

MARAIS DES CYGNES RIVER BASIN TOTAL MAXIMUM DAILY LOAD

Water Body: Marais des Cygnes Wildlife Management Area (WMA)
Water Quality Impairment: Eutrophication Bundled with pH and Dissolved Oxygen

1. INTRODUCTION AND PROBLEM IDENTIFICATION

Subbasin: Lower Marais des Cygnes **County:** Linn

HUC 8: 10290102

HUC 11 (HUC 14s): **060** (060)
 070 (060)
 080 (010)

Drainage Area: Approximately 10.7 square miles.

Conservation Pool: Area = 1,169 acres, Maximum Depth = approximately 0.5 meter

Designated Uses: Secondary Contact Recreation, Special Aquatic Life Support, and Food Procurement

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)).

Artificial sources of pollution shall not cause the pH of any surface water outside of a zone of initial dilution to be below 6.5 and above 8.5 (KAR 28-16-28e(c)(2)(C))

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

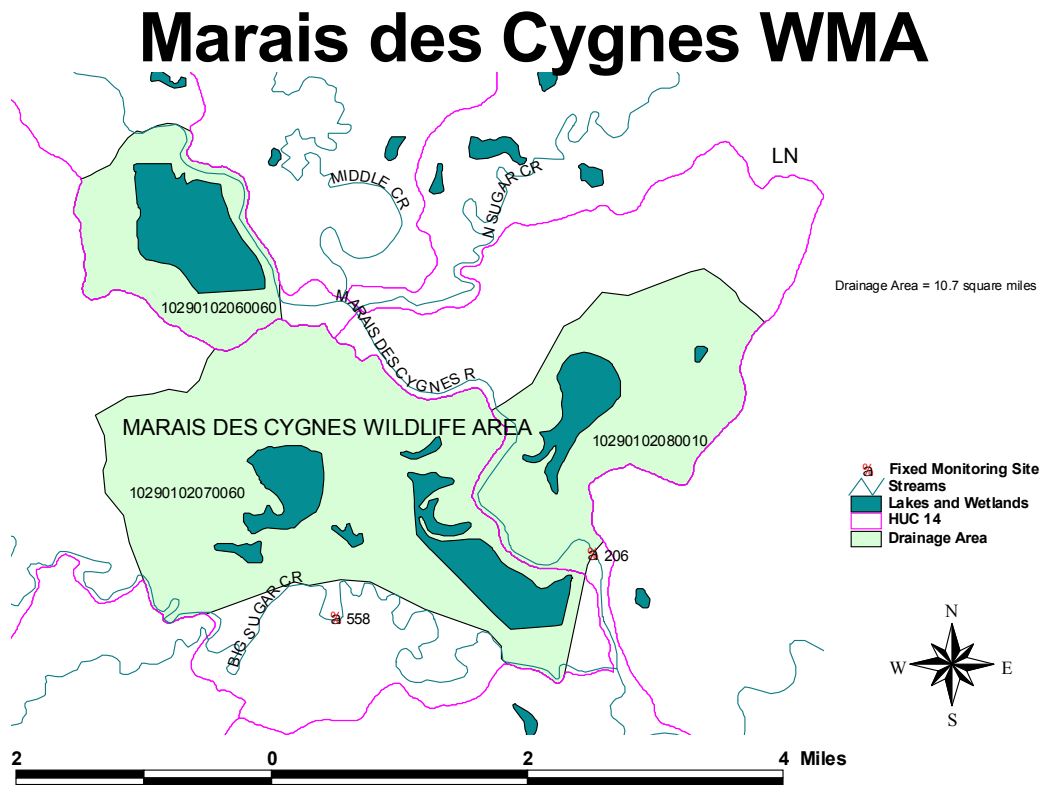
2. CURRENT WATER QUALITY CONDITION AND DESIRED ENDPOINT

Level of Eutrophication: Hypereutrophic, Trophic State Index = 82.27

Monitoring Sites: Station 053201 in the Marais des Cygnes WMA (Figure 1).

Period of Record Used: Seven surveys during 1990-2000.

Figure 1



Current Condition: The Marais des Cygnes WMA has elevated chlorophyll a concentrations averaging 194.3 ppb (Figure 2). This relates to a Trophic State Index of 82.27, indicating hypereutrophic conditions. The chlorophyll a concentration has increased over time. During the 1990 and 1993 surveys, the average concentration was 17.0 ppb. The highest concentrations (averaging 600.8 ppb) were seen in 2000.

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

The total phosphorus concentrations are high, averaging 555.1 ppb. One hundred percent of the samples are over 50 ppb (Figure 3). The total nitrogen to total phosphorus ratio is 8.7, indicating that phosphorus and nitrogen are co-limiting. The average total Kjeldahl nitrogen concentration is 4.7 mg/L. The chlorophyll a to total phosphorus yield is moderate to high. Despite moderate to high turbidity in the wetland, light is not indicated to be a limiting factor.

Figure 2

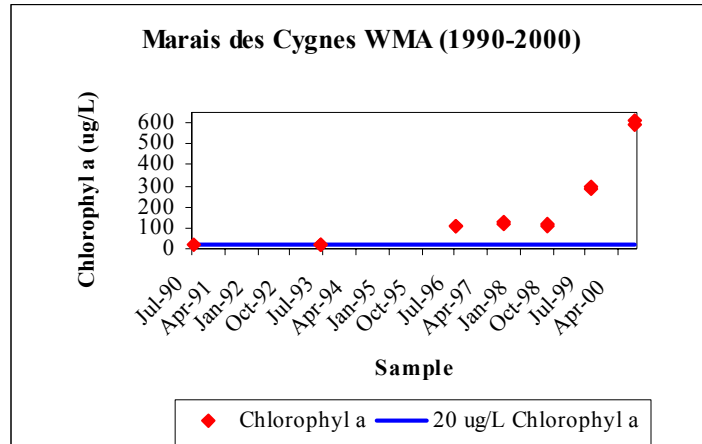


Figure 3

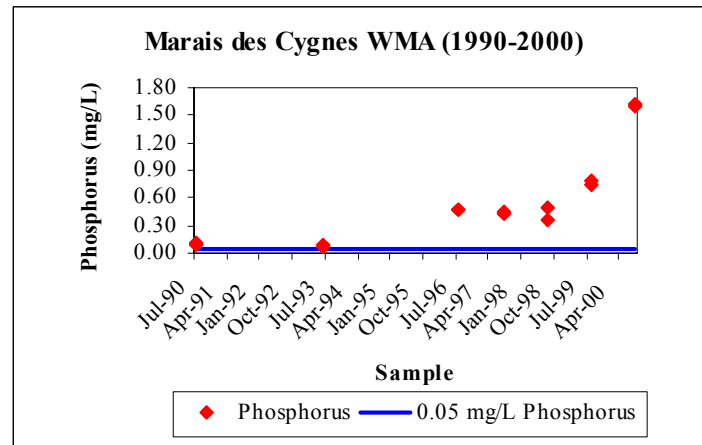
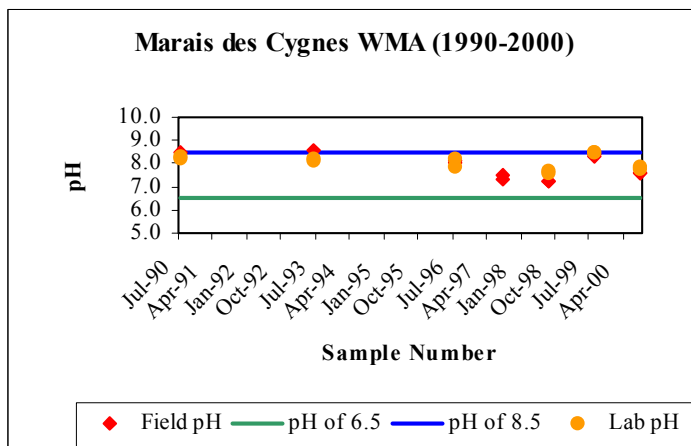


Figure 4



The pH exceeded the criteria once in 1993. Overall, the pH samples were in the acceptable range and averaged 7.87 (Figure 4). However, the samples were taken in the morning. If the samples had been taken later in the day, then a greater number of exceedences would have been seen. High pH problems relate directly to the high trophic state.

Station	Date	Depth (feet)	Dissolved Oxygen
LM053201	7/31/90	0.00	8.2
LM053201	7/31/90	1.64	8.2
LM053201	7/31/90	3.28	6.8
LM053201	6/10/93	0.00	10.4
LM053201	6/10/93	1.64	10.4
LM053201	6/10/93	3.28	10.0
LM053201	6/10/93	4.92	5.2
LM053201	7/15/96	0.00	10.0
LM053201	8/18/97	0.00	4.3
LM053201	8/18/97	0.33	4.3
LM053201	8/11/98	0.00	1.5
LM053201	8/11/98	0.33	1.3
LM053201	8/11/98	1.64	0.7
LM053201	8/11/98	3.28	0.3
LM053201	8/10/99	0.00	6.0
LM053201	8/8/00	0.00	3.9

The availability of dissolved oxygen has declined over time. From 1990 to 1996, the concentration of dissolved oxygen was sufficient to support aquatic life. After 1996, with the exception of 1999, the dissolved oxygen concentrations fell below the water quality standard (5 mg/L). (See above table). Low dissolved oxygen problems may be endemic to such a stagnant wetland environment.

Interim Endpoints of Water Quality (Implied Load Capacity) at Marais des Cygnes WMA over 2005 - 2009:

In order to improve the trophic condition of the wetland 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 2009. Achievement of this endpoint should also result in pH values between 6.5 and 8.5 and dissolved oxygen concentrations above 5 mg/L. Refined endpoints will be developed in 2005 to reflect additional sampling and artificial source assessment and confirmation of impaired status of wetland.

3. SOURCE INVENTORY AND ASSESSMENT

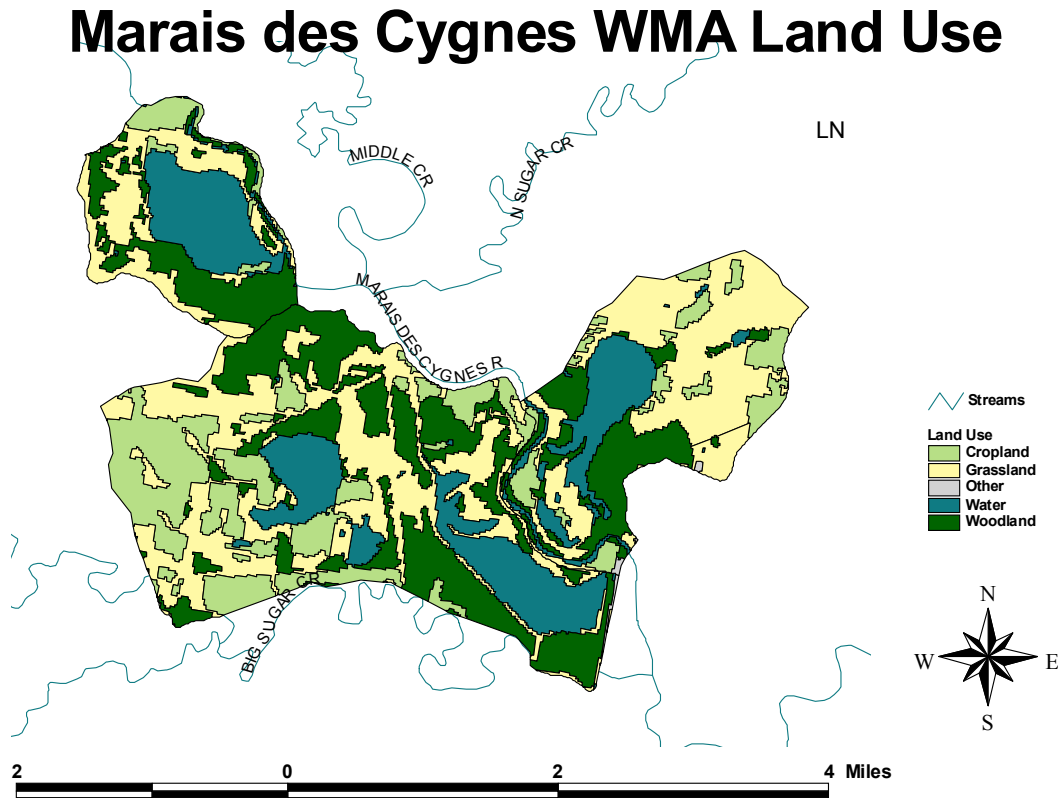
Land Use: The Marais des Cygnes WMA has a low potential for nonpoint source pollutants. An annual phosphorus load of 40,688 pounds per year and an annual nitrogen load of 77,984 pounds per year is necessary to correspond to the concentrations seen in the wetland.

Animal waste adds to the phosphorus load going into the Marais des Cygnes WMA. Thirty-six percent of land around the wetland is grassland (Figure 5). The summer grazing density of livestock is low to moderate.

A source of phosphorus within the Marais des Cygnes WMA is probably runoff from agricultural lands where phosphorus has been applied. Land use coverage analysis indicates that 17.8% of the watershed is cropland. In 1999, 2,184 tons of fertilizer were sold in Linn County. Assuming that

the drainage area of the Marais des Cygnes WMA covers 17.9 percent of the county, then 390 tons of fertilizer were bought and potentially used with the watershed.

Figure 5



Background Levels: There is great potential for carp to resuspend bottom sediments in this wetland. The carp gain access to the wetland when the Marais des Cygnes River floods. With the low water levels in the wetland, the activity of the carp effects the whole water column. Nutrient recycling from the sediments in the wetland is likely contributing available phosphorus to the wetland for algal uptake. Waterfowl, shorebirds, and warblers travel through the Marais des Cygnes WMA during their migration. Their waste, as well as waste from numerous other types of wildlife, increases the levels of phosphorus in the wetland. Twenty-seven percent of the watershed is woodland; 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.

4. ALLOCATION OF POLLUTANT REDUCTION RESPONSIBILITY

Phosphorus and nitrogen are co-limiting nutrients in the Marais des Cygnes WMA and allocated under this TMDL. More detailed assessment of sources and confirmation of the trophic state of the wetland 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 for phosphorus and nitrogen 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: The assessment suggests that cropland and animal waste contribute to the hypereutrophic state of the wetland. Water quality violations are partially due to carp, migratory birds, and leaf litter. Generally a Load Allocation of 3,769.3 pounds of total phosphorus per year, leading to an 89.7% reduction, is necessary to reach the endpoint. The nitrogen load is 61,309.1 pounds per year, a 12.7% reduction. The Load Allocation is a gross allocation for all nonpoint sources. Details about the allocation, including the relative contributions from resuspended sediments and the watershed, will be explained in an implementation plan that will be developed for the 2006 milestone evaluation.

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 418.8 pounds per year of total phosphorus and 6,812.1 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 the Marais des Cygnes WMA is an outstanding national resource water, this TMDL will be a High Priority for implementation.

Unified Watershed Assessment Priority Ranking: This watershed lies within the Lower Marais des Cygnes (HUC 8: 10290102) with a priority ranking of 12 (High Priority for restoration).

Priority HUC 11s: The majority of the watershed is within HUC 11 (070).

5. IMPLEMENTATION

Desired Implementation Activities

It is not very likely that this water body can be brought to such a low trophic state as to fully support all beneficial uses. However, a reduction in nonpoint source loads can be achieved, with some improvement in the percent of the year that might see impairments occurring. 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

Fisheries Management - KDWP

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

Water Resource Cost Share and Nonpoint 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.

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. Educate livestock producers on livestock waste management and manure applications and nutrient management planning.
- c. Provide technical assistance on livestock waste management systems and nutrient management plans.
- d. Provide technical assistance on buffer strip design and minimizing cropland

runoff.

e. Encourage annual soil testing to determine capacity of field to hold phosphorus.

Time Frame for Implementation: Pollutant reduction practices should be installed within the priority subwatersheds during the years 2002-2006, with minor follow up implementation, including other subwatersheds over 2006-2010.

Targeted Participants: Primary participants for implementation will be the Kansas Department of Wildlife and Parks and agricultural producers within the drainage of the wetland. Initial work in 2006 should include local assessments by conservation district personnel and county extension agents to locate within the wetland drainage:

1. Total row crop acreage
2. Cultivation alongside wetland
3. Livestock use of riparian areas
4. Fields with manure applications

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 Marais des Cygnes WMA should indicate evidence of reduced phosphorus levels in the conservation pool elevations relative to the conditions seen over 1990-2000.

Delivery Agents: The primary delivery agents for program participation will be the Kansas Department of Wildlife and Parks, 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 High 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 wetland trophic condition, would be of value prior to 2005. Further sampling and evaluation should occur once before 2005 and twice between 2005 and 2009.

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 impairment which has occurred within the drainage and current condition of Marais des Cygnes WMA. Subsequent decisions will be made regarding implementation approach, follow up of additional implementation

and implementation in the nonpriority subwatersheds.

Consideration for 303d Delisting: Marais des Cygnes WMA will be evaluated for delisting under Section 303(d), based on the monitoring data over the period 2005-2009. Therefore, the decision for delisting will come about in the preparation of the 2010 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 during Fiscal Years 2002-2006.

Bibliography

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