GEOTECHNICAL ENGINEERING REPORT
CAL POLY TECH PARK II
MOUNT BISHOP ROAD
CAL POLY
SAN LUIS OBISPO, CALIFORNIA

July 19, 2021

Prepared for

Mr. Curtis McNally

Prepared by

Earth Systems Pacific
4378 Old Santa Fe Road
San Luis Obispo, CA 93401

Earth Systems
4378 Old Santa Fe Road | San Luis Obispo, CA 93401 | Ph: 805.544.3276 | www.earthsystems.com

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Mr. Curtis McNally
Facilities Planning and Capital Projects, Bldg. 70
California Polytechnic State University
San Luis Obispo, CA 93407

PROJECT: CAL POLY TECH PARK – PHASE II
MOUNT BISHOP ROAD
CAL POLY, SAN LUIS OBISPO, CALIFORNIA

SUBJECT: Geotechnical Engineering Report

CONTRACT
REF: Purchase Order 2000021168 MJ0085 Tech Park II, dated February 22, 2021

Dear Mr. McNally:

In accordance with the above-referenced agreement, this geotechnical engineering report has been prepared for use in the development of the Cal Poly Tech Park – Phase II which is planned to be constructed between parking lots H-1 and buildings 50J and 50K off of Mount Bishop Road at the campus of Cal Poly, San Luis Obispo, California. We understand the project will include a new pre-engineered metal building and minor site work, including concrete pedestrian walkways, site retaining walls, and driveways/loading areas. We further understand that the new building is planned to be two stories with concrete slabs-on-deck for the second story and slabs-on-grade for the first, and that shallow spread footings are planned. Based upon the structure type described, foundation loads of 3 klf and maximum isolated foundation loads of 50 kips have been used in preparation of this report.

Preliminary geotechnical engineering recommendations for site preparation, grading, utilities, foundations, interior slabs-on-grade and exterior pedestrian flatwork, site retaining walls, vehicular pavements, drainage and maintenance, and observation and testing are presented herein. One electronic copy and two paper copies have been provided to you.

We appreciate the opportunity to have provided professional services for this project and look forward to working with you again in the future. If there are any questions concerning this report, please do not hesitate to contact the undersigned.

Sincerely,

Earth Systems Pacific

REGISTERED PROFESSIONAL ENGINEER
ROBERT W. DOWN
No. 70206
CIVIL
STATE OF CALIFORNIA

Robert Down, PE
Associate Engineer

Kenrick Koo
Engineering Intern

Doc. No.: 2107-041.SER/pm

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1.0 INTRODUCTION AND SITE SETTING

The proposed project will be constructed between parking lot H-1 and buildings 50J and 50K off Mount Bishop Road on the Cal Poly Campus, San Luis Obispo, California and will include a new pre-engineered metal building and minor site work, including concrete pedestrian walkways, site retaining walls, and driveways/loading areas.

The new tech park building will be two-stories and will have slabs-on-grade for the first story and concrete slabs-on-deck for the second story. We anticipate new parking areas will be surfaced with Hot Mix Asphalt (HMA). Storm water control measures (SCM) are also planned for this project. We anticipate cuts and fills of up to three feet.

Approximate site coorindates of latitude 35.3039N and longitude 120.6703W were obtained from Google Earth (2021) and were taken at the approximate location shown on Figure 1 – Site Vicinity Map. The site is boardered by parking lot H-1 on the east, buildings 50J and 50K on the west, the existing Tech Park to the north, and agricultural fields part of the Cal Poly campus on the south. The site is accessed by turning west off Mount Bishop road, through the H-1 parking lot. Part of the northern area of the site is fenced. The site is relatively level and is roughly located at Elevation 292 feet.

2.0 SCOPE OF SERVICES

The authorized scope of work included a general site reconnaissance, field exploration, laboratory and infiltration testing, geotechnical analysis of the data gathered, and preparation of this report.

This report and recommendations are intended to comply with the considerations of Sections 1803.1 through 1803.6, J104.3 and J104.4, as applicable, of the 2019 California Building Code (CBC) and common geotechnical engineering practice in this area under similar conditions at this time. The test procedures were accomplished in general conformance with the standards noted, as modified by common geotechnical engineering practice in this area under similar conditions at this time.

Preliminary geotechnical engineering recommendations for site preparation, grading, foundation design, interior slabs-on-grade and exterior pedestrian flatwork, site retaining wall design criteria, HMA pavement design criteria, drainage, and observation and testing are presented to guide the development of project plans and specifications. As there may be geotechnical issues yet to be resolved, the geotechnical engineer should be retained to provide consultation as the design progresses, and to review project plans as they near completion, and to assist in verifying that pertinent geotechnical issues have been addressed and to aid in conformance with the intent of this report. It is our intent that this report be used exclusively by the client to form the geotechnical basis of the design of the project and in the preparation of plans and specifications. Application beyond this intent is strictly at the user's risk.

This report does not address issues in the domain of contractors such as, but not limited to, site safety, loss of volume due to stripping of the site, shrinkage of soils during compaction, construction means and methods, etc. Analyses of site or areal geology or the soil for radioisotopes, asbestos (either naturally occurring or in man-made products), lead or mold potential, hydrocarbons, or chemical properties is beyond the scope of this report. Ancillary features such as flag or light poles, temporary access roads, and non-structural fills are not within our scope and are also not addressed.

In the event that there are any changes in the nature, design, or location of improvements, or if any assumptions used in the preparation of this report prove to be incorrect, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed and the conclusions of this report modified or verified by the geotechnical engineer in writing. The criteria presented in this report are considered preliminary until such time as any peer review or review by any jurisdiction has been completed, conditions have been observed by the geotechnical engineer in the field during construction, and the recommendations have been verified as appropriate, or modified by the geotechnical engineer in writing.

3.0 GEOTECHNICAL ENGINEERING INVESTIGATION

Our geotechnical field investigation consisted of three exploratory borings that were performed on May 18th, 2021. The approximate locations of the borings are shown on Figure 2 – Exploration Location Map in Appendix A.

The borings were drilled with a truck-mounted Mobile Drill Model B-53 rig equipped with a 6-inch outside diameter hollow stem auger. The borings were drilled to depths of approximately 5.0 feet to 16.5 feet bgs.

Soils encountered in the borings were visually categorized and logged in general accordance with the Unified Soil Classification System and ASTM D 2488-17. Where bedrock was encountered, its properties were described based upon observation of ring and/or Standard Penetration Test samples, observation of the auger cuttings, the effort required to drill into the bedrock, and the effort required to drive samplers into the bedrock. Copies of the boring logs and a boring log legend are included in the Appendix A. In reviewing the boring logs and legend, the reader should recognize that the legend is intended as a guideline only, and there are a number of conditions that may influence the characteristics observed during drilling. These include, but are not limited to, the presence of cobbles or boulders, cementation, variations in soil moisture, presence of groundwater, and other factors. It should also be noted that the descriptions of bedrock must span a much wider range of density and strength characteristics than soil and are relative to other *bedrock* strata. For example, fractured and weathered bedrock may be described as “soft,” yet it will be considerably harder than almost any type of soil. Conversely, a clay soil may be described as “hard,” however it will not be nearly as hard as even “soft” bedrock such as that encountered on this site. Consequently, the logger must exercise judgment in interpreting the subsurface characteristics, possibly resulting in soil and bedrock descriptions that vary somewhat from the legend.

4.0 STORMWATER CONTROL MEASURES INFILTRATION TESTING

An additional two test borings for infiltration testing were drilled using the truck-mounted Mobile Drill Model B-53 rig. After drilling was competed, a 2-inch diameter perforated pipe was installed in each of the infiltration test borings where the anular spaces around the pipes were filled with gravel. Infiltration testing was performed in accordance with the methods developed by this firm in cooperation with the Central Coast Low Impact Development Initiative (ESP 2013).

Initially, testing consisted of introducing water into each of the test borings to just below existing grade. This water level was then maintained at constant head for 30 minutes. After the 30-minute period, the water was shut off and the amount of water introduced into each of the test borings was recorded. Readings of the change in water level were then recorded at various time intervals over periods ranging for approximately four hours. Following testing, the pipes were removed, and the test borings were backfilled with on-site soil. The SCM infiltration test results are attached in Appendix C.

Constant head infiltration testing resulted in introducing 5.0 gallons of water over a period of 30 minutes. Stabilized falling head test were 1.5 in/hr near the end of the test. The test results only indicate the infiltration rates at the specific locations tested and under specific conditions. Sound engineering judgment should be exercised in extrapolating the test results for other conditions or locations. Technical design references vary in methods they present for using these types of test results. However, most references include reduction, safety, and/or correction factors for several parameters including, but not limited to, size of the LID system relative to the test volume, number of tests conducted, variability in the soil profile, anticipated silt loading, anticipated biological buildup, anticipated long-term maintenance, and other factors. Typically, in aggregate these factors range from about 2.5 to 50 depending upon the method used. The final determination of the means by which these data are used is left to the design engineer.

5.0 LABORATORY ANALYSIS

Selected samples from the borings were tested in our laboratory for bulk density (ASTM D 2937-17, modified for ring liners), moisture content (ASTM D 2216-10), expansion index (ASTM D 2937-19), plasticity index (ASTM D 4318-17), grain size distribution by sieve analysis (ASTM D 422-63/07; ASTM D 1140-17), maximum density and optimum moisture content (ASTM D 1557-12 Modified), and cohesion and angle of shearing resistance (ASTM D 3080/3080M-11). The results of the laboratory tests are presented in Appendix B.

6.0 GENERAL SUBSURFACE PROFILE

Based upon our subsurface exploration, the site is underlain by alluvium and bedrock. The alluvium extended to depths that ranged from 2.0 to 15.0 feet bgs and consisted mainly of medium stiff to hard lean clays with variable amounts of sand, gravel, and silt; clayey sands; poorly graded gravel and medium stiff fat clay with variable amounts of sand and gravel. Underlying the alluvium, sandstone bedrock of the Franciscan Mélange was encountered in the borings. The bedrock encountered in the borings was moderately hard and intensely weathered. No subsurface water was encountered.

However, it should be noted that it is common on campus to have groudwater seepage at he soil/bedrock contact and this should be anticipated during construction, especially during and following the winter months. This water should be easily managed during construction with small gravel layers and/or sump pumps, if needed.

7.0 CONCLUSIONS

In our opinion, the site is suitable, from a geotechnical engineering standpoint, for the proposed development discussed in the “Introduction and Site Setting” Section of the report, provided the recommendations contained herein are implemented in the design and construction. In our opinion, the primary geotechnical engineering concerns at the site are the potential for strong seismic shaking, differential settlement, and expansion potential of the site soil. Liquefaction potential and erosion potential is also discussed below.

Potential for Strong Seismic Shaking

The site is in a region of high seismic activity, with the potential for large seismic events that could generate strong ground shaking. The California State University (CSU) has adopted campus-specific seismic ground motion parameters which supersede the California Building Code (CBC). As required by the CSU Seismic Requirements (CSU 2020), seismic ground motion parameters from Attachment B of the CSU Seismic Requirements are included in this report. Seismic acceleration parameters below should be utilized to reduce the impact of a seismic event on the project site.

The following table provides San Luis Obispo campus-specific seismic parameters as reported by the CSU System, detailing that the campus is not within an active fault zone and closest UCERF3 Faults used for deterministic ground shaking considerations are the Oceanic-West Huasna and Hosgri faults. Based on data from our borings, the subsurface characteristics are those of Site Class D – Stiff Soil, as defined by Table 20.3-1 of ASCE 7-16.

TABLE 1: CSU SAN LUIS OBISPO CAMPUS SPECIFIC SEISMIC PARAMETERS (CSU 2020)

Seismic Design Category	D
Site Class	D
MCE Spectral Response Acceleration Ground Motion	
Peak Ground Acceleration, PGA_M	0.54 g
Short Period Spectral Response, S_{MS}	1.15 g
1 second Spectral Response, S_{M1}	0.75 g
Design Earthquake Ground Motion	
Peak Ground Acceleration, PGA_D	0.36 g
Short Period Spectral Response, S_{DS}	0.77 g
1 second Spectral Response, S_{D1}	0.50 g

Soil Expansion Potential

Expansion index testing of the near-surface soils yielded results of 44 and 83. Per Section 1803.5.3 of the 2019 CBC, these soils are considered to be expansive, with “medium” expansion potentials per ASTM D 4829-19. Expansive soils tend to swell with increases in soil moisture and shrink as soil moisture decreases; the upper 3 to 5 feet of soil is the zone most affected by these seasonal soil moisture fluctuations. The volume changes that these materials undergo in this cyclical pattern can damage slabs and foundations if precautionary measures are not incorporated into the design and construction procedures. Recommendations for reducing the potential for damage to the proposed improvements, including moisture conditioning the soil, placement of non-expansive fill, and deepening foundations, are provided in the “Preliminary Geotechnical Recommendations” Section of this report.

Settlement Potential

Differential settlement can occur when foundations or surface improvements span materials with significantly different compression characteristics such as bedrock and soil. The portion of the improvements supported by the softer or deeper soft material will settle more than the portion supported by the firmer material. Based upon the subsurface conditions, it is feasible that the foundations may be founded on the underlying bedrock and the alluvial soils. Such a situation could stress and possibly damage buildings and surface improvements, often resulting in severe cracks and displacement. Total settlement, even if relatively uniform across the building, can also adversely affect the grades and utility penetrations adjacent to improvements.

Based upon the current plan as described in the introduction, we anticipate shallow foundation systems with continuous and spread footings will be suitable for the proposed structures and overexcavation and re-grading of the upper soils and bedrock will be sufficient to reduce the differential and total settlement to acceptable levels. Grading recommendations are provided in the recommendation section of this report.

Liquefaction Settlement

The site is mapped by the City of San Luis Obispo (2014) as being in an area of moderate liquefaction potential. However, due to the relatively shallow depth to bedrock and the lack of subsurface water encountered in our borings, it is our opinion the potential for damage due to liquefaction at the site is very low.

Erosion Potential

The soils are considered erodible. Caution should be exercised to protect the soil from erosion during and following construction.

8.0 PRELIMINARY GEOTECHNICAL RECOMMENDATIONS

These recommendations are applicable for the proposed project as described in the "Introduction and Site Setting" Section of this report. If other improvements not previously mentioned are included, the geotechnical engineer should be contacted for revised recommendations.

Unless otherwise noted, the following definitions are used in the recommendations presented below. Where terms are not defined, definitions commonly used in the construction industry are intended.

- **Building Area:** The area within and extending a minimum of 5 feet beyond the perimeter of the foundations of the proposed technical building and processing building. The building area also includes the footprint of any improvements which are rigidly connected to the structure, such as columns for covered walkways, and that are expected to perform in a similar manner.
- **Site Retaining Wall Foundation Area:** The area within and extending a minimum of 5 feet beyond the perimeter of the foundations for site retaining walls.
- **Flatwork Areas:** The areas within and extending a minimum of 1 foot beyond the limits of exterior pedestrian flatwork.
- **Vehicular Pavement Areas:** The areas within and extending a minimum of 5 feet beyond the limits of the pavement area.
- **Subgrade:** The elevation of the surface upon which a sand cushion/nonexpansive imported material or aggregate base (AB) will be placed for vehicular pavement or flatwork.
- **Existing Grade:** Elevations of the site that existed as of the date of this report.
- **Finish Pad Grade:** The elevation in the building area where earthwork operations are typically considered to be complete. It does not include any sand or gravel that might be placed below slabs in association with vapor protection for the slabs.

- **Scarified:** Thoroughly plowed or ripped in two orthogonal directions to a depth of not less than 8 inches.
- **Moisture Conditioned:** Soil moisture content adjusted to optimum moisture content, or just above, prior to application of compactive effort.
- **Compacted/Recompacted:** Soils placed in level lifts not exceeding 8 inches in loose thickness and compacted to a minimum of 90 percent of maximum dry density, unless specified otherwise. The standard tests used to establish maximum dry density and field density should be ASTM D 1557-12 and ASTM D 6938-17, respectively, or other methods acceptable to the geotechnical engineer and jurisdiction.

Site Preparation

1. The ground surface in the grading area should be prepared for construction by removing all existing improvements, foundations, pavement sections, concrete, debris, and other deleterious materials. Any existing utility lines that will not remain in service should be either removed or abandoned. The appropriate method of utility abandonment will depend upon the type and depth of the utility. Recommendations for abandonment during construction can be made by the geotechnical engineer as necessary.

2. Voids created by the removal of materials or utilities described above should be called to the attention of the geotechnical engineer. No fill should be placed unless the underlying soil has been observed by the geotechnical engineer.

Grading

1. Following site preparation, soils within the building area should be removed to a level plane at a minimum depth of 2 feet below planned bottom-of-footing elevation, or 2 feet below existing grade, whichever is deeper. The exposed surfaces should then be scarified, moisture conditioned and recompacted. Where bedrock is exposed, scarification is not required.

2. Following site preparation, soils within the site retaining wall foundation areas should be removed to a level plane at a minimum depth of 2 feet below planned bottom-of-footing elevation, or 2 feet below existing grade, whichever is deeper. The exposed surfaces should then be scarified, moisture conditioned and recompacted. Where bedrock is exposed, scarification is not required.

3. Following site preparation, exterior pedestrian flatwork areas and vehicular pavement areas should be overexcavated to a depth of 1 foot below planned subgrade elevation or existing grade, whichever is deeper. The soil surface exposed by overexcavation should be scarified, moisture conditioned, and recompacted.

4. In the remainder of the grading area, the exposed and prepared soils should be scarified to a minimum depth of 1 foot, moisture conditioned, and recompacted to a minimum of 90 percent of maximum dry density.

5. Voids created by dislodging cobbles and/or debris during scarification should be backfilled and recompacted, and the dislodged materials should be removed from the work area.

6. Previously excavated site soil may be compacted as general fill within the grading area with the exception of the non-expansive layer below the building slab and flatwork areas or aggregate base. The top of the building area should consist of a minimum of 18 inches of nonexpansive fill.

7. All imported soil used on the site should be nonexpansive. Nonexpansive materials are defined as soils that fall in the GW, GM, GC, SP, SW, SC and SM categories per ASTM D 2487-17, and that have an expansion index of 10 or less (ASTM D 4829-11).

8. Proposed imported soils should be evaluated by the geotechnical engineer before being used and on an intermittent basis during placement on the site.

9. All fill should be cleaned of any rocks, debris, and irreducible material larger than 6 inches in diameter. When fill contains rocks, they should be placed in a sufficient soil matrix to ensure that voids caused by nesting of the rocks do not occur and that the material can be properly compacted.

10. It may be difficult to achieve stability if the soils being compacted have well above optimum moisture contents. In those cases, it may be necessary to dry the soils through scarification or mixing with dry soil in order to achieve stable conditions. Other options to achieve stable conditions may include replacement of unstable soil with gravel or Class 2 aggregate base and potentially incorporating stabilization fabric or geogrid. Detailed stabilization recommendations may be provided, if requested, upon examination of actual field conditions by the Geotechnical Engineer. Based upon the moisture contents in the borings, drying of the upper soils should be anticipated, at a minimum.

11. The recommended soil moisture content should be maintained throughout construction, and during the life of the structure and sitework improvements. Failure to maintain the recommended soil moisture content can result in development of cracks and disturbance, which are an indication of degradation of the degree of soil compaction. If cracks are allowed to develop, or if soils near improvements such as foundations, flatwork, pavement, curbs, etc. are otherwise disturbed, damage to those improvements may result. Soils that have been or are otherwise disturbed should be removed, moisture conditioned, and recompacted.

12. Generally, permanent cut and fill slopes should not exceed a 2:1 (horizontal:vertical) gradient, unless otherwise recommended by the geotechnical engineer.

Utilities

1. Unless otherwise recommended, utility trenches adjacent to foundations should not be excavated within the zone of foundation influence, as shown on Typical Detail A presented in Appendix D.

2. Utilities that will pass beneath a foundation should be placed with properly compacted utility trench backfill, and the foundation should be designed to span the trench.

3. A select, non-corrosive, easily compacted sand should be used as bedding and shading immediately around utilities. Trench backfill, above the select material, may be site soils up to subgrade or the planned bottom of non-expansive fill.

4. In general, trench backfill should be compacted to a minimum of 90 percent of maximum dry density. Trenches located within areas to be paved should be compacted to a minimum of 95 percent of maximum dry density within the upper foot of subgrade and all aggregate base.

5. Trench backfill should be placed in level lifts not exceeding 6 inches in loose thickness, moisture conditioned, and compacted to the minimums noted above.

6. Long-term settlement of properly compacted, imported sand or crushed gravel trench backfill should be assumed to be about 0.2 to 0.5 percent of the depth of the backfill; long-term settlement of properly compacted site soil or crushed sandstone trench backfill

should be assumed to be about 0.5 to 1 percent of the depth of the backfill. Improvements that are constructed over or near trenches should be designed to accommodate long-term settlement.

7. Compaction of trench backfill by jetting or flooding is not recommended except under extraordinary circumstances. However, to aid in *encasing* utility conduits, particularly corrugated drain pipes, and multiple, closely spaced conduits in a single trench, jetting or flooding may be useful. Flooding or jetting should only be attempted with extreme caution, and any jetting operation should be subject to review by the geotechnical engineer.

8. The recommendations of this section are minimums only and may be superseded by the requirements of the architect/engineer, the recommendations of pipe manufacturers or utility companies, or the requirements of the governing jurisdiction based upon soil corrosivity or other factors.

Foundations

1. Continuous and spread footings may be used to support the proposed structures, including site retaining walls. The footings should be constructed at a minimum overall depth of 24 inches below lowest adjacent grade and should bear in excavations cut neat into compacted fill. Footing excavations should be horizontal and stepped as needed to bear in uniform material.

2. Continuous footings and grade beams should be reinforced, at a minimum, by two No. 4 rebar at the top and the bottom, or as required by the architect/engineer. Spread footings should be reinforced in accordance with the requirements of the architect/engineer. Spread footings should be connected by grade beams on two sides to create a foundation systems that acts as a single unit.

3. Footings bearing into firm compacted fill may be designed using maximum allowable bearing capacities of 2,000 psf for dead loads and 3,000 psf for dead plus live loads. Using these criteria, maximum total and differential static settlements are expected to be less than 1-inch. Allowable capacities may be increased by one-third when transient loads such as wind or seismicity are included.

4. In calculating resistance to lateral loads, ultimate passive equivalent fluid pressures of 350 pcf may be used for foundations bearing in compacted fill. A coefficient of friction of 0.30 may also be utilized in the design. The lateral capacities are based on the assumption that the soil adjacent to the foundations is properly compacted. Passive and friction resistance components may be combined in the analysis without reduction to either value.

5. Foundation excavations should be observed by the geotechnical engineer during excavation and prior to placement of formwork, reinforcing steel or concrete. Soil in foundation excavations should have a moisture content of optimum moisture content or just above and no desiccation cracks should be present prior to concrete placement.

Interior Slabs-on-Grade and Exterior Pedestrian Flatwork

Interior Slabs-on-Grade

1. Interior slabs-on-grade should have a minimum thickness of 4 inches. They should be reinforced and doweled to foundations per the specifications of the architect/engineer. At a minimum, interior slabs should be reinforced with No. 4 rebar placed at 18 inches on center each way. All structural slabs should contain minimum rebar meeting the criteria of ACI 318, Section 24.4 (ACI 2014). At a minimum, foundation dowels should be lap spliced to the slab rebar. The size and spacing of the dowels should match the size and spacing of the slab rebar.

Exterior Pedestrian Flatwork

1. Exterior pedestrian flatwork should have a minimum thickness of 4 inches. Minimum reinforcement for exterior pedestrian flatwork should consist of No. 3 rebar placed at 24 inches on-center each way.

2. In conventional construction, it is common to use 4 to 6 inches of imported sand beneath exterior pedestrian flatwork. However, due to the medium to high expansion potential of the site soils, there will be a risk of movement and damage to the flatwork and slabs if conventional measures are used – heaving and cracking could occur. To reduce the potential for movement and damage, flatwork should be supported on at least 18 inches of nonexpansive imported soils if desired performance is to be similar to interior slabs on grade.

3. For an added level of protection against expansion, the flatwork can be provided with perimeter trenched edges a minimum of 3 inches deeper than the chosen nonexpansive layer. The trenched edges should be reinforced with No. 4 rebar top and bottom. The decision regarding the thickness of nonexpansive material to use below flatwork, as well as the use of trenched edges, is left to the architect/engineer or owner.

4. Exterior pedestrian flatwork should have thickened edges a minimum of 6 inches below the bottom of the slab.

5. Flatwork should be constructed with frequent joints to allow articulation as the flatwork moves in response to seasonal soil temperature and moisture variations. The soil below flatwork should be moisture conditioned prior to casting the flatwork.

6. Flatwork surfaces should be sloped to freely drain toward appropriate drainage facilities. Water should not be allowed to stand or pond on or adjacent to pavement or other improvements as it could infiltrate into the aggregate base and/or subgrade, causing premature pavement deterioration.

7. Flatwork at doorways, and at other areas where maintaining the elevation of the flatwork is desired, should be doweled to the perimeter foundations, at a minimum, by No. 3 dowels lapped to the flatwork rebar at the same spacing of the flatwork. In other areas, the flatwork may be doweled to the foundation or the flatwork may be allowed to "float free," at the discretion of the architect/engineer. Flatwork that is intended to float free should be separated from foundations by a felt joint or other means.

Moisture Vapor Transmission

1. Due to the current use of impermeable floor coverings, water-soluble flooring adhesives, and the speed at which buildings are now constructed, moisture vapor transmission through slabs is a much more common problem than in past years. Where moisture vapor transmitted from the underlying soil would be undesirable, the slabs should be protected from subsurface moisture vapor. A number of options for vapor protection are discussed below; however, the means of vapor protection, including the type and thickness of the vapor retarder, if specified, are left to the discretion of the architect/engineer.

2. Where specified, vapor retarders should conform to ASTM Standard E1745-17. This standard specifies properties for three performance classes, Class “A”, “B” and “C”. The appropriate class should be selected based on the potential for damage to the vapor retarder during its installation and placement of slab reinforcement and concrete.

3. It should be noted that ASTM E 1745-17 has the same permeance threshold for Class A through Class C (0.1 perms). The class that is chosen will make a difference in how resistant the vapor retarder is to punctures and tears, but it will not insure any better permeance values to protect floor coverings.

4. Several recent studies, including those of ACI Committee 302 (ACI 2015), have concluded that excess water above the vapor retarder increases the potential for moisture damage to floor coverings and could increase the potential for mold growth or other microbial contamination. The studies also concluded that it is preferable to eliminate the typical sand layer beneath the slab and place the slab PCC in direct contact with a vapor retarder, particularly during wet weather construction. However, placing the PCC directly on the vapor retarder requires special attention to specifying the proper vapor retarder, a very low water-cement ratio in the PCC mix, and special finishing and curing techniques.

5. Another option for vapor protection would be the use of vapor-inhibiting admixtures in the slab PCC mix and/or application of a sealer to the surface of the slab. This would also require special PCC mixes and placement procedures, depending upon the recommendations of the admixture or sealer manufacturer.

6. A third option that may be a reasonable compromise between effectiveness and cost considerations would be the use of a subslab vapor retarder protected by a layer of granular material or of clean sand, with the granular material being the preferred choice. The granular material should be easily compactible and have a relatively low fines content and a low wicking potential. Clean sand is defined as a well or poorly graded sand (ASTM D2487-17) of which less than 3 percent passes the No. 200 sieve. The retarder should be covered with a minimum 4 inches of granular material or clean sand. If a Class “A” vapor retarder is specified, the retarder can be placed directly on the compacted soil material. If a less durable vapor retarder is specified (Class “B” or “C”), a minimum of 1 inch of fine-graded material such as a clean sand should be placed over the compacted soil material

to reduce the chance of puncturing the vapor retarder. The materials mentioned above may count as part of the nonexpansive fill section, not in addition to it.

7. If sand is used between the vapor retarder and the slab, it should be moistened only as necessary to promote concrete curing; saturation of the sand should be avoided, as the excess moisture would be on top of the vapor retarder, potentially resulting in vapor transmission through the slab for months or years.

8. Regardless of the underslab vapor retarder selected, proper installation of the retarder is critical for optimum performance. Where utilized, the vapor retarder should be placed a minimum of 1-inch above the flow line of the drainage path surrounding the structures, or 1-inch above the area drain grates if area drains are used to collect runoff around the structures. All seams must be properly lapped, and all seams and utility penetrations properly sealed in accordance with the vapor retarder manufacturer's recommendations and ASTM E1643-18a. At the terminating edges of the vapor retarder, the vapor retarder should be effectively sealed with accessories specifically designed to seal the material to new or existing concrete; details for edge sealing of the vapor retarder should be provided by the architect/engineer.

Slabs-on-Grade - General

1. To reduce shrinkage cracks in all interior and exterior slabs-on-grade, the concrete aggregates should be of appropriate size and proportion, the water/cement ratio should be low, the concrete should be properly placed and finished, contraction joints should be installed, and the concrete should be properly cured. This is particularly applicable to slabs that will be cast directly upon a vapor retarder and those that will be protected from transmission of vapor by use of admixtures or surface sealers. Concrete materials, placement, and curing specifications should be at the direction of the architect/engineer; AC 302.1R-15 (ACI 2015) is suggested as a resource for the architect/engineer in preparing such specification.

Retaining Walls

1. Site retaining walls may be founded in firm recompacted soil. Foundations for all site retaining walls should have a minimum depth (not including the keyway) of 27 inches below lowest adjacent grade within 8 feet of the footing.

2. Retaining wall footings should be reinforced in accordance with the requirements of the architect/engineer; however, minimum reinforcement should consist of two No. 4 rebars, one at the top and one at the bottom.

3. Retaining wall design may be based on the following drained parameters:

TABLE 2: RETAINING WALL DESIGN PARAMETERS

Parameter	Backfill Type	Value
Active Equivalent Fluid Pressure	Site Fill Materials	50 pcf
	Imported Sand/Gravel	35 pcf
At-Rest Equivalent Fluid Pressure	Site Fill Materials	65 pcf
	Imported Sand/Gravel	50 pcf

4. The site fill materials listed above exclude the fat clay soils which may not be used as wall backfill per the CBC. No surcharges are taken into consideration in the values presented in the previous paragraph. These values will require application of appropriate factors of safety, load factors, and/or other factors as deemed appropriate by the architect/engineer.

5. The active and at-rest pressures presented in Table 2 are applicable to a horizontal retained surface behind the wall. Walls having a retained surface that slopes upward from the wall should be designed for an additional equivalent fluid pressure of 1 pcf for the active case and 1.5 pcf for the at-rest case, for every degree of slope inclination.

6. Under the 2019 CBC, the Risk-Targeted Maximum Considered Earthquake (MCE_R) must be used for determining seismic pressures on walls. Further, Section 1807.2.2 of the 2019 CBC requires that dynamic seismic lateral earth pressures be provided by the geotechnical engineer for walls retaining more than 6 feet of backfill. As retaining walls for this project are not anticipated to exceed 6 feet in height, a seismic increment increase is not required.

7. Long-term settlement of properly compacted native soil retaining wall backfill or imported sand/gravel backfill should be assumed to be about 0.5 and 0.25 percent of the depth of the backfill, respectively. Improvements that are constructed near the tops of retaining walls should be designed to accommodate long-term settlement.

8. All retaining walls should be drained with perforated pipe encased in a free-draining gravel blanket. The pipe should be placed with perforations facing downward and should discharge in a nonerosive manner away from foundations and other improvements. The gravel blanket should have a width of approximately 1-foot and should extend upward to approximately 1-foot from the top of the wall backfill. The upper foot should be backfilled with native soil, except in areas where surface improvements will abut the top of the wall. In such cases, the gravel should extend to the imported nonexpansive material, aggregate base, or other material below the improved surface, as appropriate. To reduce infiltration of the soil into the gravel, a permeable synthetic filter fabric conforming to Standard Specifications Section 96-1.02B – Class C (Caltrans 2018), should be placed between the gravel and soil. Manufactured synthetic drains, such as Miradrain or Enkadrain are acceptable alternatives to the use of gravel, provided that they are installed in accordance with the recommendations of the manufacturer and Geotechnical Engineer.

9. Walls facing areas where moisture transmission through the wall would be undesirable should be thoroughly waterproofed in accordance with the specifications of the architect/engineer.

10. The architect/engineer should bear in mind that retaining walls by their nature are flexible structures, and that surface treatments on walls often crack. Where walls are to be plastered or otherwise have a finish applied, the flexibility should be considered in determining the suitability of the surfacing material, spacing of horizontal and vertical control joints, etc. The flexibility should also be considered where a retaining wall will abut or be connected to a rigid structure, and where the geometry of the wall is such that its flexibility will vary along its length.

Vehicular Pavement Sections

HMA Pavement

The following HMA pavement sections are based upon a tested R-value of 6 from adacent preojcts, and assumed Traffic Indices (TIs) of 4.0 through 7.0. Determination of the appropriate TI for specific areas of the project is left to others. The HMA sections were calculated in accordance with the method presented in the "Highway Design Manual" (Caltrans 2018). The calculated HMA and Class 2 aggregate base (AB) thicknesses are for compacted material. Normal Caltrans construction tolerances should apply.

TABLE 3: HMA Pavement Sections

Traffic Index	HMA (in)	Class 2 AB (in)
4.0	2.25	8.0
4.5	2.50	9.0
5.0	2.75	10.5
5.5	3.00	12.0
6.0	3.25	12.0
6.5	3.75	14.0
7.0	4.00	15.5

*Per Caltrans (2018) Section 26

PCC Pavement

1. If unreinforced Portland cement concrete pavement is planned, the following minimum section is recommended:
    - 8 inches plain PCC (4,000 psi minimum)
    - Joint spacing at a maximum of 12 feet on-center each way
    - #4 smooth joint dowels at 10-inch centers
    - 12 inches Class 2 AB and subgrade compacted to a minimum of 95 percent of maximum dry density

2. If reinforced concrete pavement is planned, the following minimum section may be used:
    - 6 inches PCC (4,000 psi minimum)
    - Joint spacing at a maximum of 10 feet on-center each way
    - No. 4 rebar at 18-inch centers each way
    - No. 4 smooth joint dowels at 18-inch centers
    - 12 inches Class 2 AB and subgrade compacted to a minimum of 95 percent of maximum dry density

3. Alternately, the pavement may be designed by the architect/engineer for the appropriate loads. Provided that a minimum of 12 inches of AB compacted to a minimum of 95 percent of maximum dry density is provided, the design may be based on a subgrade modulus of 200 pci (psi/in). Specification of concrete properties and reinforcing is left to the architect/engineer.

Pavement Sections - General

1. HMA and PCC pavement should be constrained by curbs, gutters, flatwork, walls, etc.; free edges to the pavement should be avoided.

2. HMA and PCC pavement should be set back a minimum of 5 feet from any descending slope. Alternately, deepened curbs may be used to constrain the pavement. Where curbs will be deepened in lieu of the recommended setback, the individual situation should be reviewed, and specific recommendations prepared by the geotechnical engineer.

3. Subgrade and AB should be firm and unyielding when proof-rolled with heavy, rubber-tired grading equipment prior to continuing construction.

4. Finished pavement surfaces should be sloped to freely drain toward appropriate drainage facilities. Water should not be allowed to stand or pond on or adjacent to pavement, as it could cause premature pavement deterioration or improvement damage.

5. To reduce migration of surface drainage into the subgrade, maintenance of pavement areas is critical. Any cracks that develop in the pavement should be promptly sealed.

6. The local jurisdiction may have additional requirements for pavement or pavers that could take precedence over the above recommendations.

Drainage and Maintenance

1. Unpaved ground surfaces should be graded during construction and, per Section 1804.4 of the CBC, finish graded to direct surface runoff away from foundations, slopes, and other improvements at a minimum 5 percent grade for a minimum distance of 10 feet. If this is not feasible due to the terrain, property lines, or other factors, swales with improved surfaces, area drains, or other drainage features should be provided to divert drainage away from these areas.

2. Finished surfaces should be sloped to freely drain toward appropriate drainage facilities. Water should not be allowed to stand or pond on or adjacent to foundations.

3. All eaves of the proposed structures should be provided with roof gutters. Runoff from roof gutters, downspouts, area drains, weep holes, etc., should discharge to an appropriate outlet in a nonerosive manner away from foundations and other improvements in accordance with the requirements of the governing agencies. Erosion protection should be placed at all discharge points unless the discharge is to a pavement surface.

4. Stabilization of surface soils, particularly those disturbed during construction, by vegetation or other means *during and following construction,* should be implemented to protect the site from erosion damage. Care should be taken to establish and maintain vegetation.

5. Erosion protection should be maintained or supplemented as needed. Irrigation systems should be maintained so that the soils are not over-watered or allowed to desiccate.

6. To reduce the potential for damage due to erosion it is essential that the surface soils, particularly those disturbed during construction, be stabilized by vegetation or other means during and following construction. Care should be taken to establish and maintain vegetation. The landscaping and exterior flatwork should be installed to maintain the surface drainage recommended above.

7. To reduce the potential for disruption of drainage patterns and undermining of foundations and other improvements, rodent activity should be aggressively controlled.

Observation and Testing

1. It must be recognized that the recommendations contained in this report are based on a limited number of borings and rely on continuity of the subsurface conditions encountered. Therefore, the geotechnical engineer should be retained to provide consultation during the design phase, to review plans as they near completion, to interpret this report during construction, and to provide construction monitoring in the form of testing and observation.

2. At a minimum, the geotechnical engineer should be retained to provide:
   - Review of the project plans as they near completion
   - Professional observation during grading and backfill
   - Oversight of soil special inspection during grading and foundation construction

3. Special inspection of grading and backfill should be provided as per Section 1705.6 and Table 1705.6 of the 2019 CBC; the special inspector should be under the direction of the geotechnical engineer. It is our opinion that none of the grading construction is of a nature that should warrant continuous special inspection; periodic special inspection should suffice. Subject to approval by the Building Official, the exception to continuous special inspection is described in Section 1704.2 of the 2019 CBC and should be specified by the architect/engineer and periodic special inspection of the following items should be provided by the special inspector.
   - Stripping and clearing of vegetation and unsuitable materials
   - Overexcavation to the recommended depths
   - Scarification, moisture conditioning, and compaction of the soil
   - Fill quality, placement, and compaction
   - Utility trench backfill
   - Foundation excavations
   - Retaining wall drains and backfill
   - Subgrade and AB compaction and proof-rolling

4. A program of quality control should be developed prior to beginning grading. The contractor or project manager should determine any additional inspection items required by the architect/engineer or the governing jurisdiction.

5. Locations and frequency of compaction tests should be as per the recommendation of the geotechnical engineer at the time of construction. The recommended test locations and frequency may be subject to modification by the geotechnical engineer, based upon soil and moisture conditions encountered, size and type of equipment used by the contractor, the general trend of the results of compaction tests, or other factors.

6. A preconstruction conference among the owner, the geotechnical engineer, the governing agency, the special inspector, the project inspector, the architect/engineer, and contractors is recommended to discuss planned construction procedures and quality control requirements.

7. The geotechnical engineer should be notified at least 48 hours prior to beginning construction operations. If Earth Systems Pacific is not retained to provide construction observation and testing services, it shall not be responsible for the interpretation of the information by others or any consequences arising therefrom.

9.0 CLOSURE

Our intent was to perform the investigation in a manner consistent with the level of care and skill ordinarily exercised by members of the profession currently practicing in the locality of this project and under similar conditions. No representation, warranty, or guarantee is either expressed or implied. This report is intended for the exclusive use by the client as discussed in the “Scope of Services” Section. Application beyond the stated intent is strictly at the user's risk.

This report is valid for conditions as they exist at this time for the type of project described herein. The conclusions and recommendations contained in this report could be rendered invalid, either in whole or in part, due to changes in building codes, regulations, standards of geotechnical or construction practice, changes in physical conditions, or the broadening of knowledge. If Earth Systems Pacific is not retained to provide construction observation and testing services, it shall not be responsible for the interpretation of the information by others or any consequences arising therefrom.

If changes with respect to project type or location become necessary, if items not addressed in this report are incorporated into plans, or if any of the assumptions used in the preparation of this report are not correct, this firm shall be notified for modifications to this report. Any items not specifically addressed in this report should comply with the CBC and the requirements of the governing jurisdiction.

The preliminary recommendations of this geotechnical report are based upon the geotechnical conditions encountered at the site and may be augmented by additional requirements of the architect/engineer, or by additional recommendations provided by the geotechnical engineer based on conditions exposed at the time of construction.

This document, the data, conclusions, and recommendations contained herein are the property of Earth Systems Pacific. This report shall be used in its entirety, with no individual sections reproduced or used out of context. Copies may be made only by Earth Systems Pacific, the client, and the client's authorized agents for use exclusively on the subject project. Any other use is subject to federal copyright laws and the written approval of Earth Systems Pacific.

Thank you for this opportunity to have been of service. If you have any questions, please feel free to contact this office at your convenience.

End of Text.

TECHNICAL REFERENCE LIST

ACI (American Concrete Institute). 2015. "Guide for Concrete Floor and Slab Construction." Documents 302.1R-15.

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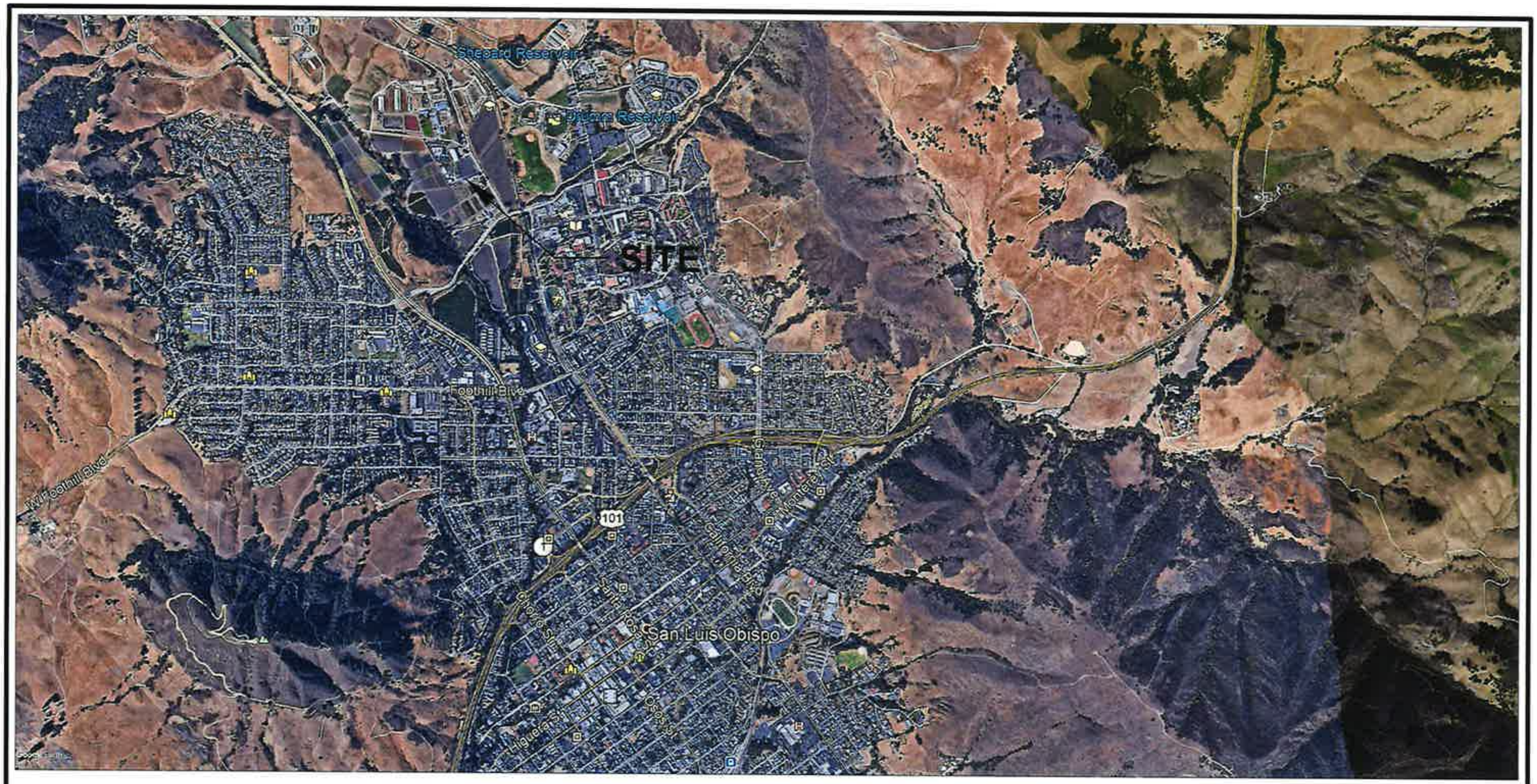
APPENDIX A

Site Vicinity Map

Exploration Location Map

Boring Log Legend

Boring Logs



BASE MAP PROVIDED BY: GOOGLE EARTH (2021)

N

NOT TO SCALE

Earth Systems Pacific
4378 Old Santa Fe Road, San Luis Obispo, CA 93401
www.earthsystems.com
(805) 544-3276 • Fax (805) 544-1786

SITE VICINITY MAP

Cal Poly Tech Park
Mount Bishop Road
San Luis Obispo, California

Date
July 2021

Project No.
300986-048

Figure 1

300986-048CALPOLYTECHPARK051821maps.dwg

LEGEND

B1 ⊕ Boring Location (Approx.)

1 ● Infiltration Test Location (Approx.)

BASE MAP PROVIDED BY: GOOGLE EARTH (2021)

N

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Earth Systems Pacific
4378 Old Santa Fe Road, San Luis Obispo, CA 93401
www.earthsystems.com
(805) 544-3276 • Fax (805) 544-1786

EXPLORATION LOCATION MAP

Cal Poly Tech Park
Mount Bishop Road
San Luis Obispo, California

Date
May 2021

Project No.
300986-048

Figure 2

300986–048CALPOLYTECHPARK051821maps.dwg

Earth Systems Pacific

BORING LOG LEGEND

SAMPLE / SUBSURFACE WATER SYMBOLS

SAMPLE / SUBSURFACE WATER SYMBOLS	GRAPH. SYMBOL
CALIFORNIA MODIFIED	▬
STANDARD PENETRATION TEST (SPT)	●
SHELBY TUBE	▭
BULK	○
SUBSURFACE WATER DURING DRILLING	▼
SUBSURFACE WATER AFTER DRILLING	▽

UNIFIED SOIL CLASSIFICATION SYSTEM (ASTM D 2487)

MAJOR DIVISIONS		GROUP SYMBOL	TYPICAL DESCRIPTIONS	GRAPH. SYMBOL
COARSE GRAINED SOILS	MORE THAN HALF OF MATERIAL IS LARGER THAN #200 SIEVE SIZE	GW	WELL GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES	○
		GP	POORLY GRADED GRAVELS, OR GRAVEL-SAND MIXTURES, LITTLE OR NO FINES	⬡
		GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES, NON-PLASTIC FINES	▥
		GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES, PLASTIC FINES	⬡
		SW	WELL GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES	▒
		SP	POORLY GRADED SANDS OR GRAVELLY SANDS, LITTLE OR NO FINES	░
		SM	SILTY SANDS, SAND-SILT MIXTURES, NON-PLASTIC FINES	▥
		SC	CLAYEY SANDS, SAND-CLAY MIXTURES, PLASTIC FINES	▨
FINE GRAINED SOILS	HALF OR MORE OF MATERIAL IS SMALLER THAN #200 SIEVE SIZE	ML	INORGANIC SILTS AND VERY FINE SANDS, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY	▥
		CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS	▨
		OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY	┄
		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SANDY OR SILTY SOILS, ELASTIC SILTS	▥
		CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS	▨
		OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS	▤
		PT	PEAT AND OTHER HIGHLY ORGANIC SOILS	▽

OBSERVED MOISTURE CONDITION

DRY	SLIGHTLY MOIST	MOIST	VERY MOIST	WET (SATURATED)

CONSISTENCY

COARSE GRAINED SOILS

BLOWS/FOOT		DESCRIPTIVE TERM
SPT	CA SAMPLER	
0-10	0-16	LOOSE
11-30	17-50	MEDIUM DENSE
31-50	51-83	DENSE
OVER 50	OVER 83	VERY DENSE

FINE GRAINED SOILS

BLOWS/FOOT		DESCRIPTIVE TERM
SPT	CA SAMPLER	
0-2	0-3	VERY SOFT
3-4	4-7	SOFT
5-8	8-13	MEDIUM STIFF
9-15	14-25	STIFF
16-30	26-50	VERY STIFF
OVER 30	OVER 50	HARD

GRAIN SIZES

U.S. STANDARD SERIES SIEVE				CLEAR SQUARE SIEVE OPENING			
# 200	# 40	# 10	# 4	3/4"	3"	12"	
SILT & CLAY	SAND			GRAVEL		COBBLES	BOULDERS
	FINE	MEDIUM	COARSE	FINE	COARSE		

TYPICAL BEDROCK HARDNESS

MAJOR DIVISIONS	TYPICAL DESCRIPTIONS
EXTREMELY HARD	CORE, FRAGMENT, OR EXPOSURE CANNOT BE SCRATCHED WITH KNIFE OR SHARP PICK; CAN ONLY BE CHIPPED WITH REPEATED HEAVY HAMMER BLOWS
VERY HARD	CANNOT BE SCRATCHED WITH KNIFE OR SHARP PICK; CORE OR FRAGMENT BREAKS WITH REPEATED HEAVY HAMMER BLOWS
HARD	CAN BE SCRATCHED WITH KNIFE OR SHARP PICK WITH DIFFICULTY (HEAVY PRESSURE); HEAVY HAMMER BLOW REQUIRED TO BREAK SPECIMEN
MODERATELY HARD	CAN BE GROOVED 1/16 INCH DEEP BY KNIFE OR SHARP PICK WITH MODERATE OR HEAVY PRESSURE; CORE OR FRAGMENT BREAKS WITH LIGHT HAMMER BLOW OR HEAVY MANUAL PRESSURE
SOFT	CAN BE GROOVED OR GOUGED EASILY BY KNIFE OR SHARP PICK WITH LIGHT PRESSURE, CAN BE SCRATCHED WITH FINGERNAIL; BREAKS WITH LIGHT TO MODERATE MANUAL PRESSURE
VERY SOFT	CAN BE READILY INDENTED, GROOVED OR GOUGED WITH FINGERNAIL, OR CARVED WITH KNIFE; BREAKS WITH LIGHT MANUAL PRESSURE

TYPICAL BEDROCK WEATHERING

MAJOR DIVISIONS	TYPICAL DESCRIPTIONS
UNWEATHERED	NO DISCOLORATION, NOT OXIDIZED
SLIGHTLY WEATHERED	DISCOLORATION OR OXIDATION IS LIMITED TO SURFACE OF, OR SHORT DISTANCE FROM, FRACTURES: SOME FELDSPAR CRYSTALS ARE DULL
MODERATELY WEATHERED	DISCOLORATION OR OXIDATION EXTENDS FROM FRACTURES, USUALLY THROUGHOUT; Fe-Mg MINERALS ARE "RUSTY", FELDSPAR CRYSTALS ARE "CLOUDY"
HIGHLY WEATHERED	DISCOLORATION OR OXIDATION THROUGHOUT; FELDSPAR AND Fe-Mg MINERALS ARE ALTERED TO CLAY TO SOME EXTENT, OR CHEMICAL ALTERATION PRODUCES IN SITU DISAGGREGATION
DECOMPOSED	DISCOLORATION OR OXIDATION THROUGHOUT, BUT RESISTANT MINERALS SUCH AS QUARTZ MAY BE UNALTERED; FELDSPAR AND Fe-Mg MINERALS ARE COMPLETELY ALTERED TO CLAY

drafting/masters/Boring Log Legend 062719.dwg

Earth Systems Pacific

LOGGED BY: K. Koo
DRILL RIG: Mobile B-53 with Automatic Hammer
AUGER TYPE: 6" Hollow Stem

Boring No. 1

PAGE 1 OF 1
JOB NO.: 300986-048
DATE: 5/18/2021

Cal Poly Tech Park II
Mount Bishop Road
San Luis Obispo, California

DEPTH (feet)	USCS CLASS	SYMBOL	SOIL DESCRIPTION	SAMPLE DATA				
				INTERVAL (feet)	SAMPLE TYPE	DRY DENSITY (pcf)	MOISTURE (%)	BLOWS PER 6 IN.
0	SC	▨	CLAYEY SAND: dark brown, medium dense, moist (Alluvium)	0.0 - 4.0	○			
4	GP	○	POORLY GRADED GRAVEL: gray, dense, moist	5.0 - 6.5	▬	111.9	4.0	10 21 32
				4.0 - 8.0	○			
8	CL	▨	SANDY LEAN CLAY: dark brown, hard, moist	10.0 - 11.5	▬	106.8	20.7	7 22 36
				15.0 - 16.5	●			4 10 17
15	CL	▨	SANDY LEAN CLAY: orange brown, very stiff, very moist (Residual Soil)					
16.5			End of Boring @ 16.5' No subsurface water encountered					

LEGEND: ▬ Ring Sample ○ Grab Sample ▭ Shelby Tube Sample ● SPT

NOTE: This log of subsurface conditions is a simplification of actual conditions encountered. It applies at the location and time of drilling. Subsurface conditions may differ at other locations and times.

Earth Systems Pacific

Boring No. 2

PAGE 1 OF 1
JOB NO.: 300986-048
DATE: 5/18/2021

LOGGED BY: K. Koo
DRILL RIG: Mobile B-53 with Automatic Hammer
AUGER TYPE: 6" Hollow Stem

DEPTH (feet)	USCS CLASS	SYMBOL	**Cal Poly Tech Park II** **Mount Bishop Road** **San Luis Obispo, California** SOIL DESCRIPTION	SAMPLE DATA				
				INTERVAL (feet)	SAMPLE TYPE	DRY DENSITY (pcf)	MOISTURE (%)	BLOWS PER 6 IN.
0	CH	▨	SANDY FAT CLAY: dark brown, medium stiff, slightly moist (Alluvium)	0.0 - 7.0	○			
5		▨		5.0 - 6.5	■	78.0	16.7	11 13 25
7			SANDSTONE: tan, moderately hard, slightly moist, slightly weathered (Franciscan Mélange)					
10				10.0 - 10.5	●			50(2)
15				15.0 - 15.5	●			50(2)
16			End of Boring @ 15.5' No subsurface water encountered					

LEGEND: ■ Ring Sample ○ Grab Sample ▭ Shelby Tube Sample ● SPT

NOTE: This log of subsurface conditions is a simplification of actual conditions encountered. It applies at the location and time of drilling. Subsurface conditions may differ at other locations and times.

Earth Systems Pacific

Boring No. 3

PAGE 1 OF 1
JOB NO.: 300986-048
DATE: 5/18/2021

LOGGED BY: K. Koo
DRILL RIG: Mobile B-53 with Automatic Hammer
AUGER TYPE: 6" Hollow Stem

Cal Poly Tech Park II
Mount Bishop Road
San Luis Obispo, California

DEPTH (feet)	USCS CLASS	SYMBOL	SOIL DESCRIPTION	SAMPLE DATA				
				INTERVAL (feet)	SAMPLE TYPE	DRY DENSITY (pcf)	MOISTURE (%)	BLOWS PER 6 IN.
0	CL	▨	SANDY LEAN CLAY: brown, medium stiff, slightly moist (Alluvium)					
2			SANDSTONE: tan, moderately hard, slightly moist, slightly weathered (Franciscan Mélange)					
5				5.0 - 5.5	●			50(2)
6			End of Boring @ 5.5' No subsurface water encountered					

LEGEND: ■ Ring Sample ○ Grab Sample ▭ Shelby Tube Sample ● SPT

NOTE: This log of subsurface conditions is a simplification of actual conditions encountered. It applies at the location and time of drilling. Subsurface conditions may differ at other locations and times.

Earth Systems Pacific

LOGGED BY: K. Koo
DRILL RIG: Mobile B-53 with Automatic Hammer
AUGER TYPE: 6" Hollow Stem

Boring No. LID1

PAGE 1 OF 1
JOB NO.: 300986-048
DATE: 5/18/2021

Cal Poly Tech Park II
Mount Bishop Road
San Luis Obispo, California

DEPTH (feet)	USCS CLASS	SYMBOL	SOIL DESCRIPTION	SAMPLE DATA INTERVAL (feet)	SAMPLE TYPE	DRY DENSITY (pcf)	MOISTURE (%)	BLOWS PER 6 IN.
0	CL	▨	SANDY LEAN CLAY: brown, medium stiff, moist					
1		▨						
2		▨						
3		▨						
4			SANDSTONE: light brown/yellow, moderately hard, slightly moist					
5			End of Boring @ 5.0' No subsurface water encountered					
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								
26								

LEGEND: ■ Ring Sample ○ Grab Sample ▭ Shelby Tube Sample ● SPT

NOTE: This log of subsurface conditions is a simplification of actual conditions encountered. It applies at the location and time of drilling. Subsurface conditions may differ at other locations and times.

Earth Systems Pacific

LOGGED BY: K. Koo
DRILL RIG: Mobile B-53 with Automatic Hammer
AUGER TYPE: 6" Hollow Stem

Boring No. LID2

PAGE 1 OF 1
JOB NO.: 300986-048
DATE: 5/18/2021

DEPTH (feet)	USCS CLASS	SYMBOL	**Cal Poly Tech Park II** **Mount Bishop Road** **San Luis Obispo, California** SOIL DESCRIPTION	SAMPLE DATA				
				INTERVAL (feet)	SAMPLE TYPE	DRY DENSITY (pcf)	MOISTURE (%)	BLOWS PER 6 IN.
0	CL	▨	SANDY LEAN CLAY: dark brown, moderately stiff, moist					
1								
2								
3								
4			SANDSTONE: light brown, moderately hard, slightly moist, moderately hard					
5			End of Boring @ 5.0' No subsurface water encountered					
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								
26								

LEGEND: ■ Ring Sample ○ Grab Sample ▭ Shelby Tube Sample ● SPT

NOTE: This log of subsurface conditions is a simplification of actual conditions encountered. It applies at the location and time of drilling. Subsurface conditions may differ at other locations and times.

APPENDIX B

Laboratory Test Results

BULK DENSITY TEST RESULTS

ASTM D 2937-17 (modified for ring liners)

June 3, 2021

BORING NO.	DEPTH feet	MOISTURE CONTENT, %	WET DENSITY, pcf	DRY DENSITY, pcf
1	6.0 - 6.5	4.0	116.4	111.9
1	11.0 - 11.5	20.7	128.8	106.8
2	6.0 - 6.5	9.2	103.3	94.6

EXPANSION INDEX TEST RESULTS

ASTM D 4829-19

BORING NO.	DEPTH feet	EXPANSION INDEX
1	0.0 - 4.0	44
2	0.0 - 7.0	83

PARTICLE SIZE ANALYSIS

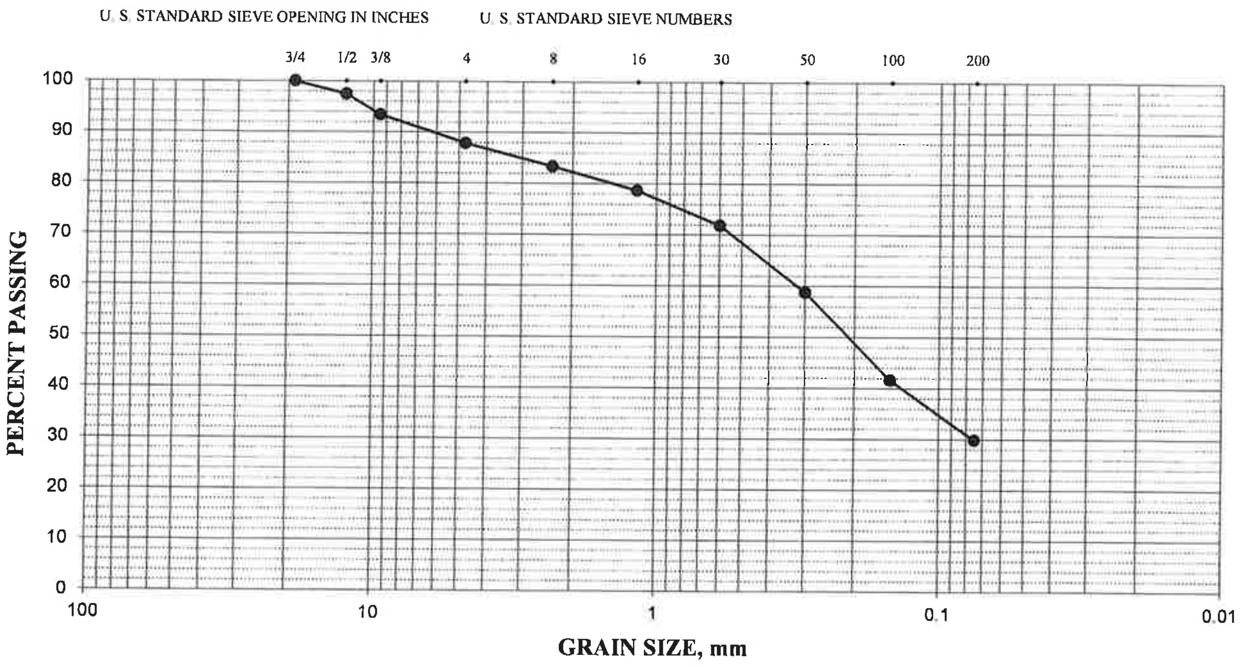
ASTM D 422-63/07; D 1140-017

Boring #1 @ 0.0 - 4.0'

June 3, 2021

Clayey Sand (SC)

Sieve size	% Retained	% Passing
3/4" (19-mm)	0	100
1/2" (12.5-mm)	3	97
3/8" (9.5-mm)	7	93
#4 (4.75-mm)	12	88
#8 (2.36-mm)	17	83
#16 (1.18-mm)	21	79
#30 (600-µm)	28	72
#50 (300-µm)	41	59
#100 (150-µm)	58	42
#200 (75-µm)	70	30



Cal Poly Tech Park

300986-048

MOISTURE-DENSITY COMPACTION TEST

ASTM D 1557-12 (Modified)

PROCEDURE USED: B

PREPARATION METHOD: Moist

RAMMER TYPE: Mechanical

SPECIFIC GRAVITY: 2.65 (assumed)

June 3, 2021

Boring #1 @ 0.0 - 4.0'

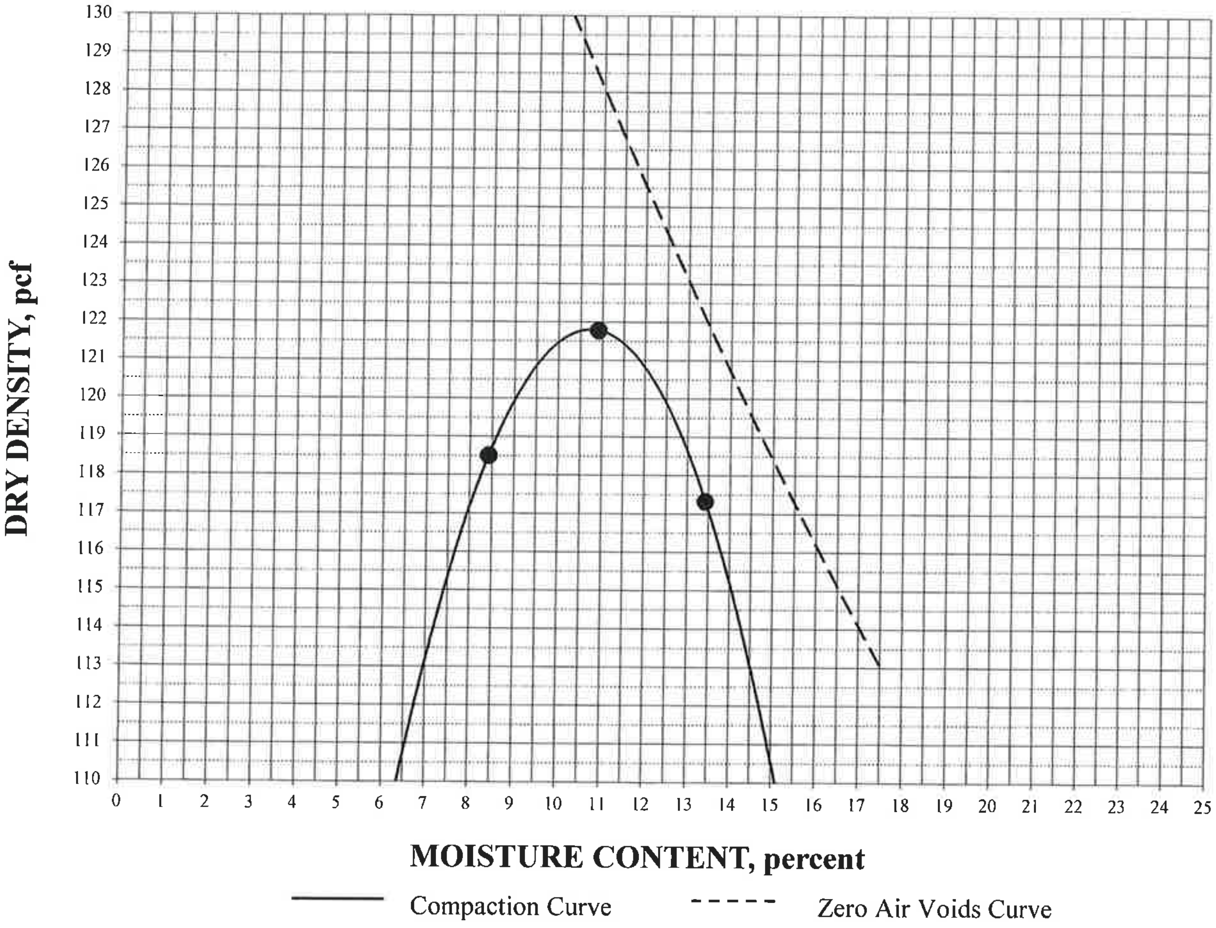
Dark Brown Clayey Sand (SC)

SIEVE DATA:

Sieve Size	% Retained (Cumulative)
3/4"	0
3/8"	7
#4	12

MAXIMUM DRY DENSITY: 121.8 pcf

OPTIMUM MOISTURE: 10.7%



DIRECT SHEAR

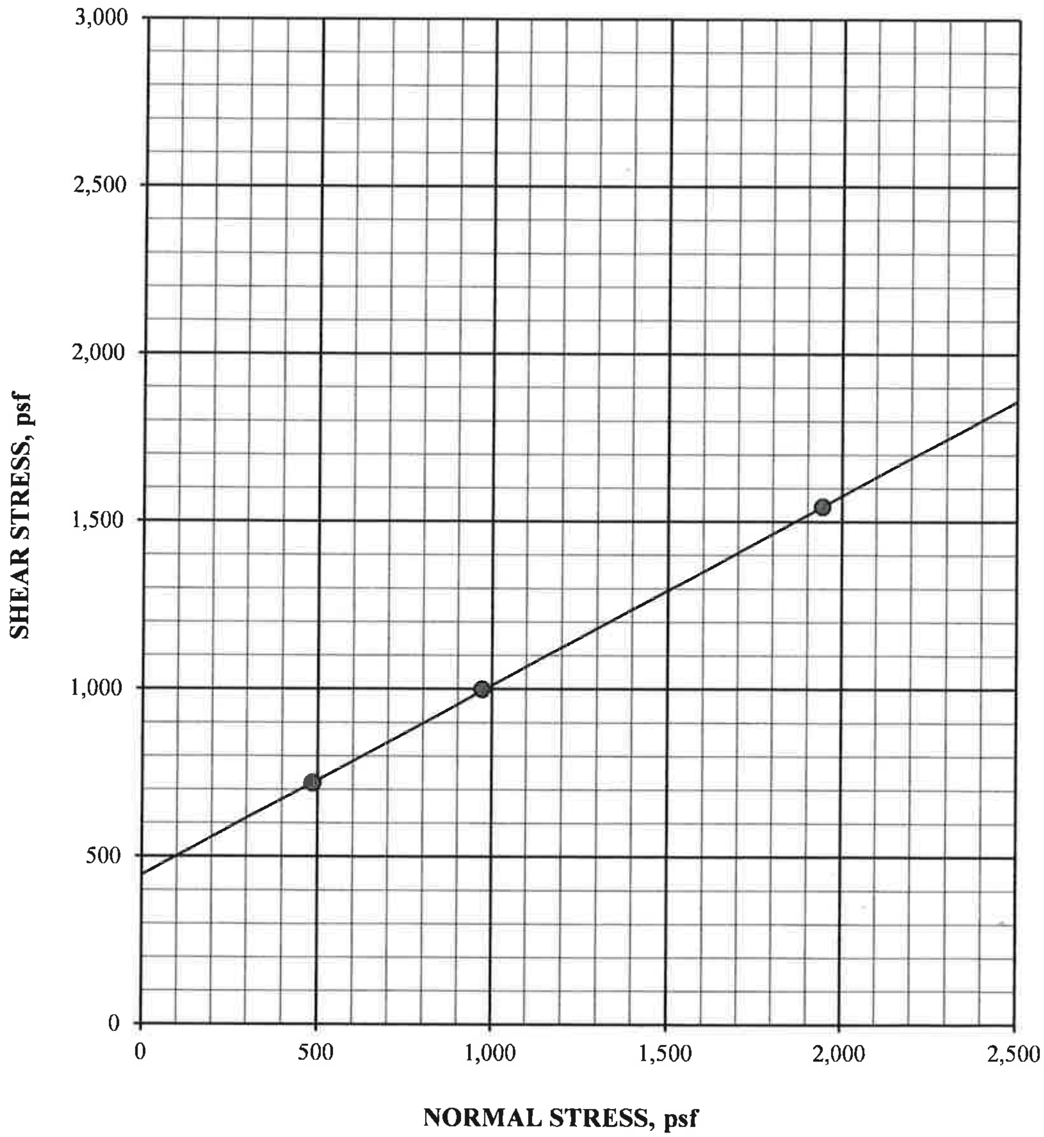
ASTM D 3080/D3080M-11^5 (modified for consolidated, undrained conditions)

June 3, 2021

Boring #1 @ 0.0 - 4.0'
Clayey Sand (SC)
Compacted to 90% RC, saturated

INITIAL DRY DENSITY: 109.6 pcf
INITIAL MOISTURE CONTENT: 10.7 %
PEAK SHEAR ANGLE (Ø): 30°
COHESION (C): 446 psf

SHEAR vs. NORMAL STRESS



DIRECT SHEAR continued

ASTM D 3080/D3080M-11^{5} (modified for consolidated, undrained conditions)

Boring #1 @ 0.0 - 4.0'

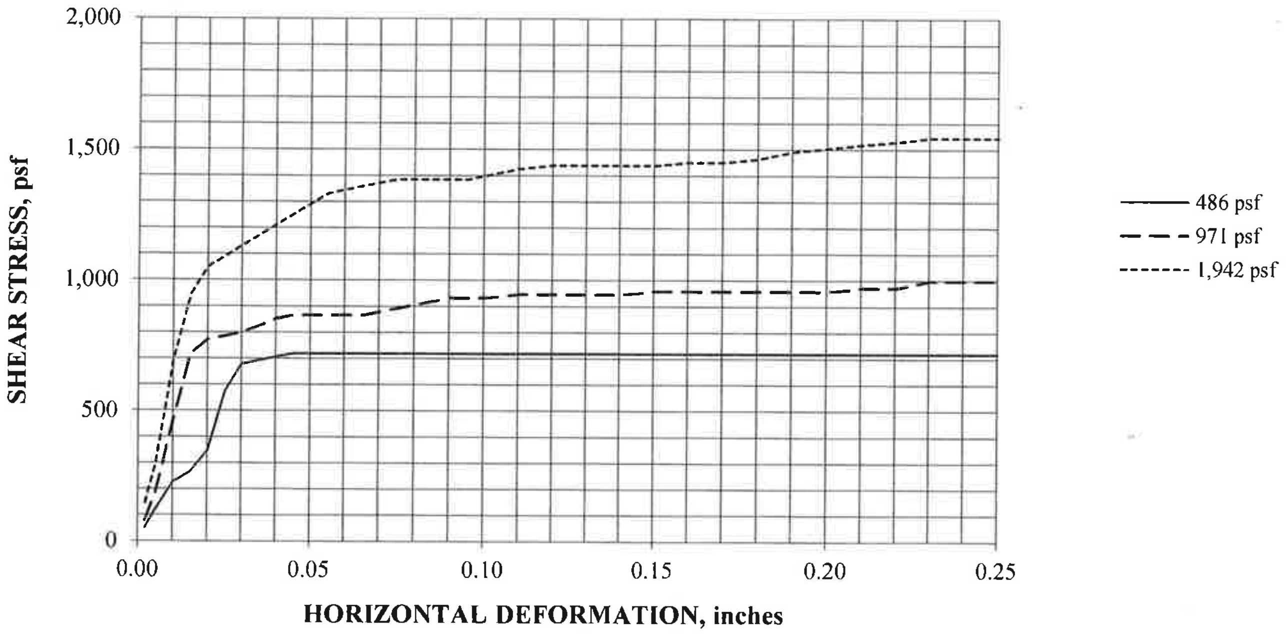
June 3, 2021

Clayey Sand (SC)

Compacted to 90% RC, saturated

SPECIFIC GRAVITY: 2.65 (assumed)

SAMPLE NO.:	1	2	3	AVERAGE
INITIAL				
WATER CONTENT, %	10.7	10.7	10.7	10.7
DRY DENSITY, pcf	109.6	109.6	109.6	109.6
SATURATION, %	55.8	55.8	55.8	55.8
VOID RATIO	0.508	0.508	0.508	0.508
DIAMETER, inches	2.410	2.410	2.410	
HEIGHT, inches	1.00	1.00	1.00	
AT TEST				
WATER CONTENT, %	23.0	23.3	22.7	
DRY DENSITY, pcf	111.2	113.4	115.0	
SATURATION, %	100.0	100.0	100.0	
VOID RATIO	0.487	0.459	0.438	
HEIGHT, inches	0.99	0.97	0.95	



PARTICLE SIZE ANALYSIS

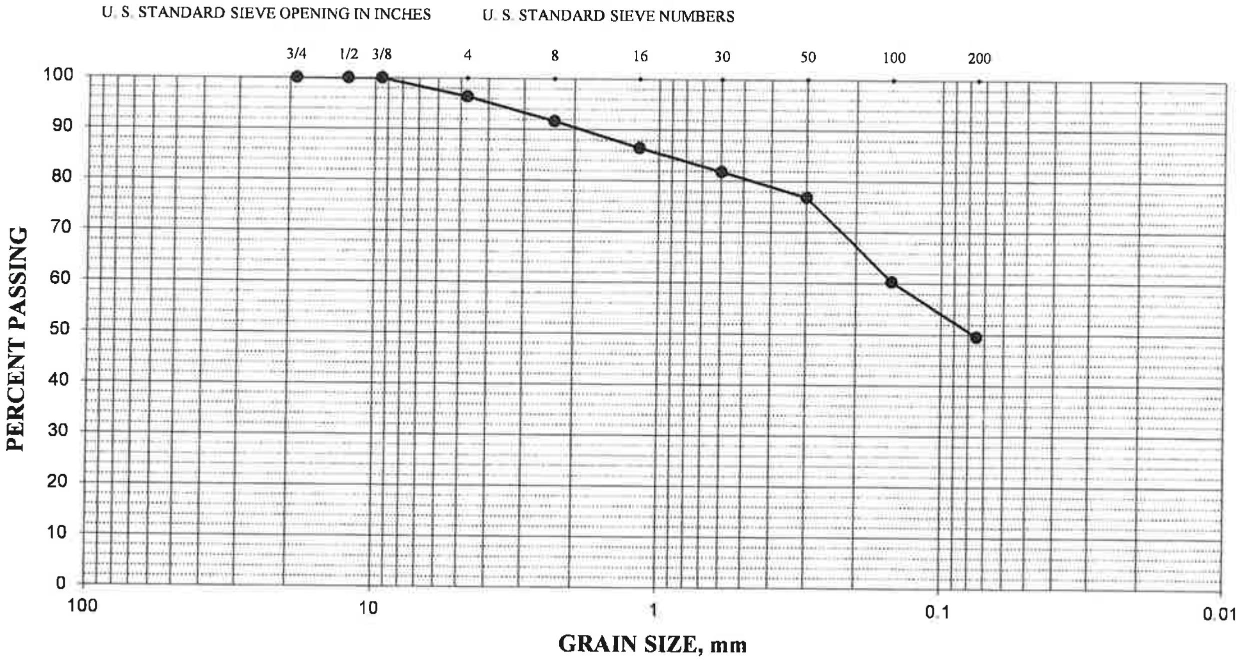
ASTM D 422-63/07; D 1140-017

Boring #2 @ 0.0 - 7.0'
Sandy Fat Clay (CH)

June 3, 2021

LL = 50; PL = 14; PI = 36

Sieve size	% Retained	% Passing
3/4" (19-mm)	0	100
1/2" (12.5-mm)	0	100
3/8" (9.5-mm)	0	100
#4 (4.75-mm)	4	96
#8 (2.36-mm)	8	92
#16 (1.18-mm)	14	86
#30 (600-µm)	18	82
#50 (300-µm)	23	77
#100 (150-µm)	40	60
#200 (75-µm)	50	50



Cal Poly Tech Park

300986-048

MOISTURE-DENSITY COMPACTION TEST

ASTM D 1557-12 (Modified)

PROCEDURE USED: A

June 3, 2021

PREPARATION METHOD: Moist

Boring #2 @ 0.0 - 7.0'

RAMMER TYPE: Mechanical

Dark Brown Sandy Fat Clay (CH)

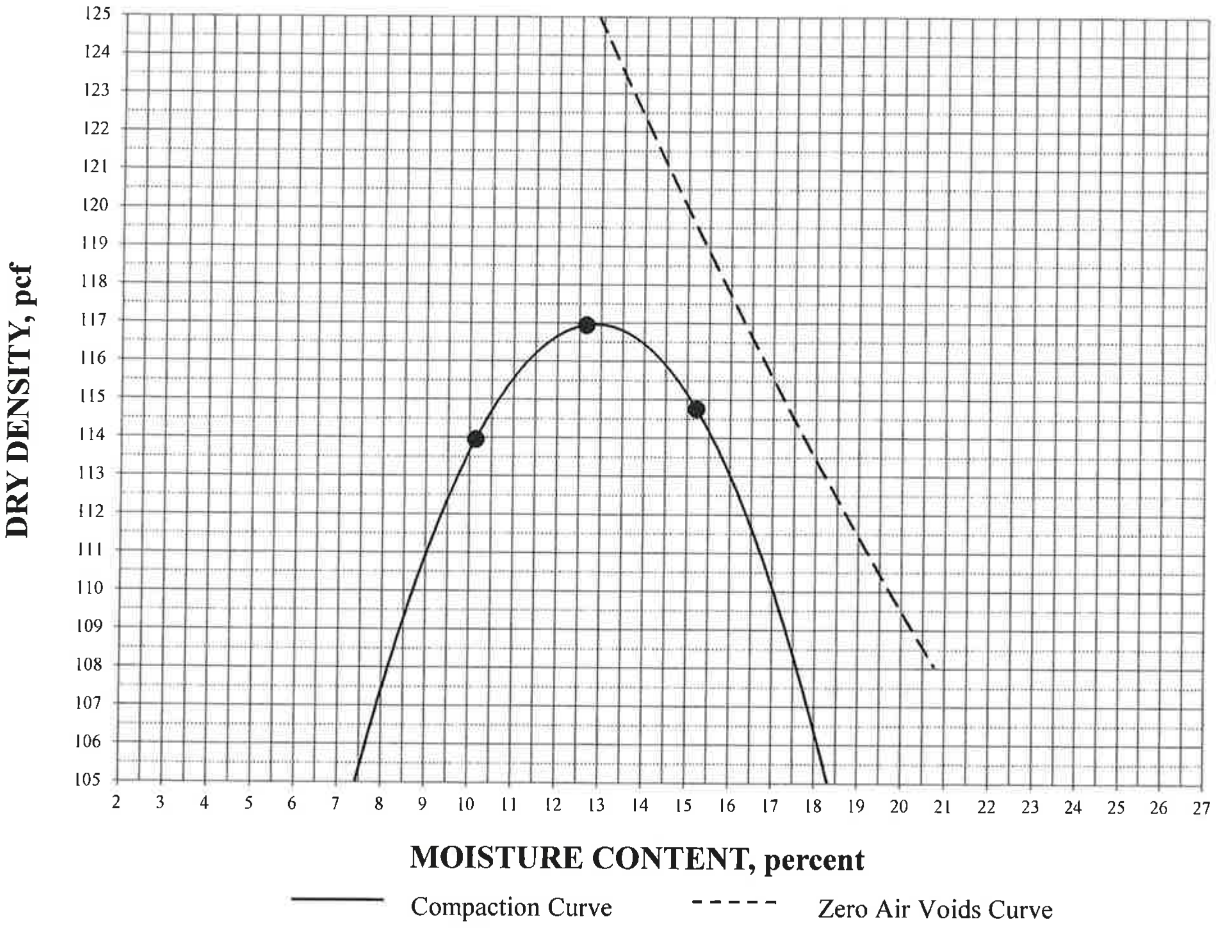
SPECIFIC GRAVITY: 2.70 (assumed)

SIEVE DATA:

Sieve Size	% Retained (Cumulative)
3/4"	0
3/8"	0
#4	4

MAXIMUM DRY DENSITY: 117.0 pcf

OPTIMUM MOISTURE: 12.9%



DIRECT SHEAR

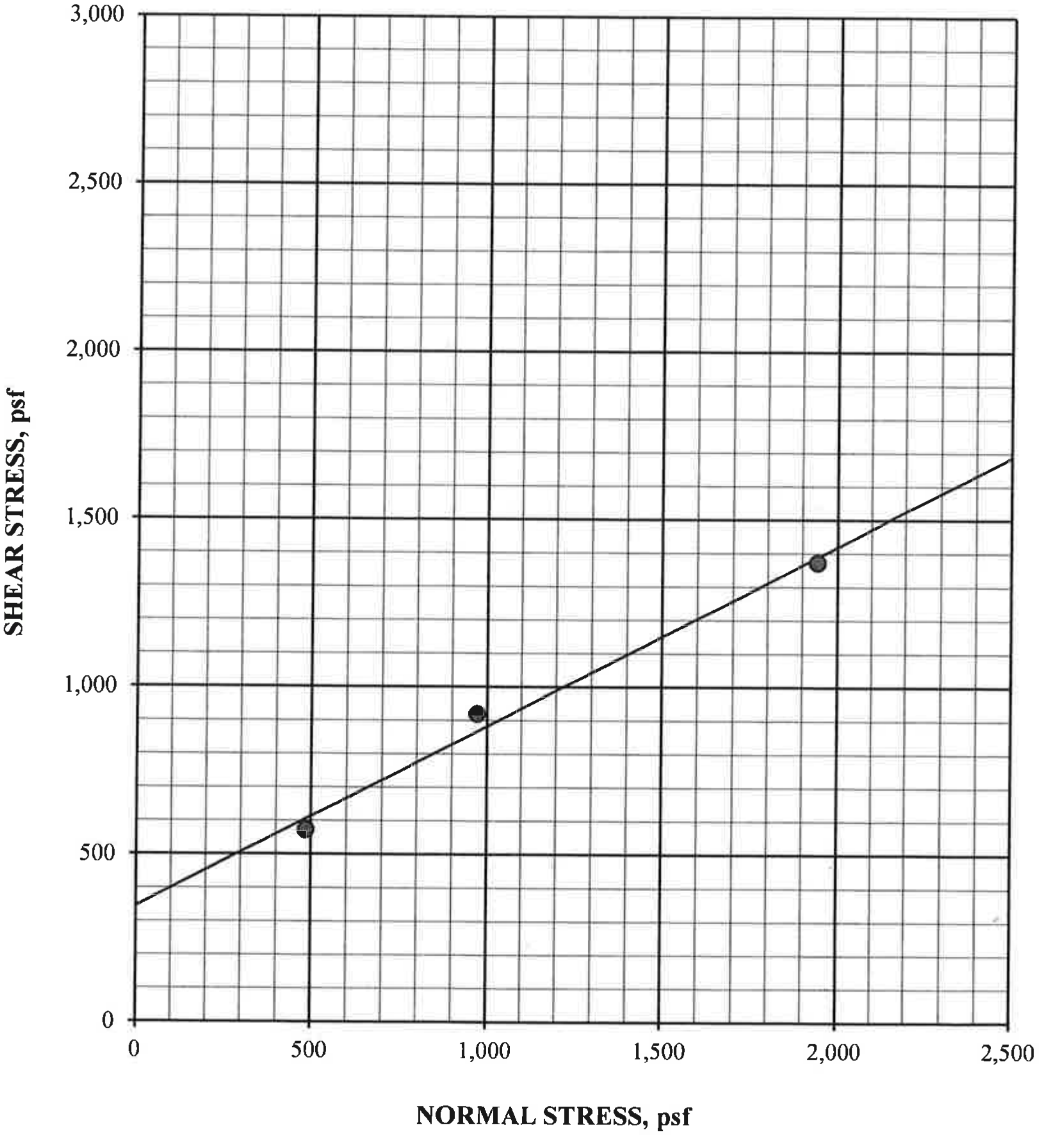
ASTM D 3080/D3080M-11^5 (modified for consolidated, undrained conditions)

June 3, 2021

Boring #2 @ 0.0 - 7.0'
Sandy Fat Clay (CH)
Compacted to 90% RC, saturated

INITIAL DRY DENSITY: 105.3 pcf
INITIAL MOISTURE CONTENT: 12.7 %
PEAK SHEAR ANGLE (Ø): 28°
COHESION (C): 346 psf

SHEAR vs. NORMAL STRESS



Cal Poly Tech Park 300986-048

DIRECT SHEAR continued

ASTM D 3080/D3080M-11^5 (modified for consolidated, undrained conditions)

Boring #2 @ 0.0 - 7.0'

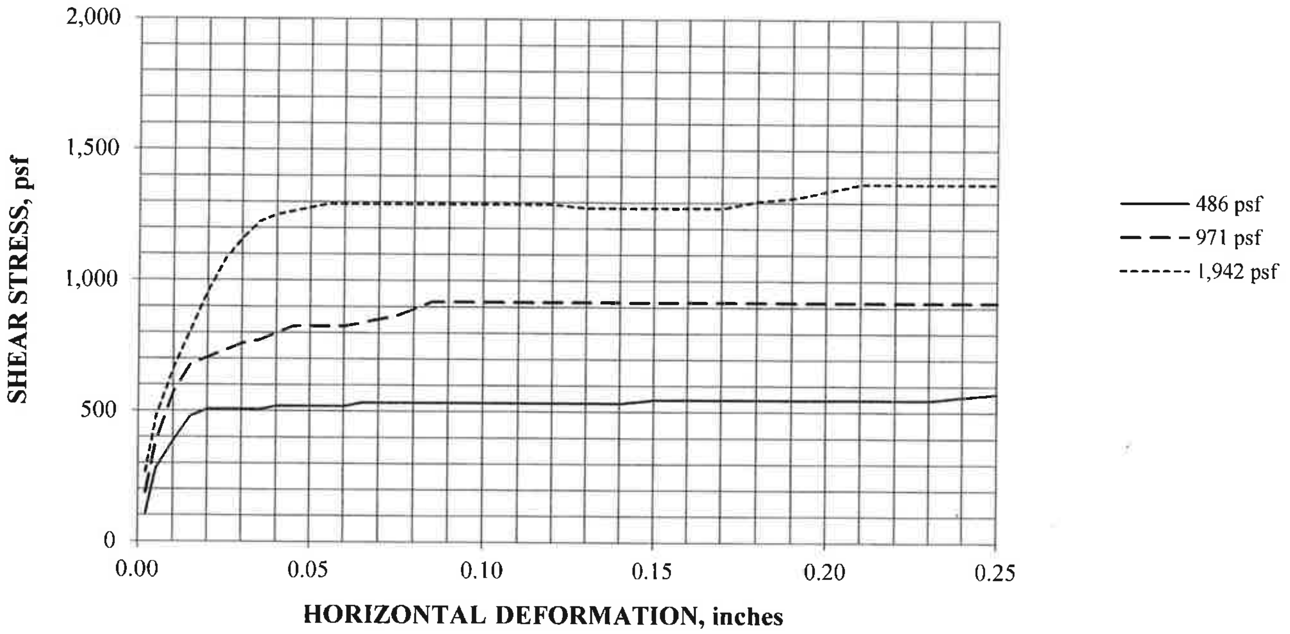
June 3, 2021

Sandy Fat Clay (CH)

Compacted to 90% RC, saturated

SPECIFIC GRAVITY: 2.70 (assumed)

SAMPLE NO.:	**1**	**2**	**3**	**AVERAGE**
INITIAL				
WATER CONTENT, %	12.7	12.7	12.7	12.7
DRY DENSITY, pcf	105.3	105.3	105.3	105.3
SATURATION, %	57.1	57.1	57.1	57.1
VOID RATIO	0.601	0.601	0.601	0.601
DIAMETER, inches	2.410	2.410	2.410	
HEIGHT, inches	1.00	1.00	1.00	
AT TEST				
WATER CONTENT, %	25.0	26.0	27.5	
DRY DENSITY, pcf	106.7	108.2	110.5	
SATURATION, %	100.0	100.0	100.0	
VOID RATIO	0.580	0.557	0.525	
HEIGHT, inches	0.99	0.97	0.95	



Cal Poly Tech Park

300986-048

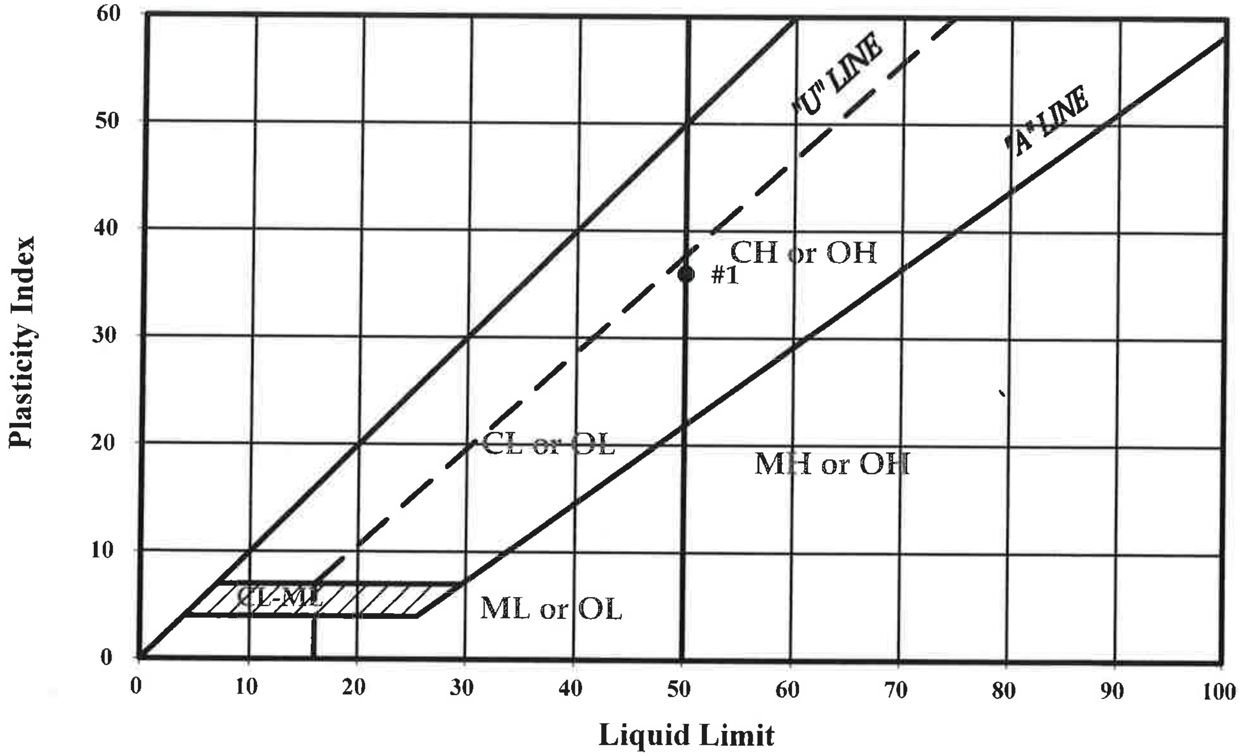
PLASTICITY INDEX

ASTM D 4318-17

June 3, 2021

Test No.:	1	2	3	4	5
Boring No.:	2				
Sample Depth:	0.0 - 7.0'				
Liquid Limit:	50				
Plastic Limit:	14				
Plasticity Index:	36				

Plasticity Chart



EXPANSION INDEX TEST RESULTS

ASTM D 4829-19

BORING NO.	DEPTH feet	EXPANSION INDEX
1	0.0 - 4.0	44
2	0.0 - 7.0	83

APPENDIX C

LID Infiltration Test Results

PROJECT: Cal Poly Tech Park II 300986-048

INFILTRATION TEST RESULTS

INFILTRATION TEST: LID 2

DATE DRILLED: 5/13/2021

DATE TESTED: 5/13/2021

TECHNICIAN: SH

TEST HOLE DIAMETER: 6 inches

TEST HOLE DEPTH: 50 inches

TEST DURATION: 240 minutes

CONSTANT HEAD DATA

Time of Constant Head: 30 minutes

Volume Added During Constant Head: 5 gallons

FALLING HEAD DATA

INTERVAL (Minutes)	READING (Inches)	INCREMENTAL FALL (Inches)	INFILTRATION RATE (Minutes / Inch)	INFILTRATION RATE (Inches / Hour)
0	1.00	---	---	---
30	2.25	1.25	24.00	2.5
30	3.25	1.00	30.00	2.0
30	4.50	1.25	24.00	2.5
30	5.75	1.25	24.00	2.5
30	6.50	0.75	40.00	1.5
30	7.25	0.75	40.00	1.5
30	8.75	1.50	20.00	3.0
30	9.75	1.00	30.00	2.0

PROJECT: Cal Poly Tech Park II

300986-048

INFILTRATION TEST RESULTS

INFILTRATION TEST: LID 2

DATE DRILLED: 5/13/2021

DATE TESTED: 5/13/2021

TECHNICIAN: SH

TEST HOLE DIAMETER: 6 inches

TEST HOLE DEPTH: 52 inches

TEST DURATION: 240 minutes

CONSTANT HEAD DATA

Time of Constant Head: 30 minutes

Volume Added During Constant Head: 5 gallons

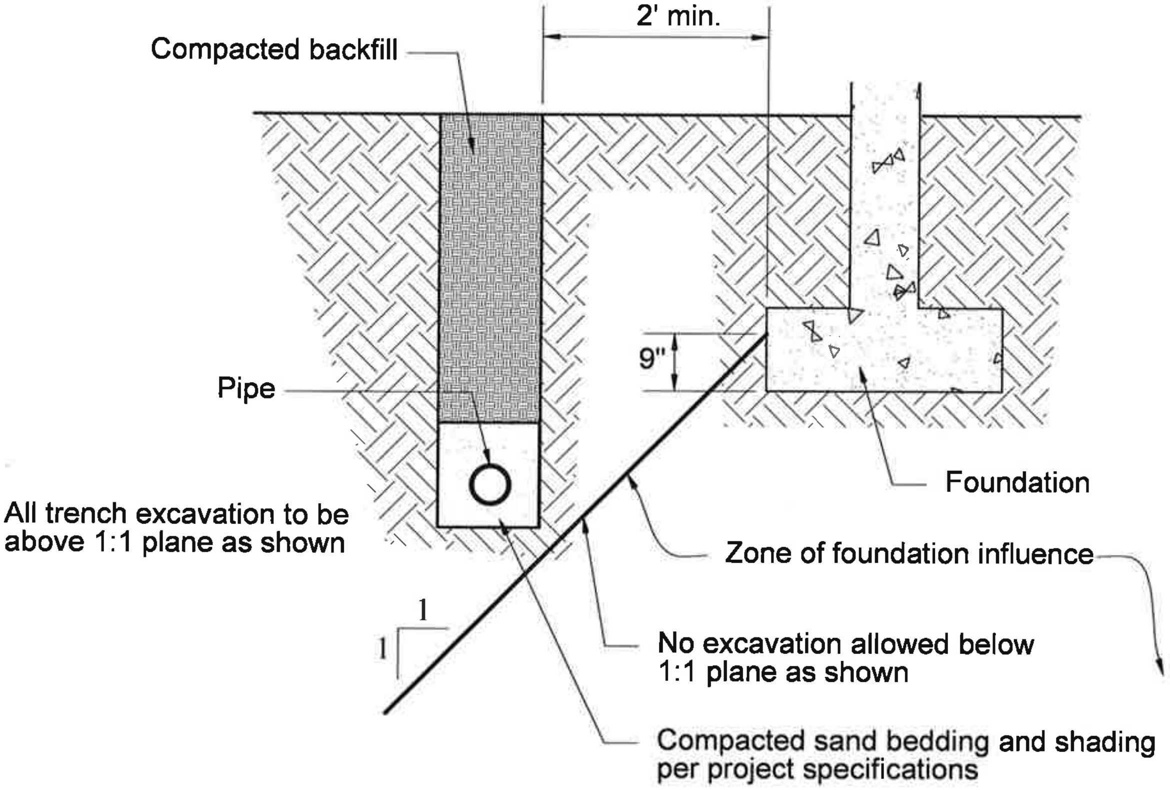
FALLING HEAD DATA

INTERVAL (Minutes)	READING (Inches)	INCREMENTAL FALL (Inches)	INFILTRATION RATE (Minutes / Inch)	INFILTRATION RATE (Inches / Hour)
0	2.75	---	---	---
30	6.00	3.25	9.23	6.5
30	9.50	3.50	8.57	7.0
30	11.50	2.00	15.00	4.0
30	13.50	2.00	15.00	4.0
30	15.25	1.75	17.14	3.5
30	16.75	1.50	20.00	3.0
30	17.75	1.00	30.00	2.0
30	18.50	0.75	40.00	1.5

APPENDIX D

Typical Detail A: Pipe Placed Parallel to Foundation

TYPICAL DETAIL A
PIPE PLACED PARALLEL TO FOUNDATIONS



SCHEMATIC ONLY
NOT TO SCALE