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MEMORANDUM

December 4, 2020

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Job No. 726-NPA01

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

Re: Results of Napa County Tier 1 Water Availability Analysis
Project Pioneer Vineyard Development Project
Angwin, Napa County, California

Introduction

Presented in this Memorandum are the key findings and conclusions, along with preliminary recommendations, regarding the Water Availability Analysis (WAA) prepared by RCS for the proposed new vineyard development at the property located at 1 Angwin Avenue, Angwin, Napa County (County), California. This document was prepared for PPI Engineering, Inc. (PPI), on behalf of the property owner, Pacific Union College (PUC), to provide hydrogeologic analyses in conformance with Napa County Tier 1 requirements, as described in the Napa County WAA Guidelines (WAA, 2015).

The property is located in the Angwin area of Napa County, and is comprised of many individual Napa County Assessor parcels. The vineyard development project is located on four of the PUC parcels, which consist of approximately 485.2 combined acres, referred to herein as the "project parcels." Groundwater for the project will be pumped from a single well located on one of the four project parcels, referred to herein as the "subject property"; the subject property has a total area of 103.8 acres,." Figure 1, "Location Map," shows the boundaries of the subject property superimposed on the USGS topographic map for the St. Helena quadrangle. Note that only the boundaries of the single subject property are shown on Figure 1; the other three parcels that comprise the "project parcels" are not shown. Property boundaries shown on Figure 1 were adapted from the County Assessor's parcel data, which are freely available on the Napa County GIS website. Also shown on Figure 1 are the locations of the existing onsite water well (known herein as Well 8) and the locations of other nearby offsite wells owned by PUC. Figure 2, "Aerial Photograph Map," shows the same property boundaries and well locations that are illustrated on Figure 1 on an aerial photograph of the area obtained via the ArcGIS Pro software package.

As reported by PPI, the 103.8-acre subject property is currently undeveloped, with the exception of some horse stables that lie in the southern portion of the property, and agricultural hay fields.

Currently, there is no groundwater use on the property, as there are no domestic water demands for the subject property, and the agricultural hay fields are currently irrigated with treated wastewater. RCS understands the proposed project is to develop 35.9 net acres of new vines across the project parcels. For this project, the future irrigation water demands for the new vines on all four project parcels are proposed to be met using groundwater pumped from Well 8, located on the subject parcel.

The basic purpose of this Memorandum is to comply with Napa County's WAA guidelines for a Tier 1 WAA (i.e., a Groundwater Recharge Estimate); those guidelines were promulgated by the County in May 2015. Because there are no known offsite wells located within 500 feet (ft) of the project Well 8, County requirements for a Tier 2 WAA analysis (i.e., a Well Interference Evaluation) have been presumptively met per the WAA Guidelines (WAA 2015). It should be noted that RCS did not conduct a site visit for this project. Site-specific information, including offsite well locations, were provided to RCS by PUC, PPI, and the pumper that was retained to conduct the pumping tests of onsite Well 8 for this project (LGS Drilling, Inc of Vacaville, California).

Site Conditions

From review of existing data, and from information provided by PUC, PPI, and LGS, the following key items were noted and/or observed (refer to Figures 1 and 2):

a. The vineyard development project is located on four parcels having Napa County Assessor's Parcel Numbers (APNs) of 024-080-040, 024-080-044, 024-080-048, and 024-080-049. The total assessed area of the project parcels is 485.2 combined acres. The project well (Well 8) is located on APN 024-080-049 (the subject property), with a total assessed area of 103.8 acres.

b. Topographically, the subject property is located in the hills to the northeast of St. Helena, adjacent to the Angwin-Parrett Airfield. Based on the topographic contours illustrated in Figure 1, the property lies west of a prominent ridgeline, and ground surface on the subject property is relatively flat, with a gentle slope to the west towards the town of Angwin. There are no mapped "blueline streams" located on the subject property.

c. The subject property is currently undeveloped, with the exception of horse stables and hay fields (which are irrigated with treated wastewater). Access to the property is via a private road from Howell Mountain Road to the west.

d. Offsite areas surrounding the subject property consist primarily of developed areas with residences and buildings associated with the PUC campus to the west and south. The area immediately east of the subject property is developed with the Angwin-Parrett Airfield. Areas north of the subject property and east of the airfield are primarily naturally vegetated or wooded hillsides (i.e., undeveloped areas) with some areas developed with vineyards.

e. As shown on Figures 1 and 2, there is an existing water-supply well (Well 8) on the subject property; this well is located in the eastern portion of the property. Currently, the well is not equipped with a permanent pump, or a totalizer flowmeter device, and it is inactive at this time.

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RCS geologists accessed the California Department of Water Resources (DWR) online Well Completion Report website to download possible driller's logs for wells within the immediate vicinity of the subject property. Since the surrounding properties are owned by PUC, the results of these efforts revealed driller's logs for only the wells drilled on PUC properties.

Figures 1 and 2 show the approximate locations of the known offsite wells owned by PUC near the subject property, as provided by PUC, PPI, and the well log research. It is noteworthy that none of these offsite wells are shown to be located with 500 ft of Well 8 (i.e. the project well).

Key Construction and Testing Data for Existing Onsite Well

A DWR Well Completion Report No. e0198361 (i.e., driller's log) is available for the onsite project well (Well 8); a copy of this report is included in the Appendix. Table 1, "Summary of Well Construction and Testing Data," provides a tabulation of key well construction and testing data available for this onsite well.

Well Construction Data

Key data for the onsite well listed on the available driller's logs and/or identified during our site visit includes:

a. Well 8 was constructed in January 2014 by Huckfeldt Well Drilling, Inc. (Huckfeldt) of Napa, California; the drilling method is listed on the driller's log as "direct air rotary."

b. Pilot hole depth (the borehole drilled before the well casing is placed downhole) was reported to be 600 ft below ground surface (bgs).

c. Well 8 is cased with polyvinyl chloride (PVC) well casing having a nominal casing diameter of 8 inches. Total casing depth was reported to be 592 ft bgs.

d. Casing perforations for Well 8 are machine-cut slots, having slot opening widths of 0.032 inches (32-slot). Perforations were placed at the following depths: 212 ft to 372 ft; 392 ft to 472 ft; and 492 ft to 572 ft

e. Gravel pack materials shown on the driller's logs for Well 8 are listed as "#6 sand."

f. Well 8 was constructed with a sanitary seal consisting of 10-sack cement set to a depth of 54 ft bgs.

Summary of Original "Testing" Data

The driller's log for Well 8 provided the depth to the original post-construction static water level (SWL) for the well, along with the original test data (as shown on Table 1). These data include:

- The initial SWL depth following completion of well construction was reported to be approximately 160 ft bgs on January 24, 2014.
- The reported maximum airlift rate for the initial post-construction airlifting operations were estimated by the drillers to be approximately 350 gallons per minute (gpm) at the time of well 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 at the date of well construction.

- Water level drawdown values during airlifting were not listed on the driller's logs for Well 8, because water level drawdown cannot be measured during airlifting operations; thus, the original post-construction specific capacity[1] value for the wells cannot be calculated from the limited data provided on the driller's log.

Pumping Test Data by Others for Well 8

A step drawdown test and a constant rate pumping test were performed in Well 8 on September 25 and October 8, 2020, respectively, by LGS. These tests were performed using a 50-Hp temporary test pump that was installed at the time of testing by LGS to a depth of approximately 485 ft bgs for the step test, and to a depth of 490 ft bgs for the constant rate test. Water levels and pumping rates were measured and recorded by the LGS pumper during the pumping test. A flowmeter with totalizer was installed by LGS along with the test pump; pumping rate and extraction volume measurements were recorded throughout the pumping tests. In addition, water levels were also recorded automatically during the constant rate pumping test using a pressure transducer that had been programmed by RCS geologists and shipped to LGS for installation. Figures 3A, "Plot of Water Levels During Step Drawdown Test," and 3B, "Plot of Water Levels During Constant Rate Test," illustrate the water level changes in Well 8 during the 8-hour step drawdown test and the 12-hour constant rate pumping test, respectively. Basic details of these pumping tests include the following:

- *Step Drawdown Testing*

  Pumping for the step drawdown test of Well 8 was performed on September 25, 2020, via an 8-hour, three-point step drawdown test. For this step drawdown test, Well 8 was pumped continuously at the RCS-recommended nominal pumping rates (or steps) of 100, 200, and 300 gpm; Step No.1 was pumped continuously for two hours, while Step Nos. 2 and 3 were pumped continuously for three hours each. Table 2, "Step Drawdown Test Data," which summarizes the results of the step drawdown test, also reveals the average pumping rate for each step test. The following summarizes the key data collected during the step test for Well 8:

  - Prior to turning on the pump, an initial pre-test SWL of 156.5 ft below reference point (brp) was recorded manually by the pumper.
  - Average pumping rates (using the totalizer flow dial readings) for each of the three steps were calculated to be 100, 200, and 279 gpm, for Step Nos. 1, 2, and 3, respectively. As stated above, Step No.1 was pumped continuously for two hours (120 minutes), while Step Nos. 2 and 3 were pumped continuously for three hours (180 minutes) each; the pump was not turned off between each of the pumping steps.
  - Pumping water levels (PWLs) measured at the end of each step rate were 170.2 ft, 198.8 ft, and 230.0 ft brp, for Step Nos. 1 through 3, respectively. These pumping levels resulted in short-term water level drawdowns in this well ranging from 13.7 ft to 73.5 ft for Step Nos. 1 through 3, respectively.

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

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- Short-term specific capacities for the step test rates ranged from 7.3 gpm/ft ddn at a pumping rate of 100 gpm (Step No. 1), to 3.8 gpm/ft ddn at a pumping rate of 279 gpm (Step No. 3).

- *Constant Rate Pumping Test*

  The constant rate pumping test portion of the aquifer test for Well 8 was performed on October 8, 2020 for approximately 12 continuous hours (720 minutes) and at an average pumping rate of 200 gpm. The average pumping rate was determined from totalizer dial readings recorded by the LGS pumper throughout the pumping period. Figure 3B graphically illustrates the water levels as automatically recorded by the pressure transducer in Well 8, and occasionally by manual measurements taken by the LGS pumper during the constant rate pumping test period. Below is a summary of the water level data collected from Well 8 during the pumping portion and the water level recovery portion of the constant rate pumping test:

  - A SWL of 151.0 ft brp was recorded by the LGS pumper prior to testing.
  - A maximum PWL of 216.7 ft brp was measured at the end of the 12-hour period of continuous pumping; this represents a maximum water level drawdown of 65.7 ft at the end of the test. The data show that water levels were continuing to decline by the end of the pumping test. Specifically, PWLs declined approximately 4.5 ft in the last 3 hours of the pumping test. This represent a rate of water level decline of about 1.5 ft/hour. Additionally, the maximum PWL at the end of the test was reported to be about 269 ft above the pump intake depth.
  - Based on the totalizer flow meter readings provided by LGS, an average pumping rate of 200 gpm was calculated for the 12-hour test. Based on this average pumping rate, and the total water level drawdown of approximately 65.7 ft, the specific capacity of Well 8 is calculated to be approximately 3.1 gpm/ft ddn at the time of this LGS test in October 2020.
  - Following the end of the pumping test, water levels recovered to a depth of 159.7 ft brp (or approximately 95% recovery) after a period of approximately 12 hours of non-pumping.

- *Final Wellblend Groundwater Sampling Results*

  Approximately 8.5 hours after startup of the constant rate pumping test, a suite of final wellblend water quality samples were collected by the LGS pumper. The sample containers were delivered to CalTest Analytical Laboratory of Napa, California for analysis of general mineral and inorganic (metal) constituents. The results of these laboratory analyses of the final wellblend water samples are listed on Table 3, "Results of Laboratory Analysis of Final Wellblend Sample;" a copy of the laboratory report is appended to this Memorandum. The following provides a summary of these results:

  - General Mineral Analyses: Each of the listed constituents was detected at a concentration below its respective current State Water Resources Control Board (SWRCB), Department of Drinking Water (DDW) and the United States Environmental Protection Agency (EPA) respective Primary and/or Secondary Maximum Contaminant Levels (MCLs) or SWRCB Notification Level (NL), as applicable, for water to be used for domestic-use purposes.

- Inorganic (Trace Element) Constituents: Each of the listed trace elements (inorganic chemicals) was detected below its respective MCL or NL.
- The water quality parameter for turbidity was detected at 12 nephelometric turbidity units (NTUs), which is above the MCL of 5 NTU for water to be used for domestic-use purposes.

Local Geologic Conditions

Figure 4, "Geologic Map," illustrates the types, lateral extents, and boundaries between the various earth materials mapped at ground surface in the region by others. Specifically, Figure 4 has been adapted from the results of regional geologic field mapping of the Eastern Sonoma and Western Napa Counties, as published by the USGS in 2007. As shown on Figure 4, the key earth materials mapped at ground surface in the area, from geologically youngest to oldest, include the following:

a. Alluvial-type deposits. These deposits consist of undifferentiated alluvium (map symbol Qa on Figure 4). These deposits are generally unconsolidated, and consist of layers and lenses of sand, gravel, silt, and clay. These geologic materials are generally exposed to the east and south of the subject property.

b. 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: andesitic to basaltic lava flows (map symbol Tsa); pumiceous ash-flow tuff (map symbol Tst); and tuff (map symbol Tsft). As shown on Figure 4, andesitic to basaltic lava flows and pumiceous ash-flow tuffs are the primary volcanic rock material exposed at ground surface on the subject property.

c. Great Valley Sequence. The geologically older Great Valley Sequence rocks are exposed offsite at ground surface to the northeast of the subject property (map symbol KJgvl on Figure 4), and are also known to underlie the rocks of the Sonoma Volcanics beneath the property. These geologically older rocks consist mainly of well-consolidated to cemented, sandstone and shale, and are considered to be the bedrock of the area.

RCS interpretation of the driller's descriptions of the drill cuttings listed on the available driller's log for Well 8, reveals that typical rocks of the Sonoma Volcanics were encountered when drilling the total depth of this well. Typical driller-terminology for the drill cuttings on this log included: "hard and soft volcanic rock;" "volcanics with ash;" and "hard and soft volcanics." Therefore, based on the generalized terminology used by the drillers for this well, the Sonoma Volcanics are interpreted by RCS to extend to depths of at least 600 ft bgs at this well location on the subject property.

Local Hydrogeologic Conditions

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

Potentially Water-Bearing Materials

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

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

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

As stated above, the principal rock type expected in the subsurface beneath the property are a combination of fine-grained volcanic ash and tuffs and hard, volcanic flow rocks; the latter may be fractured to varying degrees. Descriptions of drill cuttings by the well driller that are recorded on the available driller's log for Well 8 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. Wells constructed into deeply weathered volcanic materials and ash/tuff layers tend to have lower flow rates because these materials are finer-grained and display a lower permeability.

Potentially Nonwater-Bearing Rocks

This category includes the geologically older and fine-grained sedimentary rocks and serpentinite of the Great Valley Sequence. These potentially nonwater-bearing rocks are interpreted to underlie the volcanic rocks that exist beneath the subject property at depths greater than ±600 ft bgs, depending on location.

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

There are no faults[2] as mapped by others on the subject property or in the immediate vicinity of the property, as shown on Figure 4. Reportedly, there is a single northwest-southeast trending fault mapped by others to exist further to the southwest of the subject property, which is outside the area shown on Figure 4. There can be possible impacts of these faults on groundwater availability in the region. Faults can serve to increase the number and frequency of fracturing in the Sonoma Volcanics rocks. If such fractures were to occur, they would tend to increase the amount of open area in the rock fractures which, in turn, could increase the ability of the local earth materials to store groundwater. Faults can also act as barriers to groundwater flow. The possible nature of the offsite fault discussed above is unknown.

Project Groundwater Demands

For the purposes of this WAA, Well 8 is considered to be the "project well" and will be used to meet the irrigation water demands for the proposed vineyard development project within the project parcels. There are currently no existing groundwater demands for the subject property as it is essentially undeveloped, with the exception of some horse stables; the hay fields on the property are irrigated using treated wastewater.

Water use for the vineyard development project has been estimated by RCS geologists and are based solely on water use guidelines provided in the WAA Guidance Document (WAA 2015). Table 4, "Groundwater Use Estimates", is intended to categorize the specific water demands of the proposed project. As shown on Table 4, the estimated annual groundwater demands for the project are discussed below.

[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

Existing Groundwater Demands

There are currently no existing groundwater demands for the subject property.

Proposed Groundwater Demands

Groundwater demands for irrigation of the proposed vineyards will be met by pumping groundwater from the project Well 8. Water demand estimates[3] for the proposed project have been estimated by RCS geologists as follows:

- Proposed vineyard irrigation groundwater demand = 18.0 AF/yr; this is based on the total proposed vineyard acreage of 35.9 acres and an estimated unit water use of approximately 0.50 AF per acre vine per year (AF/ac/yr) for irrigation.

Proposed Pumping Rates

To determine an appropriate pumping rate necessary from Well 8 to meet the future proposed groundwater demands of 18.0 AF/yr required for vineyard irrigation, it was conservatively estimated that groundwater from the project well will be pumped during a 20-week irrigation season each year (roughly May through September). Based on these assumptions, and in order for the project well to meet the groundwater demands for the proposed project, the project well would need to pump at a rate of about 60 gpm. This pumping rate assumes that the project well would be pumped on a 50% operational basis (12 hours/day, 7 days/week) during the 20-week irrigation season; the necessary pumping rate would be significantly lower during the non-irrigation season each year because groundwater will not be needed for irrigation purposes during the remainder of each year. Actual operational rates during the irrigation season may be higher than 60 gpm, due to different possible operational configurations for the irrigation water system.

Based on the results of the constant rate pumping test performed on the project well by LGS in October 2020, it appears that Well 8 is capable of meeting the instantaneous groundwater pumping rate demands required for the proposed vineyards during the irrigation season of each year.

Rainfall

Long-term rainfall data are essential for estimating the average annual recharge that may occur at subject property. Average annual rainfall totals that occur specifically at the subject property are not directly known, because no onsite rain gage exists. The nearest rain gage to the subject property known to RCS with a relatively long data record is located approximately ½ mile southwest on the PUC campus; these data are for the Angwin PUC rain gage and the data are available from 1940 through September 2020 via the Western Regional Climate Center (WRCC) website. Note there are missing data in the following years: 1940 to 1943; 1946 to 1947; 1975; 1987; and 2011. The average annual rainfall for this rain gage for the period of record listed was reported to be 38.8 inches (3.23 ft). This rainfall gage is located at a lower elevation (±1,750 ft asl) than that of the subject property, and therefore the average annual rainfall at the subject property could be slightly higher than that experienced at this known gage location.

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

Another nearby WRCC rain gage with a significantly long rainfall record is located in St. Helena, California, roughly 5½ miles southwest of the subject property. The period of available record for this St. Helena rain gage is November 1907 through September 2020; data are listed by calendar year in their dataset. 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 33.3 inches (2.78 ft), as reported by the WRCC. However, this rain gage is located at a lower elevation (±225 ft asl) than that of the subject property.

Rainfall data for a shorter period exist for the Atlas Peak rain gage, which is located about 15 miles southeast of the subject property. Data for this rain gage are available from the California Data Exchange Center (CDEC) website, which is maintained by DWR, and are available from Water Year (WY) 1987-88 (October 1987 - September 1988) through WY 2019-20. Note there appear to be some erroneous and/or missing data in WY 1987-88, WY 1994-95, WY 1995-96, WY 2004-05, and WY 2006-07. RCS removed these erroneous and/or missing data from the data set before calculating an average annual rainfall for this gage. Note that RCS only removed rainfall totals; no rainfall data were "added" to the date set. With these assumed erroneous data points removed from the data set, an average annual rainfall for WY 1988-89 through WY 2019-20 at this gage was calculated to be 40.0 inches (2.92 ft). This rain gage is located at a lower elevation (±1,660 ft asl) than that of the subject property, and thus, the average annual water year rainfall at the subject property could be higher than that experienced at this known gage location.

To help corroborate the average annual rainfall data derived from the two WRCC gages and the CDEC rain gauge, 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 Napa County, including the region of 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 42.3 inches (3.53 ft).

An additional, though older, rainfall data source, an isohyetal map (a map showing contours of equal average annual rainfall) was prepared by the County for all of 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 35-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 35 inches (2.92 ft), using this data source.

Table 5, "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 5, RCS will consider the long-term average annual rainfall at the subject property to be 38.8 inches (3.23 ft), as derived from the Angwin PUC rain gauge data set. The 38.8-inch per year estimate is based on the data source with a relatively long period of record (77 years). Although the Angwin PUC data set is not as site-specific as the PRISM data set, the Angwin PUC rain gauge is relatively close to the subject property and has a more conservative average annual rainfall when compared to the other rainfall data sources listed in Table 5 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.

Estimate of Groundwater Recharge

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

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

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

Estimates of groundwater recharge as a percentage of rainfall were presented for a number of watersheds (but not all watersheds) in Napa County in the report titled "Updated Napa County Hydrogeologic Conceptual Model" (LSCE&MBK, 2013) prepared for Napa County. Watershed boundaries within Napa County are shown on Figures 8-3 and 8-4 in that report. Figure 5, "Watershed Boundaries," was prepared for this project using those same watershed boundaries provided by MBK Engineers (MBK), for which watershed water balance data are available in the LSCE&MBK 2013 report. As shown on Figure 5, the subject property is located within the watershed referred to by MBK as the "Conn Creek Watershed." As shown on Table 8-9 on page 97 of the referenced report (LSCE&MBK, 2013), 21% 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 above on Table 8-8 of LSCE&MBK (2013), several sub-watersheds, including the Conn Creek Watershed, are tributary to the "Napa River Watershed near Napa."

As stated above, the total surface area of the subject property is 103.8 acres[4]. Assuming a conservative amount of 38.8 inches (3.23 ft) of rainfall occurs on the subject property on a long-term average annual basis, then the total volume of rainfall that would fall each year directly on the property over the long term would be approximately 335.3 AF/yr (103.8 acres x 3.23 ft). Assuming 21% of that average annual rainfall volume would be able to deep percolate to the groundwater beneath the subject property over the long term, then the average annual

[4] Note that 103.8 acres represents only the area of the subject property on which Well 8 is located, and not the other three adjoining parcels that, with the subject property, comprise the project parcels. Hence, this analysis is being performed using only a portion of the project parcels and is a conservative analysis of groundwater recharge.

groundwater recharge at the subject property would be approximately 70.4 AF/yr. This estimated long-term average annual recharge volume is greater than the estimated average annual groundwater demand of 18.0 AF/yr needed from the project well for the proposed vineyard project.

Estimate of Groundwater in Storage

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

a) Approximate surface area of property = 103.8 acres.

b) Depth to the bottom of the perforated zone in the onsite well = 572 ft bgs. To provide a conservative estimate, RCS assumes that the base of the saturated zone beneath the property is 572 ft bgs. In reality, rocks of the Sonoma Volcanics are known to extend to a depth of at least 600 ft at this well site (based on the driller's log) and thus, it is likely that the saturated zone beneath the property could extend deeper than is estimated using these data.

c) To present a conservative calculation of groundwater in storage, RCS geologists have assumed that the current saturated thickness of the aquifer(s) beneath the subject property is approximately 421 vertical feet. This value is calculated by subtracting the SWL measured by the LGS pumper in Well 8 (which was measured at a depth of approximately 151 ft brp in October 2020) from the depth of the assumed base of the saturated zone beneath the property (at a depth of 572 ft bgs). These values are used for this calculation to provide a conservative analysis of the minimum volume of groundwater in storage beneath the property. Further, as discussed in subpart (b) above, the saturated volcanic rock beneath the subject property, based on the available subsurface geologic data, is thicker; this would tend to create an even greater volume of groundwater in storage beneath the site.

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

e) Thus, a conservative estimate of the groundwater in storage (S) beneath the subject property (based on the October 2020 SWL measured in Well 8) is calculated as:

   S = property area ("a") times saturated thickness ("c") times average specific yield ("d")
   = (103.8 ac)(421 ft)(2%) = 874 AF

In contrast, the proposed average annual groundwater use for the entire property is estimated to be 18.0 AF/yr for future irrigation demands. Hence, the estimated groundwater demand for the entire property represents roughly 2% of the groundwater estimated to currently be in storage in the volcanic rocks beneath the subject property based on conservative, site-specific water level data for Well 8. Furthermore, this percentage does not include annual groundwater recharge that will occur from rainfall into the aquifer(s) beneath the property. Based on the foregoing, the estimated groundwater demands of the proposed vineyard development project should not cause a net deficit in the volume of groundwater within the aquifer system(s) beneath the site so as to adversely impact water levels in nearby wells to a point that they would not support existing or permitted land uses.

Possible Effects of "Prolonged Drought"

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

However, to help understand what potential conditions might exist in the local volcanic rocks beneath the property during a "prolonged drought period", a "prolonged drought" must be defined. As discussed by DWR, "there is no universal definition of when a drought begins or ends, nor is there a state statutory process for defining or declaring drought" (DWR 2015). California's most significant historical statewide droughts were defined by DWR as occurring during the following periods (DWR 2015):

- WY 1928-29 through WY1933-34 – six years
- WY 1975-76 through WY 1976-77 – two years
- WY 1986-87 through WY 1991-92 – six years
- WY 2006-07 through WY 2008-09 – three years
- Recent drought – WY 2011-12 through WY 2015-16[5] – five years

Table 6, "Drought Period Rainfall as Percentage of Average," shows the average amount of rainfall that occurred during each drought period for which rainfall data exist at the three rain gages discussed above and shown on Table 6; that drought period rainfall amount is also expressed on Table 6 as a percentage of the total rainfall that occurred. As shown on Table 6,

[5] The DWR 2015 drought document was published in February 2015 and lists the recent significant drought through the 2013-14 water year only; the drought continued throughout the State into WY 2015-16. Due to the rains in WY 2016-17, various sources, including the National Drought Mitigation Center website (NDMC 2018), declared an end to the drought in Northern California in 2017, which included Napa County. As of December 2020, the area of Napa County in which the subject property lies, is currently mapped as "Extreme Drought" on the NDMC website (NDMC 2020).

MEMORANDUM

determining the amount of rain that might fall during a "prolonged drought" is variable and depends on the period of record for the specific rain gage. The WY 1975-76 to WY 1976-77 drought period recorded by the Angwin PUC rain gage and reported by the WRCC had the lowest total rainfall at 32% (drought period average rainfall was 12.3 inches), compared to the long-term average (38.8 inches), and that specific drought lasted two years. The WY 1986-87 to WY 1991-92 drought period lasted for six years, but rainfall during this drought period was 61% of the average annual rainfall at the Angwin PUC rain gage.

Hence, for the purposes of this analysis, a "prolonged" drought period rainfall is conservatively considered to be 32% of the average annual rainfall that occurred in the region (using the rainfall data from the WRCC Angwin PUC rain gage). Further, to again be conservative, a "prolonged drought period" is estimated to last 6 years, which is the longest drought period on record according to DWR (DWR 2015); see Table 6. This six-year period is a conservative estimate, because the 32%-average figure corresponds with a two-year drought period, not a six-year drought period.

To meet six consecutive years of groundwater demand for the proposed groundwater usage at the subject property, a total onsite groundwater extraction of 108 AF is estimated to be required (18.0 AF/yr of groundwater demand for the entire property multiplied by 6 years = 108 AF). Assuming groundwater recharge is reduced to 32% of the average annual recharge during each year of such a theoretical "prolonged drought period", then the resulting total of groundwater recharge that might occur during the six-year drought period for the subject property is calculated as follows:

- As shown herein, a conservative estimate of the average annual groundwater recharge on the subject property is estimated to be 70.4 AF/yr. Taking 32% of this annual volume yields a drought period recharge volume of 22.5 AF/yr.
- Assuming a drought period duration of 6 continuous years, then a total of 135.0 AF (22.5 AF/yr times 6 years) of water would be available to recharge the volcanic rocks beneath the property by virtue of deep percolation of the direct rainfall that occurs solely within the boundaries of the subject property.

Therefore, assuming a theoretical six-year drought period during which only 32% of the average annual rainfall might occur, a conservative estimate of the total drought-period recharge at the subject property (135.0 AF) would be greater than the estimate of the total onsite groundwater demand (108 AF) that may occur over the same six-year period.

Key Conclusions and Recommendations

1. The proposed project consists of developing 35.9 acres of new vineyards on the project parcels, which consist of approximately 485.2 combined acres .
2. Well 8, the only existing onsite well, is located in the eastern portion of the subject parcel near the Angwin-Parrett Airfield

   The existing 103.8-acre subject property is primarily undeveloped, and currently only contains some horse stables and hay fields (irrigated with treated wastewater, and not groundwater). There are currently no existing groundwater demands for the subject parcel.

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3. The proposed (future) average annual groundwater use for the proposed vineyard project is estimated to be 18.0 AF/yr for irrigation demands, using standard assumptions for water use published in the County's WAA guidance document (WAA, 2015).
4. The groundwater demand for the proposed new vineyards will be met by pumping groundwater from Well 8 (the project well).
5. To meet the estimated groundwater demands for the proposed vineyards at the subject property (18.0 AF/yr), Well 8 would need to pump at a rate of about 60 gpm during the estimated 20-week irrigation season each year. This pumping rate assumes the well would be pumped on a 50% operational basis (12 hours/day, 7 days/week) throughout the 20-week irrigation season each year. Actual operational rates during the irrigation season may be higher than 60 gpm, due to different possible operational configurations for the irrigation water system.
6. Based on the results of the constant rate pumping test conducted in Well 8 in October 2020 (Well 8 was pumped at a reported average rate of 200 gpm for a period of 12 continuous hours), the well appears to be capable of pumping at rates needed to meet the future groundwater demands needed for the proposed onsite vineyards.
7. Groundwater recharge at the subject property on an average annual basis is estimated to be 70.4 AF; this value is based on estimates of the long-term average annual rainfall at the property (38.8 inches per year) and estimates by others of rainfall (21%) that could be available to deep percolate into the pore spaces and/or fractures and joints in the Sonoma Volcanics that underlie the subject property.
8. Conservative estimates of recharge that may occur during a "prolonged drought" (as defined herein) show that, over a theoretical six-year period of continuous drought in which only 32% of the average annual rainfall might occur, a total of 135.0 AF of rainfall recharge is estimated to occur strictly within the boundaries of the subject property. This theoretical drought period recharge estimate of 135.0 AF is more than the estimated groundwater demand of the proposed project of 108.0 AF for the same continuous six-year period.
9. RCS recommends the immediate implementation of a groundwater monitoring program for Well 8 at the subject property. This would include the monitoring of static and pumping water levels in this well and the monitoring of instantaneous flow rates and cumulative pumped volumes via the installation and use of a dual-reading flow meter (that records both flow rate and totalizing values, respectively). Currently, Well 8 is not equipped with a permanent pump. Once a permanent pump is installed, Well 8 would benefit from the installation of a totalizer flow meter. RCS also recommends that water level transducers be purchased and installed in your well(s) to permit the automatic, frequent, and accurate recording of water levels in those well(s). By continuing to observe the trends in groundwater levels and future well production rates/volumes over time by qualified professionals, potential declines in water levels and well production in the onsite well, along with possible changes in operational pumping scenarios, can be addressed in a timely manner.

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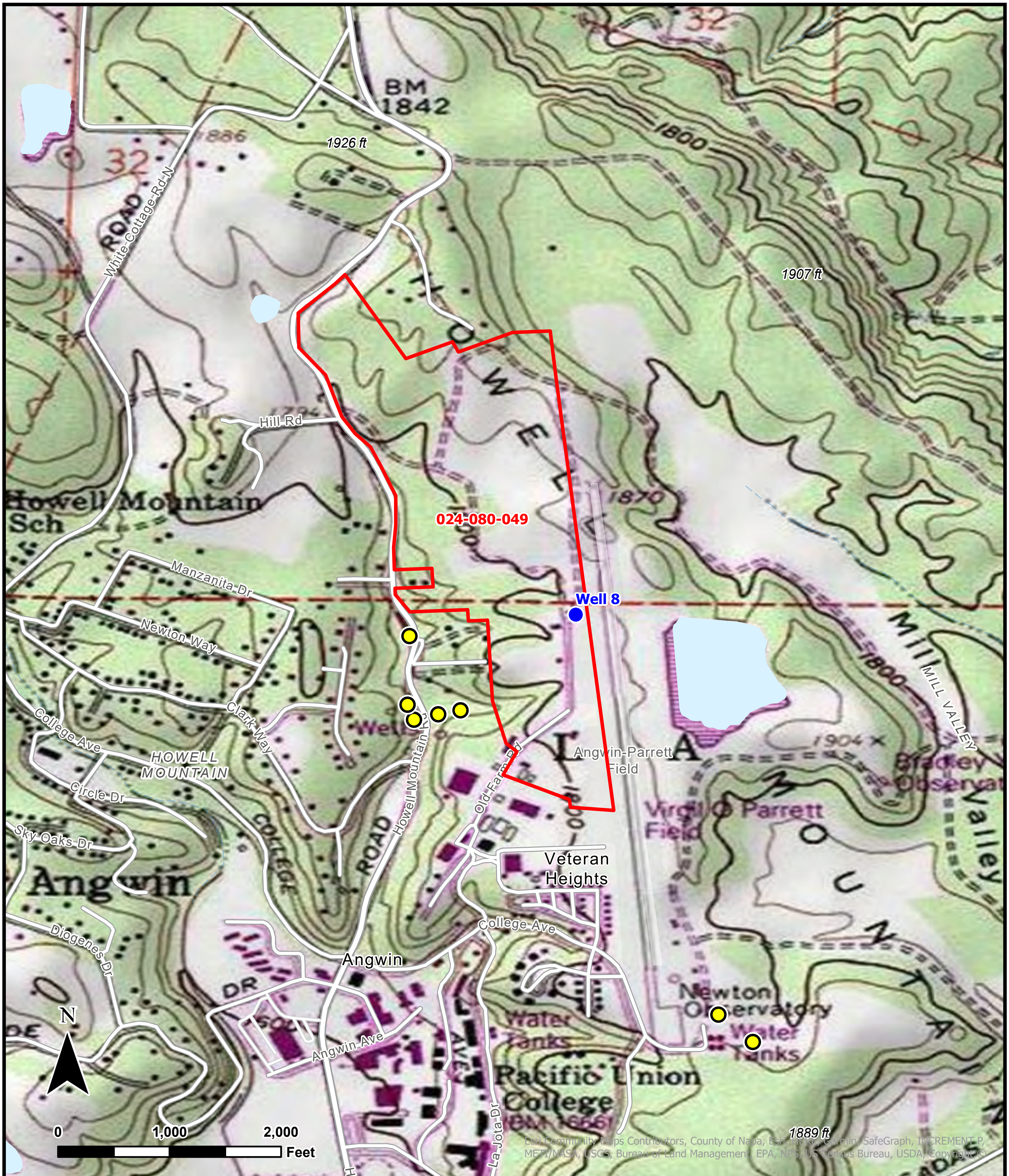

LEGEND

- Proposed Vineyard Development Parcel
- Onsite Well Location
- Offsite Well Location (Owned by PUC)

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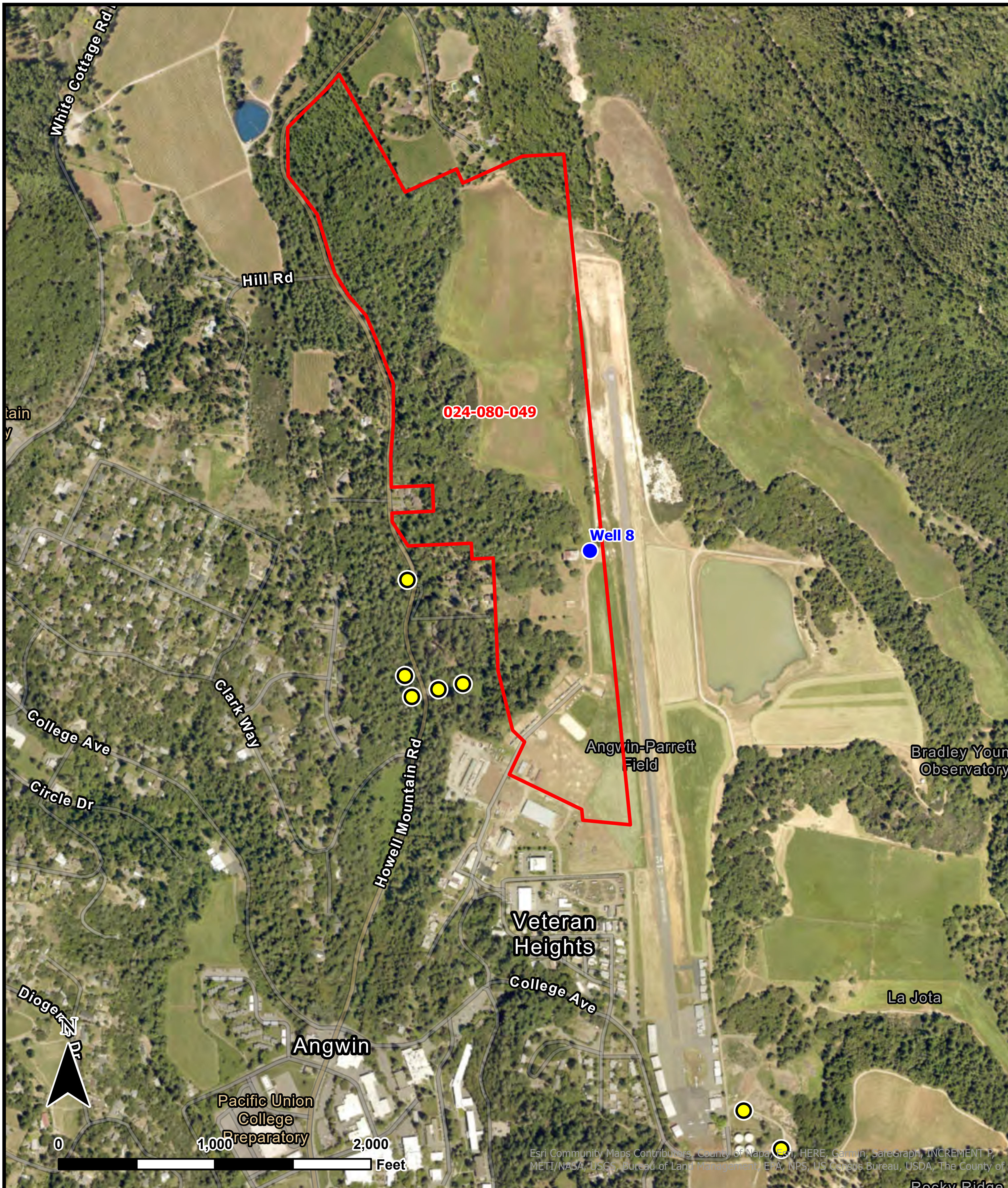
FIGURE 1
LOCATION MAP

RCS Job No. 726-NPA01

December 2020



LEGEND

Proposed Vineyard Development Parcel

Onsite Well Location

Offsite Well Location (Owned by PUC)

RCS

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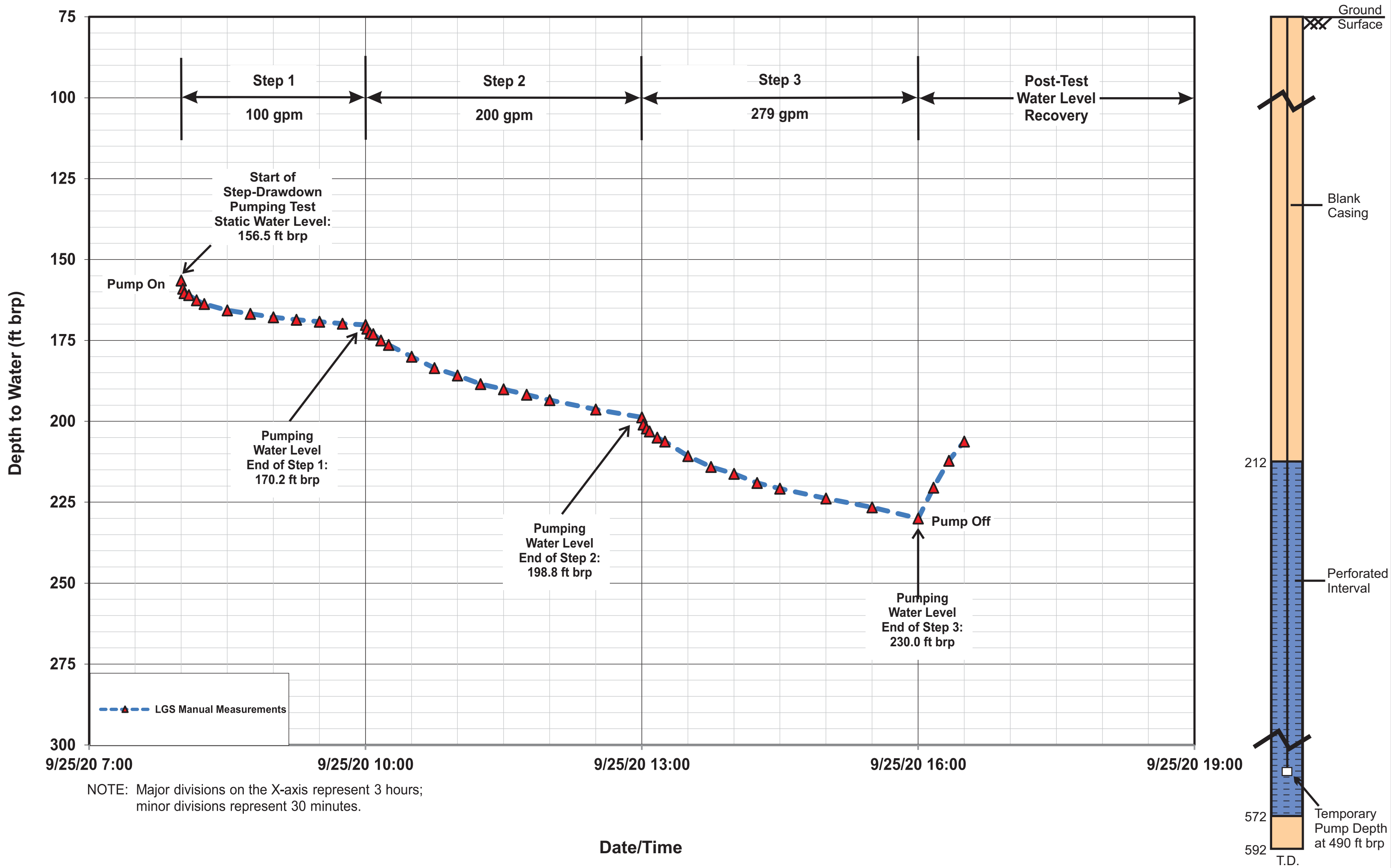
FIGURE 2

AERIAL PHOTOGRAPH MAP

RCS Job No. 726-NPA01 **December 2020**



NOTE: Major divisions on the X-axis represent 3 hours; minor divisions represent 30 minutes.

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FIGURE 3A
PLOT OF WATER LEVELS DURING STEP DRAWDOWN TEST
PROJECT PIONEER WELL NO. 8

Job No. 726-NPA01 **December 2020**

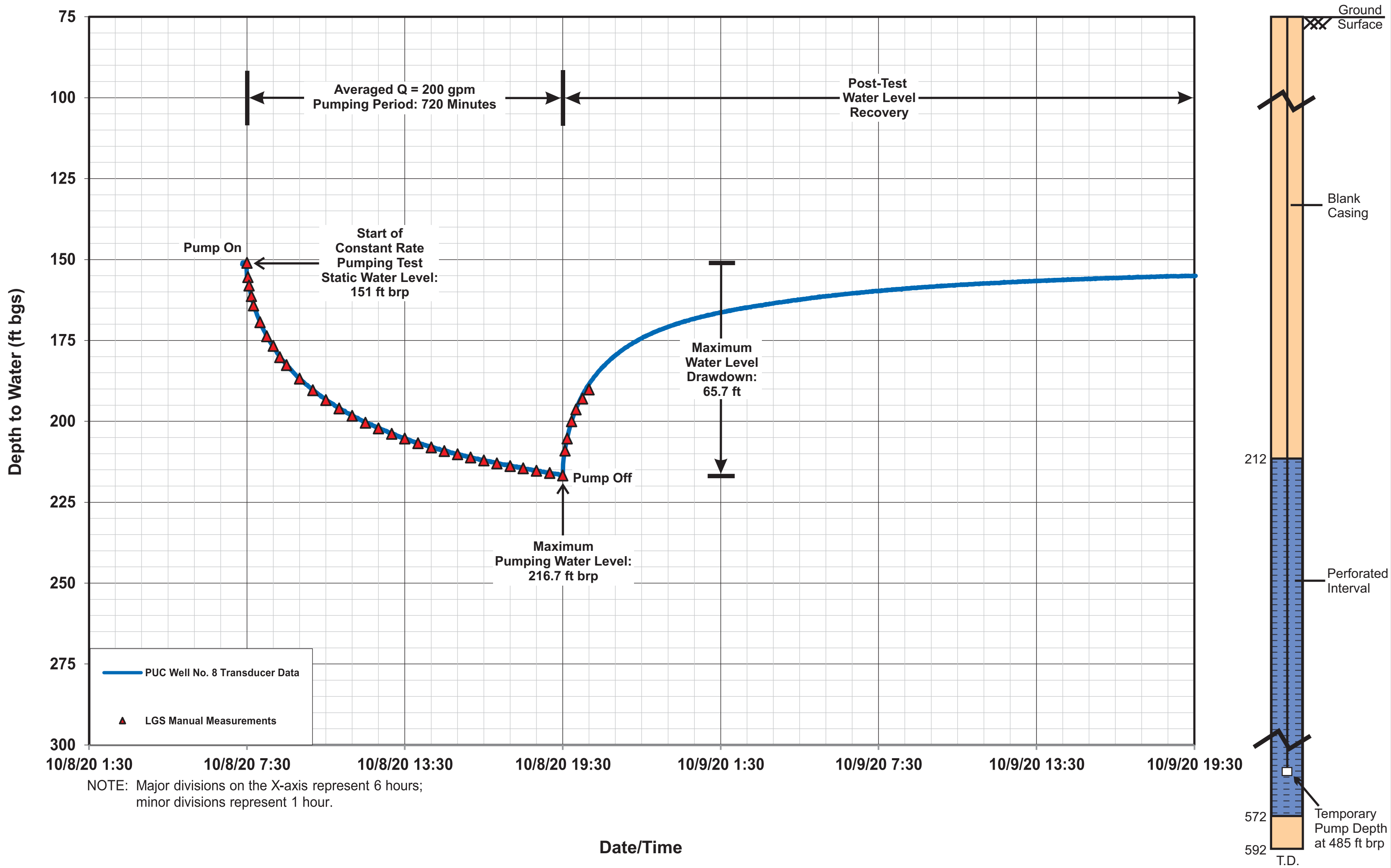

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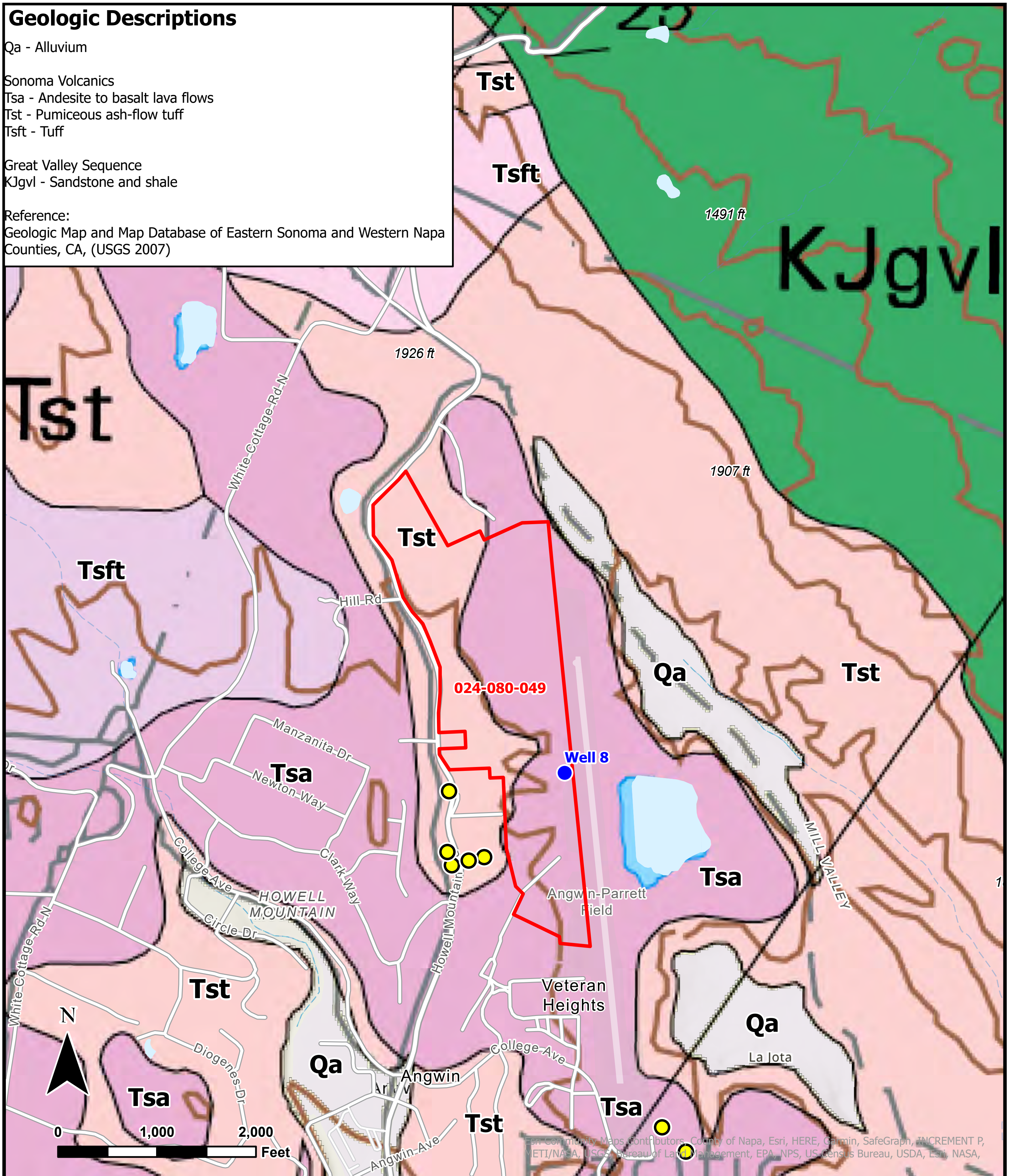
FIGURE 3B
PLOT OF WATER LEVELS DURING CONSTANT RATE TEST
PROJECT PIONEER WELL NO. 8

Job No. 726-NPA01 **December 2020**



LEGEND

- Proposed Vineyard Development Parcel
- Onsite Well Location
- Offsite Well Location (Owned by PUC)

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FIGURE 4
GEOLOGIC MAP

RCS Job No. 726-NPA01 **December 2020**

LEGEND

★ Subject Property

Napa County Watershed Boundary

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FIGURE 5 WATERSHED BOUNDARIES

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RCS Job No. 726-NPA01

December 2020

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

WELL CONSTRUCTION DETAILS

Reported Well Designation	DWR Well Log No.	Date Drilled	Method of Drilling	Pilot Hole Depth (ft bgs)	Casing Depth (ft bgs)	Casing Type	Casing Diameter (in)	Borehole Diameter (in)	Sanitary Seal Depth (ft bgs)	Perforation Intervals (ft bgs)	Type and Size (in) of Perforations	Gravel Pack Interval (ft) and Size	Current Status of Well
Well 8	e0198361	January 2014	Air Rotary	600	592	PVC	8	15 (0-60 ft) 12 (60-600 ft)	0-54 (10-Sack Cement)	212-372; 392-472; 492-572	Machine-cut 0.032	54-592 #6 Sand	Active

POST-CONSTRUCTION YIELD DATA

Reported Well Designation	DWR Well Log No.	Date & Type of Yield Data	Duration of "Test" (hrs)	Estimated Flow Rate (gpm)	Static Water Level (ft)	Pumping Water Level (ft)	Estimated Specific Capaity (gpm/ft ddn)
Well 8	e0198361	1/24/2014 Airlift	2	350	160	ND	ND
		10/8/2020 Pumping	12	200	151	217	3.1

Notes: ND = No data available
ft bgs = feet below ground surface
in = inches
hrs = hours
gpm = gallons per minute
gpm/ft ddn = gallons per minute per foot of water level drawdown

Table 2
Step Drawdown Test Data
Well No. 8
Project Pioneer Vineyard Development Project

STEP RATE NO.(1)	PUMPING RATE(2) (Q, in gpm)	PUMPING WATER LEVEL (ft brp)	WATER LEVEL DRAWDOWN (s, in ft)(3)	SPECIFIC CAPACITY (gpm/ft of drawdown)
1	100	170.2	13.7	7.3
2	200	198.8	42.3	4.7
3	279	230.0	73.5	3.8

NOTES:
(1) Length of Step No. 1 was 2 hrs. in duration; length of Step Nos. 2 and 3 were 3 hrs in duration, each.
(2) Pumping rates based on average totalizer readings.
(3) Based on a static water level of 156.5 ft brp on September 25, 2020.
gpm = gallons per minute
ft = feet
brp = below reference point

Table 3
Results of Laboratory Analysis of Final Wellblend Sample
Well No. 8
Project Pioneer Vineyard Development Project

Constituent Analyzed	Units	Maximum Contaminant Level	Reported Analytical Results
Specific Conductance	µS/cm	900; 1,600; 2,200(1)	120
pH	units	None	6.9
Sodium Absorption Ratio (SAR), Adjusted	unitless	None	0.43
Turbidity	NTU	5	**12**
Total Dissolved Solids	mg/L	500; 1,000; 1,500(1)	130
Total Hardness	mg/L	None	23
Calcium	mg/L	None	5.6
Magnesium	mg/L	None	2.2
Sodium	mg/L	None	7.3
Potassium	mg/L	None	3
Alkalinity (as $CaCO_3$)	mg/L	None	38
Bicarbonate (HCO_3)	mg/L	None	46
Sulfate	mg/L	250; 500; 600(1)	1.5
Chloride	mg/L	250; 500; 600(1)	5.8
Fluoride	mg/L	2	ND
Nitrate as N	mg/L	10	0.7
Iron	mg/L	0.3(2)	0.17
Manganese	mg/L	0.05	0.0063
Silica (as SiO_2)	mg/L	None	58
Zinc	mg/L	5(2)	0.33

Notes:

(1) The three listed numbers represent the recommended, upper and short-term Secondary Maximum Contaminant Levels for the constituent for domestic-use purposes.

(2) Values are non-enforceable Secondary Standards, Notification Levels.

µS/cm = micro Siemens per centimeter

mg/L = milligrams per liter

ND = Not Detected

Bold red numbers indicate concentrations meet or exceed MCL for drinking water

Table 4
Groundwater Use Estimates
Project Pioneer Vineyard Development Project

Groundwater Use	Estimated Groundwater Use (acre-feet/year)	
	Existing	Future
Irrigation Groundwater Use[1]		
Existing Vineyards = 0 acres	0.0	--
Proposed Vineyards = 35.9 acres	---	18.0
Total Irrigation Groundwater Use	**0.0**	**18.0**

Notes:
[1]Assumed unit irrigation water use = 0.50 acre-feet/year
1 acre-foot = 325,851 gallons

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Table 5
Comparison of Rainfall Data Sources
Project Pioneer Vineyard Development Project

Rain Gage and/or Data Source	Years of Available Rainfall Record	Average Annual Rainfall in Inches (ft)	Elevation of Rain Gage (ft amsl)	Distance of Rain Gage from Subject Property (mi)	Elevation Relative to Subject Property(1)
WRCC Angwin Pac Union College	WY 1943-44 through WY 2019-20[3]	38.8 (3.23)	1,715	0.5	Lower
WRCC St Helena	WY 1907-08 through WY 2019-20[2]	33.3 (2.78)	225	5.5	Lower
CDEC Atlas Peak	WY 1988-89 through WY 2019-20[4]	40.0 (3.33)	1,660	14.7	Lower
PRISM	1981 to 2010	42.3 (3.53)	---	---	---
Napa County Isohyetal Map	1900 to 1960	35.0 (2.92)	---	---	---

Notes:
1. The subject property is located at elevations between ±1,800 and ±1,840 ft asl
2. Missing and/or erroneous rainfall data in: 1907; 1915-1922; 1979-1980; 1985-1988; 1992; and 2011-2012.
3. Missing and/or erroneous rainfall data in: 1940-1943; 1975; and in 2011.
4. Missing and/or erroneous rainfall data in: WY 1987-88, WY 1994-95, WY 1995-96, WY 2004-05, and WY 2006-07.

ft - feet
mi - miles
amsl - above mean sea level

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Table 6
Drought Period Rainfall as Percentage of Average
Project Pioneer Vineyard Development Project

Statewide Drought Period as Defined by DWR/NDMC	Drought Duration (years)	Average Rainfall by Raingage								
		St Helena WRCC Period of Record - WY 1907-08 through WY 2019-20			Angwin Pacific Union College WRCC Period of Record - WY 1943-44 through WY 2019-20			Atlas Peak CDEC Period of Record - WY 1988-89 to WY 2019-20		
		[A] Total Gage Average (in)	[B] Drought Period Ave. (in)	[B/A] Drought Period Rainfall as % of Average	[A] Total Gage Average (in)	[B] Drought Period Ave. (in)	[B/A] Drought Period Rainfall as % of Average	[A] Total Gage Average (in)	[B] Drought Period Ave. (in)	[B/A] Drought Period Rainfall as % of Average
WY 1928-29 to WY 1933-34	6	33.3	23.9	72%	ND	ND	ND	ND	ND	ND
WY 1975-76 to WY 1976-77	2	33.3	13.4	40%	38.8	12.3	32%	ND	ND	ND
WY 1986-87 to WY 1991-92	6	33.3	18.3*	55%*	38.8	23.7	61%	40	38.7*	97%*
WY 2006-07 to WY 2008-09	3	33.3	24.8	74%	38.8	27.6	71%	40	23.4	59%
WY 2011-12 to WY 2015-16	5	33.3	21.7*	65%*	38.8	33.2	86%	40	29.3	73%

ND = No rainfall data for corresponding drought period.

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

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APPENDIX

CALIFORNIA DEPARTMENT OF WATER RESOURCES
WELL COMPLETION REPORT (DRILLER'S LOG)
LGS DRILLING, INC. PUMPING TEST RECORDS
&
LABORATORY REPORT
FOR WELL 8

ORIGINAL
File with DWR

Page 1 of 1

Owner's Well No. 1-2014

Date Work Began 1/13/2014, Ended 1/24/2014

Local Permit Agency Napa County Environmental Mgmt

Permit No. E13-00840 Permit Date 12/23/2013

STATE OF CALIFORNIA

WELL COMPLETION REPORT

Refer to Instruction Pamphlet

No. e0198361

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 AIR

DEPTH FROM SURFACE Ft.	to Ft.	DESCRIPTION Describe material, grain, size, color, etc.
0	5	TOP SOIL
5	35	HARD GRAY VOLCANIC ROCK
35	75	GRAY VOLCANICS WITH ASH
75	100	GRAY VOLCANICS
100	140	SOFT TAN VOLCANIC ROCK
140	220	SOFT GRAY VOLCANICS
220	390	HARD GRAY, TAN VOLCANICS
390	395	HARD BLACK VOLCANICS
395	420	TAN VOLCANICS
420	510	GRAY, TAN VOLCANICS
510	600	DARK GRAY VOLCANICS
		CONTINUED CASING LAYOUT
392	472	SCREEN PVC 8" .032 SLOT
472	492	BLANK PVC 8"
492	572	SCREEN PVC 8" .032 SLOT
572	592	BLANK PVC 8"

TOTAL DEPTH OF BORING 600 (Feet)

TOTAL DEPTH OF COMPLETED WELL 592 (Feet)

WELL OWNER

Name Pacific Union College

Mailing Address One Angwin Avenue

Angwin CA 94508

CITY STATE ZIP

WELL LOCATION

Address One Angwin Avenue

City Angwin CA

County Napa

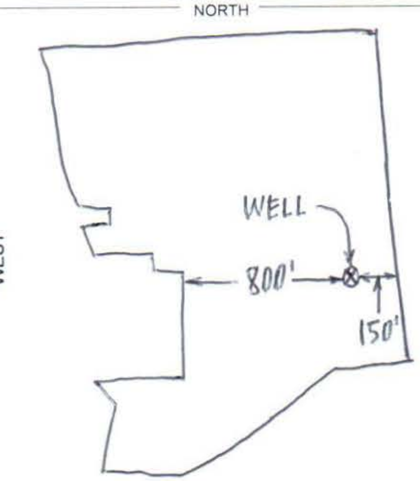
APN Book 024 Page 080 Parcel 034

Township ___ Range ___ Section ___

Latitude ___ DEG. MIN. SEC. Longitude ___ DEG. MIN. SEC.

LOCATION SKETCH

NORTH



WEST EAST SOUTH

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

ACTIVITY (✓)

✓ NEW WELL

MODIFICATION/REPAIR
___ Deepen
___ Other (Specify)

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

PLANNED USES (✓)

WATER SUPPLY
✓ Domestic ___ Public
✓ Irrigation ___ Industrial

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

WATER LEVEL & YIELD OF COMPLETED WELL

DEPTH TO FIRST WATER 190 (Ft.) BELOW SURFACE 1

DEPTH OF STATIC WATER LEVEL 160 (Ft.) & DATE MEASURED 1/24/2014

ESTIMATED YIELD * 350 (GPM) & TEST TYPE AIR LIFT

TEST LENGTH 2 (Hrs.) TOTAL DRAWDOWN N/A (Ft.)

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

CASING (S)

DEPTH FROM SURFACE Ft.	to Ft.	BORE-HOLE DIA. (Inches)	BLANK	SCREEN	CON-DUCTOR	FILL PIPE	MATERIAL / GRADE	INTERNAL DIAMETER (Inches)	GAUGE OR WALL THICKNESS	SLOT SIZE IF ANY (Inches)
0	60	15								
60	600	12								
0	212		✓				PVC F480	8	SDR-21	
212	372			✓			PVC F480	8	SDR-21	.032
372	392		✓				PVC F480	8	SDR-21	

ANNULAR MATERIAL

DEPTH FROM SURFACE Ft.	to Ft.	CE-MENT (✓)	BEN-TONITE (✓)	FILL (✓)	FILTER PACK (TYPE/SIZE)
0	54	✓			10 SK SAND
54	592			✓	#6 SAND

ATTACHMENTS (✓)

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

ATTACH ADDITIONAL INFORMATION, IF IT EXISTS.

CERTIFICATION STATEMENT

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

NAME HUCKFELDT WELL DRILLING, INC.

(PERSON, FIRM, OR CORPORATION) (TYPED OR PRINTED)

2110 Penny Lane Napa CA 94559

ADDRESS CITY STATE ZIP

Signed Wm Huckfeldt 01/29/14 439-746

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

DWR 188 REV. 11-97

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

Date: 9-25-20

Job No: Pacific Union College

WELL ID: 2016-A	Remarks: 1800' Elev.	Sheet 1 of 2
GPS: N 38 34 62	Well Depth 692	Observers SMITH S.
W 122 26 11	Pump Set 490	
	Pump HP 50	

TYPE OF TEST

Step Tests 100-200-300

Time of Day	Elapsed Time min.	sec.	Depth to water from R.P. (ft)	Depth below static level. (ft)	Remarks
					T = 1,004,700
8:00	0		156.50	0	100 GPM
	1		159.00		
	2		160.40		
	5		161.00		
	10		162.60		
	15		163.70		100 GPM
	30		165.70		Clear
	45		166.80		
9:00	60		167.80		1,010,700
	75		168.60		
	90		169.20		
	105		169.80		
10:00	120		170.20		T = 1,016,700
	1		171.30		200 GPM
	3		172.80	172.80	
	5		173.00		
	10		175.00	175.00	
	15		176.40		
	30		180.00		200 GPM
	45		183.50		
11:00	60		185.80		
	75		188.50		Slightly Cloudy
	90		190.10		
	105		191.75	191.75	
12:00	120		193.45		
	150		196.30		
13:00	180		198.75		T = 1,052,700
	1		201.00		300 GPM
	3		202.20		
	5		203.10		
	10		205.00		
	15		206.20		
	30		210.70		T = 1,068,800 = 270 GPM
	45		214.10		
14:00	60		216.20		1,068,900 = 270 GPM MAX
	75		219.00		
	90		220.75		
	120		223.80		
	150		226.60		1,086,800
16:00	180		230.00		1,103,000

Recovery

16:10	220.50
16:20	212.20
16:30	206.25

6950 Browns Valley Rd., Vacaville, CA 95688

Tel: (530) 681-2012 • Fax: (707) 448-1459

LGS

LGS DRILLING, INC

Date: 10-8-20 Job No: PUC

WELL ID: 2016-A #8	Remarks: Elev. 1800'	Sheet 1 of 1
GPS: N 38 34 52	Well Depth 592	Observers S. Smith
W 122 26 11	Pump Set 485	
	Pump HP 50	

TYPE OF TEST

12 hr. @ 200 GPM

Time of Day	Elapsed Time min.	sec.	Depth to water from R.P. (ft)	Depth below static level. (ft)	Remarks
					T = 1, 103, 000
7:30	0		151.00	0	
	2		155.45		
	5		158.05		
	10		161.30		
	15		164.20		
	30		169.40		200 GPM
	45		173.75		
	60		176.70		T = 1,115,000 200 GPM
	75		180.15		clear
	90		182.60		
	120		186.80		T = 1,127,000 200GPM
10:00	150		190.35		
	180		193.40		T = 1,139,000 200GPM
	210		196.00		Clear
	240		198.30		1,151,000 200GPM
	270		200.40		
12:30	300		202.20		Clear
	330		203.85		
	360		205.30		1,175,000 200 GPM
	390		206.75		
	420		208.05		
	450		209.20		
	480		210.20		1,199,000 200 GPM
	510		211.20		
	540		212.10		
	570		213.00		
	600		213.80		1,223,000 200GPM
	630		214.55		
	660		215.25		
	690		216.00		
	720		216.70		1,247,000 200GPM
19:30		5	209.00		
Recovery		10	205.30		
		20	200.00		
		30	196.30		
		45	193.00		
		60	190.15		

Wednesday, October 28, 2020

Scott Smith
LGS Drilling, Inc.
6950 Browns Valley Rd
Vacaville, CA 95688

Re	Lab Order:	V100408	Collected By:	SCOTT SMITH
	Project ID:	PUC #8	PO/Contract #:	

Dear Scott Smith:

Enclosed are the analytical results for sample(s) received by the laboratory on Friday, October 09, 2020. Results reported herein conform to the most current NELAC standards, where applicable, unless otherwise narrated in the body of the report.

If you have any questions concerning this report, please feel free to contact me.

Enclosures

Project Manager: Carol Battaglia

1885 North Kelly Road • Napa, California 94558
(707) 258-4000 • Fax (707) 226-1001 • e-mail: info@caltestlabs.com

SAMPLE SUMMARY

Lab Order: V100408
Project ID: PUC #8

Lab ID	Sample ID	Matrix	Date Collected	Date Received
V100408001	**PUC #8**	Water	10/08/2020 16:00	10/09/2020 08:44

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NARRATIVE

Lab Order: V100408
Project ID: PUC #8

General Qualifiers and Notes

Caltest authorizes this report to be reproduced only in its entirety. Results are specific to the sample(s) as submitted and only to the parameter(s) reported.

Caltest certifies that all test results for wastewater and hazardous waste analyses meet all applicable NELAC requirements; all microbiology and drinking water testing meet applicable ELAP requirements, unless stated otherwise.

All analyses performed by EPA Methods or Standard Methods.

Dilution Factors (DF) reported greater than '1' have been used to adjust the result, Reporting Limit (RL), and Method Detection Limit (MDL).

All Solid, sludge, and/or biosolids data is reported in Wet Weight, unless otherwise specified.

Filtrations performed at Caltest for dissolved metals (excluding mercury) and/or pH analysis are not performed within the 15 minute holding time as specified by 40CFR 136.3 table II.

Results Qualifiers: Report fields may contain codes and non-numeric data correlating to one or more of the following definitions:

ND - indicates analytical result has not been detected at or above the Reporting Limit (RL), or at above the Method Detection Limit (MDL) when it is included on the report and is not otherwise noted.

RL - Reporting Limit is the quantitation limit at which the laboratory is able to detect an analyte. An analyte not detected at or above the RL is reported as ND unless otherwise noted or qualified. For analyses pertaining to the State Implementation Plan of the California Toxics Rule, the Caltest Reporting Limit (RL) is equivalent to the Minimum Level (ML). A standard is always run at or below the ML. Where Reporting Limits are elevated due to dilution, the ML calibration criteria has been met.

MDL - The Method Detection Limit is defined as the minimum measured concentration of a substance that can be reported with 99% confidence that the measured concentration is distinguishable from method blank results.

J - reflects estimated analytical result value detected below the Reporting Limit (RL) and above the Method Detection Limit (MDL). The 'J' flag is equivalent to the DNQ Estimated Concentration flag.

B - indicates the analyte has been detected in the blank associated with the sample.

SS - compound is a Surrogate Spike used per laboratory quality assurance manual.

NOTE: This document represents a complete Analytical Report for the samples referenced herein and should be retained as a permanent record thereof.

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ANALYTICAL RESULTS

Lab Order: V100408
Project ID: PUC #8

Lab ID **V100408001** Date Collected 10/8/2020 16:00 Matrix Water
Sample ID **PUC #8** Date Received 10/9/2020 08:44

Parameters	Result	Units	R. L.	DF	Prepared	Batch	Analyzed	Batch	Qual
pH, Electrometric Analysis	**Analytical Method:**	SM 4500-H+ B-00/-11					**Analyzed by:**	MYS	
pH	6.9	pH Units		1			10/09/20 12:31	BIO 22566	
Calculation, Adjusted SAR	**Analytical Method:**	Calculated					**Analyzed by:**	TPH	
Adj. Sodium Adsorption Ratio	0.43	units		1			10/19/20 20:48	CALC	
Calculation, Hardness	**Analytical Method:**	Calculated					**Analyzed by:**	TPH	
Hardness Calculation	23	mg/L	0.5	1			10/19/20 20:48	CALC	
Calculation, Total Anions	**Analytical Method:**	Calculated					**Analyzed by:**	JH	
Total Anions	1.0	meq/L		1			10/16/20 16:10	CALC	
Calculation, Total Cations	**Analytical Method:**	Calculated					**Analyzed by:**	TPH	
Total Cations	0.88	meq/L		1			10/19/20 20:48	CALC	
Metals by ICPMS, Collision Mode, Total	**Prep Method:**	EPA 200.8					**Prep by:**	LM	
	Analytical Method:	EPA 200.8					**Analyzed by:**	TPH	
Calcium	5.6	mg/L	0.50	10	10/16/20 00:00	MPR 17599	10/19/20 20:48	MMS 10126	
Magnesium	2.2	mg/L	0.50	10	10/16/20 00:00	MPR 17599	10/19/20 20:48	MMS 10126	
Potassium	3.0	mg/L	1.0	10	10/16/20 00:00	MPR 17599	10/19/20 20:48	MMS 10126	
Sodium	7.3	mg/L	1.0	10	10/16/20 00:00	MPR 17599	10/19/20 20:48	MMS 10126	
Metals by ICPMS, Collision Mode, Diss	**Prep Method:**	EPA 200.8 (filtrate)					**Prep by:**	LM	
	Analytical Method:	EPA 200.8 (filtrate)					**Analyzed by:**	TPH	
Arsenic	ND	mg/L	0.00080	4	10/16/20 00:00	MPR 17601	10/17/20 00:59	MMS 10125	
Boron	ND	mg/L	0.040	4	10/16/20 00:00	MPR 17601	10/17/20 00:59	MMS 10125	
Iron	0.17	mg/L	0.10	4	10/16/20 00:00	MPR 17601	10/17/20 00:59	MMS 10125	
Manganese	0.0063	mg/L	0.0020	4	10/16/20 00:00	MPR 17601	10/17/20 00:59	MMS 10125	
Silica (as SiO2)	58	mg/L	1.0	4	10/16/20 00:00	MPR 17601	10/17/20 00:59	MMS 10125	
Zinc	0.33	mg/L	0.020	4	10/16/20 00:00	MPR 17601	10/17/20 00:59	MMS 10125	
Turbidity Analysis	**Analytical Method:**	SM 2130 B-01/11					**Analyzed by:**	BCP	
Turbidity	12	NTU	0.055	1			10/09/20 11:44	WET 10650	
Electrical Conductance Analysis	**Analytical Method:**	SM 2510 B-97/-11					**Analyzed by:**	JH	
Conductivity	120	umhos/cm	10	1			10/16/20 14:21	WET 10660	
Total Dissolved Solids Analysis	**Analytical Method:**	SM 2540 C-97/-11					**Analyzed by:**	JH	
Total Dissolved Solids	130	mg/L	10	1			10/10/20 14:20	WGR 7741	
Anions by Ion Chromatography	**Analytical Method:**	EPA 300.0					**Analyzed by:**	MYS	
Chloride	5.8	mg/L	1	1			10/09/20 22:22	WIC 7212	
Fluoride	ND	mg/L	0.1	1			10/09/20 22:22	WIC 7212	
Nitrogen, Nitrate (as N)	0.70	mg/L	0.1	1			10/09/20 22:22	WIC 7212	
Sulfate (as SO4)	1.5	mg/L	0.5	1			10/09/20 22:22	WIC 7212	

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ANALYTICAL RESULTS

Lab Order: V100408
Project ID: PUC #8

Lab ID **V100408001** Date Collected 10/8/2020 16:00 Matrix Water
Sample ID **PUC #8** Date Received 10/9/2020 08:44

Parameters	Result	Units	R. L.	DF	Prepared	Batch	Analyzed	Batch	Qual
Alkalinity, Total by Standard Methods	**Analytical Method:**		SM 2320 B-97/-11				**Analyzed by:**	JH	
Alkalinity, Total (as CACO3)	38	mg/L	10	1			10/16/20 16:10	WTI 3329	
Hydroxide (as OH)	ND	mg/L	2	1			10/16/20 16:10	WTI 3329	
Bicarbonate (as HCO3)	46	mg/L	12	1			10/16/20 16:10	WTI 3329	
Carbonate (as CO3)	ND	mg/L	6	1			10/16/20 16:10	WTI 3329	

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Dear Client:

Caltest provides a variety of water analyses, but cannot provide an opinion regarding the quality of the water or its suitability for any particular use. If you would like information, please feel free to contact any of the following suggested resources listed below.

Human Health Concerns:

EPA Safe Drinking Water Hotline 800/426-4791
www.epa.gov/safewater

Napa County Environmental Health 707/253-4471
http://www.countyofnapa.org/PBES/Environmental/

County of Sonoma Permit & Resource Management Department, 707/565-2849
Well and Septic Division
http://sonomacounty.ca.gov/PRMD/Eng-and-Constr/Well-and-Septic/

Irrigation Concerns:

University of California at Davis Department of Land, Air, and Water Resources - Cooperative Extension
http://www.lawr.ucdavis.edu/people/faculty/cooperative-extension

Other helpful resources:

EPA's Private Drinking Water Wells webpage:
http://water.epa.gov/drink/info/well/publications.cfm

CDC's Well Testing Overview:
http://www.cdc.gov/healthywater/drinking/private/wells/testing.html

California State Water Resources Control Board Well Owner webpage:
http://www.waterboards.ca.gov/water_issues/programs/gama/well_owners.shtml

Thank you for choosing Caltest for your water testing needs. Please feel free to email us at info@caltestlabs.com if we can provide you with any further testing assistance.

Sincerely,

Todd M. Albertson
President
Caltest Analytical Laboratory

(See next page for various regulatory and information limits)

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The following information is from California Code of Regulations Title 22, California State Water Resources Control Board, World Health Organization, EPA, and Napa County Environmental Health "Interpreting Drinking Water Test Results." This information is provided for your convenience. **Caltest does not provide consultation regarding the suitability of water for a given purpose.**

Arsenic has a drinking water Maximum Contaminant Level (MCL) of 10 ug/L (ppb) or 0.010 mg/L (ppm).

Boron has a California State Notification Level of 1000 ug/L (ppb) or 1 mg/L (ppm). Drinking water sources with greater than 10 times the Notification Level are recommended for removal from service. Boron affects the health and production of boron-sensitive plants; tolerance varies by crop.

Calcium and **Magnesium** are related to water hardness. See Hardness remarks.

Chloride has a drinking water Maximum Contaminant Level (MCL) of 500 mg/L, with a recommended level of 250 mg/L and a short-term level of 600 mg/L.

Copper has a drinking water Maximum Contaminant Level (MCL) of 1000 ug/L (ppb) or 1 mg/L (ppm).

Electrical Conductance has a drinking water Maximum Contaminant Level (MCL) of 1,600 umhos/cm, with a recommended level of 900 umhos/cm and a short-term limit of 2,200 umhos/cm. Electrical Conductance is a measure of the ability of a water to conduct an electrical current and is expressed in micromhos per centimeter at 25 degrees C.

Fluoride has an optimal level of 0.7 mg/L per the US Department of Health and Human Services Agency. It has a Maximum Contaminant Level (MCL) of 2.0 mg/L.

Iron has a drinking water Maximum Contaminant Level (MCL) of 300 ug/L (ppb) or 0.3 mg/L (ppm).

Hardness is due primarily to calcium and/or magnesium carbonates and bicarbonates. Up to 60 mg/L is SOFT. Between 60 to 120 mg/L is MODERATE (typically most desirable). Between 120 to 180 mg/L is HARD. Over 180 mg/L is VERY HARD.

Manganese has a drinking water Maximum Contaminant Level (MCL) of 50 ug/L (ppb) or 0.05 mg/L (ppm) (based on aesthetics). It also has a California drinking water Notification Level of 0.5 mg/L (based on potential health concerns) --Drinking water sources with greater than 10 times the Notification Level are recommended for removal from service.

Sodium has a recommended limit of 100 mg/L. According to the American Heart Association, water containing more than 270 mg/L should not be consumed by those on a moderately restricted sodium diet.

Nitrate as N, has a drinking water Maximum Contaminant Level (MCL) of 10 mg/L.

Lead has a drinking water EPA Action Limit of 15 ug/L (ppb) or 0.015 mg/L (ppm).

pH suggested level is 6.5 - 8.5.

Silica has a recommended limit of 70 mg/L. Silica in water may etch various household materials such as leaded crystal, marble, tile, windows and porcelain.

Sulfate has a drinking water Maximum Contaminant Level (MCL) of 500 mg/L, with a recommended level of 250 mg/L and a short-term level of 600 mg/L.

Total Dissolved Solids has a drinking water Maximum Contaminant Level (MCL) of 1,000 mg/L, with a recommended level of 500 mg/L and short-term level of 1,500 mg/L.

Zinc has a drinking water Maximum Contaminant Level (MCL) of 5000 ug/L (ppb) or 5 mg/L (ppm).

Caltest ANALYTICAL LABORATORY

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SAMPLE CHAIN OF CUSTODY

PAGE ______ OF ______

LAB ORDER #: V100408

PROJECT # / PROJECT NAME: PUC #8

P.O. #

CLIENT: LGS Drilling Inc

REPORT ATTN: Scott Smith

MAILING ADDRESS: CITY: STATE: ZIP:

BILLING ADDRESS (IF DIFFERENT): CITY: STATE: ZIP:

PHONE #: 5306812012 EMAIL ADDRESS: lgs.drilling@yahoo

SAMPLER (PRINT & SIGN NAME): Scott Smith Scott Smith

ANALYSES REQUESTED: Slade Irg PKG.

TURN-AROUND TIME
☐ STANDARD
☐ RUSH

DUE DATE: ________

REGULATORY DRINKING WATER? Y / N
If Y, write 10-digit PS Code/s below:

CALTEST #	DATE SAMPLED	TIME SAMPLED	MATRIX	CONTAINER AMOUNT/TYPE	PRESERVATIVE	SAMPLE IDENTIFICATION SITE	CLIENT LAB #	COMP. or GRAB
	10-8-20	16:00	W	½gal	—	PUC #8		

By submittal of sample(s), client agrees to abide by the Terms and Conditions set forth on the reverse of this document.

RELINQUISHED BY	DATE/TIME	RECEIVED BY	RELINQUISHED BY	DATE/TIME	RECEIVED BY
Scott Smith	10-9-20 8:44	[signature]			

OK TO PROCEED PER CLIENT [initials] 10/9/20

FOR LAB USE ONLY

TEMP: 6.9 °C / 7.5 °C SEALED: Y ✓ / N__ INTACT: Y ✓ N__ ON ICE: Y ✓ / N__ REPORTING OPTIONS (choose one): EMAIL / MAIL / BOTH

Samples: WC _____ MICRO _____ BIO _____ MET _____ SV _____ VOA _____

BD: BIO ______ ✓ WC ______ MET ______

SIL: HP ✓ PT ✓ QT ______ VOA ______

W/HNO$_3$ ✓ H$_2$SO$_4$ ______ NaOH ______

PIL: HNO$_3$ ______ H$_2$SO$_4$ ______ NaOH ______ HCL ______

COMMENTS

MATRIX: W = Aqueous Nondrinking Water, Digested Metals; ML = Final Effluent (Low-Level/Min. Level R.L.s), Aqueous Nondrinking Water, Digested Metals; DW = Drinking Water; SL = Soil, Sludge, Solid; FP = Free Product

CONTAINER TYPES: AL = Amber Liter; AHL = 500 ml, Amber; PT = Pint (Plastic); QT=Quart (Plastic); HG = Half Gallon (Plastic); SJ = Soil Jar; B4 = 4 oz. BACT; BT = Brass Tube; VOA = 40 mL.VOA; OTC = Other Type Container

REV. 12/19

WHITE - ORIGINAL TO LABORATORY YELLOW - CLIENT COPY AS RECEIPT