DAVE OLNES P.E. INC.
CIVIL & SOIL ENGINEER
7915 CREST AVENUE, OAKLAND, CALIFORNIA 94605
PHONE & FAX: (510) 568-262 daveolnes@sbcglobal.net

April 10, 2021 O-4975

Kodiak Drewery
kodiakdrewry@gmail.com

RE: Geotechnical Investigation
Proposed New Residence
50 Juniper Avenue, San Geronimo

Dear Mr. Drewery:

In accordance with your request, we have conducted a geotechnical investigation of the subsurface conditions at your property, located at 50 Juniper Avenue in San Geronimo. The purpose of the investigation was to evaluate the suitability of this site for a proposed new residence and accessory dwelling unit (ADU) on the property.

The property is located beyond the paved portion of Juniper Avenue, at the southwestern limits of the town of San Geronimo. The steeply up-sloping property is accessed by a dirt driveway which switch-backs up the slope. The proposed residence will be situated above the lower switch back, and will likely include a garage at the ground level, cut into the hillside. The proposed detached ADU will be situated north of the house.

Our investigation included the drilling of six borings, covering the proposed building sites. All of the borings encountered competent Sandstone bedrock within 2 to 3.5 feet of the surface. Given the steepness of the slopes, the proposed house structure will require pier and grade beam foundations. Pier depths on the order of 10 to 12 feet are anticipated. The proposed garage structure will bear within a deep, level bedrock cut, and therefore may bear on footings.

If you have any questions regarding the findings or recommendations contained in this report, or if you are ready for a pier or footing inspection, please contact our office.

Sincerely,

Dave Olnes, PE
GE 2469

REGISTERED PROFESSIONAL ENGINEER
DAVID A. OLNES
GE 2469
Exp. 9-30-21
GEOTECHNICAL
STATE OF CALIFORNIA

2Juniper(50)-Geotech

GEOTECHNICAL INVESTIGATION

PURPOSE AND SCOPE OF SERVICES: The purpose of this investigation was to explore the soils and geological conditions in the vicinity of proposed improvements at the subject property, and to provide appropriate geotechnical guidelines governing the construction of the proposed new structures.

The scope of services for this investigation included review of published geological literature, a brief examination of the surrounding slopes, exploration of the subsurface conditions in the vicinity of proposed construction, limited laboratory testing and preparation of this report. This investigation did not include screening for potential hazardous materials.

SITE DESCRIPTION AND PROPOSED CONSTRUCTION: The subject property consists of a steeply up-sloping lot situated beyond the paved section of Juniper Drive. Where the driveway leaves the main road, it forks to the south toward the subject property and north toward an adjacent existing residence. From the split a crude dirt driveway winds up the slope in two switch backs. There is a shipping container parked at the first switchback. The driveway terminates at another series of small buildings at the top of the ridge line, about 100 feet in elevation above the lower switchback. The driveways are formed by un-retained cuts which are typically 4 to 5 feet in height. The surrounding slopes exist in a natural state, covered with mature Redwood and Douglas Fir trees.

It is our understanding that you plan to construct a new two-story residence above the lower hairpin turn. The new house will step up with the existing slope, which rises at a gradient of roughly 2:1. There will be a two-car garage cut into the slope at the ground level. The garage will require perimeter foundation walls up to 10 to 15 feet in height. A new driveway access to Juniper Avenue may be constructed off the lower hairpin turn.

The ADU will be sited on the slope mid-way between the lower and upper hairpin turns. The ADU will also be a two-story structure, with the lower level carved into the slope at the rear. A parking area will be created in the flatter area at the base of a subtle swale in the hillside, south of the ADU. The leach field for the septic system will be sited within this swale.

GEOLOGY: Review of a geology map for the area by Smith, Rice and Strand indicates that the site is underlain by Cretaceous Sandstone and Shale bedrock (Ks), see Figure 1). Franciscan Melange is mapped to the west of the site. Franciscan Melange (fm) is common throughout much of Marin County, and consists of jumbled rock masses, highly altered by ancient tectonic activity. The bedrock units in the vicinity of the site are composed largely of sheared Sandstone, Shale and Serpentine.

Weathered Sandstone is exposed in the cut banks along the driveways and elsewhere near the site. The exposed rock appears fairly soft and should not be difficult to excavate or drill piers into.

No landslide features are mapped in the immediate vicinity of the site (see Figure 1), and no evidence of active sliding was observed in our reconnaissance of the property. The stability study associated with the Smith-Rice map has assigned the site a stability number of 2 to 3, indicating a moderate potential for instability. It is noted that a massive area of coalesced shallow landsliding is mapped east of the site, below Juniper Avenue, and that area has been assigned a stability number of 4, indicating a higher risk for instability.

SITE DRAINAGE: As stated, the lot is sited along the eastern flank of a prominent ridge line, and the local slopes descend to the northeast at a gradient of roughly 2:1. The crest of the ridge line lies about 100 feet above the proposed building sites. There are no storm drain facilities along this portion of Juniper Drive.

SEISMICITY: It should be considered common knowledge that this site and the Bay Area in general are subject to strong ground shaking due to the regular occurrence of large earthquakes. The site is located approximately 3.5 miles east of the San Andreas Fault (Type A), which has a Maximum Credible Earthquake (MCE) of 8.1 moment magnitude. Other surrounding active faults with equal or lesser expected magnitudes and probabilities include the Hayward/Rogers Creek Fault (Type A), located approximately 13 miles to the east, and the Concord Fault (Type B), located approximately 25 miles to the east.

The northern section of the San Andreas Fault has been estimated at a 22% probability for producing an earthquake larger 6.7 before 2043, and the Bay Area as a whole has a probability of 65%.

As no alluvial soils were observed in the area, there is no potential for liquefaction at the site. Since the site is located outside of the Alquist-Priolo Special Studies Zone, the risk of ground rupture is also considered to be very low. Given the shallow depth to competent bedrock, there is little risk of seismically induced landsliding.

Design of the new improvements in accordance with the 2019 CBC should utilize the following factors:

Mapped Short Period Spectral Acceleration, S_s:	1.793
Mapped 1-Second Spectral Acceleration, S_1:	0.733
Site Class:	B
Short Period Site Coefficient, F_a:	0.9
1-Second Site Coefficient, F_v:	0.8
Modified Short Period Acceleration, Sms:	1.615
Modified Short Period Acceleration, Sm1:	0.586
Design Short Period Acceleration, Sds:	1.077
Design Short Period Acceleration, Sd1:	0.391
Design Category:	D

FIELD AND LABORATORY INVESTIGATION: Subsurface conditions at the site were investigated by performing 6 exploratory borings at the locations shown on the attached Boring Location Plan (Figure 2). The first boring B1 was drilled with a portable "Minute Man" drill rig. The other four borings were performed using a 2-inch hand auger. All borings were sampled with a split spoon sampler driven by a modified 70-pound dropping hammer. The blow counts at each hand boring location were converted to standard values using a conversion factor of 2/3. Samples were initially logged in the field and later returned to the laboratory for extrusion and further identification. The samples were then weighed and dried for moisture content determination. Logs of the borings are included on attached Figures 3 through 8.

SUBSURFACE FINDINGS: All borings encountered a soft top soil layer consisting of brown fine sandy Silt with Sandstone fragments, which varied from 1 to 2 feet in depth. All of the borings contained 1 to 2 feet of residual soils, consisting of rusty tan clayey fine Sand with increasing rock structure. Consistent rusty tan Sandstone was encountered at depths of 2.5 to 3.5 feet. The bedrock is relatively soft, with most blow counts in the range of 40 to 50, although a few locations did meet relative refusal.

No groundwater was encountered during drilling.

CONCLUSIONS AND COMMENTARY: Based on our assessment, it is our opinion that the subject site is stable and suitable for the proposed construction. The majority of the proposed structures will be sited on steep slopes, and therefore will require pier and grade beam foundations. The piers should be 18 inches in diameter and should be drilled at least 8 feet into bedrock. Thus total depths of 10 to 15 feet should be anticipated.

The proposed garage structure below the main house, and possibly the lower level of the ADU, will be carved well into the slope and may therefore bear on spread footings. The deep cuts required for the garage should be shored or laid back per OSHA standards to protect workers from possible collapse of the bedrock, which is likely to contain fractures and potential shear zones.

Ideally the vertical cuts along the up-slope perimeters of the existing and proposed driveways should be retained with structural walls, to mitigate the risk of instability for the impending slopes above. Soldier Pile walls with steel I-beam posts set in drilled piers, spanned by pressure treated wood planks, may be the least costly option for these walls. Walls less than 4 feet tall may be designed per County Standards.

Gravel drains should be installed around the up-slope perimeters of both the garage and the main house. Where the slope descends directly against the buildings, concrete V-ditches or walkways should be constructed, to shed surface runoff around to either side.

Storm drains should be dispersed near the base of the slope, in a location where the runoff is not likely to affect existing improvements at down-slope residences.

In summary, it is our opinion that the site is suitable for the proposed construction, provided that the following recommendations are adhered to.

RECOMMENDATIONS

1. **GRADING:** Fairly significant cuts will be required in order to create the pad for the garage, and to create a new driveway ramp down to Juniper Avenue. No significant fill grading is anticipated. All soil spoils should be hauled off site.

   1.1 **Site Preparation:** Areas to receive fill or flatwork shall be cleared of vegetation and stripped to a sufficient depth to remove major root systems. The stripped organic top soil material may be stock piled for later use in landscaping areas.

   1.2 **Cut Grading:** Permanent cut slopes shall be at a maximum inclination of 2:1 (horizontal to vertical) or shall be retained by structural walls in accordance with the recommendations below. Temporary cut slopes over 5 feet in height should be laid back at 45-degrees, or shall otherwise be shored with temporary walls. The design and implementation of embankment shoring, in conformance with OSHA requirements, shall be the sole responsibility of the contractor.

   1.3 **Fill Grading:** Fills placed on slopes shall be retained at the base by structural walls, and shall be progressively step benched proceeding up the slope from the wall. The undersigned Geotechnical Engineer shall inspect and approve all keyways and shall intermittently inspect all fill placement in progress. Fills shall be placed in level lifts no more than 8 inches in thickness, and shall be compacted to 95% relative compaction. Fill slopes shall not exceed a 2:1 gradient. Existing site soils are suitable as fill provided they are free of organic material and of rocks or rubble greater than 6 inches in diameter.

   1.4 **Backfill of Utility Trenches:** Utility trench backfill shall be compacted to a relative density of 95% under pavement and foundation areas, and 90% elsewhere. Trenches shall be capped with at least 18 inches of relatively impermeable material (site soils are acceptable).

2. **FOUNDATIONS:** Where the proposed new structures are sited in level cuts exposing bedrock, foundations may consist of continuous spread footings per Section 2.1. Structures sited on or within 8 feet of descending grades shall bear on drilled pier and grade beam foundations per Section 2.2.

   2.1 **Spread Footings:** Spread footings shall be a minimum of 18 inches in width, and shall extend a minimum 24 inches below the *existing ground surface*, or as needed to achieve full bearing in bedrock. No footings shall bear on fill or top soils. Footings located in areas of cut need only extend 12 inches into weathered sandstone bedrock. The undersigned Geotechnical Engineer shall inspect and verify all footing trenches prior to placement of reinforcing steel concrete.

2.1a Bearing Pressures of Footings: Footings bearing on bedrock may be designed for bearing pressure of 2500 psf.

2.1b Lateral Resistance of Footings: Lateral resistance for spread footings constructed in accordance with Section 2.1, may assume a friction value of 0.40 and a passive resistance of 450pcf for footings bearing on sandstone bedrock. The bearing and passive resistance may be increased by 1/3 for short-term seismic and wind loads.

2.1c Minimal Footing Reinforcing: Where minor T-footings are used, they shall contain a minimum of one #5 bar top and bottom, with #3 shear ties at 18 inches on center.

2.2 Pier and Grade Beam Foundations: Pier and grade beam foundations shall be used on or within 8 feet of sloping grades. All piers should be at least 18-inches in diameter and should extend at least 7 feet into bedrock, or to minimum depths of 10 feet.

2.2a Bearing Friction of Piers: Piers constructed in accordance with Section 2.2 may be designed for a friction value of 750psf for the portion of pier extending into bedrock (Assumed to begin at a depth of 3 feet in the hillside locations).

2.2b Lateral Resistance of Piers: No soil creep forces are assumed to exist at this site. However, resistance to retained earth forces or other lateral structural loadings may be achieved assuming a passive pressure of 450pcf, acting against 2 pier diameters, beginning at the top of bedrock (assume a depth of 2 feet for down-slope locations). This value may be increased by 1/3 for short-term seismic loads.

2.2c Minimal Pier Reinforcing: All piers shall contain a minimum of six #5 bars enclosed by a #3 spiral at a 6-inch pitch.

3. FLOOR SLABS ON GRADE: Floor slabs constructed on grade shall be a minimum of 5 inches thick and shall be reinforced with a minimum of #4 bars at 18 inches on center each way. Slab reinforcing shall be integrated into the structural foundations. Floor slabs used as living space shall be constructed over a moisture barrier consisting of 4 inches of *3/8-inch pea gravel* (do not use 3/4-inch crushed rock as the sharp edges tend to perforate the membrane), covered by a minimum 10-mil plastic membrane.

4. RETAINING WALLS: Retaining walls or foundation walls shall be designed for an active pressure of 45pcf where the backfill gradient is less than 3:1, or 55pcf where the backfill gradient is steeper than 3:1. Walls bearing on level cuts exposing bedrock may be supported on spread footings per Section 2.1. Walls perched on sloping grades must be supported by drilled piers per Section 2.2.

4.2 Seismic Surcharge: Walls exceeding a retained height of 6 feet shall include a uniform seismic surcharge of 10psf/foot of height (ie for a 10 foot tall wall, the surcharge would be 100psf). For retaining walls supporting bedrock cuts, the active pressure may be reduced to 30pcf when considering the seismic case, and the passive resistance may be increased by 1/3. For walls supporting fill soils, there should be no reduction in active pressure, so the seismic case will govern.

4.3 Retaining Wall Drainage: Retaining walls and foundation walls shall ideally be fully back drained with 3/4-inch drain rock wrapped in filter cloth or CALTRANS Class II Permeable drain rock without filter cloth. However the foundation walls of the garage may utilize a Miradrain panel, if the wall is to be constructed with shotcrete, provided that the installer of the waterproofing and drainage panel are willing to guarantee the wall against leaks for a period of at least 10 years. A 4-inch PVC pipe shall be installed along the base of the wall, placed at least 6 inches below the adjacent floor slab or crawlspace grade, and shall be sloped at 1% minimum to outlet to an appropriate discharge point. In addition, foundation walls shall incorporate waterproofing membranes (such as Paraseal), installed per manufacturer's recommendations. Landscape walls may utilize weep holes in lieu of drainage piping.

4.4 Elimination of Footing Heals: We recommend that foundation walls be designed without footing heals, as they tend to interfere with the proper placement of drainage piping, and require deeper back cuts. Walls without heals will require commensurately larger toe extensions.

5. DRAINAGE: Adequate drainage is important to maintain bearing support for shallow foundations and to prevent potential mold and mildew problems related to seepage intrusion under the house.

5.1 Surface Drainage: All roof downspouts shall be fitted with 4-inch solid PVC discharge pipes. Surrounding yard and patio areas shall utilize cast iron or brass catch basins tied to the roof downspout lines, or shall be graded to shed runoff away from the house in an unconcentrated manner. Concrete

V-ditches or walkway should be constructed along the up-slope sides of the structures, to divert surface runoff around to the sides.

5.2 Perimeter Subsurface Drainage: A perimeter gravel subdrain shall be constructed around the up-slope and side perimeters of the structures. The subdrain shall consist of a trench extending at least 12 inches below the adjacent floor slab or crawlspace grades, sloped at 1% toward a suitable outlet point. A perforated PVC pipe shall be placed along the bottom of the trenches, and the trenches shall be backfilled with 3/4-inch drain rock wrapped in filter cloth, or CALTRANS Class II Permeable drain rock without filter cloth.

5.3 Piping: All piping shall be 4-inch SDR-35 PVC. All drain lines shall be continuously sloped at 1% minimum. The manner and location of discharge shall be approved by the undersigned Geotechnical Engineer prior to implementation. Capped clean-outs shall be installed at the beginning of each subdrain line, and at alternate bends in the line.

5.4 Maintenance: Drainage systems require regular maintenance to ensure proper functioning. Catch basins and downspout pipes should be flushed regularly (dependant on the rate of falling leaf litter). Discharge points should also be periodically inspected to ensure that outlet piping is not obstructed. It is recommended that an accurate as-built plan of the drainage systems be prepared, and that maintenance requirements be disclosed to all future buyers of the property.

6. EXTERIOR FLATWORK: Exterior flatwork, including driveways, walkways and patios shall be constructed as 5-inch thick concrete slabs and should be reinforced with a minimum of #4 bars at 18-inch centers. Flexible pavements such as asphalt, decomposed granite or pavers set in sand may be preferable over fill areas, as they can be built up over time if settlement occurs.

7. PLAN REVIEW AND CONSTRUCTION OBSERVATION: The undersigned Geotechnical Engineer should review the final foundation and drainage plans for conformance with the above recommendations. All grading work shall be inspected in progress on an intermittent basis, including approval of all benching and compaction testing for fills. All pier drilling, footing excavations and subdrain trenches should also be inspected prior to placement of reinforcing steel, concrete or backfill. Allowances should be made for potential changes to the final design requirements in the event that actual construction conditions differ from the conditions assumed in this report.

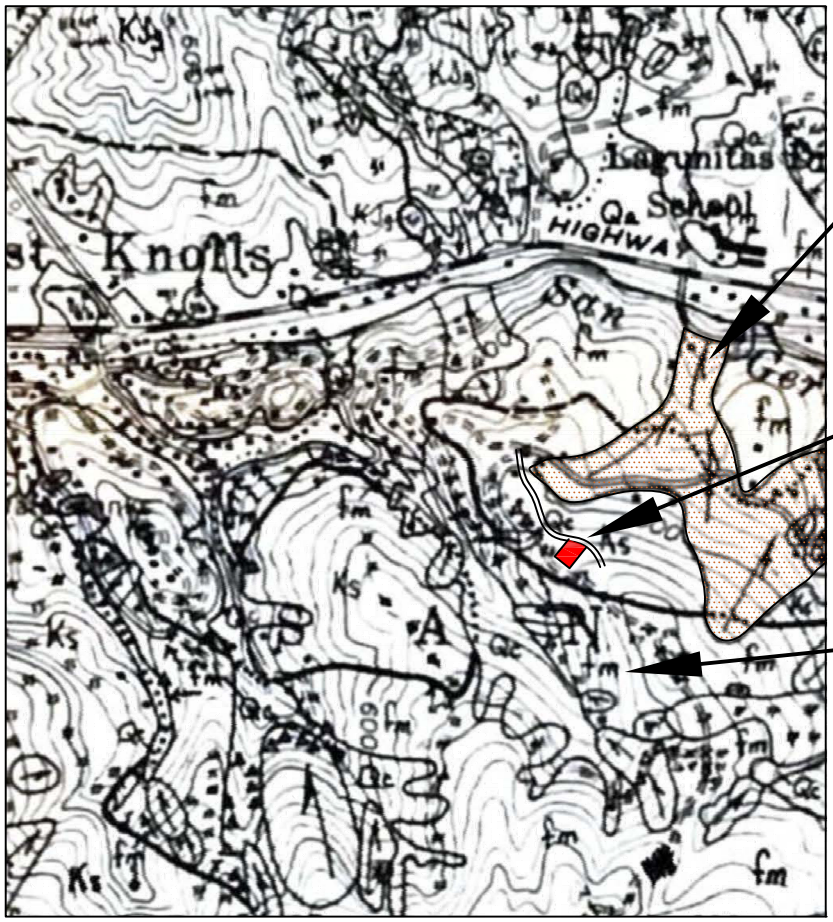
LIMIT OF LIABILITY: This report was prepared under written contractual agreement with the addressee (client) indicated above. The client has agreed to limit the liability of Dave Olnes P.E., Inc. to an amount not to exceed ten times the fee for services indicated above, for any and all matters arising from this visual examination and report. The information provided herein is for the exclusive use of the specified client. Dave Olnes P.E., Inc. shall assume no liability for other parties who use the report without its express written consent. The recommendations contained in this report are valid for a period of two years, pending further review by the undersigned Geotechnical Engineer.

REFERENCES

Knudsen, Keith L., Sowers, Janet M. Witter, Robert S., Wentworth, Carl M, Helley, Edward J., “Preliminary Maps of Quaternary Deposits and Liquefaction Susceptibility, Nine-County San Francisco Bay Region, California”, USGS Open File Report 00-444, 2000.

Rice, Salem J.; Smith, Theodore C.; Strand, Rudolph G., State of California Division of Mines and Geology, Open File Report 76-2, ”Geology for Planning: Central and Southwest Marin County, California”, 1976.

State of California Division of Mines and Geology,”Maps of Known Active Fault Near-Source Zones in California and Adjacent portions of Nevada”, 1998.



MAPPED LAND SLIDE FEATURE EAST (DOWNSLOPE) OF SITE.

SITE, MAPPED AS CRETACEOUS SANDSTONE (Ks).

FRANCISCAN MELANGE (fm) MAPPED WEST AND SOUTH OF SITE.

SOURCE:
STATE OF CALIFORNIA DEPT. OF MINING & GEOLOGY, OPEN FILE REPORT 76-2
GEOLOGY FOR PLANNING: CENTRAL & SOUTHEAST MARIN COUNTY, CALIFORNIA,
SALEM J. RICE, THEODORE C. SMITH & RUDOLPH G. STRAND, 1976.

DAVE OLNES P.E. INC.
CIVIL & SOIL ENGINEER
7915 CREST AVENUE OAKLAND CALIF. 94605
PH & FX: (510)568-2162 daveolnes@sbcglobal.net

SCALE: 1"~1500'

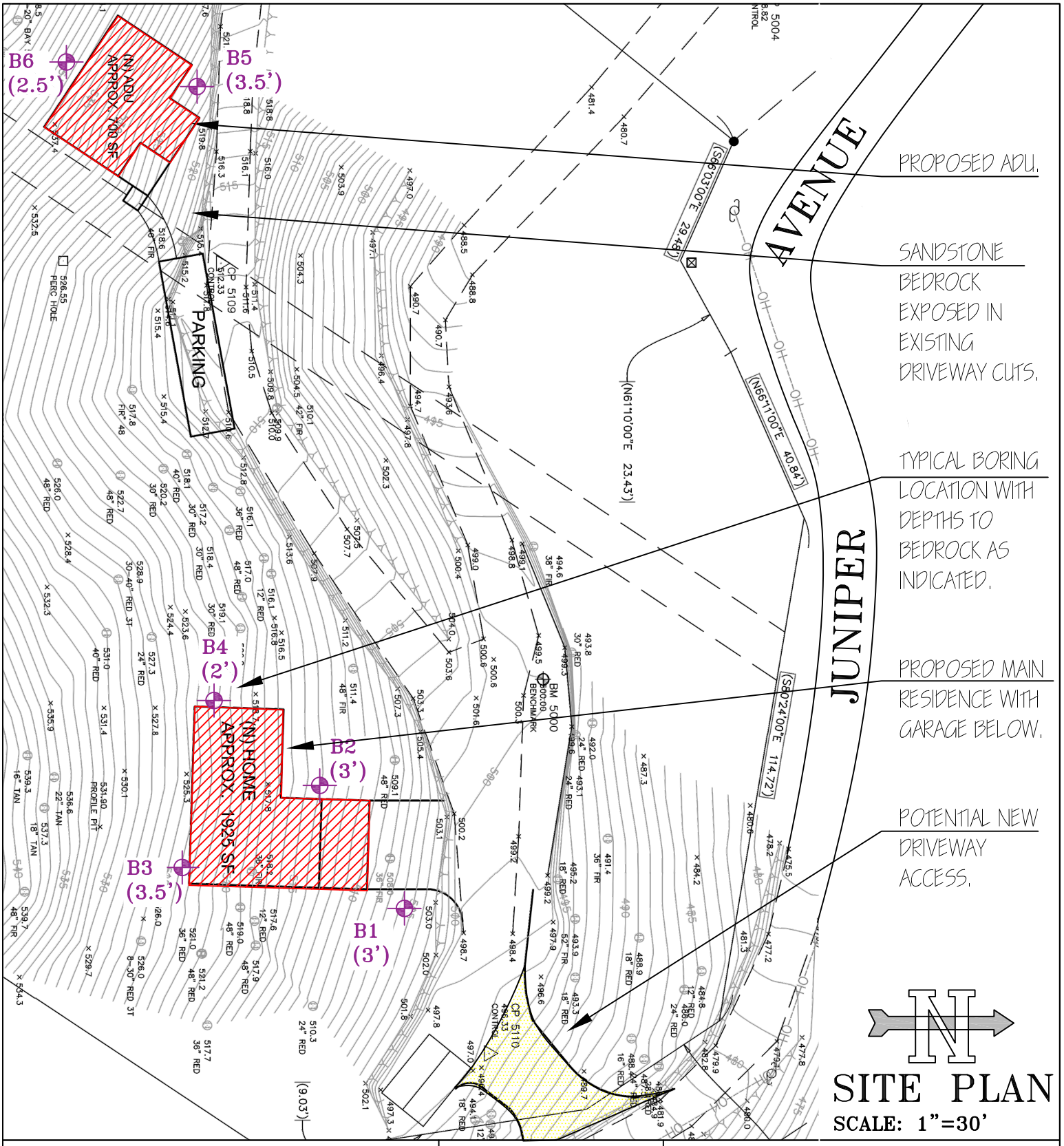
JOB #: 0-4975

DRAWN: DAO

DATE: 3/10/21

GEOTECHNICAL RECONNAISSANCE
50 JUNIPER AVENUE
SAN GERONIMO, CALIFORNIA

FIGURE: 1



SITE PLAN

SCALE: 1"=30'

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GEOTECHNICAL RECONNAISSANCE
50 JUNIPER AVENUE
SAN GERONIMO, CALIFORNIA

FIGURE: 2

BORING: 1 Location: Northeast Corner of Main House

DESCRIPTION	DEPTH FEET	SAMPLE NUMBER	BLOW COUNT	MOISTURE CONTENT	COMMENTS
brown fine Sandy SILT (SM)					**Topsoil**
rusty-tan Sandy SILT (SM)					**Residual Soil**
rusty-tan SANDSTONE		1-1	40	14%	**Bedrock**
	5				
		1-2	35	11%	
	10				
Boring Terminated @ 10.5'					No Groundwater
	15				
	20				

DAVE OLNES P.E. INC.
CIVIL & SOIL ENGINEER
7915 CREST AVENUE OAKLAND, CA 94605
TELEPHONE & FAX (510) 568-2162

PROJECT: Geotechnical Investigation
50 Juniper Drive
San Geronimo, California

DATE: March 31, 2021

Figure: 3

HAND AUGER

Probe # : B2		Depth	Probe # : B3	
Location: NORTHWEST CORNER OF MAIN HOUSE			Location: SOUTHEAST CORNER OF MAIN HOUSE	
DESCRIPTION			**DESCRIPTION**	
dark red-brown SILT (ML) with abundant Roots and Organics	**Topsoil**		dark red-brown Sandy SILT (SM) with Organics	**Topsoil**
rusty-tan Sandy SILT (SM) with Sandstone Cobbles	**Colluvium**		rusty-tan Sandy SILT (SM)	**Colluvium/ Residual Soil**
tan Silty SAND (SM)	**Residual Soil**			
tan Weathered SANDSTONE **SPT @ 4': 100+**	**Bedrock** Moisture: 6%		rusty-tan SANDSTONE **SPT @ 4': 50**	**Bedrock** Moisture: 14%
Boring Terminated @ 5'	No Groundwater	5	Boring Terminated @ 5.5'	No Groundwater

Probe # : B4		Depth	Probe # : B5	
Location: SOUTHWEST CORNER OF MAIN HOUSE			Location: NORTHWEST CORNER OF ADU	
DESCRIPTION			**DESCRIPTION**	
dark red-brown SILT (ML) with Organics and Roots	**Topsoil**		dark red-brown Sandy SILT (SM) with Organics	**Topsoil**
rusty-tan Silty SAND (SM)	**Residual Soil**		rusty-tan Sandy SILT (SM) with Sandstone fragments	**Colluvium/ Residual Soil**
tan Weathered SANDSTONE **SPT @ 3': 40**	**Bedrock** Moisture: 14%		tan Weathered SANDSTONE **SPT @ 3.5': 37**	**Bedrock** Moisture: 8%
Boring Terminated @ 4.5'	No Groundwater	5	Boring Terminated @ 5'	No Groundwater

DAVE OLNES P.E. INC.
CIVIL & SOIL ENGINEER
7915 CREST AVENUE OAKLAND, CA 94605
TELEPHONE & FAX (510) 568-2162

Project: Geotechnical Reconnaissance
50 Juniper Drive
San Geronimo, California

Date: March 31, 2021 Figure: 4

HAND AUGER

Boring # : **B6**

Location: SOUTH PERIMETER OF ADU

DESCRIPTION		Depth
dark red-brown Sandy SILT (SM) with Organics	**Topsoil**	
rusty-tan Sandy SILT (SM) with Sandstone fragments	**Colluvium/ Residual Soil**	
tan Weathered SANDSTONE **SPT @ 3': 100+**	**Bedrock** Moisture: 13%	
Boring Terminated @ 3.5'	No Groundwater	

5

10

15

DAVE OLNES P.E. INC.
CIVIL & SOIL ENGINEER
7915 CREST AVENUE OAKLAND, CA 94605
TELEPHONE & FAX (510) 568-2162

Project: Geotechnical Reconnaissance
50 Juniper Drive
San Geronimo, California

Date: March 31, 2021 Figure: 5