



Geologic Hazard Report

**Tokay High School New Classrooms and Gym
Lodi, California**

January 30, 2019

Terracon Project No. NA185132

Prepared for:

Lodi Unified School District
Lodi, California

Prepared by:

Terracon Consultants, Inc.
Lodi, California



January 30, 2019

Lodi Unified School District
12345 Street Name
Lodi, California 95240



Attn: Vickie Brum
P: (209) 331-7228
E: vbrum@lodiUSD.net

Re: Geologic Hazard Report
Tokay High School New Classrooms and Gym
1111 W. Century Boulevard
Lodi, California
Terracon Project No. NA185132

Dear Ms. Brum:

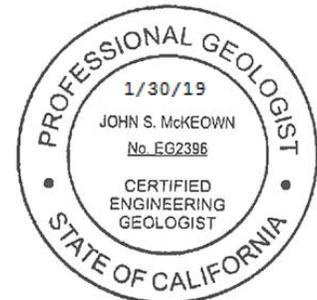
We have completed the Geologic Hazard services for the above referenced project. This study was performed in general accordance with Terracon Proposal No. PNA185132 dated August 20, 2018. This report presents the findings of the geologic hazard investigation for the proposed project. California Geologic Survey (CGS) Note 48 was referenced in preparation of this report.

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.



Ryan L. Coe, C.E.G.
Senior Staff Geologist



John S. McKeown
John S. McKeown, E.G 2396
Senior Geologist

REPORT TOPICS

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ATTACHMENTS

EXHIBITS

SUPPORTING INFORMATION

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

Geologic Hazard Report
Tokay High School New Classrooms and Gym
1111 W. Century Boulevard
Lodi, California
Terracon Project No. NA185132
January 30, 2019

INTRODUCTION

This report presents the results of our geologic hazard study for the proposed classroom and gym to be located at 1111 W. Century Boulevard in Lodi, California. The purpose of this study was to evaluate the potential for geologic hazards affecting the site in compliance with the requirements of the 2016 California Building Code (CBC) and reference documents including CGS note 48. Additionally, Terracon has conducted a geotechnical investigation at this site for the above referenced project dated October 30, 2018. The 2018 Terracon report was referenced in preparation of this report and is included in the **Supporting Information**.

This report has been prepared for the exclusive use of Terracon Consultants, Inc., their representatives and direct clients, and because conditions may change over time due to earthquakes, rainstorms, construction, and other causes, this report may require an updated investigation. This report is not to be provided to any third party without Terracon's authorization. Should this report be provided to a third part without Terracon's authorization, then the undersigned will assume no liability, whatsoever.

SITE DESCRIPTION AND GEOLOGY

Site Description

The general topography of the subject site consists of relatively flat-lying valley terrain with low relief. The site is situated within the Tokay High School Campus. Development at the campus includes buildings, parking lots and associated hardscapes. The campus is surrounded by residential tract development. A topographic map and aerial photograph of the subject property is presented on Exhibits 1 and 2, respectively. The subject site coordinates are: latitude, 38.11003 °N; longitude, 121.28609°W.

Review of Geologic Literature

Terracon reviewed available published geologic literature, including publications by the United States Geologic Survey, the California Geological Survey, and Marchand, D.E., and Atwater, B.F. (1979) that include the area of the site. A geotechnical investigation of the site was performed by Terracon in October of 2018 (Project Number NA185132). The geotechnical investigation

Geologic Hazard Report

Tokay High School New Classrooms and Gym ■ Lodi, California
January 30, 2019 ■ Terracon Project No. NA185132



revealed both subgrade soil conditions and groundwater conditions. Data from the geotechnical investigation was used in preparation of and is presented in this report.

Site Geology

The site is situated within the Great Valley Geomorphic Province. The Great Valley is an alluvial plain that lies within central California. The region is a trough into which sediments have been deposited since Jurassic¹ time.

The geology of the site is mapped as Pleistocene age Modesto Formation which is composed chiefly of eolian and fluvial sands, gravels, and clays^{2,3}. State general geology maps describe/depict the geology at the site as marine and non-marine sediments (Q) that consist of Alluvium, lake, playa, and terrace deposits; unconsolidated and semi-consolidated⁴.

Groundwater

Groundwater was not encountered in Terracon's 2018 geotechnical study. Groundwater wells in the area show groundwater ranging in depth from 57 to 70 feet below ground surface⁵.

SEISMICITY AND GROUND MOTION

Faulting and Seismicity

The subject site does not lie within an Alquist-Priolo (AP) fault zone. The closest AP zone, established for the Greenville fault, is located approximately 35 miles southwest of the site. Based on the site location outside of established AP zones and lack of faults in proximity to the school campus or other, surface rupture from faulting is not anticipated at the site.

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 Class 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

¹ California Geologic Survey, Note 36, "California Geomorphic Provinces"

²Atwater, B.F., 1982, [Geologic maps of the Sacramento-San Joaquin Delta, California](#): U.S. Geological Survey, Miscellaneous Field Studies Map MF-1401, scale 1:24,000.

³Marchand, D.E., and Atwater, B.F., 1979, [Preliminary geologic map showing Quaternary deposits of the Lodi quadrangle, California](#): U.S. Geological Survey, Open-File Report OF-79-933, scale 1:62,500

⁴California Geologic Survey, Geologic Map of California, 2010

⁵ <http://geotracker.waterboards.ca.gov/gama/gamamap/public/>

with Section 20.4 of ASCE 7-10. Terracon's 2018 geotechnical report characterized the Site Class as D and the spectral acceleration for a 1-second period, S_1 , as 0.305. The proposed buildings should be designed per the seismic recommendations given in Terracon's 2018 geotechnical report.

Central Valley Faults

The site is located 33 miles northeast of the Coast Range-Central Valley (CRCV) geomorphic boundary. The CRCV boundary is underlain by the Central Valley Thrust Fault System, a segmented 310-mile (500-km) long seismically active fold and thrust belt (Wakabayashi and Smith, 1994). The Central Valley Thrust Fault System is largely a blind thrust system. Notable earthquakes associated with the Central Valley Thrust Fault System are the 1866 Patterson earthquake (Mw 5.9), and the 1983 Coalinga earthquake (Mw 6.5). The 1983 Coalinga earthquake caused considerable damage to the Coalinga area.

The Greenville Fault system is the closest active Holocene fault to the site. The system accommodates right lateral motion and is consistent with the larger tectonic regime of the Bay Area. The Greenville Fault is composed of four segments along its approximately 57-mile length that strike approximately northwest along the eastern foothills of the Coast Range and Mount Diablo. The four sections are the Arroyo Mocho, Clayton, Marsh Creek-Greenville, and the San Antonio Valley. The Arroyo Mocho and Marsh Creek-Greenville are the most active segments, accommodating approximately 1 to 5 millimeters per year of creep⁶. The most recent rupture was a 5.8 magnitude event that occurred along the Marsh Creek-Greenville segment of the fault in January of 1980 near Livermore, California. The main earthquake event was followed by four aftershock events that ranged in magnitude from 4.6 to 5.4. The earthquake events caused surface rupture in several areas along the Marsh Creek-Greenville segment⁷.

Due to distance from causative faults, and the limited earthquake activity in the vicinity of the site, we consider the overall seismic hazard to be low.

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

⁶USGS, Quaternary Fault and Fold Database of the United States, 6/25/2002

⁷M.G Bonilla, et. al., 1980, Surface Faulting near Livermore, California associated with the January 1980 earthquakes

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Tokay High School New Classrooms and Gym ■ Lodi, California
January 30, 2019 ■ Terracon Project No. NA185132



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 2018 Geotechnical Report considers the potential for liquefaction and any associated effects to be low due to the relative density of the soils encountered in the borings and the historical depth to groundwater being greater than 50 feet below the existing grade. The City of Lodi general plan considers the potential of soil liquefaction taking place within the Planning Area to be low to moderate⁸.

SLOPE STABILITY

The site is relatively flat. Therefore, the potential for slope stability to be a geologic hazard at the site is low.

OTHER GEOLOGIC HAZARDS

SOIL CORROSIVITY

The corrosivity of the surficial soils at the site are addressed in the Corrosivity section of the 2018 Terracon report. Samples obtained during the investigation were tested for soluble chlorides and sulfides, pH, and resistivity. The results of the soil corrosivity tests are included in the Terracon's 2018 geotechnical report. The results of the corrosivity testing generally indicates a low corrosive potential to concrete and buried metal pipes.

NATURALLY OCCURRING RADON GAS

The site lies within an Environmental Protection Agency (EPA) Zone 3 Radon area. Zone 3 Radon areas contain less than 2Pci/L of predicted average indoor radon. The site is within an area of unknow radon potential according the CGS indoor radon maps⁹. Due to the low anticipated radon levels at the site, we do not consider naturally occurring radon gas to be a hazard at the site.

⁸City of Lodi General Plan, April 7, 2010, pg. 8-9

⁹<https://www.epa.gov/radon/find-information-about-local-radon-zones-and-state-contact-information#radonmap>

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January 30, 2019 ■ Terracon Project No. NA185132



FLOODING

According to FEMA flood hazard mapping, the site is within an area designated as a 0.2% annual chance flood hazard zone¹⁰. Therefore, we consider flood potential at the site to be low.

OIL AND GAS EXPLORATION

One abandoned oil and gas well is mapped approximately 0.5 mile from the site¹¹. The well is listed as being abandoned in 1978. We do not consider oil- and gas-related hazards to be potential hazards at the site.

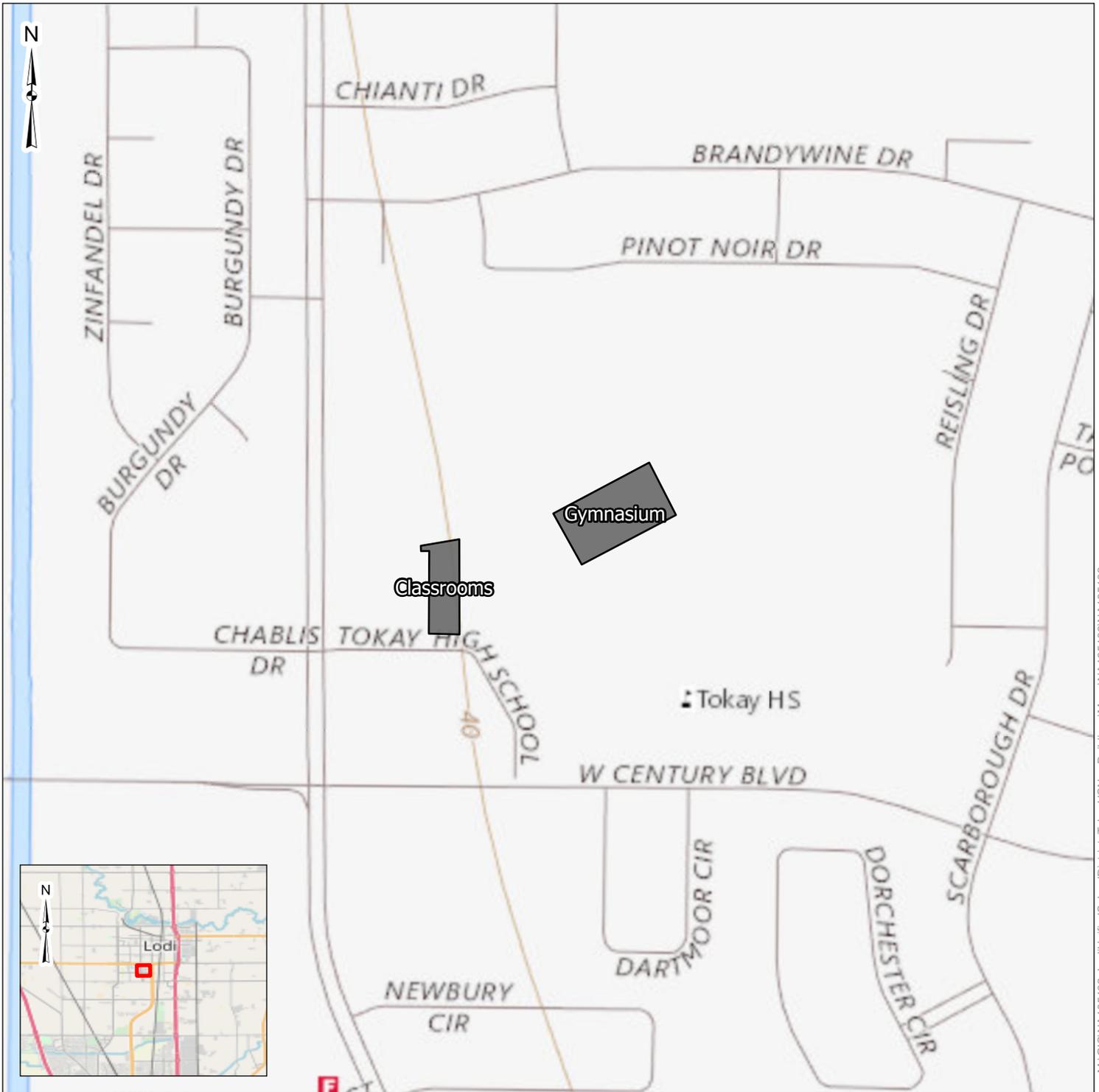
¹⁰FEMA, Flood Insurance Rate Map, San Joaquin County, CA, Panel 306 of 950

¹¹<https://maps.conservation.ca.gov/doggr/wellfinder/#close/-121.28471/38.10993/17>

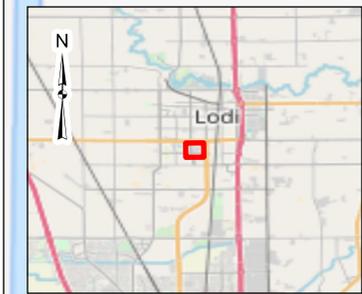
ATTACHMENTS

Exhibits:

1. Site Topographic Map
2. Site Aerial
3. Site Surficial Geology
4. Fault Activity
5. Flooding Hazard
6. Radon Hazards
7. Oil and Gas Exploration
 - Site Plan (from Terracon 2018)
 - Cross Section A-A'
 - Cross Section B-B'



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Proposed Buildings



DATA SOURCES:
 USGS - Topographic Map
 ESRI WMS - OpenStreetMap

Project No.:	NA185132
Date:	Jan 2019
Drawn By:	PNM
Reviewed By:	RLC

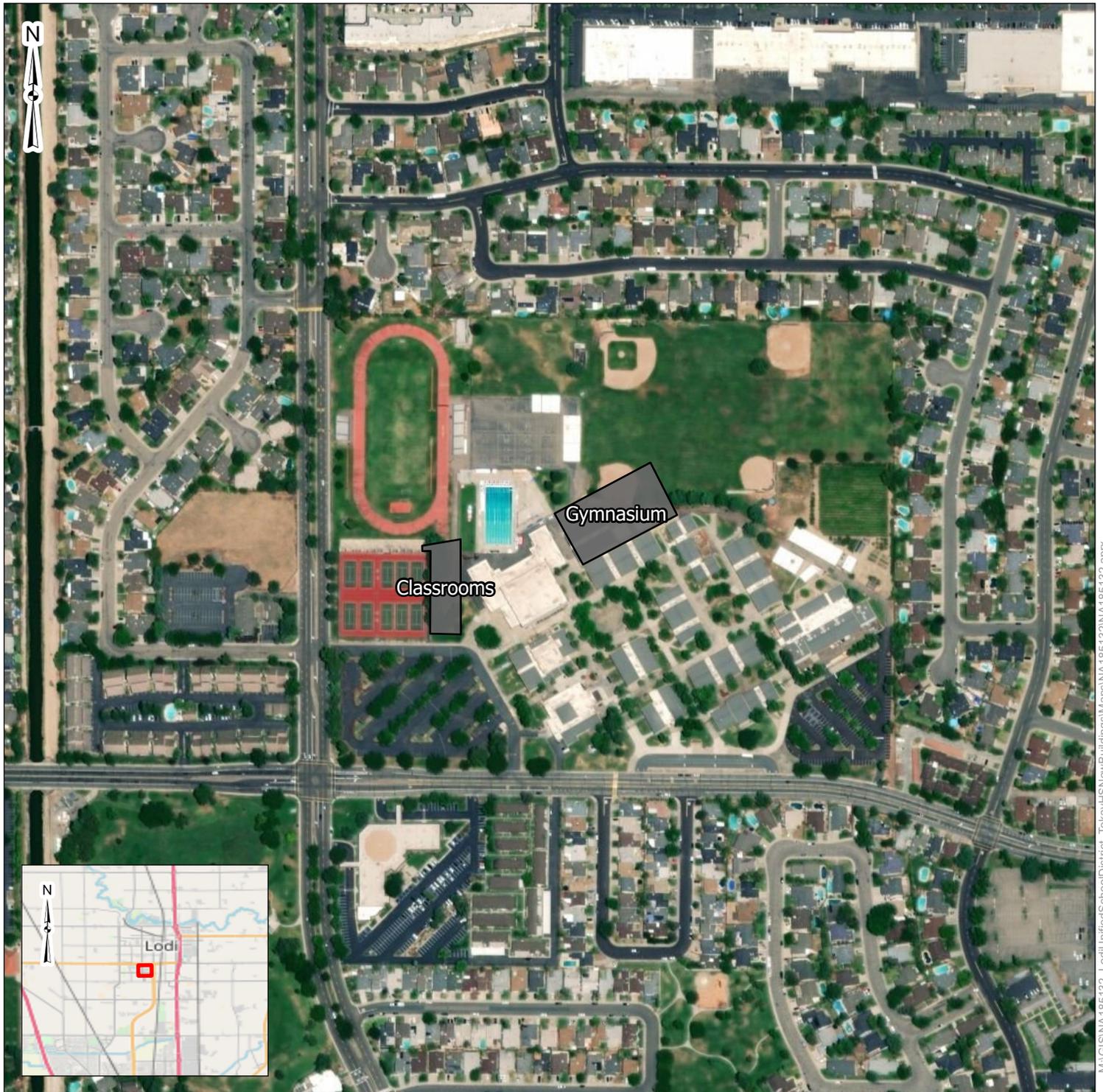
5075 Commercial Circle, Suite E Concord, CA 94520
 (925) 609-7224 terracon.com

Topographic Overview

Tokay HS New Classroom and Gym
 Lodi Unified School District
 1111 W. Century Blvd.
 Lodi, CA 95240

Exhibit

1



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Proposed Buildings



DATA SOURCES:
ESRI WMS - World Aerial Imagery, OpenStreetMap

Project No.:	NA185132
Date:	Jan 2019
Drawn By:	PNM
Reviewed By:	RLC

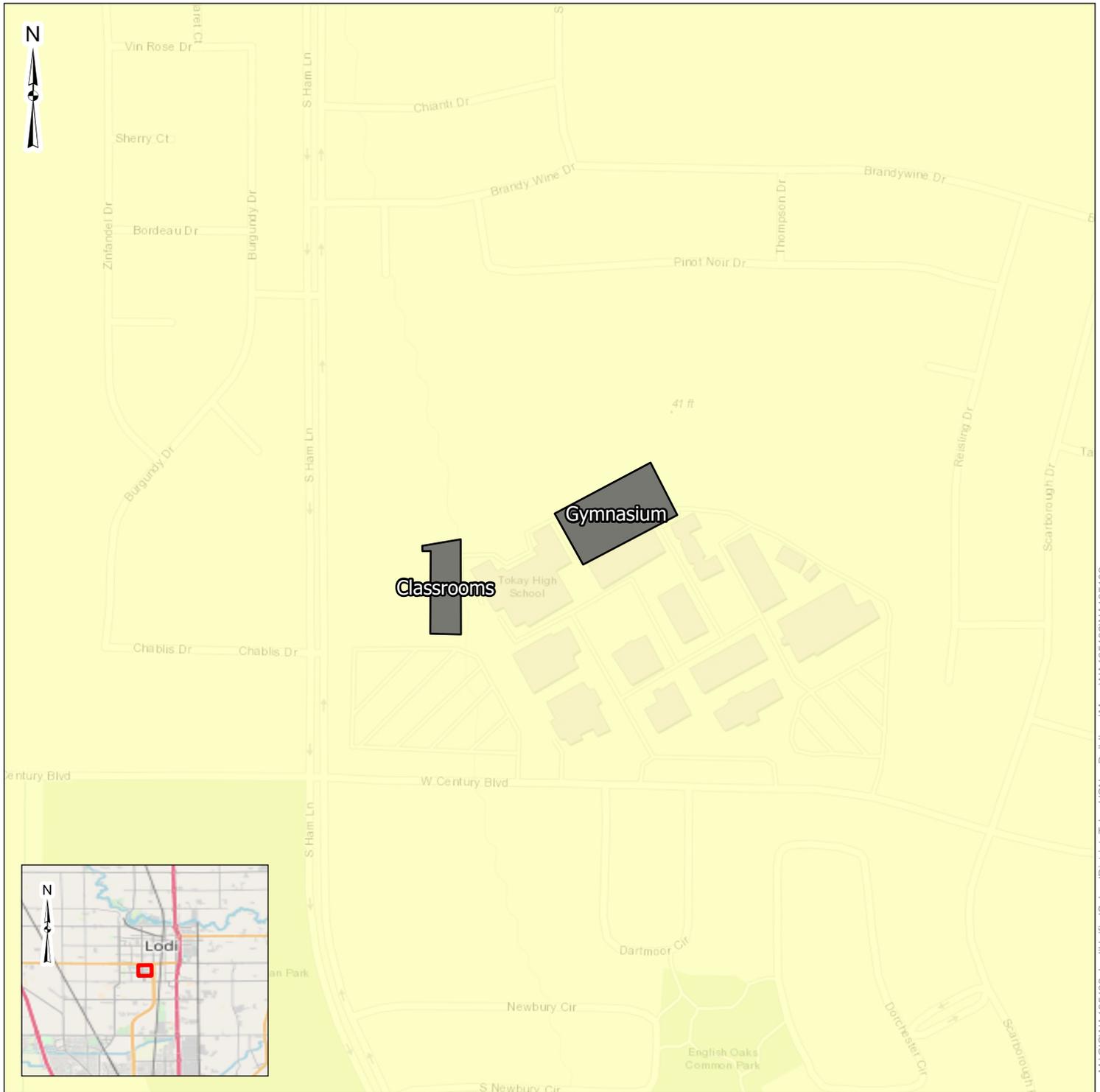
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Aerial Overview

Tokay HS New Classroom and Gym
Lodi Unified School District
1111 W. Century Blvd.
Lodi, CA 95240

Exhibit

2



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 Proposed Buildings

Rock Types

 Q -Alluvium, lake, playa, and terrace deposits; unconsolidated and semi-consolidated. Mostly nonmarine, but includes marine deposits near the coast.



DATA SOURCES:
 CGS - Surficial Geology
 ESRI WMS - World Topographic Map. OpenStreetMap

Project No.:	NA185132
Date:	Jan 2019
Drawn By:	PNM
Reviewed By:	RLC



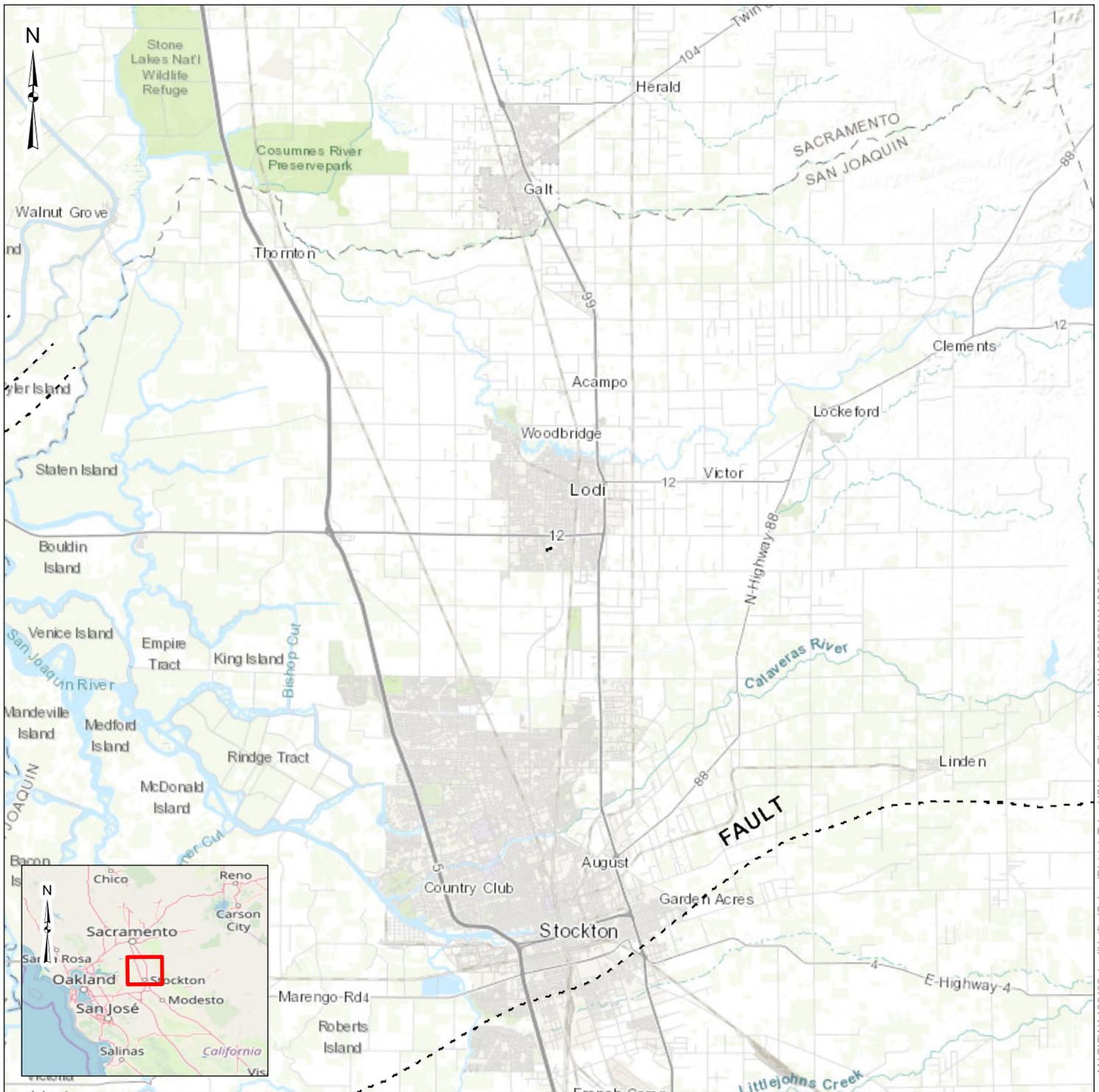
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Surficial Geology

Tokay HS New Classroom and Gym
 Lodi Unified School District
 1111 W. Century Blvd.
 Lodi, CA 95240

Exhibit

3

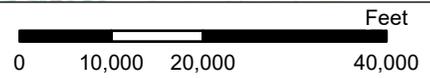


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Proposed Buildings

Pre-Quaternary Faults

Approx. Located,
Concealed, Queried



DATA SOURCES:
CGS - Quaternary Faults, Pre-Quaternary Faults, Fault Classification
ESRI WMS - World Topographic Map, OpenStreetMap

Project No.:	NA185132
Date:	Jan 2019
Drawn By:	PNM
Reviewed By:	RLC

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Fault Activity

Tokay HS New Classroom and Gym
Lodi Unified School District
1111 W. Century Blvd.
Lodi, CA 95240

Exhibit

4



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Proposed Buildings



Flood Hazard Zones

0.2% Annual Chance Flood Hazard

DATA SOURCES:
 FEMA - National Flood Hazard Layer
 ESRI WMS - World Aerial Imagery, OpenStreetMap

Project No.:	NA185132
Date:	Jan 2019
Drawn By:	PNM
Reviewed By:	RLC

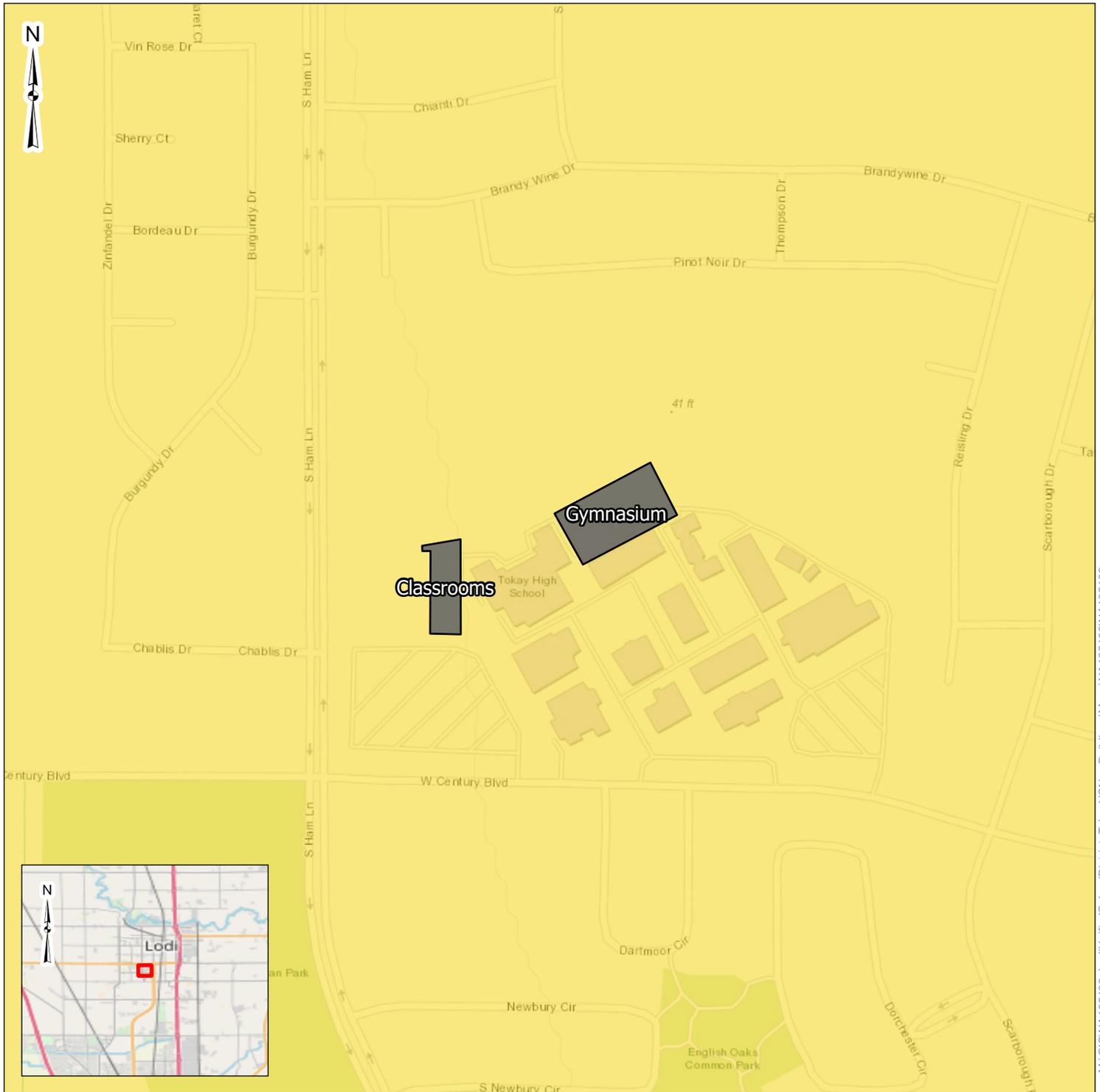
5075 Commercial Circle, Suite E Concord, CA 94520
 (925) 609-7224 terracon.com

Flood Hazard

Tokay HS New Classroom and Gym
 Lodi Unified School District
 1111 W. Century Blvd.
 Lodi, CA 95240

Exhibit

5

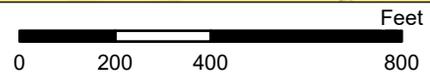


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 Proposed Buildings

Radon Data

 Zone 3: Counties with predicted average indoor radon screening levels less than 2 pCi/L



DATA SOURCES:
CGS - Radon Zones
ESRI WMS - World Topographic Map, OpenStreetMap

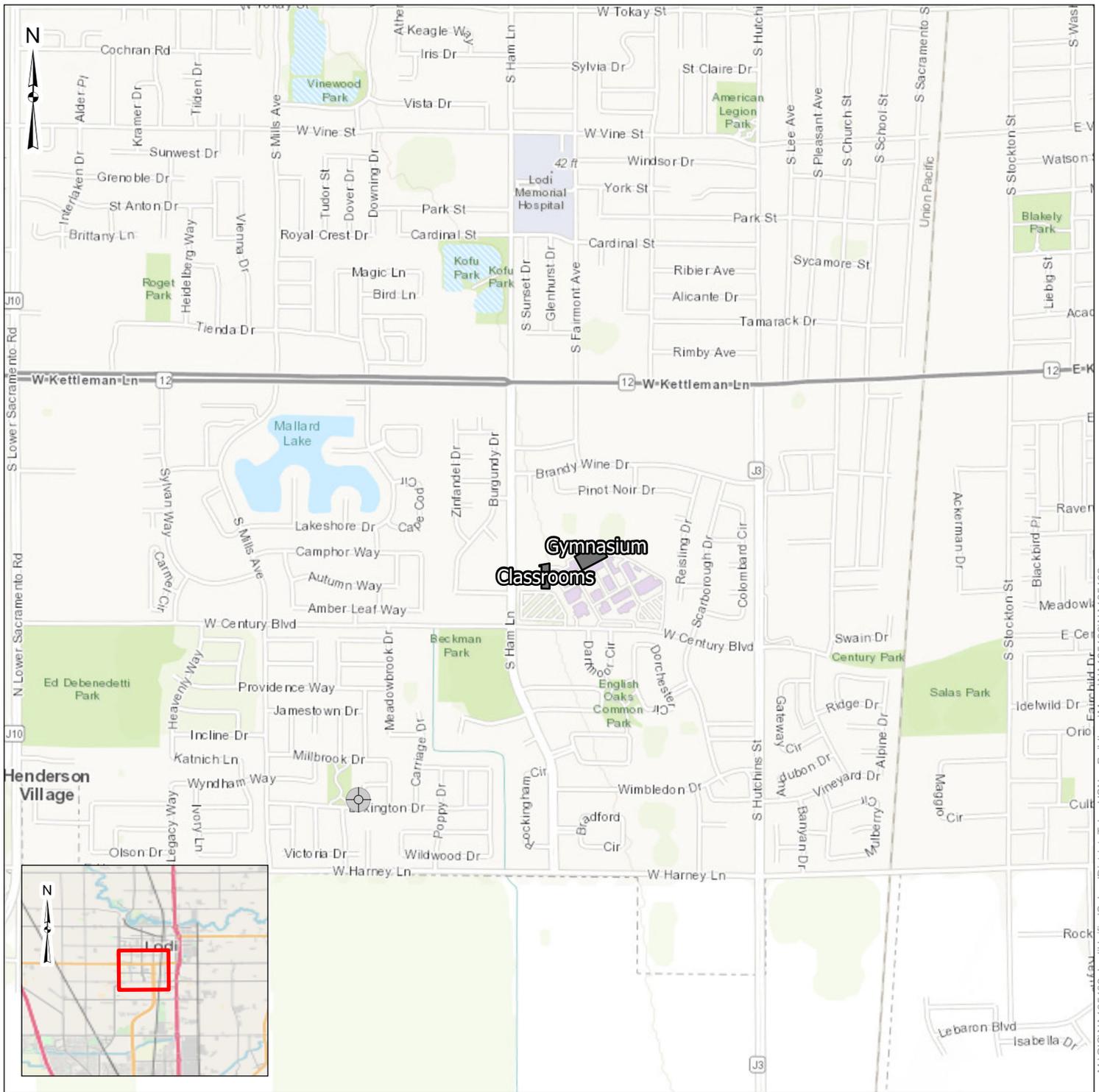
Project No.:	NA185132
Date:	Jan 2019
Drawn By:	PNM
Reviewed By:	RLC



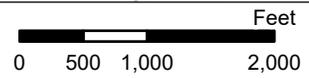
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(925) 609-7224 terracon.com

Radon Hazard
Tokay HS New Classroom and Gym Lodi Unified School District 1111 W. Century Blvd. Lodi, CA 95240

Exhibit
6



-  Proposed Buildings
-  Oil and Gas Wells
-  Plugged



DATA SOURCES:
 CA DOGGR - Oil and Gas Wells
 ESRI WMS - World Topographic Map, OpenStreetMap

Project No.:	NA185132
Date:	Jan 2019
Drawn By:	PNM
Reviewed By:	RLC



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Oil and Gas Wells

Tokay HS New Classroom and Gym
 Lodi Unified School District
 1111 W. Century Blvd.
 Lodi, CA 95240

Exhibit

7

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SITE PLAN

Tokay High School New Classrooms and Gym ■ Lodi, California
January 30, 2019 ■ Terracon Project No. NA185132

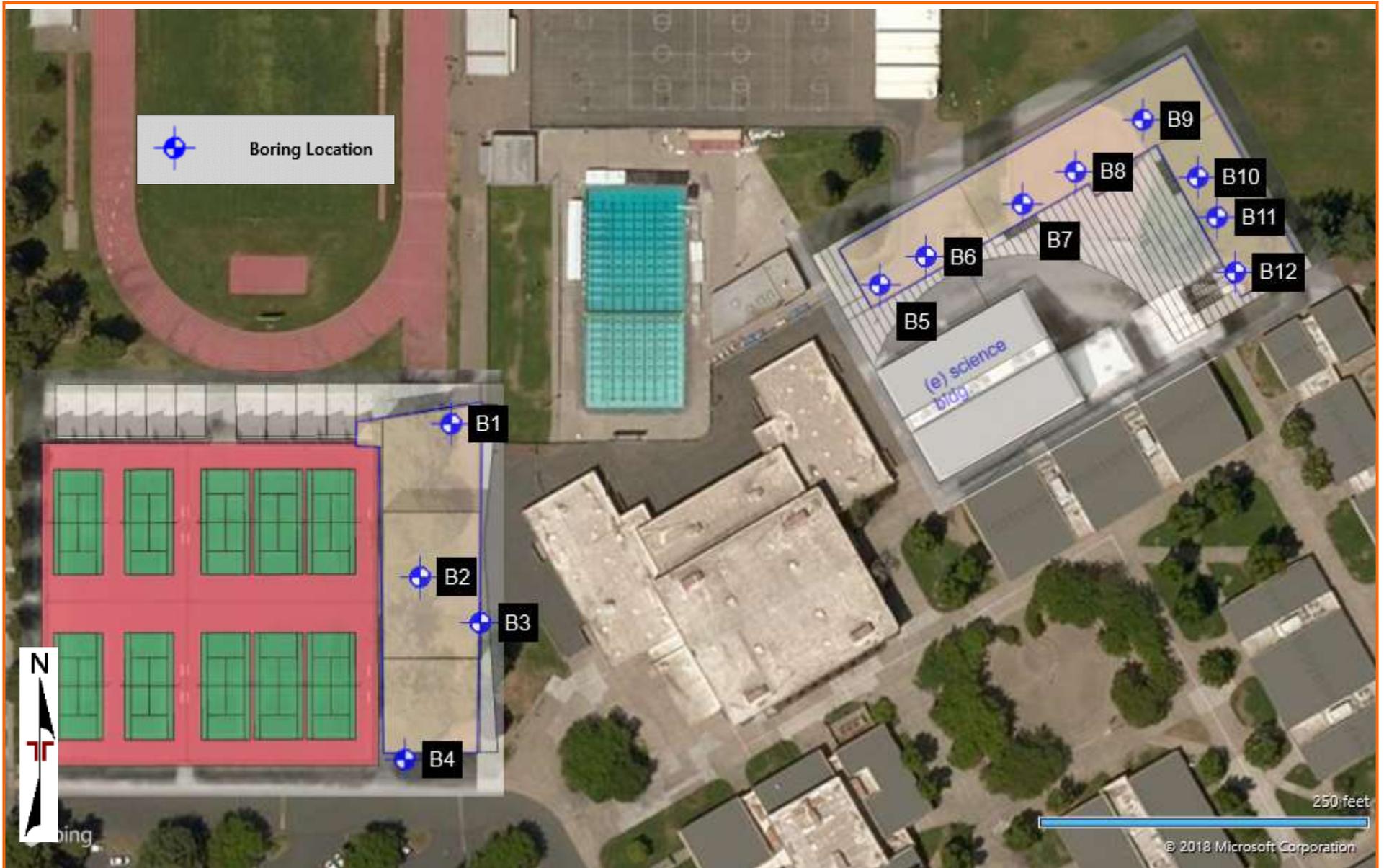


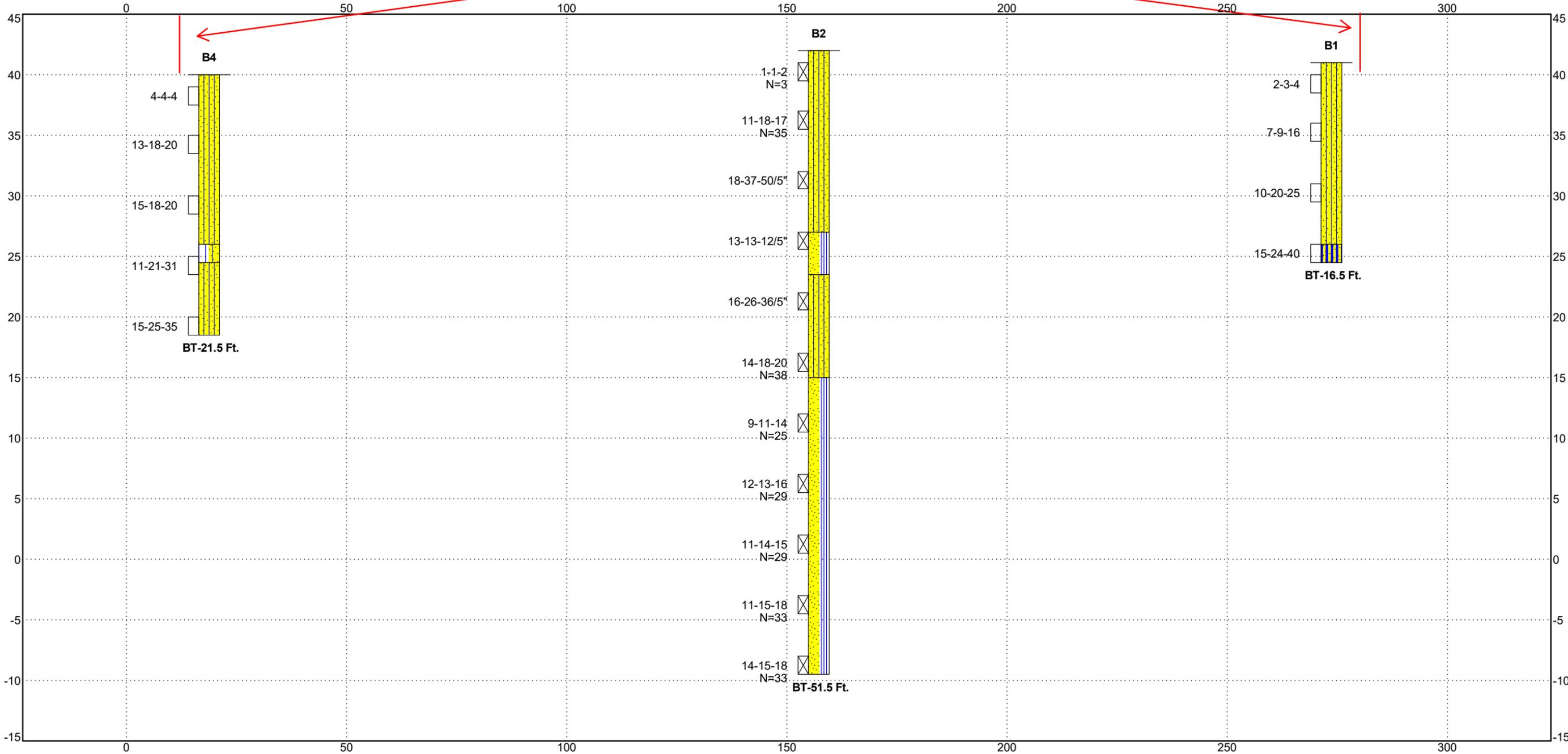
DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP PROVIDED BY MICROSOFT BING MAPS

Approximate limits of proposed modular building

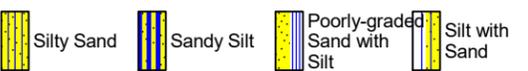
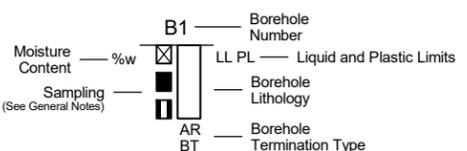
Elevation - Feet

Distance Along Baseline - Feet



NOTE: Top of boring denotes ground surface.

Explanation



NOTES:
 See [Exploration Plan](#) for orientation of soil profile.
 See General Notes in [Supporting Information](#) for symbols and soil classifications.
 Soils profile provided for illustration purposes only.
 Soils between borings may differ
 AR - Auger Refusal
 BT - Boring Termination

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. SMART FENCE NA185132 TOKAY HS NEW CLAS.GPJ TERRACON_DATATEMPLATE.GDT 1/23/19

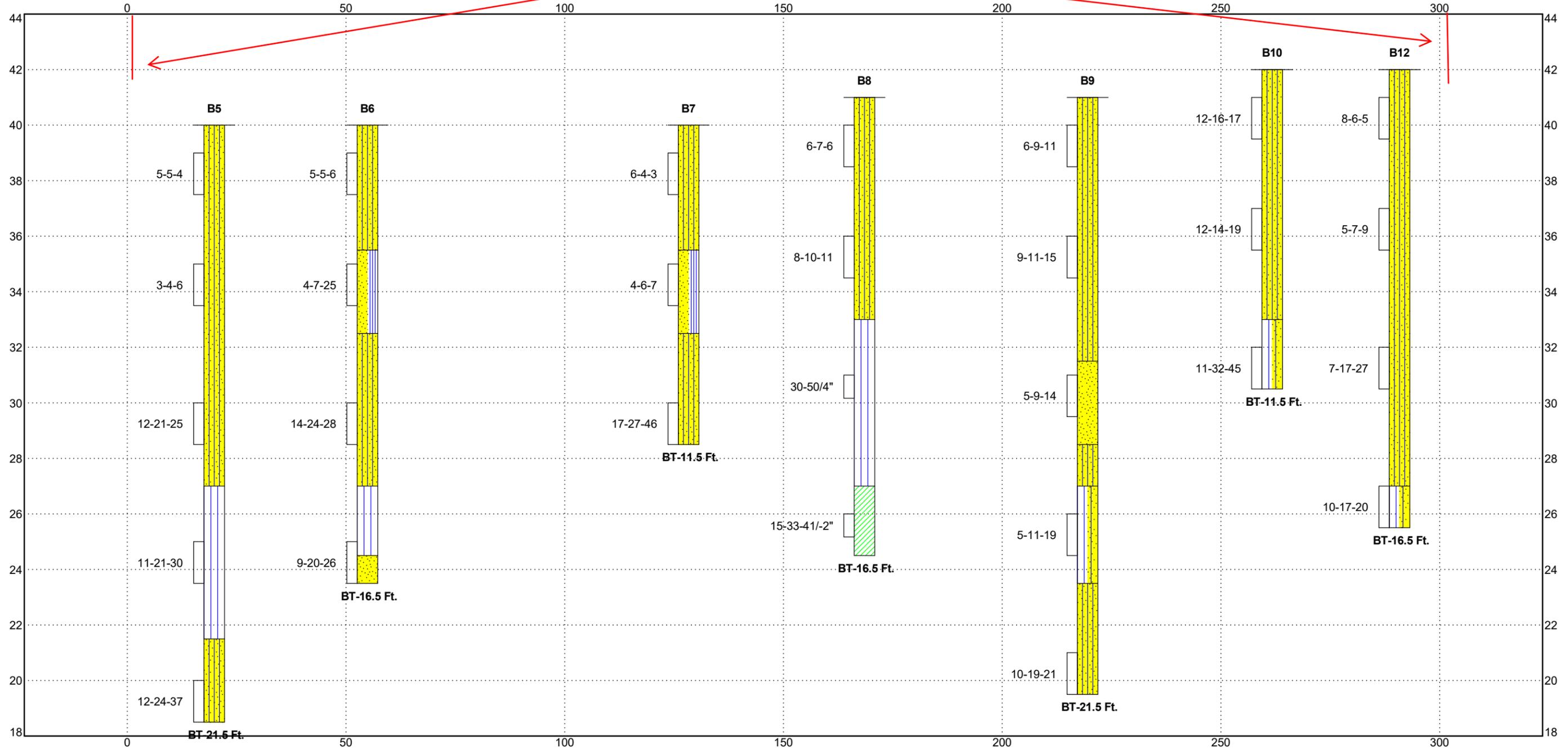
Project No.: NA185132
Date: 1/23/2019
Scale: NTS



SUBSURFACE PROFILE
 A-A'
 TOKAY HIGH SCHOOL NEW CLASSROOMS & GYM
 1111 W. CENTURY BLVD.
 LODI, CA

Approximate limits of proposed gymnasium

Elevation - Feet



Distance Along Baseline - Feet

NOTE: Top of boring denotes ground surface.

Explanation

B5 — Borehole Number
 — LL PL — Liquid and Plastic Limits
 — Borehole Lithology
 — AR BT — Borehole Termination Type

Moisture Content — %w
 Sampling (See General Notes)

Water Level Reading at time of drilling.
 Water Level Reading after drilling.

Silty Sand, Silt, Poorly-graded Sand with Silt, Poorly-graded Sand, Lean Clay, Silt with Sand

NOTES:
 See Exploration Plan for orientation of soil profile.
 See General Notes in Supporting Information for symbols and soil classifications.
 Soils profile provided for illustration purposes only.
 Soils between borings may differ
 AR - Auger Refusal
 BT - Boring Termination

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. SMART FENCE_NA185132.TOKAY HS NEW CLAS.GPJ TERRACON_DATATEMPLATE.GDT 1/23/19

Project No.: NA185132
Date: 1/23/2019
Scale: NTS

Terracon
 902 Industrial Way
 Lodi, CA

SUBSURFACE PROFILE
 B-B'
 TOKAY HIGH SCHOOL NEW CLASSROOMS & GYM
 1111 W. CENTURY BLVD.
 LODI, CA

SUPPORTING INFORMATION

- NA185132 – Geotechnical Engineering Report – Tokay High School Classrooms and Gymnasium



Geotechnical Engineering Report

Tokay High School New Classrooms and Gym
Lodi, California

October 30, 2018

Terracon Project No. NA185132

Prepared for:

Lodi Unified School District
Lodi, California

Prepared by:

Terracon Consultants, Inc.
Lodi, California



October 30, 2018

Lodi Unified School District
12345 Street Name
Lodi, California 95240



Attn: Vickie Brum
P: (209) 331-7228
E: vbrum@lodiUSD.net

Re: Geotechnical Engineering Report
Tokay High School New Classrooms and Gym
1111 W. Century Boulevard
Lodi, California
Terracon Project No. NA185132

Dear Vickie:

We have completed the Geotechnical Engineering services for the above referenced project. This study was performed in general accordance with Terracon Proposal No. PNA185132 dated August 20, 2018. 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



Garret S.H. Hubbart, Principal
Geotechnical Engineer 2588
Office Manager

REPORT TOPICS

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ATTACHMENTS

EXPLORATION AND TESTING PROCEDURES
SITE LOCATION AND EXPLORATION PLANS
EXPLORATION RESULTS
SUPPORTING INFORMATION

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

Geotechnical Engineering Report
Tokay High School New Classrooms and Gym
1111 W. Century Boulevard
Lodi, California
Terracon Project No. NA185132
October 30, 2018

INTRODUCTION

This report presents the results of our subsurface exploration and geotechnical engineering services performed for the proposed classroom and gym to be located at 1111 W. Century Boulevard 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
- Foundation design and construction
- Floor slab design and construction
- Lateral earth pressures
- Seismic site classification per 2016 CBC

The geotechnical engineering Scope of Services for this project included the advancement of twelve test borings to depths ranging from approximately 16½ to 51½ feet below existing site grades.

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 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 1111 W. Century Boulevard in Lodi, California. Approximate coordinates of the project site are 38.1099°W; 121.2869°N. See Site Location
Existing Improvements	The property consists of an existing high school campus.

Geotechnical Engineering Report

Tokay High School New Classrooms and Gym ■ Lodi, California

October 30, 2018 ■ Terracon Project No. NA185132



Item	Description
Current Ground Cover	Lawn, bare ground, and asphalt concrete pavement.
Existing Topography	Relatively level.
Geology	The near surface soils consist of Pleistocene Age arkosic alluvium deposits of the Modesto Formation (Qm).
Geologic Hazards	A geologic hazard report was not requested nor included in our scope of work. The project site is not located in a Liquefaction Hazard zone or an Alquist Priolo Fault zone.

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	Basic scope of project was provided. This project is still in the conceptual planning phase between the District and the project architect. No detailed site plans were available at this time.
Project Description	<p>-The project will include a new gym with weight room, team rooms, restrooms, ticketing and concessions. This structure will be approximately 18,000 SF. No demolition is anticipated at this location.</p> <p>-New modular building for 18 classrooms. Per information provided to us, it appears there will be 3 buildings in the location of the existing softball diamond. Each building size is approximately 14,000 SF, 12,000 SF and 7,600 SF.</p>
Proposed Structures	The structures will include two story classroom buildings as described above.
Building Construction	The building construction type is unknown at this time but will likely consist of masonry/concrete tilt up with steel interior framing for the gym and steel or wood framing may be used for the classroom buildings. Buildings will have slab on grade floors.
Finished Floor Elevation	Unknown at this time. Anticipated to be within 2 feet of existing grade.
Maximum Loads (assumed)	<ul style="list-style-type: none">■ Columns: 80 to 140 kips■ Walls: 2 to 5 kips per linear foot (klf) Slabs: 150 pounds per square foot (psf)
Grading/Slopes	The site is relatively flat and grading should consist of minor cuts and fills, less than 3 feet in vertical extent.
Below-Grade Structures	None anticipated.

Item	Description
Free-Standing Retaining Walls	None anticipated.
Pavements	None as part of this project.
Estimated Start of Construction	Unknown at this time.

GEOTECHNICAL CHARACTERIZATION

We have developed a general characterization of the subsurface conditions based upon our review of the subsurface exploration, laboratory data, geologic setting and our understanding of the project.

The near surface soils generally consisted of very loose to dense silty sands that extended to depths of between 3½ and 8 feet below the existing ground surface (bgs). These upper soils were underlain by interbedded layers of medium dense to very dense silty sand and sand with silt and very dense to hard sandy silt that extended to the maximum depths explored. In boring B8, a layer of hard lean clay was encountered at a depth of approximately 14 feet bgs that extended to the maximum depth explored of 16½ feet bgs.

Conditions encountered at each boring location are indicated on the individual boring logs shown in the **Exploration Results** section and are attached to this report. Stratification boundaries on the boring logs represent the approximate location of changes in native soil types; in situ, the transition between materials may be gradual.

GEOTECHNICAL OVERVIEW

Due to the variability relative density of the near surface silty sands within the proposed building footprints, in our opinion the foundations should be supported on a minimum of 12 inches of compacted engineered fill in order to provide uniform support for the foundations. Additional site preparation recommendations, including subgrade improvement and fill placement, are provided in the **Earthwork** section.

The soils which form the bearing stratum for shallow foundations are very loose to dense in relative density. The **Shallow Foundations** section addresses support of the buildings bearing on engineered fill. The **Floor Slabs** section addresses slab-on-grade support of the building.

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.

The subgrade should be proofrolled with an adequately loaded vehicle such as a fully-loaded tandem-axle dump 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 modified by stabilizing with cement. Excessively wet or dry material should either be removed or moisture conditioned and recompacted.

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
- foundation backfill
- trench backfill
- exterior slabs-on-grade

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

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

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

*ASTM D 4829

The on-site sands should meet the specifications above. Engineered fill should be placed and compacted in horizontal lifts, using equipment and procedures that will produce recommended moisture contents and densities throughout the lift. 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
<u>On-site sandy soils and Low volume change (non-expansive) imported fill:</u>			
Beneath foundations:	90	0%	+3%
Beneath slabs	90	0%	+3%
Miscellaneous backfill:	90	0%	+3%
Utility Trenches:	90	0%	+4%
Bottom of native soil excavation receiving fill:	90	+1%	+4%

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 buildings should be effectively sealed to restrict water intrusion and flow through the trenches, which could migrate below the buildings. The trench should provide an effective trench plug that extends at least 5 feet from the face of the building exteriors. The plug material should consist of cementitious flowable fill or low permeability clay. The trench plug

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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 buildings during and after construction and should be maintained throughout the life of the structures. Water retained next to the buildings 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 roofs should have gutters/drains with downspouts that discharge onto splash blocks at a distance of at least 10 feet from the buildings.

Exposed ground should be sloped and maintained at a minimum 5% away from the buildings for at least 10 feet beyond the perimeter of the buildings. 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 structures should also be periodically inspected and adjusted, as necessary, as part of the structures' maintenance program. Where paving or flatwork abuts the structures, 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 structures 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 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 2,500 square feet of compacted fill in the building areas. One density and water content test should be performed for each lift for every 50 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.

Design Parameters

Item	Description
Maximum Net Allowable Bearing pressure ^{1, 2}	3,000 psf
Required Bearing Stratum ³	Minimum 12 inches of compacted engineered fill
Minimum Foundation Dimensions	Columns: 3 feet Continuous: 1 foot
Maximum Foundation Dimensions	Columns: 8 feet Continuous: 4 feet
Ultimate Passive Resistance ⁴ (equivalent fluid pressures)	350 pcf
Ultimate Coefficient of Sliding Friction ⁵	0.40

Item	Description
Minimum Embedment below Finished Grade ⁶	12 inches for single story structures; 18 inches for two-story structures.
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. Values assume that exterior grades are no steeper than 20% within 10 feet of 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.
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. If passive resistance is combined with base friction to resist lateral movement, the coefficient of sliding friction should be reduced by 25 percent.
6. Embedment depth is depth below lowest adjacent exterior grade within 5 horizontal feet of foundations.
7. Differential settlements are as measured over a span of 40 feet.

Foundation Construction Considerations

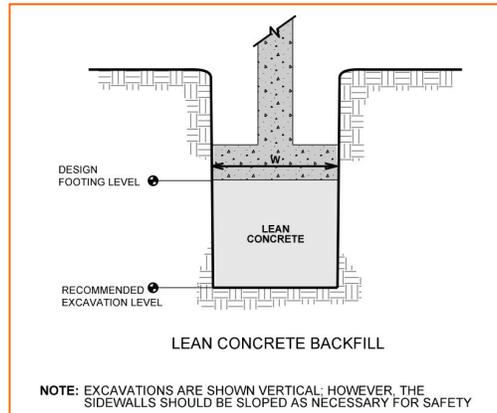
As noted in **Earthwork**, the footing excavations should be evaluated under the direction of the Geotechnical Engineer. The base of all foundation excavations should be free of water and loose soil, prior to placing concrete. Concrete should be placed soon after excavating to reduce bearing soil disturbance. 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.

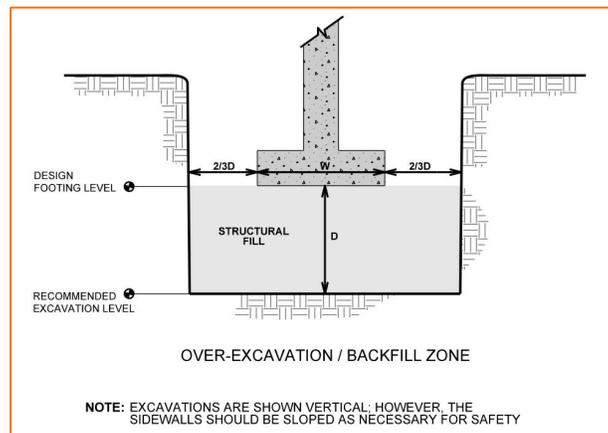
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Over-excavation for structural fill placement below footings should be conducted as shown below. The over-excavation should be backfilled up to the footing base elevation, with engineered fill placed as recommended in the **Earthwork** section.



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.

Description	Value
2016 California Building Code Site Classification (CBC) ¹	D ²
Site Latitude	38.1098° N
Site Longitude	121.2866° W
S_s Spectral Acceleration for a Short Period	0.768g
S₁ Spectral Acceleration for a 1-Second Period	0.305g
F_a Site Coefficient for a Short Period	1.193
F_v Site Coefficient for a 1-Second Period	1.790
S_{MS} Maximum Considered Spectral Response Acceleration for a Short Period	0.916g
S_{M1} Maximum Considered Spectral Response Acceleration for a 1-Second Period	0.546g
S_{DS} Design Spectral Acceleration for a Short Period ³	0.610g
S_{D1} Spectral Acceleration for a 1-Second Period ³	0.364g
PGA_M Peak Ground Acceleration	0.337g

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.

Due to the relative density of the soils encountered in our deep boring and the historical depth to groundwater being greater than 50 feet below the existing grade, in our opinion the potential for liquefaction to occur at this site is low. Accordingly, potential other effects of liquefaction, such as lateral spreading, etc. are low.

Given the relative density of the soils encountered in our borings, the potential for dry sand settlement to occur and negatively affect the buildings is considered low and not a concern in the design of these buildings.

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 (less than 5% passing the U.S. No. 200 sieve) crushed aggregate. Floor slabs should be supported on a minimum of 12 inches of compacted native soils or non-expansive engineered fill.
Estimated Modulus of Subgrade Reaction ²	150 pounds per square inch per inch (psi/in) for point loads

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. Modulus of subgrade reaction is an estimated value based upon our experience with the subgrade condition, the requirements noted in **Earthwork**, and the floor slab support as noted in this table. It is provided for point loads. For large area loads the modulus of subgrade reaction would be lower.

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

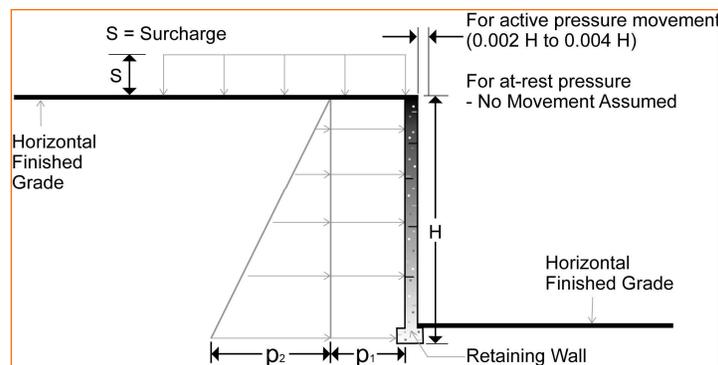
Finished subgrade, within and for at least 10 feet beyond the floor slab, should be protected from traffic, rutting, or other disturbance and maintained in a relatively moist condition until floor slabs are constructed. If the subgrade should become damaged or desiccated prior to construction of floor 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.

LATERAL EARTH PRESSURES

Design Parameters

Structures with unbalanced backfill levels on opposite sides should be designed for earth pressures at least equal to values indicated in the following table. Earth pressures will be influenced by structural design of the walls, conditions of wall restraint, methods of construction and/or compaction and the strength of the materials being restrained. Two wall restraint conditions are shown in the diagram below. Active earth pressure is commonly used for design of free-standing cantilever retaining walls and assumes wall movement. The “at-rest” condition assumes no wall movement and is commonly used for basement walls, loading dock walls, or other walls restrained at the top. The recommended design lateral earth pressures do not include a factor of safety and do not provide for possible hydrostatic pressure on the walls (unless stated).



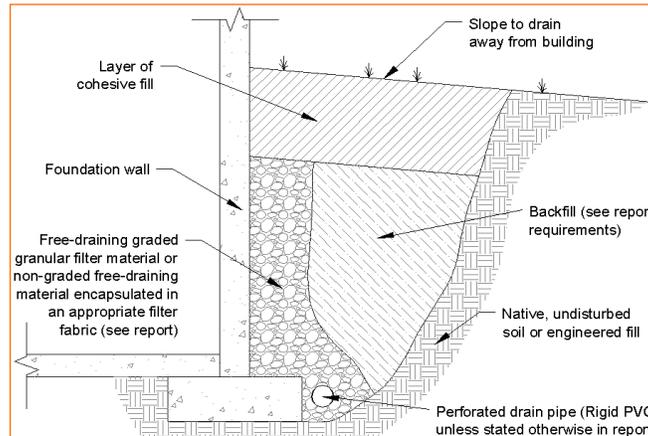
Lateral Earth Pressure Design Parameters				
Earth Pressure Condition ¹	Coefficient for Backfill Type ²	Surcharge Pressure ^{3, 4, 5} p ₁ (psf)	Effective Fluid Pressures (psf) ^{2, 4, 5}	
			Unsaturated ⁶	Submerged ⁶
Active (K _a)	Granular - 0.27	(0.27)S	(33)H	(80)H
At-Rest (K _o)	Granular - 0.42	0.42)S	(50)H	(90)H
Passive (K _p)		---	(390)H	(250)H

1. For active earth pressure, wall must rotate about base, with top lateral movements 0.002 H to 0.004 H, where H is wall height. For passive earth pressure, wall must move horizontally to mobilize resistance.
2. Uniform, horizontal backfill, compacted to at least 90% of the ASTM D 1557 maximum dry density, rendering a maximum unit weight of 120 pcf.
3. Uniform surcharge, where S is surcharge pressure.
4. Loading from heavy compaction equipment is not included.
5. No safety factor is included in these values.
6. To achieve "Unsaturated" conditions, follow guidelines in **Subsurface Drainage for Below-Grade Walls** below. "Submerged" conditions are recommended when drainage behind walls is not incorporated into the design.

Backfill placed against structures should consist of granular soils or low plasticity cohesive soils. For the granular values to be valid, the granular backfill must extend out and up from the base of the wall at an angle of at least 45 and 60 degrees from vertical for the active and passive cases, respectively.

Subsurface Drainage for Below-Grade Walls

A perforated rigid plastic drain line installed behind the base of walls and extends below adjacent grade is recommended to prevent hydrostatic loading on the walls. The invert of a drain line around a below-grade building area or exterior retaining wall should be placed near foundation bearing level. The drain line should be sloped to provide positive gravity drainage to daylight or to a sump pit and pump. The drain line should be surrounded by clean, free-draining granular material having less than 5% passing the No. 200 sieve, such as No. 57 aggregate. The free-draining aggregate should be encapsulated in a filter fabric. The granular fill should extend to within 2 feet of final grade, where it should be capped with compacted cohesive fill to reduce infiltration of surface water into the drain system.



As an alternative to free-draining granular fill, a pre-fabricated drainage structure may be used. A pre-fabricated drainage structure is a plastic drainage core or mesh which is covered with filter fabric to prevent soil intrusion and is fastened to the wall prior to placing backfill.

CORROSION

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 (ppm)	Soluble Chloride (ppm)	Electrical Resistivity (Ω-cm)	pH
B-9	1.5	Silty Sand	77	63	6305	8.73

Results of soluble sulfate testing indicate samples of the on-site soils tested possess negligible sulfate concentrations when classified in accordance with Table 19.3.1 of the ACI Design Manual. Concrete should be designed in accordance with the provisions of the ACI Design Manual, Section 318, Chapter 4.

The chloride test results indicate that the soils have a relatively low chloride content present. According to Table 19.3.1.1 of ACI 318-14, the soil should not be considered an external source of chloride (i.e. sea water, etc.) to concrete foundations. Consequently, chloride classes of C0 and C1 should be used where applicable. C0 is defined as, “Concrete dry or protected from moisture” and C1 is defined as, “Concrete exposed to moisture but not to an external source of chlorides”. For the amount of chlorides allowed in concrete mix designs, Table 19.3.2.1 of ACI 318-14 shall be adhered to as appropriate.

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	51½	Building area
4	16½	Building area
3	21½	Building area
4	11½	Building 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) and approximate elevations were obtained by interpolation from Google Earth™. If elevations and a more precise boring layout are desired, we recommend borings be surveyed following completion of fieldwork.

Subsurface Exploration Procedures: We advanced the borings with a track-mounted, rotary drill rig using continuous flight hollow stem augers. Samples were obtained depths of 1 and 5 feet in each boring 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. Modified California split-barrel 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 the same as the N-values obtained with the SPT sampler. We observed and recorded groundwater levels during drilling and sampling. For safety purposes and as required by the San Joaquin County Environmental Health Department, all borings were backfilled with neat cement grout after their completion. Pavements were patched with cold-mix asphalt.

The sampling depths, penetration distances, and other sampling information were 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.

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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 D1140 Standard Test Method for Determining the Amount of Material Finer than No. 200 Sieve by Soil Washing
- Soil Corrosivity

The laboratory testing program often 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.

Contents:

Site Location Plan

Exploration Plan

Note: All attachments are one page unless noted above.

SITE LOCATION

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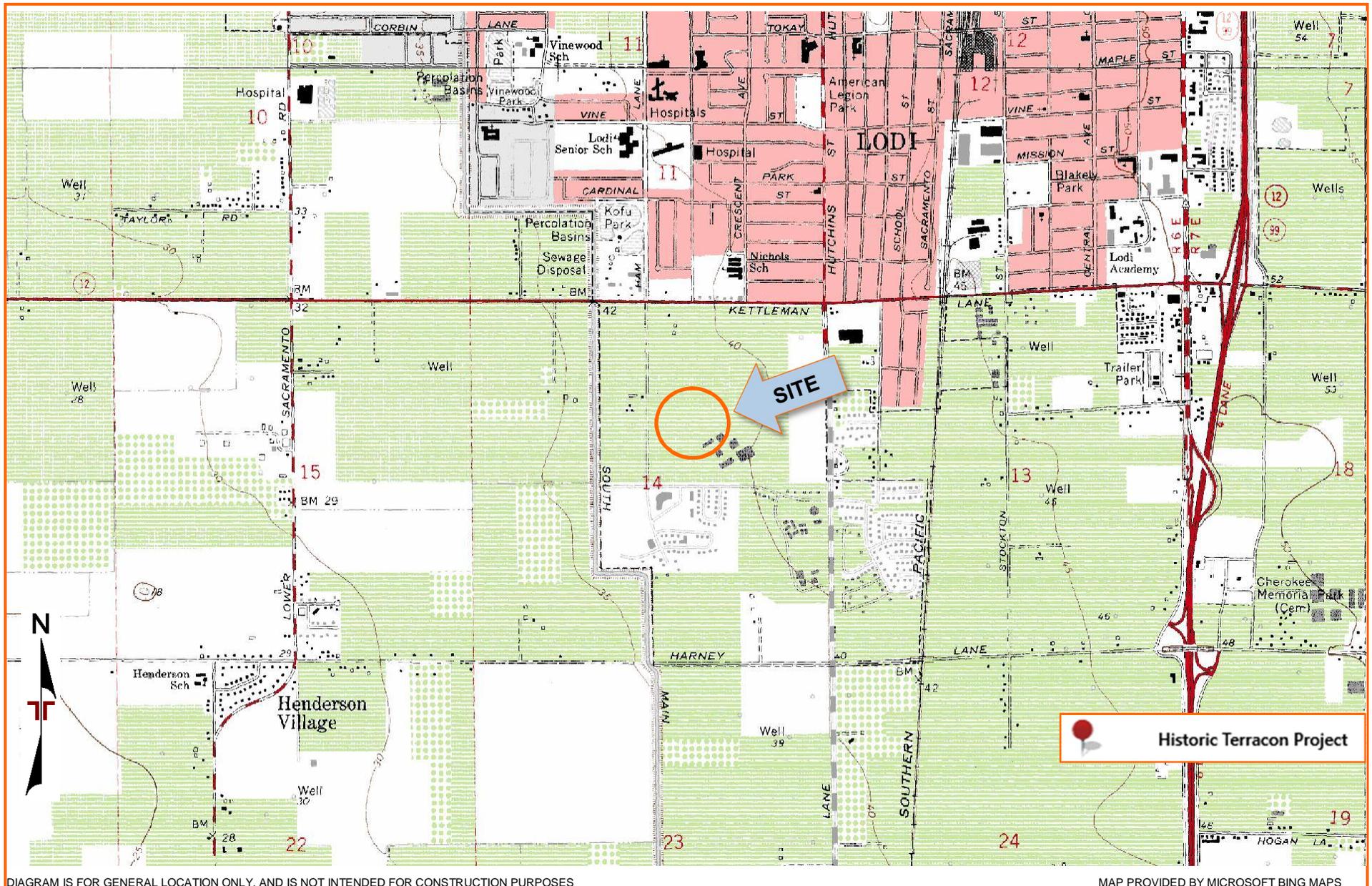


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP PROVIDED BY MICROSOFT BING MAPS

EXPLORATION PLAN

Tokay High School New Classrooms and Gym ■ Lodi, California
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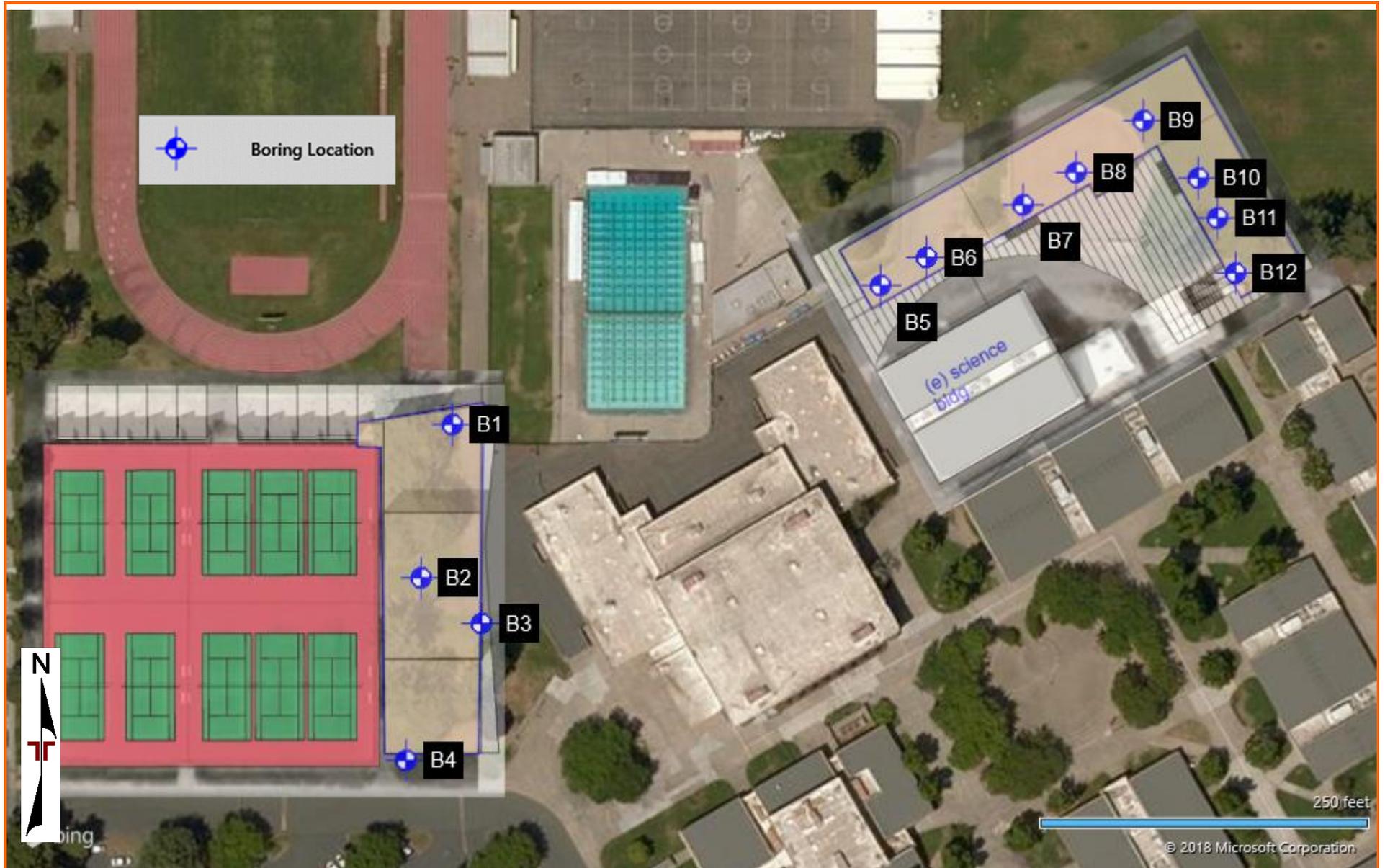


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP PROVIDED BY MICROSOFT BING MAPS

Contents:

Boring Logs (B-1 through B-12)

Corrosivity

Note: All attachments are one page unless noted above.

BORING LOG NO. B1

PROJECT: Tokay HS New Classroom & Gym

CLIENT: Lodi Unified School District
Lodi, CA

SITE: 1111 W. Century Blvd.
Lodi, CA

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL. NA185132 TOKAY HS NEW CLAS.GPJ TERRACON_DATATEMPLATE.GDT 10/30/18

GRAPHIC LOG	LOCATION See Exploration Plan Latitude: 38.1101° Longitude: -121.2867°	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	LABORATORY HP (tsf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	PERCENT FINES
DEPTH									
0	SILTY SAND (SM) , fine to medium grained, brown, loose			X	2-3-4		12	116	46
5	orange brown, medium dense	5		X	7-9-16		10	100	
10	dense	10		X	10-20-25		15	120	
15.0		15		X	15-24-40	4.5+ (HP)	22	101	
16.5	SANDY SILT (ML) , fine to medium grained, light brown, very dense								
	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

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

Notes:

Abandonment Method:
Boring backfilled with cement grout upon completion.

See [Supporting Information](#) for explanation of symbols and abbreviations.

Elevations obtained using Google Earth

WATER LEVEL OBSERVATIONS

Groundwater not encountered



Boring Started: 10-09-2018

Boring Completed: 10-09-2018

Drill Rig: D-50

Driller: R. Anderson

Project No.: NA185132

BORING LOG NO. B2

PROJECT: Tokay HS New Classroom & Gym

CLIENT: Lodi Unified School District
Lodi, CA

SITE: 1111 W. Century Blvd.
Lodi, CA

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL. NA185132 TOKAY HS NEW CLAS.GPJ TERRACON_DATATEMPLATE.GDT 10/30/18

GRAPHIC LOG	LOCATION See Exploration Plan Latitude: 38.1098° Longitude: -121.2868°	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	LABORATORY HP (tsf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	PERCENT FINES
DEPTH									
15.0	SILTY SAND (SM) , fine to medium grained, brown, loose			X	1-1-2 N=3		13		
	orange brown, medium dense	5		X	11-18-17 N=35		12		
	very dense	10		X	18-37-50/5"		13		42
18.5	POORLY GRADED SAND WITH SILT (SP-SM) , fine to coarse grained, light brown, medium dense	15		X	13-13-12/5"		24		
27.0	SILTY SAND , fine to medium grained, borwn, very dense	20		X	16-26-36/5"		11		
	dense	25		X	14-18-20 N=38		13		

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

Hammer Type: Automatic

Advancement Method:
6" Hollow stem auger

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

Notes:

Abandonment Method:
Boring backfilled with cement grout upon completion.

See [Supporting Information](#) for explanation of symbols and abbreviations.

Elevations obtained using Google Earth

WATER LEVEL OBSERVATIONS

Groundwater not encountered



Boring Started: 10-09-2018

Boring Completed: 10-09-2018

Drill Rig: D-50

Driller: R. Anderson

Project No.: NA185132

BORING LOG NO. B2

PROJECT: Tokay HS New Classroom & Gym

CLIENT: Lodi Unified School District
Lodi, CA

SITE: 1111 W. Century Blvd.
Lodi, CA

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL. NA185132 TOKAY HS NEW CLAS.GPJ TERRACON_DATATEMPLATE.GDT 10/30/18

GRAPHIC LOG	LOCATION See Exploration Plan Latitude: 38.1098° Longitude: -121.2868°	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	LABORATORY HP (tsf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	PERCENT FINES
DEPTH									
	POORLY GRADED SAND WITH SILT (SP-SM) , fine to coarse grained, brown, medium dense (<i>continued</i>)	30		X	9-11-14 N=25		6		8
	orange brown	35		X	12-13-16 N=29		5		
		39.0							
	WELL GRADED SAND (SW) , fine to coarse grained, light brown, medium dense to dense	40		X	11-14-15 N=29		5		7
		45		X	11-15-18 N=33		5		
		50		X	14-15-18 N=33		6		
	Boring Terminated at 51.5 Feet								
		51.5							

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

Hammer Type: Automatic

Advancement Method:
6" Hollow stem auger

See [Exploration and Testing Procedures](#) for a description of field and laboratory procedures used and additional data (if any).

Notes:

Abandonment Method:
Boring backfilled with cement grout upon completion.

See [Supporting Information](#) for explanation of symbols and abbreviations.

Elevations obtained using Google Earth

WATER LEVEL OBSERVATIONS

Groundwater not encountered



Boring Started: 10-09-2018

Boring Completed: 10-09-2018

Drill Rig: D-50

Driller: R. Anderson

Project No.: NA185132

BORING LOG NO. B3

PROJECT: Tokay HS New Classroom & Gym

CLIENT: Lodi Unified School District
Lodi, CA

SITE: 1111 W. Century Blvd.
Lodi, CA

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL. NA185132 TOKAY HS NEW CLAS.GPJ TERRACON_DATATEMPLATE.GDT 10/30/18

GRAPHIC LOG	LOCATION See Exploration Plan Latitude: 38.1097° Longitude: -121.2867°	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	LABORATORY HP (tsf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	PERCENT FINES
DEPTH									
5.0	SILTY SAND (SM) , fine to medium grained, brown, loose	5	X		2-2-4		12	118	
5.0 - 11.0	SANDY SILT (ML) , light brown, very dense	10	X		18-32-50		9	119	37
11.0	Boring Terminated at 11 Feet				24-50/6"		11	112	

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

Hammer Type: Automatic

Advancement Method:
6" Hollow stem auger

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

Notes:

Abandonment Method:
Boring backfilled with cement grout upon completion.

See [Supporting Information](#) for explanation of symbols and abbreviations.

Elevations obtained using Google Earth

WATER LEVEL OBSERVATIONS

Groundwater not encountered



Boring Started: 10-09-2018

Boring Completed: 10-09-2018

Drill Rig: D-50

Driller: R. Anderson

Project No.: NA185132

BORING LOG NO. B4

PROJECT: Tokay HS New Classroom & Gym

CLIENT: Lodi Unified School District
Lodi, CA

SITE: 1111 W. Century Blvd.
Lodi, CA

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL. NA185132 TOKAY HS NEW CLAS.GPJ TERRACON_DATATEMPLATE.GDT 10/30/18

GRAPHIC LOG	LOCATION See Exploration Plan Latitude: 38.1094° Longitude: -121.2869°	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	LABORATORY HP (tsf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	PERCENT FINES
DEPTH									
0	SILTY SAND (SM) , fine to medium grained, brown, loose			X	4-4-4		10	115	
5	light orange brown, dense	5		X	13-18-20		9	108	
10	fine to coarse grained, orange brown	10		X	15-18-20		8	115	
14.0									
15.5	SILT WITH SAND , fine to medium grained, light brown	15		X	11-21-31		12	120	
21.5	SILTY SAND , fine to coarse grained, orange brown w/gray, dense	20		X	15-25-35		12	124	
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

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

Notes:

Abandonment Method:
Boring backfilled with cement grout upon completion.

See [Supporting Information](#) for explanation of symbols and abbreviations.

Elevations obtained using Google Earth

WATER LEVEL OBSERVATIONS

Groundwater not encountered



Boring Started: 10-09-2018

Boring Completed: 10-09-2018

Drill Rig: D-50

Driller: R. Anderson

Project No.: NA185132

BORING LOG NO. B5

PROJECT: Tokay HS New Classroom & Gym

CLIENT: Lodi Unified School District
Lodi, CA

SITE: 1111 W. Century Blvd.
Lodi, CA

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL. NA185132 TOKAY HS NEW CLAS.GPJ TERRACON_DATATEMPLATE.GDT 10/30/18

GRAPHIC LOG	LOCATION See Exploration Plan Latitude: 38.1104° Longitude: -121.2856°	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	LABORATORY HP (tsf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	PERCENT FINES
DEPTH									
	SILTY SAND (SM) , fine to coarse grained, brown, loose			X	5-5-4		8	112	
		5		X	3-4-6		5	1418	14
	dense			X	12-21-25		8	120	
		10							
		13.0							
	SILT (ML) , fine to coarse grained, brown, hard			X	11-21-30		29	96	
		15							
		18.5							
	SILTY SAND (SM) , fine to coarse grained, dark orange brown, very dense			X	12-24-37		10	119	
		20							
		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

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

Notes:

Abandonment Method:
Boring backfilled with cement grout upon completion.

See [Supporting Information](#) for explanation of symbols and abbreviations.

Elevations obtained using Google Earth

WATER LEVEL OBSERVATIONS

Groundwater not encountered



Boring Started: 10-09-2018

Boring Completed: 10-09-2018

Drill Rig: D-50

Driller: R. Anderson

Project No.: NA185132

BORING LOG NO. B6

PROJECT: Tokay HS New Classroom & Gym

CLIENT: Lodi Unified School District
Lodi, CA

SITE: 1111 W. Century Blvd.
Lodi, CA

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL. NA185132 TOKAY HS NEW CLAS.GPJ TERRACON_DATATEMPLATE.GDT 10/30/18

GRAPHIC LOG	LOCATION See Exploration Plan Latitude: 38.1104° Longitude: -121.2855°	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	LABORATORY HP (tsf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	PERCENT FINES
DEPTH									
	SILTY SAND (SM) , fine to coarse grained, brown, loose			X	5-5-6		7	117	
		4.5							
	POORLY GRADED SAND WITH SILT (SP-SM) , fine to coarse grained, light brown, medium dense			X	4-7-25		5	109	
		7.5							
	SILTY SAND (SM) , fine to coarse grained, orange brown, dense			X	14-24-28	4.5+ (HP)	14	121	36
		13.0							
	SILT (ML) , fine to coarse grained, light brown								
		15.5							
	POORLY GRADED SAND WITH CLAY (SP) , fine to medium grained, light brown, dense			X	9-20-26		11 28	103 90	
		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

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

Notes:

Abandonment Method:
Boring backfilled with cement grout upon completion.

See [Supporting Information](#) for explanation of symbols and abbreviations.

Elevations obtained using Google Earth

WATER LEVEL OBSERVATIONS

Groundwater not encountered



Boring Started: 10-09-2018

Boring Completed: 10-09-2018

Drill Rig: D-50

Driller: R. Anderson

Project No.: NA185132

BORING LOG NO. B7

PROJECT: Tokay HS New Classroom & Gym

CLIENT: Lodi Unified School District
Lodi, CA

SITE: 1111 W. Century Blvd.
Lodi, CA

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL. NA185132 TOKAY HS NEW CLAS.GPJ TERRACON_DATATEMPLATE.GDT 10/30/18

GRAPHIC LOG	LOCATION See Exploration Plan Latitude: 38.1105° Longitude: -121.2852°	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	LABORATORY HP (tsf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	PERCENT FINES
DEPTH									
4.5	SILTY SAND (SM) , fine to coarse grained, brown, loose	4.5		X	6-4-3		4	104	
7.5	POORLY GRADED SAND WITH SILT (SP-SM) , fine to coarse grained, medium dense	7.5		X	4-6-7		5	107	
11.5	SILTY SAND (SM) , fine to medium grained, very dense	11.5		X	17-27-46		16	112	
	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

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

Notes:

Abandonment Method:
Boring backfilled with cement grout upon completion.

See [Supporting Information](#) for explanation of symbols and abbreviations.

Elevations obtained using Google Earth

WATER LEVEL OBSERVATIONS
Groundwater not encountered



Boring Started: 10-09-2018
Drill Rig: D-50
Project No.: NA185132

Boring Completed: 10-09-2018
Driller: R. Anderson

BORING LOG NO. B8

PROJECT: Tokay HS New Classroom & Gym

CLIENT: Lodi Unified School District
Lodi, CA

SITE: 1111 W. Century Blvd.
Lodi, CA

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL. NA185132 TOKAY HS NEW CLAS.GPJ TERRACON_DATATEMPLATE.GDT 10/30/18

GRAPHIC LOG	LOCATION See Exploration Plan Latitude: 38.1106° Longitude: -121.2851°	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	LABORATORY HP (tsf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	PERCENT FINES
DEPTH									
0.0	SILTY SAND (SM) , fine to coarse grained, dark brown, loose			X	6-7-6		5	105	29
8.0	brown, medium dense	5		X	8-10-11		6	111	
14.0	SILT (ML) , light brown, hard			X	30-50/4"	4.5+ (HP)	19	109	
16.5	LEAN CLAY (CL) , hard			X	15-33-41/-2"	4.5+ (HP)	29	97	
	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

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

Notes:

Abandonment Method:
Boring backfilled with cement grout upon completion.

See [Supporting Information](#) for explanation of symbols and abbreviations.

Elevations obtained using Google Earth

WATER LEVEL OBSERVATIONS

Groundwater not encountered



Boring Started: 10-09-2018

Boring Completed: 10-09-2018

Drill Rig: D-50

Driller: R. Anderson

Project No.: NA185132

BORING LOG NO. B9

PROJECT: Tokay HS New Classroom & Gym

CLIENT: Lodi Unified School District
Lodi, CA

SITE: 1111 W. Century Blvd.
Lodi, CA

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL. NA185132 TOKAY HS NEW CLAS.GPJ TERRACON_DATATEMPLATE.GDT 10/30/18

GRAPHIC LOG	LOCATION See Exploration Plan Latitude: 38.1107° Longitude: -121.2849°	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	LABORATORY HP (tsf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	PERCENT FINES
DEPTH									
9.5	SILTY SAND (SM) , fine to medium grained, brown, medium dense	5		X	6-9-11		2	96	
12.5	fine to coarse grained, light brown	10		X	9-11-15		3	110	
14.0	POORLY GRADED SAND (SP) , fine to coarse grained, light brown, medium dense	15		X	5-9-14		3	111	
17.5	SILTY SAND (SM) , fine to coarse grained, brown	20		X	5-11-19		26	98	
21.5	SILT WITH SAND (ML) , fine to medium grained, light brown, very stiff			X	10-19-21		12	119	
21.5	SILTY SAND (SM) , fine to coarse grained, reddish brown, dense			X					
	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

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

Notes:

Abandonment Method:
Boring backfilled with cement grout upon completion.

See [Supporting Information](#) for explanation of symbols and abbreviations.

Elevations obtained using Google Earth

WATER LEVEL OBSERVATIONS

Groundwater not encountered



Boring Started: 10-09-2018

Boring Completed: 10-09-2018

Drill Rig: D-50

Driller: R. Anderson

Project No.: NA185132

BORING LOG NO. B12

PROJECT: Tokay HS New Classroom & Gym

CLIENT: Lodi Unified School District
Lodi, CA

SITE: 1111 W. Century Blvd.
Lodi, CA

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL. NA185132 TOKAY HS NEW CLAS.GPJ TERRACON_DATATEMPLATE.GDT 10/30/18

GRAPHIC LOG	LOCATION See Exploration Plan Latitude: 38.1104° Longitude: -121.2847°	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	LABORATORY HP (tsf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	PERCENT FINES
DEPTH									
15.0	SILTY SAND WITH GRAVEL (SM) , fine to medium grained, dark brown, loose	5		X	8-6-5		38	87	
	orange brown, medium dense	10		X	5-7-9		8	110	
		15		X	7-17-27		17	110	
16.5	SILT WITH SAND (ML) , fine to medium grained, light borwn, very stiff	15		X	10-17-20		4 35	107 89	
	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 obtained using Google Earth

Notes:

WATER LEVEL OBSERVATIONS
Groundwater not encountered



Boring Started: 10-09-2018	Boring Completed: 10-09-2018
Drill Rig: D-50	Driller: R. Anderson
Project No.: NA185132	

CHEMICAL LABORATORY TEST REPORT

Project Number: NA185132

Service Date: 10/23/18

Report Date: 10/26/18

Task:

Terracon

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

Client

Lodi Unified School District

Project

Tokay HS New Classroom & Gym

Sample Submitted By: Terracon (NA)

Date Received: 10/22/2018

Lab No.: 18-1279

Results of Corrosion Analysis

<i>Sample Number</i>	<u>B9-1-I</u>
<i>Sample Location</i>	<u></u>
<i>Sample Depth (ft.)</i>	<u>1.5</u>
pH Analysis, AWWA 4500 H	<u>8.73</u>
Water Soluble Sulfate (SO ₄), ASTM C 1580 (mg/kg)	<u>77</u>
Sulfides, AWWA 4500-S D, (mg/kg)	<u>Nil</u>
Chlorides, ASTM D 512, (mg/kg)	<u>63</u>
Red-Ox, AWWA 2580, (mV)	<u>+680</u>
Total Salts, AWWA 2520 B, (mg/kg)	<u>367</u>
Resistivity, ASTM G 57, (ohm-cm)	<u>6305</u>

Analyzed By:



Trisha Campo
Chemist

The tests were performed in general accordance with applicable ASTM, AASHTO, or DOT test methods. This report is exclusively for the use of the client indicated above and shall not be reproduced except in full without the written consent of our company. Test results transmitted herein are only applicable to the actual samples tested at the location(s) referenced and are not necessarily indicative of the properties of other apparently similar or identical materials.

Contents:

General Notes

Unified Soil Classification System

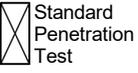
Note: All attachments are one page unless noted above.

GENERAL NOTES

DESCRIPTION OF SYMBOLS AND ABBREVIATIONS

Tokay HS New Classroom & Gym ■ Lodi, CA

October 30, 2018 ■ Terracon Project No. NA185132

SAMPLING	WATER LEVEL	FIELD TESTS
 Modified California Ring Sampler  Standard Penetration Test	 Water Initially Encountered  Water Level After a Specified Period of Time  Water Level After a Specified Period of Time 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 is based on the Unified Soil Classification System. Coarse Grained Soils have more than 50% of their dry weight retained on a #200 sieve; their principal descriptors are: boulders, cobbles, gravel or sand. Fine Grained Soils have less than 50% of their dry weight retained on a #200 sieve; they are principally described as clays if they are plastic, and silts if they are slightly plastic or non-plastic. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size. In addition to gradation, coarse-grained soils are defined on the basis of their in-place relative density and fine-grained soils on the basis of their consistency.

LOCATION AND ELEVATION NOTES

Unless otherwise noted, Latitude and Longitude are approximately determined using a hand-held GPS device. The accuracy of such devices is variable. 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.
Very Loose	0 - 3	Very Soft	less than 0.25	0 - 1
Loose	4 - 9	Soft	0.25 to 0.50	2 - 4
Medium Dense	10 - 29	Medium Stiff	0.50 to 1.00	4 - 8
Dense	30 - 50	Stiff	1.00 to 2.00	8 - 15
Very Dense	> 50	Very Stiff	2.00 to 4.00	15 - 30
		Hard	> 4.00	> 30

RELATIVE PROPORTIONS OF SAND AND GRAVEL		RELATIVE PROPORTIONS OF FINES	
Descriptive Term(s) of other constituents	Percent of Dry Weight	Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	<15	Trace	<5
With	15-29	With	5-12
Modifier	>30	Modifier	>12

GRAIN SIZE TERMINOLOGY		PLASTICITY DESCRIPTION	
Major Component of Sample	Particle Size	Term	Plasticity Index
Boulders	Over 12 in. (300 mm)	Non-plastic	0
Cobbles	12 in. to 3 in. (300mm to 75mm)	Low	1 - 10
Gravel	3 in. to #4 sieve (75mm to 4.75 mm)	Medium	11 - 30
Sand	#4 to #200 sieve (4.75mm to 0.075mm)	High	> 30
Silt or Clay	Passing #200 sieve (0.075mm)		

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 $[Cc < 1 \text{ or } Cc > 3.0]$ ^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 $[Cc < 1 \text{ or } Cc > 3.0]$ ^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	CL	Lean clay ^{K, L, M}		
			$PI < 4$ or plots below "A" line ^J	ML	Silt ^{K, L, M}		
		Organic:	Liquid limit - oven dried	< 0.75	OL	Organic clay ^{K, L, M, N}	
			Liquid limit - not dried			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	< 0.75	OH	Organic clay ^{K, L, M, P}	
			Liquid limit - not dried			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.

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

^F If soil contains ³ 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 ³ 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 ³ 30% plus No. 200 predominantly sand, add "sandy" to group name.

^M If soil contains ³ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.

^N $PI \geq 4$ 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.

