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REPORT OF LIMITED GEOTECHNICAL STUDY PROPOSED 800 MEGAHERTZ ANTENNA PROJECT FOR THE SAN BERNARDINO COUNTY CRIMINAL COURTS FACILITY 8303 HAVEN AVENUE CITY OF RANCHO CUCAMONGA SAN BERNARDINO COUNTY, CALIFORNIA

PROJECT NO.: 215-AR15
REPORT NO.: 1

JUNE 23, 2015

SUBMITTED TO:

COUNTY OF SAN BERNARDINO
ARCHITECTURE AND ENGINEERING DEPARTMENT
385 N. ARROWHEAD AVENUE
SAN BERNARDINO, CA 92415

PREPARED BY:

HILLTOP GEOTECHNICAL, INC.
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HILLTOP GEOTECHNICAL
INCORPORATED

June 23, 2015

County of San Bernardino
Architecture and Engineering Department
385 North Arrowhead Avenue, Third Floor
San Bernardino, CA 92415-0184

Project No.: 215-AR15
Report No.: 1

Attention: Mr. Paul DeArmond
Project Manager

Subject: **Report of Limited Geotechnical Study, Proposed 800 Megahertz Antenna Project for the San Bernardino County Criminal Courts Facility, 8303 Haven Avenue, City of Rancho Cucamonga, San Bernardino County, California.**

Reference:
1. **Harmish, Morgan, & Causey, Inc.**, August 15, 1983 with Revisions on 12-16-83 and 1-31-84, *Site Plan*, Not to Scale, Job Number: 4261009, Dwg. No. 2.
2. Technical References - See Appendix 'B.'

Gentlemen:

According to your request, we have completed a limited geotechnical study for the design of the proposed mono pole antenna for the existing San Bernardino County Criminal Courts facility located at 8303 Haven Avenue in the City of Rancho Cucamonga, San Bernardino County, California. We are presenting, herein, our findings and recommendations.

The findings of this study indicate that the project site is suitable for the proposed development provided the recommendations presented in the attached report are complied with and incorporated into the design and construction of the project.

Copies of this report should be forwarded to the other consultants for the project (i.e., Civil Engineer, Architect, Structural Engineer, etc.) as needed to implement the recommendations presented. The required number of the original, wet ink signed reports should be saved for submittal, along with the other required documentation to the appropriate agency having jurisdiction over the project for permitting purposes.

If you have any questions after reviewing the findings and recommendations contained in the attached report, please do not hesitate to contact this office. This opportunity to be of professional service is sincerely appreciated.

Respectfully submitted,
HILLTOP GEOTECHNICAL, INC.

REGISTERED DONALD ... No. GE254 Exp: 3/31/17 GEOTECHNICAL STATE OF CALIFORNIA

Mark Hulett, CEG No. 1623
President

Donald L. Curran, GE No. 254
Senior Engineer
Date Signed: 6-23-15

AH/MH/DLC/ah

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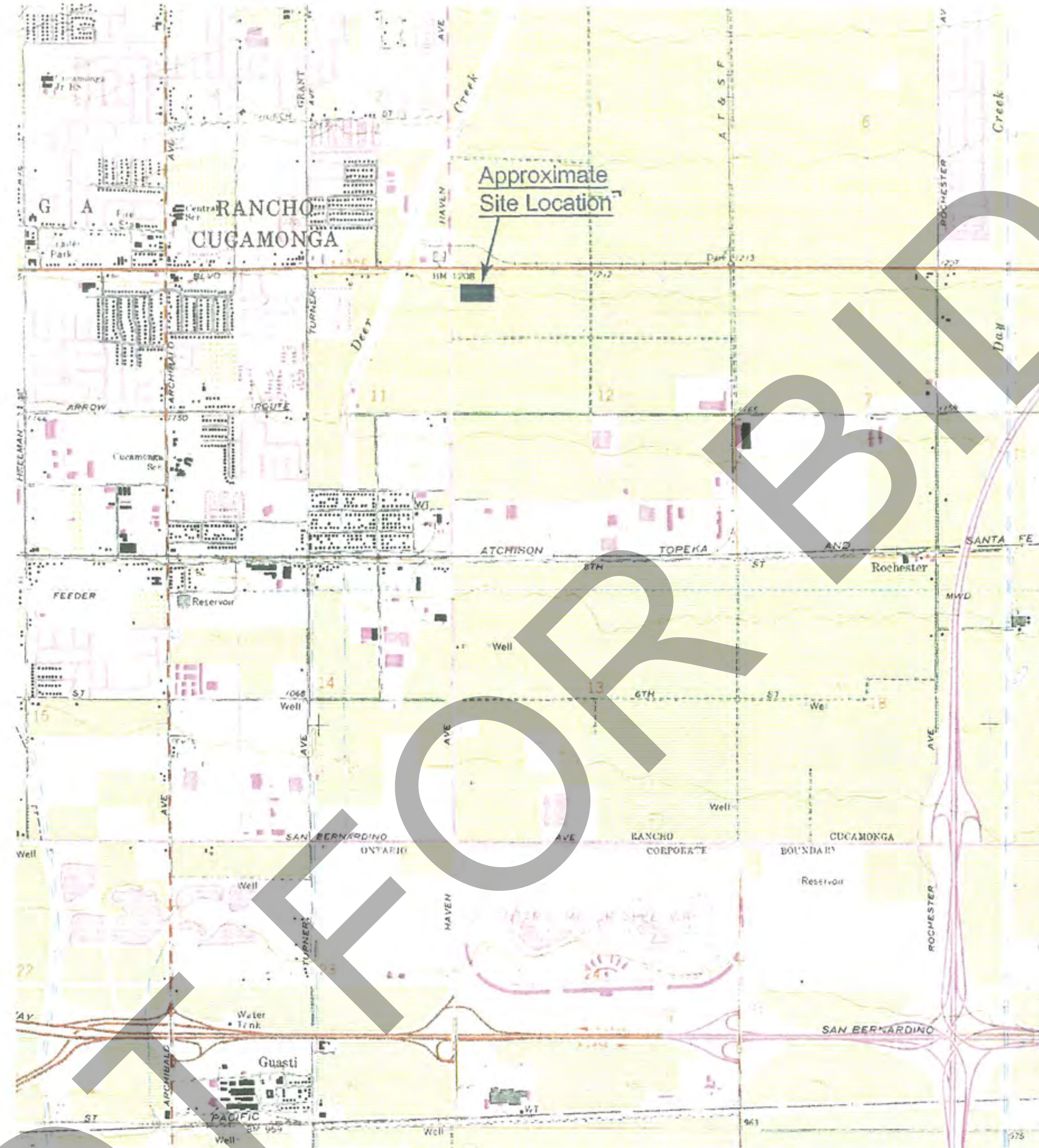
INTRODUCTION

AUTHORIZATION

This report presents results of the limited geotechnical study conducted for the proposed 800 megahertz antenna project on the subject site of the existing San Bernardino County Criminal Courts facility located at 8303 Haven Avenue, in the City of Rancho Cucamonga, San Bernardino County, California. The general location of the subject site is indicated on the 'Site Location Map,' Figure No. 1.

Authorization to perform this study was in the form of a proposal from **Hilltop Geotechnical, Inc. (HGI)** (Geotechnical / Geologic Consultant) to the **County of San Bernardino Architecture and Engineering Department** (Client), dated April 14, 2015, Proposal Number: P15055 and a P.O. No. 15-134, dated April16, 2015, received via E-Mail from Mr. Paul DeArmond on April 17, 2015.



0 0.5 1.0

Approximate Scale in Miles

N

Reference: **United States Department of the Interior, Geologic Survey**, 1966, Photorevised 1981, Guasti Quadrangle, California, 7.5 Minute Topographic Series, Scale 1:24,000.

HILLTOP GEOTECHNICAL INCORPORATED	SITE LOCATION MAP	
	By: AH	Date: 6/2015
	Project No.: 215-AR15.1	Figure No.: 1

PURPOSE AND SCOPE OF STUDY

The scope of work performed for this study was designed to determine and evaluate the surface and subsurface conditions in the vicinity of the proposed structure on the subject site with respect to geotechnical characteristics, including potential geologic hazards that may effect the development of the site, and to provide geotechnical recommendations and criteria for use in the design and construction of the proposed development. The scope of work included the following:

- Review of locally and easily available published and unpublished soil, geologic, and seismologic reports and data for the area (see References in Appendix 'B'), flood hazard maps, well data, etc. to ascertain earth material, geologic, and hydrologic conditions of the area.
- Telephone conversations with the client and/or representatives of the client.
- Site reconnaissance.
- Subsurface exploration by means of a boring excavation to characterize the existing earth materials, geologic, and groundwater conditions that could influence the proposed development.
- Sampling of on-site earth materials from the exploratory excavation.
- Laboratory testing of selected earth material samples considered representative of the subsurface conditions to determine the engineering properties and characteristics.
- Define the general geology of the subject site and evaluate potential geologic hazards which would have an effect on the proposed site development.
- Determine seismic classification of the site to meet the requirements of the 2013 California Building Code (CBC), effective on January 1, 2014.
- Engineering and geologic analysis of field and laboratory data to provide a basis for geotechnical conclusions and recommendations regarding foundation design parameters.

- Preparation of this report to present the geotechnical and geologic conclusions and recommendations for the proposed site development.

This report presents our conclusions and/or recommendations regarding:

- The geologic setting of the site.
- Potential geologic hazards (including landslides, seismicity, faulting, liquefaction potential, etc.)
- General subsurface earth conditions.
- Groundwater conditions within the depth of our subsurface study.
- Excavation characteristics of the on-site earth materials.
- Characteristics and compaction requirements of proposed fill and backfill materials.
- Recommendations and guide specifications for earthwork.
- Seismic design coefficients for structural design purposes.
- Types and depths of foundations.
- Allowable bearing pressure and lateral resistance for foundations.
- Estimated total and differential settlements.
- Preliminary corrosion potential evaluation for concrete in direct contact with the on-site earth materials.
- Utility trench excavation and backfill recommendations.

The scope of work performed for this report did not include any testing of earth materials or groundwater for environmental purposes, an environmental assessment of the property, or opinions relating to the possibility of surface or subsurface contamination by hazardous or toxic substances.

This study was prepared for the exclusive use of the **County of San Bernardino, Architecture and Engineering Department** and their consultants for specific application to the development of the proposed project in accordance with generally accepted standards of the geotechnical and geologic professions and generally accepted geotechnical (soil and foundation) engineering and geologic principles and practices at the time this report was prepared. Other warranties, implied or expressed, are not made. Although reasonable effort has been made to obtain information regarding geotechnical / geologic and subsurface conditions of the site, limitations exist with respect to knowledge of unknown regional or localized off-site conditions which may have an impact at the site. The conclusions and recommendations presented in this report are valid as of the date of this report. However, changes in conditions of a property can occur with passage of time, whether they are due to natural processes or to works of man on this and/or adjacent properties.

If conditions are observed or information becomes available during the design and construction process which are not reflected in this report, **HGI**, as Geotechnical / Geologic Consultant of record for the project, should be notified so that supplemental evaluations can be performed and conclusions and recommendations presented in this report can be verified or modified in writing, as necessary. Changes in applicable or appropriate standards of care in the geologic / geotechnical professions occur, whether they result from legislation or the broadening of knowledge and experience. Accordingly, the conclusions and recommendations presented in this report may be invalidated, wholly or in part, by changes outside the influence of the project Geotechnical / Geologic Consultant which occur in the future.

PREVIOUS SITE STUDIES

No previous geotechnical and/or geological studies for the subject site are known to have been performed or were made available for review at the time of this study, if any had been performed.

PROJECT DESCRIPTION / PROPOSED DEVELOPMENT

As part of our study, we have discussed the project with Mr. Paul DeArmond of the **County of San Bernardino, Architecture and Engineering Department**, the client. Additionally, we have also discussed the project with Mr. Rick Britt of the County of San Bernardino, Information Services Department.

Based on information presented to this firm, it is our understanding that the proposed project will consist of the addition of a 800 megahertz, mono-pole antenna and a new, pre-cast concrete structure for the existing facility. It is understood that the new structure will be 20 feet by 30 feet in plan dimension with a concrete cast-on-grade floor slab. Finish pad grade and structural loading for the proposed structure are unknown at this time. It is assumed that the antenna structure will be approximately 80 feet in height and will be supported on a cast-in-drilled-hole (CIDH) foundation adjacent to the proposed new structure. No structural loads were available for the antenna at the time of this report. No significant grading is anticipated for the development of the site in the area of the proposed antenna and structure.

The above project description and assumptions were used as the basis for the field exploration, laboratory testing program, the engineering analysis, and the conclusions and recommendations presented in this report. **HGI** should be notified if structures, foundation loads, grading, and/or details other than those represented herein are proposed for final development of the site so a review can be performed, a supplemental evaluation made, and revised recommendations submitted, if required.

FIELD EXPLORATION AND LABORATORY TESTING

The field study performed for this report included a visual reconnaissance of existing surface conditions of the subject site and surrounding area. A study of the property's subsurface condition was performed to evaluate underlying earth strata and the presence of groundwater. Surface and subsurface conditions were explored on May 15, 2015.

The subsurface exploration consisted of excavating one (1) exploratory boring in the area of the proposed structures on the subject property. The approximate location of the exploratory excavation is shown on the 'Exploratory Excavation Location Plan,' Plate No. 1, presented in Appendix 'A' of this report. The exploratory excavation was observed and logged by a representative of **HGI**. Earth materials encountered in the exploratory excavation were visually described in the field in general accordance with the current Unified Soils Classification System (USCS), ASTM D2488, visual-manual procedures, as illustrated on the attached, simplified 'Subsurface Exploration Legend,' Plate No. 2, presented in Appendix 'A' of this report. The results are presented on the 'Subsurface Exploration Log,' Plate Nos. 3a through 3c, presented in Appendix 'A' of this report. A more detailed explanation of the field study which was performed for this report is presented in Appendix 'A' of this report.

Representative bulk samples of on-site earth materials were collected during the field exploration and returned to the laboratory for testing. Laboratory tests were conducted to evaluate the index and engineering properties of the on-site earth materials and included in-situ moisture content and dry density tests, a soluble sulfate test, a sieve analysis test, metallic corrosion evaluation tests (i.e., pH, soluble chloride, sulfide, and minimum electrical resistance), and a maximum dry density / optimum moisture content relationship test. A more detailed explanation of laboratory tests performed for this study is presented in Appendix 'A' of this report. The test results are presented in Appendix 'A,' Plate Nos. 4 through 6.

FINDINGS

SITE DESCRIPTION

The subject project is located on the northeast portion of the San Bernardino County Criminal Courts facility located at 8303 Haven Avenue in the City of Rancho Cucamonga, San Bernardino County, California. The subject property is located in the northeast one-quarter of the northwest one-quarter of Section 12, T1S, R7W of the San Bernardino Principle Meridian at Latitude: 34.1047° North, Longitude: 117.5726° West.

The subject property is bounded by an existing street that circles the criminal courts building to the north and the east. Southwest of the proposed antenna and building site is the existing criminal courts building. To the south and west of the proposed project site were existing landscaped areas with various trees and plant life with sidewalks and subsurface drains.

The immediate area of the subject site was almost flat with a shallow, downward inclination toward the south. Total on-site relief in the areas of the proposed structures was approximately 2.0 feet. Drainage on and around the subject site was accomplished via subdrains, curbs, and gutters.

At the time the field exploration was performed for this study, the surface of the site in the area of the proposed building and antenna structure was landscaped. Pavers and/or stepping stones leading from the landscaped area to the building were observed. Miscellaneous subdrains and gravel was placed around the trees closest to the street surrounding the building. A sidewalk divided the landscaped area from the trees and gravel area. Behind the sidewalks, drains, and trees were various plants and shrubs. The sidewalk ran in a north-south direction west of the proposed antenna and building site.

At the time of the field study performed for this geotechnical / geologic study, utilities consisted of street lights, sprinklers, and subdrains. Although utilities were not observed in the general area where the boring was excavated, utilities consisting of electric, telephone, gas, sewer, water, as well as other unknown underground lines may be present on and adjacent to the site.

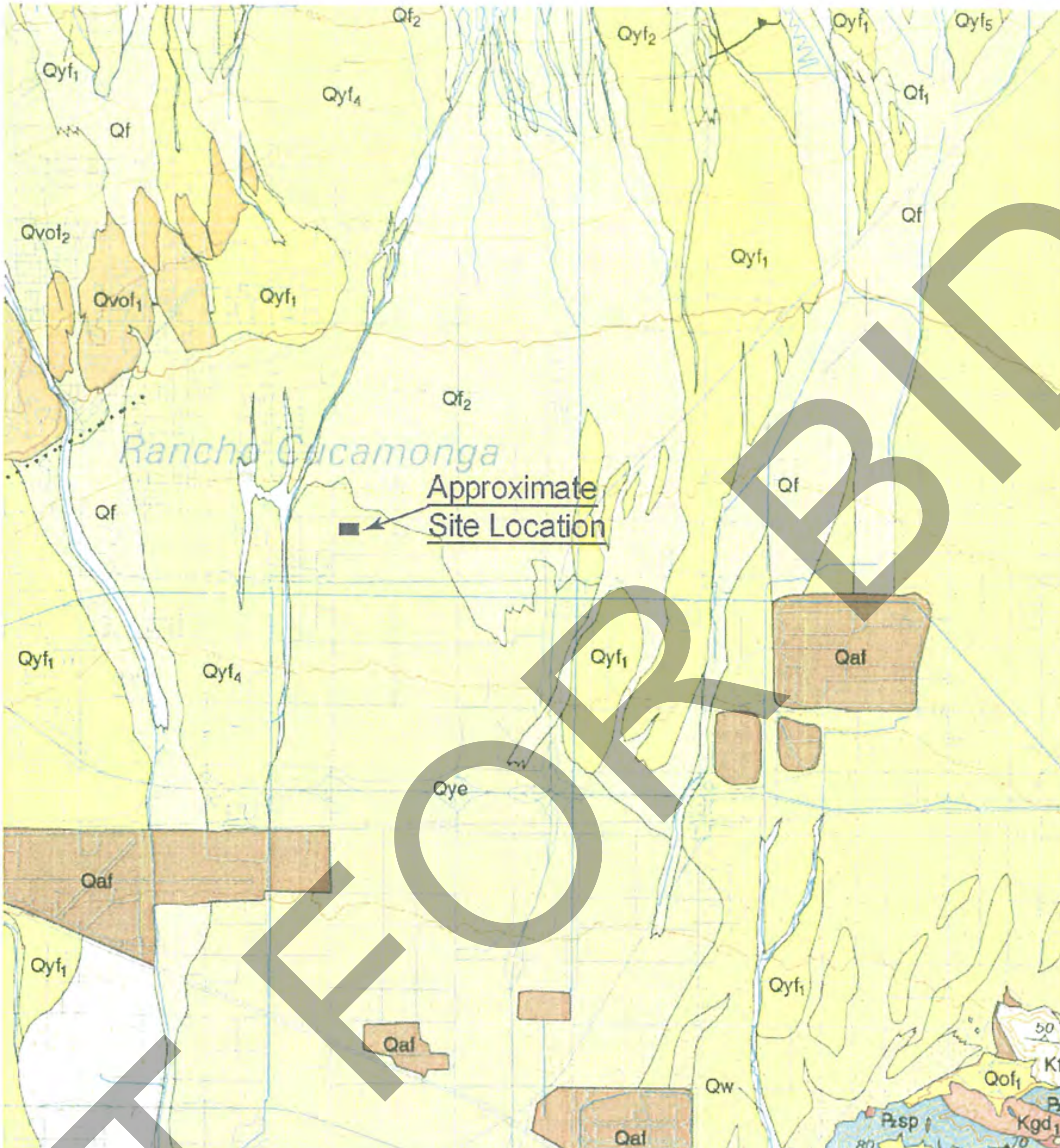
ENGINEERING GEOLOGIC ANALYSIS

Regional Geologic Setting

The project site is situated within the northern portion of the Peninsular Ranges Geomorphic Province of Southern California. This province is a well-defined, geologic and physiographic unit that occupies the southwestern corner of California and extends southward to include the Baja California Peninsula in Mexico. It is characterized by elongated ranges and valleys whose general northwesterly trend is terminated abruptly on the north by the east-west grain of the Transverse Ranges. The portion of the province that lies above sea level is approximately 900 miles long, 140 miles in maximum width, and 55 miles in average width. An additional large part of the Peninsular Ranges Province in California lies mainly submerged beneath the Pacific Ocean. This portion of the province is represented by Santa Catalina, Santa Barbara, San Nicolas, and San Clemente Islands.

The province contains a diverse array of metamorphic, sedimentary, volcanic, and intrusive igneous rocks. In general, the metamorphic rocks represent the highly altered host rocks for the emplacement of very large masses of granitic rock of varying composition. Closer to the coastline, younger rocks include thick sequences of marine and non-marine clastic sedimentary rocks of Mesozoic and Tertiary age, ranging from claystones to conglomerate. Inland, the province is dominated by crystalline basement rocks. The general geology in the area of the subject site is shown on the 'Regional Geology Map,'Figure No. 2a, and 'Regional Geology Map Legend,' Figure No. 2b.

The subject site is located near the northern edge of the Peninsular Ranges Province. This area is characterized by broad, east-west trending valleys that form the transition between the two geomorphic provinces. Coarse-grained Quaternary alluvium forms several massive fans extending southward from the mouths of canyons north of the Rancho Cucamonga area. The subject site has likely received material from more than one (1) of these sources. Eolian deposits were mapped on the subject site by Morton and Miller, however the materials encountered on site were interpreted as alluvium. Eolian deposits are generally finer grained near surface wind blown sediments and were likely removed during the development of the criminal courts facility construction. The inferred depth of alluvium at the subject site is estimated to be in excess of 1,325 feet by Fife and Rodgers (1974).



0 1.0 2.0

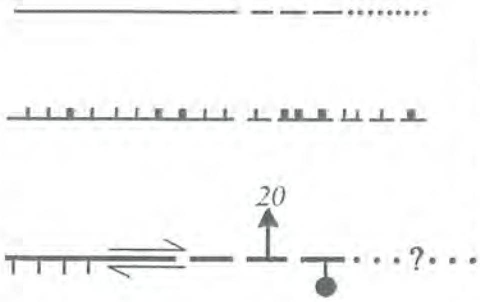
Approximate Scale in Miles

N

Reference: California Department of Conservation, Division of Mines and Geology, 2003, Morton, D.M., Miller, F.K., (Digitally Prepared by Cossette, P.M. and Bovard, K.R.); *Preliminary Geologic Map of the San Bernardino 30' x 60' Quadrangle, California*, Version 1.0, Scale: 1:100,000.

HILLTOP GEOTECHNICAL INCORPORATED	REGIONAL GEOLOGY MAP	
	By: AH	Date: 6/2015
	Project No.: 215-AR15.1	Figure No.: 2a

Legend for Geologic Symbols and Units



Separates geologic-map units. Solid where meets map-accuracy standard; dashed where may not meet map-accuracy standard; dotted where concealed

Contact—Separates terraced alluvial units where younger alluvial unit is incised into older alluvial unit; hachures at base of slope, point toward topographically lower surface. Solid where meets map-accuracy standard; dashed where may not meet map-accuracy standard

Fault—Solid where meets map-accuracy standard; dashed where may not meet map accuracy standard. Dotted where concealed by mapped covering unit; queried where existence uncertain. Hachures indicate scarp, with hachures on downdropped block. Paired arrows indicate relative movement; single arrow indicates direction and amount of fault-plane dip. Bar and ball on down-thrown block.

Qaf	Qaf - Artificial fill (late Holocene).
Qf	Qf - Very young alluvial fan deposits (late Holocene).
Qyf_5	Qyf5 - Young alluvial fan deposits, unite 5 (late Holocene).
Qyf_1	Qyf1 - Young alluvial fan deposits (middle Holocene).
Qye	Qye - Young eolian deposits (Holocene and late Peistocene) (Subject Site).
Kt	Kt - Tonalite (Cretaceous).

Reference: **California Department of Conservation, Division of Mines and Geology**, 2003, Morton, D.M., Miller, F.K., (Digitally Prepared by Cossette, P.M. and Bovard, K.R.); *Preliminary Geologic Map of the San Bernardino 30' x 60' Quadrangle, California*, Version 1.0, Scale: 1:100,000.

HILLTOP GEOTECHNICAL INCORPORATED	REGIONAL GEOLOGY MAP LEGEND	
	By: AH	Date: 6/2015
	Project No.: 215-AR15.1	Figure No.: 2b

Local Subsurface Conditions

Earth Materials Description: Presented as follows are brief descriptions of the earth materials encountered in the exploratory excavation. More detailed descriptions of encountered earth materials are presented on the 'Subsurface Exploration Log,' Plate Nos. 3a through 3c, presented in Appendix 'A' of this report. The earth material strata, as shown on the log, represent conditions at the actual exploratory excavation location. Other variations may occur beyond the excavation. Lines of demarcation between earth materials on the log represented the approximate boundary between the material types; however, the transition may be gradual.

The earth materials encountered on the subject site during the field exploration were identified as artificial fill (af) and Young Alluvium (Qyf1 / Qyf2).

The artificial fill generally consisted of silty, fine to medium sand with varying amounts of coarse sand (SM). The fill was dark brown in color. The soils were medium dense to loose with depth in 'Relative Density.'

The alluvial deposits generally consisted of silty, fine to medium sand with a trace coarse sands (SM), gravely, fine to coarse sands with a trace silt (SP), cobbles and gravel (GP), fine to medium sands with a trace coarse sand and a trace gravel (SP), and silty, fine sands (SM). The alluvium was generally brown, dark brown, gray-brown, and orange-brown in color, moist, and medium dense to very dense in 'Relative Density.' Locally, the young alluvial deposits extended to depths in excess of 51.5 feet below the existing surface at the excavation location on the subject site. The boring was terminated in the alluvial deposit.

Groundwater: Groundwater was not encountered in the exploratory excavation to the maximum depth explored of approximately 51.5 feet below the existing ground surface at the excavation location at the time the field study was performed for this report.

Depth to groundwater data for the site area was available through the **California Department of Water Resources** internet web site. The depth to groundwater in State Well No. 01S07W14L001S, located approximately 1.5 mile southwest of the site, was 404 feet on March 1, 1980. The surface elevation of this well is approximately 138 feet lower (topographically) than that of the site. Based on this information, the current depth to static groundwater beneath the site is estimated to be greater than 50 feet. Based on proposed site grading and the inferred groundwater depths, groundwater should not be a factor for project design or long-term performance.

Surface Water: Surface water was not observed on the subject site at the time the field study was performed for this report.

Site Variations: Based on results of our subsurface exploration and experience, variations in the continuity and nature of surface and subsurface conditions should be anticipated. Due to uncertainty involved in the nature and depositional characteristics of earth materials at the site, care should be exercised in extrapolating or interpolating subsurface conditions beyond the exploratory excavation location.

Groundwater observations were made in the exploratory excavation at time and under conditions stated on the excavation log. These data has been reviewed and interpretations made in the text in other sections of this report. However, it should be noted that fluctuations in levels of groundwater, springs, and/or perched water may occur due to variations in precipitation, temperature, and other factors.

Faulting and Regional Seismicity

The site is situated in an area of active and potentially active faults, as is most of metropolitan southern California. Active faults present a variety of potential risks to structures, the most common of which are strong ground shaking, dynamic densification, liquefaction, mass wasting, and surface rupture at the fault plane. Generally speaking, the following four (4) factors are the principal determinants of seismic risk at a given location:

- Distance to seismogenically capable faults.
- The maximum or "characteristic" magnitude earthquake for a capable fault.
- Seismic recurrence interval, in turn related to tectonic slip rates.
- Nature of earth materials underlying the site.

Surface rupture represents the primary potential hazard to structures built in an active fault zone. A review of official maps delineating State of California earthquake fault zones found that the subject site lies in the north portion of the Guasti Quadrangle. No Alquist-Priolo fault study zones are located within this quadrangle. In addition, the site is not located within a zone of mandatory study for active faulting per the **San Bernardino County Planning Department**, *San Bernardino County Land Use Plan, GENERAL PLAN, Geologic Hazard Overlays*, (http://www.co.san-bernardino.ca.us/landuseservices/general). Reviews of other geology maps of the Rancho Cucamonga region revealed no known faults that cross the subject site. Additionally, no known active faults trend toward the subject property. Accordingly, the potential for surface fault rupture on this site is considered to be very low.

The most recent, large earthquake that occurred in close proximity to the subject property was the June 28, 1992 Big Bear earthquake. The epicenter of this quake was located approximately 70 kilometers (43.4 miles) east-northeast of the subject site at Latitude: 34.202999° North, Longitude: 116.827003° West. The Big Bear quake had a measured magnitude of 6.7, had no surface rupture, and is believed to have occurred on a blind thrust fault, the exact location and geometry of which currently are unknown. Several aftershocks also were centered very near the epicenter, including a magnitude 5.6 aftershock.

Ground shaking is judged to be the primary hazard most likely to affect the site, based upon proximity to six (6) regionally significant active faults as listed in the following table. Other significant fault zones, including several zones in the high desert area are located at distances exceeding 22 kilometers from the site. Greater distances, lower slip rates, and lesser maximum magnitudes indicate much lower risk to the site from the latter fault zones than the six (6) closest faults including the regionally significant San Andreas fault. Characteristics of the major active fault zones selected for inclusion in analysis of strong ground shaking are listed in the following table:

Fault Zone[1]	**Distance (km)**[2] **/ Direction from Site**	**Fault Length (km)**[1]	**Slip Rate (mm/yr)**[1]	**Reference Earthquake $M_{(Max)}$**[1]	**Fault Type**[1]
Cucamonga (r,45 N)[3]	7.3 / North	28±3	5.0±2.0	6.9	B
San Jose (ll-r-o, 75 NW)	10.9 / West	20±2	0.5±0.5	6.4	B

Fault Zone[1]	Distance (km)[2] / Direction from Site	Fault Length (km)[1]	Slip Rate (mm/yr)[1]	Reference Earthquake $M_{(Max)}$[1]	Fault Type[1]
San Jacinto (San Bernardino Segment) (rl-ss)	15.0 / East Northeast	36±4	12.0±6.0	6.7	A
Sierra Madre (®, 45 N)	15.2 / Northwest	57±6	2.0±1.0	7.2	B
Chino-Central Avenue (rl-r-o, 65 SW)	17.6 / Southwest	28±3	1.0±1.0	6.7	B
San Andreas (San Bernardino Segment) (rl-ss)	21.6 / Northeast	103±10	24.0±6.0	7.5	A

1. **Tianqing, C.W., Bryant, W.A., Rowshandel, B., Branum, D., and Wills, C.J.**, June 2003, *The Revised 2002 California Probabilistic Seismic Hazards Maps (Appendix A - 2002 California Fault Parameters).*
   California Department of Conservation, Division of Mines and Geology, 1996, *Probabilistic Seismic Hazard Assessment for the State of California*, DMG Open-File Report 96-08.
2. **Blake, Thomas F.**, 2000, *Preliminary Fault-Data for EQFault, EQSearch and FriskSP* and **Blake, Thomas, F.**, *Computer Services and Software, Users Manuals, FriskSP v. 4.00, EQSearch v. 3.00, and EQFault v. 3.00.*
3. Fault Geometry: (ss) strike slip; ® reverse; (n) normal; (rl) right lateral; (ll) left lateral; (O) oblique; (45 N) direction.

Probabilistic seismic hazard maps and data files prepared by the **California Geological Survey (CGS)** determine ground motions with a 10-percent probability of being exceeded in the next 50 years (475 years mean return time) as a fraction of the acceleration due to gravity for peak ground acceleration (PGA) and spectral accelerations (Sa) for short and moderately long periods, 0.2 seconds and 1.0 second, respectively. This data was available at the **CGS** 'PSHA Ground Motion Interpolator (2008)' web site (http://www.quake.ca.gov/gmaps/PSHA/psha_interpolator.html). The values are presented in the following table for reference:

GROUND MOTION*	SITE ACCELERATION Site Class D**
PGA	0.536g
Sa @ 0.2 Sec.	1.159g
Sa @ 1.0 Sec.	0.701g

* 10-percent probability of being exceeded in the next 50 years (475 years mean return time).
** Shear Wave Velocity of 564 m/sec was assumed for the on-site materials.

Probabilistic seismic hazard maps and data files prepared by the **U.S. Geological Survey (USGS)** assign a 2-percent likelihood that a Peak Horizontal Ground Acceleration (PGA) of approximately 0.8113g will occur at this site within the next 50 years (2,475 years mean return time) due to a Model Magnitude earth quake of 6.56 located at a distance of approximately 6.9 km from the subject site. This data was available at the **U.S. Department of the Interior, U.S. Geological Survey**, Geologic Hazards Science Center's 2008 NSHMP PSHA Interactive Deaggregation Web Site (https://geohazards.usgs.gov/deaggint/2008/). The web site also assigns a 10-percent likelihood that a Peak Horizontal Ground Acceleration (PGA) of approximately 0.5293g will occur at this site within the next 50 years (475 years mean return time) due to a Model Magnitude earth quake of 6.47 located at a distance of approximately 6.9 km from the subject site. An average shear wave velocity (v_s) for the alluvial soils on the subject site of 274 meters per second (m/sec) (i.e., approximately 900 ft/s) was assumed for the analysis.

Actual shaking intensities at the site from any seismic source may be substantially higher or lower than estimated for a given earthquake magnitude, due to complex and unpredictable effects from variables such as:

- Near-source directivity effects.
- Direction, length, and mechanism of fault rupture (strike-slip, normal, reverse).
- Depth and consistency of unconsolidated sediments.
- Topography.
- Geologic structure underlying the site.
- Seismic wave reflection, refraction, and interference.

Secondary Seismic Hazards

Secondary hazards include induced landsliding or mass wasting, liquefaction, flooding (from ruptured tanks and reservoirs, surface oscillations in larger lakes, or seismic sea waves), and subsidence as a result of soil densification. Landsliding and liquefaction susceptibility maps have been prepared for much of coastal Los Angeles and Orange County, California by the CGS. However, this area of San Bernardino County, California is not presently scheduled for mapping by the State. As of the date of this report, the site has not been identified or excluded from a State-delineated zone of mandatory study for either landsliding or liquefaction.

Landslide: The subject site is not located within a designated area as having a landslide susceptibility per **San Bernardino County Planning Department**, *San Bernardino County Land Use Plan, GENERAL PLAN,* (http://www.co.san-bernardino.ca.us/landuseservices/general...).

Liquefaction: Liquefaction is a phenomenon where a sudden large decrease of shearing resistance takes place in fine grained cohesionless and/or low plasticity cohesive soils due to the cyclic stresses produced by earthquakes causing a sudden, but temporary, increase of porewater pressure. The increased porewater pressure occurs below the water table, but can cause propagation of groundwater upwards into overlying soil and possibly to the ground surface and cause sand boils as excess porewater escapes to the surface when groundwater is shallow. Potential hazards due to liquefaction include significant total and/or differential settlements of the ground surface and structures as well as potential collapse of structures due to loss of support of foundations. Laboratory testing and soil condition analyses, at sites where liquefaction has occurred, have shown that the soil types most susceptible to liquefaction are saturated, fine sand to sandy silt. These soils derive their shear strength from intergranular friction and do not drain quickly during earthquakes. Published studies and field and laboratory test data indicate that coarse sands, gravelly sands, and silty or clayey sands are considerably less vulnerable to liquefaction. To a large extent, the relative density of sands also controls the liquefaction susceptibility for a given number of cycles and acceleration levels during a seismic event. Other characteristics such as confining pressure and the stresses created within the soil during a seismic event also affect the liquefaction potential of a site. Liquefaction of soil does not generally occur below depths of 40 to 50 feet below the ground surface due to confining pressure at that depth. Moreover, saturated fine sands with relative densities of approximately 70 percent or greater are not likely to liquefy, even under very severe seismic events.

The subject site is not located within a designated area as having a liquefaction potential per **San Bernardino County Planning Department**, *San Bernardino*

County Land Use Plan, GENERAL PLAN, (http://www.co.san-bernardino.ca.us/landuseservices/general...).

It is **HGI's** opinion that the liquefaction potential at the subject site is very low due to the medium dense to very dense 'Relative Density' of the alluvial soils beneath the site.

Seismically Induced Subsidence: Loose sandy soils subjected to moderate to strong ground shaking can experience settlement. Experience from the Northridge Earthquake indicates that structural distress can result from such seismic settlement. The subject site is underlain at depth by medium dense to very dense alluvium that should not be prone to a significant degree of seismic settlement. Where applicable, loose, near-surface, soils and any undocumented fills should be removed and recompacted to uniform high densities to mitigate both settlement and consolidation potentials.

Lateral Spreading: Lateral spread is the most pervasive type of liquefaction-induced ground failure. Lateral spreads can occur on gently sloping ground or where nearby drainage or stream channels can lead to static shear stress biases on essentially horizontal ground. During lateral spread, blocks of mostly intact, surficial earth material displace downslope or towards a free face along a shear zone that has formed within the liquefied sediment. The resulting ground deformation typically has extensional fissures or a graben at the head of the failure, shear deformations along the side margins, and compression or buckling of the earth material at the toe. The amount of lateral displacement typically ranges from a few centimeters to several meters and can cause considerable damage to engineered structures and lifelines.

A formal lateral spread analysis was not performed as part of this study. The lateral spread potential of the subject site is not considered to be a geologic hazard for the proposed structure on the subject property due to the very low liquefaction potential for the area of the subject site.

Seiching: Seiching involves an enclosed body of water oscillating due to ground shaking, usually following an earthquake. Lakes and water towers are typical bodies of water affected by seiching. However, the site does not appear to be within the influence of large bodies of water and, as such, seiching should not be considered a geologic hazard for the development of the subject site.

Tsunamis: Because of the inland geographic location of the site, tsunamis are not considered a geologic hazard for the development of the subject site.

Lurching: Lurching is a phenomena in which ground cracking and/or secondary faulting occurs as a result of ground shaking. Generally, lurching primarily occurs in the immediate vicinity of faulting or within typical building setback zones or "No Human Occupancy" zones. No evidence of faulting was encountered on the site and although the potential for lurching cannot be entirely ruled out, the likelihood for lurching to impact the site is considered to be low.

OTHER GEOLOGIC HAZARDS

Flooding

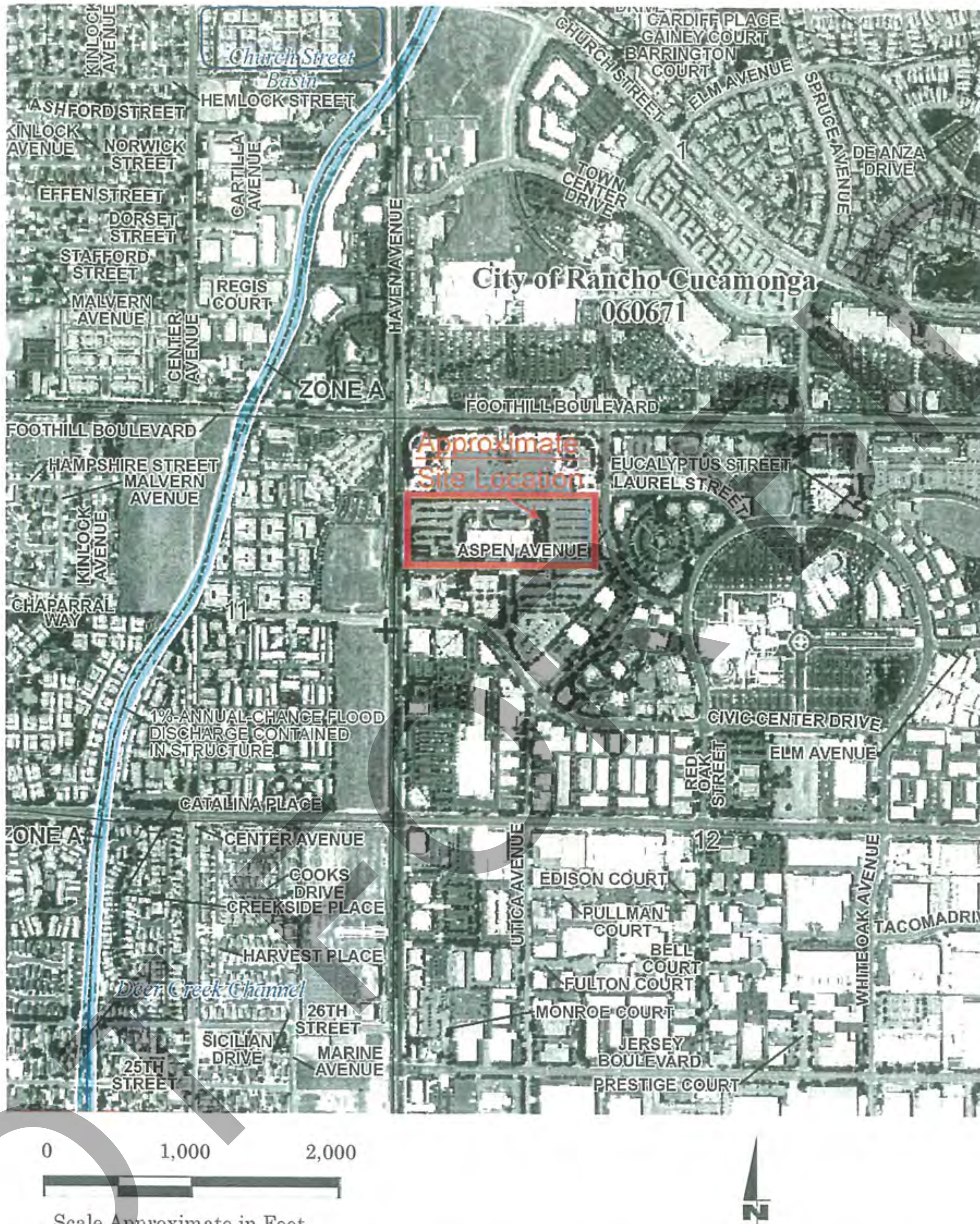
The subject site is not located within a designated area as having a flooding potential per **San Bernardino County Planning Department**, *San Bernardino County Land Use Plan, GENERAL PLAN, Hazard Overlays*, Sheet FH28 B, Guasti, Plot Date: 03/09/2010, Scale: 1:14,400 (http://www.co.san-bernardino.ca.us/landuseservices/general...).

Flood Insurance Rate Maps (FIRM) were compiled by the **Federal Emergency Management Agency (FEMA)** for the Flood Insurance Program and are available for most areas within the United States at the **FEMA** web site (http://msc.fema.gov/). The attached 'FEMA Flood Hazard Map' and 'FEMA Flood Hazard Map Legend,' Figure Nos. 3a and 3b, respectively, are based on FIRMs provided by **FEMA** and are specific to the area around the subject site. The 'FEMA Flood Hazard Map,' Figure 3a, indicates that the site is located within 'Zone X' (an area outside of 0.2-percent annual chance floodplain).

CONCLUSIONS AND RECOMMENDATIONS

GENERAL

The conclusions and recommendations presented in this report are preliminary since a grading plan, the type of structure foundation, the type of construction, structural loads, finish grade elevations, etc. were not available and are, in part, based on information provided to this firm, the results of the field and laboratory data obtained from one (1) exploratory excavation located in the vicinity of the proposed structures on the subject site, experience gained from work conducted by this firm on projects within the general vicinity of the subject site, the project description and assumptions presented in the 'Project Description / Proposed Development' section of this report, engineering analyses, and professional judgement. Based on a review of the field and laboratory data and the engineering analysis, the proposed development is feasible from a geotechnical / geologic standpoint. The subject project can be developed without adverse impact onto or from adjoining properties providing the recommendations contained within this report are adhered to during project design and construction.



Reference: **U.S. Federal Emergency Management Administration (FEMA)**, Effective August 28, 2008, Revised February 18, 2015, *Flood Insurance Rate Map*, Map No. 06071C 8630J. Site specific information obtained through FEMA website, Map Service Center (http://msc.fema.gov/).

HILLTOP GEOTECHNICAL INCORPORATED	FEMA FLOOD HAZARD MAP	
	By: AH	Date: 6/2015
	Project No.: 215-AR15.1	Figure No.: 3a

LEGEND

SPECIAL FLOOD HAZARD AREAS SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual 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.

ZONE A	No Base Flood Elevations determined.
ZONE AE	Base Flood Elevations determined.
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO	Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR	Special Flood Hazard Area formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99	Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V	Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE	Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

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.

OTHER AREAS

ZONE X	Areas determined to be outside the 0.2% annual chance floodplain.
ZONE D	Areas in which flood hazards are undetermined, but possible.

HILLTOP GEOTECHNICAL INCORPORATED

FEMA FLOOD HAZARD MAP LEGEND	
By: AH	Date: 6/2015
Project No.: 215-AR15.1	Figure No.: 3b

Any artificial fills on the site are also considered to be undocumented, loose, and compressible. Any man-made fills are not considered suitable for the support of structural fills, building foundations, slabs-on-grade, hardscape, and/or pavement.

The near-surface, on-site, undocumented fill and alluvial soils were visually identified as not having an expansion potential per the criteria presented in Section 1803.5.3, 'Expansive Soil,' in the 2013 CBC. Therefore, no special design considerations such as deepened footings or pre-saturation of earth materials is required due to expansion potential.

The average in-situ moisture contents and in-situ dry densities of the upper 10 feet of the near-surface undocumented, fill and alluvial materials on the subject site suggests that the soils have an average relative compaction of less than 85 percent.

Some remedial grading consisting of removals and replacement will have to be performed within any undocumented, artificial fill and, loose, near-surface alluvium in the area of proposed structural fills, building foundations, exterior hardscapes, and/or pavement.

The actual conditions of the near-surface supporting material across the site may vary. The nature and extent of variations of the surface and subsurface conditions beyond the location of the exploratory excavation may not become evident until construction. If variations of the material become evident during construction of the proposed development, **HGI** should be notified so that the project Geotechnical / Geologic Consultant can reevaluate the characteristics of the material and the conclusions and recommendations of this report, and, if needed, make revisions to the conclusions and recommendations presented herein.

Recommendations for site grading, foundations, etc., are presented in the subsequent paragraphs.

SITE PREPARATION RECOMMENDATIONS

General

Since mass grading is not anticipated for the development of the project, the grading recommendations presented in this report are intended for: 1) the rework of unsuitable, near-surface, undocumented fill and alluvial earth materials to create a uniformly thick, engineered building pad and satisfactory support for exterior hardscape (i.e., sidewalks, etc.) and pavement; and 2) the use of a conventional, shallow, foundation system and concrete slabs cast on-grade for the proposed structure.

The grading should be performed in accordance with the recommendations presented in this report. We recommend that **HGI**, as the Geotechnical Engineer / Geologist of Record, be retained by the owner of the proposed project to observe the excavation and grading operations, foundation preparation, and test the compacted fill and utility trench backfill. If **HGI** were not selected to perform the required observation and testing of earthwork construction, **HGI** would cease to be the Geotechnical Consultant of Record for the project. A pregrading conference should be held at the site with representatives of the grading contractor, the County of San Bernardino, the Civil Engineer, and a representative of **HGI** in attendance. Special grading procedures and/or concerns can be addressed at that time.

Earthwork observation services allow the testing of only a small percentage of the fill placed at the site. Contractual arrangements with the grading contractor by the project owner should contain the provision that he is responsible for excavating, placing, and compacting fill in accordance with the recommendations presented in this report and the approved project grading plans and specifications. Observation by the project Geotechnical / Geologic Consultant and/or his representatives during grading should not relieve the grading contractor of his responsibility to perform the work in accordance with the recommendations presented in this report and the approved project plans and specifications.

The following recommendations may need to be modified and/or supplemented during grading as field conditions require.

Final Grading Plan Review

The project Civil Engineer should review this report, incorporate critical information on to the grading plan and/or reference this geotechnical / geologic study, by Company Name, Project No., Report No., and report date, on the grading plan. Final grading plans should be reviewed by **HGI** when they become available to address the suitability of our grading recommendations with respect to the proposed improvements.

Clearing and Grubbing

Debris, grasses, weeds, brush, trees, and other deleterious materials should be removed from the proposed building, exterior hardscape and pavement areas and areas to receive structural fill before grading is performed. Any organic material and miscellaneous / demolition debris should be legally disposed of off site. Any topsoil or highly organic soils encountered should be stripped and stockpiled for use on finished grades in landscape areas or exported from the site. Disking or mixing of organic material into the earth materials proposed to be used as structural fill should not be permitted. Trees, bushes, etc. and their roots should be completely removed, ensuring that 95 percent or more of the root systems are extracted.

Man-made objects encountered (i.e., septic tanks, leach lines, irrigation systems, underground utilities, old foundations, construction debris, etc.) should be overexcavated, exported from the site, and legally disposed of off site. Cesspools or seepage pits, if encountered (none were encountered during this study), should be abandoned and capped according to directions and supervision of San Bernardino County Department of Health, the State of California, and/or the appropriate governmental agency procedures which has jurisdiction over them before fill and/or pavement is placed over the area. If no procedures are required by the Health Department or if the following recommendations are more stringent, the cesspool or seepage pit should be pumped free of any liquid and filled with a low strength sand cement slurry to an elevation 5.0 feet below the final site grade in the area. The upper 5.0 feet of the cesspool or seepage pit should be excavated and the area backfilled with a properly compacted fill material. The location of the cesspool or seepage pit should be surveyed and plotted on the final 'As-Graded' plan prepared by the project Civil Engineer.

Wells, if encountered, should be abandoned and capped according to directions and supervision of San Bernardino County Department of Health, the State of California, and/or the appropriate governmental agency procedures which has jurisdiction over the well before fill and/or pavement is placed over the area.

Excavation Characteristics

Excavation and trenching within the subject property to the depths anticipated for the proposed development is anticipated to be relatively easy in the near-surface undocumented fills and alluvial materials on the subject site and should be accomplished with conventional earth-moving equipment since the drill rig equipped with flight augers was able to penetrate to the indicated depths. Materials were not encountered or are anticipated at shallow depths (i.e., less than 10 feet in depth) that would require heavy ripping or blasting to excavate. It is anticipated that no significant amount of oversized rock material (i.e., 6.0 inches in greatest dimension) will be generated during the removal and replacement process within any undocumented fill and the alluvial materials which will require special handling during the development of the site.

Suitability of On-Site Materials as Fill

In general, the on-site earth materials are considered satisfactory for reuse as fill. Fill materials should be free of significant amounts of organic materials and/or debris and should not contain rocks or clumps greater than 6.0 inches in maximum dimension. It is noted that the average in-situ moisture content of the near-surface fill and alluvial earth materials on the subject site at the time this field study was performed was below the optimum moisture content for the on-site materials and that moisture will have to be added to the on-site earth materials if the earth materials are to be used as compacted fill material in the near future. A significant amount of oversized rock materials are anticipated to be generated from the cuts performed in the local materials.

Removal and Recompaction

Uncontrolled or undocumented fills and/or unsuitable, loose, or disturbed near-surface alluvial earth material in proposed areas which will support structural fills, structures (i.e., buildings, decorative block walls, retaining walls, trash enclosure walls, etc.), exterior hardscape (i.e., sidewalks, patios, curb / gutters, etc.), and pavement should be prepared in accordance with the following recommendations for grading in such areas. If overexcavation of undocumented fill materials is elected not to be performed in hardscape, curb / gutter, pavement, and decorative block wall or fence areas, penetration of irrigation water with time may cause some settlement and distress to the improvements in those areas. The cost of the additional grading verses the risk of distress and cost of repairs to the structures needs to be evaluated by the project owner.

- Any near-surface, undocumented fill and/or loose, near-surface, alluvial materials on the site are recommended to be overexcavated and recompacted. Based upon our exploratory boring and laboratory test results, the depth of overexcavation is anticipated to be 7.0 to 8.0 feet below existing ground surface over the majority of the site. A relative compaction of 85 percent or greater should be obtained in the exposed earth material at the overexcavation depth prior to performing any scarification, moisture conditioning, and recompaction. If 85 percent relative compaction is not present, the overexcavation should be deepened until a minimum of 85 percent relative compaction is present. Moreover, the depth of the overexcavation within the perimeter of the proposed structure should be to a uniform elevation throughout the limits of the structure. It is noted that fill placed to construct slopes and/or support sidewalks, retaining walls, block walls, driveways, and pavement are considered to be structural fill.

- In the proposed exterior hardscape (i.e., sidewalks, etc.), and pavement areas where structural fill will not be placed or cuts are proposed, the existing near-surface earth materials need only be processed to a depth of 6.0 to12 inches below existing site grades or proposed subgrade elevation, whichever is deeper unless old, undocumented fill materials are encountered at exposed grades. If undocumented fills are encountered, they will need to be overexcavated and properly compacted fill replaced to achieve proposed grades.

- Additional overexcavation will need to be performed in areas where the exposed subgrade can not be properly processed and recompacted per the following recommendations presented in this section of this report.

- In landscape or non-structural fill areas where non-structural fill will be placed, overexcavation will not need to be performed prior to placing non-structural fill materials. Any non-structural fill areas should be clearly designated on the project grading and/or site plan by the Civil Engineer or Architect.

- The limits of overexcavation for the building pad should extend to a distance of 5.0 feet or to the depth of the overexcavation beneath the finish pad grade for the structure, whichever is greater, beyond the structure perimeter or footing edges. The limits of overexcavation for the decorative concrete block perimeter wall footings and/or retaining wall footings should extend to a distance of 4.0 feet beyond the footing edges or to the depth of the overexcavation beneath the footing grade, whichever is greater. The limits of processing or overexcavation for exterior hardscape, curb / gutter, and pavement areas should extend to a distance of 2.0 feet beyond the edge of the exterior hardscape, curb / gutter, or pavement, or to the depth of the overexcavation beneath the finish subgrade elevation, whichever is greater.

- It is noted that localized areas, once exposed, may warrant additional overexcavation for the removal of existing undocumented fills, or loose, near-surface earth material, and subsurface obstructions and/or debris which may be associated with the existing structure or past usage of the site. Actual depths of removals and the competency of the exposed overexcavation bottoms should be determined by the project Geotechnical / Geologic Consultant and/or his representative during grading operations at the time they are exposed and before scarification and recompaction or the placement of fill.

- The exposed overexcavation bottom surfaces should be scarified to a depth of 6.0 to 12 inches, brought to optimum moisture content to 3.0 percent above optimum moisture content, and compacted to 90 percent or greater relative compaction before placement of fill. In landscape and non-structural fill areas, the scarified and moisture conditioned earth materials need only be compacted to 85 percent or greater relative compaction prior to placing fill. Maximum dry density and optimum moisture content for compacted materials should be determined according to current ASTM D1557 procedures. The scarification and recompaction of the exposed overexcavation bottoms in alluvial materials may be deleted upon approval by the project Geotechnical / Geologic Consultant, and/or his representative when in-place density test results in the undisturbed alluvial materials indicate a relative compaction of 90 percent or greater.

Import Material

Import fill should be 'Non-Expansive' as defined in Section 1803.5.3, 'Expansive Soil,' in the 2013 CBC (i.e., Expansion Index ≤ 20) as determined by current ASTM D4829 procedures and have strength parameters equivalent to or greater than the on-site earth materials. Import fill material should be approved by the project Geotechnical / Geologic Consultant prior to it being brought on-site.

Fill Placement Requirements

Fill material, whether on-site material or import, should be approved by the project Geotechnical / Geologic Consultant and/or his representative before placement. Fill material should be free from vegetation, organic material, debris, and oversize material (i.e., 6.0 inches in maximum dimension). Approved fill material should be placed in horizontal lifts not exceeding 6.0 to 12 inches in compacted thickness or in thicknesses the grading contractor can demonstrate that he can achieve adequate compaction and watered or aerated to obtain optimum moisture content to 3.0 percent above optimum moisture content. Each lift should be spread evenly and should be thoroughly mixed to ensure uniformity of earth material moisture. Fill soils should be compacted to 90 percent or greater relative compaction. Maximum dry density and optimum moisture content for compacted materials should be determined in accordance with current ASTM D1557 procedures.

Compaction Equipment

It is anticipated that the compaction equipment to be used for the project will include a combination of rubber-tired, track-mounted, sheepsfoot, and/or vibratory rollers to achieve compaction. Compaction by rubber-tired or track-mounted equipment, by itself, may not be sufficient. Adequate water trucks, water pulls, and/or other appropriate equipment should be available to provide sufficient moisture and dust control. The actual selection of equipment and compaction procedures are the responsibility of the contractor performing the work and should be such that uniform compaction of the fill is achieved.

Shrinkage, Bulking, and Subsidence

There will be a material loss due to the clearing and grubbing operations. The following values are exclusive of losses due to clearing, grubbing, tree root removal, or the removal of other subsurface features and may vary due to differing conditions within the project boundaries and the limitations of this study.

Volumetric shrinkage of the near-surface earth materials (i.e., undocumented fill and near-surface alluvium) on the subject site that are excavated and replaced as controlled, compacted fill should be anticipated. It is estimated that the average shrinkage of the near-surface earth materials within the upper 7.0 to 8.0 feet of the site which will be removed and replaced will be approximately 7.0 to 13.0 percent, based on fill volumes when compacted to 90 to 95 percent of maximum dry density for the earth material type based on current ASTM D1557 procedures. For example, a 6.0 percent shrinkage factor would mean that it would take 1.07 cubic yards of excavated material to make 1.0 cubic yard of compacted fill at 90 percent relative compaction. A higher relative compaction would mean a larger shrinkage value.

A subsidence factor (loss of elevation due to compaction of existing undocumented fill and/or the near-surface alluvial earth materials in-place) of 0.07 to 0.12 foot per foot of compacted earth material should be used in areas where the existing earth materials are compacted in-place to 90 to 95 percent relative compaction and to a depth of 12 inches.

Subsidence of the site due to settlement from the less than 2.0 feet of fill (not including the depth of overexcavation and replacement) during the planned grading operation is expected to be minimal.

Although the above values are only approximate, they represent the recommended estimate of some of the respective factors to be used to calculate lost volume that will occur during grading.

Abandonment of Existing Underground Lines

Abandonment of existing underground irrigation, utility, or pipelines, if present within the zone of construction, should be performed by either excavating the lines and filling in the excavations with documented, properly compacted fill or by filling the lines with a low strength sand / aggregate / cement slurry mixture. Filled lines should not be permitted closer than 3.0 feet below the bottom of proposed footings and/or concrete slabs on-grade. The lines should be cut off at a distance of 5.0 feet or greater from the area of construction. The ends of the lines should be plugged with 5.0 feet or more of concrete exhibiting minimal shrinkage characteristics to prevent water or fluid migration into or from the lines. Capping of the lines may also be needed if the lines are subject to line pressures. The slurry should consist of a fluid, workable mixture of sand, aggregate, cement, and water. Plugs should be placed at the ends of the line prior to filling with the slurry mixture. Cement should be Portland cement conforming to current ASTM C150 specifications. Water used for the slurry mixture should be free of oil, salts, and other impurities which would have an adverse effect on the quality of the slurry. Aggregate, if used in the slurry, mixture should meet the following gradation or a suitable equivalent:

SIEVE SIZE	PERCENT PASSING
1.5"	100
1.0"	80-100
3/4"	60-100
3/8"	50-100
No. 4	40-80
No. 100	10-40

The sand, aggregate, cement, and water should be proportioned either by weight or by volume. Each cubic yard of slurry should not contain less than 188 pounds (2.0 sacks) of cement. Water content should be sufficient to produce a fluid, workable mix that will flow and can be pumped without segregation of the aggregate while being placed. The slurry should be placed within 1.0 hour of mixing. The contractor should take precautions so that voids within the line to be abandoned are completely filled with slurry.

Local ordinances relative to abandonment of underground irrigation, utility, or pipelines, if more restrictive, supersede the above recommendations.

Protection of Work

During the grading process and prior to the completion of construction of permanent drainage controls, it is the responsibility of the grading contractor to provide good drainage and prevent ponding of water and damage to the in progress or finished work on the site and/or to adjoining properties.

Observation and Testing

During grading, observation and testing should be conducted by the project Geotechnical / Geologic Consultant and/or his representatives to verify that the grading is being performed according to the recommendations presented in this report. The project Geotechnical / Geologic Consultant and/or his representative should observe and test the overexcavation bottoms and the placement of fill and should take tests to verify the moisture content, density, uniformity and degree of compaction obtained. The contractor should notify the project Geotechnical / Geologic Consultant when cleanout and/or overexcavation bottoms are ready for observation and prior to scarification and recompaction. Typically, one (1) in-place density test should be performed for every 2.0 vertical feet of fill material, or one (1) test for every 500 cubic yards of fill, which ever requires the greater number of tests. In-place density and moisture content tests should be performed during the placement of the fill materials during the grading operations in general accordance with the following current ASTM test procedures:

Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth) - ASTM D6938.

Test Method for Density and Unit Weight of Soil in Place by Sand Cone Method - ASTM D1556.

Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock - ASTM D2216.

Method for Determination of Water (Moisture) Content of Soil by Direct Heating Method - ASTM D4959.

Method for Determination of Water (Moisture) Content of Soil by the Microwave Oven Method - ASTM D4643.

Where testing demonstrates insufficient density, additional compaction effort, with the adjustment of the moisture content when needed, should be applied until retesting shows that satisfactory relative compaction has been obtained. The results of observations and testing services should be presented in a formal 'Grading Report' following completion of the grading operations. Grading operations undertaken at the site without the project Geotechnical / Geologic Consultant and/or his representative present may result in exclusions of the affected areas from the grading report for the project. The presence of the project Geotechnical / Geologic Consultant and/or his representative will be for the purpose of providing observations and field testing and will not include supervision or directing of the actual work of the contractor or the contractor's employees or agents. Neither the presence and/or the non-presence of the project Geotechnical / Geologic Consultant and/or his field representative nor the field observations and testing will excuse the contractor for defects discovered in the contractor's work. If **HGI** does not perform the observation and testing of the earthwork for the project and is replaced as Geotechnical / Geologic Consultant of record for the project, the work on the project should be stopped until the replacement Geotechnical / Geologic Consultant has reviewed the previous reports and work performed for the project, agreed in writing to accept the recommendations and prior work performed by **HGI** for the subject project, or has performed their own studies and submitted their revised recommendations. If **HGI** were not selected to perform the required observation and testing of earthwork construction, **HGI** would cease to be the Geotechnical Consultant of Record for the project.

Earth Material Expansion Potential

The preliminary expansion potential of the on-site earth materials is discussed in the subsequent foundation and floor slab recommendation sections of this report.

Upon completion of grading for the building pad area, near-surface samples should be obtained for expansion potential testing to verify the preliminary expansion test results and the foundation / slab-on-grade recommendations presented in this report.

Earth Material Corrosion Potential

The preliminary corrosion potential of the on-site earth material is discussed in the subsequent corrosion recommendation sections of this report. Upon completion of grading for the building pad area, near-surface samples should be obtained for corrosion potential testing to verify the preliminary chemical test results and the recommendations presented in this report for protection of concrete and bare metal which will be in direct contact with the on-site earth materials.

2013 CBC SEISMIC DESIGN CRITERIA

Per the **California Building Standards Commission**, *2013 California Building Code* (CBC), California Code of Regulations, Title 24, Part 2, Volume 2 of 2, Section 1613, 'Earthquake Loads,' the followings coefficients and factors relevant to seismic mitigation and design for new construction include:

- **Site Class Types**

  Categorizing the upper 30 meters (±100 ft.) of earth materials into one (1) of the site class types A, B, C, D, E, and F that are based on average shear wave velocities, Standard Penetration Test blow counts, or undrained shear strength.

- **Mapped, Maximum Considered Earthquake (MSC), 5.0 Percent Damped, Spectral Response Acceleration Parameters at Short Period and at 1-Second Period**

  Mapped, Maximum Considered Earthquake (MSC), 5.0 percent damped, spectral response acceleration parameters at short period (0.2 second) and at 1-second, S_s and S_1 for Site Class 'B' are determined from Java Ground Motion Parameter Calculator - Version

5.0.9a available at the USGS web site (http://earthquake.usgs.gov/designmaps/us/application.php).

- **Site Coefficients**
  Short period site coefficient (at 0.2 second period), F_a and long-period site coefficient (at 1.0 second period), F_v are based on 'Site Class' and the 'Mapped Spectral Response Acceleration at Short Period and at 1-Second period' S_a and S_1.

Based on our understanding of local geologic conditions, the 'Site Class' judged applicable to this site is 'D', with a soil profile name of 'Stiff Soil' per Table 20.3-1, 'Site Classification,' in Chapter 20 of ASCE 7-10 with an average Shear Wave Velocity of 600 to 1,200 feet/second (ft./s) or an average Standard Penetration Test value of 15 to 50 blows per foot of penetration in the upper 100 feet (30.48 m) of the site.

The following table presents supplemental coefficients and factors relevant to seismic mitigation and design for new construction built according to the 2013 CBC based on a 10-percent probability of being exceeded in the next 50 years (475 years mean return time).

SEISMIC DESIGN CRITERIA	
Site Location	Latitude: 34.1047° North Longitude: 117.5726° West
Site Class[1]	D
Mapped, Maximum Considered Earthquake (MCE), 5.0 Percent Damped, Spectral Response Acceleration Parameter at Short Period $(S_s)^2$ (0.2 Second) for Site Class B.	1.503
Mapped, Maximum Considered Earthquake (MCE), 5.0 Percent Damped, Spectral Response Acceleration Parameter at 1-Second $(S_1)^2$ for Site Class B.	0.600
Site Coefficients $(F_a)^2$ for Site Class.	1.0

SEISMIC DESIGN CRITERIA	
Site Coefficients (F_v)[2] for Site Class.	1.5
The MSC, 5.0 Percent Damped, Spectral Response Acceleration Parameter at Short Periods Adjusted for Site Class Effects (S_{MS})[2].	1.503
The MSC, 5.0 Percent Damped, Spectral Response Acceleration Parameter at 1-Second Adjusted for Site Class Effects (S_{M1})[2]	0.900
Design, 5.0 Percent Damped, Spectral Response Acceleration Parameter at Short Periods (S_{DS})[2] for Site Class.	1.002
Design, 5.0 Percent Damped, Spectral Response Acceleration Parameter at 1-Second (S_{D1})[2] for Site Class.	0.600
Model Magnitude Earthquake (M)[3]	6.56
Average Shear Wave Velocity in the Top 30m of the Site for Site Class 'D.'[3]	274 m/s
Peak Ground Acceleration (PGA)[3]	0.8113g

1. Per Table 20.3-1, 'Site Classification,' in Chapter 20 of ASCE 7-10.
2. Java Ground Motion Parameter Calculator - Version 5.1.0 (2-10-2011) available at **USGS** web site (http://earthquake.usgs.gov/designmaps/us/application.php). Data based on **ASCE** 7, 'Standard, Minimum Design Loads for Buildings and Other Structures,' 2010 Edition.
3. Probabilistic seismic hazard maps and data files prepared by the **USGS** assign a 2-percent likelihood that the PGA will occur at this site within the next 50 years (2,475 years mean return time). This data was available at the **USGS**, Geologic Hazards Science Center's 2008 NSHMP PSHA Interactive Deaggregation Web Site (https://geohazards.usgs.gov/deaggint/2008/).

Actual shaking intensities at the site from any seismic source may be substantially higher or lower than estimated for a given earthquake magnitude, due to complex and unpredictable effects from variables such as:

- Near-source directivity effects.
- Direction, length, and mechanism of fault rupture (strike-slip, normal, reverse).
- Depth and consistency of unconsolidated sediments.

- Topography.
- Geologic structure underlying the site.
- Seismic wave reflection, refraction, and interference.

FOUNDATION DESIGN RECOMMENDATIONS

General

The foundation recommendations presented in this report are considered preliminary since the exact locations of the proposed structures, the type of structure construction, the structural loads, the ground floor level elevations, etc. were not known at the time of this report.

The recommendations presented in the subsequent paragraphs for foundation design and construction are based on geotechnical characteristics and 'Non-Expansive' conditions for the supporting earth materials as defined in Section 1803.5.3, 'Expansive Soil,' in the 2013 CBC and should not preclude more restrictive structural requirements. Foundations for the proposed building structure may consist of conventional column and continuous wall footings founded upon undisturbed, documented, properly, compacted fill, or firm, competent, undisturbed natural earth material, but not a combination of earth material types within a structure. The foundation for the proposed mono-tower structure may consist of conventional column and continuous wall footings founded upon undisturbed, documented, properly, compacted fill, or firm, competent, undisturbed natural earth material, but not a combination of earth material types within a structure.

The Structural Engineer for the project should determine the actual foundation width, depth, and reinforcing to resist design vertical, horizontal, and uplift forces under static and seismic conditions. Reinforcement recommendations presented in this report are considered the minimum for the earth material conditions present on the site and are not intended to supersede the design of the project Structural Engineer or the criteria of the governing agencies for the project.

Building Foundations

Foundation Size: Continuous footings should have a width of 12 inches or greater for 1- and 2-story structures supported by the foundations, respectively, in accordance with Table 1809.7, 'Prescriptive Footings Supporting Walls of Light-Frame Construction,' in the 2013 CBC. Footings supporting a roof only shall be as required for supporting one (1) floor. Continuous footings should be continuously reinforced with a minimum of one (1) No. 4 steel reinforcing bar located near the top and one (1) No. 4 steel reinforcing bar located near the bottom of the footings to minimize the effects of slight differential movements which may occur due to minor variations in the engineering characteristics or seasonal moisture change in the supporting earth materials. Column footings should have a width of 18 inches by 18 inches or greater and be suitably reinforced, based on structural requirements. The continuous footings should extend across doorway and garage entrances and should be founded at the same depths and reinforced the same as the adjacent footings.

Depth of Embedment: Exterior and interior footings supported in undisturbed, documented, properly compacted fill or undisturbed, firm, alluvial, earth material should extend to a depth of 12 inches or greater below lowest adjacent finish grade. Frost is not considered a design factor for foundations in the City of Rancho

Cucamonga area of San Bernardino County, California, since there will not be any significant frost penetration in the winter months.

Footings should be founded in undisturbed, documented, properly compacted fill with a relative compaction of 90 percent or greater or undisturbed, natural earth material with a relative compaction of 85 percent or greater, but not a combination of the different earth materials within the structure. Where building, decorative wall, or retaining wall footings will be constructed directly on the property line or where the limits of overexcavation and/or ground modification do not extend sufficiently beyond the footing edges per the 'Earthwork Recommendations' section of this report, the footings should be deepened to extend through the unsuitable, earth material and be founded to a depth of 12 inches or greater into firm, competent, undisturbed, natural earth material with a relative compaction of 85 percent or greater.

Bearing Capacity: Provided the recommendations for site earthwork and for footing width and depth of embedment are incorporated into the project design and construction, the allowable bearing value for design of continuous and column footings for the total dead plus frequently-applied live loads is 2,000 pounds per square foot (psf) for footings that are 12 inches in width and a depth of embedment of 12 inches or greater below lowest adjacent finished grade in accordance with Table 1806.2, 'Presumptive Load-Bearing Values,' in the 2013 CBC for footings founded in undisturbed, documented, properly, compacted fill material or undisturbed, alluvial soils with a relative compaction of 85 percent or greater (Class 4 Materials). For eccentrically loaded footings and/or overturning moments, the resultant force should be in the middle one-third of the footing and the average bearing value across the footing should not exceed the recommended allowable bearing value. The allowable bearing value has a factor of safety of 3.0 or greater and may be increased by 33.3 percent for short durations of live and/or dynamic loading such as wind or seismic forces.

Settlement: Footings designed according to the recommended bearing value, the assumed maximum wall and column loads, and founded in undisturbed, documented, properly, compacted fill material are not expected to exceed a total settlement of 1.0 inch or a differential settlement of 0.25 inch between similarly sized and loaded footings.

CIDH Pile Foundation

The recommendations presented in the following sections are for conventional Cast-In-Drilled-Hole (CIDH) piles as a foundation for the proposed antenna structure.

- The CIDH piles should be designed for end-bearing with an allowable design bearing pressure of 2,000 psf in accordance with Table 1806.2, 'Presumptive Load-Bearing Values,' in the 2013 CBC for foundations founded in undisturbed, alluvial material (Class 4 Material). The allowable bearing value has a factor of safety of 3.0 or greater and may be increased by 33.3 percent for short durations of live and/or dynamic loading such as wind or seismic forces. If CIDH piles are spaced no closer than a distance of three (3) times the pile diameter on center, no reduction in load capacity is considered necessary for a group effect. If structural design results in closely spaced pile groups, the group action can be evaluated after the design loads and geometry are established. The CIDH piles should be reinforced based on the structural conditions. The CIDH piles should be structurally tied into the pile cap.

- CIDH piles should be 24-inches or greater in diameter and founded to a depth of 20 feet or greater into the alluvial material.

- It is estimated that settlement of CIDH pile foundations designed and constructed according to criteria presented in this report will not exceed 0.25 inches. The settlement is expected to occur rapidly at completion of the construction and application of the total dead and live loads for the first time.

- The CIDH piles should be designed for an allowable lateral bearing in the alluvial materials of 300 psf per foot of depth (equivalent fluid pressure for pole design) on the projected area of the pile under static conditions per Table 1806.2, 'Presumptive Load-Bearing Values,' for a Class 4 Material (SW, SP, SM, SC, GM, and GC) in the 2013 CBC. The largest recommended allowable lateral bearing pressure (passive earth resistance) is 15 times the recommended design value. Under seismic conditions, the upper 10 feet of the material on the subject site should be ignored in the calculation. The pile cap, if utilized, may be designed for a lateral bearing of 150 psf per foot of depth (equivalent fluid pressure) under static conditions when poured neat against the in-situ soil or when the void between a formed pile cap and the existing soils is documented backfilled compacted to 90 percent or greater relative compaction based on ASTM D1557 procedures. In-lieu of backfilling and compacting, the void can be cleaned of loose soil and debris and filled with a 1.5 to 2.0 sack per cubic yard sand / cement slurry mixture. If using CBC design procedures to resist lateral loads, the above recommended lateral bearing values should not be doubled since they are already based on lateral movements within normal tolerable limits.

- Proper construction of the CIDH piles will be important. Care in drilling, placement of reinforcing steel, and the placement of concrete are recommended to avoid excessive caving of the pile excavation walls. Concrete should be placed by pump and tremie methods. The bottom of the pump outlet in the pile should stay at a depth of 5.0 feet or greater below the top of the concrete surface. Concrete placement should start at the bottom of the pile and displace any water upward as the concrete is placed. Concrete should not be allowed to free-fall through the reinforcing steel. Pile construction and concrete placement procedures should be addressed in the project drawings and specifications.

- It appears that CIDH pile excavations can be advanced to the design depths. It is anticipated that cobbles (i.e., plus 3.0 inches in least dimension) and/or boulders (i.e., plus 12 inches in least dimension) may be encountered in the pile excavations. Some caving may occur in the sandier sections of the soil profile. Caving of the granular soils can be minimized by drilling beneath the bottom of a temporary liner and advancing the liner with the excavation. If temporary liners are used, they should be of steel. Wax coated cardboard tubs are not an acceptable substitute since the tubs can not be extracted once the concrete is in-place. Some additional concrete will be needed to reestablish the finish design elevation for the piles upon removal of the temporary liners. Vibrations in the soil due to drilling of adjacent piles could also cause a collapse of the boring walls of adjacent piles if temporary liners are not used and the piles are not filled with concrete immediately upon completion of the drilling process.

- Since end bearing is used in design of the CIDH piles, it will be necessary to drill the bottom 1.0 to 2.0 foot of the boring with a cleanout bucket or other approved equivalent method. Pile borings should be observed by the project Geotechnical Consultant and/or his representative during the drilling process to determine if the construction process is in compliance with the recommendations presented in this report and the project plans and specifications.

- The CIDH pile reinforcing cage should be installed and the concrete poured quickly after drilling is completed. Piles should not be left uncovered or open overnight for safety purposes. Sufficient space should be provided in the reinforcing cage during fabrication to allow the insertion of a pump pipe for concrete placement. Concrete should not be placed by hopper or other such device and allowed to free fall through the reinforcing cage. The concrete should be vibrated to achieve densification. The concrete should be designed, from a strength standpoint, so that the slump during placement is in the range of 4.0 to 6.0 inches.

EXTERIOR CONCRETE FLATWORK

Exterior concrete slabs cast on finish subgrade (i.e., pedestrian walkways, sidewalks, etc., with the exception of PCC pavement) should be 4.0 inches or greater in thickness and be underlain by 12 inches or greater of earth material that has been prepared in accordance with the 'Earthwork Recommendation' section of this report. Reinforcing in the slab, the design compressive strength of the concrete, and the use of a compacted sand or gravel base beneath the slabs should be according to the current codes and ordinances of the City of Rancho Cucamonga and/or San Bernardino County, California. Subgrade earth materials should be moisture conditioned to optimum moisture content to 3.0 percent above optimum moisture content to a depth of 12 inches or greater and proof compacted to 90 percent or greater relative compaction based on current ASTM D1557 procedures immediately before placing aggregate base material, placing reinforcing steel, or placing the concrete.

CORROSION POTENTIAL EVALUATION

The recommendations for corrosion protection should be verified at the time of grading for the site. A bulk sample of the near surface, on-site earth materials was obtained during the field study to evaluate the potential for corrosivity. Results from the test are included in the 'Summary of Laboratory Test Results' presented in Appendix 'A.'

Concrete Corrosion Potential

A preliminary test on a sample of near-surface, on-site earth material suggest a soluble sulfate concentration of 0.0028 percent. Earth materials with a water soluble sulfate (SO_4) concentration of less than 0.10 percent are considered to be Category S, Class S0 in accordance with Table 19.3.1.1, 'Exposure Categories and Classes,' in **American Concrete Institute (ACI)** 318-14. Therefore the requirements in Table 19.3.2.1, 'Requirements for Concrete by Exposure Class,' in **ACI** 318-14 are applicable. The referenced **ACI** Table 19.3.2.1 should be used to determine the type cement, the maximum water cement ratio, and the minium compressive strength to be used for normal weight concrete which comes in direct contact with the on-site earth materials (i.e., CIDH piles, etc.).

Experience in the southern California area has shown that even though the earth materials do not contain levels of soluble sulfate which would require the use of sulfate resistant cement, maximum water cement ratios, or minimum compressive strength for concrete, concrete corrosion and erosion problems still occur. These problems are the result of concentrations of soluble sulfate, chloride, and other salts and/or acids present in groundwater, irrigation water, rain water, and potable water sources, and in fertilizers or amendments used to promote plant growth (i.e., some domestic water sources contain levels of dissolved sulfate which would be a Class S1 exposure to concrete which comes in contact with it). Therefore, it may be wise to use a concrete designed for a Category S, Class S1, that comes into contact with surface run-off or other sources of water. Higher strength, lower water / cement ratio, and denser concrete may also be effective in reducing the potential for corrosion to occur and preventing damage due to salt or acid exposure. The use of sulfate resistant concrete for non-structural elements (i.e., driveway slabs, sidewalks, curbs / gutters, etc.), is considered to be a value / risk assessment and decision to be made by the owner.

Metallic Corrosion Potential

The life of buried metals depends on type of material, thickness, and construction details. If corrosion protection of metals in direct contact with the on-site earth materials is considered to be a design issue, tests should be performed at the completion of the grading for the subject site and/or an engineer specializing in corrosion should be consulted regarding the potential damage due to corrosion. The corrosion engineer should recommend appropriate types of piping and/or protective measures where needed.

A preliminary minimum resistivity test on a sample of the near-surface, on-site, earth material of 12,523 ohm-cm suggest a mild corrosive environment for buried ferrous metal in direct contact with the on-site earth materials when the earth materials are wet.

A preliminary test on a sample of near-surface, on-site, earth material suggests a soluble chloride concentration of 35 parts per million (ppm). Earth materials with greater than 300 and 500 ppm of soluble chloride are considered to be aggressive to buried ferrous and copper material, respectively, in direct contact with the earth materials.

Earth material pH is a general indicator of the corrosivity of earth materials. The measured pH of a sample of near-surface, on-site, earth material of 7.48 indicates a non-corrosive environment to copper and ferrous metals when in direct contact with the on-site earth materials.

Sulfide in soils is a general indicator of the corrosivity of earth materials. The measured sulfide of the samples of near-surface, on-site, earth material tested as part as part of this report was 'Negative' which indicates a non-corrosive environment to copper and ferrous metals when in direct contact with the on-site earth materials.

Salt Crystallization Exposure

Damage of concrete, concrete masonry units, slump stone block, etc. surface can occur when evaporation of moisture takes place at the surface of the materials. As evaporation takes place, salts (i.e,. carbonates, chloride, sulfur, sodium, potassium, etc.) are deposited in or form on the surfaces. As the salts crystalize, they can exert extreme pressures in the pore spaces of the materials they are deposited in and/or on. The formation of the crystals within the pore spaces of the material can result in what is generally called 'salt crystallization damage.' This results in the scaling and/or etching of the surface of the material on which they are deposited. The damaging effects of this phenomenon can be greatly reduced and/or even eliminated by the following or other such methods: 1) either using a higher strength concrete or a denser, low porosity product; 2) seal the surface of the material with a water proofing substance which will prevent the evaporation of the moisture from within the cementitious product. If 'salt crystallization damage' is considered to be an issue, an engineer or chemist specializing in this area should be consulted regarding the potential damage due evaporation and the deposition of salts. The engineer or chemist should recommend appropriate types of materials or protective measures where needed.

UTILITY TRENCH RECOMMENDATIONS

Utility trenches within the zone of influence of foundations or under exterior hardscape and/or pavement areas should be backfilled with documented, compacted earth material. Where exterior utility trenches are proposed to pass beneath or parallel to building, retaining wall, and/or decorative concrete block perimeter wall footings, the bottom of the trench should not be located below a 1H:1V (Horizontal to Vertical) plane projected downward from the outside bottom edge of the adjacent footing unless the utility lines are designed for the footing surcharge loads.

Trench Excavation

It is recommended that utility trench excavations be designed and constructed in accordance with current OSHA regulations. These regulations provide trench sloping and shoring design parameters for trenches up to 20 feet in vertical depth based on a description and field verification of the earth material types encountered. Trenches over 20 feet in vertical depth should be designed by the Contractor's Engineer based on site specific geotechnical analyses. For planning purposes, we recommend that the following OSHA earth material type designations and temporary slope inclinations be used:

EARTH MATERIAL	OSHA SOIL TYPE*	TEMPORARY SLOPE INCLINATION (H:V)**
Undocumented Fill	C	1.5:1
Compacted Fill	C	1.5:1
Alluvium	C	1.5:1

* Type 'C': Cohesive soils with an unconfined compressive strength of 0.5 tsf or less: or Granular soils including sands, gravels, loamy, clayey or silty sands, etc.

** Steepest allowable slopes for excavations less than 20 feet in vertical height. Slopes for excavations greater than 20 feet in vertical height should be designed by a Registered Professional Engineer with experience in Geotechnical Consulting and Soil Mechanics.

Excavations of less than 5.0 feet in depth may also be subject to collapse due to water, vibrations, previously disturbed earth materials, or other factors and may require protection for workers such as temporary slopes, shoring, or a shielding protective system. The excavations should be observed by a qualified, competent person (as defined in the current OSHA regulations) looking for signs of potential cave-ins on a daily basis before start of work, as needed throughout the work shifts, and after every rainstorm or other hazard-increasing occurrence.

Surcharge loads (i.e., spoil piles, earthmoving equipment, trucks, etc,) should not be allowed within a horizontal distance measured from the top of the excavation slope equivalent to 2.0 times the vertical depth of the excavation. Excavations should be initially observed by the project Geotechnical / Geologic Consultant and/or his representative to verify the recommendations presented or to make additional recommendations to maintain stability and safety. Moisture variations, differences in the cohesive or cementation characteristics, or changes in the coarseness of the deposits may require slope flattening or, conversely, permit steepening upon review and appropriate testing by the project Geotechnical /

Geologic Consultant and/or his representative. The excavations should be observed by a qualified, competent person (as defined in the current OSHA regulations) looking for signs of potential problems on a daily basis before start of work, as needed throughout the work shifts, and after every rainstorm or other hazard-increasing occurrence. Deep utility trenches may experience caving which will require special considerations to stabilize the walls and expedite trenching operations. Surface drainage should be controlled along the top of the construction slopes to preclude erosion of the slope face. If excavations are to be left open for long periods, the slopes should be sprayed with a protective compound and/or covered to minimize drying out, raveling, and/or erosion of the slopes.

Utility Line Foundation Preparation

If the utility trench excavation bottom is in material that is not suitable for support of the utility pipe, the material should be removed to a minimum depth of 1.0 foot below the bottom of the pipe and replaced with concrete slurry, sand, or crushed gravel meeting the following appropriate gradation limits.

SIEVE SIZE	CRUSHED ROCK OR GRAVEL (PERCENT PASSING)
1"	100
3/4"	90-100
½"	30-60
3/8"	0-20
No. 4	0-5

SIEVE SIZE	SAND (PERCENT PASSING)
3/8"	100
No. 4	75-100
No. 30	12-50
No. 100	5-20
No. 200	0-15

Most of the granular native earth materials encountered on the subject site **are not** expected to meet the above granular earth material criteria.

We recommend, that where the bottom of the pipe foundation excavation is loose or soft, the foundation earth materials be removed to firm materials as determined by the Engineer. This condition would likely only apply where fill underlies the pipe in localized areas along a utility alignment. If firm material is not encountered within 24 inches of the bottom of the pipe zone, the contractor may then elect to stabilize the trench bottom with 24 inches of crushed rock as described above. Alternately, soft or loose material may be excavated to firm earth material and the overexcavation replaced with select earth material.

The bottom of the utility trench excavation should be proof compacted to 90 percent or greater relative compaction prior to placement of compacted fill. Maximum dry density and optimum moisture content for compacted materials should be determined according to current ASTM D1557 procedures.

Prior to placement of trench slurry or crushed rock, the bottom need only be cleaned of loose materials created by the excavation process. Where the bottom of the trench contains rocks or hard objects protruding above a depth of 6.0 inches below the pipe bottom, such objects should be removed or broken and any resulting cavities filled to produce a smooth surface.

Bedding Requirements

It is recommended that the pipe be bedded on either clean sand, gravel, crushed rock or any approved suitable material in order to provide a smooth, firm, and uniform foundation for the pipe. The pipe bedding material, thickness, shaping, and placement should satisfy the design requirements as determined by the design Civil Engineer and/or in accordance with Section 306-1.2.1 of the 2012 Edition of the 'Greenbook' with the 2014 Cumulative Supplement. The majority of the man-made fills and alluvial soils on the subject site may not be suitable to be used as bedding and pipe zone backfill materials depending upon the bedding and pipe zone backfill specifications required by the project designer and/or the agency having jurisdiction over the utility line.

Trench Zone Backfill

The excavated earth materials from the trench may be used as backfill in the trench zone unless more restrictive specifications are required by the design engineer or the permitting agency. The trench backfill material should consist of approved earth materials free of trash debris, vegetation or other deleterious matter, and oversize particles (i.e., 3.0 inch in maximum dimension). Trench zone backfill should be compacted to 90 percent or greater relative compaction. Maximum density and optimum moisture content for compacted materials should be determined according to current ASTM D1557 procedures.

Trench backfill material should be placed in a lift thickness appropriate for the type of backfill material and compaction equipment used. Backfill material should be brought to optimum moisture content to 3.0 percent above optimum moisture content and compacted to 90 percent or greater relative compaction by mechanical means. Jetting or flooding of the backfill material will **not** be considered a satisfactory method for compaction. Maximum dry density and optimum moisture content for backfill material should be determined according to current ASTM D1557 procedures.

FINISH SURFACE DRAINAGE RECOMMENDATIONS

Positive drainage should be established away from the exterior walls of structures, the back of retaining walls, decorative concrete block walls, etc. Finish surface gradients in unpaved areas should be provided next to buildings to guide surface water away from foundations, hardscape, and pavement. The surface water should be directed toward adequate drainage facilities. Ponding of surface water should not be allowed next to structures or on pavements. Design criteria for finish lot drainage away from structures and off the site should be determined by the project Structural Engineer designing the foundations and slabs in conjunction with the project Civil Engineer designing the precise grading for project drainage, respectively, in accordance with the 2013 CBC and/or the current City of Rancho Cucamonga or San Bernardino County, California codes and ordinances and the earth material types and expansion characteristics for the earth materials contained in this report. Finished landscaped and hardscape or pavement grades adjacent to the proposed structures should maintain a vertical distance below the bottom elevation of the weep screed per the 2013 CBC and/or the current City of Rancho Cucamonga or San Bernardino County codes and ordinances. Landscape plants with high water needs and trees should be planted at a distance away from the structure equivalent to or greater than the width of the canopy of the mature tree or 6.0 feet, whichever is greater. Downspouts from roof drains should discharge to a permanent all-weather surface which slopes away from the structure. Downspouts from roof drains should not discharge into planter areas immediately adjacent to the building unless there is positive drainage out of the planter and away from the structure in accordance with the recommendations of the project foundation and slab designer and/or the project Civil Engineer designing the precise grades for the lot drainage.

LIMITATIONS

REVIEW, OBSERVATION, AND TESTING

The recommendations presented in this report are contingent upon review of final plans and specifications for the project by **HGI**. The project Geotechnical / Geologic Consultant should review and verify in writing the compliance of the final grading plan and the final foundation plans with the recommendations presented in this report.

It is recommended that **HGI** be retained to provide continuous Geotechnical / Geologic Consulting services during the earthwork operations (i.e., rough grading, utility trench backfill, subgrade preparation for slabs-on-grade and pavement areas, finish grading, etc.) and foundation installation process. This is to observe compliance with the design concepts, specifications and recommendations and to allow for design changes in the event that subsurface conditions differ from those anticipated prior to start of construction. If **HGI** is replaced as Geotechnical / Geologic Consultant of record for the project, the work on the project should be stopped until the replacement Geotechnical / Geologic Consultant has reviewed the previous reports and work performed for the project, agreed in writing to accept the recommendations and prior work performed by **HGI** for the subject project, or has submitted their revised recommendations.

UNIFORMITY OF CONDITIONS

The recommendations and opinions expressed in this report reflect our understanding of the project requirements based on an evaluation of subsurface earth material conditions encountered at the subsurface exploration locations and the assumption that earth material conditions do not deviate appreciably from those encountered. It should be recognized that the performance of the foundations may be influenced by undisclosed or unforeseen variations in earth material conditions that may occur in intermediate and unexplored areas. Any unusual conditions not covered in this report that may be encountered during site development should be brought to the attention of the **HGI** so that we may make modifications, if necessary.

CHANGE IN SCOPE

HGI should be advised of any changes in the project scope of proposed site grading so that it may be determined if recommendations contained herein are valid. This should be verified in writing or modified by a written addendum.

TIME LIMITATIONS

The findings of this report are valid as of this date. Changes in the condition of a property can, however, occur with the passage of time, whether they be due to natural processes or the work of man on this or adjacent properties. In addition, changes in the State-of-the-Art and/or government codes may occur. Due to such changes, the findings of this report may be invalidated wholly or in part by changes beyond our control. Therefore, this report should not be relied upon after a period of two (2) years without a review by **HGI** verifying the validity of the conclusions and recommendations.

PROFESSIONAL STANDARD

In the performance of our professional services, we comply with the standard of care and skill ordinarily exercised under similar circumstances by members of the geologic / geotechnical professions currently practicing under similar conditions and in the same locality. The client recognizes that subsurface conditions may vary from those encountered at the locations where our surveys and exploratory excavations were made, and that our data, interpretations, and recommendations are based solely on information obtained by us. We will be responsible for those data, interpretations, and recommendations, but should not be responsible for interpretations by others of the information presented and/or developed. Our services consist of professional consultation and observation only, and other warranties, expressed or implied, are not made or intended in connection with work performed by **HGI** or by the proposal for consulting or other services or by the furnishing of oral or written reports or findings.

CLIENT'S RESPONSIBILITY

It is the responsibility of the client and/or the client's representatives to ensure that information and recommendations contained herein are brought to the attention of the Engineers and Architect for the project and incorporated into project plans and specifications. It is further their responsibility to take measures so that the contractor and his subcontractors carry out such recommendations during construction.

APPENDIX A

FIELD EXPLORATION

The field study performed for this report included a visual reconnaissance of existing surface conditions of the subject site and surrounding area. Site observations were conducted on May 15, 2015 by a representative of **HGI**.

A study of the property's subsurface condition was performed to evaluate underlying earth strata and the presence of groundwater. One (1) exploratory boring excavation was performed in the area of the proposed structures on the subject site on May 15, 2015. The location of the exploratory excavation was determined in the field by sighting from the adjacent existing streets and adjacent structures as shown on the Reference No. 1, '*Site Plan*' noted on the first page of the cover letter for this report. The approximate location of the exploratory excavations is denoted on the 'Exploratory Excavation Location Plan,' Plate No. 1, presented in this Appendix. The approximate elevation at the location of the exploratory excavation was determined from the Google Earth Website (http://www/google.com/earth). The location and elevation of the exploratory excavation should be considered accurate only to the degree implied by the method used in determining it.

The exploratory boring was performed by using a truck-mounted drill rig equipped with 8-inch outside-diameter, hollow-stem augers. The exploratory excavation were explored to a depth of approximately 51.5 feet below existing ground surface at the excavation locations. Bulk and relatively undisturbed samples of encountered earth materials were obtained at various depths in the exploratory excavations and returned to our laboratory for testing and verification of field classifications. The bulk sample was obtained from cuttings developed during the excavation process and represent a mixture of earth materials within the depth indicated on the logs. Relatively undisturbed samples of encountered earth materials were obtained by driving a thin-walled, steel sampler lined with 1-inch high, 2.416-inch inside diameter brass rings. The sampler was driven with successive drops of a 140-pound weight having a free fall of approximately 30 inches. Blow counts for each successive 6.0 inches of penetration, or fraction thereof, are shown on the 'Subsurface Exploration Log,' Plate Nos. 3a through 3c, presented in this Appendix. Ring samples were retained in close-fitting moisture-proof containers and returned to our laboratory for testing.

Groundwater observations were made during, and at the completion of the excavation process and are noted on the 'Subsurface Exploration Log' presented in this Appendix, if encountered.

The exploratory excavation was logged by a representative of **HGI** for the earth materials and subsurface conditions encountered. Earth materials encountered in the exploratory excavation were visually described in the field in general accordance with the current Unified Soils Classification System (USCS), ASTM D2488, visual-manual procedures, as illustrated on the attached, simplified 'Subsurface Exploration Legend,' Plate No. 2, presented in this Appendix. The visual textural description, color of the earth material at natural moisture content, apparent moisture condition of the earth materials, etc., were recorded on the field log. The field log for the excavation contains factual information and interpretation of earth material conditions between samples. The 'Subsurface Exploration Log' presented in this Appendix represent the interpretation of the field log contents and results of laboratory observations and tests performed on samples obtained in the field from the exploratory excavation.

The exploratory excavation was backfilled with excavated earth materials and with reasonable effort to restore the area to the initial condition before leaving the site.

LABORATORY TESTING PROGRAM

Laboratory tests were performed on selected bulk samples obtained from exploratory excavations during the field study. Tests were performed in general accordance with generally accepted American Society for Testing and Materials (ASTM), State of California - Department of Transportation (CALTRANS), Environmental Protection Agency (EPA) or other suitable test methods or procedures. The remaining samples obtained during the field study will be discarded 30 days after the date of this report. This office should be notified immediately if retention of samples will be needed beyond 30 days. A brief description of the tests performed is presented below:

CLASSIFICATION

The field classification of earth material materials encountered in the exploratory excavation was verified in the laboratory in general accordance with the current Unified Soils Classification System, ASTM D2488, 'Standard Practice for Determination and Identification of Soils (Visual-Manual Procedures).' The final classification is shown on the 'Subsurface Exploration Log,' Plate Nos. 3a through 3c, presented in this Appendix.

IN-SITU MOISTURE CONTENT AND DRY DENSITY

The in-situ moisture content and dry density were determined in general accordance with current ASTM D2216 (Moisture Content) and D2937 (Drive Cylinder) procedures, respectively, for selected undisturbed samples obtained. This information was an aid to classification and permitted recognition of variations in material consistency with depth. The dry density is determined in pounds per cubic foot and the moisture content is determined as a percentage of the oven dry weight of the earth material. Test results are shown on the

'Subsurface Exploration Log,' Plate Nos. 3a through 3c, presented in this Appendix.

SOLUBLE SULFATE TEST

The concentration of soluble sulfate was determined on a selected sample of near-surface earth material in general accordance with current EPA 300.0 procedures. The test results are summarized in the 'Summary of Laboratory Test Results,' Plate No. 4, presented in this Appendix.

SIEVE ANALYSIS

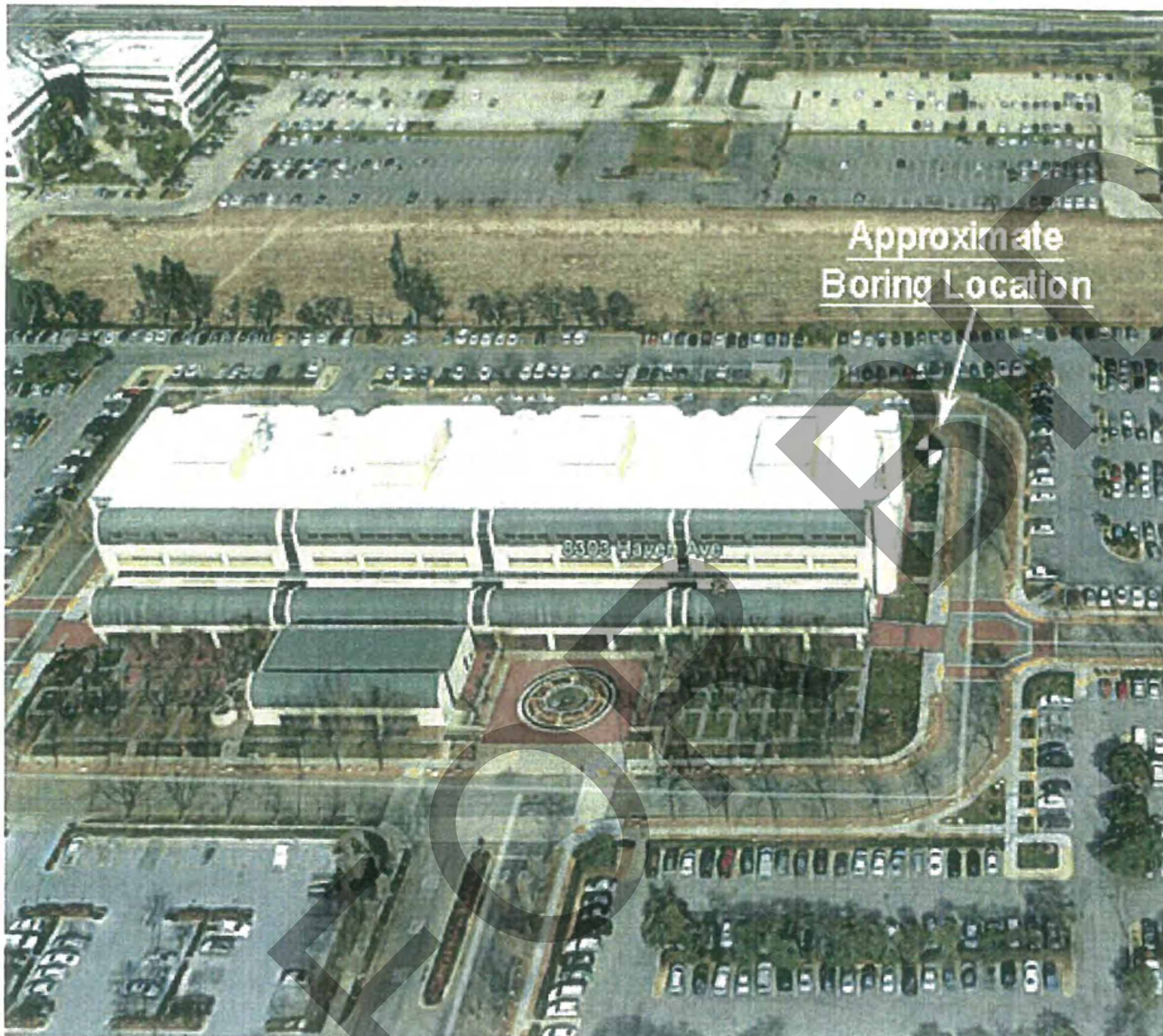
The percent by weight finer than a No. 200 sieve (silt and clay content) was determined for a selected sample of earth material in general accordance with current ASTM D1140 procedures. The test is performed by taking a known weight of an oven dry sample of earth material, washing it over a No. 200 sieve, and oven drying the earth material retained on the No. 200 sieve. The dry weight of earth material retained on the No. 200 sieve is measured and the resulting percentage retained is calculated based on the original total dry earth material sample weight. The percent passing the No. 200 sieve is determined by subtracting the percent retained from 100. The test result is summarized in the 'Summary of Laboratory Test Results,' Plate No. 4, presented in this Appendix.

CHEMICAL AND MINIMUM ELECTRICAL RESISTIVITY

The concentration of soluble chloride, pH, as well as other chemical constituents and the minimum electrical resistivity were determined for a selected sample of near-surface earth material. The pH test was performed in general accordance with current EPA 9045C procedures. The test results are summarized in the 'Summary of Laboratory Test Results,' Plate No. 5, presented in this Appendix.

MAXIMUM DRY DENSITY / OPTIMUM MOISTURE CONTENT RELATIONSHIP TEST

A maximum dry density / optimum moisture content relationship determination was performed on a sample of near-surface earth material in general accordance with current ASTM D1557 procedures using a 4-inch diameter mold. Samples were prepared at various moisture contents and compacted in five (5) layers using a 10-pound weight dropping 18 inches and with 25 blows per layer. A plot of the compacted dry density versus the moisture content of the specimens was constructed and the maximum dry density and optimum moisture content determined from the plot. The test results are summarized in the 'Maximum Dry Density / Optimum Moisture Content Relationship Test Results,' Plate No. 6, presented in this Appendix.



N

Reference: **Unauthored**, January 1, 2015, Untitled '*Google Earth Image*', Not to Scale.

HILLTOP GEOTECHNICAL INCORPORATED	EXPLORATORY EXCAVATION LOCATION PLAN	
	By: AH	Date: 6/2015
	Project No.: 215-AR15.1	Plate No.: 1

SUBSURFACE EXPLORATION LEGEND

UNIFIED SOIL CLASSIFICATION SYSTEM
Visual-Manual Procedure (ASTM D2488-09a)

MAJOR DIVISIONS			GROUP SYMBOLS	TYPICAL NAMES
Coarse-Grained Soils* More than 50 % Retained on No. 200 Sieve	Gravels 50 % or more of Coarse Fraction Retained on No. 4 Sieve	Clean Gravels	GW	Well Graded Gravels and Gravel-Sand Mixtures, Little or no Fines
			GP	Poorly Graded Gravels and Gravel-Sand Mixtures, Little or no Fines
		Gravels with Fines	GM	Silty Gravels, Gravel-Sand-Silt Mixtures**
			GC	Clayey Gravel, Gravel-Sand-Clay Mixtures**
	Sands More than 50 % of Coarse Fraction Passes No. 4 Sieve	Clean Sands	SW	Well Graded Sands and Gravely Sands, Little or no Fines
			SP	Poorly Graded Sands and Gravelly Sands, Little or no Fines
		Sands with Fines	SM	Silty Sands, Sand-Silt Mixtures**
			SC	Clayey Sands, Sand-Clay Mixtures**
Fine Grained Soils* 50 % or more Passes No. 200 Sieve	Silts and Clays Liquid Limits 50 % or less		ML	Inorganic Silts, Sandy Silts, Rock Flour
			CL	Inorganic Clays of Low to Medium Plasticity, Gravelly Clays, Sandy Clays, Silty Clays, Lean Clays
			OL	Organic Silts and Organic silty Clays of Low Plasticity
	Silts and Clays Liquid Limits Greater than 50 %		MH	Inorganic Silts, Micaceous or Diatomaceous silts, Plastic Silts
			CH	Inorganic Clays of High Plasticity, Fat Clays
			OH	Organic Clays of Medium to High Plasticity
Highly Organic Soils			PT	Peat, Muck, or Other Highly Organic Soils

CONSISTENCY / RELATIVE DENSITY

CRITERIA

Reference: 'Foundation Engineering', Peck, Hansen, Thornburn, 2nd Edition.

Standard Penetration Test
Granular Soils

Penetration Resistance, N, (Blows / Foot)	Relative Density
0 - 4	Very Loose
5 - 10	Loose
11 - 30	Medium Dense
31 - 50	Dense
> 50	Very Dense

Standard Penetration Test
Cohesive Soils

Penetration Resistance, N, (Blows / Foot)	Consistency	Unconfined Compressive Strength, (Tons / Sq. Ft.)
< 2	Very Soft	< 0.25
2 - 4	Soft	0.25 - 0.5
5 - 8	Firm (Medium Stiff)	0.5 - 1.0
9 - 15	Stiff	1.0 - 2.0
16 - 30	Very Stiff	2.0 - 4.0
> 31	Hard	> 4.0

* Based on material passing the 3-inch sieve.

** More than 12% passing the No. 200 sieve; 5% to 12% passing No. 200 sieve requires use of duel symbols (i.e., SP-SM., GP-GM, SP-SC, GP-GC, etc.); Border line classifications are designated as CH/CI, GM/SM, SP/SW, etc.

U.S. Standard Sieve Size	12"	3"	3/4"	#4	#10	#40	#200	
Unified Soil Classification Designation	Boulders	Cobbles	Gravel		Sand			Silt and Clay
			Coarse	Fine	Coarse	Medium	Fine	

Moisture Condition

Dry	Absence of moisture, dusty, dry to the touch.
Moist	Damp but no visible moisture.
Wet	Visible free water, usually below the water table.

Material Quantity

Trace (Few)	< 5 %
Slight	5 - 10%
Little	15 - 25%
Some	30 - 45 %

Other Symbols

C - Core Sample
S - SPT Sample
B - Bulk Sample
CK - Chunk Sample
R - Ring Sample
N - Nuclear Gauge Test
∇ - Water Table

HILLTOP GEOTECHNICAL INCORPORATED

(Revised 7-10-2013)

Hilltop Geotechnical

SUBSURFACE EXPLORATION LOG
BORING NO. B-1

Project Name:	8303 Haven Avenue, 800 MHz Antenna Project				
Project No.	215-AR15.1	Date:	5/15/2015	Logged By:	AH
Type of Rig:	Hollow-Stem Auger	Drive Wt.:	140 lb	Elevation:	± 1201
Drill Hole Dia.:	8 in.	Drop:	30 in.	Depth of Boring (ft.):	51.5

Depth (ft.)	Sample Type	Penetration Resistance	Soil Classification	Dry Density (lb/ft3)	Moisture Content (%)	Lithology	Groundwater	Description
0	R/B	8	SM			af		ARTIFICIAL FILL:
1		17						Silty, fine to medium sand, trace coarse sand, trace gravel, trace roots;
		27						Dark brown; Medium dense to loose.
2								
3	R	13						Trace thin lenses of gray-brown fine sand.
		15						
4		18		105.7	5.6			
5	R	4						
6		5						
		6						
7			SM			Qf_2		YOUNG ALLUVIAL DEPOSITS:
8	R	9						Silty, fine to medium sand, trace coarse sand; a little caliche, slightly
		12						porous; Brown; Moist; Medium dense.
9		12		104.3	5.1			
10								Drill chatter: Possible cobble and/or boulder encoutnered.
11								
12								
13	R	12						A little gravel.
		25						
14		22						
15	R	28	SP					Gravelly, fine to coarse sand, trace silt; Gray-brown; Moist; Very dense.
16		32						
		42		141.4	1.0			
17								
18								
19			GP					Drill chatter; gravels to cobbles observed in cuttings.
20	R	50/3"		N.R.				
21								
22			SP					Fine to medium sand, trace coarse sand, trace gravels; Gray-brown; Moist; Medium dense.
23								
24								
25								

S - SPT Sample R - Ring Sample B - Bulk Sample N - Nuclear Gauge Test D - Disturbed Sample

N.R. - No Recovery

Plate No. 3a

HILLTOP GEOTECHNICAL

SUBSURFACE EXPLORATION LOG
BORING NO. B-1 (CONT.)

Project Name:	8303 Haven Avenue, 800 MHz Antenna Project				
Project No.	215-AR15.1	Date:	5/15/2015	Logged By:	AH
Type of Rig:	Hollow-Stem Auger	Drive Wt.:	140 lb	Elevation:	± 1201
Drill Hole Dia.:	8 in.	Drop:	30 in.	Depth of Boring (ft.):	51.5

Depth (ft.)	Sample Type	Penetration Resistance	Soil Classification	Dry Density (lb/ft3)	Moisture Content (%)	Lithology	Groundwater	Description
25–26	R	13, 16, 20	SP			Qf2		YOUNG ALLUVIAL DEPOSITS (CONT.); Fine to medium sand, trace coarse sand, trace gravels; Gray-brown; Moist; Medium dense.
28			SP					Gravelly, fine to coarse sand, trace silt; Orange-brown; Moist; Dense to very dense.
30–31	R	16, 29, 25		106.9	2.1			
35–36	R	27, 35, 35						
40	R	50/4"		111.5	2.6			Trace fine to medium sand lenses.
45–46	R	39, 33, 27	SM					Silty, fine sand; Brown; Moist; Dense.
47			SP					Fine to medium sand, trace coarse sand; Dark brown; Moist; Very dense.

S - SPT Sample R - Ring Sample B - Bulk Sample N - Nuclear Gauge Test D - Disturbed Sample

N.R. - No Recovery

Hilltop Geotechnical Incorporated

SUBSURFACE EXPLORATION LOG
BORING NO. B-1 (CONT.)

Project Name:	8303 Haven Avenue, 800 MHz Antenna Project				
Project No.	215-AR15.1	Date:	5/15/2015	Logged By:	AH
Type of Rig:	Hollow-Stem Auger	Drive Wt.:	140 lb	Elevation:	± 1201
Drill Hole Dia.:	8 in.	Drop:	30 in.	Depth of Boring (ft.):	51.5

Depth (ft.)	Sample Type	Penetration Resistance	Soil Classification	Dry Density (lb/ft3)	Moisture Content (%)	Lithology	Groundwater	Description
	R	18	SP			Qf2		YOUNG ALLUVIAL DEPOSITS (CONT.):
51		27						Fine to medium sand, trace coarse sand; Dark brown; Moist; Very dense.
		27		101.4	7.8			
52								Bottom of boring at 51.5 feet.
								No groundwater encountered.
53								Boring backfilled with excavated material.
54								
55								
56								
57								
58								
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60								
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62								
63								
64								
65								
66								
67								
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72								
73								
74								
75								

S - SPT Sample R - Ring Sample B - Bulk Sample N - Nuclear Gauge Test D - Disturbed Sample

N.R. - No Recovery

SUMMARY OF LABORATORY TEST RESULTS

800 MEGAHERTZ ANTENNA PROJECT FOR THE SAN BERNARDINO COUNTY CRIMINAL COURTS FACILITY 8303 HAVEN AVENUE CITY OF RANCHO CUCAMONGA SAN BERNARDINO COUNTY, CALIFORNIA

SOLUBLE SULFATE TEST RESULTS (EPA 300.0 Test Procedure)*		
SAMPLE	SOLUBLE SULFATE CONTENT (%)	CLASS**
B-1, 1.0'-1.5'	0.0028	S0

* Test performed by **A & R Laboratories**.

** Per Table 19.3.1.1, 'Exposure Categories and Classes,' in **American Concrete Institute (ACI)** 318-14.

PERCENT PASSING #200 SIEVE TEST RESULTS (ASTM D1140 Test Method)		
SAMPLE	EARTH MATERIAL DESCRIPTION	PERCENT PASSING #200 SIEVE
B-1, 1.0'-1.5'	Brown, silty, fine to medium sand, trace coarse sand, trace gravel (SM)	28

SUMMARY OF LABORATORY TEST RESULTS

800 MEGAHERTZ ANTENNA PROJECT
FOR THE SAN BERNARDINO COUNTY
CRIMINAL COURTS FACILITY
8303 HAVEN AVENUE
CITY OF RANCHO CUCAMONGA
SAN BERNARDINO COUNTY, CALIFORNIA

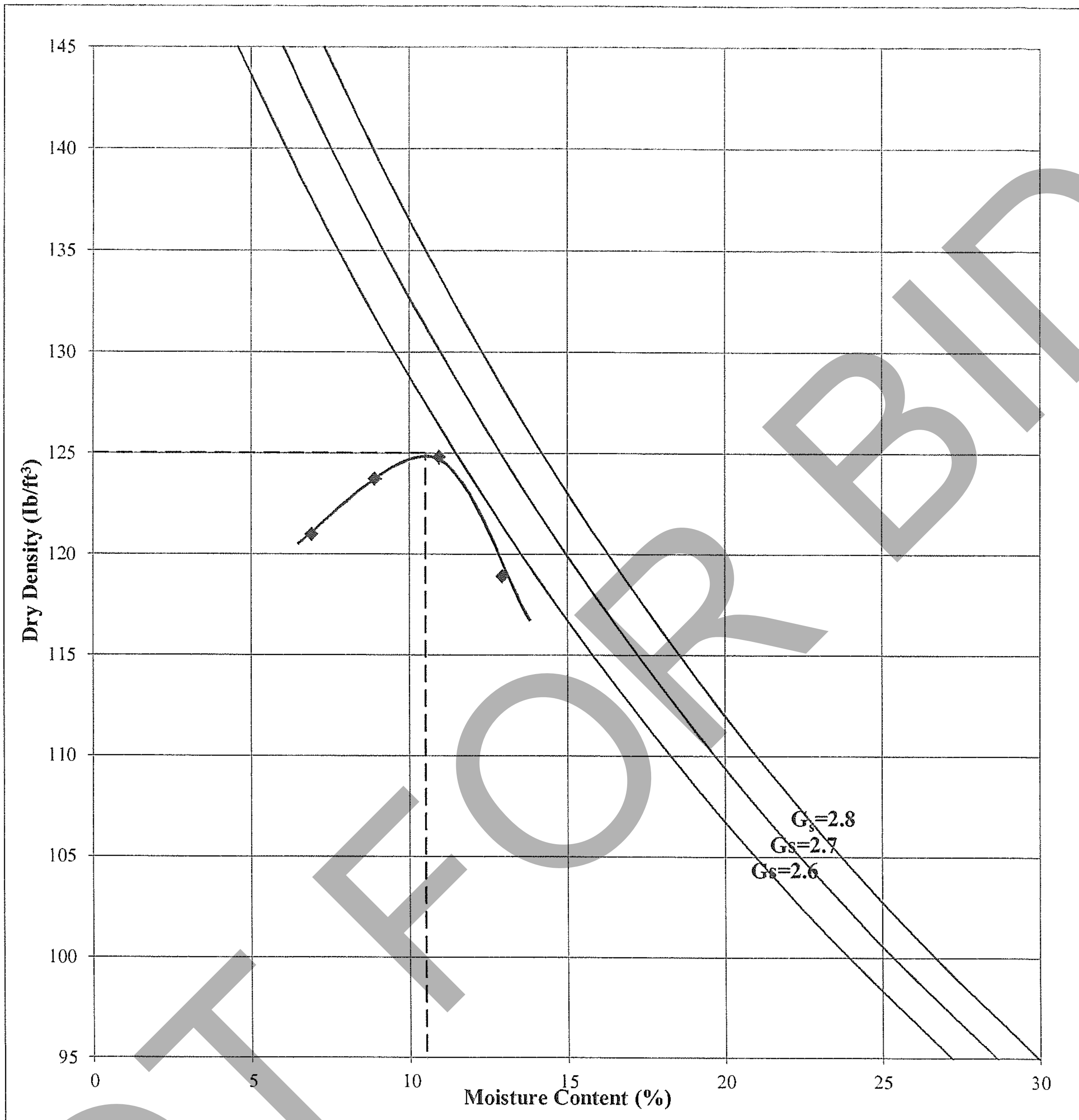
CHEMICAL / MINIMUM ELECTRICAL RESISTIVITY TEST RESULTS

SAMPLE	RESISTIVITY Minimum (ohm-cm)	pH*	SULFIDE	CHLORIDE (ppm)**
B-1, 1.0'-1.5'	12,523	7.48	Neg.***	35

* Test performed by **A & R Laboratories** in accordance with EPA 9045C procedures.

** Test performed by **A & R Laboratories** in accordance with EPA 300.0 procedures.

*** Neg. - Negative.



Maximum Dry Density (lb/ft^3)	125.0
Optimum Moisture Content (%)	10.5
Procedure	A

HILLTOP GEOTECHNICAL
INCORPORATED

MAXIMUM DRY DENSITY / OPTIMUM MOISTURE CONTENT RELATIONSHIP TEST RESULTS (ASTM D1557 Test Method)

SAMPLE: B-1`, 0'-5'			
SOIL DESCRIPTION:	Dark brown, silty, fine to medium sand, trace coarse sand, trace gravel (SM)		
BY:	DLC	DATE:	6/2015
JOB NO.:	215-AR15.1	PLATE NO.:	6

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