

KANSAS-LOWER REPUBLICAN BASIN TOTAL MAXIMUM DAILY LOAD

Waterbody: Crooked Creek Watershed

Water Quality Impairment: Nutrients and Oxygen Demand Impact on Aquatic Life

1. INTRODUCTION AND PROBLEM IDENTIFICATION

Subbasin: Lower Kansas River

Counties: Atchison and Jefferson

HUC 8: 10270104

HUC 11: 070

Drainage Area: 65.5 square miles.

Main Stem Segments: 10 and 12, starting at confluence with Stranger Creek and extending upstream near Dunavant in Jefferson County.

Designated Uses: Expected Aquatic Life Support, Secondary Contact Recreation and Food Procurement.

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 303d: Partially Supporting for Aquatic Life

Monitoring Sites: Station 683 near Winchester

Period of Record Used: 1995

Current Condition:

Parameter	Sample Average & Range
Macroinvertebrate Biotic Index (MBI)	4.48 (4.39 - 4.53)
% Ephemeroptera, Plecoptera, and Trichoptera (EPT) Taxa	28.25 (23.00 - 34.00%)
Biochemical Oxygen Demand (BOD)	4.9 mg/L (3.2 - 6.6 mg/L)
Phosphorus	323.5 $\mu\text{g/L}$ (150 - 720 $\mu\text{g/L}$)
Nitrate	775 $\mu\text{g/L}$ (10 - 880 $\mu\text{g/L}$)
Ammonia	57 $\mu\text{g/L}$ (10 - 180 $\mu\text{g/L}$)

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.

In this watershed, the MBI indicates that aquatic life is partially supported; the MBI exceeded the partially impairment line twice (40% of the time) during the survey. The average MBI was 4.48, which is below the partial impairment line (4.51). Average MBI under partial support conditions was 4.52; average MBI under full support conditions was 4.45. When aquatic life is partially impaired, the percentage of EPT taxa ranges from 23.0 - 24.0% (23.5% average). Under full support conditions, the percentage averages 31.0. The average BOD was within normal background levels, yet appear slightly elevated

The average nutrient concentrations were very high (775 $\mu\text{g/l}$ for nitrate and 323.5 $\mu\text{g/l}$ for phosphorus), and the highest concentrations occurred with highest flows when sample dates were matched with average daily streamflow on Stranger Creek at Tonganoxie (closest USGS gaging station). This suggests nutrients being transported to streams by runoff events.

Desired Endpoint for Crooked Creek for 2004 - 2008:

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. As such there is

no described seasonal variation of the desired endpoint of this TMDL. The endpoint would be average MBI values of 4.5 or less over 2004-2008.

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

Land Use: The most likely cause of high concentrations of nutrients (nitrogen and phosphorus) is from fertilizer applications on croplands. Cropland (63% of land use) and grassland (30% of land use) comprise the majority of land in the watershed. Over half of the land adjacent to the main stem (within 660 feet) is cropland.

The following amounts of fertilizer were purchased in 1998:

Atchison County--14,588 tons
Jefferson County--16,645 tons

Three percent of Atchison County and 9.5 % of Jefferson County lie within the watershed. Assuming an even distribution across the counties, up to 2,119 tons of fertilizer were applied in the watershed in 1998.

Residential fertilizer applications may be a contributing factor as well. The population within the watershed is projected to increase through the year 2020. With the rising populations, the acreage devoted to suburban homes and the residential fertilizer applications will increase.

Contributing Runoff: The watershed has an average soil permeability of 0.5 inches/hour according to NRCS STATSGO data base. Runoff would be produced under storms ranging in duration from one to six hours, having a recurrence interval of five, ten or twenty five years. Runoff is chiefly generated as infiltration excess with rainfall intensities greater than soil permeabilities. Generally, 69 percent of the watershed would generate runoff under dryer conditions or smaller storms. Moderate or wet conditions or larger storms would see runoff contributed from 92 to 98 percent of the watershed.

NPDES: Although not as great a contributor as cropland, lagoons discharge some nutrients into watershed. There are two NPDES permitted wastewater dischargers located within the watershed. Both systems are municipal discharging waste stabilization lagoons.

MUNICIPALITY	STREAM REACH	SEGMENT	DESIGN FLOW	# of CELLS	DETENTION TIME	EXPIRATION DATE
Nortonville MWTP	Crooked Creek	12	0.08 mgd	2	>150 day	2001
Winchester MWTP	Crooked Creek	12	0.122 mgd	4	>120 day	2001

Both municipalities are expected to increase in population. Projections of future water use and resulting wastewater appear to be within design flows for the Nortonville and Winchester lagoon systems. Presuming that the point sources influence water quality in flows up to ten times the design flows, the impacts would be seen at flows which are seen approximately 10-15% of the time in the summer and winter. Both facilities probably discharge nutrients to the stream.

There are a number of on-site wastewater systems in place in Atchison and Jefferson counties. Both counties are projected to have rural population growth through the year 2020.

There are four of livestock operations in the watershed which have a total of 1,479 animal units. Grazing density for the watershed is about 44 animal units per square mile (moderate to heavy for the KLR basin).

Background Levels: Nineteen percent of the land next to streams is wooded. Leaf litter falls into the streams and decomposes increasing the biochemical oxygen demand. Geological formations contain small amounts of phosphorus (up to 0.5% of total weight), and may contribute to phosphorus loads.

4. ALLOCATION OF POLLUTION REDUCTION RESPONSIBILITY

There is an indirect, yet un-quantified 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 non-point sources. The relative presence of point and non-point 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 in the belief that qualitative reduction in nutrient loads will yield improved MBI values. More detailed allocations will be made in 2004 based on additional source assessment and establishment of appropriate numerical nutrient criteria.

Point Sources: Based on the source assessment, municipal wastewater systems provide minor contributions to this water quality impairment. Ongoing inspections and monitoring of the lagoons will be made to ascertain the contributions have been made by these sources into the stream. At this point, the Wasteload Allocation will be a reduction of BOD loadings from point sources such that monthly average BOD concentrations are maintained below 30 mg/l, leading to instream concentrations of DO remaining above 5 mg/l at flows below 1 cfs. The sporadic occurrence of partial support conditions, indicated by MBI values over 4.5, seems to indicate a lack of consistent loading from the upper drainage.

Non-Point 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, non-point 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 100 ppb in stream and nitrate concentrations average below 200 ppb.

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 30% 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: The Crooked Creek is a low priority TMDL, because of the lack of conclusive sample data indicating impairment at this point in time.

Unified Watershed Assessment Priority Ranking: This watershed lies within the Lower Kansas Subbasin (HUC 8: 10270104) with a priority ranking of 1 (Highest Priority for restoration work).

Priority HUC 11s and Stream Segments: HUC 070 encompasses the entire watershed. The main stem segments (10 and 12) of Crooked Creek should be the priority focus.

5. IMPLEMENTATION

Desired Implementation Activities

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

Implementation Programs Guidance

Industrial Program KDHE

- a. Ensure proper permitting and inspection of livestock waste management systems

Municipal Program - KDHE

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

Non-Point 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.

Local Environmental Protection Program - KDHE

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

Water Resource Cost Share Program - SCC

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

Non-Point Source Pollution Control Program - SCC

- a. Provide sediment control practices to minimize erosion and sediment and nutrient transport
- b. Provide livestock waste management systems for proper manure storage, disposal and land application.
- c. Provide livestock watering sites to reduce use of streams
- d. Repair failing septic systems in proximity to streams

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. Educate livestock producers on livestock waste management and manure applications and nutrient management planning
- c. Provide technical assistance on livestock waste management systems and nutrient management plans.
- d. Provide technical assistance on buffer strip design and minimizing cropland runoff
- e. Encourage annual soil testing to determine capacity of field to hold phosphorus

Timeframe for Implementation: Management practices necessary to implement this TMDL beyond the initial emphasis should be deferred until 2004, pending additional source assessment and evaluation of biological data collected over 2000-2004.

Targeted Participants: Primary participants for implementation will be agricultural producers operating within the drainages of the priority subwatershed. Initial work in 2000-2004 should include local assessments by conservation district personnel and county extension agents to locate within one mile of the streams:

1. Total rowcrop acreage
2. Cultivation alongside stream (main stem)
3. Drainage alongside or through animal feeding lots
4. Livestock use of riparian areas
5. Fields with manure applications
6. On-site wastewater discharges to stream

Some inventory of local needs should be conducted in 2000 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 2004: 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 Crooked Creek over 2000-2004 should not indicate trends of reduced support of the aquatic community. Numeric nutrient criteria should be established by 2004 and sampled data from Crooked Creek should indicate evidence of reduced nutrient levels relative to the conditions seen over 1995.

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 Atchison and Jefferson counties.

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 non-point 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 Kansas-Lower Republican 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 is **low priority** consideration.

Effectiveness: Nutrient control has been proven effective through conservation tillage, contour farming and use of grass waterways and buffer strips as well as runoff control around animal feeding operations. 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 next five years or monitoring indicates lack of progress in improving water quality conditions from those seen in previous sampling regimes, 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

KDHE will continue to collect seasonal biological samples from Crooked Creek for three years over 2000 - 2004 and an additional three years over 2004-2008 to evaluate achievement of the desired endpoint. As numeric nutrient criteria become established, routine sampling at the Winchester station for nutrients should be evaluated over 2000-2008. Periodic 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 2000-2004 in order to support appropriate implementation projects.

7. FEEDBACK

Public Meetings: Public meetings to discuss TMDLs in the KLR Basin were held March 10, 1999 in Topeka, April 27 in Lawrence and April 29 in Manhattan. 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 Kansas-Lower Republican Basin.

Public Hearing: A Public Hearing on the TMDLs of the Kansas-Lower Republican Basin was held in Topeka on June 3, 1999.

Basin Advisory Committee: The Kansas-Lower Republican Basin Advisory Committee met to discuss the TMDLs in the basin on December 3, 1998; January 14, 1999; February 18, 1999; March 10, 1999; May 20, 1999 and June 3, 1999.

Discussion with Interest Groups: Meetings to discuss TMDLs with interest groups include:
Agriculture: November 10, 1998; December 18, 1998; February 10, 1999; April 10, 1999, May 4, 1999, June 8, 1999 and June 18, 1999.
Municipal: November 12, 1998, January 25, 1999; March 1, 1999; May 10, 1999 and June 16, 1999.
Environmental: November 3, 1998; December 16, 1998; February 13, 1999; March 15, 1999, April 7, 1999 and May 3, 1999.
Conservation Districts: March 16-18, 24-25, 1999

Milestone Evaluation: In 2004, evaluation will be made as to the degree of implementation which has occurred within the drainage and current condition of the Crooked Creek watershed. Subsequent decisions will be made regarding implementation approach, follow up of additional implementation and implementation in the non-priority subwatersheds.

Consideration for 303d Delisting: The Crooked Creek watershed will be evaluated for delisting under Section 303d, based on the monitoring data over the period 1999-2003. Therefore, the decision for delisting will come about in the preparation of the 2004 303d list. Should

modifications be made to the applicable water quality criteria 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 2004.

Approved January 26, 2000.