1999 -2002 Ground Water Report

Groundwater Conditions
In
Solano County

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1.0 INTRODUCTION

1.1 Background

This report is the 1999 to 2002 groundwater report by the Solano County Water Authority (SWA). This and subsequent reports constitute the second element of an ongoing two-fold effort by SWA to characterize and document groundwater conditions in Solano County. In the first element, SWA is compiling a groundwater database that will ideally contain all relevant, publicly available groundwater data collected to date. These historical data will provide the basis for the analysis of long-term trends. Groundwater reports, such as this one, are intended to document prevailing groundwater conditions and to characterize prevailing conditions in the context of the historical record.

Both the groundwater database and this groundwater report are based in part on previous work by the U.S. Geological Survey (USGS). In the 1950's the USGS, in cooperation with the U.S. Bureau of Reclamation (USBR), conducted extensive hydrogeologic investigations in Solano County. These investigations were eventually published in 1960 as USGS Water Supply Paper 1464. This USGS document is generally considered to be the definitive text on the hydrogeology of the two principal groundwater basins in Solano County. USGS Water Supply Paper 1464 also represents the first significant compilation of groundwater data for Solano County.

SWA's groundwater database and the format used to be present data in this groundwater report are patterned after a Solano County groundwater database developed by the Department of Water Resources (DWR) in 1992. Much of the data contained in the groundwater database and this groundwater report were collected by the Solano Irrigation District (SID), USGS, USBR, and DWR. Other contributors include the City of Vacaville and the California Water Services (CWS).

1.2 Scope of Report

This report presents groundwater monitoring data collected by various organizations in the 1999 to 2002 calendar years, and to the extent they are available, data describing the physical characteristics of each well sampled (well depth, location of perforations, etc.). Also included in the report are hydrographs depicting long-term trends for selected wells, contour maps depicting groundwater elevations and "depth-to-groundwater" in the spring months of 1999 and 2002, and a comparison of groundwater elevations and depth –to-groundwater in the spring of 1999 to 2002 at selected locations in the County.

2.0 GROUNDWATER BASINS IN SOLANO COUNTY

The USGS has identified two economically significant groundwater basins in the Solano County' the "Putah Area", which extends from the Putah Creek southward to the Montezuma Hills, and from the foothills of the Coast Ranges eastward to the west edge of the Yolo Bypass; and the "Suisun-Fairfield Area", located to the south of Vacaville and north of Vallejo, and from the foothills of the Coast Ranges eastward to the northwest edge of the Suisun Marsh (Thomasson et al., 1960). The Putah Area and Suisun-Fairfield Area encompass regions that can be differentiated from one another on the basis of site specific hydrogeologic attributes. Accordingly, Summers Engineering (1988) has subdivided the two groundwater basins delineated by the USGS into a total of seven "Hydrogeologic Sub-Areas"; the "Putah Creek Fan", "Los Putos Foothills", "Southwest Putah Plain", and "English Hills/Vaca Valley" Sub-Areas, which encompass the Putah Area defined by the USGS; and the "Tolenas Bench", "Suisun Valley" and "Green Valley" Sub-areas, which collectively encompass the Suisun-Fairfield Area defined by the USGS (Figure 5.1)

The groundwater data for this report are organization accordance with the seven Hydrogeologic Sub-Areas defined by Summers Engineering (1988). A brief description of each Hydrogeologic Sub-Area is presented below, followed by a summary of historical groundwater conditions in Solano County.

2.1 Hydrogeologic Sub-Areas

2.1.1 Sub-Area I (Putah Creek Fan)

The Putah Creek Fan; often delineated as the triangular area located between the cities of Winters; Dixon, and Davis, consists of two layers of alluvial deposits from Putah Creek; "younger alluvium" and "older alluvium", followed by a third layer of geologic material, the Tehama formation, which unlike the overlying alluvial deposits from Putah Creek, extends throughout much of the Sacramento Valley. Groundwater supplies in this area are for the most part plentiful. Although generally less permeable than the overlying younger alluvium, and to a lesser extent the older alluvium, the Tehama formation, by virtue of its thickness, constitutes the principal source of groundwater in the Putah Creek Fan.

Both the vertical and to a lesser extent the horizontal movement of groundwater within and between the geologic layers of the Putah Fan is inhibited by the preponderance of discontinuous silt and clay bodies in each of the three layers. Thomasson et al (L1960) note that during the irrigation pumping season the water table in some locations may become semi-perched, but that water levels in relatively shallow wells (i.e., maximum depth of 300 to 500 feet) recover in the spring and typically return to more or less the same elevations. Generally speaking, the deeper the groundwater well, the more dissimilar the patterns of groundwater draw down and recovery become, when compared with nearby shallow wells.

2.1.2 Sub-Area II (Los Putos Foothills)

The Los Putos Foothills encompass the rolling hills between Vacaville and Lake Solano, along and generally west of Interstate 505. The definitive hydrogeologic features of this Sub-Area are its widespread outcroppings of the Tehama formation, which create the rolling hills that dominate the sub-area, and the comparatively shallow stringers of younger and older alluvium deposited in the small valleys located among the rolling hills.

Groundwater supplies in the Los Putos Foothills are reasonably abundant. However, the occurrence and quantity of groundwater is highly site specific. Thomasson et al (1960) report that groundwater conditions in nearby wells are often distinctly different from one another, even when the wells are perforated at similar depths.

2.1.3 Sub-Area III (Southwest Putah Plain)

The Southwest Putah Plain lies to the south and west of the Putah Creek Fan and to the east of the Los Putos Foothills. Included in the southern portion of the Southwest Putah Plain are low rolling outcrops of the Tehama formation. Elsewhere, the Tehama formation is overlain by the younger and older alluvial deposits of Sweeney, Ulatis, and Alamo Creeks. These alluvial deposits consist largely of clay, with fewer and less permeable stringers of gravel than those of the Putah Creek Fan.

Groundwater supplies are reasonably abundant but largely restricted to the underlying Tehama formation. The vertical and to a lesser extent the horizontal movement of water within and between geologic layers is inhibited by the preponderance of discontinuous silt and clay bodies in each of the three layers. Thomasson et al (1960) and the USBR (1959) note that during the pumping season the water table in some locations may become semi-perched, but that water levels in the relatively shallow wells (i.e., maximum depth of 200 to 500 feet) recover in the spring and typically return to more or less the same elevations. Generally speaking, the deeper the groundwater well, the more dissimilar the patterns of groundwater draw down and recovery become, when compared with nearby shallow wells.

2.1.4 Sub-Area IV (English Hills/Vaca Valley)

The English Hills/Vaca Valley Sub-Area includes Vaca Valley and the westerly slopes of English Hills. This Sub-Area consists largely of old, non water-bearing sedimentary rocks. Groundwater supplies are limited and for the most part, restricted to regions with poorly cemented and/or fractured sandstones.

2.1.5 Sub-Area V (Tolenas Bench)

The Tolenas Bench is largely located within the trapezoidal-shaped area between Fairfield on the west and Travis Air Force Base to the east, and State Highway 12 to the south and Putah South Canal to the north. Topographically, the Tolenas Bench consists of small flat valleys separated by low rolling hills. Valley areas typically exhibit a thin, fine textured layer of alluvium, underlain by hard non water-bearing rocks. Groundwater supplies in the Tolenas Bench are limited and for the most part, highly mineralized.

2.1.6 Sub-Area VI (Suisun Valley)

The Suisun Valley Sub-Area encompasses all of Suisun Valley and extends from the Napa-Solano County line to the Suisun Marsh. The principal hydrogeologic features of this Sub-Area include the younger and older alluvial deposits from Suisun and Ledgewood Creeks and the underlying old sedimentary and volcanic rocks. The alluvium from Suisun and Ledgewood creeks was deposited during the same geologic time periods as the corresponding alluvium in the Putah Creek Fan. However, both Suisun and Ledgewood Creek are significantly smaller than Putah Creek and accordingly, the alluvial deposits within the Suisun Valley Sub-Area tend to be finer grained and less permeable than those of the Putah Creek Fan.

Nearly all of the usable groundwater in the Suisun Valley Sub-Area is found in the alluvial deposits from Suisun and Ledgewood creeks. Groundwater is present to some extent in the old sedimentary and volcanic rocks that lie beneath the alluvium. However, the available supply is typically highly mineralized

2.1.7 Sub-Area VII (Green Valley)

The Green Valley Sub-Area encompasses all of the Green Valley and extends southerly to the Suisun Marsh. The principal hydrogeologic features of this Sub-Area include the younger and older alluvial deposits from Green Valley Creek and the underlying rocks of the Sonoma volcanics.

Much of the available groundwater supply in the Green Valley Sub-Area although not particularly plentiful, is found in the alluvial deposits from Green Valley Creek. Unlike the underlying old sedimentary and volcanic rocks of the Suisun Valley Sub-Area, usable groundwater is occasionally found in the Sonoma volcanics of the Green Valley Sub-Area.

2.2 Historical Groundwater Conditions

The historical groundwater conditions in the Putah and Suisun-Fairfield Areas have been characterized by Thomasson et al (l960) and more recently by DWR (1992). The following summary is taken largely from DWR's 1992 assessment of historical conditions, with additional information added to describe conditions since the 1987-1992 drought.

Putah Area

The first regional assessment of groundwater conditions in the Putah Area was performed by the USGS in 1912, as part of a basin-wide ground water study of the Sacramento Valley. The groundwater elevations measured by the USGS in 1912 are generally considered to be representative of natural, predevelopment conditions in the Putah Area (Thomasson et al., 1960). At that time, the general direction of ground water flow in Solano County was from northwest to southeast. Over time, the general direction of flow changed as a result of groundwater pumping, particularly in the Dixon area, and the importation of surface water supplies for irrigated agriculture, most notably by SID, Reclamation District 2068 and the Maine Prairie Water District.

In 1912, groundwater elevations ranged from about 70 feet above sea level along the foothills northwest of Dixon, to approximately 15 feet above sea level southeast of Dixon, near the Yolo County line. Groundwater elevations declined by five to ten feet between 1912 and 1932, as a result of an extended dry period that included a severe six-year drought, then recovered slightly between 1932 and 1941, a wet period that included one of the wettest years on record (1941). Between 1941 and 1950, ground water levels declined again. However, unlike the 20-year period between 1912 and 1932, the declining groundwater table in the 1940's is largely attributed to increasing groundwater extractions. Groundwater extractions continued to increase through the 1950's with groundwater elevations generally reaching all-time lows by the close of the decade. During the 1950's a large pumping depression developed in the northeastern part of the country, between Davis and Dixon. Groundwater elevations at the center of this depression dropped to about 40 feet below sea level.

Groundwater conditions changed dramatically with the onset of surface water deliveries from the Solano Project, in 1959. Groundwater elevations increased throughout the 1960's and early 1970's, in some instances reaching elevations similar to and occasionally greater than those recorded in the late 1930's and early 1940's. Although still present, the pumping depression east of Dixon recovered somewhat and appeared to stabilize. The overall trend of rising groundwater elevations was subsequently interrupted by the 1976-1977 drought. During the 1976-1977 drought, groundwater levels declined by 5 to 15 feet, and in some instances approached levels not seen since the 1950's. By 1977, the pumping depression east of Dixon had deepened to about 50 feet below sea level and had grown laterally.

Conditions were quickly reversed during the wet period of the early 1980's. By 1983, the wettest year on record in the Putah Creek drainage, the pumping depression east of Dixon had disappeared, thereby allowing for a return to the northwest to southeast direction of groundwater flow that had first been observed by the USGS in 1912. Drought conditions returned in the late 1980's, and with the drought, declining groundwater elevations. By 1992, the final year of what turned out to be the most severe six-year drought on record for the Putah Creek drainage, groundwater elevations decreased and in some instances approached levels previously observed in the 1950's and the 1976-1977 drought. Groundwater elevations have risen since 1992. As discussed elsewhere in this report, groundwater elevations have now recovered and in some instances are higher than those observed in the early 1980's.

Suisun-Fairfield Area

Groundwater level data were first collected in the Suisun-Fairfield Area by the USGS in 1918, followed by the City of Vallejo between 1918 and 1940, the State Division of Water Resources, between 1929 and 1948, and the USBR in 1948 and 1949. Unfortunately, none of these organizations collected sufficient data to characterize predevelopment conditions throughout the basin. By the time a comprehensive basin-wide monitoring program was initiated in the early 1950's, there were already significant demands on the groundwater system, especially near Fairfield. Data from the early 1950's indicate that the overall movement of groundwater was from north to south and that the slope of the groundwater surface roughly paralleled the slope of the land surface. At that time, the groundwater elevation was about 100 feet above sea level along the northern margin of the basin, and declined to near sea level adjacent to the Suisun March to the south.

By 1950, a pumping depression had developed in the area west and southwest of Fairfield. Groundwater levels within this depression were about 10 to 20 feet below sea level. The pumping depression was eventually eliminated and groundwater levels stabilized with the arrival of alternative surface water supplies, primarily Solano Project water, for irrigation and municipal use. Since 1970, groundwater levels have experienced only minor fluctuations, despite the 1976-1977 and 1987-1992 droughts and conversely, the wet years of the early 1980's.

3.0 COMPILATION OF DATA

3.1 Contributors of Data

Groundwater elevation data were obtained from a total of 195 to 220 wells, depending on the year sampled. Most of the data were collected by the USBR, SISD, and DWR. A summary of the organizations and individuals that contributed data for the 1999 to 2002 calendar years, and the frequency with which they collected data (i.e., annual, semiannual or monthly), is presented in Table 3-1. Well locations are depicted in figures 5-2A through 5-2D.

Background information (if available) describing the location; topographic elevation, depth of well perforations and total well depth were obtained from well logs. Information describing the location of well perforations, relative to geologic strata (younger alluvium, older alluvium or Tehama formation), was developed by Dr. John Mann. A summary of the available background information for those wells sampled in 1999 to 2002 is presented in Table 3-2.

3.2 Data Collection and Reporting

Groundwater levels were measured using a steel tape or electric sounder, or in the case of Vacaville, with an electric sounder and/or pressure transducer probe, using sampling protocols described in or patterned after those presented in the National Handbook or Recommended Methods for Water-Data Acquisition (USGS, 1977).

Groundwater elevations were calculated by subtracting the depth-to-groundwater from the estimated ground surface elevation of the well. Most of the ground surface elevations were estimated from USGS 7.5-minute topographic quadrangle maps. The accuracy of these ground surface elevation estimates, and in turn the computed groundwater elevations, is dependent on the accuracy of the elevation contours indicated on the quadrangle maps, and in instances where it was necessary to interpolate ground surface elevations between existing contours, the total change in elevation between existing contours (i.e., contour interval).

Depth-to-groundwater and groundwater elevation contours maps were prepared for Hydrogeologic Sub-Area I (Putah Creek Fan) and Hydrogeologic Sub-Area III (Southwest Putah Plain), the only two sub-acres for which there are sufficient data to develop meaningful contour maps or the analysis of spring groundwater elevation trends are data for six municipal wells owned and operated by the City of Vacaville (see Tables 5-1 and 5-2). Spring groundwater elevation data for these wells do not appear to be representative of static spring groundwater elevations in the region.

Included in the database are several wells which do not have official well numbers assigned by DWR, and/or lack sufficient data to determine "map-able" coordinated. In such instances temporary, albeit unofficial well numbers were assigned using the same "township-range-section-subsection" numbering methodology used by DWR. Wells with unofficial DWR well numbers are identified by the "X" in the subsection well number portion of the DWR well number format (i.e., 07N/01W-32AO**X**M, versus the official DWR well number: 07N/01W-32AO**1**M.

For the purposes of this report, short-term trends are defined as trends that occur from one year to the next (i.e., spring of 1999 to spring of 2000). Long-term trends are those that have occurred over the period of record.

4.0 CLIMATIC CONDITIONS

The 1995 water year was one of the wettest years on record. Rainfall totals at Lake Solano, Dixon, Vacaville and Green Valley were 189%, 141%, 151% and 161% of the respective historical averages. Record breaking rainfall totals were reported for January at Lake Solano, Dixon and Vacaville; and for March at Lake Solano and Green Valley (Table 4-1). As indicated in Figure 4-1, the heavy rains of 195 have eliminated the long-term rainfall deficit (expressed as the "cumulative departure from normal") associated with the 1987-1992 drought and the dry water year of 1994.

5.0 GROUNDWATER CONDITIONS

A review of short and long-term groundwater elevation trends, by Hydrogeologic Sub-Area, is presented in the following paragraphs and in Table 5-1a though 5-1d. Contour maps depicting groundwater elevations and depth-to-groundwater in the spring of 1999 to 2002, as well as the difference between groundwater levels in the spring of 2000 and2002, are presented in figures 5-3B through 5-5B4, respectively. Data for individual wells are tabulated in Table 5-2 and graphically displayed, in form of well hydrographs, in the report appendix.

5.1 Sub-Area I (Putah Creek Fan)

Spring groundwater elevations decreased from 1999 to 2002 in all but one of the 28 wells sampled in the Putah Creek Fan, with the change in groundwater elevations ranging from -9.5 to +0.6 feet and averaging -4.27 feet.

5.2 Sub-Area II (Los Putos Foothills)

Groundwater elevations decreased from 1999 to2002 in the two wells sampled in the Los Putos Foothills, with the change in groundwater elevations ranging from -6.5 to -4.7 feet and averaging -5.6 feet.

5.3 Sub-Area III (Southwest Putah Plain)

Groundwater elevations varies both in increase and decrease from 1999 to 2002 in all 14 wells sampled in the Southwest Putah Plain, with the change in groundwater elevations ranging from -2 to +3.9 feet and averaging +0.04 feet.

5.4 Sub-Area IV (English Hills/Vaca Valley)

No spring groundwater elevation data available.

5.5 Sub-Area V (Tolenas Bench)

Spring groundwater elevations decreased from 1999 to 2002 in all three wells sampled in the Tolenas Bench, with the decrease in groundwater elevations ranging form -1.5 to -0.3 feet and averaging -0.9 feet.

5.6 Sub-Area VI (Suisun Valley)

Spring groundwater elevations decreased from 1999 to 2002 in all 5 wells sampled in Sub-Area VI, with the decrease in groundwater elevations ranging from -3.7 to -0.5 feet and averaging -1.72 feet.

5.7 Sub-Area VII (Green Valley)

No spring groundwater elevation data available.

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