Redding Groundwater Basin, Millville Subbasin

- Groundwater Basin Number: 5-6.05
- County: Shasta
- Surface Area: 67,900 acres (106 square miles)

Basin Boundaries and Hydrology

The Millville Subbasin comprises the portion of the Redding Groundwater Basin bounded on the west by Cow Creek, Little Cow Creek, and the Sacramento River; on the north by the Klamath Mountains; on the east by the Cascade Range; and on the south by Battle Creek. Annual precipitation ranges from 27- to 31-inches, increasing to the north.

Hydrogeologic Information

Water-Bearing Formations

The Millville Subbasin aquifer system is comprised of continental deposits of late Tertiary to Quaternary age. The Quaternary deposits include Holocene alluvium and Pleistocene Modesto and Riverbank formations. The Tertiary deposits include the Pliocene Tehama Formation along the Sacramento River and the Tuscan Formation. The Tuscan Formation is the primary water-bearing unit in the subbasin. The following descriptions of water-bearing formations are from Helley and Harwood (1985) unless otherwise noted.

Holocene Alluvium. The alluvium consists of unconsolidated gravel, sand, silt and clay from stream channel and floodplain deposits. These alluvial deposits are found along stream and river channels. The thickness ranges up to 30 feet. This unit represents the perched water table and the upper part of the unconfined zone of the aquifer. Although the alluvium is moderately permeable, it is not a significant contributor to groundwater usage due to its geomorphic distribution.

Pleistocene Modesto and Riverbank Formations. The Modesto and Riverbank formations consist of poorly consolidated gravel with some sand and silt deposited during the Pleistocene. The formations are usually found as terrace deposits near the surface along the Sacramento River and tributaries. The thickness ranges to 50 feet. They are moderately to highly permeable and can yield limited domestic water supplies.

Pliocene Tehama Formation. The Tehama Formation consists of locally cemented silts, sand, gravel, and clay of fluviatile origin derived from the Klamath Mountains and Coast Ranges. The permeability of the formation is moderate to high with yields of 100- to 1,000-gpm.

Pliocene Tuscan Formation. The Tuscan Formation is composed of a series of volcanic mudflows, tuff breccia, tuffaceous sandstone and volcanic ash layers and is the principal water-bearing formation in the subbasin. The formation is described as four separate but lithologically similar units, Units A through D (with Unit A being the oldest), which in some areas are separated by layers of thin tuff or ash units.

Unit A is the oldest water bearing unit of the formation and is characterized by the presence of metamorphic clasts within interbedded lahars, volcanic conglomerate, volcanic sandstone and siltstone. Unit B is composed of a fairly equal distribution of lahars, tuffaceous sandstone, and conglomerate. Coarse cobble to boulder conglomerate predominates the deposit in the eastern and northern parts of mapped unit. Unit C consists of several massive mudflow or lahar deposits with some interbedded volcanic conglomerate and sandstone. Unit D consists of fragmental deposits characterized by large monolithologic masses of andesite, pumice, and fragments of black obsidian in a mudstone matrix. The unit has limited areal extents and may not occur within the Redding Basin. Unit C is the primary surfacial deposit within the subbasin. Surfacial deposits of Unit B are exposed over 15- to 20- percent of the subbasin to the north.

Deposits of the Tehama and Tuscan formations interfinger along the western extents of the subbasin. Deposits of the Chico Formation outcrop in the northern most portion of the subbasin in the vicinity of Little Cow Creek and Cow Creek. DWR (1964) reports that deposits of Tehama and Tuscan formations begin at the northern extents of the subbasin and increase in thickness to approximately 1,000 feet at the confluence of Cow Creek and the Sacramento River. In the vicinity of Palo Cedro, the thickness of the sediments is approximately 500 feet. The thickness of the deposits decreases to the east and deposits of the Chico Formation between Cow Creek and Oak Run Creek in the northern half of the subbasin show that the Tuscan has been totally eroded in those areas.

Recharge Areas

Recharge to the principal aquifer is mostly by infiltration of stream flows. Infiltration of applied water and stream flows and direct infiltration of precipitation are the main sources of recharge into the alluvium (Pierce 1983).

Groundwater Level Trends

Review of hydrographs for long-term comparison of spring-spring groundwater levels indicates a slight decline of approximately 5-feet associated with the 1976-77 and 1987-94 droughts, followed by a gradual recovery in levels to pre-drought conditions of the early 1970's and 1980's. Generally, seasonal fluctuations range from 2- to 8-feet for normal and dry years. Overall, there does not appear to be any increasing or decreasing trend in groundwater levels.

Groundwater Storage

Groundwater Storage Capacity. The storage capacity for the entire Redding Basin is estimated to be 5.5 million acre-feet for 200 feet of saturated thickness over an area of approximately 510 square miles (Pierce 1983). Specific yield data for the Millville Subbasin aquifer system is not available to estimate storage capacity at the subbasin level.

Groundwater Budget (Type B)

Estimates of groundwater extraction are based on surveys conducted by the California Department of Water Resources during 1994 and 1995. Surveys

included land use and sources of water. Estimates of groundwater extraction for agricultural and municipal/industrial uses are 250 and 1,273 acre-feet respectively. Deep percolation of applied water is estimated to be 912 acre-feet.

Groundwater Quality

Characterization. Groundwater in the basin is characterized as bicarbonate type waters with mixed cationic character. Some sodium chloride type waters occur locally. Total dissolved solids concentration is approximately 140 mg/L (DWR unpublished data).

Impairments. High concentrations of total dissolved salts and chlorides are present in underlying marine deposits. Groundwater containing sodium and boron occurs where wells draw from the Chico Formation. Locally high iron and manganese concentrations can occur.

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	1	0
Radiological	1	0
Nitrates	1	0
Pesticides	1	0
VOCs and SVOCs	1	0
Inorganics – Secondary	1	0

[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)	
Irrigation	Range: 8 – 500	Average: 254 (2 Well Completion Reports)
	Total depths (ft)	
Domestic	Range: 40 – 650	Average: 156 (487 Well Completion Reports)
Irrigation	Range: 50 – 700	Average: 265 (8 Well Completion Reports)

Active Monitoring Data

Agency	Parameter	Number of wells /measurement frequency
DWR	Groundwater levels	6 wells semi-annually
DWR	Miscellaneous Water Quality	5
Department of Health Services	Miscellaneous Water Quality	9

Basin Management

Groundwater management:	Shasta County adopted a groundwater management ordinance in 1998.
Water agencies	
Public	Redding Area Water Committee, Bella Vista WD, Shasta Co. Water Agency, Shasta Community Service District.
Private	

References Cited

Helley EJ, Harwood DS. 1985. Geologic Map of the Late Cenozoic Deposits of the Sacramento Valley and Northern Sierran Foothills, California. Map MF-1790.

Pierce MJ. 1983. Ground Water in the Redding Basin Shasta and Tehama Counties California. Water-Resources Investigations Report 83-4052.

California Department of Water Resources. 1964. Shasta County Investigation. Appendixes E through P. Bulletin 22.

Additional References

Bailey EH. 1966. Geology of Northern California. California Division of Mines and Geology. Bulletin 190.

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. 1965. Upper Sacramento River Basin Investigation. California Department of Water Resources. Bulletin 150.

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. 1968. Water Well Standards-Shasta County, California. California Department of Water Resources. Bulletin 74-8.

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. 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. 1980. Ground Water Basins in California. California Department of Water Resources. Bulletin 118-80.

California Department of Water Resources. 1984. Eastern Shasta County Ground Water Study. California Department of Water Resources. Northern District Report.

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. 1995. Sacramento Valley Groundwater Quality Investigation. California Department of Water Resources, Northern District.

California Department of Water Resources. 1996. Groundwater Levels in the Redding Groundwater Basin. 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.

CH2M Hill. 1975. Redding Regional Water Supply Alternatives for Shasta County Water Agency, City of Redding, Enterprise Public Utility District, Cascade Community Services District, and Bella Vista Water District. Engineering Report.

CH2M Hill. 2001. Redding Basin Water Resources Management Plan, Phase 2B Report, Prepared for Redding Area Water Council.

Dickinson WR, Ingersoll RV, Grahm SA. 1979. Paleogene Sediment Dispersal and Paleotectonics in Northern California. Geological Society of America Bulletin 90:1458-1528.

Diller JA. 1906. Description of the Redding Quadrangle (California). USGS. Report No.138. 14 p.

Fogelman RP, Evenson KD. 1984. Water Resources Monitoring in the Cottonwood Creek Area, Shasta and Tehama Counties, California, 1982-1983. USGS. Water Resources Investigations 84-4187.

Fraticelli LA, Albers JP, Irwin WP, Blake MC. 1987. Geologic Map of the Redding 1 x 2 Degree Quadrangle, Shasta, Tehama, Humboldt, and Trinity Counties, California. USGS. OF-87-257.

Hinds NEA. 1933. Geologic Formations of the Redding and Weaverville Districts, Northern California. California Journal of Mines and Geology 29(1): 76-122.

Planert M, Williams JS. 1995. Ground Water Atlas of the United States, Segment 1, California, Nevada. USGS. HA-730-B.

Steele WC. 1980. Quaternary Stream Terraces in the Northwestern Sacramento Valley, Glenn, Tehama, and Shasta Counties, California. USGS.

Strand RG. 1963. Geologic Atlas of California [Redding Sheet]. California Division of Mines and Geology.

United States Army Corps of Engineers Sacramento District. 1971. Flood Plain Information : Cow Creek, Palo Cedro, California. Sacramento, Calif.: United States Army Corps of Engineers Sacramento District.

United States Army Corps of Engineers Sacramento District. 1978. Flood Hazard Information: Sacramento River and Cottonwood and Battle Creeks, Cottonwood-Bend Area, California. Sacramento, Calif.: United States Army Corps of Engineers Sacramento District.

United States Bureau of Reclamation, William M. Kier Associates. 2001. Battle Creek Salmon and Steelhead Restoration Project: Adaptive Management Plan. Sausalito, Calif.: Kier Associates. 79 p.

Errata

Changes made to the basin description will be noted here.