

# MARAIS DES CYGNES BASIN TOTAL MAXIMUM DAILY LOAD

## Waterbody: Middle Creek Water Quality Impairment: Dissolved Oxygen

### 1. INTRODUCTION AND PROBLEM IDENTIFICATION

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

**HUC 8:** 10290102

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

**Drainage Area:**      73.2 square miles

**Main Stem Segments:** WQLS: 12 and 13; starting at confluence with Marais des Cygnes River and traveling upstream to headwaters in eastern Miami County (**Figure 1**).

**Tributary Segment:** WQLS: Walnut Creek (14)  
WQLS: Jake Branch (54)

**Designated Uses:** Special Aquatic Life Support, Primary Contact Recreation, Domestic Water Supply; Food Procurement; Ground Water Recharge; Industrial Water Supply Use; Irrigation Use; Livestock Watering Use for Main Stem Segment 12; Expected Aquatic Life, Secondary Contact Recreation and Food Procurement for Main Stem Segment 13.

Expected Aquatic Life Support and Secondary Contact Recreation for Walnut Creek and Jake Branch.

**1998 303(d) Listing:** Table 1 - Predominant Non-point Source and Point Source Impacts

**Impaired Use:** Aquatic Life Support

**Water Quality Standard:** Dissolved Oxygen (DO): 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 1998 303(d):** Not Supporting Aquatic Life

**Monitoring Sites:** Station 697 near New Lancaster

**Period of Record Used:** 1997, 1999 and 2000 for Station 697 (**Figure 2**)

**Flow Record:** Middle Creek near La Cygnes (USGS Gaging Site 06915900); 1967-2000; Little

Osage River near Fulton (USGS Station 06917000); 1971-2000 and Pottawatomie Creek near Garnett; 1971-1999

**Long Term Flow Conditions:** 10% Exceedence Flows = 82 cfs, 7Q10 = 1 cfs

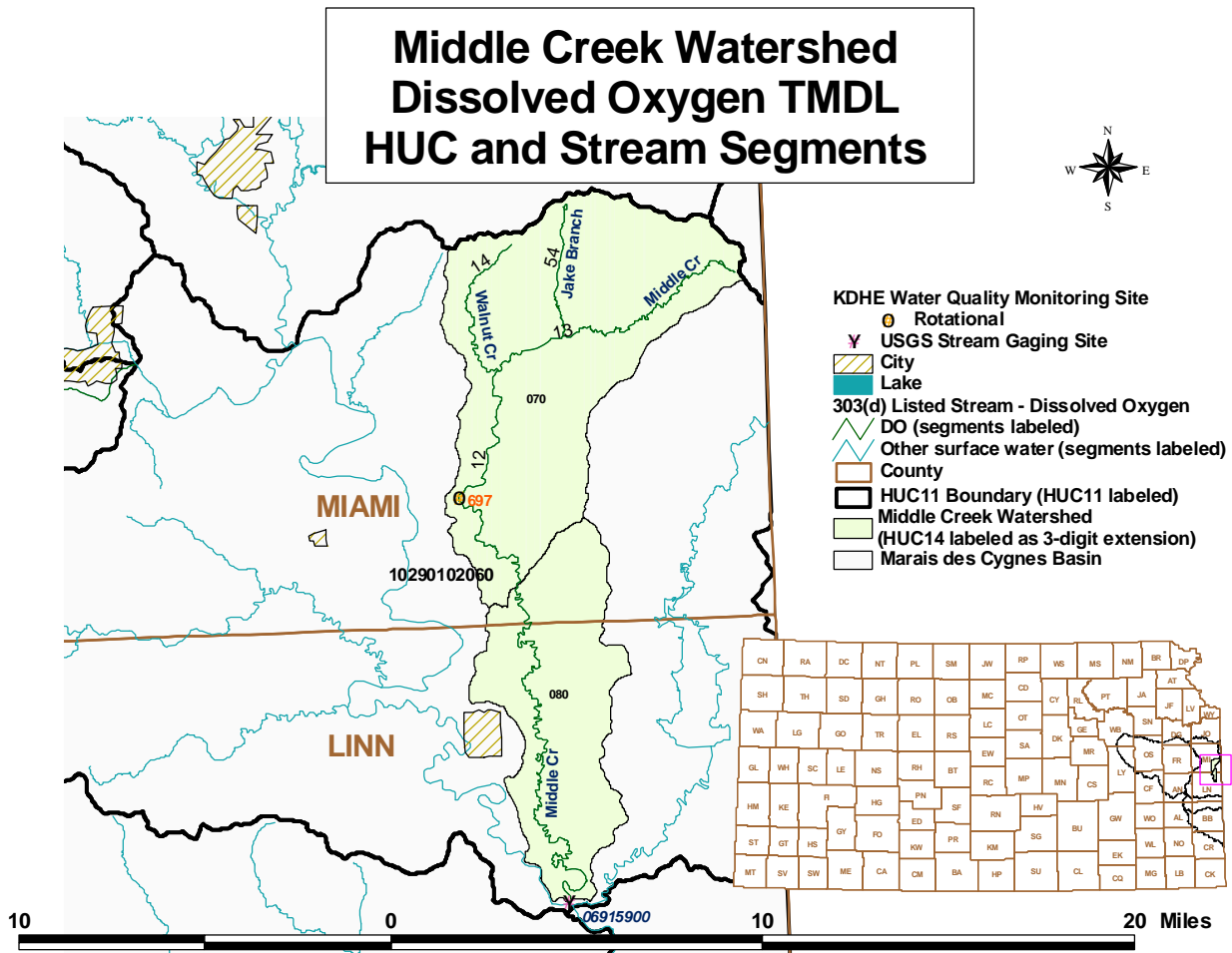


Figure 1

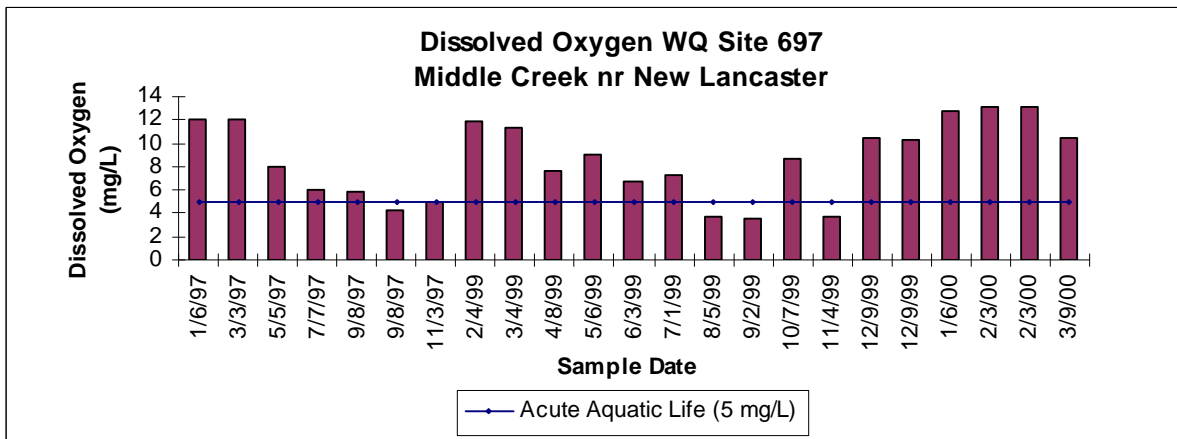
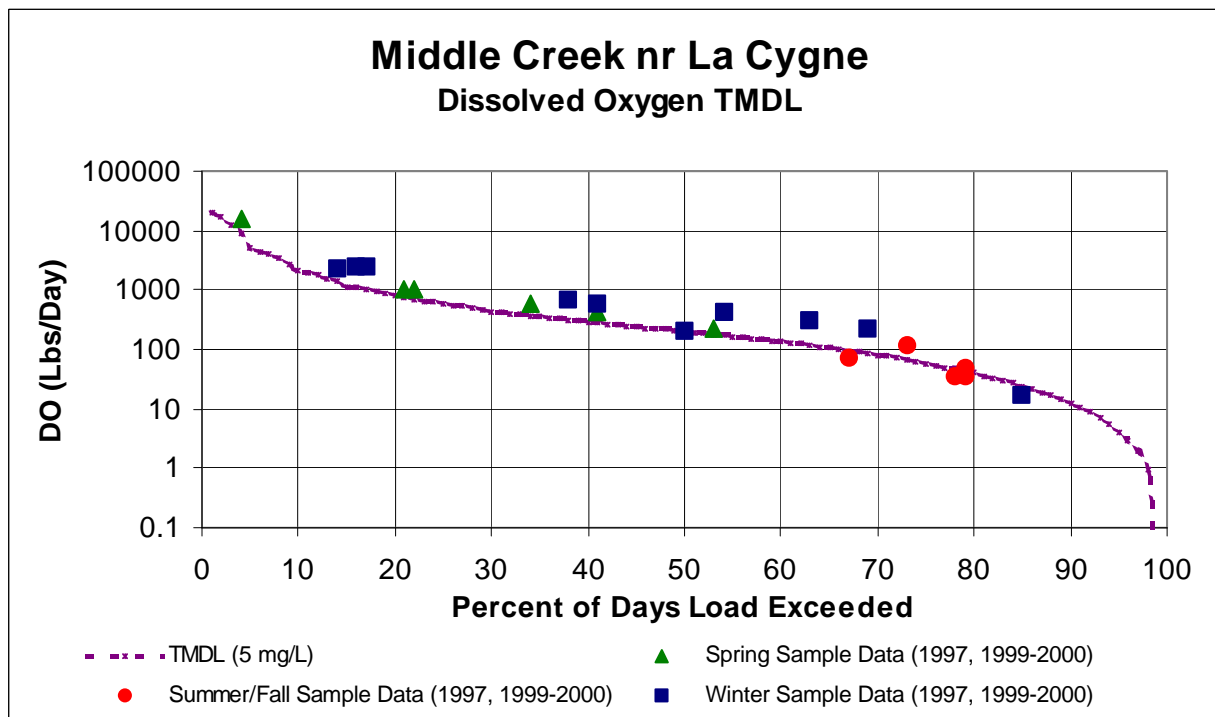


Figure 2

**Current Conditions:** Since loading capacity varies as a function of the flow present in the stream, this TMDL represents a continuum of desired loads over all flow conditions, rather than fixed at a single value. Sample data for the sampling site were categorized for each of the three defined seasons: Spring (Mar-Jul), Summer-Fall (Aug-Oct) and Winter (Nov-Feb). High flows and runoff equate to lower flow durations, baseflow and point source influences generally occur in the 75-99% range. Load curves were established for the Aquatic Life criterion by multiplying the flow values for Middle Creek along the curve by the applicable water quality criterion and converting the units to derive a load duration curve of pounds of DO per day. This load curve graphically displays the TMDL since any point along the curve represents water quality at the standard at that flow. Historic excursions from water quality standards (WQS) are seen as plotted points below the load curves. Water quality standards are met for those points plotting above the applicable load duration curves.

Excursions were seen in the Summer-Fall and Winter seasons and are outlined in Table 1. Sixty percent of the Summer-Fall samples and 20% of Winter samples were below the aquatic life criterion. None of Spring samples were under the aquatic life criterion. Overall, 24% of the samples were under the criterion (**Figure 3**). This would represent a baseline condition of non-support of the impaired designated use.



**Figure 3**

No DO violations have been encountered at flows exceeding 7.5 cfs on Middle Creek near La Cygnes, therefore a critical low flow can be identified on Middle Creek as those flows of 7.5 cfs or less.

**Table 1**

**NUMBER OF SAMPLES UNDER DISSOLVED OXYGEN STANDARD OF 5 mg/L BY FLOW**

Station	Season	0 to 10%	10 to 25%	25 to 50%	50 to 75%	75 to 90%	90 to 100%	Cum Freq.
Middle Creek near La Cygnes (697)	Spring	0	0	0	0	0	0	0/6 = 0%
	Summer	0	0	0	1	2	0	3/5 = 60%
	Winter	0	0	0	1	1	0	2/10 = 20%

A watershed comparison approach was taken in developing this TMDL. The Little Osage River watershed (Water Quality Sampling Site 207 in the watershed was not impaired by low DO) has similar land use characteristics and is located to the south of the Middle Creek watershed. The relationship of DO to Biochemical Oxygen Demand (BOD), water temperature, turbidity, nitrate, phosphorus and stream flow were used in the comparisons.

Table 2 outlines those water quality data for the samples taken on the same date for the two sites of interest between 1990 and 2000 when DO was below the aquatic life criterion for sample site 697.

At site 697 the average BOD concentration for the samples was about 22% higher than that of site 207, while average nitrate, phosphorus, temperature, turbidity and flow were much the same. This indicates that, in addition to the naturally driven climatic factors of extremely low flow and high water temperature which cause occasional DO excursions, a probable oxygen demanding substance load is being added to Middle Creek upstream of site 697 and under certain conditions is likely a factor influencing some of the DO violations.

**Table 2**

COL DATE	DO (mg/L)		BOD (mg/L)		TEMP Degrees C		TURBIDITY (FTU)		NITRATE (mg/L)		TPHOS (mg/L)		Flow (cfs)	
	WQ site 697	WQ site 207	WQ site 697	WQ site 207	WQ site 697	WQ site 207	WQ site 697	WQ site 207	WQ site 697	WQ site 207	WQ site 697	WQ site 207	06915 900	06917 000
	697	207	697	207	697	207	697	207	697	207	697	207	697	207
9/8/97	4.2	6.6	4.56	2.13	21	24	15	15	0.01	0.1	0.079	0.083	1.61	3.40
11/3/97	4.9	8.9	3.51	1.53	10	10	14	6.6	0.26	0.29	0.094	0.084	7.54	79.0
8/5/99	3.8	7.5	2.37	2.1	27	29	13	16	0.01	0.01	0.13	0.08	3.56	4.8
9/2/99	3.6	4.9	1.0	1.0	25	26	11	10.1	0.06	0.09	0.08	0.07	1.74	0.34
11/4/99	3.7	3	2.19	3.84	11	10	4.8	5.6	0.01	0.01	0.08	0.11	0.88	0.41
<b>AVERAGE</b>	<b>4.04</b>	<b>6.18</b>	<b>2.73</b>	<b>2.12</b>	<b>18.8</b>	<b>19.8</b>	<b>11.6</b>	<b>10.7</b>	<b>0.07</b>	<b>0.1</b>	<b>0.09</b>	<b>0.09</b>	<b>3.1</b>	<b>17.6</b>

### Desired Endpoints of Water Quality at Site 697 over 2005 - 2009

The desired endpoint will be reduced biochemical oxygen demand from artificial sources such that average BOD concentrations remain below 2.1 mg/l in the stream under the critical flow conditions which results in no excursions below 5 mg/l of DO detected between 2005 - 2009 attributed to these sources.

This desired endpoint should improve DO concentrations in the creek at the critical lower flows (0-7.5 cfs) in the warmer months of the year (Aug-November). Seasonal variation is accounted for by this TMDL, since the TMDL endpoint is sensitive to the low flow and/or higher temperature conditions, generally occurring in the specified months.

This endpoint will be reached as a result of expected, though unspecified, reductions in organic 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 this endpoint will provide full support of the aquatic life function of the creek and attain the dissolved oxygen water quality standard.

### 3. SOURCE INVENTORY AND ASSESSMENT

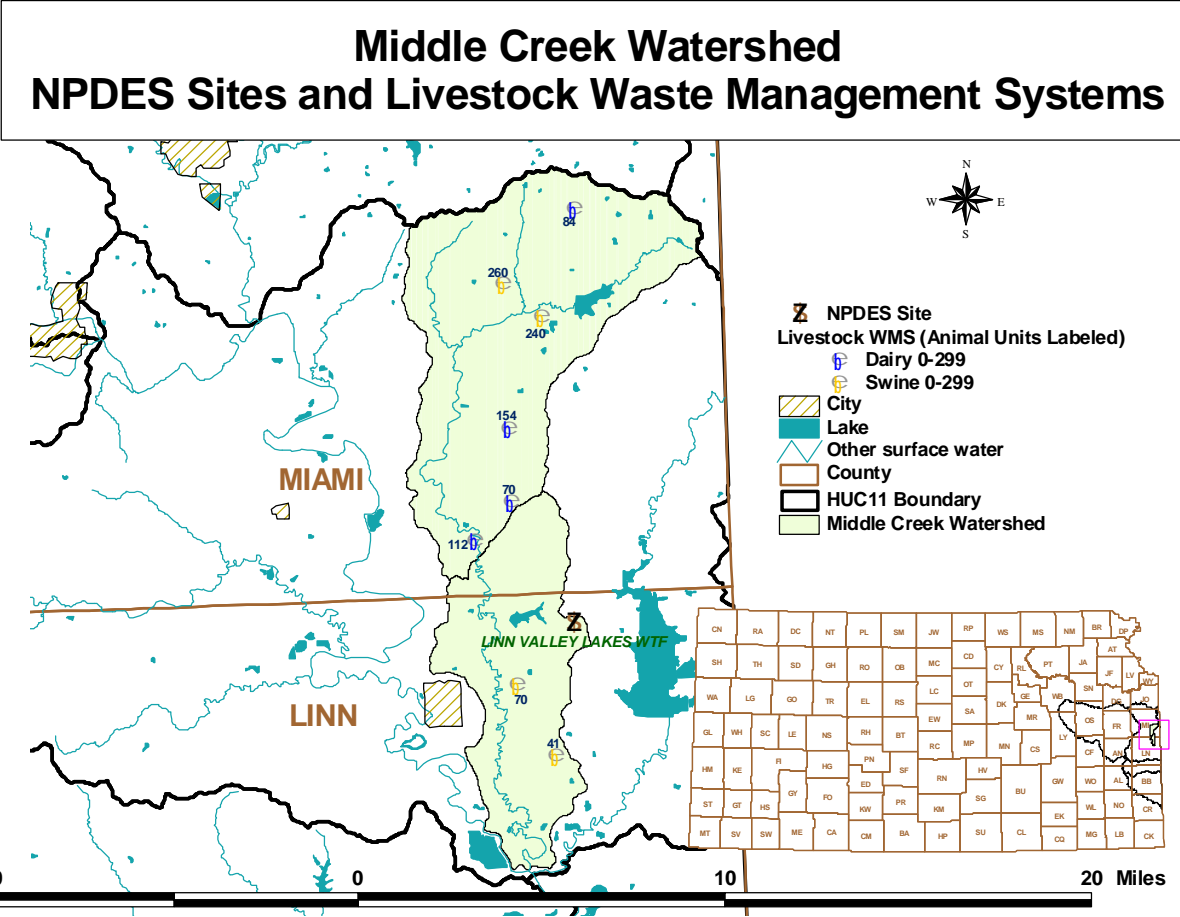
**NPDES:** There is one NPDES permitted wastewater discharger within the watershed (**Figure 4**). While located within the Middle Creek Watershed, this facility is downstream of monitoring site 697. The system is outlined in Table 3.

**Table 3**

DISCHARGING FACILITY	STREAM REACH	SEGMENT	DESIGN FLOW	TYPE
Linn Valley Lakes WTF	Middle Cr. via unnamed tributary	12	0.03 mgd	Lagoon

Population projection for Linn Valley Lakes to the year 2020 indicates significant growth. Projections of future water use and resulting wastewater appear to be within design flows for the the current system's treatment capacity. Examination of effluent monitoring indicates that discharge from the facility is rare (no discharges in 1999 or 2000). Since the facility is located downstream of the water quality monitoring site, this facility cannot be considered a factor in the DO excursions noted at site 697.

**Livestock Waste Management Systems:** Eight operations are registered, certified or permitted within the watershed. The facility type is either dairy or swine. These facilities are distributed evenly down the watershed (**Figure 4**). Potential animal units for all facilities in the watershed total 1,031. The actual number of animal units on site is variable, but typically less than potential numbers.



**Figure 4**

**Land Use:** Most of the watershed is grassland (60% of the area), cropland (22%), woodland (14%) or urban use (2.5%). Most of the grassland is located toward the upper end of the watershed. The grazing density estimate is high (55 animal units/mi<sup>2</sup>) at the upper end of the watershed and average (35 animal units/mi<sup>2</sup>) at the lower end of the watershed when compared to densities in the Marais des Cygnes and Missouri Basins (**Figure 5**).

**On-Site Waste Systems:** The watershed’s population density is low for the upper end of the watershed (13 persons/sq mi) and average at the lower end (35 persons/ sq mi) when compared to densities for the Marais des Cygnes and Missouri Basins (**Figure 5**). The rural population projections for Linn and Miami County through 2020 show substantial growth (30-100% increase, respectively).

# Middle Creek Watershed Land Use, Grazing Density and Population Density Maps

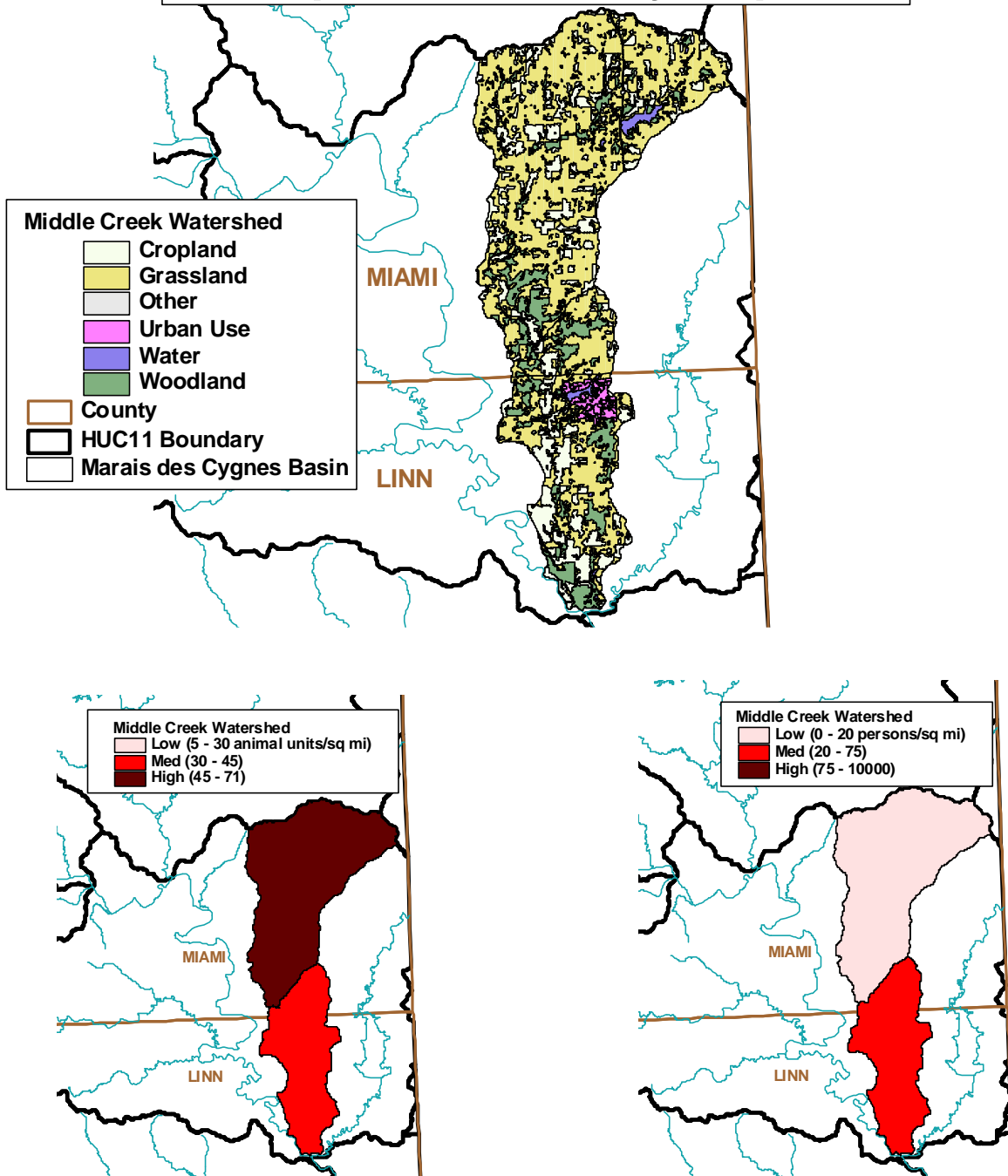


Figure 5

**Background Levels:** Some organic enrichment may be associated with environmental background levels, including contributions from wildlife and stream side vegetation, but it is likely that the density of animals such as deer is fairly dispersed across the watershed and that the loading of oxygen demanding material is constant along the stream. In the case of wildlife, this loading should result in minimal loading to the streams below the levels necessary to violate the water quality standards. In the case of stream side vegetation, the loading should be greater toward the lower end of the watershed with its larger proportion of woodland near the stream

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

It is presumed that reductions in BOD loads will reduce DO excursions under certain critical flow conditions. Therefore, any allocation of wasteloads and loads will be made in terms of BOD reductions. Yet, because DO is a manifestation of multiple factors, the initial pollution load reduction responsibility will be to decrease the BOD over the critical range of flows encountered on Middle Creek. These reductions have been based on the relationship between DO and BOD for the samples taken at Water Quality Monitoring site 697 as compared to the relatively unimpaired Little Osage River watershed and its water quality monitoring site 207. Allocations relate to the BOD levels seen in Middle Creek at site 697 relative to site 207 for the critical lower flow conditions (0-7.5 cfs). Based on this relationship (Table 2), BOD loading at site 697 needs to be reduced by 22% (so that in stream average BOD is 2.1 mg/L or less). Additional monitoring over time will be needed to further ascertain the relationship between BOD reductions of non-point sources, flow conditions, water temperatures and DO levels along the stream.

For this phase of the TMDL, the average condition is considered across the seasons, to establish goals of the endpoint and desired reductions. Therefore, the target average BOD level was multiplied by the average daily flow estimated for Middle Creek across all hydrologic conditions. This is represented graphically by the integrated area under each BOD load duration curve established by this TMDL. The area is allocated to nonpoint sources (LA) under the critical flow. If necessary, future growth in wasteloads should be offset by reductions in the loads contributed by nonpoint sources. This offset along with appropriate permit limitations should eliminate the impairment. This TMDL represents the “Best Professional Judgment” as to the expected relationship between physical factors, organic matter and DO.

**Point Sources:** Point sources are responsible for maintaining their systems in proper working condition and appropriate capacity to handle anticipated wasteloads of their respective populations. The State and NPDES permits will continue to be issued on 5 year intervals, with inspection and monitoring requirements and conditional limits on the quality of effluent released from this facility. Ongoing inspections and monitoring of the systems will be made to ensure that minimal contributions have been made by this source.

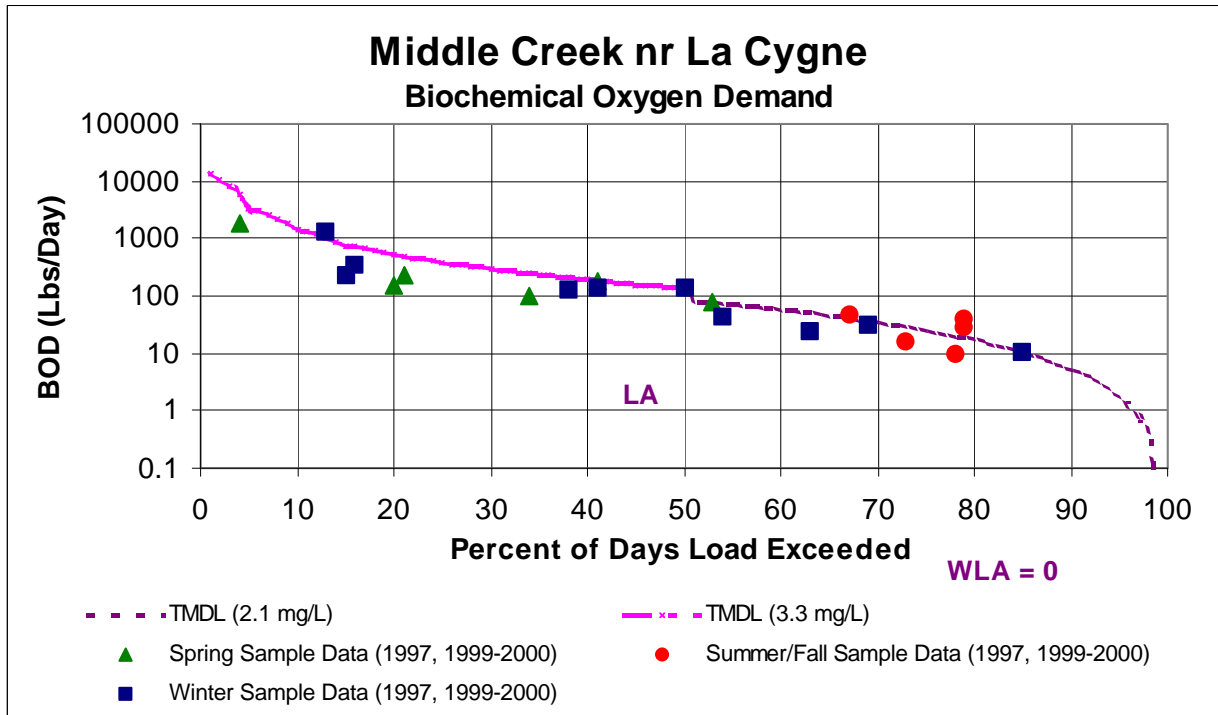
Based upon the preceding assessment, the point source in the watershed cannot be considered a significant contributor to the BOD load in the Middle Creek watershed. The WLA for this TMDL as it relates to water quality at monitoring site 697 in terms of BOD load is zero (**Figure 6**). Future growth in wasteloads should be offset by reductions in the loads contributed by nonpoint sources. This offset along with appropriate limitations should eliminate the impairment.



**Non-Point Sources:** Based on the prior assessment of sources, the distribution of excursions from water quality standards at site 697 and the relationship of those excursions to runoff conditions and seasons, non-point sources are seen as a contributing factor to the occasional DO excursions in the watershed. The previous assessment suggests that, in addition to the contribution of non-point sources, lack of flow in the stream and high water temperatures are also significant natural components in the occasional dissolved oxygen excursion.

The samples from Middle Creek show there were no DO violations at flows in excess of 7.5 cfs. The Load Allocation assigns responsibility for reducing the in stream BOD levels at site 697 to 2.1 mg/L across the 0 - 7.5 cfs critical flow (51 - 99% exceedence) and maintaining the in stream BOD levels at site 697 to the historical levels of 3.3mg/L for flows in excess of 7.5 cfs (which is 90<sup>th</sup> percentile of BOD samples for flows above 7.5 cfs for Middle Creek near La Cygne)(**Figure 6**). Sediment control practices such as buffer strips and grassed waterways should help reduce the non-point source BOD load under higher flows as well as reduce the oxygen demand exerted by the sediment transported to the stream that may occur during the critical flow period.

To address the DO violations that occurred because of low flow and high seasonal temperatures alone (as on 9/22/99 and 11/4/99 from Table 2), riparian vegetation restoration should occur adjacent to the main stem of Middle Creek to provide shade for the stream and generally reduce surface water temperatures during the seasons of concern.



**Figure 6**

**Defined Margin of Safety:** The margin of safety will be established in anticipation of any new point sources effecting water quality at site 697 within the watershed. The margin of safety will explicitly reduce the revised Wasteland Allocation by 10% to ensure that the resulting oxygen sag created by any new effluent discharge does not create dissolved oxygen conditions in the stream below 5 mg/L.

**State Water Plan Implementation Priority:** Because this watershed has indicated some problem with dissolved oxygen which has short term and immediate consequences for aquatic life, this TMDL will be a High Priority for implementation.

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

**Priority HUC 11s and Stream Segments:** Because of the location of the water quality sampling site in the watershed, priority should be directed toward baseflow generating and conducting stream segments; the main stem of Middle Creek, Segments 12 and 13 and listed tributaries (Segments 14 and 54) in HUC14 10290102060070, and then extending with diminishing priority downstream on Segment 12 in HUC14 102901060080 to its confluence with the Marais des Cygnes River.

## **5. IMPLEMENTATION**

### **Desired Implementation Activities**

1. Where needed, restore riparian vegetation along main stem.
2. Install grass buffer strips where needed along contributing tributaries.
3. Renew state and federal permits and inspect permitted facilities for permit compliance
4. Install proper manure and livestock waste storage
5. Insure proper on-site waste system operations in proximity to main streams.
6. Insure that labeled application rates of chemical fertilizers are being followed

### **Implementation Programs Guidance**

#### **NPDES and State Permits - KDHE**

- a. Municipal permits for facilities in the watershed will be renewed after 2002 with continuation of DO and BOD monitoring and permit limits preventing excursions in these criteria.
- b. Livestock permitted facilities will be inspected for integrity of applied pollution prevention technologies.
- c. Registered livestock facilities with less than 300 animal units will apply pollution prevention technologies.
- d. Manure management plans will be implemented.

**Non-Point Source Pollution Technical Assistance - KDHE**

- a. Support Section 319 demonstration projects for pollution reduction from livestock operations in watershed.
- b. Provide technical assistance on practices geared to small livestock operations which minimize impact to stream resources.
- c. Provide technical assistance in urban and agricultural setting on practices geared to minimize chemical fertilizer impact to stream resources.
- d. Guide federal programs such as the Environmental Quality Improvement Program, which are dedicated to priority subbasins through the Unified Watershed Assessment, to priority watersheds and stream segments within those subbasins identified by this TMDL.

**Water Resource Cost Share & Non-Point Source Pollution Control Programs - SCC**

- a. Provide alternative water supplies to small livestock operations
- b. Develop improved grazing management plans
- c. Reduce grazing density on pasturelands
- d. Install livestock waste management systems for manure storage
- e. Implement manure management plans
- f. Install replacement on-site waste systems
- g. Coordinate with USDA/NRCS Environmental Quality Improvement Program in providing educational, technical and financial assistance to agricultural producers.

**Riparian Protection Program - SCC**

- a. Develop riparian restoration projects along main stem especially those areas with baseflow.
- b. Design winter feeding areas away from streams.

**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 livestock producers on riparian and waste management techniques.
- b. Educate chemical fertilizer users on proper application rates and timing.
- c. Provide technical assistance on livestock waste management design.
- d. Continue Section 319 demonstration projects on livestock management.

**Agricultural Outreach - KDA**

- a. Provide information on livestock management to commodity advocacy groups.
- b. Support Kansas State outreach efforts.

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

- a. Inspect on-site waste systems within one mile of priority stream segments (12 and 13 on the main stem and tributary segments 14 and 54).

**Timeframe for Implementation:** Pollution reduction practices should be installed along the main stem and listed tributaries within the priority subwatersheds over the years 2002-2006, with follow up implementation thereafter.

**Targeted Participants:** Primary participants for implementation will be landowners immediately adjacent to the creek. Implemented activities should be targeted to those stream segments with greatest potential contribution to baseflow. Nominally, this would be most likely be:

1. Areas of denuded riparian vegetation along the targeted main stem.
2. Facilities without water quality controls
3. Unbuffered cropland adjacent to stream
4. Sites where drainage runs through or adjacent livestock areas
5. Sites where livestock have full access to stream and stream is primary water supply
6. Poor riparian sites
7. Sites which have an urban runoff component
8. Failing on-site waste systems

Some inventory of local needs should be conducted in 2002 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 2006:** The year 2006 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 two-thirds of the landowners responsible for riparian restoration or buffer strips, cited in the local assessment, participating in the implementation programs provided by the state. Additionally, sampled data from site 697 should indicate evidence of improved dissolved oxygen levels at the critical flow conditions relative to the conditions seen over 1997 and 1999-2000. At this early stage of implementation the establishment of riparian vegetation and buffer strips is important and it is acknowledged that, in the case of riparian vegetation, it may take 20 years and beyond to provide a shade canopy over the stream.

**Delivery Agents:** The primary delivery agents for program participation will be the 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 County staff managing.

## **Reasonable Assurances:**

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

1. K.S.A. 65-164 and 165 empowers the Secretary of KDHE to regulate the discharge of sewage into the waters of the state.
2. 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.
3. K.A.R. 28-16-69 to -71 implements water quality protection by KDHE through the establishment and administration of critical water quality management areas on a watershed basis.
4. 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.
5. 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.
6. 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.
7. K.S.A. 82a-951 creates the State Water Plan Fund to finance the implementation of the *Kansas Water Plan*.
8. 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 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 TMDL is a High Priority consideration.

**Effectiveness:** Riparian restoration projects are being touted as a significant means for water temperature buffers of streams. Non-point source controls for livestock waste have been shown to be effective in reducing pollution in locales such as the Herrington Lake watershed. The key

to effectiveness is participation within a finite subwatershed to direct resources to the activities influencing water quality. The milestones established under this TMDL are intended to gauge the level of participation in those programs implementing this TMDL.

Should participation significantly lag below expectations over the next five years or monitoring indicates lack of progress in improving water quality conditions from those seen over 1990-2000, the state may employ more stringent conditions on agricultural producers and urban runoff in the watershed in order to meet the desired endpoints expressed in this TMDL. The state has the authority to impose conditions on activities with a significant potential to pollute the waters of the state under K.S.A. 65-171. If overall water quality conditions in the watershed deteriorate, a Critical Water Quality Management Area may be proposed for the watershed, in response.

## **6. MONITORING**

KDHE should collect bimonthly samples at Station 697 in 2005 and 2009 in order to assess progress and success in implementing this TMDL in reaching its endpoint.

Local program management needs to identify its targeted participants of state assistance programs for implementing this TMDL. This information should be collected in 2002 in order to support appropriate implementation projects.

## **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 Middle Creek. Subsequent decisions will be made regarding the implementation approach and follow up of additional implementation in the watershed.

**Consideration for 303(d) Delisting:** The creek 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 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 2002-2006.