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November 12, 2008

Ms. Kimberly Burr, Esquire
P.O. Box 1246
Forestville, CA 95436

Subject:: Technical Review of Henry Cornell Winery, 245 Wappo Road, Santa Rosa, CA
APN 028-260-041

Dear Ms. Burr:

I am a hydrologist with over twenty years of technical and consulting experience in the fields of geology and hydrology. I have a Master's of Science degree in Geology received from Miami University (Oxford, Ohio) in 1989 and I am a California Professional Geologist and Certified Hydrogeologist. I have been providing professional hydrology services in California since 1991 and routinely manage projects in the areas of surface- and groundwater hydrology, water supply, water quality assessments, water resources management, and geomorphology. Most of my work is located in the Coast Range watersheds of California, including the Northern San Francisco Bay Counties. My areas of expertise include: characterizing and modeling watershed-scale hydrologic and geomorphic processes; evaluating surface- and ground-water resources/quality and their interaction; assessing hydrologic, geomorphic, and water quality responses to land-use changes in watersheds and causes of stream channel instability; and designing and implementing field investigations characterizing surface and subsurface hydrologic and water quality conditions. I also teach an annual course on hydrology and geomorphology through the University of California Extension (Berkeley) and provide technical presentations and lectures to public/community and non-profit groups. I co-own and manage the hydrology and engineering consulting firm Kamman Hydrology & Engineering, Inc. in San Rafael, California (established in 1997).

I have reviewed the project's Mitigated Negative Declaration (Declaration) dated November 13, 2008 and many of the County staff reports, supporting technical reports and correspondence regarding the surface water and groundwater hydrology conditions at the project site. The focus of my review was to provide a technical assessment on the potential project-induced impacts on water resources and whether the Declaration and supporting materials adequately assess potential impacts. I also reviewed a number of additional hydrologic and meteorologic data sets, reports, and maps to substantiate the assumptions and values I use to evaluate potential impacts to water resources by project proponents.

Based on my review and technical experience within Sonoma County and the Northern San Francisco Bay area, it is my opinion that the Declaration does not fully or correctly characterize and quantify potential project-induced impacts to water resources and the project still poses potential adverse impacts to these and related resources. The rationale supporting my opinions are discussed in the following sections.

1.0 Uncharacterized Groundwater Aquifer Conditions

The project proponents have not adequately evaluated or ruled out the potential for adverse impacts on local groundwater and surface water resources due to proposed groundwater extractions from the Cornell wells or the combined effect of groundwater extractions from other vineyards and development planned on neighboring parcels. As described in the 2006 Todd report, the Cornell site is underlain by a variety of geologic formations, primarily the Franciscan Complex and Sonoma Volcanics. These deposits consist of a variety of rock types, including lava flows and ash deposits of varying composition, degree of cementation, fracture porosity and permeability. A geologic fault trending NE-SW also occurs within or immediately adjacent to the site, contributing to the complex juxtaposition of geologic units. These rocks are arranged in a complex fashion – any given unit may lack wide aerial continuity, lack consistent depth and some units may have lenticular geometry or have interfingering contacts with differing adjacent rock types. The primary permeability hosting groundwater movement through these rocks results from fractures in the relatively impermeable rock matrix. The complex transitions/boundaries between rock types also likely result in heterogenous water flow patterns through and between rock types.

Based on my experience in conducting hydrologic investigations at sites underlain by the Franciscan Complex and Sonoma Volcanics and published accounts of groundwater flow conditions in these rocks by others (USGS, 2003; Slade & Associates, 2001a and 2001b; Lamphier-Gregory, 2003), it is my opinion that the groundwater flow conditions (i.e., rates of flow, patterns of flow, contributing aquifer storage capacity) have not been sufficiently characterized at the Cornell site to make any definitive statements as to whether the project will or will not adversely impact surrounding wells, seeps, springs, or other consumptive users.

One concern I have regarding the proponents characterization of groundwater conditions is that the simplified and empirically-derived analytical relationships that were used to calculate aquifer transmissivity and storativity (see pages 11 and 12; Todd, 2006) are premised on a long-list of governing assumptions, which are compromised, if not entirely invalidated, when applied to a non-homogeneous aquifer of limited lateral dimensions and not displaying similar hydraulic properties in all directions (e.g., bedrock fracture-dominated and many volcanic-derived aquifer systems). It is not unreasonable to expect that the zone of influence from a pumping well in a fractured bedrock aquifer, with preferred flow directions possibly influenced and enhanced by the alignment of a contributing fault zone, would extend for notable distances beyond what would be estimated for a homogeneous and laterally extensive aquifer. Because of this possibility and the fact that the local fault bisects both the North and South Watershed Creeks, it is not unreasonable to assume that there is a direct connection between the groundwater system underlying the project site and adjacent creeks.

As described above, aquifers within the Franciscan Complex and Sonoma Volcanics are typically heterogeneous in nature. The best and most appropriate method for determining groundwater flow and storage characteristics in fractured bedrock aquifers like those that exist under the Cornell site is to perform an aquifer test, where a well is pumped in a controlled fashion for an extended period and adjacent wells and water bodies (e.g., Mark West Creek) are monitored for a response (Driscoll, 1986). The California DWR also specifically recommends an aquifer (pump) test as part of the Cornell project impact assessment and further describe the procedure (DWR, 2005). If performed correctly, an aquifer pumping test can quantify the optimum well pumping rate from the aquifer as well as a storage estimate for the aquifer and radius of influence - parameters that are needed to determine the safe yield from an aquifer and potential impacts on the surrounding users and environment. Therefore, it is my opinion that an aquifer pump test is required to adequately evaluate potential impacts from Cornell groundwater withdrawls on local area water resources, and in turn, ecological conditions sustained by dry-season, groundwater-fed baseflow in the Northern and Southern drainage area creeks.

2.0 Inadequate Impact Evaluation on Mark West Creek

The project proponents evaluation of potential project impacts on Mark West Creek is misleading and inappropriate in that it does not address the watershed within, adjacent to, or even within approximately 17 river miles of the project. The amount of consumptive water use by the winery (estimated at about 2.0-AFY) has been compared to creek flows measured and estimated for a USGS stream gauge located at Highway 101 or approximately 17-miles downstream of the project site. No evaluation of potential impacts to creek flows and ecological conditions within the North and South Watersheds was completed nor the mainstem creek reach immediately downstream of the North and South Watersheds. Any impacts to water resources and the environment associated with the project will be greatest and most significant within and immediately adjacent to the site - not a location 17-miles downstream and having an intervening drainage area of approximately 40-square miles. Thus, the contention that project water usage is a small percentage of Mark West Creek flow is misleading and inaccurate conclusion.

I've reviewed available USGS stream flow records for gauged watersheds to the Russian River which display similar rainfall and runoff characteristics to the North and South Watersheds. I've also reviewed CDFG Stream Survey reports for the summers of 1965, 1969, 1979 and 1996. In addition, I completed a field reconnaissance on November 10, 2008 and observed dry conditions on the lower North Watershed creek and very low flows on the South Watershed creek adjacent to project parcels. Based on these data and observations, flows in the North Watershed creek typically go dry by late summer and very low summer perennial flows (0.6 to 2-cubic feet per second [cfs]) are maintained in the lower portion of the South Watershed creek and mainstem below the confluence of the North and South Watersheds. These flows are significantly lower than the Mark West Creek flows (dry year flow of 17,600 AFY [equivalent dry year flow rate of 24.3 cfs] and average water year-type flow of 42,671-AFY [equivalent average year flow rate of 58.9 cfs]) used by project proponents to evaluate project-induced impacts on Mark West Creek. It is also important to point out that dry-season baseflows in the North and South Watershed creeks are sustained by groundwater contributions and groundwater pumping during the summer and fall months will have the potential to significantly impact (i.e. reduce) creek baseflows that support aquatic organisms and riparian vegetation.

Using data provided in Todd's 2006 report, I've estimated the groundwater pumping rates for the overlapping the 45-day crush/processing period and 120-day irrigation season. When both of these activities are occurring under the Phase 1 project conditions, I estimate average groundwater pumping rates to be 7.7 gpm, increasing to 8.4 gpm under Phase 2 project conditions. Todd (2006) reports maximum groundwater pumping rates of 15 gpm are possible during this period. These pumping rates are not small or insignificant in comparison to dry season creek flow, but actually reflect a relatively large, if not entire (100%), percentage of the dry season creek flow. Thus, the potential certainly does exist for the Cornell project to impart significantly adverse reductions in creek summer base flow and, in turn, impacts to creek ecology within and downstream of the confluence of the North and South Watersheds.

3.0 Incorrect Water Budget Assessment

The quantification of potential adverse project impacts on water resources by the project proponents relies substantially on the water budget prepared by Todd (2006). It is my opinion that this water budget is flawed and the estimates on several water demand variables are significantly underestimated as described below. This results in overestimates of water availability for groundwater recharge and storage, leading to inaccurate conclusions (i.e., reduced threat) regarding potentially significant impacts. I also call into question two other items: 1) the estimate for project return flows, equal to approximately 2 AFY, a value that is unsubstantiated; and 2) the estimated water demand for bottling 10,000 and 20,000 cases of wine.

3.1 Unsubstantiated Return Flows

On pages 19 and 20 of the 2006 Todd report, an irrigation and septic tank return flow of 1.99 AFY is stated as a source of water inflow to the project water budget. This value is 50% of stated total groundwater demands for the project. There is no explanation of how this value was derived or justified. Assuming that the majority of this return flow is irrigation return flow, this value reflects a very poor irrigation efficiency. A notable reduction in project groundwater demand and potential stress on limited water resources could be realized by introducing better water conservation practices through improved irrigation efficiency. This would reduce the potential for project-induced impacts.

3.2 Bottling Water Demand

The proposed project indicates that it will support 20-acres of vineyard. Using data supplied in the April 13, 2008 Sonoma County Fact Sheet (www.SonomaCounty.com/media/press-releases/), a 20-acre vineyard will produce approximately 6600 cases on wine (3958 bottles per acre; 12 bottles per case). It is unclear why the project water demand is based on 10,000 and 20,000-cases of wine for Phase 1 and Phase 2, respectively. Unless the Cornell winery is anticipating importing additional grapes for production, the project could reduce groundwater pumping demands and potential impacts to local water resources if it only needs to process 20 acres of vineyard.

3.3 Evapotranspiration

The estimated water budget losses by evapotranspiration (ET) are significantly underestimated. In essence, Todd (2006) assumes that because monthly rainfall rates are greater than evapotranspiration rates during the months of October through March, they can discount water losses due to evapotranspiration during this period. This results in reducing an initial annual ET demand of 42.29-inches by 10.47 inches, yielding an annual ET total of 31.82. This assumption is incorrect because the process of evapotranspiration continues year-round including October through March. Todd's (2006) Figure 13 indicates that ET occurs during these periods. This error in the ET water demand overestimates the amount of water available to surface water runoff and groundwater recharge in the project Watersheds.

3.4 Stream Flow

Annual stream runoff estimates for the North and South Watersheds are stated to be 34-percent of annual rainfall while the runoff 17-miles downstream at the former USGS Highway 101 stream gauge is estimated at 50-percent of the annual rainfall. It is my opinion that the estimated annual runoff for the North and South Watersheds are significantly underestimated for the following reasons. First, a typical runoff phenomenon experienced in Northern California watersheds is that there is an increase in the runoff volume per unit area as one moves upstream or towards the headwater reaches. This pattern is reversed in Todd's estimates of runoff between the project and former USGS gauge drainage areas. The principal reason for the increase in runoff per unit area in the upstream direction is associated with increasing average slope of the contributing drainage area – increased slope promotes faster and increased runoff.

Another reason I feel the runoff volumes from the North and South Watersheds are underestimated comes from review of available annual rainfall and runoff figures for drainage areas within the Russian River basin as published by Rantz (1974) of the USGS (see Table 1, attached). This report indicates that with the exception of one basin, runoff from Russian River watersheds range from 41- to 74-percent of mean annual rainfall and from 51- to 63- percent of mean annual rainfall from headwater drainages similar in elevation, slope and meteorology to the North and South Watersheds (e.g., Big Sulphur, Dry and Mill Creeks). Based on these data, I estimate the annual creek runoff from the North and South Watershed to be around 55- to 60-percent of the mean annual rainfall. Similar to the inaccurate ET estimate, the low surface water runoff values used in the water budget lead to overestimates in the amount of water available to groundwater recharge and inaccurate conclusions (i.e., reduced threat) regarding potentially significant impacts.

4.0 Incomplete Analysis of Cumulative Impacts

The project proponents have not completed a full evaluation of the cumulative project impacts on water resources. An accurate existing conditions water budget has not yet been created; one that includes the water demands of the adjacent Pride Winery, located east of the Cornell project site and any other existing residential and agricultural entities within the North and South Watersheds. Only after all cumulative existing demands are incorporated into the existing water budget can an accurate assessment of Cornell project conditions be completed. Incorporating the demands and water withdrawals associated with the Pride Winery (e.g., vineyard irrigation demands for approximately 60-acres of vineyard as measured off of aerial images), will incorporate an estimated 10-AFY of additional irrigation demands not currently captured in the project impact assessment.

5.0 Groundwater Basin Overdraft

In order to better evaluate the current overdraft condition of the groundwater basin, the water budget will need to be revised and recalculated to incorporate more realistic ET and stream runoff variables. It will also need to incorporate demands and influences from the Pride Winery and other residents and agricultural operations within the affected watershed. It is our understanding that water is being trucked up to the Pride Winery alluding that the existing Pride wells and other supplies are currently insufficient to meet their existing needs. The degree to which this is associated with dry water year-type conditions or excessive demands should be assessed.

It's my sense that updating the water budget with more accurate ET and runoff estimates will lead to significantly greater cumulative water outflows than previously estimated. This will lead to significantly less water available to groundwater recharge, altering the relative proportion of project withdrawals to recharge and posing a greater potential project impact on groundwater resources. In addition to a refined water budget, a better estimate of aquifer storage will be needed to responsibly assess the state of groundwater overdraft within the basin. The only accurate method for determining the true aquifer storage is through completion of the aquifer test discussed under Section 1.0 above. These are all important and necessary analyses required to accurately evaluate if these potential impacts are significant or not.

In closing, its my opinion that the potential impacts to water resources in the North and South Watersheds have not been adequately assessed and there is a real potential for project-induced adverse impacts to water and other resources. Until these potential impacts are assessed, I recommend that the Sonoma County Permit and Resource Management Department reconsider authorizing a Mitigated Negative Declaration on the Cornell Winery project. At the very least, the County should require that the Cornell project proponents address the water resource assessment deficiencies outline in this letter prior to authorizing the project to proceed.

If you have any questions or concerns, please call me.

Sincerely,

Greg Kamman, P.G., R.HG.
Principal Hydrologist

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Russian River Basin	Drainage Area (mi2)	Mean Annual Precipitation (inches)	Mean Annual Runoff (inches)	Runoff / Precip (%)
Russian River drainage between gages near Cloverdale and near Healdsburg, but excluding gaged areas of Big Sulphur Creek, Maacama Creek, and Franz Creek	148.6	40	15.3	38
Russian River drainage between gages near Healdsburg and near Guerneville, but excluding gaged areas of Dry Creek, Mill Creek, and Santa Rosa Creek	361	35	18	51
Cummisky Creek near Cloverdale	13.4	39	22.2	57
Big Sulphur Creek near Cloverdale	82.3	48	30.1	63
Maacama Creek near Kellogg	43.4	58	23.7	41
Franz Creek near Kellogg	15.7	40	18.9	47
Dry Creek near Cloverdale	87.8	47	24.1	51
Warm Spring Creek at Skaggs Springs	32.7	50	30.5	61
Dry Creek drainage between gages near Cloverdale and near Geyserville, but excluding gaged area of Warm Spring Creek	41.5	46	23.4	51
Mill Creek near Healdsburg	11.5	50	26.6	53
Santa Rosa Creek near Santa Rosa	12.5	36	18.7	52
Big Austin Creek at Cazadero	26.6	65	47.8	74
Austin Creek near Cazadero, but excluding gaged area of Big Austin Creek	36.5	59	32	54

Table 1. Mean annual precipitation and runoff for watersheds to the Russian River (Rantz, 1974).