



EXPLANATION

Boundaries

- Mojave River drainage basin
- Mojave River groundwater basin (approximate)
- Morongo groundwater basin (approximate)
- Mojave Water Agency management area
- Mojave Water Agency management area subarea
- Perched water table
- Military installation
- Location uncertain
- Approximately located
- Location uncertain
- Water-table contour—Shows elevation of water table (spring 2014). Contour interval, in feet, is variable. Contour is queried where uncertain. Thick contour indicates 100-foot contour interval. North American Vertical Datum of 1988 (NAVD 88).
- Location uncertain
- Depression—bathymetry point to depression

Generalized direction of groundwater flow

- Well—Top number is abbreviated State well number. Bottom number is elevation of water level, in feet above NAVD 88 (spring 2014).
- Water-level record may contain pressure-transducer data—Top number is abbreviated State well number. Bottom number is elevation of water level, in feet above NAVD 88 (spring 2014).
- Well with perched water level—Top number is abbreviated State well number. Bottom number is elevation of water level, in feet above NAVD 88 (spring 2014).
- Well with historical data shown on a hydrograph
- Multi-depth well—Well shown is most shallow well used to generate water-table contours. Top number is abbreviated State well number. Bottom number is elevation of water level, in feet above NAVD 88 (spring 2014).
- Multi-depth well with pressure-transducer data—Well shown is most shallow well used to generate water-table contours.
- Washday well—Top number is abbreviated State well number. Bottom number is elevation of water level, in feet above NAVD 88 (spring 2014).
- Artificial recharge site and name
- Artificial Recharge System Authority (AYRA)
- Hydrograph—Shows period of record for well. Symbols indicate actual data values from National Water Information System (NWIS). Number represents well identifier. Shaded hydrographs are long-term data. Replaced wells are indicated by \oplus on map.

2014 WATER TABLE

Surface water in these basins is minimal and normally is limited to ephemeral flow during winter and spring storms and discharge from perennial springs in some areas of the Morongo groundwater basin. The major source of surface water is the Mojave River, however, its flow is unpredictable and not a dependable source for water supply because most of the 100-mile river channel is usually dry. The lack of reliable surface-water resources has resulted in the use of groundwater as the primary water source for private, agricultural, and municipal supply. Because of increasing urbanization, demands on local water supplies have created overall conditions in some areas of the basins. Greatly lowered water levels have the potential to induce or increase subsidence in the Mojave River and Morongo groundwater basins.

MOJAVE RIVER GROUNDWATER BASIN

The Mojave River groundwater basin has an area of approximately 1,400 square miles that extends from the San Bernardino and the San Gabriel Mountains in the south to south of Harper and Coyote Lakes (dry). The groundwater basin is bordered on the west by Antelope Valley and in its southeastern boundary with the Morongo groundwater basin. For water-management purposes, the Mojave River drainage basin was divided into five sub-basins, partially based on the Mojave River drainage basin boundary—Onts, Aho, East, Centro, and Hah (fig. 2).

MORONGO GROUNDWATER BASIN

The Morongo River and Morongo groundwater basins are separated by the Helendale Fault, which acts as a barrier to groundwater flow near Lucerne Valley. The regional aquifer in the Morongo groundwater basin consists of continental deposits of Oligocene and Tertiary age that is as much as 10,000 ft deep (Moyle, 1964). For a more comprehensive description of the geology and hydrology of the basin, see the report by Stanton and others (2014). The regional aquifer also consists of partly consolidated to consolidated sedimentary deposits of Tertiary age. The regional aquifer is as much as 1,000 ft thick. Other geologic units, such as bedrock and lake deposits, commonly contain groundwater, but they are not considered reliable sources of groundwater in the study area.

MOJAVE RIVER AND MORONGO GROUNDWATER BASINS

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GROUNDWATER MOVEMENT

Groundwater flow perpendicular to water-level contours from areas of higher hydraulic head to areas of lower hydraulic head (downgradient). Water-table contours in the vicinity of faults indicate that some faults in the study area act as barriers to groundwater flow. The barrier effect of the fault is probably caused by compression and deformation of water-bearing deposits immediately east of the fault and by concentration of the fault zone by mineral deposits from groundwater (Lundquist and Martin, 1991).

The southern part of the Helendale Fault, near the town of Lucerne, is an effective barrier to subsurface flow. The water-table map indicates that directions of groundwater movement on the east side of the Helendale Fault is toward the east (Lucerne Valley). Therefore, groundwater east of the Helendale Fault in this area is considered to be in the Morongo groundwater basin. Groundwater flow systems in the Lucerne Lake area have changed little since 1917, the time of the first available data (Schaefer, 1979). West of the Helendale Fault, groundwater is considered to be in the Aho sub-basins of the Mojave River groundwater basin, and the water-table gradient is relatively flat.

MOJAVE RIVER GROUNDWATER BASIN

In most sub-basins of the Mojave River groundwater basin, groundwater generally flows northward and eastward. In the Aho sub-basins, the flow is northward and westward. The amount of subsurface flow across the boundary between the Aho and East sub-basins was estimated by Stanton and Prohman (1995). Hand (1977) estimated that the transmissivity of the aquifer materials below the boundary of the Aho and East sub-basins ranged from 0.001 to 0.003 gpd/ft per day per foot. The south of the boundary is about 4 miles, and the hydraulic gradient was determined from the water-table map in 1992 (Stanton and Prohman, 1995) to be 0.0025 ft/ft. The estimated subsurface flow is estimated to be 100 to 200 million gallons per day from the East sub-basins to the Aho sub-basins was 300 to 600 gpd/ft per day. Available data in the southernmost part of the basin are insufficient to estimate the quantity of flow across the Centro-Aho sub-basin boundary.

The water-table contour indicate that subsurface flow crosses the Helendale Fault from the Aho sub-basins to the Centro sub-basins along the Mojave River. Water-level data from multiple-well monitoring sites, as well as historical data, indicate that this fault restricts subsurface flow in the regional aquifer, but in the overlying alluvial aquifer (Hand, 1977). Groundwater moving into the Centro sub-basins flows either to the north, away from the Mojave River toward the City of Lancaster, or to the south, away from the Mojave River toward the City of Lancaster. Steep water-level gradients between the Helendale Fault and Iron Mountain indicate the probable presence of surface flow or shallow geologic structures that impede subsurface flow to Harper Lake. On the east side of Iron Mountain, groundwater flows from the Mojave River northwest to Harper Lake. Groundwater from the Centro sub-basins crosses the Camp Rock-Harper Lake fault zone and enters the Aho sub-basins east of Harper Lake. In the Aho sub-basins, the water-table gradient is marked by sharp, step-like changes in the water-table gradient, decreasing in elevation as water flows eastward. Water-level data from multiple-well monitoring sites indicate that the fault zone impedes groundwater movement both in the shallow alluvial aquifer and in the underlying regional aquifer. East of the Camp Rock-Harper Lake fault zone, the water-table gradient is relatively flat. But where groundwater flows northward through the Baja sub-basins, as indicated by more than a 50-foot drop in the water table on the west side of the fault. Water-level data from multiple-well monitoring sites on both sides of the Camp Rock-Harper Lake fault zone indicate that groundwater flow is impeded by the fault zone.

MORONGO GROUNDWATER BASIN

In the Morongo groundwater basin, groundwater generally flows eastward and northward from the San Bernardino Mountains. From Pipe Wash, flow is eastward toward Lucerne Valley. In the eastern part of the basin, groundwater levels near well 7N-28-2182 have increased slightly as a result of recharge from treated wastewater that is discharged by the Victor Valley Wastewater Reclamation Authority (VYWAR) at this site.

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WATER-LEVEL CHANGES 2012-2014

Water-level data exist for 479 wells in the Mojave River and Morongo groundwater basins for 2012 and 2014. Overall, water levels in wells along the Mojave River in the Aho sub-basins and the Aho transition zone have remained constant (Feague and others, 2016) because of the infiltration resulting from surface flow through the Lower Narrows (1020560) and the treated wastewater discharged by the VYWAR. Data from the Centro and Baja sub-basins showed that most wells had groundwater-level decreases. A small pumping depression that occurred in the region of wells 7N-28-2182, 7N-28-2181, and 7N-28-2180 near Lucerne Lake (dry) in the Lucerne sub-basin since the early 1950s (well 7N-28-2181) and about 1.5 ft in the eastern part of the Victor Valley sub-basins since 1952 (well 7N-28-2181). Between 1951 and the early 1960s, water levels in the Warren sub-basins (wells 7N-58-36K1 and 7N-58-36K2) decreased by about 20 ft, but have not substantially since 1964 in response to artificial recharge with imported water through the use of ponds at the HI-Desert Water District recharge site (Stanton and others, 2013; fig. 3).

A majority of the wells in the Morongo groundwater basin had water levels within 5 ft of those recorded in 2012. In the Dodman, Mesquite, and Mainland sub-basins, the water-level increases can be attributed either to fluctuations in pumping or to a possible reduction in pumping (Li and Martin, 2011). The greatest water-level increases continue to be observed in the Warren sub-basins, where artificial recharge operations in 2013 have resulted in water-level increases in groundwater pumping (Stanton and others, 2013) have caused water levels to rise more than 25 ft (wells 7N-58-36K1 and 7N-58-36K2) since 1994.

LONG-TERM AND SHORT-TERM WATER-LEVEL CHANGES

Historical water-level data from the National Water Information System (NWIS) database were used in conjunction with data collected for this study to construct 35 water-level hydrographs to show long-term (1970-2014) and short-term (1990-2014) water-level changes in the Mojave River and Morongo groundwater basins. Water-level changes between the spring of 2012 and spring of 2014 were determined by comparing water levels in the same well during both periods.

Long-term (1970-2014) water-level changes are depicted by 25 water-level hydrographs (shaded) for the Mojave River and the Morongo groundwater basins. Wells for these hydrographs (wells 7N-58-2216, 7N-58-2209, and 11A-200) were not determined or were unable to be monitored in 2014, but are shown to provide information on previous versions of this report.

Data from more than one well were combined in hydrographs to show water-level changes during long periods in particular sub-basins. Combining data from multiple wells in a single hydrograph was done when a well went dry or a well was not used to generate the record, but it could no longer be measured, and data from a nearby well were used to continue the record. Data from the different wells are shown by using different colored data points on the hydrographs.

MOJAVE RIVER GROUNDWATER BASIN

The long-term hydrographs for the Mojave River groundwater basin showed that water levels east of the Mojave River in the Aho sub-basins have declined almost 50 ft since 1917 (well 4N-3W-1M1) and more than 40 ft in the eastern part of the Harper Lake region of the Centro sub-basins since the 1930s (wells 7N-28-2181, 2182). Water levels southwest of Harper Lake (dry) in the Centro sub-basins (wells 10A-3W-1D1) have increased from 200 to 105 ft since 2014 because of a sustained reduction in groundwater pumping since the early 1990s (Mojave Water Agency Watermaster, 2015). In the Baja sub-basins, water levels have declined more than 10 ft since the late 1940s (wells 9N-21-2001, 208K1, and 208K2).

Regional Water Table (2014) in the Mojave River and Morongo Groundwater Basins, Southwestern Mojave Desert, California

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