

Marais des Cygnes River Basin

January 2009

General Description

The Marais des Cygnes River rises near Eskridge in Wabaunsee County, Kansas and flows east and south to join the Little Osage River in Bates County, Missouri. The [basin](#) covers 4,304 square miles of east-central and southeast Kansas and includes all or parts of 13 counties. Dagoon Creek, Bull Creek, Pottawatomie Creek and Sugar Creek are major tributaries in Kansas. The Marmaton and Little Osage Rivers originate in Kansas and join in Missouri just above their confluence with the Marais des Cygnes to become the Osage River. The Marais des Cygnes basin includes four [Hydrologic Unit Code](#) (HUC) Subbasins: 10290101, 10290102, 10290103 and 10290104.

Major federal reservoirs in the basin are Melvern, Pomona and Hillsdale. Other significant lakes include the La Cygne Power Station Lake and impoundments within the Marais des Cygnes Wildlife Management Area and Refuge. Ground water [aquifers](#) underlying the watershed include portions of the Ozark and Glacial Aquifer and alluvial aquifers of the Marais des Cygnes River and its tributaries.

Population and Economy

There were an estimated 125,000 residents in the basin in the year 2000 (KWO estimate). The 13 counties either partly or wholly located within the basin had a combined [population](#) of 761,561 in 2000 (U.S. Census) and projected population of 1,076,146 in 2040.⁽¹⁾

Miami County, in the northern part of the basin, is poised for growth as urbanization of the Kansas City metropolitan area moves south. Miami County, with a population of 28,499 in 2000, has a projected population of 41,917 in 2040. By contrast, Linn County had a population in 2000 of 9,606 and a projected 2040 population of 8,679.

Despite the continuing urban growth, the Marais des Cygnes watershed maintains a robust agricultural industry comprised of feed grain operations, grazing lands and confined animal feeding operations. Wheat and sorghum are the primary crops. The value of [crops](#) grown in the 13 counties either partly or wholly within the basin exceeded \$318 million while [livestock](#) and dairy production topped \$192 million in 2006. Two large retail distribution centers have been developed near Ottawa in Franklin County.

Water-based recreation is an important component of the basin economy with recreational development associated with the three federal reservoirs in the basin, four state fishing lakes, and 20 community lakes attracting boaters, anglers, hunters and campers. State Parks and commercial marinas are located at each federal reservoir in the basin. Waterfowl hunting on private, state, and federal lands is a major activity, particularly in the lower basin.

Physical Characteristics

Geology and Soils

The Marais des Cygnes basin slopes gently west to east from a surface elevation of 1,472 feet above sea level at the headwaters in Wabaunsee County to about 742 feet at the state line. The Marais des Cygnes basin lies predominantly within the Osage Cuestas physiographic region with the extreme southeast corner located in the Cherokee Lowlands. This area is characterized by many east-facing escarpments which trend irregularly north to south across the basin. Major cities in the basin include Osage City, Ottawa, Garnett, Paola, Louisburg and Fort Scott.

Most of the surface [geology](#) in the basin is Pennsylvanian in age with Permian age rock in the headwater counties. Strata consist primarily of alternating thin beds of limestone and shale with some local sandstone deposits in the Lawrence shale and Stranger formations. Between the ridges are flat or gently rolling plains

formed by softer rocks in the region.

The consolidated sediments derived from the Permian and Pennsylvanian rocks lie in widespread and nearly parallel layers dipping gently toward the north and west. Unconsolidated rock of Tertiary and Quaternary age is present locally in uplands as gravel or chert deposits and as gravel, silt and clay deposits in alluvium.

There are 11 soil series represented in the basin and vary from easily-worked, productive soils to compacted clay. Soils may be divided into three major associations: upland, terrace and bottomland. Upland soils tend to be moderately deep and dark-colored with a clay subsoil and occupy approximately 87% of the basin. Bottomland soils, which are mostly undifferentiated, deep and well-drained, occupy about 11% of the basin. Terrace soils along the edges of stream channels occupy less than two percent of the basin and tend to be deep soils with a clay subsoil.

Land Use/Land Cover

The predominant land features in the basin are grasslands (55%) followed by cropland (23%) and woodlands (16%). In 2006, there were 10,780 farms comprised of 4.1 million acres, that lie in the 13 counties. Average farm size is 383 acres.

The basin contains many important highways. Interstates 35 and 135 cross the basin from northeast to southwest. U.S. Highways 75, 59, 169 and 69 cross the basin from north to south while U.S. 54 and 56 cross from east to west.

The Marais des Cygnes basin contains the largest percentage of riparian acreage of the twelve major river basins in Kansas. Within the 100-foot corridor along each bank of streams in the basin, 40% of the land is forested followed by cropland (17%) and pasture/grassland (15%).

Climate

The climate of the basin is classified as humid continental with cold winters and hot summers. Normal mean temperature generally increases from northwest to southeast across the basin. The average mean temperature of the basin is 54° F. Most of the [precipitation](#) falls in the summer and spring. June is typically the wettest month. Flood events and the drought experienced from 1952-1956, underscore the variability in precipitation.

Wildlife and Habitat

The Marais des Cygnes basin encompasses a wide array of habitat types that support rich and diverse wildlife populations. Habitat ranges from tallgrass prairie in the western portion of the watershed to riparian forests in the east. Some bottomland along major streams has been cultivated for row crops. Twenty-five state or federally listed threatened or endangered species share a probable or historic range or critical habitat within the basin including seven birds, four reptiles, three amphibians, two fish, two mammals and six mollusks including one snail species.

Significant wildlife habitat includes extensive wetlands in the lower basin. The Marais des Cygnes State Wildlife Area and adjacent U.S. Fish and Wildlife Service refuge, along with numerous private duck clubs hold recreational water rights on the Marais des Cygnes River. Water is pumped from the river to flood marshes and attracts large numbers of waterfowl during migration.

Water Resources

The Marais des Cygnes basin contains 8,821 miles of intermittent and 2,011 miles of perennial streams for a total of 10,832 stream miles. The density of 2.5 stream miles per square mile is typical among basins located in the eastern third of the state.

U.S. Army Corps of Engineers (Corps) operates three reservoirs in the Marais des Cygnes basin: Pomona, Melvern and Hillsdale. Four State Multipurpose Small Lakes have been constructed in the basin including Bone Creek, Xenia, Cedar Creek and Little Sugar Creek.

Ground water resources in the basin are associated with alluvial and terrace deposits along the larger stream valleys. Ground water deposits in the Flint Hills in the upper basin are characterized by thin saturated zones and high levels of dissolved solids and hardness.

[Surface water](#) is the principal source of supply in the basin, accounting for over 97% of the use in 2006. Alluvial deposits along streams provide a minor source of ground water in the basin. As shown in Figure 1, most [water use](#) withdrawals are made for municipal (27%) and industrial (53%) supply.⁽⁴⁾ The primary industrial water user in the basin is the La Cygne electrical generating station where Kansas City Power and Light maintains a 2,600 acre cooling lake.

Water Management

The Corps manages pool elevations in their three reservoirs according to specific operating rules. Flood flows are stored until downstream conditions allow their release. A conservation pool is maintained with a fluctuating pool plan to maximize fish and wildlife production and recreational use. Each federal lake contains storage to maintain downstream water quality.

[Water storage](#) in Melvern, Pomona and Hillsdale lakes is maintained under the state Water Marketing Program. The 40 [public water suppliers](#) in the basin rely predominantly on surface water. The Marais des Cygnes Water Assurance District No. 2 was organized in 1990 and became operational in 1995. Seven municipal and industrial water right holders on the river are members. State-owned water assurance storage is located in Melvern and Pomona Lakes.

Gages to monitor minimum desirable streamflow (MDS) are located on the Marais des Cygnes River at Ottawa in Franklin County (15 to 25 cubic feet per second) and La Cygne in Linn County (20 to 25 cubic feet per second).

There are eight organized [watershed districts](#) in the basin. Watershed districts may be formed to construct, operate and maintain works of improvement needed to provide for water management. The primary function is to develop a comprehensive general plan for a watershed that will provide flood protection for the residents and landowners.

Each county in the basin also has a Conservation District dedicated to reducing soil erosion, improving water quality and conserving natural resources. The basin is primarily covered by the federal Big Lakes Resource Conservation and Development (RC&D) Program, with three southeastern counties in the See-Kan RC&D.

Watershed Restoration and Protection Strategies (WRAPS) are local stakeholder-driven watershed management programs designed to address multiple water resource issues. WRAPS projects have been established above the three federal reservoirs in the basin which provide public water supply along with projects in the lower Marais des Cygnes and Marmaton watersheds.⁽⁶⁾

Bi-State EPA Grant Holds Promise for Water Quality Improvement

Kansas and Missouri received a \$900,000 Targeted Watershed Grant for the Lower Marais des Cygnes River Basin from the Environmental Protection Agency on December 3, 2007. The funding will be devoted to watershed restoration and protection practices, cost shared with landowners and communities. The Kansas Department of Health and Environment developed and will administer the bi-state grant that was supported by Kansas Governor Kathleen Sebelius and Missouri Governor Matt Blunt. The project will supplement existing Watershed Restoration and Protection Strategies (WRAPS) in the Marais des Cygnes basin.

The bi-state initiative has five objectives: improve the health of riparian areas and the adjacent streams, reduce adverse water quality impacts (pollution) from livestock operations, reduce pollution from on-site wastewater systems, reduce the adverse affects of urbanization and study the aquatic insects, fish, and plant life of a stream or river to help assess their health.

A variety of educational programs targeted to specific audiences are planned including pasture management and grazing systems for livestock operations. For crop farmers, there will be clinics on stream bank stabilization and, riparian area restoration practices. For the general public, there will be training modeled after the Kansas Environmental Leadership Program (KELP) on basin water resource issues.

The problems in the bi-state Marais des Cygnes basin are well documented. Earlier scientific evaluation has determined which streams or sections of streams do not meet water quality standards for their intended designated uses including recreation activities such as fishing and swimming. The key causes of the pollution: excess nutrients, fecal coliform bacteria, and limited dissolved oxygen, also have been identified. The unknown, however, is the exact source of the pollutant. Given the difficulty in pointing to a specific source, as with a discharge pipe from industry or a municipality, this form of water contamination is known as nonpoint source pollution.

Once the possible water quality impairment are identified, best management practices will be determined. Through computer modeling, twelve such practices will be compared, ranked and promoted to landowners for their adoption. All of these activities are made possible, in whole or in part, by this bi-state grant.

Resources

1. U.S. Census Data, 2000
2. USDA, *Kansas 2006-2007 Farm Facts, Agricultural Statistics and Ranking*
3. Wilson, Brownie. 2003. *Assessment of Riparian Areas Inventory, State of Kansas.*
4. Kansas Department of Agriculture-Division of Water Resources. 2007 Water Rights Information System (WRIS).
5. Natural Resources conservation Service. Accessed January 2009. Resource Conservation and Development Information. www.ks.nrcs.usda.gov/partnership/rcd/index.html
6. Kansas Department of Health and Environment. Accessed January 2009. Watershed Restoration and Protection Strategies (WRAPS) www.kswraps.org

Marais des Cygnes River Basin Management Categories

MANAGEMENT CATEGORIES

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

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

These categories correspond to the *Kansas Water Plan, Volume II*. That contains new policy issues and the existing policy and statutory framework that relate to the management categories.

ISSUE: WATER MANAGEMENT

See the [Water Supply Management and Conservation](#) priority issue in the Marais des Cygnes basin section.

The mainstem of the Marais des Cygnes and Marmaton rivers and three federal reservoirs are the major sources of water supply in the basin. There are also four State Multipurpose Small Lakes that provide public water supply and alluvial deposits along streams provide a minor source of ground water in the basin. All the major streams in the basin are restricted to new appropriations for the period of July 1 through September 30. There are two sites in the basin where minimum desirable streamflows (MDS) have been set: Ottawa and La Cygne.

Applicable *Kansas Water Plan* Objectives

- Achieve sustainable yield management of Kansas surface and ground water sources outside of the Ogallala High Plains 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 (quantity) category. For more information on the programs and associated policies, see the [Programs Manual](#).

- Kansas Department of Agriculture-Division of Water Resources: Water Appropriation Program
- Kansas Geological Survey and Kansas Department of Agriculture, Division of Water Resources: Water Well Measurement
- USDA-Natural Resource Conservation Service: Environmental Quality Incentive Program
- Kansas Water Office: Water Marketing Program
- Kansas Water Office: Water Assurance 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 beneficial uses. Conservation is defined as a careful preservation and protection of something, especially the planned management of a natural resource, to prevent exploitation or destruction. Water conservation is a part of maintaining a long-term water supply for Kansas.

Water conservation activities apply to all uses: irrigation, municipal, industrial, etc, and from all sources. Industrial water supply (53%) accounts for the majority of water used in the basin followed by municipal supply (27%), irrigation (11%) and recreation (7 percent). Stock water, domestic and other uses make up the balance of water [use in the basin](#) (2006).

Water use conservation plans are required when: a) purchasing water from the state Water Marketing Program, b) participating in the Water Assurance District Program, c) sponsoring or purchasing the public water supply portion of a Multipurpose Small Lakes Program project, d) transferring water under the Water Transfers Act and e) applying for a loan from the Public Water Supply Loan Fund. There are sixty-one [public water suppliers](#) in the Marais des Cygnes basin with an approved municipal conservation plan.

Water conservation plans include drought stage triggers that are the signals that a water shortage or other conditions indicative of drought have reached certain stages or levels. They act as the signal to begin implementation of actions appropriate to the stage. Triggers may be related to supply conditions or demand levels. A given stage should have more than one trigger to confirm that conditions are worsening. Appropriate conservation practices in the areas of education, management and regulation should be listed under each stage. Delay in action may lead to a major disruption of the water supply system at a later time.

Most water utilities consider water as a commodity and encourage the use of water by their customers by striving to keep rates low. The availability of plentiful, inexpensive water is often promoted by communities to attract new growth. More recently, some communities have adopted rate structures that result in higher unit cost with increased use. This is one form of demand management.

The four basic types of water rate structures used by public water suppliers in Kansas are described as flat rate, decreasing block rate, uniform block rate and increasing block rate. Utilities with a flat rate charge each customer a fixed amount per month regardless of the amount of water used. With a decreasing block rate, the unit cost of water decreases as usage increases. The unit cost of water is the same for all levels of usage with a uniform block rate. With an increasing block rate, the unit cost of water rises as usage increases.

The type of rate structure can affect water usage as measured in gallons per capita per day (gpcpd). Systems with flat rates tend to use considerably more water per capita than systems that meter customer use. The other three types of rate structures, in which cost depends on amount of water used, have a less dramatic effect on gpcpd. Decreasing block rates are assumed to discourage conservation because customers are charged lower rates for high-volume usage. Increasing block rates are considered an effective way to promote conservation among high-volume users while keeping the cost of moderate use affordable. However, the rate structure does not appear to influence usage by individual customers as much as the total monthly water cost and the geographic area in which they live.

Applicable *Kansas Water Plan Objectives*

- 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 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
- Kansas Water Office: Water Conservation Program
- Kansas Department of Health and Environment: Kansas Public Water Supply Loan Fund
- USDA-Farm Services Agency: Conservation Reserve Program

ISSUE: PUBLIC WATER SUPPLY

See also, [Surface Water Management and Conservation](#) priority issue in the Marais des Cygnes basin section.

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 84 [public water suppliers](#) in the basin, including 31 rural water districts. There are currently two public wholesale water supply districts in the basin. Surface water is the primary source for most public water supplies, accounting for over 97% of the total [water use](#). There are four State Multipurpose Small Lakes in the basin that serve public water suppliers. The Marais des Cygnes Water Assurance District is also active in the basin. The U.S. Army Corps of Engineers (Corps) operates Melvern, Pomona and Hillsdale lakes in coordination with the state to meet Water Assurance District member needs during periods of low flow.

Water usage in gpcd is calculated for each water system in the state from reported data on water use and [population](#) served. Average gpcd figures for large, medium and small water suppliers are calculated in eight regions of the state based on similar geographic areas. The Marais des Cygnes basin is located in regions 7 and 8. Average gpcd usage for large, medium and small suppliers is, 148, 107 and 96 respectively in region 7. Average gpcd in region 8 is 130, 102 and 84 for large, medium and small suppliers. These figures serve as a reference to indicate if individual suppliers are above or below average usage for the region.

Reducing unaccounted for water is a focus of water conservation efforts in the Marais des Cygnes basin. Unaccounted for water includes any unmetered uses plus water loss in the distribution system. Technical assistance is available through the Kansas Water Office (KWO) for systems with more than 30% unaccounted for water. High amounts of unaccounted for water may result from water line breaks, under registering customers, unmetered uses, faulty metering or inaccurate accounting. The statewide average percentage of unaccounted for water use in 2006 was 14%. Management of unaccounted for water is a fundamental tool in providing adequate water supply.

Drought vulnerable water supplies are those systems most likely to be first impacted by drought due to basic source, distribution system or treatment capacity limitations; or that rely on a single well as a water supply source. Drought vulnerable water supplies were surveyed by the Kansas Department of Health and Environment (KDHE) and KWO in 2003 and 2006. While the number of public water supplies considered drought vulnerable increased between the two surveys, issues causing supplies to be listed as vulnerable in 2003 have been corrected with one exception (Table 1). The KDHE Capacity Development Program has been beneficial in reducing drought vulnerability throughout the state as communities assess their systems and identify areas in need of improvement.

Capacity development is the process of water systems acquiring and maintaining adequate technical, financial and managerial (TFM) capabilities to assist them in providing safe drinking water. The capacity development provisions in the Safe Drinking Water Act provide a framework for the state and public water supply systems to work together to help ensure that systems acquire and maintain the TFM capacity needed to meet the public health protection objectives.

The KDHE surveyed the TFM capability of public water suppliers in 2002, 2005 and 2008. The surveys provided information for a ranking system of high, medium and low for targeting the need for capacity

development assistance. In the Marais des Cygnes basin, the number of systems rated high for the need of capacity development decreased from 10 to 4 between 2002 and 2005 reports (2008 results pending).

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.
- Reduce the number of public water suppliers with excessive “unaccounted for” water by first targeting those with 30% or more “unaccounted for” water.
- 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 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

ISSUE: WATER QUALITY

Water quality is addressed through a combination of restoration and protection efforts using both voluntary, incentive-based approaches and regulatory programs. See the [Watershed Restoration and Protection basin priority issue](#) for a discussion of current issues concerning water quality.

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 and 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 category. For more information on the programs and associated policies, see the [Programs Manual](#).

- Kansas Department of Health and Environment: Watershed Management Section/WRAPS
- Kansas Department of Health and Environment: Watershed Planning Section/TMDL Program
- 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
- State Conservation Commission: Nonpoint Source Pollution Control Program
- State Conservation Commission: Water Resources Cost-Share Program

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 these resources in priority watersheds through the implementation of best management practices (BMPs). See the [Watershed Restoration and Protection basin priority issue](#) for a discussion of current activities concerning wetland and riparian area protection.

Applicable *Kansas Water Plan* Objective

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

Applicable Programs

The following programs help to meet the objective 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
- State Conservation Commission: Kansas Water Quality Buffer Initiative

ISSUE: FLOOD MANAGEMENT

The primary approach to flood management in the basin focuses on floodplain management through community participation in the National Flood Insurance Program (NFIP) and reduction of rural flood damages through construction of watershed dams in organized watershed districts.

See the [Comprehensive Flood Assessment priority issue](#) for a discussion of current activities concerning flood management.

Applicable *Kansas Water Plan* Objective

- 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
- State Conservation Commission: Watershed Dam Construction Program
- State Conservation Commission: Watershed Planning Assistance Program
- Kansas Division of Emergency Management: Hazard Mitigation Grants Program
- FEMA: National Flood Insurance Program

ISSUE: WATER-BASED RECREATION

The rivers, streams and lakes of Kansas represent valuable recreational resources. Consideration of the economic contribution of water-based recreation is addressed in the [Water-Based Recreation Management Category](#). Even though the Marais des Cygnes basin has a wide variety and relatively high number of public water recreation sites, there is a demand for more water based-recreation facilities to meet the needs of the population.

The Marais des Cygnes River and its tributaries are not among the three rivers in the state legally accessible for public recreation. However, a portion of the river as it passes through the Marais des Cygnes state wildlife area and federal refuge is publicly owned. The approach to enhancing opportunities for recreation in the basin is to improve access to the federal reservoirs, community lakes and other water bodies that are available for public use.

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 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: Community Fisheries Assistance Program
- Kansas Water Office: State Water Planning Program

ISSUES FOR FUTURE ACTION

Regional Public Water Supply Coordination
Cellulosic Bioenergy Development

Marais des Cygnes Basin High Priority Issue Comprehensive Flood Assessment January 2009

Issue

Persistent flood damages in the [Marais des Cygnes basin](#) indicate a need for a comprehensive assessment of existing flood control infrastructure and storage to determine current status, mapping needs and opportunities for flood management actions in the future.

In the summer of 2007, widespread flooding occurred in the lower Marais des Cygnes basin. Heavy [precipitation](#) fell downstream of the federal flood control reservoirs in the basin. The City of Osawatomie and other communities sustained considerable flood damage. Numerous flood control structures and levees in the basin were also damaged.

The 2003 Marais des Cygnes Basin Section of the *Kansas Water Plan* contained a priority issue on Fort Scott Flooding. Major floods in the Marmaton River watershed impacted the City of Fort Scott in 1986 and 1998. Four water control structures received federal funding in 2004 in the Marmaton Joint Watershed District No. 102. To date, two of these flood control structures have been built and another is under construction.

Flood Insurance Rate Maps (FIRMS) have been prepared for most of the communities subject to flooding in the basin by the Federal Emergency Management Agency (FEMA). Dam breach inundation zone mapping has been conducted by the State Conservation Commission (SCC). Development downstream of some small dams has resulted in changes in hazard class and necessitated upgrading of some structures.

Description

Rivers and streams in the Marais des Cygnes basin have been historically prone to flooding during high rainfall events. Most communities and cities are sited near stream channels and Osawatomie and Fort Scott are located at the confluence of major drainages in the basin, making them especially vulnerable to flood damage.

Three federal reservoirs: Pomona, Melvern and Hillsdale, have been constructed in the basin by the U.S. Army Corps of Engineers (Corps), primarily for flood control. There are eight [watershed districts](#) in the basin administering 100 water retention structures (including permitted structures pending construction). These smaller flood control structures are located on tributary streams and have multiple benefits including protecting crops planted in the floodplain.

In 2002 the Kansas Legislature directed the Secretary of Agriculture and the Chief Engineer, Division of Water Resources (DWR) to evaluate the current policies regarding stream obstructions (roads, bridges, culverts, levees) and present a report outlining the strengths and weaknesses of a watershed approach to the permitting of dams and other stream obstructions. The Secretary and the Chief Engineer were to make recommendations to the Legislature with regard to clarifying the obligations of the Water Structures Program to upstream and downstream landowners.

A questionnaire was sent to city and county governments, the Kansas Department of Transportation (KDOT) and other interest groups to gather their input on pros and cons of a watershed-based approach to permitting of stream obstructions. The approach would have required more rigorous hydrologic and hydraulic modeling to evaluate the effect of structures further upstream and downstream of proposed projects than was currently required. Several alternatives were evaluated that would have imposed various levels of increased requirements.

Two public hearings were held. As a result of the evaluation and public input, the approach was not adopted due largely to concerns of local governments about increased costs and time to process permits. In addition, local governments did not recognize that the current procedures were causing problems and the benefits did not seem to justify the increased cost and work load. Some changes were made to the program including

increased notification of upstream and downstream land owners of pending permits. An in-house evaluation was conducted on several streams with permitted structures to determine the downstream flooding impact resulting from the structures.

Accumulation of debris within and behind bridges, culverts and other structures can obstruct the flow of water and limit the ability of the stream to carry flood water through permitted stream obstructions. It is important that permitted obstructions be kept clear of log jams caused by trees, utility poles and other debris that may wash into streams during high flows. Management of riparian areas to prevent debris from entering the system and causing blockages is an important part of a preventive and routine maintenance program. Well-managed and healthy riparian and wetland areas along streams also benefit flood reduction by storing water on floodplains.

Summer 2007 Flooding

Nearly \$40 million was approved by the FEMA and the U.S. Small Business Administration to assist those affected by the severe storms and flooding occurring from June 26 through July 25, 2007 in Kansas. The Kansas National Guard was sent to help with a mandatory evacuation of the City of Osawatomie, as overflowing Pottawatomie Creek inundated neighborhoods.

A total of 31 watershed district water control structures in the Marais des Cygnes basin sustained an estimated \$378,500 in damage during the 2007 summer floods. Pottawatomie Creek Watershed District site H-26 had an estimated \$250,000 in damage. On June 30, 2007, Cedar Creek Valley Reservoir which is the public water supply for the City of Garnett sustained an estimated \$645,000 in damage when almost half of a 400-foot spillway wall was eroded.

Although the federal flood control reservoirs in the basin functioned properly, this event demonstrated that even with extensive structural efforts to control flooding, excessive rainfall over successive days can overcome the ability of the system to prevent damage. Additionally, the Marmaton River (Fort Scott) and Pottawatomie Creek (Osawatomie) watersheds lack flood protection from federal reservoirs.

National Flood Insurance

The Flood Management Policy Section of the *Kansas Water Plan* describes flood related activities of FEMA and the National Flood Insurance Program (NFIP).⁽¹⁾ DWR provides coordination and technical assistance for the NFIP in Kansas. DWR provides technical assistance to local governments and offers the *Floodplain Management Guide*⁽⁶⁾ to landowners.

To be eligible to participate in the NFIP, cities or counties must enact flood control ordinances designed to limit floodplain development and to protect those buildings that are constructed in the floodplain from flood damage. Management of floodplain development is the first priority in preventing flood damage.

DWR assists cities and counties with the development of flood control ordinances and is responsible for approving them. In the Marais des Cygnes basin, seven counties and 24 cities have enacted floodplain ordinances. Property owners in these political subdivisions are eligible to buy flood insurance through the NFIP program. All eligible entities in the basin participate in the NFIP program with a total of 208 policies. Bourbon County had the seventh highest flood insurance payments of all Kansas counties since 1978, with \$2,421,938 paid on only 59 claims (Table 1).

In 1997, FEMA initiated a plan to modernize the flood mapping program. The plan proposed a seven-year upgrade of the flood map inventory and enhancement of the associated products and services. Most existing FEMA flood maps were produced using now outdated manual cartographic techniques and do not include recent development. The desire was to produce digital maps compatible with computerized geographic information system (GIS) software. Federal funding to implement the map modernization plan has not yet been made available.

The FY 2005 *Kansas Water Plan Flood Management Policy Section* identified 29 priority counties to be mapped, remapped or to have existing information digitized. Financial assistance from the State Water Plan

Fund has been provided for mapping in Allen, Anderson, Bourbon, Coffey, Douglas, Franklin, Johnson, Osage and Wabaunsee counties. Digital flood insurance maps were approved for Miami and Linn counties in 2007.

The Kansas Hazard Mitigation Plan was updated in 2007 by the Kansas Division of Emergency Management (KDEM).⁽¹⁾ In the prioritization of risk associated with 22 hazards conducted as part of the planning process, flooding and winter storms ranked second behind only tornadoes in the degree of risk present. The plan contains the following in the *Mitigation Action Strategy Summary*: “Integrate flood mitigation into KDOT construction projects. Lead agency: KDOT; Support Agency: Kansas Department of Agriculture”. This is shown in the Hazard Mitigation Plan as having a medium planning priority. It is noted that this action applies to all new construction projects and that more coordination with other state and local agencies is needed. This recommendation also addresses some aspects of watershed based planning and permitting discussed above.

The *Kansas Hazard Mitigation Plan* includes a summary of high and significant risk dams (Table 2). A high hazard dam (Class C) is a structure located in an area where failure could result in any of the following: extensive loss of life, damage to more than one home, damage to industrial or commercial facilities, interruption of a public utility serving a large number of customers, damage to traffic on high volume roads, a high volume railroad line, inundation of a frequently used recreation facility serving a relatively large number of persons, or two or more individual hazards described in Hazard Class B. A significant hazard dam (Class B) is a dam located in an area where failure could endanger a few lives, damage an isolated home, damage traffic on moderate volume roads, damage low volume railroad tracks, interrupt the use or service of a utility serving a small number of customers, or inundate recreation facilities such as campground areas used intermittently and serving a relatively small number of persons. Dam hazard ratings are based on the risk for loss of life and/or property damage and are not related to the condition of the structure. The DWR requires emergency action plans to be developed for Hazard Class C dams. In May 2007, this requirement was extended to include Hazard Class B dams.

The Hazard Mitigation Plan also includes a summary of flood control levees in Kansas (Table 3). Levees, along with dams, are engineered to withstand floods with a computed risk of occurrence (100-year flood).

Watershed Districts

The eight [watershed districts](#) in the Marais des Cygnes basin have developed general plans, approved by the SCC or the Natural Resources Conservation Service (NRCS), that describe the location and floodwater storage capacity of flood control retention and detention structures. Most impound water even during non-flood conditions and many have benefits in addition to flood control. General plans also include watershed protection actions including construction of terraces, grassed waterways and grade control structures to limit sediment delivery to the structures.

Watershed districts have the authority to levy taxes on residents within the district to be used for operating expenses, new structure construction, and routine maintenance of infrastructure. Local funding can also be used to implement best management practices (BMPs) to restore wetland and riparian areas that also provide flood detention benefits.

Funding for construction of watershed structures comes from federal, state and local sources (Figure 1). Construction under the NRCS P.L. 83-566 Program in the basin includes a total nine structures built in the Frog and Middle Creek Watersheds. NRCS activity peaked in Kansas in 1964 with over 70 structures completed. There has been no funding in Kansas under the program since 2006.

One hundred SCC watershed district structures are in place with two pending permits in the basin. State assistance to the watershed dam construction program peaked in 1994 at about \$1.6 million (Figure 2).

Local Floodplain Development and Management

Expansion of urban development in floodplains has increased the potential for flood damage. Future flood damages may be reduced by preventing inappropriate development in flood prone areas. Local governments can implement floodplain management through use of planning and zoning authority. There is no state

requirement for local units of government to implement floodplain management.

By minimizing structural development in floodplains, the land is available to allow flood waters to spread out, thus slowing the water and reducing erosive potential. Culverts and bridges can be designed to minimize flood damage by allowing adequate space for floodwater conveyance which reduces backwater effects and damage to upstream areas. Roads can be designed to be at elevations high enough to minimize floodwater encroachment. Increased watershed storage of floodwater in key areas can also reduce the volume of runoff, reducing impacts to structures.

Nonstructural mitigation measures including forecast and warning systems, and wetland and riparian areas can reduce flood damages. The National Weather Service (NWS) provides river stage and flood forecasts for the basin through its Missouri River Basin Forecast Center located in Pleasant Hill, Missouri. The Kansas Mesonet Steering Committee selected priority counties for new automated weather stations in 2008. River Forecast Center needs were considered in this process and additional near real-time hourly [precipitation](#) data stations are planned for Wabaunsee, Osage and Miami counties. This network will be informative in developing future design standards for permitted stream obstructions.

Watershed Planning Coordination

The 2005 Flood Management Policy Section of the *Kansas Water Plan* recommends multi-objective management of flood prone areas and the incorporation of nonstructural measures into watershed district plans to further reduce flood damage while providing other benefits. The 2007 Kansas Hazard Mitigation Plan supports incorporating nonstructural measures into wetland and riparian management plans to further enhance the reduction of damage from floods.

Since 2005, the state has coordinated the development of Watershed Restoration and Protection Strategies (WRAPS). Local WRAPS groups develop management plans to address locally identified priority issues. Each watershed district in the basin is also within an area covered by a WRAPS.

Recommended Actions

1. Assess the effectiveness of existing flood control infrastructure and develop plans to address necessary improvements.
2. Address repair of damaged flood control structures and deferred maintenance.
3. Determine the current floodplain status and promote model ordinances and BMPs to local units of government. Promote limiting development in the 100-year floodplain using FIRMs to delineate prohibited areas.
4. Engage basin WRAPS groups, watershed districts and federal agencies to integrate flood management with existing floodplain and riparian programs. Assess and inventory watersheds to identify potential locations for nonstructural flood control measures.
5. Examine the basin application of nonstructural flood controls.
6. Purchase properties having repetitive flood damage and prevent redevelopment of these areas.
7. Develop emergency plans for high hazard dams still needing them.
8. Complete breach inundation zone mapping.
9. Coordinate with DWR, Water Structures Program to determine if increased hydrologic and hydraulic evaluation of stream obstructions should be considered in the Marais des Cygnes basin in areas particularly prone to flooding. Identify and evaluate areas where flooding may be attributed to permitted stream obstructions. Consider the costs to repair flood damages against the costs to implement watershed

based permitting.

10. Coordinate with county emergency management agencies on development of county-wide All Hazards Mitigation Plans.

Resources

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Marais des Cygnes Basin High Priority Issue Watershed Restoration and Protection Approved January 2008

Issue

Water quality is addressed through a combination of restoration and protection efforts using both voluntary incentive-based approaches and regulatory programs. The restoration and protection of watersheds, particularly those watersheds above public water supply reservoirs, is a priority in the [Marais des Cygnes Basin](#). Growing [populations](#) in the northern portion of the basin, combined with a corresponding increase in the demand for water make the restoration and protection of these watersheds were important.

Description

There are three federal reservoirs, Pomona, Melvern and Hillsdale, in the Marais des Cygnes basin. All of these reservoirs are operated by the U.S. Army Corps of Engineers (Corps). The federal reservoirs are used for public water supply that serve numerous cities and rural water districts in the basin, primarily in the rapidly growing areas in the northeast portion of the basin. These reservoirs are also managed by the Corps for flood control and recreation.

Hillsdale and Pomona reservoirs and many streams within the basin are experiencing water quality impairments. Fecal coliform bacteria and low levels of dissolved oxygen are the most prevalent stream impairments. Sedimentation and eutrophication (nutrient loading) are the primary water quality problems affecting reservoirs in this basin.

Reservoir sedimentation is a major water quantity concern, particularly in reservoirs where the state owns water supply storage. As sediment accumulates in a reservoir's multipurpose pool, the capacity for water supply storage is reduced. Figure 1 shows the estimated capacity lost, including water supply storage, to sediment deposition in federal reservoirs in the basin since construction.

Water Quality Impairments

[Surface waters](#) not meeting water quality standards in the basin are included on the 2006 303d list. High priority Total Maximum Daily Loads (TMDLs) for impaired surface waters in the Marais des Cygnes basin were originally submitted to the Environmental Protection Agency for approval on June 30, 2001 by the Kansas Department of Health and Environment (KDHE). An additional round of TMDL development was completed in 2007 (Figure 2, Table 1). High priority TMDL watersheds are used to target technical and financial assistance for implementation of nonpoint source pollution management practices to address designated pollutants.

A TMDL is the maximum amount of a pollutant that a water body can receive without violating water quality standards. Since pollution can arrive via point and non-point sources, the TMDL development process identifies contributing sources for the pollutant loads.

Surface Water Nutrient Reduction

Nutrient sources within the basin include both point and non-point sources. The major point sources in the basin include large wastewater treatment plants, which are regulated under the National Pollutant Discharge Elimination System (NPDES) Program (Figure 3).⁽⁶⁾

Nonpoint sources of pollution include both agricultural and urban areas. Table 2 shows the relative contribution of point and non-point sources in the Marais des Cygnes basin for total phosphorus (TP) and total nitrogen (TN) leaving the state.

The Kansas Surface Water Nutrient Reduction Plan, developed by KDHE, outlines a statewide strategy for reducing the export of TN and TP in surface waters leaving the state. This involves additional reductions in

nutrients from point source discharges through the NPDES Program and reductions in nonpoint sources through development and implementation of Watershed Restoration and Protection Strategy (WRAPS). The Nutrient Reduction Plan includes Improvement Potential Index (IPI) maps for Kansas counties for TP and TN reductions (see maps in Water Quality Policy Section). In the Marais des Cygnes basin, Anderson County showed the highest improvement potential for both TP and TN.

Source Water Protection

All [public water suppliers](#) in the basin completed Source Water Assessments in cooperation with KDHE in 2004. The next step, which is voluntary, is the development of source water protection plans.

Forty public water suppliers in the basin treat raw water. Twenty-two use [surface water](#) and 18 use ground water. Most residents in the basin get water from the Marais des Cygnes River, one of its major tributaries or one of the three federal reservoirs in the basin.

Each source water assessment included a susceptibility score which can help communities determine which contaminants pose the most significant threat to their water supply. A score, generated from the susceptibility analysis, indicates whether the susceptibility range is low, moderate or high for potential threats of contamination in an assessment area.

KDHE provided public water suppliers susceptibility scores in the following contaminant categories: microbiological, nitrates (applicable for ground water only), pesticides, inorganic compounds, synthetic organic compounds, volatile organic compounds, sedimentation (surface water only) and eutrophication/phosphorus (surface water only).

Of public water suppliers using ground water in the Marais des Cygnes basin, 67% had low susceptibility scores and 33% had moderate scores. Of public water suppliers using surface water, 45% had low scores, 45% had moderate scores and nine (figures rounded) percent had high scores. The most commonly identified problems with ground water were volatile and synthetic organic compounds, pesticides and microbes. The most commonly identified problems with surface water were volatile and synthetic organic compounds, inorganic compounds, sediment and eutrophication/phosphorus.

Development of a wellhead protection program is recommended. The development of a WRAPS is the best mechanism to ensure water quality protection for their public water supply for communities using surface water. The Marais des Cygnes basin has one approved source water protection plan and another in progress.

Wetland and Riparian Area Management

The primary approach to wetland and riparian area 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 BMPs. Water quality has been a primary focus with implementation efforts targeted to high priority TMDL watersheds (Figure 2). All conservation districts in the basin except Anderson and Coffey, have developed wetland and riparian protection plans.

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, reduced reservoir sedimentation, riparian and wetland management and other natural resource objectives.

Watersheds above the three federal reservoirs in the basin that serve public water supply needs have been identified as watersheds of significant state interest for WRAPS development and implementation. WRAPS projects have been initiated in each of the watersheds above the federal reservoirs. WRAPS have been prepared for the entire basin and the Marmaton watershed.⁽⁴⁾ Watersheds with WRAPS projects currently

underway in the basin encompass high priority areas for TMDL implementation, areas with a high improvement potential index for nutrient reduction, source water assessment areas and priority areas for wetland and riparian protection.

An important consideration for watershed restoration and protection in this basin, particularly in the northern portion of the watershed, is urbanization. Between 2002 and 2006, the combined population of Miami and Franklin counties increased by 4,278 or 7.5%.

As the amount of impervious surface in a watershed (i.e. rooftops, roads, parking lots, etc.) increases, water resources can be adversely impacted. Runoff volume increases and additional pollutants associated with urban environments may enter streams and ponds unless preventive steps are taken by local governments and urban residents. Sound land use planning and storm water management are essential to limit adverse effects.

Local [land use](#) planning and zoning efforts provide cities and counties effective tools to minimize the potential impacts of development on water resources. Urban stormwater management programs can be implemented to manage the amount of impervious surface in urbanizing watersheds and properly control increased runoff resulting from urbanization. Programs that provide technical assistance and education to urban residents regarding actions that can reduce or eliminate potential pollution sources also play an important role. These programs can be integrated with WRAPS projects to ensure a comprehensive approach to watershed management in urban areas.

Other Watershed Related Activities

- The 13 counties either wholly or partly within the basin have adopted local sanitary/environmental codes or participate in the Local Environmental Protection Program.
- All counties have countywide planning and zoning programs.
- All conservation districts in the basin have adopted nonpoint source pollution management plans. Grants under the State Water Quality Buffer Initiative have also been awarded in nine counties in the basin supporting buffer coordinators and facilitating enrollment of stream buffers in continuous CRP.
- Of cities in the basin, only Ottawa is subject to the Phase II Permitted Municipal Separate Storm Sewer System under the NPDES Stormwater Program.
- As of December 2005, there were three active contamination sites being remediated through the *State Water Plan* (Contamination Remediation Program).
- There are eight 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.

Basin Specific Objectives

- Over 25% of the high priority TMDLs identified in 2001 and 2007 for the Marais des Cygnes basin will have data supporting their delisting as impaired on the 2012 Kansas 303(d) list.
- All public water suppliers will complete and implement a source water protection plan.
- Nutrient reduction goals will be included in all WRAPS projects within the basin and sediment reduction goals included in WRAPS projects above the three federal priority reservoirs.

- Integrate urban stormwater management goals into all urban area WRAPS and support the implementation of urban stormwater management projects as outlined in WRAPS action plans.

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 TMDLs and WRAPS action plans.

Resources

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Marais des Cygnes Basin High Priority Issue Water Supply Management and Conservation January 2009

Issue

Increasing [population](#) and development in portions of the [Marais des Cygnes basin](#) along with aging reservoirs and public water supply infrastructure indicates a need to evaluate the river/reservoir system capacity to meet future water supply needs in the basin.

In 2007, the Kansas Water Office (KWO) prepared an analysis of surface water supply and demand projections for selected basins in eastern Kansas.⁽¹⁾ The analysis utilized historic climate, streamflow and population information to predict the total water supply and demand in the basin over time. In those counties primarily served by the Marais des Cygnes River and supported by federal reservoirs, demand was predicted to exceed the total existing supply during a two percent probability drought in the year 2109. This estimate includes the current state-owned supply along with the purchase of water supply storage in Hillsdale Reservoir reserved for future state use. The analysis did not include that portion of the basin supplied by Marmaton and Little Osage Rivers or other areas not served by the mainstem of the Marais des Cygnes.

Also in 2007, KWO released updated *Guidelines for Municipal Water Conservation Plans* for use by public water suppliers. While the supply and demand analysis did include implementation of some conservation practices during drought, demand management could extend water supplies. Controlling water loss and enhancing treatment efficiency could further enhance demand management.

In 2008, KWO initiated the Reservoir Sustainability Initiative (RSI) to conserve and restore reservoir storage capacity and provide for long-term public water supply needs. Public water supply storage has been impacted by sedimentation in all the federal reservoirs in the basin. Maintaining this storage is critical to meeting future public water supply needs.

Description

Water Supply

Water supply in the basin is primarily provided by three federal reservoirs: Pomona, Melvern and Hillsdale, along with four State Multipurpose Small Lakes, city-owned lakes, ground water wells and natural stream flows. All of the streams in this basin are restricted so that no new appropriation rights are available for the time period July through September (typically the irrigation season) unless there is an alternate source of water shown to be available.

Based on bathymetric survey information and projected sedimentation rates, reservoir water supply storage and yield was calculated over time in the basin by KWO in 2002.⁽⁴⁾ The 2007 analysis of supply and demand in the Marais des Cygnes basin used the previously calculated yield available from the federal reservoirs in the basin along with natural flows to calculate the total available water supply in a severe drought similar to the 1950s. While the analysis showed adequate water supply in the basin into the next century, efforts are being made to reduce the rate of sedimentation in the reservoirs to extend the existing supply further.

The 2007 analysis was not structured to account for the quantity of water supply available in specific stream reaches under different conditions. A more refined modeling process using a computer model to identify water supply and demand at specific points in the basin has been initiated by the KWO in the Marais des Cygnes basin. Through the computer model, the available water supply at specific demand points and under various conditions in the basin can be estimated. KWO staff will work directly with water supply utilities, industry, other water users and the Marais des Cygnes Basin Advisory Committee (BAC) to obtain detailed information on expected water demand in the future. Minimum desirable streamflows (MDS) to support water quality along with aquatic life would be accounted for in the model.

Marketing and Assurance

Reservoirs provide dependable water supplies in streams with highly variable flow in addition to providing flood control, recreation and other benefits. The 1958 Federal Water Supply Act made storage in federal reservoirs available to local governments if they agreed to repay the cost of construction, operation and maintenance of the water supply storage. The State of Kansas has purchased water supply storage in each of the federal reservoirs in the basin. The state gave a commitment to the federal government in 1969 that the water supply storage in Hillsdale Lake would be purchased if it was included during development of the reservoir.⁽⁴⁾ Only a portion of this storage is currently being utilized; ultimately, all of the storage will be needed.

In 1985, through a Memorandum of Agreement (MOA) between the State of Kansas and the U.S. Army Corps of Engineers (Corps), water quality storage in Pomona and Melvern Lakes was reallocated to water supply storage and purchased by the state at the original development cost.⁽⁴⁾ The state purchased the maximum amount made available in the reallocation. In exchange for the significant reduction in cost, the state agreed to obtain water reservation rights for water quality storage and to protect water quality releases from diversion by water right holders.

The Water Marketing Program provides long-term (10-40 years) contracts for water supply for municipal and industrial uses only. [Customers of the Marketing Program](#) pay for water on a per 1,000 gallon basis and the state pays costs of the capital investment along with the annual operation and maintenance. The marketing rate is based on the combined costs for the 10 reservoirs where the state has purchased storage. The state currently has storage in Hillsdale and Melvern Lakes committed to the Water Marketing Program in the Marais des Cygnes basin. Hillsdale storage will be brought into service incrementally only as additional water supply is needed under the Water Marketing Program.

Prior to the KWO entering into negotiation for a contract under the Water Marketing Program, a determination is made by the Kansas Water Authority (KWA) that the proposed withdrawal and use of water is in the interest of the people of the State of Kansas. The amount of water that can be contracted is limited to a quantity that is estimated to be available during a significant drought. Water not needed to meet long-term contract obligations can be acquired annually under a surplus contract. Surplus contracts are only good for one calendar year. To date, there have been no surplus contracts in the Marais des Cygnes basin.

Access to water in storage is also available through the Water Assurance Program that operates the Marais des Cygnes basin reservoirs as a system, maximizing the availability of water. Through this program, municipal and industrial water right holders that have formed a district can purchase storage in federal reservoirs. Under agreements negotiated with the state, water in the purchased portion of reservoir storage is released during dry periods to support the water rights of assurance district members. These releases are protected from diversion by other users.

The Marais des Cygnes Water Assurance District was formed in 1990 with seven municipal and industrial water right holders.⁽⁴⁾ The District has purchased a portion of the water supply storage in Pomona and Melvern Lakes. Additional reserve storage at Melvern and Pomona is owned by the state but is not currently committed to either the Water Marketing or Assurance programs. This storage will be sold to the Assurance District or committed to the Water Marketing Program incrementally as demand requires.

The key difference between the Water Assurance Program and the Water Marketing Program is that the water assurance districts own the storage in the reservoirs in the particular basin and pay only the principal and interest and operation and maintenance costs associated with that reservoir storage, as well as costs of the administration and enforcement dedicated to the program. These costs are pooled in the Water Marketing Program for all state-owned reservoir storage and customers pay a statewide averaged rate.

Water Demand

In the 2007 KWO supply and demand analysis, demand was combined for the basin in the same manner as water supply.⁽¹⁾ [Population](#) estimates were developed from the Kansas Division of Budget projections to the year 2027. These trends were further projected as necessary in the supply and demand analysis. Entire

counties were assigned to the basin based upon predominance of area *and* existence of larger incorporated areas. The Marais des Cygnes corridor in the analysis included Osage, Franklin, Miami, Anderson and Linn counties.

Municipal and Industrial Demand

Water demand associated with population projections is based on municipal water use as gallons per capita per day (gpcd) usage reported to the Kansas Department of Agriculture-Division of Water Resources (DWR), for 2000 through 2004 by suppliers in the basin.⁽⁶⁾ The quantity of water that municipalities sold for non-domestic use is not included in those gpcd calculations but was added to the total. To develop the projected water use from industry, commerce, agriculture and recreation, all non-municipal surface water points of diversion within five miles of the mainstem of each basin were included.

The estimated [surface water](#) demand increase in the Marais des Cygnes River corridor is primarily associated with the population growth projected to occur in Miami County. While a significant increase in demand was demonstrated in the recreational sector in Linn County over the last 12 to 15 years,⁽¹⁾ recreation water use (waterfowl marshes) was limited to current levels since there is little to no suitable land remaining near the mainstem in the county that has not already been developed.

The Kansas Division of Budget projections from the 2000 U.S. Census did not indicate significant future growth for Franklin County. There has been development of new industry and distribution centers in Ottawa since the last census and Franklin County is anticipated to show population growth in the next census. Updated growth projections can be incorporated in the OASIS model to more accurately reflect these changes as described below.

Refining Supply and Demand Projections

The KWO is currently using the simulation of Operational Analysis and Integrated Systems (OASIS) computer software product to further analyze the supply and demand in the Neosho and Marais des Cygnes basins. OASIS models the operations of the river/reservoir system by simulating the routing of water through a system represented by nodes (reservoirs, cities, etc.) and arcs (rivers). OASIS can account for physical constraints such as reservoir capacity, evaporation and sedimentation. The model can also account for system management issues such as minimum release requirements and lake level management plans.

The advantage of OASIS modeling is that it can simulate the interaction of multiple reservoirs and rivers in a system. OASIS can also identify “problem areas” in a system and evaluate alternative improvements (off-stream storage, new reservoirs, dredging, reallocation, etc.). The KWO will be working with all users in the Marais des Cygnes River corridor to identify supply and demand options. These options will be tested through the OASIS model and the results shared with basin stakeholders.

In-Reservoir Demand

Water held in storage at federal reservoirs supports water-based recreation and associated economic activity. In 2007, the Corps performed an economic analysis of recreation at their lake projects.⁽⁷⁾ Four components were analyzed to estimate economic effects: recreation spending, visitor use estimates, capture rates and economic multipliers. Hillsdale, Melvern and Pomona Reservoirs had a combined 1,075,471 visits in 2006. These visits were estimated to produce \$26.25 million in total direct sales along with \$13.12 million in value added through wages, salaries, payroll benefits, profits, rents and taxes. The three reservoirs were estimated to support 376 jobs in local communities.

Recreation use varies by season and reservoir condition with activity reduced during periods of flood storage and low water conditions. Lake level management plans for each reservoir are designed to maximize fish, wildlife and recreation benefits during periods of adequate inflow. Storage contracted under the Water Marketing and Assurance Programs is designated for municipal and industrial water supply.

Water Conservation

Water conservation and demand management are essential components of extending water supplies. Demand management is not a concept that has been routinely incorporated in water utility operations. With the recognition of the potential for future water supply shortages, water suppliers and communities should begin to incorporate this concept into their planning. Demand management may include less water-intensive landscaping, low water use plumbing, conservation design for urban areas, water reuse and other elements.⁽³⁾ A movement beyond excessive use of water into more sustainable long-term management is needed.

Local [land use](#) planning and zoning authorities provide cities and counties with effective tools to minimize the impacts of development on water resources. Counties with planning and zoning regulations often require landscape plans for new development. While landscaping can provide aesthetic and environmental benefits, heavily irrigated landscape designs can increase demand on public water supplies. Of the counties either partly or wholly within the Marais des Cygnes basin, all are zoned with the exception of Bourbon County.

Conservation of reservoir storage has received attention as the impacts of sedimentation become increasingly apparent. While supply in the basin is adequate in the near term, the closures of recreation areas and algae blooms due to siltation in reservoirs in other areas of the state are indicators of a general loss of water supply. Research has been conducted on the causes of reservoir storage loss and on identifying solutions.⁽⁵⁾ Solutions generally fall into short-term measures such as more efficient reservoir operations and longer-term strategies to restore storage. Examples of reservoir operations include pool reallocation, raising dams/pools, modification of operational rules. Restoration includes dredging, reservoir flushing, treatment of the upstream watershed to limit erosion or other means of removing accumulated sediment. Protection and restoration of streams, wetlands and riparian areas in the watershed and also measures to reduce sedimentation.

Recommended Actions

1. Work with stakeholders to identify options for supply and demand management including: reservoir pool raise, pool reallocation, dredging, new supplies, modification of reservoir operations, operation of Water Marketing and Water Assurance Programs and conservation measures.
 - a. Test various options through the OASIS model.
 - b. Share information with stakeholders from the basin model including supply and demand information for specific stream segments.
 - c. Implement the most beneficial and cost-effective options.
2. Encourage incorporation of water demand management into utility operating plans. Demand management should include education and interaction with the development community and existing local authorities.
3. Compare annual Corps visitation figures to pool conditions during the primary recreation seasons. Determine when high and low pool levels create impacts on recreational use.

Resources

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