# Sacramento Valley Groundwater Basin, Red Bluff Subbasin

Groundwater Basin Number: 5-21.50

• County: Tehama

• Surface Area: 266,750 acres (416 square miles)

## **Basin Boundaries and Hydrology**

The Red Bluff Subbasin is bounded on the west by the Coast Ranges, on the north by the Red Bluff Arch, on the south by Thomes Creek and on the east by the Sacramento River. The Red Bluff Arch is a hydrologic divide between the Redding Basin to the north and the Sacramento Valley. The Red Bluff Subbasin is likely contiguous with the Corning Subbasin at depth. Annual precipitation in the subbasin ranges from 19- to 27-inches with higher precipitation occurring to the north.

# **Hydrogeologic Information**

## Water-Bearing Formations

The Red Bluff Subbasin aquifer system is composed of continental deposits of late Tertiary to Quaternary age. The Quaternary deposits include Holocene stream channel deposits and Pleistocene Modesto and Riverbank formations. The Tertiary deposits consist of Pliocene Tehama and Tuscan formations.

Holocene Stream Channel Deposits. These deposits consist of unconsolidated gravel, sand, silt and clay derived from the erosion, reworking, and deposition of adjacent Tehama Formation and Quaternary stream terrace deposits found at or near the surface along stream and river channels. The thickness varies from 1-to 80-feet (Helley and Harwood 1985). This unit represents the upper part of the unconfined zone of the aquifer. Although it is moderately to highly permeable it is not a significant contributor to groundwater because of its limited areal extent.

**Pleistocene Modesto Formation.** The Modesto Formation (deposited between 14,000 to 42,000 years ago) consists of poorly indurated gravel and cobbles with sand, silt, and clay derived from reworking and deposition of the Tehama and Riverbank formations. The deposit ranges from less than 10 feet to nearly 200 feet across the valley floor (Helley and Harwood 1985). The terrace deposits are observed along Thomes, Elder, and Red Bank Creeks.

**Pleistocene Riverbank Formation.** The Riverbank Formation (deposited between 130,000 to 450,000 years ago) consists of poorly-to-highly permeable pebble and small cobble gravels interlensed with reddish clay sands and silt. The formation ranges from less than one foot to over 200 feet thick depending on location (Helley and Harwood 1985). Riverbank terrace deposits are observed along Thomes, Pine, Dibble, Reeds, Red Bank, Oat and Elder Creeks.

**Pliocene Tehama Formation.** The Tehama Formation consists of sediments originating from the Coast Range and Klamath Mountains, and is the primary

source of groundwater for the subbasin. The majority of the Tehama Formation consists of fine-grained sediments indicative of deposition under floodplain conditions (McManus 1993). The thickness of coarse-grained beds of sand and gravel, as indicated by drill log data, are typically no more than 5- to 10-feet. The majority of both coarse and fine-grained sediments appears unconsolidated or moderately consolidated. The thickness of the formation is estimated to be up to 1,200 feet north of the City of Corning (DWR 2000).

**Pliocene Tuscan Formation.** The Tuscan Formation consists of volcanic gravel and tuff-breccia, fine- to coarse-grained volcanic sandstone, conglomerate and tuff, and tuffaceous silt and clay; derived predominantly from andesitic and basaltic sources of the Cascade Range. In the subsurface the Tuscan Formation is found juxtaposed with the Tehama Formation in the axis of the valley near the Sacramento River. Permeability is moderate to high with yields ranging from 100 to 1,000 gpm, excluding areas where beds of the impermeable tuff-breccia exist.

#### Restrictive Structures

The Red Bluff Arch is a hydrologic divide between the Redding Basin to the north and the Sacramento Valley.

#### **Groundwater Level Trends**

Review of hydrographs for long-term comparison of spring-spring groundwater levels indicates a decline of 3- to 7-feet associated with the 1976-77 and 1987-94 droughts, followed by a recovery to pre-drought conditions of the early 1970's and 1980's. Generally, groundwater level data show a seasonal fluctuation ranging from 5- to 10-feet for unconfined, semi-confined, and composite wells. Wells constructed in confined aquifers can fluctuate up to 50 feet. Overall, there does not appear to be any increasing or decreasing trends in the groundwater levels.

#### **Groundwater Storage**

The storage capacity of the subbasin was estimated based on estimates of specific yield for the Sacramento Valley as developed in DWR (1978). Estimates of specific yield, determined on a regional basis, were used to obtain a weighted specific yield conforming to the subbasin boundary. The estimated specific yield for the subbasin is 7.9 percent. The estimated storage capacity to a depth of 200 feet is approximately 4,208,851 acre-feet.

#### Groundwater Budget (Type B)

Estimates of groundwater extraction for the Red Bluff Subbasin are based on a survey conducted by the California Department of Water Resources in 1994. The survey included landuse and sources of water. The estimate of groundwater extraction for agricultural use is estimated to be 81,000 acrefeet. Groundwater extraction for municipal and industrial uses is 8,900 acrefeet. Deep percolation from applied water is estimated to be 20,000 acrefeet.

## **Groundwater Quality**

**Characterization.** Calcium-magnesium bicarbonate and magnesium-calcium bicarbonate are the predominant groundwater types in the subbasin. Total dissolved solids (TDS) concentrations range from 120- to 500-mg/L and average 207 mg/L (DWR unpublished data).

**Impairments.** Impairments include high magnesium, TDS, calcium, ASAR, and phosphorus.

## 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	41	2
Radiological	33	0
Nitrates	41	0
Pesticides	23	0
VOCs and SVOCs	16	0
Inorganics – Secondary	41	4

<sup>&</sup>lt;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).

#### **Well Characteristics**

Well yields (gal/min)				
Municipal/Irrigation	Range: 50 – 1,200	Average: 363 (4 Well		
Completion Reports)  Total depths (ft)				
Domestic	Range: 20 – 780	Average: 197 (3293 Well Completion		
Municipal/Irrigation	Range: 22 – 465	Reports) Average: 207 (18 Well Completion Reports)		

Bulletin 118 by DWR (2003).
 Represents distinct number of wells sampled as required under DHS Title 22 program from 1994 through 2000.
 Each well reported with a concentration above an MCL was confirmed with a

<sup>&</sup>lt;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.

## **Active Monitoring Data**

Agency	Parameter	Number of wells /measurement frequency
DWR	Groundwater levels	29 wells semi-annually
USBR	Groundwater levels	1 well semi-annually
DWR	Miscellaneous water quality	10 wells biennially
Department of Health Services and cooperators	Miscellaneous water quality	56

#### **Basin Management**

Basiii Management	
Groundwater management:	Tehama County adopted a groundwater management ordinance in 1994. Tehama County adopted a countywide AB 3030 plan in 1996.
Water agencies	·
Public	Tehama County Flood Control and Water Conservation District. El Camino ID, Elder Creek WD, Gerber-Los Flores Community Service District, Gerber Water Works Inc., Tehama Ranch M.W.C., Proberta WD, Rawson WD, Thomes Creek WD, City of Red Bluff.
Private	

#### **Selected References**

- California Department of Water Resources. 1978. Evaluation of Groundwater Resources: Sacramento Valley. Department of Water Resources in cooperation with the United States Geological Survey. Appendix A. Bulletin 118-6.
- California Department of Water Resources (DWR). 2000. Geology and Hydrogeology of the Freshwater Bearing Aquifer Systems of the Northern Sacramento Valley, California. In Progress.
- McManus D. 1993. Groundwater Resource Evaluation of the West-Side of the Upland Area: Sacramento Valley [M.S.]: California State University, Chico.
- Helley EJ, Harwood DS. 1985. Geologic Map of the Late Cenozoic Deposits of the Sacramento Valley and Northern Sierran Foothills, California. USGS Map MF-1790.

## **Bibliography**

- Bailey EH. 1966. Geology of Northern California. California Division of Mines and Geology. Bulletin 190.
- Berkstressor CF. 1973. Base of Fresh Water in the Sacramento Valley and Sacramento-San Joaquin Delta, California. U.S. Geological Survey in Cooperation with California Department of Water Resources.
- Bertoldi G. 1976. Chemical Quality of Ground Water in the Tehama Colusa Canal Service Area, Sacramento Valley, California. USGS. Water Resources Investigations 76-92.
- Bertoldi GT, Johnson RH, Evenson KD. 1991. Groundwater in the Central Valley, California A Summary Report. Regional Aquifer System Analysis--Central Valley, California. USGS. Professional Paper 1401-A.
- Beyer LA. 1993. Sacramento Basin Province. USGS.

- Blake MC, Jayko AS, Murchey BL, Jones DL. 1987. Structure, Age, and Tectonic Significance of the Coast Range Ophiolite and Related Rocks Near Paskenta, California. Geological Society of America.
- Bryan K. 1923. Geology and Ground-water Resources of Sacramento Valley, California. USGS. 495.
- California Department of Pesticide Regulation. 1993. Sampling for Pesticide Residues in California Well Water, 1993 Well Inventory Database. California Environmental Protection Agency.
- California Department of Water Resources. 1958. Ground Water Conditions in Central and Northern California 1957-58. California Department of Water Resources. Bulletin 77-58.
- California Department of Water Resources. 1964. Quality of Ground Water in California 1961-62, Part 1: Northern and Central California. California Department of Water Resources. Bulletin 66-62.
- California Department of Water Resources. 1964. Groundwater Conditions in Central and Northern California,1961-62. California Dept. of Water Resources.
- California Department of Water Resources. 1966. Precipitation in the Central Valley. Coordinated Statewide Planning Program. California Department of Water Resources, Sacramento District. Office Report.
- California Department of Water Resources. 1975. California's Ground Water. California Department of Water Resources. Bulletin 118.
- California Department of Water Resources. 1975. Progress Report Sacramento And Redding Basins Groundwater Study. California Department of Water Resources, Northern and Central Districts, in cooperation with the U.S. Geological Survey. Bulletin 118.
- California Department of Water Resources. 1976. Progress Report in Ground Water Development Studies, North Sacramento Valley. California Department of Water Resources, Northern District. Memorandum Report.
- California Department of Water Resources. 1980. Ground Water Basins in California. California Department of Water Resources. Bulletin 118-80.
- California Department of Water Resources. 1987. Progress Report Sacramento and Redding Basins Ground Water Study. California Department of Water Resources, Northern and Central Districts, in cooperation with the U.S. Geological Survey.
- California Department of Water Resources. 1993. Ground Water Levels in the Sacramento Valley Ground Water Basin; Tehama County. California Department of Water Resources, Northern District.
- California Department of Water Resources. 1995. Sacramento Valley Groundwater Quality Investigation. California Department of Water Resources, Northern District.
- California Department of Water Resources. 1998. California Water Plan Update. California Department of Water Resources. Bulletin 160-98 Volumes 1 and 2.
- Cherven VB, Edmondson WF. 1992. Structural Geology of the Sacramento Basin: Annual Meeting, Pacific Section AAPG, Sacramento, California, April 27, 1992-May 2,1992.
- Dickinson WR, Ingersoll RV, Grahm SA. 1979. Paleogene Sediment Dispersal and Paleotectonics in Northern California. Geological Society of America Bulletin 90:1458-1528.
- Fogelman RP. 1976. Descriptions and Chemical Analysis for Selected Wells in the Central Sacramento Valley, California. USGS. OF-76-472.
- Fogelman RP. 1978. Chemical Quality of Ground Water in the Central Sacramento Valley, California. USGS. Water Resources Investigations77-133.
- Fogelman RP. 1982. Dissolved-solids Concentrations of Groundwater in the Sacramento Valley, California. USGS. HA-645.
- Fogelman RP. 1983. Ground Water Quality in the Sacramento Valley, California, Water Types and Potential Nitrate and Boron Problem Areas. USGS. HA-651.

- Fogelman RP, Rockwell GL. 1977. Descriptions and Chemical Analysis for Selected Wells in the Eastern Sacramento Valley, California. USGS. OF-77-486.
- Graham SA, Lowe DR, editors. 1993. Advances in Sedimentary Geology of the Great Valley Group, Sacramento Valley, California.
- Harwood DS, Helley EJ. 1982. Preliminary Structure Contour Map of the Sacramento Valley, California, Showing Major Late Cenozoic Structural Features and Depth to Basement. USGS.
- Harwood DS, Helley EJ. 1987. Late Cenozoic Tectonism of the Sacramento Valley. USGS.
- Helley EJ, Harwood DS. 1985. Geologic Map of the Late Cenozoic Deposits of the Sacramento Valley and Northern Sierra Foothills, California. USGS. Map MF-1790.
- Helley EJ, Jaworowski C. 1985. The Red Bluff Pediment; A Datum Plane for Locating Quaternary Structures in the Sacramento Valley, California. USGS.
- Hull LC. 1984. Geochemistry of Groundwater in the Sacramento Valley, California. Central Valley of California RASA Project. USGS. Professional Paper 1401-B.
- Ingersoll RV, Rich EI, Dickerson WR. 1977. Field Guide: Great Valley Sequence, Sacramento Valley.
- Mankinen EA. 1978. Paleomagnetic Evidence for a Late Cretaceous Deformation of the Great Valley Sequence, Sacramento Valley, California. USGS.
- Mitten HT. 1972. Estimated Ground-water Pumpage in the Northern Part of the Sacramento Valley, California,1966-69. USGS.
- Mitten HT. 1973. Estimated Ground-water Pumpage in the Northern Part of the Sacramento Valley, California, 1970-71. USGS.
- Olmsted FH, Davis GH. 1961. Geologic Features and Ground Water Storage Capacity of the Sacramento Valley, California. USGS. Water Supply Paper 1497.
- Page RW. 1974. Base and Thickness of the Post-Eocene Continental Deposits in the Sacramento Valley, California. U.S. Geological Survey in cooperation with California Department of Water Resources. Water Resources Investigations 45-73.
- Page RW. 1986. Geology of the Fresh Groundwater Basin of the Central Valley, California, with Texture Maps and Sections. Regional Aquifer System Analysis. USGS. Professional Paper 1401-C.
- Planert M, Williams JS. 1995. Ground Water Atlas of the United States, Segment 1, California, Nevada. USGS. HA-730-B.
- Poland JF, Evenson RE. 1966. Hydrogeology and Land Subsidence, Great Central Valley, California, Geology of Northern California. California Division of Mines and Geology. 239-247 p.
- Russell RD. 1931. The Tehama Formation of Northern California [Ph.D]: University of California.
- Steele WC. 1980. Quaternary Stream Terraces in the Northwestern Sacramento Valley, Glenn, Tehama, and Shasta Counties, California. USGS.
- Tehama County Flood Control and Water Conservation District. 1996. Coordinated AB 3030 Groundwater Management Plan. Tehama County Flood Control and Water Conservation District.
- Tehama County Flood Control and Water Conservation District. 1999. Coordinated AB 3030 Groundwater Management Plan, First Annual Report. Tehama County Flood Control and Water Conservation District.
- U.S.Geogolgical Survey. 1981. Water Resources Data for California; Volume 4, Northern Central Valley Basins and the Great Basin from Honey Lake Basin to Oregon State Line. USGS
- Williamson AK, Prudic DE, Swain LA. 1985. Groundwater Flow in the Central Valley, California. USGS. USGS OF-85-345.

Williamson AK, Prudic DE, Swain LA. 1989. Groundwater Flow in the Central Valley, California. Regional Aquifer-System Analysis--Central Valley, California. USGS. Professional Paper 1401-D.

## **Errata**

Changes made to the basin description will be noted here.