December 4, 2015

RE: GEOLOGIC REPORT FOR GENERAL PLAN POLICY WR-2e
9795 WEST SUMMIT TRAIL, SANTA ROSA, CALIFORNIA
EBA JOB No. 14-2085

Dear M

This Geologic Report presents the results of a groundwater availability study conducted for the property located at 9795 West Summit Trail, in Santa Rosa, California (see Figure 1, Appendix A for site location). The groundwater availability study was implemented to comply with requirements set forth in Policy WR-2e of the Sonoma County General Plan (SCGP) based on the project's proposal to build a home and second unit within a Zone 4 groundwater availability area as designated in the SCGP's Water Resources Element. The purpose of Policy WR-2e is to determine whether there are adequate existing and future groundwater supplies to accommodate the proposed development demands and to estimate the effects of drawdown, if any, within the designated cumulative impact area. This report was prepared to meet these objectives.

1.0 BACKGROUND INFORMATION

1.1 Project Description

The existing property consists of a 99.45-acre (AC) parcel identified as Assessor's Parcel No. (APN) 028-260-042. A site plan illustrating the primary site features is presented as Figure 2 (Appendix A). As shown on Figure 2, the property is undeveloped and characterized by hilly terrain that includes a pond and a combination of open areas covered with seasonal grasses and thick stands of trees. Site elevations range from approximately 1,600 to 2,100 feet above mean sea level (MSL).

Water supply for the property will be serviced by two water supply wells (identified herein as "Well #1" and "Well #2") located in the northeast and northern portion of the project site, respectively (see Figure 2, Appendix A). Well #1 and Well #2 were installed

in September 1993 and March 2015, respectively, and completed to depths of 242 and 299 feet below ground surface (BGS). A well yield certification test conducted on Well #2 in August 2015 in accordance with County of Sonoma, Permit and Resource Management Department (CS-PRMD) Policy No. 9-2-28 revealed a sustained pumping rate of 2.6 gallons per minute (GPM) over an 8-hour period.

The proposed project will entail constructing a two-bedroom home with an accompanying second one-bedroom unit. Water for the project site will be provided by Well #2 or a combination of Well #1 and Well #2.

1.2 Local Hydrogeology

A geologic map presented in *Bulletin 118-4* (California Department of Water Resources [CDWR], 1975) indicates that the project site area is underlain by rocks associated with the Sonoma Volcanics (Pliocene) in the southern and eastern portions of the property and Franciscan Formation (Upper Jurassic) in the central and western portions. The geology observed during EBA Engineering's (EBA's) site visit was generally consistent with the CDWR mapping. Please refer to Figures 3 and 4 (Appendix A) for a geologic map and cross section of the site vicinity.

Well #1 is completed in Franciscan Formation with Sonoma Volcanics present in the upper 200 feet of the borehole. Well # 2 is also completed in Franciscan Formation with approximately 20 feet of Sonoma Volcanics in the upper portion of the borehole. Rock descriptions provided in the corresponding Water Well Driller's Reports (WWDR) include volcanics, serpentine, sandstone and shale with a minor clay zone. The static groundwater level in Well #1 at the time of drilling was 131 feet BGS and 180 feet BGS in Well #2. Recent depth to water measurements collected on October 30, 2015 indicated groundwater in Well #1 and Well #2 at approximately 28 and 161 feet BGS, respectively. It should be noted that Well #1 is approximately 65 feet higher in elevation than Well #2. According to *Bulletin 118-4* (CDWR, 1975 and 1982), yields of groundwater to wells in Franciscan Formation materials may provide small quantities of groundwater and typically exhibit specific yield characteristics of less than 3 percent. Yield characteristics are often seasonal, with higher yields occurring during the spring and lower yields occurring in the late summer-early fall.

The most prominent surface water features in proximity to the project site are an on-site pond, approximately 0.40 AC in size, and Mark West Creek, located approximately 500 feet south of the property. In addition, an unnamed ephemeral drainage identified on United States Geological Survey (USGS) quadrangle is located north of the property. A small ephemeral drainage also bisects the property from east to west and terminates at the pond.

1.3 Local Climate

According to the *County Wide Rainfall Map* prepared by the Sonoma County Water Agency (2005), the average annual rainfall at the location of the project site is

approximately 40 inches per year. The mean annual potential evapotranspiration (ET_o) for the area is estimated to be approximately 44 to 49 inches per year based on a *1999 Reference Evapotranspiration Map* prepared by the California Irrigation Management Information System (http://wwwcimis.water.ca.gov-etomap.jpg).

2.0 RESEARCH

The following subsections provide a summary of the scope of research performed and the corresponding findings used to implement the hydrogeologic assessment. The scope of the research was developed to comply with the Policy WR-2e guidelines.

2.1 Site Reconnaissance

EBA conducted site reconnaissance of the property on August 20, 2014 and October 30, 2015. The purpose of each site reconnaissance was to observe existing site features, site topography, local geology, etc. As previously noted, the property is characterized by hilly terrain that includes a combination of open areas covered with seasonal grasses and stands of trees. The on-site pond contained water and no surface water flow was observed in the ephemeral drainage during the site visits.

The reconnaissance also encompassed the observance of neighboring properties to establish the nature of nearby developments and property uses. Please be advised that due to the rural nature of the area and limited public access, visual observations were limited to what could be seen from the property line (where readily accessible), or at a distance from West Summit Trail and St. Helena Road. In general, most of the properties in all directions from the project site were comprised of rural properties, with development being limited to mostly single family dwellings. Exceptions include vineyards observed on two properties to the east and west of the project site. Only two off-site water supply wells were visually identified in proximity of the project site. Both of these wells are located on properties east and northwest of the project site (see Figure 2, Appendix A for locations).

The site reconnaissance was supplemented with review of Google aerial imagery for the area. Three additional features identified from the aerial imagery included: a winery (Pride Mountain Vineyards) located east of the project site; a vineyard located approximately west-northwest of the project site and another vineyard located east of the project site, and an above ground storage tank located on a parcel west of the project site.

2.2 Water Well Drillers Reports (WWDRs)

WWDRs maintained by CDWR were reviewed to obtain pertinent information for the area regarding water supply use, well completion depths, yields, etc. The scope of the CDWR research encompassed available records for wells located within Sections 19 and 30 of Township 8 North (T8N), Range 6 West (R6W), and Sections 24 and 25 of

T8N, Range 7 West (R7W), Mount Diablo Baseline and Meridian. The off-site search radius was set at approximately ¼- to ½-mile of the project site property boundary as a means of obtaining available information representative of the local hydrogeologic conditions. The results of this research identified six WWDRs, two of which corresponded to the project site and one dry hole on a nearby property. The following breakdown provides a summary of the well/borehole and water supply characteristics for both the on-site and off-site locations:

Project Site (Franciscan Formation)

- *Water Supply Wells:* 2 (Well #1 and #2)
- *Number of Dry Holes:* 0
- *Drilling Depths:* 260 feet BGS (Well #1) and 300 feet BGS (Well #2)
- *Static Groundwater Level:* 131 feet BGS (Well #1) and 180 feet BGS (Well #2)
- *Reported Yields:* 4 GPM (Well #1) and 80 GPM (Well #2)
- *Specific Capacity:* Not recorded.

Off-Site Properties (Sonoma Volcanics)

- *Water Supply Wells:* 3
- *Number of Dry Holes:* 1
- *Distance from Project Site (estimated):*
  - Range: 200 to 1,000 feet
- *Drilling Depths:*
  - Range: 175 to 285 feet BGS
  - Average: 246 feet BGS
- *Static Groundwater Levels:*
  - Range: 45 to 100 feet BGS
  - Average: 73 feet BGS
- *Reported Yields:*
  - Range: 10 to 25 GPM
  - Average: 17.5 GPM
- *Specific Capacity:*
  - Range: 0.096 to 0.06 gallons per minute per foot of drawdown (GPM/ft)
  - Average: 0.08 GPM/ft

It should be noted that the reported yields presented above correspond to those derived from air lift/pumping performed at the time of drilling. However, it is EBA's experience that these reported values often overestimate the actual well yields recorded during pumping tests performed following well installation and development. Please also note that in the case of the two on-site water supply wells, the lithologic information recorded on the respective WWDRs indicated a distinct transition between Sonoma Volcanics and Franciscan Formation materials. However, the information provided above assumes that the Franciscan Formation is the primary water-bearing formation at the project site based on interpretation of the WWDR information, coupled with findings

from the project site reconnaissance and the Bulletin 118-4 geologic map (CDWR, 1975).

2.3 Assessor's Parcel Maps

County assessor's parcel maps for the area were reviewed to assist in identifying neighboring property boundaries and addresses. This information, in turn, was used to establish the number of properties within the designated cumulative impact area (described in Section 3.0) for this study. Findings from this exercise identified seven properties ranging in size from approximately seven to 149 AC. Of these seven properties, well/borehole information was identified for three properties as determined from WWDRs.

2.4 Zoning Information

Zoning designation records maintained by CS-PRMD were reviewed for neighboring properties within the designated cumulative impact area (discussed in Section 3.0) to evaluate potential future uses and implications of the proposed project on future groundwater use in these areas. Findings from this research revealed that the project site itself, as well as the properties to the south, west, northwest, north and northeast, are located within a Rural Residential District (RRD). This zoning designation is intended to preserve the rural character and amenities of those lands best utilized for low density residential development.

With regard to zoning density, Combining Districts for Sonoma County specifying residential density and/or minimum parcel or lot size for the parcels, lots and/or the area includes B6, B7 and B8. All of the properties outlined above (including the project site) have a B8 district designation that specifies maximum permitted densities ranging from 20 to 320 AC. Of these parcels (excluding the project site), only one is large enough (i.e., greater than 40 AC) to permit additional splits based on the maximum permitted densities.

2.5 Other WR-2e Reports

EBA researched CS-PRMD's historical database and files for properties in the area that had subdivision projects, extra units or planning projects as a means of potentially identifying properties that may have been required to prepare a WR-2e report. Findings from this exercise identified a neighboring property/project that was required to prepare a WR-2e report. The project corresponds to a proposed winery located at the Cornell property located at 420 Spring Mountain Summit Trail (formerly Wappo Road). The proposed winery has reportedly garnered significant criticism from neighbors over the years and the final conditional use permit does not appear to have been issued as of the date of this report. Attempts to locate and review the WR-2e report for this site were unsuccessful.

2.6 Well Yield Certification Tests

As previously noted in Subsection 1.1 (*Project Description*) of this report, a well yield certification test was conducted for Well #2 in August 2015 that revealed a sustainable pumping rate of approximately 2.6 GPM and a specific capacity of 0.2 GPM/ft. A measurement of the static groundwater level 72 hours following the cessation of the test revealed approximately 95 percent recovery. In addition, two earlier well yield certification tests were performed on Well #1 in April 1995 and March 2005. Results from both of these tests revealed sustainable pumping rates of approximately 6 GPM over four hours. Static groundwater levels in Well #1 as measured prior to the respective pumping tests were 15 feet BGS in 1995 and 28 feet BGS in 2005.

2.7 Documentation of Expended Effort

Approximately 40 hours have been expended in identifying existing wells within the area of interest, as well as other pertinent information with respect to the local hydrogeologic conditions, property uses, and determination of aquifer characteristics. This estimate reflects the cumulative time expended by EBA in researching the information (i.e., site reconnaissance, literature searches, interviews, and telephone calls) and performance of various calculations.

3.0 CUMULATIVE IMPACT AREA

The definition of “cumulative impact area” corresponds to the change in a specific area resulting from the incremental impact of the project when added to other closely related past, present, and reasonably foreseeable future projects. Based on this criterion, existing and future site development characteristics and zoning designations for surrounding properties were considered, coupled with the site hydrogeology and the nature of the proposed development, to estimate the cumulative impact area for the proposed project.

An important consideration in establishing the cumulative impact area for this project is the local topography and hydrogeology. In this regard, the western and eastern boundaries of the cumulative impact area are delineated by topographic ridges that define the local watershed. The east-west unnamed ephemeral drainage located to the north of the project site constitutes the northern boundary of the cumulative impact area and discharges to Mark West Creek west of the project site. Thus, this topographic low feature defined by Mark West Creek was selected as the southern boundary of the cumulative impact area. Please refer to Figure 2 (Appendix A) for an illustration of the established cumulative impact area as defined above. Based on the stated boundary designations, the overall size of the cumulative impact area is approximately 250 AC and encompasses eight rural properties (including the project site).

Please note that the cumulative impact area defined above includes both Franciscan Formation and Sonoma Volcanics. A review of the geologic map for the area (see

Figure 3, Appendix A) and the available WWDRs indicate that the Franciscan Formation represents the principal water-bearing formation for approximately 88 percent (220 AC) of the cumulative impact area. Sonoma Volcanics in the southern portion of the cumulative impact area comprise the remaining 12 percent (30 AC).

4.0 SUMMARY OF EXISTING / PROJECTED GROUNDWATER USE

The following subsections provide a general synopsis of both the existing and projected water uses (including groundwater) associated with the proposed development, as well as estimates of the off-site groundwater use on adjoining and nearby properties located within the cumulative impact area.

4.1 On-Site Water Use

Existing

There is no current water demand at the project site.

Future

The future water demand will include the construction of one two-bedroom dwelling and an associated one-bedroom second unit. For the purpose of this analysis, an incremental water use of 0.25 acre-feet per year (AF/yr) per bedroom was assumed for the respective dwelling units. Also applied was 0.25 AF/yr for incidental use associated with the primary residence. Based on these assumptions, the corresponding water demand for the proposed improvements equates to 1 AF/yr.

4.2 Off-Site Groundwater Use

Existing

The cumulative impact area established for this project encompasses seven off-site rural properties, of which five of the properties have currently been developed with a dwelling unit(s). While WWDRs were identified for only three of the developed properties, it is reasonable to assume that each of these properties is serviced by a water supply well. In regards to groundwater use, the amount of existing groundwater extraction for the various properties was estimated based on the nature of site development as determined from the site reconnaissance and review of aerial images, size of dwellings as determined from assessor's information, and the employment of estimated unit usage rates for specific types of development. The following provides a breakdown of the estimated groundwater extraction sources and volumes:

- 3-Bedroom Dwelling (4): 3.0 AF/yr[(1)]
- 2-Bedroom Dwelling (1): 0.5 AF/yr[(1)]
- Dwelling Incidental Use (5): 1.25 AF/yr[(2)]

- Vineyard Irrigation: 20.0 AF/yr[(3)]
- *Total:* *24.75 AF/yr*

[(1)]: Based on unit usage rate of 0.25 AF/yr per bedroom.
[(2)]: Based on unit usage rate of 0.25 AF/yr per dwelling unit. Incidental uses may include landscaping, pool, and/or second unit.
[(3)]: Based on unit usage rate of 0.5 AF/yr per AC of vineyard (40 AC total).

As presented above, the estimated current off-site groundwater use within the cumulative impact area equates to 24.75 AF/yr. Please note that in cases where the cumulative impact area boundary does not fully encompass a parcel that contains a dwelling unit, the corresponding water use was included regardless of the dwelling unit's and/or water supply well's location. This was done as a conservative measure. Conversely, in the cases of the vineyards, only the portions of vineyards that lie within the cumulative impact area were used in the above analysis. This approach was chosen because the remaining vineyards lie outside of the topographical region chosen for the cumulative impact area and only the portions within the cumulative impact area were used in the water balance calculations. Finally, the Pride Mountain Vineyards winery was not included in the water use calculations because it is outside the cumulative impact area, its distance from the project site is approximately 1,800 feet, and its geographical location in a separate drainage.

Future

In regards to future water use, one of the off-site rural properties within the cumulative impact area that is currently partially developed has a maximum permitted density that would allow the property to be further divided, which could result in the development of three new parcels under the current zoning designation. However, since this parcel is currently planted with vineyard and part of the Pride Mountain Winery, it is not expected to be further developed into individual parcels. Thus, no additional future water use was assessed for this parcel.

Another off-site property, located south of the project site, is approximately 36 AC in size and is currently undeveloped. For the purpose of this analysis, future water use on this parcel was set at 1 AF/yr based on an assumed future development of a three-bedroom house (0.75 AF/yr) with incidental water use (0.25 AF/yr).

5.0 GROUNDWATER AVAILABILITY ANALYSIS

As outlined in the introduction of this report, the primary objectives of the groundwater availability analysis were to evaluate whether there are adequate existing and future groundwater supplies to accommodate the proposed project and to estimate the effects of drawdown within the designated cumulative impact area. The following subsections address each of these issues.

5.1 Water Supply Capabilities

Groundwater Storage Capacity

The storage capacity for the cumulative impact area was estimated by multiplying the volume of the aquifer by its specific yield or secondary porosity volume. Since the cumulative impact area encompasses the Franciscan Formation and Sonoma Volcanics, the storage capacities for these units were calculated separately to account for different aquifer characteristics. In this regard, the area of each unit was estimated based on information shown on the geologic map (Figure 3), site reconnaissance and WWDR information. The aquifer thickness, in turn, was based on the average static groundwater level in the units based on WWDR information and the maximum aquifer depth, which was set at the deepest producing water supply well identified within each unit. Finally, the aquifer's specific yield or secondary porosity volume was based on literature values (Bulletin 118-4 [CDWR, 1982]) and previously recorded yield characteristics. Using this information, the storage capacity for each unit was calculated by multiplying the respective variables. The following provides a breakdown of the calculations:

Franciscan Formation

- Aquifer Area: 220 acres (AC)
- Average Static Groundwater Level: 119 feet BGS
- Maximum Aquifer Depth: 299 feet BGS
- Aquifer Thickness: 180 feet
- Specific Yield/Secondary Porosity: 1.0 percent (adjusted literature value)
- Calculated Storage Capacity: 396 AF

Sonoma Volcanics

- Aquifer Area: 30 AC
- Average Static Groundwater Level: 86 feet BGS
- Maximum Aquifer Depth: 285 feet BGS
- Aquifer Thickness: 199 feet
- Specific Yield/Secondary Porosity: 7.5 percent (average literature value)
- Calculated Storage Capacity: 448 AF

Based on the above calculations, the combined storage capacity within the cumulative impact area equates to 843 AF. As presented in Subsection 4.1 (*On-Site Water Use*), the additional groundwater supply requirement for the proposed development is 1 AF/yr. This estimated annual groundwater supply requirement represents approximately 0.1 percent of the groundwater in storage within the cumulative impact area.

Water Balance

A general estimate of water balance was determined by comparing groundwater recharge characteristics to the projected on-site groundwater use. In this regard, the groundwater recharge estimate for the cumulative impact area was calculated by assuming that precipitation represents the primary source of potential inflow into the underlying aquifer, and run-off and evapotranspiration represent the primary outflow variables. Whereas other secondary sources of inflow (i.e., groundwater inflow from upgradient boundaries, recharge from irrigation, etc.) and outflow (i.e., groundwater outflow along downgradient boundaries, discharge from surface springs, etc.) contribute to the overall groundwater recharge characteristics, these secondary sources were assumed to be relatively equal, resulting in no net gain or loss. Based on this approach, the following equation was used to calculate potential groundwater recharge:

$$\text{Groundwater Recharge} = P - (R + ET_a)$$

where "P" is equal to precipitation (in AF/yr), "R" is equal to run-off (in AF/yr), and "ET_a" is equal to actual evapotranspiration (in AF/yr). Details regarding the calculation of each of these variables are presented below.

Precipitation (P)

The total volume of precipitation that falls within the cumulative impact area was calculated by multiplying the annual precipitation rate (40 inches per year) by the size of the cumulative impact area (250 AC). This equates to a total precipitation volume within the cumulative impact area of approximately 833 AF/yr.

Run-off (R)

The percentage of the total precipitation that results as outflow (i.e., run-off) was estimated by comparing the ground slopes within the cumulative impact area to type curves for various surfaces (Sonoma County Water Agency, 1983). In general, the majority of the ground slopes within the cumulative impact area are greater than 20 percent. Areas with slopes in the five to 15 percent range are limited to the southern portion of the cumulative impact area. Based on available topographic data, the following slopes and acreages were used in the analysis: five percent slopes (55 AC); 15 percent slopes (36 AC); and 20 percent slopes or greater (159 AC). The corresponding run-off coefficients (i.e., percent of precipitation that results as run-off) for these slope conditions are 0.35, 0.43 and 0.45, respectively. The respective run-off coefficients were multiplied by the percentage of the annual precipitation volume that falls within each area to determine the annual outflow run-off volume. The corresponding results reveal annual run-off volumes of approximately 64, 52 and 238 AF/yr for the respective slope areas, or a total combined volume of 354 AF/yr.

Actual Evapotranspiration (ET_a)

The ET_a of various vegetation are roughly equivalent to the irrigation water needs and changes over the course of the year due to moisture and temperature variations. In the absence of site-specific ET_a data, irrigation demands for different vegetative species were used as a surrogate for ET_a in the analysis. In this regard, estimated applied water use (EAWU) calculations were performed using a Water Use Classification of Landscape Species (WUCOLS) model as described in *A Guide to Estimating Irrigation Water Needs of Landscape Plantings in California* (UC Cooperative Extension, 2000). The WUCOLS model, coupled with ET_o data for the area as previously outlined in Subsection 1.3 (*Local Climate*), allowed for estimation of EAWU for the vineyards, and native vegetation within the cumulative impact area. Whereas the native vegetation is not irrigated by artificial means in the same manner as crops or landscape plantings, the same approach can be applied to estimate water needs. In the case of areas occupied by vineyards (40 AC), EAWU was only calculated for the rainy season (October through March) as any EAWU occurring during the dry season (April through September) is offset by irrigation, the volume of which is already accounted for as part of the water use calculations. Using this model, the estimated ET_a for the vineyards was calculated to be approximately 7 AF during the rainy season, while the native vegetation was calculated to be 158 AF over the entire year. This translates to a total ET_a of 165 AF/yr.

Using each of the calculated values in the "Groundwater Recharge" equation, the corresponding estimated volume of water potentially available for groundwater recharge is approximately 314 AF/yr. Based on the estimated groundwater supply requirement of 1 AF/yr for the project site, the proposed groundwater use represents less than one percent of the estimated potential annual groundwater recharge volume within the cumulative impact area. The combined groundwater use, in turn, for the project site and the off-site properties (existing and/or future) equates to approximately seven percent of the estimated potential groundwater recharge volume.

5.2 Drawdown Characteristics

Projected drawdown characteristics associated with Well #2 at the project site was estimated through the performance of a preliminary analysis using aquifer pumping data, site-specific usage rates, and an analytical computer model. Since site-specific well pumping data was available for Well #2, the analysis was performed assuming a well completed in the Franciscan Formation. The following subsections provide a summary of the various parameters considered in the analysis and the corresponding results.

Daily Water Demand

In accordance with the estimates outlined earlier, the projected annual groundwater use for the project site is 1 AF/yr, with 0.75 AF/yr being attributed to the two-bedroom dwelling and second unit, and an additional 0.25 AF/yr for incidental uses. This equates to a daily water demand of approximately 893 gallons per day (GPD). However, it is

conservatively assumed that this daily water demand will vary seasonally, with all of the incidental water use occurring between June and October for landscape irrigation, thereby increasing the daily water demand during this period. Based on this assumption, the maximum daily water demand equates to 1,205 GPD. Conversely, the daily water demand between the period of November through May equates to 670 GPD.

Aquifer Transmissivity

Determination of aquifer transmissivity for modeling purposes was accomplished using data compiled as part of the dry weather pumping test conducted on Well #2 in August 2015. The average yield (2.6 GPM) and drawdown (12 feet) data from the pumping test were used in an empirical transmissivity equation published in *Groundwater and Wells* (Driscoll, 1986). This equation is as follows:

$$\frac{Q}{s} = \frac{T}{2000}$$

for a confined aquifer, where "Q" is discharge rate (GPM), "s" is feet of drawdown in the well, and "T" is transmissivity (gallons per day per foot [GPD/ft]). For the purpose of this analysis, the aquifer is assumed to be confined based on its substantial depth and the fracture controlled nature of the aquifer flow system. The corresponding results from the calculation revealed a transmissivity value of 433 GPD/ft.

Aquifer Storage Coefficient

A site-specific aquifer storage coefficient was estimated using a time-versus-drawdown analytical computer model as described later in this subsection for the determination of well interference characteristics. In essence, the dry weather pumping test outlined in the previous paragraph was simulated using the analytical computer model and the calculated transmissivity value (433 GPD/ft). Using the same average pumping rate (2.6 GPM) and pumping duration (eight hours), the aquifer storage coefficient variable in the model was adjusted until the predicted drawdown matched the actual drawdown observed at the end of the pumping test. The findings from this exercise yielded an aquifer storage coefficient value of 3×10^{-6}.

Pumping Rate and Duration

As presented earlier in this subsection, the maximum daily water demand for project site is approximately 1,205 GPD. Whereas the water demand would likely occur intermittently throughout the day, the total volume was assumed to be pumped at one time as a conservative measure to induce the maximum potential drawdown characteristics. Based on the sustained pumping rate achieved during the pumping test in August 2015, the pumping duration required to meet the maximum daily water demand is approximately 463 minutes. This was rounded up to 480 minutes (eight hours) as a conservative measure.

Well Interference Characteristics

The evaluation of well interference was conducted utilizing a time-versus-drawdown analytical computer model. Given a discharge rate and estimates of aquifer characteristics, the analytical model predicts groundwater drawdown as a function of distance from a pumping well. For this study, the classic nonequilibrium equation of Theis (1935) and the modified nonequilibrium equation of Jacob (1946) were used as the basis of our analysis. The following input parameters were used in the analytical model:

- *Pumping Rate:* 2.6 GPM
- *Aquifer Transmissivity:* 433 GPD/ft
- *Aquifer Storage Coefficient:* 3×10^{-6}
- *Pumping Duration:* 480 minutes

Results from the analytical modeling indicate that approximately 12 feet of drawdown would occur in the pumping well after 480 minutes of continuous pumping at a rate of 2.6 GPM. In addition, this pumping episode would induce less than three feet of drawdown at a distance of 500 feet from the pumping well. Based on these characteristics and the known or estimated locations of existing water supply wells and dwellings (see Figure 2, Appendix A), it does not appear that any appreciable drawdown affects will be induced on nearby properties adjoining the project site.

In the case of the project site, potential well interference induced by off-site wells is difficult to predict since the property is underlain by Sonoma Volcanics and Franciscan Formation materials, which can be highly variable. With that being said, the relative paucity of wells in proximity of project site and the substantial distance from those wells that do exist, suggest that the potential for any appreciable well interference is low.

5.3 Conclusions

Based on the proposed water use and the estimates presented herein, it is concluded that the proposed project will not have a significant impact on current and future groundwater availability at the project site, nor within the cumulative impact area under existing or foreseeable future use conditions. This conclusion is based on the following:

- As presented earlier, the projected estimated annual water supply requirement for the project site represents only 0.1 percent of the groundwater in storage within the cumulative impact area and is significantly less than the amount of potential annual groundwater recharge for the area (1 AF/yr versus 351 AF/yr). In fact, a significant positive water balance exists when considering potential annual groundwater recharge for the project site alone (1 AF/yr versus 119 AF/yr).

In regards to drought considerations, comparison of groundwater data collected as part of the March 2005 well yield certification test and the depth to water measurement

conducted on Well #1 in October 2015 revealed little change in static groundwater levels between the two dates. This data reveals very stable groundwater conditions, even though below average rainfall years had occurred in the ten years separating the tests. It also reflects the minor amount of groundwater development that has occurred in the area in relationship to the overall size of the cumulative impact area. Based on these circumstances, the aquifer(s) underlying the project site should be capable of maintaining adequate water supply during periods of drought.

6.0 SURFACE WATER / AQUATIC HABITAT

Policy WR-2e requires that the scope of the groundwater assessment encompass potential impacts to surface waters and aquatic habitats. As previously noted, the most prominent surface water feature in proximity of the project site is Mark West Creek, located approximately 500 feet south of the property and approximately 1,600 feet from Well #2. The only surface water features at the project site correspond to an ephemeral drainage and pond. Based on the depth to water in Well #2 (180 feet BGS) and the surface elevation of the pond (1,787 feet mean sea level [Google Earth]), it appears that groundwater at the Well #2 location is approximately 40 feet higher in elevation than the pond surface. Given that approximately 12 feet of drawdown was observed in Well #2 during the August 2015 pumping test, it does not appear likely that pumping from Well #2 will influence the water elevations in the pond. Therefore, it is concluded that the proposed project should not have an appreciable impact on surface water or aquatic habitats.

7.0 LIMITATIONS

This report was prepared in accordance with generally accepted standards of professional hydrogeologic consulting principles and practices at the place and time this study was performed. This warranty is in lieu of all other warranties, either expressed or implied. The conclusions presented herein are based solely on information made available to us by others, and includes professional interpretations based on limited research and data. Based on these circumstances, the decision to conduct additional investigative work to substantiate the findings and conclusions presented herein is the sole responsibility of the Client. This report has been prepared solely for the Client and any reliance on this report by third parties shall be at such party's sole risk.

8.0 CLOSING

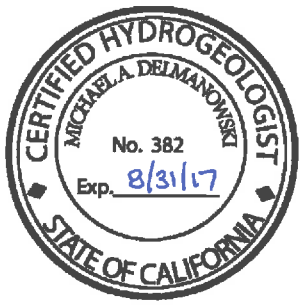
EBA appreciates the opportunity to be of service to you on this project. If you should have any questions regarding the information contained herein, please do not hesitate to contact our office at (707) 544-0784.

Sincerely,
EBA ENGINEERING

Paul Nelson, P.G.
Senior Project Geologist

Mike Delmanowski, P.G., C.E.G., C.Hg.
Senior Hydrogeologist

Appendices: Appendix A - Figures



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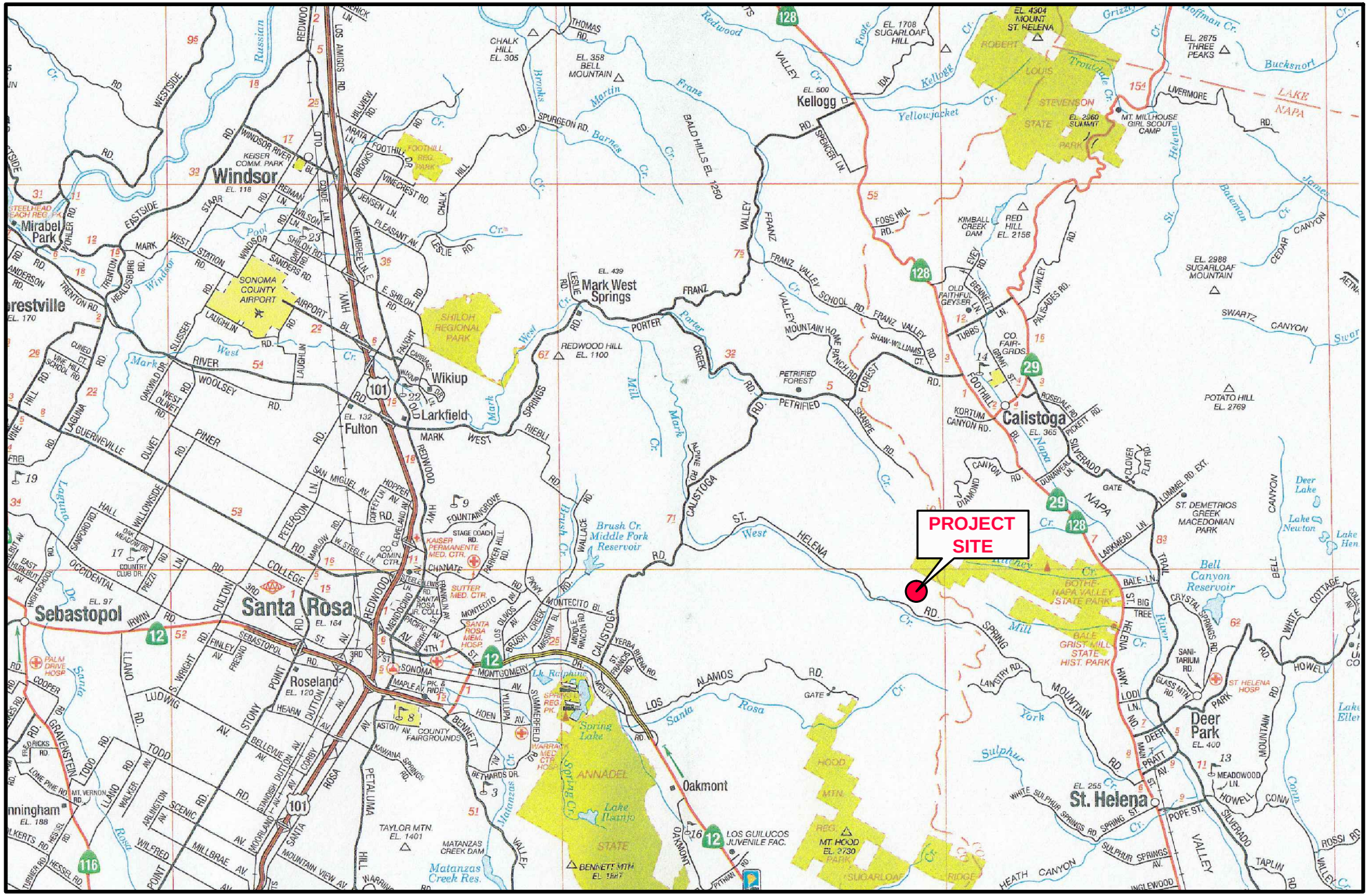
APPENDIX A

FIGURES



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LOCATION MAP

9795 WEST SUMMIT TRAIL
SANTA ROSA, CALIFORNIA

FIGURE
1

14–2085

Q:\2085\Location Map.dwg, Location Map, 12/4/2015 10:09:39 AM

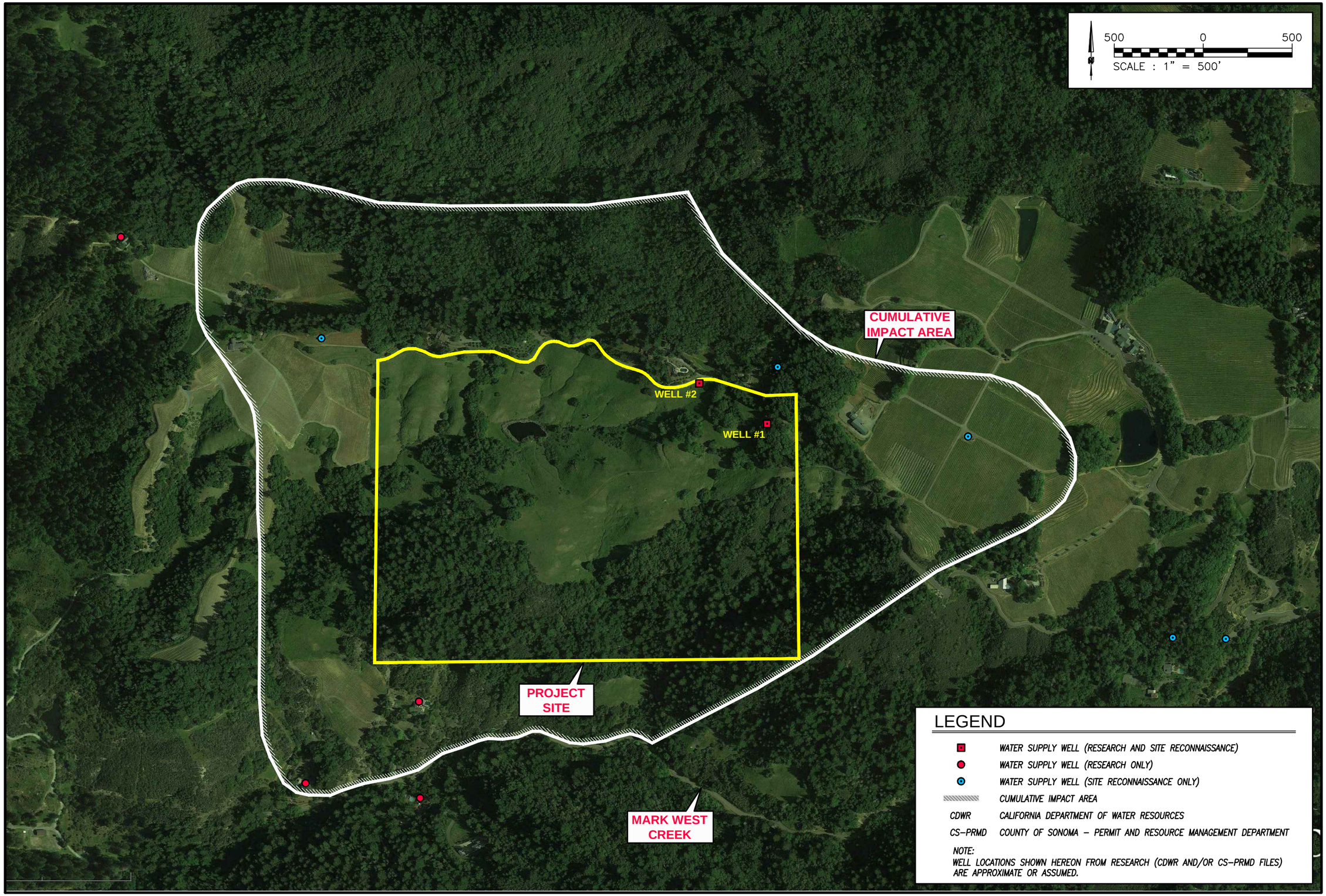

FIGURE 2

14-2085

SITE PLAN

9795 WEST SUMMIT TRAIL
SANTA ROSA, CALIFORNIA

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LEGEND

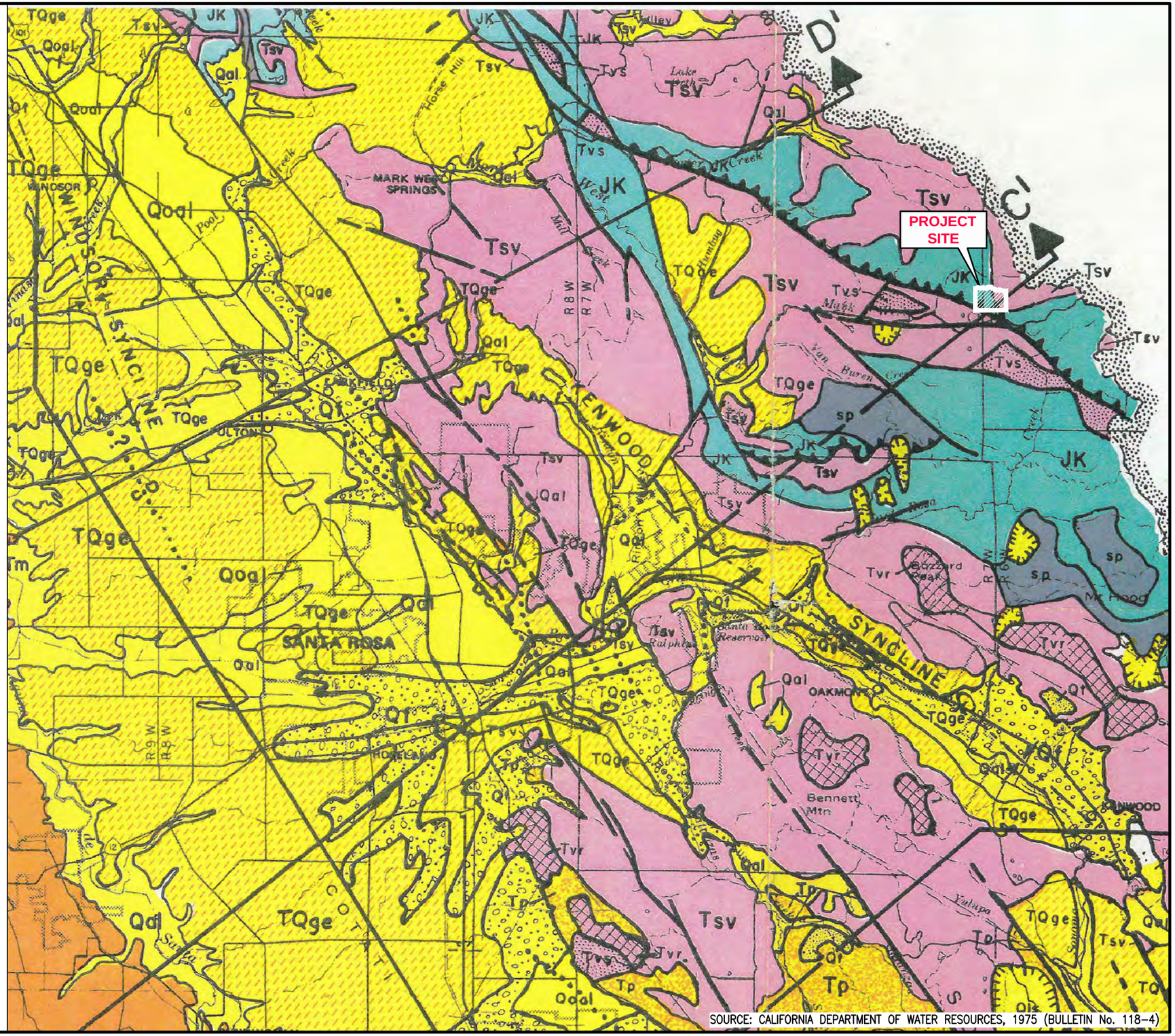
- Qls — LANDSLIDES
- Qal — YOUNGER ALLUVIUM
- Qf — ALLUVIAL FANS
- Qt — RIVER TERRACE DEPOSITS
- Qoal — OLDER ALLUVIUM
- TQge — GLEN ELLEN FORMATION
- Tm — MERCED FORMATION (WILSON GROVE FORMATION)
- Tsv — SONOMA VOLCANICS
- Tvs — VOLCANIC SEDIMENTS
- Tvr — RHYOLITE INTRUSIVES
- Tp — PETALUMA FORMATION
- JK — FRANCISCAN FORMATION
- sp — SERPENTINE

FAULT, DASHED WHERE INFERRED, DOTTED WHERE CONCEALED

THRUST FAULT; BARBS ON UPPER PLATE

AXIS OF ANTICLINE OR SYNCLINE

C' CROSS SECTION TRACE



1.5mi 0 1.5mi

SCALE : 1" = 1.5 miles

FIGURE 3

14-2085

GEOLOGIC MAP

9795 WEST SUMMIT TRAIL
SANTA ROSA, CALIFORNIA

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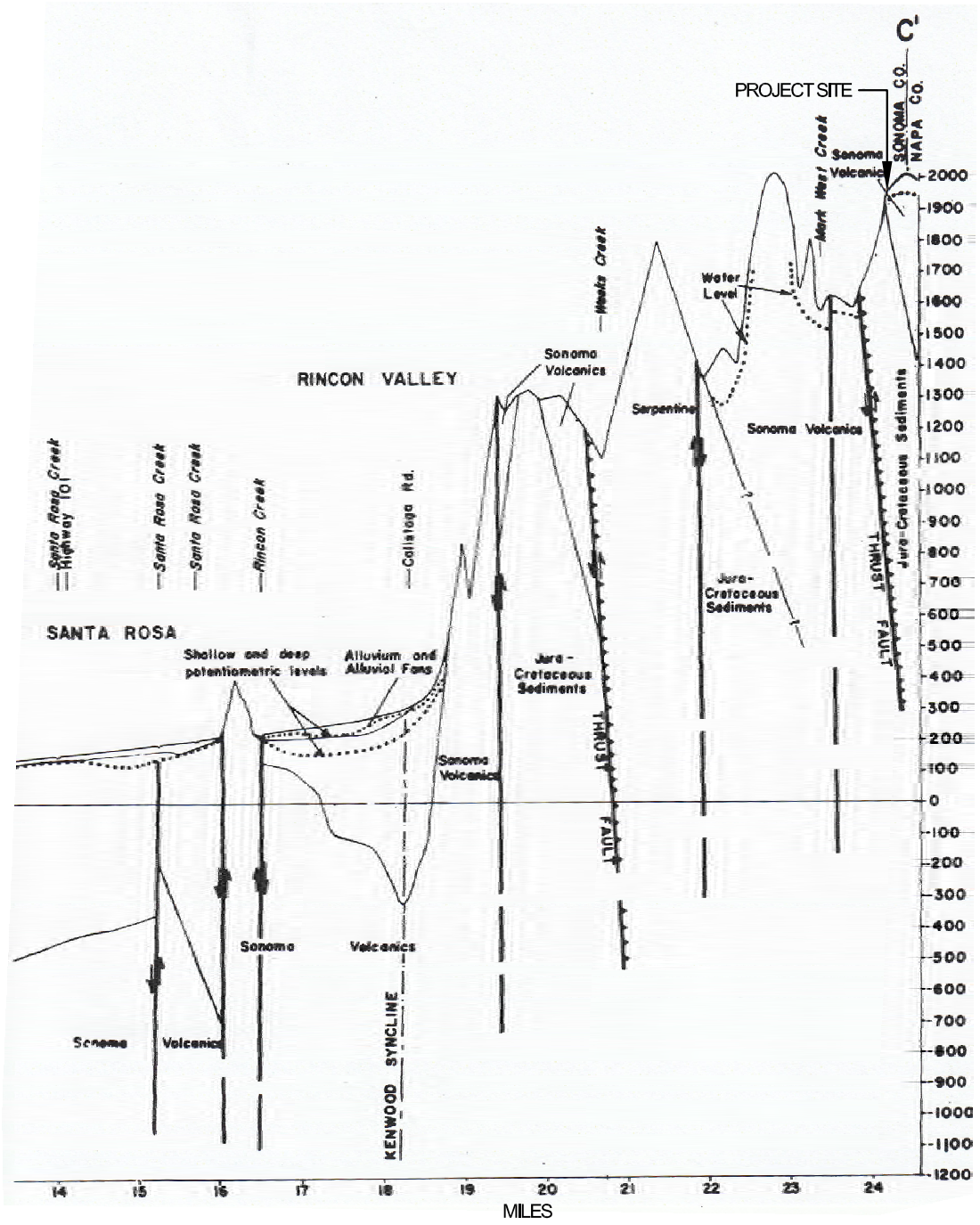

LEGEND

?– – – LITHOLOGIC CONTACT (QUERRIED WHERE INFERRRED)

FAULT (AND RELATIVE MOVEMENT)

SOURCE: CALIFORNIA DEPARTMENT OF WATER RESOURCES, 1975 (BULLETIN No. 118–4)

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GEOLOGIC CROSS SECTION

9795 WEST SUMMIT TRAIL
SANTA ROSA, CALIFORNIA

FIGURE
4
14–2085