Sacramento Valley Groundwater Basin
Solano Subbasin

Groundwater Basin Number: 5-21.66
County: Solano, Sacramento, Yolo
Surface Area: 425,000 acres (664 square miles)

Basin Boundaries and Hydrologic Features

The Solano Subbasin lies in the southwestern portion of the Sacramento Basin and the northern portion of the Sacramento-San Joaquin Delta. The elevation varies from 120 feet in the northwest corner to sea level in the south. Subbasin boundaries are defined by; Putah Creek on the north, the Sacramento River on the East (from Sacramento to Walnut Grove), the North Mokelumne River on the southeast (from Walnut Grove to the San Joaquin River), and the San Joaquin River on the South (from the North Mokelumne River to the Sacramento River. The western subbasin border is defined by the hydrologic divide that separates lands draining to the San Francisco Bay from those draining to the Sacramento-San Joaquin River Delta. That divide is roughly delineated by the English Hills and the Montezuma Hills.

Primary waterways in and bordering the basin include the Sacramento, Mokelumne and San Joaquin Rivers, the Sacramento River Deep Water Ship Channel, and Putah Creek.

Annual precipitation averages in the basin range from approximately 23 inches in the western portion of the subbasin to 16 inches in the eastern portion of the basin.

Hydrogeologic Information

Water Bearing Formations

The primary water-bearing formations comprising the Solano subbasin are sedimentary continental deposits of Late Tertiary (Pliocene) to Quaternary (Recent) age. Fresh water-bearing units include younger alluvium, older alluvium, and the Tehama Formation (Thomasson and others 1960). The units pinch out near the Coast Range on the west and thicken to a section of nearly 3000 feet near the eastern margin of the basin. Saline water-bearing sedimentary units underlie the Tehama formation and are generally considered the saline water boundary (adapted from Thomasson and others, 1960).

Flood basin deposits occur along the eastern margin of the subbasin. These deposits consist primarily of silts and clays, and may be locally interbedded with stream channel deposits of the Sacramento River. In the delta, flood basin deposits contain a significant percentage of organic material (peat), and are sometimes mapped as peaty mud (Wagner and others 1987). Thickness of the unit ranges from 0 to 150 feet. The flood basin deposits have low permeability and generally yield low quantities of water to wells. Recent stream channel deposits consist of unconsolidated silt, fine- to medium-grained sand, gravel and in some cases cobbles deposited in and adjacent to active streams in the subbasin. They occur along the Sacramento, Mokelumne and San Joaquin Rivers, and the upper reaches of Putah Creek.

Thickness of the younger alluvium ranges from 0 to 40 feet, however with the exception of the Delta, they generally lie above the saturated zone.

Older alluvium consists of loose to moderately compacted silt, silty clay, sand, and gravel deposited in alluvial fans during the Pliocene and Pleistocene. Thickness of the unit ranges from 60 to 130 feet, about one-quarter of which is coarse sand and gravel generally found as lenses within finer sands, silts, and clays. Permeability of the older alluvium is highly variable. Wells penetrating sand and gravel lenses of the unit produce between 300 and 1000 gpm. Adjacent to the Sacramento River, wells completed in ancestral Sacramento River stream channel deposits yield up to 4000 gpm. Wells completed in the finer-grained portions of the older alluvium produce between 50 and 150 gpm.

The Tehama Formation is the thickest water-bearing unit underlying the Solano subbasin, ranging in thickness from 1500 to 2500 feet. Surface exposures of the Tehama Formation are limited mainly to the English Hills along the western margin of the basin. It consists of moderately compacted silt, clay, and silty fine sand enclosing lenses of sand and gravel, silt and gravel, and cemented conglomerate. Permeability of the Tehama Formation is variable, but generally less than the overlying younger units. Because of its relatively greater thickness, however, wells completed in the Tehama can yield up to several thousand gpm.

Underlying the Tehama Formation are brackish to saline water-bearing sedimentary units including the somewhat brackish sedimentary rocks of volcanic origin (Pliocene to Oligocene?) underlain by undifferentiated marine sedimentary rocks (Oligocene? to Paleocene). These units are typically of low permeability and contain connate water. The upper contact of these units generally coincides with the fresh/saline water boundary at depths as shallow as a few hundred feet near the Coast Range on the west to nearly 3000 feet near the eastern margin of the basin (Berkstresser and others 1973).

Groundwater Level Trends

Groundwater levels were measured at what we now consider to be natural, predevelopment levels in 1912 by the USGS. At that time the general direction of groundwater flow in this subbasin was from northwest to southeast. From 1912 to 1932, below-average precipitation resulted in lower groundwater levels throughout the basin. Due to above-average precipitation from 1932 and 1941 groundwater levels recovered slightly in spite of increased groundwater development. After 1941, groundwater levels continued to decline due to increasing agricultural and urban development, reaching their lowest historical levels in the late 1950s. A large pumping depression between Davis and Dixon was one of the more notable groundwater level depressions in the subbasin. Surface water deliveries from the Solano Project beginning in 1959 caused groundwater levels to rise slightly or slow their descent. Since this time, groundwater level trends within the Solano subbasin have been impacted by drought periods in the mid-1970s and late-1980s but have recovered quickly in the following "wet" years. (This discussion is taken largely from California Department of Water Resources, 1994.)

Groundwater Storage

Groundwater Storage Capacity. To date, there has been no groundwater storage calculation for the Solano subbasin as it is described by Bulletin 118. The USGS, however, has determined specific yield averages and groundwater storage calculations for some areas within and around the Solano subbasin (Thomasson and others 1960).

Groundwater in Storage. (see above)

Groundwater Budget (Type C)

Currently no groundwater budget has been calculated for the Solano Subbasin.

Groundwater Quality

Characterization. This discussion of groundwater quality is based on USGS Water Supply Investigation Report 84-4244 (Evenson, 1985) except where noted.

Groundwater within the Solano subbasin is considered to be of generally good quality, and useable for both domestic and agricultural purposes. Chemical water types within the basin are variable and classified generally as magnesium bicarbonate in the central and northern areas, sodium bicarbonate in the southern and eastern areas, and calcium magnesium or magnesium calcium bicarbonate around and west of Dixon. Total dissolved solids (TDS) range from between 250 and 500 ppm in the northwest and eastern portion of the basin and are found at levels higher than 500 ppm in the central and southern areas. (Evaluation of data from the Department of Health Services (Department of Health Services, 2000) shows the TDS minimum = 150 ppm, maximum = 880 ppm, average = 427 ppm). In general, most of the water within the subbasin is classified as hard to very hard (see below).

Chloride concentrations are found over 100 ppm in the southern areas, while sulfate concentration is greater than 50 ppm in the southern areas. The maximum contaminant level (MCL) for both chloride and sulfate is 600 ppm.) Boron concentrations are less than 0.75 ppm except in the southern and southeastern basin where concentrations average between 0.75 and 2.0 ppm (more than 1.0 ppm will affect sensitive tree crops).

Iron concentrations increase toward the eastern side of the subbasin, from less than 0.02 ppm to greater than 0.05 ppm (MCL = 0.3 ppm) along the Sacramento River, while manganese concentrations also increase from west to east with concentrations from .01 ppm to over 0.1 ppm (MCL = 0.050 ppm) found north of Rio Vista and east of the Solano-Yolo County line.

Impairments. Overall hardness (as $CaCO_3$) is generally greater than 180 ppm. Approximately one half of drinking water well samples taken between 1970 and 2000 analyzed for overall hardness measured above 200 ppm, but rarely over 400 ppm (Department of Health Services 2000). High concentrations of bicarbonate which cause precipitation of Ca and Mg carbonates is found in the southern portion of the basin.

Arsenic concentrations are typically between 0.02 and 0.05 ppm, with the highest concentrations found along the southeastern margin of the basin. Although this is currently not considered problematic, there could be impacts if the MCL is lowered. The current MCL (as set by the EPA) for arsenic is 0.05 ppm. Also, manganese (a secondary constituent) is found at concentrations above the MCL of 0.05 ppm along the Sacramento River along the eastern portion of the subbasin.

Water Quality in Public Supply Wells

Constituent Group[1]	**Number of wells sampled**[2]	**Number of wells with a concentration above an MCL**[3]
Inorganics – Primary	71	1
Radiological	41	0
Nitrates	96	8
Pesticides	56	3
VOCs and SVOCs	57	1
Inorganics – Secondary	71	17

[1] A description of each member in the constituent groups and a generalized discussion of the relevance of these groups are included in *California's Groundwater – Bulletin 118* by DWR (2003).
[2] Represents distinct number of wells sampled as required under DHS Title 22 program from 1994 through 2000.
[3] Each well reported with a concentration above an MCL was confirmed with a second detection above an MCL. This information is intended as an indicator of the types of activities that cause contamination in a given basin. It represents the water quality at the sample location. It does not indicate the water quality delivered to the consumer. More detailed drinking water quality information can be obtained from the local water purveyor and its annual Consumer Confidence Report.

Well Characteristics

Well yields (gal/min)

Currently there is insufficient data to provide statistics on water well yields.

Total depths (ft) [1]

Domestic	Range: 38 to 1070 ft	Average: 239 ft
Municipal/Irrigation	Range: 62 to 2275 ft	Average: 510 ft

[1]Based on DWR well completion report data from 2001.

Active Monitoring Data

Agency	Parameter	Number of wells /measurement frequency
DWR	Groundwater levels	35 semi-annually 7 monthly
Solano ID		7 semi-annually 2 monthly
USBR		60 semi-annually 12 monthly
DWR	Miscellaneous water quality	23
Department of Health Services and cooperators	Title 22 water quality	136

Basin Management

Groundwater management:	City of Vacaville adopted AB3030 plan in 2/95 Maine Prairie Water District adopted AB3030 plan in 1/97 Reclamation District #2068 adopted AB3030 plan in 1/97 Solano Irrigation District adopted AB3030 plan in 2/95
Water agencies	
Public	City of Dixon City of Rio Vista California Water Service City of Vacaville University of California, Davis
Private	Maine Prairie Water District Solano Irrigation District Solano County Water Agency North Delta Water Agency Reclamation District #501 Reclamation District #536 Reclamation District #1607 Reclamation District #1667 Reclamation District #2060 Reclamation District #2068 Reclamation District #2084 Reclamation District #2093 Reclamation District #2098 Reclamation District #2104 Reclamation District #2112

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Errata

Changes made to the basin description will be noted here.