Lower Arkansas River Basin

January 2009

General Description

The Lower Arkansas River Basin in Kansas is part of the Arkansas River basin. The Arkansas River originates in central Colorado, where it flows southeast into and across southern Kansas. The Arkansas River crosses the Kansas-Oklahoma border south of Arkansas City (Cowley County). The Arkansas basin in Kansas is divided into two basins, Upper and Lower, for planning purposes. The Lower Arkansas basin begins where Rattlesnake Creek confluences with the Arkansas River in southwestern Rice County. Major tributaries entering the river along its course through the basin are Rattlesnake Creek, Cow Creek, Little Arkansas River, Ninnescah River and Slate Creek. Other major streams in the basin that flow within Kansas and join the Arkansas River in Oklahoma are the Chikaskia River, Medicine Lodge River and Salt Fork. The only major federal reservoir in the basin is Cheney Reservoir. The Lower Arkansas basin covers 11,500 square miles of south central Kansas and includes all or part of 20 counties.

Population and Economy

The basin has the second largest population of the twelve major river basins, with an estimated 641,000 residents in the year 2000.(1) According to projections conducted using Kansas Division of Budget population data, the population in the 20 counties included as a whole or in part in the basin, is projected to grow to nearly 887,450 in the year 2040.(2) Nearly all of this growth will be in Sedgwick and the surrounding counties. Major population centers include Wichita, Newton, Hutchinson, Wellington and McPherson.

This basin illustrates major demographic changes taking place in Kansas. In the past 40 years, two trends have dominated the state and the Lower Arkansas basin. Rural counties have lost population, sometimes more than 10 percent every decade. Urban counties, particularly in the greater Wichita area, are gaining population at an even greater rate. Two examples demonstrate these trends. Barber County, which had a population of 8,713 in 1960, had a population of 5,307 in 2000. Sedgwick County, which had a population of 343,321 in 1960, had a population of 452,869 in 2000.

The general economy of the basin is diversified with farming throughout the area and industrial activity most heavily concentrated in the Wichita-Newton-Hutchinson vicinity. Corn, wheat and livestock are the principal agricultural products.(3)

Many kinds of industries are represented in the basin, with the aircraft and oil and gas industries being of major importance. The salt mines of the state are located largely in this basin. There is a sizable gypsum production facility west of Medicine Lodge. There is one oil refinery located in the basin in McPherson.

Wichita State University, and the Hutchinson and Pratt County Community Colleges offer opportunities for higher education.

Recreation is an increasingly significant part of the economics of the basin, as is industry. The state parks and associated recreation and wildlife areas draw hunters to the area. There is one multipurpose small lake, Wellington Lake in Sumner County, located in the basin.

The growing industrial contribution to the basin economy is primarily related to energy production, including ethanol. As of November 2008, three ethanol plants are located in the basin in Pratt (now idle), Sedgwick and Rice counties. An additional ethanol plant is under construction in Sedgwick County. Two biodiesel plants have been permitted for construction in Stafford and Kiowa Counties, and one is under construction in Sedgwick County.

Physical Characteristics

Geology and Soils

The subsurface formations within the Lower Arkansas basin include three major systems; from oldest to youngest: Permian, Cretaceous, and Quaternary. The formations in the Permian system are relatively poor sources of ground water in terms of quantity and quality. The same is true of the formations in the Cretaceous system, except in the northern part of the Lower Arkansas River valley where the Dakota Formation is a principal source of water supplies.

The sands and gravels of the Quaternary system are a good source of ground water in the basin.

The topography in the basin varies from flat, undulating plains of slight relief to rolling uplands and, in places, steep bluffs and hills. Elevation ranges from about 1700 feet to about 1100 feet. Sandy soils and sand dunes are prevalent, mostly in the river valleys, but fine textured soils, tight clays and many other soil types are also represented.

Land Use/Land Cover

Land use in the basin typically is dominated by cropland (55.8%) or grassland (32.5%) and Conservation Reserve Program land (5.5%). The remaining land cover is forest or woody (2.4%) and industrial use, municipal use, open water and barren ground.

The Lower Arkansas basin contains 49,108 stream bank miles. Within a 100-foot corridor along each bank, about 36% of the land is pasture/grassland followed by crop/tree mix (35%), cropland (34%), pasture/tree mix (13%) and forest land (11%). While comprising less than 1% of the bank miles, the Lower Arkansas basin has the most urban land stream bank area of the Kansas basins.[4]

Climate

The climate of the Lower Arkansas basin is classified as subhumid with moderate precipitation. The average annual temperature for the basin is about 57 degrees Fahrenheit, but temperatures fluctuate considerably within a year. The weather in this part of the state is subject to frequent and abrupt change.

Temperatures tend to increase mildly from west to east across the basin in response to declining elevations. At Greensburg, the average annual temperature is 54.3° F while at Wichita it is 56.4° F. Precipitation and the frost free period shows a similar west-to-east pattern (See table below).

Wildlife and Habitat

The Lower Arkansas River basin is comprised primarily of four physiographic regions: High Plains, Red Hills, Arkansas River Lowlands and Wellington-McPherson Lowlands. Native vegetation in these regions ranges from mixed grass and sandsage prairie grasses to floodplain woodlands species such as cottonwood and black willow.

Numerous threatened and endangered species occur in the Lower Arkansas basin. Of these, ten are birds, two are mammals, three are reptiles, one is an amphibian and six are fish.

Water Resources

Ground water, which is very shallow in some places, i.e. the Equus Beds aquifer, is the source for 92 percent of supply for all reported uses in 2006. Irrigation accounted for nearly 75% of all reported water pumped or diverted. Municipal use accounted for 15% of water used in the basin; industry for five percent; and recreation, stockwater and other uses combined equal about five percent (2006).[5]

The Lower Arkansas basin contains 20,974 miles of intermittent and 2,592 miles of perennial streams for a total of 23,566 stream miles. The basin has a density of 2.1 stream miles per square mile.

Streamflows in the Lower Arkansas basin are highly variable within the year, and from one year to another. The major sources of surface water are Cheney Reservoir on the North Fork of the Ninnescah River in Reno County, and Wellington Lake in Sumner County, which drains into the Chikaskia River.

Water Management

There are two Groundwater Management Districts (GMDs) in the Lower Arkansas basin which cover most of the area. The Equus Beds GMD2 was formed in 1975 and operates under a "safe yield concept" in which appropriations are managed so that the quantity of ground water withdrawn from a given area is approximately equal to the average annual recharge to the same area. Big Bend GMD #5, in the northwestern part of the basin, was formed in 1976 and also operates under a safe yield policy.

There are two Intensive Ground Water Use Control Areas (IGUCAs) within GMD2: the McPherson Area IGUCA, and a 36 square mile area surrounding the town of Burrton in Harvey County. Each IGUCA is managed with programs and activities for the particular needs of that area. There are two IGUCAs in GMD5: the eastern portion of the Wet Walnut IGUCA, and the Pawnee IGUCA in Pawnee County.

Seven watershed districts are included in the Lower Arkansas basin: Upper Little Arkansas, Sand Creek, Mount Hope, Andale, Goose Creek, Spring Creek and Clear Creek.

The county conservation district is the primary local unit of government responsible for the conservation of soil, water and related natural resources within the county boundary. Each county within the Lower Arkansas River basin has a county conservation district. Three Resource Conservation and Development (RC&D) districts serve the counties of the Lower Arkansas basin: the Sunflower RC&D, Flint Hills RC&D and Central Prairie RC&D. The RC&Ds are designed to help community leaders develop rural economies by improving and conserving local natural, human and economic resources.[6]

Cheyenne Bottoms/Quivira National Wildlife Refuge

Cheyenne Bottoms is a wetland of international importance located north of Great Bend in Barton County. It was designated as such by the Ramsar Convention in 2000. The wetland encompasses approximately 41,000 acres that includes 19,857 acres as a wildlife area. This wildlife area is recognized as an important migration point for shorebirds in North America. Past studies reflect almost half of the North America shorebirds migrate through the Bottoms. It is designated critical habitat for endangered species such as the Whooping Crane, Least Tern, Peregrine Falcon and numerous others. The Cheyenne Bottoms is owned by the State of Kansas and is managed by the Department of Wildlife and Parks.

Formed thousands of years ago, the wetland's natural depression has a drainage area of approximately 254 square miles including drainage from Blood and Deception Creeks. Availability of water plays a major role in productivity at the wetland.

The wildlife refuge also receives surface water from the Arkansas River through a canal system. Through the years, the availability of surface water in the Arkansas River has been reduced due to human activities in the upper reaches of the river above the wetland's diversion point.

Cheyenne Bottoms Wildlife Area receives, on average, more than 50,000 visitors each year. Estimated total number of visitors and hunters on opening day of the regular duck season increased steadily from 1996 to 2001. Numbers were down during the drought of 2002-2003; however, 2004 had a rebound in hunters. Crane and duck presence at the Bottoms has been constant to slightly increasing since 1986. Geese populations have increased significantly with the largest peak occurring in 2002.

Quivira National Wildlife Refuge, 20 miles from Cheyenne Bottoms, is also recognized as a wetland of international importance recognized by the Ramsar Convention in 2001. Quivira contains 22,135 acres of

prairie grass, salt water marshes, sand dunes, canals, dikes and timber. During spring migration, Quivira is a staging area for over 500,000 birds. Quivira and Cheyenne Bottoms are joined by a National Scenic Byway, also know as the Wetland and Wildlife Scenic Byway.

Resources

1. US Census data, 2000

2. Kansas Division of Budget 2007. County population estimates.

3. USDA, Kansas 2006-2007 County Farm Facts, Agricultural Statistics and Ranking.

4. Wilson, Brownie, State of Kansas, 2003. Assessment of Riparian Areas Inventory.

5. Water Right Information System (WRIS) database, Division of Water Resources, December 13, 2007.

6. USDA Natural Resources Conservation Services, Resource Conservation and Development Information. http://www.ks.nrcs.usda.gov/partnerships/rcd/

7. Kansas Water Office, Kansas Water Authority, Lower Arkansas Basin Water Quality Management Category, *Kansas Water Plan.*

8. Kansas Water Resources Board Water Plan Studies Lower Arkansas Unit June 1962.

Lower Arkansas River Basin Management Categories

WATER MANAGEMENT CATEGORIES

The following categories include issues identified in the Lower Arkansas 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
- 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

Ground water recharge rates are variable throughout the basin, with both the Big Bend Prairie and Equus Beds aquifer areas managed under a safe yield policy. A majority of the basin is restricted or closed for new water appropriations. The basin is managed for sustainability, with the local leadership of Equus Bed Groundwater Management District No. 2 (GMD2), Big Bend Groundwater Management District No. 5 (GMD5) and the Kansas Department of Agriculture-Division of Water Resources.

Minimum desirable streamflow (MDS) levels have been set for 11 sites in the basin. According to an assessment conducted by the Kansas Water Office (KWO) in 2006, five MDS gages in the basin have shown improvement in the annual frequency, magnitude or duration of meeting minimum desirable streamflow.

Two Intensive Groundwater Use Control Areas (IGUCAs), Burrton and McPherson, have been initiated in the basin by GMD2. In 2006, the KWO calculated the median annual water level changes in wells from 1981 to 2005 for GMD2 and GMD5. The data assembled indicates that sustainable ground water yield has not yet been attained in GMD2 and GMD5.

Intensive management focus has been placed on the Rattlesnake Creek sub-basin over the last several years. Under the U.S. Department of Agriculture, Natural Resources Conservation Service's Environmental Quality Incentives Program (EQIP), grants have been offered to irrigators in the Rattlesnake Creek subbasin "quick response area" to transition to dryland farming or other non-irrigated use. Non-use of the irrigation water right must be for a minimum of four years. The Rattlesnake Creek is also an eligible area for state purchase and retirement of irrigation water rights through the Water Right Transition Assistance Program.

Applicable *Kansas Water Plan* Objectives

- Reduce water level decline rates within the 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 Department of Agriculture-Division of Water Program
- Kansas Geological Survey, Kansas Department of Agriculture, Division of Water Resources: Water Well Measurement
- Kansas Water Office: State Water Planning Program
- State Conservation Commission: Water Right Transition Assistance Program
- USDA-Natural Resources Conservation Service: Environmental Quality Incentive Program (EQIP)
- Kansas Geological Survey: High Plains Aquifer Technical Assistance 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 by Webster's Dictionary 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, etc., and from all sources. Irrigation accounted for nearly 75% of all reported water pumped or diverted in the basin. Municipal use accounted for 15% of water used in the basin (2006).

Of the 614 public water suppliers in Kansas that had an approved conservation plan in place as of December 31, 2008, 81 plans were for suppliers in the Lower Arkansas basin. One hundred and eighty four conservation plans have been approved for irrigation water rights. The number of diversion points in central Kansas, including the Lower Arkansas basin, that reported irrigation application rates over the regional average decreased for the period from 1991 to 2005. In the 2006 water use report, 85% of the points of diversion in the Lower Arkansas basin that pumped water were metered.

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
- State Conservation Commission: Water Resources Cost-Share Program
- Kansas Water Office: Water Conservation Program
- 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.

There are 118 public water suppliers in the basin, including 28 rural water districts. There are currently four public wholesale water supply districts in the basin. Ground water is the primary source for most public water supplies, accounting for over 90% of the total supply. The two major sources of ground water are the Equus Beds aquifer in Harvey, McPherson, eastern Reno and northern Sedgwick counties, and the Great Bend Prairie aquifer, predominately underlying Pratt, Stafford, southern Barton, Edwards, Kiowa and Reno counties. Streamflows in the basin are highly variable within the year and from one year to another and so generally are not used as sources of public water supply. Cheney Reservoir, located on the North Fork of the Ninnescah River in Reno, Kingman and Sedgwick counties, supplies a portion of the water supply for the City of Wichita. Wellington Lake serves as a surface water supply for the City of Wellington.

Coping with drought presents a challenge for public water suppliers. During drought periods, the amount of raw water available typically is reduced at the same time customer demand for water increases. While all suppliers may be potentially impacted, some are particularly vulnerable. Of the public water suppliers in the basin, 13 (10%) were considered drought vulnerable in 2006.

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 Water Office: State Water Planning Program
- Kansas Water Office: Water Conservation Program
- Kansas Department of Health and Environment: Capacity Development 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 programs (see Watershed Restoration and Protection Basin Priority Issue).

All the counties within the basin with the recent addition of Comanche County have developed sanitary/environmental codes, and have a sanitarian funded by the Local Environmental Protection Program (LEPP). Counties in the basin that have countywide planning and zoning programs include Barton, Ford, Harper, Harvey, Kingman, Marion, McPherson, Pawnee, Reno, Rice, and Sumner. All conservation districts in the basin have adopted nonpoint source pollution management plans. Buffer coordinators have also been employed in nine counties in the basin to facilitate enrollment of stream buffers in the continuous Conservation Reserve Program (CRP) and State Water Quality Buffer Initiative. Several entities and municipalities in association with the Wichita urban area are included in the Phase I and Phase II National Pollutant Discharge

Elimination System (NPDES) Stormwater Program. There are seven organized watershed districts in the basin.

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 Watershed Restoration Protection Strategy (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 Corporation Commission: Conservation Division Programs
- Kansas Department of Health and Environment: Local Environmental Protection Program
- Kansas Department of Health and Environment: Watershed Management Program
- State Conservation Commission: Nonpoint Source Pollution Control Program
- State Conservation Commission: Water Resources Cost-Share Program

ISSUE: FLOOD MANAGEMENT

Kansas Water Plan flood management guidance has emphasized targeting watershed dam construction assistance to priority watersheds encouraging participation in the National Flood Insurance Program and preparing updated floodplain maps for priority communities.

In 1993, the Kansas Department of Agriculture-Division of Water Resources launched the *Kansas Flood Mapping Initiative.* The FY 2005 *Kansas Water Plan* Flood Management Policy Section update identifies Sumner, Sedgwick, McPherson, and Barton counties to be mapped, remapped or to have existing information digitized in the Lower Arkansas basin. Financial assistance from the *State Water Plan Fund* has been provided for this mapping.

There is growing national concern that many small flood control dams that were built by local watershed districts with U.S. Department of Agriculture technical and financial assistance are at or near the end of their 50-year planned design life. Watershed Rehabilitation Amendments to the Watershed Protection and Flood Prevention Act of 1954 (PL 83-566) were enacted in 2000. These amendments authorize the USDA Natural Resources Conservation Service (NRCS), to work with local communities and watershed project sponsors to address the public health and safety concerns and potential adverse environmental impacts of aging dams.

Only dams that were constructed through USDA assisted water resource programs or authorizations qualify for rehabilitation assistance. Rehabilitation projects must be cost shared between the federal government and local project sponsors. The NRCS may provide up to 65% of the total cost of the rehabilitation project. To date, the NRCS has received one application for dam rehabilitation planning in Kansas. This request was for the Sand Creek Site #2 in Harvey County. There is about a 3-year project implementation time period.

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
- FEMA: National Flood Insurance Program
- State Conservation Commission: Watershed Dam Construction Program
- State Conservation Commission: Watershed Planning Assistance Program

ISSUE: WATER BASED RECREATION

Even though the Lower Arkansas basin has a wide variety and fairly high number of public water recreation sites proportional to the area covered, there is a demand for more water based recreation facilities to meet the needs of a comparatively large population.

The Arkansas River is one of the three streams in the state that are considered navigable as determined at time of statehood, and as such the land is considered public up to the channel's high water mark. Cheney Reservoir and State Park offer recreational opportunities including fishing, sailing, hunting and camping. The approach to enhancing opportunities for recreation is to improve access to water bodies in the basin.

Applicable *Kansas Water Plan* Objective

- 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: Walk In Hunting Access Program
- Kansas Department of Wildlife and Parks: Fishing Impoundments and Stream Habitats Program/Walk-in Fishing

ISSUE: WETLAND AND 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 resources in priority watersheds through the implementation of best management practices. Wetland and riparian management is addressed as a basin priority issue in the Lower Arkansas basin (see Watershed Restoration and Protection Basin Priority Issue). Cheyenne Bottoms and Quivira National Wildlife Refuge are designated wetlands of international importance that provide excellent birding, photography and hunting opportunities. In 2008, construction began on a Wetland Interpretive Center at Cheyenne Bottoms to expand public awareness of the Bottoms and the nearby Quivira wetland complex.

Riparian lands along the Arkansas River have been seriously impacted by the infestation of non-native phreatophytes. Of greatest concern are the effects tamarisk (salt cedar) and Russian olive are having on the basin's native riparian ecosystems.

Applicable *Kansas Water Plan* Objective

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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

Lower Arkansas River Basin High Priority Issue
Bioenergy and Water
January 2009

Issue

Renewable fuel production is a growing issue in the Lower Arkansas basin, where increased biofuel production provides economic opportunity. As new biofuel facilities are sited and changes are made to the basin's cropping patterns, more evaluation is needed of the impacts from the increased demand on both water supply and water quality.

Description

Gas and oil production is the second largest industry in Kansas and is very important to the Lower Arkansas basin's economy. The growing industrial contribution to the basin's economy is also related to bioenergy production, primarily ethanol. As of December 2008 (Figure 1), three ethanol plants are located in the basin in Pratt (idled), Sedgwick and Rice counties. An additional ethanol plant is under construction in Sedgwick county. Two biodiesel plants are permitted for construction in Kiowa and Stafford counties and one is under construction Sedgwick County.

Water Quantity

Ethanol production, like many industrial and agricultural practices, involves a consumptive use of water. A 50-million gallon per year (MGY) ethanol plant uses about 200 MGY of water (or about 550,000 gallons per day), primarily from evaporation during cooling and wastewater discharge. Ethanol production technology uses water more efficiently; plants today use about 50% less water than 10 to 15 years ago. It currently takes roughly three to four gallons of water to produce one gallon of ethanol. Under Kansas law for appropriating water, ethanol plants, as any industry, must purchase water from a rural water district or municipality or acquire a water right.

Parts of the basin are closed to new water appropriations; in closed areas, any new venture must purchase an existing water right, and any change in use of that appropriation must be approved by the Chief Engineer of the Division of Water Resources to ensure that the net consumptive use does not increase. Nonetheless, some people have raised concerns that increased corn production, a water-intensive crop, for ethanol may cause additional declines over time.[2, 3]

Most U.S. ethanol is made from corn, but it can also be produced from other feedstocks such as grain sorghum, wheat, barley or potatoes. In Kansas, more than half of the ethanol produced comes from grain sorghum, with most facilities using corn and sorghum interchangeably.[2] This new demand for corn, and the new opportunities for value-added processing and distiller's grains for cattle feed in rural communities, has created a significant economic development opportunity in Kansas and throughout the Lower Arkansas basin. However, the potential changes to the basin's cropping patterns, specifically increasing the number of irrigated corn acres, may negatively impact the aquifer and stream conditions.

According to the U.S. Department of Agriculture, National Agricultural Statistics Service (NASS), the number of irrigated corn acres in southwest Kansas grew from 195,000 acres in 1990 to 296,000 in 2007. Improved agronomic practices and crop genetics have led to higher corn yields. In south central Kansas, while there was a 26% increase in irrigated corn acres from 1993 to 2003, there was a 67% increase in irrigated corn production.[10] Recent years reflect the highest recorded irrigated corn acres for this region (Figure 2).[6] In 2006, approximately 16% of Kansas corn and sorghum crops were used for ethanol production, up 13% from 2000. Corn production in Kansas may be slowing down. According to NASS, producers intended to plant eight percent fewer corn acres in 2008, as a result of multiple factors including crop rotation considerations and high input costs. In 2008, Kansas was expected to plant their largest soybean crops in history.[5]

Water Quality

Wastewater from ethanol plants is regulated by the Kansas Department of Health and Environment (KDHE), which administers both the federal National Pollution Discharge Elimination System (NPDES) permits and Kansas Water Pollution Control permits. In most instances, KDHE issues the state-level permit, which requires ethanol plants to use the wastewater for beneficial land applications rather than simply discharging into streams and rivers.

A rise in the number of corn acres may also impact the basin's water quality through increased fertilizer application and soil erosion. Corn has the greatest application rates of both fertilizer and pesticides per acre, higher than for soybeans and mixed-species grassland biomass. The switch from other crops or noncrop plants to corn may lead to higher application rates of highly soluble nitrogen. Harvested row crops, such as corn, have a higher potential for soil erosion than grasses or perennial crops. The potential water quality impact of an increased demand for corn may be mitigated through Best Management Practices (BMPs), especially those addressing soil erosion and herbicide applications.

The restoration of watersheds with impaired water quality and the protection of watersheds above public water supply reservoirs and ground water sources used for drinking water supplies are also a high priority issue in the Lower Arkansas Basin.

Biodiesel

Biodiesel is produced using oils extracted from crops, animal fat or waste vegetable oil using a chemical process called transesterification. Most U.S. biodiesel is produced from soybean oil, although other vegetable oils such as canola, corn, cottonseed, flax seed, sunflower, or peanut oil can be used. As of December 2008, two biodiesel facilities, are permitted for the Lower Arkansas basin; one in St. John and one in Greensburg (Figure 1).

Biodiesel production uses roughly three gallons of water per gallon of fuel, about a gallon of which is consumptive use. Wastewater from biodiesel plants, which may contain high amounts of oxygen, grease and oils, is regulated by the Kansas Department of Health and Environment (KDHE).

Cellulosic Ethanol

Cellulosic ethanol uses lignocellulose, the main structural material in any plant, as a feedstock. Cellulosic feedstocks require an extra step to break down the lignocellulose into fermentable starch, thus increasing production costs. The bulkier cellulosic feedstocks are also more costly to harvest, transport and store. Processing of cellulosic materials would require more water than corn, perhaps twice as much, as the feedstock is dry. Research on cellulosic feedstocks such as switchgrass, wood chips and corn stover is ongoing. The U.S. Department of Energy (DOE) has set 2012 as a target to achieve technological advances to make cellulosic ethanol cost competitive with corn ethanol. While not located in the Lower Arkansas basin, in 2007, Abengoa Bioenergy, a Spanish energy company, announced that Hugoton, Kansas would be the site of the nation's first cellulosic ethanol plant. In conjunction with cellulosic ethanol research, some researchers are investigating the use of perennial polyculture crop systems for cellulosic feedstocks.

Production of cellulosic ethanol may have greater positive environmental impacts than grain-based ethanol such as reduced greenhouse gas emissions, decreased fertilizer application, and less reliance on water intensive crops.

Corn Research and Varieties

Breeding of corn hybrids that maximize yield for ethanol production while reducing additional strains on water supplies has been a focus of much research by universities and corn breeding companies. Drought tolerant hybrids, specifically transgenic drought resistant corn, are especially important in areas of western Kansas where rainfall averages fewer than 16 inches per year. In addition to drought tolerant varieties, industries are identifying corn varieties that produce higher yield and more ethanol per acre. High total fermentable ethanol

corn hybrids provide higher levels of fermentable starch, consisting of the sum of all starches and simple sugars that ferment during the typical dry grind process.[4,7]

Recommended Actions

1. Coordinate, where applicable, the development, implementation and public input process between the *Kansas Water Plan* and Kansas energy policy.

2. Maintain regulatory oversight by state and local government on the siting of ethanol and biodiesel plants, with special emphasis on water supply availability.

3. Look for increased water recycling opportunities within the biofuel facilities.

4. Promote research for less water-dependent corn varieties and improved irrigation scheduling that maintains or increases crop yield without increasing water use.

5. Promote research and pilot projects for viable, commercial cellulosic ethanol production and other biofuels that are less dependent on water intensive crop production.

6. Increase corn water use efficiency (amount of grain produced per inch of water) through research and extension efforts. Educational emphasis should be placed on utilization of irrigation scheduling tools such as KanSched and the Mobile Irrigation Lab (MIL).

7. Evaluate the biofuel facility watershed and watersheds of input crops to identify potentially environmentally sensitive areas. Target programs such as stream buffers, grass filters, BMPs, etc., to mitigate environmental impacts.

8. Provide education and/or incentives to landowners of marginal lands that have expiring Conservation Reserve Program contracts that can not be renewed to stay in a conservation planting with special consideration to acres that could return to irrigation. If coming out of CRP, encourage landowners to explore all options for conservation.

Resources

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Lower Arkansas River Basin High Priority Issue
The Role of Reuse in Water Conservation
January 2009

Issue

The State of Kansas should identify opportunities to better utilize reclaimed water as a valuable water resource.

Description

Many states have been remarkably successful in moving toward water reuse as a means for managing domestic wastewater, conserving water and managing water resources. Several states including Texas (10-16%), Arizona (20%) and California (50%) project that a significant portion of the future water supplies will come from wastewater reuse.[3]

Reclaimed water may play a significant role in water supply in Kansas. The State of Kansas should identify strategies for implementation of an institutional and regulatory framework to better utilize reclaimed water as a valuable water resource that should be used efficiently and effectively.

Water reuse should be considered an important component of both wastewater management and water resource management in the Lower Arkansas basin. Reuse offers an environmentally sound means for managing wastewater that dramatically reduces environmental impacts associated with discharge of wastewater effluent to surface waters. In addition, use of reclaimed water provides an alternative water supply for many activities that do not require potable quality water, such as irrigation, cooling water reuse, and toilet flushing, which serves to conserve available supplies of potable quality water. Finally, some types of reuse offer the ability to recharge and augment available water supplies with high quality reclaimed water.

Water Use in the Basin

In 2006, over 700,000 acre feet of water was reported used in the Lower Arkansas basin. Irrigation accounted for nearly 75 percent of all reported water pumped or diverted. Municipal use accounted for 15 percent of water used in the basin, industry for five percent and recreation, stockwater, and other uses combined equal about 5 percent[7]. According to projections conducted using Kansas Division of Budget population data, the basin population is projected to grow more than 38% by the year 2040. Projected future water supplies in the basin may not be adequate to meet the projected demands. Water reuse may provide an alternative supply while conserving current and future supplies to better serve the projected demands.

Current Regulatory Authority

The Kansas Department of Health and Environment (KDHE), Bureau of Water administers programs related to public water supplies, wastewater treatment systems, the treatment and disposal of sewage and nonpoint sources of pollution. Programs are designed to provide safe drinking water, prevent water pollution and assure compliance with state and federal laws and regulations such as the federal Clean Water Act and Safe Drinking Water Act.

State Water Quality Standards include provisions for alternative disposal of treated wastewater and residue material resulting from the waste treatment process.[8] KDHE's minimum standards for the design of water pollution control facilities include guidelines for agricultural application of wastewater and sludge. Reuse of treated wastewater may contribute to water conservation within the basin.

In the 2008 Kansas Legislature, a bill was introduced that would authorize the Biological Survey at the University of Kansas to conduct a survey that examines the potential to treat non-potable waters for productive reuse.[5] The Kansas Water Authority, the Kansas Water Office, the Kansas Corporation Commission and the Kansas Geological Survey would collaborate with the Biological Survey to produce a report of the survey

findings. The report would also identify potential amounts of water that can be productively treated, cost-estimates for the treatment, potential locations of these treatable waters; identify water discharged from municipal and industrial processes and the potential for productive reuse of such waters; and any policy recommendations to the Governor and the Legislature. The bill was introduced and referred to the Committee on Energy and Utilities, but received no further action in 2008.

Examples of Reuse in Kansas

In Kansas, there are more than 140 communities and facilities that are authorized to reuse treated wastewater. The reuse of wastewater for applications like irrigating turf on golf courses and parks allows these communities to reserve potable water for residential use.

The City of Colby treats more than 2 million gallons of wastewater annually. Through their mechanical treatment process, the city reuses some of the water for irrigation of crops that are not for human consumption. The City of Hays also reuses a portion of its wastewater to irrigate golf courses, parks and ball fields.

In the Lower Arkansas basin, a total of 11 communities and commercial facilities are authorized to reuse treated wastewater (Figure 1). One commercial facility, located in Kingman, is authorized to utilize the wastewater effluent for the irrigation of grass and/or agricultural areas. As a condition of the permit, this facility must control tailwater to prevent runoff to surface waters, must only draw water from the final cell in the treatment process and must not irrigate crops for direct human consumption. Two industrial facilities, located in Colwich and Hutchinson, are authorized to use wastewater effluent for irrigation. Eight municipalities, including Hutchinson (four permits), Newton, Park City, Wellington and Winfield, are authorized to use the wastewater effluent for the irrigation of golf courses and other public use areas such as parks, ball fields and cemeteries.[1]

Opportunities for Reuse

Renewable fuel production is a growing industry in the Lower Arkansas basin. Ethanol production, like many industrial and agricultural practices, involves a consumptive use of water. A 50-million gallon per year (MGY) ethanol plant uses about 200 MGY of water (or about 550,000 gallons per day), primarily from evaporation during cooling and wastewater discharge. As new facilities are sited and current facilities are improved, ethanol production in the basin presents an opportunity for industrial water reuse.

Irrigation accounts for nearly 75% of all reported water pumped or diverted in the basin.[7] Reclaiming water for irrigation of agricultural land could have a significant impact on water use in this region. As in Colby, most current examples of reuse for irrigation in Kansas are for the application to crops that are not for human consumption. Some other states such as Florida promote water reuse for edible crop irrigation. In 2001, a total of 34 million gallons per day was reused to irrigate edible crops such as citrus, tomatoes, cabbage, peppers and beans in Florida.

Artificially recharging the Equus Beds aquifer, which underlies the City of Wichita well field, is one water reuse alternative being employed to meet future demands for water for the city and other users in the area. An additional benefit of artificial recharge includes creating a hydraulic high in the ground water, thus blocking migration of saltwater plumes from the Burrton oil field to the northwest into the aquifer region of the city well field. Diverting water from the Little Arkansas River through streambank storage (diversion) wells when flow in the river exceeds base flow and then artificially recharging water into the Equus Beds aquifer through injection wells and recharge basins is an example of a successful water reuse strategy. The water is treated to drinking water standards prior to recharge at the Segdwick site. In 2007, over 350 million gallons were recharged into the aquifer through this project.

Parks, golf courses and other recreational facilities also hold an opportunity to utilize wastewater reuse. More than 24 communities in the basin have at least one golf course. Maintaining green turf for golf courses requires significant quantities of water. Average water use for those facilities with an irrigation water right for golf course turf in 2006 was about 47 acre feet per year. Some facilities, typically those larger than 150 acres, reported more than 200 acre feet of water use in 2006.[7]

South central Kansas is an area where communities rely on ground water from the High Plains, Arkansas River alluvial and Permian bedrock aquifers for domestic, municipal, agricultural and industrial uses. However, substantial areas of these aquifers contain brackish ground water which appreciably limits the locations and quantities of freshwater resources that can be withdrawn. A characterization of the quantities of high quality ground water available, and the suitability for various treatment schemes for brackish water, is needed. This may a region of future water shortages.

Barriers to Reuse

Protection of human health is the primary concern when developing and implementing a wastewater reuse program. KDHE identifies several standard management practices for reuse of treated domestic wastewater for instances when the wastewater will be applied to public areas such as golf courses or parks. Typical protective practices include an increased degree of disinfection, only applying the treated wastewater when public access is restricted and posting signs warning against swimming in or drinking ponded wastewater. Irrigation of crops produced for direct human consumption is not permitted by KDHE. Monitoring of the treated wastewater is required using Environmental Protection Agency (EPA) approved methods and KDHE certified laboratories if applicable.

Community involvement and public education is an important component in developing large scale wastewater reuse projects in the basin. In some states, public perception of utilizing reclaimed water to augment potable water sources, even in an indirect manner, has prevented some projects from implementation.

A portion of water diverted for all beneficial uses is considered “non-consumptive” when it is returned to the natural system through streamflow or ground water recharge. Consideration of the potential impacts of water reuse to downstream users is needed to ensure local water conservation activities do not negatively impact larger regional conditions. Under the rules and regulations of the Kansas Water Appropriation Act, the extent of consumptive use can not increase after a water right has been perfected.[(9)]

Water reuse and the associated change in water returned to the natural system may impact instream habitat. Numerous threatened and endangered species including six fish, occur in the Lower Arkansas basin. Consideration of the potential impacts to instream habitat and species viability is needed to ensure that water conservation measures do not negatively impact instream use.

Salt accumulation may be a factor when evaluating the potential for water reuse, especially on golf courses and in agricultural irrigation. Water softening and other activities can add substantial amounts of sodium chloride to the wastewater. Typical wastewater treatment processes in use today often do not remove or manage inorganic salts. Facilities choosing to irrigate with treated wastewater may need to alter plant species selections or use other methods to address total dissolved solids, sodium and salinity in effluent.

The use and disposal of pharmaceuticals and personal care products entering sewer systems and surface water is an emerging concern for wastewater treatment. Wastewater treatment plants are designed to remove biodegradable compounds, but they are not designed to remove low concentrations of synthetic pollutants, such as pharmaceuticals.[(2)] Depending on the purpose and application of treated wastewater, the affect and mitigation of these contaminants needs to be considered.

Recommended Actions

1. Provide public education on water reuse in irrigation, industry, municipal and domestic uses, and encourage communities to build in water reuse as part of their plans to meet future demand.

2. Where appropriate, establish the promotion and encouragement of water conservation and reuse as formal basin specific objectives for the Lower Arkansas basin.

3. Facilitate storage of seasonal reclaimed water from streamflow (including aquifer storage and recovery).

4. Facilitate interagency coordination between Kansas Department of Agriculture-Division of Water

Resources and Kansas Department of Wildlife and Parks to ensure water reuse activities and permits remain in compliance with Kansas Water Appropriation rules and regulations and stream habitat issues are discussed.

5. KDHE evaluate the potential impact of water reuse on downstream users and stream habitat.

6. Encourage use of reclaimed water in lieu of other water sources in the agricultural irrigation, landscape irrigation, industrial/commercial/institutional and indoor water use sectors.

7. Link reuse to regional water supply planning including integrated water resource planning.

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Lower Arkansas River Basin High Priority Issue
Long Term Public Water Supply
January 2009

Issue

Projected sources of water supply are insufficient to meet projected demands in some areas of the Lower Arkansas River basin. Artificially recharging and conserving the existing supplies of the Equus Beds aquifer should be considered to meet future demands for water for Wichita and other users in the area, as well as to prevent degradation of the water quality of the aquifer by saltwater plumes. Another component of extending the future water supplies is ensuring the sustainability of water supply storage in Cheney Reservoir.

Description

Supply and Demand

In 2006, over 700,000 acre feet of water was reported used in the Lower Arkansas basin. Irrigation accounted for nearly 75% percent of all reported water pumped or diverted. Municipal use accounted for 15% of water used in the basin, industry for five percent with recreation, stockwater, and other uses combining to equal about 5 percent.(4) According to projections conducted using Kansas Division of Budget population data, the population of the basin is projected to grow more than 38% by the year 2040. Projected future water supplies in the basin may not be adequate to meet the projected demands.

In 2007, the Kansas Water Office (KWO) conducted an analysis of the surface water supply and demand projections for selected basins in eastern Kansas. The analysis compared population growth projections and non-municipal water use demand estimations with Federal reservoir yield and natural streamflow estimates. Demand anticipated to occur under sever drought conditions was then projected. In 2004, a supply and demand projection was conducted by the Burns & McDonnell engineering firm for five counties: Harvey, Butler, Sedgwick, Cowley and Sumner.(2) According to the Burns & McDonnell's population and demand projections, Sedgwick County would have the largest population increase amongst the five counties. The City of Wichita, the largest water user within the area, was shown to have a projected demand of 112 million gallons per day (MGD) in the year 2050. The Equus Beds Aquifer Storage and Recovery (ASR) project is part of the city's Integrated Local Water Supply Plan to meet these future demands, along with withdrawals from Cheney Lake.

An assessment of water needs in the southwest portion of this basin, Kingman, Harper, Pratt, Barber, Kiowa, Comanche, and three counties in Oklahoma, was reported by Bartlett & West in 2008, as a preliminary engineering report for Sunflower H_2O Initiative.(1) Current supplies appear to meet projected demands in this area.

An inventory of the current water supplies and potential demands was also conducted for nine counties of south central Kansas (Butler, Cowley, Harper, Harvey, Kingman, McPherson, Reno, Sedgwick and Sumner), as a Special Study by the U.S. Bureau of Reclamation for the Kansas Water Office and Regional Economic Area Partnership (REAP). The report provides information to support decision making by local entities to meet future water supply needs.

Aquifer Recharge

The water supply for the City of Wichita in south central Kansas currently comes from two primary sources: the City of Wichita well field in northern Sedgwick and southwestern Harvey counties, and Cheney Reservoir located mostly in southeastern Reno County. These sources will not be adequate to meet the projected water needs of the Wichita metropolitan area in the 21st century. Artificially recharging the Equus Beds aquifer, which underlies the city well field, is a strategy being implemented to meet future demands for water for Wichita and other users in the area. An additional benefit of artificial recharge includes establishing a hydraulic ridge, thus preventing migration of saltwater plumes originating from the Arkansas River to the southwest and the Burrton oil field to the northwest, which would degrade the water quality of the city's well field.

The Wichita well field was developed in the Equus Beds aquifer to supply water to the city beginning in 1940. Declines in ground water levels can be attributed to pumping from the aquifer by the City of Wichita and local irrigation water users. Increased reliance on surface water from Cheney Reservoir since 1965 and decreased city pumping from the Equus Beds aquifer have moderated the aquifer water level declines. Between 1992 and 2006, water levels recovered by more than 10 feet in much of the area.

Areas of the Lower Arkansas River basin are affected by salt contamination of fresh ground water and surface water (Figure 1). Several sources of salt have been identified as contributing to the contamination, including waste from salt mining or oil production, and human activities. Some of the salt is naturally occurring, arising from the dissolution of salt deposits in the underlying bedrock.

Artificial recharge is one strategy for addressing both water quantity and water quality concerns for the region. This approach is the vision of the City of Wichita, which has led the effort in partnership with the U.S. Bureau of Reclamation (Bureau) to test the approach and implement later phases.[9,10] In 1995, the Equus Beds Groundwater Recharge Demonstration Project was initiated to evaluate recharge techniques and their impact on the water quality of the aquifer. As part of the demonstration project, water was diverted from the Little Arkansas River during high flow events. The diverted water was either pumped to the Halstead recharge site and recharged to the aquifer by basin, trench or injection well, or treated and recharged at the Sedgwick recharge site. The demonstration phase of the project was completed in May 2002. The quantity of artificial recharge during the demonstration project was equivalent to less than three percent of the water pumped for municipal use from the aquifer by the City of Wichita (Table1).

In 2006, the first non-demonstration phase of the project was initiated. The purpose of the Equus Beds Aquifer Storage and Recovery (ASR) Project, Phase I, is to inject larger quantities of water into the aquifer for the purposes of storage and later recovery and to form a hydraulic barrier to the brine plume. The project diverts water from the Little Arkansas River through bank storage (diversion) wells and surface water intakes, when flow in the river exceeds base flow. The diverted water then is artificially recharged into the Equus Beds aquifer through injection wells and recharge basins. In 2007, over 350 million gallons were recharged into the aquifer through the ASR project, and in the first six months of 2008, approximately 600 million gallons were recharged.

To protect water quality, the City of Wichita and the State Conservation Commission have cooperatively cost shared with farmers on implementing for atrazine control. Roughly 75% of the farmers planting grain sorghum in the Little Arkansas River watershed participated and implemented Best Management Practices (BMPs).

Design for Phase II (Figure 2) of the ASR project began in 2008 for the surface water intakes, with construction slated to begin in 2009 and the project to be operational in 2011. Bank storage wells may get incorporated into the project after the capacity performance is fully evaluated. Phase II design elements will capture and recharge up to 30 million gallons per day (MGD) and will rely on a treatment plant to treat the water adequately to return directly into recharge wells. The project includes replacement of approximately 17 miles of existing raw water pipeline and 26 recharge/recovery wells.

Phase I and II had been estimated to cost $137 million five years ago; in 2008, due to inflation, cost estimates for just Phase II are $200 million or more. There is federal authorization (but not yet an appropriation) that allows cost share of up to 25% of project costs or a maximum of $30 million (based on the original cost estimate). In addition to the federal assistance, the city is seeking $1 million from the State, annually, for 5 to 8 years. In fiscal year 2009, $1 million to the ASR was approved from the State Water Plan Fund. When complete, the ASR will be a major regional water supply for over 600,000 people.

Cheney Reservoir

Cheney Reservoir, located 24 miles west of Wichita on the North Fork of the Ninnescah River, was constructed in 1962-1965 by the Bureau.[7] The primary purposes for the dam's construction were water supply, flood control, recreation and wildlife benefits. The land use of the watershed that drains to Cheney is 99% production agriculture. The reservoir has storage of 151,800 acre feet at conservation pool, with an additional flood control capacity of 80,860 acre feet.[11] The City of Wichita draws more than 60% of its daily water supply from the reservoir.

Approximately 7,100 acre feet of sediment deposition occurred in Cheney Reservoir from 1965 through 1998. As of 1998, sediment had filled 27% of the reservoir's inactive conservation storage pool. Sedimentation affects both the useful life and aesthetic quality of a reservoir. Sediment quality is an important environmental concern because sediment may act as a sink for water quality contaminants and as a source of harmful constituents to the overlying water column and biota. Sedimentation also decreases the water storage capacity of the large federal reservoirs, including Cheney.

In 1992, the Reno County Conservation District created a task force including farmers and representatives of state, federal and local agencies to identify potential sources of pollution in the watershed and Cheney Reservoir. The task force prepared a master plan for watershed pollution management to reduce phosphorus and sediment and extend the life of the reservoir to 200 years. Implementation of the plan began in July 1994 under the leadership of the Citizen's Management Committee (CMC) which operates as a subcommittee of the Reno County Conservation District. All members of the CMC live in or own land in the watershed and are farmers, land owners or agribusiness persons with rural interests.

The CMC continues to partner with the agencies and organizations that assisted the original task force. One of the most significant achievements of the Cheney Reservoir Watershed Project is the partnership of rural-urban stakeholders. Because the City of Wichita recognized the value of correcting pollution problems prior to water entering the reservoir, they agreed to provide incentive payments to farmers for implementing BMPs which often times are non-income generating assets for the farmers. For the farmers, implementation carries the obligation of maintaining the practices for the long term.

Since 1994, CMC's accomplishments include:

- Development of a citizen-led organization that promotes conservation practices through farmer-to-farmer information transfer;
- More than 1,400 BMPs implemented on watershed farms over the life of the project;
- Identification of key areas in the watershed with the potential to contribute the most sediment and nutrients to Cheney Reservoir; and
- Development of policy and programs to focus education and incentives to key areas.

Collaborative Water Resource Planning

The Regional Economic Area Partnership (REAP), is comprised of 34 city and county governments in nine counties of south central Kansas, which include Butler, Cowley, Harper, Harvey, Kingman, McPherson, Reno, Sedgwick and Sumner counties. REAP has established Water Resources Committee to identify and coordinate collaborative efforts on regional issues of water quality and supply in south central Kansas.

REAP participated as a partner in a Special Study conducted by the Bureau, in conjunction with the KWO. The objective of the study was to provide information for the formulation of alternative opportunities to meet the future municipal and industrial demand and usage within the area. Findings of the study report provide areas for further review. These include a focus on the value of conservation and the full utilization of existing surface water supplies. Development of additional ground water sources in the alluvial river valleys or new reservoir supplies could be evaluated. Reuse of municipal & industrial effluent and desalination of brackish ground water in the area are other areas identified for potential future study.

The Sunflower H_2O Initiative is a consortium of rural communities and water districts in six counties (Barber, Comanche, Harper, Kingman, Kiowa, and Pratt) along with 3 counties in Oklahoma (Alfalfa, Grant and Woods) that are working together to address common water issues. The consortium conducted a regional planning study with funding assistance from the Kansas Department of Health and Environment to evaluate water needs in the area and the most cost effective manner of developing and delivering the needed water supply.[(1)] All current systems in the area are ground water dependent. Many water supplies have experienced contamination or have threats to their supplies. The Consortium is in the process of trying to move into a next phase of review to evaluate opportunities for further regionalization of resources and systems and to evaluate opportunities to develop additional supply sources, both ground and surface water.

The Equus Beds Groundwater Management District No. 2 (GMD2) is an important water management entity in the basin, covering the eastern portion of the basin where some of the larger municipalities are located. The Big Bend Groundwater Management District No. 5 (GMD5) is another major water management entity in the basin, covering much of the western portion of the basin, including much of the irrigated lands, where most of the water use in the basin occurs.

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Lower Arkansas River Basin High Priority Issue
Rattlesnake Creek Subbasin
January 2009

Issue

Management solutions are needed to address water level decline rates, the achievement of sustainable yield, and the meeting of minimum desirable streamflows in the Rattlesnake Creek Subbasin.

Description

Ground water depletion due to over appropriation, and the maintenance of minimum desirable streamflows (MDS), is a priority issue in the Rattlesnake Creek Sub-basin. The subbasin is a targeted area to meet the *Kansas Water Plan* objectives.[7] These objectives include the reduction of water level decline rates within the High Plains aquifer, the achievement of sustainable yield management of Kansas surface and ground water resources outside of the Ogallala aquifer and the meeting of minimum desirable streamflows.

When the amount of water withdrawn from an aquifer continually exceeds the recharge, a ground water depletion situation exists. The rate of depletion in a given area depends on the hydraulics of the water bearing formation, the amount of recharge and the amount of withdrawal. Ground water depletion may contribute to stream flow depletion, water quality deterioration, land subsidence and ecosystem disruption.

The Rattlesnake Creek Subbasin is located predominantly within Big Bend Groundwater Management District No. 5 (GMD5), with the exception of Ford County which is within Southwest Kansas Groundwater Management District No. 3 (GMD3). The Quivira National Wildlife Refuge wetlands, which have a senior surface water right, is located in this subbasin.

Declines in the ground water table result in lower streamflows that are often inadequate to meet appropriated surface water demands. The timing of irrigation water demands often coincides with demands for surface water from Rattlesnake Creek into the Quivira wetlands.

A water resource management program proposal was developed by the Rattlesnake Creek/Quivira Partnership in 1999 to provide solutions, other than regulatory, for water resource scarcities within the Rattlesnake Creek Subbasin.[8] The partnership consists of GMD5; the U.S. Fish and Wildlife Service; the Kansas Department of Agriculture-Division of Water Resources (DWR) and WaterPACK, an organization of area irrigators. The program was accepted by the Chief Engineer, DWR in June 2000. It outlines a 12 year implementation schedule, as measured from August 1, 2000, to achieve the water use reduction goals and is reviewed every four years.

The goal of the management plan proposal is to stabilize ground water levels over the long term in an effort to improve streamflow in Rattlesnake Creek for the future (Figure 1). Within the Rattlesnake Creek corridor, ground water use is to decrease 12 percent under the plan to attain a 10-year moving average January streamflow of 25 cubic feet per second at the Zenith gage. Within the ground water management area beyond the stream corridor, annual ground water use is to decrease 16% or 16,400 acre feet, as measured in a 10-year moving average.

Current total appropriations within the subbasin are 221,068 acre feet/year. The average water use per year (72% of appropriations) is 158,189 acre feet/year. To achieve the management plan goals, a reduction of 28,620 acre feet in authorized quantity, or a reduction of 20,403 acre feet from the average water use, by the year 2012 is needed.

The management plan proposal includes the following strategies to achieve reduction in average water use per year: water banking, water right purchase, flex water right accounts, improved water conservation through education and irrigation water management, enhanced compliance with better enforcement of water right violations, water appropriation transfers away from high decline and river corridor areas, and end gun removals

from irrigation systems. Strategies are also directed to decrease adverse effects of pumping that would aggravate a natural salt-water intrusion into the freshwater aquifer. Sufficient funding and participation in voluntary programs to implement and carry out these strategies are essential to avoid mandatory reductions. More recently, two other programs have been used: the State Water Right Transition Assistance Program (WTAP) and the USDA Natural Resources Conservation Service EQIP program for “quick response areas”.

Water Banking

Water banking was proposed in the Rattlesnake Creek Management Plan proposal as a potential water conservation tool in need of consideration. The primary purpose of water banking in the Rattlesnake Creek subbasin is to provide incentives for water conservation and redistribution of water use within the subbasin. A state task force studied the concept and the legislature passed the Water Banking Act in 2001. Rules and regulations for the program were adopted in 2004. The water bank is authorized by the Chief Engineer. The Water Banking Act requires a minimum of 10% water savings in consumptive use on all deposit/lease transactions as well as the safe deposit boxes where a water right owner can save water for their own future use. In 2005, the Chief Engineer approved the Central Water Bank Charter, the first water banking charter in Kansas.[1] The charter targets the entire GMD5 district. This water bank charter is approved for seven years, at the end of which its operation will be reviewed to determine its effectiveness for water conservation. Actual consumptive use through water banking was reduced 40 acre feet in 2007.[2] Irrigators’ awareness of the program is growing, as reflected in the increasing calls about the program and increasing deposits.

End Gun Removal

Voluntary end gun removal is a management strategy under the Management Plan that could decrease the appropriated quantity, amount of irrigation water pumped, and the number of acres irrigated. The end gun proposal has temporarily been halted by GMD5 until their board members can review various concerns surrounding end gun removal.

Compliance and Enforcement

Voluntary, incentive-based water conservation programs can be most effective when combined with stronger enforcement of existing regulations. As a component of the Management Plan, DWR and GMD5 are seeking to enhance the current compliance and enforcement efforts to ensure water right conditions are followed.

Since 2000, DWR has focused the Blatant and Recurring Overpumping (BRO) Enforcement Program to the Rattlesnake Creek subbasin. Increased concentration of compliance inspections has increased awareness of the monitoring efforts as well as the quantity of water savings associated with these programs. To date, approximately 1,300 acre feet of water usage has been reduced by targeting the BRO program to the Rattlesnake Creek subbasin.

In 1978, the Kansas Legislature enacted provisions for the initiation and designation of Intensive Groundwater Use Control Areas (IGUCA) within the Groundwater Management District Act.[9] These statutes allow the Chief Engineer to implement additional corrective control provisions in areas where it is determined through a public hearing process, that ground water levels are declining excessively, the rate of ground water withdrawal exceeds the rate of ground water recharge, unreasonable deterioration of ground water quality has occurred or may occur, or other conditions exist warranting additional regulation to protect public interest. No IGUCAs are currently located within the Rattlesnake Creek subbasin.

Water Appropriation Transfers

The water appropriation transfer component of the Management Plan allows water right holders to move rights to other locations in the subbasin that are not experiencing major water level fluctuations. The goal of the strategy is an overall reduction in water use. No water rights would be allowed to be moved into the stream corridor, closer to the stream or into the priority high decline areas. There have been three water rights totaling 485 acre feet moved from within the Rattlesnake Creek corridor and the high decline area for a total savings of 30 acre feet.

Water Right Purchase Program and Water Transition Assistance Program

The Rattlesnake Creek Management Plan recommended using the State's Water Rights Purchase Program to permanently reduce water use in the stream corridor and areas of high decline within the management area. This program has been authorized for a number of years, but never funded. To assist with implementing the Rattlesnake Creek strategies, the Water Right Purchase Program was funded for two years; however, no viable offers were made to the state for a water right purchase. There are components with the program design that may have contributed to the lack of success.

In 2006, the Legislature approved the Water Right Transition Assistance Program (WTAP), a five year pilot for the purchase and retirement of water rights. This program corrected some of the concerns with the other water right purchase program. WTAP allows the state to purchase and permanently retire water rights in targeted, high priority areas. In 2007, the first year eligible, one water right was purchased in this subbasin, retiring 225 acre feet of authorized quantity. Rattlesnake Creek subbasin continues to be an eligible area for this program (Figure 2).

GMD5 has purchased one water right within the subbasin for a total savings of 195 acre feet of appropriated water. There has also been approximately 800 acre feet set aside through the U.S. Department of Agriculture, Natural Resources Conservation Service, Environmental Quality Incentive Program "quick response areas" for a minimum of four years, as the enrolled acres are converted to dryland farming or other non-irrigated uses.

The DWR, along with the rest of the subbasin partnership, reviews and evaluates the effectiveness of the management strategies at least every four years over the 12 year implementation period (years 2004, 2008, and 2012) as indicated in the management program. In 2004, the total water use and water demands within the Rattlesnake Creek subbasin were reviewed to determine if progress was on track for reducing total water use and meeting demands, as outlined in the proposal.

The four-year evaluation and review was completed by the Partnership for the Rattlesnake Creek Management Program in 2004.[3] In 2004, the streamflow goal (10-year rolling average of 25 cubic feet per second (cfs) or higher during January) at the Zenith USGS streamflow gage was met. The 10-year rolling average had been above 25 cfs from 1998 to 2008. Ground water levels declined for the third straight year for all the priority areas in 2004. The 10-year rolling average for water use in priority areas increased in both 2002 and 2003. Incentive programs like Water Banking and the Water Rights Purchase Program had not yet begun during this review period as they required legislation, adoption of rules and regulation and funding. The DWR provided enhanced compliance and enforcement to the subbasin. The BRO enforcement program was targeted to this subbasin which has increased awareness of monitoring efforts as well as water savings. It was noted during this review that approximately 58% (3,800 acres) of the acres previously enrolled in the USDA's Conservation Reserve Program were returned to irrigation in 1997 and 1998. Water use goals are based on the average water use from 1987 to 1996.

The eight-year review of the Rattlesnake Creek Management Plan began in August 2008. DWR has assembled findings for the initial evaluation of the eight-year review.[4]

If, by the year 2012, the final evaluation shows the goals have not been achieved, then reductions in water rights will be implemented to achieve the goals. Reductions in appropriations will be calculated by dividing the remaining amount of water use needed to reach the 72% reduction goal.

Ground Water Model

In 2008, DWR proposed updating a ground water model of the subbasin. GMD5 suggested that the entire district be modeled, including the Rattlesnake Creek subbasin. A district-wide model will reduce the boundary uncertainties. The district-wide Modflow model is under development, supported by both GMD5 and DWR. They have an open door policy on the development process, including inviting stakeholder groups and other agencies to all the meetings. The model will serve as a tool from which to base management options, administrative decisions and other applicable needs of the water resources in the subbasin. The model is scheduled to be completed in 2009.

Streamflow Augmentation

Streamflow augmentation was one of a number of the management strategies introduced in the June 29, 2000, Rattlesnake Creek Management Program Proposal by the Rattlesnake Creek/Quivira Partnership to address stream flow shortages due to fluctuating aquifer levels in the subbasin. In a report entitled, "Streamflow Augmentation of Rattlesnake Creek", the Kansas Water Office estimated the frequency that an augmentation year would occur in the future is about 50%. The typical quantity of water needed for augmentation during a year that augmentation is necessary is about 1,460 acre feet. [(5)]

Should the augmentation strategy be implemented, the KWO recommended the use of freshwater sources for augmentation, that water rights be purchased rather than leased for the supply of augmentation water and that GMD5 be responsible for the strategy's operation and maintenance.

Based upon the projected frequency and magnitude of augmentation in the future, and the recommendations of its source, supply and operation, the KWO estimated in early 2006 the total water right purchase cost for the augmentation strategy at $2.9 million, the total engineering and construction cost of the strategy at $2.2 million, the annual operation and maintenance cost of the strategy should average about $74,370 per year (with an augmentation year operation and maintain cost of $92,000 per year) and a 10-year total strategy cost of $5.9 million.

Recommended Actions

1. Implement the Rattlesnake Creek Subbasin Management Program Proposal and evaluate effects of voluntary implementation measures to restore streamflows and stabilize ground water declines.

2. State water resource agencies should continue to work with the Rattlesnake Creek Quivira partnership to implement the management plan.

Resources

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Lower Arkansas Basin High Priority Issue
Watershed Restoration and Protection
Approved January 2007

Issue

The restoration of watersheds with impaired water quality and the protection of watersheds above public water supply reservoirs and ground water sources used for drinking water supplies are high priority in the Lower Arkansas Basin. Three main components guide watershed restoration and protection efforts: achievement of Total Maximum Daily Loads, development of Source Water Protection Plans, and restoration and protection of wetland and riparian areas.

Description

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 programs.

Water Quality Impairments

Surface waters not meeting surface water quality standards in the basin are included on the 2004 303d list. High priority Total Maximum Daily Loads (TMDLs) for impaired surface waters in the Lower Arkansas basin were submitted to the Environmental Protection Agency (EPA) for approval on June 29, 2000. An additional round of TMDL development was completed in 2006. Table 1 provides information on rivers and lakes within the basin that are designated as high priority for TMDL implementation. Figure 1 shows the location of these areas within the basin. High priority TMDL watersheds are used to target voluntary, incentive based programs that provide technical and financial assistance for implementation of nonpoint source pollution management practices that can address designated pollutants.

Six additional TMDLs covering nutrient impairments were drafted and submitted for public review from September 13 to 30, 2006; these TMDLs were submitted to EPA in late 2006. Atrazine impairments on the Little Arkansas River and its tributaries are being addressed through a watershed management plan implemented through the Little Arkansas Watershed Restoration and Protection Strategy (WRAPS). This alternative, categorized by EPA in its 2006 listing guidance as a "4B alternative", addresses the impairment in lieu of a TMDL.

A complete description of each TMDL is available on the Kansas Department of Health and Environment TMDL website.[9]

Surface Water Nutrient Reduction

Nutrient sources within the basin include both point and nonpoint sources. The major point sources in the basin include large wastewater treatment plants, which are regulated under the National Pollutant Discharge Elimination Systems (NPDES) Program (Figure 2).

A major component of the Kansas Surface Water Nutrient Reduction Plan (Plan) involved looking at nitrogen transport to the Gulf of Mexico. In order to calculate the contribution of nitrogen to the Gulf, nitrogen concentrations of waters exiting the state borders were collected and estimated.

As predicted by studies from the USGS, only a small amount of nitrogen is expected to be transported from watersheds in the upper part of the Arkansas River basin to the Gulf of Mexico. Thus, to try to predict the contribution the Upper Arkansas basin makes to the Lower Arkansas basin would be difficult. It should also be noted that while the Upper Arkansas basin is not predicted to produce a significant surface water impact, exfiltration to local aquifers could produce significant ground water impacts. Furthermore, TMDLs on the Arkansas River between Great Bend and Hutchinson are influenced by nutrient loading coming from the Upper Arkansas Basin. Therefore, some degree of nutrient reduction should be expected from the eastern portion of the Upper Arkansas basin.

Since there are no “exit points” for the Upper Arkansas basin, all contribution from this basin is added to the Lower Arkansas basin where the Arkansas River exits Kansas into Oklahoma. Therefore, for the purpose of the Plan, the Upper and Lower Arkansas River basins were combined as a single composite basin.[6]

The primary nonpoint sources of pollution include both agricultural and urban areas. Table 2 shows the relative contributions of point and nonpoint sources in the Lower Arkansas and Upper Arkansas basins for total phosphorous and nitrogen leaving the state.

The Plan, developed by KDHE, outlines a statewide strategy for reducing the export of total nitrogen (TN) and total phosphorus (TP) in surface waters leaving the state.[6] This involves additional reductions in nutrients from point source discharges through the NPDES Program and reduction in nonpoint sources through development and implementation of Watershed Restoration and Protection Strategies (WRAPS). The Plan includes Improvement Potential Index (IPI) maps for Kansas counties for TP and TN reductions (see Water Quality Policy Section for statewide maps; basin maps Figures 3 and 4). In the Lower Arkansas basin, Barton, Rice, Reno, Stafford and Pratt counties showed the highest improvement potential for TN. Barton, Stafford, Pratt, Reno and McPherson counties showed the highest improvement potential for TP. These counties should receive priority consideration for the installation of nutrient management and reduction practices.

Source Water Protection

The KDHE, Bureau of Water administers programs related to public water supplies, wastewater treatment systems, the disposal of sewage and nonpoint sources of pollution. Programs are designed to provide safe drinking water, prevent water pollution and assure compliance with state and federal laws and regulations such as the Clean Water Act and Safe Drinking Water Act. State Water Quality Standards include provisions for alternative disposal of treated wastewater and residue material resulting from the waste treatment process.[10] KDHE’s minimum standards for the design of water pollution control facilities include guidelines for agricultural application of wastewater and sludge. Reuse of treated wastewater may contribute to water conservation within the basin.

All public water suppliers in the basin have completed Source Water Assessments in cooperation with KDHE. The next step, which is voluntary, is the development of source water protection plans.[4]

There are 118 public water suppliers in the basin, including 28 rural water districts. There are currently four public wholesale water supply districts in the basin. Ground water is the primary source for most public water supplies, accounting for over 90% of the total supply. The two major sources of ground water are the Equus Beds aquifer in Harvey, McPherson, eastern Reno and northern Sedgwick counties, and the Great Bend Prairie aquifer, predominately underlying Pratt, Stafford, southern Barton, Edwards, Kiowa and Reno counties. Cheney Reservoir, constructed on the North Fork of the Ninnescah River in Reno County, supplies a portion of the water supply for Wichita. Wellington Lake serves as a surface water supply for the City of Wellington.

Each Source Water Assessment includes a susceptibility score that can help communities determine which contaminants pose the most significant threat to their water supply. A susceptibility score was generated from the susceptibility analysis and indicates whether the susceptibility range is low, moderate or high for potential threats of contamination in an assessment area. Each public water supplier received susceptibility scores in the following contaminant categories: microbiological, nitrates (ground water only), pesticides, inorganic compounds, synthetic organic compounds, volatile organic compounds, sedimentation (surface water only) and eutrophication-phosphorus (surface water only).

Of the public water suppliers using ground water in the Lower Arkansas River Basin, 41% had low susceptibility scores, 58% had moderate scores and one had a high score. Of the public water suppliers using surface water in the Lower Arkansas River Basin, 33% had low susceptibility scores, 67% had moderate scores and none had high scores.

For communities using ground water, development of a wellhead protection program is recommended. For communities using surface water, the development of a watershed restoration and protection strategy (WRAPS) is the best mechanism to ensure water quality protection for their public water supply.

Wetland and Riparian Area 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. Water quality has been a primary focus with implementation efforts targeted to high priority TMDL watersheds (Figure 1). In addition, several watersheds have been identified in the Kansas Wetlands and Riparian Areas Protection and Restoration Implementation Plan as areas of high biological importance and a priority for implementation activities. Sixteen conservation districts in the basin have developed wetland and riparian protection plans.

Watershed Restoration and Protection Strategies

Watershed Restoration and Protection Strategies (WRAPS) are stakeholder-driven watershed management plans designed to address multiple water resource issues within a specific watershed. The WRAPS process provides a means to integrate objectives from multiple local, state and federal programs into a comprehensive, coordinated strategy for a specific watershed. This can include TMDL attainment, nutrient reduction, source water protection, riparian and wetland management and other natural resource objectives.[5]

The watershed above Cheney Reservoir in the basin has been identified as a watershed of significant state interest for development and implementation of WRAPS. A WRAPS project is being implemented in this watershed as well as other watersheds within the basin including the Little Arkansas River watershed (see WRAPS Project Status Map in the Water Quality Policy Section). Watersheds in the WRAPS projects currently underway in the basin encompass priority areas for TMDL implementation, areas with a high improvement potential index for nutrient reduction, source water assessments areas and priority areas for wetland and riparian protection, and other watershed issues.

A consideration for watershed restoration and protection in the basin is the potential for conversion of Conservation Reserve Program (CRP) acreage back to production agriculture as contracts expire. Of the acres enrolled in the twenty Kansas counties contained wholly or partly within the Lower Arkansas basin, 330,872 acres will expire in 2007. Of those, 107,695 acres (33%) will be offered a 5-year reenrollment option and 73,127 acres (22%) will receive a 10-year reenrollment option.[8] If land is taken out of permanent grass cover, implementation of best management practices will be needed to minimize potential adverse impacts to water resources in the basin.

Other Watershed Related Activities

- All the counties within the basin have a sanitarian funded by the Local Environmental Protection Program (LEPP).
- Counties in the basin that have countywide planning and zoning programs include Barton, Cowley, Ford, Harper, Harvey, Kingman, Marion, McPherson, Pawnee, Reno, Rice, Sedgwick and Sumner.
- All conservation districts in the basin have adopted nonpoint source pollution management plans. Buffer coordinators have also been employed in nine counties in the basin to facilitate enrollment of stream buffers in the continuous CRP and State Water Quality Buffer Initiative.
- Several entities and municipalities in association with the Wichita urban area are included in the Phase I and Phase II NPDES Stormwater Program. A list of affected communities is available on the KDHE website.[11]
- There are seven organized watershed districts in the basin.

Recommended Actions

1. Work with stakeholder groups to incorporate TMDL implementation, nutrient and sediment reduction and urban stormwater management goals into applicable WRAPS projects.

2. Target technical and financial assistance programs for water quality protection and restoration to implement WRAPS action plans, including those addressing high priority TMDLs and counties with high

Improvement Potential Index values for nutrient reduction.

Resources

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