SWiG Comments on Kleinfelder Report

11/4/03

INTRODUCTION

The 2003 Kleinfelder report is the second stage of a 2-part project initiated in 2000. The first stage of the paired projects was completed in June of 2001. As originally proposed, the second-stage Task 5 was to assess 4 water-scarce areas: Joy Road, Mill Creek, Bennett Valley, and Green Valley.

The Task 5 Scope of Work was revised after a Board of Supervisor vote on the proposal. Task 5 became item 4 in the revision, which cut the number of study areas to 3, and reduced the broad groundwater investigation to a pilot study. The pilot study report is the subject of the following comments.

SUMMARY

When compared to the revised Scope of Work, the Kleinfelder pilot project report contains virtually none of the promised results.

In particular, the data have not been used, as proposed, to calculate water budgets for each area, to show the "current groundwater elevations, directions of water movement, and quality, or " ... an analysis of the "rate of increased groundwater extraction" versus water availability. A summary memorandum to discuss "hydrogeology relating to water quality, quantity, recharge, and consumption rates, [and] environmental regulations," is also missing.

According to the report, Kleinfelder "prepared GIS maps and databases to represent and analyze the collected data." Sadly, the power of a GIS database to overlay and compare multiple data set at the same scale is not demonstrated in this report.

Especially disappointing is the large number of factual and data presentation mistakes.

The improper data analysis is a more critical flaw.

Variable scaling in single graphs, and (or) mistakes in labeling the graphs raise other questions about Kleinfelder's competence and technical capacity. It is hard to believe that a computer program could plot such inconsistently variable graph scales (or were they not computer-plotted?). Reviews by Kleinfelder's Senior Project Manager, a California Registered Geologist, should insure that the text and data analyses exhibit a high level of expertise and technical competence, but expertise and competence are not very evident to the trained reader.

The Plates contain information missing from figures, but are not all plotted at the same scale, or with the same projection so that they cannot even be overlaid on a light table, to make comparisons between natural and cultural features. Only one diagram (Fig. 24) shows the congruence between settlement patterns and geology.

As required by the revised Scope of Work, the most important product of this pilot study was to be a computer database, compatible with the County's Geographic Information System. Unfortunately, the data reduction and graphical representations of yearly precipitation, well water-level, and well depth data, in Figures 1 through 10 are multiply flawed. A major flaw is the supposed lack of well location data, which prevents conversion of well-depth data to elevations, which is the standard for professional groundwater level analysis. Lacking locations, the well water and depth data cannot be examined in relation to the geologic units in which they are drilled.

Although the lack of most location data would render the study nearly valueless, this excuse is insupportable. The data were obtained from state files, which assign a standardized well identification number to each well. These standardize IDs consist of location information detailed enough to place any well within a 40-acre area.

Ignoring the location data in their hands Kleinfelder, crudely averaged well and water depth values for each year represented. Wells drilled into aquifer rocks are lumped with those in aquitard rocks, and the depths of wells on ridges are also combined with those in valleys and on hillslopes, creating graphs that could be said to represent apples, oranges, and grapefruit.

As may be expected from graphs that average unlike data, these contain obvious distortions. Combinations of unrelated data types are the probable explanation for incoherencies between low well water levels and high prior-year precipitation in the Figure 1 and 2 graphs (explained on p. 35 as due to "other variables ... also at play."). Averaging such disparate data likely obscures actual water level changes in the study areas.

Another problem is the absence of very recent water or well data in this study the most recent are at least 5 (or 10) years old mistakes in graph scales, or labels, and missing dates in the data tabulations, make it difficult to impossible to determine where the problems lie. Only the tabulated Joy Ridge area data include dates.

The worst data-handling error in this report are plots of well water depths from an unidentified surface, ignoring topography. The lack of well locations apparently made it impossible to calculate and plot any but a few water levels as elevations. Thus, there are no plots of the groundwater levels as elevation ("piezometric surfaces") for any of the study areas. This omission seems inexplicable and does not accord with "generally accepted standards of care" that I am aware of. Perhaps this problem related to the fact that none of the Kleinfelder staff responsible for this report are qualified hydrologists.

The study was limited to using existing data so the design apparently precluded obtaining current well water-level measurements from area residents. But surely it did not preclude use of recent references for geologic and hydrologic data! There is no indication that Kleinfelder researchers sought current water levels on the internet, nor that they sought ways to use State assigned well designations to proxy for locations. This suggests little experience with water data, no competence in computer based research, and a low capacity for innovative research.

Mistakes in the report include inconsistent x-axis graph scales (in units of Years), found in 7 of the 10 figures. In each of Figures 1, 2, 4, 5, 7, 8, 10, the scale representing years varies across individual graphs. For most of Fig. 1 (Joy Road data) the scale and labeling is consistent: 5 tics mark the distance between labels 1955, 1960, 1965, and so on, each representing 1 year intervals. But the last two labels on the same graph, are 1985 and 1997, a span of 12 years. Five tics also mark off the space between those labels, yielding 2.4-year intervals between tics. Similarly, in Figure 2, the five tics between labels 1942 and 1952 each represent 2 years, but after 1952 the labels depict 5-year intervals, and each tic represents only 1 year. In Fig. 4, the distances between tics can represent 1, 1.6, or 3.3 years; in at least one other graph, the tic spacing can represent 1-year, or 3-year intervals. Unlike logarithmic scales, there is no regular sequence to these inconsistently-scaled axes, and such errors are peculiar for graphs supposedly made by computer databases or graphical-plotting computer programs.

Whether intentional or due to a glitch in the system, we must question how inconsistently-scaled diagrams came to be approved by a senior Kleinfelder project manager. These deficiencies are another aspect of the report which do not seem to accord with "generally accepted standards of care."

Geological descriptions are minimal in this report (p. 6-7; 16-17; 23-24), "boilerplate" repetitions of an old source (California DWR Groundwater Bulletin 118, v. 5, published in 1975) with out-of date nomenclature and data. Bulletin 118 is clearly the source of the "Merced Formation" name applied to marine sandstone aquifer rock in the Joy Ridge study area. In Sonoma County the currently-accepted name for this rock unit has been "Wilson Grove Formation" for more than a decade. The name mistake is a minor error, but it points to the uncritical use of old data from outdated references throughout the report, and also the fact that data from remote sites are commonly applied to the study areas, even when local data do exist (on the internet). Many are citations to geohydrologic data, such as well yields, infiltration rates etc., also come from Bulletin 118 (1975). The influence of faults on water availability is never mentioned in this report, even though faults are everywhere in the hilly country of Sonoma County, and many unnamed faults probably lie between the major faults cited in the study area descriptions.

SPECIFIC ISSUES

jr1. p. 7 The assertion that the "Merced" (Wilson Grove) Formation in the Joy Ridge area is thicker in the valleys and along the base of the hills, may be correct, but where is the evidence? The lack of any citation suggests that this and other geologic information in that report are extrapolated from other sites.

jr2. p. 7 The total volume of rainfall for the Joy Road area does not yield the volume of groundwater eventually available to wells, because the volume of stored groundwater cannot be larger than that of the perched "Merced" (Wilson Grove) aquifer. The precipitation data indicate only that maximum recharge may be possible, but the actual recharge is limited by the aerial distribution of the unit, its thickness, and by springs, representing leakage at the edges of the perched aquifer, as noted in the report. On p. 6 "Merced" rock is said to cover about 54 percent of the study area, so by estimating thickness variations and recharge limitations due to areas of dense development, paved roads, and harvested timber areas, a maximum possible recharge could be roughly estimated.

jr3. p. 9 A clear omission from the Joy Road area groundwater analysis is the lack of a figure showing the development density plotted on geologic unit distributions (equivalent to Plate 24 for the Bennett Valley area). The text suggests that the distribution of thin and thick aquifer rock may be generally known to the report's preparers, and a diagram combining housing density with areas of thick and thin "Merced" (Wilson Grove) Formation would be highly valuable.

jr4. p. 9 The study does not explore the effects on recharge capacity caused by dense development on "Merced" (Wilson Grove) recharge areas, or effects of tree cutting, or of grazing. All these land uses tend to increase rainfall runoff, and reduce recharge.

jr5. p. 11 Even though vineyards may use less water than housing, the report should have included the depths of wells drilled for vineyards, and considered their likely effects on shallower nearby householder wells in the Joy Road study area.

jr6. p. 13 The statement "About 56 percent of the [Joy Road] Study Area rests on the Franciscan Formation..." seems to contradict one on p. 6, that "The Merced is exposed on about 54 percent of the Study Area." If each statement is meant to report outcrop area, the total is an impossible 110 percent. The contradiction reveals both sloppy work and sloppy review by senior Kleinfelder staff.

jr7. p. 14 contains the interesting comment that recharge potential on ridge tops (in the Joy Ridge study area) underlain by "Merced" rocks "is mostly limited to the surface area of the lot itself." This statement omits two important considerations: first, recharge is limited also by the amount of development on, and upslope from, each lot, especially by the roofs of structures, paved roadways, and parking areas. Second, complete information about the water availability for ridgetop properties depends on the topographic position of each lot, also. Once absorbed into soil, groundwater continues to move, both downward to the groundwater table, and downslope under the influence of gravity, so lots at lower elevations along a ridge, especially in areas where the recharge (aquifer) rock is relatively thick, have a potentially larger water supply than lots higher on the ridge, particularly where the aquifer rock is thin.

mw1. p. 16 This is another broad-brush geologic description (from Bulletin 118), with no site-specific details. Hydrologic data are also not site-specific: for example, the Glen Ellen formation is said to be characterized by highly variable water yields, but the high water-yield figure on this page refers to a Windsor site, where US Geological Survey geophysicists have recently reported finding a deep subbasin, a geologic setting quite unlike that of the Mark West Springs study area.

mw2. p. 19 Water demand growth in the Mark West Springs study area is assumed to be related to an increase in structures, yet the report also reveals huge water usage by area golf courses - 660 acre-feet per year. The number of structures has increased 42 percent per year since 1953, over 2,000 percent. Kleinfelder did not discuss the trend to larger houses, evident in Fountaingrove and other recent developments - with water-hungry landscaping (particularly lawns), and many water-using devices and amenities, in this affluent area, such as pools, hot tubs, and the like. All are factors that could be increasing water demand growth above levels estimated only from the number of structures.

mw3. p. 22. There are no recognized areas with water-availability problems in the Mark West Springs area, although they may exist... If not, why was this area studied instead of Green Valley or Mill Valley?

bv1. p. 24. Yet another broad-brush geologic description (from Bulletin 118), with no significant site-specific details. Description of the Sonoma Volcanics on this page is virtually identical to that on p. 16.

bv2. p. 25. "Limited" streamflow data from (apparently) the only nearby stream gauging station, sited on Matanzas Creek north of the Bennett Valley study area, are not present in the Appendix tables and seemingly were not used in the study. The gauge only records water height in real time, although the data are displayed on a website. This is the only online data that the report admits Kleinfelder knew about. But it's unclear whether or not they were able to accumulate data from the website and store it the during the course of this project

bv3. p. 29. The Bennett Valley study area section of the report contains the best discussion of geologic constraints on water availability for any of the study areas. Unfortunately, the discussion lacks any mention of the Petaluma Formation's recharge characteristics. Since the highest proportion of development in the area is concentrated on Petaluma Formation strata, the potential for recharge (or not) is crucial.

da1. p. 31. As mentioned in the introduction to this review, the data analysis section is unfortunately the weakest part of the report. The crude approach to data handling in this report is justified on the basis of a lack of well locations. Yet on p. 31, Kleinfelder reports that their well data files contain "the well's location relative to township, range and section," neglecting to mention that the State well identification number for each well also contains the location within a 40-acre tract in the section, and indicates how many wells have been assigned numbers within that parcel. A 40-acre area is good enough resolution for locations, and well water elevations could have been calculated from the data in hand, adding another meaningful way of assessing the data using water level variations shown by wells in the same 40-acre tract.

Given the geologic information, also available from well completion reports, geologic differences between well sites in each 40-acre parcel could have been examined through screening and sorting database functions.

da2. p. 34-35. Averaging each year's well water level data by lumping all measurements together, regardless of topographic level or the different water storage and water-transmission characteristics of geologic units, produces graphs with wide error bars that are difficult to interpret. The objective of any good data analysis is to find correlations that reduce error bars.

Assuming that the data really did lack well locations, averaging was not the best statistical approach to finding trends in a mass of values from unlike settings. Averages are heavily influenced by extreme data values, and adding error bars only serves to further emphasize extreme measurements. For the water level and well depth data, determining the modal value (most frequent value in a data set) for each year would have been a better way to display trends, because modes emphasize the most common values in the data.

da3. p. 32. Removing zero depth data before averaging takes evidence of artesian conditions out of the data set, and gives greater influence to higher values (that is, deeper water levels) in the resulting average. On the west side of the Santa Rosa Plain, artesian conditions have diminished and disappeared over the past 15 years, so the presence of zero data are likely more common in the older well data. Removing the zeroes before averaging the depths of wells by year would tend to yield deeper average depths for older data, and that effect would tend to reduce the difference in depth between older and more recent data averages, which in turn reduces the apparent rate of water-level decline in the graphs. Including the artesian data might show substantially higher rates of groundwater decline for the 3 study areas, than the average trends depicted in the Kleinfelder report's graphs.

da4. p. 39. The explanation for trends in depths to water in new wells must be due both to water withdrawals and to lowering recharge rates, since development and other land uses such as grazing and timber harvesting increase runoff and decrease infiltration rates. The cumulative effect of water withdrawals by all land use types is never discussed in the report, and whether drilled for agriculture, rural housing developments, or golf courses, the effects of deeper wells with powerful pumps on older, shallow, individual householder wells is never considered, either.

CONCLUSIONS

The Scope of Work for this pilot groundwater study specified that it would determine "...a water budget for each area, current groundwater elevations, directions of water movement, and quality, and" ... an analysis of the "rate of increased groundwater extraction" versus water availability. A summary memorandum was to discuss "hydrogeology relating to water quality, quantity, recharge, and consumption rates, [and] environmental regulations."

In the actual report before us, we find none of the above. Instead, we have quite old and unspecific recycled geologic data, and random bits of hydrologic data that are distantly related to the rock units in the study areas. But the mis-handled and mis-plotted data in inconsistently-scaled graphs, still show the likelihood of water level declines through time in the 3 study areas, due to groundwater overdrafts. But these conditions are not limited to officially defined "water-scarce" areas; they affect private well owners across Sonoma County. The disappearance of groundwater due to Rohnert Park's water overdrafting, withdrawing 3 to 4 times more water than average annual recharge, is well documented.

The Sebastopol Water information Group (SWiG) is investigating groundwater decline and drying wells close to Sebastopol's southern city limits, near the city-operated wells. This is happening in an area of prime recharge rock, formerly an area of abundant groundwater supplies. The rate of drying wells appears to have accelerated between August and November of this year and has become a matter of concern for City officials.

SWiG is finding that voluntary well monitoring is a popular new idea among individual county well owners, who are seeing declining water levels in their wells. Absent any interest from cities and the County about groundwater depletion trends in areas close to municipal and county "emergency" wells, SWiG and other Sonoma County neighborhood associations are instituting well monitoring programs. Under the guidance of professional hydrologists, we will apply standard, defensible, scientific approaches to analyses of the data that we collect.

Although Sonoma County is built on complex geology, the complexities are not a barricade to rational policy-making, especially if the County insists on the highest quality when contracting for geohydrologic studies. To impose high standards, the County needs reviews of study proposals and study reports by a board of State-recommended professional hydrologists and geohydrologists.

Before ordinances are written, the County should obtain at least three professional peer reviews of the 2003 Kleinfelder report by State-recommended professional hydrologists and geohydrologists, and on the bases of the reviews require that Kleinfelder upgrade the report. On the basis of data in hand, plus that readily available on the internet, Kleinfelder should add locations as indicated above, and further should be directed to produce the promised water budgets, water movement, and recharge analyses, plus improved analyses of water extraction trends, in particular the effects of newer, deep, agricultural, golf course, water association, and resort wells on older, shallow householder wells for each study area.

In addition, the County needs to enlarge its focus on groundwater, and recognize that even water-abundant parts of Sonoma County are experiencing groundwater level declines.

It is often truly said that water supply and quality issues are the worst future problems that the world will have to solve to preserve our economic system and life support. But the future is already here. Sonoma County should take heed and quickly adopt a groundwater-conserving water element for the County's General Plan revision. The County must also start formulating an integrated groundwater management plan, based on the State model. If this does not happen very soon, the consequences will be forced upon all of us in most unpleasant ways.