

SMOKY HILL/SALINE RIVER BASIN TOTAL MAXIMUM DAILY LOAD

Water Body: Fossil Lake Water Quality Impairment: Siltation

Subbasin: Middle Smoky Hill

County: Russell

HUC 8: 10260006 **HUC 11 (HUC 14):** 040 (020)

Ecoregion: Central Great Plains, Smoky Hills (27a)
Central Great Plains, Rolling Plains and Breaks (27b)

Drainage Area: Approximately 15.5 square miles

Conservation Pool: Area = 44.6 acres
Watershed Area: Lake Surface Area = 222:1
Maximum Depth = 3.0 meters (9.8 feet)
Mean Depth = 1.3 meters (4.3 feet)
Retention Time = 0.21 years (2.5 months)

Designated Uses: Primary and Secondary Contact Recreation; Expected Aquatic Life Support; Domestic Water Supply; Food Procurement; Industrial Water Supply

Authority: City of Russell

2002 303(d) Listing: Smoky Hill/Saline River Basin Lakes

Impaired Use: Expected Aquatic Life Support and Primary and Secondary Contact Recreation

Water Quality Standard: 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)).

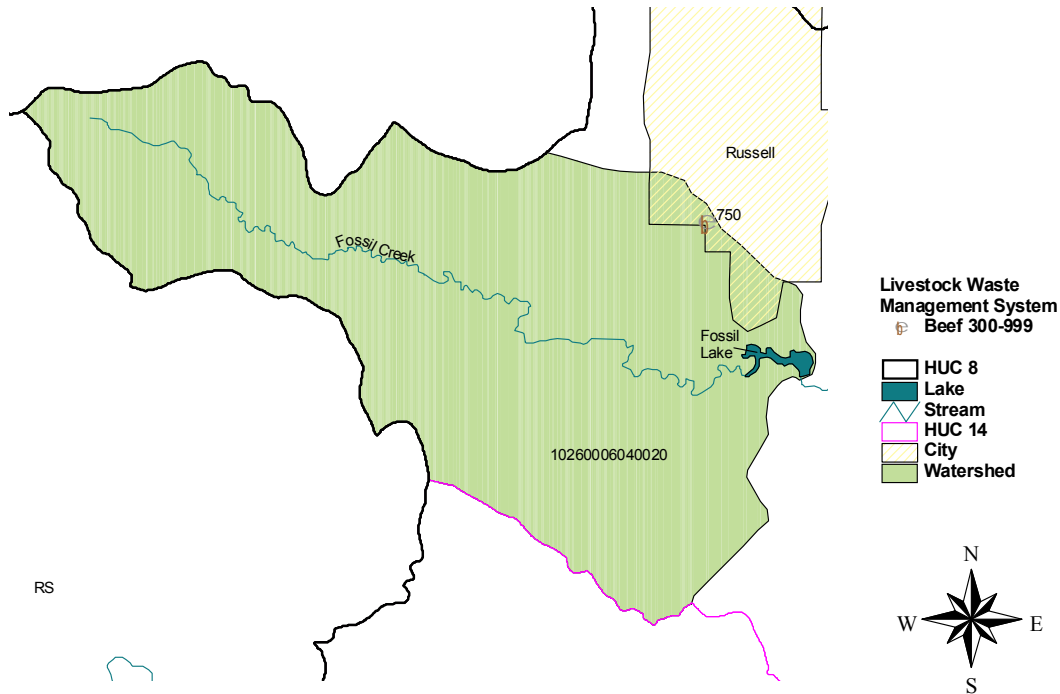
2. CURRENT WATER QUALITY CONDITION AND DESIRED ENDPOINT

Monitoring Sites: Station 052601 in Fossil Lake (Figure 1).

Period of Record Used: One survey during 1989

Figure 1

Fossil Lake TMDL Reference Map



Current Condition: Surface water in Fossil Lake has high turbidity, dominated by inorganic materials because the lake receives a steady inflow of silt. The lake is light limited (Appendix B). The transparency (Secchi Disc depth) is 0.15 meter, the average turbidity is 81.3 formazin turbidity units, and the average total suspended solid concentration is 124 mg/L (Appendix A). Lakes are considered to have a siltation problem if they meet the following criteria: chronically turbid, trophic state index plots indicate light limitation, and Secchi Disc Depth less than 0.5 meters. Fossil Lake is deemed to be Argillotrophic, as its average chlorophyll a concentration is 5.4 ppb (TSI = 47.11) and its average total phosphorus concentration is 243 ppb.

Interim Endpoints of Water Quality (Implied Load Capacity) at Fossil Lake over 2008 - 2012:

In order to improve the quality of the water column, the endpoint for Fossil Lake will be an increase in average transparency as measured by Secchi Disc Depth of 0.88 meter. The current turbidity impairment impedes primary productivity and dampens the support of aquatic life within the lake. However, a concomitant reduction in phosphorus loading must accompany any reduction in sediment loads and accompanying siltation. Much of the phosphorus entering Fossil Lake is attached to sediment. In reducing sediment loads, the associated phosphorus loads

should also be reduced, reflected in reduced in-lake total phosphorus concentrations. Modeling with CNET predicts that reduction of phosphorus levels, as specified in the Fossil Lake Eutrophication TMDL, should allow Secchi Disc depths to reach 0.88 meter. This increased clarity will boost biological productivity in the lake without causing the inception of excessive eutrophic conditions.

Additionally, sediment accumulation in the lake reduces the reservoir volume, and limits accessibility to portions of the lake which have silted in. Additionally, accumulated sediment contributes to recycling of nutrients within the lake. Therefore, reduction of the turbidity improves the quality of the lake and extends the utility as a water supply and recreation facility.

This TMDL endpoint meets water quality standards as measured and determined by Kansas Water Quality Assessment protocols. When the Secchi Disc depth is increased to 0.88 meter, the turbidity will be reduced to a level that encourages primary productivity and the support of aquatic life within the lake. The primary and secondary contact recreation uses will be supported because with less sediment accumulation a greater portion of the lake can still be used for recreation. These assessment protocols are similar to those used to cite the stream segments in this watershed as impaired on the Kansas 2002 Section 303(d) list.

Seasonal variation in the endpoint is not established by this TMDL. This endpoint can be reached as a result of expected reductions in loading from the various sources in the watershed resulting from implementation of corrective actions and Best Management Practices, as directed by this TMDL. Achievement of the endpoints indicates loads are within the loading capacity of the stream, water quality standards are attained and full support of the designated uses of the stream has been restored, therefore the narrative water quality standard pertaining to suspended solids would be attained.

Current Condition and Reductions for Fossil Lake

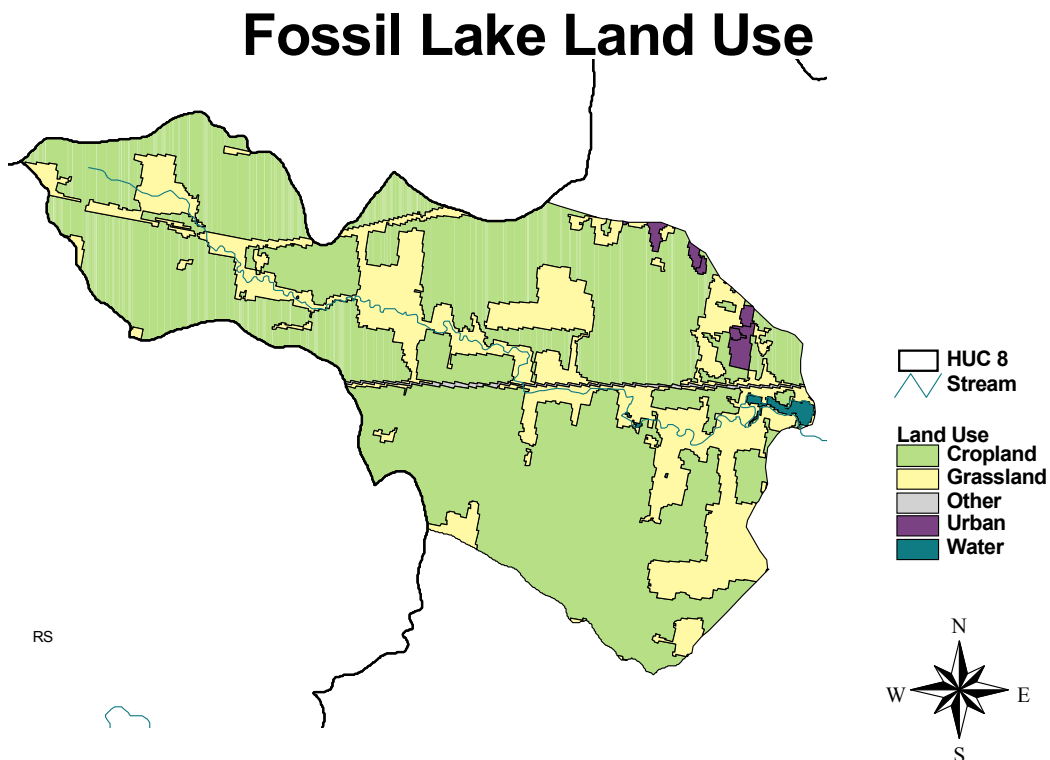
Parameter	Current Condition	TMDL	Percent Reduction
Turbidity (formazin turbidity units)	81.3	37.8	54 %
Secchi Disc Depth (cm)	15	88	486 % Increase

3. SOURCE INVENTORY AND ASSESSMENT

Land Use: The siltation impairment is most likely due to cropland that is adjacent to the streams that drain into Fossil Lake. Soil from exposed land runs-off into the lake, increasing the turbidity and concentration of total suspended solids and decreasing the transparency. Land use coverage analysis indicates that 74% of the watershed is cropland, and 24% is grassland (Figure 2). More woodland and grassland are needed around the streams to prevent erosion.

Sediment from urban land may get transported into the watershed. Part of Russell is located within the watershed. Russell anticipates a 2.2% population decrease by the year 2020. The average population density in the watershed is 83.8 people per square mile. One percent of the watershed is a combination of commercial and residential properties.

Figure 2



Contributing Runoff: The watershed's average soil permeability is 1.5 inches/hour according to NRCS STATSGO database. About 91.4% of the watershed produces runoff even under relatively low (1.5"/hr) potential runoff conditions. Runoff is chiefly generated as infiltration excess with rainfall intensities greater than soil permeabilities. As the watersheds' soil profiles become saturated, excess overland flow is produced. Generally, storms producing less than 0.5"/hr of rain will generate runoff from 4.9% of this watershed, chiefly along the stream channels.

Background Levels: Carp may cause some resuspension of sediment. Background levels of total suspended solids come from geological sources. Sediment becomes suspended during high flow events as soil along the banks is eroded.

4. ALLOCATION OF POLLUTANT REDUCTION RESPONSIBILITY

The load capacity of Fossil Lake is 37.8 formazin turbidity units. When the turbidity is reduced as specified in this TMDL, the clarity of the lake will improve. Reducing the phosphorus loading, as detailed in the Fossil Lake Eutrophication TMDL, will insure that the algal community will not increase as the clarity improves. More detailed assessment of sources and confirmation of the siltation impairment must be completed before detailed allocations can be made. The general inventory of sources within the drainage does provide some 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: Siltation loading comes predominantly from nonpoint source pollution. Given the runoff characteristics of the watershed, overland runoff can easily carry sediment into the streams. The Load Allocation within the lake is turbidity levels not to exceed 34.0 formazin turbidity units, a 54% reduction from current condition.

Defined Margin of Safety: The margin of safety provides some hedge against the uncertainty of the Secchi disc depth endpoint. Therefore, the margin of safety will be 3.8 formazin turbidity units (10%) taken from the load capacity to ensure that adequate load reduction occurs to meet the endpoint.

State Water Plan Implementation Priority: Because of the lack of recent monitoring data, this TMDL will be a Low Priority for implementation.

Unified Watershed Assessment Priority Ranking: Fossil Lake lies within the Middle Smoky Hill (HUC 8: 10260006) with a priority ranking of 51 (Low Priority for restoration).

Priority HUC 11s: The HUC 11 (040) contains the Fossil Lake, and thus this subwatershed should take priority.

5. IMPLEMENTATION

Desired Implementation Activities

There is a very good potential that agricultural best management practices will improve the water quality in Fossil Lake. Some of the recommended agricultural practices are as follows:

1. Maintain conservation tillage and contour farming to minimize cropland erosion.
2. Install grass buffer strips along streams.
3. Reduce activities within riparian areas.

Implementation Programs Guidance

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. Update and implement nutrient and sediment abatement strategies.
- e. Develop a Watershed Restoration and Protection Strategy for HUC 10260006.

Water Resource Cost Share Nonpoint Source Pollution Control Program - 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.

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. Continue to educate residents and landowners about nonpoint source pollution.
- b. Educate agricultural producers on sediment, nutrient, and pasture management.
- c. Provide technical assistance on buffer strip design and minimizing cropland runoff.

Time Frame for Implementation: Continued monitoring over the years from 2003 to 2008.

Targeted Participants: Primary participants for implementation will be agricultural producers and residents who are within the drainage of the lake. A detailed assessment of sources will be conducted by KDHE over 2003-2008.

Milestone for 2008: The year 2008 marks the midpoint of the ten-year implementation window for the watershed. At that point in time, sampled data from Fossil Lake will be reexamined to confirm the impaired status of the lake. Should the case of impairment remain, source assessment, allocation, and implementation activities will ensue.

Delivery Agents: The primary delivery agents for program participation will be the City of Russell. 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 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 Smoky Hill/Saline 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 pollutant 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 Low Priority consideration and should not receive funding.

Effectiveness: Sediment 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 within the watersheds cited in this TMDL.

6. MONITORING

Additional data, to further determine source loading and mean summer lake trophic condition, would be of value prior to 2008. Further sampling and evaluation should occur twice before 2008.

7. FEEDBACK

Public Meetings: Public meetings to discuss TMDLs in the Smoky Hill/Saline Basin were held January 7 and March 5, 2003 in Hays. 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 Smoky Hill/Saline Basin.

Public Hearing: A Public Hearing on the TMDLs of the Smoky Hill/Saline Basin was held in Hays on June 2, 2003.

Basin Advisory Committee: The Smoky Hill/Saline Basin Advisory Committee met to discuss the TMDLs in the basin on October 3, 2002, January 7, March 5, and June 2, 2003.

Milestone Evaluation: In 2008, evaluation will be made as to the degree of implementation which has occurred within the watershed and current condition of Fossil Lake. Subsequent decisions will be made regarding the implementation approach and follow up of additional implementation in the watershed.

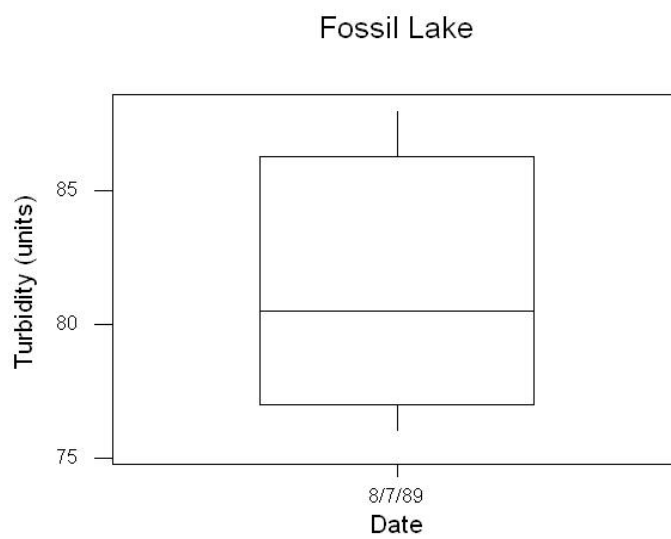
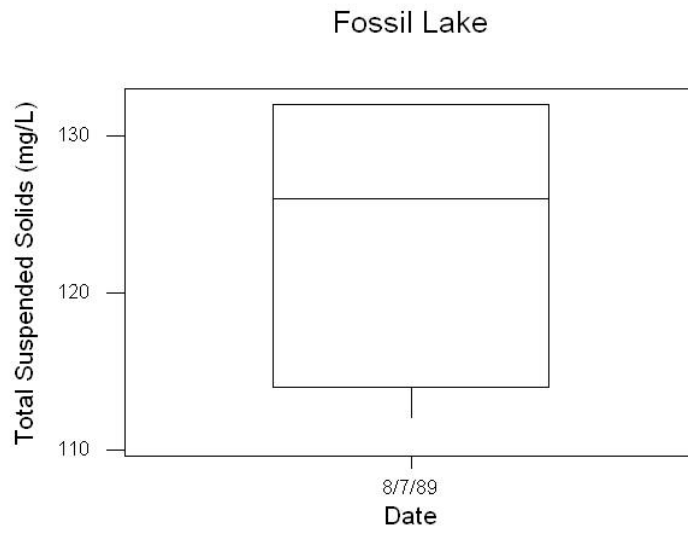
Consideration for 303(d) Delisting: The lake will be evaluated for delisting under Section 303(d), based on the monitoring data over the period 2008-2012. Therefore, the decision for delisting will come about in the preparation of the 2012 303(d) list. Should modifications be made to the applicable water 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 2004 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 2004-2008.

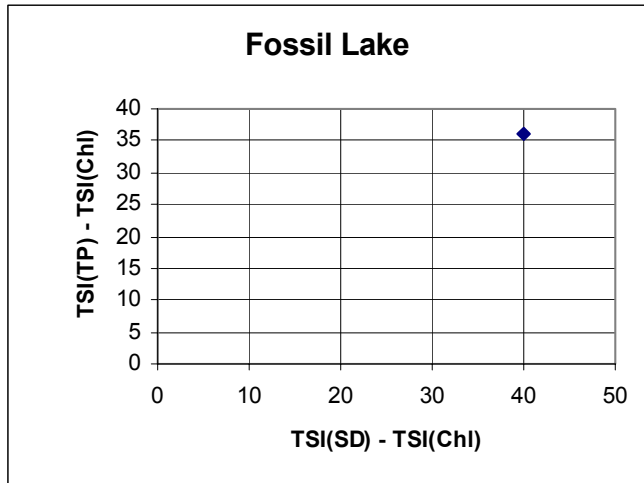
Bibliography

Liscek, Bonnie C. Methodology Used in Kansas Lake TMDLs [web page] Jul. 2001; <http://www.kdhe.state.ks.us/tmdl/eutro.htm> [Accessed 30 September 2002].

Appendix A - Boxplot



Appendix B - Trophic State Index Plots



The Trophic State Index plots indicate that light is the primary limiting factor, due to clay turbidity. This is inferred by examining the relationship between the TSI(SD) - TSI(Chl) and TSI(TP)-TSI(Chl). The deviation of chlorophyll from the sediment load indicates the degree of light penetration, while the difference between chlorophyll and phosphorus indicates the level of phosphorus limitation. Therefore, if the final plot is in the first quadrant, it shows that the transparency of the water is impaired due to the presence of small particles, and that phosphorus does not limit algae growth.

Approved Sep. 30, 2003