Appendix F:
Geotechnical Engineering Investigation

GEOTECHNICAL ENGINEERING INVESTIGATION
PROPOSED WEST COLLEGE AVENUE APARTMENTS
2150 W. COLLEGE AVENUE
SANTA ROSA, CALIFORNIA

KA PROJECT NO. 042-19004
APRIL 16, 2019

Prepared for:

MS. ROYCE PATCH
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Krazan & ASSOCIATES, INC.

GEOTECHNICAL ENGINEERING • ENVIRONMENTAL ENGINEERING
CONSTRUCTION TESTING & INSPECTION

April 16, 2019

KA Project No. 042-19004

Ms. Royce Patch
USA Properties Fund, Inc.
3200 Douglas Boulevard, Suite 200
Roseville, California 95661

RE: Geotechnical Engineering Investigation
Proposed West College Avenue Apartments
2150 W. College Avenue
Santa Rosa, California

Dear Ms. Patch:

In accordance with your request, we have completed a Geotechnical Engineering Investigation for the above-referenced site. The results of our investigation are presented in the attached report.

If you have any questions, or if we may be of further assistance, please do not hesitate to contact our office at (925) 307-1160.

DAVID R. JAROSZ II
NO. 2698
EXP. 6/30/2020

Respectfully submitted,
KRAZAN & ASSOCIATES, INC.

David R. Jarosz, II
Managing Engineer
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DRJ:ht

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Krazan & ASSOCIATES, INC.

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GEOTECHNICAL ENGINEERING INVESTIGATION
PROPOSED WEST COLLEGE AVENUE APARTMENTS
2150 W. COLLEGE AVENUE
SANTA ROSA, CALIFORNIA

INTRODUCTION

This report presents the results of our Geotechnical Engineering Investigation for the proposed West College Avenue Apartments to be located at 2150 W. College Avenue in Santa Rosa, California. Discussions regarding site conditions are presented herein, together with conclusions and recommendations pertaining to site preparation, Engineered Fill, utility trench backfill, drainage and landscaping, foundations, concrete floor slabs and exterior flatwork, retaining walls, soil cement reactivity, and pavement design.

A site plan showing the approximate boring locations is presented following the text of this report. A description of the field investigation, boring logs, and the boring log legend are presented in Appendix A. Appendix A also contains a description of the laboratory testing phase of this study, along with the laboratory test results. Appendices B and C contain guides to earthwork and pavement specifications. When conflicts in the text of the report occur with the general specifications in the appendices, the recommendations in the text of the report have precedence.

PURPOSE AND SCOPE

This investigation was conducted to evaluate the soil and groundwater conditions at the site, to make geotechnical engineering recommendations for use in design of specific construction elements, and to provide criteria for site preparation and Engineered Fill construction.

Our scope of services was outlined in our proposal dated January 15, 2019 (KA Proposal No. P041-19) and included the following:

- A site reconnaissance by a member of our engineering staff to evaluate the surface conditions at the project site.
- A field investigation consisting of drilling 6 borings to depths ranging from approximately 20 to 50 feet for evaluation of the subsurface conditions at the project site.
- Performing laboratory tests on representative soil samples obtained from the borings to evaluate the physical and index properties of the subsurface soils.

- Evaluation of the data obtained from the investigation and an engineering analysis to provide recommendations for use in the project design and preparation of construction specifications.
- Preparation of this report summarizing the results, conclusions, recommendations, and findings of our investigation.

PROPOSED CONSTRUCTION

We understand that design of the proposed development is currently underway; structural load information and other final details pertaining to the structures are unavailable. On a preliminary basis, it is understood the planned development will include the construction of a multi-family residential development. It is anticipated the buildings will be two- to four-story structures with an associated recreation area and carport structures. The buildings are planned to be wood-framed structures utilizing concrete slab-on-grade construction. Footing loads are anticipated to be light to moderate. On-site parking and landscaping are also planned for the development of the project.

In the event, these structural or grading details are inconsistent with the final design criteria, the Soils Engineer should be notified so that we may update this writing as applicable.

SITE LOCATION AND SITE DESCRIPTION

The site is irregular in shape and encompasses approximately 7.46 acres. The site is located just south of College Avenue, at Navarro Street in Santa Rosa, California. The site is associated with a street address of 2150 W. College Avenue. A drainage ditch trends along the southern and eastern edges of the site. Commercial developments are located east and west of the site. A drainage basin is located south of the site. The remainder of the site is predominately surrounded by residential developments.

Presently, the site is occupied by three commercial buildings with associated parking lots and landscaping consisting of grass and trees. Concrete and asphaltic concrete pavements are located along the edges of the site and extend into portions of the site. Portions of the site are covered with a sparse to moderate weed and grass growth and the surface soils have a loose consistency. Buried utility lines are located within the site associated with the existing and surrounding developments. The site is relatively level with no major changes in grade.

GEOLOGIC SETTING

The site lies within the Coast Ranges Geomorphic Province of California. The Coast Range Geomorphic Province borders the Coast of California and generally consists of more or less discontinuous series of nearly parallel northwest trending mountain ranges, ridges, and intervening valleys characterized by intense, complex folding and faulting. Numerous northwest to southeast trending faults parallel the trend of the Coast Ranges. The ridges are most often comprised of granitic, metavolcanic, and metasedimentary rocks.

The Franciscan Complex, which is comprised of oceanic rocks mixed by faulting as the ocean floor slid east under the edge of the continent lies to the east of the San Andreas fault. The San Andreas fault lies along the Sonoma County coastline. The Franciscan Assemblage is the principal rock complex within the Coast Ranges. The Franciscan Assemblage in this region of California is Jurassic- to Cretaceous-age and consists primarily of greenstone (altered volcanic rocks), basalt, chert (ancient silica-rich ocean deposits), and sandstone that originated as ancient seafloor sediments.

As the ridges have eroded over tens of thousands of years, the eroded materials were washed downslope and were deposited in the valleys present between the Coast Ranges ridges. The project site is located at the northern end of Cotate Basin. Holocene (last 10 thousand years) alluvial fan and fluvial terrace deposits are mapped in the area of the project site. The alluvial fan and fluvial sediments include clay, silt, sand and gravel and are generally poorly sorted and moderately to poorly bedded. These deposits where mapped along existing creek channels are mapped as having a moderate potential to undergo liquefaction due to strong to violent ground shaking as a result of seismic activity on regional faults.

The San Andreas fault, (SAF) located about 17.4 miles (28 km) to the southwest of the site, dominates the structure and seismicity of the San Francisco Bay Area. This right-lateral strike-slip fault extends from the Gulf of California, in Mexico, to Cape Mendocino, off 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, which is 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 faults which include the Rodgers Creek, Hayward, Calaveras, Concord-Green Valley and Greenville faults, among others. Together, these faults are referred to as the SAF system. The Rogers Creek fault zone is located about 2.8 miles (4.5 km) to the northeast of the site, as shown on the State of California special Studies Zone map for the Santa Rosa Quadrangle. The Maacama-Garberville fault lies to the east of the Rogers (south) zone, is located about 9.6 miles (15.4 km) northeast of the site. There are numerous local faults in the region as well. The Healdsburg fault is located northeast of the site. This fault lies in line with and is just north of the mapped Rogers Creek fault. The Petaluma Valley, Tolay and Bloomfield faults are located in the mountains between the southwest side of the valley floor and the mapped trace of the San Andreas fault along the coastal shoreline. Though the site is in close proximity to several faults, the State of California does not show any faults bisecting the site or immediately adjacent areas. The site is not located within a State of California Earthquake Fault Study Zone (formerly known as Alquist-Priolo Special Study Zone).

FIELD AND LABORATORY INVESTIGATIONS

Subsurface soil conditions were explored by drilling 6 borings to depths ranging from approximately 20 to 50 feet below existing site grade, using a truck-mounted drill rig. In addition, 2 bulk subgrade samples were obtained from the site for laboratory R-value testing. The approximate boring and bulk sample locations are shown on the site plan. During drilling operations, penetration tests were performed at regular intervals to evaluate the soil consistency and to obtain information regarding the engineering properties of the subsoils. Soil samples were retained for laboratory testing. The soils encountered were continuously examined and visually classified in accordance with the Unified Soil Classification System. A more detailed description of the field investigation is presented in Appendix A.

Laboratory tests were performed on selected soil samples to evaluate their physical characteristics and engineering properties. The laboratory testing program was formulated with emphasis on the evaluation of natural moisture, density, gradation, shear strength, atterberg limits, consolidation potential, expansion potential, R-value, and moisture-density relationships of the materials encountered. In addition, chemical tests were performed to evaluate the soil-cement reactivity. Details of the laboratory test program and results of the laboratory tests are summarized in Appendix A. This information, along with the field observations, was used to prepare the final boring logs in Appendix A.

SOIL PROFILE AND SUBSURFACE CONDITIONS

Based on our findings, the subsurface conditions encountered appear typical of those found in the geologic region of the site. Portions of the site were covered with concrete and asphaltic concrete pavements and associated aggregate base. Within areas not covered by pavement, the upper soils consisted of approximately 6 to 12 inches of very loose gravelly silty sand and sandy clay. These soils are disturbed, have low strength characteristics, and are highly compressible when saturated.

Beneath the pavement section and loose surface soils, approximately 6 inches to 4½ feet of fill material was encountered. The fill material predominately consisted of gravelly silty sand and gravelly clayey sand. The thickness and extent of fill material was determined based on limited test borings and visual observation. Thicker fill may be present at the site. Limited testing was performed on the fill soils during the time of our field and laboratory investigations. The limited testing indicates the fill material had varying strength characteristics ranging from loosely placed to compacted.

Below the fill material, approximately 2 to 3 feet of stiff to hard sandy clay or sandy silty clay or medium dense clayey sand were encountered. Field and laboratory tests suggest that these soils are moderately strong, slightly compressible and have a low to moderate expansion potential. Penetration resistance ranged from 16 to 52 blows per foot. Dry densities ranged from 90 to 134 pcf. A representative soil sample consolidated approximately 3 percent under a 2 ksf load when saturated. A representative soil sample had an angle of internal friction of 27 degrees. Representative samples of the clayey soils had expansion indices of 34 to 54.

Below 5 to 7 feet, layers of predominately loose to medium dense silty sand, sandy silt, sand, and clayey sand or stiff to hard sandy clay were encountered. Field and laboratory tests suggest that these soils are moderately strong and slightly compressible. Penetration resistance ranged from 11 to 54 blows per foot. Dry densities ranged from 90 to 125 pcf. Representative soil samples contained approximately 7 to 62 percent fines. These soils had slightly stronger strength characteristics than the upper soils and extended to the termination depth of our borings.

For additional information about the soils encountered, please refer to the logs of borings in Appendix A.

PERCOLATION TESTING

Three percolation tests were performed on the site. The percolation tests were performed at depths of 1½ to 2 feet. The tests were conducted in accordance with the criteria set in the "Manual of Septic Tank Practice" published by the Department of Health, Education, and Welfare. The tests were performed within the project site to represent the anticipated storm water disposal areas. Results of the tests are as follows:

Test No.	Depth (feet)	Percolation Rate (min/in)	Soil Type
1	1½	30	Gravelly Silty Sand (SM)
2	2	240	Sandy Clay (CL)
3	2	60	Gravelly Silty Sand (SM)

The gravelly silty sand soils had moderate drainage characteristics. These soils were fill material that was placed over the native clayey soils that have poor drainage characteristics. The percolation rates given are based on 1 inch of fall within an 8-inch diameter hole with a 6-inch head of water.

GROUNDWATER

Test boring locations were checked for the presence of groundwater during and immediately following the drilling operations. Free groundwater was encountered at depths of 7 to 13 feet below existing site grade during our subsurface investigation. Information obtained from the State of California Department of Water Resources indicates that groundwater has historically been encountered at depths as shallow as 6 feet within the project site vicinity.

It should be recognized that water table elevations may fluctuate with time, being dependent upon seasonal precipitation, irrigation, land use, and climatic conditions as well as other factors. Therefore, water level observations at the time of the field investigation may vary from those encountered during the construction phase of the project. The evaluation of such factors is beyond the scope of this report.

SOIL LIQUEFACTION

Soil liquefaction is a state of soil particles suspension caused by a complete loss of strength when the effective stress drops to zero. Liquefaction normally occurs under saturated conditions in soils such as sand in which the strength is purely frictional. However, liquefaction has occurred in soils other than clean sand. Liquefaction usually occurs under vibratory conditions such as those induced by seismic event.

To evaluate the liquefaction potential of the site, the following items were evaluated:

1) Soil type

2) Groundwater depth

3) Relative density

4) Initial confining pressure

5) Intensity and duration of groundshaking

The predominant soils within the project site consist of alternating layers of silty sands, clayey sands, sandy clays and silty sand/sand. These soils contained varying amounts of gravel. Groundwater was encountered at a depth of 7 feet during our field investigation. Historically groundwater has been encountered at depths as shallow as 6 feet within the project site vicinity.

The potential for soil liquefaction during a seismic event was evaluated using the LIQUEFYPRO computer program (version 5.8h) developed by CivilTech Software. For the analysis, a maximum earthquake magnitude of 7.5 was used. A peak horizontal ground surface acceleration of 0.71g was considered conservative and appropriate for the liquefaction analysis. An estimated high groundwater depth of 6 feet was used for our analysis. The computer analysis indicates that soils above a depth of 6 feet are non-liquefiable due to the absence of groundwater.

The analysis also indicates that the estimated total seismic induced settlement is about 1½ inches. The differential seismic settlement is estimated to be less than 1 inch. The anticipated differential settlement is estimated to over the width of the structure(s).

CONCLUSIONS AND RECOMMENDATIONS

Based on the findings of our field and laboratory investigations, along with previous geotechnical experience in the project area, the following is a summary of our evaluations, conclusions, and recommendations.

Administrative Summary

In brief, the subject site and soil conditions, with the exception of the fill material, moderate shrink/swell potential of the upper clayey soil, and existing development, appear to be conducive to the development of the project.

Approximately 6 inches to 4½ feet of fill material was encountered throughout the site. The fill material predominately consisted of gravelly silty sand and sandy clay. The thickness and extent of fill material was determined based on limited test borings and visual observation. Thicker fill may be present at the site. Limited testing was performed on the fill soil during the time of our field and laboratory investigations. The limited testing indicates that the fill material ranged from loosely placed to compacted. Therefore, it is recommended that fill soils that have not been properly compacted and certified be excavated and stockpiled so that the native soils can be properly prepared. The clayey fill soils will not be suitable for reuse as non-expansive Engineered Fill. However, the clayey fill material will be suitable for reuse as General Engineered Fill, provided it is cleansed of excessive organics and debris, and moisture-conditioned to a minimum of 2 percent above optimum moisture content. Preliminary testing indicates the silty sand soils will be suitable for re-use as non-expansive Engineered

Fill provided they are cleansed of excessive organics and debris. However, it may be difficult for the grading contractor to separate these materials during mass grading operations. The fill material should be compacted to a minimum of 90 percent of maximum density based on ASTM Test Method D1557. Prior to fill placement Krazan & Associates, Inc. should inspect the bottom of the excavation to verify no additional removal will be required. Prior to backfilling, Krazan & Associates, Inc. should inspect the bottom of the excavation to verify no additional excavation will be required.

The on-site clayey soils appear to have a moderate shrink/swell potential. To reduce the potential soil movement related to shrink/swell potential of the clayey soils, it is recommended that slab-on-grade and exterior flatwork areas be supported by at least 18 inches of non-expansive Engineered Fill. The fill material should be a well-graded silty sand or sandy silt soil. A clean sand or very sandy soil is not acceptable for this purpose. A sandy soil will allow the surface water to drain into the expansive soils below, which may result in soil swelling. The replacement soils and/or upper 18 inches of Imported Fill soils should meet the specifications as described under the subheading Engineered Fill. The replacement soils should extend 5 feet beyond the perimeter of slab-on-grade areas. The non-expansive replacement soils should be compacted to at least 90 percent of relative compaction based on ASTM Test Method D1557. The exposed native soils in the excavation should not be allowed to dry out and should be kept continually moist, prior to backfilling. In addition, it is recommended that slab-on-grade, continuous footings and slabs be nominally reinforced to reduce cracking and vertical off-set.

As an alternative to the use of non-expansive soils, the upper 18 inches of soil supporting the slab areas can consist of lime-treated clayey soils. The lime-treated soils should be recompacted to a minimum of 90 percent of maximum density. Preliminary application rate of lime should be 5 percent by dry weight. The lime material should be calcium oxide, commonly known as quick-lime. The clayey soils should be at or near optimum moisture during the mixing operations.

Based on the soil liquefaction analysis performed within the site, the estimated total seismic-induced settlement is not anticipated to exceed 1½ inches. Differential settlement caused by a seismic event is estimated to be less than 1 inch. The anticipated differential settlement is estimated over the width of the structure(s). The seismic settlements would develop if liquefaction of the underlying saturated subsurface soils were to occur during a seismic event.

Portions of the site are covered with concrete and asphaltic concrete pavements. In addition, the site is presently occupied by several structures. Associated with these developments are buried structures, such as utility lines that extend into the project site. Demolition activities should include proper removal of any buried structures. Any buried structures, including utilities or loosely backfilled excavations, encountered during construction should be properly removed and the resulting excavations backfilled. After demolition activities, it is recommended that these disturbed soils be removed and/or recompacted. This compaction effort should stabilize the upper soils and locate any unsuitable or pliant areas not found during our field investigation.

Trees and shrubs are located throughout the site. If not utilized for the proposed development, tree and shrub removal operations should include roots greater than 1 inch in diameter. The resulting excavations should be backfilled with Engineered Fill compacted to a minimum of 90 percent of maximum density based on ASTM Test Method D1557.

As requested, we attempted to locate the existing sewer line. Based on the information provided, it is understood the sewer line consists of a PVC pipe. Based on this information, a magnetometer survey would not locate the line because it was a non-ferrous material. An attempt was made to locate the existing sewer line utilizing Ground Penetrating Radar (GPR). However, due to the depth of pipe and soil conditions, the pipe was not able to be located utilizing GPR.

After completion of the recommended site preparation and over-excavation, the site should be suitable for shallow footing support. The proposed structure footings may be designed utilizing an allowable bearing pressure of 2,500 psf for dead-plus-live loads. Footings should have a minimum embedment of 18 inches. As an alternative, the structures can be supported on a post-tensioned foundation system. If a post-tensioned slab system designed utilizing the parameters in this report is used, the use of non-expansive or lime-treated soil in the upper 18 inches of building pads can be eliminated. However, removal and recompaction of the existing fill material and upper native subgrade soils should still be performed.

Groundwater Influence on Structures/Construction

During our field investigation free groundwater was encountered within a depth of 7 feet. However, groundwater has historically been as shallow as 6 feet within the project site vicinity. Therefore, dewatering and/or waterproofing may be required should structures or excavations extend below this depth. If groundwater is encountered, our firm should be consulted prior to dewatering the site. Installation of standpipe piezometers is suggested prior to construction should groundwater levels be a concern.

In addition to the groundwater level, if earthwork is performed during or soon after periods of precipitation, the subgrade soils may become saturated, pump, or not respond to densification techniques. Typical remedial measures include discing and aerating the soil during dry weather; mixing the soil with dryer materials; removing and replacing the soil with an approved fill material; or mixing the soil with an approved lime or cement product. Our firm should be consulted prior to implementing remedial measures to observe the unstable subgrade conditions and provide appropriate recommendations.

Site Preparation

General site clearing should include removal of vegetation; existing utilities; structures including foundations; basement walls and floors; existing stockpiled soil; trees and associated root systems; rubble; rubbish; and any loose and/or saturated materials. Site stripping should extend to a minimum depth of 2 to 4 inches, or until all organics in excess of 3 percent by volume are removed. Deeper stripping may be required in localized areas. These materials will not be suitable for reuse as Engineered Fill. However, stripped topsoil may be stockpiled and reused in landscape or non-structural areas.

The upper soils consisted of approximately 6 inches to 4½ feet of fill material. The fill material predominately consisted of gravelly silty sand and sandy clay. The thickness and extent of fill material was determined based on limited test borings and visual observations. Thicker fill may be present at the site. Limited testing was performed on the fill soil during the time of our field and laboratory investigations. The limited testing indicates that the fill material ranged from loosely placed to compacted. Therefore, it is recommended that fill soils that have not been properly compacted and certified be excavated and stockpiled so that the native soils can be properly prepared. The clayey fill soils will not be suitable for reuse as non-expansive Engineered Fill. However, the clayey fill material will be suitable for reuse as General Engineered Fill, provided it is cleansed of excessive organics and debris, and moisture-conditioned to a minimum of 2 percent above optimum moisture content. Preliminary testing indicates the silty sand soils will be suitable for re-use as non-expansive Engineered Fill provided they are cleansed of excessive organics and debris. However, it may be difficult for the grading contractor to separate these materials during mass grading operations. The fill material should be compacted to a minimum of 90 percent of maximum density based on ASTM Test Method D1557. Prior to fill placement Krazan & Associates, Inc. should inspect the bottom of the excavation to verify no additional removal will be required.

The site is presently occupied by several structures. In addition, portions of the site are covered with concrete and asphaltic concrete pavements. Associated with these developments are buried structures, such as utility lines that extend into the site. Demolition activities should include proper removal of any surface and buried structures. Any buried structures, such as utilities or loosely backfilled excavations, encountered during construction should be properly removed and the resulting excavations backfilled. After demolition activities, it is recommended that these disturbed soils be removed and/or recompacted. Excavations, depressions, or soft and pliant areas extending below planned, finished subgrade levels should be cleaned to firm, undisturbed soil and backfilled with Engineered Fill. In general, any septic tanks, debris pits, cesspools, or similar structures should be entirely removed. Concrete footings should be removed to an equivalent depth of at least 3 feet below proposed footing elevations or as recommended by the Soils Engineer. Any other buried structures should be removed in accordance with the recommendations of the Soils Engineer. The resulting excavations should be backfilled with Engineered Fill.

Following stripping, fill removal operations, demolition activities and prior to fill placement, the exposed subgrade in building, pavement, and exterior flatwork areas should be excavated to a depth of at least 12 inches, worked until uniform and free from large clods, moisture-conditioned to a minimum of 2 percent above optimum moisture content, and recompacted to a minimum of 90 percent of maximum density based on ASTM Test Method D1557. Prior to backfilling, the bottom of the excavation should be proofrolled and observed by Krazan & Associates, Inc. to verify stability. This compaction effort should stabilize the surface soils and locate any unsuitable or pliant areas not found during our field investigation. Soft or pliant areas should be excavated to firm native ground.

It is recommended that the upper 24 inches of soil within proposed conventional slab-on-grade and exterior flatwork areas consist of non-expansive Engineered Fill or lime-treated Engineered Fill. The fill placement serves two functions: 1) it provides a uniform amount of soil which will more evenly distribute the soil pressures and 2) it reduces moisture content fluctuation in the clayey material beneath the building area. The non-expansive fill material should be a well-graded silty sand or sandy silt soil. A clean sand or very sandy soil is not acceptable for this purpose. A sandy soil will allow the surface water to drain into the expansive clayey soil below, which may result in soil swelling. Imported Fill should be approved by the Soils Engineer prior to placement. The fill should be placed as specified as Engineered Fill.

As indicated previously, fill material is located across the site. It is recommended that any uncertified fill material encountered within pavement areas, be removed and/or recompacted. The fill material should be moisture-conditioned to a minimum of 2 percent above optimum moisture and recompacted to a minimum of 90 percent of maximum density based on ASTM Test Method D1557. As an alternative, the Owner may elect not to recompact the existing fill within paved areas. However, the Owner should be aware that the paved areas may settle which may require annual maintenance. At a minimum, it is recommended that the upper 12 inches of subgrade soil be moisture-conditioned to a minimum of 2 percent above optimum moisture content, and recompacted to a minimum of 95 percent of maximum density based on ASTM Test Method D1557.

The upper soils, during wet winter months, become very moist due to the absorptive characteristics of the soil. Earthwork operations performed during winter months may encounter very moist unstable soils, which may require removal to grade a stable building foundation. Project site winterization consisting of placement of aggregate base and protecting exposed soils during the construction phase should be performed.

A representative of our firm should be present during all site clearing and grading operations to test and observe earthwork construction. This testing and observation is an integral part of our service, as acceptance of earthwork construction is dependent upon compaction and stability of the material. The Soils Engineer may reject any material that does not meet compaction and stability requirements. Further recommendations of this report are predicated upon the assumption that earthwork construction will conform to recommendations set forth in this section and the Engineered Fill section.

Engineered Fill

The upper, on-site native soils and fill material are predominately gravelly silty sand, clayey sand and sandy clay. The clayey soils will not be suitable for reuse as non-expansive Engineered Fill. The clayey soils will be suitable for reuse as Engineered Fill within the upper 24 inches of slab-on-grade and exterior flatwork areas provided they are lime-treated. The preliminary application rate of lime should be 5 percent by dry weight. The lime material should be calcium oxide, commonly known as quick-lime. The clayey soils should be at or above optimum moisture-condition during mixing operations. Additional testing is recommended to determine the appropriate application rate of lime prior to placement. These clayey soils will be suitable for reuse as General Engineered Fill, within pavement areas and below 24 inches from finished pad grade in slab-on-grade areas, provided they are cleansed of excessive organics, debris, fragments larger than 4 inches in maximum dimension and moisture-conditioned to at least 2 percent above optimum moisture. It is recommended that additional testing be performed on the on-site soils and fill material to evaluate the physical and index properties prior to reuse as Engineered Fill. The on-site soils that do not contain clay will be suitable for re-use as non-expansive Engineered Fill provided they are cleansed of excessive organics and debris. However, it may be difficult for the grading contractor to separate these materials during grading operations. Asphaltic concrete will not be suitable for reuse as Engineered Fill within the proposed building areas.

The preferred materials specified for Engineered Fill are suitable for most applications with the exception of exposure to erosion. Project site winterization and protection of exposed soils during the construction phase should be the sole responsibility of the Contractor, since he has complete control of the project site at that time.

Imported Fill should consist of a well-graded, slightly cohesive, fine silty sand or sandy silt soil, with relatively impervious characteristics when compacted. This material should be approved by the Soils Engineer prior to use and should typically possess the following characteristics:

Percent Passing No. 200 Sieve	20 to 50
Plasticity Index	10 maximum
UBC Standard 29-2 Expansion Index	15 maximum

Fill soils should be placed in lifts approximately 6 inches thick, moisture-conditioned to a minimum of 2 percent above optimum moisture content, and compacted to achieve at least 90 percent of maximum density as determined by ASTM D1557. Additional lifts should not be placed if the previous lift did not meet the required dry density or if soil conditions are not stable.

Drainage and Landscaping

The ground surface should slope away from building pad and pavement areas toward appropriate drop inlets or other surface drainage devices. In accordance with Section 1804 of the 2016 California Building Code, it is recommended that the ground surface adjacent to foundations be sloped a minimum of 5 percent for a minimum distance of 10 feet away from structures, or to an approved alternative means of drainage conveyance. Swales used for conveyance of drainage and located within 10 feet of foundations should be sloped a minimum of 2 percent. Impervious surfaces, such as pavement and exterior concrete flatwork, within 10 feet of building foundations should be sloped a minimum of 1 percent away from the structure. Drainage gradients should be maintained to carry all surface water to collection facilities and off-site. These grades should be maintained for the life of the project.

Slots or weep holes should be placed in drop inlets or other surface drainage devices in pavement areas to allow free drainage of adjoining base course materials. Cutoff walls should be installed at pavement edges adjacent to vehicular traffic areas these walls should extend to a minimum depth of 12 inches below pavement subgrades to limit the amount of seepage water that can infiltrate the pavements.

Where cutoff walls are undesirable subgrade drains can be constructed to transport excess water away from planters to drainage interceptors. If cutoff walls can be successfully used at the site, construction of subgrade drains is considered unnecessary.

Utility Trench Backfill

Utility trenches should be excavated according to accepted engineering practice following OSHA (Occupational Safety and Health Administration) standards by a Contractor experienced in such work. The responsibility for the safety of open trenches should be borne by the Contractor. Traffic and vibration adjacent to trench walls should be reduced; cyclic wetting and drying of excavation side slopes should be avoided. Depending upon the location and depth of some utility trenches, groundwater flow into open excavations could be experienced; especially during or following periods of precipitation.

Utility trench backfill placed in or adjacent to buildings and exterior slabs should be compacted to at least 90 percent of maximum density based on ASTM Test Method D1557. The utility trench backfill placed in pavement areas should be compacted to at least 90 percent of maximum density based on ASTM Test Method D1557. Pipe bedding should be in accordance with pipe manufacturer's recommendations.

Sandy and gravelly soil conditions were encountered at the site. These cohesionless soils have a tendency to cave in trench wall excavation. Shoring or sloping back trench sidewalls may be required within these sandy and gravelly soils.

The Contractor is responsible for removing all water-sensitive soils from the trench regardless of the backfill location and compaction requirements. The Contractor should use appropriate equipment and methods to avoid damage to the utilities and/or structures during fill placement and compaction.

Foundations - Conventional

After completion of the recommended site preparation, the site should be suitable for shallow footing support. The proposed structures may be supported on a shallow foundation system bearing on undisturbed native soils or Engineered Fill. Spread and continuous footings can be designed for the following maximum allowable soil bearing pressures:

Load	Allowable Loading
Dead Load Only	1,875 psf
Dead-Plus-Live Load	2,500 psf
Total Load, Including Wind or Seismic Loads	3,325 psf

The footings should have a minimum embedment depth of 18 inches below pad subgrade (soil grade) or adjacent exterior grade, whichever is lower. Footings should have a minimum width of 12 inches, regardless of load.

The footing excavations should not be allowed to dry out any time prior to pouring concrete. It is recommended that footings be reinforced by at least one No. 4 reinforcing bar in both top and bottom.

Resistance to lateral footing displacement can be computed using an allowable friction factor of 0.3 acting between the base of foundations and the supporting subgrade. Lateral resistance for footings can alternatively be developed using an allowable equivalent fluid passive pressure of 250 pounds per cubic foot acting against the appropriate vertical footing faces. The frictional and passive resistance of the soil may be combined without reduction in determining the total lateral resistance. A ⅓ increase in the value above may be used for short duration, wind, or seismic loads.

The total static movement is not expected to exceed 1 inch. Differential static movement should be less than ½ inch. Most of the static settlement is expected to occur during construction, as the loads are applied. However, additional post-construction movement may occur if the foundation soils are flooded or saturated. The total and differential seismic-induced settlement is estimated to be about 1½ inches and 1 inch, respectively. The anticipated seismic differential settlement is estimated over a distance of 100 feet.

Post-Tensioned Concrete Slabs-On-Grade (Slabs-On-Ground)

Post-tensioned slab-on-grade foundations, also referred to as post-tensioned slabs-on-ground, are anticipated to be used for support of the proposed structures. Post-tensioned concrete slab-on-grade foundations have been in use to mitigate expansive and compressible soil effects on residential and commercial structures for decades. Early post-tensioned slabs were often on the order of five inches thick and were stiffened by incorporating stiffening beams into the monolithically constructed foundation. The recent trend has been to design and construct post-tensioned concrete slab foundations with a more uniform thickness and with less substantial stiffening beams. Slab thicknesses on the order of 10 to 12 inches are not uncommon.

The thickness of the slab-on-grade and locations and sizing of stiffening beams (if used) should be determined by the structural consultant during a subsequent structural analysis, which incorporates our design recommendations, including a deepened perimeter or edge section. Post-tensioned slab-on-grade foundations should be structurally designed to resist or distribute the stresses that are anticipated to develop as the result of supporting soil movement. The following preliminary parameters are recommended for use in the structural design of the post-tensioned slab-on-grade foundations in accordance with *Design of Post-Tensioned Slabs-on-Ground*, 3rd Edition, by the Post-Tensioning Institute. In addition, the computer software program Volflo 1.5, by Geostructural Tool Kit, Inc. was also utilized in the analyses. As discussed in our previous Geotechnical report, a preliminary allowable bearing pressure of 2,000 pounds per square foot due to dead plus live loads may be considered in design of the slab. The recommended edge moisture variation (e_m) and differential swell (y_m) values for use in preliminary design of post-tensioned slabs are as follows:

Edge Moisture Variation Distance:	Estimated Differential Swell:
Center lift, e_m = 7 feet	Center lift, y_m = 1 inch
Edge lift, e_m = 5 feet	Edge lift, y_m = 1¼ inch

To aid in reducing the potential for differential soil movement associated with shrinkage and swelling of the fine-grained soils due to changes in moisture contents with changing seasons and landscaping, we recommend that the exterior edge of the slab be deepened to provide a moisture cut-off around the perimeter of the building. The deepened edge should extend at least 12 inches below the top of the pad grade, where the top of pad grade is defined as the grade beneath the bottom of the capillary moisture break gravel course or the adjacent exterior subgrade, whichever is deeper. In addition, it is recommended the upper 12 inches of subgrade soil be moisture-conditioned to at least 2 percent above optimum moisture content prior to pouring concrete. The moisture content should be verified within 48 hours of pouring concrete.

Slabs adjacent to landscape areas may be subject to additional distress due to increased soil moisture level fluctuations from flowerbed watering, as well as drying from tree root moisture removal. Therefore, we recommend that property owners be notified of the potential for soil movement and resulting slab distress which may occur in these instances of landscape neglect. In addition, property owners should be instructed to maintain consistent moisture levels and avoid extreme fluctuations in any flowerbeds adjacent to structures, and to avoid planting trees with invasive root systems within 10 feet of the structures.

The thickness of the slab-on-grade and locations and sizing of stiffening beams (if used) should be determined by the project Structural Engineer. Post-tensioned concrete slabs designed to be of uniform thickness without interior stiffening beams should be designed in accordance with the procedures presented in *Design of Post-Tensioned Slabs-on-Ground*. Perimeter columns located outside of the main structure, such as those required for covered terraces or second floor areas projecting out beyond the building footprint should not be founded on isolated spread footings structurally separated from the slab foundation.

The post-tensioned slab-on-grade foundation system will not prevent the structure from undergoing vertical displacement as a result of shrinkage and swelling of the underlying expansive soils. However, the use of a post-tensioned slab-on-grade foundation system, as opposed to a conventionally reinforced non-structural slab-on-grade, will reduce the amount of objectionable slab cracks and vertical off-set of adjacent concrete panels. The use of post-tension reinforcement does not necessarily eliminate the development of bending stresses in the slab due to differential movement of the supporting soils. Therefore, cracking in brittle finishes such as stucco and dry wall should be anticipated. This type of slab essentially distributes the differential movement of the supported structure over a longer span through controlled bending of the slab.

Floor Slabs and Exterior Flatwork

To reduce post-construction soil movement beneath floor slabs and exterior flatwork, it is recommended that mitigation measures be performed. For conventional slab-on-grade, it is recommended that the upper 18 inches of soil consist of non-expansive or lime-treated Engineered Fill.

Concrete slab-on-grade floors should be underlain by a water vapor retarder. The water vapor retarder should be installed in accordance with accepted engineering practice. The water vapor retarder should consist of a minimum 15 mil polyolefin membrane vapor retarder sheeting underlain by 6 inches of compacted Class 2 aggregate base, and 2 inches of clean sand on top of the vapor barrier. The sand should be free of clay, silt, or organic material. Rock dust which is manufactured sand from rock crushing operations is typically suitable for the granular fill. This granular fill material should be compacted.

It is recommended that the concrete slabs be reinforced at a minimum with No. 3 reinforcing bars, placed at 18 inches on center in each direction within the slabs middle third, to reduce crack separation and possible vertical offset at the cracks. Thicker floor slabs with increased concrete strength and reinforcement should be designed wherever heavy concentrated loads, heavy equipment, or machinery is anticipated.

The exterior floors should be poured separately in order to act independently of the walls and foundation system. Exterior finish grades should be sloped a minimum of 2 percent away from all interior slab areas to preclude ponding of water adjacent to the structures. All fills required to bring the building pads to grade should be Engineered Fills.

Moisture within the structure may be derived from water vapors, which were transformed from the moisture within the soils. This moisture vapor can travel through the vapor membrane and penetrate the slab-on-grade. This moisture vapor penetration can affect floor coverings and produce mold and mildew in the structure. It is recommended that the utility trenches within the structure be compacted, as specified in our report, to reduce the transmission of moisture through the utility trench backfill. Special attention to the immediate drainage and irrigation around the building is recommended. Positive drainage should be established away from the structure and should be maintained throughout the life of the structure. Ponding of water should not be allowed adjacent to the structure. Over-irrigation within landscaped areas adjacent to the structure should not be performed. In addition, ventilation of the structure (i.e. ventilation fans) is recommended to reduce the accumulation of interior moisture.

Lateral Earth Pressures and Retaining Walls

Walls retaining horizontal backfill and capable of deflecting a minimum of 0.1 percent of its height at the top may be designed using an equivalent fluid active pressure of 50 pounds per square foot per foot of depth. Walls that are incapable of this deflection or walls that are fully constrained against deflection may be designed for an equivalent fluid at-rest pressure of 70 pounds per square foot per foot per depth. Expansive soils should not be used for backfill against walls. The wedge of non-expansive backfill material should extend from the bottom of each retaining wall outward and upward at a slope of 2:1 (horizontal to vertical) or flatter. The stated lateral earth pressures do not include the effects of hydrostatic water pressures generated by infiltrating surface water that may accumulate behind the retaining walls; or loads imposed by construction equipment, foundations, or roadways. All of the above earth pressures are unfactored and are, therefore, not inclusive of factors of safety.

During grading and backfilling operations adjacent to any walls, heavy equipment should not be allowed to operate within a lateral distance of 5 feet from the wall, or within a lateral distance equal to the wall height, whichever is greater, to avoid developing excessive lateral pressures. Within this zone, only hand operated equipment ("whackers," vibratory plates, or pneumatic compactors) should be used to compact the backfill soils.

Retaining and/or below grade walls should be drained with either perforated pipe encased in free-draining gravel or a prefabricated drainage system. The gravel zone should have a minimum width of 12 inches wide and should extend upward to within 12 inches of the top of the wall. The upper 12 inches of backfill should consist of native soils, concrete, asphaltic concrete or other suitable backfill to reduce surface drainage into the wall drain system. The aggregate should conform to Class 2 permeable materials graded in accordance with the CalTrans Standard Specifications (2018). Prefabricated drainage systems, such as Miradrain®, Enkadrain®, or an equivalent substitute, are acceptable alternatives in lieu of gravel provided they are installed in accordance with the manufacturer's recommendations. If a prefabricated drainage system is proposed, our firm should review the system for final acceptance prior to installation.

Drainage pipes should be placed with perforations down and should discharge in a non-erosive manner away from foundations and other improvements. The pipes should be placed no higher than 6 inches above the heel of the wall in the center line of the drainage blanket and should have a minimum diameter of 4 inches. Collector pipes may be either slotted or perforated. Slots should be no wider than ⅛ inch in diameter, while perforations should be no more than ¼ inch in diameter. If retaining walls are less than 6 feet in height, the perforated pipe may be omitted in lieu of weep holes on 4 feet maximum spacing. The weep holes should consist of 4-inch diameter holes (concrete walls) or unmortared head joints (masonry walls) and not be higher than 18 inches above the lowest adjacent grade. Two 8-inch square overlapping patches of geotextile fabric (conforming to the CalTrans Standard Specifications for "edge drains") should be affixed to the rear wall opening of each weep hole to retard soil piping.

R-Value Test Results and Pavement Design

Two subgrade soil samples were obtained from the project site for R-value testing at the locations shown on the attached site plan. The samples were tested in accordance with the State of California Materials Manual Test Designation 301. The results of the tests are as follows:

Sample	Depth	Description	R-Value at Equilibrium
1	12-24"	Clayey Sand (SC)	24
2	12-24"	Sandy Clay (CL)	Less than 5

The test results are low and indicate poor subgrade support characteristics under dynamic traffic loads. The following table shows the recommended pavement sections for various traffic indices.

Traffic Index	Asphaltic Concrete	Class II Aggregate Base*	Class III Aggregate Subbase	Compacted Subgrade**
4.0	2.0"	8.5"	--	12.0"
4.0	2.0"	4.5"	4.5"	12.0"
4.5	3.0"	9.0"	--	12.0"
4.5	3.0"	4.0"	5.5"	12.0"
5.0	3.0"	11.0"	--	12.0"
5.0	3.0"	5.0"	6.5"	12.0"
5.5	3.0"	11.5"	--	12.0"
5.5	3.0"	5.0"	7.0"	12.0"
6.0	3.0"	13.5"	--	12.0"
6.0	3.0"	6.5"	8.0"	12.0"
6.5	3.5"	14.0"	--	12.0"
6.5	3.5"	6.0"	9.0"	12.0"
7.0	4.0"	15.5"	--	12.0"
7.0	4.0"	6.5"	10.0"	12.0"
7.5	4.0"	17.0"	--	12.0"
7.5	4.0"	7.5"	10.5"	12.0"

**** 95% compaction based on ASTM Test Method D1557 or CAL 216***
***** 90% compaction based on ASTM Test Method D1557 or CAL 216***

If traffic indices are not available, an estimated (typical value) index of 4.5 may be used for light automobile traffic, and an index of 7.0 may be used for light truck traffic.

The following recommendations are for light-duty and heavy-duty Portland Cement Concrete Pavement Sections based on the design procedures developed by the Portland Cement Association.

PORTLAND CEMENT PAVEMENT

LIGHT DUTY

Traffic Index	Portland Cement Concrete***	Class II Aggregate Base*	Compacted Subgrade**
4.5	6.0"	5.0"	12.0"

HEAVY DUTY

Traffic Index	Portland Cement Concrete***	Class II Aggregate Base*	Compacted Subgrade**
7.0	7.0"	6.0"	12.0"

**** 95% compaction based on ASTM Test Method D1557 or CAL 216***
***** 90% compaction based on ASTM Test Method D1557 or CAL 216***
******Minimum Compressive Strength of 3000 psi***

As indicated previously, fill material is located across the site. It is recommended that any uncertified fill material encountered within pavement areas be removed and/or recompacted. The fill materials should be moisture-conditioned to a minimum of 2 percent above optimum moisture and recompacted to a minimum of 90 percent of maximum density based on ASTM Test Method D1557. As an alternative, the Owner may elect not to recompact the existing fill within paved areas. However, the Owner should be aware that the paved areas may settle which may require annual maintenance. At a minimum, it is recommended that the upper 12 inches of subgrade soil be moisture-conditioned to a minimum of 2 percent above optimum moisture content and recompacted to a minimum of 90 percent of maximum density based on ASTM Test Method D1557.

Seismic Parameters – 2016 California Building Code

The Site Class per Section 1613 of the 2016 California Building Code (2016 CBC) and Table 20.3-1 of ASCE 7-10 is based upon the site soil conditions. It is our opinion that a Site Class D is most consistent with the subject site soil conditions. For seismic design of the structures based on the seismic provisions of the 2016 CBC, we recommend the following parameters:

Seismic Item	Value	CBC Reference
Site Class	D	Section 1613.3.2
Site Coefficient F_a	1.000	Table 1613.3.3 (1)
S_s	1.842	Section 1613.3.1
S_{MS}	1.842	Section 1613.3.3
S_{DS}	1.228	Section 1613.3.4
Site Coefficient F_v	1.500	Table 1613.3.3 (2)
S_1	0.738	Section 1613.3.1
S_{M1}	1.107	Section 1613.3.3
S_{D1}	0.738	Section 1613.3.4

Soil Cement Reactivity

Excessive sulfate in either the soil or native water may result in an adverse reaction between the cement in concrete (or stucco) and the soil. HUD/FHA and CBC have developed criteria for evaluation of sulfate levels and how they relate to cement reactivity with soil and/or water.

Soil samples were obtained from the site and tested in accordance with State of California Materials Manual Test Designation 417. The sulfate concentrations detected in these soil samples were greater than 150 ppm and are above the maximum allowable values established by HUD/FHA and CBC. Therefore, it is recommended that a Type II cement be used within the concrete to compensate for sulfate reactivity with the cement.

Compacted Material Acceptance

Compaction specifications are not the only criteria for acceptance of the site grading or other such activities. However, the compaction test is the most universally recognized test method for assessing the performance of the Grading Contractor. The numerical test results from the compaction test cannot be used to predict the engineering performance of the compacted material. Therefore, the acceptance of compacted materials will also be dependent on the stability of that material. The Soils Engineer has the option of rejecting any compacted material regardless of the degree of compaction if that material is considered to be unstable or if future instability is suspected. A specific example of rejection of fill material passing the required percent compaction is a fill which has been compacted with an in situ moisture content significantly less than optimum moisture. This type of dry fill (brittle fill) is susceptible to future settlement if it becomes saturated or flooded.

Testing and Inspection

A representative of Krazan & Associates, Inc. should be present at the site during the earthwork activities to confirm that actual subsurface conditions are consistent with the exploratory fieldwork. This activity is an integral part of our service, as acceptance of earthwork construction is dependent upon compaction testing and stability of the material. This representative can also verify that the intent of these recommendations is incorporated into the project design and construction. Krazan & Associates, Inc. will not be responsible for grades or staking, since this is the responsibility of the Prime Contractor.

LIMITATIONS

Soils Engineering is one of the newest divisions of Civil Engineering. This branch of Civil Engineering is constantly improving as new technologies and understanding of earth sciences advance. Although your site was analyzed using the most appropriate and most current techniques and methods, undoubtedly there will be substantial future improvements in this branch of engineering. In addition to advancements in the field of Soils Engineering, physical changes in the site, either due to excavation or fill placement, new agency regulations, or possible changes in the proposed structure after the soils report is completed may require the soils report to be professionally reviewed. In light of this, the Owner should be aware that there is a practical limit to the usefulness of this report without critical review. Although the time limit for this review is strictly arbitrary, it is suggested that 2 years be considered a reasonable time for the usefulness of this report.

Foundation and earthwork construction is characterized by the presence of a calculated risk that soil and groundwater conditions have been fully revealed by the original foundation investigation. This risk is derived from the practical necessity of basing interpretations and design conclusions on limited sampling of the earth. The recommendations made in this report are based on the assumption that soil conditions do not vary significantly from those disclosed during our field investigation. If any variations or undesirable conditions are encountered during construction, the Soils Engineer should be notified so that supplemental recommendations may be made.

The conclusions of this report are based on the information provided regarding the proposed construction. If the proposed construction is relocated or redesigned, the conclusions in this report may not be valid. The Soils Engineer should be notified of any changes so the recommendations may be reviewed and re-evaluated.

This report is a Geotechnical Engineering Investigation with the purpose of evaluating the soil conditions in terms of foundation design. The scope of our services did not include any Environmental Site Assessment for the presence or absence of hazardous and/or toxic materials in the soil, groundwater, or atmosphere; or the presence of wetlands. Any statements, or absence of statements, in this report or on any boring log regarding odors, unusual or suspicious items, or conditions observed, are strictly for descriptive purposes and are not intended to convey engineering judgment regarding potential hazardous and/or toxic assessment.

The geotechnical engineering information presented herein is based upon professional interpretation utilizing standard engineering practices and a degree of conservatism deemed proper for this project. It is not warranted that such information and interpretation cannot be superseded by future geotechnical engineering developments. We emphasize that this report is valid for the project outlined above and should not be used for any other sites.

If you have any questions, or if we may be of further assistance, please do not hesitate to contact our office at (925) 307-1160.

Respectfully submitted,
KRAZAN & ASSOCIATES, INC.

Steve Nelson
Project Engineer

DAVID R. JAROSZ II
NO. 2698
EXP. 6/30/2020

David R. Jarosz, II
Managing Engineer
RGE No. 2698/RCE No. 60185

SN/DRJ:ht

SITE MAP	**Scale:** NTS	**Date:** June 2019	Krazan GEOTECHNICAL ENGINEERING
West College Avenue Apartments **2150 W. College Avenue** **Santa Rosa, California**	**Drawn by:** HT	**Approved by:** DJ	
	Project No. 042-19004	**Figure No.** 1	

APPENDIX A

FIELD AND LABORATORY INVESTIGATIONS

Field Investigation

The field investigation consisted of a surface reconnaissance and a subsurface exploratory program. Six 4½-inch to 6½-inch diameter exploratory borings were advanced. The boring locations are shown on the attached site plan.

The soils encountered were logged in the field during the exploration and with supplementary laboratory test data are described in accordance with the Unified Soil Classification System.

Modified standard penetration tests and standard penetration tests were performed at selected depths. These tests represent the resistance to driving a 2½-inch and 1½-inch diameter split barrel sampler, respectively. The driving energy was provided by a hammer weighing 140 pounds falling 30 inches. Relatively undisturbed soil samples were obtained while performing this test. Bag samples of the disturbed soil were obtained from the auger cuttings. The modified standard penetration tests are identified in the sample type on the boring logs with a full shaded in block. The standard penetration tests are identified in the sample type on the boring logs with half of the block shaded. All samples were returned to our Clovis laboratory for evaluation.

Laboratory Investigation

The laboratory investigation was programmed to determine the physical and mechanical properties of the foundation soil underlying the site. Test results were used as criteria for determining the engineering suitability of the surface and subsurface materials encountered.

In-situ moisture content, dry density, consolidation, direct shear, and sieve analysis tests were completed for the undisturbed samples representative of the subsurface material. Atterberg limits, expansion index and R-value tests were completed for select bag samples obtained from the auger cuttings. These tests, supplemented by visual observation, comprised the basis for our evaluation of the site material.

The logs of the exploratory borings and laboratory determinations are presented in this Appendix.

UNIFIED SOIL CLASSIFICATION SYSTEM

UNIFIED SOIL CLASSIFICATION AND SYMBOL CHART

COARSE-GRAINED SOILS (more than 50% of material is larger than No. 200 sieve size.)		
		Clean Gravels (Less than 5% fines)
GRAVELS More than 50% of coarse fraction larger than No. 4 sieve size	GW	Well-graded gravels, gravel-sand mixtures, little or no fines
	GP	Poorly-graded gravels, gravel-sand mixtures, little or no fines
		Gravels with fines (More than 12% fines)
	GM	Silty gravels, gravel-sand-silt mixtures
	GC	Clayey gravels, gravel-sand-clay mixtures
		Clean Sands (Less than 5% fines)
SANDS 50% or more of coarse fraction smaller than No. 4 sieve size	SW	Well-graded sands, gravelly sands, little or no fines
	SP	Poorly graded sands, gravelly sands, little or no fines
		Sands with fines (More than 12% fines)
	SM	Silty sands, sand-silt mixtures
	SC	Clayey sands, sand-clay mixtures
FINE-GRAINED SOILS (50% or more of material is smaller than No. 200 sieve size.)		
SILTS AND CLAYS Liquid limit less than 50%	ML	Inorganic silts and very fine sands, rock flour, silty of clayey fine sands or clayey silts with slight plasticity
	CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
	OL	Organic silts and organic silty clays of low plasticity
SILTS AND CLAYS Liquid limit 50% or greater	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts
	CH	Inorganic clays of high plasticity, fat clays
	OH	Organic clays of medium to high plasticity, organic silts
HIGHLY ORGANIC SOILS	PT	Peat and other highly organic soils

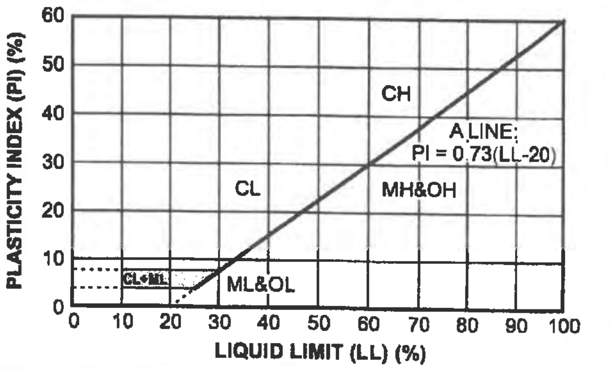
CONSISTENCY CLASSIFICATION

Description	**Blows per Foot**
Granular Soils	
Very Loose	< 5
Loose	5 – 15
Medium Dense	16 – 40
Dense	41 – 65
Very Dense	> 65
Cohesive Soils	
Very Soft	< 3
Soft	3 – 5
Firm	6 – 10
Stiff	11 – 20
Very Stiff	21 – 40
Hard	> 40

GRAIN SIZE CLASSIFICATION

Grain Type	*Standard Sieve Size*	*Grain Size in Millimeters*
Boulders	Above 12 inches	Above 305
Cobbles	12 to 13 inches	305 to 76.2
Gravel	3 inches to No. 4	76.2 to 4.76
Coarse-grained	3 to ¾ inches	76.2 to 19.1
Fine-grained	¾ inches to No. 4	19.1 to 4.76
Sand	No. 4 to No. 200	4.76 to 0.074
Coarse-grained	No. 4 to No. 10	4.76 to 2.00
Medium-grained	No. 10 to No. 40	2.00 to 0.042
Fine-grained	No. 40 to No. 200	0.042 to 0.074
Silt and Clay	Below No. 200	Below 0.074

PLASTICITY CHART



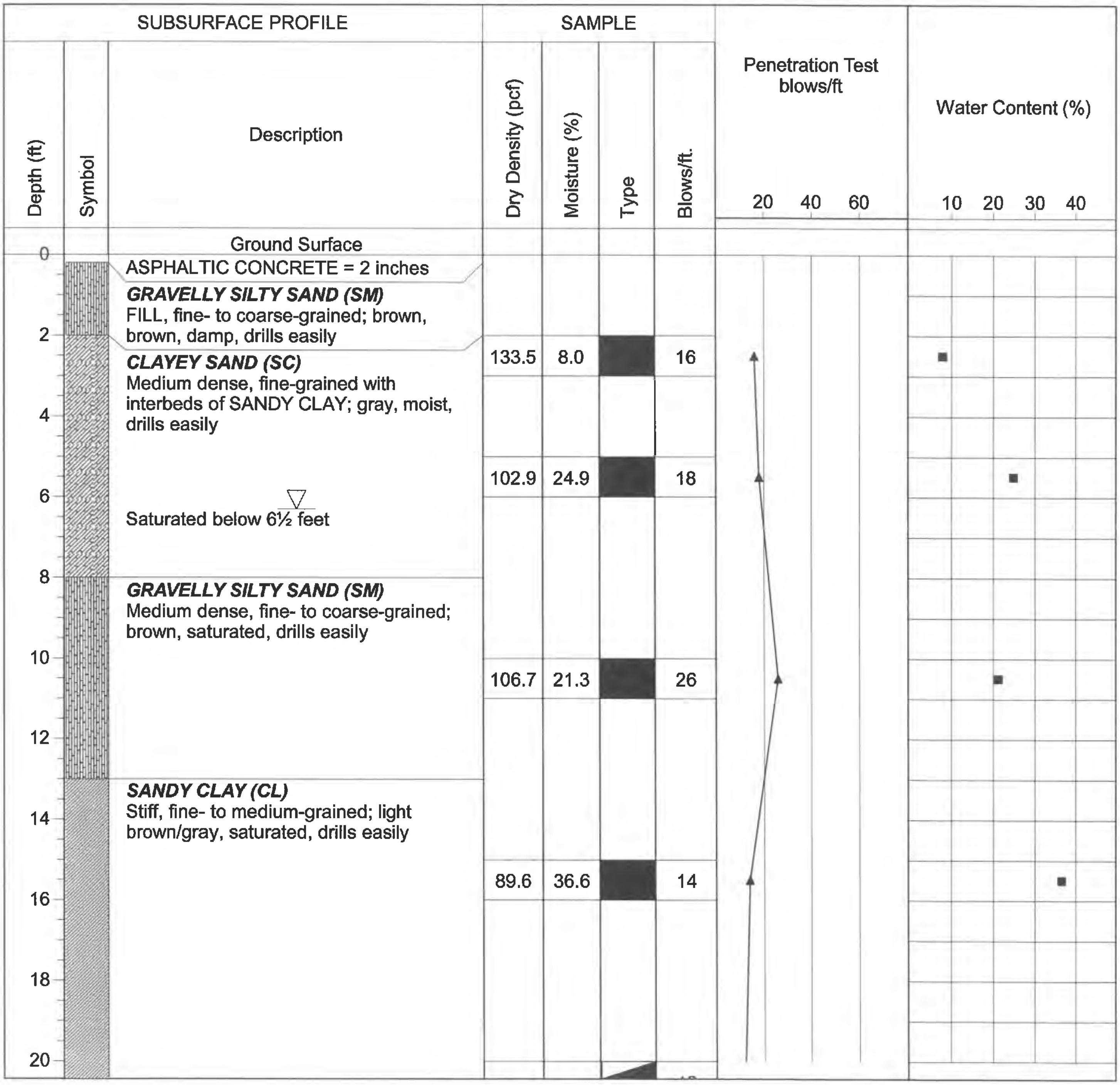
Log of Boring B1

Project: West College Avenue Apartments
Project No: 042-19004

Client: USA Properties Fund, Inc.
Figure No.: A-1

Location: 2150 W. College Avenue, Santa Rosa, California
Logged By: R. Alexander

Depth to Water> **Initial:** 6½ Feet **At Completion:** 6½ Feet



Description	Dry Density (pcf)	Moisture (%)	Type	Blows/ft.
Ground Surface				
ASPHALTIC CONCRETE = 2 inches				
GRAVELLY SILTY SAND (SM) FILL, fine- to coarse-grained; brown, brown, damp, drills easily				
CLAYEY SAND (SC) Medium dense, fine-grained with interbeds of SANDY CLAY; gray, moist, drills easily	133.5	8.0	■	16
	102.9	24.9	■	18
Saturated below 6½ feet				
GRAVELLY SILTY SAND (SM) Medium dense, fine- to coarse-grained; brown, saturated, drills easily	106.7	21.3	■	26
SANDY CLAY (CL) Stiff, fine- to medium-grained; light brown/gray, saturated, drills easily	89.6	36.6	■	14

Drill Method: Hollow Stem
Drill Date: 3-27-19

Drill Rig: CME 45B
Krazan and Associates
Hole Size: 6½ Inches

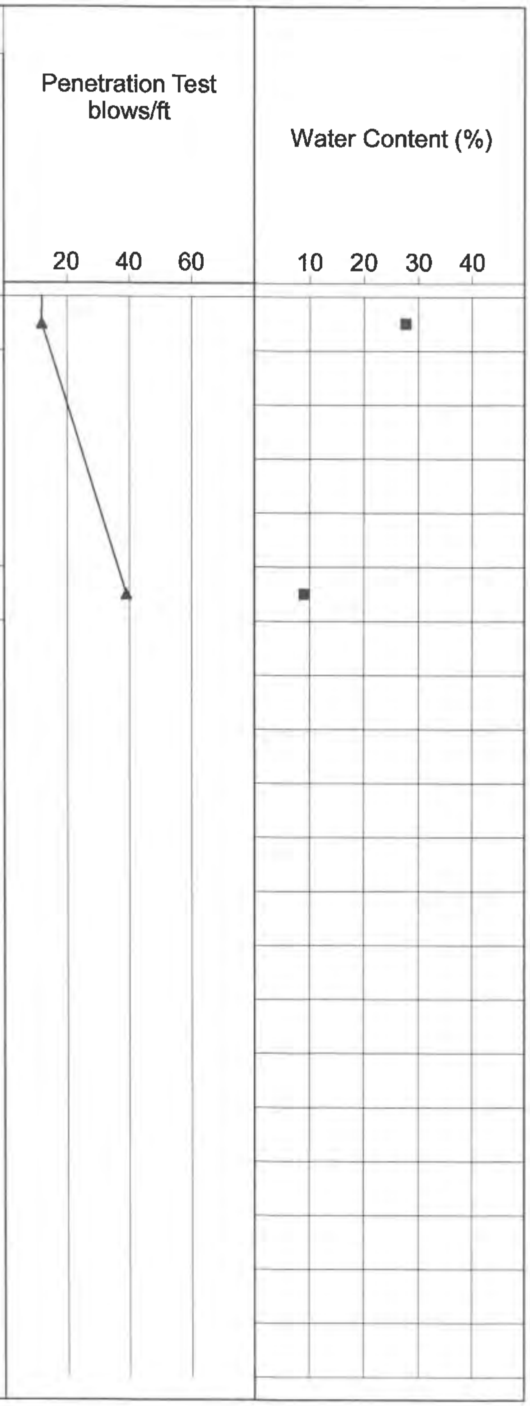
Driller: Brent Snyder
Elevation: 27 Feet

Sheet: 1 of 2

Log of Boring B1

Project: West College Avenue Apartments
Project No: 042-19004
Client: USA Properties Fund, Inc.
Figure No.: A-1
Location: 2150 W. College Avenue, Santa Rosa, California
Logged By: R. Alexander
Depth to Water> **Initial:** 6½ Feet
At Completion: 6½ Feet

SUBSURFACE PROFILE			SAMPLE			
Depth (ft)	Symbol	Description	Dry Density (pcf)	Moisture (%)	Type	Blows/ft.
22	▨		91.4	27.7	◢	12
24	▨	***SILTY SAND (SM)*** Medium dense, fine- to coarse-grained; brown, saturated, drills easily				
26	▨	***CLAYEY SAND (SC)*** Dense, fine- to medium-grained; brown, saturated, drills firmly Auger refusal at 27 feet	125.2	9.1	◢	39
28		End of Borehole				
30						
32						
34						
36						
38						
40						



Drill Method: Hollow Stem
Drill Date: 3-27-19
Drill Rig: CME 45B
Krazan and Associates
Hole Size: 6½ Inches
Driller: Brent Snyder
Elevation: 27 Feet
Sheet: 2 of 2

Log of Boring B2

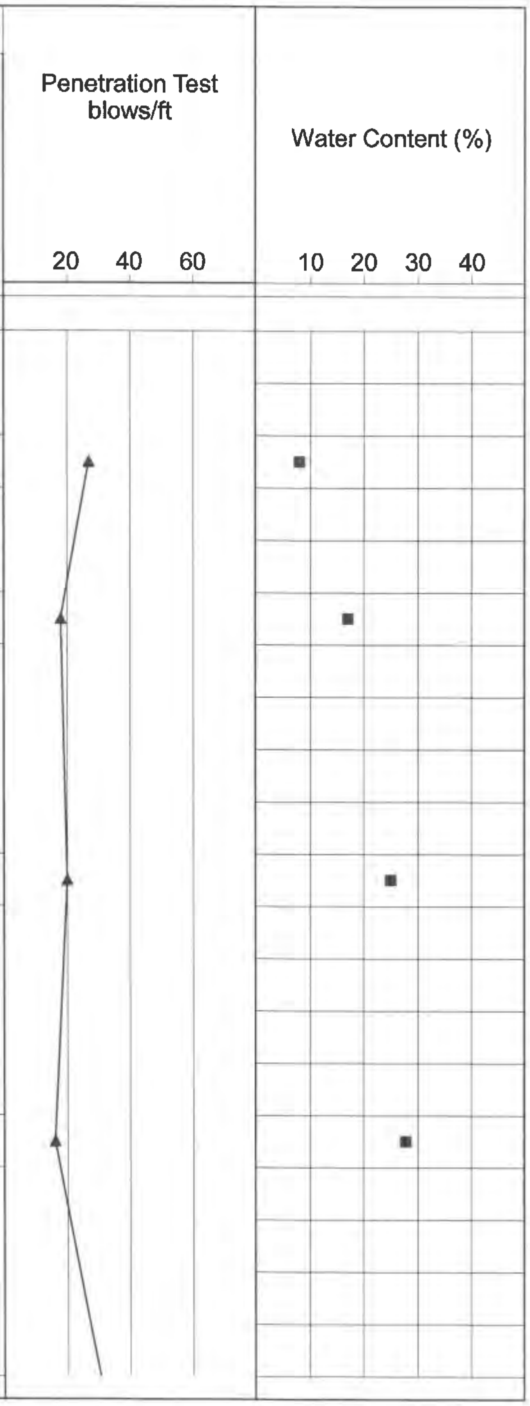
Project: West College Avenue Apartments
Project No: 042-19004

Client: USA Properties Fund, Inc.
Figure No.: A-2

Location: 2150 W. College Avenue, Santa Rosa, California
Logged By: R. Alexander

Depth to Water> **Initial:** 7 Feet **At Completion:** 7 Feet

SUBSURFACE PROFILE			SAMPLE			
Depth (ft)	Symbol	Description	Dry Density (pcf)	Moisture (%)	Type	Blows/ft.
		Ground Surface				
0		ASPHALTIC CONCRETE = 2 inches AGGREGATE BASE = 4 inches				
2		***GRAVELLY SILTY SAND (SM)*** FILL, fine- to coarse-grained; brown, moist, drills easily	116.3	8.0	■	27
4		***SANDY CLAY (CL)*** Very stiff, fine- to coarse-grained; dark brown, moist, drills easily				
6 8		***CLAYEY SAND (SC)*** Medium dense, fine- to medium-grained; brown, moist, drills easily ▽ Saturated below 7 feet	113.9	17.4	■	18
10 12		***GRAVELLY CLAYEY SAND (SC)*** Medium dense, fine- to coarse-grained; brown, saturated, drills easily	102.4	25.1	■	20
14 16		***CLAYEY SAND/SANDY CLAY (SC/CL)*** Stiff, fine- to medium-grained; light brown, saturated, drills easily	90.0	27.8	■	16
18 20		***SANDY CLAY (CL)*** Very stiff, fine-grained; gray, saturated, drills easily			■	



Drill Method: Hollow Stem
Drill Date: 4-4-19

Drill Rig: CME 45B
Hole Size: 6½ Inches

Krazan and Associates

Driller: Brent Snyder
Elevation: 50 Feet

Sheet: 1 of 3

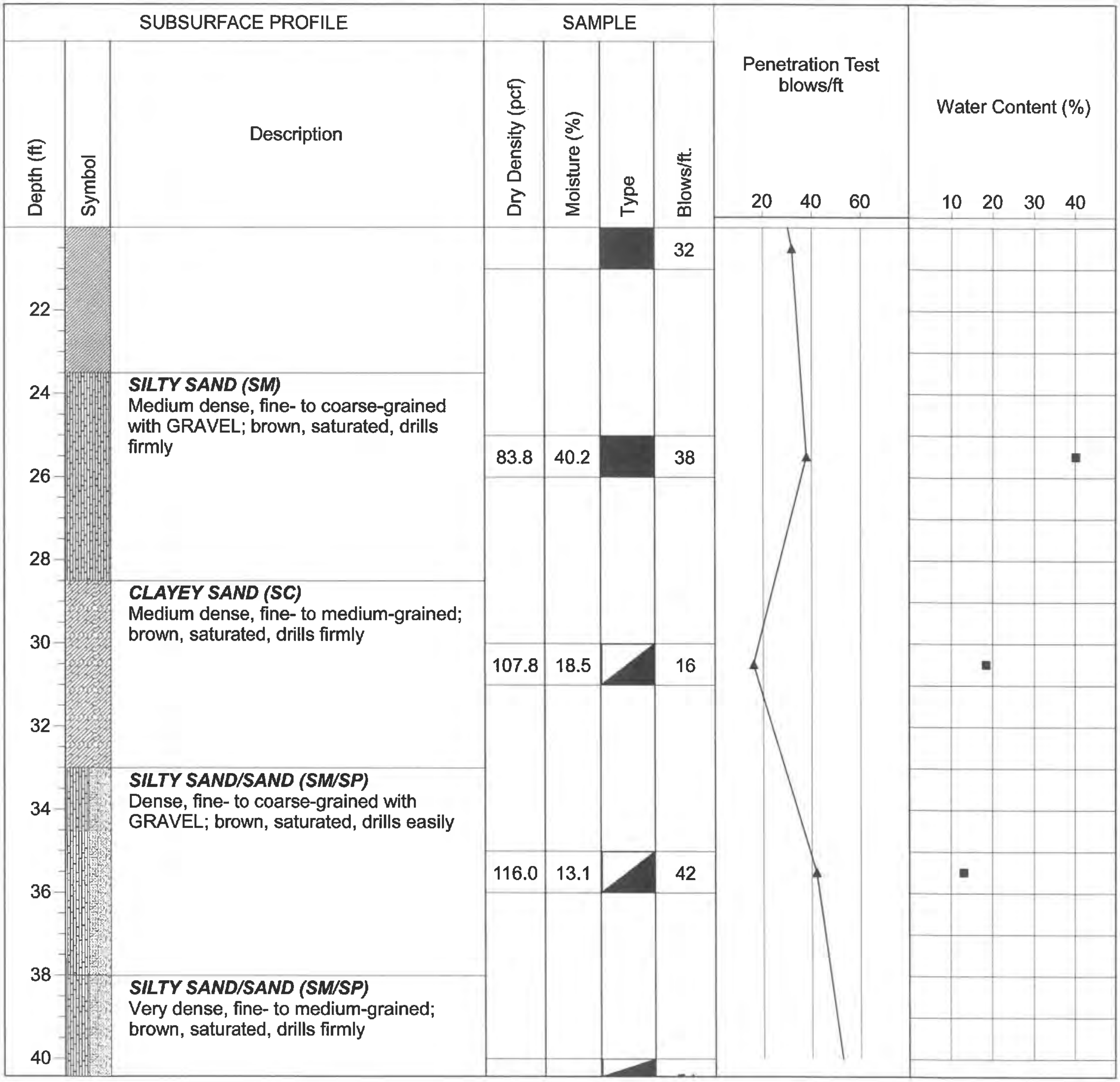
Log of Boring B2

Project: West College Avenue Apartments
Project No: 042-19004

Client: USA Properties Fund, Inc.
Figure No.: A-2

Location: 2150 W. College Avenue, Santa Rosa, California
Logged By: R. Alexander

Depth to Water> **Initial:** 7 Feet **At Completion:** 7 Feet



Description	Dry Density (pcf)	Moisture (%)	Type	Blows/ft.
			■	32
SILTY SAND (SM) Medium dense, fine- to coarse-grained with GRAVEL; brown, saturated, drills firmly	83.8	40.2	■	38
CLAYEY SAND (SC) Medium dense, fine- to medium-grained; brown, saturated, drills firmly	107.8	18.5	◢	16
SILTY SAND/SAND (SM/SP) Dense, fine- to coarse-grained with GRAVEL; brown, saturated, drills easily	116.0	13.1	◢	42
SILTY SAND/SAND (SM/SP) Very dense, fine- to medium-grained; brown, saturated, drills firmly			◢	

Drill Method: Hollow Stem
Drill Date: 4-4-19

Drill Rig: CME 45B
Krazan and Associates
Hole Size: 6½ Inches

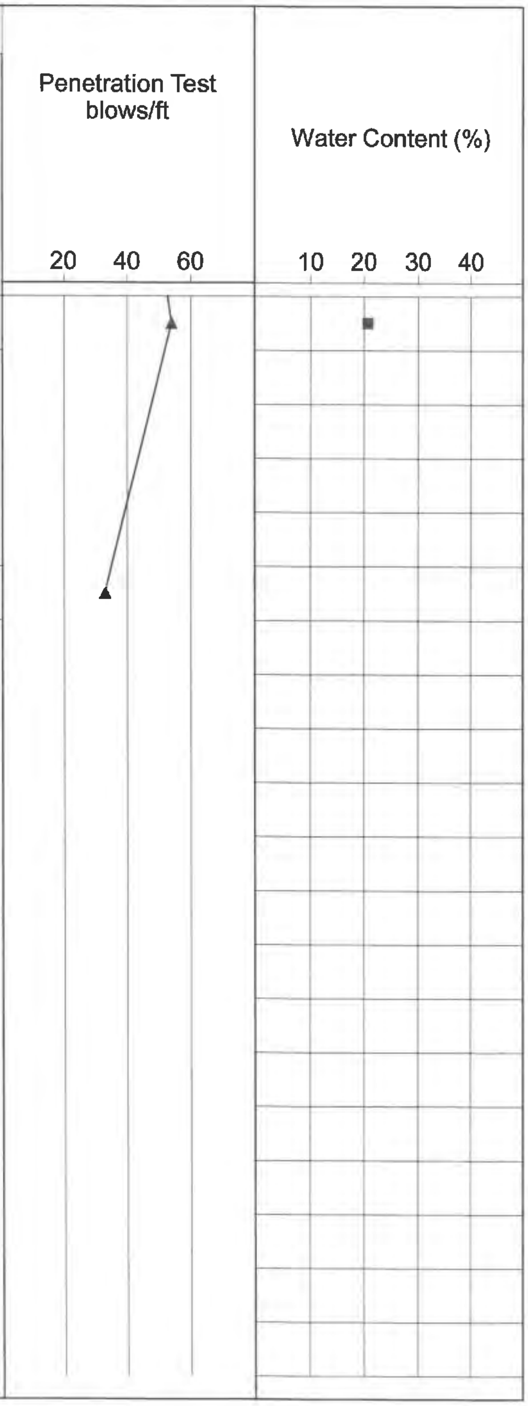
Driller: Brent Snyder
Elevation: 50 Feet

Sheet: 2 of 3

Log of Boring B2

Project: West College Avenue Apartments
Project No: 042-19004
Client: USA Properties Fund, Inc.
Figure No.: A-2
Location: 2150 W. College Avenue, Santa Rosa, California
Logged By: R. Alexander
Depth to Water> **Initial:** 7 Feet **At Completion:** 7 Feet

SUBSURFACE PROFILE			SAMPLE			
Depth (ft)	Symbol	Description	Dry Density (pcf)	Moisture (%)	Type	Blows/ft.
	▨		103.4	20.8	◢	54
42	▨					
44	▨					
	▨	***SANDY CLAY (CL)*** Very stiff, fine- to medium-grained; grayish-brown, saturated, drills easily			◢	33
46	▨					
48	▨					
50		End of Borehole				
52						
54						
56						
58						
60						



Drill Method: Hollow Stem
Drill Date: 4-4-19
Drill Rig: CME 45B

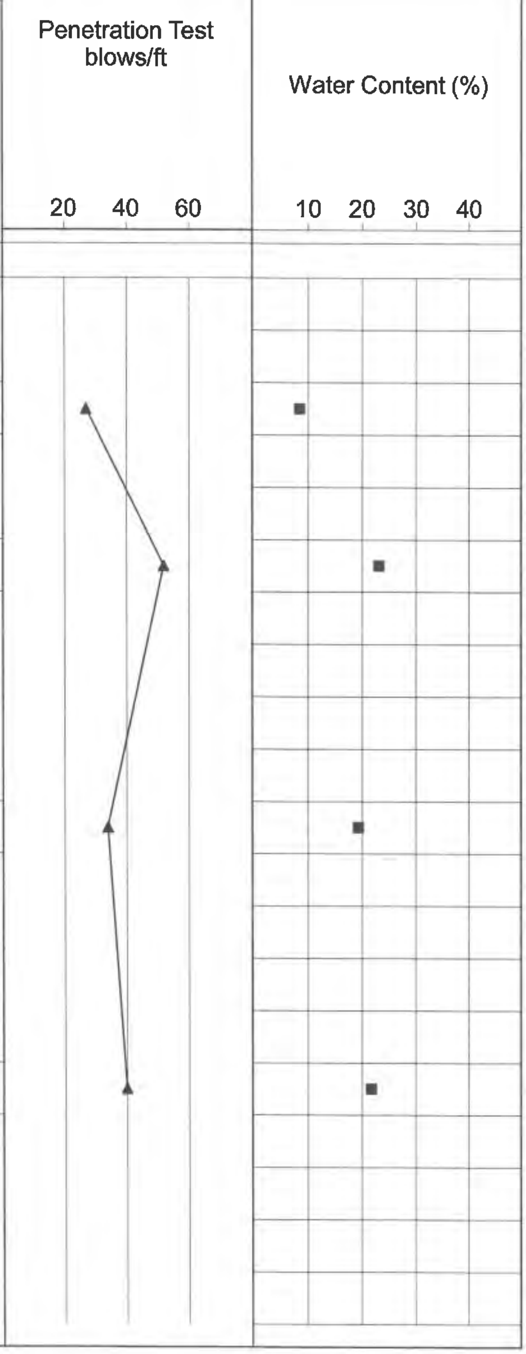
Krazan and Associates

Hole Size: 6½ Inches
Driller: Brent Snyder
Elevation: 50 Feet
Sheet: 3 of 3

Log of Boring B3

Project: West College Avenue Apartments
Project No: 042-19004
Client: USA Properties Fund, Inc.
Figure No.: A-3
Location: 2150 W. College Avenue, Santa Rosa, California
Logged By: R. Alexander
Depth to Water> **Initial:** 7½ Feet **At Completion:** 7½ Feet

SUBSURFACE PROFILE			SAMPLE			
Depth (ft)	Symbol	Description	Dry Density (pcf)	Moisture (%)	Type	Blows/ft.
		Ground Surface				
0	▥	***GRAVELLY SILTY SAND (SM)*** FILL, fine- to coarse-grained; brown, brown, damp, drills easily				
2	▥		125.3	8.5	■	27
4	▨	***SANDY CLAY (CL)*** Very stiff, fine- to medium-grained; brown, damp, drills easily Hard and light brown below 5 feet	89.4	23.2	■	52
6	▨	▽ Saturated below 7½ feet				
8	▨					
10	▨		122.6	19.4	■	34
12	▒	***GRAVELLY CLAYEY SAND (SC)*** Medium dense, fine- to coarse-grained; brown, saturated, drills easily				
14	▥	***GRAVELLY SILTY SAND (SM)*** Medium dense, fine- to coarse-grained; light brown, saturated, drills firmly				
16	▨	***SANDY CLAY (CL)*** Hard, fine- to medium-grained; light brown, saturated, drills firmly	95.3	21.8	■	40
18	▨					
20						



Drill Method: Solid Flight
Drill Date: 4-4-19
Drill Rig: CME 45B
Krazan and Associates
Hole Size: 4½ Inches
Driller: Brent Snyder
Elevation: 20 Feet
Sheet: 1 of 1

Log of Boring B4

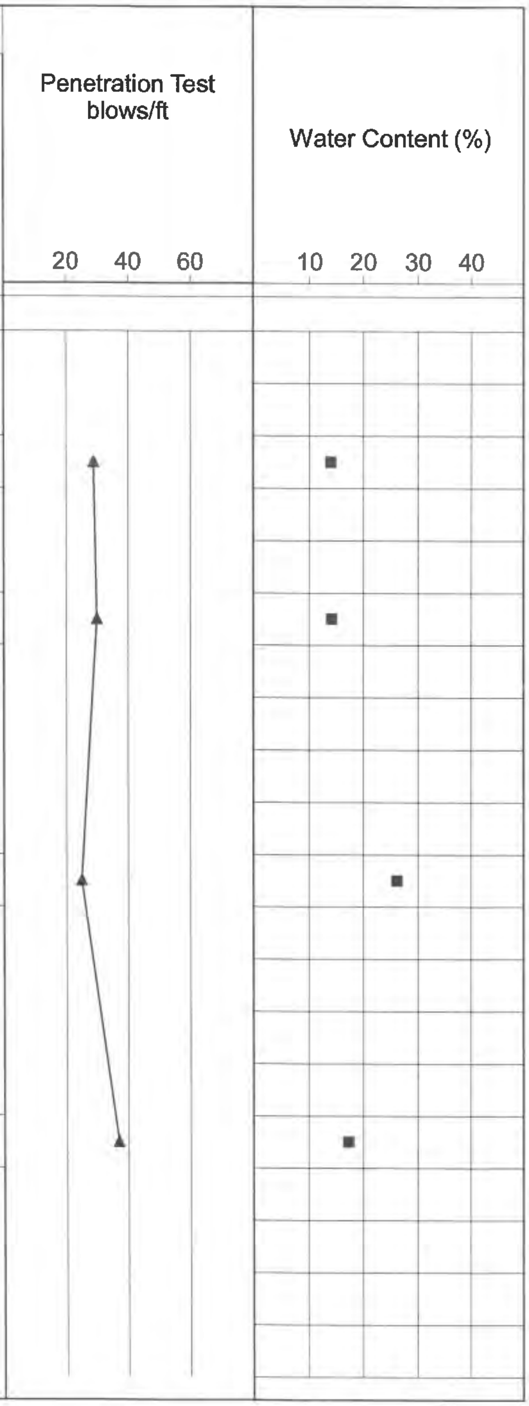
Project: West College Avenue Apartments
Project No: 042-19004

Client: USA Properties Fund, Inc.
Figure No.: A-4

Location: 2150 W. College Avenue, Santa Rosa, California
Logged By: R. Alexander

Depth to Water>
Initial: 9 Feet
At Completion: 9 Feet

SUBSURFACE PROFILE			SAMPLE			
Depth (ft)	Symbol	Description	Dry Density (pcf)	Moisture (%)	Type	Blows/ft.
		Ground Surface				
0		ASPHALTIC CONCRETE = 2 inches AGGREGATE BASE = 4 inches				
2		***GRAVELLY SILTY SAND (SM)*** FILL, fine- to coarse-grained; brown, brown, damp, drills easily	105.0	14.0	■	29
4		***SANDY CLAY (CL)*** Very stiff, fine- to medium-grained; brown, moist, drills easily				
6			112.0	14.2	■	30
8		▽ Saturated below 9 feet				
10						
		GRAVELLY CLAYEY SAND (SC) Medium dense, fine- to coarse-grained; brown, saturated, drills easily	110.2	26.2	■	25
12						
14						
16			105.0	17.4	■	37
18						
20						



Drill Method: Solid Flight
Drill Date: 4-4-19

Drill Rig: CME 45B
Krazan and Associates
Hole Size: 4½ Inches

Driller: Brent Snyder
Elevation: 20 Feet

Sheet: 1 of 1

Log of Boring B5

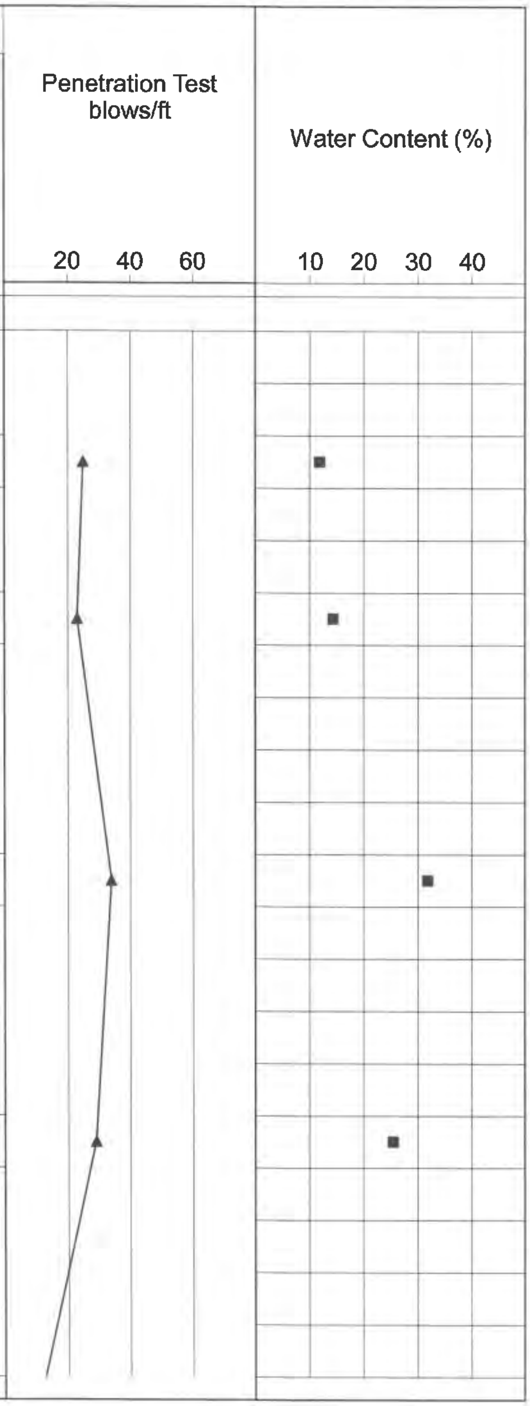
Project: West College Avenue Apartments
Project No: 042-19004

Client: USA Properties Fund, Inc.
Figure No.: A-5

Location: 2150 W. College Avenue, Santa Rosa, California
Logged By: R. Alexander

Depth to Water>
Initial: 13 Feet
At Completion: 13 Feet

SUBSURFACE PROFILE			SAMPLE			
Depth (ft)	Symbol	Description	Dry Density (pcf)	Moisture (%)	Type	Blows/ft.
		Ground Surface				
0		ASPHALTIC CONCRETE = 2½ inches AGGREGATE BASE = 3 inches				
2	▨	***GRAVELLY SILTY SAND (SM)*** FILL, fine- to coarse-grained; brown, moist, drills easily	118.0	11.9	■	25
4	▨	***CLAYEY SAND (SC)*** Medium dense, fine- to medium-grained; brown, moist, drills easily	109.1	14.4	■	23
6	▨	***SANDY CLAY (CL)*** Very stiff, fine- to medium-grained; brown, moist, drills easily				
10	▨		93.2	31.8	■	34
12	▨	▽ Saturated below 13 feet				
16	▨		99.6	25.5	■	29
18	▨	Stiff below 19 feet				
20	▨				■	



Drill Method: Solid Flight
Drill Date: 4-4-19

Drill Rig: CME 45B
Hole Size: 4½ Inches

Krazan and Associates

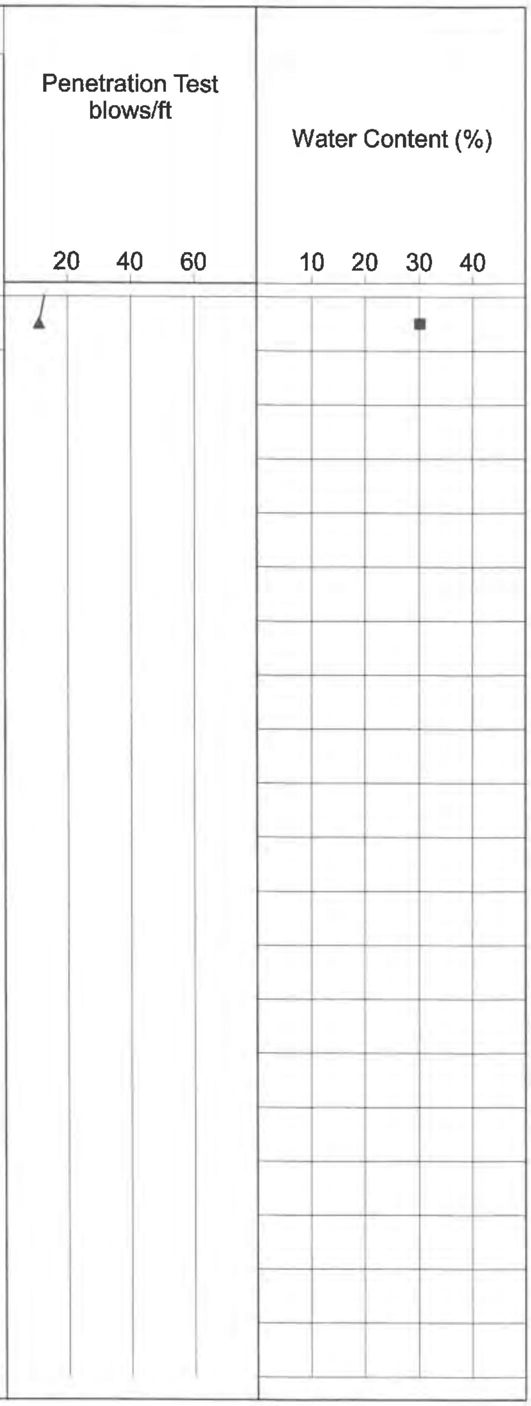
Driller: Brent Snyder
Elevation: 25 Feet

Sheet: 1 of 2

Log of Boring B5

Project: West College Avenue Apartments
Project No: 042-19004
Client: USA Properties Fund, Inc.
Figure No.: A-5
Location: 2150 W. College Avenue, Santa Rosa, California
Logged By: R. Alexander
Depth to Water>
Initial: 13 Feet
At Completion: 13 Feet

SUBSURFACE PROFILE			SAMPLE			
Depth (ft)	Symbol	Description	Dry Density (pcf)	Moisture (%)	Type	Blows/ft.
	▨		90.3	30.2	■	11
22	▨					
24	▨					
		End of Borehole				
26						
28						
30						
32						
34						
36						
38						
40						



Drill Method: Solid Flight
Drill Date: 4-4-19
Drill Rig: CME 45B
Krazan and Associates
Hole Size: 4½ Inches
Driller: Brent Snyder
Elevation: 25 Feet
Sheet: 2 of 2

Log of Boring B6

Project: West College Avenue Apartments

Project No: 042-19004

Client: USA Properties Fund, Inc.

Figure No.: A-6

Location: 2150 W. College Avenue, Santa Rosa, California

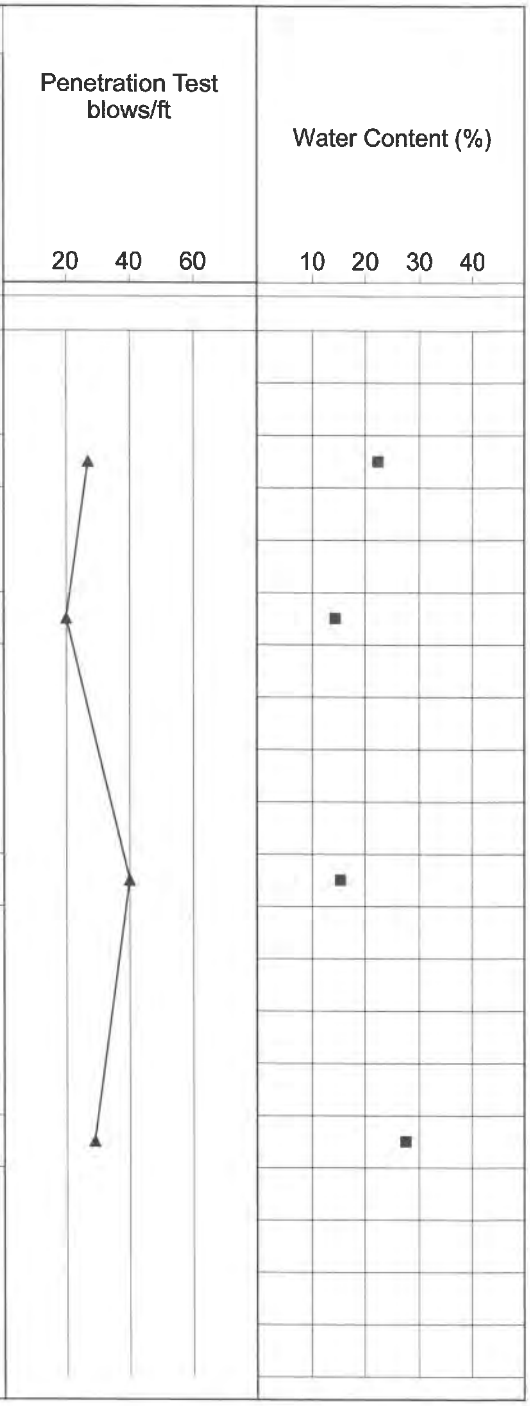
Logged By: R. Alexander

Depth to Water>

Initial: 9 Feet

At Completion: 9 Feet

SUBSURFACE PROFILE			SAMPLE			
Depth (ft)	Symbol	Description	Dry Density (pcf)	Moisture (%)	Type	Blows/ft.
		Ground Surface				
0		***SILTY SAND (SM)*** FILL, fine- to medium-grained; brown, brown, damp, drills easily				
2 4		***SANDY CLAY (CL)*** FILL, fine- to medium-grained; brown, damp, drills easily	107.2	22.4	■	27
6 8		***SANDY CLAY (CL)*** Stiff, fine- to medium-grained; brown, moist, drills easily ▽	117.7	14.5	■	20
10 12		***GRAVELLY CLAYEY SAND (SC)*** Medium dense, fine- to coarse-grained; brown, saturated, drills easily	120.1	15.5	■	40
14 16 18 20		***GRAVELLY SANDY CLAY (CL)*** Very stiff, fine- to medium-grained; gray, saturated, drills firmly	91.7	27.6	■	29



Drill Method: Solid Flight

Drill Date: 4-4-19

Drill Rig: CME 45B

Krazan and Associates

Hole Size: 4½ Inches

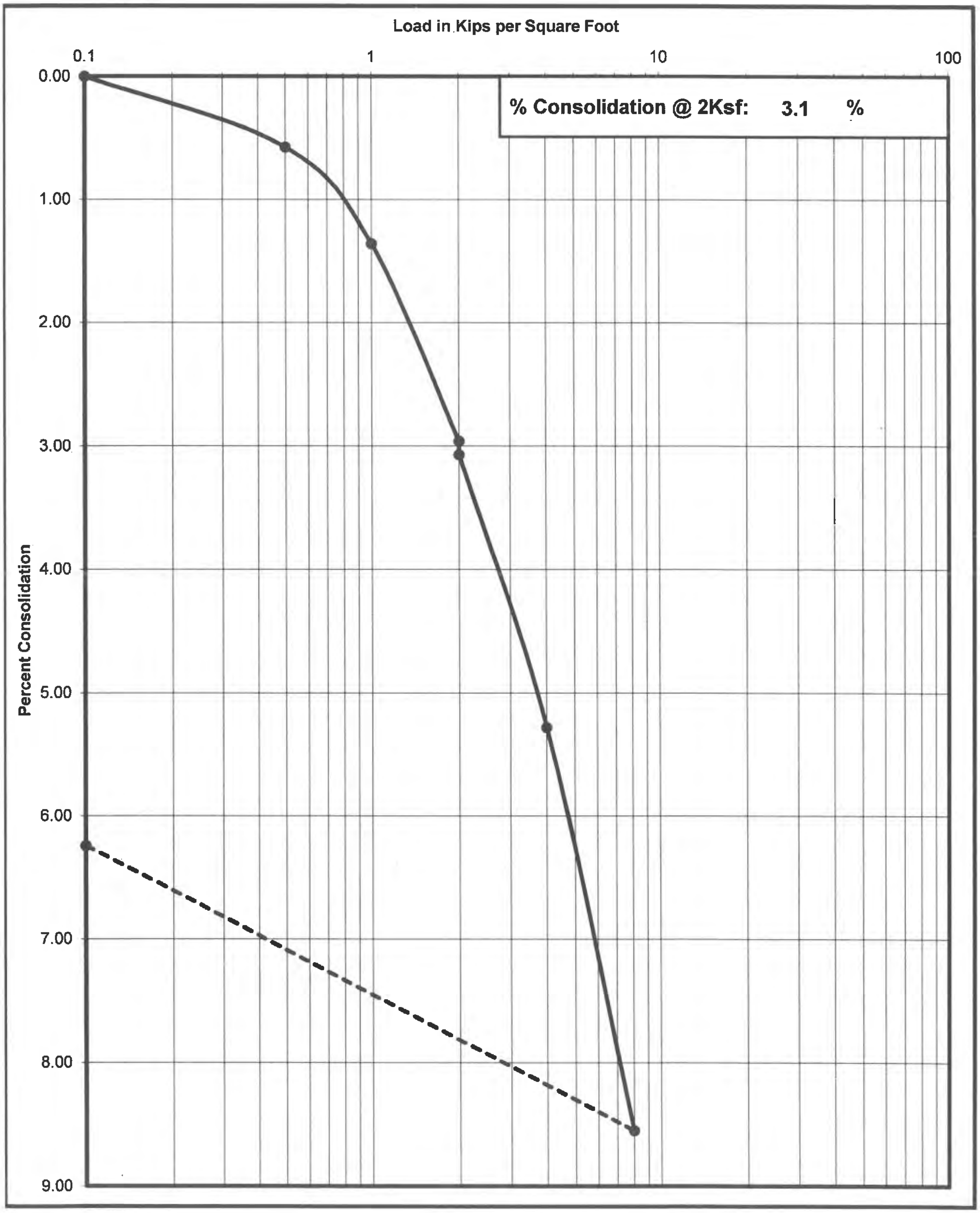
Driller: Brent Snyder

Elevation: 20 Feet

Sheet: 1 of 1

Consolidation Test

Project No	Boring No. & Depth	Date	Soil Classification
042-19004	B1 @ 2-3'	4/5/2019	SC w/ grvl



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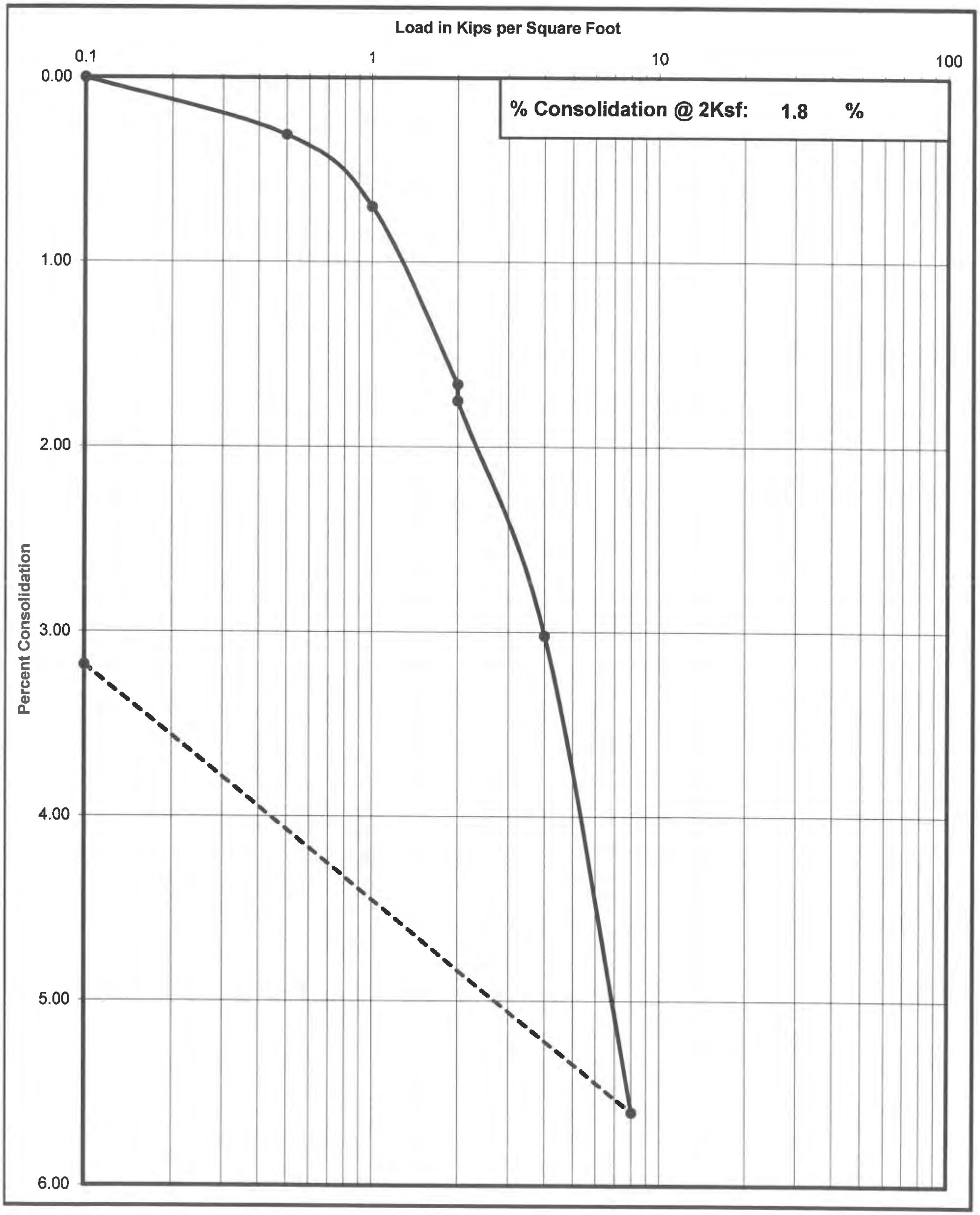
Consolidation Test

Project No	Boring No. & Depth	Date	Soil Classification
042-19004	B5 @ 2-3'	4/12/2019	SC w/ grvl



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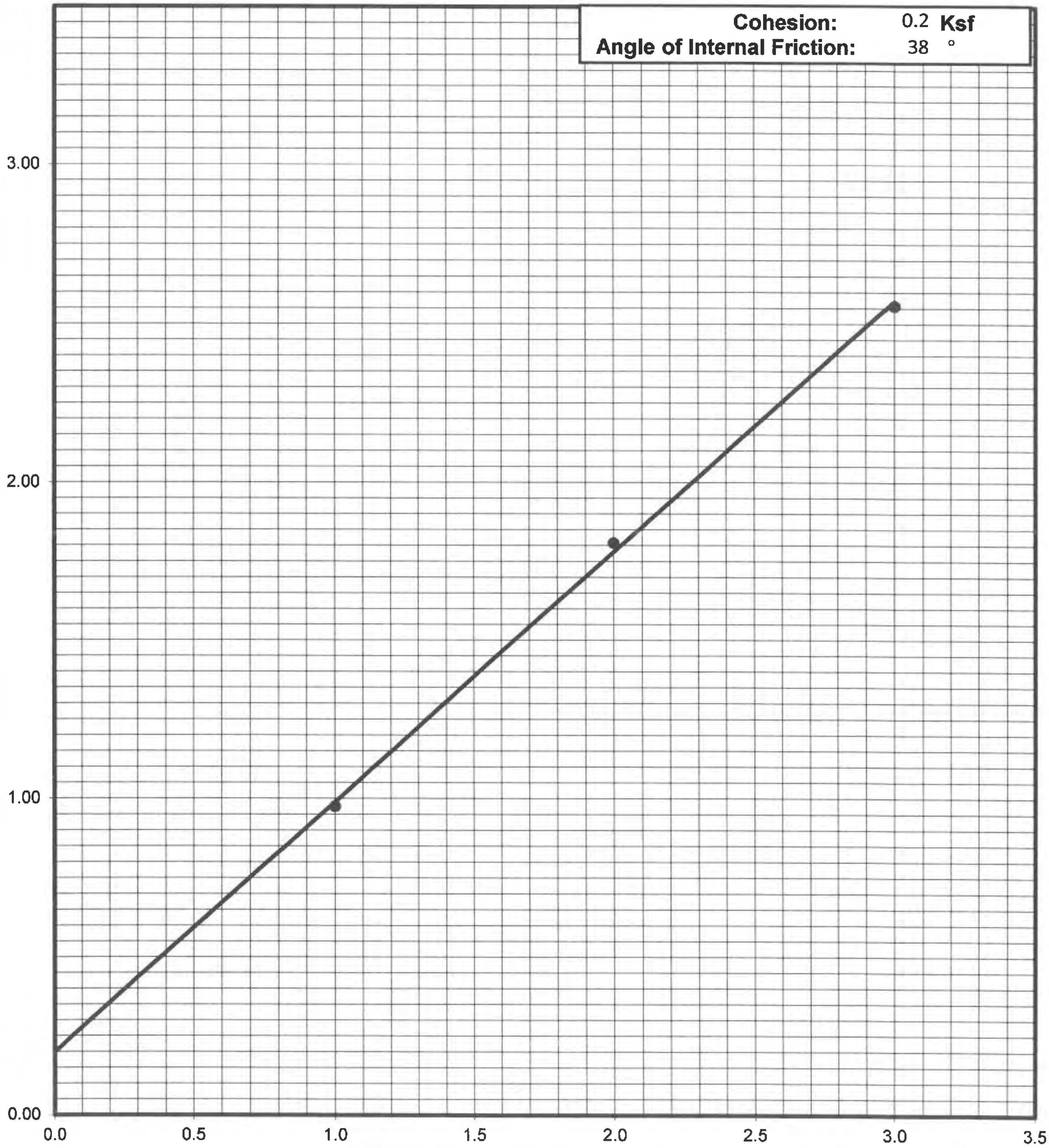
Shear Strength Diagram (Direct Shear)

ASTM D - 3080 / AASHTO T - 236

Project Number	Boring No. & Depth	Soil Type	Date
042-19004	B3 @ 2-3'	SC w/ grvl	4/12/2019



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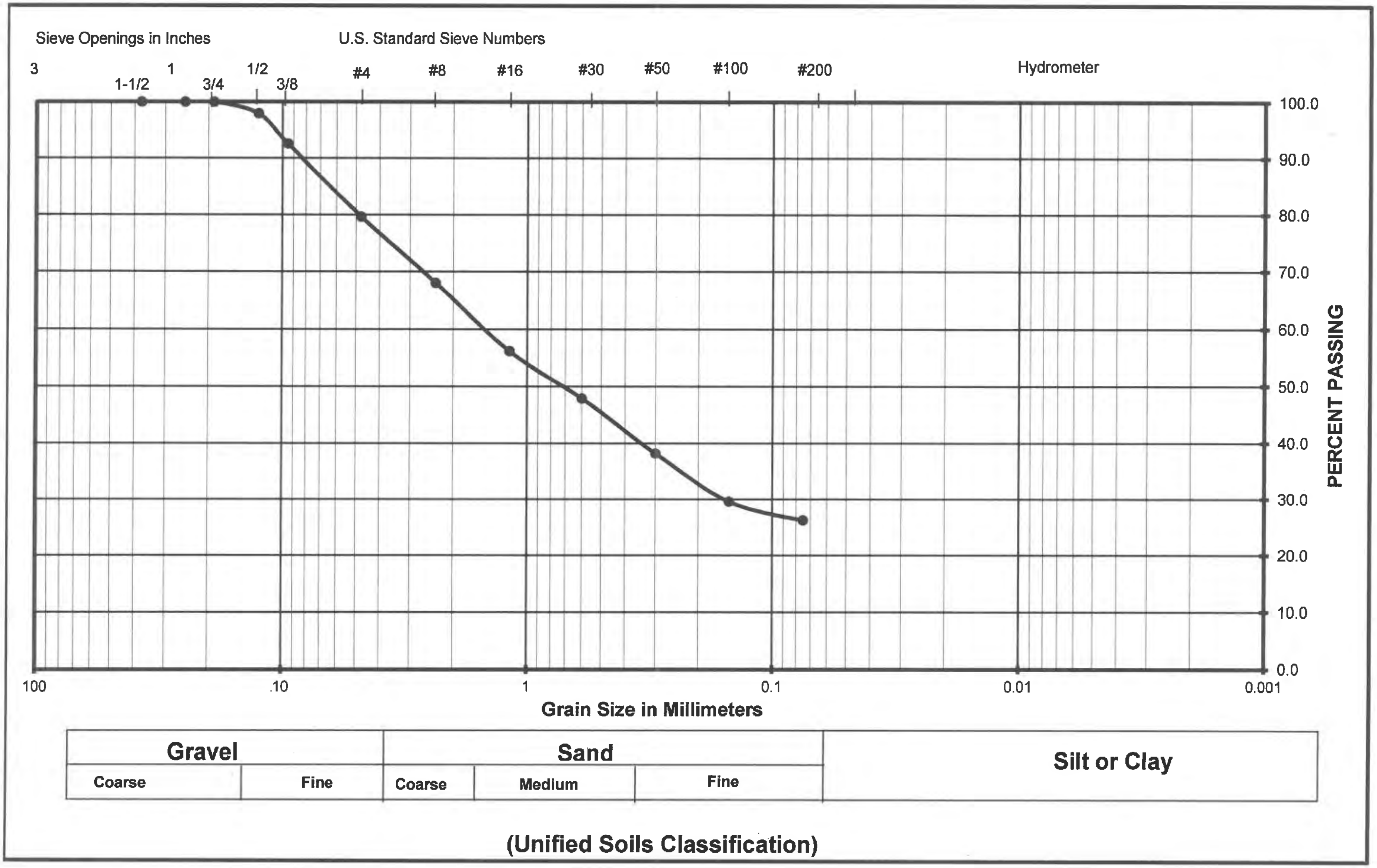
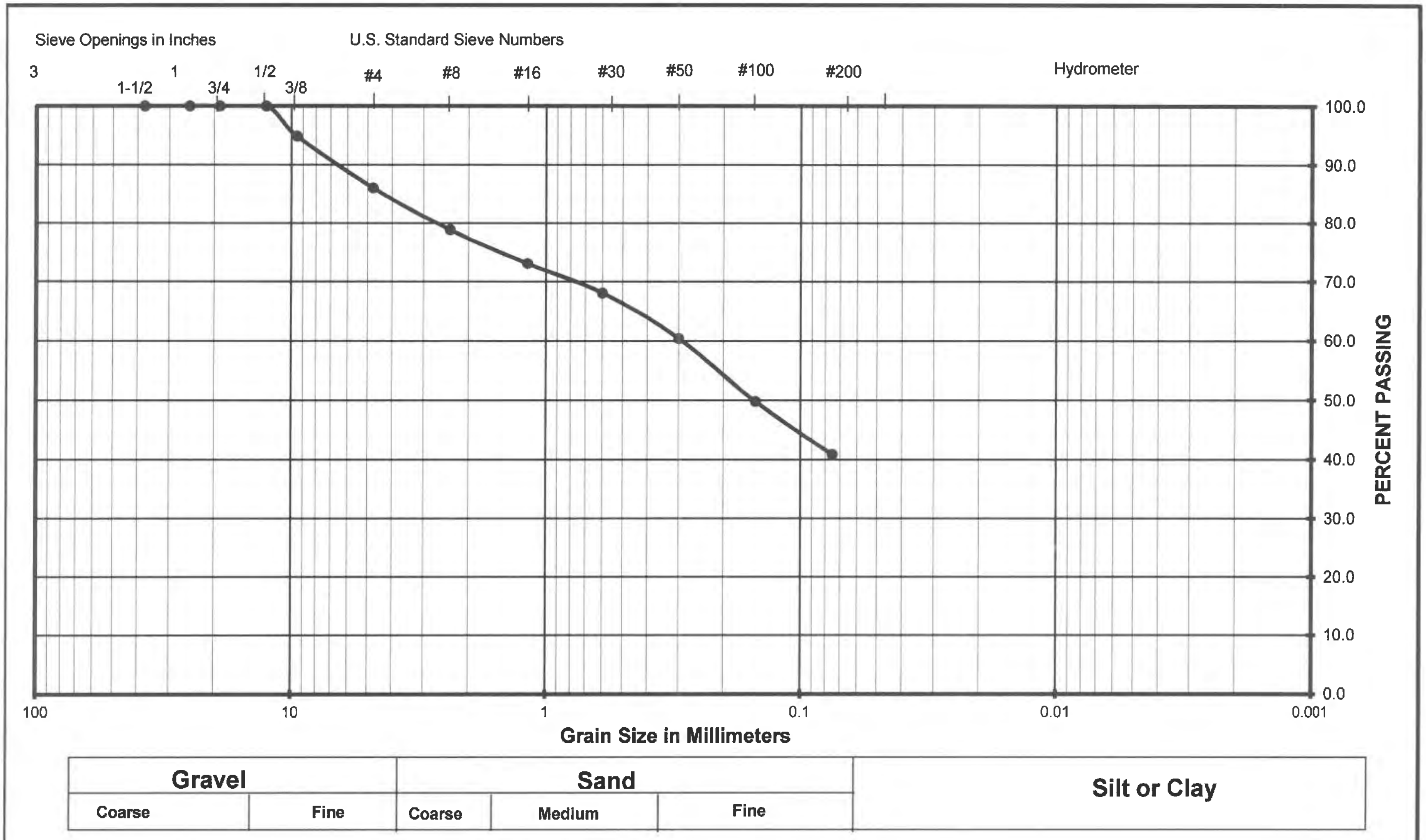
Grain Size Analysis



Project Name	West College Ave Apartments
Project Number	042-19004
Soil Classification	SC w/ grvl
Sample Number	B1 @ 2-3'

Krazan Testing Laboratory

Grain Size Analysis



(Unified Soils Classification)

Project Name	West College Ave Apartments
Project Number	042-19004
Soil Classification	SC w/ grvl
Sample Number	B5 @ 2-3'

Krazan Testing Laboratory

Expansion Index Test

ASTM D - 4829

Project Number	: 042-19004
Project Name	: West College Ave Apartments
Date	: 4/5/2019
Sample location/ Depth	: B1 @ 3-4'
Sample Number	: X1
Soil Classification	: CL

Trial #	**1**	**2**	**3**
Weight of Soil & Mold, gms	768.2		
Weight of Mold, gms	367.4		
Weight of Soil, gms	400.8		
Wet Density, Lbs/cu.ft.	120.9		
Weight of Moisture Sample (Wet), gms	300.0		
Weight of Moisture Sample (Dry), gms	272.5		
Moisture Content, %	10.1		
Dry Density, Lbs/cu.ft.	109.8		
Specific Gravity of Soil	2.7		
Degree of Saturation, %	51.0		

Time	Inital	30 min	1 hr	6hrs	12 hrs	24 hrs
Dial Reading	0	--	--	--	--	0.0543

Expansion Index $_{\text{measured}}$ = 54.3

Expansion Index = 54

Expansion Potential Table	
Exp. Index	Potential Exp.
0 - 20	Very Low
21 - 50	Low
51 - 90	Medium
91 - 130	High
>130	Very High

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Expansion Index Test

ASTM D - 4829

Project Number	: 042-19004
Project Name	: West College Ave Apartments
Date	: 4/5/2019
Sample location/ Depth	: B2 @ 2-5'
Sample Number	: X2
Soil Classification	: CL

Trial #	1	2	3
Weight of Soil & Mold, gms	764.3		
Weight of Mold, gms	367.8		
Weight of Soil, gms	396.5		
Wet Density, Lbs/cu.ft.	119.6		
Weight of Moisture Sample (Wet), gms	300.0		
Weight of Moisture Sample (Dry), gms	272.2		
Moisture Content, %	10.2		
Dry Density, Lbs/cu.ft.	108.5		
Specific Gravity of Soil	2.7		
Degree of Saturation, %	49.9		

Time	Inital	30 min	1 hr	6hrs	12 hrs	24 hrs
Dial Reading	0	--	--	--	--	0.0341

Expansion Index $_{\text{measured}}$ = 34.1

Expansion Index = 34

Expansion Potential Table	
Exp. Index	Potential Exp.
0 - 20	Very Low
21 - 50	Low
51 - 90	Medium
91 - 130	High
>130	Very High

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Expansion Index Test

ASTM D - 4829

Project Number	: 042-19004
Project Name	: West College Ave Apartments
Date	: 4/12/2019
Sample location/ Depth	: B3 @ 2.5-7'
Sample Number	: Bulk-2
Soil Classification	: CL

Trial #	**1**	**2**	**3**
Weight of Soil & Mold, gms	736.9		
Weight of Mold, gms	370.0		
Weight of Soil, gms	366.9		
Wet Density, Lbs/cu.ft.	110.7		
Weight of Moisture Sample (Wet), gms	300.0		
Weight of Moisture Sample (Dry), gms	264.0		
Moisture Content, %	13.6		
Dry Density, Lbs/cu.ft.	97.4		
Specific Gravity of Soil	2.7		
Degree of Saturation, %	50.4		

Time	Inital	30 min	1 hr	6hrs	12 hrs	24 hrs
Dial Reading	0	--	--	--	--	0.0411

Expansion Index $_{\text{measured}}$ = 41.1

Expansion Index = 41

Expansion Potential Table	
Exp. Index	Potential Exp.
0 - 20	Very Low
21 - 50	Low
51 - 90	Medium
91 - 130	High
>130	Very High

Krazan Testing Laboratory

Plasticity Index of Soils

ASTM D4318/AASHTO T89 T90/CT 204

Project: **West College Ave Apartments**
Project Number: **042-19004**
Date Sampled: 4/4/2019
Sampled By: RA
Sample Number:
Sample Location: B2 @ 5-6'
Sample Description: SC

Date Tested: 4/11/2019
Tested By: J Mitchell
Verified By: J Gruszczynski

	Plastic Limit			Liquid Limit		
Trial Number	1	2	3	1	2	3
Weight of Wet Soil & Tare (g)	25.87	25.83		37.58		
Weight of Dry Soil & Tare (g)	24.45	24.37		33.28		
Weight of Tare (g)	14.15	13.24		13.96		
Weight of water (g)	1.42	1.46		4.30		
Weight of Dry Soil (g)	10.30	11.13		19.33		
Water Content (% of dry wt.)	13.8%	13.1%		22.3%		
Number of Blows				25		

Plastic Limit : 13

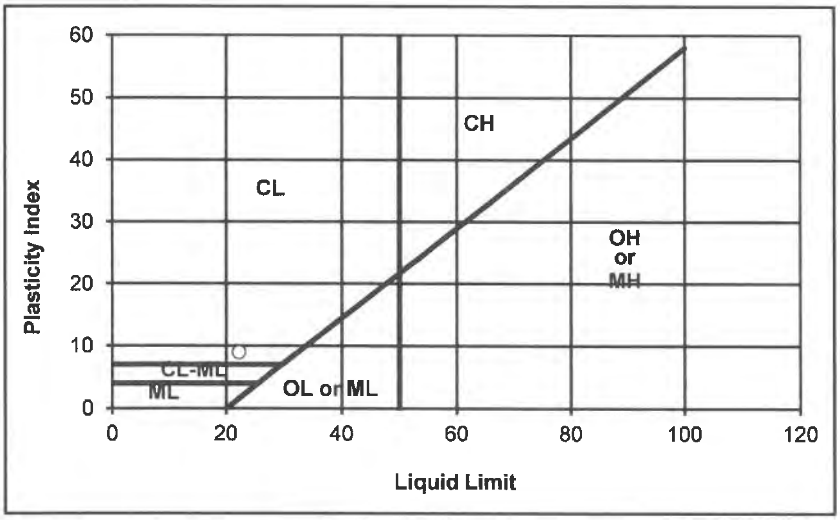
Liquid Limit : 22

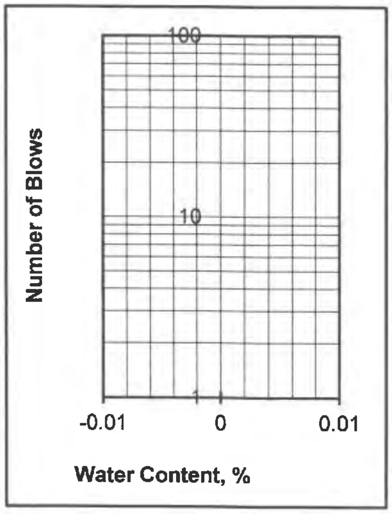
Plasticity Index : 9

Unified Soil Classification : CL

Requirement:

Approx. % of Material Retained on # 40 Sieve:





Departures from Outlined Procedure:

Unusual Conditions, Other Notes:

Plasticity Index of Soils

ASTM D4318/AASHTO T89 T90/CT 204

Project: **West College Ave Apartments**
Project Number: **042-19004**
Date Sampled: 4/4/2019
Sampled By: RA
Sample Number:
Sample Location: B2 @ 15-16'
Sample Description: SC-CL w/ grvl

Date Tested: 4/11/2019
Tested By: J Mitchell
Verified By: J Gruszczynski

	Plastic Limit			Liquid Limit		
Trial Number	1	2	3	1	2	3
Weight of Wet Soil & Tare (g)	22.39	23.91		34.01		
Weight of Dry Soil & Tare (g)	20.79	21.77		27.41		
Weight of Tare (g)	14.21	13.48		13.58		
Weight of water (g)	1.60	2.14		6.60		
Weight of Dry Soil (g)	6.58	8.29		13.83		
Water Content (% of dry wt.)	24.3%	25.8%		47.7%		
Number of Blows				25		

Plastic Limit : 25

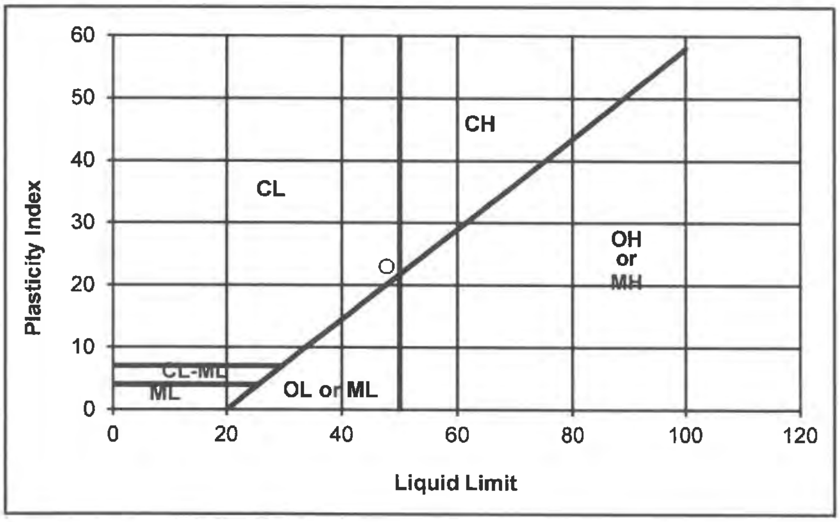
Liquid Limit : 48

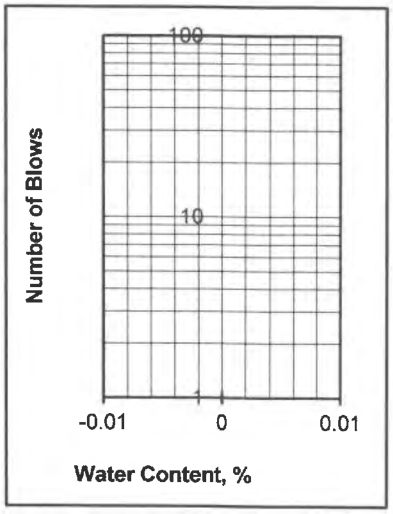
Plasticity Index : 23

Unified Soil Classification : CL

Requirement:

Approx. % of Material Retained on # 40 Sieve:





Departures from Outlined Procedure:

Unusual Conditions, Other Notes:

Plasticity Index of Soils

ASTM D4318/AASHTO T89 T90/CT 204

Project: **West College Ave Apartments**
Project Number: **042-19004**
Date Sampled: 4/4/2019
Sampled By: RA
Sample Number:
Sample Location: B2 @ 30-31'
Sample Description: SC

Date Tested: 4/11/2019
Tested By: J Mitchell
Verified By: J Gruszczynski

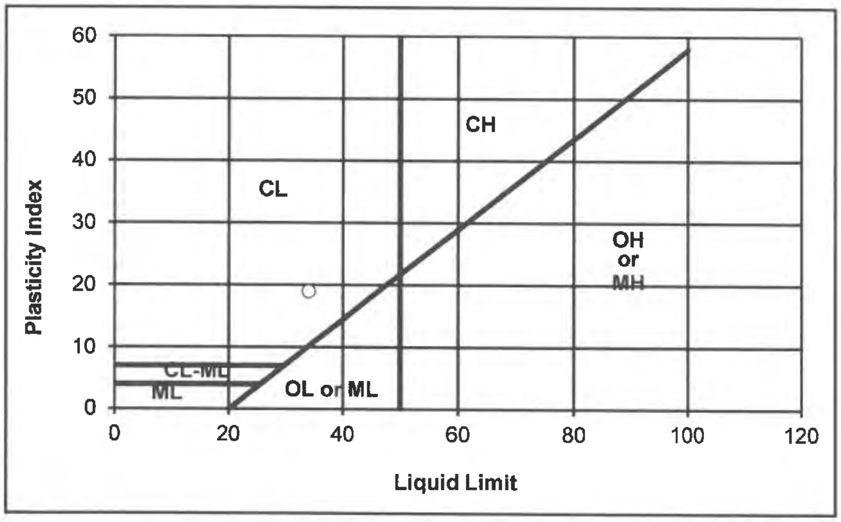
	Plastic Limit			Liquid Limit		
Trial Number	1	2	3	1	2	3
Weight of Wet Soil & Tare (g)	26.56	35.08		35.61		
Weight of Dry Soil & Tare (g)	24.99	32.30		30.02		
Weight of Tare (g)	14.44	14.24		13.62		
Weight of water (g)	1.57	2.78		5.59		
Weight of Dry Soil (g)	10.54	18.06		16.40		
Water Content (% of dry wt.)	14.9%	15.4%		34.1%		
Number of Blows				25		

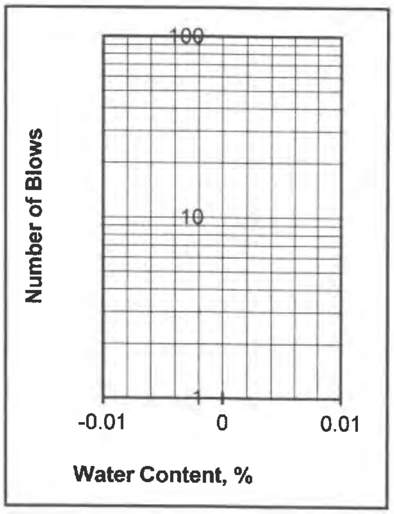
Plastic Limit : 15

Liquid Limit : 34

Plasticity Index : 19
Unified Soil Classification : CL

Requirement:
Approx. % of Material Retained on # 40 Sieve:





Departures from Outlined Procedure:

Unusual Conditions, Other Notes:

Plasticity Index of Soils

ASTM D4318/AASHTO T89 T90/CT 204

Project: **West College Ave Apartments**
Project Number: **042-19004**
Date Sampled: 4/4/2019
Sampled By: RA
Sample Number:
Sample Location: B2 @ 35-36'
Sample Description: SP-SM w/ grvl

Date Tested: 4/11/2019
Tested By: J Mitchell
Verified By: J Gruszczynski

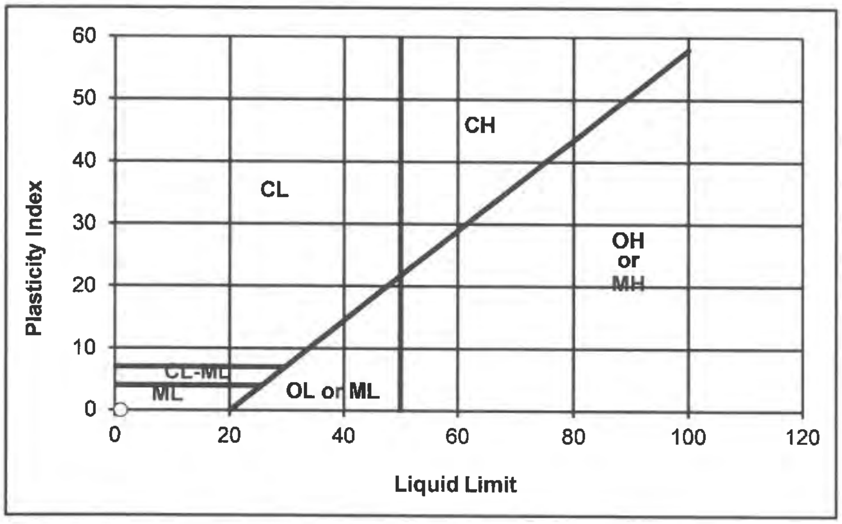
	Plastic Limit			Liquid Limit		
Trial Number	1	2	3	1	2	3
Weight of Wet Soil & Tare (g)						
Weight of Dry Soil & Tare (g)						
Weight of Tare (g)						
Weight of water (g)						
Weight of Dry Soil (g)						
Water Content (% of dry wt.)						
Number of Blows						

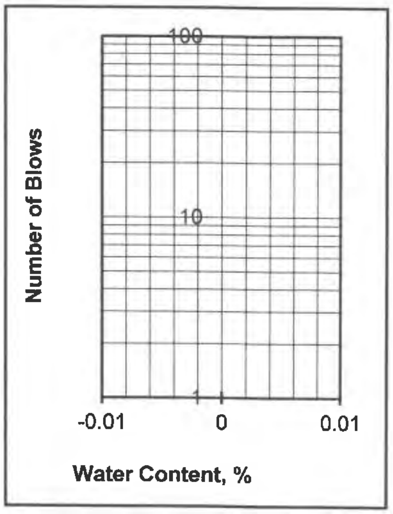
Plastic Limit : N/D

Liquid Limit : N/D

Plasticity Index : NON-PLASTIC
Unified Soil Classification : NON-PLASTIC

Requirement:
Approx. % of Material Retained on # 40 Sieve:





Departures from Outlined Procedure:

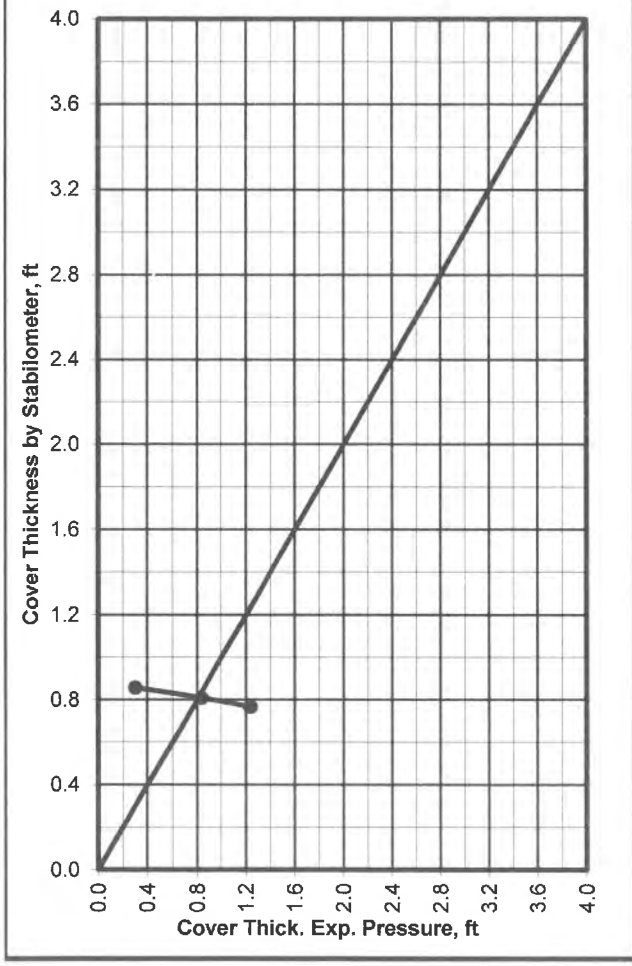
Unusual Conditions, Other Notes:

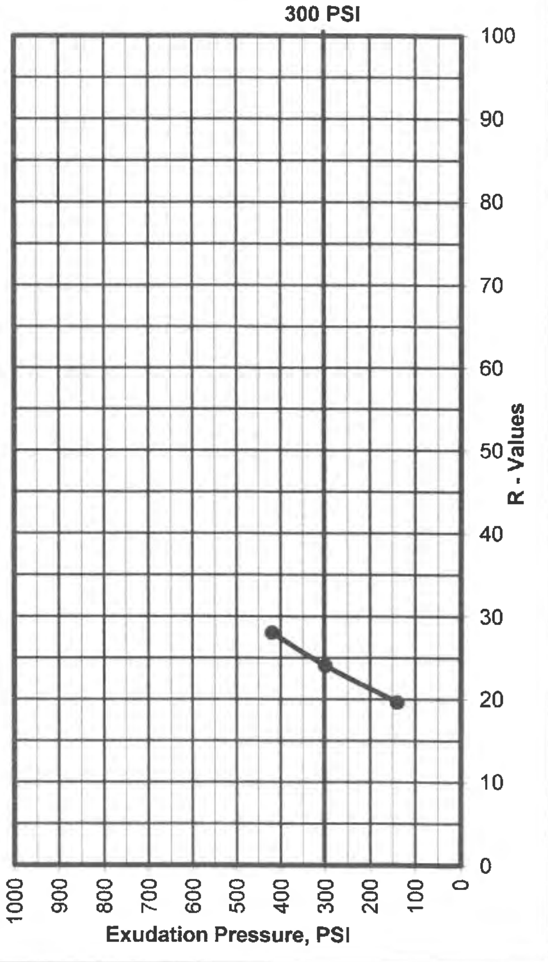
R - VALUE TEST
ASTM D - 2844 / CAL 301

Project Number	:	042-19004
Project Name	:	West College Ave Apartments
Date	:	4/1/2019
Sample Location/Curve Number	:	RV#1
Soil Classification	:	SC

TEST	A	B	C
Percent Moisture @ Compaction, %	10.8	11.4	11.9
Dry Density, lbm/cu.ft.	119.9	120.2	120.7
Exudation Pressure, psi	420	300	140
Expansion Pressure, (Dial Reading)	37	25	9
Expansion Pressure, psf	160	108	39
Resistance Value R	28	24	20

R Value at 300 PSI Exudation Pressure	**24**
R Value by Expansion Pressure (TI =): 5	**25**





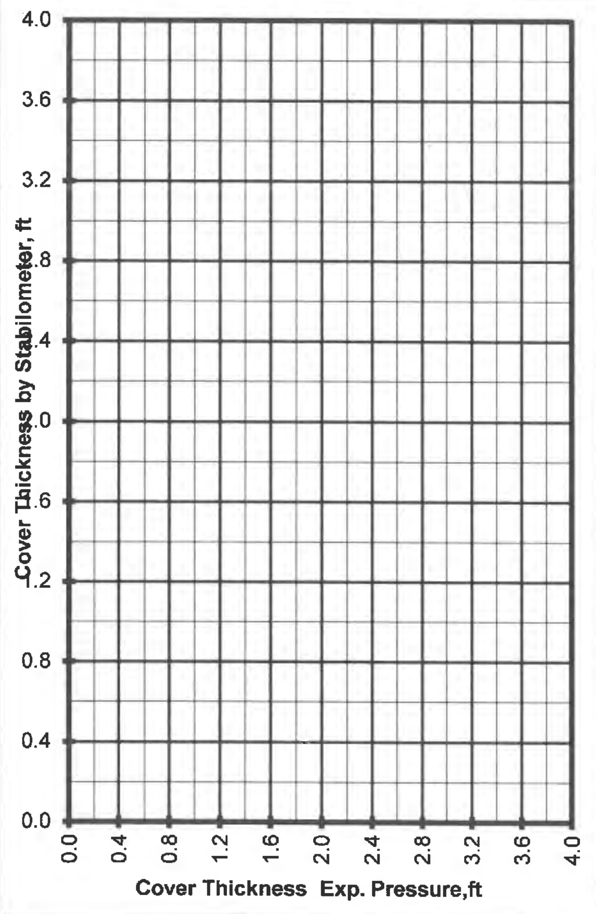
Krazan Testing Laboratory

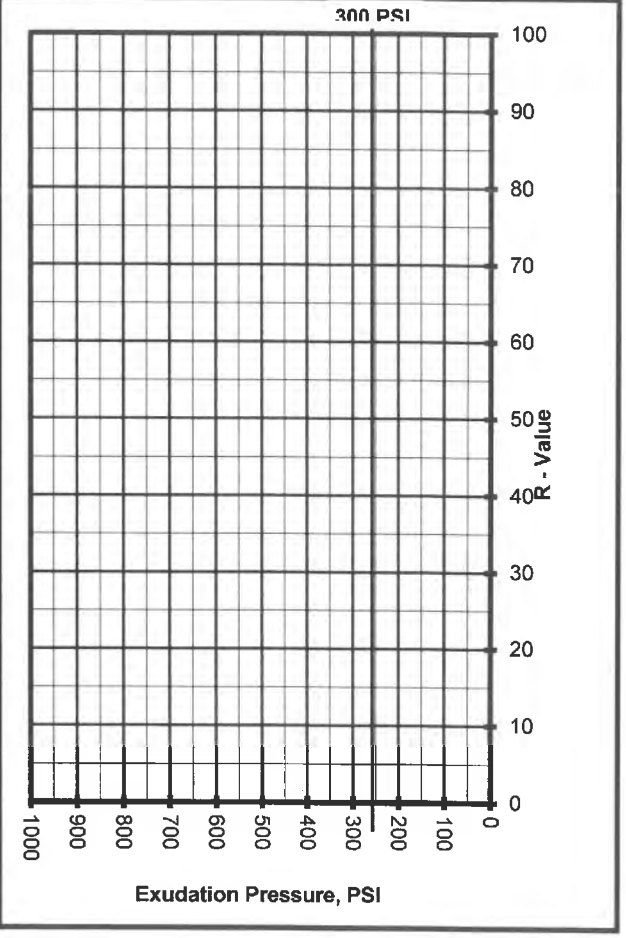
R - VALUE TEST
ASTM D - 2844 / CAL 301

Project Number : 042-19004
Project Name : West College Ave Apartments
Date : 4/1/2019
Sample Location/Curve Number : RV#2
Soil Classification : CL

TEST	A	B	C
Percent Moisture @ Compaction, %			
Dry Density, lbm/cu.ft.	R - Value less than 5 Sample Exuded from bottom of Mold During test		
Exudation Pressure, psi			
Expansion Pressure, (Dial Reading)			
Expansion Pressure, psf			
Resistance Value R			

R - Value at 300 PSI Exudation Pressure	< 5
R - Value by Expansion Pressure	





APPENDIX B

EARTHWORK SPECIFICATIONS

GENERAL

When the text of the report conflicts with the general specifications in this appendix, the recommendations in the report have precedence.

SCOPE OF WORK: These specifications and applicable plans pertain to and include all earthwork associated with the site rough grading, including but not limited to the furnishing of all labor, tools, and equipment necessary for site clearing and grubbing, stripping, preparation of foundation materials for receiving fill, excavation, processing, placement and compaction of fill and backfill materials to the lines and grades shown on the project grading plans, and disposal of excess materials.

PERFORMANCE: The Contractor shall be responsible for the satisfactory completion of all earthwork in accordance with the project plans and specifications. This work shall be inspected and tested by a representative of Krazan and Associates, Inc., hereinafter known as the Soils Engineer and/or Testing Agency. Attainment of design grades when achieved shall be certified by the project Civil Engineer. Both the Soils Engineer and the Civil Engineer are the Owner's representatives. If the Contractor should fail to meet the technical or design requirements embodied in this document and on the applicable plans, he shall make the necessary readjustments until all work is deemed satisfactory as determined by both the Soils Engineer and the Civil Engineer. No deviation from these specifications shall be made except upon written approval of the Soils Engineer, Civil Engineer or project Architect.

No earthwork shall be performed without the physical presence or approval of the Soils Engineer. The Contractor shall notify the Soils Engineer at least 2 working days prior to the commencement of any aspect of the site earthwork.

The Contractor agrees that he shall assume sole and complete responsibility for job site conditions during the course of construction of this project, including safety of all persons and property; that this requirement shall apply continuously and not be limited to normal working hours; and that the Contractor shall defend, indemnify and hold the Owner and the Engineers harmless from any and all liability, real or alleged, in connection with the performance of work on this project, except for liability arising from the sole negligence of the Owner or the Engineers.

TECHNICAL REQUIREMENTS: All compacted materials shall be densified to a density not less than 90 percent relative compaction based on ASTM Test Method D1557 or CAL-216, as specified in the technical portion of the Soil Engineer's report. The location and frequency of field density tests shall be as determined by the Soils Engineer. The results of these tests and compliance with these specifications shall be the basis upon which satisfactory completion of work will be judged by the Soils Engineer.

SOILS AND FOUNDATION CONDITIONS: The Contractor is presumed to have visited the site and to have familiarized himself with existing site conditions and the contents of the data presented in the soil report.

The Contractor shall make his own interpretation of the data contained in said report, and the Contractor shall not be relieved of liability under the Contract documents for any loss sustained as a result of any variance between conditions indicated by or deduced from said report and the actual conditions encountered during the progress of the work.

DUST CONTROL: The work includes dust control as required for the alleviation or prevention of any dust nuisance on or about the site or the borrow area, or off-site if caused by the Contractor's operation either during the performance of the earthwork or resulting from the conditions in which the Contractor leaves the site. The Contractor shall assume all liability, including court costs of codefendants, for all claims related to dust or windblown materials attributable to his work.

SITE PREPARATION

Site preparation shall consist of site clearing and grubbing and the preparations of foundation materials for receiving fill.

CLEARING AND GRUBBING: The Contractor shall accept the site in this present condition and shall demolish and/or remove from the area of designated project earthwork all structures, both surface and subsurface, trees, brush, roots, debris, organic matter, and all other matter determined by the Soils Engineer to be deleterious or otherwise unsuitable. Such materials shall become the property of the Contractor and shall be removed from the site.

Tree root systems in proposed building areas should be removed to a minimum depth of 3 feet and to such an extent which would permit removal of all roots larger than 1 inch. Tree roots removed in parking areas may be limited to the upper 1½ feet of the ground surface. Backfill of tree root excavations should not be permitted until all exposed surfaces have been inspected and the Soils Engineer is present for the proper control of backfill placement and compaction. Burning in areas which are to receive fill materials shall not be permitted.

SUBGRADE PREPARATION: Surfaces to receive Engineered Fill, building or slab loads shall be prepared as outlined above, excavated/scarified to a depth of 12 inches, moisture-conditioned as necessary, and compacted to 90 percent relative compaction.

Loose soil areas, areas of uncertified fill, and/or areas of disturbed soils shall be moisture-conditioned as necessary and recompacted to 90 percent relative compaction. All ruts, hummocks, or other uneven surface features shall be removed by surface grading prior to placement of any fill materials. All areas which are to receive fill materials shall be approved by the Soils Engineer prior to the placement of any of the fill material.

EXCAVATION: All excavation shall be accomplished to the tolerance normally defined by the Civil Engineer as shown on the project grading plans. All over-excavation below the grades specified shall be backfilled at the Contractor's expense and shall be compacted in accordance with the applicable technical requirements.

FILL AND BACKFILL MATERIAL: No material shall be moved or compacted without the presence of the Soils Engineer. Material from the required site excavation may be utilized for construction site fills provided prior approval is given by the Soils Engineer. All materials utilized for constructing site fills shall be free from vegetation or other deleterious matter as determined by the Soils Engineer.

PLACEMENT, SPREADING AND COMPACTION: The placement and spreading of approved fill materials and the processing and compaction of approved fill and native materials shall be the responsibility of the Contractor. However, compaction of fill materials by flooding, ponding, or jetting shall not be permitted unless specifically approved by local code, as well as the Soils Engineer.

Both cut and fill areas shall be surface-compacted to the satisfaction of the Soils Engineer prior to final acceptance.

SEASONAL LIMITS: No fill material shall be placed, spread, or rolled while it is frozen or thawing or during unfavorable wet weather conditions. When the work is interrupted by heavy rains, fill operations shall not be resumed until the Soils Engineer indicates that the moisture content and density of previously placed fill are as specified.

APPENDIX C

PAVEMENT SPECIFICATIONS

1. **DEFINITIONS** - The term "pavement" shall include asphaltic concrete surfacing, untreated aggregate base, and aggregate subbase. The term "subgrade" is that portion of the area on which surfacing, base, or subbase is to be placed.

The term "Standard Specifications": hereinafter referred to is the 2018 Standard Specifications of the State of California, Department of Transportation, and the "Materials Manual" is the Materials Manual of Testing and Control Procedures, State of California, Department of Public Works, Division of Highways. The term "relative compaction" refers to the field density expressed as a percentage of the maximum laboratory density as defined in the applicable tests outlined in the Materials Manual.

2. **SCOPE OF WORK** - This portion of the work shall include all labor, materials, tools, and equipment necessary for, and reasonably incidental to the completion of the pavement shown on the plans and as herein specified, except work specifically noted as "Work Not Included."

3. **PREPARATION OF THE SUBGRADE** - The Contractor shall prepare the surface of the various subgrades receiving subsequent pavement courses to the lines, grades, and dimensions given on the plans. The upper 12 inches of the soil subgrade beneath the pavement section shall be compacted to a minimum relative compaction of 90 percent. The finished subgrades shall be tested and approved by the Soils Engineer prior to the placement of additional pavement courses.

4. **UNTREATED AGGREGATE BASE** - The aggregate base material shall be spread and compacted on the prepared subgrade in conformity with the lines, grades, and dimensions shown on the plans. The aggregate base material shall conform to the requirements of Section 26 of the Standard Specifications for Class 2 material, 1½ inches maximum size. The aggregate base material shall be spread and compacted in accordance with Section 26 of the Standard Specifications. The aggregate base material shall be spread in layers not exceeding 6 inches and each layer of aggregate material course shall be tested and approved by the Soils Engineer prior to the placement of successive layers. The aggregate base material shall be compacted to a minimum relative compaction of 95 percent.

5. **AGGREGATE SUBBASE** - The aggregate subbase shall be spread and compacted on the prepared subgrade in conformity with the lines, grades, and dimensions shown on the plans. The aggregate subbase material shall conform to the requirements of Section 25 of the Standard Specifications for Class 2 material. The aggregate subbase material shall be compacted to a minimum relative compaction of 95 percent, and it shall be spread and compacted in accordance with Section 25 of the Standard Specifications. Each layer of aggregate subbase shall be tested and approved by the Soils Engineer prior to the placement of successive layers.

6. ASPHALTIC CONCRETE SURFACING - Asphaltic concrete surfacing shall consist of a mixture of mineral aggregate and paving grade asphalt, mixed at a central mixing plant and spread and compacted on a prepared base in conformity with the lines, grades and dimensions shown on the plans. The viscosity grade of the asphalt shall be PG 64-10. The mineral aggregate shall be Type B, ½ inch maximum size, medium grading and shall conform to the requirements set forth in Section 39. The drying, proportioning and mixing of the materials shall conform to Section 39.

The prime coat, spreading and compacting equipment and spreading and compacting mixture shall conform to the applicable chapters of Section 39, with the exception that no surface course shall be placed when the atmospheric temperature is below 50° F. The surfacing shall be rolled with a combination of steel wheel and pneumatic rollers, as described in Section 39-6. The surface course shall be placed with an approved self-propelled mechanical spreading and finishing machine.

7. FOG SEAL COAT - The fog seal (mixing type asphaltic emulsion) shall conform to and be applied in accordance with the requirements of Section 37.