Geotechnical Study

EUER VALLEY PROJECT

PROJECT

BRIDGE AND WALKWAY FOUNDATION SUPPORTS

PREPARED FOR

CAROL BEAHAN

WILDSCAPE ENGINEERING INC.

PROJECT LOCATION

EUER VALLEY ROAD

TRUCKEE, CA

REPORT DATE:

October 25, 2020

PREPARED BY

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PROJECT NO.

119-2020-1

Bear Engineering Group, Inc.
Earth Science Consultants

Ms. Carol Beahan
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1901 Airport Rd, South
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Subject: **GEOTECHNICAL STUDY EUER VALLEY PROJECT**
EUER VALLEY ROAD
TRUCKEE, CA

Dear Ms. Beahan;

We are pleased to present this Geotechnical Study for the planned site improvements located at the subject site. This report describes the services performed and presents our conclusions and recommended geotechnical design criteria for construction. Recommendations in this report should be integrated into the design and implemented during construction. Ancillary recommendations may be needed during construction, based on unforeseen circumstances that may arise during construction.

In our opinion, the site is suitable for the proposed improvements, provided the recommendations in this report are integrated into the design and implemented during construction. We reserve the right to make ancillary recommendations at any time during construction, based on circumstances that may arise during construction.

It has been a pleasure to be of service to you on this project. Should you have any questions concerning the discoveries, recommendations or conclusions of the attached report, please contact this office at your earliest convenience.

Very truly yours,
Bear Engineering Group, Inc.

Mark L. Schroeder, P.E., M.S.G.E.
Principal Engineer

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SECTION 1.0 INTRODUCTION

Section 1.1 - Project Description and Location

The subject site is located about 6 miles northeast from the paved section of Alder Creek Road in Truckee California as presented in ***Figure 1***. Generally, the area surrounding the Plan Area is characterized by gently rolling hills with some steeper hills rising to the north and northeast.

The project consists of constructing bridge supports for snow grooming equipment that actively groom the site in the winter for cross-country skiing but also for recreational hikers, mountain bikers and equestrian riders.. The planned bridge for equipment and pedestrians is estimated to be up to 150 feet long and 16 to 20 feet wide. To protect sensitive wetland areas suspended above ground pedestrian walkways are planned. Walkways are estimated to be 25 to 45 feet long and about 8 feet wide.

Section 1.2- Purpose

The purpose of this study was to evaluate the soil and geologic characteristics relevant to design and construction of the wall. Geotechnical foundation engineering design and recommendations are provided based on the physical characteristics of the subsurface materials and the geotechnical limitations created by the site's surface features.

Section 1.3 - Scope

The scope of our services for the proposed renovations, as set forth in our September 2020, agreement included the following tasks as listed below: This phase of the study did not include assessments for toxic substances or soil or groundwater contamination.

- Researching readily available geologic and seismic reports and maps of the area; including Review of United States Geological Survey (USGS) Earthquake Hazards Program (2007), to select nearest fault source that could potentially impact the site.
- A subsurface exploration program involving a minimum of two borings to a maximum depth of 20-25.0 feet below existing grade unless bedrock refusal was encountered.
- Soil Sampling for classification using ASTM D 2487 procedure.
- Laboratory testing of selected soil samples to evaluate in-situ moisture/density.
- Provide the near-surface Hazard Response Spectra and Design parameter seismic design criteria and per the California Building Code ASCE 7-16
- Engineering analyses to develop geotechnical recommendations for design and construction of the project.
- Preparation of this engineering report.

SECTION 2.0 SITE SETTING

Section 2.1- Regional Geology

The Plan Area is located in the east-central portion of the Sierra Nevada Geomorphic Province of Northern California, which is part of a relatively geologically young and seismically-active region on the western portion of the North American plate. The Sierra Nevada Mountains were formed by large intrusions of molten granitic rock, and subsequent faulting and volcanic activity raised the range to its current position. The Sierra Nevada Geomorphic Province is a relatively narrow, northwest trending, approximately 400-mile long tilted fault block. The western margin of the province originates under the sediments of California's Great Valley province. The block rises to the east with an average slope of approximately 2 percent to form the western face of the Sierra Nevada Mountains. Because of the tilted nature of the block the eastern face is more abrupt and comprised largely of rugged steep scarps which front the Basin and Range province to the east of northern Nevada.

The geology of the Truckee area is dominated by volcanic rocks while the floor of the valley is layered in glacial till and outwash from the repeated cycles of Sierra Nevada glacial ice fields spilling over into the Donner Lake and Truckee area. Progressing ice mass expanded canyons, smoothed off and steepened their sides, and separated immense quantities of loose rock and soil. This material organized rough and angular rock but not water-rounded boulders of all sizes, diversified with finer detritus and sand, deposited by the ice that rolled down valleys, becoming more pronounced near the valley termination locations and along the gentle slopes below steep granitic bluffs. Below the glaciated region the valleys are narrow and V-shaped in cross section, but the glaciated valleys are broader and U-shaped and many of them are characterized by nearly level stretches occupied by meadows (filled-in lakes), separated by rocky portions of steeper grade very similar to the Euer Valley. Geology in these areas is predominantly outwash consisting of silty sandy gravels and gravelly sand with rounded cobbles and boulders.

Section 2.2- Local Geology

Local geology suggests the site is underlain by Tertiary pyroclastic and volcanic mudflow deposits as provided in ***Figure 2***. Exploration results suggest the near surface soil in the location of the planned bridge abutment is predominantly alluvium outwash consisting of silty sandy gravels and gravelly sand with cobbles of stream terraces decreasing to rich mineral silt and clays. Where water flows decelerate or along shorelines of seasonal water bodies these locations promoted vegetation which continuously becomes enveloped slowly with additional silt and clays promoting decomposed organic soils a few feet thick.

Section 2.3 - Seismic Setting

Similar to most of California and Nevada, the site is located in a seismically active area. Seismicity in the site area is dominated by activity along the Sierra Nevada-Great Basin Boundary Zone (SNGBZ). The SNGBZ is a seismic belt formed by a nearly continuous north to northwest-trending zone of earthquakes and faults extending from the Garlock fault in southern California along the eastern Sierra to the Lake Almanor region in northern California. Earthquakes in this zone tend to concentrate along the east flank of the Sierra Nevada.

The California State Mining and Geology Board define an "active fault" as one that has had surface displacement within the last 11,000 thousand years (Holocene). Potentially active faults are defined as those that have ruptured between 11,000 thousand and 1.6 million years ago (Quaternary). If a fault has not shown activity within this time, it is generically considered inactive. We have listed fault activity in the area in Table 1 with brief discussions about these faults below.

Faults discovered near the subject site include the Mohawk Valley Fault, the southern section of which lies approximately 20 miles northwest of Truckee in Sierra County, and the Dog Valley Fault, which extends in from Dog Valley (approximately 20 miles northeast of Truckee) southwest to near Donner Lake as shown in ***Figure 3***. The Dog Valley Fault is associated with ground rupture during the Truckee earthquake of 1966. Previous studies completed in the Lake Tahoe Basin (Schweickert et. al. 2004 and Brothers, et. al., 2009) identify three primary faults in the basin including the West Tahoe – Dollar Point Fault (WTDPF), Incline Village Fault (IVF), and the North Tahoe Fault (SNTF). Each of these faults trend in a general north-south direction and display an eastward down dipping pattern. Additional faults in the area are discussed below;

East Tahoe Fault; The East Tahoe fault is inferred to bound the east margin of the Lake Tahoe basin, principally based on the presence of a prominent (<1,100-m-high) steep escarpment, much of which is subaqueous. The fault length is about 36km with a slip-rate of about less than 0.2 mm/yr. with a dip direction of west to east.

Incline Village Fault: Most recent prehistoric deformation is considered to be Quaternary (<15 ka). The approximate length of the fault is Length with a slip-rate of between 0.2 and 1.0 mm/yr. There has been no Historic earthquake on this fault. The probability of a seismic event occurring is less than 1.0 over the next 30 years.

North Tahoe Fault; the North Tahoe fault is bounded by steep bathymetric escarpments adjacent to the deepest part of Lake Tahoe. The fault has been imaged on a seismic reflection profile as a 14-m-high scarp on the floor of Lake Tahoe off Dollar Point, which is associated with warped and offset recent lake sediments; displacements increase with depth indicating recurrent Quaternary movement. The fault is approximetly25 km long with a slip-rate of between 0.2 and 1.0 mm/yr. Most recent prehistoric deformation is about late Quaternary (<15 ka). The probability of a seismic event occurring is less than 3.5 over the next 30 years.

Polaris Fault: The U.S. Geological Survey (USGS) Quaternary Fault and Fold Database indicate (LiDAR) imagery was used to identify this fault in densely vegetated terrain surrounding Martis Creek Dam near Truckee. Imagery exposes a previously unrecognized and apparently youthful right-lateral strike-slip fault that exhibits laterally continuous tectonic geomorphic features over 35-km-long with a tectonic slip rate of 0:4 0:1 mm/yr.

Section 2.4 - Seismic Probability

The long-term occurrence of earthquakes modeling was founded on geologic and geophysical observations and constrained by plate tectonics. The Uniform California Earthquake Rupture Forecast, Version 3 (UCERF3) is a comprehensive model of earthquake occurrence for California. Based on their estimates the likelihood that California will experience a magnitude 8 or larger earthquake in the next 30 years increased from about 4.7% in UCERF2 to about 7% from there earlier estimates in the 1990's. UCERF3 has incorporated analysis of the gradual movement of hundreds of locations throughout California using space-based geodesy (GPS data) in order to estimate rates of deformation for faults lacking geologic data to arrive at their predictions. ***Figure 4*** presents the probability of a 6.7 magnitude earthquake occurring from one of the fault systems listed in the next 30 years.

> *The Alquist-Priolo Earthquake Fault Zoning Act was passed by the California Legislature in 1972 to mitigate the hazard of surface faulting to structures. Its intent is to increase safety and minimize the loss of life during and immediately following earthquakes by facilitating seismic retrofits to strengthen buildings against ground shaking. The Act addresses only surface fault rupture; it is not directed toward other earthquake hazards. No faults have been mapped crossing the site, and the site is not within an Alquist-Priolo Special Studies Zone (California Geological Survey [CGS], 2007).*

TABLE 1
QUATERNARY ACTIVE FAULTS DISTANCE TO THE SITE

Faults	Magnitude	Distance from Site (miles)	Fault Classification
Dog Valley Fault	6.0	2.5 NE	A
East Tahoe Fault	7.1	16.3 SW	A
Incline Village Fault	6.5	19.5 SE	A
Mohawk Valley Fault	6.9	9.0 NW	A
North Tahoe Fault	7.3	17.2 SE	B
Polaris Fault	6.0	3.5 E	

- An "active" fault is defined by the State of California as a fault that has had surface displacement within Holocene time (approximately the last 10,000 years). A "potentially active" fault has shown evidence of displacement during Quaternary time (approximately the last 2 million years). The fault classifications are derived from the Fault Activity Map of California and Adjacent Areas (Jennings, 1994).
- Moment magnitude (Mw) is related to the physical size of a fault rupture and movement across a fault. Moment magnitude provides a physically meaningful measure of the size of a faulting event (CDFG, 1997). The Maximum Moment Magnitude Earthquake, derived from the joint CDMG/USGS Probabilistic Seismic Hazard Assessment for the State of California (USGS, 1996).
- Polaris Fault considered restively new no data found on estimated magnitude

SECTION 3.0 SITE EXPLORATIONS AND LABORATORY TESTING

Section 3.1 - Field Exploration

Field exploration was conducted on October 8, 2020, consisting of seven (7) exploratory boreholes to a maximum depth of approximately 25-feet below existing grade averaging about 20 feet. The borings were located within the footprint/pathway of the planned improvements as shown in ***Figure 5*** The boring was drilled by a track mounted drilling unit using a 4-inch solid stem auger. Samples were gathered by driving a 2-inch Modified California Sampler at 18-inch intervals into underlying soil using a 140-pound hammer free falling 30-inches. The number of blows required to drive the sampler was recorded in 6-inch penetration intervals. The last 12 inches of penetration is provided on the Log of Borings as penetration resistance per foot. Blow counts provided have been corrected for energy efficiency. Both borings were backfilled with Portland cement by tremmie each bore hole. Description and identification of the samples were conducted in the field using ASTM D2488 and D2487 methods.

Section 3.2 – Laboratory Testing

Laboratory testing was conducted on selected soil samples to obtain data on density, moisture content (ASTM D2167), and soil description and identification (ASTM 2488). Laboratory test results are presented on the Log of Test Borings.

SECTION 4.0 SURFACE AND SUBSURFACE CONDITIONS

Section 4.1 Subsurface Conditions

The onsite soil is primarily composed of loose to medium dense poorly graded alluvium classified as silty sandy grading to grading to ¼ to ½ inch rounded gravels in the matrix at approximately 20 feet for borings 1 through 3 near the planned bridge abutment. Boring 4 consisted of tan/brown poorly grade fine alluvium in the upper 4 feet grading to sand silt below 5 feet underlain by ¼ to ½ inch rounded gravels at 15 feet with a more impervious layer of gray to bluish green clay sand to the final depth of 25 feet. Borings 5 and 6 found a 2 feet thick layer of organically rich low bulk density silt sand in the upper 2 feet underlain by orange/brown well poorly graded sand grading to silty sand at 8 feet. At 13 feet silty sandy with ¼ to ½ inch rounded gravels was encountered to a depth of 18 feet followed by bluish green clay sand to the final depth of 25 feet. Boring 7 found lose poorly graded sand to a depth of about 4 feet followed by brown silt sand with moderate cohesive properties at 8 feet underlain by poorly graded medium grain sand to a depth of 14 feet. From 14 to 20 feet silty sandy with ¼ to ½ inch rounded gravels was found underlain by bluish green soft sandy clay to the final depth of 20 feet. For clarity please refer to the Log of Borings.

Section 4.2 - Groundwater

In general groundwater was encountered between 7 and 13 feet depending on location.

Soil and groundwater conditions are expected to deviate from those conditions encountered at the boring location depending on the time of year. Groundwater is not expected to pose a problem with the foundation system recommended.

Section 4.3 - Ground Shaking

Ground shaking accompanying earthquakes on nearby faults can be expected to be felt within the site. However, the intensity of ground shaking would depend upon the magnitude of the earthquake, the distance to its epicenter, and the geology of the area between the epicenter and the property.

Maximum ground motions (referred to as the peak ground acceleration [PGA]) at the project site were determined by utilizing the 2019 California Building Code (CBC) procedures (per ASCE 7-16) which can be found in Section 6.2.

Section 4.4 - Liquefaction

Soil liquefaction describes a phenomenon whereby a saturated or partially saturated soil temporarily drops in strength and acts as a fluid in response to an applied cyclic stress. The phenomenon is most often observed in saturated, loose low density or un-compacted, sandy soil. Shaking experienced at the subject site depends strongly on the type of deposits found near the surface. Generally there are three factors that need to take place for liquefaction to occur.

1. Loose, granular sediment
2. Saturation of the sediment
3. Strong shaking

Figueroa et al. (1995) examined the grain size distribution of soil samples collected from liquefaction related sand boils generated at the Lower San Fernando Dam, California during the Northridge earthquake of 1994. The grain size distribution indicates that the soil liquefying was very silty sand with clay content less than 10 percent. General consensus from studies indicate Clay Content <15 percent has a tendency to liquefy provided there is a relatively high ground water table and the cyclic stresses induced in the soil have sufficient intensity.

We analyzed the liquefaction potential of each boring individually using the SPT blowcounts measured in the field. Correction factors were applied to the SPT data in accordance with the procedures outlined in Idriss and Boulanger (2008) liquefaction monograph. Average soil unit weight values above and below the water table were estimated based on soil type and our laboratory test results. Fines content of the soil was obtained through laboratory tests and field estimates.

Based on Field and Laboratory results the liquefiable zone is likely to be confined in the upper 10 feet as clay type soils are found below this depth.

Section 4.5 - Lateral Spreading

Lateral spreading is the lateral displacement of surficial blocks of sediment as a result of liquefaction in a subsurface layer. Earthquake shaking leading to liquefaction of saturated soil can result in lateral spreading where the soil undergoes a temporary loss of strength Minor strength loss in the near surface granular soil can be expected during an earthquake resulting in lateral spreading at the stream face.

Section 4.6 - Seismically Induced Ground Settlement

Strong ground shaking can cause settlement by allowing sediment particles to become more tightly packed, thereby reducing pore space. Unconsolidated, loosely packed alluvial deposits are especially susceptible to this phenomenon.

Based on our analysis, we estimate that vertical settlements could be approximately 1.5 inches to nearly 3 inches. To reduce the potential for damage to structures due to seismically induced settlement, we recommend structures be supported on Helical Anchors. This type of pier has been widely implemented in seismically active areas.

Section 4.7 - Expansive Soils

Expansive soils are characterized by their ability to undergo significant volume change (shrink or swell) due to variations in moisture content. Our exploration program found near surface soil where predominantly granular with the exception of Borings 5 and 6 which found organic rich soil. Typically granular soils do not exhibit expansion and contraction properties. The recommended foundation system basically rules out this concern.

Section 4.8 - Findings

The Sierra Nevada is a young mountain range, not more than 10 million years old. Geology maps for the area suggest Tertiary pyroclastic and volcanic mudflow deposits developed the area. Since that time at least four periods of glacial advance have coated the mountains in a thick mantle of ice forming the valleys scoring the low areas of pyroclastic and volcanic mudflow deposits developing large to small sized valleys throughout the Sierra Nevada range. The Euer Valley is considered to be one such valley with a gentle slope to the east of about 5 degrees. The glacial till is outwash can typically be found at the end of the valleys. The Euer Valley is overlain by thick beds of stream deposits consisting of silty sandy gravels and gravelly sand with medium sized cobbles. Our exploration uncovered the stream deposits to the depths explored. The valley can expect moderate ground shaking from one of the faults listed in Section 2.2. Quaternary fault maps indicates the Dog Valley Fault shown as ***Figure 3 and 4*** located about 2.5 northeast to the site is predicted to produce a 6.0 magnitude earthquake. If this were to occur seismic wave may be amplified as the waves propagate through the valley increasing duration time. Minor Surface manifestations due to liquefaction could take place. Based on dynamic settlement analysis a seismic event has the potential to induce ½ to ¾ inches of earthquake induced subsidence from the Dog Valley fault. Borings 5 and 6 indicated organic laden soil mixed with silty sand. Surface foundation system in this area has the ability to settle greatly. Static settlement should be evaluated in the field by a load frame test for other areas. Groundwater was encountered between 7 and 13 feet depending on location but is assumed to increase during the spring months from snow melt. Lateral spreading is a form of horizontal displacement of soil toward an open channel or other “free” face, such as the stream cut. Foundation system for bridge abutment should be placed away from the stream face. However, the foundation system recommended will not necessarily be impacted by this concern. The site is not considered to be a part of the Alquist-Priolo Special Studies Zone as not trace faults cross the site. This would indicate that surface rupture conditions to be low. The site soil conditions observed during the surface reconnaissance and during the subsurface geotechnical investigation are characterized as granular with a low potential to expand and contract with moisture variation.

According to the USGS Map of Potential Areas of Volcanic Hazards (Jennings, C.W., 1994), the property is not situated within a recognized active volcanic area. The nearest known active volcanic zone is the Mt. Lassen area, approximately 105 miles northwest of the site. The most recent volcanic eruptions occurring at Mt. Lassen were from 1914 to 1917. There is a low potential for encountering a volcanic hazard within the proposed building area.

SECTION 5.0 CONCLUSIONS

It is our opinion, based on an analysis of the data and information obtained from the site exploration, laboratory testing, and geotechnical evaluation and our experience and knowledge of the soil conditions in the area, the site is geotechnically suitable for the proposed site improvements provided the recommendations contained herein are incorporated into the project designs and adhered to during construction.

1. Ground shaking at the site from one of the fault systems listed in Table 1 is expected to be moderate producing amplified seismic waves in the Euer Valley. As the wave refract through the valley the duration period may be increased.

2. Near surface soil are considered to be granular with low to medium densities. This type of soil does have the potential to induce liquefaction will reduce the strength properties of the soil inducing the unraveling of the creek face.

3. The proposed project would not be expected to expose people or structures to substantial risk of loss, injury or death from a surface rupture as the site is not delineated as an Alquist-Priolo Special Studies Zone. Our exploration found no evidence of fault traces

4. Surface soil does not exhibit the ability to expand or contract with moisture fluctuations.

5. Seismically induced settlement of ½ to 1 inch can be expected from a strong seismic event in close proximity to the site. Winter snow loads will obviously fluctuate. We suggest a static load frame test be conducted based on historic snow loads to evaluate potential settlement. Preliminary static settlement for a 16 inch diameter flight is estimated to be 1 inch for a 24 kip load.

SECTION 6.0 RECOMMENDATIONS

Section 6.1 – Geotechnical Hazards

Risk of geotechnical hazards will always exist due to uncertainties of geologic conditions and the unpredictability of seismic activity in the Bay Area. However, in our opinion, based on available data, there are no indications of geotechnical hazards that would preclude use of the site for the proposed development.

Section 6.2 - Seismic Criteria

The proposed structures should be designed in accordance with local design practice to resist the lateral forces generated by ground shaking associated with a major earthquake occurring within the central portion of California. Based on the subsurface conditions encountered in our borings, our evaluation of the geology of the site, and extrapolating the alluvial soil site condition to the uppermost 100 feet of the soil profile, we have estimated the average N value of the soil at the site is on the order of 20 blows per foot which corresponds to a site classification of **Site Class "D".**

Based on ASCE 7-16, Section 11.4.8, a ground motion hazard analysis is required for structures on Site

Class "D" with S1 greater than or equal to 0.2 (unless Exceptions are taken). Since the project site is mapped as S1 equal to 0.616, a site specific ground motion analysis in accordance with CBC 2019 and ASCE 7-16, Section 21.2.1.2, is required for the site; however, we assume that Exception No.2 was taken in accordance with ASCE 7-16, Section 11.4.8.

Therefore, the spectral acceleration parameters found in Table 2 below were developed with that assumption in consideration and per the procedures of the 2019 CBC (Section 1613.3). The values were obtained from the SEOC/OSHPD seismic hazard mapping website based on the ASCE/SEI 7-16 Standard, as required by the 2019 CBC.

If a site specific ground motion analysis is desired by the structural engineer, we should be contacted to provide such additional services.

Table 2:
Seismic Coefficients Based on 2019 CBC (per ASCE 7-16)

Item	Value	2019 CBC	ASCE 7-16 Table/FigureR2
Site Class	D	Table 1613.3.2	Table 20.3-1
Short Period Spectral acceleration, Ss	1.339		Figure 22-1
1 sec Period Spectral Acceleration, S1	0.44		Figure 22-2
Site Coefficient, Fa	1.0	Table 1613.3.3(1)	Table 11.4-1
Site Coefficient, Fv	1.90	Table 1613.3.3(2)	Table 11.4-2
Max Short Period Spectral Response Accelerations SMs (SMs=Fa x Ss)	1.607	Equation 16-37	Equation 11.4-1
Max 1 sec Period Spectral Response Accelerations SM1 (SM1 = Fv x S1)	.836	Equation 16-38	Equation 11.4-2
Dampened Design Spectral Response-Short Period (SDs=2/3 x SMs)	1.072	Equation 16-39	Equation 11.4-3
Dampened Design Spectral Response-1 sec Period (SD1=2/3 x SM1)	.552	Equation 16-40	Equation 11.4-4
Site modified peak ground acceleration, PGAM	0.698		Equation 11.8-1

❖ The expected peak horizontal acceleration (with a 10 percent chance of being exceeded in the next 50 years).

Section 6.3 – Grading

We expect minimal grading will be necessary for this project with the possible exception of the bridge abutment areas.

In the event this is done we recommend the following;

<u>Clearing, Stripping, Grubbing, and Debris Removal</u>

Trees, roots, vegetation, and organic surficial soil shall be removed from structural areas unless specified otherwise by the Geotechnical Engineer or the Engineer's Representative. The depth of organic soil to be removed will be recommended by the Geotechnical Engineer or the Engineer's

Representative but, in general, will probably vary from about 4 to 6 inches.

Strippings are defined as surface vegetation and organic surficial soil. Strippings may not be used in fill unless specifically authorized and observed by the Geotechnical Engineer or the Engineer's Representative. Stripping material may be stockpiled for landscaping use, with the approval of the landscape architect. The final clearing, stripping, and grubbing shall be approved by the Geotechnical Engineer before further grading is started.

Section 6.4 – Foundation

Helical Anchor Design Criteria

We anticipate loads for 12 feet thick snow load over the width of the bridge deck to be in excess of 300 kips. This value is not based on historic snow loads for the valley but just an estimate. We recommended historic loads be evaluated proper to conducting a load frame test. The load frame test will assist in evaluating the number of anchors necessary to support snow loads and to determine static settlement.

The depth provided in table below is based on our Boring logs which encountered a gravel bed at approximately 18 feet for boing 1 through 3.

A helical anchor/pile consists of one or more helix-shaped bearing plates attached to a central shaft, which is installed by rotating or "torqueing" into the ground. The magnitude of the required installation torque and the pile capacity can be directly attributed to the soil shearing resistance developed over the embedded area of the pile including the shaft and helical plates. Hence, the pile capacity can be correlated to the installation torque. The contractor installing the anchors shall have a pressure gauge attached to the hydraulic motor which will be recorded in the field to measure soil resistance. Inlet to the hydraulic gear motor is a dangerous practice and not recommended because in nearly every hydraulic system there is back pressure. Differential pressure between the input pressure and output pressure across the motor shall be provided on the equipment by the contractor installing the anchors. Hydraulic Torque Motor Specifications shall be provided to the engineer prior to installing anchors (i.e. load chart versus torque). We recommend a minimum of 1-week notice. Anchors are to rest on coarse sand found at approximately 13-feet below existing grades.

Rotational speed shall be maintained between 5 and 10 rpm until the required embedment depth is reached. Exceeding the rpm values will have a tendency to disturb surrounding soil.

The contractor selected for the project shall be proficient at installing Helical Anchors and shall have all drill head motor torque calibrated to a method of testing torque. Contractor shall submit method of evaluating torque during installation.

Lateral Restraint Device (LRD), has been developed in the industry which increases the lateral capacity of the helical pile foundation system by increasing the soil-structure contact laterally near the ground surface. An active coefficient of .30 and passive values of 3.0 may be used in the calculations as shown in the diagram attached. The upper 2 feet relative to the lowest adjacent grade soil should be neglected in the structural calculations.

To structurally integrate the ADS to the anchor shaft the bolt holes in the anchor maybe used with all thread bolted to the inside and outside portion of the ADS pipe. The last section of anchor pipe shall be fitted with 8-inch diameter pipe and shall engage during anchor installation.

TABLE 4
FOUNDATION DESIGN CRITERIA

Shaft Size (Pipe) Square Stock NOT recommended **Pipe ASTM A500 Grade Grade 80 steel tubing**	**Min. 3.5 in. OD**
Min Wall Thickness	**Min. 0.300 in.**
Helical Flight Diameter	**Single 16.0 in.**
Helical Pier Spacing	**Spacing determined by the Structural Engineer. However, no anchor shall be positioned within 6 feet center to center distance**
Depth	**The intent is to rest bearing flight on the gravel bed found between 12 and 16 feet. Load frame test recommended determining depth.**
Working Load	**25 Kips (<u>TO BE VERIFIED IN THE FIELD</u>) or as determined by structural engineer.** **Min. Torque gage pressure using a Kt value of 7**

- ***All grade beams must be cleaned of loose material and debris prior to placement of concrete.***
- ***The allowable bearing capacity is for dead plus live loads. The bearing capacity may be increased by 1/3 for wind and seismic***
- ***Torque coupling bolts between brackets, extension, and lead section with ASTMA193 Grade B7 or A325 high strength bolt, bolt firmly.***
- **Kt value of 7 shall be used with a safety factor of 2.0 for ultimate strength capacity of the torque loads**
- **All anchor capacity shall be determined in the field by the geotechnical engineer**
- **Each Helical Anchor shall come delivered to the site with a galvanized coating.**
- **The system recommend shall be used for pedestrian path in the areas of Borings 5 and 6.**

Section 6.5 – Plan Review

Before submitting design drawings and construction documents to the appropriate local agency for approval, we recommend that copies of the documents be reviewed by our firm to confirm that the recommendations in this report have been effectively incorporated into the design.

Section 6.6 – Construction Observations

Our office should be contacted prior to anchor installation to ensure the depth and torque values are implemented and to provide recommendations as needed. We will issue a letter after anchor installation is completed.

To allow proper scheduling so that our personnel are present at the job site when needed, we should be contacted no less than <u>2 working days</u> in advance of work requiring our presence to be accomplished.

Section 6.7 - Site Safety

All excavations and site work must comply with applicable local, state, and federal safety regulations. Construction site safety is the responsibility of the contractor, who shall be solely responsible for the means, methods, and sequencing of construction operations. Our services and recommendations for site safety are available upon request and are advisory only and supplemental to current regulatory standards. Bear Engineering Group, Inc. assumes no responsibility for construction site safety or the contractor's activities during any phase of the construction project.

Section 6.8 – Miscellaneous

Our exploration did not reveal the presence of buried items such as leaching fields, septic tanks, storage tanks, etc. at the location of the borings. If such items are encountered during grading or demolition, our firm should be notified immediately to provide recommendations for proper disposal procedures.

SECTION 7.0 - LIMITATIONS

This report has been prepared for the exclusive use of Wildscape Engineering Inc., and their consultants for specific application to the proposed improvements as discussed above. If changes occur in the nature, design location, or configuration of the proposed development, the conclusions and recommendations contained here shall not be considered valid. Changes must be reviewed by our firm.

The analysis, opinions, conclusions, and recommendations submitted in this report are based in part on the referenced materials, site visit and evaluation, and subsurface exploration. The nature and extent of variation among exploratory borings may not become evident until construction. If variations appear, it will be necessary to re-evaluate or revise recommendations made in this report.

The recommendations in this report are contingent on conducting an adequate testing and monitoring program during construction of the proposed development. Unless the construction monitoring and testing program is provided by or coordinated with our firm, Bear Engineering Group will not be held responsible for compliance with design recommendations presented in this report and other supplemental reports submitted as part of this report. Our services have been provided in accordance with generally accepted geotechnical engineering practices. No warranties are made, express or implied, as to the professional opinions or advice provided. Recommendations contained in this report are valid for a period of 1 year; after 1 year they must be reviewed by this firm to determine whether or not they still apply.

SECTION 8.0 - REFERENCES

Arthur Gibbs Sylvester, William S. Wise, Jordan T. Hastings, and Lorre A. Moyer, 2012, Geologic map of the north Lake Tahoe--Donner Pass region, northern Sierra Nevada, California, 1:48,000 scale

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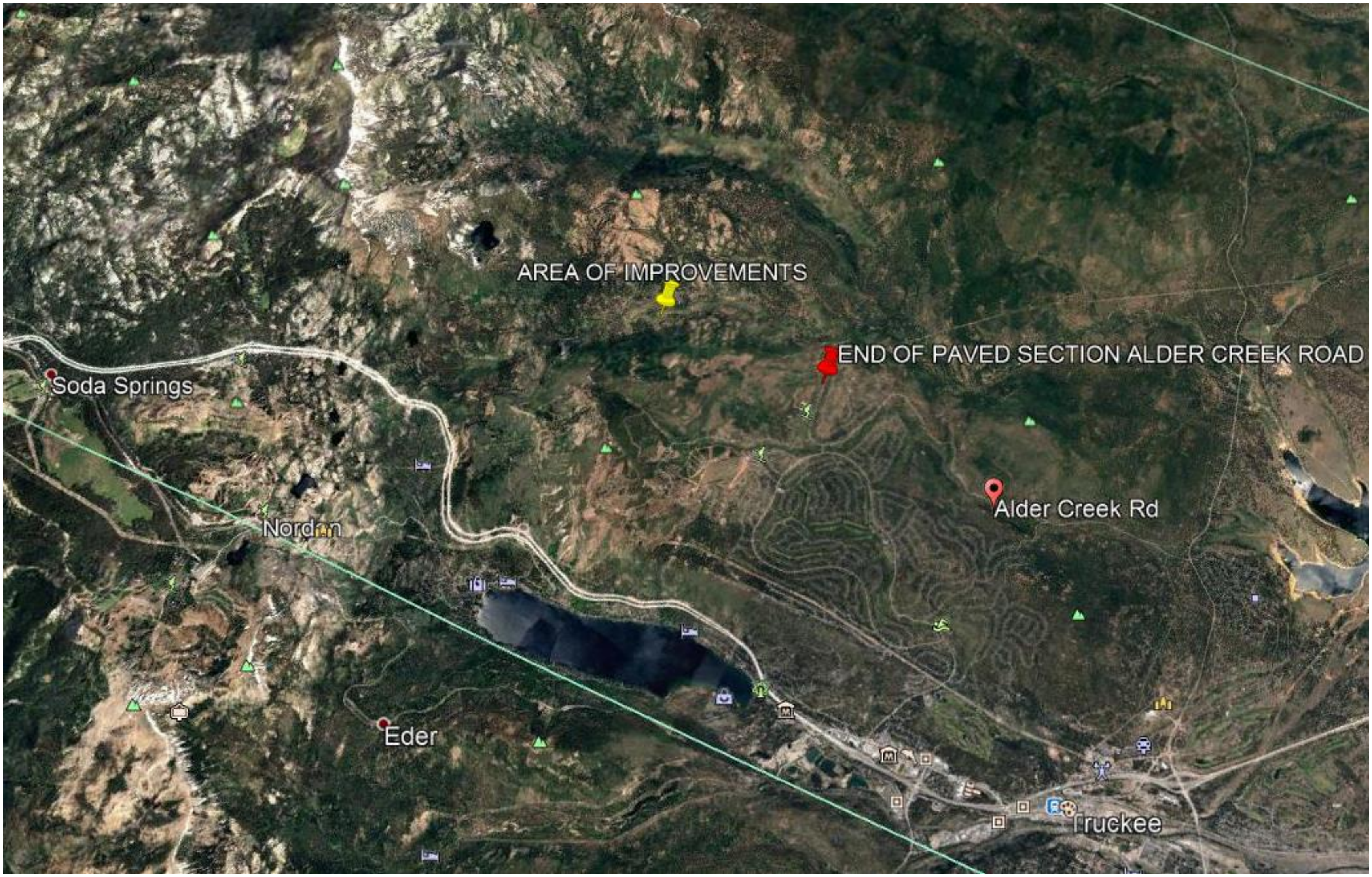
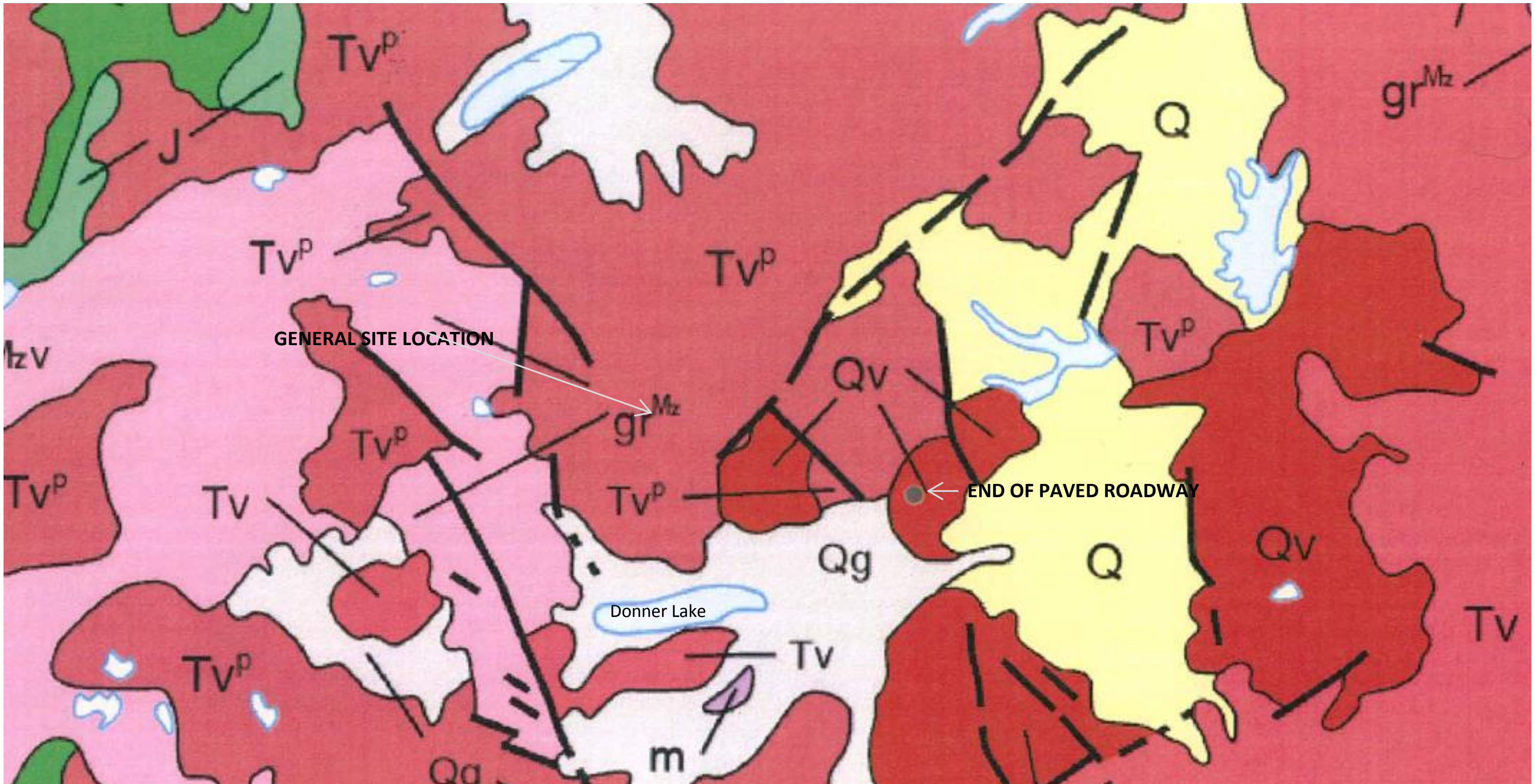
FIGURES

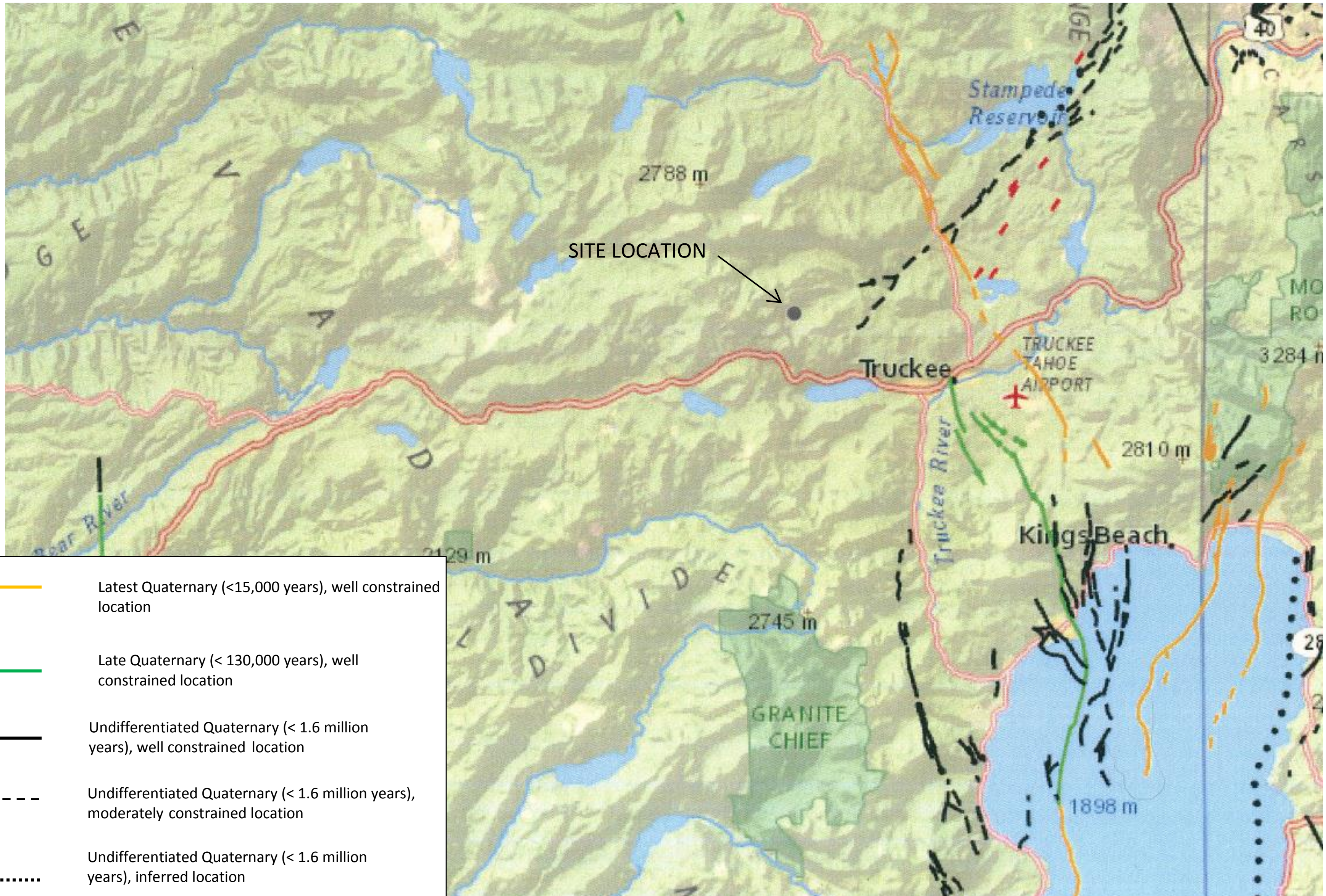


VICINITY MAP



Tv: Tertiary pyroclastic and volcanic mudflow deposits.

Qv: Quaternary volcanic flow rocks; minor pyroclastic deposits.



Latest Quaternary (<15,000 years), well constrained location

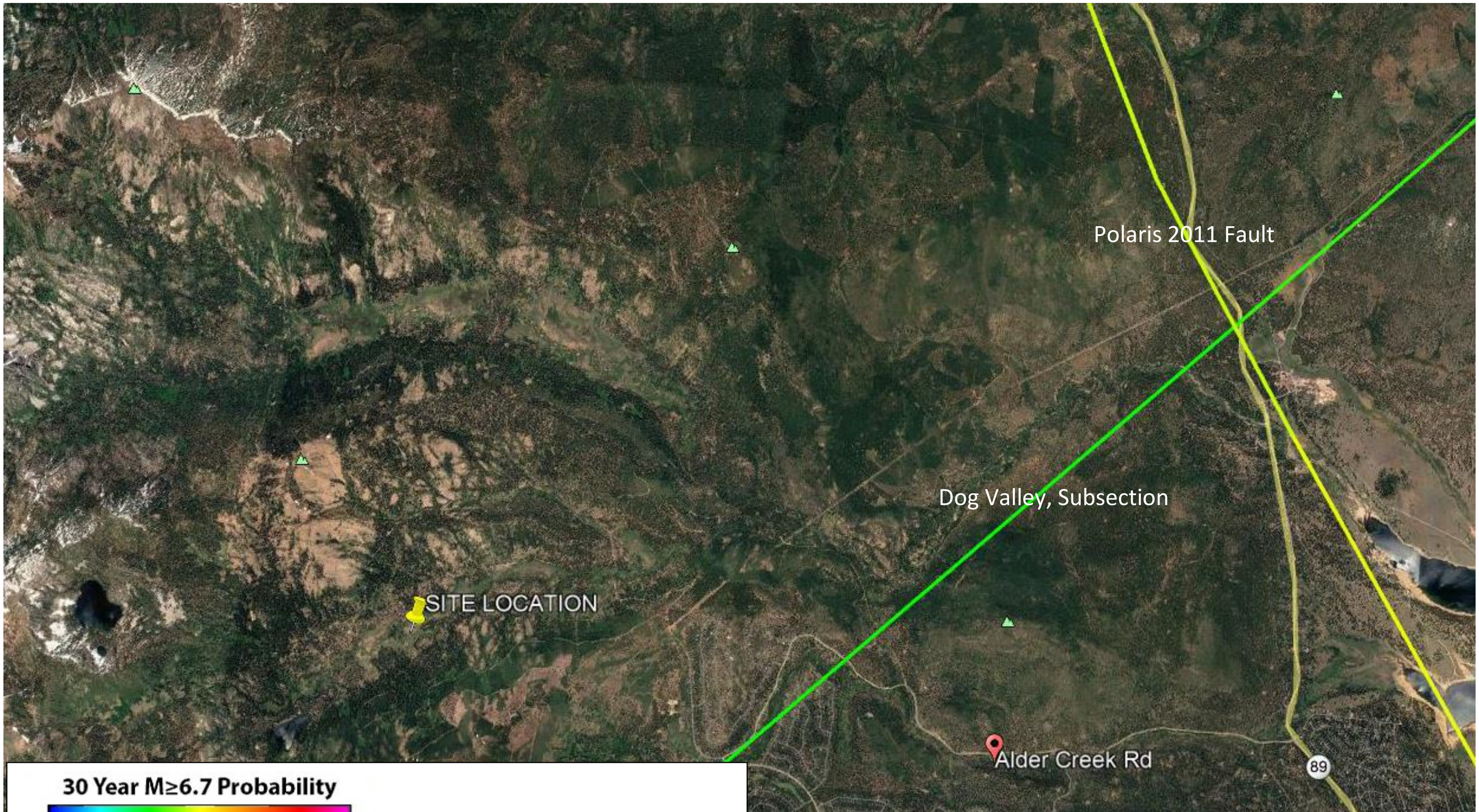
Late Quaternary (< 130,000 years), well constrained location

Undifferentiated Quaternary (< 1.6 million years), well constrained location

Undifferentiated Quaternary (< 1.6 million years), moderately constrained location

Undifferentiated Quaternary (< 1.6 million years), inferred location

3 | FIGURE
QUATERNARY FAULT MAP



30 Year M≥6.7 Probability

0.01% 0.1% 1% 10% 100%

Dog Valley, Subsection; 30 Year Participation Prob (%) 1.55, M≥6.7, 3 Std Dev.

Polaris 2011; 30 Year Participation Prob (%) 3.83, M≥6.7, 3 Std Dev.


B7
B6
B5
B4
B2
B1
B3
N
0
25
50
100
150
US Feet

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Boring No. B1

Project No. 119-2020-1

Date:10-8-2020

Client: WILDSCAPE ENGINEERING INC.

Boring Depth:24 ft.

Location: EUER VALLEY ROAD

Ground Elev. NA

Driller: HILLSIDE DRILLING

Latititude:

Drilling Type: SOLID STEM AUGER

Longititude:

Elev. (ft.)	Depth (ft.)	Sample No.	Blow Count	Lithology	Description	Dry Unit Wt. (pcf)	Moisture Content %	Plasticity Index	Unconfined Compression (psf)	% Passsing #200	Compression Strength Penetrometer (tsf) / Shear Strength Torvane (tsf) / Sym. Denotes what test was taken falling between column denotes approx. strength in tsf. 1 2 3 4 5 6
		1	6		Sand tan/brown, dry, poorly graded, fine, loose, alluvium (Stream Bed Deposits)	81.7	24.9				
	5				Sand medium brown, slightly well graded, medium dense alluvium (Stream Bed Deposits)						
		2	10		Boring collapsed used drill cutting below 8 feet for description **GROUNDWATER 8 FT.**						
	10										
					No change						
	15										
	20				Clay sand gray/brown with ¼ in. gravels, saturated, moderately plastic						
	25				TERMINATED 24 FT.						
	30										

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Boring No. B2

Project No. 119-2020-1

Date:10-8-2020

Client: WILDSCAPE ENGINEERING INC.

Boring Depth:24 ft.

Location: EUER VALLEY ROAD

Ground Elev. NA

Driller: HILLSIDE DRILLING

Latititude:

Drilling Type: SOLID STEM AUGER

Longititude:

Compression Strength Penetrometer (tsf)

Shear Strength Torvane (tsf)

Sym. Denotes what test was taken falling between column denotes approx. strength in tsf.

Elev. (ft.)	Depth (ft.)	Sample No.	Blow Count	Lithology	Description	Dry Unit Wt. (pcf)	Moisture Content %	Plasticity Index	Unconfined Compression (psf)	% Passsing #200	1 2 3 4 5 6
					Sand tan/brown, dry, poorly graded, fine, loose, alluvium (Stream Bed Deposits)						
	5	1	3								
					GROUNDWATER 8 FT. Boring collapsed used drill cutting below 8 feet for description						
	10				Sand Silt tan/brown, saturated, poorly graded, fine, loose, alluvium (Stream Bed Deposits)						
	15				Clay sand gray brown, saturated, medium dense alluvium						
	20				Silt sand light brown fine to fine to medium grain with small sub-angular gravels size alluvium				5,000		
	25				TERMINATED 24 FT.						
	30										

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Boring No. B3

Project No. 119-2020-1

Client: WILDSCAPE ENGINEERING INC.

Location: EUER VALLEY ROAD

Driller: HILLSIDE DRILLING

Drilling Type: SOLID STEM AUGER

Date:10-8-2020

Boring Depth:25 ft.

Ground Elev. NA

Latititude:

Longititude:

Elev. (ft.)	Depth (ft.)	Sample No.	Blow Count	Lithology	Description	Dry Unit Wt. (pcf)	Moisture Content %	Plasticity Index	Unconfined Compression (psf)	% Passsing #200	Compression Strength Penetrometer (tsf); Shear Strength Torvane (tsf); Sym. Denotes what test was taken falling between column denotes approx. strength in tsf. 1 2 3 4 5 6
		1	5		Sand tan/brown, dry, poorly graded, fine, loose, alluvium (Stream Bed Deposits)						
	5				**GROUNDWATER 8 FT.**						
					Sand Silt tan/brown, saturated, poorly graded, fine, medium dense, alluvium (Stream Bed Deposits)	87.8	35.7	17.0		5	
	10	2	11								
	15	3	10		**20% recovery**						
					Clay sand gray/brown with ¼ in. gravels, saturated, moderately plastic						
	20										
					Silt sand light brown fine to fine to medium grain with small sub-angular gravels size alluvium						
	25										
					TERMINATED 25 FT.						
	30										

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Boring No. B4

Project No. 119-2020-1

Date:10-8-2020

Client: WILDSCAPE ENGINEERING INC.

Boring Depth:20 ft.

Location: EUER VALLEY ROAD

Ground Elev. NA

Driller: HILLSIDE DRILLING

Latititude:

Drilling Type: SOLID STEM AUGER

Longititude:

Elev. (ft.)	Depth (ft.)	Sample No.	Blow Count	Lithology	Description	Dry Unit Wt. (pcf)	Moisture Content %	Plasticity Index	Unconfined Compression (psf)	% Passsing #200	Compression Strength Penetrometer (tsf) Shear Strength Torvane (tsf) Sym. Denotes what test was taken falling between column denotes approx. strength in tsf. 1 2 3 4 5 6
		1	5		Sand tan/brown, dry, poorly graded, fine, loose, alluvium						
	5										
		2	10		Sand silt tan/brown, wet, fine to medium grain size, medium dense, alluvium **GROUNDWATER 10 FT.**						
	10										
		3			Sand with 1/4 rounded gravel medium dense alluvium						
	15										
					Clay sand gray fine, plastic, alluvium						
	20				TERMINATED 20 FT.						
	25										
	30										

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Boring No. B5

Project No. 119-2020-1

Date:10-8-2020

Client: WILDSCAPE ENGINEERING INC.

Boring Depth:22 ft.

Location: EUER VALLEY ROAD

Ground Elev. NA

Driller: HILLSIDE DRILLING

Latititude:

Drilling Type: SOLID STEM AUGER

Longititude:

Elev. (ft.)	Depth (ft.)	Sample No.	Blow Count	Lithology	Description	Dry Unit Wt. (pcf)	Moisture Content %	Plasticity Index	Unconfined Compression (psf)	% Passsing #200	Compression Strength Penetrometer (tsf) / Shear Strength Torvane (tsf) / Sym. Denotes what test was taken falling between column denotes approx. strength in tsf. 1 2 3 4 5 6
		1	7		Sand organic laden medium brown low bulk density, compressible, alluvium	64.9	41.0				
	5				Sand, orange brown, very moist, oxide staining well graded medium dense, alluvium						
		2	12		Sand silt, tan/brown, wet, fine to medium grain size, medium dense, alluvium **GROUNDWATER 8 FT. INCREASING TO 6 FT. WHERE IT STABILIZED**						
	10										
	15	3	12		Sand silt, tan/brown, saturated, with ¼ to ½ in. rounded gravels, medium dense, alluvium Boring collapsed at 14 ft.						
	20	4			Clay sand gray fine, plastic, alluvium						
					TERMINATED 22 FT.						
	25										
	30										

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Boring No. B6

Project No. 119-2020-1

Date:10-8-2020

Client: WILDSCAPE ENGINEERING INC.

Boring Depth:22 ft.

Location: EUER VALLEY ROAD

Ground Elev. NA

Driller: HILLSIDE DRILLING

Latititude:

Drilling Type: SOLID STEM AUGER

Longititude:

Compression Strength Penetrometer (tsf)

Shear Strength Torvane (tsf)

Sym. Denotes what test was taken falling between column denotes approx. strength in tsf.

1 2 3 4 5 6

Elev. (ft.)	Depth (ft.)	Sample No.	Blow Count	Lithology	Description	Dry Unit Wt. (pcf)	Moisture Content %	Plasticity Index	Unconfined Compression (psf)	% Passsing #200
		1	9		Sand organic laden medium brown low bulk density, compressible, alluvium	65.4	39.1			
	5	2	12		Sand gray wet medium to fine alluvium					
	10	3	5		**GROUNDWATER 9 FT. INCREASING TO 6 FT. WHERE IT STABILIZED** Silt sand, medium brown, saturated alluvium	87.4	38.0		6,000	
	15	4			Sand silt, tan/brown, saturated, with ¼ to ½ in. rounded gravels, medium dense, alluvium					
	20	5			Clay sand gray fine, plastic, alluvium					
					TERMINATED 22 FT.					
	25									
	30									

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Project No. 119-2020-1

Client: WILDSCAPE ENGINEERING INC.

Location: EUER VALLEY ROAD

Driller: HILLSIDE DRILLING

Drilling Type: SOLID STEM AUGER

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Date:10-8-2020

Boring Depth:25 ft.

Ground Elev. NA

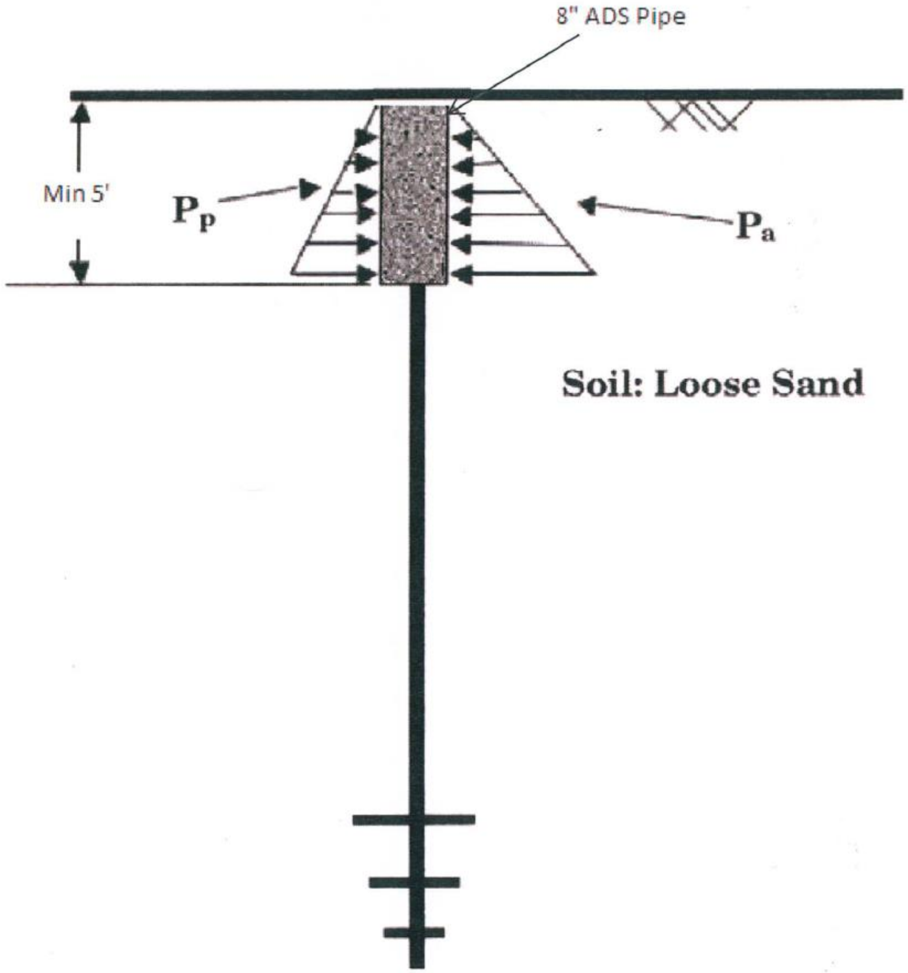
Latititude:

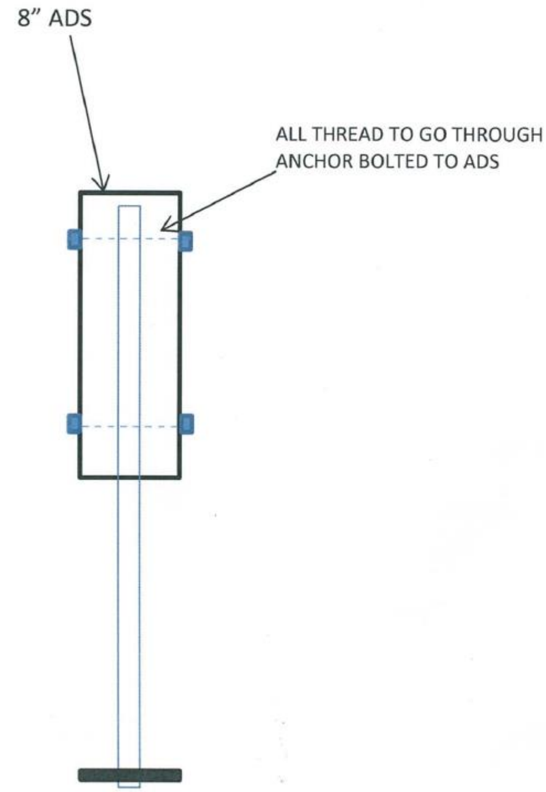
Longititude:

Boring No. B7

Elev. (ft.)	Depth (ft.)	Sample No.	Blow Count	Lithology	Description	Dry Unit Wt. (pcf)	Moisture Content %	Plasticity Index	Unconfined Compression (psf)	% Passsing #200	Compression Strength Penetrometer (tsf) / Shear Strength Torvane (tsf) / Sym. Denotes what test was taken falling between column denotes approx. strength in tsf. 1 2 3 4 5 6
		1	2		Sand, brown, slightly moist, fine, poorly graded, lose alluvium	87.9	18.2				
	5	2	5		Silt sand, brown, some cohesive properties, wet, alluvium						
	10	3	8		Sand, gray, medium grain size very wet, loose						
					Boring collapsed at 12 ft.						
		4			**GROUNDWATER 13 FT.**						
	15				Sand silt, tan/brown, saturated, with ¼ to ½ in. rounded gravels, medium dense, alluvium						
	20	5			Clay silt gray low strength compressible alluvium						
	25				TERMINATED 25 FT.						
	30										

APPENDIX


8" ADS Pipe
Min 5'
Pp
Pa
Soil: Loose Sand


8" ADS
ALL THREAD TO GO THROUGH
ANCHOR BOLTED TO ADS