Middle Arkansas River Subbasin

Management Strategies

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Subbasin Water Resource Management Program

Division of Water Resources
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Disclaimer

All recommendations and suggestions made by the working group are based on information supplied from the Division of Water Resources. The working group disclaims any responsibility for the assumptions that have been derived from the analysis of this data and information. The working group and the water users in the Middle Arkansas are not bound by the management strategies. Participation does not act as a forfeiture of any rights.

The Middle Arkansas Working Group advocates incentive-based conservation measures that are strictly voluntary. If mandatory measures are instituted, the recommendation of the working group should not be used as a bar to any legal defense or challenge. The working group reserves the right of any Middle Arkansas water user to assert any appropriate legal claim.

The Division of Water encourages development of voluntary conservation measures that do not conflict with the Kansas Water Appropriations Act, and the regulations promulgated there under by the Chief Engineer.

I. Introduction

In 1998, the Kansas Department of Agriculture, Division of Water Resources, Sub-basin Water Resource Management Program (SWRMP), residents of the Middle Arkansas Sub-basin and other governmental agencies came together in a working group to address issues related to water resource concerns in the region. The program is funded by State Water Plan funds and is designed to take a proactive approach in developing water management strategies that address declines in stream flows and groundwater levels. A goal of the working group is to maintain a healthy groundwater and surface water system with long-term management strategies that fall within the framework of state water law. The proposed management strategies recommended by the Middle Arkansas Working Group focus on voluntary incentive based programs with water use goals to be met by 2015.

Throughout the course of this project, the working group has evolved into a knowledgeable working group in respect to understanding the hydrological conditions of the sub-basin. Active participants in the group represent numerous interests, including but not limited to: Groundwater Management District #5, Municipalities, Water Pack, County Conservation Districts, Kansas Department of Health and Environment, Kansas Wildlife and Parks, Kansas Department of Agriculture, Division of Water Resources, Kansas Livestock Association, and other interested parties.

The working group has concentrated efforts on developing voluntary approaches in lowering water usage in the sub-basin, rather than imposing strict administration of water rights. As a result, the implementation of these strategies will not provide a "quick fix" solution to the issues of the region. The success of these management strategies, as well as their degree of effectiveness, will depend upon the education and participation of the water users in the Middle Arkansas River Sub-basin. The working group recognizes the need to evaluate additional information and data related to the Upper Arkansas and the impact to Middle Arkansas Sub-basin. Additional recommendations may be included into future proposals as data and information is completed.

Recommendations and suggestions made by the working group are based on technical information compiled or supplied by the Division of Water Resources. The working group disclaims any responsibility for the assumptions that have been derived from the analysis of this data and information.

II. Background Information

A. Physiography

The Middle Arkansas River Sub-basin encompasses approximately 781,455 acres in south-central Kansas. Portions of Barton, Edwards, Kiowa, Pawnee, Rice, Rush, and Stafford counties make up the sub-basin; approximately three-fourths lies inside of Groundwater Management District No. 5. *(See map, figure 1)*

The region consists of uplands north of the river covered in semi-permeable loess and terrace deposits. South of the river is a region of more permeable unconsolidated sediments, covered by sand dunes. Layers of sandstone, shale, and limestone underlay the entire region.

Groundwater is withdrawn from both the alluvial and Great Bend Prairie aquifers. Both are composed of unconsolidated, interbedded silt, clay, sand, and gravel. Clay stringers interbedded with sands and gravels may occur locally, yet are not continuous, making it difficult to differentiate between the two groundwater sources. Clay stringers are approximately 10 feet thick and allow for a distinction between the alluvial and High Plains "Great Bend Prairie" Aquifer systems. It is common for irrigation wells in this area to tap into the Great Bend Prairie Aquifer, or the "second water" as referred to locally, rather than the alluvial aquifer. Water quality may play a role in this decision.

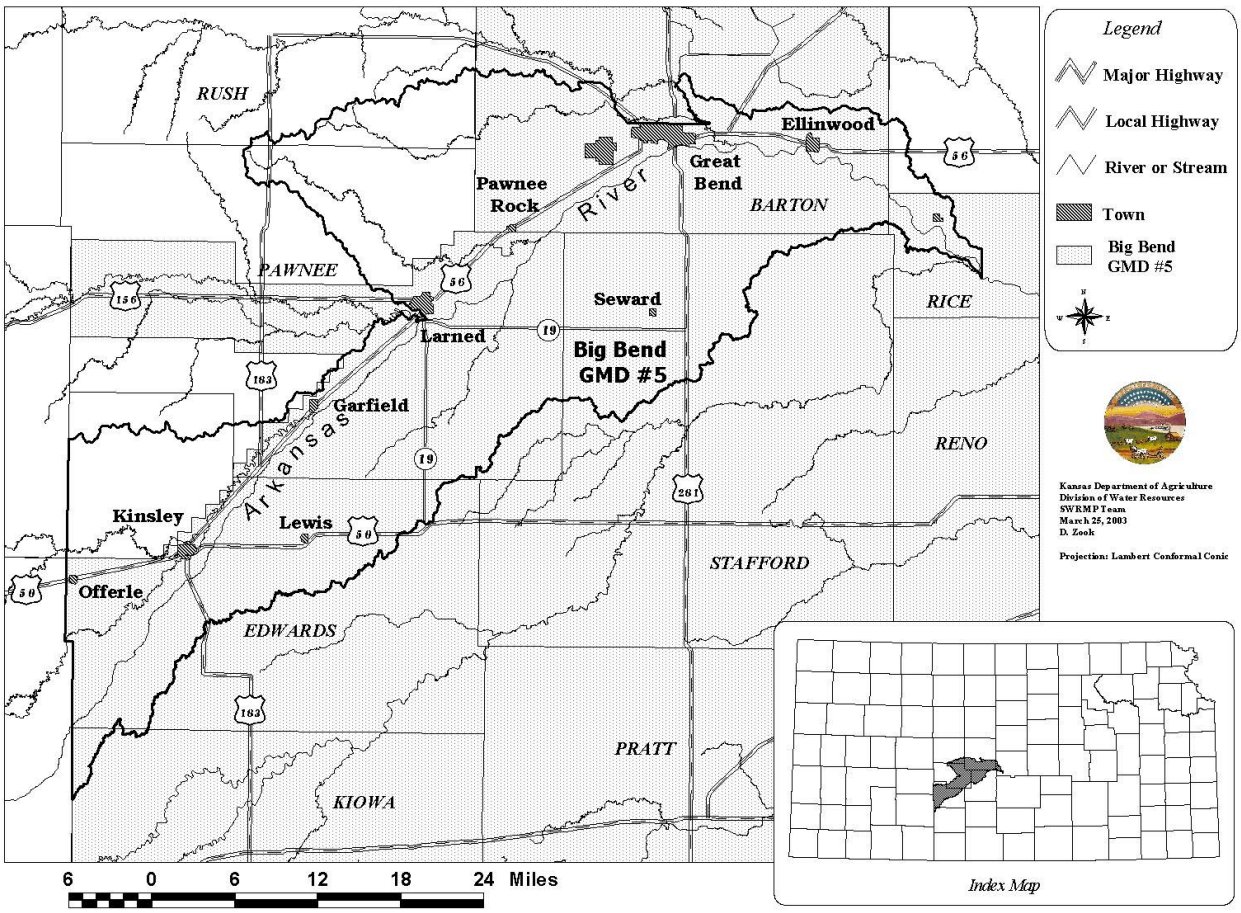

Figure 1 - Map of the Middle Arkansas River Sub-basin area.

B. Precipitation

Climatic conditions can be highly variable with some areas receiving large amounts of rain and others lacking significant rainfall. The average precipitation for the region ranges from 23.63 inches in the west to 28.25 inches per year in the east from 1971 to 2000 (source: Kansas State University Extension & Services and the State Climatologist, Mary Knapp). The extreme variations in the average amount of precipitation for the years 1971 to 2000 and for all counties

included in the Middle Arkansas River Sub-basin range from a high of 42.82 inches in 1973 to a low of 15.25 inches in 1988. (Figure 2)

Precipitation 1971-2000	Barton	Edwards	Kiowa	Pawnee	Rice	Rush	Stafford	Average
Minimum - 1988	12.99	15.42	16.59	13.63	17.41	15.76	14.98	**15.25**
Maximum - 1973	42.63	43.00	42.21	39.50	47.49	43.05	41.89	**42.82**
Average	26.62	26.75	25.49	23.99	28.25	23.63	26.03	**25.82**

Table 1 – Minimum, maximum, and average precipitation amounts occurring within the Middle Arkansas River Sub-basin. The minimums and maximums show the year occurrence.

Annual runoff ranges from 0.75 inches in southwestern portion of the sub-basin to 2.0 inches in the northeastern portion of the sub-basin (**K.A.R. 5-13-7,** section e, **"**figure 12 -- mean annual runoff in Kansas," dated June 1982, published by the Kansas water office). The wettest months typically occur in the spring and early summer. Low intensity rains that continue for several days at a time saturate the soil, providing periods of groundwater recharge. Targeting long-term management strategies are dependent on understanding the climatic variations of an area.

C. Streamflow

The Arkansas River flows in an easterly trend from the Colorado/Kansas state line until it reaches the Ford/Edwards county line, where it begins to flow in a northeasterly trend. It continues northeasterly, until approaching Great Bend, where it gradually turns and flows east/southeast to the Kansas/Oklahoma state line.

Since 1975, the number of days of no flow at the USGS gage at Dodge City has outnumbered the number of days of measurable streamflow. At times, the High Plains Aquifer no longer contributes baseflow to the Arkansas River as well as the river flow has diminished over time and is not readily available to recharge the aquifer system. Linear trends back to the 1940's reflect a continued decline in streamflow along the Arkansas River at the USGS gages at Dodge City, Kinsley, Great Bend, and Rozel on the Pawnee River. The working group recommends that streamflow data be further evaluated between the Upper and Middle Arkansas River Sub-basins.

D. Groundwater

The High Plains aquifer system has an average depth to water of less than 20ft within the Middle Arkansas River Sub-basin. This aquifer system is considered unconfined except for some places where water is confined or semiconfined (Fader and Stullken, 1978). The water levels tend to respond rapidly following a significant precipitation event in some areas, while in other areas the water levels have a **delayed** response, possibly due to the presence of clay layers.

The direction of groundwater movement and slope vary, but the general flow trend is toward the northeast (south of the river) and toward the southeast (north of the river). The average gradient for the Arkansas River is slight, at approximately 7.5 ft/mile (Latta, 1950), whereas the groundwater gradient is steeper in the southwest corner of Edwards County, at 15 ft/mile

(McLaughlin, 1949). The differences in the groundwater gradient can be accounted for by several factors including "local differences in the permeability" of the aquifer substrate. Local flow regimes can be affected by natural and anthropogenic factors allowing stream flow to infiltrate into the local aquifer system, creating losing stretches in stream segments. Withdrawals, especially during dry periods, have caused water level fluctuations resulting in groundwater declines that have reduced or eliminated baseflow to the stream. The Arkansas River valley is capable of responding to significant amounts of precipitation, thus providing recharge to the aquifer system and even raising water levels above pre-development levels in some areas. Saturated thickness of the aquifer system varies across the sub-basin because of the geology and subcroppings or outcroppings of the Cretaceous stratigraphy in the region. Cretaceous age strata underlie the unconsolidated alluvium in the majority of the Middle Arkansas River Sub-basin and are considered the bedrock surface (Fader and Stullken, 1978).

The Division of Water Resources, Kansas Geological Survey, and Groundwater Management District #5 collectively measure over a 100 wells, monthly, quarterly, or annually. Data from these wells have assisted in identifying areas with changes in water levels.

Overall, the historical well data indicates a lowering in groundwater levels over a 30-year period, with above average recharge occurring throughout the sub-basin in the past decade. Research of historical water level data indicates that saturated thickness in the southern area of this sub-basin has been reduced and is changing the groundwater gradient away from the river.

The average water use reported for all water use types to the Division of Water Resources from 1988 to 2000 is approximately **60.12 percent** of authorized quantity. Agricultural irrigation comprises the largest portion of authorized groundwater use in the Middle Arkansas Sub-basin. *(See Table 2)* The Kansas Department of Agriculture, Division of Water Resources (KDA/DWR), Water Information Management and Analysis System (WIMAS) indicate that there are approximately 187,000 acres authorized for irrigation in the region with authorized appropriations of approximately 222,000 acre-feet. The average irrigation water use reported to the Division of Water Resources from 1988 to 2000 is approximately 65.09 percent of authorized quantity.

Water Use and Authorized Quantities within Middle Arkansas River Sub-basin
Numbers are in Acre-Feet

	Use Made of Water				
Year	Irrigation	Industrial	Municipal	Recreation	Stock Water
1988	172,905	2,693	5,054	8,459	1,078
1989	161,256	2,633	4,571	5,281	1,145
1990	174,408	1,286	4,405	5,676	1,022
1991	192,065	1,251	4,770	481	975
1992	102,972	1,292	4,229	446	952
1993	82,160	1,800	3,968	352	876
1994	178,325	1,982	4,693	392	1,043
1995	145,853	2,127	4,204	150	1,064
1996	117,007	2,041	4,200	370	1,446
1997	108,404	1,905	3,826	3,886	1,418
1998	150,490	1,828	4,248	1,271	1,159
1999	131,433	1,842	4,020	3,706	1,153
2000	164,240	1,976	4,178	9,925	1,348
Average Water Use 1988 - 2000	144,732	1,897	4,336	3,107	1,129
Authorized Quantity	222,374	6,668	7,701	18,885	2,520
Percent of Average Water Use from Authorized Quantity	65.09%	28.44%	56.31%	16.45%	44.81%

Average Total Water Use 1988 - 2000	155,201
Total Authorized Quantity	258,147
Percent of Total Water Use from Total Authorized Quantity	60.12%

Table 2 – Total Authorized Quantity (acre-feet) by Water Usage: KDA, Division of Water Resources. ***Term permits are not included in the analysis.***

E. Groundwater and Surface Water Economy

Irrigation is a prominent and important economic practice in the sub-basin and is utilized for the production of grain, row, and forage crops. Local as well as state economies are highly dependent on this area's water resources for agriculture and other industries. Entities such as school districts and county governments all rely on the irrigated economy generated by the river and aquifer in this area. A 1990 economic impact study conducted by Water PACK reflected irrigated agriculture generated approximately 349 million dollars that year through additional jobs and related services in the counties located within the Middle Arkansas Sub-basin (Water PACK, 1991).

Part of developing the long-term water management strategies for the Middle Arkansas Sub-basin involves understanding the irrigation systems, practices, and conservation efforts presently utilized. To assist in this understanding, the KDA/DWR coordinated with the Middle Arkansas Working Group to develop and compile an irrigation survey. The irrigation survey results provided the working group information to base management strategies.

In addition, visitation to Cheyenne Bottoms has averaged over 60,000 people annually since 1996 (Kansas Department of Wildlife and Parks, 2003). With 15 to 17 percent of all hunters and hundreds of bird watchers each year being from out-of-state, the economic impact to the state and local economy is significant

A portion of surface water use in the Middle Arkansas Sub-basin is dedicated to the maintenance of the Cheyenne Bottoms Wildlife Area. The Cheyenne Bottoms diversion structure and water conveyance system was constructed in 1954 to augment and preserve approximately 13,000 acres of fresh water marsh. Cheyenne Bottoms is certified to divert a maximum of 18,185 AF from the Arkansas River. Additional water is obtained through regulated diversion of the Walnut Creek. Natural flows from Blood Creek and Deception Creek contribute during high precipitation events. The Bottoms were renovated during the 1990's, reducing pool size, developing water storage, installing pump stations, and improving existing structures.

Cheyenne Bottoms is an internationally recognized wetland, well known for its role in sustaining large numbers of migratory birds. Estimates place 45-percent of the North American shorebird population passing through this wildlife area during spring migration. In addition, it provides critical habitat for several threatened and endangered species. The Ramsar group has officially listed the Bottoms as a "Wetland of International Importance", one of only 18 such sites in the United States, and the second in the American heartland. In addition, the Western Hemisphere Shorebird Reserve Network has recognized Cheyenne Bottoms as a Hemispheric Shorebird Reserve.

Clearly, the restoration of a healthy Arkansas River is vital to several segments of the economy and affects a broad spectrum of Kansas's residents. The health of the River has impacts far beyond the Rivers' Sub-basin in terms of human and wildlife use.

F. Groundwater Recharge

Groundwater recharge can be separated into various components that include natural and anthropogenic sources. These factors include recharge through precipitation, surface water by streambed infiltration, and accumulated surface water such as ponds, lakes, etc. Increased or induced recharge can occur where farm cultivation practices and irrigation allow more infiltration to occur than other areas where native grasses occur. (Hecox and others, 2002)

There have been numerous studies by federal, state, and local agencies, in this region, to quantify an average annual recharge value. It is important to note that utilizing any recharge value is a matter of picking an estimate. This quantity varies with time and location, and therefore must carry with it some degree of uncertainty. Management strategies should be developed that minimizes the risk of undesirable consequences, such as depleting the aquifer at a rate faster than its being replenished.

G. Potential Surface Water Recharge

Groundwater use did not play an important role in stream discharge until after widespread expansion of center-pivot irrigation systems in the 1960's through the 1970's, because few large capacity wells were in operation until that time. The Upper Arkansas River generated a substantial amount of flow up to the early 1880's when dramatic changes occurred directly related to the withdrawal of surface and groundwater. Decreases in discharge began with expansion of irrigation ditches in the late 1800's and early 1900's. With the completion of John Martin Reservoir in the late 1940's, maximum flows were replaced with increased frequency of minimum flows. (Sophocleous and others, 1993) Currently, only minimal flows begin east of Dodge City and continue eastward to Great Bend except during rare large run-off events or flood pool releases at John Martin Reservoir in Colorado. These high surface water flows will begin infiltrating into the underlying aquifer as recharge to the groundwater. This loss of maximum flow from the Upper Arkansas has eliminated one recharge source for the Middle Arkansas. These factors should be taken into consideration when evaluating the sub-basin.

H. Data Collection and Monitoring

The Middle Arkansas River SWRMP conducts streamflow measurements at ten sites along the Arkansas River. In addition, the USGS has three gaging stations located at Kinsley, Larned, and Great Bend. The KGS and SWRMP have installed six monitoring wells within half mile of each of the three gaging stations in the alluvial aquifer. The KGS also installed additional deeper wells at the Larned gaging station in the Great Bend Prairie Aquifer.

Data from monitoring these well sites and gaging stations is for understanding stream infiltration rates, stream-aquifer interaction, effects of groundwater pumping, and groundwater flow directions. In addition, streamflow data already collected has allowed for the classification of streamflow in terms of "gaining" and "losing" stretches of the stream.

Most of the wells measured monthly are located near the Arkansas River. Some measurements occur in a series or transect and give a cross-section of the river alluvial system. Other wells were chosen for the historical record of measurement. Quarterly well measurement sites provide seasonal data for analysis within the sub-basin area.

Continuation of monitoring the water levels is critical to understanding fluctuations that may occur throughout the year. During the growing season, variations in water levels can take place around areas of intense groundwater pumping. Historical records from some observation wells can give an indication of long-term stability or decline. The wells located within the alluvium area typically indicate seasonal fluctuations in water levels, where as wells located outside the alluvium in the high plains aquifer tend not to be as variable. Water levels in some areas outside the alluvium are declining.
Regional average evapotranspiration and precipitation data is acquired from Big Bend G.M.D. 5 weather stations within the Middle Arkansas Sub-basin area. Other precipitation data is obtained from the State Climatologists stations within the region.

Future methods of data acquisition will be primarily from the sources given above for short and long-term assessment of the sub-basins condition. Locating existing wells or installing new

wells that would add relevant information to the overall assessment process could derive new water level measurement information.

III. Management Objectives and Descriptions

Flows in the Arkansas River have declined over the past several decades to a point where flow at Dodge City is a rare occurrence. The Middle Arkansas River Sub-basin will continue to experience periods of low flow to even no flow in western and central sections of the sub-basin without streamflow from the west and additional water management strategies within the sub-basin to address groundwater level declines.

Maintaining baseflow (except during periods of extreme drought) in the river and slowing the declines in static water levels in priority areas are goals of the working group. The goals need to be dynamic in nature so to address variations in climatic and economic conditions. The development of voluntary incentive based management strategies will assist water users in meeting water use goals.

Conservation is being practiced in the Middle Arkansas River Sub-basin based on irrigation survey conducted in 2002. Irrigators in the sub-basin have conservatively used approximately 65.09 percent of their appropriated amount (average water use from 1988 to 2000); and yet, some areas of the sub-basin have experienced declines in water levels. Alternatives to mandatory reductions to water use include: 1) incentive based programs to reduce water use, 2) increase enforcement of existing water laws, 3) irrigation scheduling, and 4) public education. The water banking, water rights purchase and conservation of water are examples of voluntary-incentive based programs that will help meet the goals in conserving water in the Middle Arkansas River Sub-basin.

The Middle Arkansas Working Group is to determine the best measure to manage the river sub-basin and to maintain a healthy and sustainable groundwater and surface water system. It is in the public interest to manage water in the sub-basin to allow maximum benefits from the use of water in the area consistent with the long-term sustainability of the areas water resources. In order to meet long-term sustainable yield by 2015, efforts will need to be made by local water users to take advantage of the voluntary incentive based programs established by the Middle Arkansas Working Group and approved by the chief engineer. The goal of this management program is to conserve approximately 14,000 AF of water by 2015 using voluntary-incentive based programs. Voluntary programs are based on both short term and long term goals. The short-term goals will require a maximum level of participation. The long-term goals should provide additional savings to the project area and are goals based on funding availability.

A water budget analysis is under development for the sub-basin. Additional analysis will be conducted in the upper reaches of the Arkansas River Sub-basin to determine the affects water resource development may have had on the middle reaches of the stream system. Although, it may be necessary in the future for DWR to pursue alternatives for water resource management a mutual agreement between working group members and DWR has been reached to address the water budget analysis separately.

The Division of Water Resources will measure the level of voluntary participation on short-term goals and the amount of water saved through water conservation practices, field data collection activities, research, and water use reporting analysis. Water levels and streamflow will be monitored to measure whether goals are sustaining the groundwater and surface water system. If these goals are not met in the first three years, then alternatives will be reviewed by the committee and DWR in an effort to best address water resource issues in the sub-basin. **The Middle Arkansas Working Group recommends that water users file conservation plans with DWR to document participation in voluntary programs. The working group and DWR plan to research and develop ways that can protect participants from a penalty for conservation if in the future mandatory reductions are necessary.**

Short Term Goals

The following strategies should provide options for water users to voluntary save water in order to meet short-term goals:

Management Conversion

The Middle Arkansas River Sub-basin Working Group recommends that improvements to existing irrigation systems be eligible for improvements when identified. It is recommended that the sub-basin be eligible for Environmental Quality Incentives Program (EQIP) and State Conservation Commission (SCC) programs as a priority area. The working group has identified and ranked three priority areas for funds to be targeted. (Appendix B) For water users not participating in EQIP and SCC Cost-Share programs it is recommended for center pivot operators to voluntarily remove end guns to improve overall irrigation efficiency and to conserve water. The purpose of EQIP and SCC programs is to install 'water saving' practices in agricultural operations. The SCC Water Resources Cost-Share Program operates under **statutory authority:** K.S.A. 2-1915, as amended.

By inclusion into this program, water savings will:

- Improve irrigation systems;
- Enhance irrigation efficiencies;
- Convert to less water intensive commodities or dryland farming;
- Improve water storage through water banking and groundwater recharge;
- Mitigate the effects of drought
- Install other practices that improve groundwater or surface water conservation, as deemed by the USDA Secretary.

Source; *Ground and Surface Water Conservation - Environmental Quality Incentives Program (EQIP), Kansas Fact Sheet and Key Points,* July 2002*,* United States Department of Agriculture, Natural Resources Conservation Service

Funds made available through EQIP and SCC programs can supply cost-share and incentive payments for improvements on new and existing irrigation practices and systems. Factors affecting technological improvements are site-specific and limited to field characteristics.

System conversion should be recommended for upgrading existing systems to the highest level of efficiency. Cost-share programs and incentive payments to improve system efficiency can be attained through EQIP and SCC programs.

Estimated savings if practices are implemented:
(*Calculations are based on data retrieved from the 2002 Irrigation Survey and average reported water use during 1988-2000.)*
Average Annual Irrigation Water use 1988-2000: 144,732 AF

Lowering of Drop Nozzles from above-canopy to in-canopy
(Approximately 6% of center pivots are equipped with impact nozzles
And 58% are equipped with drop nozzles above the canopy)

7% savings to convert from Impact to drop nozzle
(144,732 AF*6 %(systems equipped*7 %(savings)*92% (participation) 560 AF

2-5% savings to lower drop nozzles into canopy 2-4 ft above ground
(144,732 AF ***58 %(systems equipped) *3.5 %(savings)***20% (participation) 588 AF

Flood to Center-Pivot Irrigation
(Approximately 18% of systems are surface irrigation with 12% indicating they would convert)
20% savings to convert from Flood to Center Pivot
144,732 AF * 18 %(flood systems) * 20% (savings) * 12% participation 625 AF

Voluntary Conservation of water (30% participation)
(Examples: End Gun Removal and Irrigating Fewer Acres)
Average Annual Irrigation water use for period 1988 to 2000: 144,732 acre-feet
10% conservation in water: 14,473 acre-feet *30% participation 4,342 AF

Tillage Practices:

The increased practice of conservation tillage should be utilized to increase soil moisture for reducing the amount of irrigation needed. Conservation tillage includes any system that leaves about a third of the soil covered after planting. These practices include no-till, strip-till, ridge-till, reduced tillage, or mulch-till. Other conservation management practices include scheduling crop rotation; analyzing soil conditions; analyzing soil temperature and moisture; regulating nutrient and weed management. This practice could net approximately ten percent of water conservation.

Practice could be implemented to meet the ten percent voluntary water conservation.

Enforcement Efforts:

Recommend administrative action on over-pumping. Enforce over-pumping immediately with implementation of conservation plan. The estimated savings is based on a query from WRIS for water use years 1997 to 2001 show the following range of values. The lowest over-pumping amount of 1,685 Acre-Feet occurred in 1997 and the highest amount of 6,630 Acre-Feet occurred in 2000. The average amount of over-pumping for the Middle Arkansas River sub-basin is 4,425 Acre-Feet for the past five years. Note: These quantities have not been field verified.

	1997	1998	1999	2000	2001	Average 1997 - 2001
Over-pumping Authorized Quantity	1,685	6,121	1,938	6,630	5,748	4,425
Over-pumping Authorized Quantity and Regional Quantity of 18 inches per Acre	935	3,431	674	2,977	2,247	2,053

*All values in Acre-Feet

Table 3 – Evaluation of over-pumping from 1997 – 2001

Estimated savings if practices are enforced: 4,425 AF

Education:

Recommend Kansas Water Office initiate activities with appropriate municipal stakeholders to educate municipal water users in the importance of water conservation. The activities could include public service announcements, information pamphlets, billboards, and public awareness meetings.

Long-Term Goals

The following management strategies will provide voluntary long-term goals for water users in the Middle Arkansas Sub-basin and are based on funding availability:

Stream Buffer Development

Recommend the landowners adjacent to streams and rivers participate in EQIP, CRP, and WCRP programs for the benefit of establishing healthy riparian zones. The goal of the Kansas Water Quality Buffer Initiative is to establish filter strips and riparian buffers for land adjacent to streams and rivers by providing incentives through enhancement of CRP contracts.

Participation in the Kansas Water Quality Initiative program can increase federal CRP rental payments by either 30% (for grass strips) or 50% (for riparian buffers).

Important benefits to enrolling in this program are:

- Reducing sediment load in runoff from 50% to 80%
- Removing up to 70% of nutrients and pesticides
- Removing up to 60% of certain pathogens
- Providing income from woodlands
- Providing habitat for fish and wildlife

The SCC operates the Kansas Water Quality Buffer Initiative under statutory authority: K.S.A. 2-1915, as amended.

Estimated savings if practices are implemented:
Approximately 5450 acres (250ft each side of stream) could potentially implement stream buffers along the Arkansas River. An estimated savings based on vegetation consumption could be between .6 to 1.3 AF/acre. A savings range could be 327 AF to 872 AF with an estimated 10% participation.

5450 acres * 95% (midpoint consumption level) *10% participation 517 AF

Water Banking

Recommend Water Banking program to be used as a means of flexibility of water rights that includes a conservation component. Conservation components of the water bank must meet requirements set forth in the act to minimize any hydrologic impacts from the operation of the bank. The act requires a minimum of ten percent savings. The water bank could provide water right holders the ability to deposit and lease groundwater. The water-banking program provides an additional option a water user has in the sub-basin to meet water use goals.

Estimated savings if practices are implemented:
Water use savings (15% participation)
155,201 AF *10% water savings component * 15% participation 2,328 AF

Water Rights Purchase Program

Recommend consideration of the Water Rights Purchase Program to place water rights into the custodial care of the State from designated priority areas as a possibility for the sub-basin. Water savings are based on the purchase one water right per year. The SCC operates the Water Rights Purchase Program under statutory authority: K.S.A. 82a-701 and K.S.A. 2-1915 and 1918

Estimated savings if practices are implemented:
The average water right is approximately 195AF for a center pivot system. 195 AF

Water Rights Transfer Program

Recommend the consideration of the Water Rights Transfer Program be administered in parts of the Middle Arkansas River Sub-basin. Details of this program are still underdevelopment and may be available to water users at a future date. No water savings has been quantified for this program.

Investigate water savings options for Cheyenne Bottoms diversion canal at Dundee

Recommend that the diversion canal for Cheyenne Bottoms be studied for possible improvements for more efficient water conveyance.

Municipalities water savings (KWO statistical report) Add Date

Recommend municipalities adopt water conservation plans to take appropriate steps to conserve water.

Estimated savings if practices are implemented:
Average water consumption for region is 150 GPCD * 365 days = 54,750 GPC/yr/7.48 gal = 7,320 cubic foot/person/year. Approximate population size for Sub-basin is 24,000 * 7,320 cft = 175,680,000 cft/43,560 cft/acre = 4,033 AF annual use by municipalities

4,033 AF *10% participation 200 to 400 AF

Meter Compliance

Recommend enforcement of rules and regulations of meter operation and installation. Water users should replace or repair meters and insure proper maintenance procedures are followed. Enhanced enforcement could be done in coordination with the enforcement efforts for over-pumping.

Funding Options:

1. EQIP Funding
2. Kansas v. Colorado potential damage proceeds
3. State Conservation Commission
4. State Water Plan
5. Federal Grants

Sub-basin Evaluation Meetings

The chief engineer would establish a Middle Arkansas River Sub-basin Advisory Committee upon the approval of management strategies document. Each formal participant at the conclusion of the Middle Arkansas River Sub-basin project shall be invited to be a representative or shall be invited to recommend a representative. It is recommended the advisory committee meet on an annual basis to review hydrologic data and determine level of water savings in the sub-basin. Short-term goals should be met within the first three years. If goals are not met the advisory committee could make recommendations to the chief engineer concerning:

1. The evaluation and refinement of the management strategies of the sub-basin.
2. Recommend to the chief engineer approximately every three years any information pertinent to managing the sub-basin that will optimize efficient use of water and beneficial use of water in the area consistent with the protection of existing water rights and public interest.
3. Modifications can be recommended to the chief engineer if additional studies are conducted in the sub-basin indicating that such modifications are necessary so that groundwater use does not exceed long-term sustainability of the aquifer.

The advisory committee should consist of representatives from Kansas Department of Agriculture, Division of Water Resources, Big Bend Groundwater Management District, Kansas Department of Wildlife and Parks, Conservation Districts, Kansas Livestock Association, Water Pack, Municipality, and Mid Kansas Water Quality Association. Other representatives may be considered. This group will assist in implementing the short-term goals for irrigation season 2004. Public meetings will be held prior to the 2004 irrigation season to educate water users on the Management Strategies. Participation will be vital to the success of achieving the stated goals of this program.

A designated representative from the advisory committee would be appointed to attend the Upper Arkansas Sub-basin Advisory Committee meetings to give updates and status reports to be included in the State Water Plan.

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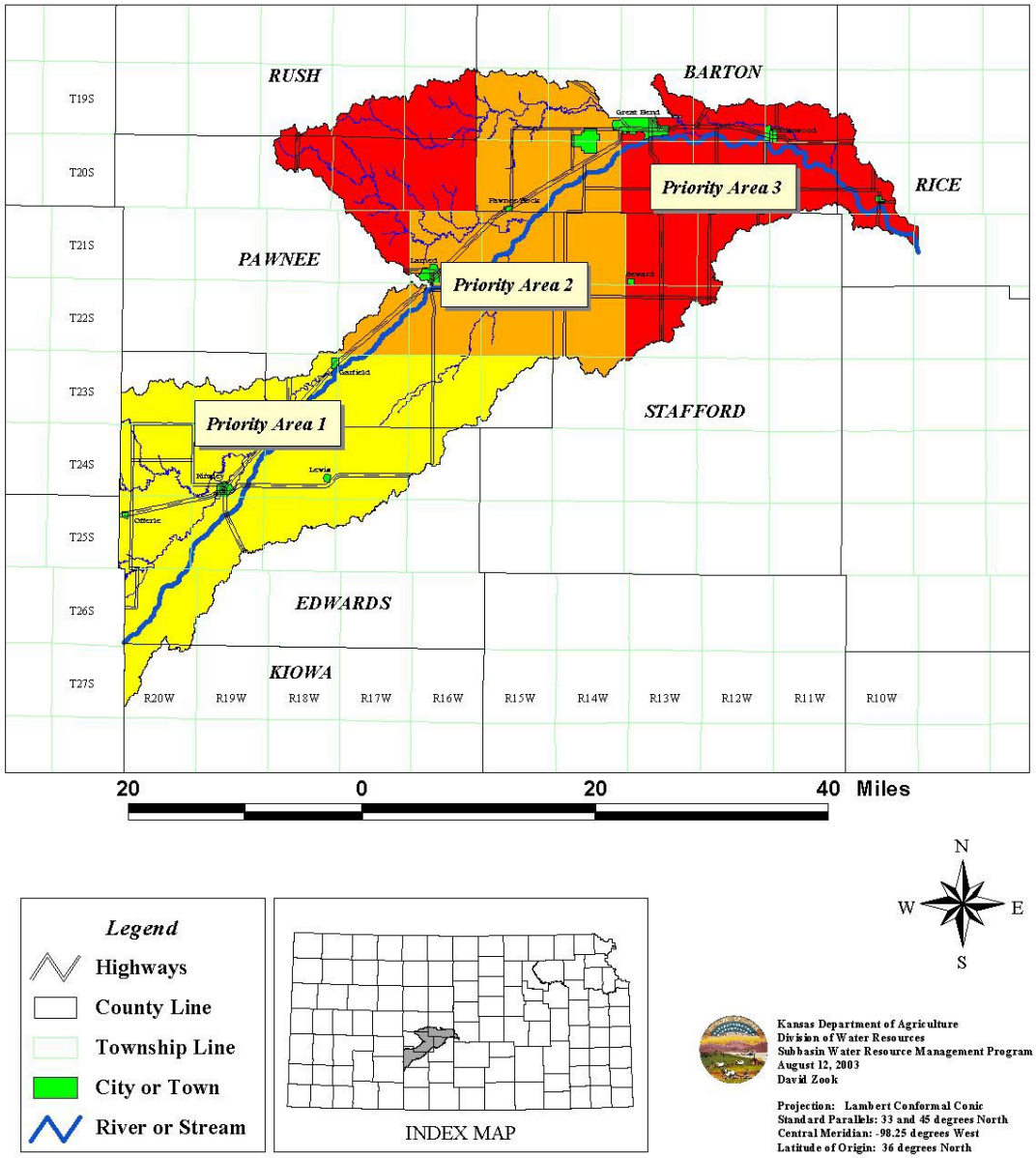
Appendix A

Middle Arkansas Sub-basin Management Strategies Estimated Savings and Funding Sources

Program Goals	Savings (AF)	Source of Funding
Total Appropriations	258,147	
Average Annual for All water use (1988 - 2000)	155,201	
Average Annual Irrigation water use (1988-2000)	144,732	
Short Term Goals		
Improved Water Conservation		
Objective: Water Use Reduction of 10 to 20%		
Convert Impact to Drop Nozzles	560	EQIP, SCC
Drop nozzle lowering	588	EQIP
Flood to center pivot conversion	625	EQIP
Water Use Savings	**1,773**	
Voluntary Reduction in Water Use		
Objective: Water Use Reduction of 10%		
Anticipate ~ 30% Participation		
Water Use Savings	**4,342**	Conservation Credit Program
Compliance and Enforcement		
Objective: Water Use Reduction of 16% (250 water right holders)		
Water Use Savings	**4,425**	State Water Plan, General Fund
Long Term Goals		
Water Rights Purchase		
Objective: Reduce Appropriations		
Water Use Savings	**195**	SCC, EQIP
Water Banking		
Objective: Water Use Reduction of 10 %		
Anticipate ~ 15% Participation		
Savings From Current Appropriations		Formation of Central Water Bank
Water Use Savings	**2,328**	
Stream Buffer Development		
Objective: Controlled reestablishment of riparian vegetation		
Water savings	**517**	EQIP, CRP, WRCP, SCC
Municipals Water Savings		
Water Use Savings	**400**	Action by municipals
Improved Water Conservation	1,773	
Voluntary Reduction in Water Use	4,342	
Compliance and Enforcement	4,425	
Total Short Term Goal	10,540	
Water Rights Purchase	195	
Water Banking	2,328	
Stream Buffer Development	517	
Municipals Water Savings	400	
Total Savings from All Voluntary Management Strategies	**13,980**	

Appendix B:
Priority areas to be used for cost-share funding purposes only. The areas are ranked with one being highest priority for funding.

Middle Arkansas River Sub-basin Priority Areas