Draft Initial Study and Mitigated Negative Declaration Rancho Cielito Residential Development Project

APPENDIX E

Appendix E – Geotechnical/Geologic Study

REPORT OF
GEOTECHNICAL / GEOLOGIC STUDY
PROPOSED RESIDENTIAL DEVELOPMENT
NORTH OF LOS SERRANOS BLVD. /
BIRD FARM RD.
BETWEEN PIPELINE AVE. & RAMONA AVE.
CITY OF CHINO HILLS
SAN BERNARDINO COUNTY, CALIFORNIA

PROJECT NO.: 982-A14 REPORT NO.: 4

SEPTEMBER 29, 2017

SUBMITTED TO:

ROLLING RIDGE RANCH c/o MESA BLUFFS DEVELOPMENT COMPANY, LLC 700 E. REDLANDS BLVD., STE. U-209 REDLANDS, CA 92373

PREPARED BY:

HILLTOP GEOTECHNICAL, INC. 786 SOUTH GIFFORD AVENUE SAN BERNARDINO, CA 92408



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September 29, 2017

Rolling Ridge Ranch c/o Mesa Bluffs Development Company, LLC 700 E. Redlands Blvd., Ste. U-209 Redlands, CA 92373

Attention: Mr. Louis R. Fernandez

Subject: Report of Geotechnical / Geologic Site Study, Proposed Residential

Development, North of Los Serranos Blvd. / Bird Farm Rd., Between Pipeline Ave. & Ramona Ave., City of Chino Hills, San Bernardino

Project No.: 982-A14

Report No.: 4

County, California.

References: 1. Hilltop Geotechnical, Inc., April 9, 2015, Report of Geotechnical/Geologic Site Feasability Evaluation, The Lake Property, Proposed Residential Development, North of Los Serranos Blvd. / Bird Farm Rd., Between Pipeline Ave. & Ramona Ave., City of Chino Hills, San Bernardino County, California, Project No.: 982-A14, Report No.: 4.

- 2. Pioneer Consultants, November 25, 1985, Preliminary Soils Investigation, Proposed Residential Development, North Side of Los Serranos Boulevard and Bird Farm Road, Lake Los Serranos Club Area, San Bernardino County, California, Project No.: 4021-002.
- 3. Hilltop Geotechnical, Inc., May 22, 2015, Report of Fault Investigation, The Lake Property, Proposed Residential Development, North of Los Serranos Blvd. / Bird Farm Rd., Between Pipeline Ave. & Ramona Ave., City of Chino Hills, San Bernardino County, California, Project No.: 982-A14, Report No.: 2.

- 4. City of Chino Hills, Reviewed by GMU Geotechnical, Inc., May 18, 2016, Geotechnical Review Sheet, Request Additional Data For Review, TDA No.: 160396, GMU Reference No. CH15-04.
- 5. Hilltop Geotechnical, Inc., January 24, 2017, Response to City of Chino Hills Geotechnical Report Review, The Lake Property, Proposed Residential Development, North of Los Serranos Blvd. / Bird Farm Rd., Between Pipeline Ave. & Ramona Ave., City of Chino Hills, San Bernardino County, California, Project No.: 982-A14, Report No.: 3.
- 6. City of Chino Hills, Reviewed by GMU Geotechnical, Inc., February 7, 2017, Geotechnical Review Sheet, Conditions of Approval, TDA No.: 160396, GMU Reference No. CH15-04.
- 7. **Engineering Solutions**, September 14, 2017, Unsigned, Unapproved by the **City of Chino Hills**, *The Lake Property Site Plan*, Scale: 1" = 100', Sheet 1 of 1.
- 5. Technical References See Appendix 'B.'

Gentlemen:

According to your request, we have completed a geotechnical / geologic study for the design and construction of the proposed residential development. We are presenting, herein, our findings and recommendations. This geotechnical / geologic study update supercedes the Reference No. 1 'Report of Geotechnical / Geologic Site Feasability Evaluation' in its entirety.

The findings of this study indicate that the project site is suitable for the proposed residential 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 CD containing a pdf

copy of this report and the other required documentation to the appropriate agency having jurisdiction over the project for review and 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 IN

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Dec 12-3/-1

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EXECUTIVE SUMMARY

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

Based on a review of the field exploration, laboratory test results, and geotechnical / geologic analysis, the subject site appears to be suitable for the proposed development provided the conclusions, comments, and recommendations presented in the following report are implemented. The primary development considerations are summarized as follows:

- Generally, the site may be characterized as being underlain by surficial documented and undocumented fill material (af), colluvium (Col), young alluvial fan deposits (Q_{yf3}) , very old alluvial fan deposits (Q_{vof}) , and Puente Formation, Yorba Member, bedrock (T_{py}) .
- This study indicated that there are no geologic hazards such as active faults, landsliding, liquefaction, seismic induced subsidence, lateral spreading, seiching, or tsunamis that are of concern to the development of the subject site.
- This study indicated that there is shallow, perched groundwater in the lower elevations of the site that may be of concern to excavations (i.e., overexcavations and replacements, basements, etc.), utility trench construction, groundwater retention basins, etc. De-watering or lowering of the lake level to some extent may be temporarily necessary to allow overexcavation to be conducted. Additionally, buildings in the western portion of the site at elevations closest to the lake may require deep foundations.
- The near-surface earth materials on the subject site exhibit an expansion potential in accordance with the criteria presented in Section 1803.5.3, 'Expansive Soil,' in the 2016 CBC. Therefore, a deepened foundation system with pre saturation under the slab or a 'Slab-on-Ground Foundation' system per the Wire Institute design method for sites with expansive soils or 'Post-

Tensioned Slab-on-Ground' foundation system per the Post-Tension Institute design method will be required for the development of the site.

- The near-surface earth materials on the subject site have a very slow percolation rate which may be problematic to the design of storm water retention / recharge basins.
- The removal and replacement of undocumented fills, loose or soft colluvial and alluvial soils in areas which will receive structural fill and/or support structures will be required. The depths of the removal are anticipated to be approximately 4.0 feet over the majority of the site, up to about 12 feet in the northwestern area near the lake and 18.5 feet or greater along the southern boundary of the site, where the stockpile is located.
- Preliminary corrosion tests performed on near-surface earth material samples indicate that the soils were not corrosive to concrete, ferris, and or copper materials in direct contact with the near-surface soils.

The results of this study indicate that the subject site is feasible for the development of the proposed project provided the conclusions and recommendations presented in this report are implemented in the project planning, design, and construction. We recommend that the structural engineer for the project be consulted to discuss foundation options, especially in the areas where deep artificial fills exist with shallow groundwater conditions.

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REPORT OF
GEOTECHNICAL / GEOLOGIC STUDY
PROPOSED RESIDENTIAL DEVELOPMENT
NORTH OF LOS SERRANOS BLVD. /
BIRD FARM RD.
BETWEEN PIPELINE AVE. & RAMONA AVE.
CITY OF CHINO HILLS
SAN BERNARDINO COUNTY, CALIFORNIA

PROJECT NO.: 982-A14 REPORT NO.: 4

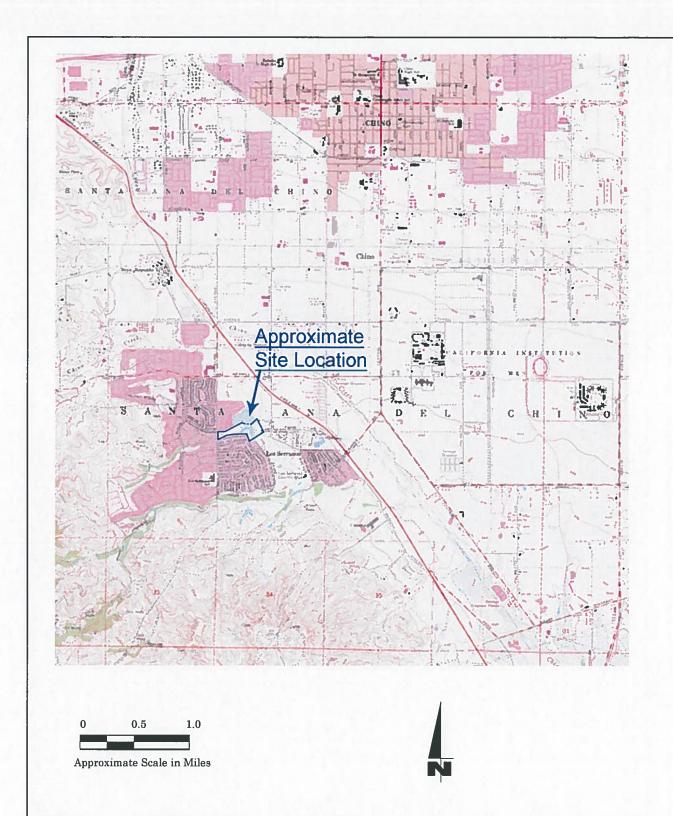
SEPTEMBER 29, 2017

INTRODUCTION

AUTHORIZATION

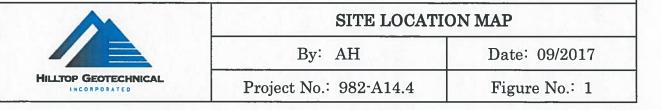
This report presents results of the geotechnical / geologic study conducted on the subject site for the proposed residential development to be located north of Los Serranos Blvd. / Bird Farm Road between Pipeline Ave. and Ramona Ave. in the City of Chino Hills, San Bernardino County, California. The general location of the subject site is indicated on the 'Site Location Map,' Figure No. 1.

A proposal to Rolling Ridge Ranch (Client) from Hilltop Geotechnical, Inc. (HGI) (Geotechnical / Geologic Consultant) HGI, dated July 18, 2017 Proposal Number: P17109 was submitted to the client on July 18,2017. Authorization to perform this study was in the form of verbal communication from Mr. Louis R. Fernandez of Rolling Ridge Ranch to Mark Hulett of Hilltop Geotechnical, Inc. (HGI).



Reference:

United States Department of the Interior, Geologic Survey, 1967, Photorevised 1981, *Prado Dam Quadrangle, California, San Bernardino Co.*, 7.5 Minute Topographic Series, Scale 1:24,000.



PURPOSE AND SCOPE OF STUDY

The scope of work performed for this study was designed to determine and evaluate the surface and subsurface conditions 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'), including Report of Geotechnical / Geologic Site Feasability Evaluation, and the Geotechnical Fault Investigation Report both prepared by HGI (Reference Nos. 1 & 3 noted on the cover sheet of this report), flood hazard maps, well data, etc. to ascertain earth material, geologic, and hydrologic conditions of the area.
- Meetings and telephone conversations with the client and/or representatives of the client.
- Site reconnaissance.
- Subsurface exploration by means of borings to characterize earth materials, geologic, and groundwater conditions that could influence the proposed development.
- Sampling of on-site earth materials from the exploratory excavations.
- 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 2016 California Building Code (CBC), effective on January 1, 2017.

- Engineering and geologic analysis of field and laboratory data to provide a
 basis for geotechnical conclusions and recommendations regarding site
 grading and foundation, floor slab, retaining wall, pavement, etc. 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.
- Presence and effect of expansive, collapsible, and compressible earth materials.
- Groundwater conditions within the depth of our subsurface study.
- Excavation characteristics of the on-site earth materials.
- Temporary shoring recommendations.
- 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 and buried metal in direct contact with the on-site earth materials.
- Temporary and permanent cut and fill slope recommendations.
- Utility trench excavation and backfill recommendations.
- Slope maintenance and protection recommendations.
- Preliminary pavement recommendations.

The scope of work performed for this report did <u>not</u> 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 Rolling Ridge Ranch and their consultants for specific application to the development of the proposed single family residential development 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

Prior to this report, two previous subsurface explorations consisting of a preliminary soils investigation and geotechnical / geologic site feasability evaluation had been performed on the subject site. Additionally, a detailed fault investigation was prepared by HGI for the proposed development. The results of the previous studies correspond with the results of this study, recognizing the normal variations in subsurface materials within natural alluvial deposits and man made fills on the site. The boring logs and laboratory test results from the Reference No. 1 'Report of Geotechnical / Geologic Site Feasability Evaluation, The Lake Property' are included for reference in Appendix 'C.' Reference is made to inform the reader of the existence of the previous reports.

PROJECT DESCRIPTION / PROPOSED DEVELOPMENT

As part of our study, we have discussed the project with Mr. Louis Fernandez of Mesa Bluffs Development Company, LLC, a representative of the client, and Mr. David Currington, R.C.E. of Engineering Solutions, the Civil Engineer for the

project. We also have been provided with the Reference No. 7 'Site Plan' noted on the first page of the cover letter for this report. In addition, we have reviewed the Reference Nos. 1 through 3 reports which was previously prepared for the subject site.

Based on information presented to this firm, it is our understanding that the proposed project will consist of a multi-family, residential development. The project will consist of multi-story structures for single family residential condominiums and/or townhouses. The project will also consist of paved streets and parking areas, open spaces, and underground utilities. It is understood that the proposed grading for the subject site will encompass cuts and fills approximately 20 feet in vertical height or less to create pads for structures, driveways, and access roads. Cut and fill slope inclinations will be 2H:1V (Horizontal to Vertical) or flatter. It is assumed that light loads will be imposed on the foundations for the structures. The foundation loads are not anticipated to exceed 3,000 plf for continuous footings and 50 kips for column footings. The proposed ground level floors for the structures will consist of a concrete slab cast on compacted subgrade. Finish ground level floor elevations for the structures had not been furnished at the time of this report, however, it is anticipated to be within 0 to 20 feet of existing site grades. Subterranean construction is not anticipated for the proposed structures. Proposed bridges on the subject site are not addressed under this report and will be addressed at a later date under a separate report heading.

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 and geologic reconnaissance of existing surface conditions of the subject site. A study of the property's subsurface condition was performed to supplement the previous 'Geotechnical Feasability Study' performed for the subject site and to further evaluate underlying earth strata and the presence of groundwater. Surface and subsurface conditions were explored on August 21st, August 23rd, August 24th, and September 20th, 2017.

The subsurface exploration consisted of excavating twenty four (24) exploratory borings in the area of the proposed development on the subject property. The approximate locations of the exploratory excavations are shown on the 'Exploratory Excavation Location & Geology Plan,' Plate No. 1, presented in the map pocket in Appendix 'A' of this report. The actual locations of the exploratory borings at the designated locations were adjusted as dictated by topography and overhead obstructions in the immediate area of the proposed boring locations. The exploratory excavations were observed and logged by a representative of HGI. Earth materials encountered in the exploratory excavations 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. 3 through 26, 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.

Relatively undisturbed ring samples, and representative bulk samples of on-site fill and natural 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 on-site earth materials and included in-situ dry density and moisture content tests, organic content tests, expansion index tests, soluble sulfate, sieve analysis tests, collapse potential tests, resistance (R-Value) tests, an Atterberg Limit tests, maximum dry density / optimum moisture content relationship tests, and direct shear tests. A more detailed explanation of laboratory tests performed for this study and test results are presented in Appendix 'A' of this report, Plate Nos. 27 through 35.

FINDINGS

SITE DESCRIPTION

The Greening Family LLC property comprises approximately 95.94 acres. The property was divided into three (3) parcels. Parcel Nos. 1 and 2 were not evaluated during this study. This study encompasses Parcel No. 3, which includes Lake Los Serranos. Parcel No. 3 contains approximately 48.44 net acres based on recorded information and was irregular in shape. The subject property, Parcel No. 3, is bound by Los Serranos Blvd. / Bird Farm Road to the south, Pipeline Avenue to the west and Ramona Avenue to the East as shown on the Exploratory Excavation

Location Plan,' Plate No. 1, presented in Appendix 'A' of this report. In general, Lake Los Serranos bounds the property to the north with the exception of the eastern portion of the site, which is bound by existing mobile homes in the City of Chino Hills, San Bernardino County, California. The subject property is located north of Section 34, in the southeast one-quarter of T2S, R8W of the San Bernardino Principle Meridian at Latitude: 33.9753° North, Longitude: 117.7107° West.

The legal description for the subject property as presented on the referenced 'Lake Project Plan' is as follows:

APN: 1025-561-04

Per the Reference No. 2, 'The Lake Project Site Plan,' the topography in the immediate area of the subject site, that does not include the subaqueous Lake Los Serranos, was characterized by generally undulating native gentle hills, nobs, old drainages, and both documented and undocumented fill at various locations throughout the site. The north-south trending finger of the lake splits the subject site into a western and eastern area.

The western area of the proposed development, including land west of the existing southern most portion of the lake, consists of undulating topography including nobs, elongate gentle hills, drainages, and fill. The western portion of the proposed development had a general downward inclination toward the north at an average gradient of approximately 5.0 percent. On-site relief in the west area of the proposed development was approximately 34 feet. The maximum elevation within the western portion of the site was obtained from a stockpile of imported materials

located along the southern property line. On-site drainage was accomplished by sheetflow toward Lake Los Serranos.

The eastern area of the subject site consists primarily of one (1) north sloping native hill. The native hill had radial drainage with an average gradient of approximately 8.0 percent. On-site relief in the eastern portion of the site was approximately 39 feet. The maximum elevation was 670 feet and found along the southeastern border of the site. The minimum elevation in the eastern portion of the site was 626 feet and is lower (topographically) than the lake elevation.

Previous drainage improvements are known to have been preformed prior to the investigation. A concrete/shotcrete culvert and drainage gutters were placed in the central portion of the site at the lake inlet. Today, the inlet has now been filled with artificial fill documented in Reference No. 2, by Pioneer Consultants as further discussed below.

Artificial fill was encountered at various locations on the site, as well as two known drainage locations. The majority of the fill encountered during the previous study was located along the southern border in a large stockpile that was described to be import materials, per a verbal conversation with Mr. Greening. Although not confirmed, the peninsula extending into the lake is also believed to be artificial fill based upon aerial photo graphic analysis as discussed further below. During the field investigation performed during this study, undocumented fill was encountered on the northern portion of the site generally along the lake outline around the entire site. In the south center portion of the site fill was placed in an inlet where Lake Los Serranos used to flow. The fill was placed to close the inlet. It is this firms understanding that the documented fill was made up of dredged lake materials and on-site materials produced during a previous grading operation, per

verbal conversation with Mr. Greening. Pioneer Consultants provided geotechnical oversight during the fill placement. However, density testing conducted by HGI during the feasibility study showed less than 90% in situ compaction results. A second older drainage was also located in the southwestern most portion of the site, where artificial fill was encountered, but not documented.

At the time the field explorations were made for the previous report, the surface of the site was generally firm and covered in wood chips throughout the western and central portions of the property and native grasses the eastern areas. This was consistent with the observations made at the time of this study. Dirt paths existed along the outskirts of the lake and leading towards the eastern areas. The wood chip layer ranged from approximately 5.0 to 16 inches thick and was generally scattered across the entire site. The drilling equipment and the backhoe did not experience difficulty moving around on the site. The surface conditions contained minimal vegetation sparsely distributed among the wood chips and included mushrooms, small palm trees, weeds, and minimal bushes. Numerous palm trees, eucalyptus trees, pepper trees and smaller amounts of other various types of trees were observed locally across the entire site.

At the time of the field study, buildings and other type structures were present on the site. An abandoned, one-story building was located in the central portion of the site, a second building with a garage, that was occupied at the time of this field study, was located on the middle eastern portion of the site as well as a one-story storage shed located on the southeastern portion of the site as shown on Plate No. 1, 'Exploratory Excavation Location Plan.' Utilities consisting of electric, telephone, gas, sewer, water, as well as other unknown underground and overhead lines, were mainly observed adjacent to the site in the surrounding street right of way. A utility plan showing locations of known sewer, water, and electrical lines

was provided and used as a resource for the preparation of the field work during this study. Due to the ages of the structures and the locations on the site, it is anticipated that cisterns, leach lines, and septic tanks also may still be present on the site.

Several piles of construction debris, pallets, bricks, miscellaneous construction debris and refuse, soil, etc. were observed at various locations throughout the subject property at the time the field study for this report was performed.

ENGINEERING GEOLOGIC ANALYSIS

Regional Geologic Setting

Chino Hills is situated in the northern portion of the Peninsular Ranges Physiographic Province, one (1) of 11 provinces recognized in California. The physiographic provinces are topographic geologic groupings of convenience based primarily on landforms, characteristic lithologies, and late Cenozoic structural and geomorphic history. The northern portion of the Peninsular Ranges province encompasses southwestern California west of the Imperial-Coachella Valley trough including Santa Catalina and San Clemente Islands, and south of the major portion of the Transverse Ranges geomorphic province, which includes the Santa Monica, San Gabriel, and San Bernardino mountains. Most of the Peninsular Ranges province lies outside California, continuing south to include the Baja California Peninsula.

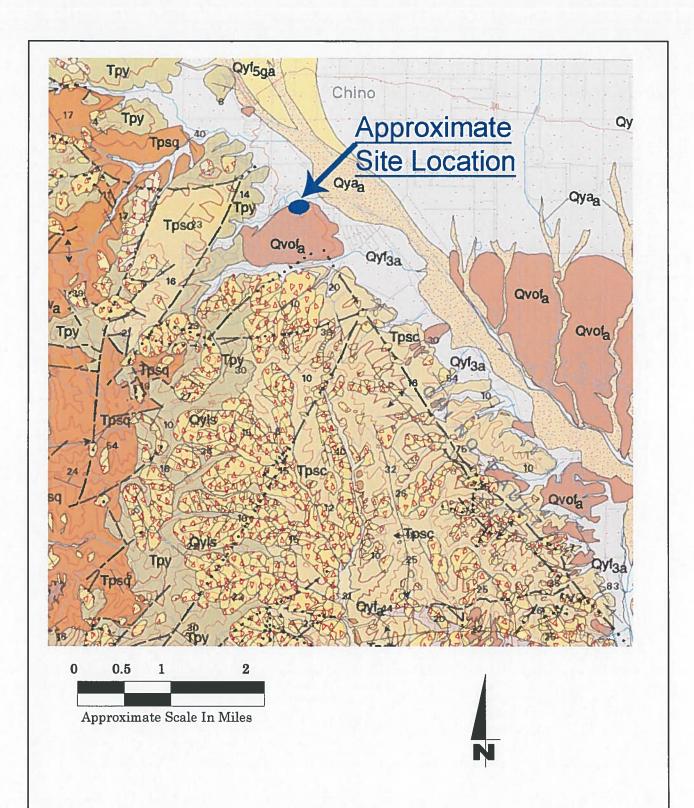
The province is characterized by youthful, steeply sloped, northwest-trending elongated ranges and intervening valleys whose general northwesterly trend is terminated abruptly on the north by the east-west grain of the Transverse Ranges. Average elevations across the province rise slowly to the east, culminating in generally abrupt escarpments and steep slopes near the eastern margin. Near the

northern edge of the province lie several anomalously flat and low basins that stretch from the San Bernardino region to western Los Angeles. These basins generally result from fault junctures and tectonic interaction with the adjacent Transverse Ranges Province.

Structurally, the bulk of the Peninsular Ranges are composed of a number of relatively stable crustal blocks bounded by active strike slip faults of the San Andreas transform system. Two (2) fault systems local to the Chino Hills area that generally parallel the San Andreas fault system include the Chino fault and the Elsinore fault, Whittier segment.

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 claystone to conglomerate. The Chino Hills region contains thick sequences of Puente Formation, once submerged by the ocean, now forming bedrock that has been uplifted and faulted (Morton and Miller, 2006). These rocks are widely exposed in the hills bounding the southeast side of the city of Chino, and underlie the surrounding axial channel areas of Chino Hills at depth. The general geology in the area of the subject site is shown on the 'Regional Geology Map,' Figure No. 2a, and the 'Regional Geology Map Legend,' Figure No. 2b.

Fine-grained older alluvial deposits (early to middle Pleistocene) generally blanket a good portion the site and likely formed as flood plain deposits with incised fanglomerate deposits from several local hills extending from the mouths of the eroding Chino Hills. The subject site has likely received more recent alluvial



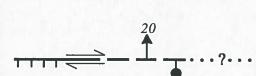
Reference:

California Department of Conservation, Division of Mines and Geology, 2004, Morton, D.M., (Digitally Prepared by Alvarez, R.M., Bovard, K.R.); *Preliminary Digital Geologic Map of the Santa Ana 30' x 60' Quadrangle, Southern California*; Version 2.0, Scale 1:100,000.



REGIONAL GEO	LOGY MAP
By: AH	Date: 09/2017
Project No.: 982-A14.4	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.

Qyf3 - Young Alluvial Fan Deposits, Unit 3 (middle Holocene).

Qya - Young Axial Channel Deposits (Holocene and late Pleistocene).

Oyls, Qyls -Young Landslide Deposits, Unit 5 (Holocene and later Pleistocene).

Qvof · Very Old Alluvial Fan deposits, Unit 3 (middle to early Pleistocene).

Puente Formation

Tpscc - Tpsc - Sycamore Canyon Member (Early Pleistocene and Miocene).

Tpy Tpy - Yorba Member (Miocene).

Tpsq · Soquel Member (Miocene).

Reference:

California Department of Conservation, Division of Mines and Geology, 2004, Morton, D.M., (Digitally Prepared by Alvarez, R.M., Bovard, K.R.); Preliminary Digital Geologic Map of the Santa Ana 30' x 60' Quadrangle, Southern California; Version 2.0, Scale 1:100,000.



L	REGIONAL GEOLOGY	REGIONAL GEOLOGY MAP LEGEND	
	By: AH	Date: 09/2017	
I	Project No.: 958-A14.4	Figure No.: 2b	

material from neighboring stream channels that continue to eroded Chino Hills today.

Local Subsurface Conditions

Earth Materials Description: Presented as follows are brief descriptions of the earth materials encountered in the exploratory excavations. More detailed descriptions of encountered earth materials are presented on the 'Subsurface Exploration Log,' Plate Nos. 3 through 26, presented in Appendix 'A' of this report. The earth material strata, as shown on the logs, represent conditions at the actual exploratory excavation locations. Other variations may occur beyond and/or between the excavations. Lines of demarcation between earth materials on the logs 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 man-made fill (af), colluvium (Col), young alluvial fan deposits (Qyf3), very old alluvial fan deposits (Qvof) and weathered, Puente Formation, Yorba Member bedrock (Tpy). The approximate spatial proximity of these units are shown in Appendix 'A,' 'Exploratory Excavation Location and Geology Plan," Plate No. 1.

Cross sections, A·A', B·B' and C·C' shown on Plate No. 1b "Cross Sections," in Appendix A of this report show lines of demarcation between earth materials that are based upon interpolation between exploratory excavation locations and may not represent actual subsurface conditions.

Man made fill (af) was encountered along the lake side and in two known fill placement locations on site. The largest area was in the southwest portion of the site and consisted of mostly imported stockpile materials. The stockpiled materials and known fill placement areas were explored under Reference No.1, "Feasibility Study". As previously discussed, fill materials were also encountered in an old inlet in the south central portion of the site. Fill materials investigated as part of this study was encountered all along the lake side in Borings B-1, B-9, B-10, B-13 through B-21.

The fill located in the old drainage and stockpile was explored under Reference No. 1, "Feasibility Study". It is our understanding that the fill in the drainages was placed years ago under the supervision of **Pioneer Consultants**. Geotextile fiber and gravel was encountered near the base of the fill and was apparently used to stabilize the bottom, due to shallow ground water. The man made fill in the southern drainage in the center portion of the site consisted of coarse, sandy, gravels with traces of brick from a depth of 7.0 to 11 feet in thickness. The artificial fill located in the central portion of the site was investigated recently under Reference No. 1, "Feasibility Study" and was found to be un compacted. If structures or bridge foundations are to be located within the uncompacted fill drainage additional overexcavation and recompaction will be necessary.

The fill in the stockpile extended to a depth of approximately 18.5 feet below the existing site grades. This fill generally consisted of silty fine to coarse sand with a little clay, trace of gravel, miscellaneous asphalt and debris (SM/SC) which was dark brown to dark brown-black in color, dry at the surface to wet with depth, and loose in relative density.

The artificial fill encountered near the lakeside during this exploration contained organics and was loose in relative density. In general the artificial fill alond the lake side ranged from a silty clay to clayey silts with various amounts of fine to medium sand (CL/ML).

All of the artificial fills are considered to be undocumented and unsuitable for support of structural fill and/or a building structures.

Colluvium (Col) was encountered at the surface of borings B·2 thorugh B·8 and B·22 through B·24. The colluvium consisted of dark brown, brown light brown, silty clay with various amounts of fine to coarse sand and zero to a trace of gravel (CL), and clayey silt, with a little fine to coarse sand (ML). The colluvium contained traces of roots at the surface and extended to a depth of 2.0 to 4.5 feet at the locations of the excavations at the time of this field study for this report. The upper several feet of the colluvium was visually porous in some places.

Young Alluvial Fan Deposits (Qyf3) were encountered primarily in the southwestern portion of the site under the previous feasibility study and consisted of dark brown and dark brown black, fine to medium grained, sandy silts with little clay and a trace of gravel (ML), and silty clays with a trace of fine to medium sand and a trace of gravel (CL). The young alluvial fan deposits extend from the surface to a maximum of 14.0 feet. The upper several feet of the young alluvium was visually porous.

Old Alluvial Fan Deposits (Qvof) were located across the majority of the site and generally consisted of small amounts of interbedded sandy/gravelly alluvial materials and finer grained flood plain deposits. The materials consisted of silty, fine to coarse sands with varying amounts of gravel and cobbles (SM), clayey, fine

to coarse sands with some gravel (SC), fine to medium grained, sandy silts with a trace clay and a little gravel (ML), and fine to coarse grained, sandy clays with a little gravel (CL). The older alluvium was light brown, olive brown, or red-brown in color and dry near the surface to moist with depth. Locally, the alluvium extended to depths up to 48 feet below the existing ground surface in boring B-4. The upper several feet of the older alluvium was visually porous in some locations. Borings B-1 through B-3, B-8, B-9, B-11, B-12, B-13, B-21 through B-24 were terminated in the older alluvial deposits.

Weathered Puente Formation, Yorba Member Bedrock (Tpy) was encountered in borings B·2, B·4, B·5 through B·7, B·10, and B·14 through B·20. The bedrock material broke down into silts (ML) and clays (CL) with traces of fine sand. The weathered bedrock was olive gray and dark brown in color with traces of orange fine sand with manganese staining and dry near the surface to wet with depth. The above listed borings were terminated in the bedrock materials. Additionally bedrock was encountered under Reference No. 1, "Feasibility Study."

Groundwater: Los Serranos Lake is a man made reservoir that was constructed in the early 1900's and was used to supply water to much of the Chino area. An earth dam exists on the north side of the lake. The lake level is currently maintained at an approximate elevation of 642.5 feet MSL. Groundwater was encountered locally in the majority of the subsurface explorations. This groundwater is believed to be largely influenced by the lake and was only encountered in the lower drainages surrounding the lake. It is presumed that the groundwater is perched and exists at the current depths primarily because of the lake.

Groundwater was encountered at depths that ranged between 3.5 and 28.1 feet below the existing ground surface at the location of borings B-1, B-2, B-4, B-9 through B-24 at the time the field study was performed for this report.

Groundwater was also encountered in boring BH-4 at a depth of approximately 26 feet below the existing ground surface at the location of the boring at the time the field study was performed for the Reference No. 2 'Geotechnical Investigation' for the subject site in November, 1985.

Groundwater was not encountered in the exploratory excavations B-3, and B-5 through B-9 to the maximum depth explored of approximately 31.5 feet below existing ground surface at the boring locations at the time the field study was performed for this report.

Depth to groundwater data for the general area was available through the California Department of Water Resources internet web site. The depth to groundwater in State Well No. 02S08W23C006S, located approximately 1.0 mile northeast of the site was 66.4 feet on October 7, 2014. The surface elevation of this well is approximately 20 feet lower (topographically) than that of the site. The well information was the closest well to the site available to report. However, due to the local terrain and the nearby influence of Los Serranos Lake, this well information should be considered irrelevant.

In general, shallow groundwater was encountered at the south and southwestern portions of the site and around the lake edges. The upper southeastern portion of the site contained deeper groundwater elevations, when encountered. Where encountered, measured static groundwater elevations generally coincided with Lake Los Serranos surface water elevation. Where observed, groundwater depths

are shown on each of the exploratory logs. Specific consideration should be given for all proposed development in these areas and should be further evaluated when plans are developed. The relatively shallow groundwater will likely impact the grading in these areas as well as utility emplacements and should be taken into consideration during the design process. Groundwater is not anticipated to be a problem in the topographically higher areas on site.

Surface Water: Los Serranos Lake is located in the northern portion of the site and exists year round. No other surface water was 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 between and beyond the exploratory excavation locations.

Groundwater level readings were made in the exploratory excavations at times and under conditions stated on the boring logs. These data have 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.

Stereographic Photograph Analysis

Multiple pairs of stereo photographs, provided by the County of San Bernardino Flood Control District, and a single, earlier photograph were examined and analyzed for general site development and evidence of faulting or visible

lineaments that trended toward the subject property. The photographs were viewed on January 21, 2015 and May 6, 2015. The dates of the photographs and photo numbers are listed below.

Date of Photographs	Photo Number
May 30, 1938	AXL 40-80
May 30, 1938	AXL 40·79
May 30, 1938	AXL 40-78
March 3, 1953	AXL 50K-68
March 3, 1953	AXL 50K-69
March 3, 1953	AXL 50K-40
March 3, 1953	AXL 50K-41
January 30, 1969	C-293
February, 1969	C-295 105
February, 1969	C-295 106
February 7, 1970	C-297
August 12, 1983	T·99, 13
August 12, 1983	T-99, 14

The portion of the subject site excavated was observed to be part of a gently-sloping, radial nob. The property located south-southeast of the subject site was generally vacant allowing an easy view of the topography in that location. The vacant property is also higher topographically than that of the other surrounding areas. The most obvious lineament in the photographs corresponded with the mapped location of the Chino fault, approximately 450 feet to the southeast of the subject site. The visible lineament of the Chino fault was easily seen south of the

subject site but appeared to die out at the subject site. North of the subject site there appeared to be minimal topographic expression. The areas north of the subject site were low lying. No visible lineaments or disruption of topography was evident along the trend of the Chino fault north of the site.

The photographs were viewed from older to younger. In general, the earliest photograph (1938) viewed showed Lake Los Serranos in existence surrounded by lush greenery and dirt roads. The dirt roads led along the lower topographic portions of the lake to a beach located in the south central portion of the property. An older drainage found on the most southwestern portion of the site appeared to be active due to the dense surrounding greenery southwest of the site. Most of the area at that time was farm land. In the 1953, the photographs of the lake show the elevation to be low, with very little change in vegetation.

The more recent photographs viewed showed an increase in housing development and roads were paved and more prevalent. A sand bar connecting the north portion of the lake to the southern portion of the lake was apparent. Currently the location of the sand bar only forms a peninsula located on the northeast portion of the site not connecting the north of the lake to the south. Also noted, it appeared that the lake elevation was higher in the 1970 and 1969 photographs. No topographic expression of on-site faulting was observed in the photographs.

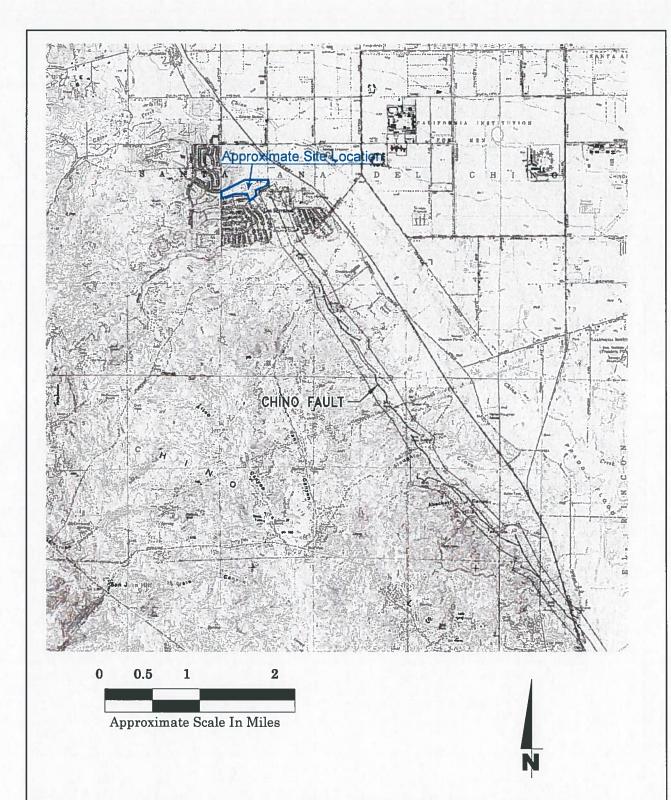
In summation of all the photographs viewed, changes from the time period of 1938 through 1983, of undisturbed geomorphic expressions, vegetation, and soil contrasts of the lake and surrounding areas was generally minimal. No other lineaments were observed to be on or around the subject site, with most of the changes related to an increase in development.

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 (California Department of Conservation, Division of Mines and Geology, Effective May 1, 2003, State of California Earthquake Fault Zones, Prado Dam Quadrangle, Revised Official Map, Scale 1:24,000) indicated the site is not located within a zone of mandatory study for active faulting. However, a designated fault study zone ends immediately to the southeast of the subject site as shown on Figure No. 3, 'Alquist-Priolo Special Studies Zones Map.' In addition, a residential project immediately to the south of the subject site located on the south side of Bird Farm Road performed a fault study and reportedly found active faulting on that property. As a result, HGI conducted a site specific fault study on the property to see if the faulting extends onto the site and also determined its activity. The results of the fault study were presented Reference No. 4, "Report of Fault Investigation,". Below is excerpts of the report including the conclusions.



Reference: California Department of Conservation, Division of Mines & Geology, Effective May 1, 2003, State of California, Earthquake Fault Zones, Prado Dam Quadrangle, Revised Official Map, Scale: 1:24,000.



ALQUIST-PRIOLO SPECIAL STUDIES ZONES MAP

By: AH Date: 09/2017

Project No.: 982-A14.4 Figure No.: 3

FAULT INVESTIGATION FINDINGS AND CONCLUSIONS STUDY METHODS

The field study performed for fault investigation report included a visual reconnaissance of the site, review of aerial photographs, discussions with city representatives, excavation of selected trenches for subsurface examination, cleaning trench walls for greater visibility, marking subsurface features, and logging the subsurface features of the trenches. Soils were described in general accordance with USCS Soils classifications. In place, soil color descriptions were based on the Munsell Soil Color chart. The trenches were excavated with a track mounted excavator and backfilled after completion of the field work. Approximate locations of the trenches are shown on the 'Exploratory Excavation Location & Geology Plan,' Plate No. 1a, located in Appendix 'A' of this report. The approximate locations were based on tape measurements and Brunton compass sightings from known and mapped nearby features, initially. After excavation and logging had been performed, the fault trenches were surveyed. After surveying, to verify the absence of faulting, Trench No. 3 was extended an additional 90 feet or so to the north. Upon logging and after the City personnel as well as other geologists had walked the trenches, the excavations were backfilled. No significant compaction efforts or compaction testing was performed during this study. The trenches extended generally between 10.0 and 15.0 feet deep. The approximate locations of our exploratory trenches, including the extended portion of Trench No. 3, are shown on Plate No. 1a. Dr. Sally McGill, a well known professor at California State University San Bernardino, who has conducted a lot of fault investigations and analysis, has walked the trenches and assisted in estimating the age of the subsurface sediments. Mr. Richard George, a Certified Engineering Geologist also assisted in the fault trench analysis. Finally, Ms. Lisa Bates, the City of Chino Hills Geologic Reviewer was consulted and met with us prior to any excavation. Our scope of work, the prior work on the adjacent property and our

trench locations were discussed. Upon excavation and our logging, Ms. Bates met with us and also walked the trenches. Our field interpretations and conclusions were discussed in the field, prior to any backfilling operations.

DISCUSSION

The October 2005 MTC Engineering, Inc. fault hazard investigation found geologic evidence that indicated the presence of two northwest striking southwest -dipping faults. In their report, they indicated that the older alluvium and the basement rock was overlain by Quaternary colluvium and alluvium which was either or both Holocene or Pleistocene in age. Both faults represented on MTC Engineering, Inc. logs do not break what they determined to be artificial fill but do penetrate all other geologic units, and therefore they concluded that the faults were less than 11,000 years old.

However, it should be noted that large description discrepancies and conflicting lighologic interpretations exist between the reports prepared for the adjacent site and the subject site. Largely because of this and the fact that no materials were found in the trenches that were usable to date the age of the sedimentation, in addition to the City Reviewer (Ms. Bates) walking the trenches, we invited Mr. Richard George (CEG) to assist in the trench logging. Also, Ms. Sally McGill (Professor of Geology and Interim Chair at California State University, San Bernardino) was invited and observe the trench walls, review the trench logs and provided insight into the age of the alluvial materials encountered on site. All of the geologists agreed that the Older Alluvial Materials observed in the trenches are older than Holocene and agree that the deposits are probably Early to Mid Pliestocene as documented in the geologic literature.

As such, all units encountered on-site beneath the colluvium are interpreted to be older than 11,000 years in age. This interpretation was used to determine whether or not the observed fault was active. Out of the two faults identified in MTC Engineering, Inc. report, only one fault was observed on site. The fault observed by HGI on site had a similar attitude to MTC Engineering, Inc.'s westerly mapped fault, but was not in line with the on-site fault, suggesting the fault either ended or possibly had a right stepover associated between the two sites. However, no evidence was found to suggest the latter and most likely, the fault ends.

When the western MTC Engineering, Inc. fault was projected northward, the projected fault location was not observed in any of the three fault trenches. When the eastern MTC Engineering, Inc. fault was projected northward, the projected fault location generally lies at the location the fault was observed in Trench Nos. T-1 and T-2.

During the latest MTC Engineering, Inc. investigation, they identified two (2) faults. The age of the last movement on either identified fault was not specifically addressed and it appears that it was just assumed to be active. As such, they reasonably concluded that, based on the location and the fault tracing almost to the surface, they probably were part of the Chino Hills fault system, and the Chino Hills fault is published as active, based upon subsurface excavations south of the subject site. However, positive evidence on the subject site suggests that the faulting should not be considered to be active.

ON-SITE FAULTING CONCLUSIONS

Evidence of on site faulting was encountered in two of the three trenches mapped during **HGI's** previous study. Positive evidence of faulting was found within Trench Nos. 1 and 2. However, no evidence of faulting was noted in Trench No. 3.

All fault evidence was restricted to the early to mid Pleistocene **Qvof** units. No faulting was observed in the overlying Holocene colluvial unit (**Col**). Additionally, no surface expression of the faulting encountered was noted onsite. No evidence was observed onsite that would suggest the faulting is Holocene in age. The lack of evidence of recent fault activity coupled with the regional interpretations of the Chino Fault ending south of the subject site all support the idea that the Chino Fault dies out onsite. Our evidence strongly suggests that this northernmost extension of the Chino Fault is not active and dies out between Trench Nos. 2 and 3. Based upon this, we conclude that the faulting observed onsite is older than 11,000 years old.

CITY OF CHINO HILLS REVIEW

Based upon the geotechnical conclusions addressed above and from Reference No. 3, "Fault Investigation," the City of Chino Hills issued a review sheet, Reference No. 4, addressing the need for additional comments and a response. HGI, responded with a letter, Reference No. 5, addressing the each comment. GMU Geotechnical Inc. (City of Chino Hills Reviewer's), then conditionally approved the project development on the basis of three conditions per Reference No. 6 noted on the cover of this report. The first was the preparation of this report addressing the proposed planned development. The final grading report must document the fault trenches were re-excavated and recompacted to the recommendations issued in this report, and thirdly, the final plan must address a plan that will adequately mitigate the risk of seiching, discussed further below.

Recent Earthquakes and Ground Shaking

The most recent, large earthquake that occurred in close proximity to the subject site was on October 1st, 1987 Whittier Narrows earthquake. The epicenter of this quake was located approximately 22 miles east northeast of the subject site at

Latitude: 34.0610° North, Longitude: 118.0790° West. The Whittier Narrows quake had a measured magnitude of 5.9. Post earthquake, ground surface cracks were observed at Worksham Creek oil field and Whittier Narrows golf course. The earthquake is thought to have ruptured a thrust fault that had not been known prior to the quake. Several aftershocks occurred following the quake and a few days later the largest aftershock followed with a magnitude of 5.3.

Another large earthquake that occurred near the subject property was the June 28, 1992 Big Bear earthquake. The epicenter of this quake was located approximately 52.5 miles east-northeast of the subject property at Latitude: 34.2030° North, Longitude: 116.8270° 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 12 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 40.5 kilometers from the site. Greater distances, lower slip rates, and lesser maximum magnitudes indicate much lower risk to the site than the 12 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
Chino-Central Avenue (rl-r-o) (65 SW) ³	<0.1 / Southeast	28±3	1.0±1.0	6.7	В
Whittier (rl-r-o) (75 NE)	9.8 / Southwest	38±4	2.5±1.0	6.8	A
Elysian Park ®, 20 NE)	11.6 / West- Northwest	34±3	1.5±1.0	6.7	В
San Jose (ll-r-o, 75 NW)	12.2 / North	20±2	0.5±0.5	6.4	В
Elsinore (Glen Ivy Segment) (rl-ss)	15.1 / South- Southeast	36±4	5.0±2.0	6.8	A
Sierra Madre ®, 45 N)	16.7 / North	57±6	2.0±1.0	7.2	В
Cucamonga (r,45 N)	16.8 / North- Northeast	28±3	5.0±2.0	6.9	В
Compton Thrust ®, 20 NE)	31.4 / West	39±4	1.5±1	6.8	В
Clamshell - Sawpit ®, 45 NW)	31.7 / North- Northwest	16±2	0.5±0.5	6.5	В
San Jacinto (San Bernardino Segment) (rl-ss)	34.1 / Northeast	36±4	12.0±6.0	6.7	A
Raymond (ll-r-o, 75 N)	34.5 / Northwest	23±2	1.5±1.0	6.5	В
San Andreas (San Bernardino Segment) (rl-ss)	40.4 / Northeast	103±10	24.0±6.0	7.5	A

Fault Zone ¹ Distance $(km)^2$ / Direction from Site $(km)^1$	Slip Rate (mm/yr) ¹	Reference Earthquake M(_{Max}) ¹	Fault Type ¹
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- 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 I n t e r p o l a t o r (2 0 0 8)' we b s i t e (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		0.480g		
Sa @ 0.2 Sec. 1.046g		1.046g		
	Sa @ 1.0 Sec. 0.601g			
* 10-percent probability of being exceeded in the next 50 years (475 years mean return time). ** Shear Wave Velocity of 274 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 0.7528g will occur at this site within the next 50 years (2,475 years mean return time) due to a Model Magnitude earth quake of 6.57 located at a distance of approximately 2.4 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 0.4680g will occur at this site within the next 50 years (475 years mean return time) due to a Model Magnitude earth quake of 6.57 located at a distance of approximately 1.4 km from the subject site. An average shear wave velocity (v_s) for the earth materials on the subject site of 274 meters per second (m/sec) (i.e., 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. The subject property does not lie within an earthquake induced landslide or liquefaction hazard area as shown on the CGS maps (California Department of Conservation, Division of Mines and Geology, Effective January 1, 2001, State of California Seismic Hazard Zones, Prado Dam Quadrangle, Official Map, Scale 1:24,000).

Landslide: The subject site is <u>not</u> located within a designated area as having a landslide susceptibility per 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).

Due to the relatively flat-lying to moderately sloping nature of the site, on-site landsliding or debris flows sourced from higher elevations should not be considered to be a geologic constraint at this site. Field reconnaissance did not disclose the presence of older, existing landslides within or near the subject property. Therefore, the potential for landsliding and/or seismic induced landsliding is considered to be low.

Liquefaction: Liquefaction is a phenomenon in which cohesionless, saturated, fine-grained sand and sandy silt soils lose shear strength due to ground shaking. The subject site is <u>not</u> located within a designated area as having a liquefaction potential per 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).

It is our opinion that liquefaction potential at the subject site is very low due to the dense to very dense relative density to stiff to hard consistency of the underlying older alluvium and shallow depth to bedrock material.

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. Based upon the results of this study, the subject site is underlain at depth by dense to very dense relative density or stiff to hard consistency, consolidated deposits that should not be prone to a significant degree of seismic settlement. Where applicable, loose, near-surface, alluvial soils and 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 shallow depth to bedrock.

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. Lake Los Serranos is considered to be a large body of water. As such, seiching should be considered a geologic hazard for portions of the site that are close to the lake. Although seiching is a relatively rare geologic occurrence, where feasible within project planning, steps should be taken to mitigate the risk of human and structure endangerment. Where feasible, structures should be set back from the waters edge, and/or designed at a higher base ground elevation to lower the risk of seiching. As with most lakes in Southern California, homeowners/visitors who occupy the land near a lake should be aware of the hazard.

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

OTHER GEOLOGIC HAZARDS

Flooding

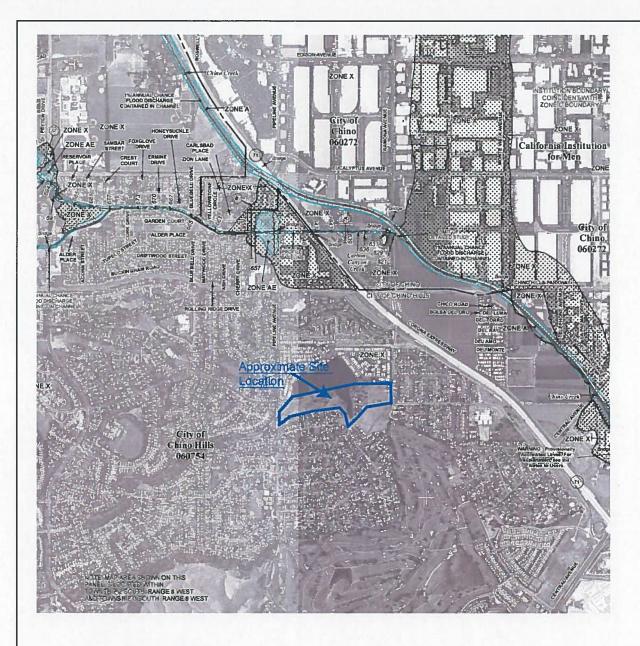
The subject site is not located within a designated area as having a flooding potential per San Bernardino County Planning Department, San Bernardino County Land Use Plan, GENERAL PLAN, Hazard Overlays (http://www.co.sanbernardino.ca.us/landuseservices/general).

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. 4a and 4b, respectively, are based on FIRMs provided by FEMA and are specific to the area around the subject site. The 'FEMA Flood Hazard Map,' Figure 4a, indicates that the site is located within 'Zone X' (an area of 0.2 percent annual chance flood; an area of 1 percent annual chance flood (100 year flood) with average depths of less than 1.0 foot or with drainage areas less than 1.0 square mile; and an area protected by levees from the 1 percent annual chance flood).

CONCLUSIONS AND RECOMMENDATIONS

GENERAL

The conclusions and recommendations presented in this report are, in part, based on the review of the previous studies for the subject site, information provided to this firm, the results of the field and laboratory data obtained from twenty four (24) exploratory excavations located on the subject property, 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 property 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.



0 1250 2500

Scale Approximate in Feet



Reference:

U.S. Federal Emergency Management Administration (FEMA), Effective August 28, 2008, Flood Insurance Rate Map, Map Nos. 06071C9330H, Panel No. 9330 of 9400. Site specific information obtained through FEMA website, Map Service Center (http://msc.fema.gov/).



	FEMA	FLOOD	HAZARD	MAP
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By: AH Date: 09/2017

Project No.: 982-A14.4 Figure No.: 4a

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

FEMA FLOOD HAZARD MAP LEGEND AH Date: 09/2017 By:

Project No.: 982-A14.4

Figure No.: 4b

The average in-situ moisture contents and in-situ dry densities of the upper 10 feet of the near-surface undocumented fill and/or alluvial materials on the subject site suggests that the soils have an average relative compaction of less than 90 percent.

The field observations indicate that, locally, up to 18.5 feet of material present on the subject site was an undocumented fill material. The artificial fills on the site are also considered loose and compressible. The undocumented, man-made fills are not considered suitable for the support of structural fills, fill slopes, foundations, slab-on-grade floor slabs, hardscape, and/or pavement.

The near-surface fill and alluvial soils present on the subject site exhibit an expansion potential in accordance with the criteria presented in Section 1803.5.3, 'Expansive Soil,' in the 2016 CBC. If precautions are not taken during the design and construction of the project, the on-site expansive earth materials could cause heaving and distress to the structures, hardscape, and pavement if they should become saturated in the future.

Groundwater was encountered locally in some of our subsurface explorations. This groundwater is believed to be largely influenced by the lake and was only encountered near the lake and in the lower drainages surrounding the lake.

Some of the near-surface earth materials in the northwest portion of the site near the lake contain excessive amounts of organic material and therefore are not suitable for use as structural fill (i.e., Boring B-16, 7.0'-10.0' had an organic content of 5.2 percent and Boring B-18, 8.5' had an organic content of 4.2 percent). Typically, soils with organic contents in excess of 3.0 percent are not acceptable as structural fill. These soils can be used as fill in proposed landscape areas on the

subject site. Therefore, some selective sorting and placement of soils with high organic content will need to be performed during the site grading process.

Preliminary tests on samples of near-surface, on-site, earth material suggests R-value of less than 5. Subgrade soils with R-value <20 are considered poor or weak soils and require Subgrade Enhancement Geotextile (SEG) to provide reinforcement as the primary function and separation as the secondary function.

Some remedial grading consisting of removals and replacement will have to be performed within loose, compressible, artificial fill and near-surface alluvium and weathered bedrock materials in the area of proposed structural fills, structures, 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 between the exploratory excavations 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.

Specific recommendations for site grading, foundations, slab support, pavement design, slope maintenance, etc., are presented in the subsequent paragraphs.

SITE PREPARATION RECOMMENDATIONS

General

If hardscape and pavement subgrade earth materials are prepared at the time of grading of the building pads, and the improvements are not constructed immediately, additional observations and testing of the subgrade earth material will have to be performed to locate areas which may have been damaged by construction traffic, construction activities, and/or seasonal wetting and drying. The additional observations and testing should be performed before placing aggregate base material, Hot Mix Asphalt (HMA) concrete, and/or Portland Cement concrete (PCC) in those areas.

If hardscape and pavement subgrade earth materials are prepared at the time of grading of the building sites, and the improvements are not constructed immediately, additional observations and testing of the subgrade earth material will have to be performed to locate areas which may have been damaged by construction traffic, construction activities, and/or seasonal wetting and drying. The additional observations and testing should be performed before placing aggregate base material, Hot Mix Asphalt (HMA) concrete, and/or Portland Cement concrete (PCC) in those areas.

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 owner, the grading

contractor, the City of **Chino Hills**, 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 from the demolition of the existing structures, 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. Due to the age of the existing structures on the subject site, the structures should be checked for asbestos prior to demolition. 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. For landscape areas (i.e., open areas, trees, etc.), vegetation from the clearing and grubbing operations consisting of light brush, grasses, forbs, and weeds can be mixed and blended into the fill utilized in these non-structural areas. 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, colluvial, alluvial, and highly weathered bedrock 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 that would require heavy ripping or blasting to excavate. It is not anticipated that a significant amount of oversized rock material (i.e., 12 inches in greatest dimension) will be generated during the removal and replacement process within 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 present below any topsoil and/or highly organic materials encountered on site 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 3 inches in maximum dimension. It is noted that the average in-situ moisture content of the near-surface, undocumented fill and alluvial earth materials on the subject site at the time this field study was performed was above the optimum moisture content for the on-site materials and that drying of the on-site earth materials may have to be performed if the earth materials are to be used as compacted fill material in the

near future. No significant amount of oversized rock materials are anticipated to be generated from the cuts performed in the local, on-site 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.), fill slopes, exterior hardscape (i.e., sidewalks, patios, curb / gutters, etc.), fill slopes, and pavement should be prepared in accordance with the following recommendations for grading in such areas. If overexcavation of undocumented fill or moisture sensitive, collapsible earth 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.

- Stockpile Areas: All stockpiles on the site are recommended to be overexcavated entirely and recompacted. The approximate locations of the stockpile areas are shown on the 'Exploratory Excavation Location & Geology Plan,' Plate No. 1a. Based upon our exploratory excavations borings and laboratory test results, we anticipate that the overexcavation will extend to a depth of approximately 10 to 20 feet below existing ground surface and to a uniform elevation within the horizontal limits of the overexcavation in the areas which will receive structural fill, building structures, retaining walls, trash enclosure walls, and decorative concrete block walls.
- Undocumented Fill: The near-surface undocumented fill on the site are recommended to be overexcavated and recompacted. The approximate locations of the stockpile and general fill areas are shown on the 'Exploratory Excavation Location & Geology Plan,' Plate No. 1a. Based upon our exploratory excavations borings and laboratory test results, we

anticipate that the overexcavation will extend up to a depth of approximately 12 feet below existing ground surface and to a uniform elevation within the horizontal limits of the overexcavation in the areas which will receive structural fill, building structures, retaining walls, trash enclosure walls, and decorative concrete block walls.

- The near-surface colluvial and alluvial earth materials on the site are recommended to be overexcavated and recompacted. Based upon the exploratory trench excavations and borings and the laboratory test results, we anticipate that the overexcavation will extend to a depth of approximately 4.0 feet below existing ground surface.
- 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 structures should be to a uniform elevation throughout the limits of the structures. It is noted that fill placed to construct slopes and/or support sidewalks, patios, retaining walls, block walls, driveways, and pavement are considered to be structural fill.
- Where a cut / fill transition zone or a bedrock / compacted fill and/or alluvial zone extends through a proposed building pad area, a compacted mat of fill will have to be constructed under the building area to prevent differential settlement between the two (2) dissimilar materials. This mat should be constructed by overexcavating the materials in the cut portion of the pad to a distance outside the proposed building limits of 5.0 feet or to the depth of the overexcavation below the finish pad grade, whichever is greater. The overexcavation should extend to a depth of 4.0 feet below the pad elevation, to a depth of 2.0 times the width of the largest footing below the bottom of the proposed deepest footing, or to a minimum depth of 0.5 times the depth of the deepest fill within the building pad, whichever is greater.
- In a total cut building pad in the bedrock material, no over excavation and recompaction is required.
 - If a 4.0 foot deep overexcavation is performed in the weathered bedrock material, the overexcavated area should be provided with an adequate drainage system to prevent the build up of water from surface infiltration

in the fill material (bath tub effect) and cause a wet, moist condition under the structure.

- In the proposed exterior hardscape (i.e., sidewalks, patio slabs, 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 to 12 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.

If wet, unstable earth material is encountered at the overexcavation depth, additional overexcavation and a placement of rock blanket may be required to establish a firm working base for the placement of fill. The rock blanket should be graded from 1.0 to 3.0 inches in diameter and be enclosed in a geotextile fabric such as Mirafi 140N series, or an equivalent substitute, to prevent the infiltrations of fine material from the underlying subgrade into the voids in the rock with the movement of water through the rock.

- 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. Proposed fill slopes are structural fills and do not fall under this provision. 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 pads 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.

The limits of overexcavation for fill slopes should extend to a distance of 4.0 feet beyond the toe of the slope or to the depth of the overexcavation beneath the toe of the slope, whichever is greater.

The limits of overexcavation for 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.

In areas where overexcavation can not be performed to the required distance beyond the foundations, (i.e., perimeter project block walls, retaining walls, etc.) along property lines, the foundations should be deepened to extend through the unsuitable, near-surface earth materials and be founded to a minimum depth of 1.0 foot into the firm underlying material.

- Where the exploratory backhoe trenches and fault trenches are located within the limits of the proposed overexcavations for the proposed structural fills, structures, decorative walls, trash enclosure walls, retaining walls, exterior hardscape, and/or pavement areas, the trenches should be located and overexcavated to the width and depth of the trench.
- It is noted that localized areas, once exposed, may warrant additional overexcavation for the removal of existing undocumented fills, soft 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 bedrock materials may be deleted upon approval by the project Geotechnical / Geologic Consultant, and/or his representative. 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.

• A detailed table of proposed finish grade elevations, maximum cuts, maximum fills, and specific minimum overexcavation requirements for each building can be found below:

Building Number	Lot Type*	Approximate Maximum Cut (Feet)**	Approximate Maximum Fill (Feet)**	Finish Grade Elevation (Feet) ***	Minimum Depth of Over- excavation**** (Feet)
****1	Т	3.3	4.0	664.2	4
****2	F	0	19.1	663.0	8
3	Т	3.2	0.3	664.8	4
****4	Т	1.8	4.0	664.0	4
****5	F	0	11.3	663.33	6
6a	Т	5.0	4.5	649.0	4
*****6b	Т	6.5	11.5	648.5	4
7	F	0	4.8	647.75	4
8	F	0	5.3	647.25	4
9	Т	4.0	2.0	654.0	4
10	Т	6.5	3.0	654.0	4
11	С	9.7	0	655.8	0
12	С	9.5	0	657.5	0
13a	Т	4.0	2.2	651.2	4

Building Number	Lot Type*	Approximate Maximum Cut (Feet)**	Approximate Maximum Fill (Feet)**	Finish Grade Elevation (Feet) ***	Minimum Depth of Over- excavation**** (Feet)
13b	Т	6.6	4.8	651.6	4
14	C	12.5	0	652.0	0
15	C	12.4	0	652.93	0
16	C	14.2	0	653.8	0
17	Т	4.0	6.2	654.0	4
18	С	6.0	0	654.5	0
19	C	7.3	0	654.7	0
20	Т	6.5	5.5	652.0	4
21	C	12.0	0	655.0	0
22	Т	4.8	8.0	654.5	4
23a	Т	3.5	3.7	649.5	4
23b	Т	3.7	2.0	649.5	4
24	С	3.2	0	650.8	0
Pool/ Club East	Т	0.5	1.5	659.0	4
Pool / Club West	Т	3.3	2.0	651.5	4

^{*} Lot Type: C = Cut, F = Fill, T = Transition

^{**} Cuts and Fills estimated to nearest tenth of a foot based upon Reference No. 3, "Site Plan."

^{***} Finish grade elevation assumed to be one (1) foot lower than finish floor elevation of Reference No. 3 "Site Plan."

^{****} 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.

^{*****}Buildings 1,2,4,5 and 6b minimum depths of overexcavation are as listed, less the fault trench locations, that will need to be entirely removed and recompacted at the time of grading.

Import Material

Import fill should not be more expansive in nature than the existing on-site material 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., 3 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 10 feet of the site which will be removed and replaced will be approximately 4.0 to 10 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 4.0 percent shrinkage factor would mean that it would take 1.04 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 0.04 to 0.09 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 placement of less than 10 feet of fill (not including the depth of overexcavation and replacement) during the anticipated grading operation or rebound of the underlying bedrock due to unloading during the planned grading operation is expected to be minimal.

Although the above values are only approximate, they represent the 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.

Fill Slope Key

A fill key excavated to a minimum depth of 2.0 feet into competent, weathered bedrock or 5.0 feet into competent undisturbed natural earth material will have to be placed at the base of fills deeper than 5.0 feet which are to be constructed on natural slope surfaces inclined at 5H:1V (Horizontal to Vertical) or steeper. The width of the fill key should be 10 feet or greater and the bottom of the key should be tilted back into the hillside at a gradient of 2.0 percent or steeper per Appendix J, 'Grading,' Section J107.3, 'Benching,' in the 2016 CBC. The project Engineering

Geologist and/or his representative should observe the key excavations and make recommendations for additional keys where needed.

Benching

Compacted fill deeper than 5.0 feet and placed on natural slope surfaces inclined at 5H:1V (Horizontal to Vertical) or steeper should be placed on a series of level benches excavated into competent native materials per Appendix J, 'Grading,' Section J107.3, 'Benching,' in the 2016 CBC. The benches should have a 2.0 foot or higher backcut in competent material.

Fill Slopes

Finish fill slopes should not be inclined steeper than 2H:1V (Horizontal to Vertical). Fill slope surfaces should be compacted to 90 percent relative compaction to the face of the finished slope. Overexcavation beneath proposed fill slopes, the construction of fill slope keys, and benching of fills should be performed in accordance with the recommendations presented in previous sections of this report. Fill slopes should be constructed in a skillful manner so that they are positioned at the design orientations and slope ratio. Achieving a uniform slope surface by subsequent thin wedge filling should be avoided. Add-on correction to a fill slope should be conducted under the observation and recommendations of the project Geotechnical / Geologic Consultant. The proposed add-on correction procedures should be submitted in writing by the contractor before commencement of corrective grading and reviewed by the project Geotechnical / Geologic Consultant. Compacted fill slopes should be backrolled with appropriate equipment for the type of earth material being used during fill placement at intervals not exceeding 4.0 feet in vertical height. As an alternative to the backrolling of the fill slopes, over-filling of the slopes will be considered acceptable and preferred. The fill slope should be constructed by over-filling with compacted fill to a distance of 3.0 feet or greater horizontally, and then trimmed back to expose the dense inner core of the slope surface. Fill slopes steeper than 3H:1V are moderately susceptible to erosion due to the low cohesion parameters of the earth materials.

Cut Slopes

Finish cut slopes in alluvium and/or bedrock should not be inclined steeper than 2H:1V (Horizontal to Vertical). The cut slopes should be observed by the project Geotechnical / Geologic Consultant and/or his representative during grading to provide supplemental recommendations for stability of slopes, if needed. Cut slopes that face in the same direction as the prevailing natural slope will require top of cut paved interceptor swales. Cut slopes steeper than 3H:1V are moderately susceptible to erosion due to the low cohesion parameters of the earth materials.

Loose Material on Slope Face

The grading contractor should be made aware to take care to avoid spillage of loose material down the face of slopes during grading and during drainage terrace and downdrain construction. Fine grading operations for benches and downdrains should not deposit loose trimmed earth materials on the finished slope surfaces.

Slope Creep

Proposed slopes are planned to be stable under normal conditions and moderate earthquakes. However, movement due to creep effects of improvements located near the tops of proposed fill and cut slopes must be considered. Due to moisture variations and natural gravity forces, the earth materials on the face of a slope tend to move downward and outward with time. Past experience has indicated that there is a zone which ranges back from the top of the slope edge that may experience movement. This zone varies from approximately 5.0 feet to 15 to 20 feet

depending on the type of earth material the slope is composed of, the height of the slope, the inclination of the slope, moisture conditions, etc. The movement tends to be greatest at the top of the slope near the slope edge. Improvements within the creep zone should be designed and constructed to accommodate the anticipated movements. The movements may very from a fraction of an inch to several inches and is dependent on the slope height, earth material type, distance from the slope edge, and other factors.

Slope Protection

Permanent slope maintenance and protection measures as presented in the subsequent 'Slope Maintenance and Protection Recommendations' section of this report should be initiated as soon as practicable after completion of cut and/or fill slope construction. Fill slopes, cut slopes in undocumented fill, and cut slopes in alluvium and highly weathered bedrock materials steeper than 3H:1V (Horizontal to Vertical) are moderately susceptible to erosion due to the low cohesion parameters of the earth materials. The plant mix, method of application, and maintenance requirements are subject to the approval of a registered Landscape Architect or other qualified landscape professional. Construction delays, climate or weather conditions, and plant growth rates may be such that additional short-term non-plant erosion management measures may be needed. Examples would include matting, netting, plastic sheets, deep staking (5.0 feet or deeper), etc.

Temporary Roads

Temporary roads created during grading should be removed in their entirety or replaced as documented compacted fill as part of the rough grading of the tract.

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. 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 areas, 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 areas, 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.

2016 CBC SEISMIC DESIGN CRITERIA

Per the California Building Standards Commission, 2016 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

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

Occupancy Category

Relationship between the number of lives placed at risk by a failure of the structure as determined from Figure C1-1, 'Approximate Relationship between Number of Lives Placed at Risk by a Failure and Occupancy Category,' in Chapter C1 of ASCE 7-10.

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 long period (1-second), S_s and S₁, respectively, 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/research/hazmaps/design/).

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 , respectively.

Seismic Design Category

A classification assigned to a structure based on its 'Risk Category' and the severity of the design earthquake ground motion at the site (i.e., Short Period Response Acceleration (S_{DS}) and Long Period Response Acceleration (S_{DI}) Parameters).

Based on our understanding of local geologic conditions and limited in-situ penetration tests performed for this study, 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 2016 CBC

based on a 2-percent probability of being exceeded in the next 50 years (2,475 years mean return time).

SEISMIC DESIGN CRITERI	A		
Site Location	Latitude: 33.9753° North Longitude: 117.7107° West		
Occupancy Category ¹	I/II/III		
Site Class ²	D		
Mapped, Maximum Considered Earthquake (MCE), 5.0 Percent Damped, Spectral Response Acceleration Parameter at Short Period (S_s) ³ (0.2 Second) for Site Class 'B.'	2.142		
Mapped, Maximum Considered Earthquake (MCE), 5.0 Percent Damped, Spectral Response Acceleration Parameter at 1-Second (S ₁) ³ for Site Class 'B.'	0.782		
Site Coefficients (F _a) ³ for Site Class 'D.'	1.0		
Site Coefficients (F _v) ³ for Site Class 'D.'	1.5		
The MSC, 5.0 Percent Damped, Spectral Response Acceleration Parameter at Short Periods Adjusted for Site Class 'D' Effects $(S_{MS})^3$.	2.142		
The MSC, 5.0 Percent Damped, Spectral Response Acceleration Parameter at 1-Second Adjusted for Site Class 'D' Effects $(S_{M1})^3$	1.173		
Design, 5.0 Percent Damped, Spectral Response Acceleration Parameter at Short Periods $(S_{DS})^3$ for Site Class 'D.'	1.428		
Design, 5.0 Percent Damped, Spectral Response Acceleration Parameter at 1-Second $(S_{D1})^3$ for Site Class 'D.'	0.7882		
Seismic Design Catagory ⁴	D		
Model Magnitude Earthquake (M) ⁵	6.57		
Average Shear Wave Velocity in the Top 30m of the Site for Site Class 'D.' ⁵	274 m/s		
Peak Ground Acceleration (PGA) ⁵	0.793g		
Site Coefficient (F _{PGA}) ⁶	1.0		
$PGA_{M} = F_{PGA} * PGA^{7}$	0.793		

SEISMIC DESIGN CRITERIA

- 1. Determined from Figure C1-1, 'Approximate Relationship between Number of Lives Placed at Risk by a Failure and Occupancy Category,' in Chapter C1 of **ASCE 7-10**, 2010 Edition.
- 2. Per Table 20.3-1, 'Site Classification,' in Chapter 20 of ASCE 7-10, 2010 Edition.
- 3. Java Ground Motion Parameter Calculator · Version 5.1.0 (2-10-2011) available at USGS web site (http://earthquake.usgs.gov/research/hazmaps/design/). Data based on ASCE 7-10, 2010 Edition, 'Standard, Minimum Design Loads for Buildings and Other Structures.'
- 4. Per Table 11.6-1, 'Seismic Design Category Based on Short Period Response Acceleration Parameters' and Table 11.6-2, 'Seismic Design Category Based on 1-S Period Response Acceleration Parameters' in Chapter 11 of **ASCE 7-10**, 2010 Edition.
- 5. 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/).
- 6. Per Table 11.8-1, 'Mapped Maximum Considered Geometric Mean (MCE_G) Peak Ground Acceleration, PGA,' in Chapter 11 of **ASCE 7-10**, 2010 Edition.
- 7. Per Section 11.8.3 in Chapter 11 of **ASCE 7-10**, 2010 Edition.

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 recommendations presented in the subsequent paragraphs for foundation design and construction are based on geotechnical characteristics and 'Expansive' conditions for the supporting earth materials as defined in Section 1803.5.3, 'Expansive Soil,' in the 2016 CBC and should not preclude more restrictive structural requirements. Per Section 1808.6, 'Design for Expansive Soils,' in the 2016 CBC, foundations for structures resting on earth materials with an Expansion Index greater than 20 require special design considerations or such other engineering design based on geotechnical recommendations as approved by the building official. Foundations for proposed building structures should consist of a deepened foundation system with pre saturation under the slab or a 'Slab-on-Ground Foundation' system based on the current Wire Reinforcement Institute, Inc. procedures or a 'Post-Tension Slab-on-Ground' system based on the current Post Tensioning Institute.

Because of the presence of shallow groundwater and deep undocumented fill, the removal and replacement of undocumented fill may not be economically feasible for the use of shallow foundation for the buildings in the western portion of the site. Therefore, the use of a deep foundation system with a structurally supported floor slab may be an economically feasible alternative. Supplemental deep foundation recommendations can be submitted upon request after supplemental borings and lab testing are performed, if needed.

Within the western portion of the site, the presence of shallow groundwater on the subject site will likely require dewatering to be performed within the area of the proposed structure prior to performing the excavation. The earth materials exposed at the bottom of the excavation may be saturated and the excavation

bottom may expose a yielding subgrade which may require stabilization prior to the construction of the foundations and the basin structure's bottom slab. Dewatering and subgrade stabilization procedures are discussed in more detail in subsequent sections of this report.

The Structural Engineer for the project should determine the actual footing 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.

The foundations for proposed decorative block walls, retaining walls, etc. may consist of conventional continuous footings which are deepened to a depth below where volume changes occur in the earth materials due to wetting and drying or be isolated from the expansive earth materials. The Structural Engineer for the project should determine the actual foundation type and footing 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.

Foundations for a structure should be founded in undisturbed, documented, properly compacted fill, or undisturbed, natural, earth material with a relative compaction of 85 percent or greater, or bedrock, but not a combination of the different earth materials within a 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, expansive earth material and be founded to a depth of 12 inches or greater into firm, competent, undisturbed, bedrock material.

Excavation Bottom Stabilization Recommendations

The earth materials exposed at the bottom of the excavation for the structure will be saturated and the excavation bottom may expose a yielding subgrade which may require stabilization prior to the construction of the foundations and the basin structure's bottom slab.

An alternative solution may be to overexcavate the excavation by an additional 2.0 feet and placing crushed rock to achieve a working platform for the construction of the structure foundation and bottom slab. The crushed rock should be graded from 1.0 to 3.0 inches in diameter and be enclosed in a geotextile fabric such as Mirafi 140N series, or an equivalent substitute, to prevent the infiltrations of fine material from the underlying subgrade into the voids in the rock with the movement of water through the rock. The rock should be proof compacted prior to placement of footings and or the bottom slab on it.

Footing Setback

Embedment of footings on or near existing or planned slopes should be determined by a setback distance measured from the bottom outside edge of the footing to the slope face in accordance with Section 1808.7, 'Foundations on or Adjacent to Slopes,' in the 2016 CBC or the current **City of Chino Hills**, California codes and ordinances, whichever is greater.

Foundations for the proposed structure and/or retaining walls on slopes that are steeper than 10H:1V (Horizontal to Vertical) (10 percent slope) should be designed in accordance with the provisions of Section 1809.3, 'Stepped Footings,' in the 2016 CBC. The top surface of the footings should be level or should be stepped so that both the top and bottom of such foundations are in accordance with the provisions in Section 1809.3 in the 2016 CBC. The stepped foundation should be suitably reinforced and designed by a qualified Civil or Structural Engineer.

The fine grained earth materials overlying the natural slopes on the subject site are prone to downslope creep. The rate of creep is a function of the length and steepness of the slope, the moisture content of the earth materials, the depth of creep prone earth materials, and the degree and care and maintenance of the slope. Slope creep is activated by wetting of the earth material mantle. In addition, the presence of burrowing animals can reduce the integrity of the earth materials and increase the downslope creep. Effects of creep may impact structures up to 20 feet back from the top of the slope.

Deepened Conventional Foundations

For deepened foundations, subgrade earth materials should be moisture conditioned to 130 percent of optimum moisture content to a depth of 18 inches or greater immediately before placing the sand or gravel material, the vapor barrier, or pouring concrete.

Foundation Size: Exterior walls and interior bearing walls shall be supported on continuous footings. Continuous footings should have a width of 12 inches, 15 inches, 18 inches or greater for one (1), two (2), or three (3) floors (1- and 2-story structures) (3-story structure) (4-story structure) supported by the foundations, respectively, in accordance with Table 1809.7, 'Prescriptive Footings Supporting

Walls of Light-Frame Construction,' in the 2016 CBC. Footings shall be reinforced with four ½-inch-diameter deformed reinforcing bars. Two bars shall be placed within 4 inches of the bottom of the footings and two bars within 4 inches of the top of the footing with a minimum concrete cover per ACI 318, Section 7.7.1. 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 should extend to a depth of 24 inches or greater below lowest adjacent finish grade. Frost is not considered a design factor for foundations in the City of Chino Hills, California, since there will not be any significant frost penetration in the winter months.

Footing Setback: Embedment of footings on or near existing or planned slopes should be determined by a setback distance measured from the bottom outside edge of the footing to the slope face in accordance with Section 1808.7, 'Foundations on or Adjacent to Slopes,' in the 2016 CBC or the current City of Chino Hills, California codes and ordinances, whichever is greater.

Foundations for the proposed structure and/or retaining walls on slopes that are steeper than 10H:1V (Horizontal to Vertical) (10 percent slope) should be designed in accordance with the provisions of Section 1809.3, 'Stepped Footings,' in the 2016 CBC. The top surface of the footings should be level or should be stepped so that both the top and bottom of such foundations are in accordance with the provisions in Section 1809.3 in the 2016 CBC. The stepped foundation should be suitably reinforced and designed by a qualified Civil or Structural Engineer.

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 1,500 pounds per square foot (psf) for footings that are 12 inches in width and a depth of embedment of 12 inches below lowest adjacent finish grade in accordance with Table 1806.2, 'Presumptive Load Bearing Values,' in the 2016 CBC for footings founded in undisturbed, documented, properly, compacted fill material (Class 5 Material). 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.

'Slab-on-Ground Foundation' System

A 'Slab-on-Ground Foundation' system based on the current **Wire Reinforcement Institute, Inc.** procedures appears to be an economical system to mitigate the onsite expansive earth material conditions. Geotechnical parameters for the design
of a 'Slab-on-Ground Foundation' system are presented in the subsequent section.

Based on an assumed unconfined compressive strength (q_u) of 1.5 kip per square foot (ksf), an 'Effective Plasticity Index' of 24 for the expansive earth materials in the upper 15 feet of the on-site earth material deposits, and a 'Climatic Rating (C_w) of 15 for southern California, a 'Soil / Climatic Scaling Factor' (1-C) of 0.12 is recommended for use in the design of the 'Slab-On-Ground Foundation' system for the proposed structures. Other design criteria should be in accordance with the current **Wire Reinforcement Institute, Inc.** procedures.

A 'Slab-on-Ground Foundation' system designed according to the current Wire Reinforcement Institute, Inc. procedures is not expected to exceed a total settlement of 0.5 inch due to structural loads.

'Post-Tensioned Slab-on-Ground' System

A 'Post-Tensioned Slab-on-Ground' system also appears to be a suitable system to mitigate the on-site expansive earth material conditions for the support of the proposed structures. Geotechnical parameters for the design of a 'Post-Tensioned Slab-on-Ground' system based on the current **Post Tensioning Institute** procedures ('Design of Post-Tensioned Slabs-on-Ground,' the Third Edition, Copyright 2004 with Addendum 1 dated May 2007, Addendum 2 dated May 2008, and the VOLFLO 1.5 computer program) are presented as follows:

POST-TENSIONING INSTITUTE DESIGN CRITERIA				
	Shrink Swell Calculation Calculation Edge			
Edge Moisture Variation Distance - e _m (Distance measured inward from slab edge in which soil moisture content varies)	9.00 ft.	4.6 ft.		
Value for Center Lift Swell Condition (Shrinkage), - y _{m Shrink}	-1.01 in.			
Value for Edge Lift Swell Condition (Swelling), - y _{m Swell}		+1.36 in.		
Allowable Bearing Value*, psf	1,500			

Per Table 1806.2, 'Presumptive Load'Bearing Values,' for a Class 5 Material (CL, ML, MH and CH) in the 2016 CBC. 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.

The e_m and y_m values were calculated for the average and highest expansive earth materials that were encountered on the subject site. The final selection of a these

values is considered to be a value / risk assessment and decision to be made by the project owner / developer in conjunction with the structural engineer who is designing the Post-Tensioned Slab-on-Ground' System.

The depth of the perimeter stiffening beams (h) is a design calculation and needs to be determined by the Structural Engineer designing the Post-Tension slab. This in turn will determine the depth of embedment below the finish pad grade which will also be a function of the designed top of slab elevation from finish pad grade. A 'Post-Tensioned Slab-on-Ground' system designed according to the recommended bearing value is not expected to exceed a total settlement of 0.5 inch due to structural loads.

In determining the above recommended design parameters, the following assumptions were made based on the laboratory test results presented in the Reference No.1 'Geotechnical Study' and past experience in the vicinity of the site:

- Amount of fines in soil material (≤0.075 mm dia.), percent = 66
- Amount of clay in soil material (≤ 0.002 mm dia.), percent = 40
- Liquid Limit = 42
- Plastic Limit = 18
- Depth to Constant Suction, ft. = 9.0
- Constant Suction, pF = 3.9
- Dryest Suction, pF = 4.5 (typical high value to be used for normal design conditions per the PTI Addendum No. 1 to the 3rd Edition of the design of 'Post-Tensioned Slabs-on Ground').
- Wettest Suction, pF = 3.0 (typical low value of a properly drained site per the PTI Addendum No. 1 to the 3rd Edition of the design of 'Post-Tensioned Slabs-on Ground').

- Thornthwaite Moisture Index, _{Im} = ⋅20
- Gamma 100, γ_o = 0.01 (assumed as typical model for 'Non-Expansive' soils per the PTI Addendum No. 1 to the 3rd Edition of the design of 'Post-Tensioned Slabs-on Ground')
- Soil Fabric Factor, $F_f = 1.0$ (per Table 3.1, 'Soil Fabric Factor,' in the PTI Addendum No. 2 to the 3rd Edition of the design of 'Post-Tensioned Slabs-on Ground' for Non CH soils)
- Vertical Barrier Depth = 0.0 ft.
- Horizontal Barrier Length = 0.0 ft.
- K_0 Drying = 0.33
- K_0 Wetting = 0.67

Lateral Capacity

Resistance to lateral loads can be provided by a combination of friction acting at the base of the foundation and passive earth pressure on the sides of the footings and stem walls. Foundation design parameters, based on undisturbed, documented, properly compacted fill (Class 5 Material) for resistance to static lateral dead forces are as follows:

ALLOWABLE LATERAL BEARING PRESSURE (Equivalent Fluid Pressure), Passive Case			
Material Type Bearing Pressure*			
Undisturbed, Documented, Compacted Fill	100 pcf**		
Undisturbed, Existing, On- Site Soil	***		

*	Per Table 1806.2, 'Presumptive Load-Bearing Values,'			
	for a Class 5 Material (CL, ML, MH and CH) in the			
	2016 CBC with a relative compaction of 85% or greater			

** Pounds per square foot per foot of depth (pcf).

*** Materials are to be removed and replaced as properly compacted fill to support foundations.

ALLOWABLE LATERAL SLIDING RESISTANCE BETWEEN SOIL AND CONCRETE				
Material Type	Cohession			
Undisturbed, On-Site, 'Expansive,' Alluvial Soil*	130 psf			
Undisturbed, Existing, On- Site Soil	**			
* Per Table 1806.2, 'Presumptive Load-Bearing Values,' for a Class 5 Material (CL, ML, MH, and CH) in the				

- * Per Table 1806.2, 'Presumptive Load-Bearing Values,' for a Class 5 Material (CL, ML, MH, and CH) in the 2016 CBC to be multiplied by the contact area as limited in Section 1806.3.2, 'Lateral Sliding Resistance Limit,' in the CBC.
- ** Materials are to be removed and replaced as properly compacted fill to support foundations.

The above values are allowable design values and have safety factors of 2.0 or greater incorporated into them and may be used in combination without reduction in evaluating the resistance to lateral loads. The recommended lateral resistance assumes a horizontal surface for the earth material mass extending to a distance of 10 feet or greater from the face of the footing, or three (3) times the height of the surface generating passive pressure, whichever is greater. The allowable values may be increased by 33.3 percent for short durations of live and/or dynamic loading, such as wind or seismic forces. For the calculation of the allowable lateral bearing pressure (passive earth resistance), the upper 1.0 foot of material should be neglected unless confined by a concrete slab or pavement. The largest

recommended allowable lateral bearing pressure (passive earth resistance) is 15 times the recommended design value for the appropriate CBC class of material. The lateral sliding resistance value is to be multiplied by the contact area but should not exceed one half the dead load for the footing.

Interim Foundation Plan Review

It is recommended that **HGI** review the foundation plans for the structures as they become available. The purpose of this review is to determine if these plans have been prepared in accordance with the recommendations contained in this report. This review will also provide **HGI** an opportunity to submit additional recommendations as conditions warrant.

Final Foundation Design Recommendations

Final foundation recommendations should be made upon completion of grading and be included in the 'Report of Grading' prepared by the Geotechnical / Geologic Consultant for the project.

Foundation Excavations

Foundation excavations should be observed by the project Geotechnical / Geologic Consultant and/or his representative prior to placement of forms, reinforcing steel, or placement of concrete for the purpose of verification of the recommendations presented in this report and for compliance with the project plans and specifications. The foundation areas should be properly dewatered prior to and during excavation to assure that no caving will occur. The foundation excavations should be trimmed neat, level, and square. Any loose or sloughed material and debris should be removed from the foundation excavations prior to placement of reinforcing steel and removed again prior to the placement of concrete. Earth materials removed from the foundation excavations should not be placed in slab-

on-grade, hardscape, and/or pavement areas unless compacted to 90 percent or greater relative compaction. The maximum dry density and optimum moisture content for the earth material should be determined in accordance with current ASTM D1557 procedures.

SLAB-ON-GRADE FLOOR RECOMMENDATIONS

The recommendations for concrete slabs on-grade, both interior and exterior, excluding Portland Cement Concrete (PCC) pavement, are based on geotechnical characteristics and 'Expansive' conditions for the supporting earth material as defined in Section 1803.5.3, 'Expansive Soil,' in the 2016CBC. The expansion potential of the slab subgrade areas should be verified at the completion of grading of the building pad areas. Concrete slabs should be designed to minimize cracking as a result of shrinkage. Joints (isolation, contraction, and construction) should be placed in accordance with the current American Concrete Institute (ACI) or Portland Cement Association (PCA) guidelines. Special precautions should be taken during placement and curing of concrete slabs. Excessive slump (high water / cement ratio) of the concrete and/or improper curing procedures used during either hot or cold weather conditions could result in excessive shrinkage, cracking, or curling in the slabs. It is recommended that concrete proportioning, placement, and curing be performed in accordance with ACI recommendations and procedures.

Interior Floor Slabs with a Deepened Conventional Foundation System

Interior concrete slabs-on-grade should be 4.0 inches or greater in thickness and be underlain by 4.0 inches or greater (does not include the 1.0 to 2.0 inches of sand above a vapor barrier) of clean coarse sand, gravel, or other approved granular material with an Expansion Index (EI) = 0 and a Sand Equivalent (SE) value of 30 or greater placed on properly prepared subgrade per the 'Earthwork

Recommendations' section of this report. The granular layer should be compacted to 90 percent or greater of maximum dry density as determined by current ASTM D1557 procedures. The concrete for the floor slab should have a compressive strength of 2,500 psi or greater at 28 days. The slabs shall be reinforced with ½-inch-diameter deformed reinforcing bars. Reinforcing bars shall be spaced at intervals not exceeding 16 inches each way. The amount of reinforcing in the floor slab should be increased as necessary based on the structural loads placed on the floors. The reinforcing should be placed at mid-depth to 1.5 inches below the top surface of the slab to minimize cracking. The reinforcing should be tied into the adjacent footing stem walls. The concrete section, reinforcing steel, and/or design concrete compressive strength should be increased appropriately for anticipated excessive or concentrated floor loads.

Subgrade earth materials should be moisture conditioned to 130 percent of optimum moisture content to a depth of 18 inches or greater immediately before placing the sand or gravel material, the vapor barrier, or pouring concrete.

'Slab-on-Ground Foundation' System

The recommendations presented in the previous foundation design section for a 'Slab-on-Ground Foundation' system includes the interior floor slab design criteria for the structures. The amount of reinforcing in the floor slab should be increased as necessary based on the structural loads placed on the floors.

A compacted sand or gravel bedding layer beneath lightly loaded floor slabs is not needed but may be desirable to enhance the design section for heavy floor loads. If gravel bedding is used, it should consist of a well graded, crushed aggregate. The sand or gravel layer should be compacted to 90 percent or greater of maximum dry density, as determined by current ASTM D1557 procedures.

If a vapor barrier / moisture retarder is used under the floor slab and it is placed on well graded, crushed, gravel material, it is recommended that a 1.0 inch thick layer of sand or other approved granular material be placed beneath the vapor barrier / moisture retarder to prevent punctures from angular gravel fragments and projections. If open graded gravel (capillary break) is placed beneath the vapor barrier or retarder, the gravel should be a 6.0 inches or greater in thickness. If open graded gravel is used, a separation fabric such as Mirafi 140N series or an equivalent substitute should be used in-leu of a sand cushion to protect the vapor barrier / moisture retarder from punctures.

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 and proof compacted to 90 percent or greater relative compaction based on current ASTM D1557 procedures immediately before placing the gravel material, the moisture barrier, or pouring concrete.

'Post-Tensioned Slab-on-Ground' System

The recommendations presented in the previous foundation design section for a 'Post-Tensioned Slab-on-Ground' foundation' system includes the interior floor slab design criteria for the structures. The amount of reinforcing in the floor slab should be increased as necessary based on the structural loads placed on the floors.

A compacted sand or gravel bedding layer beneath lightly loaded floor slabs is not needed but may be desirable to enhance the design section for heavy floor loads. If gravel bedding is used, it should consist of a well graded, crushed aggregate. The sand or gravel layer should be compacted to 90 percent or greater of maximum dry density, as determined by current ASTM D1557 procedures.

If a vapor barrier / moisture retarder is used under the floor slab and it is placed on well graded, crushed, gravel material, it is recommended that a 1.0 inch thick layer of sand or other approved granular material be placed beneath the vapor barrier / moisture retarder to prevent punctures from angular gravel fragments and projections. If open graded gravel (capillary break) is placed beneath the vapor barrier or retarder, the gravel should be a 6.0 inches or greater in thickness. If open graded gravel is used, a separation fabric such as Mirafi 140N series or an equivalent substitute should be used in leu of a sand cushion to protect the vapor barrier / moisture retarder from punctures.

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 and proof compacted to 90 percent or greater relative compaction based on current ASTM D1557 procedures immediately before placing the gravel material, the moisture barrier, or pouring concrete.

Vapor Barrier / Moisture Retarder Recommendations

HGI does not practice in the field of moisture vapor transmission evaluation / mitigation. Therefore, it is recommended that a qualified person or firm be engaged or consulted with to evaluate the general and specific moisture vapor transmission paths and any impact on the proposed construction. This person or firm should provide recommendations for mitigation of potential adverse impact of moisture vapor transmission on various components of the structure as deemed appropriate in accordance with ACI, PCA, ASTM, PTI, the California Building Code, and/or the International Residential Code.

In heated / air conditioned areas in a structure where moisture sensitive floor coverings are anticipated over the floor slab, the use of a vapor barrier / moisture

retarder beneath the slab should be considered. Typically, a vapor retarder is not utilized under the floor slabs in garages, utility buildings, and other unheated accessory structures, driveways, walks, patios, and/or other flatwork not likely to be enclosed and heated at a later date. The use or non-use of a vapor barrier / moisture retarder, the thickness of the vapor barrier / moisture retarder, the use of a granular layer over the vapor barrier / moisture retarder, the thickness of the granular materials, the type of granular material, etc. should be determined by the Structural Engineer who is designing the floor slab in conjunction with the Architect who is specifying the use and the type of floor coverings to be placed over the floor slab, and/or a person or firm that practices in the field of moisture vapor transmission evaluation / mitigation. The vapor barrier / moisture retarder recommendations provided by the supplier of the flooring materials should also be incorporated into the project plans.

EXTERIOR CONCRETE FLATWORK

Due to the expansion potential of the near-surface on-site earth materials, exterior slabs-on-grade will experience seasonal vertical movement and cracking. There are several alternatives for minimizing or mitigating the impacts of expansive earth materials beneath exterior flatwork. Recommendations to reduce the distress to concrete flatwork include moisture conditioning the subgrade earth materials, using 'Non-Expansive' fill, and providing adequate construction and control joints in the concrete. It should be noted that localized cracking, vertical movement, and distress could still occur.

• The minimum recommendations for concrete flatwork constructed on expansive earth materials is to properly prepare the clayey earth materials prior to placing concrete. This is typically achieved by scarifying, moisture conditioning, and re-compacting the subgrade earth material. The subgrade earth materials should be moisture conditioned to a depth of 30 inches or greater and to 130 percent or greater of the optimum moisture content for the supporting earth materials as determined by current ASTM D1557 procedures. The subgrade earth materials should be compacted using moderate compaction effort to a relative compaction of 87 to 92 percent relative compaction. If the near-surface subgrade earth materials had previously been compacted and tested, the subgrade earth materials could possibly be moisture conditioned by gradually wetting the earth material, depending on the time of the year the flatwork construction occurs. This procedure should not include flooding or excessively wetting of the earth material, which would likely result in soft, unstable subgrade conditions, and possible delays in the construction while waiting for the earth materials to dry out. In general, the subgrade earth materials should be firm and non-yielding prior to constructing the flatwork.

- The replacement of 'Expansive' earth materials with 'Non-Expansive' earth materials, aggregate base, crushed rock, gravel, sand, etc, in localized areas under exterior flatwork should be avoided unless the materials are provided with a positive drainage system which will prevent a "bathtub" type situation. If 'Non-Expansive' earth materials, aggregate base, crushed rock, gravel, sand, etc, are used under the exterior flatwork, the materials should be a minimum of 36 inches in thickness and compacted to 90 percent or greater relative compaction based on ASTM D1557 procedures. The subgrade earth materials under the 'Non-Expansive' earth materials, aggregate base, crushed rock, gravel, sand, etc, should be prepared in accordance with the recommendations in the above bulleted paragraph.
- Use of maximum control joint spacing of no more than 8.0 feet in each direction and a construction joint spacing of 10 to 12 feet should be used in the design of flatwork on expansive earth materials. Construction joints that abut the foundations or garage slab should include a felt strip, or approved equivalent, that extends the full depth of the exterior slab. This will help to reduce the potential for permanent vertical offset between the slabs due friction between the concrete edges. It is recommended that exterior slabs be isolated from adjacent foundations.

If the subgrade earth materials are allowed to become saturated, there is a risk of heaving and vertical differential movement of the exterior concrete hardscape, sidewalks, curbs / gutters, etc. Therefore, proper drainage should be established away from such improvements and minimal precipitation or irrigation water

allowed to percolate into the earth materials adjacent to and/or under the exterior concrete flatwork or hardscape, curbs / gutters, etc.

RETAINING WALL RECOMMENDATIONS

Retaining walls may be needed to achieve finish grades for the proposed building pads, driveways, parking areas, and/or landscape areas. Retaining walls should be designed in accordance with the recommendations in the following sections. If earth reinforced walls, crib wall, keystone walls, etc. are used for the development of the subject site, the design requirement of the proprietary retaining wall system should supercede the following recommendations if there are any conflicts.

Static Lateral Earth Pressures

Retaining walls backfilled with 'Non-Expansive' granular soil (i.e., Expansion Index (EI) ≤ 20 and Unified Soil Classifications of SP, SW, SM, GP, GW, and GM) within a zone extending upward and away from the heel of the footing at a slope of 0.5H:1V (Horizontal to Vertical) or flatter for level backfill and 0.7H:1V for a 2H:1V slope behind the retaining wall can be designed to resist static lateral earth pressures equivalent to those recommended in the following table:

LATERAL EARTH PRESSURE						
Condition	Level Backfill and Soil Classification*		2H:1V Sloped Backfill and Soil Classification***			
	SP, SW, GP, GW	GM	SM	SP, SW, GP, GW	GM	SM
Active	30 pcf**	40 pcf	45 pcf	40 pcf	62 pcf	81 pcf
At-Rest	60 pcf	60 pcf	60 pcf	87 pcf	110 pcf	120 pcf

- * Per Table 1610.1, 'Lateral Soil Load,' in the 2016 CBC.
- ** Equivalent fluid Pressure, pounds per square foot per foot of depth (pcf).
- *** Based on a moist unit weight of 125 pcf and an Angle of Internal Friction of 38 degrees for SP, SW, GP, and GW backfill soils, 31 degrees an for GM backfill soils, and 28 for an Angle of Internal Friction of 28 for SM backfill soils.

The designer of the retaining wall should specify the type of backfill material to be used in the active / at-rest zone behind the retaining wall. Any expansive soils which may be encountered on the subject site should not be used as backfill for retaining walls. Retaining walls that are free to deflect 0.001 radian at the top should be designed for the above-recommended active condition. Retaining walls that are not capable of this movement should be assumed rigid and designed for the at-rest condition. The above values assume well-drained backfill and that a buildup of hydrostatic pressure will not occur. Surcharge loads, dead and/or live (i.e., construction loads, etc.), acting on the backfill within a horizontal distance behind the retaining wall, equivalent to or less than the vertical height of the retaining wall, should also be considered in the design. Uniform surcharge pressures should be applied as an additional uniform (rectangular) pressure distribution. The lateral earth pressure coefficient for a uniform vertical surcharge load behind the retaining wall is 0.50. Seismic and wind loads should also be added to the design loads on the retaining walls, if applicable.

Seismic Lateral Earth Pressure

In accordance with Section 1803.5.12, 'Seismic Design Categories D through F,' in the 2016 CBC for the structures, seismic loads should also be added to the design loads on the retaining walls. Recommended seismic lateral earth pressures can be provided upon request.

Foundation Design

Retaining wall footings should be founded to the same depths below lowest adjacent finished grade and offsets from the face of slopes, and into undisturbed bedrock, undisturbed, observed and tested, compacted fill, or firm, competent, undisturbed, alluvial earth material as deepened conventional foundations. The foundations may be designed for the same average allowable bearing value across the footing (as long as the resultant force is located in the middle one-third of the footing), and with the same allowable static and seismic allowable lateral bearing pressure, allowable passive earth pressure, and allowable sliding resistance as recommended in the 'Foundation Design Recommendations' section of this report. Retaining walls should be designed for a factor of safety of 1.5 against lateral sliding and overturning per Section 1807.2.3, 'Safety Factor,' in the 2016 CBC. Geotechnical parameters for the design of retaining wall foundations can be presented in a subsequent report after supplemental borings and lab testing are performed.

Subdrain

A subdrain system should be constructed behind, and at the base of retaining walls to allow drainage and to prevent the buildup of excessive hydrostatic pressures. The subdrain system should be designed by the project Civil Engineer. The use of water-stops, impermeable barriers, or other dampproofing or waterproofing methods should be considered for any retaining walls where moisture migration through the retaining wall is considered critical to the performance and/or appearance of the retaining walls. A waterproofing consultant should be retained to provide specific waterproofing recommendations for the project, if required.

Typical subdrains may include weep holes with a continuous free draining gravel gallery, perforated pipe surrounded by free draining filter rock, or another

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approved system. The option of providing an ungrouted, open coarse of block at the bottom of a retaining wall is not a recommended drainage option since the openings in this coarse are so often covered by landscape soil, hardscape, and or pavement. Gravel galleries and/or filter rock, if not designed and graded for the on-site and/or import materials, should be enclosed in a geotextile fabric such as Mirafi 140N series, or an equivalent substitute, to prevent infiltration of fine soil particles into the subdrain and clogging of the system. Before placement of the fabric, the top of the footing should be cleared of loose soil materials, large stones, and/or other debris. Any large depressions or holes should be filled with a concrete slurry or a suitable equivalent to permit close contact of the fabric with the surrounding surface. The fabric should be placed smoothly without folds or excessive wrinkles. Successive sheets of the fabric should be placed with an overlap of 24 inches or more in the direction of the flow of the water in the pipe with the upstream layer overlapping the downstream layer. The fabric should be folded over the top of the free draining granular material producing an overlap of 12 inches or more. The perforated pipes should be Schedule 40 or stronger and 4.0 inches or greater in diameter. Perforations may be either bored 0.25-inch diameter holes or 0.1875-inch (3/16-inch) wide slots placed on the bottom one-third of the pipe perimeter. If the pipe is bored, a minimum of 10 holes per linear foot should be uniformly placed along the pipe. If slots are used, they should not exceed 2.0 inches in length and should not be closer than 2.0 inches on center along the length of the pipe. The total length of the slots should not be less than 50 percent of the pipe length and should be uniformly spaced along the length of the pipe. Pipe perforations should be placed downward. Gravel filters should have a volume of 3.0 cubic feet or greater per linear foot of pipe. Subdrains should maintain a positive flow gradient and have outlets that drain in a non-erosive manner.

Prefabricated drainage products such as 'Miradrain,' or a suitable equivalent, may also be used for the purpose of providing drainage behind retaining walls when installed in accordance with the manufacturers recommendations.

Backfill

Backfill directly behind retaining walls (if backfill width is less than 3.0 feet) may consist of 0.75 inch diameter, rounded to subrounded gravel with less than 5.0 percent passing the 0.5 inch sieve enclosed in a geotextile fabric such as Mirafi 140N series, or an equivalent substitute, or a clean sand (Sand Equivalent Value greater than 50) water jetted into place to obtain compaction. If water jetting is used, the subdrain system should be in place. Even if water jetting is used, the sand should be densified to 90 percent or greater relative compaction. If the specified density is not obtained by water jetting, mechanical methods will have to be used. If other types of soil or gravel are used for backfill, mechanical compaction methods will have to be used to obtain a relative compaction of 90 percent or greater of maximum dry density. Backfill directly behind retaining walls should not be compacted by wheel, track or other rolling by heavy construction equipment unless the retaining wall is designed for the surcharge loading. If gravel, clean sand, or other imported backfill is used behind retaining walls in unpaved areas, the upper 12 to 18 inches of backfill should consist of typical on site material compacted to 90 percent or greater relative compaction to prevent the influx of surface run off into the granular backfill and into the subdrain system. Maximum dry density and optimum moisture content for backfill materials should be determined according to current ASTM D1557 procedures.

V-Drain Design

A V-drain should be constructed directly behind retaining walls which have a sloping backfill to intercept surface water and drain it from the back of the retaining wall. The V-drain should be designed and constructed in accordance with the current typical standards of the City of Chino Hills, California. The V-drain should direct water from the back of the retaining wall to an adequate down drain and discharge it in a non-erosive manner.

Observation and Testing

During retaining wall construction, observation and testing should be conducted by the project Geotechnical / Geologic Consultant and/or his representatives to verify that the work is being performed according to the recommendations presented in this report.

The foundation excavations should be observed by the project Geotechnical / Geologic Consultant and/or his representative prior to placement of forms, reinforcing steel, or placement of concrete for the purpose of verification of the recommendations presented in this report and for compliance with the project plans and specifications. The foundation excavations should be trimmed neat, level, and square. Any loose or sloughed material and debris should be removed from the foundation excavations prior to placement of reinforcing steel and removed again prior to the placement of concrete.

The placement and construction of the subdrain system behind the retaining walls should be observed by the project Geotechnical / Geologic Consultant and/or his representatives to verify that the work is being performed according to the recommendations presented in this report.

During backfill of the retaining walls, observation and testing should be conducted by the project Geotechnical / Geologic Consultant and/or his representatives to verify that the backfilling is being performed according to the recommendations presented in this report. The project Geotechnical / Geologic Consultant and/or his representative should observe the placement of fill and should take tests to verify the moisture content, density, uniformity and degree of compaction obtained. 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 report following completion of the construction operations. Retaining wall backfill 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 final 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.

Reinforced Earth Retaining Walls

If earth reinforced walls, crib walls, segmented walls, keystone walls, etc. are used for the development of the subject site, the design requirement of the proprietary wall system should utilized. Preliminary values for use in design of a reinforced earth retaining wall system can be submitted upon request, if required.

CORROSION POTENTIAL EVALUATION

The recommendations for corrosion protection should be verified at the completion of grading of the building pads on the subject site. Bulk samples of the near surface, on site earth materials were obtained during the field study to evaluate the potential for corrosivity. Results from the tests are included in the 'Summary of Laboratory Test Results' presented in Appendix 'A.'

Concrete Corrosion Potential

Preliminary tests on samples of near-surface, on-site earth material suggest a soluble sulfate concentration of 0.0015 to 0.1100 percent. Earth materials with a water soluble sulfate (SO₄) concentration of 0.10 to 0.20 percent are considered to be Category S, Class S1 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., foundations, floor slabs, driveway slabs, sidewalks, patios, curbs / gutters, etc.).] The applicable portion of the referenced ACI Table 19.3.2.1, as presented on Figure No. 4, 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., storm drain pipe / box culvert, driveway slabs, sidewalks, curbs / gutters, etc.). A lower water / cement ratio or higher compressive strength may be required for design of concrete for water tightness or for protection against freezing and thawing, or for corrosion protection of concrete reinforcement per Section 1904, 'Durability Requirements,' in the 2016 CBC, if applicable.

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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 criteria 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 nonstructural elements (i.e., driveway slabs, sidewalks, patios, curbs / gutters, etc.), is considered to be a value / risk assessment and decision to be made by the owner / developer.

Metallic Corrosion Potential

The life of buried metals depends on type of material, thickness, and construction details. Since HGI does not practice metallic corrosion engineering, if corrosion protection is considered to be a design issue, an engineer specializing in corrosion should be consulted regarding the potential damage due to corrosion. corrosion engineer should recommend appropriate types of piping and/or protective measures where needed.

Preliminary minimum resistivity tests on samples of the near-surface, on site, earth material of 1,193 and 1,810 ohm-cm suggest a mild to moderate corrosive

environment for buried ferrous metal in direct contact with the on-site earth materials when the earth materials are wet. Soils with a minimum resistivity of less than 1,000 ohm-cm indicates a severe corrosive environment.

Preliminary tests on samples of near-surface, on-site, earth material suggests a soluble chloride concentration of 120 to 240 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 samples of near-surface, on-site, earth material of 7.94 and 8.98 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.

SWIMMING POOL RECOMMENDATIONS

Retaining walls and foundations for a swimming pool and/or spa can be designed in accordance with the recommendations previously presented in this report.

A subdrain system should be constructed around and beneath the pool and spa structures to allow drainage and to prevent the buildup of excessive hydrostatic pressures and uplift if the pool and/or spa are drained. Typical subdrains may include perforated pipe surrounded by filter rock, or another approved system. Gravel galleries and/or filter rock, if not designed and graded for the on-site and/or import backfill materials, should be enclosed in a geotextile fabric such as Mirafi 140N series, or an equivalent substitute, to prevent infiltration of fine soil particles and clogging of the system. The perforated pipes should be 4.0 inches or larger in diameter. Pipe perforations should be placed downward. Gravel filters should have a volume of 1.0 cubic feet or larger per linear foot of pipe. Subdrains should maintain a positive flow gradient and have outlets that drain in a non-erosive manner or be connected to a sump with a pump or reverse flow valves installed in the pool bottom.

The walls of the pool and spa should be designed for the following conditions:

Pool full of water without earth material on the outside.

Pool empty and earth material on the outside.

The approximate earth material pressures acting on the walls of the pool and spa can be determined by the recommendations presented in the retaining wall section of this report.

If a new pool and/or spa are to be constructed near an existing structure, special design and construction procedures will be needed if the foundations for the existing structure are located above a zone defined by a 1:1 (Horizontal to Vertical) plane inclined upward toward the existing structure from the nearest edge of the pool excavation.

If the existing foundations are within this zone, the foundations for the existing structure should be underpinned or deepened to a depth below the above described plane or the pool and spa walls designed for the additional surcharge loads due to the footings. The amount of the additional surcharge load will be dependent on the actual loads on the existing footings and the actual location of the existing footings with respect to the pool and spa walls. If the footings for the existing structure are located within the above described zone, and are not underpinned, special construction techniques such as shoring or slot cuts, will have to be utilized to prevent loss of vertical and lateral support of the existing foundations.

Recommendations for wall surcharge loads, foundation underpinning, shoring, or slot cut procedures can be presented when specific information regarding the pool location, the depth of the pool or spa, and the depth and loads on the existing structure foundations are available.

If the pool and/or spa are to be constructed near the top of a slope and within the anticipated creep zone, the design of the foundations should be such that the improvement within the creep zone are supported below the anticipated creep zone.

SLOPE STABILITY EVALUATION

Since anticipated cut and fill slopes for the development of the site are not anticipated to exceed 20 feet in vertical height and will not be steeper than 2H:1V (Horizontal to Vertical), a formal slope stability analysis was not performed as part of this study. The proposed cut and fill slopes should be constructed at an inclination of 2H:1V or flatter. It is anticipated that the proposed cut slopes will expose fill materials, alluvial, colluvium, and weathered bedrock materials. It is anticipated that the proposed fill slopes will be constructed of the materials obtained from the proposed cuts for the development of the subject site and will be composed of the fill, alluvial, colluvium, and weathered bedrock materials which are present on the subject site. It is the opinion of this firm that the proposed cut and fill slopes will be grossly and surficially stable when designed at a 2H:1V inclination or flatter. However, the compacted fill and exposed cut materials could be vulnerable to erosion if precautions as recommended in the 'Slope Maintenance and Protection' section of this report are not implemented as soon as practicable after completion of grading.

PRELIMINARY PAVEMENT RECOMMENDATIONS

Preliminary tests on samples of near-surface, on-site, earth material suggests R-value of less than 5. Subgrade soils with R-value <20 are considered poor or weak soils and require Subgrade Enhancement Geotextile (SEG) to provide reinforcement as the primary function and separation as the secondary function.

As an alternative to SEG, soil stabilization methods such as lime or cement treatment may be used. Recommendation for lime or cement treatment can be provided upon request.

Subgrade Enhancement Geotextile (SEG): The specifications for SEGT is provided in Caltrans Standard Specifications, Sections 19-8 and 88-1.020. Caltrans Class B1 Woven SEG is recommended to be used for the project. Minimum overlapping per the manufacturer's specifications or 18 inches, whichever is greater, shall be required. For applications involving drainage and filtration, the design engineer should verify that the permeability of the SEG is greater than the permeability of the soil.

Placing a thicker initial lift (minimum of 6 inches) of aggregate base material on top of SEG to effectively bridge the soft soils and avoid bearing capacity failure under construction traffic loading.

Use of geogrid is not recommended unless the aggregate material meets the following natural filter criteria:

- o D15Aggregate Base / D85Subgrade ≤ 5 and D50Aggregate Base / D50Subgrade ≤ 25.
- o D15, D85, and D50 are grain sizes of the soil particles for which 15 percent, 85 percent, and 50 percent of the material is smaller than these sieve sizes.

D15,: The particle (or grain) size represented by the "15 percent passing" point when conducting a sieve analysis of a soil sample.

D85: The particle (or grain) size represented by the "85 percent passing" point when conducting a sieve analysis of a soil sample.

D50: The particle (or grain) size represented by the "50 percent passing" point when conducting a sieve analysis of a soil sample.

The following are preliminary recommendations for the structural pavement sections for the proposed streets, parking areas, and driveway areas for the subject development utilizing the **Subgrade Enhancement Geotextile**. The Hot Mix Asphalt (HMA) concrete pavement sections have been determined in general accordance with current **California Department of Transportation (CALTRANS)** design procedures using the CalFP Ver. 1.1 'Hot Mix Asphalt Empirical Design' computer program developed by the **CALTRANS**, **Office of Pavement Design** and are based on an assumed Traffic Index (TI) for a 20 year design life and an R-Value of at least 20 if a Subgrade Enhancement Geotextile is utilized.

The preliminary recommendations for the pavement sections should consist of the following:

RECOMMENDED PAVEMENT SECTIONS							
Site Area	Traffic Index*	Subgrade R-Value**	Pavement Section				
Driveway and Parking Areas for Autos and Light Weight Vehicles Only.	≤5.0	≥20	3.0" Hot Mix Asphaltic (HMA) Concrete over 10" Aggregate Base (AB)				
Interior Streets for the Development	≤5.5	≥20	3.0" HMA over 12.0" AB				
Pipeline Avenue, Los Serranos Road, Bird Farm Road, and Ramona Avenue (Collector Streets)	≤7.0	≥20	5.0" HMA over 12.0" AB				

^{*} Traffic Index was assumed for the project.

^{**} R-Value of 20 was assumed if a soil stabilization method such as SEG is utilized.

It is noted that the City of Chino Hills, California minimum guidelines for minimum pavement sections may override the above pavement recommendations without prior City review and approval.

HMA concrete pavement materials should be as specified in Section 39, 'Hot Mix Asphalt,' in the current CALTRANS 2010 'Standard Specifications' with the 7-18-2014 Revisions, or an equivalent substitute. Aggregate base should conform to Class 2 Material, 3/4" Maximum or 1-1/2" Maximum, as specified in Section 26-1.02B, 'Class 2 Aggregate Base,' in the current, CALTRANS 2010 'Standard Specifications' with the 7-18-2014 Revisions, or an equivalent substitute.

The subgrade earth material, including utility trench backfill, should be compacted to 90 percent or greater relative compaction to a depth of 1.0 foot or greater below the finish pavement subgrade elevation. The aggregate base material should be compacted to 95 percent or greater relative compaction. If asphaltic concrete and/or PCC pavement is placed directly on subgrade, the upper 6.0 inches of the subgrade should be compacted to 95 percent or greater relative compaction. Maximum dry density and optimum moisture content for subgrade and aggregate base materials should be determined according to current ASTM D1557 or California Test 216 procedures, whichever is required by the City of Chino Hills, California. The asphalt concrete pavement should be densified to 95 percent or greater of the density obtained by current California Test 304 and 308 procedures (Hveem compacted laboratory samples).

Where HMA concrete pavement abuts concrete aprons, drives, walks, or curb and gutter sections, a thickened edge transition zone is recommended for the HMA concrete section to minimize the effects of impact loading as vehicles transition from PCC paving to HMA concrete paving. This thickened edge should consist of

an increased thickness of 2.0 inches for parking areas and 4.0 inches for areas of heavy truck usage. This thickened edge should extend to a distance of 3.0 feet or greater from the edge of pavement and then gradually taper back to the design pavement thickness. If pavement subgrade earth materials are prepared at the time of grading of the building sites and the areas are not paved immediately, additional observations and testing will have to be performed before placing aggregate base material, asphaltic concrete, or PCC pavement to locate areas that may have been damaged by construction traffic, construction activities, and/or seasonal wetting and drying. In the proposed pavement areas, earth material samples should be obtained at the time the subgrade is graded for Resistance (R-Value) testing according to current California Test 301 procedures to verify the pavement design recommendations.

Because the full design thickness of the HMA concrete is frequently not placed prior to construction traffic being allowed to use the streets in a development or the parking lots, rutting and pavement failures can occur prior to project completion. To reduce this occurrence, it is recommended that either the full-design pavement section be placed prior to use by the construction traffic, or a higher Traffic Index (TI) be specified where construction traffic will use the pavement.

Surface water infiltration beneath pavements could significantly reduce the pavement design life. To limit the need for additional long-term maintenance of the pavement or pre-mature failure, it would be beneficial to protect at-grade pavements from landscape water infiltration by means of a concrete cutoff wall, deepened curbs, or equivalent. Pavement cut-off barriers should be considered where pavement areas are located downslope of any landscape areas that are to

be irrigated. The cut-off barrier should extend to a depth of at least 4.0 inches below the pavement section aggregate base material.

Gradation is not the only quality guidelines for aggregate base material. The longevity and performance of pavements utilizing aggregate base material for support is dependent upon the quality of the material which composes the aggregate base. CALTRANS specifications do not specifically exclude the use of material other than a natural, crushed rock and rock dust for Class 2 Aggregate Base material as the 'Standard Specifications for Public Works Construction' (2012) Edition of the 'Greenbook' with the 2014 Cumulative Supplement), Section 200-2.2, does for Crushed Aggregate Base material. Often times, reclaimed Portland Cement concrete, Hot Mix Asphalt concrete, lean concrete base, and cement treated base are crushed, combined with broken stone, crushed gravel, natural rough surfaced gravel, and sand per the current Section 26-1.02B, 'Class 2 Aggregate Base,' of the current CALTRANS 2010 'Standard Specifications,' with the 7-18-2014 Revisions, and graded to produce a Class 2 Aggregate Base material per CALTRANS gradation specifications. Bricks, concrete masonry units, tile, glass, ceramics, porcelain, wood, plastic, metal, etc. are not an acceptable reclaimed material for use in a Class 2 Aggregate Base material per the current CALTRANS 2010 'Standard Specifications' with the 7-18-2014 Revision. The aggregate base material should be tested prior to delivery to the subject project site for the following quality requirements per the current, appropriate CALTRANS test procedures:

	mpom	QUALITY R	EQUIREMENT
TEST	TEST METHOD NO.	OPERATING RANGE	CONTRACT COMPLIANCE
Resistance (R-Value)	Calif. Test 301		78 Minimum

	magn	QUALITY R	EQUIREMENT
TEST	TEST METHOD NO.	OPERATING RANGE	CONTRACT COMPLIANCE
Sand Equivalent	Calif. Test 217	25 Minimum	22 Minimum
Durability Index	Calif. Test 229		35 Minimum

If a reclaimed material or a pit run aggregate is proposed for use on the project as a 'Greenbook' Crushed Miscellaneous Base (CMB), the materials should be tested for the following quality requirements prior to delivery to the subject project, per the current 'Greenbook,' 2012 Edition with the 2014 Cumulative Supplement, Section 200-2.4.3, and appropriate procedures as well as the required gradation and other requirements:

TEST	TEST METHOD NO.	QUALITY REQUIREMENT
Resistance (R-Value)	Calif. Test 301	78 Minimum¹
Sand Equivalent	Calif. Test 217	35 Minimum
Percent Wear ² 100 Revolutions 500 Revolutions	ASTM C131	15 Maximum 52 Maximum

^{1.} R-Value requirement may be waived if Sand Equivalent is 40 or more.

A 'Greenbook' CMB may contain broken or crushed asphalt concrete or Portland Cement concrete and may contain crushed aggregate base or other rock materials.

^{2.} The percentage wear requirements may be waived if the material has a minimum Durability Index of 40 in accordance with CALTRANS Test Method 229.

The CMB may contain no more than 3.0 percent brick retained on the # 4 sieve by dry weight of the total sample.

Samples of the proposed aggregate base using reclaimed material should be sampled from the manufacturer's stockpiles and tested prior to delivery to the project. The samples should be obtained at a time as near the delivery to the project as possible but would allow enough time to complete the testing and report the results before delivery to the site. Samples should again be obtained and tested for quality compliance from the materials delivered to the project. In addition, per the current CALTRANS 2010 'Standard Specifications' with the 7-18-2014 Revisions, an aggregate grading and Sand Equivalent test shall not represent more than 500 cubic yards or one (1) days production if less than 500 cubic yards.

Concrete gutters should be provided at flow lines in paved areas. Pavements should be sloped to permit rapid and unimpaired flow of runoff water. In addition, paved areas should be protected from moisture migration and ponding from adjacent water sources. Saturation of aggregate base and/or subgrade materials could result in pavement failure and/or premature maintenance. The gutter material and construction methods should conform to the current standards of the City of Chino Hills, California.

POST-GRADING CRITERIA

Earth materials generated from the excavation of foundations, utility trenches, swimming pools and/or spas, etc., to be used on site, should be moisture conditioned to optimum moisture content to 3.0 percent above optimum moisture content and compacted to 90 percent or greater of the maximum dry density for the material type as determined by current ASTM D1557 procedures when it is to be placed under floor slabs, under hardscape areas, and/or in paved areas. The

placement of the excess material should not alter positive drainage away from structures and/or off the lot and should not change the distance from the weep screed on the structure to the finished adjacent earth material grade per the 'Finish Surface Drainage Recommendations' presented in a subsequent section of this report, the final and approved project plans, and/or the 2016 CBC.

SLOPE MAINTENANCE AND PROTECTION RECOMMENDATIONS

Although the design and construction of slopes are planned to create slopes that possess stability against mass rotational failure, surficial slumping, creep, and pop-outs, certain factors are beyond the influence of the project Geotechnical / Geologic Consultant. Earth material slopes are subject to some erosion when subjected to sustained water application. To reduce long term erosion, the following recommendations for slope protection and maintenance should be considered when planning, designing, and implementing slope erosion methods:

- Surface water should <u>not</u> be allowed to flow over the on-site natural or proposed man-made slopes other than incidental rainfall and irrigation. Alterations of manufactured or natural slopes, terraces, top of slope berms, and/or pad gradients should not be allowed that will prevent pad and roof run-off from the structures from being expediently directed to approved disposal areas and away from the tops of slopes.
- Surface drainage should be positively maintained from the rear yard, through the side yards, and to the street or storm drain in a non-erosive manner.
- Top of slope berms should be constructed and compacted as part of finish grading of the development and should be maintained by the property owners and/or home owners association. The recommended drainage patterns should be established at the time of finish grading and maintained throughout the life of the proposed development.

- Concentrated surface waters entering the property from off-site sources should be collected and directed to a permanent drainage system.
- The property owner and/or home owners association are responsible for the maintenance and cleaning of the interceptor ditches, drainage terraces, downdrains and other drainage devices that have been installed to promote slope stability.
- It is recommended that slopes be planted with light-weight ground cover, shrubs and trees that possess deep (5.0 feet or greater), dense root structures that require minimal of irrigation (drought resistance). It should be the responsibility of the Landscape Architect or other suitably qualified individual to provide such plants initially and of the property owner and/or home owners association to maintain such planting. Alteration of the planting scheme is at the property owner's and/or home owners association risk.
- If automatic sprinkler systems are installed their use should be adjusted to account for natural rainfall.
- The property owner and/or home owners association should establish a program for the elimination of burrowing animals. This should be an on-going program to protect slope stability.
- The property owner and/or home owners association should observe the lot drainage during heavy precipitation periods as this is often when trouble occurs. Problems such as gullying or ponding should be corrected as soon as practicable.
- High moisture content in slope earth materials is a major factor in slope erosion and slope failures. Therefore, precautions should be taken to minimize earth material saturation. Leakage from pools, waterlines, irrigation systems, etc. or bypassing of clogged drains should be promptly repaired.

The above guidelines are provided to mitigate slope maintenance and protection problems and should be included in an information packet to the home owners association, when applicable, by the project developer. The above guidelines are

general maintenance and design procedures but may be superseded under specific direction of a licensed Landscape Architect or other suitably qualified individual.

UTILITY TRENCH RECOMMENDATIONS

Utility trenches within the zone of influence of foundations or under building floor slabs, exterior hardscape, and/or pavement areas should be backfilled with documented, compacted earth material. Utility trenches within the building pad and extending to a distance of 5.0 feet beyond the building exterior footings should be backfilled with on site or similar earth material. Where interior or 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)**						
Und	locumented Fill	В	1:1						
Co	ompacted Fill	В	1:1						
	Alluvium	В	1:1						
Wea	thered Bedrock	В	1:1						
*	Type 'B':		s with an unconfined ngth greater than 0.5 tsf but						
**									

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 1.5 times the vertical depth of the excavation (for medium stiff or dense earth materials). 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.

Prior to excavating utility trenches in areas of shallow groundwater, the groundwater should be lowered to a depth of 3.0 feet or greater below the excavation bottom, if needed.

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

SIEVE SIZE	CRUSHED ROCK OR GRAVEL (PERCENT PASSING)
1/2"	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 earth materials encountered on the subject site <u>are not</u> 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 manmade 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., 6.0 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 tops of slopes, the exterior walls of structures, the back of retaining walls, trash enclosure walls, decorative concrete block walls, etc. Finish surface gradients in unpaved areas should be provided next to tops of slopes and buildings to guide surface water away from foundations, hardscape, pavement, and from flowing over the tops of slopes. 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 lot drainage, respectively, in accordance with the 2016 CBC and/or the current City of Chino Hills, 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 2016 CBC and/or the current City of Chino Hills 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.

PLANTER RECOMMENDATIONS

Planters around the perimeter of the structures should be designed so that adequate drainage is maintained and minimal irrigation water is allowed to percolate into the earth materials underling the buildings. This should include enclosed or trapped planter areas that are created as a result of sidewalks. Planters with solid bottoms, independent of the underlying earth material, are recommended within a distance of 6.0 feet from the buildings. The planters should drain directly onto surrounding paved areas or into a designed subdrain system. If planters are raised above the surrounding finished grades or are placed against the building structure, the interior walls of the planter should be waterproofed.

STORM WATER INFILTRATION FEASIBILITY

Infiltration testing was conducted on the subject site in two locations under Reference No. 1 "Feasibility Study". The infiltration test results yielded very slow infiltration rates. The Project Engineer should determine the best methods for storm water retention/infiltration.

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 geologic reconnaissance of existing surface conditions of the subject site. Site observations were conducted on August 21, August 23, August 24, and September 20, 2017 by a representative of **HGI**. The aerial distribution of the earth materials observed is shown on the 'Exploratory Excavation Location and Geology Plan,' Plate No. 1, presented in the map pocket in this Appendix.

A study of the property's subsurface condition was performed to evaluate underlying earth strata and the presence of groundwater. Twenty four (24) exploratory borings excavations were performed on the subject site on August 21, August 23, and August 24, 2017. Locations of the exploratory excavations were determined in the field by pacing, tape measuring, and sighting from the adjacent existing streets, adjacent structures, and topographic features as shown on the Reference No. 3, 'Site Plan,' noted on the first page of the cover letter for this report. Approximate locations of the exploratory excavations are denoted on the 'Exploratory Excavation Location and Geology Plan,' Plate No. 1, presented in the map pocket in this Appendix. Approximate elevations at the locations of the exploratory excavations were determined by interpolation to the closest foot from a 1-foot contour interval topographic plot of the site (Reference No. 3 noted on the first page of the cover letter for this report). Locations and elevations of the exploratory excavations should be considered accurate only to the degree implied by the method used in determining them.

The exploratory borings were performed by using a truck-mounted drill rig equipped with 8-inch outside-diameter, hollow-stem augers. The exploratory excavations were explored to depths ranging from approximately 21.5 to 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. Bulk samples were 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. 3 through 26, presented in this Appendix. Ring samples were retained in close-fitting moisture-proof containers and returned to our laboratory for testing. Standard Penetration Tests were also performed at various depths in the borings. The test was performed in general accordance with current American Society of Testing Materials (ASTM) D1586 procedures using a standard penetration sampler (2.0-inch outside diameter, 1.375-inch inside diameter) driven with a 140 weight dropping 30 inches. The blow counts to drive the sampler for three (3) successive 6.0 inch intervals are recorded on the 'Subsurface Exploration Log,' Plate Nos. 3 through 26, presented in this Appendix. The standard penetration resistance ('N' value) is the sum of the blow counts for the last two (2) 6.0 inch intervals.

Groundwater observations were made during, and at the completion of the excavation process and on the following subsequent days of exploration. Final groundwater measurements were made on September 20, 2017 and are noted on the 'Subsurface Exploration Log' presented in this Appendix, if encountered.

The exploratory excavations were logged by a representative of HGI for fill material, natural earth material, and subsurface conditions encountered. Earth materials encountered in the exploratory excavations 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, and apparent relative density or consistency of the earth materials, etc., were recorded on the field logs. The 'Relative Density' of granular soils (SP, SW, SM, SC, GP, GW, GM, GC) is given as very loose, loose, medium dense, dense, or very dense and is based on the number of blows to drive the sampler 1.0 foot or fraction thereof. The 'Consistency' of silts or clays (ML, CL, MH, CH) is given as very soft, soft, medium stiff, stiff, very stiff, or hard and is also based on the number of blows to drive the sampler 1.0 foot or fraction thereof. The field log for each excavation contains factual information and interpretation of earth material conditions between samples. The 'Subsurface Exploration Log' presented in this Appendix represent our interpretation of the field log contents and results of laboratory observations and tests performed on samples obtained in the field from the exploratory excavations.

LABORATORY TESTING PROGRAM

Laboratory tests were performed on selected, relatively undisturbed ring, bulk samples, and standard penetration samples (-200) 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 excavations 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. 3 through 26, 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. 3 through 26, presented in this Appendix.

EXPANSION TEST

Laboratory expansion tests were performed on selected sample of near-surface earth material in general accordance with the current ASTM D4829 procedures. In this testing procedure, a remolded sample is compacted in two (2) layers in a 4-inch inside diameter mold to a total compacted thickness of approximately 1.0 inch by using a 5.5-pound weight dropping 12 inches and with 15 blows per layer. The sample should be compacted at a saturation between 48 and 52 percent. After remolding, the sample is confined under a pressure of 144 pounds per square foot (psf) and allowed to soak for 24 hours. The resulting volume change due to the increase in moisture content within the sample is recorded and the Expansion Index (EI) calculated. The test results are summarized in the 'Summary of Laboratory Test Results,' Plate No. 27, presented in this Appendix.

SOLUBLE SULFATE TEST

The concentration of soluble sulfate was determined on selected samples of near-surface earth materials in general accordance with current EPA 300.0 procedures. The test results are summarized in the 'Summary of Laboratory Test Results,' Plate No. 27, presented in this Appendix.

SIEVE ANALYSIS

The percent by weight finer than a No. 200 sieve (silt and clay content) was determined for selected sample of earth materials 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 results are summarized in the 'Summary of Laboratory Test Results,' Plate No. 28, presented in this Appendix.

The grain size distribution of earth material particles smaller than the No. 200 sieve was determined for selected samples in general accordance with the 'Hydrometer and Sieve Analysis of Portion Passing the No. 10 (2.00-mm) Sieve' section of ASTM D422. This portion of the test uses a sample of earth material which passes the No. 10 sieve, is dried to a constant weight, then soaked in a water and dispersing agent solution for a specified period of time, then agitated in a 1,000 ml cylindrical tube filled with distilled water. Using a calibrated hydrometer, readings were taken at specified time intervals and the corresponding earth material particle diameter calculated according to Stokes' law.

RESISTANCE (R-VALUE) TEST

Resistance (R-Value) test were performed on selected samples of near-surface earth materials that are anticipated to comprise the subgrade for proposed pavement areas. This test procedure measures the ability of earth materials and aggregate materials to resist lateral deformation under saturated conditions and applied vertical wheel loads. The R-Value is used in developing parameters for structural pavement sections. The R-Value is determined based on the following seperate measurements:

 The exudation pressure test determines the thickness cover or pavement structure required to prevent plastic deformation of the soil under imposed wheel loads. • The expansion pressure test determines the pavement thickness or weight of cover required to withstand the expansion pressure of the soil.

Testing was performed in general accordance with current California Test 301 procedures. The test results are summarized in the 'Summary of Laboratory Test Results,' Plate No. 28, presented in this Appendix.

CONSOLIDATION TESTS

Hydroconsolidation or the Collapse Potential, I_C, of the on-site earth material behavior under load were made on the basis of consolidation tests that were performed on selected relatively undisturbed ring samples of the alluvial soils in general accordance with current ASTM D5333 procedures. The consolidation apparatus is designed to receive a 1-inch high, 2.416-inch diameter ring sample. Porous stones are placed in contact with the top and bottom of each specimen to permit addition and release of pore water. A load of 1,600 pounds per square foot (psf) was applied normal to the face of the specimen at field moisture condition and the sample was allowed to consolidate. Upon completion of the consolidation process, water was added to the test apparatus to create a submerged condition and to measure the collapse (hydroconsolidation) or expansion potential of the sample. The resulting change in sample thickness was recorded. The test results are summarized in the 'Summary of Laboratory Test Results,' Plate No. 29, presented in this Appendix.

ORGANIC CONTENT TEST

The in-situ organic content for selected samples of near-surface earth material were determined in general accordance with current ASTM D2974, Test Method 'C,' procedures. This information was an aid to classification and permitted

recognition of variations in material consistency with depth. The organic content is determined by calculating the moisture content of the earth material by drying at 105°C. Then determining the ash content of the test sample by drying at 440°C, dividing this mass by the mass of the oven dry earth material from the moisture content test, and multiplying by 100. The organic content, expressed as a percent of the oven dry weight of the earth material, is then determined by subtracting the ash content of the earth material expressed in a percent from 100 percent. The test results are summarized in the 'Summary of Laboratory Test Results,' Plate No. 29, presented in this Appendix.

ATTERBERG LIMITS

The Atterberg Limits (Liquid Limit and Plastic Limit) of a selected sample of earth material was determined in general accordance with current ASTM D4318 procedures, 'Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.' The Liquid Limit of a earth material is defined as the moisture content at which a sample of earth material placed in a standard liquid limit cup and cut by a groove 11-mm wide at the top, 2-mm wide at the bottom, and 8-mm deep will flow together at the base of the groove for a distance of 13-mm (0.5 inch) when subjected to 25 shocks from the cup being dropped 10-mm in a standard Liquid Limit apparatus at a rate of two (2) blows per second. The Plastic Limit of a earth material is defined as the moisture content at which a sample of earth material can not be deformed by rolling into 1/8 inch diameter threads without crumbling. The Plasticity Index for the earth material is equivalent to the Liquid Limit minus the Plastic Limit. The test results are summarized in the 'Summary of Laboratory Test Results,' Plate No. 30, presented in this Appendix.

MAXIMUM DRY DENSITY / OPTIMUM MOISTURE CONTENT RELATIONSHIP TEST

Maximum dry density / optimum moisture content relationship determinations were performed on samples of near-surface earth materials 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 Nos. 31 through 33, presented in this Appendix.

DIRECT SHEAR TEST

Direct shear tests were performed on selected in situ samples of near surface earth materials obtained from the borings in general accordance with current ASTM D3080 procedures. The shear machine is of the constant strain type. The shear machine is designed to receive a 1-inch high, 2.416-inch diameter ring sample. Three (3) specimens from each of the selected in situ earth material samples were tested. Specimens from the in situ samples were sheared at various pressures normal to the face of the specimens. The specimens were tested in a submerged condition. The peak and ultimate shear stresses were plotted verses the normal confining stresses to determine the shear strength (cohesion and angle of internal friction). The test results are summarized in the 'Direct Shear Test Results,' Plate Nos. 34 and 35, presented in this Appendix.

SUBSURFACE EXPLORATION LEGEND

				ION SYSTEM 4 D2488-09a)	CONSIS	TENCY / RE DENSITY	ELATIVE	
MA	JOR DIVISIONS	S	GROUP SYMBOLS	TYPICAL NAMES	CRITERIA			
		C)	GW	Well Graded Gravels and Gravel- Sand Mixtures, Little or no Fines	Reference: 'Four Thornburn, 2nd	ndation Engineerin Edition.	g', Peck, Hansen,	
Coarse- Grained Soils* More than 50 % Retained on No. 200 Sieve	Gravels 50 % or more of Coarse	Clean Gravels	GP	Poorly Graded Gravels and Gravel-Sand Mixtures, Little or no Fines	Sta	Standard Penetration Test Granular Soils		
	Fraction Retained on No. 4 Sieve	Gravels	GM	Silty Gravels, Gravel-Sand-Silt Mixtures**		Penetration Resistance, Relative N, (Blows / Foot) Density		
		with Fines	GC	Clayey Gravel, Gravel-Sand-Clay Mixtures**	0 - 4		Very Loose	
	Sands More than 50 % of Coarse Fraction Passes No. 4 Sieve	Clean	sw	Well Graded Sands and Gravely Sands, Little or no Fines		5 - 10 Loos		
		Sands	SP	Poorly Graded Sands and Gravelly Sands, Little or no Fines	11 - 30 31 - 5		Medium Dense Dense	
		Sands with	SM	Silty Sands, Sand-Silt Mixtures**	> 50 Very Dense		Very Dense	
		Fines	SC	Clayey Sands, Sand-Clay Mixtures**				
			ML	Inorganic Silts, Sandy Silts, Rock Flour	Standard Penetration Test Cohesive Soils			
Fine Grained	Silts and Clays Liquid Limits 50 % or less		CL	Inorganic Clays of Low to Medium Plasticity, Gravelly Clays, Sandy Clays, Silty Clays, Lean Clays	Penetration Consistency Resistance, N, (Blows / Foot)		Unconfined Compressive Strength, (Tons / Sq.	
Soils*			OL	Organic Silts and Organic silty Clays of Low Plasticity	< 2	Very Soft	Ft.) < 0.25	
50 % or more Passes No. 200 Sieve				Inorganic Silts, Micaceous or Diatomaceous silts, Plastic Silts	2 - 4	Soft	0.25 - 0.5	
	Silts and Clays Liquid Limits Greater than		СН	Inorganic Clays of High Plasticity, Fat Clays	5 - 8	Firm (Medium Stiff)	0.5 - 1.0	
	50 %		ОН	Organic Clays of Medium to High	9 - 15 Stiff 16 - 30 Very Stiff		1.0 - 2.0 2.0 - 4.0	
Hi	ghly Organic Soils		PT	Peat, Muck, or Other Highly Organic Soils	> 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/Cl, GM/SM, SP/SW, etc.

U.S. Standa	rd Sieve Size	1	2" 3	3"	3/4"	#4 #1	10 #	40 #20	00	
Unified Soil Classification Designation		Boulders Cobbles		Boulders Cobbles Grav			Sand	Sand		
		100		Coarse	Fine	Coarse	Medium	Fine	Clay	
Moisture Condition						al Quantity		Other S	Symbols	
Dry	Dry Absence of moisture, dusty,				Trace	< 5 %		C - Core	Sample	
	dry to the to	ouch.			Few	5 - 10%		S - SPT	Sample	
Moist	Damp but n	o visible me	oisture.		Little	15 - 25%		B - Bulk	Sample	
Wet	Visible free	water, usua	lly		Some	30 - 45 %		CK - Chu	nk Sample	
	below the w	ater table.						R - Ring	Sample	
							N	- Nuclear		
									er Table	

MILITOP GEOTECHNICA

SUBSURFACE EXPLORATION LOG BORING NO. B-1

Project Name:

The Lake Property, City of Chino Hills

Project No.

982-A14.4

Date:

8/21/2017

Logged By: Elevation: AH

Type of Rig:

Hollow-Stem Auger

N.R. - No Recovery

Drive Wt.:

140 lb

±659

Plate No. 3

Sample Type	Penetration Resistance	Soil Classification	Dry Density (Ib/ft3)	Moisture Content (%)	Lithology	Groundwater	Description
R	12 13 11	ML			af		ARTIFICIAL FILL: Gravelly, silt, a little fine to coarse sand, slightly porous; Dark brown; Moist; Very stiff.
R	7 8 14	CL	109.2	13.4	col		COLLUVIUM: Clay, a little silt, trace fine sand; Dark brown; Moist; Very stiff.
R	8 14 18	CL	107.6	18.6	Qvof		VERY OLD ALLUVIAL FAN DEPOSITS: Clay, a little silt, trace fine sand; Orange brown; Moist; Very stiff.
R	5 9 16		104.9	14.7			
R	8 16 23		106.6	13.2			
R	5 10 16						
R	4 10 17	CL					Clay, a little fine to medium sand, trace silt; Light gray brown; Moist; Very stiff.
	************	*************	***************************************	**************	***************************************	**********	Clay, trace silt,trace coarse sand, slightly porous; Gray mottled orange; Very moist to wet; Very stiff.
R	4 9 15						Groundwater encountered at 20.0'.
	13						Bottom of boring 12.5 feet. Groundwater encountered at 20.0 feet. Boring backfilled with excavated materials on 8-21-17

III I TOP GEOTECHNICAL

S - SPT Sample

N.R. - No Recovery

R - Ring Sample

B - Bulk Sample

N - Nuclear Gauge Test

D - Disturbed Sample

Plate No. 4

SUBSURFACE EXPLORATION LOG BORING NO. B-2

Project Name:

The Lake Property, City of Chino Hills

Project No.

982-A14.4

Date:

Logged By:

Elevation:

AH

Type of Rig: Drill Hole Dia.: Hollow-Stem Auger

8 in.

Drive Wt.: Drop: 140 lb 30 in.

8/21/2017

Depth of Boring (ft.):

±646 21.5

Sample Type	Penetration Resistance	Soil Classification	Dry Density (Ib/ft3)	Moisture Content (%)	O Lithology	Groundwater	Description
R		ML			Col		COLLUVIUM: Silt, a little fine to coarse sand, trace roots, porous; Dark brown; Moist; Stiff.
R	12 20 24	SC	113.6	13.8	Qvof		VERY OLD ALLUVIAL FAN DEPOSITS: Clayey fine to coarse sand; Red brown; Moist; Dense to medium dense.
R	10 13 16						
R	8 9 17	CL	105.5	20.1	***************************************		Clay, a little silt; Brown mottled light brown; Moist; Stiff.
R	4 9 18		107.5	19.5			
R	8 12 17	CL/ML					Fine sandy clay to fine sandy silt; Light brown; Very moist; Very stiff to stiff.
R	5 13 18						
R	4 6 11						
							Bottom of boring 21.5 feet. No groundwater encountered at the time of drilling. Boring left open. Groundwater remeasured 8-23-17 to 13.6 feet. Groundwater remeasured 8-24-17 to 13.8 feet. Groundwater remeasured 9-20-17 to 13.7 feet. Boring backfilled with excavated materials on 9-20-17.



SUBSURFACE EXPLORATION LOG BORING NO. B-3

Project Name:

The Lake Property, City of Chino Hills

Project No. 982-A14.4

S - SPT Sample

N.R. - No Recovery

R - Ring Sample

B - Bulk Sample

N - Nuclear Gauge Test

Date: 8/21/2017 Drive Wt.: 140 lb

Logged By: Elevation: AH ±635

21.5

Type of Rig: Drill Hole Dia.:

Hollow-Stem Auger 8 in.

Drive Wt.: Drop:

30 in.

Depth of Boring (ft.):

D - Disturbed Sample

Plate No. 5

	Sample Type	Penetration Resistance	Soil Classification	Dry Density (Ib/ft3)	Moisture Content (%)	O Lithology	Groundwater	Description
	R	9 8 8	SM	101.8	6.0	Col		COLLUVIUM: Silty fine to coarse sand, trace clay, porous, trace fine roots; Dark brown; Moist; Medium dense.
	R	5 9 12	ML/SM			Qvof		VERY OLD ALLUVIAL FAN DEPOSITS: Silt to silty fine to medium sand, trace clay, trace roots; Dark brown mottled light brown; Moist; Stiff to medium dense.
-	R	9 17 22	ML/CL	105.8	10.3			Fine sandy silt to fine sandy clay; Red brown; Moist; Very stiff.
-	R	7 13 23						A little fine to medium sand.
) -	R	7 20 29	***************************************	113.8	12.7			
-	R	5 14 28	SC					Clayey fine to coarse sand; Red brown; Moist; Dense.
5 -	R	18 20 28	CL					Clay; Olive brown; Moist; Hard.
	R	5 12 20	ML/CL					Silt to Clay; Olive brown; Moist; Very stiff.
		20						Bottom of boring 21.5 feet. No groundwater encountered. Boring backfilled with excavated materials.



S - SPT Sample

N.R. - No Recovery

R - Ring Sample

SUBSURFACE EXPLORATION LOG BORING NO. B-4

Project Name: The Lake Property, City of Chino Hills

8/21/2017 Logged By: AH Project No. 982-A14.4 Date: ±657 Type of Rig: Hollow-Stem Auger Drive Wt.: 140 lb Elevation: Drill Hole Dia.: Drop: 30 in. Depth of Boring (ft.): 51.5

Depth (ft.)	Sample Type	Penetration Resistance	Soil Classification	Dry Density (Ib/ft3)	Moisture Content (%)	Lithology	Groundwater	Description
1 -	R	9 9 9	SM	94.7	4.9	Col		COLLUVIUM: Silty fine to coarse sand, porous, trace roots, trace clay; Dark brown; Moist; Medium dense.
3 -	R	9 11 22	CL/SCC	108.2	14.4	Qvof		VERY OLD ALLUVIAL FAN DEPOSITS: Silty clay to clayey silt with fine to medium sand; Orange brown; Moist; Medium dense to dense / very stiff to hard.
5 – 6 – 7 –	R	12 20 24						
8 –	R	29 32 50/5"		D			4491004490	Clayey silt to silty clay; Light orange brown; Moist; Very stiff to hard.
1 -	R	15 16 22	ML/CL	112.2	13.3			Clayey silt to silty clay; Light orange brown; Moist; Very stiff to hard.
13 — 14 —	R	8 18 30						
16 – 17 –	R	7 16 32						A little fine sand.
18 – 19 – 20 –	R	6						
21 -	K	13 22						
23 24 - 25 _								

B - Bulk Sample

N - Nuclear Gauge Test

D - Disturbed Sample

Plate No. 6a



SUBSURFACE EXPLORATION LOG BORING NO. B-4 (CONT.)

Project Name: The Lal

The Lake Property, City of Chino Hills

Project No. 982-A14.4 Date: 8/21/2017 Logged By: AH ±657 Type of Rig: Hollow-Stem Auger Drive Wt.: 140 lb Elevation: Drill Hole Dia.: 8 in. Drop: 30 in. Depth of Boring (ft.): 51.5

Sample Type	Penetration Resistance	NO Classification	Dry Density (Ib/ft3)	Moisture Content (%)	Lithology	Groundwater	Description
R	5 11 17	ML/CL			Qvof		VERY OLD ALLUVIAL FAN DEPOSITS: Clayey silt to silty clay, trace fine sand; Brown; Moist; Very stiff.
R	6 11 19	CL					Clay, a little silt, trace black inclusions; Brown mottled gray; Moist; Very stiff to stiff.
R	6 11 16						
R	5 16 19						
R	5 13 25						Trace gravel (3 in sampler up to 2.5").
					Тру		PUENTE FORMATION (YORBA MEMBER): Siltstone/claystone, highly to slightly weathered, with thin layers of fine sand; Dark brown to black.



S - SPT Sample

N.R. - No Recovery

R - Ring Sample

SUBSURFACE EXPLORATION LOG BORING NO. B-4 (CONT.)

Project Name:

The Lake Property, City of Chino Hills

Project No.

982-A14.4

Date:

8/21/2017

Logged By: Elevation: AH ±657

Type of Rig: Drill Hole Dia.: Hollow-Stem Auger 8 in.

Drive Wt.: Drop: 140 lb 30 in.

Depth of Boring (ft.):

D - Disturbed Sample

Plate No. 6c

51.5

•	Sample Type	Penetration Resistance	Soil Classification	Dry Density (Ib/ft3)	Moisture Content (%)	Lithology	Groundwater	Description
_	R	15 31				Тру		PUENTE FORMATION (YORBA MEMBER): Siltstone/claystone, highly to slightly weathered, with thin layers of fine
-		46						sand; Dark brown to black. Bottom of boring at 51.5 feet. Groundwater was not encountered during drilling. Bore hole left open. Groundwater remeasured 8-23-17 to 28.5 feet. Groundwater remeasured 8-24-17 to 28.2 feet. Groundwater remeasured 9-20-17 to 28.1 feet. Boring backfilled with excavated material on 9-20-17.
								Borning backfired with excavated material on 7-20-17.
3 -								
9 -								
1 -								
2 -								
4 –								
5 – 6 –					11 A A A A A A A A A A A A A A A A A A			
7 –								
8 – 9 –								
0 -								
1 -								
3 -								
4 -								

B - Bulk Sample

N - Nuclear Gauge Test

HILLTOP GEOTECHNICAL

S - SPT Sample

N.R. - No Recovery

R - Ring Sample

B - Bulk Sample

N - Nuclear Gauge Test

D - Disturbed Sample

Plate No. 7

SUBSURFACE EXPLORATION LOG BORING NO. B-5

Project Name: T

The Lake Property, City of Chino Hills

Project No.

982-A14.4

8 in.

Date:

Logged By: Elevation: AH

Type of Rig:

Drill Hole Dia.:

Hollow-Stem Auger

Drive Wt.: Drop: 8/21/2017 140 lb 30 in.

Depth of Boring (ft.):

±655 16.5

Sample Type	Penetration Resistance	Soil	Dry Density (Ib/ft3)	Moisture Content (%)	Lithology	Groundwater	Description
R	6 7 13	SM	98.0	8.9	Col		COLLUVIUM: Silty fine to sand, trace roots, trace clay; Dark brown; Moist; Medium dense. (thin layer of fill >6")
R	17 18 23	CL	104.5	10.0	Qvof		VERY OLD ALLUVIAL FAN DEPOSITS: Clay, a little silt, trace coarse sand; Red brown; Moist; Very stiff to hard
R	19 30 50/5"		D				
R	22 25 35	SC	101.8	6.6	•••••		Clayey, fine to coarse sand; Red brown; Moist; Dense to very dense.
R	21 29 29				T		PUENTE FORMATION (YORBA MEMBER):
R	19 27 50/3"				Тру		Siltstone/claystone, highly to slightly weathered, with thin layers of fine sand; Gray to orange.
R	15 22 50						
							Bottom of boring 16.5 feet. No grounwater encountered. Boring Backfilled with excavated materials.



S - SPT Sample

N.R. - No Recovery

R - Ring Sample

SUBSURFACE EXPLORATION LOG BORING NO. B-6

Project Name:

The Lake Property, City of Chino Hills

Project No.

982-A14.4

Date:

8/21/2017

Logged By: Elevation: AH

Type of Rig: Drill Hole Dia.: Hollow-Stem Auger 8 in.

Drive Wt.: Drop: 140 lb 30 in.

Depth of Boring (ft.):

D - Disturbed Sample

Plate No. 8a

±658

Sample Type	Penetration Resistance		Dry Density (Ib/ft3)	Moisture Content (%)	Lithology	Groundwater	Description
F		SM	99.7	4.9	Col		COLLUVIUM: Silty fine to coarse sand, trace clay, trace gravel; Dark brown; Moist; Medium dense to very dense.
F	32 50/5"		112.9	5.9			
	23 23 15	ML/CL	118.0	7.0	Qvof		VERY OLD ALLUVIAL FAN DEPOSITS: Clayey silt to silty clay with a little fine to coarse sand; Red brown; Mois Very stiff to hard.
- F	13 20 35						
F	13 16 19	CL	109.7	14.4			Clay, trace manganese stains, trace coarse sand; Light brown to brown; Moist; Very stiff to hard.
F	18 30 46						
F	11 20 42						
	3 11				Тру		PUENTE FORMATION (YORBA MEMBER): Siltstone/claystone, highly to slightly weathered, with thin layers of fine sand; Near vertical fractures, possible bedding; Gray to orange.
	22 31						

B - Bulk Sample

N - Nuclear Gauge Test



S - SPT Sample

N.R. - No Recovery

R - Ring Sample

B - Bulk Sample

N - Nuclear Gauge Test

SUBSURFACE EXPLORATION LOG BORING NO. B-6 (CONT.)

Project Name:

The Lake Property, City of Chino Hills

Project No.

982-A14.4

Date:

8/21/2017

Logged By: Elevation:

AH ±658

Type of Rig: Drill Hole Dia.:

Hollow-Stem Auger 8 in.

Drive Wt.: Drop: 140 lb 30 in.

Depth of Boring (ft.):

D - Disturbed Sample

Plate No. 8b

31.5

Depth (tt.)	Sample Type	Penetration Resistance	Soil Classification	Dry Density (Ib/ft3)	Moisture Content (%)	Lithology	Groundwater	Description
6 — 7 — 8 —	R	14 33 50/5"				Тру		PUENTE FORMATION (YORBA MEMBER): Siltstone/claystone, highly to slightly weathered, with thin layers of fine sand; Near vertical fractures, possible bedding; Gray to orange.
0 -	S	4 18 26						
2 - 3 - 4 -								Bottom of boring 31.5 feet. No groundwater encountered. Boring backfilled with excavated materials.
5 — 6 —								
7								
9 - 0 - 1 -								
2 -								
4 - 5 - 6 -								
7 — 8 —								
9								



SUBSURFACE EXPLORATION LOG BORING NO. B-7

MILLIOP GEOTECHNICA

Project Name: The Lake Property, City of Chino Hills

Project No. 982-A14.4 Date

Hollow-Stem Auger

Date: 8/21/2017 Drive Wt.: 140 lb Logged By: Elevation: AH ±668

31.5

Type of Rig: Drill Hole Dia.:

S - SPT Sample

N.R. - No Recovery

R - Ring Sample

8 in.

Drop:

140 lb 30 in.

Depth of Boring (ft.):

Depth (ft.)	Sample Type	Penetration Resistance	Soil	Dry Density (Ib/ft3)	Moisture Content (%)	O Lithology	Groundwater	Description
	R	9 14 11	SM/ML	101.5	6.9	Col		COLLUVIUM: Silty fine to medium sand to silt, a little clay, porous, trace roots; Dark brown; Moist; Medium dense to very stiff.
-	R	19 20 18		N.R.				
	R	7 16 28	CL	103.3	16.3	Qvof		VERY OLD ALLUVIAL FAN DEPOSITS: Clay, a little silt, trace fine to coarse sandm trace gravel; Light brown; Moist; Very stiff to hard.
	R	13 24 50		108.3	17.9			
0 - 1 - 2	R	11 27 42						
3 -	R	8 19 29				Тру		PUENTE FORMATION (YORBA MEMBER): Siltstone/claystone, highly to slightly weathered, with thin layers of fine sand; Near vertical fractures, possible bedding; Gray to orange.
5 – 6 – 7 –	R	14 25 50						
8 -								
11 -	S	12 15 17						Trace manganese inclusions.
13 -								

B - Bulk Sample

N - Nuclear Gauge Test

D - Disturbed Sample

Plate No. 9a



SUBSURFACE EXPLORATION LOG BORING NO. B-7 (CONT.)

S - SPT Sample

N.R. - No Recovery

R - Ring Sample

Project Name: The Lake Property, City of Chino Hills

Project No. 982-A14.4 Date:

Type of Rig: Hollow-Stem Auger Drive Wt.: Logged By: Elevation:

AH ±668

Drill Hole Dia :

8 in.

Dron:

8/21/2017 140 lb 30 in.

Depth of Boring (ft.):

D - Disturbed Sample

Plate No. 9b

31.5

Orill F	Iole I	Dia.:	8 in.			Drop:		30 in. Depth of Boring (ft.): 31.5
Depth (ft.)	Sample Type	Penetration Resistance	Soil Classification	Dry Density (Ib/ft3)	Moisture Content (%)	Lithology	Groundwater	Description
26 - 27 - 28 - 29 -	R	14 31 48				Тру		PUENTE FORMATION (YORBA MEMBER): Siltstone/claystone, highly to slightly weathered, with thin layers of fine sand; Near vertical fractures, possible bedding; Gray to orange.
30 -	S	11 15 18						
32 - 33 - 34 -								Bottom of boring 31.5 feet. No groundwater encountered. Boring backfilled with excavated materials.
35 — 36 — 37 —								
19 -								
1 - 2 -								
13								
46 -								
49 - 50 -								

B - Bulk Sample

N - Nuclear Gauge Test

N.R. - No Recovery

SUBSURFACE EXPLORATION LOG BORING NO. B-8

Project Name: The Lake Property, City of Chino Hills

Project No. 982-A14.4 Date: 8/21/2017 Logged By: AH Type of Rig: Hollow-Stem Auger Drive Wt.: 140 lb Elevation: ±666 Drill Hole Dia.: Depth of Boring (ft.): 8 in. Drop: 30 in. 21.5

Depth (ft.)	Sample Type	Penetration Resistance	Soil Classification	Dry Density (Ib/ft3)	Moisture Content (%)	Lithology	Groundwater	Description
_	R/B	7 8 12	CL			Col		COLLUVIUM: Silty clay, slightly porous; Dark brown; Moist; Medium dense to very stiff.
1 1 1 1	R	8 13 19	CL			Qvof		VERY OLD ALLUVIAL FAN DEPOSITS: Clay, a little silt, trace fine to medium sand, slightly porous, caliche; Moist Very stiff.
	R	13 16 16	SC					Clayey fine to medium sand, a little silt, slighty porous, caliche; Light brown; Moist; Medium dense.
1 1 1 1	R	9 11 13	SC/SP				*****	Clayey fine to coarse sand, to fine to coarse sand; Light brown; Moist; Medium dense.
	R	8 16 26	CL					Clay, slightly porous, manganese staining; Light brown; Moist; Very stiff.
	R	11 13 25						
	R	9 13						
		32						Bottom of boring 21.5 feet. No groundwater encountered. Boring backfilled with excavated materials.
				515115				

Plate No. 10

N.R. - No Recovery

SUBSURFACE EXPLORATION LOG BORING NO. B-9

INCOMPOSATES

Project Name: The Lake Property, City of Chino Hills

Project No. 982-A14.4 8/23/2017 AH Date: Logged By: Drive Wt.: 140 lb ±654 Type of Rig: Hollow-Stem Auger Elevation: Drill Hole Dia.: 8 in. Drop: 30 in. Depth of Boring (ft.): 31.5

Deptil (It.)	Sample Type	Penetration Resistance	Soil Classification	Dry Density (Ib/ft3)	Moisture Content (%)	Lithology	Groundwater	Description
	R	17 16 13	CL	102.6	7.6	af		ARTIFICIAL FILL: Clay, trace fine to medium sand, trace gravel, trace caliche; Dark brown black; Moist; Very stiff.
	R	12 17 23		107.3	9.1			
	R	9 13 16	CL/ML	106.2	7.7	Qvof		VERY OLD ALLUVIAL FAN DEPOSITS: Silt to clay, slightly porous; Light brown; Moist; Very stiff.
	R	16 18 27	SM/ML		***************************************	••••••	***********	Silty, fine to medium sand to silt; Light brown; Moist; Very stiff.
	R	5 10 19	CL	104.2	19.6		***********	Clay, a little silt, porous; Light brown; Moist; Very stiff.
	R	5 12 16						Very moist, thin lenses of fine sand.
	R	5 9 14						
+							$\overline{\nabla}$	Groundwater at 19.0 feet.
	S	4 7 9						Trace black inclusions; Olive brown.

Plate No. 11a



SUBSURFACE EXPLORATION LOG BORING NO. B-9 (CONT.)

Project Name:

S - SPT Sample

N.R. - No Recovery

R - Ring Sample

B - Bulk Sample

N - Nuclear Gauge Test

D - Disturbed Sample

Plate No. 11b

The Lake Property, City of Chino Hills

Project No.

982-A14.4

Date:

8/23/2017

Logged By: Elevation:

AH

Type of Rig: Drill Hole Dia.: Hollow-Stem Auger 8 in.

Drive Wt.: Drop: 140 lb 30 in.

Depth of Boring (ft.):

±654

1	e Dia.:	8 In.			Drop:		30 in. Depth of Boring (it.): 31.3
Sample Type	Penetration Resistance	Soil Classification	Dry Density (Ib/ft3)	Moisture Content (%)	Lithology	Groundwater	Description
R 5		CL			Qvof		VERY OLD ALLUVIAL FAN DEPOSITS: Clay, a little silt, trace fine sand, slightly porous; Olive brown; Moist; Very stiff to stiff.
)	4 6 9						
2 - 3 4 5							Bottom of boring 31.5 feet. Groundwater encountered at 19.0 feet. Bore hole left open. Groundwater remeasured 8-24-17 to 12.8 feet. Groundwater remeasured 9-20-17 to 12.7 feet. Boring backfilled with excavated materials on 9-20-17.
7							
0							
3 - 4 -							
5 6 7							
18							

SUBSURFACE EXPLORATION LOG BORING NO. B-10

Project Name:

The Lake Property, City of Chino Hills

Project No.

982-A14.4

Date:

Logged By:

AH

Type of Rig:

Hollow-Stem Auger

Drive Wt.:

Elevation:

±651

Drill Hole Dia.:

S - SPT Sample

N.R. - No Recovery

R - Ring Sample

B - Bulk Sample

N - Nuclear Gauge Test

D - Disturbed Sample

Plate No. 12a

8 in.

Drop:

140 lb 30 in.

8/23/2017

Depth of Boring (ft.):

31.5

Sample Type	Penetration Resistance	Soil Classification	Dry Density (Ib/ft3)	Moisture Content (%)	af Cithology	Groundwater	Description
R	7 13 19	CL	107.0	7.2	af		ARTIFICIAL FILL: Clay, trace fine to medium sand, trace gravel; Dark brown black; Moist; Stiff.
R	16 12 12	CL	*************				Clay, a little silt, slightly porous; Dark brown black; Moist; Stiff.
R	7 5 5		92.5	9.4			Trace organics, trace gravel.
R	8 9 16	CL	106.4	16.8	Qvof		VERY OLD ALLUVIAL FAN DEPOSITS: Clay, trace coarse sand; Dark brown to olive brown; Very moist; Very stiff.
R	3 6 10	ML/CL	102.4	21.0			Clayey silt, a little fine sand to silty clay; Olive brown; Very moist; Stif
R	4 7 13					<u>~</u>	Groundwater encountered at 13.5 feet.
S	10 17 14	CL					Gravelly clay, trace fine to medium sand; Olive brown; Moist; Hard.
S	6 10 13				Тру		PUENTE FORMATION (YORBA MEMBER): Siltstone/claystone, highly to slightly weathered, with thin layers of fine sand; Near vertical fractures, possible bedding; Gray to orange.



S - SPT Sample

N.R. - No Recovery

R - Ring Sample

B - Bulk Sample

N - Nuclear Gauge Test

D - Disturbed Sample

Plate No. 12b

SUBSURFACE EXPLORATION LOG BORING NO. B-10 (CONT.)

Project Name:

The Lake Property, City of Chino Hills

Project No.

982-A14.4

Date:

8/23/2017

Logged By: Elevation: AH

Type of Rig: Drill Hole Dia.: Hollow-Stem Auger 8 in.

Drive Wt.: Drop: 140 lb 30 in.

Depth of Boring (ft.):

±651 31.5

	e)		-				Sau .	
Deptn (It.)	Sample Type	Penetration Resistance	Soil Classification	Dry Density (Ib/ft3)	Moisture Content (%)	Lithology	Groundwater	Description
6 — 7 — 8 —	S	8 16 23				Тру		PUENTE FORMATION (YORBA MEMBER): Siltstone/claystone, highly to slightly weathered, with thin layers of fine sand; Near vertical fractures, possible bedding; Gray to orange.
0 —	S	9 10 16						
32 — 33 — 34 —								Bottom of boring 31.5 feet. Groundwater encountered at 13.5 feet. Bore hole left open. Groundwater remeasured 8-24-17 to 9.3 feet. Groundwater remeasured 9-20-17 to 9.3 feet. Boring backfilled with excavated materials on 9-20-17.
5 — 6 — 7 — 8 —								
9								
2 - 3 - 4 -								
5 – 6 – 7 –								
48 — 49 —								

SUBSURFACE EXPLORATION LOG BORING NO. B-11

Drill Hole Dia.:

Project Name: The Lake Property, City of Chino Hills

8 in.

Project No. 982-A14.4 Date: 8/23/2017 Type of Rig: Hollow-Stem Auger

Drive Wt.: 140 lb

Drop:

Logged By: AH Elevation:

±651 Depth of Boring (ft.): 21.5 30 in.

Sample Type	Penetration Resistance	Soil	Dry Density (Ib/ft3)	Moisture Content (%)	Lithology	Groundwater	Description
. R	8 10 12	CL			Col		COLLUVIUM Clay, trace fine to medium sand, trace gravel; Dark brown black; Moist;
R	9 10 8	ML/CL	102.0	9.1	Qvof		VERY OLD ALLUVIAL FAN DEPOSITS: Clayey silt to silty clay; Dark brown; Moist; Stiff.
R	5 7 10 8 13 22 4 10 15 5 11 16	CL	106.4	19.5			Clay, a little silt, trace fine sand; Olive brown; Moist to wet; Stiff to very stiff to stiff. Groundwater encountered at 9.5 feet.
	14						Bottom of boring 21.5 feet. Groundwater encountered at 9.5 feet. Bore hole left open. Groundwater remeasured 8-24-17 to 8.1 feet. Groundwater remeasured 9-20-17 to 7.6 feet. Boring backfilled with excavated materials on 9-20-17.

SUBSURFACE EXPLORATION LOG BORING NO. B-12

Project Name:

The Lake Property, City of Chino Hills

Project No.

982-A14.4

Date:

Logged By:

AH

Type of Rig:

Hollow-Stem Auger

Drive Wt.:

140 lb Elevation:

±650 21.5

Drill Hole Dia.:

S - SPT Sample

N.R. - No Recovery

R - Ring Sample

B - Bulk Sample

N - Nuclear Gauge Test

D - Disturbed Sample

Plate No. 14

8 in.

Drop:

30 in.

8/24/2017

Depth of Boring (ft.):

Sample Type	Penetration Resistance	Soil Classification	Dry Density (Ib/ft3)	Moisture Content (%)	O Lithology	Groundwater	Description
R	9 11 11	CL			Col		COLLUVIUM: Clay, trace fine to medium sand, trace gravel; Dark brown black; Moist;
R	10 12 13	ML/CL	102.5	14.9	Qvof	$\underline{\nabla}$	VERY OLD ALLUVIAL FAN DEPOSITS: Clayey silt to silty clay, trace fine to medium sand; Dark brown; Moist to wet; Stiff. Groundwater encountered at 4.4 feet.
S	5 6 8						
R	9 10 13	CL	102.2	21.3	***************************************		Clay; Dark brown mottled light brown; Wet; Very stiff.
S	2 5 4	CL					Silty clay, trace fine to medium sand; Brown gray; Wet; Stiff.
R	2 4 5		104.7	20.7			
S	3 4 6						
R	2 6 12						
							Bottom of boring 21.5 feet. Groundwater encountered at 4.4 feet. Boring backfilled with excavated materials.

III LTOP GEOTECHNICA

SUBSURFACE EXPLORATION LOG BORING NO. B-13

Project Name:

The Lake Property, City of Chino Hills

Project No.

982-A14.4

Date:

8/23/2017

Logged By: Elevation: AH ±646

21.5

Plate No. 15

Type of Rig: Drill Hole Dia.: Hollow-Stem Auger 8 in.

N.R. - No Recovery

Drive Wt.: Drop: 140 lb 30 in.

Depth of Boring (ft.):

	Sample Type Penetration	Soil	Classification	Dry Density (Ib/ft3)	Moisture Content (%)	O Lithology	Groundwater	Description
	R 8 7 7 7	C	CL			Col		COLLUVIUM: Clay, a little silt, trace roots; Dark brown black; Moist;
VVVV	R 4 6 10		CL	106.2	17.2	Qvof		VERY OLD ALLUVIAL FAN DEPOSITS: Clay, some silt, trace fine to medium sand; Olive brown; Moist to wet; Stiff to very stiff.
	R 5 9 13			103.0	20.7		\geq	Groundwater encountered at 5.7 feet.
	R 7		CL	106.0	20.5	************		Clay, a little silt, trace fine sand; Olive brown; Wet; Very stiff.
	R 8 13 20			108.0	19.2			
	R 4 7 13							
	S 3 5 6							
	R 6							
								Bottom of boring 21.5 feet. Groundwater encountered at 5.7 feet. Bore hole left open. Groundwater remeasured 8-24-17 to 3.9 feet. Groundwater remeasured 9-20-17 to 3.5 feet. Boring backfilled with excavated materials on 9-20-17.



S - SPT Sample

N.R. - No Recovery

R - Ring Sample

B - Bulk Sample

N - Nuclear Gauge Test

D - Disturbed Sample

Plate No. 16

SUBSURFACE EXPLORATION LOG BORING NO. B-14

Project Name:

The Lake Property, City of Chino Hills

Project No.

982-A14.4

Date:

8/23/2017

Logged By: Elevation: AH

Type of Rig:

Hollow-Stem Auger

Drive Wt.:

140 lb

±647

63						L	
Sample Type	Penetration Resistance	Soil Classification	Dry Density (Ib/ft3)	Moisture Content (%)	E Lithology	Groundwater	Description
R	5 7 8	CL	91.6	9.6	af		ARTIFICIAL FILL: Clay, a little silt, trace fine to medium sand, trace roots; Dark brown; Moist; Stiff.
R	4 6 10		99.5	21.5			Trace organics.
R	4 9 12	ML/CL			Qvof	_	VERY OLD ALLUVIAL FAN DEPOSITS: Groundwater encountered at 5.6 feet. Clayey silt to silty clay, trace cliche; Light brown; Wet; Firm to stiff.
S	2 5 7						Olive brown.
R	3 6 9		105.1	20.9			
S	3 4 6						
R	3 8 12						
					Тру		PUENTE FORMATION (YORBA MEMBER):
S	3 5 11						Siltstone/claystone, highly to slightly weathered, with thin layers of fine sand; Gray to orange.
							Bottom of boring 21.5 feet. Groundwater encountered at 5.6 feet. Bore hole left open. Groundwater remeasured 8-24-17 to 3.8 feet. Groundwater remeasured 9-20-17 to 3.6 feet. Boring backfilled with excavated materials on 9-20-17.

S - SPT Sample

N.R. - No Recovery

R - Ring Sample

B - Bulk Sample

N - Nuclear Gauge Test

D - Disturbed Sample

Plate No. 17a

SUBSURFACE EXPLORATION LOG BORING NO. B-15

Project Name:

The Lake Property, City of Chino Hills

Project No.

982-A14.4

Date:

8/23/2017

Logged By: Elevation: AH ±646

31.5

Type of Rig: Drill Hole Dia.: Hollow-Stem Auger 8 in.

Drive Wt.: Drop: 140 lb 30 in.

Depth of Boring (ft.):

Deptin (11.)	Sample Type	Penetration Resistance	Soil Classification	Dry Density (Ib/ft3)	Moisture Content (%)	Lithology	Groundwater	Description
	R	23 23 15	SC	109.5	10.4	af		ARTIFICIAL FILL: Clayey fine to coarse sand, trace gravels; Dark brown; Moist; Medium dense.
	R	3 6 10	CL	104.3	21.5	Qvof		VERY OLD ALLUVIAL FAN DEPOSITS: Silty clay, trace coarse sand, trace roots; Olive brown; Moist to wet; Stiff.
	S	4 6 7					$\overline{\Box}$	Groundwater at 5.3 feet.
-	R	3 6 10	CL	100.6	22.6			Clay, trace silt, slightly porous, trace black inclusions; Olive brown; Wet; Stiff.
	S	4 8 10						Not porous
	R	4 9 19		110.6	17.7			
-	S	5 7 9						Trace fine sand.
3 -								
-	R	5 9 24		91.5	28.5	Тру		PUENTE FORMATION (YORBA MEMBER): Siltstone/claystone, highly to slightly weathered, with thin layers of fine sand; Gray to orange.
-								



S - SPT Sample

N.R. - No Recovery

R - Ring Sample

B - Bulk Sample

N - Nuclear Gauge Test

D - Disturbed Sample

Plate No. 17b

SUBSURFACE EXPLORATION LOG BORING NO. B-15 (CONT.)

Project Name:

The Lake Property, City of Chino Hills

Project No.

982-A14.4

Date:

8/23/2017

Logged By: Elevation: AH

Type of Rig: Drill Hole Dia.:

Hollow-Stem Auger

8 in.

Drive Wt.: Drop: 140 lb 30 in.

Depth of Boring (ft.):

±646 31.5

Deptil (11.)	Sample Type	Penetration Resistance	Soil Classification	Dry Density (Ib/ft3)	Moisture Content (%)	Lithology	Groundwater	Description
5 — 7 — 8 —	S	4 12 15	80	<u> </u>	O	Тру	0	PUENTE FORMATION (YORBA MEMBER): Siltstone/claystone, highly to slightly weathered, with thin layers of fine sand; Gray to orange.
0 -	R	4 11 26						
3 -								Bottom of boring 31.5 feet. Groundwater encountered at 5.3 feet. Bore hole left open. Groundwater remeasured 8-24-17 to 3.8 feet. Groundwater remeasured 9-20-17 to 3.5 feet. Boring backfilled with excavated materials on 9-20-17.
5 — 6 — 7 —								
8 - 9 - 0 -								
2 -								
4 — 5 — 6 —								
7 — 8 —								
49 50								

SUBSURFACE EXPLORATION LOG BORING NO. B-16

Project Name:

The Lake Property, City of Chino Hills

Project No.

982-A14.4

Date:

Logged By:

AH

Type of Rig:

Hollow-Stem Auger

Drive Wt.:

Elevation:

±647

Drill Hole Dia.:

8 in.

N.R. - No Recovery

Drop:

30 in.

8/23/2017

140 lb

Depth of Boring (ft.):

21.5

Plate No. 18

Carlo (un)	Sample Type	Penetration Resistance	Soil Classification	Dry Density (Ib/ft3)	Moisture Content (%)	g Lithology	Groundwater	Description
-	R	8 9 8	CL	95.0	7.4	af		ARTIFICIAL FILL: Silty clay, slightly porous, trace roots; Dark brown to black; Moist to we Stiff.
	R	9 9 13		99.0	10.4			Black mottled gray.
	R	7 7 7		95.0	13.5			trace red inclusions.
-	S	1 1 2	CL					Clay, a little silt, trace fine sand, some organics; Black; Very soft.
	R	1 1 2		74.2	45.1		∇	Groundwater encountered at 11.5 feet.
	S	P P P						
-	R	4 5			-X4.1			
-		5	CL	95.3	25.4	Qvof		VERY OLD ALLUVIAL FAN DEPOSITS: Silty clay, Olive brown to gray; Wet; Firm.
	S	4 13 18				Тру		PUENTE FORMATION (YORBA MEMBER): Siltstone/claystone, highly to slightly weathered, with thin layers of fine sand; Gray to orange.
		10						Bottom of boring 21.5 feet. Groundwater encountered at 11.5 feet. Bore hole left open. Groundwater remeasured 8-24-17 to 6.3 feet. Boring backfilled with excavated materials on 8-24-17.

P-Push



SUBSURFACE EXPLORATION LOG BORING NO. B-17

Project Name:

The Lake Property, City of Chino Hills

Project No.

982-A14.4

Date:

8/23/2017

Logged By: Elevation: AH

Type of Rig: Drill Hole Dia.:

Hollow-Stem Auger 8 in.

N.R. - No Recovery

P-Push

Drive Wt.: Drop: 140 lb 30 in.

Depth of Boring (ft.):

±649 21.5

Plate No. 19

()	Sample Type	Penetration Resistance	Soil Classification	Dry Density (Ib/ft3)	Moisture Content (%)	g Lithology	Groundwater	Description
	R	6 8 8	ML/CL	86.6	10.2	af		ARTIFICIAL FILL: Clayey silt to silty clay, a little fine sand, slightly porous; Dark brown; Moist; Stiff.
	R	3 7 6		93.2	9.6			
	S	5 4 3	CL	••••				Clay, a little silt, trace fine sand, some organics; Black; Wet; Firm to soft.
	R	2 3 3		81.5	37.1			
	S	1 2 2						Groundwater encountered at 11.7 feet.
	R	2 3 4						
	S	2 3 4	CL			Qvof		VERY OLD ALLUVIAL FAN DEPOSITS: Silty clay, Olive brown to gray; Wet; Firm.
						Тру		PUENTE FORMATION (YORBA MEMBER): Siltstone/claystone, highly to slightly weathered, with thin layers of fine sand; Gray to orange.
	R	9 15 27						
								Bottom of boring 21.5 feet. Groundwater encountered at 11.7 feet. Bore hole left open. Groundwater remeasured 8-24-17 to 6.8 feet. Boring backfilled with excavated materials on 8-24-17.
-								



SUBSURFACE EXPLORATION LOG BORING NO. B-18

Project Name:

The Lake Property, City of Chino Hills

Project No.

Drill Hole Dia.:

S - SPT Sample

N.R. - No Recovery

R - Ring Sample

B - Bulk Sample

N - Nuclear Gauge Test

D - Disturbed Sample

Plate No. 20a

982-A14.4

Date:

8/24/2017

Logged By: Elevation:

AH ±652

39.0

Type of Rig:

Hollow-Stem Auger

8 in.

Drive Wt.: Drop:

140 lb 30 in.

Depth of Boring (ft.):

Depth (ft.)	Sample Type	Penetration Resistance	Soil Classification	Dry Density (Ib/ft3)	Moisture Content (%)	af Lithology	Groundwater	Description
	R	4 6 5	ML/CL	82.9	23.7	af		ARTIFICIAL FILL: Calyey silt, to silty clay, a little fine sand; Brown gray; Moist; Firm.
	R	3 5 6		73.2	17.2			
	R	3 7 9	CL	103.4	17.5	*************	<u>\</u>	Groundwater encountered at 6.0 feet. Clay, a little silt, trace fine sand, some organics; Black; Wet; Firm.
	S	2 3 4						
	R	2 4 6		92.2	28.9			
	S	3 4	CL			Qvof		VERY OLD ALLUVIAL FAN DEPOSITS: Clay, trace silt, trace fine sand; Black mottled dark blue; Wet;
	R	6 18 32				Тру		PUENTE FORMATION (YORBA MEMBER): Siltstone/claystone, highly to slightly weathered, with thin layers of fine sand; Gray to orange.
	S	8 15 21						
3 – 4 – 5 –								



S - SPT Sample

N.R. - No Recovery

R - Ring Sample

B - Bulk Sample

N - Nuclear Gauge Test

D - Disturbed Sample

Plate No. 20b

SUBSURFACE EXPLORATION LOG BORING NO. B-18 (CONT.)

Project Name:

The Lake Property, City of Chino Hills

Project No.

Drill Hole Dia.:

982-A14.4

8 in.

Date:

Logged By:

AH

Type of Rig:

Hollow-Stem Auger

Drive Wt.:

Drop:

140 lb 30 in.

8/24/2017

Elevation: Depth of Boring (ft.): ±652 39.0

Sample Type	Penetration Resistance	Soil Classification	Dry Density (Ib/ft3)	Moisture Content (%)	Lithology	Groundwater	Description
S	12 31 50				Тру		PUENTE FORMATION (YORBA MEMBER): Siltstone/claystone, highly to slightly weathered, with thin layers of fine sand; Gray to orange.
R	8 17 26						
R	15 50						
							Bottom of boring 39.0 feet due to refusal. Groundwater encountered at 6.0 feet. Bore hole left open. Groundwater remeasured 8-24-17 after augers removed to 8.4 feet. Boring backfilled with excavated material on 8-24-17.



SUBSURFACE EXPLORATION LOG BORING NO. B-19

Project Name:

The Lake Property, City of Chino Hills

Project No.

982-A14.4

Date:

8/23/2017

Logged By:

AH

Type of Rig: Drill Hole Dia.:

Hollow-Stem Auger

8 in.

N.R. - No Recovery

P-Push

Drive Wt.: Drop: 140 lb 30 in. Elevation: Depth of Boring (ft.): ±654 21.5

Plate No. 21

(un) undaza	Sample Type	Penetration Resistance	Soil Classification	Dry Density (Ib/ft3)	Moisture Content (%)	g Lithology	Groundwater	Description
-	P/B	5 4 5	CL	86.2	11.2	af		ARTIFICIAL FILL: Clay, trace fine to medium sand, porous; Dark brown; Moist; Firm.
	R	4 8 8		93.3	11.9			
	S	4 4 4	CL/ML			Qvof		VERY OLD ALLUVIAL FAN DEPOSITS: Silty clay to clayery silt; Light brown to gray; Moist; Stiff.
	R	5 7 9	CL	96.9	9.9			Clay, a little silt, trace caliche; Dark brown mottled light brown; Moist to wet; Stiff.
	S	5 5 8						
-	R	4 6 10						
	S	3 4 6					_	Groundwater encountered at 17.0 feet.
-								
	R	5 13 42				Тру		PUENTE FORMATION (YORBA MEMBER): Siltstone/claystone, highly to slightly weathered, with thin layers of fine sand; Gray to orange.
								Bottom of boring 21.5 feet. Groundwater encountered at 17.0 feet. Bore hole left open. Groundwater remeasured 8-24-17 to 10.4 feet. Boring backfilled with excavated materials on 8-24-17.

S - SPT Sample

N.R. - No Recovery

R - Ring Sample

B - Bulk Sample

N - Nuclear Gauge Test

D - Disturbed Sample

Plate No. 22a

SUBSURFACE EXPLORATION LOG BORING NO. B-20

Project Name:

The Lake Property, City of Chino Hills

Project No.

982-A14.4

Date:

8/24/2017

Logged By: Elevation: AH ±662

31.5

Type of Rig: Drill Hole Dia.: Hollow-Stem Auger

8 in.

Drive Wt.: Drop: 140 lb 30 in.

Depth of Boring (ft.):

Sample Type	Penetration Resistance	Soil Classification	Dry Density (Ib/ft3)	Moisture Content (%)	Elithology	Groundwater	Description
R	5 7 9	CL			af		ARTIFICIAL FILL: Clay, some silt, trace fine to medium sand; Dark brown gray; Moist; Stiff.
R	9 8 12		103.0	14.2			
R	8 15 13	ML/CL	108.8	5.0	Qvof		VERY OLD ALLUVIAL FAN DEPOSITS: Clayey silt to silty clay; Dark brown; Moist; Very stiff.
R	6 7 12	SC/CL	103.3	13.3			Clayey fine sand to fine sandy clay, slightly porous; Red brown; Moist; Medium dense to dense / stiff to very stiff.
R	7 16 22		99.9	19.1			
R	8 10 13	CL					Clay, a little silt, a little fine sand; Brown mottled light brown; Moist to wet; Very stiff.
R	7 13 16						Trace caliche, slightly porous.
						∇	Groundwater encountered at 20.6 feet.
R	6 13 20						



N.R. - No Recovery

SUBSURFACE EXPLORATION LOG BORING NO. B-20 (CONT.)

Project Name:

The Lake Property, City of Chino Hills

Project No. 982-A14.4 Date: 8/24/2017 Logged By: AH Type of Rig: Hollow-Stem Auger Drive Wt.: 140 lb Elevation: ±662 Drill Hole Dia.: 8 in. Drop: 30 in. Depth of Boring (ft.): 31.5

Deptil (11.)	Sample Type	Penetration Resistance	Soil Classification	Dry Density (Ib/ft3)	Moisture Content (%)	Lithology	Groundwater	Description
5 -	R	5 9 13	CL			Qvof		VERY OLD ALLUVIAL FAN DEPOSITS: Clay, a little silt, a little fine sand; Brown mottled light brown; Moist to wet; Very stiff.
7 — 3 — 3 —) —		10				Тру		PUENTE FORMATION (YORBA MEMBER): Siltstone/claystone, highly to slightly weathered, with thin layers of fine sand; Gray to orange.
i	R	10 18 30					91-	Production 21.5 Cont
3 -								Bottom of boring 31.5 feet. Groundwater encountered at 20.6 feet. Boring backfilled with excavated materials on 8-24-17.
; —								
5 — 7 —								
3 -								
) - 								
5								
3 -								
9 – 0 –								

Plate No. 22b

SUBSURFACE EXPLORATION LOG BORING NO. B-21

Project Name: The Lake Property, City of Chino Hills

N.R. - No Recovery

8/24/2017 Project No. Logged By: AH 982-A14.4 Date: Elevation: ±660 Type of Rig: Hollow-Stem Auger Drive Wt.: 140 lb Drill Hole Dia.: 8 in. Drop: 30 in. Depth of Boring (ft.): 31.5

Depuii (it.)	Sample Type	Penetration Resistance	Soil Classification	Dry Density (Ib/ft3)	Moisture Content (%)	Lithology	Groundwater	Description
	R/B	7 21 22	CL	114.5	8.3	af		ARTIFICIAL FILL: Clay, some silt, a little fine to medium sand, trace asphalt debris; Dark brown; Very stiff.
	R	9 10 15	ML/CL	91.2	6.7	Qvof		VERY OLD ALLUVIAL FAN DEPOSITS: Clayey silt to silty clay, trace fine to medium sand, slightly porous; Brown Moist; Very stiff.
	R	8 12 12	CL	114.3	10.5			Clay, a little silt, trace fine to medium sand; Red brown; Moist; Stiff to very stiff.
	R	14 12 13		104.5	13.9			
	R	9 15 16						Trace gravel.
	R	3 8 13						
	R	5 4 14						
	S	2 4 6	CL				_	Clay, trace coarse sand; Olive brown; Moist to wet; Stiff. Groundwater encountered at 19.6 feet.
		0						

Plate No. 23a



SUBSURFACE EXPLORATION LOG BORING NO. B-21 (CONT.)

Project Name: The Lake Property, City of Chino Hills

Project No.

S - SPT Sample

N.R. - No Recovery

R - Ring Sample

B - Bulk Sample

N - Nuclear Gauge Test

D - Disturbed Sample

Plate No. 23b

982-A14.4

Date:

8/24/2017

Logged By: Elevation:

AH

Type of Rig: Drill Hole Dia.:

Hollow-Stem Auger

8 in.

Drive Wt.: Drop:

140 lb 30 in.

Depth of Boring (ft.):

±660 31.5

Copin (ne)	Sample Type	Penetration Resistance	Soil Classification	Dry Density (Ib/ft3)	Moisture Content (%)	Povof	Groundwater	Description
	R	6 12 13	CL			Qvof		VERY OLD ALLUVIAL FAN DEPOSITS: Clay, trace coarse sand; Olive brown; Moist to wet; Very stiff to stiff.
	S	3 5 8						
3 -								Bottom of boring 31.5 feet. Groundwater encountered at 19.6 feet. Boring backfilled with excavated materials on 8-24-17
5 — 6 — 7 — 8 —								
9 -								
3 -								
5 — 6 — 7 —								
8 - 9 - 0 -								

SILLTOP GEDTECHNICA

SUBSURFACE EXPLORATION LOG BORING NO. B-22

INCOMPORATED

Project Name: The Lake Property, City of Chino Hills

Project No. 982-A14.4 Date: 8/24/2017 Logged By: AH Type of Rig: Drive Wt.: 140 lb Elevation: ±660 Hollow-Stem Auger Drill Hole Dia.: 8 in. Drop: 30 in. Depth of Boring (ft.): 21.5

Depth (ft.)	Sample Type	Penetration Resistance	Soil Classification	Dry Density (Ib/ft3)	Moisture Content (%)	O Lithology	Groundwater	Description
1 -	R	4 6 8	CL	91.5	7.1	Col		COLLUVIUM: Silty clay, trace fine to medium sand, slightly porous; Dark brown; Moist; Stiff.
	R	6 11 20	CL	106.0	17.0	Qvof		VERY OLD ALLUVIAL FAN DEPOSITS: Clay, a little silt, trace caliche; Olive brown; Moist; stiff to very stiff.
	R	9 16 22		106.1	17.4			
	R	6 8 13		103.2	18.2			
	R	6 10 14	CL/ML					Silty clay to clayey silt, trace fine to coarse sand; Olive brown; Moist; Stiff to very stiff.
-	R	4 9 13						
	R	7 12 14	CL					Clay, tracve fine to coarse sand; Olive brown; Moist to wet; Very stiff.
7		14					<u></u>	Groundwater encountered at 16.7 feet.
			CL					Clay, trace silt; Olive brown; Wet; Stiff.
	S	4 5 7						
							A STATE OF THE STA	Bottom of boring 21.5 feet. Groundwater encountered at 16.7 feet. Boring backfilled with excavated materials on 8-24-17.
; <u> </u>		SPT Samp	ole R Recovery	- Ring Sa	ımple	B - Bulk P-Push		ple N - Nuclear Gauge Test D - Disturbed Sample Plate No.

SUBSURFACE EXPLORATION LOG BORING NO. B-23 HILLTOP GEOTECHNICAL

Project Name: The Lake Property, City of Chino Hills

Project No. 982-A14.4 Date:

Type of Rig: Hollow-Stem Auger

Logged By: Elevation:

AH ±656

31.5

Drill Hole Dia.:

S - SPT Sample

N.R. - No Recovery

R - Ring Sample

8 in.

Drive Wt.: Drop:

140 lb 30 in.

8/24/2017

Depth of Boring (ft.):

D - Disturbed Sample

Plate No. 25a

Depth (ft.)	Sample Type	Penetration Resistance	Soil Classification	Dry Density (Ib/ft3)	Moisture Content (%)	O Lithology	Groundwater	Description
1 -	R	6 8 7	CL	93.2	7.7	Col		COLLUVIUM: Clay, trace fine to medium sand, trace roots, slightly porous; Dark brown; Moist; Stiff.
3 -	R	5 5 7		90.1	9.6			
5 -	R	9 15 20	CL	101.3	13.0	Qvof		VERY OLD ALLUVIAL FAN DEPOSITS: Clay, trace silt, trace fine to medium sand, slightly porous; Brown mottled light brown; Moist; Stiff to very stiff.
8 - 9 -	R	4 8 13		105.3	15.5			
10 -	R	8 13 14						A little fine to coarse sand.
12	R	3 7 17	CL				_	Groundwater encountered at 12.5 feet. Clay trace coarse sand; Olive brown; Wet; Stiff to very stiff.
15 -	R	6 6 11						
18 -								
20 - 21 - 22 -	S	4 8 10			Address of the control of the contro			
23 - 24 - 25 -					And the second s			

B - Bulk Sample

N - Nuclear Gauge Test



SUBSURFACE EXPLORATION LOG BORING NO. B-23 (CONT.)

N.R. - No Recovery

Project Name: The Lake Property, City of Chino Hills

Project No. 982-A14.4 8/24/2017 Logged By: AH Date: Type of Rig: Hollow-Stem Auger Drive Wt.: 140 lb Elevation: ±656 Drill Hole Dia.: 8 in. 30 in. Depth of Boring (ft.): 31.5 Drop:

Deptil (III.)	Sample Type	Penetration Resistance	Soil Classification	Dry Density (Ib/ft3)	Moisture Content (%)	Lithology	Groundwater	Description
	R	7 11 15	CL			Qvof		VERY OLD ALLUVIAL FAN DEPOSITS: Clay trace coarse sand; Olive brown; Wet; Very stiff.
0 -	S	5 9 13						
2 - 3 - 4 - 5 - 6 -								Bottom of boring 31.5 feet. Groundwater encountered at 12.5 feet. Boring backfilled with excavated materials on 8-24-17.
8 — 9 — 0 — 1 —								
3 — 4 — 5 —								
7 – 8 – 9 –								

Plate No. 25b



SUBSURFACE EXPLORATION LOG BORING NO. B-24

Project Name:

The Lake Property, City of Chino Hills

Project No.

982-A14.4

8 in.

Date:

Drop:

8/24/2017

Logged By:

AH

Plate No. 26

Type of Rig: Drill Hole Dia.:

N.R. - No Recovery

P-Push

Hollow-Stem Auger Drive Wt.:

140 lb 30 in.

Elevation: Depth of Boring (ft.):

±651 21.5

(m) mdsa	Sample Type	Penetration Resistance	Soil Classification	Dry Density (Ib/ft3)	Moisture Content (%)	Lithology	Groundwater	Description
	R/B	9 11 13	CL	92.9	7.5	Col		COLLUVIUM: Silty clay, trace fine to medium sand, slightly porous; Dark brown; Moist Stiff to very stiff.
	R	9 6 10		95.5	8.3			
	R	9 10 10	CL	107.0	12.7	Qvof		VERY OLD ALLUVIAL FAN DEPOSITS: Clay, a little silt, trace fine to medium sand; Light brown; Moist; Stiff to very stiff.
	R	6 11 22		117.0	14.4		_	Groundwater encountered at 7.7 feet.
	R	6 9 9	CL					Gravelly fine to coarse sand layer thin.
	R	5 9 15	CL/CH					Clay, trace silt, trace coarse sand; Oive brown; Wet; Very stiff.
	R	4 11 15						
								Groundwater encountered at 7.7 feet.
	S	2 5 8						
+								Bottom of boring 21.5 feet. Groundwater encountered at 7.7 feet. Bore hole left open. Groundwater remeasured 9-20-17 to 9.6 feet. Boring backfilled with excavated material on 9-20-17.

SUMMARY OF LABORATORY TEST RESULTS THE LAKE PROPERTY, CHINO HILLS

	EXPANSION INDEX TEST RESULTS (ASTM D4829 Test Method)											
SAMPLE NO.	MOISTURE CONTENT PRIOR TO TEST (to 0.1%)	DRY DENSITY PRIOR TO TEST (to 0.1 pcf)	SATURATION PRIOR TO TEST (to 0.1% between 48% & 52%)*	MOISTURE CONTENT AFTER TEST (to 0.1%)	EXPANSION INDEX	EXPANSION POTENTIAL**						
B-8, 0.0-4.0	9.6	112.2	41.7	21.5	93	Expansive						
B-13, 0.5-4.0'	11.9	101.1	48.2	28.3	108	Expansive						
B-19, 0.0'-4.0'	13.5	98.8	51.7	27.4	92	Expansive						

* Assumes a 2.70 Specific Gravity for the earth material.

** As defined in Section 1803.5.3, 'Expansive Soil,' in the 2016 California Building Code (CBC) (i.e., Non-Expansive: EI ≤20; Expansive: EI >20).

SOLUBLE SULFATE TEST RESULTS (EPA 300.0 Test Procedure)*							
SAMPLE	SOLUBLE SULFATE CONTENT (%)	CLASS**					
B-8, 0.0-4.0'	0.0015	S0 S1 S0					
B-13, 0.5-4.0'	0.1100						
B-19, 0.0-4.0'	0.0410						
Labora ** Per 7 Catego	performed by tories. Table 19.3.1.1 ries and Classes te Institute (A	l, 'Exposure s,' in American					

SUMMARY OF LABORATORY TEST RESULTS THE LAKE PROPERTY, CHINO HILLS

PERCENT PASSING #200 SIEVE TEST RESULTS (ASTM D1140 Test Method)							
SAMPLE	EARTH MATERIAL DESCRIPTION	PERCENT PASSING #200 SIEVE					
B-8, 0.0-4.0'	Silty clay, trace fine to medium sand (CL)	58.0					
B-13, 0.5-4.0'	Clay, a little to some silt (CL)	64.3					
B-19, 0.0-4.0'	Silty clay, trace fine to medium sand, trace gravel (CL)	66.2					
B-12, 5.0'	Silty clay to clayey silt, trace fine to medium sand (ML/CL)	54.2					
B-12, 15.0'	Silty clay, trace fine to medium sand (CL)	81.1					

RESISTANCE (R-VALUE) TEST RESULTS (California Test 301 Procedures)									
		R-V	ALUE						
SAMPLE	EARTH MATERIAL DESCRIPTION	BY EXUDATION PRESSURE AT 300 psi	BY EXPANSION PRESSURE						
B-8, 0.0-4.0'	Silty clay, trace fine to medium sand (CL)	<5	N/A						
B-13, 0.5-4.0'	Clay, a little to some silt (CL)	<5	N/A						
B-19, 0.0-4.0'	Silty clay, trace fine to medium sand, trace gravel (CL)	<5	N/A						
B-24, 0.0-4.0'	Silty clay, trace fine to medium sand (CL)	<5	N/A						

^{*} Per ASTM 2844 Section 7.4 Note 3, for clay specimen that extrudes from the mold around the follower ram during the loading specimen and when fewer than 5 light were lit at 800PSI the soils should be reported less than 5 R-Value.

SUMMARY OF LABORATORY TEST RESULTS THE LAKE PROPERTY, CHINO HILLS

COLLAPSE POTENTIAL TEST RESULTS (ASTM D5333 Test Method)										
SAMPLE	SETTLEMENT AT 1,600 PSF LOAD (%)	COLLAPSE / SWELL* (%)	COLLAPSE INDEX, (I _c), (%)	DEGREE OF COLLAPSE*						
B-2, 10.0-11.5'	1.8	+0.4	0.0	None						
B-12, 2.5-4.0'	2.3	+1.8	0.0	None						

^{*} Percent collapse (-) or swell (+) measured when water added at 1,600 psf load during test procedure.

** Per Table 1, 'Classification of Collapse Index, I_c ,' in ASTM Standard Test Method D5333-03.

None - 0%

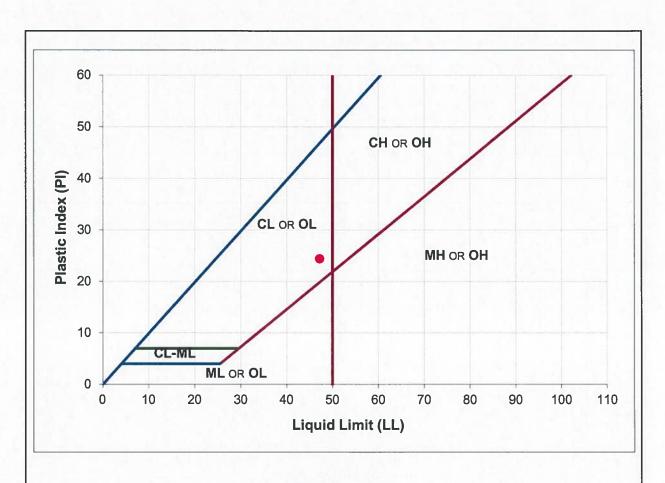
Slight - 0.1 - 2.0%

Moderate - 2.1 - 6.0%

Moderately Severe - 6.1 - 10.0%

Severe - >10.0%

ORGANIC CONTENT TEST RESULTS (ASTM D2974 Test Method)								
SAMPLE NO.	EARTH MATERIAL DESCRIPTION	MOISTURE CONTENT (%)	ORGANIC CONTENT (%)					
B-16, 7.0-10.0'	Clay, a little silt, trace fine sand, some organics (CL)	44.4	5.2					
B-18, 7.5-9.0'	Clay, a little silt, trace sand, some organics (CL)	20.1	4.2					



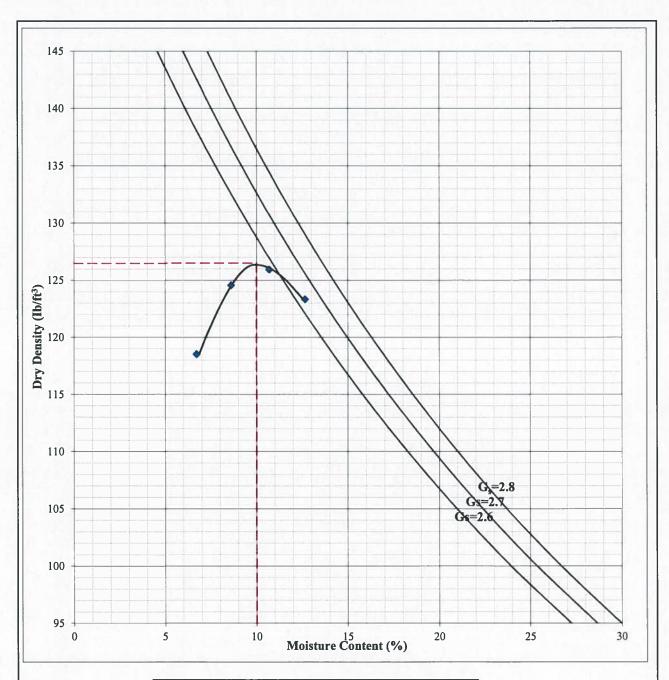
Plasticity Chart

Sample	Soil Description	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index
B-13, 0.5-4.0'	Clay, a little to some silt (CL)	47	18	24



ATTERBERG LIMIT TEST RESULTS (ASTM D4318 Test Method)

BY:	SS	DATE:	9/29/2017	r'i ka
JOB NO.:	982-A14.4	PLATE NO	.:	30



Maximum Dry Density (Ib/ft³)	126.5
Optimum Moisture Content (%)	10.0
Procedure	A

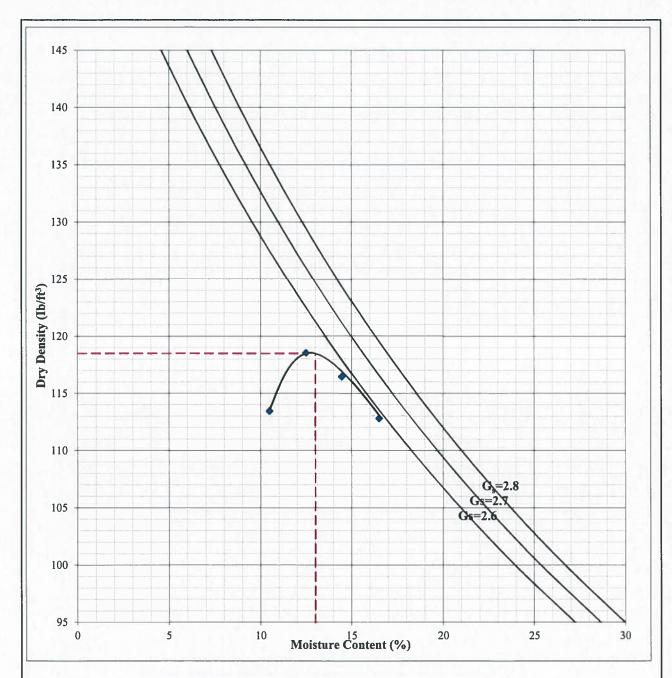
JOB NO.: 982-A14.4



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

PLATE NO.: 31

SAMPL	E: B-8, 0.0-4.0			
SOIL D	ESCRIPTION:	Silty clay, trace fine to	medium sand (CL)	
BY:	SS	DATE:	9/29/17	

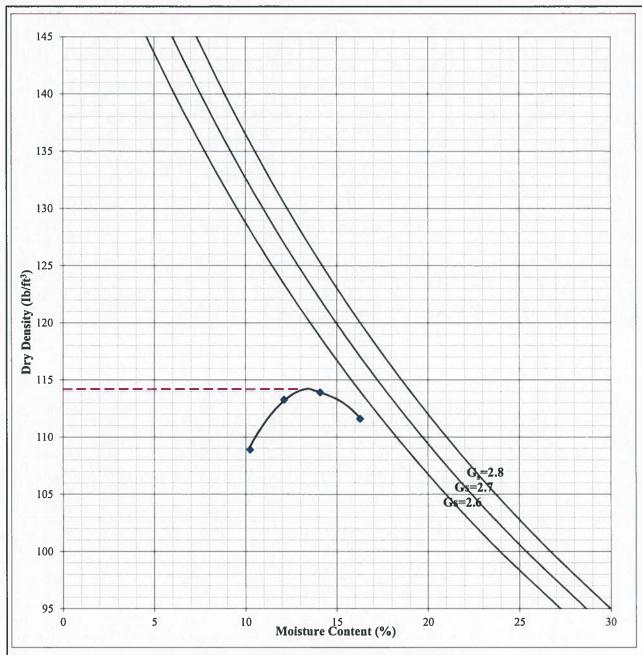


Maximum Dry Density (Ib/ft³)	118.5
Optimum Moisture Content (%)	13.0
Procedure	A



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

SAMPLE:	B-13, 0.5-4.0)'			
SOIL DES	CRIPTION:	Clay, a littl	e to some silt (C	CL)	
BY:	SS		DATE:	9/29/17	
JOB NO.:	982-A14.4		PLATE NO.:	32	



Maximum Dry Density (Ib/ft³)	114.5
Optimum Moisture Content (%)	13.0
Procedure	A

Corrected Maximum Dry Density for 5.3% +#4 (Ib/ft ³)	116.4
Corrected Optimum Moisture Content for 5.3% +#4 (%)	12.4



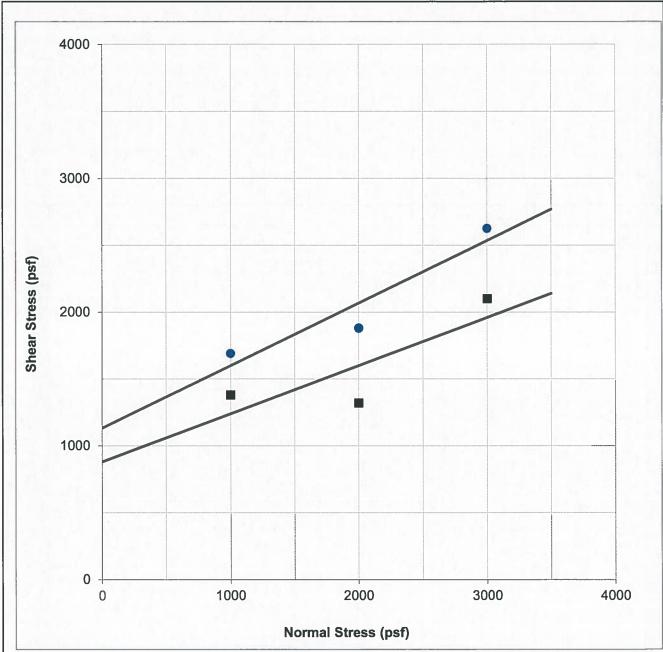
MAXIMUM DRY DENSITY / OPTIMUM MOISTURE CONTENT RELATIONSHIP TEST RESULTS (ASTM D1557 Test Method)

SAMPLE: B-19, 0.0-4.0'

SOIL DESCRIPTION: Silty clay, trace fine to medium sand, trace gravel (CL)

BY: SS DATE: 9/29/17

JOB NO.: 982-A14.4 PLATE NO.: 33



Shear Speed: 0.0139 in. / hr.

Samples tested in a submerged condition.

Average In-Situ Dry	01.5
Density (pcf)	91.3

Average In-Situ	28.5
Moisture Content	20.3

Peak	Cohesion	1132 psf
	Internal Friction Angle	25 degrees
Ultimate	Cohesion	880 psf
	Internal Friction Angle	20 degrees
Residual	Cohesion	psf
	Internal Friction Angle	degrees

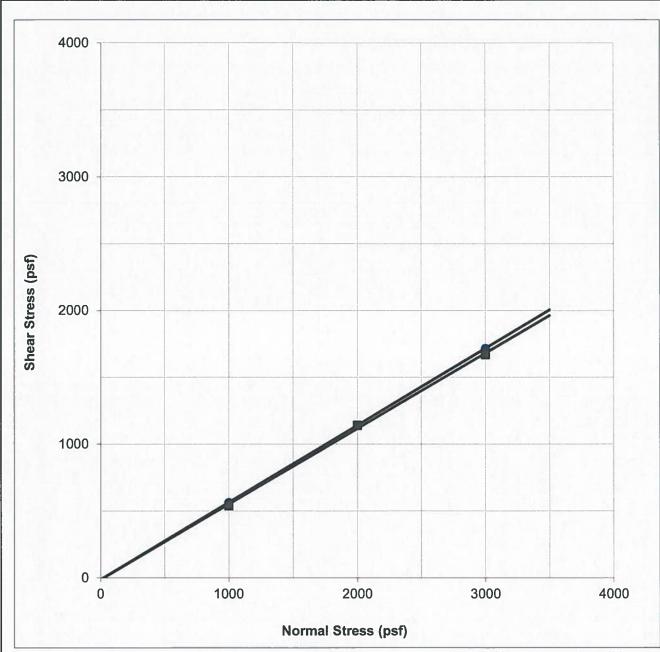


DIRECT SHEAR TEST RESULTS (ASTM D3080 Test Method)

SAMPLE: B-15, 20.0'-21.5'

SOIL DESCRIPTION: Siltstone/claystone, highly to slightly weathered, with thin layers of fine sand (TPY)

BY: SS DATE: 09/2017
PROJECT NO.: 982-A14.4 PLATE NO.: 34



Shear Speed: 0.0139 in. / hr.

Samples tested in a submerged condition.

Average In-Situ Dry Density (pcf)	74.2
Defisity (pci)	

Average In-Situ	45.1
Moisture Content	43.1

Peak	Cohesion	0 psf
Feak	Internal Friction Angle	30 degrees
Ultimate	Cohesion	0 psf
Ollinate	Internal Friction Angle	29 degrees
Residual	Cohesion	psf
Residual	Internal Friction Angle	degrees



DIRECT SHEAR TEST RESULTS (ASTM D3080 Test Method)

SAMPLE: B-16, 10.0'-11.5'

SOIL DESCRIPTION: Clay, a little silt, trace fine sand, some organics; Black (CL)

 BY:
 SS
 DATE:
 09/2017

 PROJECT NO.:
 982-A14.4
 PLATE NO.:
 35

APPENDIX B

Abrahamson, N.A. and Silva, W.J., 1996, *Technical Notes to Brookhaven National Laboratory (Unpublished)*.

American Society of Civil Engineers, 2010, Minimum Design Loads for Buildings and Other Structures: ASCE Standard No. 7-10.

Blake, Thomas F., 2000, Preliminary Fault-Data for EQFAULT, EQSEARCH and FRISKSP.

Blake, Thomas, F., Computer Services and Software, Users Manuals, FRISKSP v. 4.00, EQSEARCH v. 3.00, and EQFAULT v. 3.00.

Boore, David M., Joyner, William B., and Fumal, Thomas E., January / February 1997, Spectra and Peak Acceleration from Western North American Earthquakes: A Summary of Recent Work: Seismological Research Letters, Volume 68, Number 1.

Bray, J.D., 1998, Arias Duration of Strong Shaking Attenuation: Presented in Evaluation and Mitigation of Seismic Hazards: University of California, Berkeley, Continuing Education in Engineering, August 1998.

California Building Standards Commission, Effective January 1, 2017, 2016 California Building Code: California Code of Regulations, Title 24, Part 2, Volume 1 of 2 and Volume 2 of 2 (Based on 2012 International Building Code).

California Department of Conservation, Division of Mines and Geology, Geomorphic Provinces and Some Principal Faults of California: CDMG Note 36.

California Department of Conservation, Division of Mines and Geology, 1986, Guidelines for Evaluating the Hazard of Surface Fault Rupture: CDMG Note 41.

California Department of Conservation, Division of Mines and Geology, Guidelines to Geologic/Seismic Reports: CDMG Note 42.

California Department of Conservation, Division of Mines and Geology, Guidelines for Preparing Engineering Geologic Reports: CDMG Note 44.

California Department of Conservation, California Geological Survey, Interim Revision 2007, Fault-Rupture Hazard Zones in California, Alquist-Priolo Earthquake Fault Zoning Act with Index to Earthquake Fault Zones Maps, (Iname Changed from 'Special Studies Zones,' January 1, 1994.): Special Publication 42.

California Department of Conservation, Division of Mines and Geology, 1982, Earthquake Planning Scenario for a Magnitude 8.3 Earthquake on the San Andreas Fault in Southern California: Special Publication 60.

California Department of Conservation, Division of Mines and Geology, 2008, Guidelines for Evaluating and Mitigating Seismic Hazards in California: Special Publication 117A.

California Department of Conservation, Division of Mines and Geology, 1976, Geologic Hazards in Southwestern San Bernardino County, California: Special Report 113.

California Department of Conservation, Division of Mines and Geology, 1990, Index to Fault Evaluation Reports Prepared 1976-1989 Under the Alquist-Priolo Special Studies Zone Act: CDMG Open-File Report 90-9.

California Department of Conservation, Division of Mines and Geology, 1996 (Appendix A - Revised 2002), *Probabilistic Seismic Hazard Assessment for the State of California*: CDMG Open-File Report 96-08.

California Department of Conservation, Division of Mines and Geology, 1992, Quick Report on CSMIP Strong-Motion Records from the June 28, 1992 Earthquakes Near Landers and Big Bear, California: CSMIP Report OSMS 92-06.

California Department of Conservation, Division of Mines and Geology, 1994, CSMIP Strong-Motion Records from the Northridge, California Earthquake of January 17, 1994: CSMIP Report OSMS 94-07.

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

California Department of Conservation, Division of Mines and Geology, 2004, Morton, D.M., (Digitally Prepared by Alvarez, R.M., Bovard, K.R.); Preliminary Digital Geologic Map of the Santa Ana 30'x 60' Quadrangle, Southern California; Version 2.0, Scale 1:100,000.

California Department of Conservation, Division of Mines and Geology, 1994, Jennings, C.W., Fault Activity Map of California and Adjacent Areas with Locations and Ages of Recent Volcanic Eruptions: Geologic Data Map No. 6, Scale: 1:750,000.

California Department of Conservation, Division of Mines and Geology, Effective May 1, 2003, State of California Earthquake Fault Zones, Prado Dam Quadrangle, Revised Official Map: Scale: 1:24,000.

California Department of Conservation, Division of Mines and Geology, November 1992, Future Seismic Hazards in Southern California, Phase I: Implications of the 1992 Landers Earthquake Sequence.

California Department of Conservation, Division of Mines and Geology, 1999, Seismic Shaking Hazard Maps of California: Map Sheet 48.

Campbell, K.W. and Bozorgnia, Y., 1994, Near-Source Attenuation of Peak Horizontal Acceleration from Worldwide Accelerograms Recorded from 1957 to 1993: Fifth U.S. National Conference on Earthquake Engineering Proceedings, Vol. III, pp. 283-292.

CivilTech Software, 2006, LiquefyPro, Liquefaction and Settlement Analysis, Software Manual, Version 5 and Later.

Committee on Earthquake Engineering, Commission on Engineering and Technical Systems, National Research Council, 1985, Liquefaction of Soils During Earthquakes.

Earthquake Engineering Research Institute, July 10-14, 1994, Earthquake Awareness and Mitigation Across the Nation Proceedings, Volume III: Fifth U.S. National Conference on Earthquake Engineering, Chicago, Illinois.

Frankel, A., Harmeson, S., Mueller, C., Barnhard, Y., Leyendecker, E.V., Perkins, D., Hanson, S., Dickman, N., and Hopper, M., 1997, Uniform Hazard Spectra, Deaggregation, and Uncertainty: Proceedings of FHWA/NCEER Workshop on the National Representation of Seismic Ground Motion for New and Existing Highway Facilities: NCEER Technical Report 9700010, pp. 39-73 [Text to accompany gridded values for the California probabilistic seismic hazard model, downloadable data at http://www.geohazards.cr.usgs.gov/eq/data/CNUmap1r.asc].

Haner, B.E., 1982, Quaternary Geomorphic Surfaces on the Northern Perris Block, Riverside County, California: Interrelationship of Soils, Vegetation, Climate and Tectonics: PhD. Thesis, University of Southern California.

Harden, D.R., 1997, California Geology: Prentice Hall.

Idriss, I.M., Principal, Evaluating Seismic Risk in Engineering Practice: Woodward-Clyde Consultants, Santa Ana California, and Adjunct Professor of Civil Engineering, University of California, Los Angeles, USA.

Inland Geological Society, 1986, Geology Around the Margins of the Eastern San Bernardino Mountains: Volume I.

International Conference of Building Officials, February 1988, Maps of Known Active Fault Near-Source Zones in California and Adjacent Portions of Nevada, To be used with the 1997 Uniform Building Code: Prepared by California Department of Conservation, Division of Mines and Geology in cooperation with Structural Engineers Association of California Seismology Committee.

Ishihara, K., 1985, Stability of Natural Deposits During Earthquakes: Proceedings: 11th International Conference on Soil Mechanics and Foundation Engineering, San Francisco, Vol. 1. pp. 321·376.

Ishihara, K., 1993, Liquefaction and Flow Failures During Earthquakes: Geotechnique, Vol.43, No. 3, pp. 351-415.

Lew, M., Hudson, M.B., Acosta, J.A., of MACTEC Engineering and Consulting, Inc., and Elhassan, R.E., of Integrated Design Services, Inc. Structural

Engineers, Undated, White Paper on Seismic Increment of Active Earth Pressure: 12 p.

Liao, S.S.C. and Whitman, R.V., 1986, Overburden Correction Factors for SPT in Sand: Journal of Geotechnical Engineering, ASCE, Vol. 112, No. 3, pp. 373-377.

Matti, J.C. and Morton, D.M., 1993, Paleogeographic Evolution of the San Andreas Fault in Southern California: a Reconstruction Based on a New Crossfault Correlation, in the San Andreas Fault System: Displacement, Palinspastic Reconstruction and Geologic Evolution, Edited by R.E. Powell, R.J. Weldon, and J.C. Matti, Mem. Geologic Society of America, Bulletin 178, pp. 107-160.

Meisling, K.E. and Weldon, R.J., 1989, Late Cenozoic Tectonics of the Northwestern San Bernardino Mountains, Southern Ca.: Geologic Society of America, Bulletin 101, pp. 106-128.

Moriwaki, Yoshiharu, 1991, Earthquake Hazard Evaluation and Site Response Analyses, Seismic Short Course, Evaluation and Mitigation of Earthquake Induced Liquefaction Hazards: San Francisco State University, Division of Engineering, San Francisco, January 28 & 29, 1991, University of Southern California, School of Engineering, Department of Civil Engineering, Los Angeles, February 4 & 5.

Navel Facilities Engineering Command, September 1986, Foundations & Earth Structures: Design Manual 7.02, Change 1.

Public Works Standards, Inc., 2012 Edition with 2014 Cumulative Supplement, The "Greenbook", Standard Specifications for Public Works Construction.

Seeber, L. and Armbruster, J.G., 1995, The San Andreas Fault System Through the Transverse Ranges as Illuminated by Earthquakes Abstract: J. Geophys. Res., 100, 8285.

Seed, H.B., 1996, Recent Advances in Evaluation and Mitigation of Liquefaction Hazards: Ground Stabilization and Seismic Mitigation, Theory and Practice, Oregon, Nov. 6 and 7, 1996.

Seed, H.B. and Idriss, I.M., 1971, Simplified Procedure for Evaluating Soil Liquefaction Potential: Journal of Soil Mechanics and Foundation Division, ASCE, Vol. 97, No. SM9, pp. 1249-1274, September 1971.

Seed, H.B. and Idriss, I.M., 1982, Ground Motions and Soil Liquefaction During Earthquakes: Earthquake Engineering Research Institute, Berkeley, California, 134 p.

South Coast Geological Society, Inc., 1989, San Andreas Fault, Cajon Pass to Wallace Creek: Guidebook Number 17, Volumes 1 and 2.

Southern California Earthquake Center, March 1999, Recommended Procedures for Implementation of DMG Special Publication 117, Guidelines for Analyzing and Mitigating Liquefaction Hazards in California.

Southern California Earthquake Center, June 2002, Recommended Procedures for Implementation of DMG Special Publication 117, Guidelines for Analyzing and Mitigating Landslide Hazards in California.

Spotilla, J. and Sieh, K., 1997, Characterizing Seismonic Sources Associated with Uplift of the San Bernardino Mountains: Progress Report to Southern California Earthquake Center: 4 p., (http://www.scec.org/research/97progreports).

State of California, Department of Transportation, 2010 with Revisions Dated February 21, 2014, Standard Specifications.

Tokimatsu, K. and Seed, H.B., 1987, Evaluation of Settlements in Sands Due to Earthquake Shaking: Journal of Geotechnical Engineering Division, ASCE, Volume 113, No. 8, August, pp.861-878.

U.S. Department of the Interior, U.S. Geological Survey, 1991, Matti, J.C. and Carson, S.E., Liquefaction Susceptibility in the San Bernardino Valley and Vicinity, Southern California - A Regional Evaluation: U.S. Geological Survey Bulletin 1898.

- U.S. Department of the Interior, U.S. Geological Survey, 1987, Recent Reverse Faulting in the Transverse Ranges, California: Text and Plates, U.S. Geological Survey Professional Paper 1339.
- U.S. Department of the Interior, U.S. Geological Survey, 1985, Evaluating Earthquake Hazards in the Los Angeles Region-An Earth-Science Perspective: U.S. Geological Survey Professional Paper 1360.
- U.S. Department of the Interior, U.S. Geological Survey, 1985, Matti, J.C., Morton, D.M., and Cox, B.F., Distribution and Geologic Relations of Fault Systems in the Vicinity of the Central Transverse Ranges, Southern California: U.S. Geological Survey Open-File Report 85-365.
- U.S. Department of the Interior, U.S. Geological Survey, 1985, Carson, S.E. and Matti, J.C., Contour Map Showing Minimum Depth to Groundwater, Upper Santa Ana River Valley, California, 1973-1979. U.S. Geological Survey, Miscellaneous Field Studies Map, MAP MF-1802, Sheet 1 of 2 and 2 of 2, Scale: 1:48,000.
- U.S. Department of the Interior, U.S. Geological Survey, Design Maps Web Site (https://earthquake.usgs.gov/designmaps/us/application.php).
- 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/).
- U.S. Department of the Interior, U.S. Geological Survey, 2012, Prado Dam Quadrangle, California: 7.5 Minute Series (Topographic), Scale: 1:24,000.
- U.S. Federal Emergency Management Administration (FEMA), Effective August 28, 2008, Flood Insurance Rate Map, Map Nos. 06071C9330H, Panel No. 9330 of 9400. Site specific information obtained through FEMA website, Map Service Center (http://msc.fema.gov/).
- Weldon, R.J., and Sieh, K.E., 1985, Holocene Rate of Slip and Tentative Recurrence Interval for Large Earthquakes on the San Andreas Fault in Cajon Pass, Southern California: Geological Society of America Bulletin 96, pp. 793-812.

Wesnousky, Steven G., Prentice, Carol S., and Sieh, Kerry E., 1991, An Offset Holocene Stream Channel and the Rate of Slip along the Northern Reach of the San Jacinto Fault Zone, San Bernardino Valley, California: Geological Society of America Bulletin, V 103.

Youd, T.L. and Idriss, I.M. (Editors), 1997, Proceedings of the NCEER Workshop on Evaluation of Liquefaction Resistance of Soils: Salt Lake City, UT, January 5-6, 1996, Technical Report NCEER-97-0022, 307 p., Buffalo, NY.

APPENDIX C

REPORT OF
GEOTECHNICAL / GEOLOGIC
SITE FEASIBILITY EVALUATION
THE LAKE PROPERTY
PROPOSED RESIDENTIAL DEVELOPMENT
NORTH OF LOS SERRANOS BLVD. /
BIRD FARM RD.
BETWEEN PIPELINE AVE. & RAMONA AVE.
CITY OF CHINO HILLS
SAN BERNARDINO COUNTY, CALIFORNIA

PROJECT NO.: 982-A14 REPORT NO.: 1

APRIL 9, 2015

SUBMITTED TO:

ROLLING RIDGE RANCH c/o MESA BLUFFS DEVELOPMENT COMPANY, LLC 700 E. REDLANDS BLVD., STE. U-209 REDLANDS, CA 92373

PREPARED BY:

HILLTOP GEOTECHNICAL, INC. 786 SOUTH GIFFORD AVENUE SAN BERNARDINO, CA 92408

SUBSURFACE EXPLORATION LEGEND

				ION SYSTEM I D2488-09a)	CONSIS	TENCY / RI DENSITY			
MA	JOR DIVISION	S	GROUP SYMBOLS	TYPICAL NAMES	CRITERIA				
		Class	GW	Well Graded Gravels and Gravel- Sand Mixtures, Little or no Fines	Reference: 'Four Thornburn, 2nd		ng', Peck, Hansen,		
	Gravels 50 % or more of Coarse	Clean Gravels	GP	Poorly Graded Gravels and Gravel-Sand Mixtures, Little or no Fines	Sta	Standard Penetration Test Granular Soils			
Coarse- Grained Soils*	Fraction Retained on No. 4 Sieve	Gravels with	GM	Silty Gravels, Gravel-Sand-Silt Mixtures**	Penetration I N, (Blows		Relative Density		
More than		With Fines	GC	Clayey Gravel, Gravel-Sand-Clay Mixtures**	0 - 4		Very Loose		
50 % Retained on No. 200	Sands	Clean	sw	Well Graded Sands and Gravely Sands, Little or no Fines	5 - 10		Loose		
Sieve	More than 50 % of	Sands	SP	Poorly Graded Sands and Gravelly Sands, Little or no Fines	11 - 30 31 - 5	0	Medium Dense Dense		
	Coarse Fraction Passes No. 4	Sands with	SM	Silty Sands, Sand-Silt Mixtures**	> 50		Very Dense		
	Sieve	Fines	SC	Clayey Sands, Sand-Clay Mixtures**					
			ML	lnorganic Silts, Sandy Silts, Rock Flour	Sta	Standard Penetration Test Cohesive Soils			
Fine Grained	Silts and C		CL	Inorganic Clays of Low to Medium Plasticity, Gravelly Clays, Sandy Clays, Silty Clays, Lean Clays	Penetration Resistance, N, (Blows / Foot)	Consistency	Unconfined Compressive Strength,		
Soils*			OL	Organic Silts and Organic silty Clays of Low Plasticity			(Tons / Sq. Ft.)		
50 % or more			МН	Inorganic Silts, Micaceous or Diatomaceous silts, Plastic Silts	< 2 2 - 4	Very Soft Soft	< 0.25 0.25 - 0.5		
Passes No. 200 Sieve	Silts and (СН	Inorganic Clays of High Plasticity, Fat Clays	5 - 8	Firm (Medium Stiff)	0.5 - 1.0		
	50 %		ОН	Organic Clays of Medium to High Plasticity	9 - 15 16 - 30				
Hi	ighly Organic Soils		PT	Peat, Muck, or Other Highly Organic Soils	> 31	Very Stiff Hard	2.0 - 4.0 > 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/Cl, GM/SM, SP/SW, etc.

U.S. Standa	rd Sieve Size	1	2"	3" 3	3/4"	#4 #1	10 #	#40 #2	00	
	il Classification	Boulders	Cobbles	Gra	vel		Sand	Silt and		
Des	ignation			Coarse	Fine	Coarse	Medium	Fine	Clay	
N	Ioisture Conditi	on			Materi	al Quantity		Other S	Symbols	
Dry	Absence of	moisture, d	usty,	T	Trace (Few) < 5 %					
	dry to the to	uch.			Slight	5 - 10%		S - SPT Sample		
Moist	Damp but ne	o visible m	oisture.		Little	15 - 25%		Sample		
Wet	Visible free	water, usua	lly		Some	30 - 45 %		CK - Chu	nk Sample	
	below the w	ater table.						R - Ring	Sample	
							N	- Nuclear	Gauge Test	
						∇ - Water 7	Γable			



Rolling Ridge Ranch, Los Serranos

Project No.

982-A14.1

Date:

2/17/2015

Logged By:

AH

Type of Rig:

Hollow-Stem Auger

Drive Wt.:

140 lb

Elevation:

 ± 654 51.5

Drill Hole Dia.:

8 in.

Drop:

30 in.

Depth of Boring (ft.):

Depth (ft.)	Sample Type	Penetration Resistance	Soil Classification	Dry Density (Ib/ft3)	Moisture Content (%)	O Lithology	Groundwater	Description
1 -	R	6 8 13	SM			Col		COLLUVIUM: Silty, fine to coarse sand, trace clay, trace gravel; Dark brown; Moist; Medium dense.
3 -	R	7 11 16	ML	111.1	15.1			Silt, a little fine to coarse sand, trace clay, slightly porous, trace organics; Dark brown; Moist; Medium dense.
5 - 6 - 7 -	R	10 19 26	ML	110.7	16.4	Qvof		VERY OLD ALLUVIAL FAN DEPOSITS: Clayey silt, a little fine sand, trace gravel, trace caliche, trace black inclusions; Orange-brown; Moist to wet; Dense to medium dense.
8 -	R	9 15 16		113.0	17.0			Slightly porous.
11 -	R	5 10 13					<u>\</u>	Groundwater encountered at 11.5'.
13 -	R	5 6 7						Orange-brown with gray mottling.
15 — 16 —	R	5 9 10						Trace thin layers of orange-gray fine sandy silt.
18								
21 -	R	7 8 9						
23 - 24 - 25 _								



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

HILLTOP GEOTECHNICAL

Project Name:

Rolling Ridge Ranch, Los Serranos

Project No.

982-A14.1

8 in.

Date:

Drop:

2/17/2015

Logged By: Elevation:

ΑH ± 654

Type of Rig: Drill Hole Dia.: Hollow-Stem Auger

Drive Wt.:

140 lb 30 in.

Depth of Boring (ft.):

51.5

.)	ype	uo o	tion	ify	(%)		ater	
Depth (ft.)	ample Type	enetration lesistance	oil Jassification	ry Density Ib/ft3)	Aoisture Content (%)	ithology	roundwater	

Depth (ft.)	Sample Typ	Penetration Resistance	Soil	Dry Density (Ib/ft3)	Moisture Content (%)	Lithology	Groundwate	Description
26 –	R	10 13 16	ML			Qvof		VERY OLD ALLUVIAL FAN DEPOSITS: Clayey silt, a little fine sand, trace gravel, trace caliche, trace black inclusions; Orange-brown; Moist to wet; Dense to medium dense.
28 - 29 - 30 -	R	8				Тру		PUENTE FORMATION (YORBA MEMBER): Siltstone/claystone, highly to slightly weathered, with thin layers of fine sand; Olive gray and dark brown; some reddish black oxide staining.
31 - 32 - 33 - 34 -		12 17						
35 - 36 - 37 -	R	13 21 30						Trace caliche, with square balck inclusions.
38 - 39 - 40 - 41 - 42 -	R	11 20 20						Reddish oxide staining more prevalent.
44 - 45 - 46 -	R	15 21 23						
48 -								

S - SPT Sample

R - Ring Sample

B - Bulk Sample

N - Nuclear Gauge Test

D - Disturbed Sample



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

Project Name: Ro Rolling Ridge Ranch, Los Serranos

Project No. 982-A14.1 Date: 2/17/2015 Logged By: AH Type of Rig: Hollow-Stem Auger Drive Wt.: ± 654 140 lb Elevation: Drill Hole Dia.: 8 in. Drop: Depth of Boring (ft.): 30 in. 51.5

Depth (ft.)	Sample Type	Penetration Resistance	Soil Classification	Dry Density (Ib/ft3)	Moisture Content (%)	Lithology	Groundwater	Description
1 -	R	21 32				Тру		PUENTE FORMATION (YORBA MEMBER): Siltstone/claystone, highly to slightly weathered, with thin layers of fine
		32						sand; Olive gray and dark brown; some reddish black oxide staining.
2 -								Bottom of boring at 51.5 feet. Groundwater encountered at 11.5 feet.
				H 1	0.7			Boring backfilled with excavated materials, some caving occurred durning
3 -								auger pull out. Minimumally backfilled.
4								
5 -								
6 –								
7 -								
8 -							15	
9 -								
0 -								
1 -								
2								
3 –	-							
4 -			4					
5 -								
	-							
6 -								
	\neg							
7 –								
8								
	-							
9 –	\neg							
0 -								
1 -								
2 -								
,								
3 -		Ť.						
4 -								



HILLTOP GEOTECHNICAL

S - SPT Sample

N.R. - No Recovery

R - Ring Sample

B - Bulk Sample

N - Nuclear Gauge Test

D - Disturbed Sample

Plate No. 4

Project Name:

Rolling Ridge Ranch, Los Serranos

Project No.

982-A14.1

Date:

2/17/2015

Logged By:

AH

Type of Rig:

Hollow-Stem Auger

Drive Wt.:

140 lb

Elevation:

 ± 650

Drill Hole Dia.:

8 in.

Drop:

30 in.

Depth of Boring (ft.):

21.5

Sample Type	Penetration Resistance	∑ Soil Classification	Dry Density (1b/ft3)	Moisture Content (%)	g Lithology	Groundwater	Description
R	3 5 7	ML			af		ARTIFICIAL FILL: Silt, a little clay, trace fine to medium sand, trace organics and wood pieces; Dark brown black; Moist; Loose to medium dense.
R	5 10 10		72.9	38.7			Brick piece encountered in sampler.
R	4 7 8		111.0	16.7			
R	4 7 7	ML	95.2	27.7	Qyf3		YOUNG ALLUVIAL FAN DEPOSITS: Transition: Silt, a little clay, trace fine to medium sand; Dark brown-black with some of olive gray siltstone and fine sand; Moist; Medium dense.
R	4 6 6						
R	11 20 25				Тру	∇	PUENTE FORMATION (YORBA MEMBER): Siltstone/claystone, slightly weathered, with thin layers of fine sand; Olive gray and dark brown; some reddish black oxide staining. Groundwater encountered at 14.5'.
R	13 31 33					-	
		,					
R	13 41 50/3"						
							Bottom of boring 21.5 feet. Groundwater encountered at 14.5 feet. Boring backfilled with excavated materials.



Project Name: Ro

S - SPT Sample

N.R. - No Recovery

R - Ring Sample

B - Bulk Sample

N - Nuclear Gauge Test

D - Disturbed Sample

Plate No. 5a

Rolling Ridge Ranch, Los Serranos

Project No.

982-A14.1

Date:

2/17/2015

Logged By:

AH

Type of Rig: Drill Hole Dia.: Hollow-Stem Auger 8 in.

Drive Wt.: Drop:

140 lb 30 in.

Elevation: Depth of Boring (ft.): ± 676 31.5

Penetration Resistance	Soil Classificati	Dry Density (Ib/ft3)	Moisture Content (%)	Lithology	Groundwater	Description
5 5 5	ML			af		ARTIFICIAL FILL: Clayey silt, trace fine to coarse sand; Dark brown; Moist; Loose to Medium dense.
5 7 7		103.5	19.9			Trace gravel, trace thin layers of white organics. Trace olive gray dark brown siltstone; gravel size; friable.
4 5 6		92.2	22.9			
5 9 10		90.4	23.2			
5 7 9						
3 5 6					Ŧ	
6 7 11						Small piece of wood encountered in sampler.
9 9 9	ML			Qvof		VERY OLD ALLUVIAL FAN DEPOSITS: Silt, some fine to medium sand, slighlty porous; Orange-brown; Moist; Medium dense.
	5 5 5 5 7 7 7 4 5 6 6 5 9 10 5 7 9	5 ML 5 5 7 7 4 5 6 5 9 10 5 7 9 ML ML	5 5 7 7 103.5 4 5 6 92.2 5 9 10 90.4 5 7 9 ML	5 5 7 7 7 103.5 19.9 4 5 6 92.2 22.9 5 9 10 90.4 23.2 5 7 9 3 5 6 6 6 7 111 ML	5 5 7 7 7 103.5 19.9 4 5 6 92.2 22.9 5 9 10 90.4 23.2 5 7 9 3 5 6 6 6 7 11	5 5 7 7 103.5 19.9 4 5 6 92.2 22.9 5 9 10 90.4 23.2 5 7 9 9 3 5 6 6 6 7 11



SUBSURFACE EXPLORATION LOG BORING NO. B-3 (CONT.)

HILLTOP GEOTECHNICAL

S - SPT Sample

N.R. - No Recovery

R - Ring Sample

B - Bulk Sample

N - Nuclear Gauge Test

D - Disturbed Sample

Plate No. 5b

Project Name:

Rolling Ridge Ranch, Los Serranos

Project No.

982-A14.1

Date:

2/17/2015

Logged By: Elevation: AH

Type of Rig: Drill Hole Dia.: Hollow-Stem Auger

8 in.

Drive Wt.: Drop: 140 lb 30 in.

Depth of Boring (ft.):

± 676

ıll Hole	Dia.:	8 in.			Drop:		30 in. Depth of Boring (ft.): 31.5
Sample Type	Penetration Resistance	Soil Classification	Dry Density (Ib/ft3)	Moisture Content (%)	Lithology	Groundwater	Description
R	6 9 9	ML			Qvof		VERY OLD ALLUVIAL FAN DEPOSITS: Silt, some fine to medium sand, slightly porous; Orange-brown; Moist; Medium dense.
	••••	ML		••••••		********	Silt, trace clay, trace fine sand, trace rootlets; Orange-brown with gray mottling; Moist; Medium dense.
R	4 6 7		/ /				
							Bottom of boring 31.5 feet. No groundwater encountered. Boring backfilled with excavated materials.
9 0							



Project Name:

Rolling Ridge Ranch, Los Serranos

Project No.

982-A14.1

Date:

2/17/2015

Logged By:

AH

Type of Rig:

Hollow-Stem Auger

Drive Wt.:

140 lb

Elevation:

± 647

Drill Hole Dia.: 8

S - SPT Sample

N.R. - No Recovery

R - Ring Sample

B - Bulk Sample

N - Nuclear Gauge Test

D - Disturbed Sample

Plate No. 6a

8 in.

Drop:

30 in.

Depth of Boring (ft.):

26.5

	Sample Type	Penetration Resistance	Soil Classification	Dry Density (Ib/ft3)	Moisture Content (%)	a Lithology	Groundwater	Description
	R	9 10 11	ML/CL			af		ARTIFICIAL FILL: Clayey silt to silty clay, trace fine to medium sand, trace gravel; Dark brown-black; Moist to wet; Medium dense.
	R	5 9 11						
	R	9 12 13		109.9	18.1			
The Party of the P	R	9 12 12					_	Groundwater encoutered at 8.5'.
Total State of the last	R	7 9 6	GP	•••••••		•••••		Gravel, trace silt, trace clay, piece of fabric recovered in rear of sampler, Gray; Medium dense; Wet.
t			ML	-		Qvof		VERY OLD ALLUVIAL FAN DEPOSITS:
	R	3 5 4		96.0	27.8			Silt, trace fine sand, trace clay; Orange-brown; Wet; Loose.
l	R	4						
		5		101.1	24.1			
	R	3 3 3						A little clay.
1				1				



SUBSURFACE EXPLORATION LOG BORING NO. B-4 (CONT.)

HILLTOP GEOTECHNICAL
Project Name: Ro

Rolling Ridge Ranch, Los Serranos

Project No.

982-A14.1

Date:

2/17/2015

Logged By:

AH

Type of Rig:

Hollow-Stem Auger

Drive Wt.:

140 lb

Elevation:

± 647

Drill Hole Dia.:

8 in.

Drop:

30 in.

Depth of Boring (ft.):

26.5

	Wesistance W Soil	Dry Density (1b/ft3)	Moisture Content (%)	Lithology	Groundwater	Description
R 3 3 4	ML	,		Qvof		VERY OLD ALLUVIAL FAN DEPOSITS: Silt, a little fine sand, a little clay; Orange-brown; Wet; Loose.
						Bottom of boring 26.5 feet. Groundwater encountered at 8.5 feet. Boring backfilled with excavated materials.



Rolling Ridge Ranch, Los Serranos

Project No.

982-A14.1

Date:

2/17/2015

Logged By:

AH

Type of Rig:

Hollow-Stem Auger

Drive Wt.:

140 lb Elevation: ± 658

Drill Hole Dia.:

8 in.

Drop:

30 in.

Depth of Boring (ft.):

21.5

()	Sample Type	Penetration Resistance	Soil Classification	Dry Density (Ib/ft3)	Moisture Content (%)	Lithology	Groundwater	Description
	R	4 5 5	ML			Col		COLLUVIUM: Silt, a little fine to coarse sand, trace roots; Dark brown; Moist; Medium dense.
	R	6 11 13	ML	101.1	13.7	Qvof		VERY OLD ALLUVIAL FAN DEPOSITS: Silt, some fine to medium sand, trace gravel, trace clay; Orange-brown; Moist; Medium dense.
	R	13 14 11						Slightly porous.
	R	12 12 12	SM/ML	101.2	12.2			Silty, fine to medium sand, trace coarse sand, to silt, some fine to medium sand; Orange-brown; Moist; Medium dense.
	R	8 10 11		101.3	17.3			
	R	7 13 15	SM					Silty, fine to coarse sand; Orange-brown; Moist; Medium dense.
	R	9 5 7	ML					Groundwater encountered at 15.0'. Silt, a little clay, trace fine sand, trace balck inclusions; Gray-brown with orange mottling; Wet; Medium dense.
	R	6 9 12						
								Bottom of boring 21.5 feet. Groundwater encountered at 15.0 feet. Boring backfilled with native materials.

N.R. - No Recovery

Plate No. 7



Project Name:

Rolling Ridge Ranch, Los Serranos

Project No. 982-A14.1

S - SPT Sample

N.R. - No Recovery

R - Ring Sample

B - Bulk Sample

N - Nuclear Gauge Test

D - Disturbed Sample

Plate No. 8

Date:

2/17/2015

Logged By:

AH

Type of Rig:

Hollow-Stem Auger

Drive Wt.:

140 lb

Elevation:

± 655

Drill Hole Dia.:

8 in.

Drop:

30 in.

Depth of Boring (ft.):

21.5

R 10 ML Silt, a little clay, trace fine sand, smells of organics; Brown-orange-gray; Moist to wet; Medium dense. R 13	Sample Type	Penetration Resistance	Soil Classification	Dry Density (1b/ft3)	Moisture Content (%)	O Lithology	Groundwater	Description
R 13	R	10 8	ML			Col		Silt, some fine to medium sand, a little clay, some roots, slighlty porous;
R 13 17 21	R	17	ML	104.3	8.8	Qvof		Silt, a little clay, trace fine sand, slighlty porous; Dark brown; Moist;
20 20 109.3 9.7 ML ML Moist to wet; Medium dense. Silt, a little clay, trace fine sand, smells of organics; Brown-orange-gray; Moist to wet; Medium dense. R 8 14 17 R 7 10 13 Groundwater encountered at 20.0'. Groundwater encountered at 20.0'. B 4 6 11 Bottom of boring 21.5 feet.	R	17	ML		•••••	••••••	**********	Silt, trace fine to medium sand, trace gravel; Dark orange-brown; Moist; Medium dense.
Moist to wet; Medium dense.	R	20		109.3	9.7			
14 17	R	15	ML					Silt, a little clay, trace fine sand, smells of organics; Brown-orange-gray; Moist to wet; Medium dense.
The second secon	R	14						
Groundwater encountered at 20.0'. R 4 6 11 Bottom of boring 21.5 feet.		10						
6 11 Bottom of boring 21.5 feet.		4					$\overline{\nabla}$	Groundwater encountered at 20.0'.
	10000	6						Bottom of boring 21.5 feet. Groundwater encountered at 20.0 feet.



Rolling Ridge Ranch, Los Serranos

Project No.

982-A14.1

Date:

2/17/2015

Logged By:

ΑH

Type of Rig:

Hollow-Stem Auger

Drive Wt.:

140 lb

Elevation:

± 637

Drill Hole Dia.:

S - SPT Sample

N.R. - No Recovery

R - Ring Sample

B - Bulk Sample

N - Nuclear Gauge Test

D - Disturbed Sample

Plate No. 9a

8 in.

Drop:

30 in.

Depth of Boring (ft.):

26.5

Sample Type	Penetration Resistance	Soil Classification	Dry Density (Ib/ft3)	Moisture Content (%)	O Lithology	Groundwater	Description
R	4 5 4	SM	92.3	6.2	Col		COLLUVIUM: Silty, fine to medium sand, trace roots, slightly porous; Dark brown; Moist; Loose.
R	5 10 16	ML	112.8	13.3	Qvof		VERY OLD ALLUVIAL FAN DEPOSIT: Silt, slightly porous, trace gravel, a little fine to medium sand, a little caliche; Dark orange-brown; Moist; Medium dense to very dense.
R	20 34 50/5"		116.5	9.5			
R	18 24 27	ML	114.0	11.3			Silt, a little fine to medium sand, pieces of miscelaneous siltstone and sandtone fragments in samples; Dark orange-brown; Very dense.
R	17 23 29						
R	12 15 18	ML					Silt, some fine to medium sand, trace gravel, slightly porous; Dark orange brown; Moist; Medium dense.
R	7 13 13						
		G) A					
R	11 14 14	SM					Silty, fine to caorse sand, trace gravel; Dark orange-brown; Moist; Medium dense.
		ML					Silt, trace fine sand, trace clay, slightly porous; Dark orange-brown; Moist; Medium dense.



SUBSURFACE EXPLORATION LOG BORING NO. B-7 (CONT.)

HILLTOP GEOTECHNICAL
Project Name: Ro Rolling Ridge Ranch, Los Serranos

N.R. - No Recovery

Project No. 982-A14.1 Date: 2/17/2015 Logged By: AH Type of Rig: Hollow-Stem Auger Drive Wt.: 140 lb Elevation: ± 637 Drill Hole Dia.: 8 in. Drop: 30 in. Depth of Boring (ft.): 26.5

Deptin (16.)	Sample Type	Penetration Resistance	Soil	Dry Density (Ib/ft3)	Moisture Content (%)	Lithology	Groundwater	Description
	R	8 11	ML			Qvof		VERY OLD ALLUVIAL FAN DEPOSIT: Silt, trace fine sand, trace clay, slightly porous; Dark orange-brown
		11		10				Moist; Medium dense. Bottom of boring 26.5 feet.
+								No groundwater encountered.
1								No groundwater encountered. Boring backfilled with excavated materials.
-+								
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Plate No. 9b



Project Name:

. D

S - SPT Sample

N.R. - No Recovery

R - Ring Sample

B - Bulk Sample

N - Nuclear Gauge Test

D - Disturbed Sample

Plate No. 10

Rolling Ridge Ranch, Los Serranos

Project No.

982-A14.1

Date:

2/17/2015

Logged By: Elevation: AH

Type of Rig: Drill Hole Dia.:

Hollow-Stem Auger 8 in.

Drive Wt.: Drop: 140 lb 30 in.

Depth of Boring (ft.):

± 669 16.5

-	Sample Type	Penetration Resistance	Soil Classification	Dry Density (Ib/ft3)	Moisture Content (%)	Lithology	Groundwater	Description
	R	3 5 7	ML			Qvof		VERY OLD ALLUVIAL FAN DEPOSIT: Clayey silt, trace fine sand, trace gravel, trace roots; Dark brown-black; Moist; Medium dense.
	R	7 15 15		103.7	18.2			
	R	5 11 12	ML	90.7	23.0			Transition: Silt, some fine sand; Gray-orange; Moist; Medium dense.
	R	8 13 26		96.1	24.0	Тру		PUENTE FORMATION (YORBA MEMBER): Siltstone/Claystone highly weathered, with thin layers of sand; Olive gray and dark brown; some layers contain reddish balck oxide staining.
	R	13 24 25						
	R	14 25 30		104.1	19.2			
	R	18 25 30						
								Bottom of boring 16.5 feet. No groundwater encountered. Boring backfilled with excavated materials.
F								



Rollling Ridge Ranch, Los Serranos

Project No.:

982-A14.1

1/28/2015

Logged By:

AH

Equipment Used: Rubber tired, tractor-mounted backhoe

Elevation:

Deptn (rt.)	Sample Type	Penetration Resistance	Soil Classification	Dry Density (Ib/ft3)	Moisture Content (%)	E Lithology	Groundwater	Description
_	N/B			88.9	16.5	af		ARTIFICIAL FILL: 5" to 10" of Mulch Silty, fine to medium sand, a little clay, trace gravel, animal burrows to approximately 2.0', a little roots, caliche from 8" to 2.5'; Gray-brown; Moist.
_	N		ML.	85.3	21.0			Silt, a little clay, trace gravel; Dark gray-black; Moist.
	CK		CL	95.5	26.5	Qyf ₃		Waterline encountered at 4.5'. YOUNG ALLUVIAL FAN DEPOSITS: Silty clay, trace fine sand; Dark brown-black; Moist to wet. from 7.0' to 9.0' soils smelled of organic materials.
1 -	В							Groundwater encountered at 11.0'. Large roots encountered from 11.0' to 13.0'; soil color changed to Brown - yellow-brown.
								Bottom of trench at 14.0 feet. Groundwater encountered at 11.0 feet. Trench backfilled with excavated material with minimal compactive efforms.
1 -								



Rollling Ridge Ranch, Los Serranos

Project No.:

982-A14.1

1/28/2015

Logged By:

AH

Equipment Used:

Rubber tired, tractor-mounted backhoe

Elevation:

Deptin (it.)	Sample Type	Penetration Resistance	Soil Classification	Dry Density (Ib/ft3)	Moisture Content (%)	Oyt ₃	Groundwater	Description
			SM			Qyf ₃		YOUNG ALLUVIAL FAN DEPOSITS: 6" to 10" of Mulch Silty, fine sand, trace gravel, animal burrows; Dark brown; Moist.
	EK/N B			79.3	24.7	Тру		PUENTE FORMATION (YORBA MEMBER): Siltstone/claystone, slightly weathered, friable, blocky, with 1 to 3 cm layer spacing; Olive gray and dark brown with blackish oxide staining thin layers of fine sand; Moist to wet. Attitude: N53W, 5S
							<u>\</u>	Groundwater encountered at 9.0'. Color changed to dark grayish purple, a little clay. Trace fine sand layers, sightly porous.
								Bottom of trench at 12.8 feet. Groundwater encountered at 9.0 feet. Trench backfilled with excavated material with minimal compactive e



Project Name: Re Rollling Ridge Ranch, Los Serranos

Project No.: 982-A14.1 Date: 1/28/2015 Logged By:

AH Equipment Used: Rubber tired, tractor-mounted backhoe Elevation: ± 666

Sample Type	Penetration Resistance	Soil Classification	Dry Density (Ib/ft3)	Moisture Content (%)	E Lithology	Groundwater	Description
N		SM	85.0	24.0	af		ARTIFICIAL FILL: 1.0' to 1.4' of Mulch Silty, fine to medium sand, trace gravel, porous near surface to 2.0'; Brown; Moist.
N		SM/ML	99.7	14.4			Silt, trace clay to silty, fine sand, trace roots, asphalt chunks; Deep brown gradually to Orange-brown; Moist. Hard digging.
CK		SP	110.7	5.7	Qvof		VERY OLD ALLUVIAL FAN DEPOSITS: Fine to medium sand, trace silt, trace gravel; Light orange-brown; Moist.
		SM					Silty, fine to medium sand, trace gravel; Light orange-brown; Moist.
							Bottom of trench at 13.3 feet. No groundwater encountered. Trench backfilled with excavated material with minimal compactive efforms of the second



Rollling Ridge Ranch, Los Serranos

Project No.:

982-A14.1

1/28/2015

Logged By:

AH

Equipment Used:

Rubber tired, tractor-mounted backhoe

Elevation:

Depth (ft.)	Sample Type	Penetration Resistance	Soil Classification	Dry Density (1b/ft3)	Moisture Content (%)	af Fithology	Groundwater	Description
2 - 3 -	B/N		SM	102.8	14.9	af		ARTIFICIAL FILL: 5" to 1.0' of Mulch Silty, fine to coarse sand, trace gravel, animal burrows to 2.0 fcet; Dark brown; Moist.
3	N		ĊĹ	86.7	24.5			Silty clay, trace gravel; Asphalt chunks visible in sidewalls from 4.0' to 6.0'; Dark brown with gray and orange smears.
3								Bottom of trench at 13.4 feet. No groundwater encountered. Trench backfilled with excavated material with minimal compactive efformench terminated in the artificial fill.



Rollling Ridge Ranch, Los Serranos

Project No.:

982-A14.1

1/28/2015

Logged By:

Equipment Used: Rubber tired, tractor-mounted backhoe

Elevation:

AH ± 658

Depth (ft.)	Sample Type	Penetration Resistance	Soil Classification	Dry Density (Ib/ft3)	Moisture Content (%)	O Lithology	Groundwater	Description
1 -	B		SM	102.7	15.1	Col		COLLUVIUM: 6" to 9" of Mulch Silty, fine to medium sand, trace gravel; Dark brown; Moist.
3 -	N		SM/ML	97.3	23.5			Silt, a little clay, to silty, fine to medium sand trace gravel; Dark brown; Moist.
4 — 5 — 6 — 7 — 8 — 0 — 1 — 2 — 3 — 4 —			ML			Qvof		VERY OLD ALLUVIAL FAN DEPOSITS: Silt, slightly porous, consolidated, trace gravel, caliche pocket from 4.'5 to 5.0' feet; Orange-brown; Moist. From 5.0' to 7.0' a little fine to medium sand around silt pockets.
5 66 77 88 99 11 22 44								Bottom of trench at 14.9 feet. No groundwater encountered. Trench backfilled with excavated material with minimal compactive effort



HILLTOP GEOTECHNICAL.
Project Name: Re Rollling Ridge Ranch, Los Serranos

Project No.: 982-A14.1 Date: 1/28/2015 Logged By: AH Equipment Used: Rubber tired, tractor-mounted backhoe Elevation: ± 659

Sample Type	Penetration Resistance	Soil Value Soil	Dry Density (Ib/ft3)	Moisture Content (%)	O Lithology	Groundwater	Description
N		SM	100.9	21.3	Col		COLLUVIUM: 10" to 1'3" of Mulch Silty, fine to medium sand, trace gravel, burrows to 2.0'; Dark brown; Moist.
N		ML	91.1	19.9	Qvof		VERY OLD ALLUVIAL FAN DEPOSITS: Silt, slightly porous, consolidated, trace gravel, a little fine to medium sand; Orange-brown; Moist.
							Bottom of trench at 13.6 feet. No groundwater encountered. Trench backfilled with excavated material with minimal compactive effects.



HILLTOP GEOTECHNICAL
Project Name: Ro

Rollling Ridge Ranch, Los Serranos

Project No.:

982-A14.1

1/28/2015

Logged By:

AH

Equipment Used: Rubber tired, tractor-mounted backhoe

Elevation:

± 647

Depth (ft.)	Sample Type	Penetration Resistance	Soil Classification	Dry Density (Ib/ft3)	Moisture Content (%)	a Fithology	Groundwater	Description
1 2	B/N		CL	96.2	24.1	af		ARTIFICIAL FILL: 0 Mulch Silty clay, trace gravel; Dark brown-black; Moist.
3 – 4 – 5 –	N			89.0	31.3			Plastic and miscellaneous bebris encountered in trench.
6 – 7 – 8 –			GP				$\overline{\triangleright}$	Groundwater encountered at 7.2'. Gravel, trace silt, miscellaneous debris, clay pipe, and fabric encountered at 9.0'.
10 -	CK		CL	103.7	22.9			Silty clay, trace coarse sand and gravel; Dark gray; Saturated. Bottom of trench at 11.0 feet due to excess water. Groundwater encountered at 7.2'. Trench backfilled with excavated material with minimal compactive effor
4 — 5 — 6 — 7 — 8 —								
9								
3								



Rollling Ridge Ranch, Los Serranos

Project No.: 982-A14.1 Date:

1/30/2015

Logged By:

AH

Equipment Used: Rubber tired, tractor-mounted backhoe

Elevation:

 ± 646.5

Depth (ft.)	Sample Type	Penetration Resistance	Soil Classification	Dry Density (1b/ft3)	Moisture Content (%)	g Lithology	Groundwater	Description
			CL			af		ARTIFICIAL FILL: 0 Mulch Silty clay, trace coarse sand, traces clay pipe; Dark brown-black; Moist.
-	N			88.5	18.6			
_	N			99.2	17.3			Plastic and miscellaneous bebris encountered in trench.
								7'4" fiber mesh encountered.
-			ĞP				$\overline{\underline{\nabla}}$	Groundwater encountered at 8.2'. Gravel, trace silt, miscellaneous debris, clay pipe, and mesh encountered at 9'.
								Bottom of trench at 11.3 feet due to excess water. Groundwater encountered at 8.2 feet. Trench backfilled with excavated material with minimal compactive efforms.
						4		
5 _								



Project Name: R

Rollling Ridge Ranch, Los Serranos

Project No.:

982-A14.1

1/30/2015

Logged By:

AH

Equipment Used: Rubber tired, tractor-mounted backhoe

Elevation:

Sample Type	Penetration Resistance	Soil Classification	Dry Density (Ib/ft3)	Moisture Content (%)	O Lithology	Groundwater	Description				
N		SM	100.2	19.5	Col		COLLUVIUM: 0 Mulch Silty, fine to medium sand, animal burrows to 2.0'; Dark brown; Moist.				
B/N		SM/ML	90.7	24.1	Qvof		VERY OLD ALLUVIAL FAN DEPOSITS: Silty, fine sand to silt, trace fine sand, porous; Orange-brown; Moist. Heavy caliche layer from 5.0' to 6.0' feet.				
В		SM					Silty, fine sand, trace coarse sand, trace gravel, porous; Light orange-brown; Moist.				
							Bottom of trench at 14.1 feet. No groundwater encountered. Trench backfilled with excavated material with minimal compactive effort				



Rollling Ridge Ranch, Los Serranos

Project No.:

1/30/2015

Logged By:

AH

Equipment Used: Rubber tired, tractor-mounted backhoe

Elevation:

Depth (ft.)	Sample Type	Penetration Resistance	Soil Classification	Dry Density (Ib/ft3)	Moisture Content (%)	O Lithology	Groundwater	Description
	N		SM	96.5	17.1	Col		COLLUVIUM: 0 Mulch Silty, fine sand, trace roots to 2.0'; Dark brown-black; Moist.
	B/N		ML	102.8	15.0	Qvof		VERY OLD ALLUVIAL FAN DEPOSITS: Silt, trace fine to medium sand, a little clay; Light brown; Moist. hard digging. Heavy caliche layer from 4.0' to 5.0'.
								Color changed to orange-brown; more fine to medium sand.
								Bottom of trench at 9.8 feet. No groundwater encountered. Trench backfilled with excavated material with minimal compactive effe



Project Name: Ro Rollling Ridge Ranch, Los Serranos

Project No.: 982-A14.1

1/30/2015

Logged By:

AH

Equipment Used: Rubber tired, tractor-mounted backhoe

Elevation:

Depth (ft.)	Sample Type	Penetration Resistance	Soil WClassification	Dry Density (Ib/ft3)	Moisture Content (%)	Col Lithology	Groundwater	Description
1	N		SM	92.9	16.4	Col		COLLUVIUM: 0 Mulch Silty, fine sand, slihgtly porous, trace roots; Dark brown-black; Moist.
	N		ML	100.6	18.0	Qvof		VERY OLD ALLUVIAL FAN DEPOSITS: Silt, trace fine to medium sand, a little clay; Light brown; Moist. Hard digging Heavy caliche layer from 3.5' to 6.5'.
								Color changed to orange-brown; more fine to medium sand.
2								Bottom of trench at 10.0 feet. No groundwater encountered. Trench backfilled with excavated material with minimal compactive efforms.



HILLTOP GEOTECHNICAL
INCORPORATED
Project Name: R Rollling Ridge Ranch, Los Serranos

Project No.: 982-A14.1 1/30/2015 Logged By: AH Equipment Used: Rubber tired, tractor-mounted backhoe Elevation: ± 669

Depth (ft.)	Sample Type	Penetration Resistance	Soil Classification	Dry Density (Ib/ft3)	Moisture Content (%)	O Lithology	Groundwater	Description
1 -			SM			Col		COLLUVIUM: 0 Mulch Silty, fine sand, slihgtly porous, trace roots; Dark brown-black; Moist.
3 -	N		ML	103.2	17.3	Qvof		VERY OLD ALLUVIAL FAN DEPOSITS: Silt, trace fine to medium sand, a little clay; Light brown; Moist. Hard digging
4 — 5 —	Ņ			99.9	13.3			Heavy caliche layer from 3.7' to 5.5'.
5 – 7 – 3 –			SM					Silty, fine to coarse sand, a little gravel; Orange-brown; Moist.
0 -			SP					Fine to coarse sand, a little gravel, trace silt; Orange-brown; Moist.
1 - 2 - 3 -			SP/SM					Alternating layers of fine to coarse sand, to silty, fine to coarse sand, trace gravel; Orange-brown; Moist.
4 — 5 — 6 — 7 — 7 — 8 — 9 — 1 — 2 — 3 — 4 —								Bottom of trench at 14.5 feet. No groundwater encountered. Trench backfilled with excavated material with minimal compactive effort

SUMMARY OF LABORATORY TEST RESULTS

	EXPANSION INDEX TEST RESULTS (ASTM D4829 Test Method)									
SAMPLE	MOISTURE CONTENT PRIOR TO TEST (%)	DRY DENSITY PRIOR TO TEST (pcf)	SATURATION PRIOR TO TEST (%)*	MOISTURE CONTENT AFTER TEST (%)	EXPANSION INDEX	EXPANSION POTENTIAL**				
T-1, 9'	10.4	106.3	48.0	27.0	59	Expansive				
T-7, 1'	13.6	98.2	51.3	33.7	128	Expansive				

* Assumes a 2.70 Specific Gravity for the earth material.

SOLUBLE SULFATE TEST RESULTS (EPA 300.0 Test Procedure)*								
SAMPLE	EARTH MATERIAL DESCRIPTION	SOLUBLE SULFATE CONTENT (%)	CLASS**					
T-1, 9'	Dark brown-black, silty clay, trace fine sand (CL)	0.0027	S0					
T-7, 1'	Dark brown-black, silty clay, trace gravel (CL)	0.0120	S0					
* Test performed by A & R Laboratories. ** Per Table 19.3.1.1, 'Exposure Categories and Classes,' in American Concrete Institute (ACI) 318-14.								

^{**} As defined in Section 1803.5.3, 'Expansive Soil,' in the 2013 California Building Code (CBC) (i.e., Non-Expansive: EI ≤20; Expansive: EI >20).

SUMMARY OF LABORATORY TEST RESULTS

PERCE	PERCENT PASSING #200 SIEVE TEST RESULTS (ASTM D1140 Test Method)								
SAMPLE	EARTH MATERIAL DESCRIPTION	PERCENT PASSING #200 SIEVE							
T-1, 9'	Dark brown-black, silty clay, trace fine sand (CL)	67							
T-7, 1'	Dark brown-black, silty clay, trace gravel (CL)	67							

CHEMICAL / MINIMUM ELECTRICAL RESISTIVITY TEST RESULTS										
SAMPLE	RESISTIVITY Minimum (ohm-cm)	рН*	SULFIDE	CHLORIDE (ppm)**						
T-1, 9'	1,193	7.94	Neg.***	240						
T-7, 1'	1,810	8.98	Neg.	120						
* 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.										

SUMMARY OF LABORATORY TEST RESULTS

	COLLAPSE POTENTIAL TEST RESULTS (ASTM D5333 Test Method)									
SAMPLE	SETTLEMENT AT 3,200 PSF LOAD (%)	COLLAPSE / SWELL* (%)	COLLAPSE INDEX, (I _c), (%)	DEGREE OF COLLAPSE **						
B-2, 6.0'-6.5'	2.6	0.0	0	None						
B-4, 13.5' -14.0'	5.0	0.0	0	None						
B-7, 6.0'-6.5'	2.8	-0.3	0.3	Slight						
B-8 6.0'-6.5'	3.1	-0.6	0.6	Slight						

^{*} Percent collapse (-) or swell (+) measured when water added at 3,200 psf load during test procedure.

None - 0%

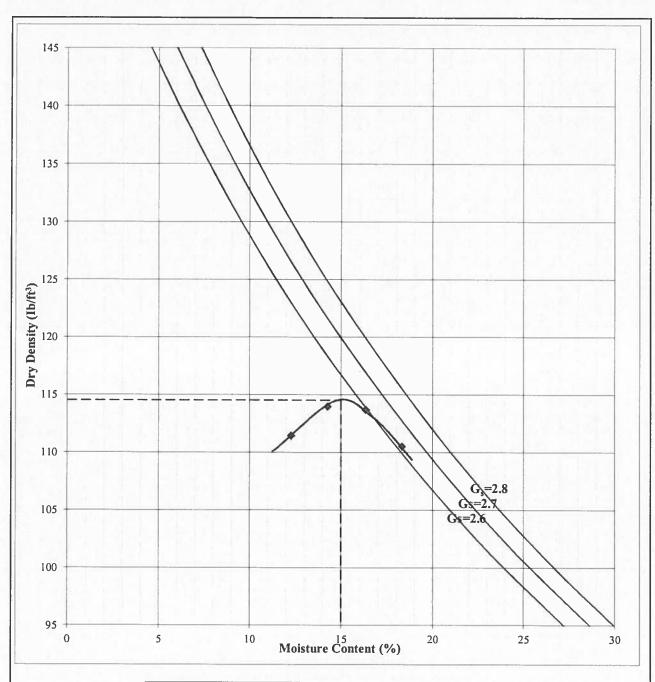
Slight - 0.1 - 2.0%

Moderate - 2.1 - 6.0%

Moderately Severe - 6.1 - 10.0%

Severe - >10.0%

^{**} Per Table 1, 'Classification of Collapse Index, I_c ,' in ASTM Standard Test Method D5333-03.



Maximum Dry Density (Ib/ft³)	114.5
Optimum Moisture Content (%)	15.0
Procedure	A



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

SAMPLE: T-7, 1'				
SOIL DESCRIPTION:		Dark brown-black, silty clay, trace gravel to 3/8" (CL)		
BY:	DLC	DATE:	4/2015	
JOB NO.:	982-A14.1	PLATEN	NO: 26	



Natural History Museum of Los Angeles County 900 Exposition Boulevard Los Angeles, CA 90007

tel 213.763.DINO www.nhm.org

Vertebrate Paleontology Section Telephone: (213) 763-3325

e-mail: smcleod@nhm.org

25 October 2019

ECORP Consulting, Inc. 215 North Fifth Street Redlands, CA 92374

Attn: Wendy Blumel, Senior Archaeologist

re: Paleontological resources for the proposed 49 acre parcel Project, ECORP Project # 2019-194, in the City of Chino Hills, San Bernardino County, project area

Dear Wendy:

I have conducted a thorough search of our paleontology collection records for the locality and specimen data for the proposed 49 acre parcel Project, ECORP Project # 2019-194, in the City of Chino Hills, San Bernardino County, project area as outlined on the portion of the Prado Dam USGS topographic quadrangle map that Julian Acuna sent to me via e-mail on 8 October 2019. We do not have any vertebrate fossil localities that lie directly within the proposed project area, but we do have localities nearby from the same sedimentary deposits that occur in the proposed project area.

In the northern-most portion of the proposed project area there are surficial deposits of younger Quaternary Alluvium, derived as alluvial fan deposits from the Puente Hills immediately to the west. These younger Quaternary deposits usually do not contain significant vertebrate fossils in the uppermost layers, but older sedimentary deposits at depth may well contain significant fossil vertebrate remains. Almost all of the proposed project area though has surface deposits of older Quaternary Alluvium, also derived as alluvial fan deposits from the elevated terrain to the west. Our closest fossil vertebrate localities from older Quaternary deposits are LACM 7268 and 7271, south-southeast of the proposed project area on the northwest flank of the hills, that both produced specimens of fossil horse, *Equus*. In English Canyon northwest of the proposed project area, our older Quaternary locality LACM 1728 produced fossil specimens of

horse, *Equus*, and camel, *Camelops*, at a depth of 15 to 20 feet below the surface. Further to the north-northwest of the proposed project area, just southwest of the intersection of the Pomona Freeway (Highway 60) and the Corona Freeway (Highway 71), our older Quaternary locality LACM 8014 produced a fossil specimen of bison, *Bison*. Slightly further to the southwest of the proposed project area, in the uppermost reaches of Soquel Canyon, our older Quaternary locality LACM 7508 produced fossil specimens of ground sloth, *Nothrotheriops*, and horse, *Equus giganteus*.

Shallow excavations in the surficial younger Quaternary Alluvium exposed in the northern-most portion of the proposed project area probably will not encounter any significant vertebrate fossils. Deeper excavations there that extend down into older Quaternary deposits, however, as well as any excavations in the older Quaternary deposits exposed in almost all of the proposed project area, may well uncover significant vertebrate fossil remains. Any substantial excavations below the uppermost layers, therefore, should be monitored closely to quickly and professionally recover any fossil remains discovered while not impeding development. Sediment samples should also be collected from the older deposits in the proposed project area and processed to determine their small fossil potential. Any fossils recovered during mitigation should be deposited in an accredited and permanent scientific institution for the benefit of current and future generations.

This records search covers only the vertebrate paleontology records of the Natural History Museum of Los Angeles County. It is not intended to be a thorough paleontological survey of the proposed project area covering other institutional records, a literature survey, or any potential on-site survey.

Sincerely,

Samuel A. McLeod, Ph.D.

Summel A. M. Level

Vertebrate Paleontology

enclosure: invoice