Middle Mojave River Valley Groundwater Basin

- Groundwater Basin Number: 6-41
- County: San Bernardino
- Surface Area: 211,000 acres (330 square miles).

Basin Boundaries and Hydrology

The Middle Mojave River Valley Groundwater Basin underlies an elongate east-west valley, with the Mojave River flowing (occasionally) through the valley from the south near the town of Helendale to the east and into the Lower Mojave River Valley Basin at the Waterman fault. The Middle Mojave River Valley Basin is bounded on the north by a combination of surface and subsurface divides, the Helendale fault, and the contact between Quaternary alluvium and consolidated basement rocks of the Kramer Hills and Iron Mountain. The southern boundary is a roughly east-west line from outcropping basement rock near Helendale to that in the Shadow Mountains. The groundwater basin is bounded on the east by the Camp Rock-Harper Lake fault zone and on the west by surface drainage divides and basement outcrops of the Shadow Mountains northward to the Kramer Hills area. Average precipitation varies across the basin from 4 to 11 inches with the average for the basin near 6 inches (USDA 1999).

Hydrogeologic Information

Water Bearing Formations

The two primary water-bearing units within the Mojave River Valley Basin system consist of regional Pliocene and younger alluvial fan deposits (fan unit) and overlying Pleistocene and younger river channel and floodplain deposits, callsed the floodplain unit (DWR 1967), or the floodplain aquifer (Lines 1996; Stamos and others 2001). Other potential, but not regionally significant, water-bearing units include older alluvium, old fan deposits, old lake and lakeshore deposits, and dune sand deposits (DWR 1967). Water-bearing deposits in this groundwater basin are predominantly unconfined. Wells yield from 100 to 4,000 gpm (Hardt 1969; Lines 1996), and the average well yield is about 480 gpm for all units (BEE 1994).

Pleistocene and Younger Floodplain Unit. The floodplain unit is the more productive and extensively studied of the two units and extends an average of 200 feet deep, but is restricted to within about 1 mile of the active Mojave River channel (Stamos and others 2001). Specific yield for the floodplain unit deposits in the Middle Mojave River Valley Groundwater Basin ranges from 20 to 23 percent, averaging about 22 percent, and wells yield up to 4,000 gpm (Lines 1996).

Pliocene and Younger Fan Unit. The regional fan unit, is composed of Late Tertiary and younger unconsolidated to partially consolidated alluvial fan deposits up to 2,000 feet thick (Stamos and Predmore 1995; Lines 1996; Stamos and others 2001). Permeability decreases with depth (Stamos and others 2001) and the estimated average effective thickness in the Middle Mojave River Valley Groundwater Basin is about 300 feet thick (DWR 1967). Available information is indicates that specific yields and well yields are generally less for the fan unit compared to the floodplain unit, but suggest generally higher well yields for younger fan deposits and lower well yields for older fan deposits (DWR 1967). Specific yield in this deposit averages about 10 percent (DWR 1967).

Restrictive Structures

This groundwater basin is transected by the Helendale, Mount General, Lenwood and Camp Rock-Harper Lake fault zones. These northwest-trending faults form barriers or partial barriers to groundwater flow (Stamos and Predmore 1995; Stamos and others 2001). Regionally, similar faults cause a stair-step pattern that lowers the water table eastward across each of the faults (Stamos and Predmore 1995; Lines 1996). The Helendale fault forms an effective barrier in the regional fan unit, but does not appear to affect the young river channel deposits (Stamos and Predmore 1995; Lines 1996). Stamos and others (2001) also interpret an unexposed northeast trending fault to cause a steep groundwater gradient west of Iron Mountain that forms the boundary of this basin with the Harper Valley Groundwater Basin. Bedrock constriction causes water to rise toward the surface of the Mojave River at Cottonwoods near Hodges, and Point of Rocks near Helendale (Lines 1996).

Recharge Areas

Natural recharge of the basin is from direct precipitation, ephemeral streamflow, infrequent surface flow of the Mojave River, and underflow of the Mojave River into the basin from the southwest (Eccles 1981; Stamos and Predmore 1995; Lines 1996). Treated waste-water effluent, septic tank effluent and irrigation waters are allowed to percolate into the ground and recharge the groundwater system (Eccles 1981; Lines 1996). A large, but sporadic contribution to recharge occurs when the Mojave River is flowing, with 40 feet of rise in the water table observed during 1969 and 87 feet of rise observed in 1993 (Hardt 1969; Robson 1974; Lines 1996).

Groundwater Level Trends

Groundwater levels for wells in the floodplain unit near the Mojave River tend to vary in concert with rainfall and runoff amounts, whereas groundwater levels in the fan unit do not show significant changes due to local rainfall (MWA 1999). The general trend in this basin is for declining groundwater levels, particularly in the fan unit. Three of the ten highest precipitation years over a 60-year base period occurred during 1991 through 1999 (MWA 1999). Infiltration of the runoff from this relatively abundant precipitation has produced an increase in the groundwater level (and groundwater storage) in the floodplain unit near the Mojave River (MWA 1999). A hydrograph for a well near Helendale in the floodplain unit shows a range of about 10 feet in water level over the last thirty years, increasing about 4 feet over the last ten years (MWA 1999). The general groundwater flow pattern is toward the active channel and then following the course of the Mojave River across this basin (Stamos and Predmore 1995; Lines 1996). Some groundwater diversion toward Harper Lake (dry) around both the east and west sides of Iron Mountain may occur (Stamos and Predmore 1995). Little is known about the groundwater flow pattern in the western portion of this basin.

Groundwater Storage

Groundwater Storage Capacity. Published total storage capacity for the Middle Mojave River Valley Groundwater Basin varies. The boundaries of the Middle Mojave River Valley Groundwater Basin correspond closely to the Helendale and Stodard storage units and a part of the Hinkley storage unit discussed by DWR (1967) . DWR (1967) calculates total storage capacity to the base of water-bearing materials, an average of about 300 feet. The total storage capacity of the Helendale, Stodard and Hinkley storage units is about 8,050,000 af total storage (DWR 1967). The boundaries of Mojave Water Agency's Centro subarea correspond closely with those of the Middle Mojave River Valley Groundwater Basin, but the Centro subarea also overlies much of the Harper Valley Groundwater Basin. MWA calculates a total effective storage capacity by using an economic pumping depth of 100 feet to limit the depth of the basin (BEE, 1994). MWA calculated a total storage capacity of the Centro subarea to be about 740,000 af (BEE, 1994). Using an overlying area of about 211,000 acres, an average thickness of about 300 feet, and an average specific yield of about 10.5 percent, the total storage capacity of the Middle Mojave Rive Valley Groundwater Basin about 6,650,000 af.

Groundwater in Storage. MWA (1999) calculated the amount of stored groundwater in the Centro subarea at the end of 1998 to be about 522,000 af, leaving about 218,000 af of storage space available. The basin is considered to be effectively full when 1930 water level elevations are reached (BEE, 1994). Assuming an average of 250 feet of saturated material (MWA 1999), an area of about 211,000 acres, and a specific yield of about 10.5 percent, about 5,540,000 af of stored groundwater was available at the end of 1998. This amount indicates that about 1,110,000 af of storage space is available.

Groundwater Budget (Type – A)

Not enough data exist to compile a detailed groundwater budget for the basin. However, the MWA monitors groundwater extraction and reports extractions of 11,400 af for urban uses, 13,600 af for agriculture, and 1,800 af for industrial and recreational uses in the 1997-1998 water year (MWA 1999). In addition to the extraction data, several other components of the water budget have been reported. For the 1997-1998 water year, MWA (1999) estimated natural recharge at 36,300 af, artificial recharge at 1,870 af, and applied water recharge estimated at 6,800 af. Subsurface inflow and outflow averages are estimated by DWR (1967) at 2,000 af inflow and 3,000 af outflow; the inflow has been corroborated by Bookman-Edmonston Engineering (1994). However, Stamos and others (2001) estimate that 5,000 to 6,000 afy flows through the floodplain unit into the Middle Mojave River Valley Groundwater Basin near the Helendale fault.

Groundwater Quality

Characterization. The groundwater in the Middle Mojave River Valley Basin is predominantly sodium bicarbonate character near the Mojave River. Sodium sulfate-chloride character water occurs near Helendale, and sodium-calcium sulfate character near Hodge. Sodium bicarbonate-sulfate character water occurs near Lenwood, and sodium chloride-sulfate character occurs east of the Shadow Mountains (DWR 1967). The average total dissolved solids content for groundwater in this basin is about 500 mg/L, with readings as high as 1,000 mg/L near Helendale (BEE 1994). Electrical Conductivity values appear to reach 1,460 µmhos near Helendale, with lower values of 570 µmhos near Hinkley and 400 µmhos in Stoddard Valley (DWR 1967).

Impairments. Volatile organic compounds, salts and nitrates have leached into the local groundwater from the Lenwood landfill in the lower part of the basin. Irrigation with effluent from the Barstow wastewater reclamation facility, along with naturally occurring nitrates and salts, may also be affecting the basin (BEE 1994). Some readings have exceeded the recommended maximum concentration levels for nitrate near Hodge and fluoride near Lenwood (DWR 1967; BEE 1994; MWA 1999).

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	4	1
Radiological	3	0
Nitrates	5	0
Pesticides	4	0
VOCs and SVOCs	4	0
Inorganics – Secondary	4	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 Production Characteristics

	Well yields (gal/min)	
Municipal/Irrigation	Range: 8–4,000	Average: 1,000 Median: 800 (73 Well Completion Reports)
	100-4,000 gpm for floodplain unit (Hardt 1969; Lines 1996)	Average = 480 gpm for all units (BEE 1994)
	Total depths (ft)	
Domestic	Range: 41-710	Average: 210 Median: 200 (327 Well Completion Reports)
Municipal/Irrigation	Range: 50-712	Average: 200 Median: 190 (146 Well Completion Reports)

Active Monitoring Data

Agency	Parameter	Number of wells /measurement frequency
U.S. Geological Survey	Water Level	74/ Annually
U.S. Geological Survey	Water Quality	3/ Annually
Department of Health Services	Title 22 Water Quality	14/ Annually

Basin Management

Groundwater management:	The Lower Mojave River Valley Groundwater Basin is a portion of an area adjudicated in 1996 setting the Mojave Water Agency as Watermaster. MWA has proposed three basic management strategy alternatives that would reduce and eliminate overdraft in the basin: water conservation, water supply enhancement, and water allocation. These alternatives will likely be implemented together in the final management strategy adopted by MWA (BEE 1994).
Water agencies	
Public	Mojave Water Agency
Private	Southern California Water Company

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Errata

Substantive changes made to the basin description will be noted here.