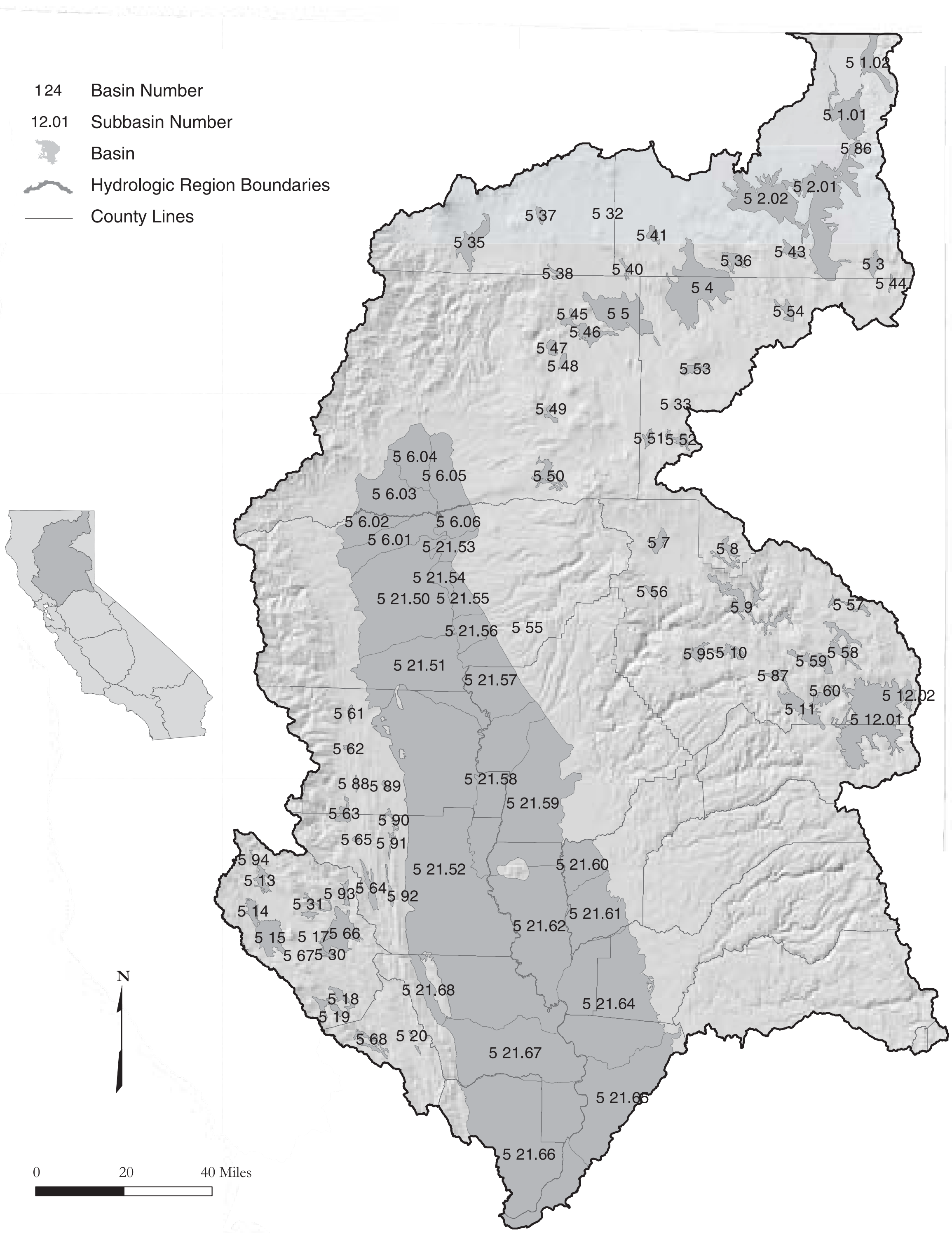

Figure 33 Sacramento River Hydrologic Region

Basins and Subbasins of the Sacramento River Hydrologic Region

Basin/subbasins	Basin name
5-1	Goose Lake Valley
5-1.01	Lower Goose Lake Valley
5-1.02	Fandango Valley
5-2	Alturas Area
5-2.01	South Fork Pitt River
5-2.02	Warm Springs Valley
5-3	Jess Valley
5-4	Big Valley
5-5	Fall River Valley
5-6	Redding Area
5-6.01	Bowman
5-6.02	Rosewood
5-6.03	Anderson
5-6.04	Enterprise
5-6.05	Millville
5-6.06	South Battle Creek
5-7	Lake Almanor Valley
5-8	Mountain Meadows Valley
5-9	Indian Valley
5-10	American Valley
5-11	Mohawk Valley
5-12	Sierra Valley
5-12.01	Sierra Valley
5-12.02	Chilcoot
5-13	Upper Lake Valley
5-14	Scotts Valley
5-15	Big Valley
5-16	High Valley
5-17	Burns Valley
5-18	Coyote Valley
5-19	Collayomi Valley
5-20	Berryessa Valley
5-21	Sacramento Valley
5-21.50	Red Bluff
5-21.51	Corning
5-21.52	Colusa
5-21.53	Bend
5-21.54	Antelope
5-21.55	Dye Creek
5-21.56	Los Molinos
5-21.57	Vina
5-21.58	West Butte
5-21.59	East Butte
5-21.60	North Yuba
5-21.61	South Yuba
5-21.62	Sutter
5-21.64	North American
5-21.65	South American
5-21.66	Solano
5-21.67	Yolo
5-21.68	Capay Valley

Basin/subbasins	Basin name
5-30	Lower Lake Valley
5-31	Long Valley
5-35	Mccloud Area
5-36	Round Valley
5-37	Toad Well Area
5-38	Pondosa Town Area
5-40	Hot Springs Valley
5-41	Egg Lake Valley
5-43	Rock Prairie Valley
5-44	Long Valley
5-45	Cayton Valley
5-46	Lake Britton Area
5-47	Goose Valley
5-48	Burney Creek Valley
5-49	Dry Burney Creek Valley
5-50	North Fork Battle Creek
5-51	Butte Creek Valley
5-52	Gray Valley
5-53	Dixie Valley
5-54	Ash Valley
5-56	Yellow Creek Valley
5-57	Last Chance Creek Valley
5-58	Clover Valley
5-59	Grizzly Valley
5-60	Humbug Valley
5-61	Chrome Town Area
5-62	Elk Creek Area
5-63	Stonyford Town Area
5-64	Bear Valley
5-65	Little Indian Valley
5-66	Clear Lake Cache Formation
5-68	Pope Valley
5-86	Joseph Creek
5-87	Middle Fork Feather River
5-88	Stony Gorge Reservoir
5-89	Squaw Flat
5-90	Funks Creek
5-91	Antelope Creek
5-92	Blanchard Valley
5-93	North Fork Cache Creek
5-94	Middle Creek
5-95	Meadow Valley

Description of the Region

The Sacramento River HR covers approximately 17.4 million acres (27,200 square miles). The region includes all or large portions of Modoc, Siskiyou, Lassen, Shasta, Tehama, Glenn, Plumas, Butte, Colusa, Sutter, Yuba, Sierra, Nevada, Placer, Sacramento, El Dorado, Yolo, Solano, Lake, and Napa counties (Figure 33). Small areas of Alpine and Amador counties are also within the region. Geographically, the region extends south from the Modoc Plateau and Cascade Range at the Oregon border, to the Sacramento-San Joaquin Delta. The Sacramento Valley, which forms the core of the region, is bounded to the east by the crest of the Sierra Nevada and southern Cascades and to the west by the crest of the Coast Range and Klamath Mountains. Other significant features include Mount Shasta and Lassen Peak in the southern Cascades, Sutter Buttes in the south central portion of the valley, and the Sacramento River, which is the longest river system in the State of California with major tributaries the Pit, Feather, Yuba, Bear and American rivers. The region corresponds approximately to the northern half of RWQCB 5. The Sacramento metropolitan area and surrounding communities form the major population center of the region. With the exception of Redding, cities and towns to the north, while steadily increasing in size, are more rural than urban in nature, being based in major agricultural areas. The 1995 population of the entire region was 2.372 million.

The climate in the northern, high desert plateau area of the region is characterized by cold snowy winters with only moderate precipitation and hot dry summers. This area depends on adequate snowpack to provide runoff for summer supply. Annual precipitation ranges from 10 to 20 inches. Other mountainous areas in the northern and eastern portions of the region have cold wet winters with large amounts of snow, which typically provide abundant runoff for summer supplies. Annual precipitation ranges from 40 to more than 80 inches. Summers are generally mild in these areas. The Coast Range and southern Klamath Mountains receive copious amounts of precipitation, but most of the runoff flows to the coast in the North Coastal drainage. Sacramento Valley comprises the remainder of the region. At a much lower elevation than the rest of the region, the valley has mild winters with moderate precipitation. Annual precipitation varies from about 35 inches in Redding to about 18 inches in Sacramento. Summers in the valley are hot and dry.

Most of the mountainous portions of the region are heavily forested and sparsely populated. Three major national forests (Mendocino, Trinity, and Shasta) make up the majority of lands in the Coast Range, southern Klamath Mountains, and the southern Cascades; these forests and the region’s rivers and lakes provide abundant recreational opportunities. In the few mountain valleys with arable land, alfalfa, grain and pasture are the predominant crops. In the foothill areas of the region, particularly adjacent to urban centers, suburban to rural housing development is occurring along major highway corridors. This development is leading to urban sprawl and is replacing the former agricultural production on those lands. In the Sacramento Valley, agriculture is the largest industry. Truck, field, orchard, and rice crops are grown on approximately 2.1 million acres. Rice represents about 23 percent of the total irrigated acreage.

The Sacramento River HR is the main water supply for much of California’s urban and agricultural areas. Annual runoff in the HR averages about 22.4 maf, which is nearly one-third of the State’s total natural runoff. Major water supplies in the region are provided through surface storage reservoirs. The two largest surface water projects in the region are USBR’s Shasta Lake (Central Valley Project) on the upper Sacramento River and Lake Oroville (DWR’s State Water Project) on the Feather River. In all, there are more than 40 major surface water reservoirs in the region. Municipal, industrial, and agricultural supplies to the region are about 8 maf, with groundwater providing about 2.5 maf of that total. Much of the remainder of the runoff goes to dedicated natural flows, which support various environmental requirements, including in-stream fishery flows and flushing flows in the Delta.

Groundwater Development

Groundwater provides about 31 percent of the water supply for urban and agricultural uses in the region, and has been developed in both the alluvial basins and the hard rock uplands and mountains. There are 88 basins/subbasins delineated in the region. These basins underlie 5.053 million acres (7,900 square miles), about 29 percent of the entire region. The reliability of the groundwater supply varies greatly. The Sacramento Valley is recognized as one of the foremost groundwater basins in the State, and wells developed in the sediments of the valley provide excellent supply to irrigation, municipal, and domestic uses. Many of the mountain valleys of the region also provide significant groundwater supplies to multiple uses.

Geologically, the Sacramento Valley is a large trough filled with sediments having variable permeabilities; as a result, wells developed in areas with coarser aquifer materials will produce larger amounts of water than wells developed in fine aquifer materials. In general, well yields are good and range from one-hundred to several thousand gallons per minute. Because surface water supplies have been so abundant in the valley, groundwater development for agriculture primarily supplement the surface supply. With the changing environmental laws and requirements, this balance is shifting to a greater reliance on groundwater, and conjunctive use of both supplies is occurring to a greater extent throughout the valley, particularly in drought years. Groundwater provides all or a portion of municipal supply in many valley towns and cities. Redding, Anderson, Chico, Marysville, Sacramento, Olivehurst, Wheatland, Willows, and Williams rely to differing degrees on groundwater. Red Bluff, Corning, Woodland, Davis, and Dixon are completely dependent on groundwater. Domestic use of groundwater varies, but in general, rural unincorporated areas rely completely on groundwater.

In the mountain valleys and basins with arable land, groundwater has been developed to supplement surface water supplies. Most of the rivers and streams of the area have adjudicated water rights that go back to the early 1900s, and diversion of surface water has historically supported agriculture. Droughts and increased competition for supply have led to significant development of groundwater for irrigation. In some basins, the fractured volcanic rock underlying the alluvial fill is the major aquifer for the area. In the rural mountain areas of the region, domestic supplies come almost entirely from groundwater. Although a few mountain communities are supplied in part by surface water, most rely on groundwater. These groundwater supplies are generally quite reliable in areas that have sufficient aquifer storage or where surface water replenishes supply throughout the year. In areas that depend on sustained runoff, water levels can be significantly depleted in drought years and many old, shallow wells can be dewatered. During 2001, an extreme drought year on the Modoc Plateau, many well owners experienced problems with water supply.

Groundwater development in the fractured rocks of the foothills of the southern Cascades and Sierra Nevada is fraught with uncertainty. Groundwater supplies from fractured rock sources are highly variable in terms of water quantity and water quality and are an uncertain source for large-scale residential development. Originally, foothill development relied on water supply from springs and river diversions with flumes and ditches for conveyance that date back to gold mining era operations. Current development is primarily based on individual private wells, and as pressures for larger scale development increase, questions about the reliability of supply need to be addressed. Many existing foothill communities have considerable experience with dry or drought year shortages. In Butte County residents in Cohasset, Forest Ranch, and Magalia have had to rely on water brought up the ridges in tanker trucks. The suggested answer has been the development of regional water supply projects. Unfortunately, the area's development pattern of small, geographically dispersed population centers does not lend itself to the kind of financial base necessary to support such projects.

Groundwater Quality

Groundwater quality in the Sacramento River HR is generally excellent. However, there are areas with local groundwater problems. Natural water quality impairments occur at the north end of the Sacramento Valley in the Redding subbasin, and along the margins of the valley and around the Sutter Buttes, where Cretaceous-age marine sedimentary rocks containing brackish to saline water are near the surface. Water from the older underlying sediments mixes with the fresh water in the younger alluvial aquifer and degrades the quality. Wells constructed in these areas typically have high TDS. Other local natural impairments are moderate levels of hydrogen sulfide in groundwater in the volcanic and geothermal areas in the western portion of the region. In the Sierra foothills, there is potential for encountering uranium and radon-bearing rock or sulfide mineral deposits containing heavy metals. Human-induced impairments are generally associated with individual septic system development in shallow unconfined portions of aquifers or in fractured hard rock areas where insufficient soil depths are available to properly leach effluent before it reaches the local groundwater supply.

Water Quality in Public Supply Wells

From 1994 through 2000, 1,356 public supply water wells were sampled in 51 of the 88 basins and subbasins in the Sacramento River HR. Samples analyzed indicate that 1,282 wells, or 95 percent, met the state primary MCLs for drinking water. Seventy-four wells, or 5 percent, have constituents that exceed one or more MCL. Figure 34 shows the percentages of each contaminant group that exceeded MCLs in the 74 wells.

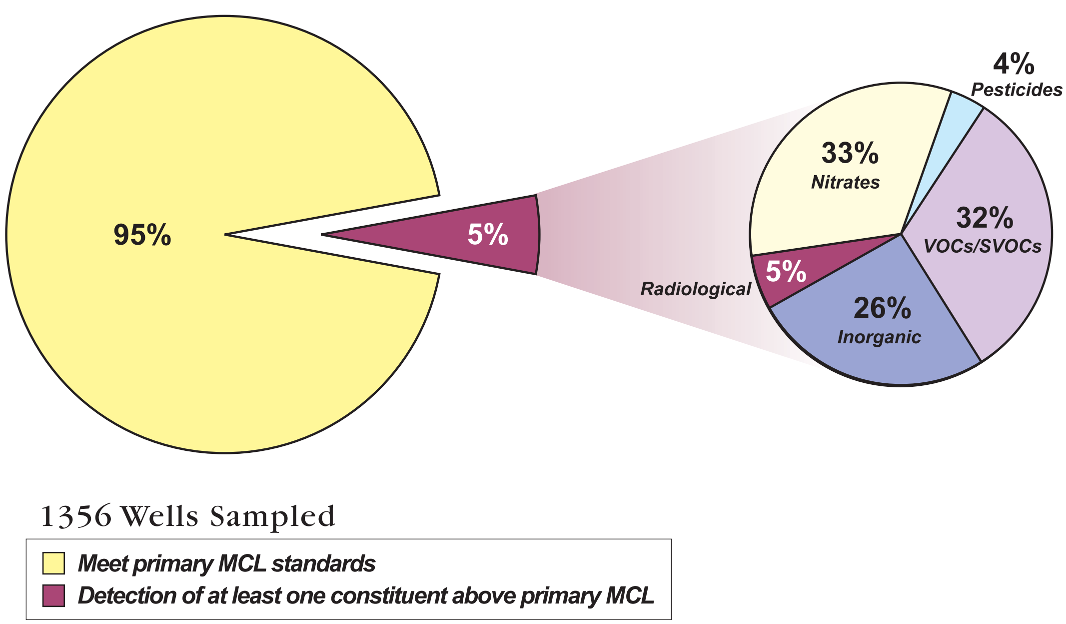

Figure 34 MCL exceedances in public supply wells in the Sacramento River Hydrologic Region

Table 25 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 25 Most frequently occurring contaminants by contaminant group in the Sacramento River Hydrologic Region

Contaminant group	Contaminant - # of wells	Contaminant - # of wells	Contaminant - # of wells
Inorganics – Primary	Cadmium – 4	Chromium (Total) – 3	3 tied at 2
Inorganics – Secondary	Manganese – 221	Iron – 166	Specific Conductance – 3
Radiological	Gross Alpha – 4		
Nitrates	Nitrate (as NO_3) – 22	Nitrate + Nitrite – 5	Nitrate Nitrogen (NO_3-N) – 2
Pesticides	Di(2-Ethylhexyl)phthalate – 4		
VOCs/SVOCs	PCE – 11	TCE – 7	Benzene – 4

PCE = Tetrachloroethylene
TCE = Trichloroethylene
VOC = Volatile Organic Compounds
SVOC = Semivolatile Organic Compound

Changes from Bulletin 118-80

Some modifications from the groundwater basins presented in Bulletin 118-80 are incorporated in this report. These are listed in Table 26.

Table 26 Modifications since Bulletin 118-80 of groundwater basins and subbasins in Sacramento River Hydrologic Region

Basin name	New number	Old number
Fandango Valley	5-1.02	5-39
Bucher Swamp Valley	deleted	5-42
Modoc Plateau Recent Volcanic Areas	deleted	5-32
Modoc Plateau Pleistocene Volcanic Areas	deleted	5-33
Mount Shasta Area	deleted	5-34
Sacramento Valley Eastside Tuscan Formation Highlands	deleted	5-55
Clear Lake Pleistocene Volcanics	deleted	5-67

No additional basins were assigned to the Sacramento River HR in this revision. However, four basins have been divided into subbasins. Goose Lake Valley Groundwater Basin (5-1) has been subdivided into two subbasins, Fandango Valley (5-39) was modified to be a subbasin of Goose Lake Valley. Redding Area Groundwater Basin has been subdivided into six subbasins, Sierra Valley Groundwater Basin has been subdivided into two subbasins, and the Sacramento Valley Groundwater Basin has been subdivided into 18 subbasins.

There are several deletions of groundwater basins from Bulletin 118-80. Bucher Swamp Valley Basin (5-42) was deleted due to a thin veneer of alluvium over rock. Modoc Plateau Recent Volcanic Areas (5-32), Modoc Plateau Pleistocene Volcanic Areas (5-33), Mount Shasta Area (5-34), Sacramento Valley Eastside Tuscan Formation Highlands (5-55), and Clear Lake Pleistocene Volcanics (5-67) are volcanic aquifers and were not assigned basin numbers in this bulletin. These are considered to be groundwater source areas as discussed in Chapter 6.

Table 27 Sacramento River Hydrologic Region groundwater data

Basin/Subbasin	Basin Name	Area (acres)	Groundwater Budget Type	Well Yields (gpm) Maximum	Well Yields (gpm) Average	Types of Monitoring Levels	Types of Monitoring Quality	Types of Monitoring Title 22	TDS (mg/L) Average	TDS (mg/L) Range
5-1	GOOSE LAKE VALLEY									
5-1.01	LOWER GOOSE LAKE	36,000	B	-	400	9	9	-	183	68 - 528
5-1.02	FANDANGO VALLEY	18,500	B	2,000	-	3	-	-	-	-
5-2	ALTURAS AREA								357	180 - 800
5-2.01	SOUTH FORK PITT RIVER	114,000	B	5,000	1,075	9	-	8	-	-
5-2.02	WARM SPRINGS VALLEY	68,000	B	400	314	3	-	11	-	-
5-3	JESS VALLEY	6,700	B		3,000	-	-	-	-	-
5-4	BIG VALLEY	92,000	B	4,000	880	19	9	10	260	141 - 633
5-5	FALL RIVER VALLEY	54,800	B	1,500	266	16	7	3	174	115 - 232
5-6	REDDING AREA									
5-6.01	BOWMAN	85,330	B	2,000	589	8	2	13	-	70 - 247
5-6.02	ROSEWOOD	45,320	B	-	-	4	-	-	-	118 - 218
5-6.03	ANDERSON	98,500	B	1,800	46	11	10	69	194	109-320
5-6.04	ENTERPRISE	60,900	B	700	266	11	3	43	-	160 - 210
5-6.05	MILLVILLE	67,900	B	500	254	6	5	4	140	-
5-6.06	SOUTH BATTLE CREEK	32,300	B	-	-	0	0	0	360	-
5-7	LAKE ALMANOR VALLEY	7,150	B	-	-	10	4	4	105	53 - 260
5-8	MOUNTAIN MEADOWS VALLEY	8,150	B	-	-	-	-	-	-	-
5-9	INDIAN VALLEY	29,400	B	-	-	-	4	9	-	-
5-10	AMERICAN VALLEY	6,800	B	40	40		4	11	-	-
5-11	MOHAWK VALLEY	19,000	B	-	500	1	2	15	248	210 - 285
5-12	SIERRA VALLEY									
5-12.01	SIERRA VALLEY	117,700	B	1,500	640	34	15	9	312	110 - 1,620
5-12.02	CHILCOOT	7,550	B	-	-	15	-	8	-	-
5-13	UPPER LAKE VALLEY	7,260	B	900	302	12	3	6	-	-
5-14	SCOTTS VALLEY	7,320	B	1,200	171	9	1	9	158	140 - 175
5-15	BIG VALLEY	24,210	B	1,470	475	49	11	7	535	270 - 790
5-16	HIGH VALLEY	2,360	B	100	37	5	2	-	598	480 - 745
5-17	BURNS VALLEY	2,900	B	-	30	1	5	-	335	280 - 455
5-18	COYOTE VALLEY	6,530	B	800	446	6	3	3	288	175 - 390
5-19	COLLAYOMI VALLEY	6,500	B	1,000	121	10	4	3	202	150 - 255
5-20	BERRYESSA VALLEY	1,400	C	-	-	0	-	0	-	-
5-21	SACRAMENTO VALLEY									
5-21.50	RED BLUFF	266,750	B	1,200	363	30	10	56	207	120 - 500
5-21.51	CORNING	205,640	B	3,500	977	29	7	30	286	130 - 490
5-21.52	COLUSA	918,380	B	5,600	984	98	30	134	391	120 - 1,220
5-21.53	BEND	20,770	B	-	275	0	3	9		334-360
5-21.54	ANTELOPE	18,710	B	800	575	4	5	22	296	-
5-21.55	DYE CREEK	27,730	B	3,300	890	8	1	3	240	159 - 396
5-21.56	LOS MOLINOS	33,170	B	1,000	500	3	3	9	217	
5-21.57	VINA	125,640	B	3,850	1,212	23	5	69	285	48 - 543
5-21.58	WEST BUTTE	181,600	B	4,000	1,833	32	8	36	293	130 - 676

Table 27 Sacramento River Hydrologic Region groundwater data (continued)

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
5-21.59	EAST BUTTE	265,390	B	4,500	1,019	43	4	44	235	122 - 570
5-21.60	NORTH YUBA	100,400	C	4,000	-	21	-	32	-	-
5-21.61	SOUTH YUBA	107,000	C	4,000	1,650	56	-	6	-	-
5-21.62	SUTTER	234,000	C	-	-	34	-	115	-	-
5-21.64	NORTH AMERICAN	351,000	A	-	800	121	-	339	300	150 - 1,000
5-21.65	SOUTH AMERICAN	248,000	C	-	-	105	-	247	221	24-581
5-21.66	SOLANO	425,000	C	-	-	123	23	136	427	150 - 880
5-21.67	YOLO	226,000	B	4,000+	1,000	127	20	185	880	480 - 2,060
5-21.68	CAPAY VALLEY	25,000	C	-	-	11	-	3	-	-
5-30	LOWER LAKE VALLEY	2,400	B	100	37		3	5	568	290 - 1,230
5-31	LONG VALLEY	2,600	B	100	63	-	-	-	-	-
5-35	MCCLOUD AREA	21,320	B	-	380	-	-	1	-	-
5-36	ROUND VALLEY	7,270	B	2,000	800	2				148 - 633
5-37	TOAD WELL AREA	3,360	B	-	-	-	-	-	-	-
5-38	PONDOSA TOWN AREA	2,080	B	-	-	-	-	-	-	-
5-40	HOT SPRINGS VALLEY	2,400	B	-	-	-	-	-	-	-
5-41	EGG LAKE VALLEY	4,100	B	-	20	-	-	-	-	-
5-43	ROCK PRAIRIE VALLEY	5,740	B	-	-	-	-	-	-	-
5-44	LONG VALLEY	1,090	B	-	-	-	-	-	-	-
5-45	CAYTON VALLEY	1,300	B	-	400	-	-	-	-	-
5-46	LAKE BRITTON AREA	14,060	B	-	-	-	-	2	-	-
5-47	GOOSE VALLEY	4,210	B	-	-	-	-	-	-	-
5-48	BURNEY CREEK VALLEY	2,350	B	-	-	-	-	2	-	-
5-49	DRY BURNEY CREEK VALLEY	3,070	B	-	-	-	-	-	-	-
5-50	NORTH FORK BATTLE CREEK VALLEY	12,760	B	-	-	-	-	3	-	-
5-51	BUTTE CREEK VALLEY	3,230	B	-	-	-	-	-	-	-
5-52	GRAYS VALLEY	5,440	B	-	-	-	-	-	-	-
5-53	DIXIE VALLEY	4,870	B	-	-	-	-	-	-	-
5-54	ASH VALLEY	6,010	B	3,000	2,200	-	-	-	-	-
5-56	YELLOW CREEK VALLEY	2,310	B	-	-	-	-	-	-	-
5-57	LAST CHANCE CREEK VALLEY	4,660	B	-	-	-	-	-	-	-
5-58	CLOVER VALLEY	16,780	B	-	-	-	-	-	-	-
5-59	GRIZZLY VALLEY	13,400	B	-	-	-	-	1	-	-
5-60	HUMBUG VALLEY	9,980	B	-	-	-	-	8	-	-
5-61	CHROME TOWN AREA	1,410	B	-	-	-	-	-	-	-
5-62	ELK CREEK AREA	1,440	B	-	-	-	-	-	-	-
5-63	STONYFORD TOWN AREA	6,440	B	-	-	-	-	-	-	-
5-64	BEAR VALLEY	9,100	B	-	-	-	-	-	-	-
5-65	LITTLE INDIAN VALLEY	1,270	B	-	-	-	-	-	-	-
5-66	CLEAR LAKE CACHE FORMATION	30,000	B	245	52		-	4	-	-
5-68	POPE VALLEY	7,180	C	-	-	-	-	1	-	-
5-86	JOSEPH CREEK	4,450	B	-	-	-	-		-	-

Table 27 Sacramento River Hydrologic Region groundwater data (continued)

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
5-87	MIDDLE FORK FEATHER RIVER	4,340	B	-	-	-	-	2	-	-
5-88	STONY GORGE RESERVOIR	1,070	B	-	-	-	-	-	-	-
5-89	SQUAW FLAT	1,300	C	-	-	-	-	-	-	-
5-90	FUNKS CREEK	3,000	C	-	-	-	-	-	-	-
5-91	ANTELOPE CREEK	2,040	B	-	-	-	-	-	-	-
5-92	BLANCHARD VALLEY	2,200	B	-	-	-	-	-	-	-
5-93	NORTH FORK CACHE CREEK	3,470	C	-	-	-	-	-	-	-
5-94	MIDDLE CREEK	700	B	-	75	-	-	1	-	-
5-95	MEADOW VALLEY	5,730	B	-	-	-	-	1	-	-

gpm - gallons per minute
mg/L - milligram per liter
TDS -total dissolved solids

Sacramento Valley Groundwater Basin, Vina Subbasin

- Groundwater Basin Number: 5-21.57
- County: Tehama, Butte
- Surface Area: 125,640 acres (195 square miles)

Basin Boundaries and Hydrology

The Vina Subbasin comprises the portion of the Sacramento Valley groundwater basin bounded on the west by the Sacramento River, on the north by Deer Creek, on the east by the Chico Monocline and on the south by Big Chico Creek. Deer Creek and Big Chico Creek serve as hydrologic boundaries in the near surface. The subbasin is contiguous with the Los Molinos and West Butte subbasins at depth. The Chico Monocline forms a geographic boundary; however, a component of basin recharge is located east of the fault structure. Annual precipitation within the subbasin ranges from 18- to 22.5-inches, increasing to the east.

Hydrogeologic Information

Water-Bearing Formations

The aquifer system is comprised of continental deposits of Tertiary to late Quaternary age. The Quaternary deposits include Holocene stream channel deposits and Pleistocene Modesto Formation deposits, located along most stream and river channels, and alluvial fan deposits. The Tertiary deposits include the Tuscan Formation.

Holocene Stream Channel Deposits. Stream channel deposits consist of unconsolidated gravel, sand, silt and clay derived from the erosion, reworking, and deposition of adjacent Tuscan Formation and Quaternary stream terrace alluvial deposits. The thickness varies from 1- to 80-feet (Helly and Harwood 1985). The unit represents the upper part of the unconfined zone of the aquifer and is moderately-to-highly permeable; however, the thickness and areal extent of the deposits limit the water-bearing capability.

Holocene Basin Deposits. Basin deposits are the result of sediment-laden floodwaters that rose above the natural levees of streams and rivers to spread across low-lying areas. They consist primarily of silts and clays and may be locally interbedded with stream channel deposits along the Sacramento River. Thickness of these deposits can range up to 150 feet and they are observed primarily between Mud Creek and Rock Creek, west of Highway 99. These deposits have low permeability and generally yield low quantities of water to wells. The quality of groundwater produced from the unit is often poor (USBR 1960).

Pleistocene Modesto Formation. The Pleistocene 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 Tuscan Formation and Riverbank Formation. The Modesto Formation makes up the majority of the alluvial plain deposits except where older Riverbank Formation terrace deposits occur south of Pine Creek and the overlying basin deposits in the Nord area predominate. Thickness of the formation can range from less than 10 feet to nearly 200 feet across the valley floor (Helley and Harwood 1985).

Pleistocene Riverbank Formation. The Riverbank Formation (older terrace deposits) consists of poorly-to-highly permeable pebble and small cobble gravels interlensed with reddish clay sands and silt. These deposits underlie the region between Pine Creek and Rock Creek. Thickness of the formation can range from less than 10 feet to nearly 200 feet across the valley floor (Helley and Harwood 1985).

Pliocene Tuscan Formation. The Tuscan Formation is composed of a series of volcanic mudflows, tuff breccia, tuffaceous sandstone and volcanic ash layers. The formation is described as four separate but lithologically similar units, A through D (with Unit A being the oldest), which in some areas are separated by layers of thin tuff or ash units (Helley and Harwood 1985). Units A, B, and C are found within the subbasin and extend in the subsurface west of the Sacramento River.

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 fairly equal distribution of lahars, tuffaceous sandstone, and conglomerate. Unit C consists of massive mudflow or lahar deposits with some interbedded volcanic conglomerate and sandstone. In the subsurface, these low permeability lahars form thick, confining layers for groundwater contained in the more permeable sediments of Unit B. Unit C is exposed as alluvial upland deposits west of the Chico Monocline, largely north of Singer Creek. South of Singer Creek, the alluvial upland deposits merge with younger alluvial fan and plain deposits.

The Tuscan Formation reaches a thickness of 1,250 feet over older sedimentary deposits (DWR 2000). The dip of the formation averages approximately 2.5 degrees, east of the valley, and steepens sharply to 10 to 20 degrees southwestward towards the valley at the Chico Monocline. The formation flattens beneath valley sediments.

Recharge Areas

Surface exposure of the Tuscan Formation (Unit B) provides recharge to the subbasin within the subbasin boundaries along stream courses and east of the Chico Monocline fault structure.

Groundwater Level Trends

As part of a groundwater inventory analysis prepared for Butte County, the portion of the Vina Subbasin located within Butte County was evaluated for seasonal and long-term changes in groundwater levels for unconfined and confined aquifer systems. Long-term comparison of spring to spring groundwater levels in the northern part of the Butte County show a decline as a result of the 1976-77 and 1987-94 droughts, followed by a recovery of groundwater levels to pre-drought conditions (DWR 2001).

Evaluation of groundwater level data at the northern edge of the California Water Service area (just north of Chico) shows an average seasonal fluctuation in groundwater levels of approximately 10 feet during years of normal precipitation. Long-term comparison of spring to spring groundwater levels shows a decline in levels associated with the above drought periods with recovery to pre-drought conditions of the early 1970's. Further long-term comparison of spring to spring groundwater levels indicates a 10- to 15-foot decline in groundwater levels since the 1950's (DWR 2001).
Areas unaffected by municipal water use reflect the natural groundwater table distribution and direction of movement. Year-round extraction of groundwater for municipal use in the Chico area causes several small groundwater depressions that tend to alter the natural southwesterly movement of groundwater in the area (DWR 2001). In the Chico area, groundwater levels in the unconfined portion of the aquifer system is about 5- to 7-feet during normal precipitation and up to approximately 16 feet during periods of drought. Annual fluctuation in the confined or semi-confined portion of the aquifer system is approximately 15- to 25-feet during normal years and up to approximately 30 feet during periods of drought. Long-term comparison of spring to spring groundwater levels for confined or semi-confined portions of the aquifer system indicates a 10 to 15-foot decline in groundwater levels since the 1950s.

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 Vina Subbasin is 5.9 percent. The estimated storage capacity to a depth of 200 feet is approximately 1,468,239 acre-feet.

Groundwater Budget (Type B)

Estimates of groundwater extraction for the Vina Subbasin are based on surveys conducted by the California Department of Water Resources during the years 1993, 1994, and 1997. Surveys included landuse and sources of water. Estimate of groundwater extraction for agricultural use is estimated to be 130,000 acre-feet. Municipal and industrial use is approximately 20,000 acre-feet. Deep percolation of applied water is estimated to be 30,000 acre-feet.

Groundwater Quality

Characterization. Calcium-magnesium bicarbonate and magnesium-calcium bicarbonate are the predominant groundwater types in the subbasin. Total dissolved solids range from 48- to 543-mg/L, averaging 285 mg/L (DWR unpublished data).

Impairments. Impairments include localized high calcium and high nitrates and total dissolved solids in the Chico area.

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	52	0
Radiological	49	0
Nitrates	56	4
Pesticides	49	0
VOCs and SVOCs	48	4
Inorganics – Secondary	52	1

[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 – 3850	Average: 1212 (22 Well Completion Reports)
	Total depths (ft)	
Domestic	Range: 14 – 754	Average: 139 (2215 Well Completion Reports)
Municipal/Irrigation	Range: 36 –1000	Average: 330 (715 Well Completion Reports)

Active Monitoring Data

Agency	Parameter	Number of wells /measurement frequency
DWR	Groundwater levels	23 wells semi-annually
DWR	Miscellaneous water quality	5 wells biennially
Department of Health Services	Miscellaneous water quality	69

Basin Management

Groundwater management:	Butte County adopted a groundwater management ordinance in 1996. Tehama County adopted a groundwater management ordinance in 1994.
Water agencies	
Public	Butte Basin Water User Association, Deer Creek ID, Stanford Vina Ranch ID, City of Chico, Tehama County Flood Control and Conservation District
Private	

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Errata

Changes made to the basin description will be noted here.

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Sacramento Valley Groundwater Basin, West Butte Subbasin

- Groundwater Basin Number: 5-21.58
- County: Butte, Glenn, Colusa
- Surface Area: 181,560 acres (284 square miles)

Basin Boundaries and Hydrology

The portion of the Sacramento Valley Groundwater Basin bounded on the west and south by the Sacramento River, on the north by Big Chico Creek, on the northeast by the Chico Monocline, and on the east by Butte Creek comprises the West Butte Subbasin. Big Chico and Butte Creeks serve as subbasin boundaries in the near surface. The subbasin is hydrologically contiguous with the Vina and East Butte Subbasins at depth. The Chico Monocline forms a geographic boundary; however, a component of recharge to the subbasin appears east of the fault structure. Groundwater flow is southwesterly toward the Sacramento River north of the city of Princeton. South of Princeton, groundwater flows away from the Sacramento River to recharge the groundwater system. Annual precipitation within subbasin is approximately 18 inches in the valley increasing to 27 inches towards the foothills.

Hydrogeologic Information

Water-Bearing Formations

The West Butte aquifer system is comprised of deposits of Late Tertiary to Quaternary age. The Quaternary deposits include the Holocene stream channel deposits and basin deposits, and the Pleistocene Modesto Formation, Riverbank Formation, and Sutter Buttes alluvium. The Tertiary deposits consist of the Pliocene Tehama Formation and the Tuscan Formation.

Holocene Stream Channel Deposits. These deposits consist of unconsolidated gravel, sand, silt and clay derived from the erosion, reworking, and deposition of adjacent Quaternary stream terrace alluvial deposits. The thickness varies from 1- to 80-feet (Helley and Harwood 1985). The unit represents the upper part of the unconfined zone of the aquifer and is moderately-to-highly permeable; however, the thickness and areal extent of the deposits limit the water-bearing capability.

Holocene Basin Deposits. Basin deposits are the result of sediment-laden floodwaters that rose above the natural levees of streams and rivers to spread across low-lying areas. They consist primarily of silts and clays and may be locally interbedded with stream channel deposits along the Sacramento River. The deposits extend from south of Big Chico Creek to north of Angel Slough. Thickness of the unit can range from 10- to 100-feet (DWR 2001). The deposits have low permeability and generally yield low quantities of water to wells. The quality of groundwater produced from the unit is often poor (USBR 1960).

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 Tuscan and Riverbank formations. Surface exposures extend south from Big Chico Creek to north of the city of Durham and also extend south of Angel Slough to the Sacramento River. The unit varies in thickness from 50- to 150-feet (DWR 2000). In locations where gravel and sand predominate, groundwater yields are moderate.

Pleistocene Riverbank Formation. The Riverbank Formation (deposited between 130,000 and 450,000 years ago) consists of poorly-to-highly permeable pebble and small cobble gravels interlensed with reddish clay sands and silt. The areal extent of the formation is limited more to the southern portion of the subbasin and underlies surface exposures of the Modesto Formation. The thickness of the formation is approximately 1- to 200-feet depending on location (DWR 2000). The formation is moderately to highly permeable and yields moderate quantities of water to domestic and shallow irrigation wells.

Pleistocene Sutter Buttes Alluvium. In the southern extents of the subbasin, Sutter Buttes alluvium is observed in the subsurface and may range in thickness up to 600 feet (DWR 2000). These alluvial fan deposits consist largely of gravel, sand, silt and clay and may extend up to 15 miles north of the Sutter Buttes and westerly beyond the Sacramento River. Utility pump test records for wells located east of the subbasin, but believed to be in the same formation, show the average well yield for the formation to be approximately 2300 gallons per minute with an average specific capacity of 64 gpm/ft.

Pliocene Tehama Formation. The Tehama Formation consists of sediments originating from the coastal mountains and interfingers with sediments of the Tuscan Formation in the vicinity of the Sacramento River at the far western extent of the subbasin (DWR 2000).

Pliocene Tuscan Formation. The Tuscan Formation is composed of a series of volcanic mudflows, tuff breccia, tuffaceous sandstone and volcanic ash layers. Thickness of the formation is estimated to be 800 feet (DWR 2000). The formation is described as four separate but lithologically similar units, A through D (with Unit A being the oldest), which in some areas are separated by layers of thin tuff or ash units (Helley and Harwood 1985). Units A, B, and C are found within the subsurface in the northern part of the subbasin and Units A and B are found in the southern part of the subbasin. Surface exposures of Units A, B, and C are located in the foothills at the far-eastern extents of the subbasin. The surface exposure of Unit B east of the subbasin boundary is a recharge area.

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. Unit B is volcaniclastic and is the most transmissive portion of the volcanic aquifer system and is the primary aquifer at depth. The surface exposure of Unit B, east of the subbasin boundary, is a recharge area. Although the Tuscan Formation is unconfined where it is exposed near the valley margin, at depth, the formation is confined. Unit C consists of massive mudflow or lahar deposits with some interbedded volcanic conglomerate and sandstone. In the subsurface, these low permeability lahars form thick, confining layers for groundwater contained in the more permeable underlying sediments of Unit B.

Groundwater Level Trends

Review of the hydrographs for long-term comparison of spring-to-spring groundwater levels indicates a decline in groundwater levels associated with the 1976-77 and 1987-94 droughts, followed by a recovery in groundwater levels to pre-drought conditions of the early-1970s and 1980s. Comparison of spring-to-spring groundwater levels from the 1950's and 1960's, versus today's levels, indicate about a 10-foot decline in groundwater levels in portions of the West Butte Subbasin (DWR 2001).

Areas unaffected by municipal water use reflect the natural groundwater table distribution and direction of movement. Year-round extraction of groundwater for municipal use in the Chico area causes several small groundwater depressions that tend to alter the natural southwesterly movement of groundwater in the area (DWR 2001). In the Chico area, groundwater levels in the unconfined portion of the aquifer system is about 5- to 7-feet during normal precipitation and up to approximately 16 feet during periods of drought. Annual fluctuation in the confined or semi-confined portion of the aquifer system is approximately 15- to 25-feet during normal years and up to approximately 30 feet during periods of drought. Long-term comparison of spring to spring groundwater levels indicates a 10 to 15-foot decline in levels since the 1950's.

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 West Butte Subbasin is 7.7 percent. The estimated storage capacity to a depth of 200 feet is approximately 2,794,330 acre-feet.

Groundwater Budget (Type B)

Estimates of groundwater extraction for the West Butte Subbasin are based on surveys conducted by the California Department of Water Resources during 1993 and 1997. Surveys included landuse and sources of water. Estimates of groundwater extraction for agricultural; municipal/industrial; and environmental wetland uses are 161,000, 10,000 and 4,600 acre-feet respectively. Deep percolation of applied water is estimated to be 64,000 acre-feet (DWR 2001).

Groundwater Quality

Characterization. Calcium-magnesium bicarbonate and magnesium-calcium bicarbonate are the predominant groundwater types found in the subbasin. Sodium bicarbonate type waters occur at the southern tip of the subbasin west of Sutter Buttes. Concentrations of total dissolved solids (TDS) range from 130- to 676-mg/L, averaging 293 mg/L (DWR unpublished data).

Impairments. Some high nitrates are found in the Chico area. Localized high calcium, conductivity, boron, TDS, and adjusted sodium absorption ratio occur within 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	29	0
Radiological	25	0
Nitrates	30	0
Pesticides	26	0
VOCs and SVOCs	26	1
Inorganics – Secondary	29	2

[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 Production characteristics

	Well yields (gal/min)	
Irrigation	Range: 7 – 4000	Average: 1833 (46 Well Completion Reports)
	Total depths (ft)	
Domestic	Range: 15 – 680	Average: 136 (1469 Well Completion Reports)
Irrigation	Range: 40 - 920	Average: 321 (1038 Well Completion Reports)

Active Monitoring Data

Agency	Parameter	Number of wells /measurement frequency
DWR	Groundwater levels	32 wells semi-annually
DWR	Miscellaneous water quality	8 wells biennially
Department of Health Services and cooperators	Miscellaneous water quality	36

Basin Management

Groundwater management:	Butte County adopted a groundwater management ordinance in 1996. Glenn County adopted a groundwater management ordinance in 2000. Colusa County adopted a groundwater management ordinance in 1998.
Water agencies	
Public	Butte Basin Water Users Association, Buzztail Communtiy Service District, Durham ID, City of Chico, RD 1004,Western Canal WD, M&T Chico Ranch Inc., Sartain MWC
Private	Dayton Mutual Water Company, Del Oro Water Company, Durham Mutual Water Company and California Water Service

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Errata

Changes made to the basin description will be noted here.

Sacramento Valley Groundwater Basin, Corning Subbasin

- Groundwater Basin Number: 5-21.51
- County: Tehama, Glenn
- Surface Area: 205,640 acres (321 square miles)

Boundaries and Hydrology

The Corning Subbasin comprises the portion of the Sacramento Valley Groundwater Basin bounded on the west by the Coast Ranges, on the north by Thomes Creek, on the east by the Sacramento River, and on the south by Stony Creek. Stony Creek is believed to be a hydrologic boundary throughout the year. The Corning Subbasin is likely contiguous with the Red Bluff Subbasin at depth. Annual precipitation ranges from 19- to 25-inches, increasing to the north.

Hydrogeologic Information

Water-Bearing Formations

The Corning Subbasin aquifer system west is comprised of deposits of late Tertiary to Quaternary age. The Quaternary deposits include Holocene alluvium and the Pleistocene terrace deposits of the Modesto and Riverbank Formations. The Tertiary deposits consist of the 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. The thickness varies from 1- to 80-feet (Helley and Harwood 1985). The unit represents the upper part of the unconfined zone of the aquifer and is moderately-to-highly permeable; however, the thickness and areal extent of the deposits limit the water-bearing capability.

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 the Riverbank formations. The deposit ranges from less than 10 feet to nearly 200 feet across the valley floor (Helley and Harwood 1985). These terrace deposits are observed along Thomes Creek, Burch Creek, and Stony Creek.

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). Surficial deposits are observed over the eastern third of the subbasin and along Burch Creek and its tributaries.

Pliocene Tehama Formation. The Tehama Formation consists of sediments originating from the coastal mountains and is the primary source of groundwater for the subbasin. The formation ranges in thickness up to 2,000 feet, increasing in thickness from west to east, dipping 4 degrees to the east (DWR 1982). The majority of the formation consists of fine-grained sediments indicative of deposition under floodplain conditions (McManus 1993). The majority of both coarse and fine-grained sediments are unconsolidated or moderately consolidated.

Pliocene Tuscan Formation. The Tuscan Formation is located within the eastern third of the subbasin. The formation occurs at a depth of approximately 200 feet from the surface and is composed of a series of volcanic mudflows, tuff breccia, tuffaceous sandstone, and volcanic ash layers. The formation is described as four separate but lithologically similar units, A through D, (with Unit A being the oldest), which in some areas are separated by layers of thin tuff or ash units (Helly and Harwood 1985). Units A, B, and C are believed to extend as far west as the Corning Canal.
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 fairly equal distribution of lahars, tuffaceous sandstone, and conglomerate. Unit C consists of massive mudflow or lahar deposits with some interbedded volcanic conglomerate and sandstone. In the subsurface, these low permeability lahars form thick, confining layers for groundwater contained in the more permeable sediments of Unit B.

Subareas of the Corning Subbasin

Sacramento Valley Floodplain. Pleistocene and Holocene silt, sand, and gravel deposits in the vicinity of the City of Corning extend to depths of 50 to 185 feet. The proportion of sand and gravel in the unconsolidated alluvium overlying the Tehama Formation averages 20, 18, and 25 percent for depth intervals of 20- to 50-feet, 50- to 100-feet, and 100- to 200-feet respectively (Olmsted and Davis 1961). The Tehama Formation near the City of Corning consists of yellow clay, poorly consolidated sandstone, and conglomerate.

Dissected Uplands. The surface of the upland area within the central third of the subbasin between Thomes Creek and Stony Creek includes a coarse-grained gravelly conglomerate locally capping the Tehama Formation. Wells drilled in this area encounter up to 60 feet of coarse deposits before reaching fine-grained Tehama deposits. The deposits are believed to be formed as a response to a fixed base level by impeded or enclosed drainages and have been referred to as the Red Bluff Formation. (Helley and Harwood 1985). The shallow gravel is not a significant contributor to groundwater storage due to its position above the saturated zone.

Thomes Creek Floodplain. Bounding the northern extents of the subbasin, the Thomes Creek floodplain includes Holocene alluvium underlain by deposits of both the Modesto and Riverbank Formations. The floodplain averages about 1 mile in width and extends from the Coast Ranges to the Sacramento River floodplain.

Stony Creek Floodplain. The southern part of the subbasin, including the Capay plain, is alluviated by older floodplain deposits and channel deposits of Stony Creek. This area includes a moderately well-defined, highly productive, shallow water-bearing zone reaching a thickness of 150 feet along Stony Creek and 110 feet along the Sacramento River. Domestic and shallow irrigation wells along the west side of Capay plain and south of the Tehama County line provide moderate-to-high yields from confined groundwater in 10- to 50-foot thicknesses of highly pervious pebble and cobble gravels. In the northwest part of Capay plain, older alluvium of the Riverbank Formation extends from the surface to 150 feet. Wells in this zone have low-to-moderate yields. This zone is underlain by a highly productive confined gravel averaging 40 feet in thickness (USBR 1960).

Groundwater Level Trends

Review of hydrographs for long-term comparison of spring-spring groundwater levels indicates a decline of 5- to 12-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. Groundwater level data show seasonal fluctuations of approximately 3- to 15-feet for unconfined wells (5-feet near the Sacramento River), up to 30-feet for semi-confined wells away from the river, 5- to 20-feet for composite wells, and 10- to 30-feet for confined wells. Overall, there does not appear to be any increasing or decreasing trends in the groundwater levels.

Groundwater Budget (Type B)

Estimates of groundwater extraction for the Corning Subbasin are based on surveys conducted during the years of 1993, 1994, and 1997. Surveys included landuse and sources of water. Groundwater extraction for agricultural use is estimated to be 152,000 acre-feet. Groundwater extraction for municipal and industrial uses is estimated to be 6,600 acre-feet. Deep percolation of applied water is estimated to be 54,000 acre-feet.

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 6.7 percent. The estimated storage capacity to a depth of 200 feet is approximately 2,752,950 acre-feet.

Groundwater Quality

Characterization. Calcium-magnesium bicarbonate and magnesium-calcium bicarbonate are the predominant groundwater types in the subbasin. The subbasin has localized areas of calcium bicarbonate waters near Stony Creek. Total dissolved solids concentrations range from 130-to 490-mg/L, averaging 286 mg/L (DWR unpublished data).

Impairments. The Corning Subbasin has locally high calcium.

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	20	0
Radiological	19	0
Nitrates	20	0
Pesticides	18	0
VOCs and SVOCs	16	0
Inorganics – Secondary	20	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)	
Municipal/Irrigation	Range 50 – 3,500	Average: 977 (63 Well Completion Reports)
	Total depths (ft)	
Domestic	Range 24 – 633	Average: 135 (1,667 Well Completion Reports)
Municipal/Irrigation	Range 27 –780	Average: 246 (822 Well Completion Reports)

Active Monitoring Data

Agency	Parameter	Number of wells /measurement frequency
DWR	Groundwater levels.	29 wells semi-annually
DWR	Miscellaneous water quality	7 wells biiennially
Department of Health Services	Miscellaneous water quality	30

Basin Management

Groundwater management:	Tehama County adopted a groundwater management ordinance in 1994. Tehama County adopted a countywide AB3030 plan in 1996.
Water agencies	
Public	Tehama County Flood Control and Water Conservation District adopted a Coordinated AB 3030 Plan, Orland Unit Water Users' Association, Capay Rancho WD, City of Corning, Corning WD, Kirkwood WD, Richfield WD, Tehama WD, O'Connell MWD, City of Orland, Glenn Colusa ID, Thomes Creek WD
Private	

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Errata

Updated groundwater management information and added hotlinks to applicable websites. (1/20/06)

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Sacramento Valley Groundwater Basin, East Butte Subbasin

- Groundwater Basin Number: 5-21.59
- County: Butte, Sutter
- Surface Area: 265,390 acres (415 square miles)

Basin Boundaries and Hydrology

The East Butte Subbasin is the portion of the Sacramento Valley Groundwater Basin bounded on the west and northwest by Butte Creek, on the northeast by the Cascade Ranges, on the southeast by the Feather River and the south by the Sutter Buttes. The northeast boundary along the Cascade Ranges is primarily a geographic boundary with some groundwater recharge occurring beyond that boundary. The subbasin is contiguous with the West Butte Subbasin at depth. Annual precipitation is approximately 18 inches in the valley increasing to 27 inches towards the eastern foothills.

Hydrogeologic Information

Water-Bearing Formations

The East Butte aquifer system is comprised of deposits of late Tertiary to Quaternary age. The Quaternary deposits include Holocene stream channel deposits and basin deposits, Pleistocene deposits of the Modesto and Riverbank formations, and Sutter Buttes alluvium. The Tertiary deposits include the Tuscan and Laguna formations.

Holocene Stream Channel Deposits. These deposits consist of unconsolidated gravel, sand, silt and clay derived from the erosion, reworking, and deposition of adjacent Quaternary stream terrace alluvial deposits. The thickness varies from 1- to 80-feet (Helley and Harwood 1985). These deposits represent the upper part of the unconfined zone of the aquifer and are moderately-to-highly permeable; however, the thickness and areal extent of the deposits limit the water-bearing capability.

Holocene Basin Deposits. These deposits are the result of sediment-laden floodwaters that rose above the natural levees of streams and rivers to spread across low-lying areas. They consist primarily of silts and clays and may be locally interbedded with stream channel deposits. These deposits result from deposition from erosion from portions of the Cascade Ranges to the Sutter Buttes. Thickness of the deposits range to 150 feet (DWR 2000). These deposits have low permeability and generally yield low quantities of water to wells. The quality of groundwater produced from the basin deposits is often poor (USBR 1960).

Pleistocene Modesto Formation. The Modesto Formation in this subbasin consists of poorly indurated gravel and cobbles with sand, silt, and clay derived from reworking and deposition of the Tuscan Formation, Laguna Formation, and the Riverbank Formation. Surface exposure of the formation is west of the Feather River extending from south of the Thermalito Afterbay to the southern subbasin boundary. The formation may extend across the entire subbasin, underlying basin deposits, with thicknesses ranging from 50- to 150-feet (DWR 2000).

Pleistocene Riverbank Formation. These older terrace deposits consist of poorly-to-highly permeable pebble and small cobble gravels interlensed with reddish clay sands and silt. Surface exposure of the Riverbank Formation is primarily south and west of the Thermalito Afterbay. The formation may extend across the entire subbasin, underlying basin and Modesto deposits, with thicknesses ranging from 50- to 200-feet (Helley and Harwood 1985).

Pleistocene Sutter Butte Alluvium. In the southern portion of the subbasin, alluvium of the Sutter Buttes is observed in the subsurface and may range in thickness up to 600 feet (DWR 2000). The fan deposits forming the apron around the buttes consist largely of gravel, sand, silt and clay and may extend up to 15 miles north of the Sutter Buttes and westerly beyond the Sacramento River. Utility pump test records show the average well yield for that formation to be approximately 2300 gallons per minute with an average specific capacity of 64.

Pliocene Tuscan Formation. The Tuscan Formation is composed of a series of volcanic mudflows, tuff breccia, tuffaceous sandstone and volcanic ash layers. Thickness of the formation is estimated to be 800 feet (DWR 2000). The formation is described as four separate but lithologically similar units, A through D (with Unit A being the oldest), which in some areas are separated by layers of thin tuff or ash units (Helley and Harwood 1985). Units A, B, and C are found within the subsurface in the northern part of the subbasin and Units A and B are found in the southern part of the subbasin. Surface exposures of Units B and C are located in the foothills at the far eastern extents of the subbasin.

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 fairly equal distribution of lahars, tuffaceous sandstone, and conglomerate. Unit C consists of massive mudflow or lahar deposits with some interbedded volcanic conglomerate and sandstone. In the subsurface, these low permeability lahars form thick, confining layers for groundwater contained in the more permeable sediments if Unit B.

Pliocene Laguna Formation. The Laguna Formation consists of interbedded alluvial sand, gravel, and silt deposits which are moderately consolidated and poorly-to-well cemented. The Laguna is compacted and generally has a low-to-moderate permeability, except in scattered gravels in the upper portion. The formation yields moderate quantities of water to wells along the eastern margin of the valley. Wells of higher capacity generally tap underlying Tuscan deposits.

Surface exposures of the Laguna appear along the eastern margin of the subbasin in the vicinity of the Thermalito Afterbay and extend westerly in the subsurface. The lateral extent of the formation is unknown. The thickness of the formation is difficult to determine because the base of the unit is rarely exposed. Estimates of maximum thickness range from 180 feet (Helley and Harwood 1985) to 1,000 feet (Olmsted and Davis 1961). Geologic cross sections developed by California Department of Water

Resources estimate the thickness to be approximately 500 feet (DWR 2000). Wells completed in the formation yield only moderate quantities of water.

Groundwater Level Trends

As part of a groundwater inventory analysis prepared for Butte County, the portion of the East Butte Subbasin located within Butte County was evaluated for seasonal and long-term changes in groundwater levels for confined and composite portions of the aquifer systems (DWR 2001).

For wells constructed in confined and composite portions of the aquifer, the increased use of groundwater in the northern portion of the subbasin has resulted in wide seasonal fluctuations in groundwater levels. In the northern portion of the subbasin, composite well fluctuations (composite wells are monitoring wells that represent groundwater levels that combine confined and unconfined portions of the aquifer system) average about 15 feet during normal years and 30- to 40- feet during drought years. Annual groundwater fluctuations in the confined and semi-confined aquifer system ranges from 15- to 30- feet during normal years.

In the portion of the subbasin located within the southern part of Butte County, groundwater level fluctuations for composite wells average about 4 feet during normal years and up to 10 feet during drought years. The groundwater fluctuations for wells constructed in the confined and semi-confined aquifer system average 4 feet during normal years and up to 5 feet during drought years.

Recharge Areas

Localized fluctuations in groundwater levels are observed just south of the Thermalito Afterbay due to the recharging of groundwater from this surface water system (DWR 2001).

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 East Butte Subbasin is 5.9 percent. The estimated storage capacity to a depth of 200 feet is approximately 3,128,959 acre-feet.

Groundwater Budget (Type B)

Estimates of groundwater extraction are based on surveys conducted by the California Department of Water Resources during 1993 and 1997. Surveys included landuse and sources of water. Estimates of groundwater extraction for agricultural; municipal and industrial; and environmental wetland uses are 104,000, 75,500 and 1,300 acre-feet respectively. Deep percolation of applied water is estimated to be 126,000 acre-feet.

Groundwater Quality

Characterization. Calcium-magnesium bicarbonate and magnesium-calcium bicarbonate waters are the predominant groundwater water types in the subbasin. Magnesium bicarbonate waters occur locally near Biggs-Gridley, south and east to the Feather River. Total dissolved solids range from 122- to 570-mg/L, averaging 235 mg/L (DWR unpublished data).

Impairments. Localized high concentrations of manganese, iron, magnesium, total dissolved solids, conductivity, ASAR, and calcium occur within 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	30	1
Radiological	25	0
Nitrates	32	2
Pesticides	16	0
VOCs and SVOCs	19	0
Inorganics – Secondary	30	3

[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 Production characteristics

	Well yields (gal/min)	
Irrigation	Range: 0 – 4500	Average: 1839 (37 Well Completion Reports)

Utility pump test records for the East Butte Subbasin show well yields ranging from a low of 65 gpm to a high of 5,459 gpm with an average yield of 1,602 gpm (DWR 2001).

	Total depths (ft)	
Domestic	Range: 25 – 639	Average: 101 (1477 Well Completion Reports)
Irrigation	Range: 35 – 983	Average: 285 (699 Well Completion Reports)

Active Monitoring Data

Agency	Parameter	Number of wells /measurement frequency
DWR	Groundwater levels	43 wells semi-annually
DWR	Miscellaneous water quality	4 wells biennially
Department of Health Services	Miscellaneous water quality	44

Basin Management

Groundwater management:	Butte County adopted a groundwater management ordinance in 1996.
Water agencies	
Public	Butte Basin Water Users Association, Biggs-West Gridley WD, Butte WD, Durham ID, City of Biggs, City of Gridley, Oroville-Wyandotte ID, Richvale ID, Thermalito ID, and Western Canal WD.
Private	North Burbank Public Utility District.

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Errata

Changes made to the basin description will be noted here.