Geotechnologies, Inc.
Consulting Geotechnical Engineers

439 Western Avenue
Glendale, California 91201-2837
818.240.9600 • Fax 818.240.9675

Celebrating 50 YEARS OF SERVICE 1971-2021

July 9, 2021
File Number 22123

UCLA Housing
345 De Neve Drive
Los Angeles, CA 90024

Attention: Winfred Ho

Subject: Geotechnical Engineering Investigation
Proposed Cottages and Tent Platforms
UCLA Conference Center
850 Willow Creek Road
Lake Arrowhead, California

Ladies and Gentlemen:

This letter transmits the Geotechnical Engineering Investigation for the subject site prepared by Geotechnologies, Inc. This report provides geotechnical recommendations for the development of the site, including earthwork, seismic design, retaining walls, excavations, shoring and foundation design. Engineering for the proposed project should not begin until approval of the geotechnical investigation is granted by the local building official. Significant changes in the geotechnical recommendations may result due to the building department review process.

The validity of the recommendations presented herein is dependent upon review of the geotechnical aspects of the project during construction by this firm. The subsurface conditions described herein have been projected from limited subsurface exploration and laboratory testing. The exploration and testing presented in this report should in no way be construed to reflect any variations which may occur between the exploration locations or which may result from changes in subsurface conditions.

Should you have any questions please contact this office.

Respectfully submitted,
GEOTECHNOLOGIES, INC.

REGISTERED PROFESSIONAL ENGINEER
REINARD T. KNUR
NO. 2755
Exp. 12/31/22
GEOTECHNICAL
STATE OF CALIFORNIA

REINARD KNUR
G.E. 2755

RTK:dy

Distribution: (3) Addressee

Email to: [who@ha.ucla.edu];
[sdebnath@ha.ucla.edu]

TABLE OF CONTENTS

SECTION **PAGE**

TABLE OF CONTENTS

SECTION **PAGE**

TABLE OF CONTENTS

GEOTECHNICAL ENGINEERING INVESTIGATION
UCLA CONFERENCE CENTER
850 WILLOW CREEK ROAD
LAKE ARROWHEAD, CALIFORNIA

INTRODUCTION

This report presents the results of the geotechnical engineering investigation performed on the subject site. The purpose of this investigation was to identify the distribution and engineering properties of the earth materials underlying the site, and to provide geotechnical recommendations for the design of the proposed development.

This investigation included excavation of 16 test pits, collection of representative samples, laboratory testing, engineering analysis, review of published geologic data and the preparation of this report. The test pit locations are shown on the enclosed Vicinity and Geologic Map and the Site Map. The results of the exploration and the laboratory testing are presented in the Appendix of this report.

PROPOSED DEVELOPMENT

Information concerning the proposed development was furnished by the client. The site is proposed to be developed with residential structures on three sites at the conference center:

Site 1- An existing, 3-story building with a 1-level basement will be demolished for two, at-grade cottages totaling 12 keys. The proposed structures will be located partially over the footprint of the existing structure and partially over a proposed cut in the hill side.

Site 2 - An existing, 1-story, at-grade maintenance garage and paved parking lot will be demolished six at-grade staff housing structures. This area is relatively flat and located alongside Willow Creek Road.

Site 3 -10 new tent platforms and two pre-fabricated restroom structures on undeveloped land. These areas are distributed across the knoll and will be accessible by an unpaved trail. The site will be located among the exiting trees.

Column loads are estimated to be between 2 and 8 kips. Wall loads are estimated to be between 1 and 4 kips per lineal foot. These loads reflect the dead plus live load, of which the dead load is approximately 75 percent. Grading will consist of excavations as deep as 10 feet to remove the footings and fill from the existing 3-story building footprint.

Any changes in the design of the project or location of any structure, as outlined in this report, should be reviewed by this office. The recommendations contained in this report should not be considered valid until reviewed and modified or reaffirmed, in writing, subsequent to such review.

SITE CONDITIONS

The site is located on the north shore of Lake Arrowhead at the UCLA Conference Center in Lake Arrowhead, California. The site is several acres in size and includes a small knoll. Site elevations range from 5270 feet above mean sea level on the knoll to 5123 feet along Willow Creek Road for a total elevation difference of 147 feet. The overall site gradient is 5 to 1 (horizontal to vertical). Drainage is by sheet flow in all directions.

The site is sparsely developed with 1 to 3 story residential and maintenance structures. The vegetation on the site consists of mature trees, bushes and grasses.

GEOTECHNICAL EXPLORATION

FIELD EXPLORATION

The site was explored on March 13, 2021, by excavating test pits that varied in depth from 4 to 8 feet, using hand labor. The test pits were approximately 30 inches in diameter. The test pit locations are shown on the Vicinity and Geologic Map and the Site Map. The geologic materials encountered are logged on Plates A-1 through A-16. The subsurface distribution of the geologic materials is presented on the attached Cross Section A-A', Cross Section B-B', and Cross Section C-C'.

The location of test pits was determined by measurement from hardscape features shown on the Vicinity and Geologic Map. Elevations of the exploratory excavations were determined by interpolation from data provided. The location and elevation of the test pits should be considered accurate only to the degree implied by the method used.

Geologic Materials

The geologic materials include of fill, colluvium, and granitic bedrock. The fill soil consists of silty sand that is dark brown, moist and medium dense. The fill soil is distributed across the entire site and is up to 4 feet in thickness.

Colluvium was identified in many of the test pits and consists of silty sand that is dark brown, most and medium dense. Roots were identified in the Colluvium.

The bedrock consists of granite that is assigned to the Monzogranite of City Creek Formation. The bedrock is yellowish brown and dark brown, most, and moderately hard. In general, the upper two feet of the rock is very weathered and relatively easy to excavate. The rock is less weathered at a depth of approximately 2 feet below the contact with the Colluvium. Joints or fractures were not identified in the rock.

More detailed descriptions of the geologic materials may be obtained from the Test Pit Logs.

Groundwater

Groundwater was not encountered during exploration. Water is not anticipated within the excavation depth.

Fluctuations in the level of groundwater may occur due to variations in rainfall, temperature, and other factors not evident at the time of the measurements reported herein. Fluctuations also may occur across the site. High groundwater levels can result in changed conditions.

Caving

Caving was not encountered during excavation of the test pits. Caving in fill soil and colluvium may be encountered where the combined depth of these materials exceeds 5 feet. Caving in the bedrock is not anticipated.

SEISMIC EVALUATION

REGIONAL GEOLOGIC SETTING

The subject site is located in the Transverse Ranges Geomorphic Province. The Transverse Ranges are characterized by roughly east-west trending mountains and the northern and southern boundaries are formed by reverse fault scarps. The convergent deformational features of the Transverse Ranges are a result of north-south shortening due to plate tectonics. This has resulted in local folding and uplift of the mountains along with the propagation of thrust faults (including blind thrusts). The intervening valleys have been filled with sediments derived from the bordering mountains.

REGIONAL FAULTING

Based on criteria established by the California Division of Mines and Geology (CDMG) now called California Geologic Survey (CGS), Faults may be categorized as Holocene-active, Pre-Holocene faults, and Age-undetermined faults. Holocene-active faults are those which show evidence of surface displacement within the last 11,700 years. Pre-Holocene faults are those that have not moved in the past 11,700 years. Age-undetermined faults are faults where the recency of fault movement has not been determined.

Buried thrust faults are faults without a surface expression but are a significant source of seismic activity. They are typically broadly defined based on the analysis of seismic wave recordings of hundreds of small and large earthquakes in the southern California area. Due to the buried nature of these thrust faults, their existence is usually not known until they produce an earthquake. The risk for surface rupture potential of these buried thrust faults is inferred to be low (Leighton, 1990). However, the seismic risk of these buried structures in terms of recurrence and maximum potential magnitude is not well established. Therefore, the potential for surface rupture on these surface-verging splays at magnitudes higher than 6.0 cannot be precluded.

SEISMIC HAZARDS AND DESIGN CONSIDERATIONS

The primary geologic hazard at the site is moderate to strong ground motion (acceleration) caused by an earthquake on any of the local or regional faults. The potential for other earthquake-induced hazards was also evaluated including surface rupture, liquefaction, dynamic settlement, inundation and landsliding.

Surface Rupture

Surface rupture is defined as displacement which occurs at the ground surface of the causative fault during an earthquake. Based on research of available literature and results of site reconnaissance, no known Holocene-active or Pre-Holocene faults underlie the subject site. In addition, the subject site is not located within an Alquist-Priolo Earthquake Fault Zone. Based on these considerations, the potential for surface ground rupture at the subject site is considered low.

Liquefaction

Liquefaction is a phenomenon in which saturated silty to cohesionless soils below the groundwater table are subject to a temporary loss of strength due to the buildup of excess pore pressure during cyclic loading conditions such as those induced by an earthquake. Liquefaction-related effects include loss of bearing strength, amplified ground oscillations, lateral spreading, and flow failures.

The site is underlain by moderately hard bedrock at a shallow depth. Bedrock is not considered liquefiable due to its long tectonic history and hardness. The potential for liquefaction occurring on the site is negligible.

Landsliding

No landslides or areas of instability were noted during the geologic reconnaissance. The probability of seismically-induced landslides occurring on the site is considered to be low due to the lack of fractures and planar discontinuities in the rock.

CONCLUSIONS AND RECOMMENDATIONS

Based upon the exploration, laboratory testing, and research, it is the finding of Geotechnologies, Inc. that construction of the proposed structures is considered feasible from a geotechnical engineering standpoint provided the advice and recommendations presented herein are followed and implemented during construction.

The site is mantled with a thin cover of fill soil and natural colluvium over granitic bedrock. The fill soil ranges in thickness from 1.5 to 4 feet and the colluvium ranges from 0 to 3 feet in thickness. The bedrock is composed of very weathered to moderately weathered bedrock. The rock may be excavated with conventional excavation equipment. Groundwater was not identified in any of the test pits excavated to a depth of 8 feet.

The existing fill and colluvium are not suitable for support of the proposed foundations, floor slabs or additional fill. Conventional foundations bearing in newly placed controlled fill are recommended for foundation support.

Where building will have a floor slab, the existing fill soil and colluvium should be completely removed within the building areas and recompacted. The footings may bear in either bedrock or compacted fill, but not a combination of both. Where footings will be supported on compacted fill, the geologic materials should be removed to a minimum depth of 2 feet below proposed foundations and recompacted as controlled fill prior to foundation excavation.

Where the proposed cottages overlap the existing 3-story building with basement, it is recommended that all of the existing building footings and wall elements be removed and replaced with compacted fill bearing on the bedrock.

Where the buildings will be supported on piers and a raised floor, the piers should bear in the bedrock and the fill and colluvium may be left in place.

SEISMIC DESIGN CONSIDERATIONS

California Building Code Seismic Parameters

Based on information derived from the subsurface investigation, the subject site is classified as Site Class C, which corresponds to a "Stiff Soil" Profile, according to Table 20.3-1 of ASCE 7-

16. This information and the site coordinates were input into the OSHPD seismic utility program in order to calculate ground motion parameters for the site.

CALIFORNIA BUILDING CODE SEISMIC PARAMETERS	
California Building Code	2019
ASCE Design Standard	7-16
Risk Category	II
Site Class	C
Mapped Spectral Acceleration at Short Periods (S_S)	1.869g
Site Coefficient (F_a)	1.2
Maximum Considered Earthquake Spectral Response for Short Periods (S_{MS})	2.243g
Five-Percent Damped Design Spectral Response Acceleration at Short Periods (S_{DS})	1.495g
Mapped Spectral Acceleration at One-Second Period (S_1)	0.709g
Site Coefficient (F_v)	1.4
Maximum Considered Earthquake Spectral Response for One-Second Period (S_{M1})	0.992g
Five-Percent Damped Design Spectral Response Acceleration for One-Second Period (S_{D1})	0.661g

FILL SOILS

The maximum depth of fill encountered on the site was 4 feet. This material and any fill generated during demolition should be removed and recompacted as controlled fill prior to foundation excavation.

EXPANSIVE SOILS

The onsite geologic materials are in the very low to low expansion range. The Expansion Index was found to be 13 to 26 for bulk samples remolded to 90 percent of the laboratory maximum density. Special reinforcement considerations are not required.

WATER-SOLUBLE SULFATES

The Portland cement portion of concrete is subject to attack when exposed to water-soluble sulfates. Usually, the two most common sources of exposure are from soil and marine environments.

The water-soluble sulfate content of the onsite geologic materials was tested by California Test 417. The water-soluble sulfate content was determined to be less than 0.1% percentage by weight for the soils tested. Based on the most recent revision to American Concrete Institute (ACI) Standard 318, the sulfate exposure is considered to be negligible for geologic materials with less than 0.1% and Type I cement may be utilized for concrete foundations in contact with the site soils. Concrete strength should be a minimum of 2,500 psi.

GRADING GUIDELINES

Site Preparation

- A thorough search should be made for possible underground utilities and/or structures. Any existing or abandoned utilities or structures located within the footprint of the proposed grading should be removed or relocated as appropriate.

- All vegetation, existing fill, and soft or disturbed geologic materials should be removed from the areas to receive controlled fill. All existing fill materials and any disturbed geologic materials resulting from grading operations shall be completely removed and properly recompacted prior to foundation excavation.

- Any vegetation or associated root system located within the footprint of the proposed structures should be removed during grading.

- Subsequent to the indicated removals, the exposed grade shall be scarified to a depth of six inches, moistened to optimum moisture content, and recompacted in excess of the minimum required comparative density.

- The excavated areas shall be observed by the geotechnical engineer prior to placing compacted fill.

Recommended Overexcavation

Where a structure will have a slab on grade and the building will be supported on compacted fill, the proposed building areas shall be excavated to a minimum depth of 2 feet below the bottom of all foundations. The excavation shall extend at least three feet beyond the edge of foundations or for a distance equal to the depth of fill below the foundations, whichever is greater. It is very important that the positions of the proposed structures are accurately located so that the limits of the graded area are accurate and the grading operation proceeds efficiently.

Compaction

Comparative compaction is defined, for purposes of these guidelines, as the ratio of the in-place density to the maximum density as determined by applicable ASTM testing.

All fill should be mechanically compacted in layers not more than 8 inches thick. The materials placed should be moisture conditions to within 3 percent of the optimum moisture content of the particular material placed. All fill shall be compacted to at least 90 percent of the maximum laboratory density for the materials used. The maximum density shall be determined by the laboratory operated by Geotechnologies, Inc. in general accordance with the most recent revision of ASTM D 1557.

Field observation and testing shall be performed by a representative of the geotechnical engineer during grading to assist the contractor in obtaining the required degree of compaction and the proper moisture content. Where compaction is less than required, additional compactive effort shall be made with adjustment of the moisture content, as necessary, until a minimum of 90 percent compaction is obtained.

Acceptable Materials

The excavated onsite materials are considered satisfactory for reuse in the controlled fills as long as any debris and/or organic matter is removed. Rock greater than 6 inches in dimension must also be removed from the fill.

Any imported materials shall be observed and tested by the representative of the geotechnical engineer prior to use in fill areas. Imported materials should contain sufficient fines to provide a stable subgrade when compacted. Any required import materials should consist of geologic materials with an expansion index of less than 30. The water-soluble sulfate content of the import materials should be less than 0.1% percentage by weight.

Imported materials should be free from chemical or organic substances which could affect the proposed development. A competent professional should be retained in order to test imported materials and address environmental issues and organic substances which might affect the proposed development.

Utility Trench Backfill

Utility trenches should be backfilled with controlled fill. The utility should be bedded with clean sands at least one foot over the crown. The remainder of the backfill may be onsite soil compacted to 90 percent of the laboratory maximum density. Utility trench backfill should be tested by representatives of this firm in general accordance with the most recent revision of ASTM D 1557.

Bulking and Shrinkage

Shrinkage results when a volume of soil removed at one density is compacted to a higher density. A shrinkage factor between 5 and 10 percent should be anticipated when excavating and recompacting the existing fill and underlying native geologic materials on the site to an average comparative compaction of 92 percent.

Weather Related Grading Considerations

When rain is forecast all fill that has been spread and awaits compaction shall be properly compacted prior to stopping work for the day or prior to stopping due to inclement weather. These fills, once compacted, shall have the surface sloped to drain to an area where water can be removed.

Temporary drainage devices should be installed to collect and transfer excess water to the street in non-erosive drainage devices. Drainage should not be allowed to pond anywhere on the site, and especially not against any foundation or retaining wall. Drainage should not be allowed to flow uncontrolled over any descending slope.

Work may start again, after a period of rainfall, once the site has been reviewed by a representative of this office. Any soils saturated by the rain shall be removed and aerated so that the moisture content will fall within three percent of the optimum moisture content.

Surface materials previously compacted before the rain shall be scarified, brought to the proper moisture content and recompacted prior to placing additional fill, if considered necessary by a representative of this firm.

Abandoned Seepage Pits

No abandoned seepage pits were encountered during exploration and none are known to exist on the site. However, should such a structure be encountered during grading, options to permanently abandon seepage pits include complete removal and backfill of the excavation with compacted fill, or drilling out the loose materials and backfilling to within a few feet of grade with slurry, followed by a compacted fill cap.

If the subsurface structures are to be removed by grading, the entire structure should be demolished. The resulting void may be refilled with compacted soil. Concrete and brick generated during the seepage pit removal may be reused in the fill as long as all fragments are less than 6 inches in longest dimension and the debris comprises less than 15 percent of the fill by volume. All grading should comply with the recommendations of this report.

Where the seepage pit structure is to be left in place, the seepage pits should cleaned of all soil and debris. This may be accomplished by drilling. The pits should be filled with minimum 1-1/2 sack concrete slurry to within 5 feet of the bottom of the proposed foundations. In order to provide a more uniform foundation condition, the remainder of the void should be filled with controlled fill.

Geotechnical Observations and Testing During Grading

Geotechnical observations and testing during grading are considered to be a continuation of the geotechnical investigation. It is critical that the geotechnical aspects of the project be reviewed by representatives of Geotechnologies, Inc. during the construction process. Compliance with the design concepts, specifications or recommendations during construction requires review by this firm during the course of construction. Any fill which is placed should be observed, tested, and verified if used for engineered purposes. Please advise this office at least twenty-four hours prior to any required site visit.

Proper compaction is necessary to reduce settlement of overlying improvements. Some settlement of compacted fill should be anticipated. Any utilities supported therein should be designed to accept differential settlement. Differential settlement should also be considered at the points of entry to the structure.

LEED Considerations

The Leadership in Energy and Environmental Design (LEED) Green Building Rating System encourages adoption of sustainable green building and development practices. Credit for LEED Certification can be assigned for reuse of construction waste and diversion of materials from landfills in new construction.

In an effort to provide the design team with a viable option in this regard, demolition debris could be crushed onsite in order to use it in the ongoing grading operations. The environmental ramifications of this option, if any, should be considered by the team.

The demolition debris should be limited to concrete, asphalt and other non-deleterious materials. All deleterious materials should be removed including, but not limited to, paper, garbage, ceramic materials and wood.

For structural fill applications, the materials should be crushed to 2 inches in maximum dimension or smaller. The crushed materials should be thoroughly blended and mixed with onsite soils prior to placement as compacted fill. The amount of crushed material should not exceed 20 percent. The blended and mixed materials should be tested by this office prior to placement to insure it is suitable for compaction purposes. The blended and mixed materials should be tested by Geotechnologies, Inc. during placement to ensure that it has been compacted in a suitable manner.

Hillside Grading Issues

Sidehill fills should have a key placed at the toe of the proposed fill slope. This key should be cut a minimum of 2 feet into the bedrock. The base of the key shall be sloped back into the hill. Where slopes are steeper than 5:1 (5 horizontal to 1 vertical), horizontal benches shall be cut into bedrock in order to provide both lateral and vertical stability.

Sidehill fills shall have backdrains installed at the compacted fill contact to prevent future poor water pressure buildup. Backdrains shall consist of four-inch diameter, perforated pipe; placed with perforations down. The pipe should be encased with at least one foot of gravel. The minimum cover on the pipe should be one foot. The gravel should consist of three-quarter inch to one-inch diameter crushed rock.

The first drain shall be placed no higher than three feet above the front cut of the key excavation. Additional backdrains shall be placed at intervals roughly equivalent to 10 feet of vertical rise in elevation or where considered necessary by the representative of this firm.

Each drain shall be placed into a trench excavated along the back of a horizontal bench at the fill/bedrock contact. The trench bottom shall slope downward to each exit drain with a minimum gradient of two percent. The exit pipe shall consist of a four-inch, diameter non-perforated pipe. This pipe need not be encased in gravel. It shall exit at a minimum gradient of two percent to the finish face of the fill slope. A cutoff wall consisting of concrete or soil cement shall be placed at the junction of the perforated pipe and the exit drains to stop seepage and force the water being removed into the perforated pipe.

Materials excavated uphill from where fills are to be placed, shall not be cast over the slope into the fill area. Materials shall be channeled down a ramp to the area to receive compacted fill and then spread in horizontal layers. As compacted fills are placed, this ramp will be trimmed out to expose the dense, tight materials approved by the soils engineer. The minimum vertical height of bench in approved materials shall be three feet. This will maintain the proper benching, as fill is placed up the slope. The ramp will be shifted periodically during the grading operations to allow for complete removal of the loose fill materials and for the proper benching.

A minimum compaction of 90 percent out to the finish face of fill slopes will be required. Compaction on slopes may be achieved by over building the slope and cutting back to the compacted core or by direct compaction of the slope face with suitable equipment. Direct compaction on the slope faces shall be accomplished by back-rolling the slopes in three foot to four-foot increments of elevation gain.

FOUNDATION DESIGN

Conventional

Conventional foundations may bear in bedrock or compacted fill but not a combination of both. All conventional foundations for a structure should bear in the same material.

Footings in Bedrock

Continuous foundations may be designed for a bearing capacity of 4,000 pounds per square foot and should be a minimum of 12 inches in width, 18 inches in depth below the lowest adjacent grade and 18 inches into the bedrock.

Column foundations may be designed for a bearing capacity of 4,500 pounds per square foot, and should be a minimum of 24 inches in width, 18 inches in depth below the lowest adjacent grade and 18 inches into the bedrock.

The bearing capacity increase for each additional foot of width is 250 pounds per square foot. The bearing capacity increase for each additional foot of depth is 250 pounds per square foot. The maximum recommended bearing capacity is 5,000 pounds per square foot.

The bearing capacities indicated above are for the total of dead and frequently applied live loads, and may be increased by one third for short duration loading, which includes the effects of wind or seismic forces.

Footings in Compacted Fill

Continuous foundations may be designed for a bearing capacity of 2,000 pounds per square foot and should be a minimum of 12 inches in width, 24 inches in depth below the lowest adjacent grade and 24 inches into the compacted fill.

Column foundations may be designed for a bearing capacity of 2,500 pounds per square foot, and should be a minimum of 24 inches in width, 24 inches in depth below the lowest adjacent grade and 24 inches into the compacted fill.

The bearing capacity increase for each additional foot of width is 250 pounds per square foot. The bearing capacity increase for each additional foot of depth is 250 pounds per square foot. The maximum recommended bearing capacity is 3,000 pounds per square foot.

The bearing capacities indicated above are for the total of dead and frequently applied live loads, and may be increased by one third for short duration loading, which includes the effects of wind or seismic forces.

Miscellaneous Foundations

Conventional foundations for structures such as privacy walls or trash enclosures which will not be rigidly connected to the proposed cottages or residential buildings the bedrock or compacted fill, but not a combination of both. Continuous footings may be designed for a bearing capacity of 2,000 pounds per square foot, and should be a minimum of 12 inches in width, 18 inches in depth below the lowest adjacent grade and 18 inches into the recommended bearing material. No bearing capacity increases are recommended.

Since the recommended bearing capacity is a net value, the weight of concrete in the foundations may be taken as 50 pounds per cubic foot and the weight of the soil backfill may be neglected when determining the downward load on the foundations.

Foundation Reinforcement

All continuous foundations should be reinforced with a minimum of four #4 steel bars. Two should be placed near the top of the foundation, and two should be placed near the bottom.

Lateral Design

Footings in Bedrock

Resistance to lateral loading may be provided by friction acting at the base of foundations and by passive earth pressure. An allowable coefficient of friction of 0.4 may be used with the dead load forces for footings bearing in bedrock.

Passive geologic pressure for the sides of foundations poured against undisturbed or recompacted soil may be computed as an equivalent fluid having a density of 400 pounds per cubic foot with a maximum earth pressure of 4,000 pounds per square foot.

The passive and friction components may be combined for lateral resistance without reduction. A one-third increase in the passive value may be used for short duration loading such as wind or seismic forces.

Footings in Compacted Fill

Resistance to lateral loading may be provided by friction acting at the base of foundations and by passive earth pressure. An allowable coefficient of friction of 0.3 may be used with the dead load forces for footings bearing in bedrock.

Passive geologic pressure for the sides of foundations poured against undisturbed or recompacted soil may be computed as an equivalent fluid having a density of 300 pounds per cubic foot with a maximum earth pressure of 3,000 pounds per square foot.

The passive and friction components may be combined for lateral resistance without reduction. A one-third increase in the passive value may be used for short duration loading such as wind or seismic forces.

Foundation Settlement

Footings in Bedrock

Settlement of the foundation system is expected to occur on initial application of loading. The maximum settlement is expected to be 1/2 inch and occur below the heaviest loaded columns. Differential settlement is not expected to exceed 1/4 inch.

Footings in Compacted Fill

Settlement of the foundation system is expected to occur on initial application of loading. The maximum settlement is expected to be 3/4 inch and occur below the heaviest loaded columns. Differential settlement is not expected to exceed 1/2 inch.

Building Setback

The Building Code requires that the planned building be setback horizontally from the retaining wall, located at the toe of the adjacent ascending slopes. The required setback corresponds to a horizontal distance equal to one-half of the vertical height of the slope above the retaining wall, with a minimum distance of three feet and a maximum distance of fifteen feet. This distance is measured from the face of the building to the face of the retaining wall.

The Building Code requires that foundations be excavated to a sufficient distance from the face of a descending slope to provide sufficient vertical and lateral support. The required setback is 1/3 the height of the descending slope with a minimum of five feet and a maximum of 40 feet measured horizontally from the base of the foundation to the slope face.

RETAINING WALL DESIGN

Cantilever Retaining Walls

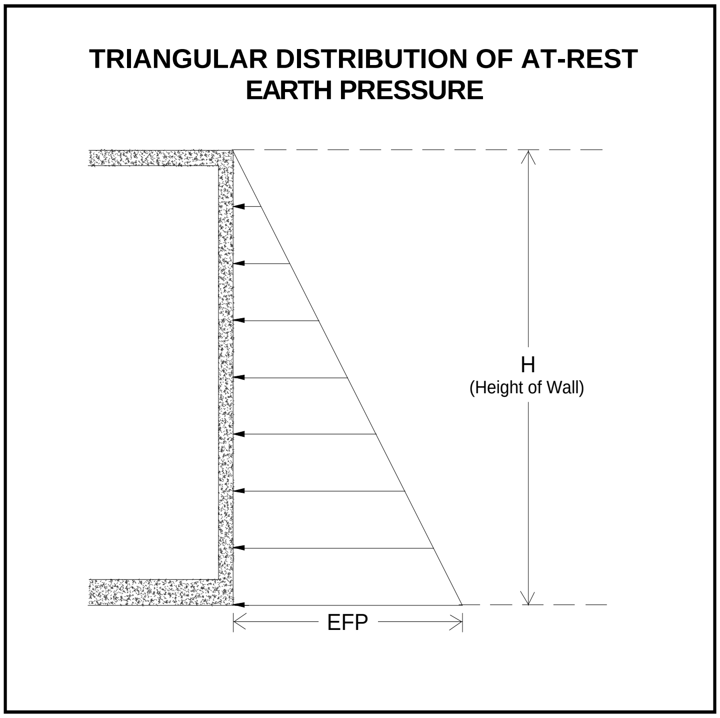
Retaining walls supporting a level backslope may be designed utilizing a triangular distribution of pressure. Cantilever retaining walls may be designed for 30 pounds per cubic foot for walls retaining up to 10 feet of earth.

For this equivalent fluid pressure to be valid, walls which are to be restrained at the top should be backfilled prior to the upper connection being made. Additional active pressure should be added for a surcharge condition due to sloping ground, vehicular traffic or adjacent structures.

All walls retaining an ascending slope should maintain a minimum of 2 feet of freeboard. In addition, a concrete swale shall be provided behind the proposed retaining walls to aid in facilitating drainage. Drainage shall be collected and discharged to an acceptable drainage area.

Restrained Drained Retaining Walls

Restrained retaining walls may be designed to resist a triangular pressure distribution of at-rest earth pressure as indicated in the diagram below. The at-rest pressure for design purposes would be 67 pounds per cubic foot. Additional earth pressure should be added for a surcharge condition due to sloping ground, vehicular traffic or adjacent structures.



In addition to the recommended earth pressure, the upper ten feet of the retaining wall adjacent to streets, driveways or parking areas should be designed to resist a uniform lateral pressure of 100 pounds per square foot, acting as a result of an assumed 300 pounds per square foot surcharge behind the walls due to normal street traffic. If the traffic is kept back at least ten feet from the retaining walls, the traffic surcharge may be neglected.

The lateral earth pressures recommended above for retaining walls assume that a permanent drainage system will be installed so that external water pressure will not be developed against the walls. Also, where necessary, the retaining walls should be designed to accommodate any surcharge pressures that may be imposed by existing buildings on the adjacent property.

Retaining Wall Drainage

Subdrains may consist of 4-inch diameter perforated pipes, places with perforations facing down. The pipe shall be encased in at least one foot of gravel around the pipe. The gravel shall be wrapped in filter fabric. The gravel may consist of three-quarter inch to one-inch crushed rock. As an alternative, the use of gravel pockets and weepholes is an acceptable drainage method. Weepholes shall be a minimum of 2 inches in diameter, placed at 8 feet on center along the base of the wall. Gravel pockets shall be a minimum of 1 cubic foot in dimension, and may consist of three-quarter inch to once inch crushed rock, wrapped in filter fabric.

Certain types of subdrain pipe are not acceptable to the various municipal agencies, it is recommended that prior to purchasing subdrainage pipe, the type and brand is cleared with the proper municipal agencies. Subdrainage pipes should outlet to an acceptable location.

Where retaining walls are to be constructed adjacent to property lines there is usually not enough space for emplacement of a standard pipe and gravel drainage system. Under these circumstances, the use of a flat drainage produce is acceptable.

Some municipalities do not allow the use of flat-drainage products. The use of such a product should be researched with the building official. As an alternative, omission of one-half of a block at the back of the wall on eight-foot centers is an acceptable method of draining the walls. The resulting void should be filled with gravel. A collector is placed within the gravel which directs collected waters through the wall to a sump or standard pipe and gravel system constructed under the slab. This method should be approved by the retaining wall designer prior to implementation.

Where shoring will not allow the installation of a standard subdrainage system outside the wall rock pockets may be utilized. The rock pockets with should drain through the wall. The pockets should be a minimum of 12 inches in length, width and depth. The pocket should be filled with gravel. The rock pockets should be no more than 8 feet on center.

Dynamic (Seismic) Earth Pressure

The maximum dynamic active pressure is equal to the sum of the initial static pressure and the dynamic (seismic) pressure increment. Under the most recent building code, as interpreted by most building departments, seismic earth pressure is required in the design of restraining walls which support over 6 feet of earth. The proposed walls are less than 6 feet in height therefore the dynamic earth pressure may be omitted.

Retaining walls exceeding 6 feet in height shall be designed to resist the additional earth pressure caused by seismic ground shaking. A triangular pressure distribution should be utilized for the additional seismic loads, with an equivalent fluid pressure of 26 pounds per cubic foot. When using the load combination equations from the building code, the seismic earth pressure should be combined with the lateral active earth pressure for analyses of restrained basement walls under seismic loading condition.

Waterproofing

Moisture effecting retaining walls is one of the most common post construction complaints. Poorly applied or omitted waterproofing can lead to efflorescence or standing water inside the building. Efflorescence is a process in which a powdery substance is produced on the surface of the concrete by the evaporation of water. The white powder usually consists of soluble salts such as gypsum, calcite, or common salt. Efflorescence is common to retaining walls and does not affect their strength or integrity.

Waterproofing is recommended for retaining walls. Waterproofing design and inspection of its installation is not the responsibility of the geotechnical engineer. A qualified waterproofing consultant should be retained in order to recommend a product or method which would provide protection to below grade walls.

Retaining Wall Backfill

Any required backfill should be mechanically compacted in layers not more than 8 inches thick, to at least 90 percent of the maximum density in general accordance with the most recent revision of ASTM D 1557 method of compaction. Flooding should not be permitted. Compaction within 5 feet, measured horizontally, behind a retaining structure should be achieved by use of light weight, hand operated compaction equipment.

Proper compaction of the backfill will be necessary to reduce settlement of overlying walks and paving. Some settlement of required backfill should be anticipated, and any utilities supported therein should be designed to accept differential settlement, particularly at the points of entry to the structure.

TEMPORARY EXCAVATIONS

Excavations on the order of up to 8 feet in vertical height will be required. The excavations are expected to expose fill, natural colluvium, and bedrock which are suitable for vertical excavations up to 6 feet where not surcharged by adjacent traffic or structures.

Where sufficient space is available, temporary unsurcharged embankments could be cut at a uniform 1 to 1 slope gradient. A uniform sloped excavation is sloped from bottom to top and does not have a vertical component.

Where sloped embankments are utilized, the tops of the slopes should be barricaded to prevent vehicles and storage loads near the top of slope within a horizontal distance equal to the depth of the excavation. If the temporary construction embankments are to be maintained during the rainy season, berms are strongly recommended along the tops of the slopes to prevent runoff water from entering the excavation and eroding the slope faces. Water should not be allowed to pond on top of the excavation nor to flow towards it.

Excavation Observations

It is critical that the soils exposed in the cut slopes are observed by a representative of Geotechnologies, Inc. during excavation so that modifications of the slopes can be made if variations in the geologic material conditions occur. Many building officials require that temporary excavations should be made during the continuous observations of the geotechnical engineer. All excavations should be stabilized within 30 days of initial excavation.

Slot Cutting

The slot cutting method employs the earth as a buttress and allows the earth excavation to proceed in phases. The initial excavation is made at a uniform 1:1 slope. Alternate "A" slots of 8 feet may be worked. The remaining earth buttresses ("B" and "C" slots) should each be 8 feet in width for a combined intervening length of 16 feet. The retaining wall should be completed and backfilled in the "A" slots before the "B" slots are excavated. After completing and backfilling the wall in the "B" slots, finally the "C" slots may be excavated. Where the retaining wall in the "A" and/or "B" slots is to be braced, the bracing should be designed for a triangular pressure distribution a minimum equivalent fluid pressure of 25 pounds per cubic foot.

SLABS ON GRADE

Concrete Slabs-on Grade

Concrete floor slabs should be a minimum of 4 inches in thickness. Slabs-on-grade should be cast over compacted fill soil. Any geologic materials loosened or over-excavated should be wasted from the site or properly compacted to 90 percent of the maximum dry density.

Outdoor concrete flatwork should be a minimum of 3 inches in thickness. Outdoor concrete flatwork should be cast over undisturbed natural geologic materials or properly controlled fill materials. Any geologic materials loosened or over-excavated should be wasted from the site or properly compacted to 90 percent of the maximum dry density.

Design of Slabs That Receive Moisture-Sensitive Floor Coverings

Geotechnologies, Inc. does not practice in the field of moisture vapor transmission evaluation and mitigation. Therefore, where necessary, it is recommended that a qualified consultant should be engaged to evaluate the general and specific moisture vapor transmission paths and any impact on the proposed construction. The qualified consultant should provide recommendations for mitigation of potential adverse impacts of moisture vapor on various components of the structure.

Where any dampness would be objectionable or where the slab will be cast below the historic high groundwater level, it is recommended that floor slabs should be waterproofed. A qualified waterproofing consultant should be engaged in order to recommend a product and/or method which would provide protection from unwanted moisture.

Based on ACI 302.2R-30, Chapter 7, for projects which do not have vapor sensitive coverings or humidity-controlled areas, a vapor retarder/barrier is not necessary. Where a vapor retarder/barrier is considered necessary, the design of the slab and the installation of the vapor retarder/barrier should comply with the most recent revisions of ASTM E 1643 and ASTM E 1745. The vapor retarder/barrier should comply with ASTM E 1745 Class A requirements. The necessity of a vapor retarder/barrier is not a geotechnical issue and should be confirmed by qualified members of the design team.

Based on ACI 302.2R-30, Chapter 7, for projects with vapor sensitive coverings, a vapor retarder/ barrier should be provided. The slab should be poured on the vapor retarder/barrier. Experience has shown, however, that the greatest level of protection for floor coverings, coating, or building environments is provided when the vapor retarder/barrier is placed in direct contact with the slab. The necessity of a vapor retarder as well as the use of dry granular material, as discussed above is not a geotechnical issue and should be confirmed by qualified members of the design team.

Where a vapor retarder/barrier is used, it should be placed on a level and compact subgrade. Precautions should be taken to protect the vapor retarder/barrier from damage during installation of reinforcing, utilities and concrete. The use of stakes driven thought the vapor retarder/barrier should be avoided. Repair any damaged areas of the vapor retarder/barrier prior to concrete placement.

Concrete Crack Control

The recommendations presented in this report are intended to reduce the potential for cracking of concrete slabs-on-grade due to settlement. However even where these recommendations have been implemented, foundations, stucco walls and concrete slabs-on-grade may display some cracking due to minor soil movement and/or concrete shrinkage. The occurrence of concrete cracking may be reduced and/or controlled by limiting the slump of the concrete used, proper concrete placement and curing, and by placement of crack control joints at reasonable intervals, in particular, where re-entrant slab corners occur.

For standard control of concrete cracking, a maximum crack control joint spacing of 12 feet should not be exceeded. Lesser spacings would provide greater crack control. Joints at curves and angle points are recommended. The crack control joints should be installed as soon as practical following concrete placement. Crack control joints should extend a minimum depth of one-fourth the slab thickness. Construction joints should be designed by a structural engineer.

Complete removal of the existing fill soils beneath outdoor flatwork such as walkways or patio areas, is not required, however, due to the rigid nature of concrete, some cracking, a shorter design life and increased maintenance costs should be anticipated. In order to provide uniform support beneath the flatwork it is recommended that a minimum of 12 inches of the exposed subgrade beneath the flatwork be scarified and recompacted to 90 percent relative compaction.

Slab Reinforcing

Concrete slabs-on-grade should be reinforced with a minimum of #4 steel bars on 16-inch centers each way.

Outdoor flatwork should be reinforced with a minimum of #3 steel bars on 18-inch centers each way.

PAVEMENTS

Prior to placing paving, the existing grade should be scarified to a depth of 12 inches, moistened as required to obtain optimum moisture content, and recompacted to 90 percent of the maximum density as determined by the most recent revision of ASTM D 1557. The design team should be aware that removal of all existing fill in the area of new paving is not required, however, pavement constructed in this manner will most likely have a shorter design life and increased maintenance costs. The following pavement sections are recommended:

Service	Asphalt Pavement Thickness Inches	Base Course Inches
Passenger Cars (TI=5)	3	4
Moderate Truck (TI=6)	4	6

Aggregate base should be compacted to a minimum of 95 percent of the most recent revision of ASTM D 1557 laboratory maximum dry density. Base materials should consist of Crushed Aggregate Base which conform with Section 200-2.2 of the most recent edition of "Standard Specifications for Public Works Construction", (Green Book).

The performance of pavement is highly dependent upon providing positive surface drainage away from the edges. Ponding of water on or adjacent to pavement can result in saturation of the subgrade materials and subsequent pavement distress. If planter islands are planned, the perimeter curb should extend a minimum of 12 inches below the bottom of the aggregate base. In addition where landscaping is planned adjacent to pavement, it is recommended that a cutoff wall should be provided along the edge of the pavement. The cutoff wall should extend at least 12 inches below the depth of the base course.

The management of pavement wear primarily is focused on the distress caused by vertical loads. The reduction of vertical loading from large vehicles is assisted by increasing the number of axles. Multi-axle groups reduce the peak vertical loading and, when closely spaced, reduce the magnitude of the strain cycles to which the pavement is subjected. However, where tight low-speed turns are executed, non-steering axle groups lead to transverse shear forces (scuffing) at the pavement-tire interface.

With asphaltic concrete pavements, tensile shear stresses from tires can cause surface cracking and raveling, thus, the increased use of non-steering axle groups results in increased pavement wear in the vicinity of intersections and turnarounds where tight low speed turns are executed.

When designing intersections and turnarounds the turn radius should be as large as possible. This will lead to reduced “scuffing” forces. Where tight radius turns are unavoidable, the pavement surface design should take into account the high level of “scuffing” forces that will occur and thickened pavement and subgrade and base course keyways should be considered to assist in the reduction of lateral deflection.

SITE DRAINAGE

Proper surface drainage is critical to the future performance of the project. Saturation of a soil can cause it to lose internal shear strength and increase its compressibility, resulting in a change in the designed engineering properties. Proper site drainage should be maintained at all times.

All site drainage, with the exception of any required to disposed of onsite by stormwater regulations, should be collected and transferred to the street in non-erosive drainage devices. The proposed structure should be provided with roof drainage. Discharge from downspouts, roof drains and scuppers should not be permitted on unprotected soils within five feet of the building perimeter. Drainage should not be allowed to pond anywhere on the site, and especially not against any foundation or retaining wall. Drainage should not be allowed to flow uncontrolled over any descending slope. Planters which are located within a distance equal to the depth of a retaining wall should be sealed to prevent moisture adversely affecting the wall. Planters which are located within five feet of a foundation should be sealed to prevent moisture affecting the earth materials supporting the foundation.

STORMWATER DISPOSAL

Due to the shallow depth to granitic bedrock and the poor water transmission properties of granitic rock, stormwater infiltration is not considered feasible at the subject site. Some other means of stormwater infiltration is recommended.

Where percolation of stormwater into the subgrade soils is not advisable, most Building Officials have allowed the stormwater to be filtered through soils in planter areas. Once the water has been filtered through a planter it may be released into the storm drain system. It is recommended that overflow pipes are incorporated into the design of the discharge system in the planters to prevent flooding. In addition, the planters shall be sealed and waterproofed to prevent leakage. Please be advised that adverse impact to landscaping and periodic maintenance may result due to excessive water and contaminants discharged into the planters.

DESIGN REVIEW

Engineering of the proposed project should not begin until approval of the geotechnical report by the Building Official is obtained in writing. Significant changes in the geotechnical recommendations may result during the building department review process.

It is recommended that the geotechnical aspects of the project be reviewed by this firm during the design process. This review provides assistance to the design team by providing specific recommendations for particular cases, as well as review of the proposed construction to evaluate whether the intent of the recommendations presented herein are satisfied.

CONSTRUCTION MONITORING

Geotechnical observations and testing during construction are considered to be a continuation of the geotechnical investigation. It is critical that this firm review the geotechnical aspects of the project during the construction process. Compliance with the design concepts, specifications or recommendations during construction requires review by this firm during the course of construction. All foundations should be observed by a representative of this firm prior to placing concrete or steel. Any fill which is placed should be observed, tested, and verified if used for engineered purposes. Please advise Geotechnologies, Inc. at least twenty-four hours prior to any required site visit.

If conditions encountered during construction appear to differ from those disclosed herein, notify Geotechnologies, Inc. immediately so the need for modifications may be considered in a timely manner.

It is the responsibility of the contractor to ensure that all excavations and trenches are properly sloped or shored. All temporary excavations should be cut and maintained in accordance with applicable OSHA rules and regulations.

EXCAVATION CHARACTERISTICS

The exploration performed for this investigation is limited to the geotechnical excavations described. Direct exploration of the entire site would not be economically feasible. The owner, design team and contractor must understand that differing excavation and drilling conditions may be encountered based on boulders, gravel, oversize materials, groundwater and many other conditions. Fill materials, especially when they were placed without benefit of modern grading codes, regularly contain materials which could impede efficient grading and drilling. Excavation and drilling in these areas may require full size equipment. The contractor should be familiar with the site and the geologic materials in the vicinity.

CLOSURE AND LIMITATIONS

The purpose of this report is to aid in the design and completion of the described project. Implementation of the advice presented in this report is intended to reduce certain risks associated with construction projects. The professional opinions and geotechnical advice contained in this report are sought because of special skill in engineering and geology and were prepared in accordance with generally accepted geotechnical engineering practice. Geotechnologies, Inc. has a duty to exercise the ordinary skill and competence of members of the engineering profession. Those who hire Geotechnologies, Inc. are not justified in expecting infallibility, but can expect reasonable professional care and competence.

The recommendations of this report pertain only to the site investigated and are based upon the assumption that the geologic conditions do not deviate from those disclosed in the investigation. If any variations are encountered during construction, or if the proposed construction will differ from that anticipated herein, Geotechnologies, Inc. should be notified so that supplemental recommendations can be prepared.

This report is issued with the understanding that it is the responsibility of the owner, or the owner's representatives, to ensure that the information and recommendations contained herein are brought to the attention of the project architect and engineer and are incorporated into the plans. The owner is also responsible to see that the contractor and subcontractors carry out the geotechnical recommendations during construction.

The findings of this report are valid as of the date of this report. However, changes in the conditions of a property can occur with the passage of time, whether they are due to natural processes or the works of man on this or adjacent properties. In addition, changes in applicable or appropriate standards may occur, whether they result from legislation or the broadening of knowledge. Accordingly, the findings of this report may be invalidated wholly or partially by changes outside control of this firm. Therefore, this report is subject to review and should not be relied upon after a period of three years.

Geotechnical observations and testing during construction is considered to be a continuation of the geotechnical investigation. It is, therefore, most prudent to employ the consultant performing the initial investigative work to provide observation and testing services during construction. This practice enables the project to flow smoothly from the planning stages through to completion.

Should another geotechnical firm be selected to provide the testing and observation services during construction, that firm should prepare a letter indicating their assumption of the responsibilities of geotechnical engineer of record. A copy of the letter should be provided to the regulatory agency for review. The letter should acknowledge the concurrence of the new geotechnical engineer with the recommendations presented in this report.

EXCLUSIONS

Geotechnologies, Inc. does not practice in the fields of methane gas, radon gas, environmental engineering, waterproofing, dewatering organic substances or the presence of corrosive soils or wetlands which could affect the proposed development including mold and toxic mold. Nothing in this report is intended to address these issues and/or their potential effect on the proposed development. A competent professional consultant should be retained in order to address environmental issues, waterproofing, organic substances and wetlands which might effect the proposed development.

GEOTECHNICAL TESTING

Classification and Sampling

The soil is continuously logged by a representative of this firm and classified by visual examination in accordance with the Unified Soil Classification system. The field classification is verified in the laboratory, also in accordance with the Unified Soil Classification System. Laboratory classification may include visual examination, Atterberg Limit Tests and grain size distribution. The final classification is shown on the excavation logs.

Samples of the geologic materials encountered in the exploratory excavations were collected and transported to the laboratory. Undisturbed samples of soil are obtained at frequent intervals. Unless noted on the excavation logs as an SPT sample, samples acquired while utilizing a hollow-stem auger drill rig are obtained by driving a thin-walled, California Modified Sampler with successive 30-inch drops of a 140-pound hammer. Samples from bucket-auger drilling are obtained utilizing a California Modified Sampler with successive 12-inch drops of a kelly bar, whose weight is noted on the excavation logs. The soil is retained in brass rings of 2.50 inches outside diameter and 1.00 inch in height. The central portion of the samples are stored in close fitting, waterproof containers for transportation to the laboratory. Samples noted on the excavation logs as SPT samples are obtained in general accordance with the most recent revision of ASTM D 1586. Samples are retained for 30 days after the date of the geotechnical report.

Moisture and Density Relationships

The field moisture content and dry unit weight are determined for each of the undisturbed soil samples, and the moisture content is determined for SPT samples in general accordance with the most recent revision of ASTM D 4959 or ASTM D 4643. This information is useful in providing a gross picture of the soil consistency between exploration locations and any local variations. The dry unit weight is determined in pounds per cubic foot and shown on the "Excavation Logs", A-Plates. The field moisture content is determined as a percentage of the dry unit weight.

Direct Shear Testing

Shear tests are performed in general accordance with the most recent revision of ASTM D 3080 with a strain controlled, direct shear machine manufactured by Soil Test, Inc. or a Direct Shear Apparatus manufactured by GeoMatic, Inc. The rate of deformation is approximately 0.025 inches per minute. Each sample is sheared under varying confining pressures in order to determine the Mohr-Coulomb shear strength parameters of the cohesion intercept and the angle of internal friction. Samples are generally tested in an artificially saturated condition. Depending upon the sample location and future site conditions, samples may be tested at field moisture content. The results are plotted on the "Shear Test Diagram," B-Plates.

The most recent revision of ASTM 3080 limits the particle size to 10 percent of the diameter of the direct shear test specimen. The sheared sample is inspected by the laboratory technician running the test. The inspection is performed by splitting the sample along the sheared plane and observing the soils exposed on both sides. Where oversize particles are observed in the shear plane, the results are discarded and the test run again with a fresh sample.

Consolidation Testing

Settlement predictions of the soil's behavior under load are made on the basis of the consolidation tests in general accordance with the most recent revision of ASTM D 2435. The consolidation apparatus is designed to receive a single one-inch-high ring. Loads are applied in several increments in a geometric progression, and the resulting deformations are recorded at selected time intervals. Porous stones are placed in contact with the top and bottom of each specimen to permit addition and release of pore fluid. Samples are generally tested at increased moisture content to determine the effects of water on the bearing soil. The normal pressure at which the water is added is noted on the drawing. Results are plotted on the "Consolidation Test," C-Plates.

Expansion Index Testing

The expansion tests performed on the remolded samples are in accordance with the Expansion Index testing procedures, as described in the most recent revision of ASTM D 4829. The soil sample is compacted into a metal ring at a saturation degree of 50 percent. The ring sample is then placed in a consolidometer, under a vertical confining pressure of 1 lbf/square inch and inundated with distilled water. The deformation of the specimen is recorded for a period of 24 hour or until the rate of deformation becomes less than 0.0002 inches/hour, whichever occurs first. The expansion index, EI, is determined by dividing the difference between final and initial height of the ring sample by the initial height, and multiplied by 1,000.

Laboratory Compaction Characteristics

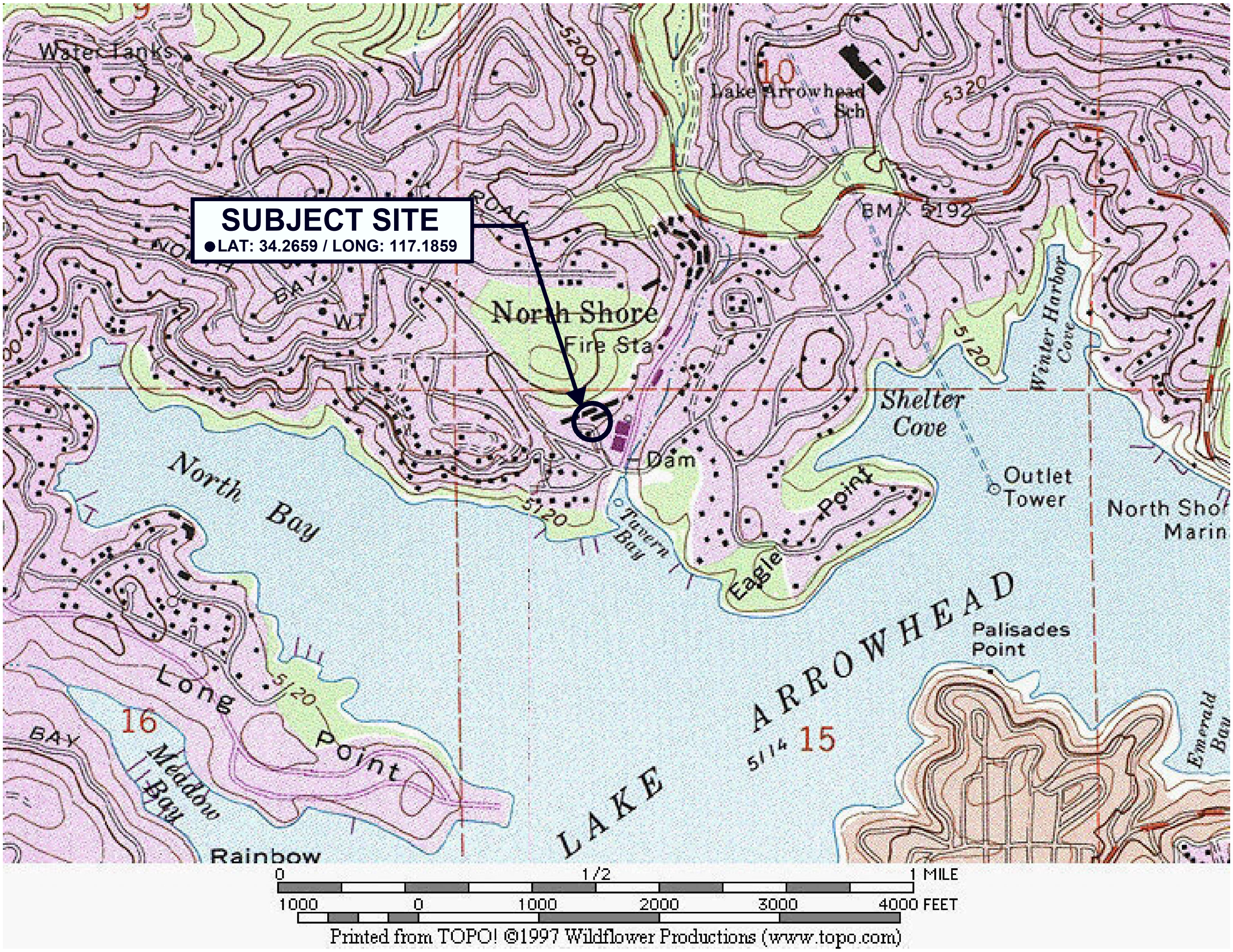
The maximum dry unit weight and optimum moisture content of a soil are determined in general accordance with the most recent revision of ASTM D 1557. A soil at a selected moisture content is placed in five layers into a mold of given dimensions, with each layer compacted by 25 blows of a 10-pound hammer dropped from a distance of 18 inches subjecting the soil to a total compactive effort of about 56,000 pounds per cubic foot. The resulting dry unit weight is determined. The procedure is repeated for a sufficient number of moisture contents to establish a relationship between the dry unit weight and the water content of the soil. The data when plotted represent a curvilinear relationship known as the compaction curve. The values of optimum moisture content and modified maximum dry unit weight are determined from the compaction curve.

REFERENCES

California Geological Survey, 2021, www.http//maps.conservation.ca.gov/cgs/eqzapp

County of San Bernardino, 1990, San Bernardino County General Plan, Geologic Hazard Overlay, Map FH15D, Map Scale 1:24.000.

Morton, D.M., and Miller, F.K., 2006, Preliminary Geologic Map of the San Bernardino 30' x60' Quadrangle, California, Version 1.0, map scale 1:100,00.



REFERENCE: U.S.G.S. TOPOGRAPHIC MAPS, 7.5 MINUTE SERIES, LAKE ARROWHEAD, CA QUADRANGLE

VICINITY MAP

Geotechnologies, Inc.
Consulting Geotechnical Engineers

U.C.L.A.
LAKE ARROWHEAD CONFERENCE CENTER

FILE NO. 22123

REFERENCE: SITE SURVEY BY RJL USING PHOTOGRAMMETRIC METHODS DATED 10/31/18
NOTE: NE = NOT ENCOUNTERED

LEGEND

- TP-16 — TEST PIT LOCATION AND NUMBER (BY: GEOTECHNOLOGIES, INC. 4/13/2021)
- TP2 — TEST PIT LOCATION AND NUMBER (BY: GEOTECHNOLOGIES, INC. 8/20/2009)
- B7 — TEST PIT LOCATION AND NUMBER (BY: GEOTECHNOLOGIES, INC. 4/10/2003)

SYMBOLS

- C C' — GEOLOGIC CROSS SECTION LOCATION
- — — GEOLOGIC CONTACT

GEOLOGIC UNITS

- **af** UNCERTIFIED FILL
- **Qcol** QUATERNARY COLLUVIUM
- **Qal** QUATERNARY ALLUVIUM
- **Kcc** BEDROCK (MONZOGRANITE OF CITY CREEK)

TEST PIT &BORING DETAILS

GEOTECHNOLOGIES, INC. (THIS REPORT)

TEST PIT 1	TEST PIT 2	TEST PIT 3	TEST PIT 4	TEST PIT 5	TEST PIT 6
G.S. 5122' af 0-3' Qcol 3-6.5' Qgr 6.5-8' NO GW	G.S. 5122' af 0-3' Qcol 3-6.5' Qgr 6.5-8' NO GW	G.S. 5125' af 0-3' Qcol 3-4' Qgr 4-6' NO GW	G.S. 5143' af 0-1.5' Qgr 1.5-5' NO GW	G.S. 5146' af 0-2.5' Qgr 2.5-6' NO GW	G.S. 5148' af 0-3' Qgr 3-6' NO GW

TEST PIT 7	TEST PIT 8	TEST PIT 9	TEST PIT 10	TEST PIT 11	TEST PIT 12
G.S. 5146' af 0-4' Qgr 4-5' NO GW	G.S. 5126' af 0-4' Qcol 4-7' Qgr 6.5-8' NO GW	G.S. 5230' af 0-1.5' Qcol 1.5-3' Qgr 3-6' NO GW	G.S. 5237' af 0-2' Qgr 2-6' NO GW	G.S. 5240' af 0-1.5' Qgr 1.5-4' NO GW	G.S. 5246' af 0-2' Qgr 2-6' NO GW

TEST PIT 12	TEST PIT 14	TEST PIT 15	TEST PIT 16
G.S. 5253' af 0-1.5' Qgr 1.5-6' NO GW	G.S. 5234' af 0-3.5' Qcol 3.5-6' Qgr 6-8' NO GW	G.S. 5254' af 0-2' Qcol 2-3' Qgr 3-6' NO GW	G.S. 5257' af 0-2' Qcol 2-3' Qgr 3-6' NO GW

GEOTECHNOLOGIES, INC. (FN: 19877)

TEST PIT 1	TEST PIT 2
G.S. 5145' af 0-4' Qgr 4-8' NO GW	G.S. 5145' af 0-2' Qal 2-4.5' NO GW

GEOTECHNOLOGIES, INC. (FN: 18335-S)

BORING 1	BORING 2	BORING 3	BORING 4	BORING 5
G.S. 5128' af 0-4' Qal 4-12.5' Qgr 12.5-20' NO GW	G.S. 5130' af 0-7' Qgr 7-30' NO GW	G.S. 5125' af 0-2' Qal 2-7.5' NO GW	G.S. 5125' af 0-5' Qal 5-12' Qgr 12-12.5' NO GW	G.S. 5128' af 0-4' Qal 4-13' Qgr 13-13.5' NO GW

BORING 6	BORING 7
G.S. 5128' af 0-2.5' Qal 2.5-7.5' NO GW	G.S. 5128' af 0-2' Qal 2-7.5' NO GW

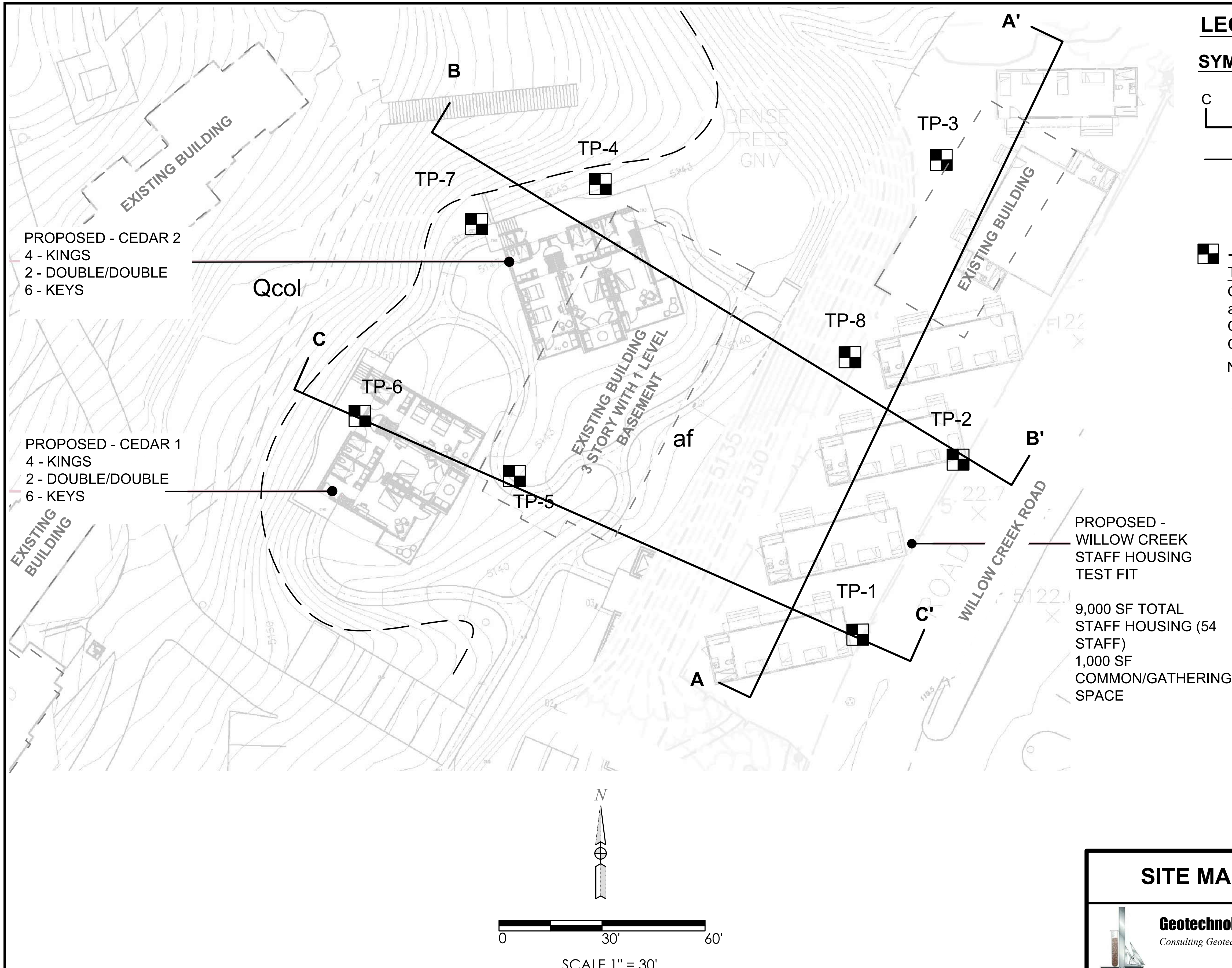
VICINITY & GEOLOGIC MAP

Geotechnologies, Inc.
Consulting Geotechnical Engineers

UCLA
80 WILLOW CREEK ROAD, LAKE ARROWHEAD, CA

FILE No. 22123 | DRAWN BY: SJM

DATE: JUNE 23, 2021



LEGEND

SYMBOLS

C — C' GEOLOGIC CROSS SECTION LOCATION

— — GEOLOGIC CONTACT

TEST PIT &BORING DETAILS

GEOTECHNOLOGIES, INC. (THIS REPORT)

TEST PIT 1	TEST PIT 2	TEST PIT 3
G.S. 5122'	G.S. 5122'	G.S. 5125'
af 0-3'	af 0-3'	af 0-3'
Qcol 3-6.5'	Qcol 3-6.5'	Qcol 3-4'
Qgr 6.5-8'	Qgr 6.5-8'	Qgr 4-6'
NO GW	NO GW	NO GW

TEST PIT 4	TEST PIT 5	TEST PIT 6
G.S. 5143'	G.S. 5146'	G.S. 5148'
af 0-1.5'	af 0-2.5'	af 0-3'
Qgr 1.5-5'	Qgr 2.5-6'	Qgr 3-6'
NO GW	NO GW	NO GW

TEST PIT 7	TEST PIT 8
G.S. 5146'	G.S. 5126'
af 0-4'	af 0-4'
Qgr 4-5'	Qcol 4-7'
NO GW	Qgr 6.5-8'
	NO GW

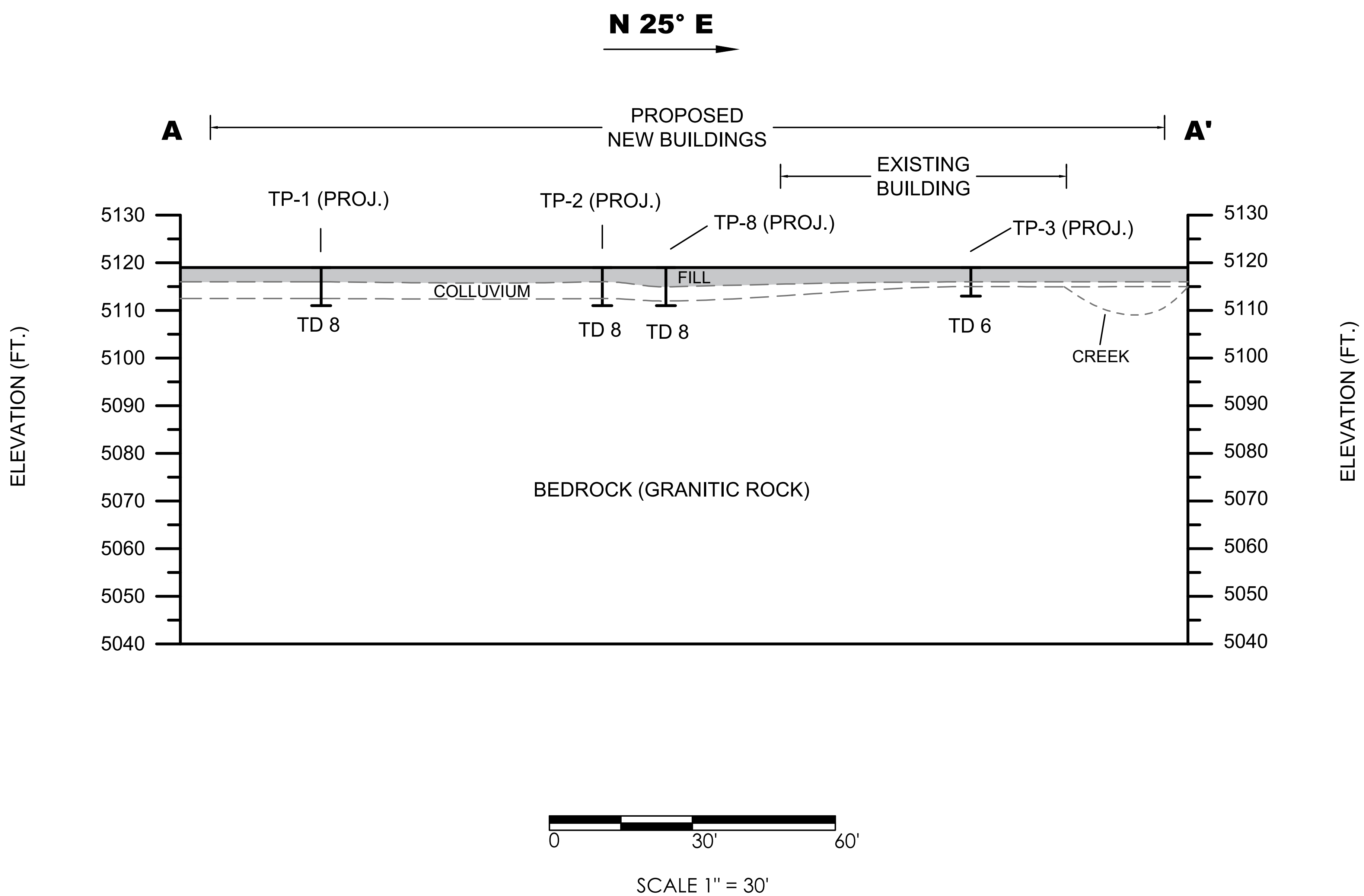
SITE MAP - PROPOSED NEW HOUSING

Geotechnologies, Inc.
Consulting Geotechnical Engineers

UCLA
80 WILLOW CREEK RD, LAKE ARROWHEAD, CA

FILE No. 22123 — DRAWN BY: SJM

DATE: JUNE 4, 2021



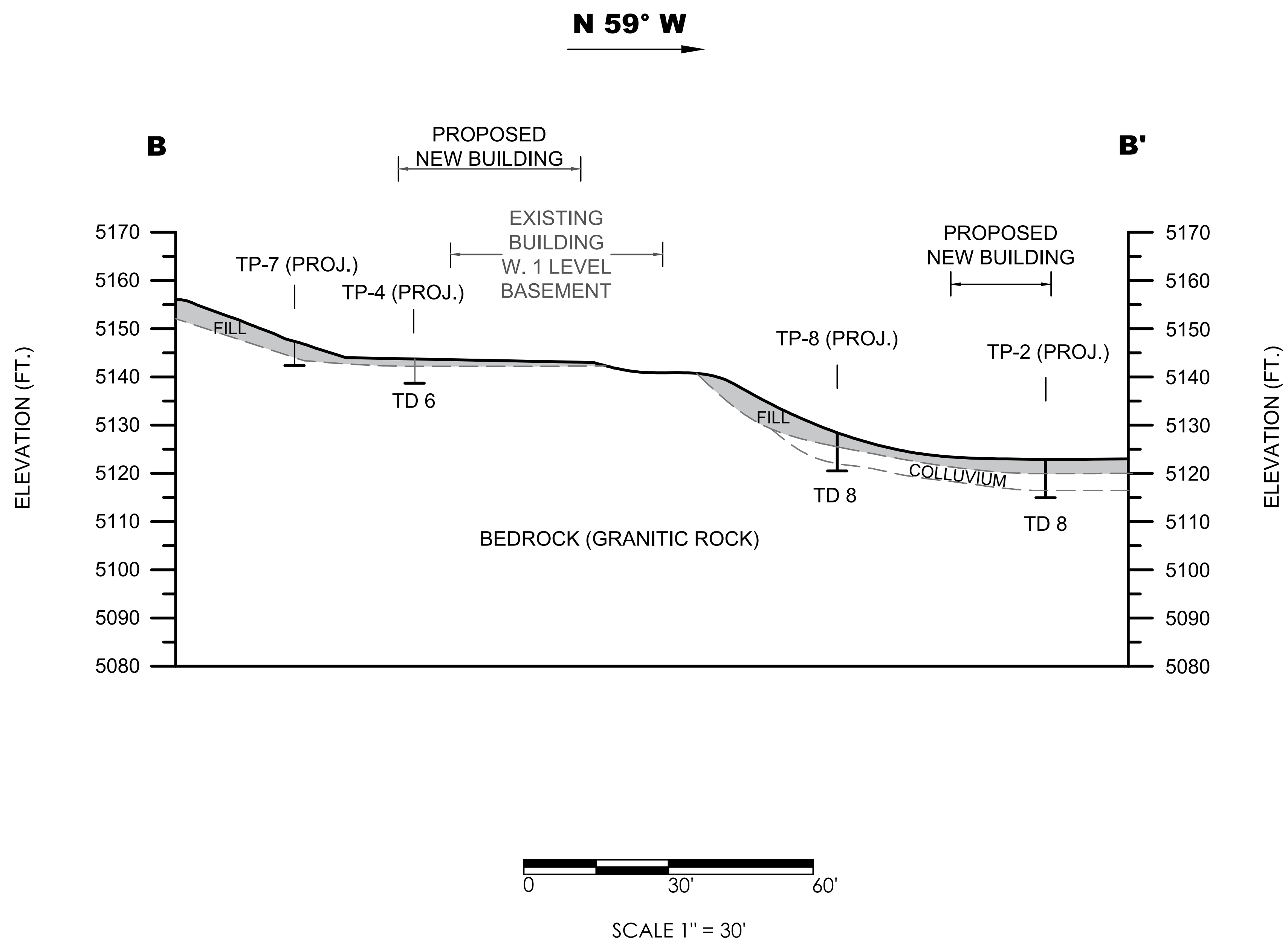
CROSS SECTION A-A'

Geotechnologies, Inc.
Consulting Geotechnical Engineers

UCLA
80 WILLOW CREEK RD, LAKE ARROWHEAD, CA

FILE No. 22123	DRAWN BY: SJM
DATE: JUNE 4, 2021	

NOTE: ALL BORINGS ARE PROJECTED PERPENDICULAR TO CROSS SECTION
PROJ. - PROJECTED EXCAVATION



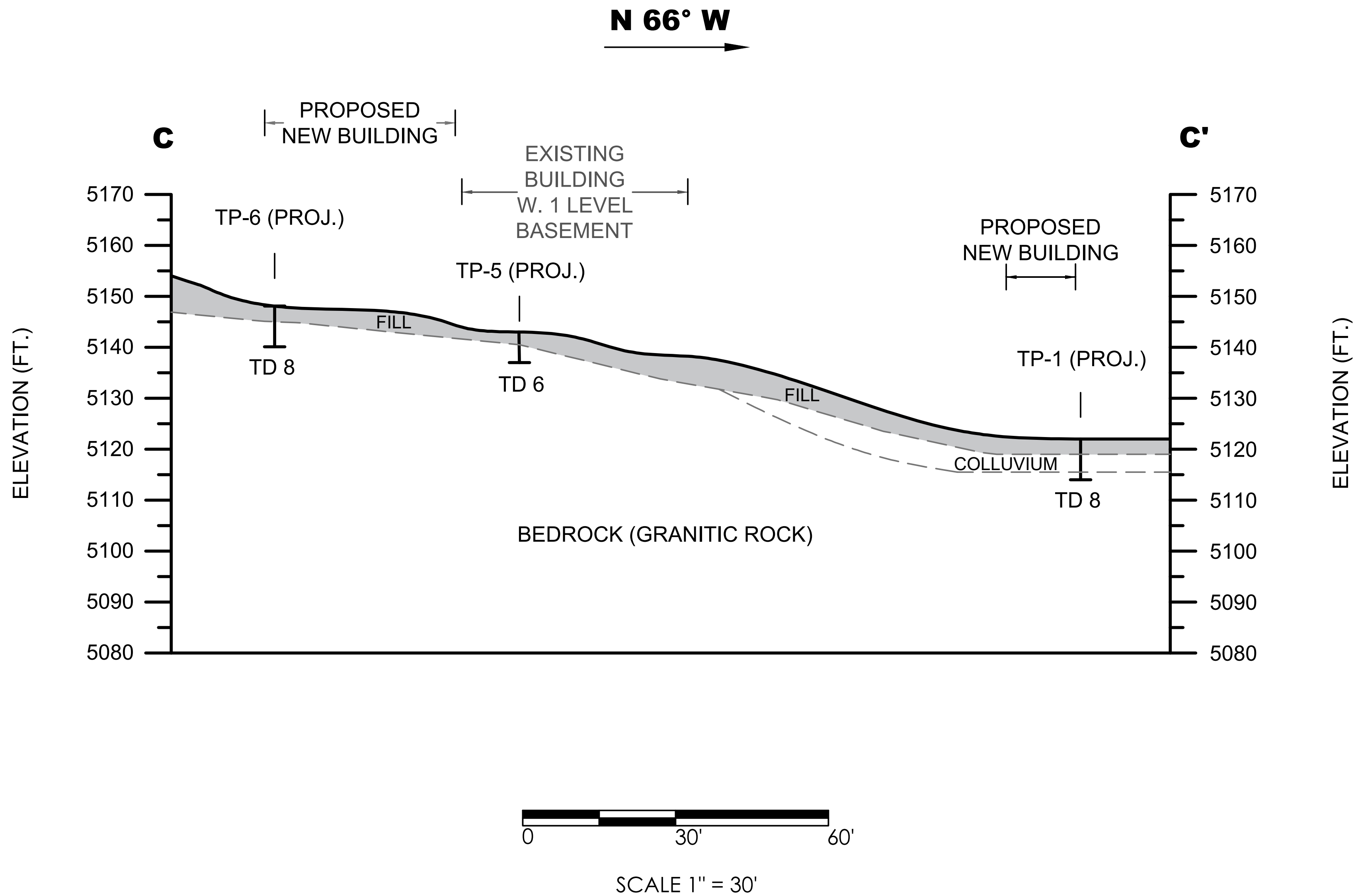
NOTE: ALL BORINGS ARE PROJECTED PERPENDICULAR TO CROSS SECTION
PROJ. - PROJECTED EXCAVATION

CROSS SECTION B-B'

Geotechnologies, Inc.
Consulting Geotechnical Engineers

UCLA
80 WILLOW CREEK RD, LAKE ARROWHEAD, CA

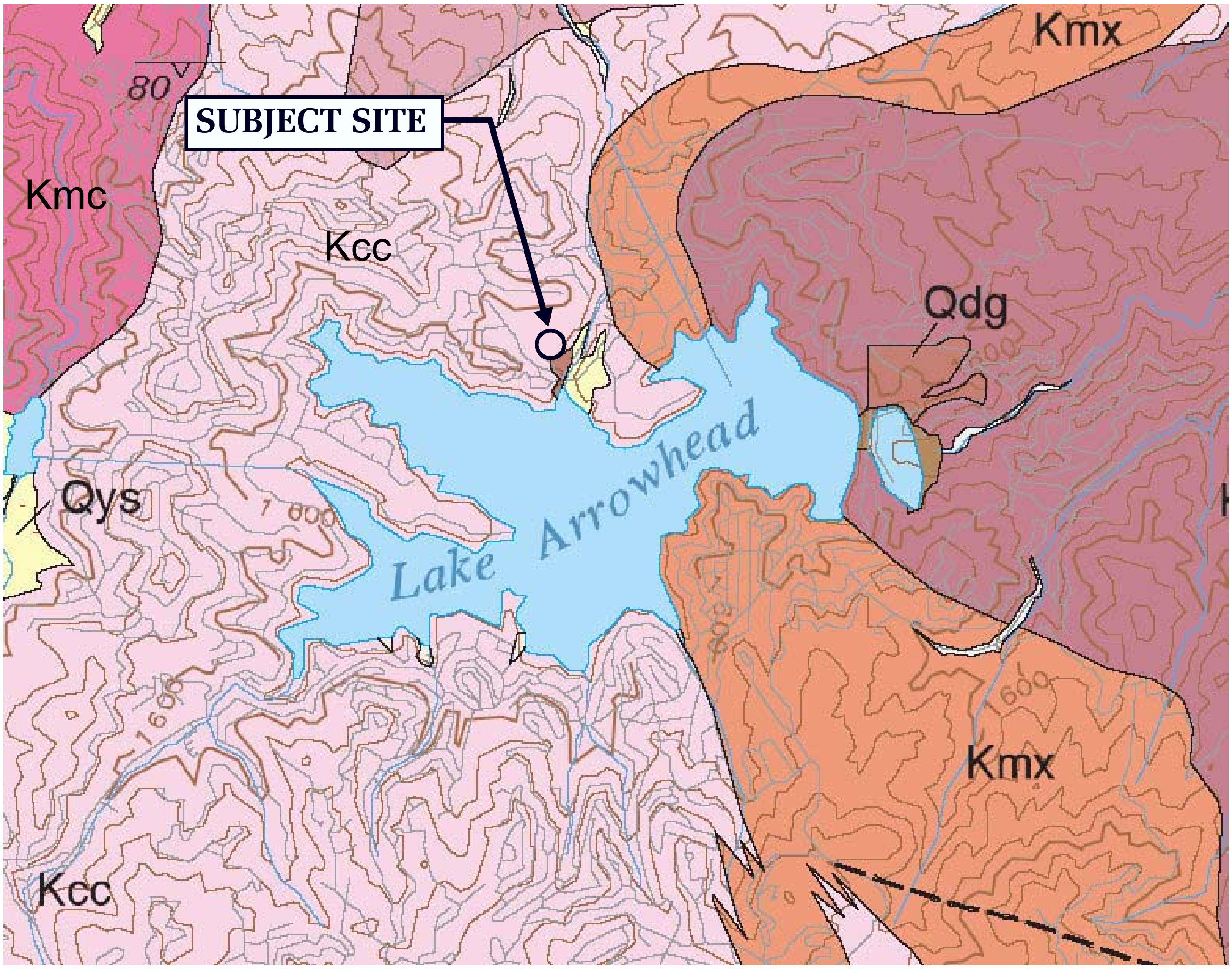
FILE No. 22123	DRAWN BY: SJM
DATE: JUNE 4, 2021	



NOTE: ALL BORINGS ARE PROJECTED PERPENDICULAR TO CROSS SECTION
PROJ. - PROJECTED EXCAVATION

CROSS SECTION C-C'

Geotechnologies, Inc. *Consulting Geotechnical Engineers*	UCLA 80 WILLOW CREEK RD, LAKE ARROWHEAD, CA	
	FILE No. 22123	DRAWN BY: SJM
	DATE: JUNE 4, 2021	



0 1 2 3 4 Kilometers

0 1 2 3 4 5 6 7 8 9 10 Thousand Feet

Scale

N

LEGEND

Qdg: Disturbed ground (Late Holocene)
Qys: Young Surficial deposits (Holocene and late Pleistocene)
Kcc: Monzogranite of City Creek (Cretaceous)
Kmc: Monzogranite of Malony Creek (Cretaceous)
Kmx: Mixed granitic rocks of Heaps Peak (Cretaceous)

REFERENCE: PRELIMINARY GEOLOGIC MAP OF THE SAN BERNARDINO 30'x 60' QUADRANGLE
DIGITAL VERSION BY COSSETTE, P.M., BOVARD, K.R., 2003

GEOLOGIC MAP

Geotechnologies, Inc.
Consulting Geotechnical Engineers

UCLA
LAKE ARROWHEAD CONFERENCE CENTER

FILE NO. 22123

LOG OF TEST PIT NUMBER 1

UCLA Conference Center | **Drilling Date: 04/13/21** | **Elevation: 5122'***

File No. 22123 | **Method: Hand Dug**

km

*Reference: Topographic Map by RJL surveyed 10/31/18, W.O. 92530

Sample Depth ft.	Moisture Content %	Dry Density p.c.f.	Depth in feet	USCS Class.	Description Surface Conditions: Bare Ground
			0 --		FILL: Silty Sand, dark brown, moist, medium dense, fine grained
			-		
1	10.4	115.9	1 --		
			-		
			2 --		
			-		
3	13.9	111.9	3 --		
			-	SM	COLLUVIUM: Silty Sand, dark brown, moist, medium dense, fine grained
			4 --		
			-		
5	12.5	111.7	5 --		
			-		
			6 --		
			-		
7	9.6	121.9	7 --		BEDROCK: Granite, yellowish brown, moist, moderately hard,
			-		very weathered, massive, phaneritic
			8 --		
			-		Total Depth 8 feet
			9 --		No Water
			-		Fill to 3 feet
			10 --		
			-		
			11 --		NOTE: The stratification lines represent the approximate
			-		boundary between earth types; the transition may be gradual.
			12 --		
			-		Used Hand Tools and 4-inch diameter Hand-Augering Equipment, Hand
			13 --		Sampler
			-		
			14 --		
			-		
			15 --		
			-		
			16 --		
			-		
			17 --		
			-		
			18 --		
			-		
			19 --		
			-		
			20 --		
			-		
			21 --		
			-		
			22 --		
			-		
			23 --		
			-		
			24 --		
			-		
			25 --		
			-		

LOG OF TEST PIT NUMBER 2

UCLA Conference Center **Drilling Date: 04/13/21** **Elevation: 5122'***

File No. 22123 **Method: Hand Dug**

km

*Reference: Topographic Map by RJL surveyed 10/31/18, W.O. 43933

Sample Depth ft.	Moisture Content %	Dry Density p.c.f.	Depth in feet	USCS Class.	Description Surface Conditions: Bare Ground
			0 --		FILL: Silty Sand, dark brown, moist, medium dense, fine grained
			-		
			1 --		
			-		
2	11.8	112.7	2 --		
			-		
			3 --		
			-	SM	COLLUVIUM: Silty Sand, dark brown, moist, medium dense, fine grained
4	12.9	117.2	4 --		
			-		
			5 --		
			-		
			6 --		
			-		
7	17.8	113.1	7 --		BEDROCK: Granite, dark and yellowish brown, moist, very weathered,
			-		massive, moderately hard, phaneritic
			8 --		
			-		Total Depth 8 feet
			9 --		No Water
			-		Fill to 3 feet
			10 --		
			-		
			11 --		NOTE: The stratification lines represent the approximate
			-		boundary between earth types; the transition may be gradual.
			12 --		
			-		Used Hand Tools and 4-inch diameter Hand-Augering Equipment, Hand
			13 --		Sampler
			-		
			14 --		
			-		
			15 --		
			-		
			16 --		
			-		
			17 --		
			-		
			18 --		
			-		
			19 --		
			-		
			20 --		
			-		
			21 --		
			-		
			22 --		
			-		
			23 --		
			-		
			24 --		
			-		
			25 --		
			-		

LOG OF TEST PIT NUMBER 3

UCLA Conference Center **Drilling Date: 04/13/21** **Elevation: 5125'***

File No. 22123 **Method: Hand Dug**

km

*Reference: Topographic Map by RJL surveyed 10/31/18, W.O. 43933

Sample Depth ft.	Moisture Content %	Dry Density p.c.f.	Depth in feet	USCS Class.	Description Surface Conditions: Asphalt for Paving
			0 --		2½-inch Asphalt, No Base
			-		
1	13.0	117.7	1 --		FILL: Silty Sand, dark brown, moist, medium dense, fine to medium grained
			-		
			2 --		
			-		
3	9.0	125.0	3 --		
			-	SM	COLLUVIUM: Silty Sand, dark brown, moist, medium dense, fine to medium grained
			4 --		
			-		
5	11.2	123.4	5 --		BEDROCK: Granite, gray and yellowish brown, moist, medium dense, very weathered, massive, moderately hard, phaneritic
			-		
			6 --		
			-		Total Depth 6 feet
			7 --		No Water
			-		Fill to 3 feet
			8 --		
			-		
			9 --		NOTE: The stratification lines represent the approximate boundary between earth types; the transition may be gradual.
			-		
			10 --		
			-		Used Hand Tools and 4-inch diameter Hand-Augering Equipment, Hand Sampler
			11 --		
			-		
			12 --		
			-		
			13 --		
			-		
			14 --		
			-		
			15 --		
			-		
			16 --		
			-		
			17 --		
			-		
			18 --		
			-		
			19 --		
			-		
			20 --		
			-		
			21 --		
			-		
			22 --		
			-		
			23 --		
			-		
			24 --		
			-		
			25 --		
			-		

LOG OF TEST PIT NUMBER 4

UCLA Conference Center | **Drilling Date: 04/13/21** | **Elevation: 5143'***

File No. 22123 | **Method: Hand Dug**

km | *Reference: Topographic Map by RJL surveyed 10/31/18, W.O. 43933

Sample Depth ft.	Moisture Content %	Dry Density p.c.f.	Depth in feet	USCS Class.	Description Surface Conditions: Bare Ground
			0 --		FILL: Silty Sand, dark brown, moist, colluvium
			-		
			1 --		
			-		
2	12.5	114.1	2 --		BEDROCK: Granite, dark brown, moist, very weathered,
			-		massive moderately hard, phaneritic
			3 --		
			-		
4	16.3	105.9	4 --		– – – – – – – – – – –
			-		less weathered
			5 --		
			-		Total Depth 5 feet
			6 --		No Water
			-		Fill to 1½ feet
			7 --		
			-		
			8 --		NOTE: The stratification lines represent the approximate
			-		boundary between earth types; the transition may be gradual.
			9 --		
			-		Used Hand Tools and 4-inch diameter Hand-Augering Equipment, Hand
			10 --		Sampler
			-		
			11 --		
			-		
			12 --		
			-		
			13 --		
			-		
			14 --		
			-		
			15 --		
			-		
			16 --		
			-		
			17 --		
			-		
			18 --		
			-		
			19 --		
			-		
			20 --		
			-		
			21 --		
			-		
			22 --		
			-		
			23 --		
			-		
			24 --		
			-		
			25 --		
			-		

LOG OF TEST PIT NUMBER 5

UCLA Conference Center | **Drilling Date: 04/13/21** | **Elevation: 5146'***

File No. 22123 | **Method: Hand Dug**

km

*Reference: Topographic Map by RJL surveyed 10/31/18, W.O. 43933

Sample Depth ft.	Moisture Content %	Dry Density p.c.f.	Depth in feet	USCS Class.	Description Surface Conditions: Bare Ground
			0 --		FILL: Silty Sand, dark brown, moist, medium dense, fine grained
			-		
1	23.3	103.3	1 --		
			-		
			2 --		
			-		
3	17.6	105.4	3 --		BEDROCK: Granite, dark to yellowish brown, moist, moderately hard
			-		
			4 --		
			-		
5	11.4	115.9	5 --		
			-		
			6 --		
			-		Total Depth 6 feet
			7 --		No Water
			-		Fill to 2½ feet
			8 --		
			-		
			9 --		NOTE: The stratification lines represent the approximate
			-		boundary between earth types; the transition may be gradual.
			10 --		
			-		Used Hand Tools and 4-inch diameter Hand-Augering Equipment, Hand
			11 --		Sampler
			-		
			12 --		
			-		
			13 --		
			-		
			14 --		
			-		
			15 --		
			-		
			16 --		
			-		
			17 --		
			-		
			18 --		
			-		
			19 --		
			-		
			20 --		
			-		
			21 --		
			-		
			22 --		
			-		
			23 --		
			-		
			24 --		
			-		
			25 --		
			-		

LOG OF TEST PIT NUMBER 6

UCLA Conference Center | **Drilling Date: 04/12/21** | **Elevation: 5148'***

File No. 22123 | **Method: Hand Dug**

km

*Reference: Topographic Map by RJL surveyed 10/31/18, W.O. 43933

Sample Depth ft.	Moisture Content %	Dry Density p.c.f.	Depth in feet	USCS Class.	Description Surface Conditions: Bare Ground along hillside
			0 --		FILL: Silty Sand, dark brown, moist, medium dense, fine grained
			1 --		
2	20.7	98.6	2 --		
			3 --		
					BEDROCK: Granite, dark brown, moist, moderately hard, very weathered
4	19.6	105.7	4 --		
			5 --		- - - - - - - -
					less weathered, dark and yellowish brown, moist, moderately hard
6	15.2	94.8	6 --		
					Total Depth 6 feet No Water Fill to 3 feet
			7 --		
			8 --		
			9 --		NOTE: The stratification lines represent the approximate boundary between earth types; the transition may be gradual.
			10 --		Used Hand Tools and 4-inch diameter Hand-Augering Equipment, Hand Sampler
			11 --		
			12 --		
			13 --		
			14 --		
			15 --		
			16 --		
			17 --		
			18 --		
			19 --		
			20 --		
			21 --		
			22 --		
			23 --		
			24 --		
			25 --		

LOG OF TEST PIT NUMBER 7

UCLA Conference Center **Drilling Date: 04/12/21** **Elevation: 5146'***

File No. 22123 **Method: Hand Dug**

km *Reference: Topographic Map by RJL surveyed 10/31/18, W.O. 43933

Sample Depth ft.	Moisture Content %	Dry Density p.c.f.	Depth in feet	USCS Class.	Description Surface Conditions: Bare Ground along hillside
			0 --		FILL: Silty Sand, dark brown, moist, medium dense, fine to medium grained
			-		
1	19.6	100.0	1 --		
			-		
			2 --		
			-		
3	16.3	106.2	3 --		
			-		
			4 --		
			-		BEDROCK: Granite, yellowish brown, moist, moderately hard
5	11.1	85.3	5 --		to hard, very weathered
			-		
			6 --		Total Depth 5 feet
			-		No Water
			7 --		Fill to 4 feet
			-		
			8 --		
			-		NOTE: The stratification lines represent the approximate
			9 --		boundary between earth types; the transition may be gradual.
			-		
			10 --		Used Hand Tools and 4-inch diameter Hand-Augering Equipment, Hand
			-		Sampler
			11 --		
			-		
			12 --		
			-		
			13 --		
			-		
			14 --		
			-		
			15 --		
			-		
			16 --		
			-		
			17 --		
			-		
			18 --		
			-		
			19 --		
			-		
			20 --		
			-		
			21 --		
			-		
			22 --		
			-		
			23 --		
			-		
			24 --		
			-		
			25 --		
			-		

LOG OF TEST PIT NUMBER 8

UCLA Conference Center | **Drilling Date: 04/13/21** | **Elevation: 5126'***

File No. 22123 | **Method: Hand Dug**

km

*Reference: Topographic Map by RJL surveyed 10/31/18, W.O. 43933

Sample Depth ft.	Moisture Content %	Dry Density p.c.f.	Depth in feet	USCS Class.	Description Surface Conditions: Bare Ground along hillside
			0 --		FILL: Silty Sand, dark brown, moist, medium dense
			-		
			1 --		
			-		
2	9.6	106.7	2 --		
			-		
			3 --		
			-		@ 3½' 4" concrete slab
			4 --		
			-	SM	COLLUVIUM: Silty Sand, dark brown, moist, medium dense, fine grained
5	15.7	108.0	5 --		to hard
			-		
			6 --		
			-		
7	18.6	109.4	7 --		BEDROCK: Granite, yellowish brown, moist, moderately hard to hard,
			-		weathered
			8 --		
			-		Total Depth 8 feet
			9 --		No Water
			-		Fill to 4 feet
			10 --		
			-		
			11 --		NOTE: The stratification lines represent the approximate
			-		boundary between earth types; the transition may be gradual.
			12 --		
			-		Used Hand Tools and 4-inch diameter Hand-Augering Equipment, Hand
			13 --		Sampler
			-		
			14 --		
			-		
			15 --		
			-		
			16 --		
			-		
			17 --		
			-		
			18 --		
			-		
			19 --		
			-		
			20 --		
			-		
			21 --		
			-		
			22 --		
			-		
			23 --		
			-		
			24 --		
			-		
			25 --		
			-		

LOG OF TEST PIT NUMBER 9

UCLA Conference Center **Drilling Date: 04/13/21** **Elevation: 5230'***

File No. 22123 **Method: Hand Dug**

km

*Reference: Topographic Map by RJL surveyed 10/31/18, W.O. 43933

Sample Depth ft.	Moisture Content %	Dry Density p.c.f.	Depth in feet	USCS Class.	Description Surface Conditions: Bare Ground near top of hill
			0 --		FILL: Silty Sand, dark brown, moist, medium dense, fine grained
			-		
1	13.7	107.5	1 --		
			-		
			2 --	SM	COLLUVIUM: Silty Sand, dark and yellowish brown, moist, medium dense,
			-		fine grained
3	17.4	107.0	3 --		
			-		BEDROCK: Granite, yellowish brown, moist, moderately hard,
			4 --		fine grained, weathered
			-		
5	14.8	104.1	5 --		- - - - - - - - - - -
			-		less weathered, yellowish brown, moist, moderately hard to hard
			6 --		
			-		Total Depth 6 feet
			7 --		No Water
			-		Fill to 1½ feet
			8 --		
			-		
			9 --		NOTE: The stratification lines represent the approximate
			-		boundary between earth types; the transition may be gradual.
			10 --		
			-		Used Hand tools and 4-inch diameter Hand-Augering Equipment, Hand
			11 --		Sampler
			-		
			12 --		
			-		
			13 --		
			-		
			14 --		
			-		
			15 --		
			-		
			16 --		
			-		
			17 --		
			-		
			18 --		
			-		
			19 --		
			-		
			20 --		
			-		
			21 --		
			-		
			22 --		
			-		
			23 --		
			-		
			24 --		
			-		
			25 --		
			-		

LOG OF TEST PIT NUMBER 10

UCLA Conference Center **Drilling Date: 04/13/21** **Elevation: 5237'***

File No. 22123 **Method: Hand Dug**

km *Reference: Topographic Map by RJL surveyed 10/31/18, W.O. 43933

Sample Depth ft.	Moisture Content %	Dry Density p.c.f.	Depth in feet	USCS Class.	Description Surface Conditions: Bare Ground near top of hill
			0 --		FILL: Silty Sand, dark brown, moist, medium dense, fine grained
			-		
1	7.6	92.8	1 --		
			-		
			2 --		
			-		BEDROCK: Granite, dark and yellowish brown, moist, moderately hard,
3	12.2	101.3	3 --		fine grained, weathered
			-		
			4 --		
			-		
5	9.3	103.7	5 --		
			-		less weathered, yellowish brown, moist, moderately hard to hard
			6 --		
			-		Total Depth 6 feet
			7 --		No Water
			-		Fill to 2 feet
			8 --		
			-		
			9 --		NOTE: The stratification lines represent the approximate
			-		boundary between earth types; the transition may be gradual.
			10 --		
			-		Used Hand Tools and 4-inch diameter Hand-Augering Equipment, Hand
			11 --		Sampler
			-		
			12 --		
			-		
			13 --		
			-		
			14 --		
			-		
			15 --		
			-		
			16 --		
			-		
			17 --		
			-		
			18 --		
			-		
			19 --		
			-		
			20 --		
			-		
			21 --		
			-		
			22 --		
			-		
			23 --		
			-		
			24 --		
			-		
			25 --		
			-		

LOG OF TEST PIT NUMBER 11

UCLA Conference Center **Drilling Date: 04/13/21** **Elevation: 5240'***

File No. 22123 **Method: Hand Dug**

km

*Reference: Topographic Map by RJL surveyed 10/31/18, W.O. 43933

Sample Depth ft.	Moisture Content %	Dry Density p.c.f.	Depth in feet	USCS Class.	Description Surface Conditions: Bare Ground near top of hill
			0 --		FILL: Silty Sand, dark brown, moist, medium dense, fine grained, with boulders
			-		
1	9.7	107.6	1 --		
			-		
			2 --		BEDROCK: Granite, dark and yellowish brown, moist, moderately hard, fine grained, weathered
			-		
3	15.2	104.4	3 --		
			-		less weathered, yellowish brown, moist, hard
			4 --		
			-		Total Depth 4 feet
			5 --		No Water
			-		Fill to 1½ feet
			6 --		
			-		
			7 --		NOTE: The stratification lines represent the approximate boundary between earth types; the transition may be gradual.
			-		
			8 --		
			-		Used Hand Tools and 4-inch diameter Hand-Augering Equipment, Hand Sampler
			9 --		
			-		
			10 --		
			-		
			11 --		
			-		
			12 --		
			-		
			13 --		
			-		
			14 --		
			-		
			15 --		
			-		
			16 --		
			-		
			17 --		
			-		
			18 --		
			-		
			19 --		
			-		
			20 --		
			-		
			21 --		
			-		
			22 --		
			-		
			23 --		
			-		
			24 --		
			-		
			25 --		
			-		

LOG OF TEST PIT NUMBER 12

UCLA Conference Center | **Drilling Date: 04/13/21** | **Elevation: 5246'***

File No. 22123 | **Method: Hand Dug**

km

*Reference: Topographic Map by RJL surveyed 10/31/18, W.O. 43933

Sample Depth ft.	Moisture Content %	Dry Density p.c.f.	Depth in feet	USCS Class.	Description Surface Conditions: Bare Ground near top of hill
			0 --		FILL: Silty Sand, dark brown, moist, medium dense, fine grained
			-		
1	16.7	107.6	1 --		
			-		
			2 --		
			-		BEDROCK: Granite, dark and yellowish brown, moist, moderately hard,
3	20.0	105.1	3 --		fine grained, weathered
			-		
			4 --		
			-		
5	16.7	104.6	5 --		
			-		less weathered, dark and yellowish brown, moist, moderately hard
			6 --		
			-		Total depth 6 feet
			7 --		No Water
			-		Fill to 2 feet
			8 --		
			-		
			9 --		NOTE: The stratification lines represent the approximate
			-		boundary between earth types; the transition may be gradual.
			10 --		
			-		Used Hand Tools and 4-inch diameter Hand-Augering Equipment, Hand
			11 --		Sampler
			-		
			12 --		
			-		
			13 --		
			-		
			14 --		
			-		
			15 --		
			-		
			16 --		
			-		
			17 --		
			-		
			18 --		
			-		
			19 --		
			-		
			20 --		
			-		
			21 --		
			-		
			22 --		
			-		
			23 --		
			-		
			24 --		
			-		
			25 --		
			-		

LOG OF TEST PIT NUMBER 13

UCLA Conference Center **Drilling Date: 04/13/21** **Elevation: 5253'***

File No. 22123 **Method: Hand Dug**

km

*Reference: Topographic Map by RJL surveyed 10/31/18, W.O. 43933

Sample Depth ft.	Moisture Content %	Dry Density p.c.f.	Depth in feet	USCS Class.	Description Surface Conditions: Bare Ground near top of hill
			0 --		FILL: Silty Sand, dark brown, moist, medium dense, fine grained
			-		
1	16.0	104.0	1 --		
			-		
			2 --		BEDROCK: Granite, dark brown, moist, moderately hard,
			-		fine grained, weathered
3	20.9	102.6	3 --		
			-		
			4 --		
			-		
5	17.1	73.2	5 --		- - - - - - - - - -
			-		less weathered granite, dark and yellowish brown, moist, moderately hard
			6 --		
			-		Total depth 6 feet
			7 --		No Water
			-		Fill to 1½ feet
			8 --		
			-		
			9 --		NOTE: The stratification lines represent the approximate
			-		boundary between earth types; the transition may be gradual.
			10 --		
			-		Used Hand Tools and 4-inch diameter Hand-Augering Equipment, Hand
			11 --		Sampler
			-		
			12 --		
			-		
			13 --		
			-		
			14 --		
			-		
			15 --		
			-		
			16 --		
			-		
			17 --		
			-		
			18 --		
			-		
			19 --		
			-		
			20 --		
			-		
			21 --		
			-		
			22 --		
			-		
			23 --		
			-		
			24 --		
			-		
			25 --		
			-		

LOG OF TEST PIT NUMBER 14

UCLA Conference Center | **Drilling Date: 04/13/21** | **Elevation: 5234'***

File No. 22123 | **Method: Hand Dug**

km

*Reference: Topographic Map by RJL surveyed 10/31/18, W.O. 43933

Sample Depth ft.	Moisture Content %	Dry Density p.c.f.	Depth in feet	USCS Class.	Description Surface Conditions: Bare Ground near top of hill
			0 --		FILL: Silty Sand, dark brown, moist, medium dense, fine grained
			1 --		
2	13.1	103.0	2 --		
			3 --		
4	12.5	118.2	4 --	SM	COLLUVIUM: Silty Sand, dark brown, moist, medium dense, fine grained
			5 --		
			6 --		BEDROCK: Granite, dark and yellowish brown, moist, moderately hard,
7	16.1	103.5	7 --		fine grained, weathered
			8 --		Total depth 8 feet
			9 --		No Water Fill to 3½ feet
			10 --		
			11 --		NOTE: The stratification lines represent the approximate boundary between earth types; the transition may be gradual.
			12 --		
			13 --		Used Hand Tools and 4-inch diameter Hand-Augering Equipment, Hand Sampler
			14 --		
			15 --		
			16 --		
			17 --		
			18 --		
			19 --		
			20 --		
			21 --		
			22 --		
			23 --		
			24 --		
			25 --		

LOG OF TEST PIT NUMBER 15

UCLA Conference Center | **Drilling Date: 04/13/21** | **Elevation: 5254'***

File No. 22123 | **Method: Hand Dug**

km

*Reference: Topographic Map by RJL surveyed 10/31/18, W.O. 43933

Sample Depth ft.	Moisture Content %	Dry Density p.c.f.	Depth in feet	USCS Class.	Description Surface Conditions: Bare Ground near top of hill
			0 --		FILL: Silty Sand, dark brown, moist, medium dense, fine grained
			-		
1	10.6	97.2	1 --		
			-		
			2 --		
			-	SM	COLLUVIUM: Silty Sand, dark and yellowish brown, moist, medium dense,
3	14.6	109.1	3 --		fine grained
			-		BEDROCK: Granite, dark and yellowish brown, moist, moderately hard,
			4 --		fine grained, weathered
			-		
5	17.2	102.6	5 --		
			-		less weathered, dark and yellowish brown, moist, moderately hard,
			6 --		fine grained
			-		
			7 --		Total depth 6 feet
			-		No Water
			8 --		Fill to 2 feet
			-		
			9 --		
			-		NOTE: The stratification lines represent the approximate
			10 --		boundary between earth types; the transition may be gradual.
			-		
			11 --		Used Hand Tools and 4-inch diameter Hand-Augering Equipment, Hand
			-		Sampler
			12 --		
			-		
			13 --		
			-		
			14 --		
			-		
			15 --		
			-		
			16 --		
			-		
			17 --		
			-		
			18 --		
			-		
			19 --		
			-		
			20 --		
			-		
			21 --		
			-		
			22 --		
			-		
			23 --		
			-		
			24 --		
			-		
			25 --		
			-		

LOG OF TEST PIT NUMBER 16

UCLA Conference Center **Drilling Date: 04/13/21** **Elevation: 5257'***

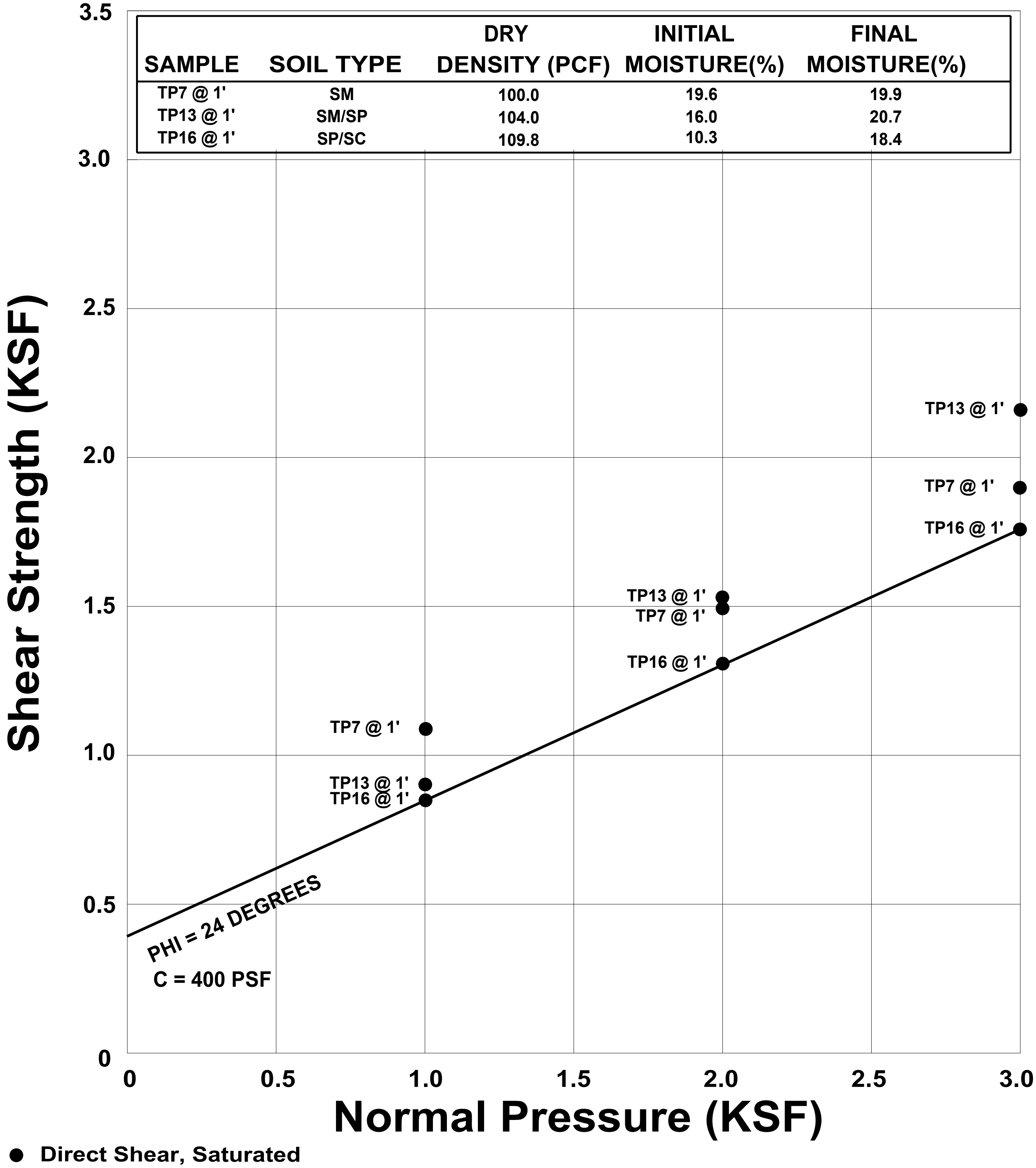
File No. 22123 **Method: Hand Dug**

km *Reference: Topographic Map by RJL surveyed 10/31/18, W.O. 43933

Sample Depth ft.	Moisture Content %	Dry Density p.c.f.	Depth in feet	USCS Class.	Description Surface Conditions: Bare Ground near top of hill
			0 --		FILL: Silty Sand, dark brown, moist, medium dense, fine grained
			-		
1	10.3	109.8	1 --		
			-		
			2 --		
			-	SM	COLLUVIUM: Silty Sand, dark and yellowish brown, moist, medium dense, fine grained
3	13.2	100.7	3 --		
			-		BEDROCK: Granite, dark and yellowish brown, moist, moderately hard, fine grained, weathered
			4 --		
			-		
5	13.5	104.7	5 --		
			-		less weathered granite, dark and yellowish brown, moist, moderately hard
			6 --		
			-		Total depth 6 feet
			7 --		No Water
			-		Fill to 2 feet
			8 --		
			-		
			9 --		NOTE: The stratification lines represent the approximate
			-		boundary between earth types; the transition may be gradual.
			10 --		
			-		Used Hand Tools and 4-inch diameter Hand-Augering Equipment, Hand
			11 --		Sampler
			-		
			12 --		
			-		
			13 --		
			-		
			14 --		
			-		
			15 --		
			-		
			16 --		
			-		
			17 --		
			-		
			18 --		
			-		
			19 --		
			-		
			20 --		
			-		
			21 --		
			-		
			22 --		
			-		
			23 --		
			-		
			24 --		
			-		
			25 --		
			-		

FILL

SAMPLE	SOIL TYPE	DRY DENSITY (PCF)	INITIAL MOISTURE(%)	FINAL MOISTURE(%)
TP7 @ 1'	SM	100.0	19.6	19.9
TP13 @ 1'	SM/SP	104.0	16.0	20.7
TP16 @ 1'	SP/SC	109.8	10.3	18.4



SHEAR TEST DIAGRAM

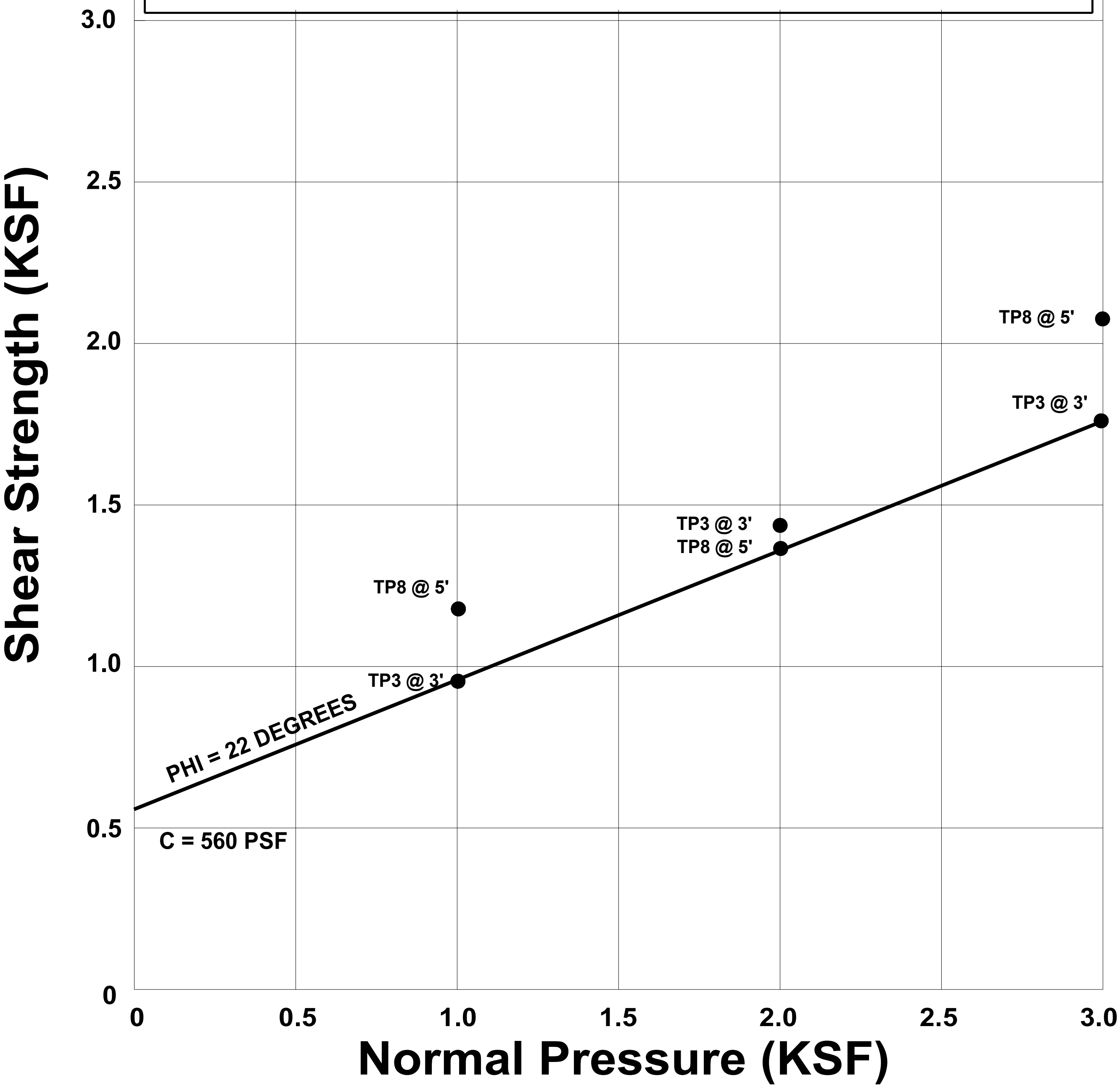
Geotechnologies, Inc.
Consulting Geotechnical Engineers

UCLA
UCLA LAKE ARROWHEAD CONFERENCE CENTER

FILE NO. 22123 | PLATE: B-1

COLLUVIUM

SAMPLE	SOIL TYPE	DRY DENSITY (PCF)	INITIAL MOISTURE(%)	FINAL MOISTURE(%)
TP3 @ 3'	SP/SC	125.0	9.0	17.7
TP8 @ 5'	SM/SW	108.0	15.7	18.4



● Direct Shear, Saturated

SHEAR TEST DIAGRAM

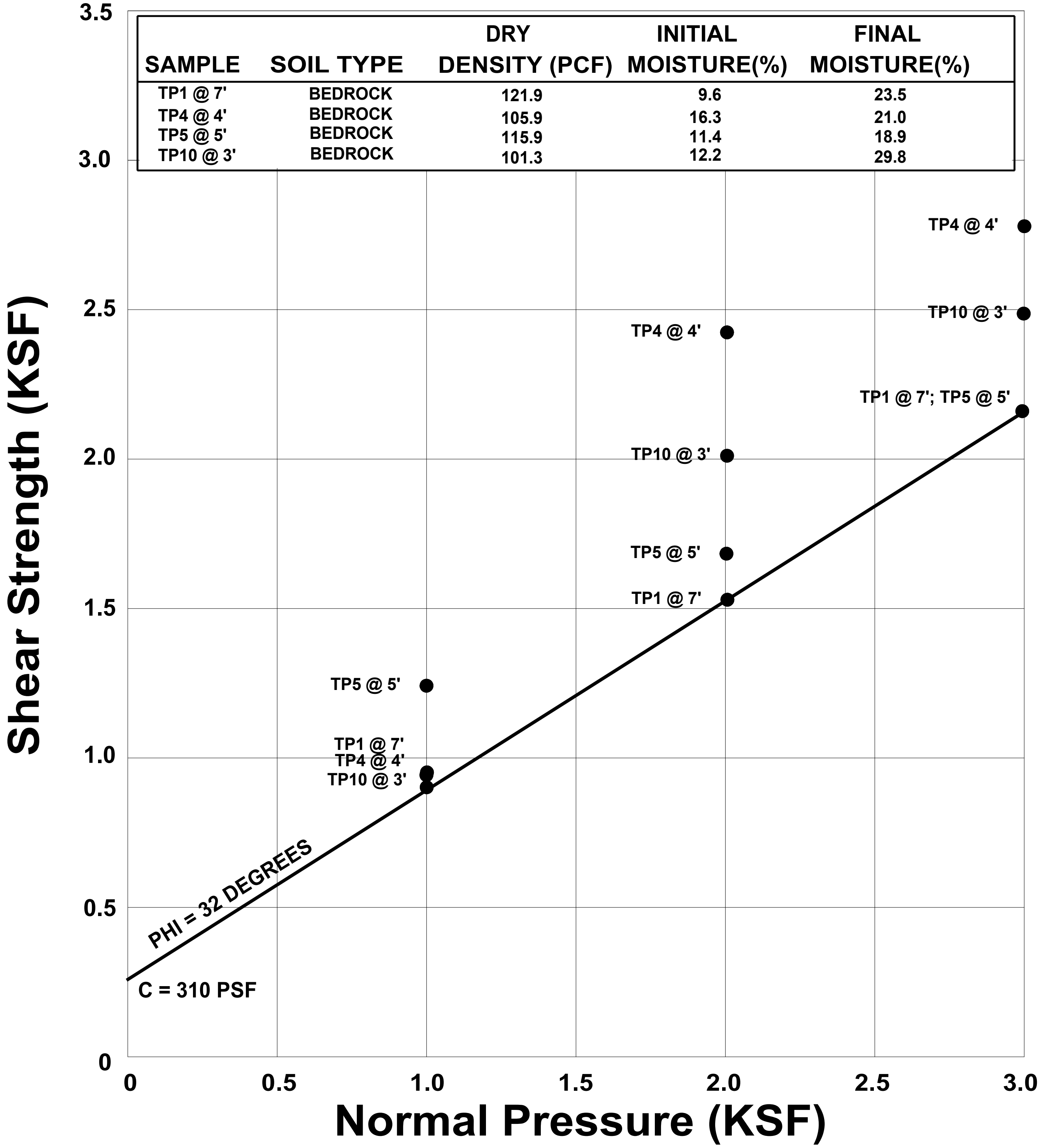
Geotechnologies, Inc.
Consulting Geotechnical Engineers

UCLA- CONFERENCE CENTER
UCLA LAKE ARROWHEAD CONFERENCE CENTER

FILE NO. 22123 | **PLATE: B-2**

BEDROCK

SAMPLE	SOIL TYPE	DRY DENSITY (PCF)	INITIAL MOISTURE(%)	FINAL MOISTURE(%)
TP1 @ 7'	BEDROCK	121.9	9.6	23.5
TP4 @ 4'	BEDROCK	105.9	16.3	21.0
TP5 @ 5'	BEDROCK	115.9	11.4	18.9
TP10 @ 3'	BEDROCK	101.3	12.2	29.8



● Direct Shear, Saturated

SHEAR TEST DIAGRAM

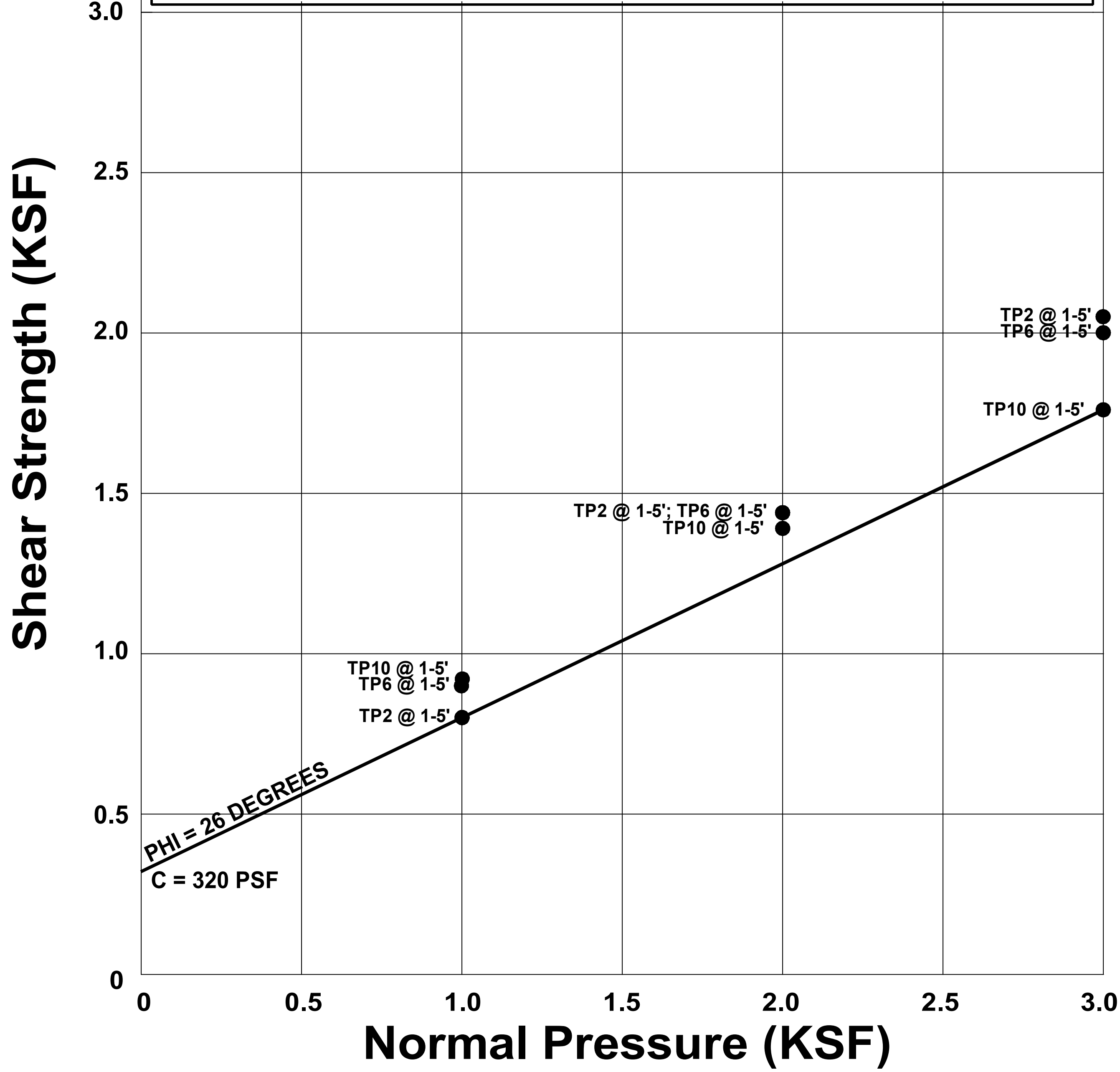
Geotechnologies, Inc.
Consulting Geotechnical Engineers

UCLA-CONFERENCE CENTER
UCLA LAKE ARROWHEAD CONFERENCE CENTER

FILE NO. 22123 | PLATE: B-3

BULK SAMPLE REMOLDED TO 90 PERCENT OF THE MAXIMUM LABORATORY DENSITY

SAMPLE	SOIL TYPE	DRY DENSITY (PCF)	INITIAL MOISTURE(%)	FINAL MOISTURE(%)
TP2 @ 1-5'	SM	115.7	9.1	15.7
TP6 @ 1-5'	SM/BR	104.7	13.7	28.1
TP10 @ 1-5'	BR	109.0	12.4	19.5



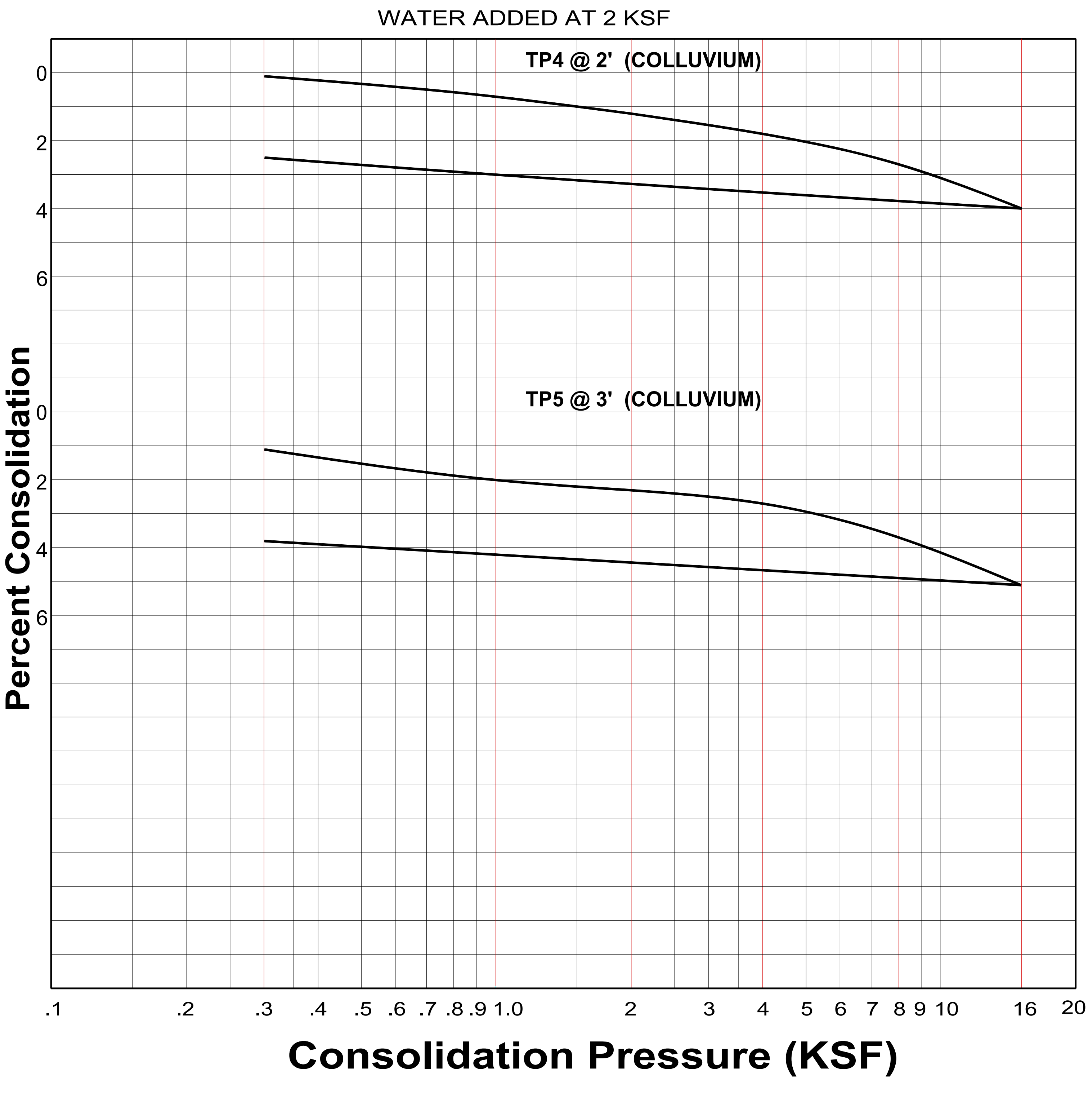
● Direct Shear, Saturated

SHEAR TEST DIAGRAM

Geotechnologies, Inc.
Consulting Geotechnical Engineers

UCLA
UCLA LAKE ARROWHEAD CONFERENCE CENTER

FILE NO. 22123 | **PLATE: B-4**



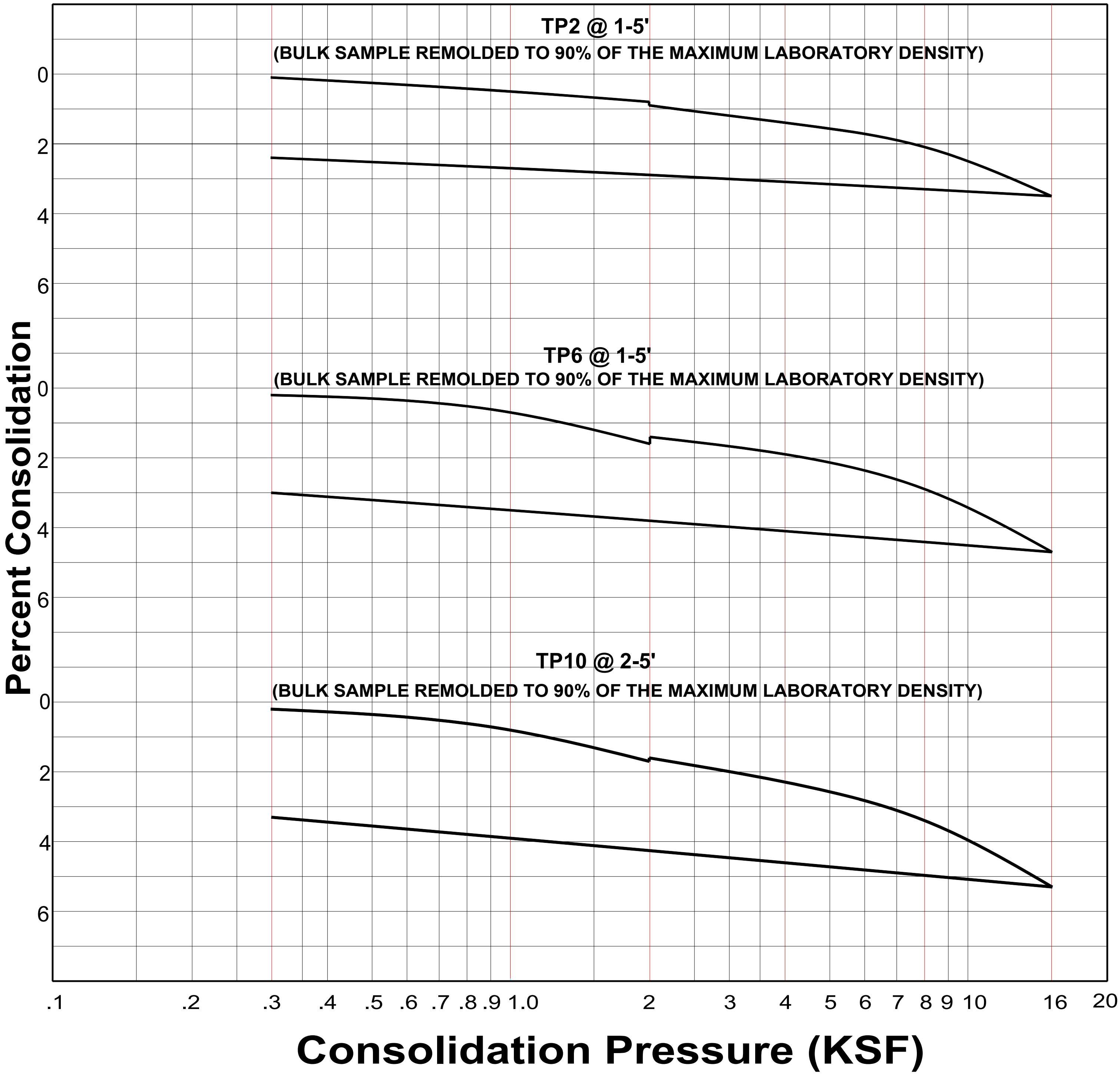
CONSOLIDATION TEST

Geotechnologies, Inc.
Consulting Geotechnical Engineers

UCLA- CONFERENCE CENTER
UCLA LAKE ARROWHEAD CONFERENCE CENTER

FILE NO. 22123 | **PLATE: C-1**

WATER ADDED AT 2 KSF



CONSOLIDATION TEST

Geotechnologies, Inc.
Consulting Geotechnical Engineers

UCLA- CONFERENCE CETER
UCLA LAKE ARROWHEAD CONFERENCE CENTER

FILE NO. 22123 | **PLATE: C-2**

ASTM D 1557

SAMPLE	TP2 @ 1-5'	TP6 @ 1-5'	TP10 @ 1-5'
SOIL TYPE:	SM	SM/BR	BR
MAXIMUM DENSITY pcf.	128.5	116.3	121.1
OPTIMUM MOISTURE %	9.1	13.7	12.4

ASTM D 4829

SAMPLE	TP2 @ 1-5'	TP6 @ 1-5'	TP10 @ 1-5'
SOIL TYPE:	SM	SM/BR	BR
EXPANSION INDEX UBC STANDARD 18-2	13	13	26
EXPANSION CHARACTER	VERY LOW	VERY LOW	LOW

SULFATE CONTENT

SAMPLE	TP1 @ 7'	TP3 @ 3'	TP4 @ 2'	TP8 @ 5'	TP2 @ 1-5'
SULFATE CONTENT: (percentage by weight)	< 0.10 %	< 0.10 %	< 0.10 %	< 0.10 %	< 0.10 %

SAMPLE	TP6 @ 1-5'	TP10 @ 1-5'
SULFATE CONTENT: (percentage by weight)	< 0.10 %	< 0.10 %

COMPACTION/EXPANSION DATA SHEET

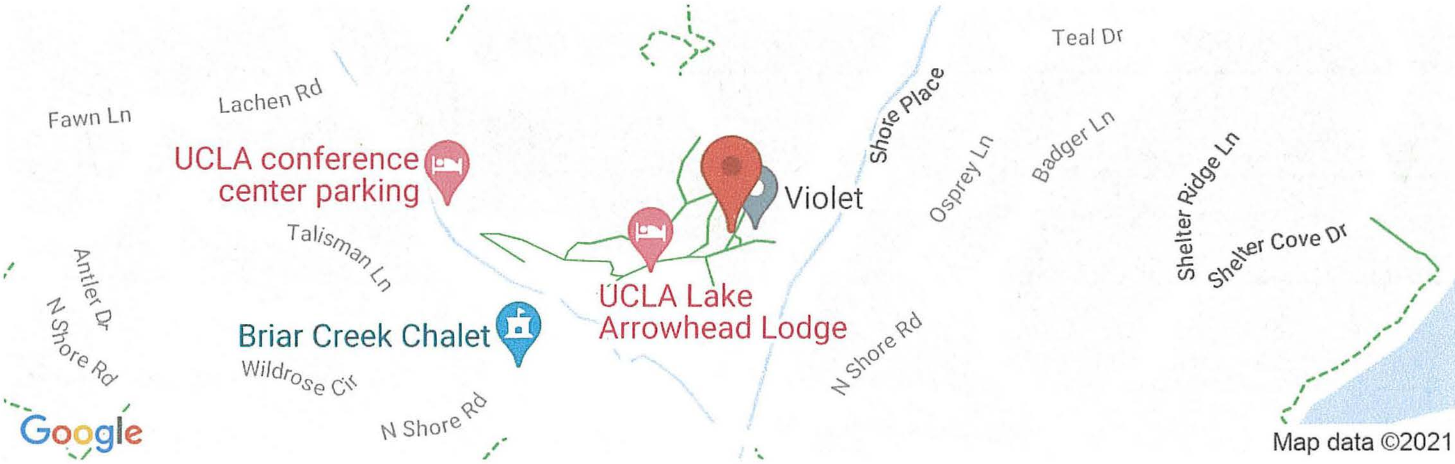
Geotechnologies, Inc.
Consulting Geotechnical Engineers

UCLA
UCLA LAKE ARROWHEAD CONFERENCE CENTER

FILE NO. 22123 | PLATE: D-1

22123 UCLA Conference Center

Latitude, Longitude: 34.2659, -117.1859



Date	7/9/2021, 8:01:30 AM
Design Code Reference Document	ASCE7-16
Risk Category	II
Site Class	C - Very Dense Soil and Soft Rock

Type	Value	Description
S_S	1.869	MCE_R ground motion. (for 0.2 second period)
S_1	0.709	MCE_R ground motion. (for 1.0s period)
S_{MS}	2.243	Site-modified spectral acceleration value
S_{M1}	0.992	Site-modified spectral acceleration value
S_{DS}	1.495	Numeric seismic design value at 0.2 second SA
S_{D1}	0.661	Numeric seismic design value at 1.0 second SA

Type	Value	Description
SDC	D	Seismic design category
F_a	1.2	Site amplification factor at 0.2 second
F_v	1.4	Site amplification factor at 1.0 second
PGA	0.795	MCE_G peak ground acceleration
F_{PGA}	1.2	Site amplification factor at PGA
PGA_M	0.954	Site modified peak ground acceleration
T_L	8	Long-period transition period in seconds
SsRT	1.869	Probabilistic risk-targeted ground motion. (0.2 second)
SsUH	2.016	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration
SsD	2.374	Factored deterministic acceleration value. (0.2 second)
S1RT	0.709	Probabilistic risk-targeted ground motion. (1.0 second)
S1UH	0.784	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration.
S1D	0.776	Factored deterministic acceleration value. (1.0 second)
PGAd	0.956	Factored deterministic acceleration value. (Peak Ground Acceleration)
C_{RS}	0.927	Mapped value of the risk coefficient at short periods
C_{R1}	0.904	Mapped value of the risk coefficient at a period of 1 s

Geotechnologies, Inc.

Project: UCLA- Conference Center
File No.: 22123
Description: Compacted fill

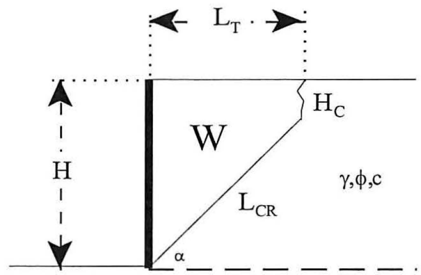
Retaining Wall Design with Level Backfill
(Vector Analysis)

Input:

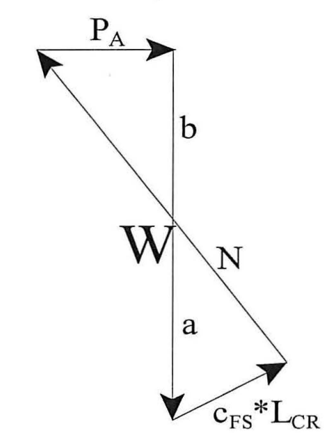
Retaining Wall Height	(H)	10.00 feet
Unit Weight of Retained Soils	(γ)	125.0 pcf
Friction Angle of Retained Soils	(ϕ)	26.0 degrees
Cohesion of Retained Soils	(c)	320.0 psf
Factor of Safety	(FS)	1.50

28

Factored Parameters:	(ϕ_{FS})	18.0 degrees
	(c_{FS})	213.3 psf



Failure Angle (α) degrees	Height of Tension Crack (H_C) feet	Area of Wedge (A) feet^2	Weight of Wedge (W) lbs/lineal foot	Length of Failure Plane (L_{CR}) feet	a lbs/lineal foot	b lbs/lineal foot	Active Pressure (P_A) lbs/lineal foot
20	49.8	-3269	-408588.6	-116.3	-680511.4	271922.8	0.0
21	33.4	-1319	-164845.5	-65.2	-253643.8	88798.3	0.0
22	25.2	-660	-82540.1	-40.5	-118143.7	35603.5	0.0
23	20.3	-367	-45830.9	-26.3	-61390.1	15559.2	0.0
24	17.0	-213	-26679.5	-17.3	-33619.1	6939.6	0.0
25	14.7	-125	-15638.7	-11.2	-18624.7	2986.0	0.0
26	13.0	-71	-8824.4	-6.8	-9973.7	1149.3	0.0
27	11.7	-35	-4410.2	-3.7	-4748.2	338.0	0.0
28	10.6	-12	-1449.1	-1.3	-1491.2	42.1	0.0
29	9.7	5	587.4	0.5	579.5	7.9	1.5
30	9.0	16	2012.0	2.0	1908.6	103.3	21.9
31	8.4	24	3018.5	3.1	2760.4	258.0	59.5
32	7.9	30	3731.7	3.9	3298.1	433.7	108.0
33	7.5	34	4234.9	4.6	3625.3	609.7	163.2
34	7.1	37	4584.7	5.2	3809.7	775.1	222.1
35	6.8	39	4821.0	5.6	3896.4	924.6	282.5
36	6.5	40	4972.0	6.0	3916.0	1056.0	342.9
37	6.2	40	5058.3	6.2	3889.5	1168.8	402.2
38	6.0	41	5095.2	6.5	3831.6	1263.7	459.6
39	5.8	41	5094.0	6.6	3752.5	1341.5	514.6
40	5.7	41	5063.3	6.8	3659.6	1403.7	566.8
41	5.5	40	5009.6	6.8	3558.0	1451.7	615.8
42	5.4	40	4938.1	6.9	3451.4	1486.6	661.5
43	5.3	39	4852.5	7.0	3342.5	1510.0	703.7
44	5.1	38	4756.1	7.0	3233.2	1522.9	742.4
45	5.1	37	4651.1	7.0	3124.6	1526.5	777.4



Design Equations (Vector Analysis):

$a = c_{FS}*L_{CR}*\sin(90+\phi_{FS})/\sin(\alpha-\phi_{FS})$

$b = W-a$

$P_A = b*\tan(\alpha-\phi_{FS})$

$EFP = 2*P_A/H^2$

Maximum Active Pressure Resultant

$P_{A,\ max}$ 777.4 lbs/lineal foot

Equivalent Fluid Pressure (per lineal foot of wall)

$EFP = 2*P_A/H^2$

EFP 15.5 pcf

Design Wall for an Equivalent Fluid Pressure: 30 pcf

Geotechnologies, Inc.

Project: UCLA Conference Center
File No.: 22123
Geologic Material Compacted fill

Soil Weight	γ	120 pcf
Internal Friction Angle	ϕ	26 degrees
Cohesion	c	320 psf
Height of Retaining Wall	H	10 feet

Cantilever Retaining Wall Design based on At Rest Earth Pressure

$\sigma'_h = K_o\sigma'_v$

$K_o = 1 - \sin\phi$	0.562
$\sigma'_v = \gamma H$	1200.0 psf

$\sigma'_h =$ 674.0 psf

EFP = 67.4 pcf

$P_o =$ 3369.8 lbs/ft (based on a triangular distribution of pressur

Design wall for an EFP of 67 pcf

Geotechnologies, Inc.

Project: UCLA- Conference Center

File No.: 22123

Seismically Induced Lateral Soil Pressure on Retaining Wall

(Based on City of Los Angeles P/BC 2020-083)

Input:

Height of Retaining Wall:	(H)	10.0	feet
Retained Soil Unit Weight:	(γ)	120.0	pcf
Short Duration Acceleration	PGAm	0.954	g
Horizontal Ground Acceleration:	(k_h)	0.32	g

Seismic Increment (ΔP_{AE}):

$\Delta P_{AE} = (0.5*\gamma*H^2)*(0.75*k_h)$

$\Delta P_{AE} =$ 1431.0 lbs/ft

Force applied at 0.6H above the base of the wall
Transfer load to 2/3 of the height of the wall

$T*(2/3)*H = \Delta P_{AE}*0.6*H$

T = 1287.9 lbs/ft

$EFP = 2*T/H^2$

EFP = 25.8 pcf Triangular shape