

# MARAIS DES CYGNES RIVER BASIN TOTAL MAXIMUM DAILY LOAD

## Water Body: Crystal Lake Water Quality Impairment: Eutrophication

### 1. INTRODUCTION AND PROBLEM IDENTIFICATION

**Subbasin:** Upper Marais des Cygnes

**County:** Anderson

**HUC 8:** 10290101

**HUC 11 (HUC 14):** 060 (010)

**Drainage Area:** Approximately 0.58 square mile.

**Conservation Pool:** Area = 12.1 acres, Maximum Depth = 4 meter

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

**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)).

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

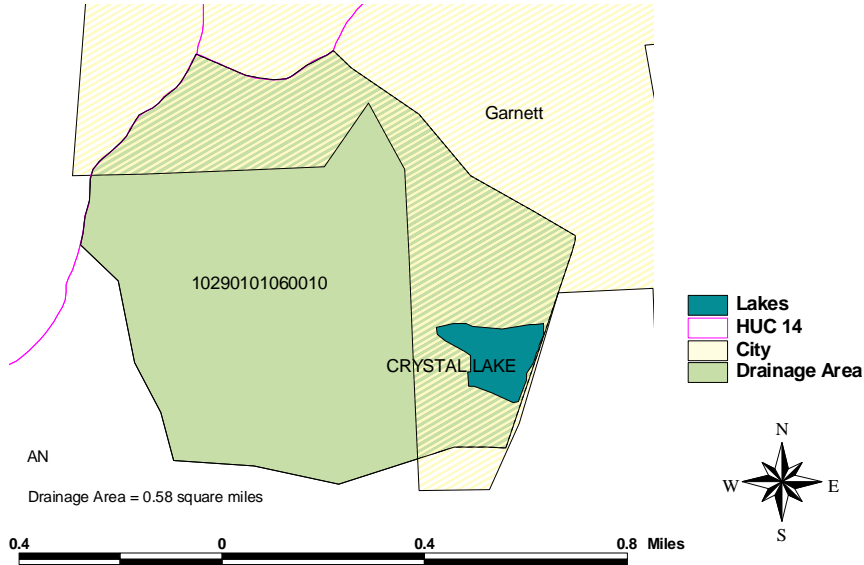
**Level of Eutrophication:** Hypereutrophic, Trophic State Index = 68.91

**Monitoring Sites:** Station 064901 in Crystal Lake (Figure 1)

**Period of Record Used:** Six surveys during 1992 - 1994.

**Figure 1**

## Crystal Lake TMDL Reference Map



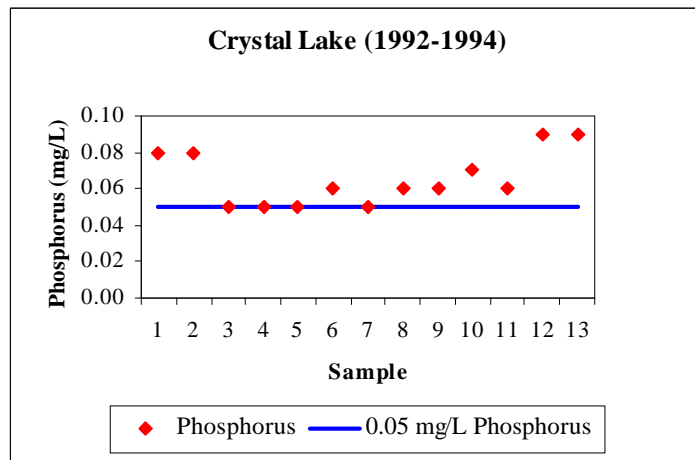
**Current Condition:**

The average chlorophyll a concentration was 49.8 ppb in 1994. The average, total phosphorus concentration was 65.4 ppb over the period of record (Figure 2). The chlorophyll a to total phosphorus yield appears high. Phosphorus and nitrogen are co-limiting; the total nitrogen to total phosphorus ratio is equal to 10.4. Light is probably not a limiting factor.

The Trophic State Index 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 is seen with chlorophyll a concentrations over 7 ug/l and hypereutrophy occurs at levels over 30 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       |

**Figure 2**



### Interim Endpoints of Water Quality (Implied Load Capacity) at Crystal Lake over 2006 - 2010:

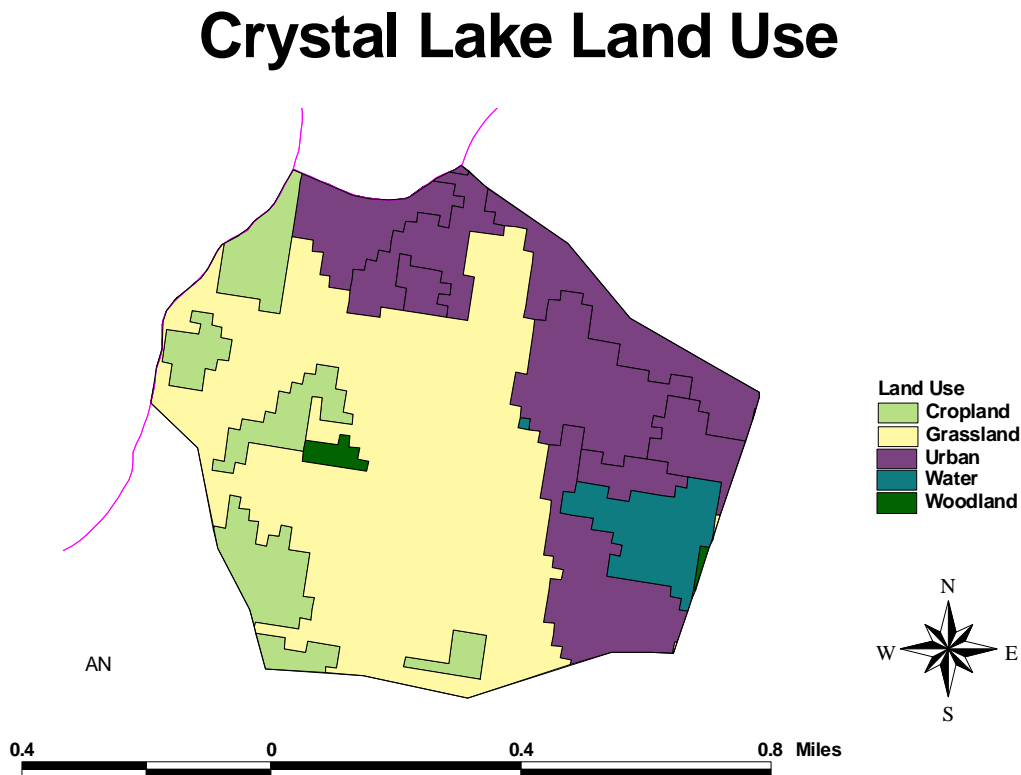
In order to improve the trophic condition of the lake from its current hypereutrophic status, the desired endpoint will be summer chlorophyll a concentrations at or below 20 ug/l, corresponding to a trophic state of eutrophic conditions by 2010. Refined endpoints will be developed in 2006 to reflect additional sampling and artificial source assessment and confirmation of impaired status of lake.

### 3. SOURCE INVENTORY AND ASSESSMENT

**Land Use:** The watershed has a moderate to high potential for nonpoint source pollution. An annual phosphorus load of 716.5 pounds per year and an annual nitrogen load of 2,596.4 pounds per year is necessary to correspond to the concentrations seen in the lake.

Fertilizer applications to lawns within the drainage and stormwater delivery to the lake are probably primary loading sources. The watershed is 37.8% urban (Figure 3). The population of Garnett is projected to increase 2.5% to the year 2020.

Figure 3



Another source of phosphorus within the lake is runoff from agricultural lands where phosphorus has been applied. Land use coverage analysis indicates that 11.5 % of the watershed is cropland and 49.9% is grassland. In 1999, the total amount of fertilizer sold in Anderson County was 22,966 tons. Assuming that the drainage area of Crystal Lake covers 0.1% of the county, then 23.0 tons of fertilizer were bought and potentially used with the watershed. The grazing density is high in the watershed.

**Contributing Runoff:** The watershed's average soil permeability is 0.6 inches/hour according to NRCS STATSGO database. About 100% 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 42.1% of this watershed, chiefly along the stream channels.

**Background Levels:** Trees are adjacent to Crystal Lake; leaf litter may be adding to the nutrient load. The atmospheric phosphorus and geological formations (i.e. soil and bedrock) may contribute to phosphorus loads. Nitrogen loads may be contributed from the atmosphere. Fish feeders are present in the lake, though they have no observable impact on either annual nutrient loads or water quality.

Crystal Lake receives 0.249 MGD of water from two lakes. Sixty-five percent of the water comes from Cedar Creek Lake and 35% comes from Garnett North Lake. Although these lakes can contribute to the nutrient load, neither have poor water quality nor require a TMDL

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

Phosphorus and nitrogen are co-limiting nutrients in Crystal Lake and allocated under this TMDL. 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:** 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 partially due to nonpoint source pollutants. Background levels may be attributed to leaf litter and geology. The assessment suggests that urban and agricultural runoff in the watershed contributes to the hypereutrophic state of the lake. Generally a Load Allocation of 210.3 pounds of total phosphorus per year, leading to a 67.4% reduction, is necessary to reach the endpoint. The nitrogen load is 1,012.0 pounds per year, a 56.7% reduction.

**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 23.4 pounds per year of total phosphorus and 112.4 pounds per year of nitrogen 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 Crystal Lake is a source of drinking water and a more detailed source assessment and additional in-lake monitoring of nutrient and algal content is needed, this TMDL will be a Medium Priority for implementation.

**Unified Watershed Assessment Priority Ranking:** This watershed lies within the Upper Marais des Cygnes subbasin (HUC 8: 10290101) with a priority ranking of 5 (High Priority for restoration).

**Priority HUC 11s:** The lake is within HUC 11 (060).

## 5. IMPLEMENTATION

### Desired Implementation Activities

There is ample opportunity to reduce nonpoint source nutrient loads to Crystal Lake, with a good chance to improve overall water quality and use support levels. Attention should be given to both the urban and agricultural 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. 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

#### Stormwater Management - KDHE

- a. Assist the city with evaluation of Best Management Practices which will lead to reduction in nutrient loading from urban settings during runoff into lake.

#### 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. Provide technical assistance on nutrient management in vicinity of streams.

- d. Assist evaluation of stormwater quality from urbanized areas of the watershed.

**Fisheries Management - KDWP**

- a. Assist evaluation in-lake or near-lake potential sources of nutrients to lake.
- b. Advise the city on application lake management techniques which may reduce nutrient loading and cycling in lake.

**Water Resource Cost Share Program - SCC**

- a. Apply conservation farming practices, including terraces and waterways, sediment control basins, and constructed wetlands.

**Nonpoint 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 buffer strip design and minimizing cropland runoff.
- c. Encourage annual soil testing to determine capacity of field to hold phosphorus.

**Time Frame for Implementation:** Pollution reduction practices should be installed within the lake drainage after the year 2006. Evaluation of nutrient sources to lake and identification of potential management techniques should occur prior to 2006.

**Targeted Participants:** Primary participants for implementation will be agricultural producers within the drainage of the lake. Initial work in 2006 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 2006:** The year 2006 marks the midpoint of the ten-year implementation window for the watershed. At that point in time, sampled data from Crystal Lakes should indicate probable sources of nutrients and plans in place to initiate implementation.

**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 Marais des Cygnes 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 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 within the watersheds cited in this TMDL.

## 6. MONITORING

Additional data, to establish nutrient ratios, source loading and further determine mean summer lakes trophic condition, would be of value prior to 2006. Further sampling and evaluation should occur once before 2006 and once between 2006 and 2011.

## 7. FEEDBACK

**Public Meeting:** The public meeting to discuss TMDLs in the Marais des Cygnes Basin was held February 28, 2001 in Ottawa. 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 Marais des Cygnes Basin.

**Public Hearings:** Public Hearings on the TMDLs of the Marais des Cygnes Basin were held in Fort Scott on May 30 and Ottawa on May 31, 2001.

**Basin Advisory Committee:** The Marais des Cygnes Basin Advisory Committee met to discuss the TMDLs in the basin on October 4, 2000, February 28 and May 30, 2001.

**Milestone Evaluation:** In 2006, evaluation will be made as to the degree of implementation which has occurred within the watershed and current condition of Crystal Lake. Subsequent decisions will be made regarding the implementation approach and follow up of additional implementation in the watershed.

**Consideration for 303d Delisting:** Crystal Lake will be evaluated for delisting under Section 303(d), based on the monitoring data over the period 2006-2010. Therefore, the decision for delisting will come about in the preparation of the 2014 303(d) 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.

### **Bibliography**

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