RCS

RICHARD C. SLADE & ASSOCIATES LLC
CONSULTING GROUNDWATER GEOLOGISTS

MEMORANDUM

September 27, 2024

PROFESSIONAL GEOLOGIST ANTHONY S. HICKE CERTIFIED HYDROGEOLOGIST No. 858 STATE OF CALIFORNIA

To: Mr. Jeremy Nickel
c/o Mr. Paul Kelley
Paul Kelley Architecture
541 Jefferson St.
Napa, CA 94559
Sent via email (paul@paulkelleyarchitecture.com)

Cc: Mike Muelrath
Applied Civil Engineering (ACE)
Sent via email (mike@appliedcivil.com)

Job No. 571-NPA04

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

Re: Results of Aquifer Testing of Two Onsite Wells and
Napa County Tier 1 and Tier 3 Water Availability Analysis
The Vineyard House
Vicinity Oakville, County APN 027-360-022
Napa County, California

Introduction

This Memorandum presents the key findings and conclusions, along with our preliminary recommendations, regarding the testing of two onsite water wells and the associated Water Availability Analysis (WAA) prepared by RCS for the proposed new winery development at The Vineyard House (TVH) property in Napa County (County), California. This document was prepared by RCS to provide conformance with Napa County Tier 1 requirements, as described in the Napa County WAA Guidelines (Napa County, 2015). The Vineyard House property is comprised by 42.7 acres and is located at 1581 Oakville Grade Road, just west of Oakville in Napa County.

This document has been prepared at the request of Napa County to combine four previous documents prepared for this project. Since submission of the first WAA document by RCS in 2019 for the Winery project (RCS, 2019), RCS has prepared Addenda to respond to County questions/comments, and also prepared a Tier 3 document. The documents prepared by RCS in the past for this project include the following:

- (RCS, 2019) "Results of Aquifer Testing of Two Onsite Wells and Napa County Tier 1 Water Availability Analysis, The Vineyard House, Vicinity Oakville, County APN 027-360-022, Napa County, California", dated January 21, 2019.

14051 BURBANK BLVD., SUITE 300, SHERMAN OAKS, CALIFORNIA 91401
SOUTHERN CALIFORNIA: (818) 506-0418 • NORTHERN CALIFORNIA: (707) 963-3914 • RCSLADE.COM

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- (RCS, 2022) "Preparation of Napa County Tier 3 Water Availability Analysis (WAA), Vineyard House Winery Property, Vicinity Oakville, Napa County, California", dated July 15, 2022.

- (RCS, 2023) "Response to Napa County Planning, Building & Environmental Services (PBES) Comments in Application Status Letter V.4, The Vineyard House Winery Property, Vicinity Oakville, Napa County, California", addendum Memorandum, dated January 9, 2023.

- (RCS, 2023b) "Response to Napa County Planning, Building & Environmental Services (PBES) Comments in Application Status Letter, dated January 9, 2023, The Vineyard House Winery Property, Vicinity Oakville, Napa County, California", Second Addendum Memorandum, dated May 24, 2023.

Napa County Planning, Building & Environmental Services (PBES) has requested that the above-listed documents be combined into a single document. Hence, this subject document represents a consolidation of the information in the four documents into a format similar to the original RCS 2019 submittal. Note that several of the Figures and Tables that appeared separately in those prior documents have been consolidated into a more succinct set of attachments for this document, to reduce the presentation of redundant data. The numbering of the Figures and Tables attached to this document has been updated accordingly, to reflect the newly consolidated attachments. In addition, two Figures that were inadvertently included in the 2019 WAA have been excluded from this document; they were not referenced in the original document and were irrelevant to the analyses presented therein. In the 2019 WAA, those Figures were titled "Figure 8A Watershed Geology," and "Figure 5B Description and Legend of Geologic Units".

Figure 1, "Location Map," shows the boundaries of the subject property superimposed on the USGS topographic map for the Rutherford quadrangle. Property boundaries shown on Figure 1 were adapted from the County Assessor's parcel data and/or parcel data provided by Albion Surveys (Albion) of St. Helena, California; County parcel data are freely available on the Napa County GIS website. Also shown on Figure 1 are the locations of the existing onsite water wells used by TVH (known herein as "Well 1"; "Well 2"; and "Domestic Well"), the onsite easement well ("Harlan Easement Well") used by a neighboring property, and the locations of nearby but 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; this aerial photograph was obtained from the USGS EarthExplorer website (the date of the imagery is June 3, 2016).

As reported by the project engineer, Applied Civil Engineering (ACE) of Napa, California, the 42.7-acre subject property is currently developed with the following: 26 acres of existing vineyards; a residence that will be converted to winery uses; onsite landscaping; and other ancillary buildings. Irrigation water demands for the existing vineyards at the subject property have historically been met using water delivered from an offsite property via an existing water easement. Other existing onsite water demands (including those for the residence and the landscape irrigation) have historically been met by pumping groundwater from two of the existing onsite wells: the Domestic Well and/or Well 2.

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RCS understands the proposed project is to develop a new winery with a production capacity of 20,000 gallons of wine per year. For this project, the future groundwater demands for the new winery are proposed to be met using existing onsite Wells 1 and 2; these two wells are considered to be the "project wells" for the purpose of this WAA. The owner also proposes to use groundwater pumped from Wells 1 and 2 to help meet future water demands of the existing onsite landscape irrigation. Water demands for the existing vineyard will continue to be met using water delivered from an offsite property via an existing water easement, as been done historically. Groundwater may also be used in the future for vineyard irrigation if delivery of the offsite easement water supply were to be unavailable, or interrupted for maintenance or other purposes, etc. If water is unavailable from the offsite source, total annual groundwater use at the subject property will not exceed the volume of site-specific annual groundwater recharge calculated elsewhere in this WAA. As stated in various portions of the WAA Guidance Document, analyses must consider the effects of "project wells" on nearby wells, springs, or streams (Napa County, 2015), known as a "Tier 2" WAA or "Tier 3" WAA. Two other non-project wells are shown to exist within the boundaries of the subject property on Figure 2. The Domestic well is not considered a project well for the Vineyard House Winey project, as it is not proposed to supply groundwater for the winery project. The Harlan Easement Well pumps water as part of an existing water easement agreement and is only used to help augment water demands for the neighboring Harlan Estate property. The Harlan Easement Well is not under the control of or used by the Vineyard House ownership, and will not supply water to the proposed Vineyard House Winery project. Because they are not project wells, no Tier 2 or Tier 3 assessment of the Domestic Well or the Harlan Easement Well are required as part of the WAA analyses. Extraction from those wells are considered as part of the Tier 1 WAA assessment, however.

The purpose of this Memorandum is to comply with Napa County's WAA guidelines for a "Tier 1" WAA (i.e., a Groundwater Recharge Estimate); those guidelines were promulgated by the County in May 2015. Because there are no known offsite wells located with 500 ft of the project wells (Wells 1 and 2), 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 was requested by Napa County PBES in a January 12, 2022-dated letter titled "P18-00448 & P21-00341; The Vineyard House Winery Use Permit and Use Permit Exception to the Conservation Regulations, 1581 Oakville Grade Road; APN 027-360-022, Application Status Letter" (PBES, 2022a). This Tier 3 analysis was requested prior to the issuance of the list of County-defined Significant Streams (Napa County, 2022b) and the County-defined 1,500-foot buffer areas around those Significant Streams (Napa County, 2022c), and therefore includes analysis of many drainage channels in the vicinity of the subject property identified by PBES in January 2022 that would not need to be analyzed today. However, RCS is providing the Tier 3 analyses performed as requested in 2022, even if such analyses are not required under the current Tier 3 WAA rules and regulations.

Site Conditions

From our data review work, and from an initial field reconnaissance visit to the subject property on May 19, 2015, and from a few subsequent visits to the subject property (between April 7, 2016 and February 8, 2018), the following key items were noted and/or observed (refer to Figures 1 and 2):

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a. The Vineyard House property is comprised of a single parcel having a Napa County Assessor's Parcel Number (APN) of 027-360-022. This parcel is referred to herein as the "subject property." The total assessed area of the subject property, as reported by ACE, is 42.7 acres.

b. Topographically, the subject property is located in the hills on the western side of Napa Valley, and west of Oakville, south of Oakville Grade Road. The subject property is situated in a small valley that lies between two steep ridgelines that generally trend to the northwest-southeast. This valley was observed by RCS geologists to slope slightly to the north and northwest.

c. A few ephemeral drainages are shown on the topographic map to exist on the subject property, as illustrated by dashed blue lines (see Figure 1). One drainage is located in the northern portion of the property and runoff in it would flow east across the property into the small valley which comprises most of the property. This onsite drainage was observed to be flowing during our initial May 19, 2015 site visit. A second drainage is located in the central portion of the property and flows east across the property toward the same small valley. The third "main" drainage lies along most of the valley that forms the property; this drainage flows north/northwest across the property. RCS geologists did not observe these two additional drainages during the site visits. All three drainages are tributary to a slightly larger creek that lies offsite to the northeast (mapped as Dwyer Creek on Figure 1).

d. Developments on the subject property currently consist of a residence, roughly 1 acre of landscaping, and other buildings used for offices and storage.

e. There are also approximately 26 acres of existing vineyards throughout the subject property.

f. Offsite areas surrounding the subject property consist primarily of vineyards, wineries, and residences to the north, east and west of the subject property. Naturally vegetated and/or wooded hillsides (i.e., undeveloped areas) were also observed farther offsite to the south and west.

g. As shown on Figures 1 and 2, four existing water wells are located on the subject property. These include: Well 1 and the Harlan Easement Well, in the southern portion of the property; and Well 2 and the Domestic Well, in the northern portion of property. Although the Harlan Easement Well is located onsite, water from this well is used by the neighboring Harlan Estate property through an existing water easement agreement.

h. An offsite spring was reported by Albion to exist to the east of the subject property (see Figures 1 and 2). Based on its reported location, this spring is greater than 1,500 ft away from onsite Well 1 and Well 2. This spring reportedly flows year round and is likely the source of flowing water observed by RCS geologists in the northernmost tributary drainage during our May 19, 2015 site visit, as noted above in subpart (c). Historically, this spring water has been collected and used to meet a portion of the landscape irrigation demand onsite. However, for the purposes of this analysis, and to present a more conservative analysis, it is assumed no spring water (and therefore, only groundwater) will be used for irrigation in the future.

i. During our initial May 19, 2015 site visit and other subsequent site visits to the property, RCS geologists also traveled along onsite roads and offsite public roads in the area surrounding the subject property in attempt to identify the possible locations and/or existence of nearby but offsite wells owned by others, and to verify certain offsite well locations provided by Albion. As a result, none of these privately-owned but offsite observed by RCS geologists are known to exist within 500 ft of the two subject project wells: Well 1 and Well 2 (see Figure 2).

   RCS geologists also contacted Napa County Planning, Building, and Environmental Service (PBES) in an attempt to acquire "Well Completion Reports" (also known as "driller's logs") that might exist for wells located on those neighboring but offsite properties. In addition, RCS geologists also used the California Department of Water Resources (DWR) online Well Completion Report website to download driller's logs for wells within the immediate vicinity of the subject property. As a result of those inquiries, several driller's logs and/or well drill permits were obtained for wells historically drilled in the area.

   Figures 1 and 2 show the approximate locations of known, reported, and/or inferred nearby offsite wells surrounding the subject property, as determined from the field reconnaissance and well log research. None of these mapped offsite wells are known to lie to within 500 of any project wells.

<u>Key Construction and Testing Data for Existing Onsite Wells</u>

DWR Well Completion Reports are available for three of the four onsite wells. The Well Completion Report log numbers for those wells are as follows: Well 1 (Log No. 0992224); Well 2 (Log No. 0992225); and the Domestic Well (Log No. 281555). Copies of these driller's logs are appended to this Memorandum; no driller's log is available for the onsite well known as the Harlan Easement Well. Table 1, "Summary of Well Construction and Pumping Data," provides a tabulation of key well construction data, groundwater airlifting data, and pumping data that are available for the onsite wells.

<u>Well Construction Data</u>

Key data listed on the available driller's logs and/or identified during our site visits include:

a. Wells 1 and 2 were drilled and constructed in November and December 2015, respectively, by Pulliam Well Exploration (PWE), of Angwin, California. The Domestic Well was drilled and constructed in August 1989 by Doshier-Gregson, Inc. (DGI) of Vallejo, California. All three wells were drilled using direct mud rotary (bentonite clay) methods.

b. Pilot hole depths (the borehole drilled before the well casing was placed downwell) for those three wells were reported to have ranged from 350 feet below ground surface (bgs) in the Domestic Well, to 715 ft bgs in both Wells 1 and 2.

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c. These three onsite wells were all cased with PVC well casing and have nominal diameters ranging from 6 inches in both Well 1 and the Domestic Well, to 8 inches in Well 2; total casing depths ranged from 350 ft bgs in the Domestic Well, to 710 ft bgs in Well 2. The casing depth for the Harlan Easement Well is unknown due to the lack of an available driller's log for this well; the casing diameter for this well was observed in the field to be 6 inches.

d. Casing perforations for the onsite wells with available data are reported to be factory-cut slots and have slot opening widths of 0.032 inches (32-slot). The top of the uppermost perforations in the wells ranges in depth from 50 ft bgs (in the Domestic Well), to 110 ft bgs (in Well 2). The depth to the base of the bottommost perforations ranges from 350 ft bgs (in the Domestic Well), to 710 ft bgs (in Well 2).

e. Gravel pack materials shown on the driller's logs for these wells were listed as "pea gravel" for the Domestic Well, and "Well Pack #6" for Wells 1 and 2.

f. The three onsite wells with available construction data were reportedly installed with sanitary seals consisting of cement (grout) and/or bentonite and concrete. The sanitary seals were set to depths ranging from 26 ft (in the Domestic Well), to 57 ft bgs (in Well 1).

Summary of Key Well "Test" Data for Onsite Wells

The driller's logs for Well 1, Well 2, and the Domestic Well provided the original post-construction static water levels, and their original airlift test rates (as shown on Table 1). These data include:

- Initial static water levels (SWLs), following completion of well construction, ranged from 55 ft to 120 ft bgs, depending on the well and its date of construction.
- Following its construction, the Domestic Well was reportedly test pumped for a period of 5 hours and at a rate of 50 gallons per minute (gpm). A "water level drawdown" of 80 ft was reported (based on a SWL of 120 ft bgs) at the end of the pumping period.
- Maximum airlift flow rates during initial post-construction airlifting operations in Wells 1 and 2 were estimated by the drillers to have ranged from 120 gallons per minute (gpm) in Well 1, to 200 gpm in Well 2, on the dates of their respective construction. As a rule of thumb, RCS Geologists estimate that normal operational pumping rates for a new well equipped with a permanent pump are typically on the order of only about one-half or less of the airlifting rate reported on a driller's log.
- Water level drawdown values were not listed on the driller's logs for Wells 1 and 2, because water level drawdown cannot be measured during airlifting operations; thus the original post-construction specific capacity values for these two onsite wells cannot be calculated. For the 5-hour pumping test performed in 1989 in the Domestic Well, the specific capacity was calculated to be 0.63 gpm/ft ddn. Specific capacity, in gallons per minute per foot of water level drawdown (gpm/ft ddn), represents the ratio of the pumping rate in a well (in gpm) divided by the amount of water level drawdown (in ft ddn) created in the well while pumping at that rate.

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Well Data from Site Visits

The following information for the onsite wells was gleaned from RCS site visits performed on the following dates: April 7, 2016; May 12, 2016; June 15, 2016; June 28, 2016, and February 7, 2018; and February 8, 2018. Note that during our initial May 19, 2015 site visit, Wells 1 and 2 had not yet been constructed, and a water level was not measured in the existing Domestic Well at that time due to a lack of downhole access. The later site visits (April 2016 to February 2018) were performed by RCS geologists as part of the aquifer testing that was performed in Wells 1 and 2 in 2016, and as part of additional water level monitoring work performed for this WAA. Key water well information and water level data include:

- Well 1 – A SWL of 96.3 ft below the wellhead reference point (brp) was measured during our April 2016 site visit; the reference point for the measurement was approximately 1.7 ft above ground surface (ags). To our knowledge, Well 1 has never been equipped with a permanent pump since its construction.

  Additional SWL depths ranged between 95.6 ft brp (on May 12, 2016) and 100.1 ft brp (on June 28, 2016). A recent SWL of 97.2 ft brp was measured by the RCS geologist on February 7, 2018. In comparison, the driller's log shows an original SWL for this well at 65 ft bgs in November 2015.

- Well 2 – Reportedly, this well was equipped with a permanent pump in September 2016. A SWL of 73.6 ft brp was measured during our April 2016 site visit; the reference point was measured to be 1 ft ags at that time.

  SWLs ranging from 69.2 ft brp (on June 15, 2016) to 94.3 ft brp (on February 8, 2018) have been measured by RCS geologists since our initial SWL measurement in April 2016; the current reference point (on February 8, 2018) was measured to be 1.8 ft ags. In comparison, the driller's log shows an original SWL for this well at 55 ft bgs in December 2015. This well was reportedly equipped with a totalizer flow dial by others in September 2016, and during our February 2018 site visit, the totalizer was observed to have a reading of 7.03 acre feet (AF); note that 1 AF = 325,851 gallons.

- Domestic Well – This well was observed to be equipped with a permanent pump during our April 2016 site visit. During our April 2016 site visit to the property, a water level could not be measured at this well due to limited wellhead access; a sounding tube was later installed by others sometime after that April 2016 site visit. During our subsequent site visits to the well between May 2016 and February 2018, SWLs ranging from 146.5 ft brp (on May 12, 2016) to 158.6 ft brp (on February 7, 2018) were measured by the RCS geologist; the reference point for these measurements was approximately 1.3 ft ags. In comparison, the driller's log shows an original SWL for this well at 120 ft bgs in August 1989. This well was equipped with a totalizer flow dial device and was observed to have the following readings: 2,564,407 gallons (on April 7, 2016); 2,735,744 gallons (on June 15, 2016); 2,748,340 gallons (on June 28, 2016); and 3,512,944 gallons (on February 7, 2018).

- Harlan Easement Well – This well was observed to be equipped with permanent pump at time of our initial site visit to this well on May 12, 2016. An initial SWL of 122.0 ft brp was measured by the RCS geologist on May 12, 2016; the reference point was measured to be approximately 1 ft ags. Additional SWL readings of 125.3 ft and 118.7 ft brp, were measured by the RCS geologist on June 15, 2016 and June 28, 2018, respectively. No totalizer flow dial device was observed to be installed at this well during any of our site visits. Reportedly, groundwater extracted from this well is used by the neighboring Harlan Estate property through an existing water well easement; the operational frequency of use of this well and/or the amount of water annually that is pumped from this well are not known to RCS.

The water level differences observed in these wells between their respective original, post-construction static water levels and more recent static water levels measured could partially be the result of differences in the various manual water level measurement devices (i.e., tape sounders, airlines, etc.) used by the drilling contractors, pumpers, and RCS geologists. Differences in the time of year and antecedent rainfall are also among the causes for these water level differences over time.

Local Geologic Conditions

Figure 3A, "Geology Map (2005)," illustrates the types, lateral extents, and boundaries between the various earth materials mapped at ground surface in the region by others. Specifically, Figure 3A has been adapted from the results of regional geologic field mapping of the Rutherford quadrangle, as published by the California Geological Survey (CGS) in 2005. Note that a more recent geologic map (CGS 2017) is presented on Figure 3B, "Geology Map (2017)", but consideration of that map is limited to the Tier 3 analyses herein, which were originally presented in the RCS 2022 document. Use of the Figure 3A 2005 geologic map is maintained herein for the following discussion (which originally preceded the Tier 3 WAA) in an effort to maintain consistency with prior published documents. However, except for the recent surficial landslide deposits (map symbol Qls), RCS considers these CGS geologic maps (2005 and 2017) to be extremely similar, and use of either geologic map for this WAA would result in the same interpretations and conclusions presented herein.

As shown on Figure 3A, the key earth materials mapped at ground surface in the area from geologically oldest to youngest, include the following:

a. Alluvial-type deposits. These deposits consist of undifferentiated and/or undivided alluvial fan deposits (map symbols Qhf and Qf, on Figure 3A). These deposits are generally unconsolidated, and consist of layers and lenses of sand, gravel, silt, and clay. These geologic materials are shown to be exposed at ground surface throughout the valley sections of the property and further to the north and east along the main floor of Napa Valley. Based on topography of the area, these geologic materials are estimated to be relatively thin where they are mapped along the small valley that occurs on much of the subject property.

b. Landslide deposits. Landslide deposits[1] (map symbol Qls) have been mapped in the region and on the subject property by others (see the bright yellow-colored areas on Figure 3A). Arrows within these mapped landslide areas show the general direction

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

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of downslope movement within each landslide mass. Portions of these landslides are only exposed at ground surface in two small areas on the subject property, as shown on Figure 3A, but larger landslide masses have been mapped offsite, mainly in the hillsides east and west of the property.

c. Sonoma Volcanics. The Sonoma Volcanics are comprised by a highly variable sequence of chemically and lithologically diverse volcanic rocks. These rock types include the following: dacite lava flows (map symbol Tsvdg); andesite lava flows (map symbol Tsvabsl); andesite flow breccias (map symbol Tsvasl); and andesite ash flow tuff and tuff breccia (map symbol Tsvatsl). As shown on Figure 3A, andesite flows and flow breccias are exposed at ground surface in the northern and southern portions of the property, and are generally exposed in the hillsides that flank the southern portion of the property. These volcanic rocks also directly underlie the alluvial-type deposits that are exposed along the floor of the small valley which occupies much of the subject property.

   Review of the driller's descriptions and/or RCS geologic interpretations of the drill cuttings listed on the available logs for Wells 1 and 2, reveals that drilling of Wells 1 and 2 encountered typical rocks of the Sonoma Volcanics at each well site. Typical driller-terminology for the drill cuttings on those logs included: "brown ash and rock;" "black ash;" and "streaks of broken up black ash." Therefore, based on the available subsurface geologic data, the Sonoma Volcanics are interpreted by RCS to extend to depths of at least 715 ft bgs (in the vicinity of Wells 1 and 2).

d. Great Valley Sequence. The geologically older (Cretaceous-aged) Great Valley Sequence rocks (may symbol KJgv) are exposed at ground surface in small areas along the western edge of the subject property, but primarily make up much the hillsides west of the property, as shown on Figure 3A. These rocks consist mainly of well consolidated to cemented rocks, thickly bedded mudstone, siltstone, and shale, with minor amounts of thinly bedded sandstone. These rocks are also known to underlie all younger geologic materials (including the Sonoma Volcanics) that occur in the region, and are considered to be the bedrock of the area.

   Again, based solely on RCS geologists' interpretations of the driller's descriptions of the drill cuttings listed on the available driller's logs for Wells 1 and 2, these bedrock materials are interpreted to exist at depths greater than the drilled borehole depths of Wells 1 and 2.

Local Hydrogeologic Conditions

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

Potentially Water-Bearing Materials

The principal water-bearing materials beneath the subject property and its environs are represented by the hard, fractured volcanic flow rocks and flow breccias of the Sonoma Volcanics. The occurrence and movement of groundwater in these rocks tend to be controlled primarily by

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the secondary porosity within the rock mass, that is, by the fractures and joints that have been created in these harder volcanic flow-type rocks over time by various volcanic and tectonic processes. Specifically, these fractures and joints have been created as a result of the cooling of these originally molten flow rocks and flow breccias deposits following their deposition, and also from mountain building or tectonic processes (faulting and folding) that have occurred over time in the region after the rocks were erupted and hardened. Some groundwater can also occur in zones of deep weathering between the periods of volcanic events that yielded the various flow rocks, and also with the pore spaces created by the grain-to-grain interaction in the volcanic tuff and ash, if those rock types exist beneath the harder, flow-type rocks.

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

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

As stated above, the principal rock type expected in the subsurface beneath a portion of the property is a combination of hard, volcanic flow rock, and flow breccias that may be fractured to varying degrees. Descriptions of drill cuttings by the well driller that are recorded on the available driller's log for Wells 1 and 2 are consistent with the typical descriptions of the various rocks known in the Sonoma Volcanics. From our long-term experience with the fractured flow rocks within the Sonoma Volcanics, based on numerous other water well construction projects in Napa County, pumping capacities in individual wells have ranged widely, from rates as low as 5 to 10 gpm, to rates as high as 200 gpm, or more.

Potentially Nonwater-Bearing Rocks

This category includes the geologically older and fine-grained sedimentary rocks of the Great Valley Sequence. These potentially nonwater-bearing rocks would underlie the volcanic rocks that exist beneath the subject property at depths greater than 715 ft bgs, depending on the location, as interpreted by RCS from the driller's descriptions listed on the available driller's logs for Wells 1 and 2.

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

Geologic Structure

Several faults[2], as mapped by others, have been interpreted to exist on and in the vicinity of the subject property as shown by the dark-colored, short dashed lines or black dots on Figure 3A (CGS 2005). Also shown on Figure 3A are several fault traces of the "West Napa fault, Browns Valley section (Class A) No. 36a"; these fault traces, shown as green-colored lines, were mapped by the USGS in conjunction with the CGS and are available as GIS files via the USGS "Quaternary Fault and Fold Database" website. The USGS-mapped faults and the faults shown in CGS (2005) are presumably the same faults, and their slight variation in placement on Figure 3A is likely due to GIS mapping projection inaccuracies. Specifically, one of these northwest-southeast trending fault traces is shown to be mapped through the eastern edge of the subject property.

The possible impacts of these faults on groundwater availability in the region are unknown due to an absence of requisite data. Faults can serve to increase the number and frequency of fracturing in the Sonoma Volcanics rocks. If such fractures were to occur, they would tend to increase the amount of open area in the rock fractures which, in turn, could increase the ability of the local earth materials to store groundwater. Faults can also act as barriers to groundwater flow; it is unknown if these mapped faults impact groundwater flow, as water level data necessary to make such a determination are not available.

Project Water Demands

For the purposes of this WAA, Wells 1 and 2 are considered to be the "project wells," as they will represent the only wells that will be used to meet water demands of the proposed new winery project. As discussed above, the existing residence will re-purposed and become part of the new winery, and the water demands for this use are included in the proposed winery water demands. All existing onsite water demands currently supplied by groundwater (excluding the residence) will continue to use groundwater pumped from Well 1, Well 2, and/or the Domestic Well.

Groundwater pumped by the onsite Harlan Easement Well has been and will continue to be used to supply groundwater for offsite use on a nearby property.

Existing and proposed (future) onsite water demands for the property have been estimated by the project civil engineer (ACE); the table prepared by ACE is adapted herein as "Table 2, Groundwater Use Estimate." As shown on Table 2, the proposed groundwater use for the project is 5.3 AFY, and is summarized below.

Existing Water Demands

Water demands for the existing vineyards have historically been met by using offsite water from an existing water easement, and those vineyards will continue to be irrigated with the offsite easement water in the future. Historic onsite domestic uses have been met by pumping groundwater from the Domestic Well and/or Well 2. Existing landscaping irrigation demands are currently met using groundwater (note that historically, spring water was also used for landscaping irrigation demand). Note that Well 1 has not yet been equipped with a permanent pump, and thus is not currently used for any existing uses, but could be in the future as site development evolves.

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[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.

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Existing groundwater demands for the Vineyard House property have been estimated by ACE[3] to be the following:

a. Existing residential demand = 0.750 acre feet per year (AF/yr)
   - Note that 1 AF = 325,851 gallons

b. Existing landscape irrigation demand = 4.815 AF/yr
   - This demand estimate includes groundwater used for the onsite lawn and other onsite landscaping. This category does not include water used for vineyard irrigation, because the onsite vineyards are currently, and have historically been irrigated using offsite easement water.

Based on the data presented above, groundwater demands for all existing onsite uses are estimated to be approximately 5.6 AF/yr; these demands do not include water for vineyard irrigation, which is currently met using offsite easement water.

Proposed (Future) Water Demands

In the future, the landscaping irrigation demands will continue to be met by pumping groundwater[4] from the Domestic Well, Well 1, and/or Well 2. As discussed above, the current onsite residence is being converted to winery use, and those water demands are included in the proposed total winery demand. Although the property owner has no current plans to do so, it is possible that at some point in the future a new residence could be built at the subject property. To present a more conservative analysis herein, the groundwater demands of a conceptual future residence are included in the total combined (proposed) groundwater use; groundwater from Well 1, Well 2, and/or the Domestic Well could potentially be used to meet the conceptual residential water demand.

For the proposed new winery project, all future winery water demands (including those of the re-purposed residence) are proposed to be met by pumping groundwater from the project wells, Wells 1 and 2. These water demands for the winery (both domestic and process water uses) are estimated by ACE to be 0.567 AF/yr. Thus, the total proposed onsite groundwater demands for the property will be as follows:

a. Proposed winery groundwater demand = 0.567 AF/yr
   - This includes: 0.029 AF/yr for daily visitors; 0.006 AF/yr for events with meals prepared offsite; 0.002 AF/yr for event staff; 0.101 AF/yr for winery employees; and 0.430 AF/yr for winery process water.

b. Proposed (conceptual) residential groundwater demand = 0.750 AF/yr
   - This conceptual residence is being considered only to present a more conservative analysis; the property owner has no current plans to construct a new residence at the subject property.

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[3] These water demand estimates were reportedly based on those values presented for specified land uses provided in Appendix B of the County's WAA Guidance Document (Napa County, 2015); see the ACE "Groundwater Use Estimate" on Table 2.

[4] For the purposes of this WAA, to present a more conservative analysis, it is assumed no spring water (and therefore, only groundwater) will be used for irrigation in the future.

c. Landscape irrigation groundwater demand = 3.984 AF/yr
   - This is reduced from the existing demand, according to the landscape plan prepared by MWS Consulting (MWS).

d. Vineyard irrigation groundwater demand = 0 AF/yr (same as existing)
   - Vineyard irrigation demands will continue to be met using water delivered from an offsite easement[5].

e. Total proposed annual groundwater demand for The Vineyard House property:

   = a + b + c + d = 5.3 AF/yr

As shown on the “Groundwater Use Estimate” table prepared by ACE, the total groundwater demand for the property represents a slight decrease from current conditions, and includes a conceptual future residence. Totalizer-measured extraction data from the Domestic Well and Well 2 totalizer flow dials have been collected by RCS geologists during their site visits between April 2016 and February 2018 (Well 1 is unused and has no totalizer). A total of approximately 9.9 AF have been pumped from the Domestic Well (2.9 AF) and Well 2 (7.0 AF) in this 22-month period of record. This calculates to an average groundwater extraction of 0.45 AF/month, or 5.4 AF/yr. This amount is similar to the ACE-estimated existing groundwater demand of 5.6 AF/yr, and therefore corroborates the estimate made by ACE.

Proposed Pumping Rates

To determine an appropriate estimated combined pumping rate necessary from the Well 1, Well 2, and/or the Domestic Well, it will be conservatively assumed that the future landscape irrigation demands (3.984 AF/yr) at the subject property will be required only during a 4-month (roughly 16-week) irrigation season each year (May through August)[6]. In addition, it is assumed that domestic use water and winery process water for the winery will be required year-round (365 days/year), but will vary monthly; the monthly variation of those water demands were provided to RCS by ACE. The monthly proportion for winery demands throughout the year range between 4% (during April and May) and 18% (during September and October) of the total annual demand. Additionally, to be conservative, it is assumed that the conceptual future residence (for which there are no plans to actually build) will also require water year-round (365 days/year). Based on those assumptions, and in order to meet future groundwater demands of the project and existing site uses, Well 1, Well 2, and the Domestic Well would need to pump at a combined rate of about 17 gpm to meet the peak monthly project demand of 1.144 AF, which would occur in the month of August each year. This pumping rate assumes that the onsite wells would be pumped at a 50% operational basis, that is, 12 hours/day, 7 days/week during the August peak monthly demand period each year. Based on the pumping rates reported by LGS during testing in June 2016 of Well 1 and Well 2, each well was successfully pumped at an average rate of 50 gpm for

[5] Although unexpected to occur, the property owner may elect to use groundwater pumped from onsite wells to irrigate the existing onsite vines should access to the offsite easement water be interrupted in the future. If water is unavailable from the offsite source, total annual groundwater use at the subject property will not exceed the volume of site-specific annual groundwater recharge calculated elsewhere in this WAA.

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

a period of approximately 24 hours, and could likely have been tested at higher pumping rates. Thus, it appears the project wells themselves are more than capable of meeting the instantaneous groundwater flow demands required for the winery project and existing uses each year. The Domestic Well may also be used in the future to provide a portion of the landscape irrigation demands (as it is used in the existing condition), which would reduce the amount of water necessary from Wells 1 and 2. The Domestic Well will not be used for any portion of the new winery project demands.

Estimated Groundwater Demand from Harlan Easement Well

As noted above, groundwater is pumped from the onsite "Harlan Easement Well" through an existing water easement agreement and is only used to help augment water demands for the neighboring Harlan Estate property. Therefore, as part of this WAA analysis (and discussed in the subsequent "Estimate of Groundwater Recharge" section herein) RCS will also consider how much groundwater is being pumped (extracted) from this onsite well for vineayrd uses, as it relates to the total onsite groundwater extractions. It is the understanding of RCS that this well is currently not equipped with a totalizer flow meter. Thus, there are no totalizer data to help define how much water is actually pumped from this easement well on an annual basis. Multiple attempts have been made by RCS geologists to contact Mr. Micah Flynn of the Harlan Estate Property to request any available information and/or data regarding estimated extraction volumes and/or the current uses of this Easement Well for the Harlan Estate property. RCS geologists have not received that information and/or any groundwater extraction data directly from Harlan Estate personnel.

Therefore, in order to estimate how much groundwater the Harlan Easement Well might pump on an annual basis, several assumptions of the well use were made by RCS geologists. Based on data provided by others, and based on air photo review, approximately five (5) wells exist within the boundaries of the five parcels that comprise the offsite Harlan Estate property. In general, the Harlan Estate property reportedly has been developed with residences, wineries, vineyards, and a small amount of orchards. Due to the existence of these other wells directly on the adjoining Harlan Estate property, RCS assumed the Harlan Easement Well only provides water demands for those developments that exist on the three nearest parcels (APNs 027-360-006, 027-340-054, and 027-490-018) to the well. Land use data for those parcels (i.e., residences, wineries, vineyards, and orchards) were available from the Napa County GIS website. Notable from the aerial photographs (see Figure 2) and available land-use data from those three nearest parcels to the Harlan Easement Well are the following:

a. A single-family residence was determined to exist on APN 027-360-006. It is assumed that this residence meets its domestic demands via groundwater pumped from the Harlan Easement Well (nearest onsite well to the residence). For the purposes of our analysis, it will be assumed that this single-family residence requires approximately 0.75 AF/yr of groundwater, thus:
    - Total residential groundwater demand = 0.75 AF/yr
b. The total acreage of existing vineyards on these three parcels was estimated to be approximately 8.9 acres, based on available aerial photo maps of the property. RCS has conservatively estimated that 0.5 AF/yr/acre is required for vineyard irrigation.
    - Total vineyard irrigation

= 8.9 acres of vines x 0.5 AF/yr/acre vine = 4.45 AF/yr

c. The total acreage of existing orchards was estimated from the air photos to be 0.7 acres. RCS has conservative estimated that 0.5 AF/yr/acre of orchard is required for orchard irrigation.

   - Total orchard irrigation

     = 0.7 acres of vines x 0.5 AF/yr/acre vine = 0.35 AF/yr

d. There is one winery reported to exist on APN 027-340-054. This existing winery has a reported winery production of 20,000 gallons per year. For the purposes of our analysis, we will conservatively assume this winery requires the same amount of water as the proposed Vineyard House winery project (or about 0.6 AF/yr), which is proposed to be a 20,000 gallon winery.

   - Total water demand = 0.6 AF/yr

e. Total estimated groundwater demand of the Harlan Easement Well

   = a + b + c + d = 6.15 AF/yr (rounded to 6.2 AF/yr)

Hence, the total estimated groundwater demand from the Harlan Easement Well for the three nearest Harlan Estate parcels would be approximately 6.2 AF/yr. For comparison, The Vineyard House winery project has a proposed water demand of approximately 5.3 AF/yr. This represents a total estimated annual groundwater extraction ("water demand") from the subject property of approximately 11.5 AF/yr.

June 2016 Aquifer Testing of Well 1 and Well 2

Wells 1 and 2 were drilled and constructed by PWE in November 2015, and each well was subsequently subjected to a pumping test in June 2016. The basic purpose of the pumping tests in Well 1 and Well 2 was to determine whether or not these wells could pump at sufficient rates to meet the proposed future winery and landscape irrigation demands.

During the pumping tests of Wells 1 and 2, RCS recommended using the onsite Domestic Well and Harlan Easement Well as additional water level observation wells. In addition, RCS attempted to monitor water levels in the offsite "Futo Well" and "Harlan Main Well" during the pumping tests of Wells 1 and 2; the locations of these offsite wells are shown on Figures 1 and 2. An offer was provided to Mr. Futo to include his well as part of the pumping test and after consideration and telephone conversation with RCS geologists, Mr. Futo opted not to participate. Due to well access issues in the Harlan Main Well, it was decided not to monitor water levels in this well, and proceed with the testing of Wells 1 and 2 without any observation water level data from these two offsite wells. Note that neither the Futo Well and/or the Harlan Main Well are within 500 ft of Well 1 or Well 2.

The protocol for these pumping tests were prepared by RCS to meet the following requirements:

1. Determine if Wells 1 and 2 can pump at sufficient rates to meet the peak pumping rate of the proposed project and existing uses (a total of about 17 gpm).
2. Monitor the amount of self-induced drawdown created in each pumping well by virtue of its own pumping.

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3. Monitor water level recovery rates in each pumping well following the end of its respective pumping test.
4. Monitor the amount of water level (i.e., water level drawdown interference), if any, that might be induced in the other water level observation wells by virtue of the subject pumping test in each pumping well.
5. Determine the aquifer parameters of transmissivity and storativity (if possible) for the volcanic rocks that are perforated in Wells 1 and 2.
6. Collect a representative water sample from each pumping well, and submit the collected samples to a laboratory for water quality testing.

Aquifer Test Protocol

The protocol for the separate aquifer (pumping) tests of Wells 1 and 2 were developed by RCS geologists and provided to TVH on June 10, 2016. Pumping and field monitoring tasks for these aquifer tests were initially contracted by TVH to Oakville Pump Service (OPS) of Oakville, California. However, due to scheduling conflicts, OPS subcontracted with LGS Drilling, Inc. (LGS) of Vacaville, California to perform the aquifer tests of Well 1 and Well 2. Key portions of that aquifer test protocol for each well included: limited mechanical and pumping development work prior to any pumping tests; a 3-step drawdown to help determine an appropriate rate for the constant rate pumping test; a period of water level monitoring (i.e., baseline water level monitoring) prior to the start of the constant rate pumping test; the constant rate pumping test portion of aquifer testing for Wells 1 and 2; and a final period of water level recovery following the pumping tests. A water quality sample was collected from each well by OPS personnel near the end of their pumping test periods. Provided below is a summary of the key aquifer testing protocol:

- Well Development – LGS reportedly performed mechanical and pumping development of Wells 1 and 2. Mechanical development work reportedly included: bailing of the well casing to remove remaining drilling muds, and mechanical development by swabbing and airlifting to help remove remnant drilling fluids from the casing, gravel pack, and the borehole walls. Following mechanical development work, LGS installed a temporary test pump into each well to conduct additional development via pumping methods. Pumping development was then performed in each well until they were producing relatively clear groundwater and the pumped groundwater was visually observed to be free of fine-grained sediment, as determined by the LGS pump operator.
- Step Drawdown Test – The purpose of the step drawdown tests were to pump Wells 1 and 2 at different rates (or steps) for specific time periods, record water levels and pumping rates at each step, and permit analysis of the test results. Evaluation of these data then allowed RCS geologists to select an appropriate pumping rate for the subsequent, separate, 24-hour constant rate pumping tests in Wells 1 and 2. The separate step drawdown tests were performed at each well on the following dates:
  - Well 1 – May 6, 2016
  - Well 2 – April 28, 2016

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Note that water level pressure transducers were installed in Wells 1 and 2 on May 12, 2016, which is after the step drawdown tests had been performed in these two wells. Therefore, no transducer data are available for the step drawdown tests that were separately performed in Wells 1 and 2. The RCS geologist relied solely on manual water level measurements collected by the LGS pumper during these step tests to help determine the appropriate pumping rates for the subsequent, separate, 24-hour constant rate pumping tests in each of those wells.

- Transducer Installation – Water level pressure transducers were installed into Well 1, Well 2, and the Domestic Well by RCS geologists during a site visit to the subject property on May 12, 2016. A barometric pressure transducer was also installed by the RCS geologist near the wellhead of the Domestic Well. All four installed devices were operational and collected their respective water level and/or barometric pressure readings between May 12 and June 28, 2016.

  A 300 psi water level transducer was installed inside the well casings of Well 1, Well 2, and the Domestic Well; the transducer manufacturer and model type were In-Situ LevelTROLL™ 400. The accuracy of the 300 psi transducer, as reported by the transducer manufacturer, is ±0.0658 ft. The barometric pressure transducer, which was installed near the Domestic Well, had a manufacturer-reported accuracy of ±0.0691 ft.

  No transducer was installed into the Harlan Easement Well due to limited downwell access. However, manual water level measurements were collected occasionally by the LGS pumper in this well during the pumping tests of Wells 1 and 2.

- Baseline Water Level Monitoring – The purpose of baseline water level monitoring was to record groundwater level fluctuations that may have been occurring in the area prior to each of the two separate constant rate pumping tests. Changes in such background (baseline) water levels can occur due to natural water level fluctuations in the aquifer and/or water level declines caused by possible water level drawdown interference from other pumping wells in the area. As noted above, water level pressure transducers were not installed in Wells 1, 2, or the Domestic Well until after the completion of the individual step drawdown tests performed in Wells 1 and 2. Thus, baseline water level monitoring generally occurred for a period of a few weeks prior to the start of the separate constant rate pumping tests performed Wells 1 and 2. During this baseline monitoring period, the Domestic Well was operational and was being pumped to meet the water demands of the onsite residence (when in use) and landscaping. The Domestic Well was turned off on June 14, 2016, approximately 2 days prior to the start of the Well 1 constant rate pumping test. Wells 1 and 2 were not pumped at any time during the baseline monitoring period.

  Because there was no transducer installed in the Harlan Easement Well, only sporadic water level data were collected from this well during the baseline monitoring period. The only manual water level measurements collected from this well during this period were on May 12 (by RCS geologists) and June 15, 2016 (by the LGS pumper).

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- Constant Rate Pumping Tests – The key portion of each aquifer test (i.e., the 24-hour constant rate pumping test) was performed at Wells 1 and 2 on the following dates and at the following average pumping rates:
  - Well 1 – June 16 to 17, 2016, at an average rate of 50 gpm
  - Well 2 – June 20 to 21, 2016, at an average rate of 50 gpm

  Water levels were continually collected by all transducers during the pumping tests at a frequency of one measurement every minute; the barometric pressure transducer was collecting measurements once every 10 minutes. Occasional manual water level measurements were also collected in Well 1, Well 2, and the Domestic Well by the LGS pumper to help corroborate the transducer-collected measurements in those wells. Following review of the datasets, the collected manual measurements (via the LGS pumper) were determined by RCS geologists to be in general agreement, and thus corroborated the transducer-collected water level data. Periodic manual water level measurements were also collected by the LGS pumper in the Harlan Easement Well between June 15, 2016 (1-day prior to testing at Well 1) and June 21, 2016 (final day of pumping at Well 2).

- Water Level Recovery Monitoring – Following the end of the pumping portion of each constant rate pumping test at Well 1 and Well 2, water level recovery data were then collected by the transducers for an additional period of roughly 3 days at Well 1, Well 2, and the Domestic Well. The transducers installed in these three onsite wells were eventually removed from those wells by an RCS geologist on June 28, 2016.

- Discharge of Pumped Groundwater – During each 24-hour pumping test period at Wells 1 and 2, the pumped groundwater was discharged into an existing drainage system on the subject property that had been previously approved by the Owner.

Step Drawdown Testing – Wells 1 and 2

Separate 9-hour, three-point step drawdown tests were performed in Wells 1 and 2 on May 6, 2016, and April 28, 2016, respectively. There are no transducer data available for the step test portion of the aquifer testing of Wells 1 and 2, because the transducers were not installed in those two wells prior to performing these step tests. Therefore, only manual water level measurements collected by the LGS pumper were available during the step testing portion of the aquifer tests. The following summarizes the key data collected and reported by the LGS pumper during the step tests for Wells 1 and 2:

Well 1

- Well 1 was pumped continuously at the RCS-recommended nominal pumping rates (or steps) of 40, 70, and 100 gpm; each of the three step rates were pumped continuously for three hours.
- Prior to turning on the pump, an initial pre-test SWL of 95.4 ft brp was measured by the LGS pumper.
- Using the totalizer flow dial data, average pumping rates for each of the three steps were calculated to be 40, 70, and 100 gpm, for Steps 1, 2, and 3, respectively.

- Pumping water levels (PWLs) measured at the end of each step rate ranged from 99.0 ft to 106.4 ft brp, for Steps 1 through 3, respectively. These PWLs resulted in water level drawdowns ranging from 3.6 ft to 9.1 ft for Steps 1 to 3, respectively.
- Short-term specific capacities for the step test rates ranged from 11.1 gpm/ft ddn at a pumping rate of 40 gpm (Step 1), to 9.1 gpm/ft ddn at pumping rate of 100 gpm (Step 3). Calculated specific capacity values in wells tend to be higher at lower pumping rates (and for shorter pumping durations), and vice versa.

Well 2

- Well 2 was pumped continuously at the RCS-recommended steps of 25, 75, and 125 gpm; each of the three step rates was pumped continuously for three hours. Totalizer flow dial data show that the average pumping rates for each of the three steps were calculated to be 25, 75, and 125 gpm.
- An initial pre-test SWL of 71.6 ft brp was measured by the LGS pumper, prior to turning on the pump.
- Pumping water levels (PWLs) measured at the end of each step rate ranged from 117.5 ft to 252.0 ft brp for Steps 1 through 3, respectively. These PWLs resulted in water level drawdowns ranging from 45.9 ft to 180.4 ft for Steps 1 to 3, respectively.
- Short-term specific capacities for the step test rates ranged from 0.54 gpm/ft ddn at a pumping rate of 25 gpm (Step 1), to 0.69 gpm/ft ddn at pumping rate of 125 gpm (Step 3).

Results of Aquifer Testing Period

Water level data collected between May 12 and June 28, 2016 for Well 1, Well 2, the Domestic Well, and the Harlan Easement Well are shown on Figure 4, “Water Level Data During Monitoring, Existing Onsite Wells.” It is important to note that, although not shown independently on the water level graphs herein, barometric pressure data were also collected during each of the two separate aquifer tests. Before plotting these water level data, the transducer data for Well 1 and Well 2, and also for the additional water level observation well (the Domestic Well) were corrected using the barometric data (that is, changes in barometric pressure were factored out of each data set, so that the graphed water level data now reflect only changes in water levels in these three wells). It is also noteworthy that during the entire aquifer testing period, barometric pressure measurements in the area varied by a maximum of 0.24 pounds per square inch (psi); this equates to a water level change of approximately 0.55 ft. Since there was no transducer installed in the Harlan Easement Well, only occasional manual water level measurements collected by RCS and/or LGS were available.

Background Water Level Monitoring

As previously noted, background water levels were monitored for a period of roughly 1 month in Well 1, Well 2, and the Domestic Well, via transducers, prior to the start of the constant rate pumping test at Well 1. Below is a summary of these pre-test (background) water level observations for each well (refer to Figure 4):

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- Well 1 – Water levels in Well 1 showed a very slight, but continual decline during the background monitoring period. Using the transducer data, water levels were detected to have declined by a total of 2.5 ft (from 95.6 ft to 98.1 ft brp) over the roughly 1-month baseline monitoring period prior to testing at Well 1. Water levels recorded by the transducer in this well were also observed to oscillate by as much as 0.7 ft. These oscillations were observed to generally occur every few minutes and are likely the result of the stated accuracy of the transducer.
- Well 2 – In the first 11 days of the roughly 1-month background water level monitoring period, water levels in Well 2 were observed to have increased slightly from a depth of 70.2 ft brp on May 12, 2016 to 68.5 ft brp on May 23, 2016. Between May 23 and the start of the constant rate test at Well 1 on June 16, 2016, water levels were observed to have slightly decreased a total of 0.4 ft (from 68.5 ft to 68.9 ft brp). It is unclear if this slight water level decline is related to the periodic pumping of the nearby Domestic Well (located 360 ft west of Well 2). Similar to Well 1, water levels in Well 2 were observed to oscillate by as much as 0.3 ft. Again, these oscillations may be the result of the stated accuracy of the transducer.
- Domestic Well – The Domestic Well was pumped periodically throughout the baseline water level monitoring period from May 12 to June 14, 2016. This well was turned offline approximately 2 days prior to the June 16, 2016 start of the constant rate pumping test in Well 1. During this baseline water level monitoring period, water levels (both static and pumping) were observed to have continually decreased between May 12 and June 16, 2016. SWLs in the Domestic Well decreased by a total of 4.9 ft between May 12 and June 16, 2016 (from 143.7 ft to 148.6 ft brp). This decline in water levels was likely due to the periodic pumping of this well to supply existing onsite uses. Water level oscillations on the order of 0.4 ft were also observed in the transducer data.
- Harlan Easement Well – This well was not monitored by a transducer, thus, only occasional manual water level data are available for this well. On May 12, 2016, a SWL of 122.0 ft brp was measured by an RCS geologist in this well. Prior to the start of the Well 1 constant rate pumping test, a SWL of 124.7 ft brp was measured by the LGS pumper. Thus, water levels in the Harlan Easement Well appeared to have declined by approximately 2.7 ft during the baseline monitoring period. A part of this water level difference may have resulted from the use of different manual water level devices by the LGS pumper and the RCS geologist.

Constant Rate Pumping Periods

Well 1 – Constant Rate Pumping Test

Pumping for the constant rate pumping test portion for Well 1 began on June 16, 2016, and continued for approximately 1,465 continuous minutes (24 hours and 25 minutes) at an average pumping rate of 50 gpm. The pumping rate was determined from totalizer flow dial readings recorded by the LGS pumper throughout the pumping period.

Figure 5, “Water Levels During Constant Rate Pumping Test of Wells 1 and 2,” graphically illustrates the water levels as recorded by the pressure transducers in Wells 1, 2, and the

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Domestic Well during the constant rate pumping test periods of Wells 1 and 2. Also shown on Figure 5 are the water level data collected from the Harlan Easement Well because this well was being used as an additional water level observation well during the separate aquifer tests of Well 1 and Well 2. Below is a summary of the water level data collected from the pumping well (Well 1), and from the water level observation wells (Well 2, Domestic Well, and Harlan Easement Well) that were being used during the pumping and water level recovery portions of the Well 1 constant rate pumping test:

- Well 1 (pumping well) – A pre-test SWL of 98.1 ft brp was measured in Well 1 just before the pump was turned on to begin the subject pumping test. This pre-test SWL is roughly 3 ft deeper than the SWL recorded prior to the step test of this well on May 6, 2016. After 24 hours and 25 minutes (1,465 minutes) of continuous pumping, the maximum PWL in Well 1 was measured at a depth of 106.3 ft brp, as shown on Figure 5. This represents a total water level drawdown during the constant rate pumping test of 8.2 ft and the calculated current specific capacity for this well is 6.10 gpm/ft ddn. As shown on Figure 5, water levels were still slowly declining near the end of the pumping test. In the last 4 hours of the pumping test, the PWL in this well decreased by 0.8 ft, or about 0.2 ft/hr.

  Following pump shut-off, water levels during the first 24 hours of recovery were observed to recover to a depth of 99.5 ft brp on June 18, 2016. This represents a recovery of 83% of the total drawdown recorded in this well during the pumping portion of this test. Water levels continued to recover and reached the pre-test water level of 98.1 ft brp (100% recovery) roughly 2 days after the end of this constant rate pumping test of Well 1.

- Water Level Observation Wells
  - Well 2 – Water levels in Well 2 increased slightly during the constant rate pumping test of Well 1, and only fluctuated both up and down by a few tenths of foot during the entire pumping period. In the 3-day water level recovery period, water levels appeared to be relatively stable and only fluctuated up and down by a couple tenths of a foot during this period. Some of this water level fluctuation may be the result of diurnal water level fluctuations and/or possible impacts from offsite pumping. Therefore, based on the transducer data, no definitive water level drawdown impact was observed in Well 2 during the constant rate pumping test of Well 1. Well 2 lies roughly 2,400 ft northwest of Well 1 (see Figure 1).
  - Domestic Well – Water levels recorded by the transducer in the Domestic Well also showed no definitive water level drawdown impact while performing the constant rate pumping test at Well 1. Water levels in the Domestic Well were relatively stable during the pumping portion of Well 1. Similar to Well 2, only very slight diurnal water level fluctuations were observed, and water level oscillations on the order of a few tenths of a foot were also observed in the transducer data. The Domestic Well is located roughly 2,690 ft northwest of Well 1.

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- Harlan Easement Well – This well was not equipped with a transducer during the pumping test of Well 1, thus, there are no transducer data available for this well during the aquifer test of Well 1. However, occasional manual water level measurements in the Harlan Easement Well were collected by the LGS pumper during the pumping test of Well 1. Based on the data provided by the pumper, it appears that water levels in the Harlan Easement Well increased by approximately 1-foot (from 124.7 ft to 123.7 ft bgs) during the constant rate pumping test of Well 1. Thus, no definitive water level drawdown impact was observed in the manual water level data while performing the constant rate pumping test of Well 1. The Harlan Easement Well is located roughly 980 ft northwest of Well 1.

Well 2 – Constant Rate Pumping Test

Pumping at Well 2 for the constant rate pumping test began on June 20, 2016, and continued for 24 continuous hours (1,440 minutes) at an average pumping rate 50 gpm; this average pumping rate was calculated from totalizer dial readings recorded by the LGS pumper during the test. Figure 5 graphically illustrates the water levels in the well recorded by the pressure transducer and via occasional manual water level measurements recorded by the pumper. Below is a summary of the water level data collected from Well 2 (the pumping well) and from the water level observation wells (Well 1, Domestic Well, and Harlan Easement Well) during the pumping portion and subsequent water level recovery portion of the Well 2 aquifer test:

- Well 2 (pumping well) – A pre-test SWL of 69.1 ft brp was measured in this well just before the pump was turned on to begin the subject pumping test. After 24 hours (1,440 minutes) of continuous pumping, the final PWL in Well 2 was measured at a depth of 160.4 ft brp, as shown on Figure 5. This represents a total water level drawdown during the 24-hour constant rate pumping test of 91.3 ft; the current specific capacity of this well is calculated to be 0.55 gpm/ft. As shown on Figure 5, water levels in Well 2 were not stabilizing near the end of the pumping test. In the last 4 hours of the pumping test, the PWL in this well was still declining at a rate of approximately 0.85 ft/hr. Note that it appears the pumping rate during this test was adjusted a couple of times by the pumper, thus, causing the sudden increases/decreases in water levels that were observed in the transducer data in the early portion of the pumping test. Also, the LGS pumper reported that vineyard property staff had driven over the discharge hose connected to Well 2 and possibly caused some back pressure on the pump, thus causing water levels to increase/decrease in the well near the end of the pumping test. At the very end of the 24-hour pumping test period, pumping water levels appear to suddenly decrease to a depth on the order of 190 ft brp. LGS reported that the pumper likely got his electric tape sounder cable tangled with the steel wire rope that hangs the transducer downwell and inadvertently moved the transducer. Therefore, a portion of the water level data recorded by the transducer near the end of testing may be erroneously deep.

  Following pump shut-off, water level recovery data were collected in Well 2 for a period of 3 days (72 hours) prior to resuming normal operation of the Domestic Well by TVH staff. At the end of this 3-day recovery period, a water level depth of 74 ft brp was

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recorded in the transducer data. After 24 hours following the end of the Well 2 pumping test, a water level recovery measurement of 80.4 ft brp was recorded by the transducer in Well 2. This 24-hour water level recovery represents 88% of the total water level drawdown recorded during the pumping portion of the test (see Figure 5). Figure 4 shows that water levels in Well 2 did not fully recover before the transducer was removed on June 28, 2016, but recovered to a depth of 72 ft brp (roughly 3 ft deeper than pre-test water levels).

- Water Level Observation Wells
  - Well 1 – Water levels in Well 1 remained relatively stable during the constant rate pumping test of Well 2, and fluctuated by only a few tenths of a foot during the entire testing period. Therefore, no definitive water level drawdown impact is considered to have occurred in Well 1 while pumping Well 2 during its 24-hour constant rate pumping test. Transducer data show slight diurnal fluctuations in water levels in Well 1 during the water level recovery period.
  - Domestic Well – Water levels in the Domestic Well decreased by approximately 0.5 ft during the 24-hour pumping period of Well 2. During the 3-day water level recovery period, water levels initially increased by approximately 0.4 ft in the first few hours of the water level recovery period and then decreased slightly by approximately 0.3 ft during the remainder of this water level recovery period. Therefore, based on these changes in the water levels, the Domestic Well is considered to have been impacted very slightly by the pumping of Well 2 during its aquifer test. The Domestic Well is located only 360 ft northwest of Well 2 (see Figure 1).
  - Harlan Easement Well – The occasional manual water level measurement collected by the pumper in the Harlan Easement Well showed that water levels increased by 0.1 ft (from 121.6 ft to 121.5 ft brp) during the 24-hour pumping period of Well 2. Thus, no definitive water level drawdown impact was detected in the manual water level data for this Easement Well while performing the constant rate pumping test of Well 2.

Specific Capacity Data

A useful indicator of well performance or efficiency (in terms of changes in water level drawdown over time with respect to pumping rate) is the specific capacity (SC) of a well, which can be calculated from the results of the aquifer test or from data generated during regular periods of pumping and water level monitoring. In general, when groundwater is pumped from an active water well, a hydraulic gradient is established toward the well, and a cone of water level depression forms within the local aquifer system, with the pumping well located at the locus (center) of this cone. In general, the greater the pumping rate (and/or the longer the duration of pumping), the greater the water level drawdown will be in the pumping well (drawdown represents the vertical distance between the non-pumping (or static) water level and the resulting pumping water level in the well). As an indication of the relative efficiency or productivity of a well, the term “specific capacity” is commonly used to define the amount of water (in gallons per minute) that the well will yield for each foot of water level drawdown created while the well is pumping at a particular rate. The specific capacity[7] of a well is calculated using the pumping rate of the well (in gpm) divided by the total water level drawdown (in ft) created in that well while pumping at that rate, and is expressed in units of gallons per minute per foot of water level drawdown (gpm/ft ddn).

During the 24-hour constant rate pumping tests of Wells 1 and 2 in June 2016, the specific capacities were calculated to be 6.10 and 0.55 gpm/ft ddn, respectively. Specific capacity is useful to help evaluate changes in well performance over time, and helping to determine when a well is in need of rehabilitation. In general, the higher the specific capacity for a well, the more productive (or efficient) a well is with respect to pumping rates and resulting drawdowns. However, the specific capacity values calculated from each of the June 2016 aquifer tests are considered to be quite varied, especially considering Wells 1 and 2 appear to be constructed within similar geologic materials. The specific capacity of Well 1 appears on the high side of SC values typically calculated for wells constructed within the Sonoma Volcanics. The specific capacity of Well 2 appears to be somewhat low. These SC values suggest that the volcanic rocks perforated in Well 1 are more fractured than those in Well 2.

Calculation of Aquifer Parameters

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

Water level drawdown and recovery data collected from Well 1, Well 2, and the Domestic Well during the June 2016 constant rate pumping tests were input into the software program AQTESOLV (version 4.5 Professional). Numerous analytical solutions were then applied in attempt to determine transmissivity and/or storativity values using automatic and/or manual curve fitting procedures. The solutions utilized consisted of unconfined, confined, semi-confined, and/or fractured aquifer solutions, where applicable. Several variations of these solutions were analyzed by RCS. Typically, water drawdown data from each set of the observation wells are used in these solutions, but as discussed above, Well 1, Well 2, and the Domestic Well that were monitored with transducers showed only minimal to no definitive water level drawdown during the separate pumping test periods of Wells 1 and 2. Because there was some amount of water level drawdown observed in the Domestic Well during the pumping test of Well 2, a storativity value could be

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

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calculated. Nevertheless, water level drawdown data from the two pumping wells (Wells 1 and 2) were input into the AQTESOLV software.

Certain assumptions must be made about the aquifer when using these solutions. In general, for the solutions listed below, key assumptions are: that the aquifer has an infinite areal (lateral) extent; that the aquifer is isotropic (same in all directions); that the pumping well fully and/or partially penetrates the aquifer system(s); and that water is instantaneously released from storage with the decline of hydraulic head. Also, for the purposes of this analysis, the assumption is made that the saturated aquifer thicknesses at Wells 1 and 2 are 605 ft and 640 ft, respectively. This saturated aquifer thickness was determined by taking the vertical distance between each well's respective static water level (prior to the start of the pumping tests) and the respective bottom of its casing perforations.

Listed below are the curve-fitting solutions used, the transmissivity values calculated, and the figure numbers in this Memorandum on which the water level data and fitted-curves are presented. In some cases (as with water level drawdown data from the Domestic Well during the Well 2 pumping test), a storativity value could be calculated. Otherwise, no storativity value could be calculated because no definitive drawdowns were observed in those observation wells.

Well 1 (Pumping Well)

- Theis – Figure 6A, "Constant Rate Pumping Test Analysis, Theis Confined Aquifer Solution, Well No. 1 (Pumping Well)." – As shown on the figure, the curve for the confined aquifer solution has been matched to fit much of the water level drawdown and recovery data acquired during the pumping test of Well 1. A transmissivity value of approximately 3,090 gpd/ft is calculated for these data. Storativity could not be calculated in this solution because the analysis uses data from the pumping well, and not an observation well. The Theis (1960) solution assumes numerous conditions, including that the aquifer is isotropic (the same in all directions).
- Barker – Figure 6B, "Constant Rate Pumping Test Analysis, Barker Fractured Aquifer Solution, Well No. 1 (Pumping Well)." – As shown on the figure, the curve for the fractured aquifer solution using the Barker (1988) with slab—shaped blocks solution has been matched to the later time portion of the water level data acquired during the test and during the water level recovery period in the pumping Well 1. A transmissivity value of roughly 1,820 gpd/ft is calculated for these data. Storativity could not be calculated in this solution because the analysis uses data from the pumping well, and not an observation well. The Moench (1984) solution for a fractured aquifer was also performed in our analysis (not shown herein), which resulted in the same transmissivity value as that of the Barker (1988) solution (i.e., 1,820 gpd/ft).
- Hantush-Jacob – Figure 6C, "Constant Rate Pumping Test Analysis, Hantush-Jacob Leaky Aquifer Solution, Well No. 1 (Pumping Well)." – As shown on the figure, the curve for the leaky aquifer solution has been matched to the later time portion of the water level data acquired during the test and during the water level recovery period in Well 1. A transmissivity value of approximately 2,540 gpd/ft is calculated for these data. Storativity could not be calculated in this solution because the analysis uses data from the pumping well, and not an observation well. The Moench solution assumes numerous conditions, including that the aquifer is isotropic (the same in all directions).

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Well 2 (Pumping Well)

- Barker – Figure 6D, "Constant Rate Pumping Test Analysis, Barker Fractured Aquifer Solution, Well No. 2 (Pumping Well)." – As shown on the figure, the curve for the fractured aquifer solution using the Barker (1988) with slab—shaped blocks solution has been matched to the early time portion of the water level data acquired during the test and during the water level recovery period in the pumping Well 2. The solution was not matched to the later time portion of the water level data of the pumping test due the possibly erroneous water level data as discussed above. A transmissivity value of approximately 320 gpd/ft is calculated for these data. Storativity could not be calculated in this solution because the analysis uses data from the pumping well, and not an observation well. The Moench solutions for a leaky (1985) and fractured aquifers (1988) were also performed in our analysis (not shown herein), which resulted in the same transmissivity value as that of the Barker (1988) solution above (320 gpd/ft).

Domestic Well (Observation Well)

- Theis – Figure 6E, "Constant Rate Pumping Test Analysis, Theis Confined Aquifer Solution, Domestic Well (Observation Well)." – As shown on the figure, the curve for the confined aquifer solution has been matched to the later time portion of the water level data acquired during the test and during the water level recovery period in the water level observation Domestic Well. A transmissivity value of approximately 17,880 gpd/ft is calculated for these data. A storativity value of 5.7×10^{-3} was calculated.

- Barker – Figure 6F, "Constant Rate Pumping Test Analysis, Barker Fractured Aquifer Solution, Domestic Well (Observation Well)." – As shown on the figure, the curve for the fractured aquifer solution has been matched to the later time portion of the water level data acquired during the test and during the water level recovery period in the water level observation well used (i.e., the Domestic Well). A transmissivity value of approximately 9,570 gpd/ft is calculated for these data. A storativity value of 8.6×10^{-6} was calculated.

- Moench – Figure 6G, "Constant Rate Pumping Test Analysis, Moench Leaky Aquifer Solution, Domestic Well (Observation Well)." – As shown on the figure, the curve for the leaky aquifer solution has been matched to the later time portion of the water level data acquired during the test and during the water level recovery period in the Domestic Well. A transmissivity value of approximately 3,680 gpd/ft is calculated for these data. A storativity value of 1.9×10^{-5} was calculated.

Based on the analytical solutions described above, the resulting transmissivity and storativity values were somewhat varied. Water level data from an observation well is typically more definitive of actual aquifer parameters (if induced drawdown was observed). Thus, based on the observation water level data from the Domestic Well (presented above), transmissivity values are shown to have ranged from a low of 3,680 gpd/ft to 17,880 gpd/ft, whereas storativity values ranged from 8.6×10^{-6} to 5.7×10^{-3}, depending on the analytical solution used.

An independent evaluation of transmissivity (T), using data from the subject pumping test, was also made via the empirical relationship $T \approx 1,750\ (Q/s)$, where (Q/s) is the specific capacity of the pumping well and 1,750 is an empirical constant for a semi-confined aquifer system in the fractured rocks of the Sonoma Volcanics. Applying this relationship to the specific capacity value calculated for the subject pumping tests, a transmissivity value on the order of 960 to 10,450 gpd/ft, respectively, was calculated for the two wells.

Long-Term Water Level Data

Also shown on Figure 4 are the manual water level measurements collected by RCS geologists in Well 1, Well 2, and the Domestic Well (based on site visits between April 2016 and February 2018). As shown on Figure 4, the February 2018 SWL depth of 97 ft brp in Well 1 is roughly 1-foot higher than the 98-foot SWL depth reported by LGS prior to the June 2016 constant rate pumping test in Well 1. Water levels in Well 2 are shown to have decreased from a pre-test SWL depth of 69 ft brp in June 2016 to 94 ft brp in February 2018. This decrease in water levels may be partially due to the known slow water level recovery rate in this well that was observed during the June 2016 aquifer testing period. Also, during our site visit on February 7, 2018, Well 2 was observed to be pumping, and the SWL of 94 ft brp recorded by the RCS geologist was collected only ±15 hours after the pump had reportedly been turned off by TVH personnel. Thus, the February 2018 SWL may only be considered to be a partial recovery level. Water levels in the Domestic Well appear to have decreased by roughly 10 ft (from 148 ft brp in June 2016 to 158 ft brp in February 2018). Again, this well is used daily for onsite water demands, thus, the February 2018 SWL recorded by RCS geologist may be considered to be a partial recovery level, as well. Differences in the time of year and in antecedent rainfall are also among the causes for these water level changes over time.

Original Rainfall Calculation

Long-term rainfall data are essential for estimating the average annual recharge that may occur at The Vineyard House property. Average annual rainfall totals that occur specifically at the subject property are not directly known, because no onsite rain gage exists. At the time of the original publication of this WAA document, rainfall data were calculated as presented below, using available data from nearby rain gages.

Rainfall data exist for the nearby “Dry Creek Fire Station” rain gage, which is located roughly 1½ miles southwest of the subject property. Data for this rain gage are available from the Napa One Rain website; this website is maintained by Napa County. Data from the Napa One Rain website for this gage are available beginning in water year (WY) 2006-07 (October 2006 - September 2007) through WY 2016-17. The average annual rainfall for WY 2006-07 through WY 2016-17 at this gage is calculated to be 31.2 inches (2.60 ft). Because the period of rainfall record for this gage is relatively short (11 years) and includes 5 years of drought (as defined by DWR), RCS does not consider these data to be representative of the long-term annual average rainfall in the area surrounding the subject property. This rain gage is also located at a slightly higher elevation (560 ft above sea level, asl) than the subject property (between ±230 and ±350 ft asl, depending on location on the property), and therefore the average annual rainfall at the subject property could be slightly lower than that experienced at this known gage location.

Another nearby Napa One Rain gage with a relatively short rainfall record was found to be located near Yountville, California, approximately 2 miles southeast of the subject property. Data for this “Hopper Creek at Highway 29” rain gage are available from WY 2001-02 through WY 2016-17. However, there appear to be several days and/or months of missing data in WY 2001-02 and WY 2002-03 and RCS removed these water years from the data set. With these assumed missing

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water years removed from the data set, then an average rainfall for WY 2003-04 through 2016-17 is calculated to be 27.7 inches (2.31 ft). As with “Dry Creek Fire Station” rain gage, the period of rainfall record for this gage is short (14 years), and includes several years of drought. Therefore, RCS does not consider these data to be representative of the long-term annual water year average rainfall in the area surrounding the property. This rain gage is also located at a slightly lower elevation (160 ft asl) than that of the subject property, and therefore the average water year rainfall at the subject property could be higher than that experienced at this gage.

The nearest rain gage to the subject property known to RCS with a significantly longer data record is located approximately 6 miles north in St. Helena, California. The data for this gage are available from the Western Regional Climate Center website (WRCC 2017). For this rain gage, the period of available record is November 1907 through June 2018; data for this gage are listed by calendar year, not water year. Note that there are several months and/or years of rainfall data missing in 1907, between 1915 and 1922, between 1979 and 1980, between 1985 and 1988, in 1992, and between 2011 and 2012. For the available period of record, the average annual rainfall at this St. Helena gage is 34.2 inches (2.85 ft), as reported by the WRCC. This rainfall gage is located at a similar elevation (±240 ft asl) to that of the subject property, and therefore the average annual rainfall at the subject property is likely to be similar to that experienced at this known gage location.

To help corroborate the average annual rainfall data derived from the Napa One Rain and/or WRCC gages, RCS reviewed the precipitation data published by the PRISM Climate Group at Oregon State University. This data set, which is freely available from the PRISM website contains “spatially gridded average annual precipitation at 800m (800-meter) grid cell resolution.” The date range for this dataset includes the climatological period between 1981 and 2010. These gridded data provide an average annual rainfall distributed across the subject property. Using this data set, RCS determined that the average rainfall for the subject property for the stated date range may be approximately 35.6 inches (2.97 ft).

An additional rainfall data source, an isohyetal map (a map showing contours of equal average annual rainfall) was prepared by the County for all of Napa County, and is freely available for download from the online Napa County GIS database (a copy of this map is not provided herein). As described in the metadata for the file (also available via the 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 is difficult to discern. The subject property is situated within the boundaries of the 45-inch average annual rainfall contour on this County map. Based on our interpretation of the actual isohyetal contour map (not provided herein), the long-term average annual rainfall at the subject property may be on the order of 40 inches (3.33 ft), using these rainfall data.

Table 3, “Comparison of Rainfall Data Sources,” provides a comparison of the data collected from the different rainfall sources discussed above. Based on those rainfall data sources and as summarized on Table 3, RCS will consider the long-term average annual rainfall at the subject property to be 35.6 inches (2.97 ft), as derived from the PRISM data set. The 35.6-inch per year estimate is based on the data source with a relatively long period of record (29 years) and is more site-specific, when compared to the other rainfall data sources listed in Table 3 that: exist at different elevations; and/or are located at a significant distance from the subject property; and/or have a shorter period of available data.

Tier 1 - Estimate of Groundwater Recharge

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

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

Estimates of groundwater recharge as a percentage of rainfall are presented for a number of watersheds (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 boundaries within Napa County are shown on Figures 8-3 and 8-4 in that report. At the request of RCS, those watershed boundaries were provided to RCS by MBK Engineers (MBK). Figure 7, "Watershed Boundaries," was prepared for this project using those watershed boundaries for which data are available. As shown on Figure 7, the subject property is located within the watershed referred to by MBK as "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 watershed was estimated to be able to deep percolate as groundwater recharge. Note that, as shown on Table 8-9 of LSCE&MBK (2013), several sub-watershed areas are tributary to the "Napa River Watershed near Napa."

Napa County recently promulgated new guidelines for WAA preparation with respect to groundwater recharge calculations in response to the Governor's Executive Order N-7-22 (PBES, 2022b). The County has mandated for parcels outside of the Napa Valley Subbasin of the Napa-Sonoma Valley Groundwater Basin, as defined by the California Department of Water Resources (CA DWR) Bulletin 118 (CA DWR, 2021), that groundwater recharge must consider "average rainfall" to be only the average annual rainfall that has occurred in the last 10 years. If a parcel is within the groundwater basin, then the allowable groundwater usage allotments are calculated as 0.3 acre feet per year (AFY) of allowable groundwater usage for each one acre of land occupied by the subject property.

Figure 8, "Groundwater Basin Map with Aerial Imagery," shows that only 8% (3.4 acres) of the 42.7-acre subject property lies within the Napa Subbasin of the Napa-Sonoma Groundwater Basin (CA DWR, 2021). That portion of the property is therefore subject to the 0.3 AFY per acre (AFY/ac) of allowable groundwater use rate mandated by Napa County (PBES, 2022b). For areas outside of the groundwater basin, a property-specific groundwater recharge calculation is required. That calculation is now mandated to consider the average rainfall for the most recent 10-year period. The 10-year average rainfall values throughout the County have been calculated by Napa County's consultants, and published as a publicly available map (Napa County GIS Data, 2022).

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As described above under the heading "Original Rainfall Calculation," the average annual rainfall value used to calculate groundwater recharge was 35.6 inches (2.97 ft), as derived from the PRISM data set (RCS, 2019). Using the County-mandated 10-year PRISM average (Napa County GIS Data, 2022), the average rainfall at the property is considered to be 30.1 inches (2.5 ft) per year. Table 4, "Recalculated Groundwater Recharge, The Vineyard House Property," shows the revised recharge calculation by RCS for the Vineyard House property using the updated County requirements.

Table 4: Recalculated Groundwater Recharge, The Vineyard House Property

	Portion of Property	Assessed Area (acres)	Average Rainfall (ft)	Rainfall Recharge Percentage (RCS, 2019)	Allowable Groundwater Use (AFY)
Original Calculation (RCS, 2019)	Entire Property	42.7	2.97	17%	21.6
Revised Calculation	Outside GWB	39.3	2.5	17%	16.7
	Inside GWB	3.4	0.3 AFY/ac (PBES, 2022d)		1.0
				Total =	**17.7**

GWB = Groundwater Basin

As shown above in Table 4, calculating recharge according to the County's revised guidelines, the allowable groundwater use at the property is 17.7 AFY, which is less than the 21.6 AFY previously calculated (RCS, 2019). It is also notable that a "prolonged drought analysis" is no longer required for WAA preparation due to the required use of the 10-year annual rainfall average and the unit groundwater use of 0.3 AFY/ac (PBES, 2022d). Those drought year analyses presented in the original WAA document (RCS, 2019) have not been included in this updated document.

Groundwater Recharge Compared to Groundwater Demand

The estimated average annual recharge volume (17.7 AFY) is greater than the estimated total onsite future (proposed) groundwater extraction of 11.5 AFY, and would result in a recharge "surplus" of 6.2 AF/yr. In the event that delivery of offsite easement water currently used at the property is disrupted or otherwise not available, the subject property owner may elect to use, if/as needed, a portion or all of the estimated groundwater recharge "surplus" of 6.2 AFY to irrigate the existing onsite vineyards. Even if groundwater is used to irrigate the onsite vineyards, the total annual groundwater use at the subject property will not exceed 17.7 AFY (the volume of site-specific annual groundwater recharge calculated above).

Estimate of Groundwater in Storage

To help evaluate possible impacts to the local aquifer systems that might occur as a result of pumping for the proposed project and pumping for offsite uses via the onsite easement well, the volume of groundwater extracted for the property 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 = 42.7 acres

b) Depth of Domestic Well = 350 ft bgs; the Domestic Well is the shallowest well on the subject property from which recent water level data are available, and thus for this analysis provide a more conservative estimate of the minimum thickness of currently saturated rocks within the Sonoma Volcanics that might exist beneath the property. Based on the depths of Wells 1 and 2, and on data listed on the driller's logs for Wells 1 and 2, rocks of the Sonoma Volcanics likely extend to a much greater depth than that of the Domestic Well, and thus, it is likely that the saturated zone beneath the property could extend much deeper to a depth of 700 ft or deeper.

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 approximately 190 ft vertical feet. This value is calculated using Domestic Well data by subtracting the RCS-measured SWL of about 160 ft brp in this well (measured in February 2018) from the reported depth to bottom of the perforations in the well at 350 ft bgs. Based on the available water level data presented in this Memorandum, that February 2018 SWL is the deepest SWL measured for this well, and thus is used here to provide a more conservative calculation of the minimum volume of groundwater currently in storage beneath the property. Further, as discussed in subpart (b) above, the saturated volcanic rock aquifers beneath the subject property, based on water level data from the other onsite wells, is actually much thicker; this would tend to create an even greater volume of groundwater currently in storage in this area.

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.

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e) Thus, a conservative estimate of the groundwater currently in storage (S), beneath the subject property (based on February 2018 water levels) is calculated as:

S = subject property area (subpart a) times saturated thickness (subpart c) times average specific yield (subpart d) = (42.7 ac)(190 ft)(2%) = 162.3 AF

In contrast, the average annual groundwater use for the property (including the conceptual future residence and the estimated annual groundwater extraction by the Harlan Easement Well) is estimated to be 11.5 AF/yr. Hence, the estimated groundwater demand for the entire property represents only about 7% of the groundwater conservatively estimated to currently be in storage in the rocks beneath the subject property based on water level data for February 2018. Furthermore, this percentage does not include 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 (which include those groundwater extractions from the Harlan Easement Well) should not cause a net deficit in the volume of groundwater within the aquifers beneath the site so as to impact nearby wells to a point that they would not support existing or permitted land uses.

Groundwater Quality

Samples of groundwater were collected by OPS from Wells 1 and 2 at the end of each 24-hour constant rate pumping test on June 17 and 21, respectively. Table 5, "Summary of Available Groundwater Quality Data," summarizes water quality data from laboratory analyses of those groundwater samples; the laboratory analyses were performed by Caltest Analytical Laboratory of Napa, California. Data presented on Table 5 reveal the following with regard to key water quality constituents for groundwater pumped by Wells 1 and 2:

- The character of the groundwater from the local volcanic rock aquifer systems appears primarily to be a mixed calcium-magnesium-bicarbonate ($Ca\text{-}Mg\text{-}HCO_3$) type of water.
- Specific conductance (also known as electrical conductivity, or EC) was reported to be 380 microSiemens per centimeter (µS/cm) in Well 1, and 390 µS/cm in Well 2.
- Total dissolved solids (TDS) was detected at 280 mg/L in Well 1, and at 270 mg/L in Well 2.
- Total hardness (TH) was reported to be 160 milligrams per liter (mg/L) in Well 1, and 150 mg/L in Well 2. Water with a TH between 120 and 180 mg/L is considered to be "hard."
- The pH of groundwater was reported to be 7.0 in Well 1, and 7.4 in Well 2. These values indicate that the water is neutral (pH is 7) to slightly basic (above pH 7).
- The adjusted sodium adsorption ratio (SAR) was reported to be 0.49 in Well 1, and 0.78 in Well 2.
- Nitrate (as N) and nitrite (as N) were reportedly not detected in either well.
- Arsenic (As) was detected at a concentration of 2.3 micrograms per liter (µg/L) in Well 1, and 5.4 µg/L in Well 2; arsenic has a State Primary Maximum Contaminant Level (MCL) of 10 µg/L for water to be used for domestic purposes. Thus, arsenic

concentrations in Wells 1 and 2 appear to be below the Primary MCL for this constituent.

- Boron (B) was reportedly not detected in either well.
- Iron (Fe) was reportedly not detected in Well 2, but was detected at a concentration of 2,200 µg/L in Well 1. This iron concentration in Well 1 appears to be anomalously high. Typically, turbid samples can cause “false positive” results of excessive to elevated iron concentration. In this instance, the turbidity of the Well 1 sample was found to be only 0.5 nephelometric turbidity units (NTU). Nevertheless, an iron concentration of 2,220 µg/L is still anomalously high. For domestic water-supply purposes, iron has a State Secondary MCL of 300 µg/L.
- The manganese (Mn) concentration in Well 1 was reported to be 120 µg/L in Well 1, and 40 µg/L in Well 2. Because the State Secondary MCL for this constituent is 50 µg/L, then the Mn concentration in Well 1 exceeds this MCL for domestic use.

Thus, elevated concentrations of manganese and possibly iron (depending on if the sample was turbid upon analysis) were detected in Well 1; elevated concentrations of Fe and/or Mn are relatively common in groundwater within rocks of the Sonoma Volcanics. Although Well 1 is not currently equipped with a permanent pump and currently used for existing onsite domestic water demands, treatment of these elevated constituents will be required if the well is to be used for the domestic portion of the proposed winery water demands (e.g., winery employees and guests). Since Well 2 did not have any elevated concentrations of these constituents at this time, it may be possible that water from Well 1 could be blended with water from Well 2.

Tier 3 – Evaluation of Stream and Spring Interference

This Tier 3 analysis was requested prior to the issuance of the list of County-defined Significant Streams (Napa County, 2022b) and the County-defined 1,500-foot buffer areas around those Significant Streams (Napa County, 2022c), and therefore includes analysis of many drainage channels in the vicinity of the subject property identified by PBES in January 2022 that would not need to be analyzed today. However, RCS is providing the Tier 3 analyses performed as requested in 2022, even though such analyses are not required under the current Tier 3 WAA rules and regulations.

A map was also provided by Napa County PBES that shows the approximate locations of blue-lined streams identified by the County in the vicinity of the Vineyard House property. The map was adapted from Figure 2 prepared by RCS for the Tier 1 WAA (RCS, 2019). Figure 9, “Napa County PBES Markup” shows the markup map that was provided to the applicant as part of a subsequent conversation with the project planner and civil engineer related to the County PBES-requested Tier 3 WAA. A number of streamlines and offset distances are shown on Figure 9, suggesting a number of active, intermittent stream channels on the property. Notable on the map is the fact that a number of the streamlines shown on the southwestern portion of the property (with highlighted offset distances from Well 1) are not “blueline streams” as shown in the Napa County “bluelines_public” GIS data layer, nor are they “blueline streams” shown on the USGS topographic map for the Rutherford Quadrangle (USGS, 1951). Figure 1 shows that the purple-colored drainage channels do not coincide with “blueline” perennial or intermittent streams shown on the USGS basemap. It is the opinion of RCS that the relatively short, purple-colored

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stream lines shown on Figure 1 do not represent streams (perennial, intermittent, or otherwise), but likely represent drainage channels that collect sheet-flow runoff water during and immediately following rain events.

Site Visit for Tier 3 WAA

Based on conversations with the Project Planner and the Project Civil Engineer, Mr. Jeff Redding and Mr. Mike Muelrath, respectively, RCS understands that the "blueline" intermittent streams and drainage channels at the subject property were diverted underground into piped drainages long before the current owner took possession of the property. To confirm the subsurface piping, RCS performed a site visit to the subject property on May 12, 2022, with Mr. Redding and Mr. Muelrath. Figure 2 shows various data points and observations made by the RCS geologist during that visit. Location data shown on Figure 2 were collected using a mobile phone GPS mapping application. During the site visit, the geologist visited the locations of each of the drainages and "blueline" intermittent streams shown on the Figure 9, County-prepared map. As noted on the map, three of the four "blueline" intermittent streams were noted to be flowing at the time of the site visit. The northwestern "blueline" intermittent stream was noted to be dry by the RCS geologist (see Figure 2).

During the site visit, the geologist also observed and recorded the locations of visible infrastructure associated with the subsurface piping. Those points are shown on Figure 2, and are labeled with the geologist's observations. Observations included: inflow or inlet points, where surface water entered a corrugated metal pipe (CMP) or corrugated plastic pipe (CPP); and drainage system access panels on the property roads where metal covers could be lifted and CMP/CPP pipe junctions could be observed. Using those data, RCS prepared an inferred pipe layout based on the observable points of infrastructure. The inferred subsurface pipe locations are shown as the green-colored lines on Figure 1, Figure 2, and Figure 3B. The inferred pipe locations illustrate the fact that the "blueline" intermittent stream flow and drainage channels are directed to the subsurface pipe drainage system, and the flows are confined to the subsurface pipes. Hence, within the boundaries of the subject property, any stream flow that may exist cannot interact with the subsurface.

The geologist also measured the water levels in both of the project wells in May 2022. In Well 1, a static (non-pumping) water level depth of 126 ft below ground surface (bgs) was measured. Well 2 was being actively pumped during the site visit, and the pump was observed by the geologist to be frequently cycling on and off. During a period of non-pumping, the geologist measured a water level of 142.8 ft bgs in Well 2. This water level is not considered to be a true static level, as the well was still recovering from the recent pumping events while the measurement was taken. Hence, this water level is considered to be a "pumping water level" for the purposes of this Memorandum.

Well Construction and Hydrogeology

Well 1 and Well 2, the wells that will provide groundwater for the proposed project, are constructed similarly. Both wells have deep cement sanitary seals (57 ft bgs for Well 1, and 56 ft bgs for Well 2), and their perforations range between the depths of 105 and 705 ft bgs in Well 1, and 110 ft

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and 710 ft bgs in Well 2. As stated above, both wells derive groundwater from aquifers within the Sonoma Volcanics. Figure 3B, “Geologic Map (2017),” is a geology map of the property updated with the “blueline” intermittent stream information, the county-drawn drainages, and the field-inferred locations of the subsurface pipes. In addition, Figure 3B shows the alignments of three geologic cross sections created by RCS for the purposes of this Tier 3 analysis. These same cross section alignments are also shown on Figures 1 and 2.

Each of the cross sections are shown on Figures 10, 11, and 12, Cross Sections A-A’, B-B’, and C-C’, respectively. The cross sections are scaled drawings, and show the interpreted geologic conditions beneath the property and the construction of the wells. Each section is notated with the surface features that each cross section intercepts, including the subsurface piping, surface water channels, drainages, etc. Also shown on the cross sections are water level measurements previously collected in the wells. Specifically, each cross section shows two water levels for the wells depicted on the section: the water level measured by the geologist during the May 12, 2022 site visit described above; and one measurement collected in 2016 during prior work at the property, as reported on Table 1.

Important to note from the cross sections are the depths of the water levels in the wells in relation to the “blueline” intermittent stream channels and County-drawn drainages. Water levels from 2016 and 2022 in both Well 1 and Well 2 are at elevations on the order of 50 to 150 ft below the surface channels in question. The closest elevation difference between a water level and a blueline surface water channel is illustrated on cross section C-C’ (see Figure 12). As shown thereon, the static water level measured in June 2016 in Well 2 was roughly 50 ft lower in elevation than the surface water channel that begins at the CMP outflow pipe located 650 ft northeast of the well. This significant elevation difference between the water level elevations in the wells and the surficial stream channels is significant evidence to support the assertion that the project wells are not hydraulically connected to the “blueline” intermittent streams that surround the subject property.

It is also noteworthy that neither Well 1 nor Well 2 have perforated casing within the shallow, unconsolidated alluvial deposits that are shown on Figure 3B (see the cross sections also). Therefore, these wells do not pump groundwater from the unconsolidated alluvial sediments. In fact, both wells have deep cement sanitary seals (deeper than 50 ft bgs) and deep perforations (beginning deeper than 100 ft bgs) that preclude the pumping of groundwater by these wells from the unconsolidated alluvial deposits.

Based on the data above, and as illustrated on the cross sections, neither Well 1 nor Well 2 are hydraulically connected to the “blueline” intermittent streams that surround the Vineyard House property. As shown on the Figure F-2 “Decision Tree” in the County’s WAA Guidance Document (Napa County, 2015), and described in the Guidance Document text, because the project wells are not hydraulically connected to surface water(s), the “Groundwater/Surface Water Evaluation is complete.”

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Key Conclusions and Recommendations

1. The existing property is currently developed with 26 acres of vineyards, landscaping, ancillary buildings for offices and storage, and a residence.
2. The proposed project consists of developing a new winery with a production capacity of 30,000 gallons of wine per year.
3. Current groundwater demands for the existing property are estimated by ACE to be approximately 5.6 AF/yr. This demand includes 0.750 AF/yr for the existing residence and 4.815 AF/yr for the landscape irrigation (lawn and other associated landscaping).
4. The future average annual groundwater demand for the proposed project (including the proposed winery, conceptual new residence, and existing landscape irrigation demands) is estimated to be approximately 5.3 AF/yr by ACE (and approximately 4.55 AF/yr if there is no new residence constructed onsite). Recall that the existing residence will be converted to winery uses, and therefore future water demand for that structure is included in the proposed winery demands. While there is no current plan to do so, a new residence could conceptually be constructed at some time in the future. To present a more conservative analysis, water demands for the conceptual residence are included in the total proposed water demand for the project.
5. The Harlan Easement Well is located on The Vineyard House property, and groundwater pumped from this Easement Well is transmitted to the offsite Harlan Estate property. Water demands for the onsite Harlan Easement Well have been estimated to be approximately 6.2 AF/yr. These offsite Harlan demands include water used for: a single residence; estimated vineyard acreage of 8.9 acres; estimated orchard acreage of 0.7 acres; and a winery. The actual amount of groundwater extracted from this Easement Well for these offsite uses is unknown due to a lack of a flow meter on this well. However, for this analysis, an estimated groundwater extraction of approximately 6.2 AF/yr from the Harlan Easement Well is considered to be conservative, since there appear to be at least four other water wells on the Harlan Estate property. Therefore, the total annual groundwater extraction (for onsite and offsite use) of the subject property is estimated to be approximately 11.5 AF/yr (approximately 5.3 AF/yr for The Vineyard House property and 6.2 AF/yr for the Harlan Estate property).
6. Historically, roughly 30% of the existing onsite water demand for the irrigation of onsite landscaping was met via the collection of spring water that flows from an offsite spring to the subject property. Currently, 100% of the existing onsite landscaping irrigation comes from (and will continue to come from)[8] pumping groundwater from Well 1, Well 2, and/or the Domestic Well (if needed). All future winery water demands will be met by pumping groundwater from Well 1 and Well 2 only (i.e., the project wells). If ever constructed in the future, water demands for a conceptual onsite residence would be met by pumping groundwater from Well 1, Well 2, or the Domestic well.

[8] For the purposes of this WAA, to present a more conservative analysis, it is assumed no spring water (and therefore, only groundwater) will be used for irrigation in the future.

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7. To meet the estimated peak monthly demand groundwater of the project each year, Well 1, Well 2, and the Domestic Well would need to pump at a combined rate of 17 gpm to meet the irrigation demands during the assumed 4-month irrigation season (landscaping) and also to meet the year-round winery and future residential water demands. This total peak combined pumping rate assumes Well 1 and Well 2 would be pumping on a 50% operational basis (pumping 12 hours per day, every day) throughout the year.

8. Based on the results of the separate constant rate pumping tests of Wells 1 and 2 in June 2016 (both wells were pumped at a constant rate of 50 gpm for a continuous period of 24 hours), Wells 1 and 2 appear to be more than capable of pumping at rates needed to meet the future groundwater demands needed from the project (17 gpm is the peak combined rate needed each August). Using the pumping data generated from the pumping tests performed in June 2016, the combined pumping capacity of the two project wells is currently on the order of 100 gpm.

9. Aquifer testing, which included a step drawdown test, background water level monitoring, a constant rate pumping test, and a final water level recovery period, were performed in Wells 1 and 2 between April and June 2016. Water level measurements were automatically recorded during each constant rate test by water level pressure transducers that were installed by RCS geologists into Well 1, Well 2, and the Domestic Well; occasional manual water level measurements were also collected by the pumper in the onsite Harlan Easement Well. Results of these pumping tests of Wells 1 and 2 revealed that following for each well:

   - Well 1 was pumped at an average rate of 50 gpm for a period of 24 continuous hours. Based on a static water level of 98.1 ft brp, a maximum water level drawdown of 8.2 ft was created; this calculated to a current specific capacity value of 6.10 gpm/ft ddn. Results of the Well 1 pumping test also showed that water levels did not become completely stable at the end of the pumping portion of the aquifer test, but were only slowly declining at a rate of about 0.2 ft/hr in the last 4 hours of testing. Following 24 hours of water level recovery, water levels in the well were 83% recovered (of the full water level drawdown experience during testing), and reached 100% full recovery (water levels at pre-pumping test levels) after a period of 2 days. During the pumping portion of Well 1 aquifer test, no water level drawdown impacts were induced in onsite Well 2, the Domestic Well, or the onsite Harlan Easement Well.

   - Well 2 was also pumped at a constant rate of 50 gpm for a period of 24 continuous hours. Pumping data from this testing revealed that the total water level drawdown was observed to be 91.3 ft. Based on a pre-test static water level of 69.1 ft brp, the specific capacity value for this well was calculated to be 0.55 gpm/ft ddn. Results of the Well 2 pumping test also showed that water levels did not become completely stabilized at the end of the pumping test, and were declining at a rate of 0.85 ft/hr in the last 4 hours of testing. Recovery water level data was recorded in this well for a period of 3 days, and after 3 days, water levels did not completely recover to their pre-pumping test levels. After 24 hours following the end of the pumping test, water levels had recovered to 88% (up to 80 ft brp). Only very minor water level drawdown impacts were observed in the nearby Domestic Well during the pumping test of Well 2. Water levels in the Domestic Well decreased by only 0.3 ft during the pumping test in Well 2.

10. Groundwater recharge at the subject property on an average annual basis is estimated to be 17.7 AFY when calculating recharge according to the County's revised guidelines. This is 6.2 AF/yr more than the 11.5 AF/yr estimated to be extracted on an average annual basis in the future from the subject property. In the event that delivery of the offsite easement water currently used for vineyard irrigation is disrupted or otherwise not available, the property owner may elect to use the "surplus" 6.2 AF/yr of groundwater (on average) to irrigate the existing onsite vineyards. Even if groundwater is used to irrigate the onsite vineyards, the total groundwater use at the subject property will not exceed 17.7 AFY (the calculated volume of site-specific annual groundwater recharge).

11. Because a lack of hydraulic connection has been demonstrated, according to the WAA Guidance document (Napa County, 2015), the Tier 3 analysis has been satisfied. Well 1 and Well 2 (the project wells) are not in direct hydraulic connection with any of the County-defined "blueline" intermittent stream channels or the drainage channels shown on Figure 1 or 2. This lack of connection is demonstrated by the following:

    a. The project wells are constructed solely into consolidated, fractured volcanic rock formations. Hence, neither well has any perforations in the unconsolidated alluvial deposits.

    b. Both wells have deep cement seals (>50 ft bgs) and even deeper perforated interval (beginning at depths >100 ft bgs)

    c. Based on the hydrogeology of the property and the known well construction, the two project wells are not able to produce water from shallow, unconsolidated alluvial materials.

    d. Water levels in the two project wells are currently and have always been at much lower elevations than the "blueline" intermittent stream elevations.

    e. Within the boundaries of the subject property, the "blueline" intermittent streams are diverted to subsurface piping that flow through the property. Hence, the streams are isolated from and cannot interact with the alluvial deposits within the property.

12. In the future, RCS recommends monitoring on a regular basis of static and pumping water levels, and also of the instantaneous flow rates and cumulative pumped volumes from each of the onsite wells via the use of water level pressure transducers and dual-reading flow meters (that records both flow rate and totalizing values, respectively). RCS also recommends that new water level transducers be purchased and installed in your wells to permit the automatic, frequent, and accurate recording of water levels in those wells. By continuing to observe the trends in groundwater levels and future well production rates/volumes over time by qualified professionals, potential declines

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in water levels and well production in the onsite wells can be addressed in a timely manner.

13. Based on available water quality data, groundwater pumped by the existing wells contains elevated to excessive concentrations of iron and manganese. Thus, because this water is used for domestic purposes, treatment for these constituents will be needed. It is relatively common for wells constructed into the Sonoma Volcanics to produce groundwater that contains elevated to excessive concentrations of iron and/or manganese.

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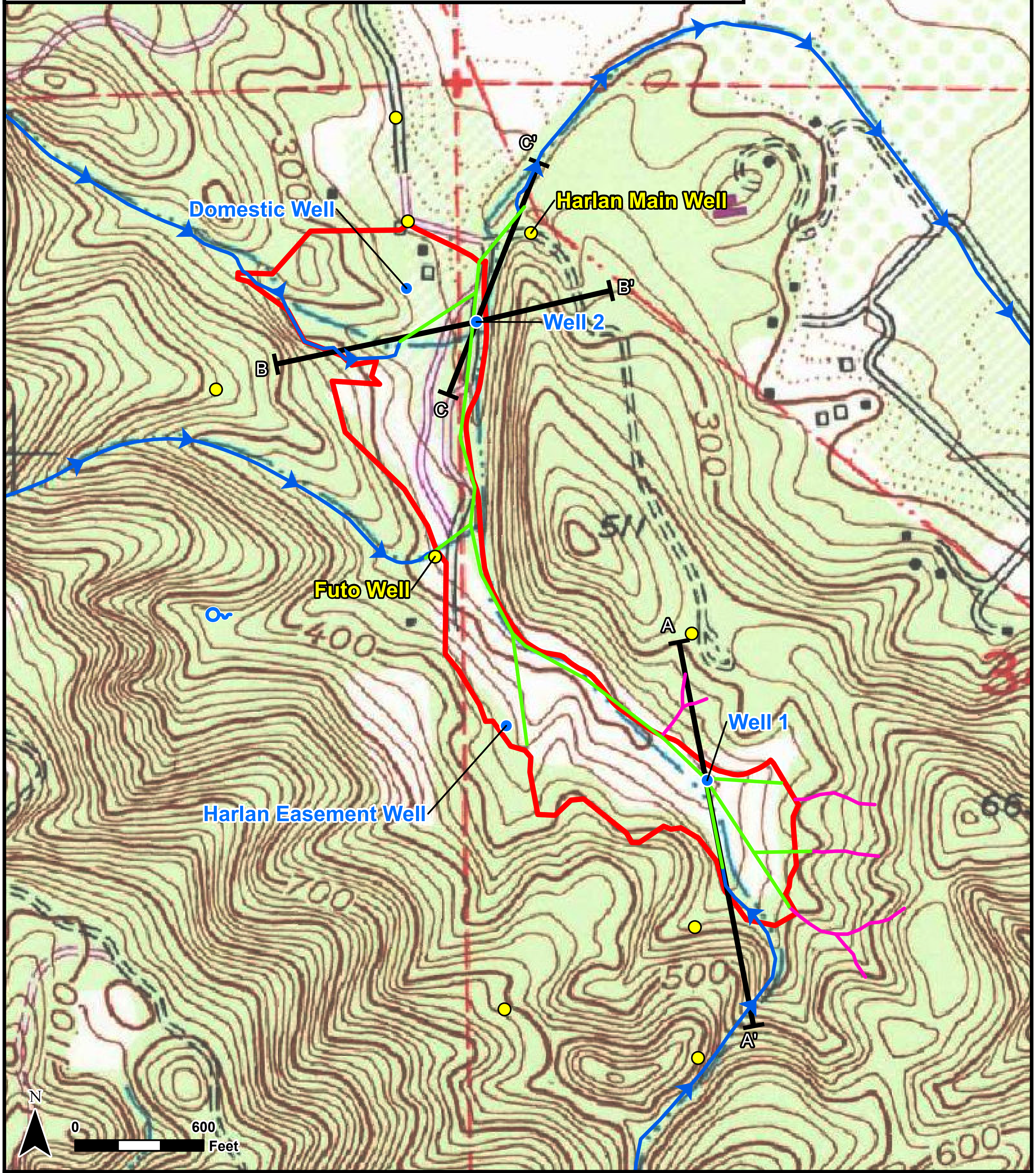
Basemap Credit: U.S. Geological Survey, 1951, USGS 1:24000-scale Quadrangle for Rutherford, CA 1951: U.S. Geological Survey.



LEGEND

- Onsite Well Location
- Approximate Offsite Well Location
- Approximate Subject Property Boundary
- Approximate Spring Location
- Napa County GIS Bluelines (2004)
- County-Drawn Channel
- Subsurface Pipe, Inferred
- A A' Cross Section

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Figure 1
Location Map

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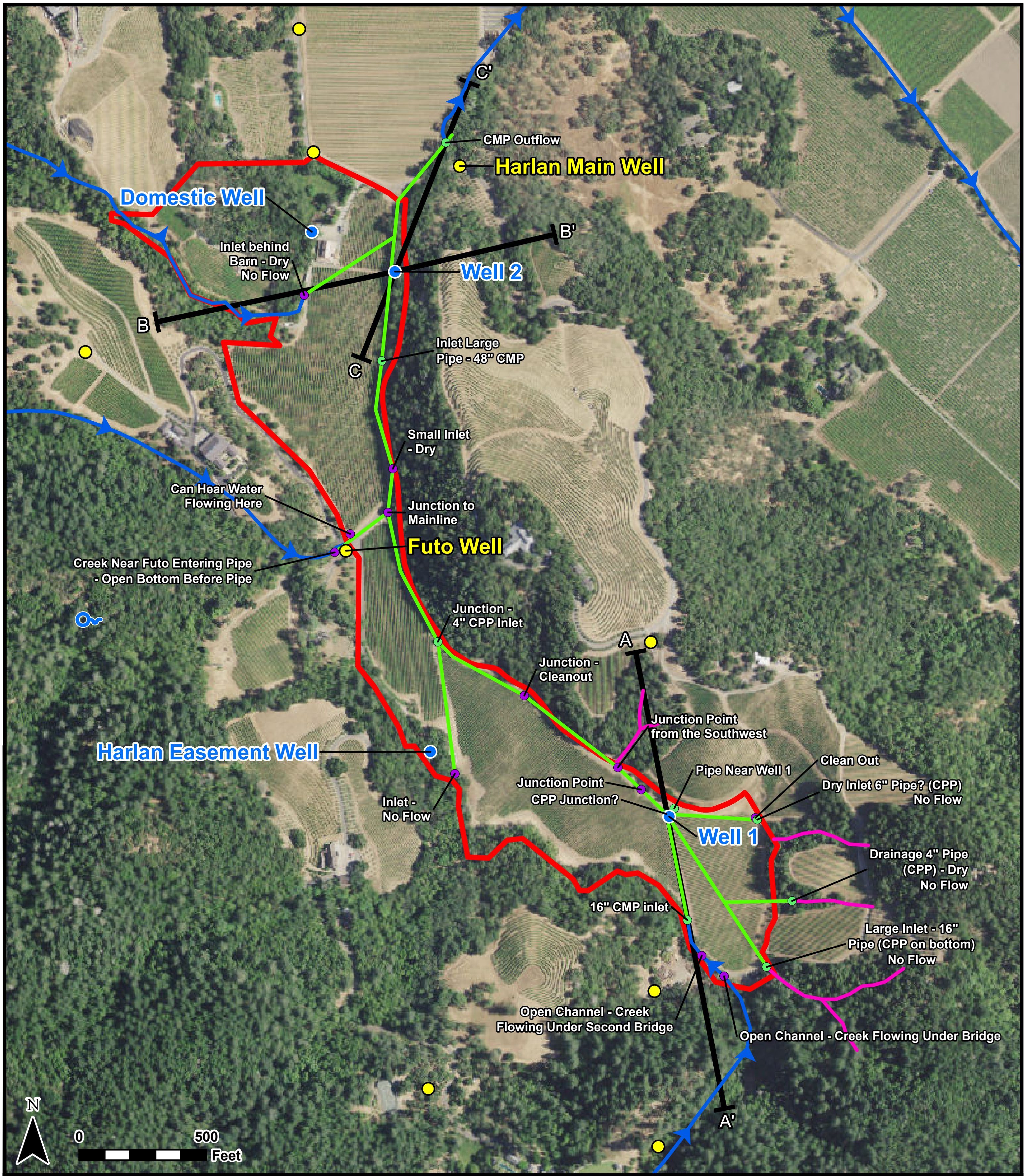

LEGEND

- Approximate Subject Property Boundary
- Onsite Well Location
- Approximate Offsite Well Location
- Subsurface Pipe
- Other Point of Interest
- Approximate Spring Location
- County-Drawn Channel
- Subsurface Pipe, Inferred
- Napa County GIS Bluelines (2004)
- A A' Cross Section

RCS

Figure 2
Aerial Photograph Map

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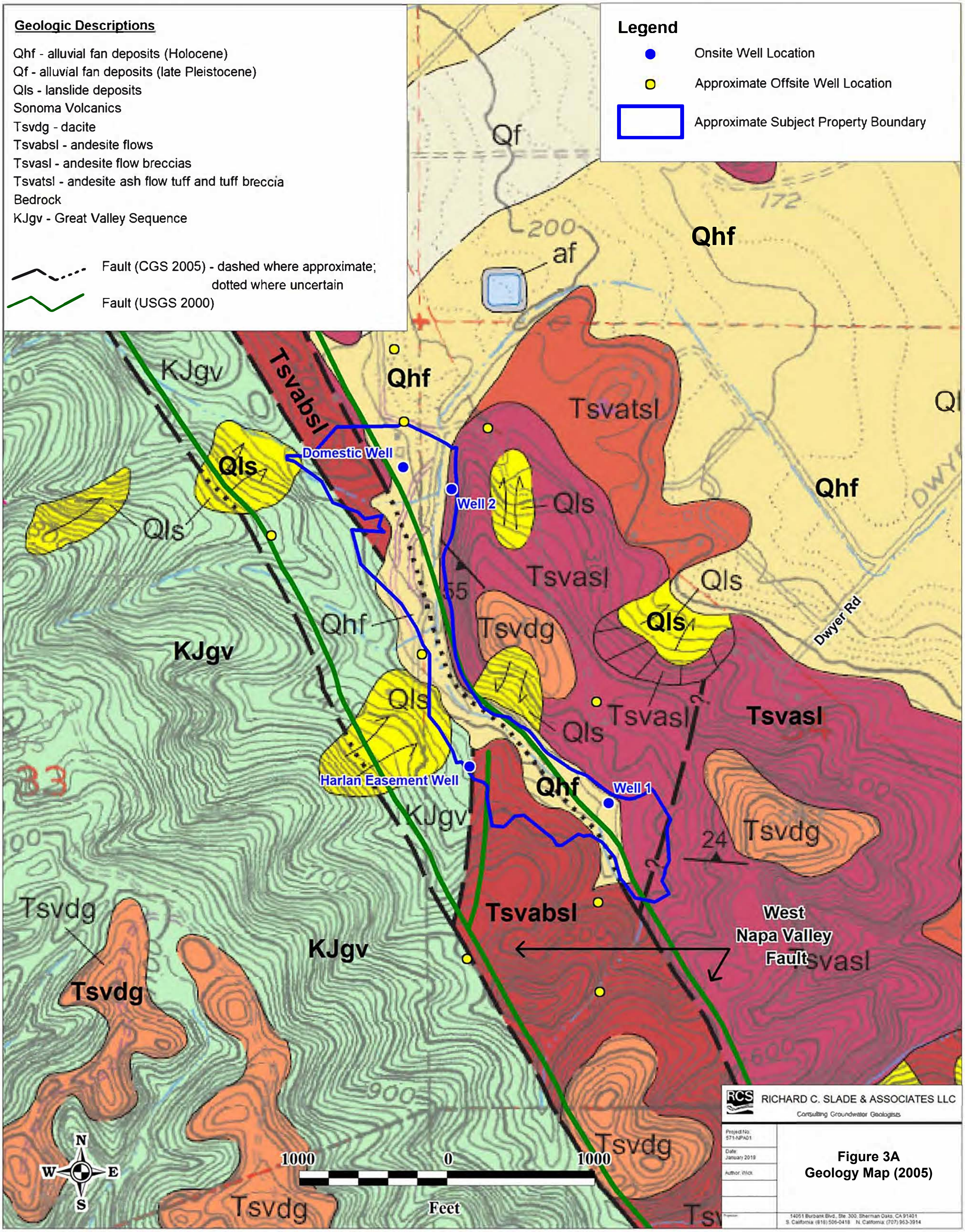
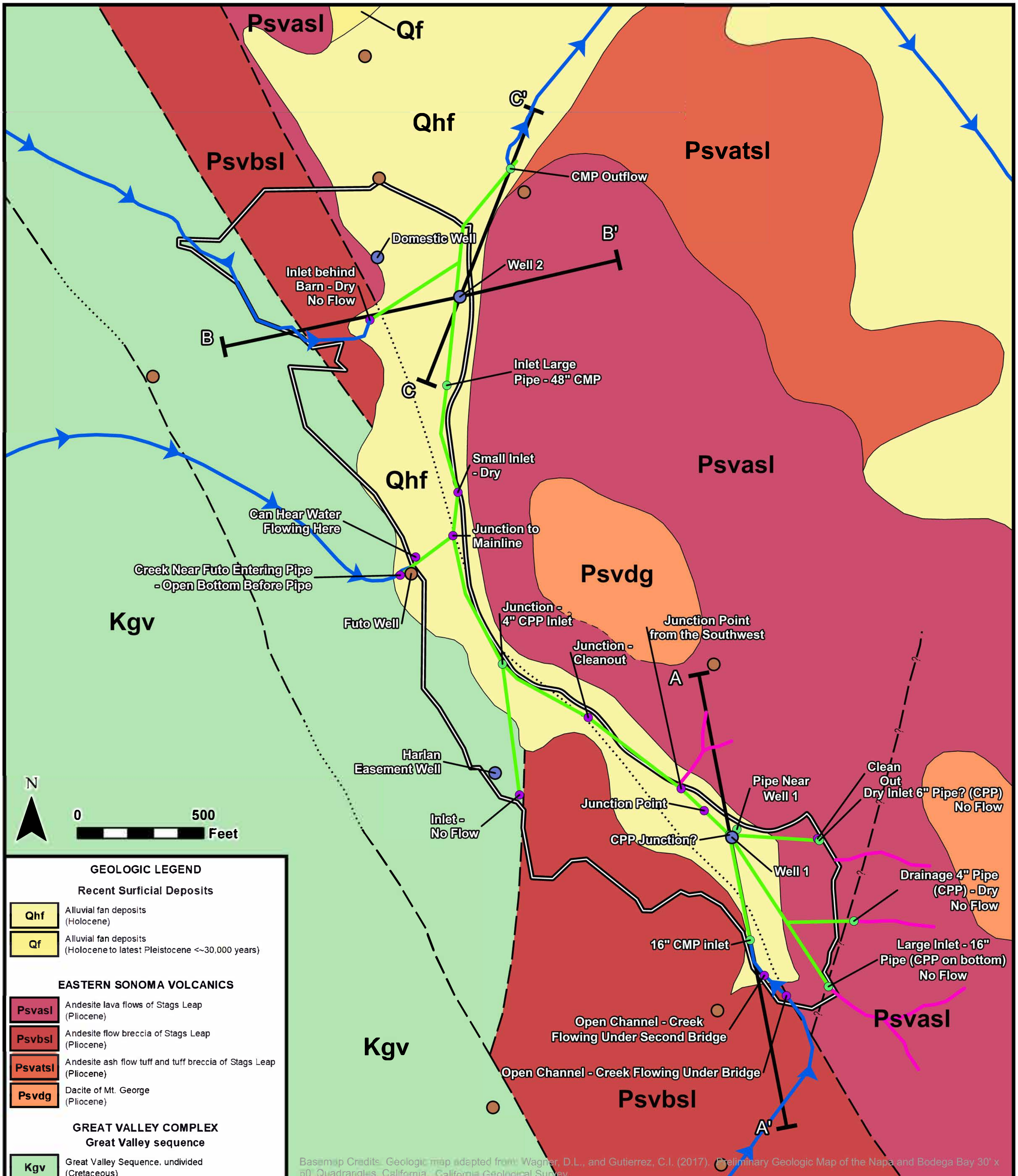


Figure 3A
Geology Map (2005)



LEGEND

- Subject Property Boundary
- Offsite Well
- Onsite Well
- Subsurface Pipe
- Other Point of Interest
- Napa County GIS Bluelines (2004)
- County Drawn Channels
- Subsurface Pipes, Inferred
- A–A' Cross Section

RCS

Figure 3B
Geology Map (2017)

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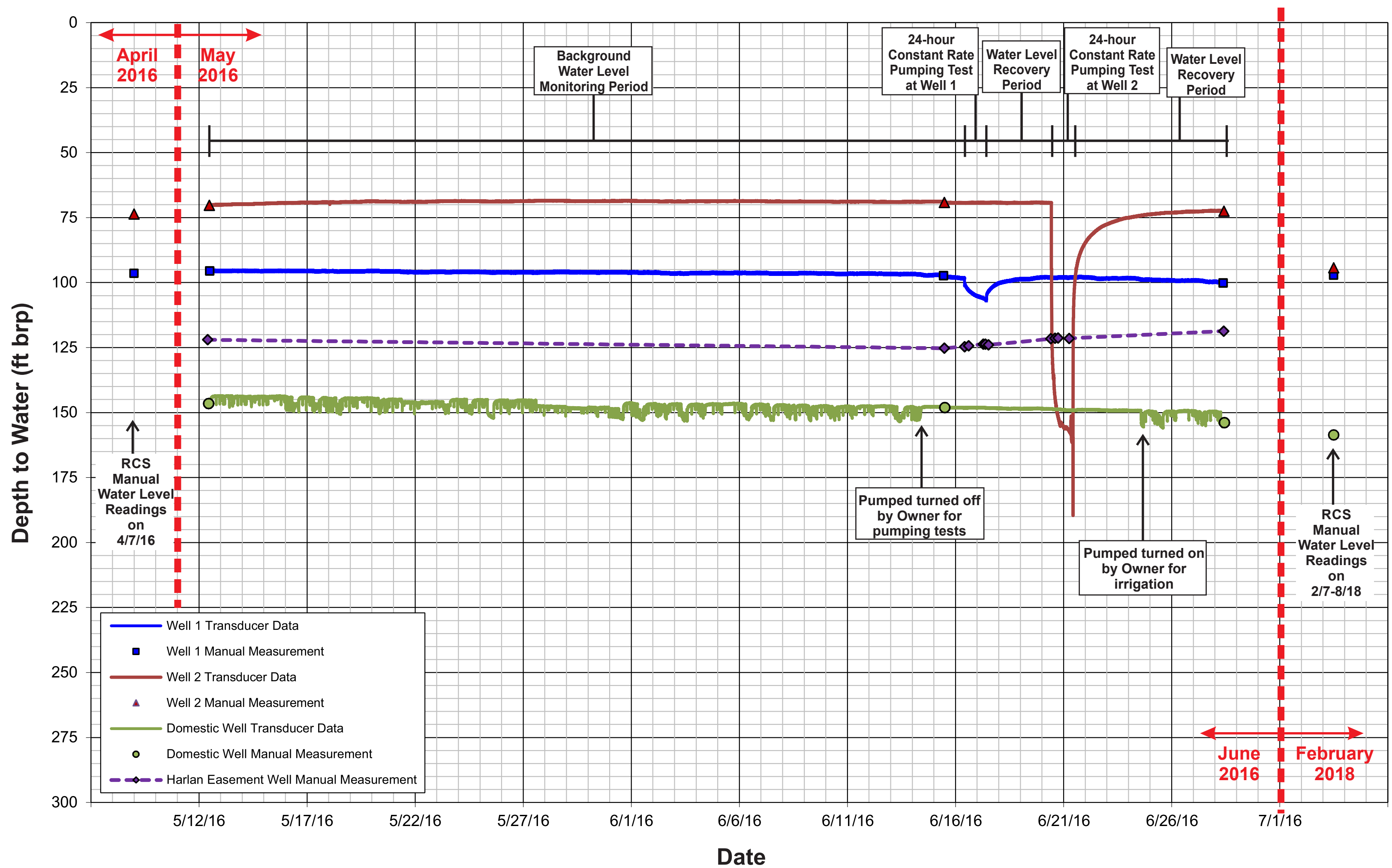

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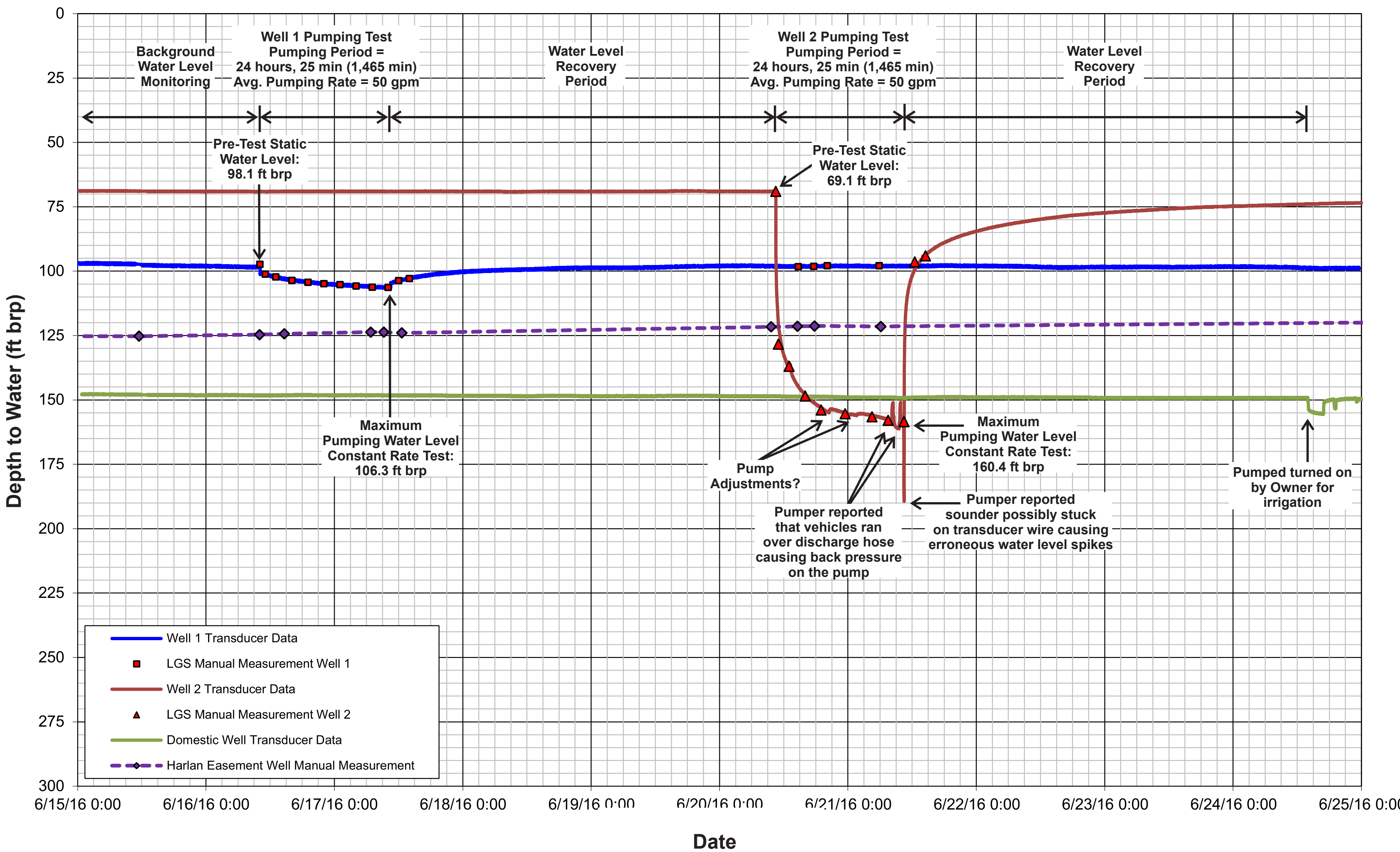
RICHARD C. SLADE & ASSOCIATES LLC
CONSULTING GROUNDWATER GEOLOGISTS
14051 Burbank Boulevard, Ste. 300
Sherman Oaks, CA 91401
Southern California (818) 506-0418
Northern California (707) 963-3914
www.rcslade.com

FIGURE 4
WATER LEVEL DATA DURING MONITORING PERIOD
EXISTING ONSITE WELLS
THE VINEYARD HOUSE

Job No. 571-NPA04

September 2024



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Sherman Oaks, CA 91401
Southern California (818) 506-0418
Northern California (707) 963-3914
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FIGURE 5
WATER LEVELS DURING CONSTANT RATE PUMPING TESTs
WELL 1 AND WELL 2
VINEYARD HOUSE WINERY

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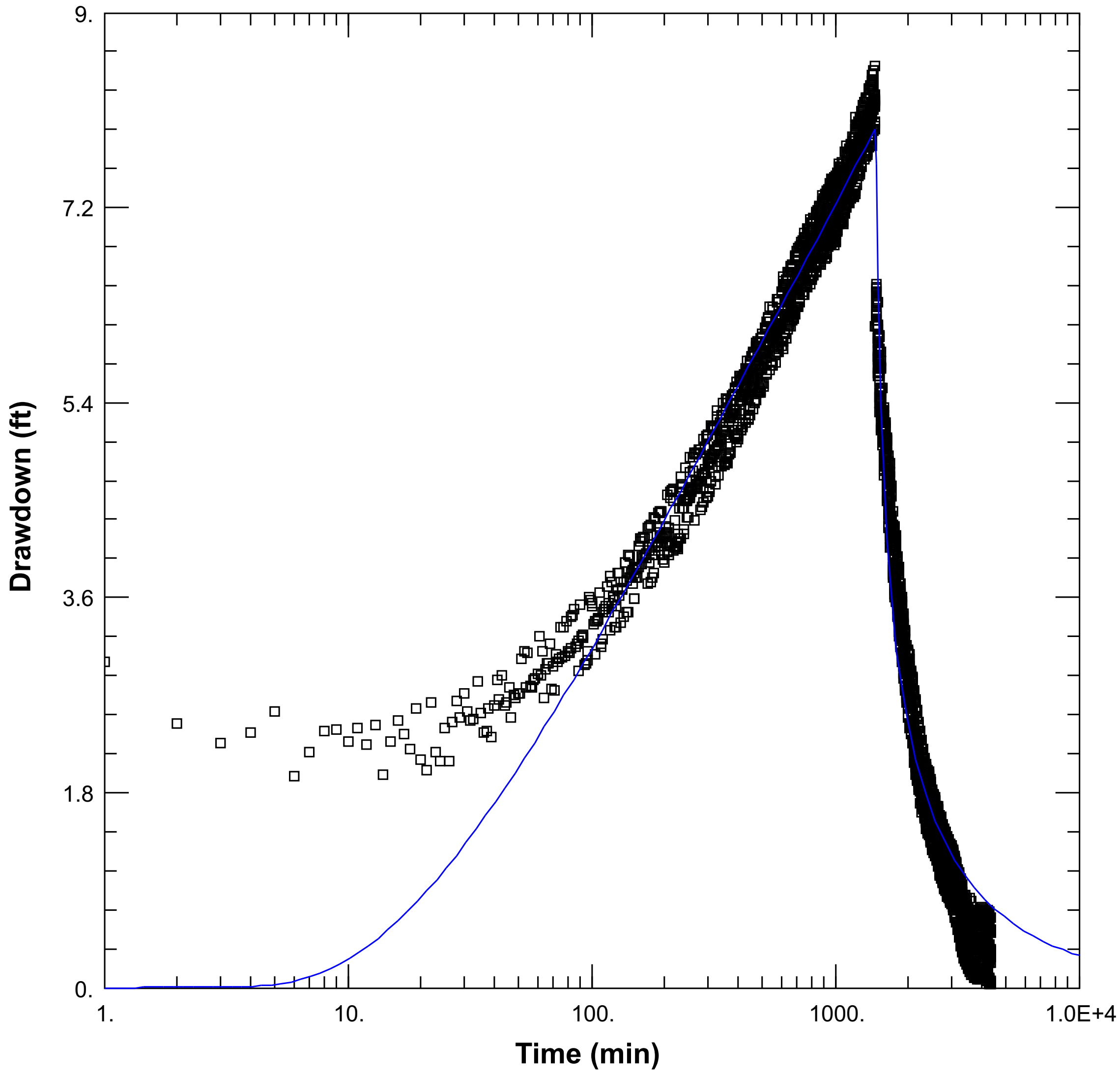

Obs. Wells

□ Well No. 1 (pumping well)

Aquifer Model

Confined

Solution

Theis

Parameters

T = 3,090 gal/day/ft

*No storativity (S) value because Well No. 1 is the pumping well.

Test Date = June 16, 2016 (24-hour test)

Pre-Test Static Water Level = 98.1 ft brp

Average pumping rate = 50 gpm

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

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Sherman Oaks, CA 91401
Southern California (818) 506-0418
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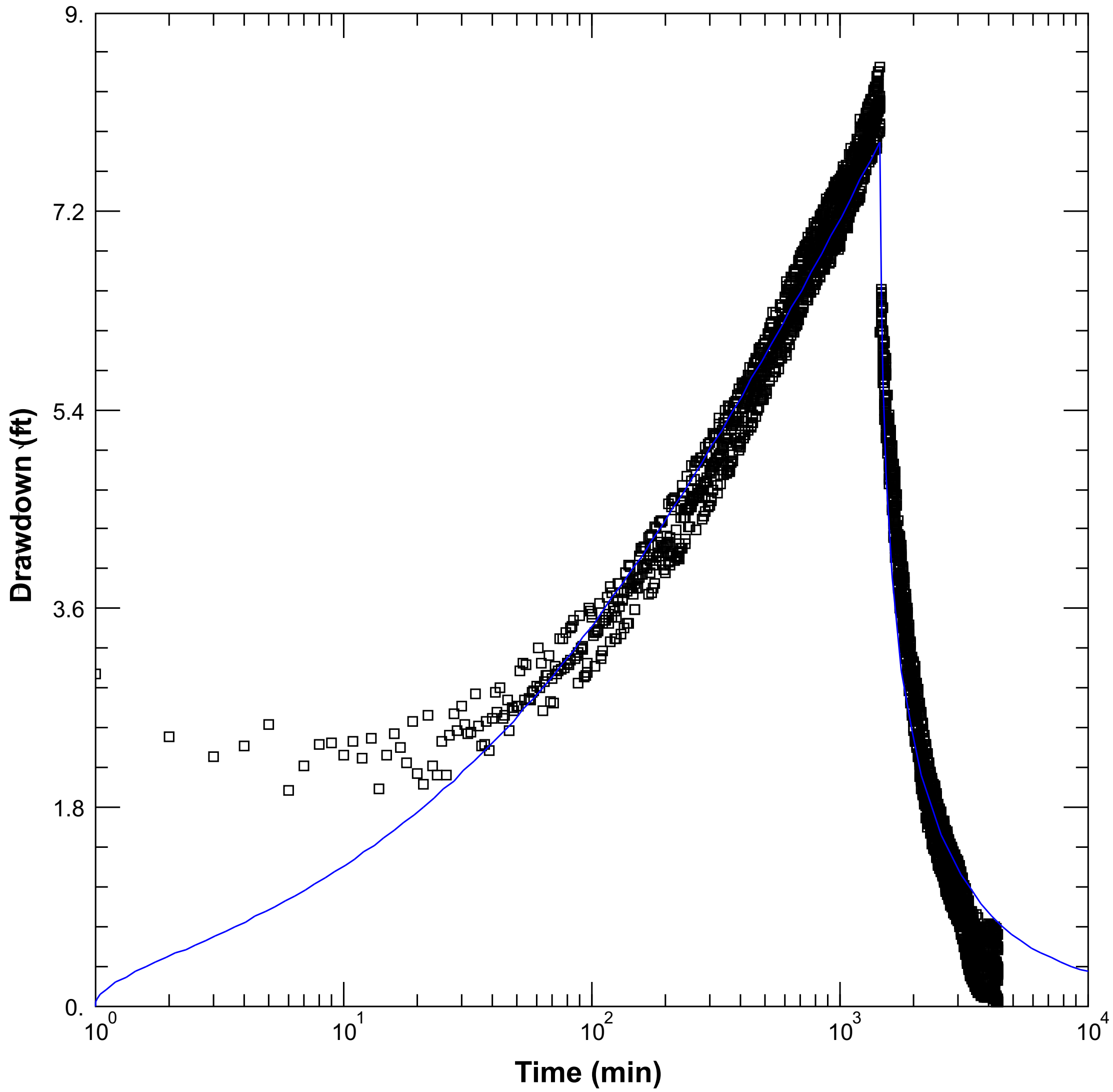
FIGURE 6A
CONSTANT RATE PUMPING TEST ANALYSIS
THEIS CONFINED AQUIFER SOLUTION
WELL NO. 1 (PUMPING WELL)

Job No. 571-NPA04

September 2024



Obs. Wells

□ Well No. 1 (pumping well)

Aquifer Model

Fractured

Solution

Barker w/ slab blocks

Parameters

T = 1,820 gal/day/ft

*No storativity (S) value because Well No. 1 is the pumping well.

Test Date = June 16, 2016 (24-hour test)

Pre-Test Static Water Level = 98.1 ft brp

Average pumping rate = 50 gpm

Graphical Solution by:
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by Hydrosolve, Inc.

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CONSULTING GROUNDWATER GEOLOGISTS
14051 Burbank Boulevard, Ste. 300
Sherman Oaks, CA 91401
Southern California (818) 506-0418
Northern California (707) 963-3914
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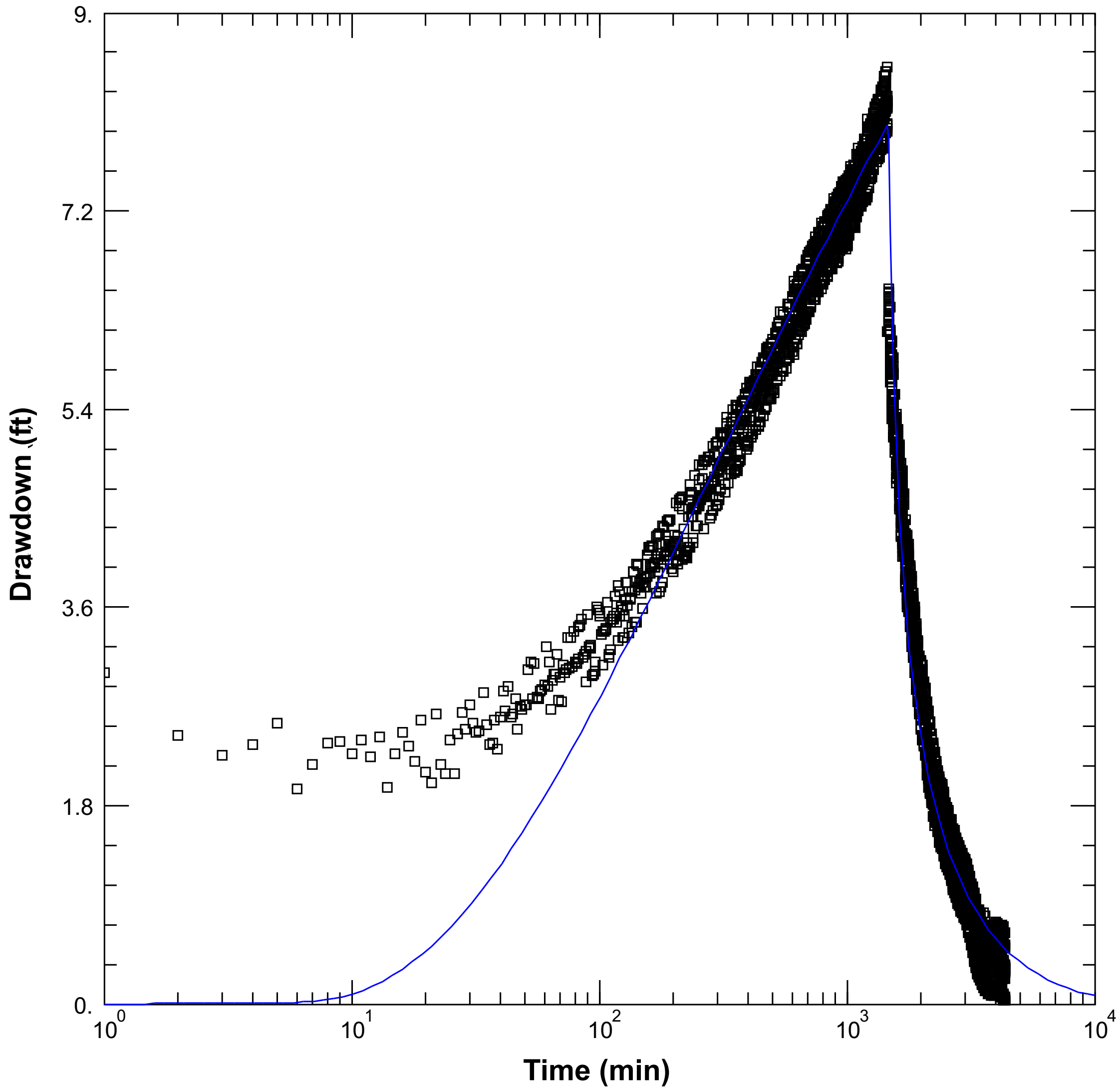
FIGURE 6B
CONSTANT RATE PUMPING TEST ANALYSIS
BARKER FRACTURED AQUIFER SOLUTION
WELL NO. 1 (PUMPING WELL)

Job No. 571-NPA04 September 2024



Obs. Wells

□ Well No. 1 (pumping well)

Aquifer Model

Leaky

Solution

Hantush-Jacob

Parameters

T = 2,540 gal/day/ft

*No storativity (S) value because Well No. 1 is the pumping well.

Test Date = June 16, 2016 (24-hour test)

Pre-Test Static Water Level = 98.1 ft brp

Average pumping rate = 50 gpm

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

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Southern California (818) 506-0418
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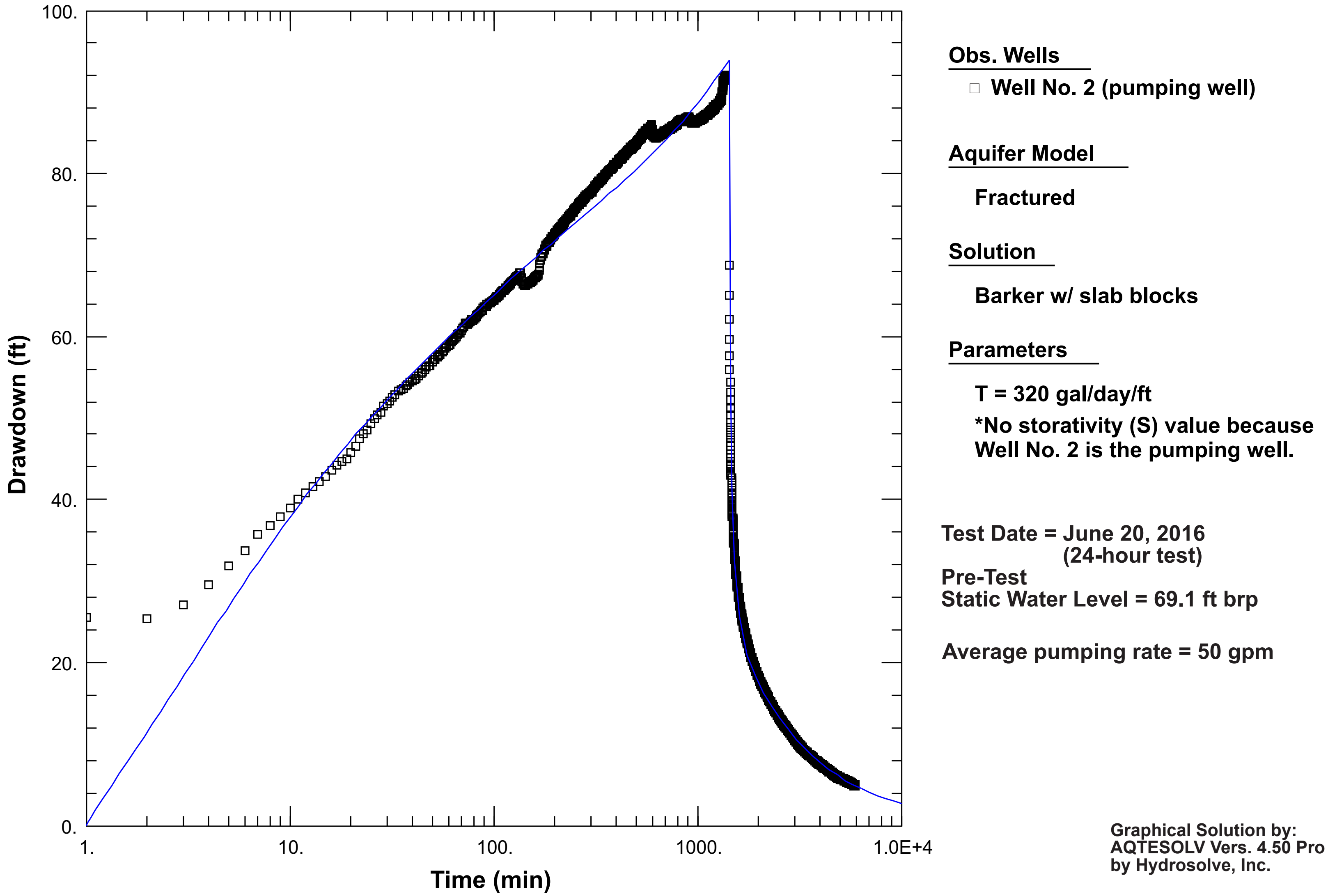
FIGURE 6C
CONSTANT RATE PUMPING TEST ANALYSIS
HANTUSH-JACOB LEAKY AQUIFER SOLUTION
WELL NO. 1 (PUMPING WELL)

Job No. 571-NPA04 September 2024



Test Date = June 20, 2016
(24-hour test)
Pre-Test
Static Water Level = 69.1 ft brp

Average pumping rate = 50 gpm

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

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Sherman Oaks, CA 91401
Southern California (818) 506-0418
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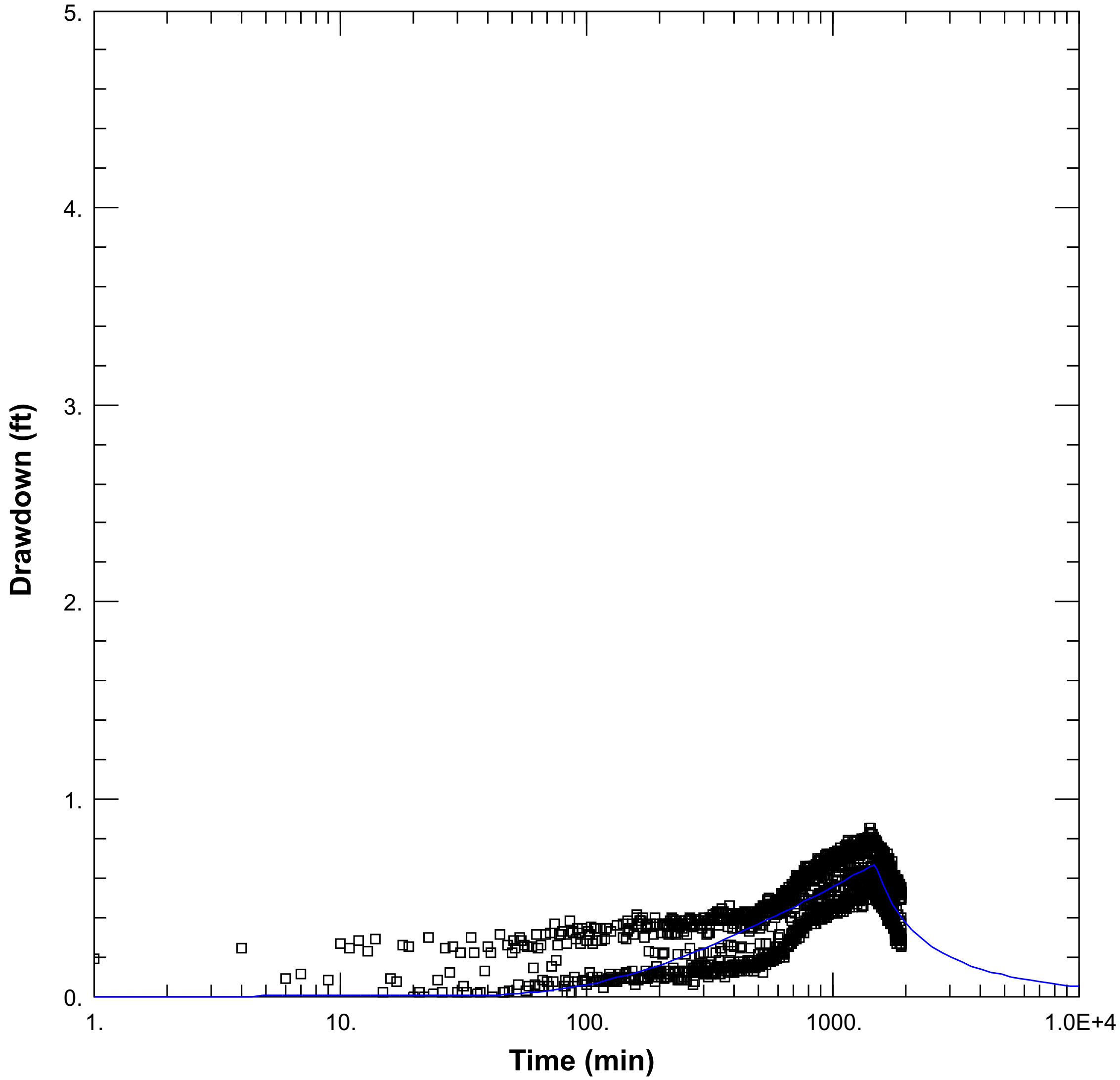
FIGURE 6D
CONSTANT RATE PUMPING TEST ANALYSIS
BARKER FRACTURED AQUIFER SOLUTION
WELL NO. 2 (PUMPING WELL)

Job No. 571-NPA04 **September 2024**



Obs. Wells

□ Domestic Well

Aquifer Model

Confined

Solution

Theis

Parameters

T = 17,880 gal/day/ft

s = 5.7 x 10 $^{-3}$

Test Date = June 20, 2016
(24-hour test)
Pre-Test
Static Water Level = 69.1 ft brp

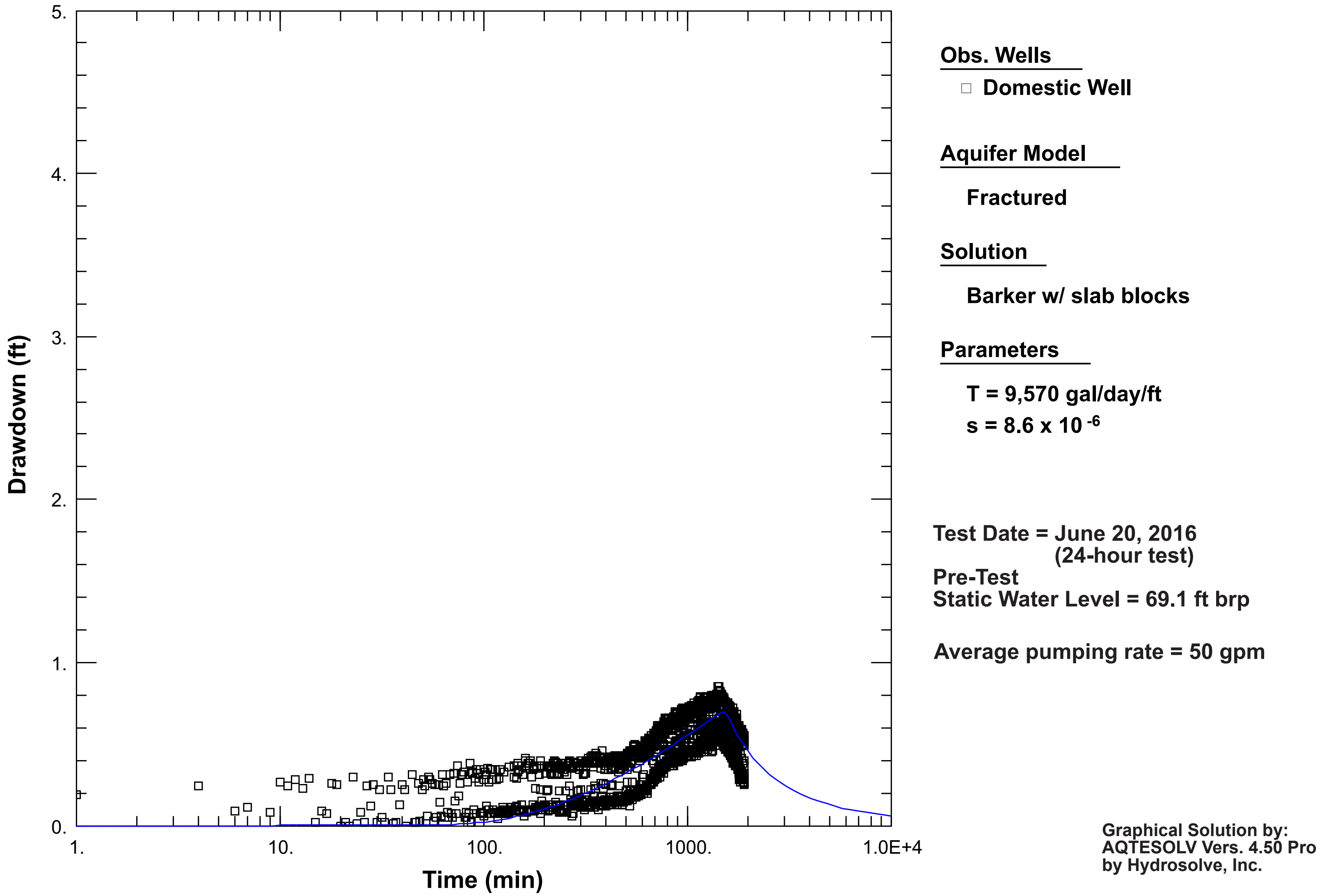
Average pumping rate = 50 gpm

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

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

FIGURE 6E
CONSTANT RATE PUMPING TEST ANALYSIS
THEIS CONFINED AQUIFER SOLUTION
DOMESITC WELL (OBSERVATION WELL)

Job No. 571-NPA04 — September 2024



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Sherman Oaks, CA 91401
Southern California (818) 506-0418
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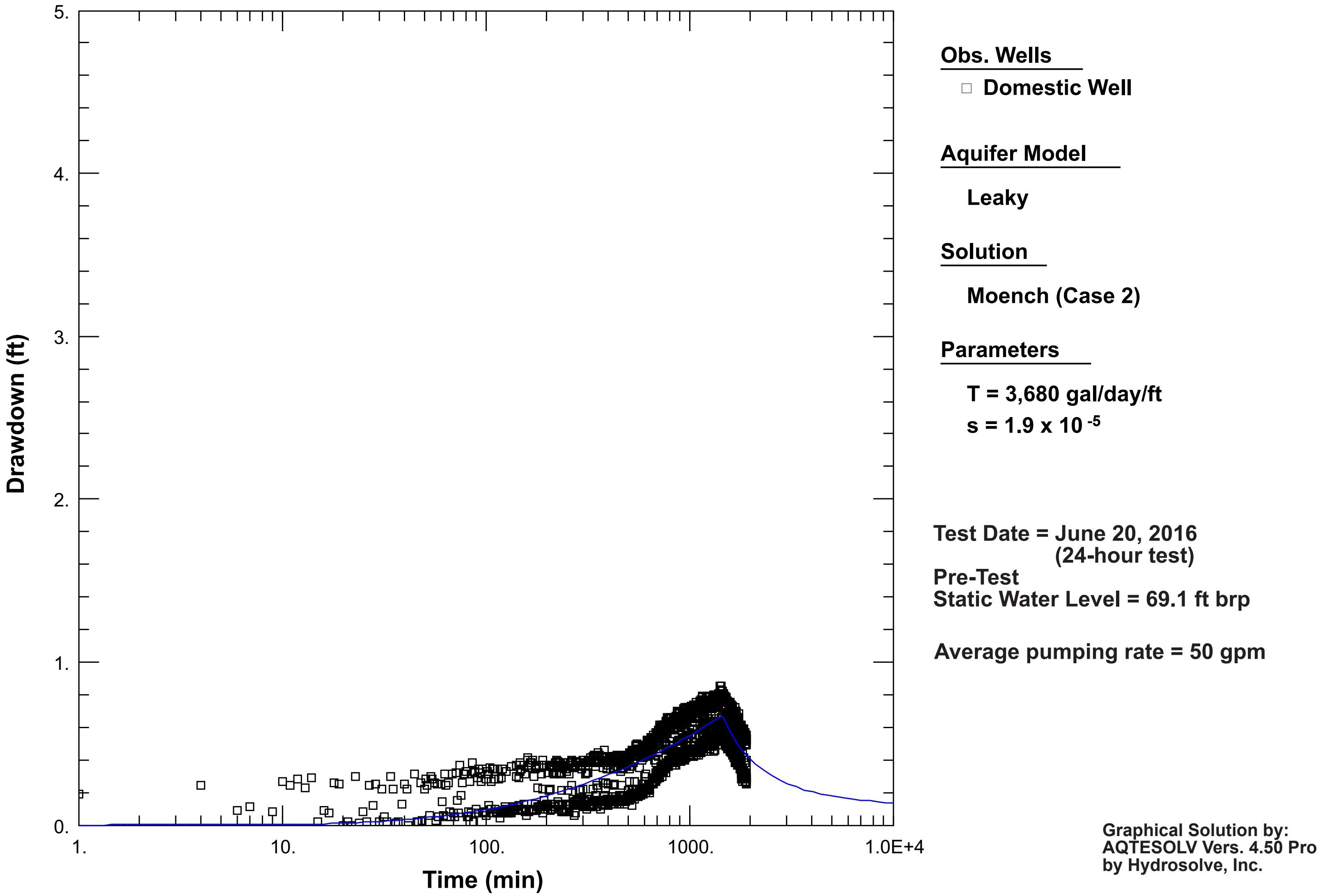
FIGURE 6F
CONSTANT RATE PUMPING TEST ANALYSIS
BARKER FRACTURED AQUIFER SOLUTION
DOMESTIC WELL (OBSERVATION WELL)

Job No. 571-NPA04 **September 2024**



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www.rcslade.com

FIGURE 6G
CONSTANT RATE PUMPING TEST ANALYSIS
MOENCH LEAKY AQUIFER SOLUTION
DOMESTIC WELL (OBSERVATION WELL)

Job No. 571-NPA04 September 2024

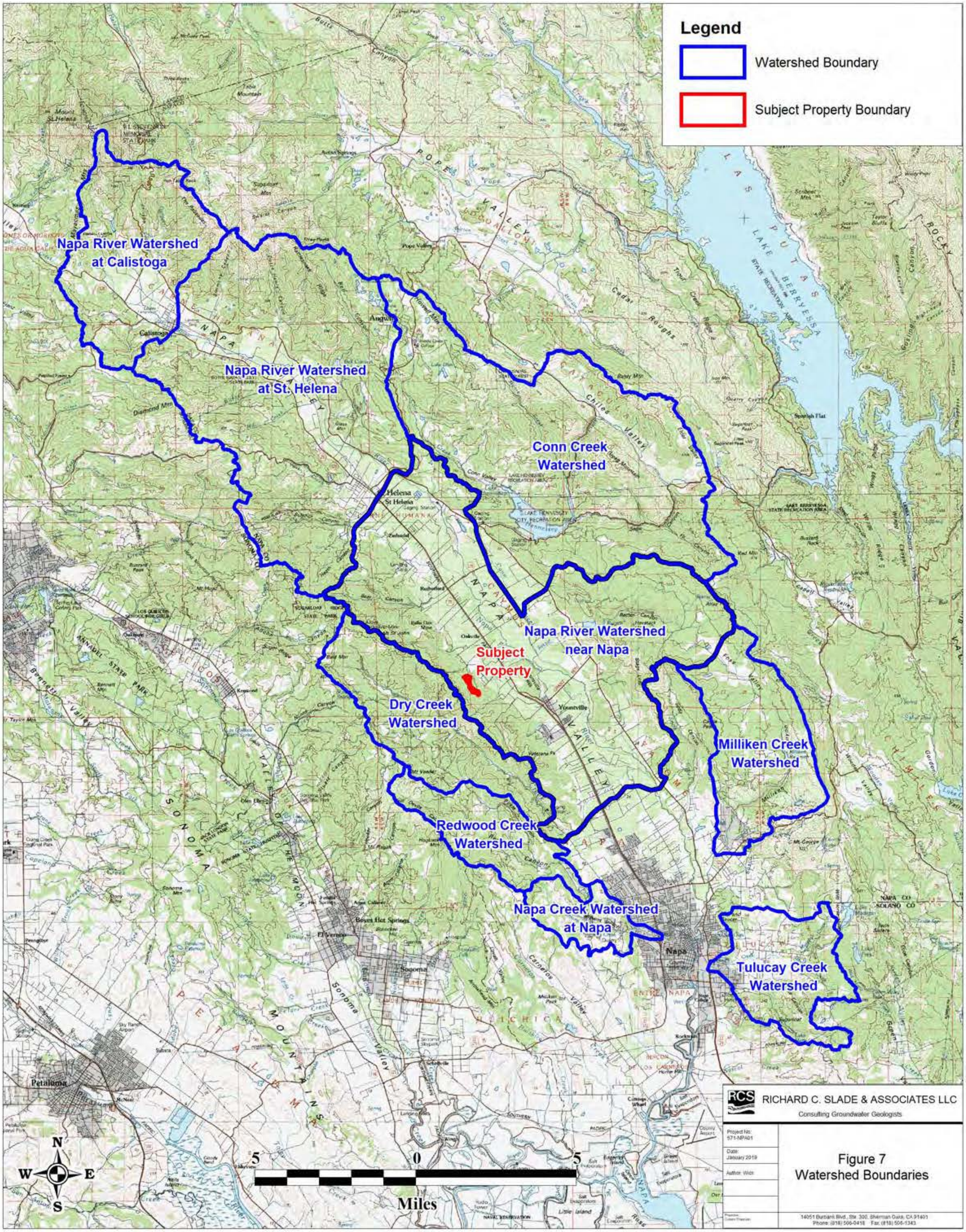


Figure 7
Watershed Boundaries

LEGEND

- Onsite Well
- Offsite Well
- Subject Property Boundary

Bulletin 118 California Groundwater Basins (DWR; Version 6.2; 12/6/2021)

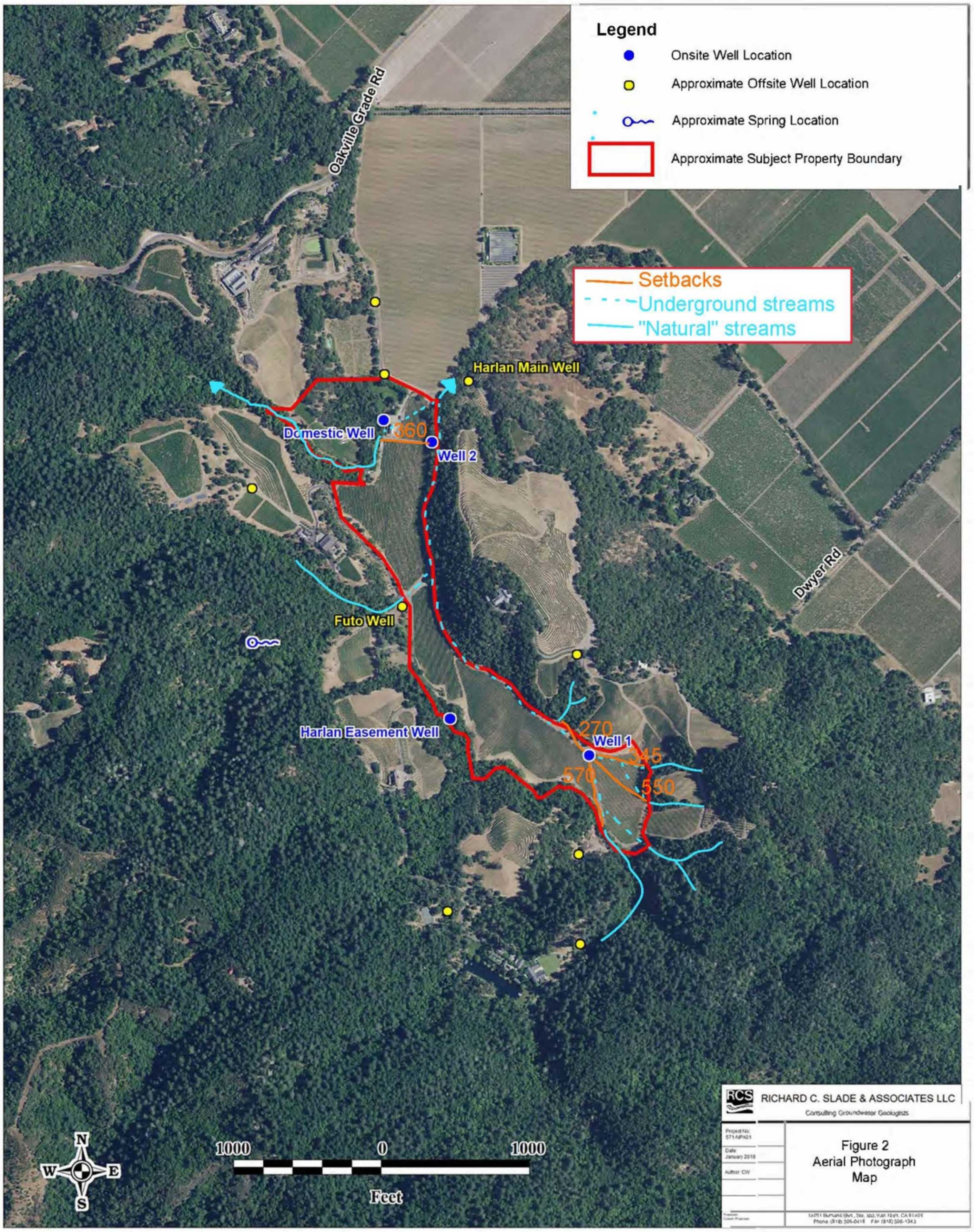
- Napa Valley Subbasin of Napa-Sonoma Valley Groundwater Basin

RCS

Figure 8
Groundwater Basin Map with Aerial Imagery

RCS Job No. 571-NPA04 **September 2024**

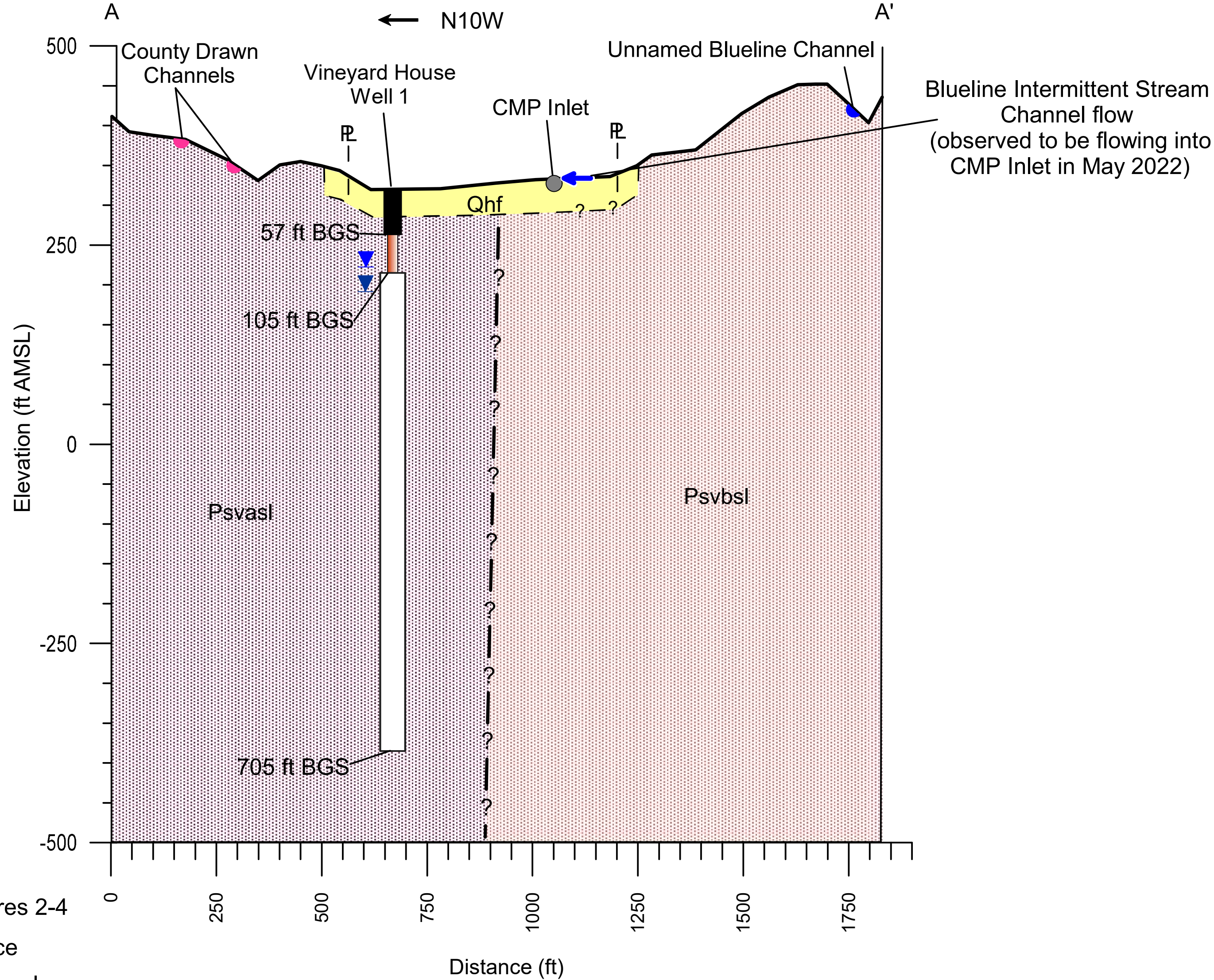
Spatial Reference: NAD 1983 StatePlane California II FIPS 0402 Feet



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

Figure 9
Napa County PBES Markup

Job No. 571-NPA04 **September 2024**



Vertical Exaggeration = 2x

See location of section line on Figures 2-4

ft BGS = Feet Below Ground Surface

ft AMSL = Feet Above Mean Sea Level

LEGEND

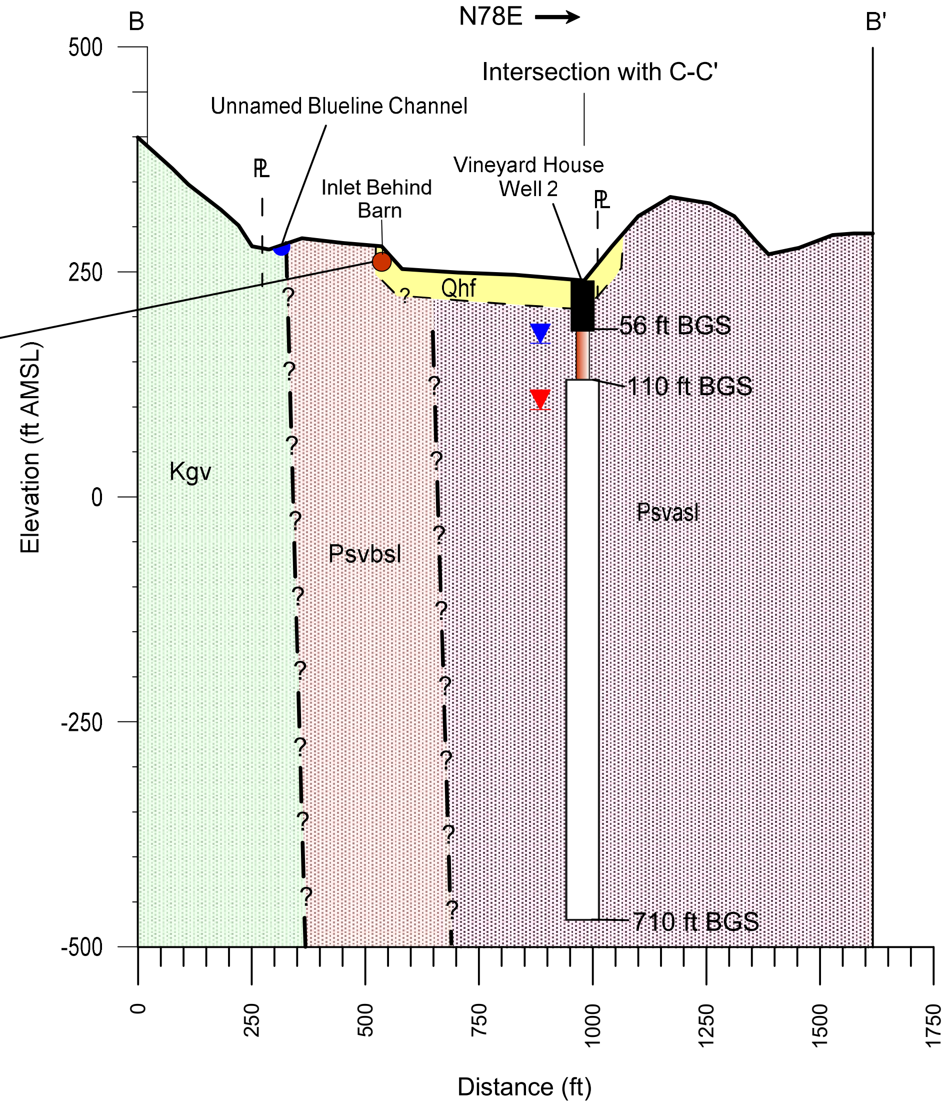
- Cement Seal
- Blank Casing
- Perforated Interval
- Static Water Level (June 2016)
- Static Water Level (May 2022)
- Qhf — Alluvial fan deposits (Holocene)
- Psvasl — Andesite lava flows of Stags Leap (Pliocene)
- Psvbsl — Andesite flow breccia of Stags Leap (Pliocene)
- Fault, Queried where Approximate

RCS

FIGURE 10
CROSS SECTION A-A'

RCS Job No. 571-NPA04

September 2024



Vertical Exaggeration = 2x

See location of section line on Figures 2-4

ft BGS = Feet Below Ground Surface

ft AMSL = Feet Above Mean Sea Level

LEGEND

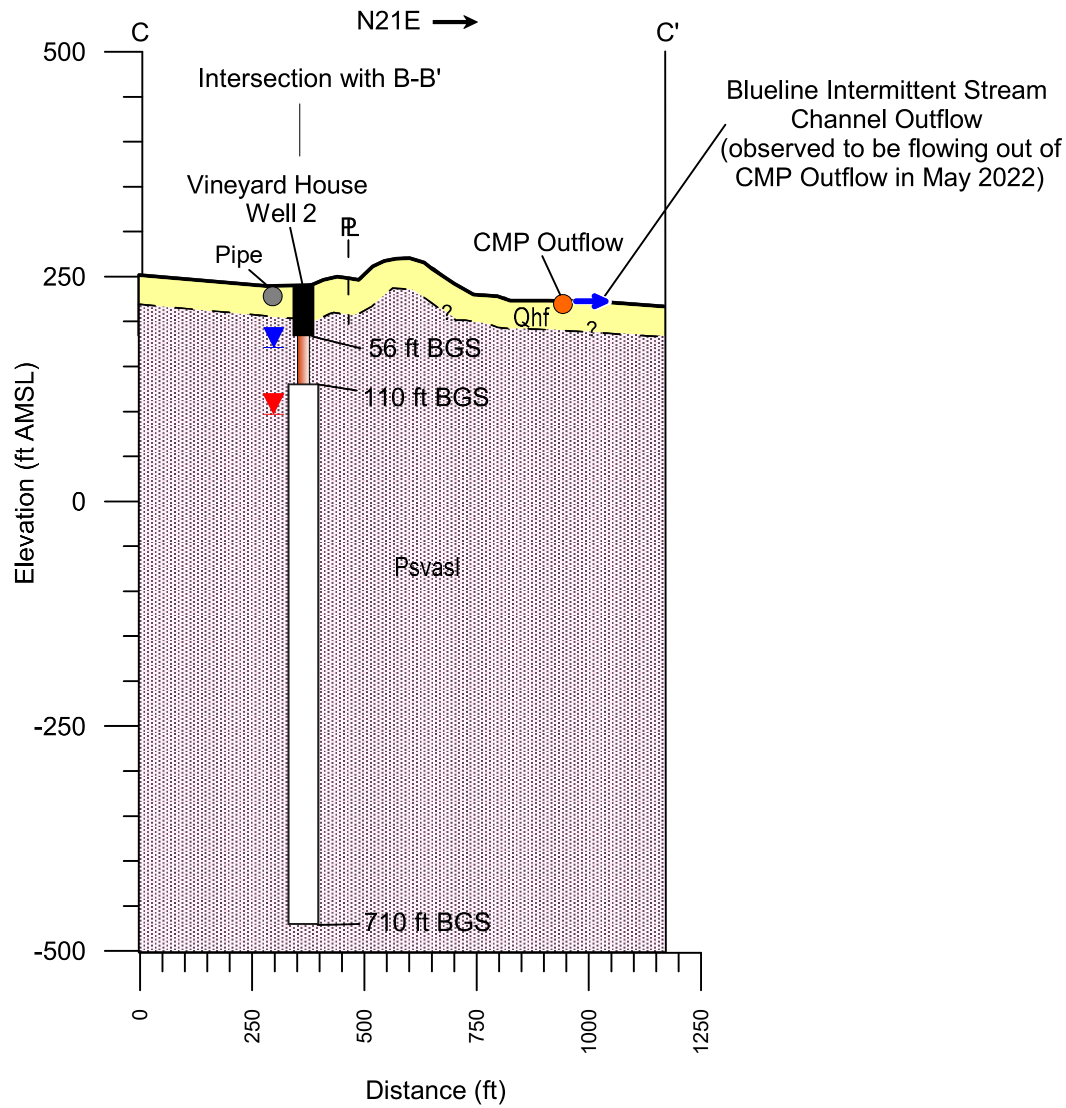
- Cement Seal
- Blank Casing
- Perforated Interval
- Static Water Level (June 2016)
- Pumping Water Level (May 2022)
- Qhf — Alluvial fan deposits (Holocene)
- Psvasl — Andesite lava flows of Stags Leap (Pliocene)
- Psvbsl — Andesite flow breccia of Stags Leap (Pliocene)
- Kgv — Great Valley Sequence, undivided (Cretaceous)
- Fault, Queried where Approximate

RCS

FIGURE 11
CROSS SECTION B-B'

RCS Job No. 571-NPA04

September 2024



Vertical Exaggeration = 2x

See location of section line on Figures 2-4

ft BGS = Feet Below Ground Surface

ft AMSL = Feet Above Mean Sea Level

LEGEND

- Cement Seal
- Blank Casing
- Perforated Interval
- Static Water Level (June 2016)
- Pumping Water Level (May 2022)
- Qhf — Alluvial fan deposits (Holocene)
- Psvasl — Andesite lava flows of Stags Leap (Pliocene)

RCS

FIGURE 12
CROSS SECTION C-C'

RCS Job No. 571-NPA04

September 2024

Table 1
Summary of Well Construction and Pumping Data
The Vineyard House

Reported Well Designation	DWR Well Log No.	Date Drilled	Method of Drilling	Pilot Hole Depth (ft bgs)	Casing Depth (ft bgs)	Casing Type	Casing Diameter (in)	Borehole Diameter (in)	Sanitary Seal Depth (ft bgs)	Perforation Intervals (ft bgs)	Type and Size (in) of Perforations	Gravel Pack Interval (ft) and Size	Current Status of Well	Post-Construction Yield Data					
														Date & Type of Yield Data	Duration of "Test" (hrs)	Estimated Flow Rate (gpm)	Static Water Level (ft)	Pumping Water Level (ft)	Estimated Specific Capaity (gpm/ft ddn)
Well 1	0992224	November 2015	Mud Rotary	715	705	PVC	6	10	57 (cement)	105-705	Factory-cut 0.032	"Well Pack #6" 57-705	Active	11/2015 Airlift	4	120	65	ND	ND
														6/16/16 Pump	24	50	98.1	106.3	6.10
Well 2	0992225	November 2005	Mud Rotary	715	710	PVC	8	10	56 (cement)	110-710	Factory-cut 0.032	"Well Pack #6" 56-710	Inactive	12/2015 Airlift	4	200	55	ND	ND
														6/20/16 Pump	24	50	69.1	160.4	0.55
Domestic Well	281555	August 1989	Mud Rotary	350	350	PVC	6	12	26 (concrete & bentonite)	50-90; 110-150; 170-190; 210-230; 250-310; 330-350	Factory-cut 0.032	Pea Gravel 26-350	Active	8/1989 Pump	5	50	120	200	0.63
Harlan Easement Well	No Available Construction Data					PVC	8	No Available Construction Data					Active	No Data					

Notes: ft bgs = feet below ground surface
SWL = static water level
brp = below reference point, generally top of wellhead

The Vineyard House Winery
Groundwater Use Estimate

	Estimated Water Use (Acre-Feet / Year)		
	Existing		Proposed
Residential Water Use			
Primary Residence(10)	0.750		0.750
Pool - Not Applicable	0.000		0.000
Second Dwelling Unit - Not Applicable	0.000		0.000
Guest Cottage - Not Applicable	0.000		0.000
Total Residential Domestic Water Use	0.750		0.750
Winery Domestic & Process Water Use			
Winery - Daily Visitors(1)(2)	0.000		0.029
Winery - Events with Meals Prepared Onsite(1)(3)	0.000		0.000
Winery - Events with Meals Prepared Offsite(1)(4)	0.000		0.006
Winery - Employees(1)(5)	0.000		0.101
Winery - Event Staff(1)(5)	0.000		0.002
Winery - Process(6)	0.000		0.430
Total Winery Water Use	0.000		0.567
Irrigation Water Use			
Lawn(7)	4.360		2.799
Other Landscape(8)	0.455		1.185
Vineyard - Irrigation (9)	0.000		4.450
Vineyard - Frost Protection	0		0
Vineayrd - Heat Protection	0		0
Total Irrigation Water Use	4.815		8.434
Total Combined Water Use	5.6		9.8

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

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

(2) 3 gallons of water per guest per Napa County WAA Guidance Document

(3) 15 gallons of water per guest per Napa County WAA - Guidance Document

(4) 5 gallons of water per guest used because all food preparation, dishwashing, etc. to occur offsite

(5) 15 gallons per shift per Napa County WAA - Guidance Document

(6) 2.15 ac-ft per 100,000 gallons wine per Napa County WAA - Guidance Document

(7) See landscape plan

(8) See landscape plan.

(9) 26 +/- acre vineyard. Water demands for the existing vineyard will continue to be met using water delivered from an offsite property via an existing water easement, as has been done historically. If water is unavailable from the offsite source, total annual groundwater use at the subject property will not exceed the volume of site-specific annual groundwater recharge calculated elsewhere in this WAA.

(10) 0.75 ac-ft/yr per Napa County WAA Guidance Document

The Vineyard House Winery
Winery Production, Visitor, Employee & Event Staff Statistics

Winery Production[1]		20,000	gallons per year
Tours and Tastings by Appointment[1]			
Monday through Sunday	60 guests max per week		
Total Guests Per Year		3,120	
Events - Meals Prepared Offsite[1]			
12 per year	20 guests max	240	
1 per year	50 guests max	50	
1 per year	100 guests max	100	
Total Guests Per Year		390	
Events - Meals Prepared Onsite[1]			
0 per year	0 guests max	0	
0 per year	0 guests max	0	
0 per year	0 guests max	0	
Total Guests Per Year		0	
Winery Employees[2]			
6 employees	1 shift per day		
Total Employee Shifts Per Year		2,190	
Event Staff[3]			
12 per year, 20 guests	2 event staff	24	
1 per year, 50 guests	5 event staff	5	
1 per year, 100 guests	10 event staff	10	
Total Event Staff Per Year		39	

(1) Winery production, tours and tasting and event guest statistics per Winery Use Permit Application
(2) Employee counts per Winery Use Permit Application
(3) Assumes 1 event staff per 10 guests (in addition to regular winery employees)

Table 3
Comparison of Rainfall Data Sources
The Vineyard House

Rain Gage and/or Data Source	Years of Available Rainfall Record	Average Annual Rainfall in Inches (ft)	Elevation of Rain Gage (ft asl)	Distance of Rain Gage from Subject Property[1] (mi)	Elevation Relative to Subject Property
Napa One Rain Dry Creek Fire Station	WY 2006-07 through WY 2016-17	31.2 (2.60)	560	1.5	Higher
Napa One Rain Hopper Creek at Highway 29	WY 2003-04 through WY 2016-17	27.7 (2.31)	120	2.0	Lower
WRCC Saint Helena	1907 through June 2018[2]	34.2 (2.85)	240	6.0	Similar
PRISM Climate Group	1981 to 2010	35.6 (2.97)	---	---	---
Napa County Isohyetal Map	1900 to 1960	40.0 (3.33)	---	---	---

Notes:

1. The subject property is located at an elevation between ±230 and ±350 ft asl
2. Missing rainfall data in 1907, 1915-1922; 1979-1980; 1985-1988; 1992; and 2011-2012.

Table 5
Summary of Available Groundwater Quality Data
The Vineyard House

Constituent Analyzed	Units	Maximum Contaminant Level	Well 1	Well 2
		Date of Samples:	**6/17/2016**	**6/21/2016**
General Physical Constituents				
Specific Conductance	µmhos/cm	900; 1,600; 2,200(1)	380	390
pH	units	6.5 to 8.5	7.0	7.4
Turbidity	NTU	5	0.5	ND
Sodium Absorption Ratio (SAR)	units	None	0.49	0.78
General Mineral Constituents				
Total Dissolved Solids	mg/L	500; 1,000; 1,500(1)	280	270
Total Hardness	mg/L	None	160	150
Alkalinity (Total) as $CaCO_3$	mg/L	None	143	144
Bicarbonate	mg/L	None	174	176
Calcium	mg/L	None	28	30
Magnesium	mg/L	None	21	18
Sodium	mg/L	None	14	22
Sulfate	mg/L	250, 500, 600(1)	41	41
Chloride	mg/L	250, 500, 600(1)	5.1	5.9
Fluoride	mg/L	2	0.23	0.18
Silica (as SiO_2)	mg/L	None	80	70
Nitrate (as N)	mg/L	45	ND	ND
Nitrite (as N)	mg/L	1	ND	ND
Detected Inorganic Constituents (Trace Elements)				
Arsenic	µg/L	10	2.3	5.4
Barium	µg/L	1000	29	5.7
Iron	µg/L	300	**2200**	ND
Manganese	µg/L	50	**120**	40
Zinc	µg/L	5000	220	170

Notes:

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

µmhos/cm = micromhos per centimeter; NTU = nephelometric turbidity unit; mg/L = milligrams per liter; µg/L = micrograms per liter

ND = constituent not detected or below reporting detection limit

Constituents that exceed State MCLs for water used for domestic purposes at listed in **BOLD**.

MEMORANDUM

APPENDIX
CALIFORNIA
DEPARTMENT OF WATER RESOURCES
WELL COMPLETION REPORTS (DRILLER'S LOGS)

ORIGINAL
File with DWR

Well #1

STATE OF CALIFORNIA

WELL COMPLETION REPORT

Refer to Instruction Pamphlet

No. 0992224

Page ___ **of** ___

Owner's Well No. ___

Date Work Began 11-10-15 Ended 11-23-15

Local Permit Agency Napa County

Permit No. E15-00872 Permit Date 11-2-15

DWR USE ONLY — DO NOT FILL IN

STATE WELL NO./STATION NO.

LATITUDE | LONGITUDE

APN/TRS/OTHER

GEOLOGIC LOG

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

DRILLING METHOD rotary FLUID Mud

DEPTH FROM SURFACE Ft.	to Ft.	DESCRIPTION *Describe material, grain size, color, etc.*
0	110	brown ash & rock
110	705	black ash, streaks of broken up black ash

TOTAL DEPTH OF BORING 715 (Feet)

TOTAL DEPTH OF COMPLETED WELL 705 (Feet)

WELL OWNER

Name Jeremy J. Nickel

Mailing Address 7107 S. Yale Ave #322

CITY ___ STATE ___ ZIP ___

WELL LOCATION

Address 1581 Oakville Grade

City Napa

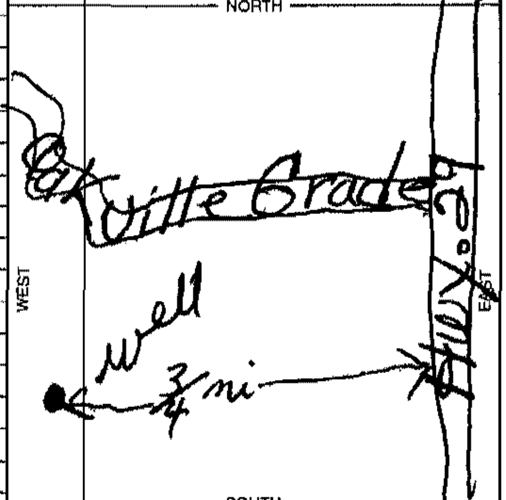
County Napa

APN Book ___ Page ___ Parcel 027-360-022

Township ___ Range ___ Section ___

Lat ___ N DEG. MIN. SEC. Long ___ W DEG. MIN. SEC.

LOCATION SKETCH



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

ACTIVITY (✓)

X NEW WELL

MODIFICATION/REPAIR
___ Deepen
___ Other (Specify)

___ DESTROY *(Describe Procedures and Materials Under "GEOLOGIC LOG")*

USES (✓)

WATER SUPPLY
___ Domestic ___ Public
X Irrigation ___ Industrial

MONITORING ___
TEST WELL ___
CATHODIC PROTECTION ___
HEAT EXCHANGE ___
DIRECT PUSH ___
INJECTION ___
VAPOR EXTRACTION ___
SPARGING ___
REMEDIATION ___
OTHER (SPECIFY) ___

WATER LEVEL & YIELD OF COMPLETED WELL

DEPTH TO FIRST WATER 70 (Ft.) BELOW SURFACE

DEPTH OF STATIC WATER LEVEL 65 (Ft.) & DATE MEASURED ___

ESTIMATED YIELD * 120 (GPM) & TEST TYPE AIR LEFT

TEST LENGTH 4 (Hrs.) TOTAL DRAWDOWN 500 (Ft.)

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

CASING (S)

DEPTH FROM SURFACE Ft.	to Ft.	BORE-HOLE DIA. (Inches)	BLANK	SCREEN	CON-DUCTOR	FILL PIPE	MATERIAL / GRADE	INTERNAL DIAMETER (Inches)	GAUGE OR WALL THICKNESS	SLOT SIZE IF ANY (Inches)
0	57'	15	X				PLASTIC	6"	200	
57'	105'	10"	X				"	"	"	
105'	705	10"	FACT PREF				"	"	"	3/32

ANNULAR MATERIAL

DEPTH FROM SURFACE Ft.	to Ft.	CE-MENT (✓)	BEN-TONITE (✓)	FILL (✓)	FILTER PACK (TYPE/SIZE)
0	57	X			
57	705	WELL PACK			#6

ATTACHMENTS (✓)

___ Geologic Log
___ Well Construction Diagram
___ Geophysical Log(s)
___ Soil/Water Chemical Analyses
___ Other ___

ATTACH ADDITIONAL INFORMATION, IF IT EXISTS.

CERTIFICATION STATEMENT

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief.

NAME Pulliam Well Drilling
(PERSON, FIRM, OR CORPORATION) (TYPED OR PRINTED)

ADDRESS 2877 Piedmont CITY Napa STATE Ca ZIP 94558

Signed Bill Pulliam
C-57 LICENSED WATER WELL CONTRACTOR

DATE SIGNED 12-2015 C-57 LICENSE NUMBER 248677

Well #2 ATT: Unthony

ORIGINAL
File with DWR

STATE OF CALIFORNIA
WELL COMPLETION REPORT
Refer to Instruction Pamphlet

No. 0992225

DWR USE ONLY — DO NOT FILL IN

STATE WELL NO./STATION NO.

LATITUDE | LONGITUDE

APN/TRS/OTHER

Page ____ of ____
Owner's Well No. ________
Date Work Began 11-24-15 Ended 12-16-15
Local Permit Agency Napa County
Permit No. E15-00873 Permit Date 11-2-15

GEOLOGIC LOG

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

DRILLING METHOD rotary FLUID Mud

DEPTH FROM SURFACE Ft. to Ft.	DESCRIPTION Describe material, grain size, color, etc.
0 to 90	brown ash & rock
90 to 710	black ash, streaks of broken up black ash

TOTAL DEPTH OF BORING 715 (Feet)
TOTAL DEPTH OF COMPLETED WELL 710 (Feet)

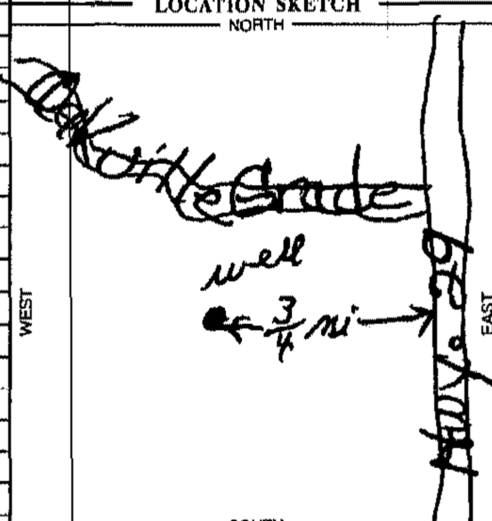
WELL OWNER

Name Jeremy J Nickel
Mailing Address ________
CITY ________ STATE ____ ZIP ____

WELL LOCATION

Address 1581 Oakville Grade
City Napa
County Napa
APN Book ____ Page ____ Parcel 027-360-02
Township ____ Range ____ Section ____
Lat ____ DEG. MIN. SEC. N Long ____ DEG. MIN. SEC. W

LOCATION SKETCH



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

ACTIVITY (✓)

X NEW WELL

MODIFICATION/REPAIR
___ Deepen
___ Other (Specify)

___ DESTROY (Describe Procedures and Materials Under "GEOLOGIC LOG")

USES (✓)

WATER SUPPLY
___ Domestic ___ Public
X Irrigation ___ Industrial

MONITORING ___
TEST WELL ___
CATHODIC PROTECTION ___
HEAT EXCHANGE ___
DIRECT PUSH ___
INJECTION ___
VAPOR EXTRACTION ___
SPARGING ___
REMEDIATION ___
OTHER (SPECIFY) ___

WATER LEVEL & YIELD OF COMPLETED WELL

DEPTH TO FIRST WATER 55 (Ft.) BELOW SURFACE
DEPTH OF STATIC WATER LEVEL 55 (Ft.) & DATE MEASURED ________
ESTIMATED YIELD * 200 (GPM) & TEST TYPE AIR LERF
TEST LENGTH 4 (Hrs.) TOTAL DRAWDOWN 500 (Ft.)
* *May not be representative of a well's long-term yield.*

CASING (S)

DEPTH FROM SURFACE Ft. to Ft.	BORE-HOLE DIA. (Inches)	TYPE (✓) BLANK	SCREEN	CON-DUCTOR	FILL PIPE	MATERIAL / GRADE	INTERNAL DIAMETER (Inches)	GAUGE OR WALL THICKNESS	SLOT SIZE IF ANY (Inches)
0 to 56	15"	X				PLASTIC	8	200	
56 to 110	10"	X				"	"	"	
110 to 710	10"	FACT PERF				"	"	"	5/32

ANNULAR MATERIAL

DEPTH FROM SURFACE Ft. to Ft.	CEMENT (✓)	BENTONITE (✓)	FILL (✓)	FILTER PACK (TYPE/SIZE)
0 to 56	X			
56 to 710	WELL PACK #6			

ATTACHMENTS (✓)

___ Geologic Log
___ Well Construction Diagram
___ Geophysical Log(s)
___ Soil/Water Chemical Analyses
___ Other ________

ATTACH ADDITIONAL INFORMATION, IF IT EXISTS.

CERTIFICATION STATEMENT

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief.

NAME Pulliam Well Drilling
(PERSON, FIRM, OR CORPORATION) (TYPED OR PRINTED)

ADDRESS 2877 Piedmont CITY Napa STATE Ca ZIP 94558

Signed Bill Pulliam
C-57 LICENSED WATER WELL CONTRACTOR

DATE SIGNED 12-20-15 C-57 LICENSE NUMBER 248672

QUADRUPLICATE
Use to comply with local requirements

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES

WATER WELL DRILLERS REPORT

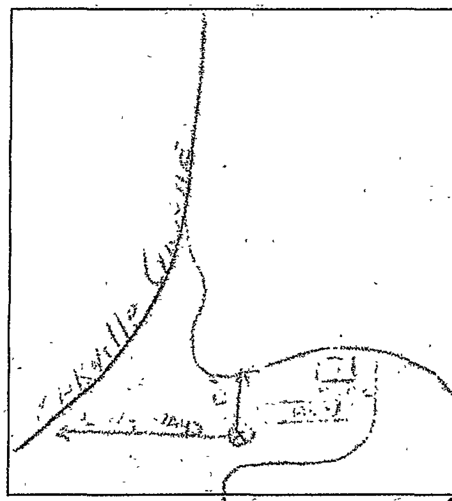
Do not fill in
No. 281555

Notice of Intent No. ______
Local Permit No. or Date 24368

State Well No. ______
Other Well No. ______

(1) OWNER: Name [redacted]
Address [redacted]
City San Francisco ZIP 94109

(2) LOCATION OF WELL (See instructions):
County Napa Owner's Well Number 27-360-12
Well address if different from above 1581 Oakville Grade
Township ______ Range ______ Section ______
Distance from cities, roads, railroads, fences, etc. ______



WELL LOCATION SKETCH

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

(4) PROPOSED USE:
Domestic [X]
Irrigation [X]
Industrial [ ]
Test Well [ ]
Municipal [ ]
Other [X]
(Describe)

(5) EQUIPMENT:
Rotary [X] Reverse [ ]
Cable [ ] Air [ ]
Other [ ] Bucket [ ]

(6) GRAVEL PACK:
Yes [X] No [ ] Size Pea
Diameter of bore 12¼"
Packed from 26 to 350 ft.

(7) CASING INSTALLED:
Steel [ ] Plastic [X] Concrete [ ]

(8) PERFORATIONS:
Type of perforation or size of screen Machine

From ft.	To ft.	Dia. in.	Gage or Wall	From ft.	To ft.	Slot size
0	50	6	200	50	90	.032
90	110	6	200	110	150	.032
150	170	6	200	170	190	.032

(9) WELL SEAL:
Was surface sanitary seal provided? Yes [X] No [ ] If yes, to depth 26 ft.
Were strata sealed against pollution? Yes [ ] No [ ] Interval ______ ft.
Method of sealing Concrete & bentonite pellets

(10) WATER LEVELS:
Depth of first water, if known ? ft.
Standing level after well completion 120' ft.

(11) WELL TESTS:
Was well test made? Yes [X] No [ ] If yes, by whom? driller
Type of test Pump [X] Bailer [ ] Air lift [ ]
Depth to water at start of test 120 ft. At end of test 200 ft.
Discharge 50 gal/min after 5 hours Water temperature ______
Chemical analysis made? Yes [X] No [ ] If yes, by whom? Caltest Lab
Was electric log made Yes [ ] No [X] If yes, attach copy to this report

(12) WELL LOG: Total depth 350 ft. Completed depth 350 ft.

from ft.	to ft.	Formation (Describe by color, character, size or material)
0	5	Top soil
5	10	Sandy brn clay
10	17	Gravel imb. brn clay
17	22	Small gravel
22	36	Gravel imb brn clay
36	45	Sandy brn clay
45	57	Sandy brn clay gravel imb.
57	62	Small gravel
62	88	Gray & brn hard rock fract.
88	145	Red & blk volcanic rock
145	152	Hard black & pink fract. rock
152	230	Hard blk and white fract rock
230	290	Hard black & gray fract rock
290	325	Red, blk, & brn volcanic rock
325	345	Black & brn volcanic rock
345	350	Green and gray clay

NOT PUBLIC UNDER WATER CODE SEC 13752

RECEIVED
AUG 16 1989
DEPT. OF ENVIRONMENTAL MANAGEMENT

CASING CONTINUED

From ft	To ft	Dia in	Gage wall	From ft	To ft	Slot size
190	210	6	200	210	230	.032
230	250	6	200	250	310	.032
310	330	6	200	330	350	.032

Work started 7/20/89 19__ Completed 8/10/89 19__

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

Signed ______ (Well Driller)
NAME Dosbier-Gregson, Inc.
(Person, firm, or corporation) (Typed or printed)
Address 5365 Napa Vallejo Hwy
City Vallejo ZIP 94589
License No. 258826 Date of this report 8/11/89

DWR 188 (REV. 12-86) IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM 86 96355