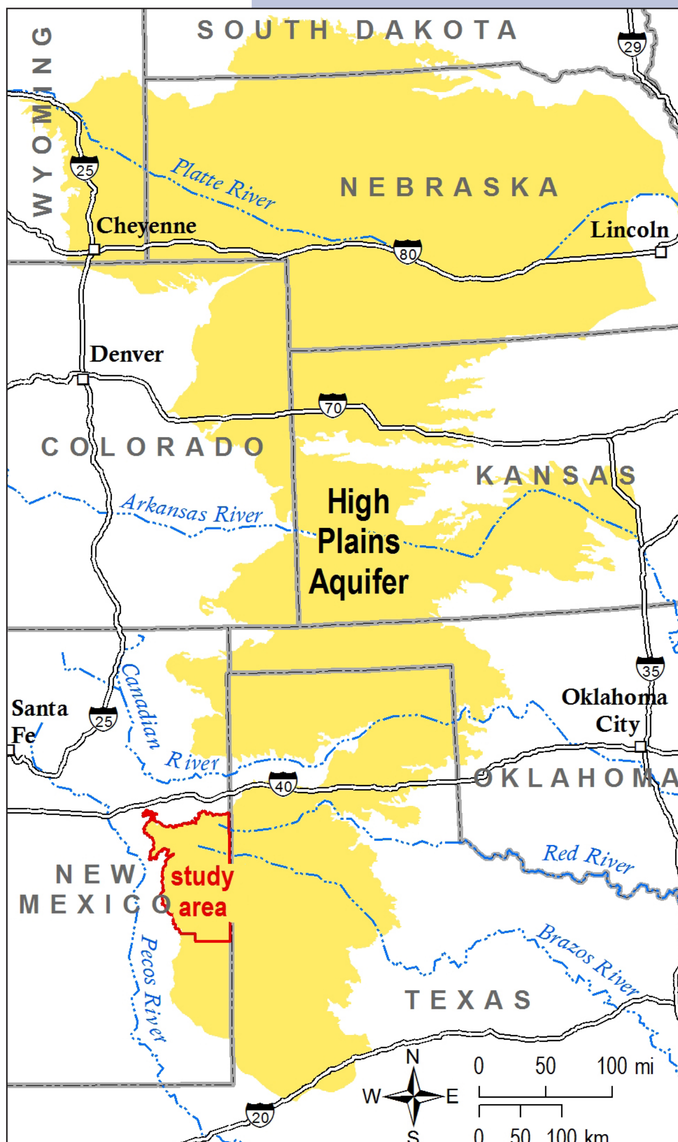
August 2017

Mapping the AQUIFER LIFETIME in the Curry and Roosevelt County Region

Funding from
City of Clovis, Eastern New Mexico Water Utility Authority, and Curry County



The study area in eastern New Mexico. Extent of the High Plains Aquifer from https://water.usgs.gov/ogw/aquiferbasics/ext_hpaq.html

Groundwater is a limited resource in most of the Southwest. The High Plains Aquifer, also known as the Ogallala Aquifer, in eastern New Mexico is no exception.

The High Plains Aquifer extends from South Dakota to New Mexico and Texas, covering large portions of the states in between. The aquifer is formed in the Ogallala Formation, which is composed of sediments that were deposited 20 to 5 million years ago by streams flowing eastward from the Rocky Mountains. In northern regions of this huge aquifer, there is active groundwater recharge. Large rivers such as the Platte River in western Nebraska and the Arkansas River in eastern Colorado contribute significant amounts of groundwater recharge to the aquifer in those regions.

In eastern New Mexico and west Texas there are very few perennial streams and much less surface water overall compared to the northern states, resulting in far less groundwater recharge. Average temperatures increase from north to south, increasing the amount of water lost to evaporation, and decreasing the amount to recharge the aquifer. The High Plains Aquifer in eastern New Mexico overlies older sedimentary rocks that are poor aquifers. Playas provide a small amount of groundwater recharge where they are abundant. Groundwater in the High Plains Aquifer of eastern New Mexico is a limited natural resource primarily because there is very little recharge to the aquifer.

In the early 1950s in eastern New Mexico, farmers began extracting groundwater for irrigation using large-capacity wells that could pump hundreds to thousands of gallons per minute. This was a revolutionary time for farming across the western United States, where many areas were previously limited to dryland farming. With large-capacity wells, agriculture shifted to more water-intensive crops such as alfalfa, corn, and cotton. Irrigated agriculture in eastern New Mexico is completely dependent upon groundwater for crop production. The New Mexico Office of the State Engineer reports that irrigated agriculture is the largest user of groundwater, totaling approximately 93% of all the groundwater used in Curry and Roosevelt Counties.

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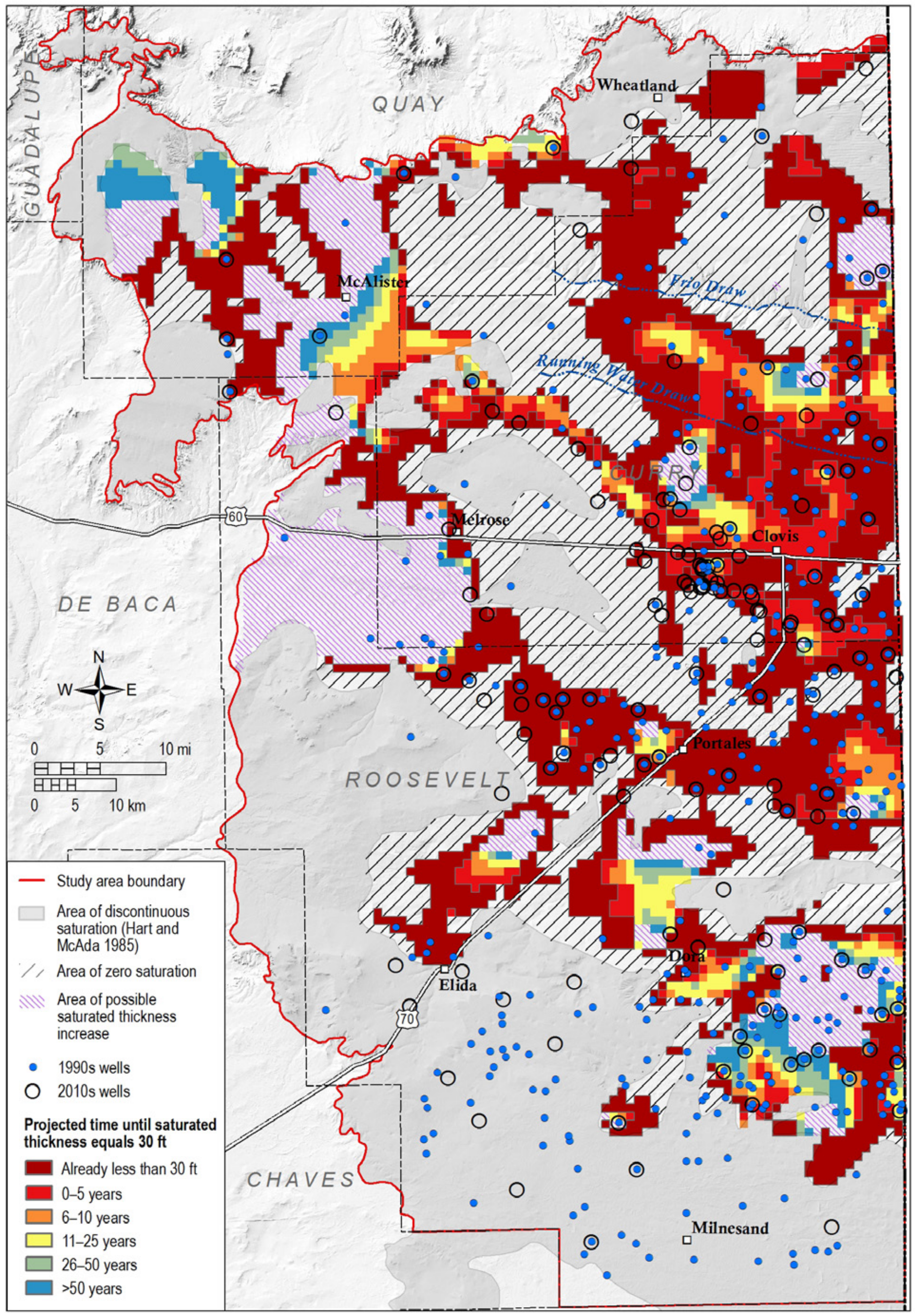
Aquifer lifetime mapping

Groundwater pumping since the 1950s has continuously reduced the amount of groundwater remaining in the High Plains Aquifer. Across eastern New Mexico, and in Curry and Roosevelt Counties, farmers have already experienced declines in yield in some of their irrigation wells. Homeowners in some areas have seen their domestic wells go dry. Decision makers and elected officials in the region are aware of these problems. They are looking for information as they consider options in water management to sustain the local economy and community livelihood.

Through local funding from the City of Clovis, Curry County, and Eastern New Mexico Water Utility Authority, we have developed maps that answer some of the big water questions. These maps show the estimated lifetime, in years, of the aquifer for this region. There are two scenarios for the aquifer lifetime, which are described in much more detail in **http://geoinfo.nmt.edu/publications/openfile/details.cfml?Volume=591.** Map Scenario 1 shows the projected time until groundwater levels have declined to the point where irrigation is no longer sustainable, and Map Scenario 2 shows the projected lifetime of all the remaining water in the aquifer.

These aquifer lifetime maps are based on thousands of groundwater level measurements collected since 1950 from domestic wells, irrigation wells and monitoring wells across Curry, Roosevelt, and Quay Counties. We used the best data available, primarily from the U.S. Geological Survey. Some groundwater level measurements were collected as recently as 2016. We examined the groundwater level changes over time at each well. In most wells with long-term data, water-level declines of 10 to over 100 feet have occurred. By calculating rates of water-level decline in feet per year, we developed the maps projecting the remaining life of the aquifer across the region.

Aquifer lifetime maps have previously been developed for the High Plains Aquifer in Kansas and the Texas Panhandle. The maps prepared for Curry and Roosevelt County match up well with aquifer lifetime maps covering the Texas Panhandle. It is concerning, but not surprising, that projected lifetimes are short across this region, and in some areas the aquifer has already reached a point of "zero saturation." Groundwater is being depleted (or "mined") from the High Plains Aquifer in eastern New Mexico, western Texas and Kansas. This is because pumping rates are so much larger than natural recharge rates.



Map scenario 1: Thirty feet of saturated thickness is roughly the minimum needed to sustain large-scale, widespread irrigation. This map shows the projected lifetime until this level is reached, and areas where the saturated thickness is already below this level. The map is most reliable in areas with many wells and least reliable where wells are sparse. The areas highlighted as "discontinuous saturation" are regions where the aquifer is either unsaturated or has only small, scattered pockets of groundwater. These regions were identified by the U.S. Geological Survey in the 1960s. Areas mapped as "zero saturation" are regions where recent water-level measurements indicate little or no remaining groundwater.

MAP SCENARIO 1

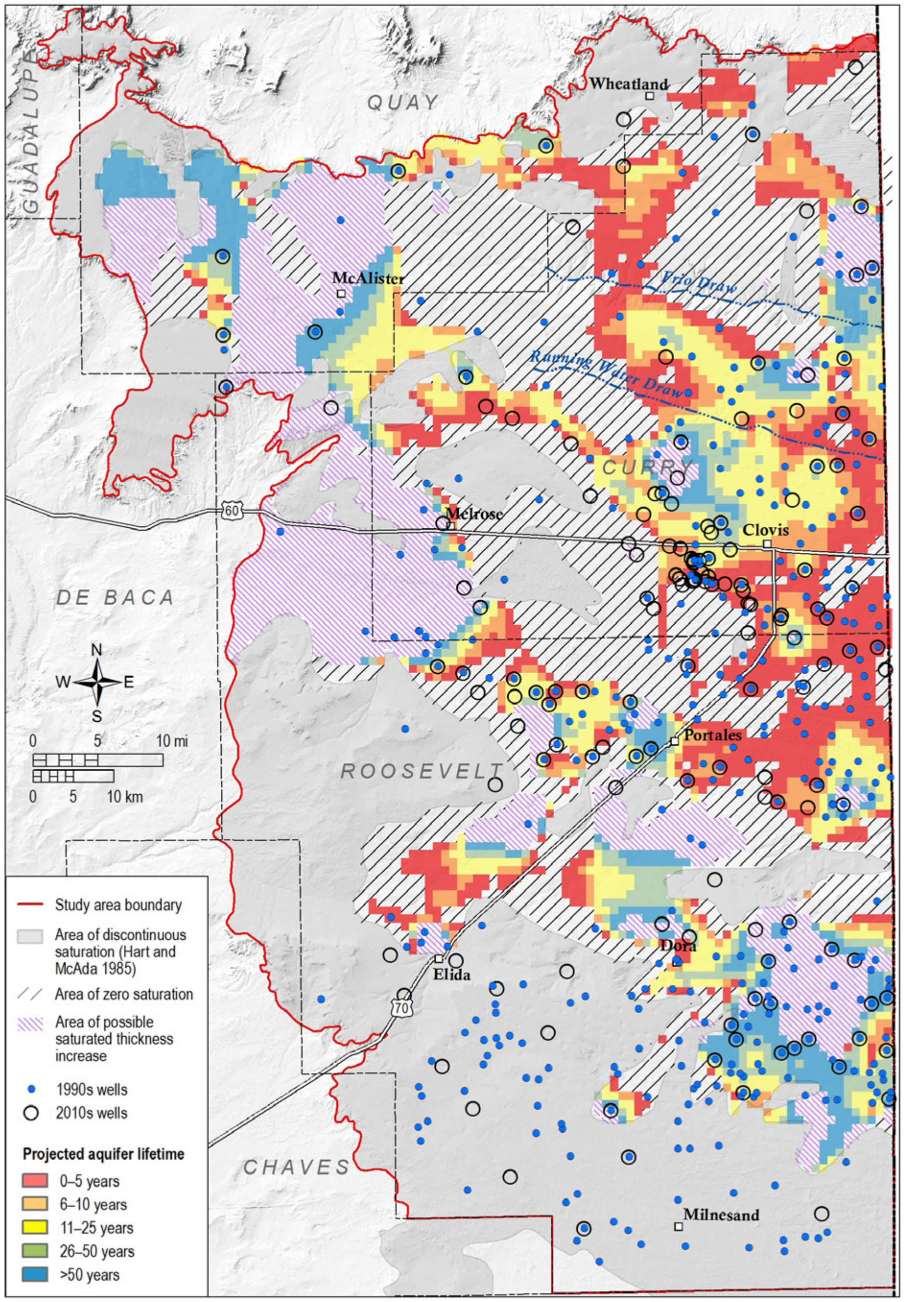
Aquifer lifetime for irrigation

This aquifer lifetime scenario portrays the projected time until water levels decline to a point at which large-scale irrigation is no longer sustainable. Many regions of the High Plains Aquifer have essentially zero remaining water, and can no longer sustain extensive irrigation (shown on the map by "discontinuous saturation" or "zero saturation"). The standard rule-of-thumb is that 30 feet of water in the aquifer, or a saturated thickness of 30 feet, is the minimum needed to operate large-capacity irrigation pumps (yielding hundreds to thousands of gallons per minute). This scenario is based on the rate of water-level decline observed over the last two decades.

MAP SCENARIO 2

Lifetime of the whole aquifer

Lower capacity pumps (yielding tens of gallons per minute or less), such as those in household wells, may operate while the aquifer thickness is less than 30 ft. This aquifer lifetime scenario projects the lifetime of all remaining water in the aquifer. It is also based on the rate of decline observed over the last two decades.



Map scenario 2: This map shows the projected lifetime until all of the water is pumped from the aquifer at the current rate of decline. The map is most reliable in areas with many wells and least reliable where wells are sparse. The areas highlighted as "discontinuous saturation" are regions where the aquifer is either unsaturated or has only small, scattered pockets of groundwater. These regions were defined and mapped by the U.S. Geological Survey in the 1960s. Areas mapped as "zero saturation" are regions where recent water-level measurements indicate little or no remaining groundwater.

Reading Recommendations

Kansas Geological Survey High Plains Aquifer studies http://www.kgs.ku.edu/HighPlains/index.shtml

Texas Tech University Ogallala aquifer studies, http://www.depts.ttu.edu/geospatial/center/Ogallala/Index.html

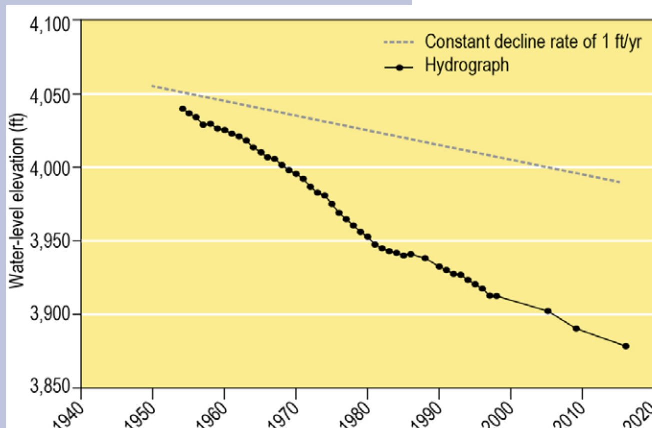
U.S. Geological Survey information on the High Plains Aquifer, https://ne.water.usgs.gov/projects/HPA/index.html

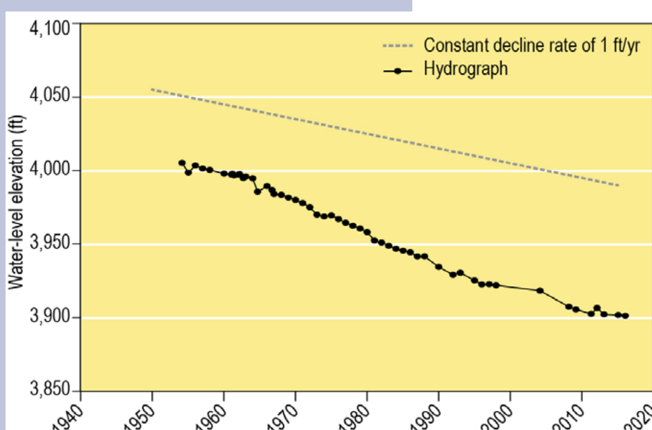
New Mexico Office of the State Engineer Water Use Reports, http://www.ose.state.nm.us/Pub/pub_waterUseData.php

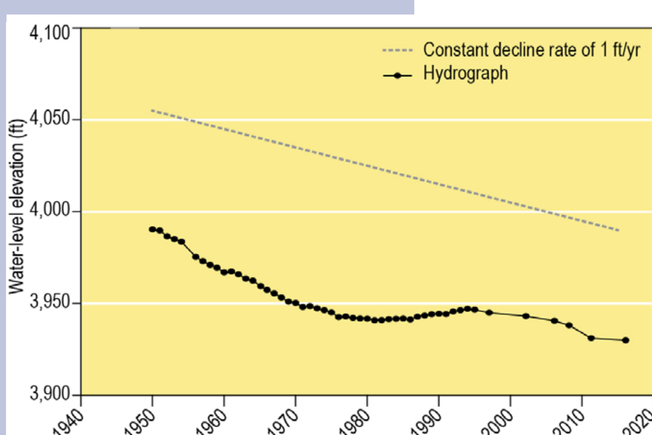
AQUIFER MAPPING PROGRAM

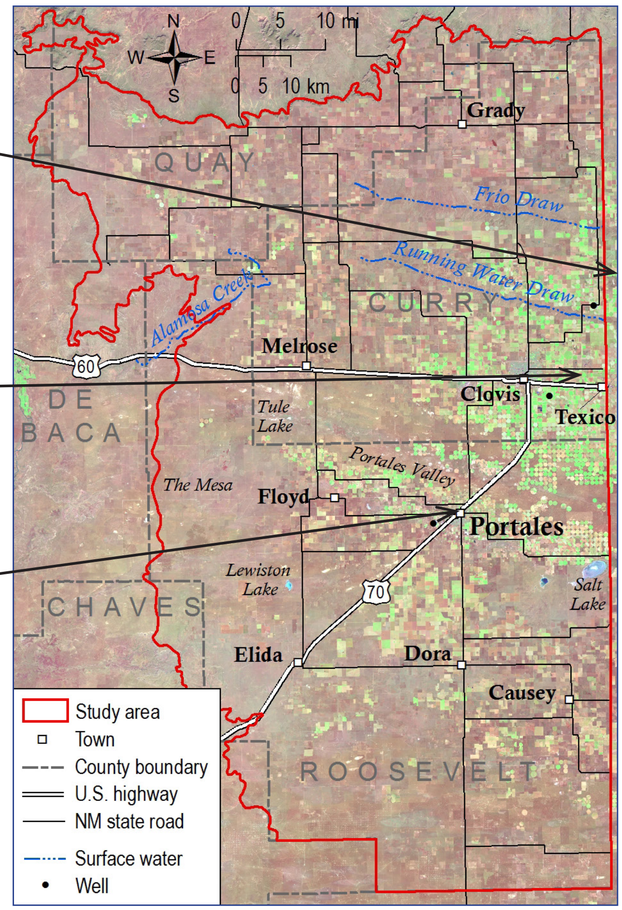
Use with caution! These aquifer lifetime maps are projections—they assume that past rates of water-level decline will continue into the future. We can't predict the future! In some regions, changes in land and/or water use are already underway, and decline rates may be slowing. If agricultural groundwater use decreases once the 30 ft threshold is reached, decline rates should decrease as well—thus the full aquifer lifetime may be longer than that shown in Map Scenario 2. In other words, Map Scenario 2 may be a "worst-case scenario."

In many areas, there are very few water level measurements; our results are less certain where there is little data. We have done our best to accurately project the aquifer lifetime using the best data available and the most rigorous mathematical methods. Our results are very similar to those found in other areas of the southern High Plains Aquifer. A reading list of other recommended resources available online is provided on the previous page.









Satellite image of the study area from 1992. Bright green areas are irrigated land. Typical water-level declines in the aquifer from the 1950s to the present are illustrated in the charts.
Hydrographs show when measurements of groundwater level were made, and the trend in the groundwater level over time. Each well measurement is represented by a point, connected by a line to show the trend. From top to bottom, these wells are U.S. Geological Survey IDs: 343057103034701, 342214103091301, and 342310103101201. A constant water-level decline of one foot per year is shown for comparison.

New Mexico Bureau of Geology & Mineral Resources
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More information available in
New Mexico Bureau of Geology & Mineral Resources
Open File Report 591

http://geoinfo.nmt.edu/publications/openfile/details.cfml?Volume=591