New Mexico Bureau of Geology and Mineral Resources
Open-file Report 561

Regional Water Table Map of the Northeastern Tularosa Basin region, Otero and Lincoln Counties, New Mexico

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by
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ABSTRACT

A regional map of the water table in the northeastern Tularosa Basin region has been prepared based on elevations of springs and well water levels. Water levels were measured by the New Mexico Bureau of Geology and Mineral Resources from 2009-2011. This map extends up to the western escarpment of the Sacramento Mountains, and is an extension of the water table map of the southern Sacramentos prepared by Land et al. (2012).

In general, within the area indicated on the map, most groundwater flows from east to west following topography. Near the crests of the highest mountains in the region, from the Sierra Blanca mountains to the southern Sacramentos, a groundwater divide exists wherein some groundwater flows west into the Tularosa Basin region, while the rest flows eastward toward the Pecos Slope. Water flowing west into the Tularosa Basin eventually flows southward.

The aquifer system in the southern Sacramento Mountains is developed primarily within the Yeso Formation, and the vast majority of water supply wells produce from fractured carbonates, siltstones and mudstones within that rock unit (Land et al., 2012). By contrast, aquifers in the northeastern Tularosa Basin region occur within several different geologic formations with highly variable hydrologic properties. The heterogeneous aquifer system in this area results in part from the fact that the mapped area covers several distinctly different physiographic provinces with differing underlying lithologies. The primary physiographic provinces, which were identified by Mamer et al. (2014), include the Tularosa Basin, the Carrizozo hilly plain, the northern high mountains (i.e. Sierra Blanca and Nogal Peaks), and the southern high mountains (southern Sacramento Mountains). A significant number of wells are screened in two or more aquifers. The water table represented on this map thus reflects water levels in multiple water-bearing zones, and is intended to show regional groundwater patterns and flow paths. Local conditions may deviate from the larger scale, general trends shown on this regional map.

The principal aquifers in this study area include:

1) Fractured carbonates, mudstones and siltstones of the Permian age San Andres, Yeso, and Abo Formations;
2) late Cretaceous to early Eocene fluvial channel-fill sandstones, floodplain deposits, and marine nearshore sands of the Sanders Canyon, Cub Mountain, Crevasse Canyon and Gallup Formations. While these are all dominantly sandstone units, the lower Crevasse Canyon and Gallup Formation are less permeable (Mamer et al., in press). But based on drillers records these units are difficult to distinguish, therefore are grouped with the more permeable overlying units for this map publication;
3) Sierra Blanca volcanic flows and volcaniclastic sediments from the late Eocene and early Oligocene epochs; and
4) Late Eocene through Quaternary sands and gravels of the Tularosa Basin fill.

In addition to these four major aquifer systems, three wells near the western margin of the map are screened collectively in lower Cretaceous Dakota, Triassic Moenkopi, and Permian Grayburg sandstones.

Water resources in the northern and southern regions are distinctly different. In the southern region, most water wells on the western escarpment of the Sacramento Mountains produce from the Yeso and Abo Formations. The steep hydraulic gradient on the escarpment of 200 to 400 feet per mile reflects both the steep topography of the area and the relatively low permeability of those lithologies. Near the village of Tularosa, both the topographic and hydraulic gradients flatten abruptly. Wells north, south and west of Tularosa are screened in strata that include porous and permeable sands and gravels of the Tularosa Basin fill. In contrast to the western escarpment, the hydraulic gradient in the Tularosa Basin proper is only 20 to 30 feet per mile.

North of Rocky Arroyo, near Three Rivers, the Yeso Formation ceases to be a primary water source. The Carrizozo hilly plain is a transitional area between the northern Sacramento Mountains and the northern Tularosa Basin. Most wells in this area are screened in either Cretaceous and Eocene channel sandstones or Eocene-Oligocene volcanics. A few wells in the Tularosa Basin on the western edge of the study area produce from basin fill sands and gravels interbedded in clayey-silty fine sand. The hydraulic gradient in this area ranges from 75 to 200 feet per mile, becoming much steeper near the flanks of the northern high mountains, and much flatter to the west in the Tularosa Basin. Water level contours in the vicinity of Rocky Arroyo are dashed because hydraulic continuity between the northern and southern halves of the study area is unclear due to the dramatic changes in bedrock lithologies.

Late Eocene and early Oligocene volcanic rocks yield water in the Godfrey Hills and along Nogal Creek, primarily from flow breccias. Because of their similar sandstone lithologies, we grouped the Cretaceous-Eocene sandstone aquifers (Sanders Canyon, Cub Mountain, Crevasse Canyon and Gallup Formations) which are to varying degrees, hydraulically connected to each other, and can be regarded as a single aquifer unit. However, the lower Crevasse Canyon and Gallup Formations are more cemented and less permeable, so there are some hydrologic differences within this group (discussed in more detail in Mamer et al., in press). The degree of communication of these sandstone aquifers with the late Eocene-early Oligocene volcanics is less clear.

Contours in the northeast corner of the map are dashed where they extend across Carrizo Mountain to indicate uncertainty about the degree of hydraulic continuity between the fractured igneous intrusive rocks that form that feature and Cretaceous-Eocene sandstone aquifers to the south and west. Contours extending up the flanks of Sierra Blanca and Nogal Peaks are also dashed because high elevation springs in that area are probably discharging from perched aquifers formed in fractured igneous intrusives, and are probably not hydraulically connected to aquifers to the north and west.

Carrizozo spring, about two miles north of the town of Carrizozo, produces water at an anomalously high elevation. Field observations suggest that the spring may be discharging from a Cretaceous bedrock high, which could account for its relatively high topographic position.

References

Land L, Rawling G, Timmons, S. 2012. Regional water table map of the southern Sacramento Mountains. New Mexico Bureau of Geology and Mineral Resources Open-File Report 542, 1:100,000: geoinfo.nmt.edu/publications/openfile/details.cfml?Volume=542

Mamer, E.A., Newton, B.T., Koning, D., Timmons, S.S., and Kelley, S.A., 2014, Hydrogeology of the northeastern Tularosa Basin region, New Mexico Bureau of Geology and Mineral Resources, Open-file Report 562.

Sloan, C. E. and Garber, M. S., 1971, Scale 1:125,000, Ground-water hydrology of the Mescalero Apache Indian Reservation, south-central New Mexico, Scale 1:125,000, USGS, atlas format.

Comments to Map Users

The purpose of this map is to illustrate important aspects of regional groundwater flow. Groundwater elevation data depicted herein were calculated primarily from depth-to-water measurements taken between 2009 and 2011 by the New Mexico Bureau of Geology and Mineral Resources (NMBGMR) at New Mexico Tech and from the elevations of springs. Locations where these data were not available, static water levels were used from selected, recent New Mexico Office of the State Engineer's (NMOSE) well records. Water table contours from Sloan and Garber's (1971) water table map of the Mescalero Apache Reservation are shown along the eastern margin of this map. Land surface elevations used to calculate groundwater elevation values originated from the 10-m digital elevation model (DEM). Groundwater levels in the vicinity of pumping wells are erratic and fluctuate significantly over time and natural variations also occur. The user should be aware that conditions change and information contained on this map may not reflect actual or current conditions. Site- and time-specific conditions should be verified by the user. All additional information contained on this map, other than groundwater elevation data, are interpretations of the authors. The groundwater elevation contours were drawn by hand based on the authors interpretation of water level data. The groundwater elevation contours were used to further interpret or generate groundwater flow direction and the boundaries of groundwater flow units.

NEW MEXICO

Map Symbols

1049 Site Number
7798 Water level elevation
NMBGMR measured well
OSE static water level
Spring

Water-level elevation contour

200-ft, dashed where approximate
100-ft, dashed where approximate
Water table contour, NMBGMR, OFR-542 (Land et al., 2012)
Water table contour (Sloan and Garber, 1971)
Horizontal groundwater flow direction

MN

Magnetic Declination
June 2014, 8° 22' East
At Map Center

1:100,000

4 2 0 4 MILE

16,000 8,000 0 16,000 FEET

4 2 0 4 KILOMETERS

NATIONAL GEODETIC VERTICAL DATUM OF 1983