Groundwater Storage Change Estimates in Alluvial Aquifers in Central New Mexico

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The Driving Question and What We Did

We used depth-to-water measurements from wells over the last six decades to map water level changes and find basin-wide total storage changes in the alluvial aquifers of the Rio Grande-rift basins and the headwaters of the Pecos River using watershed boundaries to split up the problem.

Basin-fill aquifers are a primary source of freshwater in much of New Mexico and are being used more and more as river flows become less reliable. These aquifers are saturated water-bearing sand, clay and gravel aquifers that have no confining geologic layer at the upper surface of the groundwater. Because alluvial aquifers have been used as a fresh water source for a range of societal uses for at least the last 70 years, it is vital for us to understand how the availability of this resource has changed. A first step is to understand how much water levels have declined and where.

How We Did It

Data quantity and quality in many of the basins was a major challenge. In basins where we estimated groundwater storage changes, we were forced to use two levels of data quality.

The highest quality data used measurements from the non-irrigated season (Figure, green labels). In more sparsely measured regions, we excluded irrigated lands but used measurements from throughout the year (Figure, yellow labels).

In the El Paso-Las Cruces basin, we only use measurements shallower than 100 ft. The well water level measurements were too sparse in space and time for this analysis in the Arroyo Chico, Caballo, Conejos, Elephant Butte, Estancia (Eastern), Jemez, North Plains, Pintada Headwaters, or Rio Salado units.

What We Found Out And Why It's Important

Because well networks are restricted to limited areas, our estimates are likely to be *underestimates* of groundwater storage declines. In other words, our estimates are likely best-case scenario estimates of the quantity of water that has been removed from the region.

Our best estimate of the water level changes through time for each basin is given in the Table.

In almost all cases, groundwater levels in the alluvial aquifers of the Rio Grande and uppermost Pecos systems have declined. Compared to 1950s water levels, basin-wide declines are generally greatest in basins with no perennial flowing rivers and with high societal water demands, including: Estancia (1.0 Maf decline); Mimbres (2.8 Maf decline); Tularosa Valley (2.7 Maf decline).

Less populated basins generally showed smaller declines (Salt Basin, Jornada Draw, Playas Lake, and Plains of San Agustin, Rio Chama, Rio San Jose, Pecos Headwaters). Because of lack complete data coverage, these regions are estimates for a subset of the desired decades. In most of the closed basins or basins that are tributaries to the Rio Grande (Estancia, Mimbres, Rio Puerco, and Tularosa Valley), water level declines were observed around population centers with some mild water level increases along the mountain fronts. Rio Grande basins had a combination of behaviors. Near the river and under low pumping load, the water levels remained static. Away from the river, the river recharge does not balance groundwater withdrawals, and the aquifer has large storage declines. For example, in the Albuquerque unit, there has been roughly -1.9 Maf of groundwater storage declines, mostly away from the Rio Grande. Along the Rio Grande in the Albuquerque unit, there is a zone of almost no change over the last 60 years.

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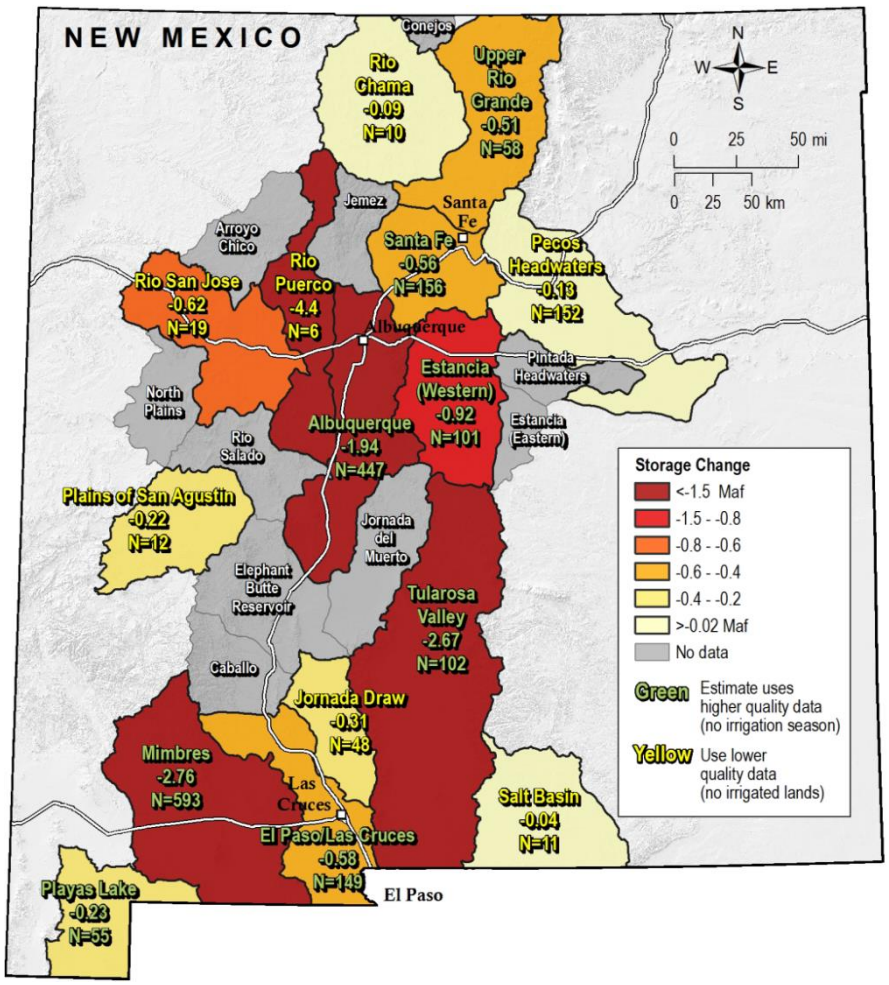

Figure: Depiction of the storage change volumes of all units considered in the state. These are likely underestimates of storage declines, because of the restricted areas that measurements were available. In other words, the estimate is from a small area within the unit. The color of the unit shows maximum storage decline during the last 60 years in millions of acre-feet (Maf). Grey units did not have enough data to construct estimates. The name of each unit, the amounts of decline are shown. The color of the text shows the quality of the data used— green is higher quality data using measurements from the non-irrigated season, and yellow is lower quality data using wells from non-irrigated lands. We also show the number (N) of wells used to estimate the storage change displayed.

Table Summary of basin-wide storage changes from the 1950s through the 2010s. Negative means declining water levels and decrease in the amount of groundwater in storage. These estimates are likely underestimates because of the restricted area of sampling. Estimates are restricted to alluvial sediments (laid down by streams and rivers), and to close to the wells. They also assume a constant specific yield in the alluvial sediments. Highlighted values are the maximum storage decline shown in the figure.

	STORAGE CHANGE (Maf)					
HUC	1960s	1970s	1980s	1990s	2000s	2010s
Albuquerque	-0.17	-0.91	-0.83	-0.60	-1.94	-1.86
El Paso/Las Cruces	-0.02	-0.08	0.06	-0.04	-0.09	-0.58
Estancia (Western)	-0.24	-0.53	-0.71	-0.92	-0.29	-
Jornada Draw	-	-	-0.08	-0.08	0.01	-0.25
Mimbres	-0.12	-1.64	-2.76	-2.23	-2.06	-
Pecos Headwaters	-0.04	-	0.00	-0.13	-	-0.01
Plains of San Agustin	-	0.07	-0.16	-0.22	-	-
Playas Lake	-0.09	-0.20	-0.20	-0.16	-0.23	-
Rio Chama	-0.09	0.11	-	-	-	-
Rio Puerco	-1.31	-1.27	-2.19	-4.13	-4.03	-4.40
Rio San Jose	-0.29	-0.22	-0.33	-0.46	-0.43	-0.62
Salt Basin	-0.01	-0.03	-0.04	-0.02	-0.02	-0.04
Santa Fe	-0.02	-0.29	-0.28	-0.21	-0.56	-0.50
Tularosa Valley	-0.11	-1.24	-0.99	-1.57	-2.67	-1.83
Upper Rio Grande	-0.42	-0.51	-0.13	-0.13	-	-

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