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## Richard C. Slade & Associates, LLC
## Hydrology Response

Mountain Peak Winery P13-00320
Planning Commission Hearing January 4, 2017

RICHARD C. SLADE & ASSOCIATES LLC
CONSULTING GROUNDWATER GEOLOGISTS

DRAFT MEMORANDUM

November 30, 2016

To: Steve Rea
Mountain Peak Vineyards LLC
1114 Petra Dr
Napa, CA 94558

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

Job No. 537-NPA01

Re: Response to Public Comments
Proposed Mountain Peak Winery (Application #P13-00320)
3265 Soda Canyon Road, Napa County, California

Ref: "Updated Summary of April 2014 Constant Rate Pumping Test,
Existing Onsite Water Well
3265 Soda Canyon Road, Napa County, California"
Dated October 21, 2015, prepared by RCS

Included herein are responses to comments received by Napa County as a result of the distribution of the Initial Study/Proposed Negative Declaration (IS/ND) for the proposed Mountain Peak Winery (Application #P13-00320) (the "Project"). As part of that IS/ND, the above-referenced RCS Updated Summary, dated October 21, 2015 ("RCS 2015 Memorandum"), was also distributed by the County. This response pertains solely to public comments regarding the groundwater conditions related to the proposed Project.

**October 11, 2016 Letter from Kamman Hydrology & Engineering, Inc. (Kamman 2016)**

Kamman 2016 comments on many aspects of the IS/ND for the subject Project, including specific comments to the referenced RCS 2015 Memorandum. Below, RCS responds to those specific comments that relate to the RCS 2015 Memorandum, and offers additional data where appropriate. The numbering scheme and header titles in the text below are preserved from Kamman 2016.

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1. "Inaccurate water demand estimates that underestimated impacts to groundwater."

As detailed in the RCS 2015 Memorandum, measurements of the volumes of groundwater extracted from the onsite well (derived from monitoring data by Mountain Peak LLC) for the period from January 2015 through September 2015 are higher than the estimated volumes of "existing use" calculated by Bartelt Engineering. Kamman 2016 asserts that the higher nine-month 2015 groundwater volumes purportedly demonstrate that the Bartelt estimates of water use for the Project are incorrect.

As reported to RCS by the applicant, in addition to existing onsite vineyard operations, the existing onsite well has been used to supply pumped groundwater for road work on the portion of Soda Canyon Rd not maintained by Napa County. This groundwater applied to road work has not been separately accounted for during the recent monitoring period.

It is also noteworthy that only water use for the proposed Winery Project is discretionary. The subject property has existed as an operating vineyard since the early 1990s, with an expansion in early 2003. Hence, since at least 2003, the onsite well has been used to irrigate the existing onsite vineyards. The County's discretionary determination on the Winery use permit application will not affect groundwater extraction for the existing onsite vineyards. As set forth below, the "delta" or change in groundwater demand associated with the Winery Project is 0.5 acre feet per year (AFY) *less groundwater* than that currently used for vineyard irrigation purposes, i.e., a net reduction as follows:

- Net Groundwater Demand Change (i.e., the "delta") due to Winery Project
    a. Winery Process Water = 1.84 AFY
    b. Potable Water used for Marketing and Winery Non-Process Water = 1.01 AFY
    c. Irrigation Demand, Tasting Room Landscaping = 0.59 AFY
    d. The 1.84 AFY of groundwater used for the winery process water discussed in point "a" above will be treated and used for vineyard irrigation purposes via the wastewater treatment system proposed for the Project. Hence, this 1.84 AF/yr volume of re-used winery process water will offset groundwater that would normally be used for existing vineyard irrigation, and therefore must be deducted from this "Net Groundwater Demand Change" calculation.

e. As reported by Bartelt, 2.96 acres of existing vineyard will be removed from the property as part of the Winery Project. This will result in a reduction of groundwater use for vineyard irrigation of 2.1 AFY of groundwater.
    i. This reduction, using data from the Bartelt report, is calculated as follows: (50,826 existing vines - 45,440 future vines) x 129 gal/vine existing water use = 694,794-gallon reduction each year, or 2.1 AFY

f. Net groundwater demand change (the “delta”) as a result of Winery Project operation:
    i. = a + b + c - d - e = 1.84 + 1.01 + 0.59 – 1.84 – 2.1 = -0.5 AFY.
    ii. Thus, development of the Mountain Peak Winery Project will *reduce* the annually used groundwater demand at the subject property by 0.5 AFY, even if changes to vineyard irrigation practices were not implemented.

Water level data collected over time at the subject property do not suggest a long-term progressive, continuous and increasing decline in water levels at the subject property, even when considered in conjunction with prior drought conditions. Further, as illustrated above, total annual groundwater use will decrease at the Mountain Peak property as a result of the Winery Project.

2. <u>“Well yield test results that don’t evaluate potential impacts to groundwater”</u>

Kamman 2016 notes that water level data collected during normal operation of the well (as illustrated on Figure 7 of the RCS 2014 Memorandum) show drawdown during pumping of six to seven feet, and speculates why the drawdown observed during the operation of the well is greater than the 3.3 ft of water level drawdown observed during the April 2014 pumping test by RCS, when the well was pumped at a rate of 50 gallons per minute (gpm). Kamman’s initial assumption that when the well was pumping at its normal operational rate, it was pumping at a rate higher than the 50-gpm rate during the pumping test is correct, but irrelevant to Project groundwater demand or impacts. Mountain Peak LLC confirms that the well is operationally pumped at a rate on the order of 100 gpm, which correlates with the water level drawdown observed in the water level record. By doubling the pumping rate from 50 gpm (as was pumped for the pumping test) to 100 gpm, the resulting drawdown in the well was also doubled (from 3.3 ft to 6 or 7 ft of drawdown). This pumping rate data supports that the specific capacity of the well (the pumping rate of the well divided by the drawdown induced in the well while pumping at that rate) is consistent, whether pumping at either 50 gpm or 100 gpm. The calculated specific capacity, 14 to 15 gpm per foot of water level drawdown (gpm/ft ddn), at rates of 50 and 100 gpm, respectively, is relatively very high for a well that is constructed into the rocks of the Sonoma Volcanics, indicating that this well is quite efficient.

Kamman 2016 speculates that "one possible explanation" for the greater observed drawdown in the water level record is the time of year the pumping test was performed, coupled with the variable nature of volcanic rock aquifer systems. On the contrary, the data reflects that higher drawdown value in the well is simply a direct result of higher current pumping rates (100 gpm operationally, versus 50 gpm during the pumping test), and thus is not reflective of "less transmissive deeper fractures". In addition, as illustrated on Figure 7 of the RCS 2015 Memorandum (not included herein), all water levels in the existing well are 15 ft or more above the top of the perforated well interval, and therefore the water levels in the well do not likely move between more transmissive fracture systems in the winter months, and less transmissive fracture systems in the summer months. Also note that the entire range of water levels shown on the Figure 7 monitoring period between summer pumping levels and winter pumping levels is only approximately 10 ft (again, above the uppermost perforated interval in the onsite well); such a small difference in seasonal pumping levels is not likely to result in a noticeable change in pumping test performance between dry and wet season testing.

Kamman 2016 also questions the potential effects of Project well pumping on offsite wells and the surrounding aquifer[1]. Page 8 of the Napa County Water Availability Analysis Guidelines (WAA 2015) states that "the Tier 2 well interference criterion is presumptively met if there are no non-Project wells located within 500 feet of the existing or proposed Project well(s)." No offsite wells owned by others are known to exist within 500 ft of either the existing onsite well or the proposed Project well. This is illustrated on Figure 1, and in greater detail on Figure 3, of the RCS 2015 Memorandum (not reproduced herein). Hence, evaluation of offsite impacts

[1] *"Acknowledging that the effects of well pumping at off-site wells may be seen at the existing site well, what is the effect of pumping the existing and proposed Project wells on surrounding offsite wells? What is the radius and magnitude of influence of pumping the existing well on the surrounding aquifer?" (Kamman 2016)*

on nearby wells has been presumptively met by the County standards set forth in its 2015 WAA Guidelines.

Nor are there any offsite well impacts under the 2015 WAA Guidelines "Default Well Interference Criteria" (Page 9, Table 2B therein). Table 2B includes the "the minimum significant drawdown values… intended for use in cases where information about existing non-Project wells is limited or non-existent." (WAA 2015). For the existing onsite well, the 3.3 ft of water level drawdown and the 7 ft of water level drawdown are both less than the default well interference significance criteria presented in the Napa County Water Availability Analysis Guidelines (See WAA Page 9, Table 2B). This is consistent with the basic hydrogeology principle that self-induced water level drawdown in a pumping well is always greater than the water level drawdown interference that would be induced in any other onsite or offsite well. This water level drawdown phenomenon is described in hydrogeology textbooks as a "cone of depression," wherein the greatest water level drawdown is created in the well casing of the pumping well, with a decreasing amount of water level drawdown being induced as distance from the pumping well increases. **Figure A,** "Idealized Cone of Depression Diagram," has been adapted from Freeze & Cherry (1979), to illustrate water level drawdown effects in an idealized aquifer. For the subject property, this clearly means that potential water level drawdown impacts from onsite pumping on other "sensitive receptors" would be only a fraction of either 3.3 ft when the onsite well is pumping at 50 gpm, or 7 ft when this well is pumping at 100 gpm (the two drawdown values observed in the onsite well while pumping).

(For further illustration of the above hydrogeological phenomena, see calculation of theoretical drawdown values under point "6." below.)

3. <u>"Misleading statement on historic vineyard impacts to groundwater levels"</u>

Kamman 2016 questions the statement by RCS that water levels in the onsite well have "essentially remained unchanged over time." Referencing RCS' comparison of two measurements from one month in 1991 to "discontinuous measurements over a year and a half period in 2014-15", Kamman 2016 asserts that "temporal trends in groundwater level data require regular measurements over a longer period during similar seasonal periods… and multiple water year types." However, Kamman 2016 uses the same purportedly "discontinuous measurements" to state that *"Arguably, a 7 foot decline in summer water levels as measured during dry water year types reflects a long-term decline in groundwater levels and aquifer storage."* An inherent problem with comparing water levels in the summer months when pumping is highest, is that the static, non-pumping water levels at that time may not represent the true static water level in the aquifer.

It is also noteworthy that 1991 was a drought year (as defined in the RCS 2015 Memorandum, on Table 3 therein), and therefore the data set does not meet the "multiple water year types" requirement mentioned by Kamman; all data in the available data set were derived during drought years. Kamman also does not comment on the role that an ongoing drought (such as has been experienced in 2014 and 2015) plays in water level trends. Droughts tend to cause a downward trend in regional water levels; such a downward trend is reversed following periods of above-average rainfall. The available data set shown on Figure 7 of the RCS 2015 Memorandum reflects water level data collected only during drought periods.

A more robust, continuous data set to measure trends in water level data in the Project area does not exist. What is important to note is that the existing onsite vineyards have been irrigated using the subject well since at least 1993, and the available water level records do not suggest a continuous or progressive or long-term decline in water levels, particularly when considering that the periods in which data were available were drought periods.

4. <u>"Water Availability Analysis does not comply with current County code"</u>

Data presented in the RCS 2015 Memorandum fully complies with the May 12, 2015 Napa County WAA Guidelines. On page 21 of the RCS 2105 Memorandum, the statement is made "Groundwater recharge that occurs at the subject property on a long-term average annual basis is estimated to be 17.0 AF/yr, based on data available in the referenced report (LSCE&MBK 2013). This volume is higher than the estimated groundwater demand for the subject property of 16.64 AF/yr." Bartelt initially prepared the County's standard WAA long before implementation of the newer May 15, 2015 WAA Guidelines, and has updated the same document to be consistent with the initial filing. In fact, RCS performed the initial pumping test work for this Project in April 2014, also before promulgation of the new May 15, 2015 WAA Guidelines. In order to fulfill the requirements of a "Tier 1" WAA for a property located in “all other areas” (in which the Project is located), an estimate of site-specific annual groundwater recharge was compared to the proposed future groundwater use at the Project property; that information from the RCS 2015 Memorandum is reproduced above.

5. “Water Availability Analysis does not evaluate impacts to adjacent spring-fed pond’

Until receipt of Kamman 2016, no assertion had been made either to the County or the Project team that the pond on the private property north of the Project property was “spring fed”; the Napa County Assessor’s Parcel Number (APN) of that property with a pond is believed to be APN 032-500-032. **Figure B,** “Location Map”, shows the location of the spring-fed pond reported by Kamman, along with the approximate locations of wells mapped by Bartelt, superimposed on the basemap presented as “Figure 3” in the RCS 2015 Memorandum.

As Kamman 2016 states, WAA Guidelines require for a Tier 2 analysis in the following circumstances (underlining added by RCS), *“It is required that any proposed Project wells within 1,500 feet of natural springs that are being used for domestic or agricultural purposes be evaluated to assess potential connectivity between the part of the aquifer system from which groundwater is planned to be produced and the spring(s)*.” However, Kamman 2016 does not provide any factual basis establishing that the spring use meets those County-promulgated Tier 2 evaluation criteria.

Kamman 2016 further asserts that *“Review of project groundwater level monitoring data indicates that groundwater flow gradients within the project vicinity are generally from south to north (i.e., towards Rector Creek and canyon).”* Kamman’s assertion is factually unsupported and fails to follow generally accepted geologic methodology and practice. The RCS 2015 Memorandum included groundwater monitoring data for the single existing well on the Project property. Kamman 2016 purports that their review of those data yielded information on “groundwater flow gradients” but fails to include groundwater level data for any other wells in the area to support this claim. The direction or gradient of groundwater flow cannot be determined using a single water level monitoring data point; a minimum of three data points are required to determine groundwater flow direction and gradient.

In order to properly evaluate the spring, data related to the typical flow rate of the spring, and information related to the seasonal variations of the spring would be required; no such data are provided within Kamman 2016, nor have any data been provided by the spring owner. The only purported information related to flow rates that has been provided is the statement by Kamman that "*According to the property owner, the annual late summer (September) water level in the pond has been getting lower and lower over the past decade. In July of 2016, this spring-fed pond had dried up completely for the first time in at least 22 years (record of observation of current landowner)*." This is not a qualitative assessment of spring flow, only Kamman's speculative assertion as to the possible reasons for the declining pond water level over time. No information has been provided to rule out that, in its existing condition, flow from this spring that reportedly runs-off into the spring-fed pond is, and always has been, intermittent and strictly seasonal in nature. Nor has any data as to the surface area, depth, or typical storage volume of the pond been provided.[2]

Kamman 2016 also provides no basis to conclude that the asserted decline in water level in the pond was not the result of drought conditions and lack of filling of the pond by direct rainfall rather than a purported reduction in spring-flow over the 22-year "record of observation" by the owner of the pond. As illustrated on Table 3 of the RCS 2015 Memorandum, since 1994, there have been two recognized droughts in the region: one lasting three years (WY2006-07 to WY 2008-09), and five years (WY 2011-12 to WY 2015-16). It is likely that the reduced rainfall over the last five years is the principal cause by not "refilling" the pond annually, than a wholly conjectured reduction in spring flow to the pond. Note also that earthquakes (like the 6.0, August 24, 2014 South Napa Earthquake) can affect/alter spring flow rates and patterns.

As shown on **Figure B**, a well is known to exist on the neighboring property at the approximate location provided by the County by Bartelt (included on Figure 3 of the RCS 2015 Memorandum). The well on the neighboring property that contains the asserted spring-fed pond would tend to have greater drawdown influence on the reported spring that feeds that

[2] Based on review of Google Earth images of the property, the surface area of the pond is estimated to be on the order of 0.1 acres.

pond than does the existing well on the Project property that induced only 7 ft of self-induced water level drawdown in its well casing when pumping.

It is also assumed that the offsite property with the spring-fed pond, because it includes a residence, also has an onsite, subsurface wastewater disposal system (such as a leach field). Variations in flow to the subsurface onsite wastewater disposal system (if one exists in close proximity to the pond spring) could also influence the flow of the spring. Kamman 2016 fails to discuss or provide any information on this additional flow variable.

Nonetheless, RCS has calculated theoretical drawdown values that might be induced at the reported spring-fed pond location as discussed below under point "6".

6. "Water Availability Analysis does not evaluate project impacts to groundwater/surface water interaction that sustain adjacent creek flow"

Kamman 2016 reports that an offsite "spring/seep" is located on private property north of the Project site, as shown on **Figure B.** This location is reportedly based on the "upstream limit of the wetted channel" observed by Kamman and described in their 2016 letter, and is Kamman's purported basis for a WAA Tier 3 analysis. Kamman 2016 states (underlining added by RCS), "*For the purposes of this procedure, surface waters are defined to include only those surface waters known or likely to support special status species or surface waters with an associated water right; however, as with all of the procedures in this WAA, there may be unique circumstances that require additional site specific analysis to adequately evaluate a project's potential impacts on surface water bodies.*"

Kamman (2016) does not provide any facts to establish that the spring/seep in question meets those County-promulgated evaluation criteria. No flow rate observations for the "spring/seep" are provided other than the description that at an unknown distance "*Downstream (north) of this [upstream limit of wetted channel] location the bedrock dominated channel contains low surface flows with abundant intervening pools, many several feet deep.*" Nor does Kamman 2016 specify whether it actually observed a flowing "spring/seep", or if the location was inferred from observation of the "upper limit of wetted channel."

As shown on **Figure B**, the "upstream extent of wetted channel" presented in Kamman 2016 is plotted on the map shown in Figure 3 of the RCS 2015 Memorandum. There are two important observations to be gleaned from review of **Figure B**. First, there are two offsite residences (not on the Project property) that are located relatively near the "upper extent of wetted channel" site. Presumably those residences dispose of wastewater using onsite, subsurface discharge. Such wastewater discharges could affect the variability of the "upper extent of wetted channel" during the dry season. Second, those offsite residences presumably rely on groundwater pumped from wells shown at the approximate locations on **Figure B** to meet their onsite groundwater demands; those wells are closer to the "upper extent of the wetted channel" than are the existing or proposed Project property wells. Therefore, those nearby wells owned by others may very well have greater water level drawdown impacts on the reported spring/seep (presumed to be located at the site of the "upper extent of wetted channel") than any purported impact from the well on the Project site that is known to have induced only 7 ft of self-induced drawdown in its well casing when pumping (theoretically assuming, for the purposes of this discussion only, that the Project well could induce any measurable offsite drawdown).

Nonetheless, using water level data collected during the 2014 pumping test of the existing onsite well, RCS has calculated theoretical water level drawdown values that could be induced at the reported spring-fed pond location as well as at the "upstream extent of wetted channel" location by virtue of pumping the Project well.

Using the AQTESOLV Professional (version 4.5) software package (and Theis Equation solver), RCS performed a predictive simulation of the future pumping by the Project well. The key inputs/assumptions used as part of the theoretical drawdown calculations include:

- <u>Theoretical Calculation Locations</u> – Distances from the "spring-fed pond" and the "upper extent of wetted channel" from the existing and proposed Mountain Peak wells are as follows:

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**Table A - Distances Between Mountain Peak Wells and Theoretical Calculation Locations**

| Mountain Peak Wells | Approx. Distance to "Spring-Fed Pond" | Approx. Distance to "upper extent of wetted channel" |
|---|---|---|
| Existing Well | 700 ft | 1100 ft |
| Proposed Well | 750 ft | 900 ft |

For these simulations, RCS assumed only one Project well is pumping, and the more conservative (shorter) distance to the theoretical monitoring site (highlighted in green in Table A above)

- Peak Pumping Rate and Duration – As determined by Bartelt, and re-stated in the RCS 2015 Memorandum, the onsite wells will need to pump at a combined rate of 44.5 gallons per minute (gpm) for 12 hours (720 minutes) per day during the peak irrigation season in the month of July, and at a rate of 20.6 gallons per minute (gpm) for 12 hours (720 minutes) per day in order to meet the average demand of the Project property.
- Well Penetration – The onsite well is considered to be a "partially penetrating well" because it does not extend to the bottom of the water-bearing, fractured rocks of the Sonoma Volcanics.
- Aquifer Thickness – The thickness of the saturated volcanic rock aquifer system is estimated to be 200 ft thick, the distance between the bottom of the perforations in the well (205 ft below ground surface, or "bgs") and a groundwater surface that is roughly 25 ft bgs in the existing Project well (see Figure 7 of the RCS 2015 Memorandum for water level reference).
- Aquifer parameter of Transmissivity. Transmissivity (T) is a measure of the rate at which groundwater can move through an aquifer system, and therefore is essentially a measure of the ability of an aquifer to transmit water to a pumping well. Transmissivity (T) is expressed in units of gallons per day per foot of aquifer width (gpd/ft), or feet squared per day ($ft^2$/day).

Water level drawdown data and recovery data collected during the Project pumping test were input into the software program AQTESOLV Professional (version 4.5). Numerous analytical solutions were utilized to determine transmissivity values using an automatic curve fitting procedure. **Figure C** – "Results of Curve-Fitting Analysis" shows two of the

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numerous solutions analyzed. Based on those data, a transmissivity of 4,100 $ft^2$/day (30,668 gpd/ft) is considered to be representative for the fractured rock aquifers in the vicinity of the Project property.

- Aquifer Parameter of Storativity - Storativity (S) is a measure of the volume of groundwater taken into or released from storage in an aquifer for a given volume of aquifer materials; storativity is dimensionless and has no units. Storativity can only be determined using pumping test data if induced water level drawdown is detected in an observation well (not the pumping well). No such data are available for the Project pumping test. Therefore, we will assume a storativity value of $1x10^{-4}$ for the local fractured-rock aquifer system. This is a value similar to values of storativity used in other analyses by RCS for the Sonoma Volcanics rocks. Note that the WAA Guidance document provided a range of specific storage values for "rock, fissured" in Appendix F, Table F-3 (WAA 2015); the lowest value is $1x10^{-6}$ ($ft^{-1}$). Multiplying this specific storage value by the estimated aquifer thickness of 200 ft yields a dimensionless storativity value of $2x10^{-4}$, which is only slightly higher than the RCS assumed value.
- Inherent Theis Equation Assumptions - The Theis solution assumes numerous conditions about the aquifer system, including that the aquifer is homogeneous and isotropic (the same in all directions) and that the aquifer is of infinite areal extent.

Using the assumptions described above, Figure D "Theoretical Water Level Drawdown Calculations," has been prepared to show the calculated water level drawdown values at the "spring-fed pond" and the "upper extent of wetted channel" following 720 minutes of continuous pumping at the for two different pumping rates: at a constant rate of 21 gpm and at a constant rate of 46 gpm. A summary of the results of the AQTESOLV software calculations are as presented in the following Table:

**Table B – Calculated Theoretical Water Level (WL) Drawdown Values**

| Mountain Peak (Mtn Pk) Well Pumping Rate | WL Drawdown inside Mtn Pk Well Casing | WL Drawdown @ "Spring-Fed Pond" (700 ft from Mtn Pk Well) | WL Drawdown @ "upper extent of wetted channel" (900 ft from Mtn Pk Well) |
|---|---|---|---|
| 21 gpm for 720 minutes | 1.5 ft | 0.35 ft | 0.31 ft |
| 46 gpm for 720 minutes | 3.5 ft | 0.79 ft | 0.71 ft |

These theoretical drawdown values (i.e., theoretical water level interference values) at both the "spring-fed pond" location and the "upper extent of wetted creek" location, respectively, are less than 0.5 ft; such small water level changes while pumping the Project well are very likely immeasurable, due to natural fluctuations in the flow of springs/seeps. These values are also far less than the "Default Well Interference Criteria" shown on Table F-1 of the May 12, 2015 Napa County WAA Guidelines. In addition, in our long-term experience in the field monitoring of water levels in wells during actual pumping tests, RCS has typically found that theoretically-calculated values are virtually always greater than the actual field-monitored values.

7. "Groundwater study overestimates groundwater recharge"

Kamman 2016 asserts that the RCS 2915 Memorandum "settled on" a deep percolation percentage of 14% of annual rainfall and that this is not a reasonable estimate for the subject property. As described in the RCS 2015 Memorandum, RCS did not simply "settle" on a value of 14% deep percolation recharge. Kamman 2016's erroneous statement discounts, oversimplifies, and completely dismisses (and fails to follow) the methodologic evaluation RCS used to determine deep percolation percentage at the subject property in the RCS 2015 Memorandum. As described below, RCS provided detailed analyses and verifiable, scientifically-sound methodologies to determine a conservative rainfall deep percolation percentage for the Project property using data developed by other consultants for Napa

County, and data that are specific to the watershed in which the Project property lies. Also, those data have been further corroborated with additional data sources.

The RCS calculation relies on watershed-specific data for the watershed in which the Project property is located, as derived from the Hydrogeologic Conceptual Model report prepared for Napa county (LSCE&MBK 2013).

Kamman 2016 incorrectly states that "The 17% rainfall recharge estimate is representative of the entire 93.5 square mile Napa River watershed upstream of Napa. Pursuant to LSCE&MBK (2013), the Sonoma Volcanics make up 42% of the surficial geology contained in this area, with the remaining area comprised of alluvial and channel deposits that, in general, have higher infiltration rates than volcanics." First, Kamman 2016's statement is factually incorrect, as there are three major types of geologic materials within the Napa River Watershed near Napa; the "remaining area" of the watershed is not solely comprised of the alluvial and channel deposits. Kamman 2016 does not mention the older, well consolidated geologic materials belonging to the Great Valley Complex and/or Franciscan Complex that exist within the watershed area. It is well known that these geologically older rocks are a poor source of groundwater throughout the County. For reference see Figure 6A, "Watershed Geology Map," from the RCS 2015 Memorandum; that figure illustrates the geologic conditions throughout the watersheds in question.

Importantly, the principal reason that RCS calculated a lower percolation percentage for the subject property than the watershed-wide 17% rate is because the alluvial materials along the floor of the Napa Valley very likely exhibit a deep percolation percentage greater than 17%. RCS arrived at the calculated 14% deep percolation for the subject property by assuming that 30% of the rainfall that falls on alluvial deposits along the floor of the Napa Valley is available to deep percolate and become groundwater (this is a conservative assumption). Then using that assumption, RCS calculated a reduced deep percolation percentage for the remainder (non-alluvial) portions of the watershed. Note that this methodology combines both the water-bearing Sonoma Volcanics rocks, and the highly consolidated, poor water-bearing, geologically older rocks of the Great Valley Complex and the Franciscan Complex. Those consolidated rocks are considered to exhibit lower deep percolation percentages than the

Sonoma Volcanics. To remain conservative, no adjustment was made to increase the deep percolation of the Sonoma Volcanics in order to account for lower recharge rates in the highly consolidated older rocks.

RCS has performed the same calculation for other sub watersheds of the Napa River for other, confidential clients throughout Napa County. Table C, "Calculation of Theoretical Rainfall Recharge Percentage," reprints the deep percolation percentage calculation that was originally presented in the RCS 2015 Memorandum for the "Napa River Watershed near Napa", and then presents the same calculation for the "Napa River Watershed at St. Helena" and also for the "Napa River Watershed at Calistoga". The calculated deep percolation results for the hillside areas for those two watersheds are 11% and 16%, respectively. Based on these data, the 14% deep percolation percentage calculation for the Project property is reasonable.

Kamman 2016 then suggests that the Milliken Creek Watershed rainfall deep percolation percentage of 8% (as listed in LSCE&MBK, 2013) is a possible appropriate recharge rate for the Project property, due to the proximity of the Milliken Creek watershed to the watershed in which the Project property lies, and that the fact that the Milliken Creek watershed is comprised primarily of rocks of the Sonoma Volcanics, as is the watershed in which with Project property lies. However, Kamman 2016 fails to mention that in the LSCE&MBK 2013 report, the Conn Creek Watershed, just north of the Project property was shown by LSCE&MBK 2013 to have a rainfall deep percolation percentage of 21%. That watershed is comprised of both water-bearing rocks of the Sonoma Volcanics, and older, highly consolidated, generally poor water-bearing rocks of the Great Valley Complex and/or the Franciscan Complex.

Another source for estimates of deep percolation data can be derived from "Basin Characterization Model" (BCM) data published by the United States Geological Survey. This Basin Characterization Model (BCM) data "provides historical and projected climate and hydrology data at a 270 meter resolution" (USGS 2014). The model is described as grid-based, and includes calculation using precipitation runoff, recharge, and evapo-transpiration for each of the grid cells; the grid cells are reported to be 18 acres in size (USGS 2014).

Importantly, because these data are grid-based, and are spatially distributed throughout the entire state of California, calculations can be performed for any polygon (such as the Project property boundaries) within the dataset using GIS software.

Spatially-gridded data sets from the BCM for average precipitation (BCM data variable "ppt") and model-derived calculations of recharge (BCM data variable "ppt") were downloaded via the California Landscape Conservation Cooperative Climate Commons Website (http://climate.calcommons.org/). These data sets represented the 30-year historical averages for the dates ranging from 1981 through 2010. Using the Project property boundaries polygon and zonal statistics calculations from GIS software, the BCM dataset provides an average annual rainfall for the Project property of 36.4 inches, and an average annual recharge of 9.4 inches; this calculates to a rainfall recharge percentage of 25%. This recharge percentage is much higher than the 14% RCS conservatively estimated for the subject property[3].

A watershed-wide assessment can also be made using the BCM data. Such use is consistent with the recommended "watershed-scale evaluations" described in the "limitations of use" section of the document that is distributed with the BCM dataset. Figure E, "Watershed Boundaries" illustrates two watershed boundaries: the "Napa Watershed near Napa" boundary adapted from LSCE&MBK 2013; and the approximate "Rector Reservoir Watershed" from Figure 2 of Kamman 2016. The Project property lies within the latter watershed. Using the same zonal statics calculations on those watershed polygons with GIS software in conjunction with the BCM gridded data sets, the same calculation was performed as was described above, and the results of those calculations are presented in Table C "Watershed-scale Calculated Rainfall Recharge Percentage Using BCM Dataset".

[3] In the "limitations of use" section of the document that is distributed with the USGS (2013) data, the statement is made that "*The user of this data should be aware that these model outputs are intended for watershed-scale evaluation. Use of the data for analyses at a scale smaller than the planning watershed is not intended and could yield misleading results.*" Therefore, the 25% deep percolation estimate could potentially be "misleading" as stated in the BCM distribution package.

**Table C – Watershed-scale Calculated Rainfall Recharge Percentage Using BCM Dataset**

| Watershed | Average Annual Rainfall (in) | Average Annual Recharge (in) | Calculated Rainfall Recharge Percentage |
|---|---|---|---|
| Napa River Watershed Near Napa (LSCE&MBK 2013) | 38.3 | 11.3 | 30% |
| Rector Reservoir Watershed (Kamman 2016, Figure 2) | 36.9 | 10.3 | 28% |

As shown in Table C, the watershed-scale calculations using the BCM data suggest that the calculated rainfall recharge percentage for the "Rector Reservoir Watershed" (proposed by Kamman 2016) is roughly 93% of the calculated rainfall recharge percentage for the "Napa River Watershed Near Napa" (this is calculated as 28% ÷ 30% = 93%). This same ratio between the larger "Napa River Watershed Near Napa" watershed and the smaller "Rector Reservoir Watershed" can be applied to the actual calculated data presented in the LSCE&MBK 2013 report. In Table 8-9 of that LSCE&MBK 2013 report, the rainfall deep percolation percentage for the "Napa River Watershed Near Napa" was estimated to be 17%. Taking 93% of the LSCE&MBK-reported percentage (17%) yields a deep percolation percentage of 15.8% for the "Rector Reservoir Watershed" in which the Project property is located. This value is also higher than the 14% deep percolation presented in the RCS 2015 Memorandum.

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- Western Regional Climate Center (WRCC), 2015. http://www.wrcc.dri.edu)

# Table C
# Calculation of Theoretical Rainfall Recharge Percentage

DRAFT

## Napa River Watershed near Napa

| Portion of "Napa River Watershed Near Napa" | Area | | Average Rainfall per PRISM Dataset (1980-2010) | Rainfall Volume | Scenario 1 | | Scenario 2 | | Scenario 3 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Deep Percolation Percentage | Deep Percolation Volume | Deep Percolation Percentage | Deep Percolation Volume | Deep Percolation Percentage | Deep Percolation Volume |
| | (sq mi) | (acres) | (in) | (AF) | (%) | (AF) | (%) | (AF) | (%) | (AF) |
| Valley Floor Portion of Watershed | 45.5 | 29,120 | 34.7 | 84,205 | 20% | 16,841 | 25% | 21,051 | 30% | 25,262 |
| Hillside Area Portion of Watershed | 172.8 | 110,592 | 39.3 | 362,189 | 16% | 58,964 | 15% | 54,754 | 14% | 50,544 |
| Entire Watershed | 218.3 | 139,712 | 38.3 | 445,914 | 17% | 75,805 | 17% | 75,805 | 17% | 75,805 |

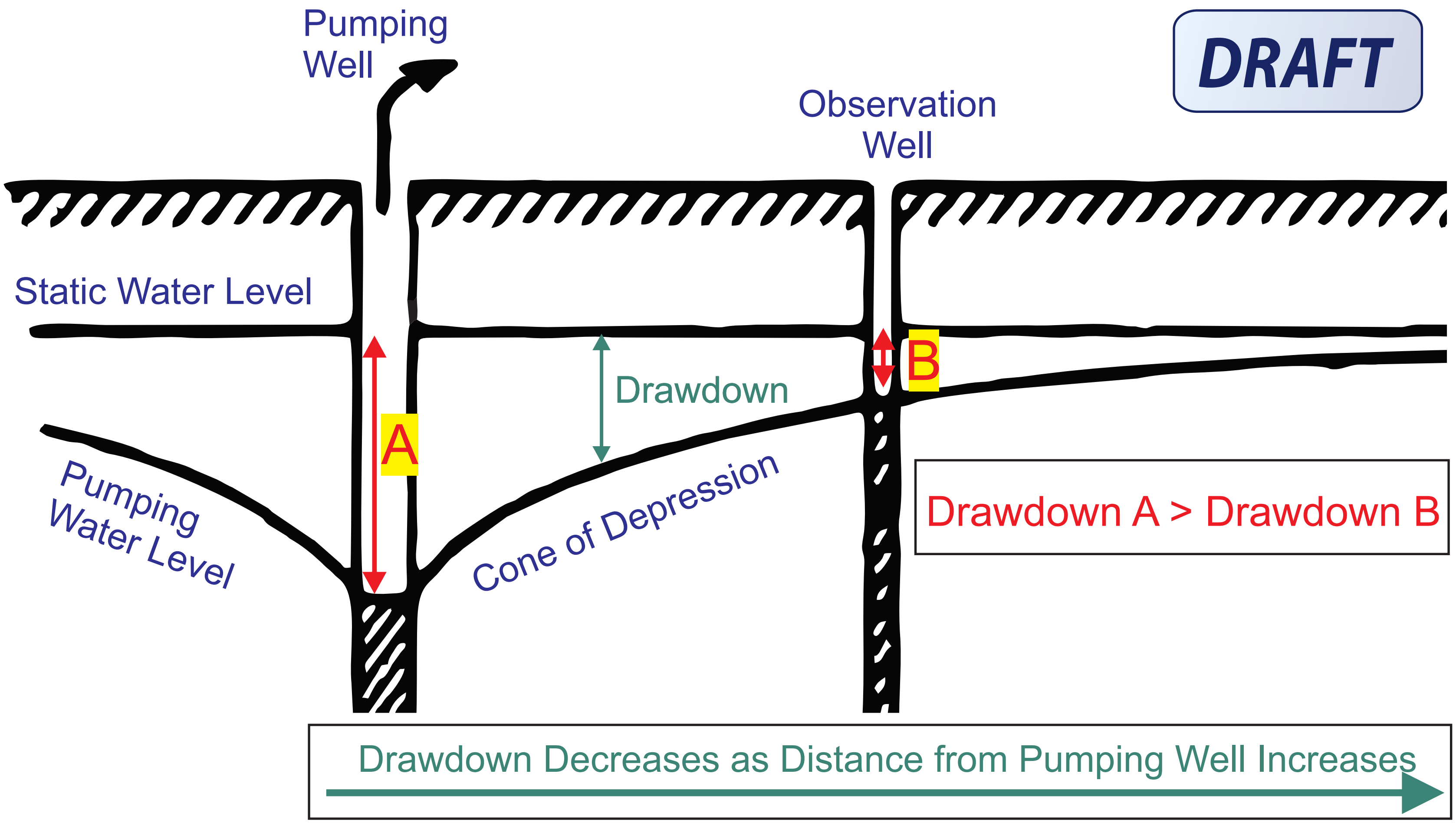
## Napa River Watershed at St. Helena

| Portion of "Napa River Watershed at St. Helena" | Area | | Average Rainfall per PRISM Dataset (1980-2010) | Rainfall Volume | Scenario 1 | | Scenario 2 | | Scenario 3 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Deep Percolation Percentage | Deep Percolation Volume | Deep Percolation Percentage | Deep Percolation Volume | Deep Percolation Percentage | Deep Percolation Volume |
| | (sq mi) | (acres) | (in) | (AF) | (%) | (AF) | (%) | (AF) | (%) | (AF) |
| Valley Floor Portion of Watershed | 14.8 | 9,472 | 38.5 | 30,389 | 20% | 6,078 | 25% | 7,597 | 30% | 9,117 |
| Hillside Area Portion of Watershed | 64.8 | 41,472 | 42.4 | 146,534 | 13% | 18,706 | 12% | 17,187 | 11% | 15,667 |
| Entire Watershed | 79.6 | 50,944 | 41.7 | 177,030 | 14% | 24,784 | 14% | 24,784 | 14% | 24,784 |

## Napa River Watershed at Calistoga

| Portion of "Napa River Watershed at Calistoga" | Area | | Average Rainfall per PRISM Dataset (1980-2010) | Rainfall Volume | Scenario 1 | | Scenario 2 | | Scenario 3 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Deep Percolation Percentage | Deep Percolation Volume | Deep Percolation Percentage | Deep Percolation Volume | Deep Percolation Percentage | Deep Percolation Volume |
| | (sq mi) | (acres) | (in) | (AF) | (%) | (AF) | (%) | (AF) | (%) | (AF) |
| Valley Floor (Alluvium) Portion of Watershed | 4.9 | 3,136 | 39.7 | 10,375 | 20% | 2,075 | 25% | 2,594 | 30% | 3,112 |
| Hillside Area Portion of Watershed | 16.9 | 10,816 | 44.5 | 40,109 | 19% | 7,534 | 17% | 7,015 | 16% | 6,497 |
| Entire Watershed | 21.8 | 13,952 | 43.5 | 50,576 | 19% | 9,609 | 19% | 9,609 | 19% | 9,609 |

Note:
Adapted from RCS 2015 Memorandum and from other Memoranda for confidential clients within Napa County. Source data adapted from LSCE & MBK 2013. Watershed boundaries shown on Figure 6 of the RCS 2015 Memorandum.




Drawing adapted from Freeze, R.A., and Cherry, J.A., 1979, Groundwater: Englewood Cliffs, NJ, Prentice-Hall, 604 p.

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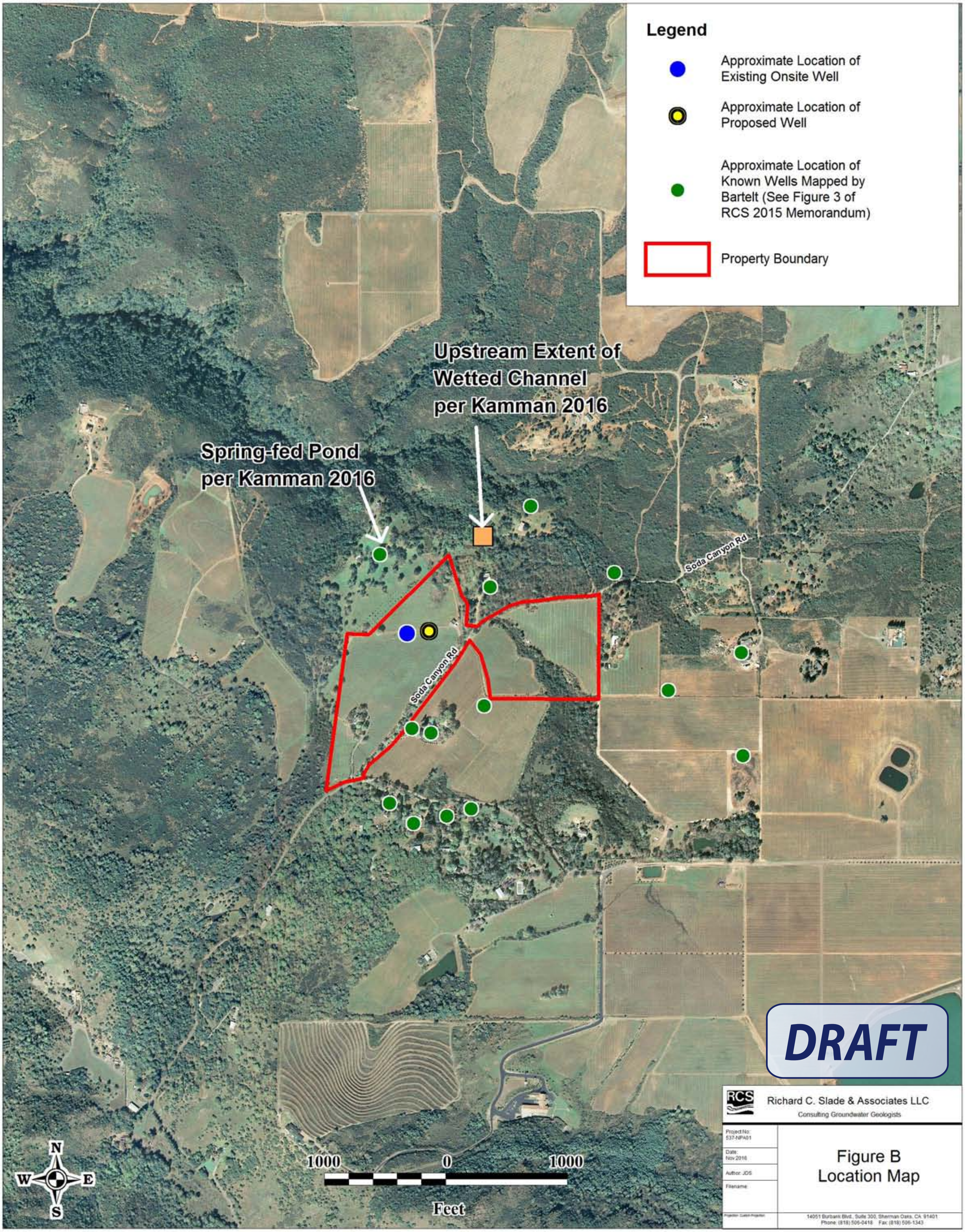
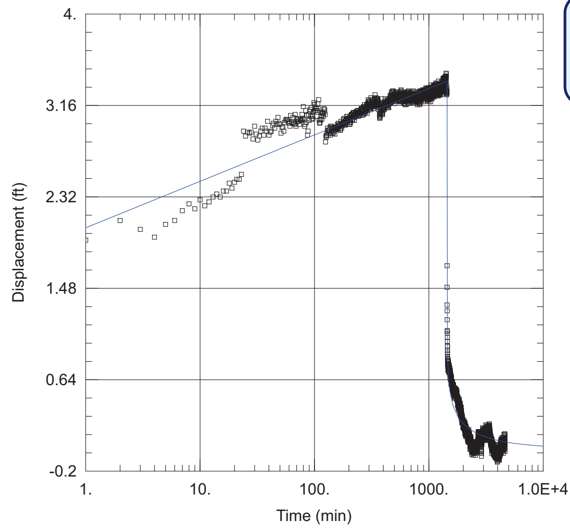
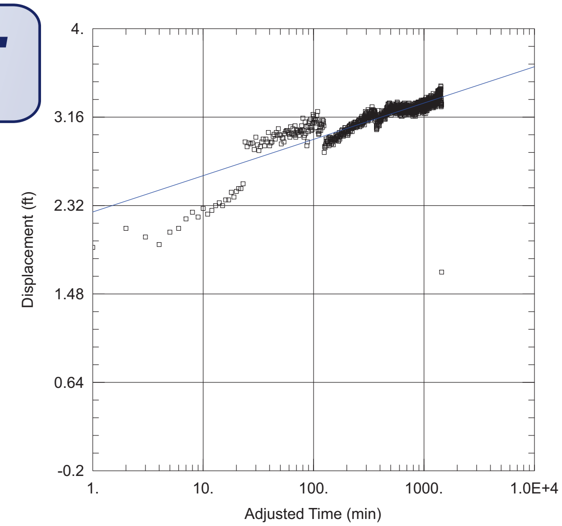
**FIGURE A**
**IDEALIZED CONE OF DEPRESSION DIAGRAM**

**Job No. 537-NPA01** **November 2016**


Legend
Approximate Location of Existing Onsite Well
Approximate Location of Proposed Well
Approximate Location of Known Wells Mapped by Bartelt (See Figure 3 of RCS 2015 Memorandum)
Property Boundary
Upstream Extent of Wetted Channel per Kamman 2016
Spring-fed Pond per Kamman 2016
Soda Canyon Rd
Soda Canyon Rd
N
W
E
S
1000
0
1000
Feet
DRAFT
RCS
Richard C. Slade & Associates LLC
Consulting Groundwater Geologists
Project No: 537-NPA01
Date: Nov 2016
Author: JDS
Filename:
Figure B
Location Map
14051 Burbank Blvd., Suite 300, Sherman Oaks, CA 91401
Phone: (818) 506-0418 Fax: (818) 506-1343




DRAFT




## WELL TEST ANALYSIS

Data Set: \...\PPG Test Solution Theis.aqt
Date: 11/29/16 Time: 09:17:30

### PROJECT INFORMATION

Company: RCS
Client: Mtn Peak
Project: 537-NPA01
Location: Soda Canyon rd
Test Well: Existing Well
Test Date: April 2014

### WELL DATA

Pumping Wells

| Well Name | X (ft) | Y (ft) |
|---|---|---|
| Mountain Peak Well | 0 | 0 |

Observation Wells

| Well Name | X (ft) | Y (ft) |
|---|---|---|
| ▫ Mountain Peak Well | 0 | 0 |

### SOLUTION

Aquifer Model: Confined Solution Method: Theis

T = 4132.7 $ft^2$/day
Kz/Kr = 1. b = 200. ft

## WELL TEST ANALYSIS

Data Set: \...\PPG Test Solution Cooper Jacob.aqt
Date: 11/29/16 Time: 09:17:46

### PROJECT INFORMATION

Company: RCS
Client: Mtn Peak
Project: 537-NPA01
Location: Soda Canyon rd
Test Well: Existing Well
Test Date: April 2014

### AQUIFER DATA

Saturated Thickness: 200. ft Anisotropy Ratio (Kz/Kr): 1.

### WELL DATA

Pumping Wells

| Well Name | X (ft) | Y (ft) |
|---|---|---|
| Mountain Peak Well | 0 | 0 |

Observation Wells

| Well Name | X (ft) | Y (ft) |
|---|---|---|
| ▫ Mountain Peak Well | 0 | 0 |

### SOLUTION

Aquifer Model: Confined Solution Method: Cooper-Jacob

T = 5110.5 $ft^2$/day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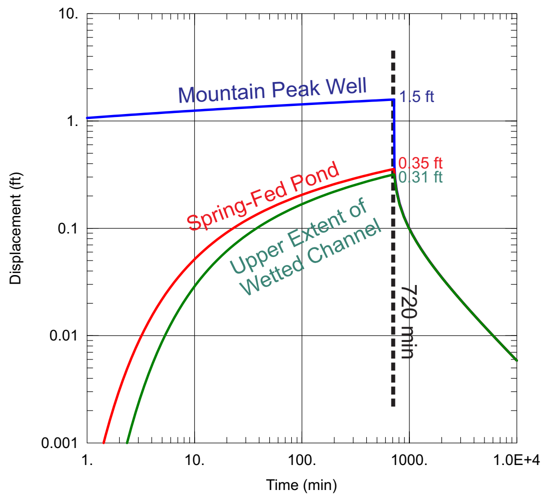
# FIGURE C
# RESULTS OF CURVE-FITTING ANALYSIS

**Job No. 537-NPA01** **November 2016**

**DRAFT**

## Pumping for 720 min at 21 gpm




WELL TEST ANALYSIS

Data Set: \...\PPG Test Fwd Simulation 21 GPM.aqt
Date: 11/29/16 Time: 08:33:23

PROJECT INFORMATION

Company: RCS
Client: Mtn Peak
Project: 537-NPA01
Location: Soda Canyon rd
Test Well: Existing Well
Test Date: April 2014

WELL DATA

Pumping Wells

| Well Name | X (ft) | Y (ft) |
|---|---|---|
| Mtn Peak Well | 0 | 0 |

Observation Wells

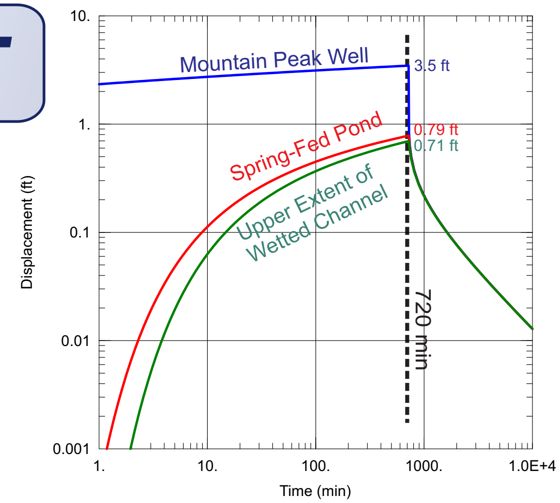
| Well Name | X (ft) | Y (ft) |
|---|---|---|
| □ Mtn Peak Well | 0 | 0 |
| ○ Spring-Fed Pond | 700 | 0 |
| △ Upper Wetted Channel | 900 | 0 |

SOLUTION

Aquifer Model: Confined
Solution Method: Theis

T = 4100. $ft^2$/day
S = 0.0001
Kz/Kr = 1.
b = 200. ft

## Pumping for 720 min at 46 gpm




WELL TEST ANALYSIS

Data Set: \...\PPG Test Fwd Simulation 46 GPM.aqt
Date: 11/29/16 Time: 08:33:41

PROJECT INFORMATION

Company: RCS
Client: Mtn Peak
Project: 537-NPA01
Location: Soda Canyon rd
Test Well: Existing Well
Test Date: April 2014

WELL DATA

Pumping Wells

| Well Name | X (ft) | Y (ft) |
|---|---|---|
| Mtn Peak Well | 0 | 0 |

Observation Wells

| Well Name | X (ft) | Y (ft) |
|---|---|---|
| □ Mtn Peak Well | 0 | 0 |
| ○ Spring-Fed Pond | 700 | 0 |
| △ Upper Wetted Channel | 900 | 0 |

SOLUTION

Aquifer Model: Confined
Solution Method: Theis

T = 4100. $ft^2$/day
S = 0.0001
Kz/Kr = 1.
b = 200. ft


RCS

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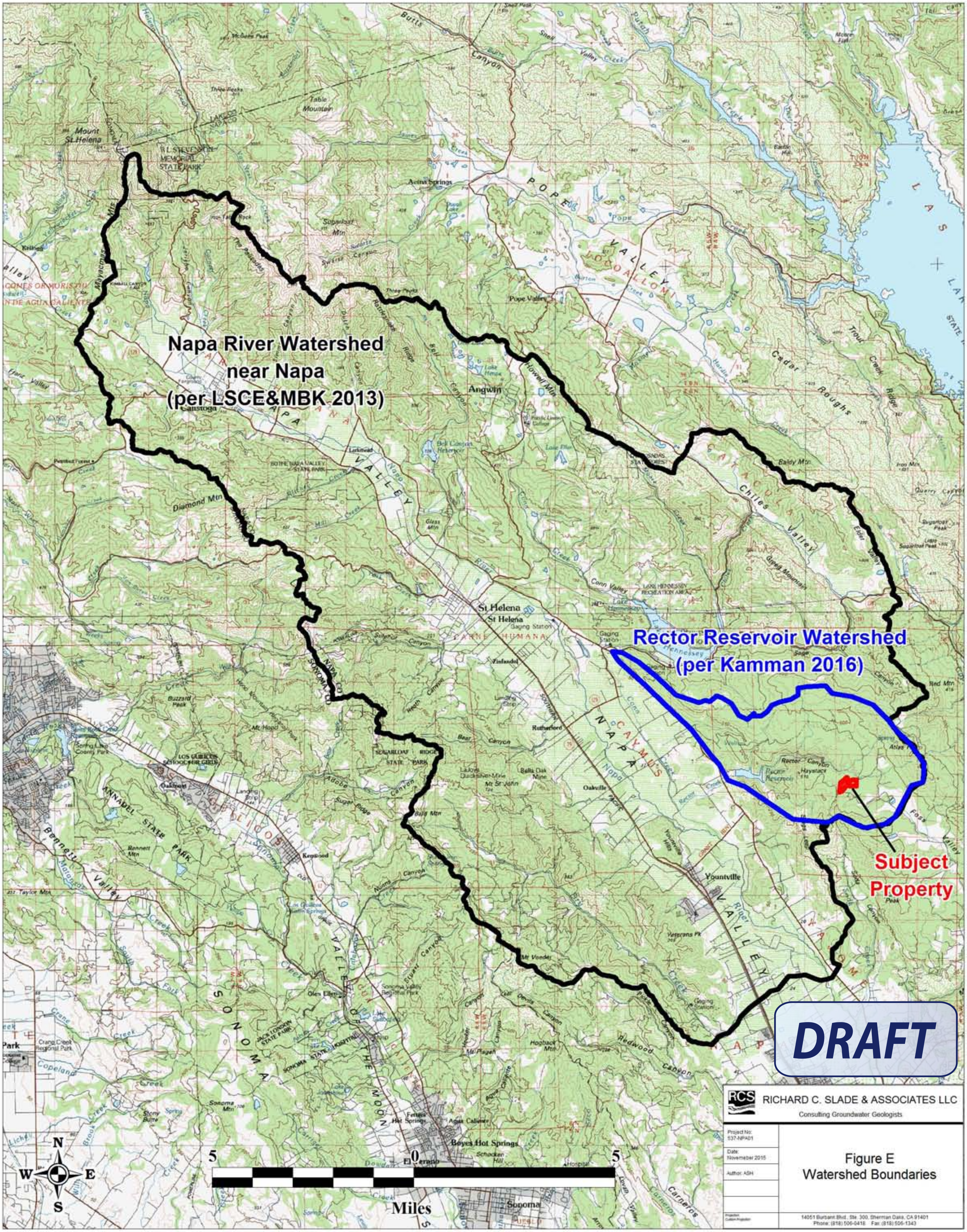
**FIGURE D**
**THEORETICAL WATER LEVEL DRAWDOWN CALCULATIONS**

**Job No. 537-NPA01** **November 2016**


Napa River Watershed
near Napa
(per LSCE&MBK 2013)
Rector Reservoir Watershed
(per Kamman 2016)
Subject
Property
DRAFT
RCS
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Consulting Groundwater Geologists
Figure E
Watershed Boundaries
5
0
5
Miles
N
S
E
W