



DRAFT
MEMORANDUM

January 26, 2022

To: Mr. Austin Peterson
3496 Soda Canyon Road
Sent via email (a.peterson100@gmail.com)

Cc: Jim Bushey and Annalee Sanborn
PPI Engineering, Inc. (PPI)
Sent via email (jbushey@ppiengineering.com);
(asanborn@ppiengineering.com)

Job No. 603-NPA02

From: Geza Demeter, Anthony Hicke, and Richard Slade
Richard C. Slade & Associates LLC

Re: Results of Napa County Tier 1 Water Availability Analysis
Peterson Vineyard Development Project
3496 Soda Canyon Road
Soda Canyon Area, Napa County, California

Introduction

Provided herein are the key findings, conclusions, and preliminary recommendations regarding the Water Availability Analysis (WAA) for the Peterson property in Napa County (County), California, as prepared by RCS in conformance with County Tier 1 requirements for a WAA. The Peterson property, known herein as the “subject property,” is located on the east side of Soda Canyon Road, roughly 6 miles north of its intersection with the Silverado Trail. The subject property is comprised by a single parcel with an area of 14.3 acres according to the County Assessor. Figure 1, “Location Map”, shows the boundary of the subject property superimposed on a United States Geological Survey (USGS) topographic map. Property boundaries shown on Figure 1 were adapted from the County Assessor’s parcel data that are freely available from the County GIS website. Also shown on Figure 1 are the locations of the existing, active onsite water well (referred to herein as the “Onsite Well”), two inactive onsite wells, and the locations of known, but nearby offsite wells owned by others. Figure 2, “Aerial Photograph Map”, shows the same property boundaries and well locations 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.

Currently, the subject property contains an abandoned residence and barn, the active Onsite Well, and the two inactive onsite wells. We understand that the proposed project includes the development of 5.3 acres of new vineyards at the subject property. Groundwater pumped from the existing Onsite Well is proposed to be used to meet the irrigation demands of the proposed new vineyards.

DRAFT
MEMORANDUM

As part of the permit submittal for the proposed new vineyard project, a WAA is required by the County. The purpose of this Memorandum is to comply with the 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. Because there are no known offsite wells located with 500 feet (ft) of the Onsite Well (the project well), County requirements for a "Tier 2" WAA analysis (i.e., a Well Interference Evaluation) have been "presumptively met" per the WAA Guidelines. A Tier 3 WAA analysis is also not required for this project. As shown on Table 1 of the WAA Guidance document (pg. 7, WAA, 2015) Tier 3 analyses are not required for projects in "All Other Areas", with the caveat that "Further analysis may be required under CEQA if substantial evidence, in the record, indicates a potentially significant impact may occur from the project." The project is located in an area considered to be "All Other Areas" by the WAA guidelines, and RCS is not aware of any substantial evidence in the record related to groundwater/surface water interaction.

Site Conditions

From our field reconnaissance visit at the subject property on September 16, 2021, the following key items were noted and/or observed (refer to Figures 1 and 2):

- a. The 14.3-acre subject property is comprised of a single parcel, and is located in the Soda Canyon area in Napa County; its County Assessor's Parcel Number (APN) is 032-500-025.
- b. The subject property is undeveloped at this time, and contains an abandoned residence and barn, both of which are no longer in use. Much of the property was observed to be generally undeveloped with a majority of the area covered by native brush and trees.
- c. Topographically, the subject property is relatively flat and generally slopes gently to the southwest towards Soda Canyon Road.
- d. As shown on Figures 1 and 2, the existing active water well and the two inactive wells are located in the northern portion of the property near the abandoned residence. At the time of the September 2021 site visit, the Onsite Well was equipped with a pump, but was not actively pumping at that time. The two inactive, non-functioning wells were also observed to be located adjacent to the abandoned residence. One of the inactive wells was observed to likely have the original pump remaining downhole, but a lack of power hookup and discharge line suggest the well has been unused for a long period of time. The second inactive well was observed to not have a pump installed.
- e. The offsite areas surrounding the subject property consist primarily of naturally vegetated and/or sparsely wooded hillsides and a few existing residences; a few existing vineyards also exist on nearby but offsite properties.
- f. No nearby offsite wells owned by others were directly observed by the RCS groundwater geologist during the September 16, 2021 site visit at the property. However, the property owner reported the existence of two water wells on adjacent properties, and provided an approximate location for these two wells, as shown on Figure 2. Based on the reported locations of these two wells, the existing Onsite Well appears to be greater than 500 ft from either of these two offsite wells.



DRAFT
MEMORANDUM

RCS geologists also reviewed the County Planning, Building, and Environmental Service (PBES) electronic document retrieval website, in an attempt to acquire "Well Completion Reports" (also known as "driller's logs") that might exist for the onsite inactive wells, and for the wells located on those neighboring, but offsite properties. In addition, RCS groundwater 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 additional driller's logs were obtained for wells historically constructed in the area.

Key Construction Data for Existing Onsite Well

A DWR driller's log is available for the Onsite Well (listed as WCR No. e0290728). This driller's log was provided to RCS Geologists by the property owner; a copy of this log is attached hereto. Driller's logs were not recovered for either of the inactive wells on the property from either of the online data sources reviewed by RCS. Table 1, "Summary of Well Construction and Testing Data", provides key well construction data and groundwater airlifting data that was available for the onsite well.

Key data for the existing Onsite Well includes:

- a. This well was drilled and constructed in August 2015 by McLean & Williams, Inc. (M&W) of Napa, California using the direct air rotary drilling method.
- b. The pilot hole depth (the initial borehole drilled before the well casing was placed downhole) was reported to be 435 ft below ground surface (bgs).
- c. The Onsite Well was cased to a total depth of 420 ft bgs with polyvinyl chloride (PVC) well casing having a nominal diameter of 6 inches.
- d. Casing perforations in the Onsite Well are machine-cut slots and have slot opening widths of 0.032 inches (32-slot). Casing perforations in the onsite well were reportedly placed between the depths of: 100 ft and 120 ft bgs; 140 ft and 160 ft bgs; 200 ft and 280 ft bgs; 300 ft and 380 ft bgs; and 400 ft and 420 ft bgs.
- e. The gravel pack material listed on the driller's log for the Onsite Well is described as "pea gravel" and was emplaced from 62 ft to 420 ft bgs; a 5-foot long bentonite seal was emplaced on top of the gravel pack from 57 ft to 62 ft bgs.
- f. The well was reportedly constructed with a sanitary seal consisting of cement (grout) to a depth of 57 ft bgs.
- g. No geophysical electric log survey was performed in the open borehole by the drilling contractor.

Summary of Key Well "Test" Data for Onsite Well

The WCR for the well also provides a brief summary of the original, post-construction "testing" data for the onsite well. These limited "test" data include:

- An initial static water level (SWL) following completion of well construction was reported to be 172 ft bgs on September 3, 2015.



DRAFT
MEMORANDUM

- The reported maximum airlift flow rate during initial post-construction airlifting operation in the Onsite Well was estimated by the driller to be 100 gallons per minute (gpm). As a rule of thumb, RCS groundwater geologists estimate that typical operational pumping rates for a new well equipped with a permanent pump are generally 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 was not (and 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 capacity¹ value for the Onsite Well cannot be calculated from the data on the available driller's log.

Well Data from Site Visit

As discussed above, a site visit to the subject property was performed by an RCS groundwater geologist on September 16, 2021. The following information for the onsite wells was collected from that site visit:

- The Onsite Well was observed to be equipped with a permanent pump, but the well was not being actively pumped at the time of the site visit. A SWL of 172.0 ft brp was measured by the RCS groundwater geologist during this site visit. This SWL is the same as the SWL depth reported on the driller's log for the Onsite Well, immediately after it had been constructed in August 2015.
- A well with a 6-in. outer diameter steel casing was observed to the east of the Onsite Well. This inactive onsite well (referred to herein as the "Inactive Well 1") was observed to be equipped with a permanent pump but it was not pumping at the time of the site visit, again, because the well is not currently used (inactive). An attempt was made by the RCS groundwater geologist to measure the SWL inside the well, but the wellhead entry port was not accessible. No other data are available for this well.
- A second inactive well with a 6-in. outer diameter steel casing was observed to the south of Inactive Well 1. This other inactive onsite well (referred to herein as the "Inactive Well 2") was not equipped with a pump and was capped with a PVC cap. According to the property owner, the well is an old shallow well that had been capped previous to taking ownership of the subject property. No other data are available for this well.
- No totalizer flow dial devices (to measure flow rates and flow volumes) were observed near the wellhead of the Onsite Well, the only active well on the property.

Local Geologic Conditions

Figure 3, "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 3 has been adapted from the results of regional geologic field mapping of the Yountville quadrangle, as published by the California Geological Survey (CGS) in 2005. Key earth materials mapped at

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.



DRAFT
MEMORANDUM

ground surface in the vicinity of the subject property, as shown on Figure 3 include, from geologically youngest to oldest, the following:

- a. Alluvial-type deposits. These geologic materials are shown to exist south of the subject property, but are not exposed within the boundaries of the subject property. In general, these deposits consist of undifferentiated and/or undivided alluvial fan, channel, or terrace materials (map symbols Qha and Qf, on Figure 3) and are typically unconsolidated, consisting of layers and lenses of sand, gravel, silt, and clay.
- b. Sonoma Volcanics (map symbol Tsvasl). The Sonoma Volcanics, as mapped by others, occur as ground surface exposures across the entire property and throughout most of the surrounding area shown on Figure 3. As shown on Figure 3, andesitic lava flows and flow breccias (map symbol Tsvasl) represent the only types of volcanic rocks exposed on and near ground surface at the subject property.

Review of the driller's descriptions of drill cuttings listed on the available WCR for the onsite well revealed that the drilling of this well encountered typical rocks of the Sonoma Volcanics throughout the total drilled depth of the borehole. Typical driller terminology for the drill cuttings on the driller's log included: "multicolor hard volcanic rock;" "volcanic red and brown hard rock;" and "multicolor volcanic hard rock with red rock." Therefore, based on the driller's log, the Sonoma Volcanics are interpreted by RCS geologists to extend to a minimum depth of 420 ft bgs in the vicinity of the onsite well. It is very likely that these volcanic rocks extend to greater depths at this site.

- c. Bedrock. Underlying the volcanic rocks at even greater depths beneath the subject property, and also exposed at ground surface in offsite areas located far northeast of the subject property (not shown on Figure 3) are geologically older, well consolidated to cemented rocks assigned to the Great Valley Sequence. Principal rock types in these geologically older Great Valley Sequence rocks are thick-bedded sandstone, pebble conglomerate, siltstone, and shale. These geologically older rocks that underlie the Sonoma Volcanics are considered to represent the local bedrock.

Local Hydrogeologic Conditions

Earth materials exposed throughout the subject property can generally be classified 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 at and beneath the subject property and its environs are represented by the hard, fractured volcanic flow rocks and volcanic 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



DRAFT
MEMORANDUM

occur in zones of deep weathering between the periods of volcanic events that yielded the various flow rocks.

The amount of groundwater available at a particular drill site for a new well in such hard volcanic flow rocks 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 fractures may have been 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 into the various fracture systems

As stated above, the principal rock types exposed at ground surface on the property and also expected in the subsurface beneath the property are a combination of hard, volcanic flows of andesitic composition and flow breccias that appear to be fractured to varying degrees (Figure 3, map symbol Tsvasl). Descriptions of drill cuttings by the well driller that are recorded on the available driller's log for the Onsite Well are consistent with typical descriptions of the Sonoma Volcanic rocks known to be present in the area. From our long-term experience with the harder flow rocks for numerous other water well construction projects in Napa County, operational pumping rates 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 all geologically older and fine-grained sedimentary and/or crystalline rocks intrusive of the Great Valley Sequence. These rocks underlie the volcanic rocks that exist beneath the subject property and are also exposed directly at ground surface in different directions and at different distances from the subject property. These potentially nonwater-bearing rocks are also interpreted to directly underlie the Sonoma Volcanics at depths greater than 420 ft bgs, as interpreted by RCS from information available on the driller's log for the onsite well, as well as from the experience of RCS with other wells in the area.

In essence, these are diverse rocks that are well-cemented and well-lithified, or crystalline, 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. However, even in areas of abundant fractures, successful 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 constituents.

Geologic Structure

There are no faults² as mapped by others on the subject property or in the immediate vicinity of the property, as shown on Figure 3. Reportedly, there is a single northwest-southeast trending fault mapped by others to exist further to the north of the subject property, which is outside the

² 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



DRAFT
MEMORANDUM

area shown on Figure 3. There can be possible impacts of these faults on groundwater availability in the region. For example, 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. Further, faults can also act as barriers to groundwater flow.

Project Groundwater Demands

For the proposed vineyard project, the Onsite Well is proposed to be used to meet all onsite water demands. Below is a summary of the onsite groundwater demands.

Existing Groundwater Demands

There are currently no existing groundwater demands for the subject property. As previously discussed, there are no existing onsite vineyards, and the abandoned onsite residence and barn are no longer in use (but may be used in the future).

Proposed Groundwater Demands

Groundwater demands for irrigation of the proposed vineyards and possible future residence will be met by pumping groundwater from the project well. Water demand estimates herein are based on values presented for specified land uses provided in Appendix B of the County's WAA Guidance Document (WAA 2015), as follows:

- a) Future residential groundwater demand = 0.75 AF/yr
 - It is possible that the property owner may choose to resume use of the abandoned residence in the future. Therefore, to present a more conservative analysis, the water demands associated with the possible future use of the residence are included herein.
- b) Proposed vineyard irrigation groundwater demand = 2.65 acre-feet per year (AF/yr); this is based on the total proposed vineyard acreage of 5.3 acres and an estimated unit water use of approximately 0.50 AF per acre vine per year (AF/ac/yr) for irrigation.
- c) Total future groundwater demand for the Peterson property = $a + b = 3.4$ AF/yr

No other groundwater demands are proposed for the subject property.

Proposed Pumping Rates

To determine an appropriate pumping rate necessary from the Onsite Well (the project well) to meet the future proposed groundwater demands of 3.4 AF/yr, it was conservatively estimated that groundwater required for vineyard irrigation (2.65 AF/yr) from the project well will be pumped during a 20-week irrigation season each year, and all future domestic (residence) groundwater demands (0.75 AF/yr) will be required (and pumped) year-round (365 days/year). Based on these assumptions, and in order for the project well to meet the groundwater demands for the proposed project, the project well would need to pump at a rate of about 10 gpm. This pumping rate assumes that project well would be pumped on a 50% operational basis (12 hours/day, 7 days/week) during the 20-week irrigation season; the necessary pumping rate would be significantly lower during the non-irrigation season each year because groundwater demands for the remainder of the year are only needed for domestic purposes.

DRAFT
MEMORANDUM

Based on the reported airlifting rate (approximately 100 gpm) reported by the driller at the date the Onsite Well was constructed in 2015, it appears that this well is more than capable of meeting the instantaneous groundwater flow demands required for the proposed vineyard project and possible future residence. RCS geologists estimate that normal operational pumping rates for a new well equipped with a permanent pump are typically on the order of about one-half or less of the airlifting rate reported on a driller's log. Hence, based on the reported airlifting rate, the onsite well is likely capable of pumping at rates as high as 50 gpm.

Rainfall

Long-term rainfall data are essential for estimating the average annual recharge that may occur at the subject 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 a relatively long rainfall record was found to be located approximately 2.1 miles southeast from the subject property. Data for this "Atlas Peak" rain gage are available from the California Data Exchange Center (CDEC) website between Water Year (WY) 1986-87 through WY 2021-22. Note there are several months and/or years of rainfall data missing, such as: between WY 1994-95; WY 1995-96; WY 2004-05; and WY 2006-07. Based on these data, an average water year rainfall for WY 1988-89 through WY 2021-22 at this gage was calculated to be 38.1 inches (3.2 ft). This rain gage is located at an elevation 1,660 feet above mean sea level (ft amsl), which is higher than the elevation of the subject property (between $\pm 1,380$ and $\pm 1,465$ ft amsl), and thus, the average annual water year rainfall at the subject property could be lower than that experienced at this known gage location.

A rain gage with a relatively short rainfall record was found to be located 4.2 miles southwest of the subject property. Data for this "Napa River at Yountville Cross Road" rain gage are available from the Napa OneRain website between WY 2000-01 and WY 2021-22. Based on these data, an average water year rainfall for WY 2000-01 through WY 2021-22 at this gage was calculated to be 28.5 inches (2.4 ft). This rain gage is located at a lower elevation (94 ft amsl) than that of the subject property, and thus, the average annual water year rainfall at the subject property could be higher than that experienced at this known gage location. However, because the period of record for this gage is relatively short (21 years), and about 4 miles from the subject property at a lower elevation, RCS does not consider these data to be representative of the long-term annual average rainfall in the area surrounding the subject property.

Another rain gage with a relatively long rainfall record is the St. Helena rain gage, which is located 11.2 miles northwest from the subject property. Data for this rain gage are available from the Western Regional Climate Center (WRCC) website. For this rain gage, the available period of record is between WY 1907-08 and WY 2021-22. Note that there are several months and/or years of rainfall data missing from this gage, including WY 1979-80 and WY 1987-88. For the available period of record, the average annual rainfall at this St. Helena gage is 32.2 inches (2.7 ft), as reported by the WRCC. Because this rainfall gage is located at an elevation (± 225 ft amsl) that is lower than that of the subject property, the average long-term annual rainfall at the subject property could be higher than that experienced at this known gage location.

To further help define the average annual rainfall data derived from the CDEC, Napa OneRain, and WRCC gages, RCS reviewed the precipitation data published by the PRISM Climate Group at Oregon State University. This dataset, which is freely available from the PRISM website, contains "spatially gridded average annual precipitation at 800m [800-meter] grid cell resolution."



DRAFT
MEMORANDUM

The date range for this dataset includes the climatological period between 1991 and 2020. These gridded data provide an average annual rainfall distributed across Napa County, including the region of the subject property. Using this dataset, RCS determined that the average annual rainfall for the subject property for the stated date range is approximately 38.9 inches (3.2 ft).

An additional, though older, rainfall data source, an isohyetal map (a map showing contours of equal average annual rainfall) was prepared by the County for all of the County and is freely available for download from the online Napa County GIS database. As described in the metadata for the file (also available via the County GIS database), 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 (including the subject property) cannot be readily discerned. The subject property is located within the boundaries of the 35-inch per year rainfall contour on the map. From the 35-inch contour, the next contour interval is 27.5 inches per year to the northeast and 27.5 inches per year to the south. Based on the interpretation of the actual isohyetal contour map (not provided herein) by RCS, the long-term average annual rainfall at the subject property may be on the order of 35 inches (2.9 ft).

Table 2, "Comparison of Rainfall Data Sources", provides a comparison of the data collected from the rainfall sources discussed above. Based on the various rainfall data sources described in Table 2, RCS will conservatively assume that the long-term average annual rainfall at the subject property is 38.9 inches (3.2 ft) as determined using the PRISM data set, as the PRISM data includes a significantly long period of record, includes current data, and is specific to the subject property.

Estimate of Groundwater Recharge

Groundwater recharge on a long-term average annual basis at the subject property can be estimated as a percentage of average rainfall that falls directly on the subject property and becomes available to deep percolate into the local aquifer system(s) 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 surface; 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 rocks of the Sonoma Volcanics, as relied upon by other consultants, government agencies, and by RCS for other projects in the 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 (by calendar year or water year) 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 were presented for a number of watersheds (but not all watersheds) in Napa County in the report titled "Updated Napa County Hydrogeologic Conceptual Model" (LSCE&MBK, 2013) prepared for Napa County. Watershed



DRAFT
MEMORANDUM

boundaries within Napa County are shown on Figures 8-3 and 8-4 in that report (not reproduced herein). Figure 4, "Watershed Boundaries", was prepared for this project using those same watershed boundaries provided by MBK Engineers (MBK), for which watershed water balance data are available in the LSCE&MBK (2013) report. As shown on Figure 4, the subject property is located within the boundaries of the watershed referred to by MBK as the "Napa River Watershed near Napa." As shown on Table 8-9 on page 97 of the referenced report (LSCE&MBK, 2013), 17% of the average annual rainfall that occurs within this named watershed was estimated to be able to deep percolate as groundwater recharge (i.e., the recharge rate). Note that, as shown on Table 8-8 of LSCE&MBK (2013), several sub-watershed areas are tributary to the "Napa River Watershed near Napa." A groundwater recharge estimation by RCS for rainfall percolation in the Sonoma Volcanics on nearby projects located within the "Napa River Watershed near Napa," provided a more conservative 14% estimate for deep percolation for those other projects.

As stated above, the total surface area of the subject property is 14.3 acres. Assuming 38.9 inches (3.2 ft) of rainfall occurs on the subject property on a long-term average annual basis, then the total volume of rainfall that would fall each year directly on the property over the long term would be approximately 45.8 AF/yr (14.3 acres x 3.2 ft). Conservatively assuming that 14% of the average annual rainfall volume would be able to deep percolate to the groundwater within the Sonoma Volcanics that occur directly on and beneath the subject property over the long term, then the average annual groundwater recharge at the subject property would be approximately 6.4 AF/yr (45.8 AF/yr x 14%). This estimated annual recharge volume of 6.4 AF/yr is greater than the total estimated average annual groundwater demand for the proposed project of 3.4 AF/yr.

Estimate of Groundwater in Storage

To help evaluate possible impacts to the local volcanic rock aquifer systems 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:

- a) Approximate surface area of subject property = 14.3 acres
- b) Depth to base of perforations in the Onsite Well = 420 ft bgs; driller's logs for the inactive onsite wells could not be located, therefore, only data from the active Onsite Well can be used to estimate the thickness of currently saturated rocks within the Sonoma Volcanics that exist beneath the property. It is possible that the rocks of the Sonoma Volcanics extend to a much greater depth than that known for the Onsite Well, and thus, the saturated zone beneath the property could extend deeper than is estimated using these data.
- c) To present a conservative calculation of groundwater in storage, we will also assume that the current saturated thickness of the aquifer(s) beneath the subject property is about 248 ft vertical feet. This value is calculated using the Onsite Well data by subtracting the RCS-measured SWL of about 172 ft bgs in this well (on September 16, 2021) from the reported depth to the bottom of the perforations in the well at 420 ft bgs. Based on the water level data presented herein, the September 2021 SWL is similar to the SWL measured for this well after it was completed in September 2015,

DRAFT
MEMORANDUM

and thus, that depth is used herein to provide a conservative calculation of the minimum volume of groundwater currently in storage beneath the property.

- 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 nearby 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) A conservative estimate of the groundwater currently in storage (S), beneath the subject property (as of September 2021) is calculated as:

$S = \text{property area (subpart a, above) times saturated thickness (subpart c, above) times average specific yield (subpart d, above)} = (14.3 \text{ acres})(248 \text{ ft})(2\%) = 70.9 \text{ AF}$

In contrast, the proposed average annual groundwater use for the property is estimated to be 3.4 AF/yr. Hence, the estimated groundwater demand for the entire property represents only about 5% of the groundwater conservatively estimated to currently be in storage in the volcanic rocks beneath the subject property based on water level data for September 2021 and the known depth to the bottom of the perforations in the Onsite Well. Furthermore, this percentage does not include the known annual groundwater recharge that will occur from rainfall into the onsite aquifers. Based on the foregoing, the estimated groundwater demands of the proposed project and the entire subject property should are not expected to cause a net deficit in the volume of groundwater within the aquifer systems beneath the property so as to impact nearby wells to a point that they would not support permitted land uses.

Possible Effects of “Prolonged Drought”

California has experienced a number of periods of extended drought throughout its history. Here, drought is defined as a meteorological drought, that is, a period in which the total annual precipitation is less than the long-term average annual precipitation (DWR 2015). For similar projects in the County, Napa County PBES has asked RCS to consider what the effects on groundwater availability at a particular property might be if a period of “prolonged drought” were to occur in the region, assuming the project were to operate in the future as described herein. Recharge volumes estimated in this document are based on the long-term average rainfall value determined for the subject property using available data. Recall 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, it is the opinion of RCS that the preceding calculations do inherently include consideration of drought year conditions.

However, to help understand what potential conditions might exist in the local volcanic rock aquifers beneath the property during a “prolonged drought period,” a “prolonged drought” must be defined. As discussed by DWR, “there is no universal definition of when a drought begins or



DRAFT
MEMORANDUM

ends, nor is there a state statutory process for defining or declaring drought” (DWR 2015). California’s most significant historical statewide droughts have been defined by DWR as occurring during the following periods (DWR 2015):

- WY 1928-29 through WY1933-34 – six years
- WY 1975-76 through WY 1976-77 – two years
- WY 1986-87 through WY 1991-92 – six years
- WY 2006-07 through WY 2008-09 – three years
- WY 2011-12 through WY 2015-16³ – five years

Since publication of the DWR drought document (2015), WY 2019-20 through WY 2021-22 exhibited below average rainfall totals, and are also considered to have been drought years in the State. As of January 24, 2022, the area of Napa County in which the subject property lies is currently mapped as “Severe Drought” on the NDMC website (NDMC, 2022).

Table 3, “Drought Period Rainfall as Percentage of Average”, shows the average amount of rainfall that occurred during each drought period for which rainfall data exist at the three rain gages discussed above and shown on Table 3; that drought period rainfall amount is also expressed on Table 3 as a percentage of the total rainfall that occurred. As shown on Table 3, determining the amount of rain that might fall during a “prolonged drought” is variable, and depends on the period of record for the specific rain gage. Clearly, WY 2019-20 to WY 2021-22 (the current drought period) recorded the lowest total rainfall at 25% for the St. Helena rain gage (drought period average was 8.0 inches). However, this rain gage is located about 11.2 miles from the subject property and at a much lower elevation (± 225 ft amsl) than the subject property ($\pm 1,400$ ft amsl), and therefore, may not be representative of the actual rainfall amounts that occur at the subject property. Therefore, the WY 2019-20 to WY 2021-22 drought period recorded by the Atlas Peak gage at 47% (drought period average was 17.8 inches, compared to the long-term average 38.1 inches), and which is at a similar elevation ($\pm 1,600$ ft amsl) to the subject property, may be more representative of the rainfall amounts experienced at the subject property during the same time period. It should be noted that data for WY 2021-22 is current as of January 2022, and does not include any rainfall that may occur during the remainder of the water year.

For the purposes of this analysis, a “prolonged” drought period rainfall is conservatively considered to be 47% of the average annual rainfall that occurred in the region (using the rainfall data from the CDEC Atlas Peak rain gage). Further, to again be conservative, a “prolonged drought period” is estimated to last 6 years, which is the longest drought period on record according to DWR (DWR 2015); see Table 3. This six-year period is a quite conservative estimate, because the 47%-average figure corresponds with a three-year drought period, not a six-year drought period.

To meet six consecutive years of groundwater demand for the subject property, a total onsite groundwater extraction of 20.4 AF is estimated to be required (3.4 AF/yr of groundwater demand multiplied by 6 years = 20.4 AF). Assuming groundwater recharge is reduced to 47% of the

³ The DWR 2015 drought document was published in February 2015 and lists the drought that began in water year 2011-12 through the 2013-14 water year only; the drought continued throughout the State into WY 2015-16. Due to the rains in WY 2016-17, various sources, including the National Drought Mitigation Center website (NDMC 2018), declared an end to the drought in Northern California in 2017, which included Napa County.



DRAFT
MEMORANDUM

average annual recharge during each year of such a theoretical “prolonged drought period”, then the resulting total of groundwater recharge that might occur during the six-year drought period for the subject property is calculated as follows:

- As shown herein, a conservative estimate of the average annual groundwater recharge on the subject property is estimated to be 6.4 AF/yr. Taking 47% of this annual volume yields a drought period recharge volume of 3.0 AF/yr.
- Assuming a drought period duration of 6 continuous years, then a total of 18 AF (3.0 AF/yr times 6 years) of water would be available to recharge the volcanic rocks beneath the property by virtue of deep percolation of the direct rainfall that occurs solely within the boundaries of the subject property.

Therefore, assuming a theoretical, extreme, six-year drought period during which only 47% of the average annual rainfall might occur, a conservative estimate of the total drought-period recharge at the subject property (18.0 AF) would be less than the estimate of the total onsite groundwater demand (20.4 AF) that may occur over the same six-year period.

As conservatively estimated above, 70.9 AF of groundwater may currently be in storage within the rocks of the Sonoma Volcanics beneath the property. Hence, the theoretical six-year long drought period groundwater “recharge deficit” of 2.4 AF would represent about 3% of that volume of groundwater in storage. Temporarily removing an average of approximately 0.4 AF (when that deficit is divided by 6 years) of groundwater from storage every year during this 6-year long prolonged, extreme, theoretical drought may cause water levels to decline somewhat beneath the subject property, but removal of such a relatively small percentage of groundwater from storage over an entire 6-year period of time would not be expected to significantly impact groundwater levels beneath the property. Recharge that occurs during periods of average and above-average rainfall would continue to recharge the local aquifer system(s). Again, this theoretical drought analysis is quite conservative, and assumes an extreme drought (47% of average rainfall occurring every year for six consecutive years).

Key Conclusions and Recommendations

1. The existing property is currently undeveloped and contains an abandoned residence and barn, one active water well, and two inactive water wells. There are no current water demands for the property because the older residence and barn are not in use at this time, and there are no existing developed vineyards on the subject property.
2. The proposed project includes the development of 5.3 acres of new onsite vineyards. There is a possibility that the residence could be occupied again in the future, and therefore water use associated with an onsite residence was included as part of the analysis. The irrigation water demand for the vineyards and the future use of the residence are estimated to require 3.4 AF/yr of groundwater annually.
3. The groundwater demand for the proposed new vineyards and the future use of the residence will be met by pumping groundwater from the existing, active Onsite Well.
4. To meet the estimated peak pumping rate for the project each year, the Onsite Well would need to pump at an operational basis of 12 hours per day, every day, and at a rate of about 10 gpm to meet vineyard irrigation and domestic use demands during an assumed 20-week irrigation season each year. During the remainder of the year, when there are

DRAFT
MEMORANDUM

no irrigation demands and only domestic needs are being met, the pumping rate necessary from the well will be much lower. .

5. The reported initial post-construction airlifting rate for the Onsite Well was 100 gpm. As a rule of thumb, actual operational pumping rates may be on the order of roughly one-half of the airlifting rate reported at the date of well construction. Thus, it is possible that the Onsite Well may be capable of pumping at an operational basis of up to 50 gpm. This assumed pumping rate would be much greater than the pumping rate of 10 gpm, which is estimated to be needed from this well to meet onsite groundwater demands.
6. Groundwater recharge at the subject property on a long-term average annual basis is estimated to be 6.4 AF/yr; this value is based on conservative estimates of the average annual rainfall at the property (38.9 inches per year) and conservative estimates of average rainfall that could be available to deep percolate into the fractures and jointed rocks of the Sonoma Volcanics that occur on and beneath the subject property.
7. Conservative estimates of recharge that may occur during a “prolonged drought” show that, over a theoretical six-year period of continuous, extreme drought during which only 47% of the average annual rainfall might occur, a total of 18 AF of rainfall recharge is estimated to occur strictly within the boundaries of the subject property. This theoretical drought period recharge estimate of 18 AF is less than the estimated groundwater demand of the proposed project of 20.4 AF for the same continuous six-year period. In this scenario, about 3% of groundwater currently estimated to be in storage beneath the subject property would be utilized over that entire six-year period of continuous extreme, theoretical drought. Rainfall recharge during years of average and above-average rainfall would then replenish groundwater in storage that is used to meet the groundwater demand of the entire property during this theoretical 6-year-long drought.
8. RCS recommends monitoring, on a regular basis, static and pumping water levels, and also of the instantaneous flow rates and cumulative pumped volumes from the Onsite Well, via the use of a water level pressure transducer and the proper installation of a dual-reading flow meter near the wellhead (that records both flow rate and totalizing values, respectively). 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/or well production in the Onsite Well can be addressed in a timely manner.



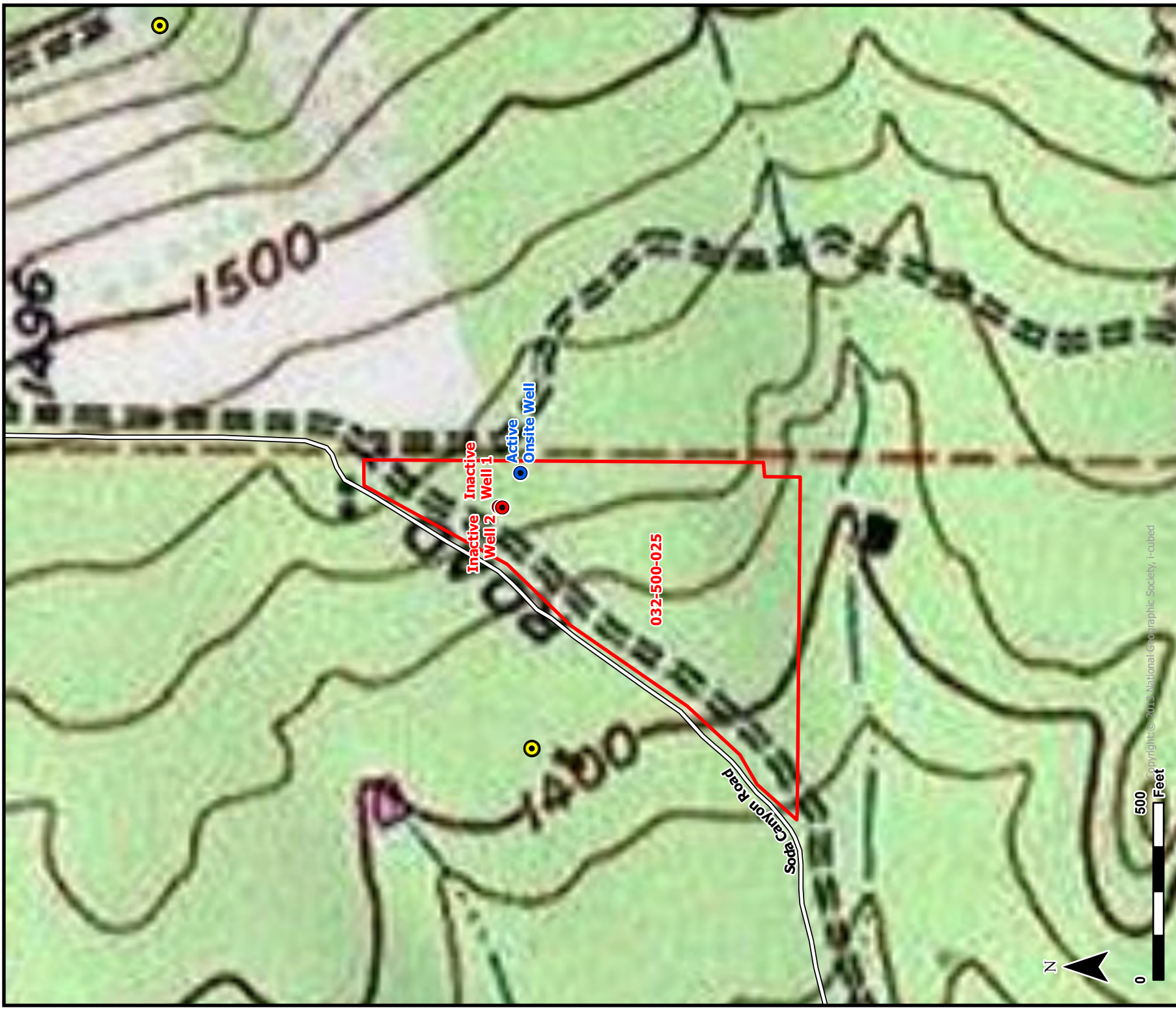
DRAFT
MEMORANDUM

References

- **(CGS 2005)** Bezore, Clahan, et al., 2005. Geologic Map of the Yountville 7.5' Quadrangle, Napa County, California: A Digital Database. California Geological Survey.
- **(DWR 2015)** Jones, Jeanine, et al., February 2015. California's Most Significant Droughts: Comparing Historical and Recent Conditions, California Department of Water Resources
- **(LSCE&MBK 2013)** Luhdorff & Scalmanini Consulting Engineers and MBK Engineers, January 2013. Updated Hydrogeologic Conceptualization and Characterization of Conditions, Prepared for Napa County.
- **(USGS 1960)** Kunkel, F., and J.E. Upson, 1960. Geology and Groundwater in Napa and Sonoma Valleys, Napa and Sonoma Counties, California. USGS Water-Supply Paper 1945.
- **(WAA 2015)** Napa County Board of Supervisors, Adopted May 12, 2015. Water Availability Analysis (WAA) – Guidance Document.

Websites

- California Data Exchange Center, 2022: <https://cdec.water.ca.gov/index.html>
- Napa County Electronic Document Retrieval, 2021; <https://www.countyofnapa.org/2474/Electronic-Document-Retrieval>
- Napa County GIS database, 2021; <https://gis.napa.ca.gov>
- Napa One Rain, 2022; <https://napa.onerain.com>
- National Drought Mitigation Center website, 2022; <https://droughtmonitor.unl.edu/>
- PRISM Climate Group, Oregon State University, 2021; <https://prism.oregonstate.edu>
- Western Regional Climate Center, 2022; <https://www.wrcc.dri.edu>



Subject Property (showing County APN)

DRAFT

Active Onsite Well (Approx.)

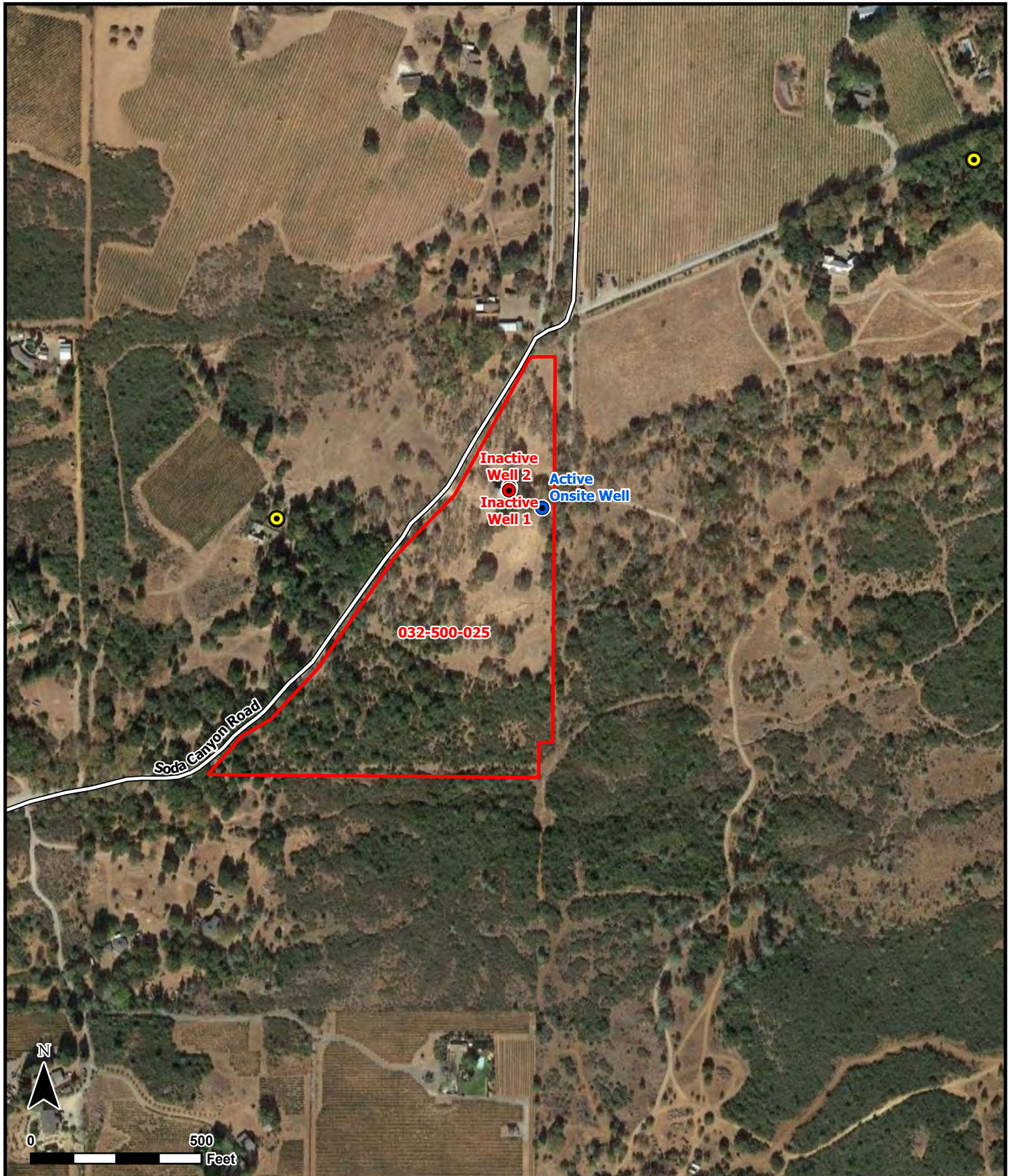
Figure 1

Inactive Onsite Well (Approx.)

Location Map

Offsite Well (Approx.)

LEGEND



LEGEND

- Subject Property (showing County APN)
- Active Onsite Well (Approx.)
- Inactive Onsite Well (Approx.)
- Offsite Well (Approx.)



Figure 2
Aerial Photograph Map

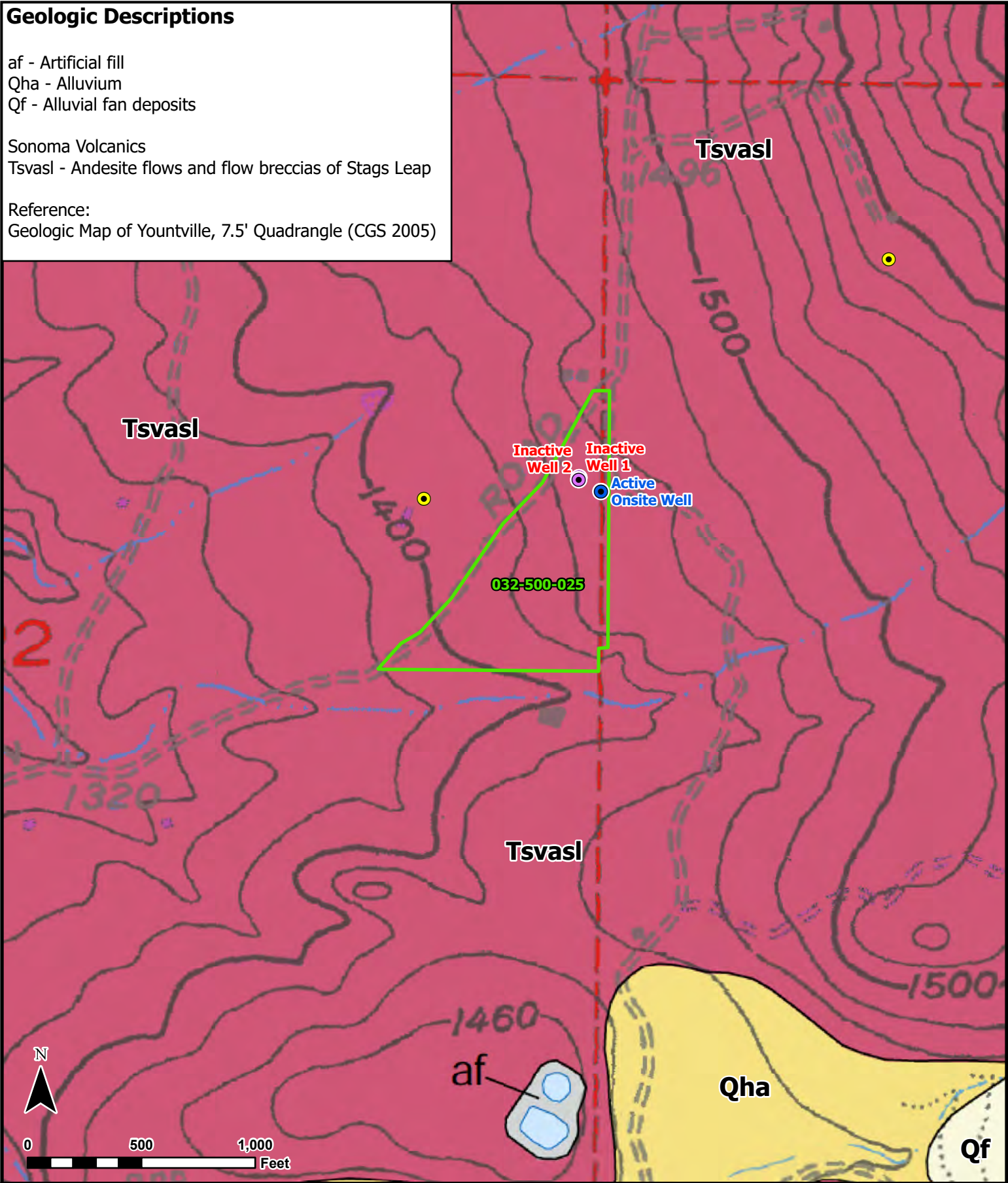
DRAFT

Geologic Descriptions

af - Artificial fill
Qha - Alluvium
Qf - Alluvial fan deposits

Sonoma Volcanics
Tsvasl - Andesite flows and flow breccias of Stags Leap

Reference:
Geologic Map of Yountville, 7.5' Quadrangle (CGS 2005)



LEGEND

- Subject Property (showing County APN)
- Active Onsite Well (Approx.)
- Offsite Well (Approx.)
- Inactive Onsite Well (Approx.)



Figure 3
Geologic Map

DRAFT



Esri, CGIAR, USGS, County of Napa, Yolo County, California State Parks, Esri, HERE, Garmin, SafeGraph, METI/NASA, USGS, Bureau of Land Management, EPA, NPS, USDA

LEGEND



Subject Property



Napa County Watershed Boundary (LSCE&MBK, 2013)



DRAFT

**Figure 4
Watershed Boundaries**

Table 1
Summary of Well Construction and Testing Data
Peterson Vineyard Development Project

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	Current Status of Well
Onsite Well	e0290728	August 2015	Air Rotary	435	420	PVC	6	10	0-57 Cement 57-62 Bentonite	100-120; 140-160; 200-280; 300-380; 400-420	0.032 Machine-Slotted	62-420 Pea Gravel	Active

POST-CONSTRUCTION YIELD DATA

Reported Well Designation	DWR Well Log No.	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)
Onsite Well	e0290728	9/3/2015 Airlift	ND	100	172.0	ND	ND

Notes: ND = No data available
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

Table 2
Comparison of Rainfall Data Sources
Peterson Vineyard Development Project

Rain Gage and/or Data Source	Years of Available Rainfall Record	Average Annual Rainfall in Inches (ft) ⁽¹⁾	Elevation of Rain Gage (ft amsl)	Approximate Distance of Rain Gage from Subject Property (miles)	Rain Gage Elevation Relative to Subject Property ⁽²⁾
CDEC Atlast Peak	WY 1986-87 through WY 2021-22 ⁽³⁾	38.1 (3.2)	1,660	2.1	Higher
Napa OneRain Napa River at Yountville Cross Rd	WY 2000-01 through WY 2021-22 ⁽⁴⁾	28.5 (2.4)	94	4.2	Lower
WRCC St. Helena	WY 1907-08 through WY 2021-22 ⁽⁵⁾	32.2 (2.7)	225	11.2	Lower
PRISM	1991 to 2020	38.9 (3.2)	---	---	---
Napa County Isohyetal Map	1900 to 1960	35.0 (2.9)	---	---	---

Notes:

1. Rainfall totals for WY 2021-22 are current through January 2022.
2. The subject property is located at elevations between ±1,380 and ±1,465 ft amsl
3. Erroneous and/or missing rainfall data in WY 1994-95, WY 1995-96, WY 2004-05, and WY 2006-07.
4. Erroneous and/or missing rainfall data in: WY 1987-88; WY 1994-95; WY 1995-96; WY 2004-05; and WY 2006-07.
5. Erroneous and/or missing rainfall data in: WY1979-80 and WY 1987-88.

ft = feet

amsl = above mean sea level

DRAFT

Table 3
Drought Period Rainfall as Percentage of Average
Peterson Vineyard Development Project

Statewide Drought Period as Defined by DWR/NDMC	Drought Duration (years)	Average Rainfall by Raingage								
		Atlas Peak CDEC			Napa River at Yountville Cross Road Napa OneRain			St. Helena WRCC		
		Period of Record - WY 1986-87 to WY 2021-22			Period of Record - WY 2000-01 to WY 2021-22			Period of Record - WY 1907-08 to WY 2021-22		
		[A] Total Gage Average (in)	[B] Drought Period Ave. (in)	[B/A] Drought Period Rainfall as % of Average	[A] Total Gage Average (in)	[B] Drought Period Average (in)	[B/A] Drought Period Rainfall as % of Average	[A] Total Gage Average (in)	[B] Drought Period Ave. (in)	[B/A] Drought Period Rainfall as % of Average
WY 1928-29 to WY 1933-34	6	ND	ND	ND	ND	ND	ND	32.2	23.9	74%
WY 1975-76 to WY 1976-77	2	ND	ND	ND	ND	ND	ND	32.2	13.4	42%
WY 1986-87 to WY 1991-92	6	38.1	34.9	92%	ND	ND	ND	32.2	21.2*	66%*
WY 2006-07 to WY 2008-09	3	38.1	23.8*	62%*	28.5	22.1	78%	32.2	24.8	77%
WY 2011-12 to WY 2015-16	5	38.1	29.3	77%	28.5	23.6	83%	32.2	21.7	67%
WY 2019-20 to WY 2021-22†	2	38.1	17.8	47%	28.5	15.5	54%	32.2	8.0	25%

Notes:

ND = No rainfall data for corresponding drought period.

* = Raingage data do not extend through entire drought period and/or are missing rainfall data within drought period.

† = WY 2021-22 is current through January 2022.

DRAFT



APPENDIX WELL COMPLETION REPORT

DRAFT

File Original with DWR

State of California

Well Completion Report

Refer to Instruction Pamphlet

No. e0290728

Page _____ of _____

Owner's Well Number _____

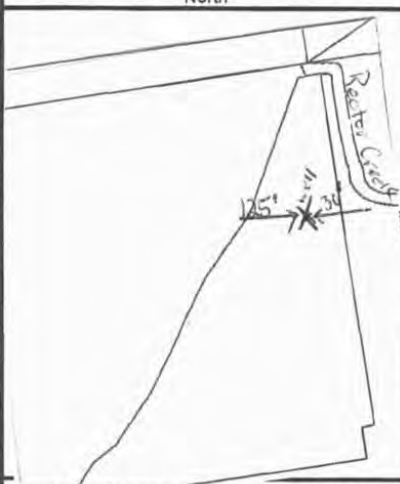
Date Work Began 08/24/2015 Date Work Ended 9/3/2015

Local Permit Agency Napa Planning, Building & Environmental Services

Permit Number E15-00490 Permit Date 6/24/15

DWR Use Only - Do Not Fill In	
State Well Number/Site Number	
Latitude	Longitude
APN/TRS/Other	

Geologic Log			
Orientation ☒ Vertical ☐ Horizontal ☐ Angle Specify _____		Drilling Method _____ Drilling Fluid _____	
Depth from Surface Feet to Feet	Description Describe material, grain size, color, etc		
0	20	Top soil, brown clay, multicolor rock.	
20	60	Multicolor hard volcanic rock.	
60	100	Multicolor soft volcanic rock.	
100	160	Volcanic red and brown hard rock.	
160	240	Multicolor volcanic hard rock	
240	260	Multicolor volcanic hard rock with red rock.	
260	380	Multicolor volcanic hard rock.	
380	435	Multicolor hard rock.	
			
*****CONTINUE CASING LIST*****			
200	280	10	Screen F480 PVC .316 6.625 Mill 0.032
280	300	10	Blank F480 PVC .316 6.625
300	380	10	Screen F480 PVC .316 6.625 Mill 0.032
380	400	10	Blank F480 PVC .316 6.625
400	420	10	Screen F480 PVC .316 6.625 Mill 0.032
Total Depth of Boring <u>435</u> Feet Total Depth of Completed Well <u>420</u> Feet			

Well Owner	
Name <u>Austin Peterson</u>	
Mailing Address <u>1532 Main Street</u>	
City <u>Napa</u> State <u>CA</u> Zip <u>94558</u>	
Well Location	
Address <u>3496 Soda Canyon Road</u>	
City <u>Napa</u> County <u>Napa</u>	
Latitude _____ N Longitude _____ W	
Datum _____ Dec. Lat. _____ Dec. Long. _____	
APN Book <u>032-</u> Page <u>500-</u> Parcel <u>025-000</u>	
Township _____ Range _____ Section _____	
Location Sketch	
(Sketch must be drawn by hand after form is printed.)	
	
Illustrate or describe distance of well from roads, buildings, fences, rivers, etc. and attach a map. Use additional paper if necessary. Please be accurate and complete.	
Activity	
☒ New Well ☐ Modification/Repair ☐ Deepen ☐ Other _____ ☐ Destroy Describe procedures and materials under "GEOLOGIC LOG"	
Planned Uses	
☒ Water Supply ☒ Domestic ☐ Public ☐ Irrigation ☐ Industrial ☐ Cathodic Protection ☐ Dewatering ☐ Heat Exchange ☐ Injection ☐ Monitoring ☐ Remediation ☐ Sparging ☐ Test Well ☐ Vapor Extraction ☐ Other _____	
Water Level and Yield of Completed Well	
Depth to first water <u>170</u> (Feet below surface)	
Depth to Static _____	
Water Level <u>172</u> (Feet) Date Measured <u>09/03/2015</u>	
Estimated Yield * <u>100</u> (GPM) Test Type <u>Air Lift</u>	
Test Length _____ (Hours) Total Drawdown _____ (Feet)	
*May not be representative of a well's long term yield.	

Casings							Annular Material				
Depth from Surface Feet to Feet	Borehole Diameter (Inches)	Type	Material	Wall Thickness (Inches)	Outside Diameter (Inches)	Screen Type	Slot Size if Any (Inches)	Depth from Surface Feet to Feet	Fill	Description	
0	62	10	Blank	F480 PVC	.316	6.625		0	57	Cement	
62	100	10	Blank	F480 PVC	.316	6.625		57	62	Bentonite	
100	120	10	Screen	F480 PVC	.316	6.625	Milled Slots	0.032	62	420	Filter Pack
120	140	10	Blank	F480 PVC	.316	6.625					
140	160	10	Screen	F480 PVC	.316	6.625	Milled Slots	0.032			
160	200	10	Blank	F480 PVC	.316	6.625					

Attachments		Certification Statement	
☐ Geologic Log ☐ Well Construction Diagram ☐ Geophysical Log(s) ☐ Soil/Water Chemical Analyses ☐ Other _____		I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief Name <u>McLean & Williams, Inc.</u> Person, Firm or Corporation <u>878 El Centro Ave.</u> <u>Napa</u> <u>CA</u> <u>94558</u> Address City State Zip Signed <u>[Signature]</u> <u>11-13-2015</u> <u>396352</u> C-57 Licensed Water Well Contractor Date Signed C-57 License Number	