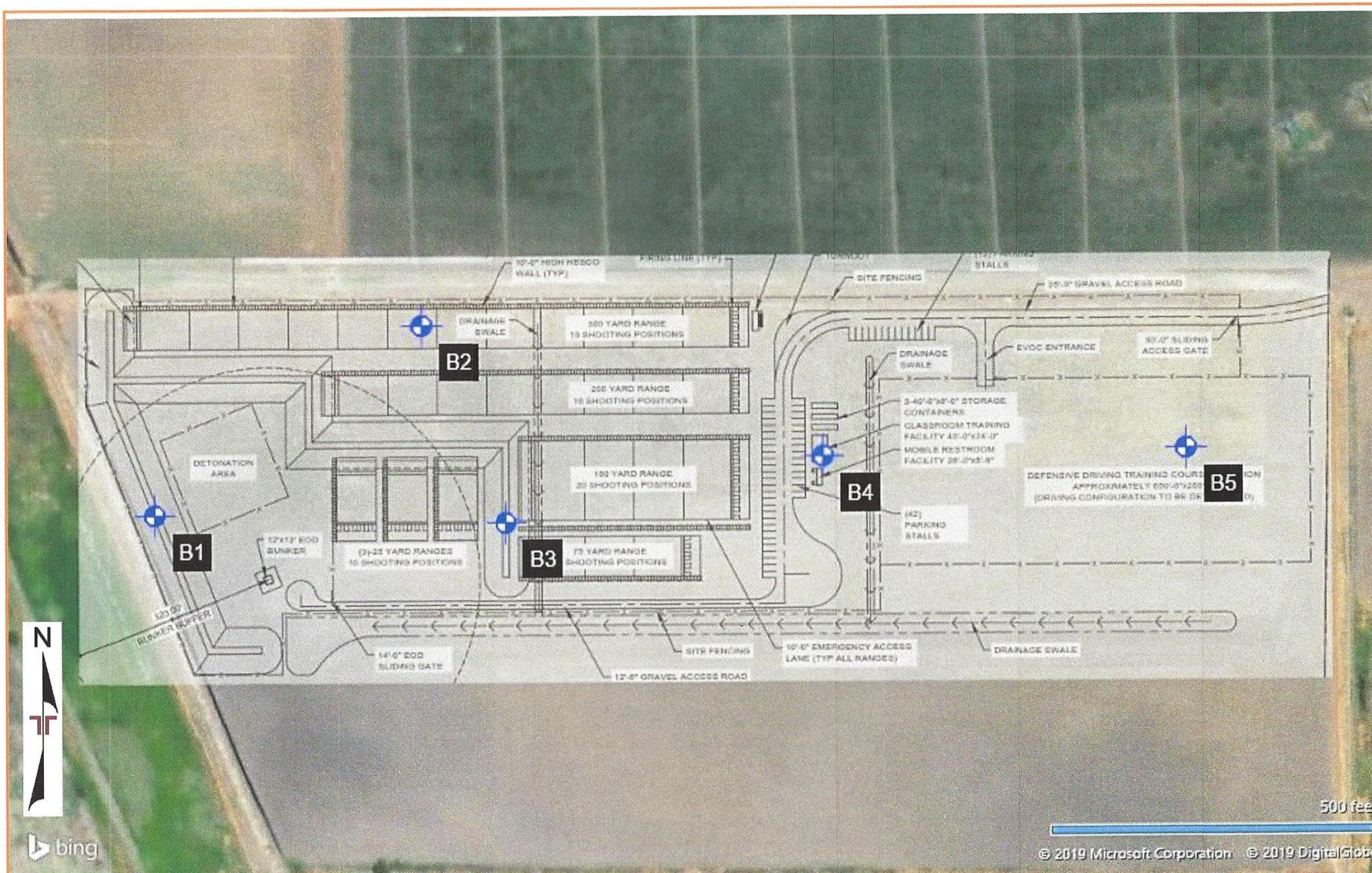


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP PROVIDED BY MICROSOFT BING MAPS

EXPLORATION RESULTS

Contents:

Boring Logs (B-1 through B-5)
Corrosivity

Note: All attachments are one page unless noted above.

BORING LOG NO. B1

PROJECT: Lodi Police Shooting Range

CLIENT: Petralogix Engineering, Inc.
Galt, CA

SITE: 12751 N Thornton Road
Lodi, CA

LOCATION See Exploration Plan

Latitude: 38.0933° Longitude: -121.3999°

DEPTH	Description	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	PERCENT FINES
	SANDY SILT (ML), fine grained, low plasticity, dark brown							
	stiff			Split spoon	2-2-5 N=7	18		
2.5	**SILTY SAND (SM)**, fine grained, low plasticity, brown to light brown, medium dense			Split spoon	4-4-7 N=11	21		44
	tan, very loose	5		Split spoon	1-1-1 N=2	24		
				Shelby tube				
	reddish brown, dense	10		Split spoon	8-17-30 N=47	16		43
14.0	**SANDY SILT (ML)**, fine grained, tan							
	very stiff	15		Split spoon	6-6-6 N=12	32 27		
16.0	**LEAN CLAY (CL)**, medium plasticity, tan, very stiff							
18.0	**SILTY SAND (SM)**, fine to coarse grained, brown							
	medium dense	20		Split spoon	3-6-9 N=15	30 34		26
	fine grained, brown, medium dense							
	fine grained, nonplastic, reddish tan, medium dense							
25.5	**SILT WITH SAND (ML)**, fine grained, nonplastic, tan, very stiff	25		Split spoon	7-9-13 N=22	31 38		

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Mud Rotary

Abandonment Method:
Boring backfilled with cement grout upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations estimated using Google Earth

Notes:

WATER LEVEL OBSERVATIONS
Water level not determined

Terracon
902 Industrial Way
Lodi, CA

Boring Started: 09-04-2019	Boring Completed: 09-04-2019
Drill Rig: D-50	Driller: R. Anderson
Project No.: NA195023	

BORING LOG NO. B1

PROJECT: Lodi Police Shooting Range

CLIENT: Petralogix Engineering, Inc.
Galt, CA

SITE: 12751 N Thornton Road
Lodi, CA

LOCATION See Exploration Plan

Latitude: 38.0933° Longitude: -121.3999°

DEPTH	Description	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	PERCENT FINES
28.0	**SILTY SAND (SM)**, fine to medium grained, brown							
	medium dense	30		X	4-4-5 N=9	31		
	medium dense	35		X	3-3-6 N=9	37		
38.0	**LEAN CLAY (CL)**, medium plasticity, tan with rust mottlling							
	very stiff	40		X	3-6-12 N=18	28		
43.0	**POORLY GRADED SAND WITH SILT (SP-SM)**, fine to coarse grained, light brown, medium dense	45		X	9-8-10 N=18	14 20		
45.5	**SANDY SILT (ML)**, fine grained, light brown, very stiff							
48.0	**LEAN CLAY (CL)**, medium plasticity, gray with rust mottlling, hard	50		X	9-16-18 N=34	30		
51.5	***Boring Terminated at 51.5 Feet***							

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Mud Rotary

Abandonment Method:
Boring backfilled with cement grout upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations estimated using Google Earth

Notes:

WATER LEVEL OBSERVATIONS

Water level not determined

Terracon
902 Industrial Way
Lodi, CA

Boring Started: 09-04-2019	Boring Completed: 09-04-2019
Drill Rig: D-50	Driller: R. Anderson
Project No.: NA195023	

BORING LOG NO. B2

PROJECT: Lodi Police Shooting Range

CLIENT: Petralogix Engineering, Inc.
Galt, CA

SITE: 12751 N Thornton Road
Lodi, CA

LOCATION See Exploration Plan

Latitude: 38.0941° Longitude: -121.3985°

DEPTH	Description	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	PERCENT FINES
	SILTY SAND (SM), fine grained, dark brown, medium dense			X	2-3-5	15	99	28
	dark brown, dense		▽	X	5-8-11	18	65	
4.0	**SANDY SILT (ML)**, fine grained, light brown, hard	5		X	17-22-32 N=54	20	108	
	nonplastic, light brown, hard			X	5-9-7 N=16	20		
	low plasticity, light brown, hard	10		X	7-10-12 N=22	14		
	light brown with red, hard	15		X	6-8-12 N=20	25		
	fine grained, light brown, hard	20		X	7-12-13 N=25	38 27		58
21.5	***Boring Terminated at 21.5 Feet***							

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
6" Hollow Stem Auger

Abandonment Method:
Boring backfilled with cement grout upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations estimated using Google Earth

Notes:

WATER LEVEL OBSERVATIONS

▽ *While drilling*

Terracon
902 Industrial Way
Lodi, CA

Boring Started: 08-23-2019	Boring Completed: 08-23-2019
Drill Rig: D-50	Driller: R. Anderson
Project No.: NA195023	

BORING LOG NO. B3

PROJECT: Lodi Police Shooting Range

CLIENT: Petralogix Engineering, Inc.
Galt, CA

SITE: 12751 N Thornton Road
Lodi, CA

LOCATION See Exploration Plan

Latitude: 38.0933° Longitude: -121.398°

DEPTH	Description	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	PERCENT FINES
	SILTY SAND (SM), fine grained, dark brown, medium dense				2-3-7	14	109	
4.0	dense				3-6-12	15	116	28
	SANDY SILT (ML), fine grained, nonplastic, reddish brown, hard	5	▽		2-9-16 N=25	22	106	
	fine grained, tan with red, hard				13-20-25 N=45	13	123	
12.5	fine to medium grained, reddish orange, hard	10			13-18-24 N=42	20	110	60
	LEAN CLAY (CL), low plasticity, tan							
18.0	very stiff	15			3-5-8 N=13	34 35		
21.5	**SILT WITH SAND (ML)**, fine grained, tan, very stiff	20			4-6-9 N=15	37		

Boring Terminated at 21.5 Feet

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
6" Hollow Stem Auger

Abandonment Method:
Boring backfilled with cement grout upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations estimated using Google Earth

Notes:

WATER LEVEL OBSERVATIONS

▽ *While drilling*

Terracon
902 Industrial Way
Lodi, CA

Boring Started: 08-23-2019	Boring Completed: 08-23-2019
Drill Rig: D-50	Driller: R. Anderson
Project No.: NA195023	

BORING LOG NO. B4

PROJECT: Lodi Police Shooting Range

CLIENT: Petralogix Engineering, Inc.
Galt, CA

SITE: 12751 N Thornton Road
Lodi, CA

LOCATION See Exploration Plan

Latitude: 38.0936° Longitude: -121.3963°

DEPTH	Description	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	PERCENT FINES
	SILTY SAND (SM), fine grained, dark brown, medium dense				3-4-6	11	97	
2.5	**SANDY SILT (ML)**, fine grained, nonplastic, brown, hard				10-11-21	15	114	
	light brown, stiff	5			4-6-7	21	99	
			▽					
	light brown, hard				6-8-9 N=17	17	111	
	light brown to tan, hard	10			5-7-14 N=21	29	96	
15.0	**SILTY SAND (SM)**, fine grained, light brown with orange, dense	15			12-12-12 N=24	18	113	20
16.5	***Boring Terminated at 16.5 Feet***							

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
6" Hollow Stem Auger

Abandonment Method:
Boring backfilled with cement grout upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations estimated using Google Earth

Notes:

WATER LEVEL OBSERVATIONS

▽ *While drilling*

Terracon
902 Industrial Way
Lodi, CA

Boring Started: 08-23-2019	Boring Completed: 08-23-2019
Drill Rig: D-50	Driller: R. Anderson
Project No.: NA195023	

BORING LOG NO. B5

PROJECT: Lodi Police Shooting Range

CLIENT: Petralogix Engineering, Inc.
Galt, CA

SITE: 12751 N Thornton Road
Lodi, CA

LOCATION See Exploration Plan

Latitude: 38.0936° Longitude: -121.3944°

DEPTH	Description	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	PERCENT FINES
	SILTY SAND (SM), fine grained, dark brown, medium dense							
2.5				X	5-5-6	8	98	37
	SANDY SILT (ML), *fine to medium grained, nonplastic, brown, stiff*			X	4-5-5	13	107	
5.0		5						
	SANDY LEAN CLAY (CL), fine grained, low plasticity, tan, medium stiff			X	3-2-3	28	95	
7.5								
	SILT (ML), nonplastic, brown with orange, hard			X	11-14-14	17	108	
9.5								
	SANDY SILT (ML), fine grained, nonplastic, brown, hard	10		X	9-14-16	17	105	
11.5								

Boring Terminated at 11.5 Feet

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
6" Hollow Stem Auger

Abandonment Method:
Boring backfilled with cement grout upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations estimated using Google Earth

Notes:

WATER LEVEL OBSERVATIONS

Terracon
902 Industrial Way
Lodi, CA

Boring Started: 08-23-2019	Boring Completed: 08-23-2019
Drill Rig: D-50	Driller: R. Anderson
Project No.: NA195023	

CHEMICAL LABORATORY TEST REPORT

Project Number: NA195023
Service Date: 09/27/19
Report Date: 10/03/19
Task:

Terracon
750 Pilot Road, Suite F
Las Vegas, Nevada 89119
(702) 597-9393

Client

Petralogix Engineering, Inc.
Galt, CA

Project

Lodi Police Shooting Range

Sample Submitted By: Terracon (NA) **Date Received:** 1/10/1900 **Lab No.: 19-1068**

Results of Corrosion Analysis

Sample Number	1
Sample Location	B4
Sample Depth (ft.)	1.0-2.5
pH Analysis, AWWA 4500 H	8.37
Water Soluble Sulfate (SO4), ASTM C 1580 (percent %)	0.02
Sulfides, AWWA 4500-S D, (mg/kg)	Nil
Chlorides, ASTM D 512, (percent %)	<0.01
Red-Ox, AWWA 2580, (mV)	+688
Total Salts, AWWA 2540, (mg/kg)	1034
Resistivity, ASTM G 57, (ohm-cm)	2522

Analyzed By: Trisha Campo
Trisha Campo
Chemist

SUPPORTING INFORMATION

Contents:

Note: All attachments are one page unless noted above.

GENERAL NOTES
DESCRIPTION OF SYMBOLS AND ABBREVIATIONS
Lodi Police Shooting Range ■ Lodi, CA
December 7, 2019 ■ Terracon Project No. NA195023

Terracon GeoReport

SAMPLING	WATER LEVEL	FIELD TESTS
Modified California Ring Sampler Shelby Tube Standard Penetration Test	Water Initially Encountered Water Level After a Specified Period of Time Water Level After a Specified Period of Time Cave In Encountered Water levels indicated on the soil boring logs are the levels measured in the borehole at the times indicated. Groundwater level variations will occur over time. In low permeability soils, accurate determination of groundwater levels is not possible with short term water level observations.	N — Standard Penetration Test Resistance (Blows/Ft.) (HP) — Hand Penetrometer (T) — Torvane (DCP) — Dynamic Cone Penetrometer UC — Unconfined Compressive Strength (PID) — Photo-Ionization Detector (OVA) — Organic Vapor Analyzer

DESCRIPTIVE SOIL CLASSIFICATION

Soil classification as noted on the soil boring logs is based Unified Soil Classification System. Where sufficient laboratory data exist to classify the soils consistent with ASTM D2487 "Classification of Soils for Engineering Purposes" this procedure is used. ASTM D2488 "Description and Identification of Soils (Visual-Manual Procedure)" is also used to classify the soils, particularly where insufficient laboratory data exist to classify the soils in accordance with ASTM D2487. In addition to USCS classification, coarse grained soils are classified on the basis of their in-place relative density, and fine-grained soils are classified on the basis of their consistency. See "Strength Terms" table below for details. The ASTM standards noted above are for reference to methodology in general. In some cases, variations to methods are applied as a result of local practice or professional judgment.

LOCATION AND ELEVATION NOTES

Exploration point locations as shown on the Exploration Plan and as noted on the soil boring logs in the form of Latitude and Longitude are approximate. See Exploration and Testing Procedures in the report for the methods used to locate the exploration points for this project. Surface elevation data annotated with +/- indicates that no actual topographical survey was conducted to confirm the surface elevation. Instead, the surface elevation was approximately determined from topographic maps of the area.

STRENGTH TERMS

RELATIVE DENSITY OF COARSE-GRAINED SOILS (More than 50% retained on No. 200 sieve.) Density determined by Standard Penetration Resistance		CONSISTENCY OF FINE-GRAINED SOILS (50% or more passing the No. 200 sieve.) Consistency determined by laboratory shear strength testing, field visual-manual procedures or standard penetration resistance			
Descriptive Term (Density)	**Standard Penetration or N-Value Blows/Ft.**	**Descriptive Term (Consistency)**	**Unconfined Compressive Strength Qu, (tsf)**	**Standard Penetration or N-Value Blows/Ft.**	**Ring Sampler Blows/Ft.**
Very Loose	0 - 3	Very Soft	less than 0.25		< 3
Loose	4 - 9	Soft	0.25 to 0.50	2 - 4	3 - 4
Medium Dense	10 - 29	Medium Stiff	0.50 to 1.00		5 - 9
Dense	30 - 50	Stiff	1.00 to 2.00	8 - 15	10 - 18
Very Dense	> 50	Very Stiff	2.00 to 4.00	15 - 30	19 - 42
		Hard	> 4.00	> 30	> 42

RELEVANCE OF SOIL BORING LOG

The soil boring logs contained within this document are intended for application to the project as described in this document. Use of these soil boring logs for any other purpose may not be appropriate.

UNIFIED SOIL CLASSIFICATION SYSTEM

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Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests [A]				Soil Classification: Group Symbol	Group Name [B]
Coarse-Grained Soils: More than 50% retained on No. 200 sieve	**Gravels:** More than 50% of coarse fraction retained on No. 4 sieve	**Clean Gravels:** Less than 5% fines [C]	$Cu \geq 4$ and $1 \leq Cc \leq 3$ [E]	GW	Well-graded gravel [F]
			$Cu < 4$ and/or [$Cc<1$ or $Cc>3.0$] [E]	GP	Poorly graded gravel [F]
		Gravels with Fines: More than 12% fines [C]	Fines classify as ML or MH	GM	Silty gravel [F, G, H]
			Fines classify as CL or CH	GC	Clayey gravel [F, G, H]
	Sands: 50% or more of coarse fraction passes No. 4 sieve	**Clean Sands:** Less than 5% fines [D]	$Cu \geq 6$ and $1 \leq Cc \leq 3$ [E]	SW	Well-graded sand [I]
			$Cu < 6$ and/or [$Cc<1$ or $Cc>3.0$] [E]	SP	Poorly graded sand [I]
		Sands with Fines: More than 12% fines [D]	Fines classify as ML or MH	SM	Silty sand [G, H, I]
			Fines classify as CL or CH	SC	Clayey sand [G, H, I]
Fine-Grained Soils: 50% or more passes the No. 200 sieve	**Silts and Clays:** Liquid limit less than 50	**Inorganic:**	PI > 7 and plots on or above "A"	CL	Lean clay [K, L, M]
			PI < 4 or plots below "A" line [J]	ML	Silt [K, L, M]
		Organic:	Liquid limit - oven dried / Liquid limit - not dried < 0.75	OL	Organic clay [K, L, M, N]
					Organic silt [K, L, M, O]
	Silts and Clays: Liquid limit 50 or more	**Inorganic:**	PI plots on or above "A" line	CH	Fat clay [K, L, M]
			PI plots below "A" line	MH	Elastic Silt [K, L, M]
		Organic:	Liquid limit - oven dried / Liquid limit - not dried < 0.75	OH	Organic clay [K, L, M, P]
					Organic silt [K, L, M, Q]
Highly organic soils:	Primarily organic matter, dark in color, and organic odor			PT	Peat

[A] Based on the material passing the 3-inch (75-mm) sieve.

[B] If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

[C] Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.

[D] Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay.

[E] $Cu = D_{60}/D_{10}$ $Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}}$

[F] If soil contains ≥ 15% sand, add "with sand" to group name.

[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

[H] If fines are organic, add "with organic fines" to group name.

[I] If soil contains ≥ 15% gravel, add "with gravel" to group name.

[J] If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.

[K] If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.

[L] If soil contains ≥ 30% plus No. 200 predominantly sand, add "sandy" to group name.

[M] If soil contains ≥ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.

[N] PI ≥ 4 and plots on or above "A" line.

[O] PI < 4 or plots below "A" line.

[P] PI plots on or above "A" line.

[Q] PI plots below "A" line.