MISSOURI RIVER BASIN TOTAL MAXIMUM DAILY LOAD

Water Body: Atchison County State Fishing Lake
Water Quality Impairment: Siltation

Subbasin: Independence-Sugar **County:** Atchison

HUC 8: 10240011 **HUC 11** (HUC 14)**:** **010** (050)

Drainage Area: Approximately 3.5 square miles.

Conservation Pool: Area = 75.5 acres, Maximum Depth = 10 meters

Designated Uses: Primary Contact Recreation (B); Expected Aquatic Life Support; Domestic Water Supply; Food Procurement; Industrial Water Supply; Irrigation Use; Livestock Watering

Impaired Use: Primary Contact Recreation, Expected Aquatic Life Support, and Food Procurement are all impaired

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)).

Dissolved Oxygen: 5 mg/L (KAR 28-16-28e(c)(2)(A))

Suspended Solids – Narrative: Suspended solids added to surface waters by artificial sources shall not interfere with the behavior, reproduction, physical habitat or other factor related to the survival and propagation of aquatic or semi-aquatic or terrestrial wildlife. (KAR 28-16-28e(c)(2)(D)).

(Figure 1- The Atchison County State Fishing Lake (located in the upper right-hand corner) watershed is delineated with the heavy black line. Finer lines within the watershed are 10 foot contours. The underlying image is the National Agricultural Imaging Program 2005 aerial photograph of the region.**)**

2. CURRENT WATER QUALITY CONDITION AND DESIRED ENDPOINT

Monitoring Sites: Station 012601 in Atchison County SFL. (Figure 1)

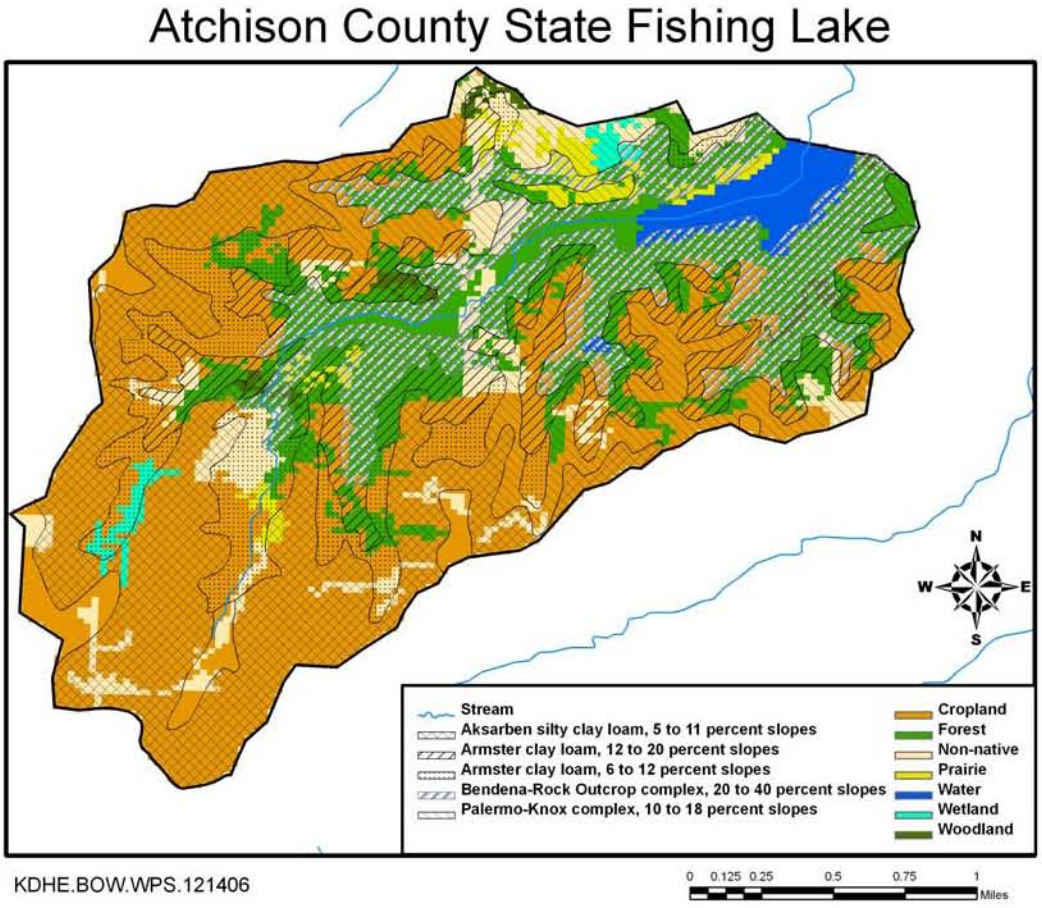
Period of Record Used: Four surveys from 1997 to 2004.

Current Condition: During the monitoring period the lake has typically been anoxic at a 2 meter depth, and surface pH has exceeded 8.5 during the two most recent sampling events. Average chlorophyll A at the surface has been 32 ppb. TSS has averaged 9 mg/l. Hypolimnetic total nitrogen has averaged 2.5 mg/l and hypolimnetic total phosphorus has averaged 0.27 mg/l.

Interim Endpoints of Water Quality (Implied Load Capacity) at Atchison County SFL after 2012: While Atchison County State Fishing Lake is designated for use as a primary contact

B water, open to the public and large enough to support swimming, swimming is illegal at Kansas state fishing lakes. Therefore, the interim endpoint of this TMDL shall be to reduce summer chlorophyll A concentrations belew the 20 ppb criteria used for secondary contact recreation sites. The still, deep water of the main basin of ASFL, combined with locally minimal wind, keeps TSS levels low, averaging 9 mg/l, however ongoing siltation is reducing the size of the lake arms. Therefore, the interim endpoint shall be to reduce sediment yield across the watershed to no more than 5 tons per acre per year, the acceptable T-value for soil erosion established by the NRCS (http://soildatamart.nrcs.usda.gov/) for soils in this watershed. Total area at each erosion rate modeled in AGNPS was summed, and for areas modeled with more than 5 tons per acre per year are instead multiplied by the 5 ton rate the total reduction is calculated as the difference between the current total load as modeled by AGNPS and the total load with all areas at either their modeled rate or the 5 ton rate, whichever is lower. This reduction corresponds to a decrease of 368 tons/year entering the reservoir.

3. SOURCE INVENTORY AND ASSESSMENT



(Figure 2- Land uses and soil types in the ASFL watershed. The streams marked are included in the National Hydrography Dataset, but are not registered streams in Kansas. Land use is drawn from the GAP dataset, soils information was retrieved from the NRCS SSURGO dataset.**)**

Land Use Type	Percentage of Watershed
Forest	27.8%
Woodland	1.2%
Prairie	2.6%
Wetland	1.2%
Non-native	9.3%
Cropland	54.4%
Water	3.5%

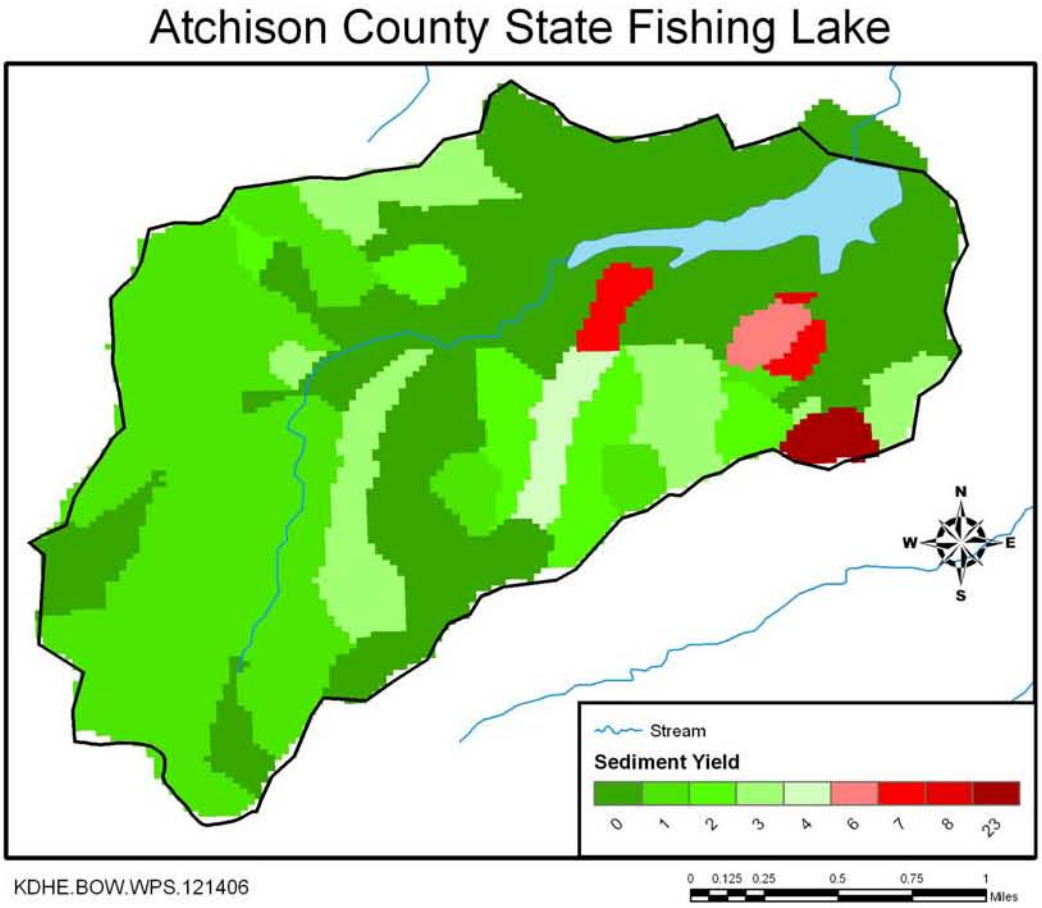
(Table 1- Land use in the ASFL watershed, as reported by the GAP dataset.**)**

Point Sources: No permitted confined animal feeding operations or NPDES permitted facilities exist within the watershed.

Land Use: Land use in the watershed includes row crop production, steeply sloping wooded areas and pasture (Table 1, Figure 2). The underlying soils are predominantly highly erodable loams. Erosion from agricultural activities are likely a dominant source of sediment entering ASFL, and contribute nutrients when soils are mobilized during runoff events.

The Kansas Biological Survey (KBS) conducted a study of runoff in the ASFL watershed during 2002. While TSS was not measured during this study, nutrient concentrations were documentated ranging from <0.1 mg/l to 6.5 mg/l TP, and 0.76 mg/l to 5.9 mg/l TN. Since the watershed lacks point sources, the dominant mechanism for phosphorus entry into the lake is sediment, and the high levels recorded by KBS suggest that significant sediment movement is occurring during runoff events.

KDHE used a watershed model (AGNPS) to estimate loading of sediment under current land management. Model results indicate an annual average yield of 2,800 tons of sediment per year. This corresponds to greater than 7,000 pounds of phosphorus per year, and greater than 14,000 pounds of nitrogen per year. Sediment yields ranged from 1 ton per acre per year in the western portion of the watershed to 23 tons per acre per year in a rowcrop field in the southeast portion of the watershed (Figure 3). Not all sediment included in the yield calculation gets to the lake. Using the proportion of total load modeled, 2,000 tons per year, to the yield, 2,800 tons per year, allows us to estimate reductions in loading to the lake.



(Figure 3- Sediment yield of the ASFL watershed as modeled by AGNPS. Sediment yield is in tons per acre per year.**)**

Internal Loading: The previously mentioned KBS study also examined sediment cores taken from the lake bottom to determine nutrient loading rates. They reported 33 mg PO_4-/sq. meter/day. They did not report values for total phosphorus. Using the lake area, 75.5 acres, this corresponds to an internal phosphorus load of 8,100 lbs annually. This loading is the result of Fick's Law of Diffusion J=D(C1-C2)/(x1-x2), "where the diffusion flux (J, the amount of a compound diffusing per unit area per unit time) is a function of the diffusion coefficient (D, the intrinsic rate of diffusion independent of concentration and distance), the difference in concentration (C), and the distance (x) between points 1 and 2." Dodds, 2002.

Other Sources: The Kansas Department of Wildlife and Parks maintains a series of fish feeders in ASFL. They annually add 6000 lbs. of fish food, corresponding to an annual estimated phosphorus load of 60 lbs.

Background Levels: Some of the land in the watershed is woodland; leaf litter may be contributing to the nutrient loading. The nutrient recycling, atmospheric deposition, and

geological formations (i.e., soil and bedrock) may contribute to phosphorus loads.

4. ALLOCATION OF POLLUTANT REDUCTION RESPONSIBILITY

Sediment is the primary pollutant of concern Atchison County SFL and allocated under this TMDL. The general inventory of sources within the drainage does provide guidance as to areas of load reduction.

Point Sources: A current Wasteload Allocation of zero is established by this TMDL because of the lack of point sources in the watershed. Should future point sources be proposed in the watershed and discharge into the impaired segments, the current Wasteload allocation will be revised by adjusting current load allocations to account for the presence and impact of these new point source dischargers.

Nonpoint Sources: Water quality violations are predominantly due to nonpoint source pollutants. Some erosion of soils in the watershed is expected. A reduction of sediment entering ASFL by 18%, 332 tons per year will be allocated to nonpoint sources. This reduction should limit the nutrients, and solids entering ASFL and allow the waterbody to fully support its designated uses. This reduction may also reduce atrazine entering the water body, potentially addressing an additional listed impairment of ASFL.

Defined Margin of Safety: The margin of safety provides some hedge against the uncertainty of variable annual TSS loading. The margin of safety will be to provide capacity for 10% more potential sediment than is seen in average annual loads, or 243 tons of sediment per year.

TMDL	WLA	LA	MOS
2442 tons/year	0 tons/year	2199 tons/year	243 tons/year

(Table 2- Total Maximum Annual Load, WLA, LA & MOS. See Appendix A for conversion to daily loads.**)**

State Water Plan Implementation Priority: Because this water provides a valuable recreational resource near a large urban area, the Atchison County SFL TMDL will be a **High Priority** for implementation.

Unified Watershed Assessment Priority Ranking: This watershed lies within the Independence-Sugar (HUC 8: 10240011) with a priority ranking of 25 (Medium Priority for restoration).

Priority Areas: Implementation of land use practices should be targeted to those areas marked in red in Figure 3.

5. IMPLEMENTATION

Desired Implementation Activities

There is a good potential for reducing pollutant loads to this lake through the use of best management practices. Some of the recommended agricultural practices are as follows:

1. Implement soil sampling to recommend appropriate fertilizer applications on cropland.
2. Maintain conservation tillage and contour farming to minimize cropland erosion.
3. Place highly erodible areas into permanent cover, including CRP enrollment.
4. Install grass buffer strips along streams.
5. Reduce activities within riparian areas.
6. Implement nutrient management plans to manage manure application to land.
7. Provide alternate water sources for livestock, and fence stream channels.
8. Build sediment traps above the lake to capture silt entering the reservoir.
9. Incorporate the TMDL into the Missouri Basin WRAPS

Implementation Programs Guidance

Non-Point Source Pollution Technical Assistance - KDHE

a. Support Section 319 demonstration projects for reduction of siltation runoff from agricultural or road construction activities

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

c. Provide technical assistance on road construction activities in vicinity of streams.

d. Support the development, assessment, planning and implementation of the Missouri Basin WRAPS to comprehensively reduce the loading and delivery of pesticides, sediment and nutrients to the stream system throughout its watershed.

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

a. Apply conservation farming practices, including terraces and waterways

b. Provide sediment control practices to minimize erosion and sediment transport from highly contributing tributaries into the lake

Riparian Protection Program - SCC

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

b. Develop riparian restoration projects

Buffer Initiative Program - SCC

a. Install grass buffer strips near streams.

b. Leverage Conservation Security Program to hold riparian land out of production.

CRP Enrollment- NRCS

a. Enroll highly erodable lands in the conservation reserve program.

Extension Outreach and Technical Assistance - Kansas State University

a. Educate agricultural producers on sediment and pasture management
b. Provide technical assistance on buffer strip design and minimizing cropland runoff

Sediment Trap Construction –Kansas Department of Wildlife and Parks

a. Construct appropriately sized sediment traps in the immediate vicinity of the reservoir
b. Annually remove collected sediment from the sediment traps to maintain proper operation

Construction of sediment traps above the water body should receive first priority for new funding. Implementation of best management practices in the watershed should continue. Removal of existing sediment from the reservoir arms may be considered to reduce internal nutrient loading, should conditions fail to meet water quality standards.

Time Frame for Implementation: Construction of sediment traps should occur before 2012. During 2007-2012 monitoring of in lake conditions shall continue.

Delivery Agents: The primary delivery agents for program participation will be the Atchison County Conservation District for programs of the State Conservation Commission and the Natural Resources Conservation Service. Producer outreach and awareness will be delivered by Kansas State Extension. The Kansas Department of Wildlife and Parks will build and maintain the sediment traps. The Kansas Department of Health and Environment shall continue to monitor lake conditions.

Targeted Participants: Primary participants for implementation of best management practices will be agricultural producers within the drainage of the lake.

Milestone for 2012: The year 2012 marks the next visit to the Missouri River Basin for TMDL development and revision. At that point in time, sampled data from Atchison County SFL will be reexamined to confirm the impaired status of the lake. Should impairment remain, more aggressive techniques will be examined to remove potential sources of sediment and nutrients from the lake.

Reasonable Assurances:

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

1. 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.

2. 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.

3. 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.

4. 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.

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

6. The *Kansas Water Plan* and the Missouri 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. Priority should be given to activities which reduce loadings of suspended solids to the lake prior to 2012.

Effectiveness: Sediment capture and removal has proven effective at reducing nutrient loadings to lakes.

6. MONITORING

Further sampling will occur before 2012. The Kansas Department of Health and Environment will survey the lake two times before the midpoint of this TMDL. The Kansas Department of Wildlife & Parks will document improvements in visitation and fishing once implementation is underway.

7. FEEDBACK

Public Meetings: Public meetings to discuss TMDLs in the Missouri Basin have been held since 2001. An active Internet Web site was established at www.kdheks.gov/tmdl/ to convey information to the public on the general establishment of TMDLs in the Missouri Basin and these specific TMDLs.

Public Hearing: A Public Hearing on these Missouri Basin TMDLs was held in Hiawatha on May 30, 2007.

Basin Advisory Committee: The Missouri Basin Advisory Committee met to discuss these TMDLs on June 26, 2006 in Atchison, December 1, 2006 and January 26, 2007 in Highland, March 16, 2007 in Atchison and May 14, 2007 in Hiawatha.

Milestone Evaluation: In 2012, evaluation will be made as to implementation of management practices to minimize the non-point source runoff contributing to this impairment. Subsequent decisions will be made regarding the implementation approach, priority of allotting resources for implementation and the need for additional or follow up implementation in this watershed at the next TMDL cycle for this basin in 2012.

Consideration for 303d Delisting: The lake will be evaluated for delisting under Section 303d, based on the monitoring data over the period 2008-2015. Therefore, the decision for delisting will come about in the preparation of the 2016 303d list. Should modifications be made to the applicable water quality criteria during the 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 would come in 2007 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 for Fiscal Years 2008-2015.

Revised January 8, 2008

Appendix A – Conversion to Daily Loads as Regulated by EPA Region VII

The TMDL has an estimated annual average load for sediment that, if achieved, should meet the water quality targets. A recent court decision often referred to as the "Anacostia decision" has dictated that TMDLs include a "daily" load (Friend of the Earth, Inc v. EPA, et al.).

Expressing this TMDL in daily time steps could be misleading to imply a daily response to a daily load. It is important to recognize that the growing season mean chlorophyll *a* is affected by many factors such as: internal lake nutrient loading, water residence time, wind action and the interaction between light penetration, nutrients, sediment load and algal response.

To translate long term averages to maximum daily load values, EPA Region 7 has suggested the approach describe in the Technical Support Document for Water Quality Based Toxics Control (EPA/505/2-90-001)(TSD).

Maximum Daily Load (MDL) = (Long-Term Average Load) * $e^{[Z\sigma - 0.5\sigma^2]}$

where $\sigma^2 = \ln(CV^2 + 1)$

CV = Coefficient of variation = Standard Deviation / Mean

Z = 2.326 for 99th percentile probability basis

LTA= Long Term Average
LA= Load Allocation
MOS= Margin of Safety

LTA-Tons/day	CV	$e^{[Z\delta - 0.5\delta^2]}$	MDL-Tons/day	LA-Tons/day	MOS (10%)-Tons/day
2442 tons/year	0.5	2.683671435	17.95486478	16.1593783	1.795486478

Maximum Daily Load Calculation

Maximum Daily Load = (Long-Term Average Load) * $e^{[Z\sigma - 0.5\sigma^2]}$

where $\sigma^2 = \ln(CV^2 + 1)$

CV = Coefficient of variation (0.5)

Z = 2.326 for 99th percentile probability basis

Annual Sediment Load = 2,442 tons/yr

Maximum Daily Sediment Load = [(2,442 tons/yr)/(365 days/yr)]*$e^{[2.326*(0.472) - 0.5*(0.472)^2]}$

= 17.95 tons/day

Margin of Safety (MOS) for Daily Load

Annual Sediment MOS = 243 tons/yr

Daily Sediment MOS = [(243 tons/yr)/(365 days/yr)]*$e^{[2.326*(0.472) - 0.5*(0.472)^2]}$

= 1.795 tons/day

Source- *Technical Support Document for Water Quality-based Toxics Control (EPA/505/2-90-001)*

Appendix B:

References

Dodds, W.K., 2002. Freshwater Ecology Concepts and Environmental Applications. Academic Press, San Diego.

Kansas Biological Survey. 2005. Predicting the effects of watershed management on the eutrophication of reservoirs in the central plains: an integrated modeling approach. KBS Publication No. 123. University of Kansas.