

Upper Republican Basin High Priority Issue

Ogallala-High Plains Aquifer Declines

January 2009

Page 1

Issue

Long-term management of the Ogallala-High Plains aquifer to extend and conserve the life of the [aquifer](#).

Vision

Sufficient water resources in western Kansas to support healthy, economically strong communities and rural lifestyles, today and for future generations.

Goal

Extend and conserve the life of the Ogallala-High Plains aquifer.

Description

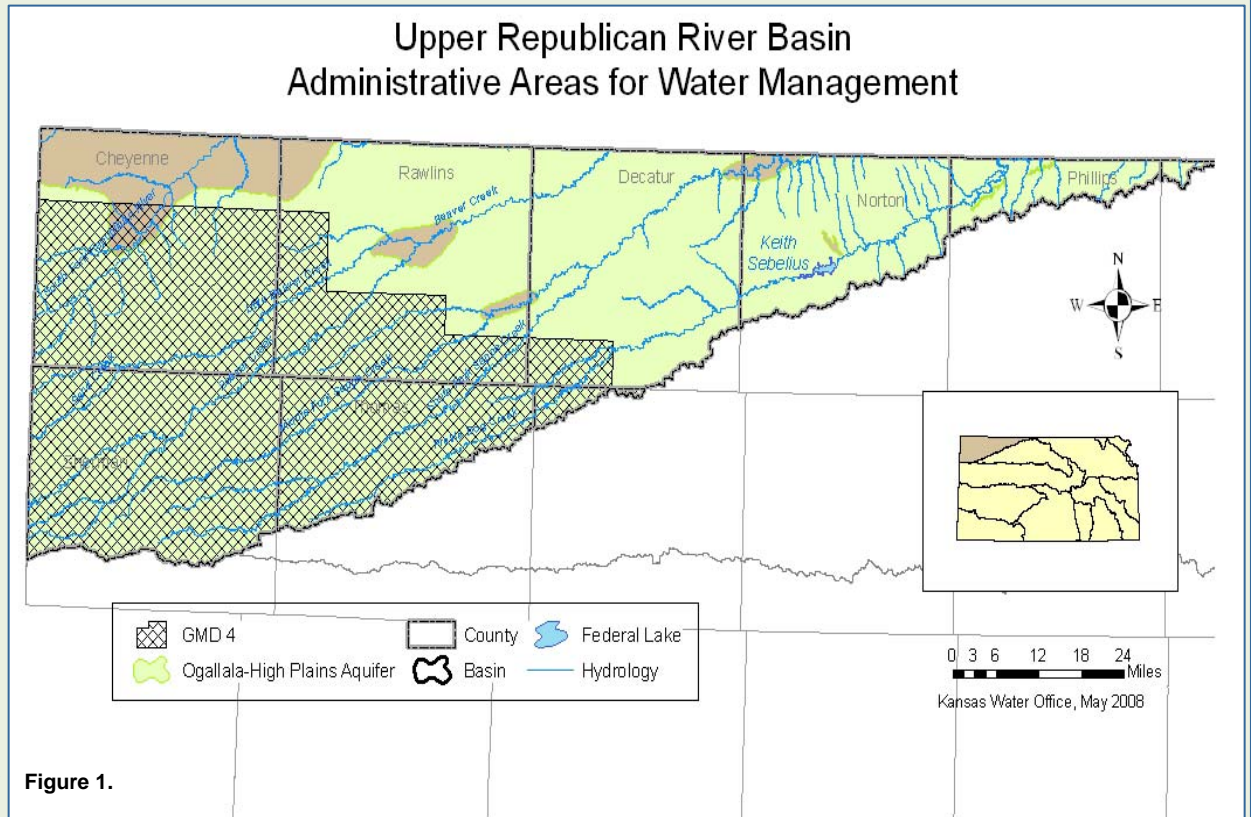
The Ogallala portion of the High Plains aquifer (Ogallala-High Plains aquifer) underlies most of [Upper Republican River basin](#) (Figure 1). Within the basin, the Ogallala underlies all or part of Cheyenne, Rawlins, Decatur, Norton, Phillips, Sherman, Thomas, and Sheridan counties. Thomas and Sherman counties along with parts of Cheyenne, Rawlins, Decatur, and Sheridan counties are in Northwest Kansas Groundwater Management District No. 4 (GMD4). The aquifer fringe, outside GMD4 is managed by the Kansas Department of Agriculture-Division of Water Resources (DWR).

Ground water supplies significant amounts (95% of appropriations in 2006) of municipal, irrigation, industrial and domestic water in the basin.⁽¹⁾ The Ogallala-High Plains aquifer has been developed so extensively that the amount of water withdrawn annually is significantly more than the annual recharge, resulting in ground water declines. As ground water levels decline, the aquifer

loses hydraulic connection with the overlying alluvial aquifers and rivers and no longer contributes much, if any, base stream flow. Since the 1950s (predevelopment), Ogallala water levels have declined as much as 75 feet in that portion of Sherman County located in the basin. The majority of Thomas and Sherman counties in the basin have measured declines, some up to 50 feet.

Aquifer water levels in the basin have declined up to 30 feet over the ten-year period from 1996-2006. With the greatest decline centered in southwest Sherman County. Generally, Sherman and Thomas county areas in the basin have declined by 5-20 feet in the ten-year period. The overall decline has contributed to a progressive reduction in surface water flow during the past several decades.

Water users in parts of Wallace, Sherman, Thomas, Sheridan and Graham counties are already experiencing shortages in meeting demand. To extend and conserve



the life of the Ogallala-High Plains aquifer, GMD4 and the DWR are defining priority areas and management goals to reduce aquifer declines. Federal and state voluntary incentive programs to reduce water use have been developed and targeted to priority areas.

A 2006 Kansas Water Office (KWO) analysis of water level data indicated that the aquifer decline rate had not

Upper Republican Basin High Priority Issue Ogallala-High Plains Aquifer Declines January 2009

been reduced by a statically significant amount between two time periods, 1981-1993, and 1993-2005.⁽²⁾

Water Appropriations

Approximately 530,391 acre feet of the ground water appropriations in the Upper Republican basin. Total appropriations in the basin from the Ogallala-High Plains aquifer are approximately 515,902 acre feet for all beneficial uses. There are about 2,312 active Ogallala-High Plains water rights from 2,683 wells.⁽¹⁾

The majority of the producing wells in the Ogallala-High Plains aquifer and associated alluvium are within the GMD4. The appropriations for these wells total 468,011 acre feet, or about 89% of the Ogallala-High Plains appropriations in the basin.

Water Use

The 2006 reported water use in the basin from the Ogallala-High Plains aquifer was 268,077 acre feet. Reported water use for 2006 within GMD4 in the basin was 242,649 acre feet, from 1,933 wells. Irrigation use was 97% of the Ogallala-High Plains reported use in the basin.

Annual water use reported and quantified by township for 2002-2006 is provided in Table 1, based on data analysis by DWR.⁽³⁾ Some townships have water use in more than one area, such as a GMD and the fringe, therefore the sum of the number of townships analyzed for each area is not the same as those included under ALL in Table 1. The majority of a township may be in another basin or not underlain by the Ogallala aquifer.

There has been widespread adoption of more efficient

irrigation systems in the Kansas High Plains shifting from flood and center pivot to center pivot with drop nozzles.⁽⁴⁾ A study by Kansas State University in 2006 found that the number of acres irrigated is a more important determinant of changes in water use than the adoption of more efficient irrigation systems.⁽⁵⁾ The authors concluded that if the irrigated acres are held steady after conversion to a more efficient irrigation system, net water use would, on average, change little; it is with a decrease in irrigated acres that a reduction in water use is assured.

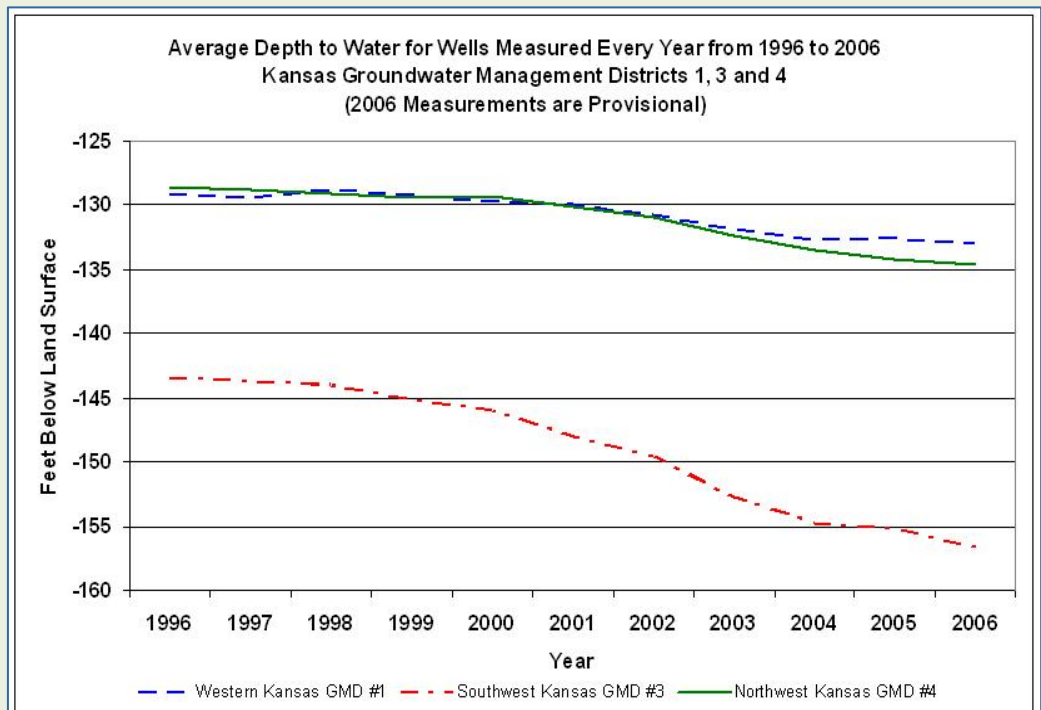


Figure 2.

Aquifer Declines

Average water levels in the aquifer within the groundwater management districts have continued to decline over the past ten years (Figure 2).

The overall average water level decline in the Ogallala-High Plains region over the 2005 calendar year was 0.57

Table 1.

Irrigated Water Use for Ogallala Area in Upper Republican Basin

Area	Number Townships Quantified	Number Points of Diversion	2006 Water Use (Acre Feet)	Acre feet/ acre 2002	Acre feet/ acre 2003	Acre feet/ acre 2004	Acre feet/ acre 2005	Acre feet/ acre 2006
GMD4	64	1,787	242,193	1.28	1.18	1.18	1.00	1.08
Fringe	21	552	22,254	1.02	0.85	0.99	0.71	0.89
All	NA	2,392	267,460	1.22	1.10	1.13	0.94	1.03

Upper Republican Basin High Priority Issue Ogallala-High Plains Aquifer Declines January 2009

feet. This was more than the average decline over 2004 (0.15 feet), but less than the average annual decline rate over the five years since 2001 measurements (approximately 0.98 feet/year).

Figure 3 is an estimated projection of the years until the Ogallala-High Plains aquifer reaches a point where wells will only be able to produce 400 gallons per minute (gpm) assuming ground water level trends from 1996 to 2006 repeat continuously and unchanged into the future. This methodology is best suited to the Ogallala portion of the Ogallala-High Plains aquifer because of the relatively extensive data sets for the Ogallala. The variability of the system is the biggest drawback.

veloping management plans to reach these goals has been the responsibility of GMD4, and the DWR.

Good data is essential to the determine the decline rate. Data development includes calibration of ground water models to better understand the aquifer and subunits. Water meters, now required on almost all wells, provide improved information on withdrawals. All wells in GMD4 should be metered by December 31, 2009. Annual water level measurements, "index" wells and weather station data provide information contributing to better models.

GMD4 has identified six high priority subunits within their area, of which portions of five are in the Upper Republican basin (Figure 4). The GMD4 board is in the process of establishing water use goals and enhanced management actions for the high priority aquifer sub-units. These areas are the target of incentive programs.

The state and GMD4 have modeled management scenarios for the six high priority subunits. Corresponding economic estimates were produced for the anticipated cropping changes as ground water levels change, based on historical farm decision triggers as determined by Kansas State University.⁽⁵⁾

For areas outside GMD4, but still overlying the Ogallala-High Plains aquifer, DWR is to set high priority areas and develop goals.

Voluntary programs have been previously offered and targeted

to areas determined by the appropriate management entity. Federal ground and surface water programs of the Environmental Quality Incentive Program (EQIP) were focused for two years on areas selected annually. GMD4 targeted areas utilized all available resources allocated for incentive payments of \$100 per acre annually for three years on eligible acres to convert irrigated land to non-irrigated land.

The Water Right Transition and Assistance Program

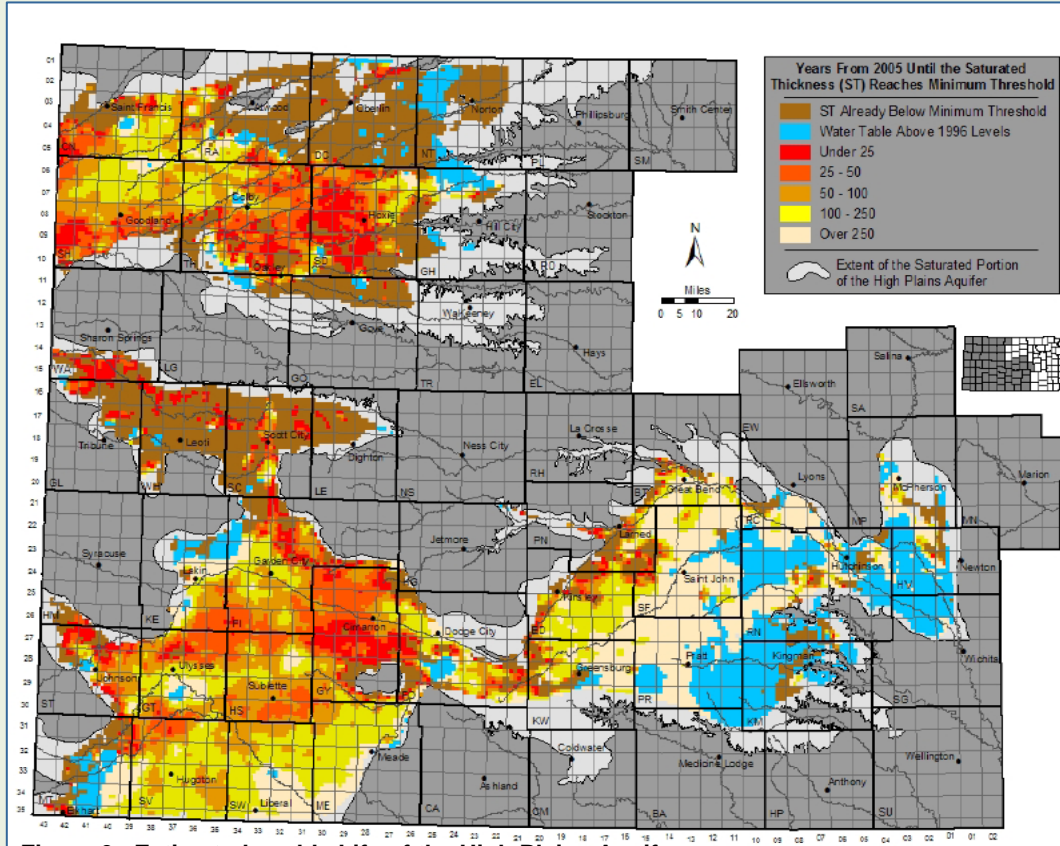


Figure 3. Estimated usable Life of the High Plains Aquifer

Activities and Progress

Various programs and activities have been initiated to reduce the decline rate of the Ogallala-High Plains aquifer and extend and conserve the aquifer. Tools such as ground water and surface water models and more detailed aquifer characterization have been developed. In the Upper Republican basin, the determination of Ogallala subunit priority areas, setting subunit goals, and de-

Upper Republican Basin High Priority Issue Ogallala-High Plains Aquifer Declines January 2009

(WTAP) has been available to retire water rights along portions of Prairie Dog Creek. State programs offer incentives to retire water rights. However that opportunity was not available to the Upper Republican basin Ogallala-High Plains area.

Regulatory programs have included special assistance by DWR to irrigators that have pumped in excess of water rights and the area average.

Progress toward reducing the decline rate was evaluated by the KWO in 2006 using water level data from 1981-2005.⁽²⁾ The median annual water level changes were calculated for each region and standardized or indexed to antecedent moisture conditions using the Palmer

Drought Severity Index (PDSI) for the appropriate region. The comparison of 1981-1993 and 1993-2005 periods concluded that there was no discernable change in the rate of water level declines in the Ogallala-High Plains region. It also concluded that in the northwest Ogallala aquifer area (GMD4 and DWR fringe areas), as of 2005, there has been no statistically significant change in the rate of decline.

It should be noted that the percentage of total water use that has been reduced through the voluntary and regulatory programs is small. A reduction of decline rates will likely take many years or decades to be recognizable unless participation and reductions are greater.

Priority Aquifer Subunits

Priority aquifer subunit maps are used to guide state and federal efforts on water conservation. The priority aquifer subunit areas are being further defined by the groundwater management districts inside each district, and the DWR for areas of the Ogallala-High Plains aquifer outside of the districts, with input from the public. Currently, an interim map (Figure 4) is being used until new priority aquifer subunit maps are defined and approved. Specific target areas are defined for areas eligible for enrollment in the Conservation Reserve Enhancement Program (CREP) (Upper Arkansas basin), EQIP quick response areas (statewide) and WTAP (statewide). Eligibility requirements are determined by each program.

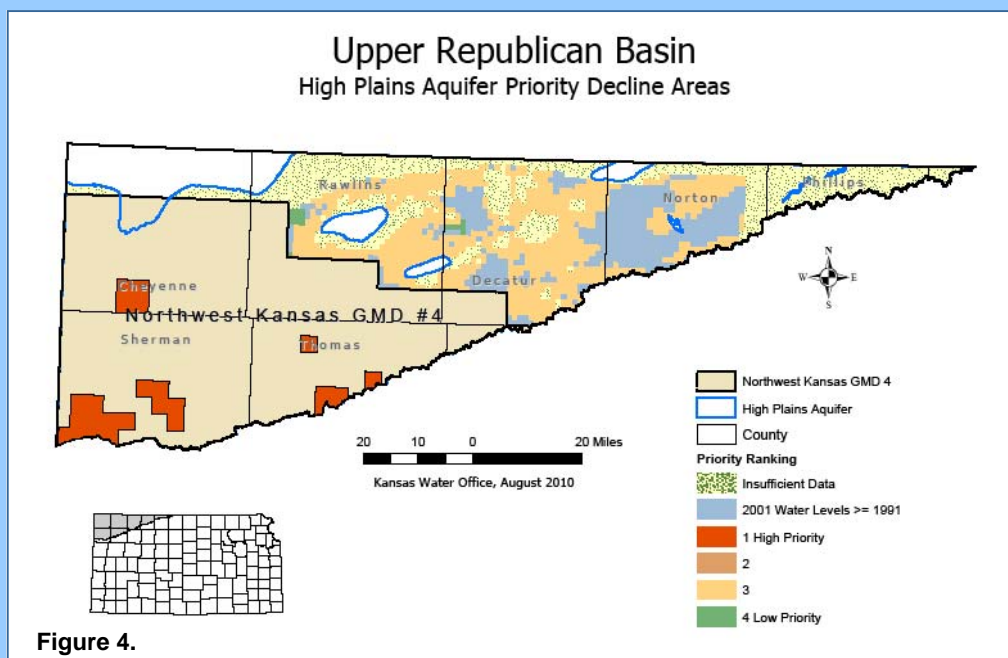


Figure 4.

The priority rank shown on this map outside GMD4 is based on an area's total score from two databases: estimated usable lifetime and density of ground water use. Useable lifetime is defined as the ability to support a 400 gallons per minute (gpm) well yield, on every quarter section, pumping for 90 days. Rank 1 indicates areas with a short estimated usable lifetime and a history of higher ground water usage. Rank 4, the lowest concern areas, have a relatively long useable lifetime and low total water use.

Upper Republican Basin High Priority Issue Ogallala-High Plains Aquifer Declines January 2009

Page 5

Recommended Actions

1. DWR identify priority aquifer subunits or areas, and GMD4 and DWR develop specific goals and management strategies to extend and conserve the life of the aquifer.
2. GMD4 and DWR manage aquifer subunits to maintain economic health while ensuring sufficient water resources for future generations of western Kansas communities and rural populations and chosen lifestyles.
3. Provide opportunities to permanently and temporarily reduce water use through voluntary programs (state, federal, and local).
4. Educate water users, decision makers and the general public on the condition of the aquifer and methods and opportunities to reduce water use.
5. Support research for high value, low water use crops.
6. Seek crop insurance option for limited irrigation crops from USDA Risk Management Agency.

In order to implement the main actions stated above, the following specific activities are recommended:

- Provide technical support, including hydrologic modeling if appropriate, to project aquifer current and future conditions. Identify and implement activities to promote local conservation to extend the life of the aquifer that accrue to the aquifer subunit or region where water savings has occurred.
- Recognize the benefit of aquifer subunit planning. Management of the aquifer by subunit can benefit the local community economic wellbeing and social connectedness, reduce over pumping and widespread well shut offs from impairments.
 - Encourage ownership in one's aquifer subunit; promote local leadership.
 - Form subunit teams for local leadership of aquifer subunits or other methods of managing local areas/subunits for reduced consumptive water use.
 - Target incentive-based programs to aquifer subunits that have developed a long term vision and plan.
 - Implement aquifer subunit plans that assure water into the future that can help attract industry thus contributing to the economic health of the subunit and area.
- Consider the long term impact of climatic change on the water demands for the region.
- Consider interstate discussions on water conservation and planning.



**Ogallala Outcrops Along Ravine, Rawlins County, KS
Photo courtesy Kansas Geological Survey**

Upper Republican Basin High Priority Issue Ogallala-High Plains Aquifer Declines January 2009

Page 6

Resources

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Ogallala Outcrop. Photo courtesy KGS.