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National Water-Quality Assessment Program

Water Quality in the High Plains Aquifer, Colorado, Kansas, Nebraska, New Mexico, Oklahoma, South Dakota, Texas, and Wyoming, 1999–2004

Circular 1337

U.S. Department of the Interior
U.S. Geological Survey

Water Use

Use of groundwater from the High Plains aquifer as a source of irrigation water has transformed the study area into one of largest and most productive agricultural regions, earning it the nickname “breadbasket of the world” (Opie, 2000). The High Plains aquifer is the most intensively used aquifer in the United States for irrigation, public supply, and self-supplied industry, producing almost two-times more water than any other U.S. aquifer (Maupin and Barber, 2005). Groundwater withdrawals from the High Plains aquifer in the year 2000 accounted for about 20 percent of total groundwater withdrawn in the United States (fig. 2–3). Most (97 percent) of the water withdrawn from the High Plains aquifer is used for irrigation (fig. 2–3). Although withdrawals for drinking water account for a relatively small percentage of the total groundwater use, they provide drinking water for about 82 percent of the 2.3 million people who live within the study area boundary.

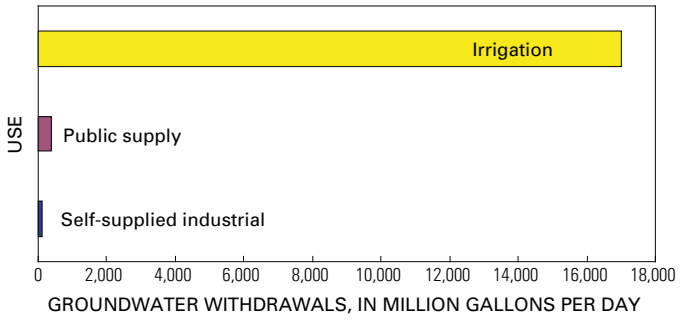


Figure 2–3. Irrigated agriculture is the dominant use of groundwater from the High Plains aquifer (data from the year 2000 and modified from Maupin and Barber, 2005).

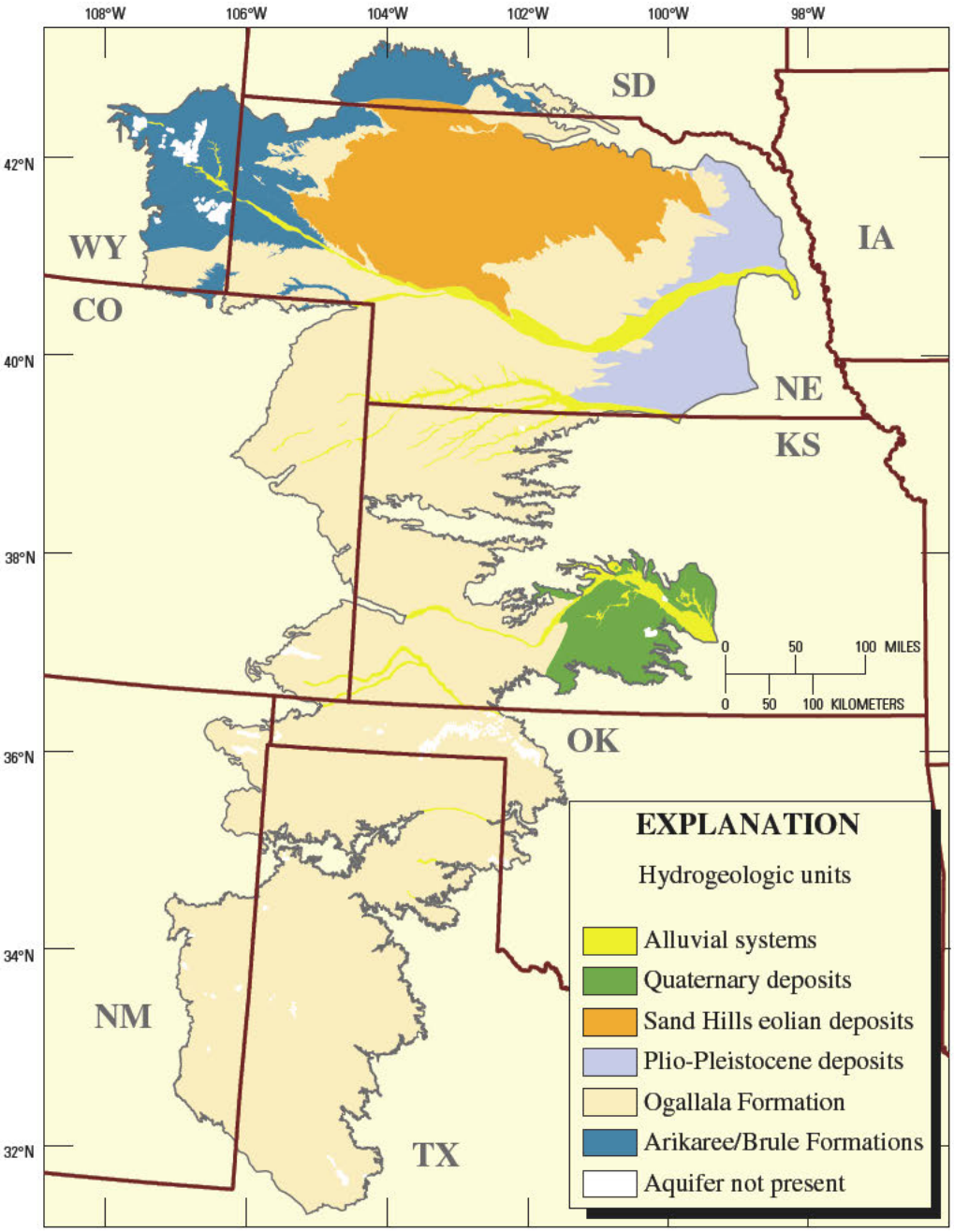
Hydrogeologic Setting

The High Plains aquifer consists of sedimentary deposits that form six hydraulically connected hydrogeologic units. The most extensive of these hydrogeologic units is the Ogallala Formation, which makes up about three-fourths of the total High Plains study area (fig. 2–4).

The depth to water below land surface (unsaturated-zone thickness) ranges from 0 to approximately 500 feet, averages about 100 feet, and is generally greatest in the central and southern High Plains. The saturated thickness of the High Plains aquifer ranges from less than 1 to more than 1,000 feet and averages about 200 feet. The saturated thickness varies geographically and is greatest in the northern High Plains.

Evaporation rates exceed precipitation rates across much of the High Plains, so little water is available to recharge the aquifer. Recharge to the High Plains aquifer occurs by infiltration of irrigation water, areally diffuse infiltration from precipitation, focused infiltration of storm- and irrigation-water runoff through streambeds and other topographic depressions (Gurdak and others, 2008), and upward movement of water from underlying aquifers. Discharge from the High Plains aquifer is primarily to irrigation well pumping, streams and underlying aquifers, groundwater flow across the eastern boundary of the aquifer, and evapotranspiration. Regional groundwater flow is generally from west to east; however, local variability in hydraulic gradients can result in different directions of groundwater flow, particularly near high-capacity pumping wells and major rivers like the Platte, Republican, and Arkansas Rivers (fig. 2–1).

Water levels have declined (fig. 2–5) substantially since predevelopment times (approximately the mid-1950s) because groundwater withdrawals have greatly exceeded recharge across much of the aquifer (McGuire and others, 2003). This is particularly true in the central and southern High Plains. The largest water-level declines range from 50 to more than 150 feet, primarily across parts of Kansas, Oklahoma, New Mexico, and Texas (fig. 2–5). The saturated thickness of the aquifer has decreased by more than 50 percent in some parts of Kansas and Texas. This groundwater depletion has led to increased pumping costs and a reduction of water discharging to streams, among other things. Ecosystems along riparian corridors that rely on groundwater discharge are adversely affected by even small volume changes in the groundwater system (Alley, 2006).



Base information from U.S. Geological Survey digital data, 1:100,000
Albers Equal-Area projection
Standard Parallels 29°30' and 45°30', central meridian –96°

Figure 2–4. The Ogallala Formation is the largest and most important hydrogeologic unit of the High Plains aquifer.