

# KANSAS-LOWER REPUBLICAN BASIN TOTAL MAXIMUM DAILY LOAD

**Waterbody: Kansas River at Lawrence**

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

## 1. INTRODUCTION AND PROBLEM IDENTIFICATION

**Subbasin:** Lower Kansas

**HUC 8:** 10270104

**Waterbody:** Kansas River at Lawrence Watershed

**HUC 11s:** 020 & 030 (Main Stem Segments)

**Counties:** Douglas, Jefferson, and Leavenworth

**Drainage Area:** 58,460 miles<sup>2</sup> at Lecompton

**Main Stem Segments:** 21 & 23, starting at confluence of Delaware River in Lecompton and ending at confluence of the Wakarusa River, headwaters Douglas County near Lecompton

**Designated Uses:** Special Aquatic Life Support on Main Stem Segments.

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

**Impaired Use:** Special 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:** Fully Supporting Aquatic Life but Threatened

**Monitoring Sites:** Stream Chemistry-Station 256 at Lawrence  
Biological Monitoring–Station 257 near Lecompton

**Period of Record Used:** 1996--1998 (Lawrence); 1980–1996 (Lecompton)

**Flow Record:** USGS Station at Lecompton (06891000), Recorded daily data 1936–1997

**Long Term Flow Conditions:** 10% Duration High Flow Exclusion = 21,000 cfs; 7Q10 = 680 cfs

**Current Condition:**

Parameter	Average for Lawrence	Average & Range for Lecompton
Macroinvertebrate Biotic Index (MBI)	NA	4.52 (3.62 - 5.50)
% Ephemeroptera, Plecoptera, and Trichoptera (EPT) Taxa	NA	38.3 (23.1 - 50.0)
Biochemical Oxygen Demand (BOD)	3.59 mg/L (1.00 - 9.6 mg/L)	NA
Phosphorus	361 ug/L (120 - 1,440 ug/L)	NA
Nitrate	732 ug/L (10 - 1,490 ug/L)	NA

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 fully supported but threatened; the MBI is on the borderline of being partially impaired (near 4.51). Forty-four percent of the surveys resulted in MBI values over 4.5, the rest were under 4.5. Average MBI under partial support conditions was 5.08; average MBI under full support conditions was 4.08. The percent EPT taxa range from 23.1 - 50.0% (38.3% average). Under full support conditions, the percentage averages 39.3. The historical average of BOD is within normal background levels (3 - 4 mg/L).

Phosphorus and nitrate were graphed against the flow. The nutrient concentration increased with increased flow, which suggests that phosphorus and nitrate are being transported into the stream segments during high runoff events. Overall, the average concentration of nutrients in the Kansas River at Lawrence watershed tends to be high (361 ug/L phosphorus and 732 ug/L nitrate).

**Desired Endpoint for Kansas River at Lawrence 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:** Urban fertilizer applications are a contributing factor to the water quality impairment. Population projections for all three counties to the year 2040 indicate significant growth. With the rising populations, the acreage devoted to suburban homes and the residential fertilizer applications will increase. Fertilizer will continue to be applied to golf courses and business grounds as well. The following amounts of fertilizer were bought in 1998:

Douglas County—9,631 tons  
Jefferson County—16,645 tons  
Leavenworth County—13,171 tons

Forty percent of Douglas County, 5 percent of Leavenworth County, and 10 percent of Jefferson County lie within the watershed. Assuming an even distribution, up to 6,176 tons of fertilizer were bought and used in the watershed in 1998.

A significant portion of the 6,176 tons of fertilizer are used for agricultural purposes. 70,761 acres of cropland (35% of total land use) are located within the watershed.

**Contributing Runoff:** The watershed has an average soil permeability of 0.8 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, 30 percent of the watershed would generate runoff under dryer conditions. Moderate or wet conditions (larger storms) would see runoff contributed from 65 and 93 percent of the watershed respectively.

**NPDES:** Several NPDES permitted wastewater facilities discharge into the river, most notably the Topeka Oakland plant. Effluent can be high in phosphorus and nitrogen.

**Background Levels:** Fifteen 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:** The thirteen municipal facilities rely on lagoon systems for wastewater detention and long holding times to minimize the release of nutrients to receiving streams. 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 below 625 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 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 this TMDL needs additional source assessment and definition of the relationship between aquatic community response and nutrient loading and because numeric nutrient criteria will 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 Lower Kansas Subbasin (HUC 8: 10270104) with a priority ranking of 1 (Highest Priority for restoration work).

**Priority HUC 11s and Stream Segments:** Because all the impaired stream segments are in HUC 11 020 and 030, the main stem segments should be the priority focus of implementation.

## **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. Implement nutrient management plans to manage manure application to land
6. Monitor wastewater discharges for excessive phosphorus loadings

### **Implementation Programs Guidance**

#### **NPDES - 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

#### **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 nutrient management plans.
- c. Provide technical assistance on buffer strip design and minimizing cropland runoff
- d. 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 subwatersheds. 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
3. Fields with manure applications
4. 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:** The year 2004 marks the mid-point 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 problem. Additionally, sampled data from Kansas River at Lawrence should indicate evidence of reduced nutrient levels relative to the conditions seen over 1980-1998.

**Delivery Agents:** The primary delivery agents for program participation will be 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.

**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 a **Medium Priority** consideration.

**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 next five years or monitoring indicates lack of progress in improving water quality conditions from those seen over 1990-1998, 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 the Kansas River at Lawrence 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 Lawrence 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 necessary within the watershed of the Kansas River and its current condition of water quality.

**Consideration for 303d Delisting:** Kansas River at Lawrence will be evaluated for delisting under Section 303d, based on the monitoring data over the period 2004-2008. Therefore, the decision for delisting will come about in the preparation of the 2008 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 2004.

Approved January 26, 2000.