LOWER ARKANSAS RIVER BASIN TOTAL MAXIMUM DAILY LOAD

Water Body: **Arkansas River below Wichita**
Water Quality Impairment: Nutrients and Oxygen Demand Impact on Aquatic Life

1. INTRODUCTION AND PROBLEM IDENTIFICATION

Subbasin: Middle Arkansas–Slate **County:** Sedgwick

HUC 8: 11030013 **HUC 11** (HUC 14s)**: 010** (050, 060, 080)

Drainage Area: 1720 square miles between Derby and Maize

Main Stem Segments: WQLS: 3; starting at the confluence with the Little Arkansas River and ending with the confluence of Cowskin Creek.

Tributary Segments: Non-WQLS: Dog Creek
Chisholm Creek
Gypsum Creek
Spring Creek

Designated Uses: Secondary Contact Recreation and Expected Aquatic Life Support on all segments

Primary Contact Recreation; Domestic Water Supply; Food Procurement; Ground Water Recharge; Industrial Water Supply Use; Irrigation Use; Livestock Watering Use for Main Stem Segments

1998 303d Listing: Table 2–Stream Segments Identified by Biological Monitoring

Impaired Use: Expected Aquatic Life Support on Main Stem Segments.

Water Quality Standard: Nutrients--Narrative: The introduction of plant nutrients into streams, lakes, or wetlands from artificial sources shall be controlled to prevent the accelerated succession or replacement of aquatic biota or the production of undesirable quantities or kinds of aquatic life. (KAR 28-16-28e(c)(2)(B)).

2. CURRENT WATER QUALITY CONDITION AND DESIRED ENDPOINT

Level of Support for Designated Use under 1998 303d: Partially Supporting

Monitoring Sites: Station 281 in Derby

Period of Record Used: 1980 to 1999

Flow Record: Arkansas River at Derby (USGS Station 07144550): 1970-1999

Long Term Flow Conditions: Average Flow = 1200 cfs;Median Flow = 528 cfs; 7Q10 = 109 cfs

Current Conditions:

Parameter	Historical Average & Range (1980 - 1996 for biological data)
Macroinvertebrate Biotic Index (MBI)	5.20 (4.28-6.16)
% Ephemeroptera, Plecoptera, and Trichoptera (EPT) Taxa (Count)	29 % (10 - 62 %)
Biochemical Oxygen Demand (BOD)	6.60 mg/L (1.00 - 16.2 mg/L)
Phosphorus	820 ug/L (21 - 2750 ug/L)
Ammonia	730 ug/L (20 - 5820 ug/L)
Nitrate	1890 ug/L (10 - 11,300ug/L)
TSS	98 mg/L (4 - 550 mg/L)

Three main parameters (MBI, %EPT, and BOD) were analyzed to address the nutrient/ oxygen demand impairment. The Macroinvertebrate Biotic Index rates the nutrient and oxygen demanding pollution tolerance of large taxonomic groups (order and family). Higher values indicate greater pollution tolerances. Along with the number of individuals within a rated group, a single index value is computed which characterizes the overall tolerance of the community. The higher the index value the more tolerant the community is of organic pollution exerting oxygen demands in the stream setting. Index values greater than 5.4 are indicative of non-support of the aquatic life use; values between 4.51 and 5.39 are indicative of partial support and values at or below 4.5 indicate full support of the aquatic life use.

The EPT index is the proportion of aquatic taxa present within a stream belonging to pollution intolerant orders; Ephemeroptera, Plecoptera and Trichoptera (mayflies, stoneflies and caddisflies). Higher percentages of total taxa comprising these three groups indicate less pollutant stress and better water quality.

On this stream segment, the average MBI value indicates that aquatic life support is partially impaired (MBI between 4.51 and 5.39). Three of the surveys resulted in MBI values under 4.5, 9 were under 5.4 and 5 were over 5.4. MBI under full support conditions averaged 4.31, MBI under partial support conditions was 5.38. When aquatic life is fully or partially impaired, the percentage of EPT taxa averages 33-35%. Under non-support conditions, the average drops to 19%. Since Wichita began nitrification of its wastewater, ammonia levels have dropped as have MBI values, indicating improved biotic health downstream of the outfall. The average MBI value prior to 1992 was 5.34, whereas, the average since 1992 is 4.81.

Overall, the average concentration of nutrients in the Arkansas River averages to 820 ug/L phosphorus, 6.6 mg/l BOD, 730 ug/L ammonia, and 1890 ug/L nitrate.

Comparison of Biological Index Values and Average Nutrient and Sediment Concentrations

Station	MBI	Total P	Nitrate	Ammonia	BOD	TSS
Great Bend	5.45	1.13 mg/l	1.3 mg/l	1.0 mg/l	6.1 mg/l	106 mg/l
Valley Center	4.67	0.80 mg/l	0.95 mg/l	0.16 mg/l	4.6 mg/l	127 mg/l
Derby	**5.15**	**0.82 mg/l**	**1.89 mg/l**	**0.73 mg/l**	**6.6 mg/l**	**98 mg/l**
Ark City	4.81	0.73 mg/l	1.37 mg/l	0.15 mg/l	6.6 mg/l	153 mg/l
Cowskin	4.56	0.33 mg/l	0.65 mg/l	0.085 mg/l	4.7 mg/l	103 mg/l

Desired Endpoint for Arkansas River for 2005 - 2009

The use of biological indices allows assessment of the cumulative impacts of dynamic water quality on aquatic communities present within the stream. As such, these index values serve as a baseline of biological health of the stream. Sampling occurs during open water season (April to November) within the aquatic stage of the life cycle of the macroinvertebrates. The endpoint would be average MBI value of 4.5 or less over 2005-2009.

Achievement of this endpoint would be indicative of full support of the aquatic life use in the stream reach. Therefore, the narrative water quality standard pertaining to nutrients would be attained.

3. SOURCE INVENTORY AND ASSESSMENT

NPDES: There are eight NPDES permitted wastewater dischargers to Segment 3, however six are industrial facilities discharging process water and cooling water. The remaining two facilities potentially contribute nutrients and organic matter loading to the river (Wichita WWTP #2 and Derby). While permit limits are determined by combining the two effluents, the monitoring site is located between the two outfalls, therefore data do not register impacts from Derby. Little information exists on the nutrient content of either facility's waste water. However, both nitrify their effluent, reducing ammonia levels. After nitrification of Wichita wastewater in 1990, MBI scores improved immensely.

Livestock Waste Management Systems: Since the drainage is principally urban, there are few livestock operations within the drainage, except those which drain to the Little Arkansas and Cowskin Creek. Grazing density is light within the city's drainage.

Land Use: Most of the watershed is urban with a high percentage of impervious area covering the drainage area of Segment 3. The two main tributaries (Little Arkansas River and Cowskin Creek) entering Segment 3 are chiefly cropland with grasslands available for grazing.

On-Site Waste Systems: A number of residents within northern Sedgwick County are in rural settings without sewer service, relying instead on on-site waste systems. Failing septic systems contribute nutrient loadings. The sporadic conditions of partial support seem to indicate a lack of persistent loadings from such systems on any grand scale. However, population projections for the Sedgwick County indicate substantial growth in rural population to the year 2020, suggesting that proliferation of on-site systems may be occurring in the watershed.

Background Levels: Most of the woodland in the watershed is adjacent to the Arkansas River. Leaf litter falls into the streams and decomposes increasing the oxygen demand. Small amounts of phosphorus are contributed from the watershed soils. Nitrogen loads may be contributed from the atmosphere.

4. ALLOCATION OF POLLUTION REDUCTION RESPONSIBILITY

There is an indirect, yet unquantified relation between nutrient loading and biological integrity. Decreased loads should result in aquatic communities, indicative of improved water quality. The characteristics of biological data to integrate the impacts of the entire watershed on the aquatic community defies allocation of specific loads between point and nonpoint sources. The relative presence of point and nonpoint activities has to be used to assess the relative contributions and responsibilities for nutrient load reduction in the watershed. Therefore, allocations are made for this TMDL in a general sense to direct appropriate action, following the belief that initial reduction in nutrient loads will yield improved MBI values. More detailed allocations will be made after 2006 based on additional source assessment, including assessment of wastewater nutrient levels and establishment of appropriate numerical nutrient criteria.

For this phase of the TMDL, an average condition is considered across the seasons, to establish goals of the endpoint and desired reductions. Therefore, average ambient levels are multiplied by the average flow estimated for the Arkansas River. This is represented graphically by the integrated area under each load duration curve established by this TMDL. The area is segregated into allocated areas assigned to point sources (WLA) and nonpoint sources (LA). Future growth in wasteloads should be offset by reductions in the loads contributed by nonpoint sources. This offset along with appropriate limitations should eliminate the impairment.

Point Sources: There are two municipal facilities releasing effluent along the segment. The existing loads contributed by these facilities are unknown and will need to be determined in the future through monitoring of effluent and ambient receiving streamflow. Most of the effluent volume discharges above the monitoring site and likely influences flow conditions which were exceeded 75% of the time on the Arkansas River. Therefore, the allocation for point sources is demarcated by the area under each respective load duration curve bounded from 75% to 100%. At this stage of the TMDL, the assumed condition is maintenance of current conditions at those low

flows, presuming an offset of lower nonpoint loading at higher flows. The Wasteload Allocation represents the load in the stream which the point sources contribute. In most cases, this is a function of permit limits and plant performance; in the case of nutrients and BOD, there is some assimilation and degradation of the constituents in transit while flowing downstream. Further refinement of this allocation will come with information on effluent concentrations and developed nutrient criteria for streams, resulting in specific permit limits in the second stage of this TMDL.

Nonpoint Sources: Given the runoff characteristics of the watershed, overland runoff can easily carry phosphorus and nitrates from the watershed into the streams. The sporadic nature of the MBI values indicates that nutrient impairment waxes and wanes over time, hinting that loadings are variable. As such, nonpoint sources are implicated as a primary source of these loadings. There are variety of sources contributing nutrient loads to the stream. Additional assessment is necessary to quantify those contributions. At this point, the Load Allocation will be a reduction of nutrient loadings such that average phosphorus concentrations are below 70 ppb in stream and nitrate concentrations average below 1700 ppb.

TMDL Goals and Gross Allocations for the Arkansas River at Derby

	MBI	TOTAL P	Potential Available N	BOD	TSS
CURRENT	5.15	2.7 T/D	8.5 T/D	21.4 T/D	318 T/D
REDUCTION	0.65	0.4 T/D	1.4 T/D	0.7 T/D	107 T/D
TMDL	4.50	2.3 T/D	7.1 T/D	20.7 T/D	211 T/D
WLA		0.2 T/D	0.9 T/D	6.8 T/D	6.8 T/D
L.A.		2.1 T/D	6.2 T/D	13.9 T/D	204 T/D

Defined Margin of Safety: Given the variable nature of the MBI values seen on this stream, additional biological measures are necessary to assure indications of good aquatic community health. Therefore, the defined Margin of Safety for this TMDL will be a proportion of EPT individuals making up at least 40% of the sample population when MBI values are 4.5 or lower. This will ensure that the majority of aquatic macroinvertebrate population is composed of pollution intolerant taxa.

State Water Plan Implementation Priority: Because the Arkansas River is in an urban setting, additional source assessment and definition of the relationship between aquatic community response and nutrient loading is needed, in addition, nutrient management on the principal streams feeding into the river will be given high priority in the hope that improvement on the tributaries will accrue to the mainstem. Given the presence of a major wastewater discharger and the current movement of numeric nutrient criteria to be developed over the next five years, this TMDL will be a Medium Priority for implementation.

Unified Watershed Assessment Priority Ranking: This watershed lies within the Middle Arkansas–Slate Subbasin (HUC 8: 11030013) with a priority ranking of 6 (Highest Priority for restoration work).

Priority HUC 11s and Stream Segments: The mainstem and its immediate drainage will be the priority focus of implementation once implementation on the Cowskin and Little Arkansas are underway.

5. IMPLEMENTATION

Desired Implementation Activities

1. Implement necessary soil sampling to recommend appropriate fertilizer applications on cropland
2. Maintain necessary conservation tillage and contour farming to minimize cropland erosion.
3. Install necessary grass buffer strips along streams.
4. Reduce activities within riparian areas
5. Install proper manure storage
6. Implement necessary nutrient management plans to manage manure application to land
7. Monitor wastewater discharges for excessive nutrient loadings

Implementation Programs Guidance

NPDES - KDHE

a. Ensure proper monitoring, permitting, and operations of municipal wastewater systems to limit nutrient and BOD discharges.

Nonpoint Source Pollution Technical Assistance - KDHE

a. Support Section 319 demonstration projects for reduction of sediment runoff from agricultural activities as well as nutrient management.

b. Provide technical assistance on practices geared to establishment of vegetative buffer strips.

c. Provide technical assistance on nutrient management in vicinity of streams.

d. Assist evaluation of stormwater quality from urbanized areas of watershed.

e. Evaluate any potential anthropogenic activities which might contribute nutrients to the river as part of an overall Watershed Restoration and Protection Strategy

Local Environmental Protection Program - KDHE

a. Support inspection of on-site wastewater systems to minimize nutrient loadings

Water Resource Cost Share & Non-Point Source Pollution Control Programs - SCC

a. Apply conservation farming practices, including terraces and waterways, sediment control basins, and constructed wetlands.

b. Provide sediment control practices to minimize erosion and sediment and nutrient transport

Riparian Protection Program - SCC

a. Establish or reestablish natural riparian systems, including vegetative filter strips and streambank vegetation.

b. Develop riparian restoration projects
c. Promote wetland construction to assimilate nutrient loadings

Buffer Initiative Program - SCC

a. Install grass buffer strips near streams.
b. Leverage Conservation Reserve Enhancement Program to hold riparian land out of production.

Extension Outreach and Technical Assistance - Kansas State University

a. Educate agricultural producers on sediment, nutrient and pasture management
b. Provide technical assistance on buffer strip design and minimizing cropland runoff
c. Encourage annual soil testing to determine capacity of field to hold phosphorus

Time Frame for Implementation: Pollutant reduction practices should be installed within the priority subwatersheds after the year 2005. To some degree, reduction practices associated with reducing bacteria impairment will have an impact on reducing nutrient loads to the stream. Monitoring of wastewater and receiving stream quality should commence with the renewal of permits.

The second stage involves incorporating refined allocations and load reductions including permit limits which should be in place after final EPA guidance has established numeric criteria and those criteria have been incorporated into Kansas water quality standards.

Targeted Participants: Primary participants for implementation will likely be agricultural producers operating within the drainage of the priority subwatershed. Initial work in 2005 should include an inventory of activities in those areas with greatest potential to impact the stream, including, within a mile of the stream:

1. Total rowcrop acreage
2. Cultivation alongside stream
3. Fields with manure applications
4. On-site wastewater discharges to stream
5. Condition of riparian areas
6. Presence of livestock along stream

Some inventory of local needs should be conducted in 2005 to identify such activities. Such an inventory would be done by local program managers with appropriate assistance by commodity representatives and state program staff in order to direct state assistance programs to the principal activities influencing the quality of the streams in the watershed during the implementation period of this TMDL.

Milestone for 2006: The year 2006 marks the midpoint of the ten-year implementation window for the watershed. At that point in time, adequate source assessment should be complete which allows an allocation of resources to responsible activities contributing to the nutrient impairment. Additionally, biological data from the Arkansas River over 2001-2005 should not indicate trends of reduced support of the aquatic community. Numeric nutrient criteria should be established by

2005 and sampled data from Arkansas River should indicate evidence of reduced nutrient levels relative to the conditions seen over 1985-1999.

Delivery Agents: The primary delivery agents for program participation will be the point source dischargers, the conservation districts for programs of the State Conservation Commission, and the Natural Resources Conservation Service. Producer outreach and awareness will be delivered by Kansas State Extension and agricultural interest groups such as Kansas Farm Bureau and Kansas Livestock Association and grain crop associations. On-site waste system inspections will be performed by Local Environmental Protection Program personnel for Sedgwick County.

Reasonable Assurances:

Authorities: The following authorities may be used to direct activities in the watershed to reduce pollution.

1. K.S.A. 65-164 and 165 empowers the Secretary of KDHE to regulate the discharge of sewage into the waters of the state.

2. K.S.A. 65-171d empowers the Secretary of KDHE to prevent water pollution and to protect the beneficial uses of the waters of the state through required treatment of sewage and established water quality standards and to require permits by persons having a potential to discharge pollutants into the waters of the state.

3. K.S.A. 2-1915 empowers the State Conservation Commission to develop programs to assist the protection, conservation and management of soil and water resources in the state, including riparian areas.

4. K.S.A. 75-5657 empowers the State Conservation Commission to provide financial assistance for local project work plans developed to control nonpoint source pollution.

5. K.S.A. 82a-901, et seq. empowers the Kansas Water Office to develop a state water plan directing the protection and maintenance of surface water quality for the waters of the state.

6. K.S.A. 82a-951 creates the State Water Plan Fund to finance the implementation of the *Kansas Water Plan*.

7. The *Kansas Water Plan* and the Lower Arkansas Basin Plan provide the guidance to state agencies to coordinate programs intent on protecting water quality and to target those programs to geographic areas of the state for high priority in implementation.

Funding: The State Water Plan Fund annually generates $16-18 million and is the primary funding mechanism for implementing water quality protection and pollution reduction activities in the state through the *Kansas Water Plan*. The state water planning process, overseen by the Kansas Water Office, coordinates and directs programs and funding toward watersheds and water resources of highest priority. Typically, the state allocates at least 50% of the fund to programs

supporting water quality protection. This watershed and its TMDL are a **Medium Priority** consideration. Priority should be given to activities which reduce loadings of bacteria and nutrients to the stream after 2005.

Effectiveness: Nutrient control has been proven effective through conservation tillage, contour farming and use of grass waterways and buffer strips. The key to success will be widespread utilization of conservation farming and waste management within the watersheds cited in this TMDL.

Should participation significantly lag below expectations over the implementation period or monitoring indicates lack of progress in improving water quality conditions from those seen over 1990-1999, the state may employ more stringent conditions on agricultural producers in the watershed through establishment of a Critical Water Quality Management Area in order to meet the desired endpoints expressed in this TMDL.

6. MONITORING

As numeric nutrient criteria become established, KDHE will continue to collect seasonal biological samples from Arkansas River Creek for three years over 2001 - 2005 and an additional three years over 2005-2009 to evaluate achievement of the desired endpoint. Routine monitoring of nutrient content of wastewater discharged from treatment systems will be expected under reissued NPDES and state permits.

Additional source assessment needs to be conducted and local program management needs to identify its targeted participants of state assistance programs for implementing this TMDL. This information should be collected in 2001-2005 in order to support appropriate implementation projects.

7. FEEDBACK

Public Meetings: Public meetings to discuss TMDLs in the Lower Arkansas River Basin were held March 9, 2000 and April 26-27, in Hutchinson, Wichita, Arkansas City and Medicine Lodge. An active Internet Web site was established at http://www.kdhe.state.ks.us/tmdl/ to convey information to the public on the general establishment of TMDLs and specific TMDLs for the Lower Arkansas River Basin. A draft of this TMDL has been maintained on the website since June 1, 2000 and modifications to the original draft have been available to the public for viewing and review up to the date of submitting this TMDL to EPA.

Public Hearing: A Public Hearing on the original draft of these TMDLs of the Lower Arkansas River Basin was held in Wichita on June 1, 2000.

Basin Advisory Committee: The Lower Arkansas River Basin Advisory Committee met to discuss the TMDLs in the basin on September 27, and November 8, 1999; January 13 and March 9, 2000. The Committee recommended approval of the Basin Plan which set high priority TMDLs in the basin, thereby, delegating medium and low priority status to this and subsequent TMDLs for the basin. The Kansas Water Authority approved the Basin Plan on July 11, 2000.

Discussion with Interest Groups: Meetings to discuss TMDLs with interest groups include:

Sedgwick County Technical Advisory Group: August 8, October 14, November 15, 1999, January 20, 2000, April 27, 2000 and May 25, 2000.
Agriculture: January 12, February 2 and 29, 2000
Environmental: March 9, 2000
Conservation Districts: November 22, 1999
Industry: December 15, 1999, January 13, February 9 and 22, 2000
Local Environmental Protection Groups: September 30, November 2, December 16, 1999

Milestone Evaluation: In 2006, evaluation will be made as to the degree of impairment which has occurred within the drainage and current condition of Arkansas River. Subsequent decisions will be made regarding implementation approach, follow up of additional implementation and implementation in the nonpriority subwatersheds. The second stage of this TMDL is anticipated to begin in 2006 after the adoption of numeric criteria in water quality standards.

Consideration for 303d Delisting: Arkansas River will be evaluated for delisting under Section 303d, based on the monitoring data over the period 2005-2009. Therefore, the decision for delisting will come about in the preparation of the 2010 303d list. Should modifications be made to the applicable nutrient criterion during the ten-year implementation period, consideration for delisting, desired endpoints of this TMDL and implementation activities may be adjusted accordingly.

Incorporation into Continuing Planning Process, Water Quality Management Plan and the Kansas Water Planning Process: Under the current version of the Continuing Planning Process, the next anticipated revision will come in 2002 which will emphasize revision of the Water Quality Management Plan. At that time, incorporation of this TMDL will be made into both documents. Recommendations of this TMDL will be considered in *Kansas Water Plan* implementation decisions under the State Water Planning Process after Fiscal Year 2005.

APPENDIX

CALCULATIONS OF CURRENT AND DESIRED LOADS

Estimated Existing Loads calculated by average flow and average concentration:

Total Phosphorus: 1200 cfs * 0.82 mg/l * 5.4/2000 = 2.7 T/D
Nitrate: 1200 cfs*1.89 mg/l*5.4/2000 = 6.1 T/D
Ammonia: 1200 cfs*0.73 mg/l*5.4/2000 = 2.4 T/D
BOD: 1200 cfs* 6.6 mg/l*5.4/2000 = 21.4 T/D
TSS: 1200 cfs* 98 mg/l*5.4/2000 = 318 T/D

Desired Loads recalculated using lower ambient concentrations:

Total Phosphorus: 1200 cfs * 0.70 mg/l * 5.4/2000 = 2.3 T/D
Nitrate: 1200 cfs* 1.70 mg/l*5.4/2000 = 5.5 T/D
Ammonia: 1200 cfs* 0.5 mg/l*5.4/2000 = 1.6 T/D
BOD: 1200 cfs*6.4 mg/l*5.4/2000 = 20.7 T/D
TSS: 1200 cfs*65 mg/l*5.4/2000 = 211 T/D

Wasteload Allocations calculated by design flow and desired or permitted concentrations

Sum of upstream dischargers = 54 MGD (83.6 cfs)
Total Phosphorus: 83.6 cfs * 1.00 mg/l * 5.4/2000 = 0.2 T/D
Nitrate: 83.6 cfs*1.9 mg/l*5.4/2000 = 0.4 T/D
Ammonia: 83.6 cfs*2.0 mg/l*5.4/2000 = 0.5 T/D
BOD: 83.6 cfs*30 mg/l*5.4/2000 = 6.8 T/D
TSS: 83.6 cfs*30 mg/l*5.4/2000 = 6.8 T/D

Load Allocations found by subtracting Wasteload Allocation from Desired Load:

Total Phosphorus: 2.1 T/D
Nitrate: 5.1 T/D
Ammonia: 1.1 T/D
BOD: 13.9 T/D
TSS: 204 T/D

Approved July 27, 2001.