Sacramento Valley Groundwater Basin
North American Subbasin

- Groundwater Basin Number: 5-21.64
- County: Sutter, Placer, Sacramento
- Surface Area: 351,000 acres (548 square miles)

Basin Boundaries and Hydrology

The North American subbasin lies in the eastern central portion of the Sacramento Groundwater Basin. The Bear River is its northern boundary, the Feather River is its western boundary, and the Sacramento River is its southern boundary. The eastern boundary is a north-south line extending from the Bear River south to Folsom Lake, which passes about 2 miles east of the town of Lincoln. The eastern boundary represents the approximate edge of the alluvial basin, where little or no groundwater flows into or out of the groundwater basin from the rock of the Sierra Nevada (DWR 1997). The eastern portion of the study area is characterized by low rolling dissected uplands. The western portion is nearly a flat flood basin for the Bear, Feather, Sacramento and American rivers, and several small east side tributaries. The general direction of drainage is west-southwest at an average grade of about 5 percent.

Precipitation ranges from 18-20 inches in the western half of the subbasin to 20-24 inches in the eastern half of the subbasin.

Hydrogeologic Information

The following geologic references are presented in Feasibility Report, American Basin Conjunctive Use Project by California Department of Water Resources (1997).

Water Bearing Formations

The water-bearing materials of the North American subbasin are dominated by unconsolidated continental deposits of Late Tertiary and Quaternary age. Deposits include Miocene/Pliocene volcanics, older alluvium, and younger alluvium. The alluvium can be characterized as comprising the upper aquifer system, occupying the upper 200 to 300 feet below ground surface; the Mehrten and older geologic units can be characterized as comprising the lower aquifer system, occurring generally deeper than 300 feet towards the west side of the subbasin. The cumulative thickness of these deposits increases from a few hundred feet near the Sierra Nevada foothills on the east to over 2,000 feet along the western margin of the subbasin. Most of the groundwater is produced in the northern portion of the subbasin. The aquifer zones in the upper 200 to 300 feet of this portion of the subbasin appear to be unconfined and behave similarly to stresses imposed on them. Conversely, deeper zones show a delayed response to stresses in the upper zone, indicating possibly limited interconnection with the shallower zones (DWR 1997).

Younger Alluvium. These deposits include flood basin deposits and recent stream channel deposits. The flood basin deposits occur along the western margin of the subbasin adjacent to the Sacramento River. The flood basin

deposits consist primarily of silts and clays, although they may be locally interbedded with stream channel deposits of the Sacramento River. Thickness of the unit ranges from 0 to 100 feet. Because of the fine-grained nature, the flood basin deposits have low permeability and generally yield low quantities of water to wells. Brackish water is often encountered in these deposits.

The stream channel deposits include sediments deposited in the channels of active streams as well as overbank deposits of those streams, terraces, and local dredge tailings. These deposits occur predominantly along the Sacramento and American Rivers and their major tributaries, and consist primarily of unconsolidated silt, fine- to medium-grained sand, and gravel. Thickness of the unit ranges from 0 to about 100 feet. Sand and gravel zones in the younger alluvium are highly permeable and yield significant quantities of water to wells.

Older Alluvium. These deposits consist of loosely to moderately compacted sand, silt, and gravel deposited in alluvial fans during the Pliocene and Pleistocene. A number of formational names have been assigned to the older alluvium, including the Modesto, Riverbank, and Turlock Lake Formations (Helley and Harwood 1985), Victor and Laguna Formations (Olmstead and Davis 1961), and Arroyo Seco Gravels, South Fork Gravels, and Fair Oaks Formation (DWR 1974). The older alluvial units are widely exposed between the Sierra Nevada foothills and overlying younger alluvial units near the axis of the Sacramento Valley. Thickness of the older alluvium ranges between 100 to 650 feet. It is moderately permeable.

Miocene/Pliocene Volcanics. These deposits consist of the Mehrten Formation, a sequence of fragmented volcanic rocks. The Mehrten Formation is exposed along the eastern margin of the subbasin between the towns of Lincoln and Folsom. It is composed of intervals of "black sands," stream gravels, silt, and clay interbedded with intervals of dense tuff breccia. The sand and gravel intervals are highly permeable and wells completed in them have reported yields of over 1,000 gpm. The tuff breccia intervals act as confining layers. Thickness of the unit is between 200 and 1,200 feet.

Groundwater Level Trends

Groundwater levels in southwestern Placer County and northern Sacramento County have generally decreased, with many wells experiencing declines at a rate of about one and one-half feet per year for the last 40 years or more (PCWA1999). Some of the largest decreases have occurred in the area of the former McClellan AFB. Groundwater levels in Sutter and northern Placer Counties generally have remained stable, although some wells in southern Sutter County have experienced declines (DWR 1997).

Groundwater Storage

Groundwater Storage Capacity. DWR (1997) assumed a specific yield of 7% and an aquifer thickness of 200 feet for 200,000 acres within the North American subbasin. Storage capacity can be estimated for the North American subbasin by applying the same assumptions as DWR (1997) – specific yield of 7% and an assumed thickness of 200 feet over the entire

351,000 acre subbasin. This results in an estimated storage capacity of approximately 4.9 million acre-feet.

Groundwater in Storage. There are no known published reports that discuss groundwater in storage.

Groundwater Budget (Type B)

As part of its water planning process, DWR estimated the following components of the groundwater budget. The calculations are for a 1990 level of development. Estimated inflows include natural recharge at 83,800 acre-feet and applied water recharge at 29,800 acre-feet. There was no artificial recharge. Estimated outflows include urban extraction at 109,900 acre-feet and agricultural extraction at 289,100 acre-feet.

Groundwater Quality

Characterization. The chemistry and quality of groundwater has been assessed for the American Basin. Many areas of good quality groundwater exist in the North American subbasin. In some portions of the basin groundwater quality is marginal. The three major groundwater types are: magnesium calcium bicarbonate or calcium magnesium bicarbonate; magnesium sodium bicarbonate or sodium magnesium bicarbonate; and sodium calcium bicarbonate or calcium sodium bicarbonate (DWR 1997).

Comparison of groundwater quality data with applicable water quality standards and guidelines for drinking and irrigation indicate elevated levels of TDS/specific conductance, chloride, sodium, bicarbonate, boron, fluoride, nitrate, iron manganese, and arsenic may be of concern in some locations within the subbasin (DWR 1997).

High TDS levels exist in an area along the Sacramento River extending from Sacramento International Airport northward to the Bear River. The highest levels of TDS are found in an area extending just south of Nicholas to Verona, between Reclamation District 1001 and the Sutter Bypass. Some wells in this area have reported TDS exceeding 1,000 mg/L.

This same area along the Sacramento River extending from Sacramento International Airport northward to the Bear River also contains high levels of chloride, sodium, bicarbonate, manganese, and arsenic. The groundwater in the southern part of the basin is generally characterized as good quality, low in disinfection by-product precursor materials and moderate in mineral content, although some localized contamination issues do exist.

Impairments. There are three sites within the subbasin with significant groundwater contamination issues: the former McClellan AFB, Union Pacific Railroad Rail Yard in Roseville and the Aerojet Superfund Site. Although the Aerojet site lies south of the North American subbasin, a contaminant plume (including TCE and PCE) extends north from Aerojet, under the American River and into the North American subbasin (Montgomery Watson 2000). Other localized areas of contamination exist throughout the basin and are generally smaller in scope and extent of contamination.

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	265	7
Radiological	254	2
Nitrates	276	0
Pesticides	268	0
VOCs and SVOCs	267	6
Inorganics – Secondary	265	75

[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: 752-2,500	Average: 800 (DWR 1997)
	Total depths (ft)	
Domestic	Range: 50-1,750	Average: 190 (665 well completion reports)
Municipal/Irrigation	Range: 77-1,025	Average: 396 (105 well completion reports)

Active Monitoring Data

Agency	Parameter	Number of wells /measurement frequency
DWR	Groundwater levels	53 wells semi-annually, 7 monthly
Sacramento County		17 wells semi-annually
South Sutter WD		21 wells semi-annually, 1 monthly
Sutter County		22 wells semi-annually
DWR	Mineral, nutrient, & minor element.	32 wells biennially
Department of Health Services (including co-operators)	Title 22	Approximately 275 wells

Basin Management

Groundwater management:	The Sacramento Groundwater Authority (SGA) is a joint powers authority responsible for the protection of the regional groundwater basin within Sacramento County north of the American River. SGA adopted a groundwater management plan on December 11, 2003. South Sutter WD adopted an AB 3030 plan in 1995. Placer County Water Agency adopted an AB 3030 plan in 1998 and updated this plan in 2003. City of Lincoln adopted a groundwater management plan on November 12, 2003.
Water agencies	
Public	South Sutter WD, Camp Far West ID, Rio Linda/Elverta CWD, Citrus Heights WD, San Juan Suburban WD, Fair Oaks WD, Carmichael WD, Sacramento Suburban WD, Western Placer ID, Placer County WA, Del Paso Manor WD, City of Sacramento WSA, City of Roseville, Sacramento County Water Agency
Private	Pleasant Grove – Verona MWC, Natomas Central MWC, California-American WC, Orangevale WC, Southern California WC,

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Errata

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

Sacramento Valley Groundwater Basin
South American Subbasin

- Groundwater Basin Number: 5-21.65
- County: Sacramento
- Surface Area: 248,000 acres (388 square miles)

Basin Boundaries and Hydrology

The subbasin is bounded on the east Sierra Nevada, on the west by the Sacramento River, on the north by the American River, on the south by the Cosumnes and Mokelumne Rivers. These perennial rivers generally create a groundwater divide in the shallow subsurface. It is clear that there is interaction between groundwater of adjacent subbasins at greater depths. Average annual precipitation ranges from about 14" along the western boundary to greater than 20" along the eastern boundary.

Hydrogeologic Information

Water Bearing Formations

The South American subbasin aquifer system is comprised of continental deposits of Late Tertiary to Quaternary age. These deposits include younger alluvium (consisting of flood basin deposits, dredge tailings and Holocene stream channel deposits), older alluvium, and Miocene/Pliocene volcanics. The cumulative thickness of these deposits increases from a few hundred feet near the Sierra Nevada foothills on the east to over 2,500 feet along the western margin of the subbasin. The maximum combined thickness of all the younger alluvial units is about 100 feet. Calculated specific yield values range from about 5.4% in the flood basin deposits to 10% in the stream channel deposits (Olmstead and Davis 1961).

Flood basin deposits. These deposits occur along the western margin of the subbasin adjacent to the Sacramento River. They consist primarily of silts and clays, but along the western margin of the subbasin may be locally interbedded with stream channel deposits of the Sacramento River. Because of their fine-grained nature, the flood basin deposits have low permeability and generally yield low quantities of water to wells.

Dredger tailings. Tailings are exposed primarily along the American River in the northeastern corner of the subbasin. They consist of windows of gravel, cobbles, boulders, sand, and silt resulting from the activities of gold dredging operations. The tailings are highly permeable, but well construction is complicated by the presence of cobbles and boulders.

Stream Channel Deposits. The stream channel deposits include sediments deposited in the channels of active streams as well as overbank deposits of those streams, terraces, and local dredger tailings. They occur along the Sacramento, American, and Cosumnes Rivers and their major tributaries and consist primarily of unconsolidated silt, fine- to medium-grained sand, and gravel. Sand and gravel zones in the younger alluvium are highly permeable and yield significant quantities of water to wells.

Older alluvium. These deposits consist of loosely to moderately compacted sand, silt and gravel deposited in alluvial fans during the Pliocene and Pleistocene. A number of formational names have been assigned to the older alluvium, including the Modesto and Riverbank Formations (Helley and Harwood, 1985), Victor Formation and Laguna Formation (Olmstead and Davis 1961), and Victor Formation, Laguna Formation, Arroyo Seco Gravels, South Fork Gravels, and Fair Oaks Formation (DWR 1974). The older alluvial units are widely exposed between the Sierra Nevada foothills and overlying younger alluvial units near the axis of the Sacramento Valley. Thickness of the older alluvium is about 100 to 650 feet. It is moderately permeable. The calculated specific yield of these deposits is about 7% (Olmstead and Davis 1961).

Miocene/Pliocene Volcanics. These consist of the Mehrten Formation, a sequence of fragmental volcanic rocks, which crops out in a discontinuous band along the eastern margin of the basin. It is composed of intervals of "black sands," stream gravels, silt, and clay interbedded with intervals of dense tuff breccia. The sand and gravel intervals are highly permeable and wells completed in them can have high yields. The tuff breccia intervals act as confining layers. Thickness of the unit is between 200 and 1,200 feet.

Groundwater Level Trends

A review of 18 long-term hydrographs dating back into the 1960s shows a consistent pattern of water level trends through much of the basin. Groundwater elevations generally declined consistently from the mid-1960s to about 1980 on the order of 20 feet. From 1980 through 1983 water levels recovered by about 10 feet and remained stable until the beginning of the 1987 through 1992 drought. From 1987 until 1995, water levels declined by about 15 feet. From 1995 to 2000 most water levels recovered by up to 20 feet leaving them generally higher than levels prior to the 1987 through 1992 drought. Exceptions to this trend include: 1) wells in the vicinity of the city of Sacramento, which fluctuated generally less than 10 feet overall since the mid-1970s; and 2) wells in the vicinity of Rancho Cordova, which appear to have recovered less than the other wells in the subbasin since 1995 (generally less than 10 feet).

Groundwater Storage

No published calculations for subbasin storage capacity are available. However, based on available information from Olmstead and Davis (1961), DWR calculated groundwater storage capacity in the subbasin at 4,816,000 af. This was calculated by superimposing the hydrogeologic units described in Olmstead and Davis over a map of the subbasin. A planimeter was used to determine the percent coverage of each of these units in the subbasin. The specific yield values provided by Olmstead and Davis for each unit were then used to calculate an average specific yield of 6.8 percent for a depth range of 20 feet below ground surface to 310 feet bgs. The surface area used in that calculation was 243,200 acres.

Groundwater Budget (Type A)

A groundwater model was developed for Sacramento County by Montgomery Watson (see Montgomery Watson 1993). Based on this model

and subsequent data updates, Bookman-Edmonston/Navigant Consulting provided estimates of several groundwater budget components for an area generally corresponding to the South American Subbasin. The data represent an average budget for the period from 1970 to 1995. Basin inflows include natural and applied water recharge, which total 257,168 af. Subsurface inflow and outflow are not known specifically, but the model indicates that there is a net subsurface outflow of 29,676 af annually. Other groundwater outflows include annual urban extraction of 68,058 af and agricultural extraction of 162,954 af.

Groundwater Quality

Characterization. Groundwater is typically a calcium magnesium bicarbonate or magnesium calcium bicarbonate. Other minor groundwater types include a sodium calcium bicarbonate or calcium sodium bicarbonate in the vicinity of Elk Grove and a magnesium sodium bicarbonate or sodium magnesium bicarbonate near the confluence of the Sacramento and American rivers (Bertoldi and others 1991). TDS ranges from 24 – 581 mg/l and averages 221 mg/l based on 462 records (Montgomery Watson 1993).

Impairments. Montgomery Watson (1997) listed seven sites within the subbasin with significant groundwater contamination. Included in the list are three USEPA Superfind sites – Aerojet, Mather Field, and the Sacramento Army Depot. Other sites are the Kiefer Boulevard Landfill, an abandoned PG&E site on Jiboom Street near Old Sacramento, the Southern Pacific and Union Pacific Rail Yards in downtown Sacramento.

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	144	2
Radiological	147	1
Nitrates	170	1
Pesticides	148	0
VOCs and SVOCs	144	8
Inorganics – Secondary	144	46

[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:	Range: N/A	Average: 908 (Montgomery Watson 1997)
Irrigation:	Range: N/A	Average: 971 (Montgomery Watson 1997)
	Total depths (ft)	
Domestic	Range: 87 – 575	Average: 247 (422 Well Completion Reports)
Municipal/Irrigation	Range: 41 – 1,000	Average: 372 (78 Well Completion Reports)

Active Monitoring Data

Agency	**Parameter**	**Number of wells /measurement frequency**
DWR	Groundwater levels	34 wells semi-annually 3 wells monthly
Sacramento County		30 wells semi-annually
SMUD		9 wells semi-annually
USBR		29 wells semi-annually
DWR (incl. Cooperators)	Mineral, nutrient, & minor element.	9 wells every two years
Department of Health Services and local cooperators	Coliform, nitrates, mineral, organic chemicals, and radiological.	247 wells as required in Title 22, Calif. Code of Regulations

Basin Management

Groundwater management:	No AB3030 plan - Sacramento North Area Groundwater Management Authority (SNAGMA), is a joint powers authority responsible for the protection of the regional groundwater basin. No AB3030 plans – Initial phase 3/94 - Sacramento Metropolitan Water Authority (SMWA) is a joint powers authority and non-profit benefit association formed by 16 water supply agencies and utilities.
Water agencies	
Public	Arden Cordova Water Service, City of Folsom, City of Sacramento, County of Sacramento, Elk Grove Water Works, Florin County WD Fruitridge Vista, Mather Air Force Base, North Delta Water Agency Omochumne-Hartnell WD, Rancho Murieta CSD, Tokay Park Sacramento County WMD, Sacramento County WMD- Zone 40
Private	Citizens Utilities Company.

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Errata

Changes made to the basin description will be noted here.