GEOLOGIC AND SEISMIC HAZARDS ASSESSMENT REPORT
C-4016 NEW SCIENCE BUILDING
CONTRA COSTA COLLEGE
2600 MISSION BELL DRIVE
SAN PABLO, CALIFORNIA

PROJECT No.: 20181569.001A

OCTOBER 20, 2017

October 20, 2017
Project No.: 20181569.001A

Contra Costa Community College District (District)
2600 Mission Bell Drive
San Pablo, California 94806
C/O Mr. Ron Johnson
ronj@csipm.com

SUBJECT: Geologic and Seismic Hazards Assessment Report
C-4016 New Science Building
Contra Costa College
2600 Mission Bell Drive, San Pablo, California

Dear Mr. Johnson:

Kleinfelder is pleased to present this geologic and seismic hazards assessment report for the planned New Science building at Contra Costa College in San Pablo, California. Figure 1 – Site Vicinity Map and Figure 2 – Site Plan and Geology Map show the approximate location of the planned project within the college campus. The project site is currently occupied by the Liberal Arts and Health Sciences buildings, which are abandoned and earmarked for demolition.

This report is intended to identify and characterize potential geologic and seismic hazards at the project site and adjacent area of the campus in order to satisfy and comply with Note 48 guidelines and checklist items prepared by the California Geological Survey (CGS) for public school projects. The CGS reviews geologic and seismic hazard assessment reports for the Division of the State Architect (DSA). Conclusions pertaining to the potential impacts of these geologic hazards on the planned improvements are provided in the report.

The accompanying report summarizes the results of our field reconnaissance, data research and review, and engineering geologic interpretations, conclusions, and recommendations. In addition, this report describes the geologic setting, faulting, seismicity, and potential geologic and seismic hazards that could impact the planned project. The primary geologic/seismic hazard considerations performed as part of this assessment include fault-related ground surface rupture, seismically-induced ground failures (liquefaction, lateral spreading, and dynamic compaction), expansive soils, landslides, flooding including from heavy rainstorms, tsunamis and seiches hazards, naturally-occurring asbestos, soil corrosion, and radon gas. Conclusions pertaining to the potential impacts of these geologic and seismic hazards on the planned development are provided in the report.

A site-specific Seismic Hazards Analysis has been prepared for this site as part of our scope and is attached hereto in Appendix E. Kleinfelder (2017) has recently prepared a site-specific geotechnical engineering study for the subject project, which was issued under a separate cover and which we list in the References Section of this report.

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Based on the results of our assessment, it is our opinion that, from an engineering geologic and geotechnical viewpoint, the subject site is considered suitable for the planned project and associated improvements provided that our conclusions and recommendations presented herein and in our concurrent geotechnical engineering report are adhered to and incorporated into the design and construction of the planned new science building. The primary geological and seismic issues of concern are:

1. The project site is situated within the limits of the Alquist-Priolo Earthquake Fault Zone (AP Zone) associated with the active Hayward fault;
2. The proximity of the planned project to the main creeping trace of the Hayward fault;
3. Anticipated strong to violent ground shaking as a result of future seismic events along the Hayward fault and one of the active earthquake faults within the region;
4. The presence of low to highly expansive soils;
5. The presence of undocumented fill; and
6. The potential for highly corrosive soils.

Utilizing subsurface trenching techniques, Kleinfelder and other consultants have evaluated the presence and activity of any secondary sympathetic fault splays associated with the active Hayward fault within the vicinity of the planned new science building. The geologic trenches were excavated and logged in the general vicinity of the project area between 1972 through 2008 as shown on Figure 2. Kleinfelder evaluated these geologic trenches and existing earthquake fault mapping in our report titled *Master Plan Seismic Study, Contra Costa College Campus, San Pablo, California,* dated July 15, 2009 (Project Number 80412/Report/PLE9R266). In this report, three colored zones were delineated across the campus as follows:

- Red – indicating the presence of active faulting and the limits of a setback zone excluding the construction of structures intended for human habitation and occupancy;
- Yellow – areas that have yet to be cleared of secondary fault traces and that would require additional exploration to assess faulting; and
- Green – habitable zones where it has been demonstrated that no active faults exist and no additional studies would be needed to clear the area for development including structures intended for human habitation and occupancy.

The report concluded, based on existing available data, that the Liberal Arts and Health Sciences buildings were free of active fault traces and the surrounding trenches provided enough coverage and "shadowing" for possible fault traces in a northwestwardly trend. Therefore, the buildings were placed within the green-zone. However, the report concluded that there should be a 50-foot setback zone established on the northeast side of the Liberal Arts building from the western most fault observed in the trenches excavated by Harding-Lawson and Associates in 1972/1973 for the then proposed Physical Sciences building addition. Based on the above information, the currently planned location of the New Science building will be situated within the habitable zone colored green on the campus-wide seismic and fault setback map, which we utilize as base for Figure 2 of this report.

The colored zones were further evaluated and adjusted by Kleinfelder in 2011 per the recommendations of CGS. Our conclusions and recommendations were provided in our letter report titled *Re-Assessment of Fault-Related Exclusionary Boundaries Pertaining to Habitable Structures for the Campus Center Project/New Student Activities Building Proposed within the*

Contra Costa College Campus in San Pablo, California, dated March 24, 2011 (Project Number 112252/PWPORTABLES/PLE11L027). The green-zone was further adjusted to the southwest near the Liberal Arts and Health Sciences buildings.

As noted above, our concurrent geotechnical engineering study for the subject project (Kleinfelder, 2017) provided conclusions and recommendations pertaining to grading, drainage, foundation design, and earthwork recommendations. Seismic design recommendations were presented in the site-specific ground motions seismic analysis report attached hereto in Appendix E. The geotechnical report also presented recommendations to mitigate potential fill settlement any potentially adverse geologic conditions associated with soil expansion and corrosion. We understand that the existing Liberal Arts building has sustained some distress, which may be related to the presence of undocumented fill or the magnitude of grading and type of foundations utilized.

This assessment was performed based on conclusions developed from the review of published studies and maps, nearby site-specific evaluations, a site reconnaissance visit by our project Engineering Geologist, results of geologic trenching studies referenced, review of subsurface information obtained from our concurrent preliminary geotechnical engineering study, and our experience with this college campus and similar projects.

If you have any questions regarding the information or recommendations presented in our report, please contact us at your convenience at (925) 484-1700.

Sincerely,

KLEINFELDER, INC.

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1 INTRODUCTION

This report presents the results of Kleinfelder's geologic and seismic hazards assessment for the planned new science building at Contra Costa College in San Pablo, California. The approximate location of the school campus is shown on the Site Vicinity Map (Figure 1) and the approximate limits of the planned new science center are shown on the Site Plan and Geology Map (Figure 2).

This report has been prepared for submittal with supporting design documents to the Division of the State Architect (DSA), as required for new construction of public schools and essential services facilities. This report addresses the potential geologic and seismic hazards that could impact the site as required by the California Geological Survey (CGS) Note 48, which may be incorporated into future projects with appropriate updates of the information presented herein. The updates should include site-specific borings and/or Cone Penetration Tests (CPTs), reconnaissance for individual projects by qualified personnel, and evaluation of the data to confirm that it is consistent with this report.

Kleinfelder has vast experience at the campus. That experience, coupled with our concurrent geotechnical engineering study for the planned New Science building were relied on to characterize the subsurface conditions. For the concurrent geotechnical engineering study we drilled four soil borings at the planned New Science building site on August 11 and 18, 2017 to a depth of approximately 31 to 41½ feet deep. The approximate locations of the borings are shown on Figure 2. The subsurface conditions revealed by the borings drilled by Kleinfelder as part of the concurrent geotechnical study and our previous experience at the campus were utilized to characterize the potential for and magnitude of liquefaction at the project site and to generate engineering recommendations pertaining to grading, drainage, foundation design, and construction considerations for the planned new science center.

1.1 SITE LOCATION AND DESCRIPTION

The western part of the campus is located mostly on a level alluvial plain west of Rheem Creek. The eastern portion of the campus slopes upward to the northeast. The active Hayward fault, which crosses the campus, approximately separates the flat lying portion of the campus with the elevated/hillside portion of the campus. Rheem Creek flows through the campus in a northwesterly direction generally parallel to the base of the hillside. Most of the academic buildings on the campus are located on the hillside portion of the campus, while the flat lying portion of the campus contains mostly the athletic buildings and facilities. The ground surface elevation at the campus ranges from about 50 feet above mean sea level along the southwestern margin of the campus to about 130 feet in the northeast corner along Campus Drive.

We understand that the campus plans to demolish the existing abandoned Liberal Arts and Health Sciences buildings and construct a new 3-story building with an approximate footprint of up to about 20,000 square feet. It is anticipated that cuts up to about 20 to 40 fee can be anticipated to achieve finished grades. This could change since the project is currently in conceptual design phase. Structural loads are assumed to be less than 300 kips for column loads. It is anticipated that the structure will be founded on shallow spread footings. The final layout of the building has not been determined at this time.

The existing buildings are currently situated northeast of Rheem Creek along the elevated portion of the campus. As shown of Figure 2, the buildings are situated in between the Physical Sciences building (located to the northeast), Administrative and Applied Arts building (located to the southeast), and Library and Learning Resource Center (located to the west). In between the Library and Learning Resource Center and Liberal Arts and Health Sciences buildings there is an open, grass covered courtyard area gently sloping to the southwest. A fire access road runs parallel with the Liberal Arts and Health Sciences buildings along the northeastern end of the buildings, situated at a higher topographic level than the grass covered open area. The project site generally slopes to the southwest. Sloped walkways and stairways are located around the buildings.

According to the U.S. Geological Survey (USGS, 1993) 7½-Minute Richmond Topographic Quadrangle map, the existing ground elevation at the site ranges between about 70 and 100 feet above mean sea level. The coordinates at the center of the planned new science center location are approximately:

Latitude: 37.969664° N

Longitude: -122.336584° W

1.2 PURPOSE AND SCOPE OF SERVICES

The purpose of our geologic and seismic hazards assessment is to identify potential geologic and seismic hazards and conditions that could adversely impact development of the proposed new science center or restrict its overall use. Our scope of services included a site reconnaissance by a Certified Engineering Geologist (CEG), review of readily available published geotechnical data and unpublished site-specific geologic and seismic evaluations, and the subsurface exploration and laboratory data obtained during our concurrent geotechnical engineering investigation. The objectives of this report are the identification and assessment of potential geologic and seismic hazards at the site in accordance with the requirements of the current California Code of Regulations, Title 24, 2016 CBC using guidelines outlined by the CGS. In addition to these requirements, this report has been prepared in accordance with the guidelines established in the following documents:

- California Department of Conservation, Division of Mines and Geology (DMG, currently known as the California Geological Survey [CGS]) Special Publication 117A (*Guidelines for Evaluating and Mitigating Seismic Hazards*);
- CGS Note 41 (Guidelines for Reviewing Geologic Reports)
- DMG Special Publication 42 (Fault-Rupture Hazard Zones in California);
- DMG Note 42 (Guidelines to Geologic/Seismic Reports);
- DMG Note 44 (Recommended Guidelines for Preparing Engineering Geologic Reports);
- CGS Note 48 (Checklist for the Review of Engineering Geology and Seismology Reports for California Public Schools, Hospitals, and Essential Services Buildings); and
- DSA IR A-4.13 (Geohazard Report Requirements: 2013 & 2016 CBC).

Specifically, our scope of services included the following:

- Review of the regional and local geologic and seismic setting of the site and surrounding area, including research and review of available geologic/seismic reports published by the USGS and the CGS, and a review of available geologic and geotechnical site-specific studies performed by Kleinfelder.
- Performing a reconnaissance of the site and adjacent areas by our CEG.
- Reviewing subsurface geotechnical soil borings and geologic trench data including depth to groundwater, from the published literature and site-specific previous geotechnical investigations.
- Preparing this Geologic and Seismic Hazards Assessment report for the site that covers the checklist items in CGS Note 48, and which presents the conclusions and results of our study. The report may include the following:

  a) A site vicinity map;
  b) A site plan and geology map
  c) An area geologic map;
  d) A regional geology map;
  e) A geologic cross section(s);
  f) Regional fault and historic seismicity map;

g) A description of regional geology, area geology, and nearby seismic sources (faults);
h) Discussion of the site location as it pertains to the Alquist-Priolo Earthquake Fault Zone pertaining to liquefaction and slope stability;
i) A description of the site's seismicity;
j) Conducting a site specific ground motion analysis; and
k) Conclusions regarding:
    1. Fault-related ground surface rupture;
    2. Seismically-induced ground failures including liquefaction, lateral spreading, and dynamic compaction;
    3. Expansive soils, collapsible, peaty, or compressible soils;
    4. Presence of undocumented fill soils;
    5. Slope stability and landslides (seismically-induced or otherwise);
    6. Flooding, tsunami-related hazard, and seiches;
    7. Naturally-occurring asbestos;
    8. Radon gas; and
    9. Soil corrosion.

Our current scope excluded an assessment of pipeline locations within 1,500 feet of the project site. Our evaluation also specifically excluded the assessment of environmental spills and hazardous substances at the site.

2 GEOLOGIC SETTING

2.1 REGIONAL GEOLOGY

The San Francisco Bay Area lies within the Coast Range geomorphic provinces, a more or less discontinuous series of northwest-southeast trending mountain ranges, ridges, and intervening valleys characterized by complex folding and faulting. The general geologic framework of the San Francisco Bay Area is illustrated in studies by Schlocker (1970), as well as studies by Helley and Lajoie (1979), Wagner et al. (1990), Chin et al. (1993), Ellen and Wentworth (1995), Wentworth et al. (1999), Knudsen et al. (1997 and 2000), and Witter et al. (2006). The regional geologic conditions of the site are depicted on Figure 3.

Geologic and geomorphic structures within the San Francisco Bay Area are dominated by the San Andreas fault (SAF), a right-lateral strike-slip fault that extends from the Gulf of California in Mexico to Cape Mendocino on the Coast of Humboldt County in northern California. It forms a portion of the boundary between two independent tectonic plates on the surface of the earth. To the west of the SAF is the Pacific Plate, which moves north relative to the North American Plate, located east of the fault. In the San Francisco Bay Area, movement across this plate boundary is concentrated on the SAF; however, it is also distributed, to a lesser extent across a number of other faults that include the Hayward, Calaveras and Concord among others (Graymer et al., 2002). Together, these faults are referred to as the SAF System. Movement along the SAF system has been ongoing for about the last 25 million years. The northwest trend of the faults within this fault system is largely responsible for the strong northwest structural orientation of geologic and geomorphic features in the San Francisco Bay Area.

Basement rocks west of the SAF are generally granitic, while to the east consist of a chaotic mixture of highly deformed marine sedimentary, submarine volcanic and metamorphic rocks of the Franciscan Complex. Both are typically Jurassic to Cretaceous in age (199-65 million years old). Overlying the basement rocks are Cretaceous (about 145 to 65 million years old) marine, as well as Tertiary (about 65 to 2.6 million years old [USGS, 2010]) marine and non-marine sedimentary rocks with some continental volcanic rock. These Cretaceous and Tertiary rocks have been extensively folded and faulted as a result of late Tertiary and Quaternary regional compressional forces. Regional geologic maps of the area covering the school campus indicate that bedding planes in adjacent hillside areas dip from about 50 to 75 degrees to the southwest.

The inland valleys, as well as the structural depression within which the San Francisco Bay is located, are filled with unconsolidated to semi-consolidated continental deposits of Quaternary age (about the last 2.6 million years). Continental surficial deposits (alluvium, colluvium, and landslide deposits) consist of unconsolidated to semi-consolidated sand, silt, clay, and gravel while the Bay deposits typically consist of very soft organic-rich silt and clay (Bay mud) or sand.

2.2 AREA AND SITE GEOLOGY

Geologic maps emphasizing bedrock formations in the vicinity of the site have been prepared by Weaver (1949), Sheehan (1956), Wagner (1990), Dibblee (1980), Graymer et al. (1994), and Crane (1995) among others. Weaver (1949), Dibblee (1980), and Graymer et al. (1994) mapped the bedrock as Tertiary age (Late Miocene to Pliocene) Orinda Formation. Sheehan (1956), however, mapped the Tertiary strata near Point Pinole as undifferentiated Contra Costa Group following the suggestion of Savage, Ogle, and Creely (1951). Wagner (1978) mapped exposures of the undifferentiated Contra Costa Group in the vicinity of the site as the “Garrity Member.” Graymer et al. (1994) described the Orinda Formation as non-marine, conglomerate, sandstone and siltstone with abundant rock clasts that have been derived from the Franciscan Complex and other Cretaceous age rocks. Wagner (1978) distinguished the “Garrity Member” from the Orinda Formation and other members of the Contra Costa Group by the presence of significant quantities of reworked Monterey formation detritus such as siliceous shale and chert.

Localized studies, which emphasize the Quaternary (younger than approximately 2.6 million years old) geology in the general area of the site, have been prepared by Helley et al. (1979), Knudsen et al. (1997), Helley and Graymer (1997), Graymer (2000) and Witter, et al. (2006). Generally, the unconsolidated alluvial deposits of Pleistocene age are mapped along slightly elevated areas, while the younger Holocene alluvial deposits are mapped blanketing level zones or young creek channels and drainage courses. Based on information obtained from the extensive fieldwork at the campus during previous fault trench studies, we mapped the level areas of the campus as being underlain by Holocene basin deposits and Holocene fine- to coarse-grained channel deposits near Rheem Creek. The Holocene deposits are presumably underlain by a thicker sequence of older (Pleistocene age) alluvium that is underlain, in turn, by the terrestrial sedimentary bedrock of the Garrity Member of the Contra Costa Group.

According to Graymer (2000), the project site is underlain by late Miocene Orinda formation (map symbol Tor), as shown on Figure 4, Area Geology Map. The Orinda formation is described by Graymer (2000) as distinctly to indistinctly bedded, non-marine, pebble to boulder conglomerate, conglomeratic sandstone, coarse- to medium-grained lithic sandstone, and green and red siltstone and mudstone. Conglomerate clasts are subangular to well rounded, and contain a high percentage of detritus derived from the Franciscan complex.

2.3 SITE RECONNAISSANCE

A Certified Engineering Geologist with our firm performed a site reconnaissance of the project area during middle October 2017 and observed site conditions. The site and surrounding areas are occupied by structures and appear to have been developed completely as part of the college center as far back as the early 1990s on available aerial photographs. The Rheem Creek channel appears to have been shifted southwestward slightly between 1939 and 1993. The area remained essentially unaltered until the recent college center renovations.

2.4 SUBSURFACE CONDITIONS

The subsurface conditions described herein are based on the soil and groundwater conditions encountered during the current and previous geologic and geotechnical investigations in the vicinity of the site area. The project site subsurface consists mostly of fill and native soils underlain by claystone. The fill was encountered in borings B-3 and B-4 measuring between about 8 to 13 feet and generally consisting of very stiff to hard sandy clays. The native soil consisted stiff sandy clays interbedded with clayey sands and gravels, which in turn were underlain by weathered claystone. The claystone was generally weak to strong, moderately to highly weathered, and highly fractured.

Groundwater was not observed and encountered in our current borings. However, groundwater was observed in our previous borings and fault trenches at depths of about 9 to 23 feet below the ground surface. It should be noted that groundwater levels can fluctuate depending on factors such as seasonal rainfall and construction activities on this or adjacent properties, and may rise several feet during a normal rainy season.

The above is a general description of soil and groundwater conditions encountered in the borings from this investigation and our experience at the campus. More detailed descriptions of the subsurface conditions encountered are presented in the Boring Logs on Figures A-4 and A-7 in Appendix A, and on the Boring Logs, and fault trenches from our previous investigations presented in Appendix C.

Soil and groundwater conditions can deviate from those conditions encountered at the boring locations. If significant variations in the subsurface conditions are encountered during construction, Kleinfelder should be notified immediately, and it may be necessary for us to review the recommendations presented herein and recommend adjustments as necessary.

3 FAULTING AND SEISMICITY

The faulting and seismicity of the site and surrounding areas, including a site-specific ground motion analysis is discussed in Appendix E of this report.

4 CONCLUSIONS - GEOLOGIC AND SEISMIC HAZARDS

Discussion and conclusions regarding specific geologic hazards, which could impact the site, are included below. The hazards considered include: fault-related ground surface rupture, seismically-induced ground failures (liquefaction, lateral spreading, and dynamic compaction/seismic settlement), expansive soils, landslides, tsunami/seiches, flooding, naturally-occurring asbestos, soil corrosion, radon gas, and existing fill.

4.1 FAULT-RELATED GROUND SURFACE RUPTURE

Much of the campus, including the project site, is located within an Alquist-Priolo Earthquake Fault Zone, associated with the active Hayward fault. Evidence of fault creep across the campus has been documented for several decades (CDMG, 1980) and was observed and mapped during previous site reconnaissance and studies by our project CEG. Therefore, it is our opinion that the potential for continued surface creep along the main fault trace located to the west/southwest of the project site is high. Because the Hayward fault is known to be active and has been the locus of historic earthquakes with associated ground rupture, the potential for future ground rupture during an earthquake along active traces of this fault within the Contra Costa College campus cannot be ruled out. However, based on historic performance, the knowledge that the main trace is more than more than 400 feet to the southwest from the planned project site, and the knowledge that the Hayward fault ground surface rupture is generally contained along the trace itself and generally not extending for hundreds of feet laterally, we conclude that the potential for fault-related ground surface rupture to impact the planned project is considered low.

4.2 SEISMICALLY-INDUCED GROUND FAILURE

4.2.1 Liquefaction and Lateral Spreading

Soil liquefaction is a condition where saturated, granular soils undergo a substantial loss of strength and deformation due to pore pressure increase resulting from cyclic stress application induced by earthquakes. In the process, the soil acquires mobility sufficient to permit both horizontal and vertical movements if the soil mass is not confined. Soils most susceptible to liquefaction are saturated, loose, clean, uniformly graded, and fine-grained sand deposits. If liquefaction occurs, foundations resting on or within the liquefiable layer may undergo settlements. This will result in reduction of foundation stiffness and capacities.

The campus lies with the Richmond 7.5 Minute Quadrangle, which was partially mapped by CGS during its ongoing effort to map landslide and liquefaction related hazards throughout the San Francisco Bay Area. However, the campus does not lie within the area mapped by CGS. There are no recorded signs of ground failures associated with past earthquakes in Northern California within about 4 km of the project site (Youd and Hoose, 1978). No historic ground failures were reported within approximately 6½ km of the site in the mapped results of Holzer (1998) as a result of the 1989 M6.9 Loma Prieta earthquake.

Based on the subsurface data obtained from our previous and recent investigations at the campus, the project site subsurface consists mostly of interbedded layers of firm to hard fine-grained clayey soils underlain by bedrock. As a result, liquefaction potential at the site is considered minimal due to the soil types encountered.

4.2.2 Dynamic (Seismic) Compaction

Another type of seismically-induced ground failure, which can occur as a result of seismic shaking, is dynamic compaction, or seismic settlement. Such phenomena typically occur in unsaturated, loose granular material or uncompacted fill soils. The subsurface conditions encountered in our borings are not considered conducive to such seismically-induced ground failures since our borings indicate the fill to be comprised mostly of lean to fat clay soils with sand. For this reason we conclude that the potential for shaking related random ground cracking to affect the site and surrounding areas is low.

Furthermore, recommendations have been provided in our concurrent geotechnical engineering investigation (Kleinfelder, 2017) to address the presence of the reported undocumented fill.

4.3 EXPANSIVE SOILS

Based on the results of our concurrent field investigation and laboratory testing program, near-surface soils located within the building site are low to highly expansive. Pertinent mitigation measures addressing the potential presence of expansive soils at the site are presented in our concurrent geotechnical investigation report (Kleinfelder, 2017) for the site.

4.4 EXISTING FILL

Fill measuring between 8 to 13 feet was encountered in our borings B-3 and B-4 which was comprised of interbedded very stiff to hard sandy clays. Our concurrent geotechnical study evaluated the presence of the noted undocumented fill and presented recommendations to mitigate.

4.5 LANDSLIDES

No landslides are mapped in the project area nor did we observe any slope creep or cracks. Therefore, it is our opinion that the potential for seismically induced (or otherwise) landslides and slope failure to occur at the proposed site is considered low.

Rheem Creek is located approximately 200 feet southwest of the project site. Small, shallow localized creek bank sloughing or slumping may occur during a moderate to major seismic event, especially if the slopes are saturated. We would not expect such failures to extend more than approximately 10 feet from the current top of banks. The creek banks do appear to exhibit evidence of soil creep and it is our opinion that soil creep will continue along these banks and could affect any improvements within 10 feet of the top of banks if not mitigated.

4.6 TSUNAMIS, SEICHES, AND FLOODING

Flood hazards are generally considered from three sources:

- Seismically-induced waves (tsunami or seiche);
- Dam failure inundation; and
- Long-cycle storm events.

The site is located more than a mile southeast of the San Pablo Bay at an estimated elevation of about 80 feet above mean sea level. The only historical account of tsunamis impacting the San Francisco Bay area is the "Good Friday" earthquake of 1964 (generated off the coast of Alaska). Run-up at the Golden Gate Bridge was measured at 7.4 feet from the Good Friday earthquake and generally less further to the east. Ritter and Dupre (1972) indicate that the coastal lowland areas, immediately adjacent to San Francisco Bay, are subject to possible inundation from a tsunami with a run up height of 20 feet at the Golden Gate Bridge. Ritter and Dupre's 1972 map does not show the site area to be within an area that could become inundated by tsunami waves. In addition, the California Emergency Management Agency (CalEMA) in concert with CGS and the University of Southern California have prepared tsunami inundation maps for emergency planning in 2009 and these maps indicate that tsunami generated waves will not reach the site area due to its distance from the Bay and prominent water courses.

Based on the above-noted references, the site's distance from the Bay, topographical elevation, and the lack of historically damaging tsunamis and seiches, we judge that the potential for a seismically-induced wave to impact the site should be considered negligible.

The Association of Bay Area Governments (ABAG, 1995) prepared maps that show areas that may be inundated by flood water if nearby dams are overtopped or fail catastrophically. According to ABAG, the site could be inundated by 5 different dams. Based on these maps, the potential for flooding to occur at the site due to nearby dam failure should be considered high.

The East Bay Municipal Utility District North Reservoir, a ground level covered structure, is located approximately ½-mile northeast of the project site near Highland Elementary School. The San Pablo Reservoir/Dam is location approximately 4½ miles southeast of the project site. If these reservoirs were to fail during a seismic event, the project site would flood.

With respect to the 100-year storm events, the Federal Emergency Management Agency's (FEMA, 2009) Flood Insurance Rate Map, Community-Panel Number 06013C0227G, effective date September 30, 2015, indicates that the site is located within **Zone X**, which is defined as **areas determined to be outside the 0.2% annual chance flood plain.**

4.7 NATURALLY-OCCURRING ASBESTOS

The geologic units that underlie the site (Contra Costa Group, alluvium) are not generally known to contain naturally occurring asbestos (NOA). However, the Contra Costa Group contains many conglomerate beds which received sediment/clasts from Franciscan sources during its time of deposition. Therefore, the presence of occasional clasts made up of rock types which may contain NOA (such as serpentinite) cannot be ruled out. The closest mapped formation, which may contain NOA is ultramafic rock located approximately 1½ miles to the southeast according to Graymer et al. (1994) and Churchill and Hill (2000). It is our opinion that the potential for NOA to impact the proposed development at the site is low.

4.8 SOIL CORROSION

Kleinfelder has completed laboratory testing to provide data regarding corrosivity of onsite soils. The testing was performed by a State of California certified laboratory, CERCO Analytical of Concord, California on a selected sample of the near-surface soils. Our scope of services does not include corrosion engineering and, therefore, a detailed analysis of the corrosion test results is not included in this report. A qualified corrosion engineer should be retained to review the test results and design protective systems that may be required. Kleinfelder may be able to provide those services.

Laboratory chloride concentration, sulfate concentration, sulfide concentration, pH, oxidation reduction potential, and electrical resistivity tests were performed on the near surface soil sample. The results of the tests are presented in Appendix C and are summarized and are summarized below in Table 4.8-1. These tests are generalized indicator of soil corrosivity for the sample tested. Other soils on-site may be more, less, or similarly corrosive in nature. Imported fill materials should be tested to confirm that their corrosion potential is not more severe than those noted.

Table 4.8-1
Chemistry Laboratory Test Results

Boring	Depth, feet	Resistivity, ohm-cm		pH	Oxidation Reduction Potential, mV	Water-Soluble Ion Concentration, ppm		
		100% Saturated	In-Situ Moisture			Chloride	Sulfide	Sulfate
B-3	6	1,100	720	7.86	+440	N.D.	N.D.*	N.D.

*N.D. - None Detected

Ferrous metal and concrete elements in contact with soil, whether part of a foundation or part of the supported structure, are subject to degradation due to corrosion or chemical attack. Therefore, buried ferrous metal and concrete elements should be designed to resist corrosion and degradation based on accepted practices.

Based on the "10-point" method developed by the American Water Works Association (AWWA) in standard AWWA C105/A21.5, the soils at the site are corrosive to buried ferrous metal piping, cast iron pipes, or other objects made of these materials. We recommend that a corrosion engineer be consulted to recommend appropriate protective measures.

The degradation of concrete or cement grout can be caused by chemical agents in the soil or groundwater that react with concrete to either dissolve the cement paste or precipitate larger compounds within the concrete, causing cracking and flaking. The concentration of water-soluble sulfates in the soils is a good indicator of the potential for chemical attack of concrete or cement grout. The American Concrete Institute (ACI) in their publication "*Guide to Durable Concrete*" (ACI 201.2R-08) provides guidelines for this assessment. The sulfate tests indicated the sample had no sulfate detected. The results of sulfate test indicate the potential for deterioration of concrete is mild, no special requirements should be necessary for the concrete mix.

Concrete and the reinforcing steel within it are at risk of corrosion when exposed to water-soluble chloride in the soil or groundwater. Chloride tests indicated the sample had no chloride detected. The project structural engineer should review this data to determine if remedial measures are necessary for the concrete reinforcing steel.

4.9 RADON GAS

Radon gas is a naturally-occurring colorless, tasteless, and odorless radioactive gas that forms in soils from the decay of trace amounts of uranium that are naturally present in soils. Radon enters buildings from the surrounding soil through cracks or other openings in foundations, floors over crawlspaces, or basement walls. Once inside a building, radon can become trapped and concentrate to become a health hazard unless the building is properly ventilated to remove radon. Long-term exposure to elevated levels of radon increases one's risk of developing lung cancer.

The U.S. Environmental Protection Agency (EPA) recommends that all homes (or structures intended for human occupancy) be tested for radon whatever their geographic location. The U.S. EPA recommends that action be taken to reduce radon in structures with an average annual level higher than four picocuries per liter (4.0pCi/l).

The California Department of Public Health services (2016) performed 52 tests within Zip Code 94806 (last updated on February 2016) where the school campus is located. Of the 52 tests, none reported a minimum of four (4) picocuries per liter (pCi/L). The maximum results reported was 2.3 pCi/L.

The noted testing is not intended to represent the entire zip code area for determining which buildings have excessive indoor radon levels. In addition to geology, indoor radon levels can be influenced by local variability in factors such as soil permeability and climatic conditions, and by factors such as building design, construction, condition, and usage. Consequently, building specific radon levels can only be determined by indoor radon testing.

Based on the above information, consideration should be given to consult a radon specialist to provide appropriate tests and recommendations to review this concern.

Additional information about radon gas can be found at the following websites:

California Department of Public Health – Indoor Radon Program:
https://www.cdph.ca.gov/Programs/CEH/DRSEM/Pages/EMB/Radon/Radon.aspx

California Geological Survey-Mineral Resources Program:
http://www.conservation.ca.gov/cgs/minerals/hazardous_minerals/radon/Pages/Index.aspx

U.S. EPA: https://www.epa.gov/radon

4.10 VOLCANIC ACTIVITY

There are no known active volcanic sources within the region, therefore the potential for volcanic hazards to impact this site are considered non-existent.

4.11 BEDROCK RIPPABILITY

Excavations can be performed by conventional earthmoving equipment. However, during site grading, foundation and utility trench excavation, localized zones of strong to very strong bedrock, resulting in hard digging, may be encountered. Contractor(s) and subcontractors should expect hard drilling, digging, and excavating and should be prepared to use heavy ripping and excavating equipment, including hydraulic hammers and/or hoe-ram equipment.

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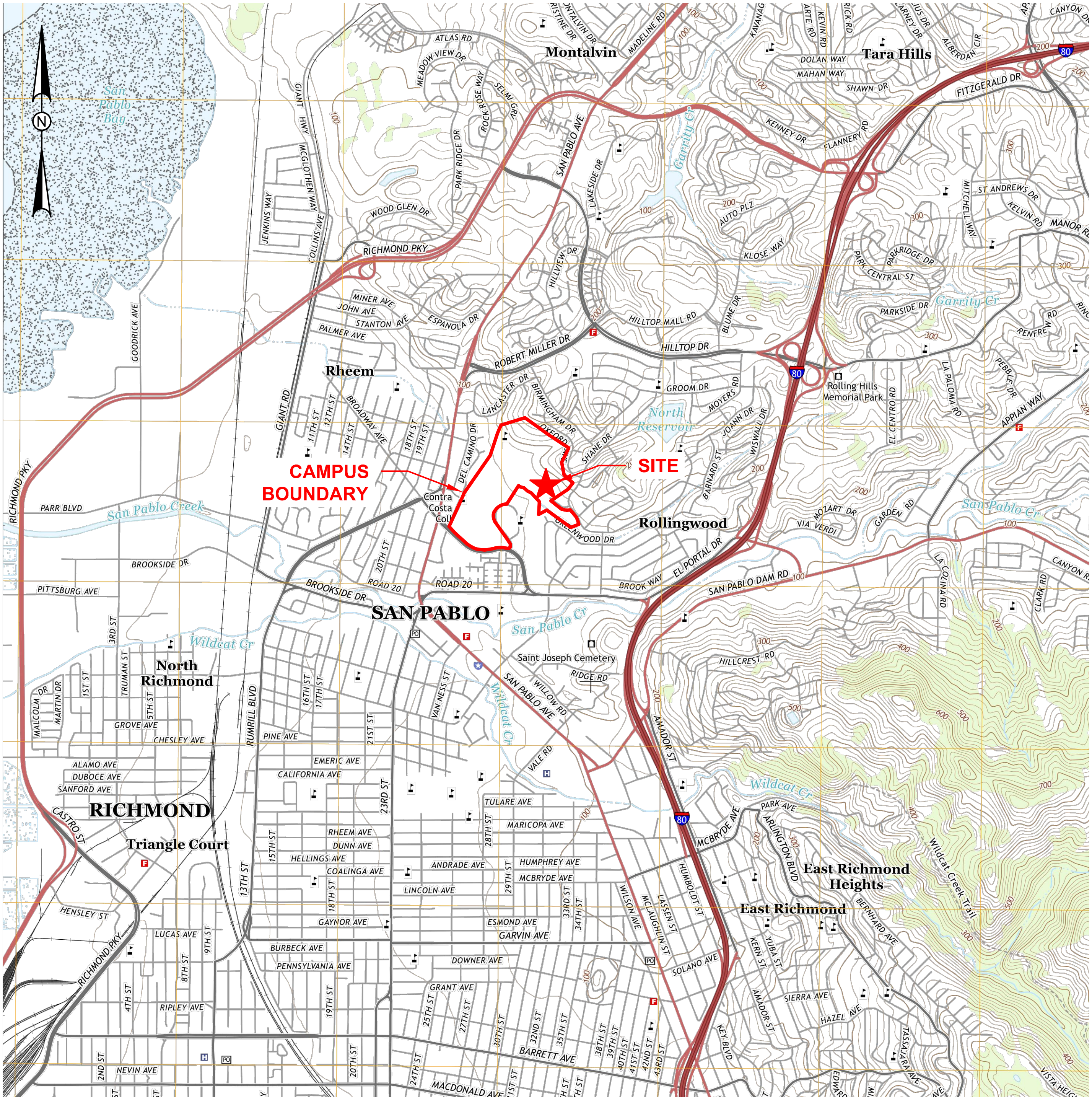
FIGURES

LIST OF ATTACHMENTS

The following figures are attached and complete this appendix.

Figure



REFERENCE:

VICINITY MAP CREATED FROM DATA COMPILED
BY USGS US TOPO RICHMOND, CA.
QUADRANGLE 7.5-MINUTE, 2015

0 3000 6000

SCALE: 1" = 3000' SCALE IN FEET

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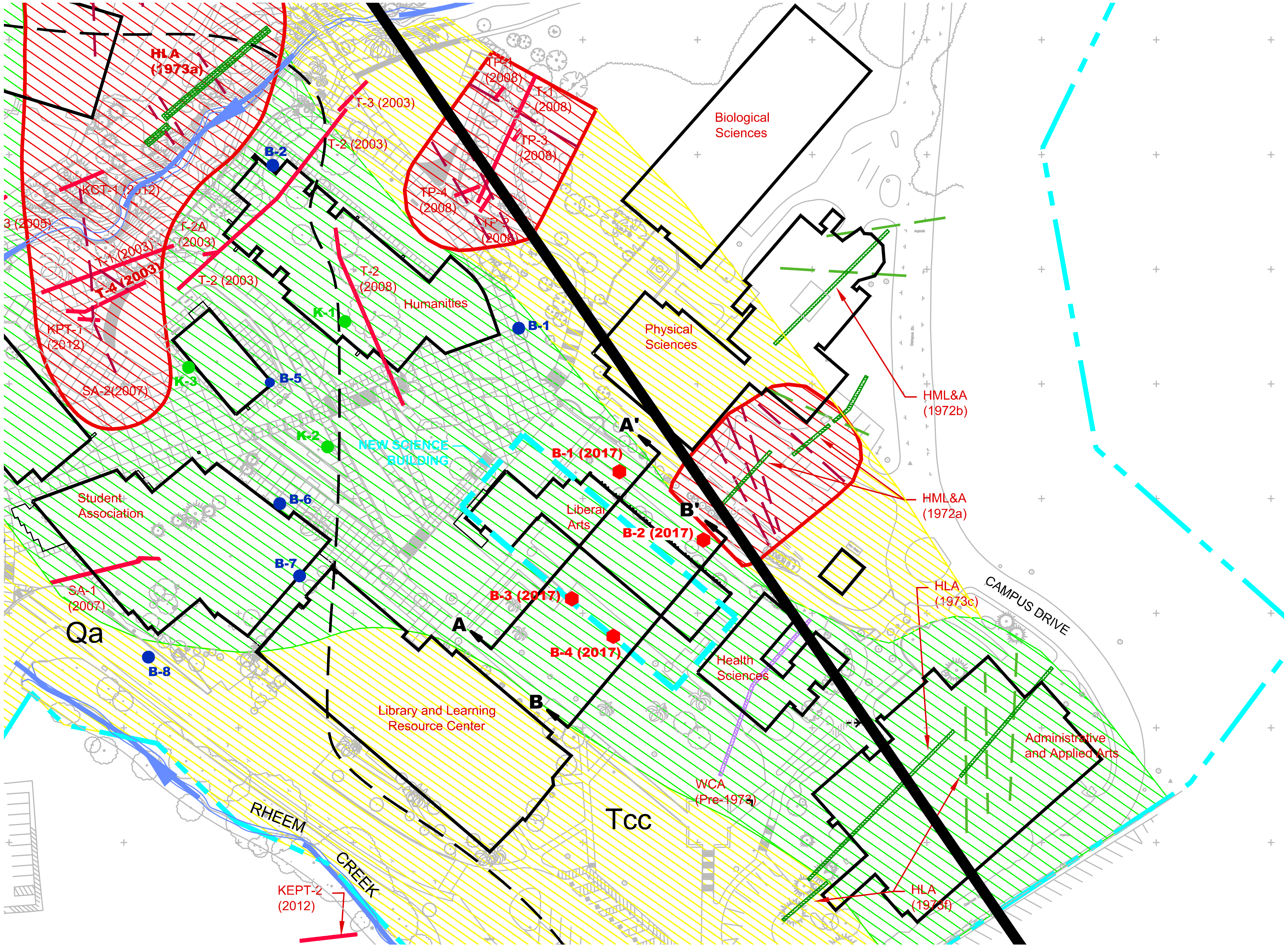
PROJECT NO. 20181569	SITE VICINITY MAP	FIGURE
DRAWN BY: JDS		1
CHECKED BY: OK	CONTRA COSTA COLLEGE NEW SCIENCE BUILDING 2600 MISSION BELL DRIVE SAN PABLO, CALIFORNIA	
DATE: 09/07/2017		
REVISED:		

CAD FILE: W:\2018\20181569.001A_CCCCD_C-4016 GeoSeis\GRAPHICs\GEOHAZ\20181569.dwg
PLOTTED: 9/7/2017 4:45 PM BY: jeff sala



LEGEND

CAMPUS BOUNDARY

APPROXIMATE GEOLOGIC CONTACT (BASED ON GRAYMER, 2000)

EASTERN LIMIT OF APEFZ - by California Geological Survey (CGS)

APPROXIMATE CREEK LOCATION

APPROXIMATE INACTIVE FAULT LOCATION

APPROXIMATE POTENTIALLY ACTIVE FAULT LOCATION

APPROXIMATE FAULT TRENCH LOCATION (report date in parentheses):

HARDING-LAWSON ASSOCIATES (HLA) or (HML&A)

WOODWARD-CLYDE & ASSOCIATES (WCA)

KLEINFELDER, INC.

A' A — GEOLOGIC CROSS SECTION LINE (See Figure 5 for cross section)

B-4 (2017) — SOIL BORING (BY KLEINFELDER, 2017)

B-8 — SOIL BORING (BY KLEINFELDER, 2010)

K-3 — SOIL BORING (BY KLEINFELDER, 2004)

Qa — QUATERNARY ALLUVIUM

Tcc — GARRITY MEMBER, CONTRA COSTA GROUP (TERTIARY)

EXCLUSION ZONE

AREAS NOT CLEARED OF SECONDARY FAULT TRACES (further investigation required)

HABITABLE STRUCTURE ZONE

Reference: Kleinfelder, 2017, Proposed Adjustment of Habitable Zone Boundaries within the Campus of Contra Costa Community College, San Pablo, California, dated August 24, 2017

N

100 50 0 100

APPROXIMATE SCALE (feet)

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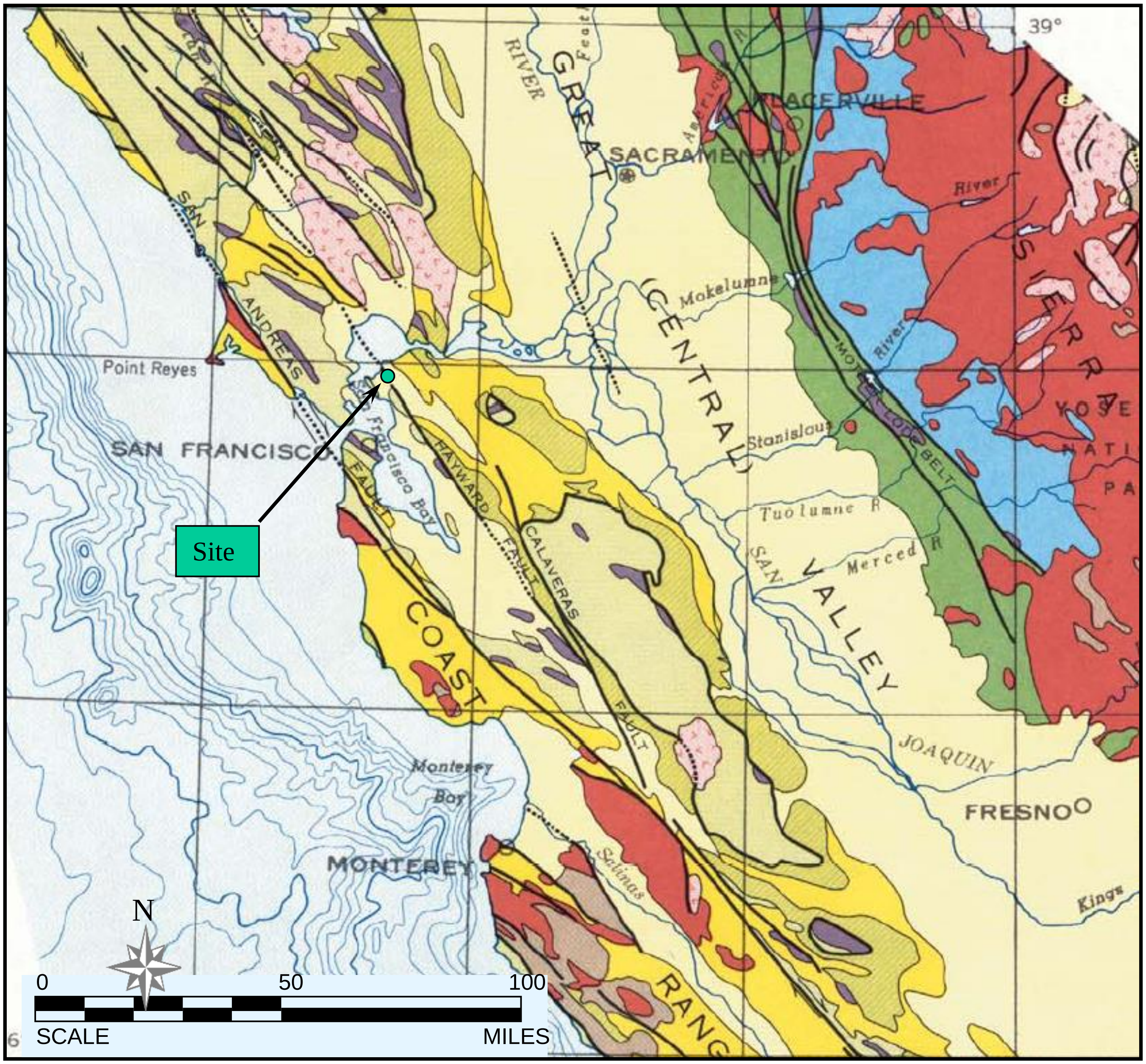
PROJECT NO.	20181569
DRAWN BY	JDS
CHECKED BY	OK
DATE:	10/04/2017
REVISED:	

SITE PLAN AND GEOLOGY MAP

CONTRA COSTA COLLEGE
NEW SCIENCE BUILDING
2600 MISSION BELL DRIVE
SAN PABLO, CALIFORNIA

FIGURE 2



EXPLANATION
of units in SF Bay Area

Cenozoic nonmarine	Mesozoic Granitic rocks
Cenozoic marine	Mesozoic Ultramafic rocks
Late Mesozoic shelf and slope	
Late Mesozoic of the Franciscan Formation	
Fault, dotted where concealed, arrows indicate direction of movement	

Map source: California Geological Survey, 2002, Geologic Map of California, California Department of Conservation.

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PROJECT NO.	20164720
DRAWN:	SEPT 2017
DRAWN BY:	P.H./J.S.
CHECKED BY:	O.K.
FILE NAME:	REGIONAL GEOLOGIC MAP.ppt

REGIONAL GEOLOGIC MAP

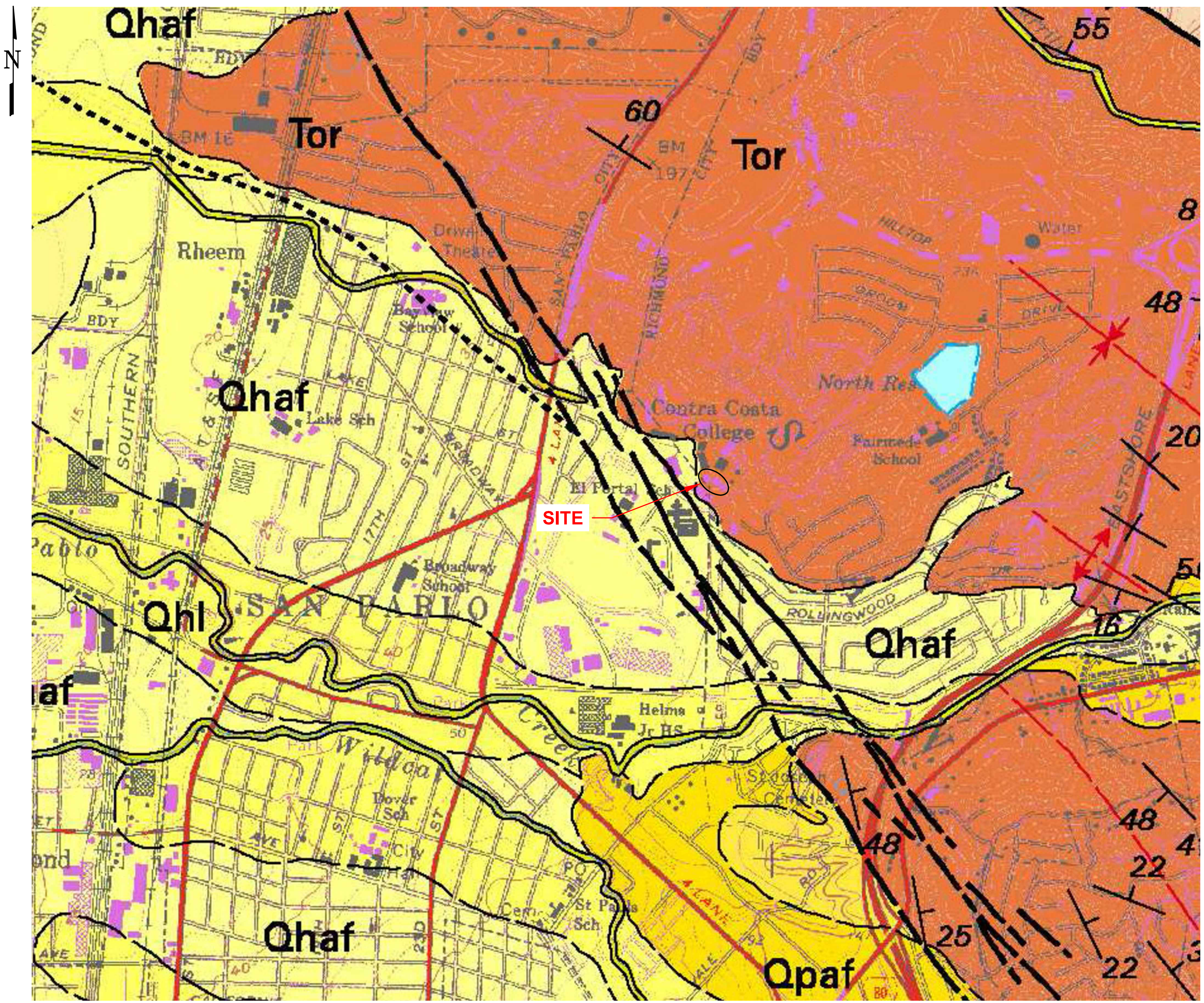
CONTRA COSTA COLLEGE
NEW SCIENCE BUILDING
2600 MISSION BELL DRIVE
SAN PABLO, CALIFORNIA

FIGURE
3

PLOTTED: 10/2/2017 9:31 AM BY: jeff sala

LAYOUT: AREA GEO

CAD FILE: W:\2018\20181569.001A_CCCCD_C-4016 GeoSeis\GRAPHICs\GEOHAZ\20181569_2.dwg



MAP UNITS

Qhaf	ALLUVIAL FAN AND FLUVIAL DEPOSITS (HOLOCENE)
Qhl	NATURAL LEVEE DEPOSITS (HOLOCENE)
Qpaf	ALLUVIAL FAN AND FLUVIAL DEPOSITS (PLEISTOCENE)
Tor	ORINDA FORMATION (LATE MIOCENE)

Contact-- Depositional or intrusive contact, dashed where approximately located, dotted where concealed

Fault-- Dashed where approximately located, small dashes where inferred, dotted where concealed, queried where location is uncertain.

Reverse or thrust fault-- Dashed where approximately located, dotted where concealed

Normal fault-- Dashed where approximately located, dotted where concealed

Anticline-- Shows fold axis, dashed where approximately located, dotted where concealed

Syncline

35 **Strike and dip of bedding**

48 **Strike and dip of bedding, top indicator observed**

60 **Strike and dip of bedding, approximate**

83 **Overturned bedding**

79 **Overturned bedding, top indicator observed**

Horizontal bedding

Vertical bedding

Vertical bedding, top indicator observed

35 **Strike and dip of foliation**

Vertical foliation

35 **Strike and dip of joints**

REFERENCE:

Graymer, R.W., 2000, Geologic Map and map database of the Oakland Metropolitan Area, Alameda, Contra Costa, And San Francisco Counties, California: U.S. Geological Survey, Miscellaneous Field Studies Map MF - 2342, scale 1:50,000.

1200 0 600 1200 2400

APPROXIMATE SCALE: 1 inch = 1,200 feet

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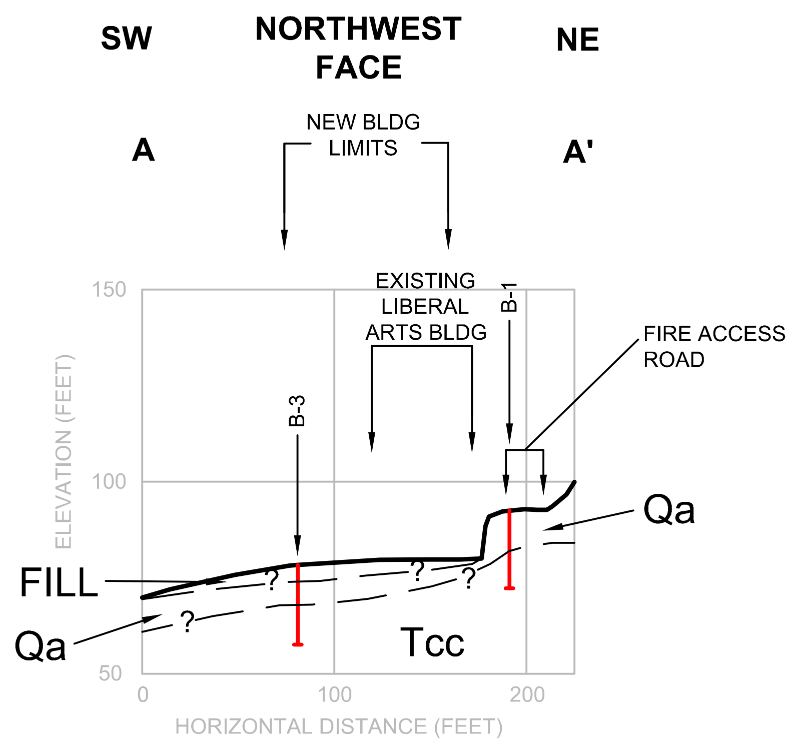
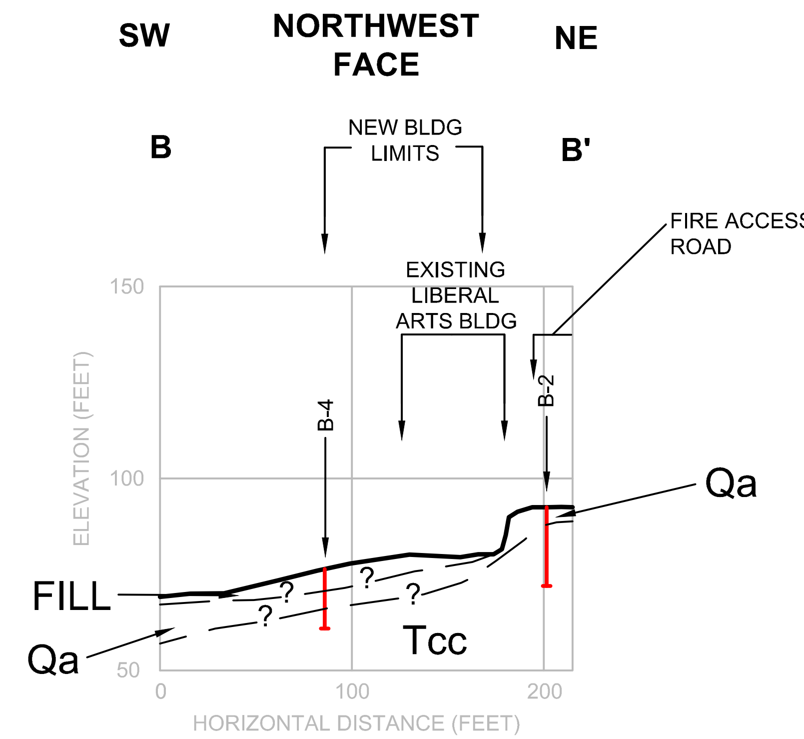
PROJECT NO. 20181569	AREA GEOLOGY MAP		FIGURE
DRAWN BY JDS			
CHECKED BY OK	CONTRA COSTA COLLEGE NEW SCIENCE BUILDING 2600 MISSION BELL DRIVE SAN PABLO, CALIFORNIA		4
DATE: 09/07/2017			
REVISED:			





LEGEND

(heavy line)	GROUND SURFACE
— ? —	CONTACT LINE
Qa	QUATERNARY ALLUVIUM
Tcc	GARRITY MEMBER, CONTRA COSTA GROUP (TERTIARY)

NOTES:
1. LOCATIONS ARE APPROXIMATE.

2. SEE FIGURE 2 FOR APPROXIMATE CROSS SECTION LOCATIONS.

3. THESE CROSS SECTIONS ARE FOR ILLUSTRATIVE PURPOSES ONLY AND ARE BASED ON OUR INTERPRETATION OF THE SUBSURFACE CONDITIONS. THESE CROSS SECTIONS SHOULD NOT BE USED FOR CONSTRUCTION AND SHOULD BE CONSIDERED APPROXIMATE.

N

100 50 0 100
APPROXIMATE SCALE (feet)

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PROJECT NO. 20181569	GEOLOGIC CROSS SECTION A-A' AND B-B'	FIGURE	
DRAWN BY JDS			
CHECKED BY OK	CONTRA COSTA COLLEGE NEW SCIENCE BUILDING 2600 MISSION BELL DRIVE SAN PABLO, CALIFORNIA	5	
DATE: 10/04/2017			
REVISED:			

APPENDIX A

Boring Logs

LIST OF ATTACHMENTS

The following figures are attached and complete this appendix.

SAMPLER AND DRILLING METHOD GRAPHICS

- BULK / GRAB / BAG SAMPLE
- MODIFIED CALIFORNIA SAMPLER (2 or 2-1/2 in. (50.8 or 63.5 mm.) outer diameter)
- CALIFORNIA SAMPLER (3 in. (76.2 mm.) outer diameter)
- STANDARD PENETRATION SPLIT SPOON SAMPLER (2 in. (50.8 mm.) outer diameter and 1-3/8 in. (34.9 mm.) inner diameter)
- SHELBY TUBE SAMPLER
- HOLLOW STEM AUGER
- SOLID STEM AUGER
- WASH BORING

GROUND WATER GRAPHICS

- WATER LEVEL (level where first observed)
- WATER LEVEL (level after exploration completion)
- WATER LEVEL (additional levels after exploration)
- OBSERVED SEEPAGE

NOTES

- The report and graphics key are an integral part of these logs. All data and interpretations in this log are subject to the explanations and limitations stated in the report.
- Lines separating strata on the logs represent approximate boundaries only. Actual transitions may be gradual or differ from those shown.
- No warranty is provided as to the continuity of soil or rock conditions between individual sample locations.
- Logs represent general soil or rock conditions observed at the point of exploration on the date indicated.
- In general, Unified Soil Classification System designations presented on the logs were based on visual classification in the field and were modified where appropriate based on gradation and index property testing.
- Fine grained soils that plot within the hatched area on the Plasticity Chart, and coarse grained soils with between 5% and 12% passing the No. 200 sieve require dual USCS symbols, ie., GW-GM, GP-GM, GW-GC, GP-GC, GC-GM, SW-SM, SP-SM, SW-SC, SP-SC, SC-SM.
- If sampler is not able to be driven at least 6 inches then 50/X indicates number of blows required to drive the identified sampler X inches with a 140 pound hammer falling 30 inches.

ABBREVIATIONS

WOH - Weight of Hammer
WOR - Weight of Rod

UNIFIED SOIL CLASSIFICATION SYSTEM (ASTM D 2487)

COARSE GRAINED SOILS (More than half of material is larger than the #200 sieve)	GRAVELS (More than half of coarse fraction is larger than the #4 sieve)	CLEAN GRAVEL WITH <5% FINES	Cu ≥4 and 1≤ Cc≤3	GW	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE OR NO FINES
			Cu <4 and/ or 1>Cc >3	GP	POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE OR NO FINES
		GRAVELS WITH 5% TO 12% FINES	Cu ≥4 and 1≤ Cc≤3	GW-GM	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE FINES
				GW-GC	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE CLAY FINES
			Cu <4 and/ or 1>Cc >3	GP-GM	POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE FINES
				GP-GC	POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE CLAY FINES
		GRAVELS WITH > 12% FINES		GM	SILTY GRAVELS, GRAVEL-SILT-SAND MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES
				GC-GM	CLAYEY GRAVELS, GRAVEL-SAND-CLAY-SILT MIXTURES
	SANDS (More than half of coarse fraction is smaller than the #4 sieve)	CLEAN SANDS WITH <5% FINES	Cu ≥6 and 1≤ Cc≤3	SW	WELL-GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE OR NO FINES
			Cu <6 and/ or 1>Cc >3	SP	POORLY GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE OR NO FINES
		SANDS WITH 5% TO 12% FINES	Cu ≥6 and 1≤ Cc≤3	SW-SM	WELL-GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE FINES
				SW-SC	WELL-GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE CLAY FINES
			Cu <6 and/ or 1>Cc >3	SP-SM	POORLY GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE FINES
				SP-SC	POORLY GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE CLAY FINES
		SANDS WITH > 12% FINES		SM	SILTY SANDS, SAND-GRAVEL-SILT MIXTURES
				SC	CLAYEY SANDS, SAND-GRAVEL-CLAY MIXTURES
				SC-SM	CLAYEY SANDS, SAND-SILT-CLAY MIXTURES

FINE GRAINED SOILS (More than half of material is smaller than the #200 sieve)	SILTS AND CLAYS (Liquid Limit less than 50)	ML	INORGANIC SILTS AND VERY FINE SANDS, SILTY OR CLAYEY FINE SANDS, SILTS WITH SLIGHT PLASTICITY
		CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
		CL-ML	INORGANIC CLAYS-SILTS OF LOW PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
		OL	ORGANIC SILTS & ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS (Liquid Limit greater than 50)	MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILT
		CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
		OH	ORGANIC CLAYS & ORGANIC SILTS OF MEDIUM-TO-HIGH PLASTICITY

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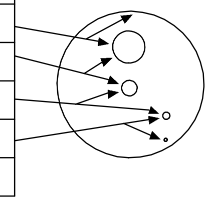
PROJECT NO.: 20181569	GRAPHICS KEY	FIGURE
DRAWN BY: MAP/JDS		
CHECKED BY: OK	CONTRA COSTA COMMUNITY COLLEGE NEW SCIENCE BUILDING 2600 MISSION BELL DRIVE SAN PABLO, CALIFORNIA	A-1
DATE: 9/19/2017		
REVISED: -		

GRAIN SIZE

DESCRIPTION		SIEVE SIZE	GRAIN SIZE	APPROXIMATE SIZE
Boulders		>12 in. (304.8 mm.)	>12 in. (304.8 mm.)	Larger than basketball-sized
Cobbles		3 - 12 in. (76.2 - 304.8 mm.)	3 - 12 in. (76.2 - 304.8 mm.)	Fist-sized to basketball-sized
Gravel	coarse	3/4 -3 in. (19 - 76.2 mm.)	3/4 -3 in. (19 - 76.2 mm.)	Thumb-sized to fist-sized
	fine	#4 - 3/4 in. (#4 - 19 mm.)	0.19 - 0.75 in. (4.8 - 19 mm.)	Pea-sized to thumb-sized
Sand	coarse	#10 - #4	0.079 - 0.19 in. (2 - 4.9 mm.)	Rock salt-sized to pea-sized
	medium	#40 - #10	0.017 - 0.079 in. (0.43 - 2 mm.)	Sugar-sized to rock salt-sized
	fine	#200 - #40	0.0029 - 0.017 in. (0.07 - 0.43 mm.)	Flour-sized to sugar-sized
Fines		Passing #200	<0.0029 in. (<0.07 mm.)	Flour-sized and smaller



SECONDARY CONSTITUENT

Term of Use	AMOUNT: Secondary Constituent is Fine Grained	AMOUNT: Secondary Constituent is Coarse Grained
Trace	<5%	<15%
With	≥5 to <15%	≥15 to <30%
Modifier	≥15%	≥30%

MOISTURE CONTENT

DESCRIPTION	FIELD TEST
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, usually soil is below water table

CEMENTATION

DESCRIPTION	FIELD TEST
Weakly	Crumbles or breaks with handling or slight finger pressure
Moderately	Crumbles or breaks with considerable finger pressure
Strongly	Will not crumble or break with finger pressure

CONSISTENCY - FINE-GRAINED SOIL

CONSISTENCY	SPT - N_{60} (# blows / ft)	Pocket Pen (tsf)	UNCONFINED COMPRESSIVE STRENGTH (Q_u)(psf)	VISUAL / MANUAL CRITERIA
Very Soft	<2	PP < 0.25	<500	Thumb will penetrate more than 1 inch (25 mm). Extrudes between fingers when squeezed.
Soft	2 - 4	0.25≤ PP <0.5	500 - 1000	Thumb will penetrate soil about 1 inch (25 mm). Remolded by light finger pressure.
Medium Stiff	4 - 8	0.5≤ PP <1	1000 - 2000	Thumb will penetrate soil about 1/4 inch (6 mm). Remolded by strong finger pressure.
Stiff	8 - 15	1≤ PP <2	2000 - 4000	Can be imprinted with considerable pressure from thumb.
Very Stiff	15 - 30	2≤ PP <4	4000 - 8000	Thumb will not indent soil but readily indented with thumbnail.
Hard	>30	4≤ PP	>8000	Thumbnail will not indent soil.

FROM TERZAGHI AND PECK, 1948; LAMBE AND WHITMAN, 1969; FHWA, 2002; AND ASTM D2488

REACTION WITH HYDROCHLORIC ACID

DESCRIPTION	FIELD TEST
None	No visible reaction
Weak	Some reaction, with bubbles forming slowly
Strong	Violent reaction, with bubbles forming immediately

APPARENT / RELATIVE DENSITY - COARSE-GRAINED SOIL

APPARENT DENSITY	SPT-N_{60} (# blows/ft)	MODIFIED CA SAMPLER (# blows/ft)	CALIFORNIA SAMPLER (# blows/ft)	RELATIVE DENSITY (%)
Very Loose	<4	<4	<5	0 - 15
Loose	4 - 10	5 - 12	5 - 15	15 - 35
Medium Dense	10 - 30	12 - 35	15 - 40	35 - 65
Dense	30 - 50	35 - 60	40 - 70	65 - 85
Very Dense	>50	>60	>70	85 - 100

FROM TERZAGHI AND PECK, 1948

PLASTICITY

DESCRIPTION	LL	FIELD TEST
Non-plastic	NP	A 1/8-in. (3 mm.) thread cannot be rolled at any water content.
Low (L)	< 30	The thread can barely be rolled and the lump or thread cannot be formed when drier than the plastic limit.
Medium (M)	30 - 50	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. The lump or thread crumbles when drier than the plastic limit.
High (H)	> 50	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rerolled several times after reaching the plastic limit. The lump or thread can be formed without crumbling when drier than the plastic limit.

STRUCTURE

DESCRIPTION	CRITERIA
Stratified	Alternating layers of varying material or color with layers at least 1/4-in. thick, note thickness.
Laminated	Alternating layers of varying material or color with the layer less than 1/4-in. thick, note thickness.
Fissured	Breaks along definite planes of fracture with little resistance to fracturing.
Slickensided	Fracture planes appear polished or glossy, sometimes striated.
Blocky	Cohesive soil that can be broken down into small angular lumps which resist further breakdown.
Lensed	Inclusion of small pockets of different soils, such as small lenses of sand scattered through a mass of clay; note thickness.

ANGULARITY

DESCRIPTION	CRITERIA
Angular	Particles have sharp edges and relatively plane sides with unpolished surfaces.
Subangular	Particles are similar to angular description but have rounded edges.
Subrounded	Particles have nearly plane sides but have well-rounded corners and edges.
Rounded	Particles have smoothly curved sides and no edges.

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PROJECT NO.:	20181569
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DATE:	9/19/2017
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SOIL DESCRIPTION KEY

CONTRA COSTA COMMUNITY COLLEGE
NEW SCIENCE BUILDING
2600 MISSION BELL DRIVE
SAN PABLO, CALIFORNIA

FIGURE

A-2

INFILLING TYPE

NAME	ABBR	NAME	ABBR
Albite	Al	Muscovite	Mus
Apatite	Ap	None	No
Biotite	Bi	Pyrite	Py
Clay	Cl	Quartz	Qz
Calcite	Ca	Sand	Sd
Chlorite	Ch	Sericite	Ser
Epidote	Ep	Silt	Si
Iron Oxide	Fe	Talc	Ta
Manganese	Mn	Unknown	Uk

DENSITY/SPACING OF DISCONTINUITIES

DESCRIPTION	SPACING CRITERIA
Unfractured	>6 ft. (>1.83 meters)
Slightly Fractured	2 - 6 ft. (0.061 - 1.83 meters)
Moderately Fractured	8 in - 2 ft. (203.20 - 609.60 mm)
Highly Fractured	2 - 8 in (50.80 - 203.30 mm)
Intensely Fractured	<2 in (<50.80 mm)

ADDITIONAL TEXTURAL ADJECTIVES

DESCRIPTION	RECOGNITION
Pit (Pitted)	Pinhole to 0.03 ft. (3/8 in.) (>1 to 10 mm.) openings
Vug (Vuggy)	Small openings (usually lined with crystals) ranging in diameter from 0.03 ft. (3/8 in.) to 0.33 ft. (4 in.) (10 to 100 mm.)
Cavity	An opening larger than 0.33 ft. (4 in.) (100 mm.), size descriptions are required, and adjectives such as small, large, etc., may be used
Honeycombed	If numerous enough that only thin walls separate individual pits or vugs, this term further describes the preceding nomenclature to indicate cell-like form.
Vesicle (Vesicular)	Small openings in volcanic rocks of variable shape and size formed by entrapped gas bubbles during solidification.

ADDITIONAL TEXTURAL ADJECTIVES

DESCRIPTION	CRITERIA
Unweathered	No evidence of chemical / mechanical alternation; rings with hammer blow.
Slightly Weathered	Slight discoloration on surface; slight alteration along discontinuities; <10% rock volume altered.
Moderately Weathered	Discoloring evident; surface pitted and alteration penetration well below surface; Weathering "halos" evident; 10-50% rock altered.
Highly Weathered	Entire mass discolored; Alteration pervading most rock, some slight weathering pockets; some minerals may be leached out.
Decomposed	Rock reduced to soil with relic rock texture/structure; Generally molded and crumbled by hand.

RELATIVE HARDNESS / STRENGTH DESCRIPTIONS

GRADE		UCS (Mpa)	FIELD TEST
R0	Extremely Weak	0.25 - 1.0	Indented by thumbnail
R1	Very Weak	1.0 - 5.0	Crumbles under firm blows of geological hammer, can be peeled by a pocket knife.
R2	Weak	5.0 - 25	Can be peeled by a pocket knife with difficulty, shallow indentations made by firm blow with point of geological hammer.
R3	Medium Strong	25 - 50	Cannot be scraped or peeled with a pocket knife, specimen can be fractured with a single firm blow of a geological hammer.
R4	Strong	50 - 100	Specimen requires more than one blow of geological hammer to fracture it.
R5	Very Strong	100 - 250	Specimen requires many blows of geological hammer to fracture it.
R6	Extremely Strong	> 250	Specimen can only be chipped with a geological hammer.

ROCK QUALITY DESIGNATION (RQD)

DESCRIPTION	RQD (%)
Very Poor	0 - 25
Poor	25 - 50
Fair	50 - 75
Good	75 - 90
Excellent	90 - 100

APERTURE

DESCRIPTION	CRITERIA [in (mm)]
Tight	<0.04 (<1)
Open	0.04 - 0.20 (1 - 5)
Wide	>0.20 (>5)

BEDDING CHARACTERISTICS

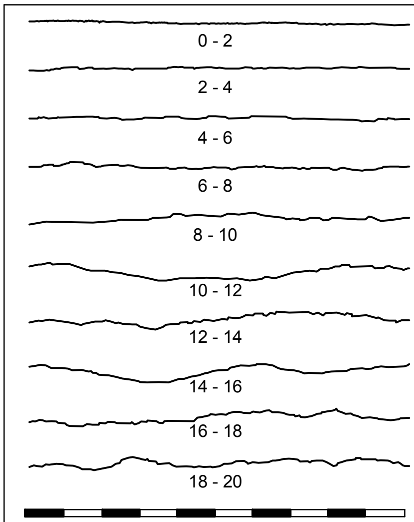
DESCRIPTION	Thickness [in (mm)]
Very Thick Bedded	>36 (>915)
Thick Bedded	12 - 36 (305 - 915)
Moderately Bedded	4 - 12 (102 - 305)
Thin Bedded	1 - 4 (25 - 102)
Very Thin Bedded	0.4 - 1 (10 - 25)
Laminated	0.1 - 0.4 (2.5 - 10)
Thinly Laminated	<0.1 (<2.5)

Bedding Planes — Planes dividing the individual layers, beds, or stratigraphy of rocks.

Joint — Fracture in rock, generally more or less vertical or traverse to bedding.

Seam — Applies to bedding plane with unspecified degree of weather.

JOINT ROUGHNESS COEFFICIENT (JRC)



From Barton and Choubey, 1977

RQD — Rock-quality designation (RQD) Rough measure of the degree of jointing or fracture in a rock mass, measured as a percentage of the drill core in lengths of 10 cm. or more.

CORE SAMPLER TYPE GRAPHICS

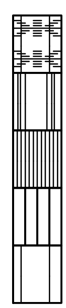
CORE SAMPLER

AQ CORE BARREL
(1.067 in. (27.1 mm.) core diameter)

AX CORE BARREL
(1.185 in. (30.1 mm.) core diameter)

BQ CORE BARREL
(1.433 in. (36.4 mm.) core diameter)

CONTINUOUS CORE SAMPLE
(2.000 in. (50.8 mm.) core diameter)



EX CORE BARREL
(0.846 in. (21.5 mm.) core diameter)

HQ CORE SAMPLE
(2.500 in. (63.5 mm.) core diameter)

NQ CORE SAMPLE
(1.874 in. (47.6 mm.) core diameter)

NO RECOVERY CORE SAMPLE

NX CORE SAMPLE
(2.154 in. (54.7 mm.) core diameter)

KLEINFELDER Bright People. Right Solutions.	PROJECT NO.: 20181569 DRAWN BY: MAP/JDS CHECKED BY: OK DATE: 9/19/2017 REVISED: -	ROCK DESCRIPTION KEY CONTRA COSTA COMMUNITY COLLEGE NEW SCIENCE BUILDING 2600 MISSION BELL DRIVE SAN PABLO, CALIFORNIA	FIGURE A-3

BORING LOG B-1

Date Begin - End:	8/11/2017	**Drilling Co.-Lic.#:**	Gregg - #CA107979
Logged By:	J. Anderson	**Drill Crew:**	Jeremy
Hor.-Vert. Datum:	Not Available	**Drilling Equipment:**	Truck Mounted M11
Plunge:	-90 degrees	**Drilling Method:**	Hollow Stem Auger
Weather:	Cloudy	**Exploration Diameter:**	Approx. 6 in.

Hammer Type - Drop: 140 lb. Auto - 30 in.

FIELD EXPLORATION

Latitude: 37.96986° N
Longitude: -122.33678° E
Approximate Ground Surface Elevation (ft.): 92.00
Surface Condition: Asphalt

LABORATORY RESULTS

Approximate Elevation (feet)	Depth (feet)	Lithologic Description	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in. Pocket Pen(PP)= tsf	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
	0	approximately 2-inches of asphalt											
90		**Sandy Lean CLAY with Gravel (CL)**: low plasticity, yellowish brown, moist, stiff to very stiff, subrounded to subangular gravel		BC=5 7 9	12"		18.9	109.7					
85	5	olive brown, stiff to very stiff		BC=5 6 8	12"		19.1	108.8					TXUU: c = 2.12 ksf
80	10	**Sandy Lean CLAY (CL)**: fine-grained sand, some gravel, medium plasticity, reddish yellow mottled, moist, very stiff		BC=6 10 14	12"		14.0	115.8					TXUU: c = 2.55 ksf
		some angular claystone fragments, yellowish brown, hard											
75	15			BC=12 18 22	12"								
70	20	**CLAYSTONE**: fine-grained, medium plasticity, yellowish brown, moderately weathered, weak to medium strong		BC=22 36 50/5"	11"								
65	25			BC=11 29 50	12"								
60	30	moderately weathered, weak to medium strong, interbedded with siltstone		BC=29 50/3"	8"								

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PROJECT NO.:	20181569
DRAWN BY:	MAP/JDS
CHECKED BY:	OK
DATE:	9/19/2017
REVISED:	-

BORING LOG B-1

CONTRA COSTA COMMUNITY COLLEGE
NEW SCIENCE BUILDING
2600 MISSION BELL DRIVE
SAN PABLO, CALIFORNIA

FIGURE
A-4

Date Begin - End:	8/11/2017	**Drilling Co.-Lic.#:**	Gregg - #CA107979		**BORING LOG B-1**
Logged By:	J. Anderson	**Drill Crew:**	Jeremy		
Hor.-Vert. Datum:	Not Available	**Drilling Equipment:**	Truck Mounted M11	**Hammer Type - Drop:**	140 lb. Auto - 30 in.
Plunge:	-90 degrees	**Drilling Method:**	Hollow Stem Auger		
Weather:	Cloudy	**Exploration Diameter:**	Approx. 6 in.		

FIELD EXPLORATION: Latitude: 37.96986° N; Longitude: -122.33678° E; Approximate Ground Surface Elevation (ft.): 92.00; Surface Condition: Asphalt

Approximate Elevation (feet)	Depth (feet)	Graphical Log	Lithologic Description	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in. Pocket Pen(PP)= tsf	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
55			**CLAYSTONE**: fine-grained, yellowish brown, moderately weathered, medium strong		BC=26 50	2"								
	40		- light brownish gray, slightly weathered, medium strong to strong		BC=44 50/2"	8"								
50														
	45													
45														
	50													
40														
	55													
35														
	60													
30														
	65													
25														

The boring was terminated at approximately 40.5 ft. below ground surface. The boring was backfilled with cement grout on August 11, 2017.

GROUNDWATER LEVEL INFORMATION:
Groundwater was not observed during drilling or after completion.
GENERAL NOTES:
The exploration location and elevation are approximate and were estimated by Kleinfelder.

Date Begin - End:	8/11/2017	**Drilling Co.-Lic.#:**	Gregg - #CA107979		**BORING LOG B-2**
Logged By:	J. Anderson	**Drill Crew:**	Jeremy		
Hor.-Vert. Datum:	Not Available	**Drilling Equipment:**	Truck Mounted M11	**Hammer Type - Drop:**	140 lb. Auto - 30 in.
Plunge:	-90 degrees	**Drilling Method:**	Hollow Stem Auger		
Weather:	Cloudy	**Exploration Diameter:**	Approx. 6 in.		

FIELD EXPLORATION / LABORATORY RESULTS

Latitude: 37.96973° N
Longitude: -122.33647° E
Approximate Ground Surface Elevation (ft.): 93.00
Surface Condition: Asphalt

Approximate Elevation (feet)	Depth (feet)	Graphical Log	Lithologic Description	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in. Pocket Pen(PP)= tsf	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
			approximately 2-inches of asphalt											
			Clayey SAND (SC): fine to medium-grained sand, low plasticity, mottled yellowish brown, dry, medium dense		BC=10 12 14	12"								
90			**Lean CLAY (CL)**: medium plasticity, yellowish brown, moist, very stiff					11.3	110.8					
	5		**CLAYSTONE**: fine-grained, yellowish brown, moderately weathered to highly weathered, weak to medium strong		BC=17 18 26	6"								
85														
			reddish yellow, fragmented moderately weathered, weak to medium strong											
	10				BC=16 14 50/4"	10"		9.5	118.9					
80														
	15		olive brown, weak to medium strong		BC=14 36 50/5"	2"								Very hard drilling
75														
	20		- yellowish brown with reddish brown stains, moderately weathered, intensely fractured medium strong		BC=23 50	4"								
70														
	25		weak		BC=13 14 20	2"								
65														
	30		medium-grained, yellow, moderately weathered, weak, highly fractured, interbedded with subrounded gravel		BC=11 18 34	10"								
60														

Date Begin - End:	8/11/2017	**Drilling Co.-Lic.#:**	Gregg - #CA107979
Logged By:	J. Anderson	**Drill Crew:**	Jeremy
Hor.-Vert. Datum:	Not Available	**Drilling Equipment:**	Truck Mounted M11
Plunge:	-90 degrees	**Drilling Method:**	Hollow Stem Auger
Weather:	Cloudy	**Exploration Diameter:**	Approx. 6 in.

BORING LOG B-2

Hammer Type - Drop: 140 lb. Auto - 30 in.

FIELD EXPLORATION

Latitude: 37.96973° N
Longitude: -122.33647° E
Approximate Ground Surface Elevation (ft.): 93.00
Surface Condition: Asphalt

LABORATORY RESULTS

Approximate Elevation (feet)	Depth (feet)	Graphical Log	Lithologic Description	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in. Pocket Pen(PP)= tsf	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
55			**CLAYSTONE**: fine-grained, yellowish brown, moderately weathered to highly weathered, weak to medium strong fine-grained, light brownish gray, weak to medium strong, highly fractured		BC=9 29 50/5"	3"								
	40				BC=21 50									
50	45													
45	50													
40	55													
35	60													
30	65													
25														

The boring was terminated at approximately 41 ft. below ground surface. The boring was backfilled with cement grout on August 11, 2017.

GROUNDWATER LEVEL INFORMATION:
Groundwater was not observed during drilling or after completion.
GENERAL NOTES:
The exploration location and elevation are approximate and were estimated by Kleinfelder.

KLEINFELDER Bright People. Right Solutions.	PROJECT NO.: 20181569	BORING LOG B-2	FIGURE
	DRAWN BY: MAP/JDS		A-5
	CHECKED BY: OK	CONTRA COSTA COMMUNITY COLLEGE NEW SCIENCE BUILDING 2600 MISSION BELL DRIVE SAN PABLO, CALIFORNIA	
	DATE: 9/19/2017		
	REVISED: -		PAGE: 2 of 2

BORING LOG B-3

Date Begin - End: 8/18/2017
Logged By: J. Anderson
Hor.-Vert. Datum: Not Available
Plunge: -90 degrees
Weather: Overcast
Drilling Co.-Lic.#: Gregg - #CA107979
Drill Crew: Jeremy and Leo
Drilling Equipment: D42
Drilling Method: Hollow Stem Auger
Exploration Diameter: Approx. 6 in.
Hammer Type - Drop: 140 lb. Auto - 30 in.

FIELD EXPLORATION / LABORATORY RESULTS

Latitude: 37.96965° N
Longitude: -122.33695° E
Approximate Ground Surface Elevation (ft.): 80.00
Surface Condition: Grass

Approximate Elevation (feet)	Depth (feet)	Lithologic Description	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in. Pocket Pen(PP)= tsf	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
		Sandy Lean CLAY (CL): medium plasticity, olive brown, moist, very stiff, (FILL)		BC=3 8 13	12"						27	12	
75	5	**Lean CLAY with Sand (CL)**: medium plasticity, olive brown, moist, very stiff, (FILL)		BC=4 8 12	11"								
		Sandy Lean CLAY (CL): medium plasticity, yellowish brown, moist, stiff											
70	10			BC=2 4 7	12"		26.8	94.7					TXUU: c = 1.25 ksf
65	15	**Clayey SAND (SC)**: non-plastic to low plasticity, yellowish brown, moist, loose		BC=4 4 5	12"	SC				49	33	18	
60	20	**CLAYSTONE**: fine-grained, olive brown, weak to medium strong, interbedded with siltstone		BC=20 42 50/5"	11"								
55	25	light gray, medium strong to strong		BC=40 50/5"	11"								
50	30	moderately to slightly weathered, weak, highly fractured		BC=20 25 26	12"								

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PROJECT NO.:	20181569
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BORING LOG B-3

CONTRA COSTA COMMUNITY COLLEGE
NEW SCIENCE BUILDING
2600 MISSION BELL DRIVE
SAN PABLO, CALIFORNIA

FIGURE
A-6

Date Begin - End: 8/18/2017	**Drilling Co.-Lic.#:** Gregg - #CA107979		**BORING LOG B-3**
Logged By: J. Anderson	**Drill Crew:** Jeremy and Leo		
Hor.-Vert. Datum: Not Available	**Drilling Equipment:** D42	**Hammer Type - Drop:** 140 lb. Auto - 30 in.	
Plunge: -90 degrees	**Drilling Method:** Hollow Stem Auger		
Weather: Overcast	**Exploration Diameter:** Approx. 6 in.		

Latitude: 37.96965° N
Longitude: -122.33695° E
Approximate Ground Surface Elevation (ft.): 80.00
Surface Condition: Grass

Approximate Elevation (feet)	Depth (feet)	Graphical Log	FIELD EXPLORATION: Lithologic Description	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in. Pocket Pen(PP)= tsf	Recovery (NR=No Recovery)	LABORATORY RESULTS: USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
			CLAYSTONE: fine-grained, olive gray, weak		BC=18 27 30	12"								
40	40		olive, medium strong		BC=17 36 50/5"									
35	45													
30	50													
25	55													
20	60													
15	65													

The boring was terminated at approximately 41.5 ft. below ground surface. The boring was backfilled with cement grout on August 18, 2017.

GROUNDWATER LEVEL INFORMATION:
Groundwater was not observed during drilling or after completion.

GENERAL NOTES:
The exploration location and elevation are approximate and were estimated by Kleinfelder.

KLEINFELDER Bright People. Right Solutions.	PROJECT NO.: 20181569	BORING LOG B-3	FIGURE
	DRAWN BY: MAP/JDS		A-6
	CHECKED BY: OK	CONTRA COSTA COMMUNITY COLLEGE NEW SCIENCE BUILDING 2600 MISSION BELL DRIVE SAN PABLO, CALIFORNIA	
	DATE: 9/19/2017		
	REVISED: -		PAGE: 2 of 2

Date Begin - End:	8/18/2017	**Drilling Co.-Lic.#:**	Gregg - #CA107979		**BORING LOG B-4**
Logged By:	J. Anderson	**Drill Crew:**	Jeremy and Leo		
Hor.-Vert. Datum:	Not Available	**Drilling Equipment:**	D42	**Hammer Type - Drop:**	140 lb. Auto - 30 in.
Plunge:	-90 degrees	**Drilling Method:**	Hollow Stem Auger		
Weather:	Overcast	**Exploration Diameter:**	Approx. 6 in.		

Latitude: 37.96953° N
Longitude: -122.33673° E
Approximate Ground Surface Elevation (ft.): 80.00
Surface Condition: Grass

Approximate Elevation (feet)	Depth (feet)	Lithologic Description	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in. Pocket Pen(PP)= tsf	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
		Lean Fat CLAY with Sand (CL): medium to high plasticity, olive brown, moist, hard, (FILL)											
				BC=11 13 16 PP=4-4.5+	11"								
75	5	**Lean CLAY with Sand (CL)**: medium plasticity, olive brown, moist, hard, (FILL)		BC=9 12 23 PP=4.5	12"						43	28	
70	10	increase in sand content, very stiff, organics, brick fragments; with gravel and brick at 11.5 feet		BC=9 11 12 PP=1.5-1.75									
		Clayey GRAVEL with Sand (GC): dark brown, moist, medium dense, fine to coarse gravel											
65	15	**Clayey SAND with Gravel (SC)**: medium to coarse-grained, olive brown, moist, medium dense		BC=17 18 12						16			
60	20	**Sandy CLAYSTONE**: fine-grained, olive, weak to medium strong, moderately weathered, interbedded with siltstone		BC=20 27 25	12"								
55	25	medium strong		BC=18 33 48	12"								
50	30	medium strong to strong		BC=27 50/5"									

The boring was terminated at approximately 31 ft. below ground surface. The boring was backfilled with cement grout on August 18, 2017.

GROUNDWATER LEVEL INFORMATION:
Groundwater was not observed during drilling or after completion.

GENERAL NOTES:
The exploration location and elevation are approximate and were estimated by Kleinfelder.

PROJECT NO.:	20181569	BORING LOG B-4	FIGURE
DRAWN BY:	MAP/JDS		A-7
CHECKED BY:	OK	CONTRA COSTA COMMUNITY COLLEGE NEW SCIENCE BUILDING 2600 MISSION BELL DRIVE SAN PABLO, CALIFORNIA	
DATE:	9/19/2017		
REVISED:	-		PAGE: 1 of 1

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APPENDIX B

Laboratory Results

LIST OF ATTACHMENTS

The following figures are attached and complete this appendix.

Exploration ID	Depth (ft.)	Sample Description	Water Content (%)	Dry Unit Wt. (pcf)	Sieve Analysis (%)			Atterberg Limits			Additional Tests
					Passing 3/4"	Passing #4	Passing #200	Liquid Limit	Plastic Limit	Plasticity Index	
B-1	2.5	YELLOWISH BROWN SANDY LEAN CLAY WITH GRAVEL (CL)	18.9	109.7							
B-1	6.0	OLIVE BROWN SANDY LEAN CLAY (CL)	19.1	108.8							TXUU: c = 2.12 ksf
B-1	11.0	REDDISH YELLOW MOTTLED SANDY LEAN CLAY (CL)	14.0	115.8							TXUU: c = 2.55 ksf
B-2	2.5	YELLOWISH BROWN LEAN CLAY (CL)	11.3	110.8							
B-2	11.0	REDDISH YELLOW CLAYSTONE	9.5	118.9							
B-3	2.5	OLIVE BROWN CLAYEY SAND (SC)						27	15	12	
B-3	11.0	YELLOWISH BROWN SANDY LEAN CLAY (CL)	26.8	94.7							TXUU: c = 1.25 ksf
B-3	16.0	OLIVE BROWN CLAYEY SAND (SC)					49	33	15	18	
B-4	6.0	OLIVE BROWN LEAN CLAY WITH SAND (CL)						43	15	28	
B-4	16.0	OLIVE BROWN CLAYEY SAND WITH GRAVEL (SC)					16				

Refer to the Geotechnical Evaluation Report or the supplemental plates for the method used for the testing performed above.
NP = NonPlastic

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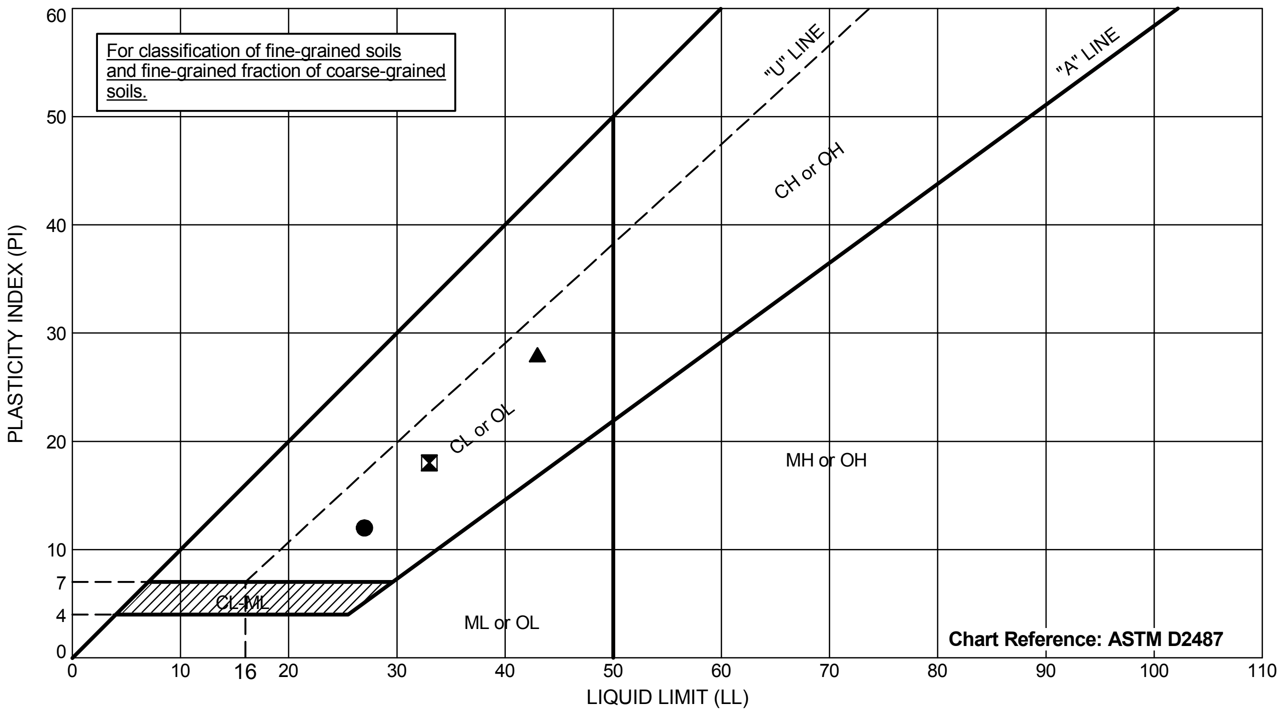
PROJECT NO.: 20181569
DRAWN BY: MAP/JDS
CHECKED BY: OK
DATE: 9/19/2017
REVISED: -

LABORATORY TEST RESULT SUMMARY

CONTRA COSTA COMMUNITY COLLEGE
NEW SCIENCE BUILDING
2600 MISSION BELL DRIVE
SAN PABLO, CALIFORNIA

FIGURE

B-1



	Exploration ID	Depth (ft.)	Sample Description	Passing #200	LL	PL	PI
●	B-3	2.5	OLIVE BROWN CLAYEY SAND (SC)	NM	27	15	12
⊠	B-3	16	OLIVE BROWN CLAYEY SAND (SC)	49	33	15	18
▲	B-4	6	OLIVE BROWN LEAN CLAY WITH SAND (CL)	NM	43	15	28

Testing perfomed in general accordance with ASTM D4318.
NP = Nonplastic
NM = Not Measured

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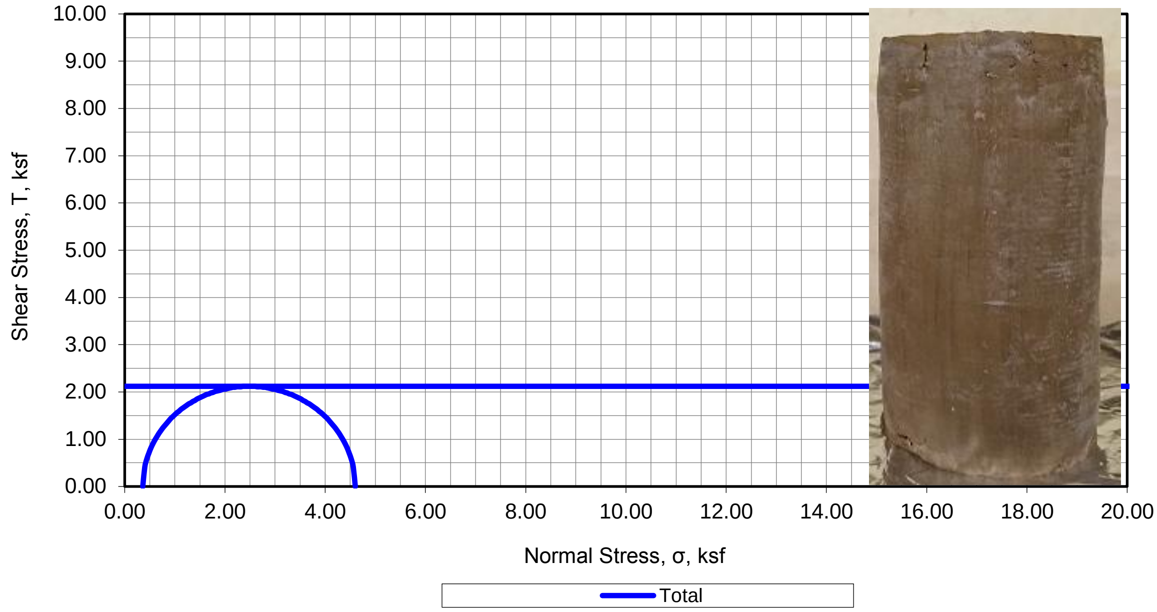
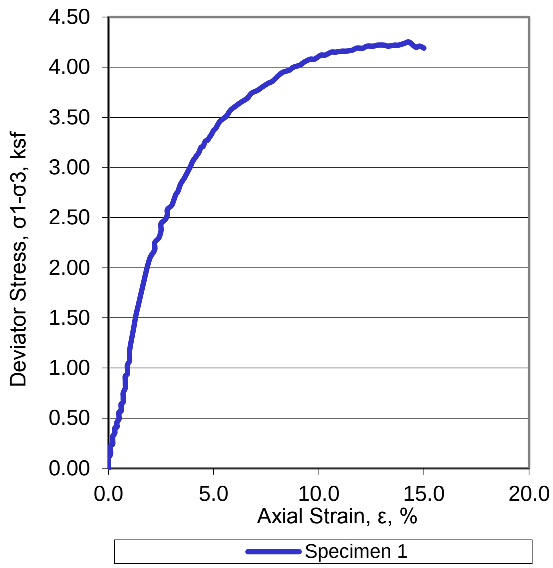
PROJECT NO.: 20181569	ATTERBERG LIMITS	FIGURE
DRAWN BY: MAP/JDS		B-2
CHECKED BY: OK	CONTRA COSTA COMMUNITY COLLEGE NEW SCIENCE BUILDING 2600 MISSION BELL DRIVE SAN PABLO, CALIFORNIA	
DATE: 9/19/2017		
REVISED: -		

Total	
c = 2.12	ksf

Specimen Shear Picture





Specimen No.			1
Initial	Diameter, in	D_O	2.39
	Height, in	H_O	5.69
	Water Content, %	ω_O	19.1
	Dry Density, lbs/ft^3	γd_o	108.8
	Saturation, %	S_O	97
	Void Ratio	e_O	0.519
Minor Principal Stress, ksf		σ_3	0.36
Maximum Deviator Stress, ksf		$(\sigma 1-\sigma 3)_{max}$	4.25
Time to $(\sigma_1-\sigma_3)_{max}$, min		t_f	14.33
Deviator Stress @ 15% Axial Strain, ksf		$(\sigma_1-\sigma_3)_{15\%}$	4.19
Ultimate Deviator Stress, ksf		$(\sigma_1-\sigma_3)_{ult}$	na
Rate of strain, %/min		$'\varepsilon$	1.00
Axial Strain at Failure, %		ε_f	14.33

Description of Specimen: Olive Brown Sandy Lean Clay (CL)

Amount of Material Finer than the No. 200, %: nm

LL: nm	PL: nm	PI: nm	G_S: 2.65 Assumed	Specimen Type:	Undisturbed	Test Method: ASTM D2850

Membrane correction applied

Boring:	B-1
Sample:	2C
Depth, ft:	6.0
Test Date:	9/8/17

Remarks: nm= not measured, na = not applicable

KLEINFELDER
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2601 Barrington Ct, Hayward, CA 94545

Project No.:	20181569
Date:	9/11/17
Entry By:	CP
Checked By:	CP
File Name:	HL10558

TRIAXIAL COMPRESSION TEST (UU)

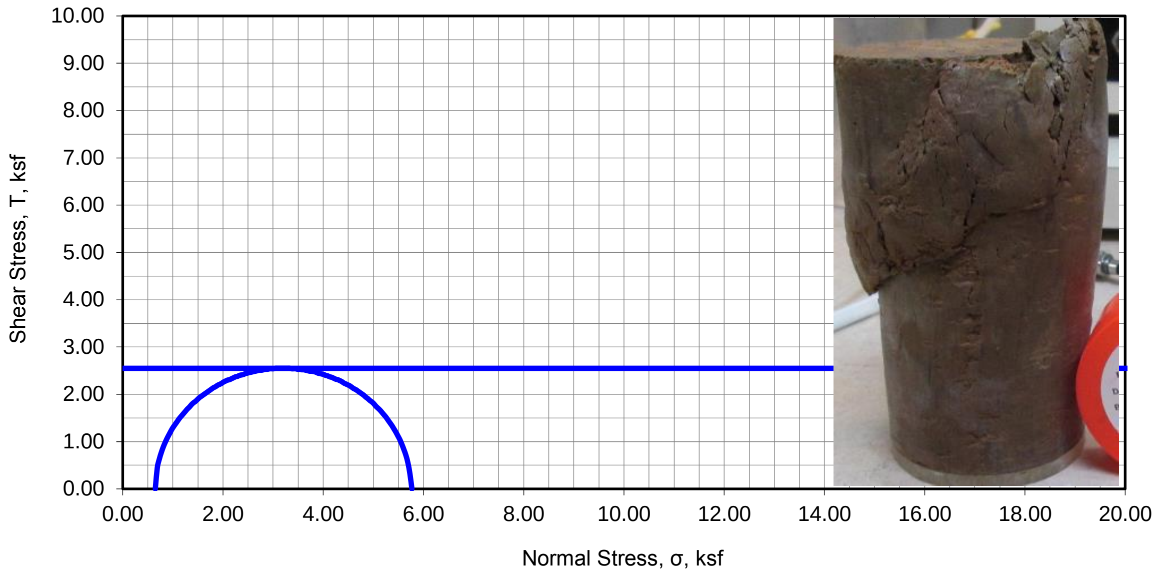
CONTRA COSTA COMMUNITY COLLEGE
NEW SCIENCE BUILDING
2600 MISSION BELL DRIVE
SAN PABLO, CALIFORNIA

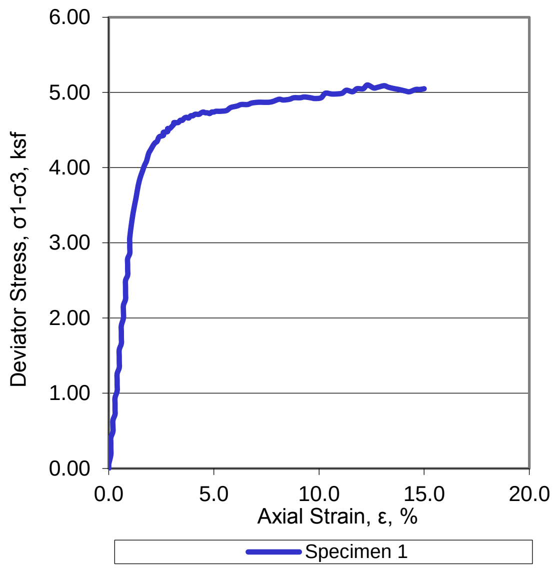
FIGURE

B-3

Total	
c = 2.55	ksf

Specimen Shear Picture





Specimen No.			1
Initial	Diameter, in	D_O	2.43
	Height, in	H_O	5.67
	Water Content, %	ω_O	14.0
	Dry Density, lbs/ft^3	γd_o	115.8
	Saturation, %	S_O	87
	Void Ratio	e_O	0.428
Minor Principal Stress, ksf		σ_3	0.65
Maximum Deviator Stress, ksf		$(\sigma1-\sigma3)_{max}$	5.10
Time to $(\sigma_1-\sigma_3)_{max}$, min		t_f	12.33
Deviator Stress @ 15% Axial Strain, ksf		$(\sigma_1-\sigma_3)_{15\%}$	5.05
Ultimate Deviator Stress, ksf		$(\sigma_1-\sigma_3)_{ult}$	na
Rate of strain, %/min		'ε	1.00
Axial Strain at Failure, %		ε_f	12.33

Description of Specimen: Brown Lean Clay with Sand (CL)

Amount of Material Finer than the No. 200, %: nm

LL: nm	PL: nm	PI: nm	G_S: 2.65 Assumed	Specimen Type: Undisturbed	Test Method: ASTM D2850

Membrane correction applied

Boring:	B-1
Sample:	3C
Depth, ft:	11.0
Test Date:	9/8/17

Remarks: nm= not measured, na = not applicable

KLEINFELDER
Bright People. Right Solutions.

2601 Barrington Ct, Hayward, CA 94545

Project No.:	20181569
Date:	9/11/17
Entry By:	CP
Checked By:	CP
File Name:	HL10558

TRIAXIAL COMPRESSION TEST (UU)

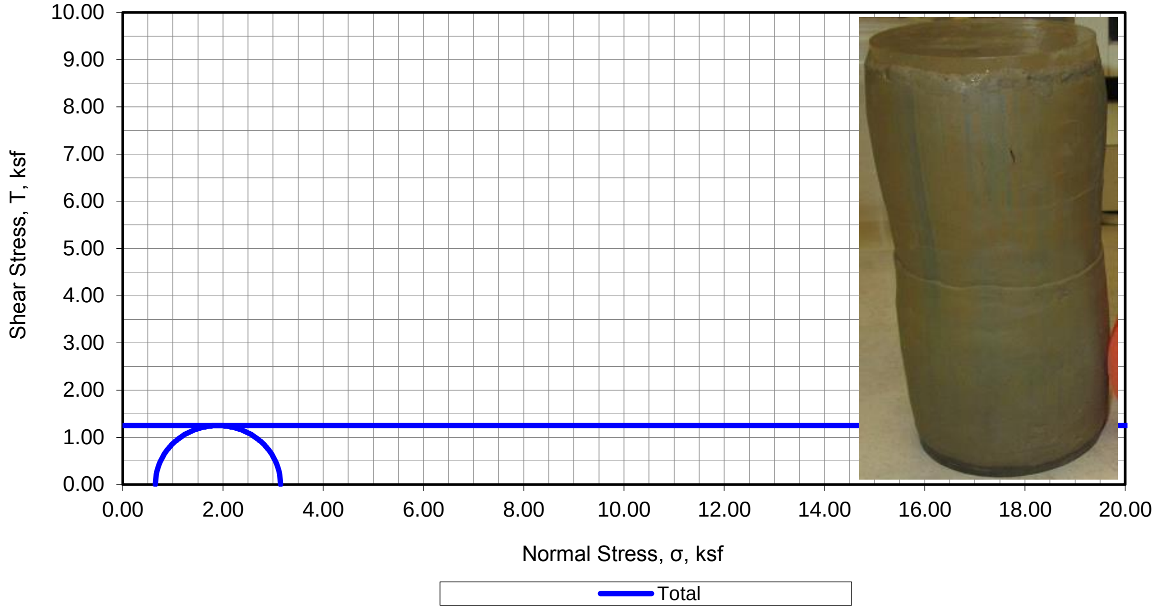
CONTRA COSTA COMMUNITY COLLEGE
NEW SCIENCE BUILDING
2600 MISSION BELL DRIVE
SAN PABLO, CALIFORNIA

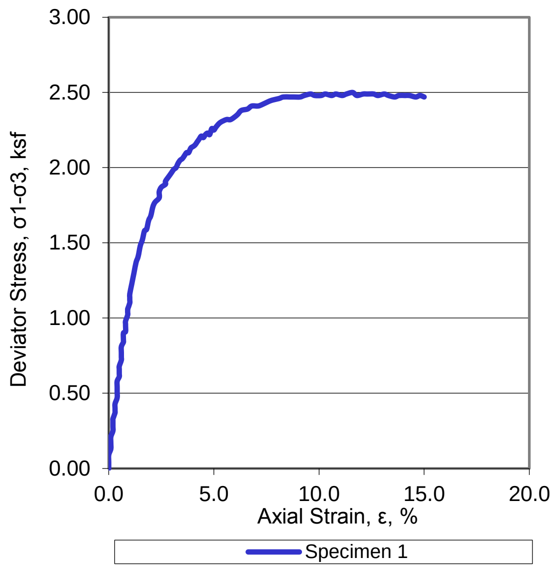
FIGURE

B-4

Total	
c = 1.25	ksf

Specimen Shear Picture





Specimen No.			1
Initial	Diameter, in	D_O	2.43
	Height, in	H_O	5.70
	Water Content, %	ω_O	26.8
	Dry Density, lbs/ft^3	γd_o	94.7
	Saturation, %	S_O	95
	Void Ratio	e_O	0.747
Minor Principal Stress, ksf		σ_3	0.65
Maximum Deviator Stress, ksf		$(\sigma 1-\sigma 3)_{max}$	2.50
Time to $(\sigma_1-\sigma_3)_{max}$, min		t_f	11.58
Deviator Stress @ 15% Axial Strain, ksf		$(\sigma_1-\sigma_3)_{15\%}$	2.47
Ultimate Deviator Stress, ksf		$(\sigma_1-\sigma_3)_{ult}$	na
Rate of strain, %/min		$'\varepsilon$	1.00
Axial Strain at Failure, %		ε_f	11.58

Description of Specimen: Brown Lean Clay (CL)

Amount of Material Finer than the No. 200, %: nm

LL: nm | PL: nm | PI: nm | G_S: 2.65 Assumed | Specimen Type: Undisturbed | Test Method: ASTM D2850

Membrane correction applied

Boring:	B-3
Sample:	3C
Depth, ft:	11.0
Test Date:	9/8/17

Remarks: nm= not measured, na = not applicable

KLEINFELDER
Bright People. Right Solutions.
2601 Barrington Ct, Hayward, CA 94545

Project No.:	20181569
Date:	9/11/17
Entry By:	CP
Checked By:	CP
File Name:	HL10558

TRIAXIAL COMPRESSION TEST (UU)

CONTRA COSTA COMMUNITY COLLEGE
NEW SCIENCE BUILDING
2600 MISSION BELL DRIVE
SAN PABLO, CALIFORNIA

FIGURE

B-5

APPENDIX C

Boring Logs and Trench Logs from Previous Kleinfelder Studies

- Kleinfelder, 2003, Subsurface Fault Investigation, Proposed Addition to the Student Activities Building
- Kleinfelder, 2004, Geotechnical Investigation Report, Student Activities Building Addition
- Kleinfelder, 2007, Subsurface Fault Investigation at the Existing Student Activities Building
- Kleinfelder, 2008, Subsurface Fault Investigation in Vicinity of the Existing Humanities Building
- Kleinfelder, 2011, Geotechnical Investigation Report, Campus Center

Kleinfelder, 2003, Subsurface Fault Investigation, Proposed Addition to the Student Activities Building

UNIT DESCRIPTION

① LEAN CLAY (CL) with sand, gravel, and cobbles, black (7.5YR 2.5/1), moist, hard, slightly porous, prismatic, contains a stoneline with clast lithologies comprised of subrounded Tertiary volcanics (basalt and rhyolite) measuring up to 6-inches in diameter (Holocene alluvium)

② Sandy LEAN/FAT CLAY with sand and gravel (CL-CH), dark gray (10YR 4/1), moist, hard, sand and gravel clasts are angular to subrounded and are comprised of sandstone, chert, vein quartz, siliceous shale and Tertiary volcanics (Holocene/Pleistocene alluvium)

③ LEAN/FAT CLAY (CL/CH) with sand and gravel, dark grayish brown (10YR 4/2), moist, hard, prismatic, contains angular to subrounded gravels that are composed of Mesozoic variegated chert and sandstone (Pleistocene alluvium)

④ Clayey SILT (ML) with sand and gravel, olive brown (2.5YR 4/4), moist, hard, contains veinlets of white carbonate, gravels are angular to subrounded Mesozoic clasts (Pleistocene alluvium)

⑤ SANDTONE with interbeds of siltstone, claystone, and conglomerate, laminated locally, moist, gray to light brown, highly weathered, widely fractured, weak to friable, oxide stained, horizontal to gently inclined bedding towards the south, contained Teleoceras (Rhinoceras) scapula fossil fragment similar to the late Hemphillian (Late Miocene) fauna from the Pinole Tuff. (Correlated to the Late Miocene Garrity Member of the Contra Costa Group Bedrock).

⑥ CLAYEY GRAVEL (GC) with sand, damp to moist, dense to very dense, oxidized clayey coating surrounds gravels, gravels are subrounded to rounded Mesozoic graywacke, variegated chert, siliceous shale and Tertiary volcanics (pleistocene channel deposit)

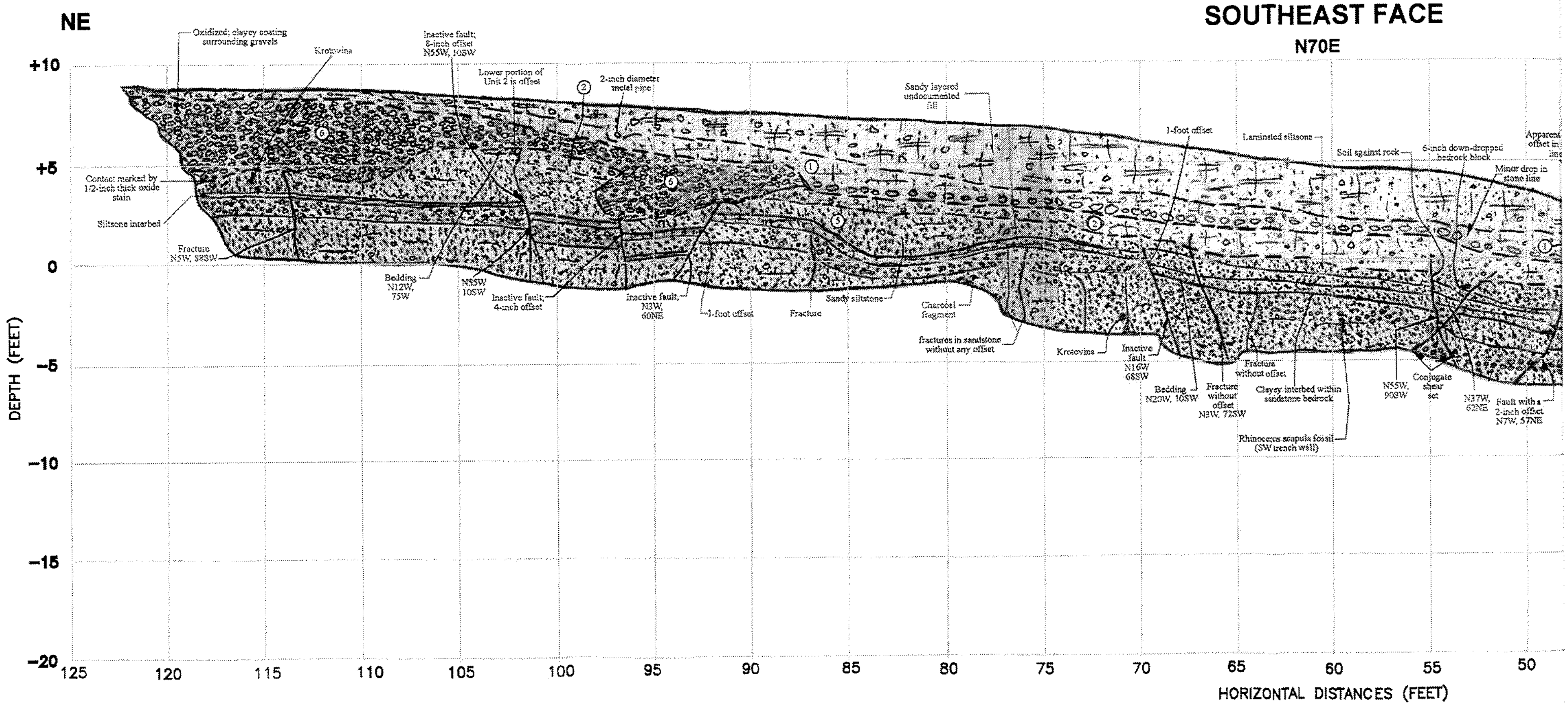
⑦ CLAYSTONE with trace gravel, olive, moist, foliated, plastic, reddish stain throughout, grades upward into sandstone, polished (Garrity Member of the Contra Costa Group Bedrock)

⑧ LEAN CLAY (CL) with sand and silt, very dark brown to black, moist, hard, prismatic, minor gravel within (Holocene/Pleistocene alluvium)

TRENCH T-1

SOUTHEAST FACE

N70E

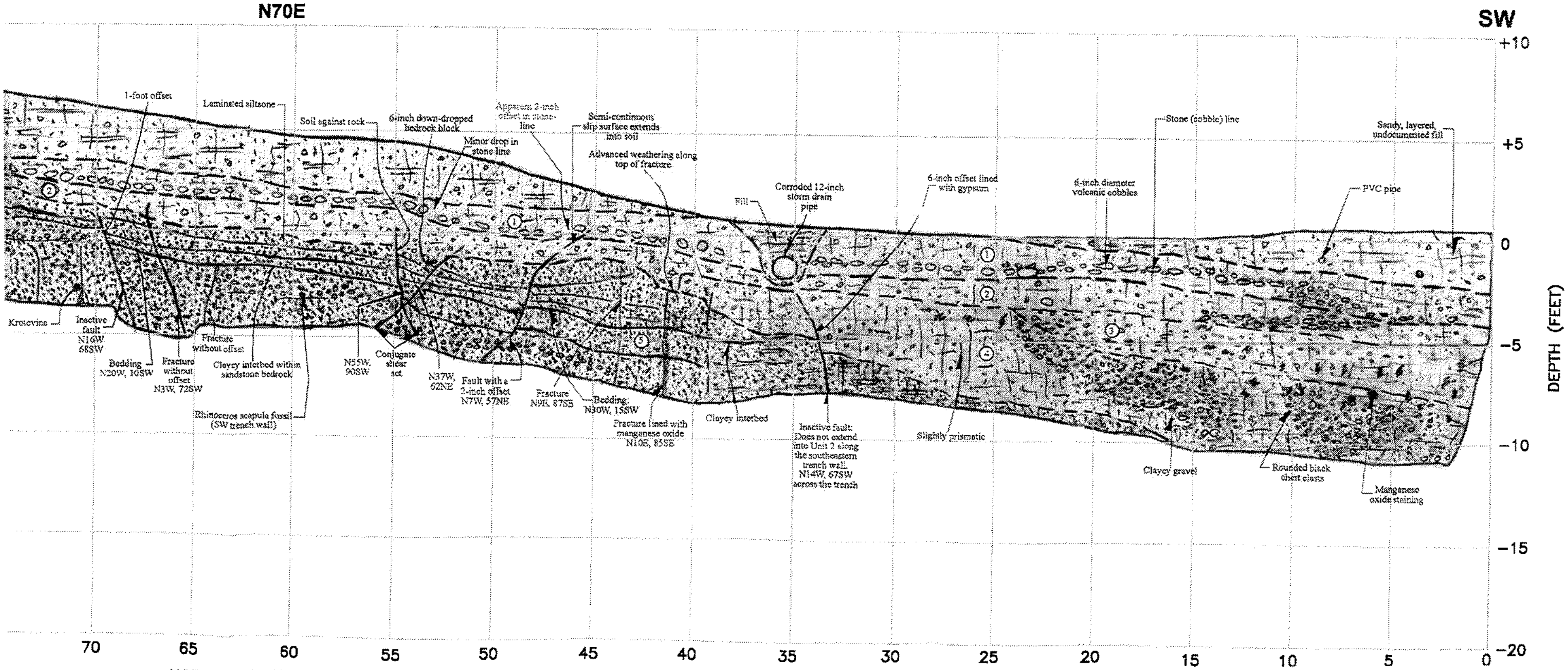


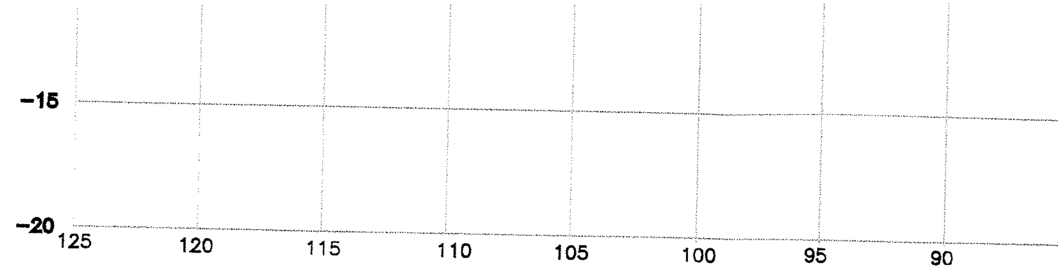
TRENCH T-2

TRENCH T-1

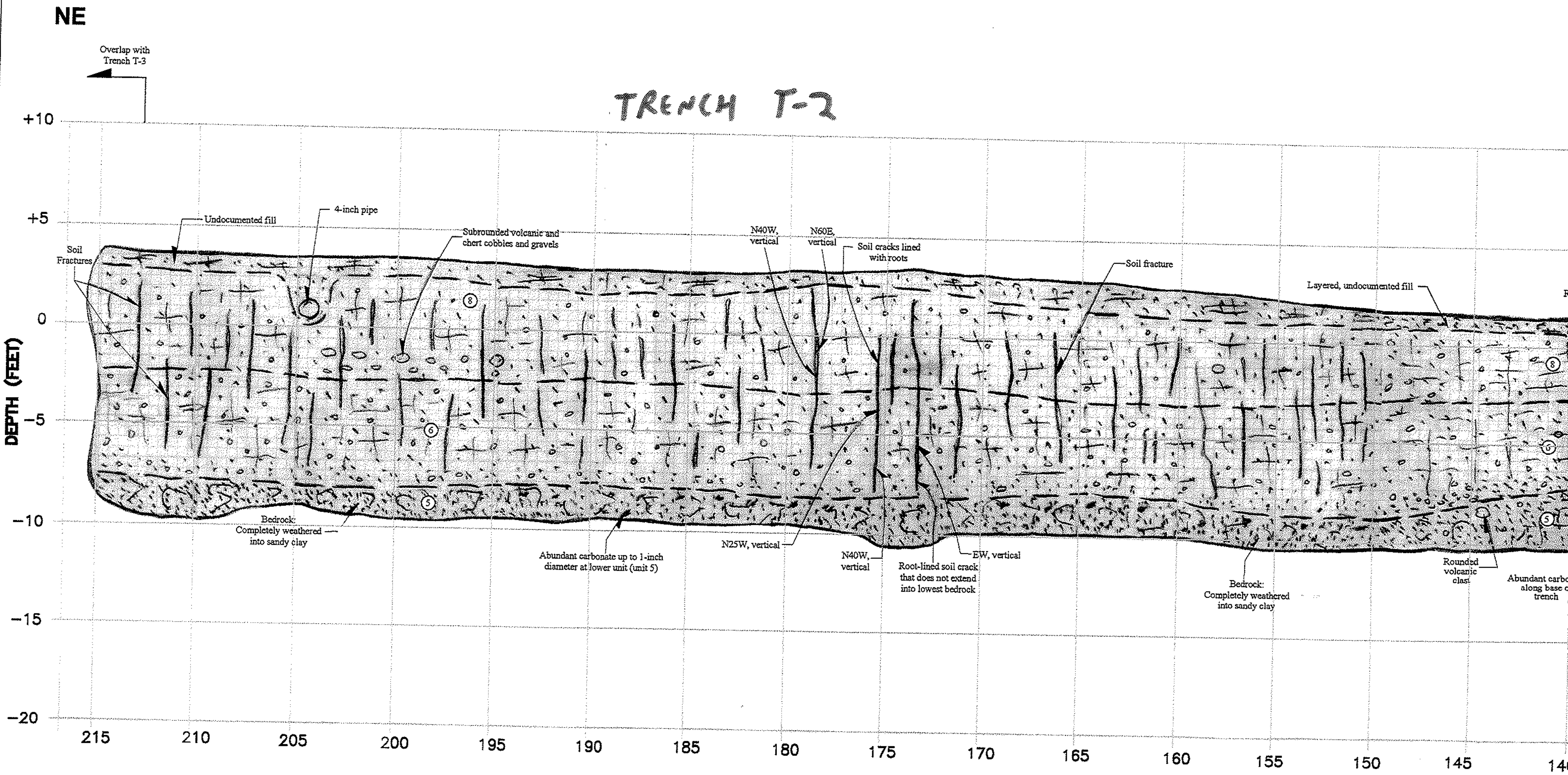
SOUTHEAST FACE

N70E

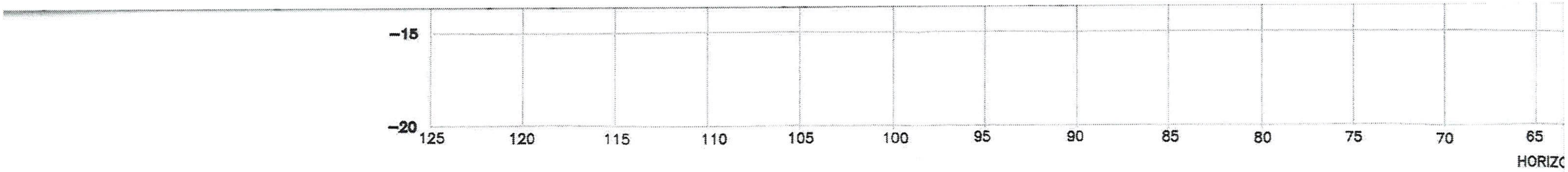




-15
-20
125
120
115
110
105
100
95
90

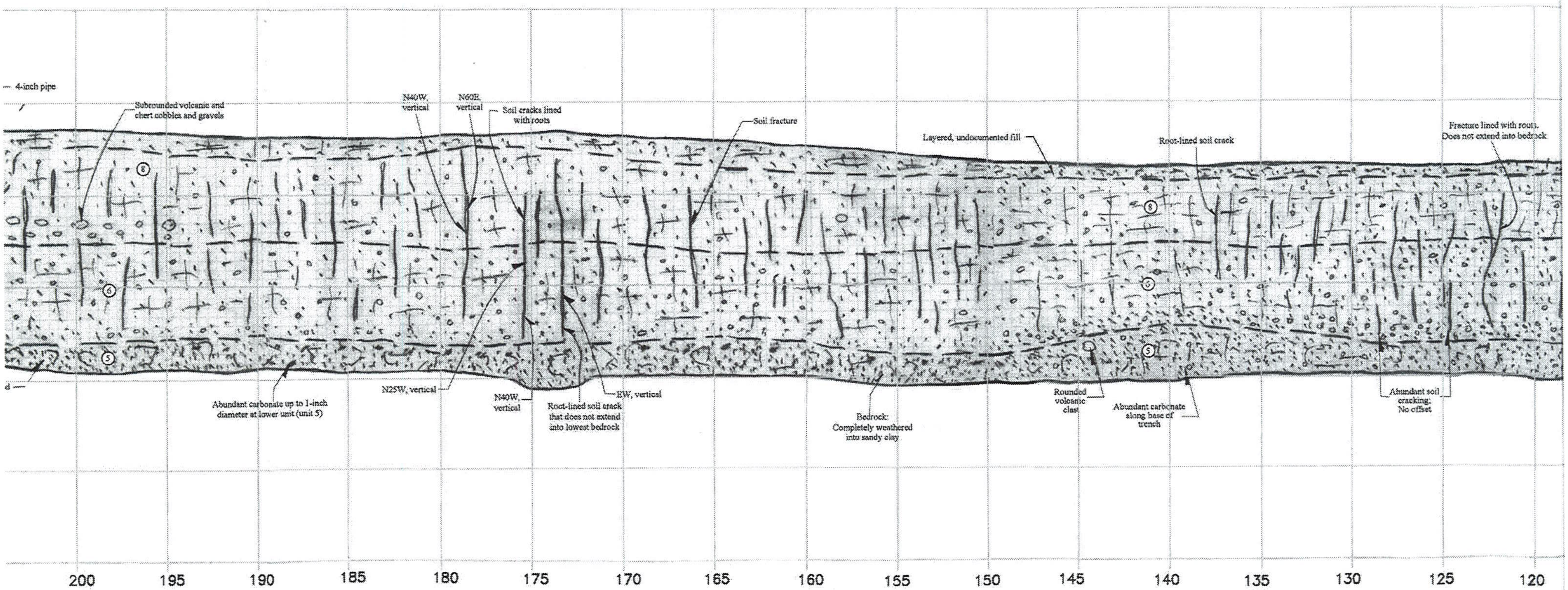


NE
Overlap with Trench T-3
TRENCH T-2
+10
+5
0
-5
-10
-15
-20
DEPTH (FEET)
Soil Fractures
Undocumented fill
4-inch pipe
Subrounded volcanic and chert cobbles and gravels
N40W, vertical
N60E, vertical
Soil cracks lined with roots
Soil fracture
Layered, undocumented fill
Bedrock: Completely weathered into sandy clay
Abundant carbonate up to 1-inch diameter at lower unit (unit 5)
N25W, vertical
N40W, vertical
Root-lined soil crack that does not extend into lowest bedrock
EW, vertical
Bedrock: Completely weathered into sandy clay
Rounded volcanic clast
215
210
205
200
195
190
185
180
175
170
165
160
155
150
145



-15
-20
125 120 115 110 105 100 95 90 85 80 75 70 65
HORIZ
TRE
SOU

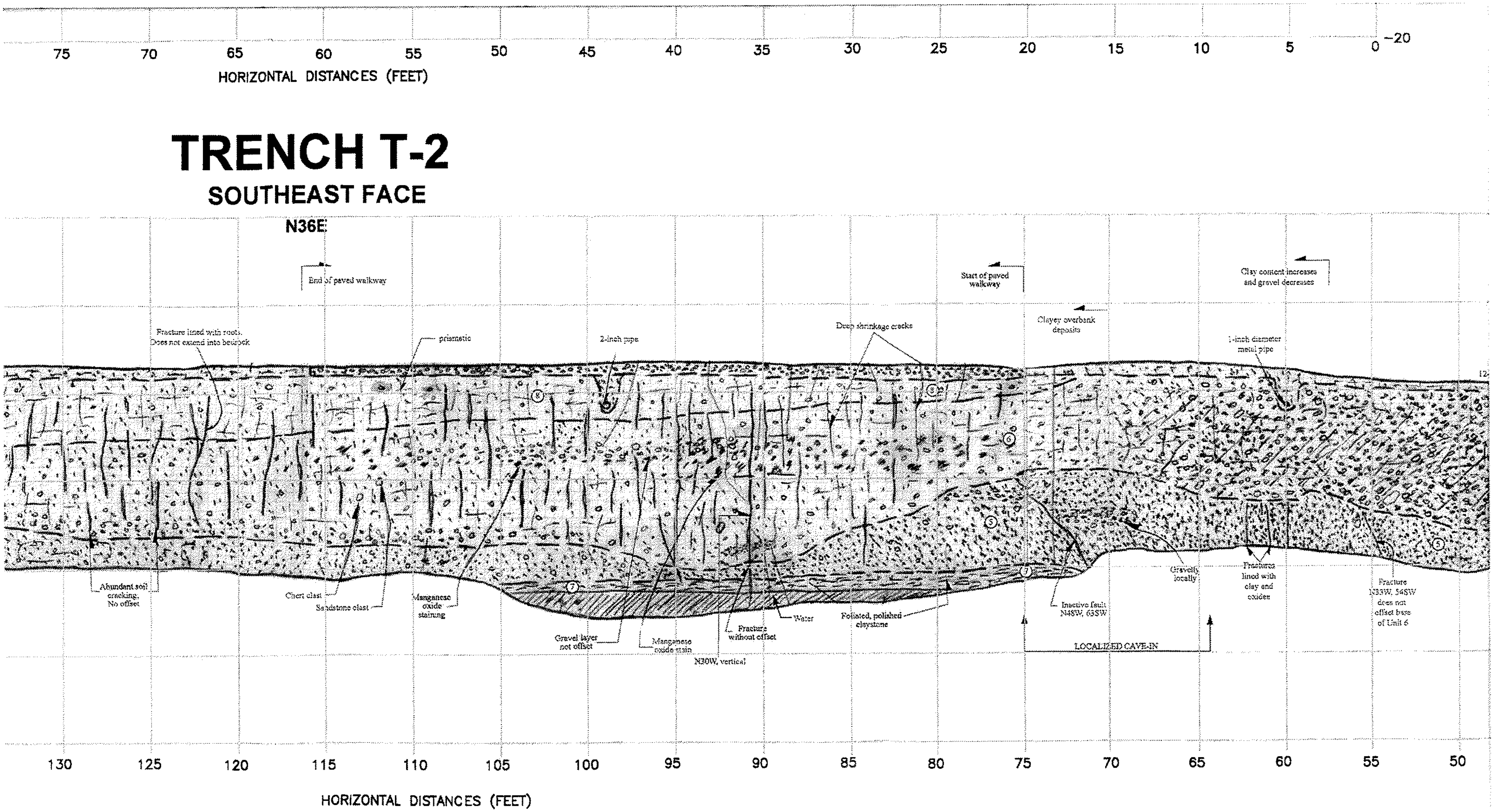
TRENCH T-2



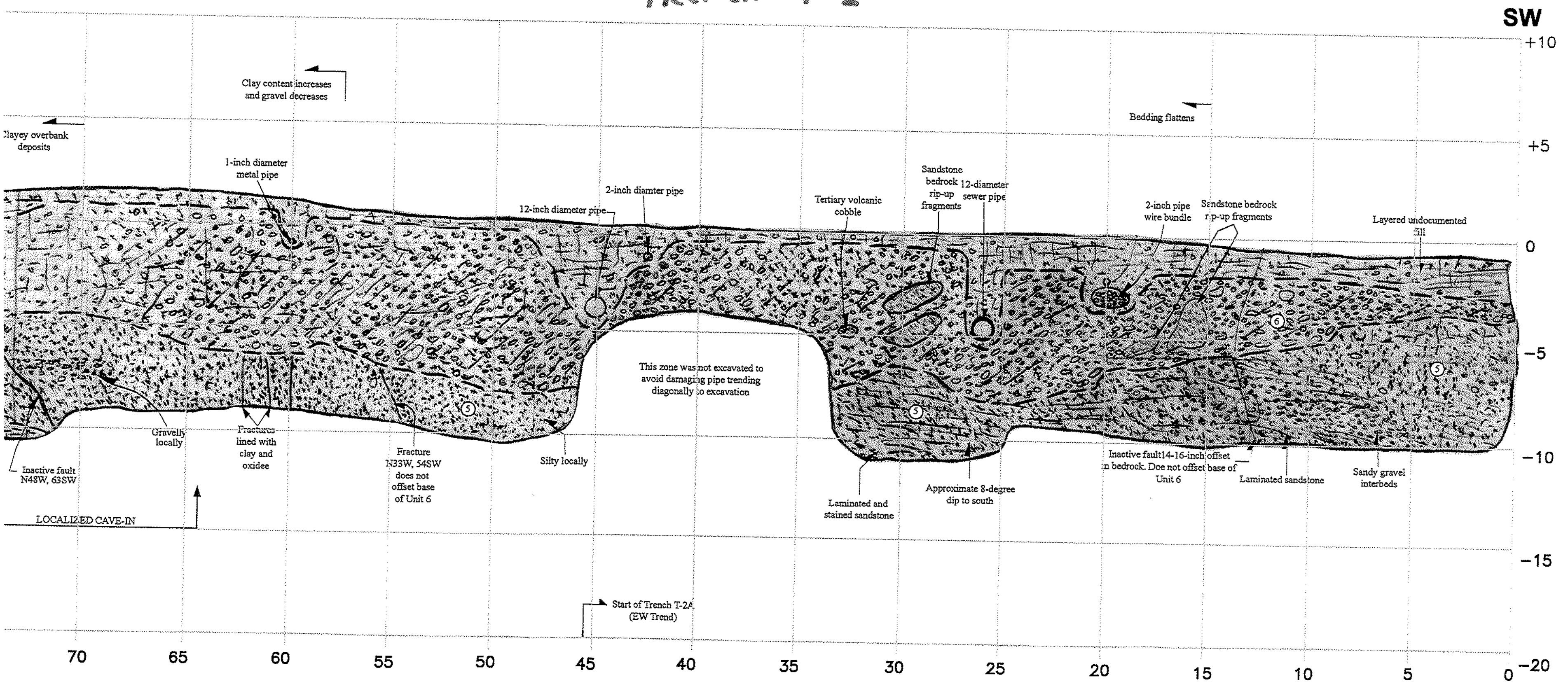
4-inch pipe
Subrounded volcanic and chert cobbles and gravels
N40W, vertical
N60E, vertical
Soil cracks lined with roots
Soil fracture
Layered, undocumented fill
Root-lined soil crack
Fracture lined with roots. Does not extend into bedrock
8
6
5
N25W, vertical
N40W, vertical
EW, vertical
Abundant carbonate up to 1-inch diameter at lower unit (unit 5)
Root-lined soil crack that does not extend into lowest bedrock
Bedrock: Completely weathered into sandy clay
Rounded volcanic clast
Abundant carbonate along base of trench
Abundant soil cracking; No offset
200 195 190 185 180 175 170 165 160 155 150 145 140 135 130 125 120

TRENCH T-2

SOUTHEAST FACE



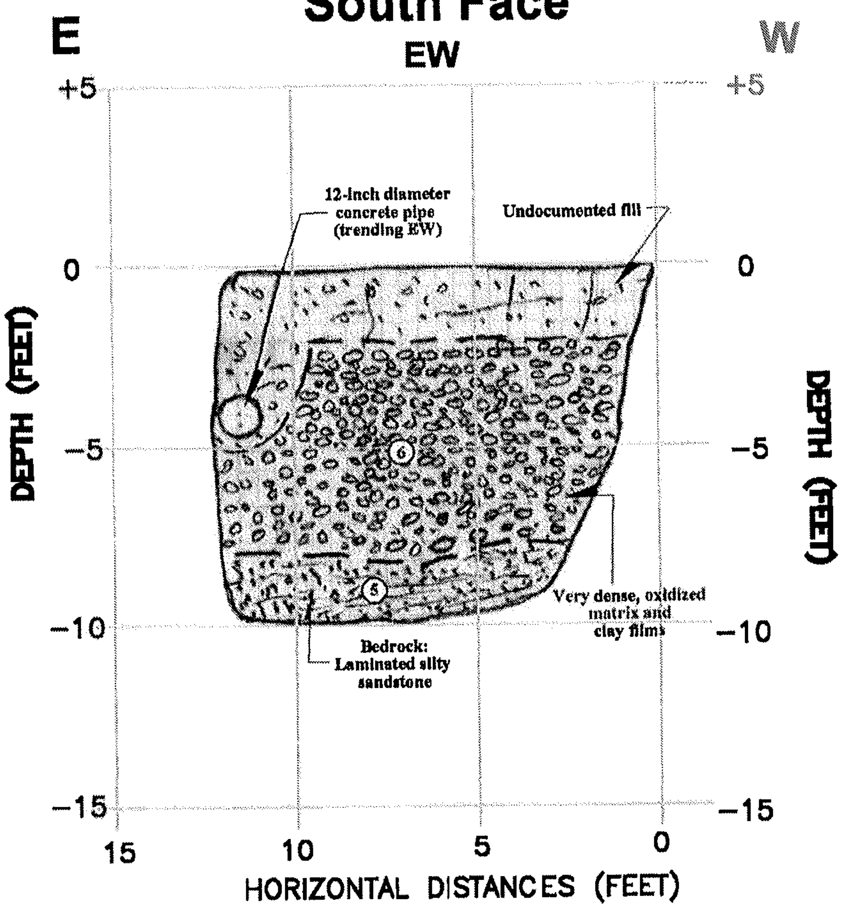
TRENCH T-2



SW
+10
+5
0
-5
-10
-15
-20
DEPTH (FEET)
Clay content increases and gravel decreases
Clayey overbank deposits
Bedding flattens
1-inch diameter metal pipe
2-inch diamter pipe
12-inch diameter pipe
Tertiary volcanic cobble
Sandstone bedrock rip-up fragments
12-diameter sewer pipe
2-inch pipe wire bundle
Sandstone bedrock rip-up fragments
Layered undocumented fill
6
5
This zone was not excavated to avoid damaging pipe trending diagonally to excavation
Inactive fault N48W, 63SW
Gravelly locally
Fractures lined with clay and oxidee
Fracture N33W, 54SW does not offset base of Unit 6
Silty locally
Laminated and stained sandstone
Approximate 8-degree dip to south
Inactive fault 14-16-inch offset in bedrock. Does not offset base of Unit 6
Laminated sandstone
Sandy gravel interbeds
LOCALIZED CAVE-IN
Start of Trench T-2A (EW Trend)
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0

TRENCH T-2A

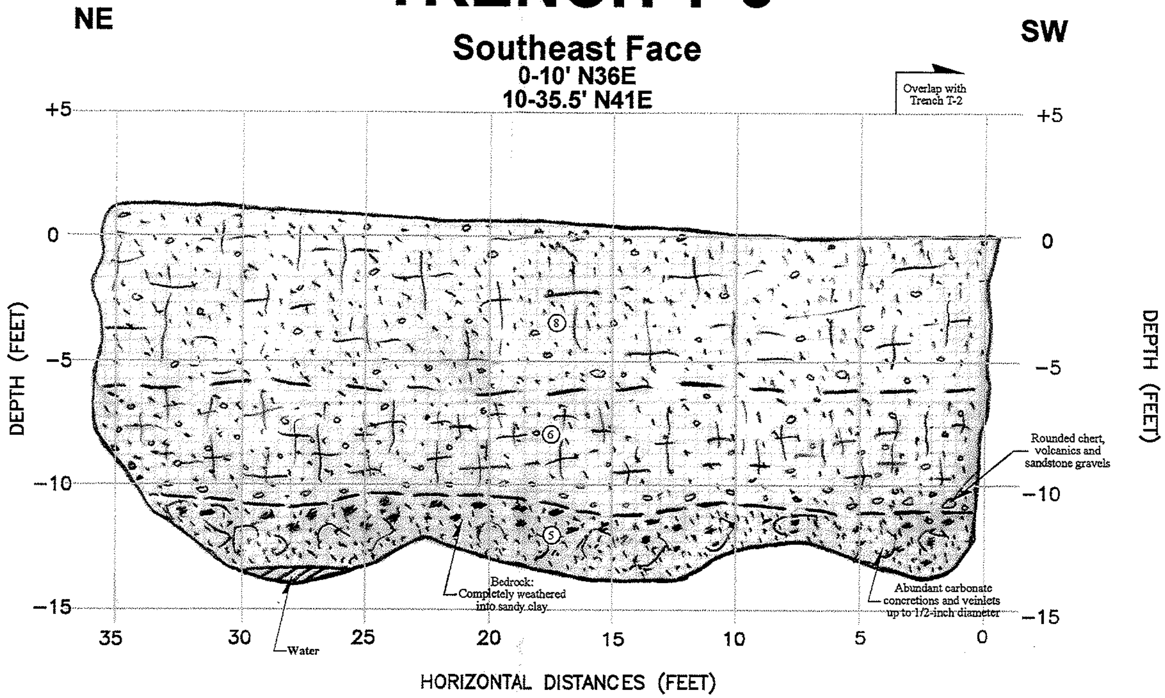
South Face



TRENCH T-3

Southeast Face

0-10' N36E
10-35.5' N41E



DEPTH (FEET)

PLATE NO.	DATE:

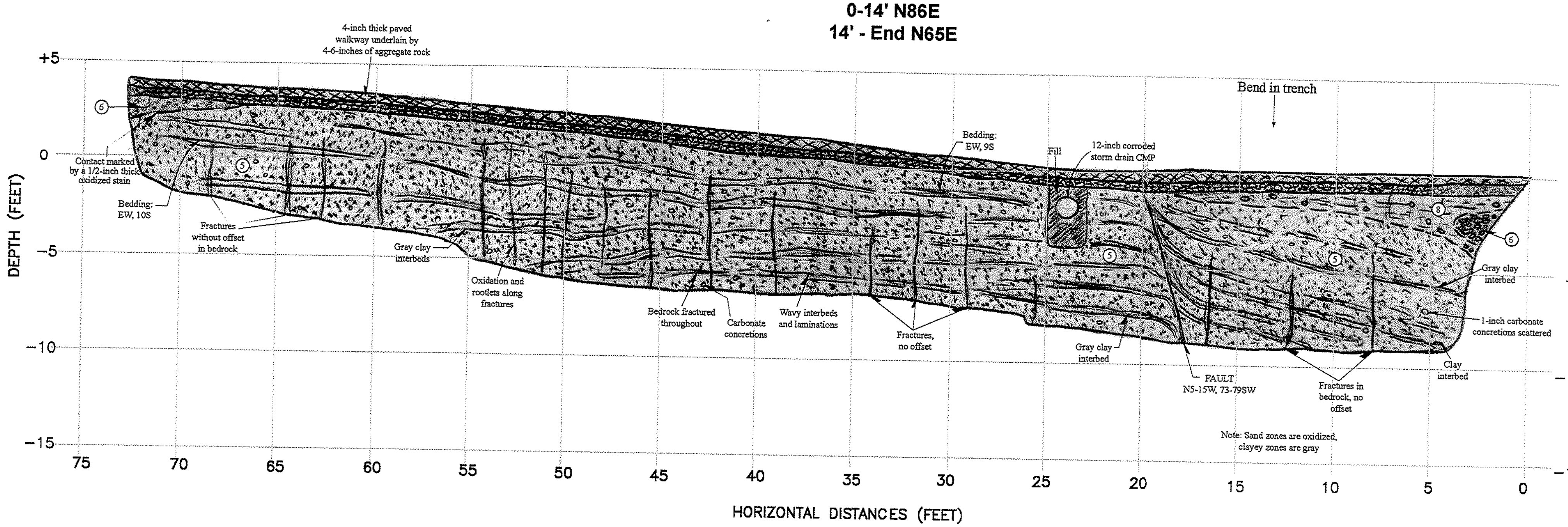
NE

TRENCH T-4

SOUTHEAST FACE

0-14' N86E
14' - End N65E

SW



LOGS OF TRENCH T-1, TRENCH T-2, TRENCH T-2A, TRENCH T-3 AND TRENCH T-4

PROPOSED STUDENT ACTIVITIES BUILDING ADDITION
CONTRA COSTA COMMUNITY COLLEGE
SAN PABLO, CALIFORNIA

Kleinfelder, 2004, Geotechnical Investigation Report, Student Activities Building Addition

UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS		LTR	ID	DESCRIPTION
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY	GW		Well-graded gravels or gravel with sand, little or no fines.
		GP		Poorly-graded gravels or gravel with sand, little or no fines.
		GM		Silty gravels, silty gravel with sand mixture.
		GC		Clayey gravels, clayey gravel with sand mixture
	SAND AND SANDY	SW		Well-graded sands or gravelly sands, little or no fines.
		SP		Poorly-graded sands or gravelly sands, little or no fines.
		SM		Silty sand.
		SC		Clayey sand.

MAJOR DIVISIONS		LTR	ID	DESCRIPTION
FINE GRAINED SOILS	SILTS AND CLAYS	ML		Inorganic silts and very fine sands, rock flour or clayey silts with slight plasticity.
		CL		Inorganic lean clays of low to medium plasticity, gravelly clays, sandy clays, silty clays.
		OL		Organic silts and organic silt-clays of low plasticity.
	SILTS AND CLAYS	MH		Inorganic elastic silts, micaceous or diatomaceous or silty soils.
		CH		Inorganic fat clays (high plasticity).
		OH		Organic clays of medium high to high plasticity.
HIGHLY ORGANIC SOILS		Pt		Peat and other highly organic soils.

Modified California Sampler 2.5 inch O.D., 2.0 inch I.D.

Bulk Sample

California Sampler, 3.0 inch O.D., 2.5 inch I.D.

Shelby Tube 3.0 inch O.D.

0745, 5/31 Approximate water level first observed in boring. Time recorded in reference to a 24 hour clock.

0800, 5/31 Approximate water level observed in boring following drilling

PEN	Pocket Penetrometer reading, in tsf
TV:Su	Torvane shear strength, in ksf

LL	LIQUID LIMIT	TX	TRIAXIAL SHEAR
PI	PLASTICITY INDEX	CONSOL	CONSOLIDATION
%-#200	SIEVE ANALYSIS (#200 SCREEN)	R-Value	RESISTANCE VALUE
DS	DIRECT SHEAR	SE	SAND EQUIVALENT
C	COHESION (PSF)	EI	EXPANSION INDEX
PHI	FRICTION ANGLE	FS	FREE SWELL (U.S.B.R.)

Notes: Blow counts represent the number of blows a 140-pound hammer falling 30 inches required to drive a sampler through the last 12 inches of an 18 inch penetration, unless otherwise noted.

The lines separating strata on the logs represent approximate boundaries only. The actual transition may be gradual. No warranty is provided as to the continuity of soil strata between borings. Logs represent the soil section observed at the boring location on the date of drilling only.

KLEINFELDER

PROJECT NO. 40698-GEO

BORING LOG LEGEND

Student Activities Building Addition
Contra Costa College
San Pablo, California

PLATE **B-1**

4/13/04 3:38:39 PM

Date Completed:	2/17/04	Drilling method:	6" Hollow Stem Auger
Logged By:	C. Melo	Hammer Wt:	140 lbs., 30" drop
Total Depth:	25.0 ft	Notes:	Drilled in barren landscaping

Surface Elevation: **Estimated 80 feet (MSL)**

Depth, ft	FIELD: Sample	FIELD: Blows/ft	LABORATORY: Dry Density pcf	LABORATORY: Moisture Content %	LABORATORY: Compress. Strength tsf	LABORATORY: Other Tests	Pen, tsf	DESCRIPTION
0								**SANDY LEAN CLAY with SILT (CL)** - dark brown mottled with gray-brown, low plasticity, fine grained sand, mottled, rootlets throughout, moist to very moist (Fill)
		34					2.8-3.7	**CLAYSTONE/SILTSTONE** - yellow-brown mottled with gray, completely weathered, friable, low to medium plasticity, fine grained sand, rootlets within, moist
5		75					>4.5	- gray with gray-brown mottling, calcium carbonate within, trace fine grained sand, slightly moist to moist
10		54	118	11		Direct Shear on Remold (see Plate C-2)	3.0-4.5	
15		85/11"	117	12			>4.5	- yellow-brown, higher sand content - gray with gray-brown mottling
20		50/3"						- no recovery
25		43				LL=35; PI=21 (see Plate C-1)		- completely to highly weathered
								Boring terminated at 25 feet. No free water observed. Boring backfilled with grout.
30								

Date Completed:	2/17/04
Logged By:	C. Melo
Total Depth:	24.0 ft
Drilling method:	6" Hollow Stem Auger
Hammer Wt:	140 lbs., 30" drop
Notes:	Drilled in lawn

Depth, ft	FIELD: Sample	FIELD: Blows/ft	LABORATORY: Dry Density pcf	LABORATORY: Moisture Content %	LABORATORY: Compress. Strength tsf	LABORATORY: Other Tests	Pen, tsf	DESCRIPTION (Surface Elevation: Estimated 75 feet (MSL))
0								**CLAYEY SILT with SAND (ML)** - dark brown, mottled, low plasticity, fine grained sand, mottled, high organic content, very moist to wet (Fill)
1								**SANDY LEAN CLAY (CL)** - yellow-brown with gray mottling, low to medium plasticity, stiff to very stiff, fine grained sand lenses, up to 1/4-inch subangular gravel, very moist
		22					2.0	
5		19					1.0-2.0	- stiff, high sand content, calcium carbonate within
		12					1.3-1.5	- rootlets within, black inclusions within
10								
								- gray-brown with yellow-brown mottling, low plasticity, fine grained sand, up to 1-inch subrounded gravel, black inclusions within, iron-oxide, moist to very moist
		17	107	21		Passing -#200=61%	1.3-1.6	
15								
17								**CLAYSTONE/SILTSTONE** -olive-brown and gray mottled, completely to highly weathered, friable, medium plasticity, trace fine grained sand, slightly moist to moist
		82/11"					>4.5	
20								
		50/6"					>4.5	
24								Boring terminated at 24 feet. No free water observed. Boring backfilled with grout.
25								
30								

KLEINFELDER

PROJECT NO. 40698-GEO

LOG OF BORING NO. K-2

Student Activities Building Addition
Contra Costa College
San Pablo, California

PLATE

B-3

L:\2004\04PROJECTS\40698\40698.GPJ

Drilling method: 6" Hollow Stem Auger

Date Completed: 2/17/04

Logged By: C. Melo

Hammer Wt: 140 lbs., 30" drop

Total Depth: 15.0 ft

Notes: Drilled in Amphitheatre Concrete Slab

Depth, ft	Sample	Blows/ft	Dry Density pcf	Moisture Content %	Compress. Strength tsf	Other Tests	Pen, tsf	DESCRIPTION
								Surface Elevation: Estimated 65 feet (MSL)
								CONCRETE - approximately 5 inches thick
								CLAYEY GRAVEL (GC) - approximately 2 inches thick
							2.0	**SANDY LEAN CLAY (CL)** - yellow-brown, low plasticity, very stiff, fine grained sand, moist to very moist
	X	27				LL=40; PI=26 (see Plate C-1)	2.0-4.0	**SILTY LEAN CLAY (CL)** - gray-brown to gray, medium plasticity, very stiff, trace fine grained sand, black inclusions within, moist
5	X	28	117	20			2.5-3.0	- gray, fine grained sand lenses within, possibly completely weathered claystone/siltstone - 1/4-inch rounded gravel
	X	46	98	20			3.0-4.5	**CLAYSTONE/SILTSTONE** - red and gray mottled, completely weathered, friable, low to medium plasticity, trace fine grained sand, calcium carbonate within, slightly moist to moist
10								
	X	43					>4.5	- gray, completely to highly weathered, calcium carbonate
15								Boring terminated at 15 feet. No free water observed. Boring backfilled with soil cuttings and 6 inches of Quikrete.
20								
25								
30								

KLEINFELDER

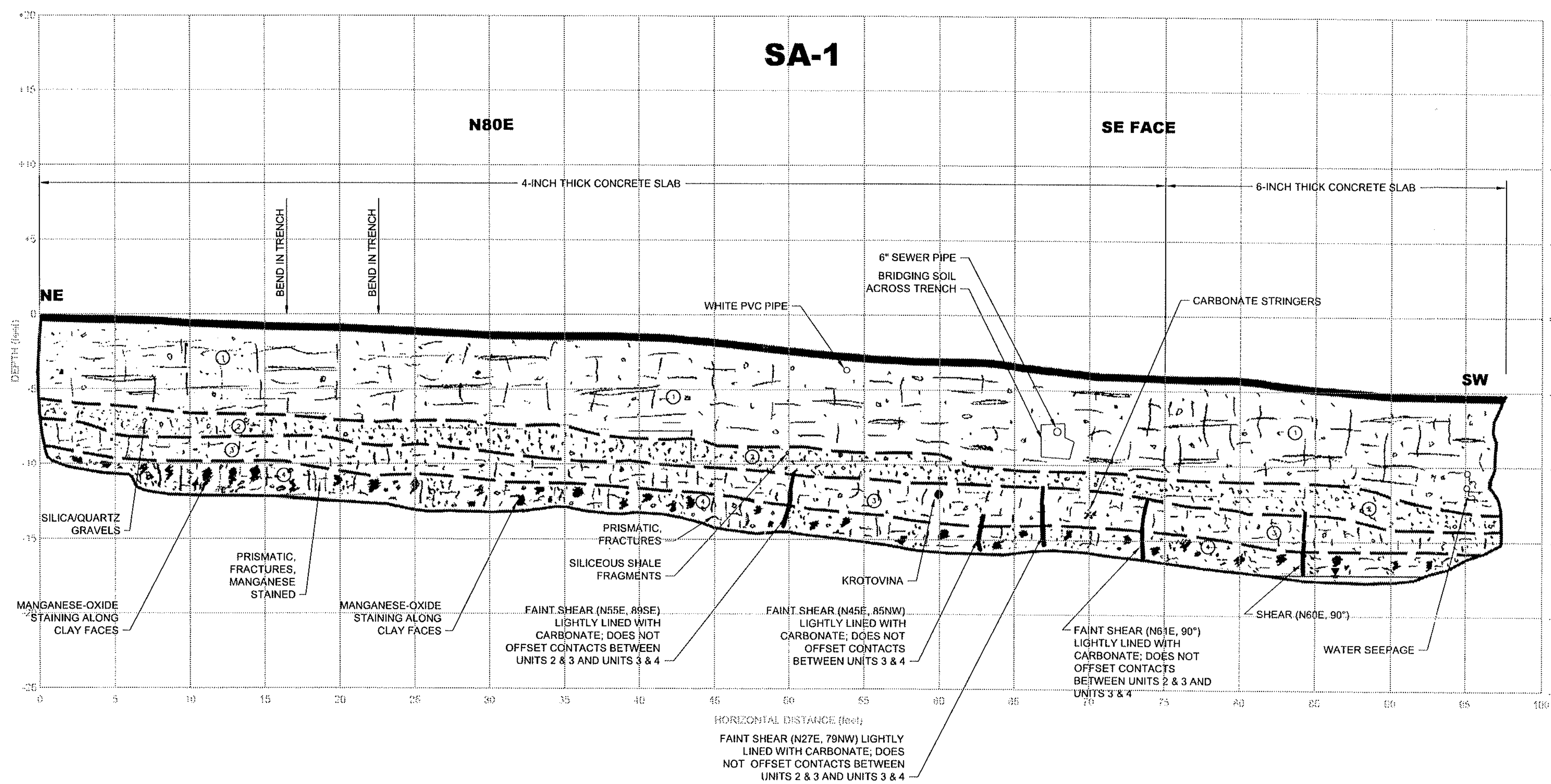
PROJECT NO. 40698-GEO

LOG OF BORING NO. K-3

Student Activities Building Addition
Contra Costa College
San Pablo, California

PLATE B-4

Kleinfelder, 2007, Subsurface Fault Investigation at the Existing Student Activities Building



① **LEAN CLAY (CL)** - yellowish-brown to dark brown, moist, stiff, mottled, layered, trace sand and gravel (FILL)

② **SANDY LEAN CLAY (CL)** - black, moist, with silt, trace gravel (quartz and silica), rootlets (RESIDUAL SOIL)

③ **SANDY CLAYSTONE** - grayish blue to brown, highly to completely weathered, weak to plastic, trace sand and gravel (quartz, silica, volcanics and siliceous shale), subangular to subrounded gravel (UPPER PORTION OF GARRITY MEMBER BEDROCK)

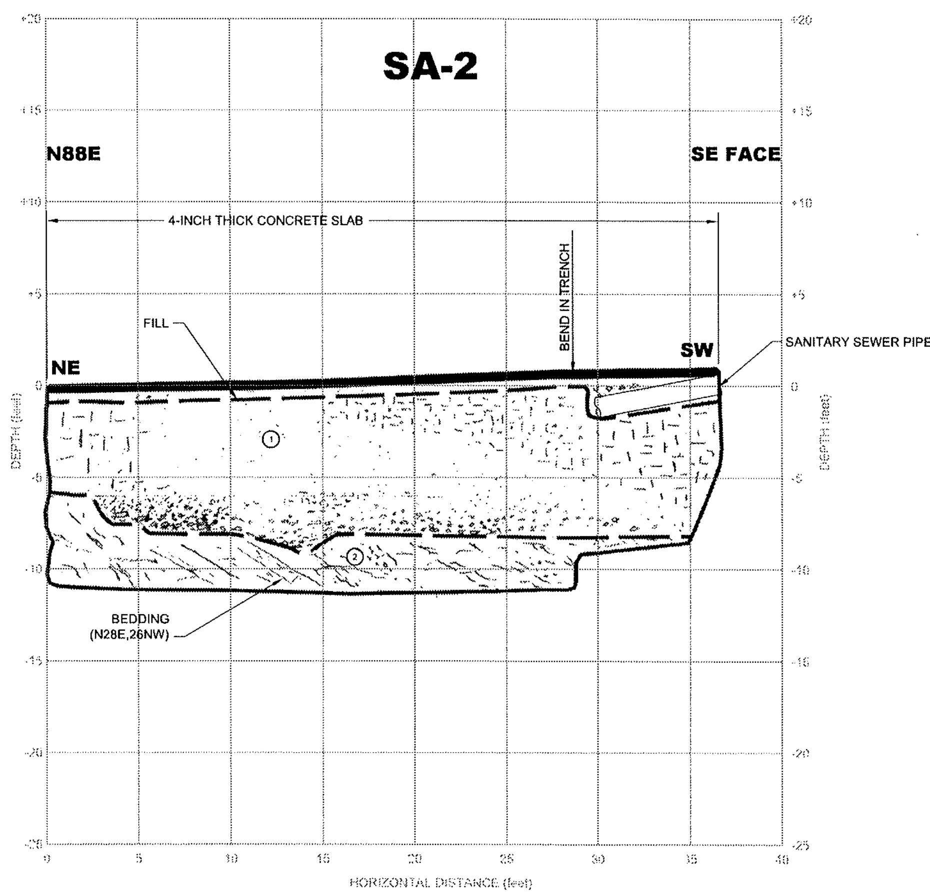
④ **CLAYSTONE** - brown, highly weathered, weak, plastic, sandy locally, prismatic texture, manganese staining along clay faces, slightly mottled due to staining (GARRITY MEMBER - CONTRA COSTA GROUP BEDROCK)

5 2.5 0 5
APPROXIMATE SCALE (feet)

DRAWN BY: LGS	LOG OF TRENCH SA-1		KLEINFELDER	PLATE
REVISED BY:			7133 Koll Center Parkway, Suite 100 Pleasanton, CA 94566-3101 PH. (925) 484-1700 FAX. (925) 484-5838 www.kleinfelder.com	A-1
CHECKED BY: SMD	STUDENT ACTIVITIES BUILDING CONTRA COSTA COMMUNITY COLLEGE SAN PABLO, CALIFORNIA			
DATE: AUGUST 2007 / APPROVED BY:	PROJECT NO. 82074/REPORT	FILE NAME: TRENCHES.dwg		

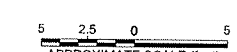
PLOTTED: 08 Aug 2007, 8:58am, jsala

ATTACHED IMAGES: Images: T-1.jpg Images: T-2.jpg Images: T-3.jpg
ATTACHED XREFS: XRef: Style A_22x34; XRef: Style A_22x34_GYM COMPLEX; XRef: Style A_22x34_STUDENT ACTIVITIES
Ple-L:\2007\07PROJ CAD FILE: L:\2007\07Projects\82074\GRAPHICs\REPORT\ LAYOUT: T-1



① **SILTY SAND with GRAVELS & COBBLES** - reddish brown,moist, dense, gravel composed of Franciscan complex and Monterey Group clasts (PLEISTOCENE ALLUVIUM)

② **CLAYSTONE** - blue-green, moist, weak to plastic, iron-oxide staining on some surfaces, (GARRITY MEMBER - CONTRA COSTA GROUP BEDROCK)



DRAWN BY: LGS	**LOG OF TRENCH SA-2**		KLEINFELDER	PLATE
REVISED BY:			7133 Koll Center Parkway, Suite 100 Pleasanton, CA 94566-3101 PH. (925) 484-1700 FAX. (925) 484-5838 www.kleinfelder.com	**A-2**
CHECKED BY: SMD	STUDENT ACTIVITIES BUILDING CONTRA COSTA COMMUNITY COLLEGE SAN PABLO, CALIFORNIA			
DATE: AUGUST 2007 / APPROVED BY:	PROJECT NO. 82074/REPORT	FILE NAME: TRENCHES.dwg		

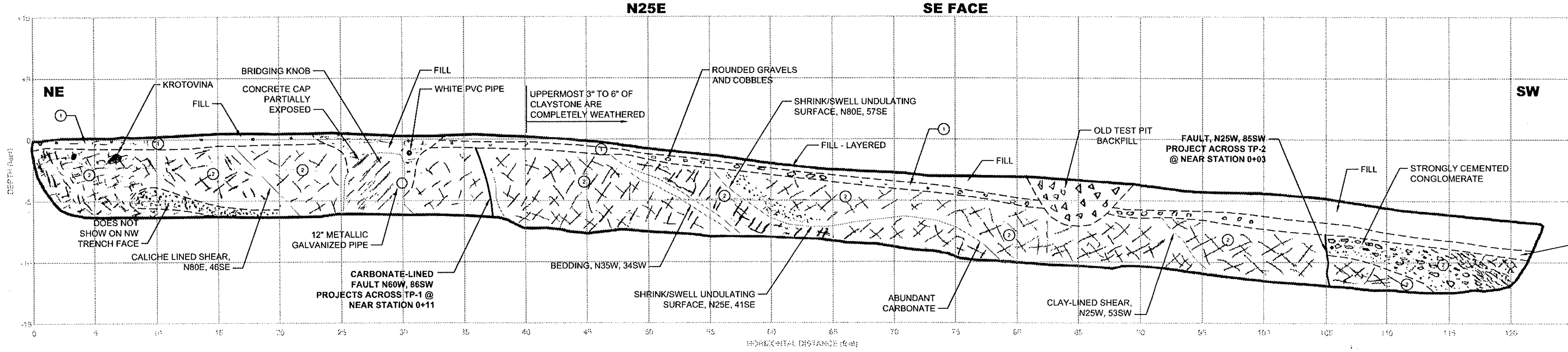
PLOTTED: 08 Aug 2007, 8:58am, jsala

ATTACHED IMAGES: Images: T-1.jpg Images: T-2.jpg Images: T-3.jpg
ATTACHED XREFS: XRef: Style A_22x34: XRef: Style A_22x34_GYM COMPLEX: XRef: Style A_22x34_STUDENT ACTIVITIES
Ple-L:\2007\07PROJ CAD FILE: L:\2007\07Projects\82074\GRAPHICs\REPORT\ LAYOUT: T-2

Kleinfelder, 2008, Subsurface Fault Investigation in Vicinity of the Existing Humanities Building

TRENCH T-1

N25E **SE FACE**



① **LEAN CLAY with SAND (CL)** - very dark brown, moist, stiff, subrounded gravel, clay film coats gravels/cobbles, rootlets (Holocene Age Residual Soil)

② **CLAYSTONE** - olive/gray, closely fractured, friable to weak, highly weathered, interbedded with sandstone, and conglomerate, abundant carbonate staining (Garrity Member - Contra Costa Group Bedrock)

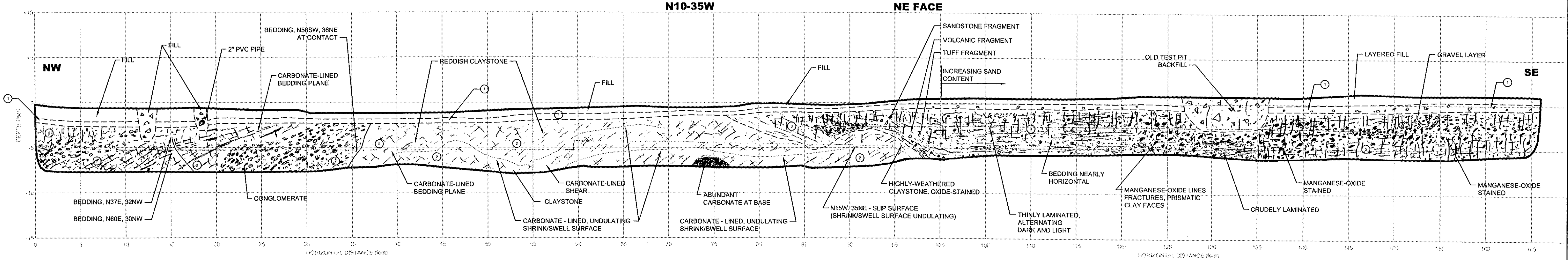
NOTES:
Krotovina: Infilled animal burrow
Logged by : Sadek Derrega & Omar Khan

DRAWN BY: LGS/JDS	**LOG OF GEOLOGIC TRENCH T-1**		KLEINFELDER	PLATE
REVISED BY:				
CHECKED BY: SMD	HUMANITIES BUILDING TRENCHING CONTRA COSTA COLLEGE 2600 MISSION BELL DRIVE SAN PABLO, CALIFORNIA		7133 Koll Center Parkway, Suite 100 Pleasanton, CA 94566-3101 PH. (925) 484-1700 FAX. (925) 484-5838 www.kleinfelder.com	**A-1**
DATE: JAN 2008 / APPROVED BY:	PROJECT NO. 86352/REPORT	FILE NAME: TRENCH.dwg		

PLOTTED: 17 Jan 2008, 11:01am, jsala

TRENCH T-2

N10-35W **NE FACE**



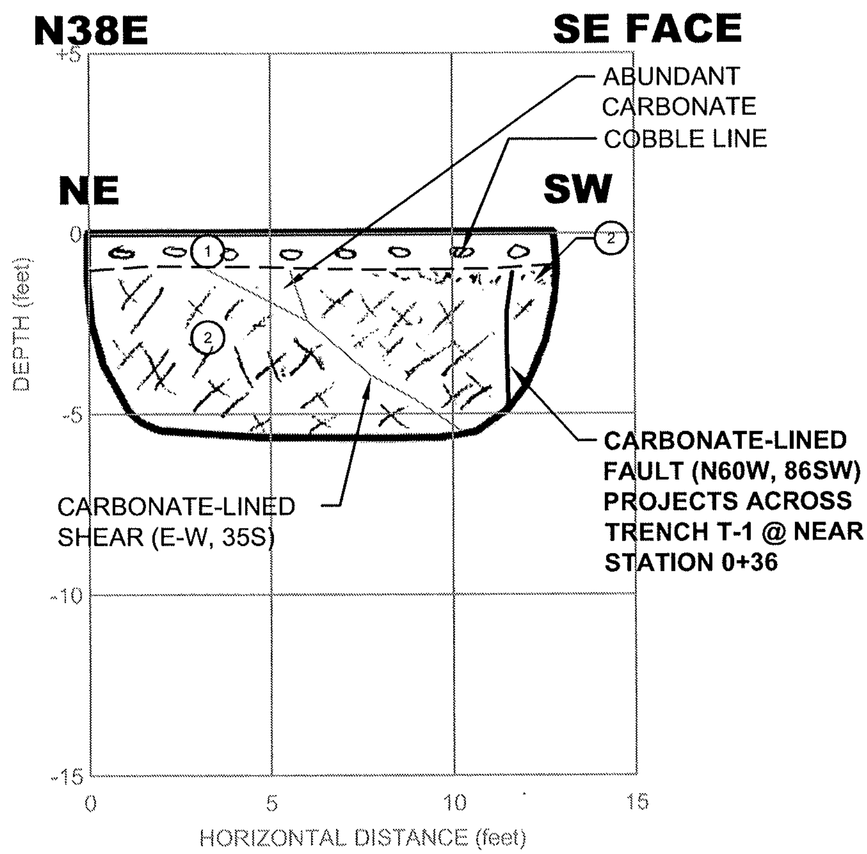
1. **LEAN CLAY with SAND (CL)** - very dark brown, moist, stiff, subrounded gravel, clay film coats gravels/cobbles, rootlets (Holocene Age Residual Soil)
2. **CLAYSTONE** - olive/gray, closely fractured, friable to weak, highly weathered, interbedded with sandstone, and conglomerate, abundant carbonate staining (Garrity Member - Contra Costa Group Bedrock)
3. **SANDY LEAN CLAY with GRAVEL (CL)** - reddish brown, moist, hard, prismatic near top of unit, subrounded gravels composed of chert, sandstone, basalt, tuff, silicious shale, laminated, oxide stained (Pleistocene Age Channel Deposit)

LOGGED BY: Sadek Derrega & Omar Khan

DRAWN BY: LGS/JDS	LOG OF GEOLOGIC TRENCH T-2		KLEINFELDER	PLATE
REVISED BY:			7133 Koll Center Parkway, Suite 100 Pleasanton, CA 94566-3101 PH. (925) 484-1700 FAX. (925) 484-5838 www.kleinfelder.com	A-2
CHECKED BY: SMD	HUMANITIES BUILDING CONTRA COSTA COLLEGE 2600 MISSION BELL DRIVE SAN PABLO, CALIFORNIA			
DATE: JAN 2008 / APPROVED BY:	PROJECT NO. 86352/REPORT	FILE NAME: TRENCH.dwg		

PLOTTED: 17 Jan 2008, 10:58am, jsala

TEST PIT TP-1



(1) **LEAN CLAY with SAND (CL) -** very dark brown, moist, stiff, subrounded gravel, clay film coats gravels/cobbles, rootlets (Holocene Age Residual Soil)

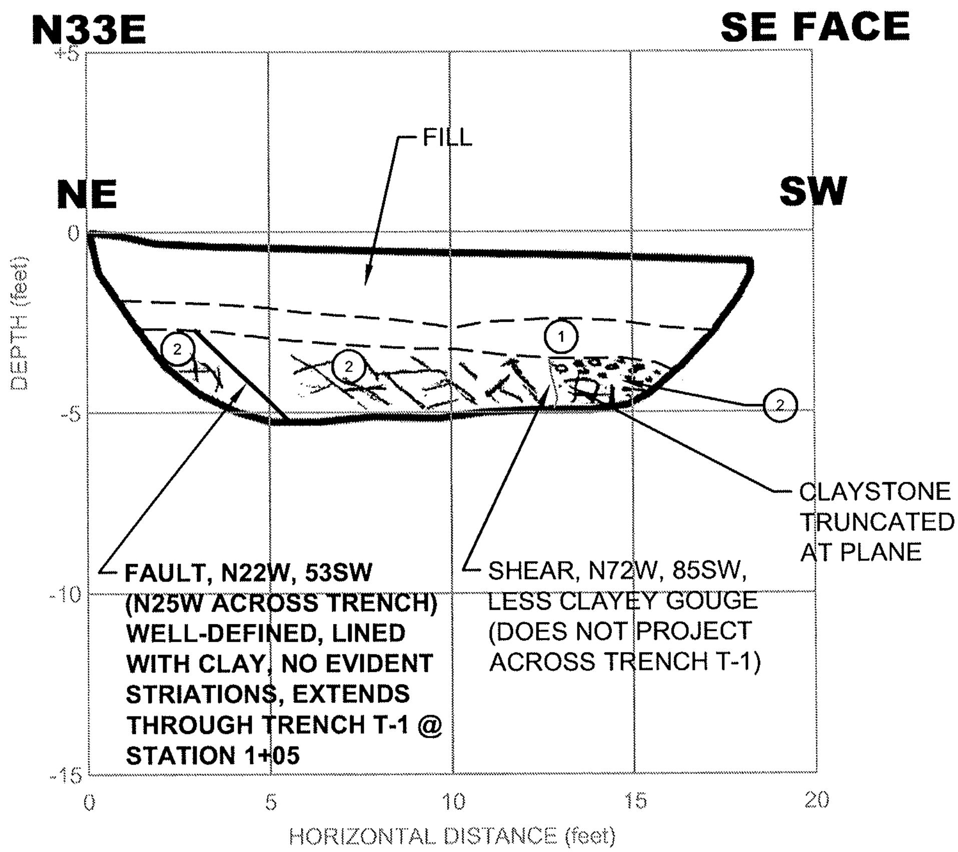
(2) **CLAYSTONE -** olive/gray, closely fractured, friable to weak, highly weathered, interbedded with sandstone, and conglomerate, abundant carbonate staining (Garrity Member - Contra Costa Group Bedrock)

LOGGED BY: Sadek Derrega & Omar Khan

KLEINFELDER 7133 Koll Center Parkway, Suite 100 Pleasanton, CA 94566 PH. (925) 484-1700 FAX. (925) 484-5838 www.kleinfelder.com	**LOG OF GEOLOGIC TEST PIT TP-1** HUMANITIES BUILDING CONTRA COSTA COMMUNITY COLLEGE 2900 MISSION BELL DRIVE SAN PABLO, CALIFORNIA	DRAWN BY: LGS/JDS REVISED BY: CHECKED BY: SMD PLATE **A-3**
DRAWN: JAN 2008 APPROVED BY:	PROJECT NO. 86352 FILE NAME: TRENCH.dwg	

ATTACHED IMAGES: Images: T-1.jpg Images: T-2.jpg Images: TP-1.jpg Images: TP-2.jpg Images: TP-3.jpg Images: TP-4.jpg
ATTACHED XREFS: XRef: Style A_08x11: XRef: Style A_11x36: XRef: Style A_11x30
L:\2008\08PROJ CAD FILE: D:_PROJECTS\86352\ LAYOUT: TP-1

TEST PIT TP-2



(1) **LEAN CLAY with SAND (CL) -** very dark brown, moist, stiff, subrounded gravel, clay film coats gravels/cobbles, rootlets (Holocene Age Residual Soil)

(2) **CLAYSTONE -** olive/gray, closely fractured, friable to weak, highly weathered, interbedded with sandstone, and conglomerate, abundant carbonate staining (Garrity Member - Contra Costa Group Bedrock)

KLEINFELDER

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PH. (925) 484-1700 FAX. (925) 484-5838
www.kleinfelder.com

LOG OF GEOLOGIC TEST PIT TP-2

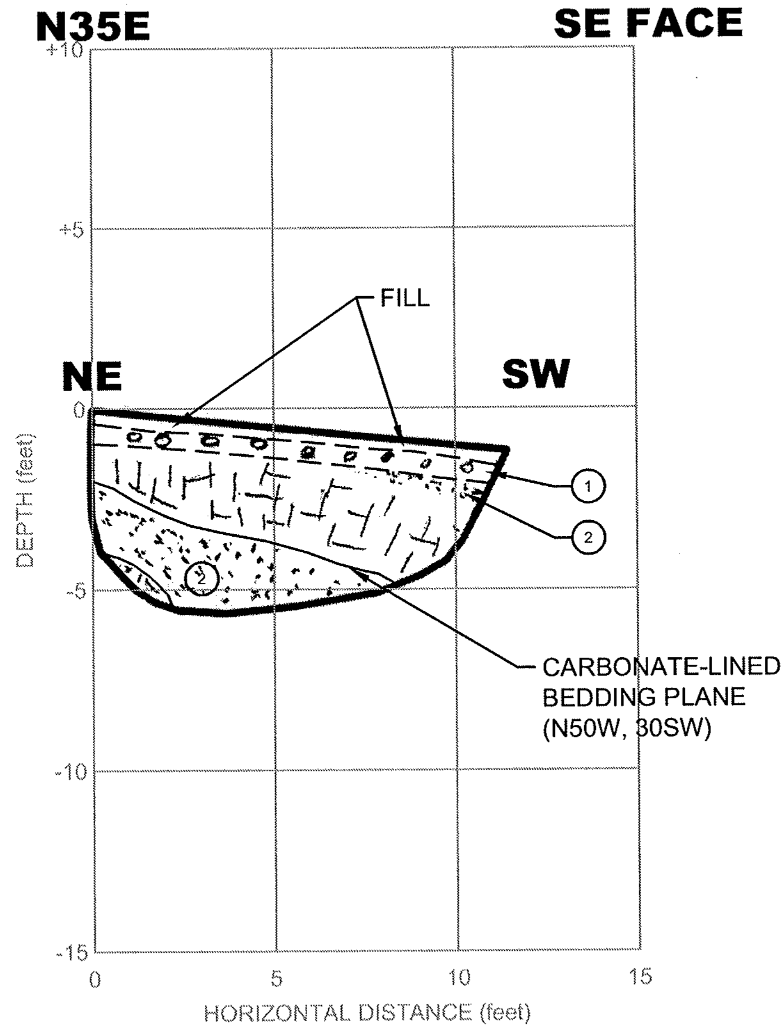
HUMANITIES BUILDING
CONTRA COSTA COMMUNITY COLLEGE
2900 MISSION BELL DRIVE
SAN PABLO, CALIFORNIA

DRAWN BY: LGS/JDS
REVISED BY:
CHECKED BY: SMD
PLATE **A-4**

DRAWN: JAN 2008 | APPROVED BY: | PROJECT NO. 86352 | FILE NAME: TRENCH.dwg

ATTACHED IMAGES: Images: T-1.jpg Images: T-2.jpg Images: TP-1.jpg Images: TP-2.jpg Images: TP-3.jpg Images: TP-4.jpg
ATTACHED XREFS: XRef: Style A_08x11: XRef: Style A_11x36: XRef: Style A_11x30
L:\2008\08PROJ CAD FILE: D:_PROJECTS\86352\ LAYOUT: TP-2

TEST PIT TP-3



1. **LEAN CLAY with SAND (CL) -** very dark brown, moist, stiff, subrounded gravel, clay film coats gravels/cobbles, rootlets (Holocene Age Residual Soil)

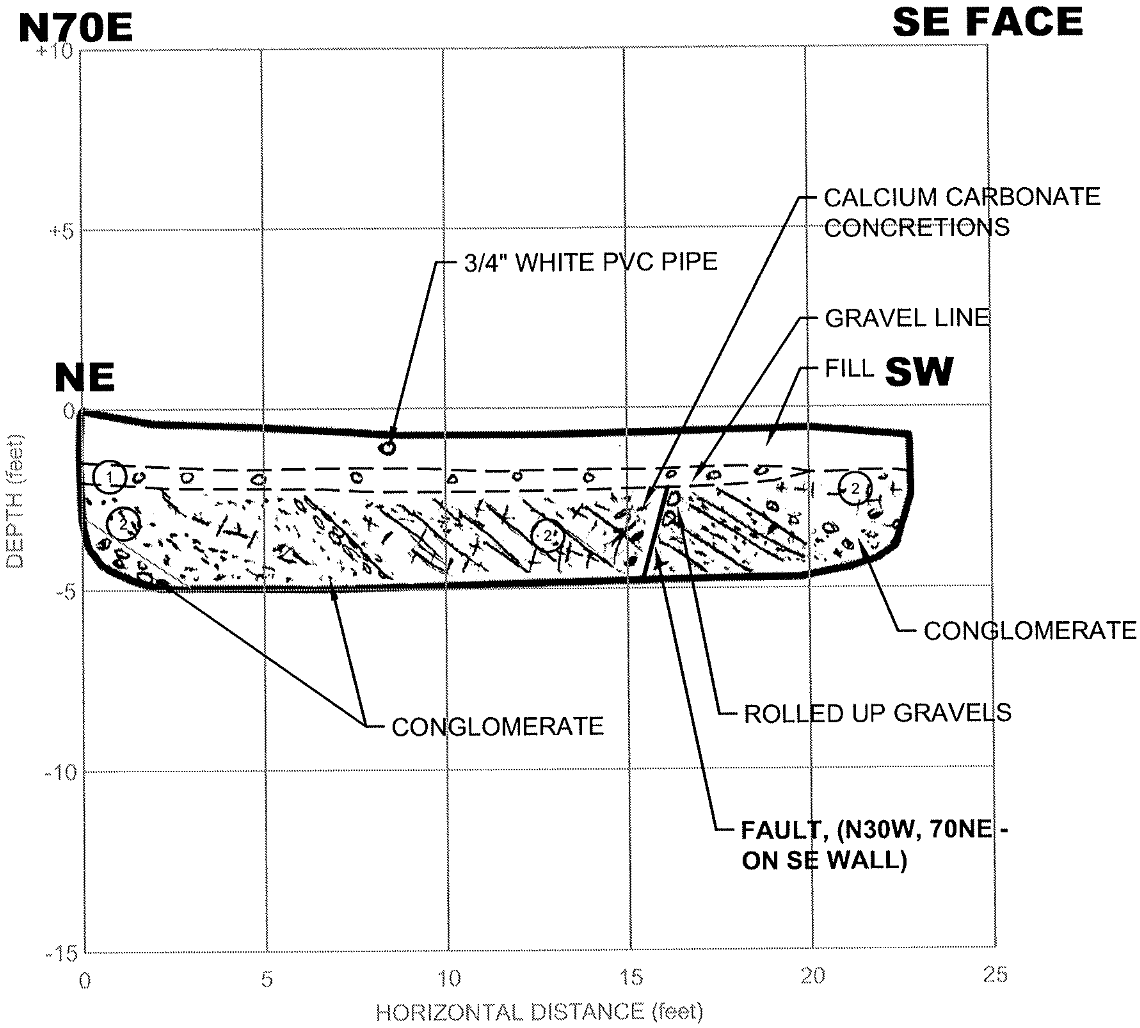
2. **CLAYSTONE -** olive/gray, closely fractured, friable to weak, highly weathered, interbedded with sandstone, and conglomerate, abundant carbonate staining (Garrity Member - Contra Costa Group Bedrock)

LOGGED BY: Sadek Derrega & Omar Khan

KLEINFELDER 7133 Koll Center Parkway, Suite 100 Pleasanton, CA 94566 PH. (925) 484-1700 FAX. (925) 484-5838 www.kleinfelder.com	**LOG OF GEOLOGIC TEST PIT TP-3** HUMANITIES BUILDING CONTRA COSTA COMMUNITY COLLEGE 2900 MISSION BELL DRIVE SAN PABLO, CALIFORNIA	**DRAWN BY:** LGS/JDS **REVISED BY:** **CHECKED BY:** SMD PLATE **A-5**
DRAWN: JAN 2008 **APPROVED BY:**	**PROJECT NO.** 86352 **FILE NAME:** TRENCH.dwg	

ATTACHED IMAGES: Images: T-1.jpg Images: T-2.jpg Images: TP-1.jpg Images: TP-2.jpg Images: TP-3.jpg Images: TP-4.jpg
ATTACHED XREFS: XRef: Style A_08x11: XRef: Style A_11x36: XRef: Style A_11x30
L:\2008\08PROJ CAD FILE: D:_PROJECTS\86352\ LAYOUT: TP-3

TEST PIT TP-4



1. **LEAN CLAY with SAND (CL) -** very dark brown, moist, stiff, subrounded gravel, clay film coats gravels/cobbles, rootlets (Holocene Age Residual Soil)

2. **CLAYSTONE -** olive/gray, closely fractured, friable to weak, highly weathered, interbedded with sandstone, and conglomerate, abundant carbonate staining (Garrity Member - Contra Costa Group Bedrock)

LOGGED BY: Sadek Derrega & Omar Khan

KLEINFELDER
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Pleasanton, CA 94566
PH. (925) 484-1700 FAX. (925) 484-5838
www.kleinfelder.com

LOG OF GEOLOGIC TEST PIT TP-4

HUMANITIES BUILDING
CONTRA COSTA COMMUNITY COLLEGE
2900 MISSION BELL DRIVE
SAN PABLO, CALIFORNIA

DRAWN BY:	LGS/JDS
REVISED BY:	
CHECKED BY:	SMD
PLATE	A-6
DRAWN:	JAN 2008
APPROVED BY:	
PROJECT NO.	86352
FILE NAME:	TRENCH.dwg

ATTACHED IMAGES: Images: T-1.jpg Images: T-2.jpg Images: TP-1.jpg Images: TP-2.jpg Images: TP-3.jpg Images: TP-4.jpg
ATTACHED XREFS: XRef: Style A_08x11: XRef: Style A_11x36: XRef: Style A_11x30
L:\2008\08PROJ CAD FILE: D:_PROJECTS\86352\ LAYOUT: TP-4

Kleinfelder, 2011, Geotechnical Investigation Report, Campus Center

UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS		LTR	ID	DESCRIPTION
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY	GW		Well-graded gravels or gravel with sand, little or no fines.
		GP		Poorly-graded gravels or gravel with sand, little or no fines.
		GM		Silty gravels, silty gravel with sand mixture.
		GC		Clayey gravels, clayey gravel with sand mixture
	SAND AND SANDY	SW		Well-graded sands or gravelly sands, little or no fines.
		SP		Poorly-graded sands or gravelly sands, little or no fines.
		SM		Silty sand.
		SC		Clayey sand.

MAJOR DIVISIONS		LTR	ID	DESCRIPTION
FINE GRAINED SOILS	SILTS AND CLAYS	ML		Inorganic silts and very fine sands, rock flour or clayey silts with slight plasticity.
		CL		Inorganic lean clays of low to medium plasticity, gravelly clays, sandy clays, silty clays.
		OL		Organic silts and organic silt-clays of low plasticity.
	SILTS AND CLAYS	MH		Inorganic elastic silts, micaceous or diatomaceous or silty soils.
		CH		Inorganic fat clays (high plasticity).
		OH		Organic clays of medium high to high plasticity.
HIGHLY ORGANIC SOILS		Pt		Peat and other highly organic soils.

Physical Properties Criteria for Rock Descriptions

FRACTURE SPACING

VERY WIDELY FRACTURED	Greater than 6.0 feet
WIDELY FRACTURED	2.0 to 6.0 feet
MODERATELY FRACTURED	8.0 inches to 2.0 feet
CLOSELY FRACTURED	2.5 to 8.0 inches
INTENSELY FRACTURED	0.75 to 2.5 inches
CRUSHED	Less than 0.75 inches

BEDDING OR LAYERING

VERY THICK OR MASSIVE	Greater than 4.0 feet
THICK	2.0 to 4.0 feet
THIN	0.2 to 2.0 feet
VERY THIN	0.05 to 0.2 feet
LAMINATED	0.01 to 0.05 feet
THINLY LAMINATED	Less than 0.01 feet

WEATHERING

FRESH - No visible sign of rock material weathering; perhaps slight discoloration on major discontinuity surfaces.

SLIGHTLY WEATHERED - Discoloration indicates weathering of rock material and discontinuity surfaces. All the rock material may be discolored by weathering and may be somewhat weaker than in its fresh condition.

MODERATELY WEATHERED - Less than half of the rock material is decomposed and/or disintegrated to a soil. Fresh or discolored rock is present either as a discontinuous framework or as corestones.

HIGHLY WEATHERED - More than half of the rock material is decomposed and/or distintegrated to a soil. Fresh or discolored rock is present either as a discontinuous framework or as corestones.

COMPLETELY WEATHERED - All rock material is decomposed and/or disintegrated to a soil. The original mass structure is still largely intact.

STRENGTH

PLASTIC - Can be remolded with hands.

FRIABLE - Can be crumbled between fingers or peeled by pocket knife.

WEAK - Can be peeled by a knife with difficulty, shallow indentations made by firm blow with point of geological hammer.

MEDIUM STRONG - Cannot be scraped or peeled with a pocket knife, specimen can be fractured with a single firm blow of geological hammer.

STRONG - Specimen requires more than one blow of geological hammer to fracture it.

VERY STRONG - Specimen withstands several blows of geological hammer without breaking.

EXTREMELY STRONG - Specimen can only be chipped with a geological hammer.

$$\text{RQD (Rock Quality Designation)} = \frac{\text{(Length of Solid Core Pieces 4" or Longer)}}{\text{(Total Length of Core Run)}} \times 100$$

Key to Test Data

Bulk Sample

Standard Penetration Split Spoon Sampler 2.0 inch O.D., 1.4 inch I.D.

Modified California Sampler 2.5 inch O.D., 2.0 inch I.D.

Shelby Tube 3.0 inch O.D.

Continuous Rock Core

California Sampler, 3.0 inch O.D., 2.5 inch I.D.

Pitcher Barrel

101 Method (Modified Pitcher Barrel)

0745, 5/31 — Approximate water level first observed in boring. Time recorded in reference to a 24-hour clock.

0800, 5/31 — Approximate water level observed in boring following drilling. Time recorded in reference to a 24-hour clock.

PEN Pocket Penetrometer reading, in tsf

TV:Su Torvane shear strength, in ksf

LL	LIQUID LIMIT
PI	PLASTICITY INDEX
%-#200	SIEVE ANALYSIS (MINUS #200 SCREEN)
R-Value	RESISTANCE VALUE
SE	SAND EQUIVALENT
C	COHESION (PSF)
PHI	FRICTION ANGLE
TX	TRIAXIAL SHEAR
CONSOL	CONSOLIDATION
DS	DIRECT SHEAR

Notes: Blow counts represent the number of blows a 140-pound hammer falling 30 inches required to drive a sampler through the last 12 inches of an 18 inch penetration, unless otherwise noted.

The lines separating strata on the logs represent approximate boundaries only. The actual transition may be gradual. No warranty is provided as to the continuity of soil strata between borings. Logs represent the soil section observed at the boring location on the date of drilling only.

KLEINFELDER
Bright People. Right Solutions.

PROJECT NO. **112252**

ROCK AND SOIL LEGEND

CONTRA COSTA COLLEGE
CAMPUS CENTER
SAN PABLO, CALIFORNIA

PLATE

B-1

8/5/2010 6:11:42 PM

GRAPHIC ROCK SYMBOLS

SHALE OR CLAYSTONE	CHERT	SERPENTINITE
SILTSTONE	PYROCLASTIC	METAMORPHIC ROCKS
SANDSTONE	VOLCANIC FLOWS	
CONGLOMERATE	PLUTONIC	SHEARED ROCKS

WEATHERING INDEX

W1 - *FRESH - No visible sign of rock material weathering; perhaps slight discoloration on major discontinuity surfaces.*

W2 - *SLIGHTLY WEATHERED - Discoloration indicates weathering of rock material and discontinuity surfaces. All the rock material may be discolored by weathering and may be somewhat weaker than in its fresh condition.*

W3 - *MODERATELY WEATHERED - Less than half of the rock material is decomposed and/or disintegrated to a soil. Fresh or discolored rock is present either as a discontinuous framework or as corestones.*

W4 - *HIGHLY WEATHERED - More than half of the rock material is decomposed and/or disintegrated to a soil. Fresh or discolored rock is present either as a discontinuous framework or as corestones.*

W5 - *COMPLETELY WEATHERED - All rock material is decomposed and/or disintegrated to a soil. The original mass structure is still largely intact.*

STRENGTH INDEX

R0 - *EXTREMELY WEAK - Indented by thumbnail*

R1 - *VERY WEAK - Crumbles under firm blows with a point of geological hammer, can be peeled by pocket knife*

R2 - *WEAK - Can be peeled by a knife with difficulty, shallow indentations made by firm blow with point of geological hammer.*

R3 - *MEDIUM STRONG - Cannot be scraped or peeled with a pocket knife, specimen can be fractured with a single firm blow of geological hammer.*

R4 - *STRONG - Specimen requires more than one blow of geological hammer to fracture it.*

R5 - *VERY STRONG - Specimen withstands several blows of geological hammer without breaking.*

R6 - *EXTREMELY STRONG - Specimen can only be chipped with a geological hammer.*

FRACTURE SPACING

VERY WIDELY FRACTURED	*Greater than 6.0 feet*
WIDELY FRACTURED	*2.0 to 6.0 feet*
MODERATELY FRACTURED	*8.0 inches to 2.0 feet*
CLOSELY FRACTURED	*2.5 to 8.0 inches*
INTENSELY FRACTURED	*0.75 to 2.5 inches*
CRUSHED	*Less than 0.75 inches*

BEDDING OR LAYERING

VERY THICK OR MASSIVE	*Greater than 4.0 feet*
THICK	*2.0 to 4.0 feet*
THIN	*0.2 to 2.0 feet*
VERY THIN	*0.05 to 0.2 foot*
LAMINATED	*0.01 to 0.05 foot*
THINLY LAMINATED	*Less than 0.01 foot*

KLEINFELDER
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PROJECT NO. *112252*

ROCK CLASSIFICATION SYSTEM

CONTRA COSTA COLLEGE
CAMPUS CENTER
SAN PABLO, CALIFORNIA

PLATE

B-2

8/5/2010 6:10:31 PM

Date Completed: 7/26/10

Logged By: O. Khan

Total Depth: Approximately 14.0 ft

Drilling method: 4" Flight Auger
Driller: Hillside Geotectnical

Hammer Wt: 140 lbs., 30" drop

Notes: Surface Condition: Asphalt

Depth, ft	FIELD Sample	FIELD Blows/ft	LABORATORY Dry Density pcf	LABORATORY Moisture Content %	LABORATORY Compress. Strength tsf	LABORATORY Other Tests	Pen, tsf	DESCRIPTION (Surface Elevation: Estimated ~91 feet (MSL))
								ASPHALT CONCRETE - approximately 1.5 inches thick
		26				Ø= 34 Degrees; C= 100 psf (See Plate D-7)	3.5-4.0	**CLAYSTONE** - light olive green, slightly moist to moist, highly weathered to decomposed, weak, low to medium plasticity (GARRITY MEMBER - Contra Costa Group Bedrock)
5		49	113	14.1			>4.5	- red brown
		50/6"					>4.5	
10								
		50/6"					>4.5	- light brown
15								Boring terminated at approx. 14 feet below ground surface. No free water observed. Boring backfilled with cement grout and capped with asphalt patching.
20								
25								
30								
35								

KLEINFELDER
Bright People. Right Solutions.

PROJECT NO. 112252

LOG OF BORING NO. B- 1

CONTRA COSTA COLLEGE
CAMPUS CENTER
SAN PABLO, CALIFORNIA

PLATE

B-3

L:\2011\11PROJECTS\112252-CONTRA COSTA COLLEGE\112252-C C COLLEGE CAMPUS CENTER.GPJ

1/20/2011 10:53:10 AM

Date Completed: 7/26/10
Logged By: O. Khan
Total Depth: Approximately 30.0 ft

Drilling method: 4" Flight Auger
Driller: Hillside Geotectnical
Hammer Wt: 140 lbs., 30" drop
Notes: Surface Condition: Landscape

Surface Elevation: Estimated ~77 feet (MSL)

Depth, ft	Sample (FIELD)	Blows/ft (FIELD)	Dry Density pcf	Moisture Content %	Compress. Strength tsf	Other Tests	Pen, tsf	DESCRIPTION
		43					>4.0	**LEAN CLAY (CL)** - brown to dark brown, dry to moist, hard, low to medium plasticity, trace fine grained gravel, rootlets (POSSIBLY FILL)
5		49	119	10.8	11.39 @ 6.0%	Corrosivity (See Appendix E)	>4.5	- very hard, increase in fine gravel
10		35					2.0	**GRAVELLY LEAN CLAY (CL)**- dark olive brown, moist, firm, medium plasticity, fine grained gravel
15		18	104	23.5		Consolidation Test (See Plate D-8)	1.0	**LEAN CLAY (CL)** - olive, wet, firm, medium plasticity, trace fine gravel and fine grained sand, mottled with manganese oxide staining
20		39						**POORLY-GRADED SAND with GRAVEL (SP)**- brown, wet, medium dense, medium to coarse grained sand, fine gravel (white quartz, chert)
								SILTY CLAYSTONE - olive, highly weathered, weak to plastic, trace fine grained sand (GARRITY MEMBER - Contra Costa Group Bedrock)
25		28						- moist
30		50-5"						Boring terminated at approx. 30 feet below ground surface. Perched water encountered at apprximately 13.5 feet. Backfilled with cement grout.
35								

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LOG OF BORING NO. B- 2

CONTRA COSTA COLLEGE
CAMPUS CENTER
SAN PABLO, CALIFORNIA

PLATE
B-4

Date Completed: 8/2/10

Logged By: O. Khan

Total Depth: Approximately 20.0 ft

Drilling method: 4" Solid Stem Auger

Driller: Hillside Geotectnical

Hammer Wt: 140 lbs., 30" drop

Notes: Surface Condition: Asphalt

Depth, ft	FIELD: Sample	FIELD: Blows/ft	LABORATORY: Dry Density pcf	LABORATORY: Moisture Content %	LABORATORY: Compress. Strength tsf	LABORATORY: Other Tests	Pen, tsf	DESCRIPTION — Surface Elevation: Estimated ~78 feet (MSL)
								ASPHALT CONCRETE - approximately 4 inches thick
		29					2.0-3.0	**SANDY LEAN CLAY (CL)** - olive, moist, firm to hard, medium plasticity, fine grained sand
5		28	97	26.3	2.40 @ 12.4%		2.8	**SANDY CLAYSTONE** - olive, weak to plastic, completely to highly weathered, fine grained sand (GARRITY MEMBER - Contra Costa Group Bedrock)
10		40						- carbonate nodules, increase in sand content and gravel
15		33						- highly weathered, mottled with fine grained sand lens
20		68						Boring terminated at approx. 20 feet below ground surface. No free water observed. Boring backfilled with cement grout and capped with asphalt patching.
25								
30								
35								

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PROJECT NO. 112252

LOG OF BORING NO. B- 5

CONTRA COSTA COLLEGE
CAMPUS CENTER
SAN PABLO, CALIFORNIA

PLATE

B-7

Date Completed: 8/2/10
Drilling method: 4" Solid Stem Auger
Driller: Hillside Geotectnical

Logged By: O. Khan

Hammer Wt: 140 lbs., 30" drop

Total Depth: Approximately 20.0 ft
Notes: Surface Condition: Asphalt

Depth, ft	FIELD: Sample	FIELD: Blows/ft	LABORATORY: Dry Density pcf	LABORATORY: Moisture Content %	LABORATORY: Compress. Strength tsf	LABORATORY: Other Tests	Pen, tsf	DESCRIPTION (Surface Elevation: Estimated ~74 feet (MSL))
								ASPHALT CONCRETE - approximately 2 inches thick
		27					2.0	**LEAN CLAY (CL)** - dark olive brown, moist, firm, medium plasticity, rootlets
			106	13.9				**SANDY LEAN CLAY (CL)** - olive to light yellowish brown, moist, firm, low to medium plasticity, fine to coarse grained sand, trace fine gravel
5		50						**CLAYEY GRAVEL with SAND (GC)** - brown, moist, dense, fine angular to sub angular gravel
			93	30.4			1.8	**SANDY LEAN CLAY (CL)** - light olive, moist, firm, low to medium plasticity, fine grained sand, iron oxide staining
10		33						**CLAYEY GRAVEL with SAND (GC)** - brown, moist, medium dense, fine to medium grained sand, fine gravel
								SANDY CLAYSTONE - light yellowish brown, weak, highly weathered, low to medium plasticity, manganese oxide staining, trace silt (GARRITY MEMBER - Contra Costa Group Bedrock)
15		48						
								- fine grained sand lens
20		54						Boring terminated at approx. 20 feet below ground surface. No free water observed. Boring backfilled with cement grout and capped with asphalt patching.
25								
30								
35								

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PROJECT NO. 112252

LOG OF BORING NO. B- 6

CONTRA COSTA COLLEGE
CAMPUS CENTER
SAN PABLO, CALIFORNIA

PLATE
B-8

Date Completed:	8/2/10	*Drilling method:*	4" Solid Stem Auger
			Driller: Hillside Geotectnical
Logged By:	O. Khan	*Hammer Wt:*	140 lbs., 30" drop
Total Depth:	Approximately 19.5 ft	*Notes:*	Surface Condition: Lawn

	FIELD		LABORATORY					DESCRIPTION
Depth,ft	Sample	Blows/ft	Dry Density pcf	Moisture Content %	Compress. Strength tsf	Other Tests	Pen, tsf	*Surface Elevation:* **Estimated ~73 feet (MSL)**
		14				LL=36; PI=21 (See Plate D-1) Corrosivity (See Appendix E)	1.0	**LEAN CLAY (CL)** - dark brown, moist, firm, mottled, low to medium plasticity, trace fine grained sand, fine subangular gravel, rootlets (FILL) - soft
5		14	95	27.6	0.99 @ 15.0%		0.5	**LEAN CLAY (CL)** - greenish gray, moist, firm, medium plasticity, trace fine gravel
10		24					1.0	**SANDY LEAN CLAY (CL)**- light yellowish brown, moist, firm, low to medium plasticity, fine grained sand, manganese oxide staining, higher sand content with depth
15		39	110	17.1				**GRAVELLY LEAN CLAY (CL)**- dark yellowish brown, moist, hard, low plasticity, iron oxide staining, fine subrounded to rounded gravel (chert and quartz) - increase in gravel and sand content
		50/4"						
20								Boring terminated at approx. 19.5 feet below ground surface. No free water observed. Boring backfilled with cement grout.
25								
30								
35								

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LOG OF BORING NO. B- 7

CONTRA COSTA COLLEGE
CAMPUS CENTER
SAN PABLO, CALIFORNIA

PLATE

B-9

Date Completed: 8/2/10
Logged By: O. Khan
Total Depth: Approximately 20.0 ft

Drilling method: 4" Solid Stem Auger
Driller: Hillside Geotectnical
Hammer Wt: 140 lbs., 30" drop
Notes: Surface Condition: Asphalt

Depth, ft	FIELD: Sample	FIELD: Blows/ft	LABORATORY: Dry Density pcf	LABORATORY: Moisture Content %	LABORATORY: Compress. Strength tsf	LABORATORY: Other Tests	Pen, tsf	DESCRIPTION — Surface Elevation: Estimated ~65 feet (MSL)
								ASPHALT CONCRETE - approximately 6 inches thick
								GRAVELLY MATERIAL - approximately 6 inches thick (Possibly Aggregate Base)
		18					1.5-1.8	
								SANDY LEAN CLAY (CL) - dark gray to yellowish brown, firm, low to medium plasticity, fine grained sand, trace fine gravel (FILL)
5		20	96	30.0			1.3-1.8	
								LEAN CLAY (CL) - light gray, moist, firm, medium plasticity
10		18	103	22.3	1.61 @ 15.0%		1.5-2.0	- grayish brown, soft to firm, trace fine grained sand
15		39					2.5	- dark yellowish brown, firm to hard, manganese oxide staining
			▽ 14:10					**SILTY SAND (SM)** - yellowish brown, wet, medium dense to dense, fine grained sand
20		43				Passing -#200=23%		- angular coarse gravel (Volcanic Clasts)
								Boring terminated at approx. 20 feet below ground surface. Boring backfilled with cement grout and capped with asphalt patching.
25								
30								
35								

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PROJECT NO. 112252

LOG OF BORING NO. B- 8

CONTRA COSTA COLLEGE
CAMPUS CENTER
SAN PABLO, CALIFORNIA

PLATE
B-10

APPENDIX D

Corrosion Results

California State Certified Laboratory No. 2153

CERCO analytical
1100 Willow Pass Court, Suite A
Concord, CA 94520-1006
925 462 2771 Fax. 925 462 2775
www.cercoanalytical.com

Client: Kleinfelder
Client's Project No.: 20181569
Client's Project Name: Contra Costa College-New Allied Science Bldg. (C-4016)
Date Sampled: 08/11 & 18/17
Date Received: 8-Sep-2017
Matrix: Soil
Authorization: Signed Chain of Custody

Date of Report: 21-Sep-2017

Job/Sample No.	Sample I.D.	Redox (mV)	pH	Resistivity (As Received) (ohms-cm)	Resistivity (100% Saturation) (ohms-cm)	Sulfide (mg/kg)*	Chloride (mg/kg)*	Sulfate (mg/kg)*
1709047-001	B-3 2C @ 6'	+440	7.86	720	1,100	N.D.	N.D.	N.D.

Method:	ASTM D1498	ASTM D4972	ASTM G57	ASTM G57	ASTM D4658M	ASTM D4327	ASTM D4327
Reporting Limit:	-	-	-	-	50	15	15
Date Analyzed:	14-Sep-2017	14-Sep-2017	13-Sep-2017	13-Sep-2017	20-Sep-2017	14-Sep-2017	14-Sep-2017

* Results Reported on "As Received" Basis
N.D. - None Detected

Cheryl McMillen
Laboratory Director

Quality Control Summary - All laboratory quality control parameters were found to be within established limits

APPENDIX E

Site-Specific Seismic Analysis

APPENDIX E
SEISMIC HAZARD ANALYSIS

INTRODUCTION

This Appendix presents the results of our site-specific seismic hazard analysis per ASCE 7-10 (ASCE 2010) and Chapter 16A of 2016 California Building Code for the New Science Building project at Contra Costa Community College in San Pablo, California. The subsurface soil conditions used in this study were obtained from our current geotechnical investigations at the project site. Since the mapped S_1 value is greater than 0.75g, a site-specific ground motion hazard analysis is required per Section 1616A.1.3 of 2016 CBC.

The purpose of this seismic hazard analysis is to develop site-specific ground motion criteria in terms of peak ground accelerations and response spectral accelerations for the subject site by using a seismic source model (proximity to active faults, major historical earthquakes, and regional seismicity) and subsurface soil conditions at the site. The response spectrum is a graphical representation relating the maximum response of a single degree of freedom, elastic damped oscillator with different fundamental periods to dynamic loads. Site-specific spectrum for any given return period represents earthquake ground motions consistent with the seismic source model and the local site response. Specifically, our scope of services includes the following:

- Literature review of available geologic and seismic setting of the area and developing a site-specific seismic source model.
- Estimating the average shear wave velocity in the upper 100 feet (V_{s30}) of the site based on the results of the field explorations.
- Classification of the site per Chapter 20 of ASCE 7-10.
- Performing site-specific probabilistic and deterministic seismic hazard analyses (PSHA and DSHA) to obtain spectral accelerations for 2% probability of exceedance in 50 years and for 84th percentile deterministic per Chapter 21 of ASCE 7-10.
- Developing site-specific response spectra for the MCE_R and the DE per Chapter 21 of ASCE 7-10 for damping value of 5%.
- Developing site-specific ground motion parameters (S_{MS}, S_{M1}, S_{DS}, and S_{D1}) per Section 21.4 of ASCE 7-10.
- Estimating site-specific PGA_M per Section 21.5 of ASCE 7-10.
- Report preparation of the results of the site-specific seismic hazard analyses.

It should be noted that a site-specific seismic hazard analysis was performed for the Campus Safety Center, southwest of this site. However, the subsurface soil conditions are not similar at these two sites. The Campus Safety Center is located over relatively thick alluvium, whereas, this site has relatively shallow bedrock. Therefore, we had to perform PSHA and DSHA for this site and could not use the results from previous studies.

PROJECT LOCATION

The project site is located in the Contra Costa Community College in San Pablo, California. We have used the center of the proposed building as the site location and the approximate site coordinates used for the seismic hazard analysis are:

Latitude:	37.9697° N
Longitude:	-122.3369° W

REGIONAL FAULTING

According to Hart and Bryant (1997), the site is located within an Alquist-Priolo Earthquake Fault Zone for the Hayward-Rodgers Creek fault. Other faults located close to the site are the West Napa fault at about 23 km, the Green Valley Connected fault at about 25 km, the Mount Diablo Thrust at about 29 km, the Calaveras fault at about 34 km, and the Northern San Andreas fault at about 28 km. A seismic event on any of these faults could cause significant ground shaking at the site. Figure E-1 shows the known faults within 100 km of the site. However, only independent seismogenic sources have been labeled. All the other faults have been included in the background seismic sources.

SEISMIC SOURCE MODEL

Our probabilistic seismic source model is based on the seismic source model used in developing the 2008 update of the United States National Seismic Hazard Maps by California Geological Survey (CGS) and US Geological Survey (Petersen et al. 2008). Table E-1 lists these individual fault segments and their seismic parameters. The various combinations of fault segments and different rupture scenarios are accounted for in the logic tree in our seismic source model per Petersen et al. (2008). However, Table E-1 only presents the scenario of rupturing all the segments. The maximum earthquake magnitudes presented in this table are based on the moment magnitude scale developed by Hanks and Kanamori (1979). CGS has assigned weights of 0.67 and 0.33 to Characteristics and G-R models, respectively, for all the faults listed in Table E-1 except for the Hayward-Rodgers Creek and N. San Andreas faults. For the Hayward-Rodgers Creek and the N. San Andreas faults, Characteristic model was assigned 1.0 weight. We have used the same approach in our analyses. We have used faults within 200 km of the site in our analyses, but only faults within 100 km are listed in Table E-1.

According to Petersen et al. (2008), characterizations of the Hayward-Rodgers Creek, the N. San Andreas, and the Calaveras faults are based on the following fault rupture segments and fault rupture scenarios:

- The Hayward-Rodgers Creek fault has been characterized by three segments and six rupture scenarios plus a floating earthquake. The three segments are the Rodgers Creek fault (RC), the Hayward North (HN), and the Hayward South (HS).
- The N. San Andreas fault has been characterized by four segments and nine rupture scenarios, plus a floating earthquake. The four segments are Santa Cruz Mountains (SAS), North Coast (SAN), Peninsula (SAP), and Offshore (SAO).
- The Calaveras fault includes three segments and six rupture scenarios, plus a floating earthquake. The three segments are southern (CS), central (CC), and northern (CN).

We have used all of the rupture scenarios for these faults as used by Petersen et al. (2008).

TABLE E-1: SIGNIFICANT FAULTS IN THE SEISMIC SOURCE MODEL

Fault Name	Closest Distance* (km)	Fault Length (km)	Magnitude of Characteristic Earthquake **	Slip Rate (mm/yr)
Hayward-Rodgers Creek	0	150	7.33	9.0
West Napa	23	30	6.70	1.0
Green Valley Connected	25	56	6.80	4.7
Northern San Andreas	28	473	8.05	17-24
Mount Diablo Thrust	29	25	6.70	2.0
San Gregorio - Connected	33	176	7.50	5.5
Calaveras	34	123	7.03	6-15
Great Valley 4b, Gordon Valley	39	28	6.80	1.3
Point Reyes	42	47	6.90	0.4
Great Valley 5, Pittsburg Kirby Hills	44	32	6.70	1.0
Greenville Connected	46	51	7.00	2.0
Hunting Creek-Berryessa	55	60	7.10	6.0
Monte Vista-Shannon	60	45	6.50	0.4
Great Valley 4a, Trout Creek	61	19	6.60	1.3
Great Valley 7	74	45	6.90	1.5
Maacama-Garberville	74	221	7.40	9.0
Great Valley 3, Mysterious Ridge	77	55	7.10	1.3
Collayomi	95	28	6.70	0.6

* Closest distance to potential rupture
** Moment magnitude: An estimate of an earthquake's magnitude based on the seismic moment

MAGNITUDE-FREQUENCY DISTRIBUTION

The earthquake probabilities for the faults and their segments were developed using a magnitude-frequency relationship derived from the seismicity catalogs and the fault activity based on their slip rates. In general, there are two models based on magnitude-frequency relationships. In the first, earthquake recurrence is modeled by a truncated form of the Gutenberg-Richter (G-R) (Gutenberg and Richter, 1956) magnitude-frequency relation given by:

$$\text{Log}(N) = a - b*M$$

where N(M) is the cumulative number of earthquakes of magnitude "M" or greater per year, and "a" and "b" are constants based on recurrence analyses. The relation is truncated at the maximum earthquake. In the G-R model, it is assumed that seismicity along a given fault or fault zones satisfies the above equation. This model generally implies that seismic events of all sizes occur continually on a fault during the interval between the occurrences of the maximum expected events along the fault zone.

The second model, generally referred to as a Characteristic model (Schwartz and Coppersmith, 1984), implies that the time between maximum size earthquakes along particular fault zones or fault segments is generally quiescent except for foreshocks, aftershocks, or low level background activity.

We have used the Peterson et al. (2008) approach in our analyses, which used both the G-R and the Characteristic models. A b-value of 0.8 is used for all the faults. The most likely a-values were estimated for each seismic source based on the recurrence rates of earthquakes and events per year associated with that seismic source as reported by Petersen et al. (2008).

HISTORICAL SEISMICITY

The project site is located in an area characterized by high seismic activity. A number of large earthquakes have occurred within this area in the past years. Some of the significant nearby events include the 1868 (M6.8) Hayward earthquake, the 2014 (M6.0) South Napa earthquake, the 1906 (M7.9) “Great” San Francisco earthquake, the 1838 (M7) San Francisco Peninsula earthquake, the 1865 (M6.4) Santa Cruz Mountains earthquake, the two 1903 (M5.5) San Jose earthquakes, and the 1989 (M6.9) Loma Prieta earthquake. A study by Toppozada and Borcherdt (1998) indicates an 1836 (M6.8) earthquake, previously attributed to the Hayward fault, occurred in the Monterey Bay area and was of an estimated magnitude M6.2. During the 1989 Loma Prieta earthquake on the San Andreas fault, several California Strong Motion Instrumentation Program (CSMIP) stations in the area recorded free-field horizontal peak ground accelerations ranging from 0.1 to 0.3 g (Thiel Jr., et al., 1990). During the South Napa earthquake, CSMIP stations in the area recorded free-field horizontal peak ground accelerations of less than 0.1g. Epicenters of significant earthquakes (M>4.0) within the vicinity of the site are shown on Figure E-1.

BACKGROUND SEISMICITY

In addition to the individual seismogenic sources, we also allow for background seismicity that accounts for random earthquakes between M 5 and 7 based on the methodology described by Frankel et al. (1996). Using the seismic source model used by CGS/USGS, some of the local faults in the area are not included in our analyses as independent seismogenic sources. However, their seismicity has been included by allowing for background seismicity in our model. The a-values are calculated using the method described in Weichert (1980). The hazard may then be calculated using this a-value, a b-value of 0.9, minimum magnitude of 5, maximum magnitude of 7, and applying an exponential distribution as described by Hermann (1977).

SEISMIC HAZARD ANALYSIS

Based on the results of the field explorations for this project and using appropriate correlations between penetration resistance and Vs and/or undrained shear strength and Vs, the site is estimated to have average shear wave velocity in the upper 100 feet (V_{S30}) varies from about 1,050 feet/sec (320 m/s) in boring B-3 to about 1,475 (450 m/s) in boring B-2, thus making this site as Site Class D (i.e., Stiff soil) on one side to Site Class C (soft rock) on the other based on Table 20.3-1 of ASCE 7-10. Conservatively, we have assumed V_{S30} of 320 m/s for this site, thus making it Site Class D. We used Caltrans procedure in estimating V_{S30} for this site (Caltrans, 2012).

According to ASCE 7-10, the MCE_R is defined as the most severe earthquake effects determined for the orientation that results in the largest maximum response to horizontal ground motions and with adjustment for targeted risk as defined by ASCE 7-10. In addition, according to ASCE 7-10, the MCE_R is defined as the lesser of: (1) 2 percent probability of being exceeded in 50 years (return period of about 2,475 years) adjusted for risk factors and for the maximum direction; and (2) greater of 84th percentile (median + 1 standard deviation) deterministic values (adjusted for the maximum direction) from the controlling fault and deterministic lower limit (DLL) of Figure 21.2-1 of ASCE 7-10. The DE is defined as two-thirds of the MCE_R. In addition, for site-specific response spectra, procedures provided in Chapter 21 of ASCE 7-10 should be used and the design spectral accelerations at any period from site-specific analyses should not be less than the 80 percent of the code spectrum based on S_{DS} and S_{D1} values from Chapter 11, ASCE 7-10.

Both probabilistic and deterministic seismic hazard analyses were used to estimate the spectral accelerations for the MCE_R. These analyses involve the selection of appropriate predictive relationships to estimate the ground motion parameters, and, through probabilistic and deterministic methods, determination of peak and spectral accelerations.

Ground Motion Prediction Equations (GMPE)

Site-specific ground motions can be influenced by the styles of faulting, magnitudes of the earthquakes, and local soil conditions. The GMPEs used to estimate ground motion from an earthquake source need to consider these effects. Many GMPEs have been developed to estimate the variation of peak ground acceleration with earthquake magnitude and distance from the site to the source of an earthquake.

We have used Boore and Atkinson (2008), Campbell and Bozorgnia (2008), and Chiou and Youngs (2008) NGA-West 1 GMPEs, as these three were used in developing 2008 USGS National Seismic Hazard Maps. All of these GMPEs use an estimate of the average shear wave velocity in the upper 100 feet (V_{S30}) of the soil profile in the analysis. Based on the results of our field investigation, a V_{S30} of 320 m/s was used in the analyses. Some of these GMPEs also require inputs for depth in meters to a layer with V_s value of 1,000 m/s ($Z_{1.0}$) and depth in km to the layer with V_s value of 2,500 m/s ($Z_{2.5}$) to account for deep soil basin effects. Since the site is not located in any known deep soil basin, we used the default (minimum) values in our analysis. Spectral acceleration values were obtained by averaging the individual hazard results. These GMPEs provide mean values of ground motions associated with magnitude, distance, site soil conditions, and mechanism of faulting. The uncertainty in the predicted ground motion is taken into consideration by including a magnitude dependent standard error in the probabilistic analysis.

Probabilistic Seismic Hazard Analysis

A probabilistic seismic hazards analysis (PSHA) procedure was used to estimate the peak and spectral ground motions corresponding to 2 percent probability of exceedance in 50 years. The PSHA approach is based on the earthquake characteristics and its causative fault. These characteristics include such items as magnitude of the earthquake, distance from the site to the causative fault, and the length and activity of the fault. The effects of site soil conditions and mechanism of faulting are accounted for in the GMPE(s) used for the site.

The theory behind seismic risk analysis has been developed over many years (Cornell, 1968, 1971; Merz and Cornell, 1973), and is based on the "total probability theorem" and on the assumption that earthquakes are events that are independent of time and space from one another. According to this approach, the probability of exceeding PE(Z) at a given level of ground motion, Z, at the site within a specified time period, T, is given by

$$PE(Z) = 1 - e^{-\vartheta(Z)T}$$

where $\vartheta(Z)$ is the mean annual rate of exceedance of ground motion level Z. Different probabilities of exceedance may be selected, depending on the level of performance required.

The PSHA can be explained through a four-step procedure as follows:

1. The first step involves identification and characterization of seismic sources and probability distribution of potential rupture within the sources. Usually, uniform probability distributions are assigned to each source. The probability distribution of site distance is obtained by combining potential rupture distributions with source geometry.

2. The second step involves characterization of seismicity distribution of earthquake recurrence. An earthquake recurrence relationship such as Gutenberg-Richter recurrence is used to characterize the seismicity of each source.

3. The third step involves the use of GMPEs in assessing the ground motion produced at the site by considering the applicable sources and the distance of the sources to site. The variability of GMPEs is also included in the analysis. The effects of site soil conditions and mechanism of faulting are accounted for in these GMPEs.

4. The fourth and the last step involve combining all of these uncertainties to obtain the probability of ground motion exceedance during a particular time period.

A simplified mathematical expression for these steps is provided below:

$$\nu \; (Sa > z) = \sum_{i=1}^{Nsource} N_i(M_{\min}) \int_{r=0}^{\infty} \int_{m=M_{\min}}^{M_{\max_i}} f_{m_i}(M) f_{r_i}(r) P(Sa > z \mid M, r) dr dM$$

Where $\nu(Sa>z)$ is the mean annual rate of a spectral acceleration (Sa) exceeding a test value (z); N_{source} is the number of seismic sources; $N_i(M_{min})$ is the rate of earthquakes with magnitude greater than M_{min} on the i^{th} seismic source; $f_{m,i}(M)$ is the probability distribution of earthquake magnitude (M) of the i^{th} source; $f_{r,i}(r)$ is the probability distribution of the fault rupture location (r); and $P(Sa>z|M,r)$ is the probability that Sa is greater than the test value (z) given the M and r.

We have used the computer program EZ-FRISK version 8.00 beta (Risk Engineering, 2015) for our probabilistic analysis. Horizontal response spectral values for the 2 percent in 50-year probability of exceedance were calculated using the probabilistic analysis approach described above. Elastic response spectral values were calculated for a damping factor of 5 percent of critical.

Deterministic Seismic Hazard Analysis

The deterministic seismic hazard analysis (DSHA) approach is also based on the characteristics of the earthquake and the causative fault associated with the earthquake. These characteristics include such items as magnitude of the earthquake and distance from the site to the causative fault. The effects of site soil conditions and mechanism of faulting are also accounted for in the GMPE for this site. Per ASCE 7-10, the 84th percentile deterministic site-specific spectral acceleration values at the site were estimated for the Hayward-Rodgers Creek fault (M7.33), which is the controlling fault for this site. Since the site is located within an A-P zone, we used a distance of 0 km in our analysis.

DETERMINATION OF SITE-SPECIFIC HORIZONTAL MCE_R AND DE RESPONSE SPECTRA

To develop the site-specific spectral response accelerations, we first obtained the general seismic design parameters based on the site class, site coordinates and the risk category of the building using the USGS online tool (http://geohazards.usgs.gov/designmaps/us/application.php). These values are summarized in Table E-2.

TABLE E-2: GENERAL GROUND MOTION PARAMETERS BASED ON ASCE 7-10

PARAMETER	VALUE	ASCE 7-10 REFERENCE
S_S	2.478g	Fig 22-1
S_1	1.030g	Fig 22-2
Site Class	D	Table 20.3-1
F_a	1.00	Table 11.4-1
F_v	1.50	Table 11.4-2
C_{RS}	0.988	Fig 22-3
C_{R1}	0.969	Fig 22-4
S_{MS}	2.478g	Eq. 11.4-1
S_{M1}	1.545g	Eq. 11.4-2
S_{DS}	1.652g	Eq. 11.4-3
S_{D1}	1.030g	Eq. 11.4-4
PGA	0.960	Fig 22-7
F_{pga}	1.00	Table 11.8-1
PGA_M	0.960	Eq. 11-8-1

As discussed earlier, the MCE_R response spectrum is developed by comparing probabilistic, deterministic, DLL, and 80% of the code values. These NGA GMPEs present the spectral accelerations in terms of geometric mean values of the rotated two horizontal ground motions. To estimate both the deterministic and probabilistic the spectral accelerations in the direction of the maximum horizontal response at each period from geometric mean values, we have used the scale factors as used by USGS. To obtain spectral acceleration values in the maximum direction, a factor of 1.1 for periods of 0.2s and less, a factor of 1.3 for period of 1.0s and greater were used.

Linear interpolation was used between 1.1 and 1.3 for periods between 0.2s and 1.0s. In addition, the probabilistic spectrum was adjusted for targeted risk using risk coefficients C_{RS} and C_{R1}. C_{RS} and C_{R1} were estimated from Figures 22-3 and 22-4 of ASCE 7-10 and they are 0.988 and 0.969, respectively. C_{RS} is applied on periods of 0.2s or less and C_{R1} is applied on periods of 1.0s or greater and linear interpolation in between.

Site-specific deterministic (84th percentile) spectrum for the Hayward-Rodgers Creek fault is compared with the DLL spectrum per Figure 21.2-1 of ASCE 7-10 on Figure E-2. Spectral values are also compared in Table E-3 for some specific periods. Figure E-2 and Table E-3 show that for all practical purposes the controlling deterministic values are governed by the 84th percentile site-specific deterministic spectrum for entire range of periods of up to 5.0 seconds. Therefore, the deterministic values are controlled by the site-specific deterministic spectrum.

TABLE E-3: COMPARISON OF SPECTRAL ACCELERATION (G)

Period (s)	Deterministic Max Rot	DLL	Probabilistic Max Rot Risk Adj	DE	80% Code DE
PGA (0.01)	1.030	0.600	1.282	0.687	0.529
0.2	1.891	1.500	2.769	1.387	1.322
0.3	2.298	1.500	2.913	1.532	1.322
0.5	2.398	1.500	2.851	1.599	1.322
1.0	1.942	0.900	2.086	1.295	0.824
2.0	1.104	0.450	1.121	0.736	0.412

Site-specific probabilistic spectrum is compared with the controlling deterministic spectrum on Figure E-3. Spectral values are also compared in Table E-3 for some specific periods. Figure E-3 and Table E-3 show that the probabilistic values are greater than the controlling deterministic for periods of up to 2.0 seconds and then deterministic values are greater beyond that. Therefore, site-specific MCE_R spectrum is developed by enveloping the controlling deterministic and probabilistic spectra. The DE spectrum was developed by taking two-thirds of the MCE_R spectrum. Comparison of the DE spectrum with the 80% of the code spectrum is shown on Figure E-4. Spectral values are also compared in Table E-3 for some specific periods. Figure E-4 and Table E-3 show that the DE spectrum is higher than the 80% of the code spectrum for all periods except the periods between 0.02 and 0.15 seconds where the 80% of the code spectrum is greater. Therefore, the recommended site-specific horizontal DE spectrum is developed by enveloping two-thirds of the MCE_R spectrum and 80% of the code spectrum. Site-specific MCE_R spectrum is taken as 1.5 times the DE spectrum. Figure E-5 shows the site-specific 5% damped DE and MCE_R spectra. Site-specific horizontal spectral acceleration values in terms of g for the DE and MCE_R are presented in Table E-4.

TABLE E-4: SITE-SPECIFIC HORIZONTAL MCE_R AND DE SPECTRAL ACCELERATIONS (g)

Period (sec)	DE	MCE_R
	5% Damping	5% Damping
0.01	0.687	1.031
0.125	1.322	1.983
0.2	1.387	2.080
0.25	1.491	2.237
0.3	1.532	2.298
0.4	1.590	2.385
0.5	1.599	2.398
0.75	1.489	2.234
1	1.295	1.942
1.5	0.969	1.453
2	0.736	1.104
2.5	0.573	0.860
3	0.460	0.690
4	0.323	0.485
5	0.258	0.387

SITE-SPECIFIC DESIGN ACCELERATION PARAMETERS

Site specific ground motion parameters for S_{DS} and S_{D1} were estimated using the site-specific design response spectrum presented in Table E-4. According to Section 21.4 of ASCE 7-10, the S_{DS} value should be taken as the value at 0.2 seconds but should not be less than 90 percent of any spectral acceleration after that period. Based on this, the S_{DS} value is governed by the 90% of the spectral acceleration at 0.5 seconds as shown in Table E-4. Additionally, the S_{D1} value should be taken as greater of the value at 1.0 second or two times the value at 2.0 seconds. Based on this, two times the value at 2.0 seconds governs the S_{D1} value as shown in Table E-4. The parameters S_{MS} and S_{M1} shall be taken as 1.5 times S_{DS} and S_{D1}. Site-specific S_{DS}, S_{D1}, S_{MS}, S_{M1} values are presented in Table E-5.

TABLE E-5: SITE-SPECIFIC DESIGN ACCELERATION PARAMETERS

Parameter	Value (5% Damping)
S_{DS}	1.439 g
S_{D1}	1.472 g
S_{MS}	2.158 g
S_{M1}	2.208 g

It should be noted that S_{D1} and S_{M1} values are greater than S_{DS} and S_{MS} values, respectively.

Site specific peak ground acceleration (PGA_M) for MCE_G was estimated using Section 21.5 of ASCE 7-10. According to Section 21.5 of ASCE 7-10, the site-specific PGA_M shall be taken as the lesser of the probabilistic geometric mean peak ground acceleration of Section 21.5.1 and the deterministic geometric mean peak ground acceleration of Section 21.5.2. Additionally, the site-specific PGA_M shall not be taken as less than 80% of PGA_M determined from Eq. 11.8-1. Based on this procedure, the site-specific PGA_M value is 0.936g and is controlled by the deterministic results. Therefore, the associated earthquake magnitude is 7.3.

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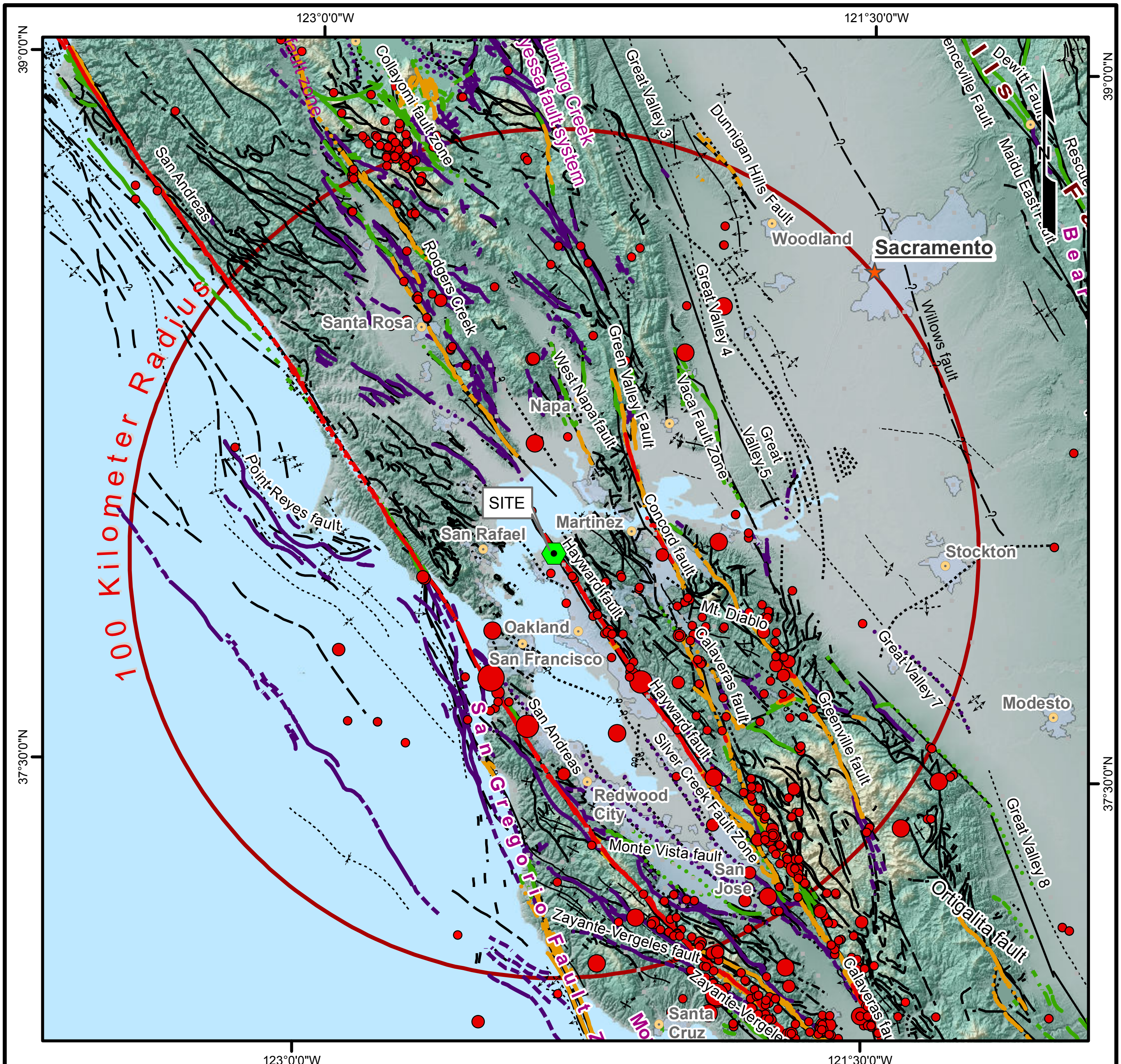

Faulting Legend

Quaternary Faults (Bryant, 2005; USGS, 2009)

Historic displacement (< 200 years)
- Mapped Fault Location
- Dashed where Approximated
- Concealed

Holocene displacement (< 11,000 years)
- Mapped Fault Location
- Dashed where Approximated
- Concealed

Late Quaternary displacement (< 750,000 years)
- Mapped Fault Location
- Dashed where Approximated
- Concealed

Quaternary displacement (< 1,600,000 years)
- Mapped Fault Location
- Dashed where Approximated
- Concealed

Pre-Quaternary Geologic Structures (CGS, 2000)
- fault, approx. located
- fault, approx. located, queried
- fault, certain
- fault, concealed
- fault, concealed, queried
- fault, inferred, queried

ANSS Earthquakes

Magnitude
- 4.0 - 4.9
- 5.0 - 5.9
- 6.0 - 6.9
- 7.0 - 7.9
- 8.0 - 8.9

35 17.5 0 35
Kilometers

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REGIONAL FAULT MAP AND EARTHQUAKE EPICENTERS (1800 - OCTOBER 2017)

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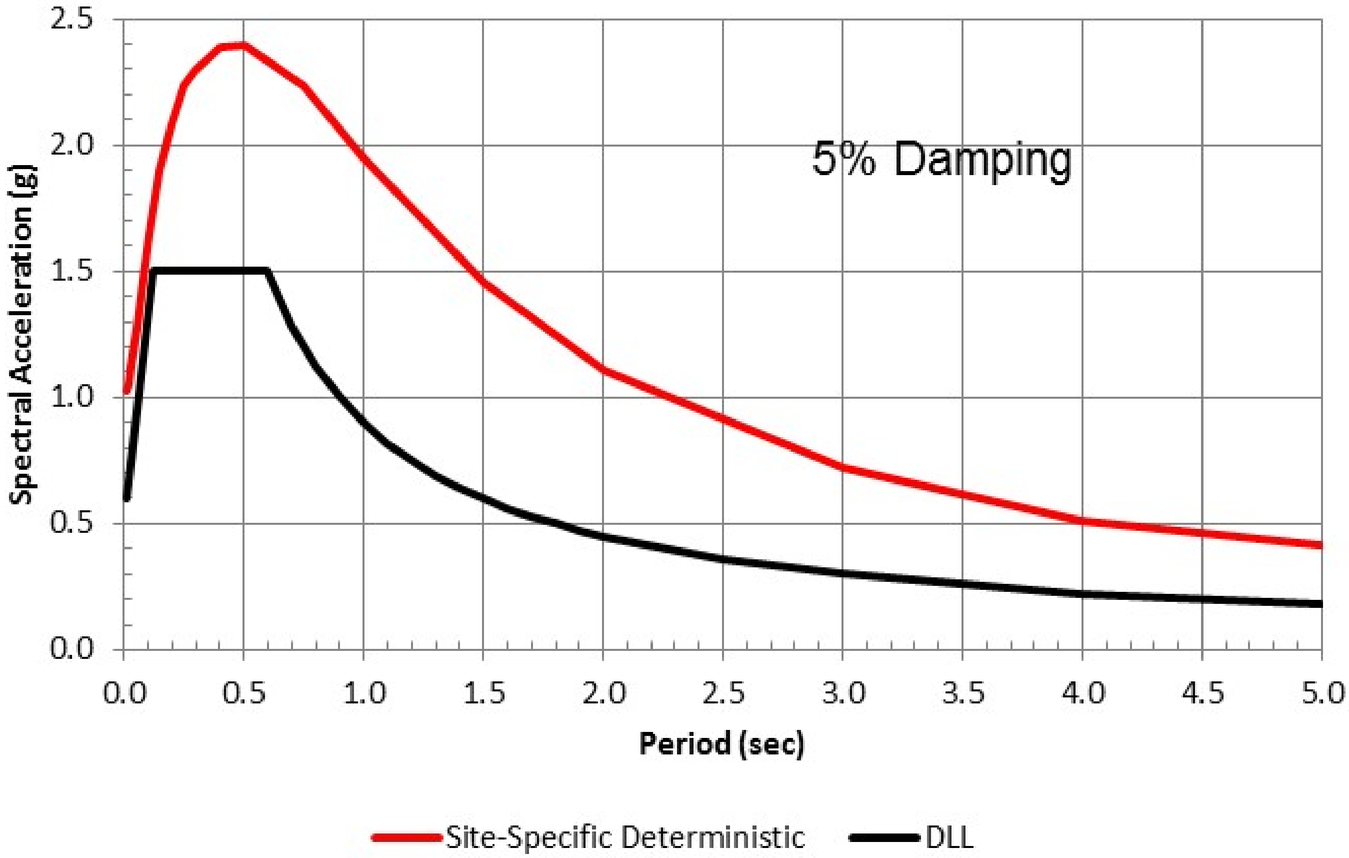
FIGURE
E-1



PROJECT NO. 20181569	**COMPARISON OF DETERMINISTIC SPECTRA—5% DAMPING**	FIGURE
DRAWN: 10/10/17		
DRAWN BY: M. Galouei		**E-2**
CHECKED BY: Z. Zafir	NEW SCIENCE BUILDING PROJECT CONTRA COSTA COMMUNITY COLLEGE SAN PABLO, CALIFORNIA	
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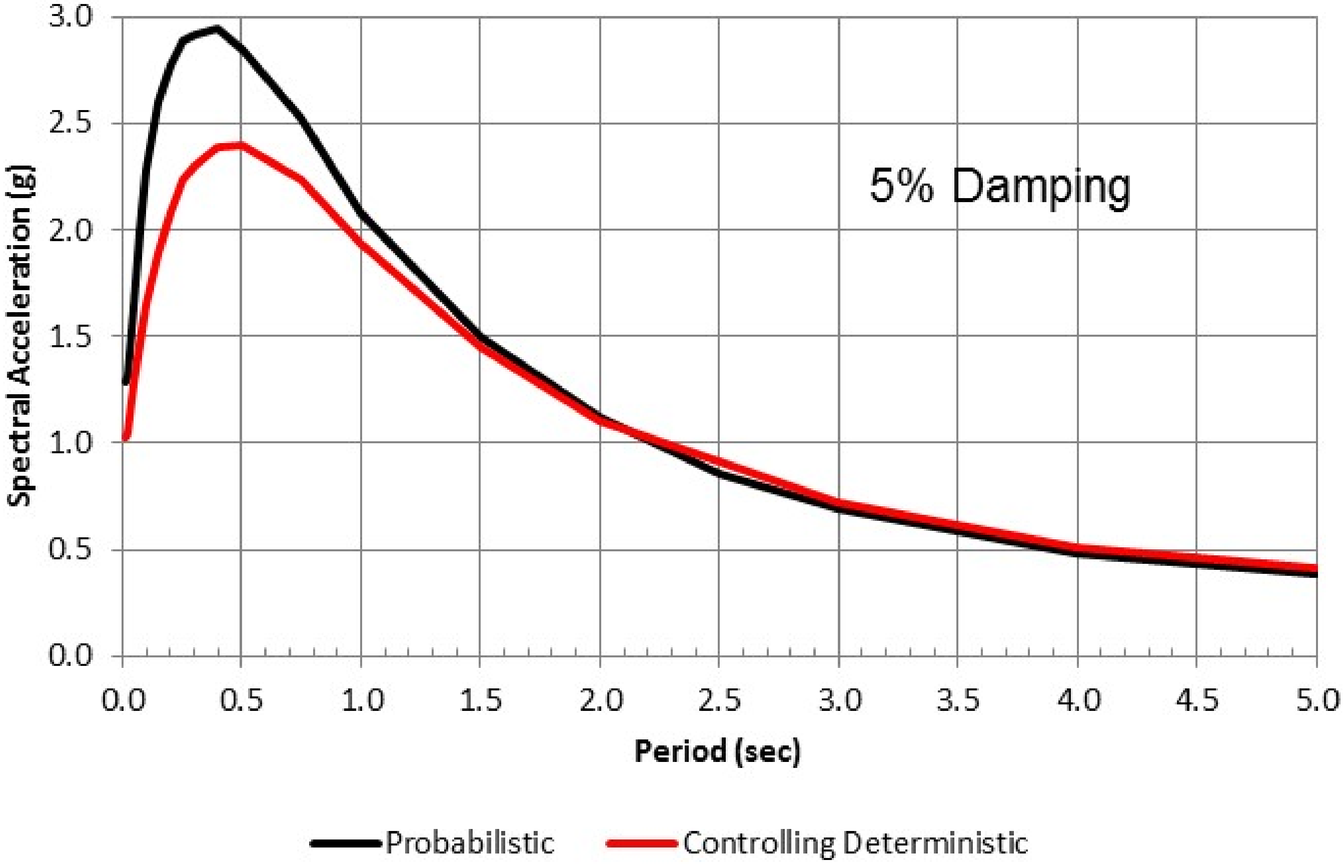

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COMPARISON OF DETERMINISTIC AND PROBABILISTIC SPECTRA

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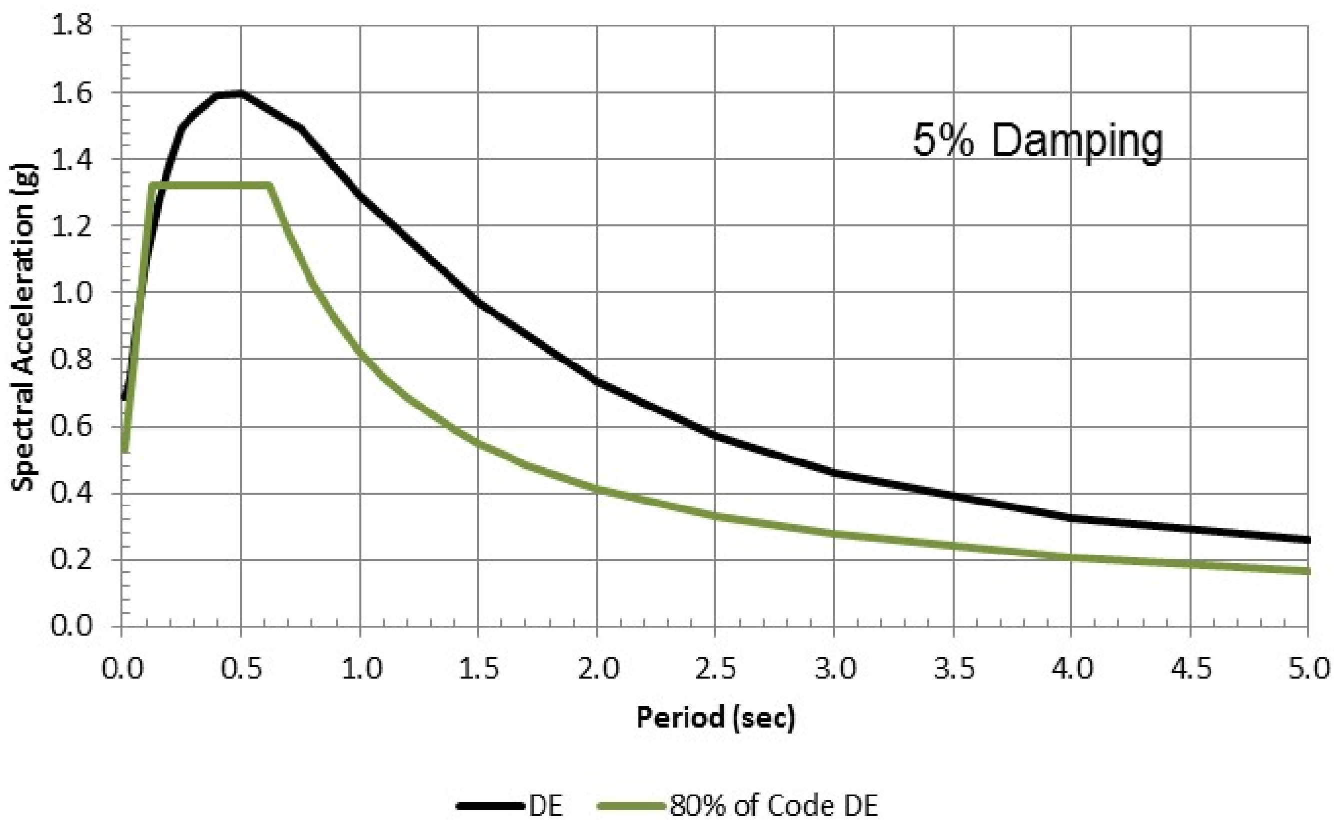
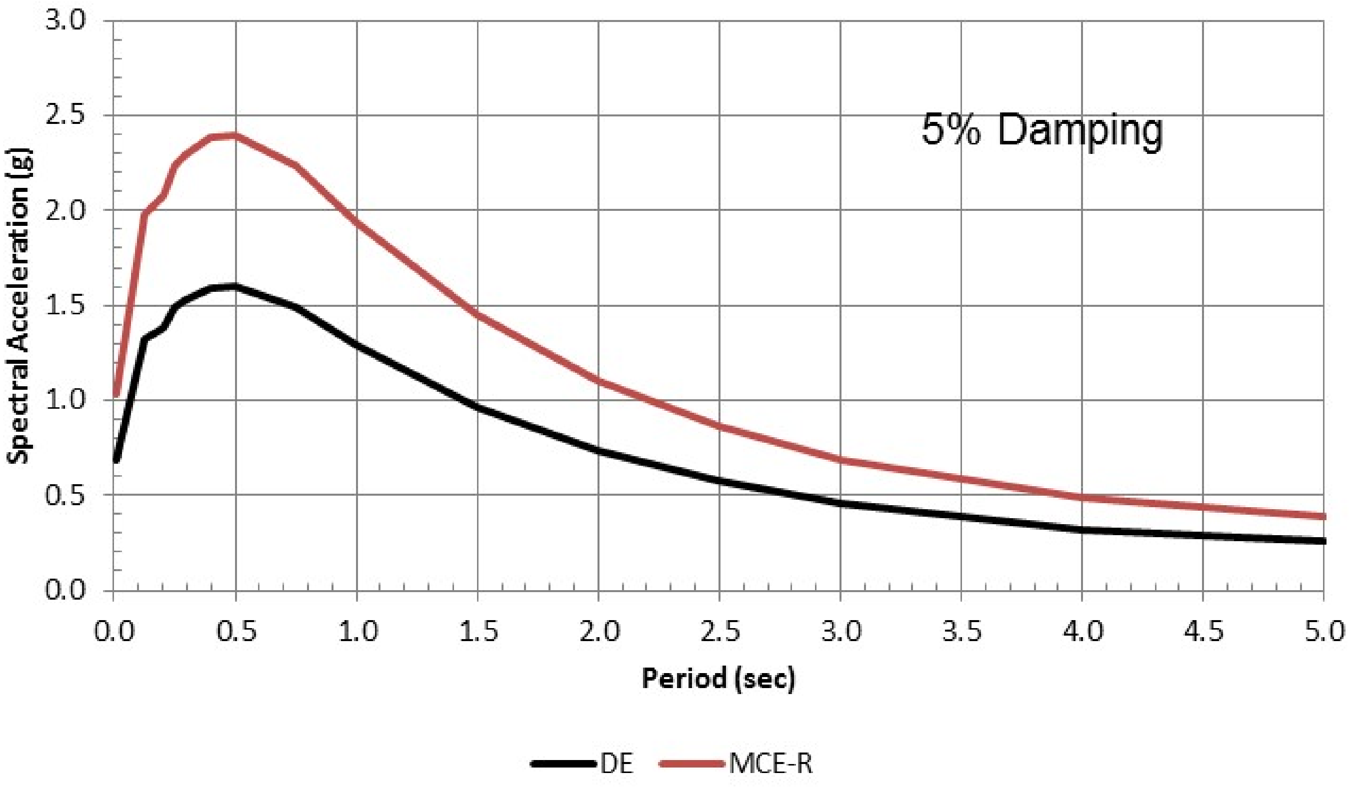
FIGURE
E-3



KLEINFELDER Bright People. Right Solutions. www.kleinfelder.com	PROJECT NO. 20181569	**COMPARISON OF DE SPECTRUM WITH THE CODE SPECTRUM**	FIGURE
	DRAWN: 10/10/17		**E-4**
	DRAWN BY: M. Galouei		
	CHECKED BY: Z. Zafir	NEW SCIENCE BUILDING PROJECT CONTRA COSTA COMMUNITY COLLEGE SAN PABLO, CALIFORNIA	
	FILE NAME:		



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FILE NAME:	

SITE-SPECIFIC RESPONSE SPECTRUM—MCE$_R$ AND DE

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FIGURE

E-5