REALM
Engineering
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GEOTECHNICAL REPORT

21258 MORGAN VALLEY ROAD, LOWER LAKE, CA

APN# 012-069-57-00

June 24, 2020

Contents

1.0 General

This report, generated by Realm Engineering, presents the results of our findings for APN 012-069-57-00 located on Morgan Valley Road in Lake County, California, hereby referred to as "Site". The results will be used to show the evaluated subsurface conditions and to provide construction recommendations at the Site, as well as to describe the geologic and seismic setting of the Site. Issues addressed will be risks associated with geological hazards found within the general vicinity.

1.1 Project Purpose and Scope

The purpose of this study is to evaluate the subsurface conditions and make recommendations for the proposed development in Lake County. The existing gravel access road to the site will not be included. Auto Canna, LLC ("Auto Canna") is seeking a Major Use Permit from the County of Lake for a proposed Outdoor Commercial Cannabis Cultivation Operation at 21258 Morgan Valley Road, Lower Lake, CA on Lake County APN 012-069-57 (Project Property). Auto Canna's proposed cultivation operation will be composed of four (4) A-Type 3 Medium Outdoor cultivation/canopy areas, with a total combined cultivation/canopy area of 153,560 ft2. Existing improvements on the Project Property include a groundwater well with a solar powered pump, a 5,000-gallon plastic water storage tank, a septic system designed for a single family dwelling, and a native soil surfaced access road. Proposed ancillary facilities include seven additional 5,000-gallon plastic water storage tanks, a gravel 20-foot wide access road, a 120 ft2 Pesticides and Agricultural Chemicals Storage Area (wooden shed), and a 5,000 ft2 Cannabis Drying & Storage Facility (metal building) with a roof-mounted photovoltaic solar array.

1.2 Previous Studies at Site

There are currently no known previous geotechnical studies that have been performed at the Site. There have been no recent studies done on neighboring parcels.

1.3 California Building Code Requirements

Section 1803 of the California Building Code (CBC), state that Geotechnical investigations shall be conducted where required by the building official or where geotechnical investigations involve in-situ testing, laboratory testing, or engineering calculations. Section 1803.1.1.1 states that each city, county, or city and county shall enact an ordinance which requires a preliminary soil report, prepared by a civil engineer who is registered by the state. The report shall be based upon adequate test boring or excavations. This section also states that the preliminary soil report may be waived if the building department of the city, county, or city and county, or other enforcement agency determines if an analysis is not necessary.

1.4 Lake County Requirements

The Lake County Development Services Department – Planning Division offers a checklist which outlines their requests of analysis and assessment reports for any project site. On this checklist, a note is included that some services may be rendered not applicable with a given explanation. Also, on this checklist, a Geotechnical Report is requested. This checklist states "A Geotechnical Report shall be provided for all projects requiring discretionary approval by the Planning Commission, or as required pursuant to the California building Code, or as otherwise recommended by the Development Services Director or his/her designee. The Development Services Director or his/her designee may waive the requirements for a geotechnical report when the proposed project is so minor that it does not pose a

threat to the public health, safety, and welfare." This project does not fall under this exception and our field test pits and excavations are logged here for use. The engineer of record will be on site to observe all grading, compaction and trenching activities. We will be obtaining the compaction results and making field recommendations weekly as the project is under construction.

2.0 Findings

2.1 Field Investigation

Realm Engineering conducted a field investigation on Thursday June 18th, 2020 to evaluate surface conditions for the proposed buildings and outdoor cultivation areas. Field investigations were limited to reconnaissance-level geologic mapping of the project site.

The weather conditions of the site at the time of the assessment were sunny and about 90 degrees Fahrenheit. The ground was dry, and exposed rock outcrops would have been easy to spot due to sparse grass cover. There were little to no outcrops found. Natural ephemeral water courses showed natural erosion. If there had been outcrops, they would have been exposed by the flowing water. None were found.

2.2 Surface/Subsurface Conditions

The general topography at the site slopes from the proposed construction area, which is the flat area of the property, Southwest and North. The most prominent types of vegetation are the native grasses and shrubs and oak trees. Much of the South side of the parcel is inaccessible due to the steep sloping topography of almost 40%. Many natural Ephemeral Class III Watercourses exist across the property sloping to the North and Southwest.

There were few barren spots on the parcel. There were few gopher holes. There were distinct trails created by deer and rabbits.

On June 18th, two test pits were dug using hand tools, digging bar, post hole digger, pick/shovel and a laborer to investigate subsurface conditions. These findings can be seen in **Attachment F** labeled "Logs of Test Pits 1-2." The concurrent locations of the test pits can be seen on **Attachment E**. Findings from test pits can be seen in **Attachment G.**

2.3 Near Surface Conditions

The project location is in the vicinity of the Lower Cretaceous-Upper Jurassic Great Valley Sequence, composed mostly of marine mudstones, siltstones, sandstones, and conglomerate, like that of the Sacramento Valley. The general surface of the Sacramento Valley is covered by recent and Pleistocene-age alluvium that washed into the bottomlands by streams draining the adjacent highlands. The stream sediments consist of a heterogeneous assemblage of channel gravels, river sands, silt, and clay. In this case, clay would be the dominating shallow surface deposit.

There have been no previous logs from neighboring parcels. In 2013 a well permitted by the Lake County Environmental Health Division was drilled to a depth of 220 feet. It was reported to have been drilled

through clay, shale, and sandstone. There have been no other near surface investigations on or around the site.

2.4 Soil

2.4.1 NRCS WSS

The Site, according to the NRCS Web Soil Survey (WSS), has predominately a Skyhigh-Millsholm Loams soil series group (68% of area) and a Maymen-Estle-Snook complex soil series group. The Skyhigh-Millsholm series is described as typically being formed on hills and is generally derived from residuum of weathered sedimentary rocks. For this profile, the soil is expected to be loam down to 2", clay loam to 8", clay to 38", and then hitting bedrock. The soil series is a well-draining soil with high runoff and no ponding properties. The Maymen-Estle-Snook complex is described as typically being formed on hillslopes and mountains, and it is generally colluvium derived from sandstone and shale and/or residuum weathered from sandstone or shale. For this profile, the soil is expected to be gravelly loam down to 12" and then hitting bedrock. Please see **Attachment A** for soil group distribution and **Attachment B** for NRCS WSS description.

2.4.2 USDA Soil Series

The Skyhigh-Millsholm series consists of shallow to moderately deep, well drained soils formed in the material weathered from sedimentary rock. These soils are on foothills and have slopes of 15 to 50 percent. The mean annual precipitation is about 32 inches and the mean annual temperature is about 60°F.

The Maymen-Estle-Snook complex consists of shallow to moderately deep, excessively drained soils formed in the material weathered from sandstone and shale. These soils are located on hillslopes and mountains and have slopes of 30 to 75 percent. The mean annual precipitation is 43 inches and the

2.4.3 Notes

It should be noted that the WSS descriptions offer a *general* profile. Further tests and observations for confirmation or corrections of this description we reconducted. It should also be noted that the hydrologic profile for this area is considered class "D", which matches the general rating for these soils in differing portions of the state thus the rating between the NRCS WSS description.

It should also be noted that the USDA Soil Series description is generally describing the soil samples that were taken in the area as depicted in the sample location areas from the NRCS Soil Data Explorer on **Attachment B**. Soil samples obtained by NRCS near the Site are not listed, so it is unclear how samples were obtained or described originally.

3.0 Geologic Conditions

The Site is in the Southeast corner of Lake County located in the Coast Range Province of California. The Coast Range province constitutes a barrier between the Pacific Ocean and the Great Valley. This province is formed as an interaction between the North American and Pacific tectonic plates. The mountain ranges of the province are composed primarily of late Mesozoic, Cenozoic sedimentary strata.

In general, the Coast Range Province consists of metamorphic rock that forms many ridges and mountains; volcanic rocks that form volcanoes, hills, geysers, and hot springs; and sedimentary rocks that form groundwater basins in valleys. After the formation was deposited, it was uplifted and squeezed by movement of the tectonic plates, forming most of the Coast Ranges as we see it today.

Faulting has occurred where Lake County is today, lowering a region in the Coast Ranges. This area was filled with gravels and sands from creeks in the mountains and became the Cache Formation. Faulting created a depression in this region which now contains Clear Lake. Other depressions and valleys in the Coast Ranges began to be filled with sands, silts and gravels carried by streams, resulting in the deposition of alluvial basins.

4.0 Geological Hazards

4.1 Seismic Hazards Zonation Program

California Building Code (CBC) requires analysis of liquefaction and slope-stability for various categories of construction and prescribes alternative methods to obtain the ground motion inputs used in these analyses. These provisions must be adhered to for certain seismic structural design categories specified in the CBC. Ground motions used to evaluate liquefaction or slope stability for projects defined under the Seismic Hazards Mapping Act (SHMA). The purpose of the SHMA is to minimize loss of life and property through the identification, evaluation and mitigation of seismic hazards. The SHMA was passed by the legislature following the 1989 Loma Prieta earthquake.

4.2 Alquist -Priolo Act

In 1972, the California State Legislature enacted the Alquist-Priolo Earthquake Fault Zoning Act (California Public Resources Code Section 2691), which requires the State Geologist to delineate Earthquake Fault Zones around all known traces of potentially and recently active faults in California. For the purposes of the Alquist-Priolo Act, active faults are faults which have caused surface rupture within the Holocene Period, which is defined as the last 11,000 years.

The Alquist-Priolo Act requires withholding of construction permit approval until geologic investigation has determined that the building site is not threatened by surface fault displacement. The Earthquake Fault Zones are usually one-quarter mile or less in width. The California Division of Mines and Geology (CDMG) has prepared maps which identify Alquist-Priolo Earthquake Fault Zones in Shasta County. These maps were adopted in November 1991 by the CDMG and affect some rural areas in northeastern Shasta County, however, the Site is not located within these Fault Zones. See **Attachment C** for proximity of faults to the Site.

4.3 Seismicity

Although not as active as some areas of the State, Lake County is a seismically active region. The seismicity of a region is described as the distribution, recurrence, and intensity of earthquakes over a period. Earthquake activity has not been a serious hazard in Lake County's history, nor is it probable that it will become a serious hazard in the future.

During an earthquake, ground rupture with horizontal and/or vertical displacement may occur. Usually, the width of surface faulting is narrow in rock and much wider in saturated soils. Ground rupture also tends to occur along lines of previous faulting. With detailed investigation, surface faulting usually can

be recognized and avoided. However, not all fault traces have been mapped, and some active faults have no surface expression.

The Site has two pre-quaternary faults with one half a mile northwest of the project location, and the other approximately 1.5 miles southeast of the Site. See **Attachment C** for proximity to the Site. Quaternary faults are those with the latest movement within the last two to three million years. The State of California (California Division of Mines and Geology) considers Quaternary faults to be potentially active. After an on-site investigation, there were no signs of active faulting or previous overgrown fault scarps. Based on the proximity of the pre-quaternary faults, a seismic hazard for the site is low.

4.4 Landslides

Landslides tend to occur in weak soil and rock on sloping terrain. The Zone of Required Investigation for earthquake-induced landslides generally indicate areas characterized by steep slopes composed of weak materials that may fail when shaken by an earthquake. The process for zonation of earthquake-induced landslides incorporates expected levels of future earthquake shaking, evidence of existing landslides, slope gradient and strength of hillslope materials.

Lake County is not normally subject to landslides. The Site is not located in a vicinity that is subject to landslides, or within the Zone of Required Investigation. The steep topography of the site would allow landslide activity. However, no evidence of previous landslide activity was present.

4.5 Liquefaction

Liquefaction occurs when loose, water-saturated sediments lose strength and fail during strong ground shaking. Liquefaction is defined as the transformation of granular material from a solid state into a liquefied state because of increased pore-water pressure. The process of zonation for liquefaction combines Quaternary geologic mapping, historical ground-water information and subsurface geotechnical data. The liquefaction hazard Zone of Required Investigation boundaries are based on the presence of shallow (< 40 feet depth) historic groundwater in uncompacted sands and silts deposited during the last 15,000 years and sufficiently strong levels of earthquake shaking expected during the next 50 years.

The Site is not located within a Zone of Required Investigation.

4.6 Expansive soil

Expansive soils, known as vertisols, are prone to large volume changes (swelling and shrinking) that are directly related to changes in water content. Soils with a high content of expansive minerals can form deep cracks in drier seasons or years. A high clay content severely affects the expansivity of a soil. The native soils that will be used in constructing the building pad are very uniform in soil type. Clay soils when sampled for expansion index testing often meet the definition of expansive soil per the California Building Code (CBC) section 1803.5.3. These soils have an EI of greater than 20. Clay soils typically exceed these criteria. The WSS and field conditions shows clay presence. The NRCS has a Calculated Coefficients of Linear Extensibility (COLE) table for clay by use of the regression equation, which shows us that the COLE value of the soil to be within expansive soil areas. The COLE value for the Site is less than 0.03. Therefore, the extensibility possibility of the Site is considered low.

Please see **Attachment D** for table of COLE values. These studies when paired to test data confirms the field dig with loam and clay presence.

4.7 Percolation Rates for Stormwater

According to field tests the disposal material has been determined to comply with both required characteristics having an adequate percolation rate and depth to the high-water table. Estimates of the percolation rates would be (80 to 120) minutes/inch which is within the specified range of greater than 5 and less than 120 minutes per inch. It was also determined with the profile pit that the depth to a seasonal high-water table, as determined by the procedures in typical drainage standards, exceeded four feet, the minimum for this commercial application.

According to field results a test pit was also excavated with the absence of groundwater. The high groundwater has not been previously found in the vicinity and the test pit did not show cracked or creviced formations and did show a clear delineation that the top of the water table did not come up to the bottom of the pit. Therefore, as a result groundwater monitoring was not deemed necessary.

Based upon the field results that were performed on the above mentioned date and the tests were within the proposed disposal area on this property, along with evidence of no standing water in the excavated soil profile pit we feel the proposed drainage system design on this property meets the regulations of the Lake County Code and Storm Disposal Standards. The two test holes located in the proposed cultivation area is estimated to have an average percolation rate of 80 to 120 minutes per inch which is within the minimum percolation rates allowed. In summary we consider this project is ready to move forward onto the next stage of storm water development and design.

5.0 Conclusions and Recommendations

Based on the above findings, the surface and subsurface conditions, and the scope of the project, Realm Engineering concludes that the Site is suitable for the proposed construction project.

6.0 CBC/IBC Information

This section presents relevant information regarding soils as pertaining to Chapter 18 of the 2015IBC and the 2016CBC. Chapter 18 in each of these documents are identical, thus, we will refer to the CBC only throughout the remainder of this report. Potential geologic hazards consisting of land sliding, and liquefiable soils, as noted in Section 1802 of the CBC, are discussed above in Sections 2.5and2.7, respectively, of this report. The following sections present soils information from the CBC that could impact design of the project. Recommendations presented, herein, are based upon discussion with project owner along with stated assumptions. Changes in the configuration from those studied during this investigation may require supplemental recommendations. 3.1.1 Class of Materials as previously noted, the bearing soils on site consist of moderately stiff to very stiff, clayey sand to sandy clay with gravel with weathered Copley Greenstone beneath. In our opinion, those materials (if properly placed and compacted) correspond to at least a Class of Materials Type 4 as noted in Table 1806.2 of the CBC (allowable bearing capacity: 2,000 pound per square foot). That table presents presumptive foundation design information associated with Class of Materials types. If foundations are located on rock (Copley Greenstone) then allowable bearing pressure of3,500psf can be used to design foundations. Prior to placing steel or concrete, foundation excavations should be cleaned of all debris,

loose or disturbed soil, and any water. It is our recommendation that a representative of the engineer of record observe all foundation excavations prior to concrete placement.

6.1 Excavation

The bottom of all over-excavations should be ripped and cross-ripped to a minimum depth of six inches, we need to excavate all topsoil and contaminated soil then compact the subsurface to at least 90 percent of the ASTM D1557 maximum dry density. All areas to remain at-grade, to receive fill, or obtained by excavation should be scarified to a depth of six inches. Compaction should be performed using a heavy, self-propelled, sheepsfoot compactor and or a bobcat roller compactor. Compaction operations should be performed in the presence of our representative who will evaluate the performance of the sub grade under a capacitive load.

6.2 Utility Trench Backfill

Utility trench backfill should be mechanically compacted in maximum six-inch lifts. Trench backfill should be brought to uniform moisture content above the optimum moisture and each lift mechanically compacted to at least 90 percent of the maximum dry density. The upper six inches of trenches in pavement areas should be compacted to at least 95 percent of the maximum dry density. Jetting of trench backfill as a means of compaction is not acceptable. We recommend that native soil be used as trench backfill within the perimeter of the foundations to help minimize soil moisture variations beneath the slab. The native soil backfill should extend at least three feet horizontally beyond perimeter foundation lines. Utility trenches within the equipment pad perimeter should be backfilled with compactable material matching the upper 12 inches of subgrade material.

We recommend that underground utility trenches that are aligned nearly parallel with foundations be at least three feet laterally from the outer edge of foundations, wherever possible. Generally, trenches should not encroach into the zone extending outward at a 1:1 (horizontal to vertical) inclination below the bottom of the foundations. In addition, trenches parallel to foundations should not remain open longer than 72 hours. The intent of these recommendations is to prevent loss of both lateral and vertical support of foundations, resulting in possible settlement.
Pipe bedding, shading and trench backfill and compaction within municipal streets should conform to jurisdictional requirements.

6.3 Fill for All Infrastructure

All engineered fill should be placed in lifts that to not exceed six inches in compacted thickness. All engineered fill should be brought to optimum moisture content and compacted to at least 90 percent of the maximum dry density as determined by ASTM D1557. Any fill deeper than 5 feet should be compacted to at least 95 percent of the maximum dry density as determined by ASTM D1557. The upper 12 inches of the final equipment pad and exterior flatwork subgrades must consist of approved on-site or imported granular, non-expansive soils. The upper six inches of final equipment pad and exterior flatwork subgrades should be scarified, brought to at least the optimum moisture content and uniformly compacted to not less than 90 percent of the maximum dry density as determined by ASTM D1557.

The upper six inches of exterior slab subgrades supporting vehicle loadings should be scarified, moisture conditioned to at least the optimum moisture content and uniformly compacted to at least 95 percent of the ASTM D1557 maximum dry and must be stable under construction traffic prior to placement of

aggregate base. Final subgrade processing and compaction should be performed just prior to placement of aggregate base, after construction of underground utilities is complete.

6.4 Foundation Design of Harvest Storage Building

The proposed facilities may be supported upon continuous and/or isolated spread foundations extending a minimum of 12 inches into the prepared equipment pad or at least 12 inches below adjacent soil grade, whichever is deeper. Continuous foundations should be at least 12 inches wide, isolated foundations should be at least 14 inches wide. Foundations should be sized for a maximum allowable soil pressure of 2,000 pounds per square foot (psf) for the dead load plus live load condition with a 1/3 increase in allowable soil pressure for consideration of seismic or wind forces. At a minimum, all continuous foundations should contain at least two No. 4 steel reinforcing bars placed one each, near the top and bottom of the foundations. Foundation excavations should be observed by a representative of Realm Engineering.

6.5 Concrete Slab Design/Exterior Flatwork Construction of Harvest Storage Building

Thicker slabs with an increase in reinforcing will be needed in areas supporting higher loads or where increased performance is desired, especially within equipment areas. All concrete slabs should be at least four inches thick and, as a minimum, should be reinforced with chaired No. 3 reinforcing bars on 18-inch center-to-center spacing, located at mid-slab depth. For increased support, floor slabs should be underlain by at least six inches of Class 2 aggregate base compacted to at least 95 percent of the maximum dry density as determined by ASTM D1557. All concrete slaps require protection against moisture or moisture vapor penetration. For this protection a concrete moisture protection specialist should be consulted.

For increased support and performance, the exterior slabs may be underlain by a minimum four inches of class 2 aggregate compacted to 95 percent relative compaction. The structural engineer (REALM) will determine the final thickness, strength, reinforcement, and joint spacing of exterior slab-on-grade concrete. However, exterior flatwork should be at least four inches thick and be constructed independent of adjacent concrete foundations and isolated column foundation by the placement of a layer of felt material between the flatwork and the foundation. Thicker slabs constructed with thickened edges to at least twice the slab thickness should be constructed where light wheeled traffic or intermittent light loading is expected over the slabs.

6.6 Depth and Width of Foundations

We recommend that minimum foundation depths and widths, unless noted elsewhere herein, be designed in accordance with specified widths and depths noted in Table 1809.7 of the CBC. We recommend that foundations be founded either entirely in cut or entirely in engineered fill material to reduce differential settlement potentials. Foundations should not span both cuts and fills. If proposed foundations span both cuts and fills, and fill materials exceed 1 foot beneath the planned bottom of foundations, we recommend that the area of cuts supporting the proposed foundations should be over excavated below the planned bottom of footings to a depth of at least 3 times the width of the foundation. Engineer of record should observe and approve the over excavated area once exposed. Over excavation limits should extend throughout the cut area and to a minimum of five horizontal feet past the perimeter foundations of the structure. The over excavated area should then be backfilled in accordance with recommendations presented in Engineering Fill of this report; or

Proposed foundations should be deepened to extend through engineered fill materials to be supported on competent undisturbed native soils, so that the entire foundation system for the structure rests on undisturbed native soils. If this depth is less than 5 feet below the planned bottom of the foundation, then two-sack sand-cement slurry can be used as backfill in lieu of structural concrete, from the excavation bottom up to the planned bottom of the proposed foundation. The engineer of record should observe and approve the deepened foundation excavation prior to placement of slurry or structural concrete. If foundations do not span both cuts and fills, then neither of the two alternatives recommended noted above should be necessary.

6.7 Earthwork Testing and Observation

A final report by the "Geotechnical Engineer or Engineer of Record that is qualified from REALM" should be prepared upon completion of the project indicating compliance with or deviations from this report and the project plans and specifications.

7.0 Frost Penetration

Frost heave is not typically a hazard in the Lower Lake area and is generally not considered in design of foundation systems. Therefore, no recommendations for frost protection have been provided herein.

8.0 Site Preparation and Grading

8.1 Stripping

Prior to general site grading and/or construction of planned improvements, vegetation, organic topsoil, debris, ashes, and deleterious materials should be stripped and disposed of off-site or outside the construction limits. Any tree or shrub root balls encountered during stripping could extend deep below grade and should be removed during stripping. Stripped topsoil (less any debris, boulders or large tree roots) may be stockpiled and reused for landscape purposes; however, this material should not be incorporated into any engineered fill.

8.2 Existing Utilities, Wells, and/or Foundations

Below-grade utility lines, cesspools, wells, irrigation ponds and/or foundations encountered during construction should be removed and disposed of off-site. Buried tanks, if present, should be removed in compliance with applicable regulatory agency requirements. Existing, below-grade utility pipelines (if any) that extend beyond the limits of the proposed construction and will be abandoned in-place should be plugged with lean concrete or grout to prevent migration of soil and/or water. All excavations resulting from removal and demolition activities should be cleaned of loose or disturbed material prior to placing any fill or backfill.

8.3 Scarification and Compaction

Following site stripping and over excavation, areas to receive engineered fill should be scarified to a depth of 6 inches, uniformly moisture-conditioned to near optimum moisture content, and compacted to at least 90 percent of the maximum dry density as determined using standard test method ASTM D15571.This test procedure applies wherever relative compaction, maximum dry density, or optimum moisture content is referenced within this report.

Wet/Unstable Soil Conditions if site preparation or grading is performed in the winter, spring, or early summer seasons, or shortly after significant precipitation, near-surface on-site soils may be significantly over optimum moisture content. This condition could hinder equipment access as well as efforts to compact site soils to a specified level of compaction. In addition, perched water can be present in subsurface layers throughout the year and contribute to wet soil conditions. If over optimum soil moisture content conditions are encountered during construction, disking to aerate, replacement with imported material, chemical treatment, stabilization with a geotextile fabric or grid, and/or other methods will likely be required to facilitate earthwork operations. The applicable method of stabilization is the contractor's responsibility and will depend on the contractor's capabilities and experience, as well as other project-related factors beyond the scope of this investigation. Therefore, if over-optimum moisture within the soil is encountered during construction, the EOR should review these conditions (as well as the contractor's capabilities) and, if requested, provide recommendations for their treatment.

8.4 Site Drainage around the cultivation areas

All grade adjacent to structures should be sloped away from the foundations at a minimum two percent slope for a distance of at least five feet of hardscape. The ponding of water should not be allowed adjacent to structures or fill slopes. Surface runoff should be directed toward engineered collection systems or suitable discharge areas. Roof downspouts should also be collected, conveyed, and discharged away from all structures and into engineered systems, such as storm drains as proposed on the drainage sheets. Overall drainage of the site is north and south-southeast with an approximate elevation range of 2850 to 2150 ft mean sea level (msl).

8.5 Over excavation & Subgrade Preparation for access roads

The upper layer of the onsite soil appears to be qualified to be used for fill/disturbed material. It should be noted that in order to create a flat pad, it is recommended that any deleterious materials or soft soil that are encountered at the project site be removed. Areas that are over excavated should be backfilled with engineered fill materials, in accordance with recommendations presented in the Engineered Fill Section of this report. If soft soil material is not removed within slab area, there is a risk that slab cracking may occur due to differential settlement, unless the slab is reinforced structurally.

8.6 Temporary & Permanent Slopes

Temporary construction slopes can be constructed at ½:1 inclination if the temporary cut slopes are less than 6 feet in height. All other temporary slopes should be constructed no steeper than 1:1. This section explicitly excludes trench slopes for buried utilities. Permanent slopes (cut and fill) should be constructed at inclinations of 2:1 or flatter. In isolated areas where a cut slope is less than 8 feet tall, is adequately protected from erosion, and is not intended to support structures or surcharges, then the cut slope can be constructed at inclinations of 1.5:1 or flatter, per Section J106 of the 2016CBC. In order to comply with CBC regulations, minimum setbacks for proposed structures should be equivalent to the height of the slope divided by 3 but need not exceed 40 feet. Minimum setbacks for proposed pools should be equivalent to height of the slope divided by 6, but not to exceed 20 feet. If the desired setbacks are less than these requirements, then the foundations of the structures should be deepened or opt for alternate setbacks in accordance with requirements of section 1808.7.5 of 2016CBC.3.3

8.7 Placement and Compaction

Soil and/or soil-aggregate mixtures used for fill should be uniformly moisture-conditioned to within 2 percent of optimum moisture content, placed in horizontal lifts less than 8 inches in loose thickness, and compacted to at least 90 percent relative compaction. It is recommended that the fill slopes be overbuilt by at least one horizontal foot then trimmed to expose a firm, compacted surface. Testing should be performed to verify that the relative compaction is being obtained as recommended herein. Compaction testing, at a minimum, should consist of one test per every 500 cubic yards of soil being placed or at every 0.5-foot vertical fill interval, whichever comes first. In general, a "bobcat roller", "sheep's foot" or "wedge foot" compactor should be used to compact fine-grained fill materials. A vibrating smooth drum roller could be used to compact granular fill materials and final fill surfaces.

9.0 Conclusion

In conclusion with the positive test holes and field results the probability of passing compaction requirements on the terracing, roads, trenches and building pads are high with appropriate construction methods. The completed testing per ASTM Standard D4829 "Test for Expansion Index of Soils" on the soil obtained from the proposed building area. The native soils that will be used in the constructing the building pad are very uniform in soil type. It is our judgement that the sample obtained for testing representative of the worst case for expansive soils on the project. The soil has an EI of less than 20 and therefore does not meet the definition of expansive soil per the California Building Code (CBC) section 1803.5.3. REALM does not represent that these tests results and/or recommendations are suitable whether modified, for any other site or structure on this site than the one for which they were specifically prepared. REALM does represent these findings to constitute as a soils report for the purposes of determining allowable bearing values of above 1,500 psf for the foundation design parameters that were used. REALM disclaims responsibility for these tests results and/or recommendations if they are used whole or in part at any other site or structure on this site. Please feel free to contact me with any questions that you might have regarding this geotechnical report.

Sincerely,
Jason Vine, P.E. 67800

References and Resources

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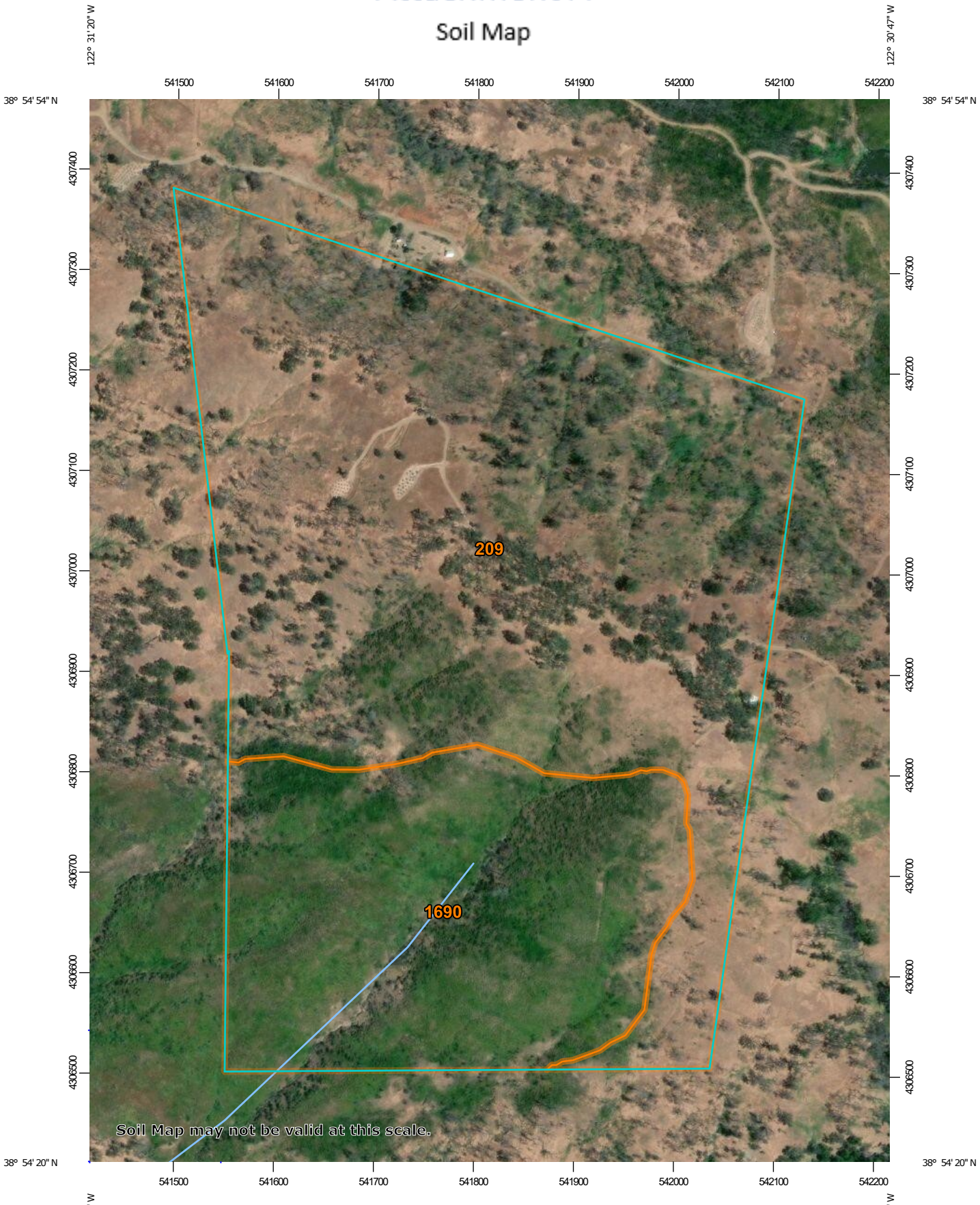
Attachment A

Soil Map



Map Scale: 1:5,160 if printed on A portrait (8.5" x 11") sheet.

N

Meters
0 50 100 200 300

Feet
0 250 500 1000 1500

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 10N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Lake County, California
Survey Area Data: Version 16, Sep 16, 2019

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Sep 18, 2016—Nov 4, 2017

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
209	Skyhigh-Millsholm loams, 15 to 50 percent slopes	71.6	68.5%
1690	Maymen-Etsel-Snook complex, 30 to 75 percent slopes, low ffd	32.9	31.5%
Totals for Area of Interest		**104.5**	**100.0%**

Lake County, California

209—Skyhigh-Millsholm loams, 15 to 50 percent slopes

Map Unit Setting

National map unit symbol: hf86
Elevation: 300 to 3,700 feet
Mean annual precipitation: 12 to 50 inches
Mean annual air temperature: 57 to 63 degrees F
Frost-free period: 130 to 330 days
Farmland classification: Not prime farmland

Map Unit Composition

Skyhigh and similar soils: 45 percent
Millsholm and similar soils: 25 percent
Minor components: 30 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Skyhigh

Setting

Landform: Hills
Landform position (two-dimensional): Backslope, footslope
Landform position (three-dimensional): Side slope
Down-slope shape: Concave
Across-slope shape: Concave, convex
Parent material: Residuum weathered from sedimentary rock

Typical profile

H1 - 0 to 2 inches: loam
H2 - 2 to 8 inches: clay loam
H3 - 8 to 38 inches: clay
H4 - 38 to 48 inches: unweathered bedrock

Properties and qualities

Slope: 15 to 50 percent
Depth to restrictive feature: 38 to 42 inches to lithic bedrock
Natural drainage class: Well drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 6.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: D
Ecological site: Steep Clayey Hills (R015XF006CA)
Hydric soil rating: No

Description of Millsholm

Setting

Landform: Hills
Landform position (two-dimensional): Backslope, shoulder, summit
Landform position (three-dimensional): Side slope
Down-slope shape: Convex, concave
Across-slope shape: Convex
Parent material: Residuum weathered from sedimentary rock

Typical profile

H1 - 0 to 6 inches: loam
H2 - 6 to 16 inches: clay loam
H3 - 16 to 26 inches: unweathered bedrock

Properties and qualities

Slope: 15 to 50 percent
Depth to restrictive feature: 16 to 20 inches to lithic bedrock
Natural drainage class: Well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 2.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: D
Hydric soil rating: No

Minor Components

Bressa

Percent of map unit: 10 percent
Hydric soil rating: No

Asbill

Percent of map unit: 4 percent
Hydric soil rating: No

Etsel

Percent of map unit: 4 percent
Hydric soil rating: No

Hopland

Percent of map unit: 3 percent
Hydric soil rating: No

Maymen

Percent of map unit: 3 percent
Hydric soil rating: No

Sleeper

Percent of map unit: 3 percent
Hydric soil rating: No

Unnamed

Percent of map unit: 3 percent
Hydric soil rating: No

1690—Maymen-Etsel-Snook complex, 30 to 75 percent slopes, low ffd

Map Unit Setting

National map unit symbol: 2y4jl
Elevation: 1,670 to 3,310 feet
Mean annual precipitation: 31 to 55 inches
Mean annual air temperature: 55 to 59 degrees F
Frost-free period: 196 to 275 days
Farmland classification: Not prime farmland

Map Unit Composition

Maymen and similar soils: 35 percent
Etsel and similar soils: 25 percent
Snook and similar soils: 20 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Maymen

Setting

Landform: Hillslopes, mountains
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Mountainflank, side slope
Down-slope shape: Convex, concave
Across-slope shape: Convex, concave
Parent material: Colluvium derived from sandstone and shale and/or residuum weathered from sandstone and shale

Typical profile

A - 0 to 4 inches: gravelly loam
Bw - 4 to 12 inches: gravelly loam
R - 12 to 22 inches: bedrock

Properties and qualities

Slope: 30 to 75 percent
Depth to restrictive feature: 10 to 20 inches to lithic bedrock
Natural drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline (0.2 to 0.5 mmhos/cm)
Available water storage in profile: Very low (about 1.7 inches)

Interpretive groups

Land capability classification (irrigated): 7e
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: D
Hydric soil rating: No

Description of Etsel

Setting

Landform: Hillslopes, mountains
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Mountainflank, side slope
Down-slope shape: Convex, concave
Across-slope shape: Convex, concave
Parent material: Colluvium derived from sandstone and shale and/or residuum weathered from sandstone and shale

Typical profile

A1 - 0 to 3 inches: gravelly loam
A2 - 3 to 10 inches: very gravelly loam
R - 10 to 20 inches: bedrock

Properties and qualities

Slope: 30 to 75 percent
Depth to restrictive feature: 4 to 12 inches to lithic bedrock
Natural drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline (0.2 to 0.5 mmhos/cm)
Available water storage in profile: Very low (about 1.2 inches)

Interpretive groups

Land capability classification (irrigated): 7e
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: D
Hydric soil rating: No

Description of Snook

Setting

Landform: Mountains, hillslopes
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Mountainflank, side slope
Down-slope shape: Concave, convex
Across-slope shape: Concave, convex
Parent material: Colluvium derived from sandstone and shale and/or residuum weathered from sandstone and shale

Typical profile

A - 0 to 5 inches: loam
R - 5 to 15 inches: bedrock

Properties and qualities

Slope: 30 to 75 percent

Depth to restrictive feature: 5 to 9 inches to lithic bedrock
Natural drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 0.9 inches)

Interpretive groups

Land capability classification (irrigated): 8
Land capability classification (nonirrigated): 8
Hydrologic Soil Group: D
Hydric soil rating: No

Minor Components

Mayacama

Percent of map unit: 7 percent
Landform: Hillslopes, mountains
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Mountainflank, side slope
Down-slope shape: Concave, convex
Across-slope shape: Concave, convex
Hydric soil rating: No

Hopland

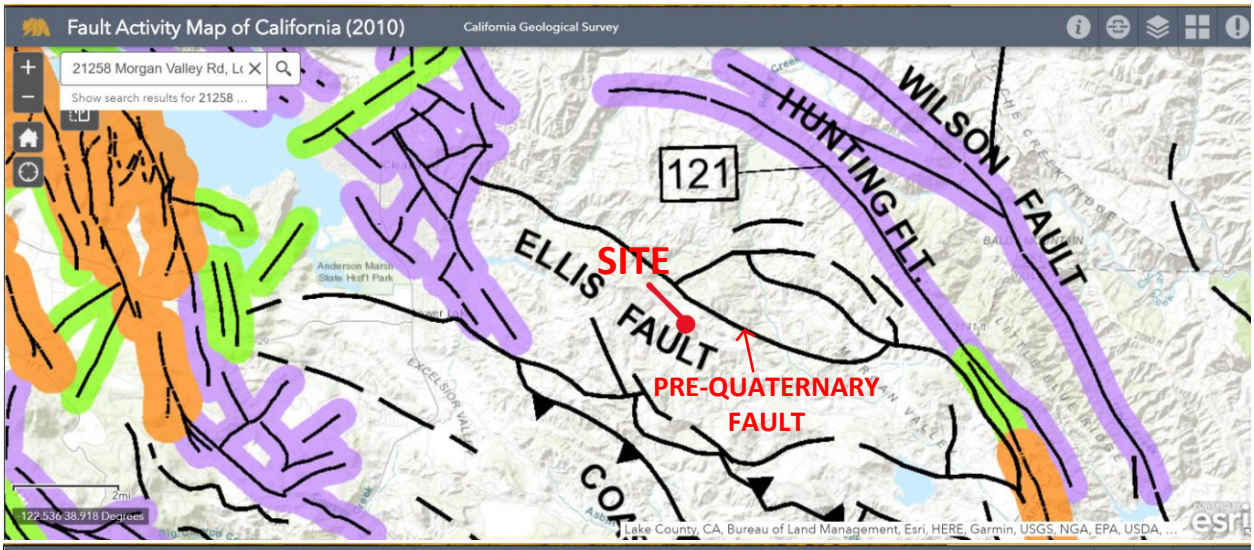
Percent of map unit: 7 percent
Landform: Hillslopes, mountains
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Mountainflank, side slope
Down-slope shape: Concave, convex
Across-slope shape: Concave, convex
Hydric soil rating: No

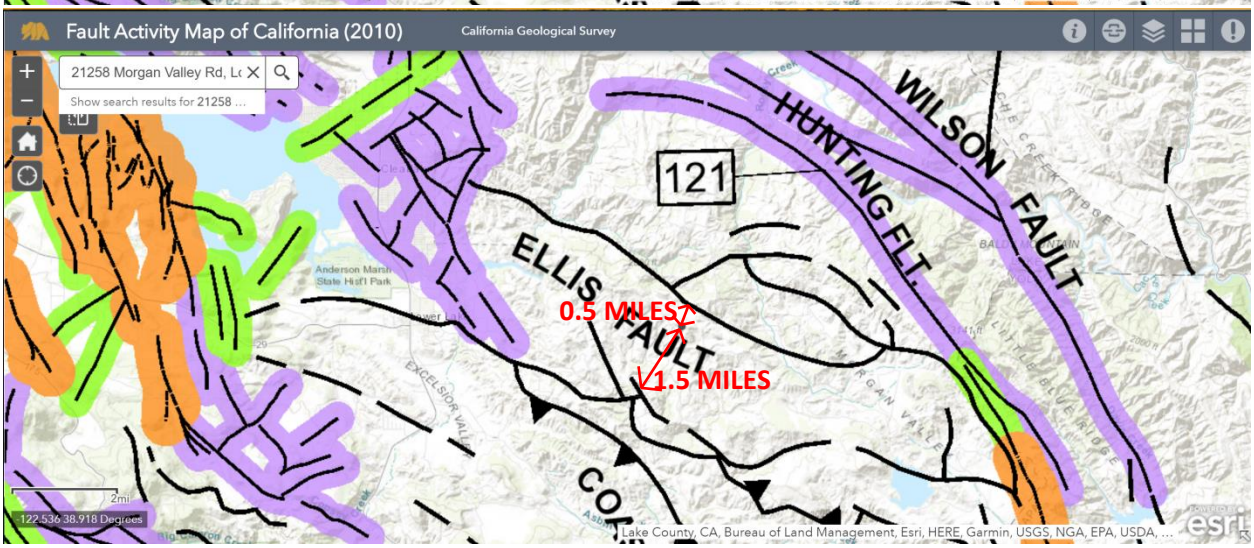
Rock outcrop

Percent of map unit: 6 percent
Landform: Mountains
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Mountainflank
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Attachment C

Alquist-Priolo Act Regional Map Reference





Attachment D

Calculated Coefficients of Linear Extensibility

Calculated Coefficients of Linear Extensibility for 20-69% Clay

Table 1. Calculated COLE values for indicated clay percentage using equation:

.60316032 *X* + -.053093 (where *X* = 20, 21, ...70)

Table 1

% Clay	COLE
20	0.01
21	0.013
22	0.016
23	0.02
24	0.023
25	0.026
26	0.029
27	0.032
28	0.035
29	0.039
30	0.042
31	0.045
32	0.048
33	0.051
34	0.054
35	0.058
36	0.061
37	0.064
38	0.067
39	0.07
40	0.073
41	0.076
42	0.08
43	0.083
44	0.086
45	0.089
46	0.092
47	0.095
48	0.099
49	0.102
50	0.105
51	0.108
52	0.111
53	0.114
54	0.118
55	0.121
56	0.124
57	0.127
58	0.13
59	0.133
60	0.137
61	0.14
62	0.143
63	0.146
64	0.149
65	0.152
66	0.155
67	0.159
68	0.162
69	0.165

By use of the regression equation, predicted COLE values were calculated for clay contents ranging from 20 to 70% (Table 1). The values generated were used to estimate COLE values for soils when clay data were available but COLE values had not been determined. In general, the data for the soils studied indicate that clay percentages of 25, 35, and 45 have COLE values that correspond to the major COLE value classes given in Section 618.37 of the National Soils Handbook.

Table 2. Relationship of shrink-swell classes and extensibility to clay content for selected soils. *

Table 2

Class	Linear extensibility	COLE	Clay
Low	<3	<0.03	<25
Moderate	3-6	0.03-0.06	25-35
High	6-9	0.06-0.09	35-45
Very high	>9	>0.09	>45

* Class, linear extensibility, and COLE from section 618.37 National Soils Handbook (Soil Survey Staff). Clay percentages are those shown in Table 1 for the relationship determined for the soils studied.

Attachment E

LOCATION OF TEST PITS 1 & 2

Post Hole Digger & Hand Tools

June 18, 2020

Test Pit LOCATION MAP

REALM CIVIL ENGINEERING	**TEST PITS LOCATIONS 1 & 2** **AutoCanna, LLC** 21258 Morgan Valley Rd Lower Lake, California	**SEE ATTACHMENT F** Date: 06/18/2020

Attachment F

LOGS OF TEST PITS 1 and 2

Post Hole Digger & Hand Tools

June 20, 2020

Test Pit 1

Skyhigh-Millsholm Loams/Maymen-Estle-Snook Complex

0 – 1.5’ Clayey Sand (SC), grayish brown, dry, moderately stiff, low to medium plasticity, traces of small gravel particles

1.0' – 2.5’ Gravelley Clay (CL), tinge of yellowish brown, dry, moderately to very stiff, low to medium plasticiity, some fine sand, gravel subangular to angular up to 1 inch diameter.

2.5' - 5.5' Clayey Gravell (GC), brown, dry, moderately to very stiff, low plasticity, mostly gravel, gravel subangular to angular up to 1 inch diameter.

Total depth = 5.5 feet.
Backfilled with excavated soil. No Groundwater was encountered.

Test Pit 2

Skyhigh-Millsholm Loams/Maymen-Estle-Snook Complex

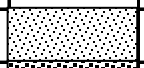
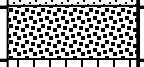
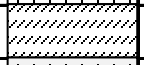
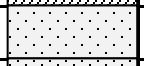
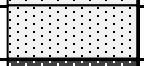
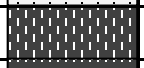
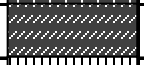
0 – 1.0’ Clayey Sand (SC), grayish brown, dry, moderately stiff, low to medium plasticity, traces of small gravel particles

1.0' – 2.5’ Gravelley Clay (CL), tinge of yellowish brown, dry, moderately to very stiff, low to medium plasticiity, some fine sand, gravel subangular to angular up to 1 inch diameter.

2.5' - 5.5' Clayey Gravell (GC), brown, dry, moderately to very stiff, low plasticity, mostly gravel, gravel subangular to angular up to 1 inch diameter.

Total depth = 5.5 feet.
Backfilled with excavated soil. No Groundwater was encountered.

UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS		SYMBOL	CODE	TYPICAL NAMES
COARSE GRAINED SOILS (More than 50% of soil > no. 200 sieve size)	GRAVELS (More than 50% of coarse fraction > no. 4 sieve size)	GW		Well graded gravels or gravel - sand mixtures, little or no fines
		GP		Poorly graded gravels or gravel - sand mixtures, little or no fines
		GM		Silty gravels, gravel - sand - silt mixtures
		GC		Clayey gravels, gravel - sand - silt mixtures
	SANDS (50% or more of coarse fraction < no. 4 sieve size)	SW		Well graded sands or gravelly sands, little or no fines
		SP		Poorly graded sands or gravelly sands, little or no fines
		SM		Silty sands, sand - silt mixtures
		SC		Clayey sands, sand clay mixtures
FINE GRAINED SOILS (More than 50% of soil < no. 200 sieve size)	SILTS & CLAYS LL< 50	ML		Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity
		CL		Inorganic clays of low to medium plasticity, gravely clays, sandy clays, silty clays, lean clays
		OL		Organic silts and organic silty clays of low plasticity
	SILTS & CLAYS LL ≥ 50	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 silty clays, organic silts
HIGHLY ORGANIC SOILS		Pt		Peat and other highly organic soils
ROCK		RX		Rocks, weathered to fresh
FILL		FILL		Artificially placed fill material

OTHER SYMBOLS

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

 = Hand Driven Sample

 =SPT Sampler

 = Initial Water Level

 = Final Water Level

 = Estimated or gradational material change line

 = Observed material change line

Laboratory Tests

PI = Plasticity Index
EI =Expansive Index
UCC = Unconfined Compression Test
TR = Triaxial Compression Test
GR = Gradation Analysis (Sieve)
K = Permeability Test

GRAIN SIZE CLASSIFICATION

CLASSIFICATION	RANGE OF GRAIN SIZES	
	U.S. Standard Sieve Size	Grain Size in Millimeters
BOULDERS	Above 12"	Above 305
COBBLES	12" to 3"	305 to 76.2
GRAVEL coarse (c) fine (f)	3" to No. 4 3" to 3/4" 3/4" to No. 4	76.2 to 4.76 76.2 to 19.1 19.1 to 4.76
SAND coarse (c) Medium (m) fine (f)	No. 4 to No. 200 No. 4 to No. 10 No. 10 to No. 40 No. 40 to No. 200	4.76 to 0.074 4.76 to 2.00 2.00 to 0.420 0.420 to 0.074
SILT & CLAY	Below No. 200	Below 0.074

REALM CIVIL ENGINEERING

Classification System
AutoCanna, LLC
21258 Morgan Valley Road
Lower Lake, California

Attachment G

Test Pit and Site Figures

Test Pit #1 Spoils 5.5’ in depth

Test Pit #2 Spoils 5.2’ in depth

Existing Early Activation on contour grading.