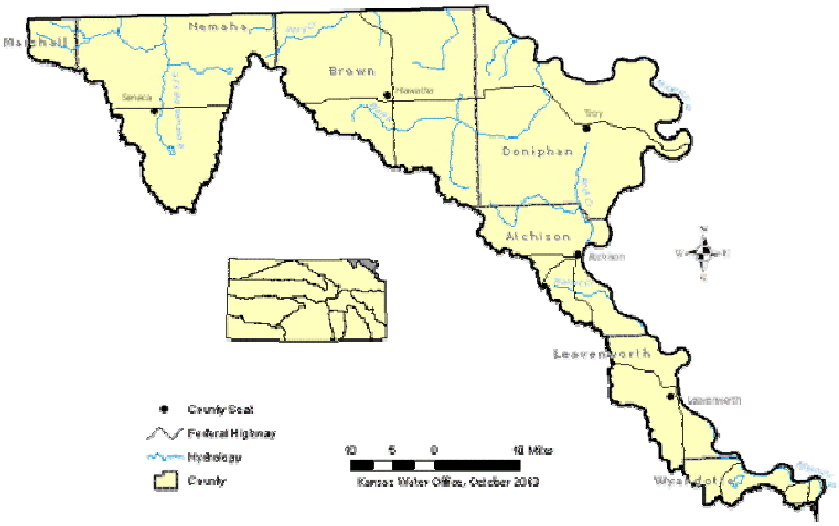
The Missouri River Basin

Watershed Restoration and Protection Strategy

Nine Element Plan

Water Quality Impairments Directly Addressed:

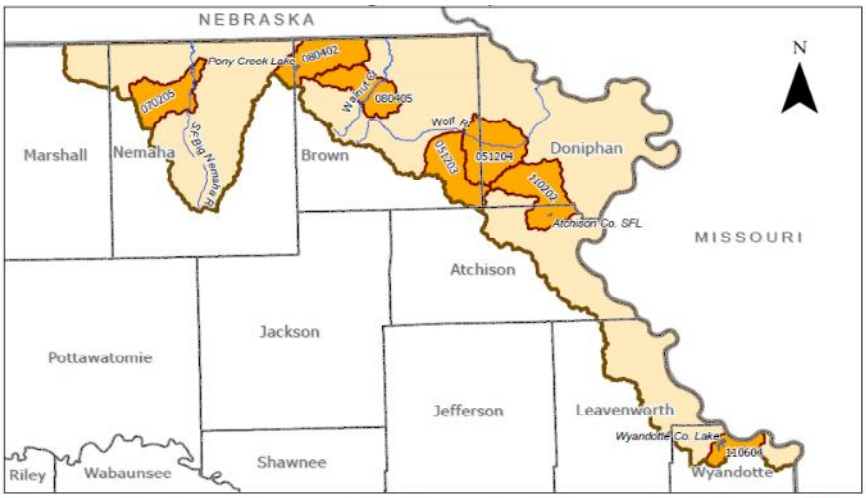
- Wolf River Bacteria TMDL (High Priority)
- Wolf River Biology TMDL (High Priority)
- South Fork Big Nemaha River Bacteria TMDL (High Priority)
- South Fork Big Nemaha River Biology TMDL (High Priority)
- Walnut Creek Bacteria TMDL (High Priority)
- Pony Creek Lake Eutrophication TMDL (High Priority
- Atchison County Lake Siltation TMDL (High Priority)
- Wyandotte County Lake Eutrophication TMDL (High Priority)



Determination of Priority Areas

- Presence of High Priority TMDLs within HUC 12 considered
- Interpretation of available information for High Priority TMDL watersheds such as STEPL maps as well as other assessments of HUC 8 watersheds within the project area such as the KAWS and KWO assessments as well as information developed by KDHE in support of TMDL development within the Missouri River Basin.
- Opinion of the leadership team members, which include local County Conservation District and NRCS staff, of areas that have potential for greatest pollutant load reductions if best management practices are applied
- A subjective opinion of which areas are most likely to have landowners and producers who are cooperative and receptive to best management practices and learning programs by the SLT

Missouri River Basin WRAPS Priority Areas for BMP Implementation



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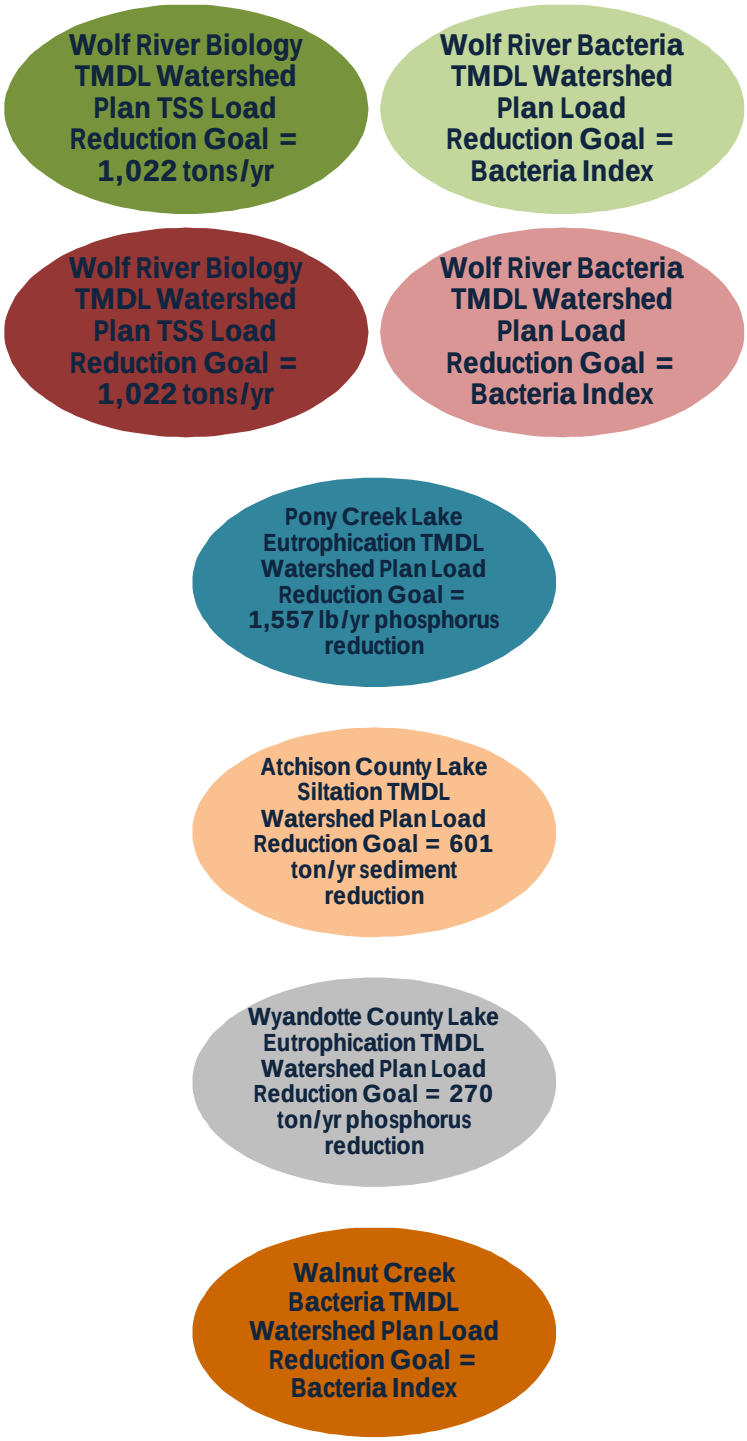
December 2010

Best Management Practice and Load Reduction Goals



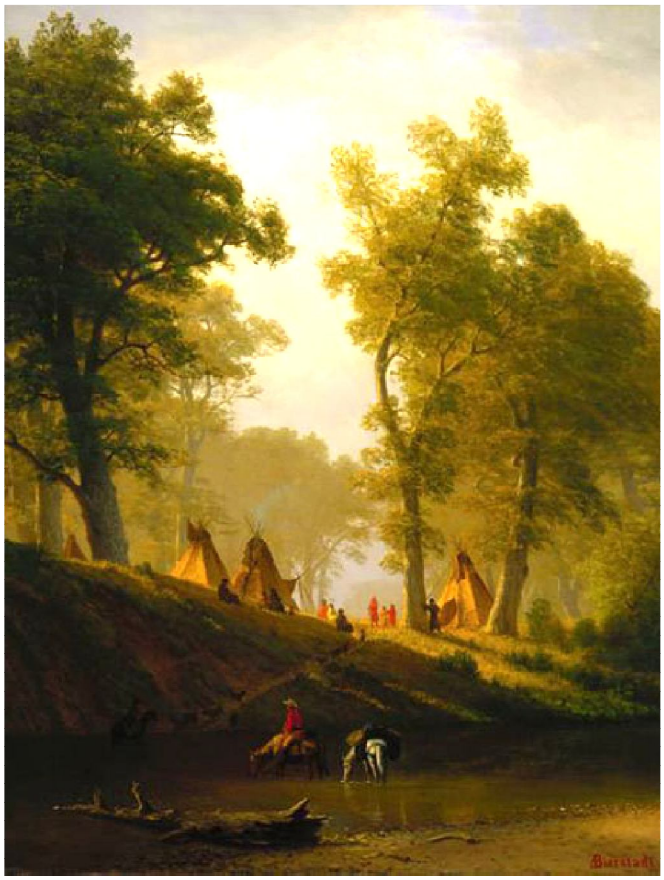
Bacteria Load Reduction Goal

The indicator will be the Upper Decile of those index values; with the target being that the index improves over time with the upper decile (90th percentile) value approaching or falling below 1.

BMPs to be implemented in association with Watershed Plan:

- Agricultural BMPs
    - No-till
    - Cover crops
    - Grassed buffers
    - Forested buffers
    - Convert steep slopes
    - Sediment basins
    - Pasture management
    - Nutrient management
    - Livestock waste management
    - Alternative watering supplies
- Other BMPs
    - Streambank Stabilization
    - Onsite Wastewater System Repair
    - Urban lawn management
    - Pet waste management

Load Reduction Goals for Watershed Plan Met within 30 Years if BMPs are Implemented as Scheduled



The Wolf River, Kansas, painting by Albert Bierstadt, 1859

The Missouri River Basin Watershed Restoration and Protection Strategy

NINE ELEMENT PLAN

Sponsored by

The Glacial Hills RC & D
Valley Falls, KS
June 2012

Acknowledgements

The Missouri River Basin Watershed Restoration and Protection Strategy is made possible through sponsorship of the Glacial Hills RC&D in Valley Falls. The Kansas Department of Health and Environment and EPA provide financial assistance to this project (KDHE project number 2006-0078 and EPA grant number C-900740513). Funding was also provided through Kansas Water Plan Funds. Thanks to the landowners, agencies, and local government representatives and other interested individuals who took time out of their busy schedules to attend meetings, provide information, and give input to the development of this plan. Special thanks to the technical and editorial support provided by KDHE Watershed Management Section.

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Introduction

Watershed restoration and protection efforts are needed to address a variety of water resource concerns in Kansas. These concerns include issues such as water quality, public water supply protection, flooding, wetland and riparian habitat protection, unplanned urban development, and others. The State of Kansas committed to implementing a collaborative strategy to address watershed restoration and protection issues when the Governor's Natural Resources Sub-Cabinet adopted the Kansas Watershed Restoration and Protection Strategy (KS-WRAPS) in May, 2004.

The KS-WRAPS effort establishes a new way of approaching watershed issues for Kansas. The effort places emphasis on engaging watershed stakeholders in implementing an action plan that achieves watershed goals established by the stakeholders themselves. This allows for an localized approach to watershed issues across the state, with input, guidance, and action to achieve watershed improvements coming from the people who live and work in the watershed. Funding for the development of Watershed Restoration and Protection Strategy (WRAPS) plans for individual watersheds is made available to sponsoring groups, using Kansas Water Plan funds and EPA Section 319 Nonpoint Source Pollution Control Grant funds through the Kansas Department of Health & Environment (KDHE).

The Missouri River Basin WRAPS project began when the Glacial Hills RC&D was awarded a grant from KDHE in 2007. A Coordinator for the Missouri River Basin WRAPS project was hired in September of 2007 to guide the development of the WRAPS planning effort in the basin, and to work with stakeholders. Individuals with an interest in water resources in the Missouri River Basin watershed met and began the process of identifying water-related issues in September, 2007. Eight public meetings were held in various locations throughout the watershed in 2007 and 2008 to gather input from local stakeholders. A variety of other public informational activities were also undertaken to make the public aware of the WRAPS planning effort, and to gather input.

A diverse group of stakeholders became involved in the Missouri River Basin WRAPS planning process. Farmers, landowners, representatives of natural resource agencies and organizations, tribal, city and county government representatives, public water suppliers and others participated. The group identified watershed priorities and issues, gathered information, planned how resource concerns would be addressed, and prioritized issues and actions to be taken. In addition to the educational benefits achieved thus far, the main outcome from this process is the development of the Missouri River Basin Watershed Restoration and Protection Strategy *Nine Element Plan*. This plan is the result of nearly four years of public input and sharing of ideas and documents watershed information and the decisions of stakeholders involved in its development.

Missouri River Basin WRAPS Stakeholder Leadership Team

The Missouri River Basin WRAPS Stakeholder Leadership Team (SLT) evolved from a core group of meeting attendees. Watershed stakeholders focused on building basin representation and consensus building for several months rather than initiating a formal structure. During the initial meetings, the stakeholders discussed methods for devising a leadership team that would encompass the broad constituent base of the watershed, given the rural and urban components. The function of the team, how it is governed, what its make-up should be and why it was needed were discussed. The SLT serves as a board to make decisions and provide guidance to the WRAPS Coordinator. They also determined priorities and provide direction to the project. The SLT will be comprised of ten members, including the following representatives

Agriculture
Carol Hughes, Seneca, Kansas

Public/Rural Water Suppliers
George Jorgensen, Troy, Kansas

Commercial/Economic Development
Lawrence Mays

Tribal
Terry Moony, White Cloud, Kansas

Environment At Large – (local health, etc.)
James Kaatz, Leavenworth County

Glacial Hills RC & D
Gary Satter, Valley Falls, Kansas

Urban/Suburban
Cheri Miller, Wyandotte County

Conservation District
Aubrey Guenther, Leavenworth

Watershed District
Barb Oltjen, Robinson, Kansas

SLT members live and/or work in the watershed and meet monthly or semi-monthly. The group agreed the SLT should not have state or federal employees serving on the board representing their agency. However, an “Advisory Group” of people representing natural resource agencies would be very helpful to the Management Team and to the WRAPS project.

SECTION 1 - DESCRIPTION OF MISSOURI RIVER BASIN

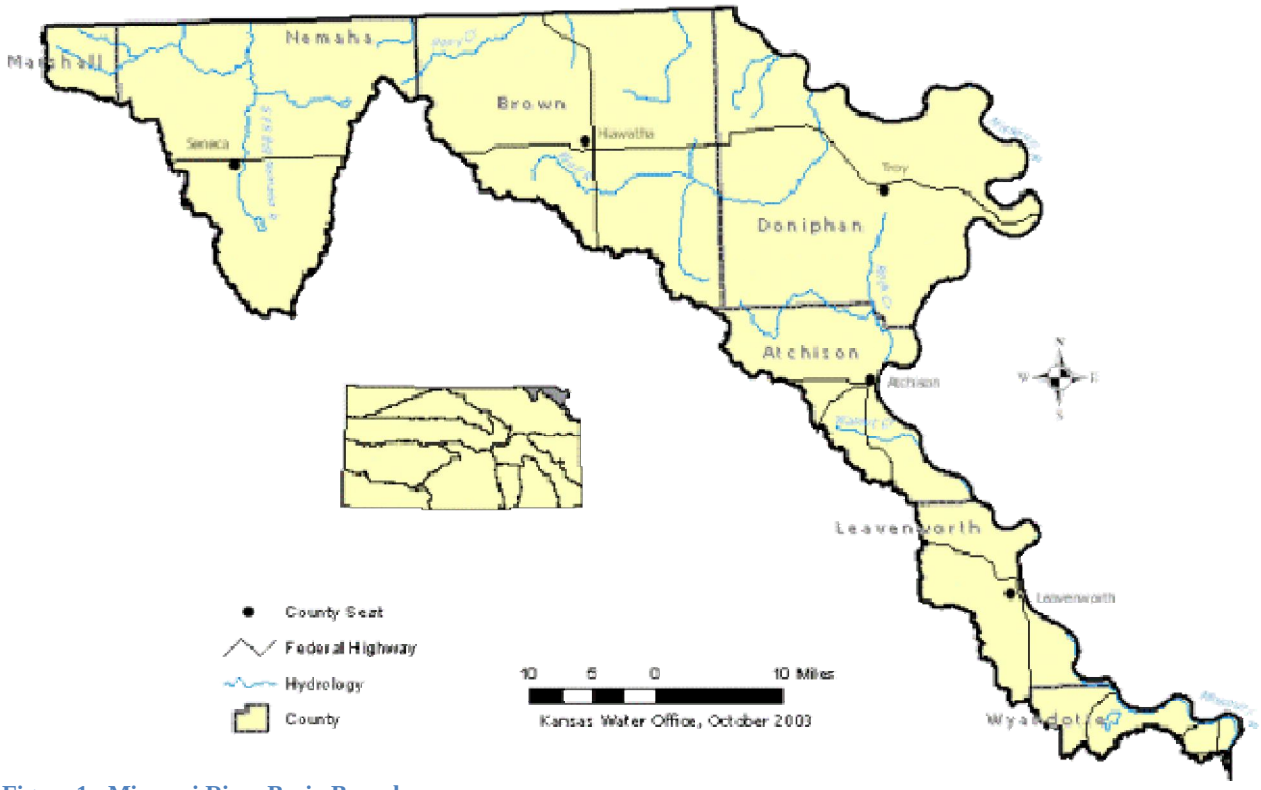

Figure 1 - Missouri River Basin Boundary

The Missouri River Basin in Kansas

Understanding the entire Missouri River system and its history facilitates understanding the dynamics of the modern day Missouri River and the interface of current urban life and agricultural practices in today's society with the river.

The Missouri River is tributary of the Mississippi River. The Missouri River begins at the confluence of the Madison, Jefferson, and Gallatin rivers in Montana, and flows south and east into the Mississippi River at St. Louis, Missouri. At 2,341 mi in length, it drains about one-sixth of the North American continent.

The Missouri River in its original natural meandering state was the longest river in North America. Nearly 72 miles of the river have been cut off by channeling and so it is now comparable in length to the Mississippi River. The combination of these two rivers forms the longest river in North American and the fourth longest river in the world.

At its confluence, the Missouri nearly doubles the volume of the Mississippi, accounting for 45 percent of the flow at St. Louis in normal times and as much as 70 percent of the flow during some droughts.[6] It is the second-largest tributary by volume of the Mississippi, trailing the Ohio River. The river is nicknamed "Big Muddy" and also "Dark River" because of high silt content. Since the river meanders from bluff to bluff in the flat Midwestern states, it is also called the "Wide Missouri".

The Missouri River Basin in Kansas is a fraction of the extensive Missouri River drainage. The Basin encompasses all or part of ten states and extends into Canada. While there are no large federal reservoirs in the Kansas portion of the basin, the flow of the Missouri River above the Kansas border is regulated by six large reservoirs operated by the Corps of Engineers in Montana, North Dakota, South Dakota and Nebraska. The Corps of Engineers maintains a navigation channel within the Missouri River and the management has included extensive bank stabilization and flood protection.

The Missouri River Basin covers some 1,600 square miles in the northeast corner of Kansas. The basin covers all or parts of Marshal, Nemaha, Brown, Doniphan, Atchison, Leavenworth and Wyandotte Counties. There were an estimated 143,000 residents in the basin in 2000 and this population is projected to grow only three percent by the year 2040. This basin illustrates major demographic changes which are taking place in Kansas. In the past 40 years, two trends have dominated the state. Rural counties have lost population, sometimes more than 10 percent every decade. Urban counties, such as Leavenworth, are gaining population at even faster rates. In the Missouri Basin, every predominately rural county is losing population.

Missouri River North of White Cloud

Unlike most other Kansas River basins, the Missouri Basin was glaciated and glacial deposits and wind deposited loess are found in the basin. In some localities the glacial deposits serve as aquifers. The glacial deposit bluffs bordering the Missouri River exceed 200 feet in height in places.

Ecoregions

The Missouri River Basin in Kansas is located within three of the EPA Ecoregions. Ecoregions were devised by the EPA to identify regions with in the United States with a general similarity in

ecosystems and in the type, quality, and quantity of environmental resources. The ecoregions are designed to serve as a spatial framework for the research, assessment, management, and monitoring of ecosystems and ecosystem components.

The eastern half of Doniphan County and a strip along the eastern edge of Atchison County are in the Level IV region -Nebraska/Kansas Loess Hills. This ecoregion is a sub-region of the Level III Western Corn Belt Plains ecoregion that extends northward through the eastern portion of Nebraska. The Nebraska/Kansas Loess Hills ecoregion is characterized by greatly rolling relief with deep loess hills. The soils are deep, silty and well drained and support a natural vegetation of tall grass prairie with scattered oak-hickory forests along stream valleys.

The northwestern portion of the Missouri River Basin lies in the Loess and Glacial Drift Hill Level IV ecoregion, directly west of the Nebraska/Kansas Loess Hills ecoregion and is also a sub-region of the Western Corn Belt Plains Level III ecoregion. This area is characterized by low, rolling loess-covered hill with areas of exposed glacial till. This area historically had less oak-hickory forest and more extensive tall grass prairie than the Nebraska/Nebraska Loess Hill region. The flatter loess hills have a silty, clay loam soil that supports cropland with rangeland more extensive on the deep clay loams in the glacial till soils.

Doniphan County Farmstead

The southern portion of the Missouri River Basin from Leavenworth south is in the Osage Cuestas Level IV ecoregion, which is a part of the Central Irregular Plains Level III Ecoregion. A cuesta is an asymmetric ridge characterized by short, steep escarpment on one side, and a long, gentle slope on the other side. The steep side exposes the edge of erosion resistant rock layers that form the cuestas.

Glacial drift covers bedrock of the Pennsylvanian and Permian systems over much of the basin. These systems consist primarily of alternating layers of limestone and shale and some local sandstone. Glacial material composed of unconsolidated till and outwash may reach thickness of 250 feet with rock outcrops along principal streams

The soils within the Missouri Basin tend to be from four major associations. The steeply sloped Monona and Marshall Silt loams along the Missouri River Bluffs are derived from loess and are fertile for agriculture but are prone to erosion. Sharpesburg silty clay loam along with the Shelby and Marshall silt loams found further west are less steep but still prone to erosion. The western third of the basin contains the Grundy and Pawnee silty clay loams and the Burchard and Shelby silt loam. The clay loams tend to be relatively level and have low permeability. The silty

loams occupy the steeper slopes and are more permeable. The alluvial soils in the floodplains of the Missouri and the larger streams are deep and productive.

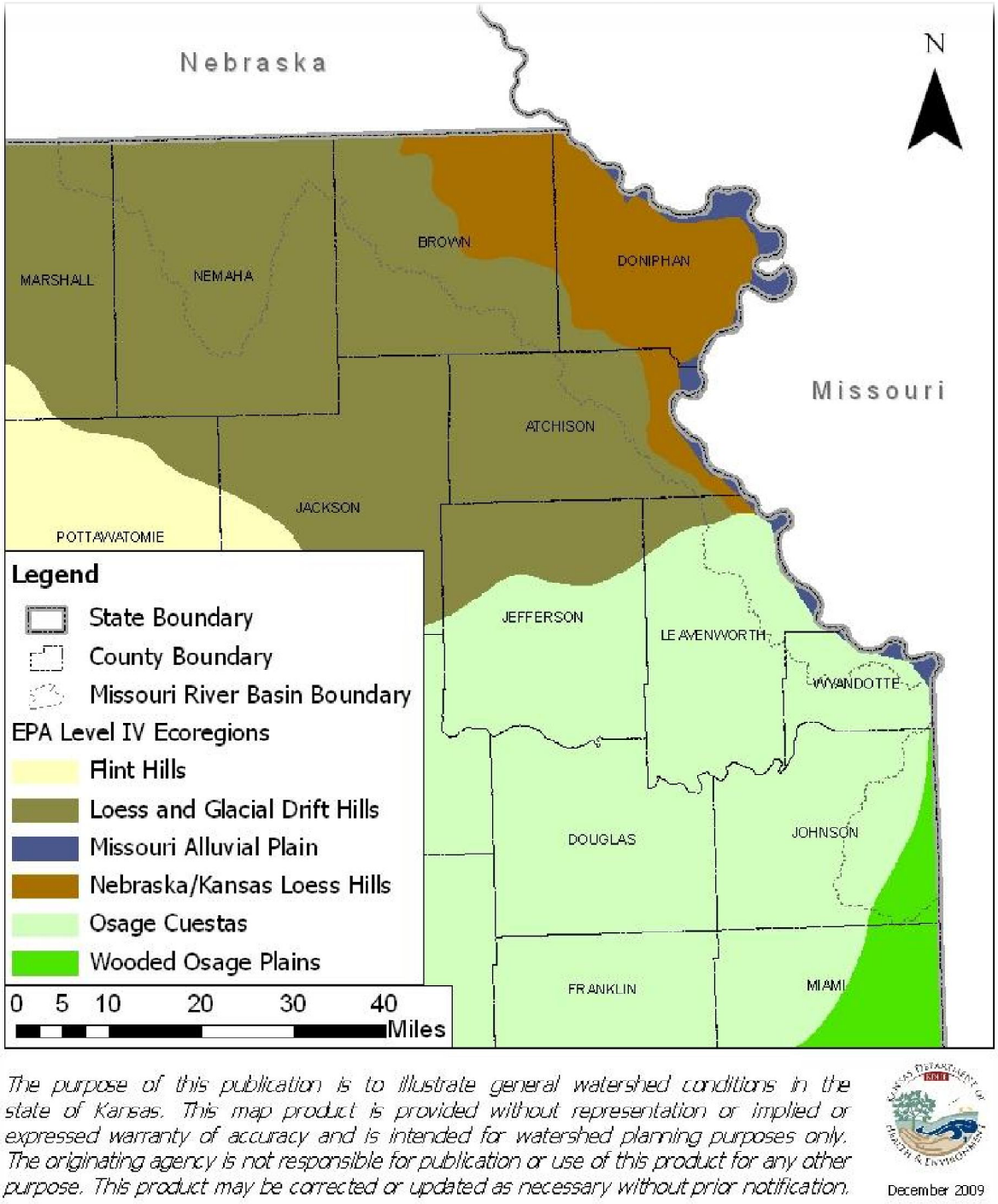

Figure 2 - EPA Level IV Ecoregions

Watersheds

The Missouri River Basin includes four HUC 8 Watersheds: The South Fork Big Nemaha Watershed (HUC 10240007); the Big Nemaha Watershed (HUC 10240008); The Tarkio-Wolf Watershed (HUC 10240005) and the Independence-Sugar Watershed (HUC 10240011).

The South Fork Big Nemaha (HUC 10240007):

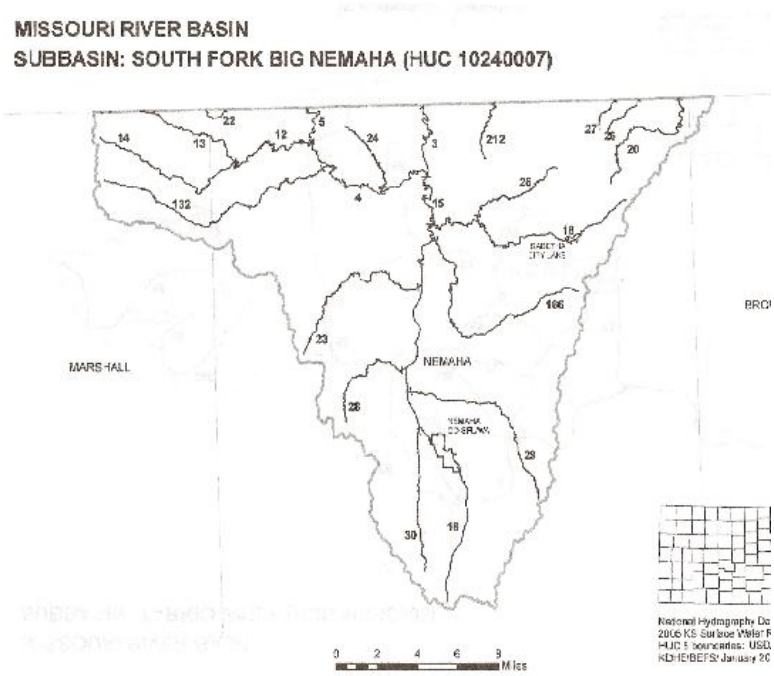

Figure 3 - South Fork Big Nemaha

The South Fork Big Nemaha Watershed is located primarily in the northern and middle portion of Nemaha County, with a small area in the north eastern corner of Marshall County. It is located entirely within the Glacial Drift Hills ecoregion. Rainfall averages 33 to 36 inches per year.

According to the Watershed Conditions Report prepared by KDHE in 2000, 85% of the total miles of surface water in this watershed do not meet their designated uses.

The primary pollutant concern for the HUC 8 streams and rivers is bacteria and Total Suspended solids (TSS). Potential sources for the Fecal Coliform bacteria include feedlots, wastewater treatment facilities and wildlife. TSS enters the water body as sediments from eroding stream banks and from eroded soil from adjacent land within the watershed.

Groundwater aquifers underlying the South Fork Big Nemaha include portions of the glacial aquifer and alluvial aquifers of the Big Nemaha River and its tributaries.

Big Nemaha Watershed (HUC 10240008):

The Big Nemaha Watershed is located primarily in the northern half of Brown County, with a small area in the northeastern corner of Nemaha County. The western half of the watershed is located within the Glacial Drift Hills ecoregion and the eastern half is in the Nebraska/ Kansas Loess Hills eco-region. Rainfall averages 36 to 37 inches per year.

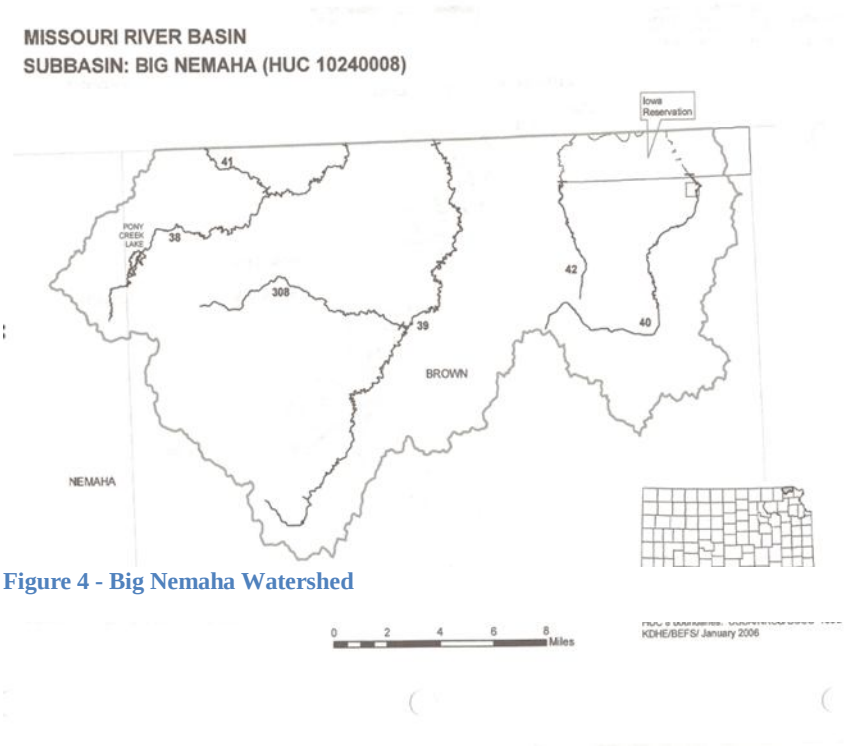

Figure 4 - Big Nemaha Watershed

The primary pollutant concern for the HUC 8 streams and rivers is bacteria. Potential sources for the Fecal Coliform bacteria include feedlots, wastewater treatment facilities and wildlife.

Ground water sources include portions of the alluvial aquifers from the river and streams. Water from the Glacial Drift aquifer is very hard and high in fluorides and dissolved solids. Water from the alluvial aquifer is generally very good but susceptible to surface water contaminates, particularly bacteria

Tarkio-Wolf Watershed (HUC 10240005)

The Tarkio-Wolf Watershed is located in the eastern portion of Brown County and the northern portion of Doniphan County. The western half of the watershed is located within the Glacial Drift Hills ecoregion and the eastern half is in the Nebraska/Kansas Loess Hills. Rainfall averages 37 inches per year.

The Tarkio River is on the Missouri side of the Missouri River. According to the Watershed Conditions Report prepared by KDHE in 2000, 67% of the total miles of water in the steams do not meet their designated uses.

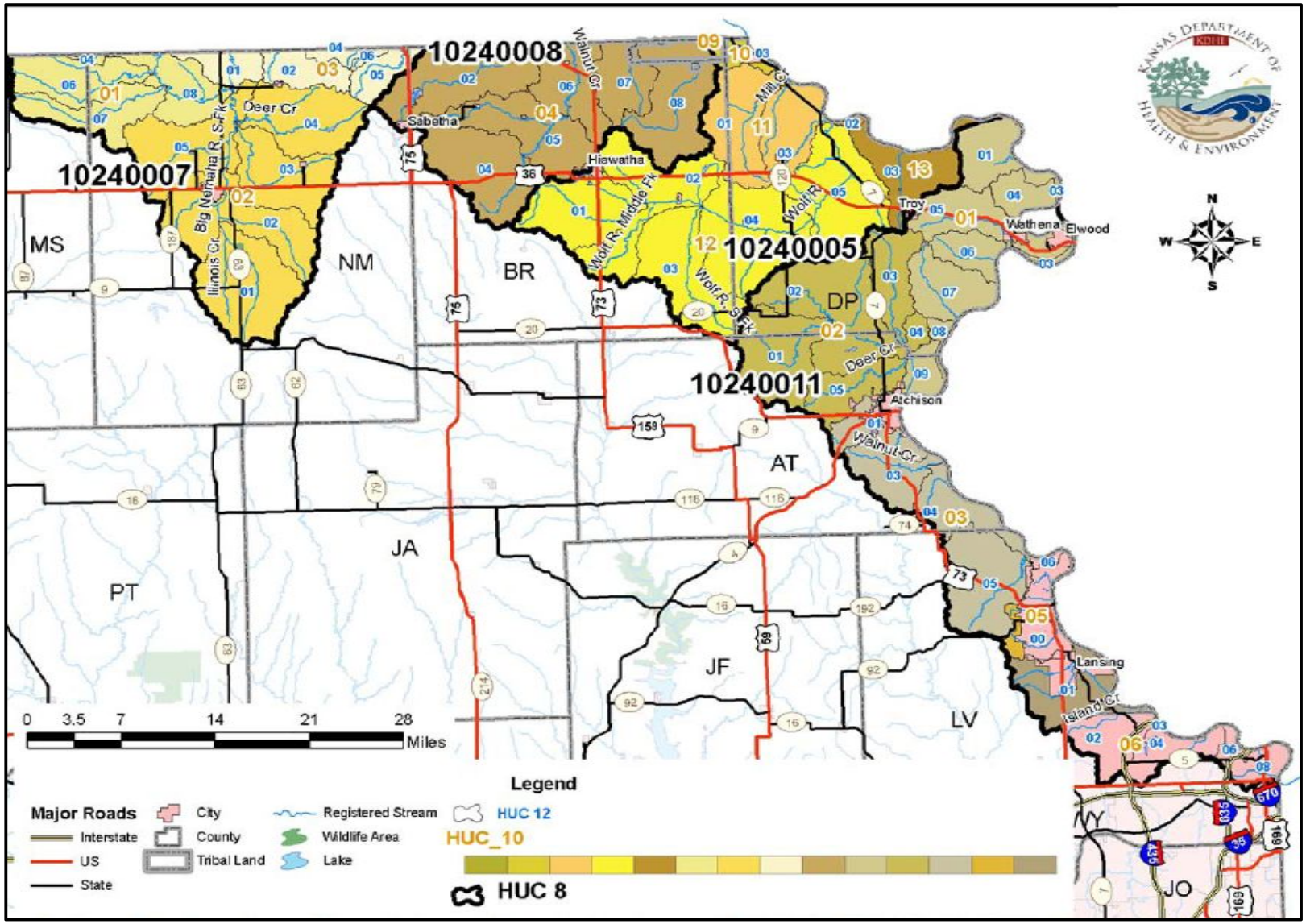

Figure 5 - Missouri River Basin Watershed Boundaries

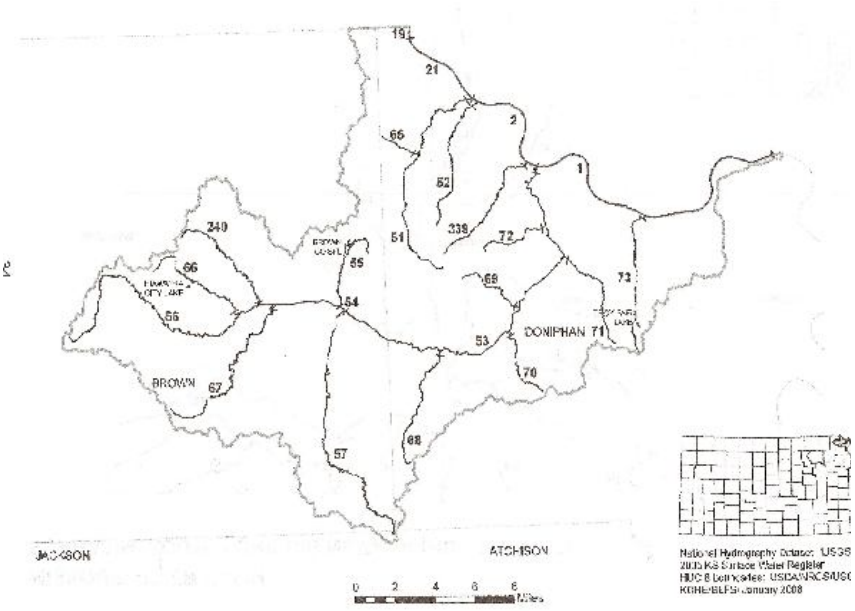

Figure 6 - Wolf River Watershed

The primary pollutant concerns of the streams and rivers are bacteria and total suspended solids. Many of the small lakes experience some levels of eutrophication, excess biomass, dissolved oxygen, pH, and Atrazine.

There are 35 public water supply sources within the watershed, most of which draw water from the Missouri river and it alluvium

Independence-Sugar Watershed (HUC 10240011):

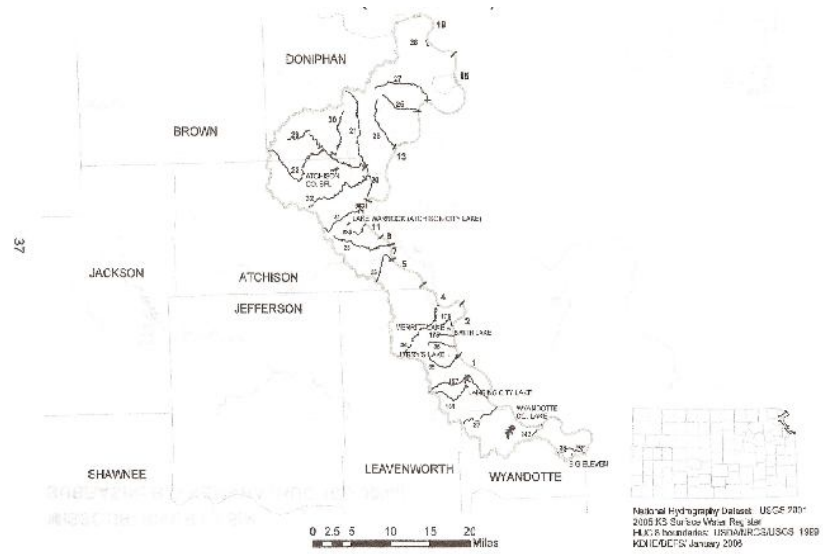

Figure 7 - Independence Sugar Watershed

The Independence-Sugar Watershed extends from the eastern portion of Doniphan County through eastern portions of Atchison and Leavenworth Counties into the northern portion of Wyandotte County. North of the City of Leavenworth, the watershed is located within the Nebraska/Kansas Loess Hills ecoregion, South of Leavenworth it is located in the Osage Cuestas ecoregion. Rainfall averages 37 to 40 inches per year.

According to the Watershed Conditions Report prepared by KDHE in 2000, 1.2% of the total miles of water do not meet their designated uses.

The major groundwater aquifers are the Glacial Drift aquifer and alluvial aquifers of the Missouri River and its tributaries. There are approximately 411 groundwater wells located with the watershed used for groundwater monitoring, domestic use, industrial use, artificial recharge and other minor uses. The primary public water supply source in the watershed is the Missouri River.

A portion of the Missouri River Basin is located in Johnson County, south of the Kansas River. This portion of the basin is not included in the Missouri River Basin WRAPS but is addressed in the Lower Kansas River WRAPS work. Note that some land data included in accompanying tables also includes data from the Johnson County.

Streams

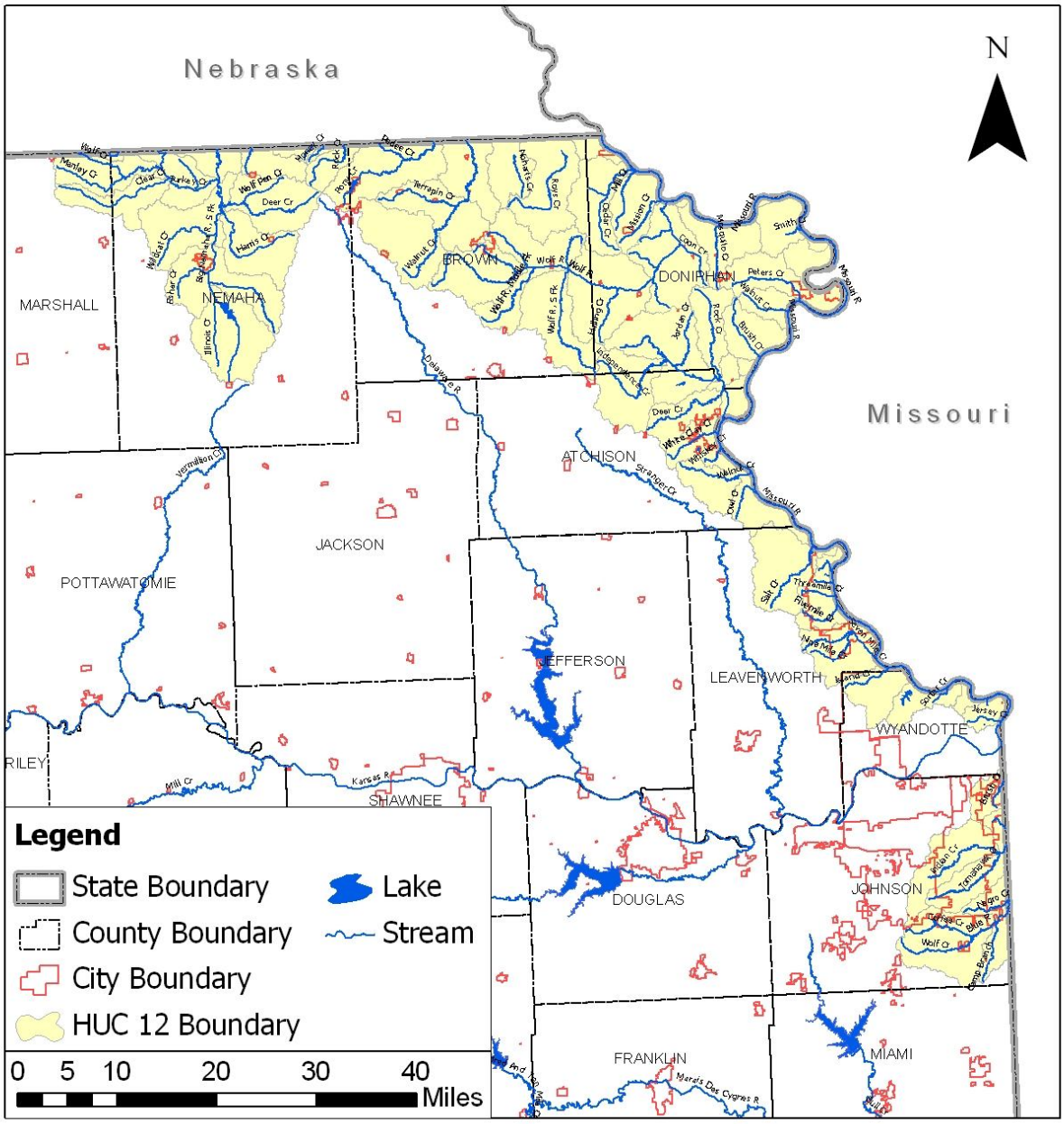

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Figure 8 - Missouri River Basin Streams

Table 1 - Principal Rivers and Streams in Missouri River Basin

Watershed	Principal Rivers and Streams	Principal Lakes
South Fork Big Nemaha	South Fork Big Nemaha	Sabetha City Lake
Big Nemaha	Walnut Creek	Pony Creek
Tarkio-Wolf	Wolf River	Brown County Lake Hiawatha City Lake Troy Fair Lake
Independence Sugar	Independence Creek Salt Creek, Peters Creek	Atchison County State Lake Lansing City Lake Wyandotte County Lake

Generally the streams in the Independence Sugar Watershed and the Tarkio Wolf Watershed, except for those tributary to the Wolf River, flow directly into the Missouri River.

The following streams and lakes within the basin have TMDL's listed by KDHE Bureau of Water in 2008.

Table 2 -Streams and Lakes with Listed TMDLs

Watershed	Principal Rivers and Streams	Principal Lakes
South Fork Big Nemaha	South Fork Big Nemaha Illinois Creek Turkey Creek	Sabetha City Lake
Big Nemaha	Walnut Creek	Pony Creek
Tarkio-Wolf	Wolf River	Brown County Lake Hiawatha City Lake Troy Fair Lake
Independence Sugar	Whiskey Creek	Atchison County State Lake Big Eleven Lake Lansing City Lake Wyandotte County Lake

There are 3,341 stream miles in the Missouri Basin. About 1,038 miles of these streams are perennial. The stream density is 2.3 stream miles per square mile, typical of the eastern part of Kansas.

There is one multipurpose lake in the basin, Pony Creek, which is a water supply for the City of Sabetha. Surface water, primarily from the Missouri River, is the chief source for the 33 public water suppliers in the basin provides 93% of the water used. Ground water is available from the alluvial and glacial deposits.

Highways

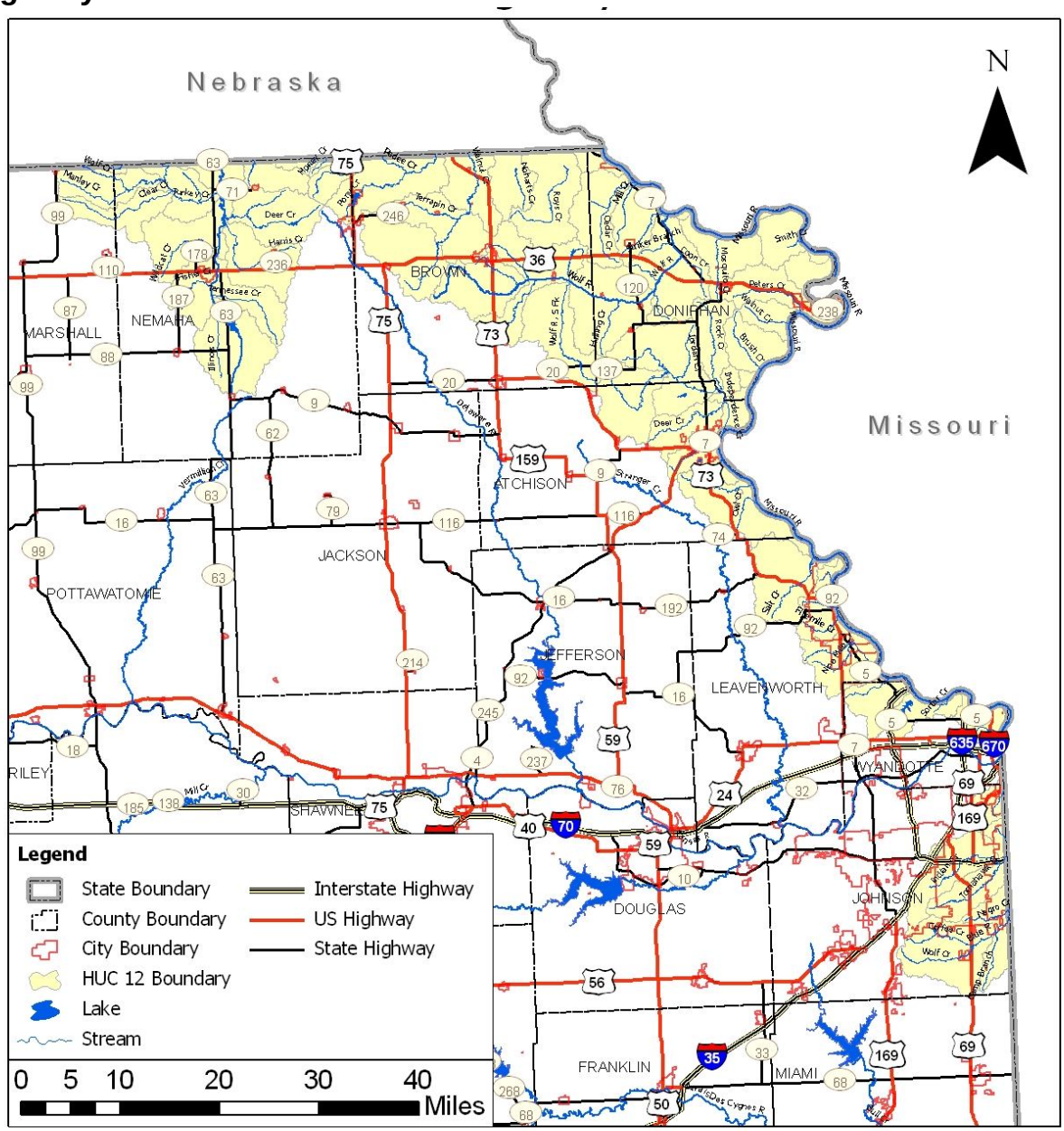

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Figure 9 - Missouri River Basin Highways

Land Use

The Missouri River Basin based largely an agricultural based economy but includes significant areas of commercial and industrial development particularly in Wyandotte, Leavenworth and Atchison Counties. Principal land use within the Basin is cropland with significant pasture/hay areas; urban and developed areas; forest and woodland areas; and grass land that would typically be Conservation Reserve Program (CRP) land. In 2006 there were an estimated 4,920 farms in the seven counties either partly or wholly within the basin, with the average farm about 400 acres.

Table 3 - Land Use of the Missouri River Basin Watershed

Land Use	Acres	%
Water	12,547	1.19%
Urban/Developed	130,737	12.38%
Barren/Transitional	306	0.03%
Forest/Woodland	120,464	11.40%
Scrubland	1,520	0.14%
Grassland/Herbaceous	99,315	9.40%
Pasture/Hay	161,387	15.28%
Cropland	522,581	49.47%
Wetland	7,586	0.72%
Total	**1,056,443**	**100%**

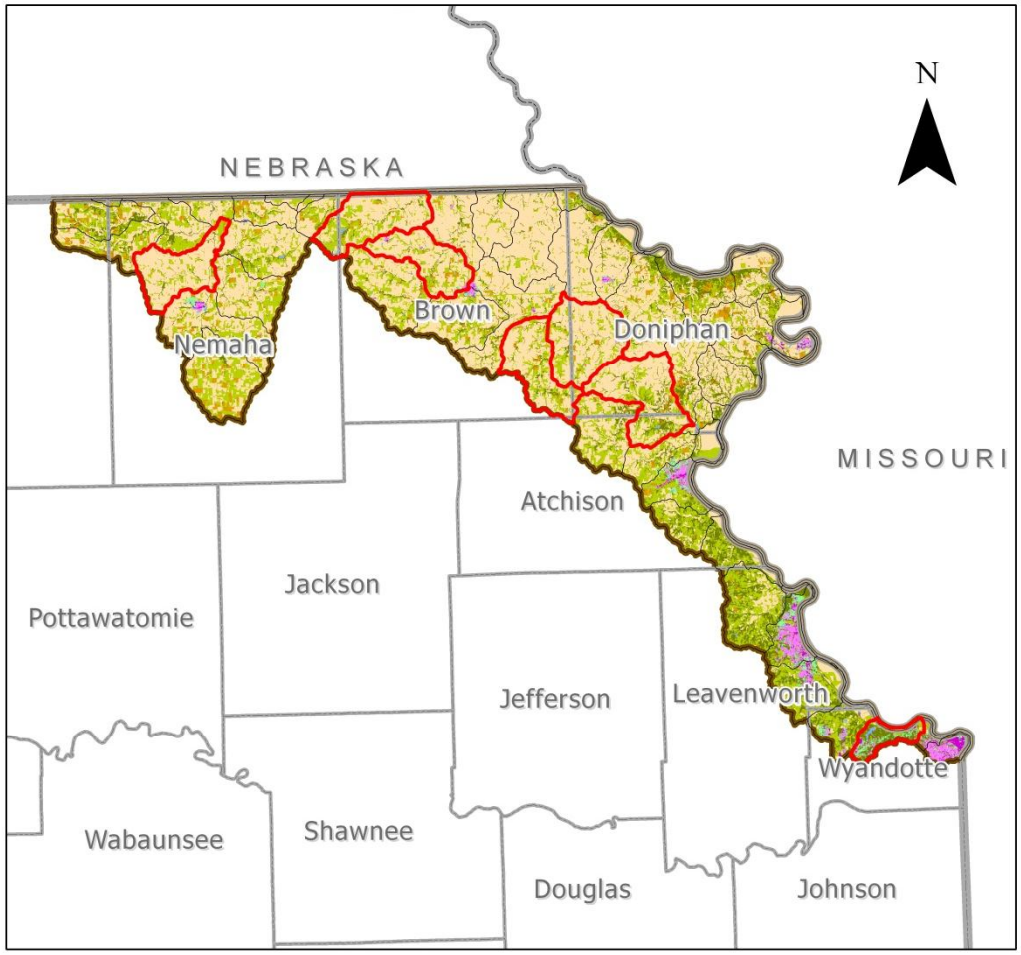
The identified impairments to the streams within the Missouri River Basin include:

1. Bacteria (primarily Fecal Coliform Bacteria [FCB]);
2. Aquatic life support as indicated by the presences and density of certain macro invertebrates, the Kansas Biotic Index, and the portion of three pollution intolerant orders present in the streams; Ammonia; Dissolved Oxygen, the heavy metal Selenium;
3. Atrazine, the broadleaf and the grass herbicide;
4. High sediment and silt in from stream bank erosion and sediment laden runoff from adjacent agricultural land.

The lake TMDLs identified within the Basin include Dissolved Oxygen; eutrophication; pH; excessive aquatic plants; Atrazine; and silt.

The Selenium levels are largely due to the high concentrations found naturally in the soil within the Illinois Creek watershed and not related to land use and/or crop and livestock production management.

A relationship exists between the water quality impairments and other environmental degradation occurring and the land use and production management practiced within the basin. Management practices of the land and in crop and livestock practices have improved water quality conditions is some instances and contributed to further impairment in others.



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Missouri River Basin WRAPS Land Cover

Legend

- HUC 12 Boundary
- Priority HUC 12 Watershed
- Urban Industrial/Commercial
- Urban Residential
- Urban Openland
- Urban Woodland
- Urban Water
- Cropland
- Grassland
- CRP land
- Woodland
- Water
- Other

Land Use	Acres	Area
Urban Indust./Comm.	6,684	0.70%
Urban Residential	17,083	1.80%
Urban Openland	13,883	1.46%
Urban Woodland	6,964	0.73%
Urban Water	219	0.02%
Cropland	534,022	56.32%
Grassland	229,600	24.21%
CRP land	30,777	3.25%
Woodland	98,924	10.43%
Water	9,822	1.04%
Other	228	0.02%
Total	948,207	100%

Source: KLCP 2005

Kansas Department of Health and Environment

February 2012

Figure 10 - Missouri River Basin Land Cover

Table 4 - Acres of Crops, Hay, and Livestock in Counties of the Missouri River Basin

County	Soybeans (Acres Harvested)	Corn (Acres Harvested)	Wheat (Acres Harvested)	Grain Sorghum (Acres Harvested)	Hay (Acres Harvested) 2006 Data	Cattle (All categories) 2006 Data	Hogs 2000 Data
Atchison	56,100	58,000	11,500	800	26,600	31,000	10,700
Brown	96,100	115,600	12,400	700	19,900	34,400	13,600
Doniphan	59,300	86,500	2,600	Unavailable	11,800	17,200	Unavailable
Leavenworth	28,200	18,600	5,500	300	39,600	25,200	6,200
Marshall	111,300	68,400	87,500	34,000	35,400	48,100	18,500
Nemaha	78,200	88,700	34,100	3,200	39,700	65,500	99,500
Wyandotte	4,200	10,700	600	Unavailable	4,000	1,800	Unavailable
Total	**432,3400**	**443,900**	**154,200**	**39,000**	**177,000**	**233,200**	**148,500**

Source: National Agricultural Statistics Service, Kansas Farm Facts, 2007, unless otherwise noted.
Note: Quantities are for the entire counties in which the Missouri River Basin is located. The Missouri River Basin does not cover the entire county areas

Corn and Soybeans equally dominate the agricultural crops within the seven counties within which the Missouri River Basin is located. Marshall and Brown counties have the greatest area devoted to the row corps. Grain sorghum is found primarily in Marshall County which only contains a small area of the total Missouri River Basin.

Table 5 - Fertilizer, Manure and Pesticide Application in the Missouri River Basin

County	Total Commercial Fertilizer Use (acres)	Manure Application (acres)	Insecticide Application (acres)	Herbicide Application (Acres)
Atchison	106,012	2,795	21,043	110,325
Brown	194,263	2,679	40,694	188,197
Doniphan	108,292	1,822	41,044	98,284
Leavenworth	76,670	3,971	11,436	54,565
Marshall	308,453	5,134	24,118	223,790
Nemaha	205,348	9,164	18,727	148,814
Wyandotte	5,131	3	678	3,917
Total	**1,004,169**	**25,568**	**157,740**	**827,892**

Source: National Agricultural Statistics Service, Kansas Farm Facts, 2002

Table 6 - County Population Trends and Density

County	Population 1990	Population 2000	Population 2007 (estimated)	Population density (persons/square mile)
Atchison	16,932	16,774	16,571	29 - 103
Brown	11,128	10,724	10,068	2 - 24
Doniphan	8,134	8,249	7,756	2 - 24
Leavenworth	64,371	68,691	73,603	148 - 219
Marshall	11,705	10,965	10,186	2 - 24
Nemaha	10,446	10,717	10,201	2 - 24
Wyandotte	161,993	157,882	153,956	946 - 1043
Total	**284,709**	**284,002**	**282,341**	

Source: US census Bureau, 2000

There were an estimated 143,000 residents in the basin in 2000 and the population is projected to grow only three percent by the year 2040. This basin illustrates major demographic changes which are taking place in Kansas. In the past 40 years, two trends have dominated the state. Rural counties have lost population, sometimes more than 10 percent every decade. Urban counties, such as Leavenworth, are gaining population at even faster rates. In the Missouri Basin, every rural county is losing population.

Table 7 - Land in farms, number of farms and average size of farms in the Missouri River Basin

COUNTY	LAND IN FARMS (ACRES)	NUMBER OF FARMS	AVERAGE SIZE OF FARMS (ACRES)
Atchison	226,807	619	366
Brown	324,016	590	548
Doniphan	205,680	469	439
Johnson	148,606	659	226
Marshall	581,100	954	609
Nemaha	341,086	1,020	408
Wyandotte	13,804	161	86

Source: National Agricultural Statistics Service, Kansas Farm Facts, 2002

Table 8 - Land Cover in HUC 8 Watersheds (1992 NRI)

Watershed	Wolf River	South Fork Big Nemaha	Big Nemaha	Independence/ Sugar
HUC 8	**10240005**	**10240007**	**10240008**	**10240011**
Water	1,520	431	457	7,735
Urban/Developed	2,099	1,252	1,221	23,796
Barren/Transitional	0	1	0	415
Forest/Woodland	19,343,	7,440	5,719	54,380
Shrub Land	1	214	0	813
Grassland/Herbaceous	22,470	39,994	17,742	9,901
Pasture/Hay	43,895	61,651	38,201	91,035
Cropland	135,914	115,923	89,090	130,196
Wetlands	3,194	2,197	1,489	8,956
Total	228,435	229,103	153,919	327,227

Riparian Areas

The riparian area is the 130-foot wide strip of land adjacent to rivers and streams. This area is particularly important to the health and viability of the streams because it acts as a filter to trap sediments and pollutants carried by surface runoff and the roots of permanent vegetation help to stabilize the stream banks. Riparian areas also provide important habitat for wildlife and often function as corridors for wildlife to move from one habitat area to another; important for species diversity and health. Healthy habitat generally has permanent deep rooted vegetation. Native riparian areas in the Missouri River Basin contained oak-hickory forests or tall grass prairies. Modern land use has often converted this native vegetation to row crop or pasture areas. Uncultivated land areas tend to be shrubby grass areas or thinly forested areas without the climax species of trees.

The Kansas Water Plan states that within the 100-foot corridor along each bank of the streams in the Missouri River basin, 39% of the land is forested, 18% is cropland and 15% is mixed trees and crop. Data on the riparian individual watersheds in the Missouri River Basin is somewhat limited. The Water Quality Impairment analysis for the South Fork Big Nemaha River Waterbody/Assessment Unit provides data for the South Fork Big Nemaha.

In October 2009, the Kansas Alliance of Wetlands and Streams (KAWS) and Blue Earth completed *Level 1 Watershed Assessment of the Main Stem of the Wolf River* for the Missouri River Basin WRAPS. This assessment conduct a GIS review of aerial photographs of the main stem region of the river from near the headwaters located approximately three miles north of Powhattan, Kansas in Brown County to its confluence with the Missouri River eight miles south east of White Cloud, in Doniphan County, Kansas. The main stem region was an area 2000 feet perpendicular to the river channel. The riparian region was investigated in greater detail and was defined as the area extending 130 feet from the center line of the river channel. The assessment:

1. Evaluated land use in the main stem region,
2. Evaluated land use within the riparian region,
3. Identified riparian areas in need of restoration, protection, or management,
4. Identified eroding streambanks, including estimates of linear feet needing stabilization,
5. Identified livestock operations/access sites and wastewater lagoons within the riparian region,
6. Identified confined animal feeding operations within the main stem region

The Assessment determined that 56% of the riparian region was in need of restoration and 16% were in need of protection. Thirty-nine streambank erosion sites were identified encompassing 40,252 linear feet of eroded banks. There were twenty livestock operations with access to the river and 2 wastewater lagoons in the riparian region and thirteen permitted confined animal feeding sites identified with in the main stem region. This report will be found on the Missouri River Basin WRAPS web site www.moriverwraps.org.

In March of 2011, the Kansas Water Office completed an ArcGIS® comparison study *South Fork Big Nemaha River Watershed Erosion Assessment* utilizing 1991 versus 2008 aerial photographs. The assessment began the photo comparison at the Nebraska/Kansas border of the main stem of the South Fork Big Nemaha and proceeded upstream evaluating the main channels

within the 368 square mile area. The assessment identified 83 streambank erosion sites with an individual area of 1,500 square feet or greater. These 83 sites encompassed 56,000 feet of unstable streambank and were estimated to generate 117,000 tons of sediment annual.

In May of 2011, the Kansas Water Office completed a similar ArcGIS® comparison study of the Wolf River, the *Wolf River Watershed Streambank Erosion Assessment* of the 1991 and 2008 aerial photographs. The Wolf River watershed has a 248 square mile drainage area, beginning in Brown County and enters the Missouri River in Doniphan County. The assessment identified twenty-five streambank erosion sites with an area of 1,500 square feet or greater, covering 13,500 feet of eroded streambank generating 28,000 tons of sediment per year. The studies also identified significant gullies within the riparian area.

Table 9 - Riparian Land Use

Watershed	Riparian Areas Acres	Row Crops %	Grass %	Pasture %	Forested %
South Fork Big Nemaha	13,044	38	17	27	17
Wolf River Main Stem	1,263	59	16	4	18

Public Water Supply

There are 33 public water suppliers (PWS) in the Missouri River Basin. Surface water is the primary source of water for these PWS, accounting for more than 93% of the water use in 2006. Thirty-two PWS water sources are either directly or indirectly from the Missouri River or from wells. The city of Sabetha has a potential to get a portion of their water from Pony Creek Lake, although the 2007 records indicate that this was not a diversion point at that time. The city of Seneca also received water from one spring in 2007. All remaining surface water use occurs in the more densely populated areas in the eastern and southern portion of the basin and is diverted from the Missouri River.

Due to the dependence on ground water, or in the case of Seneca, from a spring, it is imperative that the surface water recharging this ground water remain uncontaminated and as pollution free as possible. Potential groundwater pollutants of concern include volatile organic compounds, nitrates, microbiological, inorganic compounds, synthetic organic compounds, pesticides, and pharmaceutical products, particularly hormone and endocrine inhibitor byproducts. Additional information regarding potential sources of pollution to PWS's in Kansas can be found on the Kansas Source Water Assessment Program's website, a program administered through Kansas Department of Health and Environment (KDHE) Bureau of Water (BOW). Source Water Assessment (SWA) reports for specific public water supplies can be found at http://www.kdheks.gov/nps/swap/SWreports.html

Pony Creek Lake, one of the high priority TMDL Source waters, although not currently in use, is a water supply source for the city of Sabetha, which sells water to the PWS for Morill. The 7.4 square mile watershed for Pony Creek Lake includes livestock feeding operations and potential crop land and urban runoff. The primary pollution concern at this time is eutrophication of the Pony Creek Lake primarily from phosphorus and nitrogen include in the runoff from surrounding areas. The sources of nutrients are from livestock wastes and both urban and agricultural application of fertilizers.

Water quality improvements resulting from the implementation of this watershed plan will help maintain the viability of the Pony Creek Lake as PWS source and to help protect the ground water wells within the watershed which serve as PWS sources. Note that some of the surface water enters the ground water in Nebraska.

The majority of the population within the Missouri River Basin water source is the Missouri River. There are numerous opportunities for pollution to the Missouri River that could affect the water supply. The public water treatment facilities have the primary responsibilities to remove these contaminates from the public water supply.

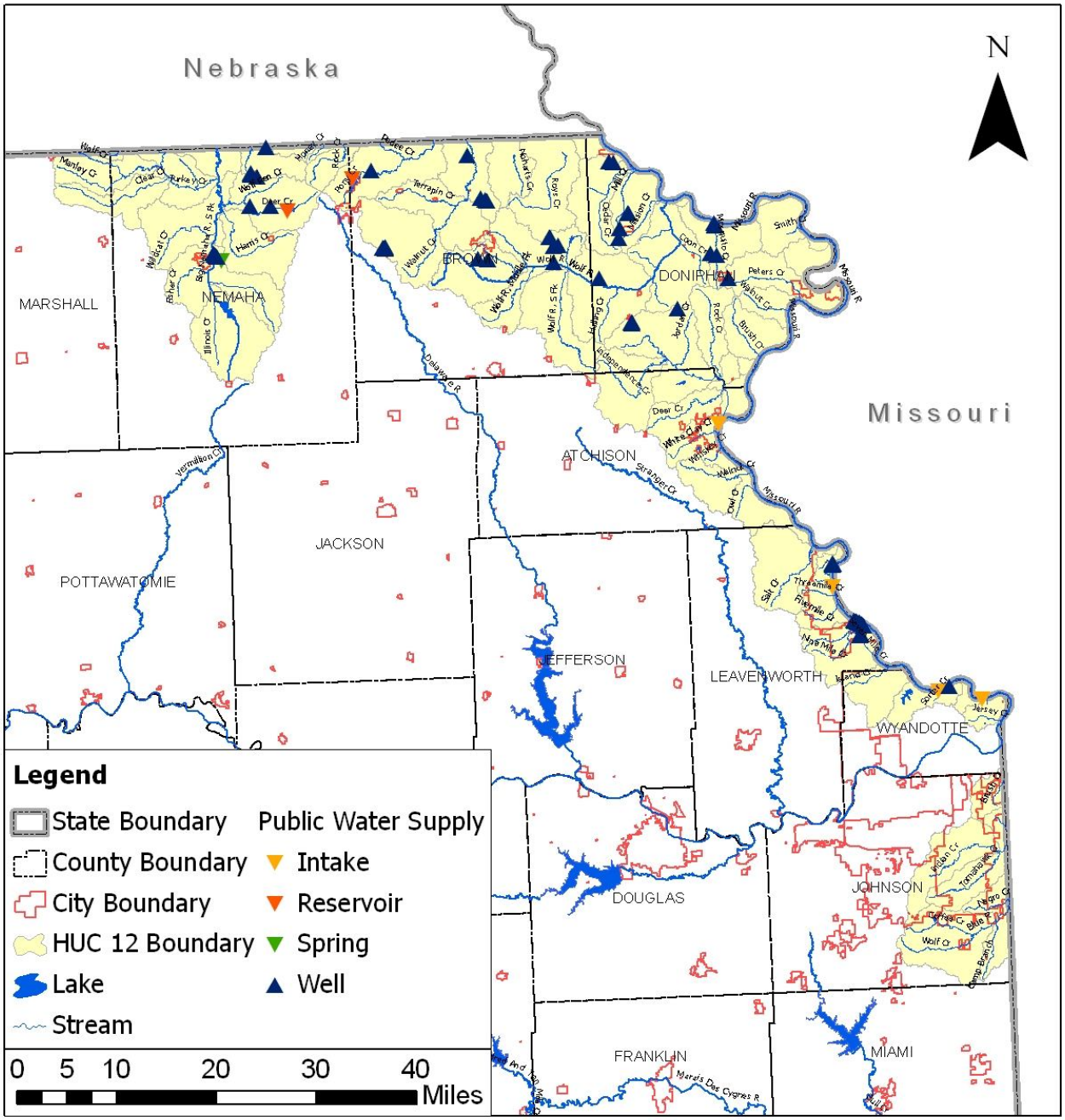

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Figure 11 - Missouri River Basin Public Water Supplies

Table 10 - 2007 Public Water Suppliers and Water Sources

DWR ID	Public Water Supplier	Own Source[a/,b/]	Other Source[b/]	Pop. Served
488	Atchison	Missouri River		10,145
33716	Atchison RWD 01		Atchison, Atchison RWD 06	490
33717	Atchison RWD 02		Atchison	-
33718	Atchison RWD 03		Atchison	110
58472	Atchison RWD 05C (formerly AT 4 & 5)		Atchison, (Valley Falls)	3085
33720	Atchison RWD 06		Atchison	485
1196	Bern	2 Wells (2)	Nemaha RWD 01	198
15192	Brown RWD 01	6 Wells (6)	Hiawatha	709
38841	Brown RWD 02		Hiawatha	724
15208	Doniphan RWD 01	1 Well (0)	Brown RWD 2	75
15214	Doniphan RWD 02	1 Well (0)	Doniphan RWD 5	167
15202	Doniphan RWD 03	3 Wells (1)	Atchison RWD 5C	437
23843	Doniphan RWD 05		Elwood	1,320
24494	Elwood	4 Wells (0) (lagoon use only)	Missouri-American Water Co - St. Joseph MO	1,145
7590	Hiawatha	5 Wells (5)		3,237
7636	Highland	3 Wells (2)		944
20297	Kansas City (BPU)	Missouri River		143,801
34182	Lan-Del Water Co. (Lansing)		Kansas City BPU, Leavenworth	7,377
10277	Leavenworth	9 Wells (9), Missouri River		34,993
34178	Leavenworth RWD 01		Leavenworth	90
34179	Leavenworth RWD 02		Leavenworth	483
34327	Missouri-American Water Co. (St. Joseph, MO)	Missouri River		8,211
12322	Morrill		Sabetha	254
15234	Nemaha RWD 01	3 Wells (3)	Nebraska Wells, (Bern)	350
13245	Oneida	1 Well (1)	Nemaha RWD 1	68
33396	Pawnee RWD (NE)		Nemaha RWD 1	
14589	Reserve	1 Well (0)	Brown RWD 1	97
14882	Robinson	2 Wells (1)	Brown RWD 2	198
15348	Sabetha	(City Lake), 2 Wells (0), Pony Creek Lake		2,519
16149	Seneca	7 Wells (6), 3 Springs (1)		2,064
18204	Troy	5 Wells (3)		1,024
21969	Wathena		Elwood, (Missouri-American Water Co - St. Joseph MO)	1,306
33077	White Cloud	2 Wells (2)		232
34204	Willis		Horton	66

[a/] Wells or diversion points with active water rights, as shown on the 2007 Division of Water Resources Municipal Water Use Report. Number in parentheses indicates the number of wells or diversion points in service during 2007.

High Quality Waters

Four streams in the Missouri River Basin have been designated as Special Aquatic Life Use Streams (SALU) by the State of Kansas. Special Aquatic Life Streams are typically included, along with Exceptional State Waters (ESW) and Outstanding National Resource Waters (ONRW) as high "High Priority Waters." These are shown on the following map. These are:

Manley Creek:	(HUC 102400070106) Located in the northwest corner of the South Fork Big Nemaha watershed in the northwest corner of Nemaha County and the northeast Corner of Marshall County.
South Fork Big Nemaha:	(HUC 1024007) Main channel. Located in South Fork Big Nemaha watershed in Nemaha County
Missouri River:	Located on the eastern boundary of Doniphan, Atchison, Leavenworth and Wyandotte Counties. The wetlands in Atchison County associated with the Missouri River are also included in the Special Aquatic Life Use Waters.
Salt Creek	(HUC 102400110305) Located in the Independence Sugar Creek Watershed in Leavenworth County north of Ft. Leavenworth.

Major Streams in the State of Kansas are assigned designated uses. "Aquatic Life Support Use" is waters used for the maintenance of the ecological integrity of the stream, lake or wetland. "Special Aquatic Use" is a subset of aquatic life support classification for waters containing unique habitats or biota that are not commonly found in the state. Surface waters that contain populations of threatened or endangered species will also be designated as "Special Aquatic Life Use" waters.

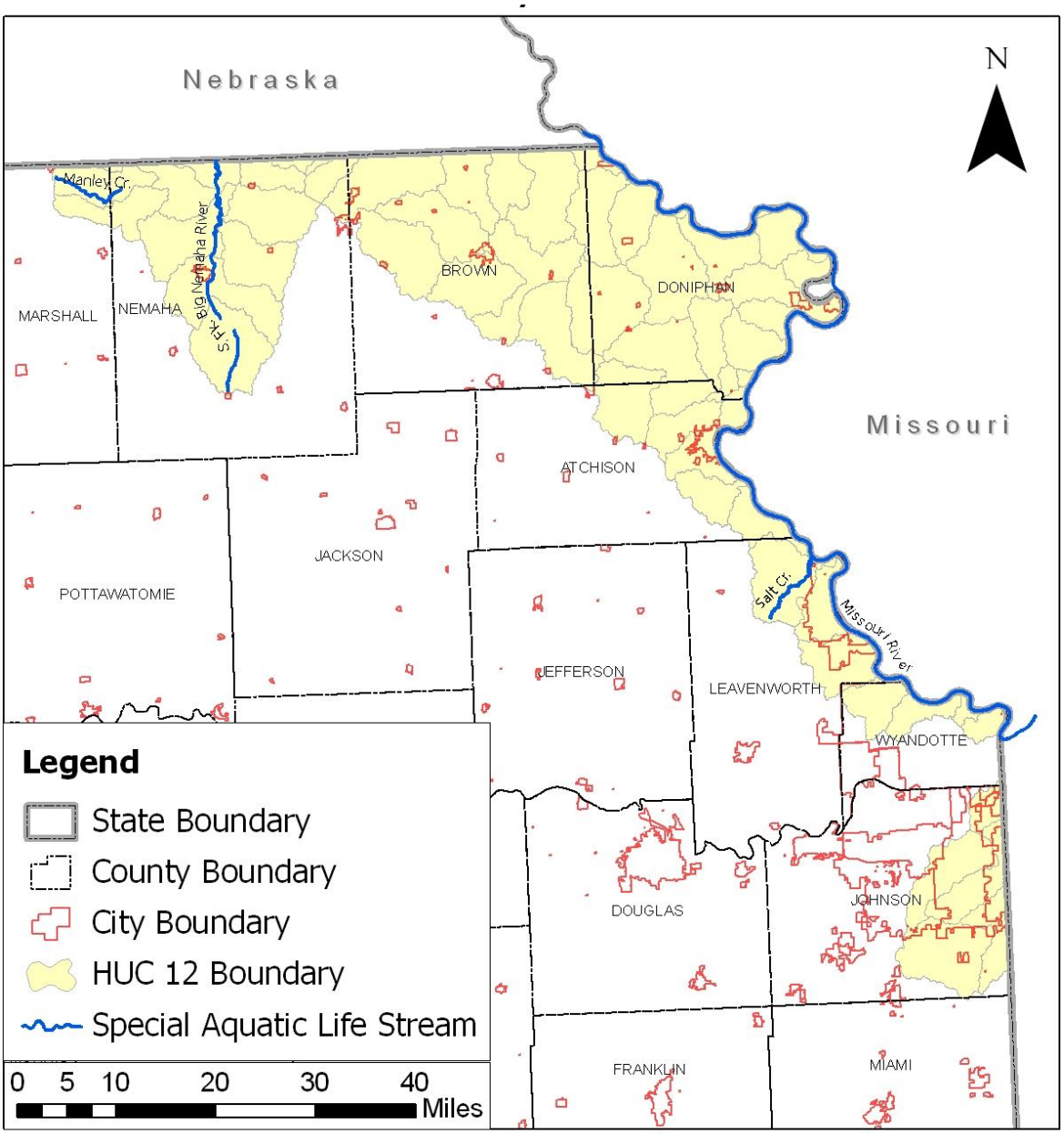

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Figure 12 - Missouri River Basin Priority Waters

SECTION 2 - IMPAIRMENTS

Land Use Impacts on Water Quality

Land use impacts on the water quality and environmental health include:

Bacteria: The South Fork Big Nemaha River Watershed, Walnut Creek in the Big Nemaha River Watershed and Wolf River in the Tarkio-Wolf Watersheds have high a priority of bacteria TMDLs. The presence of higher concentrations of FCB is indicative of disease causing organisms. Therefore, the limit for a stream to be classified for Primary Contact Recreation has an upper limit of 160 colonies per 100 ml of stream water for Class A streams, 262 colonies per 100 ml for Class B streams, and 427 colonies per 100 ml for Class C streams. The upper limit for Secondary Contract Recreation is 2,358 colonies per 100 ml for Class A streams and 3843 colonies per 100 ml for Class B streams.

The sources for bacteria are from animal wastes, regulated municipal wastewater treatment facilities, and on-site waste systems such as septic tanks. Animal wastes may be from registered confined animal feeding operations (CAFOs), smaller unregulated livestock feeding operations, from surface runoff from pastures and grazing areas or from wildlife wastes. Municipal wastewater treatment facilities are regulated KDHE under the NPDES permits. The regulated CAFOs operate under permits issued by KDHE and must meet certain waste management requirements for bacteria control. Generally, the contributions from municipal wastewater treatment facilities, from the regulated CAFOs, and from wildlife are not assumed to be major contributors to bacteria concentration in the surface water unless one of these operations is found to be out of compliance or there is an operational malfunction. However, areas where there are high concentration of CAFOs in the watersheds exhibiting high TMDLs, particularly in the South Fork Big Nemaha watershed. Therefore it will be critical to monitor these facilities, and to insure that a temporary malfunction does not skew the test results. See Figure 11 for Active CAFO's

Fifteen percent of the land area in the Missouri Basin is grass land. There are 233,300 head of cattle and 148,500 head of hogs in the 7 counties that are included within the Missouri Basin. There are 97 registered, certified or permitted CAFOs in the South Fork Big Nemaha River Basin with a potential total of 25,384 animal units. The Walnut Creek Watershed in the Big Nemaha HUC 8 has 25 registered feeding operations with a potential of 6,568 animal units. The Tarkio-Wolf River watershed has 34 operations with a potential of 8,125 animal units. There are numerous smaller, unregulated livestock feeding operations, with a probable combined total of more animal units than the regulated CAFOs. Surface water runoff from these smaller, unregulated local feeding operations generally have untreated runoff entering the tributary waters. These operations are considered to have the most significant contribution to bacteria concentrations in the surface waters in the Basin.

TSS: TSS, or total suspended solids, are particles of soil, algae and finely divided plant material suspended in water. The primary sources of TSS in this basin are the sediments resulting from erosion from croplands, stream banks and construction sites. Sediment is a significant contributor to the TMDLs in the Missouri River Basin. The TMDL Water Quality Impairment Analysis completed by KDHE on the South Fork Big Nemaha and the Wolf River Watershed note an indirect, as yet unquantified relationship between sediment loading and biological integrity and therefore to the TMDL water quality impairment to aquatic life use or "Biology", occurring in the these rivers. Sediment is also the source of the siltation TMDL occurring in the Atchison County State Fishing Lake.

Phosphorus bonds to soil particles. As sediment flows off of fertilized fields, it carries with it significant amounts of phosphorus. High levels of phosphorus are the primary contributing factors to the eutrophication occurring in Brown County State Fishing Lake, Hiawatha City Lake, Troy Fair Lake, Pony Creek Lake, Atchison County State Fishing Lake, Lansing City Lake, Big Eleven Lake, and Wyandotte County Lake.

It is clear that sediment laden surface runoff and eroding streambanks is the single greatest impairment to our surface waters in the basin. Erosion is a naturally occurring process; it is only when the erosion exceeds the carrying capacity of the water body is the water quality impaired. However there are other environmental and economic impacts to the increased erosion including loss of productive land and the weakening or destruction of infrastructure such as bridges, roads and utilities.

The Missouri River Basin land use is 49.5% or 522,580 acres of cropland including significant amounts row crop in the riparian area. Soils in the basin generally have low permeability. Since runoff occurs when the rainfall exceeds the soil permeability there are high rates of runoff after relatively minor rainfall events. Areas with high surface organic matter such as pastures, grasslands, and forested areas have greater water holding capacity on the land surface. Row crops where the crop residue is either removed or tilled into the soil also have greater mechanical erosion resulting from the rain impacting the barren unprotected soil.

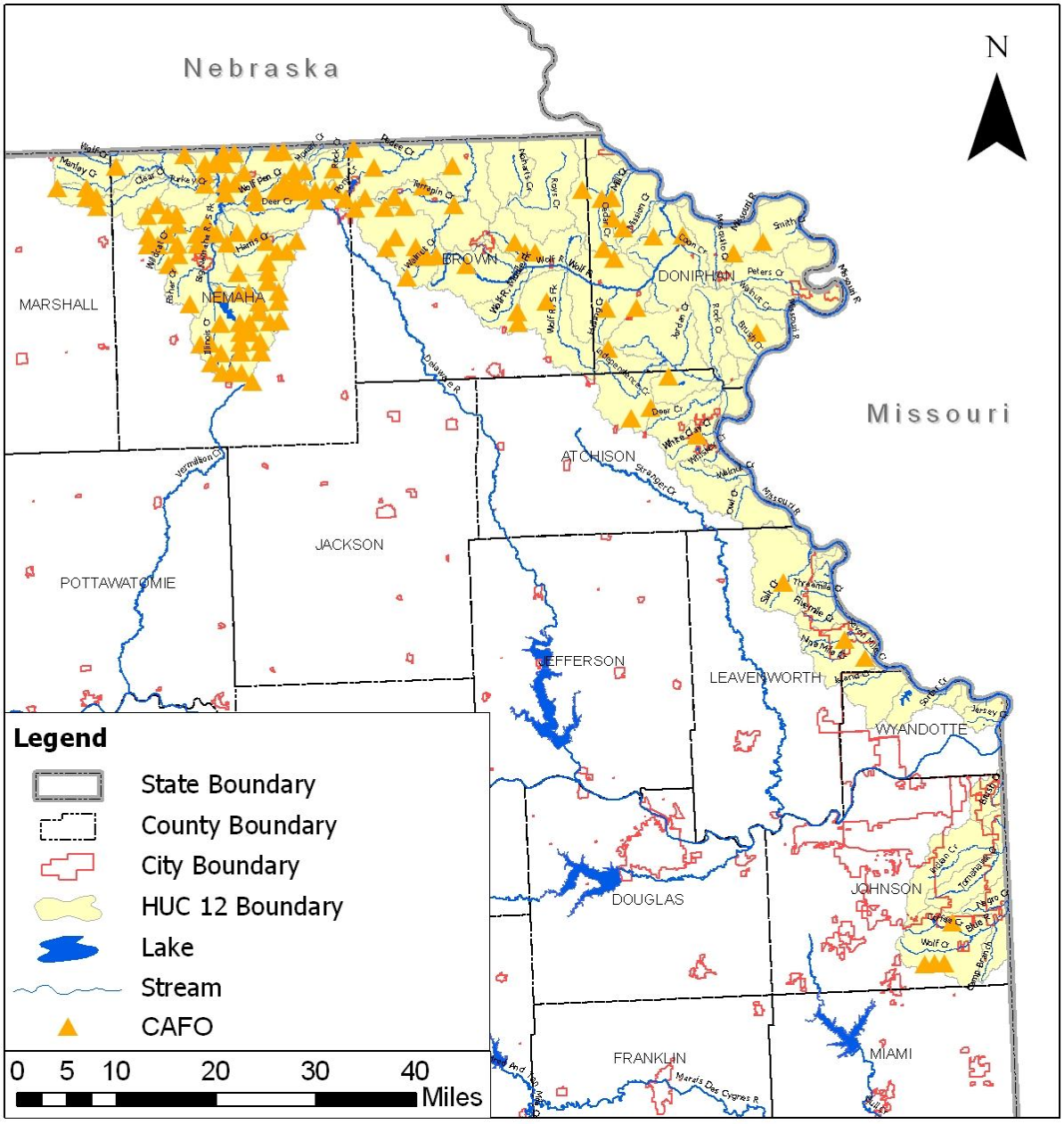

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Figure 13 - Missouri River Basin Active Combined Animal Feeding Operations (CAFOs

Table 11 - Soil Erosion Potential

Watershed	Average Soil Permeability, in/hr.	Row Crop % of Total Area
South Fork of Big Nemaha	0.4	49%
Pony Creek (Big Nemaha)	0.5	41%
Walnut Creek (Big Nemaha)	0.6	64%
Tarkio-Wolf River	0.9	72%
Atchison County SFL		54.4%
Independence Sugar Creek	0.6-2.0	43

VOC: Volatile Organic Compounds are the organic components of fuels and solvents and are the ingredients in many household and industrial products. Sources of VOCs include leaking fuel storage tanks, trash dumps and agricultural pesticides and herbicides.

Atrazine: Atrazine is herbicide used to control pre- and post-emergent broadleaf and grassy plants, typically applied prior to seed planting. Atrazine has been found during the spring in Turkey Creek in the South Fork Big Nemaha Watershed, coinciding with corn and sorghum planting time. The higher recorded levels occurred during high or medium flows in the creek. These higher levels are attributed to run off from agricultural fields, primarily corn and sorghum that have been treated with the herbicide.

Moderately high levels of Atrazine were found in Hiawatha City Lake. The source is attributed to the high proportion of cropland and the high runoff probability from the watershed.

Nutrients: Excess nutrients, such as phosphorus or nitrogen, in lake waters cause an overabundance of plants and algae. The overabundance consumes the oxygen in the water, suffocating fish and aquatic organisms. The excess nutrients often result in eutrophication of surface waters and low dissolved oxygen levels. These nutrients are primarily the result of the application of excess fertilizer to row crops and urban lawns, which then runs off into the surface water bodies. Often these fields and lawns, and adjacent impervious areas, have higher runoff rates of runoff which also increase the nutrient entering the water bodies.

Phosphorus is typically the limiting or co-limiting nutrient for plants and algae in basin lakes so is typically considered the secondary contributing factor in the eutrophication. Phosphorus typically is transported with surface runoff from agricultural lands and urban areas and from animal wastes. The KDHE *"Surface Water Nutrient Reduction Plan" (2004)* reports that Brown and Nemaha Counties have some of the highest total phosphorus sales in the state (3,200 to 5,400) tons and it is estimated that more than 200 tons per year of total phosphorus leaves the state as surface water runoff each year.

Since plants can also get some nitrogen from the air it is often not the limiting nutrient, although it can be co-limiting with Phosphorus. Nitrogen is converted to ammonium or the nitrate ion in the soils. The ammonium ion is readily converted to the nitrate ion

which is highly water soluble. Soluble nitrate can be leached into the ground water, polluting the ground water, or carried off with the surface runoff.

Ammonia (NH3): Ammonia has been delisted as impairments to the water bodies because of improvements to point source discharges. However, ammonia has historically been listed as impairment because it is highly toxic to fish and aquatic organisms and therefore impacts the biological or aquatic life designated use. Ammonia may be discharged from wastewater treatment facility, livestock wastes, on-site waste systems, fertilizers, septic tanks and municipal and industrial wastes. The improvements to the treatment of point discharges currently reduce the ammonia levels below areas of concern but the high percentage of cropland and the high runoff propensity throughout the watersheds, monitoring the levels should be still be considered and best management practices that limit ammonia entering into the water bodies should be continued. High localized discharge, particularly during high runoff events, could result in localized threats to fish and aquatic organisms.

Dissolved Oxygen (DO): Dissolved oxygen is necessary for the survival of fish and other aquatic and aerobic organisms. Populations of oxygen dependent organisms are reduced or eliminated when the concentration of dissolved oxygen in the water become too low; a common result of eutrophication. Dissolved oxygen depletion typically occurs when nutrients levels in the water become too high, leading to algal blooms and as the plants die the oxygen is consumed. Other common causes of oxygen depletion are high levels of nutrients or oxidizing chemical from septic tanks, industrial spills, and industrial, municipal and livestock wastes.

Eutrophication: Eutrophication is generally described as the biological response of a lake to elevated nutrients, organic matter, and/or silt. The nutrient loads are from a variety of sources, including wastewater treatment plant effluent, untreated sewage, urban stormwater runoff animal wastes, and pasture and cropland runoff. Runoff is particularly problematic if carries high concentration of nutrients (from fertilizers) or sediments. Eutrophication can result in high algal populations and then high aquatic life die-off.

Metals: Metals can be detrimental to the health of aquatic organisms and cause taste or toxicity in the water for domestic consumptions. Some of these metals found in the Missouri River Basin in higher concentrations include selenium which is a natural occurring element in the soils of the basin.

NPDES Permitted Facilities

The Clean Water Act of 1972 was enacted to address water pollution degrading the surface waters making them unsafe for drinking, fishing, swimming and many other activities as well as serious impacts to the existing flora and fauna within the water systems. The Clean Water Act authorized the National Pollutant Discharge Elimination System (NPDES) permit program to control water pollution by regulating point sources that discharge pollutants into the waters of the United States. Point sources are a discrete source of discharge usually a conveyance system such as a pipe or a man-made ditch. A NPDES permit is required for these point discharges; typically

from industrial, and commercial facilities and municipal wastewater treatment facilities. Individual homes that are connected to an approved septic system or a municipal wastewater collection system are not required to have a permit. Typically, the states are authorized to administer this program.

In Kansas, KDHE is the program administrator. In addition to the permit requirements for industrial and municipal point discharges, certain agricultural facilities require an NPDES permits. Figure 14 is the NPDES permitted discharging facilities other than CAFOs.

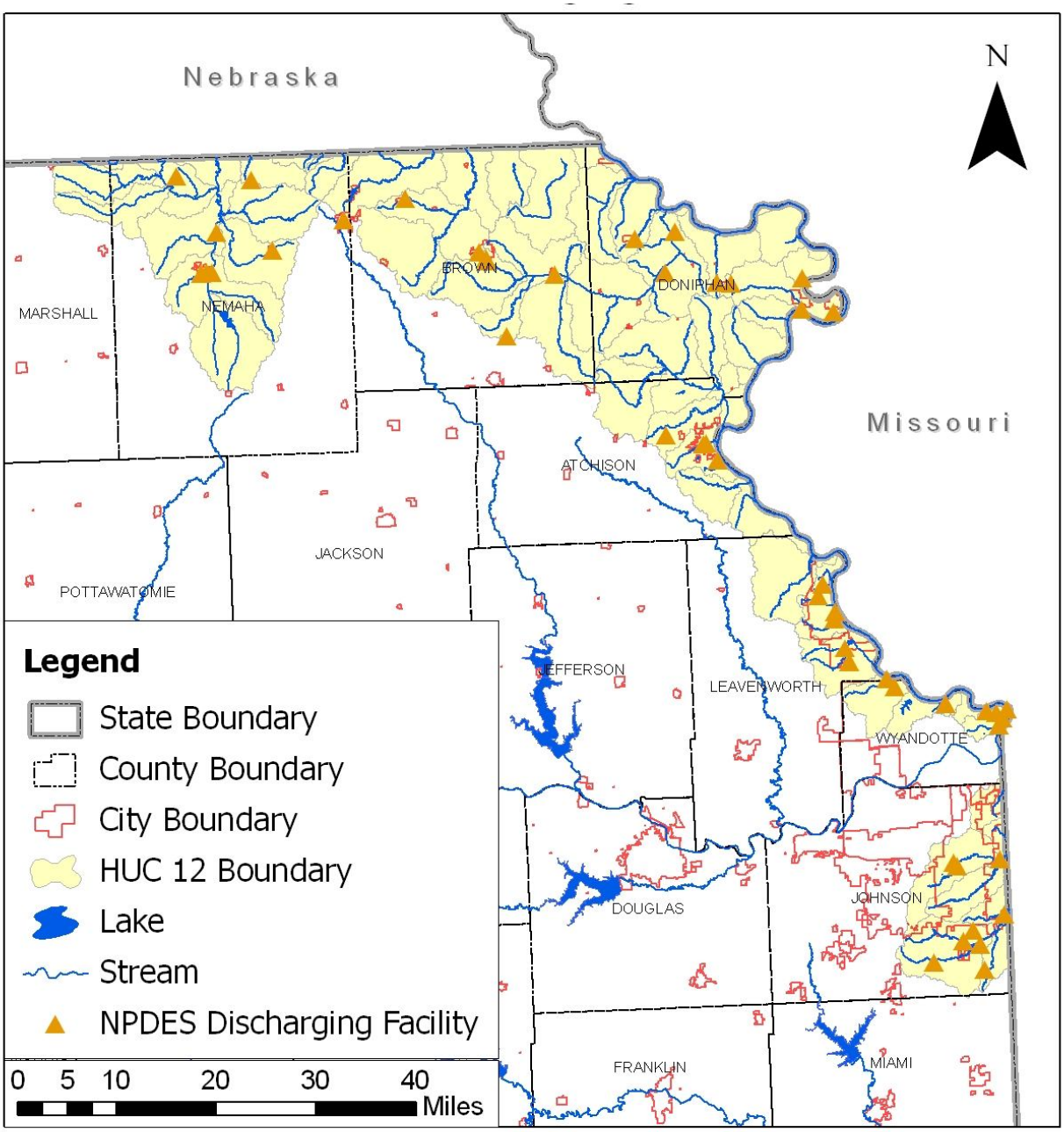

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Figure 14 - Missouri River Basin NPDES Discharging Facilities

The state is required to establish a Total Maximum Daily Load (TMDL) for significantly impaired water bodies. TMDLs specify the maximum amount of a pollutant that causes an impairment a water body can receive from all pollutant sources and still meet water quality standards and support its designated use(s). In establishing a TMDL for a stream or lake, the

state must determine the specific pollutant(s) causing the water quality impairment, the degree of deviation from the applicable water quality standard that exists, and the level of pollution reduction needed to achieve compliance with the water quality standard. The pollutant load determined by the TMDL is allocated between both point and non-point pollutant sources in the water body's watershed. TMDL's must be approved by the U.S. Environmental Protection Agency (EPA).

Stream TMDL's designated "High Priority for Implementation" include bacteria, dissolved oxygen, ammonia, biology for the Wolf River; bacteria, dissolved oxygen, biology for the South Fork Big Nemaha River; bacteria for Walnut Creek; ammonia for Whiskey Creek; and nitrate for Indian Creek. These are found on Table 17, "2010 TMDLs as Listed on KDHE Watershed Planning and TMDL Website"

Lake TMDLs designated "High Priority for Implementation" includes silt for Atchison County State Lake, eutrophication for Pony Creek Lake and eutrophication for Wyandotte County Lake. The 303(d) list refers to Section 303(d) of the Clean Water Act which requires states to identify the waters in the state that do not meet the state's water quality standards. This list is approved by the state and forwarded to the U.S. Environmental Protection Agency (EPA). The Missouri Basin 303(d) list was approved by the EPA by letter dated December 18, 2008. See Table 12 "2010 303(d) List of All Impaired/Potentially Impaired Water Missouri Basin" and Table 17 "2010 TMDLs as Listed on KDHE Watershed Planning and TMDL Website". This list is found on KDHE Watershed Planning and TMDL website, www.kdheks.gov/tmdl/motmdl.htm and is essentially equivalent to the Section 303(d) list in general information, although each list includes some additional data.

Table 12 - 2010 303(d) List of All Impaired/Potentially Impaired Waters in Missouri Basin

10240005
Tarkio-Wolf

Cat.	Stream/Lake	Impaired Use	Impairment	Station	Counties	Body Type	Priority	Comment
5	Wolf River Near Sparks	Aquatic Life	Atrazine	SC201	BR, DP	Watershed	Low	
4a	Brown Co. SFL	Recreation	Aquatic Plants	LM010301	BR	Lake	Medium	TMDL Approved on 8/28/2001
4a	Troy Fair Lake	Recreation	Aquatic Plants	LM073801	DP	Lake	Low	TMDL Approved on 8/28/2001
4a	Hiawatha City Lake	Aquatic Life	Atrazine	LM011601	BR	Lake	Medium	TMDL Approved on 8/28/2001
4a	Wolf River Near Sparks	Aquatic Life	Biology	SC201	BR, DP	Watershed	High	TMDL Approved on 2/28/2008, SB363
4a	Brown Co. SFL	Aquatic Life	Dissolved Oxygen	LM010301	BR	Lake	Medium	TMDL Approved on 8/28/2001
4a	Brown Co. SFL	Aquatic Life	Eutrophication	LM010301	BR	Lake	Medium	TMDL Approved on 8/28/2001
4a	Hiawatha City Lake	Aquatic Life	Eutrophication	LM011601	BR	Lake	Medium	TMDL Approved on 8/28/2001
4a	Troy Fair Lake	Aquatic Life	Eutrophication	LM073801	DP	Lake	Low	TMDL Approved on 8/28/2001
4a	Wolf River Near Sparks	Recreation	Fecal Coli	SC201	BR, DP	Watershed	High	TMDL Approved on 8/28/2001
4a	Brown Co. SFL	Aquatic Life	pH	LM010301	BR	Lake	Medium	TMDL Approved on 8/28/2001

Table 13 - 2010 303(d) List of All Impaired/Potentially Impaired Waters in Missouri Basin (Cont.)

10240007
South Fork Big Nemaha

Cat.	Stream/Lake	Impaired Use	Impairment	Station	Counties	Body Type	Priority	Comment
5	South Fork Nemaha River Near Bern	Aquatic Life	Total Phosphorus	SC234	NM, JA	Watershed	Medium	median value: 0.232 > median flag value:0.201
5	Sabetha City Lake	Aquatic Life	Atrazine	LM011501	NM	Lake	Low	
5	South Fork Nemaha River Near Bern	Aquatic Life	Atrazine	SC234	NM, JA	Watershed	Low	
5	Turkey Creek Near Bern	Aquatic Life	Copper	SC601	MS, NM	Watershed	Low	
4a	Turkey Creek Near Bern	Aquatic Life	Atrazine	SC601	MS, NM	Watershed	Medium	TMDL Approved on 2/28/2008
4a	South Fork Nemaha River Near Bern	Aquatic Life	Biology	SC234	NM, JA	Watershed	High	TMDL Approved on 2/28/2008
4a	Sabetha City Lake	Aquatic Life	Eutrophication	LM011501	NM	Lake	Low	TMDL Approved on 8/28/2001
4a	South Fork Nemaha River Near Bern	Recreation	Fecal Coli	SC234	NM, JA	Watershed	High	TMDL Approved on 8/28/2001
4a	Turkey Creek Near Bern	Recreation	Fecal Coli	SC601	MS, NM	Watershed	Low	TMDL Approved on 9/11/2000
4a	South Fork Nemaha River Near Seneca	Aquatic Life	Selenium	SC682	NM, PT	Watershed	Low	TMDL Approved on 8/28/2001

Table 14 - 2010 303(d) List of All Impaired/Potentially Impaired Waters in Missouri Basin (Cont.)

10240008
Big Nemaha

Cat.	Stream/Lake	Impaired Use	Impairment	Station	Counties	Body Type	Priority	Comment
5	Walnut Creek Near Reserve	Aquatic Life	Total Phosphorus	SC292	BR, DP	Watershed	High	median value: 0.27 > median flag value:0.201
5	Walnut Creek Near Reserve	Aquatic Life	Total Suspended Solids	SC292	BR, DP	Watershed	High	median value: 53 > median flag value:50
5	Roys Creek Near Reserve	Aquatic Life	Copper	SC552	BR, DP	Watershed	Low	Several violations
5	Roys Creek Near Reserve	Aquatic Life	Zinc	SC552	BR, DP	Watershed	Low	
4a	Pony Creek Lake	Aquatic Life	Eutrophication	LM073001	BR	Lake	High	TMDL Approved on 2/28/2008
4a	Walnut Creek Near Reserve	Recreation	Fecal Coli	SC292	BR, DP	Watershed	High	TMDL Approved on 8/28/2001

Table 15 - 2010 303(d) List of All Impaired/Potentially Impaired Waters in Missouri Basin (Cont.)

10240011
Independence-Sugar

Cat.	Stream/Lake	Impaired Use	Impairment	Station	Counties	Body Type	Priority	Comment
5	Atchison Co. SFL	Aquatic Life	Atrazine	LM012601	AT	Lake	Low	
5	Atchison Co. SFL	Aquatic Life	Copper	LM012601	AT	Lake	Low	
5	Jerry's Lake	Aquatic Life	Eutrophication	LM067801	LV	Lake	Low	
5	Lake Warnock (Atchison City Lake)	Aquatic Life	Eutrophication	LM039801	AT	Lake	Low	
5	Atchison Co. SFL	Aquatic Life	pH	LM012601	AT	Lake	Low	
4a	Atchison Co. SFL	Recreation	Aquatic Plants	LM012601	AT	Lake	Low	TMDL Approved on 8/28/2001
4a	Atchison Co. SFL	Aquatic Life	Dissolved Oxygen	LM012601	AT	Lake	Low	TMDL Approved on 8/28/2001
4a	Atchison Co. SFL	Aquatic Life	Eutrophication	LM012601	AT	Lake	Low	TMDL Approved on 8/28/2001
4a	Big Eleven Lake	Aquatic Life	Eutrophication	LM067101	WY	Lake	Low	TMDL Approved on 8/28/2001
4a	Lansing City Lake	Aquatic Life	Eutrophication	LM067201	LV	Lake	Low	TMDL Approved on 8/28/2001
4a	Wyandotte Co. Lake	Aquatic Life	Eutrophication	LM042401	WY	Lake	High	TMDL Approved on 2/28/2008
4a	Lansing City Lake	Aquatic Life	pH	LM067201	LV	Lake	Low	TMDL Approved on 8/28/2001
4a	Atchison Co. SFL	Water Supply	Siltation	LM012601	AT	Lake	High	TMDL Approved on 2/28/2008
3	Lansing City Lake	Aquatic Life	Copper	LM067201	LV	Lake		Only 1 sample since 1995

Note: The Blue River is not being addressed by the Missouri River Basin WRAPS.

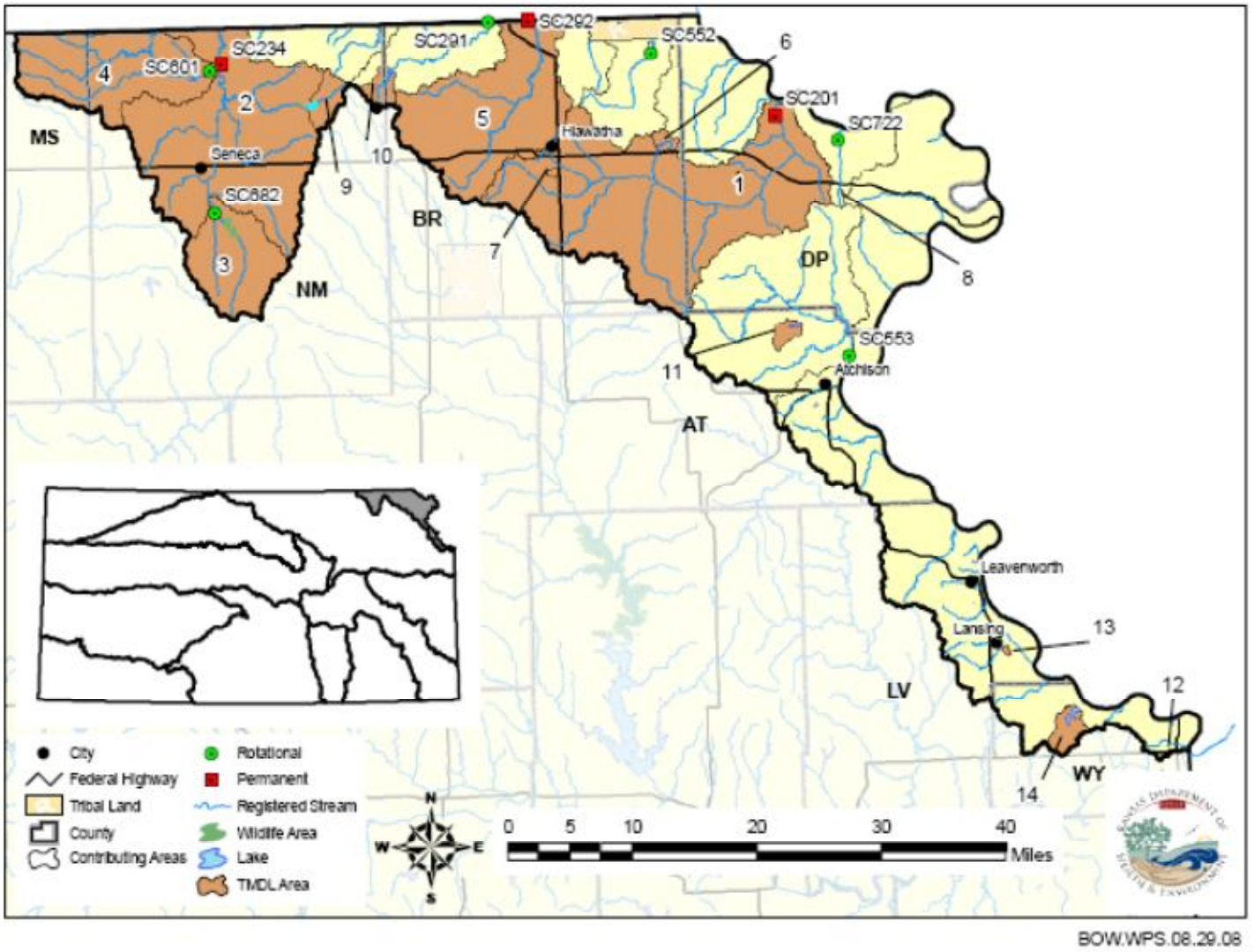

Figure 15 - TMDLs in the Missouri River Basin (2008)

Table 16 - Map Identification for Figure 13

Map ID	Water Body	Impairment	Priority
1	Wolf River	Bacteria	High
		Biology	High
2	South Fork Big Nemaha	Bacteria	High
		Biology	High
3	Illinois Creek	Selenium	Low
4	Turkey Creek	Atrazine	Medium
5	Walnut Creek	Bacteria	High
		Biology	High
		Phosphorus	High
6	Brown County SFL	Dissolved Oxygen	Medium
		Eutrophication	Medium
		pH	Medium
		Aquatic Plants	Medium
7	Hiawatha City Lake	Eutrophication	Medium
		Atrazine	Medium
8	Troy Fair Lake/ Doniphan Fair Assn. Lake	Aquatic Plants	Low
		Eutrophication	Low
9	Sabetha City Lake	Eutrophication	Low
10	Pony Creek Lake	Eutrophication	High
11	Atchison County SFL	Aquatic Plants	Low
		Dissolved Oxygen	Low
		Eutrophication	Low
		Siltation	High
12	Big Eleven Lake	Eutrophication	Low
13	Lansing City Lake	pH	Low
		Eutrophication	Low
14	Wyandotte County Lake	Eutrophication	High

Note: Map ID numbers match location indicated on Map on Page 29

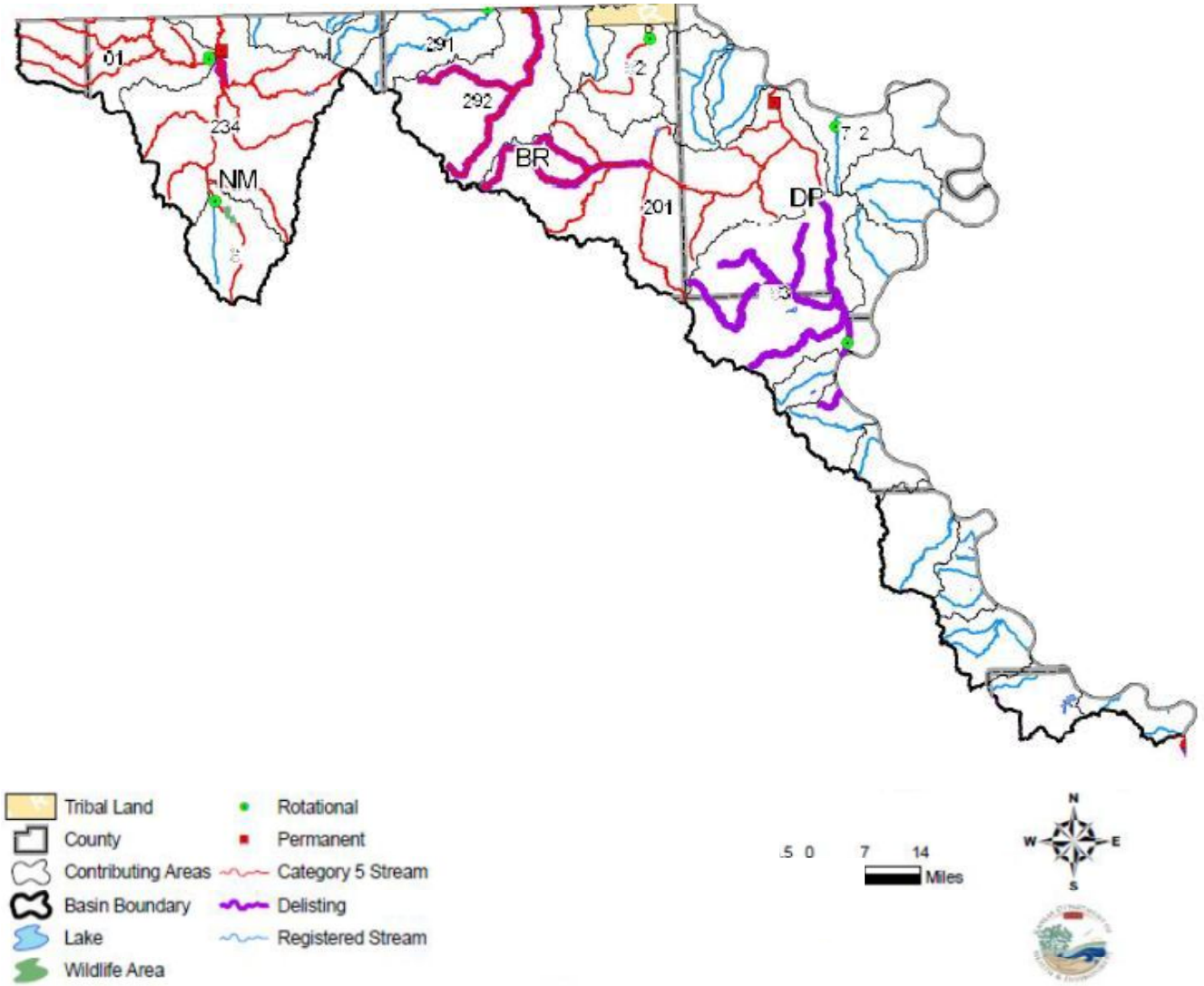

Figure 16 - Missouri Basin 303(d) Map

Table 17 - 2010 TMDLS as Listed on KDHE Watershed Planning and TMDL Website

- Stream TMDLs

Waterbody	Impairment	Priority	Station	ApprovalStatus
Subbasin: Tarkio - Wolf (HUC 10240005)				
WOLF RIVER	DO	Cat 2	SC201 - NPDES Permit	12/18/08, Delisted
WOLF RIVER	FCB	High	SC201	8/28/01
WOLF RIVER	NH3	Cat 2	SC201 - NPDES Permit	12/18/08, Delisted
WOLF RIVER (Bio)	Bio	High	SB363, SC201	2/28/08
Subbasin: South Fork Big Nemaha (HUC 10240007)				
BIG NEMAHA RIVER,SOUTH FORK	FCB	High	SC234, SC601, SC682	8/28/01
BIG NEMAHA RIVER,SOUTH FORK	DO	Cat 2	SC234 - NPDES Permit	12/18/08, Delisted
BIG NEMAHA RIVER,SOUTH FORK (Bio)	Bio	High	SB234, SC234, SC601, SC682	2/28/08
ILLINOIS CREEK	Se	Low	SC682	8/28/01
TURKEY CREEK	Atr	Medium	SC601	2/28/08
Subbasin: Big Nemaha (HUC 10240008)				
WALNUT CREEK	FCB	High	SC292	8/28/01
Subbasin: Independence-Sugar (HUC 10240011)				
WHISKEY CREEK	NH3	Cat 2	NPDES Permit	12/18/08, Delisted
Subbasin: Lower Missouri - Crooked (HUC 10300101)				
BLUE RIVER	FCB	Medium	SC205	8/28/01
BLUE RIVER (Chl)	Chl	Low	SC205	8/28/01
BLUE RIVER (Bio)	Bio	Medium	SB205	8/28/01
INDIAN CREEK	FCB	Medium	SC204	8/28/01
INDIAN CREEK (Nitrate)	Nitrate	High	SC204	2/28/08

Lake TMDLs

Waterbody	Impairment	Priority	Station	ApprovalStatus
Subbasin: Tarkio-Wolf (HUC 10240005)				
BROWN CO SFLAKE	DO	Medium	LM010301	8/28/01
BROWN CO SFLAKE	EU	Medium	LM010301	8/28/01
BROWN CO SFLAKE	pH	Medium	LM010301	8/28/01
BROWN CO SFLAKE	AP	Medium	LM010301	8/28/01
HIAWATHA CITY LAKE	EU	Medium	LM011601	8/28/01
HIAWATHA CITY LAKE (Atr)	Atr	Medium	LM011601	8/28/01
TROY FAIR LAKE (DONIPHAN FAIR ASSOCIATION LAKE)	AP	Low	LM073801	8/28/01
TROY FAIR LAKE (DONIPHAN FAIR ASSOCIATION LAKE)	EU	Low	LM073801	8/28/01
Subbasin: South Fork Big Nemaha (HUC 10240007)				
SABETHA CITY LAKE	EU	Low	LM011501	8/28/01
Subbasin: Big Nemaha (HUC 10240008)				
PONY CREEK LAKE (EU)	EU	High	LM073001	2/28/08
Subbasin: Independence-Sugar (HUC 10240011)				
ATCHINSON CO LAKE	AP	Low	LM012601	8/28/01
ATCHINSON CO LAKE	DO	Low	LM012601	8/28/01
ATCHINSON CO LAKE	EU	Low	LM012601	8/28/01
ATCHINSON CO LAKE (Silt)	Silt	High	LM012601	2/28/08
BIG ELEVEN LAKE	EU	Low	LM067101	8/28/01
LANSING CITY LAKE	pH	Low	LM067210	8/28/01
LANSING CITY LAKE	EU	Low	LM067210	8/28/01
WYANDOTTE CNTY LAKE	EU	High	LM042401	2/28/08

Abbreviations for Table 14

- AP - Aquatic Plants
- Atr - Atrazine
- Chl - Chlordane
- DO - Dissolved Oxygen
- EU - Eutrophication
- FCB - Fecal Coliform Bacteria
- ph – phw3e
- HUC - Hydrological Unit Code
- NH3 - Ammonia
- Se - Selenium

SECTION 3 - IMPAIRMENT APPROACHES

Missouri River Basin Watershed Priority

The Unified Watershed Assessment completed in 1998 by KDHE in conjunction with USDA NRCS examined 92 HUC-8 watersheds throughout the state. Seventy-one of the watersheds were classified as Category I watersheds. Category I Watersheds are those in need of restoration because of nonattainment of national clean water action goals (water quality), nonattainment of natural resource goals related to aquatic systems, both water quality and natural resources or other measures. All four HUC-8 watersheds in the Missouri River Basin are Category I Watersheds. Each watershed was rated based on a scoring system for a variety of elements including; TMDLs, Nonpoint Source Program, Kansas Water Quality Action Target Score (KATS), Severity of Water Quality Impairment (WQI), Local Conservation Leadership (LCL), Priority Water Shed Table (PWT), Sheet and Rill Erosion-Sedimentation Rate (SRE), and Socioeconomic Index (SEI). Then using the score the watershed was rated, a priority list was established of the 71 Category I Watersheds.

Table 18 - Missouri Basin Watershed Restoration Priority

HUC 8	Watershed Name	Water Quality Impairment Percent Miles Impaired	Priority Score	Watershed Restoration Priority Rank
10240007	South Fork Big Nemaha	85.1	17	9
10240005	Tarkio- Wolf	67.1	16	13
10240011	Independence-Sugar	1.2	14	25
10240008	Big Nemaha	37.7	12	37

The first TMDL Schedule 303(d) list was generated in 1998 for the Missouri River Basin. An accelerated schedule for establishing the TMDLs throughout the state was followed to meet the 1998 deadline. This deadline was established by a court order as a settlement to a suit filed by the Kansas Natural Resource Council and the Sierra Club compelling enforcement of the Section 303(d) of the Clean Water Act by establishing TMDLs. The Schedule 303(d) list was revised in 2006 to refine some of the more complex TMDLs that were encountered when the 1998 303(d) list was completed. New TMDLs will be developed for the Missouri River Basin in 2012 for an implementation period of 2013 to 2022.

Watershed Designated Uses

The major classified streams and lakes in Kansas are listed in the Kansas Surface Water Register (December 19, 2007). The streams are further sub-divided into segments to better analyze and understand the function, use, and condition of the stream or river. Each segment is then assigned a “designated use” in the Surface Water Register. Each “designated use” has water quality

standards associated with it. For example, water that comes in contact with human skin should have higher water quality than water used to water livestock. Surface waters not meeting their "designated uses" are considered impaired. A more detailed list of stream "designated uses" is provided in Appendix B.

Table 19 - Missouri Basin Stream Designated Uses and Public Water Supplies

Designated Use	Symbol	Watersheds -Percent of Stream Segments			
		South Fork of Big Nemaha	Nemaha	Tarkio-Wolf	Independence-Sugar
Expected Aquatic Life	E	24	50	16	16
Special Aquatic Life	S	5	[2]	4	7
Food Procurement	FP	13	33	12	14
Domestic Water Supply	DWS	9	[2]	12	10
Ground Water Recharge	GR	11	[2]	11	10
Livestock Watering	LW	11	[2]	11	10
Irrigation	IRR	9	[2]	12	10
Industrial Water Supply	IWS	9	[2]	12	10
Contract Recreation	PCR	9	17	9	12
Number of Public Water Supplies (2001) [1]	PWS	134	[2]	26	35

Note 1: The public water supply data broken down by watersheds is from Watershed Conditions Reports dated 2001
Note 2: Data not available

Table 20 - Missouri Basin Lakes Designated Uses

Lake	HUC 8	Designated Use						
		E	FP	DWS	LW	IRR	IWS	PCR
South Fork Big Nemaha	10240007	x	x	x			x	
Nemaha	10240008	x	x	x	x	x	x	x
Tarkio-Wolf	10240005							
Brown County SFL		x	x					
Hiawatha City Lake		x	x	x			x	
Independence Sugar	10240011							
Atchison County SFL				x				x
Wyandotte County Lake		x		x				x
Other Lakes		x	x	x	x	x	x	x

Table 21 - Extended Designated Use of Missouri River Basin WRAPS Project Area Waters

Lake/Stream Name	CUSEGA	CLASS	AL	CR	FP	DS	GR	IW	IR	LW
Big Nemaha R, S Fk	1024000715	GP	S	C	X	X	X	X	X	X
Big Nemaha R, S Fk	1024000716	GP	S	a	X	X	X	X	X	X
Big Nemaha R, S Fk	102400073	GP	S	b	X	X	X	X	X	X
Brush Cr	1024001126	GP	E	b	X	X	X	X	X	X
Burger Cr	1024000724	GP	E	b	O	X	X	X	X	X
Cedar Cr	1024000551	GP	E	C	X	X	X	X	X	X
Clear Cr	10240007132	GP	E	b	X	X	X	X	X	X
Cold Ryan Branch	1024000570	GP	E	b	O	X	X	X	X	X
Conner Cr	102400116368	GP	E	C	O	X	X	X	X	X
Coon Cr	1024000571	GP	E	b	O	X	X	X	X	X
Corral Cr	10240011175	GP	E	C	X	O	O	O	O	O
Deer Cr	1024001132	GP	E	C	O	X	X	X	X	X
Deer Cr	1024000718	GP	E	b	O	X	X	X	X	X
Fairfax Drain Ditch	102400119098	GP	R	b	O	O	O	O	O	O
Fisher Cr	1024000728	GP	E	b	X	X	X	X	X	X
Fivemile Cr	1024001135	GP	E	a	X	X	X	X	X	X
Halling Cr	1024000568	GP	E	b	O	O	X	O	X	X
Harris Cr	10240007166	GP	E	b	O	X	X	X	X	X
Honey Cr	1024000726	GP	E	b	O	O	O	O	O	X
Illinois Cr	1024000730	GP	E	b	O	X	X	X	X	X
Independence Cr	1024001120	GP	E	C	X	X	X	X	X	X
Independence Cr	1024001122	GP	E	C	X	X	X	X	X	X
Independence Cr, NBr	1024001129	GP	E	b	X	X	X	X	X	X
Island Cr	1024001137	GP	E	C	X	X	X	X	X	X
Jersey Cr	1024001138	GP	R	a	O	O	O	O	O	O
Jordan Cr	1024001130	GP	E	C	O	X	X	X	X	X
Manley Cr	1024000714	GP	E	b	X	X	X	X	X	X
Mill Cr	1024000552	GP	E	C	O	X	X	X	X	X
Mission Cr	10240005339	GP	E	b	O	X	X	X	X	X
Missouri R	102400114	GP	S	B	X	X	X	X	X	X
Missouri R	102400115	GP	S	B	X	X	X	X	X	X
Missouri R	102400117	GP	S	B	X	X	X	X	X	X
Missouri R	102400119	GP	S	B	X	X	X	X	X	X
Missouri R	102400119099	GP	S	B	X	X	X	X	X	X
Missouri R	102400051	GP	S	B	X	X	X	X	X	X
Missouri R	1024000519	GP	S	B	X	X	X	X	X	X
Missouri R	102400052	GP	S	B	X	X	X	X	X	X
Missouri R	1024000521	GP	S	B	X	X	X	X	X	X
Missouri R	102400111	GP	S	B	X	X	X	X	X	X
Missouri R	1024001111	GP	S	B	X	X	X	X	X	X
Missouri R	1024001113	GP	S	B	X	X	X	X	X	X
Missouri R	1024001115	GP	S	B	X	X	X	X	X	X
Missouri R	1024001119	GP	S	B	X	X	X	X	X	X
Missouri R	102400112	GP	S	B	X	X	X	X	X	X

Table 22 - Extended Designated Use of Missouri River Basin WRAPS Project Area Waters (Cont.)

Lake/Stream Name	CUSEGA	CLASS	AL	CR	FP	DS	GR	IW	IR	LW
Mosquito Cr	1024000573	GP	E	C	X	X	X	X	X	X
Nine Mile Cr	10240011161	GP	E	b	O	X	X	X	X	X
Noharts Cr	1024000842	GP	E	b	O	X	X	X	X	X
Owl Cr	1024001133	GP	E	C	O	X	X	X	X	X
Pedee Cr	1024000841	GP	E	C	O	X	X	X	X	X
Peters Cr	1024001127	GP	E	C	O	X	X	X	X	X
Pony Cr	1024000838	GP	E	b	X	X	X	X	X	X
Quarry Cr	10240011176	GP	E	b	O	X	X	X	X	X
Rattlesnake Cr	1024000727	GP	E	b	X	O	O	O	O	X
Rittenhouse Branch	1024000569	GP	E	b	O	X	X	X	X	X
Rock Cr	1024000720	GP	E	b	X	X	X	X	X	X
Rock Cr	1024001121	GP	S	C	O	X	X	X	X	X
Roys Cr	1024000840	GP	E	b	O	X	X	X	X	X
Salt Cr	1024001134	GP	E	C	O	X	X	X	X	X
Seven Mile Cr	10240011157	GP	E	b	O	X	X	X	X	X
Smith Cr	1024001128	GP	E	b	O	O	X	O	X	X
Sorter Cr	10240011142	GP	E	b	O	X	X	X	X	X
Spring Cr	1024000565	GP	E	b	X	X	X	X	X	X
Striker Branch	1024000572	GP	E	b	O	X	X	X	X	X
Tennessee Cr	1024000729	GP	E	b	O	X	X	X	X	X
Terrapin Cr	10240008308	GP	E	b	O	X	X	X	X	X
Threemile Cr	1024001136	GP	E	a	O	X	X	X	X	X
Turkey Cr	102400074	GP	E	b	X	X	X	X	X	X
Turkey Cr	102400075	GP	E	b	X	X	X	X	X	X
Unnamed Stream	10240005240	GP	E	b	O	X	X	X	X	X
Unnamed Stream	1024000555	GP	E	b	O	O	O	O	X	X
Unnamed Stream	10240007212	GP	E	b	O	O	X	O	O	O
Walnut Cr	1024000839	GP	E	b	X	X	X	X	X	X
Walnut Cr	1024001123	GP	E	C	O	X	X	X	X	X
Walnut Cr	1024001125	GP	E	b	O	X	X	X	X	X
Whiskey Cr	10240011235	GP	E	b	O	X	X	X	X	X
White Clay Cr	1024001131	GP	E	B	X	X	X	X	X	X
White Clay Cr	102400119031	GP	R	b	O	O	O	O	O	O
Wildcat Cr	1024000723	GP	E	b	O	X	X	X	X	X
Wildcat Cr	1024000722	GP	E	b	O	O	O	O	O	O
Wolf Cr	1024000712	GP	E	b	X	X	X	X	X	X
Wolf Cr	1024000713	GP	E	b	X	X	X	X	X	X
Wolf Pen Cr	1024000725	GP	E	b	X	O	O	O	O	X
Wolf R	1024000553	GP	S	C	X	X	X	X	X	X
Wolf R	1024000554	GP	S	b	X	X	X	X	X	X
Wolf R	1024000556	GP	E	b	X	X	X	X	X	X
Wolf R, Middle Fk	1024000567	GP	E	C	O	X	X	X	X	X
Wolf R, N Fk	1024000566	GP	E	C	O	O	O	O	X	X
Wolf R, S Fk	1024000557	GP	E	b	X	X	X	X	X	X

Table 23 - Extended Designated Use of Missouri River Basin WRAPS Project Area Waters (Cont)

Lake/Stream Name	CUSEGA	CLASS	AL	CR	FP	DS	GR	IW	IR	LW
Atchison Co. SFL	N/A	GP	E	B	X	X	O	X	X	X
Big Eleven Lake	N/A	GP	E	B	X	X	X	X	X	X
Brown Co. SFL	N/A	GP	E	B	X	X	O	X	X	X
Hiawatha City Lake	N/A	GP	E	B	X	X	O	X	X	X
Jerry's Lake	N/A	GP	E	B	X	X	O	X	X	X
Lake Warnock (Atchison City Lake)	N/A	GP	E	A	X	X	O	X	X	X
Lansing City Lake	N/A	GP	E	B	X	X	O	X	X	X
Merrit Lake	N/A	GP	E	B	X	X	O	X	X	X
Nemaha Co. SFL/W.A.	N/A	GP	E	B	X	X	X	X	X	X
Pony Creek Lake	N/A	GP	E	B	X	X	O	X	X	X
Sabetha City Lake	N/A	GP	E	B	X	X	O	X	X	X
Smith Lake	N/A	GP	E	B	X	X	O	X	X	X
Troy Fair Lake	N/A	GP	E	B	X	X	O	X	X	X
Wyandotte Co. Lake	N/A	GP	E	A	X					

Table Key

CUSEGA	=	channel unit segment
CLASS	=	antidegradation category
GP	=	general purpose waters
AL	=	designated for aquatic life use
R	=	restricted aquatic life use water
S	=	special aquatic life use water
E	=	expected aquatic life use water
CR	=	designated for contact recreational use
A	=	Primary contact recreation stream segment/lake that is a public swimming area/has a posted public swimming area
B	=	Primary contact recreation stream segment/lake that is by law or written permission of the landowner open to and accessible by the public
C	=	Primary contact recreation stream segment/lake that is not open to and accessible by the public under Kansas law
a	=	Secondary contact recreation stream segment/lake that is by law or written permission of the landowner open to and accessible by the public
b	=	Secondary contact recreation stream segment/lake that is not open to and accessible by the public under Kansas law
FP	=	designated for food procurement use
DS	=	designated for domestic water supply
GR	=	designated for ground water recharge
IW	=	designated for industrial water supply use
IR	=	designated for irrigation use
LW	=	designated for livestock watering use
X	=	referenced stream segment/lake is assigned the indicated designated use
O	=	referenced stream segment/lake does not support the indicated designated use
blank	=	capacity of the referenced stream segment/lake to support the indicated designated use has not been determined by use attainability analysis

Stream TMDL/Contaminate Concerns

Surface waters not meeting their designated uses require TMDL determinations. The compilation of the stream TMDLs is based on the number segments sampled that do not meet the designated uses and gives a generalized understanding of the environmental health of the watersheds. Specific segments may be non-attaining of the designated use based on more than one contamination.

Table 24 - Contaminate Concerns in Watershed Streams from Conditions Report

Pollutant	Watersheds			
	South Fork Big Nemaha	Nemaha	Tarkio Wolf	Independence-Sugar
HUC 8	10240007	10240008	10240005	10240011
Segments Requiring TMDLs	65%	15%	55%	3%
Primary Stream Contaminates				
Fecal Coliform Bacteria	93%	100%	86%	
Insufficient Flow (Hydro.)	7%			
Ammonia			14%	100%

Note: Data from on Watershed Conditions Reports dated 2001

High Priority TMDLS

KDHE sampled certain segments of the streams and rivers in the Missouri River Basin and established whether the TMDLs are a high, medium and low priority. Some TMDLS are associated with point discharges, such as a pipe or identified discharge point, and are from regulated municipal, industrial or animal waste treatment facilities. The waste from these regulated facilities are sampled and reported on an established regular schedule and are required to meet certain discharge limits specified by the operation permit. Compliance with these requirements from point sources is monitored and enforced by the state.

Other TMDLs come from non-point, or dispersed, sources. The high priority TMDLs from non-point sources are the focus of this plan since they cannot be controlled at a single point of discharge. The high priority TMDLs are identified in Table 25 and located on the map shown on Figure 17.

The high priority TMDLs in the Missouri River Basin are biological and fecal coliform bacteria (FCB) in streams and eutrophication and silt in the lakes. The biological TMDL is the impairment of the designated use “Expected Aquatic Life Support.” Biological impairment of these streams, as compared to less impacted, fully supported stream segment, are mainly caused by biological oxygen demand (BOD), organic materials and nutrients, nitrates (NO_3-N) and, most significantly, total suspended solids (TSS). TSS is composed of finely divided soil particles and organic particles from plant and animal residue. Phosphorus, a typical limiting nutrient in the basin is transported to the water bodies attached to sediment particles

Table 25 - High Priority TMDLs

Map ID	Waterbody	Impairment	HUC8	HUC10	HUC12
Streams					
1	Wolf River	FCB, Bio	10240005	12	01
			10240005	12	02
			10240005	12	03
			10240005	12	04
			10240005	12	05
2	South Fork Big Nemaha River	FCB, Bio	10240007	03	01
			10240007	01	06
			10240007	01	04
			10240007	01	08
			10240007	01	07
			10240007	02	05
			10240007	02	04
			10240007	02	03
			10240007	02	02
			10240007	02	01
3	Walnut Creek	FCB	10240008	04	06
			10240008	04	05
			10240008	04	04
Lakes					
4	Pony Creek Lake	E	10240008	04	002
5	Atchison Co. SFL	Silt	10240011	02	002
6	Wyandotte Co. Lake	E	10240011	06	04

Note: For each of the high priority lakes in this basin, the TMDL only applies to the area upstream of the lake. The Map ID refers to the number on the map on Figure 17.

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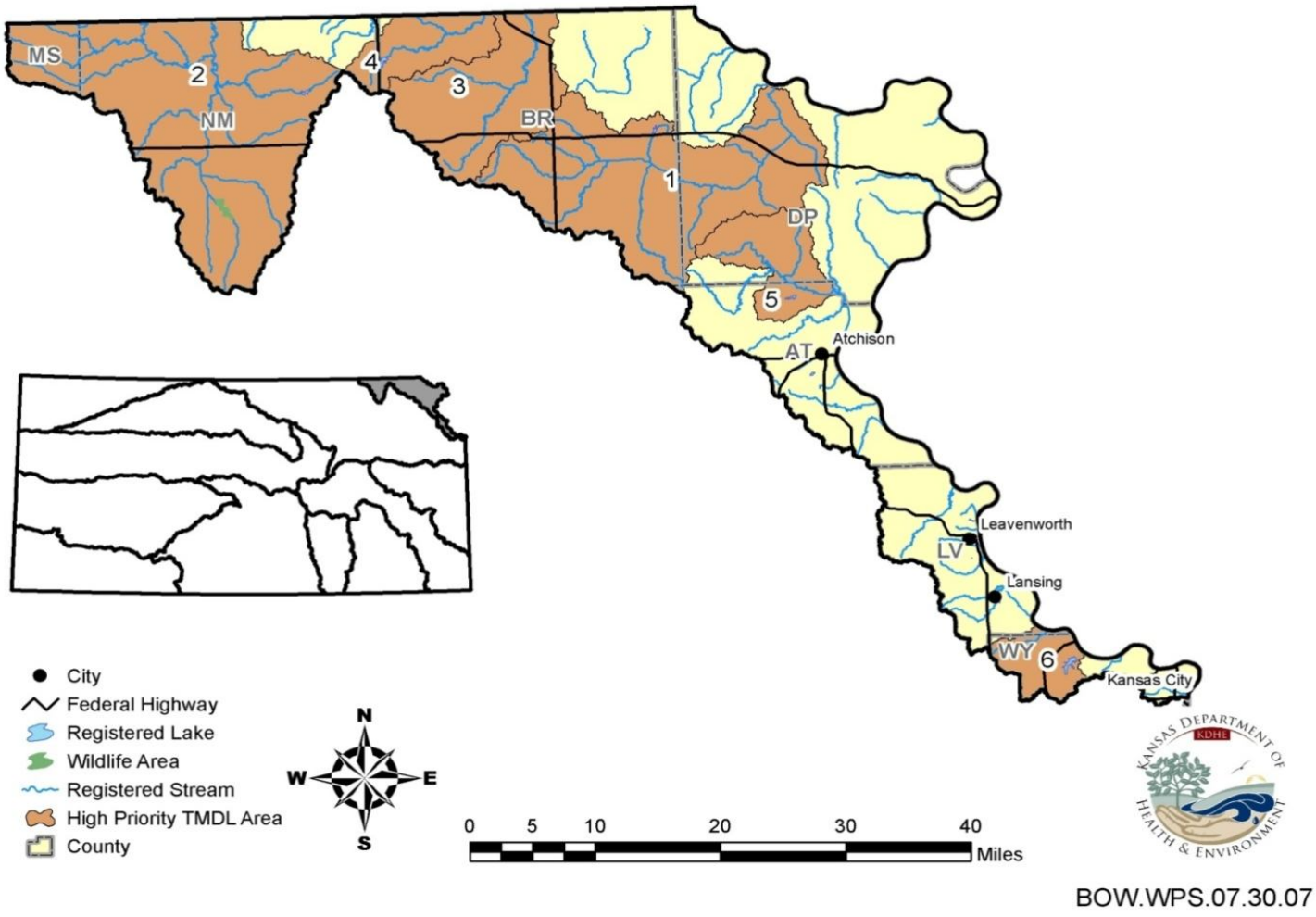

Figure 17 - High Priority TMDL Areas

In April 2008, EPA in conjunction with partner agencies established complete nationwide GIS coverage data in all fifty states. Kansas uses a HUC8/11/14 system of classification. Neighboring states use HUC8/10/12 system. Generally, to convert a HUC14 to a HUC 12, remove the trailing zero on each of the sub codes so that HUC14 10240008(050)(010) becomes HUC12 10240008(05)(01). Similarly, HUC11 10240008(050) becomes HUC10 10240008(05). Certain watersheds in the Missouri Basin do not follow this convention.

The Missouri River Basin WRAPS has a responsibility to develop a plan and strategy to address the high priority TMDLS within the basin. Because of the limited resources, the size of the basin, and the diversity of water bodies, habitats and factors contributing to the TMDLs, the WRAPS evaluated the High Priority TMDLs within the basin and further prioritized these based on severity of loading, extent of loading, resources within the watershed, and probability of public and producer participation and public interest. Then a HUC 12 region of each High Priority TMDL was selected as a location to begin focusing the WRAPS efforts to address the TMDLs. The criteria for HUC 12 selection included:

1. Presence of High Priority TMDLs within HUC 12 considered (See Table 26);
2. Interpretation of available information for High Priority TMDL watersheds such as STEPL maps (see Appendix D) as well as other assessments of HUC 8 watersheds within the project area such as the KAWS and KWO assessments as well as information developed by KDHE in support of TMDL development within the Missouri River Basin.
3. Opinion of the leadership team members, which include local County Conservation District and NRCS staff, of areas that have potential for greatest pollutant load reductions if best management practices are applied and
4. A subjective opinion of which areas are most likely to have landowners and producers who are cooperative and receptive to best management practices and learning programs by the SLT

Table 26 - Priority Waters Directly Addressed by Plan

Priority	Priority Water	Priority HUC 12	Other Waters Benefitting
1	Wolf River	102400051203 102400051204	South Fork, Halling Creek
2	South Fork Big Nemaha	102400070205	Wildcat Creek
3a	Pony Creek Lake	102400080402	
3b	Atchison County Lake	102400110202	
5*	Wyandotte Co. Lake	102400110604	
6**	Walnut Creek	120400080405	

*Wyandotte Co. Lake is listed a High Priority because of eutrophication. It is primarily impacted by urban runoff and commercial site runoff.

** Walnut Creek may be removed from the high priority list in 2010 or 2011

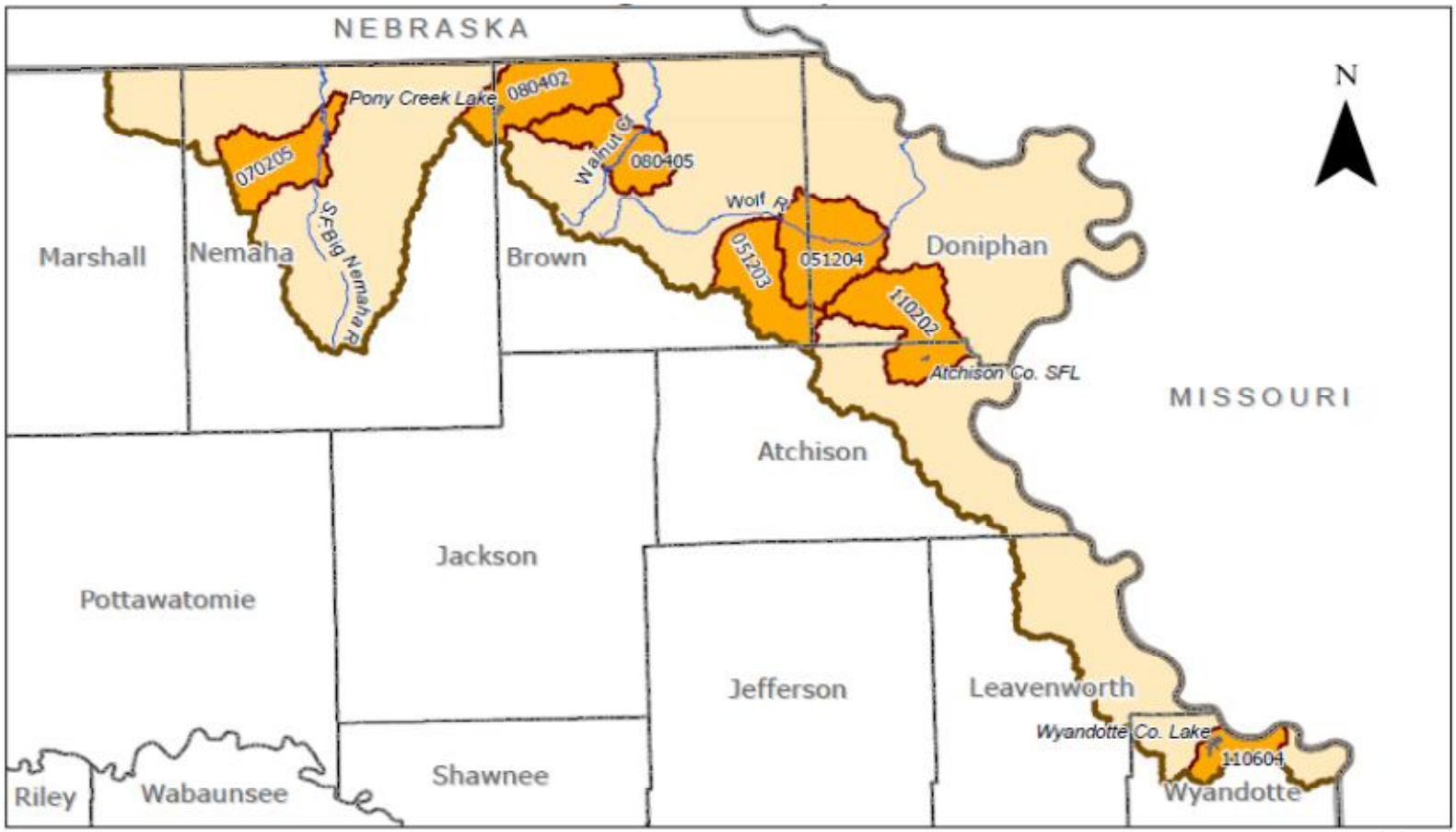

Figure 18 - Missouri River Basin WRAPS designated Prioritize High Priority Focus Areas

Best Management Practices

Best Management Practices (BMPs) are vegetative, structural or management practices that reduce the pollutants in surface and ground waters. These are practices that are adopted by individual producers, operators, corporations, municipalities and other government agencies in their day to day operations to reduce environmental impacts.

BMPs may be incorporated independently or in combination with other BMPs. A BMP may serve multiple functions and provide multiple benefits. For instance, a sediment pond will capture sediment in overland runoff, preventing it entering into the lake or stream, but it may also attenuate peak runoff flows and sequester toxic materials.

Often, BMPs are inexpensive to implement and may require only a simple modification to existing practices. In other instances, the BMP can be quite expensive and financial assistance is necessary from the state or federal government or from conservation groups. Technical assistance is also available from Kansas State Extension, county, state and federal agencies, and many non-profit organizations for all BMP programs.

There are many BMPS and they tend to evolve over time as they become more prevalent. The following BMPs are not intended to be an exhaustive list of applicable BMPs but to reflect only the BMPs considered in the preparation of this plan. It is understood that additional BMPs will be identified and applied as appropriate in the future within the Missouri River Basin.

Crop Production BMPs

Crop production BMPs are crop production management systems and practices intended to reduce sediments, nutrients and pesticides reaching surface and ground waters.

No-Till Farming: In a 100% No-till system the soil surface is never disturbed except for planting or drilling operations. Weed control is typically by agriculture chemical applications and by crop rotations. Plant residue material is left on the soil surface year-around.

Benefits include: a 75 % reduction in erosion; 40% phosphorus reduction efficiency; increase in soil organic matter; increase in soil organisms such as earthworms; soil tilth improvement; and increased production.

Cover Crops: Cover crops are areas of grass, small grain, legumes or combination of these that are planted for nutrient management and surface erosion reduction. Cover and green manure crops are grown on cropland, orchards and certain wildlife areas, and are often grown after the primary production crop is harvested. Generally the cover crop is plowed under or chemically desiccated to accommodate the primary crop production on the site.

Benefits include: erosion reduction; increased soil organic matter and fertility; improved soil tilth; increased soil infiltration and aeration; and filtering sediments, pathogens and dissolved pollutants.

Vegetative BMPs

Vegetative BMP's are permanent vegetative cover on land adjacent to streams or lakes or on highly erodible land to filter out potential pollutants and sediments or to provide soil stabilization to reduce erosion.

Vegetated Buffer Strip: Vegetated buffer strip, grass buffer or filter strip all serve similar functions. These are areas of vegetation that reduce sediment, nutrients, organic material, and other pollutant materials from entering into water bodies either by absorption of the nutrients or pollutant or by acting as a filter to remove the larger particles. Vegetated buffer strips are typically linear in shape (much longer than wide) located at the lower end of cultivated land. Vegetated buffer strips located below livestock loafing and feeding areas are typically called filter strips. Typically, a grass buffer strip is composes of only grass whereas a vegetated buffer may include forbes and trees.

In Kansas, one acre of buffer strip treats approximately 15 acres of cropland on average. Buffer strips should have a minimum width of 30 feet with 100 feet wide width desirable although limited benefits are achieved on narrower strips.

Benefits include: 50% erosion efficiency; 50% phosphorus reduction efficiency; setback from water so pesticides and other chemicals are not applied directly adjacent to or into the water body; filter out sediment; stabilize the soil to reduce surface erosion; provide or improve wildlife and fish habitat; improve equipment operations such as field access and head lands; provide recreation opportunities; and provide livestock forage sources.

Forested Buffer Strip: also called a Riparian Forest Buffer. A forested buffer strip is an area of trees and/or shrubs adjacent to a body of water. The vegetation typically extends outward from the water body for a specified distance necessary to provide a minimum level of protection and/or enhancement. Forested buffer strips include trees with deep roots to anchor the soil and typically may also include grasses, forbs and shrubs. A common design is for a grassed area adjacent to the cultivated field, followed by a strip of shrubs and forbs and finally a strip of forested land adjacent to the stream bank. Including the grass strip in the design helps to filter out some of the sediment as well as provides a buffer between the trees and cultivated area, eliminating the common problem of broken tree branches on the cropped area and the zone where the trees roots rob moisture from the crop.

Benefits include: reduce sediment, nutrients and organic material from entering into the water body; create shade to lower water temperatures and improve aquatic habitat; provide debris necessary for healthy aquatic populations; provide wildlife habitat; and stabilize the stream banks.

Convert Steep Slopes to Permanent Vegetation: Converting steep slopes to permanent vegetation is to plant grass on highly erodible land that earlier was broken up for cultivation. Essentially the purpose is to return marginally productive land, with steep slopes back to a nearly native condition to reduce erosion and re-establish top soil.

Benefits include: reduction of runoff and loss of soil from a highly erodible areas and increased wildlife habitat and established wildlife refuge areas. Since these areas tend to

be the most erodible, converting these slopes to grassed area permanent vegetation tends to have a significant reduction of sediment runoff.

Structural BMPs

Structural BMP's are earthen or other constructed physical features that serve to filter pollutants, and/or retain, obstruct or direct water flows.

New Terraces: Terraces are earthen embankments placed across the slope in cultivated fields. Typically the embankments are constructed so the flow-lines of the embankments maintain a minimum slope (1.5 to 2.5%). By flattening the slope of the runoff flow, the velocity is reduced and, consequently, the amount of soil eroded is reduced as well. Terraces either discharge the runoff at the end of the terrace into a grass waterway or channel or the runoff may be discharged from the low point in the terrace, through a drainage pipe, into a nearby stream. Currently, terracing is well established in the high priority sub-watersheds. Therefore terraces are not included in the current 9-Element Plan but should be considered as a structural BMP in future plan updates.

Benefits include: control runoff, trap soil to prevent erosion, and to retain runoff for soil moisture. Result in 30% erosion reduction efficiency and 30% phosphorus loss reduction efficiency.

Streambank Stabilization: Streambank stabilization involves using vegetative or structural methods to stop or reduce the erosion and degradation of stream banks, particularly on outer banks of stream curves. Methods may include armoring streambanks with rock, fiber material, or vegetation; installing rock or concrete protection at the toe of the bank; construction of rock diversions within the channel to direct the flow away from the bank; or by using structures to slow the flow of the water on the outer edges of the channel.

Benefits include: prevention of loss of adjacent land to the stream; maintain the flow capacity of the stream; reduce the offsite or downstream impacts of sediment resulting from the bank erosion; preserve trees and other vegetation within the riparian corridor; and to improve the stream corridor for fish and wildlife habitat.

Sediment Basins: A sediment basin is a constructed basin designed to collect and store waterborne debris and sediment. Sediment basins are typically installed on the downstream side of construction or other highly erodible sites until vegetative or other more long term practices can be initiated to prevent the soil erosion from the unprotected sites. Sediment basins typically require ongoing maintenance to remove the sediment and repair the retaining structure

Benefits include: Trap sediments from the highly erodible site; prevents excessive deposition of soil in lakes, streams and bottomland areas; preserves the water storage capacity of lakes; reduces the damage to the lake or stream from pollution or deposition of sediment.

Land Management BMPs

Land management BMPs are management practices intended to reduce the generation and transport of pollutants and sediments, to control erosion, to improve habitat, to increase vegetative covers and to enhance production.

Pasture Management Plans: Pasture management plans address various issues to reduce the impacts to the area waters, reduce erosion and increase sustainability while maintaining pasture productivity and profitability. Management issues to be addressed include stocking rates, grazing rotation, plant selection, nutrient supplements, weed and pest control, livestock wind protection facilities and livestock access to streams and lakes for water.

Benefits include: reduced sediments and other pollutant runoff into the adjacent water bodies, preserving existing topsoil, healthy and resilient livestock forage, increase productivity, and increased health and vitality of the livestock herd.

Nutrient Management Plans: Nutrient management is the practice of managing the amount, source, placement, method, and timing of plant nutrients application to obtain optimum yields, maximum nutrient utilization, and minimize the risk of surface and groundwater pollution. The source of plant nutrients may be from organic wastes, commercial fertilizers, legumes or crop residue. Nutrient management plans relies on effective soil testing, crop history, crop rotation plan and cover crops.

Benefits include: Reduced fertilizer costs, maximum utilization of nutrients; reduced risk of pollution of surface and ground water; reduced degradation of receiving water bodies and reduced maintenance costs of lakes and streams; and reduced cost in providing drinking water. Nutrient management plans typically result in 25% erosion and 25% phosphorus loss reduction.

Urban Lawn Nutrient Management: Urban lawn nutrient management programs are educational programs and ordnances that encourage the proper application of chemical fertilizers to urban lawns, parks, golf courses and recreational fields. The programs typically also include the management of pesticides with the program. The programs stress the importance of amount, timing and methods of applications that minimize the runoff of excessive fertilizers into the urban storm drainage system. The intent of the management is to minimize the nutrients and other pollutants in the runoff.

Benefits include: reduced cost for public and private lawn maintenance; reduction of algae in lakes and streams; reduction of nuisance vegetative growth along water courses and in drainage areas; reduction of nutrients in surface and ground water; and reduction of lake eutrophication.

Urban Runoff Management: Urban runoff management includes urban lawn management; pet waste management; detention and retention facilities; filter strips and infiltration facilities associated with parking and other impervious areas. The intent is to reduce nutrients, bacterial wastes, pesticides, transportation pollutants and other pollutants associated with the urban environment.

Benefits include: reduced pollution of the surface and ground waters; reduced runoff and flooding; reduced public maintenance cost; and cleaner environment.

Waste Management BMPs

Waste management BMPs are management of the waste products for maximum utilization of organic fertilizers, reduction bacterial pollution of surface and groundwater and reduction of environmental and health impacts associated with human and livestock waste generation.

Livestock Waste Management: Livestock waste management is the management of livestock waste to increase utilization for crop and grass production and for the reduction of pollutants into the surface and ground waters. Livestock waste management include relocation of feeding areas; planting vegetative buffers; installing stream fencing and hardened feeding sites; and the storage, handling and application of livestock wastes

Benefits include: organic fertilizer recovery, reduced disease and infection in livestock herds; increased livestock productivity; increase ease of livestock feeding; less mud inconvenience; reduced sediment in surface waters; and reduced bacteria pollution in the lakes and streams.

On-Site Waste System Repair: On-site waste system repair is the correction of failing septic tanks, failing drainage fields and problems with waste lagoon systems.

Benefits include: reduces or eliminates noxious odors; reduces or eliminates perennial wet and marshy areas; and reduces the fecal coliform bacteria and phosphorus entering the surface and ground water.

Pet Waste Management: Pet waste management is an effort to remove pet wastes from urban stormwater runoff and therefore from the surface waters of the basin. High concentrations of pets in urban areas, particularly dogs, can produce a significant amount of bacteria containing wastes which are washed into surface waters during storm events. Management programs include public education for pet waste disposal on private property as well as collection and disposal of pet wastes on public property; enacting and enforcing ordinances; and providing facilities such as pet waste disposal containers and plastic waste collection bags for pet wastes stations near pet exercise areas.

Benefits include: reduction of bacteria pollutants in urban runoff; reduction of nuisance waste in public areas, especially in children playgrounds recreational areas; and reduction of odors.

Livestock Production BMPs

Livestock production BMPS are structural and management practices used to enhance production and profitability while maintaining healthy pastures; ample forage production; and healthy streams, lakes and riparian habitats.

Alternative Watering Sites: Alternative (off-stream) watering sites provide available livestock water without requiring the livestock enter a stream or body of water to obtain drinking water.

Benefits include: Studies show cattle will drink from a tank over a stream 80% of the time; 30 to 98% average phosphorus reduction for limited stream access; improved habitat for fish and wildlife; reduced erosion of stream bank; and reduction of coliform bacteria in surface waters.

Stream Fencing; Stream fencing is the fencing of the area adjacent to streams and lakes to prevent livestock from entering the stream or lake for watering or standing in the water.

Benefits include: 95% phosphorus reduction from livestock wastes, reduction of coliform bacteria in surface waters, improved wildlife and fish habitat, reduced streambank erosion; and less sediment in the surface waters. Permanent fences have a 25-year life expectancy.

Planned Grazing Systems: Planned grazing systems include continuous grazing at a light to moderate stocking rate in a one-pasture system and rotational grazing systems, sometimes called mob grazing. Rotational grazing directs the livestock for short intensive grazing periods through multiple subdivided areas in the pasture. Rotational grazing allows the pasture to "rest" for a period of time after the intense grazing period. Continuous grazing systems require less management and investment in infrastructure but have reduced production. Rotational grazing systems require more management and larger investment for fencing and for water supply.

Benefits include: Rotational grazing typically allow higher grazing density and production efficiency; better organic fertilizer (manure) distribution; increased forage production, better pasture condition and sustainability; less erosion due to lack of ground cover; less sediment in the surface water; and less bacteria, manure and sediment in the water. Rotational grazing can provide approximately 50 to 70% of phosphorus reduction.

High Priority TMDL Source Inventory And Assessment

Note: – A Table of the all named streams in the basin with HUC 12 designation, designated use and impairment is included in Appendix B. Sampling data is recorded by KDHE based on stream segment.

Load Reduction Goals and Methodology

The TMDL sampling period of record ranges from 1999 for the South Fork Bacteria TMDLs to 2005 for Pony Creek, Wolf River and the South Fork Biology TMDL determination. It seems reasonable to assume that the loading levels may have increased since the sampling period of record. Additionally, since that time the commodity prices have escalated especially for corn and soybeans. As a result more land has been removed from the CRP. In Atchison and in Leavenworth Counties the reported cropland acreage in tilled commodities increased by 3.7% from 2007 to 2010 according to the County Farm Service Agencies. Further it was estimated that 95% of the increased acreage was on highly erodible land. To account for the possible increase of pollutant loading resulting from the increased tilled highly erodible land and the possible increase over time, we have increased the targeted load reduction goals established

when the sampling was completed by 150%. Although this factor of safety may be high, it appears to be reasonably achievable within the Missouri River Basin watersheds.

The Kansas Non-Point Source Needs Inventory was used to identify the conservation needs in each of the watersheds. This inventory identifies the conservation measures needed in each watershed and establishes a quantity of the perceived conservation measures needed. This data, along with the identified high priority TMDLs, were used to select the strategic BMPs and the appropriate quantities of each BMP to meet the established load reduction goals.

The load reductions from Best Management Practices implemented in the High Priority TMDL watersheds within the project area were calculated by KDHE utilizing EPA's Region 5 Model. The Region 5 Model is an Excel-based workbook used to evaluate BMP load reductions in WRAPS projects. This model is used to evaluate load reductions from BMPs such as gully stabilization, streambank stabilization, agricultural-cropland practices, feedlot-livestock activities, as well as urban runoff. The primary load reductions that are obtained from the Region 5 Model are nitrogen, phosphorus, and sediment. KDHE utilizes county-level USLE factors for input information as well as applicable load reduction efficiency information from Kansas State University Extension publications. More information about the Region 5 Model can be found at http://it.tetratech-ffx.com/stepl/.

Bacteria Standards

Fecal coliform is bacterium commonly found in the digestive tract of humans as well as many large mammals. It is discharged with fecal matter. It was adopted by the State of Kansas as an indicator of animal or human waste contamination in water and was seen as an indication of possible disease pathogens in the water.

Escherichia coli, or E coli, is a common bacteria found in the gut of animals including humans. It is also found in reptiles and fish. E coli is better able to adapt to the presence or absence of oxygen and adapts to other environmental stimuli such as pH, temperature and chemicals. There are over 700 types of pathogenic E. coli. It is predominantly a facultative organism in the human digestive system but makes up a very small proportion of the total bacteria found in humans. Because it is so commonly found in the intestinal tract, it is also a good indicator of fecal contamination in the water and wastewater.

The EPA, based on research in 1984, determined that the E coli bacteria are a better indicator of human pathogen risks in contaminated water than fecal coliform bacteria. There is a more direct correlation between the colony concentration of E coli in the water and the incidence of human illness. The EPA recommended that E coli bacteria be used as an indicator of water quality in fresh water rather than the formerly used fecal coliform bacteria.

Kansas continued to base water quality fecal contamination on the presence of fecal coliform until 2003 at which time the E coli standards were established as the indicator. However, the surface water TMDLS in the Missouri River Basin, including Wolf River are based on sampling

through 2001. Therefore, the standard still used on this watershed is the fecal coliform bacteria colonies. The E coli standard will be applied when the stream testing is completed in 2012.

The E coli bacteria criteria for streams designated as primary and secondary contact recreation is established by K.A.R. 28-16-28e(7) (D) and (E). These criteria are as follows:

Table 27 - Recreational Stream Criteria

Designated Use	**Colony Forming Units (CFUs)/100 mL**	
Primary Contact Recreation	Geometric Mean* April 1- Oct. 31	Geometric Mean* Nov. 1- March. 31
Class A	160	2358
Class B	262	2358
Class C	427	3843
Secondary Contact Recreation	Geometric Mean* Jan. 1- Dec. 31	
Class a	2358	
Class b	3843	

A geometric mean is the nth root of the product of n numbers. A geometric mean is used to determine the central tendency of a group of numbers that can vary widely. This tends to dampen the effect of very high or low values which would bias the arithmetic mean

There are different criteria for lakes. For both primary and secondary contact recreation monitoring, the requirements specify that at least five samples be collected during separate 24-hour periods within a 30-day period. There are no single sample maxima criteria for streams although there are single sample maxima criteria are included in regulation for lakes.

SECTION 4 - WATERSHED ANALYSES AND PROPOSED LOAD REDUCTION

Tarkio-Wolf River (HUC 10240005)

Drainage Area: 247.8 square miles

Water Quality Impairment: Biology, Fecal Coliform Bacteria (FCB)

Segments with Water Quality Impairment:

Main Stem Segments: Segments 53, 54 and 56; starting at the state line continuing upstream to headwaters in central Brown County – both Biology and Fecal Coliform Bacteria

Tributary Segments:

	Biology	FCB
Coon Creek (71)	x	x
Striker Branch (72)	x	x
Rittenhouse Branch (69)	x	x
Cold Ryan Branch (70)	x	x
Halling Creek (68)	x	x
Unnamed Stream (55)	x	x
S. Fork of Wolf River (57)	x	x
Middle Fork Wolf River (67)	x	x
N. Fork Wolf River (66)	x	x

High Priority Areas for Focused Effort: The WRAPS Stakeholder Leadership Team evaluated smaller areas within the watershed to focus strategic planning and management efforts to have the greatest impact on the TMDL's within the watershed. The criteria for selection included:

1. Is the HUC 12 area included on the KDHE list and map of High Priority TMDLs?
2. Are there livestock facilities near the streams that may contribute fecal coliform to the stream body as determined in the Wolf River Watershed Assessment conduct by KAWS and Blue Earth?,
3. Are there high sediment, nitrogen and phosphorus contribution potential as determined by the STEPL Model analysis?
4. Are there landowners and operators willing to participate in education programs, demonstrations and incorporate best management practices in their operations, and
5. Will there be agency cooperation in the area?

Wolf River HUC 12 areas 102400051203 and 12400051204 were selected as the focus areas for strategic planning. These areas correspond to stream segments South Fork of Wolf River (57) (HUC 12 '03) with a land area of 30,139 acres or 13% of the watershed area, and Halling Creek (68) (HUC 12 '04) with a land area of 37,164 acres or 16% of the watershed land area. The junction of HUC 12 '03 with the Wolf River main stem is located a short distance downstream from the Robinson wastewater discharge point.

NPDES: There are three wastewater dischargers within the Wolf River watershed permitted under the National Pollutant Discharge Elimination System (NPDES). These are:

City of Hiawatha	1.1 million gallons per day (mgd) design flow
Robinson	.072 mgd design flow
Willis	0.01 mgd design flow

The excursion from permitted water quality standards occur under a variety of flow conditions, but particularly during high flow conditions. The incursions from the standards under low flow conditions however will have the greatest impact on macro invertebrate communities in the streams. The Wolf River seems to recover quickly and no residual effects, including toxic effects, were observed at sampling sites downstream from the wastewater treatment plants.

Livestock Waste Management Systems: There are 14 active livestock waste management systems, 6 certified and 9 permitted, mostly located in the upper two thirds of the watershed. The potential animal units are 7,893 although actual number is likely to be less. All of the systems are designed to minimize runoff entering their operation and runoff from their facilities.

Land Use: Based on Kansas GAP Land Cover Data, the predominant land use is cultivated cropland. The land cover area is from the 1992 Natural Resource Inventory (NRI) prepared by the U.S. Department of Agriculture Soil Conservation Service (SCS).

Table 28 - Wolf River Watershed NRI Data Land Cover

Land Cover	Acres	Percent
Water	1,520	0.7
Urban/Developed	2,099	0.9
Barren Transitional	0	0.0
Forest/Woodland	19,343	8.5
Shrub Land	1	0.0
Grassland/Herbaceous	22,470	9.8
Pasture/Hay	43,895,	19.2
Cropland	135,914	59.5
Wetland	3,194	1.40
Total	**228,435**	**100%**

Table 29 - Kansas GAP Land Cover Data Land Use

Cultivated Cropland % of Total Area	Urban Area % of Total Area	Forest % of Total Area	Grasslands % of Total Area	Pasture % of Total Area	Cattle Nemaha Co.	Cattle Marshall Co.
49	<1	3	23	24	38,969	14,413

On-Site Waste Systems: The upper third of the watershed's population density averages 25- 38 persons/sq. mile which is average for similar watersheds. The lower two thirds have a lower density (10-13 persons/ sq. mile.) According to the 1992 and 1998 summary of onsite wastewater systems in the United States from the National Environmental Service Center (EPA Region 5), there are 1,034 septic tank systems in the Wolf River Watershed.

Contributing Runoff: The watershed produces runoff even under relatively low (1.71 in/hr.) rainfall rates. Under very low (1.14 in/hr.) rainfall rates, the potential contributing area is reduced 54%. This runoff may contain sediment, bacteria, plant material, nutrients, and pesticides/herbicides.

Background Levels: Though forests occupy roughly 30% of the 30-meter riparian area, the total grassland (prairie and non-native grasslands) account for 10% of the stream buffer areas where cattle likely have access to the stream channels and likely contribute sediment and/or nutrients to the Wolf River. Most background levels of TSS and associated organics and bacteria come from natural sheet and rill erosion. Some fecal coliform bacteria may be from wild life; however the wildlife density is sufficiently low so that it is unlikely that its contribution is significant. Streambank and bed erosion may also be another important source of suspended solids during high flow events, particularly since significant reaches of the main stem Wolf River were re-channelized and straightened in the early 1920's.

Allocation of Pollution Reduction Responsibility- Biology Impairment: There is an indirect, yet unquantified, relationship between sediment loading and biological integrity. Decreased sediment loads should result in better aquatic communities. Because biological integrity is a function of multiple factors, the initial pollution load reduction responsibility will be to decrease the sediment over the range of flows in the Wolf River. Among other factors affecting the biological integrity of the streams found in the sampling is elevated levels of nitrates.

Point Sources: There are three point NPDES dischargers permitted for TSS in the watershed. The total flow from these dischargers, estimated to be approximately 1.4 cfs, would constitute a flow that is exceeded 99% of the time in Wolf River. Therefore the allocation of pollutants from point sources is from 0 to 5% of the total pollutant load.

Non-Point Sources: The runoff characteristics of the watershed are such that overland runoff can easily carry sediment into the stream reaches. Cultivated land accounts for 72% of the entire watershed, and the sediment impact is observed with even

slightly elevated flows. Therefore, up to 95% of the sediment load is allocated to the non-point sources.

Allocation of Pollution Reduction Responsibility- Fecal Coliform Bacteria:
Bacteria are living organisms with rapid growth rates but whose viability and growth rate is influenced by the environmental conditions. The allocation of bacteria between point sources and non-point sources therefore depends on the flow conditions in the steams because of the presumed ability of the point or non-point sources to have the most impact on the stream water quality. Flows lower than a designated flow will be mostly influenced by the point sources to maintain water quality standards. However, greater flows will be most influenced by the non-point sources.

Point Sources: The Waste Load Allocation for Wolf River is defined at the flow condition of ten times the combined design flow of the point sources or the 7Q10, whichever is greater. (7Q10 is the lowest 7 day average flow in 10 years,) For the Wolf River at Sparks this flow is 0-33 cubic feet per second (cfs), a flow that is exceeded 57 to 99% of the time. The NPDES and state permits must be written so that permitted discharges from permitted facility will meet the criteria at or below this flow.

Non-Point Sources: The non-point sources of bacteria discharged into the streams are seen as the most significant cause of water quality problems in the Wolf River. Background levels of bacteria from natural sources do not appear to be significant. The Water Quality Impairment Analysis for Fecal Coliform Bacteria recommends that activities to reduce the fecal pollution should be directed toward smaller, unpermitted livestock operations and rural homesteads and farmsteads along the river. The Load Allocation assigns responsibility to non-point sources for flow greater than 33 cfs (flow exceeded 58% of the time) at Sparks on the Wolf River.

Pollutant Load Reduction

Biology: The biologic criteria for the Wolf River are based on multi-metric indices. The Wolf River loading capacity (LC) is set by the use of a load duration curve based on the total suspended solids (TSS) concentration measured at various percentiles of flow in a paired reference stream to address the suspended solids standard. The TSS target is used because of the effect excess sediment deposition has on macro invertebrates which use coarse substrates. The impaired use of the Wolf River is Expected Aquatic Life.

The target curve for suspended solid loading curve at SC 201 located at the lower end of the Wolf River is defined as:

Table 30 - Suspended Solid Loading Curve at SC201

Flow Exceedance %	Flow (cfs)	Load Capacity (ton/d)	Waste Load Allocation (ton/d)	Load Allocation (ton/d)	TSS Load Reduction (ton/d)
90	15.6	0.3	0.134	0.2	1.3
80	21.8	0.5	0.134	0.4	1.7
70	24.8	0.8	0.134	0.7	1.8
60	32.2	1.2	0.134	1.1	2.4
50	39.6	1.7	0.134	1.6	2.8
40	49.6	3.0	0.134	2.9	2.9
30	64.4	5.3	0.134	5.2	4.3
20	94.2	11.7	0.134	11.6	10.0
10	178.4	45.5	0.134	45.4	39.7

Note that the Waste Load Allocation is for the NPDES permitted facilities, primarily municipal wastewater treatment facilities. The Load Allocation is applied to non-point sources of runoff. The annual targeted TSS Load Reduction will be the 50% flow exceedance or 2.8 ton/day or 1,022 tons/year. Applying the 150% safety factor as discussed earlier, the WRAPS reduction goal will be 1,500 tons/year.

Bacteria: The impaired use for the Wolf River is contact recreation. The previous criterion for fecal coliform bacteria is 900 colonies per 100 ml for Primary Contact Recreation. The current criteria for primary contact recreation, Class B, are 262 CFUs/ 100 mL from April 1 to October 31 and 2358 CFUs. /100mL from Nov. 1 to March 31.

Since loading capacity varies as a function of the flow present in the stream, the load reduction goal is to achieve a continuum of desired TMDL loads over all flow conditions, rather than a fixed single value. As yet, a loading capacity for animal or human wastes defined as tons or pounds per day have not been established to achieve a given reduction of bacteria colonies within the stream. The desired endpoint of the TMDL reduction is to therefore establish an acceptable level of fecal coliform colonies present in the stream. The desired endpoint, then, is to achieve Kansas Water Quality Standards fully supporting primary contact recreation, or 800 colonies per 100 ml allowing for a 100 colonies per 100 ml margin of error.

The Waste Load Allocation (WLA) (from NPDE permitted point sources) is defined at the flow condition of ten times the combined flow of the point sources, or the 7Q10, whichever is greater. For the Wolf River at Sparks, (the lower end of the river), this flow condition is flows between 0-33 cfs, flows that are exceeded from 57 to 99% of the time. Therefore for high flows, stream greater than 33 cfs, the TMDLS reduction will be allocated to the non-point source Load Allocation and flows less than 33 will be allocated to point source Waste Load Allocation.

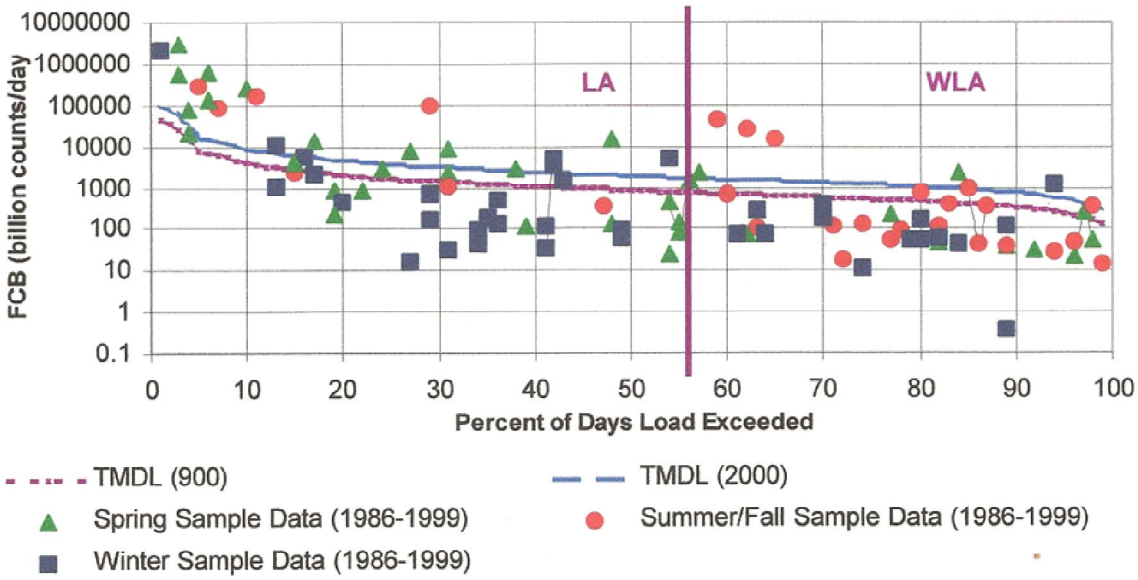

Figure 19 - Fecal Coliform Bacteria TMDLs for Wolf River at Sparks

Cropland and Livestock Conservation Needs:

The Kansas Non-Point Source Needs Inventory looked at the management, structural, and cultivation practices on the cropland within the Watershed that contribute to water quality impairments resulting from non-point source runoff. Based on the Kansas Non-Point Source Needs Inventory, the following practices are needed conservation measures within the Wolf River Watershed

Table 31 - Cropland Treatment Needs: Management

Management	Acres	Percent
Total Acres in Cropland	154,497	
Cropland Management Needed	8,312	5.4
Enhanced Nutrient Management	70,000	45.3
Enhanced Pesticide Management	70,000	45.3
With Nutrient Management Plan	17,500	11.3
Annual Soil Sampling	0	0
Acres in No-Till Cultivation	121,453	78.6
Acres in Ridge Till Cultivation	22,900	14.8
Increased Crop Residue Needed	10,144	6.6

Table 32 - Cropland Treatment Needs: Structural

Management	Acres	Percent
Total Acres in Cropland	154,497	
Structural Treatment Needed	43,246	28.0
New Terraces Needed	13,325	8.6
Terraces Restoration	13,325	8.6
New Waterways Needed	200	0.2
Waterways Needing Restoration	200	0.01
Area Needing Diversions	1,150	0.7
Area Needing Grade Stabilization	8,500	5.5
Area Needing Water/Sediment Control Basins	4,000	2.6
Area Needing Conversion to Permanent Vegetation (Steep Slopes)	8,200	5.3
Area Need to Convert to Wetlands	4,025	2.6

Goal Reduction to Meet Water Quality Standard:

The goal is to reduce TSS 2.8 tons/day average or 1,022 tons per year and E Coli bacteria 262 CFUs/100mL April 1 to Oct. 31 and 2,358 CFUs /100mL Nov.1 to March 21. Applying the safety factor of 150% to the TSS loading, the goal for TSS reduction will be 1,500 tons/year.

Biology and Fecal Bacteria TMDL load reduction will be focused in HUC 12's – 102400051203 and 102400051204 initially but applicable BM's will be initiated and applied wherever possible to achieve the desired level of TMDL reduction.

The TMDLs in the Wolf River Watershed are highly influenced by the sediment, livestock wastes and nutrients, particularly nitrogen and phosphorus, that enter into the surface waters and ultimately into the Wolf River. BMP's are therefore selected to achieve the economical high impact to reduce these influencing factors.

Note that the Wolf River Watershed Assessment conducted by KAWS and Blue Earth for the Missouri River Basin WRAPS in 2009 identified potentially 40,352 linear feet of stream bank stabilization.

Table 33 - Proposed Wolf River Biology & Fecal Coliform BMPs

Best Management Practice	TMDL	Amount	Units	Load Reductions			Unit Costs	Total Cost	Comments
				Nitrogen lbs./yr.	Phosphor. lbs./yr.	Sediment Tons/yr.			
Crop Production									
No Till Farming	TSS, N, P	100	Acres	133	107	142	**$25**	**$2,500**	
Cover Crops	TSS, N, P	50	Acres	59	29	26	**$66**	**$3,280**	
Vegetative									
Grass Buffer Strips	TSS, N, P,FC	20	Acres	649	464	318	**$215**	**$4,300**	1 ac buffer/20 ac cropland
Forested Buffer Strips	TSS, N, P	20	Acres	649	464	318	**$494**	**$9,880**	1 ac buffer/20 ac cropland
Convert Steep Slopes to Permanent Veg.	TSS, P, N	50	Acres	260	113	89	**$225**	**$11,250**	
Structural									
Stream Stabilization	TSS	900	Ln. Ft.	1,620	810	810	**$72**	**$64,800**	*
Sedimentation Basins	TSS	5	Basins	501	356	248	**$5,000**	**$25,000**	**
Land Management									
Pasture Management	FC	250	Each	86	43	29	**$15**	**$3,750**	
Nutrient Management	P, N	1,500	Acres	1,777	889	0	**$13**	**$18,750**	
Waste Management									
Livestock Waste Management	FC	10	Each	16,150	3,630	0	**$20,000**	**$200,000**	Assumes each operation is 60 AU
On-Site Waste System Repair.	FC	10	Each	120	46	0	**$5,000**	**$50,000**	Assumes 100 gal/day system
Alternative Water Supply	FC	22	Each	0	7,546		**$3,795**	**$83,490**	Assumes each operation is 60 AU
Total				21,970	14,499	1,980		**$477,000**	

* Assumed average bank height of 10 ft. and lateral recession rate of 3 ft. /yr.

** Assumes the 5 basins will collect runoff from 300 acres total.

Table 34 - Proposed Wolf River High Priority HUC 12 102400051203 and 12400051204 Biology & Fecal Coliform BMPs

Best Management Practice	TMDL	Amount	Units	Load Reductions			Unit Costs	Total Cost	Comments
				Nitrogen lbs./yr.	Phosphor. lbs./yr.	Sediment Tons/yr.			
Crop Production									
No Till Farming	TSS, N, P	50	Acres	66	53	71	**$25**	**$1,250**	
Cover Crops	TSS, N, P	50	Acres	59	29	26	**$66**	**$3,280**	
Vegetative									
Grass Buffer Strips	TSS, N, P,FC	20	Acres	649	464	318	**$215**	**$4,300**	1 ac buffer/20 ac cropland
Forested Buffer Strips	TSS, N, P	20	Acres	649	464	318	**$494**	**$9,880**	1 ac buffer/20 ac cropland
Convert Steep Slopes to Permanent Veg.	TSS, P, N	50	Acres	260	113	89	**$225**	**$11,250**	
Structural									
Stream Stabilization	TSS	900	Ln. Ft.	1,620	810	810	**$72**	**$64,800**	*
Sedimentation Basins	TSS	5	Basins	501	356	248	**$5,000**	**$25,000**	**
Land Management									
Pasture Management	FC	250	Acres	86	43	29	**$15**	**$3,750**	
Nutrient Management	P, N	1,500	Acres	1,777	889	0	**$13**	**$18,750**	
Waste Management									
Livestock Waste Management	FC	8	Each	12,900	2,900	0	**$20,000**	**$160,000**	Assumes each operation is 60 AU
On-Site Waste System Repair.	FC	5	Each	60	23	0	**$5,000**	**$25,000**	Assumes 100 gal/day system
Alternative Water Supply	FC	10	Each	0	3,430	0	**$3,795**	**$37,950**	Assumes each operation is 60 AU
Total				18,627	9,574	1,909		**$365,210**	

- * Assumed average bank height of 10 ft. and lateral recession rate of 3 ft. /yr.
- ** Assumes the 5 basins will collect runoff from 300 acres total.

South Fork Big Nemaha (HUC 010240007)

Drainage Area: 517 square miles (314.6 square miles in Kansas.)

Water Quality Impairment: Biology, Fecal Coliform Bacteria

Segments with Water Quality Impairment:

Main Stem Segments: Segments 3, 15 and 16; starting at the state line continuing upstream to headwaters near Corning – both Biology and Fecal Coliform Bacteria

Tributary Segments:	Biology	FCB
Turkey Creek (4 & 5)	x	x
Burger Creek (24)	x	x
Wolf River (12, 1)	x	x
Manley Creek (14)	x	x
Wildcat Creek (22)	x	x
Clear Creek (132)	x	x
Deer Creek (18)	x	x
Wolf Pen Creek	x	x
Harris Creek (166)	x	x
Wildcat Creek (23)	x	x
Fisher Creek (28)	x	x
Tennessee Creek (29)	x	x
Illinois Creek (30)	x	x

High Priority Areas for Focused Effort: The WRAPS Stakeholder Leadership Team evaluated smaller areas within the watershed to focus strategic planning and management efforts to have the greatest impact on the TMDL's within the watershed. The criteria for selection included:

1. Is the HUC 12 area included on the KDHE list and map of High Priority TMDLs.?
2. Are there livestock facilities near the streams that may contribute fecal coliform to the stream body as determined in the Wolf River Watershed Assessment conduct by KAWS and Blue Earth?,
3. Are there high sediment, nitrogen and phosphorus contribution potential as determined by the STEPL Model analysis?
4. Are there landowners and operators willing to participate in education programs, demonstrations and incorporate best management practices in their operations, and
5. Will there be agency cooperation in the area?

Based on these criteria, the South Fork Big Nemaha HUC 12 area for focused high priority focused effort will be 102300070205 or the Wildcat Creek watershed. HUC 102300070205 contains 28,636 acres or 12.5% of the total watershed area. A NPDES permitted discharging facility from a confined animal feeding operation (CAFO) is located on the junction of Wildcat Creek and the South Fork Big Nemaha in HUC 12 102300070205.

NPDES: There are six NPDEs permitted municipal wastewater plants within the South Fork Big Nemaha watershed permitted under the NPDES discharge permits. Note that two of these plants are located in Nemaha County, Kansas while four are located in Pawnee County, Nebraska. This is because the majority of the drainage area of Turkey Creek is located in Pawnee County, Nebraska, with the confluence with the South Fork Big Nemaha 3.2 miles south of the Kansas/Nebraska state line. These wastewater treatment plants are:

Oneida, KS	Harris Creek	0.01 mgd design flow
Seneca, KS	S.F. Big Nemaha	0.50 mgd design flow
Pawnee, NE	Turkey Creek	0134 mgd design flow
Burchard, NE	Turkey Creek	0.004 mgd design flow
Steinauer, NE	Turkey Creek	0.003 mgd design flow
Lewiston, NE	Turkey Creek	0.002 mgd design flow

The combined 2000 population of the wastewater treatment facilities in Nebraska is 1,296, whereas the combined population for the Oneida and Seneca wastewater treatment facilities in Kansas is 2,192. Population projections for Oneida for 2020 are for a slight decline while Seneca is projected to have a slight growth over this period.

Livestock Waste Management Systems: There are 97 confined animal feeding operations (CAFO) sites in this watershed. Sixty-eight of these are either certified (13) or permitted (55). One CAFO has had NPDES permit for 9.650 head of pigs. All of the permitted livestock facilities have waste management systems designed to minimize runoff entering their operation or detain runoff leaving their facilities for flow less than expected 1 to 5% of the time.

Land Use: The land cover data is from the 1992 Natural Resource Inventory (NRI) prepared by the U.S. Department of Agriculture Soil Conservation Service (SCS).

Table 35 - South Fork Big Nemaha Watershed NRI Land Cover

Land Cover	Acres	Percent
Water	431	0.2
Urban/Developed	1,252	0.7
Barren Transitional	1	0.0
Forest/Woodland	7,440	3.3
Shrub Land	214	0.01
Grassland/Herbaceous	39,994	17.5
Pasture/Hay	61,651,	28.7
Cropland	119,923	52.3
Wetland	2,197	1. 0
Total	**229,103**	**100%**

Based on the Kansas GAP Land Cover Data, some shifts in land use are observed, particularly the increase in pasture land accompanied by a decrease in cultivated

Table 36 - South Fork Big Nemaha Gap Land Use

Cultivated Cropland % of Total Area	Urban Area % of Total Area	Forest % of Total Area	Grasslands % of Total Area	Pasture % of Total Area	Cattle Nemaha Co.	Cattle Marshall Co.
49	<1	3	23	24	38,969	14,413

There are 13,044 acres of riparian area (30 meter wide) in the watershed, of which 38% is cropland, 17% grassland, 27% pasture and 17% forested.

On-Site Waste Systems: According to the 1990 U.S. Census Bureau, there were 1,096 septic systems in the watersheds; 758 in Nemaha County, 62 in Marshall County and the remainder in Nebraska. A comparison of farm to non-farm families within the watershed shows a significant decline of non-farm families that tend to rely on septic system during the period from 1990 to 2000; a trend that is expected to continue. Though failing on-site systems can contribute sediments and nutrients, the effects in the streams is likely associated with low flows.

Contributing Runoff: The areas of the watershed in Kansas have an average soil permeability of 0.4 inches per hour according to NRCS STATSGO data base. Generally, rainfall events of less than 0.57 inches per hour will produce runoff from 82% of the area.

Background Levels: The forest occupies 17% of the 30 m. riparian area but 27% is pasture where cattle may have access to the streams channels and contribute sediment, nutrients and bacteria. Most of the background levels of total suspended solids and the associated organics and nutrients come from natural sheet and rill erosion from the overland runoff. Stream bank and bed erosion may also be another important source of suspended solids during high flow events.

Some fecal bacteria in the environmental background levels include contribution from wildlife, but it is likely that the density of wildlife is sufficiently low that its contribution to water quality is not significant.

Allocation of Pollution Reduction Responsibility-

Biology Impairment: There is an indirect, yet unqualified, relationship between sediment loading and biological integrity. Decreased sediment loads should result in better aquatic communities. Because biological integrity is a function of multiple factors, the initial pollution load reduction responsibility will be to decrease the sediment over the range of flows in the South Fork Big Nemaha River.

Point Sources: The combined flow from the six NPDES dischargers into the surface waters is 0.653 mgd or 1.05 cfs. This flow is exceeded more than 95% of the time at the monitoring site near Bern. The TSS discharge permits for the two Kansas wastewater treatment facility monthly limit is 80 mg/l. At very low flows the permitted discharges will have some contribution to the pollution loads. The total Waste Load allocation (WLA) from the two Kansas wastewater treatment plants and the 97 CAFO facilities is 0.170 tons/day, which is all from the wastewater treatment plants. Maintenance of the current conditions is assumed for the low flow loading with the permitted TSS discharge from the treatment facilities.

Non-Point Sources: Given the watershed characteristics, overland runoff easily carries sediment into the streams. There is a combination of urban and rural non-point sources contributing to downstream biological impairment. These non-point sources tend to become dominate in higher flow conditions. A 71% reduction in the sediment is required to establish the desired stream conditions for biological communities in the South Fork Big Nemaha River.

Bacteria impairment: Bacteria are living organisms with rapid growth rates but whose viability and growth rate is are influenced by the environmental conditions. The allocation of bacteria between point sources and non-point sources therefore depends on the flow conditions in the steams because of the presumed ability of the point or non-point sources to have the most impact on the stream water quality. Flows lower than a designated flow will be mostly influenced by the point sources to maintain water quality standards. However, greater flows will be most influenced by the non-point sources.

Point Sources: There are two NPDES Kansas permitted dischargers into the South Fork Big Nemaha watershed system. The Waste Load Allocation is defined at the flow condition ten times the design flow of contributing point sources (Oneida and Seneca) or the 7Q10 flow, whichever is greater. At the watershed's lowest testing site near Bern, this flow condition is 0 - 5.5 cfs which

is exceeded 93 to 99% of the time. The NPDES permits should continue to be structured so that the facilities will not produce violations to the above conditions.

Non-Point Sources: Based on the assessment of sources, and the distributions of the high occurrence of high FCB sampling counts in high flow conditions, non-point sources are seen as a significant cause of water quality violations. Background levels are not significant. Best Management Practices will be directed toward those activities what contribute to the FCB at times when the stream flow is greater than 5.5 cfs.

Pollutant Load Reduction

Biology: The biologic criteria for the South Fork of the Big Nemaha are based on multi-metric indices. The South Fork loading capacity (LC) is set by the use of a load duration curve based on the total suspended solids (TSS) concentration measured at various percentiles of flow in a paired reference stream to address the suspended solids standard. The TSS target is used because of the effect excess sediment deposition has on macro invertebrates which use coarse substrates. At median flow (50^{th} percentile flow exceedance), the target is 3.87 tons/day of TSS, a 0.3 tons/day TSS for that flow at the Permanent Ambient Stream Water Quality Station (SC 234) located at the lower end of the watershed near Bern. The impaired use of the Wolf River is Expected Aquatic Life. The designated use is primary contact recreation for three segments (3, 15, and 16) of the main stem and secondary contact recreation for the affected tributaries and the two remaining main stem segments.

The target curve for suspended solid loading curve at SC 234 located at the lower end of the South Fork is defined as:

Table 37 - South Fork Loading Curve

Flow Exceedance %	Flow (cfs)	Load Capacity (ton/d)	Waste Load Allocation (ton/d)	Load Allocation (ton/d)	TSS Load Reduction (ton/d)
90	3.4	0.47	0.17	0.3	0.0
80	8.6	1.0	0.17	0.8	0.0
70	15.9	1.6	0.17	1.4	0.0
60	24.4	2.5	0.17	2.2	0.0
50	37.5	4.2	0.17	3.7	0.3
40	59.9	13.2	0.17	9.6	3.5
30	95.5	37.8	0.17	24.3	13.3
20	159.2	110.7	0.17	67.4	43.1
10	369.0	627.4	0.17	361.1	266.1

Note that the Waste Load Allocation is for the NPDES permitted facilities, primarily municipal wastewater treatment facilities. The Load Allocation is applied to non-point

sources of runoff. The targeted TSS load reduction is the 50% flow exceedance of 0.3 ton/day or 110 tons per year although attention will be given to reduction of the 10% flow exceedance which contributes 9,700 tons per year of TSS to the waters of the stream. Increasing the targeted load reduction by a safety factor of 150% as discussed above yields a goal TSS reduction of 165 tons per year.

Bacteria: The bacteria impaired use for the South Fork Big Nemaha is Contact Recreation. The designated uses include special aquatic life support in addition to others such as food procurement and ground water recharge. The previous criterion for fecal coliform bacteria is 900 colonies per 100 ml for Primary Contact Recreation. The current criteria for Primary Contact Recreation, Class B, are 262 CFUs/ 100 mL from April 1 to October 31 and 2358 CFUs. /100mL from Nov. 1 to March 31.

Since loading capacity varies as a function of the flow present in the stream, the load reduction goal is to achieve a continuum of desired TMDL loads over all flow conditions, rather than a fixed single value. As yet, a loading capacity for animal or human wastes defined as tons or pounds per day have not been established to achieve a given reduction of bacteria colonies within the stream. The desired endpoint of the TMDL reduction is to therefore establish an acceptable level of fecal coliform colonies present in the stream. The desired endpoint is to achieve Kansas Water Quality Standards fully supporting primary contact recreation, Class B or 262 CFUs/ 100 mL from April 1 to October 31 and 2358 CFUs. /100mL from Nov. 1 to March 31.

The Waste Load Allocation (WLA) (from NPDE permitted point sources) is defined at the flow condition of ten times the combined flow of the point sources, or the 7Q10, whichever is greater. For the South Fork of Big Nemaha at Bern, sampling station (SC234 is at the lower end of the river,) this flow condition is flows between 0-5.5 cfs, flows that are exceeded from 93% to 99% of the time. Therefore, for high flows, stream greater than 5.5 cfs, the TMDLS reduction will be allocated to the non-point source Load Allocation and flows less than 5.5 will be allocated to point source Waste Load Allocation.

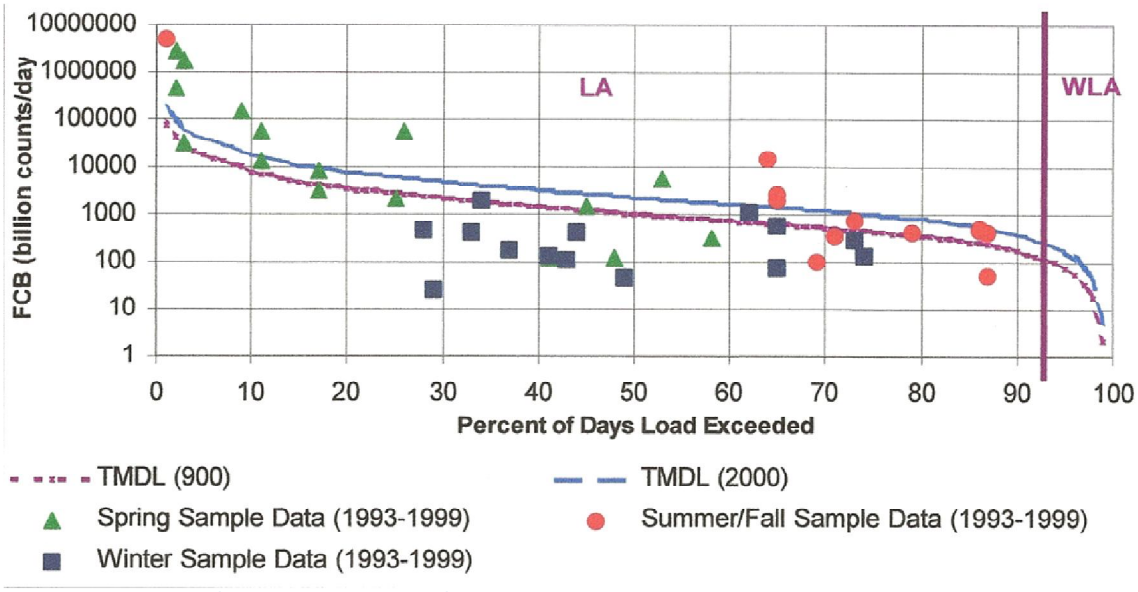

Figure 20 - Fecal Coliform Bacteria TMDL for South Fork Big Nemaha near Bern

Cropland and Livestock Conservation Needs:

Based on the Kansas Non-Point Source Needs Inventory, the following practices have been identified as needed conservation measures within the South Fork Big Nemaha Watershed.

Table 38 - Cropland Treatment Needs: Management

Management	Acres	Percent
Total Acres in Cropland	121,536	
Cropland Management Needed	46,292	38.1
Enhanced Nutrient Management	27,792	22.9
Enhanced Pesticide Management	27,792	22.9
With Nutrient Management Plan	16,200	13.3
Annual Soil Sampling	50,000	41.1
Acres in No-Till Cultivation	56,000	46.1
Acres in Ridge Till Cultivation	0	0
Increased Crop Residue Needed	1,134	0.9

Table 39 - Conservation Treatment Needs: Structural

Management	Acres	Percent
Total Acres in Cropland	121,536	
Structural Treatment Needed	32,100	26.4
New Terraces Needed	24,510	20.2
Terrace Restoration	4,052	3.3
New Waterways Needed	617	0.5
Waterways Needing Restoration	1,842	1.5
Area Needing Diversions	334	0.3
Area Needing Grade Stabilization	385	0.3
Area Needing Water/Sediment Control Basins	390	0.3
Area Needing Conversion to Permanent Vegetation (Steep Slopes)	1,107	0.9
Area Need to Convert to Wetlands	52	0.0

Reduction Goal to Meet Water Quality Standard: The goal is to reduce TSS 3.5 tons/day average or 1,278 tons per year. Increasing the goal by the 150% safety factor as noted above yields a TSS goal reduction of 1,917 tons/year. The goal for E coli bacteria is 262 CFUs/100mL for April 1 to Oct. 31 and 2,358 CFUs /100mL for Nov.1 to March 21.

Biology and Bacteria TMDL Load Reduction will be focused in HUC 12's – 102400070205, the Wildcat Creek Watershed initially but applicable BMPs will be initiated and applied wherever possible to achieve the desired level of TMDL reduction.

The TMDLs in the South Fork Big Nemaha Watershed are highly influenced by the sediment, livestock wastes and nutrients, particularly nitrogen and phosphorus, that enter into the surface waters and ultimately into the South Fork Big Nemaha River. BMPs are selected to achieve the economical highest impact to reduce these influencing factors.

The Kansas Water Office conducted aerial photograph studies of the South Fork Big Nemaha in 2010 and identified 87 streambank erosion sites with a surface area greater than 1,500 s,f, although only three of these were in HUC 102400070205.

Table 40 -Proposed South Fork Big Nemaha Biology & Fecal Coliform BMPs

Best Management Practice	TMDL	Amount	Units	Load Reductions			Unit Costs	Total Cost	Comments
				Nitrogen lbs./yr.	Phosphor. lbs./yr.	Sediment Tons/yr.			
Vegetative									
Grass Buffer Strips	TSS, N, P,FC	30	Acres	1,090	779	550	$215	**$6,450**	1 acre buffer/20 acres cropland
Structural									
Stream Stabilization	TSS	1,500	Ln. Ft.	2,700	1,350	1, 350	$72	**$108,000**	*
Land Management									
Pasture Management	FC	250	Acres	41	20	11	$15	**$3,750**	
Nutrient Management	P, N	250	Acres	413	207	N/A	$13	**$3,135**	
Waste Management									
Livestock Waste Management	FC	7	Each	11,767	2,646	N/A	$20,000	**$140,000**	Assumes each operation is 60 AU
Livestock Production									
Alternative Water Supply	FC	50	Each	N/A	17,850	N/A	$3,795	**$189,759**	Assumes each operation is 60 AU
Total				16,011	22,852	1,911		**$451,094**	

* Assumed average bank height of 10 ft. and lateral recession rate of 3 ft. /yr.

Table 41 - Proposed South Fork Big Nemaha Biology & Fecal Coliform BMPs in High Priority Area HUC 102400070205

Best Management Practice	TMDL	Amount	Units	Load Reductions			Unit Costs	Total Cost	Comments
				Nitrogen lbs./yr.	Phosphor. lbs./yr.	Sediment Tons/yr.			
Vegetative									
Grass Buffer Strips	TSS, N, P,FC	30	Acres	1,090	779	550	$215	**$6,450**	1 acre buffer/20 acres cropland
Structural									
Stream Stabilization	TSS	1,300	Ln. Ft.	2,340	1,170	1, 170	$72	**$93,600**	*
Land Management									
Pasture Management	FC	250	Acres	41	20	11	$15	**$3,750**	
Nutrient Management	P, N	250	Acres	413	207	N/A	$13	**$3,135**	
Waste Management									
Livestock Waste Management	FC	7	Each	11,767	2,646	N/A	$20,000	**$140,000**	Assumes each operation is 60 AU
Livestock Production									
Alternative Water Supply	FC	20	Each	N/A	7,140	N/A	$3,795	**$75,900**	Assumes each operation is 60 AU
Total				15,650	11,960	1,730		**$322,835**	

Pony Creek Lake, Big Nemaha Watershed (HUC 102400080402)

Pony Creek Lake Area: 7.37 square miles

Water Quality Impairment: Eutrophication

Watershed: Big Nemaha

Tributary with Water Quality Impairment: HUC 12 102400080402

High Priority Areas for Focused Effort: The WRAPS Stakeholder Leadership Team evaluated smaller areas within the watershed to focus strategic planning and management efforts to have the greatest impact on the TMDL's within the watershed. Because the Pony Creek Lake Area watershed is small, the entire area will be the high priority area for focused effort. The Pony Creek Lake Area is smaller (4,717 acres) than the HUC 12 102400080402 (38,676 acres) area.

NPDES: Pony Creek Lake is a public water supply source for the City of Sabetha. There are no NPDES permitted wastewater treatment facilities in the watershed.

Livestock Waste Management Systems: There are two active confined animal feeding operations within the watershed and one operation adjacent to the watershed where animals possibly cross over into the tributary watershed. The permitted capacities for the CAFOs are 300 beef animal units and 740 beef and swine animal units. The adjacent operation is permitted for 740 beef, swine and horse animal units. These CAFOs do not require a NPDES permit because of their small size.

Land Use: The drainage area is 7.37 square miles or 4,716 acres.

Table 42 - Pony Creek Watershed HUC 12 1002400080402 Land Cover

Land Cover	Acres	Per Cent
Water	25	0.5
Urban/Developed	375	8.0
Forest/Woodland	354	7.5
Grassland/Herbaceous	660	14
Pasture/Hay	1,368	29
Cropland	1,887	40
Wetland	47	1
Total	4,716	100%

There is a high potential for non-point source pollutants, particularly phosphorus from agricultural applications, urban lawns and golf courses. Phosphorus is a major contributor to eutrophication in this lake.

On-Site Waste Systems: Based on the 1990 census data, about 30% of the households in Brown and Nemaha County are on septic systems. There are 16 septic systems within the City of Sabetha. Therefore, it is likely that there are a few septic systems within the watersheds that are failing and may contribute nutrients (mainly nitrogen) to the Pony Creek Lake.

Contributing Runoff: The Pony Creek Watershed has a mean soil permeability of 0.46 inches per hour. Runoff is generated when the rainfall intensities is greater than the soil permeability. Consequently overland runoff occurs with relatively small rainfall events.

Background Levels: Leaf litter and plant and animal wastes may add to the nutrient load in the lake. Atmospheric and geologic formations may also contribute small nutrient loads to the lake.

Allocation of Pollution Reduction Responsibility: Phosphorus and nitrogen are predominately co-limiting nutrients in Pony Creek Lake. Based on a general inventory of sources within the drainage area, load reduction should focus on non-point sources contributions of runoff containing livestock wastes and fertilizers.

> ***Point Sources***: Since there are no NPDES discharging sources and livestock facilities have a Waste Load allocation of zero, point discharge Waste Load Allocation is zero and no pollution reduction responsibility is allocated to point sources.
>
> ***Non-Point Sources:*** Based on an assessment of existing and potential pollution sources, allocation of the pollution reduction responsibility is directed at non-point sources of cropland and urban runoff and animal wastes. Load reduction should be focused on non-point source runoff contribution from livestock wastes and fertilizer applications.

Pollutant Load Reduction: Pony Creek Lake is in the Nemaha River Watershed, (HUC 102400080402). The designated uses include primary contact recreation, expected aquatic life support, domestic water supply, food processing, industrial water supply, recreation and livestock water use. All uses are impaired due to the eutrophication in the lake. The level of eutrophication is “very eutrophic” with a Carlson Trophic State Index (TSI) of 61.43.

The Waterbody Assessment conducted by KDHE identified nitrogen and phosphorus as responsible for the growth of objectionable concentrations of algae which is linked to eutrophication. The ratios of Nitrogen to phosphorus and phosphorus to chlorophyll were used to determine the limiting nutrient loads. Based on this analysis, the algal growth is either co-limited by nitrogen and phosphorus or phosphorus limited. The target chlorophyll concentration less than 10 µg/L should be attained. Pony Creek Lake phosphorus and nitrogen loading is provided in Table 43

There are no permitted NPDES facilities within the watershed. Therefore the allocation for loading is assigned to the non-point sources.

Table 43 - Pony Creek Lake Phosphorus and Nitrogen Loading

Loads	Phosphorus		Nitrogen	
	Daily Load Pounds/day	Annual Load Pounds/year	Daily Load Pounds/day	Annual Load Pounds/year
Current Load	15.42	2,355	215.97	29,414
Load Capacity	6.92	1,057	106.9	14,553
Load Allocation	6.23	951	96.2	13,100
Load Reduction		1,298	36.5	14,861

Reduction Goal to Meet Water Quality Standard: The recorded Chlorophyll a current condition is 26.12 µg/L; the desired Chlorophyll a concentration is less than 10 µg/L. To achieve this desired Chlorophyll α concentration, the goal will be to reduce phosphorus loading 1,298 lbs. /yr. and nitrogen 14,861 lbs./yr. Rather than the 150% safety factor discussed earlier, a 120% safety factor is being applied since this is such a small watershed. Therefore the load reduction goal will be phosphorus loading reduction is 1,557 lbs./yr. and nitrogen loading reduction of 17,830 lbs./yr.

The loading reduction BMP efforts will be focused to the Pony Creek Lake Area of HUC 12: 102400080402.

The TMDL's in the Pony Creek Lake result primarily from crop and urban nutrient runoff and animal wastes. Therefore management practices will focus removal of fertilizers, animal wastes and urban runoff from on non-point source runoff within the watershed.

BMP Selection Method: The SLT reviewed the information developed by KDHE in support of TMDL development within the Missouri River Basin and specifically for Pony Creek Lake. Conversations were held with NRCS and Conservation District staff of the various BMPs that would address the contributing factors to the excess nutrient loading. The SLT selected practices to be included in the plan based on the predicted effectiveness, reasonable cost, and ones that can be expected to be adopted and maintained by the producer and other nutrient contributors.

Table 44 - Proposed Pony Creek Nitrogen and Phosphorus BMPs

Best Management Practice BMP	TMDL	Amount	Units	Load Reduction			Unit Costs	Total Costs	Comments
				Nitrogen lbs./yr.	Phosphorus lbs./yr.	Sediment tons/yr.			
Crop Production									
No Till Farming	TSS, N, P	720	Acres	6,165	3,085	2,365	$20	$14,400	
Vegetative									
Grass Buffer Strips	TSS, N, P,FC	100	Acres	2,890	2,060	1,375	$215	$21,500	Assumes 1 Ac buffer protect 20 Acres
Forested Buffer Strips	TSS, N, P	100	Acres	3,200	2,300	1,550	$494	$49,400	Assumes 1 Ac buffer protect 20 Acres
Land Management									
Pasture Management	FC	500	Acres	65	330	15	$15	$750	
Nutrient Management	P, N	2,000	Acres	1,910	960	N/A	$13	$26,000	
Waste Management									
Livestock Waste Management	F.C.	3	Each	5,040	1,130	N/A	$20,000	$60,000	Assumes 60 AU /operations
Urban Lawn Management	TSS, N, P	35	Acres	[1]	[1]	[1]	$950	$33,350	
Livestock Production									
Alternative Livestock Watering	FC	5	Each	N/A	1,750	N/A	$3,795	$18,975	Assumes 60 AU /operations
Total				**19,268**	**11,815**	**5,305**		**$224,375**	

1 We have not found reliable pollutant load reduction data for Urban Runoff Management. We know that communities, such as Kansas City, have found that up to 25% of the bacteria loading in the urban runoff can be traced to pet waste and there is substantial nutrient loading in urban runoff resulting from lawn over-fertilizing and extensive lawn irrigation. Therefore, it is assumed that Urban Runoff Management will result in significant pollutant loading reduction.

Atchison County State Fishing Lake, Independence- Sugar Watershed
(HUC 102400110202)

Drainage Area: 3.5 square miles (2,240 acres +/-)

Water Quality Impairment: Siltation

Watershed: Independence-Sugar

Tributary with Water Quality Impairment: HUC 12 102400110202

High Priority Areas for Focused Effort: The high priority area for focused effort will be the Atchison County State Fishing Lake Area in the HUC 12, 10240011202. The Atchison County State Fishing Lake Area watershed is 2,240 Acres which is 6% of the total HUC 12 102400110202 area (37,764 acres.)

NPDES: There are no NPDES permitted wastewater treatment facilities in the watershed.

Livestock Waste Management Systems: There are no permitted livestock management systems or CAFOs in the watershed. Aerial photographs indicated there is one livestock feeding operation within the watershed. Livestock grazing density is moderate.

Land Use: The topography within the watershed is cropland with steeply sloping wooded areas and pastures. The soils are predominately highly erodible loams. Erosion from the cropland areas is likely the dominate source of sediment entering the Atchison County State Fishing Lake.

Table 45 - Atchison County State Fishing Lake Watershed HUC 12 1002400080402, Land Cover

Land Cover	Acres	Per Cent
Water	75	4
Urban/Developed		0
Forest/Woodland	656	29
Grassland/Herbaceous	69	3
Pasture/Hay	202	9
Cropland	1,216	54
Wetland	22	1
Total	2,240	100%

On-Site Waste Systems: There are eight rural residences in the watershed which are likely to have on-site waste systems.

Contributing Runoff: KDHE used a watershed model (AGNPS) to estimate the loading of sediment under current land management. Model results indicate an annual average yield of 2,800 tons of sediment per year. This includes more than 7,000 pounds of phosphorus per year and more than 14,000 pounds of nitrogen per year. Sediment yields ranged from 1 ton per acre in the western portion of the watershed to 23 tons per acres in a row crop field in the southwest corner of the watershed.

Background Levels: Because of the forested and woodland areas, some of the nutrient loading may be from leaf litter and wildlife wastes. Nutrient recycling, atmospheric deposition and geological formations may contribute to the phosphorus loading.

Other Sources: The Kansas Department of Wildlife and Parks maintain a series of fish feeders at the lake, feeding 6,000 lbs. of fish food annually. This is estimated to add 60 lbs. of phosphorus to the lake.

Allocation of Pollution Reduction Responsibility: Sediment is the primary pollutant of concern in Atchison County State Fishing Lake.

> ***Point Sources***: There are no point sources of sediment discharge within the watershed therefore the Waste Load Allocation from point sources is zero.
>
> ***Non-Point Sources:*** Water quality impairments are primarily due to non-point source pollutants from soil erosion in the watershed.

Pollutant Load Reduction: Atchison County State Fishing Lake is in the Independence Sugar Watershed, (HUC 102400110202). Primary contact recreation, expected aquatic life support and food procurement use are impaired. The designated uses include the impaired uses plus domestic water supply, industrial water supply and livestock watering. The lake is typically anoxic at the 2 meter depth, and surface pH has exceeded 8.5 during two sampling events. The TSS has averaged 9 mg/l and the average chlorophyll A at the surface has been 32 ppb, significantly above the acceptable limits of less than 10 ppb.

The Waterbody Assessment conducted by KDHE identified ongoing siltation reducing the size of the lake arms. The still, deep water of the main basin combined with locally minimal wind, keeps TSS low, so the major concern is sedimentation.

Modeling (AGNPS) indicate that the annual sediment average yield into the lake is 2,800 tons of sediment per year. This corresponds to more than 7,000 pounds of phosphorus per year and more than 14,000 pounds of nitrogen per year.

The Loading Capacity (LC) of the lake is calculated to be 2,442 tons per year or 16.59 tons per day. The endpoint is to reduce the sediment yield across the watershed to no more than 5 tons per acre which is a reduction of 368 tons/year. This corresponds to the acceptable T-value for soil erosion established by NCRS. This reduction of 368 tons per year, for a non-point source load allocation (LA) of 2,199 tons/year. There are no permitted NPDES facilities so the Waste Load

allocation (WLA) is zero. The margin of safety (MOS) is equal to 10% of the load allocation or 243 tons/year.

Table 46 - Atchison County State Fishing Lake Sediment Loading

Loads	Sediment	
	Daily Load Tons/day	Annual Load Tons/year
Current Load		2,800
Load Capacity	17.95	2,442
Waste Load Allocation	0	0
Load Allocation	16.16	2,199
Background Allocation	0	0
Load Reduction	1	368
Margin of Safety (MOS)	1.795	243
Total Reduction Goal		601

Reduction Goal to Meet Water Quality Standard: Reduce Sediment load 368 tons/year. Applying the safety factor of 150% as discussed earlier, the calculated Goal is to reduce the sediment load by 550 tons/year. The recommended margin of safety included in KDHE's TMDL analysis approved by EPA Region 5 on September 5, 2007 is 243 Tons/yr. This is a total load reduction of 601 Tons/year, which is the value that will be used in this plan,

The loading reduction BMP efforts will be focused in HUC 12, 102400110202, the area tributary to Atchison County State Fishing Lake.

TMDL's found in Atchison County State Fishing Lake is the result of soil erosion from adjacent cropland areas. Therefore management practices will focus on erosion control measures on cropland.

BMP Selection Method: The SLT reviewed the information developed by KDHE in support of the TMDL development within the Missouri River Basin and specifically for Atchison County State Fishing Lake. A site visit was made to assess the drainage area. Conversations were held with the Kansas Wildlife, Parks and Tourism officer on the site, and NRCS and Conservation District staff and the SLT of the various BMP that would address the factors contributing to the excess sediment loading. The SLT selected plan practices based on predicted effectiveness, reasonable cost, and ones that can be expected to be adapted and maintained by the producer and other nutrient contributors within the project area.

Table 47 - Proposed Atchison County State Fishing Lake BMPs for Sediment

Best Management Practice BMP	TMDL	Amount	Units	Load Reduction			Unit Costs	Total Costs	Comment
				Nitrogen lbs./yr.	Phosphorus lbs./yr.	Sediment Tons/yr.			
Crop Production									
No Till Farming	TSS, N, P	250	Acres	1,250	6,225	540	$20	$5,000	
Cover Crops	TSS, N, P	100	Acres	168	80	80	$66	$6,600	
Vegetative									
Grass Buffer Strips	TSS, N, P,FC	20	Acres	995	713	545	$215	$4,300	Assumes 1 acre buffer per 20 acre cropland
Structural									
Sedimentation Basins	TSS	1	Each	650	465	361	$45,000	$45,000	Based on 250 acre drainage area per basin
Total				**3,069**	**7,490**	**1,529**		$60,900	

Wyandotte County Lake (HUC 102400110604)

Drainage Area: 8.0 square miles

Water Quality Impairment: Eutrophication

Watershed: Independence-Sugar

Tributary with Water Quality Impairment: HUC 10240110604 (western half)

The High Priority Area of Focused Effort: The high priority area for focused effort will the Wyandotte County Lake drainage area located within HUC 12 10240110604. The Wyandotte County Lake drainage area (5,120 acres) is 36% of the total HUC 10240110604 drainage area (14,095 acres.)

Eutrophication is generally described as the biological response to elevated nutrients, organic matter and/or silt in the lake. The nutrients and organic material may come from a variety of sources, including wastewater treatment plant effluent, untreated sewage, urban stormwater runoff, animal wastes, pasture runoff and cropland runoff. The Wyandotte County Lake drainage area is within the boundary of Kansas City, Kansas in a rapidly developing area, including the Legends shopping center and the Kansas Speedway

NPDES: There are no NPDES permitted wastewater treatment facilities in the watershed.

Livestock Waste Management Systems: There are no permitted CAFO's or point sources for livestock wastes.

Land Use: This watershed has experienced considerable development over the last 20 years and continues with fast paced development now. Much of the development has included large land areas of construction with the associated land disturbances and new parking areas and other impervious spaces. The Unified Government of Wyandotte County manages the stormwater under a Phase I NPDES permit.

Table 48 -Wyandotte County Lake Watershed Land Use Changes from 1991 to 2001

Year	% of Total Watershed Land Area						
	Cultivated Cropland	Pasture/ Hay	Urban Developed Area	Urban Grassland	Grassland/ Herbaceous	Forest	Open Water
1991	5	21	17	2	2	41	8
2001	3	12	21	17	7	32	7

Table 49 - Wyandotte County Lake Watershed Land Cover

Table 43 Wyandotte County Lake Watershed Land Cover

Land Cover	Acres	Percent
Water	358	7
Urban/Developed	1,075	21
Forest/Woodland	1,638	32
Grassland/Herbaceous	358	7
Urban Grassland	870	17
Pasture/Hay	614	12
Cropland	154	3
Total	5,120	

On-Site Waste Systems: There is a septic system within the Wyandotte County Lake Park surrounding the lake and in some of the older residential homes on the east side of the lake. The now closed horse and dog racetrack located southwest of the lake was also thought to be a contributor to the eutrophication in the lake.

Background Levels: Atmospheric deposition of nutrients is a constant input to the watershed. The wild geese populations have also been very high, although there are fewer geese since feeding geese was banned in 2003, this can still be a source of nutrients and organic matter to the lake.

Allocation of Pollution Reduction Responsibility:

Point Sources: The Phase I NPDES permit requires stormwater and erosion management practices for new development and for the management of existing stormwater systems. Point sources are not believed to be the primary contributor to the eutrophication of the lake.

Non-Point Sources: Non-point sources are believed to be the main sources for the nutrient input and impairment to Wyandotte County Lake. The likely sources include runoff, leaky septic tank systems and animal wastes runoff and infiltration through soil and groundwater.

Pollutant Load Reduction: Wyandotte County Lake is in the Independence Sugar Watershed, (HUC 102400110604). The designated uses include primary contact recreation, and food processing. All uses are impaired due to the eutrophication in the lake. The level of eutrophication is slightly eutrophic with a Trophic State Index of 50.9.

The Waterbody Assessment conducted by KDHE identified phosphorus as responsible for the growth of objectionable concentrations of algae which is linked to eutrophication. The CNET model was used to predict levels of chlorophyll-a and total phosphorus. Based on this analysis, the algal growth is either phosphorus limited or co-limited by nitrogen and phosphorus. With the designated loading capacity, the target chlorophyll-a concentration is 10 µg/L and the target total phosphorus concentration is 22 µg/L with a maximum level of 27 µg/L phosphorus. A corroborating endpoint of average secchi disk depth greater than 1.6 meters will also be used to

assess the aesthetic quality of the lake for recreation. Wyandotte County Lake Phosphorus loading is provided in Table 50.

The city operates Phase I NPDES stormwater facilities and there is runoff from the now non-operating Woodlands Racetrack within the watershed which are included in the "Waste Load Allocation" in the table below. There also is a significant background contribution from atmospheric sources and from geese on the lake. These loads are contained in the "Background Allocation."

Table 50 - Wyandotte County Lake Phosphorus Loading

Loads	Phosphorus	
	Daily Load Pounds/day	Annual Load Pounds/year
Current Load	7.37	1,415
Load Capacity	6.27	1,205
Waste Load Allocation	1.35	260
Load Allocation	4.06	780
Background Allocation	0.86	165
Load Reduction	1.10	210

Reduction Goals to Meet Water Quality Standard: Reduce phosphorus load 210 lbs. /year. Goal is to maintain maximum Chlorophyll-a concentration of 10 µg/L. Using the 150% margin of safety as discussed earlier, the phosphorus reduction goal is 270 lbs./yr.

The loading reduction BMP efforts will be focused on the area tributary to Wyandotte County Lake, in HUC 12 102400110604

The TMDLs in Wyandotte County Lake result primarily from surface runoff, leaky septic tank systems, animal wastes runoff and infiltration through soil and groundwater.

BMP Selection Method: The SLT reviewed the information developed by KDHE in support of TMDL development within the Missouri River Basin and Specifically for the Wyandotte County Lake. A site visit was made to the lake and conversations were held with local park, NRCS and County Conservation District staff and the SLT of the various BMPs that would address the contributing factors to the excess nutrient loading. The SLT selected practices to be included in the plan based on BMPs predicted to be effective, have a reasonable cost, and are expected to be adapted and maintained by the nutrient contributors within the project area.

Table 51 - Proposed Wyandotte County Lake Eutrophication BMPs

Best Management Practice BMP	TMDL	Amount	Units	Load Reduction			Unit Costs	Total Costs	Comment
				Nitrogen lbs./yr.	Phosphorus lbs./yr.	Sediment Tons/yr.			
Vegetative									
Grass Buffer Strips	TSS, N, P,FC	50	Acres	478	343	173	$215	**$10,750**	Assumes 1 acre buffer per 20 acre
Land Management									
Urban Lawn Management	FC	228	Acres	[1]	[1]	[1]	$950	**$216,600**	Assumes 6 urban lots / acre
Waste Management									
On-Site Waste System Repair	F.C.	5	Each	80	230	N/A	$5,000	**$25,000**	
Pet Waste Management Program	TSS, N, P	1,200	AU	[1]	[1]	[1]	$10	**$12,000**	
Structural									
Sedimentation Ponds	TSS, N, P	1	Each	112	80	42	$15,000	**$15,000**	1 basin/250 ac drainage area
Total				**880**	**448**	**215**		**$279,000**	

1 We have not found reliable pollutant load reduction data for Pet Waste Management Program and Lawn Nutrient Management. We know that communities, such as Kansas City, have found that up to 25% of the bacteria loading in the urban runoff can be traced to pet waste and there is substantial nutrient loading in urban runoff resulting from lawn over-fertilizing and extensive lawn irrigation. Therefore, it is assumed that these BMPs will result in significant pollutant loading reduction.

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Walnut Creek (Big Nemaha Watershed HUC 1024000804 (04, 05 06)

Drainage Area: 118.1 square miles (115,900 acres)

Water Quality Impairment: Fecal Coliform Bacteria

Segments with Water Quality Impairment

Main Stem Segment: Segment 39; starting at the State Line and traveling upstream to near Fairview.

Tributary Segment: Terrapin Creek (308)

Segment 39 is the main stem of Walnut Creek from the headwaters to the state boundary and is entirely within Brown County. The segment of interest is in HUC 12's 102400080404,102400080405, and 102400080406.

High Priority Areas for Focused Effort: The WRAPS Stakeholder Leadership Team evaluated smaller areas within the watershed to focus strategic planning and management efforts to have the greatest impact on the TMDL's within the watershed. The criteria for selection included:

1. Is the HUC 12 area included on the KDHE list and map of High Priority TMDLs.?
2. Are there livestock facilities near the streams that may contribute fecal coliform to the stream body as determined in the Wolf River Watershed Assessment conduct by KAWS and Blue Earth?,
3. Are there high sediment, nitrogen and phosphorus contribution potential as determined by the STEPL Model analysis?
4. Are there landowners and operators willing to participate in education programs, demonstrations and incorporate best management practices in their operations, and
5. Will there be agency cooperation in the area?

Based on these criteria, the Walnut Creek tributary in the Big Nemaha watershed HUC 12 area for focused high priority focused effort will be 1102400080405, the Terrapin Creek tributary. HUC 1102400080405 contains 26,608 acres or 17% of the total Big Nemaha watershed area.

NPDES: There is one NPDES permitted wastewater lagoon system facility at Morrill with a design capacity of 0.0326 mgd. This system is located in HUC 102800080405 on Terrapin Creek which is tributary to Walnut Creek. The population of Morrill is expected to be stable through 2020. Excursions from the water quality standards appear to occur under a variety of flow conditions but particularly under high flow conditions. Of significance to point sources are the excursions under low flow conditions in all seasons, particularly during winter which indicates that the point sources may have an impact on the watershed.

Livestock Waste Management Systems: There are twenty two registered, certified or permitted beef, dairy or swine feeding facilities within the watershed. There are 6,568 potential animal units in these 22 facilities although the actual number of animal units is typically less.

Land Use: Based on Kansas GAP Land Cover Data, the predominant land use is cultivated cropland in the Big Nemaha Watershed. The land cover area is from the 1992 Natural Resources Inventory (NRI) prepared by the U. S. Department of Agriculture Soil Conservation Service (SCS).

Table 52 - Big Nemaha Watershed NRI Data Land Cover

Land Cover	Acres	Per Cent
Water	457	0.3
Urban/Developed	1,221	0.8
Barren Transitional	0	0
Forest/Woodland	5,719	3.7
Shrub Land	0	0
Grassland/Herbaceous	17,742	11.5
Pasture/Hay	38,201	24.8
Cropland	89,090,	57.9
Wetland	1,489	1
Total	153,919	100

The watershed's grazing density estimate is 20 -28 animals units/square mile, which is low compared to Missouri Basin averages.

Table 53 - Land Cover form Kansas Gap Land Cover Data

Cultivated Cropland	Urban Area	Forest	Grasslands
% of Total Area	% of Total Area	% of Total Area	% of Total Area
64	<1	2	32

On-Site Systems: The upper and lower third of the watersheds population density is low (10 to 12 persons per square mile) compared to the Missouri Basin averages. The middle third of the basin average is 43 persons per square mile. The population is expected to decline through 2020.

Contributing Runoff: The areas of the watershed in Kansas have an average soil permeability of 0.6 inches per hour according to NRCS STATSGO data base. One hundred percent of the watershed produces runoff with rainfall events of 1.71 inches per hour. Generally, rainfall events of less than 1.14 inches per hour will produce runoff from 82% of the area. Rainfall events of 0.57 inches per hour generate runoff from 72% of the watershed area, chiefly along stream channels and in the upper two thirds of the watershed.

Background Levels: Some fecal bacteria occur in the environmental background levels which include contribution from wildlife, but it is likely that the density of wildlife is sufficiently low that its contribution to water quality is not significant. Most of the background levels of total suspended solids and the associated organics and nutrients come from natural sheet and rill erosion from the overland runoff. Streambank and bed erosion may also be another important source of suspended solids during high flow events.

Allocation of Pollution Reduction Responsibility – Fecal Coliform Bacteria:
Bacteria are living organisms with rapid growth rates but whose viability and growth rate are influenced by the environmental conditions. The allocation of bacteria between point sources and non-point sources therefore depends on the flow conditions in the steams because of the presumed ability of the point or non-point sources to have the most impact on the stream water quality. Flows lower than a designated flow will be mostly influenced by the point sources to maintain water quality standards. However, greater flows will be most influenced by the non-point sources.

Point Sources: The city of Morrill relies on a lagoon system with long detention times for treatment of their wastewater. The City is responsible for maintaining their system in proper working condition and appropriate detention volume to handle anticipated waste loads. Ongoing inspections and monitoring of this system will be made to ensure that minimal contribution will be made by this source.

The Waste Load Allocation is defined at the flow condition ten times the design flow of contributing point sources or the 7Q10 flow, whichever is greater. At the watershed's lowest testing site near Podonia, this flow condition is 0 - 1 cfs which is exceeded 95 - 99% of the time. The NPDES permits should continue to be structured so that the facilities will not produce violations to the above conditions.

Non-Point Sources: Based on the assessment of sources, and the distributions of the high occurrence of high FCB sampling counts in high flow conditions, non-point sources are seen as a significant cause of water quality violations. Background levels are not significant. Best management practices will be directed toward those activities what contribute to the FCB at times when the stream flow is greater than 1 cfs.

Pollutant Load Reduction

Bacteria: Walnut Creek is in the Nemaha River Watershed, (HUC 1024000804). The impaired use for the Walnut Creek is contact recreation. The designated uses include expected aquatic life support and food procurement. The previous criterion for fecal coliform bacteria is 900 colonies per 100 ml for primary contact recreation. Since 2006, the criteria for primary contact recreation, Class B, are 262 CFUs/ 100 mL from April 1 to October 31 and 2358 CFUs. /100mL from Nov. 1 to March 31.

Since loading capacity varies as a function of the flow present in the stream, the load reduction is to achieve a continuum of desired TMDL loads over all flow conditions, rather than a fixed single value. As yet, a loading capacity for animal or human wastes defined as tons or pounds per day has not been established to achieve a given reduction of bacteria colonies within the stream. The desired endpoint of the TMDL reduction is to therefore establish an acceptable level of fecal coliform colonies present in the stream. The desired endpoint, then, is to achieve Kansas Water Quality Standards fully supporting primary contact recreation, or 800 colonies per 100 ml allowing for a 100 colonies per 100 ml margin of error.

The Waste Load Allocation (WLA) (from NPDES permitted point sources) is defined at the flow condition of ten times the combined flow of the point sources, or the 7Q10, whichever is greater. For the Walnut Creek south of Adonis, the flow condition is flows between 0-1 cfs, flows that are exceeded from 95 to 99% of the time. Therefore for high flows, stream greater than 1 cfs, the TMDLS reduction will be allocated to the non-point source load allocation and flows less than 1 will be allocated to point source waste load allocation.

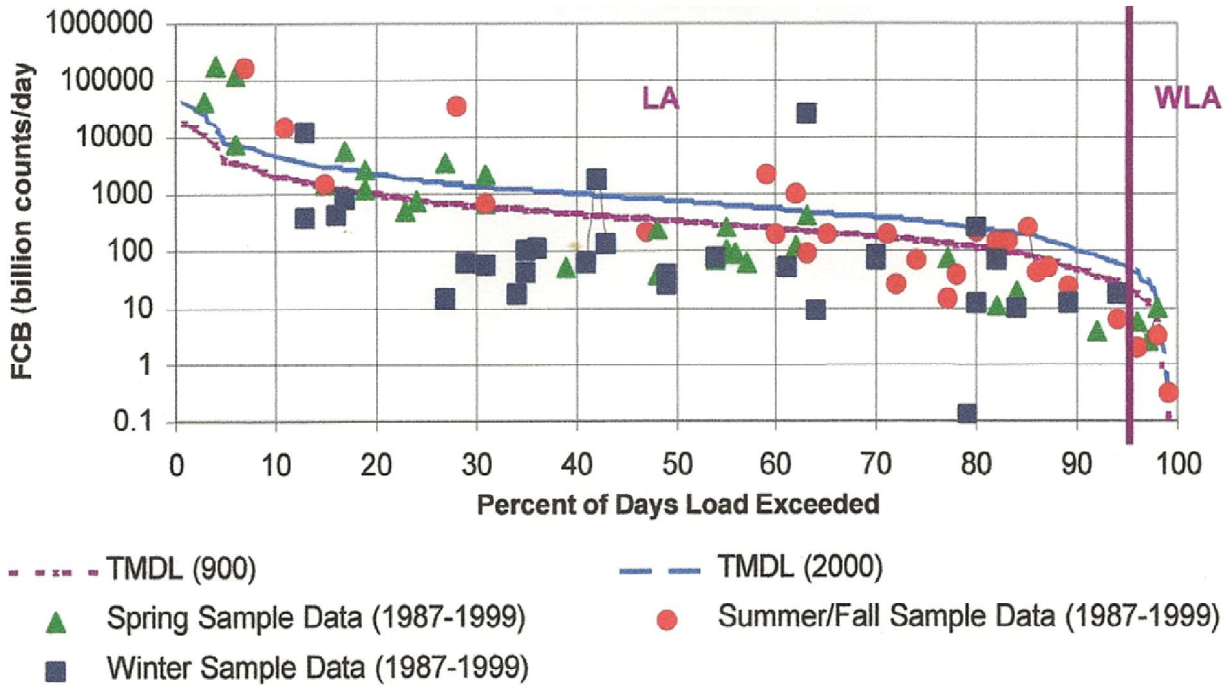

Figure 21 - Fecal Coliform Bacteria TMDL in Walnut Creek near Padonia

Cropland and Livestock Conservation Needs for Big Nemaha Watershed:

Based on the Kansas Non-Point Source Needs Inventory, the following practices have been identified as needed conservation measures within the Big Nemaha Watershed.

Table 54 - Cropland Treatment Needs: Management

Management	Acres	Percent
Total Acres in Cropland	111,309	
Cropland Management Needed	23,254	20.9
Enhanced Nutrient Management	67,440	60.6
Enhanced Pesticide Management	66,000	59.3
With Nutrient Management Plan	15,500	13.9
Annual Soil Sampling	0	0
Acres in No-Till Cultivation	79,247	71.2
Acres in Ridge Till Cultivation	0	0
Increased Crop Residue Needed	24,462	22.0

Table 55 - Conservation Treatment Needs: Structural

Management	Acres	Percent
Total Acres in Cropland	111,309	
Structural Treatment Needed	54,080	48.6
New Terraces Needed	48,930	44.0
Terrace Restoration	3,270	2.9
New Waterways Needed	580	0.5
Waterways Needing Restoration	370	0.3
Area Needing Diversions	605	0.5
Area Needing Grade Stabilization	10,800	9.7
Area Needing Water/Sediment Control Basins	5,130	4.6
Area Needing Conversion to Permanent Vegetation (Steep Slopes)	14,000	12.6
Area Need to Convert to Wetlands	4,200	3.8

Reduction Goals to Meet Water Quality Standard: The goal for E coli bacteria is 262 CFUs/100mL for April 1 to Oct. 31 and 2,358 CFUs /100mL for Nov.1 to March 21.

Fecal Coliform TMDL Load Reduction will be focused in HUC 12's – 102400080405,, the Walnut Creek main stem initially but applicable BM's will be initiated and applied wherever possible to achieve the desired level of TMDL reduction.

The TMDLs in Walnut Creek Watershed are highly influenced by the livestock wastes that enter into the surface waters and ultimately into the Big Nemaha River. BMP's are selected to achieve the economical highest impact to reduce these influencing factors.

Table 56 - Proposed Walnut Creek Fecal Coliform BMPs

Best Management Practice BMP	TMDL	Amount	Units	Load Reduction			Unit Costs	Total Costs	Comments
				Nitrogen lbs. /yr.	Phosphorus lbs. /yr.	Sediment Tons/yr.			
Vegetative									
Grass Buffer Strips	TSS, N, P,FC	250	Acres	5,880	4,205	2,660	$215	**$53,750**	Assumes 1 acre buffer per 20 acre cropland
Land Management									
Pasture Management	FC	8,000	Acres	1,785	910	545	$15	**$120,000**	Assumes each plan is for 250 Acres
Waste Management									
Livestock Waste Management	F.C.	20	Each	32,300	7,260	0	$20,000	**$400,000**	Assumes 50 AU per operation
On-Site Waste System Repair	TSS, N,P, F.C.	10	Each	120	45	0	$5,000	**$50,000**	Assumes 100 gal/day / system
Livestock Production									
Alternative Livestock Watering	FC, P	8	Each		2,740		$3,795	**$30,360**	Assumes 50 AU per operation
Total				**40,085**	**15,160**	**3,205**		**$654,110**	

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SECTION 5 - INFORMATION AND EDUCATION TO SUPPORT BMPS

Our WRAPS stakeholders recognized the importance of a good outreach program early in the development of the Missouri River Basin Watershed Restoration and Protection Strategy (WRAPS) plan. As issues were discussed, the important role that information and education would play in solutions to problems became clear.

Information itself is useful and is a crucial element of water education, but it is not education in and of itself. Water problems and issues are complex, and solutions frequently have scientific, economic, historical, political, and cultural dimensions. An effective outreach program helps citizens sort through the sometimes biased and emotional elements of water issues, weigh all sides, and make informed, balanced, and locally-appropriate decisions. It affects attitudes and actions in addition to simply informing. It is also the means by which individuals and groups in the watershed are linked with technical and financial resources to help them take steps toward resource protection. Information and education put together in a good outreach program promote decisions and responsible action that lead to stewardship and the long-term sustainability of WRAPS projects.

The Information and Education outreach plan seeks to raise awareness about the Missouri River Basin watershed, the WRAPS project and water problems in the watershed. Understanding how watersheds work, that everyone is a member of a watershed community, and that we all have a role to play in protecting and restoring watershed resources is critical. This section targets basic WRAPS and watershed education and awareness. The information is presented in chart form to ease viewing of the actions planned.

There are 12 public school districts and 6 private schools in the Missouri River Basin watershed. Schools can be very important partners in outreach, and educating students and educators about WRAPS, water and other natural resources issues is an important element of this outreach plan. For this reason, many of the actions of the outreach program will be directed at and tailored to schools, educators and students.

Wherever possible, existing materials, delivery mechanisms and information will be used and we will work with numerous agencies and organizations to accomplish our purpose. Many agencies in northeast Kansas have a long track record of providing excellent outreach and assistance to residents. Additional effort to reach specific audiences with information about WRAPS issues and refocusing of existing programs to address priority issues will be necessary in some cases. In other instances, entirely new materials and outreach will be needed. The following list includes partners and service providers who will likely participate in the education and information efforts. The order partners and service providers are listed in the I & E table indicates who will take the initial responsibility in planning the events or activities.

Table 57 - WRAPS Partners and Service Providers

	City Public Works Department (CPWD), City Water Utility (CWU), City Parks Department (CPD), County Conservation Districts (CCD), County Public Health Departments (CHD), U.S. Environmental Protection Agency (EPA) USDA Farm Service Agency (FSA), Glacial Hill Resource Conservation & Development (GHRC&D), Kansas State University Research & Extension (KSU EXT.), Kansas Alliance for Wetlands and Streams (KAWS), Kansas Association for Conservation and Environmental Education (KACEE), Kansas Department of Agriculture (KDA), Kansas Department of Health and Environment (KDHE), Kansas Department of Agriculture Division of Conservation, (DOC), Kansas Department of Wildlife, Parks and Tourism (KDWPT), Kansas Forest Service (KFS), Kansas Foundation for Agriculture in the Classroom (KFAC), Kansas Rural Center (KRC), Kansas Stream Link, Kansas WaterLINK, County Health Departments, Kansas Department of Agriculture (KDA), Kansas Rural Water Association (KRWA), Kansas Water Office (KWO), Local School Districts (LSD), No-Till On the Plains (NTOP), USDA Natural Resources Conservation Service (NRCS), Northeast Kansas Environmental Services (NEKES), U.S. Army Corps of Engineers (USCOE),Watershed Districts.

Table 58 - Information and Education Activity and Events for BMP Implementation

BMP	Target Audience	Activity/Event	Time-Frame	Estimated Costs	Sponsor/Responsible Agency
Crop Production BMP Implementation					
No-Till	Producers – Owners & Operators	Information Meetings,	Annual – Late Winter	$2,750 per Meeting	NTOP, GHRC&D, CCD, KSU Ext.
		One on One Technical Assistance Meeting	Annual Ongoing	$750 ($150/Meeting)	NTOP, KSU Ext.
		Field Day	Annual – Late Summer	$2,750	NTOP, KSU Ext.
		Newsletter Article	Annual- Spring	$300	NTOP, GHRC&D, CCD, KSU Ext.
		Scholarships for 20 producers to attend annual No-Till Winter Conference	Annual - Winter	$3.000 ($150 Each)	NTOP
Cover Crops	Producers- Owners, Operators and Seed Producers	Information Meetings	Annual – Late Winter	No Charge – (Combined with other Crop Production meeting.)	GHRC&D, NTOP, KRC CCD, KSU Ext., NRCS, FSA
		One on One Technical Assistance Meeting	Annual-On Going	$750 ($150/Meeting)	GHRC&D, KRC, KSU Ext., NRCS
		Field Day	Annual – Late Summer	No Charge, (Combined with other Crop Production Field Trip)	GHRC&D, NTOP, KSU Ext., KRC, NRCS

BMP	Target Audience	Activity/Event	Time-Frame	Estimated Costs	Sponsor/Responsible Agency
Crop Production BMP Implementation (Cont.)					
Cover Crops	Producers-Owners, Operators and Seed Producers	Newsletter Article	Annual- Spring	$300	NTOP, CCD, KSU Ext., NRCS
		Demonstration Plots	Bi-Annual	$300 per demonstration project	GHRC&D, NTOP, KRC CCD, KSU Ext.
Vegetative BMP Implementation					
Grass Buffer Strips	Land Owners and Rental Operators	Information Meetings	Annual – Late Winter	No Charge – (Combined with Crop Production Meeting.)	GHRC&D, CCD, KSU EXT., NRCS. FSA, USCOE
		One on One Technical Assistance Meeting	Annual Ongoing	$1,200 ($150/Meeting)	KSU EXT., GHRC&D, CCD, NRCS
		Demonstration Project	Bi-Annual	$300 per demonstration project	GHRC&D, CCD, KSU EXT., NRCS. USCOE
		Newsletter Article	Annual- Spring	$300	GHRC&D, KRC, CCD, KSU EXT.,
		Field Day/	Annual –Late Summer	No Charge (Combined with other Crop Production Field Trip)	GHRC&D, KRC, CCD, KSU EXT., NRCS

BMP	Target Audience	Activity/Event	Time-Frame	Estimated Costs	Sponsor/Responsible Agency
Vegetative BMP Implementation (Cont.)					
Grass Buffer Strips	Land Owners and Rental Operators	Newspaper Article	Annual- Fall	$300	GHRC&D, KRC, KSU EXT., NRCS
Forested/Riparian Buffers	Land Owners and Rental Operators	Informational Meeting	Annual- Late Winter	No Charge – (Combined with Crop Production Meeting.)	GHRC&D, KFS, CCD , KSU EXT., KDWPT
		One on One Technical Assistance Meeting	Annual Ongoing	$750 ($150/Meeting)	GHRC&D, KFS, CCD
		Newsletter Article	Annual- Spring	$300	GHRC&D, KFS, KRC, CCD , KSU EXT., KDWPT
		Field Day/	Annual - Fall	No Charge (In Conjunction with Buffer Field Day.)	GHRC&D, KFS, KRC, CCD , KSU EXT., KDWPT
		Newspaper Article	Annual- Fall	$300	GHRC&D, KFS, KRC, CCD , KSU EXT., KDWPT
		Demonstration Project	Bi-Annual	$500 per demonstration project	GHRC&D, KFS, CCD , KSU EXT., KDWPT

BMP	Target Audience	Activity/Event	Time-Frame	Estimated Costs	Sponsor/Responsible Agency
Vegetative BMP Implementation (Cont.)					
Convert Steep Slopes to Permanent Vegetation	Land Owners and Rental Operators	One on One Technical Assistance Meeting	Annual-Ongoing	$350 ($150/meeting)	GHRC&D, KSU EXT., KDWPT, KRC
		Newsletter Article	Annual- Spring	$300	GHRC&D, KDWPT, KRC
		Field Day/	Annual - Fall	No Charge (In Conjunction with Buffer Field Day.)	GHRC&D, KRC, CCD , KSU EXT., KDWPT
		Newspaper Article	Annual- Fall	$300	GHRC&D, KRC, KSU EXT., KDWPT
Structural BMP Implementation					
Streambank Stabilization	Land Owners	Informational Meeting	Annual - Spring	$2,750	GHRC&D, KSU EXT., NRCS, CCD, DOC, Wild Horse River Works
		One on One Technical Assistance Meeting	Annual Ongoing	$1,200 ($150/Meeting)	GHRC&D, KSU EXT., NRCS, CCD, Wild Horse River Works
		Newsletter Article	Annual- Spring	$300	GHRC&D, KSU EXT., NRCS, CCD,
		Field Day/	Annual – Late Summer	$2,700	GHRC&D, KRC, CCD, NRCS, Watershed Districts

BMP	Target Audience	Activity/Event	Time-Frame	Estimated Costs	Sponsor/Responsible Agency
Structural BMP Implementation (Cont.)					
Streambank Stabilization	Land Owners	Newspaper Article	Annual- Fall	$300	GHRC&D, KRC, CCD,
		Demonstration Project	Bi-Annual	$1,000 per demonstration project	GHRC&D, KSU EXT., NRCS, CCD, DOC, Wild Horse River Works.
Sediment Basin	Land Owners	One on One Technical Assistance Meeting	Annual- On Going	$300 ($150/meeting)	GHRC&D, KRC, NRCS, KSU EXT.
		Newspaper Article	Annual- Fall	$300	GHRC&D, KRC, CCD, NRCS
		Newsletter Article	Annual- Spring	$300	GHRC&D, KRC, CCD, NRCS
		Field Day	Annual- Late Summer	No charge, (Combined with Structural Field Day)	GHRC&D, KRC, CCD, NRCS, KSU EXT.

BMP	Target Audience	Activity/Event	Time-Frame	Estimated Costs	Sponsor/Responsible Agency
Land Management BMP Implementation					
Nutrient Management	Land Owners, Rental Operators Public	Information Meetings	Annual – Late Winter	No Charge – (Combined with Crop Production Meeting.)	GHRC&D, CCD, KRC, KSU EXT., NRCS, Farm Supply Org., CWU, KRWA
		One on One Technical Assistance Meeting	Annual Ongoing	$1,000 ($250/Meeting)	KRC, KSU EXT., NRCS
		Cost Share on 400 Soil Tests	Annual Ongoing	$4,800 ($12/test)	KSU EXT., CCD
		Newsletter Article	Annual- Spring	$300	GHRC&D, CCD, KRC, KSU EXT., Farm Supply Org., KRWA,
		Newspaper Article	Annual- Fall	$300	GHRC&D, CCD, KRC, KSU EXT., Farm Supply Org., KRWA,
Pasture Management	Land Owners, Rental Operators Public	Information Meetings	Annual – Late Winter	No Charge – (Combined with Crop Production Meeting.)	GHRC&D, CCD, KRC, NRCS, KSU EXT.
		One on One Technical Assistance Meeting	Annual Ongoing	$1,000 ($250/Meeting)	GHRC&D, KRC, NRCS, KSU EXT.
		Newsletter Article	Annual- Spring	$300	GHRC&D, CCD, KRC, NRCS, KSU EXT., KRWA

BMP	Target Audience	Activity/Event	Time-Frame	Estimated Costs	Sponsor/Responsible Agency
Land Management BMP Implementation (Cont.)					
Pasture Management	Land Owners, Rental Operators Public	Newspaper Article	Annual- Fall	$300	GHRC&D, KRC, NRCS, KSU EXT.
Urban Lawn Management	Urban Residents, Businesses, Lawn Care Professional	Informational Meeting	Annual Spring	$2,750	GHRC&D, KSU EXT, CWU. , CPWD, Lawn Care Supplier
		Newsletter Article	Annual- Spring	$300	GHRC&D, KSU EXT, CWU. , CPWD, Lawn Care Supplier, Pro. Golf Course Manager Assoc.
		Newspaper Article	Annual- Fall	$300	GHRC&D, KSU EXT.
		Cost Share on 100 Soil Tests	Annual Ongoing	$1,200 ($12/test)	CCD, KSU EXT.
Livestock Waste Management BMP Implementation					
Livestock Waste Management	Livestock Producers, Public	Informational Meeting	Annual- Fall	$2,750	GHRC&D, KSU EXT., KRC, CCD, NRCS
		One on One Technical Assistance Meeting	Annual Ongoing	$1,250 ($250/Meeting)	GHRC&D, KSU EXT., KRC, NRCS
		Demonstration Project	One Annual	$1,000	GHRC&D, KSU EXT., KRC

BMP	Target Audience	Activity/Event	Time-Frame	Estimated Costs	Sponsor/Responsible Agency
Livestock Waste Management BMP Implementation (Cont.)					
Livestock Waste Management	Livestock Producers, Public	Tour/Field Day	Annual Fall	$2,750	GHRC&D, KSU EXT., KRC, CCD, NRCS
		Newsletter Article	Annual- Spring	$300	GHRC&D, KSU EXT., KRC, CCD, NRCS
		Newspaper Article	Annual- Fall	$300	GHRC&D, KSU EXT., KRC, CCD, NRCS.
Pet Waste Management	Public	Event Exhibits	3 per year, Ongoing	$600	GHRC&D, CPD, CPWD, CHD, KDWPT, EPA
		Signage	Annual	$500 ($50 Each sign)	GHRC&D, CPD, CPWD, CPHD, KDWPT, EPA, Veterinarians
		Newsletters	Annual Spring	$300	GHRC&D, CPD, CPWD, CPHD, KDWPT, EPA, Veterinarians
	Cities	One on One Technical Assistance Meeting	Annual Ongoing	$300 ($150/Meeting)	GHRC&D, KSU EXT, CPHD
On-Site Waste Management	Public	One on One Technical Assistance	Annual Ongoing	$750 ($150/Meeting)	NKES
		Newspaper Article	Annual- Spring	$300	GHRC&D, CCD, CPWD, NEKES

BMP	Target Audience	Activity/Event	Time-Frame	Estimated Costs	Sponsor/Responsible Agency
Livestock Production BMP Implementation					
Alternative Livestock Watering	Livestock Producers	Informational Meeting	Annual - Fall	No charged-Combined with Livestock Waste Management Meeting)	GHRC&D, CCD, KRC, KSU EXT., NRCS
		One on One Technical Assistance Meeting	Annual Ongoing	$1,250 ($250/Meeting)	KRC, KSU EXT., NRCS
		Demonstration Project	One Annual	$500	GHRC&D, CCD, KRC, KSU EXT., NRCS
		Tour/Field Day	Annual Fall	No Charge, (Combined with Livestock Waste Management Field Day)	GHRC&D, CCD, KRC, KSU EXT., NRCS
		Newsletter Article	Annual- Spring	$300	GHRC&D, CCD, KRC, KSU EXT., NRCS
Watershed Wide Information and Education					
Education of Youth	Educators, K-12 Students	Poster, Essay and Speech Contests	Annual - Spring	$200/ Event	CCD. LSD, GHRC&D
		4-H Water Quality Projects	Annual	$100	CCD. LSD
BMP	**Target Audience**	**Activity/Event**	**Time-Frame**	**Estimated Costs**	**Sponsor/Responsible Agency**

Watershed Wide Information and Education Cont.					
Education of Youth	Educators, K-12 Students	Earth Day	Annual - Spring	$2,000	GHRC&D, CCD.LSD, KSU, KDWPT, KFS, NRCS
Education of Youth	Educators, K-12 Students	Extension Newsletter Article	Annual-Ongoing	$100	CCD, KDWPT, KFS, NRCS, KSU EXT.
Education of Adults	Educators, Public	River Friendly Farm Producer Notebook Informational Meeting	Annual - Spring	$500	KRC, CCD
Education of Adults	Educators, Public	River Friendly Farm Producer Notebook Technical Assistance/Incentive	Annual - Ongoing	$5,000 ($500 each)	KRC
Education of Adults	Educators, Public	Watershed Information Event Displays	Annual Ongoing	$500 ($100 Each)	GHRC&D, CCD.LSD, KSU, KDWPT, KFS, NRCS, KRC, EPA, KDHE
Education of Adults	Educators, Public	Soil and Grassland Awards Meeting	Annual	$500	CCD

Table 59 - Information and Education Activity and Event Summary

Activity Event	Description	Number/ year	Total Cost
Informational Meeting	Crop Production Structural Livestock Wastes Urban Lawn Management River Friendly Farm	5	$11,500
One on One Meetings		56	$9,700
Newsletter Articles		14	$4,000
Newspaper Articles		10	$3,000
Field Day	Crop Production Structural Livestock Wastes Mgmt.	3	$8,200
Demonstration Plots	Grass Buffers (Bi-Annual) Cover Crops (Bi-Annual) Forested Buffers (Bi-Annual) Streambank Stabilization Bi-Annual) Livestock Waste Management Alternative Livestock Watering	4	$2,550
Scholarships/Incentive	No-Till Meeting River Friendly Farms	30	$8,000
Soil Tests	Nutrient Management Urban Lawn Management	500	$6,000
Events/ Exhibits	Pet Wastes Education	5	$3,900
Signage	Pet Wastes	10	$500
Total Cost			**$59,900**

The estimated cost for meetings and field days includes costs for meeting rooms and facilities, advertisements, signage, meeting materials, travel and planning costs. The estimated costs for demonstration plots includes preparing signs, and descriptive handouts, One on one meetings includes costs for technical services costs and travel.

Evaluation of Education and Information Activities

All education and information activities conducted by the Missouri River Basin WRAPS or its service providers will include methods and procedures to evaluate the effectiveness of the activity. Service providers will be required to include a description of this methodology in their proposals and PIPs. The stated objectives for education and information will be required for each activity.

Methods for evaluating the effectiveness of the education and information activities include;

- Evaluation forms completed by each participant of the activities,
- Pre and post surveys to determine benefit to participant and information gained,
- Follow up interview (one on one contacts, phone calls, e-mails, etc.) with selected participants,
- Interest showed by number of attendees at activities and participants who return to participate in future events,
- Documented adoption of meeting objective recommendations.

The primary indicators of success of the information and education effort will be implementation of practices that were the objective of the events, and most importantly, the reduction of the impairment loads. Therefore the information and education events will require follow-up with participants to determine if there is interest in implementation of the practices and then to ensure that the necessary technical assistance is available to those interested. Initial indication of interest in adopting the practice will be the response on the event evaluation forms but additional follow-up will likely be necessary to achieve the level of practice adoption to reach our TMDL reduction goals.

It is important to recognize that education is often a building process. Producers may be interested in adopting a practice but may need to hear about the practice more than once before they are willing to actually adopt it. Therefore repeated attendance or participation in the education and information event is an indicator that the events are productive. The post event evaluations will be reviewed to determine how the event can be more productive or what additional information is needed to convince the participant to adopt the desired action or practice.

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SECTION 6 - FUNDING SOURCES, SCHEDULES, AND COST OF BMP'S

Vegetative, waste management and livestock production cost were collected from agencies within the Basin, typically the cost allocated by NRCS, the county Conservation Districts or the actual costs of completed projects. Structural BMP costs were based on the costs for streambank stabilization projects completed in Northeast Kansas including the Missouri River Basin. The sedimentation basin costs are based on the itemized estimate of costs to construct a basin since we do not have a recent project costs. The land management costs include incentive payments to the producer and costs to complete the management plans. The design and management plan cost are includes in the BMP project costs. Additional technical assistance costs are included in I & E costs, typically in the one-on-one meetings or in the informational meetings. Technical assistance cost estimates used in the I & E component of the total cost is typically based on 250% of the hourly cost to reflect costs for travel, printing, and preparation time in addition to the design and management time.

Table 62 - Management Practices Implementation Schedule, is a pictorial representation of each of the recommended BMPs for each watershed and the estimated the estimated time frame that the BMPs will be implemented. This implementation schedule is the basis for the estimated costs for I & E and BMP annual costs.

Table 63 - Annual BMP Schedule is a graphic showing the specific year that each BMP will be implemented in a specific watershed.

Table 64 - I & E Annual Cost Calculations, summarizes the annual cost for the information and education as developed in Table 58 - Information and Education Activity and Events for BMP Implementation in SECTION 5 – INFORMATION AND EDUCATION TO SUPPORT BMPS. This table identifies the total annual I & E cost for each BMP. The annual cost for each watershed varies based on the watershed BMPs and the years each BMP is implemented. Note that the demonstration plots are planned for alternate years so the annual costs do vary.

Tables 65 through 69 combine I & E cost in each watershed into a schedule of the I & E costs over the 30 year duration of the project program. Table 70 - Summary of I & E Annual Costs provides a summary of the total I & E cost by BMP for each year of the proposed duration of the program.

The individual costs for the each of the BMPs proposed in the 6 individual watersheds extended for the amounts targeted to achieve the TMDL reduction are included in Section 4, Table 33 - Proposed Wolf River Biology & Fecal Coliform BMPs; Table 40 -Proposed South Fork Big Nemaha Biology & Fecal Coliform BMPs; Table 43 - Pony Creek Lake Phosphorus and Nitrogen Loading; Table 47 - Proposed Atchison County State Fishing Lake BMPs for Sediment; Table 51 - Proposed Wyandotte County Lake Eutrophication BMPs; and Table 56 - Proposed Walnut Creek Fecal Coliform BMPs give the estimated cost to put the necessary BMPs in place to accomplish the TMDL reduction goals.

These costs are used to generate the estimated annual BMP costs shown in Tables 65 through 70for each watershed for each of the BMPs and annual I & E for each year are also include to produce the total annual cost and a schedule of the watersheds costs over the proposed 30 year duration of the plan. Most of the BMPs will not be implemented every year and some will be implemented in multiple watersheds in a given year. This should be a considered when planning the information and education program. In the event that a BMP is implemented in more than one watershed in a given year, then I & E costs associated with that BMP are distributed among the watersheds implementing that BMP that year. In the table the cost for the general, none BMP specific youth and adult education is distributed evenly for each watershed each year.

Table 70 - Summary of I & E Annual Costs, consolidates the annual cost for each watershed into a total annual cost throughout the proposed 30 year duration of the plan. The last column is the total cost with a 3% annual inflation factor applied. All other costs throughout this plan are 2011 costs except for the number provided in this column.

Potential funding sources to complete the plan include:

Table 60 - Potential Funding Sources

Potential Funding Source	Potential Funding Programs
Natural Resources Conservation Services NRCS	Environmental Quality Incentives Program (EQIP) Wetland Reserve Program (WRP) Conservation Reserve Program (CRP) Forestland Enhancement Program (FLEP) State Acres for Wildlife Enhancement (SAFE) Grassland Reserve Program (GRP) Farmable Wetlands Program (FWP)
EPA/KDHE	319 funds
U.S. Department of Fish and Wildlife	North American Wetlands Conservation Act
Kansas Department of Wildlife, Parks and Tourism (KDWPT)	Partnering for Wildlife Wildlife Habitat Incentive Program (WHIP)
Kansas Department of Agriculture, Division of Conservation	Riparian and Wetland Protection Program (RWPP) Water Resources Cost-Share Program (WRCSP), Governor's Water Quality Buffer Initiative.
Kansas Forest Service	Rural Forestry Program Forest Land Enhancement Program (FLEP) Seedlings
No-Till on the Plains	
Conservation Districts	

BMP		Technical Assistance	Projected Annual Costs
Crop Production	No-Till	No-Till on the Plains WRAPS Coordinator KSU County Extension KRC Coordinator NRCS Personnel	WRAPS Coordinator - $40,000 Buffer Coordinator - $30,000 No-Till on the Plains - $6,000 KSU Extension Agent- $15,000 KRC Coordinator- $20,000 NRCS Personnel- $30,000 Watershed Specialist- $17,500 Surveyor - Engineer $12,000 per Site Kansas Forest Service Tech.- $17,500 County Conservation Coordinator - $15,000
	Cover Crops	WRAPS Coordinator KRC Coordinator NRCS Personnel KSU Extension Agent	
	Grass Buffers	WRAPS Coordinator Buffer Coordinator Watershed Specialist NRCS Personnel	
	Forested Buffers	WRAPS Coordinator Buffer Coordinator NRCS Personnel Kansas Forest Service Technician	
	Convert Steep Slopes	WRAPS Coordinator NRCS Personnel Buffer Coordinator	
Structural	Streambank Stabilization	WRAPS Coordinator Surveyor Engineer Watershed Specialist	
	Sediment Basin	WRAPS Coordinator Surveyor Engineer Watershed Specialist	
Land Management	Nutrient Management	WRAPS Coordinator KSU Extension Agent KRC Coordinator	
	Pasture Management	WRAPS Coordinator KSU Extension Agent KRC Coordinator	
	Urban Lawn Management	WRAPS Coordinator KSU Extension Agent Watershed Specialist County Conservation Coordinator	
Waste Management	Livestock Waste Management	WRAPS Coordinator Watershed Specialist KRC Coordinator	
	Pet Waste Management	WRAPS Coordinator County Conservation Coordinator	
	On-Site Waste Management	WRAPS Coordinator County Conservation Coordinator KSU Extension Agent	
Livestock Production	Alternative Watering Sites	WRAPS Coordinator Watershed Specialist KRC Coordinator	

Table 61 - Technical Assistance Needed To Implement Plan

Table 62 - Management Practices Implementation Schedule

BEST MANAGEMENT PRACTICE	Total Qty.	Annual Qty.	Unit
Wolf River Watershed			
No- Till	100	14	Acres
Cover Crops	50	7	Acres
Grassed buffers	20	4	Acres
Forested Buffer	20	4	Acres
Convert Steep Slopes	50	10	Acres
Streambank Stabilization	900	300	Ln. Ft.
Sediment Basin	5	1	Each
Pasture Management	250	36	Acres
Nutrient Management	1,500	214	Acres
Livestock Waste Management	10	1.25	Each
On-Site Waste System Repair	10	2	Each
Alternate Livestock Watering	22	7	Each
South Fork Big Nemaha			
Grassed buffers	30	4	Acres
Streambank Stabilization	1,500	150	Ln. Ft.
Pasture Management	250	50	Acres
Nutrient Management	250	42	Acres
Livestock Waste Management	7	1	Each
Alternate Livestock Watering	50	7	Each
Pony Creek Lake			
No- Till	720	60	Acres
Grassed buffers	100	20	Acres
Forested Buffer	100	20	Acres
Pasture Management	500	83	Acres
Nutrient Management	2,000	333	Acres
Livestock Waste Management	3	1	Each
Urban Lawn Management	35	5	Acres
Alternate Livestock Watering	5	1	Each
Atchison County State Fishing Lake			
No- Till	250	83	Acres
Cover Crops	100	34	Acres
Grassed buffers	20	7	Acres
Sidiment Basin	1	0.3	Each
Wyandotte County Lake			
Grassed buffers	50	17	Acres
Urban Lawn Management	228	28.5	Acres
On-Site Waste System Repair	5	1.67	Each
Pet Waste Management	1,200	240	AU
Sediment Ponds	1	0.5	Each
Walnut Creek			
Grassed buffers	250	32	Acres
Pasture Management	8,000	800	Acres
Livestock Waste Management	20	2.5	Each
On-Site Waste System Repair	10	2	Each
Alternate Livestock Watering	8	1	Each

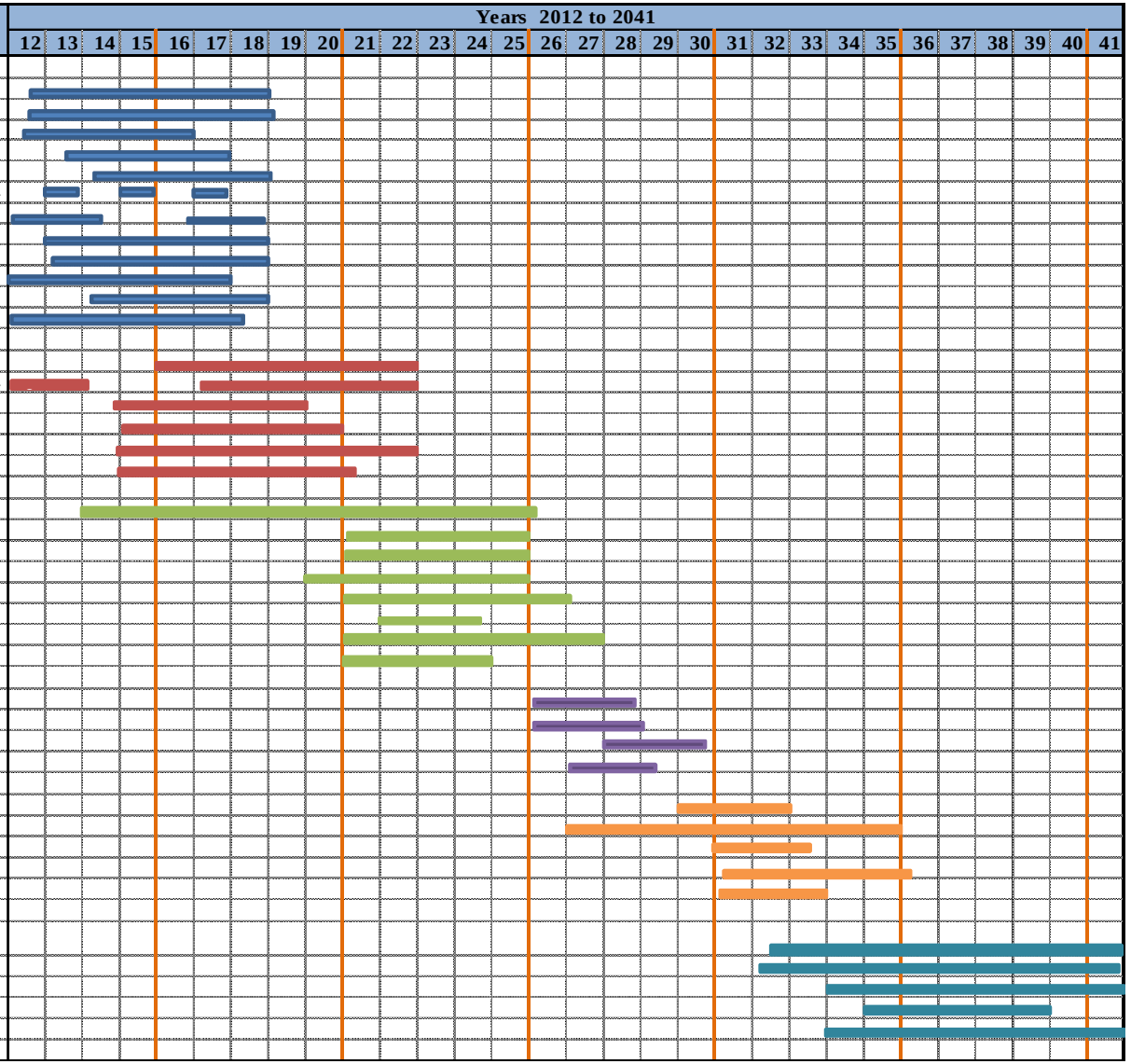
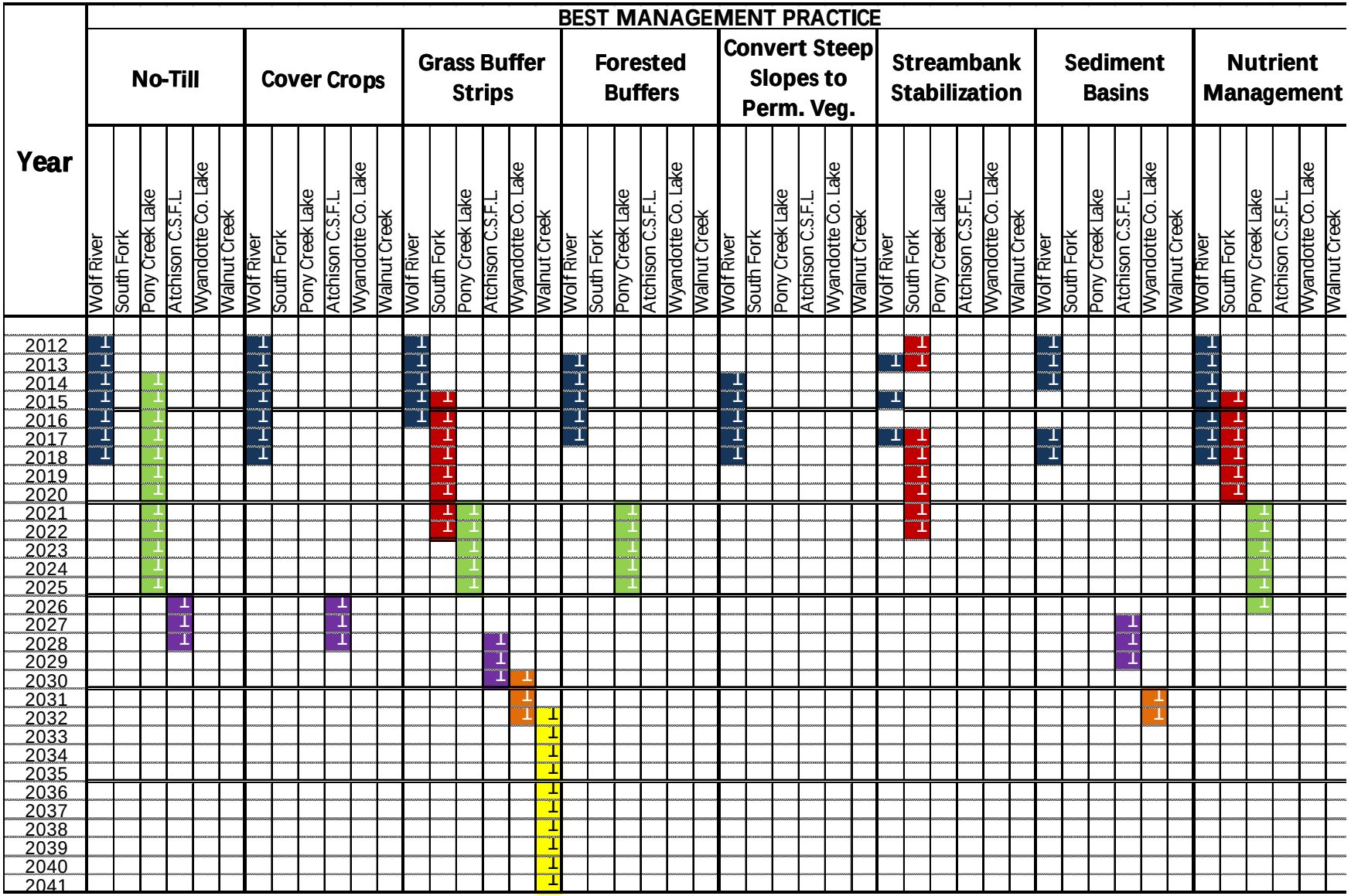


Table 63 - Annual BMP Schedule



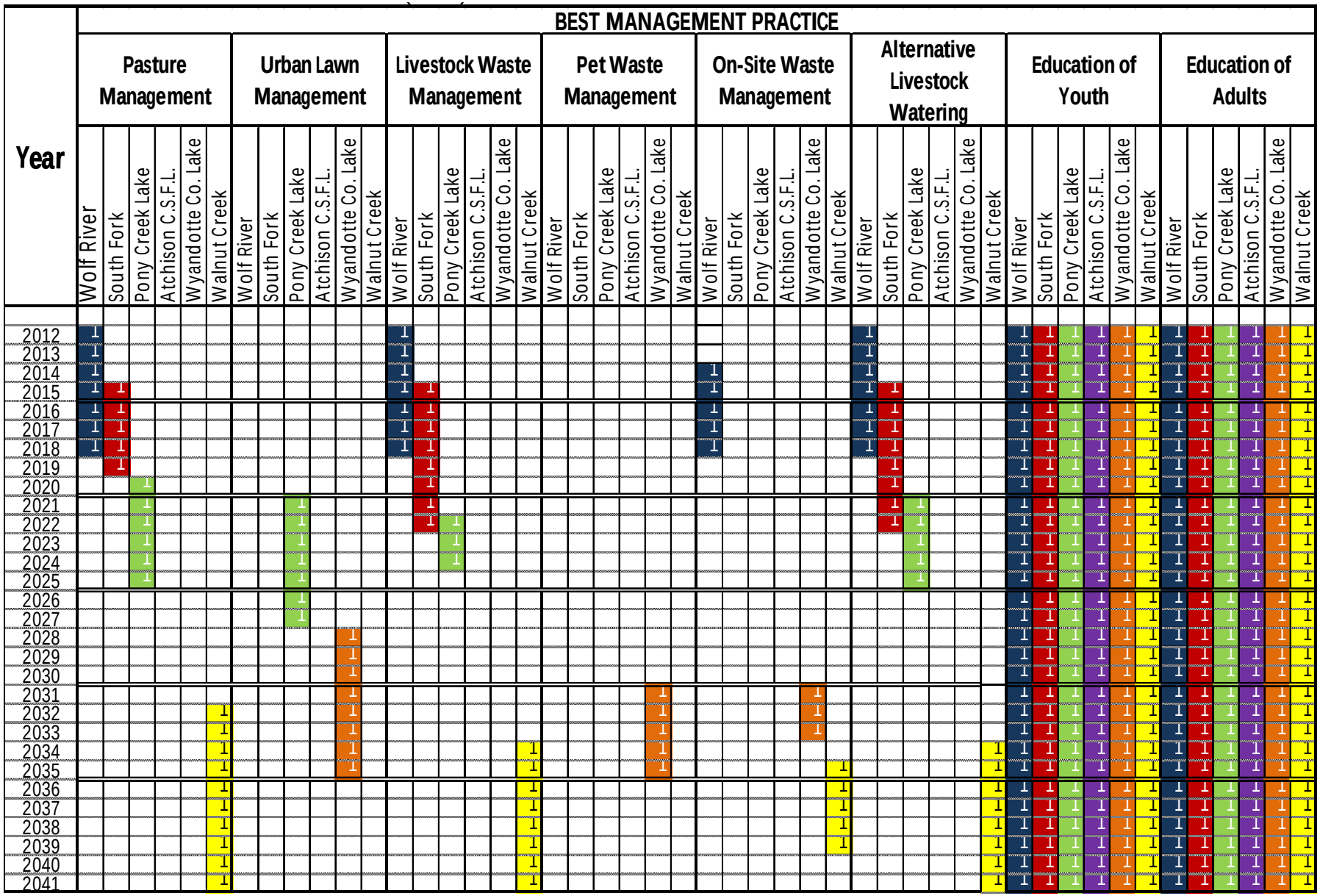

BEST MANAGEMENT PRACTICE
Year
Pasture Management
Urban Lawn Management
Livestock Waste Management
Pet Waste Management
On-Site Waste Management
Alternative Livestock Watering
Education of Youth
Education of Adults
Wolf River
South Fork
Pony Creek Lake
Atchison C.S.F.L.
Wyandotte Co. Lake
Walnut Creek
2012
2013
2014
2015
2016
2017
2018
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Table 64 - I & E Annual Cost Calculations

Best Management Practice	Year	No-Till	Cover Crops	Grass Buffer Strip	Forested Buffers	Convert Steep Slopes to Perm. Veg.	Streambank Stabilization	Sediment Basins	Nutrient Management	Pasture Management
ACTIVITIY										
Information Meeting		$2,750	*	*			$2,750		*	*
One on One Meetings		$750	$750	$1,200	$750	$350	$1,200	$300	$1,000	$1,000
Field Day		$2,750	*	*			$2,750	*		
Scholarships		$3,000								
Newsletter Article		$300	$300	$300	$300	$300	$300	$300	$300	$300
Newspaper Article				$300	$300	$300	$300	$300	$300	$300
Demonstration Plots	Even		$300		$500					
	Odd			$300			$1,000			
Soil Tests									$4,800	
Signage										
Poster/Essay Contests										
4-H Water Quality Projects										
Earth Day										
River Friendly Farm Meeting										
River Friendly Farm Tech										
Event Displays										
Awards Meetings										
Totals - Odd Year		$9,550	$1,350	$1,800	$1,850	$950	$7,300	$900	$6,400	$1,600
Totals - Even Year		$9,550	$1,050	$2,100	$1,350	$950	$8,300	$900	$6,400	$1,600

Table 64- I & E Annual Cost Calculations (Cont.)

Best Management Practice	Year	Urban Lawn Management	Livestock Waste Management	Pet Waste Management	On-Site Waste Management	Alternative Livestock Watering	Education of Youth	Education of Adults	Annual Costs Odd Year (A)	Annual Costs Even Year (B)
ACTIVITIY										
Information Meeting		$2,750	$2,750			*			$11,000	$11,000
One on One Meetings			$1,250	$300	$750	$1,250			$10,850	$10,850
Field Day			$2,750			*			$8,250	$8,250
Scholarships									$3,000	$3,000
Newsletter Article		$300	$300	$300		$300	$300		$4,200	$4,200
Newspaper Article		$300	$300		$300				$3,000	$3,000
Demonstration Plots	Even		$1,000			$500			$2,300	
	Odd		$1,000			$500				$2,800
Soil Tests		$1,200							$6,000	$6,000
Signage				$500					$500	$500
Poster/Essay Contests							$200		$200	$200
4-H Water Quality Projects							$100		$100	$100
Earth Day							$2,000		$2,000	$2,000
River Friendly Farm Meeting								$500	$500	$500
River Friendly Farm Tech Asst.								$5,000	$5,000	$5,000
Event Displays				$600				$500	$1,100	$1,100
Awards Meetings								$500	$500	$500
									$58,500	$59,000
Totals		$4,550	$8,350	$1,700	$1,050	$2,050	$2,600	$6,500	$58,500	
		$4,550	$8,350	$1,700	$1,050	$2,050	$2,600	$6,500	$59,000	

Table 65 - Wolf River Annual I & E Costs

Year	Wolf River I & E Costs														
	No-Till	Cover Crops	Grass Buffers	Forsted Buffers	Convert Steep	Streambank Stabil.	Sediment Basin	Nutrient Management	Pasture Management	Livestock Waste	On-Site Waste Manage.	Alternative Water	Education of Youth	Education of Adults	Total
2012	$9,550	$1,350	$1,800	$0	$0	$0	$900	$6,400	$1,600	$8,350	$0	$2,050	$433	$1,083	$33,517
2013	9,550	1,050	2,100	1,350	0	4,150	900	6,400	1,600	8,350	0	2,050	433	1,083	$39,017
2014	4,775	1,350	1,800	1,850	950	0	900	6,400	1,600	8,350	1,050	2,050	433	1,083	$32,592
2015	4,775	1,050	1,050	1,350	950	8,300	0	3,200	800	4,175	1,050	1,025	433	1,083	$29,242
2016	4,775	1,350	900	1,850	950	0	0	3,200	800	4,175	1,050	1,025	433	1,083	$21,592
2017	4,775	1,050	0	1,350	950	4,150	900	3,200	800	4,175	1,050	1,025	433	1,083	$24,942
2018	4,775	1,350	0	0	950	0	900	3,200	800	4,175	1,050	1,025	433	1,083	$19,742
2019	0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	$1,517
2020	0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	$1,517
2021	0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	$1,517
2022	0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	$1,517
2023	0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	$1,517
2024	0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	$1,517
2025	0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	$1,517
2026	0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	$1,517
2027	0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	$1,517
2028	0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	$1,517
2029	0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	$1,517
2030	0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	$1,517
2031	0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	$1,517
2032	0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	$1,517
2033	0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	$1,517
2034	0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	$1,517
2035	0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	$1,517
2036	0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	$1,517
2037	0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	$1,517
2038	0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	$1,517
2039	0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	$1,517
2040	0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	$1,517
2041	0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	$1,517

Table 66 - South Fork Big Nemaha and Pony Creek Annual I & Costs

Year	South Fork Big Nemaha I & E Costs									Pony Creek I & E Costs										
	Grass Buffers	Streambank Stabil.	Nutrient Management	Pasture Management	Livestock Waste	Alternative Water	Education of Youth	Education of Adults	Total	No-Till	Grass Buffers	Forested Buffers	Nutrient Management	Pasture Management	Urban Waste Manage.	Livestock Waste	Alternative Water	Education of Youth	Education of Adults	Total
2012	$0	$7,300	$0	$0	$0	$0	$433	$1,083	$8,817	$0	$0	$0	$0	$0	$0	$0	$0	$433	$1,083	$1,517
2013	0	4,150	0	0	0	0	433	1,083	$5,667	0	0	0	0	0	0	0	0	433	1,083	$1,517
2014	0	0	0	0	0	0	433	1,083	$1,517	4,775	0	0	0	0	0	0	0	433	1,083	$6,292
2015	1,050	0	3,200	800	4,175	1,025	433	1,083	$11,767	4,775	0	0	0	0	0	0	0	433	1,083	$6,292
2016	900	0	3,200	800	4,175	1,025	433	1,083	$11,617	4,775	0	0	0	0	0	0	0	433	1,083	$6,292
2017	2,100	4,150	3,200	800	4,175	1,025	433	1,083	$16,967	4,775	0	$0	0	0	0	0	0	433	1,083	$6,292
2018	1,800	7,300	3,200	800	4,175	1,025	433	1,083	$19,817	4,775	0	$0	0	0	0	0	0	433	1,083	$6,292
2019	2,100	8,300	6,400	1,600	8,350	2,050	433	1,083	$30,317	9,550	0	$0	0	0	0	0	0	433	1,083	$11,067
2020	1,800	7,300	6,400	0	8,350	2,050	433	1,083	$27,417	9,550	0	$0	0	1,600	0	0	0	433	1,083	$12,667
2021	1,050	8,300	0	0	8,350	1,025	433	1,083	$20,242	9,550	1,050	1,850	6,400	1,600	4,550	0	1,025	433	1,083	$27,542
2022	900	7,300	0	0	4,175	1,025	433	1,083	$14,917	9,550	900	$1,850	6,400	1,600	4,550	4,175	1,025	433	1,083	$31,567
2023	0	0	0	0	0	0	433	1,083	$1,517	9,550	2,100	$1,850	6,400	1,600	4,550	8,350	2,050	433	1,083	$37,967
2024	0	0	0	0	0	0	433	1,083	$1,517	9,550	1,800	$1,850	6,400	1,600	4,550	8,350	2,050	433	1,083	$37,667
2025	0	0	0	0	0	0	433	1,083	$1,517	9,550	2,100	$1,850	6,400	1,600	4,550	0	2,050	433	1,083	$29,617
2026	0	0	0	0	0	0	433	1,083	$1,517	0	0	0	6,400	0	0	0	0	433	1,083	$7,917
2027	0	0	0	0	0	0	433	1,083	$1,517	0	0	$0	0	0	0	0	0	433	1,083	$1,517
2028	0	0	0	0	0	0	433	1,083	$1,517	0	0	$0	0	0	0	0	0	433	1,083	$1,517
2029	0	0	0	0	0	0	433	1,083	$1,517	0	0	0	0	0	0	0	0	433	1,083	$1,517
2030	0	0	0	0	0	0	433	1,083	$1,517	0	0	0	0	0	0	0	0	433	1,083	$1,517
2031	0	0	0	0	0	0	433	1,083	$1,517	0	0	0	0	0	0	0	0	433	1,083	$1,517
2032	0	0	0	0	0	0	433	1,083	$1,517	0	0	0	0	0	0	0	0	433	1,083	$1,517
2033	0	0	0	0	0	0	433	1,083	$1,517	0	0	0	0	0	0	0	0	433	1,083	$1,517
2034	0	0	0	0	0	0	433	1,083	$1,517	0	0	0	0	0	0	0	0	433	1,083	$1,517
2035	0	0	0	0	0	0	433	1,083	$1,517	0	0	0	0	0	0	0	0	433	1,083	$1,517
2036	0	0	0	0	0	0	433	1,083	$1,517	0	0	0	0	0	0	0	0	433	1,083	$1,517
2037	0	0	0	0	0	0	433	1,083	$1,517	0	0	0	0	0	0	0	0	433	1,083	$1,517
2038	0	0	0	0	0	0	433	1,083	$1,517	0	0	0	0	0	0	0	0	433	1,083	$1,517
2039	0	0	0	0	0	0	433	1,083	$1,517	0	0	0	0	0	0	0	0	433	1,083	$1,517
2040	0	0	0	0	0	0	433	1,083	$1,517	0	0	0	0	0	0	0	0	433	1,083	$1,517
2041	0	0	0	0	0	0	433	1,083	$1,517	0	0	0	0	0	0	0	0	433	1,083	$1,517

Table 67 - Atchison County State Fishing Lake Annual I & Costs

Year	Atchison County SFL I & E Cost						
	No-Till	Cover Crops	Grass Buffers	Sediment Basin	Education of Youth	Education of Adults	Total
2012	0	0	0	0	433	1,083	1,517
2013	0	0	0	0	433	1,083	$1,517
2014	0	0	0	0	433	1,083	$1,517
2015	0	0	0	0	433	1,083	$1,517
2016	0	0	0	0	433	1,083	$1,517
2017	0	0	0	0	433	1,083	$1,517
2018	0	0	0	0	433	1,083	$1,517
2019	0	0	0	0	433	1,083	$1,517
2020	0	0	0	0	433	1,083	$1,517
2021	0	0	0	0	433	1,083	$1,517
2022	0	0	0	0	433	1,083	$1,517
2023	0	0	0	0	433	1,083	$1,517
2024	0	0	0	0	433	1,083	$1,517
2025	0	0	0	0	433	1,083	$1,517
2026	9,550	1,350	0	0	433	1,083	$12,417
2027	9,550	1,050	0	900	433	1,083	$13,017
2028	9,550	1,350	1,800	900	433	1,083	$15,117
2029	0	0	2,100	900	433	1,083	$4,517
2030	0	0	900	0	433	1,083	$2,417
2031	0	0	0	0	433	1,083	$1,517
2032	0	0	0	0	433	1,083	$1,517
2033	0	0	0	0	433	1,083	$1,517
2034	0	0	0	0	433	1,083	$1,517
2035	0	0	0	0	433	1,083	$1,517
2036	0	0	0	0	433	1,083	$1,517
2037	0	0	0	0	433	1,083	$1,517
2038	0	0	0	0	433	1,083	$1,517
2039	0	0	0	0	433	1,083	$1,517
2040	0	0	0	0	433	1,083	$1,517
2041	0	0	0	0	433	1,083	$1,517

Table 68 - Wyandotte County Lake Annual I & Costs

Year	Wyandotte County Lake I & E Cost							
	Grass Buffers	Sediment Basin	Urban Waste Manage.	Pet Waste	On-Site Waste Manage.	Education of Youth	Education of Adults	Total
2012	$0	$0	$0	$0	$0	$433	$1,083	$1,517
2013	0	0	0	0	0	433	1,083	$1,517
2014	0	0	0	0	0	433	1,083	$1,517
2015	0	0	0	0	0	433	1,083	$1,517
2016	0	0	0	0	0	433	1,083	$1,517
2017	0	0	0	0	0	433	1,083	$1,517
2018	0	0	0	0	0	433	1,083	$1,517
2019	0	0	0	0	0	433	1,083	$1,517
2020	0	0	0	0	0	433	1,083	$1,517
2021	0	0	0	0	0	433	1,083	$1,517
2022	0	0	0	0	0	433	1,083	$1,517
2023	0	0	0	0	0	433	1,083	$1,517
2024	0	0	0	0	0	433	1,083	$1,517
2025	0	0	0	0	0	433	1,083	$1,517
2026	0	0	0	0	0	433	1,083	$1,517
2027	0	0	0	0	0	433	1,083	$1,517
2028	0	0	4,550	0	0	433	1,083	$6,067
2029	0	0	4,550	0	0	433	1,083	$6,067
2030	900	0	4,550	0	0	433	1,083	$6,967
2031	2,100	900	4,550	1,700	1,050	433	1,083	$11,817
2032	900	900	4,550	1,700	1,050	433	1,083	$10,617
2033	0	0	4,550	1,700	1,050	433	1,083	$8,817
2034	0	0	4,550	1,700	0	433	1,083	$7,767
2035	0	0	4,550	1,700	0	433	1,083	$7,767
2036	0	0	0	0	0	433	1,083	$1,517
2037	0	0	0	0	0	433	1,083	$1,517
2038	0	0	0	0	0	433	1,083	$1,517
2039	0	0	0	0	0	433	1,083	$1,517
2040	0	0	0	0	0	433	1,083	$1,517
2041	0	0	0	0	0	433	1,083	$1,517
Total	$3,900	$1,800	$36,400	$8,500	$3,150	$13,000	$32,500	$99,250

Table 69 - Walnut Creek I & E Costs

Year	Walnut Creek I & E Cost							
	Grass Buffers	Pasture Management	Livestock Waste	On-Site Waste Manage.	Alternative Water	Education of Youth	Education of Adults	Total
2012	$0	$0	$0	$0	$0	$433	1,083	$1,517
2013	0	0	0	0	0	433	1,083	$1,517
2014	0	0	0	0	0	433	1,083	$1,517
2015	0	0	0	0	0	433	1,083	$1,517
2016	0	0	0	0	0	433	1,083	$1,517
2017	0	0	0	0	0	433	1,083	$1,517
2018	0	0	0	0	0	433	1,083	$1,517
2019	0	0	0	0	0	433	1,083	$1,517
2020	0	0	0	0	0	433	1,083	$1,517
2021	0	0	0	0	0	433	1,083	$1,517
2022	0	0	0	0	0	433	1,083	$1,517
2023	0	0	0	0	0	433	1,083	$1,517
2024	0	0	0	0	0	433	1,083	$1,517
2025	0	0	0	0	0	433	1,083	$1,517
2026	0	0	0	0	0	433	1,083	$1,517
2027	0	0	0	0	0	433	1,083	$1,517
2028	0	0	0	0	0	433	1,083	$1,517
2029	0	0	0	0	0	433	1,083	$1,517
2030	0	0	0	0	0	433	1,083	$1,517
2031	0	0	0	0	0	433	1,083	$1,517
2032	900	1,600	0	0	0	433	1,083	$4,017
2033	2,100	1,600	0	0	0	433	1,083	$5,217
2034	1,800	1,600	8,350	0	2,050	433	1,083	$15,317
2035	2,100	1,600	8,350	1,050	2,050	433	1,083	$16,667
2036	1,800	1,600	8,350	1,050	2,050	433	1,083	$16,367
2037	2,100	1,600	8,350	1,050	2,050	433	1,083	$16,667
2038	1,800	1,600	8,350	1,050	2,050	433	1,083	$16,367
2039	2,100	1,600	8,350	1,050	2,050	433	1,083	$16,667
2040	1,800	1,600	8,350	0	2,050	433	1,083	$15,317
2041	2,100	1,600	8,350	0	2,050	433	1,083	$15,617

Table 70 - Summary of I & E Annual Costs

Year	Total I & E Annual Costs																
	No-Till	Cover Crops	Grass Buffers	Forested Buffers	Convert Steep	Streambank Stabil.	Sediment Basin	Nutrient Management	Pasture Management	Urban Waste Manage.	Livestock Waste	Pet Waste	On-Site Waste Manage.	Alternative Water	Education of Youth	Education of Adults	Total
2012	$9,550	$1,350	$1,800	$0	$0	$7,300	$900	$6,400	$1,600	$0	$8,350	$0	$0	$2,050	$2,600	$6,500	$48,400
2013	9,550	1,050	2,100	1,350	0	8,300	900	6,400	1,600	0	8,350	0	0	2,050	2,600	$6,500	$50,750
2014	9,550	1,350	1,800	1,850	950	0	900	6,400	1,600	0	8,350	0	1,050	2,050	2,600	$6,500	$44,950
2015	9,550	1,050	2,100	1,350	950	8,300	0	6,400	1,600	0	8,350	0	1,050	2,050	2,600	$6,500	$51,850
2016	9,550	1,350	1,800	1,850	950	0	0	6,400	1,600	0	8,350	0	1,050	2,050	2,600	$6,500	$44,050
2017	9,550	1,050	2,100	1,350	950	8,300	900	6,400	1,600	0	8,350	0	1,050	2,050	2,600	$6,500	$52,750
2018	9,550	1,350	1,800	0	950	7,300	900	6,400	1,600	0	8,350	0	1,050	2,050	2,600	$6,500	$50,400
2019	9,550	0	2,100	0	0	8,300	0	6,400	1,600	0	8,350	0	0	2,050	2,600	$6,500	$47,450
2020	9,550	0	1,800	0	0	7,300	0	6,400	1,600	0	8,350	0	0	2,050	2,600	$6,500	$46,150
2021	9,550	0	2,100	1,850	0	8,300	0	6,400	1,600	4,550	8,350	0	0	2,050	2,600	$6,500	$53,850
2022	9,550	0	1,800	1,850	0	7,300	0	6,400	1,600	4,550	8,350	0	0	2,050	2,600	$6,500	$52,550
2023	9,550	0	2,100	1,850	0	0	0	6,400	1,600	4,550	8,350	0	0	2,050	2,600	$6,500	$45,550
2024	9,550	0	1,800	1,850	0	0	0	6,400	1,600	4,550	8,350	0	0	2,050	2,600	$6,500	$45,250
2025	9,550	0	2,100	1,850	0	0	0	6,400	1,600	4,550	0	0	0	2,050	2,600	$6,500	$37,200
2026	9,550	1,350	0	0	0	0	0	6,400	0	4,550	0	0	0	0	2,600	$6,500	$30,950
2027	9,550	1,050	0	0	0	0	900	0	0	4,550	0	0	0	0	2,600	$6,500	$25,150
2028	9,550	1,350	1,800	0	0	0	900	0	0	4,550	0	0	0	0	2,600	$6,500	$27,250
2029	0	0	2,100	0	0	0	900	0	0	4,550	0	0	0	0	2,600	$6,500	$16,650
2030	0	0	1,800	0	0	0	0	0	0	4,550	0	0	0	0	2,600	$6,500	$15,450
2031	0	0	2,100	0	0	0	900	0	0	4,550	0	1,700	1,050	0	2,600	$6,500	$19,400
2032	0	0	1,800	0	0	0	900	0	1,600	4,550	0	1,700	1,050	0	2,600	$6,500	$20,700
2033	0	0	2,100	0	0	0	0	0	1,600	4,550	0	1,700	1,050	0	2,600	$6,500	$20,100
2034	0	0	1,800	0	0	0	0	0	1,600	4,550	8,350	1,700	0	2,050	2,600	$6,500	$29,150
2035	0	0	2,100	0	0	0	0	0	1,600	4,550	8,350	1,700	1,050	2,050	2,600	$6,500	$30,500
2036	0	0	1,800	0	0	0	0	0	1,600	0	8,350	0	1,050	2,050	2,600	$6,500	$23,950
2037	0	0	2,100	0	0	0	0	0	1,600	0	8,350	0	1,050	2,050	2,600	$6,500	$24,250
2038	0	0	1,800	0	0	0	0	0	1,600	0	8,350	0	1,050	2,050	2,600	$6,500	$23,950
2039	0	0	2,100	0	0	0	0	0	1,600	0	8,350	0	1,050	2,050	2,600	$6,500	$24,250
2040	0	0	1,800	0	0	0	0	0	1,600	0	8,350	0	0	2,050	2,600	$6,500	$22,900
2041	0	0	2,100	0	0	0	0	0	1,600	0	$8,350	0	0	2,050	2,600	$6,500	$23,200
Total	$162,350	$12,300	$54,600	$17,000	$4,750	$70,700	$9,000	$96,000	$38,400	$68,250	$175,350	$8,500	$13,650	$45,100	$78,000	$195,000	$1,048,950

Table 71 - Wolf River Watershed Annual BMP and I & E Costs

BMP	Wolf River Watershed	South Fork Big Nemaha	Pony Creek Lake	Atchison Co. State Fishing Lake	Wyandotte County Lake	Walnut Creek	No- till			Cover Crops			Grass Buffers			Forested Buffers			Steep Slopes			Stream Stabilization		
BMP Cost							$2,500			$3,280			$4,300			$9,880			$11,250			$64,800		
Years BMP Applied							7			7			5			5			5			3		
Annual I & E Cost							$9,550			$1,350 / $1,050			$1,800 / $2,100			$1,850 / $1,350			$950			$7,300/ $8,300		
Quantity							100			50			20			20			50			900		
Units							Acres			Acres			Acres			Acres			Acres			Linear Feet		
Year							BMP	I & E	Total	BMP	I & E	Total	BMP	I & E	Total	BMP	I & E	Total	BMP	I & E	Total	BMP	I & E	Total
2012							$357	$9,550	$9,907	$469	$1,350	$1,819	$860	$1,800	$2,660	$0	$0	$0	$0	$0	$0	$0	$0	$0
2013							357	9,550	9,907	469	1,050	1,519	860	2,100	2,960	1,976	1,350	3,326	0	0	0	21,600	4,150	25,750
2014							357	4,775	5,132	469	1,350	1,819	860	1,800	2,660	1,976	1,850	3,826	2,250	950	3,200	0	0	0
2015							357	4,775	5,132	469	1,050	1,519	860	1,050	1,910	1,976	1,350	3,326	2,250	950	3,200	21,600	8,300	29,900
2016							357	4,775	5,132	469	1,350	1,819	860	900	1,760	1,976	1,850	3,826	2,250	950	3,200	0	0	0
2017							357	4,775	5,132	469	1,050	1,519	0	0	0	1,976	1,350	3,326	2,250	950	3,200	21,600	4,150	25,750
2018							357	4,775	5,132	469	1,350	1,819	0	0	0	0	0	0	2,250	950	3,200	0	0	0
2019							0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2020							0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2021							0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2022							0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2023							0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2024							0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2025							0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2026							0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2027							0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2028							0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2029							0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2030							0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2031							0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2032							0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2033							0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2034							0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2035							0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2036							0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2037							0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2038							0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2039							0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2040							0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2041							0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 71 - Wolf River Watershed Annual BMP and I & E Costs (Cont.)

BMP	Sediment Basins			Pasture Management			Nutrient Management			Livestock Waste Management			On-Site Waste System Repair			Alternative Watering			Youth I & E	Adult I & E	Total
BMP Cost	$25,000			$3,750			$18,750			$200,000			$50,000			$83,490					
Years BMP Applied	5			7			7			8			5			7					
Annual I & E Cost	$900			$1,600			$8,350			$8,350			$1,050			$2,050					
Quantity	5			250			1,500			10			10			22					
Units	Each			Acres			Acres			Each			Each			Each					
Year	BMP	I & E	Total	BMP	I & E	Total	BMP	I & E	Total	BMP	I & E	Total	BMP	I & E	Total	BMP	I & E	Total			
2012	$5,000	$900	$5,900	$536	$1,600	$2,136	$2,679	$6,400	$9,079	$25,000	$8,350	$33,350	$0	$0	$0	$11,927	$2,050	$13,977	$433	$1,083	$80,345
2013	5,000	900	5,900	536	1,600	2,136	2,679	6,400	9,079	25,000	8,350	33,350	0	0	0	11,927	2,050	13,977	433	1,083	$109,421
2014	5,000	900	5,900	536	1,600	2,136	2,679	6,400	9,079	25,000	8,350	33,350	10,000	1,050	11,050	11,927	2,050	13,977	433	1,083	$93,646
2015	0	0	0	536	800	1,336	2,679	3,200	5,879	25,000	4,175	29,175	10,000	1,050	11,050	11,927	1,025	12,952	433	1,083	$106,896
2016	0	0	0	536	800	1,336	2,679	3,200	5,879	25,000	4,175	29,175	10,000	1,050	11,050	11,927	1,025	12,952	433	1,083	$77,646
2017	5,000	900	5,900	536	800	1,336	2,679	3,200	5,879	25,000	4,175	29,175	10,000	1,050	11,050	11,927	1,025	12,952	433	1,083	$106,736
2018	5,000	900	5,900	536	800	1,336	2,679	3,200	5,879	25,000	4,175	29,175	10,000	1,050	11,050	11,927	1,025	12,952	433	1,083	$77,960
2019	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	$1,517
2020	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	$1,517
2021	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	$1,517
2022	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	$1,517
2023	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	$1,517
2024	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	$1,517
2025	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	$1,517
2026	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	$1,517
2027	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	$1,517
2028	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	$1,517
2029	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	$1,517
2030	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	$1,517
2031	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	$1,517
2032	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	$1,517
2033	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	$1,517
2034	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	$1,517
2035	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	$1,517
2036	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	$1,517
2037	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	$1,517
2038	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	$1,517
2039	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	$1,517
2040	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	$1,517
2041	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	$1,517
																			$13,000	$32,500	**$687,531**

Table 72 - South Fork Big Nemaha Watershed Annual BMP and I & E Costs

BMP	Wolf River Watershed	South Fork Big Nemaha	Pony Creek Lake	Adison County SEL	Wyandotte County Lake	Walnut Creek	Grass Buffer Strips			Stream Stabilization			Pasture Management		
BMP Cost							$6,450			$108,800			$3,750		
Years BMP Applied							8			10			5		
Annual I & E Cost							$1,350 / $1,050			$7,300/ $8,300			$1,600		
Quantity							30			1500			250		
Units							Acres			Linear Feet			Acres		
Year							BMP	I & E	Total	BMP	I & E	Total	BMP	I & E	Total
2012							$0	$0	$0	$10,880	$7,300	$18,180	$0	0	$0
2013							0	0	0	10,880	4,150	15,030	0	0	0
2014							0	0	0	0	0	0	0	0	0
2015							806	1,050	1,856	0	0	0	750	800	1,550
2016							806	900	1,706	0	0	0	750	800	1,550
2017							806	2,100	2,906	10,880	4,150	15,030	750	800	1,550
2018							806	1,800	2,606	10,880	7,300	18,180	750	800	1,550
2019							806	2,100	2,906	10,880	8,300	19,180	750	1,600	2,350
2020							806	1,800	2,606	10,880	7,300	18,180	0	0	0
2021							806	1,050	1,856	10,880	8,300	19,180	0	0	0
2022							806	900	1,706	10,880	7,300	18,180	0	0	0
2023							0	0	0	0	0	0	0	0	0
2024							0	0	0	0	0	0	0	0	0
2025							0	0	0	0	0	0	0	0	0
2026							0	0	0	0	0	0	0	0	0
2027							0	0	0	0	0	0	0	0	0
2028							0	0	0	0	0	0	0	0	0
2029							0	0	0	0	0	0	0	0	0
2030							0	0	0	0	0	0	0	0	0
2031							0	0	0	0	0	0	0	0	0
2032							0	0	0	0	0	0	0	0	0
2033							0	0	0	0	0	0	0	0	0
2034							0	0	0	0	0	0	0	0	0
2035							0	0	0	0	0	0	0	0	0
2036							0	0	0	0	0	0	0	0	0
2037							0	0	0	0	0	0	0	0	0
2038							0	0	0	0	0	0	0	0	0
2039							0	0	0	0	0	0	0	0	0
2040							0	0	0	0	0	0	0	0	0
2041							0	0	0	0	0	0	0	0	0

Table 72 - South Fork Big Nemaha Watershed Annual BMP and I & E Costs (Cont.)

BMP	Nutrient Management			Livestock Waste Management.			Alternative Watering			Youth I & E	Adult I & E	Total
BMP Cost	$3,135			$140,000			$189,759					
Years BMP Applied	6			8			7					
Annual I & E Cost	$8,350			$8,350			$2,050					
Quantity	250			7			50					
Units	Acres			Each			Each					
Year	BMP	I & E	Total	BMP	I & E	Total	BMP	I & E	Total			
2012	$0	$0	$0	$0	$0	$0	$0	$0	$0	$433	$1,083	$19,697
2013	0	0	0	0	0	0	0	0	0	433	1,083	$16,547
2014	0	0	0	0	0	0	0	0	0	433	1,083	$1,517
2015	523	3,200	3,723	17,500	4,175	21,675	27,108	1,025	28,133	433	1,083	$58,454
2016	523	3,200	3,723	17,500	4,175	21,675	27,108	1,025	28,133	433	1,083	$58,304
2017	523	3,200	3,723	17,500	4,175	21,675	27,108	1,025	28,133	433	1,083	$74,534
2018	523	3,200	3,723	17,500	4,175	21,675	27,108	1,025	28,133	433	1,083	$77,384
2019	523	6,400	6,923	17,500	8,350	25,850	27,108	2,050	29,158	433	1,083	$87,884
2020	523	6,400	6,923	17,500	8,350	25,850	27,108	2,050	29,158	433	1,083	$84,234
2021	0	0	0	17,500	8,350	25,850	27,108	1,025	28,133	433	1,083	$76,536
2022	0	0	0	17,500	4,175	21,675	27,108	1,025	28,133	433	1,083	$71,211
2023	0	0	0	0	0	0	0	0	0	433	1,083	$1,517
2024	0	0	0	0	0	0	0	0	0	433	1,083	$1,517
2025	0	0	0	0	0	0	0	0	0	433	1,083	$1,517
2026	0	0	0	0	0	0	0	0	0	433	1,083	$1,517
2027	0	0	0	0	0	0	0	0	0	433	1,083	$1,517
2028	0	0	0	0	0	0	0	0	0	433	1,083	$1,517
2029	0	0	0	0	0	0	0	0	0	433	1,083	$1,517
2030	0	0	0	0	0	0	0	0	0	433	1,083	$1,517
2031	0	0	0	0	0	0	0	0	0	433	1,083	$1,517
2032	0	0	0	0	0	0	0	0	0	433	1,083	$1,517
2033	0	0	0	0	0	0	0	0	0	433	1,083	$1,517
2034	0	0	0	0	0	0	0	0	0	433	1,083	$1,517
2035	0	0	0	0	0	0	0	0	0	433	1,083	$1,517
2036	0	0	0	0	0	0	0	0	0	433	1,083	$1,517
2037	0	0	0	0	0	0	0	0	0	433	1,083	$1,517
2038	0	0	0	0	0	0	0	0	0	433	1,083	$1,517
2039	0	0	0	0	0	0	0	0	0	433	1,083	$1,517
2040	0	0	0	0	0	0	0	0	0	433	1,083	$1,517
2041	0	0	0	0	0	0	0	0	0	433	1,083	$1,517
												$655,115

Table 73 - Pony Creek Lake Watershed Annual BMP and I & E Costs

BMP	Wolf River Watershed	South Fork Big Nemaha	Pony Creek Lake	Atchison Co. State Fishing Lake	Wyandotte County Lake	Wolf Creek	No- till			Grass Buffers			Forrested Buffers			Pasture Management		
BMP Cost							$14,400			$21,500			$49,400			$750		
Years BMP Applied							11			5			5			6		
Annual I & E Cost							$9,550			$1,800 / $2,100			$1,850 / $1,350			$1,600		
Quantity							720			100			100			500		
Units							Acres			Acres			Acres			Acres		
Year							BMP	I & E	Total	BMP	I & E	Total	BMP	I & E	Total	BMP	I & E	Total
2012							$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
2013							0	0	0	0	0	0	0	0	0	0	0	0
2014							1,309	4,775	6,084	0	0	0	0	0	0	0	0	0
2015							1,309	4,775	6,084	0	0	0	0	0	0	0	0	0
2016							1,309	4,775	6,084	0	0	0	0	0	0	0	0	0
2017							1,309	4,775	6,084	0	0	0	0	0	0	0	0	0
2018							1,309	4,775	6,084	0	0	0	0	0	0	0	0	0
2019							1,309	9,550	10,859	0	0	0	0	0	0	0	0	0
2020							1,309	9,550	10,859	0	0	0	0	0	0	125	1,600	1,725
2021							1,309	9,550	10,859	4,300	1,050	5,350	9,880	1,850	11,730	125	1,600	1,725
2022							1,309	9,550	10,859	4,300	900	5,200	9,880	1,850	11,730	125	1,600	1,725
2023							1,309	9,550	10,859	4,300	2,100	6,400	9,880	1,850	11,730	125	1,600	1,725
2024							1,309	9,550	10,859	4,300	1,800	6,100	9,880	1,850	11,730	125	1,600	1,725
2025							1,309	9,550	10,859	4,300	2,100	6,400	9,880	1,850	11,730	125	1,600	1,725
2026							0	0	0	0	0	0	0	0	0	0	0	0
2027							0	0	0	0	0	0	0	0	0	0	0	0
2028							0	0	0	0	0	0	0	0	0	0	0	0
2029							0	0	0	0	0	0	0	0	0	0	0	0
2030							0	0	0	0	0	0	0	0	0	0	0	0
2031							0	0	0	0	0	0	0	0	0	0	0	0
2032							0	0	0	0	0	0	0	0	0	0	0	0
2033							0	0	0	0	0	0	0	0	0	0	0	0
2034							0	0	0	0	0	0	0	0	0	0	0	0
2035							0	0	0	0	0	0	0	0	0	0	0	0
2036							0	0	0	0	0	0	0	0	0	0	0	0
2037							0	0	0	0	0	0	0	0	0	0	0	0
2038							0	0	0	0	0	0	0	0	0	0	0	0
2039							0	0	0	0	0	0	0	0	0	0	0	0
2040							0	0	0	0	0	0	0	0	0	0	0	0
2041							0	0	0	0	0	0	0	0	0	0	0	0
									$106,433			$29,450			$58,650			$10,350

Table 73 - Pony Creek Lake Watershed Annual BMP and I & E Costs (Cont.)

BMP	Nutrient Management			Livestock Waste Management			Urban Lawn Management			Alternative Watering			Youth I & E	Adult I & E	Total
BMP Cost	$26,000			$60,000			$33,350			$18,975					
Years BMP Applied	6			3			7			5					
Annual I & E Cost	$4,550			$8,350			$1,050			$2,050					
Quantity	2,000			3			35			5					
Units	Acres			Each			Acres			Each					
Year	BMP	I & E	Total	BMP	I & E	Total	BMP	I & E	Total	BMP	I & E	Total			
2012	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$433	$1,083	$1,517
2013	0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	$1,517
2014	0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	$7,601
2015	0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	$7,601
2016	0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	$7,601
2017	0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	$7,601
2018	0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	$7,601
2019	0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	$12,376
2020	0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	$14,101
2021	4,333	6,400	10,733	0	0	0	4,764	4,550	9,314	3,795	1,025	4,820	433	1,083	$56,048
2022	4,333	6,400	10,733	20,000	4,175	24,175	4,764	4,550	9,314	3,795	1,025	4,820	433	1,083	$80,073
2023	4,333	6,400	10,733	20,000	8,350	28,350	4,764	4,550	9,314	3,795	2,050	5,845	433	1,083	$86,473
2024	4,333	6,400	10,733	20,000	8,350	28,350	4,764	4,550	9,314	3,795	2,050	5,845	433	1,083	$86,173
2025	4,333	6,400	10,733	0	0	0	4,764	4,550	9,314	3,795	2,050	5,845	433	1,083	$58,123
2026	4,333	6,400	10,733	0	0	0	4,764	4,550	9,314	0	0	0	433	1,083	$21,564
2027	0	0	0	0	0	0	4,764	4,550	9,314	0	0	0	433	1,083	$10,831
2028	0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	$1,517
2029	0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	$1,517
2030	0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	$1,517
2031	0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	$1,517
2032	0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	$1,517
2033	0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	$1,517
2034	0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	$1,517
2035	0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	$1,517
2036	0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	$1,517
2037	0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	$1,517
2038	0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	$1,517
2039	0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	$1,517
2040	0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	$1,517
2041	0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	$1,517
			$64,398			$80,875			$65,198			$27,175	$13,000	$32,500	**$488,029**

Table 74 - Atchison County SFL Watershed Annual BMP and I & E Costs

BMP							No- till			Cover Crops			Grass Buffers			Sediment Basins			Youth I & E	Adult I & E	Total
BMP Cost							$5,000			$6,600			$4,300			$45,000					
Years BMP Applied							3			3			3			3					
Annual I & E Cost							$9,550			$1,350 / $1,050			$1,800 / $2,100			$900					
Quantity							250			100			20			1					
Units							Acres			Acres			Acres			Each					
Year	Wolf River Watershed	South Fork Big Nemaha	Pony Creek Lake	Atchison Co. SFL	Wyandotte County Lake	Walnut Creek	BMP	I & E	Total	BMP	I & E	Total	BMP	I & E	Total	BMP	I & E	Total			
2012							$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$433	$1,083	$1,517
2013							0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	1,517
2014							0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	1,517
2015							0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	1,517
2016							0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	1,517
2017							0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	1,517
2018							0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	1,517
2019							0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	1,517
2020							0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	1,517
2021							0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	1,517
2022							0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	1,517
2023							0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	1,517
2024							0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	1,517
2025							0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	1,517
2026							1,667	9,550	11,217	2,200	1,350	3,550	0	0	0	0	0	0	433	1,083	16,284
2027							1,667	9,550	11,217	2,200	1,050	3,250	0	0	0	15,000	900	15,900	433	1,083	31,884
2028							1,667	9,550	11,217	2,200	1,350	3,550	1,433	1,800	3,233	15,000	900	15,900	433	1,083	35,417
2029							0	0	0	0	0	0	1,433	2,100	3,533	15,000	900	15,900	433	1,083	20,950
2030							0	0	0	0	0	0	1,433	900	2,333	0	0	0	433	1,083	3,850
2031							0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	1,517
2032							0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	1,517
2033							0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	1,517
2034							0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	1,517
2035							0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	1,517
2036							0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	1,517
2037							0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	1,517
2038							0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	1,517
2039							0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	1,517
2040							0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	1,517
2041							0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	1,517
																					$146,300

Table 75 - Wyandotte County Lake Watershed Annual BMP and I & E Costs

BMP	Wolf River Watershed	South Fork Big Nemaha	Pony Creek Lake	Atchison Co. State Fishing Lake	Wyandotte County Lake	Walnut Creek	Grass Buffers			Sediment Basins			Urban Lawn Management			On-Site Waste System Repair			Pet Waste Management			Youth I & E	Adult I & E	Total
BMP Cost							$10,750			$15,000			$216,600			$25,000			$12,000					
Years BMP Applied							3			2			8			3			5					
Annual I & E Cost							$1,800 / $2,100			$900			$4,550			$1,050			$1,700					
Quantity							50			1			228			5			1,200					
Units							Acres			Each			Acres			Each			AU					
Year							BMP	I & E	Total	BMP	I & E	Total	BMP	I & E	Total	BMP	I & E	Total	BMP	I & E	Total			
2012							$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$433	$1,083	$1,517
2013							0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	1,517
2014							0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	1,517
2015							0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	1,517
2016							0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	1,517
2017							0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	1,517
2018							0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	1,517
2019							0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	1,517
2020							0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	1,517
2021							0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	1,517
2022							0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	1,517
2023							0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	1,517
2024							0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	1,517
2025							0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	1,517
2026							0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	1,517
2027							0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	1,517
2028							0	0	0	0	0	0	27,075	4,550	31,625	0	0	0	0	0	0	433	1,083	33,142
2029							0	0	0	0	0	0	27,075	4,550	31,625	0	0	0	0	0	0	433	1,083	33,142
2030							3,583	900	4,483	0	0	0	27,075	4,550	31,625	0	0	0	0	0	0	433	1,083	37,625
2031							3,583	2,100	5,683	7,500	900	8,400	27,075	4,550	31,625	8,333	1,050	9,383	2,400	1,700	4,100	433	1,083	60,708
2032							3,583	900	4,483	7,500	900	8,400	27,075	4,550	31,625	8,333	1,050	9,383	2,400	1,700	4,100	433	1,083	59,508
2033							0	0	0	0	0	0	27,075	4,550	31,625	8,333	1,050	9,383	2,400	1,700	4,100	433	1,083	46,625
2034							0	0	0	0	0	0	27,075	4,550	31,625	0	0	0	2,400	1,700	4,100	433	1,083	37,242
2035							0	0	0	0	0	0	27,075	4,550	31,625	0	0	0	2,400	1,700	4,100	433	1,083	37,242
2036							0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	1,517
2037							0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	1,517
2038							0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	1,517
2039							0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	1,517
2040							0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	1,517
2041							0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	1,517
																						$13,000	$32,500	**$378,598**

Table 76 - Walnut Creek Watershed in Big Nemaha Watershed Annual BMP and I & E Costs

BMP	Wolf River Watershed	South Fork Big Nemaha	Pony Creek Lake	Atchison Co. State Fishing Lake	Wyandotte County Lake	Walnut Creek	Grass Buffers			Pasture Management			Livestock Waste Management			On-Site Waste System Repair			Alternative Watering			Youth I & E	Adult I & E	Total
BMP Cost							$53,750			$120,000			$400,000			$50,000			$30,360					
Years BMP Applied							10			10			8			5			8					
Annual I & E Cost							$1,800 / $2,100			$1,600			$8,350			$1,050			$2,050					
Quantity							250			8,000			20			10			8					
Units							Acres			Acres			Each			Each			Each					
Year							BMP	I & E	Total	BMP	I & E	Total	BMP	I & E	Total	BMP	I & E	Total	BMP	I & E	Total			
2012							$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$433	$1,083	$1,517
2013							0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	$1,517
2014							0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	$1,517
2015							0		0	0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	$1,517
2016							0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	$1,517
2017							0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	$1,517
2018							0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	$1,517
2019							0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	$1,517
2020							0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	$1,517
2021							0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	$1,517
2022							0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	$1,517
2023							0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	$1,517
2024							0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	$1,517
2025							0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	$1,517
2026							0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	$1,517
2027							0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	$1,517
2028							0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	$1,517
2029							0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	$1,517
2030							0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	$1,517
2031							0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	433	1,083	$1,517
2032							5,375	900	6,275	12,000	1,600	13,600	0	0	0	0	0	0	0	0	0	433	1,083	$21,392
2033							5,375	2,100	7,475	12,000	1,600	13,600	0	0	0	0	0	0	0	0	0	433	1,083	$22,592
2034							5,375	1,800	7,175	12,000	1,600	13,600	50,000	8,350	58,350	0	0	0	3,795	2,050	5,845	433	1,083	$86,487
2035							5,375	2,100	7,475	12,000	1,600	13,600	50,000	8,350	58,350	10,000	1,050	11,050	3,795	2,050	5,845	433	1,083	$97,837
2036							5,375	1,800	7,175	12,000	1,600	13,600	50,000	8,350	58,350	10,000	1,050	11,050	3,795	2,050	5,845	433	1,083	$97,537
2037							5,375	2,100	7,475	12,000	1,600	13,600	50,000	8,350	58,350	10,000	1,050	11,050	3,795	2,050	5,845	433	1,083	$97,837
2038							5,375	1,800	7,175	12,000	1,600	13,600	50,000	8,350	58,350	10,000	1,050	11,050	3,795	2,050	5,845	433	1,083	$97,537
2039							5,375	2,100	7,475	12,000	1,600	13,600	50,000	8,350	58,350	10,000	1,050	11,050	3,795	2,050	5,845	433	1,083	$97,837
2040							5,375	1,800	7,175	12,000	1,600	13,600	50,000	8,350	58,350	0	0	0	3,795	2,050	5,845	433	1,083	$86,487
2041							5,375	2,100	7,475	12,000	1,600	13,600	50,000	8,350	58,350	0	0	0	3,795	2,050	5,845	433	1,083	$86,787
																						$13,000	$32,500	**$822,660**

Table 77 - Summary of Annual BMP and I & E Costs

Year	Wolf River	South Fork Big Nemaha	Pony Creek	Atchison Co. St. Fishing Lake	Wyandotte Co. Lake	Walnut Creek	TOTAL	Annual Cost w/ Annual Inflation
						Annual Inflation Rate =		3%
2012	$80,345	$19,697	$1,517	$1,517	$1,517	$1,517	$106,108	$106,110
2013	109,421	16,547	1,517	1,517	1,517	1,517	132,034	$136,000
2014	93,646	1,517	7,601	1,517	1,517	1,517	107,313	$113,850
2015	106,896	58,454	7,601	1,517	1,517	1,517	177,500	$193,960
2016	77,646	58,304	7,601	1,517	1,517	1,517	148,100	$166,690
2017	106,736	74,534	7,601	1,517	1,517	1,517	193,420	$224,230
2018	77,960	77,384	7,601	1,517	1,517	1,517	167,494	$200,000
2019	1,517	87,884	12,376	1,517	1,517	1,517	106,326	$130,770
2020	1,517	84,234	14,101	1,517	1,517	1,517	104,401	$132,250
2021	1,517	76,536	56,048	1,517	1,517	1,517	138,650	$180,910
2022	1,517	71,211	80,073	1,517	1,517	1,517	157,350	$211,470
2023	1,517	1,517	86,473	1,517	1,517	1,517	94,056	$130,200
2024	1,517	1,517	86,173	1,517	1,517	1,517	93,756	$133,670
2025	1,517	1,517	58,123	1,517	1,517	1,517	65,706	$96,490
2026	1,517	1,517	21,564	16,284	1,517	1,517	43,914	$66,420
2027	1,517	1,517	10,831	31,884	1,517	1,517	48,781	$76,000
2028	1,517	1,517	1,517	35,417	33,142	1,517	74,625	$119,750
2029	1,517	1,517	1,517	20,950	33,142	1,517	60,158	$99,430
2030	1,517	1,517	1,517	3,850	37,625	1,517	47,541	$80,940
2031	1,517	1,517	1,517	1,517	60,708	1,517	68,291	$119,750
2032	1,517	1,517	1,517	1,517	59,508	21,392	86,966	$157,070
2033	1,517	1,517	1,517	1,517	46,625	22,592	75,283	$140,050
2034	1,517	1,517	1,517	1,517	37,242	86,487	129,795	$248,700
2035	1,517	1,517	1,517	1,517	37,242	97,837	141,145	$278,560
2036	1,517	1,517	1,517	1,517	1,517	97,537	105,120	$213,690
2037	1,517	1,517	1,517	1,517	1,517	97,837	105,420	$220,730
2038	1,517	1,517	1,517	1,517	1,517	97,537	105,120	$226,700
2039	1,517	1,517	1,517	1,517	1,517	97,837	105,420	$234,170
2040	1,517	1,517	1,517	1,517	1,517	86,487	94,070	$215,230
2041	1,517	1,517	1,517	1,517	1,517	86,787	94,370	$222,390
TOTAL	$687,531	$655,115	$488,029	$146,300	$378,598	$822,660	$3,178,233	$4,876,180

Table 78 - Summary of Annual BMP, I & E and Technical Assistance Costs with 3% Annual Inflation

Year	BMPs Implemented										I & E and Techncial Assistance				Annual Cost	
	Crop Production		Structural		Land Management		Waste		Livestock		I & E		Techncial			
	2012 Dollars	3% Annual	2012 Dollars	3% Annual	2012 Dollars	3% Annual	2012 Dollars	3% Annual	2012 Dollars	3% Annual	2012 Dollars	3% Annual	2012 Dollars	3% Annual	2012 Dollars	3% Annual
														Annual Inflation Rate =	3%	
2012	$1,686	$1,690	$15,880	$15,880	$3,215	$3,220	$25,000	$25,000	$11,927	$11,930	$9,092	$9,090	$39,308	$39,310	$106,108	$106,110
2013	$3,662	$3,770	$37,480	$38,600	$3,215	$3,310	$25,000	$25,750	$11,927	$12,280	$9,192	$9,470	$41,558	$42,810	$132,034	$136,000
2014	$7,221	$7,661	$5,000	$5,300	$3,215	$3,410	$35,000	$37,130	$11,927	$12,650	$10,267	$10,890	$34,683	$36,800	$107,313	$113,850
2015	$8,027	$8,771	$21,600	$23,600	$4,488	$4,900	$52,500	$57,370	$39,035	$42,650	$11,017	$12,040	$40,833	$44,620	$177,500	$193,960
2016	$8,027	$9,034	$0	$0	$4,488	$5,050	$52,500	$59,090	$39,035	$43,930	$10,217	$11,500	$33,833	$38,080	$148,100	$166,690
2017	$7,167	$8,309	$37,480	$43,450	$4,488	$5,200	$52,500	$60,860	$39,035	$45,250	$11,067	$12,830	$41,683	$48,320	$193,420	$224,230
2018	$5,191	$6,198	$15,880	$18,960	$4,488	$5,360	$52,500	$62,690	$39,035	$46,610	$10,967	$13,090	$39,433	$47,090	$167,494	$200,000
2019	$2,115	$2,601	$10,880	$13,380	$1,273	$1,570	$17,500	$21,520	$27,108	$33,340	$12,542	$15,420	$34,908	$42,930	$106,326	$130,770
2020	$2,115	$2,679	$10,880	$13,780	$648	$820	$17,500	$22,170	$27,108	$34,340	$12,542	$15,890	$33,608	$42,570	$104,401	$132,250
2021	$16,295	$21,261	$10,880	$14,200	$9,222	$12,030	$17,500	$22,830	$30,903	$40,320	$13,292	$17,340	$40,558	$52,920	$138,650	$180,910
2022	$16,295	$21,899	$10,880	$14,620	$9,222	$12,390	$37,500	$50,400	$30,903	$41,530	$13,292	$17,860	$39,258	$52,760	$157,350	$211,470
2023	$15,489	$21,440	$0	$0	$9,222	$12,770	$20,000	$27,680	$3,795	$5,250	$12,492	$17,290	$33,058	$45,760	$94,056	$130,200
2024	$15,489	$22,084	$0	$0	$9,222	$13,150	$20,000	$28,520	$3,795	$5,410	$12,492	$17,810	$32,758	$46,710	$93,756	$133,670
2025	$15,489	$22,746	$0	$0	$9,222	$13,540	$0	$0	$3,795	$5,570	$10,892	$15,990	$26,308	$38,630	$65,706	$96,490
2026	$3,867	$5,849	$0	$0	$9,097	$13,760	$0	$0	$0	$0	$7,092	$10,730	$23,858	$36,090	$43,914	$66,420
2027	$3,867	$6,025	$15,000	$23,370	$4,764	$7,420	$0	$0	$0	$0	$5,142	$8,010	$20,008	$31,170	$48,781	$76,000
2028	$5,300	$8,505	$15,000	$24,070	$27,075	$43,450	$0	$0	$0	$0	$5,242	$8,410	$22,008	$35,320	$74,625	$119,750
2029	$1,433	$2,369	$15,000	$24,790	$27,075	$44,750	$0	$0	$0	$0	$1,642	$2,710	$15,008	$24,810	$60,158	$99,430
2030	$5,016	$8,539	$0	$0	$27,075	$46,090	$0	$0	$0	$0	$1,592	$2,710	$13,858	$23,590	$47,541	$80,940
2031	$3,583	$6,283	$7,500	$13,150	$27,075	$47,480	$10,733	$18,820	$0	$0	$2,042	$3,580	$17,358	$30,440	$68,291	$119,750
2032	$8,958	$16,179	$7,500	$13,550	$39,075	$70,570	$10,733	$19,380	$0	$0	$2,092	$3,780	$18,608	$33,610	$86,966	$157,070
2033	$5,375	$9,999	$0	$0	$39,075	$72,690	$10,733	$19,970	$0	$0	$2,042	$3,800	$18,058	$33,590	$75,283	$140,050
2034	$5,375	$10,299	$0	$0	$39,075	$74,870	$52,400	$100,400	$3,795	$7,270	$3,642	$6,980	$25,508	$48,880	$129,795	$248,700
2035	$5,375	$10,608	$0	$0	$39,075	$77,120	$62,400	$123,150	$3,795	$7,490	$3,692	$7,290	$26,808	$52,910	$141,145	$278,560
2036	$5,375	$10,926	$0	$0	$12,000	$24,390	$60,000	$121,970	$3,795	$7,710	$2,692	$5,470	$21,258	$43,210	$105,120	$213,690
2037	$5,375	$11,254	$0	$0	$12,000	$25,130	$60,000	$125,630	$3,795	$7,950	$2,692	$5,640	$21,558	$45,140	$105,420	$220,730
2038	$5,375	$11,592	$0	$0	$12,000	$25,880	$60,000	$129,400	$3,795	$8,180	$2,692	$5,800	$21,258	$45,850	$105,120	$226,700
2039	$5,375	$11,939	$0	$0	$12,000	$26,660	$60,000	$133,280	$3,795	$8,430	$2,692	$5,980	$21,558	$47,890	$105,420	$234,170
2040	$5,375	$12,298	$0	$0	$12,000	$27,460	$50,000	$114,400	$3,795	$8,680	$2,642	$6,040	$20,258	$46,350	$94,070	$215,230
2041	$5,375	$12,667	$0	$0	$12,000	$28,280	$50,000	$117,830	$3,795	$8,940	$2,642	$6,230	$20,558	$48,450	$94,370	$222,390
TOTAL	$204,667	$315,475	$236,840		$426,089		$911,999		$349,688		$209,625		$839,325			$4,876,180

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SECTION 7 - LOAD REDUCTION COSTS

Tables 79 through 85 contain the load reduction for Nitrogen (N), Phosphorus (P), and Sediment estimated for each year, identified for each of the proposed BMP in the plan and for each priority area.

The load reductions from BMPs implemented in the High Priority TMDL watersheds within the project area were calculated by KDHE utilizing EPA's Region 5 Model. The Region 5 Model is an Excel-based workbook used to evaluate BMP load reductions in WRAPS projects. This model is used to evaluate load reductions from BMPs such as gully stabilization, streambank stabilization, agricultural-cropland practices, feedlot-livestock activities, as well as urban runoff. The primary load reductions that are obtained from the Region 5 Model are nitrogen, phosphorus, and sediment. KDHE utilizes county-level USLE factors for input information as well as applicable load reduction efficiency information from Kansas State University Extension publications. More information about the Region 5 Model can be found at http://it.tetratech-ffx.com/stepl/.

The load reduction cost is determined by dividing the quantity of each load divided by the total estimated cost of the implementation of the BMP, including I & E cost associated with that BMP. In other words if a BMP cost was $100, for example, and resulted in N reduction of 10 lbs./yr.; P reduction of 25 lbs./yr. and Sediment reduction of 50 tons/yr. The user of the load reduction tables therefore needs to evaluate the load reduction cost for the primary purpose of the BMP since the BMPs typically result in beneficial load reductions in several pollutant loads in addition to the primary target load reduction.

The load reduction costs in these tables do not include the costs for the more general I & E activities identified as "Education of Youth" and "Education of Adults." Over the 31 year proposed plan period these general I & E activities amount to an estimated $273,000. Therefore these cost do not reflect the total cost of the entire plan.

We do not have reliable estimates for the load reduction of the Urban Lawn Management and the Pet Waste Management best management practices and therefore load reductions for these two BMPs are not entered in this table. There is ample evidence that more appropriate application of chemical fertilizers, selection of lawn varieties and lawn designs would have a significant reduction of the nutrients in urban runoff so it has been included as a BMP, but the load reduction has not been quantified. We also know that pet waste can be a significant source for fecal coliform bacteria in urban runoff, so this has been included as a BMP but the load reduction value has not been determined.

Table 85 - Summary of Annual Load Reduction and Load Reduction Costs by Priority Area is a summary of the annual load reductions and the load reduction cost by priority area.

Table 79 - Wolf River Watershed Load Reductions and Unit Costs

BMP	Wolf River Watershed	South Fork Big Nemaha	Pony Creek Lake	Atchison Co. SFL	Wyandotte Co. Lake	Walnut Creek	No- till				Cover Crops				Grass Buffers			
Total BMP Units							100				50				20			
BMP Units							Acres				Acres				Acres			
Years BMP Applied							7				7				5			
BMP Units Per Year							14				7				4			
Load							N	P	Sed.	Costs	N	P	Sed.	Costs	N	P	Sed.	Costs
Total Est. Load Reduction							133	107	142		59	29	26		649	464	318	
Load Units							lbs./yr.	lbs./yr.	Tons/yr.	$	lbs./yr.	lbs./yr.	Tons/yr.	$	lbs./yr.	lbs./yr.	Tons/yr.	$
Year																		
2012							19	15	20	$9,907	8	4	4	$1,819	130	93	64	$2,660
2013							19	15	20	$9,907	8	4	4	$1,519	130	93	64	$2,960
2014							19	15	20	$5,132	8	4	4	$1,819	130	93	64	$2,660
2015							19	15	20	$5,132	8	4	4	$1,519	130	93	64	$1,910
2016							19	15	20	$5,132	8	4	4	$1,819	130	93	64	$1,760
2017							19	15	20	$5,132	8	4	4	$1,519	0	0	0	$0
2018							19	15	20	$5,132	8	4	4	$1,819	0	0	0	$0
2019							0	0	0	$0	0	0	0	$0	0	0	0	$0
Watershed Totals							133	105	140	$45,474	56	28	28	$11,833	650	465	320	$11,950
Load Cost/Unit							$342	$433	$325		$211	$423	$423		$18	$26	$37	

Table 79 - Wolf River Watershed Load Reductions and Unit Costs (Cont.)

BMP	Wolf River Watershed	South Fork Big Nemaha	Pony Creek Lake	Atchison Co. SFL	Wyandotte Co. Lake	Walnut Creek	Forested Buffers				Steep Slopes				Stream Stabilization			
Total BMP Units							20				50				900			
BMP Units							Acres				Acres				Lin. Ft,			
Years BMP Applied							5				5				3			
BMP Units Per Year							4				10				300			
Load							N	P	Sed.	Costs	N	P	Sed.	Costs	N	P	Sed.	Costs
Total Est. Load Reduction							649	464	318		260	113	89		1,620	810	810	
Load Units							lbs./yr.	lbs./yr.	Tons/yr.	$	lbs./yr.	lbs./yr.	Tons/yr.	$	lbs./yr.	lbs./yr.	Tons/yr.	$
Year																		
2012							0	0	0	$0	0	0	0	$0	0	0	0	$0
2013							130	93	64	$3,326	0	0	0	$0	540	270	270	$25,750
2014							130	93	64	$3,826	52	23	18	$3,200	0	0	0	$0
2015							130	93	64	$3,326	52	23	18	$3,200	540	270	270	$29,900
2016							130	93	64	$3,826	52	23	18	$3,200	0	0	0	$0
2017							130	93	64	$3,326	52	23	18	$3,200	540	270	270	$25,750
2018							0	0	0	$0	52	23	18	$3,200	0	0	0	$0
2019							0	0	0	$0	0	0	0	$0	0	0	0	$0
Watershed Totals							650	465	320	$17,630	260	115	90	$16,000	1,620	810	810	$81,400
Load Cost/Unit							$27	$38	$55		$62	$139	$178		$50	$100	$100	

Table 79 - Wolf River Watershed Load Reductions and Unit Costs (Cont.)

BMP	Wolf River Watershed	South Fork Big Nemaha	Pony Creek Lake	Atchison Co. SFL	Wyandotte Co. Lake	Walnut Creek	Sediment Basins				Pasture Management				Nutrient Management			
Total BMP Units							5				250				1,500			
BMP Units							Each				Acres				Acres			
Years BMP Applied							5				7				7			
BMP Units Per Year							1				36				214			
Load							N	P	Sed.	Costs	N	P	Sed.	Costs	N	P	Sed.	Costs
Total Est. Load Reduction							501	356	248		86	43	29		1,777	889	0	
Load Units							lbs./yr.	lbs./yr.	Tons/yr.	$	lbs./yr.	lbs./yr.	Tons/yr.	$	lbs./yr.	lbs./yr.	Tons/yr.	$
Year																		
2012							100	71	50	$5,900	12	6	4	$2,136	254	127	0	$9,079
2013							100	71	50	$5,900	12	6	4	$2,136	254	127	0	$9,079
2014							100	71	50	$5,900	12	6	4	$2,136	254	127	0	$9,079
2015							0	0	0	$0	12	6	4	$1,336	254	127	0	$5,879
2016							0	0	0	$0	12	6	4	$1,336	254	127	0	$5,879
2017							100	71	50	$5,900	12	6	4	$1,336	254	127	0	$5,879
2018							100	71	50	$5,900	12	6	4	$1,336	254	127	0	$5,879
2019							0	0	0	$0	0	0	0	$0	0	0	0	$0
Watershed Totals							500	355	250	$29,500	84	42	28	$11,752	1,778	889	0	$50,753
Load Cost/Unit							$59	$83	$118		$140	$280	$420		$29	$57	$0	

Table 79 - Wolf River Watershed Load Reductions and Unit Costs (Cont.)

BMP	Wolf River Watershed	South Fork Big Nemaha	Pony Creek Lake	Atchison Co. SFL	Wyandotte Co. Lake	Walnut Creek	Livestock Waste Management				On-Site Waste System Repair				Alternative Watering			
Total BMP Units							10				10				22			
BMP Units							Each				Each				Each			
Years BMP Applied							7				5				7			
BMP Units Per Year							1				2				3			
Load							N	P	Sed.	Costs	N	P	Sed.	Costs	N	P	Sed.	Costs
Total Est. Load Reduction							16,150	3,630	0		120	46	0		0	7,546	0	
Load Units							lbs./yr.	lbs./yr.	Tons/yr.	$	lbs./yr.	lbs./yr.	Tons/yr.	$	lbs./yr.	lbs./yr.	Tons/yr.	$
Year																		
2012							2,307	519	0	$33,350	0	0	0	$0	0	1,078	0	$13,977
2013							2,307	519	0	$33,350	0	0	0	$0	0	1,078	0	$13,977
2014							2,307	519	0	$33,350	24	9	0	$11,050	0	1,078	0	$13,977
2015							2,307	519	0	$29,175	24	9	0	$11,050	0	1,078	0	$12,952
2016							2,307	519	0	$29,175	24	9	0	$11,050	0	1,078	0	$12,952
2017							2,307	519	0	$29,175	24	9	0	$11,050	0	1,078	0	$12,952
2018							2,307	519	0	$29,175	24	9	0	$11,050	0	1,078	0	$12,952
2019							0	0	0	$0	0	0	0	$0	0	0	0	$0
Watershed Totals							16,149	3,633	0	$216,750	120	45	0	$55,250	0	7,546	0	$93,739
Load Cost/Unit							$13	$60	$0		$460	$1,228	$0		$0	$12	$0	

Table 79 - Wolf River Watershed Load Reductions and Unit Costs (Cont.)

BMP	Wolf River Watershed	South Fork Big Nemaha	Pony Creek Lake	Atchison Co. SFL	Wyandotte Co. Lake	Walnut Creek	ANNUAL TOTAL			
Total BMP Units							TARGET LOAD REDUCTION			
BMP Units							TSS: 1,500 Tons/yr by 2018			
Years BMP Applied							Bacteria: 262 CFUs/100ml by 2018			
BMP Units Per Year										
Load							N	P	Sed.	Costs
Total Est. Load Reduction										
Load Units							lbs./yr.	lbs./yr.	Tons/yr.	$
Year										
2012							2,830	1,913	142	$78,828
2013							3,500	2,276	476	$107,904
2014							3,036	2,038	224	$92,129
2015							3,476	2,237	444	$105,379
2016							2,936	1,967	174	$76,129
2017							3,446	2,215	430	$105,219
2018							2,776	1,852	96	$76,443
2019							0	0	0	$0
Watershed Totals							22,000	14,498	1,986	$642,031

Table 80 - South Fork Big Nemaha Watershed Load Reductions and Unit Costs

BMP	Wolf River Watershed	South Fork Big Nemaha	Pony Creek Lake	Atchison Co. SFL	Wyandotte Co. Lake	Walnut Creek	Grass Buffers				Stream Stabilization				Pasture Management			
Total BMP Units							30				1,500				250			
BMP Units							Acres				Lin. Ft,				Acres			
Years BMP Applied							8				8				5			
BMP Units Per Year							4				188				50			
Load							N	P	Sed.	Costs	N	P	Sed.	Costs	N	P	Sed.	Costs
Total Est. Load Reduction							1,090	779	550		2,700	1,350	1,350		41	20	11	
Load Units							lbs./yr.	lbs./yr.	Tons/yr.	$	lbs./yr.	lbs./yr.	Tons/yr.	$	lbs./yr.	lbs./yr.	Tons/yr.	$
Year																		
2012							0	0	0	$0	338	169	169	$18,180	0	0	0	$0
2013							0	0	0	$0	338	169	169	$15,030	0	0	0	$0
2014							0	0	0	$0	0	0	0	$0	0	0	0	$0
2015							136	97	69	$1,856	0	0	0	$0	8	4	2	$1,550
2016							136	97	69	$1,706	0	0	0	$0	8	4	2	$1,550
2017							136	97	69	$2,906	338	169	169	$15,030	8	4	2	$1,550
2018							136	97	69	$2,606	338	169	169	$18,180	8	4	2	$1,550
2019							136	97	69	$2,906	338	169	169	$19,180	8	4	2	$2,350
2020							136	97	69	$2,606	338	169	169	$18,180	0	0	0	$0
2021							136	97	69	$1,856	338	169	169	$19,180	0	0	0	$0
2022							136	97	69	$1,706	338	169	169	$18,180	0	0	0	$0
2023							0	0	0	$0	0	0	0	$0	0	0	0	$0
2024							0	0	0	$0	0	0	0	$0	0	0	0	$0
Watershed Totals							1,088	776	552	$18,148	2,704	1,352	1,352	$141,140	40	20	10	$8,550
Load Cost/Unit							$17	$23	$33		$52	$104	$104		$214	$428	$855	

Table 80 - South Fork Big Nemaha Watershed Load Reductions and Unit Costs (Cont.)

BMP	Wolf River Watershed	South Fork Big Nemaha	Pony Creek Lake	Atchison Co. SFL	Wyandotte Co. Lake	Walnut Creek	Nutrient Management				Livestock Waste Management				Alternative Watering			
Total BMP Units							250				7				50			
BMP Units							Acres				Each				Each			
Years BMP Applied							6				8				8			
BMP Units Per Year							42				1				6			
Load							N	P	Sed.	Costs	N	P	Sed.	Costs	N	P	Sed.	Costs
Total Est. Load Reduction							413	207	0		11,767	2,646	0		0	17,850	0	
Load Units							lbs./yr.	lbs./yr.	Tons/yr.	$	lbs./yr.	lbs./yr.	Tons/yr.	$	lbs./yr.	lbs./yr.	Tons/yr.	$
Year																		
2012							0	0	0	$0	0	0	0	$0	0	0	0	$0
2013							0	0	0	$0	0	0	0	$0	0	0	0	$0
2014							0	0	0	$0	0	0	0	$0	0	0	0	$0
2015							69	35	0	$3,723	1,471	331	0	$21,675	0	2,231	0	$28,133
2016							69	35	0	$3,723	1,471	331	0	$21,675	0	2,231	0	$28,133
2017							69	35	0	$3,723	1,471	331	0	$21,675	0	2,231	0	$28,133
2018							69	35	0	$3,723	1,471	331	0	$21,675	0	2,231	0	$28,133
2019							69	35	0	$6,923	1,471	331	0	$25,850	0	2,231	0	$29,158
2020							69	35	0	$6,923	1,471	331	0	$25,850	0	2,231	0	$29,158
2021							0	0	0	$0	1,471	331	0	$25,850	0	2,231	0	$28,133
2022							0	0	0	$0	1,471	331	0	$21,675	0	2,231	0	$28,133
2023							0	0	0	$0	0	0	0	$0	0	0	0	$0
2024							0	0	0	$0	0	0	0	$0	0	0	0	$0
Watershed Totals							414	210	0	$28,738	11,768	2,648	0	$185,925	0	17,848	0	$227,114
Load Cost/Unit							$69	$137	$0		$16	$70	$0		$0	$13	$0	

Table 80 - South Fork Big Nemaha Watershed Load Reductions and Unit Costs (Cont.)

BMP	Wolf River Watershed	South Fork Big Nemaha	Pony Creek Lake	Atchison Co. SFL	Wyandotte Co. Lake	Walnut Creek	ANNUAL TOTAL			
Total BMP Units							TARGET LOAD REDUCTION			
BMP Units							TSS: 1,278 Tons/yr by 2022			
Years BMP Applied							Bacteria: 262 CFUs/100ml by 2022			
BMP Units Per Year										
Load							N	P	Sed.	Costs
Total Est. Load Reduction										
Load Units							lbs./yr.	lbs./yr.	Tons/yr.	$
Year										
2012							338	169	169	$18,180
2013							338	169	169	$15,030
2014							0	0	0	$0
2015							1,684	2,698	71	$56,937
2016							1,684	2,698	71	$56,787
2017							2,022	2,867	240	$73,017
2018							2,022	2,867	240	$75,867
2019							2,022	2,867	240	$86,367
2020							2,014	2,863	238	$82,717
2021							1,945	2,828	238	$75,019
2022							1,945	2,828	238	$69,694
2023							0	0	0	$0
2024							0	0	0	$0
Watershed Totals							16,014	22,854	1,914	$609,615
Load Cost/Unit							$38	$27	$319	

Table 81 - Pony Creek Lake Watershed Load Reductions and Unit Costs

BMP	Wolf River Watershed	South Fork Big Nemaha	Pony Creek Lake	Atchison Co. SFL	Wyandotte Co. Lake	Walnut Creek	No- till				Grass Buffers				Forested Buffers			
Total BMP Units							720				100				20			
BMP Units							Acres				Acres				Acres			
Years BMP Applied							12				5				5			
BMP Units Per Year							60				20				4			
Load							N	P	Sed.	Costs	N	P	Sed.	Costs	N	P	Sed.	Costs
Total Est. Load Reduction							6,165	3,085	2,365		2,890	2,060	1,375		3,200	2,300	1,550	
Load Units							lbs./yr.	lbs./yr.	Tons/yr.	$	lbs./yr.	lbs./yr.	Tons/yr.	$	lbs./yr.	lbs./yr.	Tons/yr.	$
Year																		
2013							0	0	0	$0	0	0	0	$0	0	0	0	$0
2014							514	257	197	$6,084	0	0	0	$0	0	0	0	$0
2015							514	257	197	$6,084	0	0	0	$0	0	0	0	$0
2016							514	257	197	$6,084	0	0	0	$0	0	0	0	$0
2017							514	257	197	$6,084	0	0	0	$0	0	0	0	$0
2018							514	257	197	$6,084	0	0	0	$0	0	0	0	$0
2019							514	257	197	$10,859	0	0	0	$0	0	0	0	$0
2020							514	257	197	$10,859	0	0	0	$0	0	0	0	$0
2021							514	257	197	$10,859	578	412	275	$5,350	640	460	310	$11,730
2022							514	257	197	$10,859	578	412	275	$5,200	640	460	310	$11,730
2023							514	257	197	$10,859	578	412	275	$6,400	640	460	310	$11,730
2024							514	257	197	$10,859	578	412	275	$6,100	640	460	310	$11,730
2025							514	257	197	$10,859	578	412	275	$6,400	640	460	310	$11,730
2026							0	0	0	$0	0	0	0	$0	0	0	0	$0
2027							0	0	0	$0	0	0	0	$0	0	0	0	$0
2028							0	0	0	$0	0	0	0	$0	0	0	0	$0
Watershed Totals							6,168	3,084	2,364	$106,433	2,890	2,060	1,375	$29,450	3,200	2,300	1,550	$58,650
Load Cost/Unit							$17	$35	$45		$10	$14	$21		$18	$26	$38	

Table 81 - Pony Creek Lake Watershed Load Reductions and Unit Costs (Cont.)

BMP	Wolf River Watershed	South Fork Big Nemaha	Pony Creek Lake	Atchison Co. SFL	Wyandotte Co. Lake	Walnut Creek	Pasture Management				Nutrient Management				Livestock Waste Management			
Total BMP Units							500				2,000				3			
BMP Units							Acres				Acres				Each			
Years BMP Applied							6				6				3			
BMP Units Per Year							83				333				1			
Load							N	P	Sed.	Costs	N	P	Sed.	Costs	N	P	Sed.	Costs
Total Est. Load Reduction							65	330	15		1,910	960	0		5,040	1,130	0	
Load Units							lbs./yr.	lbs./yr.	Tons/yr.	$	lbs./yr.	lbs./yr.	Tons/yr.	$	lbs./yr.	lbs./yr.	Tons/yr.	$
Year																		
2013							0	0	0	$0	0	0	0	$0	0	0	0	$0
2014							0	0	0	$0	0	0	0	$0	0	0	0	$0
2015							0	0	0	$0	0	0	0	$0	0	0	0	$0
2016							0	0	0	$0	0	0	0	$0	0	0	0	$0
2017							0	0	0	$0	0	0	0	$0	0	0	0	$0
2018							0	0	0	$0	0	0	0	$0	0	0	0	$0
2019							0	0	0	$0	0	0	0	$0	0	0	0	$0
2020							11	55	3	$1,725	0	0	0	$0	0	0	0	$0
2021							11	55	3	$1,725	318	0	0	$10,733	0	188	0	$0
2022							11	55	3	$1,725	318	160	0	$10,733	840	188	0	$24,175
2023							11	55	3	$1,725	318	160	0	$10,733	840	188	0	$28,350
2024							11	55	3	$1,725	318	160	0	$10,733	840	188	0	$28,350
2025							11	55	3	$1,725	318	0	0	$10,733	0	188	0	$0
2026							0	0	0	$0	318	0	0	$10,733	0	188	0	$0
2027							0	0	0	$0	0	0	0	$0	0	0	0	$0
2028							0	0	0	$0	0	0	0	$0	0	0	0	$0
Watershed Totals							66	330	18	$10,350	1,908	480	0	$64,398	2,520	1,128	0	$80,875
Load Cost/Unit							$157	$31	$575		$34	$134	$0		$32	$72	$0	

Table 81 - Pony Creek Lake Watershed Load Reductions and Unit Costs (Cont.)

BMP	Wolf River Watershed	South Fork Big Nemaha	Pony Creek Lake	Atchison Co. SFL	Wyandotte Co. Lake	Walnut Creek	Urban Lawn Management*				Alternative Watering				ANNUAL TOTAL			
Total BMP Units							35				5				TARGET LOAD REDUCTION			
BMP Units							Acres				Each				Phosphorous: 1,557 lbs./yr by 2027			
Years BMP Applied							7				5				Nitorgen: 17,830 lbs/yr by 2027			
BMP Units Per Year							5				1				Cholorophyll α to < 10µ/L			
Load							N	P	Sed.	Costs	N	P	Sed.	Costs	N	P	Sed.	Costs
Total Est. Load Reduction							0	0	0		0	1,750	0					
Load Units							lbs./yr.	lbs./yr.	Tons/yr.	$	lbs./yr.	lbs./yr.	Tons/yr.	$	lbs./yr.	lbs./yr.	Tons/yr.	$
Year																		
2013							0	0	0	$0	0	0	0	$0	0	0	0	$0
2014							0	0	0	$0	0	0	0	$0	514	257	197	$6,084
2015							0	0	0	$0	0	0	0	$0	514	257	197	$6,084
2016							0	0	0	$0	0	0	0	$0	514	257	197	$6,084
2017							0	0	0	$0	0	0	0	$0	514	257	197	$6,084
2018							0	0	0	$0	0	0	0	$0	514	257	197	$6,084
2019							0	0	0	$0	0	0	0	$0	514	257	197	$10,859
2020							0	0	0	$0	0	0	0	$0	525	312	200	$12,584
2021							0	0	0	$9,314	0	350	0	$4,820	2,061	1,722	785	$54,531
2022							0	0	0	$9,314	0	350	0	$4,820	2,901	1,882	785	$78,556
2023							0	0	0	$9,314	0	350	0	$5,845	2,901	1,882	785	$84,956
2024							0	0	0	$9,314	0	350	0	$5,845	2,901	1,882	785	$84,656
2025							0	0	0	$9,314	0	350	0	$5,845	2,061	1,722	785	$56,606
2026							0	0	0	$9,314	0	0	0	$0	318	188	0	$20,047
2027							0	0	0	$9,314	0	0	0	$0	0	0	0	$9,314
2028							0	0	0	$0	0	0	0	$0	0	0	0	$0
Watershed Totals							0	0	0	$65,198	0	1,750	0	$27,175	16,752	11,132	5,307	$442,529
Load Cost/Unit							?	?	?		$0	$16	$0		$26	$40	$83	

* Note that no loading reduction has been determined for Urban Lawn Management

Table 82 - Atchison County State Fishing Lake Load Reductions and Unit Costs

BMP	Wolf River Watershed	South Fork Big Nemaha	Pony Creek Lake	Atchison Co. SFL	Wyandotte Co. Lake	Walnut Creek	No- till				Cover Crops				Grass Buffers			
Total BMP Units							250				100				20			
BMP Units							Acres				Acres				Acres			
Years BMP Applied							3				3				3			
BMP Units Per Year							83				33				7			
Load							N	P	Sed.	Costs	N	P	Sed.	Costs	N	P	Sed.	Costs
Total Est. Load Reduction							1,258	6,225	540		168	80	80		995	713	545	
Load Units							lbs./yr.	lbs./yr.	Tons/yr.	$	lbs./yr.	lbs./yr.	Tons/yr.	$	lbs./yr.	lbs./yr.	Tons/yr.	$
Year																		
2025							0	0	0	$0	0	0	0	$0	0	0	0	$0
2026							419	2,075	180	$11,217	56	27	27	$3,550	0	0	0	$0
2027							419	2,075	180	$11,217	56	27	27	$3,250	0	0	0	$0
2028							419	2,075	180	$11,217	56	27	27	$3,550	332	238	182	$3,233
2029							0	0	0	$0	0	0	0	$0	332	238	182	$3,533
2030							0	0	0	$0	0	0	0	$0	332	238	182	$2,333
2031							0	0	0	$0	0	0	0	$0	0	0	0	$0
Watershed Totals							1,257	6,225	540	$33,651	168	81	81	$10,350	996	714	546	$9,099
Load Cost/Unit							$27	$5	$62		$62	$128	$128		$9	$13	$17	

Table 82 - Atchison County State Fishing Lake Load Reductions and Unit Costs (Cont.)

BMP	Wolf River Watershed	South Fork Big Nemaha	Pony Creek Lake	Atchison Co. SFL	Wyandotte Co. Lake	Walnut Creek	Sediment Basins				ANNUAL TOTAL			
Total BMP Units							1				TARGET LOAD REDUCTION			
BMP Units							Each				Sediments: 601 Tons/yr by 2030			
Years BMP Applied							3							
BMP Units Per Year							0							
Load							N	P	Sed.	Costs	N	P	Sed.	Costs
Total Est. Load Reduction							650	465	361					
Load Units							lbs./yr.	lbs./yr.	Tons/yr.	$	lbs./yr.	lbs./yr.	Tons/yr.	$
Year														
2025							0	0	0	$0	0	0	0	$0
2026							0	0	0	$0	475	2,102	207	$14,767
2027							217	155	120	$15,900	692	2,257	327	$30,367
2028							217	155	120	$15,900	1,024	2,495	509	$33,900
2029							217	155	120	$15,900	549	393	302	$19,433
2030							0	0	0	$0	332	238	182	$2,333
2031							0	0	0	$0	0	0	0	$0
Watershed Totals							651	465	360	$47,700	3,072	7,485	1,527	$100,800
Load Cost/Unit							$73	$103	$133		$33	$13	$66	

Table 83 - Wyandotte County Lake Load Reductions and Unit Costs

BMP							Cover Crops				Urban Lawn Management*				Sediment Basins			
Total BMP Units							50				228				1			
BMP Units							Acres				Acres				Each			
Years BMP Applied							3				7				2			
BMP Units Per Year							17				33				1			
Load							N	P	Sed.	Costs	N	P	Sed.	Costs	N	P	Sed.	Costs
Total Est. Load Reduction							478	343	173		0	0	0		112	80	42	
Load Units							lbs./yr.	lbs./yr.	Tons/yr.	$	lbs./yr.	lbs./yr.	Tons/yr.	$	lbs./yr.	lbs./yr.	Tons/yr.	$
Year	Wolf River Watershed	South Fork Big Nemaha	Pony Creek Lake	Atchison Co. SFL	Wyandotte Co. Lake	Walnut Creek												
2027							0	0	0	$0	0	0	0	$0	0	0	0	$0
2028							0	0	0	$0	0	0	0	$31,625	0	0	0	$0
2029							0	0	0	$0	0	0	0	$31,625	0	0	0	$0
2030							159	114	58	$4,483	0	0	0	$31,625	0	0	0	$0
2031							159	114	58	$5,683	0	0	0	$31,625	56	40	21	$8,400
2032							159	114	58	$4,483	0	0	0	$31,625	56	40	21	$8,400
2033							0	0	0	$0	0	0	0	$31,625	0	0	0	$0
2034							0	0	0	$0	0	0	0	$31,625	0	0	0	$0
2035							0	0	0	$0	0	0	0	$31,625	0	0	0	$0
2036							0	0	0	$0	0	0	0	$0	0	0	0	$0
Watershed Totals							477	342	174	$14,649	0	0	0	$253,000	112	80	42	$16,800
Load Cost/Unit							$31	$43	$84		?	?	?		$150	$210	$400	

* Note: There are no load reduction rates available for Urban Lawn Management or Pet Waste Managemen

Table 83 - Wyandotte County Lake Load Reductions and Unit Costs (Cont.)

BMP	Wolf River Watershed	South Fork Big Nemaha	Pony Creek Lake	Atchison Co. SFL	Wyandotte Co. Lake	Walnut Creek	On-Site Waste System Repair				Pet Waste Management Program*				ANNUAL TOTAL			
Total BMP Units							5				1,200				TARGET LOAD REDUCTION			
BMP Units							Each				Animal Units				Phosphorous: 270 lbs./yr by 2035			
Years BMP Applied							3				5				Cholorophyll α to < 10µ/L			
BMP Units Per Year							2				240							
Load							N	P	Sed.	Costs	N	P	Sed.	Costs	N	P	Sed.	Costs
Total Est. Load Reduction							80	230	0		0	0	0					
Load Units							lbs./yr.	lbs./yr.	Tons/yr.	$	lbs./yr.	lbs./yr.	Tons/yr.	$	lbs./yr.	lbs./yr.	Tons/yr.	$
Year																		
2027							0	0	0	$0	0	0	0	$0	0	0	0	$0
2028							0	0	0	$0	0	0	0	$0	0	0	0	$31,625
2029							0	0	0	$0	0	0	0	$0	0	0	0	$31,625
2030							0	0	0	$0	0	0	0	$0	159	114	58	$36,108
2031							27	77	0	$9,383	0	0	0	$4,100	242	231	79	$59,191
2032							27	77	0	$9,383	0	0	0	$4,100	242	231	79	$57,991
2033							27	77	0	$9,383	0	0	0	$4,100	27	77	0	$45,108
2034							0	0	0	$0	0	0	0	$4,100	0	0	0	$35,725
2035							0	0	0	$0	0	0	0	$4,100	0	0	0	$35,725
2036							0	0	0	$0	0	0	0	$0	0	0	0	$0
Watershed Totals							81	231	0	$28,149	0	0	0	$20,500	670	653	216	$333,098
Load Cost/Unit							$348	$122	$0		$0	?	$0		$497	$510	$1,542	

Table 84 - Walnut Creek Watershed Load Reductions and Unit Costs

BMP	Wolf River Watershed	South Fork Big Nemaha	Pony Creek Lake	Atchison Co. SFL	Wyandotte Co. Lake	Walnut Creek	Grass Buffers				Pasture Management				Livestock Waste Management			
Total BMP Units							250				8,000				20			
BMP Units							Acres				Acres				Each			
Years BMP Applied							9				9				8			
BMP Units Per Year							28				889				3			
Load							N	P	Sed.	Costs	N	P	Sed.	Costs	N	P	Sed.	Costs
Total Est. Load Reduction							5,880	4,205	2,660		1,785	910	545		32,300	7,260	0	
Load Units							lbs./yr.	lbs./yr.	Tons/yr.	$	lbs./yr.	lbs./yr.	Tons/yr.	$	lbs./yr.	lbs./yr.	Tons/yr.	$
Year																		
2031							0	0	0	$0	0	0	0	$0	0	0	0	$0
2032							653	467	296	$6,275	198	101	61	$13,600	0	0	0	$0
2033							653	467	296	$7,475	198	101	61	$13,600	0	0	0	$0
2034							653	467	296	$7,175	198	101	61	$13,600	4,038	908	0	$58,350
2035							653	467	296	$7,475	198	101	61	$13,600	4,038	908	0	$58,350
2036							653	467	296	$7,175	198	101	61	$13,600	4,038	908	0	$58,350
2037							653	467	296	$7,475	198	101	61	$13,600	4,038	908	0	$58,350
2038							653	467	296	$7,175	198	101	61	$13,600	4,038	908	0	$58,350
2039							653	467	296	$7,475	198	101	61	$13,600	4,038	908	0	$58,350
2040							653	467	296	$7,175	198	101	61	$13,600	4,038	908	0	$58,350
2041							653	467	296	$7,475	198	101	61	$13,600	4,038	908	0	$58,350
Watershed Totals							6,530	4,670	2,960	$72,350	1,980	1,010	610	$136,000	32,304	7,264	0	$466,800
Load Cost/Unit							$11	$15	$24		$69	$135	$223		$14	$64	$0	

Table 84 - Walnut Creek Watershed Load Reductions and Unit Costs (Cont.)

BMP	Wolf River Watershed	South Fork Big Nemaha	Pony Creek Lake	Atchison Co. SFL	Wyandotte Co. Lake	Walnut Creek	On-Site Waste System Repair				Alternative Watering				ANNUAL TOTAL			
Total BMP Units							10				8				TARGET LOAD REDUCTION			
BMP Units							Each				Each				Bacteria: 262 CFUs/100ml by 2041			
Years BMP Applied							5				8							
BMP Units Per Year							2				1							
Load							N	P	Sed.	Costs	N	P	Sed.	Costs	N	P	Sed.	Costs
Total Est. Load Reduction							120	45	0		0	2,740	0					
Load Units							lbs./yr.	lbs./yr.	Tons/yr.	$	lbs./yr.	lbs./yr.	Tons/yr.	$	lbs./yr.	lbs./yr.	Tons/yr.	$
Year																		
2031							0	0	0	$0	0	0	0	$0	0	0	0	$0
2032							0	0	0	$0	0	0	0	$0	851	568	357	$19,875
2033							0	0	0	$0	0	0	0	$0	851	568	357	$21,075
2034							0	0	0	$0	0	343	0	$5,845	4,889	1,819	357	$84,970
2035							24	9	0	$11,050	0	343	0	$5,845	4,913	1,828	357	$96,320
2036							24	9	0	$11,050	0	343	0	$5,845	4,913	1,828	357	$96,020
2037							24	9	0	$11,050	0	343	0	$5,845	4,913	1,828	357	$96,320
2038							24	9	0	$11,050	0	343	0	$5,845	4,913	1,828	357	$96,020
2039							24	9	0	$11,050	0	343	0	$5,845	4,913	1,828	357	$96,320
2040							0	0	0	$0	0	343	0	$5,845	4,889	1,819	357	$84,970
2041							0	0	0	$0	0	343	0	$5,845	4,889	1,819	357	$85,270
Watershed Totals							120	45	0	$55,250	0	2,744	0	$46,760	40,934	15,733	3,570	$777,160
Load Cost/Unit							$460	$1,228	$0		$0	$17	$0		$19	$49	$218	

Table 85 - Summary of Annual Load Reduction and Load Reduction Costs by Priority Area

BMP	Wolf River Watershed	South Fork Big Nemaha Watershed	Pony Creek Lake	Atchison Co. SFL	Wyandotte Co. Lake	Walnut Creek	Wolf River Watershed				South Fork Big Nemaha Watershed			
Total BMP Units							TARGET LOAD REDUCTION				TARGET LOAD REDUCTION			
BMP Units							TSS: 1,500 Tons/yr by 2018				TSS: 1,278 Tons/yr by 2022			
Years BMP Applied							Bacteria: 262 CFUs/100ml by 2018				Bacteria: 262 CFUs/100ml by 2022			
BMP Units Per Year														
Load							N	P	Sed.	Costs	N	P	Sed.	Costs
Total Est. Load Reduction														
Load Units							lbs./yr.	lbs./yr.	Tons/yr.	$	lbs./yr.	lbs./yr.	Tons/yr.	$
Year														
2012							2,830	1,913	142	$78,828	338	169	169	$18,180
2013							3,500	2,276	476	$107,904	338	169	169	$15,030
2014							3,036	2,038	224	$92,129	0	0	0	$0
2015							3,476	2,237	444	$105,379	1,684	2,698	71	$56,937
2016							2,936	1,967	174	$76,129	1,684	2,698	71	$56,787
2017							3,446	2,215	430	$105,219	2,022	2,867	240	$73,017
2018							2,776	1,852	96	$76,443	2,022	2,867	240	$75,867
2019							0	0	0	$0	2,022	2,867	240	$86,367
2020							0	0	0	$0	2,014	2,863	238	$82,717
2021							0	0	0	$0	1,945	2,828	238	$75,019
2022							0	0	0	$0	1,945	2,828	238	$69,694
2023							0	0	0	$0	0	0	0	$0
2024							0	0	0	$0	0	0	0	$0
2025							0	0	0	$0	0	0	0	$0
2026							0	0	0	$0	0	0	0	$0
2027							0	0	0	$0	0	0	0	$0
2028							0	0	0	$0	0	0	0	$0
2029							0	0	0	$0	0	0	0	$0
2030							0	0	0	$0	0	0	0	$0
2031							0	0	0	$0	0	0	0	$0
2032							0	0	0	$0	0	0	0	$0
2033							0	0	0	$0	0	0	0	$0
2034							0	0	0	$0	0	0	0	$0
2035							0	0	0	$0	0	0	0	$0
2036							0	0	0	$0	0	0	0	$0
2037							0	0	0	$0	0	0	0	$0
2038							0	0	0	$0	0	0	0	$0
2039							0	0	0	$0	0	0	0	$0
2040							0	0	0	$0	0	0	0	$0
2041							0	0	0	$0	0	0	0	$0
Watershed Totals							22,000	14,498	1,986	$642,031	16,014	22,854	1,914	$609,615
Load Cost/Unit							$29	$44	$323		$38	$27	$319	

Table 85 - Summary of Annual Load Reduction and Load Reduction Costs by Priority Area (Cont.)

BMP	Wolf River Watershed	South Fork Big Nemaha	Pony Creek Lake	Atchison Co. SFL	Wyandotte Co. Lake	Walnut Creek	Pony Creek Lake Watershed				Atchison County State Fishing Lake			
Total BMP Units							TARGET LOAD REDUCTION							
BMP Units							Phosphorous: 1,557 lbs./yr by 2027				TARGET LOAD REDUCTION			
Years BMP Applied							Nitorgen: 17,830 lbs/yr by 2027				Sediments: 601 Tons/yr by 2030			
BMP Units Per Year							Cholorophyll α to < 10µ/L							
Load							N	P	Sed.	Costs	N	P	Sed.	Costs
Total Est. Load Reduction														
Load Units							lbs./yr.	lbs./yr.	Tons/yr.	$	lbs./yr.	lbs./yr.	Tons/yr.	$
Year														
2012							0	0	0	$0	0	0	0	$0
2013							0	0	0	$0	0	0	0	$0
2014							514	257	197	$6,084	0	0	0	$0
2015							514	257	197	$6,084	0	0	0	$0
2016							514	257	197	$6,084	0	0	0	$0
2017							514	257	197	$6,084	0	0	0	$0
2018							514	257	197	$6,084	0	0	0	$0
2019							514	257	197	$10,859	0	0	0	$0
2020							525	312	200	$12,584	0	0	0	$0
2021							2,061	1,722	785	$54,531	0	0	0	$0
2022							2,901	1,882	785	$78,556	0	0	0	$0
2023							2,901	1,882	785	$84,956	0	0	0	$0
2024							2,901	1,882	785	$84,656	0	0	0	$0
2025							2,061	1,722	785	$56,606	0	0	0	$0
2026							318	188	0	$20,047	475	2,102	207	$14,767
2027							0	0	0	$9,314	692	2,257	327	$30,367
2028							0	0	0	$0	1,024	2,495	509	$33,900
2029							0	0	0	$0	549	393	302	$19,433
2030							0	0	0	$0	332	238	182	$2,333
2031							0	0	0	$0	0	0	0	$0
2032							0	0	0	$0	0	0	0	$0
2033							0	0	0	$0	0	0	0	$0
2034							0	0	0	$0	0	0	0	$0
2035							0	0	0	$0	0	0	0	$0
2036							0	0	0	$0	0	0	0	$0
2037							0	0	0	$0	0	0	0	$0
2038							0	0	0	$0	0	0	0	$0
2039							0	0	0	$0	0	0	0	$0
2040							0	0	0	$0	0	0	0	$0
2041							0	0	0	$0	0	0	0	$0
Watershed Totals							16,752	11,132	5,307	$442,529	3,072	7,485	1,527	$100,800
Load Cost/Unit							$26	$40	$83		$33	$13	$0	

Table 85 - Summary of Annual Load Reduction and Load Reduction Costs by Priority Area (Cont.)

BMP	Wolf River Watershed	South Fork Big Nemaha	Pony Creek Lake	Atchison Co. SFL	Wyandotte Co. Lake	Walnut Creek	Wyandotte County Lake				Walnut Creek Watershed			
Total BMP Units							TARGET LOAD REDUCTION							
BMP Units							Phosphorous: 270 lbs./yr by 2035				TARGET LOAD REDUCTION			
Years BMP Applied							Cholorophyll α to < 10µ/L				Bacteria: 262 CFUs/100ml by 2041			
BMP Units Per Year														
Load							N	P	Sed.	Costs	N	P	Sed.	Costs
Total Est. Load Reduction														
Load Units							lbs./yr.	lbs./yr.	Tons/yr.	$	lbs./yr.	lbs./yr.	Tons/yr.	$
Year														
2012							0	0	0	$0	0	0	0	$0
2013							0	0	0	$0	0	0	0	$0
2014							0	0	0	$0	0	0	0	$0
2015							0	0	0	$0	0	0	0	$0
2016							0	0	0	$0	0	0	0	$0
2017							0	0	0	$0	0	0	0	$0
2018							0	0	0	$0	0	0	0	$0
2019							0	0	0	$0	0	0	0	$0
2020							0	0	0	$0	0	0	0	$0
2021							0	0	0	$0	0	0	0	$0
2022							0	0	0	$0	0	0	0	$0
2023							0	0	0	$0	0	0	0	$0
2024							0	0	0	$0	0	0	0	$0
2025							0	0	0	$0	0	0	0	$0
2026							0	0	0	$0	0	0	0	$0
2027							0	0	0	$0	0	0	0	$0
2028							0	0	0	$31,625	0	0	0	$0
2029							0	0	0	$31,625	0	0	0	$0
2030							159	114	58	$36,108	0	0	0	$0
2031							242	231	79	$59,191	0	0	0	$0
2032							242	231	79	$57,991	851	568	357	$19,875
2033							27	77	0	$45,108	851	568	357	$21,075
2034							0	0	0	$35,725	4,889	1,819	357	$84,970
2035							0	0	0	$35,725	4,913	1,828	357	$96,320
2036							0	0	0	$0	4,913	1,828	357	$96,020
2037							0	0	0	$0	4,913	1,828	357	$96,320
2038							0	0	0	$0	4,913	1,828	357	$96,020
2039							0	0	0	$0	4,913	1,828	357	$96,320
2040							0	0	0	$0	4,889	1,819	357	$84,970
2041							0	0	0	$0	4,889	1,819	357	$85,270
Watershed Totals							670	653	216	$333,098	40,934	15,733	3,570	$777,160
Load Cost/Unit							$497	$510	$0		$0	$49	$0	

Table 85 - Summary of Annual Load Reduction and Load Reduction Costs by Priority Area (Cont.)

BMP	Wolf River Watershed	South Fork Big Nemaha	Pony Creek Lake	Atchison Co. SFL	Wyandotte Co. Lake	Walnut Creek	ANNUAL TOTAL			
Total BMP Units										
BMP Units										
Years BMP Applied										
BMP Units Per Year										
Load							N	P	Sed.	Costs
Total Est. Load Reduction										
Load Units							lbs./yr.	lbs./yr.	Tons/yr.	$
Year										
2012							3,168	2,082	311	$97,008
2013							3,838	2,445	645	$122,934
2014							3,550	2,295	421	$98,213
2015							5,674	5,192	712	$168,400
2016							5,134	4,922	442	$139,000
2017							5,982	5,339	867	$184,320
2018							5,312	4,976	533	$158,394
2019							2,536	3,124	437	$97,226
2020							2,539	3,175	438	$95,301
2021							4,006	4,550	1,023	$129,550
2022							4,846	4,710	1,023	$148,250
2023							2,901	1,882	785	$84,956
2024							2,901	1,882	785	$84,656
2025							2,061	1,722	785	$56,606
2026							793	2,290	207	$34,814
2027							692	2,257	327	$39,681
2028							1,024	2,495	509	$65,525
2029							549	393	302	$51,058
2030							491	352	240	$38,441
2031							242	231	79	$59,191
2032							1,093	799	436	$77,866
2033							878	645	357	$66,183
2034							4,889	1,819	357	$120,695
2035							4,913	1,828	357	$132,045
2036							4,913	1,828	357	$96,020
2037							4,913	1,828	357	$96,320
2038							4,913	1,828	357	$96,020
2039							4,913	1,828	357	$96,320
2040							4,889	1,819	357	$84,970
2041							4,889	1,819	357	$85,270
Watershed Totals							99,442	72,355	14,520	$2,905,233
Load Cost/Unit							$29	$40	$200	

SECTION 8 - MONITORING AND MILESTONES TO DETERMINE PROGRESS

The primary goal within the Missouri River Basin WRAPS Watershed Plan is restoration of water quality of high priority TMDL waters to meet designated uses supportive of aquatic life, domestic water supply, recreation, and other designated uses within the Missouri River Basin WRAPS project area. The plan specifically addresses high priority TMDLs within the Missouri Basin in Kansas. The following is a list of the impairments being directly addressed by the plan:

Wolf River Near Sparks (KDHE Station SC201)
- High Priority Biology (TSS) TMDL
- High Priority Bacteria TMDL

South Fork Big Nemaha River Near Bern (KDHE Station SC234)
- High Priority Biology (TSS) TMDL
- High Priority Bacteria TMDL

Walnut Creek Near Reserve (KDHE Station SC292)
- High Priority Bacteria TMDL

Pony Creek Lake (KDHE Station LM073001)
- High Priority Eutrophication TMDL

Atchison County State Fishing Lake (KDHE Station 012601)
- High Priority Eutrophication TMDL

Wyandotte County Lake (KDHE Station LM042401)
- High Priority Eutrophication TMDL

In order to reach the load reduction goals associated with the Missouri River Basin WRAPS Project Area impairments, an implementation schedule for BMP implementation spanning 30 years has been developed.

The selected practices included in the plan will be implemented throughout the targeted areas within the Missouri River Basin WRAPS project area. Water quality milestones have been developed for Wolf River, South Fork Big Nemaha River, Walnut Creek, Pony Creek Lake, Atchison County State Fishing Lake, and Wyandotte County Lake. The purpose of the milestones and indicators is to measure water quality improvements associated with the implementation schedule contained in this plan.

Monitoring Sites in the Missouri River Basin Wraps Project Area:

KDHE conducts water quality sampling in the lakes, rivers and stream and ongoing monitoring sites within each watershed within the Missouri River Basin. State wide there are 330 ambient stream chemistry monitoring sites covering the major river basins. Approximately half of the sites are core sites and visited on a bimonthly basis every year, whereas the remaining sites are monitored on a four year rotational approach. Biological monitoring samples are taken from some a portion of the sites each year and others are sampled on a three year monitoring rotational schedule. Water quality milestones contained in this section are tied to the sampling stations that KDHE continues to monitor for water quality in each of the water bodies that will be positively affected by the BMP implementation schedule in this plan. The following stations will be utilized to measure water quality improvements throughout the implementation of this plan.

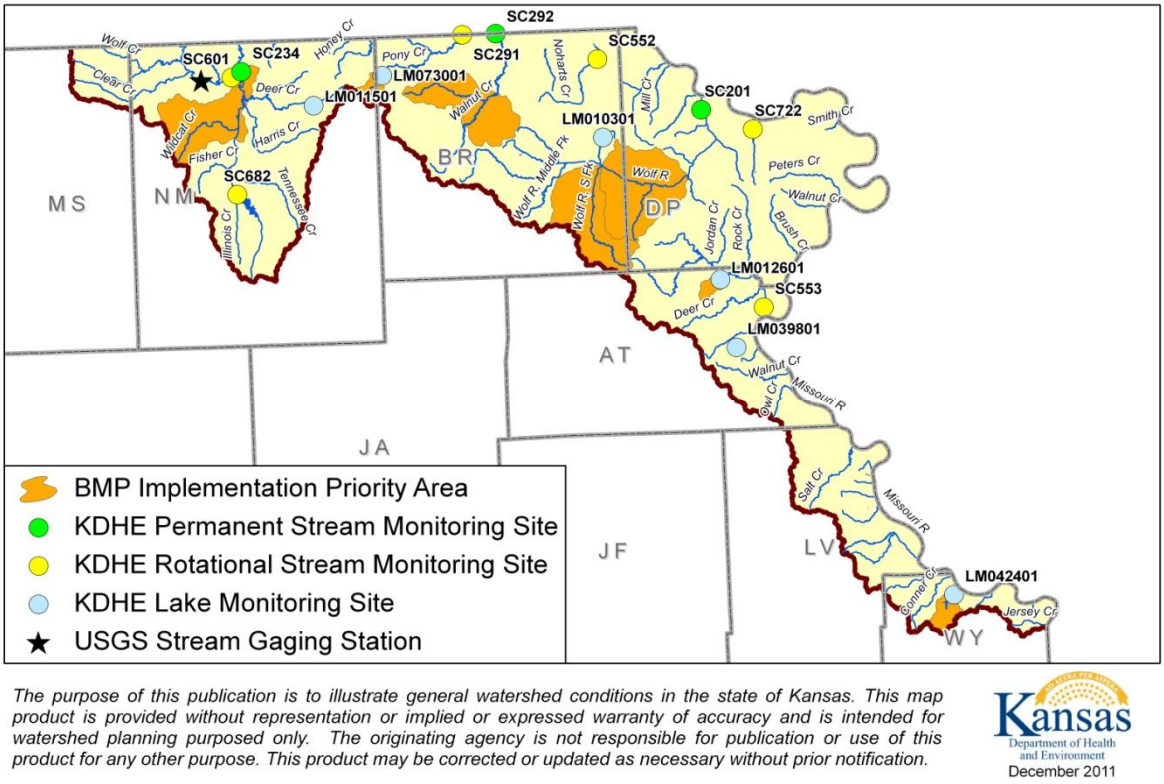
Table 86 - Stream and Lake Monitoring Sites in Missouri Basin

Site Number	Descriptions	Type
Streams		
SC 201	Wolf River near Sparks	Permanent
SC 234	South Fork near Bern	Permanent
SC 292	Walnut Creek near Reserve	Permanent
Lakes		
LM 012601	Atchison County State Fishing Lake	
LM 042401	Wyandotte County Lake	
LM 073001	Pony Creek Lake	

The SLT will track and evaluate the available data from KDHE monitoring testing to determine if BMP and I & E efforts are effective.

The following map shows both the permanent and rotational KDHE stream monitoring stations as well as monitored lakes located within the Missouri River Basin WRAPS Project Area. Also shown are targeted areas for implementation that have been identified and discussed in previous sections of this plan. The stream monitoring sites are sampled for nutrients, E. Coli bacteria, chemicals, turbidity, alkalinity, dissolved oxygen, pH, ammonia and metals. The KDHE lake monitoring sites are typically sampled once every 3 years between April and October. Lake monitoring sites are sampled for chlorophyll a, total nitrogen (TN), total phosphorus (TP), total suspended solids (TSS), turbidity, dissolved oxygen, and secchi disk depth. The pollutant indicators tested for at each site may vary depending on the season at collection time and other factors.

In addition to the KDHE monitoring stations, the Missouri River Basin WRAPS project area has several USGS gaging stations located within the watershed that provide real-time flow information. Stream flow information for these sites as well as other gaging stations within Kansas can be found at http://ks.water.usgs.gov/.



The purpose of this publication is to illustrate general watershed conditions in the state of Kansas. This map product is provided without representation or implied or expressed warranty of accuracy and is intended for watershed planning purposed only. The originating agency is not responsible for publication or use of this product for any other purpose. This product may be corrected or updated as necessary without prior notification.

Kansas Department of Health and Environment
December 2011

Figure 22 - Missouri River Basin WRAPS Water Monitoring Network

Data collected at the USGS gages includes gage height, discharge, precipitation and turbidity. By monitoring and tracking this data, the SLT will be able to evaluate if discharge rates are decreasing for a given rainfall and if turbidity, an indication of sediment in the river, is decreasing; both of which indicate the effectiveness of the BMP implementation.

Water Quality Milestones for Missouri River Basin WRAPS Project Area:

As previously stated, this plan estimates that it will take 30 years to implement the planned BMPs necessary to meet the load reduction goals for the impairments being addressed in the Missouri River Basin WRAPS Project Area. Several water quality milestones and indicators have been developed. The table below includes short term, mid-term, and long term water quality goals for various parameters monitored in the watershed. Sediment-related water quality milestones for Wolf River and S.F. Big Nemaha River have been developed as benchmarks to evaluate TSS loads within each of these rivers contributing to the biological impairments noted within these respective TMDLs. Determination of delisting of these biological impairments will ultimately be determined by improvements in biological criteria such as the Macro invertebrate Biotic Index (MBI) or other biological indices. Nutrient-related water quality milestones for Wolf River, S.F. Big Nemaha River, and Walnut Creek have been developed as milestones to measure improvements in nutrient loads for water bodies exiting Kansas. It is anticipated that BMPs implemented in association within this watershed plan will also help to yield nutrient reductions discussed within the Kansas Nonpoint Source Management Plan as well as the Kansas

Nutrient Management Plan. These nutrient milestones for the streams noted are meant to be representative of objectives noted within these plans as well.

Table 87 - River Nutrient Water Quality Milestones for Missouri River Basin WRAPS

	Current Condition (2000-2011) Median TP	10-Year Goal		Long Term Goal	
		Improved Condition (2012 - 2021) Median TP	Total Reduction Needed	Improved Condition Median TP	Total Reduction Needed
Sampling Site	**Total Phosphorus (median of data collected during indicated period), µg/L**				
Wolf River Near Sparks SC201	187	168	10.0%	131	30.0%
S.F. Big Nemaha River Near Bern SC234	235	223	5.0%	165	30.0%
Walnut Creek Near Reserve SC292	265	252	5.0%	186	30.0%

Table 88 - River Sediment Water Quality Milestones for Missouri River Basin

	Current Condition (2000-2011) 75th Percentile TSS	10-Year Goal		Long Term Goal	
		Improved Condition (2012 - 2021) 75th Percentile TSS	Total Reduction Needed	Improved Condition 75th Percentile TSS	Total Reduction Needed
Sampling Site	**Total Phosphorus (median of data collected during indicated period), µg/L**				
Wolf River Near Sparks SC201	59	53	10.0%	50	15.0%
S.F. Big Nemaha River Near Bern SC234	99	89	9.0%	84	15.0%
Walnut Creek Near Reserve SC292	104	99	5.0%	88	15.0%

Table 89 - Lake Water Quality Milestones for Missouri River Basin WRAPS

Sampling Site	Water Quality Parameter	Current Condition Period	Data Analysis Methodology	Unit of Measure	Current Condition	10-Year Goal		Long Term Goal	
						Improved Condition (2012 - 2021)	Total Reduction/ Improve-ment Needed	Improved Condition	Total Reduction/ Improve-ment Needed
Pony Creek Lake LM073001	Chl a	2000-2011	Average	ppb	22.12	21.01	5%	<10	55%
	TP	2000-2011	Average	ppb	65.4	62.1	5%	21	67%
	TN	2000-2011	Average	mg/L	1.10	1.05	5%	0.70	36%
Atchison County State Fishing Lake LM012601	Chl a	2004-2011	Average	ppb	85	81	5%	20	76%
	TSS	2004-2011	Average	mg/L	15	14	5%	<9	41%
	Secchi Disk	2004-2011	Average	m	0.7	0.67	5%	>1.0	43%
Wyandotte County Lake LM042401	Chl a	1988-2008	Average	ppb	7.8	7.8	Maintain	7.8	Maintain
	TP	1988-2008	Average	ppb	24	23	5%	22	8%
	Secchi Disk	1988-2008	Average	m	1.9	1.9	Maintain	1.9	Maintain

Water Quality Milestones for Bacteria:

The water quality goal associated with the bacteria impairments in the Missouri River Basin WRAPS Project Area can be tied to the *E. Coli* Bacteria (ECB) Index values. ECB index values for individual samples are computed as the ratio of the sample count to the contact recreation criterion. The calculated index is the natural logarithm of each sample value taken during the primary recreation season (April through October), divided by the natural logarithm of the bacteria criteria. Plotting the ECB ratio against the percentile rank for each individual sample within the data set for each sampling location illustrates the frequency and magnitude of the bacteria impairment for the sampling location. Higher bacteria frequencies are evident when the ECB ratio is over 1 for a large percentage of samples.

The water quality milestones associated with bacteria are based on the contact recreation designation of the impaired water body, as well as the proximity and designation of the downstream water body. Contact recreation is designated as either primary or secondary. Primary contact recreation designation is assigned to water bodies that have a high likelihood of ingestion based on public access, while secondary contact recreation designation is assigned to waters that are not as likely to be ingested due to restricted public access.

Bacteria load reductions should result in less frequent exceedance of the nominal ECB criterion. For Wolf River Near Sparks (SC201), S.F. Big Nemaha River Near Bern (SC234), and Walnut Creek Near Reserve (SC292). These bacteria index values represent the natural logarithm of each sample value taken during the April-October Primary Recreation season, divided by the natural logarithm of the bacteria criteria for applicable contract recreation designated use for the assessed water body.

Wolf River Bacteria

The calculated bacteria index for the Wolf River sampling station SC201 is the natural logarithm of each sample value taken during the April-October Primary Recreation season, divided by the natural logarithm of the bacteria criteria for Primary Recreation Class C [ln(427)].

$$\textbf{Index} = \ln(\textbf{ECB Count}) / \ln(427)$$

The indicator will be the Upper Decile of those index values; with the target being that the index is below 1.0 at the upper decile (90^{th} percentile).

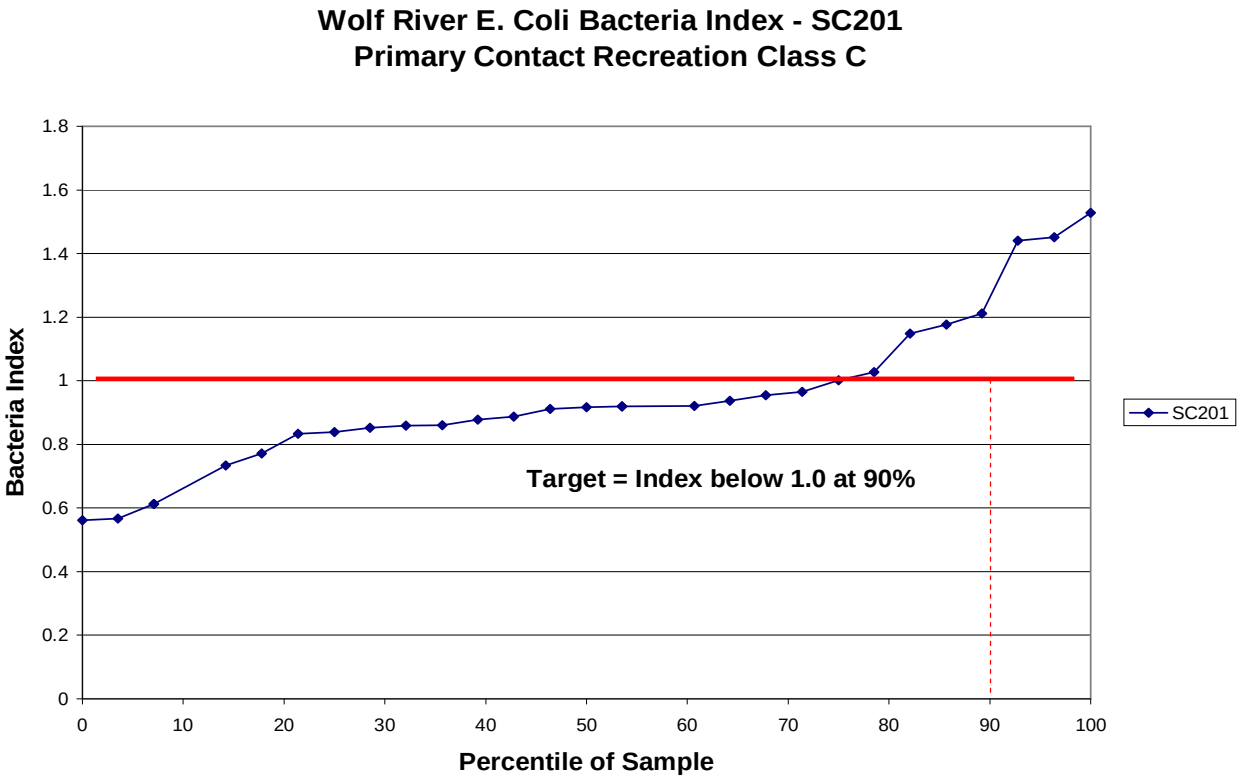


Figure 23 - Wolf River Bacteria Index at Sampling Station SC201

S.F. Big Nemaha River Bacteria

The calculated bacteria index for the South Fork Big Nemaha River sampling station SC234 is the natural logarithm of each sample value taken during the April-October Primary Recreation season, divided by the natural logarithm of the bacteria criteria for Primary Recreation Class C [ln(427)].

Index = ln(ECB Count) / ln(427)

The indicator will be the Upper Decile of those index values; with the target being that the index is below 1.0 at the upper decile (90^{th} percentile).

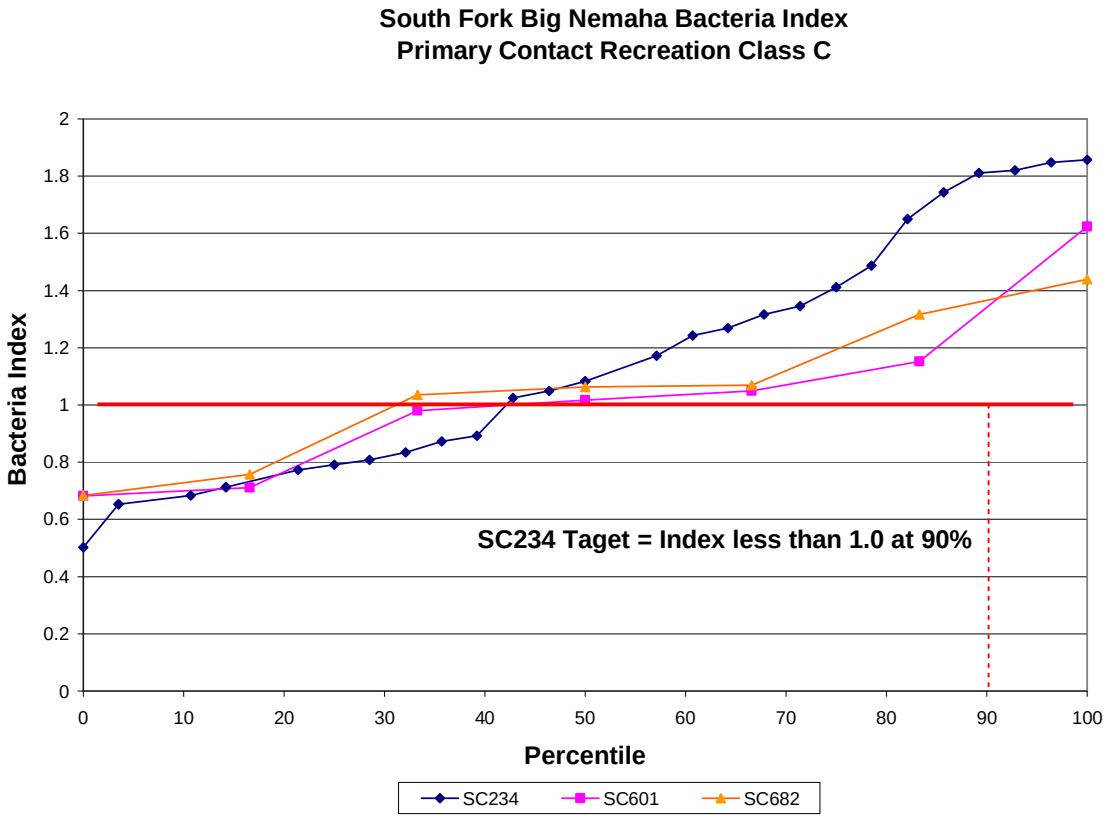


Figure 24 - South Fork Big Nemaha Bacteria Index at Sampling Station SC234

Walnut Creek Bacteria

The calculated bacteria index for the Walnut Creek sampling station SC292 is the natural logarithm of each sample value taken during the April-October Primary Recreation season, divided by the natural logarithm of the bacteria criteria for Secondary Recreation Class b [ln(3843)].

Index = ln(ECB Count) / ln(3843)

The indicator will be the Upper Decile of those index values; with the target being that the index is below 1.0 at the upper decile (90^{th} percentile).

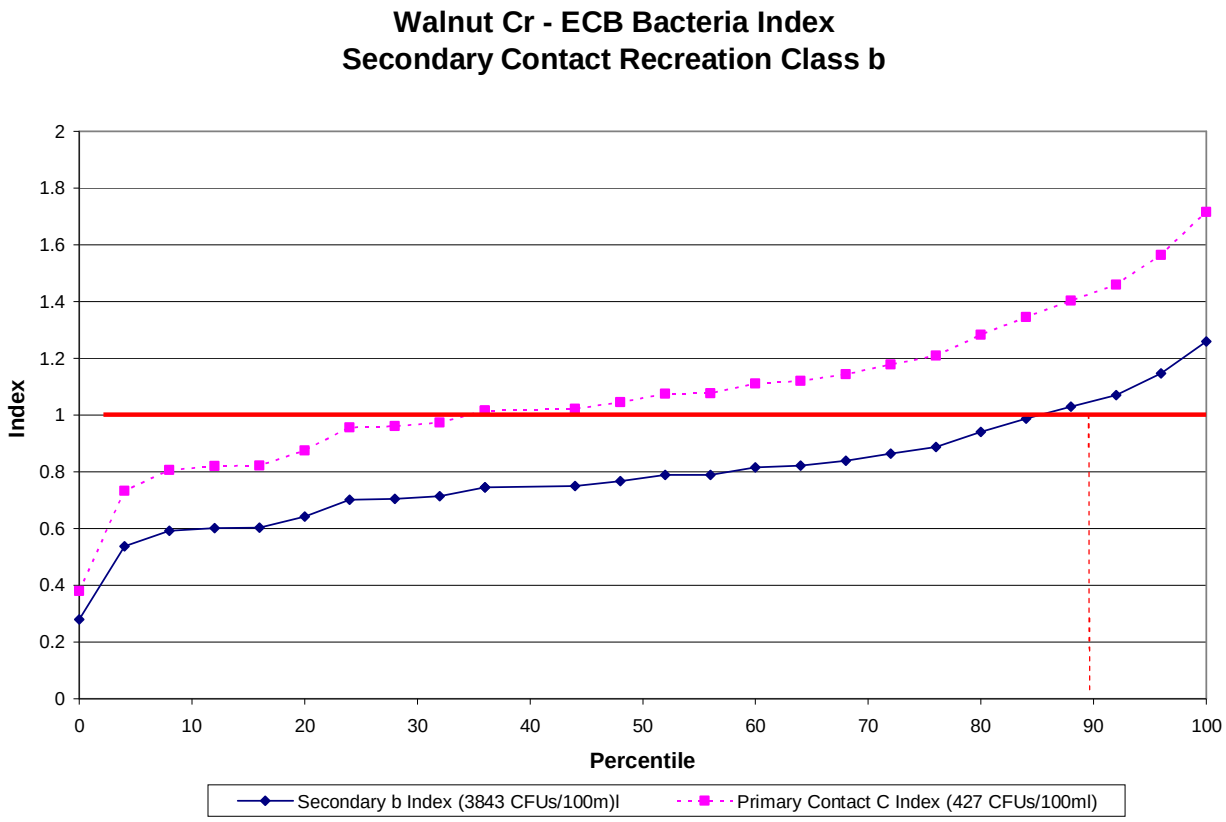


Figure 25 - Walnut Creek Bacteria Index at Sampling Station SC292

Ultimately, compliance with water quality standards of Wolf River, S.F. Big Nemaha River, and Walnut Creek will require sampling 5 times within 30 days during several periods during the primary recreation season, and calculating the geometric mean of those samplings. Meeting that test would be justification for delisting the stream impairment.

Additional Water Quality Indicators:

In addition to the monitoring data, other water quality indicators can be utilized by KDHE and the SLT. Such indicators may include anecdotal information from the SLT and other citizen groups within the watershed (skin rash outbreaks, fish kills, nuisance odors), which can be used to assess short-term deviations from water quality standards. These additional indicators can act as trigger-points that might initiate further revisions or modifications to the WRAPS plan by KDHE and the SLT.

- Taste and odor issues from public water supplies utilizing water from sources located within the Missouri River Basin WRAPS project area
- Occurrence of algal blooms in lakes within the project area
- Visitor traffic to lakes within the project area

- Trends of quantity and quality of fishing within the water bodies of the project area

Evaluation of Monitoring Data:

Monitoring data in the Missouri River Basin WRAPS project area will be used to determine water quality progress, track water quality milestones, and to determine the effectiveness of the implementation of conservation practices outlined in the plan. The schedule of review for the monitoring data will be tied to the water quality milestones that have been developed, as well as the frequency of the sampling data.

The implementation schedule and water quality milestones for the Missouri River Basin WRAPS project area extend through a 30-year period from 2012 to 2041. Throughout that period, KDHE will continue to analyze and evaluate the monitoring data collected. After the first ten years of monitoring and implementation of conservation practices, KDHE will evaluate the available water quality data to determine whether the water quality milestones have been achieved. If milestones are not achieved, KDHE will assist the Missouri River Basin WRAPS group to analyze and understand the context for non-achievement, as well as the need to review and/or revise the water quality milestones included in the plan. KDHE and the SLT can address any necessary modifications or revisions to the plan based on the data analysis. In 2041, at the end of the plan, a final determination can be made as to whether the water quality standards have been attained for the high priority TMDLs addressed within the Missouri River Basin WRAPS project area as a result of this plan.

In addition to the planned review of the monitoring data and water quality milestones, KDHE and the SLT may revisit the plan in shorter increments. This would allow the group to evaluate newer available information, incorporate any revisions to applicable TMDLs, or address any potential water quality indicators that might trigger an immediate review.

The Missouri River WRAPS is working with local high school teachers to develop a program of student stream and lake testing and sampling. We will correlate this information with the KDHE sampling test results to calibrate the student testing and to confirm its reliability. These sample results will be used as indicators of changes within the stream systems and to collect data from specific locations to further identify contributing factors to the stream water quality. The collection and evaluation of this data will be beneficial to the SLT as well as provide a learning experience and a heightened awareness' of water quality with the students.

BMP and I & E Activity Benchmarks and Milestones

The ultimate goal of the Missouri River WRAPS plan is to achieve water quality goals that meet or exceed the standards for the designated uses of all of the surface water bodies in the Missouri River WRAPS' watersheds. So the ultimate measure of success of the plan is the water quality monitoring and testing. When the water test indicate that the waters meet the designated use standards, it is likely that the plan was successful in restoring the water body.

However, the objective is not only to restore the water bodies to meet the designated use standards, but to also protect the water bodies for future digression of these designated use or other impairments and for the watersheds to remain healthy.

The plan depends on best management practices (BMPs) and information and education (I & E) programs to restore the water quality in the watersheds and to insure their future protection. To adequately evaluate if the proposed BMPs and I & E activities are effective, benchmarks and milestones are needed for the practices and activities completed. Table 90 – 5 year BMP Mileposts, provides the number of units of BMPs anticipated as necessary in the plan to restore the water quality in the Missouri River WRAPS project area.

Table 90 - 5-Year BMP Mileposts

Year	Wolf River Watershed	South Fork Big Nemaha	Pony Creek Lake	Atchison Co. SFL	Wyandotte Co. Lake	Walnut Creek	Best Management Practice													
							No-Till	Cover Crops	Grass Buffers	Forested Buffers	Convert Steep Slopes	Streambank Stabilization	Sediment Basin	Nutrient Management	Pasture Management	Urban Lawn Management	Livestock Waste	Pet Waste	On-Site Waste Management	Alternative Water
							Acres	Acres	Acres	Acres	Acres	Ln.Ft.	Each	Acres	Acres	Soil Tests	Each	Bags	Each	Each
2012							14	7	4			188	1	36	214		1			3
2013							14	7	4	4		488	1	36	214		1			3
2014							74	7	4	4	10		1	36	214		1		2	3
2015							74	7	8	4	10	300		77	264		2		2	9
2016							74	7	8	4	10	488		77	264		2		2	9
Milepost Subtotal							250	35	28	16	30	1,464	3	262	1,170	0	7	0	6	27
2017							74	7	4	4	10	188	1	77	264		2		2	9
2018							74	7	4		10	188	1	77	264		2		2	9
2019							60		4			188		42	50		1			6
2020							60		4			188		42	83		1			6
2021							60		24	20		188		333	83	15	1			7
Milepost Subtotal							328	14	40	24	20	940	2	571	744	15	7	0	4	37
2022							60		24	20				333	83	15	2			7
2023							60		20	20				333	83	15	1			1
2024							60		20	20				333	83	15	1			1
2025							60		20	20				333	83	15				1
2026							83	33						333		15				
Milepost Subtotal							323	33	84	80	0	0	0	1,665	332	75	4	0	0	10
2027							83	33								15				
2028							83	33	7							98				
2029									7				1			98				
2030									23							98				
2031									17							98		240	2	
Milepost Subtotal							166	66	54	0	0	0	1	0	0	407	0	240	2	0
2032									44				1		889	98		240	2	
2033									44						889	98		240	2	1
2034									44						889	98	3	240		1
2035									44						889		3	240	2	1
2036									44						889		3		2	1
Milepost Subtotal							0	0	220	0	0	0	1	0	4,445	294	9	960	8	4
2037									44						889		3		2	1
2038									44						889		3		2	1
2039									44						889		3		2	1
2040									44						889		3			1
2041									44						889		3			1
Milepost Subtotal							0	0	220	0	0	0	0	0	4,445	0	15	0	6	5

Table 91 - 5-Year I & E Mileposts by I & E provides the number of I & E activities anticipated in the plan as necessary to get the practices adopted and provide sufficient information and education to protect the watersheds.

Note that annual units are included in the tables for each BMP and I & E activity. The annual numbers are needed to develop the 5-year mileposts. But it is recommended that the focus should be on the 5-year Milepost Subtotals rather than the annual quantities since it is anticipated the actual annual numbers may fluctuate significantly over the 5 year period but be more consistent to the 5 year mileposts. Funding availability and scheduling, as well as identifying willing participants will be major factors in achieving the annual targeted practice adoption and I & E programs.

Evaluating BMP and I & E Milestones:

Every 5 years the water quality monitoring milestone data will be correlated with the BMP and I & E milestones. If the BMP and I & E milestones are met and the water quality milestones are not being met, then the plan will be revised to meet the water quality milestones. Reviewing these milestones will provide guidance how the plan should be revised. If the water quality goals are not met and BMP and I & E milestones are also not met then the implementation of the plan should be reviewed. If the water quality milestones are met and the BMP and I & E milestones are not met, then a careful review of the BMP and I & E activities actually completed will provide guidance how the plan can be reduced to be more effective.

There are a number of factors that may affect the successful implication of the plan and will also need to be considered in the 5-year evaluations. Funding may not be available to accomplish all BMPs or I & E activities in the plan. Weather conditions such as drought or significantly wet seasons may interfere with adoption of all of the best management practices. Scheduling may delay some activities. And a vital constituent of the plan requires that producers be willing to adopt the recommended best management practices. The ability to convince producers to participate is critical for the success of the plan. It is not unusual that a significant amount of time is required to get the first practices adopted, while once a few are adopted and shown to be successful, others follow quickly.

Table 91 - 5-Year I & E Mileposts by I & E

Year	Wolf River Watershed	South Fork Big Nemaha	Pony Creek Lake	Atchison Co. SFL	Wyandotte Co. Lake	Walnut Creek	I & E Activities																					
							Informational Meeting	One on One Technical Asst. Meetings	Field Day	Newletter Article	Newspaper Article	Scholorships	Demonstration Plot (Even Year)	Demonstration Plot (Odd Year)	Soil Test	Event Exhibits	Signage	Poster, Essay, & Speech Contest	4-H WQ Project	Earth Day	Extension Newsletter	River Friendly Farm Info Meeting	River Friendly Farm Technical Asst.	Watershed Information Event Display	Awards Meeting
2012							2	50	3	9	6	20	2	3	400			1	1	2	1	1	10	5	1
2013							2	57	3	10	7	20	3	3	400			1	1	2	1	1	10	5	1
2014							2	56	3	11	8	20	3	3	400			1	1	2	1	1	10	5	1
2015							2	62	3	10	8	20	3	3	400			1	1	2	1	1	10	5	1
2016							1	54	2	9	7	20	3	3	400			1	1	2	1	1	10	5	1
5-Year Milepost Subtotal							9	279	14	49	36	100	14	15	2,000	0	0	5	5	10	5	5	50	25	5
2017							2	64	3	11	9	20	3	3	400			1	1	2	1	1	10	5	1
2018							2	64	3	10	8	20	2	3	400			1	1	2	1	1	10	5	1
2019							2	41	3	7	5	20	1	3	400			1	1	2	1	1	10	5	1
2020							2	41	3	7	5	20	1	3	400			1	1	2	1	1	10	5	1
2021							3	49	3	9	7	20	2	3	500			1	1	2	1	1	10	5	1
5-Year Milepost Subtotal							11	259	15	44	34	100	9	15	2,100	0	0	5	5	10	5	5	50	25	5
2022							3	49	3	9	7	20	2	3	500			1	1	2	1	1	10	5	1
2023							2	41	2	8	6	20	2	2	500			1	1	2	1	1	10	5	1
2024							2	41	2	8	6	20	2	2	500			1	1	2	1	1	10	5	1
2025							2	36	2	7	5	20	1	2	500			1	1	2	1	1	10	5	1
2026							2	19	1	4	2	20	1		500			1	1	2	1	1	10	5	1
5-Year Milepost Subtotal							11	186	10	36	26	100	8	9	2,500	0	0	5	5	10	5	5	50	25	5
2027							3	17	1	4	2	20	1	0	100			1	1	2	1	1	10	5	1
2028							3	25	1	5	3	20	1	0	100			1	1	2	1	1	10	5	1
2029							3	8	1	3	3			1	100			1	1	2	1	1	10	5	1
2030							2	15	1		3			1	100			1	1	2	1	1	10	5	1
2031							4	15	1		4			1	100	3	10	1	1	2	1	1	10	5	1
5-Year Milepost Subtotal							15	80	5	12	15	40	2	3	500	3	10	5	5	10	5	5	50	25	5
2032							4	19	1		5			1	100	3	10	1	1	2	1	1	10	5	1
2033							3	17	1		4				100	3	10	1	1	2	1	1	10	5	1
2034							3	17	2		4		1	1	100	3	10	1	1	2	1	1	10	5	1
2035							3	26	2		5		1	11	100	3	10	1	1	2	1	1	10	5	1
2036							1	26	2		4		1	1				1	1	2	1	1	10	5	1
5-Year Milepost Subtotal							14	105	8	0	22	0	3	14	400	12	40	5	5	10	5	5	50	25	5
2037							1	26	2		4		1	1				1	1	2	1	1	10	5	1
2038							1	26	2		4		1	1				1	1	2	1	1	10	5	1
2039							1	26	2		4		1	1				1	1	2	1	1	10	5	1
2040							1	21	2		3		1	1				1	1	2	1	1	10	5	1
2041							1	21	2				1	1				1	1	2	1	1	10	5	1
5-Year Milepost Subtotal							5	120	10	0	15	0	5	5	0	0	0	5	5	10	5	5	50	25	5

SECTION 9 - REVIEW OF THE WATERSHED PLAN IN 2017

The SLT will review and update the plan as appropriate but a scheduled review will be held in 2017. In 2017, the SLT will review and revise the Plan according to the results acquired from the monitoring data. The SLT will:

1. Request current TSS and TP sampling results from KDHE for the Wolf River to determine if impairments have been reduced from the existing levels and if the reduction is in accordance with the load reduction milestones by the BMP plan. Modify the plan as indicated by the sampling results.
2. Request current bacteria colony counts in the Wolf River and review progress to reaching the impairment goals. Determine if the reduction is congruent with the predicted reduction in the Plan. If not, adjust plan or implementation schedule of the plan.
3. Review current TSS and TP and Bacteria test results from South Fork Nemaha River to determine if there has been a reduction in impairments and if appropriate progress is made toward the benchmark goals for the South Fork. If not, modify the plan or adjust implementation schedules
4. Request current TSS and TP goals from Pony Creek to determine if the No-Till implementation efforts are achieving results.
5. Review the 5-year BMP and I & E mileposts for Wolf Creek, South Fork and Pony Creek Lake to determine if the plan is being followed.
6. Review with KDHE staff if additional water quality impairments are imminent that the SLT should address with additional BMP's and or I & E activities to protect the water quality. Modify the plan accordingly.
7. Assess if there is an increased public awareness of watershed issues and support for restoration and protection of the watershed. Adjust information and education program accordingly.
8. Evaluate the Plan's effectiveness and recommend changes to the plan as is appropriate to meet the water quality milestones of the Missouri River Basin.

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Appendix A - Cooperating and Responsible Agencies and Groups.

These are the agencies and groups that we anticipate will provide the technical, organizational, and financial support for the work of these projects.

Cooperating or Responsible Agencies and Groups

Abrev.	Organization	Phone	Address	e-mail Address	Financial Assistance	Technical Assistance
CWP	Center for Watershed Protection	410-461-8323	8390 Main Street 2nd Floor Ellicott City, MD 21043	www.cwp.org		**X**
DoED	Doniphan County Economic Development	785-985-2235	PO Box 250 125 E. Chestnut St. Troy, Kansas	www.dpcountyks.com		X
DU	Ducks Unlimited	901-758-3825	One Waterfowl Way Memphis, TN 38120	www.ducks.org	X	X
GHRC&D	Glacial Hills Resource Conservation & Development Region Inc.	785-945-6292	318 Broadway Valley Falls, KS 66088	www.Glacialhillsrck.com	X	X
HEHC	Healthy Ecosystems/ Healthy Communities	785-532-3039	101 Umberger Hall Kansas State University Manhattan, KS 66506	www.kansasprideprogram.ksu.edu/healthyecosystems		X
	Iowa Tribe	785-595-3258	Iowa Tribe of Kansas & Nebraska 3345 B Thrasher	www.ioway.nativeweb.org		X

Abrev.	Organization	Phone	Address	e-mail Address	Financial Assistance	Technical Assistance
			White Cloud, KS 66094			
KACEE	Kansas Association for Conservation and Environmental Education	785-532-3322	2610 Claflin Rd. Manhattan, KS 66502	www.kacee.org		X
KAWS	Kansas Alliance for Wetlands & Streams	785-658-1619	P.O. Box 2112 Salina, KS 67402	www.KAWS.org		X
KBS	Kansas Biological Survey	785-864-1500	2101 Constant Avenue Lawrence, KS 66047	www.kbs.ku.edu		X
KDA	Kansas Department of Agriculture, Division of Water	785-296-3717	109 SW 9th Street, 2nd Fl. Topeka, KS 66612	www.ksda.gov/dwr	X	X
	Kansas Department of Agriculture, Division of Water Resources Topeka Field Office	785-862-6300	Building 282, Forbes Field, PO Box 19323 Topeka, KS 66619	www.ksda.gov/dwr/		X
	Kansas Department of Agriculture Department of Conservation	785-296-3600	109 SW 9th Street, 2A Topeka, Kansas 66612	www.ksda.gov/doc/	X	X
KDHE	Kansas Department Health & Environment				X	X
	Northeast District Office	785-842-4600	800 West 24th Street Lawrence, KS 66046	NEDOAdmin@kdheks.gov	X	X
	Bureau of Water	785-296-5500	1000 SW Jackson St Suite420 Topeka, KS 33312	www.kdheks.gov/water		
	Watershed Management	785-296-4195		www.kdheks.gov/tmdl	X	X
	Watershed Planning & TMDL	785-296-6170		www.kdheks.gov/nps		X

Abrev.	Organization	Phone	Address	e-mail Address	Financial Assistance	Technical Assistance
	Livestock Management	785-296-0075		www.kdheks.gov/feedlots	X	X
	Technical Services	785-296-0086		www.kdheks.gov/water/tech		X
	Bureau of Environmental Field Services	785-296-5572	1000 SW Jackson St Suite430 Topeka, KS 33312	www.kdheks.gov/befs		X
KDOT	Kansas Department of Transportation	785-296-3566	Dwight D. Eisenhower State Office Building 700 S.W. Harrison Street Topeka, KS 66603	www.ksdot.org	X	X
KDWP	Kansas Department of Wildlife and Parks	620-672-5911	512 SE 25th Ave. Pratt, KS 67124	www.kdwp.state.ks.us	X	X
	KDWP Region 2 Offices	785-273-6740	300 SW Wanamaker Rd Topeka, KS 66606	www.kdwp.state.ks.us		X
KELP	Kansas Environmental Leadership Program			www.ksre.ksu.edu/kelp/		X
KFS	Kansas Forest Service	785-532-3300	2610 Claflin Road Manhattan, KS 66502	www.kansasforests.org	X	X
KGS	Kansas Geological Survey	785-864-3965	1930 Constant Ave. Lawrence, KS 66047	www.kgs.ku.edu		X
KLA	Kansas Livestock Association	785-273-5115	6031 SW 37th Street Topeka, KS 66614	www.Kla.org		X
KRC	Kansas Rural Center	785-873-3431	304 Pratt PO Box 133 Whiting, KS 66552	www.Kansasruralcenter.org	X	X
KRWA	Kansas Rural Water Association	785-336-3760	706 Waterway Drive	www.KRWA.net		X

Abrev.	Organization	Phone	Address	e-mail Address	Financial Assistance	Technical Assistance
			Seneca, KS 66538			
KSU EXT	Kansas State University Research & Extension	785-532-5820	123 Umberger Hall Manhattan, KS 66506	www.ksre.ksu.edu		
	KSU Extension Northeast Area office	785-532-5833	1007 Throckmorton Hall Manhattan, KS. 66506	www.northeast.ksu.edu		X
KSU Ext.	**County Extension Offices**					
	Atchison	913-833-5450	405 Main PO Box 109 Effingham, KS	www.Atchison.ksu.edu		X
	Brown	785-742-7871	Courthouse 601 Oregon Hiawatha, KS 66434	www.brown.ksu.edu		X
	Doniphan	785-985-3623	P.O. Box 487 105 S. Liberty Troy, KS 66087	www.doniphan.ksu.edu		X
	Leavenworth	913-250-2300	500 Eisenhower Rd Suite 103 Leavenworth, KS 66048	www.leavenworth.ksu.edu		X
	Marshall	785-562-3531	1201 Broadway Marysville, KS 66508	www.marshall.ksu.edu		X
	Nemaha	785-336-2184	207 Main Seneca, KS 66538	www.nemaha.ksu.edu		X
	Wyandotte	913-299-9300	1216 North 79th Street Kansas City, KS 66112	www.wyandotte.ksu.edu		X
	Kansas Water			www.Ksre.ksu.edu/kswater		X

Abrev.	Organization	Phone	Address	e-mail Address	Financial Assistance	Technical Assistance
	Kansas WaterLINK	785-553-2732	2323 Anderson Ave. Suite 125, Manhattan, KS 66502	www.ksu.edu/waterlink		X
KWO	Kansas Water Office	785-296-3785	901 S. Kansas Avenue Topeka, KS 66612	www.KWO.org		X
NRCS	Kansas Natural Resources Conservation Service	785-823-4500	760 South Broadway Salina, KS 67401		X	X
FSA	Kansas Farm Service Agency	785-539-3531	3600 Anderson Avenue Manhattan, KS 66503	USDA.gov/FSA	X	
	Atchison	913-833-5460	605 6th Street Effingham, KS 66023-4041		X	X
	Brown	785-742-3161	1310 Oregon Street Hiawatha, KS 6643-2203		X	X
	Doniphan	785-985-2221	510 East Locust Street Troy, KS 66087-4208		X	X
	Leavenworth	785-863-2221	Oskaloosa Service Center 700 Jefferson Street Oskaloosa, KS 66066		X	X
	Marshall	785-562-5343	1133 Pony Express HWY Marysville, KS 66508-		X	X

Abrev.	Organization	Phone	Address	e-mail Address	Financial Assistance	Technical Assistance
	Nemaha	785-336-2164	409 North St. Seneca, KS 66538-2504		X	X
	Wyandotte	785-863-2221	Oskaloosa Service Center 700 Jefferson Street Oskaloosa, KS 66066		X	X
NFWF	National Fish & Wildlife Federation	202-857-0166	1120 Connecticut Av. NW Suite 900 Washington, DC 20036	www.nfwf.org	X	X
Nature	Nature Conservancy	703-841-5300	4245 North Fairfax Drive Suite 100 Arlington, VA	www.nature.org		
NKES	Northeast Kansas Environmental Services	785-985-2778	201 South Main St. PO. Box 609 Troy, Kansas 66087	www.NEKES.org		X
NTOP	No-Till on the Plains	888-330-5142	PO Box 379 Wamego, KS 66547-0379	www.notill.org		X
	Pheasants Forever	651-773-2000	1783 Buerkle Circle St. Paul, MN 55110	www.pheasantsforever.org	X	X
	Quail Unlimited	803-637-5731	PO Box 610 Edgefield, SC 29824	www.qu.org	X	X
SAKW	State Association of Kansas Watersheds	785-922-6664	2830 Rain Road Chapman, KS 67431	www.sakw.org	X	X
	County Conservation Districts					
	Atchison	913-833-5740	605 6th Street		X	X

Abrev.	Organization	Phone	Address	e-mail Address	Financial Assistance	Technical Assistance
			Effingham, KS 66023-			
	Brown	785-742-2012	1310 Oregon Street Hiawatha, KS 66432203		X	X
	Doniphan	785-985-3524	510 East Locust Street Troy, KS 66087-4208		X	X
	Leavenworth	913-682-2133	330 Shawnee Street RM 314 Leavenworth, KS 66048		X	X
	Marshall	785-562-3133	1133 Pony Express Highway Marysville, KS 66508-8501		X	X
	Nemaha	785-336-2186	411 North Street Seneca, KS 66538-2504		X	X
	Wyandotte	913-334-6329	1204 North 79th Street Kansas City, KS 66112		X	X
USACOE	U.S. Army Corps of Engineers Kansas City District	816-389-2000	601 East 12th Street Kansas City, Mo 64106	www.nwk.usace.army.mil	X	X
USDA	US Department of Agriculture	202-720-2791	1400 Independence Ave. SW Washington, DC 2050	www.usda.gov	X	X
US EPA	U.S. Environmental Protection Agency, Regions 7	913-551-7003	901 North 5th Street Kansas City, KS 66101	www.epa.gov/region7/	X	X
USFWS	US Fish & Wildlife Service		4401 N. Fairfax Drive Arlington, VA 22203	www.fws.gov	X	X
	US Fish & Wildlife Service Kansas Field Office	785-539-3474	2609 Anderson Avenue Manhattan, KS 66502	http://www.fws.gov/mountain-prairie/ks1.html	X	X

Abrev.	Organization	Phone	Address	e-mail Address	Financial Assistance	Technical Assistance
USFS	US Forest Service	800-832-1355	1400 Independence Ave SW. Washington, DC 20250	www.fs.fed.us	X	X
	US Forest Service Rocky Mountain Region	303-275-5350	750 Simms St. Golden, CO 80401	www.fs.fed.us/r2		X
USGS	US Geological Survey	785-832-3527	4821 Quail Crest Place Lawrence, KS 66049-0070	http://Ks.water.usgs.gov		X

Appendix B - Missouri River Basin Stream and Lake Designated Use and Impairment

Designated Uses & Impairment

Stream Segment Name	HUC 10	HUC 12	Seg.	Designated Uses								Impairment										
				AL	CR	DS	FP	GR	IW	IR	LW	Bio	Silt	Ap	Atr	Chl	DO	EU	FCB	NH_3	pH	Se
Tarkio Wolf (HUC 10240005)																	H*		H*			
Cedar Creek	11	01	**51**	**E**	**C**																	
Cold Ryan Branch	12	05	**70**	**E**	b							**H**							**H**			
Coon Creek	12	05	**71**	**E**								**H**							**H**			
Halling Creek	12	04	**68**	**E**	b							**H**							**H**			
Mill Creek	11	03	**52**	**E**																		
Mission Creek	11	03	**339**	**E**	b	**X**	**X**	**X**	**X**	**X**	**X**											
Missouri River				**S**	**B**	**X**	**X**	**X**	**X**	**X**	**X**											
Mosquito Creek	13	03	**73**	**E**	**C**																	
Rittenhouse Branch	12	05	**69**	**E**	b							**H**							**H**			
Spring Creek	11	01	**65**																			
Striker Branch	12	05	**72**	**E**	b							**H**							**H**			
Unnamed Stream			**55**	**E**	b	**X**	**X**		**X**	**X**		**H**							**H**			
Unnamed Stream			**240**	**E**	b																	
Wolf River	12	05	**53**	**E**	**C**	**X**	**X**	**X**	**X**	**X**	**X**	**H**										
Wolf River	12	04	**54,56**	**E**	b	**X**	**X**	**X**	**X**	**X**	**X**	**H**										

Designated Uses & Impairment

Stream Segment Name	HUC 10	HUC 12	Seg.	Designated Uses								Impairment										
				AL	CR	DS	FP	GR	IW	IR	LW	Bio	Silt	Ap	Atr	Chl	DO	EU	FCB	NH_3	pH	Se
Wolf R. Middle Fork	12	02		**E**	**C**	**X**	**X**	**X**	**X**	**X**	**X**	**H**							**H**			
Wolf R. North Fork	12	01		**E**	**C**	**X**	**X**	**X**	**X**	**X**	**X**	**H**							**H**			
Wolf R. South Fork	12	03		**E**	b	**X**	**X**	**X**	**X**	**X**	**X**	**H**										
South Fork Big Nemaha (HUC 10240007)																	**H***					
S. F. Big Nemaha	03	01	**3**	**S**	b	**X**	**X**	**X**	**X**	**X**	**X**	**H**							**H**			
S. F. Big Nemaha	02	02	**15**	**S**	C	**X**	**X**	**X**	**X**	**X**	**X**	**H**							**H**			
S. F. Big Nemaha	02	01	**16**	**S**	a	**X**	**X**	**X**	**X**	**X**	**X**	**H**							**H**			
Burger Creek	01	08	**24**	**E**	b	**X**	**O**	**X**	**X**	**X**	**X**	**H**			**M**				**H**			
Clear Creek	01	07	**132**	**E**	b										**M**							
Deer Creek	02	04	**18**	**E**	b							**H**							**H**			
Fisher Creek	02	02	**28**	**E**	b	**X**	**X**	**X**	**X**	**X**	**X**	**H**							**H**			
Harris Creek	02	03	**166**	**E**	b							**H**							**H**			
Honey Creek	03	04	**26**	**E**	b	**O**	**O**	**O**	**O**	**O**	**X**											
Illinois Creek	02	01	**30**	**E**	b		**X**					**H**							**H**			**L**
Manley Creek	01	06	**14**	**E**	b	**X**	**X**	**X**	**X**	**X**	**X**	**H**			**M**				**H**			
Rattlesnake Creek			**27**	**E**	b	**O**	**X**	**O**	**O**	**O**	**X**											
Rock Creek	03	06	**20**	**E**	b																	
Tennessee Creek	03	02	**29**	**E**	b														**H**			
Turkey Creek	01	08	**4**	**E**			**X**					**H**			**M**				**H**			

Designated Uses & Impairment

Stream Segment Name	HUC 10	HUC 12	Seg.	Designated Uses								Impairment										
				AL	CR	DS	FP	GR	IW	IR	LW	Bio	Silt	Ap	Atr	Chl	DO	EU	FCB	NH_3	pH	Se
Turkey Creek	01	06	**5**	**E**	b		**X**					**H**			**M**				**H**			
Unnamed Stream			**212**	**E**	b	**O**	**O**	**X**	**O**	**O**	**O**											
Wildcat Creek	02	05	**22**	**E**	b	**O**	**O**	**O**	**O**	**O**	**O**	**H**			**M**				**H**			
Wildcat Creek	02	05	**23**	**E**	b							**H**							**H**			
Wolf Creek	01	06	**12**	**E**	b	**X**	**X**	**X**	**X**	**X**	**X**	**H**			**M**				**H**			
Wolf Creek	?	?	**13**	**E**	b	**X**	**X**	**X**	**X**	**X**	**X**	**H**			**M**				**H**			
Wolf Pen Creek	02	04	**25**	**E**	b	**O**	**X**	**O**	**O**	**O**	**X**	**H**							**H**			
Big Nemaha (HUC 10240008)																						
Noharts Creek	04	06	**42**	**E**	b																	
Pedee Creek	04	02	**41**	**E**																		
Pony Creek	04	02	**38**	**E**			**X**															
Roys Creek	04	07	**40**	**E**			**X**															
Terrapin Creek	04	05	**308**	**E**	b		**X**												**H**			
Walnut Creek	04	04-06	**39**	**E**	b		**X**												**H**			
Independence-Sugar (HUC 10240011)																						
Brush Creek	01	07	**26**	**E**	b																	
Corral Creek	05	00	**175**	**E**	b																	
Deer Creek	02	05	**32**	**E**	**C**	**O**	**O**	**X**	**O**	**O**	**X**											
Fairfax Drain Ditch	06	04	**9098**	**R**	b																	
Fivemile Creek	05	00	**35**	**E**	a																	
Independence	02	01	**20,22**	**E**	**C**	**X**	**X**	**X**	**X**	**X**	**X**											

Designated Uses & Impairment

Stream Segment Name	HUC 10	HUC 12	Seg.	Designated Uses								Impairment										
				AL	CR	DS	FP	GR	IW	IR	LW	Bio	Silt	Ap	Atr	Chl	DO	EU	FCB	NH_3	pH	Se
Creek																						
Independence, N BR	02	02	**29**	**E**	b																	
Island Creek	06	02	**37**	**E**	**C**	**X**	**X**	**X**	**X**	**X**	**X**											
Jersey Creek			**38**	**R**	a	**X**	**X**	**X**	**X**	**X**	**X**											
Jordan Creek	02	02	**30**	**E**	**C**																	
Missouri River				**S**	**B**	**X**	**X**	**X**	**X**	**X**	**X**											
Nine Mile Creek			**161**	**E**	b		**X**															
Owl Creek	03	04	**33**	**E**	**C**																	
Peters Creek	01	05	**27**	**E**	**C**		**X**															
Quarry Creek			**176**	**E**	B																	
Rock Creek	02	03	**21**	**E**	**C**																	
Salt Creek	03	05	**34**	**S**	**C**		**X**															
Seven Mile Creek	06	01	**157**	**E**	b		**X**															
Smith Creek	01	01	**28**	**E**	b																	
Sorter Creek			**142**	**E**	b	**X**	**X**	**X**	**X**	**X**	**X**											
Threemile Creek			**36**	**E**	a																	
Walnut Creek	01	06	**23**	**E**	**C**																	
Walnut Creek	03	01	**25**	**E**	b																	
Whiskey Creek			**235**	**E**	b															**H***		
White Clay Creek			**31**	**E**	**B**																	

Designated Uses & Impairment

Stream Segment Name	HUC 10	HUC 12	Seg.	Designated Uses								Impairment										
				AL	CR	DS	FP	GR	IW	IR	LW	Bio	Silt	Ap	Atr	Chl	DO	EU	FCB	NH_3	pH	Se
Lakes																						
Tarkio Wolf (HUC 10240005)																						
Brown County SFL	12	02		**E**	**B**	**X**	**X**	**O**	**X**	**X**	**X**			**M**			**M**	**M**			**M**	
Hiawatha City Lake	12	01		**E**	**B**	**X**	**X**	**O**	**X**	**X**	**X**				**M**			**M**				
Troy Fair Lake				**E**	**B**		**X**							**L**				**L**				
South Fork Big Nemaha (HUC 10240007)																						
Nemaha Co. SFL	02	01		**E**	**B**	**X**	**X**	**X**	**X**	**X**	**X**											
Sabetha City Lake	07	04		**E**	**B**	**X**	**X**	**O**	**X**	**X**	**X**							**L**				
Big Nemaha (HUC 10240008)																						
Pony Creek Lake	04	02		**E**	**B**	**X**	**X**	**O**	**X**	**X**	**X**							**H**				
Independence-Sugar (HUC 10240011)																						
Atchison Co.SFL	02-	02		**E**	**B**	**X**	**X**	**O**	**X**	**X**	**X**		**H**	**L**			**L**	**L**				
Big Eleven Lake				**E**	**B**	**X**	**X**	**X**	**X**	**X**	**X**							**L**				
Jerry's Lake	05	00		**E**	**B**	**X**	**X**	**O**	**X**	**X**	**X**											
Lake Warnock	03	01		**E**	**A**	**X**	**X**	**O**	**X**	**X**	**X**											
Lansing City Lake	06	01		**E**	**B**	**X**	**X**	**O**	**X**	**X**	**X**							**L**		**L**		
Merrit lake				**E**	**B**		**X**															
Smith Lake				**E**	**B**		**X**															

Designated Uses & Impairment

Stream Segment Name	HUC 10	HUC 12	Seg.	Designated Uses								Impairment										
				AL	CR	DS	FP	GR	IW	IR	LW	Bio	Silt	Ap	Atr	Chl	DO	EU	FCB	NH_3	pH	Se
Wyandotte Co. Lake	06	04		**E**	**A**		**X**											**H**				

Abbreviations for Designated Use Tables

HUC = hydrologic unit code
SEG = stream segment

Designated Uses
AL = designated for aquatic life use
S = special aquatic life use water
E = expected aquatic life use water
R = restricted aquatic life use water
CR = designated for contact recreational use
A = Primary contact recreation stream segment is a designated public swimming area
B = Primary contact recreation stream segment is by law or written permission of the landowner open to and accessible by the public
C = Primary contact recreation stream segment is not open to and accessible by the public under Kansas law
a = Secondary contact recreation stream segment is by law or written permission of the landowner open to and accessible by the public
b = Secondary contact recreation stream segment is not open to and accessible by the public under Kansas law
DS = designated for domestic water supply use
FP = designated for food procurement use
GR = designated for ground water recharge
IW = designated for industrial water supply use
IR = designated for irrigation use
LW = designated for livestock watering use

X = referenced stream segment is assigned the indicated designated use
O = referenced stream segment does not support the indicated designated use
blank = capacity of the referenced stream segment to support the indicated designated use has not been determined by use attainability analysis

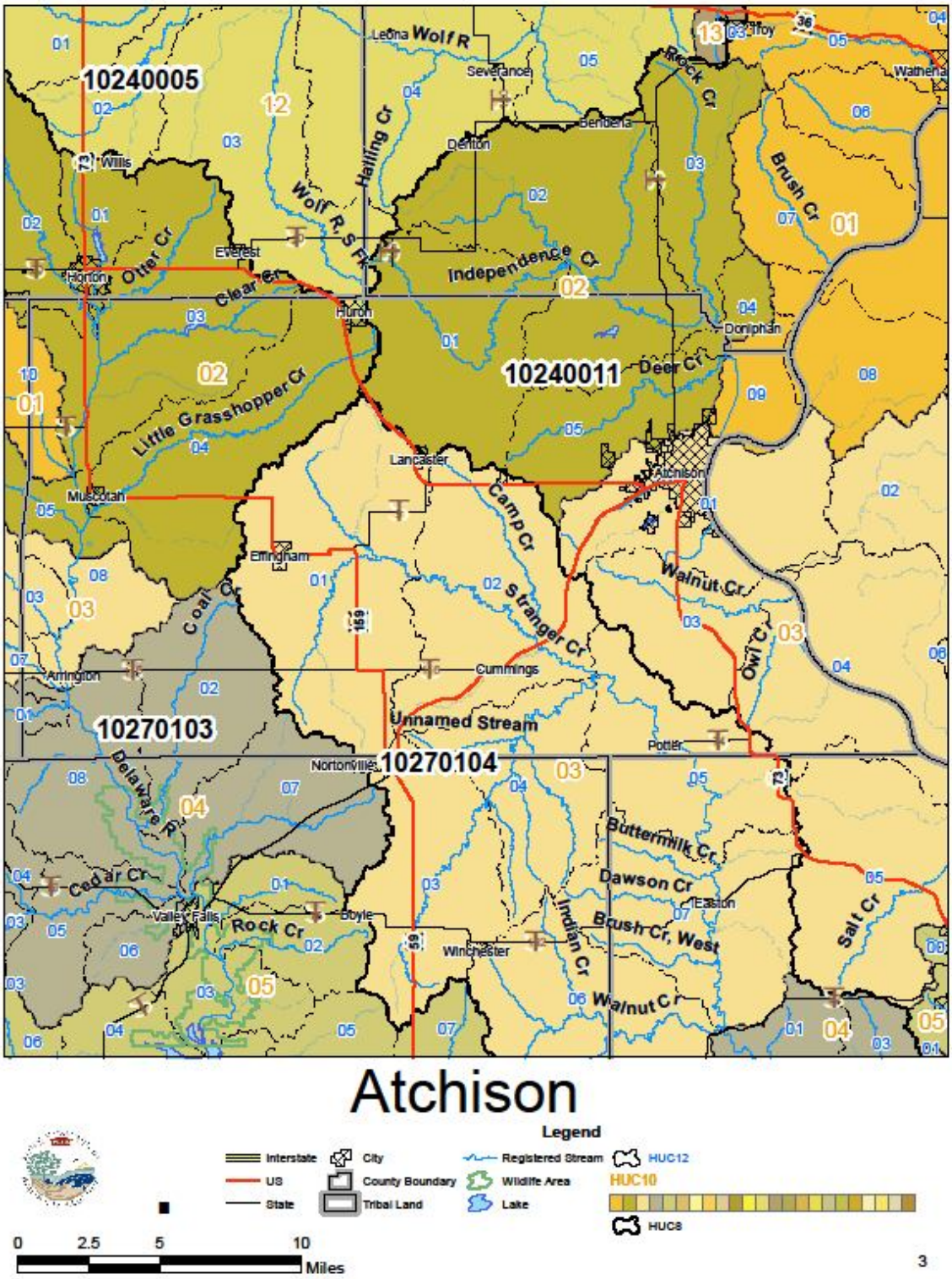
Impairment
AP = Aquatic Plants
Atr = Atrazine
Chl = Chlordane
DO = Dissolved Oxygen
EU = Eutrophication
FCB = Fecal Coliform Bacteria
NH3 -= Ammonia
pH = pH
Se = Selenium

H = High Priority

M = Medium Priority
L = Low Priority

Appendix C - County Maps with Watershed Boundaries

Figure 26 Atchison County



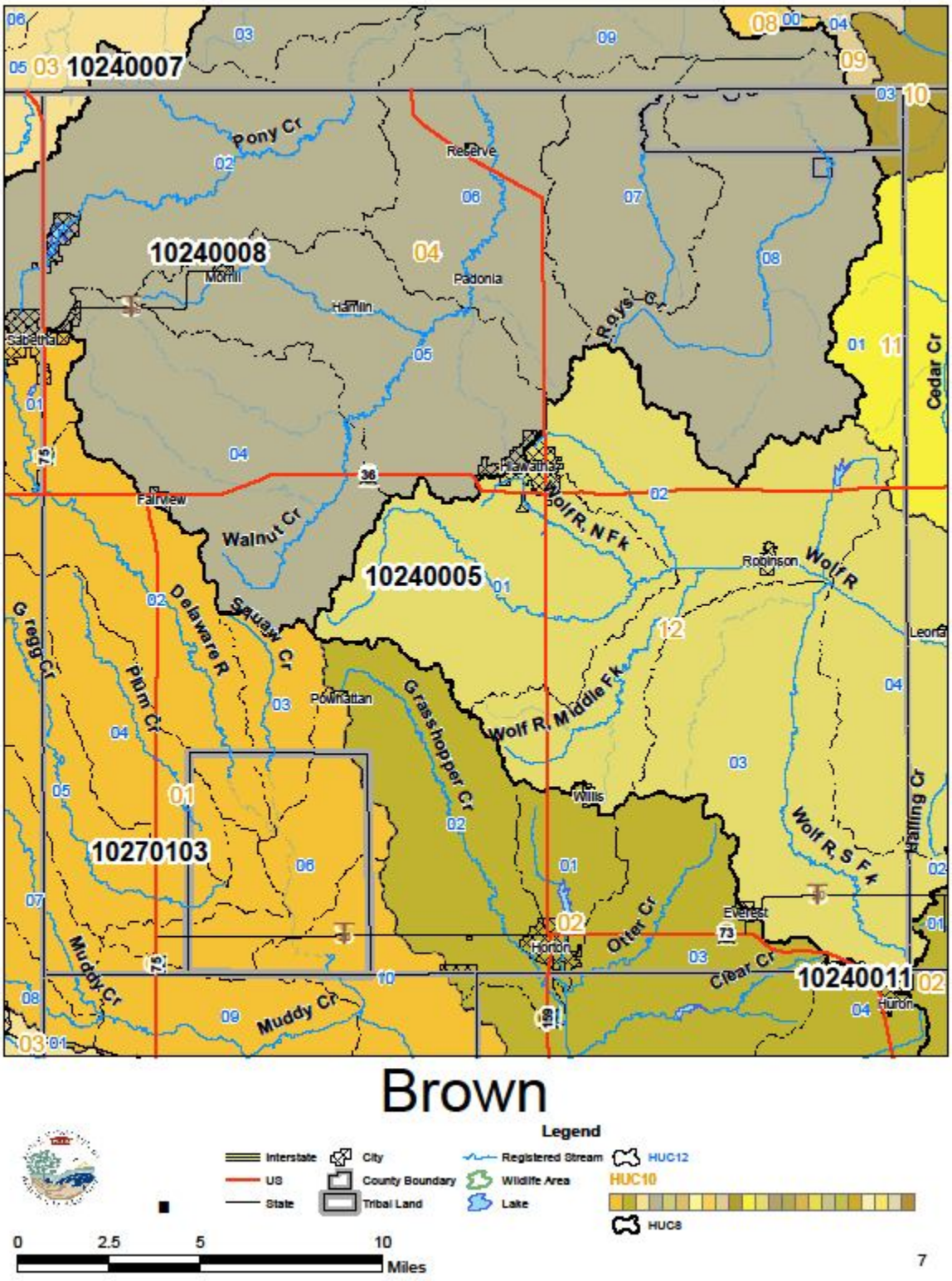


Figure 27 - Brown County

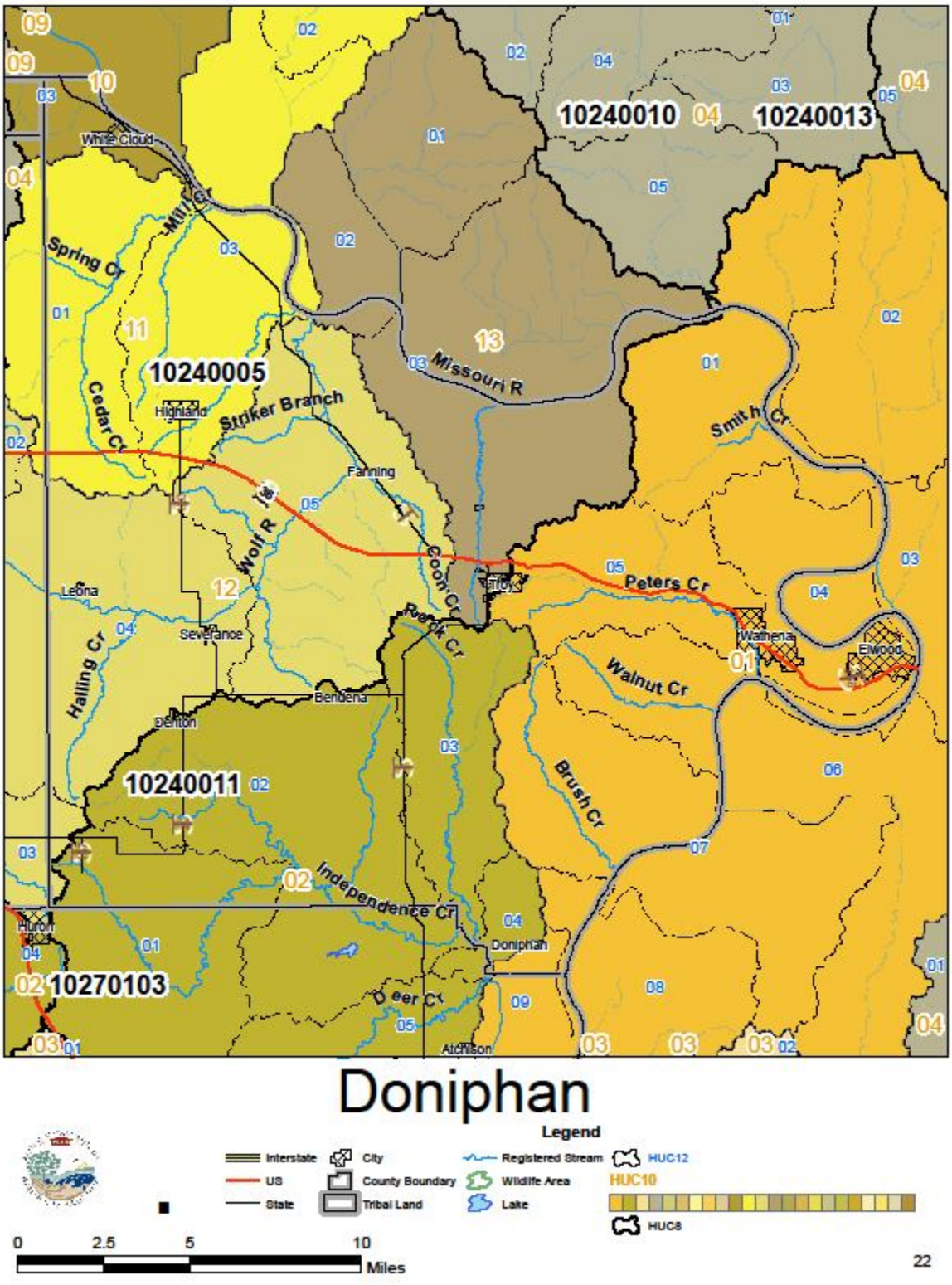


Figure 28 - Doniphan County

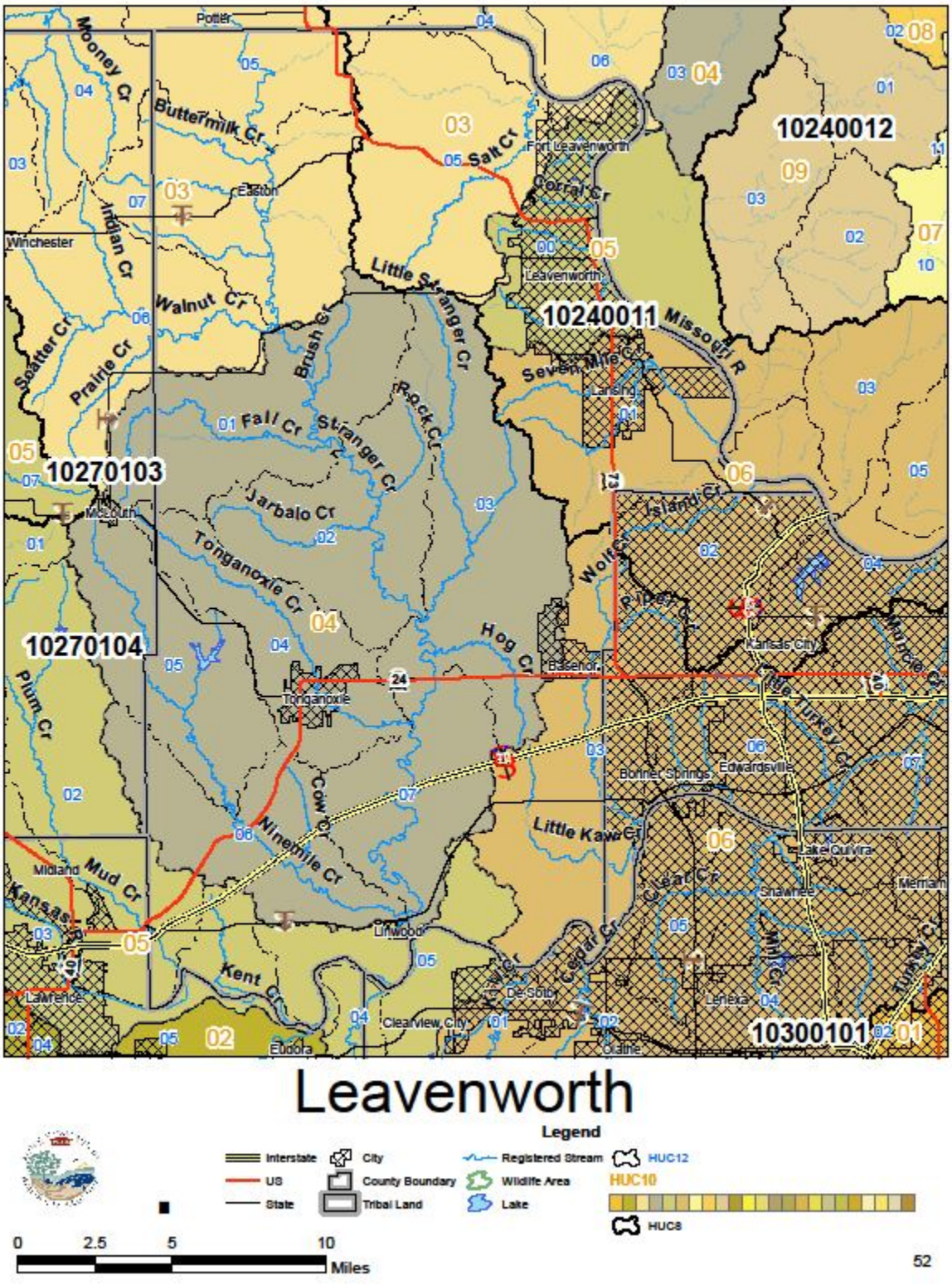


Figure 29 - Leavenworth County

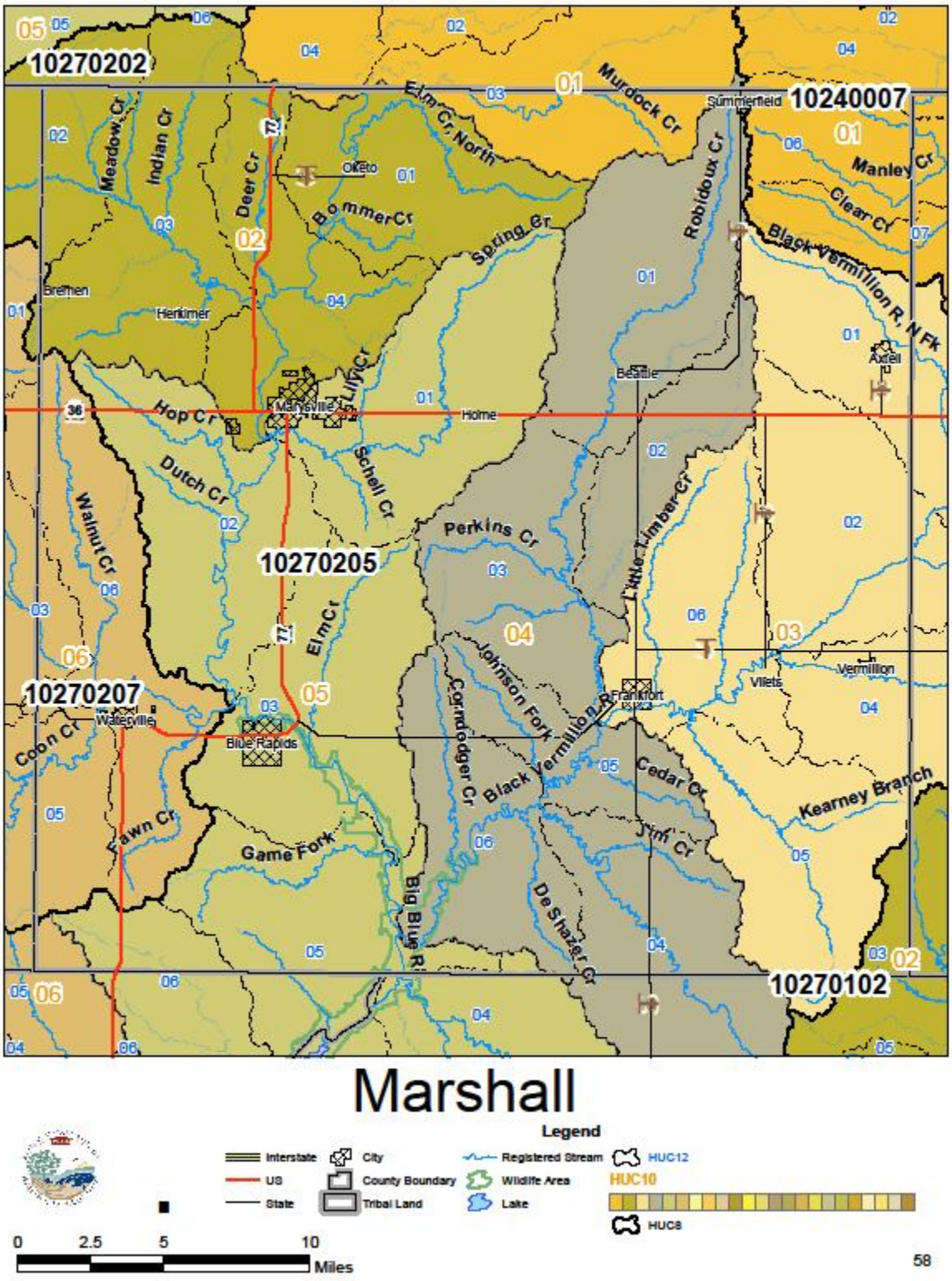


Figure 30 - Marshall County

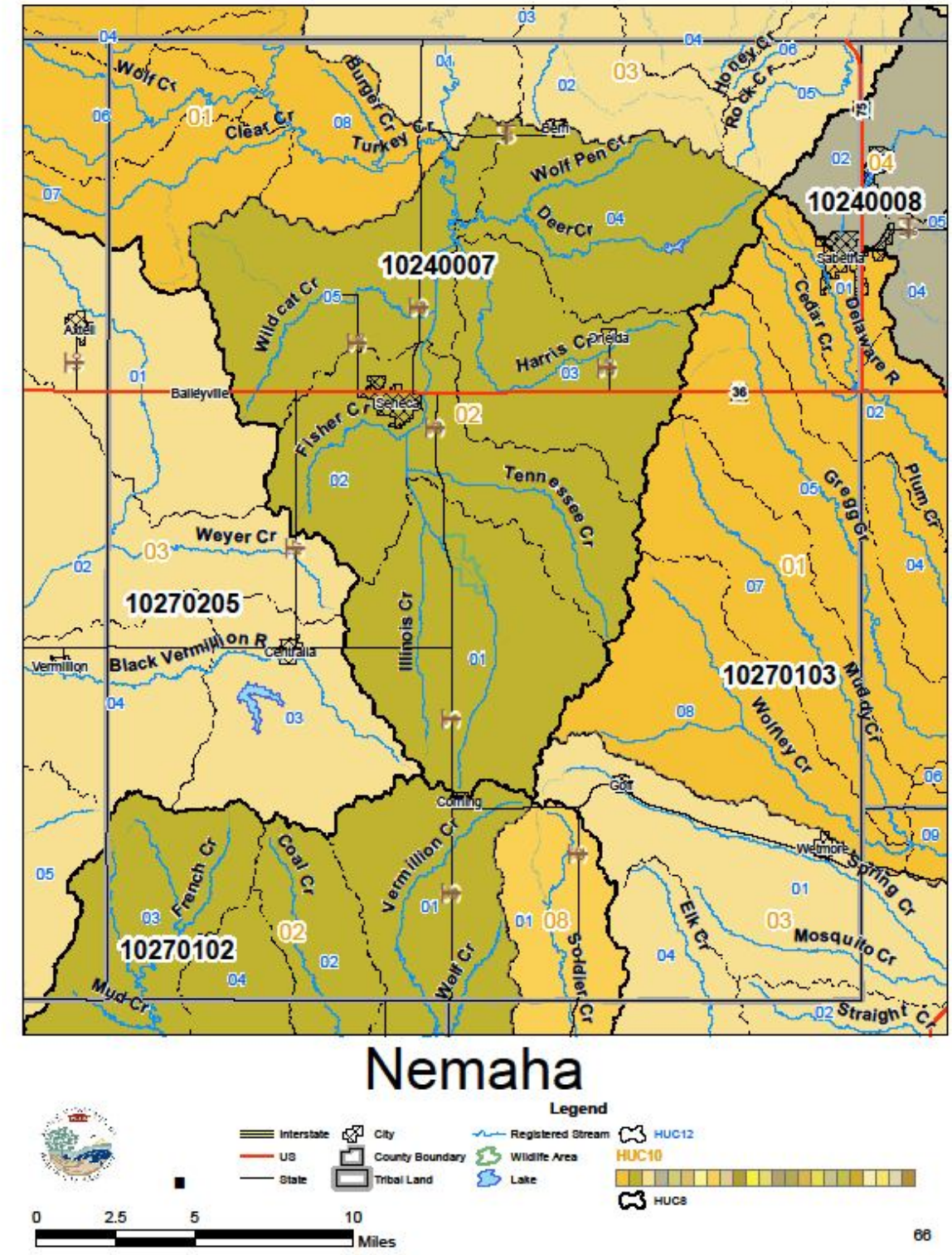


Figure 31 - Nemaha County

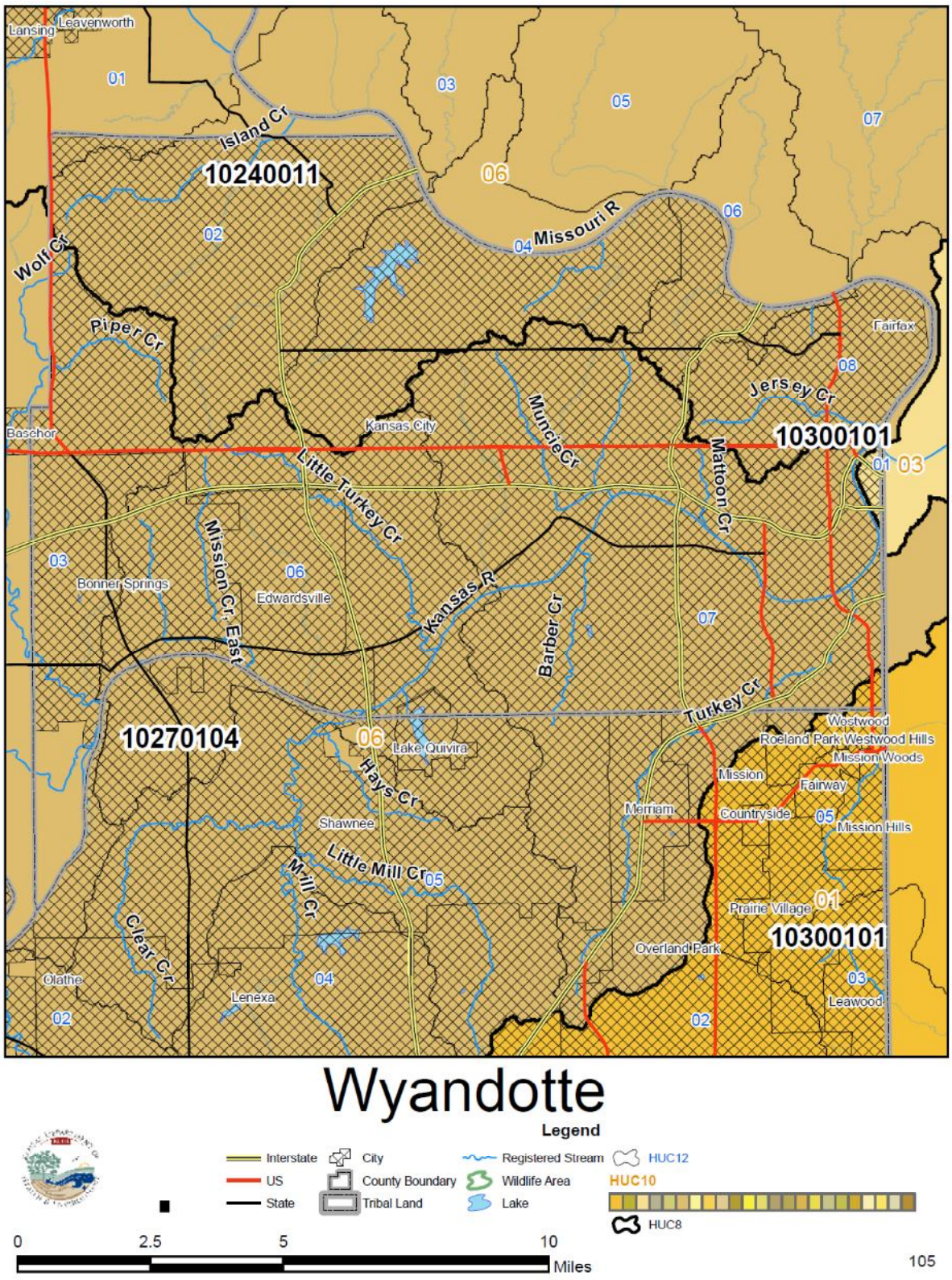


Figure 32 - Wyandotte County

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Appendix D - Missouri River Basin STPL Maps for Phosphorus, Nitrogen and Sediment

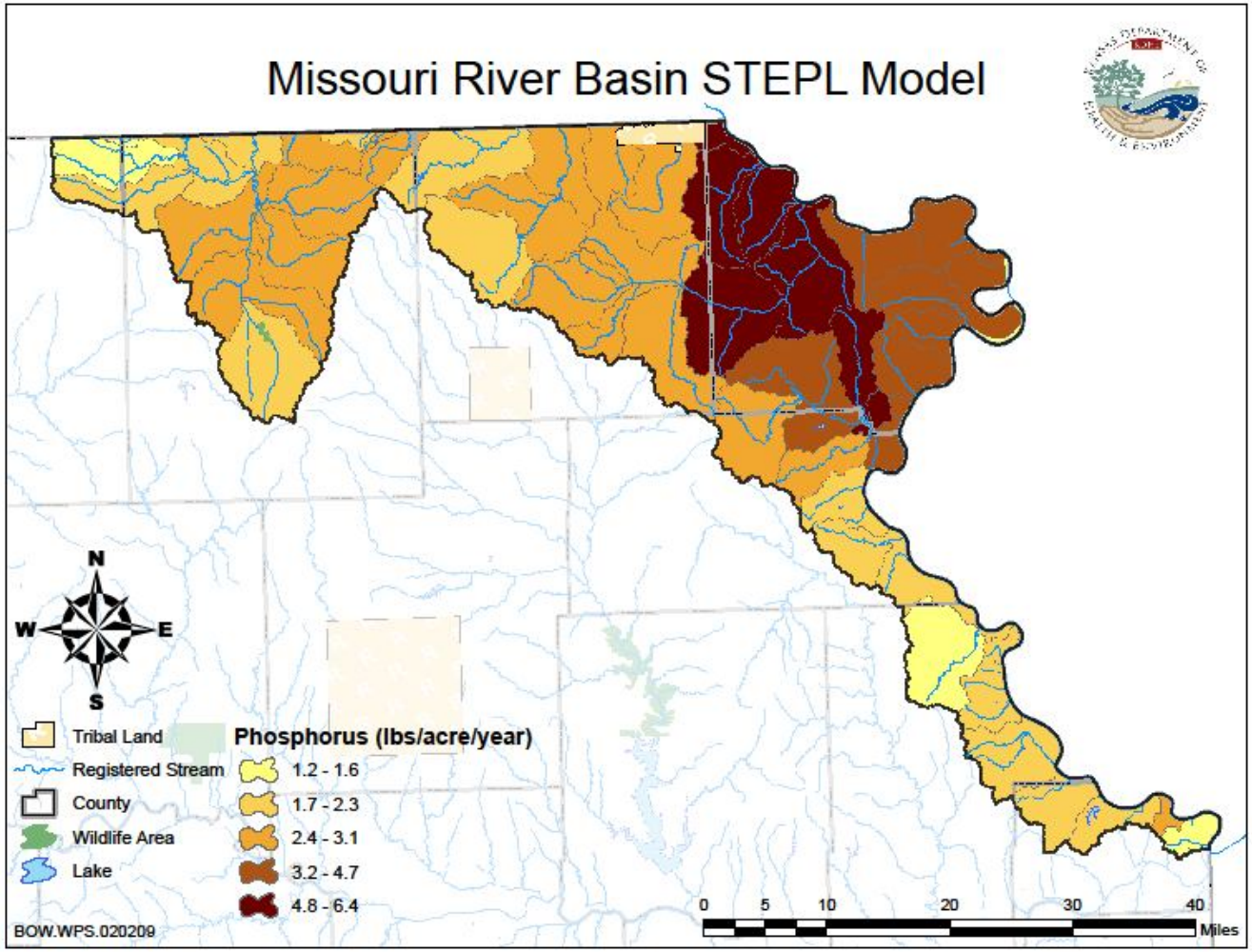

Figure 33 - STEPL Map - Phosphorus

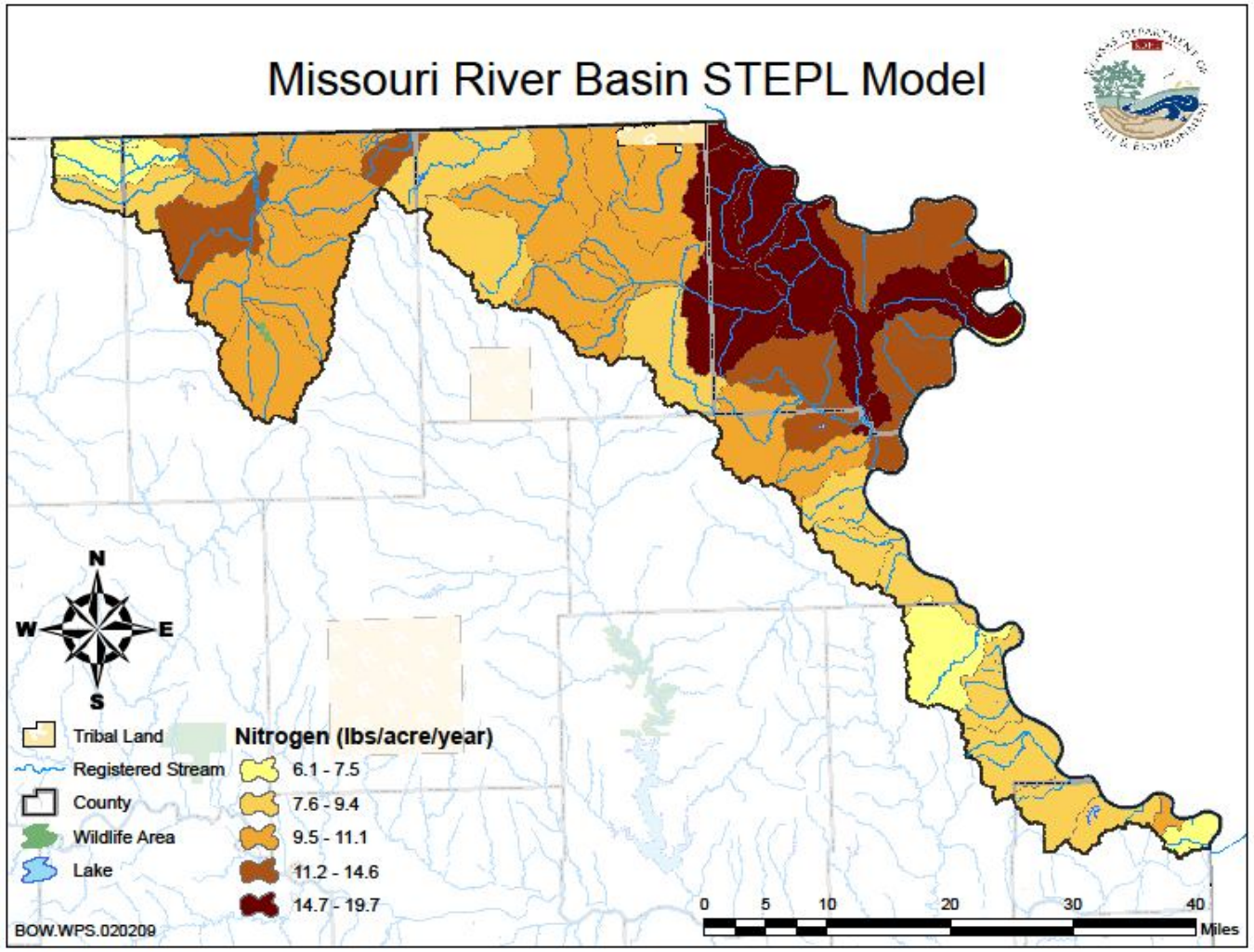

Figure 34 - STEPL Map Nitrogen

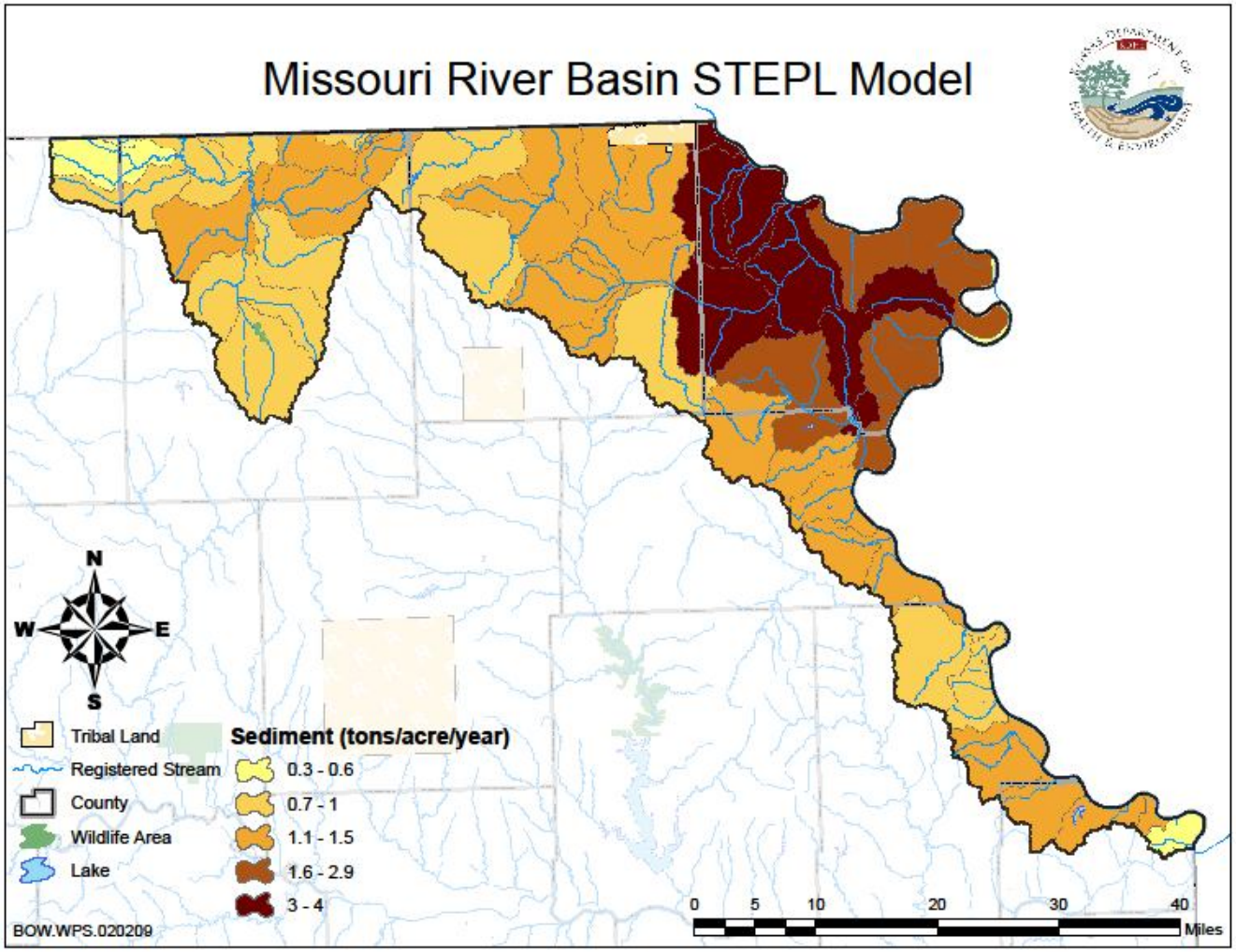

Figure 35 - STEPL Map - Sediment

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