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April 23, 2009
Project No. 3014.033

County of San Luis Obispo
Department of Planning & Building
County Government Center, Room 200
San Luis Obispo, California 93408

Attention: Mr. Brian Pedrotti

Subject: Hydrogeologic Peer Review
Water Resources Section of the Draft Environmental Impact Report
Laetitia Agricultural Cluster Subdivision, Tentative Tract Map and Conditional Use Permit, SCH No. 2005041094

Dear Mr. Pedrotti:

In accordance with our proposal dated January 12, 2009, and County of San Luis Obispo (County) Purchase Order No. 25005028 dated March 18, 2009, we have completed a peer review of hydrogeologic information provided to us by the County and the firm of SWCA related to the proposed project. The purpose of this study is to provide a peer review of the technical reports and analyses of the water supply reports prepared by Cleath and Associates (Cleath) in support of the proposed Laetitia Agricultural Cluster Subdivision. The results of the Cleath reports are generally described in the project Draft Environmental Impact Report (DEIR) prepared by SWCA.

The focus of the hydrogeologic peer review was on data and conclusions contained in reports prepared by Cleath. These reports, and other relevant information that we were provided for the purposes of the peer review, are listed as follows (the numbers assigned to these references will be referred to throughout the following peer review analysis):

1. Water Supply Assessment for Laetitia Vineyard and Winery, Arroyo Grande, California. Cleath & Associates, January 27, 2004.
2. Water Resources Studies for Laetitia Vineyard Property, Arroyo Grande, San Luis Obispo County. Cleath & Associates, October 6, 2005.
3. Revised Water Demand and Source Capacity for Laetitia Agricultural Cluster, San Luis Obispo County. Cleath & Associates, October 6, 2005.
4. Additional Water Resource Development, Laetitia Vineyard and Winery, Arroyo Grande, California. Cleath & Associates, October 6, 2005.
5. Response to County Comments on Water Resources, Laetitia Agricultural Cluster EIR, Arroyo Grande, San Luis Obispo County. Cleath & Associates, March 28, 2008.

6. Draft Environmental Impact Report, Laetitia Agricultural Cluster Subdivision, Morro Group/SWAC. September 2008.

7. Mitigation of Stream Flow Impacts, Laetitia Agricultural Cluster, Arroyo Grande, San Luis Obispo County, Cleath & Associates. November 4, 2008.

8. Laetitia Mitigated Plan, Description of Proposed Mitigations in Response to September 2008 DEIR & Acceptability of Mitigation Measures, RRM Design Group. November 6, 2008.

9. Pertinent water resource comment letters received on the DEIR. Compiled and provided to Fugro by SWCA. Transmittal letter dated December 29, 2008.

10. Water Resources Advisory Committee, Agenda Item 5, Laetitia Ranch Development DEIR. Mr. Sylas Cranor, March 4, 2009.

Proposed Project Description

The proposed project, as described in the DEIR prepared by SWCA, consists of the subdivision of 21 parcels of approximately 1,910 acres into 106 lots, including 102 residential lots of one acre each in size, four open-space lots of some 1,787 acres, and approximately 25 acres of internal residential roads. Approximately 113 acres of existing vineyards would be removed and approximately 140 acres of vineyards replanted. The open space lots would include a HOA facility, recreation center, and a community center. As described in the Draft Environmental Impact Report (DEIR) prepared by SWCA, (September 2009) the project would be developed in three phases. Infrastructure to support the development would include construction of a wastewater treatment plant, wastewater storage ponds, a wastewater irrigation system, various potable and non-potable water lines, water storage, the drilling of two new water wells, and other amenities. The water resources sections of the DEIR were derived from reports prepared by Cleath as referenced above. The DEIR cites a project water demand for the proposed project at build-out of 168.6 acre-feet per year (AFY), including a 10 percent water reserve, and also a reasonable "worst-case" analysis approach during a 3-year drought of 175.3 AFY. Water supply to meet this estimated demand(s) is proposed to be obtained from four wells, two of which produce from fractured shale of the Monterey Formation, and two producing from resistant volcanic tuff units of the Obispo Formation. The sustainable, long-term supply from these four wells, based on 41-hour to 72-hour discharge pump tests performed by Cleath at the time of construction and an analysis of aquifer storage and annual yield, was estimated at 197 AFY.

The project's water demand estimate and methodology associated with the annual yield of the aquifer (and wells) sustainable supply contained in the DEIR received a number of comments, prompting this hydrogeologic peer review. In particular, there were global concerns about the impact assessment issues, standards of analysis, thresholds of significance, proposed mitigations, and Cleath's conclusions relative to sustainability of supply and offsite impacts. The CEQA guidelines relative to thresholds of significance states that project specific impacts would occur 1) if the project substantially depletes groundwater supplies or interferes substantially with groundwater recharge such that there would be a net deficit in aquifer volume or a lowering of the groundwater table and, 2) if the project does not have sufficient supplies available to serve the proposed project from existing resources.

General Remarks Regarding Groundwater Demand Analysis

Relative to project water demand, Cleath provides several estimates. Water demand estimates and sources of water supply for the existing Laetitia winery and related improvements are described in Reference #1 dating from January 2004. The capacity of the various water supply wells were described, as well as the general water system, storage reservoirs, and the typical irrigation practices of the existing vineyards. Applied irrigation water volumes for various vineyard blocks are presented. The report does not describe the proposed agricultural cluster project and accordingly there are no water demand estimates for the project.

Reference #3 dating from October 2005 presents a water demand analysis for the Laetitia Agricultural Cluster. The residential, equestrian center, Ranch Headquarters HOA, and landscape buffer area project elements are briefly described. Water demand for the proposed project is estimated at an average of 119.6 AFY at project build-out. A residential water demand of 1.12 AFY per lot (102 lots proposed) was estimated by Cleath, based on a comparison of similarly sized estate lots in Santa Barbara and SLO County. No discussion of return water flow reductions to offset the average annual estimated project demand is presented.

The next project demand estimates are contained in Reference #5 prepared by Cleath dating from March 2008. This letter appears to be a (ADEIR) response letter to a number of County of SLO comments on the Laetitia Agricultural Cluster EIR directed to the Morro Group, who were preparing the project EIR. Relative to residential indoor and outdoor water use, Cleath cites a revised water demand estimate of 1.26 AFY. A discussion is also provided of offsets to project water demands related to the return of produced water to groundwater. A table is provided that assumes 90 percent of indoor use and 20 percent of outdoor use, totaling 56.3 AFY, is returned to the aquifer through return flow. The total project demand is estimated by Cleath to be 86.7 AFY. The technical analysis and basis for how the return flow estimate is determined is not provided, nor is the manner in which the "return flow" would benefit either the project's groundwater supply or the Santa Maria basin (i.e., the downstream users).

The water demand figures in the September 2008 DEIR (Reference #6) reflect three estimates, including:

- A "Proposed Project Estimated Demand" of 132.6 AFY based on water duty factors provided in Cleath's October 2005 report (Reference #3);
- A "CWMP Estimated Demand" of 168.6 AFY based on water duty factors from the 1998 County of San Luis Obispo Water Master Plan, and;
- A "Woodlands Estimated Demand" of 175.3 AFY based on "reasonable worst-case" water duty factors from the Woodlands Specific Plan EIR (1998).

Subsequent to the publication of the DEIR, Cleath revised the project water demand estimates in a November 4, 2008 letter (Reference #7) that addresses the mitigation of stream flow impacts. The Cleath November 2008 report describes an estimated project total water demand of 73.7 AFY (reduced from 143 AFY). A revised spreadsheet of the return flow estimates are provided, again with no supporting technical basis, which estimates the project's consumptive water use at 33 AFY, based on return flows of 40.7 AFY.

A summary of the various water demand estimates is provided in Table 1 – Summary of Water Demand Estimates.

Table 1. Summary of Water Demand Estimates

Date	Reference	Total Water Demand (AFY)	Return Flow (AFY)	Net Consumptive Water Demand (AFY)
October 2005	#3	119.6	--	--
March 2008	#5	142.9	56.3	86.7
September 2008	#6	Proposed Project – 132.6 Co. Water Master Plan – 168.6 Woodlands "Worst-Case" – 175.3		
November 2008	#7	73.7	40.7	33

General Remarks Regarding Groundwater Supply Analysis

The proposed water supply for the development is discussed in the October 6, 2005 report prepared by Cleath (Reference #4). In that report information is provided on the geologic setting of the project area, the design and capacity of the four water supply wells proposed to be used, the estimated volume of groundwater in storage in the bedrock aquifers from which the wells produce, and a discussion of aquifer recharge and yield.

A summary of project water well information including design, producing aquifer, and pumping test data as presented in the October 6, 2005 report is provided in Table 2 - Summary of Project Well Data. A discussion of the pumping test data for each well is also provided.

Table 2. Summary of Project Well Data

Well Name	Producing Aquifer	Well Depth (feet)	Perforated Interval (feet below ground surface)	Estimated Annual Yield (AFY)	Pump Test Yield (gpm)	Anticipated Pumping Level (ft below ground)	Stable Pumping Level Achieved during Pumping Test?	Observed Recovery	Boundary Condition Encountered during Pumping Test
2004-1 (13)	Monterey Shale/Chert	560	220-340 370-560	63	200	210	No	Incomplete	Yes at 600 minutes
2004-2 (12)	Monterey Shale/Chert	510	190-320 370-510	58	100	180	No	Incomplete	Yes at 1,200 minutes
2004-3 (10)	Obispo Tuff	330	150-240 280-330	34	ND	140	No	Incomplete	Yes
2005-1 (11)	Obispo Tuff	305	115-305	42	190	135	No	Incomplete	Yes at 1,000 minutes

Well 2004-1. The constant-rate pumping test for Laetitia Well 2004-1 was conducted at an average pumping rate of 200 gallons per minute (gpm) for a duration of 2,680 minutes. The data provided in Appendix C of the Cleath report (Reference #4) shows a calculated transmissivity (T) value of 24,000 gallons per day per foot of aquifer (gpd/ft). However, the actual T value should be 2,400 gpd/ft; a typographical error was apparently made by adding an extra zero to the calculation results. The resulting hydraulic conductivity (K) value based upon 310 feet of screened zone is 1.0 feet/day. As indicated on the pumping test plot, a discharge boundary condition was encountered approximately 600 to 700 minutes into the pumping test. The discharge boundary condition suggests the well is pumping from an aquifer of limited areal extent.

The recovery test was of insufficient duration (420 minutes) to draw definitive conclusions; however, a projection of the rate of recovery using available data suggests the well would be far short of complete recovery at a recovery time equivalent to the pumping time. Projection of the slope of the late-time recovery data suggests the water level in the well would be about 30 feet below the static water level of 121 feet at a recovery time (2,680 minutes) equivalent to the pumping time. This amount of recovery equates to about 70 percent of the total drawdown. The insufficient recovery demonstrated by this well test indicates over-pumping or mining of the aquifer and is typical of a well encountering a discharge boundary condition during pumping and/or too high of a pumping rate, and typically would lead to a significant down-grade in its sustainable long-term pumping rate.

Well 2004-2. The static water level prior to start of the step-drawdown test on December 26, 2004 was 45.5 feet. It is noted that the range of step-drawdown pumping rates (100 to 225 gpm) severely overstressed the aquifer and resulted in a final pumping water level of 320 feet. Water level recovery from the step-drawdown test was far from complete by the onset of the constant-rate pumping test on December 27, 2004, when a standing water level of 102 feet was measured (from an original standing level of 45.5 feet). It should be noted that any interpretation of the constant-rate pumping test data, such as described below, is compromised by the fact that constant-rate pumping was superimposed on ongoing recovery from the step-drawdown test.

The constant-rate pumping test for Laetitia Well 2004-2 was conducted at an average pumping rate of 100 gpm for a duration of 4,230 minutes (almost three days). The results in Appendix C of the Cleath report (Reference #4) show a calculated T value of 1,200 gpd/ft, which is equivalent to a K value of 0.6 feet/day based upon the 270 feet of screened zone. The pumping rate throughout the test was erratic, which makes interpretation of the data difficult. As was the case with Well 2004-1, interpretation of the data indicates the presence of a discharge boundary condition (at about 3,000 minutes of pumping) that is indicative of an aquifer of limited areal extent.

The constant-rate test recovery data are of insufficient duration (230 minutes) to draw definitive conclusions. In addition, the constant-rate test recovery is superimposed on the ongoing step-test drawdown recovery. Projection of the slope of the late-time recovery data suggests the water level in the well would be about 40 feet below the static water level of 45.5 feet at a recovery time equivalent to the pumping time (4,230 minutes). This amount of recovery amounts to less than 70 percent of the total drawdown from the step and constant rate pumping tests. The insufficient recovery demonstrated by this well test is typical of a well encountering a discharge boundary condition during pumping, and typically would lead to a significant down-grade in its sustainable long-term pumping rate.

Well 2004-3. The pumping test for Laetitia Well 2004-3 was conducted for about three days (4,350 minutes) and was not a constant rate test. The pumping rate apparently had to be reduced several times from an initial rate of 530 gpm to 200 gpm due to severe declines in the pumping water level, yet the time-drawdown data slope remained fairly constant. Thus, it is not possible to neither calculate T and K values for this test nor evaluate boundary conditions. The anticipated well yield would be far less than the lowest pumping rate used in this test (200 gpm) due to the continuing steep decline in water levels at the lowest pumping rate utilized for the test.

Recovery data of greater duration (12,830 minutes) were collected for this test, but again aquifer parameter interpretation is difficult due to the nature of the drawdown portion of the test. It is important to note that the recovery of water levels after a recovery time equal to the pumping time (4,350 minutes) is still 35 feet short of the static water level, which equates to only 33 percent of the total drawdown. This severe lack of sufficient recovery from the pumping test again indicates that a relatively low long-term pumping rate should be assigned to this well.

Well 2005-1. The constant-rate pumping test at Laetitia Well 2005-1 was conducted at an average pumping rate of 190 gpm for 4,320 minutes (3 days). It is noted that the pumping rate varied from 200 to 240 gpm in the initial 30 minutes of pumping, then gradually declined to a final pumping rate of 185 gpm for the final hour of pumping. The time-drawdown data show multiple and increasingly steeper rates of water level decline over time, indicating the presence of discharge boundary conditions and also possibly resulting from the decline of the water level into the screen interval. Calculation of aquifer parameters is uncertain due to the lack of a stable time-drawdown slope; however, the calculated T value of 4,800 gpd/ft would correspond to a K value of 3.4 feet/day if assumed to be valid.

Recovery data were collected for an insufficient duration (1,260 minutes), but indicate that recovery would be about 70 percent of total drawdown after an equivalent recovery time (4,320 minutes). This lack of complete recovery again is often associated with a well that was pumped at too high of a pumping rate and/or encountered discharge boundary conditions during pumping.

Aquifer Storage and Recharge. Relative to water level data, aquifer storage, and recharge Cleath concludes that water levels would be lowered at each of the wells and that recharge would be induced from Los Berros Creek to the wells if the project were developed using the proposed water supply wells. During periods of no surface flow in the creeks (Los Berros and Adobe Creek) there would be depletion of groundwater in storage in the alluvial aquifers.

Groundwater in storage within the bedrock aquifers was grossly estimated by Cleath by using the static water level data for each well in late 2004, the well depth, the inferred reservoir (aquifer) length, and an assumed specific yield (essentially the porosity of the fractured bedrock). The aquifer storage volume was appropriately reduced to the saturated volume available using the static water level as measured in late 2004 to the top of the perforations. The resultant volume estimates for groundwater in storage for each well as calculated by Cleath are provided in Table 3 - Estimated Aquifer Storage Volumes

Table 3. Estimated Aquifer Storage Volumes

Well Name	Total Estimated Storage (AF)	Available Storage Volume (AF)
2004-1	510	110
2004-2	460	140
2004-3	235	70
2005-1	260	55

It should be understood that the estimated available volumes of groundwater to each well as suggested above are very approximate and assume the aquifers(s) release groundwater in storage to each well uniformly. The pumping test data, however, show pronounced aquifer boundary conditions within the cone of influence of each well, given the inclined, linear nature and degree of fracturing of the aquifers. This is supported by the inability of the wells to either sustain a constant rate of discharge during the pumping tests and/or a need to reduce the rate of discharge during the pump tests to keep the pumping water level from dropping below the top of perforated well screen interval. Moreover, relative to the anticipated annual yield from each well (refer to Table 2) as advanced by Cleath, the storage volumes are quite low and provide a limited factor of safety of anticipated demand versus supply from each well given the uncertainty in the storage volume estimates.

Recharge to the bedrock aquifers from which the wells produce is inferred by Cleath (Reference #4) to derive from Los Berros Creek, Adobe Creek, and percolation of precipitation. While various stream flow records dating from the early 1980s are discussed, the conclusion is advanced that stream flow recharge to the aquifers must be occurring since the number of days of stream flow (in Los Berros Creek) has declined in recent years. Annual recharge to each well by stream flow recharge is estimated by the number of days of current stream flow, the geometry of the aquifer under the creek that can receive recharge and a hydraulic conductivity value obtained from the pumping tests. Cleath (Reference #4) provides a summary table of expected recharge to each well during a 2-year drought, to which a nominal value of recharge by precipitation is added. The estimated amount of annual recharge during a 2-year drought, as calculated by Cleath, is shown in Table 4 – Calculated Recharge to Aquifers.

Table 4. Calculated Recharge to Aquifers

Well Name	Total Annual Recharge (AFY)
2004-1	26
2004-2	11
2004-3	11
2005-1	24

Relative to the anticipated demands from each well (Table 2) and the estimated available storage (Table 3), the project water supply from the four wells is considered limited not only in actual amounts but the uncertainty associated with the estimates.

Aquifer Yield. The definition of aquifer yield as presented in the DEIR is the volume of water that can be pumped from each aquifer during drought conditions without depleting groundwater in storage in the aquifer. However, Cleath (Reference #4) suggests that a certain volume of the groundwater in storage (Table 3, above), coupled with the annual recharge estimates (Table 4, above), can be combined to estimate the annual yield of each well. The estimates of aquifer and well yield, as calculated by Cleath, are shown in Table 5 – Estimated Aquifer Yield.

Table 5. Estimated Aquifer Yield

Well Name	Available Storage (AF)	Total Annual Recharge (AFY)	Estimated Annual Yield (AFY)
2004-1	110	26	63
2004-2	140	11	58
2004-3	70	11	34
2005-1	55	24	42
		Total Aquifer Yield	197

Peer Review Comments

Water Demand. Relative to the estimates of project water demand there have been several iterations, the most recent occurring in a letter prepared by Cleath in November 2008 (Reference #7) suggesting the project water demand to be 73 AFY, with a net consumptive demand of 33 AFY. This estimate however was provided after the circulation of the DEIR, and the suggested methods to reduce demand are not included in the project description. For purposes of comparison to water supply, we believe the water duty factors presented in the DEIR (Table V.B-3) are appropriate. A worst-case total project water demand estimate on the order of 168.6 AFY to 175.3 AFY is considered reasonable. However, given the size of the project and the range of water demand estimates, the limited available water supply, and the very small margin between demand and supply, we recommend that a detailed water demand analysis be conducted. In addition, if credit for return flows to the aquifer is proposed that would result in a net consumptive demand estimate, the nexus between the return volume and benefit to the aquifer should be demonstrated.

Well Yield. Relative to a review of the pumping test data we believe in all cases the pumping rates of the wells during the tests were too high. The inability to maintain constant pumping rates and the general decline of pumping rates throughout the tests makes the resulting interpretation of the time-drawdown data questionable. Discharge boundary conditions were encountered in all of the pumping tests, which have significant implications relative to assigning long-term well yields and to a credible interpretation of aquifer extent and yield. In most cases, the recovery data collection period was insufficient but nonetheless demonstrated aquifer storage depletion over a relatively short period of time related to the pumping stress. The amount of recovery data collected at three of the four wells was insufficient. The duration of recovery measurements should be at least equal to the length of the pumping period.

Based on the limitations associated with the pumping test data, we suggest a pumping test program be developed in which the tests be performed at lower pumping rates (50 gpm maximum) for longer durations (10 to 20 days) to determine the long-term viability of each well. The pumping rates must be held constant and not allowed to decrease over time; hence the need for a sufficiently low enough pumping rate at the start of the test. Recovery data should be collected for a length of time equal to the pumping period. Long-term well yields should be assigned only after careful consideration of longer-term pumping and recovery tests, with careful consideration of discharge boundary conditions and recovery data.

Aquifer Storage and Yield. Depending on the outcome of the suggested retesting of the wells we are concerned that insufficient data exist to reasonably estimate aquifer storage volumes and perform a credible water balance and estimate annual recharge amounts. Since limited to no history of water level data exist for the aquifers proposed to be used, the estimates of creek recharge can be considered gross estimates. The creek recharge amounts suggested by Cleath are in part based on the assigned hydraulic conductivity values of the fractured bedrock aquifers. As indicated in this review, the pump test data may overstate these values considerably, and hence the estimated recharge amounts.

It should be noted also that the annual recharge estimates provided by Cleath are misleading in that they imply a component of available aquifer storage as recharge during a critical drought. The volume of groundwater in storage is very small given the limited extent of the bedrock aquifers and that amount cannot be used as a component of sustainable supply. It is simply a reservoir of available water to buffer periods of deficient recharge. Based on the data presented in the Cleath reports and the DEIR, it is our opinion that the annual recharge estimates to the wells provided by Cleath (derived essentially all from creek recharge) are significantly less than the long term project demand estimate.

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If you have any questions, please do not hesitate to call us.

Sincerely,

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