UPPER ARKANSAS BASIN TOTAL MAXIMUM DAILY LOAD

Waterbody/Assessment Unit: Mulberry Creek
Water Quality Impairment: Dissolved Oxygen

1. INTRODUCTION AND PROBLEM IDENTIFICATION

Subbasin: Arkansas-Pickerel **Counties:** Gray and Ford

HUC 8: 11030004 **HUC 10 (12):** 01 (01, 02, 03, 04, 05)

Ecoregion: Western High Plains, Flat to Rolling Cropland (25d)
Central Great Plains, Rolling Plains and Breaks (27b)
Central Great Plains, Great Bend Sand Prairie (27c)

Drainage Area: Approximately 209 square miles

Main Stem Water Quality Limited Segment: Mulberry Creek (12) starting at the confluence of Mulberry Creek with the Arkansas River in Ford County and traveling upstream to the headwaters of Mulberry Creek in Gray County.

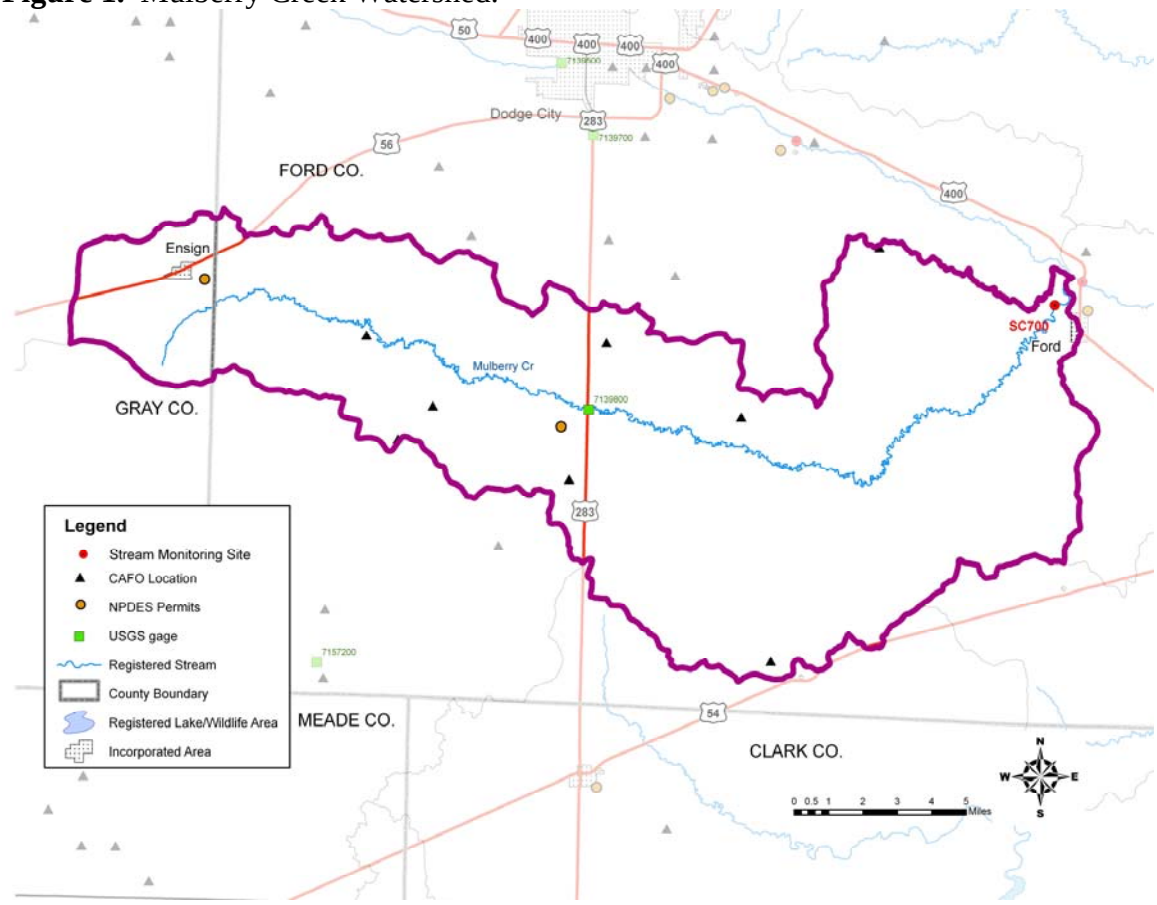
Designated Uses: Expected Aquatic Life Support, Secondary Contact Recreation 'b'.

303(d) Listings: Kansas Stream Segment monitored by Station SC700 cited as impaired in the 2004, 2008, 2010 and 2012 303(d) lists for Upper Arkansas River Basin.

Impaired Use: Expected Aquatic Life Support

Water Quality Standard: The concentration of Dissolved Oxygen in surface waters shall not be lowered by the influence of artificial sources of pollution. Dissolved Oxygen (DO): 5.0 mg/L (K.A.R. 28-16-28e(d), Table 1g).

Figure 1. Mulberry Creek Watershed.



2. CURRENT WATER QUALITY CONDITION AND DESIRED ENDPOINT

Level of Support for Designated Use under 2010 303(d): Not Supporting Aquatic Life.

Stream Monitoring Site: Active KDHE rotational ambient Stream Chemistry sampling station SC700, located ½ mile North and ½ mile West of Ford on County Road BR.

Period of Record: 1994, 1998, 2002 for rotational station SC700.

Long Term Flow Conditions: The estimated mean flow established by USGS is 8.15 cfs with a 2-year peak flow of 384 cfs (Table 1) and average precipitation is 22.2 inches per year. The Mulberry Creek flow at SC700 was also estimated using a regression equation generated by comparing flow data from the Arkansas River (USGS 07139500, 1994-2002) with the USGS estimated flow duration values in Table 1 for Mulberry Creek (Table 2).

Table 1. Estimated flow-duration values and mean flow value for Mulberry Creek in Gray and Ford Counties. (Perry, C.A., D.M. Wolock and J.C. Artman, 2004). All flow values in units of cfs.

Stream Name	CUSEGA #	Drainage Area (mi^2)	Estimated Mean Flow (cfs)	90%	75%	50%	25%	10%
Mulberry Creek	1103000412	335	8.15	0	0.22	1.70	4.13	9.47

Figure 2. Estimated flow duration curve for Mulberry Creek near Ford based on regression equation Mulberry flow = 0.514+0.029(Ark R at 07139500 1994-2002).

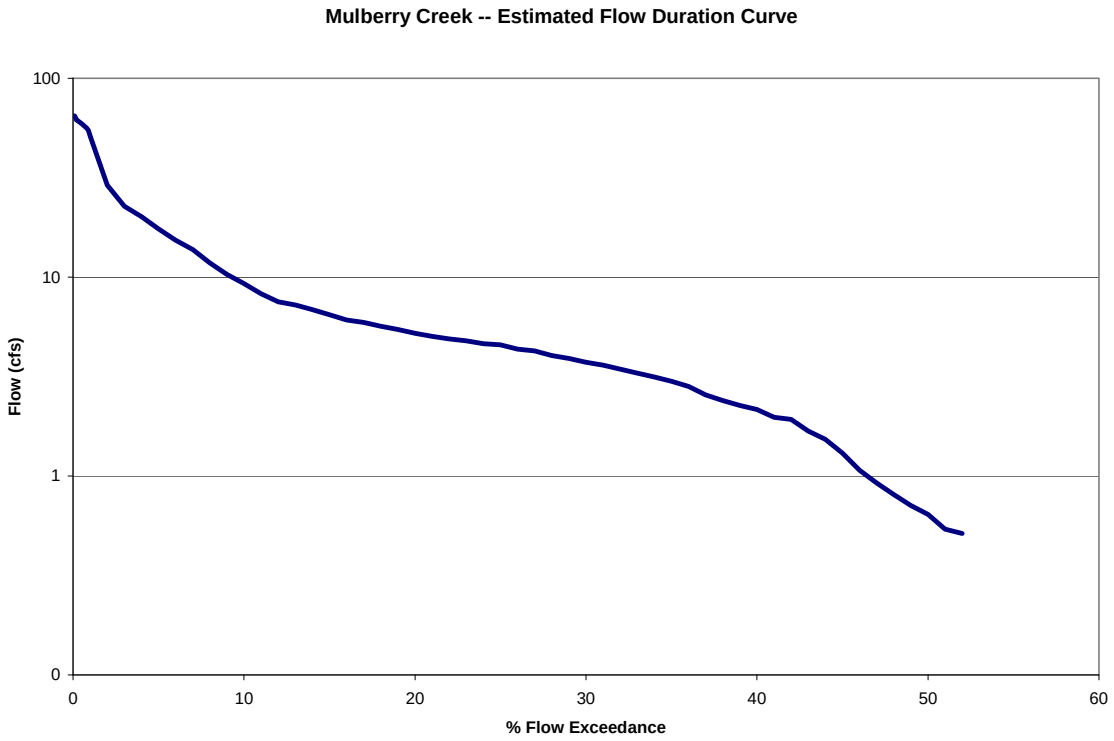


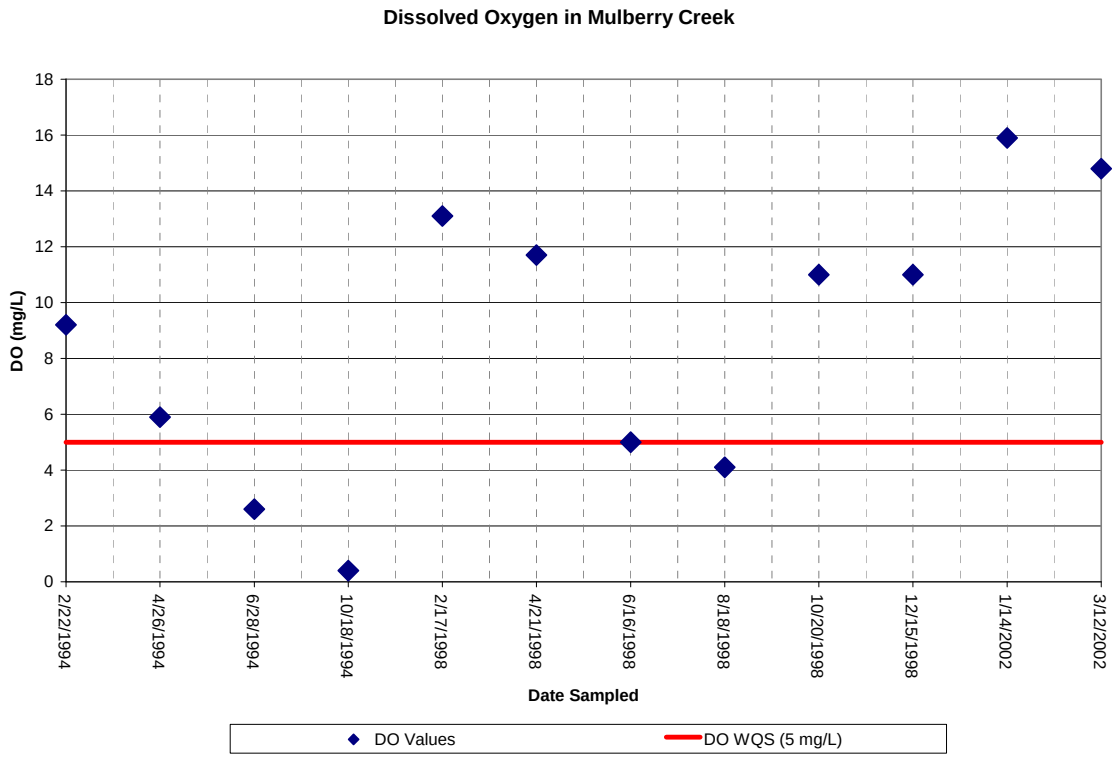
Table 2. Estimated flows in Mulberry Creek using a regression equation generated by comparing flow data from the Arkansas River (USGS 07139500, 1994-2002) with the USGS estimated flow duration values (Table 1) for Mulberry Creek.

Stream Name	Estimated Mean Flow (cfs)	90%	75%	50%	25%	10%
Mulberry Creek	3.87	0	0	0.641	4.57	9.27

Current Conditions: Sampling station SC700 is a rotational station that is typically sampled bimonthly for one year, every four years. Mulberry Creek was scheduled to be bimonthly sampled in 2002, 2006 and 2010; however, the stream was dry during the last three sampling attempts in 2002 and during all sampling attempts in 2006 and 2010. Of the 12 samples analyzed for dissolved oxygen over the period of record there were three samples that fell below the water quality standard of 5.0 mg/L for dissolved oxygen. As

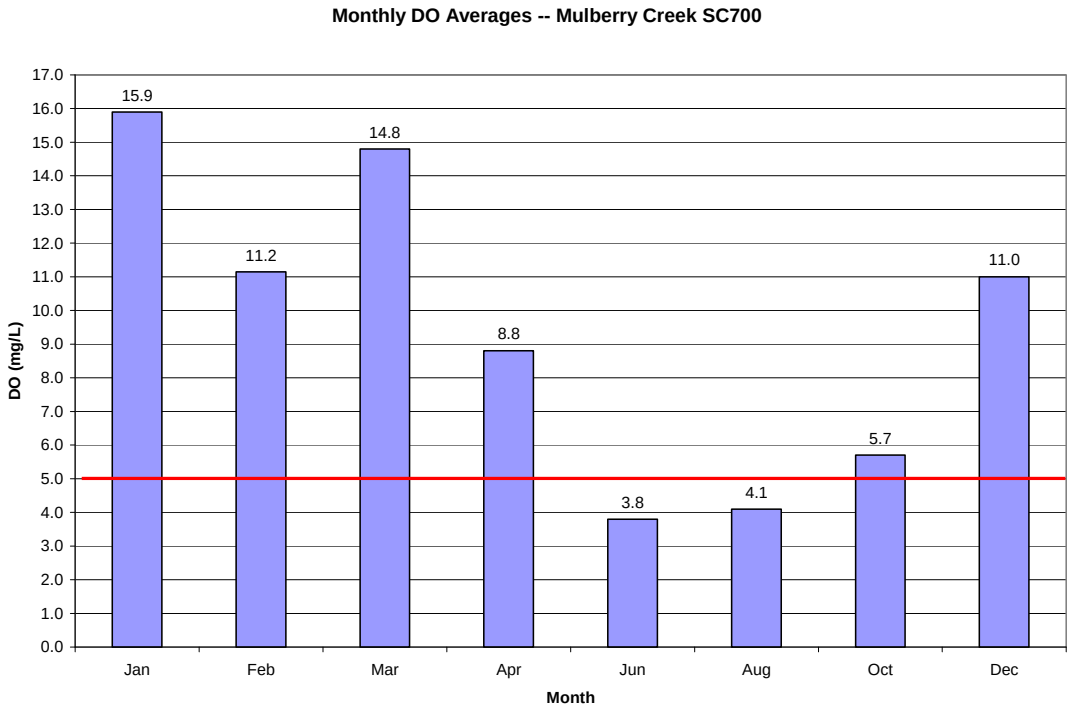
Figure 3 illustrates, there were two excursions outside of the water quality standard in June and October of 1994, with values of 2.6 mg/L and 0.4 mg/L respectively, and one excursion in 1998 at 4.1 mg/L. The June 1998 sampled measured at the water quality standard of 5.0 mg/L.

Figure 3. DO concentrations on Mulberry Creek at station SC700.



For the period of record at SC700, the Summer month of August has the lowest average dissolved oxygen concentration (4.1 mg/L), while January, with lower winter stream temperatures, has the highest average concentration at 15.9 mg/L (Figure 4).

Figure 4. Monthly DO averages for Mulberry Creek at SC700.



Sampling data has been categorized into three defined seasons: Spring (April-June), Summer-Fall (July-October) and Winter (November-March). Seasonal dissolved oxygen concentrations are higher during the Winter season while the increase in leaf litter and stream temperature during the Summer-Fall season is likely contributing to the decline in concentrations seen during those months (Figure 5). The year 1994 has the lowest average dissolved oxygen concentration of any year sampled during the period of record at 4.53 mg/L (Table 3).

Figure 5. Seasonal dissolved oxygen average (mg/L) for KDHE sampling station SC700 with the dissolved oxygen water quality standard highlighted at 5.0 mg/L.

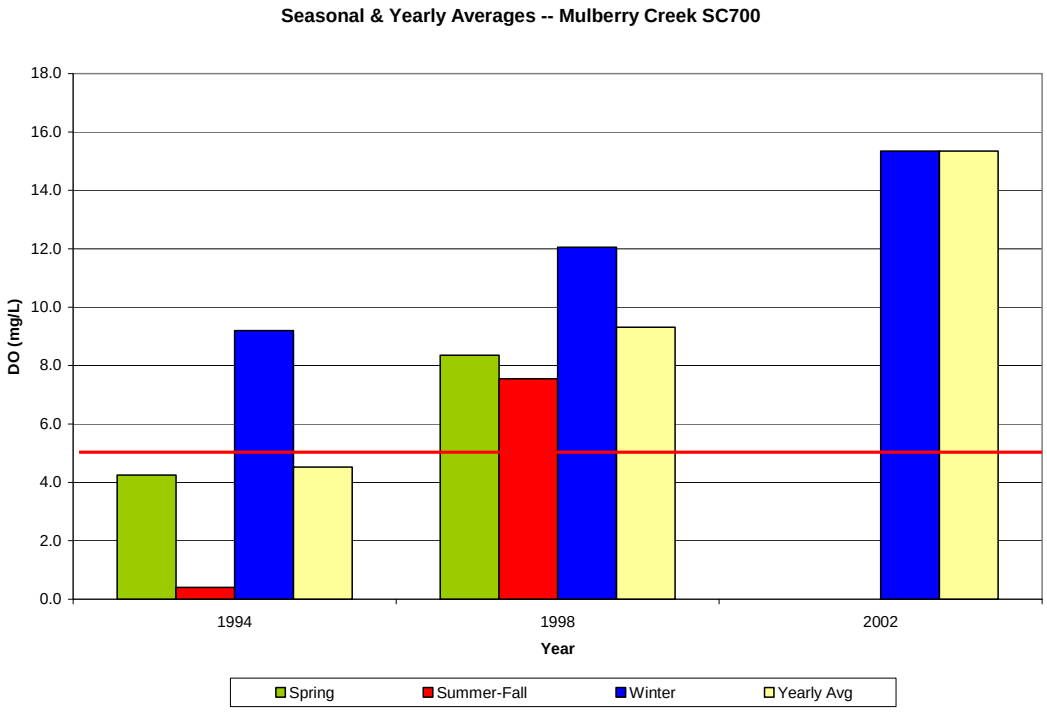


Table 3. DO averages by season for Mulberry Creek at SC700.

Sampling Year	Seasonal DO Avg. (mg/L)			Yearly Average (mg/L)
	Spring	Summer/Fall	Winter	
1994	4.25	0.400	9.20	4.53
1998	8.35	7.55	12.1	9.32
2002	*	*	15.4	15.4
Seasonal Avg.	6.30	5.17	12.8	

As observed in Table 4, DO violations occurred in the Summer-Fall season in Mulberry Creek during normal flow and low flow conditions and during the winter during low flow conditions. In total there were 12 observations for dissolved oxygen concentration in Mulberry Creek, 25% of which were in violation of the water quality standard of 5.0 mg/L.

Table 4. Number of samples under the dissolved oxygen standard of 5.0 mg/L by season & estimated flow condition.

NUMBER OF SAMPLES UNDER DISSOLVED OXYGEN STANDARD OF 5.0mg/L BY FLOW					
Station	**Season**	**High Flow ≥ 9.27 cfs**	**Normal Flow 0.641-9.28 cfs**	**Low Flow ≤ 0.641 cfs**	**Cum. Freq.**
Mulberry Creek SC700	Spring	0/1	0/1	1/2	1/4 = 25%
	Summer/Fall	0/0	1/2	1/1	2/3 = 67%
	Winter	0/1	0/1	0/3	0/5 = 0%
	Total All Seasons	0/2	1/4	2/6	3/12 = 25%

Relationships: The effect of stream temperature on dissolved oxygen concentration can be seen in Figure 6 with lower temperatures generally leading to higher dissolved oxygen concentrations in Mulberry Creek. The summary in Table 5 reveals the Spring season has the highest average stream temperature at 19.0 ^{o}C and the Winter season has the lowest average stream temperature at 5.50 ^{o}C. DO excursions in October 1994 and 1998 had stream temperatures of 12.0 ^{o}C and 25.0 ^{o}C, respectively. Three samples taken prior to the October 1994 excursion, including a third excursion that occurred in June 1994, do not appear in Figure 6 as there was no temperature data associated with them.

Figure 6. Mulberry Creek DO vs. Stream Temperature at SC700. DO samples taken on 2/22/94, 4/26/94, and 6/28/94 do not appear because they do not have temperature data associated with them.

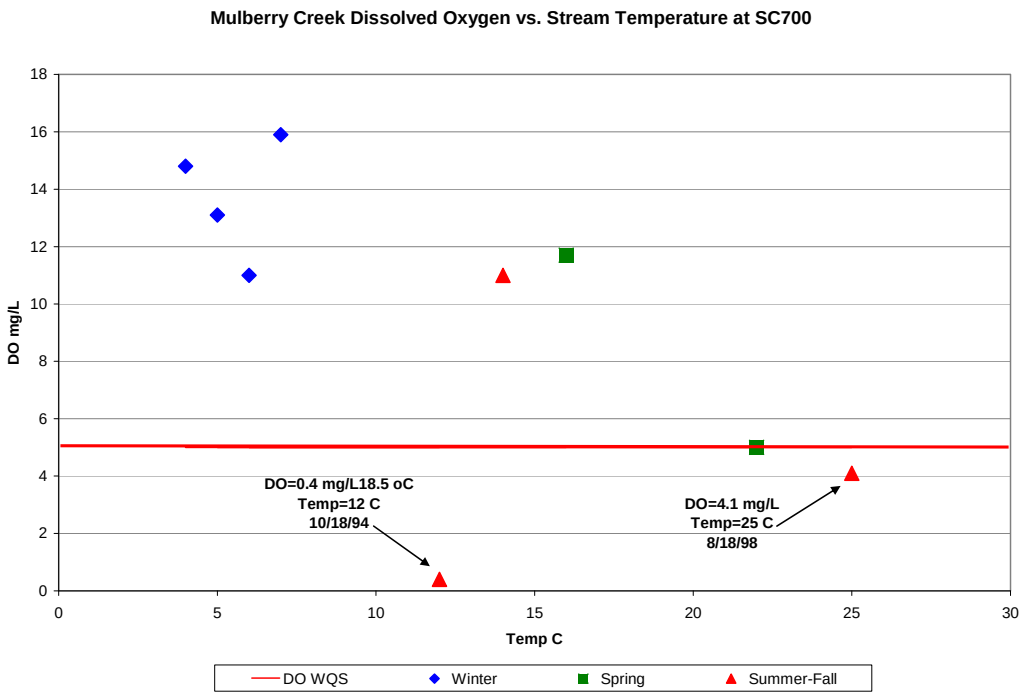
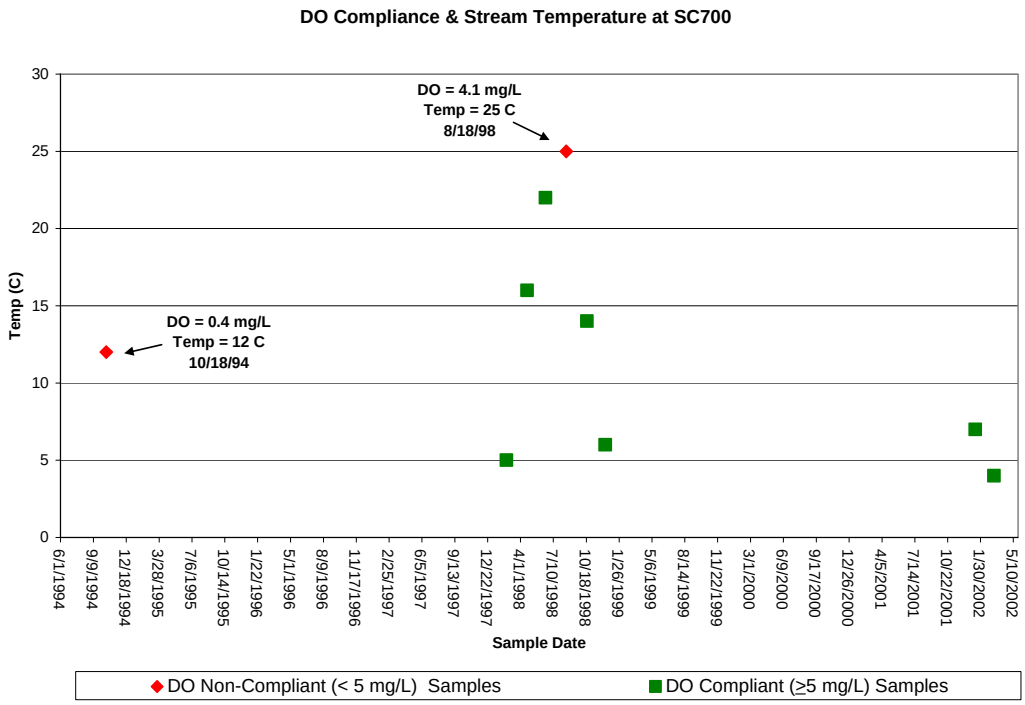


Table 5. Stream temperature by season for Mulberry Creek at SC700.

Sampling Year	Seasonal Temperature Avg. (^{o}C)			Yearly Average (^{o}C)
	Spring	Summer/Fall	Winter	
1994	*	12.0	*	12.0
1998	19.0	19.5	5.50	14.7
2002	*	*	5.50	5.50
Seasonal Avg.	19.0	17.0	5.50	

The average temperature of samples that were compliant with the dissolved oxygen water quality standard was 10.6 ^{o}C while the average of non-compliant samples was 18.5 ^{o}C (Figure 7).

Figure 7. DO compliance and stream temperature at SC700 on Mulberry Creek. DO samples taken on 2/22/94, 4/26/94, and 6/28/94 do not appear because they do not have temperature data associated with them.



KDHE discontinued sampling for BOD in 2001 and began utilizing Total Organic Carbon (TOC) analyses in late 2000 in lieu of BOD. KDHE conducted analyses in 2000 to determine if TOC concentrations could be utilized as a surrogate for BOD and whether a statistical translation could be made for this expression. KDHE utilized 675-paired sets of data in the analyses and concluded that there are relationships in the stream data. "The data suggest that, for effluent and point source related waters, the BOD/TOC ratio is almost one-to-one. Ambient waters have much lower ratios, suggesting that a portion of the TOC is in more refractory substances (i.e., cell walls, lignin, cellulose, etc.)"(Carney, 2000). The analysis of the paired ambient stream data was utilized for this report. The regression analyses for this group is summarized as follows:

R square = 0.34
P Value = <0.0001
For a TOC value of 10mg/L the most likely BOD concentration = 4.31 mg/L
Lower 95% BOD = 3.34 mg/L
Upper 95% BOD = 5.29 mg/L

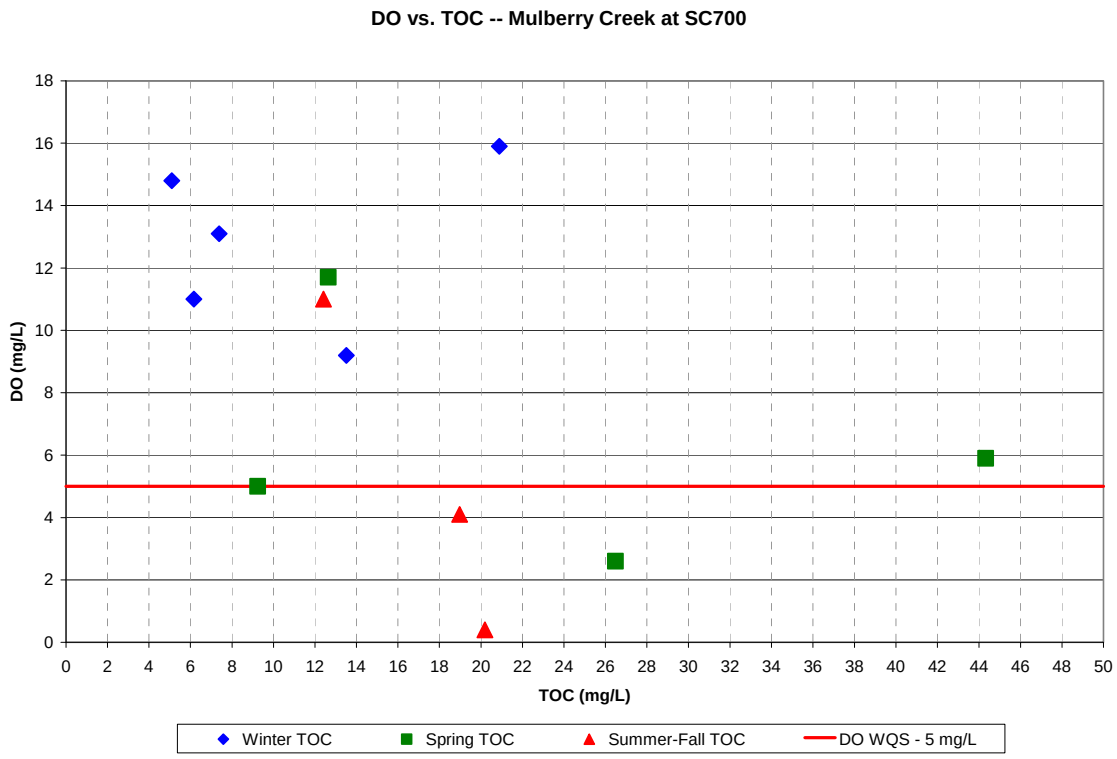
BOD/TOC Ratio:
Arithmetic Mean = 0.44
Geometric Mean = 0.35
Median = 0.37

Generally, higher BOD and TOC concentrations indicate that more oxygen will be consumed by an ecosystem, which may result in an oxygen deficient stream system as the population increases among microorganism communities.

For Mulberry Creek at SC700, BOD was reported for samples collected in 1994 and 1998 while TOC was reported for the two samples collected in 2002. For the sake of comparative analyses BOD results were converted to TOC concentrations using the median BOD/TOC ratio of 0.37 (Figure 8 & 9, Table 6).

As Figure 8 and Table 6 illustrate, the three dissolved oxygen violations occurred when their respective TOC concentrations were at or above 19.0 mg/L highlighting how higher organic carbon levels can contribute to decreased oxygen levels due to the aerobic respiration of microorganisms as they consume the organic matter.

Figure 8. Dissolved Oxygen vs. Total Organic Carbon in Mulberry Creek at SC700. BOD values have been converted to TOC using the median BOD/TOC ratio of 0.37 established by KDHE in 2000.



Two of the three DO excursions occurred when Mulberry Creek were under low flow conditions with the third violation in August of 1998 occurring under normal flow conditions (Figure 9) when the stream temperature was at its highest recorded temperature of 25.0 ^{o}C (Table 6). The data point with a TOC concentration of 44.3 mg/L was converted to TOC from the 4/25/94 BOD measurement of 16.4 mg/L. The BOD value of 16.4 mg/L is a statistical outlier (Grubbs' test) and has been removed from the data set in the remaining analyses.

Figure 9. Estimated percent of flow exceedance vs. TOC concentration in Mulberry Creek. BOD values have been converted to TOC using the median BOD/TOC ratio of 0.37 established by KDHE in 2000.

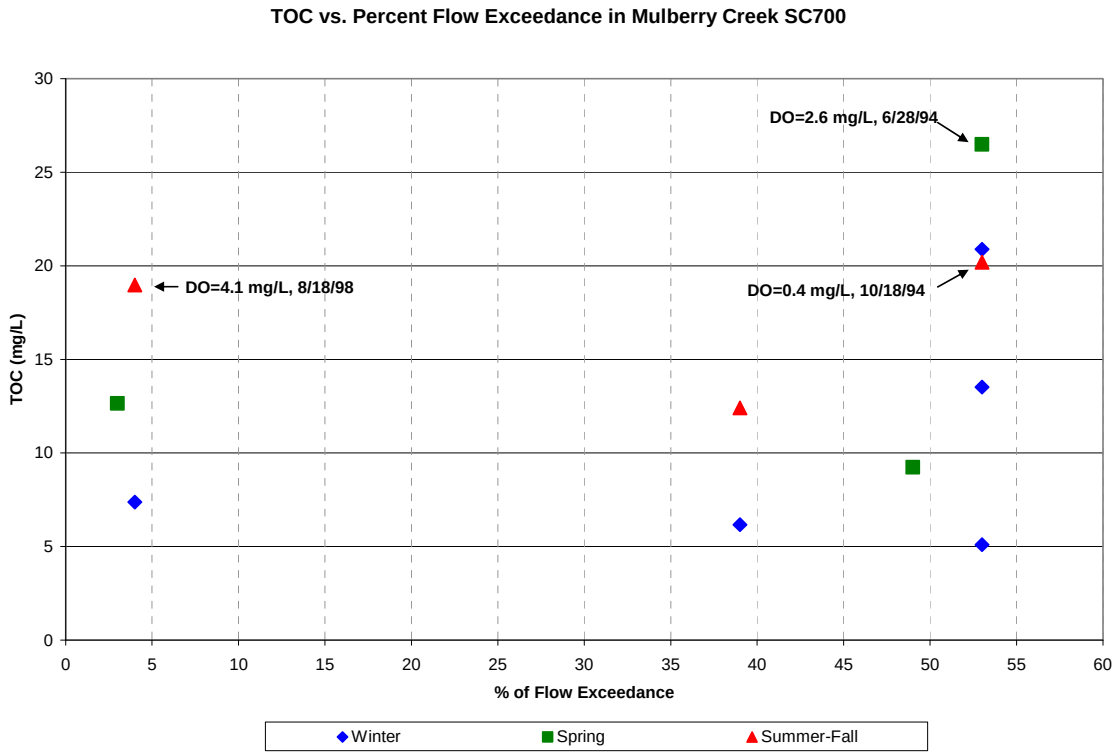


Table 6. Sample data from Mulberry Creek at SC700.

Collection Date	Flow (cfs)	Temp (^oC)	DO (mg/L)	BOD (mg/L)	TOC (mg/L)	BOD converted to TOC & 2002 TOC values (mg/L)
2/22/1994	<1	*	9.2	5.0	*	13.5
6/28/1994	**<1**	*****	**2.6**	**9.8**	*****	**26.5**
10/18/1994	**<1**	**12**	**0.40**	**7.5**	*****	**20.2**
2/17/1998	16.1	5	13.1	2.7	*	7.4
4/21/1998	19.0	16	11.7	4.7	*	12.6
6/16/1998	2.17	22	5.0	3.4	*	9.2
8/18/1998	**6.29**	**25**	**4.1**	**7.0**	*****	**19.0**
10/20/1998	2.31	14	11.0	4.6	*	12.4
12/15/1998	3.24	6	11.0	2.3	*	6.2
1/14/2002	<1	7	15.9	*	20.9	20.9
3/12/2002	<1	4	14.8	*	5.1	5.1
Average – All Samples	*N/A*	*12.3*	*8.98*	*5.22*	*13.0*	*14.1*
Average – DO Non Compliant Samples	*N/A*	*18.5*	*2.37*	*8.10*	*N/A*	*21.9*
Average – DO Compliant Samples	*N/A*	*12.3*	*11.5*	*3.78*	*13.0*	*10.2*

*****Data Not Available

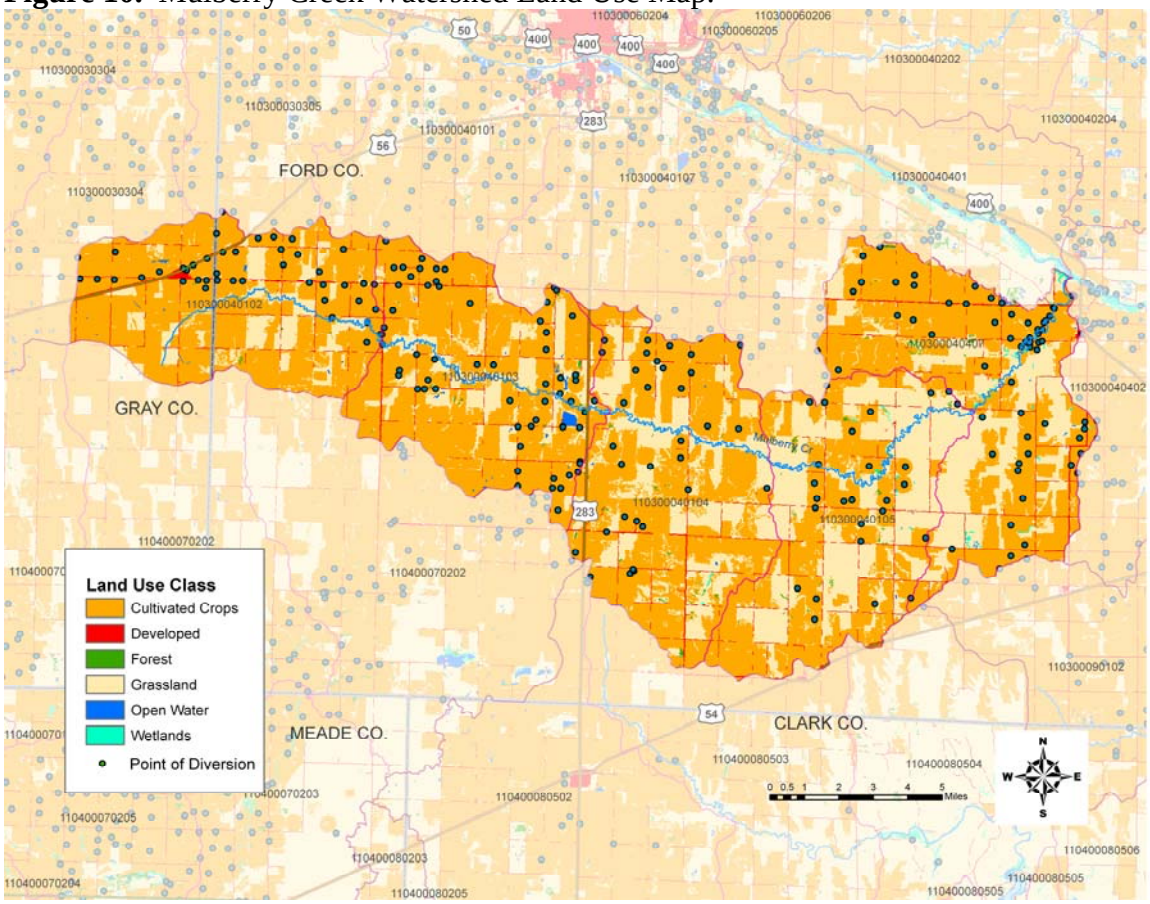
Desired Endpoints of Water Quality (Implied Load Capacity) for Mulberry Creek at Site 700:

The ultimate endpoint for this TMDL will be to achieve the Kansas Water Quality Standards fully supporting Aquatic Life, indicated by dissolved oxygen concentrations of 5.0 mg/L or more. Seasonal variation is accounted for by this TMDL as the TMDL endpoint is sensitive to the low flow conditions occurring in the Summer-Fall season in Mulberry Creek. Achievement of the endpoint indicates any loads of oxygen-demanding substance 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.

3. SOURCE INVENTORY AND ASSESSMENT

Land Use: The predominant land uses in the Mulberry Creek Watershed are cropland (67%) and grassland (30%) according to the 2001 National Land Cover Data. Together they account for 97% of the total land area in the watershed with the remaining land area consisting of developed land (2.7%), wetlands (0.25%) and open water (0.22%) (Figure 10). Depending on the proximity to the creek, runoff from fertilizer applications to cultivated cropland in the watershed is potentially a significant source of organic matter and nutrient loading to Mulberry Creek.

Figure 10. Mulberry Creek Watershed Land Use Map.



Livestock Waste Management Systems: According to the USDA National Agricultural Statistics Service, on January 1, 2010 cattle inventory for Gray and Ford Counties was 220,000 and 155,000 head, respectively. In the Mulberry Creek Watershed, there are eight active certified or permitted confined animal feeding operations (CAFOs) amounting to approximately 21,800 head of cattle (Table 7). These livestock facilities have waste management systems designed to minimize runoff entering their operation or detaining runoff emanating from their facilities. In addition, they are designed to retain a 25-year, 24-hr rainfall/runoff event as well as an anticipated two weeks of normal wastewater from their operations. Typically, this rainfall event coincides with stream flow occurring less than 1-5% of the time. It is likely, however, that there are small, unregistered livestock facilities operating in the watershed. Depending on the presence and condition of the smaller operations' waste management systems and their pasture grazing activity in the watershed, they may contribute a nutrient and organic matter load to the creek.

Table 7. CAFOs within the Mulberry Creek Watershed.

Kansas Permit Number	Federal NPDES Permit Number	Type	County	Animal Total
A-CIFO-C002	KS0115711	Beef	Ford	4500
A-UAFO-BA08	N/A	Beef	Ford	700
A-UAFO-BA15	N/A	Beef	Ford	200
A-UAFO-C012	KS0079171	Beef	Ford	10000
A-UAFO-C013	KS0079189	Beef	Ford	2000
A-UAFO-C019	KS0088129	Beef	Ford	2500
A-UAFO-C020	KS0096849	Beef	Ford	1500
N-UAFO-4725	N/A	Beef	Ford	400

Point Sources: There are two NPDES permitted facilities in the Mulberry Creek Watershed (Table 8). Both facilities are non-overflowing lagoon systems that are prohibited from discharging and would only contribute a BOD/TOC load under extreme precipitation or flooding events. Such events would not occur at a frequency or for duration sufficient to cause impairment to the watershed.

Table 8. NPDES permitted facility in the Mulberry Creek Watershed.

Discharging Facility	NPDES Permit #	State Permit #	Type	Expiration Date
City of Dodge City	KSJ000273	M-UA11-O01	Non-Overflowing	12/31/2012
City of Ensign	KSJ000277	M-UA12NO01	Non-Overflowing	3/31/2012

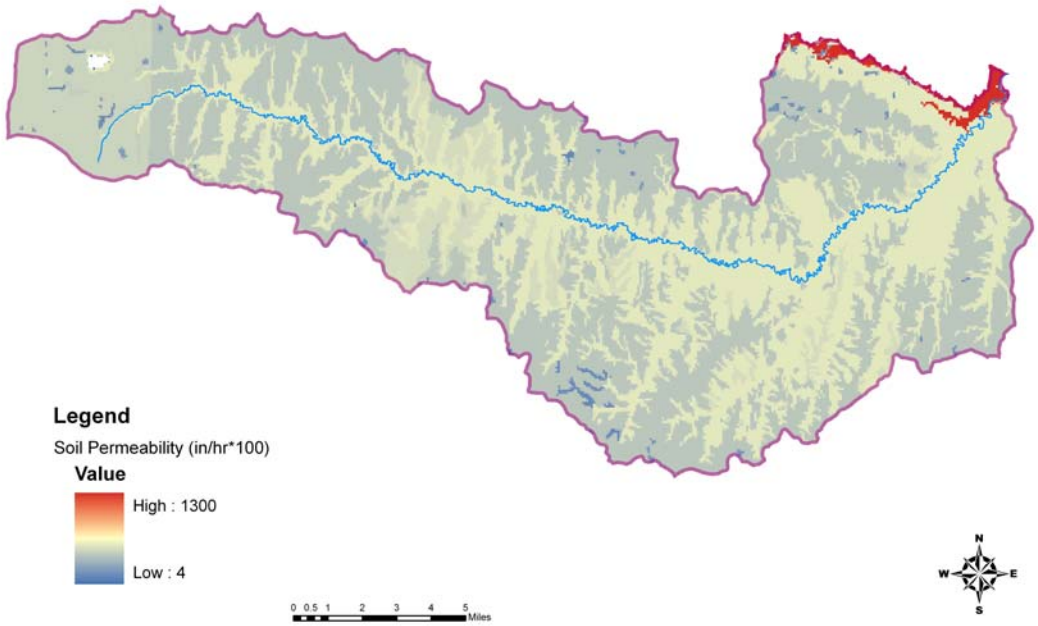
Points of Diversion: According KGS WIMAS, there are 265 unique points of diversion within the Mulberry Creek Watershed (Figure 10) with 89% of the points being used for irrigation. The remaining points of diversion are identified as being used for municipalities (5.7%), stock water (4.2%) and recreation (1.0%). Overuse of the water rights associated with the points of diversion could lead to depleted ground water levels which may in turn lead to a decrease in the base flow condition of the creek. Lower stream flows are known to contribute to a decrease in dissolved oxygen levels while the decrease in dilution capacity may lead to increases in total organic carbon concentrations in the creek.

On-Site Waste Systems: The Mulberry Creek Watershed is a rural agricultural area located in Gray and Ford Counties and, according to 2000 census data, the population within the watershed is approximately 558 people or 3 people per square mile. The 2010 census shows a 4.3% increase in population in Ford County; however, the population outside of Dodge City, including the bulk of the Mulberry Creek Watershed, decreased by approximately 11% from the 2000 population. Gray County shows a 1.7% increase in population from 5,904 in 2000 to 6,006 in 2010. According to 1990 census data, about 6% of households in Ford County and 13% of households in Gray County utilize septic or other on-site waste systems. Failing on-site waste systems can influence and contribute to the dissolved oxygen impairment.

Contributing Runoff: The watershed of Mulberry Creek has a mean soil permeability value of 1.19 inches/hour, ranging from 0.04 inches/hour to 13.0 inches/hour according to NRCS STATSGO database (Figure 11). About 71% of the watershed has a permeability value less than 1.29 inches/hour, which contributes to runoff during low to extremely low rainfall intensity events. According to a USGS open-file report (Juracek, 2000), the threshold soil-permeability values are set at 3.43 inches/hour for very high, 2.86 inches/hour for high, 2.29 inches/hour for moderate, 1.71 inches/hour for low, 1.14 inches/hour for very low, and 0.57 inches/hour for extremely low soil-permeability. Runoff is primarily generated as infiltration excess when soil profiles become saturated and produce excess overland flow due to rainfall intensities that are greater than soil permeability.

Background/Natural Contributions: The natural hydrologic characteristics of the watershed influence DO concentrations during periods of low flow in the watershed. Prolonged periods of dry conditions and warmer temperatures are the primary cause for the excursions below the dissolved oxygen water quality standard. Leaf litter and wastes derived from natural wildlife may also contribute to nutrient and organic material loads.

Figure 11. Soil permeability in the Mulberry Creek Watershed.



4. ALLOCATION OF POLLUTION REDUCTION RESPONSIBILITY

The lack of sufficient dissolved oxygen is caused by a combination of BOD loading and warmer stream temperatures. BOD is a measure of the amount of oxygen required to stabilize organic matter in a stream and, as such, BOD is a benchmark measure to anticipate DO levels. However, as KDHE discontinued sampling for BOD in late 2000 and began using Total Organic Carbon (TOC) in lieu of BOD, this allocation of loads will be made in terms of TOC (Table 9).

Point Sources: A current Wasteload Allocation of zero is assigned for total organic carbon under this TMDL due to the lack of point sources in the watershed. Should future sources be proposed in the watershed, the current wasteload allocations will be revised by adjusting current load allocations to account for the presence and impact of these new point source dischargers.

Non-Point Sources: The introduction of organic matter into Mulberry Creek from runoff events combined with low flow in the stream are likely the principal sources causing the incidents of low dissolved oxygen. The BOD/TOC ratio for compliant samples in Mulberry Creek at SC700 is 0.29 and is supported by the paired analyses of ambient stream data (Carney, 2000) which establishes a median BOD/TOC ratio of 0.37 in Kansas streams. Therefore, this TMDL assigns responsibility for maintaining the TOC levels to the average TOC (including converted BOD values) for all DO compliant samples of 10.2 mg/L, for all flow conditions (Table 9).

Table 9. Mulberry Creek TMDL, Daily Load Allocation and Margin of Safety at SC700. Flow values are USGS estimated (Table 1).

Flow Condition	TOC		
	Load Allocation (lbs/day)	**Margin of Safety (lbs/day)**	**TMDL (lbs/day)**
Mean Flow (8.15 cfs)	404	44.9	449
10% (9.47 cfs)	469	52.2	522
25% (4.13 cfs)	204	22.7	227
50% (1.70 cfs)	84.2	9.36	93.6
75% (0.22 cfs)	10.8	1.21	12.1
90% (0.0 cfs)	0	0	0

Defined Margin of Safety: The Margin of Safety provides some hedge against the uncertainty of variable TOC loads and the endpoints of the TMDL. The margin of safety is explicitly set at 10% of the calculated TOC loads, which compensates for the lack of knowledge about the relationship between the allocated loadings and the resulting water quality. The margin of safety is expressed in Table 9.

State Water Plan Implementation Priority: Short term and immediate consequences for aquatic life are attributed to dissolved oxygen violations. However, since the frequency of dissolved oxygen violations is low, this TMDL will be Low Priority for implementation.

Unified Watershed Assessment Priority Ranking: This watershed lies within the Arkansas-Pickerel Basin (HUC 8: 11030004) with a priority ranking of 40 (Medium Priority for restoration work).

Priority HUC 12: Priority focus of implementation will concentrate on installing best management practices in the riparian areas adjacent to Mulberry Creek.

5. IMPLEMENTATION

Desired Implementation Activities

1. Install grass buffer strips where needed along stream and drainage channels in the watershed.
2. Maintain conservation tillage and contour farming to minimize cropland erosion.
3. Ensure proper on-site waste system operations in proximity to targeted stream.
4. Ensure that labeled application rates of chemical fertilizers are being followed.
5. Implement nutrient management plans to manage manure land applications and runoff potential.

Implementation Programs Guidance

Non-Point Source Pollution Technical Assistance - KDHE

a. Support selected Section 319 demonstration projects for pollution reduction from livestock operations in watershed.
b. Provide technical assistance on practices geared to the establishment of vegetative buffer strips.
c. Provide technical assistance on practices geared to small livestock operations which minimize 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 stream segments identified by this TMDL.

Water Resource Cost Share & Non-Point Source Pollution Control Programs – KDA Division of Conservation

a. Establish or reestablish natural riparian systems, including vegetative filter strips and streambank vegetation.
b. Apply conservation farming practices and/or erosion control structures, including no-till, terraces and contours, sediment control basins and constructed wetlands.
c. Re-evaluate nonpoint source pollution control methods.
d. Install livestock waste management systems for manure storage.
e. Implement manure management plans.

Riparian Protection Program – KDA Division of Conservation

a. Develop riparian restoration projects.

Buffer Initiative Program – KDA Division of Conservation

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 planning.
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.
f. Continue to educate residents, landowners, and watershed stakeholders and nonpoint source pollution.

Local Environmental Protection Program – KDHE

a. Inspect on-site waste systems within one mile of priority stream segments.

Division of Water Resources – KDA

a. Ensure future water use or management activities in the watershed do not reduce or impede streamflow during low flow conditions.

Timeframe for Implementation: Initial implementation will proceed over the years from 2012-2016. Additional implementation may be required over 2017-2021 to achieve the endpoints of this TMDL.

Targeted Participants: The primary participants for implementation will be agricultural and livestock operations immediately adjacent to Mulberry Creek. Conservation district personnel and county extension agents should conduct a detailed assessment of sources adjacent to streams within the watershed over 2012-2013. Implementation activities should target those areas with the greatest potential to impact DO conditions. Nominally, this would most likely be:

1. Areas of denuded riparian vegetation along Mulberry Creek.
2. Unbuffered cropland adjacent to the stream.
3. Sites where drainage runs through or adjacent to livestock areas.
4. Sites where livestock have full access to stream and stream is primary water supply.
5. Poor riparian sites.
6. Failing on-site waste systems.

Milestone for 2016: In accordance with the TMDL development schedule for the State of Kansas, the year 2016 marks the next cycle of 303(d) activities in the Upper Arkansas Basin. At that point in time, data from 2012 at site SC700 will be reexamined to assess improved condition in the stream. Should the impairment remain adjustments to source assessment, allocation and implementation activities may occur.

Delivery Agents: The primary delivery agents for program participation will be the Kansas Department of Health and Environment, the Kansas Department of Agriculture – Division of Conservation, the Natural Resources Conservation Service, the Kansas State University Extension Service, the Gray and Ford County Conservation Districts and the Upper Arkansas Basin WRAPS teams. Producer outreach and awareness will be delivered by Kansas State University Extension Office.

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.S.A. 2002 Supp. 82a-2001 identifies the classes of recreation use and defines impairment for streams.

4. K.A.R. 28-16-69 through 071 implements water quality protection by KDHE through the establishment and administration of critical water quality management areas on a watershed basis.

5. 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.

6. 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.

7. 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.

8. K.S.A. 82a-951 creates the State Water Plan Fund to finance the implementation of the *Kansas Water Plan*, including selected Watershed Restoration and Protection Strategies.

9. The Kansas Water Plan and the Upper Arkansas Basin Plan provide the guidance to state agencies to coordinate programs intent on protecting water quality and to target those programs to geographic area 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 watershed and water resources of highest priority. Typically, the state allocates at least 50% of the fund to programs supporting water quality protection. Additionally, $2 million has been allocated between the State Water Plan Fund and EPA 319 funds to support implementation of Watershed Restoration and Protection Strategies. This watershed and its TMDL are a Low Priority consideration for funding.

Effectiveness: Minimal control can be exerted on natural contributions to loading.

6. MONITORING

Providing there is flow in Mulberry Creek at SC700, KDHE will resume its rotational sampling schedule with quarterly sampling of the creek in 2014 , including dissolved oxygen samples, in order to assess progress and success in implementing this TMDL toward reaching its endpoint. Based on sampling data, the status of the 303(d) listing will be evaluated in 2020.

7. FEEDBACK

Public Notice: An active Internet Web site was established at www.kdheks.gov/tmdl/ to convey information to the public on the general establishment of TMDLs and specific TMDLs for the Upper Arkansas Basin. The TMDLs for the Upper Arkansas Basin were available for review on the web beginning August 20, 2012.

Public Hearing: A Public Hearing was held on September 20, 2012 in Garden City to receive comments on this TMDL.

Basin Advisory Committee: The Upper Arkansas River Basin Advisory Committee met to discuss the TMDLs in the basin on April 4, 2012 in Jetmore and September 20, 2012 in Garden City.

Milestone Evaluation: In accordance with the TMDL development schedule for the State of Kansas, the year 2016 marks a future cycle of 303(d) activities in the Upper Arkansas Basin. At that point in time, sample data from Mulberry Creek will be

reexamined to assess improved conditions in the stream. Should the impairment remain adjustments to source assessment, allocation, and implementation activities may occur.

Consideration for 303(d) Delisting: Mulberry Creek will be evaluated for delisting under section 303(d), based on the monitoring data over 2012-2021. Therefore, the decision for delisting will come about in the preparation of the 2022-303(d) list. Should modifications be made to the applicable water quality criteria during the 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 would come in 2012. Recommendations of this TMDL will be considered in the Kansas Water Plan implementation decisions under the State Water Planning Process for Fiscal Years 2012-2021.

Developed 3/22/13

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