GEOTECHNICAL EVALUATION

FOR

PROPOSED OAKS RIVER ACCESS

E. FORK ROAD

ANGELES NATIONAL FOREST, COUNTY OF LOS ANGELES, CALIFORNIA

PREPARED FOR

B & E ENGINEERS
20 E. FOOTHILL BOULEVARD, SUITE 230
ARCADIA, CALIFORNIA 91006

PREPARED BY

GEOTEK, INC.
710 EAST PARKRIDGE AVENUE, SUITE 105
CORONA, CALIFORNIA 92879

PROJECT NO. 1536-CR OCTOBER 11, 2016

GEOTEK

GeoTek, Inc.
710 E. Parkridge Avenue, Suite 105, Corona, California 92879-1097
(951) 710-1160 Office (951) 710-1167 Fax www.geotekusa.com

October 11, 2016
Project No. 1536-CR

B & E Engineers
20 E. Foothill Boulevard, Suite 230
Arcadia, California 91006

Attention: Mr. Ramy F. Awad, PE

Subject: Geotechnical Evaluation
Proposed Oaks River Access
E. Fork Road
Angeles National Forest, County of Los Angeles, California

Dear Mr. Awad:

We are pleased to provide herein the results of our Geotechnical Evaluation for the subject project located off E. Fork Road in the Angeles National Forest, Los Angeles County, California. This report presents the results of our evaluation and discussion of our findings. In our opinion, site development appears feasible from a geotechnical viewpoint. Site development and grading plans should be reviewed by this firm as they become available, as it will be necessary to provide appropriate recommendations for intended specific site development as those plans become refined.

The opportunity to be of service is sincerely appreciated. If you should have any questions, please do not hesitate to call our office.

Respectfully submitted,
GeoTek, Inc.

Edward H. LaMont
CEG 1892, Exp. 7/31/18
Principal Geologist

Paul Hyun Jin Kim
PE 77214, Exp. 6/30/17
Project Engineer

Distribution: (1) Addressee (pdf via email)

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1. PURPOSE AND SCOPE OF SERVICES

The purpose of this study was to evaluate the general geotechnical conditions on the site. Services provided for this study included the following:

- Research and review of available geologic and geotechnical data, available geotechnical reports and general information pertinent to the site,
- Site exploration consisting of field mapping the geologic conditions at the site and sampling of the near surface earth materials by a geologist from our firm,
- Laboratory testing of soil samples collected during the field investigation,
- Review and evaluation of site seismicity, and
- Compilation of this geotechnical report which presents our findings and a general summary of pertinent site geotechnical conditions relevant for the proposed development.

The intent of this report is to aid in the evaluation of the site for future development from a geotechnical perspective. The professional opinions and geotechnical information contained in this report will likely need to be updated based on our review of final site development plans. These should be provided to GeoTek for review when available.

2. SITE DESCRIPTION AND PROPOSED DEVELOPMENT

2.1 SITE DESCRIPTION

The subject property is located on the southern bank of the San Gabriel (Oaks) River, north of East Fork Road, across the street and just northeast of Oaks Picnic Ground and west of Glendora Mountain Road in the Angeles Forest, Los Angeles County, California (see Figure 1). An unpaved parking area exists between the bank and East Fork Road. Currently, access to the river is via a dirt trail that traverses the bank below the parking area to concrete crib-wall steps, which descend to the river flood plain. The river flows westerly and was gently flowing and shallow at the time of this site reconnaissance. A grouted cobble and boulder wall exists west of the steps at the base of the bank below the access trail and continues westerly across the mouth of Oaks Canyon.

Past grading on the site consisted of placing fill to create a berm at the top of the bank to direct drainage away from the bank. Grading for the dirt trail consisted of cutting into the bank and placing fill along the downslope edge of the trail. Fill was likely placed behind the grouted cobble/boulder wall. Based on photographs provided by BlueGreen Consulting, it appears a trail descended from the unpaved parking area at the location of the existing steps down onto the flood plain. Over time, this trail was backfilled and fill was placed below the area of the existing steps.

The slope gradient above the trail and steps is approximately 1.5:1 (horizontal: vertical). The slope gradient below the trail, above the grouted cobble/boulder wall and below the steps is approximately 2:1. The gradient of the natural slope east of the steps/trail varies from approximately 1 to 1/2:1. The slope below the steps descends gently to the river flood plain. The elevation difference between the top of the bank at the unpaved parking and the bottom of the steps is approximately 20 feet. Site drainage generally flows northerly towards the river.

2.2 PROPOSED DEVELOPMENT

Information regarding the proposed improvements was provided by Mr. Ramy F. Awad with B & E Engineers and our review of the proposed repair documents prepared by BlueGreen Consulting dated July 19, 2016. Based on information provided the project consists of two phases:

- Interim solution
  - Construction of minimal walls and temporary stairs;
  - Remove accumulated debris and unconsolidated fill from the project area to reveal bedrock;
  - Three masonry landings/piers (one at trailhead, two at river's edge) to be constructed in phase 1 remain in permanent solution;
  - A set of removable wood stairs will mount onto the landings/piers at river level;
  - The two concrete landing/piers at the river level should have large footings and/or anchored to bedrock; and,
  - The slope of the existing trail is not modified and exceeds 10 percent.
- Permanent solution
  - Masonry rock walls support trails and river access stairs;
  - Extending the existing river wall will close gap between existing end of the wall and the bedrock upstream;
  - The lower stairs are recessed and oriented so that the flow cannot enter the stairs;
  - The slope of the upper trail does not exceed 5 percent; and,

- The trailhead incorporates an overlook, rock walls and masonry piers.

The current phase of work entails the "Interim solution."

As site development planning progresses and more finalized plans become available, the plans should be provided to GeoTek for review and comment. Additional engineering analyses and exploration may be necessary in order to provide specific earthwork recommendations and geotechnical design parameters for actual site work.

3. FIELD EXPLORATION AND LABORATORY TESTING

3.1 FIELD EXPLORATION

Field exploration was conducted by a geologist from GeoTek on September 20, 2016 and consisted of a site reconnaissance, geologic mapping and collecting a soil sample. The location of the sample collected, S-1, is shown on the enclosed Geotechnical Map (Plate 1).

3.2 LABORATORY TESTING

Laboratory testing was performed on selected soil samples collected during the field exploration. The purpose of the laboratory testing was to help confirm the field classification of the soil materials encountered and to evaluate their physical properties for use in the engineering design and analysis. Results of the laboratory testing program, along with a brief description and relevant information regarding testing procedures, are included in Appendix A.

4. GEOLOGIC AND SOILS CONDITIONS

4.1 REGIONAL SETTING

The subject property is situated in the Transverse Ranges province. The Transverse Ranges geomorphic province is so named because of the conspicuous east-west alignment of the mountain ranges, which is in contrast to the majority of the mountain ranges in North America which trend north-south. The province extends from Point Arguello and San Miguel Island (Channel Islands) on the west, about 320 miles to the Joshua Tree National Monument area on the east where it merges with the Mojave and Colorado deserts geomorphic provinces. The province reaches its maximum width (60 miles) along the Ventura-Los Angeles County line. Its most narrow width (40 miles) is at its western most end. The northern boundary from Ventura County east to the Cajon Pass is formed by the San Andreas Fault system. The Peninsular Ranges geomorphic province forms the southernmost boundary.

The province is characterized by major mountain ranges with intervening alluviated, broadly synclinal valleys and narrow stream canyons. The province subdivides into several individual ranges and geologic features. The major subdivisions of interest are the Santa Ynez Mountains, Central Ventura County Mountains, Santa Monica Mountains, Ventura/Soledad Basin, Ridge Basin, San Gabriel Mountains, Los Angeles Basin, San Bernardino Mountains, and the Eastern Boundary Ranges.

More specific to the subject property, Dibblee and Minch (2002) map the site to be underlain by alluvial gravel and sand of stream channels (Qg) and Pre-Cambrian metamorphic gneissic bedrock (gn) (see Figure 2). The gneiss exhibits foliation and variably oriented joints (see Geotechnical Map, Plate 1 and Section A-A', Plate 2). Foliation mapped by GeoTek dip 55 to 76 degrees to the southwest and southeast. These attitudes coincide with regional trends as mapped by Dibblee and Minch (2002). Joints mapped by GeoTek on the property had variable strikes and moderate to steep dips.

No active or potentially active fault is known to exist at this site, nor is the site situated within an *"Alquist-Priolo"* Earthquake Fault Zone (area not evaluated). The nearest known fault to the site is the San Andreas Fault located approximately 6 miles to the north.

4.2 EARTH MATERIALS

A brief description of the earth materials encountered during our site reconnaissance is presented in the following section. Based on our site reconnaissance, field observations, our exploratory excavations and review of published geologic maps the subject site area is locally underlain by undocumented artificial fill, alluvium and gneissic bedrock.

4.2.1 Undocumented Artificial Fill (Af)

Based on field observations, fill exists along the top of the bank above the trail and steps, fill exists along the downslope edge of the trail and behind the grouted cobble/boulder wall. Fill, estimated to be approximately four (4) feet in depth, underlies the existing steps. The fill consists of medium brown-to-brown dry, loose to dense silty sand and gravel with come cobbles and local small boulders.

4.2.2 Alluvium (Qg)

Alluvium exists below the dirt parking area above the trail and steps. Alluvium is exposed in the cut above the trail and exists in the river flood plain. Minor alluvium overlies the bedrock and likely underlies the fill in the vicinity of the existing steps. Alluvium generally consists of sand, cobbles and boulders.

4.2.3 Bedrock (gn)

Metamophic bedrock consisting of Precambrian gneiss (Dibblee and Minch, 2002) exists below the surficial soils and is exposed on outcrop in the area of the existing steps. The bedrock is medium gray to gray with white foliations and is hard to very hard.

4.3 SURFACE WATER AND GROUNDWATER

4.3.1 Surface Water

The San Gabriel River runs westerly, north of the existing steps. Surface water was not encountered in the immediate area of the existing steps. BlueGreen (2016) documents show the limits of the 100-year flood zone roughly crosses through the north end of the existing steps. If encountered during earthwork construction, surface water on this site is the result of precipitation and surface run-off that can also result in swelling of the river channel. Provisions for additional surface drainage and the 100-year flood zone will need to be accounted for by the project civil engineer.

4.3.2 Groundwater

Groundwater is not anticipated to be encountered during construction.

4.4 FAULTING AND SEISMICITY

4.4.1 Surface Fault Rupture

The geologic structure of the entire southern California area is dominated mainly by northwest-trending faults associated with the San Andreas system. The site is in a seismically active region. No active or potentially active fault is known to exist at this site nor is the site situated within an *"Alquist-Priolo"* Earthquake Fault Zone or a Special Studies Zone (area not mapped). The nearest known fault to the site is the San Andreas Fault located approximately 6 miles to the north.

4.4.2 Seismic Design Parameters

The site is located at approximately 34.2299 Latitude and -117.7780 Longitude. Site spectral accelerations (S_s and S_1), for 0.2 and 1.0 second periods for a Class "B" site, were determined from the USGS Website, Earthquake Hazards Program, U.S. Seismic Design Maps for Risk-Targeted Maximum Considered Earthquake (MCE_R) Ground Motion Response Accelerations for the Conterminous 48 States by Latitude/Longitude. The results are presented in the following table:

SITE SEISMIC PARAMETERS	
Mapped 0.2 sec Period Spectral Acceleration, S_s	2.834g
Mapped 1.0 sec Period Spectral Acceleration, S_1	0.976g
Site Coefficient for Site Class "B", F_a	1.0
Site Coefficient for Site Class "B", F_v	1.5
Maximum Considered Earthquake Spectral Response Acceleration for 0.2 Second, S_{MS}	2.834g
Maximum Considered Earthquake Spectral Response Acceleration for 1.0 Second, S_{M1}	0.976g
5% Damped Design Spectral Response Acceleration Parameter at 0.2 Second, S_{DS}	1.889g
5% Damped Design Spectral Response Acceleration Parameter at 1 second, S_{D1}	0.651g

Final selection of the appropriate seismic design coefficients should be made by the project structural engineer based upon the local practices and ordinances, expected building response and desired level of conservatism.

4.4.3 Liquefaction/Seismic Settlement

Liquefaction describes a phenomenon in which cyclic stresses, produced by earthquake-induced ground motion, create excess pore pressures in relatively cohesionless soils. These soils may thereby acquire a high degree of mobility, which can lead to lateral movement, sliding, consolidation and settlement of loose sediments, sand boils and other damaging deformations. This phenomenon occurs only below the water table, but, after liquefaction has developed, the effects can propagate upward into overlying non-saturated soil as excess pore water dissipates.

The factors known to influence liquefaction potential include soil type and grain size, relative density, groundwater level, confining pressures, and both intensity and duration of ground shaking. In general, materials that are susceptible to liquefaction are loose, saturated granular soils having low fines content under low confining pressures.

Soil liquefaction potential is not a part of this scope of work, since the project entails the construction of a non-habitable structure.

4.4.4 Other Seismic Hazards

Evidence of ancient landslides or gross slope instabilities at this site was not observed during our investigation.

The potential for secondary seismic hazards such as seiche and tsunami are considered to be remote due to site elevation and distance from an open body of water.

5. CONCLUSIONS AND RECOMMENDATIONS

5.1 GENERAL

The proposed development appears feasible from a geotechnical viewpoint. The following sections present general recommendations only. More specific geotechnical recommendations for site development can be provided when more finalized site development plans are available for review.

Development of the site should include the removal of the existing crib steps and underlying fill and alluvium to expose the bedrock in the area of the proposed new steps. Loose, unconsolidated fill on the slope between the existing steps and unpaved parking area should also be removed to dense alluvium and/or bedrock. The foundation for the proposed new steps should extend into or be bolted to the underlying bedrock. A representative of GeoTek should observe the bedrock bottom after removal of the existing steps, fill and alluvium prior to foundation construction to determine the most suitable option for the foundation embedment. More specific geotechnical recommendations for site development can be provided when site development plans are available for review.

5.2 EARTHWORK CONSIDERATIONS

5.2.1 General

Earthwork and grading should be performed in accordance with the applicable grading ordinances of the County of Los Angeles, the 2013 California Building Code (CBC), and recommendations contained in this report. The General Grading Guidelines included in Appendix B outline general procedures and do not anticipate all site specific situations. In the event of conflict, the recommendations presented in the text of this report should supersede those contained in Appendix B.

5.2.2 Site Clearing and Preparation

The existing steps should be demolished and removed from the site. Site preparation should include the removal of deleterious materials, vegetation, existing fill and loose alluvium. The deleterious materials and vegetation should be properly disposed of off-site.

5.2.3 Remedial Grading

The undocumented artificial fill and loose alluvium should be removed below the area of the proposed steps and expose bedrock. A representative of this firm should observe the bottom of all excavations.

5.2.4 Engineered Fill

Onsite materials are generally considered suitable for reuse as engineered fill provided they are free from vegetation, roots, and rock/concrete or hard lumps greater than three (3) inches in maximum dimension. The earthwork contractor should have the proposed excavated materials to be used as engineered fill at this project approved by the soils engineer prior to placement. Prior to fill placement, the approved removal bottom should be scarified and moisture conditioned to at least optimum moisture content.

Engineered fill materials should be moisture conditioned to above optimum moisture content and compacted in horizontal lifts not exceeding eight (8) inches in loose thickness to a minimum relative compaction of 90% as determined in accordance with laboratory test procedure ASTM D 1557. Any fill planned to be placed at a slope gradient steeper than 4:1 (horizontal: vertical) should be benched.

5.2.5 Slopes

Any proposed cut or fill slopes will need to be further evaluated when site development plans become available. Fill and cut slopes constructed at gradients of 2:1 or flatter, in accordance with industry standards, are anticipated to be both grossly and surficially stable.

5.2.6 Excavation Characteristics

Excavations in the onsite fill and alluvium should be readily accomplished with heavy-duty earthmoving or excavating equipment in good operating condition. Excavations in the bedrock will be more difficult and may require coring and/or blasting.

5.2.7 Temporary Excavations, Trench Excavations and Backfill

Temporary excavations within the onsite materials should be stable at 1:1 inclinations for short durations during construction, and where cuts do not exceed 10 feet in height. Temporary cuts to a maximum height of four (4) feet can be excavated vertically.

Trench excavations should conform to Cal-OSHA regulations. The contractor should have a competent person, per OSHA requirements, on site during construction to observe conditions and to make the appropriate recommendations.

Utility trench backfill should be compacted to at least 90% relative compaction (as determined per ASTM D 1557). Under-slab trenches should also be compacted to project specifications.

Compaction should be achieved with a mechanical compaction device. Ponding or jetting of trench backfill is not recommended. If backfill soils have dried out, they should be thoroughly moisture conditioned prior to placement in trenches.

5.3 DESIGN RECOMMENDATIONS

5.3.1 Foundation Design Criteria

Preliminary foundation design criteria, in general conformance with the 2013 CBC, are presented herein. These are typical design criteria and are not intended to supersede the design by the structural engineer. Based on our understanding of the onsite geotechnical conditions, presented herein are recommendations related to conventionally reinforced foundations. It is anticipated that the soils near subgrade will classify as having a "very low" expansion potential in accordance with ASTM D 4829. Typical design criteria for the site based upon a "very low" expansion potential are tabulated below. These are minimal recommendations and are not intended to supersede the design by the project structural engineer.

The foundation elements for the proposed steps should be founded entirely in bedrock. Foundations should be designed in accordance with the *2013 California Building Code* (CBC).

A summary of our foundation design recommendations is presented in the following table:

GEOTECHNICAL RECOMMENDATIONS FOR FOUNDATION DESIGN

Design Parameter	"Very Low" Expansion Potential $0 \leq EI \leq 20$
Foundation Depth or Minimum Perimeter Beam Depth (inches below the lowest adjacent grade)	12
Minimum Foundation Width (inches)*	12
Minimum Footing Reinforcement for Continuous Footings, Grade Beams and Retaining Wall Footings	Two No. 4 reinforcing bars, one placed near the top and one near the bottom

*Code minimums per Table 1809.7 of the 2013 CBC

It should be noted that the criteria provided are based on soil support characteristics only. The structural engineer should design the slab and beam reinforcement based on actual loading conditions.

5.3.1.1 An allowable bearing capacity of 4,000 pounds per square foot (psf) may be used for design of continuous and perimeter footings 12 inches deep and 12 inches wide, and pad footings 24 inches square and 12 inches deep. This value may be increased by 300 pounds per square foot for each additional 12 inches in depth and 200 pounds per square foot for each additional 12 inches in width to a maximum value of 5,000 psf. Additionally, an increase of one-third may be applied when considering short-term live loads (e.g. seismic and wind loads).

5.3.1.2 The passive earth pressure may be computed as an equivalent fluid having a density of 300 psf per foot of depth, to a maximum earth pressure of 4,000 psf for footings founded on engineered fill. A coefficient of friction between soil and concrete of 0.4 may be used with dead load forces. When combining passive pressure and frictional resistance, the passive pressure component should be reduced by one-third.

5.3.2 Miscellaneous Foundation Recommendations

5.3.2.1 Soils from the footing excavations should not be cast over the slope or be placed unless properly compacted and tested. The excavations should be free of loose/sloughed materials and be neatly trimmed at the time of concrete placement.

5.3.3 Foundation Set Backs

Where applicable, the following setbacks should apply to all foundations. Any improvements not conforming to these setbacks may be subject to lateral movements and/or differential settlements:

- The outside bottom edge of all footings should be set back a minimum of H/3 (where H is the slope height) from the face of any descending slope. The setback should be at least 7 feet and need not exceed 40 feet.
- The outside bottom edge of all footings should be set back a minimum of H/2 (where H is the slope height) from the face of any ascending slope. The setback should be at least five (5) feet and need not exceed 15 feet.
- The bottom of all footings for structures near retaining walls should be deepened so as to extend below a 1:1 projection upward from the bottom inside edge of the wall stem. This applies to the existing retaining walls along the perimeter, if they are to remain.

5.3.4 Soil Sulfate Content

The sulfate content was determined in the laboratory for onsite soil samples. The results indicate that the water soluble sulfate range is less than 0.1 percent by weight, which is considered “not applicable” (negligible) as per Table 4.2.1 of ACI 318.

5.4 RETAINING WALL DESIGN AND CONSTRUCTION

5.4.1 General Design Criteria

Recommendations presented herein apply to typical masonry or concrete vertical retaining walls to a maximum height of up to six (6) feet. Additional review and recommendations should be requested for higher walls. These are typical design criteria and are not intended to supersede the design by the structural engineer.

Retaining wall foundations should be embedded a minimum of 12 inches into engineered fill or bedrock and satisfy slope setback requirements. Retaining wall foundations should be designed in accordance with Section 5.3.1 of this report. Structural needs may govern and should be evaluated by the project structural engineer.

All earth retention structure plans, as applicable, should be reviewed by this office prior to finalization.

Earthwork considerations, site clearing and remedial earthwork for all earth retention structures should meet the requirements of this report, unless specifically provided otherwise, or more stringent requirements or recommendations made by the designer. The backfill material placement for all earth retention structures should meet the requirement of Section 5.4.4 in this report.

In general, cantilever earth retention structures, which are designed to yield at least 0.001H, where H is equal to the height of the earth retention structure to the base of its footing, may be designed using the active condition. Rigid earth retention structures (including but not limited to rigid walls, and walls braced at top, such as typical basement walls) should be designed using the at-rest condition.

In addition to the design lateral forces due to retained earth, surcharges due to improvements, such as an adjacent building or traffic loading, should be considered in the design of the earth retention structures. Loads applied within a 1:1 (h:v) projection from the surcharge on the stem of the earth retention structure should be considered in the design.

Final selection of the appropriate design parameters should be made by the designer of the earth retention structures.

5.4.2 Cantilevered Walls

The recommendations presented below are for cantilevered retaining walls up to 12 feet high. Active earth pressure may be used for retaining wall design, provided the top of the wall is not restrained from minor deflections. An equivalent fluid pressure approach may be used to compute the horizontal pressure against the wall. Appropriate fluid unit weights are given below for specific slope gradients of the retained material. These do not include other superimposed loading conditions such as traffic, structures, seismic events, or adverse geologic conditions.

ACTIVE EARTH PRESSURES	
Surface Slope of Retained Materials (h:v)	Equivalent Fluid Pressure (pcf) Native Backfill*
Level	30
2:1	45

* The design pressures assume the backfill material has an expansion index less than or equal to 20. Backfill zone includes area between back of the wall to a plane (1:1 h:v) up from bottom of the wall foundation (on the backside of the wall) to the (sloped) ground surface.

Additional loads from adjacent structures should be accounted for by the structural engineer.

5.4.3 Restrained Retaining Walls

Retaining walls that will be restrained at the top that support level backfill or that have reentrant or male corners, should be designed for an equivalent at-rest fluid pressure of 55 pcf, plus any applicable surcharge loading. For areas of male or reentrant corners, the restrained wall design should extend a minimum distance of twice the height of the wall laterally from the corner, or a distance otherwise determined by the project structural engineer.

5.4.4 Wall Backfill and Drainage

Retaining walls should be provided with an adequate pipe and gravel back drain system to help prevent buildup of hydrostatic pressures. Backdrains should consist of a 4-inch diameter perforated collector pipe (Schedule 40, SDR 35, or approved equivalent) embedded in a minimum of one (1) cubic foot per linear foot of ¾- to 1-inch clean crushed rock or an approved equivalent, wrapped in filter fabric (Mirafi 140N or an approved equivalent). The drain system should be connected to a suitable outlet. Drain outlets should be maintained over the life of the project and should not be obstructed or plugged by adjacent improvements. Waterproofing of site walls should be performed where moisture migration through the wall is undesirable.

Retaining wall backfill should be placed in lifts no greater than eight (8) inches in thickness and compacted to a minimum of 90% relative compaction in accordance with ASTM Test Method D 1557. The wall backfill should also include a minimum one (1) foot wide section of ¾- to 1-inch clean crushed rock (or an approved equivalent). The rock should be placed immediately adjacent to the back of the wall and extend up from a back drain to within approximately 24 inches of the finish grade. The rock should be separated from the earth with filter fabric. The upper 24 inches should consist of compacted on-site soil.

As an alternative to the drain rock and fabric, Miradrain 2000, or approved equivalent, may be used behind the retaining wall. The Miradrain 2000 should extend from the base of the wall to within 2 feet of the ground surface. The subdrain should be placed at the base of the wall in direct contact with the Miradrain 2000.

The presence of other materials might necessitate revision to the parameters provided and modification of the wall designs. Proper surface drainage needs to be provided and maintained.

5.4.5 Other Design Considerations

- Wall design should consider the additional surcharge loads from superjacent slopes and/or footings, where appropriate.

- No backfill should be placed against concrete until minimum design strengths are evident by compression tests of cylinders.
- The retaining wall footing excavations, backcuts and backfill materials should be approved by the project geotechnical engineer or their authorized representative.

5.5 CONCRETE CONSTRUCTION

5.5.1 General

Concrete construction should follow the 2013 CBC and ACI guidelines regarding design, mix placement and curing of the concrete. If desired, we could provide quality control testing of the concrete during construction.

5.5.2 Concrete Mix Design

Laboratory testing has indicated that the sulfate content of the soil tested is in the "not applicable" (i.e. negligible) and an exposure classification of "S0" per Table 4.2.1 of ACI 318. Based on these results and Table 4.3.1 of ACI 318, no special concrete mix design is required by code to resist sulfate attack. However, additional testing should be performed during grading so that specific recommendations can be formulated based on the as-graded conditions.

5.5.3 Concrete Flatwork

Exterior concrete flatwork (patios, walkways, driveways, etc.) is often some of the most visible aspects of site development. They are typically given the least level of quality control, being considered "non-structural" components. Cracking of these features is fairly common due to various factors. While cracking is not usually detrimental, it is unsightly. We suggest that the same standards of care be applied to these features as to the structure itself.

Flatwork may consist of four (4) inch thick concrete and the use of reinforcement is suggested. The project structural engineer should provide final design recommendations.

5.5.4 Concrete Performance

Concrete cracks should be expected. These cracks can vary from sizes that are essentially unnoticeable to more than 1/8 inch in width. Most cracks in concrete while unsightly do not significantly impact long-term performance. While it is possible to take measures (proper concrete mix, placement, curing, control joints, etc.) to reduce the extent and size of cracks that occur, some cracking will occur despite the best efforts to minimize it. Concrete undergoes chemical processes that are dependent on a wide range of variables, which are difficult, at best, to control. Concrete, while seemingly a stable material, also is subject to internal expansion and contraction due to external changes over time.

One of the simplest means to control cracking is to provide weakened control joints for cracking to occur along. These do not prevent cracks from developing; they simply provide a relief point for the stresses that develop. These joints are a widely accepted means to control cracks but are not always effective. Control joints are more effective the more closely spaced they are. GeoTek suggests that control joints be placed in two directions and located a distance apart roughly equal to 24 to 36 times the slab thickness.

5.6 POST CONSTRUCTION CONSIDERATIONS

5.6.1 Landscape Maintenance and Planting

Water has been shown to weaken the inherent strength of soil, and slope stability is significantly reduced by overly wet conditions. Positive surface drainage away from graded slopes should be maintained and only the amount of irrigation necessary to sustain plant life should be provided for planted slopes. Controlling surface drainage and runoff, and maintaining a suitable vegetation cover can minimize erosion. Plants selected for landscaping should be lightweight, deep-rooted types that require little water and are capable of surviving the prevailing climate.

Overwatering should be avoided. The soils should be maintained in a solid to semi-solid state as defined by the materials Atterberg Limits. Care should be taken when adding soil amendments to avoid excessive watering. Leaching as a method of soil preparation prior to planting is not recommended. An abatement program to control ground-burrowing rodents should be implemented and maintained. This is critical as burrowing rodents can decreased the long-term performance of slopes.

It is common for planting to be placed adjacent to structures in planter or lawn areas. This will result in the introduction of water into the ground adjacent to the foundation. This type of landscaping should be avoided. If used, then extreme care should be exercised with regard to the irrigation and drainage in these areas. Waterproofing of the foundation and/or subdrains may be warranted and advisable. We could discuss these issues, if desired, when plans are made available.

5.6.2 Drainage

The need to maintain proper surface drainage and subsurface systems cannot be overly emphasized. Positive site drainage should be maintained at all times. Drainage should not flow uncontrolled down any descending slope. Water should be directed away from foundations and not allowed to pond or seep into the ground adjacent to the footings. Soil areas within 10 feet of the proposed structure should slope at a minimum of 5 percent away from the building, if possible unless the area is paved. Paved areas are to be sloped at 2 percent away from the structure. Roof gutters and downspouts should discharge onto paved surfaces sloping away from the structure or into a closed pipe system which outfalls to the street gutter pan or directly to the storm drain system. Pad drainage should be directed toward approved areas and not be blocked by other improvements.

It is the owner's responsibility to maintain and clean drainage devices on or contiguous to their lot. In order to be effective, maintenance should be conducted on a regular and routine schedule and necessary corrections made prior to each rainy season.

5.7 PLAN REVIEW AND CONSTRUCTION OBSERVATIONS

We recommend that site grading, specifications, retaining wall and foundation plans be reviewed by this office prior to construction to check for conformance with the recommendations of this report. Additional recommendations and/or additional exploration may be necessary based on these reviews. We also recommend that GeoTek representatives be present during site grading and foundation construction to check for proper implementation of the geotechnical recommendations. The owner/developer should have GeoTek's representative perform at least the following duties:

- Observe site clearing and grubbing operations for proper removal of unsuitable materials.
- Observe and test bottom of removals prior to fill placement.
- Evaluate the suitability of on-site and import materials for fill placement, and collect soil samples for laboratory testing when necessary.
- Observe the fill for uniformity during placement including utility trenches.
- Test the fill for field density and relative compaction.
- Observe and probe foundation excavations to confirm suitability of bearing materials.

If requested, a construction observation and compaction report can be provided by GeoTek, which can comply with the requirements of the governmental agencies having jurisdiction over the project. We recommend that these agencies be notified prior to commencement of construction so that necessary grading permits can be obtained.

6. LIMITATIONS

The scope of our evaluation is limited to the area explored that is shown on the Geotechnical Map (Plate 1). This evaluation does not and should in no way be construed to encompass any areas beyond the specific area of proposed construction as indicated to us by the client. Further, no evaluation of any existing site improvements is included. The scope is based on our understanding of the project and the client's needs, our proposal (Proposal No. P-0800216) dated August 1, 2016.

The materials observed on the project site appear to be representative of the area; however, alluvial soil and bedrock materials vary in character between excavations and natural outcrops or conditions exposed during site construction. Site conditions may vary due to seasonal changes or other factors. GeoTek, Inc. assumes no responsibility or liability for work, testing or recommendations performed or provided by others.

Since our recommendations are based on the site conditions observed and encountered, and laboratory testing, our conclusions and recommendations are professional opinions that are limited to the extent of the available data. Observations during construction are important to allow for any change in recommendations found to be warranted.

GeoTek has prepared this report in a manner consistent with that level of care and skill ordinarily exercised by members of the engineering and science professions currently practicing under similar conditions in the jurisdiction in which the services are provided, subject to the time limits and physical constraints applicable to this report. Standards of care/practice are subject to change with time. No warranty of any kind is expressed or implied.

This report has been prepared for the specific site, design objective, development and purpose described to GeoTek by the Client. The factual data, interpretations and recommendations pertain to a specific project as described in this report and are not applicable to any other project or site location. Any change of site conditions, purpose, development plans or if the project is not initiated within 18 months of the date of the report may alter the validity of the report. GeoTek cannot be responsible for use of this report, or portions thereof, unless GeoTek is requested to review and, if necessary, revise the report to reflect the changes.

The professional services retained for the purpose of this report include only geotechnical aspects of the subsurface conditions at the site. The presence or implication(s) of possible surface and/or subsurface contaminations resulting from previous activities or uses of the site and/or resulting from introduction onto the site of materials from off-site sources are outside the terms of reference for the purposes of this report and have not been investigated.

The information, recommendations and opinions expressed in this report are for the sole benefit of the Client. This report was prepared exclusively for B & E Engineers, in accordance with generally accepted geotechnical engineering standards of care/practice at the referenced locality. This report, or any portion thereof, is not authorized for use by, and is not to be relied upon by any party except B & E Engineers without GeoTek's express written consent.

7. SELECTED REFERENCES

American Society of Civil Engineers (ASCE), 2013, "Minimum Design Loads for Buildings and Other Structures," ASCE/SEI 7-10, Third Printing, Errata Incorporated through March 15.

Bryant, W.A., and Hart, E.W., 2007, "Fault Rupture Hazard Zones in California, Alquist-Priolo Earthquake Fault Zoning Act with Index to Earthquake Fault Zones Maps," California Geological Survey: Special Publication 42.

California Code of Regulations, Title 24, 2013 "California Building Code," 3 volumes.

California Geological Survey (CGS, formerly referred to as the California Division of Mines and Geology), 1977, "Geologic Map of California."

_____, 2008, "Guidelines for Evaluating and Mitigating Seismic Hazards in California," Special Publication 117A.

Dibblee, T.W., Minch, J.A., 2002, "Geologic Map of the Glendora Quadrangle, Los Angeles County, California," Dibblee Geological Foundation Map #DF-89, map scale 1:24,000.

U.S. Seismic Design Maps (http://earthquake.usgs.gov/designmaps).

B & E Engineers
Oaks River Access
E. Fork Road
Angeles National Forest
Los Angeles County, California
GeoTek Project No. 1536-CR

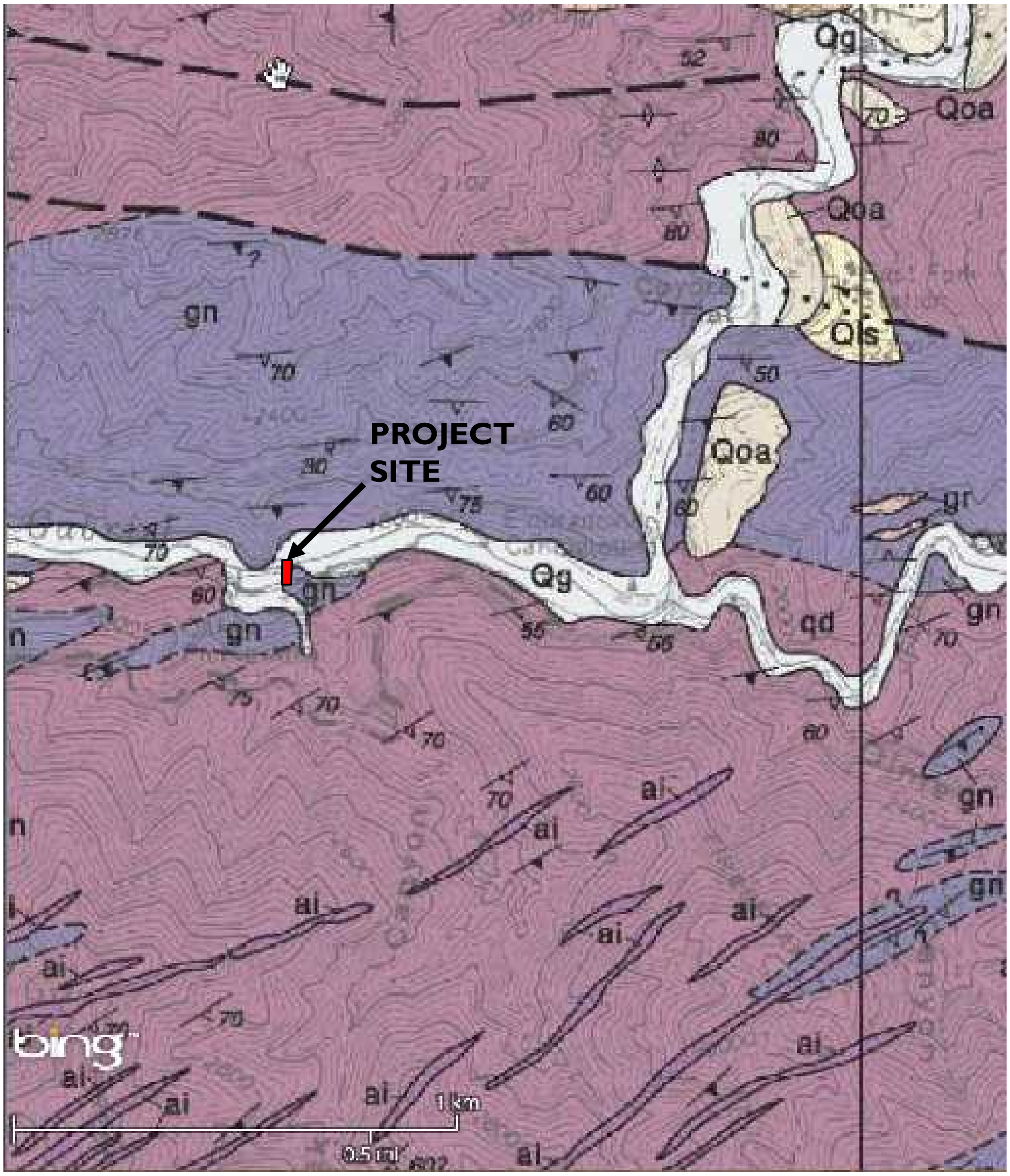
N

Modified from USGS
7.5 Topographic Map

Figure 1

Site Location Map

GEOTEK



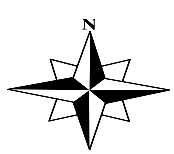
LEGEND

Qg – Alluvial Gravels and Sands of Stream Channels

qd – Quartz Diorite

gn – Gneiss

Reference: Dibblee and Minch, 2002, Geologic Map of Glendora Quadrangle, Los Angeles County, CA. DF-89

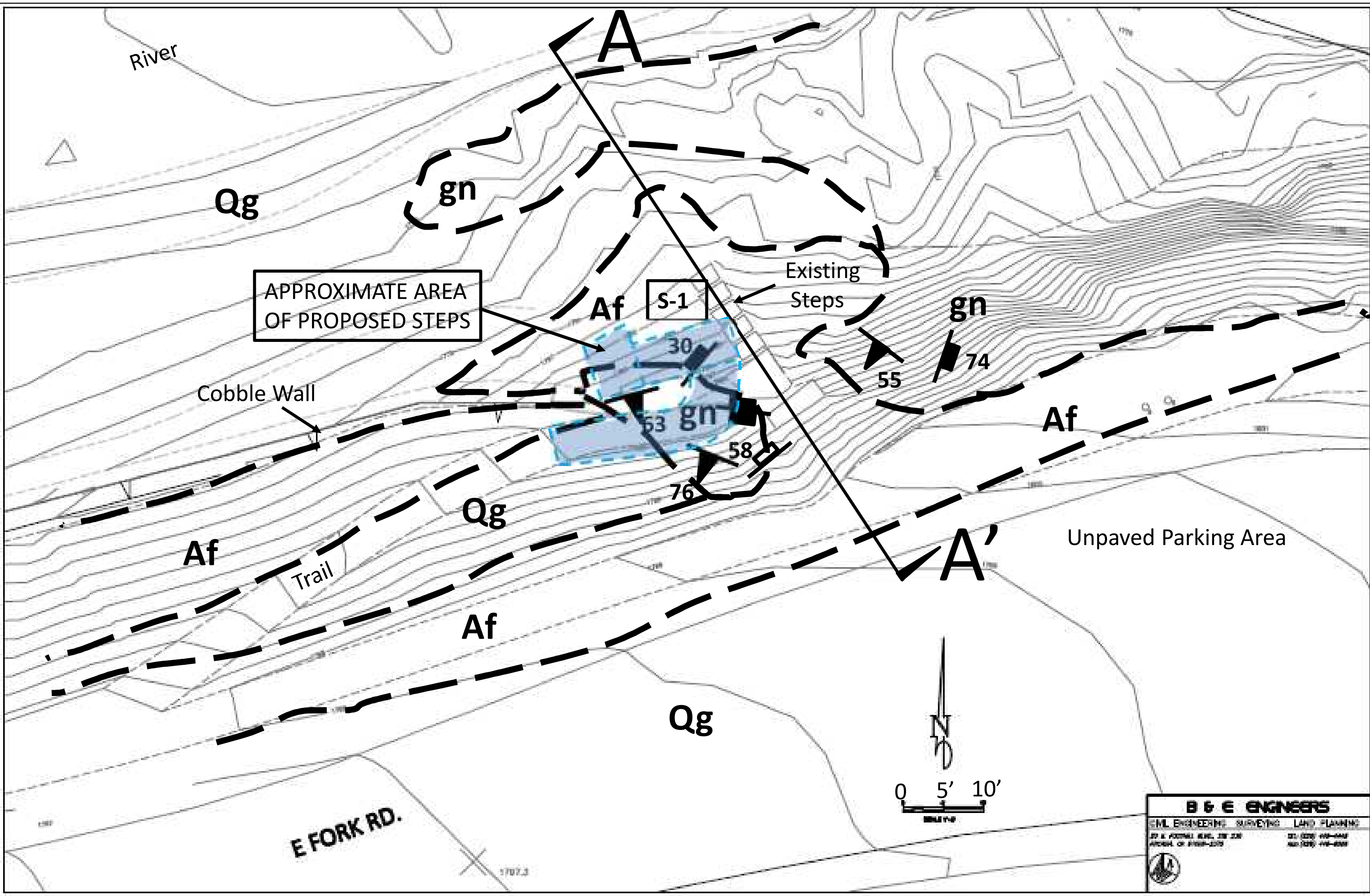
B & E Engineers Oaks River Access E. Fork Road Angeles National Forest Los Angeles County, California GeoTek Project No. 1536-CR		<u>**Figure 2**</u> **Regional Geologic Map**	GEOTEK

GEOTECHNICAL MAP

PLATE 1

GEOTEK Project No. 1536-CR

B & E Engineers
Oaks River Access
E. Fork Road,
Angeles National Forest
Los Angeles County, CA



LEGEND

- APPROXIMATE CONTACT
- **Af** UNDOCUMENTED ARTIFICIAL FILL
- **Qg** ALLUVIAL GRAVEL AND SAND OF STREAM CHANNELS
- **gn** GNEISSIC BEDROCK

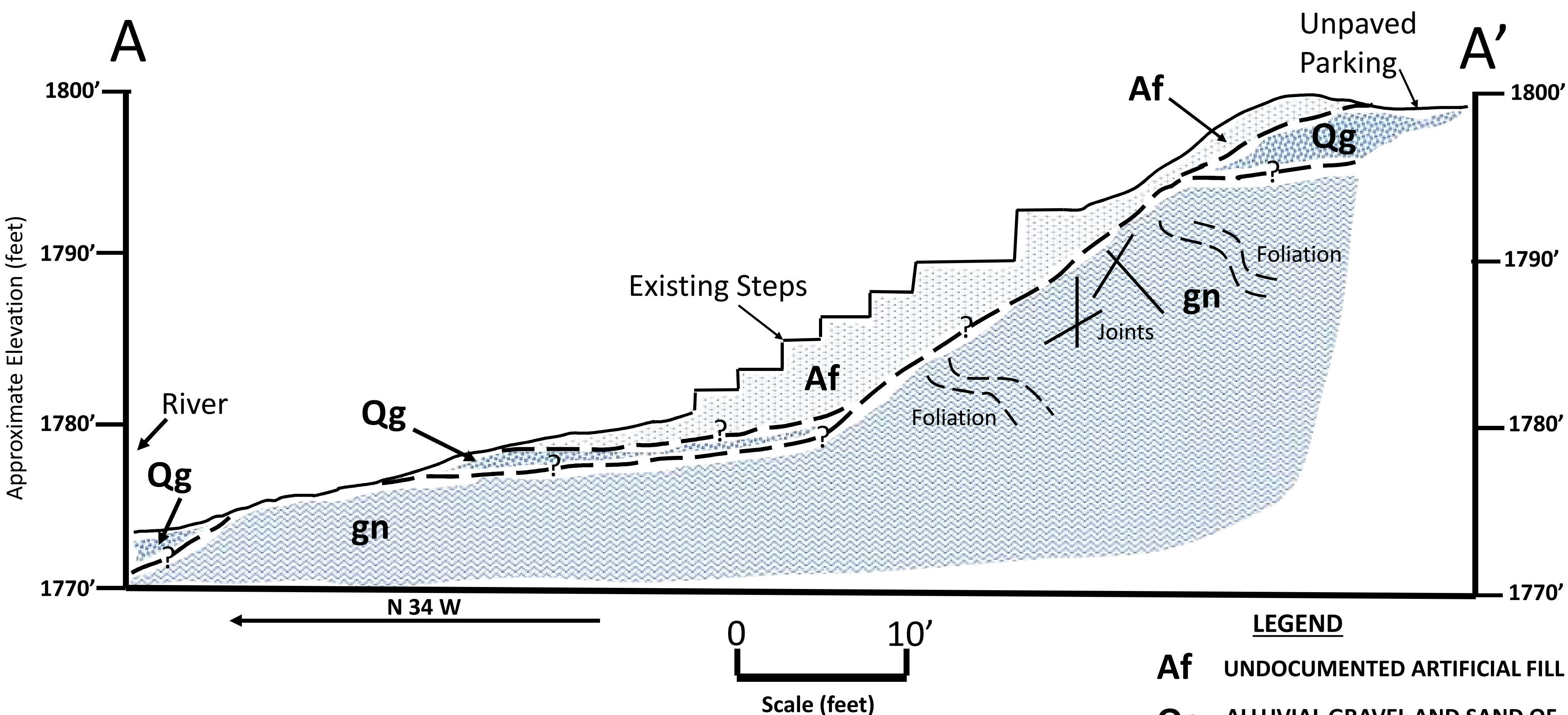
STRIKE AND DIP OF:

JOINT

- VERTICAL
- 30 INCLINED
- 76 FOLIATION

- S-1 APPROXIMATE LOCATION OF SAMPLE

GEOTEK	SECTION A-A’
Plate 2 Project No. 1536-CR	**B & E Engineers** Oaks River Access E. Fork Road, Angeles National Forest Los Angeles County, CA



LEGEND

Af UNDOCUMENTED ARTIFICIAL FILL

Qg ALLUVIAL GRAVEL AND SAND OF STREAM CHANNELS

gn GNEISSIC BEDROCK

APPENDIX A

RESULTS OF LABORATORY TESTING

B & E Engineers
E. Fork Road, Angeles National Forest
Los Angeles County, California
Project No. 1536-CR

GEOTEK

SUMMARY OF LABORATORY TESTING

Moisture-Density Relationship
Laboratory testing was performed on samples collected during the subsurface exploration. The laboratory maximum dry density and optimum moisture content for the soil type was determined in general accordance with test method ASTM Test Procedure D 1557. The results are included in Appendix A.

Sulfate Content
Testing to determine the water-soluble sulfate content was performed by others in general accordance with California Test No. 417. The results of the testing are included in Appendix A.

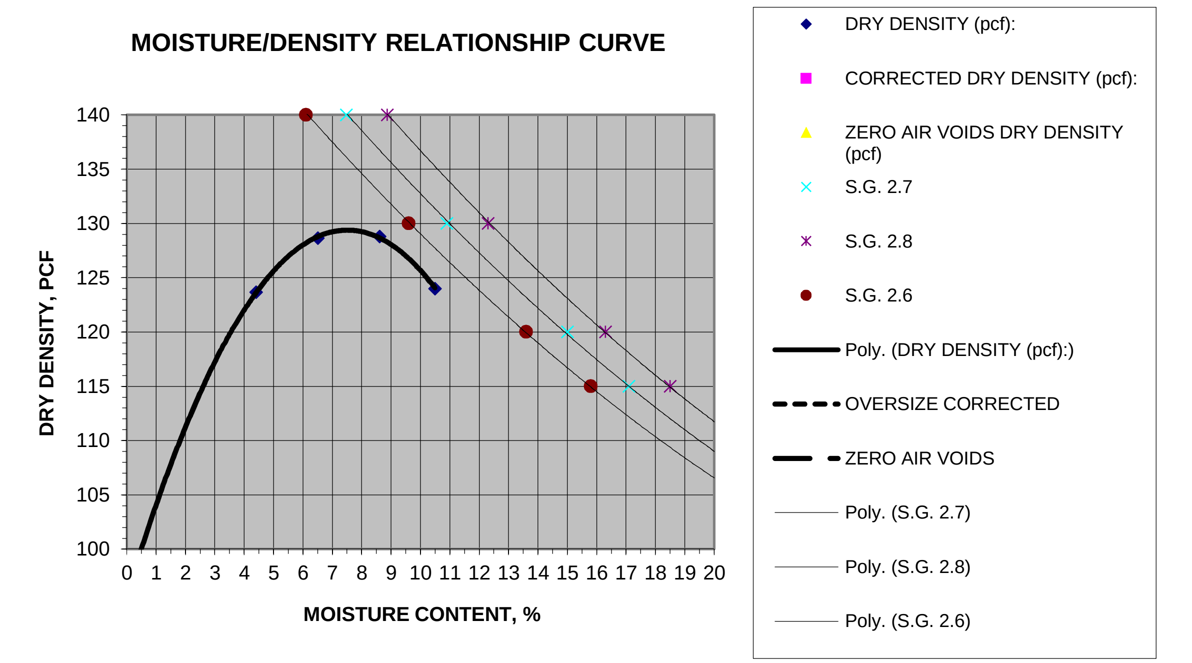
GEOTEK

MOISTURE/DENSITY RELATIONSHIP

Client:	B & E Engineers	**Job No.:**	1536-CR
Project:	Oaks River Access	**Lab No.:**	Corona
Location:	Angeles National Forest		
Material Type:	Gray-brown gravelly silty sand		
Material Supplier:			
Material Source:			
Sample Location:	S-1		
Sampled By:	DRB	**Date Sampled:**	20-Sep-16
Received By:	DLI	**Date Received:**	20-Sep-16
Tested By:	DLI	**Date Tested:**	22-Sep-16
Reviewed By:		**Date Reviewed:**	

Test Procedure: ASTM 1557 **Method:** A

Oversized Material (%): 11.4 **Correction Required:** [ ] yes [x] no



MOISTURE DENSITY RELATIONSHIP VALUES

Maximum Dry Density, pcf	129.0	**@ Optimum Moisture, %**	7.5
Corrected Maximum Dry Density, pcf		**@ Optimum Moisture, %**	

MATERIAL DESCRIPTION

Grain Size Distribution:

	% Gravel (retained on No. 4)
	% Sand (Passing No. 4, Retained on No. 200)
	% Silt and Clay (Passing No. 200)

Atterberg Limits:

	Liquid Limit, %
	Plastic Limit, %
	Plasticity Index, %

Classification:

Unified Soils Classification:

AASHTO Soils Classification:

MD-1

1 SOIL ANALYSIS LAB RESULTS

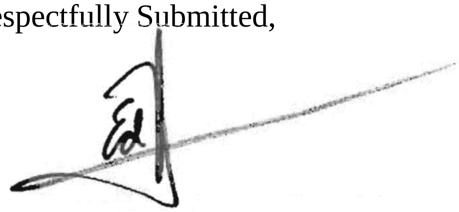
Client: Geotek Inc
Job Name: 1536CR
Client Job Number: 1536CR
Project X Job Number: S160923G
September 26, 2016

	Method	CTM 417		
Bore# / Description	Depth	Sulfates		
	(ft)	(mg/L)	(mg/kg)	(wt%)
S-1	Unk	10.0	30.0	0.0030

Unk = Unknown
NT = Not Tested
ND = 0 = Not Detected
mg/kg = milligrams per kilogram (parts per million) of dry soil weight
mg/L - milligrams per liter of liquid volume
Chemical Analysis performed on 1:3 Soil-To-Water extract

Please call if you have any questions.

Respectfully Submitted,



Eddie Hernandez, M.Sc., P.E.
Sr. Corrosion Consultant
NACE Corrosion Technologist #16592
Professional Engineer
California No. M37102
ehernandez@projectxcorrosion.com

APPENDIX B

GENERAL GRADING GUIDELINES

B & E Engineers

E. Fork Road, Angeles National Forest

Los Angeles County, California

Project No. 1536-CR

GEOTEK

GENERAL GRADING GUIDELINES

Guidelines presented herein are intended to address general construction procedures for earthwork construction. Specific situations and conditions often arise which cannot reasonably be discussed in general guidelines, when anticipated these are discussed in the text of the report. Often unanticipated conditions are encountered which may necessitate modification or changes to these guidelines. It is our hope that these will assist the contractor to more efficiently complete the project by providing a reasonable understanding of the procedures that would be expected during earthwork and the testing and observation used to evaluate those procedures.

General

Grading should be performed to at least the minimum requirements of governing agencies, Chapters 18 and 33 of the California Building Code, CBC (2013) and the guidelines presented below.

Preconstruction Meeting

A preconstruction meeting should be held prior to site earthwork. Any questions the contractor has regarding our recommendations, general site conditions, apparent discrepancies between reported and actual conditions and/or differences in procedures the contractor intends to use should be brought up at that meeting. The contractor (including the main onsite representative) should review our report and these guidelines in advance of the meeting. Any comments the contractor may have regarding these guidelines should be brought up at that meeting.

Grading Observation and Testing

1. Observation of the fill placement should be provided by our representative during grading. Verbal communication during the course of each day will be used to inform the contractor of test results. The contractor should receive a copy of the "Daily Field Report" indicating results of field density tests that day. If our representative does not provide the contractor with these reports, our office should be notified.
2. Testing and observation procedures are, by their nature, specific to the work or area observed and location of the tests taken, variability may occur in other locations. The contractor is responsible for the uniformity of the grading operations; our observations and test results are intended to evaluate the contractor's overall level of efforts during grading. The contractor's personnel are the only individuals participating in all aspect of site work. Compaction testing and observation should not be considered as relieving the contractor's responsibility to properly compact the fill.
3. Cleanouts, processed ground to receive fill, key excavations, and subdrains should be observed by our representative prior to placing any fill. It will be the contractor's responsibility to notify our representative or office when such areas are ready for observation.
4. Density tests may be made on the surface material to receive fill, as considered warranted by this firm.

5. In general, density tests would be made at maximum intervals of two feet of fill height or every 1,000 cubic yards of fill placed. Criteria will vary depending on soil conditions and size of the fill. More frequent testing may be performed. In any case, an adequate number of field density tests should be made to evaluate the required compaction and moisture content is generally being obtained.
6. Laboratory testing to support field test procedures will be performed, as considered warranted, based on conditions encountered (e.g. change of material sources, types, etc.) Every effort will be made to process samples in the laboratory as quickly as possible and in progress construction projects are our first priority. However, laboratory workloads may cause in delays and some soils may require a **minimum of 48 to 72 hours to complete test procedures**. Whenever possible, our representative(s) should be informed in advance of operational changes that might result in different source areas for materials.
7. Procedures for testing of fill slopes are as follows:
   a) Density tests should be taken periodically during grading on the flat surface of the fill, three to five feet horizontally from the face of the slope.
   b) If a method other than over building and cutting back to the compacted core is to be employed, slope compaction testing during construction should include testing the outer six inches to three feet in the slope face to determine if the required compaction is being achieved.
8. Finish grade testing of slopes and pad surfaces should be performed after construction is complete.

Site Clearing

1. All vegetation, and other deleterious materials, should be removed from the site. If material is not immediately removed from the site it should be stockpiled in a designated area(s) well outside of all current work areas and delineated with flagging or other means. Site clearing should be performed in advance of any grading in a specific area.
2. Efforts should be made by the contractor to remove all organic or other deleterious material from the fill, as even the most diligent efforts may result in the incorporation of some materials. This is especially important when grading is occurring near the natural grade. All equipment operators should be aware of these efforts. Laborers may be required as root pickers.
3. Nonorganic debris or concrete may be placed in deeper fill areas provided the procedures used are observed and found acceptable by our representative.

Treatment of Existing Ground

1. Following site clearing, all surficial deposits of alluvium and colluvium as well as weathered or creep effected bedrock, should be removed unless otherwise specifically indicated in the text of this report.

2. In some cases, removal may be recommended to a specified depth (e.g. flat sites where partial alluvial removals may be sufficient). The contractor should not exceed these depths unless directed otherwise by our representative.
3. Groundwater existing in alluvial areas may make excavation difficult. Deeper removals than indicated in the text of the report may be necessary due to saturation during winter months.
4. Subsequent to removals, the natural ground should be processed to a depth of six inches, moistened to near optimum moisture conditions and compacted to fill standards.
5. Exploratory back hoe or dozer trenches still remaining after site removal should be excavated and filled with compacted fill if they can be located.

Fill Placement

1. Unless otherwise indicated, all site soil and bedrock may be reused for compacted fill; however, some special processing or handling may be required (see text of report).
2. Material used in the compacting process should be evenly spread, moisture conditioned, processed, and compacted in thin lifts six (6) to eight (8) inches in compacted thickness to obtain a uniformly dense layer. The fill should be placed and compacted on a nearly horizontal plane, unless otherwise found acceptable by our representative.
3. If the moisture content or relative density varies from that recommended by this firm, the contractor should rework the fill until it is in accordance with the following:
   a) Moisture content of the fill should be at or above optimum moisture. Moisture should be evenly distributed without wet and dry pockets. Pre-watering of cut or removal areas should be considered in addition to watering during fill placement, particularly in clay or dry surficial soils. The ability of the contractor to obtain the proper moisture content will control production rates.
   b) Each six-inch layer should be compacted to at least 90 percent of the maximum dry density in compliance with the testing method specified by the controlling governmental agency. In most cases, the testing method is ASTM Test Designation D 1557.
4. Rock fragments less than eight inches in diameter may be utilized in the fill, provided:
   a) They are not placed in concentrated pockets;
   b) There is a sufficient percentage of fine-grained material to surround the rocks;
   c) The distribution of the rocks is observed by, and acceptable to, our representative.
5. Rocks exceeding eight (8) inches in diameter should be taken off site, broken into smaller fragments, or placed in accordance with recommendations of this firm in areas designated suitable for rock disposal. On projects where significant large quantities of oversized materials are anticipated, alternate guidelines for placement may be included. If significant oversize materials are encountered during construction, these guidelines should be requested.
6. In clay soil, dry or large chunks or blocks are common. If in excess of eight (8) inches minimum dimension, then they are considered as oversized. Sheepsfoot compactors or other suitable

methods should be used to break up blocks. When dry, they should be moisture conditioned to provide a uniform condition with the surrounding fill.

Slope Construction

1. The contractor should obtain a minimum relative compaction of 90 percent out to the finished slope face of fill slopes. This may be achieved by either overbuilding the slope and cutting back to the compacted core, or by direct compaction of the slope face with suitable equipment.
2. Slopes trimmed to the compacted core should be overbuilt by at least three (3) feet with compaction efforts out to the edge of the false slope. Failure to properly compact the outer edge results in trimming not exposing the compacted core and additional compaction after trimming may be necessary.
3. If fill slopes are built "at grade" using direct compaction methods, then the slope construction should be performed so that a constant gradient is maintained throughout construction. Soil should not be "spilled" over the slope face nor should slopes be "pushed out" to obtain grades. Compaction equipment should compact each lift along the immediate top of slope. Slopes should be back rolled or otherwise compacted at approximately every 4 feet vertically as the slope is built.
4. Corners and bends in slopes should have special attention during construction as these are the most difficult areas to obtain proper compaction.
5. Cut slopes should be cut to the finished surface. Excessive undercutting and smoothing of the face with fill may necessitate stabilization.

UTILITY TRENCH CONSTRUCTION AND BACKFILL

Utility trench excavation and backfill is the contractors responsibility. The geotechnical consultant typically provides periodic observation and testing of these operations. While efforts are made to make sufficient observations and tests to verify that the contractors' methods and procedures are adequate to achieve proper compaction, it is typically impractical to observe all backfill procedures. As such, it is critical that the contractor use consistent backfill procedures.

Compaction methods vary for trench compaction and experience indicates many methods can be successful. However, procedures that "worked" on previous projects may or may not prove effective on a given site. The contractor(s) should outline the procedures proposed, so that we may discuss them **prior** to construction. We will offer comments based on our knowledge of site conditions and experience.

1. Utility trench backfill in slopes, structural areas, in streets and beneath flat work or hardscape should be brought to at least optimum moisture and compacted to at least 90 percent of the laboratory standard. Soil should be moisture conditioned prior to placing in the trench.

2. Flooding and jetting are not typically recommended or acceptable for native soils. Flooding or jetting may be used with select sand having a Sand Equivalent (SE) of 30 or higher. This is typically limited to the following uses:
   a) shallow (12 + inches) under slab interior trenches and,
   b) as bedding in pipe zone.

   The water should be allowed to dissipate prior to pouring slabs or completing trench compaction.
3. Care should be taken not to place soils at high moisture content within the upper three feet of the trench backfill in street areas, as overly wet soils may impact subgrade preparation. Moisture may be reduced to 2% below optimum moisture in areas to be paved within the upper three feet below sub grade.
4. Sand backfill should not be allowed in exterior trenches adjacent to and within an area extending below a 1:1 projection from the outside bottom edge of a footing, unless it is similar to the surrounding soil.
5. Trench compaction testing is generally at the discretion of the geotechnical consultant. Testing frequency will be based on trench depth and the contractors procedures. A probing rod would be used to assess the consistency of compaction between tested areas and untested areas. If zones are found that are considered less compact than other areas, this would be brought to the contractors attention.

JOB SAFETY

General

Personnel safety is a primary concern on all job sites. The following summaries are safety considerations for use by all our employees on multi-employer construction sites. On ground personnel are at highest risk of injury and possible fatality on grading construction projects. The company recognizes that construction activities will vary on each site and that job site safety is the contractor's responsibility. However, it is, imperative that all personnel be safety conscious to avoid accidents and potential injury.

In an effort to minimize risks associated with geotechnical testing and observation, the following precautions are to be implemented for the safety of our field personnel on grading and construction projects.

1. Safety Meetings: Our field personnel are directed to attend the contractor's regularly scheduled safety meetings.
2. Safety Vests: Safety vests are provided for and are to be worn by our personnel while on the job site.
3. Safety Flags: Safety flags are provided to our field technicians; one is to be affixed to the vehicle when on site, the other is to be placed atop the spoil pile on all test pits.

In the event that the contractor's representative observes any of our personnel not following the above, we request that it be brought to the attention of our office.

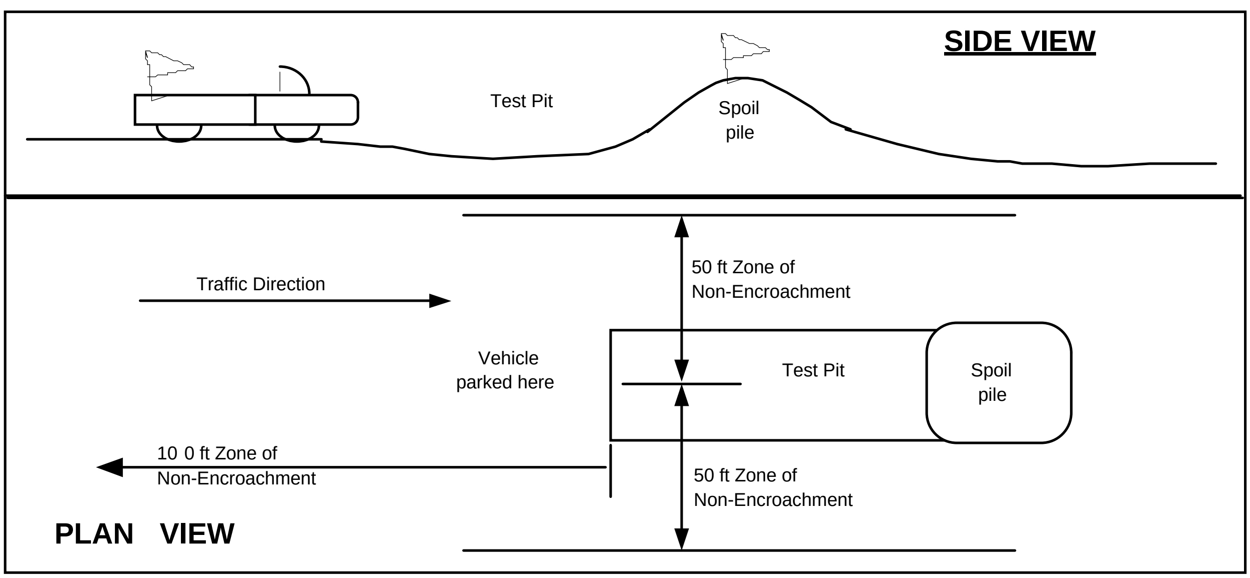
Test Pits Location, Orientation and Clearance

The technician is responsible for selecting test pit locations. The primary concern is the technician's safety. However, it is necessary to take sufficient tests at various locations to obtain a representative sampling of the fill. As such, efforts will be made to coordinate locations with the grading contractors authorized representatives (e.g. dump man, operator, supervisor, grade checker, etc.), and to select locations following or behind the established traffic pattern, preferably outside of current traffic. The contractors authorized representative should direct excavation of the pit and safety during the test period. Again, safety is the paramount concern.

Test pits should be excavated so that the spoil pile is placed away from oncoming traffic. The technician's vehicle is to be placed next to the test pit, opposite the spoil pile. This necessitates that the fill be maintained in a drivable condition. Alternatively, the contractor may opt to park a piece of equipment in front of test pits, particularly in small fill areas or those with limited access.

A zone of non-encroachment should be established for all test pits (see diagram below). No grading equipment should enter this zone during the test procedure. The zone should extend outward to the sides approximately 50 feet from the center of the test pit and 100 feet in the direction of traffic flow. This zone is established both for safety and to avoid excessive ground vibration, which typically decreases test results.

TEST PIT SAFETY PLAN



Slope Tests

When taking slope tests, the technician should park their vehicle directly above or below the test location on the slope. The contractor's representative should effectively keep all equipment at a safe operation distance (e.g. 50 feet) away from the slope during testing.

The technician is directed to withdraw from the active portion of the fill as soon as possible following testing. The technician's vehicle should be parked at the perimeter of the fill in a highly visible location.

Trench Safety

It is the contractor's responsibility to provide safe access into trenches where compaction testing is needed. Trenches for all utilities should be excavated in accordance with CAL-OSHA and any other applicable safety standards. Safe conditions will be required to enable compaction testing of the trench backfill.

All utility trench excavations in excess of 5 feet deep, which a person enters, are to be shored or laid back. Trench access should be provided in accordance with OSHA standards. Our personnel are directed not to enter any trench by being lowered or "riding down" on the equipment.

Our personnel are directed not to enter any excavation which;

1. is 5 feet or deeper unless shored or laid back,
2. exit points or ladders are not provided,
3. displays any evidence of instability, has any loose rock or other debris which could fall into the trench, or
4. displays any other evidence of any unsafe conditions regardless of depth.

If the contractor fails to provide safe access to trenches for compaction testing, our company policy requires that the soil technician withdraws and notifies their supervisor. The contractors representative will then be contacted in an effort to effect a solution. All backfill not tested due to safety concerns or other reasons is subject to reprocessing and/or removal.

Procedures

In the event that the technician's safety is jeopardized or compromised as a result of the contractor's failure to comply with any of the above, the technician is directed to inform both the developer's and contractor's representatives. If the condition is not rectified, the technician is required, by company policy, to immediately withdraw and notify their supervisor. The contractor's representative will then be contacted in an effort to effect a solution. No further testing will be performed until the situation is rectified. Any fill placed in the interim can be considered unacceptable and subject to reprocessing, recompaction or removal.

In the event that the soil technician does not comply with the above or other established safety guidelines, we request that the contractor bring this to technicians attention and notify our project manager or office. Effective communication and coordination between the contractors' representative and the field technician(s) is strongly encouraged in order to implement the above safety program and safety in general.

The safety procedures outlined above should be discussed at the contractor's safety meetings. This will serve to inform and remind equipment operators of these safety procedures particularly the zone of non-encroachment.

The safety procedures outlined above should be discussed at the contractor's safety meetings. This will serve to inform and remind equipment operators of these safety procedures particularly the zone of non-encroachment.

LIMITED SUPPLEMENTAL GEOTECHNICAL EVALUATION

FOR

PROPOSED RESTROOM & SHADE STRUCTURES

OAKS RIVER ACCESS, EAST FORK ROAD

ANGELES NATIONAL FOREST, COUNTY OF LOS ANGELES, CALIFORNIA

PREPARED FOR

BLUEGREEN CONSULTING
2616 N. FIGUEROA, SUITE A
LOS ANGELES, CALIFORNIA 900065

PREPARED BY

GEOTEK, INC.
1548 N. MAPLE STREET
CORONA, CALIFORNIA 92880

PROJECT NO. 2209-CR **SEPTEMBER 11, 2019**

GEOTEK

GEOTEK

GeoTek, Inc.
1548 North Maple Street, Corona, California 92880
(951) 710-1160 Office (951) 710-1167 Fax www.geotekusa.com

September 11, 2019
Project No. 2209-CR

BlueGreen Consulting
2616 N. Figueroa, Suite A
Los Angeles, California 90065

Attention: Mr. Martin Kammerer, PhD

Subject: Limited Supplemental Geotechnical Evaluation
Proposed Restroom & Shade Structures
Oaks River Access, East Fork Road
Angeles National Forest, County of Los Angeles, California

Dear Mr. Kammerer:

We are pleased to provide herein the results of our Limited Supplemental Geotechnical Evaluation for the subject project located off E. Fork Road in the Angeles National Forest, Los Angeles County, California. This report presents the results of our evaluation and discussion of our findings. In our opinion, site development appears feasible from a geotechnical viewpoint. Site development and grading plans should be reviewed by this firm as they become available, as it will be necessary to provide appropriate recommendations for intended specific site development as those plans become refined.

The opportunity to be of service is sincerely appreciated. If you should have any questions, please do not hesitate to call our office.

Respectfully submitted,
GeoTek, Inc.

REGISTERED GEOLOGIST
EDWARD H. LaMONT
No. 1892
Exp.______
Certified Engineering Geologist
STATE OF CALIFORNIA

REGISTERED PROFESSIONAL ENGINEER
ROBERT R. RUSSELL
No. 2042
GEOTECHNICAL
STATE OF CALIFORNIA

Edward H. LaMont
CEG 1892, Exp. 7/31/20
Principal Geologist

Robert R. Russell, PE, GE
GE 2042, Exp. 12/31/20
Sr. Project Engineer

Distribution: (1) Addressee (pdf via email)

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TABLE OF CONTENTS

TABLE OF CONTENTS

1. PURPOSE AND SCOPE OF SERVICES

The purpose of this study was to evaluate the general geotechnical conditions on the site. Services provided for this study included the following:

- Research and review of available geologic and geotechnical data, available geotechnical reports and general information pertinent to the site,
- Review of geotechnical information contained in the prior GeoTek report for this site (GeoTek, 2016),
- Site exploration consisting of excavating seven shallow hand-auger borings within he areas of the currently planned improvements,
- Laboratory testing of soil samples collected during the field investigation,
- Review and evaluation of site seismicity, and
- Compilation of this geotechnical report which presents our findings and a general summary of pertinent site geotechnical conditions relevant for the proposed improvements.

The intent of this report is to aid in the evaluation of the site for future development from a geotechnical perspective. The professional opinions and geotechnical information contained in this report will likely need to be updated based on our review of final site development plans. These should be provided to GeoTek for review when available.

2. SITE DESCRIPTION AND PROPOSED DEVELOPMENT

2.1 SITE DESCRIPTION

The subject property is located on/adjacent to the southern bank of the San Gabriel (Oaks) River, north of East Fork Road, across the street and just northeast of Oaks Picnic Ground and west of Glendora Mountain Road in the Angeles Forest, Los Angeles County, California (see Figure 1). An unpaved parking area exists between the bank and East Fork Road. Currently, access to the river is via a dirt trail that traverses the bank below the parking area to concrete crib-wall steps, which descend to the river flood plain. The river flows westerly and was gently flowing and shallow at the time of this site reconnaissance. A grouted cobble and boulder wall exists west of the steps at the base of the bank below the access trail and continues westerly across the mouth of Oaks Canyon.

Past grading on the site appears to have consisted of placing fill to create a berm at the top of the bank to direct drainage away from the bank. Grading for the dirt trail consisted of cutting into the bank and placing fill along the downslope edge of the trail. Fill was likely placed behind the grouted cobble/boulder wall. Based on photographs provided by BlueGreen Consulting, it appears a trail descended from the unpaved parking area at the location of the existing steps down onto the flood plain. Over time, this trail was backfilled and fill was placed below the area of the existing steps.

The slope gradient above the trail and steps is approximately 1.5:1 (horizontal: vertical). The slope gradient below the trail, above the grouted cobble/boulder wall and below the steps is approximately 2:1. The gradient of the natural slope east of the steps/trail varies from approximately 1:1 to 0.5:1. The slope below the steps descends gently to the river flood plain. The elevation difference between the top of the bank at the unpaved parking and the bottom of the steps is approximately 20 feet. Site drainage generally flows northerly towards the river.

2.2 PROPOSED DEVELOPMENT

According to the current project plans, prepared by BlueGreen Consulting, planned improvements will consist of a new restroom, three shade structures, an asphalt concrete paved parking area, concrete flatwork, and other small improvements. A stone barrier wall is planned adjacent to the new paved areas. These improvements are proposed to be constructed within the existing dirt area located between the riverbank and East Fork Road. In addition, to provide access to the river, a new pathway is planned at the site to replace the existing concrete crib wall steps. All structures are expected to utilize conventional shallow foundations supported on firm bedrock or competent native soils or engineered fill.

As site development planning progresses and more finalized plans become available, the plans should be provided to GeoTek for review and comment. Additional engineering analyses and exploration may be necessary in order to provide specific earthwork recommendations and geotechnical design parameters for actual site work.

3. FIELD EXPLORATION AND LABORATORY TESTING

3.1 FIELD EXPLORATION

Field exploration was conducted by a geologist from GeoTek on August 16, 2019 and consisted of a site reconnaissance, geologic mapping, excavation of seven shallow hand-auger borings and collection of representative soil samples. The hand auger borings were extended to depths of about ½ to 2 feet below grade where refusal on bedrock was encountered. The approximate boring locations are shown on the enclosed Exploration Location Map (Plate 1) and logs of the borings are provided in Appendix A.

3.2 LABORATORY TESTING

Laboratory testing was performed on selected soil samples collected during the field exploration. The purpose of the laboratory testing was to help confirm the field classification of the soil materials encountered and to evaluate their physical properties for use in the engineering design and analysis. Results of the laboratory testing program, along with a brief description and relevant information regarding testing procedures, are included in Appendix B.

4. GEOLOGIC AND SOILS CONDITIONS

4.1 REGIONAL SETTING

The subject property is situated in the Transverse Ranges province. The Transverse Ranges geomorphic province is so named because of the conspicuous east-west alignment of the mountain ranges, which is in contrast to the majority of the mountain ranges in North America which trend north-south. The province extends from Point Arguello and San Miguel Island (Channel Islands) on the west, about 320 miles to the Joshua Tree National Monument area on the east where it merges with the Mojave and Colorado deserts geomorphic provinces. The province reaches its maximum width (60 miles) along the Ventura-Los Angeles County line. Its most narrow width (40 miles) is at its western most end. The northern boundary from Ventura County east to the Cajon Pass is formed by the San Andreas Fault system. The Peninsular Ranges geomorphic province forms the southernmost boundary.

The province is characterized by major mountain ranges with intervening alluviated, broadly synclinal valleys and narrow stream canyons. The province subdivides into several individual ranges and geologic features. The major subdivisions of interest are the Santa Ynez Mountains, Central Ventura County Mountains, Santa Monica Mountains, Ventura/Soledad Basin, Ridge Basin, San Gabriel Mountains, Los Angeles Basin, San Bernardino Mountains, and the Eastern Boundary Ranges.

More specific to the subject property, Dibblee and Minch (2002) map the site to be underlain by alluvial gravel and sand of stream channels (Qg) and Pre-Cambrian metamorphic gneissic bedrock (gn) (see Figure 2). The gneiss exhibits foliation and variably oriented joints. Foliation mapped by GeoTek dip 55 to 76 degrees to the southwest and southeast. These attitudes coincide with regional trends as mapped by Dibblee and Minch (2002). Joints mapped by GeoTek on the property had variable strikes and moderate to steep dips.

No active or potentially active fault is known to exist at this site, nor is the site situated within an *"Alquist-Priolo"* Earthquake Fault Zone (area not evaluated). The nearest known fault to the site is the San Andreas Fault located approximately 6 miles to the north.

4.2 EARTH MATERIALS

A brief description of the earth materials encountered during our site reconnaissance is presented in the following section. Based on our site reconnaissance, field observations, our exploratory excavations and review of published geologic maps the subject site area is locally underlain by undocumented artificial fill, alluvium and gneissic bedrock.

4.2.1 Undocumented Artificial Fill (Af)

Undocumented fill was encountered within each test borings to depths ranging from about ½ to 2 feet below existing grade. As encountered in the borings, the undocumented fill consisted of a silty and sandy gravel and a gravelly sand.

4.2.2 Alluvial Gravel & Sand (Qg)

Although not encountered within the test borings, alluvial gravel and sand deposits are present within the adjacent San Gabriel (Oaks) river channel.

4.2.3 Bedrock (gn)

Metamorphic bedrock consisting of Precambrian gneiss (Dibblee and Minch, 2002) exists below the undocumented fill and is exposed on outcrop in the northeast site area. The bedrock is medium gray to gray with little to no weathering and is very hard.

4.3 SURFACE WATER AND GROUNDWATER

4.3.1 Surface Water

The San Gabriel River runs westerly, north of the planned improvements. Surface water was not observed in the immediate area of the project at the time of our field investigation. If encountered during earthwork construction, surface water on this site is the result of precipitation and surface run-off that can also result in swelling of the river channel.

4.3.2 Groundwater

Groundwater was not encountered within the test borings and is not anticipated to be encountered during construction.

4.4 FAULTING AND SEISMICITY

4.4.1 Surface Fault Rupture

The geologic structure of the entire southern California area is dominated mainly by northwest-trending faults associated with the San Andreas system. The site is in a seismically active region. No active or potentially active fault is known to exist at this site nor is the site situated within an *"Alquist-Priolo"* Earthquake Fault Zone or a Special Studies Zone (area not mapped). The nearest known fault to the site is the San Andreas Fault located approximately 6 miles to the north.

4.4.2 Seismic Design Parameters

The site is located at approximately 34.2299 Latitude and -117.7780 Longitude. Site spectral accelerations (S_a and S_1), for 0.2 and 1.0 second periods for a Class "B" site, was determined from the SEAOC/OSHPD web interface that utilizes the USGS web services and retrieves the seismic design data and presents that information in a report format. Due to the presence of shallow very hard bedrock, a Site Class B is considered appropriate. The results are presented in the following table

SITE SEISMIC PARAMETERS	
Mapped 0.2 sec Period Spectral Acceleration, S_s	2.834g
Mapped 1.0 sec Period Spectral Acceleration, S_1	0.976g
Site Coefficient for Site Class "B", F_a	1.0
Site Coefficient for Site Class "B", F_v	1.0
Maximum Considered Earthquake Spectral Response	2.834g

Acceleration for 0.2 Second, S_{MS}	
Maximum Considered Earthquake Spectral Response Acceleration for 1.0 Second, S_{M1}	0.976g
5% Damped Design Spectral Response Acceleration Parameter at 0.2 Second, S_{DS}	1.889g
5% Damped Design Spectral Response Acceleration Parameter at 1 second, S_{D1}	0.651g
PGA_M	0.976g
Seismic Design Category	E

Final selection of the appropriate seismic design coefficients should be made by the project structural engineer based upon the local practices and ordinances, expected building response and desired level of conservatism.

4.4.3 Liquefaction/Seismic Settlement

Liquefaction describes a phenomenon in which cyclic stresses, produced by earthquake-induced ground motion, create excess pore pressures in relatively cohesionless soils. These soils may thereby acquire a high degree of mobility, which can lead to lateral movement, sliding, consolidation and settlement of loose sediments, sand boils and other damaging deformations. This phenomenon occurs only below the water table, but, after liquefaction has developed, the effects can propagate upward into overlying non-saturated soil as excess pore water dissipates.

The factors known to influence liquefaction potential include soil type and grain size, relative density, groundwater level, confining pressures, and both intensity and duration of ground shaking. In general, materials that are susceptible to liquefaction are loose, saturated granular soils having low fines content under low confining pressures.

Due the present of shallow bedrock within the areas of the planned improvements, the potential for liquefaction during a seismic event is considered to be very low.

4.4.4 Other Seismic Hazards

Evidence of ancient landslides or gross slope instabilities at this site was not observed during our investigation.

The potential for secondary seismic hazards such as seiche and tsunami are considered to be remote due to site elevation and distance from an open body of water.

5. CONCLUSIONS AND RECOMMENDATIONS

5.1 GENERAL

The proposed improvements appear feasible from a geotechnical viewpoint. The following sections present general recommendations only. More specific geotechnical recommendations for site development can be provided when more finalized site development plans are available for review.

Improvement of the site should include the removal of all existing improvements in conflict with the new improvements, and the underlying fill, to expose the bedrock. A representative of GeoTek should observe the bedrock bottom after removal of the existing construction and fill prior to foundation construction or fill placement. More specific geotechnical recommendations for site development can be provided when site development plans are available for review.

5.2 EARTHWORK CONSIDERATIONS

5.2.1 General

Earthwork and grading should be performed in accordance with the applicable grading ordinances of the County of Los Angeles, the 2016 California Building Code (CBC), and recommendations contained in this report. The General Grading Guidelines included in Appendix C outline general procedures and do not anticipate all site-specific situations. In the event of conflict, the recommendations presented in the text of this report should supersede those contained in Appendix C.

5.2.2 Site Clearing and Preparation

All existing improvements within the new improvement areas, including the existing crib-wall steps, should be demolished and removed from the site. Site preparation within the new improvement area should include the removal of deleterious materials, vegetation, and all existing fill. The deleterious materials and vegetation should be properly disposed of off-site.

5.2.3 Remedial Grading

All undocumented fill should be removed below the area of the proposed structures and surface improvements to expose the underlying bedrock. A representative of this firm should observe the bottom of all excavations. Following approval of the exposed bedrock, the over-excavated areas may be backfilled with engineered fill.

5.2.4 Engineered Fill

On-site materials are generally considered suitable for reuse as engineered fill provided they are free from vegetation, roots, and rock/concrete or hard lumps greater than three (3) inches in maximum dimension. The earthwork contractor should have the proposed excavated materials to be used as engineered fill at this project approved by the soils engineer prior to placement. Prior to fill placement, the approved removal bottom should be scarified and moisture conditioned to at least optimum moisture content.

Engineered fill materials should be moisture conditioned to above optimum moisture content and compacted in horizontal lifts not exceeding eight (8) inches in loose thickness to a minimum relative compaction of 90% as determined in accordance with laboratory test procedure ASTM D 1557. Any fill planned to be placed at a slope gradient steeper than 4:1 (horizontal: vertical) should be benched.

5.2.5 Excavation Characteristics

Excavations in the onsite fill should be readily accomplished with heavy-duty earthmoving or excavating equipment in good operating condition. Excavations in the bedrock will be more difficult and may require coring and/or blasting and/or other special excavation technique(s).

5.2.6 Temporary Excavations, Trench Excavations and Backfill

Temporary excavations within the onsite materials should be stable at 1:1 inclinations for short durations during construction, and where cuts do not exceed 10 feet in height. Temporary cuts to a maximum height of four (4) feet can be excavated vertically.

Trench excavations should conform to Cal-OSHA regulations. The contractor should have a competent person, per OSHA requirements, on site during construction to observe conditions and to make the appropriate recommendations.

Utility trench backfill should be compacted to at least 90% relative compaction (as determined per ASTM D 1557). Under-slab trenches should also be compacted to project specifications.

Compaction should be achieved with a mechanical compaction device. Ponding or jetting of trench backfill is not recommended. If backfill soils have dried out, they should be thoroughly moisture conditioned prior to placement in trenches.

5.3 DESIGN RECOMMENDATIONS

5.3.1 Foundation Design Criteria

It is our opinion that the planned structures may be supported by conventional shallow foundations supported by bedrock and/or properly compacted engineered fill. Based on laboratory testing, it is anticipated that the soils near subgrade having a "very low" expansion potential in accordance with ASTM D 4829. Typical design criteria for the site based upon a "very low" expansion potential is tabulated below. These are minimal recommendations and are not intended to supersede the design by the project structural engineer.

A summary of our foundation design recommendations is presented in the following table:

Design Parameter	"Very Low" Expansion Potential
Foundation Depth or Minimum Perimeter Beam Depth (inches below lowest adjacent grade)	12
Minimum Foundation Width (Inches)*	12
Minimum Slab Thickness (actual)[1]	4 – Actual
Sand Blanket and Moisture Retardant Membrane Below On-Grade Building Slabs	2 inches of sand** overlying moisture vapor retardant membrane overlying 2 inches of sand**
Minimum Slab Reinforcing	6" x 6" – W1.4/W1.4 welded wire fabric placed in middle of slab
Minimum Footing Reinforcement	Two No. 4 reinforcing bars, one placed near the top and one near the bottom
Effective Plasticity Index***	N/A
Presaturation of Subgrade Soil (Percent of Optimum)	Minimum of 100% of the optimum moisture content to a depth of at least 12 inches prior to placing concrete

* Code minimums per Table 1809.7 of the 2016 CBC.
** Sand should have a sand equivalent of at least 30.
*** Effective plasticity index should be verified at the completion of rough grading.

1. Slab thickness and reinforcement should be determined necessary by the structural engineer.

It should be noted that the criteria provided are based on soil support characteristics only. The structural engineer should design the slab and beam reinforcement based on actual loading conditions.

5.3.1.1 An allowable bearing capacity of 3,000 pounds per square foot (psf) may be used for design of continuous and perimeter footings 12 inches deep and 12 inches wide, and pad footings 12 inches square and 12 inches deep. This value may be increased by 1,000 pounds per square foot for each additional 12 inches in depth and 750 pounds per square foot for each additional 12 inches in width to a maximum value of 5,000 psf. Additionally, an increase of one-third may be applied when considering short-term live loads (e.g. seismic and wind loads).

5.3.1.2 The passive earth pressure may be computed as an equivalent fluid having a density of 300 psf per foot of depth, to a maximum earth pressure of 4,000 psf for footings founded on engineered fill. A coefficient of friction between soil and concrete of 0.44 may be used with dead load forces. When combining passive pressure and frictional resistance, the passive pressure component should be reduced by one-third.

5.3.2 Miscellaneous Foundation Recommendations

5.3.2.1 Soils from the footing excavations should not be cast over the slope or be placed unless properly compacted and tested. The excavations should be free of loose/sloughed materials and be neatly trimmed at the time of concrete placement.

5.3.3 Foundation Set Backs

Where applicable, the following setbacks should apply to all foundations. Any improvements not conforming to these setbacks may be subject to lateral movements and/or differential settlements:

- The outside bottom edge of all footings should be set back a minimum of H/3 (where H is the slope height) from the face of any descending slope. The setback should be at least 5 feet and need not exceed 40 feet.
- The outside bottom edge of all footings should be set back a minimum of H/2 (where H is the slope height) from the face of any ascending slope. The setback should be at least five (5) feet and need not exceed 15 feet.
- The bottom of all footings for structures near retaining walls should be deepened so as to extend below a 1:1 projection upward from the bottom inside edge of the wall stem. This applies to the existing retaining walls along the perimeter, if they are to remain.

5.3.4 Import Soils

Import soils should have a "very low" expansion potential. GeoTek, Inc. also recommends that the proposed import soils be tested for expansion and corrosivity potential. GeoTek, Inc.

should be notified a minimum of 72 hours prior to importing so that appropriate sampling and laboratory testing can be performed.

5.4 Soil Corrosivity

Based on the chemical test results presented in Appendix B, the corrosivity test results indicate that the on-site soils are "extremely corrosive" to buried ferrous metal. This corrosion classification is obtained from "Corrosion Basics: An Introduction," by Pierre R. Roberge, 2nd Edition, 2005. Recommendations for protection of buried ferrous metal should be provided by a corrosion engineer.

5.4.1 Soil Sulfate Content

Based on the chemical test results presented in Appendix B, the sulfate test results on a soil sample obtained from the project site indicate soluble sulfate contents of less than 0.1 percent by weight should be expected. Soluble sulfate contents of this level would be in the range of "not applicable" (i.e. negligible) per Table 4.2.1 of ACI 318. Based on the test results and Table 4.3.1 of ACI 318, no special concrete mix design would be necessary to resist sulfate attack.

5.5 RETAINING WALL DESIGN AND CONSTRUCTION

5.5.1 General Design Criteria

Although retaining walls may not be needed for this site, we are presenting the following recommendation in case become necessary at a later date. Recommendations presented herein apply to typical masonry or concrete vertical retaining walls to a maximum height of up to six (6) feet. Additional review and recommendations should be requested for higher walls. These are typical design criteria and are not intended to supersede the design by the structural engineer.

Retaining wall foundations should be embedded a minimum of 12 inches into engineered fill or bedrock and satisfy slope setback requirements. Retaining wall foundations should be designed in accordance with Section 5.3.1 of this report. Structural needs may govern and should be evaluated by the project structural engineer.

All earth retention structure plans, as applicable, should be reviewed by this office prior to finalization.

Earthwork considerations, site clearing and remedial earthwork for all earth retention structures should meet the requirements of this report, unless specifically provided otherwise, or more stringent requirements or recommendations made by the designer. The backfill material placement for all earth retention structures should meet the requirement of Section 5.5.4 in this report.

In general, cantilever earth retention structures, which are designed to yield at least 0.001H, where H is equal to the height of the earth retention structure to the base of its footing, may be designed using the active condition. Rigid earth retention structures (including but not limited to rigid walls, and walls braced at top, such as typical basement walls) should be designed using the at-rest condition.

In addition to the design lateral forces due to retained earth, surcharges due to improvements, such as an adjacent building or traffic loading, should be considered in the design of the earth retention structures. Loads applied within a 1:1 (h:v) projection from the surcharge on the stem of the earth retention structure should be considered in the design.

Final selection of the appropriate design parameters should be made by the designer of the earth retention structures.

5.5.2 Cantilevered Walls

The recommendations presented below are for cantilevered retaining walls up to 12 feet high. Active earth pressure may be used for retaining wall design, provided the top of the wall is not restrained from minor deflections. An equivalent fluid pressure approach may be used to compute the horizontal pressure against the wall. Appropriate fluid unit weights are given below for specific slope gradients of the retained material. These do not include other superimposed loading conditions such as traffic, structures, seismic events, or adverse geologic conditions.

ACTIVE EARTH PRESSURES	
Surface Slope of Retained Materials (h:v)	Equivalent Fluid Pressure (pcf) Native Backfill*
Level	30
2:1	45

* The design pressures assume the backfill material has an expansion index less than or equal to 20. Backfill zone includes area between back of the wall to a plane (1:1 h:v) up from bottom of the wall foundation (on the backside of the wall) to the (sloped) ground surface.

Additional loads from adjacent structures should be accounted for by the structural engineer.

5.5.3 Restrained Retaining Walls

Retaining walls that will be restrained at the top that support level backfill or that have reentrant or male corners, should be designed for an equivalent at-rest fluid pressure of 55 pcf, plus any applicable surcharge loading. For areas of male or reentrant corners, the restrained wall design should extend a minimum distance of twice the height of the wall laterally from the corner, or a distance otherwise determined by the project structural engineer.

5.5.4 Wall Backfill and Drainage

Retaining walls should be provided with an adequate pipe and gravel back drain system to help prevent buildup of hydrostatic pressures. Backdrains should consist of a 4-inch diameter perforated collector pipe (Schedule 40, SDR 35, or approved equivalent) embedded in a minimum of one (1) cubic foot per linear foot of ¾- to 1-inch clean crushed rock or an approved equivalent, wrapped in filter fabric (Mirafi 140N or an approved equivalent). The drain system should be connected to a suitable outlet. Drain outlets should be maintained over the life of the project and should not be obstructed or plugged by adjacent improvements. Waterproofing of site walls should be performed where moisture migration through the wall is undesirable.

Retaining wall backfill should be placed in lifts no greater than eight (8) inches in thickness and compacted to a minimum of 90% relative compaction in accordance with ASTM Test Method D 1557. The wall backfill should also include a minimum one (1) foot wide section of ¾- to 1-inch clean crushed rock (or an approved equivalent). The rock should be placed immediately adjacent to the back of the wall and extend up from a back drain to within approximately 24 inches of the finish grade. The rock should be separated from the earth with filter fabric. The upper 24 inches should consist of compacted on-site soil.

As an alternative to the drain rock and fabric, Miradrain 2000, or approved equivalent, may be used behind the retaining wall. The Miradrain 2000 should extend from the base of the wall to within 2 feet of the ground surface. The subdrain should be placed at the base of the wall in direct contact with the Miradrain 2000.

The presence of other materials might necessitate revision to the parameters provided and modification of the wall designs. Proper surface drainage needs to be provided and maintained.

5.5.5 Other Design Considerations

- Wall design should consider the additional surcharge loads from superjacent slopes and/or footings, where appropriate.
- No backfill should be placed against concrete until minimum design strengths are evident by compression tests of cylinders.
- The retaining wall footing excavations, backcuts and backfill materials should be approved by the project geotechnical engineer or their authorized representative.

5.6 PRELIMINARY PAVEMENT DESIGN

Pavement design for areas to receive new pavements was conducted per Caltrans *Highway Design Manual* guidelines for flexible pavements. Based on the soil types encountered, we have assumed a design R-value of 50 and a Traffic Index (TIs) of 5.0 for the new vehicle parking area. Based on these preliminary assumptions, the following preliminary sections were calculated:

GEOTECHNICAL RECOMMENDATION FOR MINIMUM PAVEMENT SECTION		
Traffic Index	Thickness of Asphalt Concrete (inches)	Thickness of Aggregate Base (inches)
5.0	3.0	4.0

All base material and the upper 12 inches of subgrade should be compacted to at least 95% of the material's maximum dry density, per ASTM D-1557.

The Traffic Index (TI) used in our preliminary pavement design is considered a reasonable value for the proposed parking lot pavement areas and should provide a pavement life of approximately 20 years with a normal amount of flexible pavement maintenance. Irrigation adjacent to pavements, without a deep curb or other cutoff to separate landscaping from the paving may result in premature pavement failure. Traffic parameters used for preliminary design were selected based upon engineering judgment and not upon information furnished to us such as an equivalent wheel load analysis or a traffic study. We recommend that final pavement design be based on R-value testing of the subgrade soils along with the assigned TI values for the planned pavement areas.

Asphalt concrete and aggregate base should conform to current Caltrans Standard Specifications Section 39 and 26-1.02, respectively. As an alternative, asphalt concrete can conform to Section 203-6 of the current Standard Specifications for Public Work (Green

Book). Crushed aggregate base or crushed miscellaneous base can conform to Section 200-2.2 and 200-2.4 of the Green Book, respectively.

All pavement installation, including preparation and compaction of subgrade, compaction of base material, placement and rolling of asphaltic concrete, should be done in accordance with the County of Riverside specifications, and under the observation and testing of GeoTek and a County Inspector where required. Jurisdictional minimum compaction requirements in excess of the aforementioned minimums may govern.

5.7 CONCRETE CONSTRUCTION

5.7.1 General

Concrete construction should follow the 2016 CBC and ACI guidelines regarding design, mix placement and curing of the concrete. If desired, we could provide quality control testing of the concrete during construction.

5.7.2 Concrete Mix Design

Laboratory testing has indicated that the sulfate content of the soil tested is in the "not applicable" (i.e. negligible) and an exposure classification of "S0" per Table 4.2.1 of ACI 318. Based on these results and Table 4.3.1 of ACI 318, no special concrete mix design is required by code to resist sulfate attack. However, additional testing should be performed during grading so that specific recommendations can be formulated based on the as-graded conditions.

5.7.3 Concrete Flatwork

Exterior concrete flatwork (patios, walkways, driveways, etc.) is often some of the most visible aspects of site development. They are typically given the least level of quality control, being considered "non-structural" components. Cracking of these features is fairly common due to various factors. While cracking is not usually detrimental, it is unsightly. We suggest that the same standards of care be applied to these features as to the structure itself.

Flatwork may consist of four (4) inch thick concrete and the use of reinforcement is suggested. The project structural engineer should provide final design recommendations.

5.7.4 Concrete Performance

Concrete cracks should be expected. These cracks can vary from sizes that are essentially unnoticeable to more than 1/8 inch in width. Most cracks in concrete while unsightly do not significantly impact long-term performance. While it is possible to take measures (proper concrete mix, placement, curing, control joints, etc.) to reduce the extent and size of cracks that occur, some cracking will occur despite the best efforts to minimize it. Concrete undergoes chemical processes that are dependent on a wide range of variables, which are difficult, at best, to control. Concrete, while seemingly a stable material, also is subject to internal expansion and contraction due to external changes over time.

One of the simplest means to control cracking is to provide weakened control joints for cracking to occur along. These do not prevent cracks from developing; they simply provide a relief point for the stresses that develop. These joints are a widely accepted means to control cracks but are not always effective. Control joints are more effective the more closely spaced they are. GeoTek suggests that control joints be placed in two directions and located a distance apart roughly equal to 24 to 36 times the slab thickness.

5.8 POST CONSTRUCTION CONSIDERATIONS

5.8.1 Landscape Maintenance and Planting

Water has been shown to weaken the inherent strength of soil, and slope stability is significantly reduced by overly wet conditions. Positive surface drainage away from graded slopes should be maintained and only the amount of irrigation necessary to sustain plant life should be provided for planted slopes. Controlling surface drainage and runoff, and maintaining a suitable vegetation cover can minimize erosion. Plants selected for landscaping should be lightweight, deep-rooted types that require little water and are capable of surviving the prevailing climate.

Overwatering should be avoided. The soils should be maintained in a solid to semi-solid state as defined by the materials Atterberg Limits. Care should be taken when adding soil amendments to avoid excessive watering. Leaching as a method of soil preparation prior to planting is not recommended. An abatement program to control ground-burrowing rodents should be implemented and maintained. This is critical as burrowing rodents can decreased the long-term performance of slopes.

It is common for planting to be placed adjacent to structures in planter or lawn areas. This will result in the introduction of water into the ground adjacent to the foundation. This type of landscaping should be avoided. If used, then extreme care should be exercised with regard to the irrigation and drainage in these areas. Waterproofing of the foundation and/or subdrains may be warranted and advisable. We could discuss these issues, if desired, when plans are made available.

5.8.2 Drainage

The need to maintain proper surface drainage and subsurface systems cannot be overly emphasized. Positive site drainage should be maintained at all times. Drainage should not flow uncontrolled down any descending slope. Water should be directed away from foundations and not allowed to pond or seep into the ground adjacent to the footings. Soil areas within 10 feet of the proposed structure should slope at a minimum of 5 percent away from the building, if possible unless the area is paved. Paved areas are to be sloped at 2 percent away from the structure. Roof gutters and downspouts should discharge onto paved surfaces sloping away from the structure or into a closed pipe system which outfalls to the street gutter pan or directly to the storm drain system. Pad drainage should be directed toward approved areas and not be blocked by other improvements.

It is the owner's responsibility to maintain and clean drainage devices on or contiguous to their lot. In order to be effective, maintenance should be conducted on a regular and routine schedule and necessary corrections made prior to each rainy season.

5.9 PLAN REVIEW AND CONSTRUCTION OBSERVATIONS

We recommend that site grading, specifications, retaining wall and foundation plans be reviewed by this office prior to construction to check for conformance with the recommendations of this report. Additional recommendations and/or additional exploration may be necessary based on these reviews. We also recommend that GeoTek representatives be present during site grading and foundation construction to check for proper implementation of the geotechnical recommendations. The owner/developer should have GeoTek's representative perform at least the following duties:

- Observe site clearing and grubbing operations for proper removal of unsuitable materials.
- Observe and test bottom of removals prior to fill placement.
- Evaluate the suitability of on-site and import materials for fill placement, and collect soil samples for laboratory testing when necessary.
- Observe the fill for uniformity during placement including utility trenches.
- Test the fill for field density and relative compaction.
- Observe and probe foundation excavations to confirm suitability of bearing materials.

If requested, a construction observation and compaction report can be provided by GeoTek, which can comply with the requirements of the governmental agencies having jurisdiction over the project. We recommend that these agencies be notified prior to commencement of construction so that necessary grading permits can be obtained.

6. LIMITATIONS

The scope of our evaluation is limited to the area explored that is shown on the Geotechnical Map (Plate 1). This evaluation does not and should in no way be construed to encompass any areas beyond the specific area of proposed construction as indicated to us by the client. Further, no evaluation of any existing site improvements is included. The scope is based on our understanding of the project and the client's needs, our proposal (Proposal No. P-0801919) dated August 7, 2019.

The materials observed on the project site appear to be representative of the area; however, alluvial soil and bedrock materials vary in character between excavations and natural outcrops or conditions exposed during site construction. Site conditions may vary due to seasonal changes or other factors. GeoTek, Inc. assumes no responsibility or liability for work, testing or recommendations performed or provided by others.

Since our recommendations are based on the site conditions observed and encountered, and laboratory testing, our conclusions and recommendations are professional opinions that are limited to the extent of the available data. Observations during construction are important to allow for any change in recommendations found to be warranted.

GeoTek has prepared this report in a manner consistent with that level of care and skill ordinarily exercised by members of the engineering and science professions currently practicing under similar conditions in the jurisdiction in which the services are provided, subject to the time limits and physical constraints applicable to this report. Standards of care/practice are subject to change with time. No warranty of any kind is expressed or implied.

This report has been prepared for the specific site, design objective, development and purpose described to GeoTek by the Client. The factual data, interpretations and recommendations pertain to a specific project as described in this report and are not applicable to any other project or site location. Any change of site conditions, purpose, development plans or if the project is not initiated within 18 months of the date of the report may alter the validity of the report. GeoTek cannot be responsible for use of this report, or portions thereof, unless GeoTek is requested to review and, if necessary, revise the report to reflect the changes.

The professional services retained for the purpose of this report include only geotechnical aspects of the subsurface conditions at the site. The presence or implication(s) of possible surface and/or subsurface contaminations resulting from previous activities or uses of the site and/or resulting from introduction onto the site of materials from off-site sources are outside the terms of reference for the purposes of this report and have not been investigated.

The information, recommendations and opinions expressed in this report are for the sole benefit of the Client. This report was prepared exclusively for BlueGreen Consulting, in accordance with generally accepted geotechnical engineering standards of care/practice at the referenced locality. This report, or any portion thereof, is not authorized for use by, and is not to be relied upon by any party except BlueGreen Consulting without GeoTek's express written consent.

7. SELECTED REFERENCES

American Society of Civil Engineers (ASCE), 2013, "Minimum Design Loads for Buildings and Other Structures," ASCE/SEI 7-10, Third Printing, Errata Incorporated through March 15.

Bowles, J. E., 1977, "Foundation Analysis and Design", Second Edition.

Bryant, W.A., and Hart, E.W., 2007, "Fault Rupture Hazard Zones in California, Alquist-Priolo Earthquake Fault Zoning Act with Index to Earthquake Fault Zones Maps," California Geological Survey: Special Publication 42.

California Code of Regulations, Title 24, 2016 "California Building Code," 3 volumes.

California Geological Survey (CGS, formerly referred to as the California Division of Mines and Geology), 1977, "Geologic Map of California."

____, 2008, "Guidelines for Evaluating and Mitigating Seismic Hazards in California," Special Publication 117A.

Dibblee, T.W., Minch, J.A., 2002, "Geologic Map of the Glendora Quadrangle, Los Angeles County, California," Dibblee Geological Foundation Map #DF-89, map scale 1:24,000.

GeoTek, Inc., In-house proprietary information.

______, 2016, "Geotechnical Evaluation, Proposed Oaks River Access, E. Fork Road, Angeles National Forest, County of Los Angeles, California", October 11.

Roberge, P. R., 2005, "Corrosion Basics: An Introduction", second edition.

Terzaghi, K. and Peck, R. B., 1974, "Soil Mechanics in Engineering Practice", second edition.

SEA/OSHPD web service, "Seismic Design Maps" (https://seismicmaps.org)

BlueGreen Consulting
Oaks River Access
E. Fork Road
Angeles National Forest
Los Angeles County, California
GeoTek Project No. 2209-CR

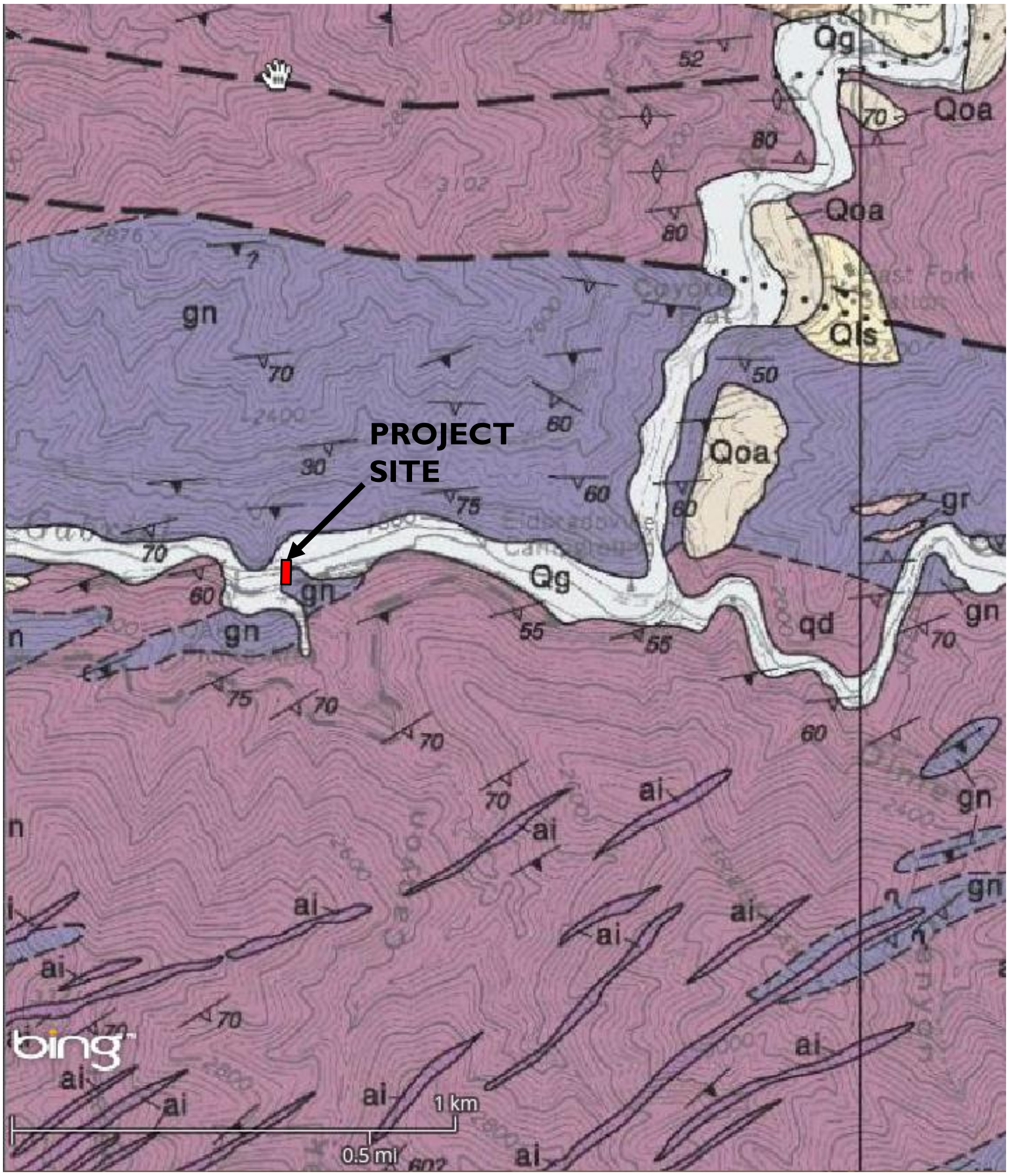
N

Modified from USGS 7.5 Topographic Map

Figure 1

Site Location Map

GEOTEK



LEGEND

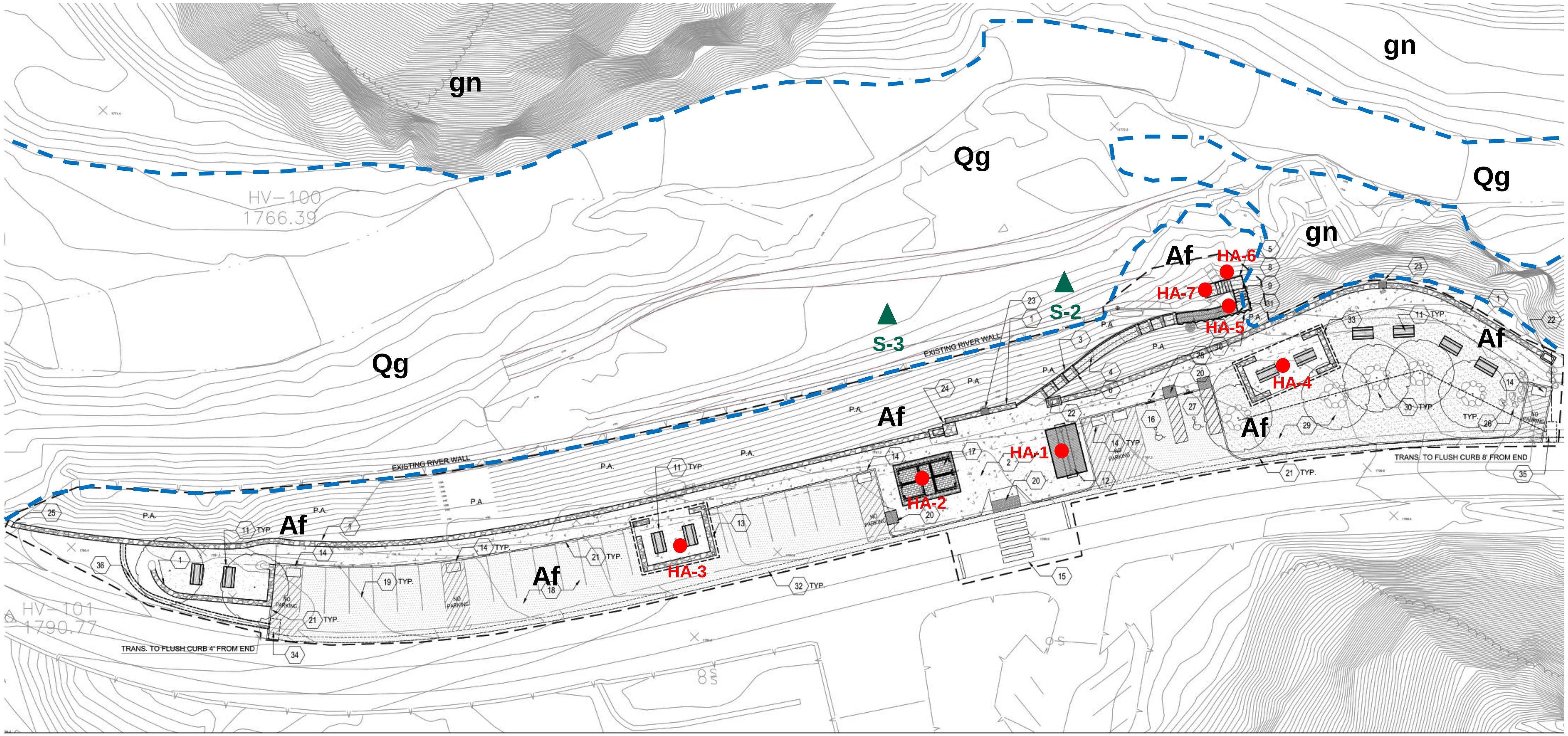
Qg – Alluvial Gravels and Sands of Stream Channels

qd – Quartz Diorite

gn – Gneiss

Reference: Dibblee and Minch, 2002, Geologic Map of Glendora Quadrangle, Los Angeles County, CA. DF-89

BlueGreen Consulting Oaks River Access E. Fork Road Angeles National Forest Los Angeles County, California GeoTek Project No. 2209-CR	N	<u>**Figure 2**</u> **Regional Geologic Map**	GEOTEK



Legend
(Locations are approximate)

Af - Artificial Fill

Qg - Alluvial Gravel and Sand of Stream Channels

gn - Gneissic Bedrock

HA-7 - Exploratory Hand Auger Boring

S-3 - Approximate Location of Sample

- Geologic Contact

NORTH

40 FEET

BlueGreen Consulting
Oaks River Access Stairway and Overlook
East Fork Road, Los Angeles County, California

Project No. 2209-CR

GEOTEK

Plate 1

Exploration Location Map

<u>APPENDIX A</u>

LOGS OF EXPLORATORY BORINGS

BlueGreen Consulting
E. Fork Road, Angeles National Forest
Los Angeles County, California
Project No. 2209-CR

GEOTEK

A - FIELD TESTING AND SAMPLING PROCEDURES

The Modified Split-Barrel Sampler (Ring)

The ring sampler is driven into the ground in accordance with ASTM Test Method D 3550. The sampler, with an external diameter of 3.0 inches, is lined with 1-inch long, thin brass rings with inside diameters of approximately 2.4 inches. The sampler is typically driven into the ground 12 or 18 inches with a 140-pound hammer free falling from a height of 30 inches. Blow counts are recorded for every 6 inches of penetration as indicated on the log of boring. The samples are removed from the sample barrel in the brass rings, sealed, and transported to the laboratory for testing.

Bulk Samples (Large)

These samples are normally large bags of earth materials over 20 pounds in weight collected from the field by means of hand digging or exploratory cuttings.

Bulk Samples (Small)

These are plastic bag samples which are normally airtight and contain less than 5 pounds in weight of earth materials collected from the field by means of hand digging or exploratory cuttings. These samples are primarily used for determining natural moisture content and classification indices.

B - BORING LOG LEGEND

The following abbreviations and symbols often appear in the classification and description of soil and rock on the log of borings:

SOILS

USCS	Unified Soil Classification System
f-c	Fine to coarse
f-m	Fine to medium

GEOLOGIC

B: Attitudes	Bedding: strike/dip
J: Attitudes	Joint: strike/dip
C: Contact line	
………..	Dashed line denotes USCS material change
———	Solid Line denotes unit / formational change
━━━	Thick solid line denotes end of the boring

(Additional denotations and symbols are provided on the log of boring)

GeoTek, Inc.

LOG OF EXPLORATORY BORING

CLIENT:	BlueGreen Consulting	**DRILLER:**	GeoTek	**LOGGED BY:**	KM
PROJECT NAME:	Oaks River Access	**DRILL METHOD:**	Hand Auger	**OPERATOR:**	KM
PROJECT NO.:	2209-CR	**HAMMER:**		**RIG TYPE:**	Hand Auger
LOCATION:	See Boring Location Map			**DATE:**	8/16/2019

BORING NO.: HA- 1 Sheet 1 of 1

Depth (ft)	SAMPLES: Sample Type	Blows/ 6 in	Sample Number	USCS Symbol	MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing: Water Content (%)	Dry Density (pcf)	Others
				GM	**Undocumented Fill** 0-0.75' - Silty/Sandy GRAVEL, tan, dry, medium dense			Bulk Sample Collected
					Bedrock GNEISS, gray, dry to slightly moist, very hard, little to no weathering			
					BORING TERMINATED DUE TO REFUSAL AT 0.75 FEET			
					No Groundwater encountered Boring backfilled with soil cuttings			
5								
10								
15								
20								
25								
30								

LEGEND

Sample type: ---Ring ---SPT ---Small Bulk ---Large Bulk ---No Recovery ---Water Table

Lab testing:
AL = Atterberg Limits
EI = Expansion Index
SA = Sieve Analysis
RV = R-Value Test
SR = Sulfate/Resisitivity Test
SH = Shear Test
HC= Consolidation
MD = Maximum Density

GeoTek, Inc.

LOG OF EXPLORATORY BORING

CLIENT:	BlueGreen Consulting	**DRILLER:**	GeoTek	**LOGGED BY:**	KM
PROJECT NAME:	Oaks River Access	**DRILL METHOD:**	Hand Auger	**OPERATOR:**	KM
PROJECT NO.:	2209-CR	**HAMMER:**		**RIG TYPE:**	Hand Auger
LOCATION:	See Boring Location Map			**DATE:**	8/16/2019

BORING NO.: HA- 2 Sheet 1 of 1

Depth (ft)	SAMPLES: Sample Type	Blows/ 6 in	Sample Number	USCS Symbol	MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing: Water Content (%)	Dry Density (pcf)	Others
				GM	**Undocumented Fill** 0-0.7' - Silty/Sandy GRAVEL, tan, dry to slightly moist, medium dense			
					Bedrock GNEISS, gray, dry to slightly moist, very hard, little to no weathering			
					BORING TERMINATED DUE TO REFUSAL AT 0.75 FEET			
					No Groundwater encountered Boring backfilled with soil cuttings			
5								
10								
15								
20								
25								
30								

LEGEND

Sample type: ---Ring ---SPT ---Small Bulk ---Large Bulk ---No Recovery ---Water Table

Lab testing:

AL = Atterberg Limits; EI = Expansion Index; SA = Sieve Analysis; RV = R-Value Test

SR = Sulfate/Resisitivity Test; SH = Shear Test; HC= Consolidation; MD = Maximum Density

GeoTek, Inc.

LOG OF EXPLORATORY BORING

CLIENT:	BlueGreen Consulting	**DRILLER:**	GeoTek	**LOGGED BY:**	KM
PROJECT NAME:	Oaks River Access	**DRILL METHOD:**	Hand Auger	**OPERATOR:**	KM
PROJECT NO.:	2209-CR	**HAMMER:**		**RIG TYPE:**	Hand Auger
LOCATION:	See Boring Location Map			**DATE:**	8/16/2019

BORING NO.: HA- 3 Sheet 1 of 1

Depth (ft)	SAMPLES: Sample Type	Blows/ 6 in	Sample Number	USCS Symbol	MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing: Water Content (%)	Dry Density (pcf)	Others
					Undocumented Fill			
				GM	0-0.5' - Silty/Sandy GRAVEL, olive, dry, medium dense			
					Bedrock			
					GNEISS, gray, dry to slightly moist, very hard, little to no weathering			
					BORING TERMINATED DUE TO REFUSAL AT 0.5 FEET			
					No Groundwater encountered			
					Boring backfilled with soil cuttings			
5								
10								
15								
20								
25								
30								

LEGEND

Sample type: ---Ring ---SPT ---Small Bulk ---Large Bulk ---No Recovery ---Water Table

Lab testing: AL = Atterberg Limits; EI = Expansion Index; SA = Sieve Analysis; RV = R-Value Test; SR = Sulfate/Resisitivity Test; SH = Shear Test; HC= Consolidation; MD = Maximum Density

GeoTek, Inc.

LOG OF EXPLORATORY BORING

CLIENT:	BlueGreen Consulting	**DRILLER:**	GeoTek	**LOGGED BY:**	KM
PROJECT NAME:	Oaks River Access	**DRILL METHOD:**	Hand Auger	**OPERATOR:**	KM
PROJECT NO.:	2209-CR	**HAMMER:**		**RIG TYPE:**	Hand Auger
LOCATION:	See Boring Location Map			**DATE:**	8/16/2019

BORING NO.: HA- 4 Sheet 1 of 1

Depth (ft)	SAMPLES: Sample Type	Blows/ 6 in	Sample Number	USCS Symbol	MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing: Water Content (%)	Dry Density (pcf)	Others
				GM	**Undocumented Fill** 0-1.0' - Silty/Sandy GRAVEL, tan, dry, medium dense			
					Bedrock GNEISS, gray, dry to slightly moist, very hard, little to no weathering			
					BORING TERMINATED DUE TO REFUSAL AT 1 FOOT			
					No Groundwater encountered Boring backfilled with soil cuttings			
5								
10								
15								
20								
25								
30								

LEGEND

Sample type: ---Ring ---SPT ---Small Bulk ---Large Bulk ---No Recovery ---Water Table

Lab testing: AL = Atterberg Limits; EI = Expansion Index; SA = Sieve Analysis; RV = R-Value Test; SR = Sulfate/Resisitivity Test; SH = Shear Test; HC= Consolidation; MD = Maximum Density

GeoTek, Inc.
LOG OF EXPLORATORY BORING

CLIENT:	BlueGreen Consulting	**DRILLER:**	GeoTek	**LOGGED BY:**	KM
PROJECT NAME:	Oaks River Access	**DRILL METHOD:**	Hand Auger	**OPERATOR:**	KM
PROJECT NO.:	2209-CR	**HAMMER:**		**RIG TYPE:**	Hand Auger
LOCATION:	See Boring Location Map			**DATE:**	8/16/2019

BORING NO.: HA- 5 Sheet 1 of 1

Depth (ft)	SAMPLES: Sample Type	SAMPLES: Blows/ 6 in	SAMPLES: Sample Number	USCS Symbol	MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing: Water Content (%)	Laboratory Testing: Dry Density (pcf)	Laboratory Testing: Others
				SP	**Undocumented Fill** Gravelly f-m SAND, tan, dry, medium dense, trace garbage/debris			
					Bedrock GNEISS, gray, dry to slightly moist, very hard, little to no weathering			
					BORING TERMINATED DUE TO REFUSAL AT 1 FOOT			
					No Groundwater encountered Boring backfilled with soil cuttings			
5								
10								
15								
20								
25								
30								

LEGEND

Sample type: ---Ring ---SPT ---Small Bulk ---Large Bulk ---No Recovery ---Water Table

Lab testing:
AL = Atterberg Limits | EI = Expansion Index | SA = Sieve Analysis | RV = R-Value Test
SR = Sulfate/Resisitivity Test | SH = Shear Test | HC= Consolidation | MD = Maximum Density

GeoTek, Inc.
LOG OF EXPLORATORY BORING

CLIENT:	BlueGreen Consulting	**DRILLER:**	GeoTek	**LOGGED BY:**	KM
PROJECT NAME:	Oaks River Access	**DRILL METHOD:**	Hand Auger	**OPERATOR:**	KM
PROJECT NO.:	2209-CR	**HAMMER:**		**RIG TYPE:**	Hand Auger
LOCATION:	See Boring Location Map			**DATE:**	8/16/2019

BORING NO.: HA- 6 Sheet 1 of 1

Depth (ft)	SAMPLES: Sample Type	SAMPLES: Blows/ 6 in	SAMPLES: Sample Number	USCS Symbol	MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing: Water Content (%)	Laboratory Testing: Dry Density (pcf)	Laboratory Testing: Others
				SP	**Undocumented Fill** Gravelly f-c SAND, tan, dry, medium dense			
					Bedrock GNEISS, gray, dry to slightly moist, very hard, little to no weathering			
					BORING TERMINATED DUE TO REFUSAL AT 2 FEET			
5					No Groundwater encountered Boring backfilled with soil cuttings			
10								
15								
20								
25								
30								

LEGEND

Sample type: ---Ring ---SPT ---Small Bulk ---Large Bulk ---No Recovery ---Water Table

Lab testing:

AL = Atterberg Limits	EI = Expansion Index	SA = Sieve Analysis	RV = R-Value Test
SR = Sulfate/Resisitivity Test	SH = Shear Test	HC= Consolidation	MD = Maximum Density

GeoTek, Inc.

LOG OF EXPLORATORY BORING

CLIENT:	BlueGreen Consulting	**DRILLER:**	GeoTek	**LOGGED BY:**	KM
PROJECT NAME:	Oaks River Access	**DRILL METHOD:**	Hand Auger	**OPERATOR:**	KM
PROJECT NO.:	2209-CR	**HAMMER:**		**RIG TYPE:**	Hand Auger
LOCATION:	See Boring Location Map			**DATE:**	8/16/2019

BORING NO.: HA- 7 Sheet 1 of 1

Depth (ft)	SAMPLES: Sample Type	SAMPLES: Blows/ 6 in	SAMPLES: Sample Number	USCS Symbol	MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing: Water Content (%)	Laboratory Testing: Dry Density (pcf)	Laboratory Testing: Others
				SP	**Undocumented Fill** Gravelly f-m SAND, tan, dry, medium dense			
					Bedrock GNEISS, gray, dry to slightly moist, very hard, little to no weathering			
					BORING TERMINATED DUE TO REFUSAL AT 2 FEET			
5					No Groundwater encountered Boring backfilled with soil cuttings			
10								
15								
20								
25								
30								

LEGEND

Sample type: ---Ring ---SPT ---Small Bulk ---Large Bulk ---No Recovery ---Water Table

Lab testing:
AL = Atterberg Limits; EI = Expansion Index; SA = Sieve Analysis; RV = R-Value Test
SR = Sulfate/Resisitivity Test; SH = Shear Test; HC= Consolidation; MD = Maximum Density

APPENDIX B

LABORATORY TEST RESULTS

BlueGreen Consulting
E. Fork Road, Angeles National Forest
Los Angeles County, California
Project No. 2209-CR

GEOTEK

SUMMARY OF LABORATORY TESTING

Moisture-Density Relationship
Laboratory testing was performed on a sample obtained during the subsurface exploration. The laboratory maximum dry density and optimum moisture content was determined in general accordance with ASTM D 1557. The results of the testing are provided below and in Appendix B.

Boring No.	Depth (ft.)	Description	Maximum Dry Density (pcf)	Optimum Moisture Content (%)
HA-1	0-1	Silty/Sandy Gravel	132	6.0

Direct Shear
Shear testing was performed in a direct shear machine of the strain-control type in general accordance with ASTM Test Method D 3080. The rate of deformation is approximately 0.035 inch per minute. The samples were sheared under varying confining loads in order to determine the coulomb shear strength parameters, angle of internal friction and cohesion. The results of the testing are presented in Appendix B.

Expansion Index
The expansion potential of the soils was determined by performing expansion index testing on one sample in general accordance with ASTM D 4829. The results of the testing are provided below.

Boring No.	Depth (ft.)	Soil Type	Expansion Index	Classification
HA-1	0-1	Silty/Sandy Gravel	0	Very Low

Sulfate Content, Resistivity and Chloride Content
Testing to determine the water-soluble sulfate content was performed by others in general accordance with ASTM D516. Resistivity testing was completed by others in general accordance with ASTM G187. Testing to determine the chloride content was performed by others in general accordance with ASTM D512B. The results of the testing are provided below and in Appendix B.

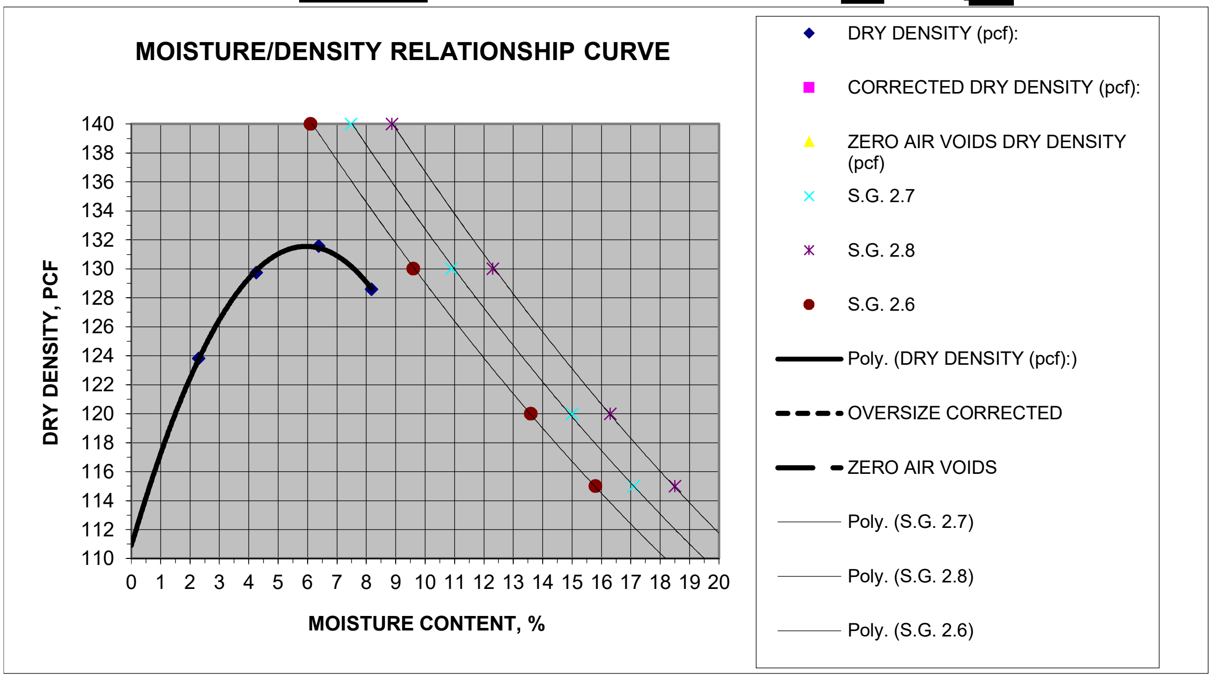
Boring No.	Depth (ft.)	pH CT-643	Chloride CT-422 (ppm)	Sulfate CT-417 (% by weight)	Resistivity ASTM G187 (ohm-cm)
HA-1	0-1	7.1	209.8	0.0159	938

GEOTEK

MOISTURE/DENSITY RELATIONSHIP

Client:	Bluegreen Consulting	**Job No.:**	2209-CR
Project:	Oaks River Access	**Lab No.:**	Corona
Location:	Los Angeles		
Material Type:	Gray Brown Gravelly Silty F-C Sand		
Material Supplier:	-		
Material Source:	-		
Sample Location:	HA-1 @ 0 - 1		
	-		
Sampled By:	KM	**Date Sampled:**	8/19/2019
Received By:	DLI	**Date Received:**	8/20/2019
Tested By:	DA	**Date Tested:**	8/29/2019
Reviewed By:	-	**Date Reviewed:**	-

Test Procedure: ASTM D1557 **Method:** B
Oversized Material (%): 15.4 **Correction Required:** ☐ yes ☒ no



MOISTURE DENSITY RELATIONSHIP VALUES

Maximum Dry Density, pcf	132.0	**@ Optimum Moisture, %**	6.0
Corrected Maximum Dry Density, pcf		**@ Optimum Moisture, %**	

MATERIAL DESCRIPTION

Grain Size Distribution:

	% Gravel (retained on No. 4)
	% Sand (Passing No. 4, Retained on No. 200)
	% Silt and Clay (Passing No. 200)

Atterberg Limits:

	Liquid Limit, %
	Plastic Limit, %
	Plasticity Index, %

Classification:

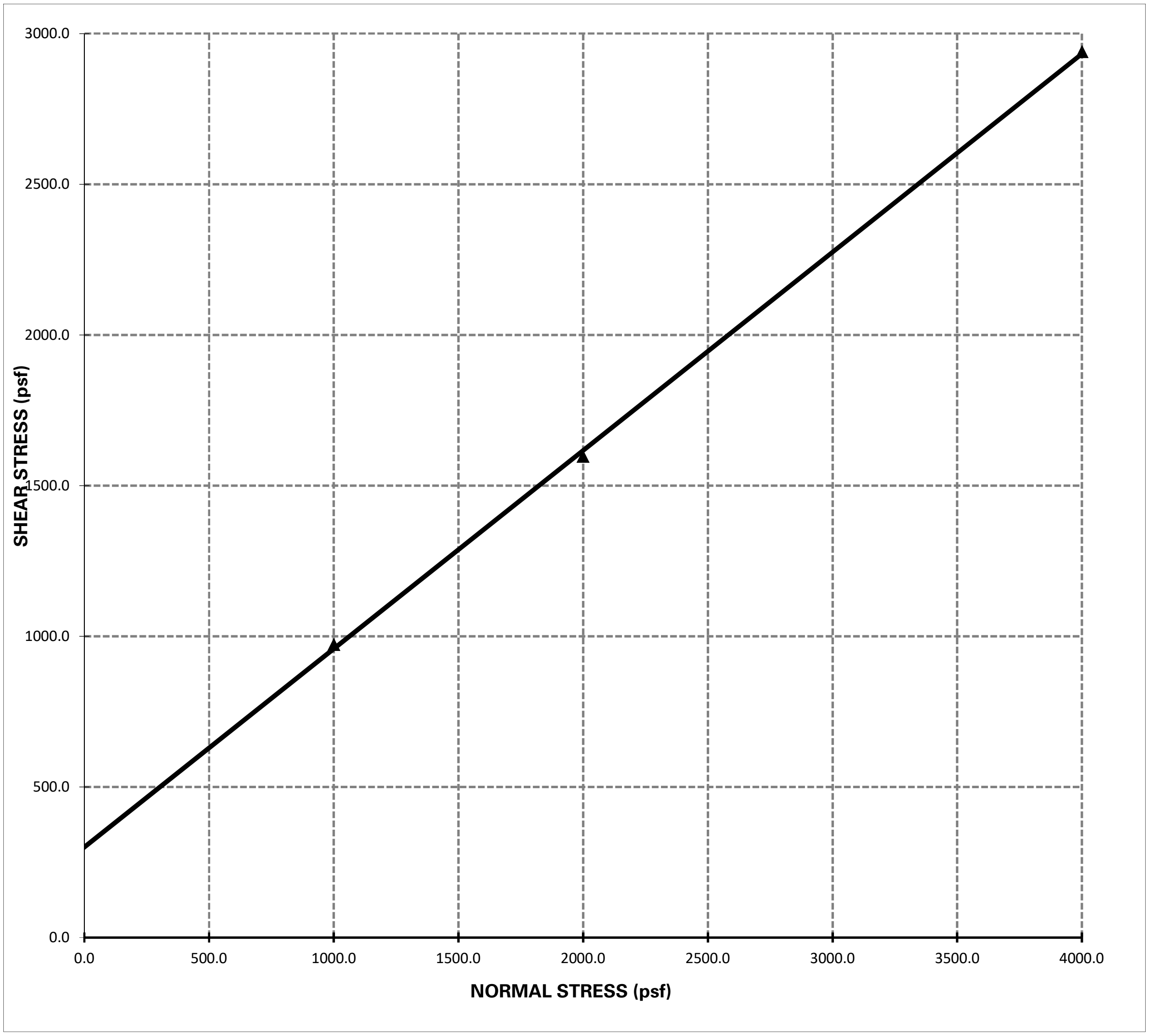
Unified Soils Classification: ________

AASHTO Soils Classification: ________

DIRECT SHEAR TEST

Project Name: Oaks River Access, Los Angeles
Sample Location: HA-1 @ 0 - 1
Project Number: 2209-CR
Date Tested: 9/3/2019

PEAK VALUE



Shear Strength: Φ = 33.4 ° , C = 300.00 psf

Notes: 1 - The soil specimen used in the shear box was a ring sample remolded to approximately 90% relative compaction from a bulk sample collected during the field investigation.

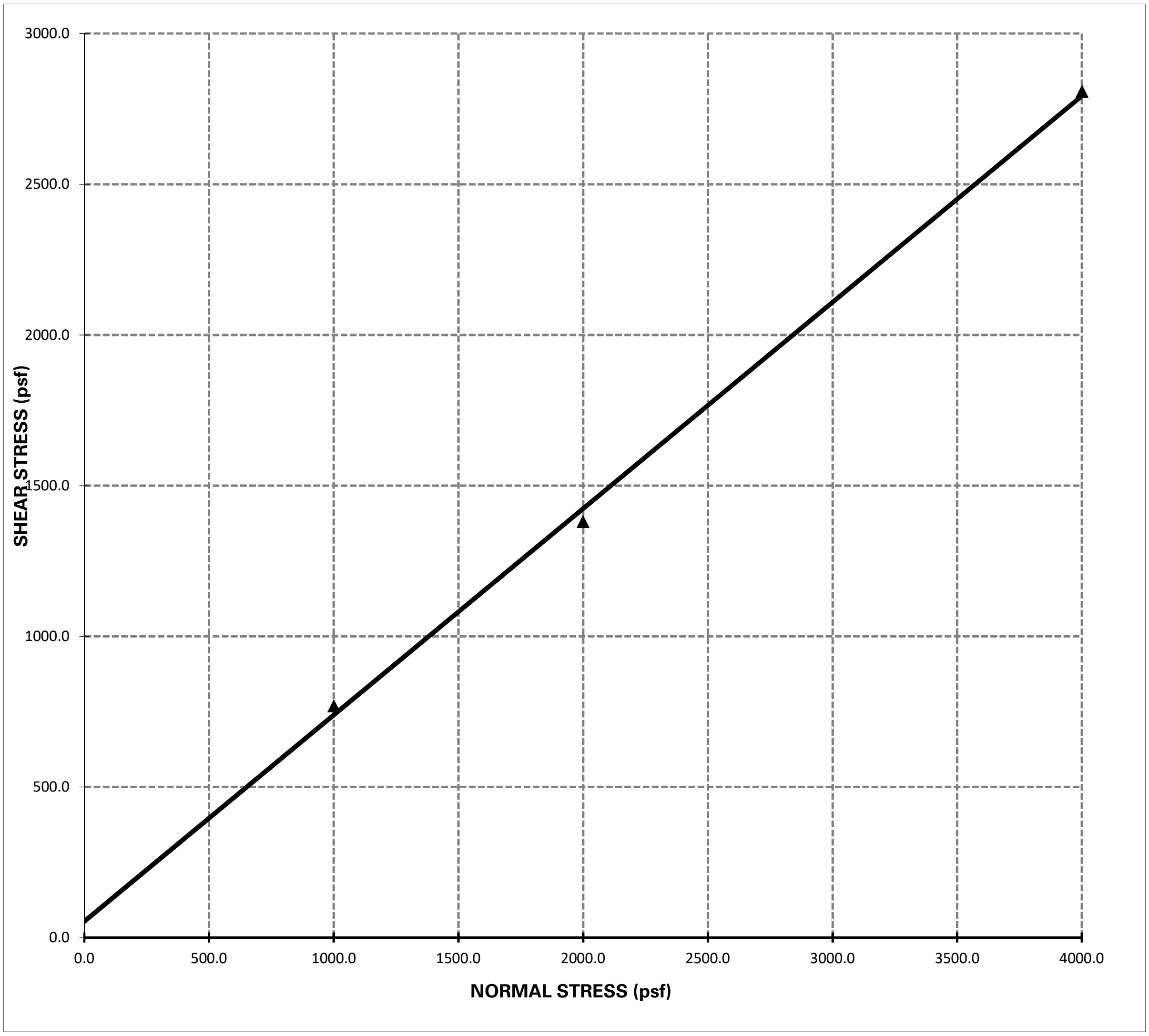
2 - The above reflect direct shear strength at saturated conditions.

3 - The tests were run at a shear rate of 0.035 in/min.

DIRECT SHEAR TEST

GEOTEK

Project Name:	Oaks River Access, Los Angeles	***Sample Location:***	HA-1 @ 0 - 1
Project Number:	2209-CR	***Date Tested:***	9/3/2019



Shear Strength: $\Phi =$ **34.4 °** , **C = 54.00 psf**

Notes: 1 - The soil specimen used in the shear box was a ring sample remolded to approximately 90% relative compaction from a bulk sample collected during the field investigation.

2 - The above reflect direct shear strength at saturated conditions.

3 - The tests were run at a shear rate of 0.035 in/min.

GEOTEK

EXPANSION INDEX TEST

(ASTM D4829)

Client:	Bluegreen Consulting	***Tested/ Checked By:***	DI Lab No Corona
Project Number:	2209-CR	***Date Tested:***	8/31/2019
Project Location:	Oaks River Access, Los Angeles	***Sample Source:***	HA-1 @ 0 - 1
		Sample Description:	

Ring #:______ Ring Dia. : 4.01" Ring Ht.:1"

DENSITY DETERMINATION

A	Weight of compacted sample & ring (gm)	783.2
B	Weight of ring (gm)	364.2
C	Net weight of sample (gm)	**419.0**
D	Wet Density, lb / ft3 (C*0.3016)	**126.4**
E	Dry Density, lb / ft3 (D/1.F)	**117.0**

SATURATION DETERMINATION

F	Moisture Content, %	8.0
G	Specific Gravity, assumed	**2.70**
H	Unit Wt. of Water @ 20 °C, (pcf)	**62.4**
I	% Saturation	**49.1**

READINGS

DATE	TIME	READING	
8/31/2019	3:17	0.3220	Initial
	3:27	0.3220	10 min/Dry
9/3/2019	4:17	0.3220	Final

FINAL MOISTURE

Final Weight of wet sample & tare	% Moisture
805.0	**13.2**

EXPANSION INDEX = 0

APPENDIX C

GENERAL GRADING GUIDELINES

BlueGreen Consulting
E. Fork Road, Angeles National Forest
Los Angeles County, California
Project No. 2209-CR

GEOTEK

GENERAL GRADING GUIDELINES

Guidelines presented herein are intended to address general construction procedures for earthwork construction. Specific situations and conditions often arise which cannot reasonably be discussed in general guidelines, when anticipated these are discussed in the text of the report. Often unanticipated conditions are encountered which may necessitate modification or changes to these guidelines. It is our hope that these will assist the contractor to more efficiently complete the project by providing a reasonable understanding of the procedures that would be expected during earthwork and the testing and observation used to evaluate those procedures.

General

Grading should be performed to at least the minimum requirements of governing agencies, Chapters 18 and 33 of the California Building Code, CBC (2016) and the guidelines presented below.

Preconstruction Meeting

A preconstruction meeting should be held prior to site earthwork. Any questions the contractor has regarding our recommendations, general site conditions, apparent discrepancies between reported and actual conditions and/or differences in procedures the contractor intends to use should be brought up at that meeting. The contractor (including the main onsite representative) should review our report and these guidelines in advance of the meeting. Any comments the contractor may have regarding these guidelines should be brought up at that meeting.

Grading Observation and Testing

1. Observation of the fill placement should be provided by our representative during grading. Verbal communication during the course of each day will be used to inform the contractor of test results. The contractor should receive a copy of the "Daily Field Report" indicating results of field density tests that day. If our representative does not provide the contractor with these reports, our office should be notified.
2. Testing and observation procedures are, by their nature, specific to the work or area observed and location of the tests taken, variability may occur in other locations. The contractor is responsible for the uniformity of the grading operations; our observations and test results are intended to evaluate the contractor's overall level of efforts during grading. The contractor's personnel are the only individuals participating in all aspect of site work. Compaction testing and observation should not be considered as relieving the contractor's responsibility to properly compact the fill.
3. Cleanouts, processed ground to receive fill, key excavations, and subdrains should be observed by our representative prior to placing any fill. It will be the contractor's responsibility to notify our representative or office when such areas are ready for observation.
4. Density tests may be made on the surface material to receive fill, as considered warranted by this firm.
5. In general, density tests would be made at maximum intervals of two feet of fill height or every 1,000 cubic yards of fill placed. Criteria will vary depending on soil conditions and size of the fill. More frequent testing may be performed. In any case, an adequate number of field density tests should be made to evaluate the required compaction and moisture content is generally being obtained.
6. Laboratory testing to support field test procedures will be performed, as considered warranted, based on conditions encountered (e.g. change of material sources, types, etc.) Every effort will

be made to process samples in the laboratory as quickly as possible and in progress construction projects are our first priority. However, laboratory workloads may cause in delays and some soils may require a **minimum of 48 to 72 hours to complete test procedures**. Whenever possible, our representative(s) should be informed in advance of operational changes that might result in different source areas for materials.

7. Procedures for testing of fill slopes are as follows:
    a) Density tests should be taken periodically during grading on the flat surface of the fill, three to five feet horizontally from the face of the slope.
    b) If a method other than over building and cutting back to the compacted core is to be employed, slope compaction testing during construction should include testing the outer six inches to three feet in the slope face to determine if the required compaction is being achieved.
8. Finish grade testing of slopes and pad surfaces should be performed after construction is complete.

Site Clearing

1. All vegetation, and other deleterious materials, should be removed from the site. If material is not immediately removed from the site it should be stockpiled in a designated area(s) well outside of all current work areas and delineated with flagging or other means. Site clearing should be performed in advance of any grading in a specific area.
2. Efforts should be made by the contractor to remove all organic or other deleterious material from the fill, as even the most diligent efforts may result in the incorporation of some materials. This is especially important when grading is occurring near the natural grade. All equipment operators should be aware of these efforts. Laborers may be required as root pickers.
3. Nonorganic debris or concrete may be placed in deeper fill areas provided the procedures used are observed and found acceptable by our representative.

Treatment of Existing Ground

1. Following site clearing, all surficial deposits of alluvium and colluvium as well as weathered or creep effected bedrock, should be removed unless otherwise specifically indicated in the text of this report.
2. In some cases, removal may be recommended to a specified depth (e.g. flat sites where partial alluvial removals may be sufficient). The contractor should not exceed these depths unless directed otherwise by our representative.
3. Groundwater existing in alluvial areas may make excavation difficult. Deeper removals than indicated in the text of the report may be necessary due to saturation during winter months.
4. Subsequent to removals, the natural ground should be processed to a depth of six inches, moistened to near optimum moisture conditions and compacted to fill standards.
5. Exploratory back hoe or dozer trenches still remaining after site removal should be excavated and filled with compacted fill if they can be located.

Fill Placement

1. Unless otherwise indicated, all site soil and bedrock may be reused for compacted fill; however, some special processing or handling may be required (see text of report).
2. Material used in the compacting process should be evenly spread, moisture conditioned, processed, and compacted in thin lifts six (6) to eight (8) inches in compacted thickness to

obtain a uniformly dense layer. The fill should be placed and compacted on a nearly horizontal plane, unless otherwise found acceptable by our representative.

3. If the moisture content or relative density varies from that recommended by this firm, the contractor should rework the fill until it is in accordance with the following:
   a) Moisture content of the fill should be at or above optimum moisture. Moisture should be evenly distributed without wet and dry pockets. Pre-watering of cut or removal areas should be considered in addition to watering during fill placement, particularly in clay or dry surficial soils. The ability of the contractor to obtain the proper moisture content will control production rates.
   b) Each six-inch layer should be compacted to at least 90 percent of the maximum dry density in compliance with the testing method specified by the controlling governmental agency. In most cases, the testing method is ASTM Test Designation D 1557.
4. Rock fragments less than eight inches in diameter may be utilized in the fill, provided:
   a) They are not placed in concentrated pockets;
   b) There is a sufficient percentage of fine-grained material to surround the rocks;
   c) The distribution of the rocks is observed by, and acceptable to, our representative.
5. Rocks exceeding eight (8) inches in diameter should be taken off site, broken into smaller fragments, or placed in accordance with recommendations of this firm in areas designated suitable for rock disposal. On projects where significant large quantities of oversized materials are anticipated, alternate guidelines for placement may be included. If significant oversize materials are encountered during construction, these guidelines should be requested.
6. In clay soil, dry or large chunks or blocks are common. If in excess of eight (8) inches minimum dimension, then they are considered as oversized. Sheepsfoot compactors or other suitable methods should be used to break up blocks. When dry, they should be moisture conditioned to provide a uniform condition with the surrounding fill.

Slope Construction

1. The contractor should obtain a minimum relative compaction of 90 percent out to the finished slope face of fill slopes. This may be achieved by either overbuilding the slope and cutting back to the compacted core, or by direct compaction of the slope face with suitable equipment.
2. Slopes trimmed to the compacted core should be overbuilt by at least three (3) feet with compaction efforts out to the edge of the false slope. Failure to properly compact the outer edge results in trimming not exposing the compacted core and additional compaction after trimming may be necessary.
3. If fill slopes are built "at grade" using direct compaction methods, then the slope construction should be performed so that a constant gradient is maintained throughout construction. Soil should not be "spilled" over the slope face nor should slopes be "pushed out" to obtain grades. Compaction equipment should compact each lift along the immediate top of slope. Slopes should be back rolled or otherwise compacted at approximately every 4 feet vertically as the slope is built.
4. Corners and bends in slopes should have special attention during construction as these are the most difficult areas to obtain proper compaction.
5. Cut slopes should be cut to the finished surface. Excessive undercutting and smoothing of the face with fill may necessitate stabilization.

UTILITY TRENCH CONSTRUCTION AND BACKFILL

Utility trench excavation and backfill is the contractors responsibility. The geotechnical consultant typically provides periodic observation and testing of these operations. While efforts are made to make sufficient observations and tests to verify that the contractors' methods and procedures are adequate to achieve proper compaction, it is typically impractical to observe all backfill procedures. As such, it is critical that the contractor use consistent backfill procedures.

Compaction methods vary for trench compaction and experience indicates many methods can be successful. However, procedures that "worked" on previous projects may or may not prove effective on a given site. The contractor(s) should outline the procedures proposed, so that we may discuss them **prior** to construction. We will offer comments based on our knowledge of site conditions and experience.

1. Utility trench backfill in slopes, structural areas, in streets and beneath flat work or hardscape should be brought to at least optimum moisture and compacted to at least 90 percent of the laboratory standard. Soil should be moisture conditioned prior to placing in the trench.
2. Flooding and jetting are not typically recommended or acceptable for native soils. Flooding or jetting may be used with select sand having a Sand Equivalent (SE) of 30 or higher. This is typically limited to the following uses:
   a) shallow (12 + inches) under slab interior trenches and,
   b) as bedding in pipe zone.

   The water should be allowed to dissipate prior to pouring slabs or completing trench compaction.
3. Care should be taken not to place soils at high moisture content within the upper three feet of the trench backfill in street areas, as overly wet soils may impact subgrade preparation. Moisture may be reduced to 2% below optimum moisture in areas to be paved within the upper three feet below sub grade.
4. Sand backfill should not be allowed in exterior trenches adjacent to and within an area extending below a 1:1 projection from the outside bottom edge of a footing, unless it is similar to the surrounding soil.
5. Trench compaction testing is generally at the discretion of the geotechnical consultant. Testing frequency will be based on trench depth and the contractors procedures. A probing rod would be used to assess the consistency of compaction between tested areas and untested areas. If zones are found that are considered less compact than other areas, this would be brought to the contractors attention.

JOB SAFETY

General

Personnel safety is a primary concern on all job sites. The following summaries are safety considerations for use by all our employees on multi-employer construction sites. On ground personnel are at highest risk of injury and possible fatality on grading construction projects. The company recognizes that construction activities will vary on each site and that job site safety is the contractor's responsibility. However, it is, imperative that all personnel be safety conscious to avoid accidents and potential injury.

In an effort to minimize risks associated with geotechnical testing and observation, the following precautions are to be implemented for the safety of our field personnel on grading and construction projects.

1. Safety Meetings: Our field personnel are directed to attend the contractor's regularly scheduled safety meetings.

2. Safety Vests: Safety vests are provided for and are to be worn by our personnel while on the job site.
3. Safety Flags: Safety flags are provided to our field technicians; one is to be affixed to the vehicle when on site, the other is to be placed atop the spoil pile on all test pits.

In the event that the contractor's representative observes any of our personnel not following the above, we request that it be brought to the attention of our office.

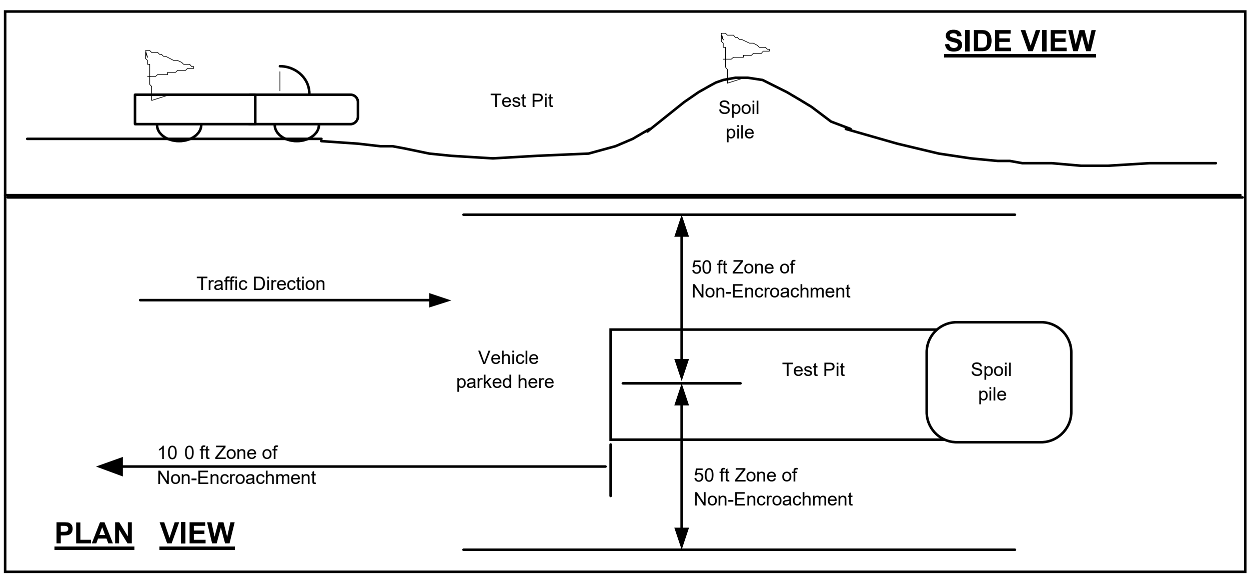
Test Pits Location, Orientation and Clearance

The technician is responsible for selecting test pit locations. The primary concern is the technician's safety. However, it is necessary to take sufficient tests at various locations to obtain a representative sampling of the fill. As such, efforts will be made to coordinate locations with the grading contractors authorized representatives (e.g. dump man, operator, supervisor, grade checker, etc.), and to select locations following or behind the established traffic pattern, preferably outside of current traffic. The contractors authorized representative should direct excavation of the pit and safety during the test period. Again, safety is the paramount concern.

Test pits should be excavated so that the spoil pile is placed away from oncoming traffic. The technician's vehicle is to be placed next to the test pit, opposite the spoil pile. This necessitates that the fill be maintained in a drivable condition. Alternatively, the contractor may opt to park a piece of equipment in front of test pits, particularly in small fill areas or those with limited access.

A zone of non-encroachment should be established for all test pits (see diagram below). No grading equipment should enter this zone during the test procedure. The zone should extend outward to the sides approximately 50 feet from the center of the test pit and 100 feet in the direction of traffic flow. This zone is established both for safety and to avoid excessive ground vibration, which typically decreases test results.

TEST PIT SAFETY PLAN



Slope Tests

When taking slope tests, the technician should park their vehicle directly above or below the test location on the slope. The contractor's representative should effectively keep all equipment at a safe operation distance (e.g. 50 feet) away from the slope during testing.

The technician is directed to withdraw from the active portion of the fill as soon as possible following testing. The technician's vehicle should be parked at the perimeter of the fill in a highly visible location.

Trench Safety

It is the contractor's responsibility to provide safe access into trenches where compaction testing is needed. Trenches for all utilities should be excavated in accordance with CAL-OSHA and any other applicable safety standards. Safe conditions will be required to enable compaction testing of the trench backfill.

All utility trench excavations in excess of 5 feet deep, which a person enters, are to be shored or laid back. Trench access should be provided in accordance with OSHA standards. Our personnel are directed not to enter any trench by being lowered or "riding down" on the equipment.

Our personnel are directed not to enter any excavation which;

1. is 5 feet or deeper unless shored or laid back,
2. exit points or ladders are not provided,
3. displays any evidence of instability, has any loose rock or other debris which could fall into the trench, or
4. displays any other evidence of any unsafe conditions regardless of depth.

If the contractor fails to provide safe access to trenches for compaction testing, our company policy requires that the soil technician withdraws and notifies their supervisor. The contractors representative will then be contacted in an effort to effect a solution. All backfill not tested due to safety concerns or other reasons is subject to reprocessing and/or removal.

Procedures

In the event that the technician's safety is jeopardized or compromised as a result of the contractor's failure to comply with any of the above, the technician is directed to inform both the developer's and contractor's representatives. If the condition is not rectified, the technician is required, by company policy, to immediately withdraw and notify their supervisor. The contractor’s representative will then be contacted in an effort to effect a solution. No further testing will be performed until the situation is rectified. Any fill placed in the interim can be considered unacceptable and subject to reprocessing, recompaction or removal.

In the event that the soil technician does not comply with the above or other established safety guidelines, we request that the contractor bring this to technicians attention and notify our project manager or office. Effective communication and coordination between the contractors' representative and the field technician(s) is strongly encouraged in order to implement the above safety program and safety in general.

The safety procedures outlined above should be discussed at the contractor's safety meetings. This will serve to inform and remind equipment operators of these safety procedures particularly the zone of non-encroachment.

The safety procedures outlined above should be discussed at the contractor's safety meetings. This will serve to inform and remind equipment operators of these safety procedures particularly the zone of non-encroachment.

GeoTek, Inc.
1548 North Maple Street, Corona, California 92880
(951) 710-1160 Office (951) 710-1167 Fax www.geotekusa.com

July 1, 2020
Project No. 2209-CR

BlueGreen Consulting
2606 N. Figueroa, Suite A
Los Angeles, California 90065

Attention: Mr. Martin Kammerer, PhD.

Subject: Additional Geotechnical Study
New Shade and Restroom Structures, Stone Barrier Wall, and River Access Path
Oaks River Access, East Fork Road
Los Angeles National Forest, County of Los Angeles, California

References: See page 6

Dear Mr. Kammerer:

As requested, GeoTek, Inc. (GeoTek) has prepared this letter to present the findings of our additional geotechnical study for the proposed site improvements on the southern bank on the San Gabriel (Oaks) River, off East Fork Road in the Los Angeles National Forest, County of Los Angeles, California. The new site improvements include shade and restroom structures, extension of a stone barrier wall adjacent to pavement areas, and a river access path. The improvements will be built within a 500-foot stretch located east of the area previously assessed in our *Limited Geotechnical Evaluation* (GeoTek, 2019a and 2019b). Plates 1 and 2 show the locations of the new improvements in relation to the previously planned enhancements.

As part of this additional geotechnical evaluation, we conducted a site reconnaissance and field investigation, laboratory testing of samples collected during the field investigation, evaluated the site seismic design criteria in conformance with the 2019 California Building Code (CBC), and provided supplemental foundation/grading recommendations.

As noted in the prior reports, references were made to previous CBC that are now considered outdated. It is recommended that the project be modified to be designed in accordance with the 2019 CBC. Unless superseded herein, all other recommendations provided in previous reports (GeoTek, 2019a and 2019b) remain applicable.

Site Reconnaissance

A site visit was made by a geologist from GeoTek on June 12, 2020 to observe current site conditions. An unpaved parking area exists between the riverbank and East Fork Road. The parking area includes a small public restroom building and three roll-off garbage containers.

Currently, access to the river is via two dirt trails that traverse the bank below the parking area. The westerly dirt trail descends to concrete crib-wall steps, which descend to the river flood plain. A grouted cobble and boulder wall exists west of the steps at the base of the bank below the access trail and continues westerly across the mouth of Oaks Canyon. The easterly dirt trail has a relatively gentle descent directly to the flood plain. The slope gradient above the trails and steps is approximately 1.5:1 (horizontal: vertical). The gradient of the natural slope east of the steps/trails varies from approximately 1:1 to 0.5:1. The elevation difference between the top of the bank at the unpaved parking and the bottom of the steps is approximately 20 feet. Site drainage generally flows northerly towards the river.

Numerous cobbles and boulders were observed within the flood plain. The boulders generally ranged from 1 foot to 2.5 feet in diameter. The river flows westerly and was gently flowing and shallow at the time of this site reconnaissance.

Past grading on the site appears to have consisted of placing fill to create a berm at the top of the bank to contain the river flow. Grading for the dirt trails consisted of cutting into the bank and placing shallow fill along the downslope edge of the trail. Fill was likely placed behind the grouted cobble/boulder wall. Based on photographs provided by BlueGreen Consulting, it appears a previous trail descended from the unpaved parking area at the location of the existing steps down onto the flood plain. Over time, this trail was backfilled and fill was placed below the area of the existing steps.

Field Investigation

Field investigation within the newly proposed improvement areas was conducted on June 12, 2020 and consisted of the excavation of five shallow hand-auger borings and collection of representative disturbed samples. The borings extended to about 1 to 4 feet below grade, and logs of the borings were kept by a professional geologist from our firm. The approximate locations of the borings are shown on Plates 1 and 2. Logs of the borings are included in Appendix A.

Laboratory Testing

Laboratory testing was performed on selected soil samples obtained during our field exploration. The purpose of the laboratory testing was to confirm the field classification of the soils encountered and to evaluate the physical properties of the soils for use in engineering design and analysis. Testing included proctor, direct shear, expansion index, and corrosion tests. The results of these tests are included in Appendix B.

Summary of Findings

Our data and field observations indicate that the proposed restroom and shade building areas contained approximately 1 to 3 feet of undocumented fill, respectively. The undocumented fill was observed to be composed of silty sand with gravel and silty to sandy gravel, which was brown, dry, and medium dense. As encountered in our borings, bedrock was present at the subject locations below the fill and consists of gneiss with little to no weathering.

The area of the future stone barrier wall extension was noted to be underlain by 1 to 4 feet of undocumented fill atop bedrock. The area of the new access river path within the eastern-most portion of the site was noted to rest on alluvial gravel and sand deposits associated with the adjacent Oaks River channel. The alluvial river channel deposits were loose to medium dense and included abundant cobbles up to 12 inches and boulders up to 2.5 feet in diameter. These deposits extended to 3 feet below grade or more.

Based on our current and previous laboratory test results, the site surficial soils were noted to be "very low" expansive and have negligible sulfate concentrations.

2019 CBC Seismic Design Criteria

The site is located at approximately 34.2300□Latitude and -117.7767□Longitude. ASCE 7-16/2019 CBC requires that the measured shear wave velocity for the upper 100 feet be in excess of 2,500 feet per second in order to consider a property a Site Class "B". Due to the lack of shear wave data and since the site underlain by hard gneiss bedrock at very shallow depths, we have estimated that a Site Class "C" be the appropriate category for the property. Site spectral accelerations (Sa and S1), for 0.2 and 1.0 second periods for a Class "C" site, were determined from the SEAOC/OSHPD web interface that utilizes the USGS web services and retrieves the seismic design data and presents that information in a report format.

The seismic design parameters for the site, based on the 2019 CBC, are presented on the following table:

SITE SEISMIC PARAMETERS	
Mapped 0.2 sec Period Spectral Acceleration, S_s	1.849g
Mapped 1.0 sec Period Spectral Acceleration, S_1	0.716g
Site Coefficient for Site Class "C," F_a	1.2
Site Coefficient for Site Class "C," F_v	1.4
Maximum Considered Earthquake Spectral Response Acceleration for 0.2 Second, S_{MS}	2.219g
Maximum Considered Earthquake Spectral Response Acceleration for 1.0 Second, S_{M1}	1.003g
5% Damped Design Spectral Response Acceleration Parameter at 0.2 Second, S_{DS}	1.479g
5% Damped Design Spectral Response Acceleration Parameter at 1 second, S_{D1}	0.668g
Site Modified Peak Ground Acceleration, PGA_M	0.947g
Seismic Design Category	D

Final selection of the appropriate seismic design coefficients should be made by the project structural engineer based upon the local practices and ordinances, expected building response and desired level of conservatism.

Supplemental Foundation Design and Grading Recommendations

As noted in our previous reports (GeoTek, 2019a and 2019b), all undocumented fill should be removed from planned building and surface improvement areas. A representative of this firm should observe and approve the bottom of all excavations. The over-excavated areas should then be refilled to grade with engineered compacted fill.

Structural footings should rest on either bedrock or engineered fill. Geotechnical parameters for footing design and setback from adjacent slopes should be obtained from the referenced *Limited Geotechnical Evaluation* (GeoTek, 2019a and 2019b).

The new river access path within the eastern-most portion of the site is anticipated to be cut into the existing slope. While grading plans showing proposed subgrade elevations along the path are not available at this time, we expect that the cuts will be minimal. However, excavations within this region will be somewhat difficult as the river channel deposits underlain the alignment include boulders up to 2.5 feet in diameter. If the removal of such large boulders is required, site excavations depths may increase. Removal depths within these areas should be approved by the geotechnical engineer during site grading.

The opportunity to be of service is sincerely appreciated. If you should have any questions, please do not hesitate to call our office.

Respectfully submitted,
GeoTek, Inc.

REGISTERED GEOLOGIST EDWARD H. LaMONT No. 1892 Exp._____ Certified Engineering Geologist STATE OF CALIFORNIA

LICENSED PROFESSIONAL ENGINEER GABY M. BOGDANOFF NO. 3133 GEOTECHNICAL STATE OF CALIFORNIA

Edward H. LaMont
CEG 1892, Exp. 07/31/22
Principal Geologist

Gaby M. Bogdanoff
GE 3133, Exp. 06/30/22
Project Engineer

PROFESSIONAL GEOLOGIST KYLE R. MCHARGUE 9790 STATE OF CALIFORNIA

Kyle R. McHargue
PG 9790, Exp. 02/28/22
Project Geologist

Distribution: (1) Addressee via email

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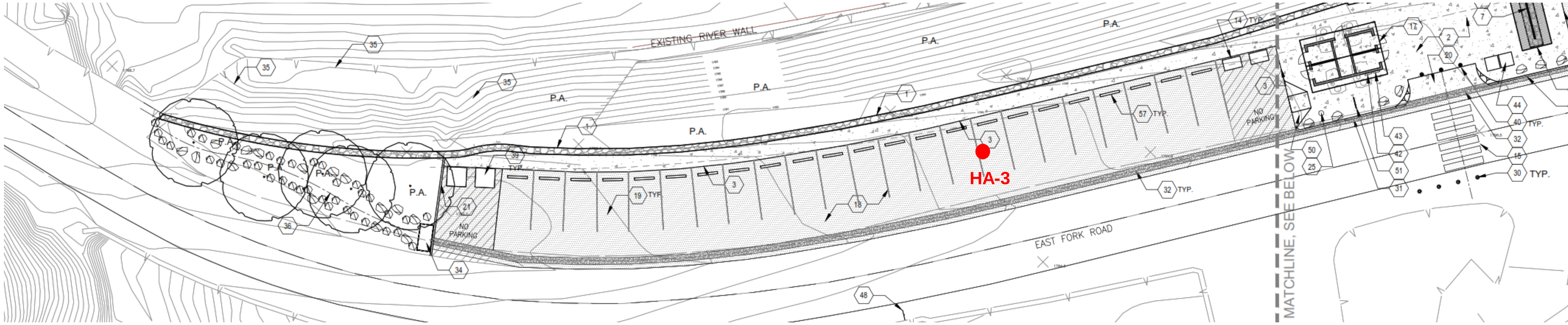
ENCLOSURES

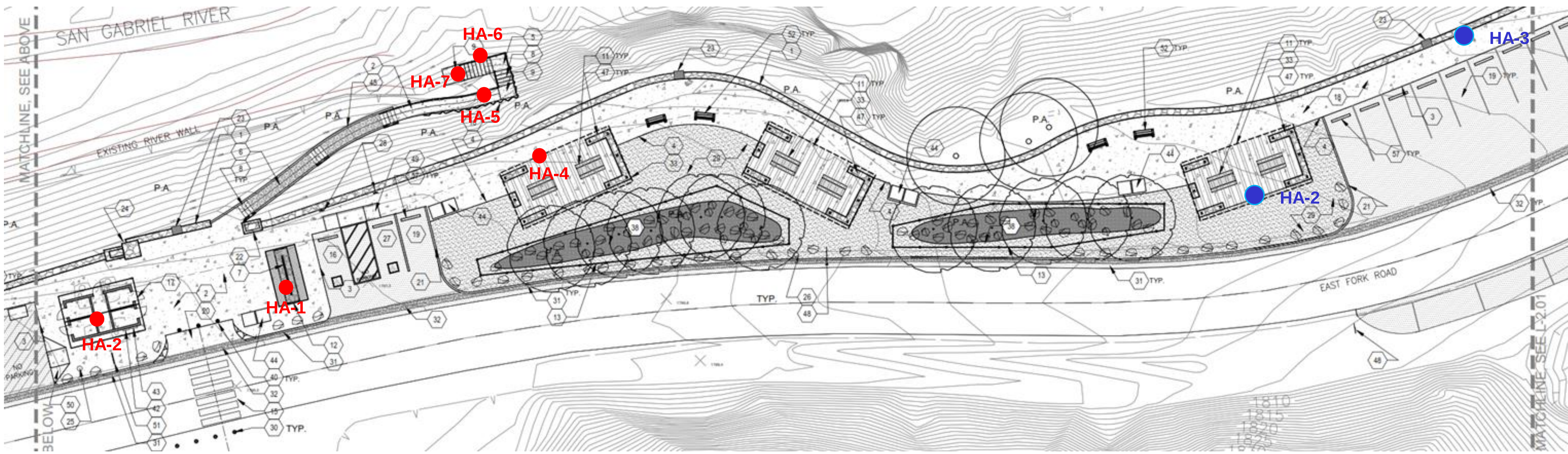
- Plates 1 and 2 – Exploration Location Maps
- Appendix A – Logs of Exploratory Borings
- Appendix B – Laboratory Test Results

REFERENCES

GeoTek, Inc., 2019a, "Limited Supplemental Geotechnical Evaluation for Proposed Restroom & Shade structures, Oaks River Access, East Fork Road, Angeles National Forest, County of Los Angeles, California", Project No. 2209-CR, dated Setpember 11.

____, 2019b, "Addendum to Limioted Supplemental Geotechnical evaluation, Proposed Restroom & Shade Structures, Oaks River Access, East Fork Road, Angeles National Forest, County of Los Angeles, California", Project No. 2209-CR, dated October 22.





HA-5 - Exploratory Hand Auger Boring (GeoTek, 2020)

HA-7 - Exploratory Hand Auger Boring (GeoTek, 2019)

SCALE: 1" =16'

0 8 16 32

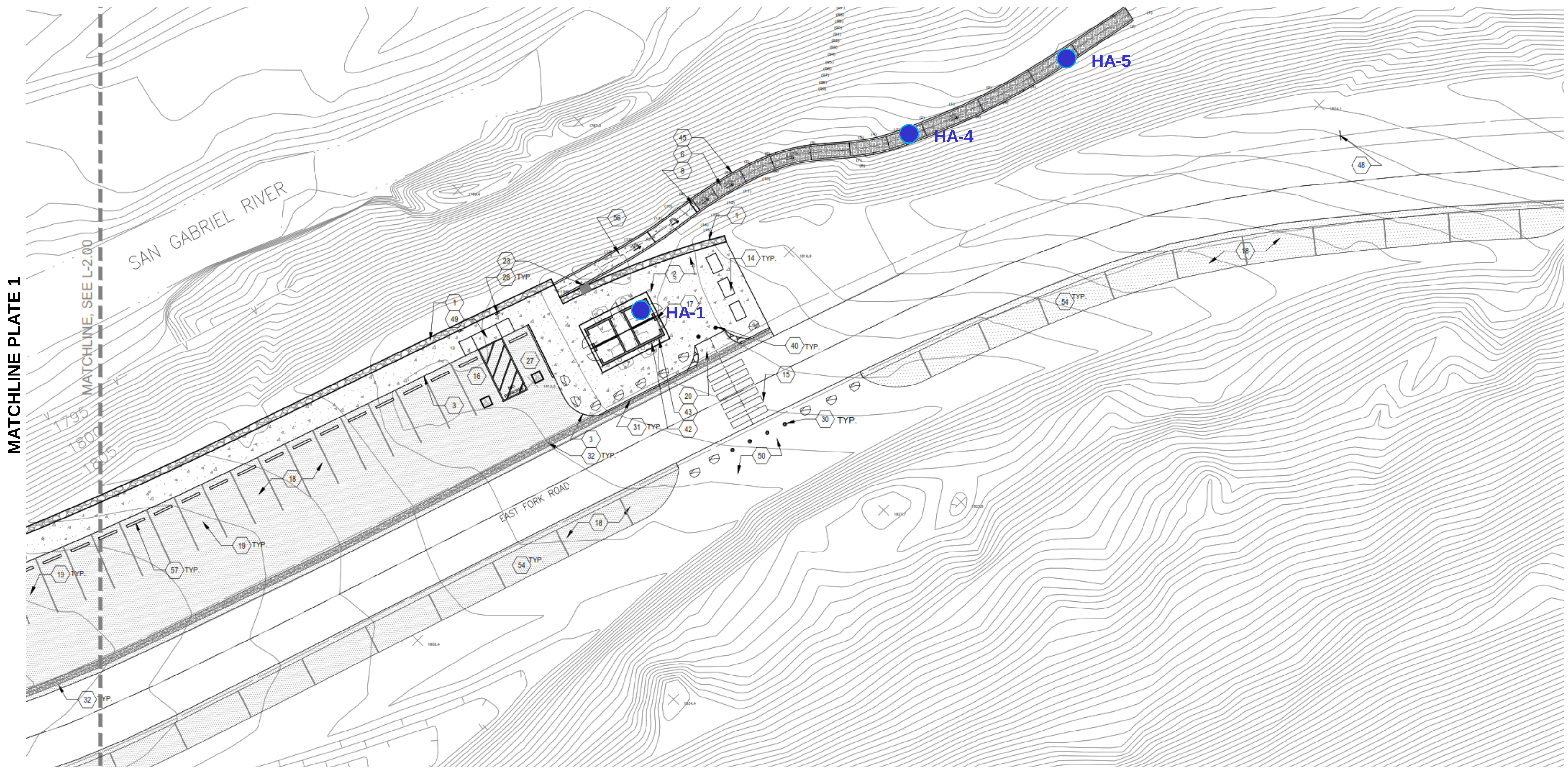
BlueGreen Consulting
Oaks River Access Stairway and Overlook
East Fork Road, Los Angeles County, California

Project No. 2209-CR

GEOTEK

Plate 1

Exploration Location Map



HA-5 - Exploratory Hand Auger Boring (GeoTek, 2020)

HA-7 - Exploratory Hand Auger Boring (GeoTek, 2019)

BlueGreen Consulting
Oaks River Access Stairway and Overlook
East Fork Road, Los Angeles County, California

Project No. 2209-CR

GEOTEK

Plate 2

Exploration Location Map

APPENDIX A

LOGS OF EXPLORATORY BORINGS

Additional Geotechnical Study
Oak River Access, East Fork Road
Los Angeles National Forest, Los Angeles County, California

Project No. 2209-CR

GEOTEK

A - FIELD TESTING AND SAMPLING PROCEDURES

The Modified Split-Barrel Sampler (Ring)
The ring sampler is driven into the ground in accordance with ASTM Test Method D 3550. The sampler, with an external diameter of 3.0 inches, is lined with 1-inch long, thin brass rings with inside diameters of approximately 2.4 inches. The sampler is typically driven into the ground 12 or 18 inches with a 140-pound hammer free falling from a height of 30 inches. Blow counts are recorded for every 6 inches of penetration as indicated on the log of boring. The samples are removed from the sample barrel in the brass rings, sealed, and transported to the laboratory for testing.

Bulk Samples (Large)
These samples are normally large bags of earth materials over 20 pounds in weight collected from the field by means of hand digging or exploratory cuttings.

Bulk Samples (Small)
These are plastic bag samples which are normally airtight and contain less than 5 pounds in weight of earth materials collected from the field by means of hand digging or exploratory cuttings. These samples are primarily used for determining natural moisture content and classification indices.

B - BORING LOG LEGEND

The following abbreviations and symbols often appear in the classification and description of soil and rock on the log of borings:

SOILS	
USCS	Unified Soil Classification System
f-c	Fine to coarse
f-m	Fine to medium
GEOLOGIC	
B: Attitudes	Bedding: strike/dip
J: Attitudes	Joint: strike/dip
C: Contact line	
………..	Dashed line denotes USCS material change
———	Solid Line denotes unit / formational change
━━━	Thick solid line denotes end of the boring

(Additional denotations and symbols are provided in the boring logs)

GeoTek, Inc.

LOG OF EXPLORATORY BORING

CLIENT:	BlueGreen Consulting	**DRILLER:**	GeoTek	**LOGGED BY:**	KM
PROJECT NAME:	Oaks River Access	**DRILL METHOD:**	Hand Auger	**OPERATOR:**	KM
PROJECT NO.:	2209-CR	**HAMMER:**		**RIG TYPE:**	Hand Auger
LOCATION:	See Exploration Location Map			**DATE:**	6/12/2020

BORING NO.: HA-1

Depth (ft)	SAMPLES: Sample Type	SAMPLES: Blows/ 6 in	SAMPLES: Sample Number	USCS Symbol	MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing: Water Content (%)	Laboratory Testing: Dry Density (pcf)	Laboratory Testing: Others
				SM	**Undocumented Fill** Silty f-m SAND with GRAVEL, brown, slightly moist, medium dense Dense, moist			
					Bedrock GNEISS, gray, slightly moist, very hard, little to no weathering			
5					**BORING TERMINATED DUE TO REFUSAL AT 3.5 FEET** No groundwater encountered Boring backfilled with soil cuttings			
10								
15								
20								
25								
30								

LEGEND

Sample type: ---Ring ---SPT ---Small Bulk ---Large Bulk ---No Recovery ---Water Table

Lab testing:
AL = Atterberg Limits | EI = Expansion Index | SA = Sieve Analysis | RV = R-Value Test
SR = Sulfate/Resisitivity Test | SH = Shear Test | HC= Consolidation | MD = Maximum Density

GeoTek, Inc.
LOG OF EXPLORATORY BORING

CLIENT:	BlueGreen Consulting	**DRILLER:**	GeoTek	**LOGGED BY:**	KM
PROJECT NAME:	Oaks River Access	**DRILL METHOD:**	Hand Auger	**OPERATOR:**	KM
PROJECT NO.:	2209-CR	**HAMMER:**		**RIG TYPE:**	Hand Auger
LOCATION:	See Exploration Location Map			**DATE:**	6/12/2020

BORING NO.: HA-2

Depth (ft)	SAMPLES: Sample Type	Blows/ 6 in	Sample Number	USCS Symbol	MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing: Water Content (%)	Dry Density (pcf)	Others
				GM	**Undocumented Fill** Silty/Sandy GRAVEL, tan, dry, dense			
					Bedrock GNEISS, gray, dry to slightly moist, very hard, little to no weathering			
					BORING TERMINATED DUE TO REFUSAL AT 1 FEET			
					No Groundwater encountered Boring backfilled with soil cuttings			
5								
10								
15								
20								
25								
30								

LEGEND

Sample type: ---Ring ---SPT ---Small Bulk ---Large Bulk ---No Recovery ---Water Table

Lab testing: AL = Atterberg Limits; EI = Expansion Index; SA = Sieve Analysis; RV = R-Value Test; SR = Sulfate/Resisitivity Test; SH = Shear Test; HC= Consolidation; MD = Maximum Density

GeoTek, Inc.

LOG OF EXPLORATORY BORING

CLIENT:	BlueGreen Consulting	**DRILLER:**	GeoTek	**LOGGED BY:**	KM
PROJECT NAME:	Oaks River Access	**DRILL METHOD:**	Hand Auger	**OPERATOR:**	KM
PROJECT NO.:	2209-CR	**HAMMER:**		**RIG TYPE:**	Hand Auger
LOCATION:	See Exploration Location Map			**DATE:**	6/12/2020

Depth (ft)	SAMPLES: Sample Type	SAMPLES: Blows/ 6 in	SAMPLES: Sample Number	USCS Symbol	**BORING NO.: HA-3** / **MATERIAL DESCRIPTION AND COMMENTS**	Laboratory Testing: Water Content (%)	Laboratory Testing: Dry Density (pcf)	Laboratory Testing: Others
				SM	**Undocumented Fill** Silty f-m SAND with GRAVEL, brown, slightly moist, medium dense			MD, SH, EI, SR
					Dense. moist			
					Bedrock GNEISS, gray, dry to slightly moist, very hard, little to no weathering			
5					**BORING TERMINATED DUE TO REFUSAL AT 4 FEET**			
					No Groundwater encountered Boring backfilled with soil cuttings			
10								
15								
20								
25								
30								

LEGEND

Sample type: ---Ring ---SPT ---Small Bulk ---Large Bulk ---No Recovery ---Water Table

Lab testing:

AL = Atterberg Limits | EI = Expansion Index | SA = Sieve Analysis | RV = R-Value Test

SR = Sulfate/Resisitivity Test | SH = Shear Test | HC= Consolidation | MD = Maximum Density

GeoTek, Inc.

LOG OF EXPLORATORY BORING

CLIENT:	BlueGreen Consulting	**DRILLER:**	GeoTek	**LOGGED BY:**	KM
PROJECT NAME:	Oaks River Access	**DRILL METHOD:**	Hand Auger	**OPERATOR:**	KM
PROJECT NO.:	2209-CR	**HAMMER:**		**RIG TYPE:**	Hand Auger
LOCATION:	See Exploration Location Map			**DATE:**	6/12/2020

BORING NO.: HA-4

Depth (ft)	SAMPLES: Sample Type	Blows/ 6 in	Sample Number	USCS Symbol	MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing: Water Content (%)	Dry Density (pcf)	Others
				GM	**Alluvial Gravel and Sand of Stream Channels:** F-c Sandy GRAVEL, gray, dry, loose to medium dense, cobbles up to 12" and boulders up to 2.5' diameter			
					Moist, medium dense, abundant cobbles			
					BORING TERMINATED DUE TO REFUSAL AT 3 FEET			
5					No Groundwater encountered Boring backfilled with soil cuttings			
10								
15								
20								
25								
30								

LEGEND

Sample type: ---Ring ---SPT ---Small Bulk ---Large Bulk ---No Recovery ---Water Table

Lab testing:
AL = Atterberg Limits; EI = Expansion Index; SA = Sieve Analysis; RV = R-Value Test
SR = Sulfate/Resisitivity Test; SH = Shear Test; HC= Consolidation; MD = Maximum Density

GeoTek, Inc.
LOG OF EXPLORATORY BORING

CLIENT:	BlueGreen Consulting	**DRILLER:**	GeoTek	**LOGGED BY:**	KM
PROJECT NAME:	Oaks River Access	**DRILL METHOD:**	Hand Auger	**OPERATOR:**	KM
PROJECT NO.:	2209-CR	**HAMMER:**		**RIG TYPE:**	Hand Auger
LOCATION:	See Exploration Location Map			**DATE:**	6/12/2020

Depth (ft)	SAMPLES: Sample Type	Blows/ 6 in	Sample Number	USCS Symbol	BORING NO.: HA-5 MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing: Water Content (%)	Dry Density (pcf)	Others
				GM	**Alluvial Gravel and Sand of Stream Channels:** F-c Sandy GRAVEL, gray, dry, loose to medium dense, cobbles up to 12" and boulders up to 2.5' diameter Moist, medium dense, abundant cobbles			
					BORING TERMINATED DUE TO REFUSAL AT 2.5 FEET			
					No Groundwater encountered Boring backfilled with soil cuttings			
5								
10								
15								
20								
25								
30								

LEGEND

Sample type: ---Ring ---SPT ---Small Bulk ---Large Bulk ---No Recovery ---Water Table

Lab testing:
AL = Atterberg Limits EI = Expansion Index SA = Sieve Analysis RV = R-Value Test
SR = Sulfate/Resisitivity Test SH = Shear Test HC= Consolidation MD = Maximum Density

APPENDIX B

LABORATORY TEST RESULTS

Additional Geotechnical Study
Oak River Access, East Fork Road
Los Angeles National Forest, Los Angeles County, California

Project No. 2209-CR

GEOTEK

SUMMARY OF LABORATORY TESTING

Classification
Soils were classified visually in general accordance to the Unified Soil Classification System (ASTM Test Method D 2487). The soil classifications are shown on the logs of borings in Appendix A.

Moisture-Density Relationship
Laboratory testing was performed on a sample obtained during the subsurface exploration. The laboratory maximum dry density and optimum moisture content was determined in general accordance with ASTM D 1557. The results of the testing are provided herein.

Direct Shear
Shear testing was performed in a direct shear machine of the strain-control type in general accordance with ASTM Test Method D 3080. The rate of deformation was approximately 0.035 inch per minute. The samples were sheared under varying confining loads in order to determine the coulomb shear strength parameters, angle of internal friction and cohesion. Testing was performed on remolded soil samples (90% of the maximum dry density per ASTM D 1557). The shear test results are presented herein.

Expansion Index
Expansion Index testing was performed on a soil sample. Testing was performed in general accordance with ASTM Test Method D 4829. The results of the testing are provided herein.

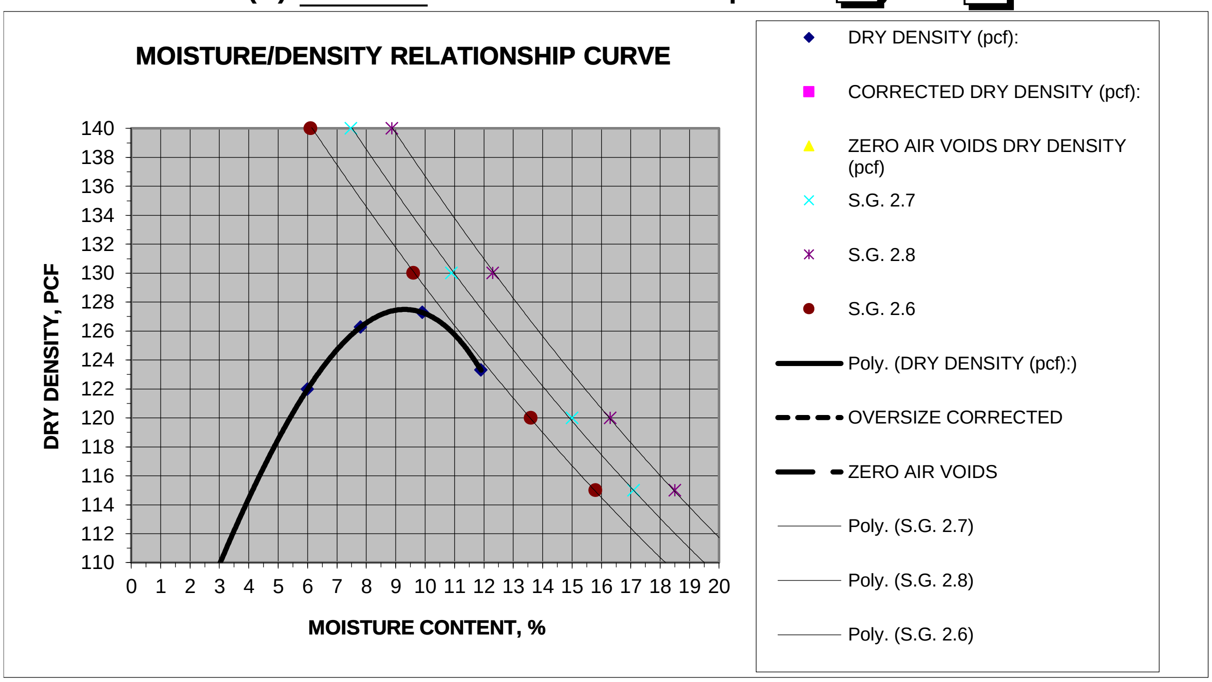
Sulfate Content, Resistivity and Chloride Content
Testing to determine the water-soluble sulfate content was performed by others on a sample collected during the subsurface exploration. The results are presented herein.

MOISTURE/DENSITY RELATIONSHIP

Client:	Bluegreen Consulting	**Job No.:**	2209-CR
Project:	Oaks River Access	**Lab No.:**	Corona
Location:	Los Angeles		
Material Type:	Brown Silty F - C Sand w/Gravel		
Material Supplier:	-		
Material Source:	-		
Sample Location:	B-3 @ 0 - 3 ft		
	-		
Sampled By:	KM	**Date Sampled:**	6/16/2020
Received By:	DLI	**Date Received:**	6/17/2020
Tested By:	DLI	**Date Tested:**	6/22/2020
Reviewed By:	-	**Date Reviewed:**	-

Test Procedure: ASTM D1557 **Method:** A

Oversized Material (%): 16.4 **Correction Required:** ☐ yes ☒ no



MOISTURE DENSITY RELATIONSHIP VALUES

Maximum Dry Density, pcf	127.5	**@ Optimum Moisture, %**	9.5
Corrected Maximum Dry Density, pcf		**@ Optimum Moisture, %**	

MATERIAL DESCRIPTION

Grain Size Distribution:

	% Gravel (retained on No. 4)
	% Sand (Passing No. 4, Retained on No. 200)
	% Silt and Clay (Passing No. 200)

Atterberg Limits:

	Liquid Limit, %
	Plastic Limit, %
	Plasticity Index, %

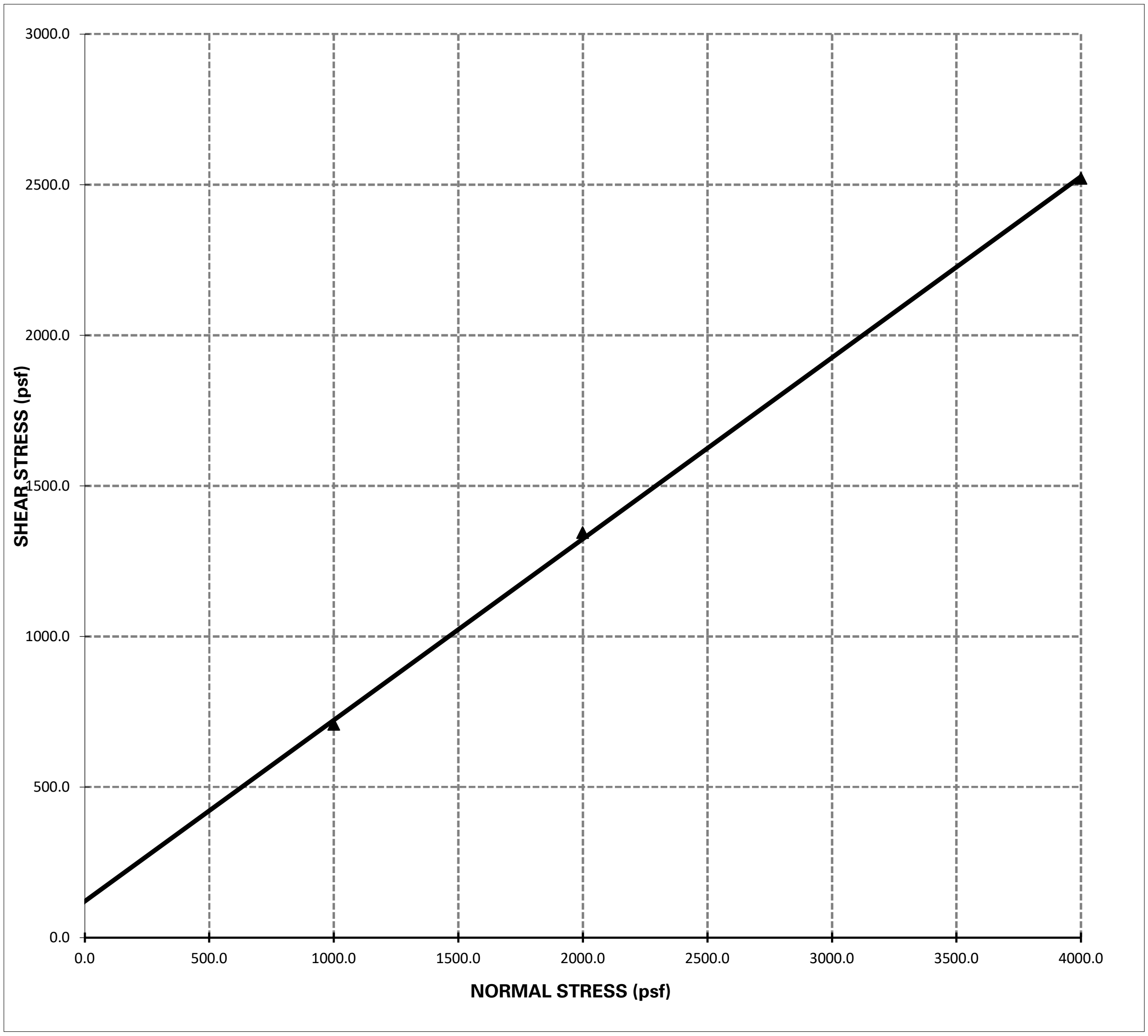
Classification:

Unified Soils Classification: ______

AASHTO Soils Classification: ______

DIRECT SHEAR TEST

Project Name: Oaks River Access, Los Angeles
Sample Location: B-3 @ 0 - 3 ft
Project Number: 2209-CR
Date Tested: 6/25/2020



Shear Strength: $\Phi =$ **31.0** $^{\circ}$, **C = 120.00 psf**

Notes: 1 - The soil specimen used in the shear box was a ring sample remolded to approximately 90% relative compaction from a bulk sample collected during the field investigation.
2 - The above reflect direct shear strength at saturated conditions.
3 - The tests were run at a shear rate of 0.035 in/min.

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EXPANSION INDEX TEST

(ASTM D4829)

Client:	Bluegreen Consulting	***Tested/ Checked By:***	DI Lab No Corona
Project Number:	2209-CR	***Date Tested:***	6/22/2020
Project Location:	Oaks River Access, Los Angeles	***Sample Source:***	B-3 @ 0 - 3 ft
		Sample Description:	

Ring #: ______ Ring Dia. : 4.01" Ring Ht. 1"

DENSITY DETERMINATION

A	Weight of compacted sample & ring (gm)	768.7
B	Weight of ring (gm)	364.8
C	Net weight of sample (gm)	**403.9**
D	Wet Density, lb / ft3 (C*0.3016)	**121.8**
E	Dry Density, lb / ft3 (D/1.F)	**111.5**

SATURATION DETERMINATION

F	Moisture Content, %	9.3
G	Specific Gravity, assumed	**2.70**
H	Unit Wt. of Water @ 20 °C, (pcf)	**62.4**
I	% Saturation	**49.1**

READINGS

DATE	TIME	READING	
6/22/2020	5:43	0.3670	Initial
	5:53	0.3670	10 min/Dry
6/23/2020	5:53	0.3670	Final

FINAL MOISTURE

Final Weight of wet sample & tare	% Moisture
794.4	**15.7**

EXPANSION INDEX = 0

Soil Analysis Lab Results

Client: GeoTek, Inc.
Job Name: Oaks River Access, Los Angeles
Client Job Number: 2209-CR
Project X Job Number: S200624C
June 29, 2020

	Method	ASTM D4327		ASTM D4327		ASTM G187		ASTM G51	ASTM G200	SM 4500-S2-D	ASTM D4327	ASTM D6919	ASTM D6919	ASTM D6919	ASTM D6919	ASTM D6919	ASTM D6919	ASTM D4327	ASTM D4327
Bore# / Description	**Depth**	**Sulfates** SO_4^{2-}		**Chlorides** Cl^-		**Resistivity**		**pH**	**Redox**	**Sulfide** S^{2-}	**Nitrate** NO_3^-	**Ammonium** NH_4^+	**Lithium** Li^+	**Sodium** Na^+	**Potassium** K^+	**Magnesium** Mg^{2+}	**Calcium** Ca^{2+}	**Fluoride** F_2^{--}	**Phosphate** PO_4^{3-}
						As Rec'd	**Minimum**												
	(ft)	**(mg/kg)**	**(wt%)**	**(mg/kg)**	**(wt%)**	**(Ohm-cm)**	**(Ohm-cm)**		**(mV)**	**(mg/kg)**	**(mg/kg)**	**(mg/kg)**	**(mg/kg)**	**(mg/kg)**	**(mg/kg)**	**(mg/kg)**	**(mg/kg)**	**(mg/kg)**	**(mg/kg)**
B-3	0.0-3.0	3.8	0.0004	3.5	0.0004	737,000	11,390	7.45	167	0.27	29.2	0.5	ND	9.6	0.7	2.4	17.0	0.8	3.6

Cations and Anions, except Sulfide and Bicarbonate, tested with Ion Chromatography
mg/kg = milligrams per kilogram (parts per million) of dry soil weight
ND = 0 = Not Detected | NT = Not Tested | Unk = Unknown
Chemical Analysis performed on 1:3 Soil-To-Water extract

Project X
Corrosion Engineering
Corrosion Control - Soil, Water, and Metallurgy Lab

Lab Request Sheet Chain of Custody
Phone: (213) 928-7213 · Fax (951) 226-1720 · www.projectxcorrosion.com
Ship Samples To: 29970 Technology Dr, Suite 105F, Murrieta, CA 92563

Project X Job Number
S200624C Geotek 2209-CR Oaks River Access 1 Full

IMPORTANT: Please complete Project and Sample Identification Data as you would like it to appear in report & include this form with samples.

Company Name:	GEOTEK Inc.	**Contact Name:**	**Phone No.:**
Mailing Address:	1548 North Maple St., Corona, CA 92280	**Contact Email:**	ascott@geotekusa.com
Accounting Contact:		**Invoice Email:**	ascott@geotekusa.com
Project Name:	OAKS RIVER ACCESS, LOS ANGELES	**Client Project No:**	2209-CR

P.O. #:	**5 Day Normal**	**3 Day RUSH 75% mark-up**	**2 Day RUSH 100% mark-up**
Turn Around Time:	X		

Results By: ☐ Phone ☐ Fax ☐ Email ☐ Mail ☐ Overnight Mail (charges apply)

Date & Received by: 4/24/2020

Default Method

SPECIAL INSTRUCTIONS:

ANALYSIS REQUESTED (Please circle)

Analysis	Method
CORROSION SERIES	Min. Resistivity, Chloride, Sulfide, Sulfate, pH, Ammonia, Nitrate, Redox.
Soil Resistivity	Caltrans CTM64 / AASHTO T288 / ASTM G187
pH	Caltrans CTM64 / AASHTO T 289 / ASTM G 51
Sulfate	Caltrans CTM41 / AASHTO T 290 / ASTM D516
Chloride	Caltrans CTM42 / AASHTO T 291 / ASTM D512B
Redox Potential	SM 2580B
BiCarbonate	SM 2320B
Alkalinity	SM 2520B
Acidity	SM 2510B
Nitrate	SM 4500-NO3 / Hach 835
Ammonia	SM 4500-NH3 / Hach 830
Sulfide	SM 4500-S2 / SM 4500-S2
Moisture Content	ASTM D2216
Soil Corrosivity Evaluation Report	
Metallurgical Analysis	

#	SAMPLE ID - BORE #	DESCRIPTION	DEPTH (ft)	DATE COLLECTED	CORROSION SERIES	Soil Resistivity	pH	Sulfate	Chloride	Redox Potential	BiCarbonate	Alkalinity	Acidity	Nitrate	Ammonia	Sulfide	Moisture Content	Soil Corrosivity Evaluation Report	Metallurgical Analysis	NOTES
1		B-3 @ 0-3			X															
2																				
3																				
4																				
5																				
6																				
7																				
8																				
9																				
10																				
11																				
12																				
13																				
14																				