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July 27, 2009

Mr. Allen Robertson
California Department of Forestry and Fire Protection
P.O. Box 94426
Sacramento, California 94244-2460
SacramentoPublicComment@fire.ca.gov

Subject: Fairfax Conversion Project Environmental Impact Report (SCH# 2004082094)

Dear Mr. Robertson:

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 been actively working the Gualala River watershed since 2002 for the Sotoyome RCD, the California Coastal Conservancy and local watershed groups. Projects have included:

- Lead hydrologist/geomorphologist and editor of Gualala Estuary and Lower River Enhancement Plan, 2005 on behalf of RCD and Conservancy.
- Summer baseflow monitoring (2004) on North Fork Gualala River on behalf of Conservancy.
- Comments on Artesa Vineyards THP/TCP Negative Declaration, No. 1-01-171SON (2003).
- Comments on Sleepy Hollow (Martin) THP/TCP Negative Declaration, No. 1-04-059SON and 04-531 (2004).
- Comments on Roessler/Zapar Inc. THP/TCP Negative Declaration, No. 1-04-055SON and 04-533 (2004).
- Comments on Sonoma County Gualala River Revised Mining Standards Negative Declaration, File No. UPE04-0040 (2007).

I have reviewed the Fairfax Conversion Project Draft Environmental Impact Report and most of the supporting technical appendices (hereafter referred to in its entirety as DEIR). The focus of my review was to provide a technical assessment on the potential project-induced impacts on water resources and water quality and whether the DEIR adequately assesses potential impacts. Based on my review and technical experience within Sonoma County and the Northern San Francisco Bay area, it is my opinion that the DEIR does not fully or correctly characterize and quantify potential project-induced impacts to water resources and the project still poses potential significant impacts to these and related resources. The rationale supporting my opinions is discussed in the following sections.

1.0 Failure to Evaluate Project Water Availability and Well Pumping Impacts in Accordance with State Law and County Policy

The DEIR fails to evaluate and address potential significant (cumulative and indirect) impacts to groundwater resources. Water resource investigations for projects in Sonoma County must be performed by properly licensed professionals and must conform to requirements prepared by the California Mining and Geology Board, the California Board of Registration for Geologists and Geophysicists and Sonoma County Permit and Resource Management Department. The following documents establish the minimum requirements for water availability investigations for projects in Sonoma County.

1. Guidelines for Groundwater Investigation Reports, by the Technical Advisory Committee to the California Board of Registration for Geologists and Geophysicists, adopted April 18, 1998.

2. Procedure for Implementing General Plan Policy Rc-3h, prepared by Sonoma County (Provided as Attachment A).

3. Well Pump Test Guidelines, in Water Scarce Areas, Sonoma County Permit and Resource Management Department Policy and procedure Number 9-2-28, effective July 1, 2005 (Provided as Attachment B)

4. Sonoma County General Plan Policy WR-2e (formerly RC-3h), adopted 2009.

The DEIR and supporting technical appendices fail to follow the required investigative procedures for water availability investigations as specified in the references listed above. For example, the project site is located within a Class 3 groundwater availability classification (water scarce area) pursuant to the Sonoma County General Plan. County Policy WR-2e (formerly Policy RC-3h) states:

> *Require proof of groundwater with a sufficient yield and quality to support proposed uses in Class 3 and 4 water areas. Require test wells or the establishment of community water systems in Class 4 water areas. Test wells may be required in Class 3 areas. Deny discretionary applications in Class 3 and 4 areas unless a hydrogeologic report establishes that groundwater quality and quantity are adequate and will not be adversely impacted by the cumulative amount of development and uses allowed in the area, so that the proposed use will not cause or exacerbate an overdraft condition in a groundwater*

basin or subbasin. Procedures for proving adequate groundwater should consider groundwater overdraft, land subsidence, saltwater intrusion, and the expense of such study in relation to the water needs of the project.

The DEIR and technical studies fail to satisfy the hydrogeologic analysis and report requirements stipulated above and, in turn, have failed to evaluate potential significant impacts on groundwater resources. For example, reports do not document attempts to learn of well failures on unsuccessful attempt to develop water in the impact area. It does not appear that well drillers were contacted for groundwater information. Nor were local property owners asked about important well information (apart from location) such as depth, yield and water levels. A water balance is not provided pursuant to standard practice detailed in reference 1. above. The DEIR does not discuss current or projected (cumulative) quantities of groundwater pumped. No aquifer storage capacity is calculated, nor is there any discussion of aquifer tests. These documents fail to evaluate if project well pumping will interfere with surrounding wells or significantly deplete existing groundwater resources. In short, my review indicates that potential significant impacts from groundwater pumping and altered hydrology have not been evaluated in accordance with State laws, County policy or to the standards of care that govern the practice of geology and hydrogeology in State of California.

2.0 Acknowledged Failure to Evaluate Impacts within Entire Project Area

The DEIR fails to complete a sediment impact assessment or water budget assessment in project subareas that drain to Grasshopper or Little Creek. The DEIR authors assume that impacts in these areas, if any, would be insignificant. Failure to complete the analysis clearly indicates that potential significant impacts have not been evaluated and the DEIR is incomplete. It is important to also note that one of these unaddressed subareas will be where the "corporation yard" and groundwater well will be constructed – the details of which are both very sparse within the DEIR.

3.0 Project Violates Sonoma County Drainage and Stormwater Management Ordinance

As stated in the DEIR, Chapter 11 of the Sonoma County Code regulates all acts that obstruct or diminish free flow of floodwaters in channels or waterways within the county (Ordinance No. 4803 § 1 and 1994: Ord. No. 1108 § 15). A permit for any of the following acts is required: (a) Impair or impede or obstruct the natural flow of storm waters or other water running in a defined channel, natural or man-made, or cause or permit the obstruction of any such channel.

The DEIR is inaccurate in the assessment that the project will not impact Patchett Creek. The DEIR clearly states that the project will, "eliminate runoff to a 1,200-ft reach of Class III channel south of the proposed reservoir site" and "the reservoir collection system would also largely eliminate storm runoff delivered to two large gullies" (pg. 3.4-142). The potential significant impacts on existing ecological conditions in affected reaches are not addressed.

4.0 Increases in Peak Flow Runoff Pose a Significant Threat to Downstream Channel Erosion

The presentation and discussion of estimated project-induced increases in peak flows from the site is confusing and inconsistent from chapter to chapter. In some places, increases in peak flows are characterized as ranging from 2- to 5-percent (pg. 3.4-13 and 3.4-144), but these increases are representative of two off-site locations over 4800-feet downstream of the project boundary, where the DEIR acknowledges project impacts are muted due to accretionary flow contributions from the intervening drainage area. Peak flow increases for the 2-year storm for on-site subbasins are reported to range from 0- to 32-percent (pg. 3.7-62), with an aggregate increase from 7- to 10-perent, depending on the water level in the project reservoir. The DEIR water supply analysis indicates an 11-percent annual average increase in runoff (pg. 3.7-48). The DEIR also cites peak 2-year storm runoff increases observed at the Casper Creek watershed that ranged from 9- to 27-percent during wet antecedent conditions (under 50-perent to full harvest, respectively) and from 23- to 60-percent during dry antecedent soil moisture conditions. It's clear from this wide range of values, the project proponents don't really know what to expect in terms of peak flow increases.

The conclusion that project induced increases in peak flow on the order of 10-perent won't pose a real and potential threat of increased erosion in receiving channels is reckless and irresponsible. One needs to look no farther than the "extensive gullying" on the project site that developed in low gradient conditions in response to historic land-use and hydrologic changes. As a professional and experienced hydrologist, it is my opinion that the stated potential project-induced increase in peak flows imparts a potential significant impact to downstream receiving waters. Given the wide range of estimated potential peak flow increases and inherent uncertainty in the estimate, it would be prudent to assume a conservative analysis and anticipate the maximum estimated peak flow increases will lead to a potential significant impact. Albeit there are no current regulations limiting project-induced increases in peak flow runoff, it is accepted in the scientific community that even small incremental and associated incremental increases in storm runoff have caused and will continue to exacerbate erosion and sediment production in the Gualala River watershed. Although Sonoma County and the North Coast RWCB haven't developed hydrograph modification or hydromodification management plans or policies, the current professional standards for hydromodification[1] management plans (e.g., Alameda and Santa Clara Counties) stipulate no net increase in flood flow magnitude between pre- and post-project conditions.

5.0 Incomplete Project-Induced Erosion and Sedimentation Impact Assessments

The DEIR sediment yield assessments bias upland soil loss sources and don't completely account for potential increased erosion to downstream receiving channels (i.e. sediment contributions from channel erosion) in association with the increase in peak storm runoff magnitudes discussed above. The sediment yield analysis does not incorporate increases in sediment concentration associated with increased erosion potential of channels receiving project runoff and located immediately off-site and therefore underestimates

[1] Hydromodification is a change to the storm water runoff characteristics of a watershed caused by a change in land use.

total sediment yield delivered to downstream Class I streams. At best the DEIR assessment provides a qualitative assessment of downstream channel erosion which assumes channels will have a low to moderate sensitivity to erosion (pg. 3.7-66). However, no attempt to quantify or account for the project-induced increase in erosion or sediment yield from downstream receiving channels are captured in the sediment yield totals provided in the DEIR, which indicates a post-project decrease in sediment yield. Again, this is not a conservative assessment and provides an overly-optimistic future condition. In the absence of adequate hydrologic or geomorphic analyses, it is most responsible that findings regarding potential significant impacts be based on worst case assumptions.

Due to uncertainty in predicted channel response to increased peak flows, mitigation for potential future channel erosion impacts consists of a monitoring and adaptive management plan. Unfortunately, this plan only proposes to monitor on-site channel reaches over a limited period. The most likely places for project-induced accelerated channel erosion (significant impact) will occur to channels immediately off-site, receiving increased peak flows. Therefore, the monitoring plan needs to address these already erosion prone reaches and include mitigation measures for impacts. The plan should also stipulate and define thresholds of disturbance that will trigger erosion mitigation measures for on- and off-site reaches. If mitigation of erosion problems is precluded or not feasible due to property boundary, access and/or setback, the project is not feasible.

Post-construction monitoring is only stipulated to occur for the first year after project construction – but the DEIR fails to address how the plan will be implemented in response to project phasing. The channel monitoring plan is proposed for only three (3) years after project construction. Typically, the RWQCB requires a minimum of five (5) years of post-project geomorphic and sediment monitoring and my firm is currently involved in a project requiring twenty (20) years of monitoring. The rationale for a longer monitoring period is that significant peak flows may not occur over a 3-year period and would be missed by a 3-year monitoring program. For the Fairfax Conversion project, there is the question of how sustainable are the sediment reduction effects from the creation of on-site sediment detention basins. Once these basins are filled (a process that may require greater than 3-years), sediment will pass through them, increasing the potential for significant impacts (over time) to downstream reaches. A three year monitoring program likely won't capture these changes. This also raises the question of what is the long-term maintenance plan for sediment detention basins - will they be cleaned out on a routine basis? Who is responsible for ensuring their continued function and effectiveness? The DEIR should address these questions and should stipulate a longer, clearer and more concise monitoring and maintenance plan for on- and off-site sediment yield reduction measures.

6.0 Lack of Water Budget Assessment in Accord with Standard Methods

The DEIR does not provide a comprehensive water budget assessment per standard methods outlined under reference 1. above. Instead, the DEIR relies on simplified assumptions and comparisons to empirical data from a stated similar watershed. As a result, the potential significant impacts to groundwater and summer baseflow have not been evaluated. The DEIR states that the Casper Creek watershed is a valid comparison to the Fairfax Conversion site due to, "similar climate, soil and geology" (pg 3.7-28). However, the O'Connor Hydrologic analysis (Appendix M) states "There are some differences in geology, soils, topography and vegetation".

Regardless of the degree of similarities in watershed characteristics, every project site is unique and warrants an independent impact assessment pursuant to the mandated water budget methods taught to licensed geologic professionals in the State of California. Although the DEIR presents a lot of data and comparison between the Casper Creek and Patchett Creek watersheds under the heading of "Water Budget Analysis", a quantified water budget assessment pursuant to state guidelines has not been completed.

A water budget is needed to evaluate potential significant impacts to groundwater recharge, aquifer storage capacity, groundwater overdraft, impacts to surrounding wells and potential changes in summer baseflows. The DEIR addresses only average water year-type conditions. A thorough and proper water budget feasibility assessment should include an evaluation of dry, average and wet year-types in order to evaluate potential long-term impacts on irrigation water availability, groundwater recharge and summer base-flows. What happens to the project if there is a prolonged drought and no water available for irrigation? What if there is a hard frost and a need for frost protection arises? A water budget is the standard approach to quantify potential significant impacts to groundwater recharge and aquifer storage. Other important variables/processes that the DEIR fails to quantitatively address (these also reflect significant differences between the Fairfax Conversion and Casper Creek water budgets) are irrigation efficiency and installation of a subsurface drainage system. The DEIR indicates a project irrigation efficiency of 95-percent, meaning 95-percent of irrigation is consumptively used leaving only 5-perent to groundwater recharge or ET. The DEIR also implies that vineyard water demand will be greatest during the first three years of vine establishment, but on page 3.7-52, the DEIR states that the short-term vine establishment demand (100-gallons/vine) is the same as the long-term, dry-farming vineyard demand. This means that irrigation demands won't be reduced with time as implied in the document.

The DEIR also does not include an assessment of potential impacts from soil dewatering and reduced groundwater recharge associated with the "extensive drainage system" proposed for the project. The geotechnical investigation report (Appendix K) indicates that shallow groundwater was encountered within 2- to 3.5-feet of the ground surface in test pits and borings completed at the proposed reservoir and sump sites. The report also indicates that a subdrain system will be installed to dewater saturated soil under compacted soil or synthetic liners (i.e. area under reservoir). Designs provided in the report indicate that these drains will be installed to a minimum depth of 3-feet, and will effectively dewater the shallow groundwater system in this important aquifer recharge area. This poses a potential significant impact by reducing groundwater recharge as well as increasing surface drainage and erosion potential to receiving creeks. Again, two potential impacts the DEIR does not address.

7.0 Unclear Use and Impacts from Groundwater Withdrawals

The DEIR is inconsistent in the stated uses of water that will be pumped from the proposed project well. On page 3.7-16 it is stated that the water will be used for drinking. On another page, the well water is stipulated for "washing and other incidental uses (pg. 3.7-48). The DEIR does not present an acceptable analysis of potential impacts from groundwater pumping on local groundwater supplies. Groundwater overdraft is a real, if not existing, concern in the Ohlson Ranch Formation Highlands Groundwater Basin. The geologic and land-use setting of the Ohlson Ranch Formation is strikingly similar to the coastal Wilson Grove Formation located further south along the Sonoma Coast. Sonoma County has completed a pilot groundwater study[2] in the 9-mile square Joy Road Study Area overlying the Wilson Grove Formation (located west of Occidental) in an effort to address severe groundwater overdraft that has occurred due to residential and vineyard growth. The Annapolis area and underlying Ohlson Ranch aquifer are currently undergoing very similar growth and increased water demands - conditions that have led to the severe groundwater overdraft in the Joy Road Study Area.

Beneficial uses of groundwater in the basin not only arise out of human uses, but there are several spring/seep outfalls along the contact between the Ohlson Ranch and Franciscan Formations that supply water to receiving channels and support riparian vegetation and wildlife. The DEIR fails to evaluate how groundwater withdrawals will impact these ecological beneficial uses of groundwater.

8.0 No Cumulative Impact Assessment to Hydrology and Water Quality

The DEIR presents no impact assessment of cumulative existing and future hydrologic changes associated with other projects within the basin. The 2020 General Plan states that new vineyard development alone will increase over 124% along the Sonoma Coast by 2020 and favorable geologic and meteorologic conditions target the Annapolis area for this development. The DEIR simply presents a computation and argument that the project-induced increase in peak flow is very small and, by itself, won't lead to a significant downstream impact. There is no effort to characterize or quantify how the project impacts will affect the basin in combination with other increases in peak flow and water demands associated with other basin projects (e.g., housing, vineyard, roads, and forestry). The DEIR does not quantify project-specific impacts related to aquifer pumping and changes in local groundwater conditions and how, if any, well pumping will impact adjacent land-owners who also rely on groundwater supplies for domestic use.

In closing, it's my professional opinion that the potential significant impacts to water resources in association with the Fairfax Conversion Project have not been adequately or fully assessed and there is a real potential for project-induced significant impacts to water resources. One of my greatest concerns is the significant erosion potential and unquantified sediment yields from downstream channels receiving project-induced increased runoff from the site to an already sediment impaired watershed. Another concern is increased demand on a limited groundwater supply, with excessive withdrawals leading to overdraft (annual withdrawals exceeding annual supply). Until these potential impacts are assessed, I recommend that the CAL FIRE not approve the project THP or ratify the EIR as complete.

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[2] Kleinfelder, 2003, Pilot study of groundwater conditions in the Joy Road, Mark West Springs, and Bennett Valley Areas of Sonoma County, California. Prepared for Sonoma County Permit Resource Management Department, September, 46p.

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

Sincerely,

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

PROCEDURE FOR IMPLEMENTING GENERAL PLAN POLICY RC-3h

Policy RC-3h:

Require proof of adequate groundwater in Class III and IV water areas. Require test wells or the establishment of community water systems in Class IV water areas. Test wells may be required in Class III water areas. Deny discretionary applications unless a geologic report establishes that groundwater supplies are adequate and will not be adversely impacted by the cumulative amount of additional development. (page 217, Sonoma County General Plan)

Implementation Procedure:

1. This procedure applies to **discretionary** (e.g., subdivisions, use permits) and **not to ministerial** (e.g., building permits, septic system permits) projects.

2. The official maps for determining whether a site is in a Class I, II, III, or IV groundwater availability area are those in the General Plan Resource Conservation Element.

3. The requirements of the fourth sentence in RC-3h are: 1) adequate on-site groundwater supplies must be available for a proposed use, and, 2) the current and future usage of groundwater supplies in the project area will not likely affect or be affected by the project.

4. Evidence that the requirements of #2 above have been met must be provided to the decision-making body **prior to** its discretionary decision. To meet this requirement, a geologic report (see 6c. below) shall be prepared prior to the public hearing on the project. Test wells may be a **condition** of project approval in Class III water availability areas if there are substantial questions as to the availability of groundwater by the geologist's report. Test wells are required in Zone IV water areas by Sections 7-12 and 25-179 of the Sonoma County Code.

5. The determination whether or not cumulative impacts have been adequately addressed in the geologic report will be based upon joint review by the Registered Environmental Health Specialist (REHS) who responds to the project referral and the Planner, as part of preparing the project's Initial Study. If cumulative impacts of the mutually agreed upon impact area (see 6c.2) below) are not adequately addressed, the project would be inconsistent with the General Plan.

6. The procedure which is to be utilized for discretionary projects is similar to the Expanded Initial Study process presently in use for addressing geologic, noise, archaeology and other technical issues. This procedure is as follows:

    a. Initial Study will identify whether the project site is in a Class III or IV area;

    b. **In most cases,** the REHS referral will review the need for preparation of a geologic report to provide the information necessary to determine that there are adequate existing and future groundwater supplies both on-site and in the impact area. In some cases, staff may be able to make these findings using existing data on file, in which case a new geologic report will not be necessary;

c. The geologic report will meet the following guidelines:

1) The geologic report must be prepared by a registered geologist, a certified engineering geologist, or a certified hydrogeologist with expertise in groundwater geology;
2) The geologist preparing the geologic report will identify a cumulative impact area mutually agreed upon through reliance on his or her own expertise and on consultation with the REHS and the project Planner;
3) The report must identify and assess the geologic formations within the impact area;
4) The report must discuss the known well depth and yields and discuss any history of known well failures or unsuccessful attempts to develop water in the impact area;
5) The report must thoroughly reveal the level of effort expended in identifying existing and abandoned wells within the impact area. This may include review of records, interviews with well drillers and interviews with impact area property owners;
6) The report must discuss and project the continued availability of groundwater, including comments on recharge balance/rate and storage capacity within the impact area during drought conditions;
7) The report must come to a conclusion that is clearly stated in the report as to the on-site water availability and the effects of drawdown on surrounding water availability.

d. If a geologic report is also required to address other issues (e.g., soil stability and stability of septic system areas), the applicant may wish to combine the studies into a single report.

e. In general, the type of development which will be considered in the cumulative scenario will be residential, commercial, industrial and similar development. The Planner will provide the likely future development scenario within the impact area, based upon General Plan residential densities, zoning designations, existing uses and reasonably foreseeable projects. Agricultural water needs would also be considered where agricultural uses are present in the subject area. Water needs for fishery and wildlife habitat are generally not relevant to this portion of the Initial Study. The latter are instead addressed under plant and/or animal impacts rather than under water supply impacts.

Well Pump Test Guidelines in Water Scarce Areas

PURPOSE

These Guidelines will apply to well pump tests performed for the purpose of demonstrating compliance with minimum water quantity requirements of the Sonoma County Code for residential construction in water scarce areas or second dwelling units in marginal water availability areas of Sonoma County.

GENERAL

Pump tests conducted on or after the effective date of this policy will remain valid for a period of 3 years or as long as aquifer conditions remain substantially the same as established by a Registered Geologist or Registered Civil Engineer. [Grandfather clause: Pump tests accepted by the County prior to this Policy's initial implementation date of 06-08-04 will remain valid for 3 years from the date of the test.]

AUTHORITY

Sections 7-12, 25-17, 25-56 and 26-88-060H of the Sonoma County Code.

DEFINITIONS

"Discharge rate" means the rate at which the well discharges water (usually expressed in gallons per minute).
"Draw down" means the difference measured in feet between the static and dynamic water levels.
"Dynamic water level or stabilized pumping level" means the level of water in the well during the pump test.
"Post-test static water level" means the level of water seventy-two hours after the pump test.
"Recovery" means the difference in feet between the post test static water level and the pumping level (dynamic water level)
"Specific capacity" means the discharge rate divided by the draw down (usually expressed as gallons per minute per foot of draw down).
"Static water level" means the level of water in the well before the pump test.

PROCEDURE

A. Pump Test Requirements

1. General Conditions

   The Sonoma County Code requires demonstration of at least one gallon per minute per dwelling unit for new or replacement dwellings located in water scarce areas and for second dwelling units in marginal water availability areas. The code specifies a sustained

yield, metered pump test from a well or wells for a specified time period of 8-12 hours for water systems with 1-2 connections, 16-24 hours for water systems with 3-4 connections and 72 hours for systems with 5 or more connections. The 72 hour test may be modified by the administrative authority but in no case shall be less than 48 hours. Note: Also refer to Section 64563 of the California Code of Regulations for systems with 5 or more connections.

Testing to meet the above yield requirements shall be conducted from July 15 to October 1 each year or as extended by the Project Review and Advisory Committee. This time period is referred to as the dry weather pump test period. The Permit and Resource Management Department shall be notified 24 hours in advance of any testing. Pump tests may be performed by or under the direction of a licensed drilling contractor (C57), pumping contractor (C61/D21), a Registered Civil Engineer or a Registered Geologist.

2. A copy of the previously completed State of California Department of Water Resources Well Completion Report, if available, shall be submitted with the completed Permit and Resource Management Department's form, Certification of Water Yield in Water Scarce Areas - WLS-010.

3. If multiple wells are being used to meet the minimum water production requirements, then all wells must be pumped simultaneously.

B. Pre-Test Requirements

1. Identify the location of the well, by either the NAD83 California State Plane II or WGS 84 lat./long. or by the measured distance reference to a fixed landmark. Record this information on the WLS-010 form. Include the estimated elevation of the well head.

2. Measure and record the static (non-pumping) water level in the well. If well is operational, so note on the WLS-010 form. Provide information on measuring points (top of casing, surface seal, access port, etc.) Measurements should be taken relative to ground level. The measuring point above ground level should be measured and noted on the WLS-010 form. In order to establish the static level, the well must not be pumped for at least 12 hours prior to measurement of the static water level.

3. Record the type of discharge measurement method. Indicate the type and model of flow meter or provide an accurate description of weir or orifice plate set up.

C. Twelve-Hour Pump Test Method

1. Record the static level.

2. Calculate the volume of water stored in the well.

3. Remove a volume of water equivalent to the calculated volume stored in the well.

4. Select a dynamic water level for the test. Lower the water level to the selected dynamic water level as quickly as possible. Maintain the dynamic water level for the duration of the test by adjusting the discharge rate. Pump at a rate of no less than one gallon per minute and continue pumping for twelve hours.

5. If it is not feasible to use a water level sensing device (probe), a stable pumping rate must be maintained for a period of 3 hours prior to the start of the sustained yield test. This condition may require pulling the pump to determine the static water level prior to conducting the test, reinstalling the pump to conduct the test, and pulling the pump again to read the 72 hour recovery.

6. If a low water yield pump protector device is used and the dynamic water level is not established above the pump setting, the dynamic water level will be assumed to be at the pump.

7. Record the dynamic water level and discharge rate according to the following schedule:

Time since pumping began (including pumping to remove stored volume)	**Time Interval**
0-5 minutes	1 minute
5-60 minutes	5 minutes
60-100 minutes	20 minutes
100 minutes to establish the dynamic water level	30 minutes

Once the stabilized dynamic water level has been reached for a minimum period of 3 hours, the water level must be read a minimum of every 12 hours to the end of the test.

8. At the end of the pumping test, measure, and record the final discharge rate and dynamic water level.

D. Alternative Eight-Hour Pump Test Method

1. An alternative eight-hour pump test method can be used instead of the twelve-hour pump test method for systems of 1 or 2 connections if, after 4 hours of pumping, the specific capacity is greater than 0.05. While conducting the alternative eight-hour pump test the dynamic water level and discharge rate are to be recorded in accordance with the time intervals specified in Section C above.

E. Alternative Sixteen-Hour Pump Test Method

1. An alternative sixteen-hour pump test method can be used instead of the twenty-four hour

pump test method for systems of 3 or 4 connections if, after 4 hours of pumping, the specific capacity is greater than 0.05. While conducting the alternative sixteen-hour pump test the dynamic water level and discharge rate are to be recorded in accordance with the time intervals specified in Section C above.

F. Post Test Measurement

1. Measure and record the static level in the well seventy-two (72) hours after the final dynamic water level measurement.

G. Calculate the Well Recovery

1. Determine the water level draw down by subtracting the initial static water level measurement from the stabilized dynamic pumping level. Record this result as the well draw down.

2. Next determine the water level recovery by subtracting the post test (72 hour) static water level from the stabilized dynamic pumping level. Record this result as the well recovery.

3. Next determine the percent recovery of the well. Divide the water level recovery by the water level draw down and multiply by 100. Record this result as the percent well recovery.

   Example:

   a. Initial static water level: _____ (Measured value)

   b. *Post test static water level: _____ (Measured value)

   c. **Stabilized Pumping level: _____ (Measured value)

   d. Draw down: _____ (Calculate by subtracting A from C)

   e. Recovery: _____ (Calculate by subtracting B from C)

   f. Percent recovery: _____ (Calculate by dividing E by D and multiplying the results by 100)

   Well percent recovery (F) must be 90% or greater within a 72 hour period.

* The static water level after 72 hours or less post pump test.
** Kleinfelder refers to this as the dynamic pumping level.

ATTACHMENTS

None

Approved by:

/s/ Pete Parkinson

Pete Parkinson, Director

Lead Author: Kleinfelder Associates

Revisions:
06-08-04 03/25/05
07-13-04
09-02-04

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