Rudd Westside Winery Groundwater Report
4603 Westside Road, Healdsburg
APN 110-110-026

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June 9, 2015

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Introduction

This groundwater study was prepared as required by Sonoma County Permit and Resource Management Division pursuant to General Plan Policy WR-3e regarding water availability in Zone 4 areas where groundwater is believed to be of limited supply. The responsible professional is Matt O'Connor, PhD, California Professional Geologist #6847 and Certified Engineering Geologist #2449.

The objective of this study is to assess the availability of groundwater as part of the Use Permit application process for a proposed winery on the 26.2 acre parcel located at 4603 Westside Road (APN 110-110-026). The subject parcel is located in a Zone 1 groundwater area, and this type of groundwater analysis has not generally been required in Sonoma County; however, Zone 4 is located in close proximity (~290-feet west) to the subject parcel. The Use Permit seeks to allow for a 10,000 case annual production winery, public tasting room, a 0.5 acre decorative citrus orchard, and 25 wine industry-related special events per year with between 50 and 150 attendees per event. PRMD notified the property owner that a groundwater study would be required in a letter dated January 26, 2015 referencing PRMD File No. PLP14-0031.

It is our understanding that this groundwater study relates primarily to the proposed uses subject to PRMD's discretionary authority, namely the proposed winery. It is also our understanding that use of groundwater for agricultural purposes is not subject to PRMD review. Nevertheless, this report considers agricultural uses of groundwater in addition to water use for the proposed winery.

This report is organized as follows. The first sections describe the hydrogeologic conditions in the vicinity of the project based on available maps and drillers' reports for wells obtained from the Department of Water Resources for the surrounding area. The available information is then synthesized to characterize aquifers and the aquifer impact area. Subsequent sections assess water supplies and potential demand for water in the project area and the potential that the proposed use may impact groundwater supplies available on adjacent parcels.

Limitations

Groundwater systems of Sonoma County and the Coast Range are typically complex, and available data rarely allows for more than general assessment of groundwater conditions and delineation of aquifers. This analysis is based on limited available data and relies significantly on interpretation of data from disparate sources of disparate quality. Drillers' reports used for this assessment were those made available to us through the California Department of Water Resources, Central District, with authorization from PRMD.

Hydrogeologic Conditions

Information Sources

The recent USGS Geologic map "Western Sonoma, Northernmost Marin and Southernmost Mendocino Counties" (Blake, Graymer et al. 2002) was used for analysis of the project area geology. It is consistent with earlier maps in wide use in Sonoma County, notably (Huffman, Armstrong et al. 1980). Figure 1 shows the project parcel boundary, topography, geology, locations of vineyards, and the hypothesized extent of the project aquifer. Figure 2 shows the locations of wells evaluated in this analysis and the location of the section line used for the hydrogeologic cross-section (Figure 3). Not all wells for which logs were obtained could be located with sufficient accuracy, or were near enough to the project area, to warrant display in Figure 2 (well logs are compiled in Appendix A and are confidential for review only by PRMD Well & Septic staff). The hydrogeologic cross-section (Figure 3) is presented as a generalized illustration of the orientation and composition of geologic units and groundwater elevations in the area based on interpretation of geologic map data, supplemented by data from the well drillers' reports.

Interpretation of Hydrogeology

The northern portion of the project parcel is underlain by Quaternary alluvial and marine terrace deposits (map unit Qt) and the southern portion of the parcel is underlain by Quaternary alluvial fan and fluvial deposits (map unit Qal). Qt is comprised of clast supported gravels, cobble and boulders in a sandy matrix. Qal is highly variable in composition but includes a basal stratum of alluvium two to six feet deep at a depth of five to ten feet overlying bedrock as described in drillers' logs on the project parcel.

These Quaternary deposits are relatively thin and are on the order of 5 to 20-ft thick in the immediate vicinity of the project parcel with someone greater thicknesses on the order of 50 to 70-ft reported in driller's logs north, south, and east of the project parcel. Aquifers associated with the Qt and Qal are expected to have a small storage capacity owing to the relatively small area and thickness of the deposit. Nine of the eleven driller's logs reviewed for this analysis are screened entirely within the underlying fractured bedrock rather than in these shallow alluvial deposits. Farther east in the Dry Creek Valley the alluvial deposits are thicker and provide a significant source of groundwater, however they do not appear to provide a significant source of groundwater to wells in the vicinity of the project parcel.

The sandstone unit of the Franciscan Complex (map unit TKfs) outcrops northwest of the project parcel and likely underlies the Quaternary units over most or all of the project parcel. The TKfs is a massive feldspathic-lithic wacke with thin beds of sandstone, shale, and slate. The majority of the watershed area up-gradient of the project parcel consists of the graywacke and melange unit of the Franciscan Complex (map unit KJfs) which is separated from the TKfs by a northwest/southeast trending fault. The KJfs consists of distinctly bedded lithic wacke and siltstone, shale, and slate, grading into melange consisting of sheared argillite and graywacke matrix enclosing blocks and lenses of other rock types. Small outcrop areas of greenstone (map unit gs), serpentinite (map unit sp), and silica carbonate rocks (map unit sc) occur in the upper portions of the watershed.

Groundwater associated with map units TKfs and KJfs are thought to be stored within interconnected fractures that permeate the bedrock. Drillers' reports in the local area indicate that wells drilled into these units are productive indicating that the fractured bedrock comprise a local aquifer.

The hydrogeologic characteristics of the fault contact separating the TKfs and KJfs located a few hundred feet west of the project parcel boundary is unknown. The fault zone may form a groundwater barrier or, alternatively, may be a region of increased fracturing and preferential groundwater flow. For purposes of defining the local aquifer and estimating aquifer recharge in this analysis, the fault contact is assumed to be a groundwater barrier. It is important to note that estimated groundwater availability would be significantly greater than reported here if the project aquifer assumed to extend across the fault contact and into the adjacent bedrock unit (KJfs). Given the limited depth and lack of wells screened within the overlying alluvial deposits, the bedrock aquifer is considered the only relevant aquifer supplying water to wells in the vicinity of the project parcel.

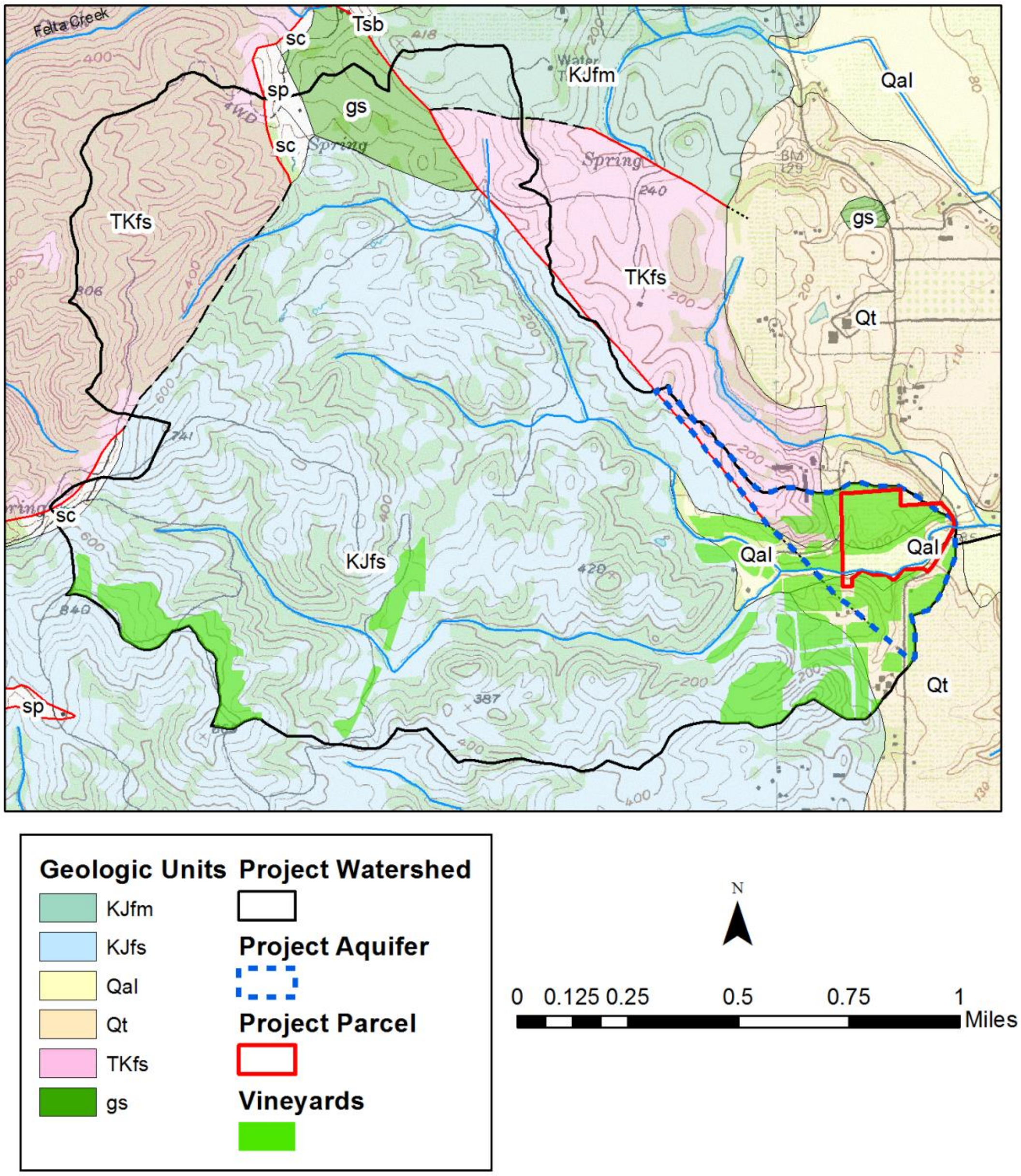

Figure 1. Generalized geologic map from Blake and Graymer (2002).

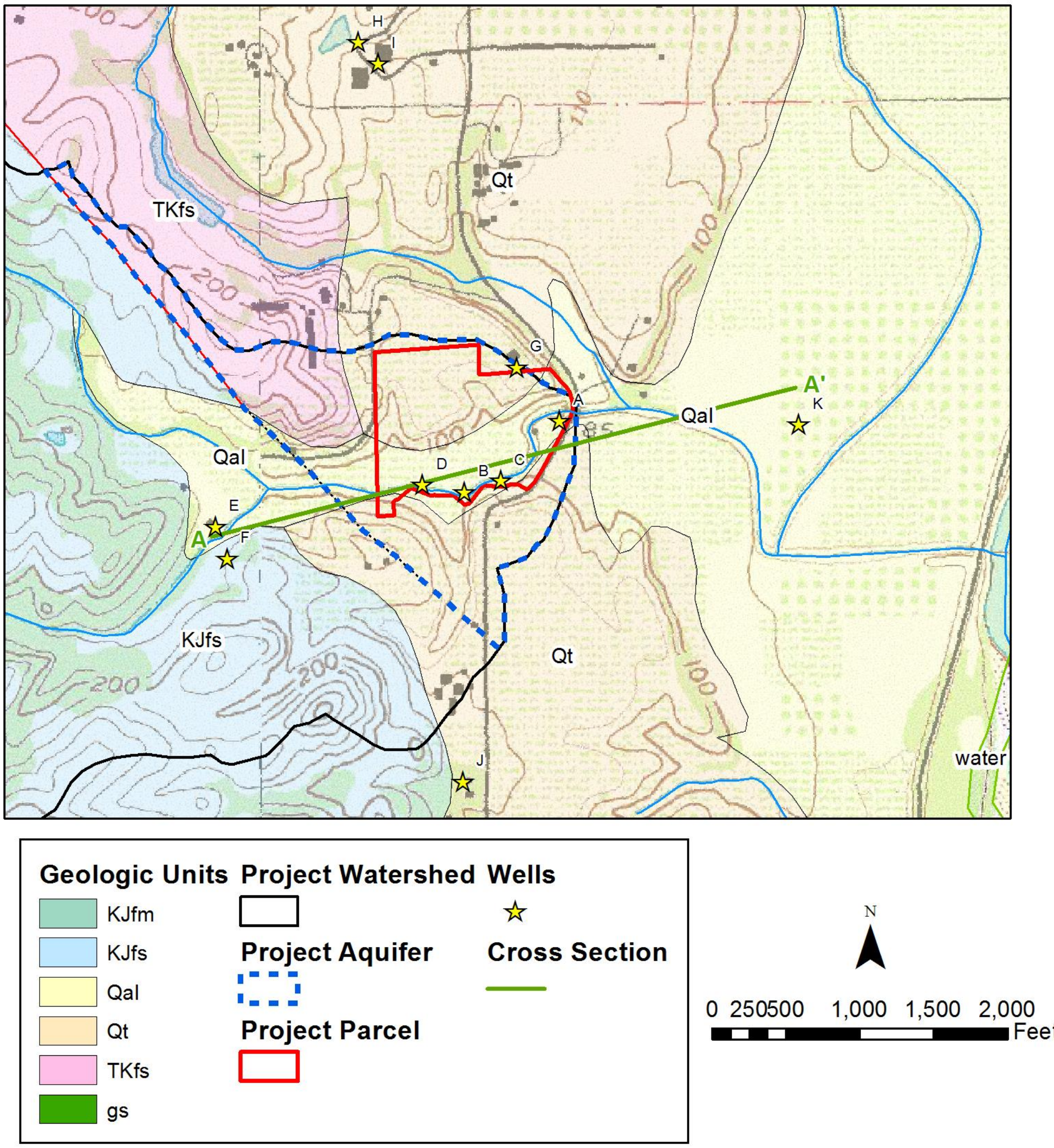

Figure 2. Locations of wells evaluated for this analysis and location of the hydrogeologic cross section presented in Figure 3.

Table 1. Details from drillers' logs in the vicinity of the project parcel that were reviewed for this analysis including APN, year driller, well depth, water level, well yield, drawdown level, duration of test associated with yield and drawdown, top and bottom of perforated casing and primary geologic unit that each well is completed in.

Well	APN	Year	Depth (ft)	Water Level (ft)	Yield (gpm)	Drawdown (ft)	Duration (hrs)	Top (ft)	Bottom (ft)	Map Unit
A	110-110-001	2007	200	32	25	99	8	59	186	TKfs
B	110-110-001	2007	252	130	8	92	3	40	240	TKfs
C	110-110-001	2007	250	11	40	143	3	40	240	TKfs
D	110-110-001	2007	250	14	20	179	3	40	240	TKfs
E	110-180-003	1995	360	60	20	300	2	85	340	KJfs
F	110-180-003	2013	120	30	3.5	--	2	20	120	KJfs
G	110-100-011	1976	173	90	60	50	2	125	173	TKfs
H	110-110-028	1994	300	60	30	260	2	97	297	TKfs
I	110-110-028	1998	360	100	50	300	2	140	360	TKfs
J	110-110-007	2006	207	--	--	--	--	--	--	KJfs
K	110-110-021	1997	66	30	--	--	--	20	65	Qal\Qt

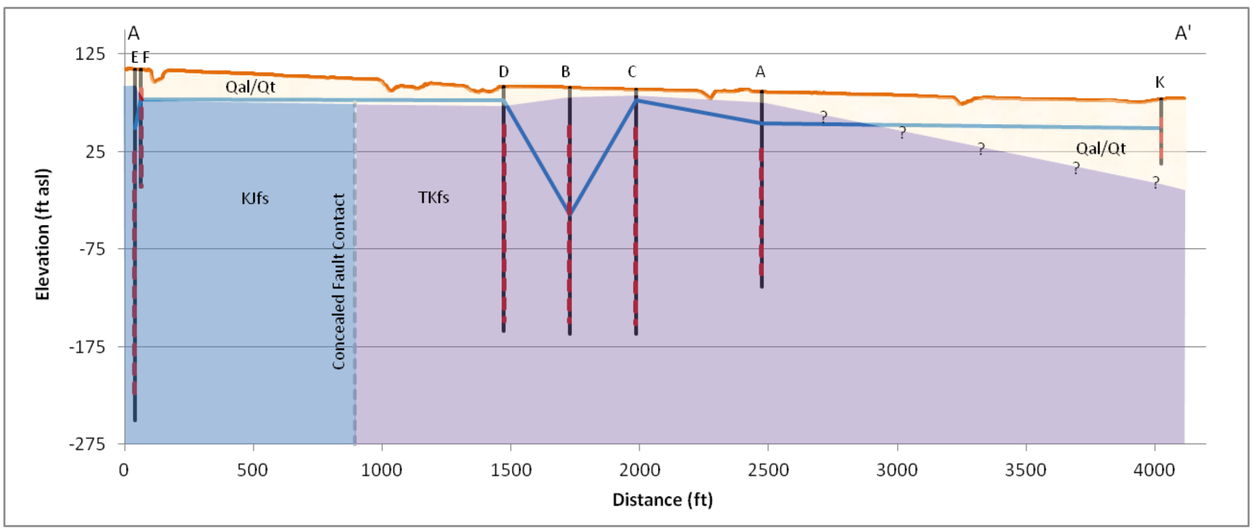

Figure 3. Generalized hydrogeologic cross section illustrating the orientation and composition of geologic units in the area of the project parcel, based on interpretation of geologic map data (Blake 2002) supplemented by data from well drillers' reports. The location of the cross section profile is shown on Figure 2. The screened intervals are shown with dashed red lines and the blue line represents the approximate groundwater elevation in the fractured bedrock aquifer; a perched aquifer is also believed to exist within the Qal\Qt unit.

Hydrogeology of the Bedrock Aquifer

In this section, characteristics of the aquifer inferred from available data pertaining to the wells in the vicinity of the project parcel are discussed. Following this is a summary interpretation regarding the potential impact on the project aquifer and nearby wells from pumping of a new well proposed to supply water for the proposed winery project. This section contains substantial detail pertaining to drillers' reports, and should be considered confidential.

Interpretation of Pump Test Data

Constant rate pump tests were performed on three existing wells on the project parcel (Wells A, C, and D) in 2007. Data from the pump tests (Appendix B) allow for estimation of important aquifer and well characteristics. Transmissivity (T) was approximated from the specific capacity (S_c) of the well at the conclusion of the pump test during the period of sustained steady-state pumping according to the procedure suggested by Weight and Sonderegger (2001, p. 431). Pump test data are from a shorter duration pump test (7 to 8 hours) than recommended for this procedure; consequently, the estimates are likely to be somewhat higher than would result from a longer duration pump test. S_c was calculated as the steady state pumping rate divided by drawdown in feet and ranged from 0.14 to 0.41 gpm per foot of drawdown. T was estimated to range from about 3.8 to 13.6 ft^2/day based on an empirical relationship for fractured bedrock aquifers relating T to specific capacity: $T = 38.9 (S_c)^{1.18}$.

Hydraulic conductivity of the aquifer was estimated from the definition T = K*b, where K is hydraulic conductivity (ft/day) and b is saturated thickness in feet. For a well that does not fully penetrate an unconfined aquifer, Weight and Sonderegger (2001, p. 438) suggest that b = 1.3 x screened length of well when evaluating data from pump tests < 24 hours in duration. From these data we estimated that K is on the order of 0.01 to 0.05 ft/day (about 10^{-7} m/s); this hydraulic conductivity is in the upper range reported for sandstone (10^{-6} to 10^{-10} m/s) and in the low end of the range for fractured metamorphic bedrock (10^{-4} to 10^{-8} m/s) (Freeze and Cherry, 1979, p. 29). The mean value of K from the three project wells (A, C and D) for which constant rate pump tests were conducted is 0.033 ft/day.

Bedrock Aquifer Wells

Well completion reports for wells listed in Table 1 and located (approximately) on Figure 2 indicate that groundwater elevations in the bedrock aquifer range from 11 to 130-ft below the ground surface, with an average value of 59-ft (Figure 3, Table 1). Well depths range from 120 to 360-ft, with an average of 247-ft. Yields range from 3.5 to 60 gpm, with an average value of 28.5 gpm. Drillers' reports primarily record weathered sandstone and shale with varying presence of other strata. The project wells range in depth from 200 to 250 feet; three of the four wells are 250 feet in depth.

Based on the available information, the fractured bedrock aquifer is conceptualized as a semi-confined aquifer. Groundwater is stored within the fractures and other secondary pore spaces formed in the bedrock. The hydrogeologic cross section provided illustrates the inferred geology and static water level (Figure 3). The groundwater level generally mimics the ground surface with the exception of an anomalously deep groundwater level at Well B.

Based on the very limited number of wells completed in the KJfs, yields appear to be somewhat lower than yields for wells completed in the adjacent TKfs. No discontinuity in water levels appears to exist across the fault contact however, and the degree of connectivity between the bedrock aquifer units on either side of the fault zone remains an unknown.

Groundwater Supply

Project Aquifer Recharge by Direct Precipitation

Recharge to the project aquifer likely occurs via percolation of rainfall falling directly on the aquifer surface and percolation from the overlying alluvial aquifer. Potential infiltration of runoff in tributaries upstream of the project parcel and groundwater inflow from areas outside of the delineated project aquifer boundaries could be substantial, but are neglected for this analysis. More detailed field observations and subsurface data would be required to estimate exchange between the various aquifers and the potential contributions of stream flow to aquifer recharge.

A simple water balance can be used to estimate the likely recharge related to direct precipitation. The approximate proportion of annual precipitation that runs off as streamflow and the evapotranspiration rate can be estimated; subtracting the sum of these values from mean annual rainfall provides an estimate of average annual recharge. In the water budget analysis for the Alexander Valley by the U.S. Geological Survey (Metzger et al., 2006) 54% of annual precipitation runs off as stream flow. For the purposes of this report, 54% of annual precipitation is assumed to leave the aquifer surface as stream flow. An evapotranspiration rate of 16.4 inches, as calculated for Healdsburg by Elford (1964), is applied in the following water balance calculation.

Annual precipitation at the project site is approximately 45 inches (3.75 ft) according to Sonoma County Water Agency's map of Sonoma County Mean Seasonal Precipitation (Plate No. B-3, Flood Control Design Criteria, August 1983). Using this value of annual precipitation and a runoff rate of 54% indicates that about 2.0-ft runs off as streamflow. Therefore, 1.75-ft infiltrates into the soil, of which 16.4 inches (1.37-ft) is lost due to evapotranspiration, leaving 0.38-ft available to percolate into the groundwater.

If we make the most conservative assumption and limit the area of the project aquifer to the portion of the drainage area up-gradient of the project parcel and underlain by TKfs (area east of the fault contact, see Figure 2), the project aquifer area is about 70.1 acres. Assuming mean annual percolation of rainfall to the aquifer of 0.38 ft, annual recharge is estimated to be about 26.6 acre-feet. As discussed above, the project aquifer may extend beyond the fault contact to the west and into the adjacent KJfs. Using this assumption would lead to a significantly higher recharge estimate potentially as high as 435 acre-feet if the project aquifer were extended to include the drainage area underlain by both KJfs and TKfs.

Project Aquifer Recharge by Seepage of Streamflow

As noted in descriptions of site geology, a thin layer of alluvium (two to six feet thick) is revealed by drillers' logs for on-site wells overlying bedrock that comprises the bedrock aquifer utilized by project wells. This layer of alluvium lies at a depth consistent with the elevation of the existing stream bed, and it can be assumed that streamflow from the two square mile watershed maintains saturation of this alluvium throughout much of the year.[1] Seepage from the stream bed to the alluvium and from the alluvium to the underlying bedrock aquifer is another source of aquifer recharge. The rate of recharge can be estimated as described below based on estimated hydraulic conductivity of the bedrock aquifer.

The principal used to estimate groundwater recharge of the bedrock aquifer from the stream alluvium is Darcy's Law, which relates hydraulic conductivity (K) to groundwater flow rate as the product of K and the hydraulic gradient. Assuming that saturated flow conditions exist between the base of the stream alluvium and the water table of the bedrock aquifer for six months per year, and that the hydraulic gradient is downward, the flux rate of flow from the alluvium to the bedrock aquifer is equal to the saturated hydraulic conductivity (K). To estimate aquifer recharge associated with the flux rate, all that is required is an estimate of the areal extent of the stream alluvium. Well Completion reports for Wells A, B and C indicate shallow alluvium at distances of 50, 45, and 35 feet from the well to the opposite stream bank; these data provide a minimum estimate of the mean width of the alluvium (about 43 feet). The length of the stream channel overlying the project aquifer is about 2,200 feet, yielding an estimated area of the alluvium of about 95,000 square feet, or about 2.2 acres. Using the mean hydraulic conductivity of the aquifer estimated from pump test data (0.033 ft/day), an estimate of annual recharge from the stream alluvium is: 2.2 acres x 0.033 ft/day x 183 days = 13.3 acre-feet.

Groundwater Storage in the Project Aquifer

Groundwater storage calculations have been made assuming that the project area aquifer is a semi-confined fractured bedrock aquifer consisting of only the TKfs (limited to the area east of the fault). Groundwater storage is estimated as the product of the aquifer surface area, the depth of the saturated zone of the aquifer intersected by wells, and the porosity of the fractured bedrock.

[1] Field observations at the project site on May 20, 2015 revealed intermittent stream flow throughout the length of the channel, indicating saturated conditions of the basal alluvium despite long-term drought conditions.

The surface area of the bedrock aquifer (Figure 1) is about 70.1 acres. The depth of the saturated zone is defined by the average difference between the depth of the top and bottom of the perforated interval of wells completed in the TKfs (Table 1); the estimated depth of the saturated zone is therefore about 171-ft. Note that the depth of the aquifer is defined by well depth, and that the saturated zone of the aquifer probably extends to substantially greater depths. The potential aquifer storage capacity is therefore likely to be substantially underestimated.

The porosity of the fractured bedrock is expected to lie between < 1 and 10% (Freeze and Cherry, 1979, p. 37; Weight and Sonderegger, 2000, p. 94). Given the relatively low yield (for fractured bedrock) of wells (Table 1) in the project aquifer, we assume a low-end (conservative) porosity of 1%. The estimated groundwater storage in the bedrock aquifer is calculated as 119.9 ac-ft.

Groundwater Demand

Project Demand

Water demands for the proposed 10,000 case winery project include winery process use, winery domestic use, visitor use, and landscape use. There are no current or proposed residential uses on the property. Total annual water use for the project was calculated by Always Engineering to be between 2.6 and 3.3 acre-feet per year (Appendix C). To be conservative with respect to potential project impacts, the maximum estimate of 3.3 acre-feet per year is used for this analysis.

In addition, irrigation of ~17 acres (+/-) of vineyard is anticipated on the project parcel; at present, 13.65 acres of vineyard are planted on the project parcel. About 4.5 acres of former vineyard are presently unplanted, including 1 acre (+/-) ac for the proposed winery site. For purposes of estimating existing groundwater demand, it is assumed that maximum historic vineyard acreage is present on the project parcel (about 18.15 acres). For purposes of estimating future groundwater demand under project conditions, about 1 acre of vineyard acreage is replaced by the winery, giving a total of about 17.15 acres of future vineyard on the project site.

Sonoma County vineyards typically use about 0.5 acre-feet of water per acre of vineyard. Flow meter data from the irrigation system for existing vineyards on the property indicate very low irrigation rates from late-June to early September 2014. It is conservatively assumed that irrigation demand for the parcel will average 0.5 ft per acre per year, therefore totaling about 9.1 acre-feet per year. Although the use of groundwater to irrigate vineyards is not subject to the discretionary use permit process, it is considered in this analysis out of concern for the potential project impact on overall water use.

Existing Aquifer Demand

Water demand for existing uses of the bedrock aquifer was estimated by measuring the area of vineyards from aerial photographs and by estimating the number of dwellings on each of the parcels overlying the aquifer. Standard water use rates for each acre of vineyard and for each dwelling were then applied to develop the estimate of groundwater use. With some exceptions discussed below, it is assumed that all water demand is met by groundwater withdrawals from the project aquifer.

A total of 42.6 acres of vineyard (including about 4.5 acres of unplanted vineyard on the project parcel) was mapped in the aquifer area from 2013 high-resolution digital ortho-photos available as part of the Sonoma County Vegetation Mapping and LiDAR Program (Figure 1). There are four active Water Rights in the aquifer area, licensed by the State Division of Water Rights to John Bacigalupi. The Water Rights indicate that surface water is used to irrigate some 56 acres of vineyard. Comparison of place of use description with the mapped aquifer area indicates that only 3 of these acres are located within the aquifer area.

Removing the 3 acres of vineyard presumed to be irrigated with surface water from the total vineyard acreage reveals that approximately 39.6 acres of vineyard are presently being irrigated with groundwater withdrawals from the project aquifer. The assumed rate of water use for irrigation is 0.5 acre-feet per acre, indicating that vineyard irrigation demand for groundwater is about 19.8 acre-feet per year.

Records provided by the project proponent (Appendix D) for vineyard irrigation in 2014 revealed extremely low irrigation rates for the MacRostie Vineyard (~90,000 gallons used for 13.5 acres) and the Rudd Vineyard (~42,000 gallons used for 13.65 acres), equivalent to a total of about 0.41 acre-feet. We confirmed these low irrigation rates with the viticulturist, but retained the assumed vineyard irrigation rate of 0.5 acre-feet per acre per year to maintain a conservative approach to estimating groundwater demand. While future owners and viticulture strategies might irrigate at higher rates, the current rates indicate that the groundwater demand for vineyard irrigation given above is conservative (higher than actually used). Similarly, if other vineyard viticulture practices in the project aquifer area use similar low irrigation rates, the estimated vineyard irrigation demand would be substantially lowered.

The 2013 ortho-photos were used to estimate the number of dwellings on each parcel in the aquifer area. This analysis identified a total of 2 primary dwellings and 1 secondary dwelling on the portions of the 5 parcels that overly the aquifer area. Each primary dwelling is estimated to require 1.0 acre-feet of water per year and each secondary dwelling is estimated to require 0.5 acre-feet per year, thus the total residential demand is estimated to be 2.5 acre-feet per year.

Summary and Comparison of Groundwater Supply and Demand

Current Conditions

The foregoing analysis of hydrogeologic conditions of the aquifer that would be utilized by the proposed project provides estimates of groundwater storage, annual recharge and groundwater demand on the aquifer for vineyard irrigation, domestic use, and winery use. Groundwater supply estimates are summarized in Table 2. Groundwater demand estimates for existing conditions are summarized in Table 3 and for proposed project conditions in Table 4.

Table 2. Summary of Aquifer Water Supply

Aquifer Area (acres)	70.1
Groundwater Storage (acre-feet)	119.9
Average Annual Recharge (acre-feet)	39.9

Table 3. Summary of Existing Aquifer Water Demand

Vineyard Irrigation Demand (39.6 acres* @ 0.5 acre-feet per acre per year)	19.8
Residential Demand (acre-feet per year)	2.5
Estimated Winery Demand (acre-feet per year)	3.0
Total Demand (acre-feet per year)	25.3

* 3 acres of existing vineyard in the aquifer area are removed from this acreage-assumed to be irrigated by surface water diversion per records of State of California Division of Water Rights; 4.5 acres of presently unplanted vineyard acreage in the project area that are included and assumed to be replanted for purposes of estimating long-term groundwater demand for this study.

The average annual groundwater recharge (39.9 acre-feet) represents an estimate of the sustainable yield of the aquifer. The estimated demand for water from the aquifer under current conditions, including maximum historic planted vineyard acreage, is 25.3 acre-feet per year, which represents about 63% of annual recharge. This comparison indicates that there is a surplus of about 14.6 acre-feet of groundwater in terms of annual use compared to annual recharge.

Project Conditions

With respect to the additional demand for groundwater for the project, the increment of increase in annual use of 2.8 acre-feet (3.3 acre-feet for winery project less 0.5 acre-feet for reduced vineyard acreage) is equivalent to about 11% of existing groundwater use and about 7.0% of average annual recharge. Adding net water demand increase under proposed project conditions of 2.8 acre-feet per year would bring estimated total demand to about 28.1 acre-feet per year (Table 4), which is equivalent to 70% of annual recharge.

The additional increment of use proposed for this winery project represents a modest increment of the existing use.

Table 4. Summary of Aquifer Water Demand, Proposed Project Conditions

Vineyard Irrigation Demand (38.6 acres @ 0.5 acre-feet per acre per year)	19.3
Residential Demand (acre-feet per year)	2.5
Winery Demand (acre-feet per year)	6.3
Total Demand (acre-feet per year)	28.1

When comparing estimated groundwater recharge to estimated groundwater use, it is important to note that both the recharge estimate and use estimate is based on conservative assumptions. With respect to the project aquifer configuration, the fault zone crossing the project drainage area was assumed to represent a groundwater barrier and no recharge was included from areas west of the fault or from areas of exposed TKfs east of the fault but north of the project drainage area that could comprise a large semi-confined aquifer system. In addition, the project aquifer is bounded on the east by a relatively large body of alluvial deposits of the Russian River that may be assumed to be saturated and has the potential to recharge the project aquifer and stabilize long-term groundwater storage in the project aquifer.

With respect to groundwater use estimates, it should also be noted that land use in the impact area is largely unchanged over the past 20 years, with no significant change in vineyard acreage and one new small winery being developed at present just to the south of the project area. Groundwater from the project aquifer appears to have been sufficient to support a consistent level of vineyard irrigation over this period, suggesting that groundwater supply is sufficient. The vineyards irrigated by wells on the project site were essentially dry-farmed in 2014, and it is reasonable to expect that this style of viticulture will continue in the future. Furthermore, it is possible if not likely that other vineyards practice similar low-irrigation viticulture, which would substantially reduce the estimate of groundwater use for irrigation.

Drought Considerations

This analysis indicates that the project aquifer has a modest surplus of water in terms of annual use compared to annual recharge, and that the aquifer storage is between four and five times the annual recharge. The significant volume of groundwater in storage serves to moderate the impacts of climatic variations on aquifer conditions. The effects of dry years and wet years are balanced out over the period of years likely required for water to move through the aquifer, such that short-term reductions in groundwater storage associated with periods of reduced groundwater recharge during dry years would be compensated by increases in storage during wetter years.

Conclusion

The preceding analysis of available hydrogeologic data indicates that the project aquifer is a semi-confined fractured bedrock aquifer comprised of sandstone of the Franciscan Complex. The aquifer is recharged by infiltration of direct precipitation on the surface of the aquifer and by percolation of stream flow. Additional recharge of the aquifer via potential connection with adjacent aquifers may be significant, but have not been quantified.

Estimated annual recharge by direct precipitation is estimated to be on the order of 39.9 ac-ft. Estimated existing demand from the project aquifer is estimated to be 25.3 acre-feet per year. Water demands for the proposed winery to be supplied from a new project well are estimated to be 3.3 acre-feet per year; the net increase in groundwater demand for the project is 2.8 acre-feet per year owing to a 1 acre decrease in vineyard area required for the winery facilities. Total groundwater demand under proposed project conditions is estimated to be 28.1 acre-feet per year. The groundwater withdrawals required for the proposed 10,000 case winery on the subject parcel is unlikely to be affected by or affect existing or potential future groundwater withdrawals on adjoining parcels that utilize the same aquifer because of the relatively small quantity of water required and the fact that the total proposed demand is substantially less than the mean annual recharge even when conservative assumptions are applied.

References

Blake, M., R. Graymer, et al. (2002). Geologic map and map database of western Sonoma, northernmost Marin, and southernmost Mendocino Counties, California, USGS.

Elford, C.R, (1964), Climate of Sonoma County, US Department of Commerce, Weather Bureau, Table 10.

Freeze, R. and Cherry, J. (1979). Groundwater. Prentice-Hall, New Jersey. 604 p.

Huffman, M. E., C. F. Armstrong, et al. (1980). Geology for planning in Sonoma County. Sacramento, California, California Department of Conservation, Division of Mines and Geology.

Metsger, L. F., C. D. Farrar, et al. (2006). Geohydrology and Water Chemistry of Alexander Valley, Sonoma County, California, USGS.

Weight, W. and Sonderegger, J. (2000) Manual of Applied Field Hydrogeology. McGraw-Hill. 608 p.

APPENDIX A

WELL COMPLETION REPORTS

10 pages

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NOT FOR PUBLIC REVIEW OR DISTRIBUTION

APPENDIX B

PUMP TEST SUMMARY FOR PROJECT IRRIGATION WELLS

1 page

From Richard C. Slade & Associates, Oct. 9, 2007

Table 1
Summary of Pumping Data
Rudd Hedin Property, Sonoma County

Well A	Test Length (minutes)	Pumping Rate (Average GPM)	Pre-Test Static Water Level (ft bgs)	End-Step Pumping Water Level (ft bgs)	Drawdown (ft)	Specific Capacity (gpm/ft ddn)
Step Test - 9/11/2007; Constant Rate Test - 9/13/2007						
Step Test No. 1	180	20	32.3	87.4	55.1	0.36
Step Test No.2	180	25	32.3	122.2	89.9	0.28
Step Test No. 3	80	35	32.3	174.8	142.5	0.25
Constant Rate Pumping Test	480	25	38.8	129.7	90.9	0.27

Well B	Test Length (minutes)	Pumping Rate (Average GPM)	Pre-Test Static Water Level (ft bgs)	End-Step Pumping Water Level (ft bgs)	Drawdown (ft)	Specific Capacity (gpm/ft ddn)
Step Test - 8/10/2007; Constant Rate Test - none						
Step Test No. 1	180	4	130.4	145.1	14.7	0.27
Step Test No. 2	180	6	130.4	165.0	34.6	0.17
Step Test No. 3	180	8	130.4	222.0	91.6	0.09
Constant Rate Pumping Test	NA	NA	NA	NA	NA	NA

Well C	Test Length (minutes)	Pumping Rate (Average GPM)	Pre-Test Static Water Level (ft bgs)	End-Step Pumping Water Level (ft bgs)	Drawdown (ft)	Specific Capacity (gpm/ft ddn)
Step Test - 9/13/2007; Constant Rate Test - 7/17/2007						
Step Test No. 1	180	20	10.4	59.9	49.5	0.40
Step Test No. 2	180	30	10.4	96.7	86.3	0.35
Step Test No. 3	180	40	10.4	153.2	142.8	0.28
Constant Rate Pumping Test	480	35	6.0	92.3	86.3	0.41

Well D	Test Length (minutes)	Pumping Rate (Average GPM)	Pre-Test Static Water Level (ft bgs)	End-Step Pumping Water Level (ft bgs)	Drawdown (ft)	Specific Capacity (gpm/ft ddn)
Step Test - 8/15/2007; Constant Rate Test - 8/16/2007						
Step Test No. 1	180	6	12.6	17.6	5.0	1.20
Step Test No. 2	180	12	12.6	23.6	11.0	1.09
Step Test No. 3	180	20	12.6	38.1	25.5	0.78
Constant Rate Pumping Test	420	25	12.6	195.1	182.5	0.14

APPENDIX C

WATER DEMAND ESTIMATE, PLP14-0031

7 pages

12504.0 Rudd_West Side
Groundwater Use Estimates
September 22, 2014
Revised:

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Civil Engineering & Topographic Surverying
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Santa Rosa, CA 95401 Fax (707) 542-8798
www.alwayseng.com JasonH@alwayseng.com

Sonoma County PRMD
ATTN: Misti Harris
2550 Ventura Ave.
Santa Rosa, Ca 95403

Project: **PLP14-0031**
Use Permit Application for:
4603 Westside Road
Healdsburg, Ca

Copies	Document Date	Description
1	~~~~~~~~~~~~	Napa County Phase One Water Availability Analysis Form
1	04/2014	Town of Windsor – Small Winery Classification and Investigation Regarding Capacity Fee

Misti,

This letter is provided in response to the letter received from Gregory Desmond at Sonoma County PRMD, dated July 31, 2014. Specifically, this letter addresses the proposed groundwater use from the project, as requested in item #1 of the letter.

Project Proposal
Rudd Wines has applied for a a Use Permit to construct a 10,000 case per year winery in 4 phases. Phases will include:

1. Convert existing Ag building to Tasting Room
2. 5,000 case winery building
3. 5,0000 case winery expansion with new building for total of 10,000 case production level
4. New Tasting Room

This report will utilize 3 methods of reviewing water use associated with the project. These methods are:

1. County of Napa Phase One Water Availability Analysis Method
2. Wastewater System Design Estimation Method
3. Town of Windsor Method

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COUNTY OF NAPA PHASE ONE WATER AVAILABILITY ANALYSIS

As a requirement of the Use Permit application process, new wineries proposing to use groundwater in Napa County must complete the Phase One Water Availability Analysis Form to demonstrate the project will not place undue burden on the local groundwater supplies. This form provides general water use information for wineries. A blank copy of this form is provided, as an attachment for reference. Water use calculations are provided below in this document:

Proposed Winery Process Use

10,000 cases wine x 2.4 gallons wine/case wine	=	24,000 gallons wine
24,000 gallons wine/yr x 2.15 ac-ft/100,000 gallons wine	=	0.516 ac-ft/yr

Proposed Winery Domestic and Landscape Use

24,000 gallons wine/yr x 0.5 ac-ft/100,000 gallons wine	=	0.12 ac-ft/yr

Total Winery Use

Process Use	=	0.516 ac-ft/yr
Domestic and Landscape Use	=	0.12ac-ft/yr
Total Winery Use	=	**0.636 ac-ft/yr**

The total winery water use is estimated to be 0.636 ac-ft/yr using the Napa County Public Works assumed values. This is equivalent to 207,241 gallons per year.

Landscape Use

In addition to the landscape number assumed above, the project will also include a decorative citrus orchard as part of landscape design. A conservative value of one half acre of orchard has been assumed. The amount of water associated with the orchard is estimated as:

0.5 acres orchard x 4.0 ac-ft/ac-yr	=	2 ac-ft/yr

Total Project Use

The total estimated water demand from the project is the sum of all winery, domestic, landscape, and orchard use. This is **2.636 ac-ft per year** which is equivalent to **858,943 gallons per year.**

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WASTEWATER SYSTEM DESIGN ESTIMATION METHOD

The next method of evaluation will use values similar to those used in wastewater system design for domestic and process water use. It will also make assumptions for landscape water use. Water use is estimated as follows:

Proposed Winery Process Wastewater (PW)

Sonoma County Peak Day

$\frac{24{,}000 \text{ gallons wine } \times 1.5}{45 \text{ days}}$ = 800 gpd PW

Depending on the source of data, the harvest period accounts for 30% to 40% of the total annual water use for wineries. To be conservative, it is assumed that that this peak water use continues for all 60 days (September and October) of harvest and also accounts for 40% of annual water use. The annual use is estimated as follows:

Harvest Total PW Water Use

800 gpd x 60 days = 48,000 gallons/year

Annual Total PW Water Use

48,000 gallons / 0.4 = 120,000 gallons/year
= 0.37 ac-ft/year

Employees Water Use

The winery is proposing 4 full-time employees and 2 part-time employees, plus an additional 8 part-time employees in the tasting room.

4 FT employees x 15 gpd/employee	=	60 gpd
10 PT employees x 7.5 gpd/employee	=	75 gpd
TOTAL DAILY EMPLOYEE USE	=	135 GPD

To be conservative in this estimation, it is assumed that this is water use for 365 days per year. Actual use will be lower due to peak employees representing only harvest, and peak employees not working 7 days a week. Annual employee use is estimated as follows:

135 gpd x 365 days/year	=	49,275 gallons per year
TOTAL ANNUAL EMPLOYEE USE	=	0.15 ac-ft/year

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Tasting Room Water Use

To estimate the annual water use, only average tasting room visitation will be evaluated, as the peak is included in the average number projections. This is estimated as follows:

139 average tasting visitors x 2.5 gpd/visitor	=	347.5 gpd
347.5 gpd X 365 days/year	=	126,837.5 gallons/year
	=	0.39 ac-ft/yr

Events Water Use

The project proposal includes 25 wine industry-related special events per year: twelve with an attendance of 50 persons, five with 100 persons and eight 150-person events. On the days of events, the tasting room schedule will be revised, so that no additional employees are required to service the event, beyond that already accounted for above. The events are summarized in the table below.

NUMBER OF ATTENDEES	EVENTS PER YEAR
50	12
100	5
150	8

It is assumed that each event will provide for catered food and water use is estimated as such. The amount of water use associated with each event is estimated as follows:

50 Person Event		
50 event visitors x 5 gpd/visitor	=	250 gpd
250 gpd x 12 days/year	=	600 gpd
100 Person Event		
100 event visitors x 5 gpd/visitor	=	500 gpd
500 gpd x 5 days/year	=	1,500 gpd
150 Person Event		
150 event visitors x 5 gpd/visitor	=	750 gpd
750 gpd x 8 days/year	=	6,000 gpd
TOTAL EVENT SS		
600 gpd + 1,500 gpd + 6,000 gpd	=	8,100 gpd

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Total Domestic Water Use

A total domestic water use is estimated by summing the employees, tasting visitors, and event visitors use for the year. This is done as follows:

Employee Use + Tasting Visitor Use + Event Visitor Use =		TOTAL DOMESTIC USE
49,275 gpd + 126,838 gpd + 8,100 gpd	=	184,213 gallons/year
	=	0.57 ac-ft/year

Landscape Use

As noted in the Napa County Method Section above, it is assumed that there will be 0.5 acres of citrus orchard planted for the project. It can also be assumed another 0.5 acres of landscape area will be provided. Using similar values to those presented in the Napa County Phase One Study, landscape water use is estimated as follows:

Orchard	=	2 ac-ft/year
Landscape	=	0.12 ac-ft year
TOTAL ANNUAL LANDSCAPE USE	=	2.12 AC-FT/YEAR
	=	690,804 gallons/year

Total Annual Water Use

The total annual water use estimated by this method is the sum of the winery process use, all domestic uses, and landscape use. This is calculated as follows:

Winery PW + Employee, Visitor, and Event Domestic + Landscape Use =

120,000 gallons + 184,213 gallons + 690,804 gallons	=	995,017 gallons/year
TOTAL ANNUAL PROJECT WATER USE	=	**3.05 AC-FT/YEAR**

TOWN OF WINDSOR METHOD

In 2014, Town of Windsor issued a document titled, *Small Winery Classification and Investigation Regarding Wastewater Capacity Fees.* A portion of this document is attached for reference. In this document it reviewed the water use for wineries currently in the town of Windsor. It found that the average water use was 20.18 gallons of water per case of wine produced. The water use for this project is estimated as follows:

20.18 gal water/case wine x 10,000 cases wine	=	201,800 gallons
201,800 gallons x 1 ac-ft/325,851 gallons	=	0.62 ac-ft/year

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Because the Town of Windsor does not provide for Domestic or Landscape water use in this document, the same values estimated in the Wastewater System Design Estimation Method shall be used for these values. This water use estimation is:

TOTAL ANNUAL DOMESTIC USE = 0.57 ac-ft/year
TOTAL ANNUAL LANDSCAPE USE = 2.12 AC-FT/YEAR

Total Annual Water Use

The total annual water use estimated by this method is the sum of the winery process use, all domestic uses, and landscape use. This is calculated as follows:

Winery PW + Employee, Visitor, and Event Domestic + Landscape Use =

201,800 gallons + 184,213 gallons + 690,804 gallons = 1,076,817 gallons/year
TOTAL ANNUAL PROJECT WATER USE = 3.30 AC-FT/YEAR

Conclusions

The total proposed water use from the project, estimated by each method, is summarized in the table below:

METHOD	TOTAL ESTIMATED ANNUAL WATER USE (AC-FT/YEAR)
Napa County Phase One Water Availability Analysis	2.636
Wastewater System Design Estimation	3.05
Town of Windsor	3.30

It should be noted that all of these methods, represent more of a worst-case water use, rather than expected average annual water use. This is because, in most cases, peak use was assumed for 365 days per year. In any event, the maximum estimated water use from the project is 3.30 ac-ft per year, which is approximately 66% of the 5.0 ac-ft threshold for the project noted in the project review letter dated July 31, 2014.

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We trust that this letter sufficiently addresses the requested information. If you require clarification or have any questions, please feel free to contact us.

Sincerely,

Ben Monroe, P.E.
ALWAYS ENGINEERING, INC.
Project Manager

REGISTERED PROFESSIONAL ENGINEER
BENJAMIN W. MONROE
No. 70012
Exp. 9-30-14
CIVIL
STATE OF CALIFORNIA

cc: Guy Byrne (LRICO)
Dusan Motolik (Backen Gilliam Kroeger Architects)
John Dobrovich (LRICO)

APPENDIX D

VINEYARD IRRIGATION DATA

2 pages

Matt O'Connor

From: Ben Monroe <benm@alwayseng.com>
Sent: Wednesday, April 08, 2015 3:26 PM
To: Matt O'Connor
Subject: FW: Rudd Winery Groundwater

FYI – There are less planted acres on the Rudd parcel than what was provided previously. This area will likely be planted in the future, minus the area required for winery development. I'll let you make the call to go with a larger (future) or lower (current) number.

Sincerely,

Ben Monroe, P.E., QSD/QSP
ALWAYS ENGINEERING, INC.
alwayseng.com
P: (707) 542-8795 x 17
F: (707) 542-8798
C: (707) 318-7099

From: Anthony Weytjens [mailto:anthony.weytjens@edgehill.com]
Sent: Wednesday, April 08, 2015 3:19 PM
To: Ben Monroe
Subject: RE: Rudd Winery Groundwater

Ben,

Sorry but the map was showing 2 unplanted blocks as plantes. Planted acres are 13.28.

Hope this didn't create any issues.

Sincerely,

Anthony Weytjens

HISTORIC WINERY
Est. 1867
EDGE HILL
THE CELEBRATED VINEYARDS

Winemaker & Estate Manager
Anthony.Weytjens@EdgeHill.com
Post Office Box 105
Oakville, CA 94562
O 707.948.2681
C 707.999.0378

From: Ben Monroe [mailto:benm@alwayseng.com]
Sent: Tuesday, April 07, 2015 9:23 AM

To: Anthony Weytjens; Guy Byrne
Subject: RE: Rudd Winery Groundwater

Thank you. I'll let you know if we have any questions.

Sincerely,

Ben Monroe, P.E., QSD/QSP
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C: (707) 318-7099

From: Anthony Weytjens [mailto:anthony.weytjens@edgehill.com]
Sent: Tuesday, April 07, 2015 9:22 AM
To: Guy Byrne
Cc: Ben Monroe
Subject: RE: Rudd Winery Groundwater

Dear Guy and Ben,

Sorry it took so long. I was waiting on getting info back from MacRostie.
Below is the information you requested.
Let me know if you need anything else.

Flow Meter Numbers

6/24/14 – first of the year
MacRostie 492,671
Rudd 868,133

8/12/14
MacRostie 567,537
Rudd 909,839

9/02/14 - end of the year
MacRostie 582,694
Rudd 909,839

No frost protection.

18.65 Acres for Rudd.
13.5 Acres for MacRostie.

Sincerely,

Anthony Weytjens