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Water Availability Analysis

Bergman Family Winery P17-00428
Planning Commission Hearing December 19, 2018

RICHARD C. SLADE & ASSOCIATES LLC
CONSULTING GROUNDWATER GEOLOGISTS

MEMORANDUM

March 7, 2018

To: Ms. Pam Bergman
Bergman Family Vineyards Winery
3825 St Helena Hwy
St. Helena, CA
Sent via email (pjbergman@me.com)

Job No. 653-NPA01

Cc: Ms. Donna Oldford
Plans4Wine
Sent via email (dboldford@aol.com)

From: Chris Wick, Anthony Hicke and Richard C. Slade
Richard C. Slade & Associates LLC (RCS)

Re: Results of Napa County Tier 1 Water Availability Analysis
Bergman Family Vineyards Winery
3285 St Helena Hwy
Vicinity St Helena, Napa County, California

Introduction

Provided herein are the key findings and conclusions, and our preliminary recommendations regarding the Water Availability Analysis (WAA) prepared by RCS for the Bergman Family Vineyards Winery property in Napa County (County), California. This WAA was prepared in conformance with Napa County Tier 1 requirements, as described in the Napa County WAA Guidelines (WAA 2015). The Bergman Family Vineyards Winery property is comprised by 16.2 acres and is located at 3825 St Helena Highway in the St. Helena area of Napa County. Figure 1, "Location Map," shows the boundaries of the subject property superimposed on the USGS topographic map for the Calistoga and St Helena quadrangles. Property boundaries shown on Figure 1 were adapted from the County Assessor's parcel data that are freely available from the Napa County GIS website. Also shown on Figure 1 are the locations of the existing onsite water well (known herein as "Vineyard Well"), as well as the locations for known and/or possible nearby but offsite wells owned by others; most of these offsite well locations are approximate. The offsite "Easement Well" is reportedly used to supply groundwater for the subject property as a result of an existing water easement agreement. Figure 2, "Aerial Photograph Map," shows the same property boundaries and well locations as are illustrated on Figure 1, but the basemap for Figure 2 is an aerial photograph of the area; this aerial photograph was obtained from the USGS EarthExplorer website (the date of the imagery is June 11, 2016).

As reported by project engineer, Mr. Mike Muelrath of Applied Civil Engineering (ACE) of Napa, California, the 16.2-acre subject property is currently developed with the following: 8.6 acres of

existing vineyards; two residences (a primary and secondary residence); and onsite landscaping.

RCS understand the proposed project is to develop a new winery at the subject property with a capacity of 8,000 gallons of wine per year. All vineyard and landscaping irrigation water demands for the subject property are currently met by using groundwater pumped from the onsite Vineyard Well. This well will also be used to meet the future water demands of the proposed new winery. Domestic water demands of the two existing onsite residences are currently met using groundwater pumped from the offsite Easement Well.

As part of the permit submittal for the proposed new winery development, a Water Availability Analysis (WAA) is required by the County. The purpose of this Memorandum is to comply with Napa County's WAA guidelines for a "Tier 1" WAA (Groundwater Recharge Estimate); those guidelines were promulgated by the County in May 2015. Because there are no known offsite wells located within 500 ft of the Vineyard Well (i.e., the "project well"), County requirements for a "Tier 2" WAA analysis have been "presumptively met" per the WAA Guidelines.

Site Conditions

From our field reconnaissance visit to the subject property on December 15, 2017, the following key items were noted and/or observed (refer to Figures 1 and 2):

a. The Bergman Family Vineyards Winery property is comprised a single parcel having a Napa County Assessor's Parcel Number (APN) of 022-080-010. This parcel is referred to herein as the "subject property." The total area of the subject property, per the assessor's records, is 16.2 acres.

b. Topographically, the subject property is located in the hills on the western side of Napa Valley and north of the City of St Helena. The property appears to be situated within a topographic "saddle", as it is situated between two small ridgelines or hilltops on the east and west sides of the property. As such, the property slopes gently to both the north and the south.

c. There were no drainages and/or creeks observed on the subject property. Based on the topographic contours, the northern portion of the property drains offsite towards Mill Creek to the north, whereas the southern portion of the property drains into an unnamed ephemeral creek which drains southeasterly into Hirsch Creek (see Figure 1).

d. Currently, developments on the subject property consist of a single-family primary residence, a secondary residence, and a pool; these structures are generally located in the northeastern portion of the property.

e. There are approximately 8.6 acres of existing vineyards located in the central portion of the subject property.

f. Offsite areas surrounding the subject property consist primarily of existing vineyards and residences to the northeast, east, and southeast, and naturally vegetated and/or wooded hillsides (i.e., undeveloped areas) to the north, west, and south. The subject property is also adjacent to parts of the Bothe-Napa Valley State Park.

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g. As shown on Figures 1 and 2, a single water well (the Vineyard Well) was observed to exist on the subject property. Specifically, this well is located in the northwestern portion of the property, and it reportedly supplies all irrigation water demands for the existing vineyards and landscaping. A second well, the "Easement Well" is located on an offsite parcel (APN 022-080-014) to the east. This Easement Well currently supplies all domestic water demands for the primary and secondary residences on the subject property.

   Based on the information presented above, and for the purposes of this WAA, the Vineyard Well is considered to be the "project well," as it represents the only well that will be used to be meet the water demands of the proposed new winery. Groundwater will continue to be derived from the offsite Easement Well for existing onsite uses.

h. During our December 15, 2017 site visit, the RCS geologist also traveled along onsite roads and nearby public roads in the area surrounding the subject property in an attempt to identify the possible locations and/or existence of nearby but offsite water wells owned by others. A few privately-owned but offsite wells were directly observed by the RCS geologist during that visit. The RCS geologist could not observe the offsite Easement Well because the gate access to that offsite parcel was locked. Publicly-available Water Availability Analysis reports for the nearby Sodhani property (OEI 2015) were reviewed, and they provided locations for a few offsite wells, including the offsite Easement Well.

   RCS geologists also contacted Napa County Planning, Building, and Environmental Services (PBES) in an attempt to acquire "Well Completion Reports" (also known as "driller's logs") that might exist for wells located on those neighboring but offsite properties. As a result of the PBES request, several driller's logs and/or well drilling permits were received. Figures 1 and 2 show the approximate location of known, reported, or inferred nearby offsite wells surrounding the subject property. Note that none of these wells are shown to lie within 500 ft of the project well (the Vineyard Well).

Key Construction and Testing Data for Existing Onsite Well

A DWR Well Completion Report is available for the existing Vineyard Well and it is represented by Log No. e0221138. Available historical pumping data for the Vineyard Well were provided to RCS by the project engineer. Table 1, "Summary of Well Construction and Pumping Data," provides a tabulation of available key well construction data, groundwater airlifting data, and pumping data for the Vineyard Well.

Well Construction Data

Key data listed on the available driller's log for the Vineyard Well and/or identified during our August 2017 site visit include:

a. This well was constructed in July 2014 by Huckfeldt Well Drilling (Huckfeldt) of Napa, California using the direct mud rotary (bentonite clay) methods.

b. The pilot hole depth (the borehole drilled before the well casing was placed downhole) was reported to be 780 ft below ground surface (bgs).

c. The Vineyard Well was cased with PVC well casing having a nominal diameter of 8 inches; the total casing depth of the Vineyard Well is reported to be 777 ft bgs.

d. Casing perforations for the Vineyard Well are factory-cut slots and have slot opening widths of 0.032 inches (32-slot). Perforations in this well were placed between the following depth intervals: 157 ft to 357 ft bgs; 557 ft to 657 ft bgs; and 677 ft to 757 ft bgs.

e. The gravel pack material listed on the driller's log for the Vineyard Well is listed as "#6 Sand."

f. The Vineyard Well is reportedly constructed a sanitary seal consisting of cement. The sanitary seal was set to a depth of 56 ft bgs.

g. A geophysical electric log (E-log) survey was not performed in the open pilot hole after it had been drilled to its total depth.

Summary of Key Airlifting "Test" Data for the Vineyard Well

The driller's log for the Vineyard Well provided the original, post-construction static water level (SWL), and the original airlift test rate (as shown on Table 1). These data include:

- The initial SWL, following completion of well construction was reported to be 159 ft bgs on July 28, 2014.
- The reported airlift flow rate during initial post-construction airlifting operations was estimated by the driller to be 100 gallons per minute (gpm). As a rule of thumb, RCS geologists estimate normal operational pumping rates for a new well equipped with a permanent pump are typically on the order of only about one-half or less of the airlifting rate reported on a driller's log.
- A "water level drawdown" value could not be provided on the driller's log, because water level drawdown cannot be measured during airlifting operations; thus the original post-construction specific capacity[1] value for the Vineyard Well cannot be calculated from the data on the available driller's log.

Pumping Test Data for the Vineyard Well

On October 23, 2014, a 25-hour constant rate pumping test of the Vineyard Well was performed by Imboden Pump (Imboden) of Napa, California. Figure 3, "Water Levels During October 2014 Constant Rate Pumping Test by Others," illustrates the water level changes in the Vineyard Well during the 25-hour constant rate pumping test period. Key data available from the constant rate pumping test by Imboden include:

- A SWL of 230 ft below the wellhead reference point (brp) was recorded by the pumper before the test began.
- Based on the reported pumping rates by the pumper, the well was pumped at an average rate of 86 gpm for the entire 25-hour pumping period; there were no pumping rate adjustments reported by the pumper during this test.

[1] Specific capacity, in gallons per minute per foot of water level drawdown (gpm/ft ddn), represents the ratio of the pumping rate in a well (in gpm) divided by the amount of water level drawdown (in ft ddn) created in the well while pumping at that rate.

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- A maximum pumping water level (PWL) of 244 ft brp was reported by the pumper at the end of the continuous 25-hour pumping period; this represents a maximum water level drawdown of 14 ft at the end of the test (the permanent pump is reportedly set at a depth of 714 ft). As shown on Figure 3, water levels appeared to be relatively stable during the pumping test. In the last 4 hours of the pumping test, the PWL in this well decreased by only 0.6 ft, or about 0.15 ft/hr.
- In the first hour following pump shut-off, water levels were observed to recover to a depth of 233.5 ft brp; this is 3.5 ft below the initial, pre-test SWL of 230 ft brp.
- Based on the average pumping rate of 86 gpm, the specific capacity of the Vineyard Well is calculated to have been 6.1 gpm/ft ddn at the time of testing.
- As seen on Figure 3, all static and pumping water levels in this well have been below the 157-foot depth to the top of its uppermost perforations. Hence, cascading water conditions have occurred and will continue to occur in this well in the future.

Well Data from Site Visit

As discussed above, a site visit to the subject property was performed by an RCS geologist on December 15, 2017. The following information for the Vineyard Well was gleaned from that site visit:

- The Vineyard Well was observed to be equipped with a permanent pump, and was initially pumping at the time of our visit. During our site visit, the pump automatically shut off when the onsite water tank became full. A SWL of 224.2 ft brp was measured by the RCS geologist while the pump was shut off. This SWL may represent a partial-recovery water level only, and not a true SWL. This SWL is roughly 6 ft shallower than the 230-foot SWL depth reported by Imboden in October 2014, and 65 ft deeper than the 159-foot SWL depth reported on the driller's log for the Vineyard Well, immediately after it had been constructed in July 2014. The July 2014 measurement by Huckfeldt and December 2017 measurement by RCS are also plotted on Figure 3.
- At the time of our site visit, this well was observed to be equipped with a totalizer flowmeter device. The totalizer was observed to have a reading of 6,695,500 gallons.

Local Geologic Conditions

Figure 4, "Geologic Map," illustrates the types, lateral extents, and boundaries between the various earth materials mapped at ground surface in the region by others. Specifically, Figure 4 has been adapted from the results of regional geologic field mapping of the Calistoga quadrangle, as published by the California Geological Survey (CGS) in 2013. Key earth materials mapped at ground surface in the area, as shown on Figure 4 include, from geologically youngest to oldest, the following:

a. Alluvial-type deposits. These deposits consist of the following: undifferentiated and/or undivided alluvial fan, stream channel, and/or terrace materials (map symbols Qhc, Qhf, Qa, and Qt). These deposits are generally unconsolidated, and consist of layers and lenses of sand, gravel, silt, and clay. No alluvial-type deposits have been

mapped at ground surface anywhere on the subject property. These deposits generally exist to the north of the property along the creek bed and to the east along the floor of the Napa Valley.

b. Landslide deposits (map symbols Qls and Qols). Landslide areas have been mapped in the region by others (see the bright yellow-colored areas on Figure 4). Arrows drawn within these mapped landslide areas show the general direction of ground surface movement within these slides. These deposits do not occur on the subject property but are shown on Figure 4 to be exposed offsite to the east and west; it appears that the Easement Well may lie within or near one of these landslides mapped by others.

   It was not a part of our Scope of Hydrogeologic Services for this project to study, investigate, analyze, determine, or opine on the potential activity of landslides, and/or on the potential impact that landslides might have on the proposed new winery, on any of the onsite structures, or to any onsite or offsite wells used for the subject property.

c. Sonoma Volcanics (map symbol Tsa and Tstp). The Sonoma Volcanics, as mapped by others, occur as ground surface exposures across the entire subject property, as shown on Figure 4. Figure 4 mapping data reveal that tuff, tuff breccias, and volcanic agglomerates intercalated with andesitic to basaltic lava flows represent the main types of volcanic rocks exposed at ground surface on and near the subject property. The tuff deposits (map symbol Tstp) are exposed in the two hillsides that flank the east and western portions of the property, whereas the harder lava flows and flow breccias (map symbol Tsa) are exposed in the central portion of the property.

   Review of the driller's descriptions listed on the available driller's log for the Vineyard Well reveal that rocks of the Sonoma Volcanics were encountered at this well site. Typical driller-terminology for the drill cuttings on that log included: "dark tan volcanic tuff;" "black/grey fractured volcanics;" "red volcanics;" "white/grey volcanic ash;" and mixed fractured volcanics." Therefore, based on the available subsurface geologic data, the Sonoma Volcanics are interpreted to RCS to extend to a depth of at least 780 ft bgs beneath the subject property at the Vineyard Well.

d. Bedrock. Underlying the volcanic rocks at even greater depths beneath the subject property (but not exposed at ground surface anywhere within the area shown on Figure 4) are geologically older, well-consolidated to cemented rocks of the Franciscan Complex. Principal rock types in these geologically older rocks are thick-bedded sandstone, shale, siltstone, conglomerate, and graywacke. These geologically older rocks directly underlie the Sonoma Volcanics beneath the subject property and are considered to represent the local bedrock. Based on our review of the driller's descriptions listed on the driller's log for the Vineyard Well, these older bedrock-type materials were not encountered in the pilot borehole for the Vineyard Well.

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Local Hydrogeologic Conditions

The earth materials described above can generally be separated into two basic categories, based on their relative ability to store and transmit groundwater to wells. These two basic categories include:

Potentially Water-Bearing Materials

The principal water-bearing materials beneath the subject property and its environs are represented by the hard, fractured volcanic flow rocks and volcanic tuffs and breccias of the Sonoma Volcanics. The occurrence and movement of groundwater in these rocks tend to be controlled primarily by the secondary porosity within the rock mass, that is, by the fractures and joints that have been created in these harder volcanic flow-type rocks over time by various volcanic and tectonic processes. Specifically, these fractures and joints have been created as a result of the cooling of these originally molten flow rocks and flow breccias deposits following their deposition, and also from mountain building or tectonic processes (faulting and folding) that have occurred over time in the region after the rocks were erupted and hardened. Some groundwater can also occur in zones of deep weathering between the periods of volcanic events that yielded the various flow rocks, and also with the pore spaces created by the grain-to-grain interaction in the volcanic tuff and ash.

The amount of groundwater available at a particular drill site for a well constructed into the Sonoma Volcanics beneath the subject property would depend on such factors as:

- the number, frequency, size and degree of openness of the fractures/joints in the subsurface
- the degree of interconnection of the various fracture/joint systems in the subsurface
- the extent to which the open fractures may have been possibly in-filled over time by chemicals precipitates/deposits and/or weathering products (clay, etc.)
- the amount of recharge from local rainfall that becomes available for deep percolation to the fracture systems
- to a lesser extent, the size of the pore-spaces formed by the grain-to-grain interactions of volcanic ash particles.

As stated above, the principal rock type exposed at ground surface on the property and also expected in the subsurface beneath a portion of the property are a combination of volcanic tuffs and ash-flows, along with hard, volcanic flows and flow breccias of andesitic to basaltic composition (Figure 4, map symbols Tstp and Tsa, respectively) that may be fractured to varying degrees. Descriptions of drill cuttings by the well driller that are recorded on the available driller's log for the Vineyard Well are consistent with the typical descriptions of the various rocks known in the Sonoma Volcanics. From our long-term experience with the fractured flow rocks within the Sonoma Volcanics, based on numerous other water well construction projects in Napa County, pumping capacities in individual wells have ranged widely, from rates as low as 5 to 10 gpm, to rates as high as 200 gpm, or more.

Potentially Nonwater-Bearing Rocks

This category includes the geologically older and fine-grained sedimentary and/or crystalline rocks of the Franciscan Complex. These rocks, which are considered to be essentially nonwater-bearing, would underlie the volcanic rocks that exist beneath the subject property at depths greater than 780 ft bgs, depending on the location, as interpreted by RCS from the driller's descriptions listed on the available driller's log for the Vineyard Well.

In essence, these diverse rocks are well-cemented and well-lithified, and have an overall low permeability. Occasionally, localized conditions can allow for small quantities of groundwater to exist in these rocks wherever they may be sufficiently fractured and/or are relatively more coarse-grained. However, even in areas with potentially favorable conditions, well yields are often only a few gpm in these rocks, and the water quality can be marginal to poor in terms of total dissolved solids concentrations, and other dissolved constituents.

Geologic Structure

Several unnamed faults, as mapped by others, have been interpreted to exist in the vicinity of the subject property as shown by the dark-colored, short dashed lines or black dots on Figure 4 (CGS 2013). A few of these northwest-southeast trending faults are shown to be mapped south of the subject property. No faults are shown to be mapped within the boundaries of the subject property. The possible impacts of these faults on groundwater availability in the region are unknown due to an absence of requisite data. Faults can serve to increase the number and frequency of fracturing in the local volcanic rocks. If such fractures occurred, it would tend to increase the amount of open area in the rock fractures which, in turn, could increase the ability of the local volcanic rocks to store groundwater. It is unknown if these faults are barriers to groundwater flow.

Please note that it is neither the purpose nor within our Scope of Hydrogeologic Services for this project to assess the potential seismicity or activity of any faults that may occur in the region.

Project Water Demands

Existing and proposed (future) onsite water demands for the property have been estimated and provided to RCS by ACE, as discussed below. Table 2, "Groundwater Use Estimates by ACE," is adapted from those water use data provided by ACE, and is intended to categorize the specific water demands of the project and other onsite uses. As shown on Table 2, the ACE-estimated annual groundwater demands for the project are as follows:

Existing Water Demands

Irrigation water demands for the existing vineyards and landscaping have historically been met by pumping groundwater from the Vineyard Well, whereas domestic water for the onsite residences have been met by pumping groundwater from the offsite Easement Well. Because there are no historic flow meter totalizer data for these two wells, the actual historic onsite water use is unknown. Therefore, the existing onsite water demands have been estimated by ACE[2] to be the following:

[2] These water demand estimates were reportedly based on those values presented for specified land uses provided in Appendix B of the County's WAA Guidance Document (WAA 2015).

Vineyard Well

a. Existing landscape irrigation = 2.178 acre feet per year (AF/yr)
b. Existing vineyard irrigation = 4.300 AF/yr
c. Total existing groundwater demand from the Vineyard Well = a + b = 6.478 AF/yr

Easement Well

a. Existing residences and pool = 1.300 acre feet per year (AF/yr)
    - This includes 0.750 AF/yr for the primary residence, 0.500 AF/yr for the secondary residence, and 0.050 AF/yr for the pool.
b. Total existing groundwater demand from the Easement Well = 1.300 AF/yr

Based on the data presented above, current groundwater demands for all existing onsite uses are estimated to be 6.478 AF/yr (2.178 AF/yr for landscape irrigation plus 4.300 AF/yr for vineyard irrigation).

Proposed (Future) Water Demands

As discussed above, water demands for the onsite vineyard and landscape irrigation have historically been met by pumping groundwater from the existing Vineyard Well, whereas the water demands for the onsite residences have been met by pumping groundwater from the offsite Easement Well. These uses will remain unchanged as part of the proposed new winery project. Therefore, use of the Easement Well will remain consistent with historic use, and groundwater from this well will not be used for the proposed winery.

For the proposed new project winery property, all future winery water demands are proposed to be met by pumping groundwater from the Vineyard Well. These new water demands for the winery (both for domestic and process water uses) are estimated by ACE to be 0.374 AF/yr. Therefore, the total proposed groundwater demand from the Vineyard Well will be as follows:

a. Proposed winery water demand = 0.374 AF/yr
    - This includes 0.202 AF/yr for winery employees (domestic use) and 0.172 AF/yr for winery process water; the domestic use water demand for the winery of 0.202 AF/yr reportedly includes losses associated with reverse osmosis (RO) water treatment.
b. Existing vineyard irrigation water demand = 4.300 AF/yr
c. Existing landscape irrigation water demand = 2.178 AF/yr
d. Total proposed groundwater demand from the Vineyard Well = a + b + c = 6.852 AF/yr

As seen on Table 2, the total groundwater demand for the project (8.152 AF/yr) represents only a 5% increase from the total existing usage (7.778 AF/yr).

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Proposed Pumping Rates

To determine an appropriate estimated peak pumping rate necessary from the Vineyard Well, it will be conservatively assumed that that future vineyard irrigation demands (4.300 AF/yr) and landscape irrigation demands (2.178 AF/yr) at the subject property will be required only during a 4-month (roughly 16-week) irrigation season each year (May through August)[3]. Domestic use water and winery process water for the winery will be required year-round (365 days/year), and the monthly variation of those water demands were provided to RCS by ACE. The monthly proportion for winery demands throughout the year range between 5% (for January, February, March, and December) to 17% in September and October. Based on these assumptions, and in order to meet the future groundwater demands of the project, the Vineyard Well would need to pump at a rate of about 25 gpm to meet the peak monthly demand of the project of 1.64 AF, which would occur in the month of June each year. This pumping rate assumes that the Vineyard Well would be pumped at a 50% operational basis, that is, 12 hours/day, 7 days/week during the June peak monthly demand period each year. Hence, based on the pumping rate reported by the Imboden test in October 2014 of 86 gpm for the Vineyard Well, it appears that the well is capable of meeting the instantaneous groundwater flow demands required for the project each year.

Rainfall

Long-term rainfall data are essential for estimating the average annual recharge that may occur at the Bergman Family Vineyards Winery property. Average annual rainfall totals that occur specifically at the subject property are not directly known because no onsite rain gage exists. However, a rain gage with relatively long-term available data is reported to exist roughly 3 miles to the southwest of the subject property. Data for this gage are available from the California Data Exchange Center (CDEC) website maintained by DWR, and the gage is named “St Helena 4WSW.” Data from the CDEC website for this gage are available beginning in 1984, but Water Year (WY) 1984-85 (October 1984 – September 1985) appears to be missing several days and/or months of rainfall data. Also, there appear to be some erroneous and/or missing data in WY 1986-87 through WY 1989-90, and WY 1994-95. RCS removed these erroneous and/or missing data from the data set before calculating an average annual rainfall for this gage (for example, for the day of December 31, 1986, the data set included a rainfall total of 811.1 inches; it is not possible that 811.1 inches of rain fell in December 1986). Note that RCS only removed rainfall totals; no rainfall data were “added” to the data set. With these assumed erroneous data points removed from the data set, then an average rainfall of 42.8 inches (3.57 ft) from WY 1985-86 through WY 2016-17 is calculated at this gage. This rain gage is located at a higher elevation (±1,780 ft asl) than that of the subject property (between ±650 ft and ±780 ft asl, depending on location on the property), and therefore the average annual rainfall at the subject property could be slightly lower than that experienced at this known gage location.

Another rain gage, labeled as “Napa River at Dunaweal Lane,” exists along the Napa Valley floor approximately 3 miles northwest of the subject property. Rainfall data for this rain gage are available on the Napa One Rain website; this website is maintained by Napa County. Data for this rain gage are available for WY 2009-10 through WY 2016-17. The average annual rainfall

[3] In reality, the irrigation season could last for a period of 20 weeks or longer. Therefore, assuming all onsite irrigation demands would occur during a 16-week irrigations season is a conservative approach, because the groundwater volume for the project would need to be extracted in a shorter period of time.

at this Napa One Rain Napa River at Dunaweal Lane rain gage is calculated to be approximately 33.7 inches (2.81 ft). Because the period of rainfall record for this is gage is very short (8 years) and includes 5 years of drought (as defined by DWR), RCS does not consider these data to be representative of the long-term annual average rainfall in the area surrounding the subject property. This rainfall gage is located at a lower elevation (±320 ft asl) than that of the subject property, and therefore the average annual rainfall at the subject property is likely to be higher than that experienced at this known gage location.

The nearest rain gage to the subject property known to RCS with a significantly longer data record is located in St. Helena, California. The data for this gage are available from the Western Regional Climate Center (WRCC) website. For this rain gage, the period of record is listed as November 1907 through October 2017; data for this gage are listed by calendar year, not water year. Note that there are several months and/or years of rainfall data missing in 1907, between 1915 and 1922, between 1979 and 1980, between 1985 and 1988, in 1992, and between 2011 and 2012. For the available period of record, the average annual rainfall at this St. Helena gage is reported to be 34.3 inches (2.86 ft), as reported by the WRCC. Similar to the Napa One Rain gage, this WRCC gage is located at a lower elevation (±240 ft asl) than that of the subject property, and it is likely the average annual rainfall at the subject property is higher than that experienced at this known gage location.

To help corroborate the average annual rainfall data derived from the Napa One Rain and/or WRCC gages, RCS reviewed the precipitation data published by the PRISM Climate Group at Oregon State University. This data set, which is freely available from the PRISM website contains “spatially gridded average annual precipitation at 800m grid cell resolution.” The date range for this dataset includes the climatological period between 1981 and 2010. These gridded data provide an average annual rainfall distributed across the subject property. Using this data set, RCS determined that the average rainfall for the subject property for the stated date range is approximately 39.0 inches (3.25 ft).

An additional rainfall data source, an isohyetal map (a map showing contours of equal average annual rainfall) was prepared by the County for all of Napa County, and is freely available for download from the online Napa County GIS database (a copy of this map is not provided herein). As described in the metadata for the file (also available via the download page at the web link shown above), the isohyets are based on a 60-year data period beginning in 1900 and ending in 1960. As stated in the metadata for the file, the contour interval for the map is reported to be “variable due to the degree of variation of annual precipitation with horizontal distance”, and therefore the resolution of the data for individual parcels is difficult to discern. The subject property is situated within the boundaries of the 35-inch average annual rainfall contour on the County map. Based on our interpretation of the actual isohyetal contour map, the long-term average annual rainfall at the subject property may be on the order of 35 inches (2.92 ft), using these rainfall data.

Table 3, “Comparison of Rainfall Data Sources,” provides a comparison of the data collected from the different rainfall sources discussed above. Based on those rainfall data sources and as summarized on Table 3, RCS will consider the long-term average annual rainfall at the subject property to be 39.0 inches (3.25 ft), as derived from the PRISM data set. The 39-inch per year estimate is based on the data source with a relatively long period of record (29 years) and is more site-specific, when compared to the other rainfall data sources listed in Table 3 that exist at different elevations and/or are located further away from the subject property.

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Estimates of Groundwater Recharge

Groundwater recharge on a long-term average annual basis at the property can be estimated as a percentage of average rainfall that falls on the subject property, and becomes available to deep percolate into the aquifers over the long-term. The actual percentage of rain that deep percolates can be variable based on numerous conditions, such as the slope of the land, the soil type that exists at the property, the evapotranspiration that occurs on the property, the intensity and duration of the rainfall, etc. Therefore, RCS has considered various analyses of deep percolation into the Sonoma Volcanics, as relied upon by other consultants and government agencies for projects in Napa Valley.

Recharge volumes estimated in this Memorandum are based on the long-term average annual rainfall values determined for the subject property using the available data presented above. Note that a calculation of average annual rainfall for any long-term period always includes periods of below-average rainfall and above-average rainfall that occurred during the period over which the average was calculated. Therefore, the following recharge calculations also include consideration of drought year conditions.

Updated Napa County Hydrogeologic Conceptual Model (LSCE&MBK, 2013)

Estimates of groundwater recharge as a percentage of rainfall are presented for a number of watersheds in Napa County in the report titled "Updated Napa County Hydrogeologic Conceptual Model" (LSCE&MBK, 2013) prepared for Napa County. Watershed boundaries within Napa County are shown on Figures 8-3 and 8-4 in that report. At the request of RCS, those watershed boundaries were provided to RCS by MBK Engineers (MBK). Figure 5, "Watershed Boundaries," was prepared for this project using those watershed boundaries. As shown on Figure 5, the subject property is located within the watershed referred to by MBK as "Napa River Watershed at St Helena." As shown on Table 8-9 on page 97 of the referenced report (LSCE&MBK, 2013), 14% of the average annual rainfall that occurs within this watershed is estimated to be able to deep percolate as groundwater recharge. Note that, as shown on Table 8-9 of LSCE&MBK (2013), the "Napa River Watershed at St Helena" is also tributary to the "Napa River Watershed near Napa."

As stated above, the total surface area of the subject property is 16.2 acres. Assuming a conservative value of 39.0 inches (3.25 ft) of rainfall occurs on the subject property on a long-term average annual basis, then the total volume of rainfall that falls each year directly on the property over the long term is approximately 52.7 AF (16.2 acres x 3.25 ft). Assuming 14% of the average annual rainfall would be able to deep percolate to the groundwater beneath the subject property, then the average annual groundwater recharge at the subject property would be approximately 7.4 AF/yr. This estimated annual future recharge volume is greater than the total estimated onsite future (proposed) groundwater demand of 6.852 AF/yr (to be provided by the Vineyard Well).

Historic Nearby Rainfall Recharge Estimates.

A "Water Availability Analysis" report was prepared by O'Conner Environmental, Inc. (OEI 2015) for the recently approved Sodhani Winery project located at 3283 St Helena Highway (County APN 022-080-004); boundaries of that property are shown on Figures 2 and 3. The Sodhani property is located near the subject property, and is underlain by similar types of volcanic rocks. Using the information and data presented in the LSCE&MBK report (2013), OEI conservatively

estimated an average annual groundwater recharge of 0.436 AF/acre for the Sodhani Winery property. If this same recharge rate (0.436 AF/acre) were applied to the subject property, the estimate annual future recharge at the subject property would be 7.1 AF/yr (16.2 acres times 0.436 AF/acre). This conservative estimated future recharge volume is greater than the estimated onsite (future) groundwater demand of 6.852 AF/yr, and similar to RCS recharge estimates presented herein. Hence, the RCS estimates herein are corroborated by the independent work presented in the data from the OEI report for the nearby Sodhani Winery.

It should be noted, that the Bergman Family Vineyard property is surrounded by primarily undeveloped areas to the north, west, and south, which includes the Bothe-Napa Valley State Park. Therefore, it is conceivable that there may be more recharge available to the subject property due the primarily undeveloped nature of the area that surrounds the property.

Groundwater Quality

Samples of groundwater were collected by others from the Vineyard Well at the end of the 25-hour constant rate pumping test in October 2014. Table 4, "Summary of Available Groundwater Quality Data," summarizes water quality data available from the laboratory analysis of those groundwater samples; the laboratory analyses were performed by Analytical Sciences of Petaluma, California. Data presented on Table 4 reveal the following with regard to key water quality constituents for groundwater pumped by the Vineyard Well:

- The character of the groundwater from the local volcanic rock aquifer systems appears to be primarily to be a calcium-sodium-bicarbonate (Ca-Na-HCO_3) type of water.
- Specific conductance (also known as electrical conductivity, or EC) was reported to be 220 micromhos per centimeter (µmhos/cm).
- Total hardness (TH) was reported to be 79 milligrams per liter (mg/L). Water with a TH between 60 and 120 mg/L is considered to be "moderately hard."
- Total dissolved solids (TDS) was detected at 190 mg/L.
- The pH of groundwater was reported to be 6.79, indicating that the water is slightly acidic (below pH 7).
- Nitrate (as NO_3) was reportedly detected at a concentration of 0.81 mg/L.
- The adjusted sodium adsorption ratio (SAR) was reported to be 0.762 (unitless) in the Vineyard Well.
- Arsenic (As) was detected at a concentration of 3.2 micrograms per liter (µg/L); arsenic has a State Primary Maximum Contaminant Level (MCL) of 10 µg/L for water used for domestic purposes.
- Boron was ND in the sample collected from the Vineyard Well.
- Iron (Fe) was detected at a concentration of 110 µg/L in the Vineyard Well. Iron has a State Secondary MCL of 300 µg/L for water to be used for domestic purposes.
- The manganese (Mn) concentration in the Vineyard Well was reported to be 180 µg/L. The State Secondary MCL for this constituent is 50 µg/L for domestic use.

Thus, elevated concentrations of manganese were detected in the onsite Vineyard Well. Because the Vineyard Well is to be used to supply the domestic use portion of the winery water demands (i.e., winery employees), treatment for this elevated constituent is required. We understand that onsite treatment of the groundwater for the winery domestic use will be performed using a reverse osmosis system.

Key Conclusions and Recommendations

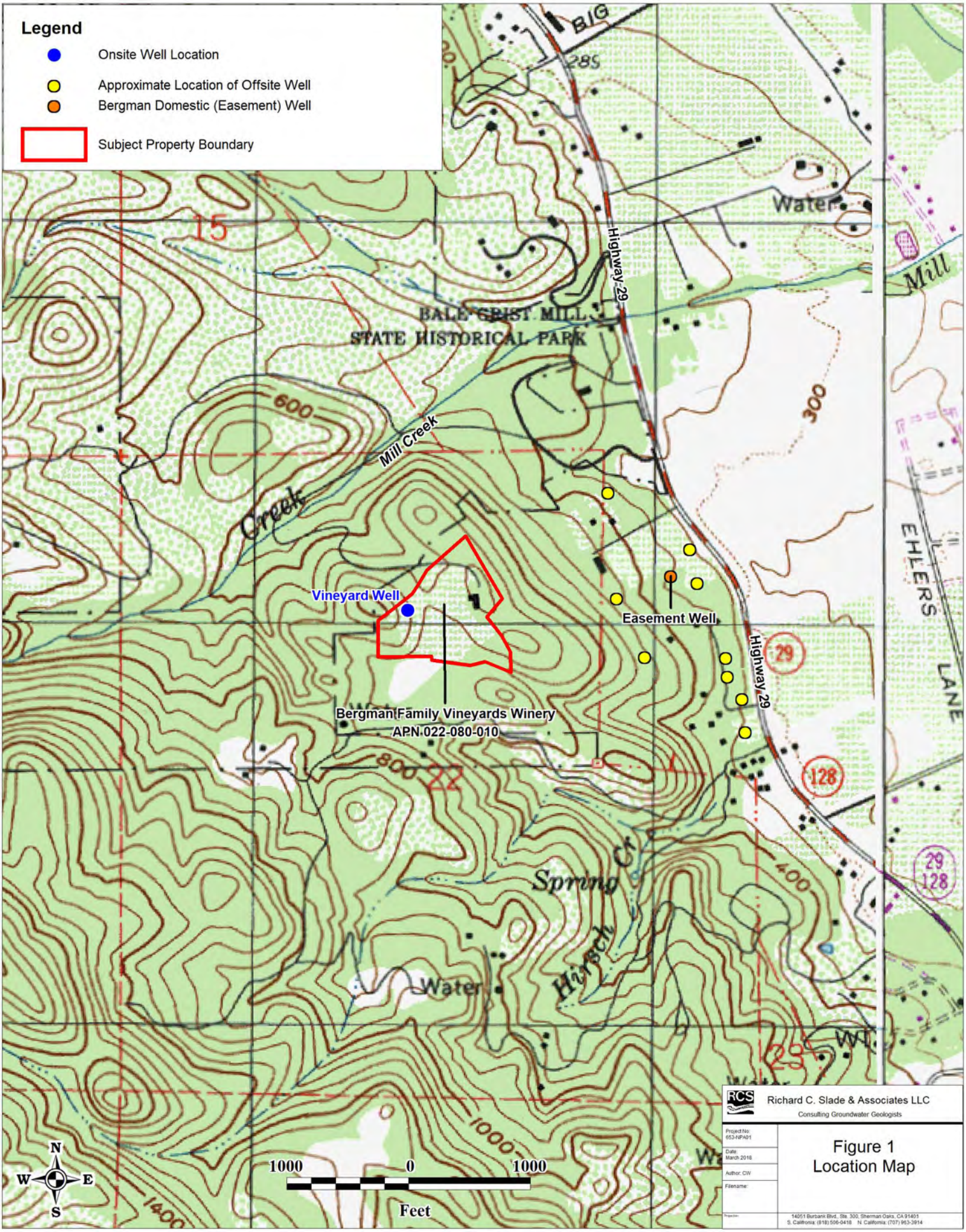
1. The existing 16.2-acre property is currently developed with a primary single-family residence, a secondary residence, a pool, 8.6 acres of vineyards, and landscaping.
2. The proposed project consists of developing a new winery with a capacity of 8,000 gallons.
3. Current water demands for the subject property are estimated by others to be 6.478 AF/yr from the Vineyard Well, and 1.300 AF/yr from the offsite Easement Well. These existing water demand include: 2.178 AF/yr for landscape irrigation (from the Vineyard Well); 4.300 AF/yr for vineyard irrigation and 2.178 AF/yr for landscape irrigation).
4. The future average annual groundwater demand for the entire property (including the existing vineyard and future winery demands) is estimated to be 6.852 AF/yr. This groundwater demand includes a proposed increase of 0.374 AF/yr for the proposed new winery. This proposed winery demand represents only a 5% increase from existing onsite water demands.
5. To meet the estimate peak monthly groundwater demand of the project each year, the Vineyard Well would need to pump at a rate of approximately 25 gpm during an assumed 4-month irrigation season (vineyard and landscape) and the year-round winery water demands. This peak pumping rate assumes the Vineyard Well would be pumped on a 50% operation basis (pumping 12 hours per day, every day) during the irrigation season.
6. Based on the October 2014 constant rate pumping test of the Vineyard Well at 86 gpm, the project well appears to be more than capable of pumping at rates needed to meet the future groundwater demands needed from the project well (25 gpm is the peak rate need in June).
7. Groundwater recharge at the subject property is estimated to be 7.1 AF/yr; this value is based on conservative estimates of rainfall recharge (0.436 AF/yr) that have been used by others for a County-approved WAA at the nearby Sodhani Winery property.
8. In the future, RCS recommends monitoring on a regular basis of static and pumping water levels, and also the instantaneous flow rates and cumulative pumped volumes from the Vineyard Well and the offsite Easement Well via the use of dual-reading flow meters (that records both flow rate and totalizing values); the Vineyard Well was equipped with a flow meter dial device at the time of our December 2017 site visit. RCS also recommends that new water level transducers be purchased and installed in your wells to permit the automatic, frequent, and accurate recording of water levels in those wells. By continuing to observe the trends in groundwater levels and future well production rates over time evaluated by qualified professionals, the property owner can address potential declines in water levels and well production in the two wells.

References

- **(CGS 2013)** Delattre and Gutierrez, 2013. Geologic Map of the Calistoga 7.5' Quadrangle, Napa County, California: A Digital Database. California Geological Survey.
- **(LSCE&MBK 2013)** Luhdorff & Scalmanini Consulting Engineers and MBK Engineers, January 2013. Updated Hydrogeologic Conceptualization and Characterization of Conditions, Prepared for Napa County.
- **(OEI 2015)** O'Connor Environmental, Inc., June 2015. Water Availability Analysis, 3283 St. Helena Highway, St. Helena, County of Napa, APN 022-080-004.
- **(WAA 2015)** Napa County Board of Supervisors, Adopted May 12, 2015. Water Availability Analysis (WAA) – Guidance Document.

Websites:

- Napa County GIS database, 2017. https://gis.napa.ca.gov.
- EarthExplorer, United States Geological Survey 2017. https://earthexplorer.usgs.gov/
- California Data Exchange Center, California Department of Water Resources, 2017. https://cdec.water.ca.gov
- Napa One Rain, County of Napa, 2017. https://napa.onerain.com
- Western Regional Climate Center, 2017. https://www.wrcc.dri.edu
- PRISM Climate Group, Oregon State University, 2017. https://prism.oregonstate.edu

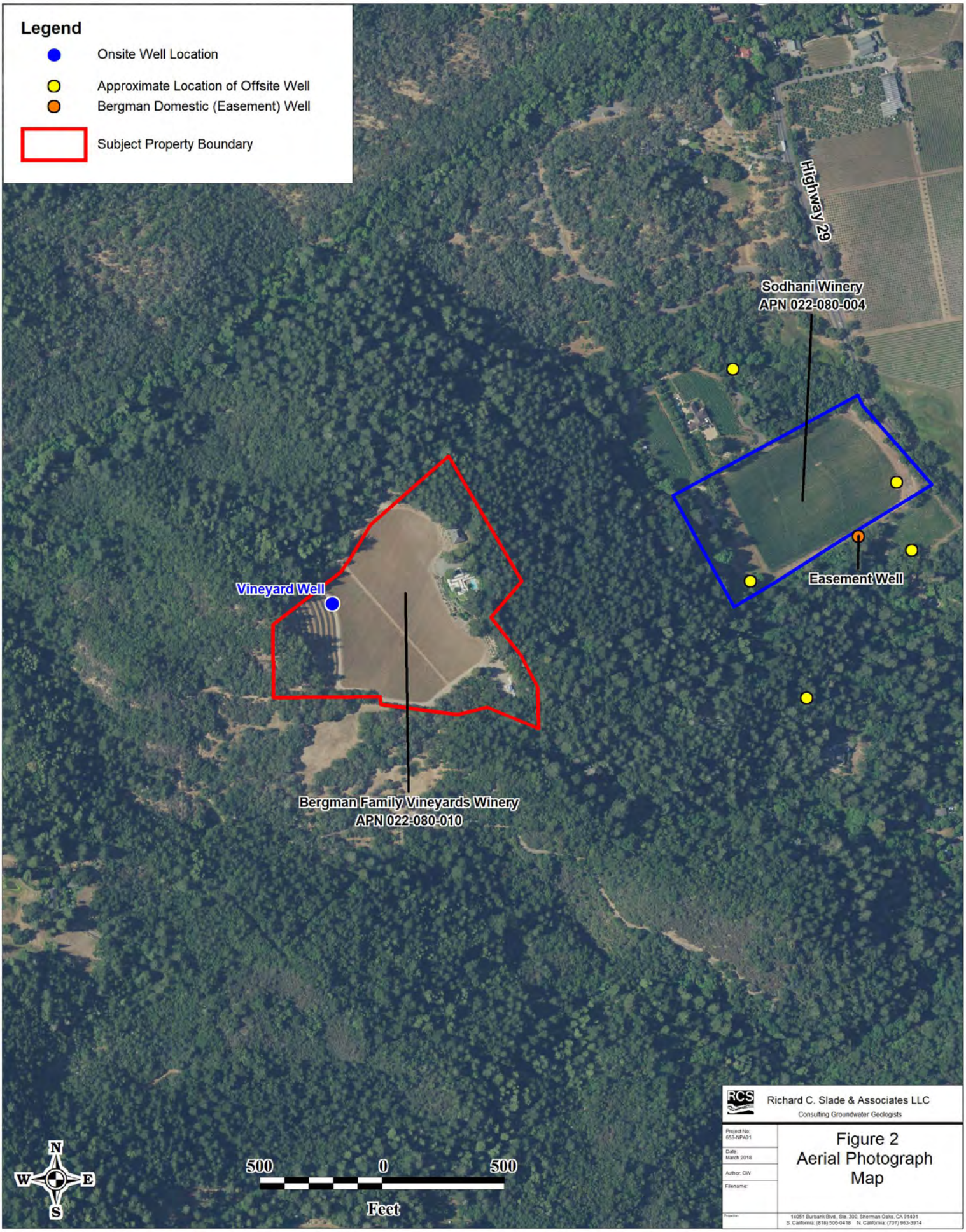


Richard C. Slade & Associates LLC
Consulting Groundwater Geologists

Project No: 653-MP401
Date: March 2016
Author: CW
Filename:

Figure 1
Location Map

14051 Burbank Blvd., Ste. 300, Sherman Oaks, CA 91401
S. California: (818) 506-0418 N. California: (707) 963-3914

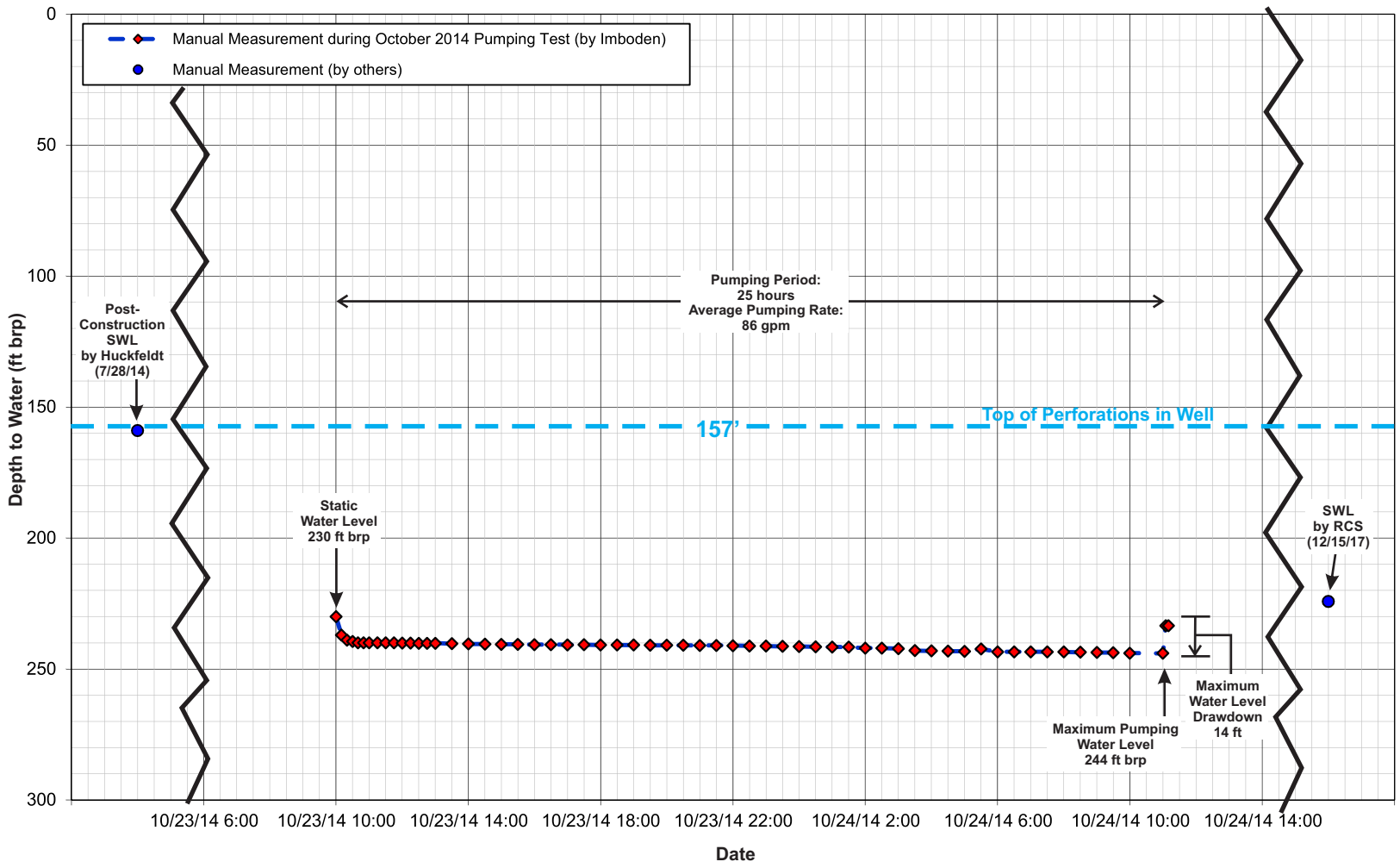


Richard C. Slade & Associates LLC
Consulting Groundwater Geologists

Project No: 653-MP-001
Date: March 2018
Author: CW
Filename:

Figure 2
Aerial Photograph Map

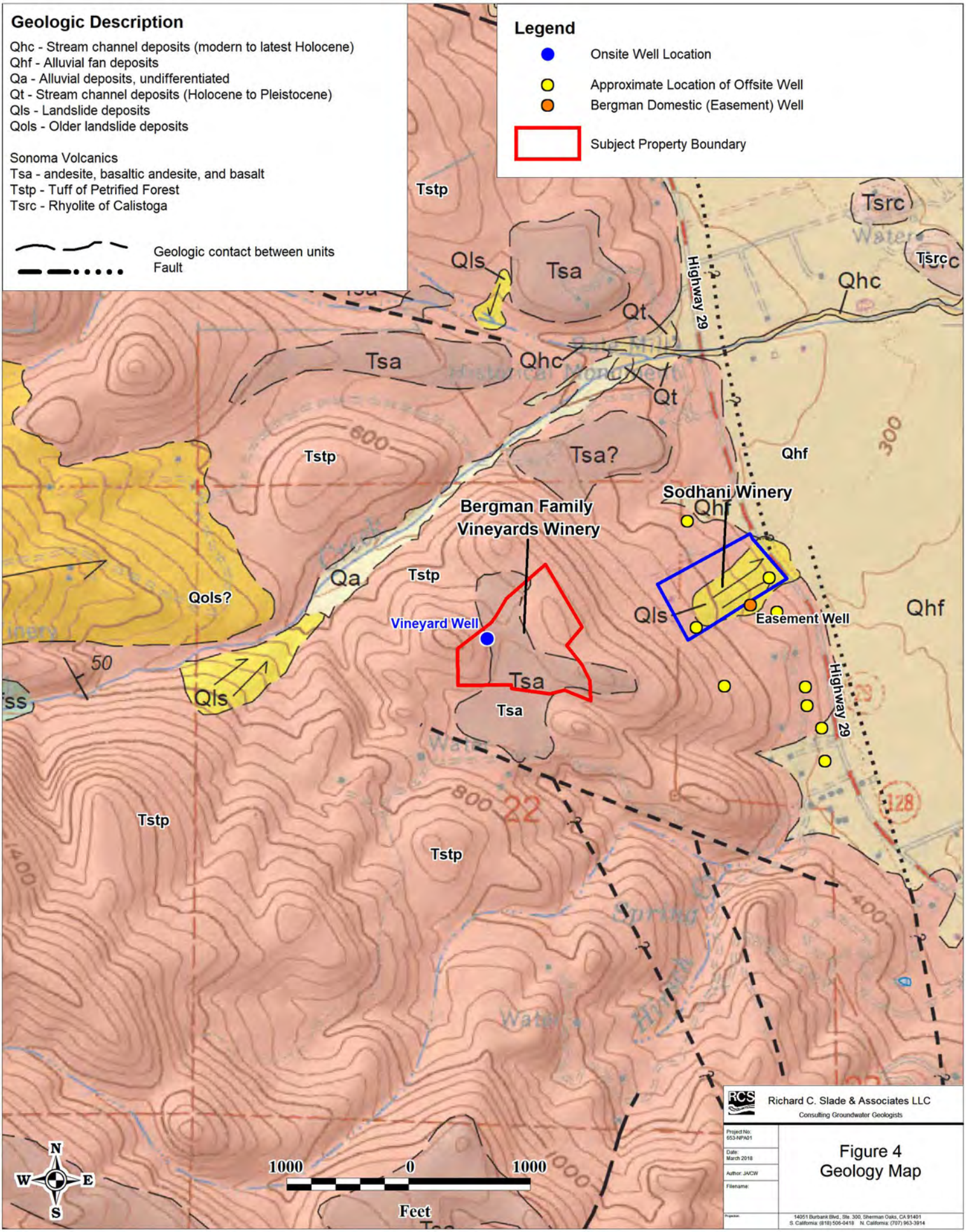
14051 Burbank Blvd., Ste. 300, Sherman Oaks, CA 91401
S. California: (818) 506-0418 N. California: (707) 963-3914



RICHARD C. SLADE & ASSOCIATES LLC
CONSULTING GROUNDWATER GEOLOGISTS
14051 Burbank Blvd., Suite 300
Sherman Oaks, CA 91401
Southern California (818) 506-0418
Northern California (707) 963-3914
www.rcslade.com

FIGURE 3
WATER LEVEL DATA DURING OCTOBER 2014
CONSTANT RATE PUMPING TEST BY OTHERS
VINEYARD WELL
BERGMAN FAMILY VINEYARDS WINERY

Job No. 653-NPA01 **March 2018**


Geologic Description
Qhc - Stream channel deposits (modern to latest Holocene)
Qhf - Alluvial fan deposits
Qa - Alluvial deposits, undifferentiated
Qt - Stream channel deposits (Holocene to Pleistocene)
Qls - Landslide deposits
Qols - Older landslide deposits
Sonoma Volcanics
Tsa - andesite, basaltic andesite, and basalt
Tstp - Tuff of Petrified Forest
Tsrc - Rhyolite of Calistoga
Geologic contact between units
Fault
Legend
Onsite Well Location
Approximate Location of Offsite Well
Bergman Domestic (Easement) Well
Subject Property Boundary
Tstp
Tsrc
Qls
Tsa
Qt
Qhc
Highway 29
Tsa?
Qhf
Sodhani Winery
Bergman Family
Vineyards Winery
Qa
Qols?
Vineyard Well
Easement Well
50
800
300
400
1000
0
Feet
N
W
E
S
Richard C. Slade & Associates LLC
Consulting Groundwater Geologists
Project No: 653-NPA01
Date: March 2018
Author: JA/CW
Filename:
Figure 4
Geology Map
14051 Burbank Blvd., Ste. 300, Sherman Oaks, CA 91401
S. California: (818) 506-0418 N. California: (707) 963-3914


Legend
Watershed Boundary (showing watershed name)
Subject Property Boundary
Napa River Watershed at Calistoga
Napa River Watershed at St. Helena
Subject Property
Mount Helena
R.L. STEVENSON MEMORIAL STATE PARK
Aetna Springs
Sugarloaf Mtn
Table Rock
The Palisades
Mayacmas Mts
KIMBALL CANYON DAM
Pope Valley
Three Peaks
Rattlesnake Ridge
Dutch Henry Canyon
Simmons Canyon
Bell Canyon
Angwin
Howell Mtn
Pacific Union College
Calistoga
County Fairgrounds
Landing Strip
Larkmead
Bell Canyon Reservoir
Lake Ellen
BOTHE NAPA VALLEY STATE PARK
Diamond Mtn
Glass Mtn
Conn Valley
LAKE HENNESSEY RECREATION
St Helena
St Helena Gaging Station
Zinfandel
Sulphur Canyon
POWERLINE
Buzzard Peak
Mt Hood
Mt Hood Regional Park
Heath Canyon
Rutherford
Bear Canyon
SUGARLOAF RIDGE STATE PARK
LOS GUILICOS SCHOOL FOR GIRLS
Oakmont
Adobe Canyon
Sugar Ridge
Bald Mtn
Bella Oak Mine
Mt St John
Oakville
ANNADEL STATE PARK
Bennett Mtn
Spring Lake County Park
Nunns Canyon
SONOMA CO
NAPA CO
N
W
E
S
1 0 1 2 3
Miles
RICHARD C. SLADE & ASSOCIATES LLC
Consulting Groundwater Geologists
Project No: 653-NPA01
Date: March 2018
Author: CW
Figure 5
Watershed Boundaries
14051 Burbank Blvd., Ste. 300, Sherman Oaks, CA 91401
S. California (818) 506-0418 N. California (707) 963-3914

Table 1
Summary of Well Construction and Pumping Data
Bergman Family Vineyards Winery

Reported Well Designation	DWR Well Log No.	Date Drilled	Method of Drilling	Pilot Hole Depth (ft bgs)	Casing Depth (ft bgs)	Casing Type	Casing Diameter (in)	Borehole Diameter (in)	Sanitary Seal Depth (ft bgs)	Perforation Intervals (ft bgs)	Type and Size (in) of Perforations	Gravel Pack Interval (ft) and Size	Current Status of Well	Post-Construction Yield Data					
														Date & Type of Yield Data	Duration of "Test" (hrs)	Estimated Flow Rate (gpm)	Static Water Level (ft)	Pumping Water Level (ft)	Estimated Specific Capacity (gpm/ft ddn)
Vineyard Well	e0221138	July 2014	Direct Mud Rotary	780	777	PVC	8	15	56 (cement)	157-357 557-657 677-757	Factory-cut 0.032"	56-777 #6 Sand	Active	7/28/14 Airlift	2	100	159	ND	ND
														10/23/14 Pump	25	86	230.0	244.0	6.1

Notes: ft bgs = feet below ground surface
SWL = static water level
brp = below reference point, generally top of well head
Reported pump depth setting = 714 ft bgs

Table 2
Groundwater Use Estimates by ACE
Bergman Family Vineyards Winery

Groundwater Use	Estimated Groundwater Use (acre-feet/year)	
	Existing	Proposed
Residential Water Use		
Primary Residence	0.750	0.750
Pool	0.050	0.050
Second Dwelling Unit	0.500	0.500
Total Residential Domestic Water Use	**1.300**	**1.300**
Winery Domestic & Process Water Use		
Winery - Employees	0.000	0.202
Winery - Process	0.000	0.172
Total Winery Water Use	**0.000**	**0.374**
Irrigation Water Use		
Other Landscape	2.178	2.178
Vineyard - Irrigation	4.300	4.300
Total Irrigation Water Use	**6.478**	**6.478**
Total Combined Water Use	**7.778**	**8.152**

Notes:
Estimates based on Napa County Water Availability Analysis Guidance Document (WAA 2015)
All "Residential" water use to be supplied by offsite Easement Well
All "Winery" and "Irrigation" water use to be supplied by onsite Vineyard Well.
Domestic water use for the winery (i.e., "Winery - Employees) includes losses associated with reverse osmosis (RO) water treatment.
This table has been adapted from table of "Water Use Estimate Calculations" provided by ACE.
1 acre-foot = 325,851 gallons

Table 3
Comparison of Rainfall Data Sources
Bergman Family Vineyards Winery

Rain Gage and/or Data Source	Years of Available Rainfall Record	Average Annual Rainfall in Inches (ft)	Elevation of Rain Gage (ft asl)	Distance of Rain Gage from Subject Property[1] (mi)	Elevation Relative to Subject Property
CDEC St. Helena 4WSW	WY 1985-86 through WY 2016-17[2]	42.8 (3.57)	1,780	3.0	Higher
Napa One Rain Napa River at Dunaweal Ln	WY 2009-10 through WY 2016-17	33.7 (2.81)	320	3.0	Lower
WRCC Saint Helena	1907 through December 2017[3]	34.3 (2.86)	240	3.5	Lower
PRISM	1981 to 2010	39.0 (3.25)	---	---	---
Napa County Isohyetal Map	1900 to 1960	35.0 (2.92)	---	---	---

Notes:

1. The subject property is located at elevations between ±650 and ±780 ft asl
2. Erroneous and/or missing rainfall data in WY 1986-87, WY 1987-88, WY 1988-89, and WY 1994-95.
3. Missing rainfall data in 1907, 1915-1922; 1979-1980; 1985-1988; 1992; and 2011-2012.

Table 4
Summary of Available Groundwater Quality Data
Bergman Family Vineyards Winery

Constituent Analyzed	Units	Maximum Contaminant Level	Vineyard Well
		Date of Sample:	**10/24/2014**
General Physical Constituents			
Electrical Conductivity	umhos/cm	900; 1,600; 2,200[(1)]	220
pH	units	6.5 to 8.5	6.79
Sodium Adsorption Ration (SAR)		None	0.762
General Mineral Constituents			
Total Dissolved Solids	mg/L	500; 1,000; 1,500[(1)]	190
Total Hardness		None	79
Alkalinity (Total) as $CaCO_3$		None	94
Calcium		None	16
Magnesium		None	9.2
Sodium		None	16
Sulfate		250, 500, 600[(1)]	3.4
Chloride		250, 500, 600[(1)]	4.9
Fluoride		2	0.11
Nitrate (as NO_3)		10	0.81
Silica		None	97
Detected Inorganic Constituents (Trace Elements)			
Arsenic	µg/L	10	3.2
Boron		1000 (NL)	ND
Iron		300	110
Manganese		50	180
Zinc		5000	170

Notes:

µmhos/cm = micromhos per centimeter; mg/L = milligrams per liter; µg/L = micrograms per liter

ND = constituent not deteceted

NL = State Notification Level

(1) The three listed numbers represent the recommended, upper and short-term State Maximum Contaminant

All laboratory analyses performed by Analytical Sciences of Petaluma, California.

MEMORANDUM

APPENDIX
CALIFORNIA
DEPARTMENT OF WATER RESOURCES
WELL COMPLETION REPORT (DRILLER'S LOG)
FOR THE
VINEYARD WELL

B14-00695

ORIGINAL
File with DWR

Page 1 of 1

STATE OF CALIFORNIA
WELL COMPLETION REPORT
Refer to Instruction Pamphlet

No. e0221138

DWR USE ONLY — DO NOT FILL IN
STATE WELL NO./ STATION NO
LATITUDE LONGITUDE
APN/TRS/OTHER

Owner's Well No. 1-2014
Date Work Began 6/30/2014 Ended 7/28/2014
Local Permit Agency Napa County Environmental Mgmt
Permit No E14-00104 Permit Date 2/11/2014

GEOLOGIC LOG

ORIENTATION (✓) ✓ VERTICAL — HORIZONTAL — ANGLE — (SPECIFY)
DRILLING METHOD ROTARY FLUID BENTONITE

DEPTH FROM SURFACE Ft	to Ft	DESCRIPTION *Describe material, grain, size, color, etc.*
0	25	DARK TAN VOLCANIC TUFF
25	50	BLACK FRACTURED VOLCANICS
50	60	RED VOLCANIC ROCK WITH ASH
60	105	BLACK, GRAY FRACTURED VOLCANICS
105	160	BLACK, GRAY VOLCANICS
160	180	RED VOLCANICS
180	220	BLACK, GRAY VOLCANICS
220	310	GRAY VOLCANIC ROCK
310	360	GRAY FRACTURED VOLCANICS
360	375	WHITE, GRAY VOLCANIC ASH
375	555	GREEN, GRAY VOLCANIC ASH
555	605	MIXED FRACTURED VOLCANICS
605	750	MIXED VOLCANICS WITH ASH STRINGERS
750	780	TAN SANDY VOLCANIC ASH
		CONTINUED CASING LAYOUT
657	677	BLANK PVC 8"
677	757	SCREEN PVC 8" .032 SLOT
757	777	BLANK PVC 8"

RECEIVED
SEP 26 2014
Napa County Planning, Building & Environmental Services

TOTAL DEPTH OF BORING 780 (Feet)
TOTAL DEPTH OF COMPLETED WELL 777 (Feet)

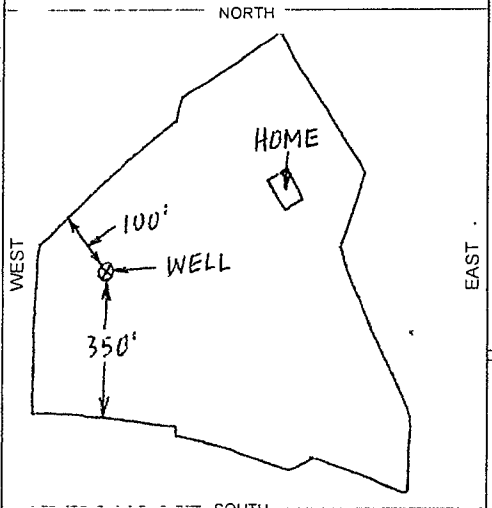
WELL OWNER

Name [redacted] Bergman
Mailing Address [redacted] Bristol Avenue
[redacted] Angeles [redacted] [redacted]
CITY STATE ZIP

WELL LOCATION

Address 3285 St. Helena Hwy
City St. Helena CA
County Napa
APN Book 022 Page 080 Parcel 010
Township Range Section
Latitude DEG MIN SEC. DEG. MIN. SEC

LOCATION SKETCH



Illustrate or Describe Distance of Well from Roads, Buildings, Fences, Rivers, etc and attach a map Use additional paper if necessary. PLEASE BE ACCURATE & COMPLETE.

ACTIVITY (✓)

✓ NEW WELL
MODIFICATION/REPAIR
— Deepen
— Other (Specify)
— DESTROY (Describe Procedures and Materials Under "GEOLOGIC LOG"

PLANNED USES (✓)
WATER SUPPLY
✓ Domestic — Public
✓ Irrigation — Industrial
MONITORING —
TEST WELL —
CATHODIC PROTECTION —
HEAT EXCHANGE —
DIRECT PUSH —
INJECTION —
VAPOR EXTRACTION —
SPARGING —
REMEDIATION —
OTHER (SPECIFY) —

WATER LEVEL & YIELD OF COMPLETED WELL

DEPTH TO FIRST WATER N/A (Ft.) BELOW SURFACE 1
DEPTH OF STATIC WATER LEVEL 159 (Ft.) & DATE MEASURED 7/28/2014
ESTIMATED YIELD 100 (GPM) & TEST TYPE AIR LIFT
TEST LENGTH 2 (Hrs.) TOTAL DRAWDOWN N/A (Ft.)
May not be representative of a well's long-term yield.

CASING (S)

DEPTH FROM SURFACE Ft	to Ft	BORE-HOLE DIA. (Inches)	TYPE (✓) BLANK	SCREEN	CONDUCTOR	FILL PIPE	MATERIAL / GRADE	INTERNAL DIAMETER (Inches)	GAUGE OR WALL THICKNESS	SLOT SIZE IF ANY (Inches)
0	780	15								
0	157		✓				PVC F480	8	SDR-21	
157	357			✓			PVC F480	8	SDR-21	.032
357	557		✓				PVC F480	8	SDR-21	
557	657			✓			PVC F480	8	SDR-21	.032

ANNULAR MATERIAL

DEPTH FROM SURFACE Ft	to Ft	TYPE CEMENT (✓)	BENTONITE FILL (✓)	FILTER PACK (TYPE/SIZE)
0	56	✓		10 SK SAND
56	777		✓	#6 SAND

ATTACHMENTS (✓)

— Geologic Log
— Well Construction Diagram
— Geophysical Log(s)
— Soil/Water Chemical Analysis
— Other
ATTACH ADDITIONAL INFORMATION, IF IT EXISTS

CERTIFICATION STATEMENT

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief.
NAME HUCKFELDT WELL DRILLING, INC.
(PERSON, FIRM, OR CORPORATION) (TYPED OR PRINTED)
2110 Penny Lane ADDRESS Napa CITY CA STATE 94559 ZIP
Signed [signature] WELL DRILLER/AUTHORIZED REPRESENTATIVE
08/11/14 DATE SIGNED
439-746 C-57 LICENSE NUMBER

DWR 188 REV 11-97

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM