Smoky Hill-Saline Basin High Priority Issue
Ogallala-High Plains Aquifer Declines
January 2009

Issue

Management of the Ogallala-High Plains aquifer ground water declines in the Smoky Hill River basin.

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 Formation of the High Plains aquifer (Ogallala-High Plains aquifer) underlies western portions of Smoky Hill River basin (Figure 1). The Equus Beds aquifer, a shallower and geologically more recent portion of High Plains aquifer, underlies a small area in McPherson County. South of the Smoky Hill River, the Ogallala is found in southern Wallace and northern Greeley, Wichita and Scott counties. Most of these areas are in Western Kansas Groundwater Management District No.1 (GMD1), with fringe areas of the aquifer outside of GMD1 managed by the Kansas Department of Agriculture-Division of Water Resources (DWR). North of the Smoky Hill River, the Ogallala underlies Sherman, Thomas, Sheridan counties, parts of Graham, Rooks, Logan, Gove, Trego and Ellis counties. Sherman, Thomas and Sheridan counties and northern Logan and Gove counties are in the Northwest Kansas Groundwater Management District No. 4 (GMD4), with the aquifer fringe managed by DWR.

In the western half of the Smoky Hill basin, the Ogallala-High Plains aquifer has been developed so extensively that the amount of water withdrawn annually is significantly more than the recharge, resulting in ground water declines.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), aquifer water levels in the basin have generally declined from 15% to over 50% in Wallace, Greeley, Wichita, Scott and Lane counties. However, water levels have declined 75 to 100 feet in parts of Wallace and Sherman counties, with the major portion of Wallace County declining 50 to 75 feet, from predevelopment through 1999.(1)

Aquifer water levels in the basin have declined up to 30 feet over the ten-year period from 1996-2006 with the greatest declines centered in the western townships of Wallace and Sherman counties. The overall decline has contributed to a progressive reduction in surface water flow during the past several decades. Note that the Saline River is not considered hydrologically connected to the Ogallala-High Plains at the headwaters in Thomas County.

Water users in parts of Wallace, Sherman, Thomas and Sheridan counties are experiencing shortages in meeting demand. To extend and conserve the life of the Ogallala–High Plains aquifer, GMD1, GMD4 and the DWR are defining priority areas to reduce aquifer declines. Federal and state voluntary incentive programs

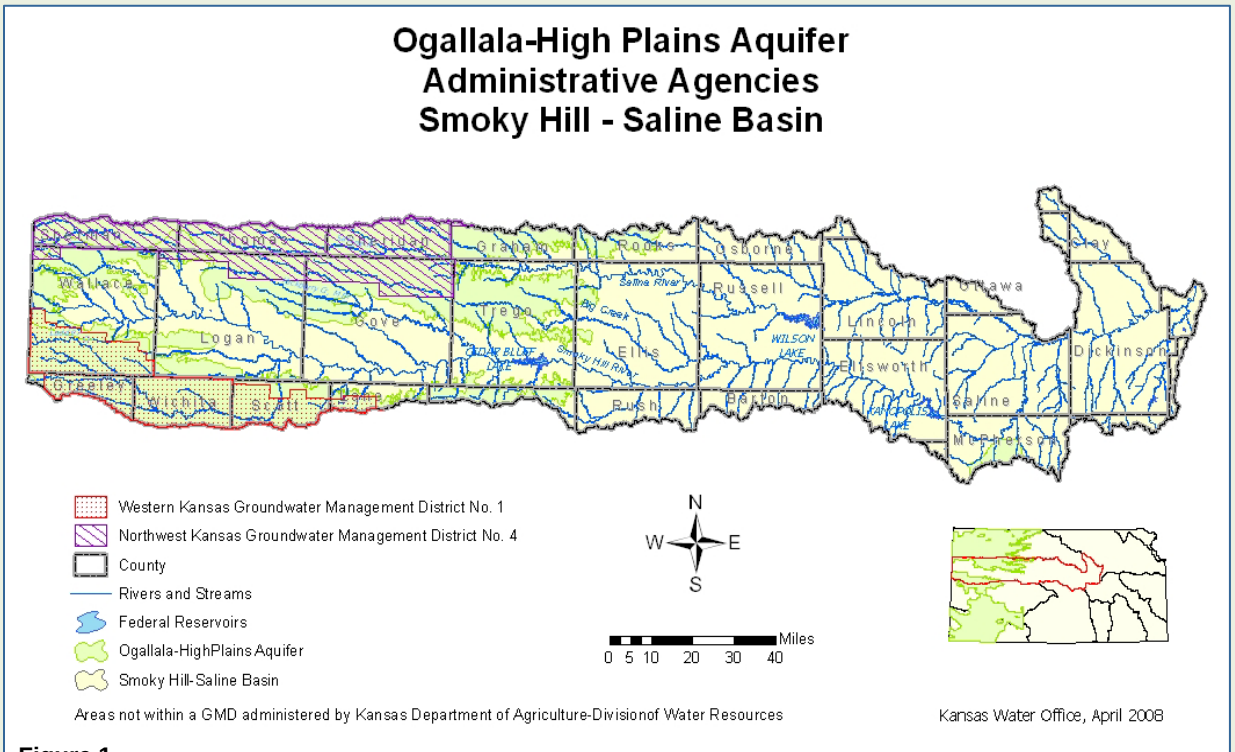

Figure 1.

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to reduce water use have been developed and target priority areas.

A 2006 the Kansas Water Office (KWO) analysis of water level data from 1981-2005 indicated that the aquifer decline rate had not been reduced by a statistically significant amount between two time periods: 1981-1993, and 1993-2005.(2)

Water Appropriations

Approximately 608,381 acre feet of the ground water appropriations in the Smoky Hill-Saline basin are from the High Plains aquifer. Total appropriations in the basin from the Ogallala-High Plains aquifer are approximately 605,769 acre feet for all beneficial uses. There are about 2,265 active Ogallala-High Plains water rights from 2,625 wells.(5)

Water Use

The 2006 reported water use from the Ogallala-High Plains aquifer in the basin was 220,183 acre feet. Reported use in the basin within GMD1 and GMD4 was 146,839 acre feet and 64,746 acre feet respectively.(5)

There are 2,805 permitted ground water wells in the GMD1 pumping water from the Ogallala-High Plains aquifer. The average annual usage has been approximately 300,000 acre-feet per year. According to GMD1, the ground water decline in that district averaged approximately one foot for the year 2007.(3) Based on the amount of water in aquifer storage and the annual recharge rate, there is approximately 20 years of pumping left without any intervention.

Annual water use reported and quantified by township for 2002-2006 is provided in Table 1, based on data analysis by DWR.(4) 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 in "All" in Table 1. The majority of a township may be in another basin or have no access to the Ogallala aquifer.

There has been widespread adoption of more efficient irrigation systems in the Kansas high plains, shifting from flood and center pivot irrigation to center pivot with drop nozzles.(11) 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. 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.(10)

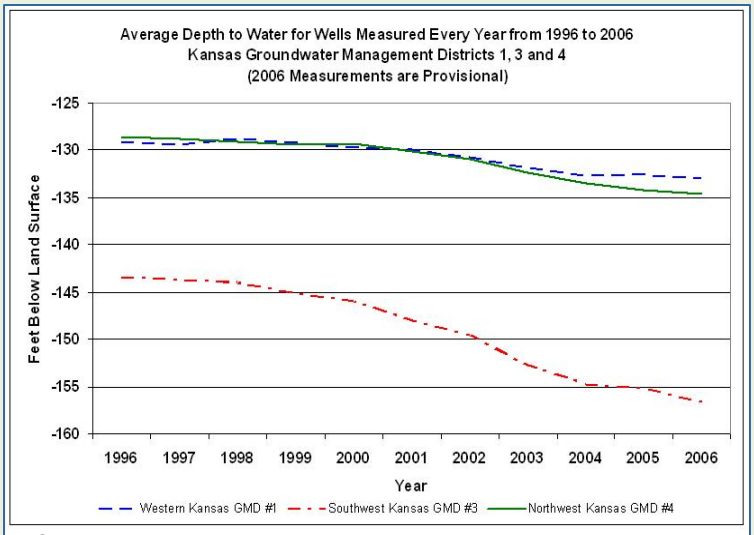

Figure 2.

Aquifer Declines

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

The overall average ground water level decline in the Ogallala-High Plains region over the 2005 calendar year was 0.57 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 water measurements (approximately 0.98 feet/ year).(7)

Figure 3 is an estimated projection of the years until the Ogallala-High

Table 1.

Irrigated Water Use for Ogallala Area in Smoky Hill-Saline Basin

Area	Number Townships	Number Points of Diversion	2006 Water Use (AF)	Acre-feet/ acre 2002	Acre-feet/ acre 2003	Acre-feet/ acre 2004	Acre-feet/ acre 2005	Acre-feet/ acre 2006
GMD1	29	1,523	140,870	1.14	0.99	0.96	0.85	0.94
GMD4	27	601	51,692	1.10	1.04	1.06	0.89	0.93
Fringe	10	190	12,202	1.01	1.04	0.97	0.81	0.87
All		2,217	197,391	1.14	0.99	0.96	0.85	0.94

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Plains aquifer reaches a point where wells will only be able to produce 400 gallons per minute (gpm) if 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.[6]

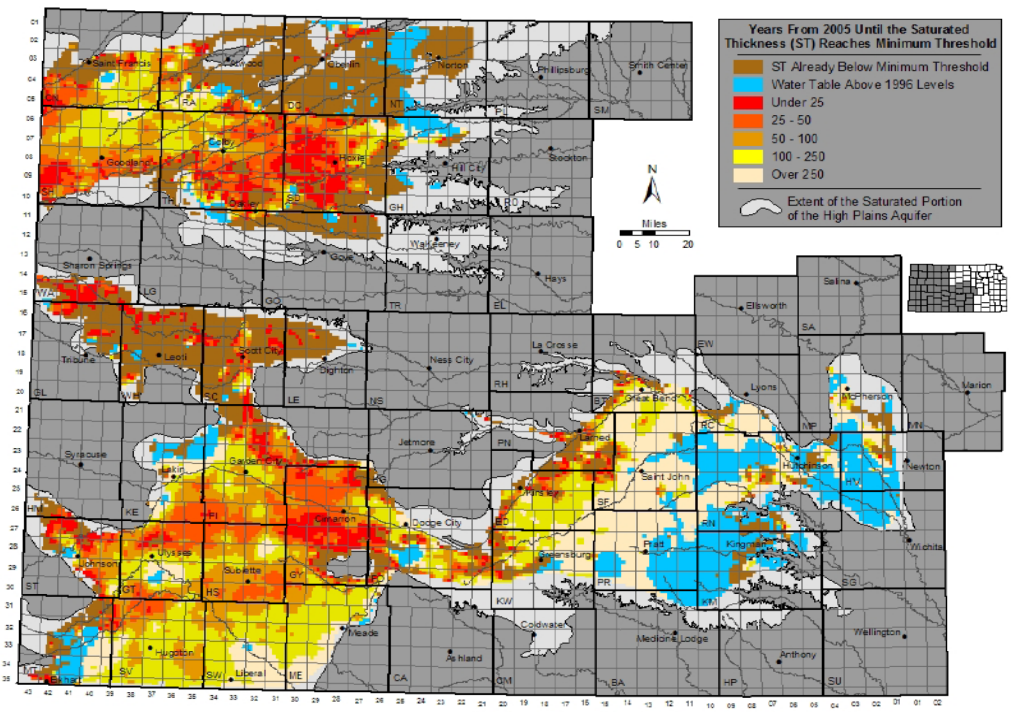

Figure 3. Estimated Usable Life of the High Plains Aquifer

urements, three "index" wells, and weather station data provide information contributing to more accurate models.

GMD1 has identified the entire district as high priority. GMD4 has identified six high priority subunits. Portions of two are in the Smoky Hill-Saline basin (Figure 4). The GMD4 board is in the process of establishing water use goals and enhanced management actions for the high priority aquifer subunits.

The State and GMD4 have modeled management scenarios for the six high priority subunits in GMD4. Corresponding economic impact estimates were made for the modeled ground water levels.[13] The economic impact was based on likely farm decisions such as changing irrigated crops or going to dryland farming in response to specific water conditions as determined by Kansas State University with input from the GMD4 board. The different types of programs to reduce irrigation water use, such as limited irrigation or dryland with farming, dryland without farming, all make significant differences in the potential economic impact to various sectors (state, regional economy, or producer).

Activities and Progress

Various programs and activities have been initiated to reduce the decline rate of the Ogallala-High Plains aquifer and to extend and conserve the aquifer. Tools such as ground water and surface water models and more detailed aquifer characterization have been developed. In the Smoky Hill-Saline basin, the determination of Ogallala subunit priority areas, setting subunit goals and developing management plans to reach these goals, has been the responsibility of GMD1, GMD4 and DWR.

Good data is essential to 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. Wells in GMD1 are already metered. Annual water level meas-

Voluntary programs have been targeted to areas determined by GMD1, GMD4 and DWR. Federal ground and surface water programs of the Environmental Quality Incentive Program (EQIP) have focused on areas selected annually. GMD1 and GMD4 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.

State programs have offered incentives to retire water rights in some areas, however that opportunity has not been provided to the Smoky Hill-Saline basin. Regulatory programs have included special assistance by DWR to irrigators that have pumped in excess of their water rights or the area average.

Progress toward reducing the aquifer decline rate was evaluated by the KWO in 2006. The median annual water level changes were calculated for each region and

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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 in the fringe areas), that as of 2005, there has been no statistically significant change in the rate of decline. There was also no significant change in the water level decline rate for the west central Ogallala aquifer area (GMD1 and DWR fringe).[(2)]

It should be noted that the percentage of total water use that has been reduced through 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. GMD1 has selected the entire district as priority subunit (hatched). GMD4 has identified 6 high priority subunits, parts of two in the basin. The DWR for areas of the Ogallala-High Plains aquifer outside of the districts, with input from the public. Specific target areas are defined for areas eligible for enrollment in the EQIP quick response areas and Water Right Transition Assistance Program (WTAP).

The priority rank shown on Figure 4 outside GMD4 is based on an area's total score from two databases: 1) estimated usable lifetime; and 2) density of ground water use. Useable lifetime is defined as the ability to support a 400 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.

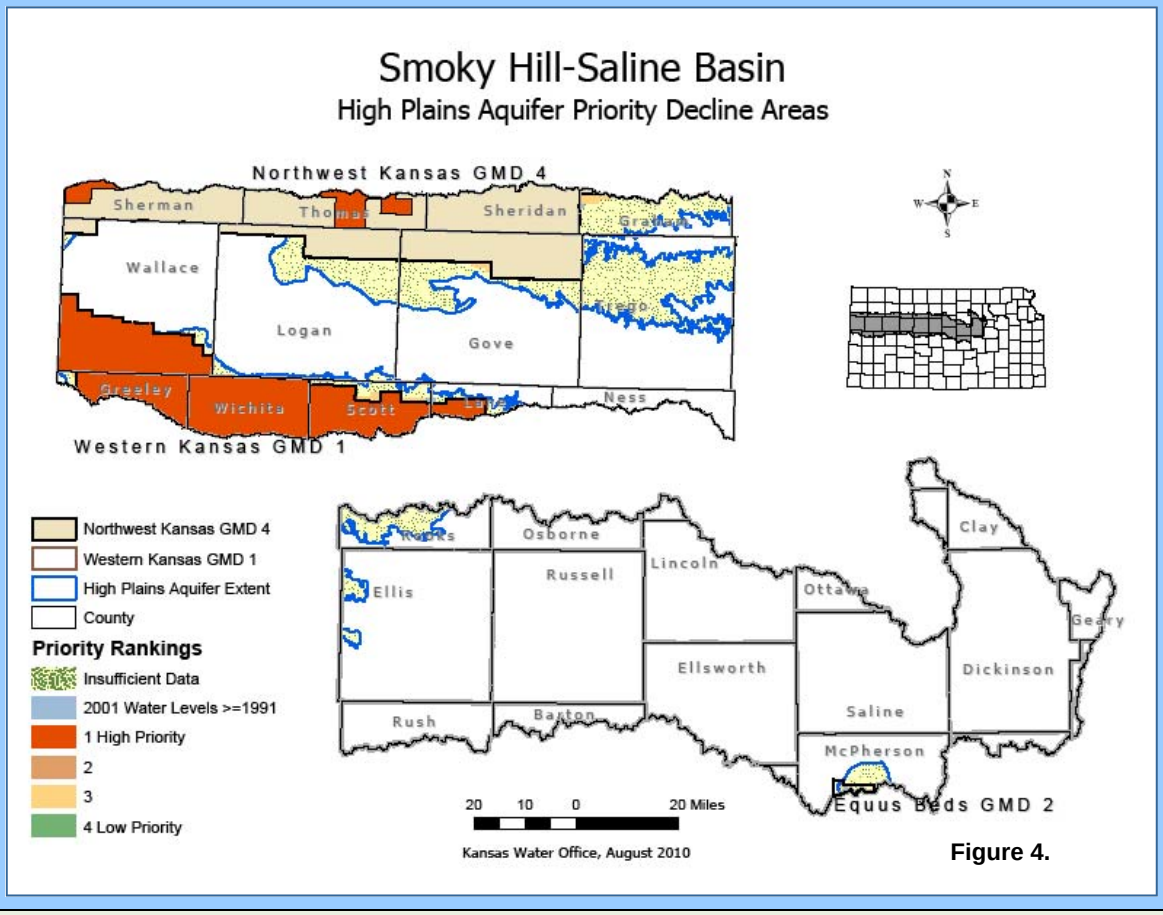

Figure 4.

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Recommended Actions

1. GMD1, and DWR where outside the district, identify priority aquifer subunits or areas, and GMD4, GMD1, and DWR develop specific goals and management strategies to extend and conserve the life of the aquifer.

2. GMD1, 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. Support research for high value, low water use crops.

4. Provide opportunities to permanently or temporarily reduce water use through voluntary programs (state, federal, and local).

5. Educate water users, decision makers and the general public on the condition of the aquifer and methods and opportunities to reduce water use.

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 to provide local leadership on management of aquifer subunits or other local areas/subunits for reduced consumptive water use.
    - Target incentive-based programs to aquifer subunits that have a long term vision and plan.
    - Implement aquifer subunit plans that assure water into the future to 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 where aquifer subunits cross state boundaries, and are not directly impacting an existing surface water compact.

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Resources

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Smoky Hill River. Photo courtesy KGS.