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GROUND-WATER RESOURCES
HYDROLOGY • DEVELOPMENT • MANAGEMENT

TECHNICAL MEMORANDUM

November 17, 2004

TO: Rohnert Park City Council

FROM: Vicki Kretsinger, Glenn Browning, Debbie Cannon

SUBJECT: Technical Memorandum
Supplement to City of Rohnert Park Draft Water Supply Assessment

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I. Introduction

On October 26, 2004, representatives from Winzler & Kelly Engineers and Luhdorff and Scalmanini, Consulting Engineers (LSCE) made a presentation to the Rohnert Park City Council on the Draft Water Supply Assessment (WSA) conducted on behalf of the City and responded to questions by Council members and the public following the presentation. At the conclusion of this agenda item for the October 26 meeting, the Council set a public hearing for November 23, 2004 to consider adoption of the Final WSA.

It was requested by the Council that the Draft WSA be reviewed for consistency with the Canon Manor West Draft Environmental Impact Report (CMW DEIR) prepared by the County of Sonoma. The Council expressed the importance of ensuring the sufficiency of water for the future and the importance of the scientific analyses, such as conducted for the WSA, that carefully evaluate water needs but also study aspects of treated water use in the county.

In response to the Council's request, this Technical Memorandum has been prepared to recap some of the questions raised at the October 26 meeting and to expand upon responses offered at that time. Particularly, this Technical Memorandum summarizes further analyses of the issues relating to the groundwater divide and differences between the PES model results and the analyses conducted for the Draft WSA. Other areas of text clarification between the Canon Manor West DEIR and the City's Draft WSA are also discussed. The study area for the WSA groundwater-related analyses is shown on **Figure 1**.

II. Groundwater Divide

A. Question: The description of the present location of the groundwater divide in the Todd (2004) report (based on the 2002 contours prepared by PES) appears to be different from

LSCE's interpretation based on 2004 contours. Is there a discrepancy between these interpretations and, if so, why? Has the location of the divide shifted over time?

B. Finding in Draft WSA: "Due to limited data in the vicinity of Penngrove in 2004, the shape of the contour lines in this area is generally based on a 1951 groundwater contour map[1]. As indicated on the figure, there is a groundwater divide in the general vicinity of the watershed boundary. North of this divide, the direction of groundwater flow is generally northwesterly and toward the City. South of the divide, the groundwater flow direction in the Petaluma Valley Groundwater Basin is southeasterly toward Petaluma." (Draft WSA, p. 2-14).

C. Discrepancies and Significance: There are differences between the shape of the 2004 groundwater elevation contours shown in the Draft WSA and the 2002 groundwater elevation contours shown in the Todd (2004) report (the PES contours). There is also a difference in the estimated location of the groundwater divide based on these contours.

However, the differences in the shape of the groundwater contours and the position of the divide do not change the findings presented in the Draft WSA. The overall direction of groundwater flow toward the Santa Rosa Plain Subbasin is similar, and the exact location of the divide is not essential to conclusions about recovering groundwater levels and the amount of future pumpage that could be sustained without causing long-term groundwater level declines.

As a result of the further analyses of the location of the groundwater divide (discussed below), it has become apparent that there has probably not been a significant shift in the position of the groundwater divide between 1951 and 2002. This potential shift is not an aspect of the Draft WSA and was not discussed in that report; however, it is referred to in the Todd (2004) report. There also does not appear to be a change in the location of the divide between 2002 and 2004.

D. Discussion: The Todd (2004) report includes contours of equal groundwater elevation from two sources: 1) Figure 12 is based on the March 2002 contour map prepared by PES Environmental, Inc. and 2) Figure 16 is a portion of the 1951 groundwater level map contained in the US Geological Survey (USGS) report by Cardwell (1958). The Cardwell report illustrates the estimated location of the groundwater divide with two directional arrows, which are given no more significance than numerous other arrows illustrating the direction of groundwater flow. A "bar" is added between the arrows in the Todd report to emphasize the estimated location of the divide. Todd's report uses these two sources of contours to conclude "the groundwater divide highlighted on Figure 16 has migrated since 1950 to the southeast." Figure 12 (in Todd report) does not show contours south of the divide and does not show the location of the divide; however, the Todd report describes in the text that the "divide is likely situated between Railroad Avenue and the main stem of Lichau Creek."

[1] Cardwell, G.T. 1958. Geology and Ground Water in the Santa Rosa and Petaluma Valley Areas Sonoma County California.

To assess the question of apparent differences in the Draft WSA and PES-based groundwater contours and also the estimated position of the groundwater divide, LSCE reviewed the available groundwater level data. This assessment included a review of the groundwater level data used to prepare the 1951 contour map; as further described below, more recent groundwater level data were also reviewed.

More data were available for Spring 1951 than any other period because the USGS monitored water levels in a large number of wells (approximately 450 shallow and deep wells) in April 1951 (Cardwell, 1958). The 1951 investigation focused on the movement of groundwater over a large area, including the Santa Rosa and Petaluma Valleys. The report contains only a brief mention of the groundwater divide that "lies beneath the Cotati plain" in the Cardwell report. A zoomed in view of the portion of the Cardwell map of contours of equal groundwater elevation in the vicinity of the divide is shown on **Figure 2**. The 1951 groundwater elevation data used for contouring have been added to this figure. Cardwell did not show the divide explicitly but rather used two flow direction arrows to indicate its approximate location. The arrows are located about midway between two 100-foot elevation contour lines on either side of the divide. The lack of water level data near the divide, and the fact that groundwater elevations north of the divide were very flat in 1951, means that the actual location of the divide cannot be precisely determined for this period. LSCE's interpretation of the 1951 water level data (discussed below) indicates that the divide was probably located further south than suggested by the arrows on Cardwell's map.

LSCE's interpretation of the most likely location of the divide in 1951 is shown on **Figure 2** as a shaded area in the general vicinity of the CASIL[2] watershed boundary. This is based in part on the location of the divide in the hills east of Cotati where it is much better defined. The groundwater divide clearly lies beneath the watershed boundary east of the Cotati plain and probably continues to follow the watershed boundary to the west. The locations of the directional arrows placed on the Cardwell map that indicate flow away from the estimated position of the groundwater divide are inconsistent with the likely position of the actual 1951 divide. A divide located as far north as suggested by the Cardwell map would result in abrupt offsets from the eastern and western portions of the divide that clearly follow the topographic expression of the watershed boundary; such offsets are considered highly unlikely. Furthermore, prior to groundwater development in the area, the location of the divide would have mirrored the watershed boundary, and it is unlikely that there was sufficient pumpage near the divide prior to or during 1951 to cause significant movement.

The current location of the divide is more difficult to determine because water level data near the divide are more limited in recent years. Water level measurements north and south of the divide are required to estimate its location. The Spring 2002 groundwater elevation contour map developed by PES (Todd, 2004) was based entirely on data from wells located north of the divide (**Figure 3a**), and it is not possible to estimate the location of the divide based on

[2] 1. The watershed boundary shown on these contour maps is based on watershed maps provided by the California Spatial Information Library (CASIL). In the vicinity of the groundwater divide, it is similar but not identical to the LSCE study area boundary. It is used on the figures because it appears to more accurately follow the topography in this area.

this map. As indicated above, the Todd report does not show the divide on the 2002 contour map but rather describes in the text the assumed location of the divide.

The shape of the PES-based 2002 groundwater elevation contours shown on **Figure 3a** is considerably different from Cardwell's 1951 map. An alternative Spring 2002 groundwater elevation contour map prepared by LSCE is shown on **Figure 3b**. The Spring 2002 contours were based on data from a number of wells, including wells in the Penngrove and Petaluma areas measured by DWR. Where data were lacking, an attempt was made to generally base the shape of the contours on Cardwell's 1951 interpretation. With the available data, the approximate location of the divide has been estimated and is shown as a shaded area on **Figure 3b**. The likely location of the divide is similar to the watershed boundary. The divide is also similarly positioned to that described above and shown as a shaded area on the 1951 contour map. There may have been a slight shift to south since 1951, but this cannot be substantiated. Spring 2004 groundwater elevation contours prepared by LSCE for the Draft WSA are similar to those depicted for Spring 2002, especially south of the divide. The location of the divide in 2004 was also considered to be similar to the watershed boundary.

Water level hydrographs for shallow wells near the groundwater divide also suggest that the location of the divide has been stable for at least the last 15 years (see **Figure 3b** for the locations of wells with hydrographs described in this Technical Memorandum). **Figure 4** is a hydrograph of three shallow wells north of the divide. One of these (well No. 5N/8W-2H1) has water level measurements going back to about 1975, and the others have periods of record beginning in 1989 or 1990. Well No. 6N/7W-30R1 is completed near the bottom of the shallow zone and, therefore, shows more seasonal fluctuations and rising water levels. **Figure 5** is a hydrograph of four shallow wells south of the divide. One of these has water level measurements going back to 1975; the period of record for the other wells begins in 1989. Water levels are generally stable in the shallow wells located north and south of the divide, and none show water level declines. There is no indication of water level changes sufficient to result in movement of the groundwater divide at least since 1989.

E. Conclusion: In summary, there are differences between the PES 2002 groundwater elevation contours displayed in the Todd report and those prepared for a different period in the Draft WSA (2004 contours) and the estimated location of the groundwater divide based on these contours. Neither of these factors affect the evaluation of groundwater supply sufficiency in the Draft WSA, which is based on the relationship between groundwater level responses to local pumpage.

Upon further review of available groundwater level data, LSCE has reiterated and/or expanded upon previous interpretations that support the findings relating to groundwater level conditions in the Draft WSA. Specifically, 1951, 2002, and 2004 groundwater level data and contours were reviewed to estimate the location of the groundwater divide. The approximate location of the divide appears to generally follow the watershed boundary during each of these years, and any southerly movement of the divide since 1951 is considered to be small. Also, the hydrographs shown in **Figures 4 and 5** provide additional evidence that the location of the divide has not changed significantly since at least 1989. While additional groundwater level monitoring would be needed to determine a more precise location of the divide (e.g., more precise than that shown by the shaded areas on the 1951 and 2002 groundwater elevation contour maps that are based on available data), LSCE does not consider this necessary to determine groundwater supply sufficiency for purposes of this assessment.

III. PES Groundwater Model

A. Question: Why are the findings different in the Rohnert Park General Plan (Revised Draft Environmental Impact Report (DEIR)) than those reported in the Draft WSA? The question referred specifically to groundwater levels, which have been increasing in recent years in most wells in the Rohnert Park area as indicated in the Draft WSA. The DEIR states that "observed groundwater levels from 1970 to 1999 indicate the decline of groundwater levels ranges from approximately 35 feet in the northwest perimeter of the proposed Urban Growth Boundary, to approximately 100 to 150 feet along the eastern boundary."

Although not directly raised as a question, another significant difference between the findings of the two studies is that the DEIR reports an average annual recharge rate of 1.6 million gallons per day (mgd) estimated using the PES model. This is considerably lower than the estimate that would result from LSCE's analysis of groundwater levels in relation to study area pumpage.

B. Findings in Draft WSA: The Draft WSA presents a detailed discussion of groundwater level trends, and Appendix C of this document contains 72 hydrographs illustrating the described conditions. It is clear from analysis of the available groundwater level data that water level trends varied by zone (e.g., shallow versus deeper zones). Where significant water level declines were historically evident in the deeper zones, particularly in the central Rohnert Park area, the decline was typically followed by a gradually increasing trend in water levels from 1990 to 1997. The total estimated pumpage in the study area was 8,400 AFY during this period. Pumpage decreased to about 7,100 AFY in 2003 (see Table 1), and this resulted in a large increase in groundwater levels from 2003 to the present.

C. Discrepancy and Significance: The discussion of groundwater elevation decline presented in the DEIR is incomplete and is not supported with hydrographs, but there appears to be a discrepancy between that discussion and the information contained in the Draft WSA. The discrepancy may only be due to the period being evaluated because the DEIR concludes that when pumping is reduced through additional use of SCWA allocations, groundwater levels would be anticipated to recover. This is consistent with what occurred during2003-2004, which is clearly shown on the hydrographs contained in Appendix C of the Draft WSA.

The average annual recharge estimate of 1.6 mgd (about 1,800 AFY) contained in the DEIR is based on the PES model. This value is inconsistent with LSCE's analyses of water level hydrographs and pumpage trends. As discussed below, two possible reasons for the difference are differences in the recharge components included in the estimates and different study area boundaries.

The basis for the findings of supply sufficiency for the Draft WSA are the result of analysis of available groundwater level data and historical trends in those data that occurred in response to pumpage rather than estimates made from model simulations. Thus, the PES model was not used as part of the WSA analysis of groundwater supply sufficiency. The apparent discrepancies between the DEIR comments on groundwater elevations and average annual recharge do not affect the findings contained in the Draft WSA.

D. **Discussion:** A detailed discussion of groundwater level trends is presented in the Draft WSA, and hydrographs for 72 area wells are contained in Appendix C of that document. It is clear from analysis of the available data that groundwater level trends varied by zone (e.g., shallow versus deeper zones), and significant declines were historically evident in the deeper zones, especially in the central Rohnert Park area. The decline in this zone was generally followed by a gradually increasing trend in water levels from 1990 to 1997. Groundwater levels exhibited a large recovery in 2003 to the present, and this large increase is displayed on the hydrographs in Appendix C of the Draft WSA. Because no hydrographs are provided in the DEIR, the evaluation of water level changes cannot be directly compared. The DEIR was prepared in May 2000 prior to the large observed groundwater level recoveries in 2003-2004, and contains the statement "the recovery of groundwater levels within the proposed Urban Growth Boundary is expected to begin during the year 2000 due to an increased interim SCWA allocation." This anticipated recovery response is supported by the recent groundwater data and also the updated and expanded analysis of groundwater level trends in the Draft WSA.

PES developed a single layer numerical groundwater flow model to assess the impact of pumping on groundwater levels. The DEIR contains very limited information on the development and application of the groundwater model. As noted above, there is a discrepancy between the recharge estimate developed from the PES model application and that which would result from the method of analysis employed for the WSA where actual (not simulated) groundwater level data and groundwater level trends were analyzed to determine groundwater supply sufficiency. The additional model information that would be needed to understand and evaluate the model results, particularly the estimated annual recharge, include: boundary conditions, simulation of stream-aquifer interaction, simulation of recharge and evapotranspiration, aquifer properties, calibration hydrographs, contour maps, and a detailed water budget. This information was not included in the DEIR.

The PES model-simulated value of 1.6 mgd (about 1,800 AFY) for the average annual recharge during 1952 and 1970-1989 (pg. 4-146) is inconsistent with LSCE's analyses of water level hydrographs and pumpage trends. The PES model-simulated value is also inconsistent with the water budget prepared for Appendix F of the Canon Manor West DEIR (Todd, 2004). The water level hydrographs show rising water levels in wells located in the central Rohnert Park area during 1990 to 1997 when the City was pumping about 4,800 AFY and total pumpage in the LSCE study area was estimated to be about 8,400 AFY. Groundwater inflow to the study area is expected to be small, and was estimated to be about 1,000 AFY by Todd (2004). Based on these estimates, groundwater recharge from all sources (precipitation, streams, and return flows from irrigation and septic systems) would need to exceed 7,400 AFY in order to support rising groundwater levels. This recharge amount is much larger than the estimate of 1,800 AFY based on the PES model. It is apparent that the PES recharge estimate does not include all sources contributing to recharge.

The impact analysis section of the DEIR describes sensitivity analyses and calibration that were performed by PES to "assess the uncertainly of selected input parameters, such as hydraulic conductivity and areal recharge from precipitation." This statement in the DEIR implies that the PES model-simulated estimate is based only on recharge due to precipitation and does not include other components of recharge.

A map of the model area is provided in the DEIR, and the difference between this area and the LSCE study area is another factor in the differing recharge estimates. The PES model boundaries and the LSCE study area are shown on **Figure 6**. The model boundary excludes a significant portion of the eastern edge of the watershed; this eastern edge contains the majority of the potential recharge areas identified by Todd (2004). The difference in study area boundaries could have a large effect on the estimate of total recharge.

E. **Conclusion:** The Draft WSA contains an updated and expanded analysis of groundwater elevations and trends. Prior discussions of historical data are less complete and do not affect the findings contained in the Draft WSA. The basis for the findings of groundwater supply sufficiency for the Draft WSA is the result of analyses of available groundwater level data and historical trends in those data that occurred in response to pumpage rather than estimates made from model simulations. Thus, the method employed for the WSA analysis did not entail use of the PES model or results of that model to assess groundwater supply sufficiency. The PES model-simulated results, therefore, have no bearing on the Draft WSA findings of groundwater supply sufficiency.

IV. Verbal Comments from City Council Meeting October 26, 2004

Question: Can you explain claims by private well owners in the Rohnert Park vicinity that their wells have run dry or are running dry?

Response: LSCE gathered all available well construction and water level elevation data for the Rohnert Park vicinity, and none of the data demonstrated dry well conditions. As described above, hydrographs for shallow wells located in the southern Rohnert Park area and south toward the unincorporated area of Penngrove show stable water levels since at least 1989. Only one shallow well northwest of Rohnert Park shows evidence of significant water level declines.

Although the data received by LSCE show no indication of dry well conditions (e.g., where a static water level cannot be measured in water level monitoring wells), the term "dry well" may not be literally that the well is dry, but rather that it is not operating in a manner that would be preferred. The City and Todd Engineers have suggested factors that could contribute to dry well conditions. One factor that may contribute to depressed water levels is local private well interference where multiple wells are operating in one area. A second factor is that well maintenance issues may have caused a reduction in well efficiency and therefore a decrease in water levels. A third factor may be a change in demand where a well owner has a change in land use that requires additional water supply, however, the well construction and formation materials restrict the yield to less than what is needed.

Question: What are the actual boundaries of Penngrove? How far does it extend into the Santa Rosa Valley?

Response: The water supply for Rohnert Park does not, and will not, include groundwater that is pumped from any well located within the postal zip code 94951as shown in 2002.

Within the text of the Draft WSA, the term "Penngrove" refers to the geographic location of the unincorporated area of Penngrove south of Rohnert Park and in the general vicinity of the intersection of Petaluma Hill Road and Adobe Road.

Question: Is the Graton Rancheria Casino and the build out of Sonoma State University included in the estimate of future increase in pumping.

Response: Yes, the Graton Rancheria Casino and Sonoma State University are included in the estimates for future pumpage in Table 2-3 of the Draft WSA. **Table 1** in this Tech Memo is a detailed summary of the historical, current, and future groundwater pumpage that was used to create Table 2-3 of the Draft WSA.

V. Canon Manor West DEIR Statements and Further Clarification

The following three quotes from the Canon Manor West DEIR are broad statements that are discussed in more detail in the Draft WSA. Additional clarification of these statements is provided below.

Statement in CMW DEIR (pg 6-1): "Groundwater levels within the study area have experienced … significant declines in the 1970s and 1980s."

Response: While LSCE agrees with the above statement as applicable to wells completed in deeper zones, the Draft WSA provides further clarification of historical groundwater conditions and trends. The statement contained in the CMW DEIR does not affect the findings presented in the Draft WSA. As described in the Draft WSA, groundwater levels historically declined in wells perforated in the deeper zones, while groundwater levels in shallow wells were generally stable. Wells located in the central Rohnert Park area and perforated in the deeper zones had stable water levels from about 1977 to 1981. As pumpage increased in the late 1980's and 1990's, water levels stabilized and even slightly increased rather than declined.

Statement in CMW DEIR (pg 6-4): "City pumping has stabilized since 1985 and groundwater levels also stabilized."

Response: LSCE reviewed the City's annual pumpage from 1977 to the present, and the statement contained in the CMW DEIR concerning the City's pumpage is an oversimplification. The Draft WSA describes the increase in City pumpage from 1982 to 1990, a smaller increase during 1990-1997, a modest decrease in 2003, and a larger decrease in 2004.

Similarly, the statement in the CMW DEIR regarding groundwater level stabilization is also over simplified. As described in the Draft WSA, groundwater levels responded to pumpage trends by showing significant declines from 1982 to 1990, a gradual recovery from 1990 to 1997, and a larger recovery during 2003-2004.

Although the broad statements contained in the CMW DEIR do not fully capture trends in pumpage or groundwater conditions in response to pumpage, the statements in the CMW DEIR do not affect the findings presented in the Draft WSA.

Statement in CMW DEIR (pg 6-11): "It is therefore concluded that the project, when considered by itself, could significantly impact groundwater because it could cause more water to be withdrawn from the aquifer than is currently being replaced."

Response: The above statement only relates to the project proposed in the CMW DEIR and is not relevant to the WSA for the City of Rohnert Park. The conclusion in the CMW DEIR is based on Todd Engineers' analysis of groundwater inflows and outflows during the period from 1986-1987 to 2000-2001.[3] That analysis showed a net annual change in groundwater storage of +795 AFY or about 1% of the total groundwater estimated to be available by Todd Engineers. The County concluded that the 206 AFY associated with the proposed Canon Manor project could potentially be significant because the inflows and outflows were so closely matched.

During the period of record analyzed by Todd Engineers, the City's average annual pumpage was 4,800 AFY. However, since that period, the City has begun the reoperation of its water system. Groundwater pumpage in 2003-2004 was approximately 1,500 AFY. In accordance with the Water Policy Resolution, which was approved in 2004, groundwater pumpage will not exceed 2,577 AFY under buildout conditions. This represents a net decrease in groundwater pumpage by the City of between 2,223 AFY and 3,300 AFY.

The conclusion drawn in the Canon Manor DEIR did not take into account the City's reoperation and overstates the groundwater pumpage that can be attributed to Rohnert Park. This a result of the period of record used (i.e., the analysis did not include the most recent data) and perhaps reflects the fact that County of Sonoma, as the lead agency under CEQA for the Canon Manor DEIR, did not believe it had the policy tools to require reoperation of City's water system.

The Draft WSA draws different conclusions because it reviewed the entire record of pumpage in the basin (through September of 2004) and because it acknowledges the City's Water Policy Resolution as a legitimate tool in the City's overall water management strategy.

[3] Canon Manor West Subdivision Assessment District DEIR, June 2004, page 6-10

Table 1

Detailed Summary of Historical, Current, and Future Groundwater Pumpage, WSA Study Area

Entities		Historical (1986-2000)[1]	Current (2003)[2]	Future (2025)[3]
		Pumpage in AFY		
City of Rohnert Park		4831	3556	2577
Cotati, SSU & PWC	City of Cotati	382	273	382
	Sonoma State University	79	139	160
	Penngrove Water Company, Canon Manor East (primary and second dwelling units)	37	37	178
Private and Commercial	Multi-Family Dwelling Units (Todd's sewered & septic)	274	274	274
	Single Family Dwelling Units (Todd's sewered & septic)	1044	1044	1980
	Commercial Parcels	248	248	310
	Accommodations	32	32	32
	Graton Rancheria Casino			100
Agricultural	Agricultural Pumpage (based on irrigated acres)	1478	1478	1766
Total Study Area pumpage		8405	7081	7758

1 Rohnert Park pumpage is the average for the years 1986 to 2000. Sources of non-City pumpage are Tables 5 and 11 (Todd, 2004) except for "Agricultural" (Todd, 2004, pg. 42, 1285 AFY corrected for a 15% return to groundwater to equal 1478 AFY).

2 Pumpage values for SSU, PWC Canon Manor East well, and the Cities of Rohnert Park and Cotati are for the 2003 calendar year; private, commercial and agricultural pumpage values are historical.

3 Rohnert Park pumpage is 2.3 mgd from 2002 Stipulated Judgment. Non Rohnert Park pumpage is estimated by Todd (2004, Table 12 and the text) and is an increase of 45%.