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.