NEOSHO RIVER BASIN TOTAL MAXIMUM DAILY LOAD

Water Body: Council Grove Lake
Water Quality Impairment: Siltation

Subbasin: Neosho Headwaters

Counties: Morris, Wabaunsee, and Geary

HUC 8: 11070201

HUC 11 (HUC 14)**:** **010** (010, 020, 030, 040, 050, 060)

Ecoregion: Flint Hills (28)

Drainage Area: Approximately 258.6 square miles.

Conservation Pool: Area = 2,589 acres
Watershed Area: Lake Surface Area = 62:1
Maximum Depth = 11 meters (36 feet)
Mean Depth = 4.4 meters (14 feet)
Retention Time = 0.49 years (5.9 months)

Authority: Federal (U.S. Army Corps of Engineers), State (Kansas Water Office)

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

1998 303d Listing: Table 4 - Water Quality Limited Lakes

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

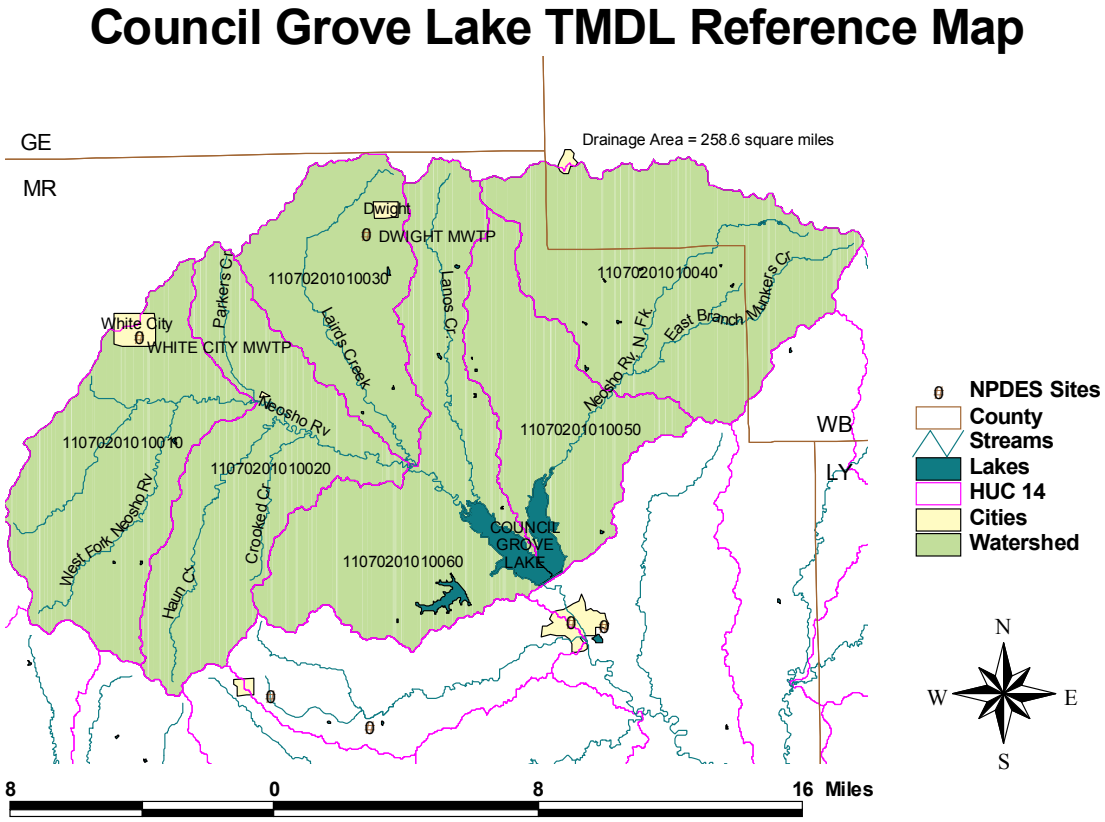
Water Quality Standard: Suspended solids - Narrative: Suspended solids added to surface waters by artificial sources shall not interfere with the behavior, reproduction, physical habitat or other factor related to the survival and propagation of aquatic or semi-aquatic or terrestrial wildlife. (KAR 28-16-28e(c)(2)(D)).

2. CURRENT WATER QUALITY CONDITION AND DESIRED ENDPOINT

Monitoring Sites: Station 022001 in Council Grove Lake. (Figure 1)

Period of Record Used: Five surveys during 1987 - 1999 and Kansas Biological Survey (2000)

Figure 1



Current Condition: Surface water in Council Grove Lake has high turbidity, dominated by inorganic materials because the lake receives a steady inflow of silt. The lake is light limited (Appendix B). Based on samples taken by KDHE, the average transparency (Secchi Disc depth) is 26 cm, the average turbidity is 75.2 formazin turbidity units, and the average total suspended solid concentration is 29 mg/L (Appendix A). See the table below. Lakes are considered to have a siltation problem if they meet the following criteria: chronically turbid, trophic state index plots indicate light limitation, average chlorophyll a concentrations less than 7.2 ppb, and Secchi Disc Depth less than 0.5 meters. Council Grove Lake is deemed to be argillotrophic, as its average chlorophyll a concentration is 5.90 ppb (TSI = 47.98), while its average total phosphorus concentration is 212 ppb.

Averages of KDHE Lake Monitoring Samples

Date	Average Total Suspended Solids (mg/L)	Average Turbidity (formazin turbidity units)	Secchi Depth (m)	Lake Elevation
8/31/87	44			
6/18/90	34	27.7	0.50	1274.03
6/15/93	27	91.0	0.15	1274.46

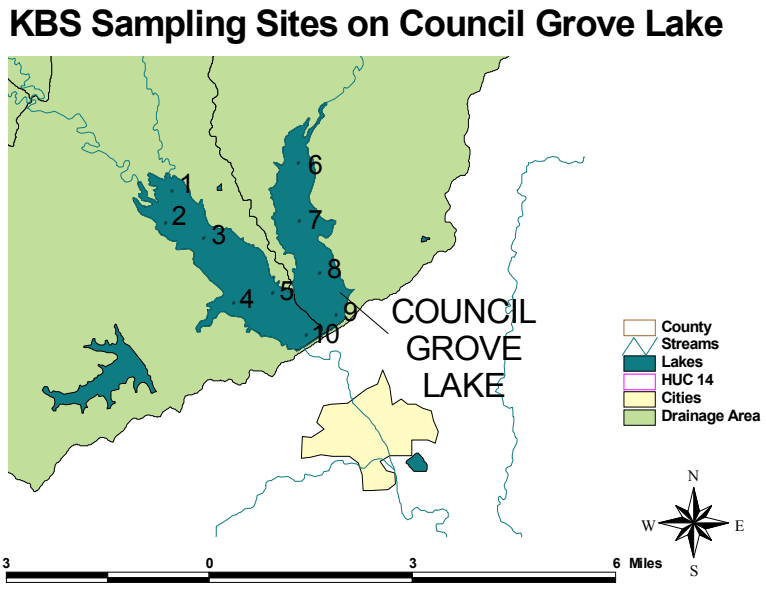
8/12/96	14	91.0	0.20	1273.83
7/12/99	27	91.0	0.18	1272.02

From May to November of 2000, the Kansas Biological Survey collected data monthly at ten stations (Figure 2) in Council Grove Lake. A summary of those results is included below.

Averages of Kansas Biological Survey Samples at the Ten Stations

Location	**Average Total Suspended Solids (mg/L)**	**Average Turbidity (formazin turbidity units)**	**Secchi Depth (m)**
Lanos Creek (Station 1) - Riverine	**64**	**82.7**	**0.43**
Neosho River (Station 2) - Riverine	**89**	**92.0**	**0.36**
Neosho River Arm (Station 3) - Transitional	**34**	**60.5**	**0.53**
Canning Creek (Station 4) - Transitional	**29**	**59.5**	**0.48**
Neosho River Arm (Station 5) - Transitional	**27**	**56.0**	**0.68**
Neosho River, N. Fork (Station 6) - Riverine	**113**	**56.8**	**0.45**
Richey Creek (Station 7) - Transitional	**26**	**51.6**	**0.66**
Neosho River, N. Fork. Arm (Station 8) - Transitional	**25**	**47.9**	**0.69**
Main Basin (Stations 9 & 10) - Lacustrine	**33**	**53.0**	**0.65**
Lake Average for 2000	**49**	**62.2**	**0.55**

Figure 2



The Neosho River/Lanos Creek subwatershed has the highest turbidity and thus the lowest clarity. The data are converted to loads by the following method. To determine the inflow into both arms of the lake, the proportion of the subwatershed to the entire watershed was multiplied times the inflow data from the U. S. Army Corps of Engineers. The load was calculated by multiplying the subwatershed inflow times the average concentration times a conversion factor. From this calculation, it is

evident that the Neosho River/Lanos Creek subwatershed is making the greatest contribution to the total suspended solid load. This conclusion is consistent with the land use assessment because the Neosho River/Lanos Creek Watershed has 2.7 times more cropland then the Neosho River, North Fork subwatershed. In addition, all of the urban land is located in the Neosho River/Lanos Creek subwatershed.

Loads Calculated from the Kansas Biological Survey Sample Data

Location	Drainage Area	Total Suspended Solids Load
Neosho River/Lanos Creek (Station 3)	170 mile^2	595 lbs/day
Neosho River, North Fork (Station 7)	89 mile^2	234 lbs/day

The samples, from the Kansas Biological Survey, were taken during low flow conditions. The data represent contributions from the subwatersheds yet do not accurately depict the total suspended solids loading to Council Grove Lake.

The reservoir was constructed in 1964 and had a conservation storage capacity of 52,735 acre-feet. The subsequent surveys have been taken of the lake bathymetry, the most recent in 1994, indicating a conservation storage capacity of 41,394 acre-feet.

The loss of 11,341 acre-feet of storage over 30 years represents an average annual loss of 378 acre-feet per year. Between the 1985 and 1994 surveys, the average annual loss was 808 acre-feet, chiefly because of the 1993 flood.

The initial design sediment storage of 10,300 acre-feet was intended to last 50 years or approximately 2014, at an average annual rate of 206 acre-feet per year. The current rate is higher in part because the projection of sediment deposition into the conservation pool is higher than designed.

Interim Endpoints of Water Quality (Implied Load Capacity) at Council Grove Lake over 2007 - 2011:

In order to improve the quality of the water column, the endpoint for Council Grove Lake will be an increase in average transparency as measured by Secchi Disc Depth of 1 meter. The current turbidity impairments impede 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 Council Grove 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 Council Grove Lake Eutrophication TMDL, should allow Secchi Disc depths to reach 1 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 contributes to recycling of nutrients within the lake. Therefore, reduction

of the sediment accumulation rate improves the quality of the lake and extends the utility as a water supply and recreation facility. Therefore, the second endpoint shall be maintaining the sediment rate at the design rate of 206 acre-feet per year, leaving 38,100 acre-feet in the conservation pool in 2010.

This TMDL endpoint meets water quality standards as measured and determined by Kansas Water Quality Assessment protocols. These assessment protocols are similar to those used to cite the stream segments in this watershed as impaired on the Kansas 1998 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.

3. SOURCE INVENTORY AND ASSESSMENT

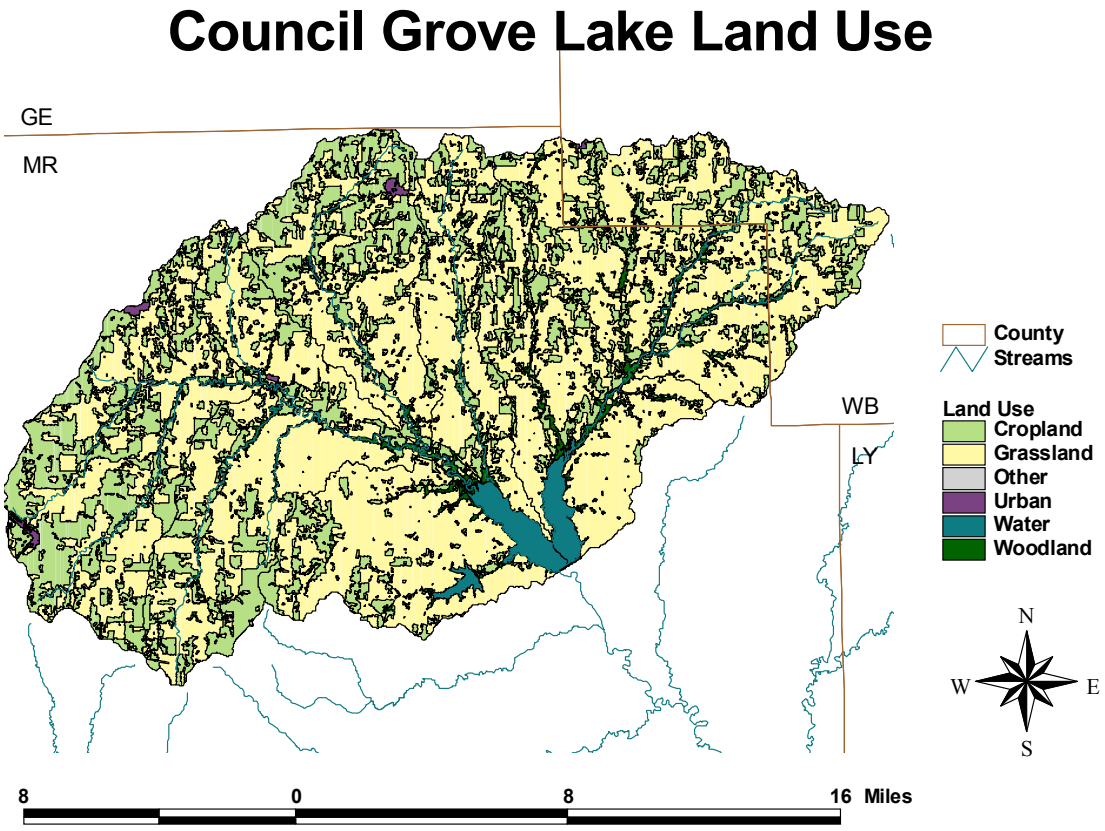
NPDES: Three NPDES permitted facilities are located within the watershed (Figure 1). Dwight WTP has no history discharge. White City WTP consistently discharges below their design flow. In compliance with their NPDES permit, these facilities sample for total suspended solids. According to projections of future water use and resulting wastewater, both wastewater treatment plants look to have sufficient treatment capacity available. The Alta Vista WTP currently has a two-cell lagoon that discharges into the Kansas-Lower Republican River Basin; a three-cell lagoon that will discharge into the Council Grove watershed is now under construction. A three-cell lagoon may be going into the Council Grove City Lake watershed in the near future in order to remove the need for septic systems around the lake. Based on the effluent limitations and the design flows, the three waste treatment plants plus the potential project would account for 157 pounds per day of total suspended solids.

Waste Treatment Plants in the Council Grove Watershed

Name	Type	Effluent Limitation (mg/L)	Design Flow (MGD)	Expiration Date
Alta Vista Wastewater Treatment Plant	3-cell lagoon in construction	80	0.054	2003
Council Grove City Lake	3-cell lagoon	80	0.09	Potential Project
Dwight WTP	3-cell lagoon	80	0.07	2003
White City Wastewater Treatment Plant	3-cell lagoon in construction	30	0.053	2003

Land Use: The siltation impairment is most likely due to cropland. 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 29.8% of the watershed is cropland, and 64.0 % is grassland (Figure 3). More woodland and grassland are needed around the streams to prevent erosion.

Figure 3



Sediment from urban land may get transported into the watershed. However, this source is probably not a major contributor because there is minimal urban land (less than 1% of the watershed) around the lake and population projections for the county to the year 2020 indicate moderate growth in population.

Contributing Runoff: The watershed's average soil permeability is 0.4 inches/hour according to NRCS STATSGO database. About 98.5% 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 only 48.2% 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 Council Grove Lake is 206.0 acre-feet per year. Assuming a bulk determination of 58 pounds per cubic foot, the load capacity is about 260,227 tons per year. 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: This impairment is partially associated with the Waste Treatment Plants. Ongoing inspections and monitoring of these NPDES sites will be made to ascertain the contributions that have been made by the source. These Waste Treatment Plants should comply with any future permit limits. Because of the long travel distance between their outfall and the lake, no reduction in Total Suspended Solids Wasteload will be required at this time. The Wasteload will be calculated with the proposed Council Grove City Lake project. Therefore, the Wasteload Allocation should be at 157 pounds of Total Suspended Solids per day (28.6 tons per year, 0.01% of the load capacity).

Nonpoint Sources: Siltation loading comes predominantly from nonpoint sources. Given the runoff characteristics of the watershed, overland runoff can easily carry sediment into the lake. The Load Allocation will be a 48% reduction in average sediment load or 195.7 acre-feet per year.

Defined Margin of Safety: The margin of safety provides some hedge against the uncertainty of variable sedimentation and Secchi Disc Depth endpoint. Therefore, the margin of safety will be 10.3 acre-feet per year of sediment taken from the load capacity subtracted to compensate for the lack of knowledge about the relationship between the allocated loadings and the resulting water quality.

State Water Plan Implementation Priority: Because Council Grove Lake is a federal reservoir with a small watershed and a large regional benefit for recreation and water supply, this TMDL will be a High Priority for implementation.

Unified Watershed Assessment Priority Ranking: This watershed lies within the Neosho Headwaters (HUC 8: 11070201) with a priority ranking of 38 (Medium Priority for restoration).

Priority HUC 11s: The watershed is within HUC 11 (010). The Neosho River/Lanos Creek subwatershed should take priority. Secondary focus should be placed the Neosho River, North

Fork subwatershed.

5. IMPLEMENTATION

Desired Implementation Activities

There is a very good potential that agricultural best management practices will improve the water quality in Council Grove 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.

Additionally, plans for reassessing the conservation pool after 2010 should be made to reclaim storage lost to sediment.

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.
d. Develop a Watershed Restoration and Protection Strategy for HUC 11070201.

Water Resource Cost Share and 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. Educate agricultural producers on sediment, nutrient, and pasture management.

b. Provide technical assistance on buffer strip design and minimizing cropland runoff.

Reservoir Management Program - KWO

a. Coordinate a comprehensive bathymetric survey of the lake by 2010 with the Tulsa District, Corps of Engineers

b. Initiate planning for a reservoir pool raise after 2010 to reclaim conservation storage lost to sediment which was to have deposited in the flood control storage.

Time Frame for Implementation: Pollutant reduction practices should be installed within the priority subwatersheds during the years 2002-2007, with minor followup implementation, including other subwatersheds over 2007-2011.

Targeted Participants: Primary participants for implementation will be agricultural producers within the drainage of the lake. Initial work in 2002 should include local assessments by conservation district personnel and county extension agents to locate within the lake drainage:

1. Total row crop acreage
2. Cultivation alongside lake

Milestone for 2007: The year 2007 marks the midpoint of the ten-year implementation window for the watershed. At that point in time, sampled data from Council Grove Lake should indicate evidence of reduced siltation in the conservation pool elevations relative to the conditions seen over 1987-1999.

Delivery Agents: The primary delivery agents for program participation will be 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 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 Neosho 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 High Priority consideration.

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 establish sediment loading and further determine mean summer lake trophic condition, would be of value prior to 2007. Further sampling and evaluation should occur once before 2007 and twice between 2007 and 2011. Some monitoring of tributary levels of sediment will help direct abatement efforts toward major contributors. Additionally, tracking of total suspended solids loads from the existing municipal lagoons should be done to confirm the low contribution to the lake. A sediment-bathymetric survey of the lake should be conducted before 2010 to ascertain the available storage in the conservation pool.

7. FEEDBACK

Public Meetings: Public meetings to discuss TMDLs in the Neosho Basin were held January 9, 2002 in Burlington and March 4, 2002 in Council Grove. 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 Neosho Basin.

Public Hearing: Public Hearings on the TMDLs of the Neosho Basin were held in Burlington

and Parsons on June 3, 2002.

Basin Advisory Committee: The Neosho Basin Advisory Committee met to discuss the TMDLs in the basin on October 2, 2001, January 9, March 4, and June 3, 2002.

Discussion with Interest Groups: Meetings to discuss TMDLs with interest groups include:
Morris County Conservation District: August 13, 2001
Kansas Farm Bureau: February 26 in Parsons and February 27 in Council Grove

Milestone Evaluation: In 2007, evaluation will be made as to the degree of implementation which has occurred within the watershed and current condition of Council Grove 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 2007-2011. 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.

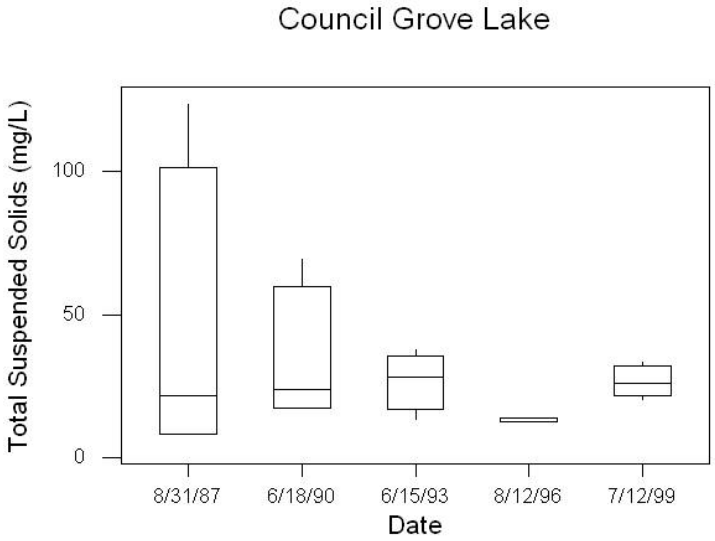
Incorporation into Continuing Planning Process, Water Quality Management Plan and the Kansas Water Planning Process: Under the current version of the Continuing Planning Process, the next anticipated revision will come in 2003 which will emphasize revision of the Water Quality Management Plan. At that 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 2003-2007.

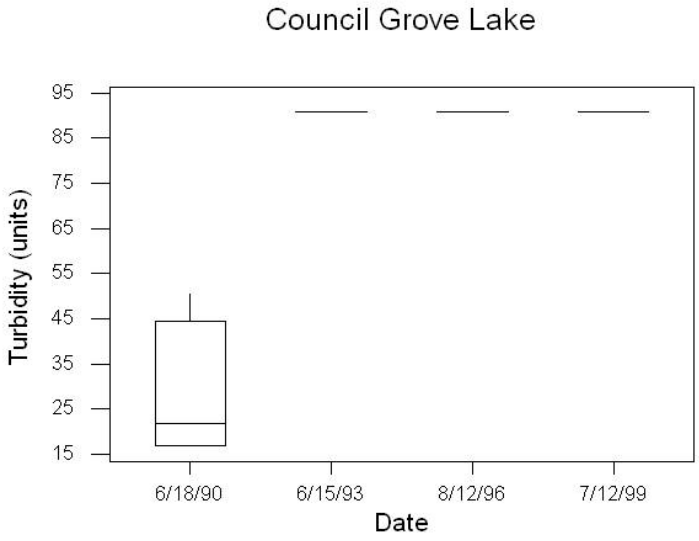
Bibliography

Lim, Niang Choo. "Assessment of Reservoir Water Quality and Its Application to Reservoir Management in the Central Plains." Thesis. University of Kansas. 2001.

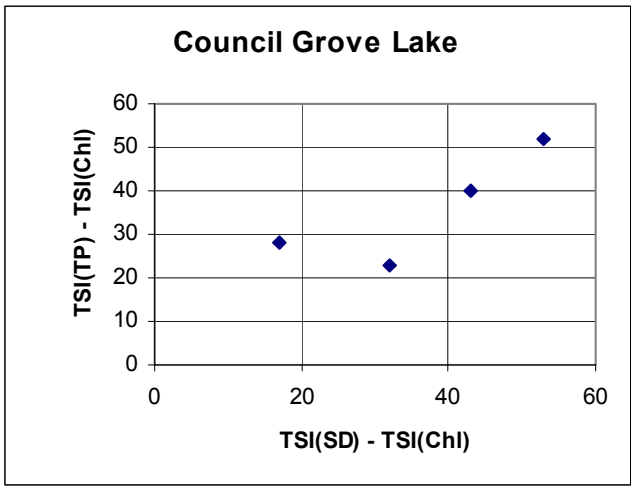
Liscek, Bonnie C. Methodology Used in Kansas Lake TMDLs [web page] Jul. 2001; http://www.kdhe.state.ks.us/tmdl/eutro.htm [Accessed 17 May 2002].

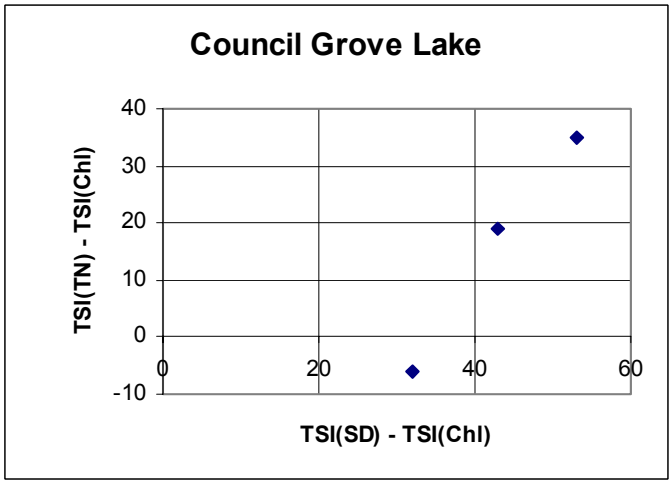
Appendix A - Boxplots





Appendix B - Trophic State Index Plots





The Trophic State Index plots indicate that light is the primary limiting factor, due to clay turbidity.

Approved September 30, 2002