

## Tulare Lake Hydrologic Region



Figure 37 Tulare Lake Hydrologic Region

## Basins and Subbasins of Tulare Lake Hydrologic Region

Basin/subbasin	Basin name
5-22	San Joaquin Valley
5-22.08	Kings
5-22.09	Westside
5-22.10	Pleasant Valley
5-22.11	Kaweah
5-22.12	Tulare Lake
5-22.13	Tule
5-22.14	Kern County
5-23	Panoche Valley
5-25	Kern River Valley
5-26	Walker Basin Creek Valley
5-27	Cummings Valley
5-28	Tehachapi Valley West
5-29	Castaic Lake Valley
5-71	Vallecitos Creek Valley
5-80	Brite Valley
5-82	Cuddy Canyon Valley
5-83	Cuddy Ranch Area
5-84	Cuddy Valley
5-85	Mil Potrero Area

## Description of the Region

The Tulare Lake HR covers approximately 10.9 million acres (17,000 square miles) and includes all of Kings and Tulare counties and most of Fresno and Kern counties (Figure 37). The region corresponds to approximately the southern one-third of RWQCB 5. Significant geographic features include the southern half of the San Joaquin Valley, the Temblor Range to the west, the Tehachapi Mountains to the south, and the southern Sierra Nevada to the east. The region is home to more than 1.7 million people as of 1995 (DWR, 1998). Major population centers include Fresno, Bakersfield, and Visalia. The cities of Fresno and Visalia are entirely dependent on groundwater for their supply, with Fresno being the second largest city in the United States reliant solely on groundwater.

## Groundwater Development

The region has 12 distinct groundwater basins and 7 subbasins of the San Joaquin Valley Groundwater Basin, which crosses north into the San Joaquin River HR. These basins underlie approximately 5.33 million acres (8,330 square miles) or 49 percent of the entire HR area.

Groundwater has historically been important to both urban and agricultural uses, accounting for 41 percent of the region's total annual supply and 35 percent of all groundwater use in the State. Groundwater use in the region represents about 10 percent of the State's overall supply for agricultural and urban uses (DWR 1998).

The aquifers are generally quite thick in the San Joaquin Valley subbasins with groundwater wells commonly exceeding 1,000 feet in depth. The maximum thickness of freshwater-bearing deposits (4,400 feet) occurs at the southern end of the San Joaquin Valley. Typical well yields in the San Joaquin Valley range from 300 gpm to 2,000 gpm with yields of 4,000 gpm possible. The smaller basins in the mountains surrounding the San Joaquin Valley have thinner aquifers and generally lower well yields averaging less than 500 gpm.

The cities of Fresno, Bakersfield, and Visalia have groundwater recharge programs to ensure that groundwater will continue to be a viable water supply in the future. Extensive groundwater recharge programs are also in place in the south valley where water districts have recharged several million acre-feet for future use and transfer through water banking programs.

The extensive use of groundwater in the San Joaquin Valley has historically caused subsidence of the land surface primarily along the west side and south end of the valley.

### **Groundwater Quality**

In general, groundwater quality throughout the region is suitable for most urban and agricultural uses with only local impairments. The primary constituents of concern are high TDS, nitrate, arsenic, and organic compounds.

The areas of high TDS content are primarily along the west side of the San Joaquin Valley and in the trough of the valley. High TDS content of west-side water is due to recharge of stream flow originating from marine sediments in the Coast Range. High TDS content in the trough of the valley is the result of concentration of salts because of evaporation and poor drainage. In the central and west-side portions of the valley, where the Corcoran Clay confining layer exists, water quality is generally better beneath the clay than above it. Nitrates may occur naturally or as a result of disposal of human and animal waste products and fertilizer. Areas of high nitrate concentrations are known to exist near the town of Shafter and other isolated areas in the San Joaquin Valley. High levels of arsenic occur locally and appear to be associated with lakebed areas. Elevated arsenic levels have been reported in the Tulare Lake, Kern Lake and Buena Vista Lake bed areas. Organic contaminants can be broken into two categories, agricultural and industrial. Agricultural pesticides and herbicides have been detected throughout the valley, but primarily along the east side where soil permeability is higher and depth to groundwater is shallower. The most notable agricultural contaminant is DBCP, a now-banned soil fumigant and known carcinogen once used extensively on grapes. Industrial organic contaminants include TCE, DCE, and other solvents. They are found in groundwater near airports, industrial areas, and landfills.

### ***Water Quality in Public Supply Wells***

From 1994 through 2000, 1,476 public supply water wells were sampled in 14 of the 19 groundwater basins and subbasins in the Tulare Lake HR. Evaluation of analyzed samples shows that 1,049 of the wells, or 71 percent, met the state primary MCLs for drinking water. Four-hundred-twenty-seven wells, or 29 percent, exceeded one or more MCL. Figure 38 shows the percentages of each contaminant group that exceeded MCLs in the 427 wells.

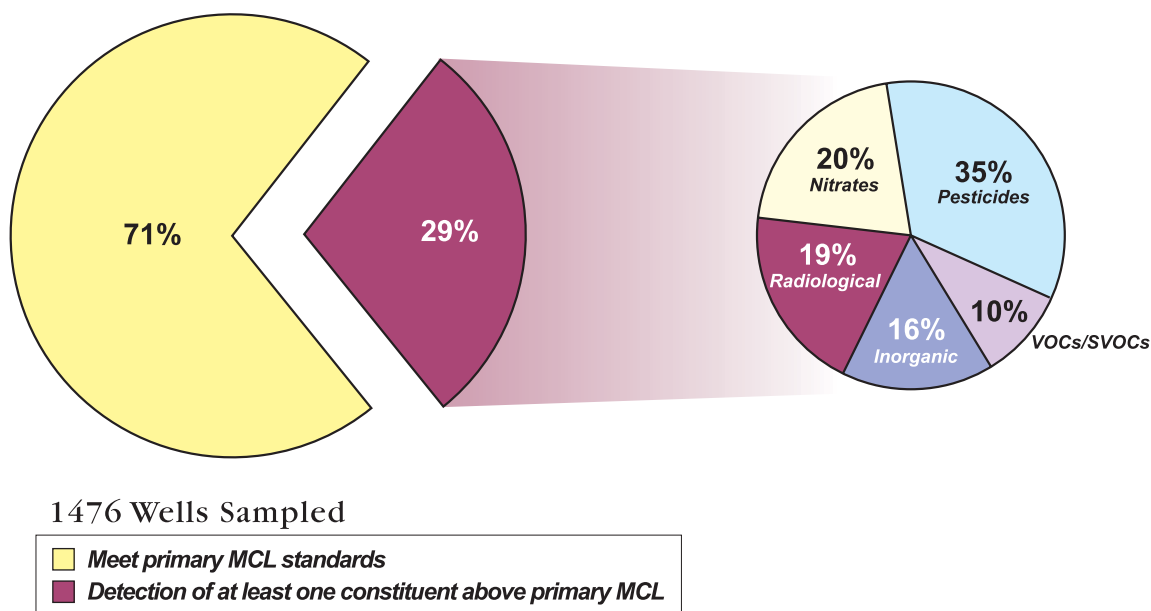


Figure 38 MCL exceedances by contaminant group in public supply wells in the Tulare Lake Hydrologic Region

Table 31 lists the three most frequently occurring contaminants in each of the six contaminant groups and shows the number of wells in the HR that exceeded the MCL for those contaminants.

Table 31 Most frequently occurring contaminants by contaminant group in the Tulare Lake Hydrologic Region

Contaminant group	Contaminant - # of wells	Contaminant - # of wells	Contaminant - # of wells
Inorganics - Primary	Fluoride – 32	Arsenic – 16	Aluminum – 13
Inorganics - Secondary	Iron – 155	Manganese – 82	TDS – 9
Radiological	Gross Alpha – 74	Uranium – 24	Radium 228 – 8
Nitrates	Nitrate(as $\text{NO}_3$ ) – 83	Nitrate + Nitrite – 14	Nitrite(as N) – 3
Pesticides	DBCP – 130	EDB – 24	Di(2-Ethylhexyl)phthalate – 7
VOCs/SVOCs	TCE – 17	PCE – 16	Benzene – 6 MTBE – 6

DBCP = Dibromochloropropane  
 EDB = Ethylenedibromide  
 TCE = Trichloroethylene  
 PCE = Tetrachloroethylene  
 VOC = Volatile organic compound  
 SVOC = Semivolatile organic compound

### Changes from Bulletin 118-80

There are no newly defined basins since Bulletin 118-80. However, the subbasins of the San Joaquin Valley, which were delineated as part of the 118-80 update, are given their first numeric designation in this report (Table 32).

**Table 32 Modifications since Bulletin 118-80 of groundwater basins and subbasins in Tulare Lake Hydrologic Region**

Subbasin name	New number	Old number
Kings	5-22.08	5-22
Westside	5-22.09	5-22
Pleasant Valley	5-22.10	5-22
Kaweah	5-22.11	5-22
Tulare Lake	5-22.12	5-22
Tule	5-22.13	5-22
Kern County	5-22.14	5-22
Squaw Valley	deleted	5-24
Cedar Grove Area	deleted	5-72
Three Rivers Area	deleted	5-73
Springville Area	deleted	5-74
Templeton Mountain Area	deleted	5-75
Manache Meadow Area	deleted	5-76
Sacator Canyon Valley	deleted	5-77
Rockhouse Meadows Valley	deleted	5-78
Inns Valley	deleted	5-79
Bear Valley	deleted	5-81

Several basins have been deleted from the Bulletin 118-80 report. In Squaw Valley (5-24) all 118 wells are completed in hard rock. Cedar Grove Area (5-72) is a narrow river valley in Kings Canyon National Park with no wells. Three Rivers Area (5-73) has a thin alluvial terrace deposit but 128 of 130 wells are completed in hard rock. Springville Area (5-74) is this strip of alluvium adjacent to Tule River and all wells are completed in hard rock. Templeton Mountain Area (5-75), Manache Meadow Area (5-76), and Sacator Canyon Valley (5-77) are all at the crest of mountains with no wells. Rockhouse Meadows Valley (5-78) is in wilderness with no wells. Inns Valley (5-79) and Bear Valley (5-81) both have all wells completed in hard rock.

Table 33 Tulare Lake Hydrologic Region groundwater data

Basin/Subbasin	Basin Name	Area (acres)	Groundwater Budget Type	Well Yields (gpm)		Types of Monitoring			TDS (mg/L)	
				Maximum	Average	Levels	Quality	Title 22	Average	Range
5-22	SAN JOAQUIN VALLEY									
5-22.08	KINGS	976,000	C	3,000	500-1,500	909	-	722	200-700	40-2000
5-22.09	WESTSIDE	640,000	C	2,000	1,100	960	-	50	520	220-35,000
5-22.10	PLEASANT VALLEY	146,000	B	3,300	-	151	-	2	1,500	1000-3000
5-22.11	KAWEAH	446,000	B	2,500	1,000-2,000	568	-	270	189	35-580
5-22.12	TULARE LAKE	524,000	B	3,000	300-1,000	241	-	86	200-600	200-40,000
5-22.13	TULE	467,000	B	3,000	-	459	-	150	256	200-30,000
5-22.14	KERN COUNTY	1,950,000	A	4,000	1,200-1,500	2,258	249	476	400-450	150-5000
5-23	PANOCHE VALLEY	33,100	C	-	-	48	-	-	1,300	394-3530
5-25	KERN RIVER VALLEY	74,000	C	3,650	350	-	-	92	378	253-480
5-26	WALKER BASIN CREEK VALLEY	7,670	C	650	-	-	-	1	-	-
5-27	CUMMINGS VALLEY	10,000	A	150	56	51	-	15	344	-
5-28	TEHACHAPI VALLEY WEST	14,800	A	1,500	454	64	-	19	315	280-365
5-29	CASTAC LAKE VALLEY	3,600	C	400	375	-	-	3	583	570-605
5-71	VALLECITOS CREEK VALLEY	15,100	C	-	-	-	-	0	-	-
5-80	BRITE VALLEY	3,170	A	500	50	-	-	-	-	-
5-82	CUDDY CANYON VALLEY	3,300	C	500	400	-	-	3	693	695
5-83	CUDDY RANCH AREA	4,200	C	300	180	-	-	4	550	480-645
5-84	CUDDY VALLEY	3,500	A	160	135	3	-	3	407	325-645
5-85	MIL POTRERO AREA	2,300	C	3,200	240	7	-	7	460	372-657

gpm - gallons per minute

mg/L - milligram per liter

TDS -total dissolved solids

## **San Joaquin Valley Groundwater Basin**

### **Kings Subbasin**

- Groundwater Subbasin Number: 5-22.08
- County: Fresno, Kings, and Tulare
- Surface Area: 976,000 acres (1,530 square miles)

#### **Subbasin 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 Kings Subbasin is bounded on the north by the San Joaquin River. The northwest corner of the subbasin is formed by the intersection of the east line of the Farmers Water District with the San Joaquin River. The west boundary of the Kings Subbasin is the eastern boundaries of the Delta-Mendota and Westside Subbasins. The southern boundary runs easterly along the northern boundary of the Empire West Side Irrigation District, the southern fork of the Kings River, the southern boundary of Laguna Irrigation District, the northern boundary of the Kings County Water District, the southern boundaries of Consolidated and Alta Irrigation Districts, and the western boundary of Stone Corral Irrigation District. The eastern boundary of the subbasin is the alluvium-granitic rock interface of the Sierra Nevada foothills.

The San Joaquin and Kings Rivers are the two principal rivers within or bordering the subbasin. The Fresno Slough and James Bypass are along the western edge of the subbasin and connect the Kings River with the San Joaquin River. Average annual precipitation values range from seven to 10 inches, increasing eastward.

#### **Hydrogeologic Information**

The San Joaquin Valley represents the southern portion of the Great Central Valley of California. The San Joaquin Valley is a structural trough up to 200 miles long and 70 miles wide. It is 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 Kings Subbasin groundwater aquifer system consists of unconsolidated continental deposits. These deposits are an older series of Tertiary and Quaternary age overlain by a younger series of deposits of Quaternary age. The Quaternary age deposits are divided into older alluvium, lacustrine and marsh deposits, younger alluvium, and flood-basin deposits.

The older alluvium is an important aquifer in the subbasin. It consists of intercalated lenses of clay, silt, silty and sandy clay, clayey and silty sand, sand, gravel, cobbles, and boulders. It is, generally, fine grained near the trough of the valley. Lacustrine and marsh deposits are interbedded with the older alluvium in the western portion of the subbasin.

The younger alluvium is a sedimentary deposit of fluvial arkosic beds that overlies the older alluvium and is interbedded with the flood-basin deposits. Its lithology is similar to the underlying older alluvium. Beneath river channels, the younger alluvium is highly permeable. Beneath flood plains, it may be of poor permeability. The flood-basin deposits occur along the Fresno Slough and James Bypass. They consist of sand, silt, and clay.

The continental deposits of Tertiary and Quaternary age crop out beneath the extreme southeastern part of the subbasin and yield small amounts of water to wells. The deposits of Quaternary age are exposed over most of the area and yield more than 90 percent of the water pumped from wells (Page and LeBlanc 1969).

Page and LeBlanc (1969) indicate that the specific yields in the subbasin range from a low of 0.2 percent to 36 percent. To calculate storage capacity in the 10 to 200 foot depth range, Davis and others (1959) used a range of specific yields from approximately six percent to 18 percent. Williamson and others (1989) used an average specific yield of 11.3 percent in the area of the subbasin for computer modeling purposes.

### ***Restrictive Structures***

The lacustrine and marsh deposits contain silts and clays and restrict the vertical movement of water. The Corcoran Clay (E-clay) member of the Tulare formation is the most extensive of these deposits and occupies the western one-quarter to one-third of the subbasin. Its depth ranges from about 250-550 feet (DWR 1981) although much of the information shown on the map is indicated as inferred. The A-clay and C-clay are less extensive and lie above the Corcoran Clay. These clay layers cause confined groundwater conditions beneath them.

### ***Recharge Areas***

Groundwater recharge occurs from river and stream seepage, deep percolation of irrigation water, canal seepage, and intentional recharge. The Cities of Fresno and Clovis, Fresno Irrigation District, and Fresno Metropolitan Flood Control District have a cooperative effort to utilize individually owned facilities to recharge water in the greater urban area. Fresno Irrigation District, Consolidated Irrigation District, and others have

recharge efforts in the subbasin. The Fresno-Clovis metropolitan area uses a regional sewage treatment facility that disposes of water in percolation ponds southwest of Fresno.

### ***Groundwater Level Trends***

Groundwater flow is generally to the southwest. Two notable groundwater depressions exist. One is centered in Fresno-Clovis urban area. The other is centered approximately 20 miles southwest of Fresno (DWR 2000) in the Raisin City Water District.

Most well water levels indicated a response to the 1976-77 drought. After the 1987-92 drought, wells in the northeast showed water levels from 10 to 40 feet below pre-1976-77 drought water levels. Water levels in the western subbasin experienced declines of 10 to 50 feet during the 1987-92 drought and are in various stages of recovery to mid-1980s levels. Water levels in the southeast have, generally, recovered to mid-1980s levels.

### ***Groundwater Storage***

Groundwater in Storage.

Williamson (1989) indicates that the groundwater in storage was 93,000,000 af in 1961. This estimate was to a depth of 1,000 feet or less.

### ***Groundwater Budget (Type C)***

The potential for subsurface flows south and westward exists. Depending upon groundwater conditions in the Westside Subbasin, subsurface flows may occur in that direction. The potential for groundwater flow in either direction along the southern boundary exists. Groundwater depressions on either side of the boundary and groundwater mounding from recharge along the Kings River complicate flow patterns in the area.

### ***Groundwater Quality***

**Characterization.** The groundwater is predominantly of bicarbonate type. The major cations are calcium, magnesium, and sodium. Sodium appears higher in the western portion of the subbasin where some chloride waters are also found (Page and LeBlanc 1969).

Page and LeBlanc (1969) noted that the TDS of groundwater in the Fresno area seldom exceeds 600 mg/L although at greater depths, 2,000 mg/L groundwater has been encountered. A typical range of groundwater quality in the basin is 200 to 700 mg/L.

DHS data indicates an average TDS of 240 mg/L from 414 samples from Title 22 water supply wells. These samples ranged from 40 to 570 mg/L.

**Impairments.** Dibromochloropropane (DBCP), a soil fumigant nematicide, and nitrates can be found in groundwater along the eastern side of the subbasin. Shallow brackish groundwater can be found along the western portion of the subbasin. Elevated concentrations of fluoride, boron, and sodium can be found in localized areas of the subbasin.

## Water Quality in Public Supply Wells

Constituent Group <sup>1</sup>	Number of wells sampled <sup>2</sup>	Number of wells with a concentration above an MCL <sup>3</sup>
Inorganics – Primary	457	8
Radiological	443	24
Nitrates	463	23
Pesticides	495	105
VOCs and SVOCs	468	17
Inorganics – Secondary	457	41

<sup>1</sup> 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).

<sup>2</sup> Represents distinct number of wells sampled as required under DHS Title 22 program from 1994 through 2000.

<sup>3</sup> 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: – 20-3,000 (Page And LeBlanc 1969)	Average: 500-1,500
Total depths (ft)		
Domestic	Range: - Not determined	Average: Not determined
Municipal/Irrigation	Range: - 100-500 (Page and LeBlanc 1969 Table 14)	Average: 210

## Active Monitoring Data

Agency	Parameter	Number of wells /measurement frequency
DWR and Cooperating Agencies	Groundwater levels	909 Semi-annually
Local Agencies	Miscellaneous water quality	Varies
Department of Health Services and Cooperators	Title 22 Water quality	722 Varies

## Basin Management

Groundwater management:	The County of Fresno has an adopted groundwater management ordinance. The following entities have adopted AB3030 management plans: Alta Irrigation District, Consolidated Irrigation District, County of Fresno, Fresno Irrigation District, James Irrigation District, Kings River Conservation District, Kings River Water District, Liberty Canal Company, Liberty Water District, Liberty Mill Race Company, Mid Valley Water District, Orange Cove Irrigation District, Raisin City Water District, and Riverdale Irrigation District.
Water agencies	
Public	City of Fresno, City of Clovis, Alta I.D., Consolidated I.D., Fresno I.D., Hills Valley I.D., James I.D., Kings River Conservation District, Kings River Water District, Laguna I.D., Liberty Water District, Mid-Valley W.D., Orange Cove I.D., Raisin City W.D., Riverdale I.D., and Tri-Valley I.D.
Private	California Water Service Co., Bakman Water Company

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## Errata

Changes made to the basin description will be noted here.