Geotechnical Engineering and Geologic Hazards Report

HERITAGE HIGH SCHOOL CULINARY ARTS BUILDING AND FUTURE TWO-STORY CLASSROOMS

WKA No. 12048.01P

October 29, 2018

Prepared for:

Liberty Union School District
20 Oak Street
Brentwood, California 94513

Geotechnical Engineering and Geologic Hazards Report

HERITAGE HIGH SCHOOL

CULINARY ARTS AND TWO-STORY CLASSROOM BUILDINGS

Sacramento, California

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101 American Avenue
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INTRODUCTION

We have completed a geotechnical engineering and geologic hazards report for the proposed Culinary Arts and future two-story classroom project for Heritage High School located at 101 American Avenue, California (See Figures 1 and 2).

The purpose of our study has been to prepare a Geologic Hazard and Geotechnical Engineering Report for the proposed new Culinary Arts Building and future two-story classroom buildings at the school. As part of this study, we have explored the existing soil and groundwater conditions in the location of the proposed new buildings and have provided geotechnical and Geologic Hazard conclusions and recommendations for the design and construction of the proposed improvements. Our study has been performed in general accordance with our *Geotechnical Engineering and Geologic Hazards Services Proposal* to the Liberty Union School District, dated July 5, 2018, as authorized by Ms. Liz Robbins on August 30, 2018. This report represents the results of our study.

Scope of Work

Our scope of work has included the following tasks:

1. Site reconnaissance;
2. Review of historic aerial photographs, topographic maps, and groundwater maps;
3. Review of geologic maps and fault maps;
4. Subsurface exploration, including the drilling and sampling of six borings to maximum depths of approximately 10½ to 16 feet below existing site grades. We also advanced three seismic cone penetrometer test (CPT) soundings to depth of about 5½ to 11½ feet below existing site grades;
5. Collection of bulk samples of near-surface soils;
6. Laboratory testing of selected soil samples;
7. Engineering and geologic analyses; and,
8. Preparation of this report.

Figures and Attachments

The following figures are included with this report:

Table 1: Figures

Figure	Title	Figure	Title
1	Vicinity Map	6	Fault Map
2	Site Plan	7	Epicenter Map
3	USGS Topographic Map	8	FEMA Flood Map
4	Geologic Map	9 – 14	Logs of Soil Borings D1 through D6
5	Geologic Cross Section A-A’	15	Unified Soil Classification System

Appended to this report are:

- General information regarding project concepts, exploratory methods used during our field investigation and laboratory test results not included on the Logs of Soil Borings (Appendix A).
- A list of references cited (Appendix B).
- Logs of the CPT soundings (Appendix C).
- Results of the Slope Stability Analysis of Cross Section B-B’ (Appendix D).
- *Guide Earthwork Specifications* that may be used in the preparation of contract documents (Appendix E).

Proposed Development

We understand the new Culinary Arts building will consist of a single-story building situated west of the existing Multi-Use building, encompassing an area of about 3,200 square feet. The future two-story classrooms are still in the conceptual design phase, but are anticipated to consist of the construction of three buildings situated on three existing cut/fill terraces northwest of the Culinary Arts building site, and east of the football field. Construction is anticipated to be of wood-framed with interior concrete slab-on-grade floors. Structural loads are anticipated to be relatively light based on this type of construction. Associated improvements will include the construction of underground utilities, landscaping, retaining walls and exterior flatwork.

Grading plans were not available to us; however, we anticipate maximum excavations and fills on the order of one to five feet for the proposed construction.

FINDINGS

Site Description

The school campus is located southwest of the intersection American Avenue and Balfour Road in Brentwood, California (Figure 1). The campus is situated on a 50-acre parcel located southwest of the intersection of Balfour Road and American Avenue. The property is bounded to the east by open grass hills, beyond which are residential developments; and to the north, south and west by open hilly terrain. Adams Middle School is located south of and adjacent to the high school campus. Deer Creek runs east-west along the northern end of campus.

Culinary Arts

The triangle-shaped proposed Culinary Arts building site is occupied by grass lawn with small to large trees and concrete sidewalks. The grass areas are landscaped with small man-made berms about one to three feet high. The existing multi-use building is located adjacent to and east of the Culinary Arts building site. Existing classroom buildings are located south of the building site, and an unnamed loop road is west of the site. Several light poles and small electrical equipment pads are located in the area, as well as existing underground utility pipes.

Two-Story Classrooms

The two-story classroom building sites are northwest of the Culinary Arts building site, separated by an unnamed loop road that runs north-south between the sites. The pool, multi-use and locker room buildings are located east of the site, and the football field and track are located west of the site. The site is occupied by three existing terraces, which were graded during original campus construction (Quattrochi Kwok, 2003). The uppermost, southern terrace is currently occupied by six portable classroom buildings situated on asphalt pavement, while the lower two terraces to the north are currently occupied by basketball hardcourts. Bleachers for the football field are situated on a cut-slope immediately west of the southern terrace and a portion of the middle terrace. A retaining wall, about 8 to 9-feet high, separates part of the middle terrace from a paved area to the west. The lowermost, northern terrace is about the same elevation as the adjacent football field and track. Stairs connect the three terraces, and Building L is situated west of the northernmost terrace.

Based on the original plans prepared by Quattrochi Kwok Architects, the three terraces were graded through a combination of cut and fill. The lowest and northernmost terrace appears to be mostly cut, while the middle and southernmost terrace generally appear to be cut on the southwest sides and fill on the northeast sides. Figure 5 presents a geologic cross section which approximates the existing cuts and fills, based on the findings of our subsurface explorations and the original grading plans for the campus.

At the time of our study, signs of settlement within the man-made fills were observed in the northern edge of asphalt pavement at the slope break, and at the top of the retaining wall. The pavement in both locations was cracked and had settled several inches.

Topography across the campus slopes down to the north, with surface elevations at the proposed building locations ranging from about +200 to +184 (south to north) feet relative to North American Vertical Datum of 1988 (NAVD88), based on information from Google Earth and the United States Geological Survey (USGS) *7.5-Minute Topographic Map of the Antioch South Quadrangle, California*, dated June 2012 (Figure 3). The football field is as much as 12 feet lower in elevation than the proposed two-story classroom site.

Supplemental Information

Supplemental information used in the preparation of this report included review of the following documents prepared by others for studies and project plans that included the site:

- Quattrocchi Kwok Architects, Inc., *Grading Plans, Heritage High School*, (May 15, 2003), prepared for the existing school campus;
- Kleinfelder, Inc., *Geologic and Seismic Hazards Assessment Report, Third High School Site, Balfour Road, Brentwood, California* (March 12, 2001), prepared for the existing school campus; and,
- Kleinfelder, Inc., *Geotechnical Investigation Report, Proposed Heritage High School*, *Balfour Road, Brentwood, California,* (April 25, 2002), prepared for the existing school campus.

Historical Aerial Photograph Review

Historical aerial photographs of the site and general vicinity were reviewed for the period from 1939 to the present (Nationwide Environmental Title Research, 1949 to 2014; Google Earth 1939-2018). Review of aerial photographs taken from 1939 to 1959 shows the site vicinity is occupied by vacant land. Images taken from 1966 to 2002 indicate the property was used for cattle ranching. Construction of the existing middle and high schools is shown from 2003 to 2007. Construction of the residential subdivision is shown from 2002 through 2005. The site has remained relatively unchanged from 2007 to the time of our site visits during February 2018.

General Site Geology

The high school campus is located at the western edge of the Great Valley geomorphic province of California. The Great Valley of California is generally considered to be an elongated sedimentary trough, approximately 450 miles long and 50 miles wide. Rock units within the Great Valley geomorphic province consist of Mesozoic to Cenozoic marine and non-marine sedimentary rocks. These sediments have been folded into an asymmetric syncline, the axis of which lies immediately east of the interior Coast Ranges. The sedimentary units on the east side of the Great Valley are minimally deformed and are deposited on basement rocks of the Sierra Nevada geomorphic province. The sedimentary rocks on the west side of the Great Valley are deformed and dip at moderate angles to the east (Norris and Webb, 1990).

Surface elevations within the Great Valley generally range from several feet below mean sea level to more than 1000 feet above sea level. The major topographical feature in the Great Valley are the Sutter Buttes (a volcanic remnant) which rise approximately 1980 feet above the surrounding valley floor. The Sutter Buttes are located approximately 137 kilometers (85 miles) north of the site. Mount Diablo is located 12 kilometers (7.5 miles) to the west.

The site is located near the eastern edge of Deer Valley and is mapped as being underlain by the Tertiary-aged Domengine Formation (Graymer, et al. 1994, Dibblee, 2006). In the site vicinity, the Domengine Formation is described by Dibblee as a middle-Eocene lithified marine clastic bedrock consisting of light gray to tan, medium grained, semi-friable arkosic sandstone. This is consistent with the findings of our subsurface exploration.

Subsurface Soil Conditions

Six borings were drilled and sampled to depths of approximately 10½ to 16 feet below ground surface (bgs), and three CPTs were performed to depths of 6 to 11½ feet bgs at the approximate locations as shown in Figure 2.

Culinary Arts Building

The soils encountered at the boring and CPT locations in the proposed Culinary Arts building site generally consisted of about three feet of man-made fill overlying five to 13 feet of colluvial soils, both of which consisted of medium dense to dense olive to yellow-brown silty sand. The colluvial soils were further underlain by yellow-gray sandstone of the Domengine Formation, which was moderately well-cemented and moderately weathered. Sampler refusal was encountered at a depth of 16 feet bgs. CPT refusal was met at about 5 feet and 11½ in CPT1 and CPT2, respectively.

Future Two-Story Classroom Buildings

The soils encountered in Borings D2 through D6 and CPT3 in the proposed two-story classroom buildings generally consisted man-made fill and sandstone of the Domengine Formation. Man-made fill was encountered in Borings D2, D3 and D5 ranging in thickness from 2½ to seven feet.

The fill in Borings D2 and D3 generally consisted of yellow-brown, medium dense silty sand. A locally loose, wet zone was encountered from about three to 6½ feet that is believed to be related to an adjacent subdrain trench (based on review of the original grading plans for the campus. The fill in Boring D5 generally consisted of brown, very stiff sandy clay which contained angular sandstone inclusions up to one inch diameter.

The Domengine Sandstone that was encountered at the two-story classroom site both at the surface and beneath the man-made fills is white to yellow-brown, weakly to well-cemented, and variably weathered. Sampler refusal and CPT refusal was encountered at depths ranging from about six to 13½ feet bgs in all of the borings and the CPT soundings.

For soil conditions at a specific location, please refer to the Logs of Borings on Figures 9 through 14. A geologic cross section is presented as Figure 5, which depicts the original and existing grades, general fill thicknesses and depths to bedrock as encountered in our subsurface exploration. A Legend explaining the Unified Soil Classification System and the symbols used on the logs is contained on Figure 15. Logs of the CPT soundings are presented in Appendix C.

<u>Groundwater</u>

Permanent groundwater was not encountered in any of our test borings or CPT soundings, performed on September 25 and 27, 2018, ranging from six to 16 feet below ground surface (bgs). However, groundwater was encountered in one boring (B-3) near the gymnasium, at a depth of about 21 feet bgs during the original 2001 and 2002 field investigations for the school, which were performed by Kleinfelder. The boring was located at the north end of campus which is lower in elevation, just south of Deer Creek.

Available groundwater data for the site vicinity is somewhat limited. However, to supplement our study we reviewed available groundwater data published by the California Department of Water Resources Geotracker Website (DWR, 2017) from two sites in the general vicinity of the subject property. The sites are located about 1.8 miles north and 1.1 miles east of the site. Based on available groundwater monitoring reports for the eastern site, water levels were recorded in the wells from 2010 to 2014. Highest and lowest groundwater levels were indicated to be 13.6 feet and 20.5 feet bgs in December 2012 and January 2014, respectively. Ground surface elevation at the site is indicated to be about +124 feet NAVD88 which is approximately 60 feet lower than the proposed building site's lowest elevation of +184 feet msl.

Based on available groundwater monitoring reports for the northern site, water levels were recorded in the wells from 2005 to 2010. Highest and lowest groundwater levels were indicated to be 17.6 feet and 31 feet bgs in September 2005 and February 2005, respectively. Ground surface elevation at the site is indicated to be about +155 feet NAVD88 which is approximately 29 feet lower than the proposed building site's lowest elevation of +184 feet msl.

Faulting

No indication of surface rupture or fault-related surface disturbance was observed at the site during our site reconnaissance or review of aerial photographs. Based on review of available geologic and seismic references, no known active or potentially active faults are shown on currently available geologic maps as crossing the site.

The site is not located within a designated Alquist-Priolo Earthquake Fault Zone (Hart and Bryant, 2007). The site is not located near any faults that are presently zoned as active or potentially active by the CGS pursuant to the guidelines of the Alquist-Priolo Earthquake Fault Zoning Act (Jennings, 2010; Parrish, 2018).

Using the *USGS National Seismic Hazard Maps* website tool (2008), and supplemented with data from the *Revised 2002 California Probabilistic Seismic Maps* (Cao, et al, 2003), we have prepared Table 2 containing faults and fault systems within 100 kilometers (62 miles) of the site that are considered capable of producing significant earthquakes. A fault map is presented as Figure 6. The nearest of these faults is the Greenville Fault, that trends northwest to southeast, located approximately 8.1 kilometers (5 miles) southwest of the site.

Table 2: Faults Influential to the site

Fault Name	Distance		Maximum Magnitude (M_w)
	miles	kilometers	
Greenville Connected	5.0	8.1	7.0
Great Valley 5, Pittsburg Kirby Hills	8.1	13.0	6.7
Mount Diablo Thrust	12.5	20.1	6.7
Green Valley Connected	12.9	20.8	6.8
Calaveras	15.7	25.2	7.0
Great Valley 7	18.1	29.2	6.9
Hayward-Rodgers Creek	24.4	39.2	7.3
Great Valley 4b, Gordon Valley	27.2	43.8	6.8
West Napa	31.5	50.7	6.7
N. San Andreas	42.5	68.5	8.1
Monte Vista-Shannon	43.1	69.3	6.7
Hunting Creek-Berryessa	43.8	70.5	7.1
Great Valley 4a, Trout Creek	44.1	70.9	6.6
Great Valley 8	47.0	75.7	6.8
San Gregorio Connected	47.9	77.1	7.5
Ortigalita	52.0	83.6	7.1
Great Valley 3, Mysterious Ridge	55.3	89.0	7.1
Zayante-Vergeles	58.7	94.5	7.0
Point Reyes	58.9	94.8	7.0

According to the *Fault Activity Map of California* prepared by the CGS (Jennings, 2010), the closest fault with Quaternary-aged displacement to the site is the north-south trending Davis Fault, located just west of the high school campus with activity in the last 1.6 million years. The Midland Fault Zone, located about 11.7 kilometers (7.3 miles) east of the site and is also indicated to be of Quaternary age. The map also shows a dotted (concealed) trace of an unnamed fault located about 2.4 kilometers (1.5 miles) east of the site. These faults do not have recognized displacement in Holocene time (within last 11,700 years) and are not identified as Alquist-Priolo Earthquake Fault Zones by the CGS. This is consistent with our opinion.

<u>Coseismic Ground Deformation</u>

The California State Legislature passed the Seismic Hazards Mapping Act (SHMA) in 1990 (Public Resources Code Division 2, Chapter 7.8) because of earthquake damage caused by the 1987 Whittier Narrows and 1989 Loma Prieta earthquakes. The purpose of the SHMA is to protect public safety from the effects of strong ground shaking, liquefaction, landslides, or other ground failure, and other hazards caused by earthquakes (CGS, 2008).

A Seismic Hazard Zone Map has not been prepared for the Antioch South 7½ minute quadrangle. However, the school campus is located about 750 feet west of the area covered by the Seismic Hazard Zone Map of the Brentwood 7½ minute quadrangle (CGS, 2018). This map indicates a liquefaction zone or required study is associated with Deer Creek and the immediately surrounding low-lying areas. To supplement our study, we reviewed the liquefaction susceptibility map provided by the Association of Bay Area Governments interactive mapping website (http://gis.abag.ca.gov/website/Hazards/?hlyr=liqSusceptibility). The proposed building sites are located within variably cemented sandstone bedrock and are uphill and outside of the areas of increased liquefaction and landslide susceptibility.

Historic Seismicity

Seismological data regarding significant historical earthquakes affecting the site was obtained using the commercially available software program EQSEARCH (Blake, 2000; database updated to August 2018). The EQSEARCH database was developed by extracting records of events greater than magnitude 4.0 from the Division of Mine and Geology Comprehensive Computerized Earthquake Catalog and supplemented by records from the USGS; University of California, Berkeley; the California Institute of Technology; and, the University of Nevada at Reno. A search radius of 100 kilometers (62 miles) was specified for this analysis. A historic earthquake epicenter map is presented as Figure 7.

An examination of the tabulated data suggests that the Heritage High School site has experienced ground shaking equivalent to Modified Mercalli Intensity VIII[1]. According to this data, the most intense earthquake ground shaking near the site resulted from three historic earthquakes:

- A M_R 5.8 earthquake was recorded in the Diablo Mountains on January 24, 1980, with an epicenter about 7 miles (11.3 kilometers) southwest of the site, on the Greenville fault.
- A M_R 6.0 earthquake was recorded in Antioch on May 29, 1889 with an epicenter about 9.5 miles (15.2 kilometers) northwest of the site.
- The M_R 8.25 San Francisco earthquake of April 18, 1906 had an epicenter located approximately 87 miles southwest of the site.

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1 Damage slight in specially designed structures; considerable in ordinary substantial buildings with partial collapse; great in poorly built structures. Panel walls thrown out of frame structures. Fall of chimneys, factory stacks, columns, monuments, and walls. Heavy furniture overturned. Sand and mud ejected in small amounts. Changes in well water. Persons driving automobiles disturbed.

The closest earthquakes to the site are indicated to be a pair of M_R 4.0 earthquakes that occurred on September 19 and 20, 1940, with epicenters located approximately 3.4 miles (5.5 kilometers) southeast of the site.

CONCLUSIONS

Seismic Hazards

No active or potentially active faults are known to underlie the school site based on the published geologic maps or aerial photographs that we reviewed. The site is not located within an Alquist-Priolo Earthquake Fault Zone, and we observed no surface evidence of faulting during our site reconnaissance. Therefore, it is our opinion that ground rupture at the site resulting from seismic activity is unlikely. The site is not located within a seismic hazard zone pursuant to the Seismic Hazard Zone Mapping Act.

Seismic Site Class

Auger and CPT refusal were met in all borings due to the presence of bedrock conditions. Average N-values of at least 50 blows per foot in the sandstone underlying the upper fills, using Table 20.3-1 of ASCE 7-10. Shear wave velocities were only obtainable within the upper 10 feet of the soil profile at location CPT-2 due to meeting refusal in the Domengine Sandstone. However, according to the information obtained from the N-values and conservatively assuming the soils from a depth of 50 to 100 feet have at least number of blows per foot in the upper 50 feet, the soils at this site can be designated as site Class C in determining seismic design forces for this project in accordance with Table 20.3-1 of ASCE 7-10 and the 2016 CBC.

2016 California Building Code/ASCE 7-10 Seismic Design Criteria

Section 1613 of the 2016 edition of the California Building Code (CBC) references the American Society of Civil Engineers (ASCE) Standard 7-10 for seismic design. The following seismic parameters provided in Table 3 were determined based on the site latitude and longitude using the public domain computer program developed by the USGS. The seismic design parameters summarized in Table 3 may be used for seismic design of the proposed school modernization project.

Table 3: Seismic Design Parameters

2016 CBC/ASCE 7-10 SEISMIC DESIGN PARAMETERS				
Latitude: 37.9225° N Longitude: 121.7564° W	ASCE 7-10 Table/Figure	2016 CBC Table/Figure	Factor/ Coefficient	Value
0.2-second Period MCE	Figure 22-1	Figure 1613.3.1(1)	S_S	1.5 g
1.0-second Period MCE	Figure 22-2	Figure 1613.3.1(2)	S_1	0.589 g
Soil Class	Table 20.3-1	Section 1613.3.2	Site Class	C
Site Coefficient	Table 11.4-1	Table 1613.3.3(1)	F_a	1.0 g
Site Coefficient	Table 11.4-2	Table 1613.3.3(2)	F_v	1.3 g
Adjusted MCE Spectral Response Parameters	Equation 11.4-1	Equation 16-37	S_{MS}	1.5 g
	Equation 11.4-2	Equation 16-38	S_{M1}	0.766 g
Design Spectral Acceleration Parameters	Equation 11.4-3	Equation 16-39	S_{DS}	1.0 g
	Equation 11.4-4	Equation 16-40	S_{D1}	0.511 g
Seismic Design Category	Table 11.6-1	Section 1613.3.5(1)	Risk Category I to IV	D
	Table 11.6-2	Section 1613.3.5(2)	Risk Category I to IV	D

Notes: MCE = Maximum Considered Earthquake
g = gravity

Liquefaction

Liquefaction is a soil strength and stiffness loss phenomenon that typically occurs in loose, saturated cohesionless soils as a result of strong ground shaking during earthquakes. Hazards to buildings associated with liquefaction include bearing capacity failure, lateral spreading, and differential settlement of soils below foundations, which can contribute to structural damage or collapse.

Our review of available historical groundwater data for the area indicates groundwater levels have been as high as about 21 feet below the existing ground surface at the high school campus. The soil conditions encountered in our subsurface exploration consist of relatively dense man-made fill and variably cemented silty sand (weathered rock), which overlies dense to very dense sandstone bedrock to the maximum explored depth of 16 feet bgs. Based on the geology of the site, we anticipate the soil conditions below the explored depth of the boring will be similarly dense to the soil conditions encountered below the anticipated high groundwater at the site.

Based on the soil, groundwater, and geology conditions at the site, in our opinion, significant deposits of saturated, loose, cohesionless soils do not exist beneath the site and the potential for liquefaction and significant seismic settlement of the soils beneath the site is very low.

Seismically Induced Settlement

As noted above, in our opinion, significant deposits of saturated, loose, cohesionless soils do not exist beneath the site and the potential for liquefaction and significant seismic settlement of the soils beneath the site is very low. Therefore, post-liquefaction settlement calculations were not required at this site. However, reconsolidation of dry sands can still result in seismically induced settlement. Based on the consistency of the man-made fills and the dense, variably cemented soil and bedrock conditions encountered at the site, and laboratory data, we anticipate less than ½ an inch of total settlement occurring as a result of seismically induced compressions and settlement at this site. Differential settlement across 50 feet, or the least dimension of the structure, whichever is less are likely to be no more than half of the predicted total settlement. These estimates of seismically induced settlement and compression represent average free-field ground settlement, not settlement of the proposed structures; however, we do not anticipate significant increases in settlement due to ratcheting or other mechanisms at this site due to the relatively low seismic loading and high strength of subgrade soils. As such, it is our opinion that the proposed structures should be designed for a "worst-case scenario" total seismic settlements of not more than ½ inch.

<u>Slope Failure and Lateral Spread</u>

Other possible modes of seismically induced displacement include slope failure and lateral spread. Due to the variably cemented, dense bedrock conditions observed at the site, we considered these modes and determined that both modes pose a very low risk to the site and do not need to be included in overall design at the site, provided prudent geotechnical engineering recommendations are followed during site grading.

However, as part of our study we performed a slope stability analysis of the slope located west of the proposed new two-story classroom buildings, between the existing portable classrooms, basketball courts and the football field below. Based on available geologic mapping, the Domengine Sandstone is oriented with an approximately east-west strike, and a dip into the slope of 19 degrees to the north (Dibblee, 2006). This 2H:1V (horizontal: vertical) slope is west-facing and was cut into the sandstone during original campus grading, and currently supports the on-grade bleachers for the football stadium. The slope was evaluated for slope stability for the cross-section B-B' (Figure D1) utilizing the commercially available software program *SLIDE 5.0,* with relatively conservative input values for the soil and rock materials.

Shear Strength Parameters

Undrained shear strength data utilized in our stability analyses were derived from the results of our laboratory triaxial compression testing on a relatively undisturbed sample of the sandstone. The laboratory test results are included in Appendix A. We have used the following parameters, which are considered appropriate and conservative for the soils considered in the slope stability study:

- *Man-made fill*
  - Unit Weight = 115 pounds per cubic foot (pcf)
  - Angle of Internal Friction = 32˚
  - Cohesion = 0
- *Sandstone*
  - Unit Weight = 105 pcf
  - Angle of Internal Friction = 39˚
  - Cohesion (intrinsic to in-situ cemented formation) = 500 PSF
- *Lateral acceleration due to seismic loading*
  - 0.348g (PGA_M / 1.5 = 0.522g/1.5 per, CGS Note 48, 2013)

Slope Stability Results

The results of the slope stability analysis indicate a factor of safety greater than 2.4 for the soils within Cross Section B-B' (Figure D1), included in Appendix D. Based on the results of our slope stability analysis, the presence of relatively dense engineered fill and native soil layers to the maximum explored depth of 16 feet below ground surface, and provided the recommendations for subgrade preparation provided below are followed, it is our opinion that the potential for loss of bearing capacity (strength) beneath the prepared building pads is very low and does not need to be further mitigated in the design of the structure.

Volcanic Hazards

The school site is not located within a volcanic hazard zone (e.g., pyroclastic flow, volcanic debris flow, lava flow, bas surge, tephra, etc.) associated with potential volcanic eruptions of Mt. Shasta, Clear Lake, Lassen Peak or the Mono Lake - Long Valley Volcanic areas (Miller, 1989). Therefore, the risk to the site associated with volcanic hazards is very low.

Tsunamis and Seiches

The publically available “Tsunami Inundation” maps developed by the CGS do not cover the site. Since the site is not located near a coastal region or near a large body of standing water, we consider the occurrence of tsunamis or seiches to be very unlikely.

Landslides

Topography across the campus slopes gently down to the north, with surface elevations at the proposed building locations ranging from about +200 to +184 (south to north) feet North American Vertical Datum of 1988 (NAVD88). An eight- to 12 foot-high cut-slope exists along the western edge of the proposed two-story classroom site, and slopes about four to seven feet high are present between the three existing man-made terraces.

Based on our review of the original grading plans for the school, these slopes were constructed by cutting into the sandstone materials, or by placing compacted fill during the original school construction. The fills encountered during our subsurface exploration were generally medium to very dense, consisting of silty sand with occasional sandy clay soils. According to the original grading plans, we understand that subsurface drainage systems were installed at the base of these slope features as part of the original mass grading for the campus.

Based on this information and the relatively low topographic relief, as well as the variably cemented, dense bedrock conditions observed at the site, it is our opinion that the potential for landslides pose a very low risk to the site and do not need to be included in overall design at the site.

Naturally Occurring Asbestos (NOA)

Tertiary sandstone deposits (Tds) underlie the site. Review of *A General Location Guide for Ultramafic Rocks in California - Areas More Likely to Contain Naturally Occurring Asbestos*, CGS Open-File Report 2000-19 (Churchill and Hill, 2000) and *Reported Historic Asbestos Mines, Historic Asbestos Prospects, and Other Natural Occurrences of Asbestos in California*, California Geological Survey Map Sheet 59 (Van Gosen and Clinkenbeard, 2011) indicate the site is not underlain by ultramafic rocks likely to contain asbestos.

Flood Hazards

According to the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map panel 06013C0345F for Contra Costa County, California (FEMA, 2009), the site is located within the zone identified as “Zone X – areas determined to be outside the 0.2% annual chance flood-plane.” The FEMA flood hazards are illustrated on Figure 8.

Dam Inundation

Review of the Flood Hazard section of the Public Health and Safety Element of the *Contra Costa County General Plan* reveals that the school site is not located within the general failure flood areas of any of the major dams located in Contra Costa County. The site is also not located within the runout area associated with a failure of the proposed expansion of the Los Vaqueros Reservoir, located approximately six miles south of the site (Contra Costa Water District, 2012).

Subsidence and Hydrocollapse

Subsidence occurs when a large land area settles due to extensive withdrawal of groundwater, oil, natural gas or oxidation of peat. Based on our subsurface exploration, the soil at the project site generally consists of sandstone bedrock and man-made fills to the explored depths of 16 feet in the borings and CPTs.

DWR has mapped the entire Central Valley of California as having potential (low to high) for future land subsidence; however, DWR indicates the mapping is intended to be advisory only to assist state and local agencies in defining areas of potential subsidence that may require additional study (DWR, 2014).

Based on the results of the current explorations for this study and the explorations included in the previous studies for the original school campus, the assumption that extensive withdrawal of groundwater, oil, natural gas, or oxidation of peat is very unlikely, and review of the 2014 DWR technical memorandum (DWR, 2014), it is our opinion that settlement at the site due to subsidence/hydrocollapse will not adversely affect the site provided the recommendations of this report are carefully followed.

Radon-222 Gas

Radon is a naturally occurring radioactive gas that is produced from radioactive decay of uranium and thorium, most abundant in coastal marine sedimentary rocks and felsic granitic and volcanic rocks. The high school campus is not underlain by geologic materials known to be associated with the emission of Radon Gas.

According to the Environmental Protection Agency's Map of Radon Zones, the project site is located within Contra Costa County, which is mapped as Zone 2. This indicates that the site has a predicted average indoor radon screening level of between 2 to 4 pCi/L (picocuries per liter).

Expansive Soil Conditions

Expansion index testing was performed on two representative samples of the near surface soil (Figures A1 and A2). Results indicate that the soils at the site have a very low to medium expansion potential when tested in accordance with the American Society of Testing and Materials (ASTM) D4829 test method. One sample of near-surface soil collected from Boring D2 at a depth of 1½ feet bgs was tested to determine the Atterberg Limits (ASTM D4318). The test results indicated the material to be non-plastic. Details of the test results are provided in Appendix A.

Based on the results of the tests as well as observed subsurface conditions, we do not anticipate that soil expansion will need to be considered in design. However, in the unlikely event that expansive clayey soils are encountered during construction, the clays should be removed from within 12 inches of the bottom of any slab-on-grade concrete.

Bearing Capacity and Anticipated Settlement

Based on our field and laboratory test results, it is our opinion the existing relatively dense man-made fills and undisturbed soils, as well as newly placed engineered fill can support the planned improvements, provided the recommendations in this report are followed. However, several areas of existing fills appear to have settled since the original grading and school construction, specifically at the edges of the terraces and along the existing retaining wall adjacent to the football field. This is likely caused by lack of lateral confinement of near-surface soils, and/or erosion. Following site clearing and demolition, these areas should be carefully evaluated by the Geotechnical Engineer, who can provide additional recommendations if necessary based on the observed field conditions.

Following site clearing activities, we anticipate the upper one foot of soil will become disturbed. The area of disturbance could be deeper where trees or utility lines are removed. Recommendations for restoring the grade by removing and reworking disturbed soils are provided in this report.

We estimate total static settlement for shallow foundations should be less than one inch. Differential settlement is estimated to be on the order of ½ inch over 50 linear feet. These settlement estimates are based on boring information and our experience with similar structures and soil conditions.

Effects of Previous Development on Planned Construction

Man-made fills are present in several areas throughout the proposed building sites. As-graded compaction testing reports were not available at the time this report was prepared. If such reports do become available, they should be reviewed by the Geotechnical Engineer. Localized areas within the existing man-made fills may require recompaction, depending on the conditions of the soil once it has been exposed following site demolition and clearing. The existing retaining wall, located west of the middle basketball court terrace, should be evaluated for any potential impacts that may result from the construction of the two-story classroom buildings. Such construction might impose a surcharge load on the retaining wall, depending on the proximity of the new buildings to the wall.

The planned improvement sites are developed with portable classrooms, underground utilities, asphalt hardcourts, concrete flatwork, grass lawn, associated landscaping irrigation systems, trees, shrubs and fencing. Near surface soils will be disturbed during removal of the existing buildings, utilities, hardscape, turf, trees, shrubs and irrigation systems resulting in disturbance of soils. These disturbed soils are not considered capable of providing adequate or uniform support of the proposed development unless removed and re-compacted as engineered fill.

Any existing underground utilities that are designated to remain beneath the building pads should be reviewed on a case-by-case basis, and may require that foundations be deepened to bear on soils below the utilities.

Complete removal of organic material, subsurface piping, and any exposed remnants of construction debris and proper backfilling of the excavations will be important to provide uniform subgrade support. Recommendations for the removal and demolition of all existing surface and subgrade structures, remnants of previous structures, and underground utilities are provided in the Site Preparation section of this report.

Excavation Conditions

The surface and near-surface fill and strongly weathered sandstone soils should be readily excavatable with conventional construction equipment. However, the less-weathered underlying sandstone deposits will be more difficult to excavate and may require special equipment for deeper excavations. We anticipate soil sidewalls for the planned foundation excavations and shallow utility excavations likely will remain stable at near-vertical inclinations without significant caving, unless saturated or disturbed soils are encountered.

Excavations deeper than five feet that will be entered by workers should be sloped, braced or shored in accordance with current OSHA regulations. The contractor must provide an adequately constructed and braced shoring system in accordance with federal, state and local safety regulations for individuals working in an excavation that may expose them to the danger of moving ground.

Excavated materials should not be stockpiled directly adjacent to an open trench to prevent surcharge loading of the trench sidewalls. Excessive truck and equipment traffic also should be avoided near open trenches. If material is stored or heavy equipment is operated near an excavation, stronger shoring would be needed to resist the extra pressure due to the superimposed loads.

Temporarily sloped excavations less than 20 feet in height, if any, 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/or saturated granular soils are not encountered. Flatter slopes would be required if these conditions are encountered.

Material Suitability for Engineered Fill Construction

In our opinion, the on-site native soils are considered suitable for use as engineered fill materials provided they are free of deleterious debris, significant clay concentrations, and organics. Concrete rubble, if encountered, is considered suitable for use as engineered fill provided it can be processed into pieces no larger than three inches in maximum dimension, and mixed with enough soil to allow compaction.

Soil Corrosion Potential

A representative sample of near-surface soil was submitted to Sunland Analytical for testing to determine 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 in Table 4 and copies of the analytical test reports are presented on Figures A4 and A5.

Table 4: Soil Corrosivity Testing

Analyte	Test Method	D4 Bulk (1-4')
pH	CA DOT 643 Modified*	7.60
Minimum Resistivity	CA DOT 643 Modified*	1,340 Ω-cm
Chloride	CA DOT 422	9.3 ppm
Sulfate	CA DOT 417	139.2 ppm
	ASTM D516M	127 mg/kg

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

The California Department of Transportation Corrosion and Structural Concrete Field Investigation Branch, Corrosion Guidelines, Version 2.1, dated January 2015, considers a site to be corrosive to foundation elements if one or more of the following conditions exists for the representative soil and/or water samples taken: has a chloride concentration greater than or equal to 500 ppm, sulfate concentration greater than or equal to 2000 ppm, or the pH is 5.5 or less. Comparing this information to the test results indicates the on-site soils tested are not considered unusually corrosive to steel reinforcement properly embedded within Portland cement concrete (PCC). Use of Type I-II Portland cement would be appropriate at the site based upon the test results and published data.

Table 19.3.1.1 – Exposure Categories and Classes, of American Concrete Institute (ACI) 318-14, Section 19.3 – Concrete Durability Requirements, as referenced in Section 1904.1 of the 2016 CBC, indicates the severity of sulfate exposure for the sample tested is Exposure Class S0. Ordinary Type I-II Portland cement is considered suitable for use on this project, assuming a minimum concrete cover as detailed in ACI 318-14, Section 20.6.1.3 is maintained for all reinforcement.

Wallace-Kuhl & Associates are not corrosion engineers. Therefore, if it is desired to further define the soil corrosion potential at the proposed improvement areas a corrosion engineer should be consulted.

Groundwater and Seasonal Moisture

Based on our review of available groundwater information within the site vicinity, it is our opinion that the static groundwater table should not adversely affect design or construction of the proposed improvements. Although the static groundwater table should not impact future development, perched water above relatively impermeable cemented soil or bedrock layers should be anticipated. The chances of encountering perched water are greater during and shortly after the rainy season. Seepage in utility excavations (if encountered) could probably be removed from the excavations by pumps without the need for major dewatering efforts.

The near-surface soils will be in a near-saturated condition during and for a considerable period following the rainy season. Grading operations attempted following the onset of winter rains and prior to prolonged periods of drying will be hampered by high soil moisture contents. Such soils, intended for use as engineered fill, will require considerable aeration or an extended period of drying to reach a moisture content to allow the specified degree of compaction to be achieved. Soil present under existing pavements, hardcourts, or slabs will likely be at elevated moisture contents regardless of the time of year of construction. This should be considered in the construction schedule.

RECOMMENDATIONS

General

The recommendations in this report are appropriate for typical construction in the late spring through fall months. The on-site soils likely will be saturated by rainfall in the winter and early spring months, and will not be compactable without drying by aeration or chemical treatment. Should the construction schedule require work to continue during the wet months, additional recommendations can be provided, as conditions dictate.

Based on our understanding of the proposed construction, the new buildings will be supported by the existing man-made fills placed during original campus construction, which will be left in-place. Due to the presence of existing cut slopes and retaining walls, appropriate minimum setback distances and deepened foundations will be required for the proposed two-story classroom buildings, such that the new buildings do not create additional surcharge loads on the retaining wall and slope materials.

Relative compaction, as referenced in this report, is based on the percent of the maximum dry density at the optimum moisture content as determined in accordance with ASTM D1557. Site preparation and other excavation and fill activities should be accomplished in accordance with the approved project plans and specifications as well as the *Guide Earthwork Specifications* (Appendix E) and the provisions of this report.

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, and to verify the conditions encountered. The Geotechnical Engineer of record referenced herein is the Geotechnical Engineer that is retained to provide Geotechnical Engineering observation and testing services during construction. References to Geotechnical Engineer should be understood to be the Geotechnical Engineer of Record, or his or her designated on-site representative.

Site Clearing and Preparation

Initially, the site should be cleared of existing features designated for removal, including but not limited to portable classroom buildings, asphalt concrete hardcourts, exterior flatwork, underground utilities, fencing, irrigation systems, sod, trees and other landscaping improvements. Landscaping trees and shrubs designated for removal should include the entire rootball and all roots larger than ½-inch in diameter. Adequate removal of deleterious debris and roots may require handpicking by laborers to clear the subgrade soils to the satisfaction of our on-site representative. Surface vegetation and organically laden soils should be removed from the property and not be used as fill in building pads or pavement areas.

Following site clearing operations, the existing fill materials should be observed and evaluated by the Geotechnical Engineer in order to confirm the stability and suitability of the soil. Any soft, unstable or unsuitable material should be removed, exposing firm underlying soil to the satisfaction of the Geotechnical Engineer. Structural areas to remain at-grade, to receive fill, or achieved by excavation should be ripped and cross-ripped scarified to a depth of at least 12 inches.

Any existing underground utilities that are designated to remain beneath the building pads should be reviewed on a case-by-case basis, and may require that foundations be deepened to bear on soils below the utilities.

The purpose of ripping and cross-ripping is to expose debris and structures associated with previous development, assist in moisture conditioning of soils, and to provide a uniform subgrade for support of structures. The processed soil should then be thoroughly moisture conditioned to at least the optimum moisture content and compacted to not less than 90 percent of the ASTM D1557 maximum dry density. Any remaining debris or subsurface structures encountered during scarification activities should be removed, and resulting excavations restored to grade with engineered fill compacted in accordance with the recommendations in the Engineered Fill Construction section of this report.

Depressions resulting from removal of the above items, as well as any loose, soft or saturated soils should be cleaned out to firm native soil and backfilled with engineered fill in accordance with the recommendations in this report. It is important that our representative be present on a regular basis during clearing operations to verify adequate removal of the surface and subsurface items, as well as the proper backfilling of resulting excavations.

Compaction of soil subgrades should be achieved using a heavy, self-propelled, sheep's-foot compactor and must be performed in the presence of the Geotechnical Engineer, or their representative, who will evaluate the performance of the subgrade under compaction efforts and identify any loose or unstable soil conditions that could require additional excavation.

Difficulty in achieving subgrade compaction or unusual soil instability may be indications of loose fill associated with past subsurface structures or utilities. Should these conditions exist, the materials should be excavated to check for subsurface structures and the excavations backfilled with engineered fill.

Engineered Fill Construction

Engineered fill consisting of native or imported soils should be placed in lifts that do not exceed six inches in compacted thickness. Each lift should be thoroughly moisture conditioned to at least the optimum moisture content and uniformly compacted to at least 90 percent of the ASTM D1557 maximum dry density. The upper six inches of soils supporting interior or exterior slab-on-grade concrete should be compacted to at least 90 percent relative compaction.

On-site soils are suitable for use as fill materials provided they do not contain significant concentrations of oversized rubble, debris and organics. Imported fill materials, if required, should be granular compactable material with a Plasticity Index not exceeding 15, an Expansion Index of less than 20, and a three-inch maximum particle size. Imported soils should be submitted to the Geotechnical Engineer for approval at least three business days prior to being transported to the site. If encountered, clay soils may not be used as fill within 12 inches of the soil subgrade elevation under interior or exterior slab-on-grade concrete.

Import fill materials also must be clean of known contamination and should have corrosion characteristics within acceptable limits. The contractor should provide appropriate documentation that demonstrates to the satisfaction of the owner that imported materials are not contaminated.

Permanent excavation and fill slopes should be constructed no steeper than two horizontal to one vertical (2:1). Engineered fill placed on sloping ground steeper than 3H:1V should begin with the construction of a base key at the toe of the fill. The base key should be at least eight feet wide or the width of the construction equipment, whichever is wider, and extend into dense native undisturbed soils, or at least two feet below existing grades. Base key depth must be verified by our representative prior to fill construction. The need for subdrain construction within base keys also should be evaluated at the time of construction. Our representative should determine the need for scarification and compaction of the bottom of the key. Engineered fill should be properly benched into the existing slope to remove loose surficial soils. Each bench should consist of a level terrace excavated at least 12 inches into the slope. For every three feet a vertical height of fill a larger bench should be constructed, extending at least five feet into the existing slope. Our representative should observe the benching of the slopes to evaluate the need for additional or larger benches into the hillside, based on exposed conditions.

To reduce the potential for differential settlement of building foundations, building pads constructed partially by cut and partially by fill that exceed five feet in thickness, and fill differentials that exceed five feet should be avoided. Building pads with either of these conditions will require over-excavation so that the fill differential across the building pad does not exceed five feet. Our office should review the final grading plans to verify that the recommendations of this report have been properly incorporated.

Site preparation should be accomplished in accordance with the recommendations of this section and the *Guide Earthwork Specifications* provided in Appendix D. We recommend that a representative of the Geotechnical Engineer be present during site clearing, preparation, and grading operations to observe and test the fill to verify compliance with these recommendations.

Final Subgrade Preparation

The upper 12 inches of final building pad subgrade should be uniformly moisture conditioned to at least the optimum moisture content and compacted to 90 percent of the maximum dry density regardless of whether final grade is left at the existing grade or is completed by excavation or filling.

The upper six inches of pavement subgrades should be uniformly compacted to at least 95 percent of the ASTM D1557 maximum dry density at a moisture content of at least the optimum moisture content and must be stable under construction traffic prior to placement of aggregate base.

Site preparation should be accomplished in accordance with the recommendations of this report and the *Guide Earthwork Specifications* provided in Appendix B. We recommend that a representative of the Geotechnical Engineer be present during site clearing and preparation and grading operations to observe and test the fill to verify compliance with these recommendations.

Utility Trench Backfill

Bedding and initial backfill for utility construction should conform with the pipe manufacturer's recommendations and applicable sections of the governing agency standards. We recommend that at a minimum four inches of bedding material (beneath the pipe) and six inches of cover (over the top of the pipe) be provided, unless otherwise specified by the pipe manufacturer. General trench backfill should consist of engineered fill placed in eight-inch thick compacted lifts with each lift moisture conditioned to at least the optimum moisture content and compacted to at least 90 percent of the maximum dry density. The upper six inches of pavement subgrades should be uniformly compacted to at least 95 percent of the ASTM D1557 maximum dry density at a moisture content of at least the optimum moisture content and must be stable under construction traffic prior to placement of aggregate base.

Trenches with unsuitable or unstable material in the foundation of the trench, such as unstable, or deleterious material, should be over-excavated to expose firm, stable soils or to a thickness determined by the Geotechnical Engineer's representative and replaced with crushed aggregate. Depending on the condition of the foundation of the trench, the crushed aggregate base may need to be wrapped in nonwoven filter fabric. The depth of overexcavation and need to use filter fabric will be determined at the time of construction by the Geotechnical Engineer's representative depending on the actual soil conditions exposed.

We recommend that prior to allowing heavy loads on the pipe, such as from vehicles or material stockpiling, that a minimum amount of cover be provided to protect the pipe from damage. Minimum cover should be provided as recommended by the pipe manufacturer.

We recommend that underground utility trenches that are aligned nearly parallel with foundations be at least three feet from the outer edge of foundations, wherever possible. As a rule, trenches should not encroach into the zone extending outward at a one horizontal to one vertical (1H:1V) inclination below the bottom of the foundations. Additionally, trenches parallel to existing foundations should not remain open longer than 72 hours. The intent of these recommendations is to prevent loss of both lateral and vertical support of foundations, resulting in possible settlement, and to prevent excessive loading of pipes post construction.

Foundation Design

The planned Culinary Arts and Two-story Classroom buildings may be supported upon continuous perimeter spread foundations with isolated and continuous interior foundations. Foundations should be embedded at least 18 inches below lowest adjacent soil grade. Lowest soil grade shall be either the compacted exterior soil grade or the compacted building pad surface on which the capillary break materials are placed, whichever is lower.

Foundations for the planned two-story classroom buildings should be deepened depending on final building locations relative to the existing slopes, such that the foundations do not impose a surcharge load on the existing retaining wall, and the foundation zone of influence does not intersect with the retaining wall or its foundation system. In general, the face of the foundation should be set back at a distance equal to the height of the retaining structure.

To reduce the potential for soil creep adversely affecting the planned two-story classroom building foundations, we recommend a minimum horizontal setback distance of five feet be provided and maintained between the outside edge of the foundation to the nearest adjacent slope (e.g. building pad hinge point), for slopes greater than two feet in height. The Geotechnical Engineer should be allowed to review the structural plans for the project when they become available in order to evaluate these conditions.

Continuous foundations should be at least 18 inches wide; isolated spread foundations should be a minimum of 24-inch inches in minimum dimension. Foundations so established may be sized for a maximum allowable soil bearing pressure of 2,500 pounds per square foot (psf) for dead plus live load, with a 1/3 increase for short term loading such as induced wind or seismic loads. The weight of the foundation concrete extending below lowest adjacent soil grade may be disregarded in sizing computations.

To impede moisture migration beneath the structures, it is crucial that perimeter foundations be continuous around the entire structure. Continuous foundations should be reinforced with a minimum of four No. 4 reinforcing bars, placed two each top and bottom, to minimize the effects of the potentially expansive clay soils, and to allow the foundations the ability to span isolated soil irregularities.

Lateral resistance of foundations may be computed using an allowable friction factor of 0.40, which may be multiplied by the vertical load on the foundation. Additional lateral resistance may be assumed to develop against the vertical face of the foundations and may be computed using a "passive" equivalent fluid pressure of 350 psf per foot of depth. These two modes of resistance should not be added unless the frictional component is reduced by 50 percent, since full mobilization of the passive resistance requires some horizontal movement, which significantly diminishes the frictional resistance.

We recommend that all foundations be adequately reinforced to provide structural continuity, mitigate cracking and permit spanning of local soil irregularities. The structural engineer should determine final foundation reinforcing requirements. All foundation excavations should be observed by the Geotechnical Engineer's representative prior to placement of reinforcement and concrete to verify firm bearing materials are exposed.

Interior Floor Slab Support

The interior concrete slab-on-grade floors for the planned structures should be at least five inches thick and can be supported upon native soil, weathered rock or man-made fill placed on soil subgrades prepared in accordance with the recommendations in this report. We recommend that interior floor slabs be reinforced to provide structural continuity, mitigate cracking and permit spanning of local soil irregularities. The project structural engineer should determine final floor slab thickness and reinforcing requirements.

Conventional floor slabs, at a minimum, should be underlain by a layer of free-draining gravel. If used, the gravel should be between four and six inches thick. Additional moisture protection may be provided by placing a water vapor retarder (at least 10-mils thick) directly over the gravel. If used, the water vapor retarder should meet or exceed the standard specification as outlined in ASTM E1745 and be installed in strict conformance with the manufacturer's recommendations.

Floor slab construction practice over the past 30 years or more has included placement of a thin layer of sand or pea gravel (about two inches) over the vapor retarder membrane. The intent of this layer is to aid in the proper curing of the slab concrete. However, recent debate over excessive moisture vapor emissions from floor slabs includes concern of water trapped within the sand/pea gravel. Therefore, we consider use of the sand layer as optional. The concrete curing benefits should be weighed against efforts to reduce slab moisture vapor transmission.

The recommendations presented above should reduce significant soils-related cracking of slab-on-grade floors. Equally 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 spacing of control joints.

Use of sub-slab base and vapor retarder membrane will not "moisture-proof" the slab, nor will it assure that slab moisture vapor transmission levels are at a level that will prevent damage to floor coverings or other building components. It is emphasized that we are not slab moisture proofing or moisture protection experts. We are expressly stating that we make no guarantee nor provide any assurance that use of the sub-slab base and membrane will reduce slab moisture penetration to any specific amount or level. They simply offer a first line of defense against soil-related moisture. If increased protection against moisture vapor penetration of slabs is desired, a concrete moisture protection specialist should be consulted. 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.

Retaining Wall Design Parameters

Retaining walls that will be allowed to slightly rotate about their base (unrestrained at the top or sides) should be capable of resisting "active" lateral earth pressure equal to an equivalent fluid pressure of 40 psf per foot of wall backfill for horizontal backfill and fully drained conditions. Retaining walls that are fixed at the top should be capable of resisting "at-rest" lateral earth pressure equal to an equivalent fluid pressure of 60 psf per foot of wall backfill, again assuming horizontal backfill and fully drained conditions. Walls supporting sloping backfill, up to a 2:1 inclination, should be designed adding an additional 20 psf per foot of wall to the pressures presented above.

Retaining walls may be supported on a continuous foundation extending at least 18 inches below lowest adjacent soil grade. Continuous footings for the retaining wall may be designed based upon the recommendations contained in the Foundation Design section of this report. Backfill behind retaining walls should be fully drained to prevent the build-up of hydrostatic pressures behind the wall. Retaining walls should be provided with a drainage blanket (Class 2 permeable material (Caltrans Specification Section 68-1.025) at least one foot wide extending from the base of wall to within one foot of the top of the wall or proprietary geocomposite drainage board. The top foot above the drainage layer should consist of compacted on-site materials, unless covered by a slab or pavement. Weep holes or perforated rigid pipe, as appropriate, should be provided at the base of the wall to collect accumulated water. Drainpipes, if used, should slope to discharge at no less than a one percent fall to suitable drainage facilities. Open-graded ½- to ¾-inch crushed rock may be used in lieu of the Class 2 permeable material, if the rock and drain pipe are completely enveloped in an approved non-woven geotextile filter fabric.

Wall backfill should consist of granular compactable soils compacted to at least 90 percent of the maximum dry density as determined by ASTM D1557.

Floor Slab Moisture Penetration Resistance

It is likely that floor slab subgrade soils will become saturated at some time during the life of the structures, especially when the slab is constructed during the wet seasons, or when constantly wet ground or poor drainage conditions exist adjacent to the structure. For this reason, it should be assumed that the interior slab intended for moisture-sensitive floor coverings or materials, require protection against moisture or moisture vapor penetration. Standard practice includes placing a layer of gravel/crushed rock and a vapor retarder membrane (and possibly a layer of sand) as discussed above. 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 membrane below the slab will not “moisture proof” the slab, nor will it assure that slab moisture transmission levels will be low enough to prevent damage to floor coverings or other building components. It is emphasized that we are not slab moisture proofing or moisture protection experts. The sub-slab gravel/crushed rock and vapor retarder membrane simply offers a first line of defense against soil-related moisture. If increased protection against moisture vapor penetration of the slab 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.

Exterior Concrete Flatwork (Non-Pavement)

Soil subgrade areas to support exterior concrete flatwork should be prepared in accordance with the Subgrade Preparation and Engineered Fill Construction recommendations included in this report. Exterior concrete flatwork should be supported on at least four inches of Class 2 aggregate base placed on the prepared subgrade. Aggregate base should be moisture-conditioned to at least the optimum moisture content and compacted to not less than 95 percent relative compaction.

Proper moisture-conditioning of the subgrade soils is considered essential to the performance of exterior flatwork. Uniform moisture-conditioning of subgrade soils is important to reduce the risk of non-uniform moisture withdrawal from the concrete and the possibility of plastic shrinkage cracks. Practices recommended by the Portland Cement Association (PCA) for proper placement and curing of concrete should be followed during exterior concrete flatwork construction.

Flatwork should be at least four inches thick and may be reinforced for crack control. Accurate and consistent location of the reinforcement at mid-slab is essential to its performance and the risk of uncontrolled drying shrinkage slab cracking is increased if the reinforcement is not properly located within the slab.

We recommend the concrete slabs be constructed with thickened edges in accordance with ACI design standards, latest edition. Expansion joints should be evaluated by the slab designer to allow for minor vertical movement of the flatwork. 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.

Site Drainage

Performance of the building foundations, slab-on-grade floors and exterior flatwork is critically dependent upon proper control of surface water on the site. Final site grading should be accomplished to provide positive drainage of surface water away from structures and prevent ponding of water adjacent to foundations, slabs or pavements. The grade adjacent to the structure should be sloped away from foundations at a minimum two percent slope for a distance of at least 10 feet, where possible. Roof gutter downspouts and surface drains should drain onto flatwork or be connected to rigid, non-perforated piping directed to an appropriate drainage point away from the structures.

If storm water control features such as storm water planters or similar features are planned for use in control of surface drainage at the site, we recommend that preliminary design assume that subgrade soils have a moderate permeability. Additional geotechnical related parameters related to storm water control features can be provided upon request.

Geotechnical Engineering Observation and Testing During Construction

Site preparation should be accomplished in accordance with the recommendations of this report. Geotechnical testing and observation during construction is considered a continuation of our geotechnical engineering investigation. Wallace-Kuhl & Associates should be retained to provide testing and observation services during site demolition, earthwork, and foundation construction at the project to verify compliance with this geotechnical report, and the project plans and specifications and to provide consultation as required during construction. These services are beyond the scope of work authorized for this study.

Section 1803.5.8 Compacted Fill Material of the 2016 CBC requires that the geotechnical engineering report provide a number, type, and frequency of field compaction tests to determine compliance with the recommended minimum compaction. Many factors can affect the number and type of tests that should be performed during construction, such as soil type, soil moisture, season of the year and contractor operations/performance. Therefore, it is crucial that the actual number, type, and frequency of testing be determined by the Geotechnical Engineer during construction based on their observations, site conditions, and difficulties encountered.

If Wallace-Kuhl & Associates 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" should be prepared upon completion of the project.

Additional Future Services

We recommend that Wallace-Kuhl & Associates 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.

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 prudent 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 our 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 or any other projects at this site. The conclusions and recommendations of this report are considered valid for a period of three years. If design is not completed and construction has not started within three years of the date of this report, the report must be reviewed and updated if necessary. Changes to building code, or other project design requirements may also require an update.

We are pleased that we have had this opportunity to provide you with these services and the resulting report. Please contact us if additional data or clarification are required, or if additional services are requested.

Wallace - Kuhl & Associates

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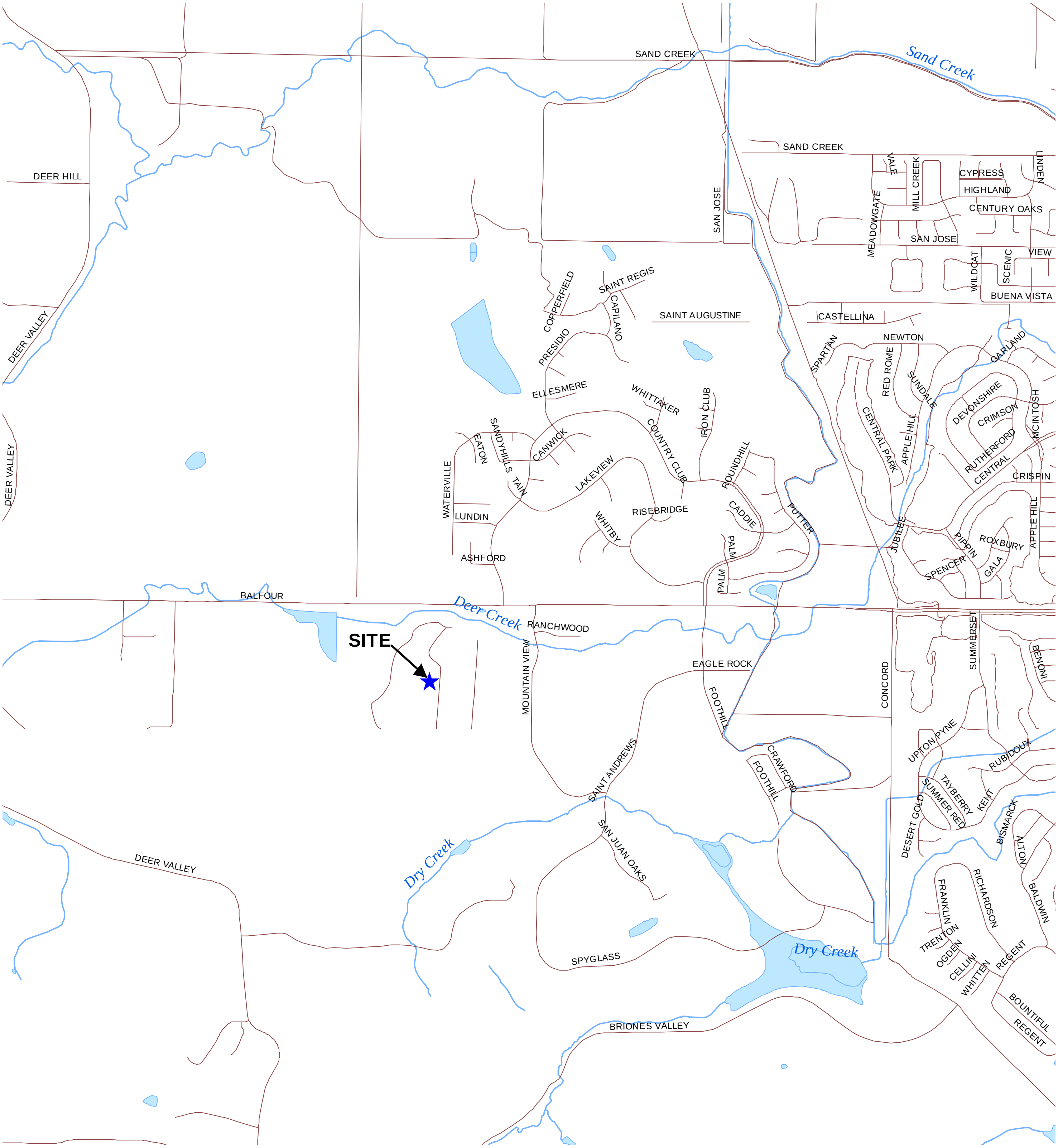


Street data courtesy of Contra Costa County.
Hydrography courtesy of the U.S. Geological Survey acquired from the GIS Data Depot, December, 2007.
Projection: NAD 83, California State Plane, Zone III

N

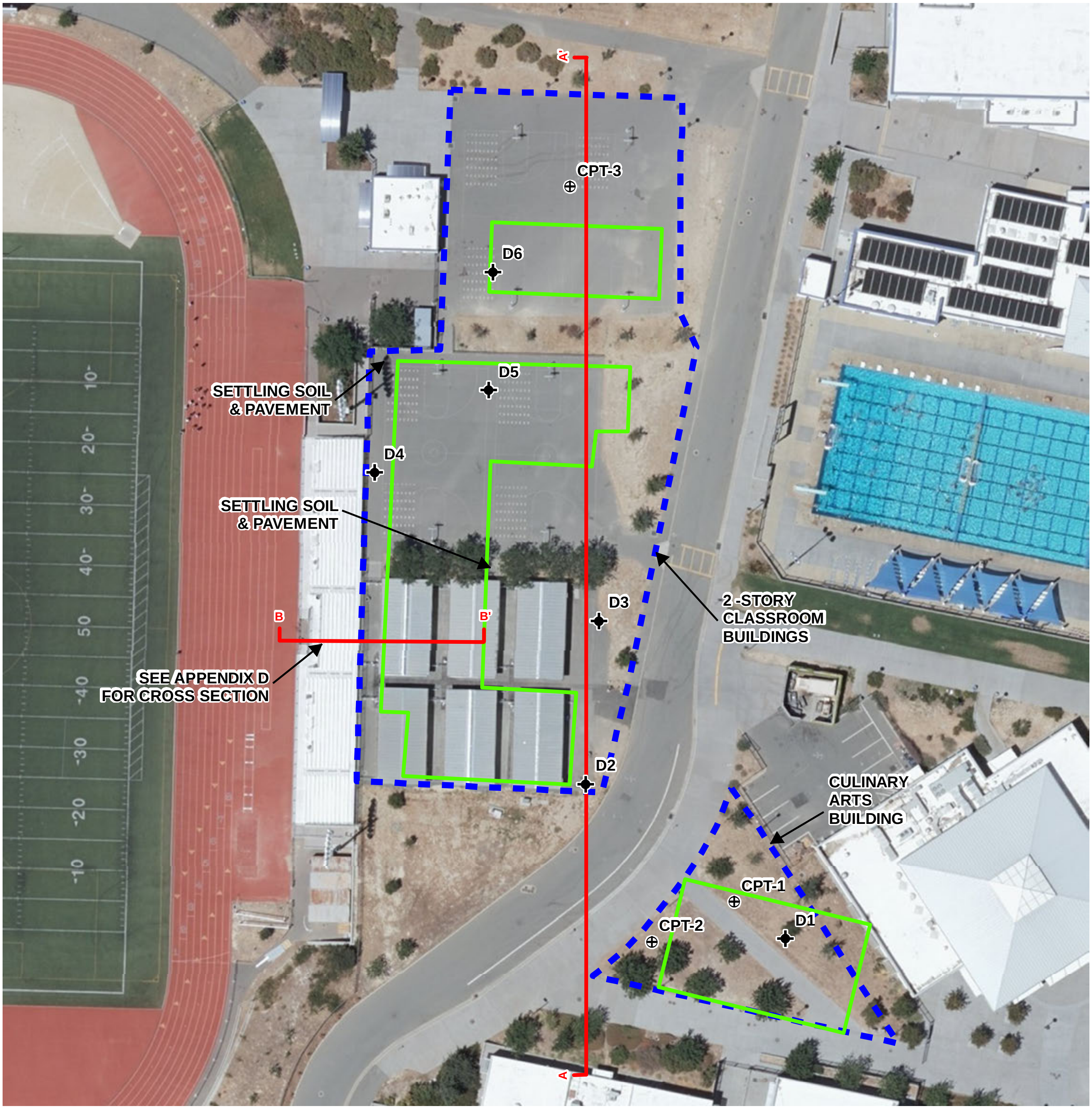
0 1,000 2,000
Feet

WallaceKuhl & ASSOCIATES

VICINITY MAP

HERITAGE HIGH SCHOOL
CULINARY ARTS AND TWO-STORY CLASSROOM BUILDINGS
Brentwood, California

FIGURE	1
DRAWN BY	RWO
CHECKED BY	TCD
PROJECT MGR	DRG
DATE	10/18
WKA NO. 12048.01P	



Aerial provided by ESRI.
Projection: NAD 83, California State Plane, Zone III

Legend

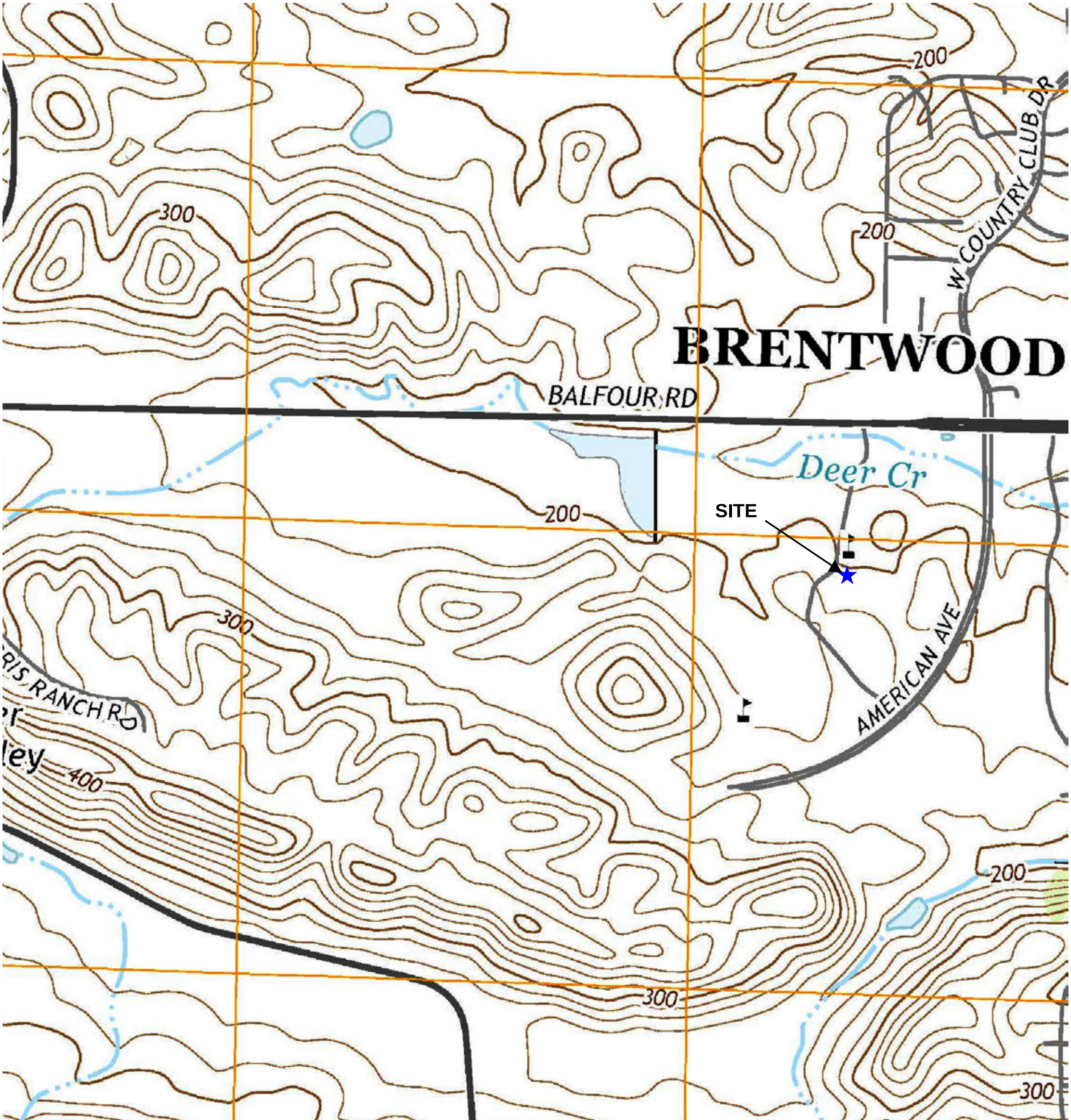
- Approximate Site Boundary
- Approximate Location of New Building Footprint
- Approximate Cross Section Location
- ⊕ Approximate CPT Location
- ✦ Approximate Soil Boring Location

N

0 35 70
Feet

SITE PLAN HERITAGE HIGH SCHOOL CULINARY ARTS AND TWO-STORY CLASSROOM BUILDINGS Brentwood, California	FIGURE	2
	DRAWN BY	RWO
	CHECKED BY	TCD
	PROJECT MGR	DRG
	DATE	10/18
	WKA NO. 12048.01P	

WallaceKuhl & ASSOCIATES



Topographic Map adapted from the Antioch South Quadrangle, California-Contra Costa Co. 7.5-Minute Series, dated 2015. Contour intervals at 20 feet. Projection: NAD 83, California State Plane, Zone III

N

0 500 1,000
Feet

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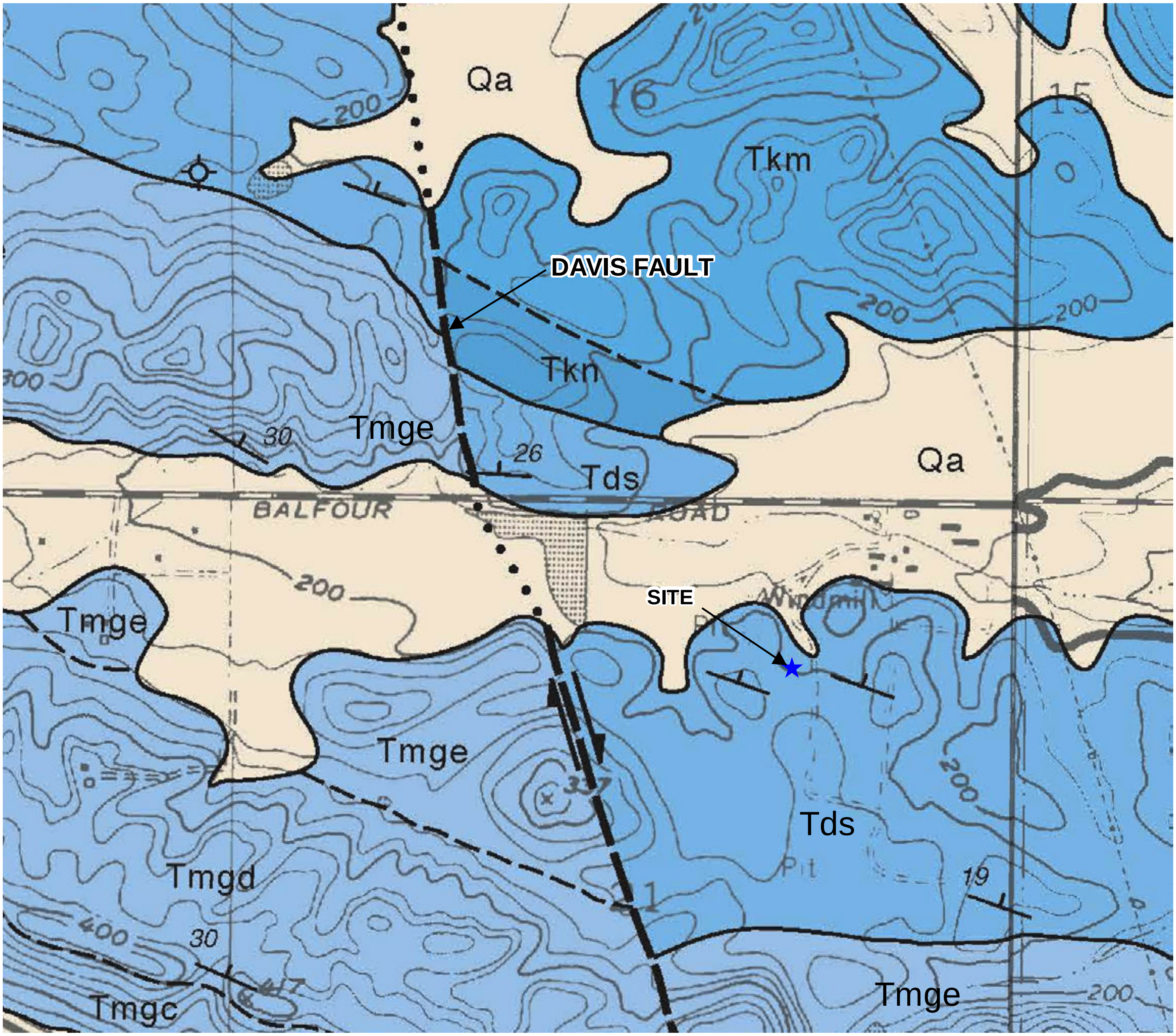
USGS TOPOGRAPHIC MAP

HERITAGE HIGH SCHOOL
CULINARY ARTS AND TWO-STORY CLASSROOM BUILDINGS
Brentwood, California

FIGURE	3
DRAWN BY	RWO
CHECKED BY	TCD
PROJECT MGR	DRG
DATE	10/18
WKA NO.	12048.01P



Adapted from the Geologic Map of the Antioch South & Brentwood Quadrangle, Contra Costa Co., California by Thomas W. Dibblee, Jr., 2006.
Projection: NAD 83, California State Plane, Zone III

Legend

Qa	Alluvial pebble gravel, sand and clay of valley areas.
Tkm	Kreyenhagen Formation, Markley Sandstone Member, light gray to tan, semi friable, bedded, fine to medium grained, arkosic.
Tds	Domengine Sandstone, light gray to tan, medium grained, semi friable, arkosic.
Tmge	Meganos Formation,Greenish-gray to light gray, biotite-rich siltstone and silty mudstone.
Tmgd	Meganos Formation, Sandstone member. Medium grained, light gray to bluish-gray sandstone; pebble conglomerate present locally at base.
Tmgc	Meganos Formation, Shale member. bluish-gray shale with sandstone interbeds. Locally includes Tmgs Sandstone interbeds.

N

0 500 1,000
Feet

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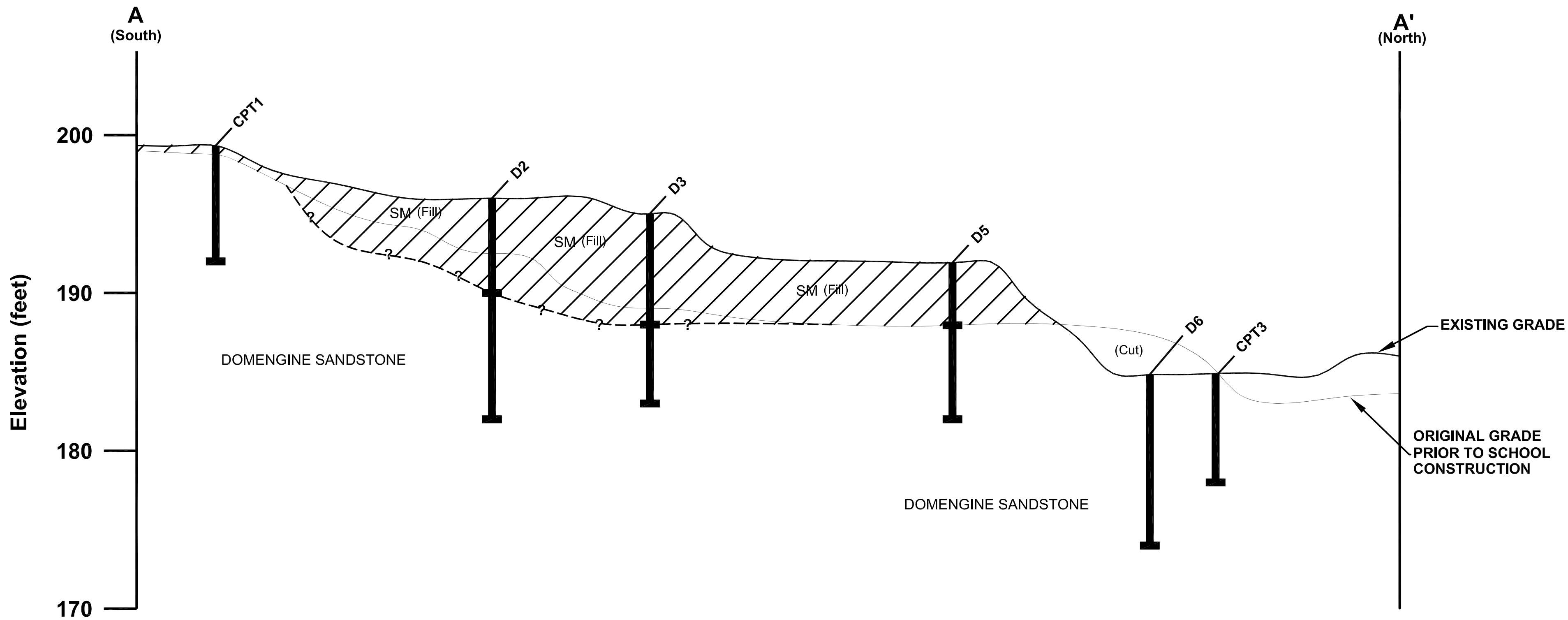
GEOLOGIC MAP

HERITAGE HIGH SCHOOL
CULINARY ARTS AND TWO-STORY CLASSROOM BUILDINGS
Brentwood, California

FIGURE	4
DRAWN BY	RWO
CHECKED BY	TCD
PROJECT MGR	DRG
DATE	10/18

WKA NO. 12048.01P



Key:

Geologic contact, solid where well located, dashed where approximate, queried where inferred.

(XX) Dominant soil types and symbols (USCS shorthand after ASTM D2487-5)*

* Elevations, Depths, and Locations are approximate.

Man-made Fill

Note:

Grading plans for proposed new construction not yet available. However, we understand grades are expected to remain the same or similar.

Scale
Horizontal: 1" = 60'
Vertical: 1" = 10'

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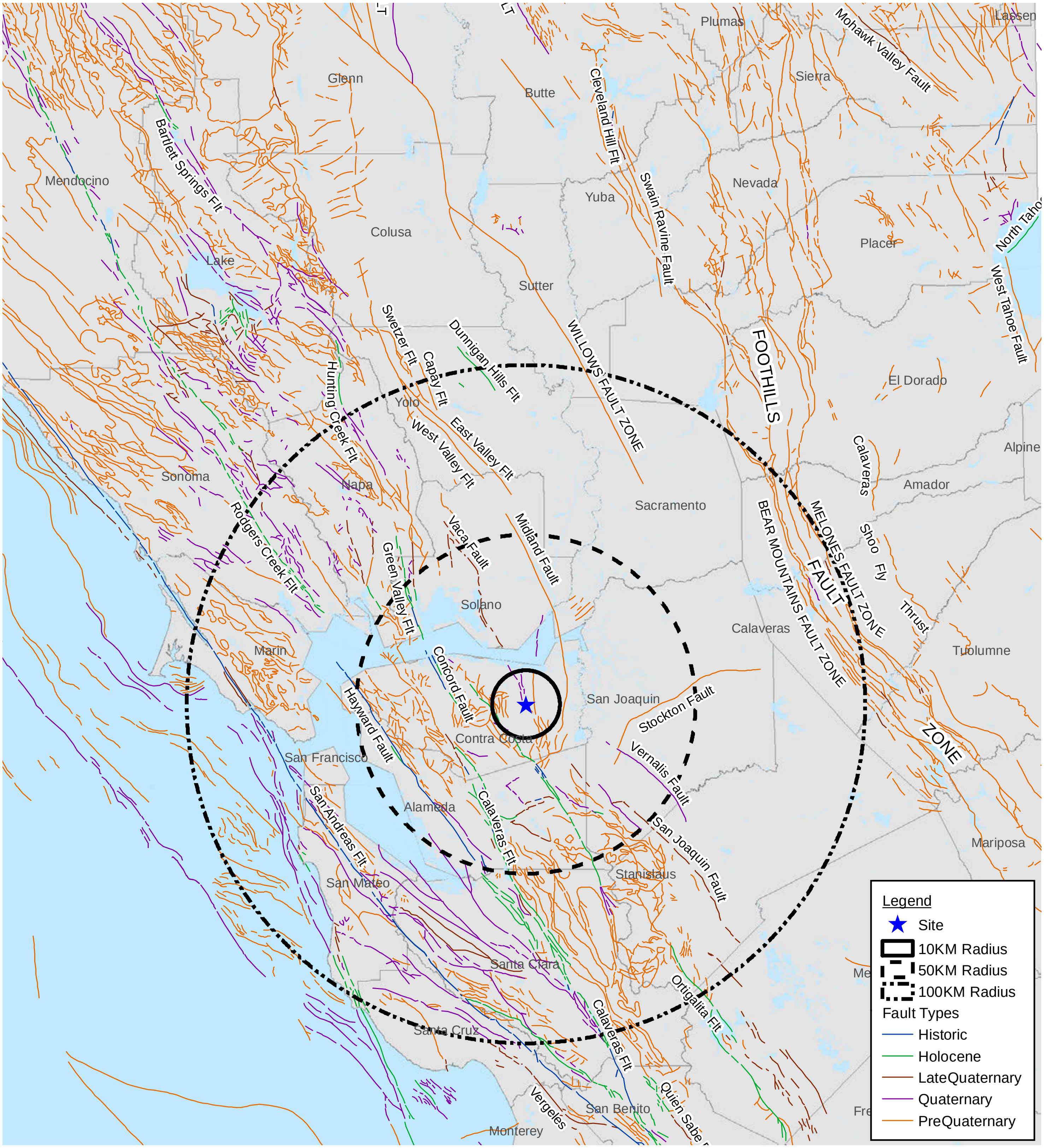
GEOLOGIC CROSS SECTION A-A'

HERITAGE HIGH SCHOOL
CULINARY ARTS AND TWO - STORY CLASSROOM BUILDINGS
Brentwood, California

FIGURE	5
DRAWN BY	RWO
CHECKED BY	TCD
PROJECT MGR	DRG
DATE	10/18

WKA NO.12048.01P



Modified from Division of Mines and Geology, CD-ROM 2000-08 (2000), Digital database of faults from the Fault Activity Map of California and Adjacent Areas and from the USGS Quaternary Fault and Fold Database of the United States, dated November 3, 2010.
Projection: NAD 83, California State Plane, Zone II

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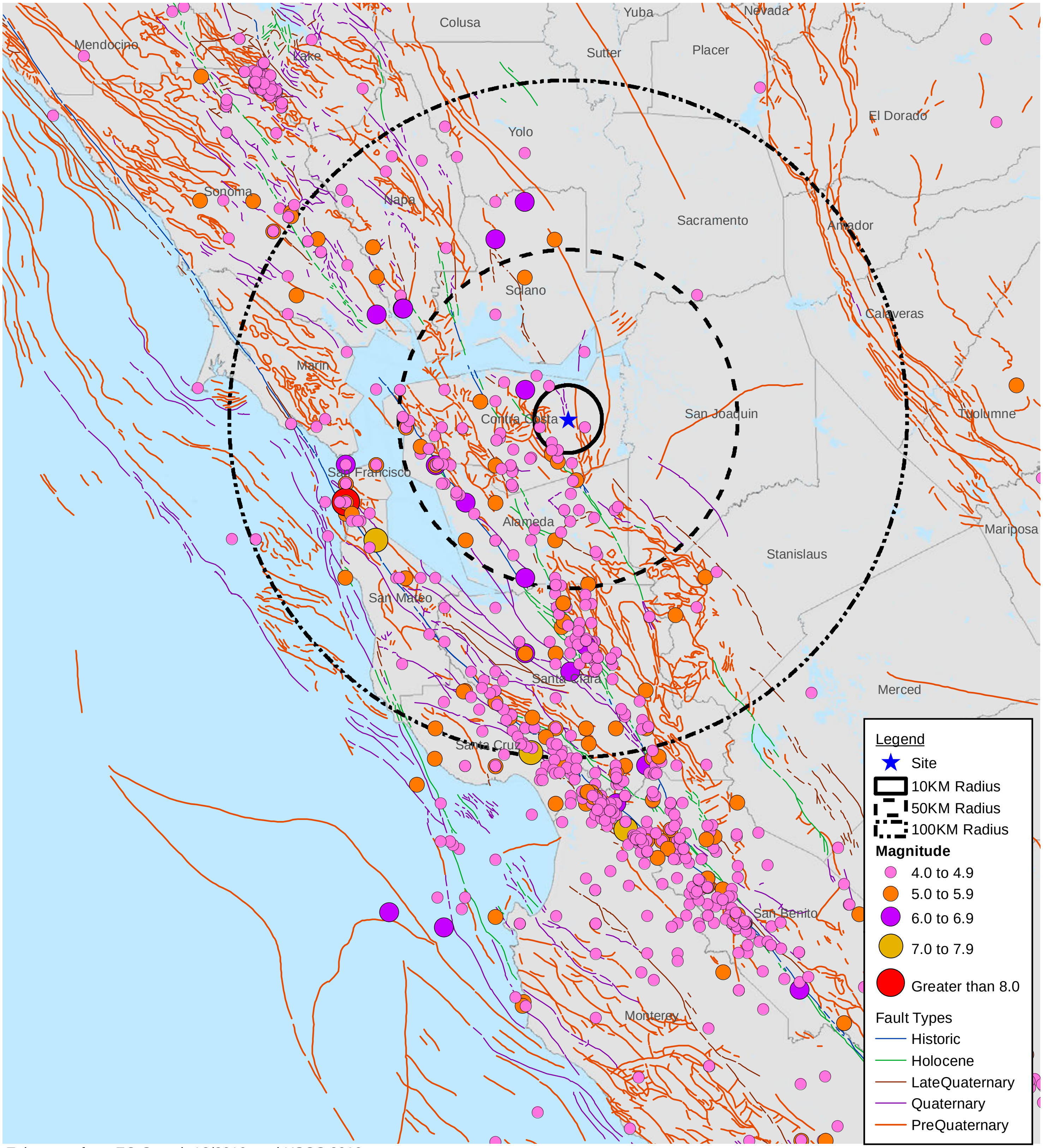
FAULT MAP

HERITAGE HIGH SCHOOL
CULINARY ARTS AND TWO-STORY CLASSROOM BUILDINGS

Brentwood, California

FIGURE	6
DRAWN BY	RWO
CHECKED BY	TCD
PROJECT MGR	DRG
DATE	10/18
WKA NO. 12048.01P	



Epicenters from EQ Search 12/2016, and USGS 2016.
Projection: NAD 83, California State Plane, Zone II

N

0 40
Kilometers

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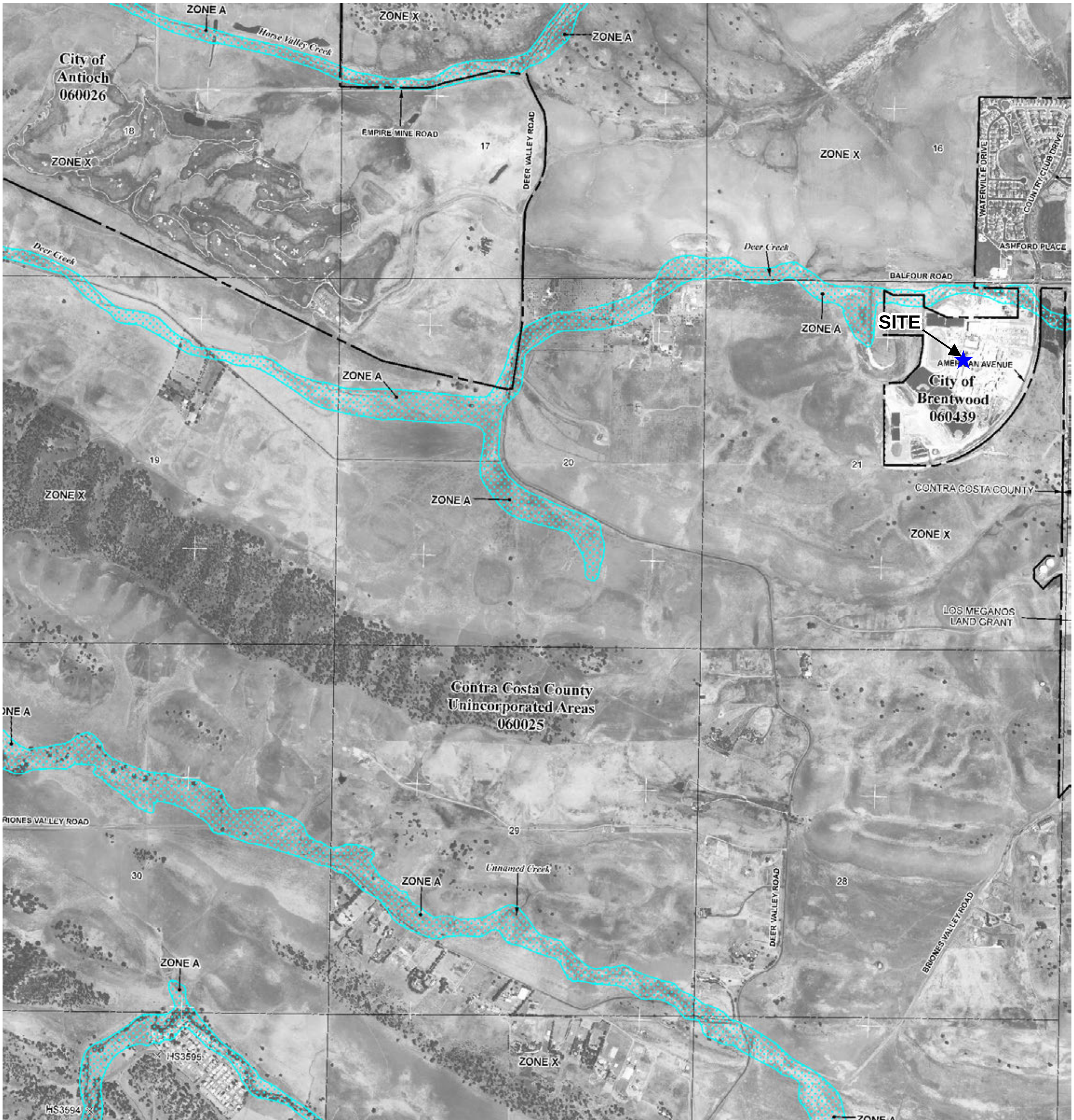
EPICENTER MAP

HERITAGE HIGH SCHOOL
CULINARY ARTS AND TWO-STORY CLASSROOM BUILDINGS
Brentwood, California

FIGURE	7
DRAWN BY	RWO
CHECKED BY	TCD
PROJECT MGR	DRG
DATE	10/18

WKA NO. 12048.01P



Flood Map provided by FEMA, panel 345 of 602.
Map number 06013C0345F dated June 16, 2009.
Projection: NAD 83, California State Plane, Zone III

Legend

Zone A Special Food Hazard area;
No base flood elevations determined

Zone X Areas of 500-year flood; areas of 100-year flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 100-year flood.

N

0 1,000 2,000
Feet

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FEMA FLOOD MAP

HERITAGE HIGH SCHOOL
CULINARY ARTS AND TWO-STORY CLASSROOM BUILDINGS
Brentwood, California

FIGURE	8
DRAWN BY	RWO
CHECKED BY	TCD
PROJECT MGR	DRG
DATE	10/18
WKA NO. 12048.01P	

Project: Heritage High School Project Location: Brentwood, California WKA Number: 12048.01P	**LOG OF SOIL BORING D1** Sheet 1 of 1

Date(s) Drilled	**9/25/18**	Logged By	**TCD**	Checked By	**DRG**
Drilling Method	**Solid Flight Auger**	Drilling Contractor	**V&W Drilling**	Total Depth of Drill Hole	**15.8 feet**
Drill Rig Type	**CME-75**	Diameter(s) of Hole, inches	**6"**	Approx. Surface Elevation, ft MSL	**198.0**
Groundwater Depth [Elevation], feet	**Not Encountered [0.0]**	Sampling Method(s)	**2.0" Modified California with 6-inch sleeve**	Drill Hole Backfill	**Grout**
Remarks	**Bulk Samples at 0-3.5' and 3.5-5'**			Driving Method and Drop	**140lb auto. hammer with 30" drop**

ELEVATION, feet	DEPTH, feet	GRAPHIC LOG	ENGINEERING CLASSIFICATION AND DESCRIPTION	SAMPLE DATA: SAMPLE	SAMPLE NUMBER	NUMBER OF BLOWS	TEST DATA: MOISTURE CONTENT, %	DRY UNIT WEIGHT, pcf	ADDITIONAL TESTS
			Brown to yellow-brown, moist, medium dense, silty fine to medium SAND (SM - FILL)						
					D1-1I	30	12.5	116	
195			Olive to yellow-brown, moist, medium dense, silty fine to medium SAND (SM), partially cemented, strongly weathered						
			DOMENGINE SANDSTONE		D1-2I	18	9.3	115	EI
	5		very dense, well cemented		D1-3I	69			
190									
	10		yellow-brown, partially cemented		D1-4I	40			
185			Yellow-gray, moist, fine grained SANDSTONE, moderately well cemented, slightly weathered						
	15		sampler refusal		D1-5I	50/3"			

Boring terminated at 15.75 feet due to sampler refusal in sandstone
Groundwater was not encountered

BORING LOG 12048.01P - HERITAGE HIGH SCHOOL.GPJ WKA.GDT 10/29/18 8:44 AM

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FIGURE 9

Project: Heritage High School **Project Location: Brentwood, California** **WKA Number: 12048.01P**	**LOG OF SOIL BORING D2** Sheet 1 of 1

Date(s) Drilled	**9/25/18**	Logged By	**TCD**	Checked By	**DRG**
Drilling Method	**Solid Flight Auger**	Drilling Contractor	**V&W Drilling**	Total Depth of Drill Hole	**13.3 feet**
Drill Rig Type	**CME-75**	Diameter(s) of Hole, inches	**6"**	Approx. Surface Elevation, ft MSL	**196.0**
Groundwater Depth [Elevation], feet	**Not Encountered [0.0]**	Sampling Method(s)	**2.0" Modified California with 6-inch sleeve**	Drill Hole Backfill	**Grout**
Remarks	**Located near subdrain based on original grading plans**			Driving Method and Drop	**140lb auto. hammer with 30" drop**

ELEVATION, feet	DEPTH, feet	GRAPHIC LOG	ENGINEERING CLASSIFICATION AND DESCRIPTION	SAMPLE DATA: SAMPLE	SAMPLE NUMBER	NUMBER OF BLOWS	TEST DATA: MOISTURE CONTENT, %	DRY UNIT WEIGHT, pcf	ADDITIONAL TESTS
			Yellow to red-brown, moist, medium dense, silty fine to medium SAND (SM - FILL), angular sandstone inclusions						
195									
				■	D2-1I	25	10.9	111	UCC= 1.4tsf
			brown, very moist, loose						
	5			■	D2-2I	9	15.6	109	
190			hard drilling						
			Light yellow-brown, slightly moist, very dense, SANDSTONE, moderately well cemented, highly weathered						
			DOMENGINE SANDSTONE						
				■	D2-3I	50/5"	9.7		
	10								
185									
			sampler refusal	■	D2-4I	50/1"			
			Boring terminated at 13.25 feet due to sampler refusal in sandstone Groundwater was not encountered						

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FIGURE 10

Project: Heritage High School
Project Location: Brentwood, California
WKA Number: 12048.01P

LOG OF SOIL BORING D3

Sheet 1 of 1

Date(s) Drilled	9/25/18	Logged By	TCD	Checked By	DRG
Drilling Method	Solid Flight Auger	Drilling Contractor	V&W Drilling	Total Depth of Drill Hole	11.5 feet
Drill Rig Type	CME-75	Diameter(s) of Hole, inches	6"	Approx. Surface Elevation, ft MSL	195.0
Groundwater Depth [Elevation], feet	Not Encountered [0.0]	Sampling Method(s)	2.0" Modified California with 6-inch sleeve	Drill Hole Backfill	Grout
Remarks	Bulk Sample at 2-5'	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
			Yellow brown, slightly moist, dense, silty fine SAND (SM- FILL), angular sandstone inclusions						
					D3-1I	38	7.4	112	
190	5		brown, moist, fine to coarse grained sand		D3-2I	32	8.3	105	
			hard drilling						
			Brown, moist, dense, fine grained SANDSTONE, partially cemented, weathered						
			DOMENGINE SANDSTONE						
185	10		wet, increased clay content		D3-3I	48			

Boring terminated at 11.5 feet due to sampler refusal in sandstone
Groundwater was not encountered

LOG OF SOIL BORING D4

Project: Heritage High School
Project Location: Brentwood, California
WKA Number: 12048.01P

Date(s) Drilled	**9/25/18**	Logged By	**TCD**	Checked By	**DRG**
Drilling Method	**Solid Flight Auger**	Drilling Contractor	**V&W Drilling**	Total Depth of Drill Hole	**10.3 feet**
Drill Rig Type	**CME-75**	Diameter(s) of Hole, inches	**6"**	Approx. Surface Elevation, ft MSL	**193.0**
Groundwater Depth [Elevation], feet	**Not Encountered [0.0]**	Sampling Method(s)	**2.0" Modified California with 6-inch sleeve**	Drill Hole Backfill	**Grout**
Remarks	**Bulk Sample at 1-4'**			Driving Method and Drop	**140lb auto. hammer with 30" drop**

ELEVATION, feet	DEPTH, feet	GRAPHIC LOG	ENGINEERING CLASSIFICATION AND DESCRIPTION	SAMPLE DATA: SAMPLE	SAMPLE NUMBER	NUMBER OF BLOWS	TEST DATA: MOISTURE CONTENT, %	DRY UNIT WEIGHT, pcf	ADDITIONAL TESTS
			Yellow brown, moist, very dense, SANDSTONE, moderately well cemented, strongly weathered						
			DOMENGINE SANDSTONE						
					D4-1I	76	11.7	107	
190			olive-brown						
	5		white, partially cemented, less weathered		D4-2I	50/6"	8.3	98	TR
185									
	10		sampler refusal		D4-3I	50/2"			
			Boring terminated at 10.25 feet due to sampler refusal in sandstone Groundwater was not encountered						

Project: Heritage High School **Project Location:** Brentwood, California **WKA Number:** 12048.01P	**LOG OF SOIL BORING D5** Sheet 1 of 1

Date(s) Drilled	**9/25/18**	Logged By	**TCD**	Checked By	**DRG**
Drilling Method	**Solid Flight Auger**	Drilling Contractor	**V&W Drilling**	Total Depth of Drill Hole	**10.3 feet**
Drill Rig Type	**CME-75**	Diameter(s) of Hole, inches	**6"**	Approx. Surface Elevation, ft MSL	**192.0**
Groundwater Depth [Elevation], feet	**Not Encountered [0.0]**	Sampling Method(s)	**2.0" Modified California with 6-inch sleeve**	Drill Hole Backfill	**Grout**
Remarks	**Bulk Sample at 0-2'**			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**						
			Brown, moist, very stiff, sandy CLAY (CL - FILL), with angular sandstone inclusions up to 1" diameter	Bulk					EI
190					D5-1I	21	10.6	111	
			hard drilling						
			White, slightly moist, very dense, fine grained SANDSTONE, well cemented, slightly weathered *DOMENGINE SANDSTONE*						
	5		sampler refusal		D5-2I	50/2"	8.6		
185									
	10		sampler refusal		D5-3I	50/3"			
			Boring terminated at 10.25 feet due to sampler refusal in sandstone Groundwater was not encountered						

BORING LOG 12048.01P - HERITAGE HIGH SCHOOL.GPJ WKA.GDT 10/29/18 8:44 AM

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FIGURE 13

Project: Heritage High School Project Location: Brentwood, California WKA Number: 12048.01P	**LOG OF SOIL BORING D6** Sheet 1 of 1

Date(s) Drilled	**9/25/18**	Logged By	**TCD**	Checked By	**DRG**
Drilling Method	**Solid Flight Auger**	Drilling Contractor	**V&W Drilling**	Total Depth of Drill Hole	**10.3 feet**
Drill Rig Type	**CME-75**	Diameter(s) of Hole, inches	**6"**	Approx. Surface Elevation, ft MSL	**184.0**
Groundwater Depth [Elevation], feet	**Not Encountered [0.0]**	Sampling Method(s)	**2.0" Modified California with 6-inch sleeve**	Drill Hole Backfill	**Grout**
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 NUMBER	NUMBER OF BLOWS	TEST DATA: MOISTURE CONTENT, %	DRY UNIT WEIGHT, pcf	ADDITIONAL TESTS
			Light yellow-brown, moist, very dense, fine grained SANDSTONE, moderately well cemented, moderately weathered *DOMENGINE SANDSTONE*						
					D6-1I	67			
180			white, less weathered		D6-2I	50/6"			
	5								
175									
	10		sampler refusal		D6-3I	50/3"			
			Boring terminated at 10.25 feet due to sampler refusal in sandstone Groundwater was not encountered						

BORING LOG 12048.01P - HERITAGE HIGH SCHOOL.GPJ WKA.GDT 10/29/18 8:44 AM

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FIGURE 14

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)	3" to No. 4	75 to 4.75
coarse	3" to 3/4"	75 to 19
fine	3/4" to No. 4	19 to 4.75
SAND	No. 4 to No. 200	4.75 to 0.075
coarse	No. 4 to No. 10	4.75 to 2.00
medium	No. 10 to No. 40	2.00 to 0.425
fine	No. 40 to No. 200	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).

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UNIFIED SOIL CLASSIFICATION SYSTEM
HERITAGE HIGH SCHOOL
CULINARY ARTS AND TWO-STORY CLASSROOM BUILDINGS
Brentwood, California

FIGURE	15
DRAWN BY	RWO
CHECKED BY	TCD
PROJECT MGR	MMW
DATE	10/18

WKA NO. 12048.01P

APPENDICES

APPENDIX A
General Project Information, Laboratory Testing and Results

APPENDIX A

A. GENERAL INFORMATION

The performance of a geotechnical engineering and geologic hazard study for the proposed Heritage High School Culinary Arts and Two-story Classroom Project located at 101 American Avenue in Brentwood, California, was authorized by Ms. Liz Robbins on August 30, 2018. Authorization was for a geotechnical and geohazard study as described in our proposal letter dated July 5, 2018, sent to our client Liberty Union School District, whose mailing address is 20 Oak Street, Brentwood, California 94513; telephone (925) 634-2166.

The project architect is Quattrochi Kwok Architects, whose mailing address is 636 Fifth Street, Santa Rosa, California, 95404, telephone (707) 576-0829.

In performing this study, we referenced conceptual drawings prepared by Quattrochi Kwok Architects, dated September 30, 2016, as well as preliminary civil drawings for the Culinary Arts Building, Dated August 31, 2018.

B. FIELD EXPLORATIONS

Six solid flight auger borings (D1 to D6) were drilled on September 25, 2018 utilizing a CME-75 truck-mounted drill rig provided by V&W Drilling of Stockton, California. The borings were drilled with 6-inch-diameter solid flight augers. Borings were drilled to depths of between about 10½ and 16 feet below the existing ground surface. Soil samples were recovered at various intervals. The bulk samples were collected from soil cuttings, while driven samples were obtained with a 2.5-inch O.D., 2.0-inch I.D. (with liners), California split-spoon. Driven samplers were driven by an automatic 140-pound hammer freely falling 30 inches. The number of blows of the hammer required to drive the 18-inch long samplers each 6-inch interval was 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 drive.

The modified California samples were retained in 2.0-inch-diameter by 6-inch-long, thin walled tubes contained within the sampler. Bulk samples were retained in large plastic bags. After recovery, the field engineer visually classified the soil recovered in general accordance with ASTM D2488. After the samples were classified, samples were sealed to preserve the natural moisture contents. All samples were taken to our laboratory for additional soil classification and selection of samples for testing.

In addition to the borings, we also completed cone penetrometer testing (CPT-1 through CPT-3) on September 27, 2018. The CPTs were advanced at a rate of about two centimeters per second using a 15-square-centimeter cone penetrometer at the location shown in Figure 2 by using a 20-ton, truck-mounted CPT rig provided by Middle Earth

Geotesting, Inc. of Hayward, California. CPT soundings were advanced to refusal, which was met at a maximum penetration depth of about 11.8 feet below existing grade. Data was collected from the CPTs at approximate depth intervals of 5 centimeters (or about 2 inches), with shear wave velocity measurements obtained at approximately five-foot intervals in CPT-2.

The Logs of Soil Borings containing descriptions of the soils encountered in each boring are presented in Figures 9 through 14. A Legend explaining the Unified Soil Classification System (ASTM D2487) and the symbols used on the logs is contained on Figure 15. Copies of the CPT logs are presented in Appendix C.

C. LABORATORY TESTING

Selected soil samples were tested to determine dry unit weight (ASTM D2937), natural moisture content (ASTM D4643) and unconfined compressive strength. The results of these tests are included on the boring logs at the depth each sample was obtained.

One sample of near-surface soil collected from Boring D2 at a depth of 1½ feet bgs was tested to determine the Atterberg Limits (ASTM D4318). The test results indicated the material to be non-plastic.

Two samples of the near-surface soil was tested for Expansion Index (ASTM D4829) with results presented in Figures A1 and A2.

The shear strength characteristics of one undisturbed soil sample was determined by triaxial compression testing (ASTM 4767). The results of the triaxial compression testing are presented in Figure A3.

One sample of the near-surface soil was submitted to Sunland Analytical to determine the soil pH and minimum resistivity (California Test 643), Sulfate concentration (California Test 417, ASTM D516) and Chloride concentration (California Test 422). The results of these tests are presented in Figures A4 and A5.

EXPANSION INDEX TEST RESULTS

ASTM D4829

MATERIAL DESCRIPTION: Yellow brown, silty sand

LOCATION: D1

Sample Depth	Pre-Test Moisture (%)	Post-Test Moisture (%)	Dry Density (pcf)	Expansion Index
3.5' - 5.0'	9.0	14.5	115	**0**

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

EXPANSION INDEX TEST RESULTS

ASTM D4829

MATERIAL DESCRIPTION: Brown, sandy clay

LOCATION: D5

Sample Depth	Pre-Test Moisture (%)	Post-Test Moisture (%)	Dry Density (pcf)	Expansion Index
0' - 2.0'	11.1	22.2	107	**63**

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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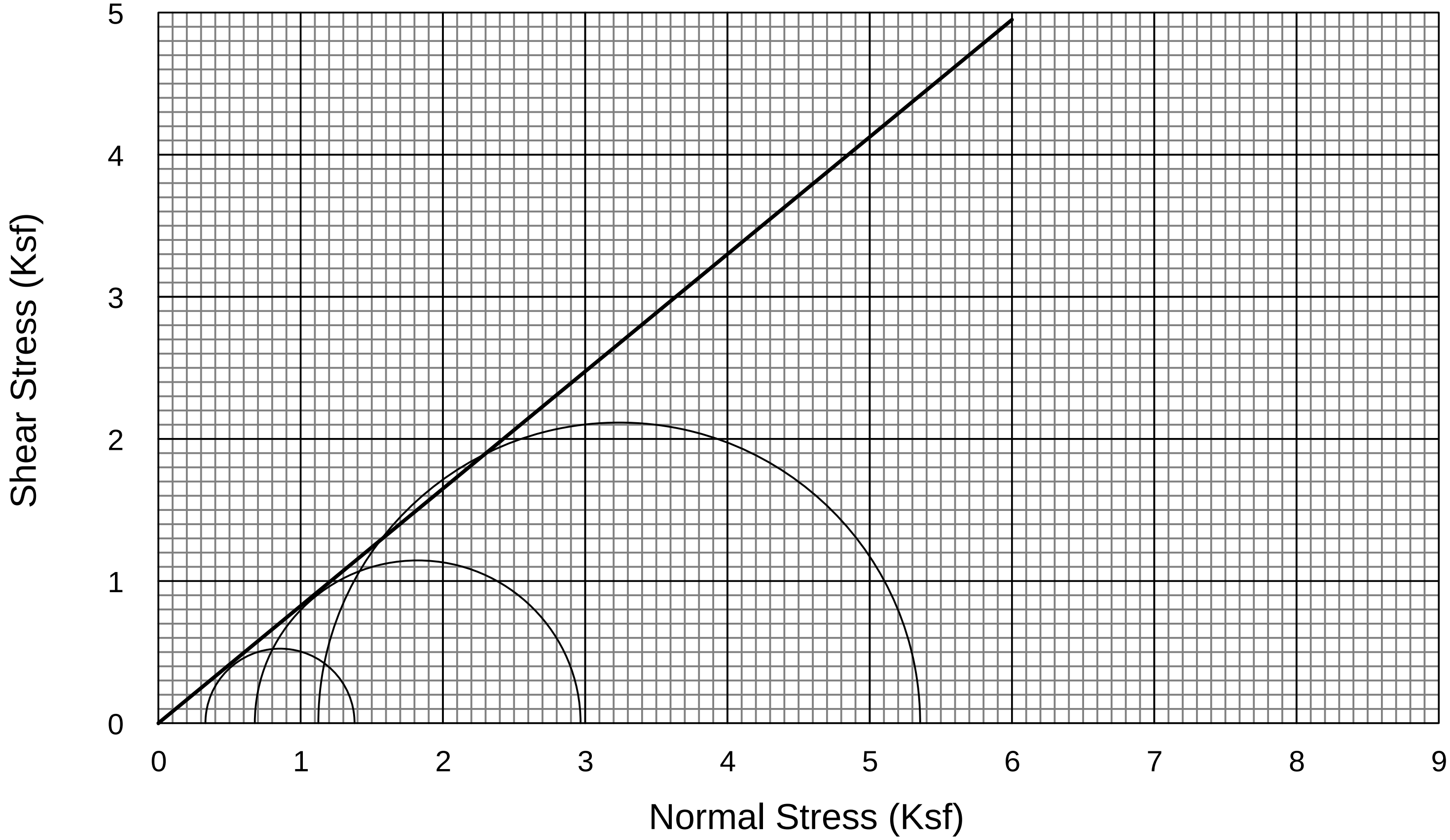
EXPANSION INDEX

HERITAGE HIGH SCHOOL
CULINARY ARTS AND TWO-STORY CLASSROOM BUILDINGS
Brentwood, California

FIGURE	A3
DRAWN BY	RWO
CHECKED BY	TCD
PROJECT MGR	DRG
DATE	10/18
WKA NO.12048.01P	

TRIAXIAL COMPRESSION TEST

ASTM D4767



SAMPLE NO. : D4-2I

SAMPLE CONDITION : Undisturbed

SAMPLE DESCRIPTION : White to Yellow Brown, sandstone

DRY DENSITY (PCF) : 97.6

INITIAL MOISTURE (%) : 8.3

FINAL MOISTURE (%) : 22.1

ANGLE OF INTERNAL FRICTION (ø) : 39°

COHESION (PSF) : 0

WallaceKuhl & ASSOCIATES

TRIAXIAL COMPRESSION TEST RESULTS

HERITAGE HIGH SCHOOL
CULINARY ARTS AND TWO -STORY CLASSROOM BUILDINGS
Brentwood, California

FIGURE	A3
DRAWN BY	RWO
CHECKED BY	TCD
PROJECT MGR	DRG
DATE	10/18
WKA NO	12048.01P

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

Date Reported 10/17/2018
Date Submitted 10/11/2018

To: Tom DeSimone
Wallace-Kuhl & Assoc.
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 : 12048.01P Site ID : D4@1-4FT.
Thank you for your business.

* For future reference to this analysis please use SUN # 78282-163708.

EVALUATION FOR SOIL CORROSION

Soil pH	7.60		
Minimum Resistivity	1.34 ohm-cm (x1000)		
Chloride	9.3 ppm	00.00093	%
Sulfate	139.2 ppm	00.01392	%

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

WallaceKuhl & ASSOCIATES

CORROSION TEST RESULTS
HERITAGE HIGH SCHOOL
CULINARY ARTS AND TWO - STORY CLASSROOM BUILDINGS
Brentwood, California

FIGURE	A4
DRAWN BY	RWO
CHECKED BY	TCD
PROJECT MGR	DRG
DATE	10/18
WKA NO. 12048.01P	

Sunland Analytical

11419 Sunrise Gold Circle, #10
Rancho Cordova, CA 95742
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The reported analysis was requested for the following location:
Location : 12048.01P Site ID : D4@1-4FT.
Thank you for your business.

* For future reference to this analysis please use SUN # 78282-163709.

Extractable Sulfate in Water

Type of TEST	Result	Units
Sulfate-SO4	127.0	mg/kg

METHODS
ASTM D-516m from sat.paste extract-reported based on dry wt.

WallaceKuhl & ASSOCIATES

CORROSION TEST RESULTS
HERITAGE HIGH SCHOOL
CULINARY ARTS AND TWO - STORY CLASSROOM BUILDINGS
Brentwood, California

FIGURE	A5
DRAWN BY	RWO
CHECKED BY	TCD
PROJECT MGR	DRG
DATE	10/18
WKA NO. 12048.01P	

APPENDIX B
References

APPENDIX B - REFERENCES

American Concrete Institute (ACI), 2011, Table 4.2.1 - Exposure Categories and Classes. In ACI, Building Code Requirements for Structural Concrete (pp. 57-63). Farmington Hills, MI: American Concrete Institute.

American Society of Civil Engineers (ASCE), 2010, Minimum design loads for buildings and other structures: Reston, Va. American Society of Civil Engineers, ASCE Standard ASCE/SEI 7-10.

ASTM International (ASTM), 2014, Annual book of standards, construction, v. 4.08, Soil and Rock.

Blake, T.F., 2000 (updated 2012), EQSEARCH, *A Computer Program for the Estimation of Peak Horizontal Acceleration from California Historical Earthquake Catalogs*, Ver. 3.0.

California Building Code, 2016, Title 24, Part 2: Washington, D.C., International Code Council, Inc.

California Department of Transportation (Caltrans), 2000, Method for determining the resistance "R" value of treated and untreated bases, subbases, and basement soils by the stabilometer, California Test 301: Sacramento, California.

California Department of Transportation (Caltrans), 2017, Highway design manual: Sacramento, CA, Chapters 600-670.

California Department of Transportation (Caltrans), 2012, Corrosion Guidelines, v2.0: Sacramento, CA, November, 44p.

California Department of Water Resources (DWR), 2014, Summary of Recent, Historical, and Estimated Potential for Future Land Subsidence in California.

California Department of Water Resources (DWR), 2018, Water Library, Retrieved on August 30, 2018, from DWR: http://www.water.ca.gov/waterdatalibrary/groundwater/hydrographs.

California Department of Water Resources (DWR), Interactive Geotracker Website, Accessed August 30, 2018, http://geotracker.waterboards.ca.gov.

California Geological Survey (CGS), 2013, *Checklist for the Review of Engineering Geology and Seismology Reports for California Public Schools, Hospitals, and Essential Service Buildings,* October 2013.

California Geological Survey (CGS), 2010, *Fault Activity Map of California,* 1:750,000, Retrieved February 28, 2018.

California Geological Survey (CGS), 2008, *Guidelines for Evaluating and Mitigating Seismic Hazards in California:* CGS Special Publication 117, 102p.

Cao, T., Bryant, W.A., Rowshandel, B., Branum, D., and Wills, C.J., June 2003, *The Revised 2002 California Probabilistic Seismic Hazard Maps*, 18p.

Churchill, R.K., 1991 (revised website version 2003), *Geologic Controls on the Distribution of Radon in California*, Department of Health Services.

REFERENCES (Continued)

Churchill, R.K., and Hill, R.L., 2000, *A General Location Guide for Ultramafic Rocks in California – Areas More Likely to Contain Naturally Occurring Asbestos:* CGS Open File Report 2000-019.

Contra Costa County, 2005, *Chapter 10 - Safety Element of the Contra Costa County General Plan,* January 18, 2005, Reprint July 2010.

Contra Costa Water District, 2011, *Maximum Depth of Inundation for Proposed Expansion of Los Vaqueros Reservoir,* Figures 3-6 and 3-7, Dated January 25, 2011.

Dibblee, T.W., and Minch, J.A., 2006, *Geologic Map of the Antioch South & Brentwood Quadrangles, Contra Costa County, California,* Dibblee Foundation Map DF-193, Scale 1:24,000.

FEMA, 2009, *Flood Insurance Rate Map, Panel 345 of 602, Map Number 06013C0345F,* dated June 16, 2009.

Google Earth Software, 2013, Version 7.1.2.2041, Google Inc.: Mountain View, CA, Google Earth Software available: http:www.google.com/earth.

Hart, E.W. and Bryant W.A., 2007, *Fault Rupture Hazard Zones in California, Alquist-Priolo Earthquake Fault Zoning Act with Index to Earthquake Fault Zone Maps*, California Geological Survey Special Publication 42, 38p.

Jennings, C.W., and Bryant, W.A., 2010, Fault activity map of California: California Geological Survey Geologic Data Map No. 6, map scale 1:750,000.

Kleinifelder, 2001, *Geologic and Seismic Hazards Assessment Report, Third High School Site, Balfour Road, Brentwood, California,* Dated March 12, 2001.

Kleinfelder, 2002, *Geotechnical Investigation Report, Proposed Heritage High School, Balfour Road, Brentwood, California,* Dated April 25, 2002.

Miller, D.C., 1989, Potential Hazards from Future Volcanic Eruptions in California: USGS, Bulletin 1847, 17p.

Nationwide Environmental Title Research, Historic Aerial Images, Accessed September 2018, https://www.historicaerials.com/.

Norris, Robert M., and Webb, Robert W., 1990, *Geology of California, 2nd Edition*, 541p.

Parrish, 2018, Fault-Rupture Hazard Zones in California, Alquist-Priolo Earthquake Fault Zoning Act with Index to Earthquake Fault Zones Maps, California Geological Survey Special Publication 42.

Quattrochi Kwok Architects, 2003, *Grading Plans, Heritage High School Construction Documents,* Sheets C5.8, C5.11, C5.14, Dated May 15, 2003.

United States Geological Survey, 2012, 7.5 Minute Topographic Map of Antioch South Quadrangle, California, 1:24,000.

United States Geological Survey, 2013, *U.S. Seismic Design Maps, 3.1.0.* Retrieved October 8, 2018, from U.S. Geological Survey: http://earthquake.usgs.gov/hazards/designmaps/usdesign.php.

REFERENCES (Continued)

United States Geologic Survey, 2008, *USGS National Seismic Hazard Maps,* Retrieved October 1, 2018: https://earthquake.usgs.gov/cfusion/hazfaults_2008_search/query_main.cfm

Van Gosen, B.S., and Clinkenbeard, J.P., 2011, *Reported Historic Asbestos Mines, Historic Asbestos Prospects, and Other Natural Occurances of Asbestos in California:* USGS Open-File Report, 22p.

APPENDIX C

Cone Penetrometer Test Results

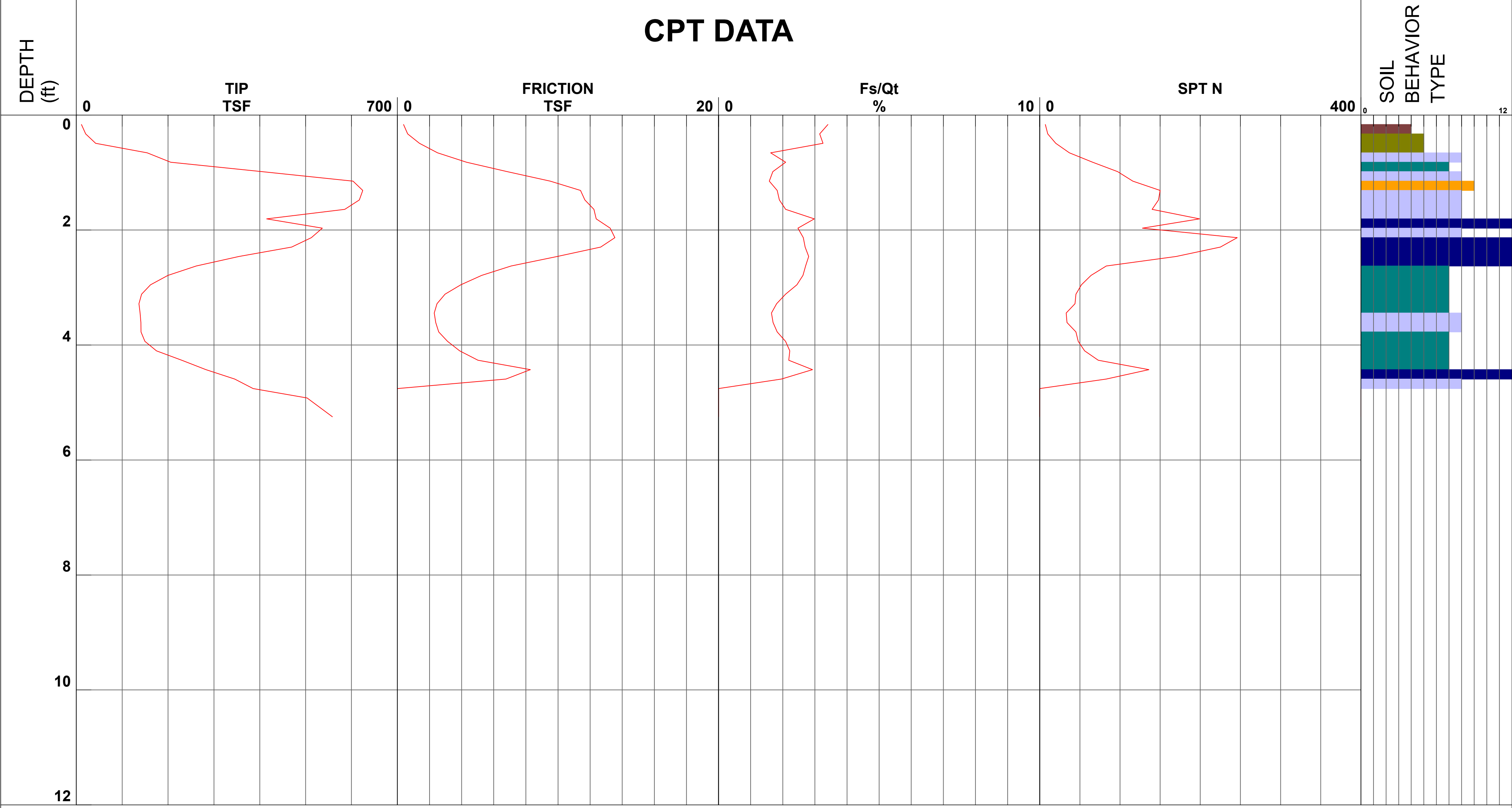
Wallace-Kuhl & Associates

Middle Earth Geo Testing Inc.

Project	Heritage High School Culinary Arts	Operator	RB-JM	Filename	SDF(122).cpt
Job Number	12048.01P	Cone Number	DDG1418	GPS	
Hole Number	CPT-01	Date and Time	9/27/2018 12:45:59 PM	Maximum Depth	5.25 ft
EST GW Depth During Test		>5.25 ft			

Net Area Ratio .8

CPT DATA



1 - sensitive fine grained	4 - silty clay to clay	7 - silty sand to sandy silt	10 - gravelly sand to sand
2 - organic material	5 - clayey silt to silty clay	8 - sand to silty sand	11 - very stiff fine grained (*)
3 - clay	6 - sandy silt to clayey silt	9 - sand	12 - sand to clayey sand (*)

Cone Size 15cm squared

S*Soil behavior type and SPT based on data from UBC-1983

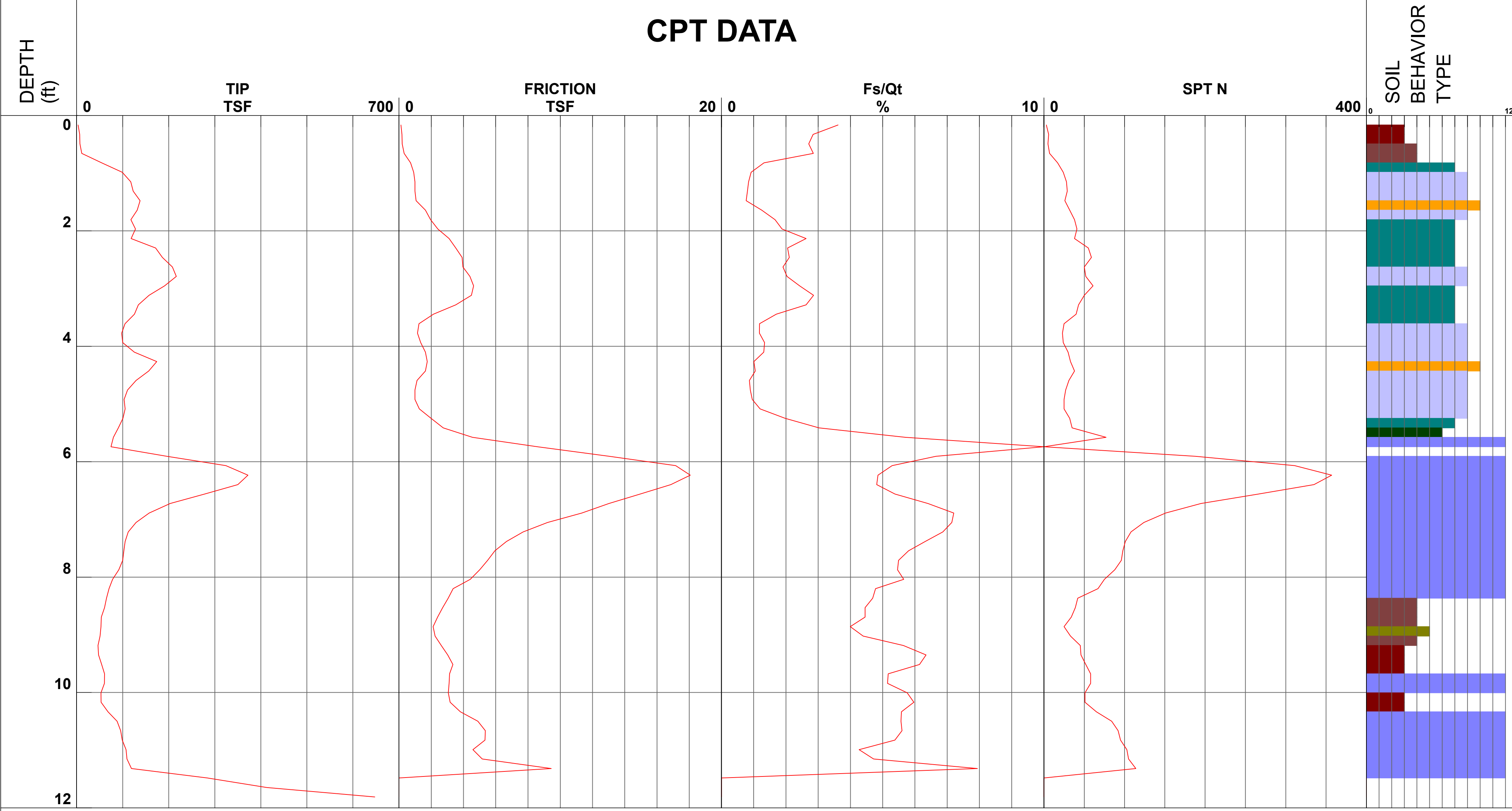
Wallace-Kuhl & Associates

Middle Earth Geo Testing Inc.

Project	Heritage High School Culinary Arts	Operator	RB-JM	Filename	SDF(123).cpt
Job Number	12048.01P	Cone Number	DDG1418	GPS	
Hole Number	CPT-02	Date and Time	9/27/2018 1:51:10 PM	Maximum Depth	11.81 ft
EST GW Depth During Test			>11.81 ft		

Net Area Ratio .8

CPT DATA



1 - sensitive fine grained	4 - silty clay to clay	7 - silty sand to sandy silt	10 - gravelly sand to sand
2 - organic material	5 - clayey silt to silty clay	8 - sand to silty sand	11 - very stiff fine grained (*)
3 - clay	6 - sandy silt to clayey silt	9 - sand	12 - sand to clayey sand (*)

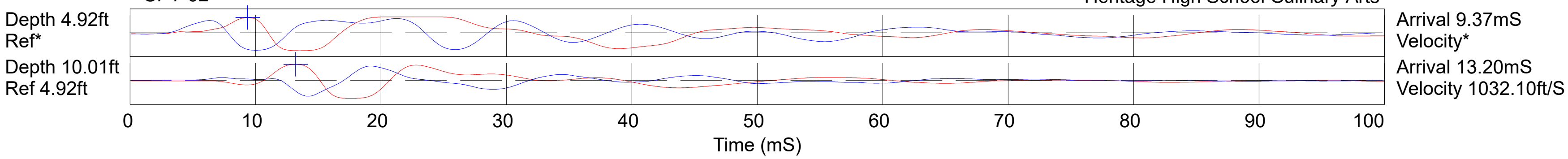
Cone Size 15cm squared

S*Soil behavior type and SPT based on data from UBC-1983

CPT-02

Wallace-Kuhl & Associates

Heritage High School Culinary Arts



Hammer to Rod String Distance (ft): 5.83

* = Not Determined

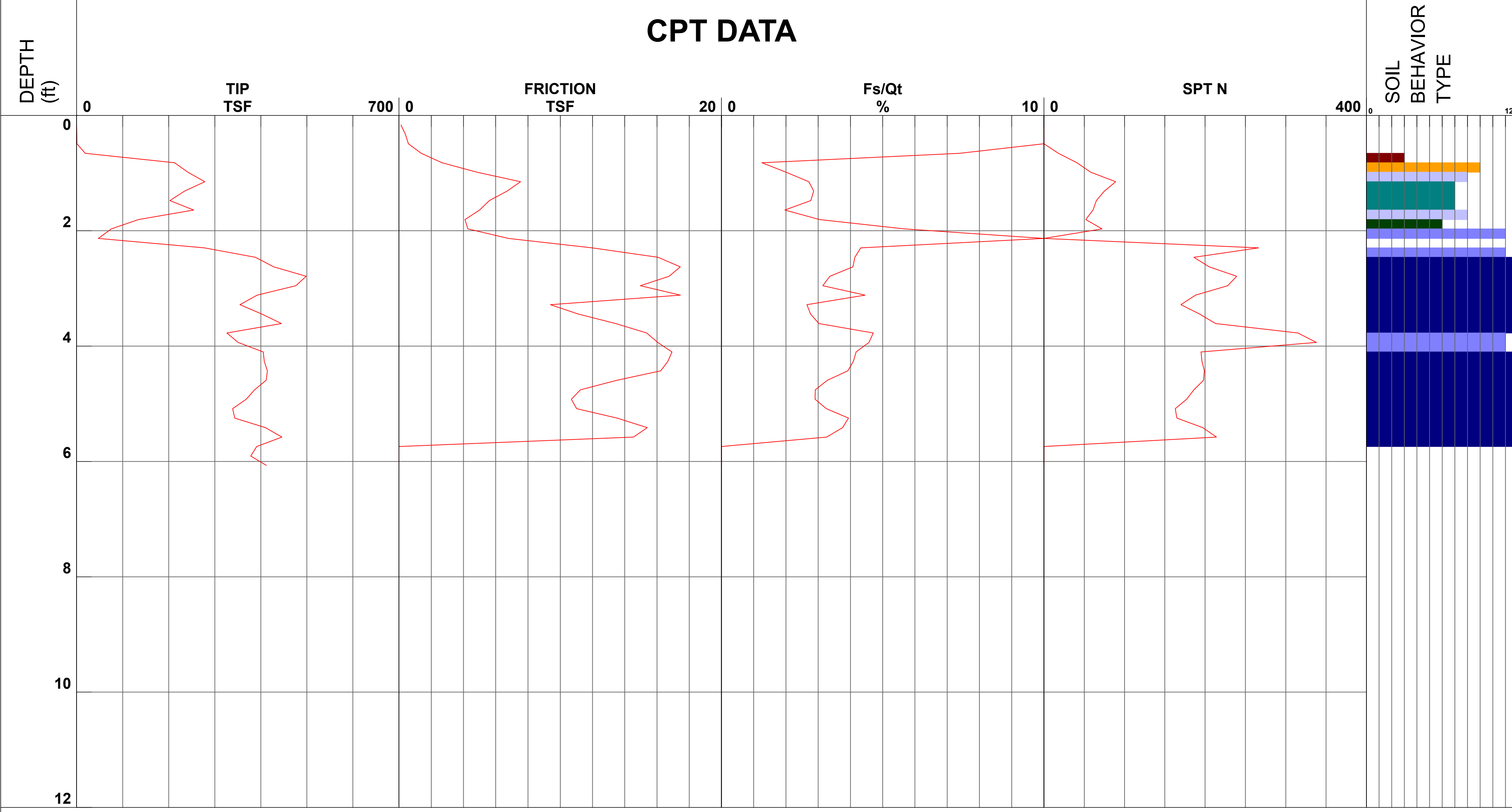
COMMENT:

Wallace-Kuhl & Associates

Project	Heritage High School Culinary Arts	Operator	RB-JM	Filename	SDF(124).cpt
Job Number	12048.01P	Cone Number	DDG1418	GPS	
Hole Number	CPT-03	Date and Time	9/27/2018 2:21:03 PM	Maximum Depth	6.07 ft
EST GW Depth During Test		>6.07 ft			

Net Area Ratio .8

CPT DATA

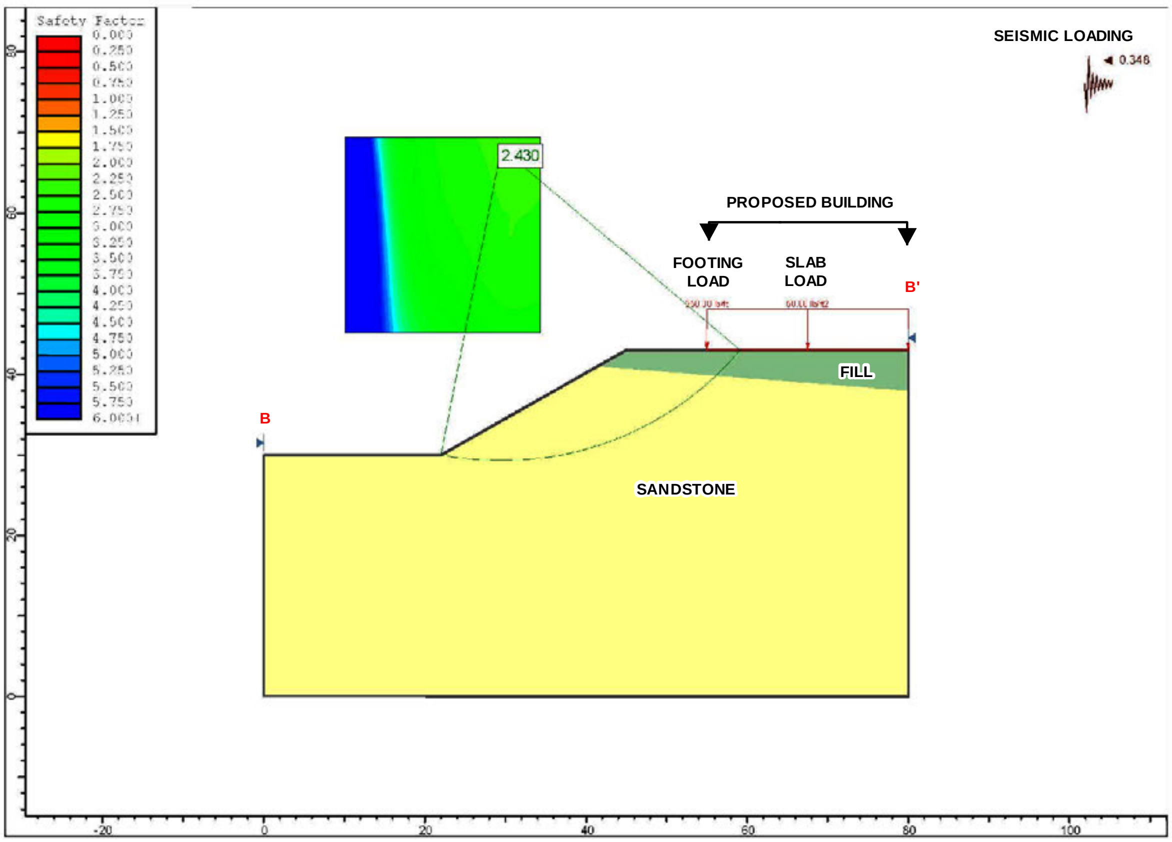


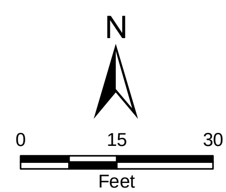
1 - sensitive fine grained
2 - organic material
3 - clay
4 - silty clay to clay
5 - clayey silt to silty clay
6 - sandy silt to clayey silt
7 - silty sand to sandy silt
8 - sand to silty sand
9 - sand
10 - gravelly sand to sand
11 - very stiff fine grained (*)
12 - sand to clayey sand (*)

Cone Size 15cm squared

S*Soil behavior type and SPT based on data from UBC-1983

APPENDIX D
Slope Stability Analysis Results for Cross Section B-B'





WallaceKuhl & ASSOCIATES	**SLOPE STABILITY ANALYSIS OF CROSS SECTION B-B'** HERITAGE HIGH SCHOOL CULINARY ARTS AND TWO-STORY CLASSROOM BUILDINGS Brentwood, California	FIGURE	D1
		DRAWN BY	RWO
		CHECKED BY	TCD
		PROJECT MGR	DRG
		DATE	10/18
		WKA NO. 12048.01P	

APPENDIX E
Guide Earthwork Specifications

APPENDIX E

GUIDE EARTHWORK SPECIFICATIONS

WKA No. 12048.01P

PART I: GENERAL

1.1 SCOPE

a. General Description

This item shall include all clearing and grubbing, preparation of land to be filled, filling, spreading, compaction, observation and testing of the fill, and all subsidiary work necessary to complete the grading of the site to conform with the lines, grades and slopes as shown on the accepted Drawings.

b. Related Work Specified Elsewhere

(1) Trenching and backfilling for sanitary sewer system: Section ____.

(2) Trenching and backfilling for storm sewer system: Section ____.

(3) Trenching and backfilling for underground water, natural gas, and electrical supplies: Section ____.

c. Geotechnical Engineer

Where specific reference is made to "Geotechnical Engineer," this designation shall be understood to include both the firm and the individual representatives of that firm.

1.2 PROTECTION

a. Adequate protection measures shall be provided to protect workers and passers-by the site. Streets and adjacent property shall be fully protected throughout the operations.

b. In accordance with generally accepted construction practices, the Contractor shall be solely and completely responsible for working conditions at the job site, including safety of all persons and property during performance of the work. This requirement shall apply continuously and shall not be limited to normal working hours.

c. Any construction review of the Contractor's performance conducted by the Geotechnical Engineer is not intended to include review of the adequacy of the Contractor's safety measures in, on or near the construction site.

d. Adjacent streets, sidewalks and properties shall not contain mud, dirt or similar nuisances resulting from earthwork operations.

e. Surface drainage provisions shall be made during the period of construction in a manner to avoid creating a nuisance to adjacent areas.

f. The site and adjacent influenced areas shall be watered as required to suppress dust nuisance.

1.3 GEOTECHNICAL REPORT

a. A Geotechnical Engineering and Geologic Hazards Report (WKA No. 12048.01P; dated October 29, 2018) has been prepared for this site by Wallace - Kuhl & Associates, Geotechnical Engineers of West Sacramento, California [(916) 372-1434]. A copy is available for review at the office of Wallace - Kuhl & Associates.

b. The information contained in this report was obtained for design purposes only. The contractor is responsible for any conclusions they may draw from this report. Should it be preferred not to assume such risk, they should employ their own experts to analyze available information and/or to make additional borings upon which to base conclusions, all at no cost to the Owner.

1.4 EXISTING SITE CONDITIONS

The Contractor shall acquaint himself with all site conditions. If unshown active utilities are encountered during the work, the Architect shall be promptly notified for instructions. Failure to notify will make the Contractor liable for damage to these utilities arising from Contractor’s operations after his discovery of such unshown utilities.

1.5 SEASONAL LIMITS

Fill material shall not be placed, spread or rolled during unfavorable weather conditions. When the work is interrupted by heavy rains, fill operations shall not be resumed until field tests indicated that the moisture contents of the subgrade and fill materials are satisfactory.

PART II: PRODUCTS

2.1 MATERIALS

a. Imported Select Non-Expansive Fill Materials (Select Fill)

Imported fill materials shall be approved by the Geotechnical Engineer; shall be compactable soils having an Expansion Index less than 20; shall be of three-inch (3") maximum particle size; and, shall have less than five percent (5%) of the material greater than one-inch (1") in maximum dimension.

b. Capillary Barrier Material (Crushed Rock)

Capillary barrier material under floor slabs shall be provided to the thickness shown on the Drawings. This material shall be clean gravel or crushed rock of one-inch (1") maximum size, with no material passing a number four (#4) sieve.

c. Class II aggregate base

Class II aggregate base shall conform to the current requirements of the 2015 Caltrans Specifications, Section 26-1.02B.

d. Controlled Low Strength Material (CLSM)

Controlled low strength material shall consist of a workable mixture of aggregate, cementitious materials, and water; conforming to the provision for slurry cement backfill in section 19-3.02G of the 2015 Caltrans Specifications.

e. Water

Water for use in subgrade stabilization shall be clean and potable and shall be added during mixing, remixing and compaction operations, and during the curing period to keep the cured material moist until covered.

f. Other Products

Aggregate base, asphalt concrete and related asphaltic seal coats, tack coat, etc., shall comply with the appropriate provisions of the 2015 State of California (Caltrans) Standard Specifications.

PART III: EXECUTION

3.1 LAYOUT AND PREPARATION

Lay out all work, establish grades, locate existing underground utilities, set markers and stakes, set up and maintain barricades and protection of utilities--all prior to beginning actual earthwork operations.

3.2 CLEARING, GRUBBING, AND PREPARING BUILDING PAD AND PAVEMENT AREAS

a. All rubble and rubbish; irrigation pipes and underground utilities, associated trench backfill, and other items encountered during site work and deemed unacceptable by the Geotechnical Engineer, shall be removed and disposed of so as to leave the disturbed areas with a neat and finished appearance, free from unsightly debris. Excavations and depressions resulting from the removal of such items, as well as existing excavations and loose soil deposits, as determined by the Geotechnical Engineer, shall be cleaned out to firm, undisturbed soil and backfilled with suitable materials in accordance with these specifications.

b. The surfaces receiving fill shall be stripped of vegetation; or, they shall be thoroughly disced provided that a compactable mixture of soil containing minor amounts of vegetation can be attained which is free of clumps, layers or pockets of vegetation. If proper compaction of the disturbed surface soils cannot be achieved, those materials shall be excavated, to a depth satisfactory to the Geotechnical Engineer, so that a firm base for support of engineered fill can be attained.

c. All fill shall be constructed in accordance with Section 3.3 of these specifications and the surfaces receiving fill shall be prepared in accordance with the following paragraphs in this section: Section 3.2.

d. All loose fill soils and/or saturated materials shall be over-excavated to firm soil, as determined by the Geotechnical Engineer, and the resulting excavations shall be backfilled with suitable materials in accordance with these specifications; or, where saturated surface soils are located over native undisturbed soils, the subgrades may be stabilized with high-calcium or dolomitic quicklime to depths and with compactive effort meeting the satisfaction of the Geotechnical Engineer.

e. The surfaces upon which fill is to be placed shall be plowed or scarified to a depth of at least twelve inches (12"), until the surface is free from ruts, hummocks or other uneven features which would tend to prevent uniform compaction by the selected equipment.

f. When the moisture content of the subgrade is less than the optimum moisture content, as defined by the ASTM D1557 Compaction Test, water shall be added until the proper moisture content is achieved.

g. When the moisture content of the subgrade is too high to permit the specified compaction to be achieved, the subgrade shall be aerated by blading or other methods until the moisture content is satisfactory for compaction.

h. After the foundations for fill have been cleared, moisture conditioned, and plowed or scarified, they shall be recompacted in place to a depth of at least twelve inches (12") to a minimum of ninety percent (90%) of the ASTM D1557 maximum dry density.

i. The building pad areas shall be defined as extending at least five feet (5') beyond the proposed building lines. The pavement areas shall be defined as extending at least two feet (2') beyond the edges of pavement.

3.3 CONSTRUCTION OF SUBGRADES

a. The selected soil fill material shall be placed in layers which, when compacted, do not exceed six inches (6") in thickness. Each layer shall be spread evenly and shall be thoroughly mixed during the spreading to promote uniformity of material in each layer.

b. When the moisture content of fill material is less than the optimum moisture content, as defined by the ASTM D1557 Compaction Test, water shall be added until the proper moisture content is achieved.

c. When the moisture content of the fill material is too high to permit the specified degree of compaction to be achieved, the fill material shall be aerated by blading or other methods until the moisture content is satisfactory.

d. After each layer has been placed, mixed and spread evenly, it shall be thoroughly compacted to not less than ninety percent (90%) of maximum dry density as determined by the ASTM D1557 Compaction Test. Compaction shall be undertaken with equipment capable of achieving the specified density and shall be accomplished while the fill material is at the required moisture content. Each layer shall be compacted over its entire area until the desired density has been obtained.

e. The fill operations shall be continued until the fills have been brought to the slopes and grades shown on the accepted Drawings.

3.4 FINAL SUBGRADE PREPARATION

a. All original ground preparation and engineered fill placed within building pads and slab-on-grade concrete areas shall be constructed in accordance with Section 3.2 and Section 3.3 of these specifications. The upper twelve inches (12") of final building pad subgrades shall be composed of approved, compactable, granular, low expansion potential fill at a uniform moisture content not less than the optimum moisture (per ASTM D1557) and shall be uniformly compacted to not less than ninety percent (90%), as defined by that test.

b. The upper eight inches (8") of any final pavement subgrades shall be uniformly compacted to at least ninety-five (95%) percent of the ASTM D1557 maximum dry density, at a moisture content at least the optimum moisture content regardless of whether the grade is achieved by filling, by excavation, or is left at or near original site grade.

3.5 Utility Trench Backfill

a. Bedding and initial backfill shall conform to the pipe manufactures recommendations and the applicable governing agencies standards.

b. If trench foundations are unstable or are composed of deleterious materials, the trench foundation shall be over excavated a minimum of six inches (6”) and replaced with crushed rock wrapped in filter fabric.

c. Trench zone backfill shall use native soils or select fill and shall extend from the top of the initial backfill to a point twelve inches (12”) below finished grade.

d. Trench zone and final zone backfill shall be compacted to not less than ninety percent (90%) of the maximum dry density as determined by ASTM D1557.

e. Final zone backfill in the upper twelve inches (12”) shall conform to the standards for final subgrade preparation shown in sections 3.3 to 3.5 above.

f. Where select fill soils are removed from trenches, the material shall be replaced with compacted aggregate base.

g. CLSM may be used in place of native soil or select fill if approved by the Geotechnical Engineer.

h. Utility trenches aligned nearly parallel with foundations shall be a minimum of three feet (3') from the outer edge of foundations, wherever possible; shall not encroach on a zone extending outward at one horizontal to one vertical (1H:1V); and, shall not remain open longer than 72 hours.

3.6 CONSTRUCTION OF PAVEMENT BASE COARSE

a. Materials supporting pavements shall be Class II aggregate base and shall be moisture conditioned to the optimum moisture content and compacted to not less than ninety-five percent (95%) of the maximum dry density as defined by ASTM D1557.

3.7 FOUNDATIONS

a. Foundation excavations shall be sized consistent with the project plans; and shall extend to firm undisturbed soil or engineered fill capable of bearing required loads. If loose or soft material is encountered, the material shall be over excavated and replaced with fill placed and compacted as required for foundation subgrade soils.

b. Foundation excavations shall be free of loose or deleterious material. Stockpiling of loose material shall not be permitted near open foundation excavations.

3.8 TESTING AND OBSERVATION

a. All grading operations, shall be tested and observed by the Geotechnical Engineer, serving as the representative of the Owner.

b. Field density tests and other tests shall be made by the Geotechnical Engineer after compaction or placement of each layer of fill. Additional layers of fill shall not be spread until the field density tests indicate that the minimum specified density has been obtained.

c. Prior to placement of steel or concrete, foundation excavations shall be observed by the Geotechnical Engineer for conformance with the recommendations in the Geotechnical Report and the project plans.

d. Earthwork shall not be performed without the notification or approval of the Geotechnical Engineer. The Contractor shall notify the Geotechnical Engineer at least two (2) working days prior to commencement of any aspect of the site earthwork.

e. If the Contractor should fail to meet the technical or design requirements embodied in this document and on the applicable plans, he shall make the necessary readjustments until all work is deemed satisfactory, as determined by the Geotechnical Engineer and the Architect/Engineer. No deviations from the specifications shall be made except upon written approval of the Geotechnical Engineer or Architect/Engineer.