

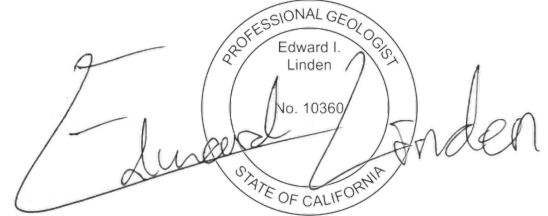


MEMORANDUM

RCS Job No. 824-NPA01

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January 6, 2025

Re: Results of Tier 1 & Tier 2 Water Availability Analyses
Proposed Vineyard Development Project
Hawkins-Damele Ranch
Napa County, CA 94558

Introduction

This Memorandum presents the key findings and conclusions regarding a Water Availability Analysis (WAA) by RCS for a proposed vineyard development project at the Hawkins-Damele Ranch property ("subject property" herein). RCS understands that the proposed project consists of developing a new onsite vineyard at the subject property. This WAA was prepared on behalf of PPI Engineering (PPI), to provide hydrogeologic analyses pertaining to the proposed new vineyard in conformance with current Tier 1, Tier 2, and Tier 3 WAA requirements (Napa County, 2015 & 2024a). The following summarizes the applicability of each WAA Tier to the proposed development:

- A "Tier 1" WAA ("Groundwater Use for Napa County") is required for County-approval of the proposed project because the project is considered discretionary, and groundwater will be used as the water supply for the project (Napa County, 2015 & 2024a).
- A "Tier 2" WAA ("Well & Spring Interference") is required for County-approval of the proposed project because at least two offsite groundwater extraction wells exist within 500 ft of one of the project wells (East Well) (Napa County, 2015 & 2024a).
- A "Tier 3" WAA ("Groundwater / Surface Water Interaction") is not required for County-approval of the proposed project because the project wells are located outside of County-defined 1,500-foot "Significant Stream" buffer areas (Napa County, 2024a; PBES & LSCE, 2023b).

Site Conditions and Project Description

The subject property is located in the hills west of the Napa Valley, at the end of Napanook Road, in Napa County, California. This property is comprised of two contiguous parcels with a total assessed area of 120 acres¹. The constituent parcels are identified by County Assessor's Parcel Number (APN) 034-030-029 and 034-030-030. Figure 1, "Regional Map", shows the approximate

¹ Assessed area per Napa County (2024b).



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boundary of the subject property; Napa County's "Significant Streams" and "Significant Streams" 1,500-foot buffer areas (PBES & LSCE, 2023a & b); local watersheds tributary to the Napa River (LSCE & MBK, 2013); and the boundaries of the local groundwater basin (DWR, 2021). The property is located outside of the local groundwater basin, known as the Napa Valley Subbasin of the Napa-Sonoma Valley Groundwater Basin. Review of watershed boundary data shown on Figure 1 reveals that the subject property is partially located within the LSCE & MBK's Dry Creek Watershed, and wholly within LSCE & MBK's (2013) Napa River Watershed near Napa.

Several of the data that are shown on Figure 1 are also shown on Figure 2, "Property Map", and Figure 3, "Geologic Map", but additional data are also shown, depending on the Figure. The additional data include the locations of the onsite wells and the approximate locations of nearby offsite wells and springs that are either known to exist or may possibly exist. The locations of the known and possible offsite water sources shown on the Figures herein were approximated by RCS based on data collected during a site visit to the property by an RCS geologist, on records retrieved from the County's Electronic Document Retrieval website (PBES, 2024), and on RCS's prior work on other properties in the area. The records retrieved from Napa County consisted of various documents including State Well Completion Reports (WCRs, also known as "driller's logs") and drilling permits for wells that were reportedly drilled in the area. The locations of known and possible offsite wells and springs shown on the Figures herein should not be considered an exhaustive representation of offsite water sources; other offsite water sources may also exist in the area, the actual locations of one or more of the offsite water sources may be different than shown herein, and one or more of those offsite water sources may no longer exist at all.

Two onsite springs used for water supply purposes exist within the boundaries of the subject property. Additional documentation retrieved from PBES for a neighboring parcel to the southeast of the subject property indicated the existence of an offsite spring that may have historically been used for water supply purposes. However, accurate location information was not available for that spring, so it could only be approximated with parcel-level accuracy (see "Spring – Center of Parcel – Used for Water Supply" on Figures 2 and 3). Review of geologic map patterns, available satellite imagery of the area, and the higher-accuracy spring locations on Figure 3 suggests that the possible spring in question (if it indeed exists) is not within 1,500 feet of the project wells.

Note that the location of one of the project wells (the easternmost well) is less than 500 feet from two offsite wells owned by others (see Figure 2). To aid in review of the proximity of offsite water sources to the project wells, 500-foot and 1,500-foot buffer rings are shown on Figure 2; these rings correspond with the 500-foot and 1,500-foot setback distances defined for Tier 2 WAA screening by Napa County (2015 & 2024a).

Based on communications with and data provided by PPI, and based on the findings of an August 7, 2024, visit by an RCS geologist to the subject property, the following key items were noted and/or observed:

- The proposed project consists of development of 8 acres of new vineyard at the subject property.
- Water-using developments that currently exist at the subject property consist of two residences and a pool; no other significant water uses are known to exist onsite.
- Two water-supply wells (East Well and West Well) and two developed springs exist onsite.



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- During the August 2024 site visit, the RCS geologist traveled along roads in the immediate vicinity of the subject property to identify nearby offsite wells. RCS refers to such work as a “windshield survey”. During this survey, the RCS geologist attempted to identify the locations of possible offsite wells by looking for well-house enclosures, pressure tanks, storage tanks, power lines, or by making direct observations of wellheads.

Key Construction and Testing Data for Onsite Wells

California Department of Water Resources (DWR) Well Completion Reports (WCRs) are available for each of the onsite Wells: East Well is described on WCR No. 822301 and West Well is described on WCR No. 462601. These WCRs were acquired from the DWR Well Completion Report Map Application (2024) and Napa County PBES records (2024). The WCRs for these wells are included in the Appendix to this Memorandum.

Well Construction Data – West Well

Key data reported on the WCR of West Well (No. 462601) include the following:

- West Well was constructed in July 1993 by Pulliam Well Drilling (Pulliam), of Napa, CA, and was drilled using the mud-rotary method.
- The pilot borehole depth of West Well was 219 feet (ft) below ground surface (bgs).
- West Well was constructed with 5-inch diameter PVC well casing, set to a total depth of 219 ft bgs.
- Casing perforations in West Well consist of 0.032-inch slotted apertures that were placed continuously within the depth interval of 120 to 219 ft bgs.
- West Well was constructed with a 25-ft deep cement sanitary seal.

Summary of Key Post-Construction “Test” Data for West Well

The WCR for West Well provides the initial, post-construction airlift data for this well, including the following:

- On July 26, 1993, following construction of West Well, an initial static water level (SWL) of 120 ft bgs was measured by Pulliam.
- The maximum flow rate estimated by Pulliam during the initial post-construction airlifting² procedure for West Well was 15 gallons per minute (gpm), after a 2-hour period of airlifting.

Well Construction Data – East Well

Key data reported on the WCR of East Well (No. 822301) include the following:

- East Well was constructed in October 1999 by D Bess Well & Pump (Bess), of Napa, CA, and was drilled using the air-rotary method.
- The depth of the pilot borehole for East Well was 400 ft bgs.

² As a rule of thumb, RCS geologists estimate the operational pumping rate for a new well equipped with a permanent pump to typically be on the order of only one-half (or less) of the initial post-construction airlift rate reported on a driller's log.



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- The casing of East Well is comprised of 5-inch diameter PVC well casing, set to a total depth of 400 ft bgs.
- Casing perforations in East Well consist of 0.032-inch slotted apertures that were placed continuously between the depths of 300 ft bgs and 400 ft bgs.
- East Well was constructed with a cement sanitary seal set to a depth of 23 ft bgs.

Summary of Key Post-Construction "Test" Data for East Well

The WCR for East Well provides the initial, post-construction airlift data for this well, including the following:

- A SWL depth was not reported, but a 300 ft bgs "depth to first water" was reported.
- The maximum flow rate during the initial post-construction airlifting procedure for East Well was estimated by Bess to be "60+ gpm" after a 2-hour airlifting period.

June 2024 Pumping Test Data

On June 26, 2024, 4-hour pumping tests were performed in both of the onsite wells by Ray's Well Testing Service (RWTS) of Sebastopol, CA. The pumping test of West Well began at 10:35 am, followed by initiation of the pumping test of East Well at 10:40 am. Thus, the onsite wells were simultaneously pumping during nearly the entire duration of these pumping tests. Key data available reported by RWTS for these pumping tests include the following:

- West Well
 - A pre-test SWL of 90 ft brp was recorded by RWTS.
 - At the end of the pumping period, RWTS reported a final flow rate of 10.8 gpm and a final PWL of 203.9 ft brp.
 - The final water level drawdown at the end of the pumping test was 113.9 ft.
 - Based on these values, the short-term specific capacity³ at the end of this pumping test was 0.09 gpm/ft.
 - A single water level recovery measurement was reported by RWTS, obtained 20 minutes after the end of the 4-hour pumping period. That measurement indicated that 88.4 ft of recovery had already occurred, or 78% recovery relative to the pre-test SWL, within 20 minutes of the pump being shut off. Although this water level recovery measured in West Well was slower than that of East Well, RCS still considers 78% recovery within 20 minutes to be rapid.
- East Well
 - A pre-test SWL of 317 ft brp was recorded by RWTS.
 - A flow rate of 24 gpm was reported at the end of the pumping period, along with a PWL of 317.8 ft brp. Pumping water levels were quite stable during the 4-hour pumping period, during which they decreased by only 0.1 ft.
 - The final water level drawdown at the end of the pumping period was 0.8 ft, resulting in a short-term specific capacity of 30 gpm/ft ddn.

³ Specific capacity, in gallons per minute of 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 (ft ddn) created in the well at that rate.



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- Nearly complete water level recovery occurred almost immediately after the pump was shut off, with water levels returning fully to the pre-test SWL depth within 20 minutes of the cessation of pumping.

Despite the simultaneous operation of the subject wells for essentially the entire pumping duration of the tests, significant well-to-well interference between these wells did not appear to occur, as evidenced by the minimal drawdown that occurred in East Well.

Well Data from RCS Site Visit

During the site visit on August 7, 2024, the RCS geologist measured the water level in each of the onsite wells, as follows:

- West Well water level: 100.2 ft brp (SWL).
 - The RCS-measured SWL is deeper than the SWL measured by RWTS in June 2024 for this well (90 ft brp), but shallower than the 1993 initial post-construction SWL reported for this well (120 ft brp).
- East Well water level: 323.7 ft brp (partially recovered).
 - The RCS geologist that made this measurement noted that the well was slowly recovering at the time of the measurement; this measurement should therefore not be considered a SWL. However, the last time that the well was pumped is not known.
 - The RCS-measured water level is deeper than the SWL for this well measured by RWTS in June 2024 (317 ft brp).

Local Geologic Conditions

Figure 3, "Geologic Map", depicts the types, lateral extents, and boundaries between the various earth materials and geologic structures mapped at ground surface by others near the subject property, as adapted by RCS from regional geologic field mapping available from the California Geological Survey (Wagner & Gutierrez, 2017). The key earth materials mapped at ground surface at and proximal to the subject property include the following, from geologically youngest to oldest:

Recent Sedimentary Deposits (map symbols Qhc, Qht, and Qls)

Stream channel deposits (Qhc), stream terrace deposits (Qht), and landslide deposits (Qls) have been mapped by others within the view of Figure 3. These recent (Holocene and Pleistocene) sedimentary deposits are typically comprised of various unconsolidated to poorly consolidated layers and lenses of clastic (granular) materials that include sands, silts, clays, and gravels, occasionally with some larger clasts. However, no recent sedimentary deposits are shown by Wagner & Gutierrez (2017) to be within the boundary of the subject property. Due to the location of these sediments, they will not contribute any groundwater directly to the project wells and are therefore not discussed further herein.

Sonoma Volcanics (map symbols Psvbsl and Psvdq)

According to Wagner & Gutierrez (2017), the earth materials that belong to the Sonoma Volcanics within the visible extent of Figure 3 are Pliocene-aged (5.3 to 2.6 million years ago [mya]). The specific units belonging to the Sonoma Volcanics within the view of Figure 3 include the Andesite



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Flow Breccia of Stags Leap Volcanic Center (Psvbsl) and the Dacite of Mt. George (Psvdg). However, within the boundary of the subject property, the only unit of the Sonoma Volcanics mapped at ground surface is Psvbsl, located in the eastern half of the property.

RCS's interpretation of the driller-reported descriptions of the earth materials encountered in the borehole of East Well suggests that the rocks beneath that portion of the subject property are likely rocks of the Sonoma Volcanics, which agrees with the map patterns in Wagner & Guitierrez. The maximum thickness of the Sonoma Volcanics beneath the eastern portion of subject property is thus at least 400 feet (the maximum depth of the borehole at East Well). The rocks of the Sonoma Volcanics are thus expected to provide the exclusive supply of groundwater to East Well.

RCS considers the Sonoma Volcanics to be the principal water-bearing materials beneath the subject property and its immediate environs. As discussed above, the earth materials of the Sonoma Volcanics beneath the subject property are comprised of the Andesite Flow Breccia of Stags Leap Volcanic Center (Psvbsl). These earth materials tend to produce more groundwater when and where they are hard and highly fractured, and/or deeply weathered. Where such zones occur, rocks like these are considered the main potentially water-bearing units in the region.

Geologically Ancient Rocks (map symbols Kgv and KJfm)

The ground surface of the western portion of the subject property has been mapped by others as geologically ancient (Cretaceous- and Jurassic-aged; at least several tens of millions of years old) rocks that comprise the regional basement rock. These rocks belong to complex assemblages of earth materials known as the Great Valley Sequence (Kgv) and the Franciscan Complex mélange (KJfm). These regional basement rocks are generally considered to be non-water bearing, but they can produce limited amounts of groundwater in certain areas. These geologic units are considered to be the main source of groundwater to West Well, based on RCS's interpretations of the earth materials encountered in the borehole of West Well and on the map patterns shown on Figure 3.

The driller-reported descriptions of the earth materials encountered in the borehole of West Well include volcanic ash and black volcanic rock down to 190 ft. Those descriptions appear to be contrary to the geologic mapping at the location of West Well. However, the KJfm geologic unit (a mélange) can contain metamorphosed volcanic rocks (such as greenstone) that can be confused for younger volcanic materials. RCS suspects that the discrepancy in earth materials is the result of generalized driller descriptions of the drill cuttings. Also, the geologic map was generally corroborated by field observations by the RCS geologist during the site visit. From 190 ft to 219 ft (the maximum depth of the West Well borehole), materials that are likely representative of KJfm were reported on the WCR.

Geologic Structure

Four faults⁴ have been mapped by others at ground surface within the view of Figure 3, according to data in Wagner & Gutierrez (2017). These geologic structures are depicted as thick, black lines that are dashed where their location is approximate, and as dotted lines where their location is concealed. Two faults traverse the middle of the subject property along a roughly northwest trend, passing through the property on either side of East Well. Another fault traverses the northeast corner of the map view, but it is not mapped as occurring within the boundary of the subject

⁴ The RCS scope of services for the subject property does not include any efforts to define or determine local seismicity; to define or determine the potential activity of any faults in the region; or to define or determine the potential for fault rupture.



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property. Another fault curves through the southwest portion of the property along a roughly northwest trend, passing south of West Well.

Faults can serve to increase the frequency and degree of fracturing in the local earth materials, including those known to occur in the Sonoma Volcanics and the regional basement rocks. Whenever and wherever such faults occur, they are thought to increase the amount of open area in the rock fractures which, in turn, could increase the capacity of the local earth materials to store and transmit groundwater. Conversely, faults can also act as barriers to groundwater flow and can even act as conduits for hydrothermal fluids that can produce deleterious effects on groundwater quality. It is not known if the faults mapped on Figure 3 have any influence on groundwater flow (e.g., act as groundwater flow barriers) due to a lack of requisite data necessary for RCS to make such a determination.

Local Groundwater Basin

Groundwater basin boundaries in California have been defined and designated by the State Department of Water Resources (DWR) in Bulletin 118, "California's Groundwater" (DWR, 2021); a version of those data were used to define groundwater basin boundaries for the purposes of Groundwater Sustainability Plan (GSP) preparation (LSCE, 2022). Figure 1 shows that the entire subject property is outside of the boundaries of the local groundwater basin, the Napa Valley Subbasin of the Napa-Sonoma Valley Groundwater Basin (DWR, 2021).

Water Demands

Existing and Future onsite water demands have been estimated based on information and assumptions provided by the property owner and/or the project engineer (PPI) and based on assumptions derived from the 2015 Napa County WAA guidance document.

Existing Water Demands

According to PPI, the existing water-using developments on the subject property consist of two residences and a pool. Historic water use data are unavailable, so these demands have been estimated by PPI and are assumed to consist of the following:

- a. Residential Demand = 0.98 acre-feet⁵ per year (AFY).
 - Estimated based on demands from the primary residence with minor to moderate landscaping (0.63 AFY) and a secondary residence (0.35 AFY).
- b. Pool (uncovered) = 0.1 AFY

Overall Existing Groundwater Demands:

$$\underline{a. + b. = 0.98 + 0.1 \text{ AFY} \approx 1.1 \text{ AFY}}$$

Existing onsite water demands are thus estimated to average roughly 1.1 AFY, based on the estimates and assumptions presented above. These demands have reportedly been met by groundwater supplied by West Well.

⁵ 1 acre-foot (AF) = 325,851 gallons



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Proposed Water Demands

Future onsite water demands, including those for the future demands of the proposed new vineyard development, will be met by groundwater and were estimated by PPI as follows:

- a. Residential Demand = 0.98 AFY (no change in volume)
- b. Pool (uncovered) = 0.1 AFY (no change in volume)
- c. Vineyard Demand = 5.6 AFY
 - Vineyard irrigation of 8.0 acres of vines is anticipated to require approximately 0.5 AFY/acre of vines, for a total of 4.0 AFY.
 - Heat protection for the vineyard is anticipated to require approximately 0.2 AFY/acre of vineyard, for a total of 1.6 AFY.

Overall Proposed Groundwater Demands:
a. + b. + c. = 0.98 + 0.1 + 5.6 AFY ≈ 6.7 AFY

Proposed onsite water demands are therefore estimated to be approximately 6.7 AFY and are proposed to be met solely using groundwater pumped from East Well and/or West Well.

Proposed Pumping Rates

Project Wells

To estimate the pumping rate that would be required from the project wells to meet the demands described above, the following assumptions and calculations were made:

- Groundwater pumping for vineyard demands (i.e., irrigation and heat/frost protection) (5.6 AFY) will occur on a daily basis during a theoretical 20-week irrigation season (140 days/year), for twelve hours per day (720 minutes/day).

Required Pumping Rate for Vineyard Demands

$$= 5.6 \text{ AFY} \times \frac{325,851 \text{ gallons}}{\text{AF}} \times \frac{\text{year}}{140 \text{ days}} \times \frac{\text{day}}{720 \text{ minutes}} \approx 18.1 \text{ gpm}$$

- Groundwater pumping for residential demands and the pool (1.1 AFY) will occur on a daily basis throughout the year (365 days/year), for twelve hours per day (720 minutes/day).

Required Pumping Rate for Residential & Pool Demands

$$= 1.1 \text{ AFY} \times \frac{325,851 \text{ gallons}}{\text{AF}} \times \frac{\text{year}}{365 \text{ days}} \times \frac{\text{day}}{720 \text{ minutes}} \approx 1.4 \text{ gpm}$$

The highest combined overall pumping rate required from the project wells to meet the demands that they are proposed to supply would occur during the vineyard irrigation season, on the days when pumping for both residential and vineyard demands is necessary. The combined pumping rate required to meet those demands is estimated to be approximately 19.5 gpm.

As demonstrated by the June 2024 pumping tests described above, East Well is capable of producing groundwater at a rate of 24 gpm and West Well is capable of producing groundwater at a rate of 10.8 gpm, for a combined rate of 34.8 gpm. The combined pumping rate available



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from East Well and West Well (34.8 gpm) is considerably higher than the 19.5 gpm pumping rate required to meet the groundwater demands that are projected to be supplied by the project wells following vineyard development. Therefore, the project wells can provide a more-than-sufficient pumping rate capacity for the future demands that they are proposed to supply. In addition, based on the pumping test data, East Well alone is capable of providing the necessary groundwater for the proposed future uses.

WAA Tier 1: "Groundwater Use for Napa County"

Napa County promulgated revised guidelines⁶ for WAA preparation with respect to groundwater recharge calculations in response to gubernatorial Executive Order N-7-22 (Napa County, 2022a). For projects that require a WAA and are located outside of the Napa Valley Subbasin of the Napa-Sonoma Valley Groundwater Basin (DWR, 2021), the County requires a calculation of parcel-specific groundwater recharge to determine allowable groundwater usage. Current Napa County requirements (2024a) also require that parcel-specific groundwater recharge estimates presented in WAAs for projects outside of the Napa Valley Subbasin consider "average rainfall" to be the average annual rainfall defined in the County's 10-year average precipitation dataset (PBES & LSCE, 2022).

Property-Specific Precipitation

Spatial analysis of the County's 10-year average rainfall data set (PBES & LSCE, 2022) shows that the area-weighted average annual rainfall for the 10-water-year period of 2012 to 2021 at the subject parcels is 2.54 ft. Multiplying this average by the 120-acre assessed area of the subject property results in a total of 304.80 AFY. This value is the average volume of rainfall that the subject property receives each water year, per the County's current 10-year average methodology, but it does not consider either the deep percolation rate at the subject property or the effect of slope on deep percolation.

Property-Specific Groundwater Recharge

Groundwater recharge on a long-term average annual basis on the subject parcels can be estimated as a percentage of the average rainfall that falls on the parcels and subsequently undergoes deep percolation, ultimately entering the local aquifer system beneath the ground surface. The actual percentage of rainfall that undergoes deep percolation is a function of numerous local and regional factors, including ground surface slope; soil type; ground cover; evapotranspiration; and the frequency, intensity, and duration of rainfall, among other possible factors.

Estimates of groundwater recharge as a percentage of rainfall were presented for several watersheds that are tributary to the Napa River in LSCE & MBK (2013). A local subset of those watersheds is shown on Figure 1 of this Memorandum. A portion of the subject property is located within the "Dry Creek Watershed", whereas the entire property is located within the "Napa River Watershed near Napa". As noted above, the Dry Creek Watershed is entirely contained by the Napa River Watershed near Napa. On Table 8-10 of LSCE & MBK (2013), referred to thereon as "Recharge (% of Precip.)", the deep percolation rate as a percentage of rainfall for the Napa River Watershed near Napa is 17%, whereas the deep percolation rate for the Dry Creek Watershed is only 6%. To present a more conservative analysis for the purposes of this Tier 1

⁶ A "prolonged drought analysis" is no longer required for WAA preparation due to the required use of the 10-year annual rainfall average or the unit groundwater use of 0.3 AFY/ac (Napa, 2022b).



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WAA, the lower deep percolation rate of 6% for the Dry Creek Watershed was selected and assumed for the entire subject property.

Multiplication of the 6% groundwater recharge rate in LSCE & MBK (2013) with the average volume of rainfall that the subject property receives each water year (304.80 AFY) results in a property-specific average groundwater recharge rate of 18.29 AFY, by the County's current 10-year precipitation average methodology. This calculation does not consider the effect that ground surface slope might have on groundwater recharge rate.

Effect of Slope on Groundwater Recharge Rate

Any estimate of the percentage of rainfall that enters an aquifer system via deep percolation that relies on estimates of rainfall, evapotranspiration, and surface water outflow for an entire watershed, such as the estimates provided by LSCE & MBK (2013), inherently includes the effects of ground surface slope. To provide a more site-specific estimate of the potential effects of ground surface slope on groundwater recharge at the subject property, a ground surface slope analysis is provided below.

Many basic geologic references assume that recharge potential is reduced on steeper slopes because steeper slopes tend to increase surface water runoff rates and less time is therefore available for rainfall to percolate deeply into the subsurface before running off as surface flow. Page 56 of LSCE & MBK (2013) asserts that deep percolation recharge from rainfall is "significantly reduced" for land areas with slopes angles (inclinations) $>30^{\circ}$. On page 11 of LSCE & MBK (2013), an assessment of slope angles $>30^{\circ}$ is also mentioned, and this was attributed to a prior LSCE report, namely "LSCE 2011" therein; that document is likely to be the reference listed as "2011a" on page 134 of LSCE & MBK (2013). LSCE (2011) states on page 29 that "areas in which the slope of the land surface exceeds 30 degrees, beyond which recharge potential is significantly reduced." No other references or data are presented in either of the above-referenced documents to quantify the qualitative description of "significantly reduced". Because the various factors that affect groundwater recharge are likely interrelated (Yeh et al., 2009), assigning a value to define the amount that recharge is diminished as a function of slope is extremely difficult. No references were reviewed by RCS that quantify the possible reduction of deep percolation that might occur as a function of ground surface slope angle.

Spatial analysis of a U.S. Geological Survey (USGS) digital elevation model (2020) reveals that 16.2% of the ground surface of the subject property is sloped in excess of 30° . Therefore, an adjustment to the parcel-specific average groundwater recharge rate of 18.29 AFY is needed to account for the steeply sloped areas of the property. Reduction of the property area available for groundwater recharge by 16.2%, and therefore reduction of the average recharge rate by that same percentage, results in a recharge rate for the subject property of 15.33 AFY.

In accordance with current Napa County guidelines (2015 & 2024a) and based on the conservative analyses presented above, average annual groundwater recharge on the subject property is 15.33 AFY. This conservative estimate of groundwater recharge is greater than the 6.7 AFY future groundwater extractions proposed for the subject property. The Tier 1 WAA conditions are thus satisfied for the future groundwater uses proposed at the subject property (i.e., new vineyard development, existing residences, and existing pool), because the estimated average annual groundwater recharge on the subject property is greater than total proposed groundwater extractions from the onsite wells (6.7 AFY).



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Tier 2 WAA – Review of Possible “Well & Spring Interference”

A Tier 2 WAA is necessary for the proposed vineyard development project because two offsite wells owned by others are located within 500 ft of East Well (a project well). These offsite wells are located approximately 370 ft and 490 ft northwest of East Well; the offsite wells are shown on Figure 2 as yellow dots inside the yellow and black ring surrounding East Well. The locations for these offsite wells were ascertained primarily from RCS's site visit to the subject property, and also from prior RCS work in the region, but WCRs for these wells were not discovered amongst Napa County PBES records. Thus, the construction details for these offsite wells were not available for inclusion in this Memorandum. No water level data were available to RCS for the offsite wells.

Water level drawdown in an aquifer (or aquifers) that is caused by pumping of a well is, with few exceptions that are not applicable to the project site, greatest near the pumping well. The region of water level drawdown surrounding a pumping well is typically referred to by hydrogeologists as a water level “cone of depression”. Within the cone of depression, water level drawdown resulting from the pumping well located at the center of the cone tends to decrease with distance from the pumping well, eventually becoming immeasurably small as distance increases. Water level drawdown in the two neighboring offsite wells to the northwest of East Well that theoretically could be induced by pumping of East Well, if any, would therefore be less than the drawdown measured in East Well. As described above, the June 2024 pumping test of East Well resulted in only 0.8 ft of drawdown in East Well after a 4-hour pumping period, with a final pumping rate of 24 gpm. Therefore, as is the nature of water level drawdown due to pumping (described above), the drawdown in any nearby wells induced by pumping of East Well, such as the two neighboring wells to the northwest of East Well, would be less than 0.8 ft when East well is pumped at that rate and duration.

As observed in the RWTS data table, water levels during the pumping test declined to a stable pumping level almost immediately, and remained virtually unchanged during the pumping test, declining by only 0.1 ft during the pumping period. In general, the rate of water level decline in a well during a continuous pumping period of that well decreases as the pumping duration increases. Therefore, based on the RWTS pumping test data, it can be surmised that longer pumping durations in East Well would likely yield final water level drawdowns of only slightly more than 0.8 ft.

According to the “Default Well Interference Criteria” shown on Table F 1 of the WAA Guidelines (Napa County, 2015), drawdown for neighboring wells with casing diameters of six inches or less can be up to 10 ft before it is considered “significant”, whereas allowable drawdown in wells with casing diameters of greater than 6 inches can be up to 15 ft. The construction details of the two nearby offsite wells are not available for this Memorandum, so the more restrictive 10-ft drawdown criterion has been assumed for this Tier 2 WAA. The discussion regarding “cone of depression” above demonstrates that any drawdown that might be caused in the neighboring offsite wells (i.e., less than 0.8 ft) as a result of pumping of East Well is not considered significant because it does not exceed the 10-ft drawdown criterion defined in the “Default Well Interference Criteria” shown on Table F 1 of the 2015 Napa County WAA Guidelines. Therefore, The Tier 2 WAA requirements are satisfied for the proposed vineyard development project.



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WAA Tier 3 – Review of Possible “Groundwater/Surface Water Interaction”

Napa County has defined the rivers, streams, and creeks within the County that are considered “significant” for the purposes of Tier 3 WAA review. These “Significant Streams” are defined in GIS data available from a County GIS data source, where they are referred to as “Significant Streams” and “Significant Streams_1500ft_Buffer” (PBES & LSCE, 2023a & b). According to the County’s updates to WAA requirements (Napa County, 2024a), a Tier 3 WAA is required if a project well is located within 1,500 ft of a Significant Stream.

Figures 1 and 2 show the spatial relationship between the subject property and the nearby Significant Streams 1,500-ft buffer areas, demonstrating that although some of the subject property is within a Significant Streams 1,500-ft buffer area, the locations of the project wells are not within any Significant Streams 1,500-ft buffer areas. The Tier 3 requirements for the proposed vineyard development are therefore presumptively met, and a Tier 3 WAA is not required for the proposed vineyard project (Napa County, 2015 & 2024a).

Key Conclusions and Recommendations

1. The proposed project consists of the development of a new vineyard on the subject property.
2. Existing demands on the subject property consist of two residences and a pool and are met entirely by groundwater provided by West Well. Existing onsite water uses and groundwater extractions for those demands are estimated to total approximately 1.1 AFY.
3. Following development of the proposed 8.0 acres of vineyard, annual groundwater extractions from the subject property are estimated to increase by 5.6 AFY relative to existing extractions, to a total of approximately 6.7 AFY.
4. The proposed project complies with Tier 1 WAA requirements (Napa County, 2015 & 2024a) because the total proposed groundwater demand on the subject property (6.7 AFY) does not exceed the annual average groundwater recharge at subject property of 15.33 AFY.
5. Following implementation of the proposed vineyard development, onsite water demands will be met by a combination of both of the onsite wells, East Well and West Well.
6. The proposed project wells, East Well and West Well, are capable of pumping at a combined rate in excess of the proposed future water demands. Furthermore, East well can pump at a rate that is sufficient to meet all onsite water demands without any contributions from West Well.
7. The proposed project complies with Tier 2 WAA requirements because available pumping test data show that pumping of East Well will not induce significant drawdown (defined as more than 10 ft) in any offsite wells within 500-ft. Data collected by RTWS showed that water level drawdown during pumping of East Well for a period of 4 hours at a rate greater than is necessary to meet project demands yielded a water level drawdown of 0.8 ft. Water level drawdown interference in wells at distance from East Well would experience less drawdown than observed in the well itself.
8. A Tier 3 WAA is not necessary for the proposed vineyard development because the proposed project wells (East Well and West Well) are not within any County-defined Significant Streams 1,500-ft buffer areas.
9. RCS recommends initiation of a groundwater monitoring program at the subject property, in all onsite wells. This should include frequent and regular monitoring of static and pumping water levels in all onsite wells, and it should also include frequent and regular monitoring of instantaneous flow rates and cumulative pumped volumes from all onsite wells.



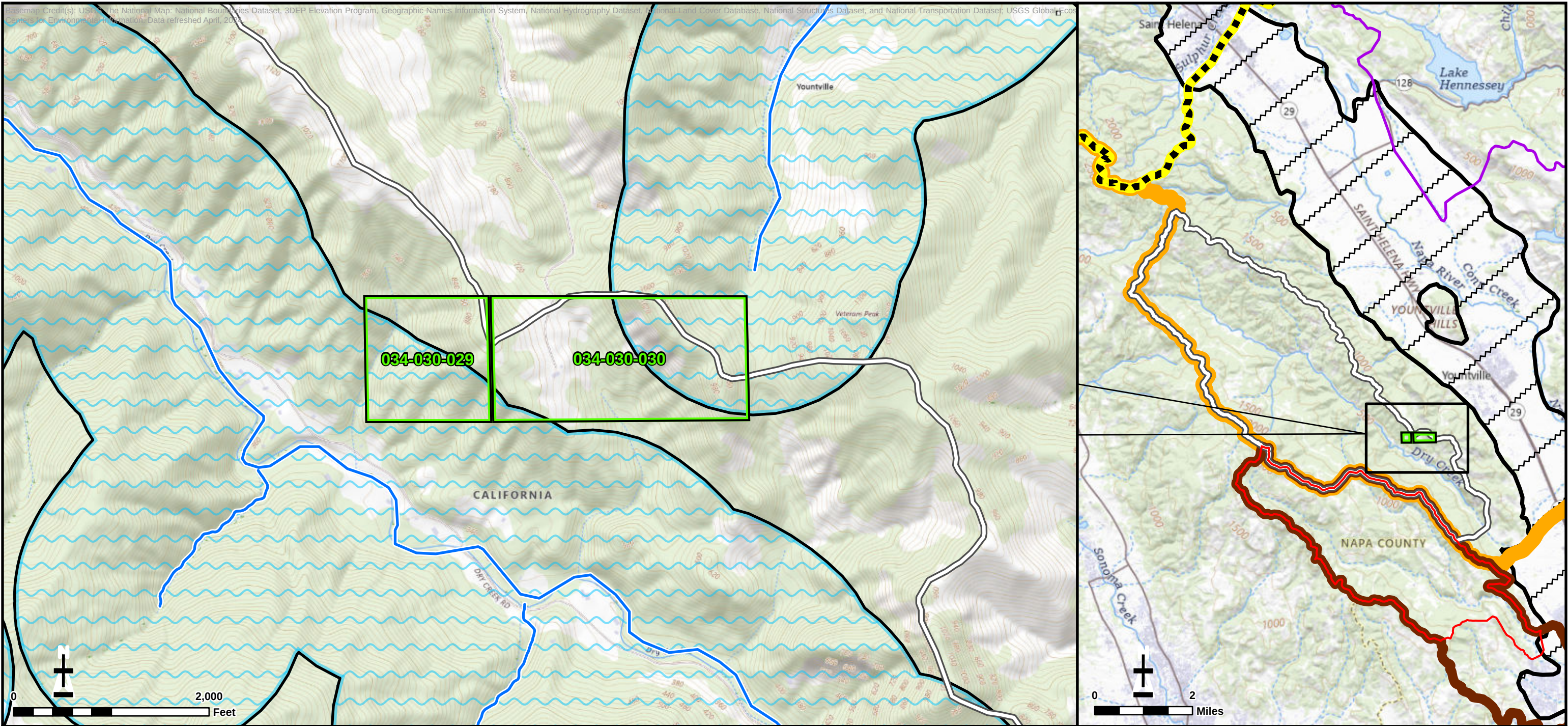
MEMORANDUM

Closure/Disclaimer

This Memorandum regarding a Tier 1 & Tier 2 Water Availability Analysis for a proposed vineyard development project at Hawkins-Damele Ranch has been prepared by RCS for PPI Engineering, and applies only to the evaluation of the subject property for the requirements discussed herein. This Memorandum has been prepared in accordance with the care and skill generally exercised by reputable professionals, under similar circumstances, and in this or similar localities. No other warranty, either express or implied, is made to the conclusions or professional advice presented herein.

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Subject Parcel (Napa County, 5/30/2024)



Napa Valley Subbasin of the Napa-Sonoma Valley Groundwater Basin (DWR, 2021)



Significant Streams (PBES & LSCE, 2023a)



Significant Streams 1,500-foot Buffer (PBES & LSCE, 2023b)

Watersheds in LSCE & MBK (2013)



Conn Creek Watershed



Dry Creek Watershed



Napa River Watershed at St. Helena



Redwood Creek Watershed



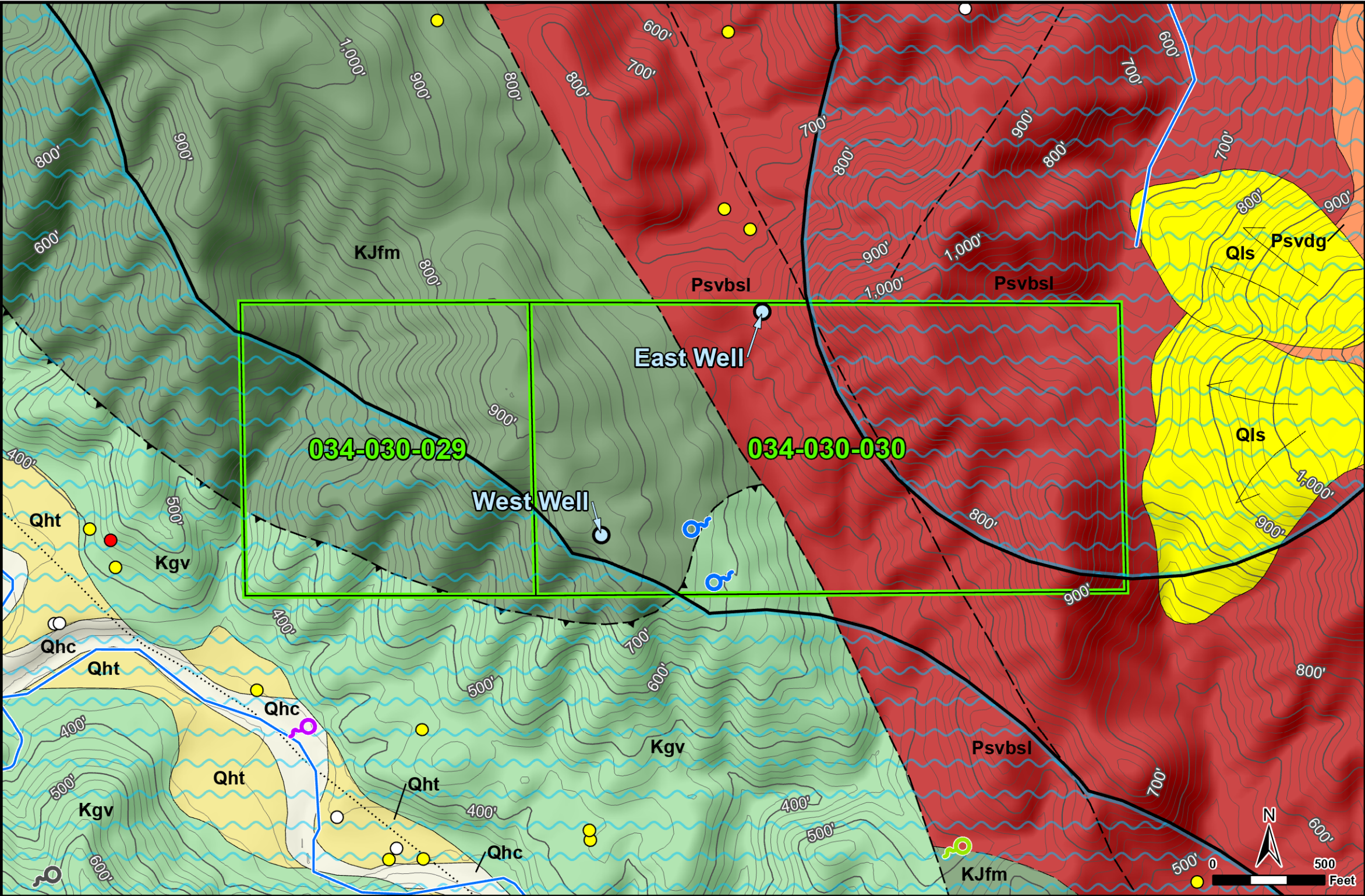
Napa Creek Watershed at Napa



Napa River Watershed near Napa



Figure 1
Regional Map



GEOLOGIC LEGEND

Recent Surficial Deposits

- Qhc** Stream channel deposits (modern <150 years to late Holocene)
- Qht** Stream terrace deposits (Holocene, 10,000 years)
- Qls** Landslides (Holocene to Pleistocene)

Sonoma Volcanics

- Psvbsl** Andesite flow Breccia of Stags Leap Volcanic Center (Pliocene)
- Psvdg** Dacite of Mt. George (Pliocene)

Great Valley Sequence

- Kgv** Great Valley Sequence, undivided (Cretaceous)

Franciscan Complex

- KJfm** Franciscan Complex mélangé (Late Cretaceous to Late Jurassic)

- Direction of landslide movement
- Geologic contact, approximately located
- Geologic contact, certain
- Fault, approximately located
- Fault, concealed
- Thrust fault, approximately located

Geologic map adapted from: Wagner, D.L., and Gutierrez, C.I. (2017). Preliminary Geologic Map of the Napa and Bodega Bay 30' x 60' Quadrangles, California. California Geological Survey.



**Figure 3
Geologic Map**

Onsite Water Sources

- Onsite Well
- Onsite Spring

Known and Possible Offsite Water Sources

- Spring - Center of Parcel - Used for Water Supply
- Spring - Possibly Used for Water Supply
- Spring - Used for Water Supply
- Well
- Well - Center of Parcel
- Well - Possibly Destroyed



Subject Parcel (Napa County, 5/30/2024)



Significant Streams (PBES & LSCE, 2023a)



Significant Streams 1,500-foot Buffer (PBES & LSCE, 2023b)



MEMORANDUM

APPENDIX

- 1.) State Well Completion Report for East Well (No. 822301)
- 2.) State Well Completion Report for West Well (No. 462601)
- 3.) Pumping Test Logs by Ray's Well Testing Service for Project Wells

DWR USE ONLY — DO NOT FILL IN

06 N 05 W

STATE WELL NO./STATION NO.

LATITUDE

LONGITUDE

APN/TRS/OTHER

Permit No. 96-11350 Permit Date 9-28-99

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

DATE, PLACE

WELL DRILLER/AUTHORIZED REPRESENTATIVE	DATE SIGNED	C-57 LICENSE NUMBER
--	-------------	---------------------

EAST WELL



Phone: 707 823 3191 **Fax:** 707 317 0057 **Email:** rayswelltesting@gmail.com **Lic#:** 903708

Address: 4853 Vine Hill Rd, Sebastopol Ca 95472

Date: 06/26/24

Report #: 15830

Report By: Matt Owens & Zack Mikalonis

Subject Property Address: 7335 St Helena Hwy, Napa CA 94558

Customer Name: Mike Hawkins

WELL DATA:

Location/Description of well:	East Well
Type of Well:	Drilled
Depth of Well:	Unknown – please refer to well log
Diameter of Well Casing:	5" PVC
Sanitary Seal (plate seal at top of well):	Yes
Annular Well Seal (in ground seal of bore hole):	Unknown – please refer to well log

PUMP DATA:

Pump HP and Type:	3 HP 230V 3PH Submersible
Depth of Pump Suction:	Unknown – please refer to installer records
Size of Tee at Well Head:	1.25 Inches
Submersible Cable Size:	#10-4
Water Level Control:	SubDrive 150 Controller
Backpressure Test:	10.1 GPM @ 100 PSI @ 317 Feet, 10.2 Amps

WELL PRODUCTION SUMMARY (see next page for pumping log):

Length of Test:	4 Hour		
Type of Test:	Drawdown and constant pumping level		
Static Water Level:	317 Feet	Starting Flow	24 GPM
Water Level Drawdown:	0.8 Feet		
Final Pumping Level:	317.8 Feet	Final Flow	24 GPM

WATER LEVEL RECOVERY SUMMARY:

Pre Test Static Water Level:	317 Feet
Post Test Static Water Level:	317 Feet
Water Level Drawdown:	0.8 Feet
Water Level Recovery:	0.8 Feet
Water Level Recovery as % of Drawdown:	100.00%
Length Between End of Test and Recovery:	20 Minutes

EAST WELL

WELL PRODUCTION DATA & PUMPING LOG:

Date	Time	Interval	Water Level	Appearance	Sulfur Odor	Sand	GPM
06/26/24	10:40 AM	0 Minutes	317	Clear	Mild	No	24
06/26/24	10:55 AM	15 Minutes	317.7	Clear	Mild	No	24
06/26/24	11:10 AM	15 Minutes	317.7	Clear	Mild	No	24
06/26/24	11:25 AM	15 Minutes	317.7	Clear	Mild	No	24
06/26/24	11:40 AM	15 Minutes	317.8	Clear	Mild	No	24
06/26/24	12:10 PM	30 Minutes	317.8	Clear	Mild	No	24
06/26/24	12:40 PM	30 Minutes	317.8	Clear	Mild	No	24
06/26/24	01:40 PM	1 Hour	317.8	Clear	Mild	No	24
06/26/24	02:40 PM	1 Hour	317.8	Clear	No	No	24

Final Pumping Level: 317.8 Feet
Final Flow Rate: 24 GPM

WATER LEVEL RECOVERY DATA:

Date	Time	Interval	Water Level	Recovery %
06/26/24	03:00 PM	20 Minutes	317	100.00%

Final post test static level measurement: 317 Feet
Final Water Level Recovery as % of Drawdown: 100.00%
Length of time between end of test and recovery: 20 Minutes

Water levels and well depth are measured as feet below top of well casing unless otherwise noted.

DISCLAIMER:

Results of well production are accurate only at time of test. We cannot predict future production or water yield.

WATER QUALITY: (The following samples are being analyzed, please refer to follow up report)

Analysis Choice: Residential & Irrigation **Turnaround:** Standard

WEST WELL



Phone: 707 823 3191 **Fax:** 707 317 0057 **Email:** rayswelltesting@gmail.com **Lic#:** 903708

Address: 4853 Vine Hill Rd, Sebastopol Ca 95472

Date: 06/26/24

Report #: 15830-2

Report By: Matt Owens & Zack Mikalonis

Subject Property Address: 7335 St Helena Hwy, Napa CA 94558

Customer Name: Mike Hawkins

WELL DATA:

Location/Description of well:	West Well
Type of Well:	Drilled
Depth of Well:	Unknown – please refer to well log
Diameter of Well Casing:	5 Inch PVC
Sanitary Seal (plate seal at top of well):	Yes
Annular Well Seal (in ground seal of bore hole):	Unknown – please refer to well log

PUMP DATA:

Pump HP and Type:	1 HP 230V Submersible
Depth of Pump Suction:	Unknown – please refer to installer records
Size of Tee at Well Head:	1.25 Inches
Submersible Cable Size:	#8-3
Water Level Control:	Pumpsaver 231 Insider – 20 minute timer delay
Backpressure Test:	10.9 GPM @ 60 PSI @ 110 Feet, 9.1 Amps

WELL PRODUCTION SUMMARY (see next page for pumping log):

Length of Test:	4 Hours		
Type of Test:	Drawdown and constant pumping level		
Static Water Level:	90 Feet	Starting Flow	10.9 GPM
Water Level Drawdown:	113.9 Feet		
Final Pumping Level:	203.9 Feet	Final Flow	10.8 GPM

WATER LEVEL RECOVERY SUMMARY:

Pre Test Static Water Level:	90 Feet
Post Test Static Water Level:	115.5 Feet
Water Level Drawdown:	113.9 Feet
Water Level Recovery:	88.4 Feet
Water Level Recovery as % of Drawdown:	77.61%
Length Between End of Test and Recovery:	20 Minutes

WEST WELL

WELL PRODUCTION DATA & PUMPING LOG:

Date	Time	Interval	Water Level	Appearance	Sulfur Odor	Sand	GPM
06/26/24	10:35 AM	0 Minutes	90	Yellow	No	No	10.9
06/26/24	10:50 AM	15 Minutes	127.4	Clear	No	No	14.1
06/26/24	11:05 AM	15 Minutes	169	Clear	No	No	13.8
06/26/24	11:20 AM	15 Minutes	184.2	Clear	No	No	12.6
06/26/24	11:35 AM	15 Minutes	191.8	Clear	No	No	12.6
06/26/24	12:05 PM	30 Minutes	201	Clear	No	No	12.5
06/26/24	12:35 PM	30 Minutes	203.9	Clear	No	No	10.8
06/26/24	01:35 PM	1 Hour	203.9	Clear	No	No	10.8
06/26/24	02:35 PM	1 Hour	203.9	Clear	No	No	10.8

Final Pumping Level: 203.9 Feet
Final Flow Rate: 10.8 GPM

WATER LEVEL RECOVERY DATA:

Date	Time	Interval	Water Level	Recovery %
06/26/24	02:55 PM	20 Minutes	115.5	77.61%

Final post test static level measurement: 115.5 Feet
Final Water Level Recovery as % of Drawdown: 77.61%
Length of time between end of test and recovery: 20 Minutes

Water levels and well depth are measured as feet below top of well casing unless otherwise noted.

DISCLAIMER:

Results of well production are accurate only at time of test. We cannot predict future production or water yield.

WATER QUALITY: (The following samples are being analyzed, please refer to follow up report)

Analysis Choice: Residential & Irrigation **Turnaround:** Standard

DATE: 6/26/24

ADDRESS: 7335 St Helena Hwy

COMMENTS:
1. The west well 1 HP 230V 1Ph submersible well pump fills the approximately 3,000 gallon concrete cistern. The pump is controlled by an electric float switch in the cistern. Water from the cistern is gravity fed to hose bibs around the property. There is a swimming pool style floating chlorination device in the cistern.
2. The east well 3 HP 230V 3 Ph submersible well pump fills the 2,500 gallon polyethylene storage tank. The pump is controlled by an electric float switch in the tank and a Franklin Electric Sub Drive 150 variable frequency drive. Water from the storage tank is gravity fed to the two houses. Pressure was measured at the upper house at 12 PSI and at the lower house at 20 PSI.
3. The upper house has a 2" X 20" cartridge filter.
4. The lower house has a 1.5" Spin Clean filter.
5. The is a Kinetico point of use reverse osmosis unit under the kitchen sink in the lower house which serves a dedicated drinking tap. This unit was not tested.
RECOMMENDATIONS:
1. There is a rodent nesting in the west well fuse disconnect located at the cistern. Recommend removing rodent material and plugging hole in disconnect box.
2. The east well polyethylene storage tank lid is missing the inner circle, recommend repair to exclude wildlife from the tank.
3. There is a dead-head valve on the cistern fill line, recommend removal to protect the pump.
4. A booster pump system was not observed. Recommend installation of booster pump system(s) if not present.
5. The water test results from the east well (well that is currently serving the house supply) indicates the water is very hard, high in iron and high in manganese. Recommend installation of filtration and softening system for the house supply. Bacteria was not detected from the kitchen sink at this time. Storage tank systems are vulnerable to bacteria as they are vented to the environment. Recommend routinely testing for bacteria or installation of an ultraviolet system as a precautionary measure. We are partnered with Northcoast Waterworks and can provide a quote upon request.

Thank you for allowing us to do your well inspection!

APPROVED BY: NICK BRASESCO



Water levels and well depth are measured as feet below top of well casing unless otherwise noted.

All wells and springs are subject to seasonal and yearly changes in regards to water yield, production and quality. Wells may be influenced by creeks or other water sources and are likely to yield less water during dry months of the year; typically August, September, & October. We make no predictions of future water production or water quality.

This report is for informational use only and is in lieu of and supercedes any other representation or statements of the agent or employee of the company, and all other such representations or statements shall be relied upon at the customer's own risk. The data and conclusions provided herein are based upon the best information available to the company using standard and accepted practices of the water well drilling industry. However, conditions in water wells are subject to dramatic changes in short periods of time. Therefore, the data and conclusions are valid only as of the date of the test and should not be relied upon to predict either the future quantity or quality the well will produce. The company makes no warranties either expressed or implied as to future water production and expressly disclaims and excludes any liability for consequential or incidental damages arising out of the breach of any expressed or implied warranty of future water production or out of any further use of the report by the customer.

East Well



Polyethylene Storage Tank



West Well



Concrete Cistern

West Well Fuse Disconnect



Main Electrical Panel

Lower House Filter



Upper House Filter



Undersink Reverse Osmosis

