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Water Availability Analysis

William Cole Use Permit Modification P19-00101-UP
Variance P19-00441-VAR
Planning Commission Hearing Date (May 1, 2024)

MEMORANDUM

February 6, 2024

To: Mr. and Mrs. Bill & Jane Ballentine
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Sent via email (william@williamcolevineyards.com)
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Job No. 711-NPA01

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Richard C. Slade & Associates LLC (RCS)

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No. 858
STATE OF CALIFORNIA

Re: Consolidation of Prior WAA Memoranda
Results of Napa County Tier 1 and Tier 2 Water Availability Analysis
William Cole Winery
2879 St Helena Highway North
Vicinity St. Helena, Napa County, California

Introduction

This Memorandum presents the key findings and conclusions, along with preliminary recommendations, regarding the associated Water Availability Analysis (WAA) prepared by RCS for the proposed modification to the existing winery use permit at the William Cole Winery property in St. Helena, Napa County (County). This document was prepared for the property owner to provide hydrogeologic analyses in conformance with Napa County Tier 1 and Tier 2 requirements, as described in the Napa County WAA Guidelines Document (WAA, 2015).

An earlier version of this WAA was originally submitted to Napa County Planning, Building, & Environmental Services Department (PBES) on July 2, 2021. Subsequent to that submittal, WAA preparation requirements were revised by PBES, specifically with respect to groundwater recharge calculations in the local groundwater basin (the subject property is partially contained within the Napa Subbasin of the Napa-Sonoma Groundwater Basin in California Department of Water Resources Bulletin 118 [DWR, 2021]). In response to the changes, additional water use efficiency improvements were proposed for the subject winery to reduce the proposed future water use of the project. RCS therefore prepared an addendum to the WAA (dated November 21, 2022) to provide calculations of recharge consistent with the County's change in WAA policy.

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In January 2024, it was requested that RCS prepare a singular combined WAA that included the original work and reflected the results of the revised recharge calculations and minor revisions to project demands. Hence, this subject document represents a consolidation of the information in the two prior Memoranda published by RCS.

Background

The William Cole Winery property (referred to herein as “subject property”) is comprised by approximately 5.7 acres and is located at 2879 St. Helena Highway North in the vicinity of St. Helena in Napa County. Figure 1, “Location Map”, shows the boundaries of the subject property superimposed on the USGS topographic map for the St. Helena quadrangle. Property boundaries shown on Figure 1 were adapted from the County Assessor’s parcel data; County parcel data are freely available on the County GIS website. Also shown on Figure 1 are the locations of the existing onsite water wells (known herein as the “New Well” and “Old Well”) and the locations of other nearby offsite wells owned by others. The locations of the offsite wells shown on Figure 1 proximal to the subject property are considered to be approximate. Other features shown on Figure 1 are discussed later in this Memorandum. Figure 2, “Aerial Photograph Map”, shows the same property boundaries and well location that are illustrated on Figure 1, but the basemap for Figure 2 is an aerial photograph of the area, which was obtained using the ArcGIS Pro software package.

As reported by the Owner, the 5.7-acre subject property is developed with the following: 1.9 acres of existing vineyards; a residence (with a pool); and a winery with an existing production of 20,000 gallons of wine per year (with visitation and tastings). Water demands for the existing winery and vineyards at the subject property have historically been met via the use of the existing onsite “New Well”; the “Old Well” is reportedly only used for irrigation purposes during peak irrigation demand periods each year. Water demands for the onsite residence, pool, and landscaping (including lawn) are met by the public water system from the City of St. Helena.

RCS understands the proposed project is to modify the existing winery use permit to increase winery production to 30,000 gallons of wine per year, increase visitations and tastings, and to modify and construct new winery facilities, including the conversion of an existing agricultural building into a winery barrel and production building. For the proposed project, future water demands for the winery (including both domestic and process water demands) are proposed to be met using groundwater pumped from the New Well. Water demands for the existing residence, pool, and landscaping will continue to be provided by the City of St. Helena public water system.

The basic purpose of this Memorandum is to comply with Napa County’s WAA guidelines for a “Tier 1” WAA (“i.e., a groundwater recharge estimate); those guidelines were promulgated by the County in May 2015, and updated by Napa County in 2024. Also, as shown on Figures 1 and 2, there is at least one known offsite well located within 500 feet (ft) of the onsite New Well (i.e., the “project well”); hence, a “Tier 2” WAA (Well Interference Evaluation) was performed.

Site Conditions

From review of existing in-house data, and from two field reconnaissance visits by an RCS geologist to the subject property on June 6 and July 9, 2019, the following key items were noted and/or observed (refer to Figures 1 and 2):

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a. The William Cole Winery property is comprised by a single parcel having the following Napa County Assessor's Parcel Number (APN) of 022-230-015. The total County-assessed area of the subject property is 5.7 acres.

b. The subject property is situated on the western side of Napa Valley near the base of foothills, and approximately 1 mile north of the City of St. Helena. Based on the topographic contours illustrated in Figure 1, the ground surface on the subject property slopes slightly to the northeast towards Highway 29 and the Napa River.

c. There are no mapped ephemeral drainages[1] on the subject property. However, a drainage culvert and pipe were observed by RCS geologists to be located near the northwest corner of the property. The drainage pipe is reportedly buried beneath the property and flows in a northeast direction across the property and offsite. During the June and July 2019 site visits, this drainage piping was observed by RCS to be dry. Because this drainage is considered to be ephemeral, it would contain surface water runoff only during or immediately following a rainfall event.

d. The subject property is currently developed with 1.9 acres of vineyards, which are primarily located in the eastern half of the property. There is also a winery and a residence located in the western portion of the property. RCS geologists also observed an office and other winery and/or vineyard facility buildings on the subject property.

e. Offsite areas surrounding the subject property consist primarily of vineyards, wineries, and residences.

f. As shown on Figures 1 and 2, there are two existing water-supply wells on the subject property. Both wells are located in the northern portion of the property; the "New Well" is located approximately 75 ft west of the "Old Well".

g. During the June and July 2019 site visits, the RCS geologist traveled along Highway 29 (or St. Helena Highway North) to the northwest and southeast of the property in an attempt to identify possible locations and/or the existence of nearby but offsite wells owned by others. RCS refers to such work as "windshield surveys." During these surveys, RCS geologists identify possible well locations by observing typical well-house enclosures, pressure tanks, storage tanks, power lines, or direct observation of a wellhead.

   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 the onsite wells, and for possible wells located on those neighboring offsite properties. In addition, RCS geologists also used the California Department of Water Resources (DWR) online Well Completion Report website to download driller's logs for wells within the immediate vicinity of the subject property. As a result of those inquiries, a few driller's logs and/or well drilling permits were obtained for wells historically drilled in the area.

Figures 1 and 2 show the approximate locations of known, reported, or inferred nearby offsite wells surrounding the subject property, as determined from the field reconnaissance and well log

[1] These drainages are typically shown as "dashed lines" on a USGS topographic map, denoting ephemeral status.

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research. Note there is at least one offsite well that appears to lie within 500 ft of the New Well (labeled as "Neighbor Well" on Figures 1 and 2). Mr. Mike Muelrath of Applied Civil Engineering (ACE), the project engineer, also confirmed the existence of that nearby offsite well on the adjacent property to the northwest. This nearby offsite well is located approximately 375 ft southwest of the existing New Well.

Key Construction and Testing Data for Onsite Wells

DWR Well Completion Reports are available for the New Well (Log No. 796923) and the Old Well (Log No. 103049); a copy of each log is appended to this Memorandum. Table 1, "Summary of Well Construction and Yield Data," provides a tabulation of key well construction data and original groundwater airlifting data that are available for these two onsite wells.

Well Construction Data

Key data for the two onsite wells listed on the available driller's logs and/or identified during the site visits include:

a. The New Well was constructed in May 2003 by Pulliam Well Exploration (PWE) of Napa, California; the drilling method for this well was not listed on the driller's log. The Old Well was constructed in July 1977 by Doshier-Gregson, Inc (Doshier) of Vallejo, California; the Old Well was drilled using the direct air rotary drilling method. No geophysical survey (i.e., an electric log) was available for either onsite well.

b. Pilot hole depths (the borehole drilled before the well casing was placed downwell) were reported to be between 170 ft below ground surface (bgs) for the Old Well, and 250 ft bgs for the New Well.

c. These two onsite wells were both cased with polyvinyl chloride (PVC) well casing having nominal diameters ranging between 5 inches (for the New Well) and 6 inches (for the Old Well); total casing depths were reported to be 170 ft bgs for the Old Well, and 249 ft bgs for the New Well.

d. Casing perforations for the New Well are factory-cut slots and have slot opening widths of 0.032 inches (32-slot), whereas for the Old Well, the perforations are machine-cut slots and have slot opening widths of 0.125 inches. Perforations in the New Well were placed continuously between the depths of 130 ft and 249 ft bgs. In the Old Well, perforations were placed continuously between the depths of 120 ft and 170 ft bgs.

e. The gravel pack material reported on the driller's log for the New Well is listed as "pea gravel"; no gravel pack type was listed on the driller's log for the Old Well.

f. The New Well and Old Well were both constructed with sanitary seals consisting of cement and bentonite. The New Well sanitary seal was set to a depth of 50 ft bgs, whereas the sanitary seal in the Old Well was set to a depth of 21 ft bgs. As such, the seal depth in the New Well meets the minimum 50-foot seal depth that is required for wells to be used for public-supply purposes, per County and State water well requirements. Note that, as reported above, proposed domestic water demands for the onsite residence, pool, and landscaping will be supplied by the City of St. Helena public water system.

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Summary of Key Airlifting "Test" Data

The driller's logs for the two onsite wells provided the depth to the original post-construction static water levels (SWL) for these wells, along with the original airlifting test rates (as shown on Table 1). These data include:

- Initial SWL depths following completion of well construction were reported to be 25 ft bgs in the New Well on May 23, 2003, and 125 ft bgs in the Old Well in July 1977.
- Reported maximum airlift rates[2] for initial post-construction airlifting operations in the onsite wells were estimated by the drillers to be approximately 100 gallons per minute (gpm) in the New Well in May 2003, and 75 gpm in the Old Well in July 1977.
- "Water level drawdown" values during airlifting were not listed on the driller's logs for the two onsite wells, because water level drawdown cannot be measured during airlifting operations; thus, the original post-construction specific capacity[3] value for the wells cannot be calculated from the data on the driller's log.

Well Data from Site Visits

As discussed above, site visits to the subject property were performed by RCS geologists in June and July 2019. The following information for the onsite wells was gleaned from those site visits:

- The New Well was observed to be equipped with a permanent pump, but the pump was turned off (not pumping) during the initial June 6, 2019 visit. A static water level (SWL) of 39.3 ft below the wellhead reference point (brp) was measured by the RCS geologist at that time; the reference point for the measurement was approximately 0.8 ft above ground surface (ags). This well was not observed to equipped with a totalizer flowmeter device at the time of the site visit.
- The Old Well was equipped with a permanent pump, but was not pumping at the time of the July 9, 2019 site visit. A SWL of 38.4 ft brp was measured by the RCS geologist at that time; the reference point for the measurement was ground surface. This well is not equipped with a totalizer flowmeter device.

Local Geologic Conditions

Figure 3, "Geology Map", illustrates the types, lateral extents, and boundaries between the various earth materials mapped at ground surface in the region by others. Specifically, Figure 3 has been adapted from the results of regional geologic field mapping of the Eastern Sonoma and Western Napa Counties, as published by the USGS in 2007. As shown on Figure 3, the key earth materials mapped at ground surface in the area from geologically youngest to oldest, include the following:

a. Alluvial-type deposits. These deposits consist of undifferentiated and/or undivided stream channel and alluvial fan deposits (map symbols Qhc, Qht, Qhf, and Qf on Figure 3). These deposits are generally unconsolidated, and consist of layers and lenses of sand, gravel, silt, and clay. As shown on Figure 3, these alluvial deposits primarily occur at ground surface across the floor of Napa Valley to the east of the

[2] As a rule of thumb, RCS geologists estimate that 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.
[3] 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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subject property. The alluvial deposits (map symbols Qhf and Qf) are interpreted to become thicker from west to east towards the Napa River. These alluvial deposits are not mapped on Figure 3 to be exposed at ground surface on the subject property.

b. Sonoma Volcanics. The Sonoma Volcanics are comprised by a highly variable sequence of chemically and lithologically diverse volcanic rocks. The rock types shown on Figure 3 include: perlitic rhyolite (map symbol Tsrp); andesite to basalt lava flows (map symbol Tsa); pumiceous ash-flow tuff (map symbol Tst); and volcanic sand and gravel (map symbol Tss). As shown on Figure 3, the ash-flow tuff volcanic rocks are exposed at ground surface across the entire subject property, and these materials extend to the north, west, and south of the subject property. Thin bands of perlitic rhyolite (map symbol Tsrp) and harder, flow-type volcanic rocks (map symbol Tsa), as well as volcanic sand and gravel (map symbol Tss) are exposed at ground surface in the hillsides to the southwest of the subject property. These volcanic rocks are also known to directly underlie the alluvial-type deposits in the Napa Valley Floor.

c. Franciscan Complex. The geologically older (Cretaceous- and Jurassic-aged) Franciscan Complex rocks are exposed offsite at ground surface to the southwest of the subject property (not shown on Figure 3). These rocks consist mainly of well-consolidated to cemented greywacke (sandstone) and mélange (breccia). Serpentinite (map symbol sp and shown in a dark purple color in the hillsides in the southwest corner of Figure 3) is also exposed in thin bands in between the volcanic rocks to the southwest of the subject property. These geologically older rocks are considered to be the bedrock of the area and are considered to underlie the volcanic rocks beneath the subject property.

Geologic Structure

A few unnamed faults[4], as mapped by others, have been interpreted to exist in the vicinity of the subject property as shown by the dark-colored, solid, or short dashed lines on Figure 3 (USGS 2007). Specifically, these northwest-southeast trending fault traces are shown to be mapped west of the subject property.

There may be potential impacts of these faults on groundwater availability in the region. Faults can serve to increase the number and frequency of fracturing in the Sonoma Volcanics rocks. If such fractures were to occur, they would tend to increase the amount of open area in the rock fractures which, in turn, could increase the ability of the local earth materials to store groundwater. Faults can also act as barriers to groundwater flow.

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 volcanic tuffs and hard, fractured volcanic flow rocks of the Sonoma Volcanics.

[4] 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.

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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. Notably, however, is that the pumiceous ash-flow tuffs (map symbol Tst) tend to be fine-grained, and/or deeply weathered, and likely of reduced permeability. Groundwater in these materials tends to occur in the void space between the individual volcanic ash grains.

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:

- Whether or not the ash-flow tuffs or the hard fractured volcanic flow rocks are the preponderant volcanic material beneath the property
- The possible thickness of the ash flow tuffs beneath the property
- the number, frequency, size, and degree of openness of the fractures/joints in the hard volcanic rocks
- the degree of interconnection of the various fracture/joint systems in the subsurface and to ground surface
- the extent to which the open fractures may have been possibly in-filled over time by chemical 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 particles of volcanic sand, gravel, and ash, where these rock types exist beneath the subject property.

As stated above, the principal rock types expected in the subsurface beneath the property, based on the driller's logs of the two onsite wells, appear to be mainly the fine-grained, ash-flow tuffs, along with lesser amounts of hard, volcanic flow rocks that may be fractured to varying degrees. Descriptions of drill cuttings by the well driller that are recorded on the available driller's logs for the New Well and Old Well and other nearby offsite wells owned by others are consistent with the typical descriptions of the various rocks known in the Sonoma Volcanics. From RCS' long-term experience with 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 a few gpm (if abundant ash-flow tuff is present), to rates as high as 200 gpm or more (if abundant hard fractured flow rocks are present).

Potentially Nonwater-Bearing Rocks

This category includes the geologically older and fine-grained sedimentary rocks of the Franciscan Complex, including serpentinite. These potentially nonwater-bearing rocks are

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interpreted to underlie the volcanic rocks that exist beneath the subject property at depths greater than ±250 ft bgs, as interpreted by RCS from the driller's descriptions listed on the available driller's log for the New Well.

In essence, these diverse and geologically-older 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.

Project Groundwater Demands

For the purposes of this WAA, the New Well is considered to be the "project well," as it will represent the only onsite well that will be used to meet new water demands of the proposed winery project. As discussed above, the existing winery water demands (domestic and process water), and the vineyard irrigation water demands are currently supplied by groundwater pumped from the New Well. The Old Well is also used to augment vineyard irrigation demands during peak demand periods in the summer. Domestic demands for the onsite residence and landscape irrigation demands (including the lawn) are currently supplied by potable water from the City of St. Helena public water system.

Existing and proposed onsite groundwater demands for the property have been estimated by ACE, as discussed below. A copy of the "Groundwater Use Estimate" table from ACE is appended to this Memorandum.

Existing Groundwater Demands

Groundwater demands for the existing winery and vineyard irrigation have historically been met using groundwater pumped from the New Well; the Old Well is still active and is used to help meet vineyard irrigation demands during peak demand periods. Existing groundwater demands for the subject property have been estimated by ACE to be the following (values below have been rounded):

a. Total existing winery groundwater demand = 0.48 acre feet per year (AF/yr)
    - This includes: 0.005 AF/yr for daily visitors; 0.003 AF/yr for events with meals prepared offsite; 0.042 AF/yr for employees; 0.001 AF/yr for event staff; and 0.43 AF/yr for winery process water.
    - Note that 1 AF = 325,851 gallons

b. Existing vineyard irrigation groundwater demand = 0.95 AF/yr
    - Based on a reported 1.9 acres of existing vineyards.

c. Total estimated existing annual groundwater demand = a + b = 1.43 AF/yr (rounded)

Proposed Groundwater Demands

In the future, groundwater demands for the winery and irrigation demands for the vineyards are proposed to be met by pumping groundwater from the New Well; the Old Well will also continue to be used to help meet vineyard irrigation demands, if necessary. Water demands for the residence, pool, and landscaping irrigation will be supplied by the City of St. Helena public water system, and will not require groundwater. Thus, the total proposed onsite groundwater demand for the property, as supplied by the New Well, will be as follows (values below have been rounded):

a. Proposed winery groundwater demand = 0.76 AF/yr
    - This includes: 0.060 AF/yr for daily visitors; 0.006 AF/yr for events with meals prepared offsite; 0.134 AF/yr for employees; 0.002 AF/yr for event staff; and 0.552 AF/yr for winery process water.
b. Proposed vineyard irrigation groundwater demand = 0.95 AF/yr
c. Total proposed annual groundwater demand = a + b = 1.71 AF/yr (rounded)

Thus, the total groundwater demand increase for the proposed project (from 1.43 AF/yr existing to 1.71 AF/yr proposed) is about 0.28 AF/yr, or approximately 91,200 gallons per year.

Proposed Pumping Rates

To determine an appropriate pumping rate necessary from the New Well (i.e., the project well), it was conservatively assumed that the proposed winery demands (0.76 AF/yr) will be required year-round (365 days/year) and that the vineyard irrigation water demands (0.95 AF/yr) will be required during a 20-week irrigation season each year. Based on these assumptions, and in order to meet the groundwater demands for the proposed project, the New Well would need to pump at a rate of about 6 gpm during the irrigation season. This pumping rate assumes that the New Well would be pumped on a 33% operational basis (8 hours/day, 7 days/week) during the year, including the assumed 20-week irrigation season. During the non-irrigation portions of the year, the New Well would only need to pump at a rate of about 1.5 gpm to meet the demands of the winery (assuming a 33% operational basis). For the purposes of this evaluation, RCS will conservatively assume the New Well will be pumped at a rate of about 7 gpm to meet the total annual groundwater demands of both the existing vineyards and proposed winery expansion.

September 2019 Constant Rate Pumping Test of "New Well"

Because historical pumping rate data for the New Well were unavailable, RCS recommended to the Owner that a pumping test be performed in this project well. The basic purpose of this recommended pumping test was to determine whether or not the New Well could meet the proposed groundwater project demands of the subject property. As a result, an 8-hour constant rate pumping test of the "New Well" was performed by LGS Drilling, Inc. (LGS) of Vacaville, California on September 4, 2019.

As shown on Figures 1 and 2, several offsite wells are reported to be located nearby and/or on adjacent properties. One of these offsite wells (labeled on Figures 1 and 2 as "Neighbor Well") is located approximately 375 ft southwest of the onsite New Well. Therefore, according to the Napa County WAA Guidelines (WAA 2015), because this well is located within 500 ft of the project well (the onsite New Well), a Tier 2 WAA (Well Interference Evaluation) was required for this project. Data from the September 2019 pumping test was also used for a Tier 2 WAA analysis.

During the recent pumping test of the New Well (the pumping well), RCS recommended using the nearby onsite Old Well as an additional water level observation well. As shown on Figures 1 and 2, the Old Well is located approximately 75 ft to the east of the New Well. The Old Well is considered to be an appropriate candidate to serve as an observation well because, based on the available well construction data, both wells appear to be perforated at relatively similar depths and likely pump from similar fractured upper aquifer systems; the two onsite wells have uppermost perforations that begin at depths ranging from 130 ft bgs in the New Well and 120 ft bgs in the Old Well.

The basic purposes of the pumping test of the New Well included:

1. To determine if the New Well can pump at sufficient rates to meet the proposed groundwater demands of the project (an estimated maximum rate of about 7 gpm).
2. To monitor the amount of self-induced drawdown created in the pumping well by virtue of its own pumping.
3. To monitor water level recovery in the pumping well following the end of the pumping portion of the test.
4. To monitor the amount of water level decline (i.e., water level drawdown interference), if any, that might be induced in the nearby, onsite Old Well (i.e., the water level observation well) by virtue of the subject pumping test of the New Well.
5. To help determine the aquifer parameters of transmissivity and possible storativity for the Sonoma Volcanics rocks encountered by the New Well. A storativity value can be calculated only if water level drawdown interference is induced in another water level observation well being monitored during a pumping test. These aquifer parameter values can be used to estimate theoretical water level drawdown impacts at distance from a pumping well.

Pumping Test Protocol

The protocol for the pumping test of the New Well was developed by RCS geologists and provided to LGS. Key portions of this pumping test included the 8-hour constant rate pumping test and a final period of water level recovery following the pumping portion of the test. Provided below is a summary of the pumping test protocol:

- Constant rate pumping test – The 8-hour constant rate pumping test was performed at the New Well on September 4, 2019. The New Well was continuously pumped at an RCS-recommended rate of 15 gpm[5] throughout the 8-hour pumping test; the onsite Old Well was not pumped during the entire 8-hour pumping period for the New Well. Frequent manual water levels were collected by the LGS pump operator in the New Well, and occasional water level measurements were collected in the Old Well (i.e., the additional water level observation well).
- Post-test water level recovery – Following the end of the pumping portion of the pumping test in the New Well, water level recovery data were collected by the pumper in the New Well for a period of approximately 3 hours.

Results of September 2019 Pumping Test

The constant rate pumping test for the New Well began at 8:00 AM on September 4, 2019 and the pumping was continued for 8 continuous hours (480 minutes) at an average rate of 15 gpm. Specifically, the average pumping rate was determined from totalizer readings recorded by the

[5] Note that RCS geologists selected a pumping rate for the test (15 gpm) that was more than double the rate necessary for the project (approximately 6 gpm).

LGS pumper throughout the pumping period. Figure 4, "Water Levels During September 2019 Constant Rate Pumping Test", graphically illustrates the water level changes in the New Well during the 8-hour constant rate pumping test period. Also shown on Figure 4 are the water level data collected from the nearby Old Well (water level observation well) during the pumping period. Copies of the field data collected by LGS (water level measurements, pumping rates, and observations) during the pumping test are appended to this Memorandum. Below is a summary of those data:

- New Well (the pumping well) – A pre-test SWL of 54.5 ft brp was measured in this well just before the pump was turned on to begin the subject pumping test. After 8 hours (480 minutes) of continuous pumping, the maximum PWL in the New Well was measured at a depth of 77.6 ft brp, as shown on Figure 4. This represents a self-induced maximum water level drawdown of 23.1 ft during the 8-hour constant rate pumping test of the subject well. As shown on Figure 4, pumping water levels in the New Well did not appear to become stable or reach "equilibrium" by the end of the pumping test. However, in the last 3 hours of the pumping test, water levels were only decreasing at a rate of about 0.8 ft per hour. Also, the maximum PWL in the New Well was still approximately 52 ft above the depth of the uppermost perforations (at a depth of 130 ft bgs), as seen on Figure 4.

  Following pump shut-off, water level data were then collected for an additional period of 3 hours in the pumping well. Water levels in the first hour (60 minutes) had recovered to a depth of 62.3 ft brp, and after 3 hours water levels had recovered to a depth of 56.0 ft brp; this latter depth is approximately 1.5 ft below the pre-test SWL (of 54.5 ft brp) and represents a water level recovery of 94% at that time.

- Old Well (the additional water level observation well) – As shown on Figure 4, water levels recorded by the LGS pumper in the nearby, onsite Old Well showed no change during the pumping period for testing of the New Well, and thus no definitive water level drawdown interference impacts were observed in this nearby well by the pumper while pumping the New Well for a period of 8 hours at a constant rate of 15 gpm. Specifically, water levels in the Old Well were recorded to have remained stable at a depth of 39.5 ft brp during the 8-hour pumping period at the New Well.

Also shown on Figure 4 are water level data for the New Well and Old Well collected by RCS during the June and July 2019 site visits, and also from each respective drilling contractor at the date of construction of each well.

Specific Capacity Data

A useful indicator of well performance or efficiency (in terms of changes in water level drawdown over time with respect to pumping rate) is the specific capacity of a well, which can be calculated from the results of an aquifer (pumping) test or from data generated during regular periods of pumping and water level monitoring. In general, when groundwater is pumped from an active water well, a hydraulic gradient is established toward the well, and a cone of water level depression forms within the local aquifer system, with the pumping well located at the locus (center) of this cone. In general, the greater the pumping rate (and/or the longer the duration of pumping), the greater the water level drawdown will be in the pumping well (drawdown represents the vertical distance between the non-pumping [or static] water level and the resulting pumping water level in the well). As an indication of the relative efficiency or productivity of a well, the term "specific capacity" is commonly used to define the amount of water (in gpm) that the well will yield for each foot of water level drawdown created while the well is pumping at a particular rate. The specific capacity[6] of a well is calculated using the pumping rate of the well (in gpm) divided by the total water level drawdown (in ft) created in that well while pumping at that rate and is expressed in units of gallons per minute per foot of water level drawdown (gpm/ft ddn). As is typical for any well, the higher the pumping rate and/or the longer the duration of continuous pumping will result in a lower specific capacity.

During the 8-hour pumping test of the New Well in September 2019, the specific capacity was calculated to be 0.65 gpm/ft ddn. There are no other available pumping data for this well to compare the results of these recent testing data. Generally, longer pumping periods tend to create greater water level drawdowns than shorter pumping periods at similar pumping rates; hence, specific capacity values calculated for long-term pumping tests typically tend to be lower than calculations resulting from relatively short-term tests, assuming the tests were conducted at similar pumping rates. Regardless, the specific capacity value calculated from the pumping test described above is considered to be typical for the finer-grained geologic materials within the Sonoma Volcanics into which the New Well has been constructed.

Calculation of Aquifer Parameters

Important aquifer parameters such as transmissivity (T) and storativity (S) can be determined using data collected during a pumping test of a well. Transmissivity is a measure of the rate at which groundwater can move through an aquifer system, and therefore is essentially a measure of the ability of an aquifer to transmit water to a pumping well. Transmissivity is expressed in units of gallons per day per foot of aquifer width (gpd/ft). Storativity (S) is a measure of the volume of groundwater taken into or released from storage in an aquifer for a given volume of aquifer materials; storativity is dimensionless and has no units. Storativity calculations can only be made using actual amounts of water level drawdown, if any, monitored in an observation well during a pumping test of another well; storativity cannot be calculated using water level drawdown data acquired solely from the pumping well.

Water level drawdown and recovery data collected from the New Well during the September 2019 constant rate pumping test were input into the software program AQTESOLV (version 4.5 Professional). Note, the observation water level data collected from the Old Well could not be used to calculate T and/or S because no water level drawdown was observed in the Old Well while pumping the New Well for the recent test. Numerous analytical solutions were then applied to the New Well data in an attempt to determine transmissivity values using an automatic curve fitting procedure. The solutions utilized consisted of unconfined, confined, semi-confined, and/or fractured aquifer solutions; several variations of these solutions were analyzed by RCS. Typically, water level drawdown data from an observation well are used in these solutions, but as stated above, no definitive water level drawdown was observed in the Old Well by virtue of the pumping of the New Well during the recent test.

[6] The specific capacity of a well depends on several factors, including the hydrogeologic characteristics and thickness of the local aquifer system, the method of well construction, well design details such as gravel pack gradation and gravel envelope thickness, the type and degree of well development performed, the age and current condition of the casing perforations and gravel pack, and the pumping rate and pumping duration of the pumping event being monitored. Hence, it can be difficult to compare specific capacity values from one well to another even if the two wells are in the same aquifer system, but such comparisons can yield valuable information when conditions are similar.

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Certain assumptions are made about the aquifer when applying these solutions. In general, for the solutions listed below, key assumptions are: that the aquifer has an infinite areal (lateral) extent; that the aquifer is isotropic (the same in all directions); that the pumping well fully and/or partially penetrates the aquifer system(s); and that water is instantaneously released from storage with the decline of hydraulic head. Also, for the purposes of this analysis, the assumption is made that the saturated aquifer thickness at the New Well is approximately 195 ft. This saturated aquifer thickness was determined by taking the vertical distance between the static water level in the New Well (approximately 54 ft brp on September 4, 2019) and the bottom of the casing perforations in the New Well (at a depth of 249 ft bgs; see Table 1).

Listed below are the curve-fitting solutions used, the transmissivity values calculated, and the figure number in this Memorandum on which the water level data and fitted-curve are presented. For each solution used, a storativity value could not be calculated because no definitive water level drawdown data were recorded in observation Old Well during the subject pumping test.

- Theis/Hantush – Figure 5A, "Constant Rate Pumping Test Analysis, Theis/Hantush Solution, Confined Aquifer, New Well (Pumping Well)". As shown on the figure, the curve for the confined aquifer solution has been "best fit" to the later-time water level drawdown data observed in the New Well. A transmissivity value of approximately 303 gallons per day per foot of aquifer (gpd/ft) is calculated for these data.
- Moench – Figure 5B, "Constant Rate Pumping Test Analysis, Moench, Leaky Aquifer, New Well (Pumping Well)". As shown on the figure, the curve for the leaky aquifer solution has been reasonably matched to the later-time portion of the water level drawdown data collected during the pumping period in the New Well. A transmissivity value of approximately 193 gpd/ft is calculated for these data.
- Gringarten-Witherspoon – Figure 5C, "Constant Rate Pumping Test Analysis, Gringarten-Witherspoon, Fractured Aquifer, New Well (Pumping Well)". As shown on the figure, the curve for the fractured aquifer solution has been reasonably fit to much of the water level drawdown data acquired during the pumping test of the New Well. A transmissivity value of approximately 291 gpd/ft is calculated for these data.

Transmissivity values reported for Sonoma Volcanic-type rocks can vary from as low as $\pm 1 \times 10^2$ gpd/ft to as high as $\pm 2 \times 10^4$ gpd/ft. The transmissivity values determined from the recent pumping test performed in the New Well using AQTESOLV (193 gpd/ft to 303 gpd/ft) fall within this range and are therefore considered to be representative of Sonoma Volcanic rocks.

An independent evaluation of transmissivity (T) using data from the subject pumping test, were made via the empirical relationship T≈1,750*(Q/s)[7], where (Q/s) is the specific capacity of the pumping well and 1,750 is an empirical constant for the semi-confined aquifer system assumed to exist in the rocks of the Sonoma Volcanics. Applying this relationship to the specific capacity value calculated for the subject pumping test of the New Well yields a transmissivity value on the order of 1,140 gpd/ft. This theoretical transmissivity value is higher than values of T determined via the analytical solutions determined using AQTESOLV software and the pumping test data. This empirical method to estimate transmissivity only considers drawdown and does not factor in any water level recovery, whereas the curve-fitting solutions used in AQTESOLV tend to utilize both drawdown and recovery to determine transmissivity. Transmissivity values determined by

[7] This methodology is described in Driscoll (1986)

the curve-fitting solutions are considered to be more representative of the regional spatial area and more indicative of long-term pumping conditions.

Theoretical Drawdown in Nearby Wells

As shown on Figures 1 and 2 there is at least one offsite well located within 500 ft of the New Well. RCS assigned a designation of "Neighbor Well" for this well for the purpose of the analysis of theoretical drawdown; the onsite Old Well was also used in the analysis. The approximate distance and direction of each of these two wells, relative to the New Well, are as follows:

- Old Well (75 ft to the east)
- Neighbor Well (375 ft to the southwest)

To calculate the theoretical drawdown in the onsite Old Well and offsite Neighbor Well that might possibly be induced by the future pumping of the New Well, and to help satisfy requirements of the County's Tier 2 WAA, RCS used the AQTESOLV software to perform a "predictive simulation" of the potential (theoretical) water level drawdowns that might occur in the region due to future pumping by the New Well. For the subject simulations, RCS specifically used the Theis (1935)/Hantush (1961) solution in the AQTESOLV software, the known construction of the onsite the New Well, and a number of other assumptions related to the hydrogeologic properties of the local Sonoma Volcanic rock aquifer system into which the wells have been constructed. Below is a list of the inputs/assumptions used as part of the theoretical drawdown calculations:

- Inherent Theis Assumptions – Again, the Theis (1935)/Hantush (1961) solution assumes numerous conditions about the aquifer system, including that aquifer is homogeneous and isotropic (the same in all directions) and that the aquifer is of infinite areal extent.
- Well Penetration – For the purposes of the simulation, the New Well is assumed to be a "partially penetrating" well. AQTESOLV states that "the screens of partially penetrating wells only extend over a portion of the aquifer's saturated thickness". Casing perforations for the New Well reportedly begin at a depth of 130 ft bgs, and the top of the "aquifer" is assumed to be at a depth of roughly 54 ft bgs. Available well construction data for the Old Well and Neighbor Well reveal these two observation wells are also "partially penetrating" their respective aquifers. Therefore, all three wells used in this simulation are assumed to be "partially penetrating" wells.
- Aquifer Thickness – The thickness of the saturated Sonoma Volcanic rock aquifer system near the New Well is estimated to be 195 ft. This represents the vertical distance from the current SWL water level in the New Well (about 54 ft brp), and the 249-foot depth to the bottom of the casing in the New Well.
- Transmissivity and Storativity – To perform the required calculations, it was first necessary to calibrate the theoretical equations by simulating an 8-hour pumping period in the New Well and then attempt to reproduce the water level drawdown values that were actually recorded by the LGS pumper in the pumping well during the September 2019 pumping test. Based on the results of the previous curve-fitting procedures to determine the aquifer parameters (see the previous section "Calculation of Aquifer Parameters"), transmissivity (T) values ranged between 193 gpd/ft and 303 gpd/ft. Because no definitive water level drawdown impact was observed in the Old Well (the water level observation well) during the 8-hour pumping period of the New Well (the pumping well), a value for storativity could

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not be determined. Therefore, a storativity[8] value of $2.0x10^{-4}$ cubic feet per square foot per foot, which represents a dimensionless value, is assumed for the local aquifer system. Note that this is considered to be a conservative assumption for storativity for the local volcanic rocks.

To better calibrate the software to the actual drawdown values that were recorded by the LGS pumper in the New Well during the 8-hour pumping test, adjustments were made to the assumed transmissivity value used in the AQTESOLV simulation. After an iterative process, a transmissivity value of 1,625 gpd/ft was found to provide drawdown values that were more comparable to those that were actually monitored in the field in the pumping well (i.e., the New Well). This transmissivity value of 1,625 gpd/ft yielded a theoretical water level drawdown value of 23 ft in the New Well; this value is very similar to the 23.1 ft of drawdown actually observed during testing of the New Well. Figure 6A, "Theoretical Drawdown Calculations/15 gpm/T=1,625 gpd/ft", shows the calculated water level drawdown value after 8 hours of pumping the New Well at a constant rate of 15 gpm, based on a transmissivity of 1,625 gpd/ft and a storativity of $2.0x10^{-4}$.

Once the transmissivity value was better calibrated to drawdown values actually observed in the field in the New Well, the predictive water level drawdown simulation was performed to include the nearby onsite Old Well, along with the offsite Neighbor Well. Figure 6B, "Theoretical Drawdown Calculations in Observation Wells", has been prepared to show the theoretically-calculated water level drawdown values in the New Well and also in the two observation wells after pumping the New Well for the assumed continuous period of 8 hours and at the assumed constant pumping rate of 7 gpm. The simulation shown on Figure 6B is considered to be more representative of the actual operational pumping rate and pumping duration that are proposed for the New Well for the winery expansion project (as mentioned above, the peak pumping rate estimated to be needed from the New Well is about 7 gpm, pumping 8 hours per day during the assumed 20-week irrigation season). In this scenario, the two water level observation wells are assumed to be not pumping during the New Well pumping period. As shown on Figure 6B, the results of the predictive simulation for water level drawdown values during pumping of the New Well are presented below:

- New Well (pumping well) – After pumping at a future rate of 7 gpm for a continuous period of 8 hours, an approximate theoretical water level decline (i.e., self-induced water level drawdown) of 10.8 ft is calculated for this well.
- Old Well (onsite observation well) – A theoretical water level drawdown value of 2.5 ft is predicted as a result of pumping the New Well at 7 gpm for 8 continuous hours. Recall that no water level decline was actually observed in this well during the pumping test of the New Well at the higher 15 gpm rate.
- Neighbor Well (offsite observation well) – A theoretical water level drawdown value of 0.9 ft is theoretically predicted as a result of the future pumping of the New Well at 7 gpm for a continuous period of 8 hours.

Because no water level drawdown was detected in the onsite Old Well (75 ft east of the New Well) during the 8-hour long September 2019 pumping test of the New Well (performed at a rate of 15

[8] In Appendix F, Table F-2 of the WAA Guidance document (WAA 2015), the specific storage value for "rock, fissured" ranges between $1x10^{-6}$ and $2.1x10^{-5}$ (ft^{-1}). Multiplying these specific storage values by the estimated aquifer thickness of 195 ft yields a range of dimensionless storativity values between $2.0x10^{-4}$ and $4.1x10^{-3}$. Therefore, using an S value of $2.0x10^{-4}$ is a conservative assumption for this analysis.

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gpm), then it is clear that the theoretical calculations overestimated actual drawdown conditions. Therefore, water level drawdown impacts to the nearby offsite wells, if any, experienced during future pumping of the onsite New Well are anticipated to be less than the values that have been theoretically predicted by these calculations.

These calculated theoretical water level drawdown values of 0.9 and 2.5 ft are less than the acceptable values defined in the "Default Well Interference Criteria" shown on Table F-1 of the May 12, 2015 Napa County WAA Guidelines (WAA 2015). Those drawdown criteria in the WAA Guidelines (WAA 2015) show that drawdown is not considered significant by the County if less than 10 ft for offsite wells that have a casing diameter of six inches or less, and if less than 15 ft for offsite wells that have a casing diameter greater than six inches.

Estimate of Groundwater Recharge

As shown on Figure 2, a majority of the subject property is contained within the Napa Subbasin of the Napa-Sonoma Groundwater Basin in California Department of Water Resources Bulletin 118 (DWR, 2021). Documentation provided by Napa County PBES (2024) states that within the Napa Subbasin, annual groundwater recharge should be assumed to be 0.3 acre feet per year per acre of land (see Equation A below).

$$\text{Equation A:}$$
$$\text{Annual Groundwater Availability } (AFY) = \frac{0.3 \text{ acre-feet per year } [AFY]}{\text{acre } [A]} * \text{Property Area } (\text{acres } [A])$$

To be conservative, RCS will calculate recharge assuming the entire property is within the groundwater basin. The area of the subject property listed in the November 2, 2022 version of Napa County's Parcel shapefile is 5.72 acres. Inserting the 5.72-acre area of the subject property into Equation A yields a groundwater availability value of 1.72 AF/yr. This recharge volume is greater than the total estimated average annual groundwater demand for the project of 1.71 AF/yr.

For comparison, the originally submitted WAA (RCS, 2021) presented an onsite groundwater recharge estimate of 2.2 AF/yr, a greater volume of recharge than is calculated above. This prior recharge estimate was calculated based on estimates of rainfall, deep percolation rates, and property area in compliance with Napa County's then-current Tier 1 WAA requirements (Napa County, 2015). Hence, the updated calculation and assumption that the entire property is within the groundwater basin is more conservative.

Note that a "prolonged drought analysis" is no longer required for WAA preparation due to the required application of the unit groundwater use of 0.3 AF/year/acre (PBES, 2022).

Estimate of Groundwater in Storage

To help evaluate possible impacts to the local aquifer system(s) that might occur as a result of pumping for the proposed project, the volume of groundwater extracted for the project can be compared to an estimate of the current volume of groundwater in storage strictly beneath the subject property. To estimate the amount of groundwater currently in storage beneath the subject property, the following parameters are needed:

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a) Approximate surface area of property = 5.7 acres

b) Depth of the New Well = 249 ft bgs. Based on the depth of the New Well, and the data listed on the driller's logs for this well and other nearby offsite wells, rocks of the Sonoma Volcanics likely extend to a greater depth than that of the New Well, and thus, it likely that the saturated zone beneath the property could extend deeper than is estimated using these well data.

c) To present a conservative calculation of groundwater in storage, RCS geologists have assumed that the current saturated thickness of the aquifer(s) beneath the subject property is approximately 195 vertical feet. This value is calculated using the depth of the New Well (249 ft bgs) and subtracting the LGS-measured SWL depth of 54 ft on September 4, 2019. Note that this current SWL for the subject well is deeper than that when it was constructed (25 ft in May 2003), and even deeper than that measured more recently in June 2019 (39 ft); this deeper value is used for this calculation to provide a more conservative analysis of the minimum volume of groundwater in storage beneath the property. Further, as discussed in subpart (b) above, the saturated volcanic rock beneath the subject property, based on the available subsurface geologic data, could actually be thicker; this would tend to create an even greater volume of groundwater in storage beneath the property than is calculated herein.

d) Approximate average specific yield of the Sonoma Volcanics = 2%. The specific yield is essentially the ratio of the volume of water that drains from the saturated portion of the geologic materials (due to gravity) to the total volume of rocks. Specific yield of the Sonoma Volcanics can vary greatly depending on a number of factors, including the degree and interconnection of the pore spaces and/or fracture zones within the rocks. A conservative estimate by Kunkel and Upson for the specific yield of the Sonoma Volcanics ranges from 3% to 5% (USGS 1960). For other Napa County properties for which RCS has performed similar analyses, an even more conservative estimate for specific yield of 2% has been used. Hence, to present a conservative analysis, we will assume a specific yield of 2% for the Sonoma Volcanics rocks that underlie the subject property, but the actual value, in reality, could be higher.

e) Thus, a conservative estimate of the groundwater in storage (S) beneath the subject property (based on the September 2019 SWL of the New Well) is calculated as:

 S = property area ("a") times saturated thickness ("c") times average specific yield ("d") = (5.7 ac)(195 ft)(2%) = 22.2 AF

In contrast, the proposed average annual groundwater use for the property is estimated to be 1.71 AF/yr in the future. Hence, the estimated groundwater demand for the entire property represents only about 8% of the groundwater conservatively estimated to currently be in storage in the volcanic rocks beneath the subject property based on conservative, site specific water level data for the New Well. Furthermore, this percentage does not include annual groundwater recharge that will occur from rainfall that deep percolates as groundwater into the local aquifers. Based on the foregoing, the estimated groundwater demands of the proposed project and the entire subject property should not cause a net deficit in the volume of groundwater within the aquifer systems beneath the site, and this should not adversely impact water levels in nearby wells to a point that they would not support existing or permitted land uses.

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Key Conclusions and Recommendations

1. The existing William Cole Winery property is currently developed with 1.9 acres of existing vineyards, a winery, a residence, landscaping (including lawn), a pool, and other onsite facilities and buildings associated with the winery and vineyard operations.
2. There are two existing onsite water wells (the "New Well" and "Old Well") on the subject property.
3. The proposed project consists of modifying the existing winery use permit to increase winery production to 30,000 gallons of wine per year, increase visitations and tastings, and construction and modification of existing winery facilities on the subject property.
4. The proposed (future) average annual groundwater demand for the proposed project (including the existing vineyards) was estimated by the project engineer to be 1.9 AF/yr. Total groundwater demands for the subject property are only proposed to increase by 0.28 AF (from 1.43 AF/yr at present to 1.71 AF/yr in the future).
5. The increased groundwater demands, which will include groundwater for the winery (domestic and process water) and irrigation for the existing vines, will be met by pumping groundwater from the New Well. The Old Well is also used to help meet onsite vineyard irrigation demands only during peak demand periods.
6. To meet the estimated groundwater demands of the proposed project (1.71 AF/yr), the New Well would need to pump at a rate of approximately 6 gpm during the irrigation portion of each year when both vineyard irrigation and winery water demands would be needed. This pumping rate assumes the New Well would be pumped on a 33% operational basis (pumping 8 hours per day) throughout the year.
7. Groundwater recharge at the subject property on an average annual basis is estimated to be 1.72 AF/yr. This value is calculated based on the assumptions that the entire property is within the Napa-Sonoma Groundwater Basin, and that the annual groundwater recharge rate in the Subbasin is 0.3 acre feet per year per acre of land. This estimated groundwater recharge of 1.72 AF/yr is greater than the 1.71 AF/yr estimated to be required for the project on an average annual basis in the future from the subject property.
8. Based on the results of the September 2019 constant rate pumping test performed by LGS, the New Well appears to be capable of pumping at rates needed to meet the future groundwater demands of the project. While pumping at an average rate of 15 gpm during that constant rate test, a maximum PWL of 77.6 ft brp was recorded by the pumper at the end of the 8-hour pumping period. Based on the initial SWL of 54.5 ft brp, a maximum water level drawdown of 23.1 ft was created in the well; this calculates to a current specific capacity for this well of 0.65 gpm/ft ddn. Results of the New Well pumping test showed that water levels did not completely stabilize at the end of the pumping portion of the pumping test. In the last 3 hours of the pumping test, water levels were declining at a rate of only 0.8 ft per hour. Following only 3 hours of water level recovery, water levels in the well had recovered to 94% of the total drawdown induced during the 8-hour pumping period. Future water demands for the

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proposed project will require that this well be pumped at a lower rate (about 6 gpm) than that used during the September 2019 pumping test (15 gpm).

9. Because there is at least one offsite well (the "Neighbor Well") located within 500 ft of the onsite New Well, a Tier 2 WAA was performed, and included the pumping test of the New Well. During the September 2019 pumping test of the New Well, water level measurements were also manually recorded by LGS in the onsite Old Well (the observation well) located only 75 ft from the New Well. During the pumping portion of the New Well pumping test, no water level drawdown impacts were induced in the onsite Old Well.

10. Using drawdown data collected from the New Well during the September 2019 pumping test, estimates of the theoretical amount of water level drawdown that might be induced in the pumping well and other nearby onsite or offsite wells were estimated. Results of these predictive simulations using AQTESOLV showed that theoretical drawdowns induced in the nearby onsite Old Well and offsite Neighbor Well by virtue of pumping the New Well (project well) at a rate and duration necessary for the project would be only 2.5 ft and 0.9 ft, respectively. These values are much less than the default drawdown interference criteria listed in Table F-1 of the 2015 WAA guidance document.

11. RCS recommends implementation of a groundwater monitoring program at the subject property. This would include the frequent, ongoing monitoring of static and pumping water levels in the onsite wells, and also of the instantaneous flow rates and cumulative pumped volumes from each of the onsite wells via installation of new dual-reading flow meters (that records both flow rate and totalizing values, respectively) at each well. RCS also recommends that water level transducers be purchased and installed in the onsite 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/volumes over time by qualified professionals, potential declines in water levels and well production in the onsite wells, along with possible changes in operational pumping scenarios, can be addressed in a timely manner.

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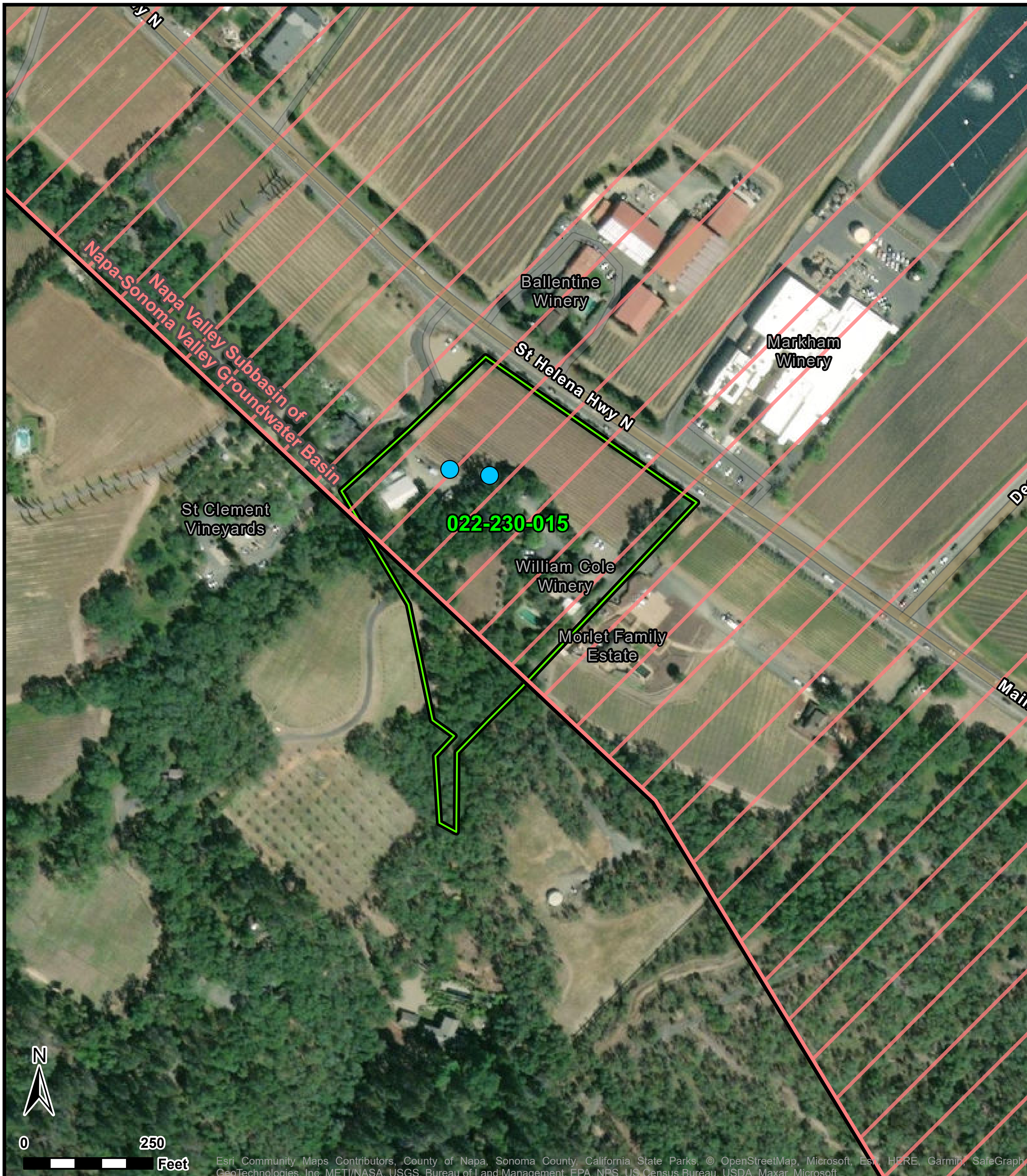
LEGEND

- Subject Property Boundary
- Onsite Well
- Offsite Well (approximate)

RCS

FIGURE 1
LOCATION MAP

RCS Job No. 711-NPA01 **July 2021**



LEGEND

- Onsite Well
- Groundwater Basin Boundary with Name (DWR Bulletin 118, 2021; Version 6.2; Pink Lines on Interior)
- Subject Parcel Boundary (Showing APN; Napa County, 11/2/22)

RCS

Figure 2
Aerial Photograph Map

RCS Job No. 711-NPA01 **November 2022**

Cartographic Presentation by E. Linden. Spatial Reference Name: NAD 1983 StatePlane California II FIPS 0402 Feet

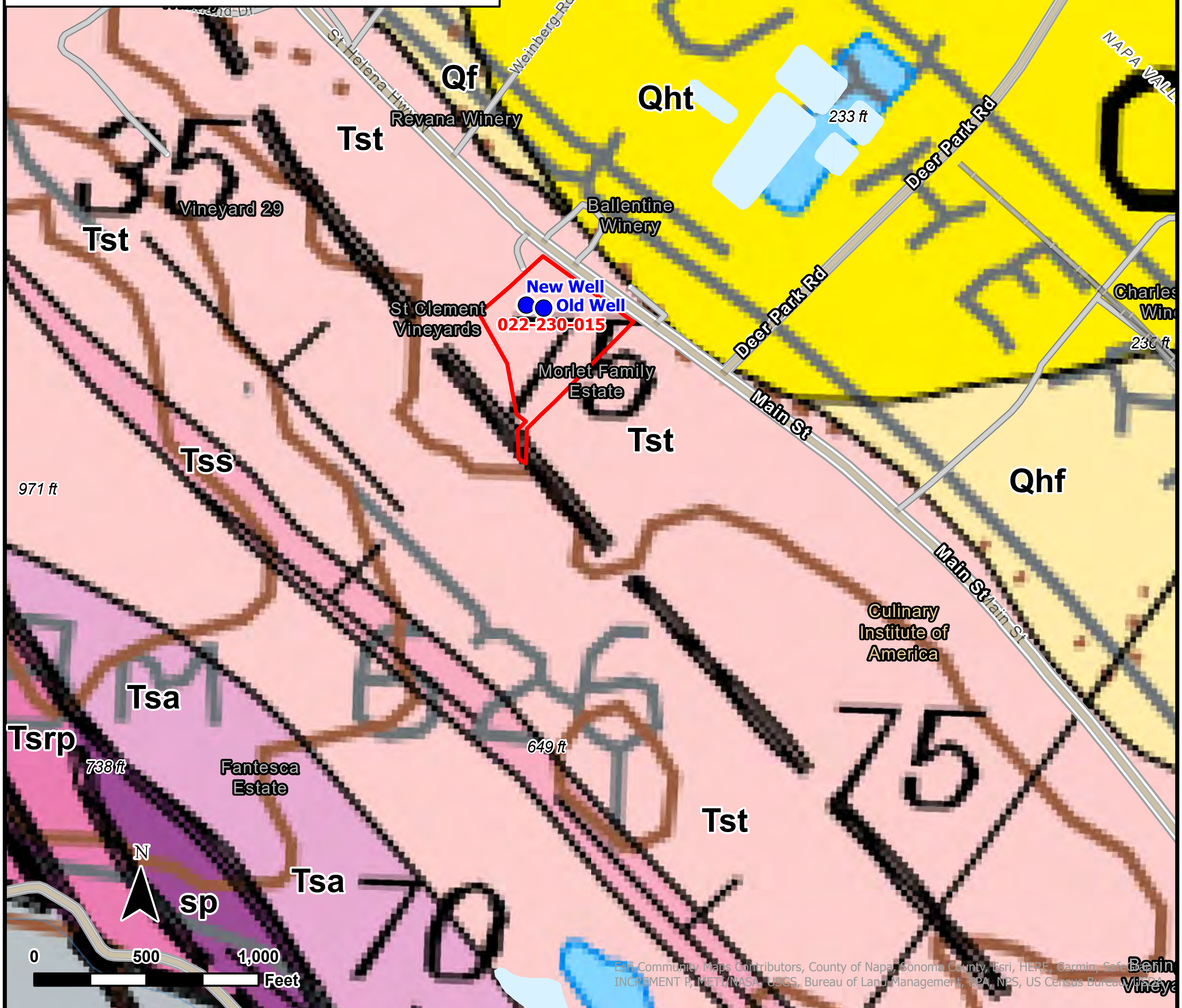
Geologic Descriptions

Qhc - Stream channel deposits
Qht - Terrace deposits
Qhf/Qf - Alluvial fan deposits

Sonoma Volcanics
Tsrp - Perlitic rhyolite
Tsa - Andesite to basalt lava flows
Tst - Pumiceous ash-flow tuff
Tss - Volcanic sand and gravel

Great Valley Sequence
sp - Serpentinite

Reference:
Geologic Map and Map Database of Eastern Sonoma and Western Napa Counties, CA, (USGS 2007)



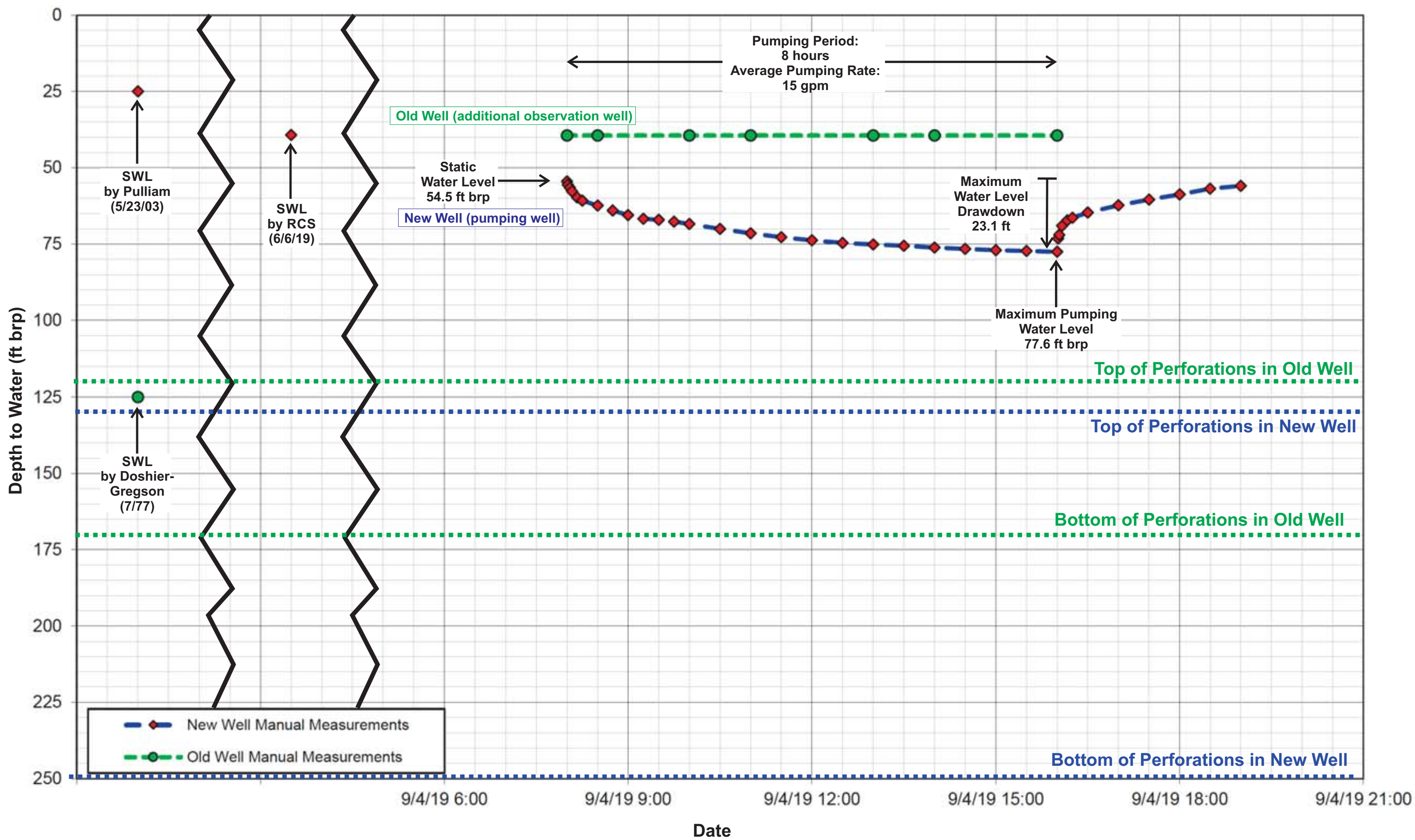
LEGEND

Subject Property Boundary
Onsite Well
Geologic Contact
Fault

RCS

FIGURE 3
GEOLOGY MAP

RCS Job No. 711-NPA01 **July 2021**



RCS

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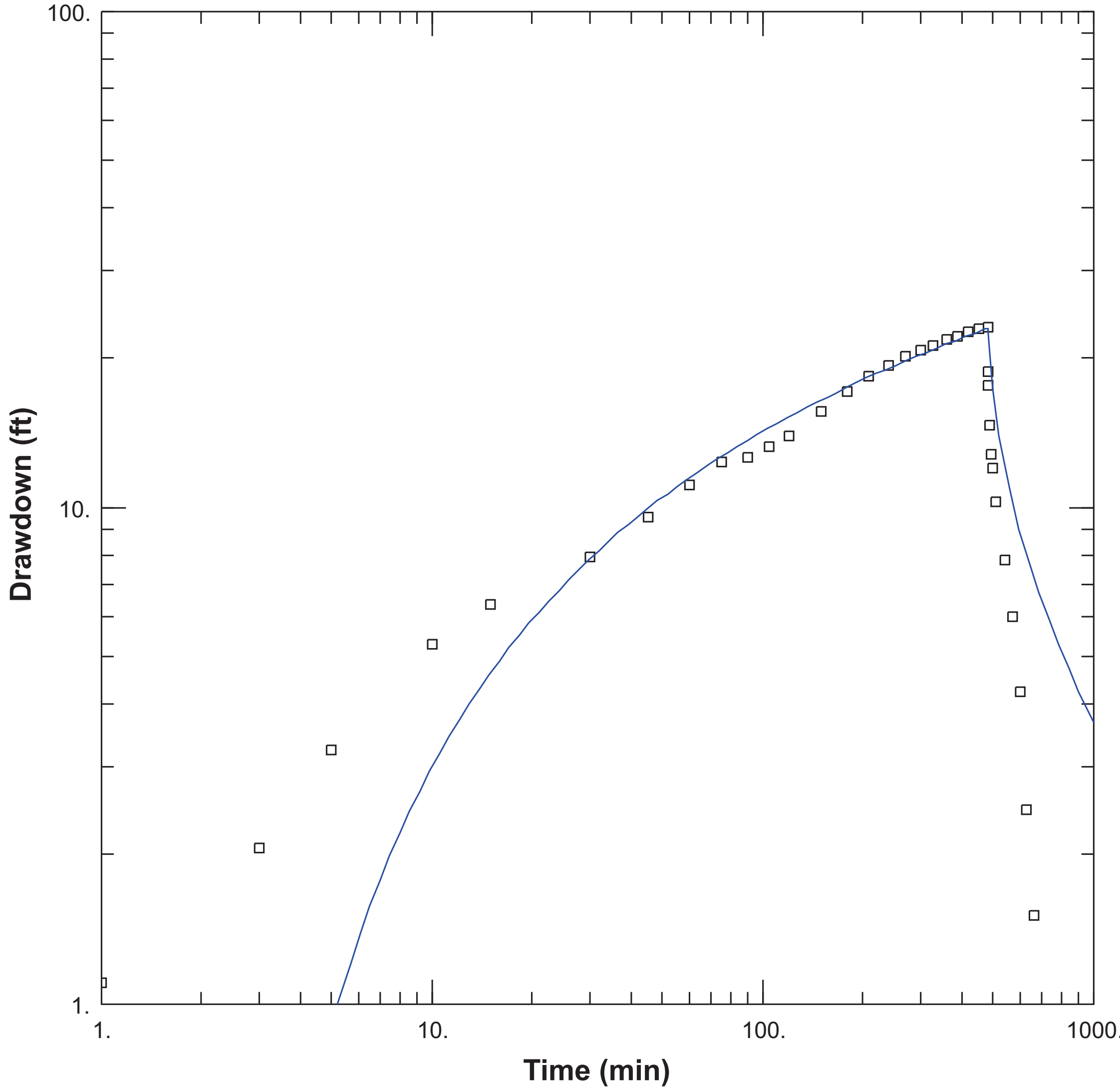
Figure 4
Water Level Data During September 2019
Constant Rate Pumping Test
William Cole Winery

Job No. 711-NPA01 **July 2021**



Obs. Wells

□ New Well (pumping well)

Aquifer Model

Confined

Solution

Theis/Hantush

Parameters

T = 303 gal/day/ft

*A storativity (S) value can only be calculated from the observation well water level data.

Test Date = September 4, 2019
(8-hour test)

Pre-Test
Static Water Level = 54.5 ft brp

Average pumping rate = 15 gpm

Graphical Solution by:
AQTESOLV Vers. 4.50 Pro
by Hydrosolve, Inc.

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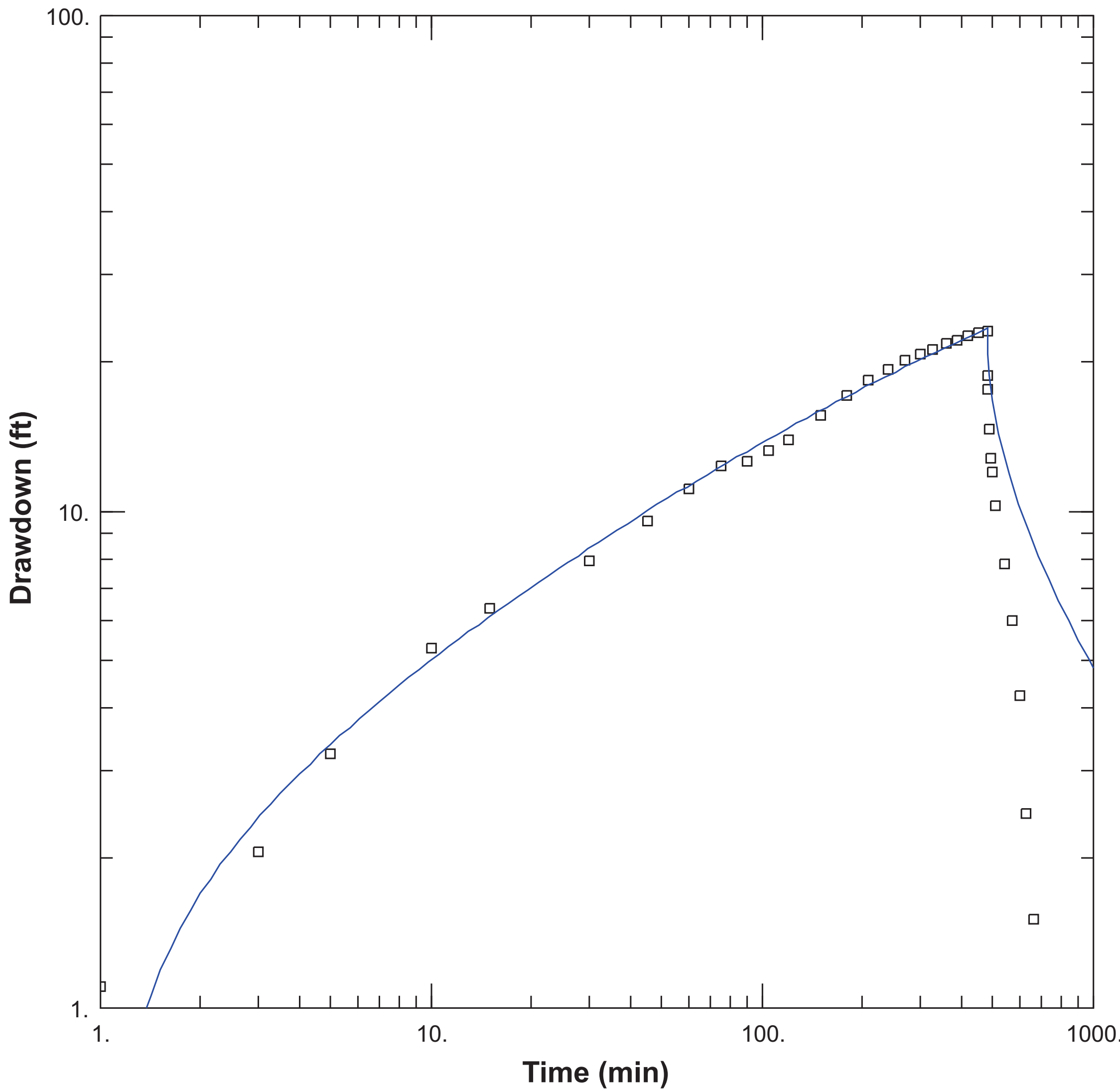
Figure 5A
Constant Rate Pumping Test Analysis
Theis/Hantush Confined Aquifer Solution
New Well (Pumping Well)

Job No. 711-NPA01

July 2021



Obs. Wells

□ New Well (pumping well)

Aquifer Model

Leaky

Solution

Moench

Parameters

T = 193 gal/day/ft

*A storativity (S) value can only be calculated from the observation well water level data.

Test Date = September 4, 2019 (8-hour test)

Pre-Test
Static Water Level = 54.5 ft brp

Average pumping rate = 15 gpm

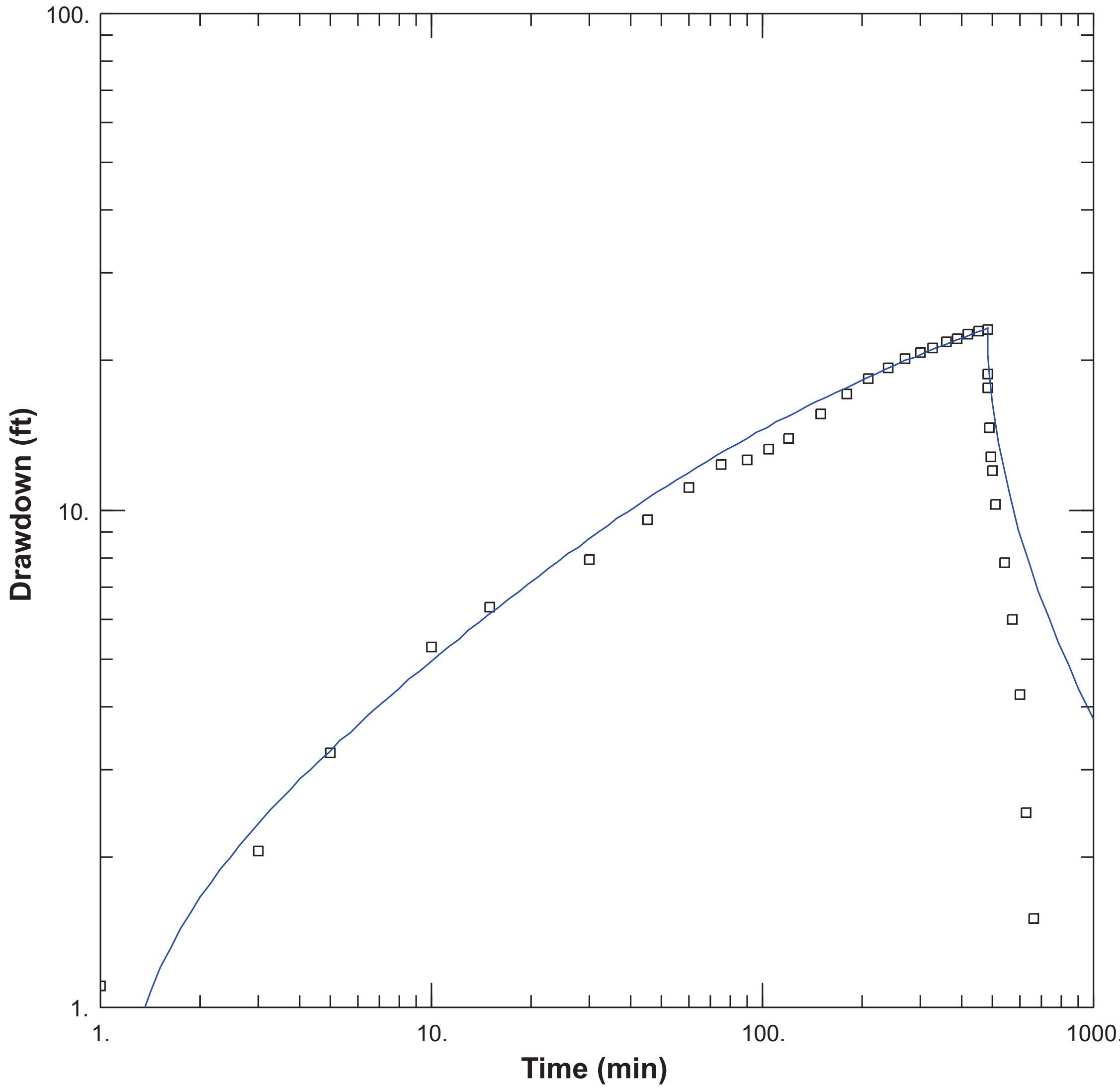
Graphical Solution by:
AQTESOLV Vers. 4.50 Pro
by Hydrosolve, Inc.

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

Figure 5B
Constant Rate Pumping Test Analysis
Moench Confined Aquifer Solution
New Well (Pumping Well)

Job No. 711-NPA01

July 2021



Obs. Wells

□ New Well (pumping well)

Aquifer Model

Fractured

Solution

Gringarten-Witherspoon

Parameters

T = 291 gal/day/ft

*A storativity (S) value can only be calculated from the observation well water level data.

Test Date = September 4, 2019
(8-hour test)

Pre-Test
Static Water Level = 54.5 ft brp

Average pumping rate = 15 gpm

Graphical Solution by:
AQTESOLV Vers. 4.50 Pro
by Hydrosolve, Inc.

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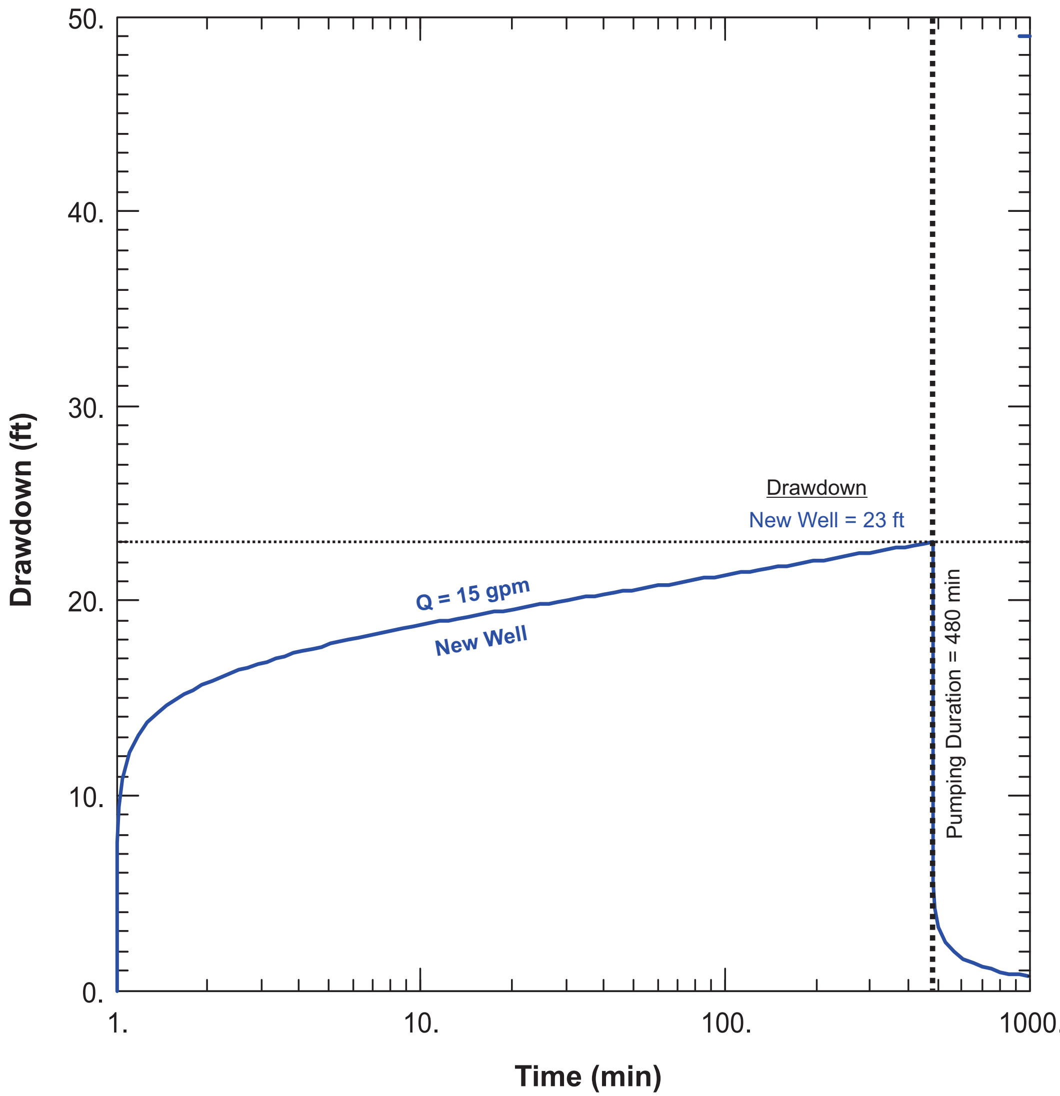
Figure 5C
Constant Rate Pumping Test Analysis
Gringarten-Witherspoon Fractured Aquifer Solution
New Well (Pumping Well)

Job No. 711-NPA01

July 2021



Pumping Well

□ New Well

Aquifer Model

Confined

Solution

Theis (1935)/Hantush (1961)

Parameters

T = 1,625 gal/day/ft
S = 0.0002 (unitless)
Pumping Rate = 15 gpm
Duration = 8 hours (480 minutes)

Graphical Solution by:
AQTESOLV Vers. 4.50 Pro
by Hydrosolve, Inc.

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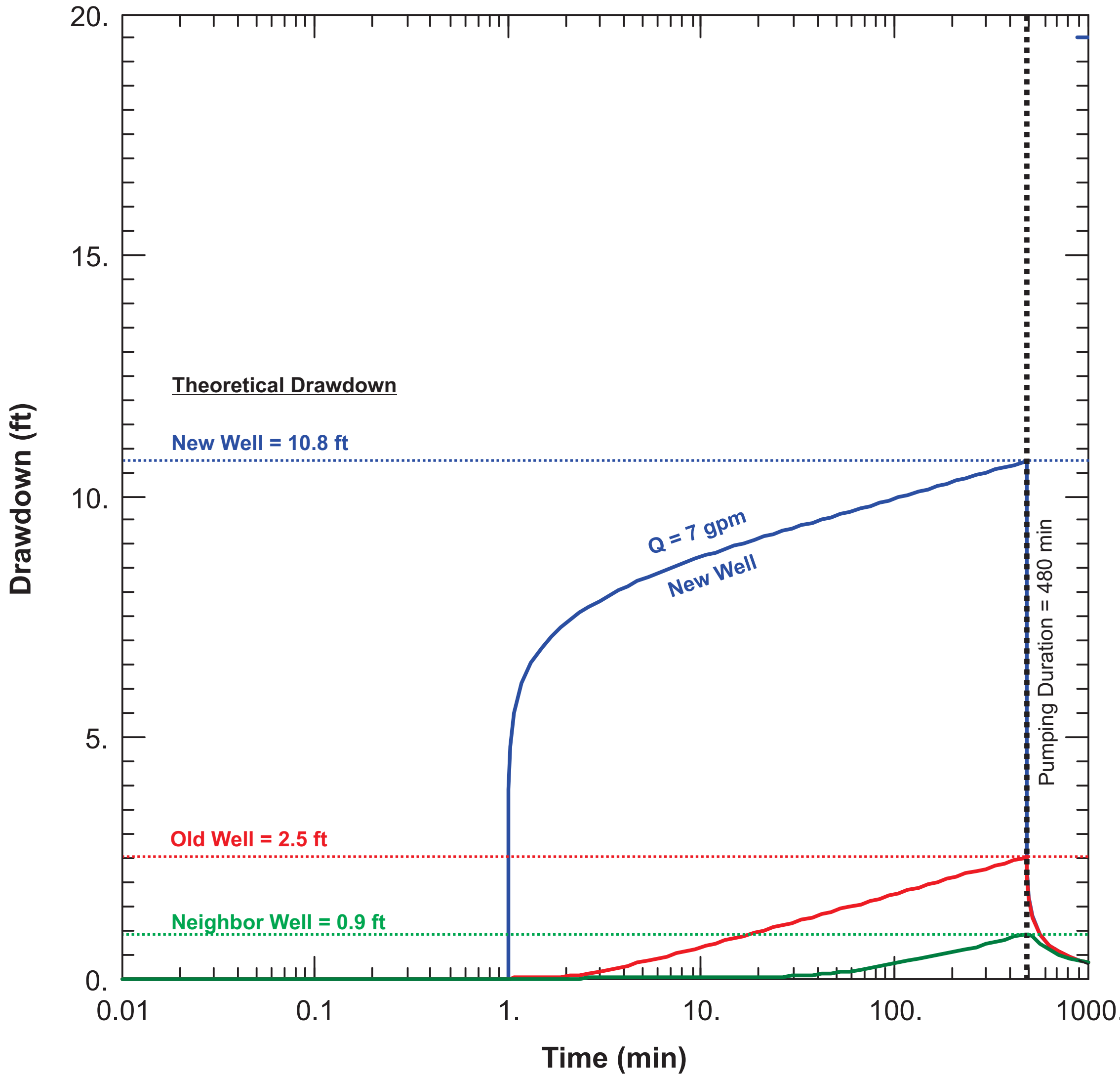
Figure 6A
Theoretical Drawdown Calculations
8 hours/15 gpm/T=1,625 gpd/ft

Job No. 711-NPA01 **July 2021**



Pumping Well

□ New Well

Observation Wells
(distance from New Well)

Old Well (75 ft)

Neighbor Well (375 ft)

Aquifer Model

Confined

Solution

Theis (1935)/Hantush (1961)

Parameters

T = 1,625 gal/day/ft

S = 0.0002 (unitless)

Pumping Rate = 7 gpm

Duration = 8 hours (480 minutes)

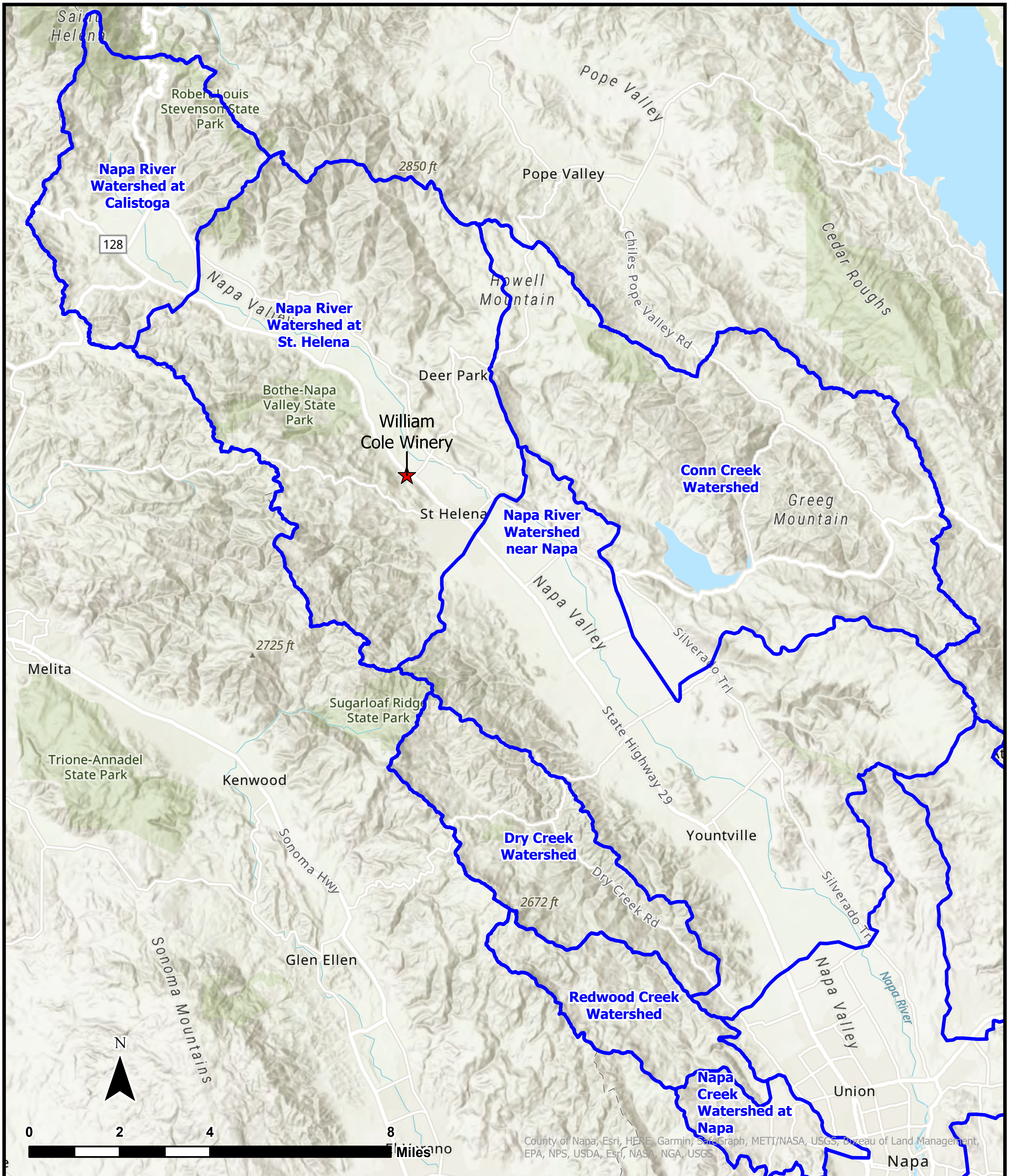
Graphical Solution by:
AQTESOLV Vers. 4.50 Pro
by Hydrosolve, Inc.

RCS

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 6B
Theoretical Drawdown Calculations in Observation Wells
8 Hours/7 gpm/T=1,625 gpd/ft

Job No. 711-NPA01 **July 2021**



LEGEND

- Watershed Boundary
- ★ Subject Property

RCS

FIGURE 7
WATERSHED BOUNDARIES

RCS Job No. 711-NPA01 **July 2021**

Table 1
Summary of Well Construction and Yield Data
William Cole Winery Wells

WELL CONSTRUCTION DETAILS

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
New Well	796923	May 2003	ND	250	249	PVC	5	8¾	0-50 (cement/ bentonite)	130-249	Factory-cut 0.032	52-249; Pea Gravel
Old Well	103049	July 1977	Direct Air Rotary	170	170	PVC	6	ND	0-21 (cement)	120-170	Machine-cut 0.125	ND

POST-CONSTRUCTION YIELD DATA

Reported Well Designation	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)
New Well	5/23/03 Airlift	2	"100+"	25	ND	ND
New Well	9/4/19 Pump	8	15	54.5	77.6	0.65
Old Well	July 1977 Airlift	ND	75	125	ND	ND

Notes:
ND = No data or not listed
ft bgs = feet below ground surface
in = inches
hrs = hours
gpm = gallons per minute
gpm/ft ddn = gallons per minute per foot of water level drawdown

MEMORANDUM

APPENDIX

CALIFORNIA DEPARTMENT OF WATER RESOURCES
WELL COMPLETION REPORTS (DRILLER'S LOGS)
"NEW WELL" AND "OLD WELL"
FOR
WILLIAM COLE WINERY

Rng #4
Roland Cross

Gomez, William A

ORIGINAL

File with DWR

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
WATER WELL DRILLERS REPORT

022 230 005

Do not fill in

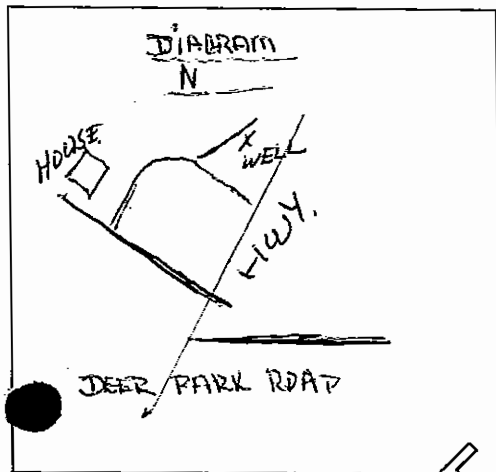
No. 103049

State Well No.
Other Well No. 08N06W26G

Notice of Intent No. ______
Local Permit No. or Date ______

WILLIAM COLE OLD WELL

(2) LOCATION OF WELL (See instructions):
County Napa Owner's Well Number 22-230-05
Well address if different from above ----Same
Township ______ Range ______ Section ______
Distance from cities, roads, railroads, fences, etc. ______



WELL LOCATION SKETCH

(3) TYPE OF WORK:
New Well ☒ Deepening ☐
Reconstruction ☐
Reconditioning ☐
Horizontal Well ☐
Destruction ☐ (Describe destruction materials and procedures in Item 12)

(4) PROPOSED USE:
Domestic ☒
Irrigation ☐
Industrial ☐
Test Well ☐
Stock ☒
Municipal ☐
Other ☐

(5) EQUIPMENT:
Rotary ☐ Reverse ☐
Cable ☐ Air ☒
Other ☐ Bucket ☐

(6) GRAVEL PACK:
Yes ☐ No ☐ Size ______
Diameter of bore ______
Packed from ______ to ______ ft.

(7) CASING INSTALLED:
Steel ☐ Plastic ☒ Concrete ☐

(8) PERFORATIONS:
Type of perforation or size of screen Power Saw

From ft.	To ft.	Dia. in.	Gage or Wall	From ft.	To ft.	Slot size
0	170'	6"	160	120'	170'	1/8X3"

(9) WELL SEAL:
Was surface sanitary seal provided? Yes ☒ No ☐ If yes, to depth 21' ft.
Were strata sealed against pollution? Yes ☐ No ☒ Interval ______ ft.
Method of sealing Grout

(10) WATER LEVELS:
Depth of first water, if known 125' ft.
Standing level after well completion 35' ft.

(11) WELL TESTS:
Was well test made? Yes ☒ No ☐ If yes, by whom? Drillers
Type of test Pump ☐ Bailer ☐ Air lift ☒
Depth to water at start of test 125 ft. At end of test 35 ft
Discharge 75 gal/min after ______ hours Water temperature ______
Chemical analysis made? Yes ☐ No ☒ If yes, by whom? ______
Was electric log made? Yes ☐ No ☒ If yes, attach copy to this report

(12) WELL LOG: Total depth 170 ft. Depth of completed well 170 ft.

from ft.	to ft.	Formation (Describe by color, character, size or material)
0	15	Clay
15	125	Blue shale
125	170	Multi color rock

Work started July 6 1977 Completed July 6 1977

WELL DRILLER'S STATEMENT:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

SIGNED J. D. Doshier
(Well Driller)

NAME Doshier-Gregson Drilling, Inc.
(Person, firm, or corporation) (Typed or printed)
Address 5365 Napa-Vallejo Highway
City Vallejo, Calif. Zip 94558
License No. 294001 Date of this report July 7, 1977

DWR 188 (REV. 7-76) IF ADDITIONAL SPACE IS NEEDED. USE NEXT CONSECUTIVELY NUMBERED FORM

ORIGINAL
File with DWR

Page ____ of ____

Owner's Well No. ____

Date Work Began 5-18-03, Ended 5-23-03

Local Permit Agency NAPA COUNTY

Permit No. 18785 Permit Date 9-26-01

STATE OF CALIFORNIA

WELL COMPLETION REPORT

Refer to Instruction Pamphlet

No. 796923

DWR USE ONLY — DO NOT FILL IN

08N06W26

STATE WELL NO./STATION NO.

LATITUDE LONGITUDE

APN/TRS/OTHER

GEOLOGIC LOG

ORIENTATION (✓) X VERTICAL ___ HORIZONTAL ___ ANGLE ___ (SPECIFY)

DRILLING METHOD ____ FLUID ____

DEPTH FROM SURFACE Ft.	to Ft.	DESCRIPTION (Describe material, grain size, color, etc.)
0	4	BWN ClAY
4	57	Gray clay
57	120	Gray clay & gravel
120	145	gravel
145	220	HARD Gray clay
220	228	BLK. & Green ash
228	250	HARD Gray clay

TOTAL DEPTH OF BORING ~~250~~ 250 (Feet)

TOTAL DEPTH OF COMPLETED WELL 249 (Feet)

WELL OWNER

WILLIAM COLE NEW WELL

WELL LOCATION

Address 2849 Saint Helena Hwy

City St. Helena

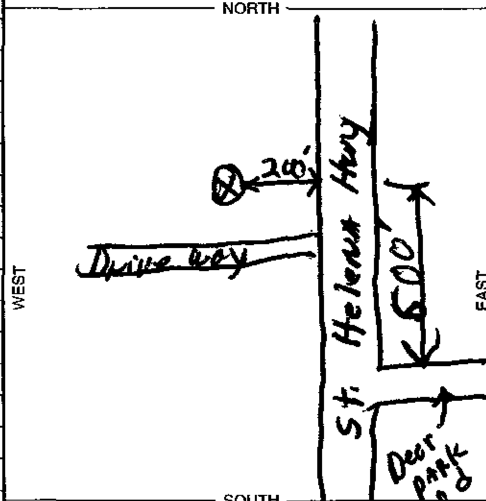
County NAPA

APN Book 22 Page 230 Parcel 05

Township ____ Range ____ Section ____

Latitude ____ NORTH (DEG. MIN. SEC.) Longitude ____ WEST (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 UK (Ft.) BELOW SURFACE

DEPTH OF STATIC WATER LEVEL 25 (Ft.) & DATE MEASURED 5-23-03

ESTIMATED YIELD * 100+ (GPM) & TEST TYPE Air lift

TEST LENGTH 2 (Hrs.) TOTAL DRAWDOWN 220 (Ft.)

** May not be representative of a well's long-term yield.*

CASING (S)

DEPTH FROM SURFACE Ft.	to Ft.	BORE-HOLE DIA. (Inches)	BLANK	SCREEN	CON-DUCTOR	FILL PIPE	MATERIAL / GRADE	INTERNAL DIAMETER (Inches)	GAUGE OR WALL THICKNESS	SLOT SIZE IF ANY (Inches)
0	52	11	✓				Plastic	5	200	
52	130	8 3/4	✓				"	"	"	
130	249	8 3/4		✓			"	"	"	Factory 1/32

ANNULAR MATERIAL

DEPTH FROM SURFACE Ft.	to Ft.	CE-MENT (✓)	BEN-TONITE (✓)	FILL (✓)	FILTER PACK (TYPE/SIZE)
0	52	✓	✓		
52	249				Pea Gravel

ATTACHMENTS (✓)

___ Geologic Log
___ Well Construction Diagram
___ Geophysical Log(s)
___ Soil/Water Chemical Analyses
___ 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 Pulliam Well Exploration
(PERSON, FIRM, OR CORPORATION) (TYPED OR PRINTED)

ADDRESS 5110 Hwy 128 CITY NAPA STATE CA ZIP 94558

Signed [signature] WELL DRILLER/AUTHORIZED REPRESENTATIVE DATE SIGNED 5-25-03 C-57 LICENSE NUMBER 808508

DWR 188 REV. 11-97

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

MEMORANDUM

APPENDIX

GROUNDWATER USE ESTIMATES
BY
APPLIED CIVIL ENGINEERING (ACE)
FOR
WILLIAM COLE WINERY

APPLIED CIVIL ENGINEERING INCORPORATED

William Cole Winery

Groundwater Use Estimate

	Estimated Water Use (Acre-Feet / Year)				
	Existing		Proposed Standard	Proposed Reduced	
Residential Water Use					
Primary Residence	0.000		0.000	0.000	(e) city water
Pool	0.000		0.000	0.000	(e) city water
Second Dwelling Unit - Not Applicable	0.000		0.000	0.000	
Guest Cottage - Not Applicable	0.000		0.000	0.000	
Total Residential Domestic Water Use	0.000		0.000	0.000	
Winery Domestic & Process Water Use					
Winery - Daily Visitors(2)(3)	0.005		0.060	0.060	
Winery - Events with Meals Prepared Onsite(2)(4)	0.000		0.000	0.000	
Winery - Events with Meals Prepared Offsite(2)(5)	0.003		0.006	0.006	
Winery - Employees(2)(6)	0.042		0.134	0.134	
Winery - Event Staff(2)(6)	0.001		0.002	0.002	
Winery - Process(2)(7)(10)	0.430		0.645	0.552	
Total Winery Water Use	0.481		0.848	0.755	
Irrigation Water Use					
Lawn(8)	0.000		0.000	0.000	(e) city water
Other Landscape(9)	0.000		0.000	0.000	(e) city water
Vineyard - Irrigation	0.95		0.95	0.95	
Vineyard - Frost Protection - Not Applicable	0		0	0	
Vineayrd - Heat Protection - Not Applicable	0		0	0	
Total Irrigation Water Use	0.950		0.950	0.950	
Total Combined Water Use	1.43		1.80	1.71	

Estimates per Napa County Water Availability Analysis - Guidance Document, May 12, 2015 unless noted

(1) 0.5 to 0.75 ac-ft/yr for Primary Residence, includes some landscaping per Napa County WAA Guidance Document - On City Wa

(2) See attached Winery Production, Guest, Employee and Event Staff Statistics

(3) 3 gallons of water per guest per Napa County WAA Guidance Document

(4) 15 gallons of water per guest per Napa County WAA - Guidance Document

(5) 5 gallons of water per guest used because all food preparation, dishwashing, etc. to occur offsite

(6) 15 gallons per shift per Napa County WAA - Guidance Document

(7) 2.15 ac-ft per 100,000 gallons wine per Napa County WAA - Guidance Document

(8) 0.1 ac-ft/yr per 1,000 sf of lawn per Napa County WAA - Guidance Document - 3,000 sf +/- estimated - On City Water

(9) 0.1 ac-ft/yr per 2,000 sf landscape per Napa County WAA - Guidance Document - 10,000 sf +/- estimated - On City Water

(10) Reduced water use to 6 gallons per gallon of wine or 1.84 ac-ft per 100,000 gallons wine (14% reduction)

APPLIED
CIVIL ENGINEERING
INCORPORATED

William Cole Winery

Existing Winery Production, Visitor, Employee & Event Staff Statistics

Winery Production(1)		20,000	gallons per year
Tours and Tastings by Appointment(1)			
Sunday through Monday	10 guests average per week		
Total Guests Per Year		520	
Events - Meals Prepared Offsite(1)			
4 per year	15 guests max	60	
3 per year	25 guests max	75	
1 per year	50 guests max	50	
Total Guests Per Year		185	
Events - Meals Prepared Onsite(1)			
0 per year	0 guests max	0	
0 per year	0 guests max	0	
0 per year	0 guests max	0	
Total Guests Per Year		0	
Winery Employees(2)			
2.5 employees	1 shift per day		
Total Employee Shifts Per Year		913	
Event Staff(3)			
4 per year, 15 guests	2 event staff	8	
3 per year, 25 guests	3 event staff	9	
1 per year, 50	5 event staff	5	
Total Event Staff Per Year		22	

(1) Winery production, tours and tasting and event guest statistics per existing Use Permit

(2) Employee counts per existing Use Permit (2 FT + 1 PT)

(3) Assumes 1 event staff per 10 guests (in addition to regular winery employees)

APPLIED CIVIL ENGINEERING INCORPORATED

William Cole Winery

Proposed Winery Production, Visitor, Employee & Event Staff Statistics

Winery Production(1)		30,000	gallons per year
Tours and Tastings by Appointment(1)			
Sunday through Saturaday	125 guests max per week		
Total Guests Per Year		6,500	
Events - Meals Prepared Offsite(1)			
4 per year	15 guests max	60	
3 per year	25 guests max	75	
4 per year	50 guests max	200	
1 per year	75 guests max	75	
Total Guests Per Year		410	
Events - Meals Prepared Onsite(1)			
0 per year	0 guests max	0	
0 per year	0 guests max	0	
0 per year	0 guests max	0	
Total Guests Per Year		0	
Winery Employees(2)			
8 employees	1 shift per day		
Total Employee Shifts Per Year		2,920	
Event Staff(3)			
4 per year, 15 guests	2 event staff	8	
3 per year, 25 guests	3 event staff	9	
4 per year, 50 guests	5 event staff	20	
1 per year, 75 guests	8 event staff	8	
Total Event Staff Per Year		45	

(1) Winery production, tours and tasting and event guest statistics per Winery Use Permit Application

(2) Employee counts per Winery Use Permit Application

(3) Assumes 1 event staff per 10 guests (in addition to regular winery employees)

MEMORANDUM

APPENDIX

SEPTMBER 4, 2019 PUMPING TEST
OF THE NEW WELL
BY
LGS DRILLING, INC.

LGS

LGS DRILLING INC

TO: Chris Wick

Date: 9-4-19 Job No: William Cole Vineyards

WELL ID: New Well	Remarks:	Sheet 1 of 1
GPS: N 38 31 06	Well Depth	Observers SMITH
W 122 29 28	Pump Set	
	Pump HP 3	

TYPE OF TEST
8 hr. Constant Rate

Time of Day	Elapsed Time min.	sec.	Depth to water from R.P. (ft)	Depth below static level. (ft)	Remarks	Observation Well
8:00	0		54.45	0	T= 20,600	39.45
	1		55.55			
	3		56.50			
	5		57.70			
	10		59.75			
	15		60.80			
	30		62.40		T= 21,060	39.45
	45		64.00			
9:00	60		65.50		T= 21,520	
	75		66.75			
	90		67.05			
	105		67.65			
	120		68.40		T = 22,430	39.45
	150		70.00			
11:00	180		71.50		T= 23,340	39.45
	210		72.80			
	240		73.80			
	270		74.60			
	300		75.15		T= 25,165	39.45
	330		75.60			
	360		76.20		T= 26,090	39.45
	390		76.60			
	420		77.00			
	450		77.30			
16:00	480		77.55		T= 27,930	39.45
Recovery	1		73.20			
	2		72.00			
	5		69.05			
	10		67.20			
	15		66.40			
	30		64.70			
	60		62.30			39.45
	90		60.45			
	120		58.70			
	150		56.90			
	180		55.95			