April 27, 2020

TO: c/o Mike Muelrath
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FROM: _____
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Geologist Hydrologist, O'Connor Environmental, Inc.

Subject: Landslide Hazard Evaluation, Kenzo Estates Vineyard
APN's 033-130-046, 033-190-014, and 033-190-015

Introduction

This Landslide Hazard Evaluation considers the potential effect on slope stability of proposed vineyard development on the above referenced parcels (County of Napa APNs 033-130-046, 033-190-014, and 033-190-015) as described in the Vineyard Development Erosion Control Plan (ECP) prepared by Applied Civil Engineering, Inc. O'Connor Environmental, Inc. (OEI) was engaged by the applicant (Kenzo Estates Inc.), to conduct this evaluation. This evaluation is intended for use by County of Napa Planning, Building and Environmental Services Department (PBES) in its permitting process for the above referenced project; the scope of the evaluation is consistent with "Guidelines for Preparing Landslide Hazard Evaluation".

OEI has conducted several similar slope stability assessments in Napa County and Sonoma County in addition to several years of experience mapping landslides and evaluating slope stability in Washington and northern California. I am a Professional Geologist in California with experience mapping landslides and unstable areas.

The three subject parcels together comprise approximately 353 acres; the northern parcel (APN 033-130-046) covers approximately 157 acres, the western parcel (APN 033-190-014) covers 37 acres while the southern parcel (APN 033-190-015) covers 159 acres (Figure 1). The northern parcel has a land cover of mostly mixed oak forest and chaparral with some open grassland meadows in valley bottoms and is presently undeveloped except for unpaved ranch roads. A portion of Vineyard Block 1 is proposed on small corner in the southwest portion of the parcel, currently the area is a mix of grassland and chaparral. Other than Wild Horse Valley Road, there is no development on the western parcel. The road, which is paved, runs north to south through the eastern half of the parcel providing access to the proposed vineyard site and two existing residences on the southern parcel. The western parcel has a mix of land cover with chaparral and grassland covering approximately 50% each. On the southern parcel existing improvements

include Wild Horse Road, a gravel road, the two existing residences and the Vineyard and Residential Wells (Figure 1) as shown in the ECP. Most of the proposed vineyard area is on the southern parcel in an area with existing grassland and a few areas of mixed hardwood trees totaling to approximately 3 acres. The proposed vineyard development sites total 13.1 acres with 3 acres proposed on the northern parcel, 10 acres proposed on the southern parcel and the remaining 0.1 acres on the western parcel. The subject parcels are owned and managed by Kenzo Estates. It is assumed that this assessment accompanies all relevant documents submitted to the County of Napa, and that detailed descriptions of the project and the project site need not be repeated here.

Methods

To evaluate existing and potential slope stability hazards at the proposed vineyard blocks, the following tasks were undertaken: review of available geologic maps, review of available historic aerial photographs, review of soil survey data, field reconnaissance in February 2020 and synthesis of available information regarding existing and likely future stability of the site. Appendix A contains site photos referenced in this report.

Regional & Site Geology

The project is located within the California Coast Ranges geomorphic province. Numerous faults oriented northwest-southeast occur in this region, and extensive tectonic activity has created a landscape of northwest-southeast trending ridges and valleys. The tectonic activity is associated with the collision between the Farallon and North American plates occurring particularly in the late Mesozoic (about 100 million years before present), and with movement along the San Andreas Fault which formed in the mid-Cenozoic (about 30 million years before present) at the boundary between the Pacific and North American plates.

The three project parcels are in the mountains east of the Napa Valley, approximately one mile north of Lake Madigan (Figure 1). The most recent geologic mapping used for this analysis comes from the Preliminary Geologic Map of the Napa and Bodega Bay 30' x 60' Quadrangles, California by Wagner and Gutierrez of the California Geological Survey (CGS, 2017). The project area is underlain by Miocene and Pliocene-aged rocks of the Sonoma Volcanics and is intersected by several traces of the north to south trending Green Valley Fault (Figure 2). The western half of these parcels are underlain by the Pliocene-aged Dacite of Mount George (map unit Psvdg), which has been described as flows, domes, and shallow intrusion of gray to tan porphyritic dacite (Wagner and Gutierrez, 2017). The central portion of the area comprised of the project parcels is underlain by Miocene to Pliocene-aged Mafic Flows and Breccia which include andesitic to basalt flow rocks as well as andesitic tuff (map unit Tsvm). The far eastern portion of this area is underlain by Pliocene-aged rhyolite ash flow tuff and flows (map unit Psvrt).

Two Quaternary landslides (map unit Qls) were previously mapped on the project parcels. The smaller of the two (approximately 14 acres in area, #9107 in the CGS geodatabase) is located

adjacent to Wild Horse Valley Road and covers the northeastern corner of western parcel (APN 033-190-014) and a small portion of the northern parcel (APN 033-130-046). A much larger, landscape-scale landslide complex (approximately 4,900 acres) is mapped to the east of the project parcels (Figure 1). A small portion of this landslide is mapped intersecting the northeast corner of the northern parcels. Specific details of these two slides are not reported in the CGS work; however, past mapping efforts by USGS classified some of these landslides as discussed in the next section. Reconnaissance confirmed the mapped bedrock geology. The site has numerous outcroppings of volcanic rocks of varied colors, weathering, and textures.

Numerous fault traces associated with the Green Valley Fault are mapped in the project vicinity; some are contacts between the mapped geologic units. Figures 1, and 2 show the locations and classifications of the locally mapped faults. All faults are classified as having experienced Holocene fault displacement (during the past 11,700 years) without historic record of displacement by the 2010 California Geologic Survey Fault Activity Map (CGS 2010). Some of these traces are mapped within the Alquist-Priolo Fault Hazard Zone (CGS 2018, see Figure 2); however, the existing residences and other inhabited developed areas (including the proposed vineyard areas) are not within these zones and an evaluation of slope stability related to earthquakes is not required.

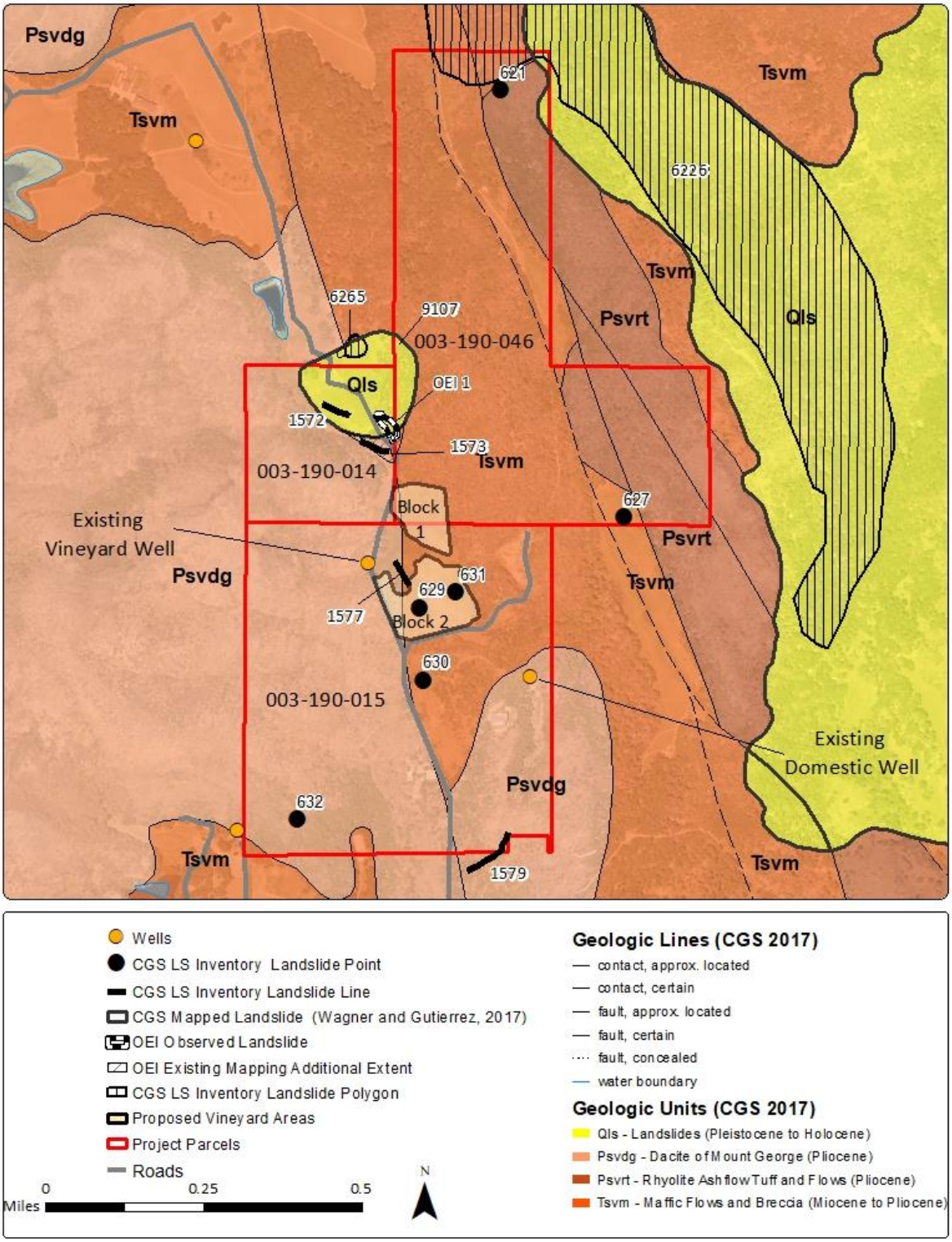

Figure 1. Surficial geology of the project parcel (Wagner and Gutierrez, 2017) and Existing mapped landslides from the California Geological Survey Landslide Inventory map (CGS, 2016).

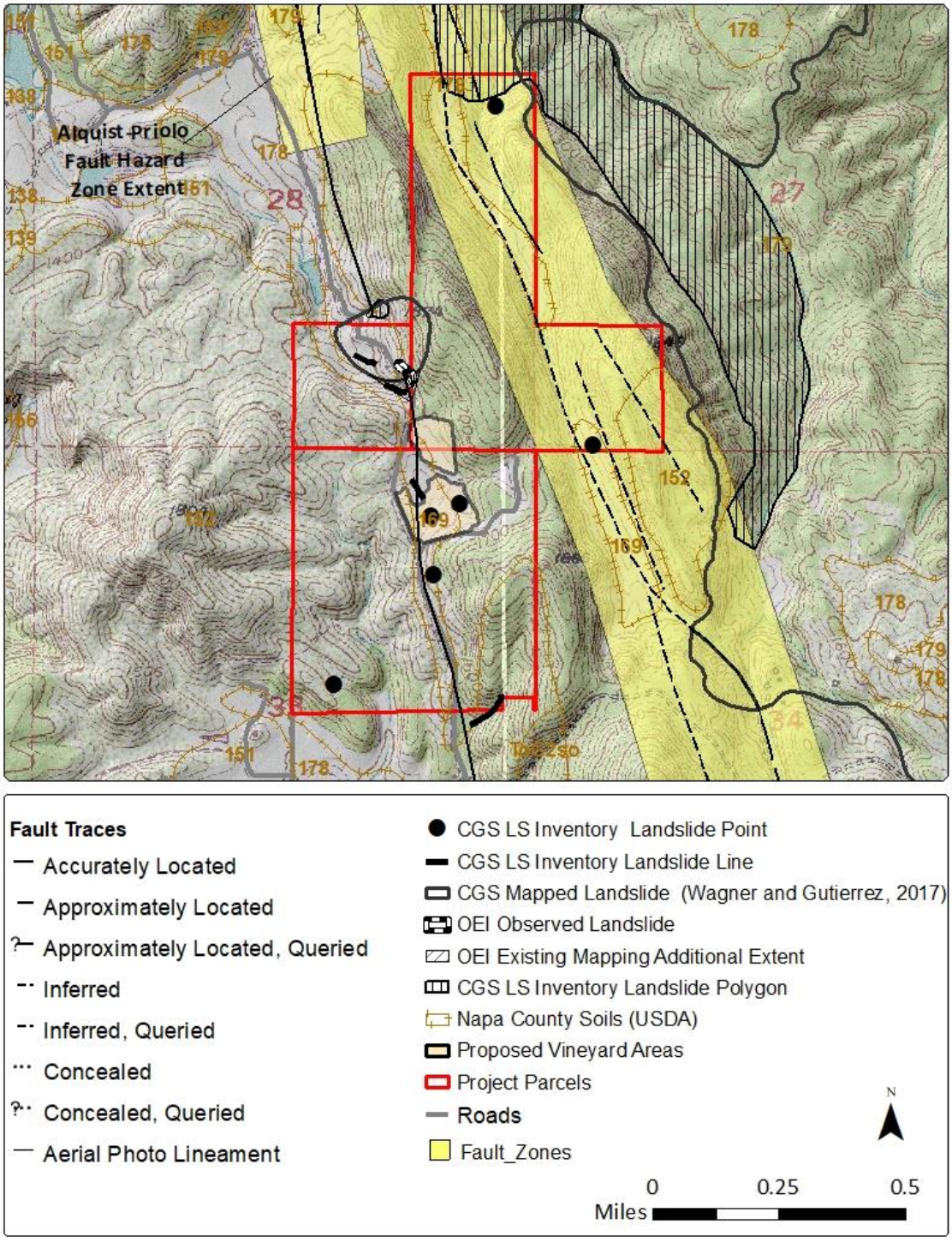

Figure 2. Alquist-Priolo Fault hazard areas near the project parcels from California Geological Survey Seismic Hazards Program (CGS 2018) , distribution of USDA Soil types (see Table 2 for soil types), and Landslides on the project parcels, CGS California Landslide Inventory Landslides shown are from Dwyer, Noguchi and O'Rourke (USGS 1976) Wagner and Gutierrez (CGS 2017) and OEI (2020).

Potential Slope Instability

Napa County GIS Parcel Reports indicate that landslides are present on all three of the project parcels. In addition to the landslides mapped in the Preliminary Geologic Map of the Napa and Bodega Bay 30' x 60' Quadrangles (CGS 2017), a regional landslide mapping effort by the California Geological Survey called the California Landslide Inventory (CGS 2016) has compiled several mapping efforts across the state. Landslides identified by interpretation of aerial photographs on the Mt. George 7.5 Minute Quadrangle in the vicinity of the project parcels by Dwyer et al. (USGS 1976) include several landslides on the project parcels (Figure 3, Table 1). Most landslides mapped in the 1976 USGS study are numbered with four-digit geodatabase codes and described with an activity level, a landslide type and a confidence level. The Landslide Inventory geodatabase is hosted by CGS on ArcGIS Online[1]. All relevant data for provided by the geodatabase is shown in Table 1 and locations are shown in Figures 1-3. Landslides identified in the 2017 Preliminary Geologic Map of the Napa and Bodega Bay 30' x 60' Quadrangles CGS do not have any data related to landslide activity, type or confidence and so were defined during field reconnaissance as shown in Table 1.

Three landslides located on the east side of the ridge far from the proposed project site and supporting infrastructure and, for that reason, are not evaluated in detail or in the field in this study. These landslides include two on the northern parcel described as "Definite[2] Debris Flows" identified by index numbers 627 and 6226 and another identified as a "Probable[3] Debris Flow" (#626; see Table 1 & Figure 1). Landslide #6226 is assumed to be associated with the larger landscape-scale landslide complex mapped (map symbol Qls) in the 2017 Preliminary Geologic Map of the Napa and Bodega Bay by CGS.

On the western parcel two "Probable Debris Slides" (#1572 and #1573) are mapped as linear features (Table 1, Figure 1). Landslide #6265 is mapped as a "Definite Dormant-Young" landslide covering a smaller area within CGS Landslide #9107 just north on the parcel. These landslides are all located in the vicinity of Wild Horse Valley Road.

On the southern parcel four probable debris slides, a "Questionable[4] Debris Flow" and a "Definite Debris Flow" are mapped (Table 1, Figure 1). Landslides #629 (Probable Debris Slide), #631 (Probable Debris Slide) and #1577 (Definite Debris Flow) are located within proposed Block 2. The remaining mapped landslides (#632 and #1579) are not located near the proposed vineyard areas or access roads.

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[1] https://maps.conservation.ca.gov/cgs/lsi/app/

[2] Definite in this context is defined by the USGS study as "100% confident it is a landslide; numerous geomorphic features indicating landslide origin; historic, recent or active movement".

[3] Probable in this context is defined by the USGS study as "75% confident it is a landslide; one or two geomorphic features suggesting a landslide origin; features recognizable but subdued by erosion".

[4] Questionable in this context is defined by the USGS study as "50% confident it is a landslide; a geomorphic feature or features that could be explained by other processes; cannot be sure it is a landslide without detailed site investigation"

Table 1. Landslides mapped by Dwyer, Noguchi and O'Rourke (USGS 1976), Wagner and Gutierrez (CGS 2017) and OEI (2020).

Northern Parcel (APN 033-130-046)			
Source	**Landslide Number**	**Landslide Type**	**Field Review Note**
USGS 1976	627	Definite Debris Flow	Not visited, out of project influence.
USGS 1976	621	Probable Debris Slide	Not visited, out of project influence.
USGS 1976	6226	Definite Debris Flow	Not visited, out of project influence.
CGS 2017	NA	Undefined Landscape-Scale Landslide Complex, extent contains USGS 6226	Not visited, out of project influence.
Western Parcel (APN 033-190-014)			
Source	**Landslide Number**	**Landslide Type**	**Field Review Note**
USGS 1976	1572	Probable Debris Slide	Linear feature associated with toe of larger previously mapped Historically Active Rockslide (CGS 9107). No slope stability issues observed.
USGS 1976	1573	Probable Debris Slide	Linear feature associated with toe of larger previously mapped Historically Active Rockslide (CGS 9107). No slope stability issues observed.
USGS 1976	6265	Definite Dormant Young Landslide (Type Undefined)	Historically Active Debris Slide located within a larger previously mapped Historically Active Rockslide (CGS 9107). 250 feet long, 180 feet wide,4 to 6 foot depth (approx.). 58% slope at head, seep observed in body of deposit. Extent extended by OEI based on observations in 2020. No impacts to paved road observed.
CGS 2017	9107	Undefined Landslide	Historically Active Large Rockslide. Extent includes two active areas identified as USGS 6265 and OEI 1. 58% slope at head. No impacts to paved road observed.
OEI 2020	1	Definite Active Debris Slide	Active road cut slope failure mapped by OEI; associated with CGS Landslide 9107. 70 feet long, 240 feet wide, 6 to 8 feet deep. 35% slope. No impacts to paved road observed.
Southern Parcel (APN 033-190-015)			
Source	**Landslide Number**	**Landslide Type**	**Field Review Note**
USGS 1976	632	Questionable Debris Flow	Not visited, no project influence.
USGS 1976	630	Probable Debris Slide	No evidence of landslide, 25% slope.
USGS 1976	629	Probable Debris Slide	No evidence of landslide, < 5% slope.
USGS 1976	631	Probable Debris Slide	No evidence of landslide, 7% slope.
USGS 1976	1577	Definite Debris Flow	No evidence of landslide, < 5% slope.
USGS 1976	1579	Probable Debris Slide	No evidence of landslide, no project influence.

A site-specific assessment of slope stability including field reconnaissance of the project site to observe mapped features described above where landslide features have been mapped on the proposed vineyard sites. This assessment evaluated only slides mapped near existing or proposed development on the project parcel including Wild Horse Valley Road and proposed vineyard blocks. A discussion of the observations made during the site visit is provided below.

Slope

A strong indicator of potential slope instability is slope gradient. Observations of slope gradient in the field did not suggest significant potential slope instability. Slope gradient on the proposed vineyard site is generally less than 30% with some small inclusions of > 30% slope. In most non-cohesive earth materials, potential instability is generally very low on slopes less than about 50% and may typically be found to be significant on slopes greater than 65%. On some landslide deposits and in some clay-rich materials under certain conditions, there may be higher potential instability on slopes in the 50% to 65% range.

Soils

Soil types at the proposed vineyard sites were queried using the NRCS Web Soil Survey. The review of soils data is not particularly relevant to site-specific determination of evidence of slope stability or instability but is sometimes helpful in identifying evidence of susceptibility to slope instability.

The soils mapped on the project parcels are listed in Table 2. The Hambright Rock outcrop and Perkins gravelly loam soils are derived from weathering of Sonoma Volcanics bedrock. The Sobrante Loam is derived from a massive fine-grained sandstone, possibly the Franciscan Complex sandstone. The typical soil profiles of the Hambright and Sobrante soils extend to depths between 12 and 30 inches; soil depths at this site are generally substantially less. The Perkins soils which occupy the lower elevations of the project site are described as having a depth to bedrock greater than 80 inches. The Perkins and Sobrante Loam soils are classified in Hydrologic Soil Group C which have a slow infiltration rate when thoroughly wet and have a slow rate of water transmission. Surface runoff is rated high. Hambright soil is classified in Hydrologic Soil Group D which has slow infiltration and a high runoff-potential when thoroughly wet. Per Web Soil Survey disclaimers, the soils data should not be considered accurate at the project scale. In summary, our review of soils and slope values in the project area did not identify conditions that would lead to slope stability issues on the project site.

Table 2. Soils located on the project parcels, properties from USDA Web Soil Survey.

Soil Type	Soil Description	Depth to Bedrock (inches)	Hydrologic Soil Group
152	Hambright Rock-Outcrop Complex, 30 to 75 % Slopes	12	D
169	Perkins gravelly loam, 5 to 9 percent slopes	> 80	C
178	Sobrante Loam, 5 to 30 % Slopes	30	C
179	Sobrante Loam, 30 to 50 % Slopes	30	C

Aerial Photo Review

Historical aerial photography available on Google Earth was reviewed for evidence of active landslides at or near the project parcel. The available imagery was abundant for the period covering the period for 2002 to 2018; the oldest image from this source was 1993. A possible cutslope failure was identified as possibly occurring between 2011 and 2014 on the western parcel. This feature was visited during field reconnaissance and mapped as Landslide OEI 1.

Beginning in 2008 grading has been occurring in the area of proposed Block 2. All grading is associated with disposing of soils separated during the processing of rock removed from other vineyard fields on the project parcels. This area does have features identified as landslides however no features indicating slope instability were observed in the aerial photography.

Observed Landslides and Slope Conditions

I conducted field reconnaissance of the proposed vineyard sites and main entrance road on February 4, 2020 over a five-hour period (Figure 3). Site photos are compiled in Appendix A. I measured the slope gradient of the ground surface at various locations in the proposed vineyard site using a clinometer. I found slopes consistent with those documented in the ECP and the Napa LiDAR-derived topographic data. In addition, I inspected the ground surface around the perimeter of the proposed vineyard Blocks where slopes are > 30% and where natural swales and ephemeral streams are found and where evidence of slope instability and landslide activity would likely exist if present. Finally, I visited all sites of landslides and suspected landslides or unstable areas identified by previous mapping efforts in the vicinity of the proposed vineyard blocks and access road.

On the northern parcel (APN 033-130-046) north and east of proposed Blocks 1 and 2, three landslides were identified in the 1976 USGS study along with portions of two landslides mapped on the 2017 CGS map. On the western parcel (APN 033-190-014), three landslides were identified in the 1976 USGS study and one landslide was mapped in the 2017 CGS study. On the southern parcel (APN 033-190-015) within and south of proposed Block 2, six landslides were identified by the 1976 USGS study. I visited all sites located withing the vicinity of the proposed vineyard blocks and access roads and assessed the slope stability of each. Table 1 summarizes each landslide and my assessment of stability. No evidence of instability or shallow landslides (debris slides or shallow rotational slumps) was observed within and around either of the proposed vineyard blocks.

In the northern project parcel, no landslides were mapped by others near the proposed vineyard areas (Table 1). I walked the proposed vineyard boundary of Block 1 to examine ground conditions, slopes and look for any evidence of unstable areas. Slopes along the edge of the Block 1 vineyard boundary are mostly less than 30% but in two locations along the eastern edge of the Block 1 measured slopes of 40 to 45% (Figure 3). The hillslope above the eastern edge of Block 1 is forested with a mix of hardwoods that burned in 2017. Most of these trees appear to have survived and are showing signs of new growth (Photo 8). No unstable areas were observed within or near the proposed boundaries of vineyard Block 1. The only landslide located near project

infrastructure within the northern parcel is a small portion of a new landslide (OEI 1, Figure 3), also mapped in the southeastern edge of the northern parcel near Wild Horse Canyon Road. The majority of OEI 1 is located on the western parcel and is described below.

On the western project parcel no landslides were mapped by others near the vineyard areas. Mapped landslides are located further north on the western parcel and are all located within the large unnamed landslide mapped by CGS (#9107) in the Preliminary Geologic Map of the Napa and Bodega Bay (CGS, 2017, Figures 1 and 4). This landslide, which is mapped across a portion of Wild Horse Canyon Road, was observed to be a Historically Active Large Rockslide (Photos 1 and 2). Slopes up to 58% at the steepest portions near the head of the landslide while the main body has slopes between 25% and 35%. Two smaller landslides were observed within its extent, Landslide #6265 mapped by USGS 1976 and OEI 1 mapped during the site visit by OEI in 2020. Landslides #1572 and #1573 are also mapped within and near the large rockslide. These features were visited in the field and it was determined that they had identified linear topographic expressions of transverse ridges or cracks associated with the toe of the large rockslide. The extent of the large rockslide was expanded to include all of Landslide OEI 1 and Landslide #1573 (Figures 1 and 3).

Landslide #6265 is located on the northern flank of the larger Landslide #9107 Historically Active Large Rockslide (Figure 3). The toe of #6265 is located approximately 50 feet from Wild Horse Canyon Road in a convergent swale. Landslide #6265 is described as a "definite" landslide (USGS 1976); however, the landslide type is not described. Field observations revealed the landslide to be a Historically Active Debris Slide (Figure 3, Photo 1) but no evidence of recent movement was observed. A small seep of groundwater was observed within the body of the landslide. Landslide #6265 presents a low hazard to Wild Horse Road and no design recommendations or other actions are needed to address this degree of hazard.

Landslide OEI 1 is a newly mapped active cutslope failure (Figure 3, Photos 3 and 4). Based on aerial photo review it appears that this landslide occurred between the years 2011 and 2014. A fresh vertical to over-hanging soil scarp is present along the width of the landslide and fresh deposits from recent unraveling of the scarp are present. The nearest portion of the landslide is within 25 feet of the road with the steepest portions located almost 100 feet from the road. There is a flat area used as a pullout between the road and the failure. This setback may be evidence that this area was associated with an old quarry site used for road building. No evidence of impacts to the road (tension cracks or hummocks) were observed; in light of this and the distance from the road Landslide OEI 1 presents a low hazard to Wild Horse Road and so no actions are recommended.

I inspected the perimeter of the southern portion of proposed Block 1 on the southern parcel and all of Block 2 reviewing slopes and ground conditions (Figure 3, Photos 5, 6 and 7). Slopes matched those presented in the ECP with maximum slopes of 30% in the southeastern corner of Block 2. In addition, I visited five of the six mapped landslides and assessed their classification, activity and stability (Figure 3, Table 1). Landslide #632 in the southeastern portion of the southern parcel was not visited as it is located outside of the project influence and away from

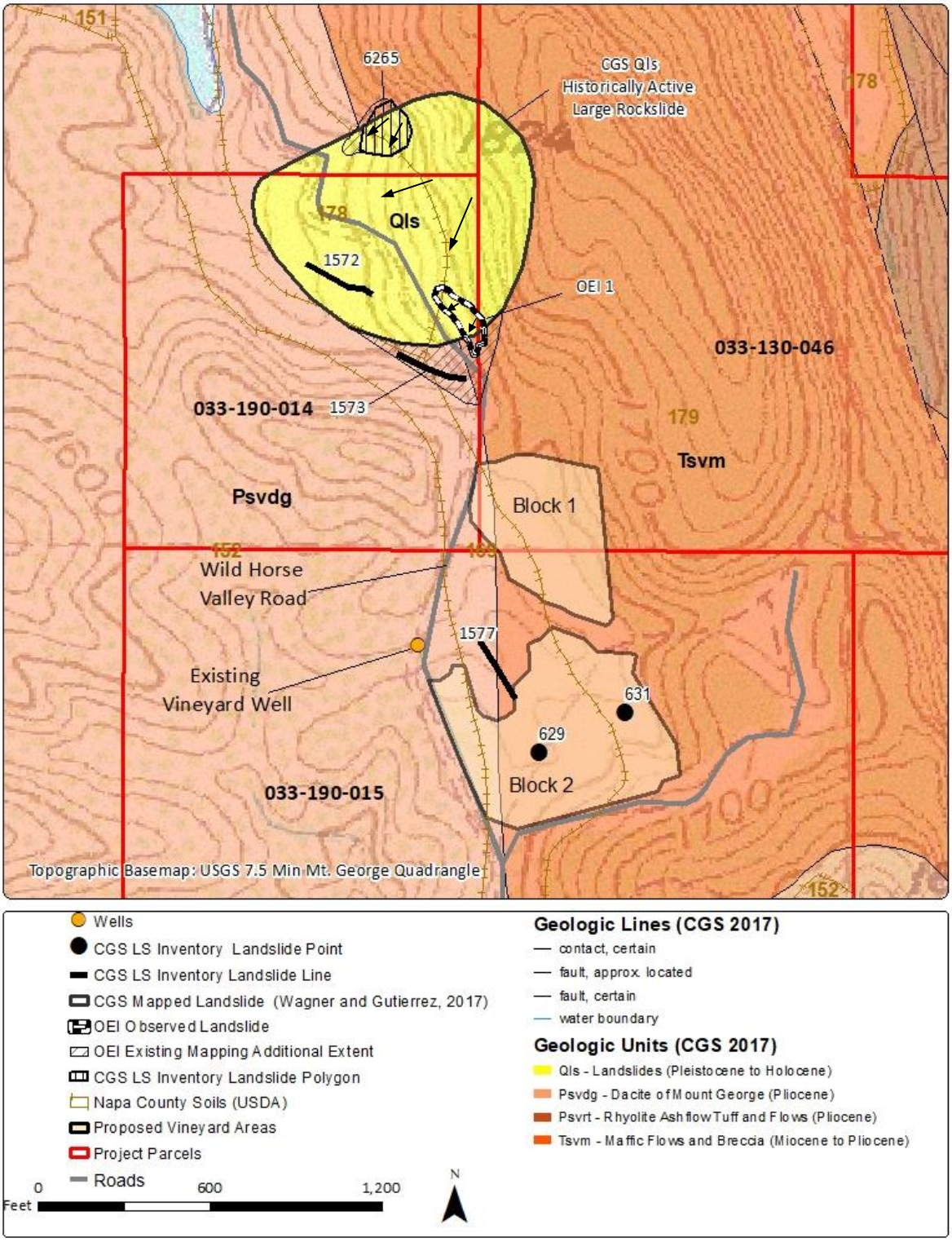

Figure 3. Proposed project area showing areas visited and landslides mapped by Dwyer, Noguchi and O'Rourke (USGS 1976), Wagner and Gutierrez (CGS 2017) and OEI (2020).

any existing infrastructure. Of the five areas where landslides are mapped on the southern parcel no evidence of existing or historic slope movement was observed.

Outcrops of volcanic materials, including bedrock, boulders and cobbles, are present throughout the steeper portions of the proposed vineyard block areas (eastern edge of Block 1 and south portion of Block 2 as shown in Photo 6). In the northern project parcel evidence of significant amounts of rock removal to prepare the nearby vineyard fields indicates shallow depths to bedrock and rock in similar soils and geology as the project site. The presence of this volcanic rock lying at or near the surface throughout much of the steeper proposed vineyard site indicates that the site is not generally susceptible to landslide processes in the absence of fractures or structural dip slopes parallel to surface slope. The volcanic rock has high strength, and overlying soils types are relatively thin and described as having cohesive characteristics (clay rich loams) and on slope gradients that are far below typical thresholds of instability.

Conclusions and Recommendations

Based on the foregoing assessment of site conditions, the proposed vineyard development is not expected to cause any significant decrease in slope stability nor any increase in erosion associated with landslide processes. Vineyard development is not expected to affect the stability of previously mapped or newly identified landslide features in the area.

The site vicinity is geologically active; the Green Valley Fault Zone lies about one-half mile east of the proposed vineyards and property owners in this area should plan for harmful effects of seismic activity including potential mobilization of existing landslides. It is conceivable that Wild Horse Valley Road and other infrastructure could be damaged by an earthquake.

Limitations

This slope stability and erosion assessment has been prepared with generally accepted principles and practices of Professional Geology. The conclusions and recommendations presented are based on available data, site observations, and professional judgment.

References Cited

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CGS, 2017, Wagner, D.L. and Gutierrez, G. I. The Preliminary Geologic Map of the Napa and Bodega Bay 30' x 60' Quadrangles, California by of the California Geological Survey. Sacramento, California.

APPENDIX A-Site Photographs, June 2019

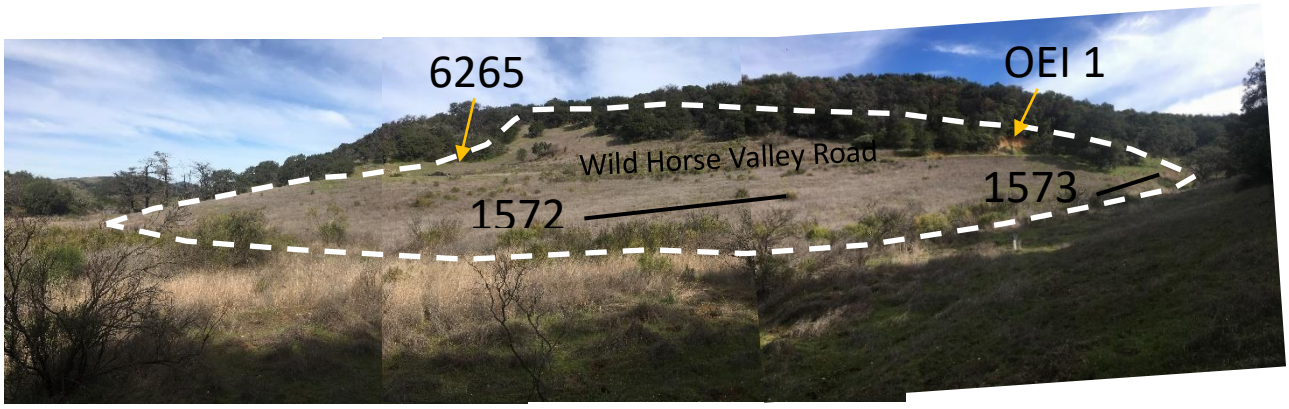

Photo 1. Oblique view to the northeast of CGS Qls. Dashed line shows approximate extent and locations of 6265 and OEI 1 indicated by arrows, linear features 1572 and 1573 approximately located in toe (foreground) indicated by black lines.

Photo 2 View to the southwest of CGS Qls of main body of slide.

Photo 3. View to the northeast of main scarp and deposit of OEI 1.

Photo 4. Views north and northeast of OEI 1 and Wild Horse Valley Road.

Photo 5. View to west from southeast corner of typical ground conditions in Block 1.

Photo 6. View to the northwest of Block 2, rock exposed at surface in the left of the picture.

Photo 7. View to the south of surface conditions in Block 2.

Photo 8. View of vegetation conditions on hillside east of proposed vineyard Block 1.