

# KANSAS-LOWER REPUBLICAN BASIN TOTAL MAXIMUM DAILY LOAD

## Waterbody: Gardner Lake Water Quality Impairment: Eutrophication

### 1. INTRODUCTION AND PROBLEM IDENTIFICATION

**Subbasin:** Lower Kansas River

**County:** Johnson

**HUC 8:** 10270104

**HUC 11:** 140 (Kill Creek Watershed)

**Drainage Area:** Approximately 5 square miles.

**Conservation Pool:** Area 70 Acres, maximum depth 11 meters

**Designated Uses:** Primary & Secondary Contact Recreation; Domestic Water Supply; Aquatic Life Support

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

**Impaired Use:** All uses are impaired to a degree by eutrophication

**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)).

The introduction of plant nutrients into surface waters designated for primary or secondary contact recreational use shall be controlled to prevent the development of objectionable concentrations of algae or algal by-products or nuisance growths of submersed, floating, or emergent aquatic vegetation. (KAR 28-16-28e(c)(7)(A)).

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

### 2. CURRENT WATER QUALITY CONDITION AND DESIRED ENDPOINT

**Level of Support for Designated Use under 303d:** Not Supporting

**Level of Eutrophication:** Eutrophic - Trophic State Index = 60.1

**Monitoring Sites:** Station 040401 in Gardner Lake.

**Period of Record Used:** Four previous surveys—1988, 1989, 1993, & 1998

**Current Condition:** The lake has elevated chlorophyll a concentrations during summer months, average concentration is 20.2 ppb, with an associated Trophic State Index of 60.1, indicative of very eutrophic conditions. Total phosphorus data tend to be elevated (average of 47.4 ppb). Fifty percent of the samples taken from the lake were at or over 100 ppb. Phosphorus is the primary limiting factor (TN/TP = 14.6, >12 indicates phosphorus is more important). Low-to-moderate inorganic turbidity, but adequate light within the water column. Chlorophyll-to-phosphorus yield is high.

The Trophic State Index of 60.1 is derived from the chlorophyll a concentration. Trophic state assessments of potential algal productivity were made based on chlorophyll a concentrations, nutrient levels and values of the Carlson Trophic State Index (TSI). Generally, some degree of eutrophic conditions are seen with chlorophyll a concentrations over 12 ug/l and hypereutrophy occurs at levels over 20 ug/l. The Carlson TSI, derives from the chlorophyll concentrations and scales the trophic state as follows:

- |                       |                 |
|-----------------------|-----------------|
| 1. Oligotrophic       | TSI < 40        |
| 2. Mesotrophic        | TSI: 40 - 49.99 |
| 3. Slightly Eutrophic | TSI: 50 - 54.99 |
| 4. Fully Eutrophic    | TSI: 55 - 59.99 |
| 5. Very Eutrophic     | TSI: 60 - 63.99 |
| 6. Hypereutrophic     | TSI: ≥ 64       |

In Gardner Lake, the dissolved oxygen concentration decreases with increased depth. (See attached table). At the surface, the concentration was approximately 8 mg/L, a sufficient amount of dissolved oxygen for aquatic life support. However, near the bottom of the lake, the concentration dropped to 0 mg/L in all surveys. The low dissolved oxygen concentrations are due to the accumulation of organic material in the lower depths resulting from lake productivity reflective of its slightly eutrophic state.

#### **Desired Endpoints of Water Quality at Gardner City Lake over 2004 - 2008:**

In order to improve the trophic condition of the lake from its current very eutrophic status, the desired endpoint will be summer chlorophyll a concentrations at or below 12 ug/l, corresponding to a trophic state of slightly eutrophic conditions by 2008. Achievement of this endpoint should also result in higher concentrations of dissolved oxygen in the water column of the lake. Refined endpoints will be developed in 2004 to reflect additional sampling and artificial source assessment and confirmation of impaired status of lake.

### **3. SOURCE INVENTORY AND ASSESSMENT**

**Land Use:** The primary source of phosphorus within Gardner City Lake is probably runoff from agricultural lands in the Kill Creek watershed where phosphorus has been applied. Land use coverage analysis indicates 32% of the watershed is in cropland. No point sources are present within the lake's drainage.

Fertilizer applications to lawns within the drainage and stormwater delivery to the lake are probably primary loading sources. Population density is high, 225 people per square mile. Fifteen percent of the watershed is urban. Urbanization of the county is projected to continue to the year 2020. An annual phosphorus load of 2450.8 pounds per year is necessary to correspond to the concentrations seen in the lake.

Houses around lake are on septic systems. At some point in the future, Gardner will likely put these homes into their collector system. Johnson County continues to have a large number of on-site waste systems established, inspections or investigations of such systems routinely number over 300 per year in the county.

**Background Levels:** Nutrient recycling from the sediments in the lake is likely contributing available phosphorus to the lake for algal uptake.

#### **4. ALLOCATION OF POLLUTION REDUCTION RESPONSIBILITY**

More detailed assessment of sources and confirmation of the trophic state of the lake 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:** Since this impairment is primarily associated with agricultural and urban non-point source pollution, there will be no Wasteload Allocation assigned to point sources for nutrients under this TMDL.

**Non-Point Sources:** Water quality violations are predominantly due to non-point source pollution. Background levels may be attributed to nutrient recycling. The assessment suggests that cropland and urban areas throughout the watershed contribute to the eutrophic state of the lake. Given the runoff characteristics of the watershed, overland runoff can easily carry phosphorus into the lake. Septic systems around the lake also contribute to nutrient loading. Generally a Load Allocation of 945 pounds per year, leading to a 57% reduction in available phosphorus is necessary to reach the endpoint.

**Defined Margin of Safety:** The margin of safety provides some hedge against the uncertainty of variable annual total phosphorus loads and the chlorophyll a endpoint. Therefore, the margin of safety will be 105 pounds per year of total phosphorus taken from the load capacity to ensure that adequate load reduction occurs to meet the endpoint.

**State Water Plan Implementation Priority:** Because this lake has a domestic water supply function and is associated with other TMDLs regarding the water quality of Kill Creek subwatershed and because of the need to comprehensive package implementation measures to handle multiple pollutants in the agricultural setting, this TMDL will be a High 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:** The entire watershed is within HUC 11 (140) of Kill Creek.

## **5. IMPLEMENTATION**

### **Desired Implementation Activities**

Projections indicate that full use support could be achieved through watershed-wide BMPs for agriculture, plus attending to septic systems around the lake. 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. Install grass buffer strips along streams.
4. Reduce activities within riparian areas
5. Implement nutrient management plans to manage manure application to land

### **Implementation Programs Guidance**

#### **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.
- d. Guide federal programs such as the Environmental Quality Improvement Program, which are dedicated to priority subbasins through the Unified Watershed Assessment, to priority subwatersheds and stream segments within those subbasins identified by this TMDL.

#### **Local Environmental Protection Program - KDHE**

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

#### **Water Resource Cost Share & Non-Point Source Pollution Control Programs - 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
- c. Provide livestock waste management systems for proper manure storage, disposal and land application.
- d. Repair failing septic systems in proximity to streams
- e. Coordinate with USDA/NRCS Environmental Quality Improvement Program in providing educational, technical and financial assistance to agricultural producers.

**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 and nutrient management
- b. Provide technical assistance on buffer strip design and minimizing cropland runoff
- c. Encourage annual soil testing to determine capacity of field to hold phosphorus

**Timeframe for Implementation:** Pollution reduction practices should be installed within the lake drainage during the years 2000-2004.

**Targeted Participants:** Primary participants for implementation will be agricultural producers and homeowners operating within the drainages of the lake. Implemented activities should be targeted at those areas with greatest potential to impact the lake. Nominally, this would be activities located within one mile of the streams including:

1. Total rowcrop acreage
2. Cultivation alongside lake
3. Fields with manure applications

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, milestones should be reached which will have at least eighty percent of the producers responsible for the land use activities cited in the local assessment participating in the implementation programs provided by the state. Additionally, sampled data from Gardner City Lake should indicate evidence of reduced phosphorus levels in the conservation pool elevations relative to the conditions seen over 1988-1998.

**Delivery Agents:** Depending upon confirmation of impairment and assessment of probable sources, the primary delivery agents for program participation will be county and city officials.

## **Reasonable Assurances:**

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

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 established water quality standards.
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 non-point 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 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 **High 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.

## **6. MONITORING**

KDHE will collect nutrient and chlorophyll a samples from Gardner City Lake in 2001 and 2003. Additional data, to establish nutrient ratios, source loading and further determine mean summer lake trophic condition, would be of value prior to 2004. Further sampling and evaluation should occur in 2005 and 2007..

## 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 Gardner City Lake. Subsequent decisions will be made regarding implementation approach, follow up of additional implementation and implementation in the non-priority subwatersheds.

**Consideration for 303d Delisting:** Gardner City Lake 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 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 for Fiscal Years 2000-2004.

Approved January 26, 2000.