San Joaquin Valley Groundwater Basin
Tule Subbasin

- Groundwater Basin Number: 5-22.13
- County: Tulare
- Surface Area: 467,000 acres (733 square miles)

Basin Boundaries and Hydrology

The San Joaquin Valley is surrounded on the west by the Coast Ranges, on the south by the San Emigdio and Tehachapi Mountains, on the east by the Sierra Nevada and on the north by the Sacramento-San Joaquin Delta and Sacramento Valley. The northern portion of the San Joaquin Valley drains toward the Delta by the San Joaquin River and its tributaries, the Fresno, Merced, Tuolumne, and Stanislaus Rivers. The southern portion of the valley is internally drained by the Kings, Kaweah, Tule, and Kern Rivers that flow into the Tulare drainage basin including the beds of the former Tulare, Buena Vista, and Kern Lakes.

The Tule Groundwater Subbasin is generally bounded on the west by the Tulare County line, excluding those portions of the Tulare Lake Subbasin Water Storage District and Sections 29 and 30 of Township 23 South, Range 23 East, that area west of the Homeland Canal. This boundary is shared with the Tulare Lake Groundwater Subbasin. The northern boundary of the subbasin follows the northern boundaries of Lower Tule Irrigation District and Porterville Irrigation District and is shared with the Kaweah Groundwater Subbasin. The eastern boundary is at the edge of the alluvium and crystalline bedrock of the Sierra Nevada foothills, and the southern boundary is the Tulare-Kern County line and is shared with the Kern County Groundwater Basin

West-flowing Tule River, Deer Creek and the White River are the major drainages in the subbasin which empty into the Tulare lakebed. Annual average precipitation is seven to 11 inches, increasing eastward.

Hydrogeologic Information

The San Joaquin Valley represents the southern portion of the Great Central Valley of California. It is a structural trough up to 200 miles long and 70 miles wide filled with up to 32,000 feet of marine and continental sediments deposited during periodic inundation by the Pacific Ocean and by erosion of the surrounding mountains, respectively. Continental deposits shed from the surrounding mountains form an alluvial wedge that thickens from the valley margins toward the axis of the structural trough. This depositional axis is below to slightly west of the series of rivers, lakes, sloughs, and marshes, which mark the current and historic axis of surface drainage in the San Joaquin Valley.

Water Bearing Formations

The sediments that comprise the subbasin's aquifer are continental deposits of Tertiary and Quaternary age (Pliocene to Holocene). These deposits include flood-basin deposits, younger alluvium, older alluvium, the Tulare Formation, and continental deposits undifferentiated.

The flood-basin deposits consist of relatively impermeable silt and clay interbedded with some moderately to poorly permeable sand layers that interfinger with the younger alluvium. These deposits are probably not important as a source of water to wells but may yield sufficient supplies for domestic and stock use. The younger alluvium is a complex of interstratified and discontinuous beds of unsorted to fairly well sorted clay, silt, sand, and gravel, comprising the materials beneath the alluvial fans in the valley and stream channels. Where saturated the younger alluvium is very permeable, but this unit is largely unsaturated and probably not important as a source of water to wells. The older alluvium consists of poorly sorted deposits of clay, silt, sand, and gravel. This unit is moderately to highly permeable and is a major source of water to wells. The Tulare Formation consists of poorly sorted deposits of clay, silt, sand, and gravel derived predominately from the Coast Ranges. It contains the Corcoran Clay Member, the major confining bed in the subbasin. The formation is moderately to highly permeable and yields moderate to large quantities of water to wells. The continental deposits undifferentiated consist of poorly sorted lenticular deposits of clay, silt, sand, and gravel derived from the Sierra Nevada. The unit is moderately to highly permeable and is a major source of ground water in the subbasin.

The estimated average specific yield for this subbasin is 9.5 percent. This estimation is based on DWR San Joaquin District internal data and Davis (1959).

Land subsidence of 12 to 16 feet due to deep compaction of fine-grained units has occurred in the subbasin (Ireland 1984).

Restrictive Structures

Groundwater flow is generally westward (DWR 2000). Groundwater elevation contours diverge from the path of the Tule and White Rivers in the north and south portions of the subbasin, respectively, suggesting that these drainages act as losing streams throughout most of their extent. Based on current and historical groundwater elevation maps, horizontal groundwater barriers do not appear to exist in the subbasin.

Recharge Areas

Groundwater recharge is primarily from stream recharge and from deep percolation of applied irrigation water (Hilton and others 1963; DWR 1995).

Groundwater Level Trends

Changes in groundwater levels are based on annual water level measurements by DWR and cooperators. Water level changes were evaluated by quarter township and computed through a custom DWR computer program using geostatistics (kriging). On average, the subbasin water level has increased about four feet from 1970 through 2000. The period from 1970 to 1978 showed a general decline, bottoming out at 13 feet below 1970 levels in 1978. There is a steep increase in water levels in the ten-year period from 1978 to 1988, topping out at 20 feet above 1970 water levels in 1988. There is a very sharp decrease in water levels of 34 feet from 1988 to

1995, with the lowest level reached in 1993 at 16 feet below 1970 water levels. From 1995 to 2000, water levels generally increase, eventually reaching four feet above 1970 water levels in 2000.

Groundwater Storage

Estimations of the total storage capacity of the subbasin and the amount of water in storage as of 1995 were calculated using an estimated specific yield of 9.5 percent and water levels collected by DWR and cooperators. According to these calculations, the total storage capacity of this subbasin is estimated to be 14,600,000 af to a depth of 300 feet and 94,100,000 af to the base of fresh groundwater. These same calculations give an estimate of 9,100,000 af of groundwater to a depth of 300 feet stored in this subbasin as of 1995 (DWR 1995). According to published literature, the amount of stored groundwater in this subbasin as of 1961 is 33,000,000 af to a depth of $\leq$ 1000 feet (Williamson 1989).

Groundwater Budget (Type B)

Although a detailed budget was not available for this subbasin, an estimate of groundwater demand was calculated based on the 1990 normalized year and data on land and water use. A subsequent analysis was done by a DWR water budget spreadsheet to estimate overall applied water demands, agricultural groundwater pumpage, urban pumping demand and other extraction data.

The natural recharge into the subbasin is estimated at 34,400 af. Artificial recharge and subsurface inflow are not determined. There is about 201,000 af of applied water recharge into the subbasin. Annual urban extraction and annual agricultural extraction are estimated to be 19,300 af and 641,000 af, respectively. Other extractions and subsurface outflow are not determined.

Groundwater Quality

Characterization. The water in the northern portion of this subbasin has a calcium bicarbonate type (Croft and Gordon 1968), while the southern portion of the subbasin is better characterized by a water chemistry of a sodium bicarbonate type (Hilton and others 1963). TDS values typically range from 200 to 600 mg/L. TDS values of shallow groundwater in drainage problem areas are as high as 30,000 mg/L (Fujii and Swain 1995). The Department of Health Services, which monitors Title 22 water quality standards, reports TDS values in 65 wells ranging from 20 to 490 mg/L, with an average value of 256 mg/L

Impairments. There is shallow, saline groundwater in the western portion of the subbasin (Vink 2001). The eastern side of the subbasin has localized nitrate pollution.

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	73	0
Radiological	71	3
Nitrates	71	6
Pesticides	73	1
VOCs and SVOCs	71	5
Inorganics – Secondary	73	10

[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)
Municipal/Irrigation	Range: 50 – 3,000
	Total depths (ft)
Domestic	
Municipal/Irrigation	Range: 200 - 1,400

Active Monitoring Data

Agency	Parameter	Number of wells /measurement frequency
DWR (incl. Cooperators)	Groundwater levels	459 Semi-annually
Department of Health Services (and cooperators)	Title 22 Water quality	150 Varies

Basin Management

Groundwater management:	None
Water agencies	
Public	Alpaugh I.D., Angiloa W.D., Atwell Island W.D., Delano-Earlimart I.D., Ducor I.D., Kern-Tulare W.D., Lower Tule River I.D., Pixley I.D., Porterville I.D., Rag Gulch W.D., Saucelito I.D., Teapot Dome W.D., Terra Bella I.D., Vandalia I.D.
Private	California Water Service.

References Cited

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Additional References

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Errata

Changes made to the basin description will be noted here.