Appendix B  Geotechnical Investigation
Appendices

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LIMITED GEOTECHNICAL INVESTIGATION REPORT

Parent Resource Center, Parking Structure and Police Station
Northeast of the Intersection of North F Street and West 7th Street
City of San Bernardino, San Bernardino County, California
Converse Project No. 17-81-293-01

February 12, 2018

Prepared For:
San Bernardino City Unified School District
Facilities Planning and Development
956 West 9th Street
San Bernardino, CA 92411

Prepared By:
Converse Consultants
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Converse Consultants
Geotechnical Engineering, Environmental & Groundwater Science, Inspection & Testing Services

February 12, 2018

Mr. Thomas Pace
Director
San Bernardino City Unified School District
Facilities Planning and Development
956 West 9th Street
San Bernardino, CA 92411

Subject: LIMITED GEOTECHNICAL INVESTIGATION REPORT
Parent Resource Center, Parking Structure, and Police Station
Northeast of the Intersection of North 'F' Street and West 7th Street
City of San Bernardino, San Bernardino County, California
Converse Project No. 17-81-293-01

Dear Mr. Pace:

Converse Consultants (Converse) is pleased to submit this Limited Geotechnical Investigation Report to present results of our geotechnical/geohazard evaluation that might impact development of the site for a parent resource center, parking structure and a police station in the City of San Bernardino, San Bernardino County, California. This report was prepared in accordance with our proposal dated October 16, 2017, and your notice to proceed on December 18, 2017.

Based upon our field investigation, laboratory data, and analyses, the proposed site is considered feasible from a geotechnical standpoint. To meet CGS Note 48 guidelines, additional investigation and analyses need to be conducted. This may result in revisions to the preliminary recommendations presented in this report.

We appreciate the opportunity to be of service to San Bernardino City Unified School District. Should you have any questions, please do not hesitate to contact us at 909-796-0544.

CONVERSE CONSULTANTS

Hashmi S. E. Quazi, PhD, GE, PE
Principal Engineer

Dist: 5/Addresssee
HSQ/SM/JB/ZA/kvg
PROFESSIONAL CERTIFICATION

This report has been prepared by the following professionals whose seals and signatures appear hereon.

The findings, recommendations, specifications and professional opinions contained in this report were prepared in accordance with generally accepted professional engineering practice and engineering geologic principle and practices in this area of Southern California. We make no other warranty, either expressed or implied.

Zahangir Alam, PhD, EIT
Senior Staff Engineer

Jay Burnham, GIT
Senior Staff Geologist

Hashmi S. E. Quazi, PhD, PE, GE
Principal Engineer

Scot Mathis, PG, CEG
Senior Geologist
EXECUTIVE SUMMARY

The following is a summary of our geotechnical study, findings, conclusions, and recommendations, as presented in the body of this report. Please refer to the appropriate sections of the report for complete conclusions and recommendations. In the event of a conflict between this summary and the report, or an omission in the summary, the report shall prevail.

- The project will consist of a 2-story parent resource center with 7,500 square feet each floor for a total of 15,000 square feet, a 1-story 15,000 square feet police station, and a 3-level parking structure with a footprint of 45,976 square feet and 114 parking stalls per level. These structures will likely be constructed of reinforced concrete, steel and masonry block walls. The parent center and police station will be founded on shallow footings. Depending on the loads, the parking structure may require deep foundations such as piles.

- The proposed development is located northeast of the intersection of North F Street and West 7th Street in the City of San Bernardino, California. The site is bounded on the north side by West 8th Street, on the south side by West 7th Street, on the east side by North E Street and on the west side by North F Street. Currently, the site has four existing buildings which are Curtis Middle School on the west side, Sturges Center for Fine Arts on the northeast corner, Town Lodge on the east side, and La Luz Del Mundo Church on the southeast corner. The remaining portion of the site is covered with asphalt paved parking lots, sidewalks, landscape and hardscape.

- Our scope of work included project setup, subsurface exploration, laboratory testing, engineering analysis, and preparation of this report.

- Six exploratory borings (BH-01 through BH-06) were drilled on December 27, 2017 at the site. The borings were advanced to their maximum planned depths of 21.5 and 51.5 feet bgs.

- Based on the exploratory brings and laboratory test results, the site is underlain by alluvial sediments consisting of sandy clay, sandy silt, sand and silty sand layers. Gravel was observed in borings BH-01, BH-02 and BH-05.

- The thickness of asphalt concrete and aggregate base varies from 3.5 to 4.5 inches and 3.0 to 8.0 inches, respectively.

- Groundwater was not encountered in our exploratory borings to a maximum explored depth of 51.5 feet bgs. Based on available data, groundwater is expected to be deeper than 51.5 feet bgs. Groundwater is not expected to be encountered during the
construction of this project. Shallow perched groundwater may be present locally, particularly following precipitation or irrigation events.

- The site is not located within a currently designated State of California or San Bernardino County Earthquake Fault Zone (CGS, 2007; San Bernardino County, 2010b). There are no known active faults projecting toward or extending across the project site. The potential for surface rupture resulting from the movement of nearby major faults is not known with certainty but is considered low.

- The potential impact to the project site from liquefaction, landsliding, lateral spreading, seiches, tsunamis, and earthquake-induced flooding is considered to be low.

- The test results indicated an Expansion Index of 10, 25 and 55, corresponding to very low to medium expansion. The test results showed collapse potential between 0.4 to 1.7 percent, indicating slight collapse potential. Relative compaction of the upper 10 feet soils was observed approximately between 71 and 92 percent.

- An R-value of 14 was observed from the laboratory test. Pavement sections based on R-value and Traffic Index are presented in the text of this report.

- The sulfate and chloride contents of soil samples tested correspond to American Concrete Institute (ACI) exposure category S0 and C1, respectively. Design recommendations for these categories are provided in the text of this report.

- The measured values of the minimum electrical resistivity when saturated were 870 and 2,100 Ohm-cm for the proposed site. These indicate that the samples tested were severely to moderately corrosive for ferrous metals in contact with the soil. A corrosion engineer should be consulted for corrosion mitigation measures for ferrous metals in contact with the soil.

- Prior to the start of any earthwork, the site should be cleared of all vegetation, existing fill, and debris. The materials resulting from the clearing and grubbing operations should be removed from the site.

- Based on our subsurface exploration, we anticipate that the site soils will be excavatable with conventional heavy-duty earthworking and trenching equipment.

- Areas to support structures should be overexcavated to a minimum depth of 24 inches below the bottom of the footings, or 5 feet from the existing ground surface, whichever is greater. The depth of overexcavation should be uniform across the entire structures. The overexcavation should extend to at least 2 feet beyond the footprint of the structures.
• All areas to receive asphalt or concrete pavement should be overexcavated to a depth of 12 inches below finish grade. The overexcavation should extend at least 1 foot beyond the edge of pavement.

• The parent resource center and police station can likely be supported on shallow foundations. The footings should be at least 18 inches in width and embedded to at least 18 inches below the lowest adjacent grade. The footing dimensions and reinforcement should be based on structural design. Continuous and isolated footings can be designed based on an allowable net bearing capacity of 2,000 psf.

• Depending of the loads, the 3-level parking structure may have to be supported on deep foundation such as piles. Design and construction recommendations, if needed will be provided in our final geotechnical investigation report.

• The total settlement of shallow footings from static structural loads and short-term settlement of properly compacted fill is anticipated to be 1 inch or less. The differential settlement resulting from static loads is anticipated to be 0.5 inches or less over a horizontal distance of 40 feet. We preliminary recommend that the planned structures be designed conservatively in anticipation of 2.2 inches total seismic settlement and seismic differential settlement to be up to 1.1 inches over 40 horizontal feet. The static and dynamic settlement estimates should not be combined for design purposes.

• Lateral earth pressures parameters are presented in the section 10.2 Lateral Earth Pressures and Resistance to Lateral Loads.

• Pavement design recommendations are presented in the section 10.6 Pavement Design Recommendations.

Based on our investigation, it is our professional opinion that the proposed location for is suitable for construction of the proposed structures provided the recommendations presented in this geotechnical investigation report are considered in the planning, design and construction of the project.

As this is a limited geotechnical study, additional geotechnical investigation will be required to construct the project. Future investigation may result in revisions to the recommendations presented in this report.
# TABLE OF CONTENTS

1.0 INTRODUCTION ...................................................................................................... 1

2.0 PROJECT DESCRIPTION ....................................................................................... 1

3.0 SITE DESCRIPTION ............................................................................................... 2

4.0 SCOPE OF WORK .................................................................................................. 3

4.1 PROJECT SET-UP ............................................................................................... 3

4.2 SUBSURFACE EXPLORATION .......................................................................... 4

4.3 LABORATORY TESTING ..................................................................................... 4

4.4 ANALYSES AND REPORT ............................................................................... 4

5.0 SUBSURFACE CONDITIONS .............................................................................. 4

5.1 EXISTING PAVEMENT SECTIONS ................................................................. 4

5.2 SUBSURFACE PROFILE .................................................................................... 5

5.3 GROUNDWATER ............................................................................................... 5

5.4 EXCAVATABILITY ............................................................................................ 6

5.5 SUBSURFACE VARIATIONS ............................................................................. 7

5.6 FLOODING ..................................................................................................... 7

6.0 GEOLOGIC CONDITIONS ................................................................................... 7

6.1 REGIONAL GEOLOGY ........................................................................................ 7

6.2 SITE GEOLOGY ................................................................................................ 8

7.0 FAULTING AND SEISMICITY ........................................................................... 8

7.1 FAULTING ....................................................................................................... 8

7.2 CBC SEISMIC DESIGN PARAMETERS ........................................................... 10

7.3 SECONDARY EFFECTS OF SEISMIC ACTIVITY ........................................... 10

8.0 LABORATORY TEST RESULTS .......................................................................... 12

8.1 PHYSICAL TESTING ....................................................................................... 12

8.2 CHEMICAL TESTING - CORROSIVITY EVALUATION .................................. 12

9.0 EARTHWORK RECOMMENDATIONS ................................................................ 13

9.1 GENERAL ..................................................................................................... 13

9.2 OVEREXCAVATION ....................................................................................... 14

10.0 DESIGN RECOMMENDATIONS ...................................................................... 14

10.1 SHALLOW FOUNDATION DESIGN PARAMETERS ...................................... 14

10.2 LATERAL EARTH Pressures and resistance to lateral loads ...................... 15

10.3 SOIL EXPANSION ........................................................................................ 16

10.4 SETTLEMENT ................................................................................................ 16

10.5 SOIL CORROSIVITY ..................................................................................... 17

10.6 PAVEMENT DESIGN RECOMMENDATIONS .................................................. 17
Limited Geotechnical Investigation Report
Parent Resource Center, Parking Structure and Police Station
Northeast of the Intersection of North 'F' Street and West 7th Street
City of San Bernardino, San Bernardino County, California
February 12, 2018
Page vii

11.0 GEOTECHNICAL SERVICES DURING CONSTRUCTION ...................... 18
12.0 CLOSURE .......................................................................................... 18
13.0 REFERENCES ..................................................................................... 20

FIGURES
Following Page Number
Figure No. 1, Approximate Project Location Map ........................................ 1
Figure No. 2, Approximate Boring Locations Map ........................................... 4
Figure No. 3, Flood Hazard Map ................................................................. 7
Figure No. 4, Project Site Geologic Map ...................................................... 8
Figure No. 5, Southern California Regional Fault Map .................................. 9

TABLES
Page Number
Table No. 1, Existing Pavement Sections ...................................................... 5
Table No. 2, Summary of USGS Groundwater Depth Data .......................... 6
Table No. 3, Seismic Characteristics of Nearby Active Faults ...................... 9
Table No. 4, CBC Seismic Parameters ....................................................... 10
Table No. 5, Overexcavation Depths .......................................................... 14
Table No. 6, Recommended Foundation Parameters .................................. 14
Table No. 7, Active and At-Rest Earth Pressures ...................................... 15
Table No. 8, Recommended Preliminary Pavement Sections ...................... 17

APPENDICES
Appendix A .............................................................................................. Field Exploration
Appendix B .............................................................................................. Laboratory Testing Program
Appendix C .............................................................................................. Seismic Settlement Analysis
1.0 INTRODUCTION

This report presents the results of our limited geotechnical investigation performed for the proposed parent resource center, parking structure, and a district police station located northeast of the intersection of North ‘F’ Street and West 7th Street, City of San Bernardino, San Bernardino County, California. The approximate project location is shown on Figure No. 1, *Approximate Project Location Map*.

The purpose of our limited geotechnical investigation was to evaluate the site to identify any geohazard that might impact the proposed development of the project. Additional purposes of this investigation were to determine the nature and engineering properties of the subsurface soils and to provide preliminary design recommendations for the proposed project.

To meet CGS Note 48 guideline, additional investigation and analyses need to be conducted. This may result in revisions to the preliminary recommendations presented in this report.

This report is prepared for the project described herein and is intended for use solely by San Bernardino City Unified School District and their authorized agents for design purposes. It should not be used as a bidding document but may be made available to the potential contractors for information on factual data only. For bidding purposes, the contractors should be responsible for making their own interpretation of the data contained in this report.

2.0 PROJECT DESCRIPTION

Based on the preliminary study conducted by Ruhnau Clarke Architects, 2017, the project will consist of the following.

- 2-story parent resource center with 15,000 square feet of floor space and a footprint of 7,500 square feet.
- 1-story district police station with a footprint of 15,000 square feet.
- 3-level parking structure with footprint of 45,976 square feet and 114 parking stalls per level.

These structures will likely be constructed of reinforced concrete, steel and masonry block walls. The parent resource center and police station will be founded on shallow footings. Depending on the loads, the parking structure may require deep foundations such as piles.
Project: Parent Resource Center, Parking Structure, and Police Station
Location: Northeast of the Intersection of North F Street and West 7th Street
City of San Bernardino, San Bernardino County, California
For: San Bernardino City Unified School District

Approximate Project Location Map

Map Credit: Portion of U.S. GEOLOGICAL SURVEY (USGS), 1980, San Bernardino South Quadrangle, California, 7.5-Minute Series, dated 2015, scale 1:24,000
3.0 SITE DESCRIPTION

The proposed development is located northeast of the intersection of North ‘F’ Street and West 7th Street in the City of San Bernardino, California. The site is bounded on the north side by West 8th Street, on the south side by West 7th Street, on the east side by North ‘E’ Street and on the west side by North ‘F’ Street. Currently, the site has four existing buildings which are Curtis Middle School on the west side, Sturges Center for Fine Arts on the northeast corner, Town Lodge on the east side, and La Luz Del Mundo Church on the southeast corner. The remaining portion of the site is covered with asphalt paved parking lots, sidewalks, landscape and hardscape. Photographs 1 and 2 depict the current site conditions.

*Photograph 1: Southwest corner of the site facing northeast*
4.0 SCOPE OF WORK

Our scope of work consisted of the tasks described in the following subsections.

4.1 Project Set-up

As part of the project set-up, our staff performed the following tasks.

- Conducted a site reconnaissance and marked the borings at locations directed by Tim Deland from SBCUSD, who was familiar with the location of existing underground utilities.
- Notified Underground Service Alert (USA) at least 48 hours prior to drilling to clear the borings locations of any conflicts with existing underground utilities.
- Engaged a California-licensed driller to drill exploratory borings.
4.2 **Subsurface Exploration**

Six exploratory borings (BH-01 through BH-06) were drilled on December 27, 2017 at the site. The borings were advanced to their maximum planned depths of 21.5 and 51.5 feet bgs. Approximate boring locations are indicated in Figure No. 2, *Approximate Boring Locations Map*.

For a description of the field exploration and sampling program, see Appendix A, *Field Exploration*.

4.3 **Laboratory Testing**

Representative samples of the site soils were tested in the laboratory to aid in the soil classification and to evaluate the relevant engineering properties of the site soils. These tests included the following.

- In-situ moisture contents and dry densities (ASTM D2216)
- Expansion index (ASTM D4829)
- R-value (Caltrans CT301)
- Soil corrosivity (California Tests 643, 422, and 417)
- Collapse potential (ASTM D5333)
- Grain size distribution (ASTM D422)
- Maximum dry density and optimum-moisture content (ASTM D1557)
- Direct shear (ASTM D3080)

4.4 **Analyses and Report**

Data obtained from the field exploration and laboratory testing program were compiled and evaluated. Geotechnical analyses of the compiled data were performed and this report was prepared to present our findings, conclusions, and recommendations for the proposed development.

5.0 **SUBSURFACE CONDITIONS**

A general description of the subsurface conditions, various materials and groundwater conditions encountered at the site during our field exploration is discussed below.

5.1 **Existing Pavement Sections**

The pavement thicknesses were measured where encountered and are included in the following table.
Result of Exploration Boring

EXPLANATION

BH-06
Number and Approximate Location of Exploratory Boring

Approximate Boring Locations Map

Project:
Parent Resource Center, Parking Structure, and Police Station

Location:
Northeast of the Intersection of North F Street and West 7th Street
City of San Bernardino, San Bernardino County, California

For:
San Bernardino City Unified School District

Converse Consultants

Project No.
17-81-293-01

Figure No.
2
Table No. 1, Existing Pavement Sections

<table>
<thead>
<tr>
<th>Boring No.</th>
<th>Asphalt Concrete Thickness (in.)</th>
<th>Aggregate Base Thickness (in.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BH-01</td>
<td>4.5</td>
<td>8.0</td>
</tr>
<tr>
<td>BH-02</td>
<td>3.5</td>
<td>3.0</td>
</tr>
<tr>
<td>BH-03</td>
<td>4.0</td>
<td>8.0</td>
</tr>
<tr>
<td>BH-04</td>
<td>3.5</td>
<td>8.0</td>
</tr>
<tr>
<td>BH-05</td>
<td>4.0</td>
<td>8.0</td>
</tr>
<tr>
<td>BH-06</td>
<td>4.0</td>
<td>7.0</td>
</tr>
</tbody>
</table>

For a detailed description of the subsurface materials encountered in the exploratory borings, see Drawings No. A-2 through A-7, Logs of Borings, in Appendix A, Field Exploration.

### 5.2 Subsurface Profile

Based on the exploratory borings and laboratory test results, the site is underlain by alluvial sediments consisting of sandy clay, sandy silt, sand and silty sand layers. Few gravel was observed at depth between 0.5 and 5 feet bgs in boring BH-02. Scattered gravel was observed in borings BH-01, BH-02, BH-03 and BH-05.

For a detailed description of the subsurface materials encountered in the exploratory borings, see Drawings No. A-2 through A-7, Logs of Borings, in Appendix A, Field Exploration.

### 5.3 Groundwater

Groundwater was not encountered during the investigation to the maximum explored depth of 51.5 feet bgs. Regional databases were reviewed to estimate expected groundwater conditions in the vicinity of the project site. The following data was found on the GeoTracker website (SWRCB, 2017).

- LA MANCHA (FORMER MOBIL SS) (Site No. T0607100080), located approximately 1,900 feet southeast of the project site, reported groundwater at depths ranging from 21 to 75 feet bgs in 2000.
- FIRESTONE STORE (BFS #180513) (Site No. T0607129188), located approximately 2,500 feet south of the project site, reported groundwater at depths ranging from 79 to 102 feet bgs in 2007.
- INTERSTATE BRANDS (Site No. T0607100025), located approximately 4,300 feet northwest of the project site, reported groundwater at depths ranging from 60 to 65 feet bgs in 1990.
• KAM SHELL (Site No. T0607100564), located approximately 3,300 feet northwest of the project site, reported groundwater depths ranging from 150 to 200 feet bgs in 2006.

Data in the following table was found on the National Water Information System (USGS, 2017a). Due to the number of sites with available data in the project area, sites closest to the proposed site were selected.

**Table No. 2, Summary of USGS Groundwater Depth Data**

<table>
<thead>
<tr>
<th>Site No.</th>
<th>Location</th>
<th>Groundwater Depth Range (ft. bgs)</th>
<th>Date Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>340633117174006</td>
<td>SW of N E St and W 6th St</td>
<td>80-90</td>
<td>2003-2007</td>
</tr>
<tr>
<td>340615117170904</td>
<td>SW of West 3rd St and N Mountain View Ave</td>
<td>21-72</td>
<td>1991-2017</td>
</tr>
<tr>
<td>340608117172601</td>
<td>SE of N D St and W 2nd St</td>
<td>0.2-105.5</td>
<td>1964-2008</td>
</tr>
<tr>
<td>340642117163901</td>
<td>SE of N Waterman Ave and E7th St</td>
<td>85</td>
<td>1971</td>
</tr>
<tr>
<td>340719117171103</td>
<td>NE of N Mountain View Ave and W Base Line St</td>
<td>127.5</td>
<td>1996</td>
</tr>
<tr>
<td>340746117170501</td>
<td>SW of N Sierra Way and W 17th St</td>
<td>238</td>
<td>1970</td>
</tr>
<tr>
<td>340737117163801</td>
<td>NE of E Gilbert St and N Waterman Ave</td>
<td>226</td>
<td>1970</td>
</tr>
</tbody>
</table>

*Highest groundwater depth of 0.2 feet occurred in 1983. All other values recorded for this location are 14 feet bgs or deeper.

Historical high groundwater at the project site is not known with certainty but is expected to be less than 1 foot bgs. The current depth to groundwater is expected to be deeper than 50 feet bgs. Considering the current depth to groundwater and the unlikely possibility of substantial recharge, dewatering should not be considered in project design or construction. It should be noted that the groundwater level could vary depending upon the seasonal precipitation and possible groundwater pumping activity in the site vicinity. Shallow perched groundwater may be present locally, particularly following precipitation or irrigation events.

### 5.4 Excavatability

Based on the exploratory soil borings, the on-site soils should be generally excavatable with conventional heavy duty earthmoving equipment.

The phrase “conventional heavy-duty excavation equipment” is intended to include commonly used equipment such as excavators, scrapers, and trenching machines. It does not include hydraulic hammers (“breakers”), jackhammers, blasting, or other specialized equipment and techniques used to excavate hard earth materials. Selection of an appropriate excavation equipment models should be done by an experienced earthwork contractor.
5.5 **Subsurface Variations**

Based on results of the subsurface exploration and our experience, some variations in the continuity and nature of subsurface conditions within the project sites should be anticipated. Because of the uncertainties involved in the nature and depositional characteristics of the earth material, care should be exercised in interpolating or extrapolating subsurface conditions between or beyond the boring locations.

5.6 **Flooding**

Review of National Flood Insurance Rate Maps (FEMA, August 28, 2008) indicates that the project site is located within Flood Hazard Zone “X”. Zone “X” is designated as “Areas determined to be outside the 0.2% chance floodplain”. The approximate project boundaries are shown relative to nearby flood hazard zones on Figure No. 3, *Flood Hazard Map*.

6.0 **GEOLOGIC CONDITIONS**

The regions and local geologic conditions are described in the following sections.

6.1 **Regional Geology**

The project site is located near the northernmost extent of the Peninsular Ranges Geomorphic Province of Southern California, near the boundary with the adjacent Transverse Ranges Geomorphic Province. The Peninsular Ranges Geomorphic Province consists of a series of northwest-trending mountain ranges and valleys bounded on the north by the San Bernardino and San Gabriel Mountains, on the west by the Los Angeles Basin, and on the southwest by the Pacific Ocean.

The province is a seismically active region characterized by a series of northwest-trending strike-slip faults. The most prominent of the nearby fault zones include the San Jacinto, Cucamonga, and San Andreas Fault Zones, all of which have been known to be active during Quaternary time.

Topography within the province is generally characterized by broad alluvial valleys separated by linear mountain ranges. This northwest-trending linear fabric is created by the regional faulting within the granitic basement rock of the Southern California Batholith. Broad, linear, alluvial valleys have been formed by erosion of these principally granitic mountain ranges.
EXPLANATION
SPECIAL FLOOD HAZARD AREAS SUBJECT TO INUNDATION BY THE
1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a
1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the
area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include
Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation
of the 1% annual chance flood.

OTHER FLOOD AREAS

ZONE X
Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average
depths of less than 1 foot or with drainage areas less than 1 square mile; and
areas protected by levees from 1% annual chance flood.

Flood Hazard Map

Project: Parent Resource Center, Parking Structure, and Police Station
Location: Northeast of the Intersection of North F Street and West 7th Street
City of San Bernardino, San Bernardino County, California
For: San Bernardino City Unified School District

Project No. 17-81-293-01
Figure No. B-18
6.2 Site Geology

The project site is situated near the central portion of the San Bernardino Valley, which is bounded by the San Bernardino Mountains and the San Andreas fault to the north, and the San Timoteo Badlands and the San Jacinto fault to the south.

Based on review of available geologic mapping, the site is underlain by Holocene to late-Pleistocene axial-channel deposits associated with valley fill of the Santa Ana River and its tributaries (Morton and Miller, 2006; Dibblee and Minch, 2004). These deposits generally range from very fine to coarse sand, with beds of gravel and small cobbles.

A historical topographic map of the area (USGS, 1901) shows an active creek mapped through or adjacent to the project site. A current topographic map (USGS, 1980) shows a channel feature within the broad sloping alluvial valley through the project area. The silts and clays found in the site’s subsurface could be attributed to historical creeks that once flowed through the project site but were later channelized upstream at the foot of the San Bernardino Mountains.

The geology in the vicinity of the project site is shown on Figure No. 4, Project Site Geologic Map.

7.0 FAULTING AND SEISMICITY

Discussion on faulting and seismicity is presented in the following sections

7.1 Faulting

The site is not located within a currently designated State of California or San Bernardino County Earthquake Fault Zone (CGS, 1977; San Bernardino County, 2010b). There are no known active faults projecting toward or extending across the project site. The potential for surface rupture resulting from the movement of nearby major faults is not known with certainty but is considered low.

The proposed site is situated in a seismically active region. As is the case for most areas of Southern California, ground shaking resulting from earthquakes associated with nearby and more distant faults may occur at the project site. During the life of the project, seismic activity associated with active faults can be expected to generate moderate to strong ground shaking at the site.

The following table contains a list of active and potentially active faults within 100 kilometers of the subject site. The fault parameters and distances presented in the following table are based on the output from EQFAULT (Blake, 2000), revised in accordance with CGS fault parameters (Cao et. al., 2003). The approximate site location
Project Site Geologic Map

EXPLANATION

SURFICIAL SEDIMENTS

Qa  Alluvial gravel and sand of valley areas, derived from rocks of San Bernardino Mountains, composed of unsorted boulders and cobbles in mountain area, down slope into finer cobble-gravel and sand outward SW in valley area.

Qs  Drift sand, deposited by north winds.

Fault:  Dashed where indefinite or inferred. Dotted where concealed, queried where existence is doubtful.

with respect to regional faults is shown on Figure No. 5, *Southern California Regional Fault Map*.

**Table No. 3, Seismic Characteristics of Nearby Active Faults**

<table>
<thead>
<tr>
<th>Fault Name</th>
<th>Approximate Distance (km)</th>
<th>Moment Magnitude (Mw)</th>
</tr>
</thead>
<tbody>
<tr>
<td>San Jacinto - San Bernardino</td>
<td>1.9 (3.1)</td>
<td>6.7</td>
</tr>
<tr>
<td>San Andreas - San Bernardino</td>
<td>4.5 (7.2)</td>
<td>7.5</td>
</tr>
<tr>
<td>San Andreas - Southern</td>
<td>4.5 (7.2)</td>
<td>7.5</td>
</tr>
<tr>
<td>San Jacinto - San Jacinto Valley</td>
<td>7.6 (12.3)</td>
<td>6.9</td>
</tr>
<tr>
<td>Cucamonga</td>
<td>10.8 (17.4)</td>
<td>6.9</td>
</tr>
<tr>
<td>Cleghorn</td>
<td>11.4 (18.4)</td>
<td>6.5</td>
</tr>
<tr>
<td>North Frontal Fault Zone (West)</td>
<td>12.3 (19.8)</td>
<td>7.2</td>
</tr>
<tr>
<td>San Andreas - Mojave</td>
<td>19.2 (30.9)</td>
<td>7.4</td>
</tr>
<tr>
<td>San Jose</td>
<td>23.0 (37.0)</td>
<td>6.4</td>
</tr>
<tr>
<td>Sierra Madre</td>
<td>24.8 (39.9)</td>
<td>7.2</td>
</tr>
<tr>
<td>Chino - Central Ave. (Elsinore)</td>
<td>25.1 (40.4)</td>
<td>6.7</td>
</tr>
<tr>
<td>Elsinore - Glen Ivy</td>
<td>26.4 (42.5)</td>
<td>6.8</td>
</tr>
<tr>
<td>Whittier</td>
<td>26.5 (42.7)</td>
<td>6.8</td>
</tr>
<tr>
<td>North Frontal Fault Zone (East)</td>
<td>29.8 (48.0)</td>
<td>6.7</td>
</tr>
<tr>
<td>Helendale - S. Lockhardt</td>
<td>30.1 (48.4)</td>
<td>7.3</td>
</tr>
<tr>
<td>Elsinore - Temecula</td>
<td>32.7 (52.6)</td>
<td>6.8</td>
</tr>
<tr>
<td>Pinto Mountain</td>
<td>33.1 (53.2)</td>
<td>7.2</td>
</tr>
<tr>
<td>San Jacinto - Anza</td>
<td>33.7 (54.2)</td>
<td>7.2</td>
</tr>
<tr>
<td>Elysian Park Thrust</td>
<td>34.0 (54.7)</td>
<td>6.7</td>
</tr>
<tr>
<td>Clamshell - Sawpit</td>
<td>34.1 (54.9)</td>
<td>6.5</td>
</tr>
<tr>
<td>Raymond</td>
<td>41.1 (66.1)</td>
<td>6.5</td>
</tr>
<tr>
<td>Lenwood - Lockhart - Old Woman Sprgs</td>
<td>41.2 (66.3)</td>
<td>7.5</td>
</tr>
<tr>
<td>Compton Thrust</td>
<td>45.0 (72.4)</td>
<td>6.8</td>
</tr>
<tr>
<td>Johnson Valley (Northern)</td>
<td>45.3 (72.9)</td>
<td>6.7</td>
</tr>
<tr>
<td>Verdugo</td>
<td>46.0 (74.1)</td>
<td>6.9</td>
</tr>
<tr>
<td>San Andreas - Coachella</td>
<td>49.1 (79.0)</td>
<td>7.2</td>
</tr>
<tr>
<td>Landers</td>
<td>50.0 (80.5)</td>
<td>7.3</td>
</tr>
<tr>
<td>Newport - Inglewood (L.A.Basin)</td>
<td>50.3 (80.9)</td>
<td>7.1</td>
</tr>
<tr>
<td>Newport - Inglewood (Offshore)</td>
<td>50.5 (81.2)</td>
<td>7.1</td>
</tr>
<tr>
<td>Burnt Mtn.</td>
<td>51.0 (82.0)</td>
<td>6.5</td>
</tr>
<tr>
<td>Eureka Peak</td>
<td>51.6 (83.1)</td>
<td>6.4</td>
</tr>
<tr>
<td>Emerson So. - Copper Mtn.</td>
<td>52.2 (84.0)</td>
<td>7.1</td>
</tr>
<tr>
<td>Elsinore - Julian</td>
<td>53.4 (85.9)</td>
<td>7.1</td>
</tr>
<tr>
<td>Hollywood</td>
<td>53.6 (86.3)</td>
<td>6.4</td>
</tr>
<tr>
<td>Gravel Hills - Harper Lake</td>
<td>56.7 (91.3)</td>
<td>7.1</td>
</tr>
<tr>
<td>San Gabriel</td>
<td>58.1 (93.5)</td>
<td>7.2</td>
</tr>
<tr>
<td>Calico - Hidalgo</td>
<td>58.2 (93.6)</td>
<td>7.3</td>
</tr>
<tr>
<td>Sierra Madre (San Fernando)</td>
<td>58.7 (94.5)</td>
<td>6.7</td>
</tr>
</tbody>
</table>
Converse Consultants

Project No. 17-81-293-01

Southern California Regional Fault Map

Approximate Project Area


Project: Parent Resource Center, Parking Structure, and Police Station
Location: Northeast of the Intersection of North F Street and West 7th Street
City of San Bernardino, San Bernardino County, California
For: San Bernardino City Unified School District

Project No. B-22

Figure No. 5
7.2 **CBC Seismic Design Parameters**

Seismic parameters determined using the USGS Seismic Design Maps tool (USGS, 2017b) based on 2016 California Building Code and site coordinates 34.1129 latitude and 117.2953 west longitude are provided in the following table.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Site Class</td>
<td>“D”</td>
</tr>
<tr>
<td>Mapped Short period (0.2-sec) Spectral Response Acceleration, $S_s$</td>
<td>2.157g</td>
</tr>
<tr>
<td>Mapped 1-second Spectral Response Acceleration, $S_1$</td>
<td>0.977g</td>
</tr>
<tr>
<td>Site Coefficient (from Table 1613.5.3(1)), $F_a$</td>
<td>1.0</td>
</tr>
<tr>
<td>Site Coefficient (from Table 1613.5.3(2)), $F_v$</td>
<td>1.5</td>
</tr>
<tr>
<td>MCE 0.2-sec period Spectral Response Acceleration, $S_{s_{ms}}$</td>
<td>2.157g</td>
</tr>
<tr>
<td>MCE 1-second period Spectral Response Acceleration, $S_{s_{m1}}$</td>
<td>1.466g</td>
</tr>
<tr>
<td>Design Spectral Response Acceleration for short period $S_{ds}$</td>
<td>1.438g</td>
</tr>
<tr>
<td>Design Spectral Response Acceleration for 1-second period, $S_{d1}$</td>
<td>0.977g</td>
</tr>
<tr>
<td>Peak Ground Acceleration, $PGA_M$</td>
<td>0.834g</td>
</tr>
</tbody>
</table>

7.3 **Secondary Effects of Seismic Activity**

In general, secondary effects of seismic activity include surface fault rupture, soil liquefaction, landslides, lateral spreading, and settlement due to seismic shaking, tsunamis, seiches, and earthquake-induced flooding. The site-specific potential for each of these seismic hazards is discussed in the following sections.

**Surface Fault Rupture:** The project site is not located within the designated State of California or San Bernardino County Fault Zone (CGS, 1977; San Bernardino County, 2010b). There are no known active faults projecting toward or extending across the project site. The potential for surface rupture resulting from the movement of nearby major faults is not known with certainty but is considered low.

**Liquefaction:** Liquefaction is defined as the phenomenon in which a cohesionless soil mass suffers a substantial reduction in its shear strength due to the development of excess pore pressures. During earthquakes, excess pore pressures in saturated soil deposits may develop as a result of induced cyclic shear stresses, resulting in liquefaction.

Soil liquefaction generally occurs in submerged granular soils and non-plastic silts located within 50 feet of the ground surface during or after strong ground shaking. There are several general requirements for liquefaction to occur. They are as follows.
• Soils must be submerged.
• Soils must be loose to medium-dense.
• Soils must be relatively near the ground surface.
• Ground motion must be intense.
• Duration of shaking must be sufficient for the soils to lose shear resistance.

Based on San Bernardino County hazard maps, the project site is located in a zone of medium liquefaction susceptibility (San Bernardino County, 2010b). There is a potential for up to 0.6 inches of liquefaction in the event that groundwater rises to historic levels.

**Seismic Settlement:** Seismically-induced settlement occurs in unsaturated, unconsolidated, granular sediments during ground shaking associated with earthquakes. The analysis presented in Appendix C, *Seismic Settlement Analysis* indicates that the site has the potential for up to 2.2 inches of dry seismic settlement.

**Landslides:** Seismically induced landslides and other slope failures are common occurrences during or soon after earthquakes. Due to the relatively flat nature of the project site, the risk of landsliding is considered low.

**Lateral Spreading:** Seismically induced lateral spreading involves primarily lateral movement of earth materials over deeper layers which have liquefied due to ground shaking. It differs from the slope failure in that complete ground failure involving large movement does not occur due to the relatively smaller gradient of the initial ground surface. Lateral spreading is demonstrated by near-vertical cracks with predominantly horizontal movement of the soil mass involved. Due to the low potential for liquefaction and flat nature of the project site, the lateral spreading potential is also considered to be low.

**Tsunamis:** Tsunamis are large waves generated in large bodies of water by fault displacement or major ground movement. Based on the inland location of the project sites, tsunamis do not pose a hazard to this site.

**Seiches:** Seiches are large waves generated in enclosed bodies of water in response to ground shaking. Due to the absence of nearby enclosed bodies of water, the risk of seiching is considered low.

**Earthquake-Induced Flooding:** Dams or other water-retaining structures may fail as a result of large earthquakes, resulting in flooding. The project site is not located within a designated dam inundation zone (San Bernardino County, 2010a). Due to the distance from any large dams or other water-retaining structures, the risk for earthquake-induced flooding at the project site is considered low.
8.0 LABORATORY TEST RESULTS

Results of physical and chemical tests performed for this project are presented below.

8.1 Physical Testing

Results of the various laboratory tests are presented in Appendix B, *Laboratory Testing Program*, except for the results of in-situ moisture and dry density tests which are presented on the Logs of Borings in Appendix A, *Field Exploration*. The results are also discussed below.

- **In-situ Moisture and Dry Density** – *In-situ* dry density and moisture content of the site soils were determined in accordance to ASTM Standard D2216. Dry densities of upper 10 feet soils ranged from 88 to 114 pcf with moisture contents of 13 to 29 percent. Results are presented in the log of borings in Appendix A, *Field Exploration*.

- **Expansion Index** – Three representative samples from the upper 10 feet of soils were tested to evaluate the expansion potential in accordance with ASTM Standard D4829. The test results indicated an EI of 10, 25 and 55, corresponding to very low to medium expansion.

- **R-Value** – One representative bulk sample of the site soils was tested in accordance with Caltrans Test Method 301. The result of the R-value test was 14.

- **Collapse Potential** – The collapse potential of three relatively undisturbed samples from the upper 10 feet of the soils were tested under a vertical stress of up to 2.0 kips per square foot (ksf) in accordance with the ASTM Standard D5333 test method. The test results showed collapse potential between 0.4 to 1.7 percent, indicating slight collapse potential.

- **Grain Size Analysis** – Three representative samples were tested to determine the relative grain size distribution in accordance with the ASTM Standard D422. The test results are graphically presented in Drawing No. B-1, *Grain Size Distribution Results*.

- **Maximum Dry Density and Optimum Moisture Content** – Two typical moisture-density relationship of representative soil samples were tested, according to ASTM Standard D1557-B, with the result presented in Drawing No. B-2, *Moisture-Density Relationship Results*, in Appendix B, *Laboratory Testing Program*. The laboratory maximum dry densities ranged from 122.0 to 124.0 pounds per cubic feet (pcf), with optimum moisture contents ranged from 12.1 to 12.5 percent.

- **Direct Shear** – Two direct shear tests were performed in accordance with ASTM Standard D3080 on relatively undisturbed ring samples from the soils. The results of the direct shear tests are presented in Drawings No. B-3 and B-4, *Direct Shear Test Results* in Appendix B, *Laboratory Testing Program*.

8.2 Chemical Testing - Corrosivity Evaluation

Two representative soil samples were tested to determine minimum electrical resistivity, pH, and chemical content, including soluble sulfate and chloride concentrations. The
The purpose of these tests was to determine the corrosion potential of site soils when placed in contact with common pipe materials. The test was performed by EG Labs in accordance with California Test Methods 643, 422, and 417. The test results are presented in Appendix B, Laboratory Testing Program and summarized below.

- The pH measurements of the samples tested were 7.79 and 8.25.
- The sulfate contents of the samples tested were 0.058 and 0.002 percent by weight.
- The chloride concentrations of the samples tested were 160 and 135 ppm.
- The minimum electrical resistivity of the samples when saturated were 870 and 2,100 ohm-cm.

9.0 EARTHWORK RECOMMENDATIONS

Preliminary earthwork recommendations for the project site are presented in the following sections.

9.1 General

This section contains our general recommendations regarding grading for the proposed site. The recommendations are based on the results of our field exploration, laboratory tests, our experience with similar projects, and data evaluation as presented in the preceding sections. The recommendations may require modification by the geotechnical consultant based on observation of the actual field conditions during grading.

Prior to the start of construction, all underground existing utilities and appurtenances should be located at the project site. Such utilities should either be protected in-place or removed and replaced during construction as required by the project specifications. All excavations should be conducted in such a manner as not to cause loss of bearing and/or lateral support of existing structures or utilities.

All debris, surface vegetation, deleterious material, existing fill, and surficial soils containing roots and perishable materials should be stripped and removed from the site.

The final bottom surfaces of all excavations should be observed and approved by the project geotechnical consultant prior to placing any fill. Based on these observations, localized areas may require remedial grading deeper than indicated herein. Therefore, some variations in the depth and lateral extent of excavation recommended in this report should be anticipated.
9.2 **Overexcavation**

Building footings, slabs-on-grade, and other shallow or at-grade structures and pavements should be uniformly supported by compacted fill. In order to provide uniform support, structural and pavement areas should be overexcavated and scarified as follows.

<table>
<thead>
<tr>
<th>Structure/Pavement</th>
<th>Excavation Depth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parent Resource Center</td>
<td>24 inches below the bottom of the footings, or 5 feet from the existing ground surface, whichever is greater</td>
</tr>
<tr>
<td>Police Station</td>
<td></td>
</tr>
<tr>
<td>Parking Structure (if shallow foundation)</td>
<td></td>
</tr>
<tr>
<td>Pavement</td>
<td>12 inches below finish grade</td>
</tr>
</tbody>
</table>

The depth of overexcavation should be uniform across the entire structures. The overexcavation should extend to at least 2 feet beyond the footprint of the structures. The bottom of excavations should be scarified to a minimum depth of 6 inches.

The overexcavation should extend at least one foot beyond the edge of pavement.

If isolated pockets of very soft, loose, or pumping subgrade are encountered, the overexcavation should be locally deepened, as needed, to expose undisturbed, firm, and unyielding soils.

10.0 DESIGN RECOMMENDATIONS

The design recommendations provided are provided below.

10.1 **Shallow Foundation Design Parameters**

The proposed parent center, parking structure and police station may be supported on continuous spread footings and/or isolated spread footings. The design of the shallow foundations should be based on the recommended parameters presented in the table below.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum continuous spread footing width</td>
<td>18 inches</td>
</tr>
<tr>
<td>Minimum isolated footing width</td>
<td>18 inches</td>
</tr>
<tr>
<td>Minimum continuous or isolated footing depth of embedment below lowest adjacent grade</td>
<td>18 inches</td>
</tr>
<tr>
<td>Allowable net bearing capacity</td>
<td>2,000 psf</td>
</tr>
</tbody>
</table>
The footing dimensions and reinforcement should be based on structural design. The allowable bearing capacity can be increased by 500 psf with each foot of additional embedment and 100 psf with each foot of additional width up to a maximum of 3,500 psf.

The allowable net bearing capacity is defined as the maximum allowable net bearing pressure on the ground. It is obtained by dividing the net ultimate bearing capacity by a safety factor. The ultimate bearing capacity is the bearing stress at which ground fails by shear or experiences a limiting amount of settlement at the foundation. The net ultimate bearing capacity was obtained by subtracting the total overburden pressure on a horizontal plane at the foundation level from the ultimate bearing capacity.

The net allowable bearing value indicated above is for the dead loads and frequently applied live loads and are obtained by applying a factor of safety of 3.0 to the net ultimate bearing capacity. If normal code requirements are applied for design, the above vertical bearing value may be increased by 33 percent for short duration loadings, which will include loadings induced by wind or seismic forces.

10.2 Lateral Earth Pressures and Resistance to Lateral Loads

In the following subsections, the lateral earth pressures and resistance to lateral loads are estimated by using on-site native soils strength parameters obtained from laboratory testing.

10.2.1 Active Earth Pressures

The active earth pressure behind any buried wall or foundation depends primarily on the allowable wall movement, type of backfill materials, backfill slopes, wall or foundation inclination, surcharges, and any hydrostatic pressures. The recommended lateral earth pressures for the site are presented in the following table.

<table>
<thead>
<tr>
<th>Loading Conditions</th>
<th>Lateral Earth Pressure (psf)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Active earth conditions (wall is free to deflect at least 0.001 radian)</td>
<td>50</td>
</tr>
<tr>
<td>At-rest (wall is restrained)</td>
<td>72</td>
</tr>
</tbody>
</table>

These pressures assume a level ground surface behind the walls for a distance greater than the walls height, no surcharge and no hydrostatic pressure.

If water pressure is allowed to build up behind the walls, the active pressures should be reduced by 50 percent and added to a full hydrostatic pressure to compute the design pressures against the walls.
10.2.2 Passive Earth Pressure

Resistance to lateral loads can be assumed to be provided by a combination of friction acting at the base of foundations and by passive earth pressure. A coefficient of friction of 0.30 between formed concrete and soil may be used with the dead load forces. An allowable passive earth pressure of 215 psf per foot of depth may be used for the sides of footings poured against recompacted soils. A factor of safety of 1.5 was applied in calculating passive earth pressure. The maximum value of the passive earth pressure should be limited to 2,000 psf for compacted fill.

Vertical and lateral bearing values indicated above are for the total dead loads and frequently applied live loads. If normal code requirements are applied for design, the above vertical bearing and lateral resistance values may be increased by 33 percent for short duration loading, which will include the effect of wind or seismic forces.

Due to the low overburden stress of the soil at shallow depth, the upper 1 foot of passive resistance should be neglected unless the soil is confined by pavement or slab.

10.3 Soil Expansion

Shallow foundations should be designed to accommodate the anticipated soil expansion. Very low and low (EI of 10 and 25) expansion potential was observed at the project site except in boring BH-06 where medium expansion potential (EI of 55) was observed. Future geotechnical investigation should fully characterize the lateral and vertical extent of expansive soils within the site and determine the range of expansiveness that may be present in the various building locations. Mitigation of soil expansion should be based on the final geotechnical investigation.

10.4 Settlement

The total settlement of shallow footings from static structural loads and short-term settlement of properly compacted fill is anticipated to be 1 inch or less. The differential settlement resulting from static loads is anticipated to be 0.5 inches or less over a horizontal distance of 40 feet.

Our analysis of the potential seismic settlement is presented in Appendix C, Seismic Settlement Analysis. We preliminary recommend that the planned structures be designed conservatively in anticipation of 2.2 inches total seismic settlement and seismic differential settlement to be 1.1 inches over 40 horizontal feet.

The static and dynamic settlement estimates should not be combined for design purposes. The maximum combined static and dynamic settlement is not anticipated to exceed the maximum anticipated dynamic settlement.
10.5 Soil Corrosivity

The results of chemical testing of two representative soil samples from the site were evaluated for corrosivity with respect to common construction materials such as concrete and steel. The test results are presented in Appendix B, Laboratory Testing Program and design recommendations pertaining to soil corrosivity are presented below.

The sulfate content of the sampled soils corresponds to American Concrete Institute (ACI) exposure category S0 for these sulfate concentrations (ACI 318-14, Table 19.3.1.1). No concrete type restrictions are specified for exposure category S0 (ACI 318-14, Table 19.3.2.1). A minimum compressive strength of 2,500 psi is recommended.

We anticipate that concrete structures such as footings, slabs, and flatwork will be exposed to moisture from precipitation and irrigation. Based on the location and the result of chloride testing of the site soils, we do not anticipate that concrete structures will be exposed to external sources of chlorides, such as deicing chemicals, salt, brackish water, or seawater. ACI specifies exposure category C1 where concrete is exposed to moisture, but not to external sources of chlorides (ACI 318-14, Table 19.3.1.1). ACI provides concrete design recommendations in ACI 318-14, Table 19.3.2.1, including a compressive strength of at least 2,500 psi and a maximum chloride content of 0.3 percent.

The measured value of the minimum electrical resistivity of the samples when saturated were 870 and 2,100 ohm-cm. These indicate that the samples tested were severely to moderately corrosive to ferrous metals in contact with the soil (Romanoff, 1957). Converse does not practice in the area of corrosion consulting. A qualified corrosion consultant should provide appropriate corrosion mitigation measures for any ferrous metals in contact with the site and alignment soils.

10.6 Pavement Design Recommendations

The observed R-value from the laboratory test was 14. Preliminary asphalt concrete pavement sections corresponding to Traffic Indices (TIs) ranging from 5 to 8 and an R-value of 14 are presented in the table below.

Table No. 8, Recommended Preliminary Pavement Sections

<table>
<thead>
<tr>
<th>R-value</th>
<th>Traffic Index (TI)</th>
<th>Pavement Section</th>
</tr>
</thead>
<tbody>
<tr>
<td>14</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>Asphalt Concrete (inches)</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>3.5</td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>4.0</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>5.5</td>
</tr>
</tbody>
</table>
At or near the completion of grading, subsurface samples should be tested to evaluate the actual subgrade R-value for final pavement design.

Prior to placement of aggregate base, at least the upper 12 inches of subgrade soils should be scarified, moisture-conditioned if necessary, and recompacted to at least 95 percent of the laboratory maximum dry density as defined by ASTM Standard D1557 test method.

Base materials should conform with Section 200-2.2, "Crushed Aggregate Base," of the current Standard Specifications for Public Works Construction (SSPWC; Public Works Standards, 2015) and should be placed in accordance with Section 301.2 of the SSPWC.

Asphaltic concrete materials should conform to Section 203 of the SSPWC and should be placed in accordance with Section 302.5 of the SSPWC.

11.0 GEOTECHNICAL SERVICES DURING CONSTRUCTION

The project geotechnical consultant should be present to observe conditions and test the density and moisture of the backfill during the earthwork for this project. The excavations and backfill should be observed and tested for compliance with project specifications.

12.0 CLOSURE

This report is prepared for the project described herein and is intended for use solely by San Bernardino City Unified School District and their authorized agents, to evaluate the site to identify any geohazard that might impact the proposed development of the project. Our findings and recommendations were obtained in accordance with generally accepted professional principles practiced in geotechnical engineering. We make no other warranty, either expressed or implied.

Converse Consultants is not responsible or liable for any claims or damages associated with interpretation of available information provided to others. Site exploration identifies actual soil conditions only at those points where samples are taken, when they are taken. Data derived through sampling and laboratory testing is extrapolated by Converse employees who render an opinion about the overall soil conditions. Actual conditions in areas not sampled may differ. In the event that changes to the project occur, or additional, relevant information about the project is brought to our attention, the recommendations contained in this report may not be valid unless these changes and additional relevant information are reviewed and the recommendations of this report are modified or verified in writing. In addition, the recommendations can only be finalized by observing actual subsurface conditions revealed during construction. Converse cannot be held responsible for misinterpretation or changes to our recommendations made by others during construction.
As the project evolves, continued consultation and construction monitoring by a qualified geotechnical consultant should be considered an extension of geotechnical investigation services performed to date. Additional geotechnical investigation, possibly resulting in revised recommendations, will be required for completion of the design and construction of this project. The geotechnical consultant should review plans and specifications to verify that the recommendations presented herein have been appropriately interpreted, and that the design assumptions used in this report are valid. Where significant design changes occur, Converse may be required to augment or modify the recommendations presented herein. Subsurface conditions may differ in some locations from those encountered in the explorations, and may require additional analyses and, possibly, modified recommendations.
13.0 REFERENCES

AMERICAN CONCRETE INSTITUTE (ACI), 2014, Building Code Requirements for Structural Concrete (ACI 318-14) and Commentary, dated October 2014.

BLAKE, T. F., 2000, EQFAULT, and EQSEARCH Computer Programs for Performing Probabilistic, and Seismic Coefficient Analysis and Historical Earthquake Search.

CALIFORNIA BUILDING STANDARDS COMMISSION (CBC), 2016, California Building Code (CBC).


CIVILTECH SOFTWARE, 2011, LiquefyPro: Liquefaction and Settlement Analysis Software, version 5.2E.


U.S. GEOLOGICAL SURVEY (USGS), 1901, San Bernardino, CA Historical Map, San Bernardino County, California, dated 1901, scale 1:62,500.


U.S. GEOLOGICAL SURVEY (USGS), 1980, San Bernardino South Quadrangle, California, 7.5-Minute Series, dated 2015, scale 1:24,000.


Appendix A

Field Exploration
Our field investigation included a subsurface exploration program consisting of drilling soil borings. The borings were marked at locations directed by Tim Deland from SBCUSD, who was familiar with the existing underground utilities. The borings were located in the field using approximate distances from the landmarks as a guide. The indicated boring locations should be considered accurate only to the degree implied by the method used to locate them.

Six exploratory borings (BH-01 through BH-06) were drilled on December 27, 2017 to their maximum planned depths of 21.5 and 51.5 feet bgs.

The borings were advanced using a truck-mounted drill rig equipped with 8-inch diameter hollow-stem augers for soils sampling. Encountered materials were continuously logged by a Converse geologist and classified in the field by visual classification in accordance with the Unified Soil Classification System. Where appropriate, the field descriptions and classifications have been modified to reflect laboratory test results.

Relatively undisturbed samples were obtained using California Modified Samplers (2.4 inches inside diameter and 3.0 inches outside diameter) lined with thin sample rings. The steel ring sampler was driven into the bottom of the borehole with successive drops of a 140 pound driving weight falling 30 inches. Blow counts at each sample interval are presented on the boring logs. Samples were retained in brass rings (2.4 inches inside diameter and 1.0 inch in height) and carefully sealed in waterproof plastic containers for shipment to the Converse laboratory. Bulk samples of typical soil types were also obtained.

Standard Penetration Testing (SPT) was also performed in boring BH-02 in accordance with the ASTM Standard D1586 test method at depths of 20, 30, 40, and 50 feet bgs using a standard (1.4 inches inside diameter and 2.0 inches outside diameter) split-barrel sampler. The mechanically driven hammer for the SPT sampler was 140 pounds, falling 30 inches for each blow. The recorded blow counts for every 6 inches for a total of 1.5 feet of sampler penetration are shown on the Log of Boring.

The exact depths at which material changes occur cannot always be established accurately. Unless a more precise depth can be established by other means, changes in material conditions that occur between drive samples are indicated on the logs at the top of the next drive sample.
Following the completion of logging and sampling, the borings were backfilled with soil cuttings, tamped and the surface was patched with asphalt concrete. There is a possibility that the surface may settle over time. So, if construction is delayed, we recommend the owner monitor the boring locations and backfill any depressions that might occur, or provide protection around the boring locations to prevent trip and fall injuries from occurring near the area of any potential settlement.

For a key to soil symbols and terminology used in the boring logs, refer to Drawing No. A-1, *Unified Soil Classification and Key to Boring Log Symbols*. For logs of borings, see Drawings No. A-2 through A-7, *Logs of Borings*. 
### SOIL CLASSIFICATION CHART

#### MAJOR DIVISIONS

**GRAVEL AND GRAVELLY SOILS**
- Clean Gravels (Little or No Fines)
- Gravels with Fines (Appreciable Amount of Fines)

**SAND AND SANDY SOILS**
- Clean Sands (Little or No Fines)
- Sands with Fines (Appreciable Amount of Fines)

**SILTS AND CLAYS**
- Clean Silts and Clays (Little or No Fines)
- Sands with Fines (Appreciable Amount of Fines)

**FINE GRAINED SOILS**
- Clean Silts and Clays (Little or No Fines)
- Sands with Fines (Appreciable Amount of Fines)

**HIGHLY ORGANIC SOILS**
- Peat, Humus, Swamp Soils with High Organic Contents

#### SYMBOLS

**TYPICAL DESCRIPTIONS**

- **GW** WELL-GRADING GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
- **GP** POORLY-GRADING GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
- **GM** SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
- **GC** CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
- **SW** WELL-GRADING SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
- **SP** POORLY-GRADING SANDS, GRAVELLY SAND, LITTLE OR NO FINES
- **SM** SILTY SANDS, SAND - SILT MIXTURES
- **SC** CLAYEY SANDS, SAND - CLAY MIXTURES
- **ML** INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOOSH, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
- **CL** INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
- **OL** ORGANIC SILTS AND ORGANIC Silt Clays of Low Plasticity
- **MH** INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
- **CH** INORGANIC CLAYS OF HIGH PLASTICITY
- **OH** ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
- **PT** PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

#### BORING LOG SYMBOLS

**SAMPLE TYPE**
- STANDARD PENETRATION TEST
  - CA Sampler in accordance with ASTM D-1586-84 Standard Test Method
  - CA Sampler
  - Drive Sample 2.42" I.D. sampler (CMS)
  - Drive Sample
  - Bulk Sample
  - Groundwater While Drilling
  - Groundwater After Drilling

**LABORATORY TESTING ABBREVIATIONS**

<table>
<thead>
<tr>
<th>TEST TYPE</th>
<th>STRENGTH</th>
<th>CLASSIFICATION</th>
<th>LABORATORY TESTING ABBREVIATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPT N (N)</td>
<td>p</td>
<td>Plasticity</td>
<td>Pocket Penetrometer</td>
</tr>
<tr>
<td>CA Sampler</td>
<td>Direct Shear</td>
<td>Grain Size Analysis</td>
<td>Direct Shear (Single point)</td>
</tr>
<tr>
<td>Fines (%)</td>
<td>Unconfined Compression</td>
<td>Passing No. 200 Sieve</td>
<td>Unconfined Compression</td>
</tr>
<tr>
<td>SPT (%)</td>
<td>Consolidation</td>
<td>Sand Equivalent</td>
<td>Direct Shear</td>
</tr>
<tr>
<td>&lt; 4</td>
<td>Collapse Test</td>
<td>Expansion Index</td>
<td>Unconfined Compression</td>
</tr>
<tr>
<td>4 - 11</td>
<td>Resilient (R)</td>
<td>Compaction Curve</td>
<td>Collapsing Test</td>
</tr>
<tr>
<td>11 - 30</td>
<td>Resistance (R)</td>
<td>Hydrometer</td>
<td>Chemical Analysis</td>
</tr>
<tr>
<td>31 - 50</td>
<td>Electrical Resistivity</td>
<td>Disturb</td>
<td>Electrical Conductivity</td>
</tr>
<tr>
<td>&gt; 50</td>
<td>Disturb</td>
<td>Soil Cement</td>
<td>Permeability</td>
</tr>
</tbody>
</table>

**UNIFIED SOIL CLASSIFICATION AND KEY TO BORING LOG SYMBOLS**

Parent Resource Center, Parking Structure and Police Station  
Northeast of the Intersection of North F Street and West 7th Street  
City of San Bernardino, San Bernardino County, CA  
For: San Bernardino City Unified School District  

Project No. 17-81-293-01  
Drawing No. A-1  

Converse Consultants  
B-38
**Log of Boring No. BH-01**

Dates Drilled: 12/27/2017  
Logged by: Michael Maldonado  
Checked By: Scot Mathis

Equipment: 8" HOLLOW STEM AUGER  
Driving Weight and Drop: 140 lbs / 30 in

Ground Surface Elevation (ft): 1077  
Depth to Water (ft): NOT ENCOUNTERED

<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>Graphic Log</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**SUMMARY OF SUBSURFACE CONDITIONS**

This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.

### 4.5" ASPHALT CONCRETE/8" AGGREGATE BASE

**ALLUVIUM**

**SANDY SILT (ML):** fine to coarse grained sand, scattered gravel up to 1.5" in largest dimension, brown.

<table>
<thead>
<tr>
<th>SAMPLES</th>
<th>DRIVE</th>
<th>BULK</th>
<th>BLOWS</th>
<th>MOISTURE</th>
<th>DRY UNIT WT.</th>
<th>OTHER</th>
</tr>
</thead>
<tbody>
<tr>
<td>7/10/10</td>
<td></td>
<td>15</td>
<td></td>
<td>105</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10/10/17</td>
<td></td>
<td>16</td>
<td></td>
<td>102</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7/8/9</td>
<td></td>
<td>16</td>
<td></td>
<td>94</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5/7/9</td>
<td></td>
<td>16</td>
<td></td>
<td>108</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

End of boring at 21.5 feet bgs.  
No groundwater encountered.  
Borehole backfilled with soil cuttings, tamped and surface patched with cold asphalt concrete on 12/27/2017.

**Converse Consultants**

Parent Resource Center, Parking Structure and Police Station  
Northeast of the Intersection of North F Street and West 7th Street  
City of San Bernardino, San Bernardino County, CA  
For: San Bernardino City Unified School District  

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**Graph**: Depth (ft) vs. Graphic Log

**Log of Boring No. BH-01**

Project No. 17-81-293-01  
Drawing No. A-2  

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B-39
**SUMMARY OF SUBSURFACE CONDITIONS**

This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.

### 3.5" ASPHALT CONCRETE/3" AGGREGATE BASE

**ALLUVIUM**

**SANDY SILT (ML):** fine to medium-grained sand, few gravel up to 1" in largest dimension, grayish brown.

<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>Graphic Log</th>
<th>SAMPLES</th>
<th>DRIVE</th>
<th>BULK</th>
<th>BLOWS</th>
<th>MOISTURE</th>
<th>DRY UNIT WT. (pcf)</th>
<th>OTHER</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td></td>
<td></td>
<td>4/7/8</td>
<td>20</td>
<td>101</td>
<td></td>
<td></td>
<td>ei, ca, er, ma</td>
</tr>
<tr>
<td>15</td>
<td></td>
<td></td>
<td>6/7/7</td>
<td>15</td>
<td>107</td>
<td></td>
<td></td>
<td>ds</td>
</tr>
</tbody>
</table>

**SAND (SP):** fine to medium-grained, brown with some orange staining.

- scattered gravel up to 1" in largest dimension

<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>Graphic Log</th>
<th>SAMPLES</th>
<th>DRIVE</th>
<th>BULK</th>
<th>BLOWS</th>
<th>MOISTURE</th>
<th>DRY UNIT WT. (pcf)</th>
<th>OTHER</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td></td>
<td></td>
<td>10/14/14</td>
<td>2</td>
<td>100</td>
<td></td>
<td></td>
<td>col</td>
</tr>
<tr>
<td>25</td>
<td></td>
<td></td>
<td>20/21/26</td>
<td>4</td>
<td>108</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>30</td>
<td></td>
<td></td>
<td>7/8/11</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>35</td>
<td></td>
<td></td>
<td>8/22/29</td>
<td>2</td>
<td>106</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>40</td>
<td></td>
<td></td>
<td>10/13/21</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**SILTY SAND (SM):** fine to coarse-grained, brown.

---

Converse Consultants

Parent Resource Center, Parking Structure and Police Station
Northeast of the Intersection of North F Street and West 7th Street
City of San Bernardino, San Bernardino County, CA
For: San Bernardino City Unified School District

Project No. 17-81-293-01
Drawing No. A-3a
**Log of Boring No. BH-02**

Dates Drilled: 12/27/2017  
Logged by: Michael Maldonado  
Checked By: Scot Mathis

Equipment: 8" HOLLOW STEM AUGER  
Driving Weight and Drop: 140 lbs / 30 in

Ground Surface Elevation (ft): 1075  
Depth to Water (ft): NOT ENCOUNTERED

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**SUMMARY OF SUBSURFACE CONDITIONS**

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<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>Graphic Log</th>
<th>SAMPLES</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>DRIVE</td>
</tr>
<tr>
<td>1075</td>
<td>8</td>
<td>17/50-5&quot;</td>
</tr>
<tr>
<td>111</td>
<td>8</td>
<td>31/50-6&quot;</td>
</tr>
</tbody>
</table>

**ALLUVIUM SAND (SP):** fine to medium-grained, scattered gravel up to 1.5" in largest dimension, trace silt, brown.

End of boring at 51.5 feet bgs.  
No groundwater encountered.  
Borehole backfilled with soil cuttings, tamped and surface patched with cold asphalt concrete on 12/27/2017.

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**Parent Resource Center, Parking Structure and Police Station**
Northeast of the Intersection of North F Street and West 7th Street  
City of San Bernardino, San Bernardino County, CA  
For: San Bernardino City Unified School District

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Converse Consultants

Project No. 17-81-293-01  
Drawing No. A-3b
SUMMARY OF SUBSURFACE CONDITIONS

This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.

4" ASPHALT CONCRETE/8" AGGREGATE BASE

ALLUVIUM
SANDY SILT (ML): fine to coarse-grained sand, scattered gravel up to 1" in largest dimension, trace clay, brown.

SILTY SAND (SM): fine-grained, brown.

SANDY CLAY (CL): fine to coarse-grained sand, dark brown.

End of boring at 21.5 feet bgs.
No groundwater encountered.
Borehole backfilled with soil cuttings, tamped and surface patched with cold asphalt concrete on 12/27/2017.
End of boring at 21.5 feet bgs.
No groundwater encountered.
Borehole backfilled with soil cuttings, tamped and surface patched with cold asphalt concrete on 12/27/2017.
### Log of Boring No. BH-05

**Dates Drilled:** 12/27/2017  
**Logged by:** Michael Maldonado  
**Checked By:** Scot Mathis  
**Equipment:** 8" HOLLOW STEM AUGER  
**Driving Weight and Drop:** 140 lbs / 30 in  
**Ground Surface Elevation (ft):** 1076  
**Depth to Water (ft):** NOT ENCOUNTERED

#### SUMMARY OF SUBSURFACE CONDITIONS

This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.

<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>Graphic Log</th>
<th>Drive</th>
<th>Blows</th>
<th>Moisture</th>
<th>Dry Unit Wt. (pcf)</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>4/8/12</td>
<td>14</td>
<td>105</td>
<td></td>
<td>ds</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>ca, er, max</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>8/12/15</td>
<td>16</td>
<td>110</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
<td>6/8/8</td>
<td>11</td>
<td>104</td>
<td></td>
<td>col</td>
</tr>
<tr>
<td>7</td>
<td></td>
<td>7/7/10</td>
<td>9</td>
<td>115</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
<td>7/10/11</td>
<td>7</td>
<td>111</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**ALLUVIUM**
- Sandy Silt (ML): fine to coarse-grained sand, scattered gravel up to 2" in largest dimension, grayish brown.

**Silty Sand (SM):** fine to medium-grained, brown.

End of boring at 21.5 feet bgs.  
No groundwater encountered.  
Borehole backfilled with soil cuttings, tamped and surface patched with cold asphalt concrete on 12/27/2017.
### Log of Boring No. BH-06

**Dates Drilled:** 12/27/2017  
**Logged by:** Michael Maldonado  
**Checked By:** Scot Mathis  
**Equipment:** 8" HOLLOW STEM AUGER  
**Driving Weight and Drop:** 140 lbs / 30 in  
**Ground Surface Elevation (ft):** 1079  
**Depth to Water (ft):** NOT ENCOUNTERED

**Summary of Subsurface Conditions**

This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.

### 4" ASPHALT CONCRETE/7" AGGREGATE BASE

**Alluvium Sandy Clay (CL):** fine to coarse-grained sand, dark brown.

<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>Graphic Log</th>
<th>Samples</th>
<th>Drive</th>
<th>Bulk</th>
<th>Blows</th>
<th>Moisture</th>
<th>Dry Unit Wt</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-5</td>
<td></td>
<td>2/3/4</td>
<td>29</td>
<td>88</td>
<td></td>
<td></td>
<td></td>
<td>ei, ma</td>
</tr>
<tr>
<td>5-10</td>
<td></td>
<td>4/5/9</td>
<td>27</td>
<td>93</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10-15</td>
<td></td>
<td>4/5/6</td>
<td>29</td>
<td>91</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15-20</td>
<td></td>
<td>5/8/12</td>
<td>22</td>
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</tr>
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<td>11/11/12</td>
<td>20</td>
<td>103</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**End of boring at 21.5 feet bgs.**  
No groundwater encountered.  
Borehole backfilled with soil cuttings, tamped and surface patched with cold asphalt concrete on 12/27/2017.
Appendix B

Laboratory Testing Program
APPENDIX B

LABORATORY TESTING PROGRAM

Tests were conducted in our laboratory on representative soil samples for the purpose of classification and evaluation of their physical properties and engineering characteristics. The amount and selection of tests were based on the geotechnical parameters required for this project. Test results are presented herein and on the Logs of Borings, in Appendix A, Field Exploration. The following is a summary of the various laboratory tests conducted for this project.

**In-Situ Moisture Content and Dry Density**

Results of these tests performed on relatively undisturbed ring samples were used to aid in the classification and to provide quantitative measure of the in situ dry density and moisture content. Data obtained from this test provides qualitative information on strength and compressibility characteristics of the site soils. For test results, see the Logs of Borings in Appendix A, Field Exploration.

**Expansion Index Tests**

Three representative bulk samples were tested to evaluate the expansion potential. The test was conducted in accordance with ASTM Standard D4829. The test result is presented in the following table.

<table>
<thead>
<tr>
<th>Boring No.</th>
<th>Depth (feet)</th>
<th>Soil Description</th>
<th>Expansion Index</th>
<th>Expansion Potential</th>
</tr>
</thead>
<tbody>
<tr>
<td>BH-02</td>
<td>0-5</td>
<td>Sandy Silt (ML)</td>
<td>10</td>
<td>Very Low</td>
</tr>
<tr>
<td>BH-04</td>
<td>0-5</td>
<td>Sandy Silt (ML)</td>
<td>25</td>
<td>Very Low</td>
</tr>
<tr>
<td>BH-06</td>
<td>5-10</td>
<td>Sandy Clay (CL)</td>
<td>55</td>
<td>Medium</td>
</tr>
</tbody>
</table>

**R-value**

One representative bulk soil sample was tested for resistance value (R-value) in accordance with California Test Method CT301. The test is designed to provide a relative measure of soil strength for use in pavement design. The test result is shown in the following table.
Table No. B-2, R-Value Test Result

<table>
<thead>
<tr>
<th>Boring No.</th>
<th>Depth (feet)</th>
<th>Soil Classification</th>
<th>Measured R-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>BH-03</td>
<td>0-5</td>
<td>Sandy Silt (ML)</td>
<td>14</td>
</tr>
</tbody>
</table>

Soil Corrosivity Tests

Two representative soil samples were tested to determine minimum electrical resistivity, pH, and chemical content, including soluble sulfate and chloride concentrations. The purpose of the tests was to determine the corrosion potential of site soils when placed in contact with common construction materials. The tests were performed by EG Labs in accordance with Caltrans Test Methods 643, 422 and 417. Test results are presented in the following table.

Table No. B-3, Summary of Soil Corrosivity Test Results

<table>
<thead>
<tr>
<th>Boring No.</th>
<th>Depth (feet)</th>
<th>pH</th>
<th>Soluble Sulfates (CA 417) (% by weight)</th>
<th>Soluble Chlorides (CA 422) (ppm)</th>
<th>Min. Resistivity (CA 643) (Ohm-cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BH-02</td>
<td>0-5</td>
<td>7.79</td>
<td>0.058</td>
<td>160</td>
<td>870</td>
</tr>
<tr>
<td>BH-05</td>
<td>5-10</td>
<td>8.25</td>
<td>0.002</td>
<td>135</td>
<td>2,100</td>
</tr>
</tbody>
</table>

Collapse Tests

To evaluate the moisture sensitivity (collapse/swell potential) of the encountered soils, three collapse tests were performed in accordance with the ASTM Standard D5333 laboratory procedure. The samples were loaded to approximately 2 kips per square foot (ksf), allowed to stabilize under load, and then submerged. The test results are presented in the following table.

Table No. B-4, Collapse Test Results

<table>
<thead>
<tr>
<th>Boring No.</th>
<th>Depth (feet)</th>
<th>Soil Classification</th>
<th>Percent Swell + Percent Collapse -</th>
<th>Collapse Potential</th>
</tr>
</thead>
<tbody>
<tr>
<td>BH-02</td>
<td>10.0-11.5</td>
<td>Sand (SP)</td>
<td>-1.0</td>
<td>Slight</td>
</tr>
<tr>
<td>BH-04</td>
<td>5.0-6.5</td>
<td>Sandy Silt (ML)</td>
<td>-0.4</td>
<td>Slight</td>
</tr>
<tr>
<td>BH-05</td>
<td>10.0-11.5</td>
<td>Silty Sand (SM)</td>
<td>-1.7</td>
<td>Slight</td>
</tr>
</tbody>
</table>
Grain-Size Analyses

To assist in classification of soils, mechanical grain-size analyses were performed on three select samples in accordance with the ASTM Standard D422 test method. Grain-size curves are shown in Drawing No. B-1, *Grain Size Distribution Results*.

Maximum Density and Optimum Moisture Content Tests

Laboratory maximum dry density-optimum moisture content relationship test was performed on two representative bulk soil samples. These tests were conducted in accordance with the ASTM Standard D1557 test method. The test results are presented in Drawing No. B-2, *Moisture-Density Relationship Results*, and are summarized in the following table.

**Table No B-5, Summary of Moisture-Density Relationship Results**

<table>
<thead>
<tr>
<th>Boring No.</th>
<th>Depth (feet)</th>
<th>Soil Description</th>
<th>Optimum Moisture (%)</th>
<th>Maximum Density (lb/ft³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BH-03</td>
<td>0-5</td>
<td>Sandy Silt (ML), Brown</td>
<td>12.1</td>
<td>124.0</td>
</tr>
<tr>
<td>BH-05</td>
<td>5-10</td>
<td>Sandy Silt (ML), Grayish Brown</td>
<td>12.5</td>
<td>122.0</td>
</tr>
</tbody>
</table>

Direct Shear Tests

Two direct shear tests were performed on relatively undisturbed samples under soaked moisture condition in accordance with ASTM D3080. For each test, three samples contained in brass sampler rings were placed, one at a time, directly into the test apparatus and subjected to a range of normal loads appropriate for the anticipated conditions. The samples were then sheared at a constant strain rate of 0.001 inch/minute. Shear deformation was recorded until a maximum of about 0.25-inch shear displacement was achieved. Ultimate strength was selected from the shear-stress deformation data and plotted to determine the shear strength parameters. For test data, including sample density and moisture content, see Drawings No. B-3 and B-4, *Direct Shear Test Results*, and the following table.

**Table No. B-6, Summary of Direct Shear Test Results**

<table>
<thead>
<tr>
<th>Boring No.</th>
<th>Depth (feet)</th>
<th>Soil Description</th>
<th>Friction Angle (degrees)</th>
<th>Cohesion (psf)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BH-02</td>
<td>5.0-6.5</td>
<td>Sandy Silt (ML)</td>
<td>26</td>
<td>290</td>
</tr>
<tr>
<td>BH-05</td>
<td>5.0-6.5</td>
<td>Sandy Silt (ML)</td>
<td>26</td>
<td>390</td>
</tr>
</tbody>
</table>
Sample Storage

Soil samples presently stored in our laboratory will be discarded 30 days after the date of this report, unless this office receives a specific request to retain the samples for a longer period.
# GRAIN SIZE DISTRIBUTION RESULTS

Parent Resource Center, Parking Structure and Police Station  
Northeast of the Intersection of North F Street and West 7th Street  
City of San Bernardino, San Bernardino County, CA  
For: San Bernardino City Unified School District

## Converse Consultants

**Project No.** 17-81-293-01  
**Drawing No.** B-1

---

### GRAIN SIZE IN MILLIMETERS

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<table>
<thead>
<tr>
<th>COBBLES</th>
<th>GRAVEL</th>
<th>SAND</th>
<th>SILT OR CLAY</th>
</tr>
</thead>
<tbody>
<tr>
<td>coarse</td>
<td>fine</td>
<td>coarse</td>
<td>medium</td>
</tr>
</tbody>
</table>

### U.S. SIEVE OPENING IN INCHES

<table>
<thead>
<tr>
<th>U.S. SIEVE NUMBERS</th>
<th>6</th>
<th>4</th>
<th>3</th>
<th>2</th>
<th>1</th>
<th>1 1/2</th>
<th>3/4</th>
<th>1</th>
<th>1/2</th>
<th>3</th>
<th>4</th>
<th>6</th>
<th>8</th>
<th>10</th>
<th>16</th>
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<th>30</th>
<th>40</th>
<th>50</th>
<th>60</th>
<th>100</th>
<th>140</th>
<th>200</th>
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<tbody>
<tr>
<td>HYDROMETER</td>
<td>0.01</td>
<td>0.001</td>
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</tbody>
</table>

### Description

<table>
<thead>
<tr>
<th>Boring No.</th>
<th>Depth (ft)</th>
<th>Description</th>
<th>LL</th>
<th>PL</th>
<th>PI</th>
<th>Cc</th>
<th>Cu</th>
</tr>
</thead>
<tbody>
<tr>
<td>BH-02</td>
<td>0.5-5</td>
<td>SANDY SILT (ML), FEW GRAVEL</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BH-03</td>
<td>1-5</td>
<td>SANDY SILT (ML)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BH-06</td>
<td>5-10</td>
<td>SANDY CLAY (CL)</td>
<td></td>
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<td></td>
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### U.S. SIEVE NUMBERS

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<th>5/8</th>
<th>3/4</th>
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<th>40</th>
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<th>60</th>
<th>100</th>
<th>140</th>
<th>200</th>
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</thead>
<tbody>
<tr>
<td>Depth (ft)</td>
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<tr>
<td>BH-02</td>
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<tr>
<td>BH-03</td>
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<td></td>
</tr>
<tr>
<td>BH-06</td>
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<td></td>
</tr>
</tbody>
</table>

### GRAIN SIZE DISTRIBUTION RESULTS

<table>
<thead>
<tr>
<th>Boring No.</th>
<th>Depth (ft)</th>
<th>D100</th>
<th>D60</th>
<th>D30</th>
<th>D10</th>
<th>%Gravel</th>
<th>%Sand</th>
<th>%Silt</th>
<th>%Clay</th>
</tr>
</thead>
<tbody>
<tr>
<td>BH-02</td>
<td>0.5-5</td>
<td>12.5</td>
<td></td>
<td></td>
<td></td>
<td>7.2</td>
<td>29.4</td>
<td></td>
<td>63.4</td>
</tr>
<tr>
<td>BH-03</td>
<td>1-5</td>
<td>9.5</td>
<td></td>
<td></td>
<td></td>
<td>2.4</td>
<td>27.6</td>
<td></td>
<td>70.0</td>
</tr>
<tr>
<td>BH-06</td>
<td>5-10</td>
<td>9.5</td>
<td></td>
<td></td>
<td></td>
<td>0.9</td>
<td>25.3</td>
<td></td>
<td>73.8</td>
</tr>
</tbody>
</table>

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Parent Resource Center, Parking Structure and Police Station  
Northeast of the Intersection of North F Street and West 7th Street  
City of San Bernardino, San Bernardino County, CA  
For: San Bernardino City Unified School District

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Converse Consultants

Project ID: 17-81-293-01.GPJ; Template: GRAIN SIZE
Curves of 100% Saturation for Specific Gravity Equal to:

- 2.80
- 2.70
- 2.60

<table>
<thead>
<tr>
<th>SYMBOL</th>
<th>BORING NO.</th>
<th>DEPTH (ft)</th>
<th>DESCRIPTION</th>
<th>ASTM TEST METHOD</th>
<th>OPTIMUM WATER, %</th>
<th>MAXIMUM DRY DENSITY, pcf</th>
</tr>
</thead>
<tbody>
<tr>
<td>●</td>
<td>BH-03</td>
<td>1-5</td>
<td>SANDY SILT (ML), BROWN</td>
<td>D1557- B</td>
<td>12.1</td>
<td>124.0</td>
</tr>
<tr>
<td>X</td>
<td>BH-05</td>
<td>5-10</td>
<td>SANDY SILT (ML), GRAYISH BROWN</td>
<td>D1557- B</td>
<td>12.5</td>
<td>122.0</td>
</tr>
</tbody>
</table>

Parent Resource Center, Parking Structure and Police Station
Northeast of the Intersection of North F Street and West 7th Street
City of San Bernardino, San Bernardino County, CA
For: San Bernardino City Unified School District
DIRECT SHEAR TEST RESULTS

Parent Resource Center, Parking Structure and Police Station
Northeast of the Intersection of North F Street and West 7th Street
City of San Bernardino, San Bernardino County, CA
For: San Bernardino City Unified School District

NOTE: Ultimate Strength.

<table>
<thead>
<tr>
<th>BORING NO.</th>
<th>DESCRIPTION</th>
<th>DEPTH (ft)</th>
<th>COHESION (psf)</th>
<th>FRICTION ANGLE (degrees)</th>
<th>MOISTURE CONTENT (%)</th>
<th>DRY DENSITY (pcf)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BH-02</td>
<td>SANDY SILT (ML)</td>
<td>5.0-6.5</td>
<td>290</td>
<td>26</td>
<td>14.7</td>
<td>108.8</td>
</tr>
</tbody>
</table>

Converse Consultants
Project No. 17-81-293-01
Drawing No. B-3

Project ID: 17-81-293-01.GPJ; Template: DIRECT SHEAR
Boring No.: BH-05  

Description: Sandy Silt (ML)  

Depth (ft): 5.0-6.5  

Cohesion (psf): 390  

Fricition Angle (degrees): 26  

Moisture Content (%): 13.7  

Dry Density (pcf): 111.3

**NOTE:** Ultimate Strength.

---

**DIRECT SHEAR TEST RESULTS**

Converse Consultants  
Parent Resource Center, Parking Structure and Police Station  
Northeast of the Intersection of North F Street and West 7th Street  
City of San Bernardino, San Bernardino County, CA  
For: San Bernardino City Unified School District  

Project No.: 17-81-293-01  
Drawing No.: B-4

---

Project ID: 17-81-293-01.GPJ; Template: DIRECT SHEAR
Appendix C

Seismic Settlement Analysis
APPENDIX C

SEISMIC SETTLEMENT ANALYSIS

The subsurface data obtained from the boring BH-02 drilled during the field investigation were used to evaluate the dynamic settlement due to potential densification of relatively loose sediments subjected to ground shaking during earthquakes.

The dynamic analysis was performed using Liquefy Pro (Civiltech, 2012). An earthquake magnitude of M6.7 and a peak ground acceleration (PGA) of 0.834g, where g is the acceleration due to gravity, were selected for this analysis. The PGA was based on the CBC seismic design parameters presented in Section 7.2, CBC Seismic Design Parameters. Analysis considering current groundwater condition was performed for the boring.

The result of our analyses is presented on Plates C-1 and C-2 and summarized in the following table.

Table C-1, Estimated Seismic Settlements

<table>
<thead>
<tr>
<th>Location</th>
<th>Boring Depth (feet)</th>
<th>Groundwater Depth (feet)</th>
<th>Dynamic Settlement (inches)</th>
<th>Differential Dynamic Settlement (inch/40 linear feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BH-02</td>
<td>51.5</td>
<td>&gt; 51.5 (Current)</td>
<td>2.17</td>
<td>1.1</td>
</tr>
<tr>
<td>BH-02</td>
<td>51.5</td>
<td>0 (Historical)</td>
<td>0.51</td>
<td>0.3</td>
</tr>
</tbody>
</table>

Based on our analysis, the project site has the potential for up to 2.2 inches of seismic settlement. The differential settlement resulting from dynamic loads is anticipated to be up to 1.1 inches over a horizontal distance of 40 feet.