

Smoky Hill-Saline River Basin

January 2009

General Description

The [Smoky Hill-Saline basin](#) lies within the Great Plains and Central Lowland physiographic provinces. The Smoky Hill-Saline basin in Kansas is an elongated drainage area, which extends eastward from the Colorado border approximately 250 miles to the vicinity of Junction City, Kansas. The Smoky Hill-Saline Basin covers all or parts of Sherman, Thomas, Sheridan, Graham, Wallace, Logan, Gove, Trego, Greeley, Wichita, Scott, Lane, Ness, Rooks, Osborne, Mitchell, Cloud, Ellis, Russell, Lincoln, Ellsworth, Dickinson, Geary, Morris, Saline, Rush, Barton, Rice, McPherson and Marion counties (Figure 1). The basin includes subbasins with [hydrologic unit codes](#) (HUCs) 10260001 thru 10260010.

The Smoky Hill River headwaters are located in eastern Colorado where the North and South Forks rise. These forks join in Logan County, Kansas. The Smoky Hill River has a drainage area of about 8,810 square miles. The Smoky Hill River flows eastward to Junction City to the confluence with the Republican River. Below this point the river is known as the Kansas River.

The drainage area of the Saline River is about 3,419 square miles. The Saline River, a tributary of the Smoky Hill, rises near the Sherman-Thomas County line in extreme western Kansas. The Saline River flows eastward to its confluence with the Smoky Hill River several miles east of Salina, Kansas.

The entire Smoky Hill-Saline basin in Kansas has a drainage area of about 12,229 square miles.

Topography within the basin is flat to gently rolling, with narrow, shallow valleys and low relief.

The highest point in Kansas, Mount Sunflower at 4,039 feet above mean sea level (MSL), is located in northwestern Wallace County. From this point, elevations in the basin decrease to approximately 1,087 feet above MSL at the confluence of the Smoky Hill and Republican rivers.

Population and Economy⁽¹⁾

The basin had a [population](#) of 156,161 in 2000. The population of the 32 counties that are entirely or partially in the Smoky Hill-Saline basin was 330,631 in the year 2000 and is projected to be 288,939 in the year 2040. Rural counties have lost population, sometimes more than 10% in the last decade.

The economy of the basin is based primarily on agriculture and manufacturing. The major [crops](#) are wheat, grain sorghum, corn and alfalfa with a sizable portion of this acreage being irrigated.⁽²⁾

In 2006 there were an estimated 17,060 farms with 15,966,000 acres in the 32 counties with all or parts in the basin. The average farm is about 936 acres.⁽²⁾

Recreation is an increasing part of the economics of the basin. The federal reservoirs and associated recreation and wildlife areas draw hunters, fishermen and boaters to the area. In addition, the state supports fishing at: Kanopolis State Park Pond (2 acres, 33 miles SW of Salina on Hwy K-149 & K-141); and Saline State Fishing Lake (Periodically Dry) (38 acres, 2-1/2 N 2 W of Salina). Logan State Fishing Lake (60 acres, 2 N 2 W of Russell Springs) is still listed by Kansas Department of Wildlife and Parks as a fishing opportunity, however it has been dry for many years.

The growing industrial contribution to the basin economy is primarily related to energy production, including ethanol. As of December 2007, two ethanol plants were in operation in the basin.

Higher education opportunities in the basin include; Fort Hays State University; Kansas Wesleyan University, KSU College of Technology and Aviation, Brown Mackie College, North Central Kansas Technical College and Salina Area Technical School.

Physical Characteristics

Geology and Soils

Cretaceous bedrock underlying the basin consists of shale, limestone, and chalk. The most notable being the Niobrara Chalk and the Dakota Sandstone. The river and tributary valleys are comprised of unconsolidated deposits of gravel, sand, silt and clay. The bedrock has an east-to-southeast drainage trend. In the west, the rocks that outcrop are sedimentary in origin and range in age from Cretaceous to Recent.

The Ogallala Formation of Late Tertiary (Pliocene) age uncomfortably overlies these older formations.

Thin, dissected and isolated deposits of sand and gravel of Pleistocene age occur along the larger streams, chiefly the South Smoky Hill and North Smoky Hill Rivers. These deposits have been derived from the Ogallala Formation and lithologically are very similar to the Ogallala. The Smoky Hill River is completely incised into the Cretaceous Niobrara Formation throughout most of Kansas, so has little contact with the Ogallala-High Plains [aquifer](#). However, two major tributaries, the Saline River and Ladder Creek, do have substantial connection.

The terrace deposits and valley fill of the Smoky Hill valley become thicker and of greater areal extent to the east.⁽²⁾

The Smoky Hill-Saline basin soils vary widely in character. The soils are poor shallow soils in the west along streams with fertile loess soil in the uplands. Shallow, acidic and infertile soils occur through Trego, Ellis and Russell counties. Bottom land soils ranging from sand to clays and from permeable, friable soils to tight soils.^(2,3)

Land Use/Land Cover

The basin covers approximately 7,726,235 acres. Over 48% is crop land, and more than 44% in grass. Crop land dominates in the west with grassland dominating through the central section of the basin. The major crops are wheat, sorghum, and corn. Approximately 249,596 acres were reported as irrigated in 2006. A major product is [beef cattle](#).

The Kansas Geological Survey (KGS) categorized riparian land use in 2003. Statewide pasture/grass land is the dominant riparian land use type in Kansas, accounting for over 142,000 bank miles or roughly 38% of all land use types.⁽⁷⁾ In this basin, the total of 56,730 bank miles vary in the riparian land use type, with 53% of the riparian cover being pasture/grass land. Table 1 provides more detail of riparian land within one mile of streams and water bodies.

Climate

The basin's climate is characterized by the extremes and highly variable [precipitation](#) and temperature common to mid-continent locations.

Average annual temperatures range from 52 degrees (°) in the west to 56° in the east, with wide day to day variations and yearly extremes. Evapotranspiration consumes the major portion of the moisture in the basin.

Average annual precipitation increases from approximately 16 inches in the extreme west to 30 inches in the east. These annual quantities are subject to wide fluctuation, with thunderstorms accounting for most of the annual rainfall. Most of the precipitation occurs between April and September. Annual snowfall averages from 24 inches in the west to 18 inches in the east.

Flooding, when it occurs, is generally the result of intense storms of short duration on tributaries. The main stem of the Smoky Hill River experiences flooding due to storms covering a wide area of longer duration.⁽³⁾

Drought is a naturally recurring feature of this climate as exemplified by the Dust Bowl of the 1930s and the severe drought of 1952-1957. Kansas has been impacted by severe drought periodically. The western part of the basin is greatly affected by reductions in precipitation. The deficit is offset by ground water pumping to irrigate crop land that has not received sufficient rainfall. Drought increases the demand on the available water supply.

The Smoky Hill and Saline rivers landscape is comprised of rolling to nearly level tallgrass and mixed grass prairie vegetation. These contain some large tracts of high quality tallgrass and mixed grass prairie that are currently used primarily for grazing. These native prairie pastures provide important seasonal habitat for migrating birds as well as crucial nesting and brood rearing habitat for grassland nesting birds such as the greater prairie chicken.⁽⁵⁾

The Smoky Hill–Saline basin includes the range for numerous endangered or threatened species including the bald eagle, whooping crane, snowy plover, piping plover, peregrine falcon, black footed ferret, eastern spotted skunk, green toad and hornyhead chub. Eastern parts of the basin are also designated as critical habitat for the bald eagle. Wallace and Logan counties are designated critical habitat for the green toad.⁽¹²⁾

Cedar Bluff Wildlife Area varies in size with the fluctuating reservoir. At full pool the Reservoir is 6,800 surface acres and the surrounding Wildlife Area lands encompassing approximately 7,000 acres.

The area lies in the mixed grass prairie and chalk bluff region. Cedar Bluff derives its name from a 1/2 mile of 100 foot chalk bluffs located on the southwest portion of the property.

Wilson Wildlife Area is located on the upper end of 9,000 acre Wilson Reservoir. The 8,069 acre public hunting area is made up of 5,000 acres of rugged rolling hills of native prairie, approximately 2,000 acres of cropland, and 1,000 acres of riparian timber along the Saline River, Cedar Creek, Turkey Creek, and Elm Creek.

Smoky Hill Wildlife Area at Kanopolis Lake offers 4,180 acres of land and 885 acres of water. The reservoir covers approximately 3,000 acres of water and the entire U.S. Army Corps of Engineers (Corps) property extends along the Smoky Hill River for over 15,000 acres.⁽⁶⁾

Water Resources

The Smoky Hill River headwaters are located in eastern Colorado where the north and south forks rise. These forks join in Logan County, Kansas. The Smoky Hill flows eastward to Junction City to confluence with the Republican River. Below this point the river is known as the Kansas River. The Saline River, a tributary of the Smoky Hill, rises near the Sherman-Thomas County line in extreme western Kansas. The Saline River flows eastward to its confluence with the Smoky Hill River several miles east of Salina, Kansas.

The streams include 50,951 intermittent stream miles and 3,832 perennial stream miles.⁽⁷⁾ Drainage density is 0.31 mile per square mile in the basin (perennial streams only).

Minimum Desirable Streamflow (MDS), an amount of flow for instream uses and downstream water rights, has been set for three U.S. Geological Survey (USGS) gages in the basin. These are on the Smoky Hill River near Ellsworth, the Saline River near Russell and Chapman Creek near Chapman. MDS sets monthly flow targets at each gage. Flows have recently been below MDS for significant periods of time.

Three large federal irrigation and/or flood control projects are located in the Smoky Hill-Saline basin. Cedar Bluff Reservoir, a Bureau of Reclamation (Bureau) project, is located on the Smoky Hill River in Trego County. Wilson Lake on the Saline River and Kanopolis Lake on the Smoky Hill River are operated and maintained by the Corps.

Much of the western half of this basin is underlain by the Ogallala-High Plains aquifer, deposits of saturated sands, gravels and silts of Tertiary and Quaternary age. The High Plains aquifer underlies most of western and south central Kansas. The High Plains aquifer consists of several hydraulically connected aquifers, the largest of which is the Ogallala. The Ogallala-High Plains aquifer is distinctive from other aquifers in Kansas because it has low annual recharge.

parts of the western half of the Smoky Hill-Saline basin. It occurs in the southern portions of Sherman, Thomas, Sheridan, and Wallace counties and the northern parts of Logan, Gove, Trego, Ellis, Greeley, Wichita, Scott and Lane counties. Within the Smoky Hill-Saline basin the Ogallala-High Plains aquifer saturated thickness is generally less than 100 feet. In a few locations the saturated sediments are 150 or 200 feet thick when combined with the overlying alluvial sediments. Ground water resources also include the alluvial deposits along the rivers and tributaries and the Flint Hills aquifer in the eastern end of the basin. The USGS estimated drainable water in storage in the High Plains aquifer in 1992 to be about 3.25 billion acre feet; 10% of that in Kansas.⁽⁸⁾

There were 3,593 water rights reporting use in the basin in 2006. These rights reported a total of 282,453 acre feet used from surface and ground water sources. Ground water sources accounted for 268,145 acre feet with the remaining from [surface water](#).⁽⁹⁾

The primary [reported water use](#) in the basin was irrigation, at 246,134 acre feet followed by municipal use at 23,820 acre feet. Municipal water use (public water supply) includes communities and rural water districts as well as those industries that obtain water through a public water supply (Figure 2).

There were 99 [public water suppliers](#) in the basin in 2006. In 2006, 721 acre feet of water was marketed from Kanopolis Lake to one public water supplier who in turn supplied 11 other suppliers and rural customers.

[Water Management](#)

Western Kansas Groundwater Management District No. 1 (GMD1) and Northwest Kansas Groundwater Management District No. 4 (GMD4) each include portions of three (3) counties in the western end of the basin (Figure 3). The groundwater management districts are pro active in developing local water policy compatible with state Laws.

Water appropriations and use are overseen by the Kansas Department of Agriculture-Division of Water Resources. Most of the streams and alluvial corridors in the basin are closed or restricted for new water appropriations. This has eliminated the possibility of additional appropriations being approved in many areas of the basin. The exception is Ladder Creek and the Saline River which have not been closed to new appropriations.⁽¹¹⁾

The Chief Engineer ordered Intensive Groundwater Use Control Areas (IGUCA) for two sections of the Smoky Hill River and for an area within the City of Hays. This closed the Smoky Hill River corridor in to further ground or surface water appropriations. An IGUCA can provide more comprehensive water management tools than provided under strict water right administration based on priority.

States generally have the responsibility to determine the management of the water resources in that state. The exception to this is the management of federal reservoirs by a federal agency. In the Smoky Hill-Saline basin, Cedar Bluff is managed by the Bureau, Wilson and Kanopolis are managed and operated by the Corps. The State of Kansas has purchased [water supply storage](#) in the Kanopolis Lake that provides water to a significant area of the basin.

Numerous other entities related to water resources may exist in the basin to address one or more water related issues. [Watershed districts](#) may be formed to develop and implement a comprehensive plan for a watershed that will provide flood protection for the residents and landowners. Parts of four watershed districts are included in the basin. These cover the watersheds for Spillman Creek Watershed Joint District No. 43 and, Lyons Creek Watershed Joint District No. 41 in Lincoln County, and Turkey Creek Watershed Joint District No. 32 and Lost Creek Watershed District No. 44 in Dickinson County.⁽¹⁰⁾

Each county has a county conservation district responsible for the conservation of soil, water, and related natural resources within that county. Multiple county groups may form Resource Conservation and Development areas (RC&Ds) to also address conservation of natural resources. Parts of five RC&Ds cover the Smoky Hill-Saline basin.⁽¹³⁾

Addressing water quality are four Watershed Restoration and Protection Strategy (WRAPS) programs that each cover a part of the basin. As of December 2007, all portions of the Smoky Hill River and parts of Big Creek were in some stage of the WRAPS process. In addition, drainage districts may also be formed in order to reclaim and protect land from the effects of water.

Reservoir Storage in the Smoky Hill-Saline Basin

Cedar Bluff Dam and Reservoir

Cedar Bluff Reservoir was completed in 1951 by the Bureau of Reclamation for flood control, water supply, irrigation, and other purposes. The main use of the lake was to support the operations of the Cedar Bluff Irrigation District. In 1963, the City of Russell entered into a contract with the Bureau of Reclamation for release of up to 2,000 acre-feet per year to recharge the city's well field.

When inflow into Cedar Bluff Reservoir was severely depleted in the 1960's and 1970's, the irrigation district ceased to be viable with the last delivery of water in 1978. The State of Kansas entered into an agreement with the Bureau of Reclamation and the Cedar Bluff Irrigation District in 1989 closing the irrigation district and giving control of all but 2,700 acre-feet of storage in the conservation pool to the State of Kansas. The main uses for the state storage are fish, wildlife and recreation as well as artificial recharge of the stream and alluvium downstream.

On January 9, 2006, the control of the majority of the stored water owned by the State in Cedar Bluff Reservoir was transferred to Kansas Department of Wildlife and Parks to better identify with the allowed uses of water and historic operations of the Reservoir. The Kansas Water Office retained control of the artificial recharge portion. The City of Russell continues to maintain their contract with the Bureau.

Kanopolis Dam and Lake

Kanopolis Lake storage of water in the lake began in February 1948. Kanopolis Lake was constructed and is operated by the U.S. Army Corps of Engineers. The lake was constructed to provide flood protection, recreation opportunities, fish and wildlife benefits, and maintain minimum stream flow on the Smoky Hill River.

In 2002, the State of Kansas acquired storage in Kanopolis Lake to be used for municipal and industrial water supply purposes through the State of Kansas Water Marketing Program. As of November 2007, Post Rock Rural Water District has a contract for a maximum quantity of 400 million gallons per year (mgy) or 1,227.555 acre feet (af) from Kanopolis Lake.

There are also irrigation and domestic use demands in the alluvial system downstream from the lake.

The Post Rock RWD currently serves retail customers and the cities of Brookville, Ellsworth, Dorrance, Gorham, Luray, Waldo, Paradise; the Wilson Lake Estates of Lincoln County Development; and the rural water districts #5 of Ellis County, #7 of Saline County and #2 of Osborne County. Requests for the remaining water in the Kansas Water Marketing Plan Storage are under consideration at the present time.

Wilson Dam and Lake

Wilson Dam and Lake, was completed by the U.S. Army Corps of Engineers in 1964. The project was authorized for flood control, irrigation, navigation, recreation, fish and wildlife and water quality purposes. Storage space was constructed for flood control storage, conservation storage and sediment storage. It was later determined that irrigation was not practical due to the concentration of dissolved minerals, primarily

chlorides, that accumulate in the reservoir. The lake's maximum capacity is 736,000 acre feet (908 million m³).

Presently there is no storage allocated for water supply, but investigation of the use of Wilson to meet increasing needs in the region is underway. Technological advances in water quality treatment have reduced costs to remove the dissolved minerals.

Resources

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Smoky Hill-Saline River Basin Management Categories

WATER MANAGEMENT CATEGORIES

The following categories include issues identified in the [Smoky Hill-Saline basin](#) plan as items that require attention in addition to the basin priority issues. These issues are addressed within the following management categories:

- Water Management
- Water Conservation
- Public Water Supply
- Water Quality
- Wetland & Riparian Management
- Flood Management
- Water-Based Recreation

These categories also correspond to the statewide management categories and policies of the *Kansas Water Plan* found in [Volume II](#). These documents contain new policy issues and the existing policy and statutory framework that relate to the management categories.

ISSUE: [WATER MANAGEMENT](#)

Management of Kansas' ground and surface water fits into six statewide categories, with five of these applicable in the Smoky Hill-Saline basin. These are:

- 1) River-Reservoir management
- 2) Stream reaches with established Minimum Desirable Streamflow;
- 3) Streams outside of Minimum Desirable Streamflow protected areas;
- 4) The Ogallala-High Plains aquifer
- 5) Ground water outside of the Ogallala-High Plains aquifer

Ground water is the primary water supply in the basin. The Ogallala-High Plains [aquifer](#) is a major source in the extreme western portion of the basin. Alluvial ground water is utilized where available throughout the basin. Ground water recharge rates are generally low throughout the basin except in the extreme eastern portion of the basin. A majority of the basin is restricted or closed for new water appropriations. The Ogallala-High Plains aquifer is managed with the local leadership of the Western Kansas Groundwater Management District No. 1 (GMD1) and Northwest Kansas Groundwater Management District No. 4 (GMD4). GMD1 has identified the entire district as high priority. GMD4 has identified six high priority subunits. Goals and management for each high priority subunit are under development. In 2008, a computer model developed for the six priority subunits in GMD4 was completed through cooperation of the Kansas Water Office (KWO), GMD4 and the U.S. Bureau of Reclamation. The model will aid in development and analysis of management scenarios.

In 2006, the KWO calculated the median annual water level changes in Ogallala–High Plains aquifer wells from 1981 to 2005. In the northwest Ogallala aquifer area, 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.⁽⁶⁾ Additional information on this issue may be found in the [Smoky Hill-Saline basin priority issue](#) section.

Reduced streamflow and runoff into streams has been reflected in lower reservoir water levels in the three federal reservoirs in the basin: Cedar Bluff, Kanopolis Lake and Wilson Lake. Yield analyses that have revised the estimated yield availability, along with known loss of storage due to sedimentation, have driven the need to revisit reservoir management. This is discussed in the basin priority issue [Lower Smoky Hill River Water Management](#).

Requests for additional water from Kanopolis Lake exceed water available through the State Water Marketing Program. While mostly a public water supply issue, there is also a component of management of water in Kanopolis and the lower Smoky Hill River system to address before the public water supply issue can be resolved. Additional information on the public water supply issue may be found in the [Smoky Hill-Saline basin priority issue](#) section.

There are three minimum desirable streamflow (MDS) locations in the basin that are part of the Smoky Hill River system: 1) on the Smoky Hill River near Ellsworth; 2) on the Saline River near Russell; and 3) Chapman Creek near Chapman. There was statistically no change in the frequency MDS was met 1984 to 2004 when compared to historical frequency (1960 – 1983).

Applicable Kansas Water Plan Objectives

- Reduce water level decline rates within the Ogallala-High Plain aquifer and implement enhanced water management in targeted areas.
- Achieve sustainable yield management of Kansas surface and ground water sources outside of the Ogallala Aquifer and areas specifically exempt by regulation. Sustainable yield management would be a goal that sets water management criteria to ensure long term trends in water use will move as close as possible to stable ground water levels and maintenance of sufficient streamflows.
- Meet minimum desirable streamflow at a frequency no less than the historical achievement for the individual sites at time of enactment.

Applicable Programs

The following programs help to meet the objectives in the water management category. For more information on the programs and associated policies, see the [Programs Manual](#).

- Kansas Department of Agriculture-Division of Water Resources: Water Appropriation Program
- Kansas Geological Survey, Kansas Department of Agriculture, Division of Water Resources: Water Well Measurement
- State Conservation Commission: Water Right Transition Assistance Program
- USDA-Natural Resources Conservation Service: Environmental Quality Incentive Program (EQIP)
- Kansas Geological Survey: Stream Aquifer Interactions
- Kansas Geological Survey: High Plains Aquifer Technical Assistance Program
- Kansas Water Office: Water Marketing Program
- Kansas Water Office: Water Assurance Program
- Kansas Water Office: State Water Planning Program

ISSUE: WATER CONSERVATION

Water conservation is essential for the effective management of water resources in the basin to assure that a sufficient, long-term, supply of water is available for the beneficial uses of the people of the state. Conservation is defined as a careful preservation and protection of something, especially the planned management of a natural resource to prevent exploitation or destruction. Water conservation is a part of maintaining a long-term water supply for Kansas.

Water conservation activities apply to all uses, irrigation, municipal, industrial, and others, and from all sources. In 2006, irrigation accounted for 87% of all reported water pumped or diverted in the basin. Municipal use accounted for nine percent of water used in the basin, livestock water for one percent, and industry, recreation, and domestic uses for less than one percent each while other uses totaled two percent.

Of the 616 [public water suppliers](#) that have an approved conservation plan in place as of December 31, 2008, 65 plans have been approved in the Smoky Hill-Saline basin. As of August 2006, 139 conservation plans had been approved for irrigation water rights in the basin. The number of wells in Kansas that were reported to

have irrigation application rates over the regional average fluctuated from about 3,700 to less than 500 from 1991 to 2005. Of the total number of wells that were reported to have diverted water in 2006, more than 59% in the Smoky Hill-Saline basin had a metered quantity, according to the Water Right Information System (WRIS) database.

Water conservation in the basin is exemplified by the efforts of the City of Hays. City policy has successfully kept consumption low while maintaining a viable and growing economy. Additional needs in the basin in the future for growth and economic expansion indicate using water efficiently will be more important than ever.

GMD1 operates the Western Kansas Weather Modification Program for 10 counties in western Kansas. The Program goals include hail suppression and precipitation enhancement. Protection of crops from hail reduces water waste if irrigated crops should be lost.

Applicable *Kansas Water Plan Objectives*

- Reduce the number of public water suppliers with excessive unaccounted for water by first targeting those with 30 percent or more unaccounted for water.
- Reduce the number of irrigation points of diversion for which the amount of water applied in acre-feet per acre (AF/A) exceeds an amount considered reasonable for the area.
- All non-domestic points of diversion meeting predetermined criteria will be metered, gaged, or otherwise measured.
- Conservation plans will be required for water rights meeting priority criteria under K.S.A. 82a-733 if it is determined that such a plan would result in significant water management improvement.

Applicable Programs

The following programs help to meet the objectives in the Water Conservation management category. For more information on the programs and associated policies, see the [Programs Manual](#).

- Kansas Department of Agriculture-Division of Water Resources: Water Appropriation Program
- Kansas State University Research and Extension: Water Conservation and Management Program/MIL
- State Conservation Commission: Water Resources Cost-Share Program
- State Conservation Commission: Water Right Transition Assistance Program
- Kansas Water Office: Water Conservation Program
- Kansas Water Office: Weather Modification Program
- USDA-Natural Resources Conservation Service: Environmental Quality Incentive Program (EQIP)
- USDA-Farm Service Agency: Conservation Reserve Program

ISSUE: PUBLIC WATER SUPPLY

The primary approach to addressing public water supply issues in the basin focuses on ensuring that there are adequate supplies of [surface](#) and ground water within the basin to meet future water demands, reducing the number of public water supply systems that are vulnerable to drought, and ensuring that systems have the technical, financial and managerial capacity to meet future needs for water quality and quantity.

In 2006 there were 79 public water supplies in the Smoky Hill-Saline basin. Ground water is the primary source for most public water supplies, accounting for nearly 73% of the total supply, principally from the Ogallala-High Plains, the Dakota and the alluvial aquifers along major streams. In addition, the City of Russell obtains a portion of their water from surface flow in the Smoky Hill River, below Cedar Bluff Reservoir. Kanopolis Lake supplies a large geographic area through rural water district connections.

Among the state's major river basins, the percentage of drought vulnerable public water suppliers in 2006 ranged from three percent (Neosho Basin) to 42% (Solomon Basin). Comparison of the KWO 2000 and 2006 lists shows a significant increase in the number of drought vulnerable public water suppliers in most western river basins including the Smoky Hill-Saline. There were 30 public suppliers considered drought vulnerable in the Smoky Hill-Saline basin in 2006.

Public water supply needs in the basin have increased in recent years and are expected to continue due to population and industrial growth in the central and eastern parts of the basin. Kanopolis and Wilson Lakes and their operation plans are under review as components to meeting future demands. Meeting public water supply needs is a basin priority issue. Additional information on this issue may be found in [the Smoky Hill-Saline Basin priority issue](#) section.

Applicable Kansas Water Plan Objectives

- Ensure that sufficient surface water storage is available to meet projected year 2040 public water supply needs for areas of Kansas with current or potential access to surface water storage.
- Less than five percent of public water suppliers will be drought vulnerable.
- Ensure that all public water suppliers have the technical, financial and managerial capability to meet their needs and to meet Safe Drinking Water Act requirements.

Applicable Programs

The following programs help to meet the objectives in the Public Water Supply management category. For more information on the programs and associated policies, see the [Programs Manual](#).

- Kansas Department of Agriculture-Division of Water Resources: Water Appropriation Program
- Kansas Department of Health and Environment: Public Water Supply Program
- Kansas Department of Health and Environment: Kansas Public Water Supply Loan Fund
- Kansas Water Office: State Water Planning Program
- Kansas Water Office: Water Conservation Program

ISSUE: WATER QUALITY

Water quality and related water resource issues are addressed through a combination of watershed restoration and protection efforts utilizing voluntary, incentive-based approaches, as well as regulatory.

All the counties within the basin have a sanitarian funded by the Local Environmental Protection Program (LEPP).⁽²⁾ All conservation districts in the basin have adopted nonpoint source pollution management plans. Buffer coordinators have also been employed in four counties in the basin to facilitate enrollment of stream buffers in the continuous Conservation Reserve Program (CRP) and State Water Quality Buffer Initiative.⁽⁴⁾

The Clean Water Act requires states to conduct Total Maximum Daily Load (TMDL) studies and develop TMDLs for water bodies identified on the state's List of Impaired Waters (Section 303(d) List). TMDLs are quantitative objectives and strategies needed to achieve the state's surface water quality standards. There are 33 approved TMDLs within the Smoky Hill-Saline basin. Five are high priority for implementation. There are 2 lakes, Lake Scott and Herrington Reservoir listed as water quality impaired by eutrophic conditions, pH, dissolved oxygen, and/or aquatic plants. Streams are sampled at 26 locations with dissolved oxygen depletion, total dissolved solids, selenium and total phosphorus identified as the cause of the greatest number of impairments. Other pollutants limiting use of Smoky Hill-Saline basin streams include arsenic, cadmium, lead, nitrates, dissolved oxygen, E. Coli bacteria, and biological stressors. Additional TMDL development is anticipated in 2009.

Kansas Watershed Restoration and Protection Strategy (WRAPS) is a planning and management framework that engages stakeholders within a watershed in a process to:

- Identify watershed restoration and protection needs.
- Establish watershed management goals.
- Create a cost-effective action plan to achieve goals.
- Implement the action plan.

As of March 2008, there were 44 active WRAPS projects located throughout Kansas⁽³⁾. Four are in the Smoky Hill-Saline basin, including all the [watersheds](#) for the Smoky Hill River.

Major point sources in the basin include waste water treatment plants. The City of Hays is included in Phase II National Pollutant Discharge Elimination System (NPDES) Stormwater Program as having municipal separate storm sewers (MS4s).

Applicable *Kansas Water Plan Objectives*

- Reduce the average concentration of bacteria, biochemical oxygen demand, solids, metals, nutrients, pesticides and sediment that adversely affect the water quality of Kansas lakes and streams.
- Ensure that water quality conditions are maintained at a level equal to or better than year 2000 conditions.
- Reduce the average concentration of dissolved solids, metals, nitrates, pesticides and volatile organic chemicals that adversely affect the water quality of Kansas ground water.
- Maintain, enhance, or restore priority wetlands and riparian areas.
- Nutrient reduction goals will be included in all WRAPS projects within the basin.
- All public water suppliers will complete and implement a source water protection plan.

Applicable Programs

The following programs help to meet the objectives in the Water Quality management category. For more information on the programs and associated policies, see the [Programs Manual](#).

- Kansas Department of Health and Environment: State Water Plan Program (Contamination Remediation)
- Kansas Department of Health and Environment: Local Environmental Protection Program
- Kansas Department of Health and Environment: Watershed Management Section/WRAPS
- State Conservation Commission: Nonpoint Source Pollution Control Program
- State Conservation Commission: Water Resources Cost-Share Program
- Kansas Corporation Commission: Conservation Division Programs
- Kansas Department of Health and Environment: Watershed Management Section/TMDL

ISSUE: WETLAND & RIPARIAN MANAGEMENT

The primary approach to wetland and riparian management in the basin focuses on providing technical and financial assistance to landowners to protect and restore these resources in priority watersheds through the implementation of best management practices.

Riparian lands in the Smoky Hill-Saline basin have been impacted by the infestation of non-native phreatophytes, although not to the degree as in other western basins. Of greatest concern are the effects tamarisk (salt cedar) and Russian olive have on native riparian ecosystems.

Applicable *Kansas Water Plan Objectives*

- Maintain, enhance or restore priority wetlands and riparian areas.

Applicable Programs

The following programs help to meet the objectives in the Wetland and Riparian management category. For more information on the programs and associated policies, see the [Programs Manual](#).

- Kansas Forest Service: Forest Stewardship Program and Conservation Tree Planting Program
- State Conservation Commission: Riparian and Wetland Protection Program
- Kansas Water Office: State Water Planning Program
- Kansas Department of Wildlife and Parks: State Parks and Wildlife Areas Planning and Development

- Kansas Department of Wildlife and Parks: Wildlife Habitat Improvement Program

ISSUE: FLOOD MANAGEMENT

Flooding is a natural, recurring event associated with streams and rivers that has resulted in the formation of natural floodplains over time. While this inundation provided benefits under natural conditions, encroachment of urban and agricultural development onto floodplains has resulted in the potential for flood damage. In addition, the Smoky Hill-Saline basin is prone to flash flooding which is characterized by a rapid rise in water level, fast-moving water and much flood debris.

Kansas Water Plan flood management guidance has targeted watershed dam construction assistance to priority watersheds, encouraged National Flood insurance participation and updating of floodplain maps for priority communities.

Significant flooding was experienced during 1903, 1938 and 1941 on the Smoky Hill River. Three federal dam projects: Cedar Bluff, Kanopolis and Wilson, contribute to flood control in the basin. Local watershed districts construct, operate and maintain works of improvement needed to provide for water management within designated boundaries. Their primary function is to develop a comprehensive general plan for a watershed that will provide flood protection for the residents and landowners. Three watershed projects are located in the basin, two of which are now completed.

Financial assistance from the State Water Plan Fund has been provided for flood mapping as part of the 1993 Kansas Department of Agriculture-Division of Water Resources *Kansas Flood Mapping Initiative* in Ellis and Saline counties in the basin. Ellsworth and McPherson counties are included in this initiative to have maps modernized by 2110.

Applicable Kansas Water Plan Objectives

- Reduce the vulnerability to damage from floods within identified priority communities or areas.

Applicable Programs

The following programs help to meet the objectives in the Flood Management category. For more information on the programs and associated policies, see the [Programs Manual](#).

- Kansas Department of Agriculture-Division of Water Resources: Water Structures Program/Floodplain Management
- Kansas Department of Agriculture-Division of Water Resources: Water Structures Program/Dam Safety
- Kansas Division of Emergency Management: Hazard Mitigation Grants Program
- State Conservation Commission: Watershed Dam Construction Program
- State Conservation Commission: Watershed Planning Assistance Program
- FEMA: National Flood Insurance Program

ISSUE: WATER-BASED RECREATION

The Smoky Hill-Saline basin has a wide variety of public water recreation sites on state and federal land. There is a demand for more consistent water levels, and access to water based recreation facilities for area residents. Recreation contributes income to the economy by attracting sportsmen and women to the area for hunting at wildlife areas, camping and picnicking at recreation areas, and fishing and boating on reservoirs and lakes.

Cedar Bluff Reservoir and Kanopolis and Wilson lakes provide recreational opportunities including fishing, boating, and camping. Wildlife areas include Cedar Bluff Wildlife Area, Wilson Wildlife Area and the Smoky Hill Wildlife Area at Kanopolis Reservoir. In addition, the state supports fishing at Kanopolis State Park Pond, Logan State Fishing Lake and Saline State Fishing Lake (Periodically Dry).

Applicable *Kansas Water Plan* Objectives

- Increase public recreational opportunities at Kansas lakes and streams.

Applicable Programs

The following programs help to meet the objectives in the water-based recreation management category. For more information on the programs and associated policies, see the [Programs Manual](#).

- Kansas Department of Wildlife and Parks: Rivers and Stream Access
- Kansas Department of Wildlife and Parks: State Parks

ISSUES FOR FUTURE ACTION

None identified at this time.

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 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⁾

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 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⁾

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 measurements, 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).

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 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.

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.

Resources

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Smoky Hill-Saline Basin High Priority Issue

Water Supply

January 2009

Issue

Meeting central Kansas Smoky Hill-Saline regional public water supply (municipal and industrial) needs.

Providing for the changing uses, demands and distribution of water use in the central part of the [Smoky Hill-Saline basin](#) to meet public water supply is a recognized need in the basin. Resource management to maintain economic stability and provide for economic growth is part of any considerations in management decisions.

Description

The provision of adequate quantities of good quality water for municipal and industrial purposes is of major concern. Increasing industrial, agribusiness and municipal needs for water supply all exist in various portions of this diverse basin. Communities in the relatively dry western part of the basin seek to expand and diversify their economic base. The Smoky-Hill-Saline basin relies on water from [surface](#) storage in the eastern portion and/or ground water available from local aquifers. Much of the central portion of the basin receives water from Kanopolis Lake through rural water district distribution to supplement any ground water appropriation held by the [public water supplier](#) or individual. Many communities seek to provide for industry as well as meet needs for population growth. The eastern portion of the basin receives greater precipitation, however demand in this area is also increasing with economic and population growth.

Recent climatic conditions, the decline of ground water levels and reduced reservoir yields contribute to water supply concerns. This issue is directly related to the Lower Smoky Hill River Management issue also found in this basin section.

Water Resources

Water sources in basin include: Cedar Bluff, Kanopolis, and Wilson Dams and associated reservoirs; the Smoky Hill and Saline rivers and tributaries and associated alluvium; as well as the Ogallala-High Plains [aquifer](#) in western portions of the basin.

Cedar Bluff Reservoir provides flood protection and storage of water for fish and wildlife, along with municipal use by the City of Russell and recharge of the Smoky Hill River alluvium. Cedar Bluff Reservoir was originally authorized for irrigation, flood control, and water supply, with incidental benefits for recreation, fish and wildlife, and water quality. In 1992, Congress reformulated the project to create an operating pool for fish, wildlife, and recreation. Irrigation was abandoned as a project purpose and the irrigation district was dissolved. Results of an analysis by Kansas Water Office (KWO) to determine the water supply yield that can be expected during a 2 percent chance drought (required for the state Water Marketing Program) indicated Cedar Bluff is not suitable for storage of water under the Marketing Program. Therefore, Cedar Bluff Reservoir is not a potential source of additional municipal and industrial water supply.

Kanopolis dam and lake provides flood protection and storage of water for municipal and industrial use, along with fish, wildlife and recreation. The state Water Marketing Program purchase of storage of 12,500 acre feet in the multipurpose pool for municipal and industrial use was 46% of the pool based adjustments for 40 years of sedimentation. Storage capacity is presently estimated at 22,607 acre feet.. Kanopolis Lake was also analyzed by the KWO to determine water supply yield expected during a two percent chance drought. The available yield was revised in 2008 to an estimated 6.5 million gallons per day (MGD), reduced from earlier estimates.⁽⁵⁾ The yield was originally estimated as 15.4 MGD, with 12.9 MGD yield estimated after 40 years due to sedimentation. The reduced 2008 yield is related to loss of inflow into the lake. Since 1950 there has been a significant reduction to the flow volume gain between the Bunker Hill and Ellsworth gages. This loss has reduced the volume of inflow to Kanopolis Lake.

Wilson dam and lake was originally authorized for construction by the U.S. Department of Interior, Bureau of Reclamation (Bureau) for the purposes of irrigation, navigation enhancement, flood control, recreation, fish and wildlife habitat, and water quality assurance. The multipurpose (conservation) pool has an estimated current capacity of 227,701 acre feet. Due to the high salinity of waters in Wilson Lake; irrigation, municipal and industrial water use from the lake were determined impracticable and the construction and operation of the lake were transferred to the U.S. Army Corps of Engineers (Corps). While an authorized purpose of the project, navigation is no longer a specific consideration for the daily operations due to Wilson Lake's distance from the Missouri River.

Wilson Lake lies in the vicinity of the cities of Russell, Hays and others with anticipated water needs in the future. The possibility exists for reallocation of storage at Wilson Lake to supply water for municipal and industrial needs. Treatment techniques to address the salinity are available now at more reasonable costs, making water supply potentially practical. This water could prove crucial to assuring the long-term economic viability of the area.

Streams in the basin include approximately 3,832 perennial stream miles.⁽⁴⁾ Diversions totaling 241,950 acre feet are authorized from all surface water sources in the basin. Approximately 9,531 acre feet are authorized for public water supply from [surface](#) supplies.⁽³⁾ Minimum Desirable Streamflow (MDS), an amount of flow for instream uses and downstream water rights, has been set for one U.S. Geological Survey (USGS) gage on the Smoky Hill River near Ellsworth. MDS sets monthly flow targets at a gage that may vary by month. On average, streamflow has been insufficient to meet the MDS.

Ground water is found in alluvial [aquifers](#) along the major rivers and tributaries, supplying some water for beneficial uses in the basin. Ground water appropriations total 78,828 acre-feet in the basin.⁽³⁾ The High Plains aquifer provides water where the Ogallala Formation is present in the western part of the basin and from the Equus Beds aquifer in McPherson County. The USGS estimated water in storage in the High Plains aquifer to be about 3.25 billion acre-feet of drainable water in 1992, with ten percent of that in Kansas.⁽⁹⁾ The Dakota aquifer underlies most of the basin, with outcrops in Russell, Lincoln, Ellsworth and eastern Saline counties. There is great variability in aquifer yield and quality from the Dakota. The salinity of Dakota aquifer waters is one of the most important factors limiting current exploration in the confined aquifer. Water availability and economics have caused the City of Hays to develop and utilize slightly saline waters in the Dakota in west central Ellis County. The Dakota-Cedar Hills aquifer underlies portions of Ellis, Russell, Rooks, Osborne, Rush and Barton counties in the basin.⁽⁸⁾ The Flint Hills aquifer is found in the eastern end of the basin.

Availability of additional water appropriations is limited as all of the streams and alluvial corridors in the basin are either closed or restricted for new appropriations. The Ogallala-High Plains aquifer, in the western part of the basin, is closed in Western Kansas Groundwater Management District No. 1 (GMD1), but small ground water appropriations may be obtained in some locations in Northwest Kansas Groundwater Management District No. 4 (GMD4).

Public Water Supply

Appropriations for municipal use water rights from all sources in the Smoky Hill-Saline basin totaled 35,247 acre feet per year. Industrial water rights, not included as part of municipal water rights, totaled an additional 7,319 acre feet per year. Corresponding [water use reported](#) for 2006 was 18,901 and 1,687 acre feet per year for municipal and industrial uses respectively.⁽³⁾

Delivery of water supply in the central portion of the basin is interrelated and interconnected among suppliers. In 2006, there were 99 [public water suppliers](#) in the basin. In 2006, 721 acre-feet of water was marketed from Kanopolis Lake to Post Rock Rural Water District who in turn supplied 11 other suppliers as well as rural customers. Eleven other public water suppliers in the basin also sell water to 13 other public water suppliers.

Post Rock Rural Water District currently has a [contract](#) for a maximum quantity of 400 million gallons per year (MGY) or 1,227.555 acre feet from Kanopolis Lake. Post Rock currently serves retail customers and the cities of Brookville, Ellsworth, Dorrance, Gorham, Luray, Waldo, Paradise; the Wilson Lake Estates of Lincoln County

Development; and the rural water districts #5 of Ellis County, #7 of Saline County and #2 of Osborne County. In 2006, the City of Russell was added as a place of use in order to meet a shortage at that time. Post Rock is currently providing water to an ethanol plant in Russell.

Future Needs

The basin had an estimated [population](#) of 156,161 in 2000. The population of the 32 counties that are entirely or partially in the Smoky Hill-Saline basin was 330,631 in the year 2000 and is projected to be 288,939 in the year 2040. There are no population projections for the basin itself for 2040. Rural counties have lost population, sometimes more than 10 percent every decade. However the populations are expected to increase from 19,726 in 2006 to 35,455 in 2050 for Hays and 4,280 in 2006 to 6,631 for Russell in 2050, respectively.⁽²⁾ Additional water demands are occurring presently as energy and other industrial users are requesting water through public water suppliers or directly.⁽¹⁰⁾

Water supply demand projections for the central area of the basin have been estimated numerous times over the past decades. The most recent study completed in 2005, estimated a need for 7.0 million gallons maximum day net water need for the regional area including the cities of Hays and Russell and other public water suppliers. The average day net water need was estimated at 3.0 million gallons per day (MGD) for the year 2050.⁽¹⁾ This estimated need did not include McPherson, located outside the basin, and the additional water to meet energy industry demands that increased in 2006.

More recent estimates indicate total maximum demand of 18.4 MGD will be needed to provide Post Rock Rural Water District, Wilson, and the cities of Hays, Russell, Victoria, Sylvan Grove and Bunker Hill in the north central part of the basin by 2050.⁽²⁾ This is 7.5 MGD of maximum daily water demands above estimated available supplies in the central portion of the basin. This does not include the City of McPherson's request for 3.65 million gallons per year (MGY) (11,201 acre feet) from Kanopolis, or the needs of the cities of Salina and Lindsborg in the future. The City of Lindsborg filed an application in 1997 for 606.735 MGY (1,862 acre feet) from Kanopolis but has not pursued negotiations. The City of Salina's population in 2008 was 45,956, according to the Chamber of Commerce. KWO has projected Salina's population to be 58,790 by 2040, a 28% increase. Salina has not submitted an application for water from Kanopolis but is investigating options to meet future needs.

In 2006, KWO projected demand from 2010 to 2040 for potential additional customers of Post Rock Rural Water District as shown in Table 1.⁽⁷⁾

Although the estimated future water needs for public water supply (municipal and industrial uses) vary, all indicate a need for water in addition to that presently available through appropriation or water marketing. Not only does the quantity of water need to be addressed, but the distribution/transportation must be considered. Many [public water suppliers](#) in the basin are interconnected, either as a supplier or purchaser. These cooperative relationships are needed to provide water throughout the basin. Planning to most effectively meet projected needs throughout the basin is the present challenge.

Recommended Actions

1. Evaluate (quantity) water resources in the basin and compare with appropriations (supply and demand analysis).
2. Evaluate management of various hydrologic systems and resources in the basin that may provide opportunities for additional water uses.
3. Develop strategy for additional supplies. Options include:
 - a. Request federal reallocation of storage in Wilson Lake.
 - b. Purchase Wilson Lake storage for Water Marketing Program, if determined feasible.
 - c. Consider additional storage in Kanopolis Lake.
 - d. Explore opportunities for long-term reconfiguring of connections if storage in Wilson Lake is purchased.

4. Negotiate water marketing contracts based on available water.
5. Explore methods to reduce need for additional water supplies such as:
 - a. Evaluate opportunities to improve efficiency and conservation of existing municipal supplies to provide additional users with the savings.
 - b. Explore options for reuse/recycling of water to allow for additional water users without increasing consumptive use.
6. Continue to support local conservation efforts and programs such as in the City of Hays and WaterOne district in Johnson County.
7. Continue to promote water quality measures to protect sources of public water supply.

Resources

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Smoky Hill-Saline Basin High Priority Issue Lower Smoky Hill River Water Management January 2009

Issue

Efficient management of the Smoky Hill River System, Kanopolis Lake and downstream reservoirs for beneficial water uses is needed.

Efficient management of the resources related to Kanopolis Lake and the Smoky Hill River below the dam is needed to meet the water needs under varying climatic conditions. Review of the available supply, expected demands and potential management scenarios to meet water appropriations and water marketing goals has been initiated.

Comprehensive understanding and management of the system and water use are needed to balance the water releases from Kanopolis Lake and the additional demands for water in the basin. An approach is needed that will allow the use of storage to meet contemporary needs, yet respect the current commitments under contract, and appropriated rights.

Description

The Smoky Hill River runs the west-east extent of the [basin](#). Two federal reservoirs are located on the Smoky Hill River in the state, Cedar Bluff Reservoir in Trego County, operated by the U.S. Bureau of Reclamation (Bureau) and Kanopolis Lake, 100 miles downstream of Cedar Bluff, in Ellsworth County. Kanopolis Lake is operated by the U.S. Army Corps of Engineers (Corps).

Kanopolis Lake was initially authorized for flood control, irrigation and recreation purposes. Kanopolis Dam was completed in 1946 and the lake filled in 1948. The irrigation purpose of Kanopolis Lake was never developed due to the lack of an irrigation district downstream of the lake. Kanopolis Lake provides flood protection and storage of water for municipal and industrial use, along with fish, wildlife and recreation benefits. Storage capacity in the multipurpose pool (for municipal and industrial use) in the State Water Marketing Program is presently estimated at 22,607 acre feet. Kanopolis Lake was analyzed by the Kansas Water Office (KWO) to determine what water supply yield can be expected during a two percent chance drought. The yield was revised by KWO in 2008 to an estimated availability of 6.5 million gallons per day (MGD) in 2048, reduced from earlier estimates.⁽³⁾ The yield was originally estimated as 15.4 MGD, reduced to 12.9 MGD yield after 40 years due to storage loss from sedimentation. The most recently reduced yield is related to loss of inflow into the lake. Since 1950, there has been a significant reduction to the flow volume gain between the Bunker Hill and Ellsworth gages upstream of the lake. This loss has reduced the volume of inflow to Kanopolis Lake.

In June 2002, the Kansas Water Office (KWO) and the Corps finalized a contract for the purchase of 46.6% of the multipurpose pool. This is an estimated 12,500 acre-feet of public water supply storage in Kanopolis Lake after adjusting for sedimentation of 40 years.

Kanopolis is the major source of municipal and industrial water to over 12,000 customers in parts of eight counties in north central Kansas through Post Rock Rural Water District (Post Rock). Post Rock has a contract for 400 million gallons per year (MGY) to meet this demand. Post Rock is the only current public water supply using water from Kanopolis Lake, leaving 7.5 MGD yield based on present yield estimates.

Like all Corps lakes, Kanopolis has a lake regulation manual that contains operating guidance. Releases from storage are made according to set schedules, most of which were established decades ago. The conservation storage pool typically contains a percentage identified as the water quality pool. Releases from this pool are generally intended to meet instream needs such as water quality and fish and wildlife support.

Recent drought years have brought attention to the operation of Kanopolis Lake. Specifically of concern are the water releases and lake levels during times of little or no inflow, such as in 2006, and the needs of

downstream water users. In the 101 miles of river below Kanopolis Dam to the New Cambria gage, which is located east of the confluence of the Smoky Hill and Saline rivers, there are nearly 300 water rights for an authorized quantity totaling 43,123 acre feet per year from surface and alluvial ground water sources.⁽¹⁾ The larger portions of this quantity are appropriations for irrigation, and municipal and industrial use, including the City of Salina.

Table 1 and Figure 1 provide basic water appropriation and use information for the stream and ground water system below Kanopolis to the New Cambria gage.

Six active applications totaling 23.4 MGD are on file with the KWO, including one from Post Rock Rural Water District for water stored (26,259.656 acre feet) in Kanopolis. This amount exceeds Kanopolis Lake's 2009 uncommitted yield of 7.5 MDG (8,401 acre feet per year).⁽⁵⁾

In November 2006, the Kansas Water Authority (KWA) identified specific information needed before negotiating any additional [water marketing contracts](#) from storage in Kanopolis Lake. Work began in 2007 and is ongoing to meet the informational needs. These include:

- Stream/aquifer and reservoir models of the Smoky Hill River and Kanopolis Lake.
- Assessment of the impact of minimum releases, both in-lake and downstream.
- An updated yield of water marketing storage using data from 1948 through present.
- Determination of interest and needs of communities and rural water districts in the area.
- Determination of impact on the lake level with full water marketing use.

Recommended Actions

The compilation and evaluation of data related to the hydrologic system along with a comparison of the system water budget to supply needs are essential in determining actions. All of the recommended actions will be completed with input and awareness of stakeholders in the area.

1. Complete and maintain the hydrologic model of the Smoky Hill River valley. Use the model to understand the relationship between the alluvial aquifer, streamflow and reservoir releases.
2. Incorporate the updated Kanopolis Lake yield information in the aquifer model to better understand impacts on the reservoir and hydrologic system.
3. Determine the impact of full utilization of the Water Marketing Program supply on lake level and corresponding recreation and downstream uses.
4. Develop a basic supply and demand analysis using population and demand trends and reported water use. Compare to information developed in above models.
5. Identify options to meet water use needs in the area based on results of models and other pertinent data. This may include review of the Kanopolis Lake Regulation Manual as part of the river system operation.
6. Develop an action plan to address preferred options for management needs based on hydrologic analysis/water budget and considering economic impacts.

Resources

1. Kansas Department of Agriculture-Division of Water Resources. 2008. Water Right Database-Water Resource Information System (WRIS).
2. Kansas Geological Survey. 2008. Smoky Hill River model – under development.
3. Kansas Water Office. May 2008. *Kanopolis Water Supply Yield Analyses and Review of Reservoir Inflow Depletions*.

4. Kansas Water Office. 2006, November 16. *Preliminary Findings Request by Rural Water District No. 1, Ellsworth County, DBA Post Rock Rural Water Supply District to Purchase Water From Kanopolis Lake for Water Supply Purposes.*
5. Kansas Water Office. 2008. Surplus Water Available in Water Marketing Program Lakes Calendar Year 2009. p 21-22.