Geotechnical Engineering Report

WEST CAMPUS HIGH SCHOOL BASEBALL AND SOFTBALL IMPROVEMENTS

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1.0 INTRODUCTION

We have completed a geotechnical engineering study for the proposed baseball and softball improvements, including new dugouts, backstops, and field lighting, to be constructed at the existing West Campus High School campus at 5022 58th Street in Sacramento, California. The purposes of our work have been to explore the existing site, soil, and groundwater conditions and to provide geotechnical engineering conclusions and recommendations for the design and construction of the proposed construction and associated improvements.

1.1.1 Scope of Work

Our scope of work included the following tasks:

1. a site survey;
2. review of previous geotechnical reports prepared by our firm on the campus;
3. review of United States Geological Survey (USGS) topographic map, historical aerials, and available groundwater information relevant to the site;
4. subsurface exploration, including five soil borings to depths up to 50 feet below the ground surface;
5. laboratory testing of selected soil samples;
6. engineering analyses; and,
7. preparation of this report.

1.1.2 Project Description

We understand the project will construct new baseball and softball fields within the western portion of the West Campus High School campus, east of the football field. Planned improvements include the construction of new baseball and softball fields, backstops, dugouts, and field lighting. We understand that the natural turf fields will remain. Associated development is anticipated to consist of underground utilities and exterior concrete flatwork.

1.1.3 Figures and Attachments

This report contains a Vicinity Map in Figure 1, a Site Plan showing the approximate boring locations in Figure 2, and the Logs of Soil Borings in Figures 3 through 7. An explanation of the symbols and classification system used on the logs is contained in Figure 8. Appendix A contains information of a general nature regarding project concepts, exploratory methods used during the field exploration phase of our investigation, and laboratory test results.

2.0 FINDINGS

2.1.1 Site Description

The subject site is located within the western portion of the West Campus High School campus, at 5022 58th Street in Sacramento, California (Figure 1). The campus is on an approximately 25-acre parcel identified as Sacramento County Assessor Parcel Number 023-0010-002-0000. The project site is bounded to the north by Twain School and 22nd Avenue; to the east by the school and parking areas, beyond which is 58th Street; to the south by a residential subdivision; and to the west by commercial lots, beyond which is Stockton Boulevard.

At the time of our field explorations on August 11, 2023, the site was developed with existing grass-covered baseball and softball fields, which include backstops, dugouts, and fencing.

The surface elevation of the site is approximately +22 feet North American Vertical Datum of 1988 (NAVD88), and the elevation estimates are based on the United States Geologic Survey (USGS) topographic data shown on the 7.5-Minute Map of the Sacramento East Quadrangle, California, dated 2021.

2.1.2 Historical Aerial Photograph Review

We reviewed historical aerial photographs from 1947, 1957, 1964, 1966, 1984, 1993, 1998, 2003 through 2023. A review of the photographs from 1947 indicates the site to be grass-covered fields. A review of the photographs from 1957 through 1964 reveals the original baseball and track fields present for the campus. The photographs from 1966 to 1984 show that the baseball and track fields are primarily grass-covered. The photographs from 1993 show more development around the baseball fields, including three roughly diamond-shaped areas and fencing on the west of the campus. The photograph from 2009 to 2020 reveals the site is in a similar condition as it was during our fieldwork in August 2023.

2.1.3 Soil Conditions

On August 11, 2023, five exploratory borings (D1 through D5) were performed at the project site. The attached Site Plan (Figure 2) shows the approximate locations.

The soil conditions encountered at the boring locations generally consist of hard, firmly cemented, silty lean clay in the upper 23 feet to 25 feet, which grades to silty fine- to coarse-grained sand with gravel. The borings extended to the explored depths of about 40 feet below the ground surface (bags).

The soil conditions encountered at the boring locations are generally consistent with those previously located there.

For soil conditions at a particular location, refer to the attached Logs of Soil Borings shown in Figures 3 through 7.

2.1.4 Groundwater

Groundwater was encountered within the borings performed on August 11, 2023, to the explored depths of about 28 to 35 feet bgs; refer to the attached Logs of Soil Borings in Figures 3 through 7.

To supplement our study, we reviewed available groundwater elevation data from the Sacramento Central Groundwater Authority monitoring well, identified as State Well Number 08N05E21H002M, located about one-mile northwest of the site. The ground surface elevation at the well is +42 NAVD88, which is about 20 feet higher than the subject site. Groundwater measurements obtained from the well indicate about 19 feet bgs at the well occurred on October 7, 2020, which is +9 feet higher than groundwater encountered in Boring 3 (see Figure 5).

3.0 CONCLUSIONS

3.1.1 2022 CBC and ASCE 7-16 Seismic Design Parameters

The 2022 California Building Code (CBC) currently references the American Society of Civil Engineers (ASCE) Standard 7-16 for seismic design. The seismic design parameters provided in Table 1 were developed based on a Site Classification D and the latitude and longitude for the site using the web interface developed by the *Structural Engineers Association of California* (SEAOC) and *California's Health Care Access and Information (HCAI)*. Since S_1 is more significant than 0.2g, the coefficient values F_v, S_{M1}, and S_{D1} presented in Table 1 below are valid for this project, provided the requirements in Exception Note No. 2 in Section 11.4.8 of ASCE 7-16 apply. If not, a site-specific ground motion hazard analysis is required. However, based on our experience with similar structures, we anticipate the exception will be met. However, this should be verified by the project structural engineer.

Table 1: 2022 CBC/ASCE 7-16 Seismic Design Parameters

Latitude: 38.5491° N Longitude: 121.4943° W	ASCE 7-16 Table/Figure	2022 CBC Table/Figure	Factor/Coefficient	Value
0.2-second Period MCE	Figure 22-1	Figure 1613.2.1(1)	S_S	0.546 g
1.0-second Period MCE	Figure 22-2	Figure 1613.2.1(3)	S_1	0.247 g
Soil Class	Table 20.3-1	Section 1613.2.2	Site Class	D
Site Coefficient	Table 11.4-1	Table 1613.2.3(1)	F_a	1.363
Site Coefficient	Table 11.4-2	Table 1613.2.3(2)	F_v	2.000*
Adjusted MCE Spectral Response Parameters	Equation 11.4-1	Equation 16-20	S_{MS}	0.744 g
	Equation 11.4-2	Equations 16-21	S_{M1}	0.494 g*
Design Spectral Acceleration Parameters	Equation 11.4-3	Equations 16-22	S_{DS}	0.496 g
	Equation 11.4-4	Equations 16-23	S_{D1}	0.329 g*
Seismic Design Category	Table 11.6-1	Section 1613.2.5(1)	Risk Category I through IV	D
	Table 11.6-2	Section 1613.2.5(2)	Risk Category I through IV	D

Notes: MCE = Maximum Considered Earthquake
g = gravity
* The value is valid provided the requirements in Exception Note No. 2 in Section 11.4.8 of ASCE 7-16 are met. If not, a site-specific ground motion hazard analysis is required.

3.1.2 Soil Expansion Potential

Laboratory tests performed on representative near-surface clay samples revealed low to moderate plasticity when tested per the American Society of Testing and Materials (ASTM) International D4318 test method (see Figure A1). Additional laboratory testing of soils collected revealed the near-surface clay soils possess “medium to high” expansion potential when testing per the ASTM D4829 test method (see Figure A2).

Although the native soils show some expansive characteristics, we conclude that recommendations to mitigate the effects of expansive soils should not be needed in site development.

3.1.3 Bearing Capacity

In our opinion, the native soils can support the proposed improvements. Our experience in the area also indicates that engineered fills composed of native soils or approved import soils that are placed and compacted per general engineering practices will be suitable for support of the proposed improvements.

3.1.4 Pavement Subgrade Quality

Laboratory test results indicate the surface and near-surface soil possesses Resistance ("R") values of 34 when tested per California Test 301 (Figure A4). Based on the laboratory test results and our previous experience at the site with similar soil types, we selected an R-value of 34 for our design.

3.1.5 Groundwater Effect on Development

Groundwater was encountered in the explored 28 to 35 feet BGS of the borings performed at the school site on August 11, 2023. A review of available groundwater data revealed the groundwater elevation at nearby monitoring wells has ranged from 1 to 42 feet below the existing ground surface during the last 50 years. Groundwater levels at the site should be expected to fluctuate throughout the year based on variations in seasonal precipitation, local pumping, and other factors. Locally perched shallower groundwater may be encountered.

Based on current explorations at the site and historical groundwater data, we do not anticipate excavations within about 10 feet of the existing ground surface to encounter permanent groundwater. However, locally perched water could be encountered and require localized dewatering (depending on the time of year). If perch water is encountered, using sumps or submersible pumps could lower the groundwater level.

If excavations extend deeper than 10 feet below the ground surface, dewatering may be required. The dewatering method will depend on the soil conditions, excavation depth, and groundwater amount present. Dewatering, if needed, should be the contractor’s responsibility. The dewatering system should be designed and constructed by a dewatering contractor with local experience. We recommend the selected dewatering system lower the groundwater level to at least two feet below the bottom of the proposed excavations.

3.1.6 Excavation Conditions

The surface and near-surface soils at the site should be readily excavated with conventional earthmoving and trenching equipment. Based on our borings, excavations associated with building foundations, shallow trenches for utilities, and other excavations less than five feet deep associated with the proposed construction should stand vertically for short periods (i.e., less than one day) required for construction. However, if encountered, cohesionless, saturated, or disturbed soils may result in caving or sloughing; therefore, the contractor should be prepared to brace or shore the excavations if necessary.

Excavations or trenches exceeding five feet in depth that workers will enter should be sloped, braced, or shored to conform to current California Occupational Safety and Health Administration (Cal/OSHA) requirements. The contractor must provide an adequately constructed and braced shoring system by federal, state, and local safety regulations for individuals working in an excavation that may expose them to the danger of moving ground.

Temporarily sloped excavations should be constructed no steeper than a one horizontal to one vertical (1H:1V) inclination. Temporary slopes likely will stand at this inclination for the short-term duration of construction, provided significant pockets of loose and saturated granular soils are not encountered. Flatter slopes would be required if these conditions are met.

Excavated materials should not be stockpiled directly adjacent to an open excavation to prevent surcharge loading of the excavation sidewalls. Excessive truck and equipment traffic should be avoided near excavations. Suppose material is stored or heavy equipment is stationed and operated near an excavation. In that case, a shoring system must be designed to resist the additional pressure due to the superimposed loads.

3.1.7 Material Suitability for Engineered Fill Construction

The existing on-site native soils encountered at the boring locations are considered suitable for engineered fill construction, provided these materials do not contain significant amounts of organics, rubble, and harmful debris. They are at a proper moisture content capable of achieving the desired degree of compaction.

3.1.8 Preliminary Soil Corrosion Potential

Two samples of near-surface soil were submitted to Sunland Analytical of Rancho Cordova, California, to test pH, chloride and sulfate concentrations, and minimum resistivity to help evaluate the potential for corrosive attack upon buried concrete. The results of the corrosivity testing are summarized below in Table 2. Copies of the test reports are presented in Figures A5 and A6.

TABLE 2: SOIL CORROSIVITY TESTING

Analyte	Test Method	Sample Identification	Sample Identification
		D3 (0-5’)	D5 (0-5’)
pH	CA DOT 643 Modified*	7.43	7.66
Minimum Resistivity	CA DOT 643 Modified*	1,800 Ω-cm	1,820 Ω-cm
Chloride	CA DOT 422	4.4 ppm	8.0 ppm
Sulfate	CA DOT 417	7.0 ppm	13.3 ppm

Notes: * = Small cell method; Ω-cm = Ohm-centimeters; ppm = Parts per million

The California Department of Transportation Corrosion and Structural Concrete Field Investigation Branch, Corrosion Guidelines (Version 3.2, dated May 2021), considers a site to be corrosive to foundation elements if one or more of the following conditions exist for the representative soil and water samples taken: has a chloride concentration greater than or equal to 500 ppm, sulfate concentration greater than or equal to 1500 ppm, or the pH is 5.5 or less.

Table 19.3.1.1 – Exposure Categories and Classes, of American Concrete Institute (ACI) 318-19, Section 19.3 – Concrete Durability Requirements, as referenced in Section 1904.1 of the 2022 CBC, indicates the severity of sulfate exposure for the sample tested is Exposure Class S0 (water-soluble sulfate concentration in contact with concrete is low and dangerous sulfate attack is not a concern). The project Structural Engineer should evaluate the requirements of ACI 318-19 and determine their applicability to the site.

Soil Resistivity for D3 and D5 is 1,800 ohm-centimeters and 1,820 ohm-centimeters, respectively, which is severely corrosive. This soil is classified as severely corrosive to ferrous and other metals.

Universal Engineering Sciences are not corrosion engineers. Therefore, if it is desired to define the soil corrosion potential at the site, a Corrosion Engineer should be consulted.

4.0 RECOMMENDATIONS

4.1.1 General

The recommendations in this report are based on assumed excavations and fill on the order of about one to three feet for the site's development. We consider it essential that our office review grading and structural foundation plans to verify the applicability of the following recommendations, verify that our recommendations' intent has been incorporated into the construction documents, and provide supplemental recommendations, if necessary.

The recommendations presented below are appropriate for typical construction in the spring through fall months. The on-site soils will likely be saturated by rainfall in the winter and spring months and will not be compactable without drying by aeration or chemical treatment. Soils present beneath existing slabs and pavements will be wet regardless of the time of year of construction. Should the construction schedule require work to continue during the wet months, additional recommendations can be provided as conditions dictate.

Site preparation should be accomplished per the provisions of this report and the appended specifications. A representative of the Geotechnical Engineer should be present during all earthwork operations to evaluate compliance with the recommendations and the guide specifications included in this report. The Geotechnical Engineer of Record referenced herein is the Geotechnical Engineer retained to provide geotechnical engineering observation and testing services during construction.

4.1.2 Site Clearing

Existing improvements to be abandoned, including but not limited to existing pavements, foundations (if encountered), and underground utilities, should be removed entirely from the site. Areas of new construction should also be cleared of vegetation and irrigation systems. Excavations to remove these items should extend to undisturbed native soils. All trees/large brush designated for removal should include the root ball and roots ½ inch or larger.

Where practical, the clearing should extend at least five feet beyond the limits of the site's proposed structural areas, including the new building, pavements, and slab-on-grade concrete.

Depressions resulting from the removal of underground structures (e.g., foundations, utilities, etc.) should be cleaned of loose soil and backfilled adequately per the recommendations of this report. Existing pavements and flatwork (asphalt concrete and concrete) not incorporated into the new design should be removed from the site. Alternatively, pulverized asphalt and Portland cement concrete rubble and any underlying aggregate base may be used as fill provided it is processed into fragments less than three inches in largest dimension, is mixed with soil to form a compactable mixture, and approved by the Owner.

Soils containing excessive organic soils should be removed and not used within the pavements, slabs, and building areas. For this project, the acceptable organic content is less than four percent (4%) of organics by weight, as determined by ASTM D2974 (Organic Content by Ignition Method). In our opinion, soils having excessive organic matter contents should be removed to expose undisturbed native soils with acceptable organic contents.

Soils containing organic material may be used in landscape areas. However, the landscape architect should have the final decision regarding the placement of soils containing organic material in landscape areas.

Where encountered, any loose, soft, or saturated soils should be cleaned out to firm native soil and backfilled with engineered fill per the recommendations in this report. The Geotechnical Engineer's representative must be present for a sufficient time during clearing operations to verify adequate removal of the surface and subsurface items, as well as the proper backfilling of resulting excavations.

4.1.3 Subgrade Preparation

Site clearing is expected to disturb the upper one to two feet of the site, and more profound disturbance will result when deeper underground utilities are removed, or piers supporting pole-mounted structures are removed. Subgrade preparation of the subgrade soils should include all soil that has been disturbed and areas where existing structures are removed to provide a uniform layer of engineered fill for support of the planned structures.

Following site clearing and stripping operations, areas to receive fill or to remain at grade should be sacrificed to a depth of at least 12 inches, moisture conditioned to at least two percent above the optimum moisture content and uniformly compacted to not less than 90 percent of the ASTM D1557 maximum dry density or to the highest degree possible for the soil moisture content and stability at the time of construction. Scarification and re-compaction should extend at least five feet beyond the perimeter of buildings and two feet beyond the outer edge of pavements. Unstable areas may require a layer of geotextile reinforcement at the time of construction. The Geotechnical Engineer should determine the need for geotextile reinforcement once the final subgrade has been exposed. As this report recommends, the building pad may be restored to grade with engineered fill compacted-in lifts. All fill soils should be compacted to at least 90 percent relative compaction.

Compaction of all subgrade soils should be performed using a heavy, self-propelled, sheepsfoot compactor capable of achieving the required compaction. It must be performed in the presence of the Geotechnical Engineer's representative, who will evaluate the performance of the subgrade under compactive load. Difficulty achieving subgrade compaction may indicate loose, soft, or unstable soil conditions requiring additional excavation. Additional subgrade stabilization recommendations may be necessary during construction if these conditions exist.

The upper 12 inches of pavement subgrades should be uniformly compacted to at least 95 percent relative compaction at a moisture content of at least the optimum moisture content, regardless of whether the final grade is established by excavation, engineered fill, or left at grade. Additional pavement subgrade recommendations are provided in this report's Pavement Design section.

4.1.4 Engineered Fill Construction

On-site soils are suitable for engineered fill construction in structural areas, provided the materials do not contain rubbish, rubble greater than three inches, and significant organic concentrations. Imported fill materials, if required, should be compactable, granular soils with an Expansion Index of 20 or less and contain no particles more significant than three inches in maximum dimension. Our office should approve imported soils before being transported to the site. In addition, if fire lane or vehicular pavement areas are required, imported fill within the upper three feet of pavement areas should possess an R-value of at least 12. Also, suppose import fills are required (other than aggregate base). In that case, the contractor must provide appropriate documentation that the import is clean of known contamination per the Department of Toxic Substances Control (DTSC) and within acceptable corrosion limits.

Engineered fill should be placed in lifts not exceeding six inches in compacted thickness. Native or imported clayey materials should be thoroughly moisture conditioned to at least two percent above the optimum moisture content and uniformly compacted to at least 90 percent of the ASTM D1557 maximum dry density. Approved granular imported fill materials should be uniformly conditioned to at least the optimum moisture content and compacted to at least 90 percent relative compaction. Relative compaction should be based on the ASTM D1557 maximum dry density.

The upper 12 inches of final building pad subgrades, including adjacent exterior flatwork areas, should be compacted to at least 90 percent relative compaction at two percent above the optimum moisture content.

The upper six inches of pavement subgrades should be uniformly compacted to at least 95 percent of the maximum dry density at a moisture content of at least two percent above the optimum moisture content. They must be stable under construction traffic before placement of aggregate base.

Permanent excavation and fill slopes should be constructed no steeper than two horizontal to one vertical (2:1) and vegetated as soon as practical following grading to minimize erosion. Slopes should be overbuilt and cut back to design grades and inclinations.

4.1.5 Engineered Fill-Controlled Low-Strength Material

If required, Controlled Low Strength Material (CLSM) should be placed per Section 1803A.5.9 of the 2019 CBC. The CLSM should possess a compressive strength between 50 and 150 psf, as determined by ASTM D4832. A minimum slump is not required for CLSM, provided the material submittal is reviewed before use. Before placement, the area to receive the material should be clean of loose soil, water, and debris and approved by a representative of the Geotechnical Engineer. The material should be submitted for review and approval by the Geotechnical Engineer before placement. Compressive strength testing of CLSM is not considered necessary provided the placement is observed by the Geotechnical Engineer and the CLSM used at the site is approved by the Geotechnical Engineer before being placed.

4.1.6 Utility Trench Backfill

Utility trench backfill within structural areas (buildings, slabs, and pavements) should be mechanically compacted as engineered fill per the following recommendations. Bedding and initial backfill around and over the pipe should conform to the pipe manufacturer's recommendations and applicable sections of the governing agency standards. Utility trench backfill should be placed in maximum 8-inch thick lifts (compacted thickness), moisture conditioned to at least two percent above the optimum moisture content and mechanically packed to at least 90 percent of the ASTM D1557 maximum dry density. Utility trench backfill within the upper six inches of final pavement subgrades should be compacted to at least 95 percent of the maximum dry density. Utility trench backfill should be continuously observed and tested during construction.

All underground utility trenches aligned nearly parallel with foundations should be at least five feet from the outer edge of the foundations, wherever possible. If this is not practical, the trenches should not encroach into a zone extending at a one horizontal to one vertical (1:1) inclination below the bottom of the foundations.

Additionally, trenches parallel to existing foundations should not remain open for 72 hours. These recommendations intend to prevent the loss of both lateral and vertical support of foundations, resulting in a possible settlement.

4.1.7 Foundation Design

The proposed modular buildings may be supported upon a continuous perimeter foundation with constant and isolated interior spread foundations embedded at least 18 inches below the lowest adjacent soil grade, provided the subgrade has been prepared per the Subgrade Preparation and Engineered Fill Construction sections of this report. For this project, the lowest soil grade is defined as either the adjacent exterior soil grade or the soil subgrade beneath the building, whichever is lower. Continuous foundations should maintain a minimum width of 24 inches, and isolated spread foundations should be at least 24 inches in plan dimension. The project structural engineer should determine the foundations' final dimensions and structural reinforcement.

Foundations constructed within the building pads prepared as recommended may be sized utilizing a net allowable bearing capacity of 2,000 pounds per square foot (psf) for dead plus live loads (based on a Factor of Safety of 2.0). This value may be increased by 1/3 to include wind or seismic forces. The weight of foundation concrete extending below the lowest adjacent soil grade may be disregarded in sizing computations.

Resistance to lateral foundation displacement may be computed using an allowable friction factor of 0.49, which may be multiplied by the effective vertical load on each foundation. Additional lateral resistance may be calculated using an allowable passive earth pressure of 300 pcf to a maximum of 2,000 psf per foot of depth. These two modes of resistance should not be added unless the frictional value is reduced by 50 percent since total mobilization of these resistances typically occurs at different degrees of horizontal movement.

A minimum of 18 inches of foundation soil should be pre-saturated to 120% of optimum moisture content prior to pouring concrete.

4.1.8 Drilled. Cast-in-Place Reinforced Concrete Piers (Drilled Piers)

Fence posts, light standards, and other ancillary structures that will proportionally support more lateral loading than axial loading may be supported upon a deep foundation system consisting of drilled, cast-in-place reinforced concrete piers (drilled piers). Drilled piers should be at least 24 inches in diameter and extend to five feet below the existing ground surface. Piers so established may be designed based on an allowable end bearing capacity of 2,000 psf or an allowable friction capacity of 300 psf for dead plus live loads. We recommend that adjacent piers be constructed no closer than three pier diameters apart, as measured between the centers of the piers. Drilled pier foundations should be structurally isolated from adjacent concrete flatwork by a felt strip or similar material.

Uplift resistance of the pier foundations may be computed assuming the following resisting forces, where applicable: 1) the unit weight of foundation concrete (150 pounds per cubic foot) and 2) uplift resistance of 150 psf applied over the shaft area of the pier. Increased uplift resistance can be achieved by increasing the diameter of the pier or increasing the depth of the embedment depth.

Sizing of drilled piers to resist lateral loads can be evaluated using Section 1807.3.2 of the 2022 CBC. An allowable value of 300 pcf for lateral bearing, as defined in Table 1806.2 of the CBC, may be used for the coefficients S1 and S3 for the non-constrained and constrained conditions, respectively. Per Section 1806.1 of the 2022 CBC, an increase of 1/3 is permitted when using the alternate load combinations in Section 1605.3.2, including wind or earthquake loads. The upper 12 inches of the subgrade should be neglected unless the drilled pier is surrounded by at least three feet of concrete on all sides.

The bottom of the pier excavations should be free of loose or disturbed soils prior to placement of the concrete. Cleaning of the bearing surface may be done mechanically with the belling bucket but should be verified by the geotechnical engineer prior to concrete placement. Reinforcement and concrete should be placed in the pier excavations as soon as possible after excavation is completed to reduce the potential of sidewall caving into the excavations.

To reduce lateral movement of the drilled shafts, it is necessary to place the concrete for the drilled shafts in intimate contact with the surrounding soil. Any voids or enlargements in the shafts due to over-excavation or temporary casing installation shall be filled with concrete at the time the shaft concrete is placed.

Suppose the drilled piers are constructed in the "dry" (with dry being less than two inches of water at the base of the excavation). In that case, the concrete may be placed by the free-fall method, using a short hopper or back-chute to direct the concrete flow out of the truck into a vertical stream of flowing concrete with a relatively small diameter. The stream should be directed to avoid hitting the sides of the excavation or any reinforcing cages. For the free-fall method of concrete placement, we recommend the concrete mix be designed with a slump of five to seven inches.

In general, we anticipate the drilled pier excavations will be relatively dry for pier excavations. However, perched groundwater may be encountered depending on the time of year when the piers are excavated. Where perched groundwater will not be controlled such that more than six inches of water accumulates at the bottom of the pier excavation and after it is confirmed that the excess water cannot be removed from the caisson excavation by bailing or with pumps, concrete should be placed using a tremie. For concrete placed using the tremie method, a slump of six to eight inches, and a maximum aggregate size of ¾-inch is recommended. The required slump should be obtained by using plasticizers or water-reducing agents. Addition of water on-site to establish the recommended slump should not be allowed. When extracting temporary casings or tremie methods from the excavation, care should be taken to maintain a head of concrete to prevent infiltration of water and soil into the shaft area. The head of concrete should always be greater than the head of water trapped outside the pier or tremie, taking into account the differences in unit weights of concrete and water.

We estimate total settlement for drilled pier foundations using the recommended maximum net allowable bearing pressure and allowable capacities presented above, will be less than one inch. Differential settlements may be as much as the total settlement between individual pier elements. The settlement estimates are based on the available soil information, our experience with similar structures and soil conditions, and field verification of suitable bearing soils during foundation construction.

4.1.9 Interior Floor Slab Support

Interior concrete slab-on-grade floors can be supported upon the soil subgrade prepared in accordance with the recommendations in this report and maintained in a moist condition and are protected from disturbance. If this is not the case and the subgrade soil becomes dry and/or disturbed, the building pad will require additional scarification, moisture conditioning and compaction prior to construction of the interior floor slabs.

Interior concrete slab-on-grade floors should be at least five inches thick and be reinforced for crack control. Final slab thickness, reinforcement and joint spacing should be determined by the slab designer. Proper and consistent location of the reinforcement near mid-slab is essential to its performance. The risk of uncontrolled shrinkage cracking is increased if the reinforcement is not properly located within the slab. Temporary loads exerted during construction from vehicle traffic, cranes, construction equipment, storage of palletized construction materials, etc. should be considered in the design of the thickness and reinforcement of the interior slab.

Floor slabs that will receive moisture sensitive floor covering (e.g. vinyl covering, wood-laminate, etc.) should be underlain by a layer of free-draining crushed rock or gravel, serving as a deterrent to migration of capillary moisture. The gravel/crushed rock layer should be between four and six inches thick and graded such that 100 percent passes a one-inch sieve and no appreciable amount passes a No. 4 sieve. Additional moisture protection may be provided by placing a plastic, water vapor retarder (at least 10-mils thick) directly over the gravel/crushed rock. The water vapor retarder should meet or exceed the minimum specifications for plastic water vapor retarders as outlined in ASTM E1745 and be installed in strict conformance with the manufacturer's recommendations.

Over the past 30 years, floor slab construction has included the placement of a thin layer of sand over the vapor retarder membrane where capillary break gravel is used. The intent of the sand is to aid in properly curing the slab concrete. However, recent debate over excessive moisture vapor emissions from floor slabs includes concern for water trapped within the sand. Therefore, we consider the use of the sand layer as optional. The concrete curing benefits should be weighed against efforts to reduce slab moisture vapor transmission.

The above recommendations are intended to mitigate any significant soil-related cracking of the slab-on-grade floors. More important to the performance and appearance of a Portland cement concrete slab is the quality of the concrete, the workmanship of the concrete contractor, the curing techniques utilized, and the spacing of control joints.

4.1.10 Floor Slab Moisture Penetration Resistance

It is considered likely that floor slab subgrade soils will become wet to near saturated at some time during the life of structures. This is a certainty when slabs are constructed during the wet seasons, or when constantly wet ground or poor drainage conditions exist adjacent to structures. For this reason, it should be assumed that interior slabs intended for moisture-sensitive floor coverings or materials, require protection against moisture or moisture vapor penetration. Standard practice includes the gravel/crushed rock and vapor retarder as suggested above. However, the gravel/crushed rock and plastic membrane offer only a limited, first line of defense against soil-related moisture; they do not moisture-proof the slab. Recommendations contained in this report concerning foundation and floor slab design are presented as minimum requirements, only from the geotechnical engineering standpoint.

It is emphasized that the use of gravel/crushed rock and plastic membrane below the slab will not "moisture proof" the slab, nor does it assure that slab moisture transmission levels will be low enough to prevent damage to floor coverings or other building components. If increased protection against moisture vapor penetration of slabs is desired, a concrete moisture protection specialist should be consulted. The design team should consider all available measures for slab moisture protection. It is commonly accepted that maintaining the lowest practical water-cement ratio in the slab concrete is one of the most effective ways to reduce future moisture vapor penetration of the completed slabs.

4.1.11 Exterior Flatwork Construction (Non-Pavement)

Exterior flatwork should be underlain by at least six inches of Class 2 aggregate base compacted to at least 95 percent relative compaction. Exterior flatwork concrete should be at least four inches thick. Consideration should be given to thickening the edges of the slabs at least twice the slab thickness where wheel traffic is expected over the slabs. Expansion joints should be provided to allow for minor vertical movement of the flatwork. Exterior flatwork should be constructed independent of other structural elements by the placement of a layer of felt material between the flatwork and the structural element. Doweling of new flatwork into existing improvements (i.e., adjacent buildings, existing flatwork, etc.) is not recommended. The slab designer should determine the final thickness, strength and joint spacing of exterior slab-on-grade concrete. The slab designer should also determine if slab reinforcement for crack control is required and determine final slab reinforcing requirements.

Areas adjacent to exterior flatwork should be landscaped to maintain more uniform soil moisture conditions adjacent to and under flatwork. We recommend final landscaping plans not allow fallow ground adjacent to exterior concrete flatwork.

Practices recommended by the Portland Cement Association (PCA) for proper placement, curing, joint depth and spacing, construction, and placement of concrete should be followed during exterior concrete flatwork construction.

4.1.12 Site Drainage

Final site grading should be accomplished to provide positive drainage of surface water away from structures and prevent ponding of water adjacent to the foundations. The grade adjacent to the relocated structures should be sloped away from foundations at a minimum two percent slope for a distance of at least five feet, where possible. Ponding of surface water should not be allowed adjacent to the structure or exterior concrete flatwork.

4.1.13 Pavement Design

We are providing several pavement design alternative designs based on the soil conditions encountered at the site, our experience, and using design Traffic Indices (TIs) considered appropriate for the proposed construction.

Based on laboratory test results for the surface and near-surface clay soils present at the site and our experience in the area, we used a Resistance (“R”) value of 34 for untreated pavement subgrades. Pavement sections presented in Table 3 have been calculated using the above R-values and traffic indices (TIs) assumed to be appropriate for this project. The procedures used for pavement design are in general conformance with Chapters 600 to 670 of the *California Highway Design Manual*, 7th Edition. The project civil engineer should determine the appropriate traffic index for pavements based on anticipated traffic conditions. If needed, we can provide additional pavement sections for different traffic indices.

Table 3: Pavement Design Alternatives

Traffic Index (TI)	Pavement Use	Untreated Subgrades R-value = 34		
		Asphalt Concrete (inches)	Class 2 Aggregate Base (inches)	Portland Cement Concrete (inches)
4.5	Automobile Parking	3.5*	3.0	--
		--	3.5	6.0
6.5	Emergency Vehicle Traffic	6.0	5.0	--
		8.0*	7.0	--
		--	3.5	8.0

* = Asphalt concrete thickness contains the Caltrans safety factor.

We emphasize that the performance of pavement is critically dependent upon uniform and adequate compaction of the soil subgrade, as well as all engineered fill and utility trench backfill within the limits of the pavements. We recommend that final pavement subgrade preparation (i.e., scarification, moisture conditioning, and compaction) be performed after underground utility construction is completed and just prior to aggregate base placement.

The upper twelve inches of pavement subgrade soils should be compacted to at least 95 percent relative compaction at no less than two percent above the optimum moisture content, maintained in a moist condition, and protected from disturbance. All aggregate bases should be compacted to at least 95 relative compaction.

It has been our experience that pavement failures may occur where a non-uniform or disturbed subgrade soil condition is created. Subgrade disturbances can result if pavement subgrade preparation is performed prior to underground utility construction and/or if a significant time period passes between subgrade preparation and placement of aggregate base. Therefore, we recommend that final pavement subgrade preparation (i.e., scarification, moisture conditioning, and compaction) be performed just prior to aggregate base placement.

In the summer heat, high axle loads coupled with shear stresses induced by sharply turning tire movements can lead to failure in asphalt concrete pavements. Therefore, PCC pavements should be used in areas subjected to concentrated heavy wheel loading, such as entryways, in front of trash enclosures, and/or within loading areas. Alternate PCC pavement sections have been provided above in Table 3.

We suggest concrete slabs be constructed with thickened edges in accordance with American Concrete Institute (ACI) design standards, latest edition. Reinforcing for crack control, if desired, should be provided in accordance with ACI guidelines. At a minimum, we recommend No. 3 reinforcing bars at 18 inches on center for crack control. Reinforcement must be located at mid-slab depth to be effective. The above PCC pavement section is based on a minimum 28-day Modulus of Rupture (M-R) of 540 psi, compressive strength of 3,600 psi, and a subgrade modulus of 160 pci. Transverse contraction joints should not be spaced more than 15 feet and should be cut to a depth of ¼ the thickness of the slab. Longitudinal joints should not be spaced more than 10 feet apart; however, they are unnecessary in the pavement adjacent to the curb and gutter section. Positive drainage should be provided away from all pavement areas to prevent surface and/or subsurface water seepage into the pavement base and/or subgrade.

All pavement materials and construction methods of structural pavement sections should conform to the applicable provisions of the *Caltrans Standard Specifications*, latest edition.

4.1.14 Geotechnical Engineering Construction Observation Services

Site preparation should be accomplished in accordance with the recommendations of this report. Representatives of the Geotechnical Engineer should be present during site preparation and all grading operations to observe and test the fill to verify compliance with our recommendations and the job specifications. Testing frequency will depend on how the site is graded and should be determined during the rough grading operations. These services are beyond the scope of work authorized for this investigation.

In the event that Universal Engineering Sciences is not retained to provide geotechnical engineering observation and testing services during construction, the Geotechnical Engineer retained to provide these services should indicate in writing that they agree with the recommendations of this report or prepare supplemental recommendations as necessary. A final report by the Geotechnical Engineer providing construction testing services should be prepared upon project completion.

4.1.15 Additional Services

Our firm should be retained to review the final plans and specifications to determine if the intent of our recommendations has been implemented in those documents. We would be pleased to submit a proposal to provide these services upon request.

5.0 LIMITATIONS

Our recommendations are based upon the information provided regarding the proposed project, combined with our analysis of site conditions revealed by the field exploration and laboratory testing programs. We have used our engineering judgment based upon the information provided and the data generated from our investigation. This report has been prepared in substantial compliance with generally accepted geotechnical engineering practices that exist in the area of the project at the time the report was prepared. No warranty, either express or implied, is provided.

If the proposed construction is modified or re-sited; or, if it is found during construction that subsurface conditions differ from those we encountered at the boring locations, we should be afforded the opportunity to review the new information or changed conditions to determine if our conclusions and recommendations must be modified.

We emphasize that this report is applicable only to the proposed construction and the investigated site and should not be utilized for construction on any other site.

The conclusions and recommendations of this report are considered valid for a period of twelve months. If design is not completed and construction has not started within two years of the date of this report, the report must be reviewed and updated if necessary.

We appreciate this opportunity to be of service on this project. If you have questions regarding this report, please do not hesitate to contact the undersigned.

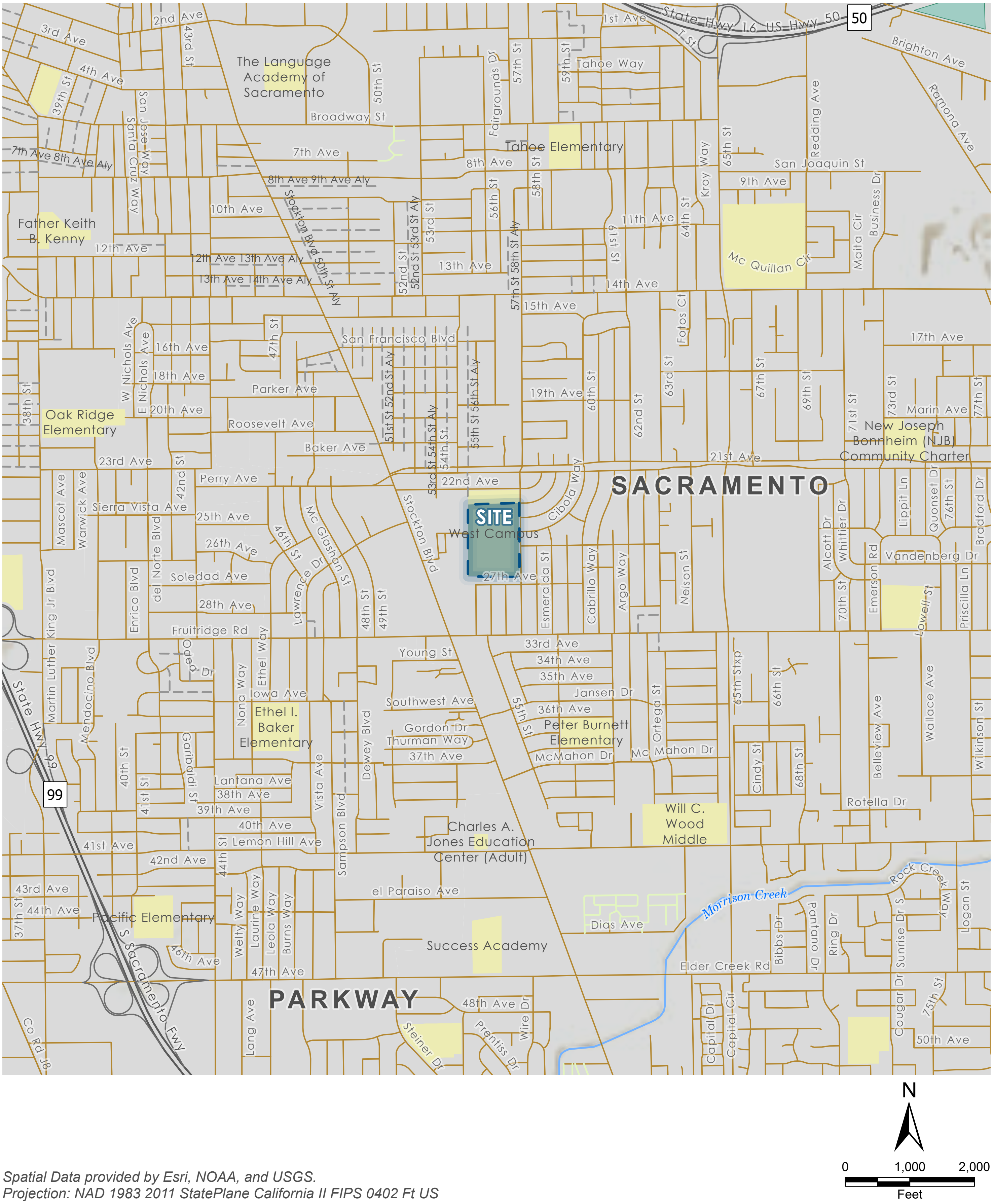
Respectfully submitted,
Universal Engineering Sciences (UES)

Jacob Alvarez
Project Engineer

Dharmesh Amin, MS, PE, GE2553
Regional Geotechnical Engineer

REGISTERED PROFESSIONAL ENGINEER
DHARMESH AMIN
2553
GEOTECHNICAL
STATE OF CALIFORNIA

FIGURES



Spatial Data provided by Esri, NOAA, and USGS.
Projection: NAD 1983 2011 StatePlane California II FIPS 0402 Ft US

VICINITY MAP

WEST CAMPUS HIGH SCHOOL ATHLETIC IMPROVEMENTS

Sacramento, California

FIGURE	1
DRAWN BY	KO
CHECKED BY	JRY
PROJECT MGR	JRY
DATE	09/2023
4630.2300077.0016	

Approximate Site Boundary

Approximate Boring Location

N

0 75 150

Feet

Aerial imagery provided by Esri.
Projection: NAD 1983 2011 StatePlane California II FIPS 0402 Ft US

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SITE PLAN

WEST CAMPUS HIGH SCHOOL ATHLETIC IMPROVEMENTS

Sacramento, California

FIGURE	2
DRAWN BY	KO
CHECKED BY	JRY
PROJECT MGR	JRY
DATE	09/2023
4630.2300077.0016	

Project: West Campus High School Athletic Improvements	LOG OF SOIL BORING D1
Project Location: Sacramento, California	Sheet 1 of 1
Project Number: 4630.2300077.0016	

Date(s) Drilled	**8/11/23**	Logged By	**GHZ**	Checked By	**JRY**
Drilling Method	**Hollow Stem Auger**	Drilling Contractor	**V&W Drilling**	Total Depth of Drill Hole	**3.5 feet**
Drill Rig Type	**CME 55 HT**	Diameter(s) of Hole, inches	**8"**	Approx. Surface Elevation, ft MSL	
Groundwater Depth [Elevation], feet	**Not Encountered**	Sampling Method(s)	**2.0" Modified California with 6-inch sleeve**	Drill Hole Backfill	**Soil Cuttings**
Remarks				Driving Method and Drop	**140lb auto. hammer with 30" drop**

ELEVATION, feet	DEPTH, feet	GRAPHIC LOG	ENGINEERING CLASSIFICATION AND DESCRIPTION	SAMPLE DATA: SAMPLE	SAMPLE DATA: SAMPLE NUMBER	SAMPLE DATA: NUMBER OF BLOWS	TEST DATA: MOISTURE CONTENT, %	TEST DATA: DRY UNIT WEIGHT, pcf	TEST DATA: ADDITIONAL TESTS
			Brown, moist, very stiff, sandy lean CLAY (CL)	■	D1-1I	34			
			Encountered fabric						
			Boring was terminated at approximately 4 feet below existing ground surface. Groundwater not encountered.						

BORING LOG 4630.2300077.0016 - WEST CAMPUS HIGH SCHOOL ATHLETIC IMPROVEMENTS.GPJ WKA.GDT 11/1/23 3:40 PM

UES™

FIGURE 3

Project: West Campus High School Athletic Improvements **Project Location:** Sacramento, California **Project Number:** 4630.2300077.0016	**LOG OF SOIL BORING D2** Sheet 1 of 1

Date(s) Drilled	**8/11/23**	Logged By	**GHZ**	Checked By	**JRY**
Drilling Method	**Hollow Stem Auger**	Drilling Contractor	**V&W Drilling**	Total Depth of Drill Hole	**45.5 feet**
Drill Rig Type	**CME 75**	Diameter(s) of Hole, inches	**8"**	Approx. Surface Elevation, ft MSL	
Groundwater Depth [Elevation], feet	**35.0**	Sampling Method(s)	**2.0" Modified California with 6-inch sleeve**	Drill Hole Backfill	**Neat Cement**
Remarks	**Bulk (0-5'); RV = 34**			Driving Method and Drop	**140lb auto. hammer with 30" drop**

ELEVATION, feet	DEPTH, feet	GRAPHIC LOG	ENGINEERING CLASSIFICATION AND DESCRIPTION	SAMPLE	SAMPLE NUMBER	NUMBER OF BLOWS	MOISTURE CONTENT, %	DRY UNIT WEIGHT, pcf	ADDITIONAL TESTS
			Brown, moist, medium dense, silty fine to medium SAND (SM)						
					D2-1I	39	9.9	113	PP = 4.5+tsf
	5		with reddish brown mottling		D2-2I	41	17.1	97	PP = 4.5+tsf
	10		with dark brown mottling		D2-3I	22	25.6	95	PP = 4.5+tsf
			Brown with reddish brown mottling, moist, hard, lean CLAY (CL)						
	15				D2-4I	28	30.2	91	PP = 4.5+tsf
	20		very stiff		D2-5I	21			PP = 3.0tsf
			Brown, moist, medium dense, silty fine SAND (SM)						
	25				D2-6I	26			
	30		with reddish brown mottling		D2-7I	27			
	35		dark brown, wet		D2-8I	14			
			encountered gravel, increased drilling resistance						
	40		fine to coarse sand, about 5 feet of heave on sampler		D2-9I	24			
	45		with gravel up to 1½ inches in largest dimension		D2-10I	50/3"			

Boring encountered practical refusal at approximately 45 feet below existing ground surface. Groundwater encountered at approximately 35 feet below exising ground surface.

BORING LOG 4630.2300077.0016 - WEST CAMPUS HIGH SCHOOL ATHLETIC IMPROVEMENTS.GPJ WKA.GDT 11/1/23 3:40 PM

UES™

FIGURE 4

Project:	**West Campus High School Athletic Improvements**
Project Location:	**Sacramento, California**
Project Number:	**4630.2300077.0016**

LOG OF SOIL BORING D3

Date(s) Drilled	**8/11/23**	Logged By	**KRO**	Checked By	**JRY**
Drilling Method	**Hollow Stem Auger**	Drilling Contractor	**V&W Drilling**	Total Depth of Drill Hole	**40.0 feet**
Drill Rig Type	**CME 55 HT**	Diameter(s) of Hole, inches	**8"**	Approx. Surface Elevation, ft MSL	
Groundwater Depth [Elevation], feet	**28.0**	Sampling Method(s)	**2.0" Modified California with 6-inch sleeve**	Drill Hole Backfill	**Neat Cement**
Remarks	**Bulk (0-5'); PI = 31; EI = 88**			Driving Method and Drop	**140lb auto. hammer with 30" drop**

ELEVATION, feet	DEPTH, feet	GRAPHIC LOG	ENGINEERING CLASSIFICATION AND DESCRIPTION	SAMPLE	SAMPLE NUMBER	NUMBER OF BLOWS	MOISTURE CONTENT, %	DRY UNIT WEIGHT, pcf	ADDITIONAL TESTS
	0		Light brown, moist, very stiff, moderately cemented, silty lean CLAY (CL)						
					D3-1I	15	11.6		PP = 4.5+ tsf
	5		stiff, weakly cemented		D3-2I	13	27.6		PP = 1.5tsf
	10		brown with dark brown mottling		D3-3I	8	33.6		PP = 0.75tsf
			Brown, moist, medium dense, sandy SILT (ML); fine sand						
	15				D3-4I	15	28.6		FC = 83%
	20		light brown, loose		D3-5I	10			
			Light brown, moist, medium dense, silty fine SAND (SM)						
	25				D3-6I	15			
			▼ (groundwater)						
	30		dark gray, wet, loose		D3-7I	10			
	35		grayish brown, fine to coarse sand, with gravel up to 1½ inches in maximum dimension		D3-8I	50/6"			
	40		about 3 feet of heave on sampler Boring encountered practical refusal at approximately 40 feet below existing ground surface. Groundwater encountered at approximately 28 feet below exising ground surface.						

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FIGURE 5

Project: West Campus High School Athletic Improvements
Project Location: Sacramento, California
Project Number: 4630.2300077.0016

LOG OF SOIL BORING D4

Date(s) Drilled	**8/11/23**	Logged By	**KRO**	Checked By	**JRY**
Drilling Method	**Hollow Stem Auger**	Drilling Contractor	**V&W Drilling**	Total Depth of Drill Hole	**40.0 feet**
Drill Rig Type	**CME 55 HT**	Diameter(s) of Hole, inches	**8"**	Approx. Surface Elevation, ft MSL	
Groundwater Depth [Elevation], feet	**30.0**	Sampling Method(s)	**2.0" Modified California with 6-inch sleeve**	Drill Hole Backfill	**Neat Cement**
Remarks	**Bulk (0-5')**			Driving Method and Drop	**140lb auto. hammer with 30" drop**

ELEVATION, feet	DEPTH, feet	GRAPHIC LOG	ENGINEERING CLASSIFICATION AND DESCRIPTION	SAMPLE	SAMPLE NUMBER	NUMBER OF BLOWS	MOISTURE CONTENT, %	DRY UNIT WEIGHT, pcf	ADDITIONAL TESTS
				SAMPLE DATA			**TEST DATA**		
	0	CL	Light brown, moist, har, silty lean CLAY (CL) with gravel						
				■	D4-1I	26	16.2	89	PP = 4.5+ tsf
	5		with light brown mottling, very stiff	■	D4-2I	7	41.3	74	PP = 2.0 tsf
	10		with light orange brown mottling, variably cemented	■	D4-3I	23	29.2	83	PP = 3.5 tsf
	15			■	D4-4I	26	29.7	86	PP = 2.75 tsf
			hard						
	20			■	D4-5I	20	35.3	82	PP = 4.25 tsf
		SM	Grayish brown, moist, loose, silty SAND (SM)						
	25			■	D4-6I	11			TR
	30		▼ wet, medium dense	■	D4-7I	17			
	35		brown, very dense, fine to coarse sand, with gravel up to 1½ inches in maximum dimension	■	D4-8I	8			
	40		about 10 feet of heave						

Boring was terminated at approximately 21 feet below existing ground surface.
Groundwater encountered at approximately 30 feet below existing ground surface.

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FIGURE 6

Project: West Campus High School Athletic Improvements
Project Location: Sacramento, California
Project Number: 4630.2300077.0016

LOG OF SOIL BORING D5

Date(s) Drilled	**8/11/23**	Logged By	**KRO**	Checked By	**JRY**
Drilling Method	**Hollow Stem Auger**	Drilling Contractor	**V&W Drilling**	Total Depth of Drill Hole	**45.0 feet**
Drill Rig Type	**CME 55 HT**	Diameter(s) of Hole, inches	**8"**	Approx. Surface Elevation, ft MSL	
Groundwater Depth [Elevation], feet	**28.0**	Sampling Method(s)	**2.0" Modified California with 6-inch sleeve**	Drill Hole Backfill	**Neat Cement**
Remarks	**Bulk (0-5')**			Driving Method and Drop	**140lb auto. hammer with 30" drop**

ELEVATION, feet	DEPTH, feet	GRAPHIC LOG	ENGINEERING CLASSIFICATION AND DESCRIPTION	SAMPLE	SAMPLE NUMBER	NUMBER OF BLOWS	MOISTURE CONTENT, %	DRY UNIT WEIGHT, pcf	ADDITIONAL TESTS
				SAMPLE DATA			TEST DATA		
	0	CL	Light brown, moist, very stiff, lean CLAY (CL)						
				■	D5-1I	30	20.6	90	PP = 2.75 tsf
	5		<<C<> hard	■	D5-2I	40	29.2	72	PP = 4.25 tsf
	10			■	D5-3I	56	36.2	81	PP = 4.5+ tsf
	15		variably cemented	■	D5-4I	36	32.6	86	PP = 4.5 tsf FC = 78%
	20			■	D5-5I	30			PP = 4.25 tsf
	23	SM	Brown, moist, medium dense, silty fine SAND (SM)						
	25			■	D5-6I	22			
	28		▼ (groundwater)						
	30		dark brown, wet	■	D5-7I	23			
	35		very dense, fine to coarse sand, with gravel up to 1 inch in maximum dimension	■	D5-8I	76			
	40		about 5 feet of heave on sampler						
	45		about 5 feet of heave on sampler						

Boring was terminated at approximately 45 feet below existing ground surface.
Groundwater encountered at approximately 28 feet below existing ground surface.

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FIGURE 7

UNIFIED SOIL CLASSIFICATION SYSTEM (ASTM D2487)

MAJOR DIVISIONS		USCS[4]	CODE	CHARACTERISTICS
COARSE GRAINED SOILS (More than 50% of soil > no. 200 sieve size)	GRAVELS[1] (More than 50% of coarse fraction > no. 4 sieve size)	GW		Well-graded gravels or gravel - sand mixtures, trace or no fines
		GP		Poorly graded gravels or gravel - sand mixtures, trace or no fines
		GM		Silty gravels, gravel - sand - silt mixtures, containing little to some fines[2]
		GC		Clayey gravels, gravel - sand - clay mixtures, containing little to some fines[2]
	SANDS[1] (50% or more of coarse fraction < no. 4 sieve size)	SW		Well-graded sands or sand - gravel mixtures, trace or no fines
		SP		Poorly graded sands or sand - gravel mixtures, trace or no fines
		SM		Silty sands, sand - gravel - silt mixtures, containing little to some fines[2]
		SC		Clayey sands, sand - gravel - clay mixtures, containing little to some fines[2]
FINE GRAINED SOILS (50% or more of soil < no. 200 sieve size)	SILTS & CLAYS LL < 50	ML		Inorganic silts, gravely silts, and sandy silts that are non-plastic or with low plasticity
		CL		Inorganic lean clays, gravelly lean clays, sandy lean clays of low to medium plasticity[3]
		OL		Organic silts, organic lean clays, and organic silty clays
	SILTS & CLAYS LL ≥ 50	MH		Inorganic elastic silts, gravelly elastic silts, and sandy elastic silts
		CH		Inorganic fat clays, gravelly fat clays, sandy fat clays of medium to high plasticity
		OH		Organic fat clays, gravelly fat clays, sandy fat clays of medium to high plasticity
HIGHLY ORGANIC SOILS		PT		Peat
ROCK		RX		Rocks, weathered to fresh
FILL		FILL		Artificially placed fill material

OTHER SYMBOLS

= Drive Sample: 2-1/2" O.D. Modified California sampler

= Drive Sampler: no recovery

= SPT Sampler

= Initial Water Level

= Final Water Level

— — — = Estimated or gradational material change line

——— = Observed material change line

Laboratory Tests

CR = Corrosion
PI = Plasticity Index
EI = Expansion Index
UCC = Unconfined Compression Test (TSF)
TR = Triaxial Compression Test
GR = Gradational Analysis (Sieve/Hydro)
FC = Wash (Fines Content)
PP = Pocket Penetrometer Test (TSF)
PID = Photo Ionization Detector Test (PPM)
RV = Resistance ("R") Value

REF = Refusal (>50 blows in 6 inches)

GRAIN SIZE CLASSIFICATION

CLASSIFICATION	RANGE OF GRAIN SIZES	
	U.S. Standard Sieve Size	Grain Size in Millimeters
BOULDERS (b)	Above 12"	Above 300
COBBLES (c)	12" to 3"	300 to 75
GRAVEL (g) coarse fine	3" to No. 4 3" to 3/4" 3/4" to No. 4	75 to 4.75 75 to 19 19 to 4.75
SAND coarse medium fine	No. 4 to No. 200 No. 4 to No. 10 No. 10 to No. 40 No. 40 to No. 200	4.75 to 0.075 4.75 to 2.00 2.00 to 0.425 0.425 to 0.075
SILT & CLAY	Below No. 200	Below 0.075

Trace - Less than 5 percent
Few - 5 to 10 percent
Little - 15 to 25 percent
Some - 35 to 45 percent
Mostly - 50 to 100 percent

* Percents as given in ASTM D2488

NOTES:

1. Coarse grained soils containing 5% to 12% fines, use dual classification symbol (ex. SP-SM).
2. If fines classify as CL-ML (4<PI<7), use dual symbol (ex. SC-SM).
3. Silty Clays, use dual symbol (CL-ML).
4. Borderline soils with uncertain classification list both classifications (ex. CL/ML).

UES™

UNIFIED SOIL CLASSIFICATION SYSTEM

WEST CAMPUS HIGH SCHOOL ATHLETIC IMPROVEMENTS

Sacramento, California

FIGURE	8
DRAWN BY	KO
CHECKED BY	JRY
PROJECT MGR	JRY
DATE	09/2023

4630.2300077.0016

APPENDIX A

General Project Information, Laboratory Testing and Results

APPENDIX A

A. GENERAL INFORMATION

The performance of a geotechnical engineering study for the proposed West Campus High School Athletic Improvements project located at West Campus High School in Sacramento, California was authorized by Mark Baginski of Verde Designs, Inc. on July 14, 2023. Authorization was for a study as described in our proposal letter dated May 17, 2023, sent to Verde Designs, Inc., whose mailing address is 1024 Iron Point Road, Suite 100, Folsom, California, 95630.

B. FIELD EXPLORATIONS

As part of our study for the proposed improvements, our field exploration included drilling and sampling of 5 borings (D1 through D5) at the approximate locations shown on Figure 2.

The soil borings D1 through D5 were performed on August 11, 2023, to depths ranging from about 3½ to 50 feet below existing site grades utilizing a CME-55HT and a CME-75 truck-mounted drilling rig equipped with six-inch-diameter solid flight augers. Soil samples were recovered at various intervals with a 2½-inch outside diameter (O.D.), 2-inch inside diameter (I.D.), modified California split-spoon sampler. The sampler was driven by an automatic 140-pound hammer freely falling 30 inches. The number of blows of the hammer required to drive each six-inch interval of the 18-inch long samplers were recorded. The sum of the blows required to drive the sampler the lower 12-inch interval, or portion thereof, is designated the penetration resistance or "blow count" for that particular drive.

The modified California samples were retained in 2-inch diameter by 6-inch long, thin-walled brass tubes contained within the sampler. After recovery, the field representative visually classified the soil recovered in the tubes. After the samples were classified, the ends of the tubes were sealed to preserve the natural moisture contents.

In addition to the driven samples, representative bulk samples of near-surface soils also were collected and retained in plastic bags. Driven and bulk samples were taken to our laboratory for additional soil classification and selection of samples for testing.

Pocket penetrometer testing was performed during drilling operations on select cohesive soil samples obtained at the boring locations. In pocket penetrometer testing, the unconfined compressive strength of a cohesive soil sample is estimated by measuring the resistance of the sample to penetration of a relatively small, calibrated, spring-loaded cylinder. The maximum capacity of the penetrometer is 4.5 tons per square-foot (tsf). The unconfined compressive strength estimated from pocket penetrometer testing on the select cohesive soil samples is included on the boring logs at the depth the sample tested was obtained. The approximate undrained shear strength of the samples tested is one-half of the unconfined compressive strength.

Descriptions of the soils encountered in the boring locations are presented on Figures 3 through 7. An explanation of the Unified Soil Classification System symbols used in the descriptions is presented on Figure 8.

C. LABORATORY TESTING

One representative near-surface sample was subjected to Atterberg Limits tests (ASTM D4318). The results of this test are presented in Figure A1.

One representative near-surface soil sample was tested for Expansion Index (ASTM D4829) with results presented in Figure A2.

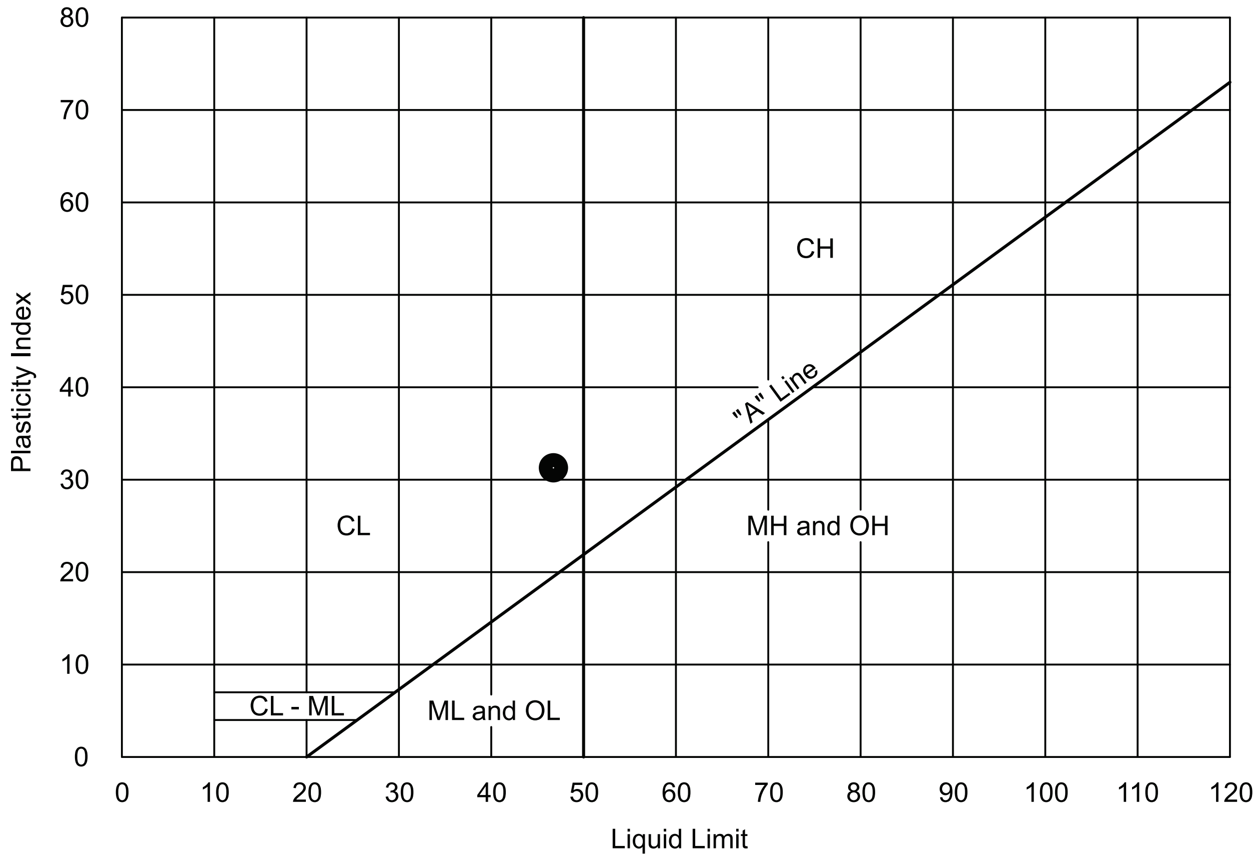
One representative sample of near-surface soil was subjected to Resistance-value ("R") testing in accordance with California Test 301. The results of the R-value test is presented in Figure A3.

One representative near-surface soil sample was subjected to a Triaxial Compression test (ASTM D4767) with results presented in Figure A4.

One sample of the near-surface soil was submitted to Sunland Analytical to determine the soil pH, minimum resistivity (California Test 643), Sulfate concentration (California Test 417) and Chloride concentration (California Test 422). The results of these tests are presented on Figures A5 and A6.

ATTERBERG LIMITS

ASTM D4318



KEY SYMBOL	LOCATION	SAMPLE DEPTH	NATURAL WATER CONTENT (%)	ATTERBERG LIMITS		PASSING No. 200 SIEVE (%)	UNIFIED SOIL CLASSIFI-CATION SYMBOL
				LIQUID LIMIT (%)	PLASTICITY INDEX (%)		
●	D3	0-5.0'	---	47	31	---	CL

UES™

ATTERBERG LIMITS

WEST CAMPUS HIGH SCHOOL ATHLETIC IMPROVEMENTS

Sacramento, California

FIGURE	A1
DRAWN BY	GHZ
CHECKED BY	JRY
PROJECT MGR	JRY
DATE	10/2023

4630.2300077.0016

EXPANSION INDEX TEST RESULTS

ASTM D4829

MATERIAL DESCRIPTION: Light brown, silty lean CLAY (CL)

LOCATION: D3

Sample Depth	Pre-Test Moisture (%)	Post-Test Moisture (%)	Dry Density (pcf)	Expansion Index
0 - 5.0'	13.0	29.3	97	**88**

CLASSIFICATION OF EXPANSIVE SOIL *

EXPANSION INDEX	POTENTIAL EXPANSION
0 - 20	Very Low
21 - 50	Low
51 - 90	**Medium**
91 - 130	High
Above 130	Very High

* From ASTM D4829, Table 1

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EXPANSION INDEX

WEST CAMPUS HIGH SCHOOL ATHLETIC IMPROVEMENTS

Sacramento, California

FIGURE	A2
DRAWN BY	GHZ
CHECKED BY	JRY
PROJECT MGR	JRY
DATE	10/2023

4630.2300077.0016

RESISTANCE VALUE TEST RESULTS

(California Test 301)

MATERIAL DESCRIPTION: Brown, silty SAND

LOCATION: D2 (0-5')

Specimen No.	Dry Unit Weight (pcf)	Moisture @ Compaction (%)	Exudation Pressure (psi)	Expansion (dial, inches x 1000)	Expansion (psf)	R Value
1	121	12.2	330	5	22	37
2	120	13.0	210	0	0	22
3	122	11.3	507	19	507	53

R-Value at 300 psi exudation pressure = **34**

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RESISTANCE VALUE TEST RESULTS

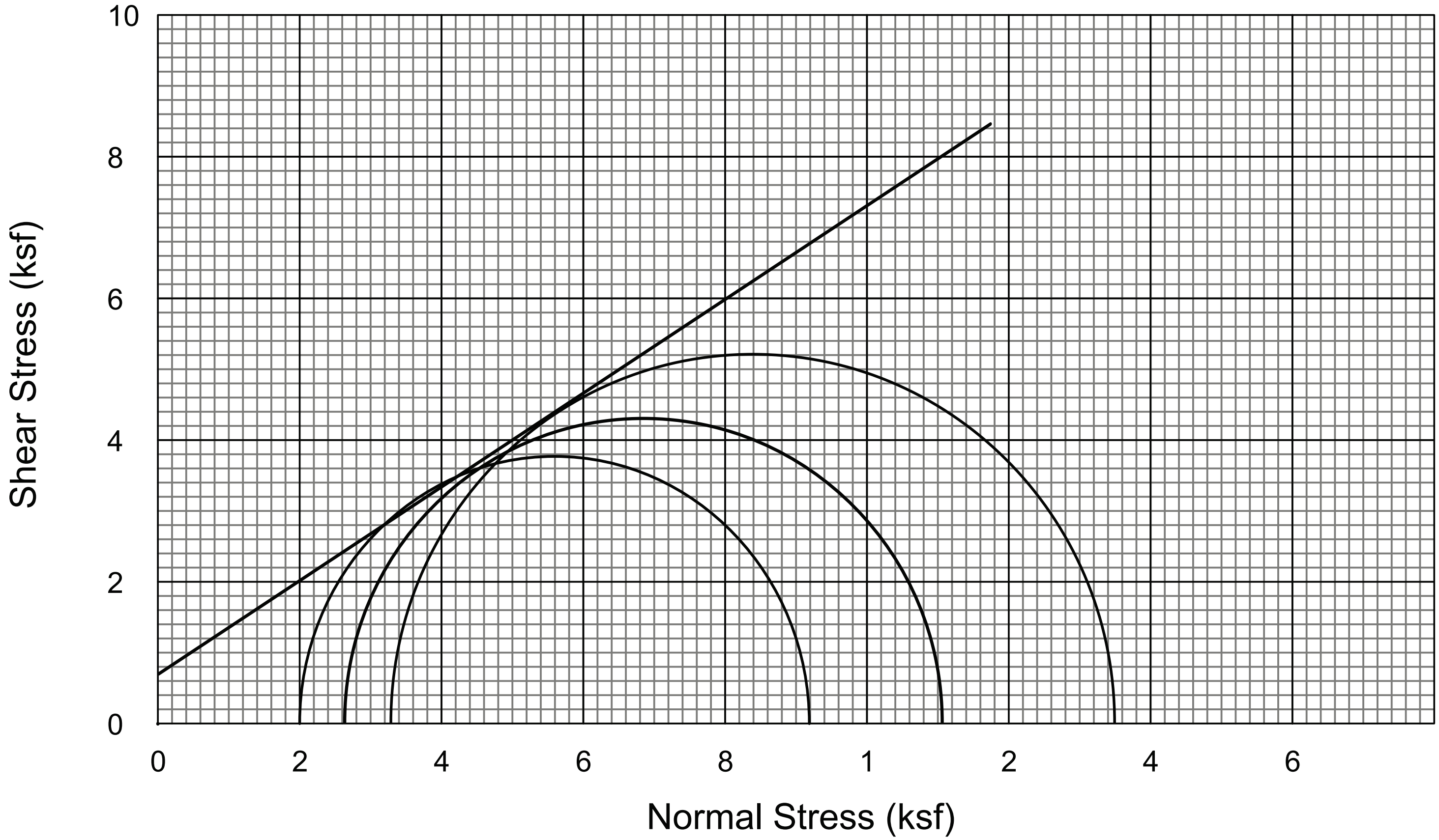
WEST CAMPUS HIGH SCHOOL ATHLETIC IMPROVEMENTS

Sacramento, California

FIGURE	A3
DRAWN BY	GHZ
CHECKED BY	JRY
PROJECT MGR	JRY
DATE	10/2023
4630.2300077.0016	

TRIAXIAL COMPRESSION TEST

ASTM D4767



SAMPLE NO. : D4-6I

SAMPLE CONDITION : Undisturbed

SAMPLE DESCRIPTION : Grayish brown, silty SAND

DRY DENSITY (PCF) : 90
INITIAL MOISTURE (%) : 27.3
FINAL MOISTURE (%) : 31.4

ANGLE OF INTERNAL FRICTION (ø) : 33°
COHESION (KSF) : 0.66

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TRIAXIAL COMPRESSION TEST RESULTS

WEST CAMPUS HIGH SCHOOL ATHLETIC IMPROVEMENTS

Sacramento, California

FIGURE	A4
DRAWN BY	GHZ
CHECKED BY	GHZ
PROJECT MGR	JRY
DATE	10/2023
4630.2300077.0000	

Sunland Analytical
11419 Sunrise Gold Circle, #10
Rancho Cordova, CA 95742
(916) 852-8557

Date Reported 08/25/2023
Date Submitted 08/21/2023

To: Guang Zhu
Universal Engineering Science
3050 Industrial Blvd
West Sacramento, CA 95691

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : 4630.2300077.0016 Site ID : D3 0-5FT.
Thank you for your business.

* For future reference to this analysis please use SUN # 90382-187578.

EVALUATION FOR SOIL CORROSION

Soil pH	7.43		
Minimum Resistivity	1.80 ohm-cm (x1000)		
Chloride	4.4 ppm	00.00044	%
Sulfate	7.0 ppm	00.00070	%

METHODS
pH and Min.Resistivity CA DOT Test #643
Sulfate CA DOT Test #417, Chloride CA DOT Test #422m

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CORROSION TEST RESULTS

WEST CAMPUS HIGH SCHOOL ATHLETIC IMPROVEMENTS

Sacramento, California

FIGURE	A5
DRAWN BY	GHZ
CHECKED BY	JRY
PROJECT MGR	JRY
DATE	10/2023
4630.2300077.0016	

Sunland Analytical

11419 Sunrise Gold Circle, #10
Rancho Cordova, CA 95742
(916) 852-8557

Date Reported 08/25/2023
Date Submitted 08/21/2023

To: Guang Zhu
Universal Engineering Science
3050 Industrial Blvd
West Sacramento, CA 95691

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : 4630.2300077.0016 Site ID : D5 0-5FT.
Thank you for your business.

* For future reference to this analysis please use SUN # 90382-187579.

EVALUATION FOR SOIL CORROSION

Soil pH	7.66			
Minimum Resistivity	1.82	ohm-cm (x1000)		
Chloride	8.0	ppm	00.00080	%
Sulfate	13.3	ppm	00.00133	%

METHODS
pH and Min.Resistivity CA DOT Test #643
Sulfate CA DOT Test #417, Chloride CA DOT Test #422m

UES	CORROSION TEST RESULTS WEST CAMPUS HIGH SCHOOL ATHLETIC IMPROVEMENTS Sacramento, California	FIGURE	A6
		DRAWN BY	GHZ
		CHECKED BY	JRY
		PROJECT MGR	JRY
		DATE	10/2023
		4630.2300077.0016	

UES

Universal Engineering Sciences
3050 Industrial Boulevard
West Sacramento, CA 95691
p. 916.372.1434 | teamues.com

December 1, 2023

Mr. Chris Sullivan
Verde Design, Inc.
1843 Iron Point Road, Suite 140
Folsom, California 95630

Supplemental Fence Posts Footing Recommendations
WEST CAMPUS HIGH SCHOOL BASEBALL AND SOFTBALL IMPROVEMENTS
5022 58TH Street
Sacramento, California 95820
UES No. 4630.2300077.0016

Reference: UES, 2023, *Geotechnical Engineering Report, West Campus High School, Baseball and Softball Improvements,* 5022 58TH Street, Sacramento, California dated November 1, 2023.

Dear Mr. Sullivan,

As requested by Mr. Tim Hyde, S.E., of AKH Structural Engineers, Inc., we are providing supplemental fence post footing recommendations for the above-referenced project. Specifically, this letter addresses the steel posts in CIDH pier footings for conventional chain-link fences and pedestrian gates from 6' high up to 16' high, spaced 8' or less on center, some with slats and some bare chain-link with no slats.

The minimum CIDH pier sizes of these posts should be 12" diameter x 3.5' deep for the six feet high fence to 18" diameter x 6.0' deep for 16 feet high fence.

We appreciate this opportunity to be of service on this project. If you have any questions regarding this report, please do not hesitate to contact the undersigned.

Respectfully submitted,

Universal Engineering Sciences (UES)

Regional Geotechnical Engineer

REGISTERED PROFESSIONAL ENGINEER
DHARMESH AMIN
2553
GEOTECHNICAL
★ STATE OF CALIFORNIA ★