Appendix E:
Geology and Soils Supporting Information

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E.1 - Geotechnical Report

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GEOTECHNICAL ENGINEERING INVESTIGATION
PROPOSED CLOVERDALE APARTMENTS
SANDHOLM LANE AND FOOTHILL BOULEVARD
CLOVERDALE, CALIFORNIA

KA PROJECT NO. 032-17032
DECEMBER 5, 2017

Prepared for:

MR. JUSTIN HARDT
INTEGRATED COMMUNITY DEVELOPMENT
21031 VENTURA BOULEVARD, SUITE 200
WOODLAND HILLS, CALIFORNIA 91364

Prepared by:

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Krazan & ASSOCIATES, INC.
GEOTECHNICAL ENGINEERING • ENVIRONMENTAL ENGINEERING
CONSTRUCTION TESTING & INSPECTION

December 5, 2017

KA Project No. 032-17032

Mr. Justin Hardt
Integrated Community Development
21031 Ventura Boulevard, Suite 200
Woodland Hills, California 91364

RE: Geotechnical Engineering Investigation
Proposed Cloverdale Apartments
Sandholm Lane and Foothill Boulevard
Cloverdale, California

Dear Mr. Hardt:

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 (916) 564-2200.

REGISTERED PROFESSIONAL ENGINEER DAVID R. JAROSZ No. 2698 EXP JUNE 30 2018 GEOTECHNICAL STATE OF CALIFORNIA

Respectfully submitted,
KRAZAN & ASSOCIATES, INC.

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

DRJ:ht

TABLE OF CONTENTS

December 5, 2017 KA Project No. 032-17032

GEOTECHNICAL ENGINEERING INVESTIGATION
PROPOSED CLOVERDALE APARTMENTS
SANDHOLM LANE AND FOOTHILL BOULEVARD
CLOVERDALE, CALIFORNIA

INTRODUCTION

This report presents the results of our Geotechnical Engineering Investigation for the proposed Cloverdale Apartments to be located on the south side of Sandholm Lane at Foothill Boulevard in Cloverdale, 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 September 27, 2017 (KA Proposal No. P602-17) 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 18 borings to depths ranging from approximately 10 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 development will consist of a multi-family development. It is anticipated the buildings will be single- or two-story wood-framed structures utilizing either conventional foundations and concrete slab-on-grade construction or post-tensioned slab foundations. Foundation 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, SITE HISTORY AND SITE DESCRIPTION

The site is irregular in shape and encompasses approximately 28.5 acres. The site is located on the south side of Sandholm Lane at Foothill Boulevard in Cloverdale, California. The site has a street address of 28195 Highway 101. The site is identified by Assessor Parcel Nos. 117-040-053 and 084. The site is identified on the U.S. Geological Survey 7.5 minute Cloverdale, California topographic quadrangle map, dated 1960, photo revised 1975 as the northern half of Section 30 and the southeastern half of Section 19, Township 11 North, Range 10 West, Mount Diablo Baseline and Meridian. Commercial developments are located to the north, south and east of the site. Single-family residences are also located to the north. A rural residence and forest land are located to the west.

Site history was obtained by reviewing historical aerial photographs dated 1953, 1966, 1974, 1983, 1993, 2004, 2010 and 2014. Review of the 1953 aerial photograph indicates the far eastern portion of the subject site appears to be occupied by an unpaved road and the southeastern corner of the subject site appears to be occupied by a structure consistent in approximate size and location with the storage barn observed in this portion of the subject site during Krazan's site reconnaissance. The eastern and central portions of the subject site appear to be utilized for agricultural purposes and/or pasture. The western portion of the subject site appears to be undeveloped forested land.

Review of the 1966 aerial photograph indicates the conditions on the subject site appear relatively similar to those noted in the 1953 aerial photograph, except structures are visible in the western portion of the subject site which are consistent in approximate size and location with the single-family dwelling and tractor storage shed/barn observed during Krazan's site reconnaissance.

Review of the 1974, 1983 and 1993 aerial photographs indicated the conditions on the subject site are similar to those observed in the 1966 aerial photograph.

Review of the 2004 aerial photograph indicates the conditions on the subject site are similar to those observed in the 1993 aerial photograph, except a structure had been constructed in the central portion of the site.

Review of the 2010 and 2014 aerial photographs indicate the conditions on the subject site are similar to those noted in the 2004 aerial photograph.

Presently, the site includes a single-family residence and a barn in the western portion of the site. In addition, a shed is located in the southeast corner of the site. The remainder of the site is predominately vacant. Trees and bushes are located in the western and eastern portions of the site. The site is covered by a moderate weed growth and the surface soils have a loose consistency. A creek is located along the western site boundary. The site is located on gently to moderately sloping ground.

FIELD AND LABORATORY INVESTIGATIONS

Subsurface soil conditions were explored by drilling 18 borings to depths ranging from approximately 10 to 50 feet below existing site grade, using a truck-mounted drill rig. Furthermore, two percolation tests were conducted at depths of 3 and 15 feet below existing site grade. In addition, 4 bulk subgrade samples were obtained from the site for laboratory R-value testing. The approximate boring, percolation 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, consolidation potential, expansion potential, plasticity, 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. In general, the upper soils consisted of approximately 6 to 12 inches of very loose silty clay or sandy clay. These soils are disturbed, have low strength characteristics, and are highly compressible when saturated.

Beneath the loose surface soils, approximately 3 to 7 feet of firm to hard silty clay, sandy clay and clayey sand/sandy clay or medium dense clayey sand and clayey sand with gravel were encountered. Field and laboratory tests suggest that these soils are moderately strong and slightly compressible. Penetration resistance ranged from 9 to 44 blows per foot. Dry densities ranged from 78 to 135 pcf.

Representative soil samples consolidated approximately 1 to 1½ percent under a 2 ksf load when saturated. Representative soil samples had angles of internal friction of 11 to 20 degrees. Representative samples of the clayey soil had expansion indices of 31 and 146.

Below approximately 3½ to 8 feet, predominately stiff to very stiff silty clay, sandy clay and sandy clay with gravel or medium dense to very dense clayey sand, clayey sand with gravel or weathered rock were encountered. Field and laboratory tests suggest that these soils are moderately strong and slightly compressible. Penetration resistance ranged from 12 blows per foot to over 50 blows per 6 inches. Dry densities ranged from 94 to 119 pcf. 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.

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 approximately 6 to 24 feet during our subsurface investigation. However, a historic high groundwater elevation of 3 feet was determined based on 3 wells located within the vicinity of the site.

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.

PERCOLATION TESTING

Two percolation tests were performed within the site to evaluate the soils absorption characteristics. The percolation tests were performed inside test holes drilled near the boring. The percolation tests were performed at depths of 3 and 15 feet below the existing ground surface. The tests were conducted in general accordance with the criteria set in the "Manual of Septic Tank Practice" published by the Department of Health, Education, and Welfare. Results of the tests are as follows:

Boring No.	Test No.	Depth (feet)	Percolation Rate (min/in)	Soil Type
B3	1	3	Nil	Sandy Clay (CL)
B4	2	15	180	Sandy Clay (CL)

The test results indicate that the soils tested below 3 to 15 feet have poor absorption characteristics. The test results do not include a factor of safety. The percolation rates given are based on 1 inch of fall within an 8-inch diameter hole with a 6-inch head of water.

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 soils encountered within a depth of 50 feet on the project site predominately consist of firm to very stiff silty clays and sandy clays or medium dense to very dense clayey sands and weathered rock. Groundwater was encountered beneath the site at depths of 6 to 24 feet during subsurface exploration. Available groundwater data, as well as our experience in the area, indicates that groundwater depth has been as shallow as 3 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 7.47 was used. A peak horizontal ground surface acceleration of 0.62g was considered conservative and appropriate for the liquefaction analysis (USGS Design Maps). A groundwater depth of 3 feet was used for the analysis. The computer analysis indicates that soils above a depth of 3 feet are non-liquefiable due to the absence of groundwater. The soils within the site are considered to be non-liquefiable with factors of safety ranging from 2.9 to 5.0. The analysis also indicates that the total and differential seismic induced settlement is not anticipated to exceed ½ inch and ¼ inch, respectively. Accordingly, the liquefaction potential at the site is considered very low and measures to mitigate the potential seismic settlement should be considered in the project design.

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 moderately compressible upper native soils, moderate to high shrink/swell potential of the clayey soils, and existing development, appeared to be conducive to the development of the project. Fill material was not encountered within our borings. However, fill material may be present between the borings performed. Based on the existing soil conditions, it is anticipated the fill material will consist of sandy clays and clayey sands. The thickness and extent of fill material was determined based on limited test borings and visual observation. It is recommended any uncertified fill soils encountered be excavated and stockpiled so that the native soils can be prepared properly. These soils will be suitable for reuse as General Engineered Fill provided they are cleansed of excessive organics and debris. Prior to fill placement, Krazan & Associates, Inc. should inspect the bottom of the excavation to verify no additional removal will be required.

It is recommended that following stripping, fill removal operations, and demolition activities, the upper 12 inches of native soils within the proposed structural areas be excavated, 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 exposed subgrade soils should be proofrolled and observed by Krazan & Associates, Inc. to verify stability.

It is recommended the upper 36 inches of soil within the area of conventional slabs-on-grade and exterior flatwork consist 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 clayey soils below, which may result in swelling. The replacement soil and/or the upper 36 inches of Imported Fill soils should meet the specifications as described under the subheading Engineered Fill. The replacement soils should extend 5 feet beyond footing lines. The non-expansive replacement soil should be compacted to at least 90 percent 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 continuously 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 36 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.

In lieu of supporting slabs-on-grade with non-expansive or lime-treated soils, the structures can be supported on post-tensioned slabs designed to withstand the uplift forces associated with the on-site clayey soils. Recommendations for post-tensioned slabs are provided in the foundations section of this report.

The site is predominately vacant. However, structures including a residence, barn and shed are located within the project site. Associated with these developments are buried structures, such as utility lines, water wells and septic systems that may extend into the project site. Demolition activities should include removal of any buried structures encountered during construction. Any surface or buried structures encountered during construction should be properly removed and/or relocated. It is suspected that demolition activities of the existing structures will disturb the upper soils. Areas disturbed by demolition activities should be excavated to firm native ground. 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.

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

A creek is located within the northeast portion of the site. If not utilized for the proposed development, the creek should be cleaned of all deleterious material, excavated to firm native ground and backfilled with Engineered Fill.

The site is located on sloping ground. It is recommended that cut and fill slopes be constructed 2:1 (horizontal to vertical) or flatter. In lieu of these slopes, retaining walls may be used. Cut and fill slopes may be revised as recommended by the Soils Engineer upon review of a more definitive site plan.

After completion of the recommended site preparation the site should be suitable for shallow footing support. The proposed structure footings may be designed utilizing conventional foundations with an allowable bearing pressure of 2,500 psf for dead-plus-live loads. Conventional footings, if utilized, should have a minimum embedment of 18 inches.

Groundwater Influence on Structures/Construction

During our recent field investigation groundwater was encountered at approximately 6 to 24 feet below existing site grade. 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 a standpipe piezometer 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.

One aspect in the preparation of this property for construction is the determination of areas of possible seasonal springs and the placement of subsurface drainage systems to intercept groundwater away from the planned area of construction. It is recommended that the site be observed by a member of our engineering staff following completion of the site clearing and stripping to evaluate the need for sub-drainage systems. Evaluation should also be performed following completion of rough site grading. This is particularly important for use in evaluating the need for subdrains for pavements. This office should be contacted regarding any future seepage on the property so appropriate mitigation measures can be recommended.

Site Preparation

General site clearing should include removal of vegetation; asphaltic concrete; 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.

Fill material was not encountered within our borings. However, fill material may be present between the borings performed. Based on the existing soil conditions, it is anticipated the fill material will consist of sandy clays and clayey sands. The thickness and extent of fill material was determined based on limited test borings and visual observation. It is recommended any uncertified fill soils encountered during construction be excavated and stockpiled so that the native soils can be prepared properly. These soils will be suitable for reuse as General Engineered Fill provided they are cleansed of excessive organics and debris. 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 predominately vacant. However, structures are located within the project site. Associated with these developments are buried structures, such as utility lines, water wells and septic systems that may extend into the project site. Any surface or buried structures encountered during construction should be properly removed and/or relocated. It is suspected that demolition activities of the existing structures will disturb the upper soils. Areas disturbed by demolition activities should be excavated to firm native ground. The resulting excavations should be backfilled with Engineered Fill. Water wells should be abandoned in accordance with county standards. 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.

Following stripping and fill removal operations, the exposed subgrade in building pad, exterior flatwork and pavement areas should be excavated to a minimum depth of 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. Limits of recompaction should extend 5 feet beyond building limits and 2 feet beyond pavement areas. This compaction effort should stabilize the surface soils and located any unsuitable or pliant areas not found during our field investigation.

It is recommended that the upper 36 inches of soil within the area of conventional slabs-on-grade and exterior flatwork consist of non-expansive Engineered Fill. The intent is to support the slab and exterior flatwork areas with 36 inches of non-expansive or lime-treated fill. The fill placement serves 2 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 structure 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.

A creek is located within the northeast portion of the site. If not utilized for the proposed development, the creek should be cleaned of all deleterious material, excavated to firm native ground and backfilled with Engineered Fill.

The site is located on sloping ground. It is recommended that cut and fill slopes be constructed 2:1 (horizontal to vertical) or flatter. In lieu of these slopes, retaining walls may be used. Cut and fill slopes may be revised as recommended by the Soils Engineer upon review of a more definitive site plan.

Site grading near slopes and the embankments, including retaining walls and wing walls, should be accomplished such that excessive sheet run-off is prevented. The completed slopes should be seeded or otherwise vegetated to protect against erosion. Well-vegetated slopes, at the recommended configuration, should be reasonably protected from typical erosional effects. However, vegetated slopes may not be protected from unusual slope conditions, such as a flood event. If erosion control from unusual flow conditions is desired, more substantial erosion protection measures, such as grouted cobble slope facing or manufactured slope protection products, should be considered.

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.

Slope Construction/Reconstruction

Slopes can be reconstructed by placement of Engineered Fill utilizing a keying and benching procedure as described below. Reconstructed slopes should be constructed at an inclination not exceeding 2:1 (horizontal to vertical). Krazan and Associates, Inc. should be retained to review all slope reconstruction plans and specifications prior to initiating the repair work.

General site clearing should include removal of vegetation, any loose and/or saturated materials. Excavations or depressions extending below subgrade levels should be cleaned to firm, undisturbed soil and backfilled with Engineered Fill, placed and recompacted in accordance with the recommendations stated herein.

Where fills greater than 8 feet are to be constructed on original ground that slopes at inclinations steeper than 6:1 (horizontal to vertical), benches should be cut into the existing slope as the filling operations proceed. Each bench should consist of a level terrace a minimum of 8 feet wide, with the rise to the next bench held to 4 feet or less. Where fills of comparable height will be constructed on ground that slopes at an inclination steeper than 4:1 (horizontal to vertical), a keyway should be provided in addition to the benches. Each keyway should consist of a level trench at least 10 feet wide and at least 2 feet deep, with side slopes not exceeding 1:1 (horizontal to vertical), cut into the existing slope. Where fills of comparable height will be constructed on ground that slopes at an inclination steeper than 2:1 (horizontal to vertical), geotextile fabric and retaining structures should be utilized in slope construction where subsequent specific building site investigations warrant.

Site grading near the crowns of the reconstructed slopes should be accomplished such that excessive sheet run-off is prevented.

The completed slopes should be seeded or otherwise vegetated to protect from future erosion. Well vegetated slopes at the recommended configuration should be reasonably protected from typical erosional effects. However, vegetated slopes may not be protected from unusual flow conditions, such as flood events or over-topping of the development's storm drainage system. If erosion control from unusual flow conditions is desired, more substantial erosion protection measures, such as grouted cobble slope facing or manufactured slope protection products should be considered.

Engineered Fill

The upper native soils within the project site are identified as sandy clays, clayey sands, silty clays and weathered rock. These clayey soils will not be suitable for reuse as non-expansive Engineered Fill. The clayey soils will be suitable for reuse for fill placement within the upper 36 inches of conventional slab-on-grade 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 near 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, provided they are cleansed of excessive organics and debris and are moisture-conditioned to at least 2 percent above optimum moisture.

The preferred materials specified for Engineered Fill is 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, 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 maximum density as determined by ASTM Test Method 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.

Grade the site to prevent water/run-off flow over the face of cut and fill slopes. To accomplish this, use asphalt berms, brow ditches, or other measures to intercept and slowly redirect flow. Plant all disturbed areas with erosion-resistant vegetation suited to the area. As an alternative, jute netting or geotextile erosion control mats may be considered for control of erosion. Slopes should be inspected periodically for erosion and repaired immediately if detected. To control surface drainage and debris, paved drainage areas should be provided on all cut and fill slopes that are 30 feet of greater in height. The drainage terraces should be a minimum of 6 feet in width and placed at intervals no greater than 20 feet. Where only one drainage terrace is necessary, it should be located at mid-height of the slope. Brow ditches and drainage terraces should be cleaned before the start of each rainy season, and if necessary, after each rainstorm.

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. 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 excavations. 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.

Pipe Bedding and Envelope

Proper bedding and envelope should be provided for the proposed pipes. The bedding surface should be smooth and true to the design grade. At least 12 inches of compacted cohesionless soil bedding (100 percent passing the No. 4 Sieve and not more than 8 percent passing and No. 200 Sieve) should be provided below the pipes. An envelope of sandy backfill material should be placed along the sides of the pipe and a minimum depth of 12 inches or ⅛ H over the top of pipe (H is the height of soil backfill above the top of the pipe).

Pipe bedding and envelope should be brought to near optimum moisture content, placed in loose lifts not more than 6 inches in thickness, and compacted to achieve at least 90 percent of maximum density based on ASTM Test Method D1557. Due to space limitations, a hand compactor may be required.

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 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 total movement is not expected to exceed 1 inch. Differential movement should be less than 1 inch. Most of the settlement is expected to occur during construction as the loads are applied. However, additional post-construction settlement may occur if the foundation soils are flooded or saturated.

The footing excavation 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 0.30 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. All of the above earth pressures are unfactored and are, therefore, not inclusive of factors of safety.

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

Post-tensioned slab-on-grade foundations, also referred to as post-tensioned slabs-on-ground, may 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 14 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 1,500 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 = 7.9 feet	Center lift, y_m = 1½ inch
Edge lift, e_m = 5.2 feet	Edge lift, y_m = 2¼ inches

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 18 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 moisture content within the upper 12 inches of soil supporting the slabs be re-established to a minimum of 2 percent above optimum moisture content within 48 hours of pouring the slabs.

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. However, cracking and distress in brittle finishes, such as stucco and drywall should be anticipated. 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. This type of slab essentially distributes the differential movement of the supported structure over a longer span through controlled bending of the slab.

Foundations - Drilled Caissons

The proposed structures can be supported on drilled caissons using an allowable sidewall friction of 300 psf. This value is for dead-plus-live loads. This value may be increased by ⅓ for short duration loads, such as wind or seismic. The upper 24 inches should be neglected from friction calculations. Uplift loads can be resisted by caissons using an allowable sidewall friction of 175 psf of the surface area and the weight of the pier. Caissons should have a minimum embedment depth of 6 feet or 3 feet into undisturbed native ground, whichever is deeper. The total settlement of the foundations is not expected to exceed 1 inch. Differential settlement should be less than ½ inch. Most of the settlement is expected to occur during construction as the loads are applied.

Caissons may be designed using a lateral bearing capacity of 125 psf/ft using the applicable formula for nonconstrained or constrained conditions in Sections 1807.3.2.1 and 1807.3.2.2 of the 2016 California Building Code. This value can be doubled for deflections of up to ½ inch. Nonconstrained or flexible cap conditions apply to isolated piers, and constrained or rigid cap (fixed against rotation) conditions apply to piers with a rigid connection to the structure.

Sandy and gravelly soils and shallow groundwater were encountered at the site. These sandy and gravelly soils and shallow groundwater may be subject to caving during drilling operations. Accordingly, cased caissons may be required.

Floor Slabs and Exterior Flatwork

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 vapor retarder sheeting underlain by a minimum of 3 inches of compacted, clean, gravel of ¾-inch maximum size. To aid in concrete curing an optional 2 to 4 inches of granular fill may be placed on top of the vapor retarder. The granular fill should consist of damp clean sand with at least 10 to 30 percent of the sand passing the 100 sieve. 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 to reduce crack separation and possible vertical offset at the cracks. The concrete slab should be reinforced at a minimum by using No. 3 reinforcing bars placed on 18-inch centers in each direction. The reinforcement should be placed at midheight of the slab.

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 1 to 1½ 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. To reduce moisture vapor intrusion, it is recommended that a vapor retarder be installed. 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 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.

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 Section 68-2.02F(3) of the CalTrans Standard Specifications (2010). 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 Section 88-1.02 of the CalTrans Standard Specifications for "edge drains") should be affixed to the rear wall opening of each weep hole to retard soil piping.

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.

R-Value Test Result and Pavement Design

Four 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"	Sandy Clay (CL)	Less than 5
2	12-24"	Sandy Clay (CL)	Less than 5
3	12-24"	Sandy Clay (CL)	Less than 5
4	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"	4.5"	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***

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 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	1.594	Section 1613.3.1
S_{MS}	1.594	Section 1613.3.3
S_{DS}	1.063	Section 1613.3.4
Site Coefficient F_v	1.500	Table 1613.3.3 (2)
S_1	0.628	Section 1613.3.1
S_{M1}	0.942	Section 1613.3.3
S_{D1}	0.628	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 from these soil samples were greater than 0.02 percent 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 field work. 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 (916) 564-2200.

Respectfully submitted,
KRAZAN & ASSOCIATES, INC.

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

DRJ:ht

APPROXIMATE PERCOLATION TEST LOCATION

APPROXIMATE BORING LOCATION

APPROXIMATE R-VALUE LOCATION

SITE MAP	Scale: NTS	Date: December 2017
Cloverdale Apartments Sandholm Lane and Foothill Boulevard Cloverdale, California	Drawn by: HT	Approved by: DJ
	Project No. 032-17032	Figure No. 1

Krazan
GEOTECHNICAL ENGINEERING

APPENDIX A

FIELD AND LABORATORY INVESTIGATIONS

Field Investigation

The field investigation consisted of a surface reconnaissance and a subsurface exploratory program. Eighteen 4½-inch to 6½-inch 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

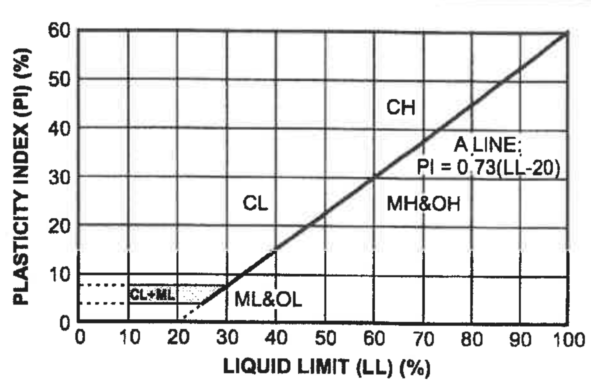
CONSISTENCY CLASSIFICATION

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

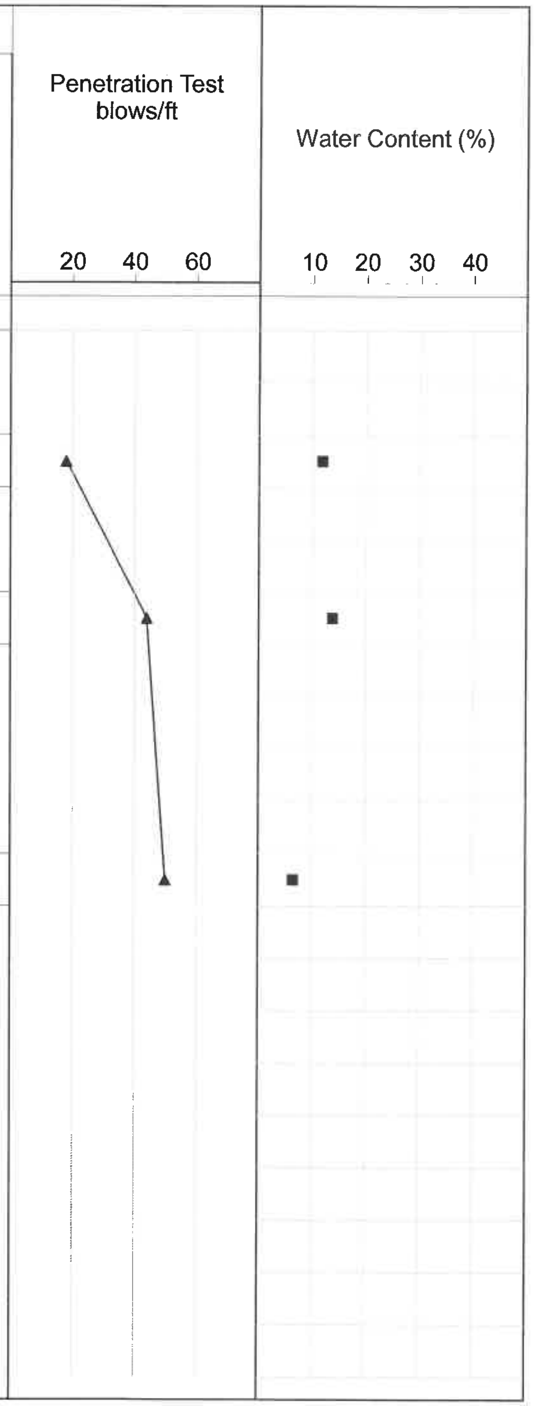
Project: Cloverdale Apartments
Project No: 032-17032

Client: Integrated Community Development
Figure No.: A-1

Location: Sandholm Lane and Foothill Boulevard, Cloverdale, CA
Logged By: R. Alexander

Depth to Water> **Initial:** None **At Completion:** 6 Feet

Depth (ft)	Symbol	Description (SUBSURFACE PROFILE)	Dry Density (pcf)	Moisture (%)	Type	Blows/ft.
0		Ground Surface				
0–8.5		***SANDY CLAY (CL)*** Very loose, fine- to medium-grained; brown, damp, drills easily. Firm below 6 inches. Stiff below 2 feet				
2.5			93.3	11.9		18
		Hard below 5 feet ▼				
5.5			114.7	13.9		44
8.5–15		***WEATHERED ROCK*** Very dense, fine-grained; grayish-brown, damp, drills hard				
10.5				6.5		50+
15		End of Borehole				



Drill Method: Solid Flight
Drill Date: 11-1-17

Drill Rig: CME 45B
Hole Size: 4½ Inches

Krazan and Associates

Driller: Brent Snyder
Elevation: 15 Feet

Sheet: 1 of 1

Log of Boring B2

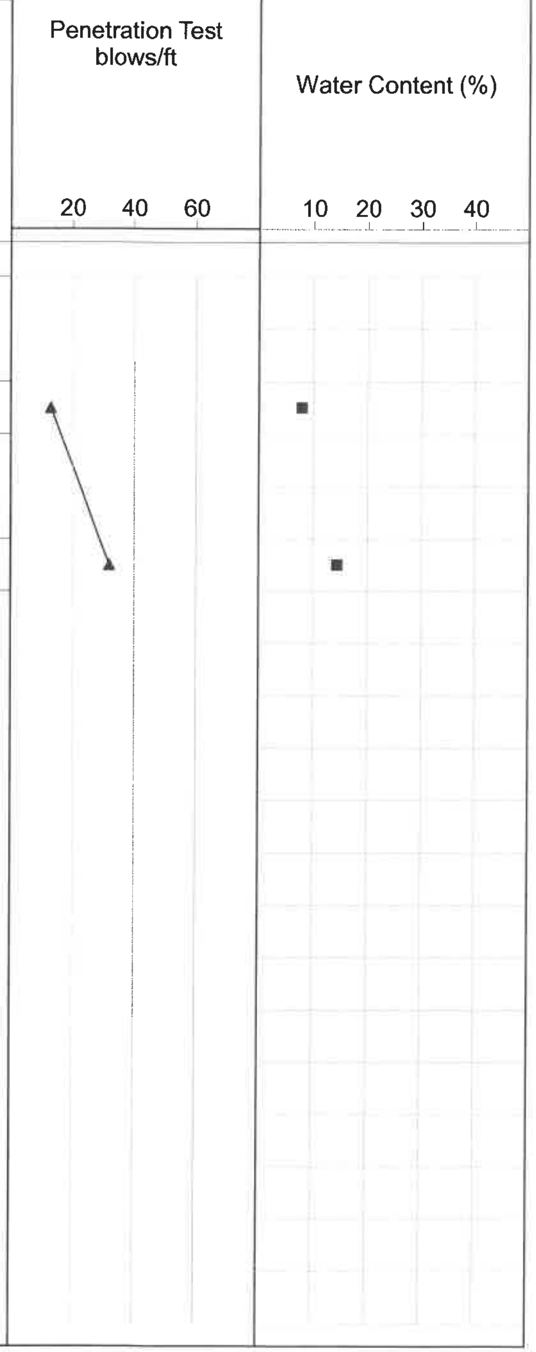
Project: Cloverdale Apartments
Project No: 032-17032

Client: Integrated Community Development
Figure No.: A-2

Location: Sandholm Lane and Foothill Boulevard, Cloverdale, CA
Logged By: R. Alexander

Depth to Water> **Initial:** None **At Completion:** None

Depth (ft)	Symbol	SUBSURFACE PROFILE – Description	SAMPLE – Dry Density (pcf)	SAMPLE – Moisture (%)	SAMPLE – Type	SAMPLE – Blows/ft.
0		Ground Surface				
0–2.5		***SANDY CLAY (CL)*** Very loose, fine- to medium-grained; light brown, damp, drills easily Stiff below 6 inches				
2.5			95.8	7.9	■	13
2.5–8		***CLAYEY SAND (SC)*** Loose, fine- to coarse-grained with GRAVEL; brown, moist, drills easily Medium dense below 5 feet				
5.5			122.0	14.5	■	32
8–10		***WEATHERED ROCK*** Very dense; gray, damp, drills hard				
10		End of Borehole				



Drill Method: Solid Flight
Drill Date: 11-1-17

Drill Rig: CME 45B
Hole Size: 4½ Inches

Krazan and Associates

Driller: Brent Snyder
Elevation: 10 Feet

Sheet: 1 of 1

Log of Boring B3

Project: Cloverdale Apartments

Project No: 032-17032

Client: Integrated Community Development

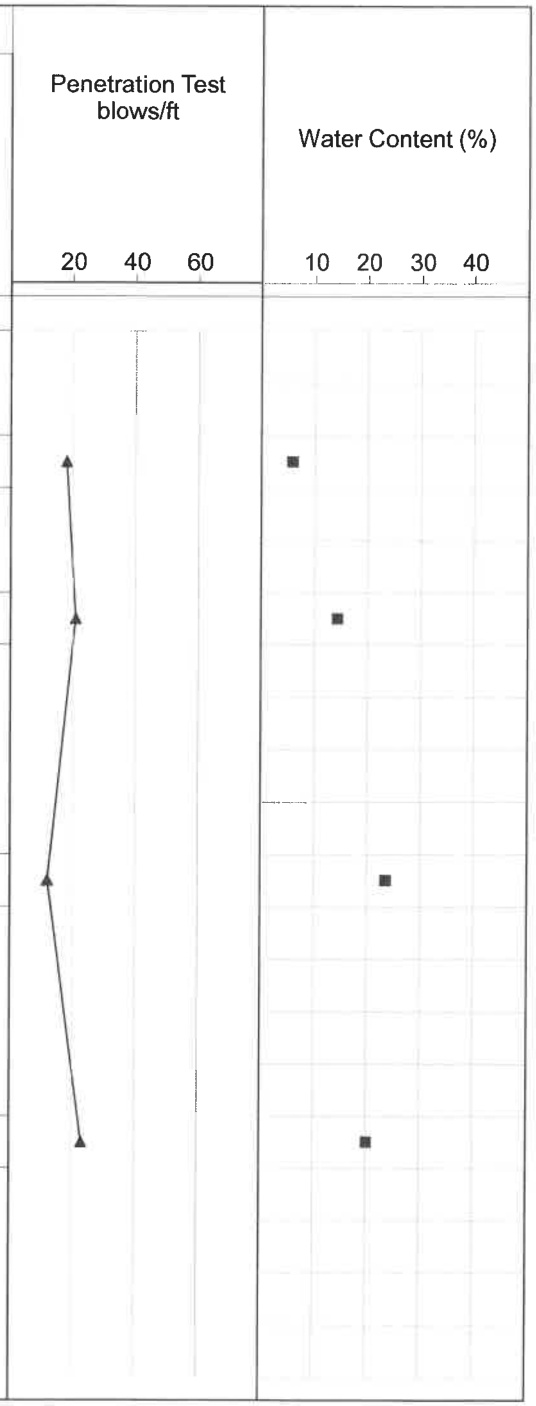
Figure No.: A-3

Location: Sandholm Lane and Foothill Boulevard, Cloverdale, CA

Logged By: R. Alexander

Depth to Water> **Initial:** None **At Completion:** 16 Feet

SUBSURFACE PROFILE			SAMPLE			
Depth (ft)	Symbol	Description	Dry Density (pcf)	Moisture (%)	Type	Blows/ft.
0		Ground Surface				
0		***SANDY CLAY (CL)*** Very loose, fine- to medium-grained with GRAVEL; light brown, damp, drills easily. Stiff below 6 inches				
2.5			114.7	5.8		18
5.5			115.4	14.4		21
5.5		***CLAYEY SAND (SC)*** Medium dense, fine- to coarse-grained with GRAVEL; light brown, moist, drills easily				
10		***SANDY CLAY (CL)*** Stiff, fine- to coarse-grained; brown, moist, drills easily	97.3	23.6		12
15.5		***WEATHERED ROCK*** Medium dense; grayish-brown, damp, drills firmly	103.8	20.2		23
20						



Drill Method: Solid Flight

Drill Date: 11-1-17

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

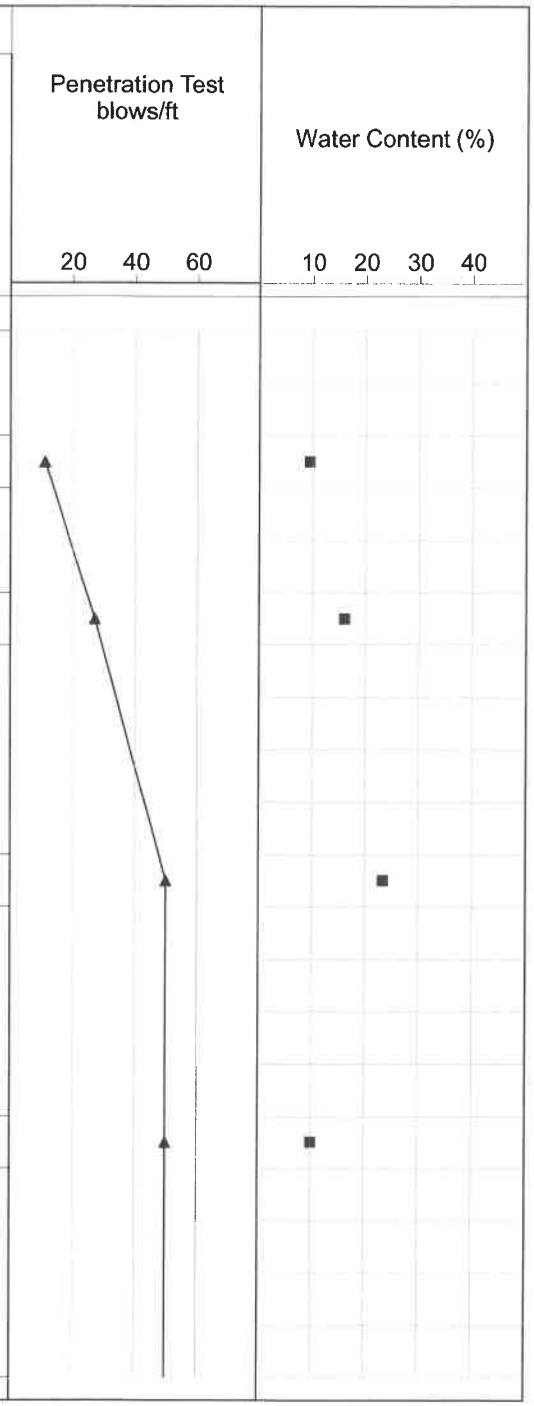
Project: Cloverdale Apartments
Project No: 032-17032

Client: Integrated Community Development
Figure No.: A-4

Location: Sandholm Lane and Foothill Boulevard, Cloverdale, CA
Logged By: R. Alexander

Depth to Water> **Initial:** 24 Feet **At Completion:** 14 Feet

Depth (ft)	Description (SUBSURFACE PROFILE)	Dry Density (pcf)	Moisture (%)	Type	Blows/ft.
0	Ground Surface				
0–4	***SANDY CLAY (CL)*** Very loose, fine- to medium-grained; brown, damp, drills easily. Firm below 6 inches				
~2.5		78.6	9.5		11
4–15	***SANDY CLAY (CL)*** Very stiff, fine-grained with GRAVEL; light brown, damp, drills firmly				
~5.5		106.2	16.1		27
~10.5		109.8	23.5		21
15–20	***WEATHERED ROCK*** Very dense; gray, damp, drills hard				
~15.5		114.0	10.0		50+



Drill Method: Hollow Stem
Drill Date: 11-2-17

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

Driller: Brent Snyder
Elevation: 50 Feet

Log of Boring B4

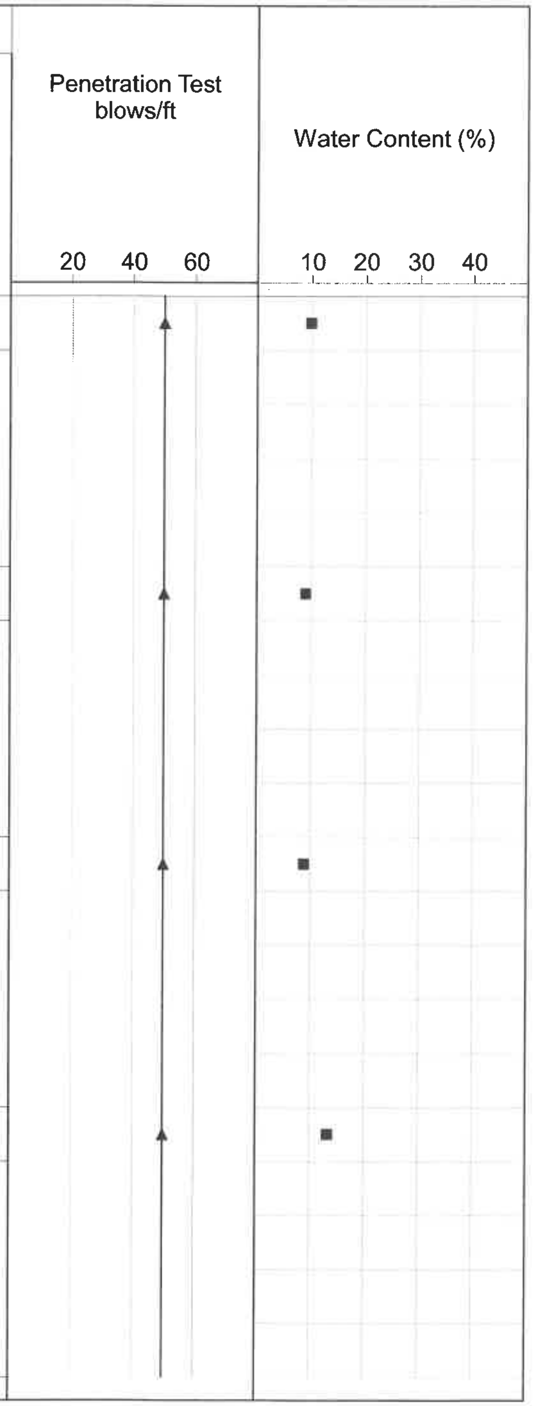
Project: Cloverdale Apartments | **Project No:** 032-17032

Client: Integrated Community Development | **Figure No.:** A-4

Location: Sandholm Lane and Foothill Boulevard, Cloverdale, CA | **Logged By:** R. Alexander

Depth to Water> **Initial:** 24 Feet | **At Completion:** 14 Feet

SUBSURFACE PROFILE			SAMPLE			
Depth (ft)	Symbol	Description	Dry Density (pcf)	Moisture (%)	Type	Blows/ft.
			123.6	9.9		50+
22						
24		Saturated below 24 feet				
			106.4	9.1		50+
26						
28						
30						
			109.3	8.9		50+
32						
34						
			87.9	13.4		50+
36						
38						
40						



Drill Method: Hollow Stem | **Drill Date:** 11-2-17

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

Driller: Brent Snyder | **Elevation:** 50 Feet

Log of Boring B4

Project: Cloverdale Apartments | **Project No:** 032-17032

Client: Integrated Community Development | **Figure No.:** A-4

Location: Sandholm Lane and Foothill Boulevard, Cloverdale, CA | **Logged By:** R. Alexander

Depth to Water> **Initial:** 24 Feet | **At Completion:** 14 Feet

Depth (ft)	Symbol	Description	Dry Density (pcf)	Moisture (%)	Type	Blows/ft.	Penetration Test blows/ft (20 40 60)	Water Content (%) (10 20 30 40)
40–41						50+		
42								
44								
45–46						50+		
46								
48								
50		End of Borehole						
52								
54								
56								
58								
60								

Drill Method: Hollow Stem | **Drill Date:** 11-2-17

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

Driller: Brent Snyder | **Elevation:** 50 Feet

Log of Boring B5

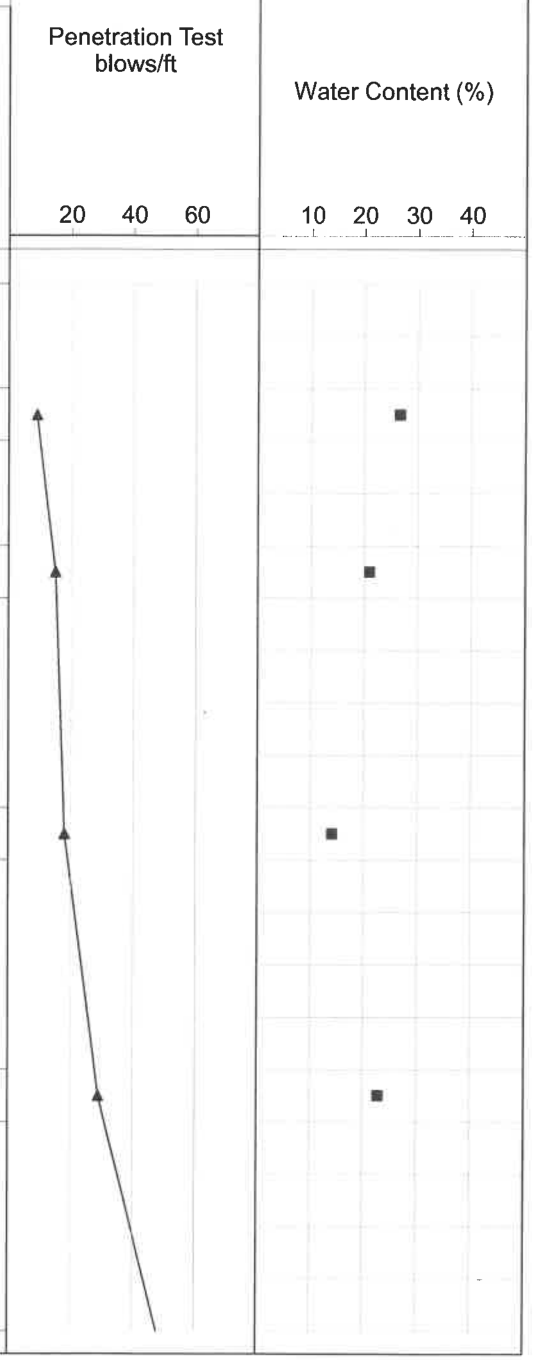
Project: Cloverdale Apartments
Project No: 032-17032

Client: Integrated Community Development
Figure No.: A-5

Location: Sandholm Lane and Foothill Boulevard, Cloverdale, CA
Logged By: R. Alexander

Depth to Water> **Initial:** 9 Feet **At Completion:** 7½ Feet

Depth (ft)	Description	Dry Density (pcf)	Moisture (%)	Type	Blows/ft.
0	Ground Surface				
0–4	***SILTY CLAY (CL)*** Very loose, fine-grained; brown, damp, drills easily. Firm below 6 inches				
~2.5		80.1	26.7	■	9
4–9	***CLAYEY SAND (SC)*** Loose, fine- to coarse-grained with GRAVEL; brown, damp, drills easily				
~5.5		104.7	21.1	■	15
9–19.5	***SANDY CLAY (CL)*** Stiff, fine- to coarse-grained with GRAVEL; brown, saturated, drills easily				
~10.5		116.5	14.2	■	18
14	Very stiff below 14 feet				
~15.5		107.0	23.0	■	29



Drill Method: Solid Flight
Drill Date: 11-2-17

Drill Rig: CME 45B
Hole Size: 4½ Inches

Krazan and Associates

Driller: Brent Snyder
Elevation: 25 Feet

Log of Boring B5

Project: Cloverdale Apartments | **Project No:** 032-17032

Client: Integrated Community Development | **Figure No.:** A-5

Location: Sandholm Lane and Foothill Boulevard, Cloverdale, CA | **Logged By:** R. Alexander

Depth to Water> **Initial:** 9 Feet **At Completion:** 7½ Feet

SUBSURFACE PROFILE			SAMPLE				Penetration Test blows/ft (20 40 60)	Water Content (%) (10 20 30 40)
Depth (ft)	Symbol	Description	Dry Density (pcf)	Moisture (%)	Type	Blows/ft.		
22, 24		***WEATHERED ROCK*** Very dense; gray, damp, drills hard		12.6		50+		
26, 28, 30, 32, 34, 36, 38, 40		End of Borehole						

Drill Method: Solid Flight | **Drill Date:** 11-2-17

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

Driller: Brent Snyder | **Elevation:** 25 Feet

Log of Boring B6

Project: Cloverdale Apartments
Project No: 032-17032

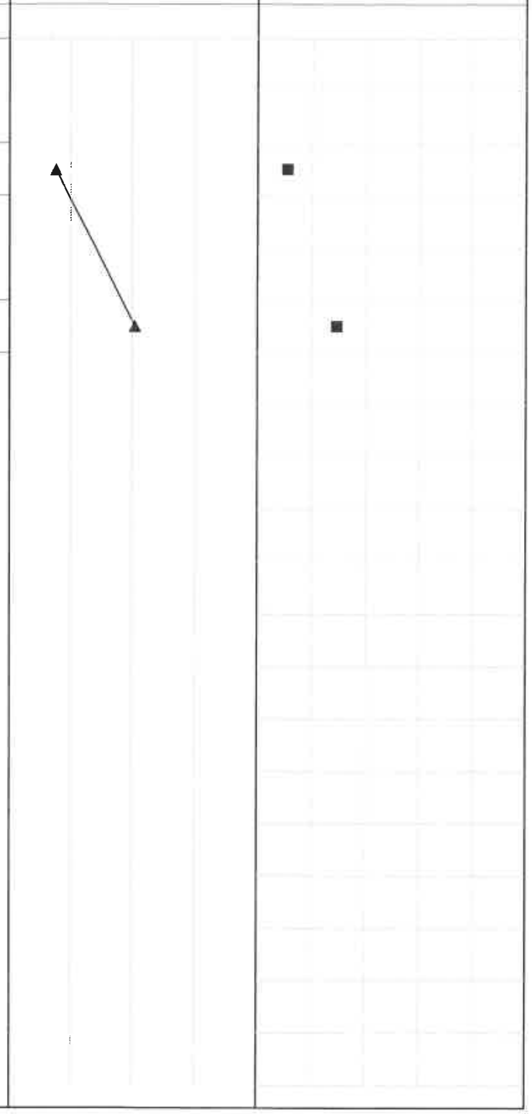
Client: Integrated Community Development
Figure No.: A-6

Location: Sandholm Lane and Foothill Boulevard, Cloverdale, CA
Logged By: R. Alexander

Depth to Water>
Initial: None
At Completion: None

Depth (ft)	Description	Dry Density (pcf)	Moisture (%)	Type	Blows/ft.
0	Ground Surface				
0–2.5	***SANDY CLAY (CL)*** Very loose, fine- to medium-grained; light brown, damp, drills easily Stiff below 12 inches				
2.5–5	***SANDY CLAY (CL)*** Stiff, fine- to medium-grained; brown, damp, drills easily	100.6	5.5		15
5–10	***CLAYEY SAND (SC)*** Dense, fine- to coarse-grained with GRAVEL; brown, damp, drills easily	113.6	14.7		41
10	End of Borehole				

Penetration Test blows/ft (20, 40, 60); Water Content (%) (10, 20, 30, 40)



Drill Method: Solid Flight
Drill Date: 11-2-17

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

Driller: Brent Snyder
Elevation: 10 Feet

Sheet: 1 of 1

Log of Boring B7

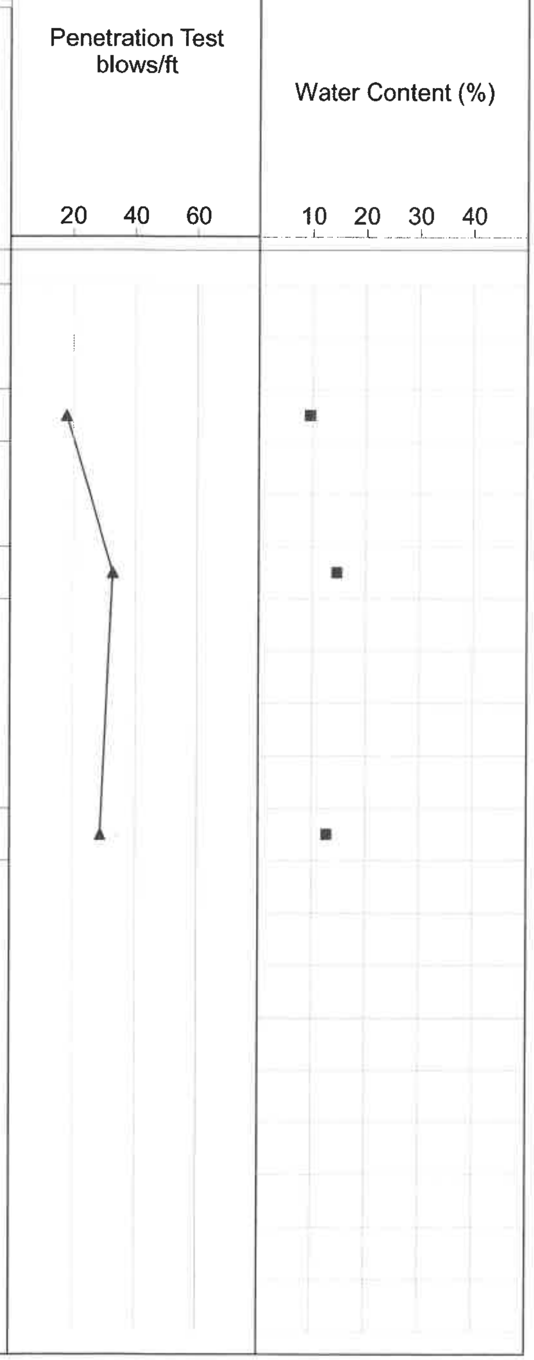
Project: Cloverdale Apartments | **Project No:** 032-17032

Client: Integrated Community Development | **Figure No.:** A-7

Location: Sandholm Lane and Foothill Boulevard, Cloverdale, CA | **Logged By:** R. Alexander

Depth to Water> **Initial:** None | **At Completion:** 9 Feet

SUBSURFACE PROFILE			SAMPLE			
Depth (ft)	Symbol	Description	Dry Density (pcf)	Moisture (%)	Type	Blows/ft.
		Ground Surface				
0		***SILTY CLAY (CL)*** Very loose; brown, damp, drills easily Stiff below 6 inches Very stiff below 18 inches				
2			83.2	9.6	■	18
4		***SANDY CLAY (CL)*** Very stiff, fine-grained; light brown, damp, drills easily				
6		***CLAYEY SAND (SC)*** Medium dense, fine-grained with GRAVEL; light brown, moist, drills easily	110.3	14.8	■	33
8		▼ Saturated below 9 feet				
10			114.7	12.9	■	29
12						
14						
15		End of Borehole				
16						
18						
20						



Drill Method: Solid Flight | **Drill Date:** 11-2-17

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

Driller: Brent Snyder | **Elevation:** 15 Feet

Sheet: 1 of 1

Log of Boring B8

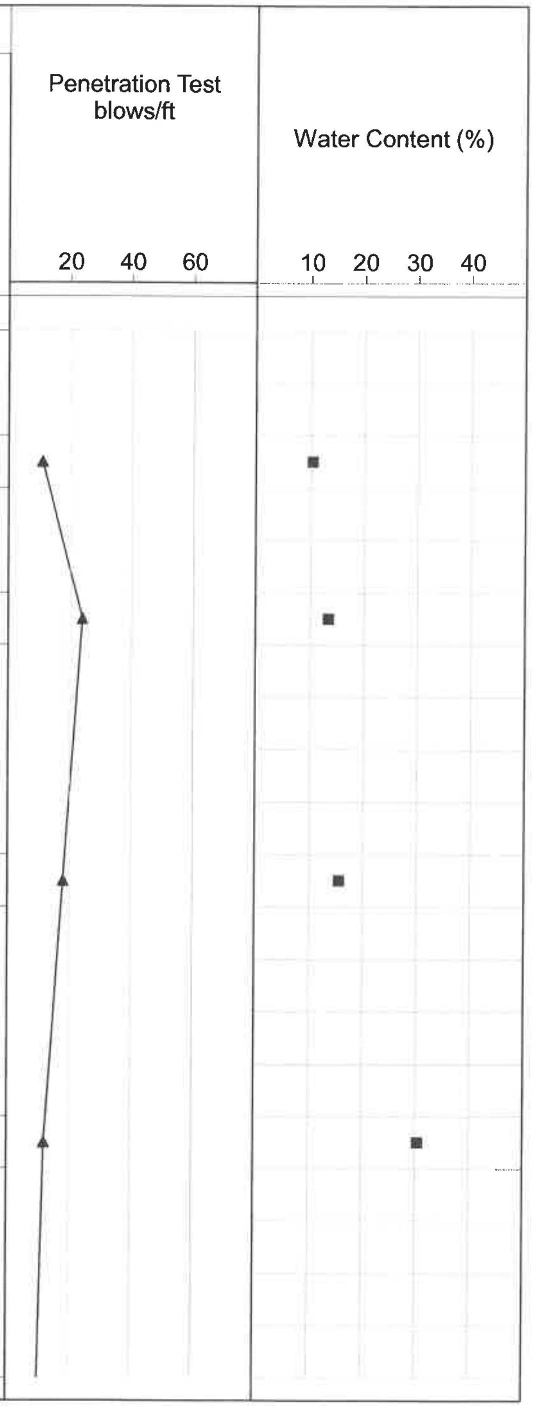
Project: Cloverdale Apartments
Project No: 032-17032

Client: Integrated Community Development
Figure No.: A-8

Location: Sandholm Lane and Foothill Boulevard, Cloverdale, CA
Logged By: R. Alexander

Depth to Water> **Initial:** 20 Feet **At Completion:** 10 Feet

Depth (ft)	Description (Subsurface Profile)	Dry Density (pcf)	Moisture (%)	Type	Blows/ft.
0	Ground Surface				
0–2.5	***SILTY CLAY (CL)*** Very loose, fine- to medium-grained; brown, damp, drills easily. Stiff below 6 inches				
2.5–4.5	***SANDY CLAY (CL)*** Stiff, fine- to coarse-grained; grayish-brown, damp, drills easily	113.2	10.4		11
4.5–13.5	***CLAYEY SAND (SC)*** Medium dense, fine- to coarse-grained with GRAVEL; brown, damp, drills easily	116.2	13.4		24
		105.0	15.6		18
13.5–18	***SANDY CLAY (CL)*** Stiff, fine-grained; grayish-brown, moist, drills easily	91.8	30.5		12
18–20	***SILTY CLAY (CL)*** Stiff; gray moist, drills easily. Saturated below 20 feet				



Drill Method: Solid Flight
Drill Date: 11-2-17

Drill Rig: CME 45B
Hole Size: 4½ Inches

Krazan and Associates

Driller: Brent Snyder
Elevation: 25 Feet

Log of Boring B8

Project: Cloverdale Apartments

Project No: 032-17032

Client: Integrated Community Development

Figure No.: A-8

Location: Sandholm Lane and Foothill Boulevard, Cloverdale, CA

Logged By: R. Alexander

Depth to Water> **Initial:** 20 Feet **At Completion:** 10 Feet

Depth (ft)	Symbol	Description	Dry Density (pcf)	Moisture (%)	Type	Blows/ft.	Penetration Test blows/ft (20 40 60)	Water Content (%) (10 20 30 40)
			94.6	26.7		10		
22								
24		***WEATHERED ROCK*** Very dense; gray, damp, drills hard						
26		End of Borehole						
28								
30								
32								
34								
36								
38								
40								

Drill Method: Solid Flight

Drill Date: 11-2-17

Drill Rig: CME 45B

Krazan and Associates

Hole Size: 4½ Inches

Driller: Brent Snyder

Elevation: 25 Feet

Sheet: 2 of 2

Log of Boring B9

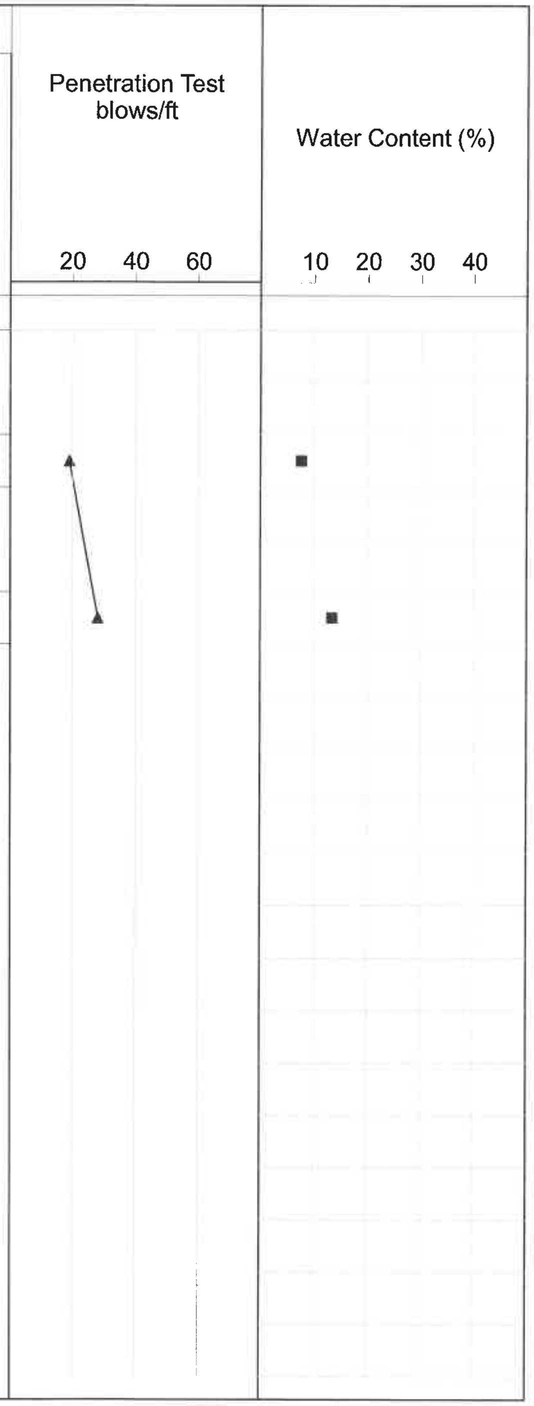
Project: Cloverdale Apartments | **Project No:** 032-17032

Client: Integrated Community Development | **Figure No.:** A-9

Location: Sandholm Lane and Foothill Boulevard, Cloverdale, CA | **Logged By:** R. Alexander

Depth to Water> **Initial:** None | **At Completion:** None

Depth (ft)	Symbol	Description (SUBSURFACE PROFILE)	Dry Density (pcf)	Moisture (%)	Type	Blows/ft.
0		Ground Surface				
0–2.5		***SANDY CLAY (CL)*** Very loose, fine-grained; light brown, damp, drills easily. Firm below 6 inches				
2.5–4		***SILTY CLAY (CL)*** Stiff; brown, damp, drills easily	132.6	7.7		19
4–10		***CLAYEY SAND (SC)*** Medium dense, fine- to coarse-grained with GRAVEL; light brown, damp, drills easily	112.8	13.4		28
10		End of Borehole				



Drill Method: Solid Flight | **Drill Date:** 11-2-17

Drill Rig: CME 45B | **Hole Size:** 4½ Inches

Krazan and Associates

Driller: Brent Snyder | **Elevation:** 10 Feet

Sheet: 1 of 1

Log of Boring B10

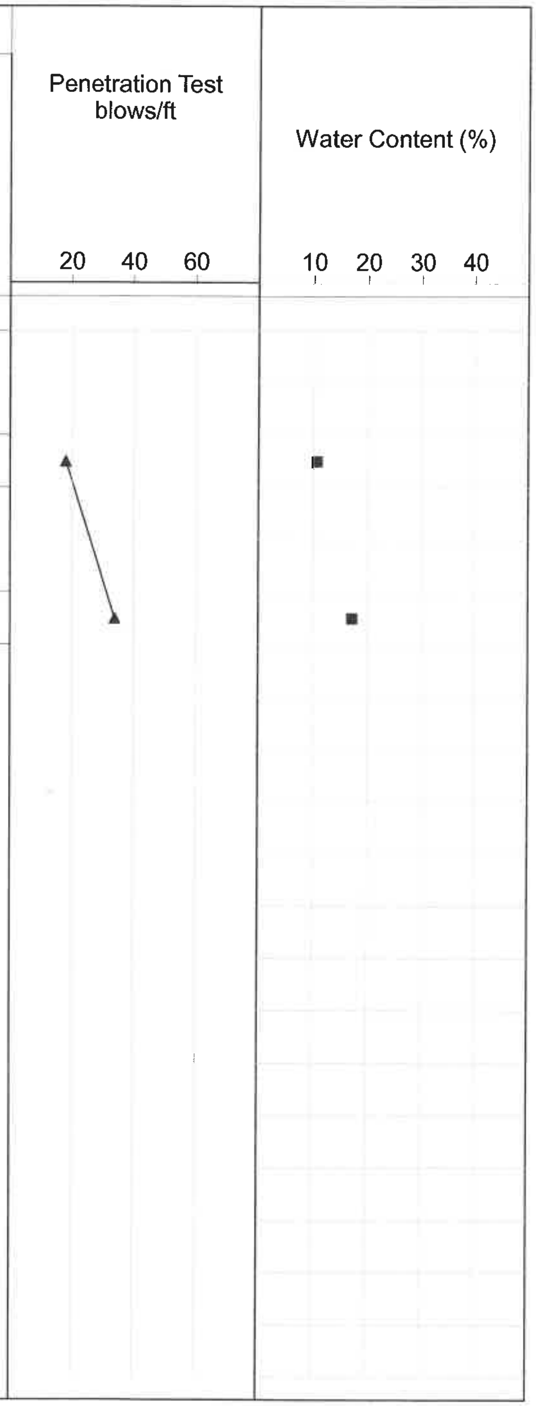
Project: Cloverdale Apartments
Project No: 032-17032

Client: Integrated Community Development
Figure No.: A-10

Location: Sandholm Lane and Foothill Boulevard, Cloverdale, CA
Logged By: R. Alexander

Depth to Water> **Initial:** None **At Completion:** None

SUBSURFACE PROFILE			SAMPLE			
Depth (ft)	Symbol	Description	Dry Density (pcf)	Moisture (%)	Type	Blows/ft.
		Ground Surface				
0		***SANDY CLAY (CL)*** Very loose, fine- to coarse-grained; light brown, damp, drills easily Stiff below 12 inches				
2			78.4	10.7	■	18
4		***SANDY CLAY (CL)*** Very stiff, fine- to medium-grained with GRAVEL; brown, damp, drills easily				
6			109.9	17.2	■	34
8						
10		End of Borehole				
12						
14						
16						
18						
20						



Drill Method: Solid Flight
Drill Date: 11-2-17

Drill Rig: CME 45B
Hole Size: 4½ Inches

Krazan and Associates

Driller: Brent Snyder
Elevation: 10 Feet

Sheet: 1 of 1

Log of Boring B11

Project: Cloverdale Apartments | **Project No:** 032-17032

Client: Integrated Community Development | **Figure No.:** A-11

Location: Sandholm Lane and Foothill Boulevard, Cloverdale, CA | **Logged By:** R. Alexander

Depth to Water> | **Initial:** None | **At Completion:** 13 Feet

Depth (ft)	Symbol	Description	Dry Density (pcf)	Moisture (%)	Type	Blows/ft.	Penetration Test blows/ft (20 40 60)	Water Content (%) (10 20 30 40)
0		Ground Surface						
0–3.5		***SANDY CLAY (CL)*** Very loose, fine-grained; brown, damp, drills easily. Stiff below 6 inches						
2.5			110.3	16.5	■	17	▲	■
3.5–15		***SANDY CLAY (CL)*** Very stiff, fine- to coarse-grained with GRAVEL; light brown, damp, drills easily						
5.5			114.6	17.3	■	25	▲	■
10		Stiff below 10 feet			■	16	▲	
13		Saturated below 13 feet ▼						
15–20		***WEATHERED ROCK*** Very dense; gray, damp, drills hard	119.0	14.2	■	50+	▲	■
20								

Drill Method: Solid Flight | **Drill Date:** 11-2-17

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

Driller: Brent Snyder | **Elevation:** 20 Feet

Log of Boring B12

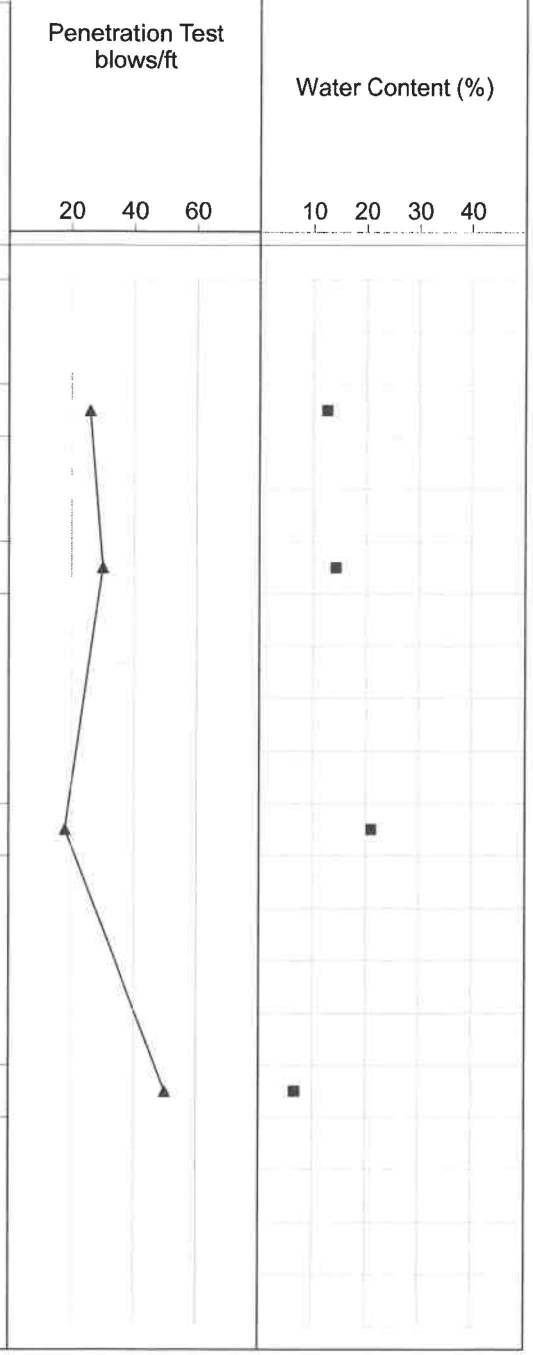
Project: Cloverdale Apartments | **Project No:** 032-17032

Client: Integrated Community Development | **Figure No.:** A-12

Location: Sandholm Lane and Foothill Boulevard, Cloverdale, CA | **Logged By:** R. Alexander

Depth to Water> | **Initial:** None | **At Completion:** None

Depth (ft)	Symbol	Description	Dry Density (pcf)	Moisture (%)	Type	Blows/ft.
0		Ground Surface				
0–2		***SANDY CLAY (CL)*** Very loose, fine- to coarse-grained with GRAVEL; brown, damp, drills easily. Stiff below 6 inches. Very stiff below 2 feet				
~2.5			101.8	12.7	■	26
~5.5			114.9	14.4	■	30
8		Stiff below 8 feet				
~10.5			106.2	21.1	■	18
11		***WEATHERED ROCK*** Dense; gray, moist, drills easily				
15		Very dense below 15 feet				
~15.5				6.8	■	50+
20						



Drill Method: Solid Flight | **Drill Date:** 11-2-17

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

Driller: Brent Snyder | **Elevation:** 20 Feet

Sheet: 1 of 1

Log of Boring B13

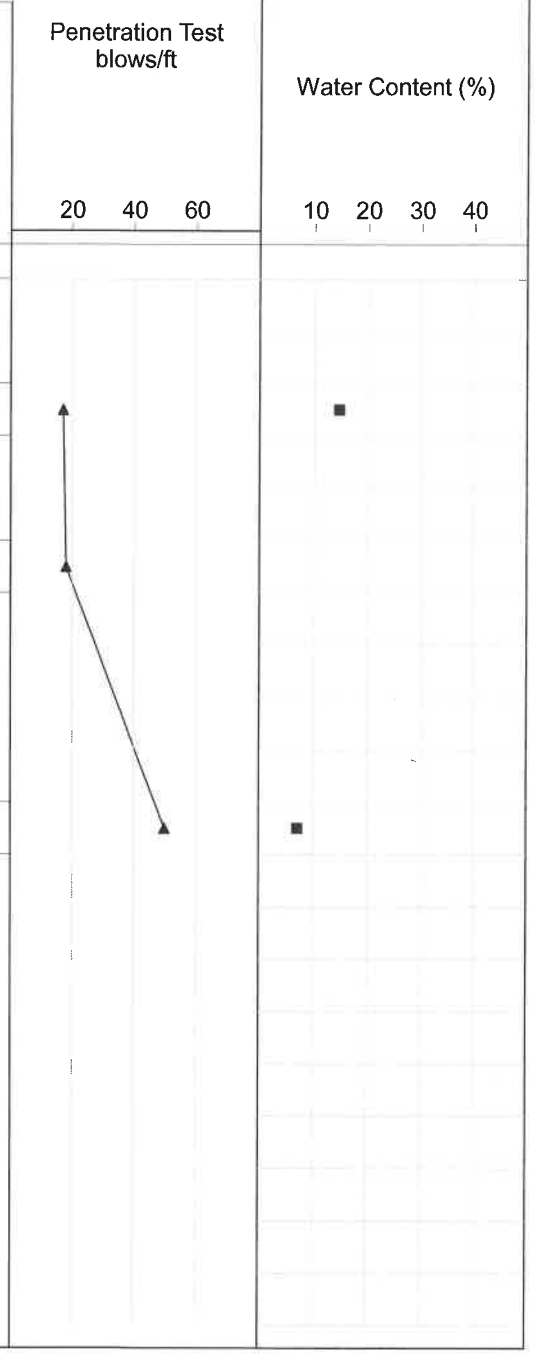
Project: Cloverdale Apartments
Project No: 032-17032

Client: Integrated Community Development
Figure No.: A-13

Location: Sandholm Lane and Foothill Boulevard, Cloverdale, CA
Logged By: R. Alexander

Depth to Water> **Initial:** None **At Completion:** None

Depth (ft)	Symbol	Description (Subsurface Profile)	Dry Density (pcf)	Moisture (%)	Type	Blows/ft.
0		Ground Surface				
0–1		***SILTY CLAY (CL)*** Very loose; dark brown, damp, drills easily				
1–3.5		***SANDY CLAY (CL)*** Stiff, fine-grained; gray, damp, drills firmly		14.7		17
3.5–4.5		***SILTY CLAY (CL)*** Stiff; dark brown, damp, drills easily				
4.5–9		***SANDY CLAY (CL)*** Stiff, with GRAVEL; light brown, damp, drills easily				18
9–15		***WEATHERED ROCK*** Very dense; brown, damp, drills firmly	130.7	7.1		50+
15		End of Borehole				



Drill Method: Solid Flight
Drill Date: 11-2-17

Drill Rig: CME 45B
Hole Size: 4½ Inches

Krazan and Associates

Driller: Brent Snyder
Elevation: 15 Feet

Sheet: 1 of 1

Log of Boring B14

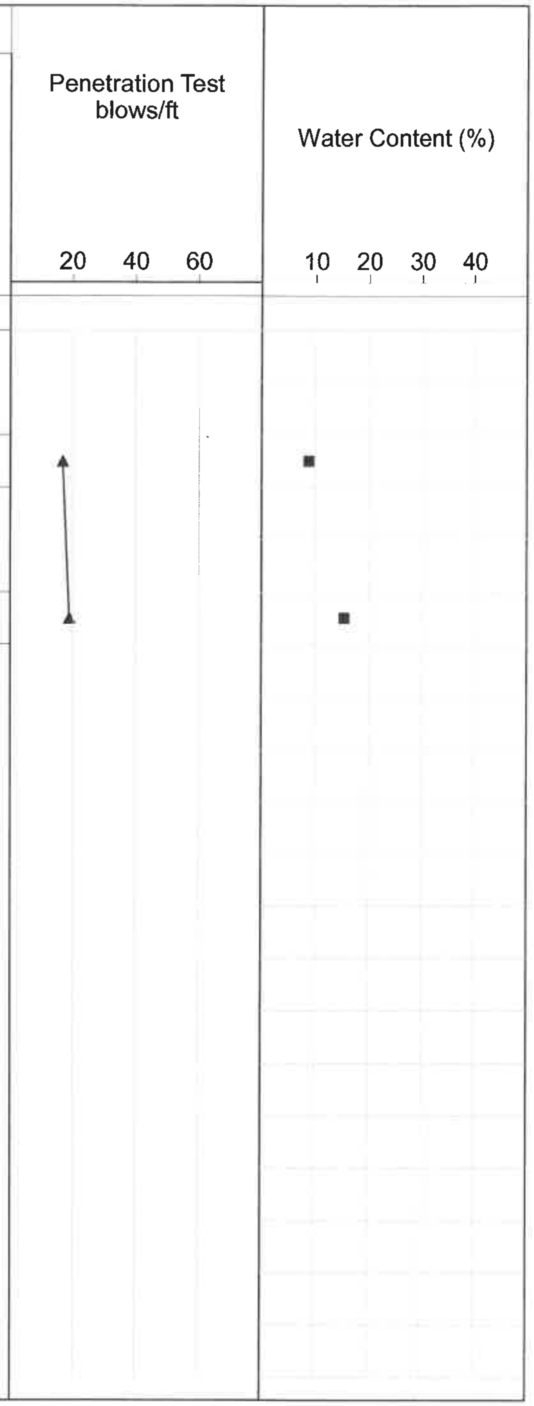
Project: Cloverdale Apartments — **Project No:** 032-17032

Client: Integrated Community Development — **Figure No.:** A-14

Location: Sandholm Lane and Foothill Boulevard, Cloverdale, CA — **Logged By:** R. Alexander

Depth to Water> — **Initial:** None — **At Completion:** None

Depth (ft)	Description (Subsurface Profile)	Dry Density (pcf)	Moisture (%)	Type	Blows/ft.
0	Ground Surface				
0–2.5	***SANDY CLAY (CL)*** Very loose, fine- to medium-grained; light brown, damp, drills easily Stiff below 6 inches	134.6	8.8	■	17
2.5–4	***CLAYEY SAND (SC)*** Medium dense, fine- to medium; dark brown, damp, drills easily				
4–10	***SANDY CLAY (CL)*** Stiff, fine- to coarse-grained with GRAVEL; light brown, damp, drills firmly	104.1	15.5	■	19
10	End of Borehole				



Drill Method: Solid Flight — **Drill Date:** 11-2-17

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

Driller: Brent Snyder — **Elevation:** 10 Feet

Sheet: 1 of 1

Log of Boring B15

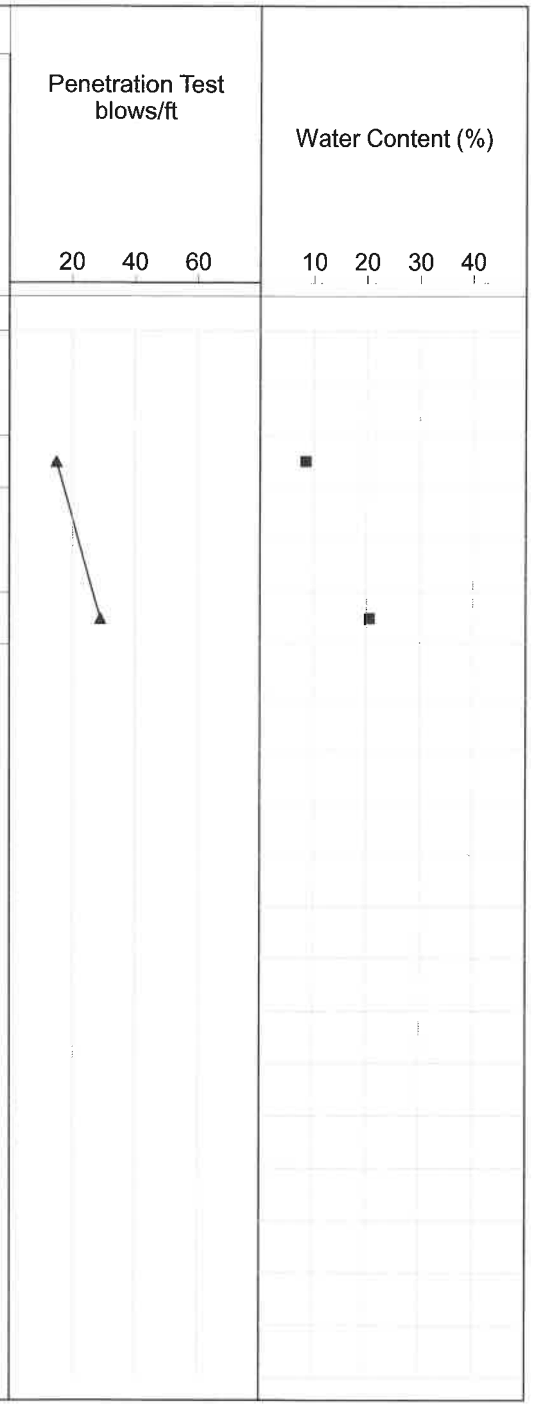
Project: Cloverdale Apartments
Project No: 032-17032

Client: Integrated Community Development
Figure No.: A-15

Location: Sandholm Lane and Foothill Boulevard, Cloverdale, CA
Logged By: R. Alexander

Depth to Water> **Initial:** None **At Completion:** None

SUBSURFACE PROFILE			SAMPLE			
Depth (ft)	Symbol	Description	Dry Density (pcf)	Moisture (%)	Type	Blows/ft.
		Ground Surface				
0		***SANDY CLAY (CL)*** Very loose; light brown, damp, drills easily Stiff below 6 inches				
2			120.3	8.6	■	15
4		***CLAYEY SAND (SC)*** Very stiff, fine- to coarse-grained with GRAVEL; brown, damp, drills firmly				
6			93.8	20.6	■	29
8						
10		End of Borehole				
12						
14						
16						
18						
20						



Drill Method: Solid Flight
Drill Date: 11-3-17

Drill Rig: CME 45B
Hole Size: 4½ Inches

Krazan and Associates

Driller: Brent Snyder
Elevation: 10 Feet

Sheet: 1 of 1

Log of Boring B16

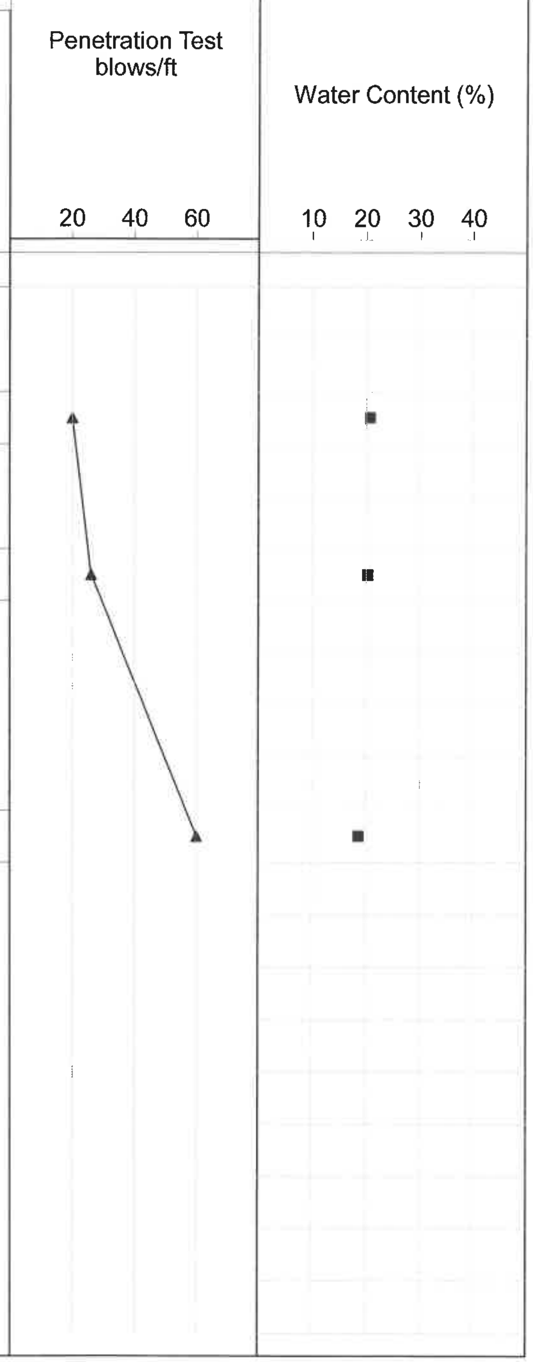
Project: Cloverdale Apartments | **Project No:** 032-17032

Client: Integrated Community Development | **Figure No.:** A-16

Location: Sandholm Lane and Foothill Boulevard, Cloverdale, CA | **Logged By:** R. Alexander

Depth to Water> **Initial:** None | **At Completion:** None

SUBSURFACE PROFILE			SAMPLE			
Depth (ft)	Symbol	Description	Dry Density (pcf)	Moisture (%)	Type	Blows/ft.
		Ground Surface				
0 – 3.5		***SANDY CLAY (CL)*** Very loose, fine- to medium-grained; dark brown, damp, drills easily. Stiff below 6 inches	102.0	20.8	■	20
3.5 – 10		***SANDY CLAY (CL)*** Very stiff, fine- to coarse-grained with GRAVEL; light brown, damp, drills firmly	104.6	20.3	■	26
10 – 15		***WEATHERED ROCK*** Dense; gray, damp, drills firmly	115.0	18.7	■	60
15		End of Borehole				



Drill Method: Solid Flight | **Drill Date:** 11-3-17

Drill Rig: CME 45B | **Hole Size:** 4½ Inches

Krazan and Associates

Driller: Brent Snyder | **Elevation:** 15 Feet

Sheet: 1 of 1

Log of Boring B17

Project: Cloverdale Apartments

Project No: 032-17032

Client: Integrated Community Development

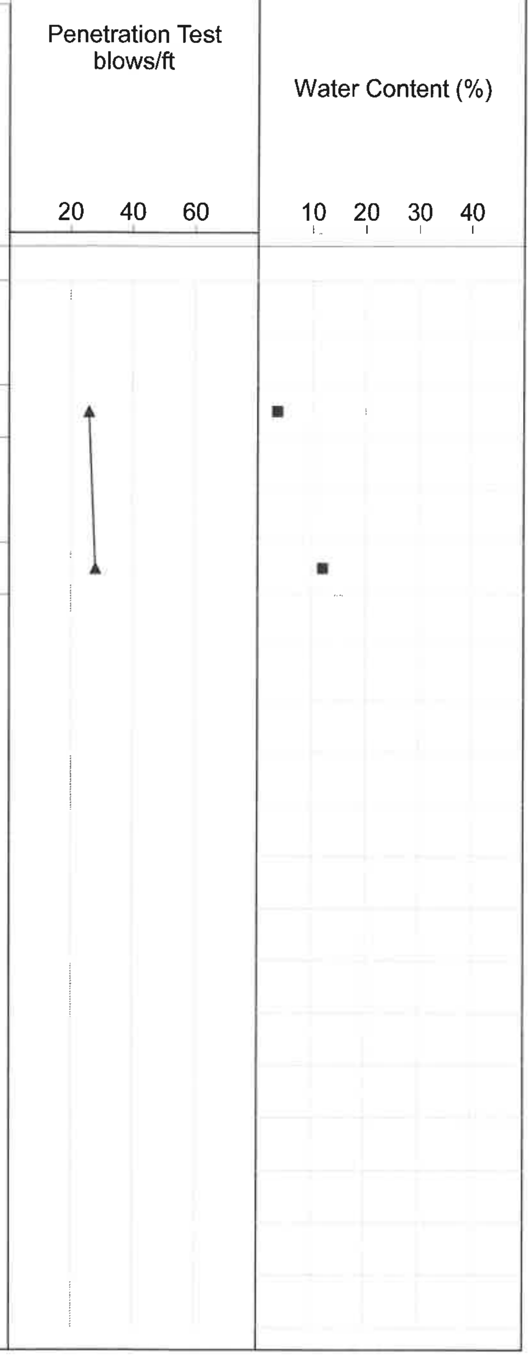
Figure No.: A-17

Location: Sandholm Lane and Foothill Boulevard, Cloverdale, CA

Logged By: R. Alexander

Depth to Water> **Initial:** None **At Completion:** None

SUBSURFACE PROFILE			SAMPLE			
Depth (ft)	Symbol	Description	Dry Density (pcf)	Moisture (%)	Type	Blows/ft.
		Ground Surface				
0		***SANDY CLAY (CL)*** Very loose, fine-grained with GRAVEL; brown, damp, drills easily. Very stiff below 6 inches				
2			115.6	3.6		26
4		Drills firmly below 3½ feet				
6			111.0	12.1		28
8						
10		End of Borehole				
12						
14						
16						
18						
20						



Drill Method: Solid Flight

Drill Date: 11-3-17

Drill Rig: CME 45B

Krazan and Associates

Hole Size: 4½ Inches

Driller: Brent Snyder

Elevation: 10 Feet

Sheet: 1 of 1

Log of Boring B18

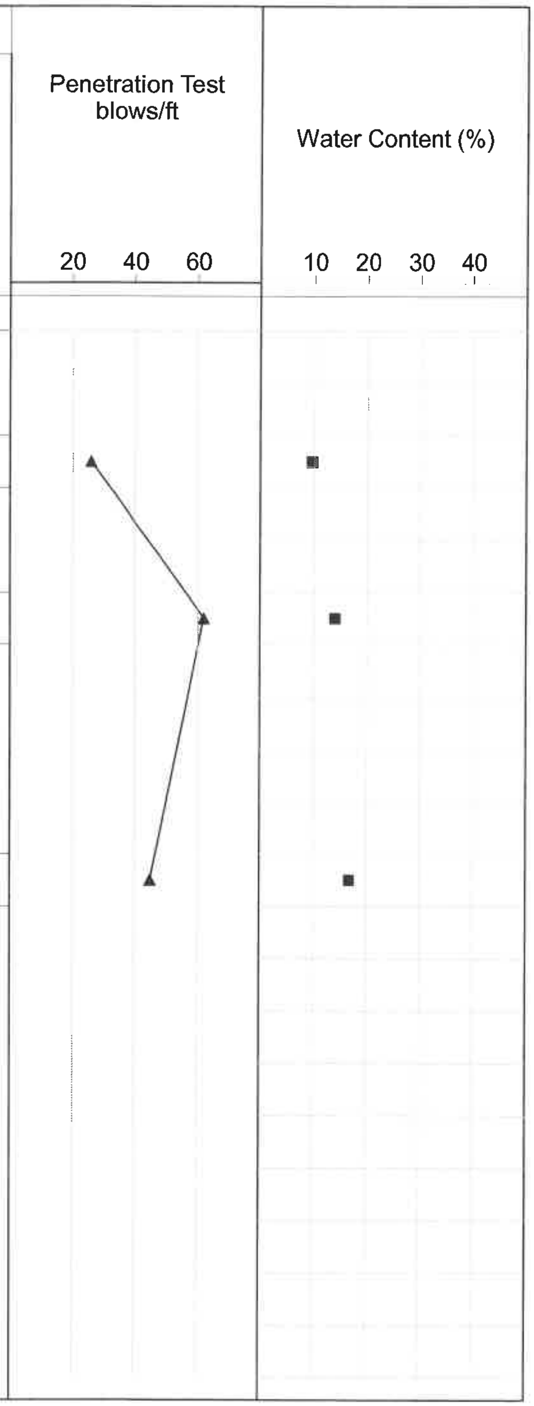
Project: Cloverdale Apartments | **Project No:** 032-17032

Client: Integrated Community Development | **Figure No.:** A-18

Location: Sandholm Lane and Foothill Boulevard, Cloverdale, CA | **Logged By:** R. Alexander

Depth to Water> **Initial:** None | **At Completion:** None

SUBSURFACE PROFILE			SAMPLE			
Depth (ft)	Symbol	Description	Dry Density (pcf)	Moisture (%)	Type	Blows/ft.
0		Ground Surface				
0–3.5		***SANDY CLAY (CL)*** Very loose, fine- to coarse-grained; light brown, damp, drills easily; Stiff below 6 inches; Very stiff below 2 feet				
2–3			93.9	9.6	■	26
3.5–15		***CLAYEY SAND (SC)*** Dense, fine- to coarse-grained with GRAVEL; light brown, damp, drills firmly				
5–6			118.0	14.0	■	62
10–11			115.4	16.8	■	45
15		End of Borehole				



Drill Method: Solid Flight | **Drill Date:** 11-3-17

Drill Rig: CME 45B | **Hole Size:** 4½ Inches

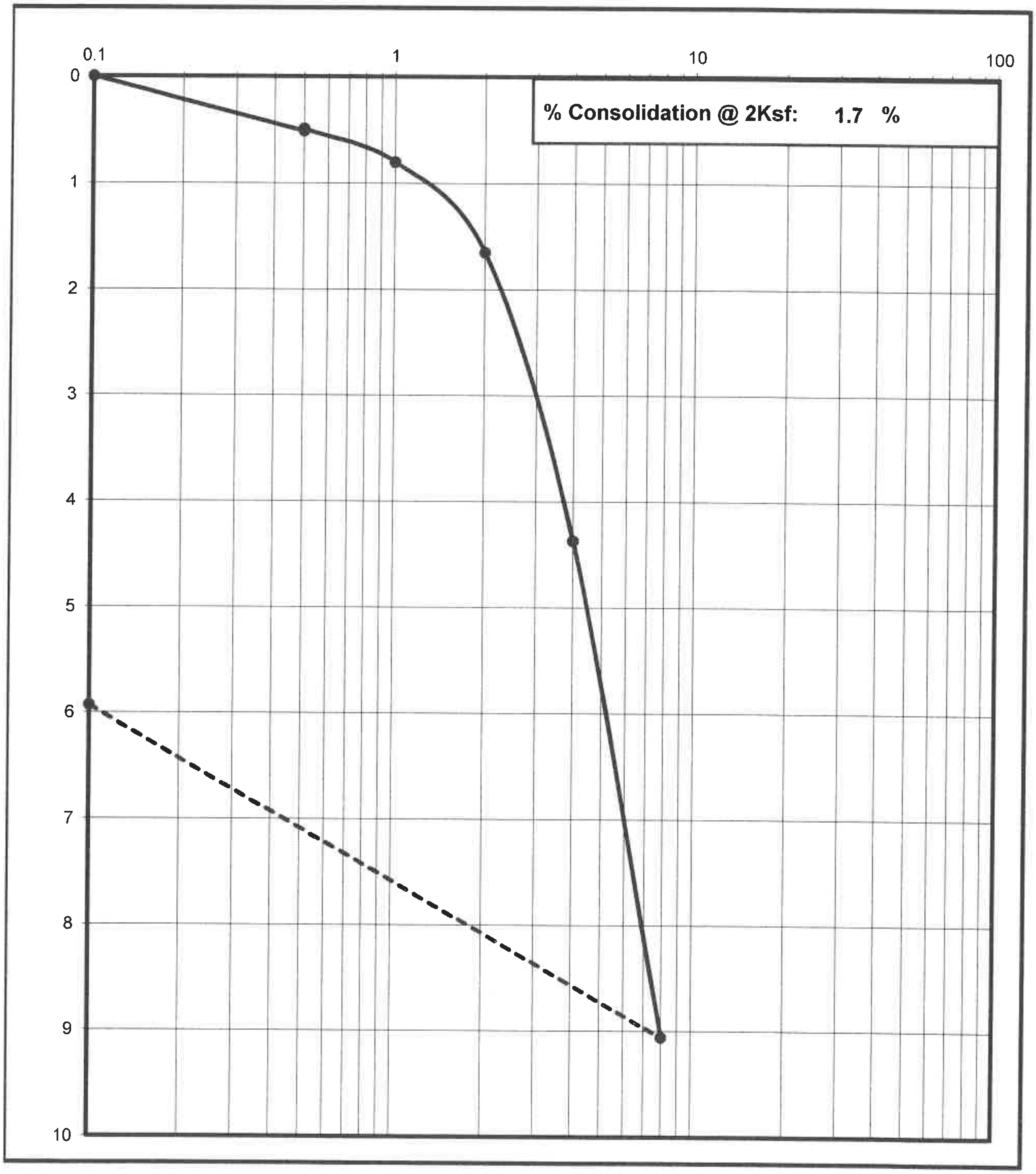
Krazan and Associates

Driller: Brent Snyder | **Elevation:** 15 Feet

Sheet: 1 of 1

Consolidation Test

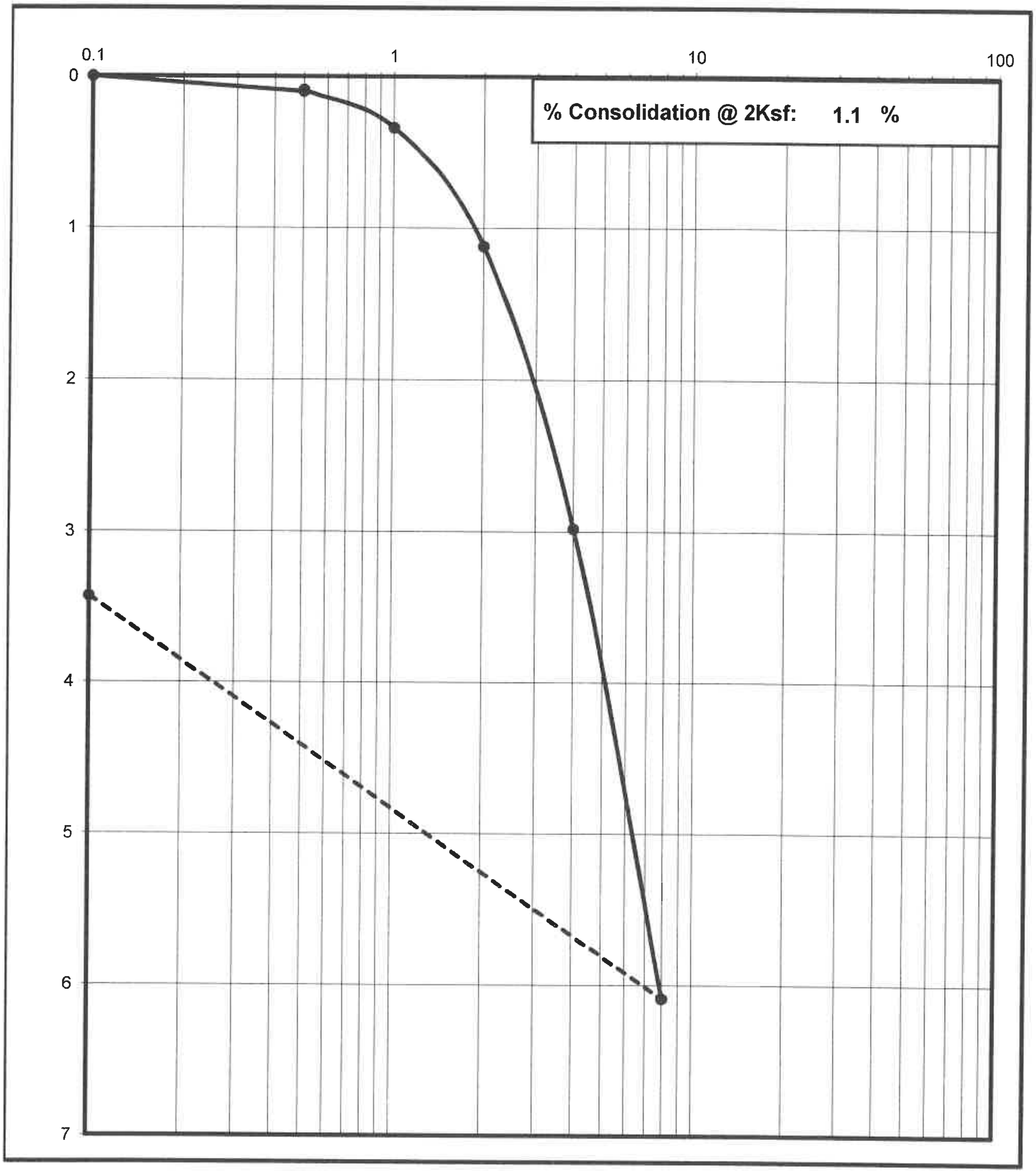
Project No	Boring No. & Depth	Date	Soil Classification
032-17032	B5 @ 2-3'	11/20/2017	CL



Krazan Testing Laboratory

Consolidation Test

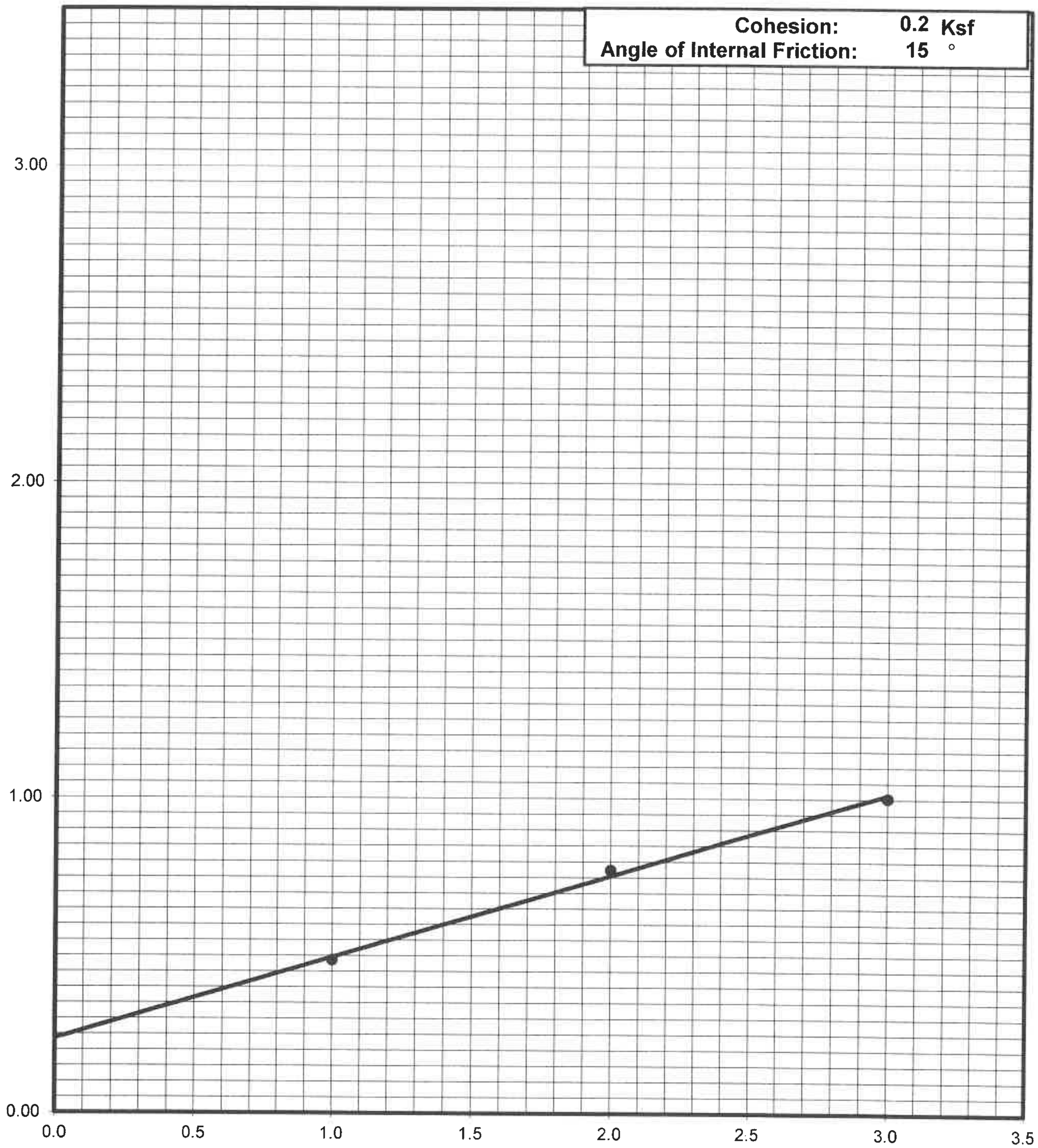
Project No	Boring No. & Depth	Date	Soil Classification
032-17032	B8 @ 2-3'	11/20/2017	CL



Krazan Testing Laboratory

Shear Strength Diagram (Direct Shear)
ASTM D - 3080 / AASHTO T - 236

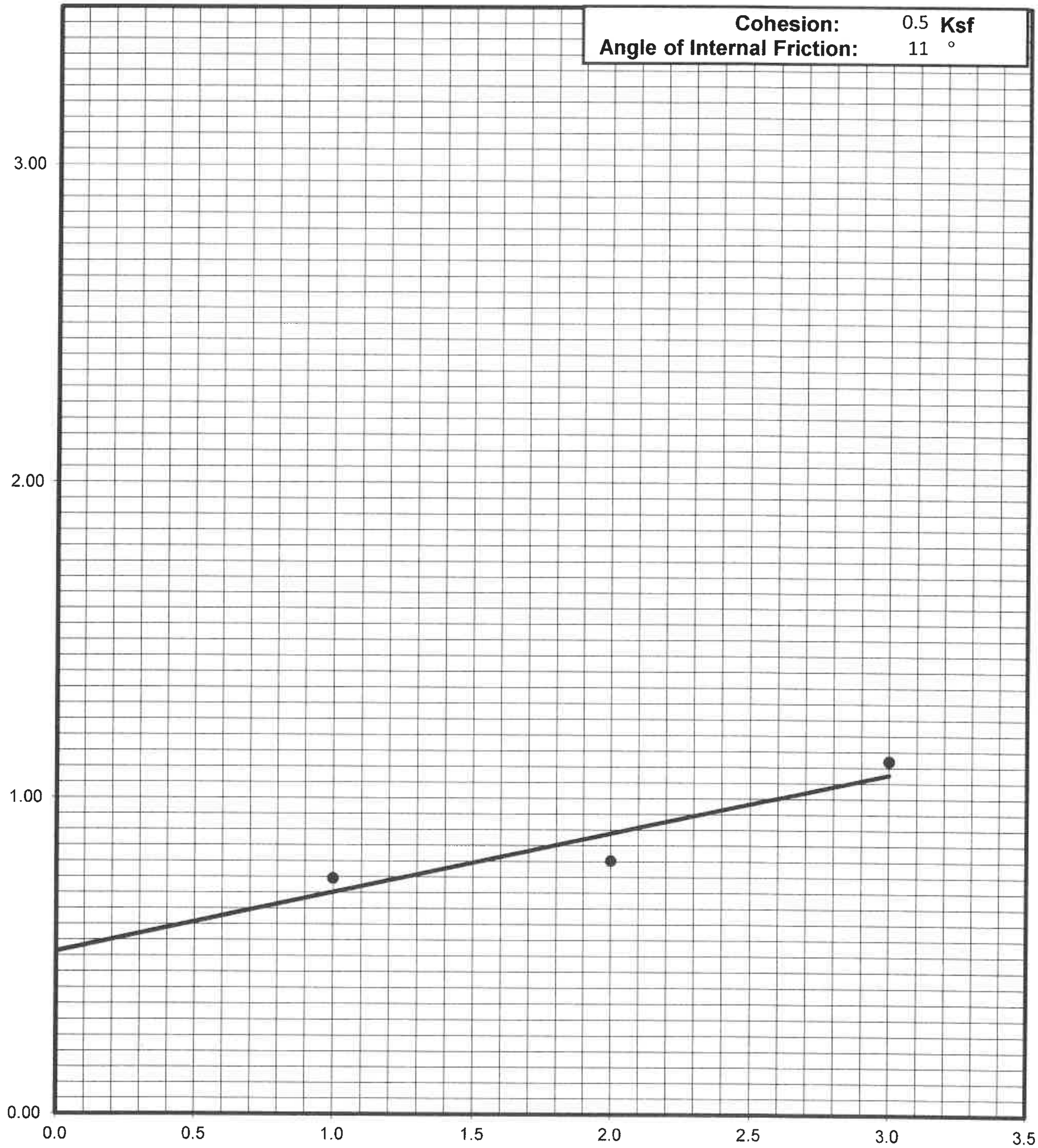
Project Number	Boring No. & Depth	Soil Type	Date
032-17032	B4 @ 2-3'	CL	11/20/2017



Krazan Testing Laboratory

Shear Strength Diagram (Direct Shear)
ASTM D - 3080 / AASHTO T - 236

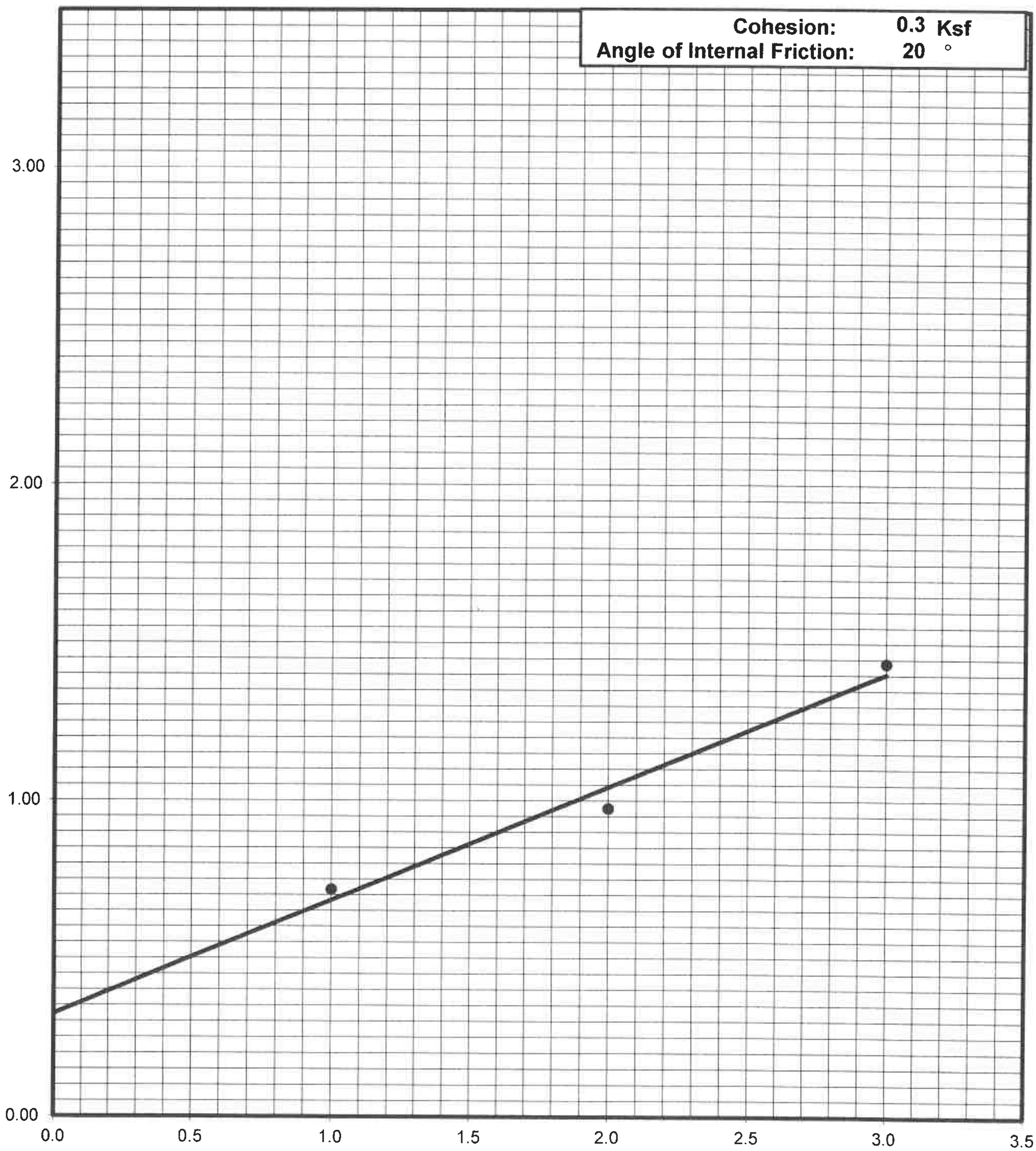
Project Number	Boring No. & Depth	Soil Type	Date
032-17032	B12 @ 2-3'	CL	11/20/2017



Krazan Testing Laboratory

Shear Strength Diagram (Direct Shear)
ASTM D - 3080 / AASHTO T - 236

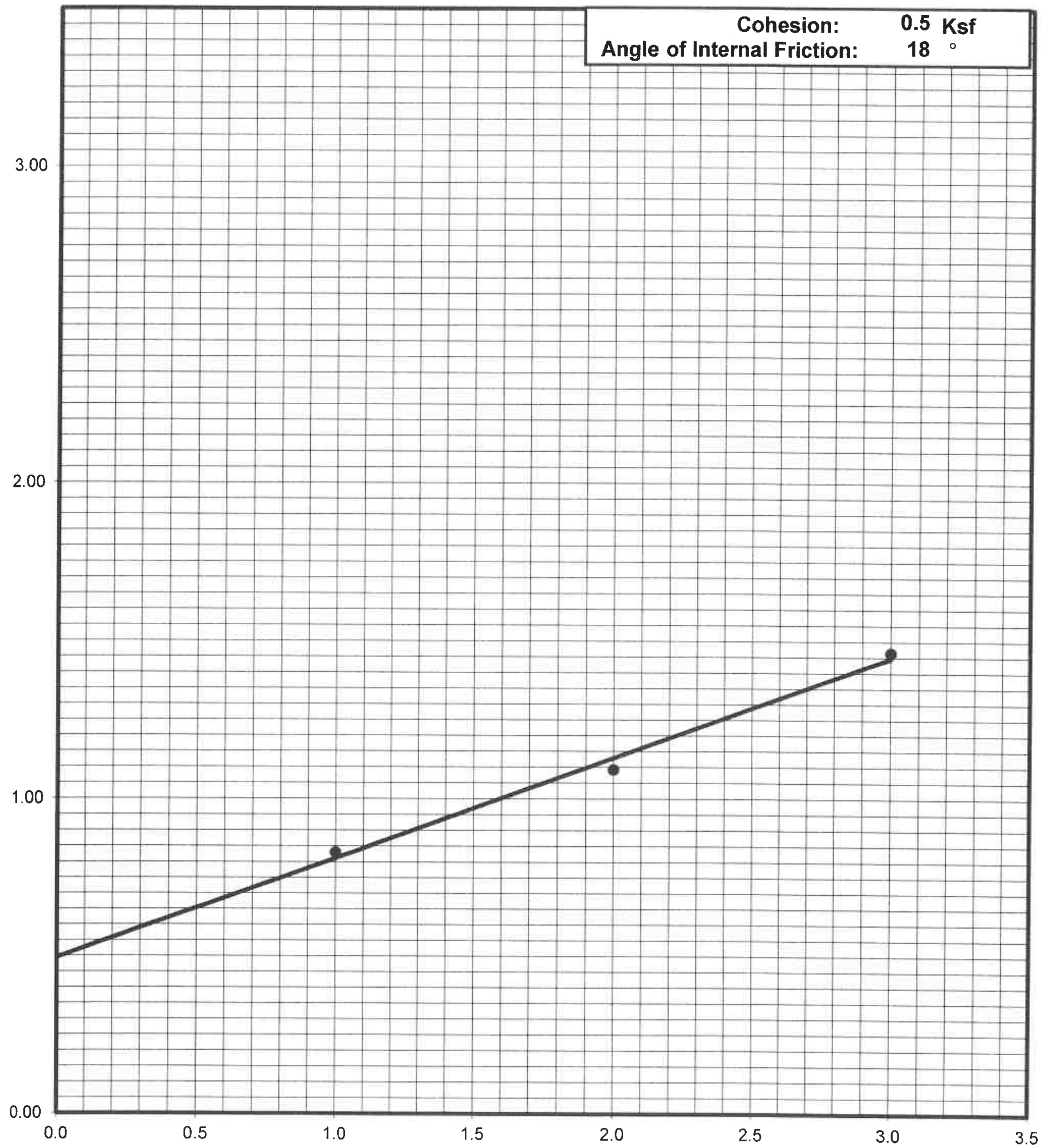
Project Number	Boring No. & Depth	Soil Type	Date
032-17032	B12 @ 5-6'	CL w/ grvl	11/20/2017



Krazan Testing Laboratory

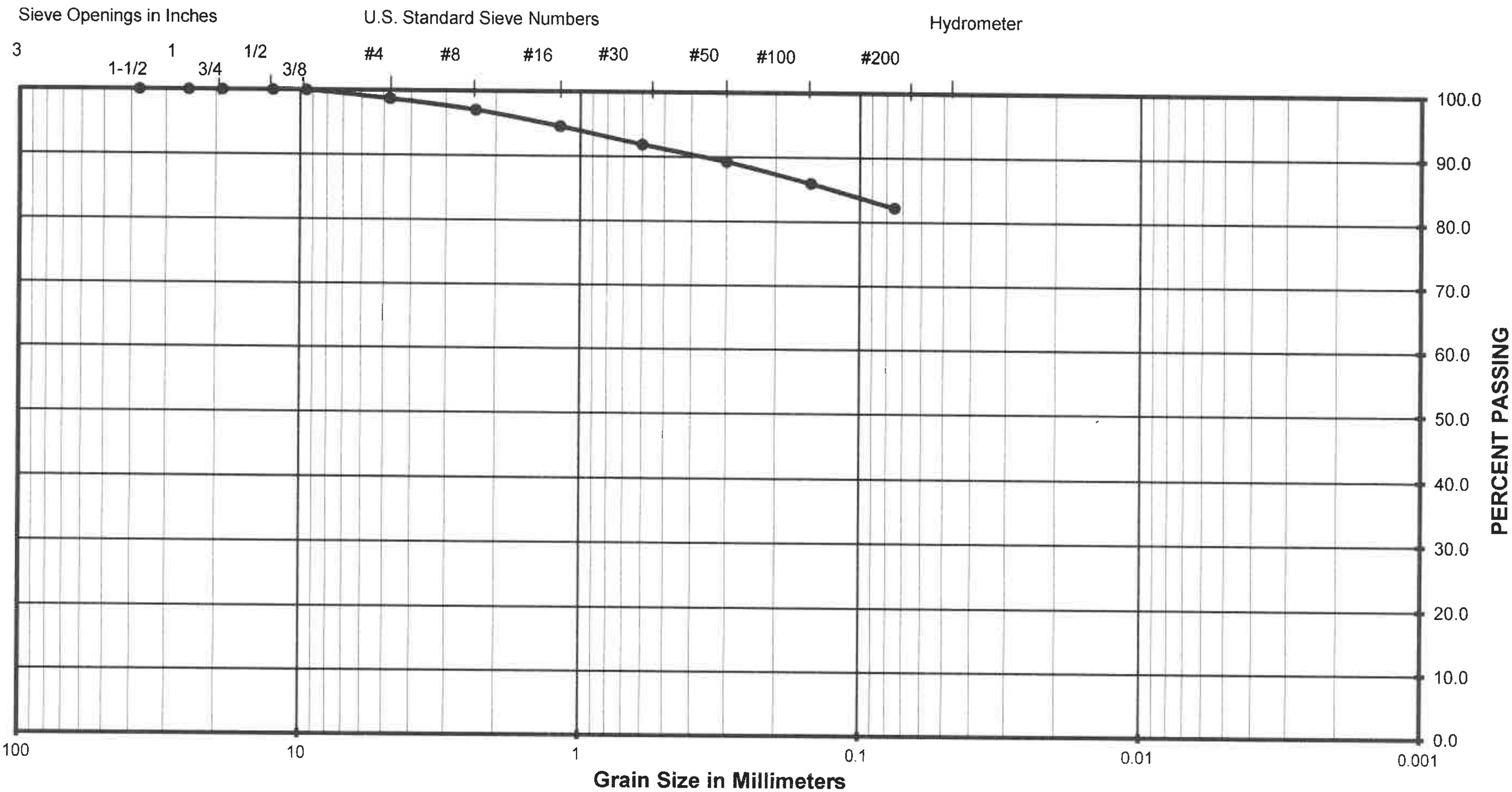
Shear Strength Diagram (Direct Shear)
ASTM D - 3080 / AASHTO T - 236

Project Number	Boring No. & Depth	Soil Type	Date
032-17032	B12 @ 10-11'	CL	11/20/2017



Krazan Testing Laboratory

Grain Size Analysis



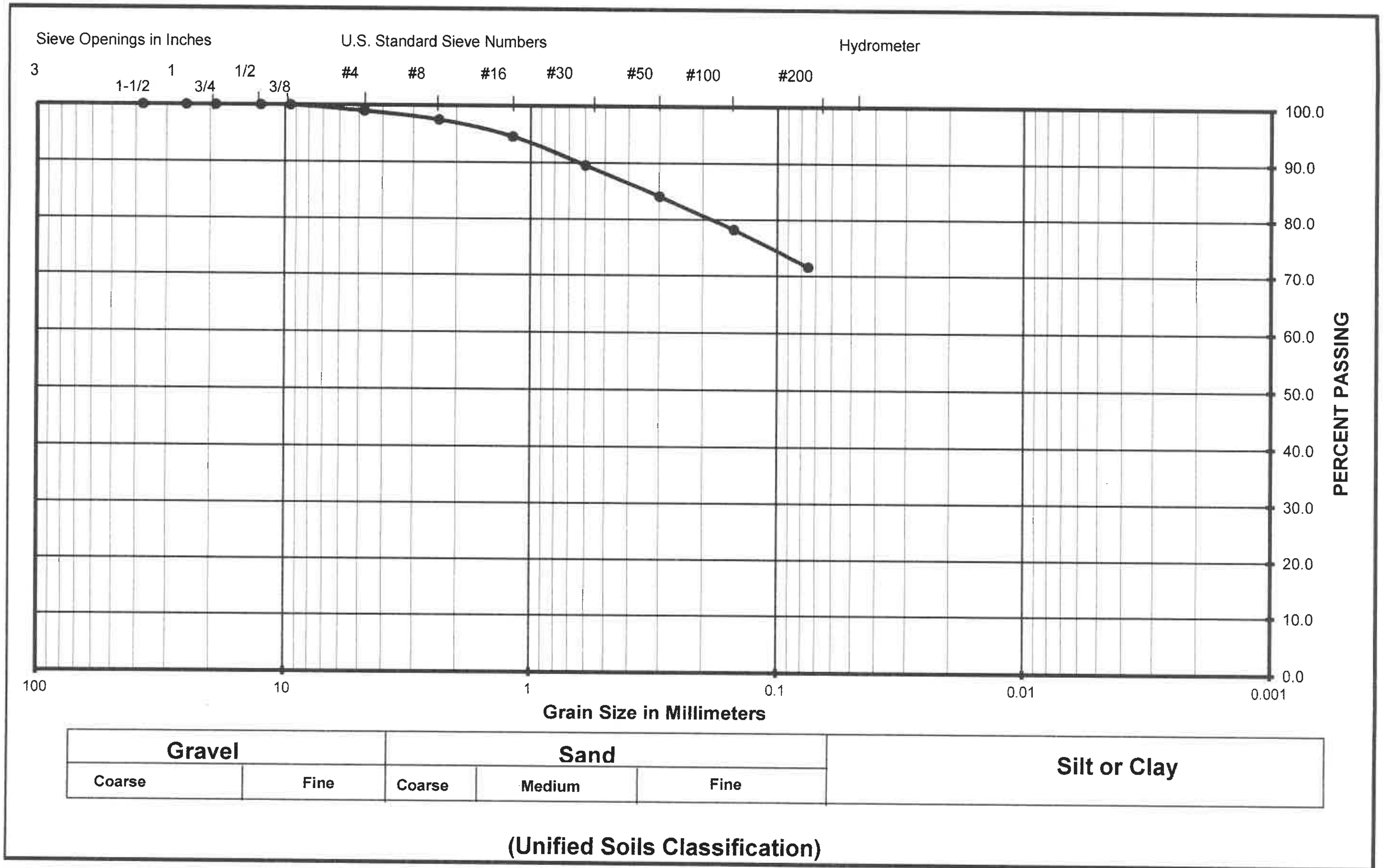
Gravel		Sand			Silt or Clay
Coarse	Fine	Coarse	Medium	Fine	

(Unified Soils Classification)

Project Name	Cloverdale Apartments
Project Number	032-17032
Soil Classification	CL
Sample Number	B5 @ 2-3'

Krazan Testing Laboratory

Grain Size Analysis



Project Name	Cloverdale Apartments
Project Number	032-17032
Soil Classification	CL
Sample Number	B8 @ 2-3'

Krazan Testing Laboratory

Expansion Index Test

ASTM D - 4829/ UBC Std. 18-2

Project Number	: 032-17032
Project Name	: Cloverdale Apartments
Date	: 11/20/2017
Sample location/ Depth	: 3-4'
Sample Number	: X2
Soil Classification	: CH

Trial #	**1**	**2**	**3**
Weight of Soil & Mold, gms	535.8		
Weight of Mold, gms	187.4		
Weight of Soil, gms	348.4		
Wet Density, Lbs/cu.ft.	105.1		
Weight of Moisture Sample (Wet), gms	300.0		
Weight of Moisture Sample (Dry), gms	259.7		
Moisture Content, %	15.5		
Dry Density, Lbs/cu.ft.	91.0		
Specific Gravity of Soil	2.7		
Degree of Saturation, %	49.2		

Time	Inital	30 min	1 hr	6hrs	12 hrs	24 hrs
Dial Reading	0	--	--	--	--	0.146

Expansion Index $_{measured}$ = 146

Expansion Index = 146

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

Expansion Index Test

ASTM D - 4829/ UBC Std. 18-2

Project Number	: 032-17032
Project Name	: Cloverdale Apartments
Date	: 11/20/2017
Sample location/ Depth	: 0-1'
Sample Number	: BS-3
Soil Classification	: SC

Trial #	**1**	**2**	**3**
Weight of Soil & Mold, gms	548.6		
Weight of Mold, gms	182.1		
Weight of Soil, gms	366.5		
Wet Density, Lbs/cu.ft.	110.5		
Weight of Moisture Sample (Wet), gms	300.0		
Weight of Moisture Sample (Dry), gms	265.0		
Moisture Content, %	13.2		
Dry Density, Lbs/cu.ft.	97.6		
Specific Gravity of Soil	2.7		
Degree of Saturation, %	49.1		

Time	Inital	30 min	1 hr	6hrs	12 hrs	24 hrs
Dial Reading	0	--	--	--	--	0.031

Expansion Index $_{measured}$ = 31

Expansion Index = 31

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

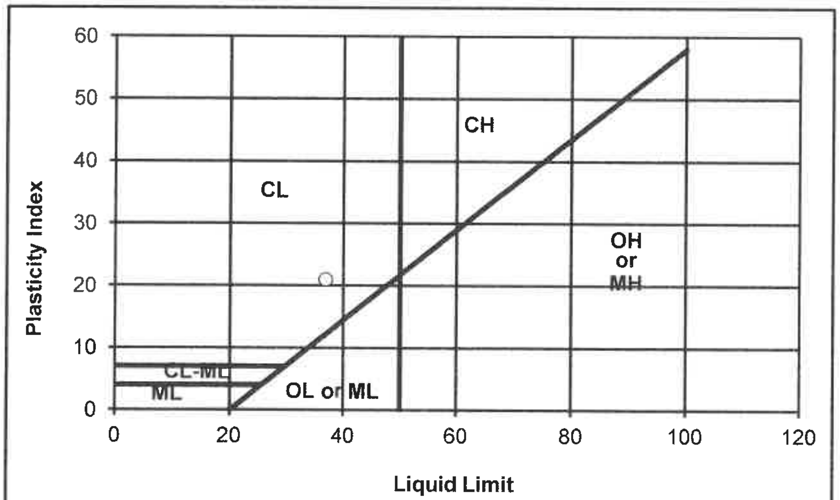
Project: **Cloverdale Apartments**
Project Number: **032-17032**
Date Sampled: 11/1/2017
Sampled By: RA
Sample Number:
Sample Location: B4 @ 10-11'
Sample Description: CL

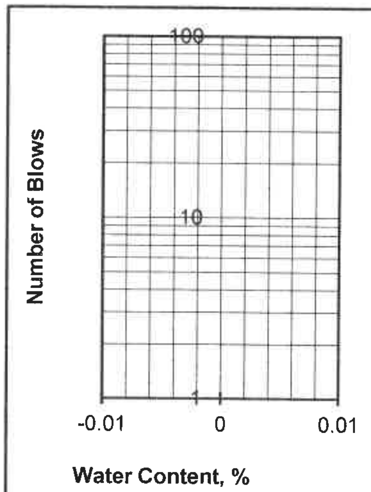
Date Tested: 11/17/2017
Tested By: J Mitchell
Verified By: J Gruszczynski

	Plastic Limit			Liquid Limit		
Trial Number	1	2	3	1	2	3
Weight of Wet Soil & Tare (g)	24.08	21.58		28.55		
Weight of Dry Soil & Tare (g)	22.77	20.63		24.73		
Weight of Tare (g)	14.98	14.76		14.36		
Weight of water (g)	1.32	0.94		3.82		
Weight of Dry Soil (g)	7.79	5.88		10.37		
Water Content (% of dry wt.)	16.9%	16.0%		36.8%		
Number of Blows				25		

Plastic Limit : 16 **Liquid Limit : 37**

Plasticity Index : 21
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

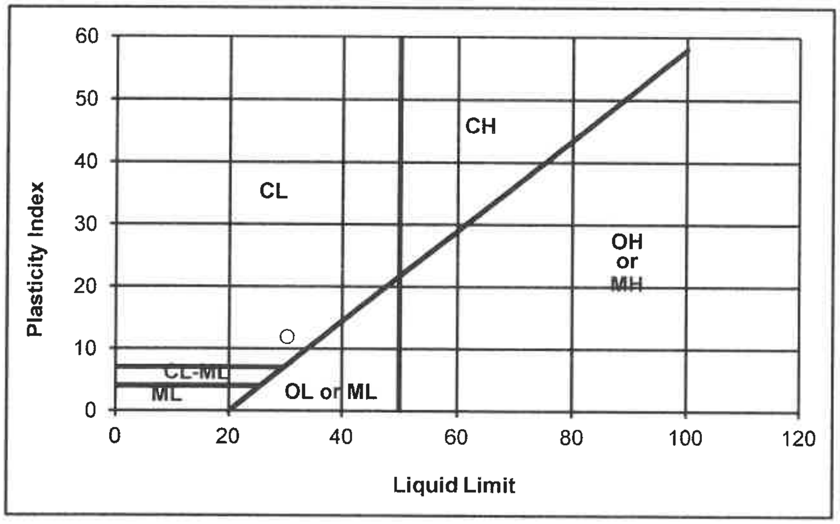
Project: **Cloverdale Apartments**
Project Number: **032-17032**
Date Sampled: 11/1/2017
Sampled By: RA
Sample Number:
Sample Location: B4 @ 15-16'
Sample Description: CL

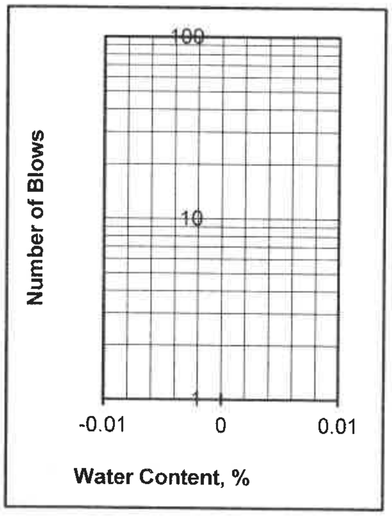
Date Tested: 11/17/2017
Tested By: J Mitchell
Verified By: J Gruszczynski

	Plastic Limit			Liquid Limit		
Trial Number	1	2	3	1	2	3
Weight of Wet Soil & Tare (g)	23.85	23.44		28.27		
Weight of Dry Soil & Tare (g)	22.59	22.04		25.01		
Weight of Tare (g)	15.38	14.64		14.16		
Weight of water (g)	1.26	1.39		3.26		
Weight of Dry Soil (g)	7.21	7.41		10.85		
Water Content (% of dry wt.)	17.5%	18.8%		30.1%		
Number of Blows				26		

Plastic Limit : 18 **Liquid Limit : 30**

Plasticity Index : 12
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

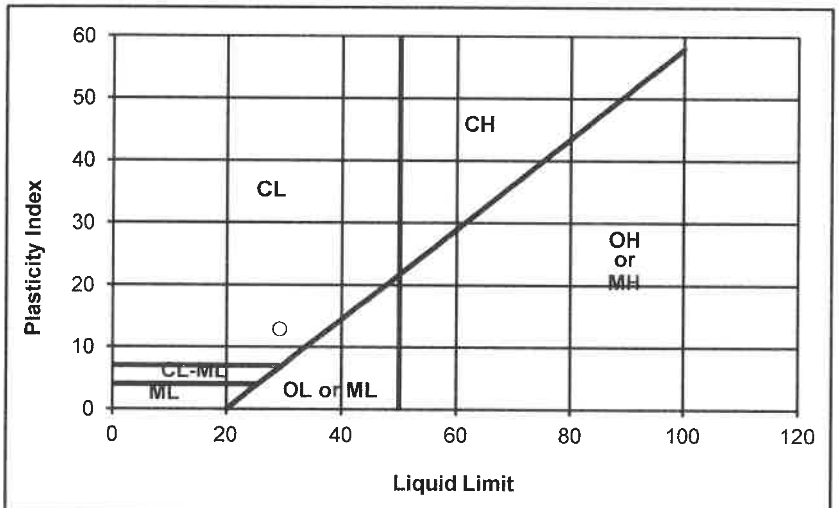
Project: **Cloverdale Apartments**
Project Number: **032-17032**
Date Sampled: 11/1/2017
Sampled By: RA
Sample Number:
Sample Location: B4 @ 20-21'
Sample Description: CL

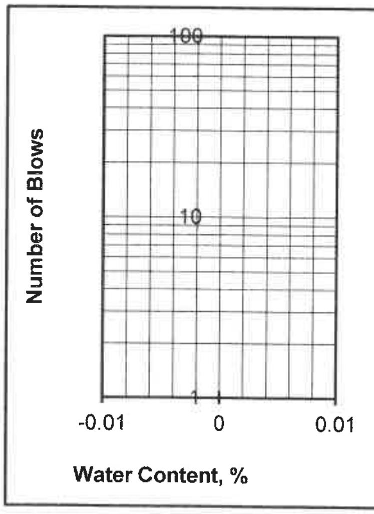
Date Tested: 11/17/2017
Tested By: J Mitchell
Verified By: J Gruszczynski

	Plastic Limit			Liquid Limit		
Trial Number	1	2	3	1	2	3
Weight of Wet Soil & Tare (g)	27.04	21.11		29.87		
Weight of Dry Soil & Tare (g)	25.63	20.03		26.47		
Weight of Tare (g)	17.06	13.47		14.81		
Weight of water (g)	1.41	1.08		3.41		
Weight of Dry Soil (g)	8.56	6.56		11.66		
Water Content (% of dry wt.)	16.5%	16.5%		29.2%		
Number of Blows				25		

Plastic Limit : 16 **Liquid Limit : 29**

Plasticity Index : 13
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: **Cloverdale Apartments**
Project Number: **032-17032**
Date Sampled: 11/1/2017
Sampled By: RA
Sample Number:
Sample Location: B4 @ 25-26'
Sample Description: CL

Date Tested: 11/17/2017
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)	24.83	27.73		32.57		
Weight of Dry Soil & Tare (g)	23.84	26.39		28.85		
Weight of Tare (g)	16.96	16.92		16.99		
Weight of water (g)	0.99	1.34		3.72		
Weight of Dry Soil (g)	6.88	9.46		11.86		
Water Content (% of dry wt.)	14.4%	14.1%		31.4%		
Number of Blows				25		

Plastic Limit : 14

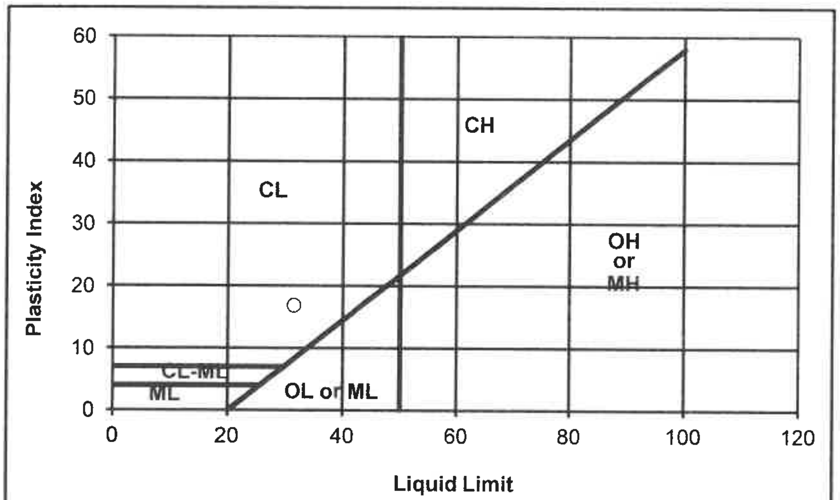
Liquid Limit : 31

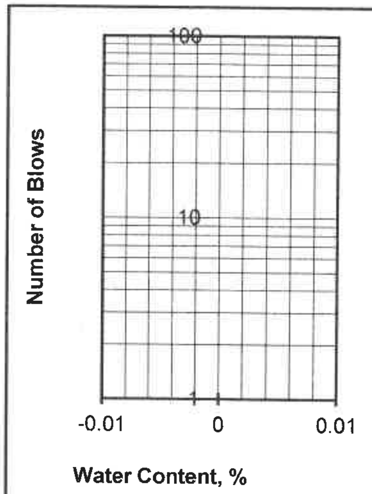
Plasticity Index : 17

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

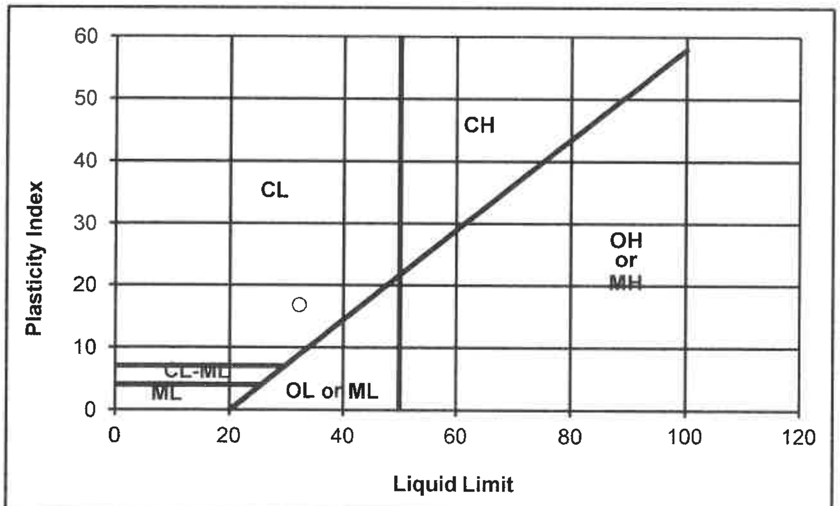
Project: **Cloverdale Apartments**
Project Number: **032-17032**
Date Sampled: 11/1/2017
Sampled By: RA
Sample Number:
Sample Location: B4 @ 30-31'
Sample Description: CL

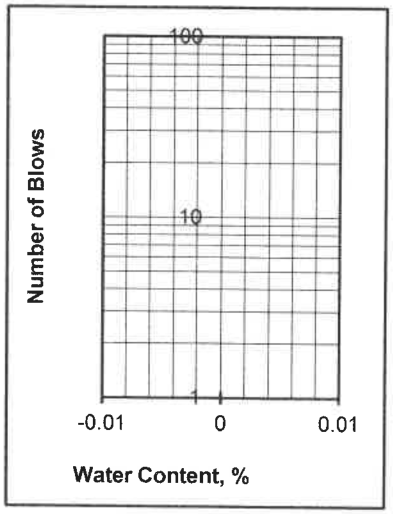
Date Tested: 11/17/2017
Tested By: J Mitchell
Verified By: J Gruszczynski

	Plastic Limit			Liquid Limit		
Trial Number	1	2	3	1	2	3
Weight of Wet Soil & Tare (g)	23.87	24.12		29.94		
Weight of Dry Soil & Tare (g)	22.69	22.91		26.14		
Weight of Tare (g)	14.96	14.73		14.36		
Weight of water (g)	1.18	1.21		3.80		
Weight of Dry Soil (g)	7.73	8.18		11.78		
Water Content (% of dry wt.)	15.2%	14.8%		32.2%		
Number of Blows				25		

Plastic Limit : 15
Liquid Limit : 32

Plasticity Index : 17
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: **Cloverdale Apartments**
Project Number: **032-17032**
Date Sampled: 11/1/2017
Sampled By: RA
Sample Number:
Sample Location: B4 @ 35-36'
Sample Description: CL

Date Tested: 11/17/2017
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)	21.65	23.48		29.89		
Weight of Dry Soil & Tare (g)	20.76	22.52		25.95		
Weight of Tare (g)	14.61	15.39		14.17		
Weight of water (g)	0.89	0.96		3.94		
Weight of Dry Soil (g)	6.15	7.14		11.78		
Water Content (% of dry wt.)	14.4%	13.5%		33.5%		
Number of Blows				25		

Plastic Limit : 14

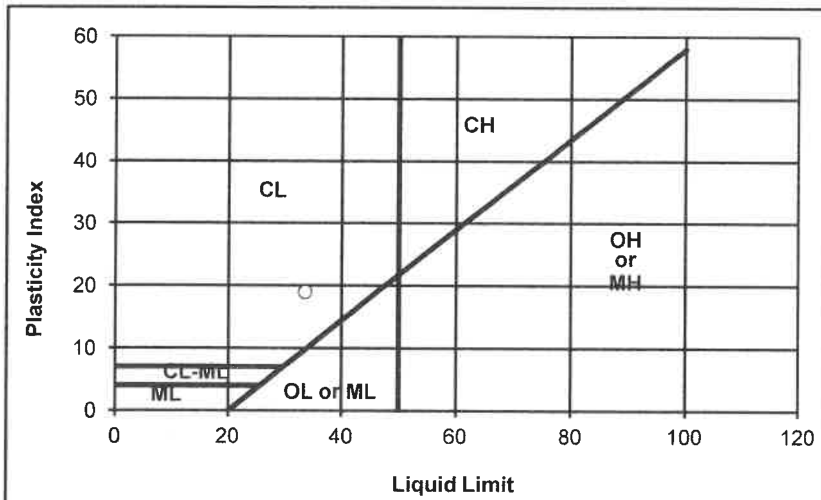
Liquid Limit : 33

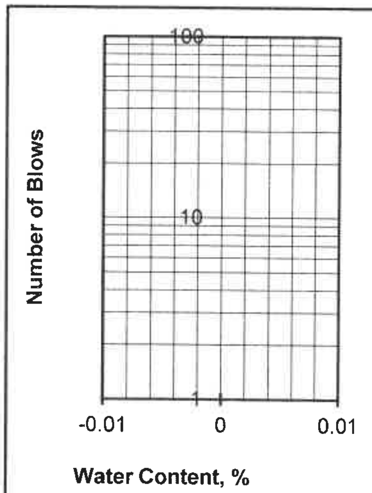
Plasticity Index : 19

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

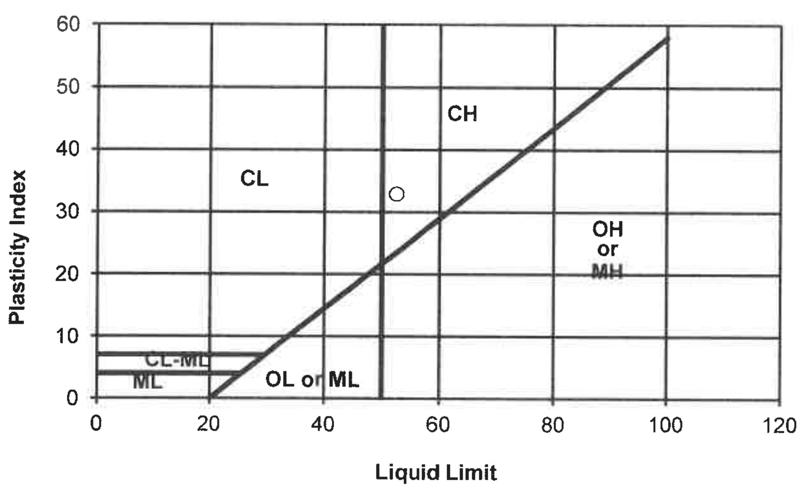
Project: **Cloverdale Apartments**
Project Number: **032-17032**
Date Sampled: 11/1/2017
Sampled By: RA
Sample Number: X2
Sample Location: 3-4'
Sample Description: CH

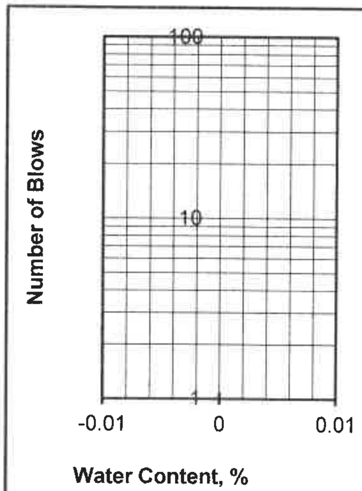
Date Tested: 11/17/2017
Tested By: J Mitchell
Verified By: J Gruszczynski

	Plastic Limit			Liquid Limit		
Trial Number	1	2	3	1	2	3
Weight of Wet Soil & Tare (g)	22.56	21.11		26.96		
Weight of Dry Soil & Tare (g)	21.38	20.11		22.61		
Weight of Tare (g)	14.73	14.95		14.33		
Weight of water (g)	1.18	1.00		4.34		
Weight of Dry Soil (g)	6.65	5.16		8.29		
Water Content (% of dry wt.)	17.7%	19.4%		52.4%		
Number of Blows				25		

Plastic Limit : 19 **Liquid Limit : 52**

Plasticity Index : 33
Unified Soil Classification : CH
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

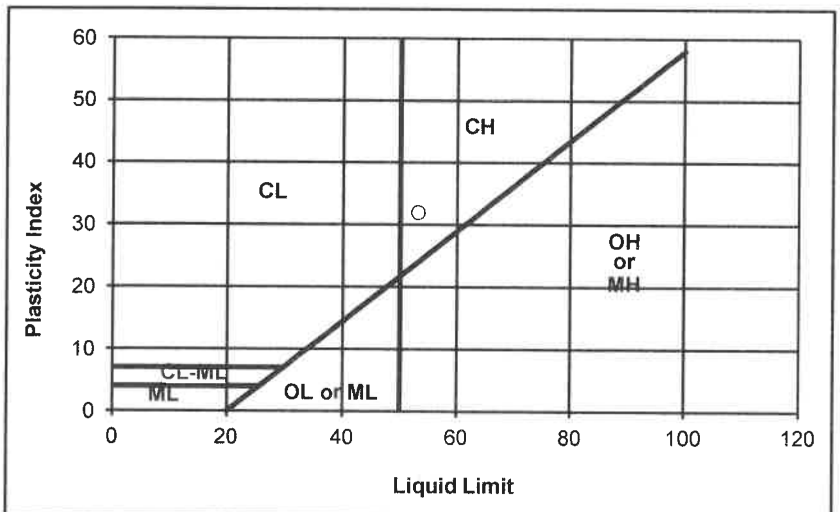
Project: **Cloverdale Apartments**
Project Number: **032-17032**
Date Sampled: 11/1/2017
Sampled By: RA
Sample Number: X4
Sample Location: 2-3'
Sample Description: CH

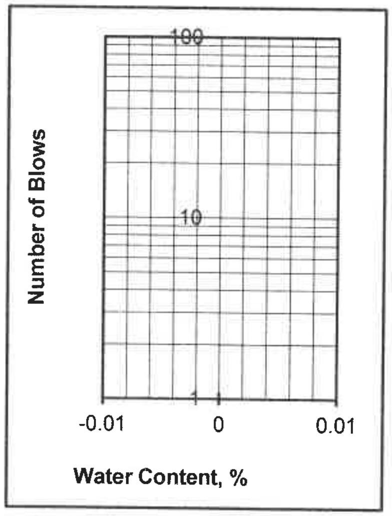
Date Tested: 11/17/2017
Tested By: J Mitchell
Verified By: J Gruszczynski

	Plastic Limit			Liquid Limit		
Trial Number	1	2	3	1	2	3
Weight of Wet Soil & Tare (g)	21.02	17.83		27.29		
Weight of Dry Soil & Tare (g)	19.96	17.29		22.80		
Weight of Tare (g)	14.97	14.74		14.35		
Weight of water (g)	1.07	0.54		4.49		
Weight of Dry Soil (g)	4.99	2.54		8.45		
Water Content (% of dry wt.)	21.4%	21.2%		53.1%		
Number of Blows				25		

Plastic Limit : 21 **Liquid Limit : 53**

Plasticity Index : 32
Unified Soil Classification : CH
Requirement:
Approx. % of Material Retained on # 40 Sieve:





Departures from Outlined Procedure:

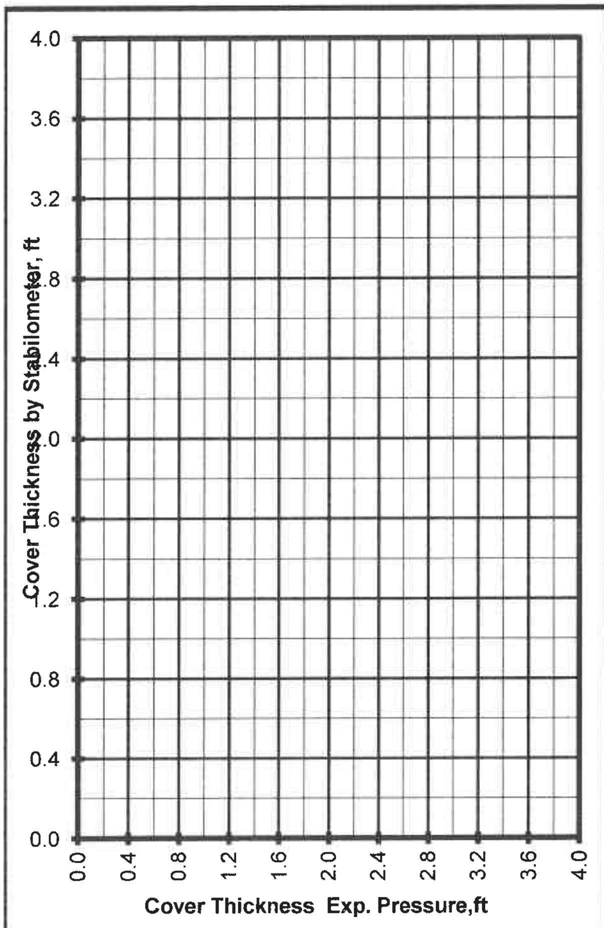
Unusual Conditions, Other Notes:

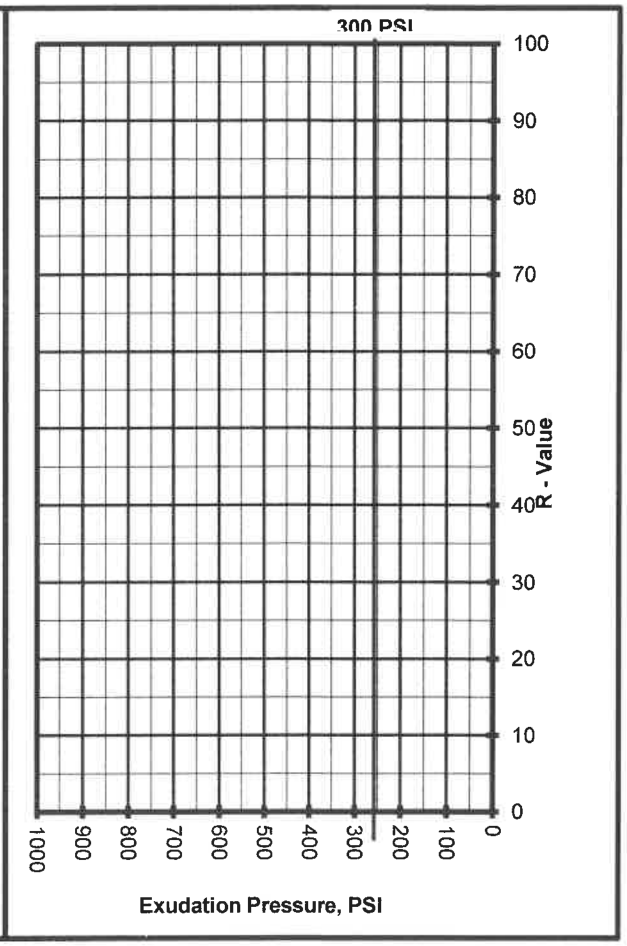
R - VALUE TEST
ASTM D - 2844 / CAL 301

Project Number	:	032-17032
Project Name	:	Cloverdale Apartments
Date	:	11/6/2017
Sample Location/Curve Number	:	RV#1
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	



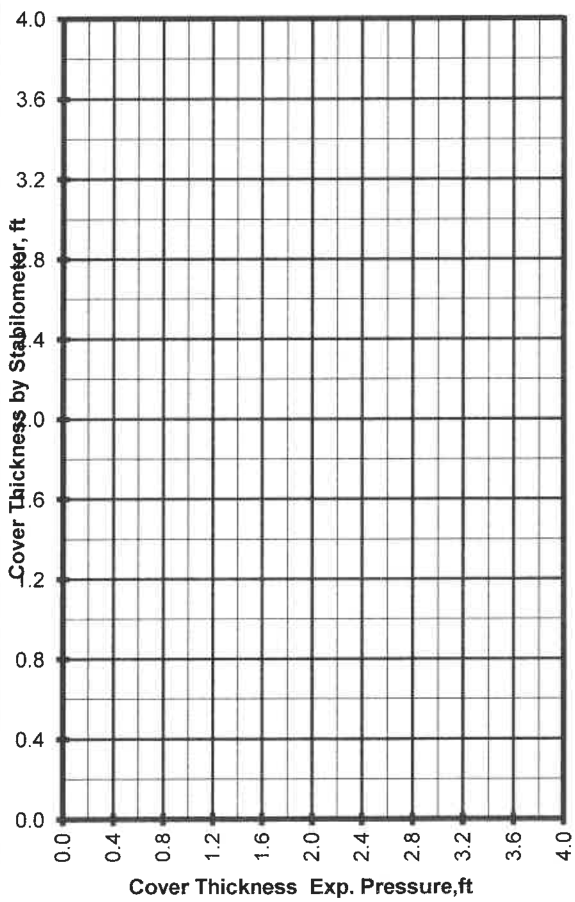


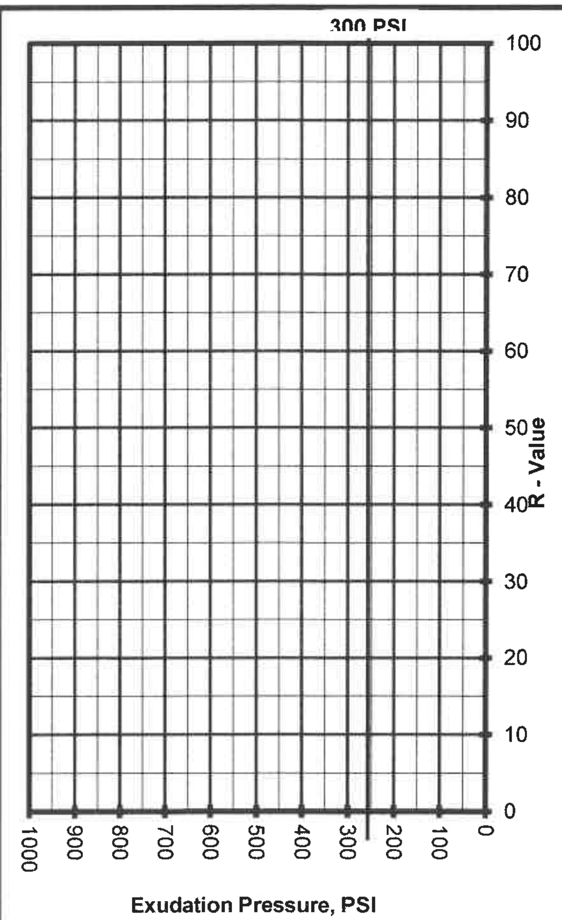
R - VALUE TEST
ASTM D - 2844 / CAL 301

Project Number	:	032-17032
Project Name	:	Cloverdale Apartments
Date	:	11/6/2017
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		
Exudation Pressure, psi	Sample Exuded from bottom of Mold		
Expansion Pressure, (Dial Reading)	During test		
Expansion Pressure, psf			
Resistance Value R			

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



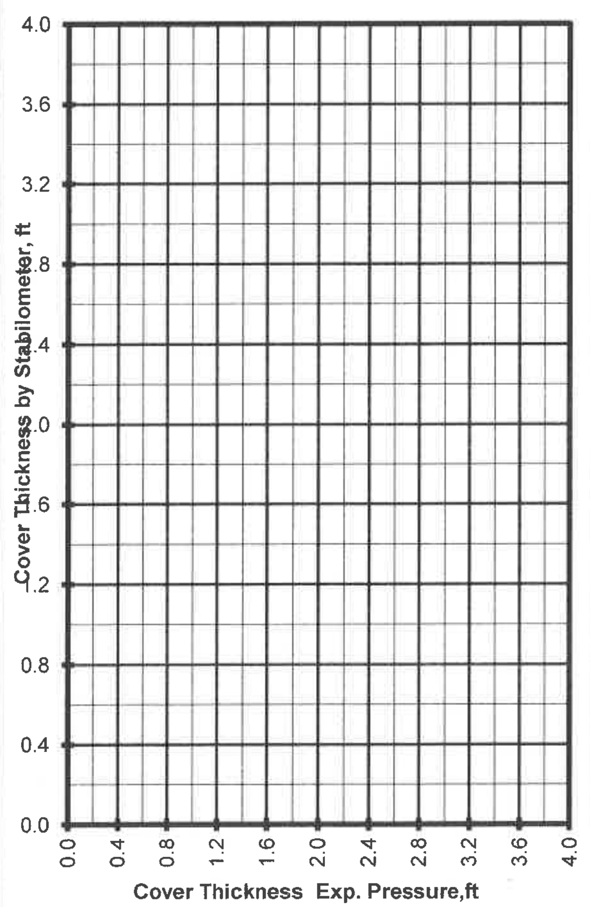


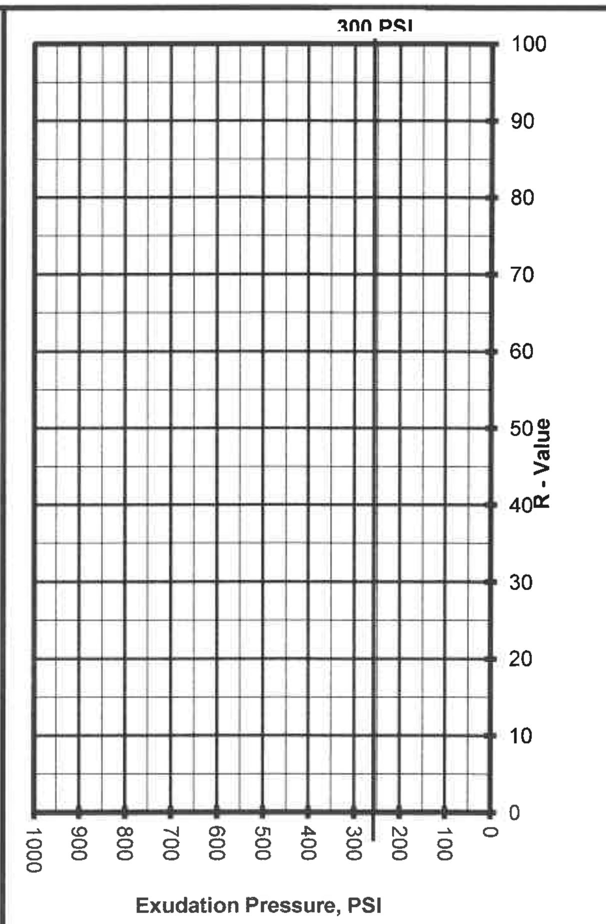
R - VALUE TEST
ASTM D - 2844 / CAL 301

Project Number	:	032-17032
Project Name	:	Cloverdale Apartments
Date	:	11/6/2017
Sample Location/Curve Number	:	RV#3
Soil Classification	:	CL

TEST	A	B	C
Percent Moisture @ Compaction, %			
Dry Density, lbm/cu.ft.	R - Value less than 5		
Exudation Pressure, psi	Sample Exuded from bottom of Mold		
Expansion Pressure, (Dial Reading)	During test		
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 2010 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 notes 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 95 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 compacted to a minimum relative compaction of 95 percent. 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.

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 of the Standard Specifications. 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 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.

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E.2 - Paleontological Records Search

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Kenneth L. Finger, Ph.D.
Consulting Paleontologist

18208 Judy St., Castro Valley, CA 94546-2306   510.305.1080   klfpaleo@comcast.net

March 18, 2019

Dana DePietro
FirstCarbon Solutions
1350 Treat Boulevard, Suite 380
Walnut Creek, CA 94597

Re: Paleontological Records Search: Baumgardner Ranch Development Project (4859.0002), Cloverdale, Sonoma County

Dear Dr. DePietro:

As per your request, I have conducted a search of the University of California Museum of Paleontology (UCMP) database for the Baumgardner Ranch Development project in the City of Cloverdale. The Public Land Survey (PRS) location of the site is SE¼, SE¼, Sec. 19 and NE¼, NE¼, Sec. 30, T11N, R10W, Cloverdale Quadrangle (USGS 7.5-series topographic map). The parcel is mostly flat and Google Earth imagery suggests that the surface has been heavily disturbed by prior agricultural development. The southwestern part of the site slopes to the northeast and has several structures indicating that its surface is disturbed as well.

<u>Geologic Units</u>

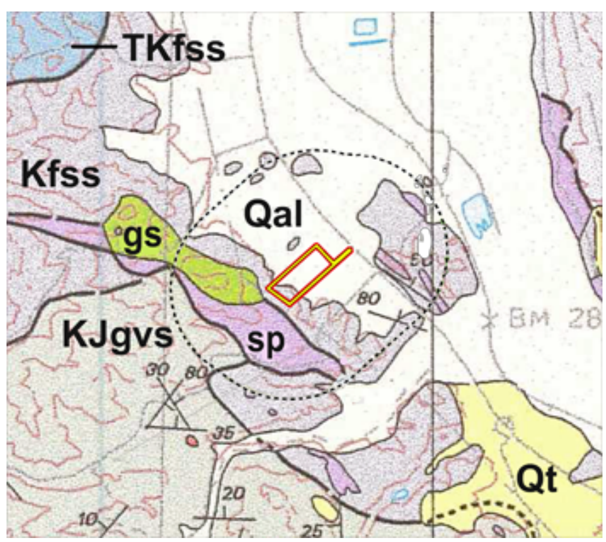
Qal Alluvial fan and fluvial deposits (Holocene–Pleistocene)
Qt Alluvial & marine terrace deposits (Pleistocene)

Franciscan Complex:
TKfss Sandstone (Late Cretaceous [Maastrichtian]–Late Eocene)
Kfss Sandstone (Late Cretaceous [Campanian–Turonian])

Mélange:
gs Greenstone block (Late? Cretaceous)

Great Valley Complex (Early Cretaceous–Late Jurassic)
KJgvs sandstone, siltstone, shale

Coast Range Ophiolite
sp Serpentinite block (Middle Jurassic)



Map derived from Blake, M.C., Jr., Graymer, R.W., and Stamski, R.E., 2002. Geologic map and map database of western Sonoma, northernmost Marin County, California. USGS Miscellaneous Field Studies Map MF-2402, scale 1:100,000.

As shown here on part of the geologic map of Blake et al. (2002), the project site (outline at center) is mostly on Quaternary alluvium (Qal); if Pleistocene, that alluvium could contain fossils. The southwestern end of the site is on Franciscan sandstone of Late Cretaceous age (Kfss) which likely extends in the subsurface subjacent the alluvium. Also within the surrounding half-mile search area (dashed outline) are older sedimentary rocks of the Great Valley Complex (KJgvs) and metamorphic blocks of greenstone (gs), serpentinite (sp). Only the three sedimentary units (Qal, Kfss, KJgvs) on the project site have the potential of being fossiliferous.

UCMP Database Records Search

For the Pleistocene of Sonoma County, the UCMP database lists one plant locality and 10 Rancholabrean (late Pleistocene) vertebrate localities. The plant locality is in a marine terrace at Bodega Head. The vertebrate locality nearest to the project site is V5213 (Five Oaks Ranch), nearly two miles northwest of the project site, which yielded cheek teeth of the *Mammut americanum* (American mastodon). The other nine vertebrate localities are in the vicinity of Santa Rosa, more than 25 miles south of Baumgardner Ranch. Their composite assemblage is 11 other Rancholabrean specimens, including *Clemmys* (pond turtle), *Glossotherium harlani* (Harlan's ground sloth), *G. robustus* (robust ground sloth), *Equus* (horse), *Bison bison antiquus* (extinct bison), and *Mammut americanum*., The database does not list any fossil localities for the Great Valley Complex (or Great Valley Sequence) in California, although there may be some listed under local subunits that were mapped in other counties. Furthermore, the database does not indicate any fossil localities of any age within a 5-mile radius of the project site. Although it records 17 vertebrate fossil localities for Sonoma County, all are in geologic units that are younger than the Great Valley Complex. The U.S. Geological Survey's website, however, notes "Jurassic and Cretaceous sedimentary rocks of both the Great Valley and Franciscan basement complexes contain fossils of the ancient mollusk, *Buchia*.

Conclusions and Recommendations

Most of the proposed project site is situated on undifferentiated Quaternary alluvium, which, if Pleistocene, would be highly sensitive but with a low potential for significant paleontological resources. Site disturbance precludes a preconstruction paleontological field survey. I don't recommend paleontological monitoring because 1) the Quaternary alluvium could be Holocene, and 2) only a single vertebrate specimen has been recovered within a 25 miles of the site. These factors suggest that it is highly unlikely any vertebrates will be unearthed on the site; however, I highly recommend having a professional paleontologist train the construction crew on what to look for and what to do if any fossils are found.

If I can be of further assistance on this project, please do not hesitate to contact me.

Sincerely,

Ken Finger

E.3 - Sonoma County Hazard Mitigation Plan, Figure 8.1

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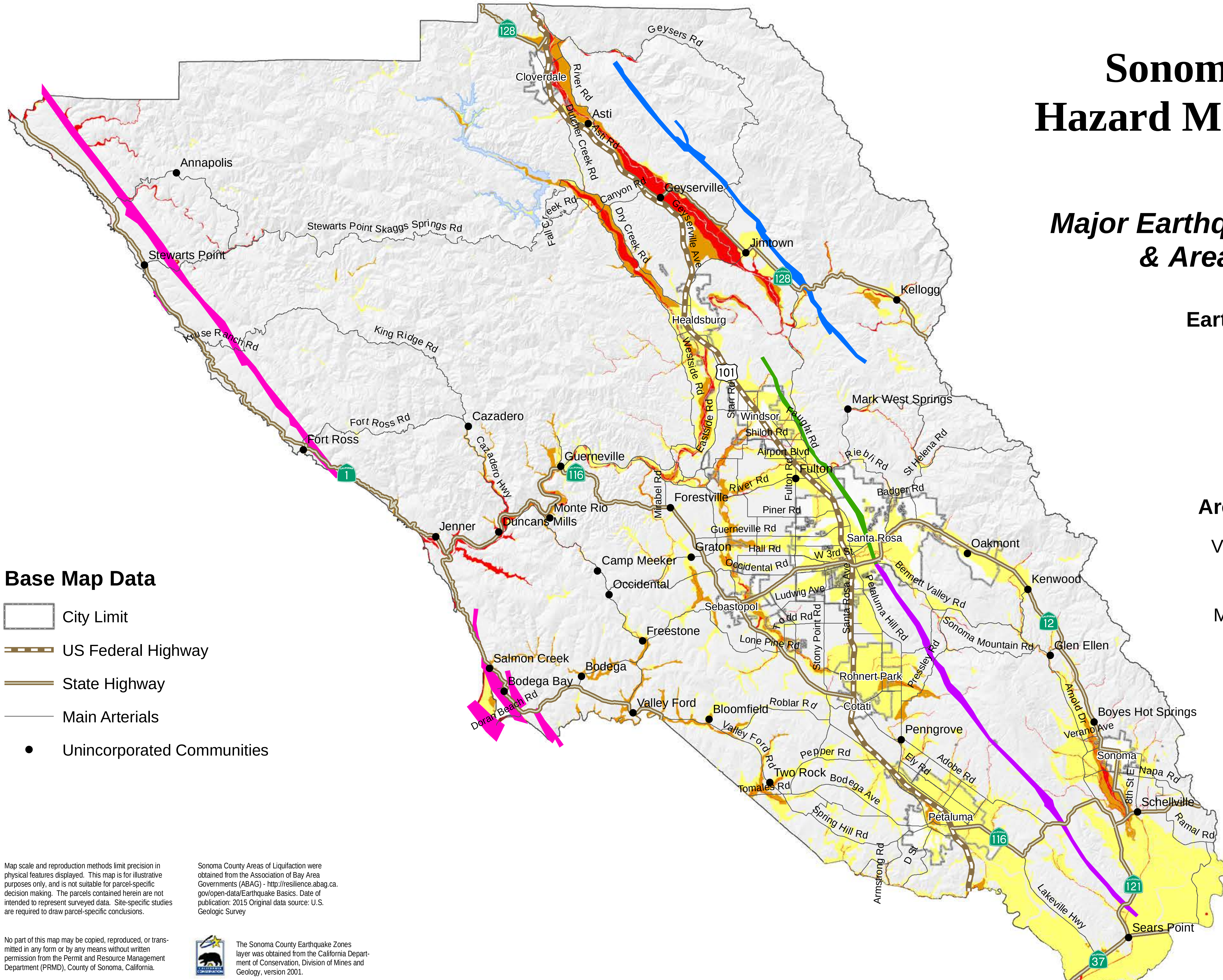
Sonoma County Hazard Mitigation Plan

Figure 8.1

Major Earthquake Fault Zones & Areas of Liquefaction



Earthquake Fault Zone Data

- Healdsburg
- Maacama
- Rodgers Creek
- San Andreas

Areas of Liquefaction Data

- Very High Susceptibility
- High Susceptibility
- Moderate Susceptibility

Base Map Data

- City Limit
- US Federal Highway
- State Highway
- Main Arterials
- Unincorporated Communities

0 2.5 5 Miles

1 inch equals 5 miles

Map scale and reproduction methods limit precision in physical features displayed. This map is for illustrative purposes only, and is not suitable for parcel-specific decision making. The parcels contained herein are not intended to represent surveyed data. Site-specific studies are required to draw parcel-specific conclusions.

Sonoma County Areas of Liquifaction were obtained from the Association of Bay Area Governments (ABAG) - http://resilience.abag.ca.gov/open-data/Earthquake Basics. Date of publication: 2015 Original data source: U.S. Geologic Survey

The Sonoma County Earthquake Zones layer was obtained from the California Department of Conservation, Division of Mines and Geology, version 2001.

County of Sonoma
Permit and Resource Management Department
2550 Ventura Avenue, Santa Rosa, California 95403
707-565-1900 FAX 707-565-1103

Author: PRMD Cartography: J. Samuels File Number: S:\GIS-DATA\PRMD_BASE\PRMD Department Projects\Comprehensive Planning\Hazard Mitigation Plan\HMP 2016\8_1_Earthquake_Faults_Liquifaction.mxd Date: 07/15/2016

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