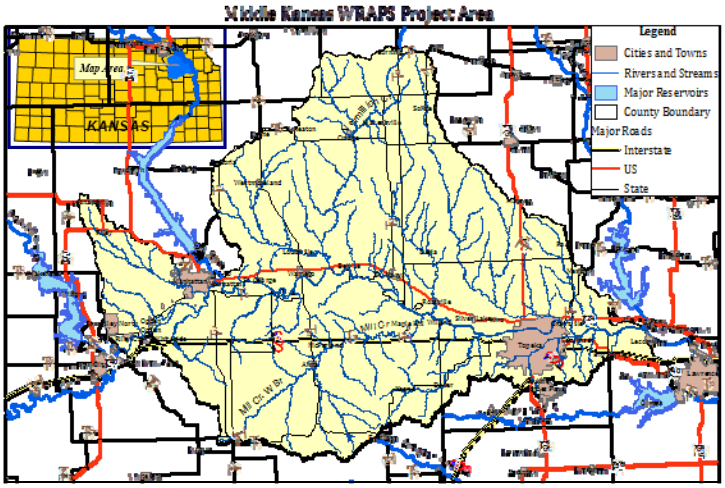
Middle Kansas WRAPS 9 Element Plan Overview

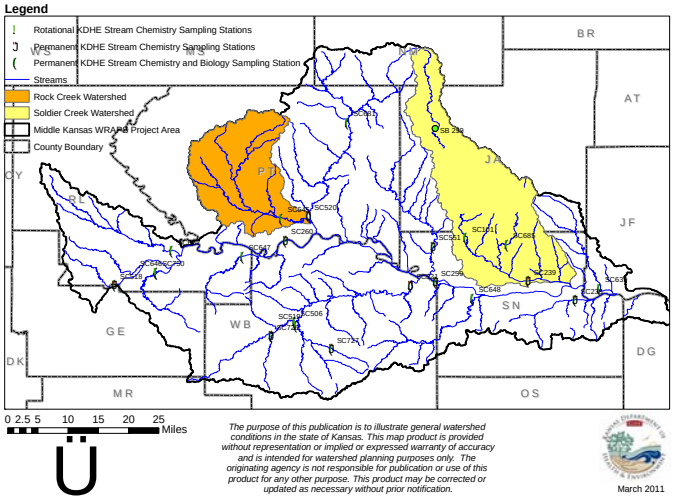
The overall goal of the Middle Kansas WRAPS 9 Element Plan is to provide a blueprint of protection and restoration strategies and activities to protect and restore surface waters in the Middle Kansas WRAPS Project Area.



The primary pollutant concern of this watershed's streams and rivers is bacteria, which is present in human and animal waste. Approximately 76% of the impaired stream/river segments within the Middle Kansas WRAPS are impaired by bacteria.

Bacteria are naturally occurring single celled microorganisms. There are numerous types of bacteria; some are good, while others are bad. Water supplies contaminated with manure contain *E-coli* and may have other disease–causing microorganisms such as *Crytosporidium* and *Giardia*.

Current KDHE Monitoring Stations in Middle Kansas WRAPS



Stream TMDLs within Middle Kansas WRAPS Project Area		
Water Segment	**TMDL Pollutant**	**Priority**
Kansas River at Topeka	Ammonia	High
Kansas River at Topeka	Fecal Coliform Bacteria	Medium
Kansas River below Topeka	Biology	Medium
Kansas River below Topeka	Fecal Coliform Bacteria	Medium
Kansas River near Wamego	Fecal Coliform Bacteria	Medium
Mill Creek	Fecal Coliform Bacteria	High
Upper Soldier Creek	Biology Sediment	High
Rock Creek	E.coli bacteria	High
Vermillion Creek	Fecal Coliform Bacteria	High
Wildcat Creek	Fecal Coliform Bacteria	High
Wildcat Creek	Fecal Coliform Bacteria	High

Impairments to be Addressed

- Bacteria on Rock Creek
- Biology on Upper Soldier Creek

Priority Areas for Rock Creek

- The priority areas for the Rock Creek Watershed include Upper Rock Creek, and Middle Rock Creek, which are depicted as the orange-colored watershed on the adjacent map.

Priority Areas for Upper Soldier Creek

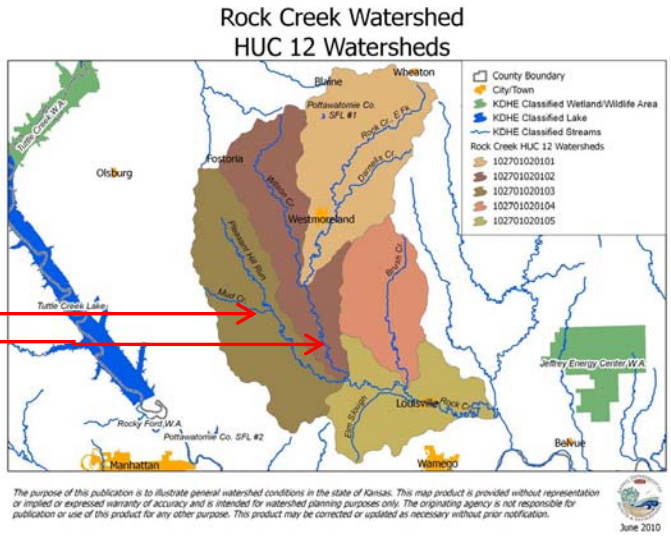
- The priority area for the Soldier Creek Watershed is depicted as the yellow-colored watershed on the adjacent map.

Best Management Practices and Load Reduction Goals

Best Management Practices (BMPs) to address bacteria, nutrients, and sediment in the watershed were chosen by the SLT based on local acceptance/adoption rate and amount of load reduction gained per dollar spent.

Bacteria /Phosphorus Reducing BMPs for the Rock Creek Watershed:

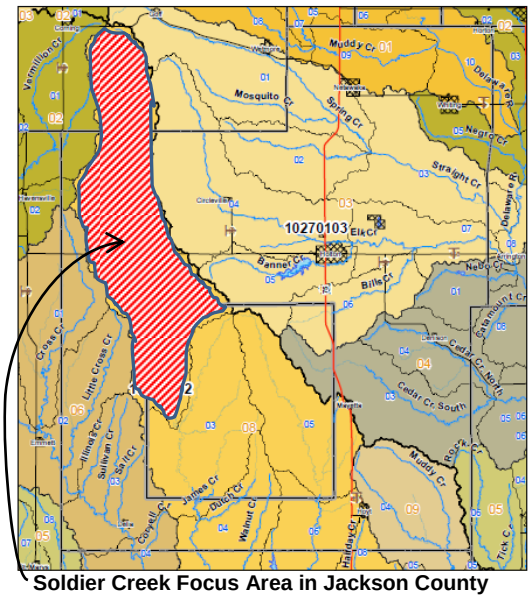
- Vegetative filter strip
- Relocate feeding sites
- Alternative (Off-Stream) watering system
- Relocate pasture feeding site
- Current Targeted HUC 12 Watersheds:
  Middle Rock Creek Watershed
  Upper Rock Creek Watershed



There is no bacteria load reduction calculation at this time. The SLT decided to use phosphorous load reduction instead. The assumption is that if you are reducing phosphorous, lowered bacteria counts should be evident in water quality samples. The annual reduction goal for phosphorous is 3,827 lbs. and will be implemented over a ten year time frame.

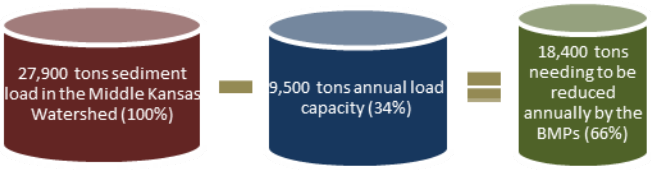
Biology Reducing BMPs for Upper Soldier Creek:

- Vegetative buffer
- Grassed waterway
- No-Till
- Terraces
- Wetland creation
- Streambank stabilization
- Sediment basin



Soldier Creek Focus Area in Jackson County

The current estimated sediment load from nonpoint sources in the Middle Kansas Watershed is 27,900 tons per year according to the TMDL section of KDHE. **The total annual load reduction allocated to Middle Kansas Watershed needed to meet the sediment TMDL is 18,400 tons of sediment**. This is the amount of sediment that needs to be removed from the watershed and is the target of the BMP installations that will be placed in the watershed. These BMPs have been determined as feasible and approved by the SLT.



September 28, 2011

Watershed Restoration and Protection Strategy
Middle Kansas Watershed
July 18, 2011

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1.0 Executive Summary

Watershed restoration and protection efforts are needed to address a variety of water resource concerns statewide 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 established a new way of approaching watershed issues for Kansas. The effort places emphasis on engaging watershed stakeholders in implementing a stakeholder developed action plan that achieves watershed goals established by the stakeholders themselves. This allows for an individualized 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 Middle Kansas WRAPS Project Area is composed of the Middle Kansas watershed and the northern portion of the Upper Kansas watershed. The goal of the Middle Kansas WRAPS is to provide a plan of restoration and protection goals and actions for the surface waters of the Kansas River and its tributaries. Watershed goals are characterized as "restoration" or "protection". Watershed restoration is for surface waters that do not meet water quality standards, and for areas of the watershed that need improvement in habitat, land management, or other attributes. Watershed protection is needed for surface waters that currently meet water quality standards, but are in need of protection from future degradation.

The Middle Kansas WRAPS project began when the Kansas Alliance for Wetlands and Streams (KAWS) was awarded a grant from the KDHE in 2006. A Coordinator for the Upper & Middle Kansas WRAPS project was hired in August of 2006 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 Middle Kansas watersheds met and began the process of identifying water-related issues in the basin in September, 2006. A diverse group of stakeholders became involved in the Middle Kansas 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 Middle Kansas WRAPS Stakeholder Leadership Team (SLT) evolved from a core group of meeting attendees. 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 determine priorities and provide direction to the project. The SLT is comprised of ten members, including the following representatives: public water supply, watershed district, conservation district, outreach/education, tribal, environmental at large/local health, fish, forestry & wildlife, local government, livestock production, crop production.

The Middle Kansas WRAPS has completed three of the four basic stages in the WRAPS process. The Development Stage included stakeholder recruitment, affirming an interest in continuing the project, and documenting stakeholder decisions. The Assessment Stage reviewed watershed conditions and identified watershed restoration and protection needs.

The Planning Phase established goals, actions needed to achieve goals, develop cost estimates, and identify stakeholder implementation strategies. The Middle Kansas WRAPS is ready to begin the Implementation Stage, which includes securing the resources needed to execute the plan, monitor and document progress, and revise the plan as needed.

In consultation with the KDHE – Watershed Management Section and the KDHE – TMDL Planning Section, the following stream TMDLs were agreed to be the focus of this plan:

1. Rock Creek – (Pending) Bacteria, Status: Active, targeted implementation.
2. Upper Soldier Creek – Biology, Status: Active, targeted implementation.

The following stream TMDLs are considered high priority to the SLT and the State of Kansas but are not a focus of the WRAPS for implementation at this time, but are currently being worked on by NRCS, SCC and other partners:

3. Shunganunga Creek- Bacteria, including Lake Shawnee for eutrophication
4. Upper Vermillion Creek – Bacteria
5. Kansas River at Wamego - Bacteria
6. Wildcat Creek - Bacteria

Rock Creek***** and Upper Soldier Creek will be the primary focus areas for WRAPS funding for the first 5 years of this plan.

Because the Middle Kansas has four additional high priority TMDLs of priority to the SLT and the State of Kansas, Shunganunga and Vermillion Creeks will become a priority focus area for BMP implementation once the Rock Creek TMDL has been achieved (in approximately 2015 and 2020 respectively). Once progress has been made towards achieving the Upper Soldier, Vermillion and Shunganunga Creek TMDLs, Kansas River at Wamego and Wildcat Creek will become priority areas of the plan (in approximately 2030 and 2035 respectively).

The overall goal of the Middle Kansas WRAPS 9 Element Plan is to provide a blueprint of protection and restoration strategies and activities to protect and restore surface waters in the Middle Kansas WRAPS project area. An additional goal is to address watershed issues identified by the Middle Kansas Stakeholder Leadership Team as resources allow. These issues, by priority, include: livestock management, source water protection, bacteria, tie – nutrient management & cropland, degraded streams and rivers, sediment/biology, water wells, urban areas, grazing lands, flooding, biological items of concern, water quantity, and eutrophication.

2.0 Kansas River Description

One of the most outstanding physical features in Northeast Kansas is the Kansas River. Beginning at the confluence of the Republican and Smoky Hill rivers, just east of the aptly-named Junction City (1030 ft.), the Kansas flows some 170 miles generally eastward to join the Missouri River at Kaw Point (730 ft) in Kansas City (Figure 1). The Kansas River valley is 138 miles long; the surplus length of the river is due to its meandering across the floodplain. This course roughly follows the maximum extent of the Kansan glaciation, and the river likely began as a path of glacial meltwater drain. Recreation along the Kansas River includes fishing, canoeing and kayaking, and rowing. There are 18 public access points along the river. The Friends of the Kaw organizes many float trips down the river each year (as well as cleanup efforts), and the Lawrence KOA rents canoes for self-guided trips. At least two rowing teams regularly use the river: The University of Kansas rowing team uses the pool above the Bowersock dam for their exercises, and the Kansas City Rowing Club rows in the final stretches of the river, near its mouth. (Wikipedia).

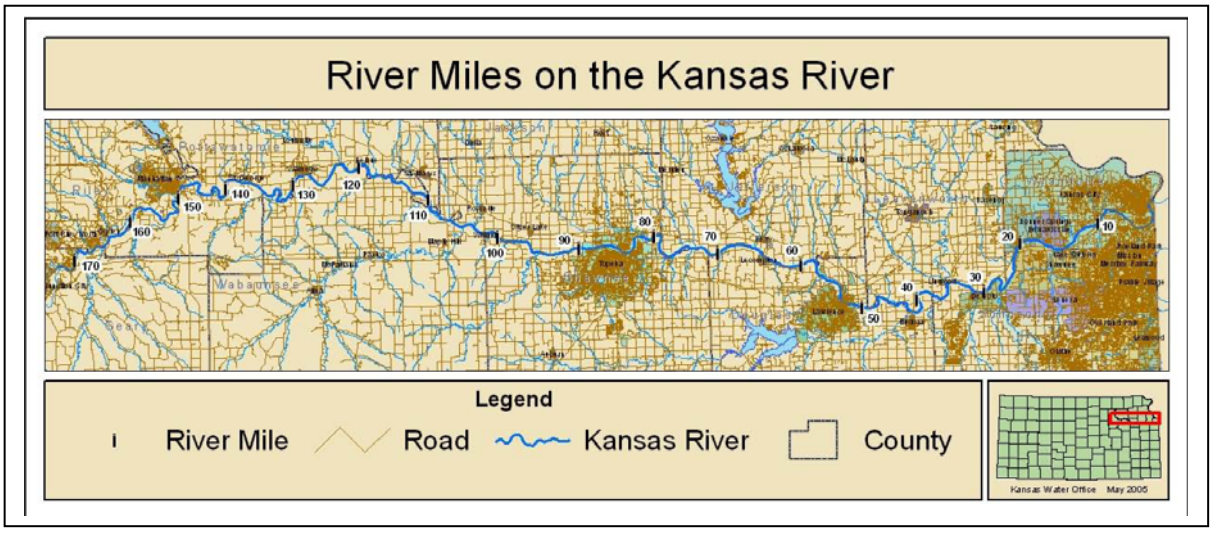


Figure 1: River Miles on the Kansas River

3.0 Watershed Description

Upper/Middle Kansas Watershed

The Middle Kansas (HUC 10270102) and the Upper Kansas (HUC 10270101) watersheds comprise an area of land approximately 2,825 square miles (1,818,303 acres) in size that drain a portion of northeast Kansas. HUCs (Hydrologic Unit Codes) are an identification system for watersheds. Each watershed has a defined HUC number in addition to a common name. HUC 8s can further be split into smaller watersheds and are given HUC 10 numbers. HUC 10s can be further divided into smaller HUC 12 watersheds. Figure 2 shows the Middle and Upper Kansas HUC 8s, 10s, and 12s.

The Middle Kansas Watershed includes parts of ten counties including Douglas, Geary, Jackson, Jefferson, Nemaha, Morris, Pottawatomie, Riley, Shawnee and Wabaunsee Counties. The Upper Kansas Watershed includes portions of four counties including Morris, Geary, Riley, and Wabaunsee. Currently, the Middle Kansas WRAPS is focused on the Middle Kansas watershed. The Upper Kansas contains the Wildcat Creek sub-watershed, but no water quality issues will be addressed specifically in this document. The Upper Kansas watershed also includes the Clark's Creek WRAPS project which is located in the lower portion of the watershed. This WRAPS group is currently working on the completion of a 9 Element Watershed Plan to address water quality issues including bacteria and rangeland management. Figure 2 shows both the Middle and Upper Kansas areas with Figure 3 showing the WRAPS project area. Figure 4 shows the HUC 12 watersheds in the Middle Kansas.

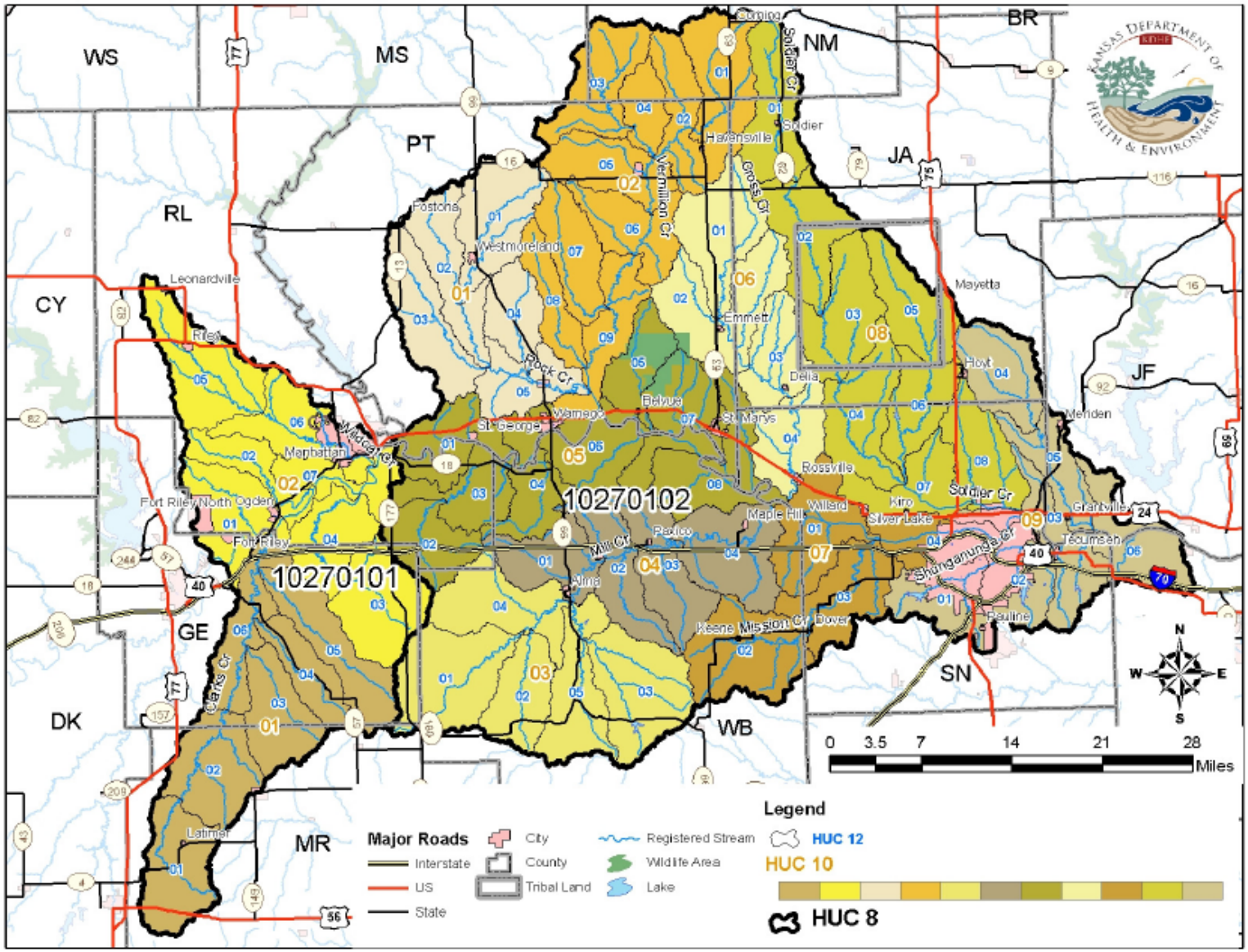


Figure 2: Middle and Upper Kansas HUC 8, 10, and 12 Watersheds

Middle Kansas WRAPS Project Area

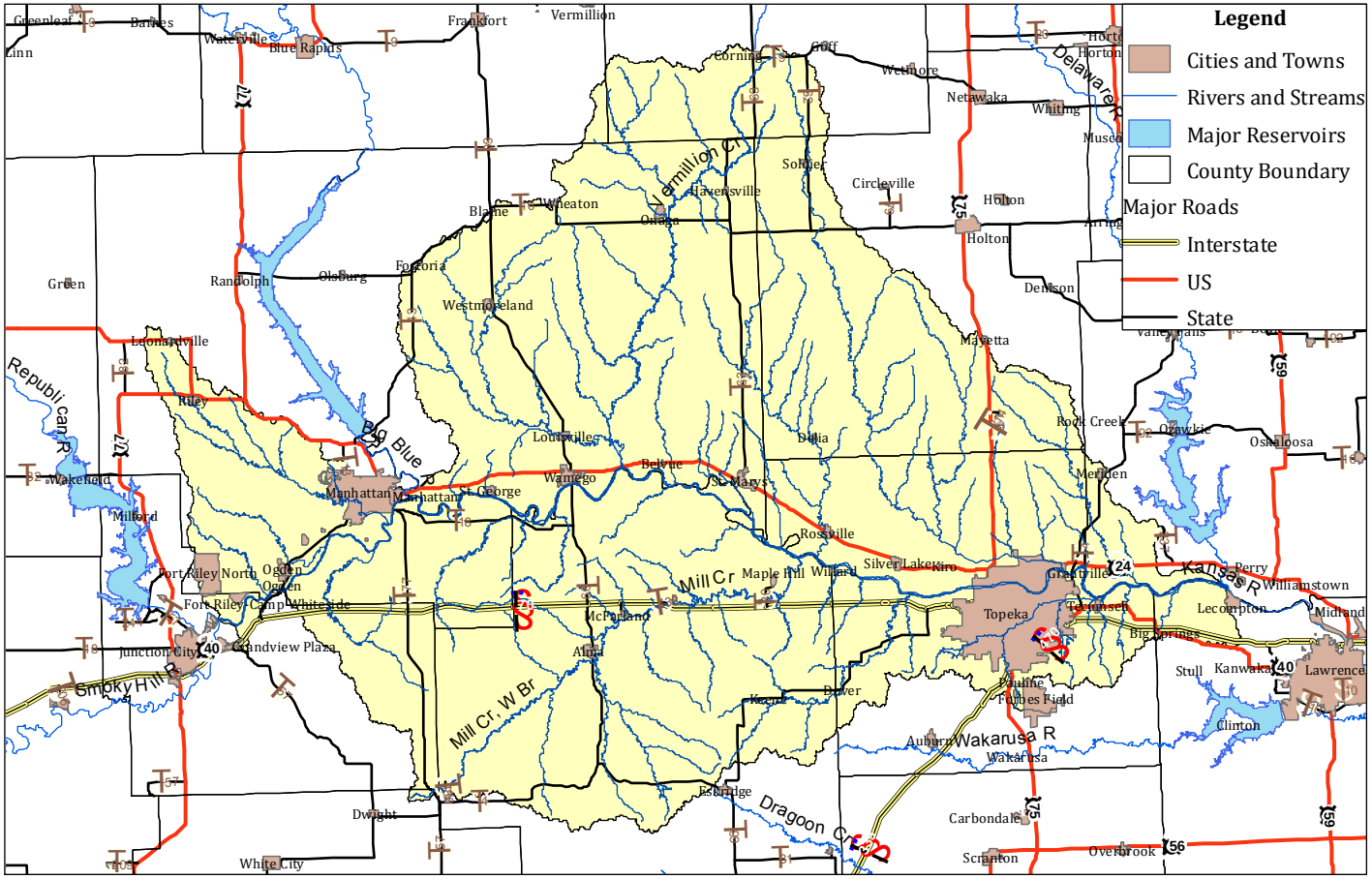


Figure 3: Middle Kansas WRAPS Project Area

Middle Kansas WRAPS
HUC 12 Watersheds

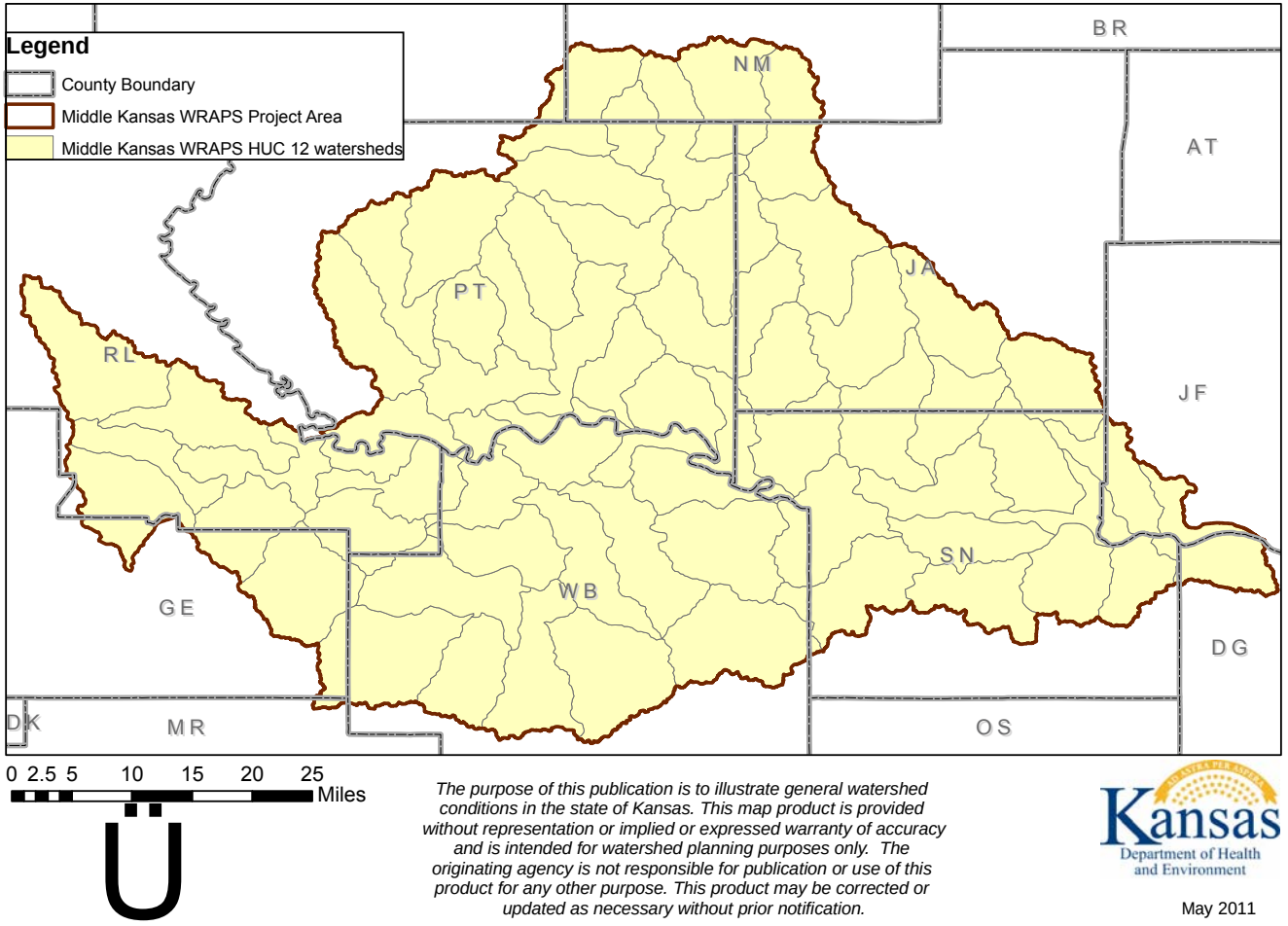


Figure 4: HUC 12's in Middle Kansas WRAPS Project Area

3.1 Land Cover Information

Land use activities can greatly affect the water quality in a watershed, and determine what pollutant concerns there are for that watershed. Grassland/ herbaceous cover, and pasture/hay constitute approximately 45% and 20% of the land cover in the Middle Kansas WRAPS. While quality grassland cover tends to enhance water quality, livestock activities in and near streams can result in high levels of *E. coli* bacteria. Cropland composes about 16% of the watershed. Poor cultivation practices can yield sediment, nutrients and pesticides. Without grass filters and stream buffers, farming to the edge of a streambank often compounds the impact to streams. Urban/developed land use constitutes nearly 8% of the land use in the watershed. Urban pollutants can include sediment from construction, excess applications of nutrients and pesticides, petroleum products and heavy metals from parking lots and streets. Land use activities in the Middle Kansas WRAPS are illustrated in Table 1 and Figure 5.

Table 1: Land Cover of the Middle Kansas WRAPS

Land Cover	Acres	Percent
Pasture/hay	304,654	36.8
Cultivated Crops	164,185	19.8
Deciduous Forest	141,582	17.1
Developed, Open Space	67,452	8.1
Developed, Low Intensity	56,795	6.9
Grassland/Herbaceous	40,794	4.9
Developed, Medium Intensity	18,366	2.2
Open Water	12,398	1.5
Developed, High Intensity	8,320	1.0
Wood Wetlands	6,275	0.8
Shrub/Scrub	2,313	0.3
Mixed Forest	2,085	0.3
Barren Land	1,961	0.2
Emergent Herbaceous	484	0.1
Evergreen Forest	185	0.0
Total	**827,850**	**100.0**

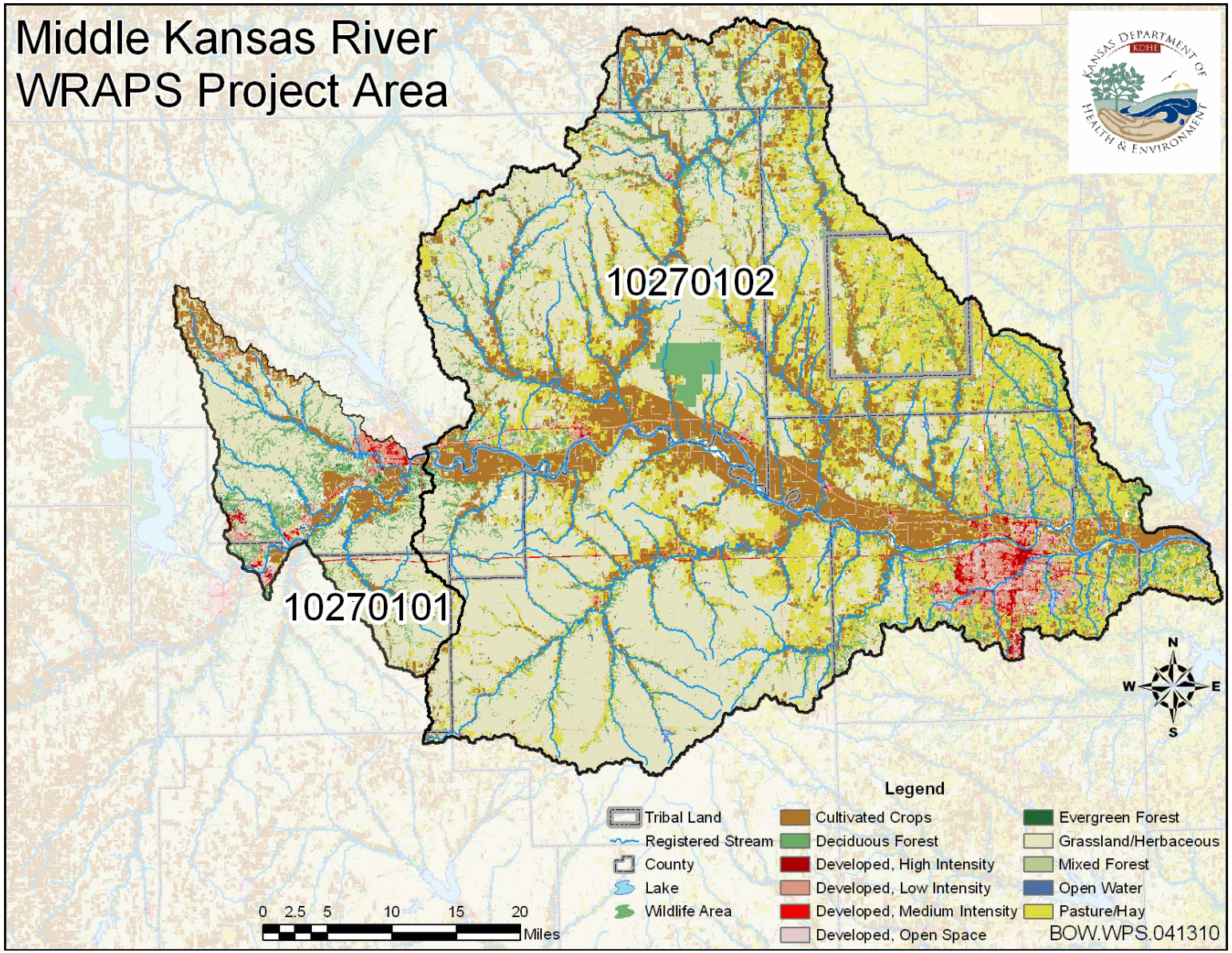


Figure 5: Land Cover of the Middle Kansas WRAPS Project Area

3.2 Agricultural Land Use in the Middle Kansas WRAPS

The most common crops planted in the Middle Kansas WRAPS include soybeans, corn, wheat, and grain sorghum. As shown in Table 2, in 2008, 366,800 acres of soybeans were reported planted in the nine counties in which the watershed is located. Corn was reported on 271,500 acres, wheat on 182,600 acres and grain sorghum on 51,700 acres [NASS, Kansas Farm Facts]. In 2005, hayland use included over 406,500 acres in the nine counties. In 2005, there were 443,600 cattle reported in the nine counties in the WRAPS project area. [NASS, Kansas Farm Facts].

Table 2: Acres of Crops, Hayland, and Livestock in Middle Kansas WRAPS Project Counties

County	Soybeans	Corn	Wheat	Grain Sorghum	Hayland (All)	Cattle (all categories)	Hogs * = 1998 ** = 1999 ***= 2000
Douglas	35,300	25,600	12,300	800	38,000	25,600	4,300***
Geary	13,600	6,700	13,900	4,700	19,200	17,600	24,000*
Jackson	38,200	27,600	11,300	2,700	60,000	51,700	2,400***
Jefferson	44, 500	37,300	6,200	1,500	47,500	39,700	3,400 ***
Nemaha	80,100	91,400	39,300	6,100	37,500	73,300	99,500***
Pottawatomie	33,800	32,900	14,000	4,500	53,400	75,100	30,500***
Riley	27,400	10,900	28,200	12,400	25,800	25,300	10,700*
Shawnee	34,200	31,900	9,600	3,400	31,700	20,400	1,800*
Wabaunsee	23,800	20,500	10,800	3,100	54,300	49,800	7,500***
Total	**366,800**	**271,500**	**182,600**	**51,700**	**406,500**	**443,600**	**186,000**

Source: National Agricultural Statistics Service, Kansas Farm Facts, 2008

Agricultural chemical use is widespread in the nine counties in which the Middle Kansas WRAPS is located (Table 3). According to the 2002 Census of Agriculture, 59% of the total land area in these counties received commercial fertilizer, lime and soil conditioner applications in 2002. A small percentage of the cropland in the nine counties, 2%, received manure applications. Insecticides were used on 6%, and herbicides were used on 41% of the total land area of the five counties.

Table 3: Fertilizer, Manure and Pesticide Application in the Middle Kansas WRAPS Project Counties

County	Total Commercial Fertilizer Use (acres)	Manure Application (acres)	Insecticide Application (acres)	Herbicide Application (acres)
Douglas	78,904	2,252	2,574	80,054
Geary	50,236	1,327	4313	34,018
Jackson	107,833	8,041	11,441	59,477
Jefferson	127,864	8,019	4,696	89,526
Nemaha	205,438	9,164	18,727	148,814
Pottawatomie	95,368	2,972	39,740	114,176
Riley	78,278	3,164	5,677	59,005
Shawnee	82,004	3,088	9,939	88,407
Wabaunsee	154,345	2,335	2,736	72,911
Total	**1,083,626**	**43,588**	**105,585**	**830,633**

Source: Kansas Department of Agriculture website, www.ksda.gov
2002 Census of Agriculture -County Data

3.3 Demographics

The total population of the nine counties in the Middle Kansas WRAPS has grown approximately 7% from 2000 - 2008 (Table 4). Douglas County (14.8 %), followed by Riley (12.9%) and Geary (11.9%) counties have experienced the most population growth. Shawnee County has the greatest density (309 persons/sq. mile) while Wabaunsee County has the least (8.6 persons/sq. mile).

Table 4: Population Statistics for Middle Kansas WRAPS Project Area Counties

County	Population 2000	Population 2008	Growth 2000 - 2008	Population density (persons/square mile)
Douglas	99,962	114,748	+14.8%	219
Geary	27,845	31,171	+11.9%	73
Jackson	12,655	13,240	+ 4.6%	19
Jefferson	18,426	18,421	0.0%	34
Nemaha	10,717	10,112	-2.6%	15
Pottawatomie	18,209	19,695	+8.2%	22
Riley	62,954	71,069	+12.9%	103
Shawnee	169,869	174,709	+2.8%	309
Wabaunsee	6,885	6,922	+0.5%	9
TOTAL	433,626	466,124	+7.0%	

Source: U.S. Census Bureau, 2000 and 2008 Census Figures

3.4 Public Water Supplies

There are 123 public water supplies within the Middle Kansas WRAPS, many of which draw water directly from the Kansas River. Groundwater wells, often in close proximity to streams, are also a source of drinking water. Both surface and groundwater are susceptible to nonpoint source pollution, including bacteria, nutrients and pesticides. Figure 6 illustrates the number and geographical distribution of public water supplies in the Middle Kansas WRAPS.

Potential sources of FCB contamination include feedlots, wastewater treatment facilities, septic systems, and wildlife. Potential sources of sediments include construction sites, stream bank erosion, and row crop agriculture. Potential sources of nutrients include row crop agriculture, urban/suburban runoff, registered feedlots, unregistered feedlots, wastewater treatment facilities, septic systems, and wildlife. Sources of ammonia include livestock, septic tanks, fertilizer, municipal and industrial waste.

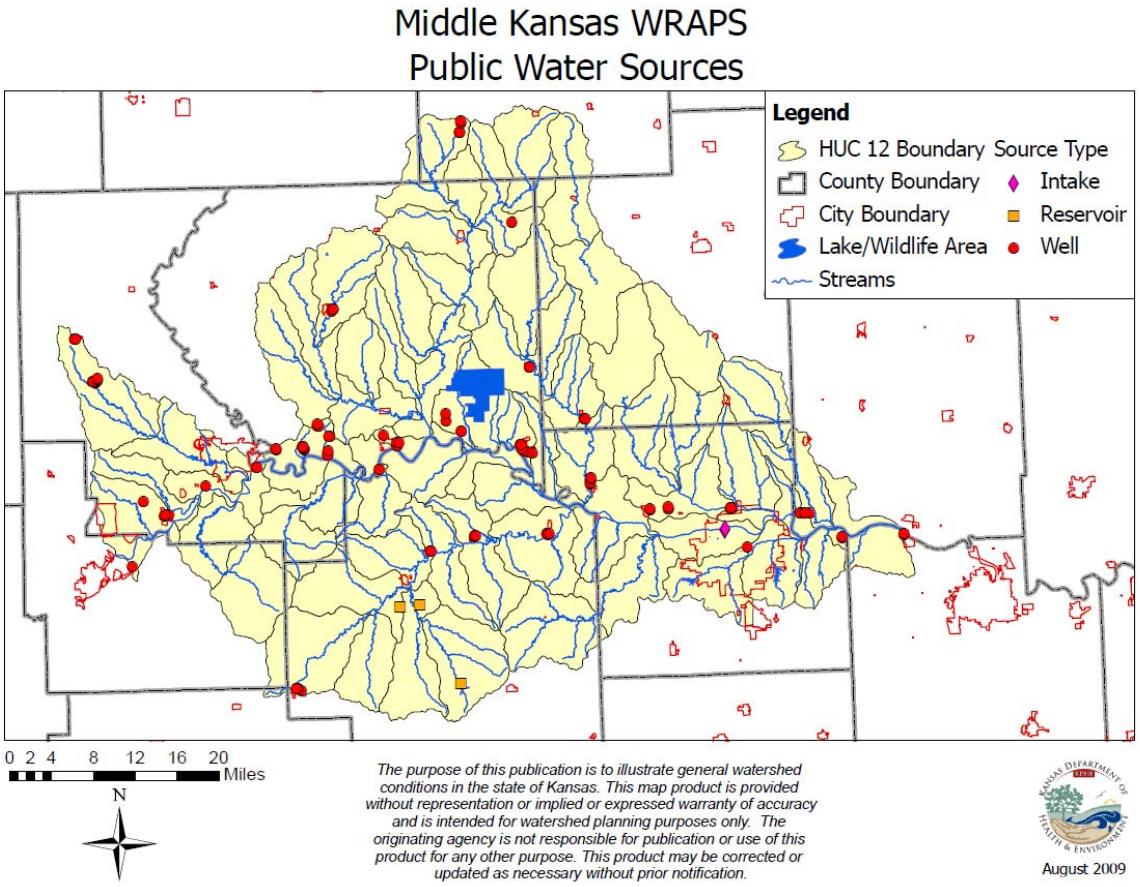


Figure 6: Middle Kansas Public Water Resources

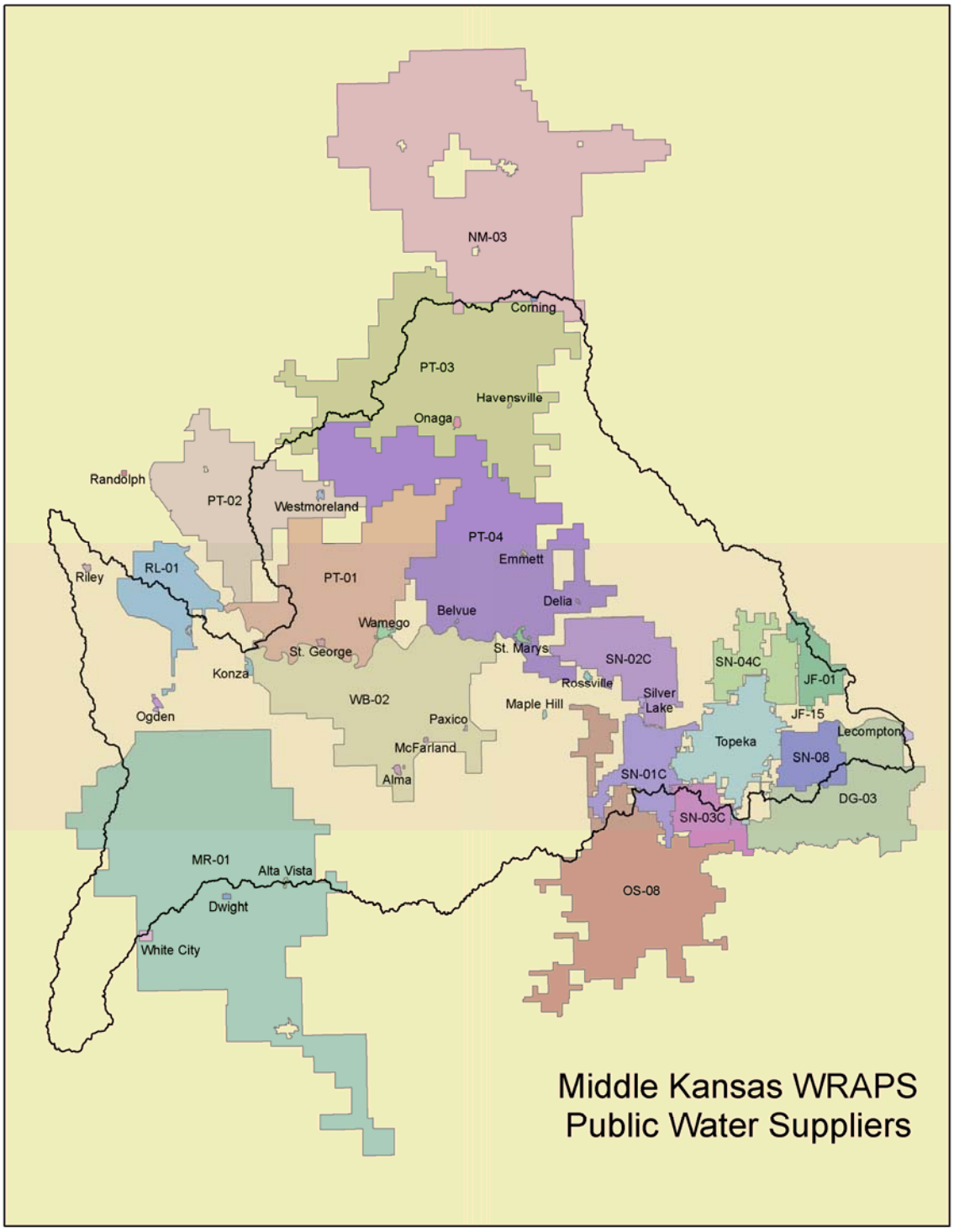


Figure 7: Middle Kansas Sub-Basin Public Water Suppliers
Note: The dark line depicts the boundaries of the WRAPS Project Area

Municipality	Water Rights	Source	County	Population Served
Middle Kansas (WRAPS)				
Nemaha County RWD No. 3	19420	Groundwater	Nemaha	1878
Nemaha County RWD No. 3	29961	Groundwater	Nemaha	
Nemaha County RWD No. 3	35359	Groundwater	Nemaha	
Nemaha County RWD No. 3	35360	Groundwater	Nemaha	
Nemaha County RWD No. 3	38415	Groundwater	Nemaha	
Nemaha County RWD No. 3	38416	Groundwater	Nemaha	
Nemaha County RWD No. 3	43230	Groundwater	Nemaha	
Nemaha County RWD No. 3	43231	Groundwater	Nemaha	
Nemaha County RWD No. 3	46818	Groundwater	Nemaha	
Nemaha County RWD No. 3	46819	Groundwater	Nemaha	
Nemaha County RWD No. 3	47192	Groundwater	Nemaha	
Pottawatomie County RWD No. 3	40017	Groundwater	Marshall	1436
Pottawatomie County RWD No. 3	40018	Groundwater	Marshall	
Pottawatomie County RWD No. 3	41838	Groundwater	Marshall	
Pottawatomie County RWD No. 3	45701	Groundwater	Marshall	
Pottawatomie County RWD No. 3	45702	Groundwater	Marshall	
Pottawatomie County RWD No. 3	45703	Groundwater	Marshall	
Pottawatomie County RWD No. 3	47294	Groundwater	Marshall	
Onaga	29763	Groundwater	Nemaha	704
Onaga	38829	Groundwater	Nemaha	
Pottawatomie County RWD No. 1 & 2	21099	Groundwater	Pottawatomie	4768
Pottawatomie County RWD No. 1 & 2	24224	Groundwater	Pottawatomie	
Pottawatomie County RWD No. 1 & 2	40510	Groundwater	Pottawatomie	
Pottawatomie County RWD No. 1 & 2	40511	Groundwater	Pottawatomie	
Pottawatomie County RWD No. 1 & 2	43757	Groundwater	Pottawatomie	
Pottawatomie County RWD No. 1 & 2	43758	Groundwater	Pottawatomie	
Pottawatomie County RWD No. 1 & 2	46635	Groundwater	Pottawatomie	
Westmoreland	PT-001	Groundwater	Pottawatomie	737
Westmoreland	29254	Groundwater	Pottawatomie	
Pottawatomie County RWD No. 4	42796	Groundwater	Pottawatomie	1298
Pottawatomie County RWD No. 4	42945	Groundwater	Pottawatomie	
Emmett	28573	Groundwater	Pottawatomie	190
Emmett	33584	Groundwater	Pottawatomie	
Emmett	44124	Groundwater	Pottawatomie	
Saint George	38090	Groundwater	Pottawatomie	525
Saint George	45523	Groundwater	Pottawatomie	
Saint George	45525	Groundwater	Pottawatomie	
Saint George	47215	Groundwater	Pottawatomie	
Saint George	47218	Groundwater	Pottawatomie	
Wamego	PT-002	Groundwater	Pottawatomie	4792
Wamego	1330	Groundwater	Pottawatomie	

Wamego	13629	Groundwater	Pottawatomie	
Wamego	33252	Groundwater	Pottawatomie	
Wamego	33807	Groundwater	Pottawatomie	
Wamego	35273	Groundwater	Pottawatomie	
Wamego	40597	Groundwater	Pottawatomie	
Wamego	42691	Groundwater	Pottawatomie	
Belvue	27394	Groundwater	Pottawatomie	199
Belvue	39995	Groundwater	Pottawatomie	
Saint Mary's	PT-005	Groundwater	Pottawatomie	2366
Saint Mary's	36844	Groundwater	Pottawatomie	
Saint Mary's	39396	Groundwater	Pottawatomie	
Saint Mary's	41018	Groundwater	Pottawatomie	
Saint Mary's	44379	Groundwater	Pottawatomie	
Wabaunsee County RWD No. 2	39807	Groundwater	Wabaunsee	1414
Wabaunsee County RWD No. 2	39808	Groundwater	Wabaunsee	
Wabaunsee County RWD No. 2	46641	Groundwater	Wabaunsee	
Shawnee County Cons. RWD No. 2	30411	Groundwater	Shawnee	1650
Shawnee County Cons. RWD No. 2	39302	Groundwater	Shawnee	
McFarland	35730	Groundwater	Wabaunsee	270
McFarland	43814	Groundwater	Wabaunsee	
Alma	12319	South Branch Mill Creek Trib 1 (Kansas)	Wabaunsee	900
Alma	33504	Mill Creek 1 Trib 1 (Kansas)	Wabaunsee	
Alma	35245	Mill Creek 1 Trib 1 (Kansas)	Wabaunsee	
Alma	40719	West Branch Mill Creek Trib 1	Wabaunsee	
Paxico	7862	Groundwater	Wabaunsee	240
Paxico	35961	Groundwater	Wabaunsee	
Paxico	35962	Groundwater	Wabaunsee	
Paxico	42640	Groundwater	Wabaunsee	
Rossville	8961	Groundwater	Shawnee	1100
Rossville	41394	Groundwater	Shawnee	
Silver Lake	20606	Groundwater	Shawnee	1460
Silver Lake	35674	Groundwater	Shawnee	
Silver Lake	41657	Groundwater	Shawnee	
Silver Lake	41658	Groundwater	Shawnee	
Shawnee County Cons. RWD No. 4	10185	Groundwater	Shawnee	10000
Shawnee County Cons. RWD No. 4	31501	Groundwater	Shawnee	

Shawnee County Cons. RWD No. 4	46601	Groundwater	Shawnee	
Shawnee County Cons. RWD No. 4	46602	Groundwater	Shawnee	
Shawnee County Cons. RWD No. 4	46603	Groundwater	Shawnee	
Jefferson County RWD No. 1	6536	Groundwater	Jefferson	2266
Jefferson County RWD No. 1	29577	Groundwater	Jefferson	
Jefferson County RWD No. 1	36770	Groundwater	Jefferson	
Jefferson County RWD No. 1	40532	Groundwater	Jefferson	
Jefferson County RWD No. 1	40533	Groundwater	Jefferson	
Jefferson County RWD No. 1	45439	Groundwater	Jefferson	
Jefferson County RWD No. 1	45440	Groundwater	Jefferson	
Jefferson County RWD No. 15	31602	Groundwater	Jefferson	225
Maple Hill	8543	Groundwater	Wabaunsee	525
Maple Hill	29337	Groundwater	Wabaunsee	
Maple Hill	36109	Groundwater	Wabaunsee	
Maple Hill	45063	Groundwater	Wabaunsee	
Maple Hill	45064	Groundwater	Wabaunsee	
Topeka	35712	Groundwater	Shawnee	130000
Topeka	35765	Groundwater	Shawnee	
Lecompton	32618	Groundwater	Douglas	650
Lecompton	44848	Groundwater	Douglas	
Alta Vista	38909	Groundwater	Wabaunsee	446
Alta Vista	38954	Groundwater	Wabaunsee	
Douglas County RWD No. 3	13729	Groundwater	Shawnee	4636
Douglas County RWD No. 3	22126	Groundwater	Shawnee	
Douglas County RWD No. 3	46404	Groundwater	Shawnee	
Konza valley Water Benefit District	31423	Groundwater	Riley	300
Ogden	RL-004	Groundwater	Riley	2324
Ogden	18454	Groundwater	Riley	
Randolph	9621	Groundwater	Riley	170
Riley	RL-002	Groundwater	Riley	950
Riley	9046	Groundwater	Riley	
Riley	33474	Groundwater	Riley	
Riley	46308	Groundwater	Riley	
Riley	46309	Groundwater	Riley	
University Park Water District	10455	Groundwater	Riley	250
			Total	**180981**
Below are the entities served by a Rural Water District (RWD)				
Corning is served by Nemaha County RWD No. 3				
Havensville is served by Pottawatomie County RWD No. 3				
Delia is served by Pottawatomie County RWD No. 4				

Municipality	Water Rights	Source	County	Population Served
Osage County RWD No. 8 is served by Topeka through Shawnee County Consolidated RWD No. 3				
Shawnee County Consolidated RWD Nos. 1, 3, & 8 are served by Topeka				
Riley County RWD No. 1 Purchases from Manhattan				

Table 5. Sub-Basin Public Water Suppliers - Population Served by Middle Kansas WRAPS Project Area

3.5 Designated Uses

According to the Kansas Surface Water Register, the rivers and streams in this area of Kansas are generally used to support aquatic life, recreation, food procurement, groundwater recharge, industrial water supply, irrigation water supply, livestock water supply, and domestic water supply.

The Middle Kansas (HUC 8 10270102) watershed is ranked fourth in priority for watershed restoration throughout the state. According to the Unified Watershed Assessment, approximately 52% percent of the total miles of water in the Middle Kansas do not meet their designated uses. The Upper Kansas (HUC 8 10270101) watershed is ranked twenty-second in priority for watershed restoration throughout the state. According to the Unified Watershed Assessment, approximately 80% percent of the total miles of water in this watershed do not meet their designated uses. The designated uses of a stream have associated water quality standards. A copy of the current Kansas Water Quality Standards and Supporting Documents can be downloaded at www.kdheks.gov/water/download/kwqs_plus_supporting.pdf

Table 6: Designated Uses for Middle Kansas WRAPS Rivers and Streams

STREAMS	Class	AL	CR	DS	FP	GR	IW	IR	LW
Adams Cr	GP	E	b	X	O	X	X	X	X
Antelope Cr	GP	E	C	X	O	X	X	X	X
Bartlett Cr	GP	E	b	X	O	X	X	X	X
Big Elm Cr	GP	E	b	O	O	O	O	O	O
Blackjack Cr	GP	E	b	X	O	X	X	X	X
Blacksmith Cr	GP	E	b	X	O	X	X	X	X
Bourbonais Cr	GP	E	C	X	O	X	X	X	X
Brush Cr	GP	E	C	X	X	X	X	X	X
Coal Cr	GP	E	b	X	O	X	X	X	X
Coryell Cr	GP	E	b	O	X	O	O	O	X
Cow Cr	GP	E	b	O	O	X	O	O	O
Cross Cr	GP	E	C	X	X	X	X	X	X
Darnells Cr	GP	E	b	X	X	X	X	X	X
Deep Cr	EX	S	B	X	X	X	X	X	X
Deep Cr	GP	E	C	X	X	X	X	X	X
Deep Cr, E Br	GP	E	b	X	O	X	X	X	X
Deer Cr	GP	E	B	X	X	X	X	X	X
Dog Cr	GP	E	b	X	O	X	X	X	X
Doyle Cr	GP	E	C	X	O	X	X	X	X
Dry Cr	GP	S	C	X	O	X	X	X	X
Dutch Cr	GP	E	b	O	X	O	O	X	X
Elm Cr	GP	E	C	O	O	O	O	O	X
Elm Cr	GP	E	b	O	O	X	O	X	X
Elm Slough	GP	E	b	O	O	X	O	X	X
Emmons Cr	GP	E	b	O	O	O	O	X	X
French Cr	GP	E	C	X	X	X	X	X	X
Gilson Cr	GP	E	b	X	O	X	X	X	X
Halfday Cr	GP	E	C	X	X	X	X	X	X
Hendricks Cr	GP	S	C	X	O	X	X	X	X
Hise Cr	GP	E	b	X	O	X	X	X	X
Illinois Cr	EX	S	C	X	X	X	X	X	X
Illinois Cr	GP	E	b	X	X	X	X	X	X
Indian Cr	GP	E	b	X	X	X	X	X	X
Indian Cr	GP	E	a	X	O	X	X	X	X
James Cr	GP	E	b	X	O	X	X	X	X
Jim Cr	GP	E	b	X	X	X	X	X	X
Johnson Cr	GP	E	b	O	O	O	O	X	X
Kansas R	GP	S	B	X	X	X	X	X	X
Kansas R	GP	S	B	X	X	X	X	X	X
Kansas R	GP	S	B	X	X	X	X	X	X
Kansas R	GP	S	B	X	X	X	X	X	X

Kansas R	GP	S	B	X	X	X	X	X	X
Kansas R	GP	S	B	X	X	X	X	X	X
Kansas R	GP	S	B	X	X	X	X	X	X
Kansas R	GP	S	B	X	X	X	X	X	X
Kansas R	GP	S	B	X	X	X	X	X	X
Kuenzli Cr	GP	S	b	X	X	X	X	X	X
Little Cross Cr	GP	E	b	X	X	X	X	X	X
Little Muddy Cr	GP	E	C	X	O	X	X	X	X
Little Soldier Cr	GP	E	C	X	X	X	X	X	X
Little Soldier Cr	GP	E	b	X	X	X	X	X	X
Loire Cr	GP	S	C	X	O	X	X	X	X
Lost Cr	GP	E	B	X	X	X	X	X	X
Messhoss Cr	GP	E	C	X	O	X	X	X	X
Mill Cr	EX	S	C	X	X	X	X	X	X
Mill Cr, E Br	EX	S	C	X	X	X	X	X	X
Mill Cr, E Br	EX	S	C	X	X	X	X	X	X
Mill Cr, S Br	GP	S	b	X	X	X	X	X	X
Mill Cr, W Br	EX	S	C	X	X	X	X	X	X
Mill Cr, W Br	EX	S	b	X	X	X	X	X	X
Mission Cr	GP	S	b	X	X	X	X	X	X
Mission Cr	GP	S	B	X	X	X	X	X	X
Mission Cr	GP	S	C	X	X	X	X	X	X
Mission Cr, N Br	GP	E	C	X	O	X	X	X	X
Mission Cr, S Br	GP	E	b	X	O	X	X	X	X
Mud Cr	GP	E	b	O	X	O	O	O	X
Mud Cr	GP	E	b	X	O	X	X	X	X
Muddy Cr	GP	E	C	X	X	X	X	X	X
Muddy Cr, W Fk	GP	E	b	X	O	X	X	X	X
Mulberry Cr	GP	E	b	X	X	X	X	X	X
Mulberry Cr	GP	S	b	X	X	X	X	X	X
Nehring Cr	GP	S	C	X	X	X	X	X	X
Paw Paw Cr	GP	S	b	X	O	X	X	X	X
Pleasant Hill Run	GP	E	C	X	X	X	X	X	X
Pomeroy Cr	GP	E	b	X	O	X	X	X	X
Post Cr	GP	E	b	X	X	X	X	X	X
Pretty Cr	GP	S	b	X	O	X	X	X	X
Riley Cr	GP	E	C	O	O	X	O	X	X
Rock Cr	GP	E	C	X	X	X	X	X	X
Rock Cr, E Fk	GP	E	b	X	X	X	X	X	X
Ross Cr	GP	S	b	X	X	X	X	X	X
Salt Cr	GP	E	b	X	O	X	X	X	X
Sand Cr	GP	E	b	O	O	X	O	X	X
Shunganunga Cr	GP	E	B	X	O	X	X	X	X
Shunganunga Cr	GP	E	B	X	X	X	X	X	X
Shunganunga Cr, S Br	GP	E	B	X	O	X	X	X	X

Snake Cr	GP	E	b	X	X	X	X	X	X
Snokomo Cr	GP	S	b	X	O	X	X	X	X
Soldier Cr	GP	E	B	X	X	X	X	X	X
Soldier Cr	GP	E	C	X	X	X	X	X	X
Soldier Cr	GP	E	C	X	X	X	X	X	X
Spring Cr	GP	E	b	X	O	X	X	X	X
Spring Cr	GP	E	C	X	X	X	X	X	X
Spring Cr	GP	S	b	O	O	X	O	O	X
Spring Cr	GP	E	b	X	O	X	X	X	X
Stinson Cr	GP	E	b	X	O	X	X	X	X
Sullivan Cr	GP	E	C	X	O	X	X	X	X
Tecumseh Cr	GP	E	b	X	X	X	X	X	X
Turkey Cr	GP	E	C	O	O	X	O	X	X
Unnamed Stream	GP	E	b	O	X	O	O	O	O
Unnamed Stream	EX	S	C	X	X	X	X	X	X
Unnamed Stream	GP	E	a	X	O	X	X	X	X
Unnamed Stream	GP	E	b	O	O	O	O	O	O
Vassar Cr	GP	E	b	X	O	X	X	X	X
Vermillion Cr	GP	E	C	X	X	X	X	X	X
Vermillion Cr	GP	E	C	X	X	X	X	X	X
Vermillion Cr	GP	E	C	X	X	X	X	X	X
Vermillion Cr	GP	E	b	X	X	X	X	X	X
Walnut Cr	GP	E	b	X	O	X	X	X	X
Wells Cr	GP	E	b	O	O	X	O	X	X
Whetstone Cr	GP	E	b	X	X	X	X	X	X
Wilson Cr	GP	E	C	O	X	X	X	X	X
Wolf Cr	GP	E	C	X	O	X	X	X	X

AL = Aquatic Life Support
CR = Contact Recreation
DS = Domestic Water Supply
FP = Food Procurement
GR = Groundwater Recharge
IW = Industrial Water Supply
IR = Irrigation Water Supply
LW = Livestock Water Supply

E = Expected Aquatic Life Use Water
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.
b = Secondary contact recreation stream segment is not open to and accessible by the public under Kansas law
O = Registered stream segment does not support the indicated designated use
X = Referenced stream segment is assigned the indicated designated use
Source: KDHE-BEFS, Kansas Surface Register, February 12, 2009

When water quality standards associated with designated uses are not met

through water samples taken by KDHE, a list of impaired waters is developed biennially and is referred to as the 303d list. There are a number of streams within the Middle Kansas WRAPS on the 2010 303d list. These are included in Table 6.

According to the Surface Water Register, the majority of the lakes in this watershed are designated for expected aquatic life use, food procurement, contact recreation and domestic water supply.

Table 7: Designated Uses for Middle Kansas WRAPS Lakes

LAKES	Class	AL	CR	DS	FP	GR	IW	IR	LW
Alma City Lake	GP	E	B	X	X	X	X	X	X
Cedar Crest Lake	GP	E	B	X	X	O	X	X	X
Central Park Lake	GP	E	B	X	X	O	X	X	X
Dornwood Park Lake	GP	E	B	O	X	O	O	O	O
Gage Park Lake	GP	E	B	X	X	O	X	X	X
Jeffrey Energy Center W.A.	GP	E	B	X	X	O	X	X	X
Lake Jivaro	GP	E	A	X	X	O	X	X	X
Lake Shawnee	GP	E	A	X	X	X	X	X	X
Lake Sherwood	GP	E	A	X	X	O	X	X	X
Myer's Lake	GP	E	B	X	X	O	X	X	X
Pillsbury Crossing W.A.	GP	E	B	X	X	X	X	X	X
Pottawatomie Co. SFL #1	GP	E	B	X	X	O	X	X	X
Shawnee Co. SFL	GP	E	B	X	X	O	X	X	X
Topeka Public Golf Course Lake	GP	E	B	X	X	O	X	X	X
Wabaunsee Co. Lake	GP	E	A	X	X		X		
Wamego City Lake	GP	E	B	X	X	X	X	X	X
Warren Park Lake	GP	E	B	X	X	O	X	X	X

Washburn Rural Environmental Lab Lake	GP	E	B	X	X	O	X	X	X

AL = Aquatic Life Support
CR = Contact Recreation
DS = Domestic Water Supply
FP = Food Procurement
GR = Groundwater Recharge
IW = Industrial Water Supply
IR = Irrigation Water Supply
LW = Livestock Water Supply

E = Expected Aquatic Life Use Water
A = Primary contact recreation lakes that have a posted 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.
b = Secondary contact recreation stream segment is not open to and accessible by the public under Kansas law
O = Referenced lake does not support the designated use.
X = Referenced stream segment is assigned the indicated designated use
blank = capacity of the referenced lake to support the indicated designated use has not been determined by use attainability analysis.

Source: KDHE-BEFS, Kansas Surface Register, February 12, 2009

3.6 Special Aquatic Life Streams and Exceptional Waters

Special aquatic life use waters are defined as “surface waters that contain combinations of habitat types and indigenous biota not found commonly in the state, or surface waters that contain representative populations of threatened or endangered species include the Kansas River, Deep Creek, Illinois Creek, South and East Branches of Mill Creek, Mill Creek, Little Arkansas Creek, Wildcat Creek, Sevenmile Creek, Mission Creek, Ross Creek, Hendricks Creek, Pretty Creek, and an unnamed stream. Special aquatic life streams in the Middle Kansas are depicted in Figure 8 and Table 8.

Table 8: Special Aquatic Life Use Streams for the Middle Kansas WRAPS Project Area

HUC 8	River Name
10270101	Little Arkansas Cr
10270101	Wildcat Cr
10270101	Sevenmile Cr
10270101	Kansas R
10270102	Deep Cr
10270102	Mill Cr
10270102	Mill Cr, W Br
10270102	Illinois Cr
10270102	Mill Cr, E Br
10270102	Mill Cr, S Br
10270102	Mission Cr
10270102	Ross Cr
10270102	Unnamed Stream
10270102	Hendricks Cr
10270102	Pretty Cr

Exceptional state waters refers to any surface waters or surface water segments that are of remarkable quality or of significant recreational or ecological value. Exceptional streams in the Middle Kansas WRAPS include Deep Creek, Illinois Creek, East and West Branches of Mill Creek and Mill Creek. Exceptional streams in the Middle Kansas are depicted in Figure 9. Potential pollutants impacting special aquatic use along the Kansas River include row crop production, and municipal/industrial effluent. Streambank erosion is often associated with poor cultivation practices or a lack of permanent vegetation adjacent a stream. Pollutants in tributaries draining into the Kansas River also contain grassland and pasture, which is often associated with livestock production. Manure deposited in or adjacent stream can result in fecal coliform bacteria.

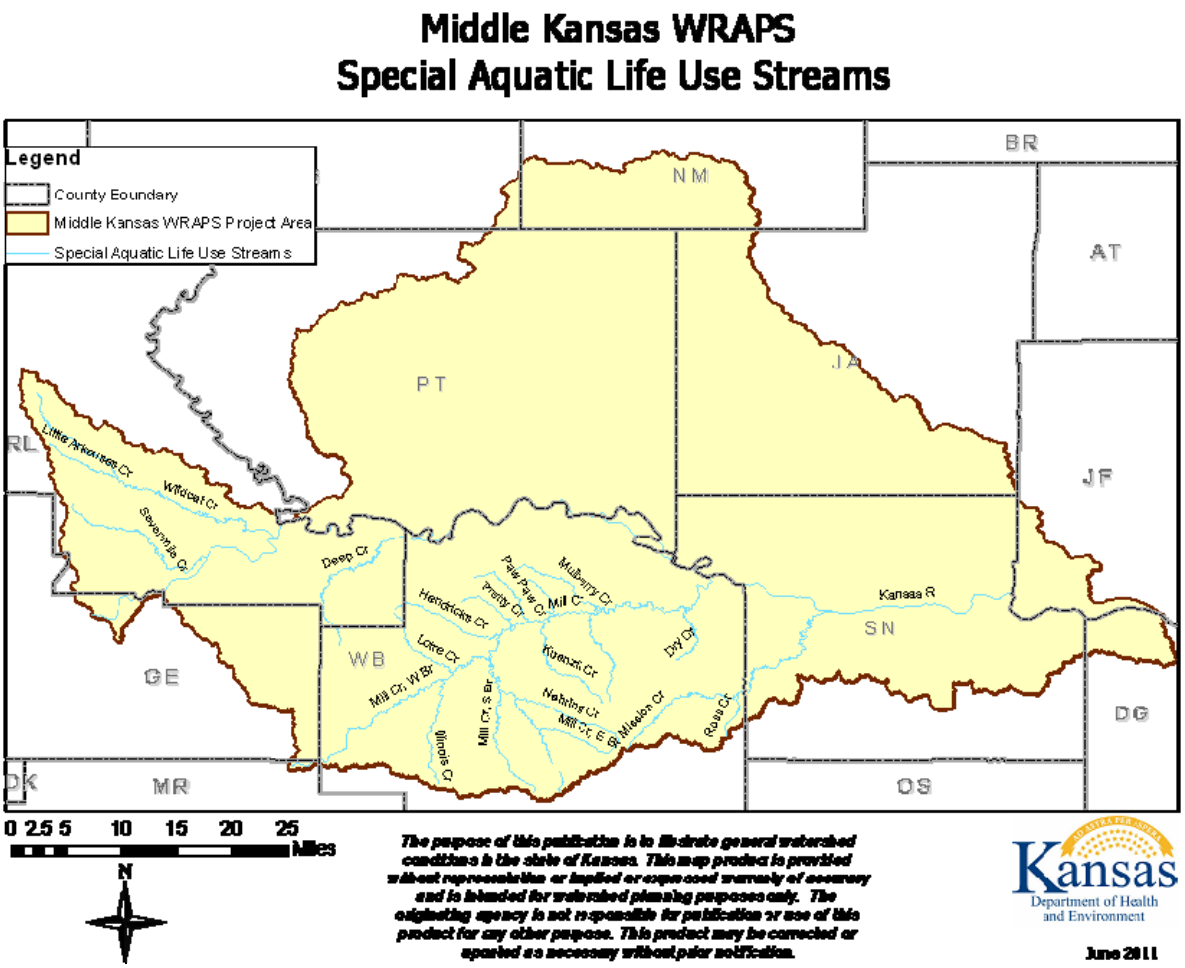


Figure 8: Middle Kansas Special Aquatic Streams

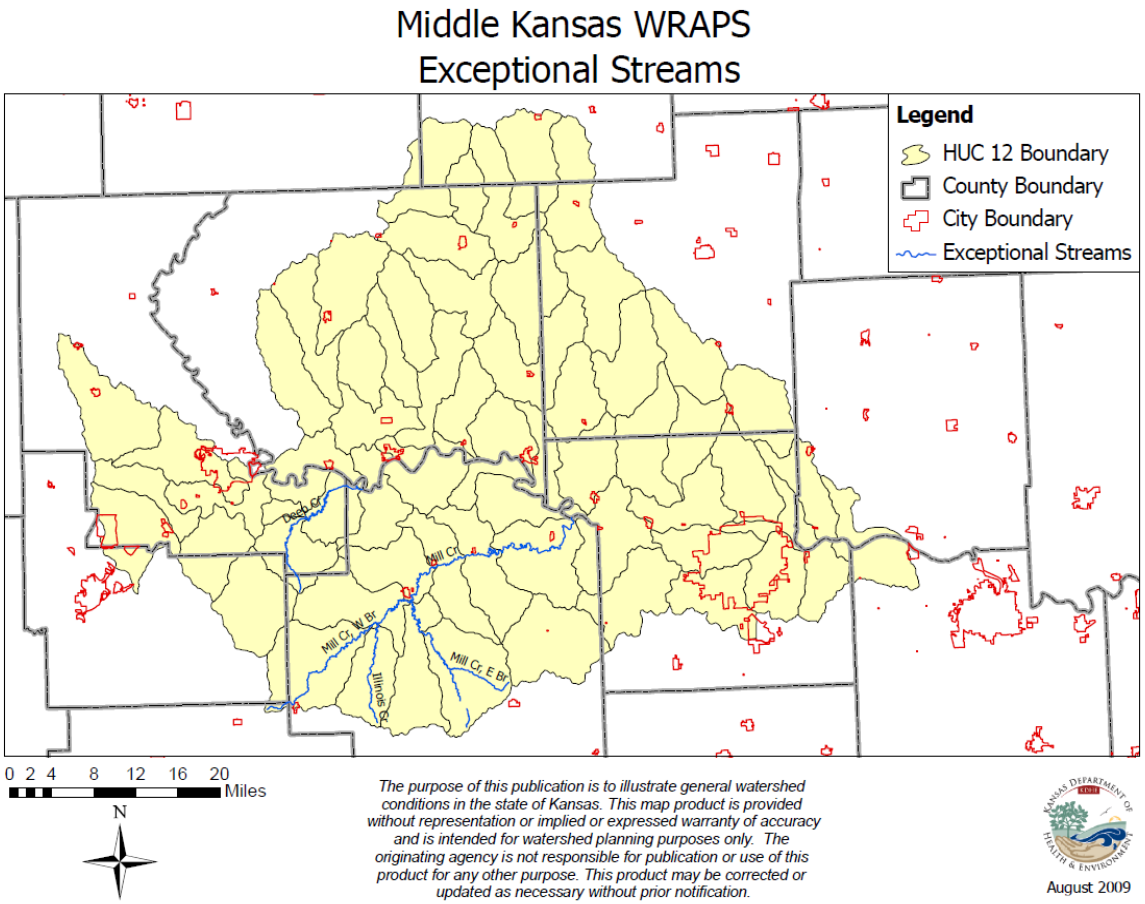


Figure 9: Middle Kansas WRAPS Exceptional Streams

4.0 Identifying Watershed Issues in the Middle Kansas WRAPS

One of the first steps in the development of a Watershed Restoration and Protection Strategy plan is to identify major watershed issues within the watershed. Through a combination of research, local knowledge, and local interests, the Middle Kansas WRAPS was able to develop a list of priority watershed issues. Research includes reviewing Total Maximum Daily Loads (TMDLs) developed by the Kansas Department of Health and Environment. A TMDL is a quantitative series of objectives and strategies needed to achieve water quality standards. Those water quality standards represent the goals of water quality adequate to fully support designated uses of streams, lakes, and wetlands. The process of identifying water quality issues through local knowledge and interest began in September 2006 with the first of many public meetings. Over the course of several months, local stakeholders engaged in a series of discussions that along with other water quality research efforts resulted in an extensive list of watershed issues.

The following watershed issues were identified:

4.1. Bacteria

Bacteria is used as an indicator of contamination. Although bacteria may not be harmful, their presence in water indicates that fecal material is present, and that disease organisms such as E. Coli, giardia, or others may also be found in the water. Generally speaking, the higher the level of bacteria, the greater the level of fecal contamination of the water, and the greater the likelihood of pathogenic organisms being present.

Bacterial contamination of surface water in the Middle Kansas WRAPS is widespread. 2006 TMDLs designated “High Priority for Implementation” include Vermillion Creek and Shunganunga Creek, which is also listed in 2007 for Dissolved oxygen. Medium to low priority TMDL’s include bacteria for the Kansas River at Wamego, and above and below Topeka. Wildcat Creek is listed as a high priority for bacteria.

Bacterial contamination of water in the Middle Kansas WRAPS comes from a variety of sources including livestock wastes, failing on-site wastewater systems (such as septic tanks and lagoons), and wildlife. Discharges from public wastewater treatment plants may contribute to bacteria levels as well.

4.2 Livestock Wastes

A portion of farm income in the Middle Kansas WRAPS comes from the livestock industry. Some of these animals are contained within confined animal feeding

operations (CAFO's). More livestock can be found in unregistered, smaller livestock operations that often over winter in riparian areas. These smaller operations may be a significant source of bacteria and nutrients to streams and lakes. Whether or not these smaller operations pose a water quality threat depends on waste management practices and their proximity to water resources.

4.3 Human Wastes

For rural populations, wastewater is usually disposed of by on-site wastewater systems. Properly designed, constructed and maintained systems are an effective and safe means of wastewater treatment. However, many of these systems are old, may not be properly maintained, and may consist of nothing more than a pipe from the house to a ditch or stream. Such systems do not provide sufficient treatment of wastes prior to release to the environment, and are considered to be failing. They can be a significant source of bacteria and other potentially disease-causing organisms, nutrients, and chemicals that are used in the household. Human wastes from public sewer systems may at times also be a source of fecal bacterial contamination. Public wastewater treatment plants are regulated under the National Pollutant Discharge Elimination System (NPDES) and must have pollution controls in place to avoid contaminating receiving waters with polluted discharges.

4.4 Wildlife Wastes

Wildlife can contribute to bacteria levels in water when their numbers are large. Migrating waterfowl congregating in large numbers on area ponds and lakes are an example of a situation where wildlife may be a significant source of bacterial contamination in water. However, it is not believed that wildlife is a consistent source of contamination in the watershed.

4.5 Sediment and Biology

Soldier Creek is designated **"High Priority for Implementation"** for sediment and biology TMDLs. The natural process of succession (the progression of an aquatic ecosystem to a terrestrial ecosystem) occurs as sediment is deposited in lakes and ponds over time. Lakes eventually fill with sediment to the point that they become marshes and finally dry land. This process usually takes many years to run its course. However, the rate at which this occurs is dependent on various characteristics of the watershed itself and land uses within the watershed. Human activity in the watershed tends to greatly accelerate this process, causing rapid aging of lakes. Cultivation of cropland, poor grazing practices, construction activity, and removal of trees or other vegetation along stream banks all increase the amount of sediment that is sent downstream into lakes and ponds. Once in the lake, sediment settles to the bottom, reducing the

water storage of the lake, causing it to become more shallow. In many cases, sediment has other materials attached to it such as pesticides and phosphorus that also pollute the water of lakes and ponds.

Soils in the Middle Kansas WRAPS are agriculturally very productive. Crop production exposes soils to erosion because the soil surface is not protected by permanent growing vegetation at all times, and is frequently disturbed for planting, cultivation and weed control. Overgrazing pastures, home and road construction and other activities also have the same effect. Runoff transports sediment and other pollutants to lakes and ponds. As the water slows it drops its load, filling ponds and lakes with the sediment that has been transported from fields, pastures and streambanks.

4.6 Eutrophication

2006 TMDLs designated “Medium to Low Priority for Implementation” include the small city lakes of Wamego, Topeka (Gage, Central, Warren Park) and Meyer’s Pond. Algae are aquatic plants containing the pigment chlorophyll *a*. Algal growth increases in response to added nitrogen and phosphorus, thereby producing more chlorophyll *a*. Measuring chlorophyll *a* concentrations in water is one simple way to gauge the level of nutrient enrichment in a lake or pond. This measurement can also be used to determine a lake’s trophic state, that is its level of aquatic productivity. Eutrophication, is a result of excessive inputs of nutrients from the watershed.

4.7 Grazing lands

Approximately 845,368 acres or 50% of the Middle Kansas WRAPS is classified as “grassland/herbaceous.” Grazing lands in Kansas are defined as agricultural lands used for the removal or harvest of perennial and annual vegetation by or for grazing animals. Grazing lands include rangeland, pastureland, woodland, and cropland. Trees and shrubs are natural invaders on grazing lands in Kansas. While woody plants have value along streams and ravines in portions of the state, excessive amounts of woody growth on grazing lands will reduce livestock carrying capacity by shading out more desirable herbaceous vegetation. Proper grazing will slow down woody plant invasion, but prescribed burning, herbicide, and mechanical treatments are necessary to control woody invasion on grasslands.

4.8 Water Quantity

Wide extremes in precipitation are characteristic in the Middle Kansas WRAPS. Average annual precipitation over the basin increases from about 31 inches in the west to about 39 inches in the east (Figure 10). Typically, 70 percent of this total falls during the growing season. Flood events, such as in July, 1993 and the

drought experienced from 1952-1956, underscore the variability in precipitation. Drought can have adverse impacts on urban and rural residents. A number of state, federal, and local agencies work together to insure that a sufficient supply of water is available for the beneficial uses of the people of the State. Individual water conservation practices can range from xeriscape for urban residents to herd management for livestock producers.

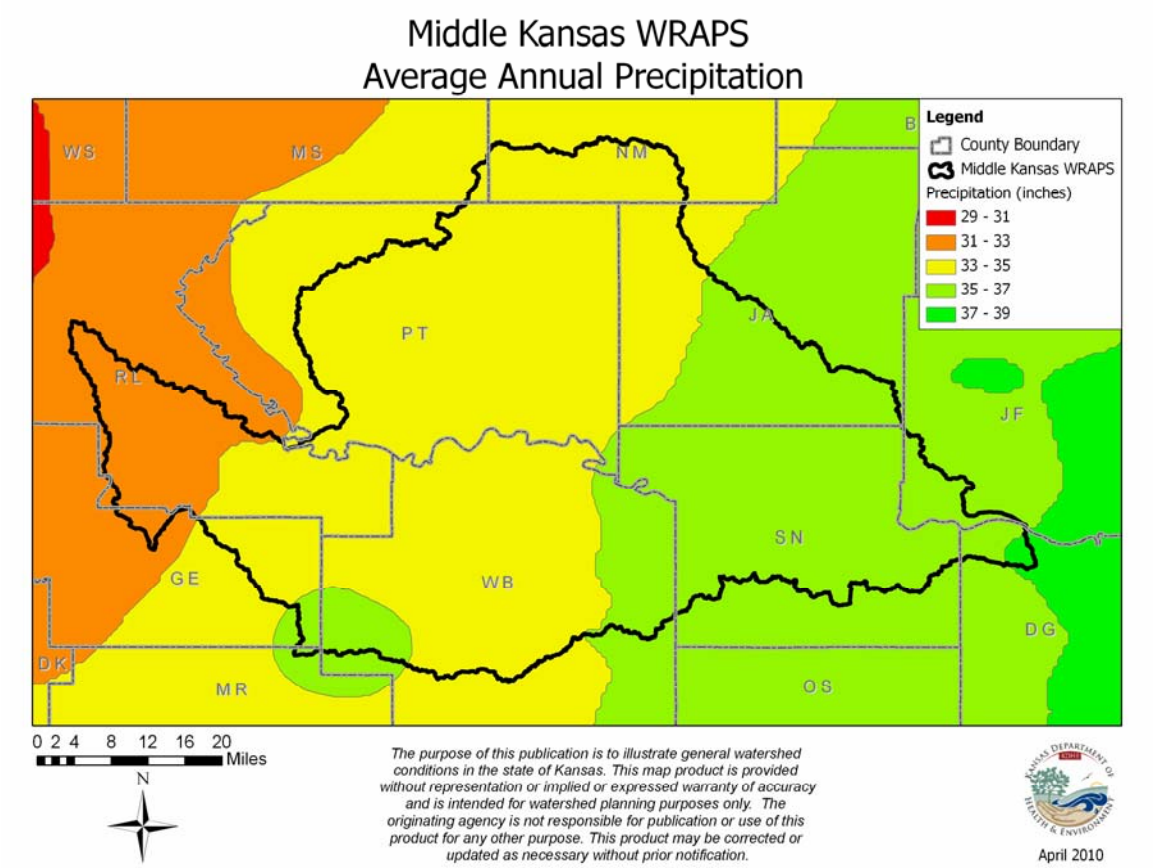


Figure 10: Middle Kansas WRAPS Average Annual Precipitation

4.9 Degraded Streams and Rivers

Streams in the Middle Kansas WRAPS that are substantially degraded are often related to cultural activities in the watershed including stream channelization, mining, drainage of cropland and other stream alterations.

Channel degradation includes both the downcutting process through which the Kansas River and its tributaries have lost its natural bed in some reaches, and bank sloughing, the loss of the river bank. At present, there appear to be two primary reasons for this degradation. Since settlement, the Kansas River has been a primary source of aggregate for building projects and road construction along the river's corridor from Topeka to the Kansas City metropolitan area. Most of this aggregate has been removed from the river bed through hydraulic dredging at multiple permitted sites.

Dredging in the Kansas River is regulated at the federal level by the U.S. Army Corps of Engineers and at the state level by the Department of Agriculture/ Division of Water Resources. The Corps' twelve existing permits on the river were originally issued for a ten year period which expired on December 31, 2001, but have been indefinitely extended. The Kansas City District Office of the Corps of Engineers has asked for the State's position on aggregate dredging before the Corps takes action on renewing these permits.

Since the 1950's, Kansas River flows have been regulated by tributary reservoirs. Sediment loads are largely deposited in these reservoirs. The result is the release of relatively clear water from the reservoirs with a large material carrying capacity and increased downcutting (degradation) of the streambed. (Kansas Water Plan Concept Paper, Channel Degradation in the Kansas River, Proposed for Consideration by the Kansas Water Authority, January 2005).

4.10 Poorly Sited, Poorly Constructed and Abandoned Wells

Contamination of wells is often the result of well location in close proximity to pollution sources such as livestock lots, septic drain fields, or other pollutant sources. Pollutants present in streams, ponds and rivers can also enter shallow groundwater that is closely connected to surface water in alluvial aquifers. Groundwater contamination can also occur when contaminated runoff has direct access to an aquifer. This happens when runoff enters drill holes around poorly constructed wells or runs into well pits and abandoned wells. For this reason, proper well location, construction and plugging of pits and abandoned wells are important to the protection of groundwater in the region. The Kansas Department of Health and Environment – Geology Section issues permits for plugging abandoned wells.

4.11 Urban Areas

Urban sources of nonpoint source pollution include improper fertilizer and pesticide application, pet waste, improper disposal of petroleum and hazardous waste, lack of construction site runoff controls, improper disposal of solid waste in streams, degradation of riparian areas, aquatic and wildlife habitat. Urban sprawl into Shawnee, Geary, and Riley Counties has the potential to contribute to nonpoint source pollution.

4.12 Biological Items of Concern (T&E and SINC species)

A number of federally listed Threatened and Endangered Species can be found in the Middle Kansas WRAPS. Some of these include the Bald Eagle, Least Tern, Piping Plover, and Topeka Shiner. The area provides federally – listed critical habitat for only the Topeka Shiner. Topeka Shiner critical habitat has been

designated in the following waters: Clear Creek (Pottawatomie County), Diamond and Mulberry Creeks (Morris County), Walnut, Wildcat, Little Arkansas, Seven-Mile, and Deep Creeks (Riley County), Mission Creek (Shawnee County), Mill and Mulberry Creeks (Wabaunsee County), and Davis, Thomas, Dry, Lyons and Clark Creeks (Geary County).

Kansas has also listed species as threatened or endangered within the Middle Kansas WRAPS, including the Blackside Darter, Sturgeon Chub, Silver Chub, Redbelly Snake, Eastern Spotted Skunk, Eskimo Curlew, and Pallid Sturgeon. The area provides Kansas-listed critical habitat for these species as well. Blackside darter critical habitat is Mill Creek (Wabaunsee County). This is the only location in Kansas where this species is found. Sturgeon chub and silver chub critical habitat is the entire mainstem length of the Kansas River. Redbelly snake critical habitat is heavily wooded areas near rivers and lakes in Jefferson and Douglas Counties.

In addition, a large number of species found in the area are listed as “Species in Need of Conservation” (SINC) by the Kansas Department of Wildlife & Parks. SINC species are non-game species in need of conservation measures in order to keep the species from becoming threatened or endangered. A complete listing of all T&E species and species designated as SINC by individual county can be found at the Kansas Department of Wildlife and Parks web site. www.kdwp.state.ks.us/news/other_services/threatened_and_endangered_species/threatened_and_endangered_species/county_lists/(offset)/20

Listing species as threatened, endangered, or as in need of conservation provides protection for native populations of these species. It also brings into play recovery plans designed to guide research and management aimed at enhancing the listed species' population. The ultimate goal is to be able to remove the species from their threatened or endangered status. Watershed restoration and protection, while not driven by the goal of restoration of threatened populations, is one way in which the protection of threatened and endangered species can be significantly enhanced.

4.13 Source Water Protection

The Safe Drinking Water Act, 1996 Amendments - Sec 1453 directs state drinking water agencies complete a source water assessment for all public water supplies that produce drinking water from a raw source, including rivers, reservoirs and lakes, and wells. Source water assessments are designed to delineate the source water assessment area, inventory potential contaminant sources, conduct a susceptibility analysis, and inform the public. The Kansas Rural Water Association provides technical assistance for Water Systems with Source Water Protection planning. Often in conjunction with Wellhead Protection assistance, water systems using surface water and/or groundwater are

encouraged and assisted to work with other nearby water systems and local agencies.

The Kansas Source Water Assessment delineates Zones A, B, and C for groundwater and surface water.

4.13. A Groundwater

Zone A
● 100 feet radius of well
- Kansas Public Water Supply Design Standards recommends public water supply own or control through easement

Zone B
● 2,000 feet radius of well
- Area eligible for Continuous Conservation Reserve Program

Zone C
● 2 mile radius of well or 10 year time of travel capture zone

4.13. B Surface Water –River Intake

Zone A
● 1,000 feet upstream radius of intake, 16 miles upstream of intake, ½ mile wide riparian buffer and six hour water travel distance.

Zone B
●16 to 65 miles upstream of intake, ½ mile wide riparian buffer, and 24 hour water travel distance

Zone C
● Balance of watershed

In order to provide source water protection for the City of Topeka, Zones A and B need to be included in the project scope of the Middle Kansas WRAPS. Water quality BMPs in Groundwater and Surface Water Zones A and B will focus on potential nonpoint source pollutants since point source pollutants are permitted activities.

4.14 Flooding

The primary approach to flood management in the Kansas – Lower Republican basin focuses on floodplain management through community participation in the National Flood Insurance Program and reduction of rural flood damages through

construction of watershed dams in organized watershed districts. The basin has 26 communities (cities and counties) participating in the National Flood Insurance Program. Four communities have been suspended from the program and eleven communities with identified flood hazard areas do not participate. Priority watersheds for rural flood damage priorities were identified for the basin in 1986 by the USDA Natural Resources Conservation. Fourteen watershed districts have been organized in the basin. (Kansas-Lower Republican River Basin Management Categories, January 2009)

Flooding is a major concern in the Middle Kansas WRAPS, especially with Cross Creek, which runs north of Rossville, and Shunganunga Creek, which runs through Topeka. In May, 2007, Shunganunga Creek flooded in areas of town that had not previously been previously flooded.

4.15 Livestock Management

A portion of farm income in the Middle Kansas WRAPS comes from the livestock industry. Some of these animals are contained within confined animal feeding operations (CAFO's), which is regulated by KDHE. More livestock can be found in unregistered, smaller livestock operations that often over winter in riparian areas. These smaller operations may be a significant source of fecal coliform bacteria and nutrients to streams and lakes. Whether or not these smaller operations pose a water quality threat depends on waste management practices and their proximity to water resources. Low to no-cost management practices can enhance economic production, while protecting water quality.

4.16 Nutrient Management

Nutrients including phosphorus and nitrogen are one of the greatest impediments to achieving improved quality of surface waters in Kansas. Additionally, nutrients exported beyond Kansas contribute to water quality problems elsewhere, such as development of a "dead zone" within the Gulf of Mexico where many bottom-dwelling organisms have been killed or forced to move.

The U.S. Environmental Protection Agency has requested that all states develop plans to establish water quality criteria for nutrients in surface waters. Kansas has focused on nutrient reduction rather than nutrient criteria as proposed in the Kansas Surface Water Nutrient Reduction Plan. The plan has a goal of 30% reduction in nutrients in waters crossing state lines

Specific actions necessary to meet the 30% reduction target are expected to be developed through Watershed Restoration and Protection Strategies and establishment of high priority Total Maximum Daily Loads. The policy infrastructure for both approaches is in place. (Kansas Water Plan, Water Quality Policy and Institutional Framework, Working Draft Released for Public Review by the Kansas Water Authority, June 2, 2006) Nutrient sources within the Kansas

Lower – Republican basin include both point and non-point sources. The major point sources in the basin include large wastewater treatment plants, which are regulated under the NPDES Program. The primary non-point sources of pollution include both agricultural and urban areas

5.0 Water Quality Issues

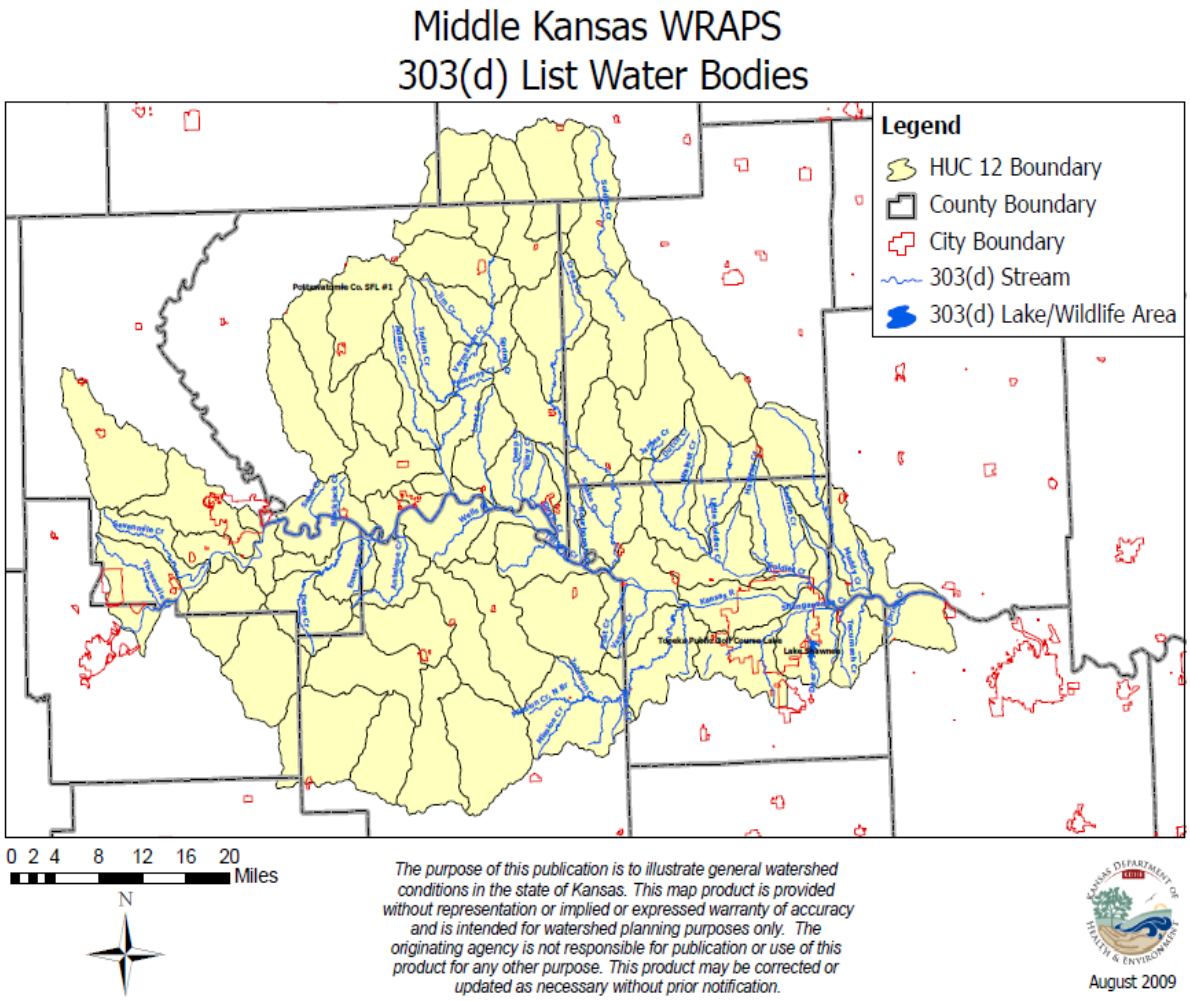
5.1 303d List

The Middle Kansas WRAPS has numerous water bodies listed on the 303d list. The 303d list of impaired waters is developed every two years and simply represents a list of impaired waters. Water bodies included on this list have shown that water quality standards are not being met therefore the designated uses are not being met. KDHE has an extensive water monitoring program with monitoring stations throughout Kansas and in the Middle Kansas WRAPS. Water quality data gathered through this water quality monitoring is used to determine whether or not an impairment is present. Table 9 and Figure 11 show the impaired waters within the Middle Kansas WRAPS.

Table 9: Middle Kansas 2010 303d list.

Waterbody Name	Designated Use	Impairment	Priority
Mission Creek Near Valencia	Recreation	E. coli	High
Mission Creek Near Valencia	Aquatic Life	Copper	Low
Mission Creek Near Valencia	Aquatic Life	Biology	Low
Lake Shawnee	Aquatic Life	Eutrophication	High
Kansas River At Willard	Recreation	E. coli	High
Kansas River At Willard	Aquatic Life	Total Suspended Solids	Low
Kansas River At Willard	Aquatic Life	Biology	Low
Kansas River At Wamego	Aquatic Life	Total Suspended Solids	Low
Kansas River At Wamego	Aquatic Life	Total Phosphorus	Medium
Kansas River At Wamego	Aquatic Life	Biology	Low
Cross Creek Near Rossville	Recreation	E. coli	High
Kansas River At Willard	Aquatic Life	Total Phosphorus	Medium
Soldier Creek Near Delia	Aquatic Life	Total Suspended Solids	Low
Vermillion Creek Near Louisville	Aquatic Life	Biology	Low
Muddy Creek Near Grantville	Recreation	E. coli	High
Soldier Creek Near Topeka	Recreation	E. coli	High
Shunganunga Creek Near Topeka	Aquatic Life	Total Phosphorus	Low
Rock Creek Near Louisville	Recreation	E. coli	High
Pottawatomie Co. SFL #1	Aquatic Life	Eutrophication	Low
Pottawatomie Co. SFL #1	Aquatic Life	Dissolved Oxygen	Low
Topeka Public Golf Course Lake	Aquatic Life	Eutrophication	Low

Figure 11. Middle Kansas 303(d) List Water Bodies



5.2 TMDLs

5.2.1 Stream TMDL/Contaminate Concerns

A TMDL designation sets the maximum amount of pollutant that a specific stream, river or lake can receive without violating surface water quality standards. Surface waters that do not meeting their designated uses require total maximum daily loads. TMDLs established by Kansas state an objective for meeting the water quality standards of the impaired water body. TMDLs are a great resource for targeting and reducing nonpoint source pollution and are typically classified as high, medium and low priority. Ideally, the goal of a WRAPS project would be to address all TMDLs. However, limited financial and technical resources require targeting BMPs toward high priority TMDLs. Unfortunately, the Middle Kansas WRAPS will not have the resources initially to address all high priority TMDLS. The primary pollutant concern of this

watershed's streams and rivers is fecal coliform bacteria (FCB), which is present in human and animal waste. The TMDL table below (Table 10) shows that approximately 76% of the impaired stream/river segments within the Middle Kansas WRAPS are impaired by bacteria, 9% by excess nutrients, 3% by ammonia (NH3), and 1% by sediment. Ammonia is a chemical which is toxic to fish and aquatic organisms. Sediment loading is a result of erosion as the bare soil enters the lake and settles to the bottom. Sediment increases the cloudiness of the lake, creates a displeasing color, and fills the lake bottom. An excess of nutrients such as phosphorous and nitrogen can cause an abundance of plants, which use oxygen in the water as they decay, suffocating fish and aquatic organisms.

The Middle Kansas WRAPS 9 Element Plan will address the following TMDLs listed in Table 10 below: (1) Upper Soldier Creek, Biology, SC 101, SB299; (2) *Rock Creek *E.coli* which is currently a pending TMDL and therefore shown with an * to designate such. Both are highlighted in bold in the table below to show that they are the focus for this WRAPS Project Area.

Table10. Stream TMDLs within Middle Kansas WRAPS Project Area

Water Segment	**TMDL Pollutant**	**Endgoal of TMDL**	**Priority**	**Sampling Station**
Kansas River at Topeka	NH3	1.27 mg/l Ammonia (as N) at pH of 8.0	High	Modeled
Kansas River at Topeka	FCB	No more than 10% of samples over applicable criteria	Medium	SC258
Kansas River below Topeka	Bio	Nutrients--Narrative: The introduction of plant nutrients into streams, lakes, or wetlands from artificial sources shall be controlled to prevent the accelerated succession or replacement of aquatic biota or the production of undesirable quantities or	Medium	SC143

		kinds of aquatic life. (KAR 28-16-28e(c)(2)(B)).		
Kansas River below Topeka	FCB	No more than 10% of samples over applicable criteria	Medium	SC143
Kansas River near Wamego	FCB	No more than 10% of samples over applicable criteria	Medium	SC260
Mill Creek	FCB	" " " "	High	SC506, SC519, SC521
Upper Soldier Creek	**Biology Sediment**	**Suspended solids - Narrative: Suspended solids added to surface waters by artificial sources shall not interfere with the behavior, reproduction, physical habitat or other factor related to the survival and propagation of aquatic or semi-aquatic or terrestrial wildlife. (KAR 28-16-**	**High**	**SC101, SB299**

		28e(c)(2)(B)).		
Rock Creek*	**E.coli**	**Currently a pending TMDL but will be addressed by this plan**	**High**	**SC645**
Vermillion Creek	FCB	No more than 10% of samples over applicable criteria	High	SC520, SC681
Wildcat Creek	FCB	No more than 10% of samples over applicable criteria	High	SC652
Wildcat Creek	DO	5 mg/l	High	SC652

***** = TMDL Pending

The TMDL's are periodically reviewed in the state to insure that water quality standards are up to date on Kansas Rivers and Streams. The table below provides the schedule in which existing TMDL's will be reviewed and any new ones evaluated in the Middle Kansas WRAPS Project Area.

Table 11: TMDLs Review Schedule for the Kansas Lower Republican Basin

Year Ending in September	Implementation Period	Possible TMDLs to Revise	TMDLs to Evaluate
2010	2011 -2020	1999	1999
2015	2016-2025	1999, 2007	1999, 2007
2020	2021 – 2030	1999, 2007, 2010	1999, 2007, 2010

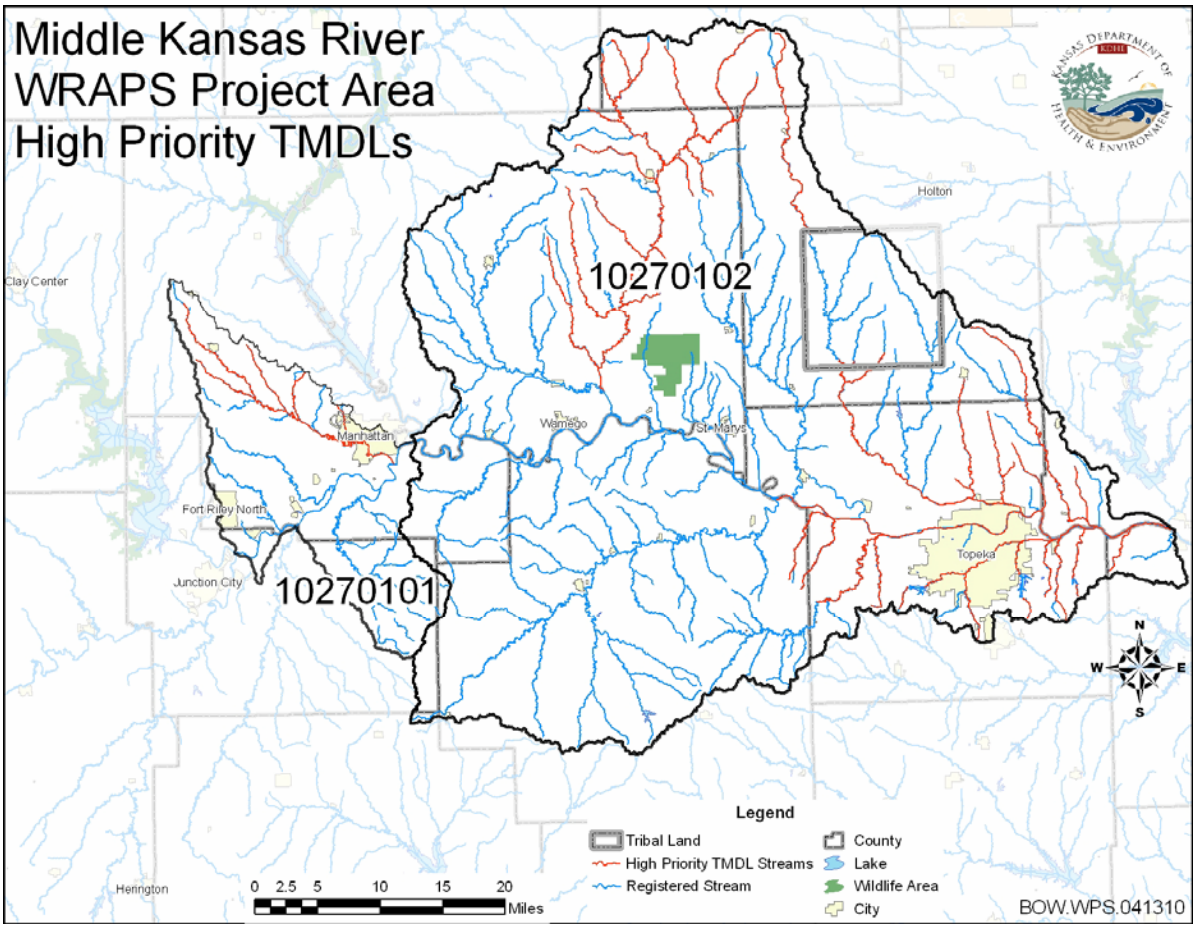


Figure 12: Middle Kansas WRAPS High Priority Stream TMDLS

5.2.2 Lake TMDL/Contaminate Concerns

The Middle Kansas WRAPS is home to Warren Park Lake, Lake Shawnee, Wabaunsee County Lake, and several smaller city and county lakes. Many of these lakes are used for recreational activities such as camping, water skiing, fishing, and sight- seeing.

Approximately 32% of the lakes in this watershed require TMDLs (Table 12). The primary pollutants for this watersheds' lakes and wetlands are eutrophication (E), excessive biomass (AP), and insufficient flow(hydro). 66% of the impaired lakes/wetland segments are impaired due to eutrophication. The remaining pollutants, biomass (AP) and hydro are present in over 16% of the lakes. Eutrophication is caused by excess nutrients from a variety of nitrogen and phosphorous sources including row crop agriculture, feedlots, septic systems, and urban/suburban runoff. Excessive biomass is an abundance of vascular plants that tend to be a nuisance and interfere with designated water uses. Hydro is a term used for lack of water flowing into a lake. This can cause the lake to

have a low temperature, low dissolved oxygen, and stagnation. Based on the watershed's land use percentages, the primary pollutant sources for nutrients causing eutrophication may be row crop agriculture. Additionally, feedlots, septic systems, and urban/suburban runoff may contribute significant amounts of nutrients into the watershed.

Table 12: Lake TMDLs within Middle Kansas WRAPS Project Area

Water Segment	TMDL Pollutant	Endgoal of TMDL	Priority	Sampling Station
Central Park Lake	EU	summer chlorophyll a concentrations at or below 20 ug/l,	Low	LM060901
Gage Park Lake	EU	summer chlorophyll a concentrations at or below 20 ug/l,	Low	LM061101
Myer's Pond	EU	summer chlorophyll a concentrations at or below 20 ug/l,	Low	LM075201
Wamego City Lake	EU	summer chlorophyll a concentrations at or below 20 ug/l,	Low	LM062101
Warren Park Lake	EU	summer chlorophyll a concentrations at or below 20 ug/l,	Low	LM062001
Warren Park Lake	AP	summer chlorophyll a concentrations at or below 20 ug/l,	Low	LM062001
Ogden City Lake	EU	summer chlorophyll a concentrations at or below 20 ug/l,	Low	LM011701

Existing lake TMDLs in the watershed are recognized and will be addressed through future priority areas.

5.2.3 TMDLs to be addressed in the Middle Kansas WRAPS Nine Element Plan

In consultation with the KDHE – Watershed Management Section and the KDHE – TMDL Planning Section, the following stream TMDLs were agreed to be the focus of this plan:

1. Rock Creek – Pending Bacteria, Status: Active, targeted implementation.
2. Upper Soldier Creek – Biology, Status: Active, targeted implementation.

The following stream TMDLs are considered high priority and are not a focus of the WRAPS at this time, but are currently being worked on by NRCS, SCC and other partners:

3. Shunganunga Creek- Bacteria, including Lake Shawnee for eutrophication
4. Upper Vermillion Creek – Bacteria

Additional existing stream TMDLs in the watershed are recognized and will be addressed through future priority areas. Targeting the TMDLs listed above will primarily benefit the Kansas River which has several designated uses.

5.2.4 Potential Nonpoint Pollution Sources Impacting Streams

Potential sources of bacteria contamination include feedlots, wastewater treatment facilities, septic systems, and wildlife. Potential sources of sediments include construction sites, stream bank erosion, and row crop agriculture. Potential sources of nutrients include row crop agriculture, urban/suburban runoff, registered feedlots, unregistered feedlots, wastewater treatment facilities, septic systems, and wildlife. Sources of ammonia include livestock, septic tanks, fertilizer, municipal and industrial waste.

5.2.4.A Animal Feeding Operations

In Kansas, confined animal feeding operations (CAFOs) with greater than 300 animal units must register with KDHE (Figure 12). There are approximately 170 registered CAFOs located within HUC8 10270102 (this number, which is based on best available information, may be dated and subject to change). Many small feeding operations exist that are not registered and may only be utilized in the winter, usually with feeding activities taking place in and around stream corridors. These small feeding operations are considered to be one of the major concerns of the WRAPS group and will be the focus of BMP's.

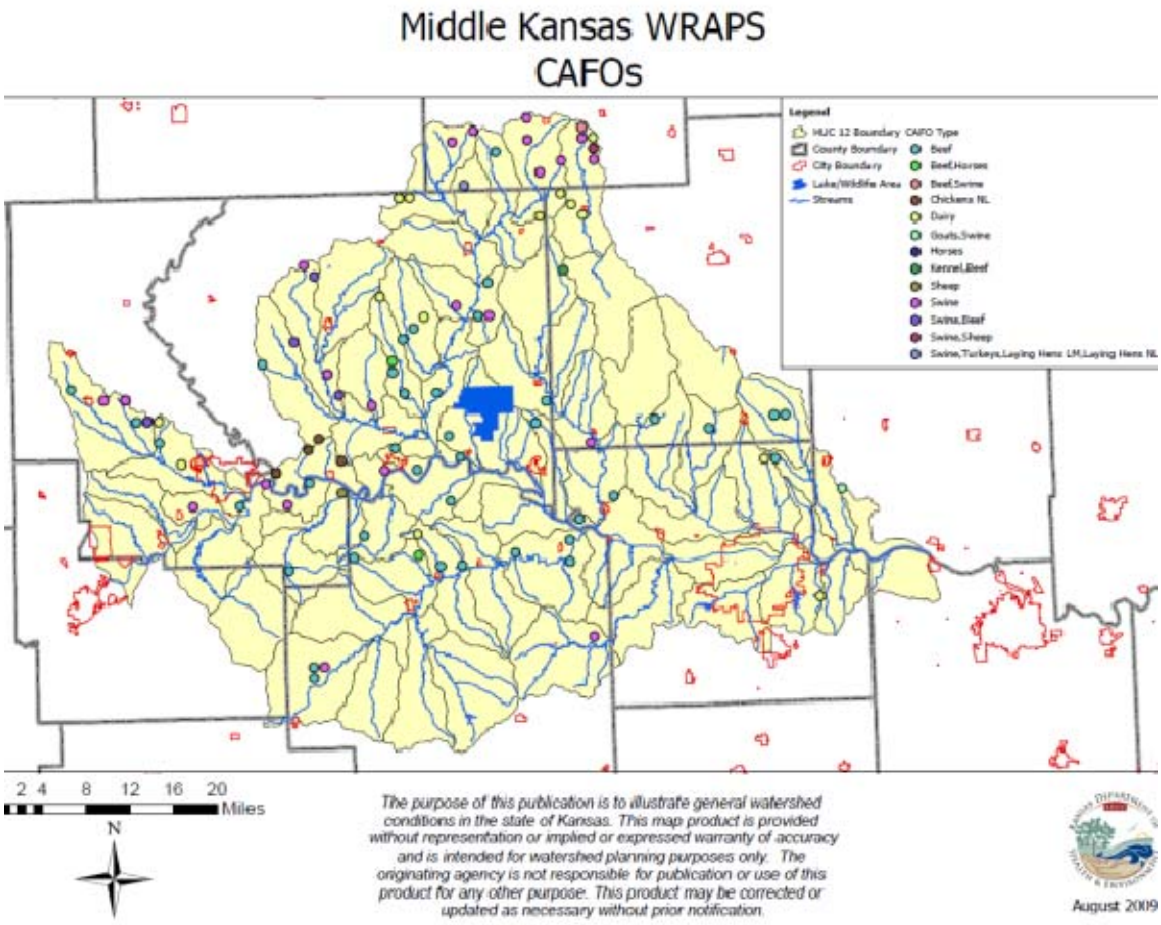


Figure 13: CAFOs in the Middle Kansas WRAPS

Registered CAFOs are not considered as significant a threat to water resources within the watershed. A portion of the State's livestock population exists on small unregistered farms. These small unregistered livestock operations may contribute a significant source of bacteria and nutrients, depending on the presence and condition of waste management systems and proximity to water resources.

5.2.4.A1. Wastewater Treatment Facilities

There are approximately 54 wastewater treatment facilities within the watershed (this number may be dated and subject to change). These facilities are currently regulated by KDHE under National Pollutant Discharge Elimination System (NPDES) permits (Figure 13). These permits specify the maximum amount of pollutants allowed to be discharged to the "waters of the State". Due to the chlorination processes involved in municipal waste treatment, these facilities are not considered to be a significant source of bacteria; however they may be a

significant source of nutrients. Nutrient Reduction Plans may provide further protection from nitrogen and phosphorus with upgrades to treatment plants when permits are renewed.

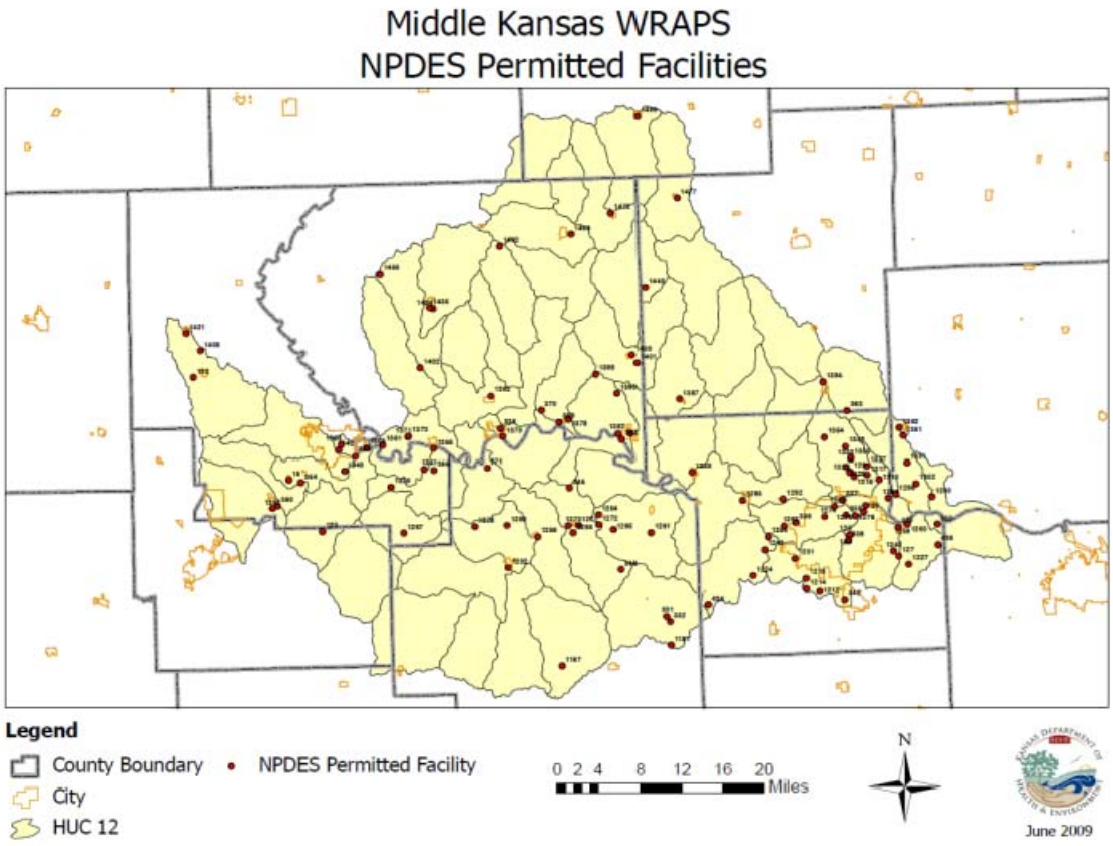


Figure 14: Middle Kansas WRAPS NPDES Permitted Facilities

5.2.4.A.II Septic Systems

There are currently thousands of septic systems within the watershed and this number is increasing. When properly designed, installed, and maintained, septic systems can act as an effective means of wastewater treatment. However, poorly maintained or “failing” septic systems can leach pollutants into nearby surface waters and groundwater. The exact number of failing septic systems within the watershed is unknown; however the number may be increasing due to the current trends in suburban development. Local Environmental Protection Programs and county health departments provide excellent sources of information regarding the proper design, installation, and maintenance for septic systems.

5.2.4.A.III Wildlife

Wildlife located throughout the watershed are not usually considered a significant source of nonpoint source pollutants. However, during seasonal migrations, concentrations of waterfowl can add significant amounts of bacteria and nutrients into surface water resources.

5.2.4.A.IV Row Crop Agriculture

Row crop agriculture can be a significant source of nonpoint source pollution. Common pollutants from row crop agriculture include sediment, nutrients, pesticides, and bacteria. Many producers within the watershed regularly implement and maintain BMPs to limit the amount of nonpoint source pollutants leaving their farm. Some common BMPs include: the use of contour plowing; use of cover crops; maintaining buffer strips along field edges; proper timing of fertilizer application and no-till practices.

5.2.4.A.V Urban/Suburban Runoff

Many urban landscapes are covered by paved surfaces including roads, driveways, parking lots, and sidewalks. These surfaces are impermeable and tend to divert water into storm drains at high velocities. Increased flow velocity from urban areas can cause excessive stream bank erosion in receiving water bodies. Additionally, urban and suburban runoff may carry other pollutants such as petroleum hydrocarbons and heavy metals. Currently, the watershed is only about 6% urban, but is growing and could lead to some additional water quality concerns. Limiting paved surfaces is the key to slowing urban nonpoint source pollution. The use of grass swales, open spaces, wetlands, and storm water retention ponds are recommended to slow runoff in urban areas. The watershed has an increasing population living in suburban areas. Residential landscapes are often designed with large turf areas which require high amounts of water and chemicals to maintain. The use of excessive amounts of fertilizers and lawn care chemicals in residential areas can contribute a significant amount of pollution to nearby water resources. Suburban nonpoint source pollution can be limited by: using less lawn fertilizers and chemicals; control of construction sites; proper disposal of pet waste; establishing large areas of native vegetation; and conserving the amount of water used for maintenance.

6.0 Prioritization of Watershed Issues

Resources necessary for addressing watershed issues include funding to implement best management practices, technical assistance, community leadership, educational, informational and data resources. These resources are frequently in limited supply, and must be allocated in the most efficient manner possible to have the greatest impact. To do this, it becomes necessary to prioritize where resources will be used. This is not intended to diminish the importance of issues that may receive lower priority, but is a necessary step in making sure that the most pressing needs receive the greatest attention first.

The size of the Middle Kansas WRAPS and the number of water issues in the basin required stakeholders involved in the development of a watershed restoration and protection strategy to make decisions as to where available resources will be focused. The prioritization process involved three phases. First, the watershed issues were ranked according to their priority relative to each other. Next, priority areas and sub-watersheds within the larger watershed were identified, keeping in mind the highest priority issues identified in the first step. Finally, best management practices necessary to improve the water quality concerns identified were also prioritized within each issue.

A series of ten public WRAPS meetings were held in 2007-08. Discussion and information sharing at these meetings resulted in the identification of thirteen major watershed issues within the Middle Kansas WRAPS. The group used a prioritization technique to assign priority ranking for each of the thirteen major watershed issues. This was done using the Pairs Comparison Technique for Prioritization, which uses preference scores to prioritize a list of items. Each cell of the matrix represents a pairing of the thirteen watershed issues. The stakeholders looked at each pair and selected the one that they perceived as most important of the two, or their “preferred choice”. The choices were tallied and a ranking assigned to the issues in order of their priority. The following list shows the thirteen watershed issues involved in the Pairs Comparison.

The following list shows the ranking of the fourteen watershed issues that resulted from this prioritization exercise.

1. Livestock Management
2. Source Water Protection
3. Bacteria
4. Tie – Nutrient Management, Cropland
6. Degraded Streams and Rivers
7. Sediment/Biology
8. Water Wells
9 Urban Areas
10. Grazing Lands
11. Flooding

12. Biological Items of Concern
13. Water Quantity
14. Eutrophication

After the fourteen watershed issues were prioritized, stakeholders examined modeling data for the watershed. Maps of watershed pollutant loads developed using the Spreadsheet Tool for Estimating Pollutant Loads (STEPL) model for the year 2006 were reviewed. These maps illustrate expected pollutant loads at the Hydrologic Unit Code 12 level. Maps showing sediment, nitrogen, phosphorus and biological oxygen demand (BOD) loads were used.

Watershed issues, other than those being directly addressed by the Middle Kansas WRAPS 9 Element Plan, will be addressed through outreach and public education/information efforts.

7.0 Middle Kansas Watershed Assessments

7.1 Total Maximum Daily Load (TMDL) Source Assessment for Upper and Middle Rock Creek Watersheds, April 15, 2008

At the May 16, 2007 Natural Resource Management Workshop, a representative from EPA stated that in collaboration with KDHE, Vermillion Creek has been selected among five watersheds in Kansas that have the potential for restoration within a period of approximately five years. Since bacteria is the leading TMDL concern in the Middle Kansas, stakeholders decided to initially focus on the Vermillion River – Rock Creek watershed in Pottawatomie County. Rock Creek watershed was chosen due to its high priority status and local interest expressed by the Pottawatomie County Conservation District and Watershed District.

An aerial photo assessment and report was completed by Blue Earth, in cooperation with the Kansas Alliance for Wetlands and Streams (KAWS) and the Pottawatomie County Conservation District. Highlights of this assessment are described in the next few pages. A full copy of the assessment can be downloaded at www.kaws.org/completed-assessments

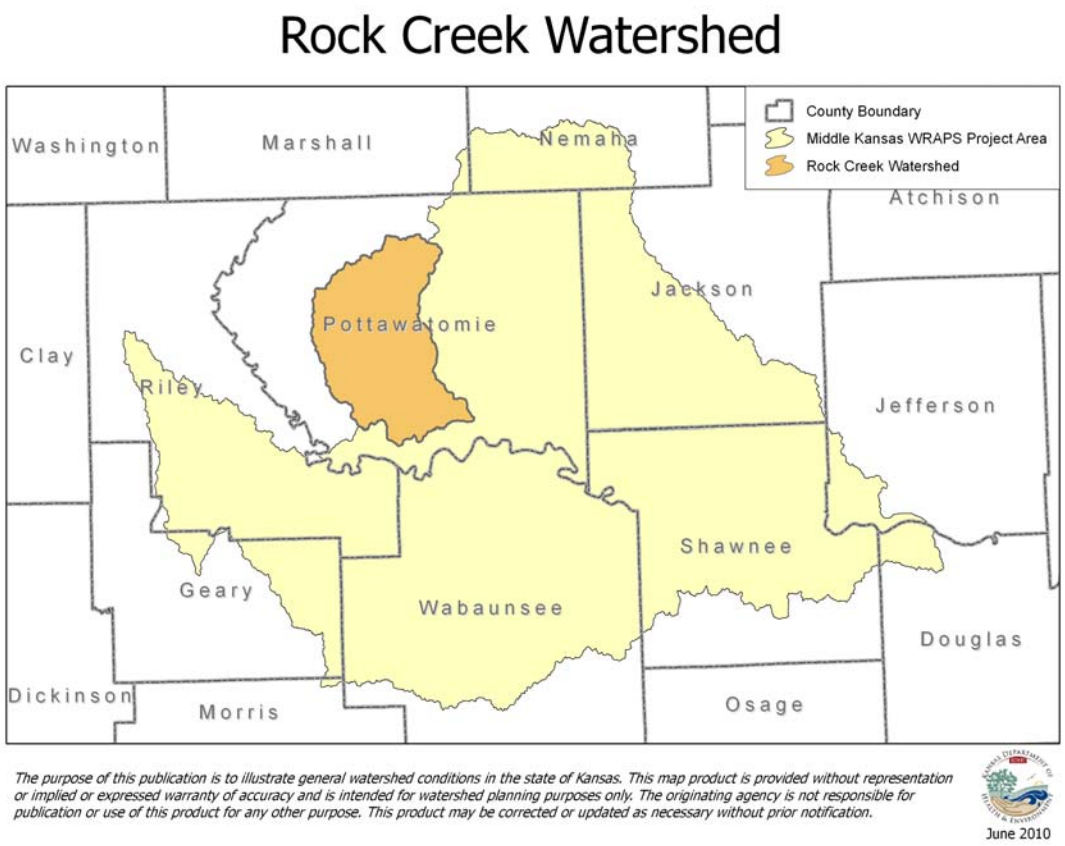


Figure 15: Rock Creek Watershed in Middle Kansas WRAPS Project Area

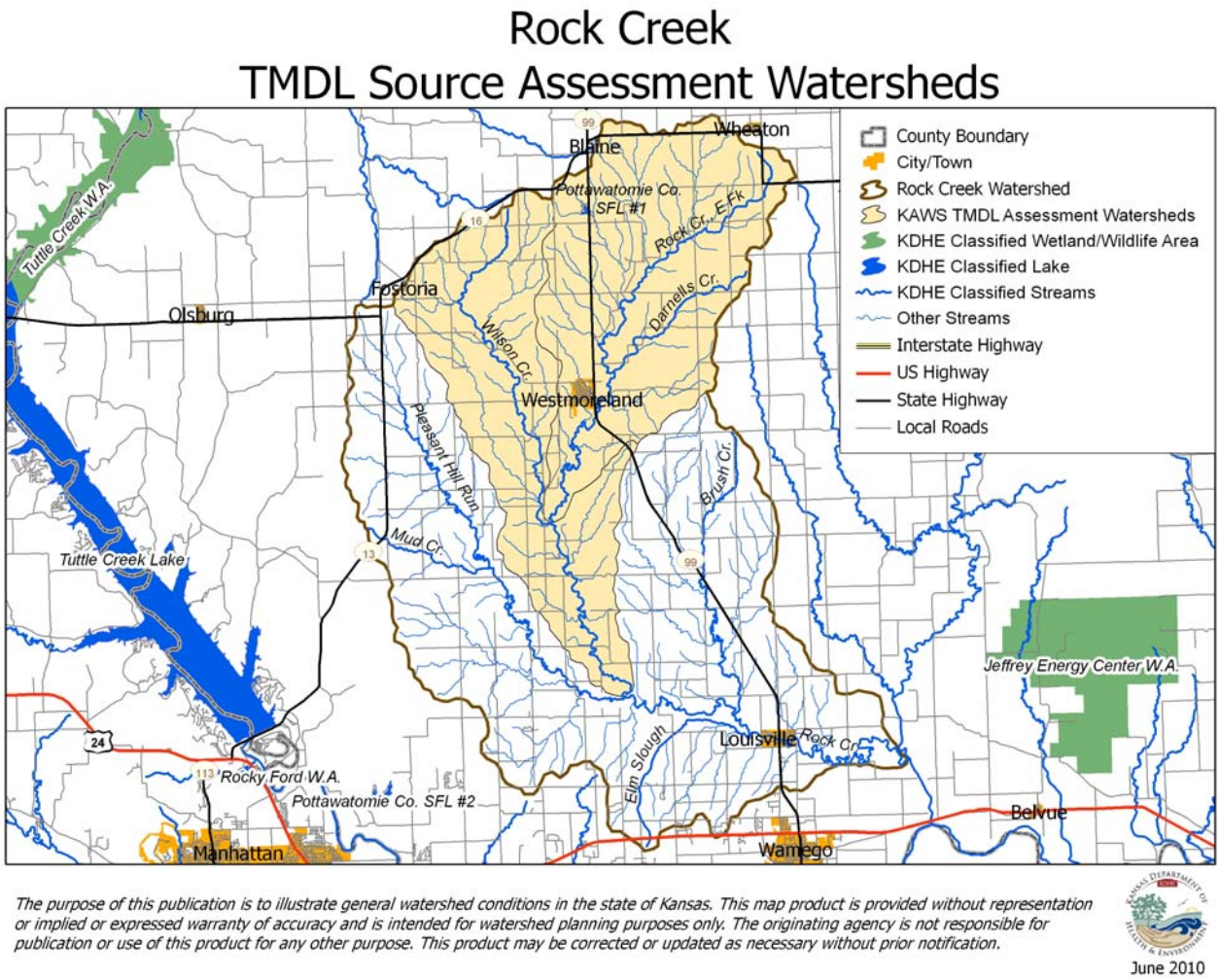


Figure 16: TMDL Source Assessment Watersheds in Rock Creek

Upper Rock Creek, HUC 1027010201 and Middle Rock Creek, HUC 1027010202, drain into the Vermillion River east of Wamego, Kansas, as part of lower Rock Creek watershed briefly before flowing into the middle Kansas River.

Scope of TMDL Issues to be evaluated in this assessment

• Identification of potential sources of fecal coliform bacteria (FCB) including *Eschericia coli (E. coli)* to Rock Creek, its tributaries and contributing drainages;

• Identification of potential sources of nutrients contributing to loading in and eutrophication of Pottawatomie County State Fishing Lake No. 1 (Pott. Co. SFL-1);

• Identification of potential sediment sources emanating from “significant” stream and river bank erosion, operationally defined as any horizontal distance running parallel to the stream and greater than 500 feet in extent which could potentially

contribute sediment or appears through visual assessment of aerial photography to represent an “unstable” stream or river bank.

One hundred and thirty five (135) potential small animal feeding operation (AFO) sites were identified throughout the Upper and Middle Rock Creek watersheds. As visual inspection of NAIP imagery was based on a single, seasonal image for this assessment and the ability to identify loafing, feeding or wintering activities located in dense riparian forest is limited, the potential for additional AFO sites in the Upper and Middle Rock Creek watersheds is highly likely. Further, there is a distinct likelihood that some AFO sites have been misidentified and potential loafing, feeding or wintering activities associated with livestock either are not present at an identified site or no longer exist at present as identified using the 2006 imagery. Field validation of a subset of identified sites throughout the extent of both watersheds indicated a high degree of compatibility between assessment results and field observations, providing a reasonable degree of confidence that the majority of identified sites have high to very high potential of being an actual AFO site. Implementation of best management practices (BMPs) for grazing operations is highly recommended at these sites and in their vicinity. Fencing or behavioral modifications for improved livestock management are suggested to reduce FCB inputs delivered by overland flow or direct defecation in streams and rivers.

Other AFO and animal waste lagoon systems located within close proximity to streams and rivers (generally 100 feet unless otherwise defined by assessor) were also identified during the assessment. Overflow of waste lagoons during high flow or runoff conditions (i.e., periods of high precipitation or runoff from inundated soil following a consistent supply of precipitation) represent potential pathways for FCB delivery to streams and rivers. Any AFO facility with an animal unit capacity of 300 or more, or any facility that presents a significant water pollution potential, must register with the Kansas Department of Health and Environment (KDHE). Any facility with an animal unit capacity of 1,000 or more must obtain a National Pollutant Discharge Elimination System (NPDES) Permit. AFOs registered with the KDHE represent potential known sources of nutrients and FCB, but these operations are supposed to be managed according to KDHE regulations and permit requirements, and accordingly, may be subject to monitoring and inspection to ensure compliance.

Potential sources of FCB that were not addressed during this assessment were failing septic tanks, land-applied manure or sewage sludge, and wildlife; their contributions to Rock Creek and its drainages are not fully understood at present.

Total potential acreage for riparian restoration was calculated as all of the cultivated and developed land area located within 100 feet of all drainages, streams and rivers cultivated land within the 100 feet buffer distance. Riparian restoration should include both the restoration of native grasses and trees located along streams and creeks, and potentially wetland conditions where they

might have previously existed. Restoration emphasis should likely be focused on combinations of historical native vegetation, with upland areas supporting more grasses and lower reaches supporting greater extents of deciduous and mixed growth riparian forest. There are 1256 acres of potential riparian restoration sites in the Upper and Middle Rock Creek watersheds.

The Rock Creek Watershed Assessment is currently being used to target future NPS activities in the watershed. Activities will include, but not be limited to, bacteria source tracking and other water sampling, and the formation of a Rock Creek Focus group comprised of local watershed stakeholders and WRAPS service providers. BMP's will be focused in Rock Creek for 10 years or until the TMDL has been eliminated.

7.2 Level 1 Watershed Assessment of Little Soldier and Soldier Creek Watershed, July, 2010

Upper Soldier Creek has a high priority TMDL for biology. The Middle Kansas WRAPS has designated the targeted watershed as high priority for BMP implementation based on consultation with KDHE staff. An aerial photo assessment and report was completed by Blue Earth, in cooperation with the Kansas Alliance for Wetlands and Streams (KAWS). A copy of the assessment results can be downloaded at

www.kaws.org/completed-assessments

Assessment Area

The scope of work for Level 1 watershed assessment for Soldier Creek and Little Soldier Creek was undertaken at three geographic scales:

1. The entire HUC-10 **watershed** of Soldier Creek (HUC 1027010208) in Nemaha, Jackson and Shawnee counties (figure 2).

2. A **main stem region** extending from the center line of the main stems of Soldier Creek and Little Soldier Creek 2000 feet perpendicular up both the right and left banks. A GIS buffer operation was performed on the main stem NHD Flowline dataset depicting both Soldier Creek and Little Soldier Creek to 2000ft to define this **main stem region**.

3. A **riparian buffer region** extending from the center line of the river channel as depicted by the National Hydrological Dataset (NHD) Flowline data. A GIS buffer operation was performed on the main stem reaches of both systems within the NHD Flowline dataset to 100ft to define this **riparian buffer region**.

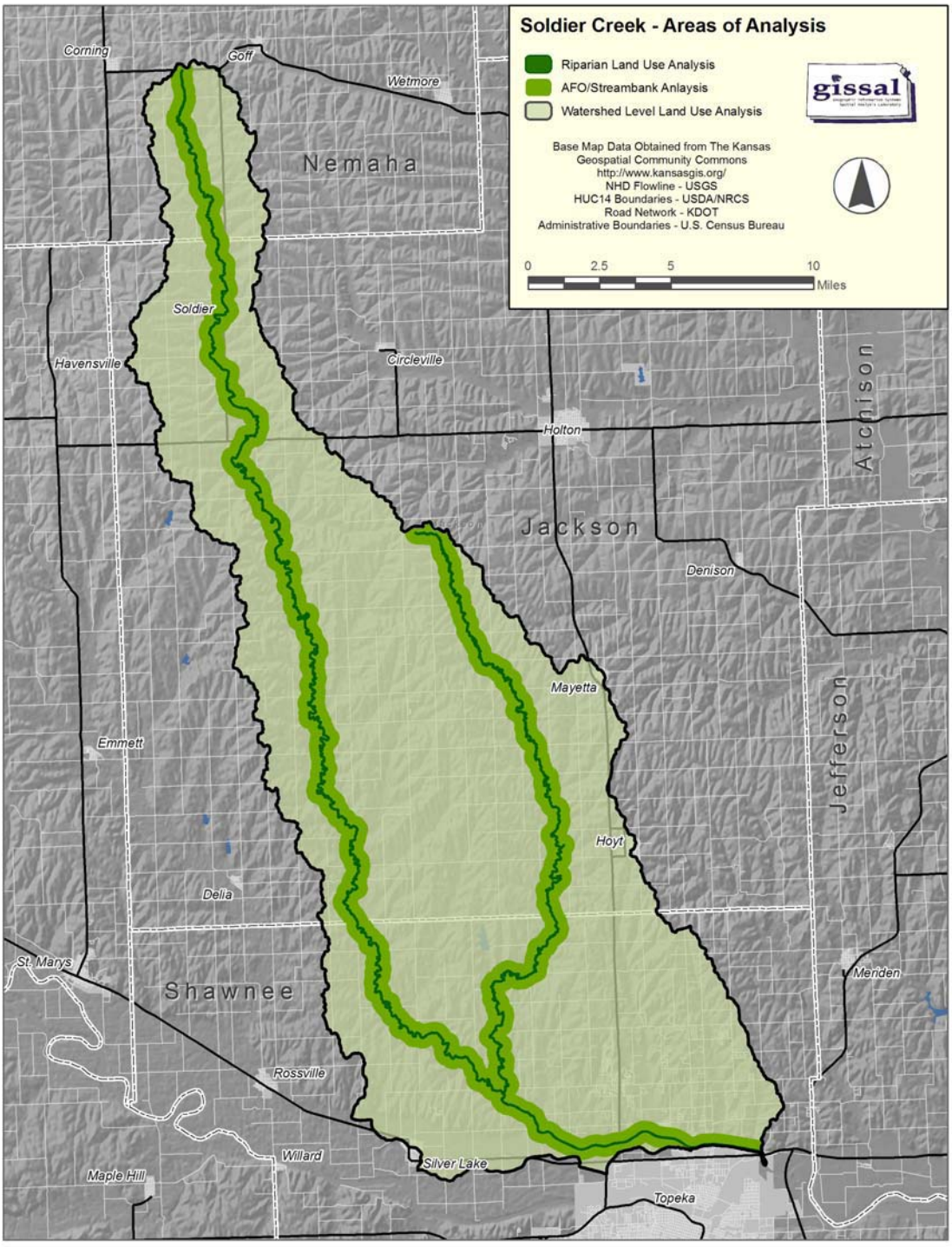


Figure 17: Analysis Levels for Level I Assessment of Soldier Creek and Little Soldier Creek

Assessment Activities

The **watershed level** was used to evaluate:

1. Land use throughout the watershed using several land cover datasets, including estimates of acreages for both a full range of land use classifications and a generalized land use classification scheme.

2. Land use changes over two time periods (1992-2001 and 1990-2005), including estimates of acreages.

The **main stem region** (including those tributaries contained within) was used to evaluate:

1. The identification of Animal Feed Operations (AFO's), Confined Animal Feeding Operations (CAFO's) and lagoons in close proximity to the stream network utilizing aerial photography assessment and ancillary GIS datasets.

2. The identification of major stream bank erosion sites for rehabilitation and stabilization utilizing aerial photography and ancillary GIS datatsets.

The **riparian buffer region** was used to evaluate:

1. Land use throughout the riparian buffer region using several land cover datasets, including estimates of acreages for both a full range of land use classifications and a generalized land use classification scheme.

2. Land use changes over two time periods (1992-2001 and 1990-2005), including estimates of acreages.

Field verification of AFO's and major stream bank erosion sites identified in the analysis period utilizing aerial photography was undertaken on July 27th, 2010 with the WRAPS coordinator and a Kansas Alliance for Wetlands and Streams representative

Results

Potential Livestock Activity Sites

Twenty (20) livestock operations and two (2) waste water treatment lagoons were identified in the main stem region (2000 ft. buffer) of Soldier Creek and Little Soldier Creek. Eight (8) additional sites were identified just outside the Soldier Creek and Little Soldier Creek main stem region. Livestock feeding sites are often transitory and seasonal and may or may not have been active at the time of identification in the 2008 NAIP imagery and/or during field verification or results.

Indicators of recent or active livestock activity were used to confirm the presence or absence of an operation in close proximity to the stream network during field verification. Bale feeders, manure piles, fencing, shelters, denuded land or other signs of recent feeding activity were considered confirmation that animals have been or are active in an identified location.

Sites where livestock may gain access to riparian areas or where livestock have or are being fed in close proximity to streams are considered to be areas where Best Management Practices (BMPs) may be required to address water quality issues related to fecal coliform bacteria and bank erosion associated with hoof shear and grazing of riparian areas that reduces vegetative cover, especially shrub and tree sapling growth whose roots are important bank stabilizers, exposes topsoil, and weakens stream banks making them more susceptible to erosion.

Two (2) wastewater treatment plants were identified and confirmed in the main stem region (2000 ft. buffer) of Soldier Creek and Little Soldier Creek. Lagoons were identified due to potential for release to surface water bodies, especially during large runoff events or flooding conditions. Releases from lagoons represent potential sources of fecal coliform bacteria and nutrients to streams and rivers.

Two confined animal feeding operations (CAFOs) were identified in the main stem region (2000 ft. buffer) of Soldier Creek and Little Soldier Creek from Kansas Department of Health and Environment (KDHE) records. A further eight (8) CAFOs were identified within the watershed from KDHE records. These locations have not been mapped since KDHE does not identify exact locations of CAFOs due to the sensitive nature of this information and to protect the rights of the landowner.

Potential Streambank Erosion Sites

Sediment can originate from streambank erosion ~~and~~ by sloughing of the sides of the stream bank. A lack of riparian cover can cause washing on the banks of streams or rivers and enhance erosion. A total fifty two potential streambank erosion sites were identified for potential rehabilitation or stabilization within the riparian region of Upper Soldier Creek. 30,920 linear feet of streambanks were associated with these sites, ranging from 326 feet to 3616 feet. Table 13 shows the number of streambank erosion sites with linear feet needing treatment for the three HUC 12s in Upper Soldier Creek.

Table 13: Streambank Stabilization Needs for Upper Soldier Creek

HUC-12 Watersheds of Upper Soldier Creek	Number of Streambank Erosion Sites	Linear Ft.
102701020801	24	12981
102701020802	25	15995
102701020803	3	1943
Total	52	30,920

The mean size of the streambank erosion sites was 826 feet. Sites tended to be located on either the outside of tight meander bends or in areas where steep banks were left unprotected along side cultivated land and/or grassland. Field verification of potential streambank erosion sites was hampered by a lack of access in most cases. However, ten (10) sites were evaluated and confirmed during the field verification process.

An adequately functioning and healthy riparian area will reduce sediment flow from cropland and rangeland. Riparian areas can be vulnerable to runoff and erosion from livestock induced activities in pastureland and overland flow from bare soil on cropland. Buffers and filter strips along with additional forested riparian areas can be used to impede erosion and streambank sloughing. Livestock restriction along the stream will prevent livestock from entering the stream and degrading the banks. Cropland needs buffer and filter strips adjacent to the stream in order to impede the flow of sediment off of fields. Conservation tillage practices are also effective for slowing the flow of rain water off of crop fields.

This WRAPS project has targeted Soldier Creek for streambank stabilization projects. A copy of the assessment report can be reviewed at http://kaws.org/files/kaws/Soldier%20Creek%20Level%20I%20Assessment.pdf.

Potential Cropland Sites Needing Treatment

The Jackson County Needs Assessment completed in 1992 was for all of Jackson County, rather than HUC 12s. In order to determine a process for estimating the BMP needs for Upper Soldier Creek, the approximate size of the watershed was used to determine that it constitutes roughly 1/7th of Jackson County. Table 14 shown below indicates there are 19,278,567 acres of cropland in Jackson County. Cropland needing treatment falls into two categories, management practices and structural. Management practices include enhanced nutrient management, enhanced pesticide management, nutrient management plans, annual soil sampling, no-till and ridge-till. Structural practices include terrace restoration, new waterways, waterway restoration, diversions, grade stabilization and water/sediment control basins.

Cropland acres needing treatment, as shown in Table 15, total 70,500. Divided by seven, cropland needing treatment in Upper Soldier Creek is estimated to be 10,071 acres. In the same table, stream miles needing treatment due to hydromodification, total 52 miles. Divided by seven, stream miles needing treatment in Upper Soldier Creek is estimated to be 7.4 miles.

BMPs to be funded for cropland treatment in Upper Soldier Creek (HUC102701020801, HUC HUC102701020802 and HUC102701020803), as determined by the SLT, include: vegetative buffers, grassed waterways, no-till, terraces, sediment and control basins, and wetland creation. Other state and federal programs have the capacity for implementing other management practices not funded by the Middle Kansas WRAPS.

Table 14: Jackson County Kansas Non-Point Source Needs Summary

Kansas Non-Point Source Needs Summary

Acres Reported*	33,515,066
Percent Reported**	64.3%

Land Cover in HUC (Acres) (1992 NRI)

Water	Urban/Developed	Barren/Transitional	Forest/Woodland	Shrubland	Grassland/Herbaceous	Pasture/Hay	Cropland	Wetlands	Total
451,397	620,384	81,224	1,522,027	646,923	22,420,908	6,611,753	19,278,567	466,191	52,099,374

Cropland Treatment Needs: Management

Total Acres of Cropland	Acres Cropland Needing Treatment (2005)	Acres Needing Enhanced Nutrient Management	Acres Needing Enhanced Pesticide Management	Acres with Nutrient Management Plan	Acres with Annual Soil Sampling	Acres in No-Till	Acres in Ridge Till	Acres in Conservation Tillage
15,744,209	7,351,697	7,034,842	6,171,986	2,060,906	2,554,981	2,929,868	328,549	6,276,643
	46.7%	44.7%	39.2%	13.1%	16.2%	18.6%	2.1%	39.9%

Cropland BMP Needs: Structural

Acres Need Structural Treatment	Acres Needing New Terraces	Acres Needing Terrace Restoration	Acres of New Waterways	Acres of Waterway Restoration	Acres Needing Diversions	Acres Needing Grade Stabilization	Acres Needing Water/Sediment Control Basins
3,767,215	2,211,539	2,770,877	552,849	465,412	282,618	223,903	133,965
23.9%	14.0%	17.6%	3.5%	3.0%	1.8%	1.4%	0.9%

Acres Needing Conversion to Permanent Vegetation (Steep Slope)	Acres Needing Conversion to Wetland (swampy areas)
740,193	91,911
4.7%	0.6%

Livestock Needs

# Permitted CAFOs	# Other Confined Livestock Facilities	# Concentrated Non-Confined Livestock Operations	Total Acres of Pasture	Acres of Pasture Needing Treatment‡	Total Acres of Range Land	Acres of Range Land Needing Treatment (2005)‡
985	4,069	8,515	2,961,283	1,372,573	11,668,542	6,881,203
				46.4%		59.0%

*Data equal sum of 1992 NRI total acres for all counties that reported

**Percent equals acres reported divided by 1992 NRI Total acres

‡Percent based on "Total acres of Pasture" and "Total acres of Range Land," Respectively

All percentages, where not noted differently, are based on 100% being "Total Acres of Cropland"

Table 15: Jackson County Kansas NPS Needs Inventory by County

Kansas NPS Needs Inventory By County Jackson County

Acres Cropland Needing Treatment (a)	**Avg. Treatment Cost (Cropland) (g)**	**Total County Treatment Cost (Cropland)**
70500	$125	$8812500
Acres Pasture/Rangeland Needing Treatment (b)	**Avg. Treatment Cost (Range/Pasture) (h)**	**Total County Treatment Cost (Pasture/Rangeland)**
85198	$25	$2129950
Livestock Facilities Requiring Treatment (Cattle) (c)	**Avg. Treatment Cost Per Facility (i)**	**Total County Treatment Cost (Livestock Facilities)**
1377	$7500	$10327500
Failing Septic Systems (d)	**Avg. Cost For Upgrade/Replacement (j)**	**Total County Septic System Upgrade/Replacement Cost**
1110	$4500	$4995000
Hydromodification (Stream Miles Needing Treatment) (e)	**Avg. Cost For Stream Bank Stabilization (k)**	**Total County Hydromodification Cost**
52	$79200	$4118400

Active 319 Projects (f)	**Cost Per 319 Project (I)**
Banner Creek Water Quality Protection Project	$102,145
Alternative Livestock Water Supply & Protection Project	$20,000
Jepson Stream Bank Stabilization	$3,678

	Total County 319 Project Cost
	$125823
Total County NPS Need	$30509173

7.3 KANSAS Rapid Watershed Assessment - Middle Kansas Watershed Hydrologic Unit Code – 10270102, December 2006

Produced by:
United States Department of Agriculture
Natural Resources Conservation Service
760 South Broadway
Salina, Kansas 67401

Kansas Department of Health and Environment
Bureau of Water
Watershed Management Section
1000 S.W. Jackson
Topeka, Kansas 66612

The Middle Kansas Rapid Watershed Assessment (RWA) organizes resource information into one document that local conservationists, units of government, and others can use to identify existing resource conditions and conservation opportunities. This will enable the user to direct technical and financial resources to the local needs in the watershed. This RWA provides a brief description of the Middle Kansas sub-basin's natural resources, resource concerns, conservation needs, and ability to resolve natural resource issues and concerns.

It is estimated that there are 823 farms and 822 operators in the Middle Kansas sub-basin. The estimated farm size in 2002 was 436 acres, down from 440 acres from the 1987 estimate. Resource concerns are numerous in the sub-basin. They include, but are not limited to, soil erosion, soil condition, deteriorated surface water quality, deteriorating plant conditions, and erosion in developing urban areas. Economic issues such as the high capital costs of crop production and farm operation, and the high level of management required to operate the farm may delay the acceptance and implementation of conservation on agricultural lands in the sub-basin.

A copy of the assessment can be obtained at:
www.ks.nrcs.usda.gov/technical/RWA/

8.0 Critical Target Areas

8.1 Rock Creek (1027010201)

8.1.1 Priority Area and Implementation Schedule

Rock Creek *E.coli* and Soldier Creek sediment/biology concerns will be given priority over other areas for resource expenditures to implement BMP's due to limits on time and funding resources which are not sufficient to meet needs basin-wide. These areas were chosen as high priority based on consultation with KDHE staff and local partners that are currently working in the target areas.

Future prioritized water bodies, primarily due to TMDLs, include Shunganunga Creek (bacteria), including Lake Shawnee (eutrophication), Vermillion Creek (bacteria), Kansas River at Wamego (bacteria) and Wildcat Creek (bacteria).

The priority areas listed below are in priority order with an implementation schedule in years. Rock and Soldier Creeks will be addressed first from 2010 to 2020, followed by Shunga and Vermillion Creeks from 2015 to 2025, and lastly by Kansas River and Wildcat Creek from 2030 to 2040. This time frame is tentative and could change based on the success of BMP's being completed.

Priority Area Implementation Schedule:
2010-2020: Rock Creek (1027010201)
2010-2030: Soldier Creek (1027010208)
2015-2025: Shunga Creek (1027010209 -01, 02, 03) (including Lake Shawnee)
2020-2025: Vermillion Creek 1027010202)
2030-2035: Kansas River at Wamego (1027010205)
2035-2040: Wildcat Creek (1027010102 – 05, 06)

8.1.2 Land Cover/Use for Area

Most of the watershed is permanent grass (71.97%). Other land cover includes cropland (13.16%), forest (10.24%) and developed land (4.09%). Grazing density of livestock is moderately high for the watershed (42-44 animal units/sq. mi.). Cropland above the primary water quality monitoring site (Station 520) is restricted to areas adjacent to watercourses and the upper reaches of the watershed.

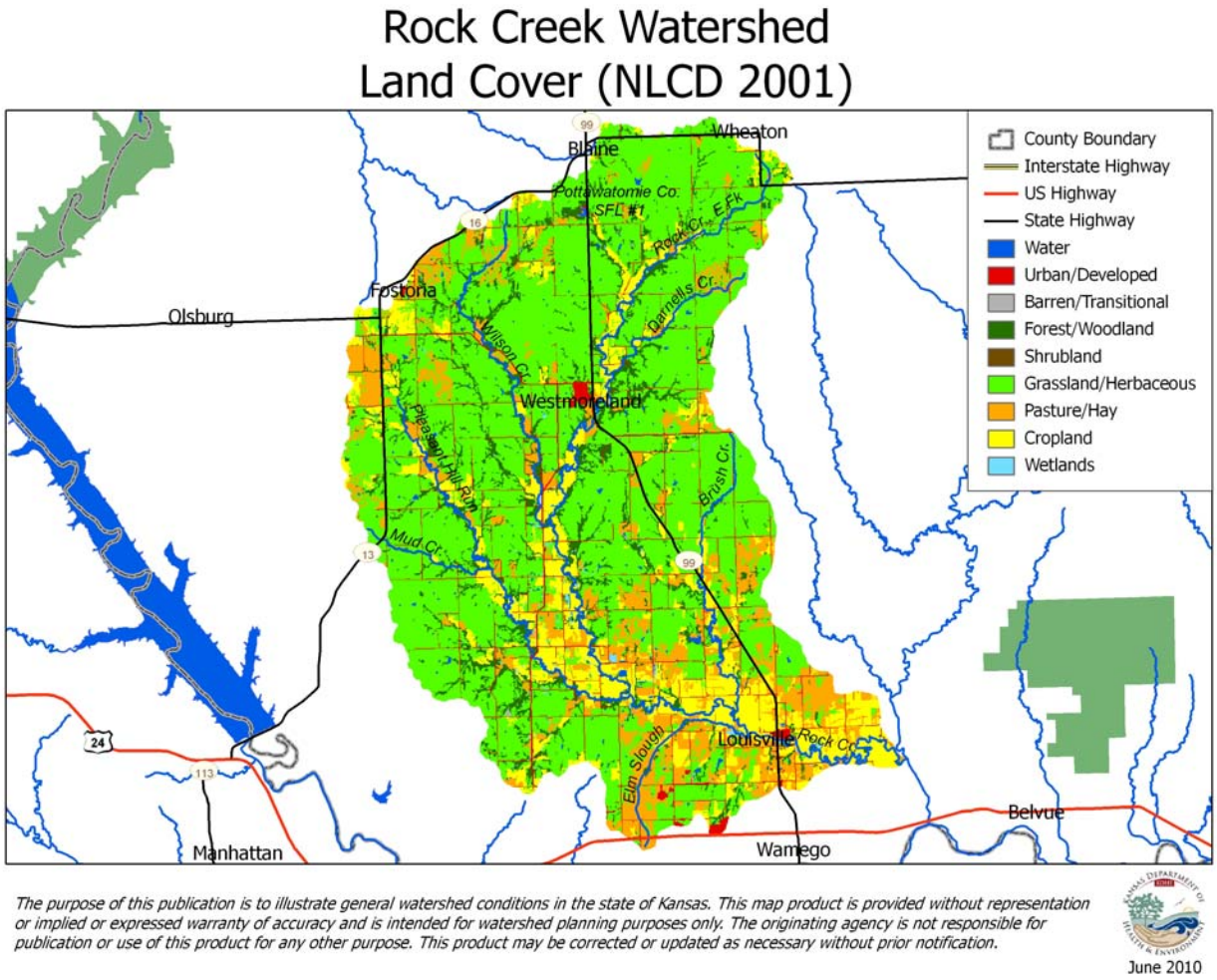


Figure 18: Rock Creek Land Cover

Figure 19 below provides an overview of Rock Creek Watershed.

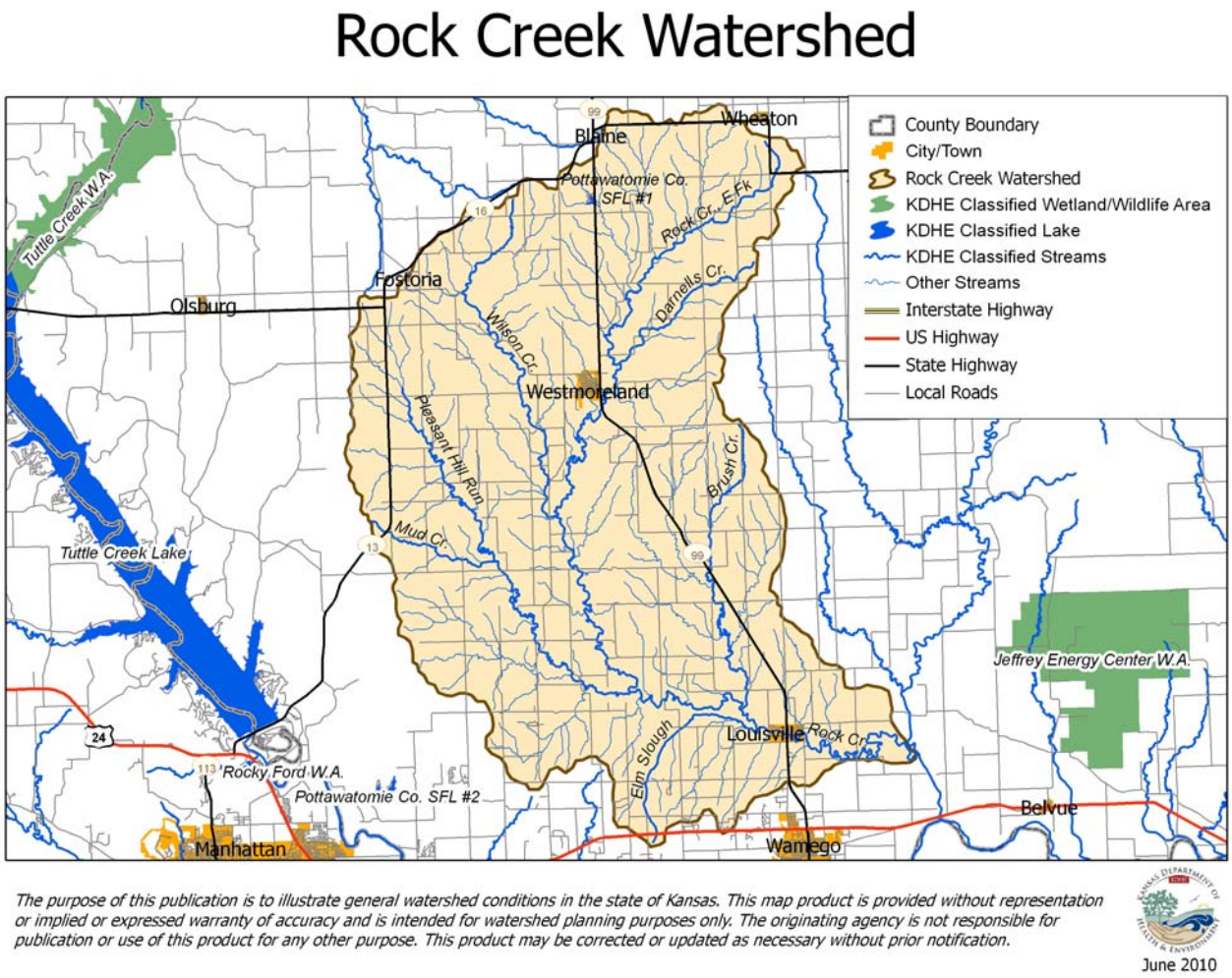


Figure 19: Overview of Rock Creek Watershed

The Rock Creek Watershed is further divided into five HUC 12 watersheds as depicted in Figure 20.

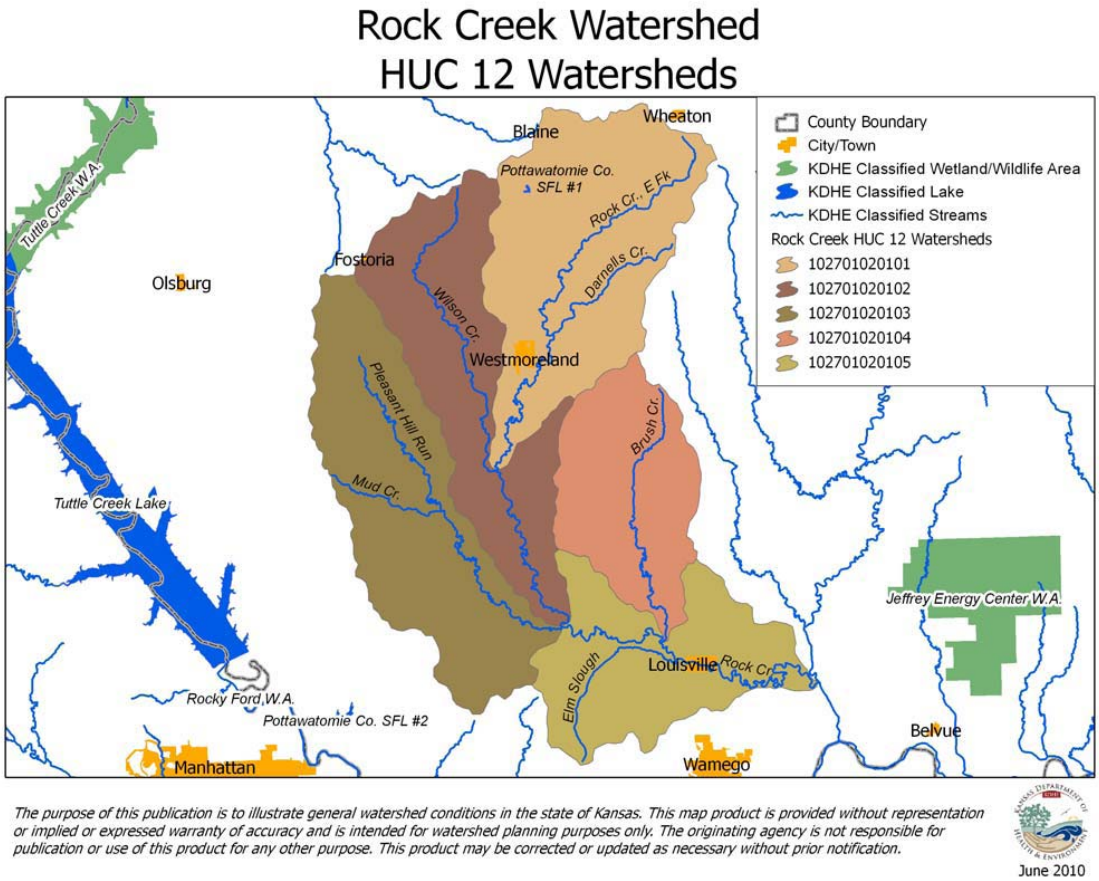


Figure 20: HUC 12 Watersheds in Rock Creek

8.1.3 Water Quality Impairments

Rock Creek has a High priority TMDL for *E. coli* bacteria. The water quality standard for *E. coli* is:

Geometric Means of at least five samples of *Escherichia coli (E. coli)* collected in separate 24-hour periods within a 30-day period shall not exceed the following criteria beyond the mixing zone

Primary Contact Recreation – Class B: 262 CFU/100 ml from April 1 to October 31; 2358 CFU/100 ml from November 1 to March 31

Primary Contact Recreation – Class C: 427 CFU/100 ml from April 1 to October 31; 3843 CFU/100 ml from November 1 to March 31

Secondary Contact Recreation – Class b: 3843 CFU/100 ml from January 1 to December 31 (KAR 28-16-28e(c)(7)(D & E))

8.1.4 Possible Nonpoint Pollution Sources for Bacteria TMDL

Based on the assessment of sources, the distribution of excursions from water quality standards and the relationship of those excursions to flow conditions, non-point sources are seen as the primary cause of water quality violations. Rock Creek has the second-to-worst overall condition, with the worst overall rank of all stations for *E. coli*, and poor rankings for nutrients and suspended solids. Additional information can be found in *The Watersheds of the Middle and Upper Kansas Sub-Basins: A Report on the Water Quality and Lands*, Eric Banner, September, 2008.

8.1.4.A *E. coli* Bacteria - Livestock Related Impairments

Livestock can contribute to nutrients and *E. coli* bacteria (**ECB)** in surface water through manure runoff. Soluble phosphorus can easily be transported in runoff from fields where livestock gather. Preventing manure runoff into streams is important in avoiding elevated phosphorus concentrations. Other nutrient issues can arise from fertilizers applied to non-native pastures used for livestock grazing. Nitrogen and phosphorus can originate from fertilizer runoff caused by either excess application or a rainfall event immediately after application. In addition to nutrients in manure ECB are present in livestock manure and can be transported into waterways if livestock have access to streams or manure is allowed to run off into a stream. A few BMPs that can assist are restricting cattle access to streams, maintaining adequate buffer areas, providing an alternate watering system and managing optimal grass cover.

It must be noted that not all ECB can be attributed to livestock. Wildlife has a contribution to ECB loads. In addition, failing septic systems can be a source of ECB bacteria from humans. However, for this WRAPS process, targeting will be for livestock

Activities in proximity to the stream may be contributing to the bacteria violations. These activities would include small livestock operations near the streams, as well as potentially failing on-site waste systems. Activities to reduce bacteria should be directed toward the smaller, unpermitted livestock operations and rural homesteads and farmsteads in the watershed.

8.1.4.B Phosphorus

Activities in proximity to the stream may be contributing to increased stream phosphorus levels. These activities would include small livestock operations near the streams, row crop agriculture, and failing on-site waste systems.

8.1.4.C Total Suspended Solids

Poor field cultivation practices, streambank erosion, and livestock activities adjacent streams can contribute to increased total suspended solids.

8.1.4.D On-Site Waste Systems

While the population density in the watershed is low, a number of residents in Pottawatomie County are in rural settings without sewer service, relying instead on on-site systems. Rural population for Pottawatomie County is projected to increase. Failing on-site waste systems can contribute bacteria loadings.

8.1.5 Possible Point Sources for Bacteria TMDL

NPDES permits: Corning MWTP (M-KS94-OO01), Havensville MWTP (MKS22-OO01), Louisville MWTP (M-KS37-NO01), Onaga MWTP (M-KS53-OO01), Westmoreland MWTP (M-KS75-OO01), Wheaton MWTP (M-KS79-OO01), Pottawatomie Co. S.D. – Fostoria (M-KS93-NO01), Rock Creek High School (M-KS75-NO04), Hamm (I-KS79-PO02). The Rock Creek watershed has a 303d listed impairment for bacteria and according to KDHE water quality monitoring data has exceeded the water quality standard for bacteria on several occasions. The frequency and magnitude of bacteria exceedances must be reduced on Rock Creek in order for the bacteria impairment to be removed. There is one facility in the watershed that contributes a regulated discharged concentration of bacteria to Rock Creek. The City of Westmoreland, discharges into Rock Creek and contributes bacteria concentrations well within the normal limits of its permit. Since this point source of bacteria is regulated and approved through the Kansas Department of Health and Environment, it cannot be subject to load reduction activities. The reduction of bacteria concentrations needed to remove the bacteria impairment for Rock Creek will have to come from nonpoint sources of pollution.

8.1.5.A Livestock Waste Management Systems

There are 30 permitted confined animal feeding operations in Rock/Vermillion Creek watersheds.

Animal Type	Total Animals
Beef	8,547
Chickens Dry	600000
Dairy	362
Swine	23,338
Swine, misc. others	14,066

Permitted facilities have systems designed for the 25 year, 24 hour rainfall/runoff event, which would be indicative of flow durations well under 10 percent of the time. The actual number of animal units on site is variable, but typically less than permitted numbers.

8.1.6 Priority Areas for the Rock Creek Watershed

The priority areas for the Rock Creek Watershed include Upper Rock Creek, HUC 102701020101 and Middle Rock Creek, HUC 102701020102.

These watersheds were chosen due to an impending TMDL for ECB. The SLT feels that it is wise to be proactive in ECB abatement. However, the BMPs that will be used for ECB reductions will also lead to beneficial reductions in phosphorus and nitrogen (nutrients) as well as sediment BMPs that have been mentioned in the previous section of this report.

There is no load reduction for ECB. There will soon be a TMDL for ECB in Rock Creek. Therefore, this plan only provides livestock BMP scenarios without load reductions for ECB.

The SLT has laid out specific BMPs that they have determined will be acceptable to watershed residents as listed below. **These BMPs will be implemented in the Livestock Targeted Area (Rock Creek Watershed). All these BMPs will simultaneously have a positive effect on reduction of phosphorus, nitrogen and sediment impairments.** Specific projects that need to be implemented per year have been determined and approved by the SLT.

Table 16. BMPs and Number of Projects to be Installed as Determined by the SLT Reducing ECB in Rock Creek Watershed.

Protection Measures	Best Management Practices and Other Actions	Total Projects Needed to be Implemented Annually
1. Prevention of ECB contribution from **livestock**	1.1 Relocate Feedlots	2
	1.2 Vegetative Filter Strip	2
	1.3 Relocate Pasture Feeding Site	2
	1.4 Alternative Watering System	3

8.1.7 Assessment Needs

Assessment needs in the Rock Creek Watershed include a combination of aerial assessment/ground truthing and water quality sampling as listed below in Table 17. Since Upper Rock and Middle Rock Creek have been assessed, BMP targeting is currently underway. All HUC's will be monitored for water quality with priority going to the HUC's that are primary contributors for bacteria. Plans are to begin assessments in the remaining 3 HUC's starting after July 1, 2012, with one being completed annually. Once the Rock Creek is delisted, activities will cease in Rock Creek and move into Vermillion Creek.

Table 17: Assessment & Monitoring Needs for Rock Creek

Assessment Needs					
Watershed	**TMDL**	**Type of Assessment**	**Water Quality Sampling**	**Technical Assistance**	**Financial Assistance**
Upper Rock Creek, HUC 102701020101	Bacteria	Aerial Completed	$400/sample x 2 samples = $800/site/yr.	KAWS	$800 WQS
Middle Rock Creek, HUC 102701020102	Bacteria	Aerial Completed	$400/sample x 2 samples = $800/site/yr.	KAWS	$800 WQS
Pleasant Hill Run/Mud Creek- 102701020103	Bacteria	Aerial/Ground truthing Combination @ $15,000	$400/sample x 2 samples = $800/site/yr.	KAWS	$800 WQS $15,000 Assessment
Brush Creek - 102701020104	Bacteria	Aerial/Ground truthing Combination @ $15,000	$400/sample x 2 samples = $800/site/yr.	KAWS	$800 WQS $15,000 Assessment
Lower Rock Creek - 102701020105	Bacteria	Aerial/Ground truthing Combination @ $15,000	$400/sample x 2 samples = $800/site/yr.	KAWS	$800 WQS $15,000 Assessment

Note: Water quality sampling will be used to determine which HUC 12 watersheds are assessed.

8.1.8 Implementation Activities to Address Pollutants

8.1.8.A Bacteria

1. Maintain necessary state and federal permits and inspect permitted facilities for permit compliance.
2. Install necessary manure and livestock waste storage of small operations in

watershed. Limit livestock access to streams by providing alternate water, feeding, and shelter sites.
3. Install grass filter strips, and woody buffer strips when applicable, along the stream.
4. Insure proper on-site waste system operations <100 meters from streams.

8.1.8.B Phosphorous

1. Install necessary manure and livestock waste storage of small operations in watershed. Limit livestock access to streams by providing alternate water, feeding, and shelter sites.
3. Install grass filter strips, and woody buffer strips when applicable, along the stream.

8.1.8.C Total Suspended Solids

1. Limit livestock access to streams by providing alternate water, feeding, and shelter sites.
2. Install grass filter strips, and woody buffer strips when applicable, along the stream.

8.1.9 Primary Participants for Implementation

Primary participants for implementation will be small livestock producers operating without need of permits within the priority sub-watershed. Implemented activities should be targeted at those areas with greatest potential to impact the stream. Nominally, this would be activities located within one mile of the streams including:
1. Facilities without water quality controls
2. Unpermitted permanent feeding/holding areas
3. Sites where drainage runs through or adjacent livestock areas
4. Sites where livestock have full access to stream and stream is primary water supply
5. Grazed acreage, overstocked acreage and acreage with poor range condition
6. Poor riparian sites
7. Near stream feeding sites
8. Failing on-site waste systems <100 meters from streams.

8.1.10 Rock Creek BMP Definitions, BMP Needs, Load Reductions, Cost for Livestock

Definition of BMPs

8.1.10.A Vegetative Filter Strip

- A vegetated area that receives runoff during rainfall from an animal feeding operation.
-Often require a land area equal to or greater than the drainage area (needs to be as large as the feedlot).
-10 year lifespan, requires periodic mowing or haying, average P reduction: 50%.
-$714 an acre

8.1.10.B Relocate Feeding Sites

-Feeding Pens- Move feedlot or pens away from a stream, waterway, or body of water to increase filtration and waste removal of manure. Highly variable in price, average of $6,600 per unit.
-Pasture- Move feeding site that is in a pasture away from a stream, waterway, or body of water to increase the filtration and waste removal (eg. move bale feeders away from stream). Highly variable in price, average of $2,203 per unit.
-Average P reduction: 30-80%

8.1.10.C Alternative (Off-Stream) Watering System

-Watering system so that livestock do not enter stream or body of water.
-Studies show cattle will drink from tank over a stream or pond 80% of the time.
-10-25 year lifespan, average P reduction: 30-98% with greater efficiencies for limited stream access.
-$3,795 installed for solar system, including present value of maintenance costs.

Average Stocking Rates for Middle Kansas Watershed:
One pair on 6.75 acres of native grass.
Average grazing dates: April 20-October 15.
- HUC 102701020102 = 34 sites x 28 head/site = 952 head

8.1.11 Rock Creek Livestock BMP Implementation Schedule, Load Reduction and Cost of Implementation

Table 18: Rock Creek Watershed BMPs, Costs, and Estimated Phosphorous Reduction

Rock Creek Watershed Livestock BMPs, Costs, and Estimated Phosphorous Reduction.					
BMP	**Approximate P Reduction Efficiency**	**Unit Cost**	**Estimated P Reduction (Pounds)**	**Additional Installations (Goal)**	**Total Estimated P Reduction**
Vegetative Filter Strip	50%	$714	638	2	1,276
Relocated Feedlot	50-90%	$6,621	957	2	1,914
Relocated Pasture Feeding Site					
Native Grass	50-90%	$2,203	76	1	76
Cool Season Grass	50-90%	$2,203	204	1	204
Off-Stream Watering System					
Native Grass	85%	$3,795	76	2	153
Cool Season Grass	85%	$3,795	204	1	204
Total Cost	$30,461				
Year 1 Cost	$3,046				
Year 10 Cost	$4,094				
Annual Estimate of Phosphorous Reduction (lbs)	3,827				
Cost of P Reduction over Project Life (25 Years)					
Phosphorous Reduction ($/lb)	$0.56				

Load Reduction Estimate Methodology

Livestock

Baseline nutrient loadings per animal unit are calculated using the Livestock Waste Facilities Handbook Livestock management practice load reduction efficiencies are derived from numerous sources including K-State Research and Extension Publication MF-2737 and MF-2454 Load reduction estimates available at MF-2737: http://www.oznet.ksu.edu/library/h20ql2/mf2737.pdf
MF-2454: http://www.oznet.ksu.edu/library/ageng2/mf2454.pdf

Table 19: Rock Creek Livestock BMPs Adoption Rate – Based on the aerial assessment and ground truthing, the following BMP's were determined to be needed to reach our water quality goals in the 10 year time frame.

Rock Creek Livestock BMPs Adoption Rate					
Year	Relocate Feedlot	Vegetative Filter Strip	Relocate Pasture Feeding Site	Alternative Watering System	Total
2011	2	2	2	3	9
2012	2	2	2	3	9
2013	2	2	2	3	9
2014	2	2	2	3	9
2015	2	2	2	3	9
2016	2	2	2	3	9
2017	2	2	2	3	9
2018	2	2	2	3	9
2019	2	2	2	3	9
2020	2	2	2	3	9

Table 20: Rock Creek Implementation Cost Before Cost-Share

Rock Creek Implementation Cost Before Cost-Share					
Year	Relocate Feedlot	Vegetative Filter Strip	Relocate Pasture Feeding Site	Alternative Watering System	Total
2011	$24,000	$1,430	$4,400	$11,385	$41,215
2012	$24,720	$1,473	$4,532	$11,727	$42,451
2013	$25,462	$1,517	$4,668	$12,078	$43,725
2014	$26,225	$1,563	$4,808	$12,441	$45,037
2015	$27,012	$1,609	$4,952	$12,814	$46,388
2016	$27,823	$1,658	$5,101	$13,198	$47,779
2017	$28,657	$1,707	$5,254	$13,594	$49,213
2018	$29,517	$1,759	$5,411	$14,002	$50,689
2019	$30,402	$1,811	$5,574	$14,422	$52,210
2020	$31,315	$1,866	$5,741	$14,855	$53,776

Table 21: Rock Creek Implementation Cost After Cost-Share

Rock Creek Implementation Cost After Cost-Share					
Year	Relocate Feedlot	Vegetative Filter Strip	Relocate Pasture Feeding Site	Alternative Watering System	Total
2011	$12,000	$715	$2,200	$5,693	$20,608
2012	$12,360	$736	$2,266	$5,863	$21,226
2013	$12,731	$759	$2,334	$6,039	$21,862
2014	$13,113	$781	$2,404	$6,220	$22,518
2015	$13,506	$805	$2,476	$6,407	$23,194
2016	$13,911	$829	$2,550	$6,599	$23,890
2017	$14,329	$854	$2,627	$6,797	$24,606
2018	$14,758	$879	$2,706	$7,001	$25,345
2019	$15,201	$906	$2,787	$7,211	$26,105
2020	$15,657	$933	$2,871	$7,427	$26,888

Table 22: Rock Creek Estimated Phosphorous Load Reduction from Livestock BMPs

Rock Creek Estimated Phosphorous Load Reduction (lbs.)						
Year	Relocate Feedlot	Vegetative Filter Strip	Relocate Pasture Feeding Site	Alternative Watering System	Annual Total	Cumulative Load Reduction
2011	1,914	1,276	280	357	3,827	3,827
2012	1,914	1,276	280	357	3,827	7,654
2013	1,914	1,276	280	357	3,827	11,481
2014	1,914	1,276	280	357	3,827	15,308
2015	1,914	1,276	280	357	3,827	19,135
2016	1,914	1,276	280	357	3,827	22,962
2017	1,914	1,276	280	357	3,827	26,789
2018	1,914	1,276	280	357	3,827	30,616
2019	1,914	1,276	280	357	3,827	34,443
2020	1,914	1,276	280	357	3,827	38,270

Table 23: Rock Creek Estimated Nitrogen Load Reduction from Livestock BMPs

Rock Creek Estimated Nitrogen Load Reduction (lbs.)						
Year	Relocate Feedlot	Vegetative Filter Strip	Relocate Pasture Feeding Site	Alternative Watering System	Annual Total	Cumulative Load Reduction
2011	3,605	2,403	528	672	7,208	7,208
2012	3,605	2,403	528	672	7,208	14,416
2013	3,605	2,403	528	672	7,208	21,624
2014	3,605	2,403	528	672	7,208	28,832
2015	3,605	2,403	528	672	7,208	36,041
2016	3,605	2,403	528	672	7,208	43,249
2017	3,605	2,403	528	672	7,208	50,457
2018	3,605	2,403	528	672	7,208	57,665
2019	3,605	2,403	528	672	7,208	64,873
2020	3,605	2,403	528	672	7,208	72,081

BMP tables provided by Josh Roe, Watershed Economist, Kansas State University

Table 24: Rock Creek Total Nitrogen Load Reduction

Rock Creek Total Nitrogen Reduction		
Year	Livestock Reduction (lbs)	Total Reduction (lbs)
1	7,208	7,208
2	14,416	21,624
3	21,624	28,832
4	28,832	36,041
5	36,041	43,249
6	43,249	50,457
7	50,457	57,457
8	57,665	64,873
9	64,873	72,081
10	72,081	79,289

Table 25: Rock Creek Total Phosphorous Load Reduction

Rock Creek Total Phosphorous Reduction		
Year	Livestock Reduction (lbs)	Total Reduction (lbs)
1	3,827	3,827
2	7,654	7,684
3	11,481	15,308
4	15,308	19,135
5	19,135	22,962
6	22,962	26,879
7	26,789	30,616
8	30,616	34,616
9	34,443	38,270
10	38,270	42,097

Next Steps for Addressing Additional Water Quality Impairments in Rock Creek

In the event BMP installation in HUC 102701020101 and HUC 102701020102 does not meet the TMDL for bacteria, the following associated watersheds in Rock Creek are targeted for additional implementation to address the bacteria TMDL. These areas will first receive an aerial assessment followed by targeting of BMP's identified in the assessment:

1. 102701020103 – Pleasant Hill Run-Mud Creek
2. 102701020104 – Brush Creek
3. 102701020105 – Lower Rock Creek

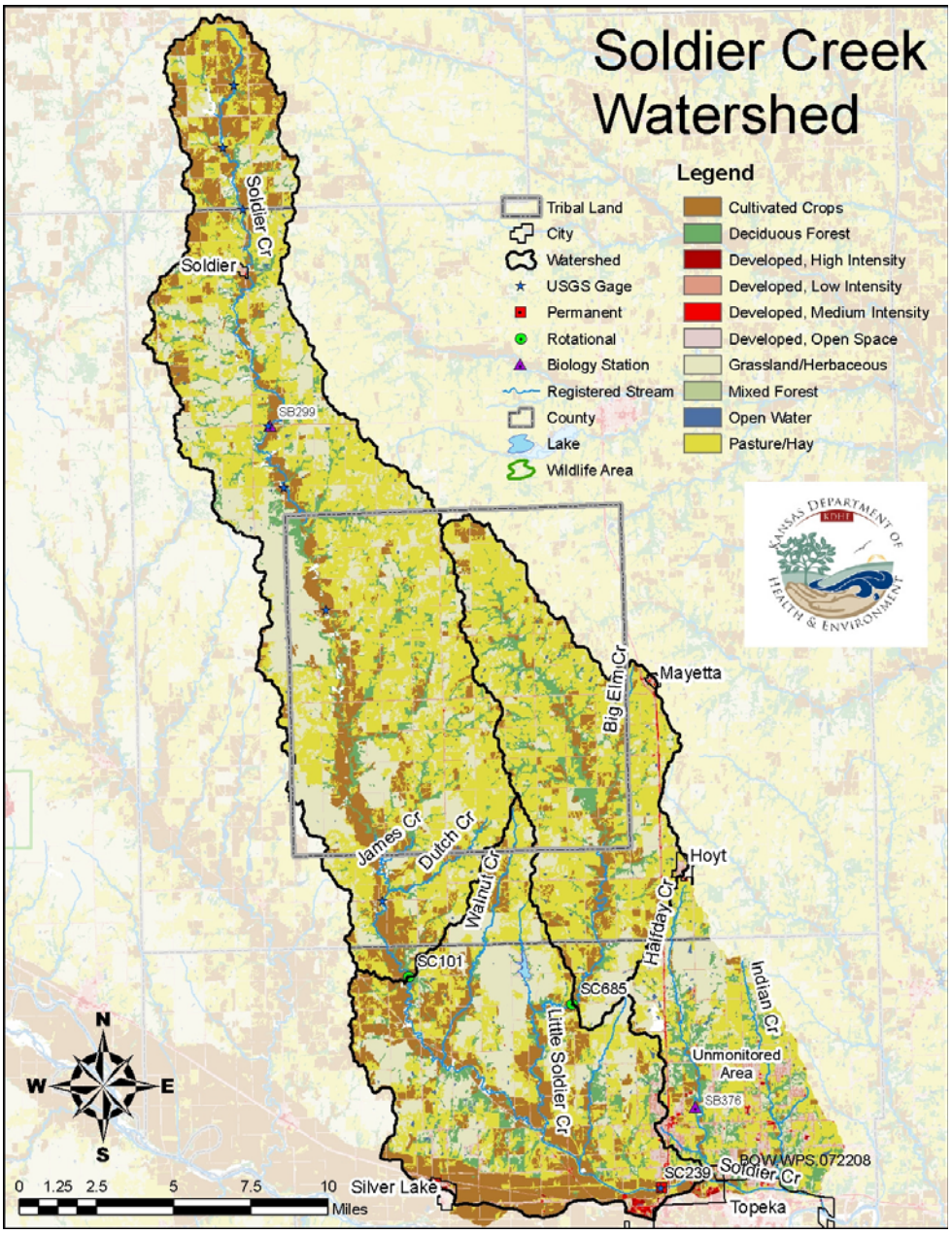
8.2. Upper Soldier Creek

8.2.1 Land cover/use for area

The Kansas GAP dataset was used to analyze land use patterns in the watershed. Most of the watershed is grassland (native and non-native) (58%), cropland (22%), and woodland (15%). Reservation land use patterns are similar to those of the watershed as a whole. A hundred foot buffer was applied to the state rivershed network, and land use data were analyzed to determine near stream riparian land use. Cropland levels are similar within the hundred foot

buffer (19%) as compared to the watershed as a whole (22%); however prairie is substantially replaced with woodland.

Figure 26: Land Use for Soldier Creek Watershed



8.2.2 Water Quality Impairments

Upper Soldier Creek has a High priority TMDL for Biology/Sediment. The ultimate endpoint for the High priority Biology TMDL will be when suspended solids added to surface waters by artificial sources shall not interfere with the behavior, reproduction, physical habitat or other factor related to the survival and

propagation of aquatic or semi-aquatic or terrestrial wildlife. (KAR 28-16-28e(c)(2)(B)).

The use of biological indices allows assessment of the cumulative impacts of dynamic water quality on aquatic communities present within the stream. As such, these index values serve as a baseline of biological health of the stream. Sampling occurs during open water season (April to November) within the aquatic stage of the life cycle of the macroinvertebrates. As such there is no described seasonal variation of the desired endpoint of this TMDL. The desired endpoint will be an average EPT count of 48% or greater over 2006-2011. Additionally, MBI values should approach 4.5 as additional evidence of improved biological condition is achieved. Achievement of this endpoint would be indicative of full support of the aquatic life use in the stream reach, therefore the narrative water quality standard pertaining to suspended solids would be attained.

Suspended sediment is an important factor influencing biological activity in this system. Sediment loads are correlated with nutrient loading and coliform loading. At levels below 100mg/l of total suspended solids (TSS) phosphorus and fecal coliform levels are low. Sampling occurs year round, and TSS levels greater than 100 mg/l have been measured in all seasons. There is no described seasonal variation of this TMDL. The desired endpoint is average TSS levels below 100 mg/l over 2006-2011 at Delia for flows less than 1000 cfs.

8.2.3 Priority Areas for the Upper Soldier Creek Watershed

The priority areas for the Upper Soldier Creek Watershed include HUC 102701020801, HUC 102701020802 and HUC 102701020803. The watersheds were selected in consultation with the KDHE – Watershed Planning Section and the Middle Kansas SLT. Figure 21 below illustrates the three priority watersheds. The square box delineates the boundary of the Prairie Band Pottawatomie Nation.

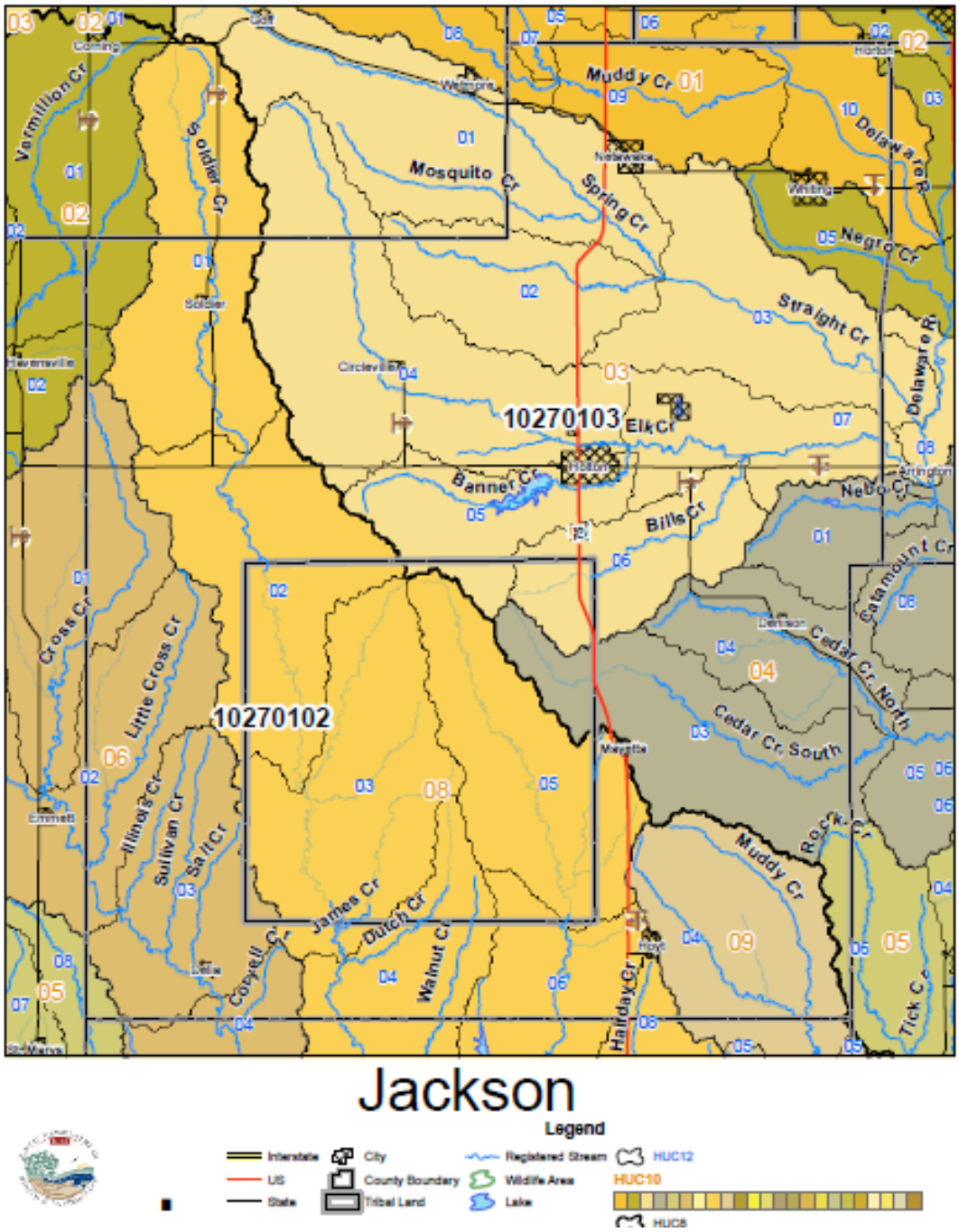


Figure 21: Upper Soldier Creek Watershed – HUC102701020801, HUC HUC102701020802 and HUC102701020803

8.2.4 Potential Nonpoint Pollution Sources Impacting Streams

8.2.4.A Total Suspended Solids

Poor field cultivation practices, streambank erosion, and livestock activities adjacent streams can contribute to increased total suspended solids.

Overland runoff carries sediment from the land surface within the watershed into the streams. Non-point sources are implicated as a primary source of these loadings. Additional assessment is necessary to quantify the specific sources of the solids loading. Because solid loadings are strongly linked with discharge, management changes that reduce solid loading at high flows will be particularly important for addressing the identified impairment. Protection and restoration of the riparian corridor and floodplain are recommended as important management strategies for reducing peak flows and reducing erosion related loading in Soldier Creek.

At this point, the Load Allocation will be a reduction of sediment loadings such that average total suspended solids concentrations are below 100 mg/L in stream a majority of the time. This is, effectively, a 35% reduction in TSS from current averages at flows less than 1000 cfs, the 2 percent exceedence flow.

8.2.5 Possible Point Pollution Sources Impacting Streams

NPDES permits: The Prairie Band Pottawatomie (KS0096202) . The TSS/Biology TMDL for Upper Soldier Creek states that there is currently 27,900 tons/yr (76 tons/day) of sediment entering the stream. The TMDL states that in order for the stream to meet designated uses the annual load should be reduced enough to meet the water quality standard of 100 mg/L TSS. This would be a total sediment load reduction of 18,400 tons/yr (KDHE, July 2010). There is one facility in the watershed that contributes a regulated discharge of sediment (TSS) into Soldier Creek. The City of Soldier discharges an average of 35 mg/l TSS/day into the creek. Since this point source is regulated and approved through the Kansas Department of Health and Environment, it cannot be subject to load reduction activities. The 18,400 tons/yr of sediment reduction needed to meet the TSS/Biology TMDL for Upper Soldier Creek will have to come from nonpoint sources of pollution.

8.2.6 Implementation Activities to Address Pollutants

Total Suspended Solids

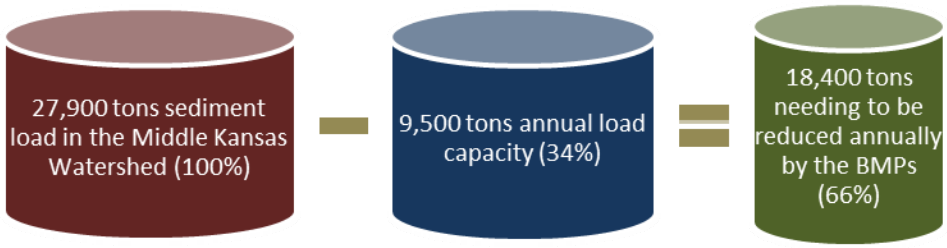
1. Implement and maintain conservation farming, including conservation tillage and no till farming.

2. Install grass buffer strips along streams.
3. Established terraces and waterways in erodible fields
4. Establish sediment basins to trap sediment before it goes into a stream
5. Establish wetlands to trap sediments and nutrients
6. Re-establish permanent vegetation in highly erodible areas next to streams

Primary participants for implementation will likely be agricultural producers operating within the drainage of the priority sub-watershed.

8.2.7 Sediment Goal for Reduction, BMPs with Acres or Projects Needed

The current estimated sediment load from nonpoint sources in the Middle Kansas Watershed is 27,900 tons per year according to the TMDL section of KDHE. **The total annual load reduction allocated to Middle Kansas Watershed needed to meet the sediment TMDL is 18,400 tons of sediment**. This is the amount of sediment that needs to be removed from the watershed and is the target of the BMP installations that will be placed in the watershed. These BMPs have been determined as feasible and approved by the SLT.



The SLT has laid out specific BMPs that they have determined will be acceptable to watershed residents as listed below. **These BMPs will be implemented in the cropland and streambank targeted areas.** An added bonus is that the cropland and streambank BMPs aimed at sediment reduction will also have a positive effect on nutrient/phosphorus runoff. Phosphorus and nitrogen load reduction tables for implemented sediment BMPs are also included in this section. Specific acreages or projects that need to be implemented per year have been determined along with economic analysis and approved by the SLT.

Table 27: BMPs and Acres or Feet Implemented Annually Aimed at Reducing Sediment Contribution Towards the Biology TMDL in Soldier Creek.

Protection Measures	Best Management Practices and Other Actions	Total Acres Needed to be Implemented Annually
1.0 Prevention of sediment (TSS) contribution from **cropland**	1.1 Permanent Vegetation	55 acres
	1.2 Grassed Waterways	184 treated acres
	1.3 No-Till	184 acres
	1.4 Vegetative Buffers	184 treated acres
	1.5 Terraces	275 acres
	1.6 Sediment Basins	92 treated acres
	1.7 Wetlands	9 treated acres
2. Prevention of sediment (TSS) contribution from **streambank** erosion	Streambank Restoration	Repair 500 feet of eroding streambank

Load Reduction Estimate Methodology

Cropland

Baseline loadings are calculated using the SWAT model delineated to the HUC 14 watershed scale. Best management practice (BMP) load reduction efficiencies are derived from K-State Research and Extension Publication MF-2572. Load reduction estimates are the product of baseline loading and the applicable BMP load reduction efficiencies.

8.2.8 Soldier Creek Crop BMP Implementation Schedule, Load Reduction and Cost of Implementation

Definitions of Cropland BMPs

8.2.8.A Vegetative Buffer

-Area of field maintained in permanent vegetation to help reduce nutrient and sediment loss from agricultural fields, improve runoff water quality, and provide habitat for wildlife.
-On average for Kansas fields, 1 acre buffer treats 15 acres of cropland.
-50% erosion reduction efficiency, 50% phosphorous reduction efficiency
Cost-share assistance is available under the CCRP Program administered by the Farm Service Agency. Additional incentive payments are available to landowners in eligible areas through the Kansas Water Quality Initiative administered through the Kansas Department of Agriculture – Division of Conservation to the local conservation districts.

-Approx. $1,000/acre. The EQIP program pays a flat rate with no percentage and is available from NRCS.

8.2.8.B Grassed Waterway

-Grassed strip used as an outlet to prevent silt and gully formation.
-Can also be used as outlets for water from terraces.
-On average for Kansas fields, 1 acre waterway will treat 10 acres of cropland.
-40% erosion reduction efficiency, 40% phosphorous reduction efficiency.
-$1,600 an acre. The EQIP program is a flat rate with no percentage and is available from NRCS.
- Diversion and sediment basin are two practices put together. Height of the practice determines which practice code is used.

8.2.8.C No-Till

-A management system in which chemicals may be used for weed control and seedbed preparation.
-The soil surface is never disturbed except for planting or drilling operations in a 100% no-till system.
-75% erosion reduction efficiency, 40% phosphorous reduction efficiency.
-WRAPS groups and KSU Ag Economists have decided $10 an acre for 10 years is an adequate payment to entice producers to convert, 50% cost-share available from NRCS.

8.2.8.D Terraces

-Earth embankment and/or channel constructed across the slope to intercept runoff water and trap soil.
-One of the oldest/most common BMPs
-30% Erosion Reduction Efficiency, 30% phosphorous reduction efficiency
- $.92 flat rate for gradient terraces
-$1.25 flat rate for tile terraces.
-Underground outlets associated with tile terraces cost is $4.51/LF flat rate for 4-6" pipe and $7.26/LF for 8-10" Pipe.

8.2.8.E Sediment Basin

-Water impoundment made by constructing an earthen dam.
-Traps sediment and nutrients from leaving edge of field.
-50% P Reduction.
-Approximately $300 per acre that drains into the basin.

8.2.8.F Wetland Creation

-Creating a wetland where water covers the soil, or is present at the surface of the soil all year or for varying periods of the year, including the growing season.

-30% erosion and P reduction efficiency.
-50% cost-share available from NRCS
-One acre of wetland will treat 15 acres of cropland, on average.
-Average construction costs of $11,000 per acre, $1,100 per treated acre.

Streambank Stabilization

8.2.8.G Streambank Stabilization BMPs

- BMPs range from soil-bioengineering to structural practices including weirs, vanes, and longitudinal peak stone toe.

Table 28: Combined Cropland and Streambank Load Reductions Aimed at Reducing Sediment Contribution in the Biology TMDL in Soldier Creek.

Combined Annual Erosion Reduction (tons)				
Year	Streambank Reduction (tons)	Cropland Reduction (tons)	Total Reduction (tons)	% of TMDL
1	750	211	961	5%
2	1,500	422	1,922	10%
3	2,250	633	2,883	16%
4	3,000	844	3,844	21%
5	3,750	1,055	4,805	26%
6	4,500	1,266	5,766	31%
7	5,250	1,477	6,727	37%
8	6,000	1,688	7,688	42%
9	6,750	1,900	8,650	47%
10	7,500	2,111	9,611	52%
11	8,250	2,322	10,572	57%
12	9,000	2,533	11,533	63%
13	9,750	2,744	12,494	68%
14	10,500	2,955	13,455	73%
15	11,250	3,166	14,416	78%
16	12,000	3,377	15,377	84%
17	12,750	3,588	16,338	89%
18	13,500	3,799	17,299	94%
19	14,250	4,010	18,260	99%
20	15,000	4,221	19,221	104%
Load Reduction to meet Sediment TMDL is 18,400 Tons				

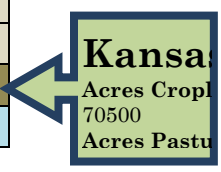


Table 29: Sediment Load Reduction at the End of Twenty Years by Category Aimed at Reducing Sediment Contribution in the Biology TMDL in Soldier Creek.

Best Management Practice Category	Total Load Reduction (tons)	% of Sediment TMDL
Cropland	4,221	22.9%
Streambank	15,000	81.5%
Total	**19,221**	**104.5%**

Table 30: Soldier Creek Cropland BMPs, Costs, and Reduction Efficiencies

Soldier Creek Cropland BMPs, Costs, and Reduction Efficiencies					
Best Management Practice	**Cost per Acre**	**Available Cost-Share**	**Erosion Reduction Efficiency**	**Phosphorous Reduction Efficiency**	**Nitrogen Reduction Efficiency**
Permanent Vegetation	$150	Flat Rate	95%	95%	95%
Grassed Waterways	$1600	Flat Rate	40%	40%	40%
No-Till	$78	Flat Rate	75%	40%	25%
Vegetative Buffers	$67	FSA - 90%	50%	50%	25%
Terraces	$125	Flat Rate	30%	30%	30%
Sediment Basins	$300	Flat Rate	50%	50%	25%
Wetlands	$1,100	Flat Rate	30%	30%	25%

Table 31. Soldier Creek Annual Soil Erosion Reduction from Cropland BMPs

Annual Soil Erosion Reduction (tons), Cropland BMPs								
Year	**Permanent Vegetation**	**Grassed Waterways**	**No-Till**	**Vegetative Buffers**	**Terraces**	**Sediment Basins**	**Wetlands**	**Total Load Reduction**
1	*23*	*32*	*60*	*40*	*36*	*20*	*1*	***211***
2	*45*	*64*	*119*	*80*	*72*	*40*	*2*	***422***
3	*68*	*96*	*179*	*119*	*108*	*60*	*4*	***633***
4	*91*	*127*	*239*	*159*	*143*	*80*	*5*	***844***
5	*113*	*159*	*299*	*199*	*179*	*100*	*6*	***1,055***
6	*136*	*191*	*358*	*239*	*215*	*119*	*7*	***1,266***
7	*159*	*223*	*418*	*279*	*251*	*139*	*8*	***1,477***
8	*182*	*255*	*478*	*319*	*287*	*159*	*10*	***1,688***
9	*204*	*287*	*538*	*358*	*323*	*179*	*11*	***1,900***
10	*227*	*319*	*597*	*398*	*358*	*199*	*12*	***2,111***
11	*250*	*350*	*657*	*438*	*394*	*219*	*13*	***2,322***

12	*272*	*382*	*717*	*478*	*430*	*239*	*14*	***2,533***
13	*295*	*414*	*777*	*518*	*466*	*259*	*16*	***2,744***
14	*318*	*446*	*836*	*558*	*502*	*279*	*17*	***2,955***
15	*340*	*478*	*896*	*597*	*538*	*299*	*18*	***3,166***
16	*363*	*510*	*956*	*637*	*573*	*319*	*19*	***3,377***
17	*386*	*542*	*1,015*	*677*	*609*	*338*	*20*	***3,588***
18	*409*	*573*	*1,075*	*717*	*645*	*358*	*22*	***3,799***
19	*431*	*605*	*1,135*	*757*	*681*	*378*	*23*	***4,010***
20	*454*	*637*	*1,195*	*796*	*717*	*398*	*24*	***4,221***

Table 32: Soldier Creek Annual Phosphorous Reduction from Cropland BMP

Annual Phosphorous Reduction (pounds), Cropland BMPs								
Year	**Permanent Vegetation**	**Grassed Waterways**	**No-Till**	**Vegetative Buffers**	**Terraces**	**Sediment Basins**	**Wetlands**	**Total Load Reduction**
1	133	187	187	234	211	117	7	**1,076**
2	267	374	374	468	421	234	14	**2,153**
3	400	562	562	702	632	351	21	**3,229**
4	533	749	749	936	842	468	28	**4,305**
5	667	936	936	1,170	1,053	585	35	**5,381**
6	800	1,123	1,123	1,404	1,263	702	42	**6,458**
7	934	1,310	1,310	1,638	1,474	819	49	**7,534**
8	1,067	1,497	1,497	1,872	1,685	936	56	**8,610**
9	1,200	1,685	1,685	2,106	1,895	1,053	63	**9,687**
10	1,334	1,872	1,872	2,340	2,106	1,170	70	**10,763**
11	1,467	2,059	2,059	2,574	2,316	1,287	77	**11,839**
12	1,600	2,246	2,246	2,808	2,527	1,404	84	**12,916**
13	1,734	2,433	2,433	3,042	2,738	1,521	91	**13,992**
14	1,867	2,621	2,621	3,276	2,948	1,638	98	**15,068**
15	2,001	2,808	2,808	3,510	3,159	1,755	105	**16,144**
16	2,134	2,995	2,995	3,744	3,369	1,872	112	**17,221**
17	2,267	3,182	3,182	3,978	3,580	1,989	119	**18,297**
18	2,401	3,369	3,369	4,212	3,790	2,106	126	**19,373**
19	2,534	3,556	3,556	4,446	4,001	2,223	133	**20,450**
20	2,667	3,744	3,744	4,680	4,212	2,340	140	**21,526**

Table 33: Soldier Creek Annual Soil Nitrogen Reduction from Cropland BMPs

Annual Nitrogen Reduction (pounds), Cropland BMPs								
Year	Permanent Vegetation	Grassed Waterways	No-Till	Vegetative Buffers	Terraces	Sediment Basins	Wetlands	Total Load Reduction
1	585	821	513	513	923	256	26	**3,637**
2	1,169	1,641	1,026	1,026	1,846	513	51	**7,273**
3	1,754	2,462	1,539	1,539	2,770	769	77	**10,910**
4	2,339	3,283	2,052	2,052	3,693	1,026	103	**14,546**
5	2,924	4,103	2,565	2,565	4,616	1,282	128	**18,183**
6	3,508	4,924	3,077	3,077	5,539	1,539	154	**21,819**
7	4,093	5,745	3,590	3,590	6,463	1,795	180	**25,456**
8	4,678	6,565	4,103	4,103	7,386	2,052	205	**29,093**
9	5,263	7,386	4,616	4,616	8,309	2,308	231	**32,729**
10	5,847	8,207	5,129	5,129	9,232	2,565	256	**36,366**
11	6,432	9,027	5,642	5,642	10,156	2,821	282	**40,002**
12	7,017	9,848	6,155	6,155	11,079	3,077	308	**43,639**
13	7,601	10,669	6,668	6,668	12,002	3,334	333	**47,275**
14	8,186	11,489	7,181	7,181	12,925	3,590	359	**50,912**
15	8,771	12,310	7,694	7,694	13,849	3,847	385	**54,549**
16	9,356	13,131	8,207	8,207	14,772	4,103	410	**58,185**
17	9,940	13,951	8,720	8,720	15,695	4,360	436	**61,822**
18	10,525	14,772	9,232	9,232	16,618	4,616	462	**65,458**
19	11,110	15,593	9,745	9,745	17,542	4,873	487	**69,095**
20	11,694	16,413	10,258	10,258	18,465	5,129	513	**72,731**

Table 34: Soldier Creek Annual Adoption, Cropland BMPs

Annual Adoption (treated acres), Cropland BMPs								
Year	Permanent Vegetation	Grassed Waterways	No-Till	Vegetative Buffers	Terraces	Sediment Basins	Wetlands	Total Adoption
1	55	184	184	184	275	92	9	982
2	55	184	184	184	275	92	9	982

3	55	184	184	184	275	92	9	982
4	55	184	184	184	275	92	9	982
5	55	184	184	184	275	92	9	982
6	55	184	184	184	275	92	9	982
7	55	184	184	184	275	92	9	982
8	55	184	184	184	275	92	9	982
9	55	184	184	184	275	92	9	982
10	55	184	184	184	275	92	9	982
11	55	184	184	184	275	92	9	982
12	55	184	184	184	275	92	9	982
13	55	184	184	184	275	92	9	982
14	55	184	184	184	275	92	9	982
15	55	184	184	184	275	92	9	982
16	55	184	184	184	275	92	9	982
17	55	184	184	184	275	92	9	982
18	55	184	184	184	275	92	9	982
19	55	184	184	184	275	92	9	982
20	55	184	184	184	275	92	9	982

The Annual adoption of treated acres totals 19,640 which appears to exceed the needs inventory which established a need of 10,071 acres. This is in part because some BMPs could be installed on the same acre, such as Grassed Waterways and Terraces and Vegetative Buffers. In addition, the amount of acres needing treatment was a rough estimate based upon 2006 best professional judgment. The plan will be evaluated to determine whether the water quality milestones and BMP milestones are being met in 5 years. The plan will be adjusted accordingly to better balance watershed needs with load reduction needs as a result of BMP implementation.

Table 35: Soldier Creek Sediment Reduction, Streambank and Cropland

Soldier Creek Sediment Reduction, Streambank and Cropland				
Year	**Streambank Reduction (tons)**	**Cropland Reduction (tons)**	**Total Reduction (tons)**	**% of TMDL**
1	750	211	961	5%
2	1,500	422	1,922	10%
3	2,250	633	2,883	16%
4	3,000	844	3,844	21%
5	3,750	1,055	4,805	26%

6	4,500	1,266	5,766	31%
7	5,250	1,477	6,727	37%
8	6,000	1,688	7,688	42%
9	6,750	1,900	8,650	47%
10	7,500	2,111	9,611	52%
11	8,250	2,322	10,572	57%
12	9,000	2,533	11,533	63%
13	9,750	2,744	12,494	68%
14	10,500	2,955	13,455	73%
15	11,250	3,166	14,416	78%
16	12,000	3,377	15,377	84%
17	12,750	3,588	16,338	89%
18	13,500	3,799	17,299	94%
19	14,250	4,010	18,260	99%
20	15,000	4,221	19,221	104%
Load Reduction to meet Sediment TMDL:				**18,400**
	Best Management Practice Category	**Total Load Reduction (tons)**	**% of Sediment Goal**	
	Cropland	4,221	22.90%	
	Streambank	15,000	81.50%	
	Total	**19,221**	**104.50%**	

Table 36. Soldier Creek Annual Streambank Load Reductions and Cost

Soldier Creek Annual Streambank Load Reductions and Cost						
Year	**Streambank Stabilization (feet)**	**Soil Load Reduction (tons)**	**Cumulative Erosion Reduction (tons)**	**Phosphorous Reduction (lbs)**	**Cumulative P Load Reduction (lbs)**	**Cost***
1	500	750	750	45	45	$35,750
2	500	750	1,500	45	90	$36,823
3	500	750	2,250	45	135	$37,927
4	500	750	3,000	45	180	$39,065
5	500	750	3,750	45	225	$40,237

6	500	750	4,500	45	270	$41,444
7	500	750	5,250	45	315	$42,687
8	500	750	6,000	45	360	$43,968
9	500	750	6,750	45	405	$45,287
10	500	750	7,500	45	450	$46,646
11	500	750	8,250	45	495	$48,045
12	500	750	9,000	45	540	$49,486
13	500	750	9,750	45	585	$50,971
14	500	750	10,500	45	630	$52,500
15	500	750	11,250	45	675	$54,075
16	500	750	12,000	45	720	$55,697
17	500	750	12,750	45	765	$57,368
18	500	750	13,500	45	810	$59,089
19	500	750	14,250	45	855	$60,862
20	500	750	15,000	45	900	$62,688
**3% Inflation*						

8.2.9 Assessment and Monitoring Needs in the Upper Soldier Creek Watershed

Assessment and monitoring needs are shown below in Table 37. HUCs 10270102080, 102701020802, and 102701020803 have had an aerial assessment. If implementation in the three watersheds doesn't result in TMDL delisting, water quality sampling may be needed in all three HUCs to further locate contributing sites to the biology impairment.

Table 37: Assessment and Monitoring Needs for Soldier Creek

	Assessment and Monitoring Needs				
Watershed	**TMDL**	**Water Quality Sampling**	**Aerial Assessment**	**Technical Assistance**	**Financial Assistance**
Soldier Creek - HUC 102701020801	Biology	$400/sample x 2 samples = $800/site/yr.		KAWS	$800
Soldier Creek- HUC 102701020802	Biology	$400/sample x 2 samples = $800/site/yr.		KAWS	$800
Soldier Creek- HUC 102701020803	Biology	$400/sample x 2 samples = $800/site/yr.	$15,000/HUC 12	KAWS	$15,000

8.3. Shunganunga Creek

8.3.1 Water Quality Impairments

Shunganunga Creek has a High priority TMDL for Bacteria. The creek also has 303d listed impairments for Lake Shawnee (Eutrophication), total phosphorus, and the Topeka Public Golf Course Lake (Eutrophication). The WRAPS is currently funding an assessment which will be completed in the fall of 2010. Based on the BMP's identified in the assessment, the City of Topeka and the Shawnee County Conservation District will begin implementing BMP's. As soon as Soldier Creek or Rock Creek are delisted, this area will become a high priority area for the WRAPS.

The ultimate endpoint for the High priority Bacteria TMDL will be to achieve the Kansas Water Quality Standard for Recreation (Fecal Coliform Bacteria: 2000 colonies per 100 ml for Secondary (KAR 28-16-28e(c)(7)(C)); 900 colonies per 100 ml for Primary (KAR 28-16-28e(c)(7)(B). This endpoint will be reached as a result of improvements in tributary buffer strip conditions, remediation of small livestock operations near the streams, as well as fixing failing on-site waste systems, and addressing stormwater that could easily be carrying waste material into streams.

8.3.2 The Shunganunga Creek Priority Area

The Shunganunga priority area includes HUCs: (1027010209 -01, 02,03.)

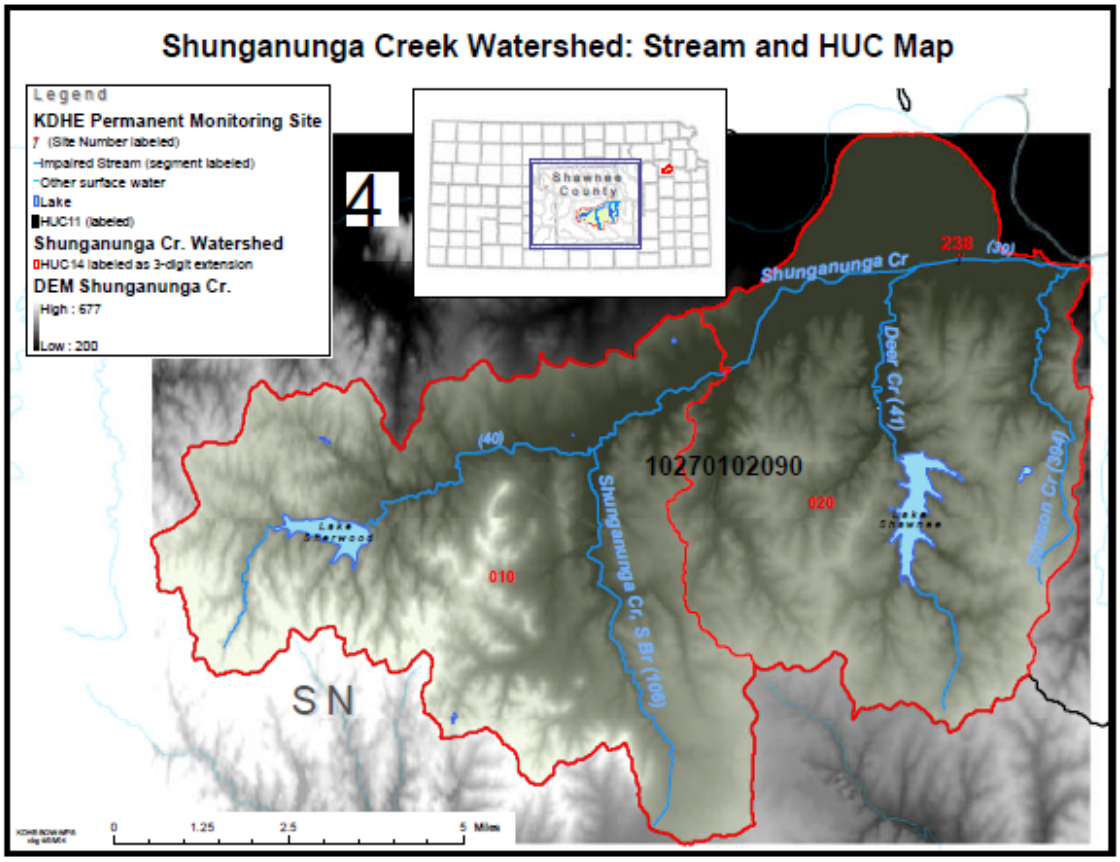


Figure 22: Shunganunga Watershed

8.3.3 Land Use

Most of the watershed is urban land and grassland (47.5 and 28.5% of the area, respectively) and cropland (17.5%). Much of the urban land is located along the main stem for most of the watershed. According to the NRCS Riparian Inventory, there are approximately 5,350 acres of riparian area in the watershed, most of which is categorized as forest land (34%), crop/tree mix (18%), cropland (13%),pasture/tree mix (8%), pasture land (6%) and shrub/scrub land (4%) .

8.3.4 Possible Nonpoint Pollution Sources of the Impairments

8.3.4.A Bacteria

Activities in proximity to the stream may be contributing to the bacteria violations. These activities would include small livestock operations near the streams, as

well as potentially failing on-site waste systems. Given the urban characteristics of the watershed, stormwater could easily carry waste material into streams. Stormwater, although currently permitted under NPDES Phase II permits and the Clean Water Act, has many of the characteristics of non-point source pollution.

8.3.4.B Phosphorus

Activities in proximity to the stream may be contributing to the increased in stream phosphorus levels. These activities would include small livestock operations near the streams, urban fertilizer runoff, row crop agriculture, and failing on-site waste systems.

8.3.4.C Eutrophication

Activities in proximity to Lake Shawnee may be contributing to the increased in nutrient levels. These activities would include golf course nutrient management, urban runoff, row crop agriculture, and failing on-site waste systems.

8.3.5 Possible Point Pollution Sources of the Bacteria Impairment

8.3.5.A NPDES permits

There are four NPDES permitted wastewater dischargers located within the watershed. The Sherwood Estates plant and Shawnee Hills Mobile Home Park lagoon system are located toward the headwaters of the watershed. The other two, Sewer Districts #8 and #33 discharge below the monitoring point. Based on the assessment of sources and the distribution of water quality violations, point source contributions of bacteria and/or phosphorus may be significant in the watershed.

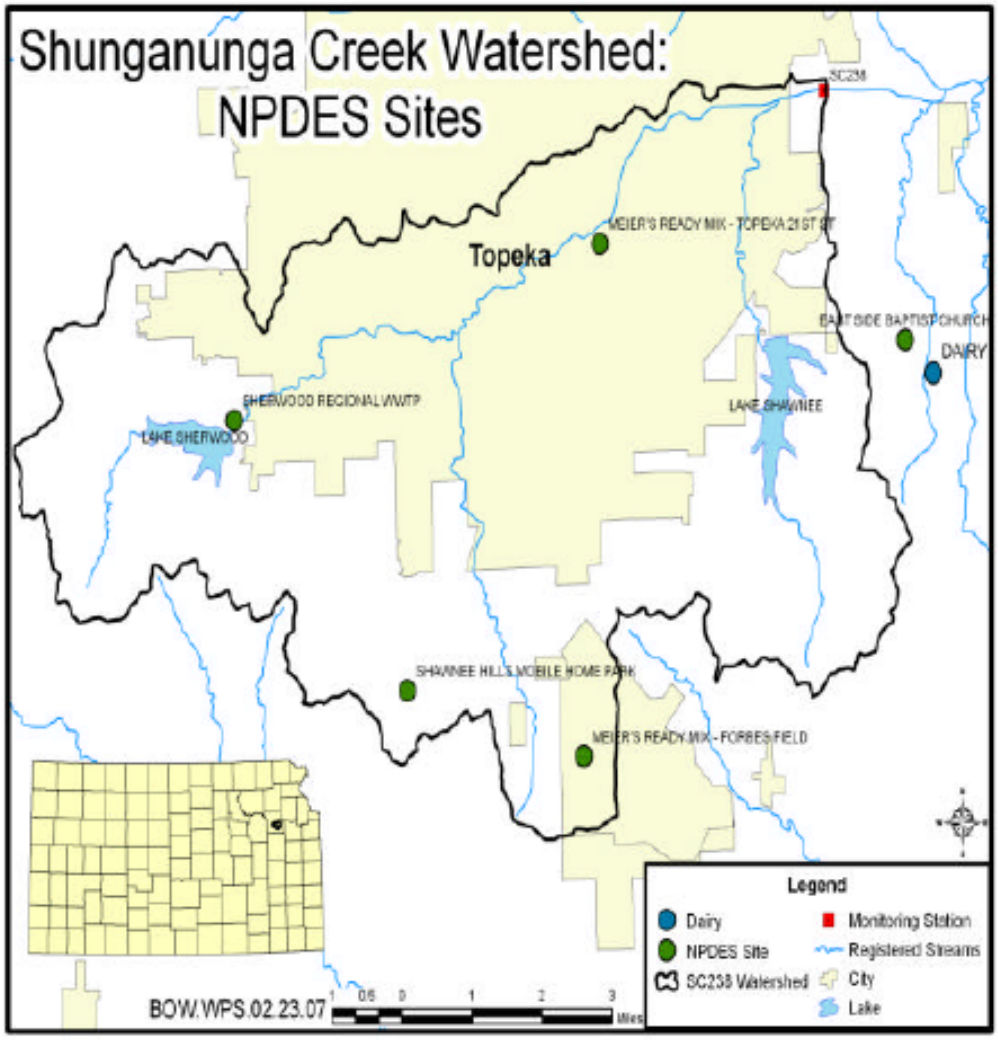


Figure 23: Shunganunga Watershed with NPDES Sites

8.3.5.B Livestock Waste Management Systems

A single operation is certified within the watershed. This facility (small dairy) is located between Stinson and Tecumseh Creeks near the edge of the watershed. The facility is not of sufficient size to warrant NPDES permitting. Permitted livestock facilities have waste management systems designed to minimize runoff entering their operations or detaining runoff emanating from their areas. Such systems are designed to retain the 25 year, 24 hour rainfall/runoff event, as well as an anticipated two weeks of normal wastewater from their operations. Such rainfall events typically coincide with stream flows that are exceeded less than 1 - 5 percent of the time. Therefore, events of this type, infrequent and of short duration, are not likely to cause chronic impairment of the designated uses of the

waters in this watershed. They may however occasionally contribute to the impairment from runoff.

8.3.5.C On-Site Waste Systems

A number of residents within Shawnee County remain without sewer service, relying instead on on-site waste systems. Failing septic systems contribute bacteria loadings. The infrequent excursions from the water quality standards seem to indicate a lack of persistent loadings from such systems on any grand scale. It is likely that the contribution of high bacteria loads from septic systems is restricted to local areas. However, there are a number of on-site wastewater systems in place in Shawnee County. Inspection and complaint numbers for on-site systems in the county are over 400 per year in 1998 and 210 in 1999. Proliferation of onsite systems and the concomitant potential for loading of bacteria is highly probable in the Shunganunga Creek watershed, presuming sewer service is not provided to the areas lying outside the urban areas.

8.3.6 Implementation Activities to Address Pollutants

Implementation activities will be limited to those completed by the City of Topeka and the Shawnee County Conservation District until this area becomes a focus area for the WRAPS project area.

8.3.6.A Bacteria

1. Maintain necessary state and federal permits and inspect permitted facilities for permit compliance
2. Install necessary manure and livestock waste storage of small operations located adjacent to the creek.
3. Improve grass buffer strips along the stream.
4. Install necessary stormwater management practices in urban areas of watershed to include bio-retention cells, rain gardens, permeable asphalt, bio-swales, etc
5. Insure proper on-site waste system operations <100 meters from streams.
6. Removing animals from the riparian areas.+

8.3.7 Primary Participants for Implementation Activities

Primary participants for implementation will be Topeka Public Works, small scale livestock operations, homestead and farmstead on-site wastewater systems and municipal utility personnel. Implemented activities should be targeted at those areas with greatest potential to impact the stream. Nominally, this would be activities located within one mile of the streams including:

1. Facilities without water quality controls
2. Unpermitted permanent livestock areas

3. Sites where drainage runs through or adjacent livestock areas
4. Sites where urban runoff discharges directly into stream
5. Areas of discharge from combined or sanitary sewer overflows.
6. Poor riparian sites
7. Failing on-site waste systems <100 meters from streams.

A BMP needs implementation schedule will be completed once the potential problem areas have been identified by the assessment.

8.4 Vermillion Creek (1027010202)

8.4.1 Water Quality Impairments

Vermillion Creek has a High priority TMDL for Bacteria. The ultimate endpoint for the High priority Bacteria TMDL will be to achieve the Kansas Water Quality Standard for Recreation (Fecal Coliform Bacteria: 2000 colonies per 100 ml for Secondary (KAR 28-16-28e(c)(7)(C)); 900 colonies per 100 ml for Primary (KAR 28-16-28e(c)(7)(B). This endpoint will be reached as a result of improvements in tributary buffer strip conditions, remediation of small livestock operations near the streams, as well as fixing failing on-site waste systems. Figure 24 below provides an overview of Vermillion Creek Watershed. Figures 25 and 26 show the HUC 12 watersheds in Vermillion Creek. Figure 27 illustrates the land cover of the Vermillion Creek Watershed.

Figure 24: Vermillion Creek Watershed in Middle Kansas WRAPS

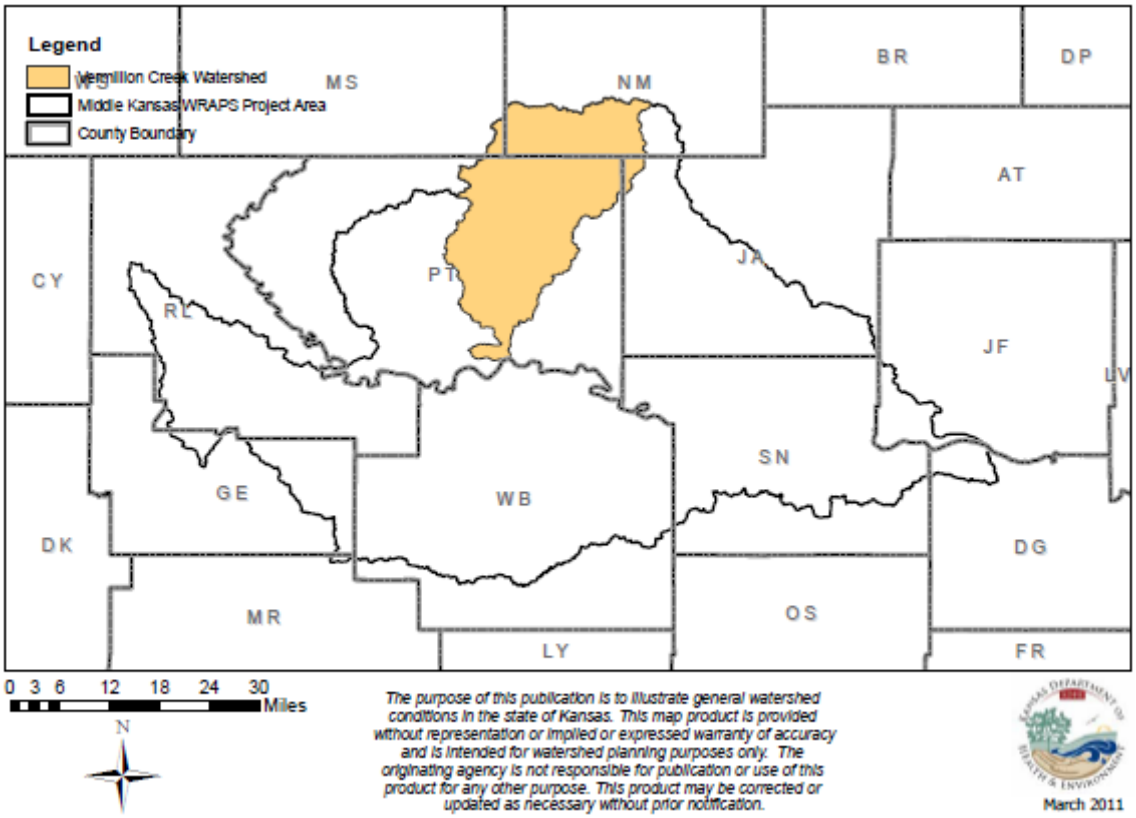


Figure 25:Vermillion Creek HUC 12 Watersheds in Middle Kansas WRAPS

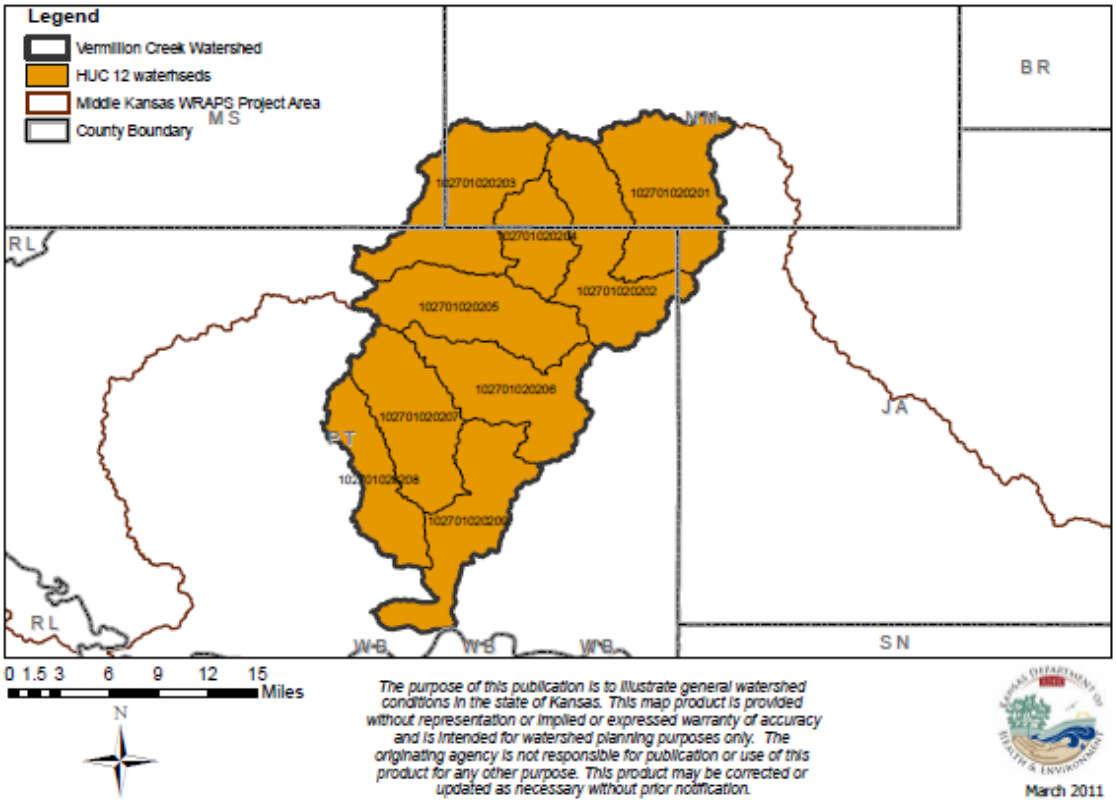
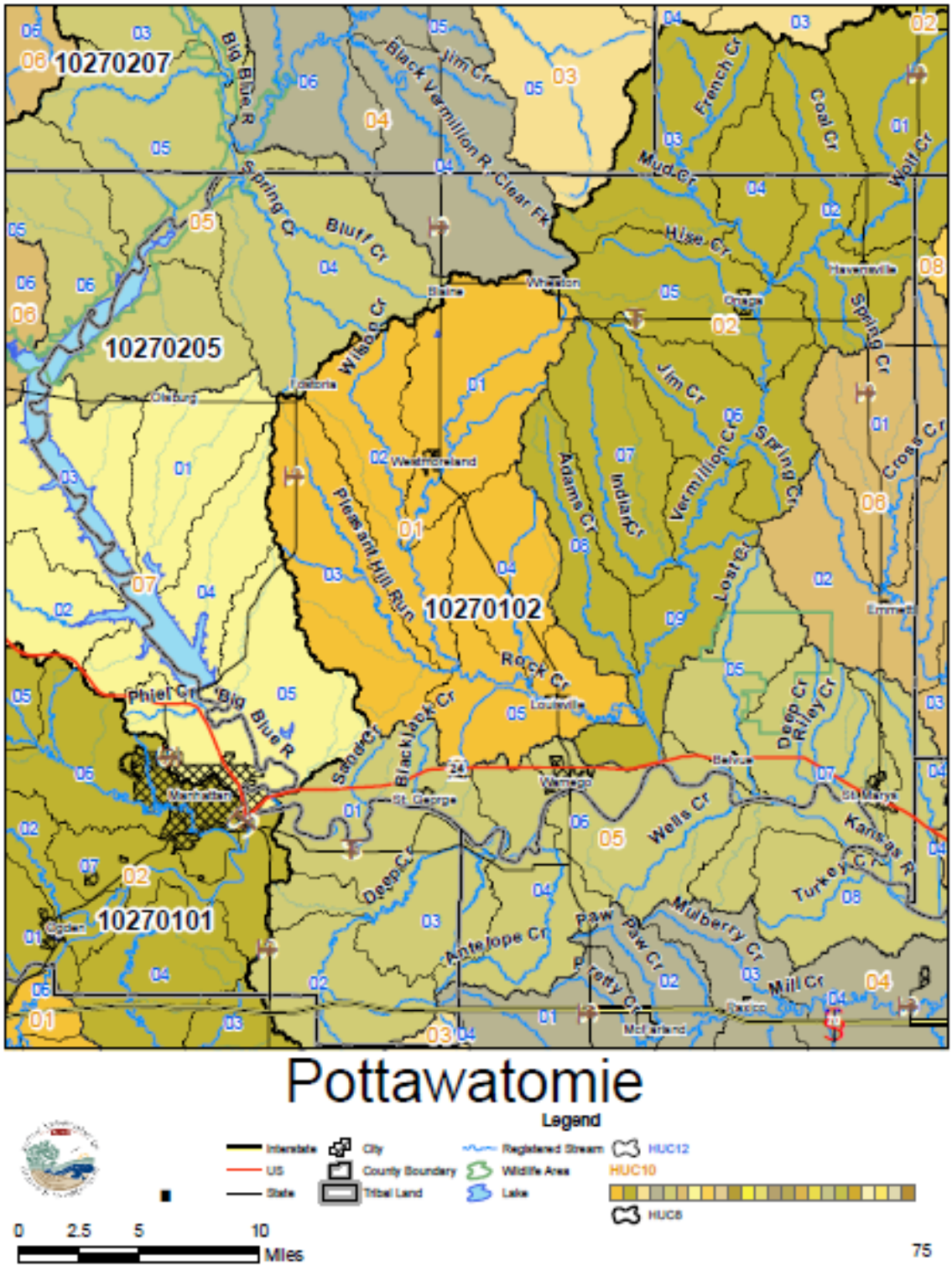


Figure 26: Vermillion Creek HUC 12 Watersheds in Middle Kansas WRAPS



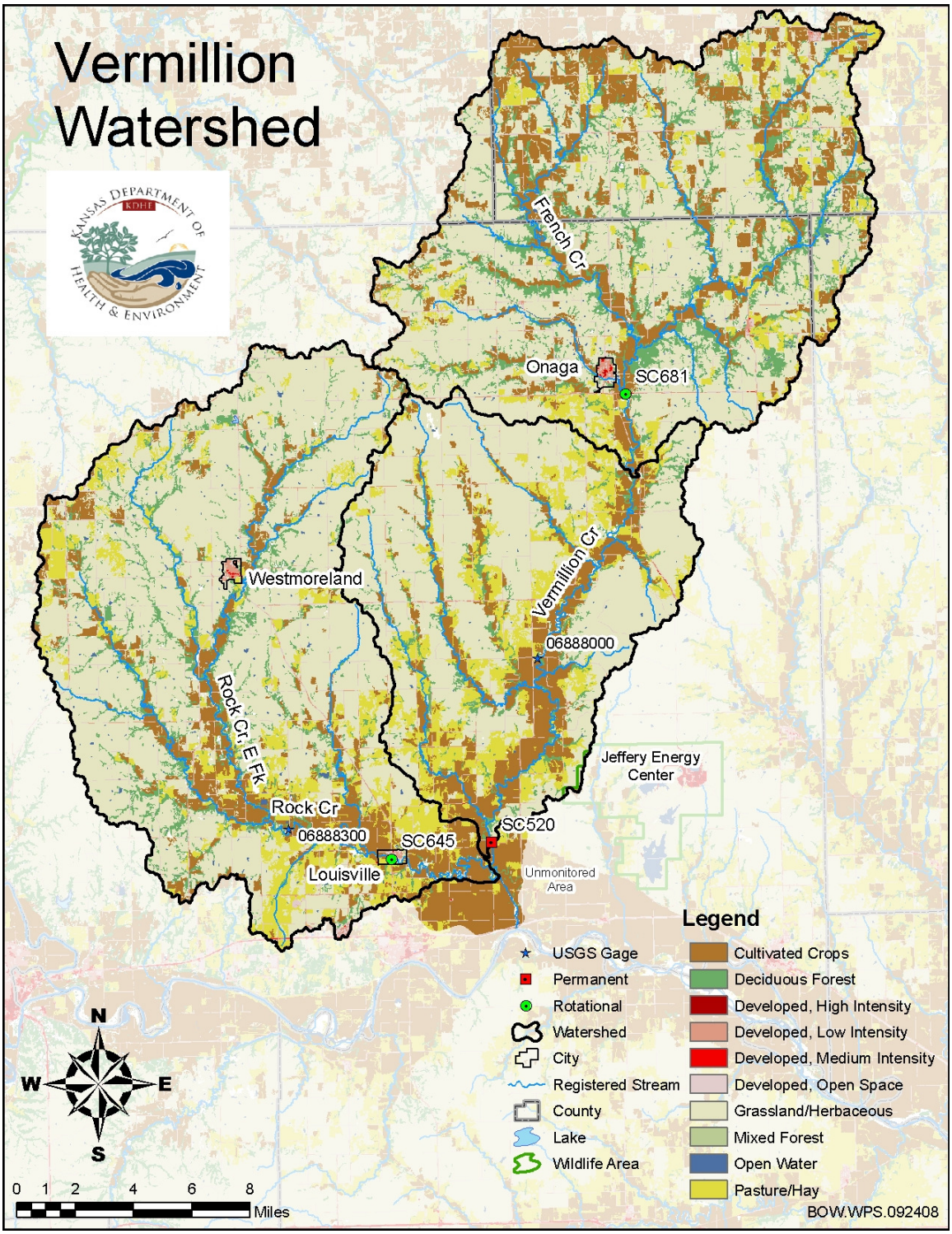


Figure 27: Vermillion Creek Land Cover

8.4.2 Priority Areas for the Vermillion Creek Watershed

The priority areas for the Vermillion Creek Watershed include HUC 102701020208 – Adams Creek and HUC 102701020209 – Vermillion Creek and Diversion Channel. These areas were chosen through coordination with KDHE staff and the local conservation district. These areas will be assessed once all the HUC's in Rock Creek are completed or it is delisted. These areas may change based on the water quality monitoring data that will begin in 2014.

8.4.3 Next Steps for Addressing Additional Water Quality Impairments in Vermillion Creek

In the event BMP installation in HUC 102701020208 and HUC 10270102029 does not meet the TMDL for bacteria, the following associated watersheds in Rock Creek are targeted for additional implementation to address the bacteria TMDL. The estimated start date is 2015 or when the TMDL is met in Rock Creek:

1. 102701020205 – Mill Creek – Vermillion Creek
2. 102701020206 – Jim Creek – Vermillion Creek

8.4.4 Assessment Needs

Assessment needs in the Vermillion Creek Watershed include a combination of aerial assessment/ground truthing and water quality sampling as listed below in Table 38. The Vermillion assessments will be based on the delisting timeframe for Rock Creek. Once Rock Creek is delisted the focus will shift to the Vermillion with one assessment annually based on water quality monitoring data. Tentative start date is 2015.

Table 38: Assessment & Monitoring Needs for Vermillion Creek

Assessment Needs					
Watershed	**TMDL**	**Type of Assessment**	**Water Quality Sampling**	**Technical Assistance**	**Financial Assistance**
Vermillion Creek/Diversion channel, HUC 102701020209	Bacteria	Aerial/Ground truthing Combination @$15,000	$400/sample x 2 samples = $800/site/yr.	KAWS	$800 WQS $15,000 Assessment
Adams Creek – HUC 102701020208	Bacteria	Aerial/Ground truthing Combination @$15,000	$400/sample x 2 samples = $800/site/yr.	KAWS	$800 WQS $15,000 Assessment
Mill Creek/Vermillion Creek HUC 102701020205	Bacteria	Aerial/Ground truthing Combination @$15,000	$400/sample x 2 samples = $800/site/yr.	KAWS	$800 WQS $15,000 Assessment

Jim Creek/Vermillion Creek HUC 102701020206	Bacteria	Aerial/Ground truthing Combination @$15,000	$400/sample x 2 samples = $800/site/yr.	KAWS	$800 WQS $15,000 Assessment
HUC 102701020207	Bacteria	Aerial/Ground truthing Combination @$15,000	$400/sample x 2 samples = $800/site/yr.	KAWS	$800 WQS $15,000 Assessment
HUC 102701020204	Bacteria	Aerial/Ground truthing Combination @$15,000	$400/sample x 2 samples = $800/site/yr.	KAWS	$800 WQS $15,000 Assessment
HUC 102701020203	Bacteria	Aerial/Ground truthing Combination @$15,000	$400/sample x 2 samples = $800/site/yr.	KAWS	$800 WQS $15,000 Assessment
HUC 102701020202	Bacteria	Aerial/Ground truthing Combination @$15,000	$400/sample x 2 samples = $800/site/yr.	KAWS	$800 WQS $15,000 Assessment
HUC 102701020201	Bacteria	Aerial/Ground truthing Combination @$15,000	$400/sample x 2 samples = $800/site/yr.	KAWS	$800 WQS $15,000 Assessment

Note: Water quality sampling will be used to determine which HUC 12 watersheds are assessed.

8.4.5 Land Use

Most of the watershed is grassland (62% of the area) or cropland (29% of the area). Grazing density of livestock is moderately high for the watershed (42-44 animal units/sq. mi.). Cropland above the primary water quality monitoring site (Station 520) is restricted to areas adjacent to watercourses and the upper reaches of the watershed.

8.4.6 Possible Nonpoint Pollution Sources for Bacteria TMDL

Based on the assessment of sources, the distribution of excursions from water quality standards and the relationship of those excursions to flow conditions, non-

point sources are seen as the primary cause of water quality violations. Rock Creek, which is a part of the Vermillion Creek watershed, has the second-to-worst overall condition, with the worst overall rank of all stations for *E. coli*, and poor rankings for nutrients and suspended solids.

8.4.6.A Bacteria

Activities in proximity to the stream may be contributing to the bacteria violations. These activities would include small livestock operations near the streams, as well as potentially failing on-site waste systems. Activities to reduce bacteria should be directed toward the smaller, unpermitted livestock operations and rural homesteads and farmsteads in the watershed.

There are also 20 operations that are registered, certified or permitted within the watershed. Most of these facilities are located in either the lower half of the watershed or near the watershed boundary. These operations are mostly swine (52% of animal units), or cattle/beef (41% of animal units). Animal units for the watershed total 6,734. Permitted facilities have systems (these facilities account for 84% of the animal units in the watershed) designed for the 25 year, 24 hour rainfall/runoff event, which would be indicative of flow durations well under 10 percent of the time. The actual number of animal units on site is variable, but typically less than permitted numbers.

8.4.6.B Phosphorus

Activities in proximity to the stream may be contributing to increased stream phosphorus levels. These activities would include small livestock operations near the streams, row crop agriculture, and failing on-site waste systems.

8.4.6.C Total Suspended Solids

Poor field cultivation practices, streambank erosion, and livestock activities adjacent to streams can contribute to increased total suspended solids.

8.4.7 Possible Point Sources for Bacteria TMDL

Table 39: NPDES Permitted Wastewater Dischargers

MUNICIPALITY	STREAM REACH	SEGMENT	DESIGN FLOW	# CELLS	DETENTION TIME
Corning	Vermillion Cr.	18	0.024 mgd	3	> 120 days
Havensville	Spring Cr.	48	0.02 mgd	3	> 120 days
Onaga	Vermillion Cr.	17 via 43	0.06 mgd	3	> 120 days

There are three NPDES permitted wastewater dischargers within the watershed as shown in Table 39.

Population projections for all municipalities to the year 2020 indicate small increases in population. Projections for associated future water use and resulting wastewater appear to be under design flows for the Corning and Havensville systems. Water use projection for Onaga indicate that design flows of the system may be exceeded by wastewater supply by 2020. At design flows, the contributions from these three systems make up 8% of the flow which was exceeded during the Summer-Fall season 90% of the time. The Summer-Fall season is the only one where water quality excursions occurred at relatively low flow conditions. The excursions from the water quality standards appear to occur under medium and high flow conditions in all seasons, indicating that point sources have little impact in watershed.

Within the watershed all municipal facilities rely on lagoon systems for wastewater detention and long holding times to minimize the release of fecal bacteria to receiving streams. The point sources are responsible to maintain their lagoons in proper working condition and appropriate detention volume to handle anticipated wasteloads of their respective populations. Ongoing inspections and monitoring of the lagoons will be made to ensure that minimal contributions have been made by these sources.

8.4.8 Implementation Activities to Address Pollutants

Vermillion Creek will not have an implementation schedule until after an assessment is completed in 2014 or Rock Creek is delisted.

8.4.8.A Bacteria

1. Maintain necessary state and federal permits and inspect permitted facilities for permit compliance.
2. Install necessary manure and livestock waste storage of small operations in watershed. Limit livestock access to streams by providing alternate water, feeding, and shelter sites.
3. Install grass filter strips, and woody buffer strips when applicable, along the stream.
4. Insure proper on-site waste system operations <100 meters from streams.

8.4.8.B Phosphorous

1. Install necessary manure and livestock waste storage of small operations in watershed. Limit livestock access to streams by providing alternate water, feeding, and shelter sites.
3. Install grass filter strips, and woody buffer strips when applicable, along the stream.

8.4.8.C Total Suspended Solids

1. Limit livestock access to streams by providing alternate water, feeding, and shelter sites.
2. Install grass filter strips, and woody buffer strips when applicable, along the stream.

8.4.9 Primary Participants for Implementation

Primary participants for implementation will be small livestock producers operating without need of permits within the priority sub-watershed. Implemented activities should be targeted at those areas with greatest potential to impact the stream. Nominally, this would be activities located within one mile of the streams including:

1. Facilities without water quality controls
2. Unpermitted permanent feeding/holding areas
3. Sites where drainage runs through or adjacent livestock areas
4. Sites where livestock have full access to stream and stream is primary water supply
5. Grazed acreage, overstocked acreage and acreage with poor range condition
6. Poor riparian sites
7. Near stream feeding sites
8. Failing on-site waste systems <100 meters from streams.

9.0 Information and Education in Support of BMPs

9.1 Information and Education Activities

The SLT has determined which information and education activities will be needed in the watershed. These activities are important in providing the residents of the watershed with a higher awareness of watershed issues. This will lead to an increase in adoption rates of BMPs. In addition to bacteria and total suspended solids and nutrients, other priority issues identified in the plan will be addressed through outreach/I&E efforts. Listed below are the activities and events along with their costs and possible sponsoring agencies. All activities will be focused in the WRAPS high priority project areas.

BMP	Target Audience	Activity/Event Technical Assistance	Time Frame	Estimated Costs	Sponsor/ Responsible Agency
Livestock BMP Implementation					
Relocate Feeding Sites adjacent to streams	Livestock Producers/Landowners	Tour/Field Day/Workshop Resource Materials Provided Innovative Speakers One-on-one Contacts with producers News Releases Evaluations	Annual, Ongoing	$10,000	Kansas Rural Center K-State Research and Extension Conservation Districts NRCS KAWS Rock Creek Focus Group Middle Kansas Coordinator
Alternative Water Supplies **Proper Grazing Use:** **-Cell Grazing** **-Extend the Grazing Season** **-Alternative Forages**	Livestock Producers/Landowners	Scholarships to Grazing Schools and Workshops Kansas Grazier's Association Winter Conference Kansas Range School Eastern KS Range School Four Season Graziers' Meetings	Annual – Jan. Annual – Sept. Annual – July-August Ongoing	25 per yr. $35 per scholarship 10 per yr. $50 per scholarship 5 per year, $250 per scholarship $500 Annual	Kansas Graziers' Association Kansas Rural Center K-State Research and Extension NRCS – Conservation District Four Season Graziers KAWS Rock Creek Focus Group

Pasture and Brush Management	Livestock Producers/Landowners	One-on-one technical assistance for a landowner/producer to implement BMPs in the targeted area.	Annual, Ongoing	$17,500	K-State Research and Extension Conservation Districts NRCS Kansas Rural Center KAWS Rock Creek Focus Group Middle Kansas Coordinator
Filter Strips and Riparian Forest Buffers	Livestock Producers/Landowners	One-on-one technical assistance in providing riparian area protection planning. Participate in one tour or workshop showcasing riparian protection on grazing lands.	Annual, Ongoing	$4,000	Kansas Forest Service KAWS Rock Creek Focus Group Conservation Districts NRCS
	Total annual cost for Livestock Information and Education if all events are implemented = $25,625				

BMP	Target Audience	Activity/Event Technical Assistance	Time Frame	Estimated Costs	Sponsor/ Responsible Agency
Cropland BMP Implementation					
Permanent Vegetation Converting of Cropland to Grass	Producers/Landowners	Workshop/Field Day	Annual	$2,000	Conservation Districts Middle Kansas WRAPS KAWS
	Producers/Landowners	Forestry Field Day	Annual	$3,000	Kansas Forest Service
See above	Producer/Landowners	One-on-one technical assistance for producers to implement BMPs in the targeted area.	Annual	No Cost	Conservation Districts NRCS KAWS
Grassed Waterways	Producers/Landowners	One-on-one technical assistance for producers to implement BMPs in the targeted area.	Annual	No Cost	Conservation Districts NRCS
No-Till	Producers/Landowners	Scholarships for producers to attend No-Till on the Plains Annual Conference	Annual, Winter	5 per year, $150 per scholarship	No-Till on the Plains Middle Kansas WRAPS
	Producers/Landowners	Workshop/Field Day	Annual, Spring	Included in Above	Conservation Districts Middle Kansas WRAPS KAWS
	Producers/Landowners	One-on-one technical assistance for producers to implement BMPs in the targeted area.	Annual	No Cost	Conservation Districts NRCS
Vegetative Buffers	Producers/Landowners	Workshop/Field Day	Annual, Spring	Included in Above	Conservation Districts Middle Kansas WRAPS KAWS
	Producers/Landowners	Forestry Field Day	Annual	Included in Above	Kansas Forest Service

	Producers/Landowners	One-on-one technical assistance for producers to implement BMPs in the targeted area.	Annual	No Cost	Conservation Districts NRCS KAWS
	Producers/Landowners	One-on-one technical assistance for riparian tree planting	Annual, ongoing	Included above	Kansas Forest Service
Terraces	Producers/Landowners	One-on-one technical assistance for producers to implement BMPs in the targeted area.	Annual	No Cost	Conservation Districts NRCS
Sediment Basin/Diversion/Retention Structures	Producers/Landowners	One-on-one technical assistance for producers to implement BMPs in the targeted area.	Annual	No Cost	Conservation Districts NRCS
	Producers/Landowners	Sediment basin and wetland field day/tour	Every other year	$2,000	Conservation Districts NRCS KAWS
Wetlands	Producers/Landowners	One-on-one technical assistance for producers to implement BMPs in the targeted area.	Annual	No Cost	Conservation Districts NRCS
	Producers/Landowners	Sediment basin and wetland field day/tour	Every other year	Included with sediment basins	Conservation Districts NRCS KAWS
Streambank Stabilization	Producer/Landowners	One-on-one technical assistance for producers to implement BMPs in the targeted areas.	Annual	No Cost	Conservation District NRCS
	Producer/Landowners	Streambank Stabilization Tour in the Targeted	Every other year	Included with sediment basins	Conservation District NRCS

Total annual cost for Cropland Information and Education if all events are implemented = $7,750

BMP	Target Audience	Activity/Event Technical Assistance	Time Frame	Estimated Costs	Sponsor/ Responsible Agency
General / Watershed Wide Information and Education					
Educational Activities Targeting Youth	Educators, K-12 Students	Envirothon Regional/Kansas	Annual	$500	Conservation Districts NRCS
		Day on the Farm Ag/Water Festival	Annual	$500/District $1500	Conservation Districts
		Poster, essay, and speech contests	Annual	No Cost	Conservation Districts
		Topeka Water Festival	Annual	$3,000	Shawnee County Conservation District and KACEE
		Range Youth Camp	Annual	5 Scholarships@ $220/ea. $1,100	Conservation Districts NRCS
Educational Activities Targeting Adults	Watershed Residents	BMP Auction (To be conducted in targeted watersheds only)	Annual	$9,000	K-State Research and Extension Conservation Districts
		River Friendly Farms (To be conducted in targeted	Annual	$20,000	Kansas Rural Center

		watersheds only)			
		Focus groups and workshops	Annual, ongoing	$17,500	K-State Research and Extension Conservation Districts KAWS Rock Creek Focus Group Middle Kansas Coordinator
		Newsletters, press releases, advertisements, and producer mailings	As needed	$1,000	K-State Research and Extension Conservation Districts ; KAWS Kansas Rural Center Kansas PRIDE
		Total annual cost for General/Watershed Wide Information and Education if all events are implemented = $52,100			

The following watershed issues identified by the Middle Kansas SLT are listed in the table below. Other than those issues being directly addressed by this plan, which include bacteria, total suspended solids, and agricultural runoff, the priority watershed issues will be addressed through outreach/I&E efforts.

Watershed Issue	Target Audience	Activity/Event Technical Assistance	Time Frame	Estimated Costs	Sponsor/ Responsible Agency
Watershed Issues Information and Education					
Source Water Protection	Public Water Systems in the Watershed	Kansas Rural Water Association will publicize the availability of technical assistance in development and updating of source water plans.	Annually	No cost to Middle Kansas River WRAPS.	Kansas Rural Water Association
Degraded Streams and Rivers	Watershed residents	Onsite visits	As needed	$500	Conservation Districts KAWS Kansas Forest Service
Water Wells	Watershed residents	Onsite visits	As needed	$250	Conservation Districts
Urban Areas	Watershed residents	Publicize WQ BMPs for urban areas	Annually	$500	Conservation Districts
Flooding	City/County, Watershed Landowners	Onsite visits	As needed	$250	Conservation Districts
Biological Items of Concern	Watershed residents	Promote management practices that protect endangered species	Annually	$250	KDWP US Fish & Wildlife
Water Quantity	Watershed residents	Promote drought management practices for cropland and livestock producers	As needed	$250	Conservation Districts
Eutrophication	Watershed residents	Promote urban WQ BMPs	Annually	$500	Conservation Districts
Total annual cost for Watershed Issues Information and Education if all events are implemented = $3,000.00					
Total annual cost per year for Information and Education if all events are implemented = $88,475.00					

Project Management					
		WRAPS Coordination	Annual	$42,000	KAWS
		Grant Administration	Annual	10% of total grant	KAWS

Total annual cost per year for all Information and Education to include project management = $130,475.00
Plus 10 percent of grant total for administration of the grant

9.1.2 Evaluation of Information and Education Activities

All service providers conducting Information and Education (I&E) activities funded through the Middle Kansas WRAPS will be required to include an evaluation component in their project proposals and Project Implementation Plans. The evaluation methods will vary based on the activity. At a minimum, all I&E projects must include participant learning objectives as the basis for the overall evaluation. Depending on the scope of the project, development of a basic logic model identifying long-term, medium-term, and short-term behavior changes or other outcomes that are expected to result from the I&E activity may be required.

Specific evaluation tools or methods may include (but are not limited to):
* Feedback forms allowing participants to provide rankings of the content, presenters, useful of information, etc.
* Pre and post surveys to determine amount of knowledge gained, anticipated behavior changes, need for further learning, etc.
* Follow up interviews (one-on-one contacts, phone calls, e-mails) with selected participants to gather more in-depth input regarding the effectiveness of the I&E activity.

All service providers will be required to submit a brief written evaluation of their I&E activity, summarizing how successful the activity was in achieving the learning objectives, and how the activity contributed to achieving the long-term WRAPS goals and/or objectives for pollutant load reductions.

10.0 Costs of Implementing BMPs and Possible Funding Sources

The SLT has reviewed all the recommended BMPs listed of this report for each individual impairment. It has been determined by the SLT that specific BMPs will be the target of implementation funding for the Cropland Targeted Area.

Table 40: Annual Costs Before Cost Share for Cropland Implemented BMPs in Soldier Creek Watershed.

Annual Cost* Before Cost-Share, Cropland BMPs								
Year	Permanent Vegetation	Grassed Waterways	No-Till	Vegetative Buffers	Terraces	Sediment Basins	Wetlands	Total Cost
1	$8,258	$29,362	$14,257	$12,234	$34,408	$27,527	$10,093	**$136,139**
2	$8,506	$30,243	$14,685	$12,601	$35,441	$28,353	$10,396	**$140,224**
3	$8,761	$31,150	$15,125	$12,979	$36,504	$29,203	$10,708	**$144,430**
4	$9,024	$32,085	$15,579	$13,369	$37,599	$30,079	$11,029	**$148,763**
5	$9,294	$33,047	$16,046	$13,770	$38,727	$30,982	$11,360	**$153,226**
6	$9,573	$34,038	$16,528	$14,183	$39,889	$31,911	$11,701	**$157,823**
7	$9,861	$35,060	$17,024	$14,608	$41,085	$32,868	$12,052	**$162,558**
8	$10,156	$36,111	$17,534	$15,046	$42,318	$33,854	$12,413	**$167,434**
9	$10,461	$37,195	$18,060	$15,498	$43,588	$34,870	$12,786	**$172,457**
10	$10,775	$38,311	$18,602	$15,963	$44,895	$35,916	$13,169	**$177,631**
11	$11,098	$39,460	$19,160	$16,442	$46,242	$36,994	$13,564	**$182,960**
12	$11,431	$40,644	$19,735	$16,935	$47,629	$38,103	$13,971	**$188,449**
13	$11,774	$41,863	$20,327	$17,443	$49,058	$39,247	$14,390	**$194,102**
14	$12,127	$43,119	$20,937	$17,966	$50,530	$40,424	$14,822	**$199,925**
15	$12,491	$44,412	$21,565	$18,505	$52,046	$41,637	$15,267	**$205,923**
16	$12,866	$45,745	$22,212	$19,060	$53,607	$42,886	$15,725	**$212,101**
17	$13,252	$47,117	$22,878	$19,632	$55,215	$44,172	$16,197	**$218,464**
18	$13,649	$48,531	$23,565	$20,221	$56,872	$45,498	$16,682	**$225,018**
19	$14,059	$49,987	$24,272	$20,828	$58,578	$46,862	$17,183	**$231,768**
20	$14,481	$51,486	$25,000	$21,453	$60,335	$48,268	$17,698	**$238,721**
**3% Inflation*								

Table 41: Annual Costs After Cost Share for Cropland Implemented BMPs in Soldier Creek Watershed.

Annual Cost* After Cost-Share, Cropland BMPs								
Year	Permanent Vegetation	Grassed Waterways	No-Till	Vegetative Buffers	Terraces	Sediment Basins	Wetlands	Total Cost
1	$4,129	$14,681	$8,697	$1,223	$17,204	$13,763	$1,009	**$59,698**
2	$4,253	$15,121	$8,958	$1,260	$17,720	$14,176	$1,040	**$61,489**
3	$4,380	$15,575	$9,226	$1,298	$18,252	$14,602	$1,071	**$63,333**

4	$4,512	$16,042	$9,503	$1,337	$18,800	$15,040	$1,103	**$65,233**
5	$4,647	$16,524	$9,788	$1,377	$19,364	$15,491	$1,136	**$67,190**
6	$4,787	$17,019	$10,082	$1,418	$19,944	$15,956	$1,170	**$69,206**
7	$4,930	$17,530	$10,384	$1,461	$20,543	$16,434	$1,205	**$71,282**
8	$5,078	$18,056	$10,696	$1,505	$21,159	$16,927	$1,241	**$73,421**
9	$5,231	$18,597	$11,017	$1,550	$21,794	$17,435	$1,279	**$75,623**
10	$5,387	$19,155	$11,347	$1,596	$22,448	$17,958	$1,317	**$77,892**
11	$5,549	$19,730	$11,688	$1,644	$23,121	$18,497	$1,356	**$80,229**
12	$5,716	$20,322	$12,038	$1,693	$23,815	$19,052	$1,397	**$82,636**
13	$5,887	$20,932	$12,400	$1,744	$24,529	$19,623	$1,439	**$85,115**
14	$6,064	$21,559	$12,772	$1,797	$25,265	$20,212	$1,482	**$87,668**
15	$6,246	$22,206	$13,155	$1,851	$26,023	$20,818	$1,527	**$90,298**
16	$6,433	$22,872	$13,549	$1,906	$26,804	$21,443	$1,572	**$93,007**
17	$6,626	$23,559	$13,956	$1,963	$27,608	$22,086	$1,620	**$95,797**
18	$6,825	$24,265	$14,374	$2,022	$28,436	$22,749	$1,668	**$98,671**
19	$7,029	$24,993	$14,806	$2,083	$29,289	$23,431	$1,718	**$101,631**
20	$7,240	$25,743	$15,250	$2,145	$30,168	$24,134	$1,770	**$104,680**
**3% Inflation*								

Table 42: Costs Before Cost Share for Livestock BMPs in the Rock Creek Watershed.

Rock Creek Implementation Cost Before Cost-Share					
Year	Relocate Feedlot	Vegetative Filter Strip	Relocate Pasture Feeding Site	Alternative Watering System	Total
2011	$24,000	$1,430	$4,400	$11,385	$41,215
2012	$24,720	$1,473	$4,532	$11,727	$42,451
2013	$25,462	$1,517	$4,668	$12,078	$43,725
2014	$26,225	$1,563	$4,808	$12,441	$45,037
2015	$27,012	$1,609	$4,952	$12,814	$46,388
2016	$27,823	$1,658	$5,101	$13,198	$47,779
2017	$28,657	$1,707	$5,254	$13,594	$49,213
2018	$29,517	$1,759	$5,411	$14,002	$50,689
2019	$30,402	$1,811	$5,574	$14,422	$52,210
2020	$31,315	$1,866	$5,741	$14,855	$53,776

Table 43: Costs After Cost Share for Livestock BMPs in the Rock Creek Watershed.

Rock Creek Implementation Cost After Cost-Share					
Year	Relocate Feedlot	Vegetative Filter Strip	Relocate Pasture Feeding Site	Alternative Watering System	Total
2011	$12,000	$715	$2,200	$5,693	$20,608
2012	$12,360	$736	$2,266	$5,863	$21,226
2013	$12,731	$759	$2,334	$6,039	$21,862
2014	$13,113	$781	$2,404	$6,220	$22,518
2015	$13,506	$805	$2,476	$6,407	$23,194
2016	$13,911	$829	$2,550	$6,599	$23,890
2017	$14,329	$854	$2,627	$6,797	$24,606
2018	$14,758	$879	$2,706	$7,001	$25,345
2019	$15,201	$906	$2,787	$7,211	$26,105
2020	$15,657	$933	$2,871	$7,427	$26,888

Table 44: Total Annual Cost After Cost-Share by BMP Category

Total Annual WRAPS Cost after Cost-Share by BMP Category				
Year	Streambank	Cropland	Livestock	Total Annual Cost
1	$35,750	$59,698	$20,608	**$116,055**
2	$36,823	$61,489	$21,226	**$119,537**
3	$37,927	$63,333	$21,862	**$123,123**
4	$39,065	$65,233	$22,518	**$126,817**
5	$40,237	$67,190	$23,194	**$130,621**
6	$41,444	$69,206	$23,890	**$134,540**
7	$42,687	$71,282	$24,606	**$138,576**
8	$43,968	$73,421	$25,345	**$142,733**
9	$45,287	$75,623	$26,105	**$147,015**
10	$46,646	$77,892	$26,888	**$151,426**
11	$48,045	$80,229	$0	**$128,274**
12	$49,486	$82,636	$0	**$132,122**
13	$50,971	$85,115	$0	**$136,086**
14	$52,500	$87,668	$0	**$140,168**
15	$54,075	$90,298	$0	**$144,373**
16	$55,697	$93,007	$0	**$148,704**
17	$57,368	$95,797	$0	**$153,166**
18	$59,089	$98,671	$0	**$157,761**

19	$60,862	$101,631	$0	**$162,493**
20	$62,688	$104,680	$0	**$167,368**

Table 45: Potential BMP Funding Sources

Potential Funding Sources	Potential Funding Programs
Natural Resources Conservation Service	- Environmental Quality Incentives Program (EQIP) - Wetland Reserve Program (WRP) - Conservation Reserve Program (CRP) - Wildlife Habitat Incentive Program (WHIP) - Forestland Enhancement Program (FLEP) - State Acres for Wildlife Enhancement (SAFE) - Grassland Reserve Program (GRP) - Farmable Wetlands Program (FWP)
EPA/KDHE	- 319 Funding Grants
KS Dept. of Wildlife and Parks	- Partnering for Wildlife
Kansas Alliance for Wetlands &Streams	
State Conservation Commission	
Conservation District	
Kansas Rural Center	River Friendly Farms Program
Kansas Forest Service	
US Fish and Wildlife	

Table 45: Potential Service Providers for BMP Implementation

BMP		Services Needed to Implement BMP		Service Provider
		Technical Assistance	*Information & Education*	
Cropland	1. Buffers	Design, cost share and maintenance	BMP workshops, tours, field days	NRCS FSA KRC SCC No-Till on the Plains KFS KSRE CD RC&D KDWP
Cropland	2. Continuous No-till	Design, cost share and maintenance	BMP workshops, tours, field days	
Cropland	3. Waterways	Design, cost share and maintenance	BMP workshops, field days, tours	
Livestock	1. Vegetative filter strips	Design, cost share and maintenance	BMP workshops, field days, tours	KSRE NRCS SCC KRC No-Till on the Plains KAWS CD RC&D KDWP
Livestock	2. Relocate small feedlots	Design, cost share and maintenance	BMP workshops, field days, tours	
Livestock	3. Relocate pasture feeding sites	Design, cost share and maintenance	BMP workshops, field days, tours	
Livestock	4. Establish off stream watering systems	Design, cost share and maintenance	BMP workshops, field days, tours	
Streambank	1. Riparian buffers	Design, cost share and maintenance	BMP workshops, field days, tours	KAWS NRCS SCC FSA KFS KRC KSRE CD RC&D KDWP
Streambank	2. Field borders	Design, cost share and maintenance	BMP workshops, field days, tours	
Streambank	3. Bottomland timber in wetlands	Design, cost share and maintenance	BMP workshops, field days, tours	
Streambank	4. Streambank restoration	Design, cost share and maintenance	BMP workshops, field days, tours	

11.0 Timeframe

The SLT will request an update of monitoring data from KDHE every year. The plan will be reviewed every five years starting in 2016. The timeframe of this document for BMP implementation to meet bacteria in Rock Creek is ten years, addressing biology in Soldier Creek through cropland BMPs will be 20 years, streambank stabilization will be 50 years The SLT will review bacteria and biology TMDLs in year 2021. They will examine BMP placement and implementation in 2016 and every subsequent five years after. Targeting and BMP implementation might shift over time in order to achieve TMDLs when water quality samples do not meet their criteria.

Table 46. Review Schedule for Pollutants and BMPs.

Review Year	Sediment	Nitrogen	Phosphorus	Bacteria	BMP Placement
2016	X	X	X	X	X
2021		X	X	X	X
2026	X	X			X
2031		X			X
2036	X				X
2041					X
2046	X				X
2051					X
2056	X				X
2061					X

12.0 Interim Measurable Milestones

Milestones will be determined by number of acres treated, projects installed, contacts made to residents of the watershed and water quality parameters at the end of every five years. The SLT will examine these criteria to determine if adequate progress has been made from the current BMP implementations. If they determine that adequate progress has not been made, they will readjust the implementation projects in order to achieve the TMDL.

12.1 Anticipated Adoption Rates for Cropland BMPs.

Table 47: Annual Adoption Rates of Cropland BMPs in the Soldier Creek Watershed.

Annual Adoption (treated acres), Cropland BMPs									
	Year	Permanent Vegetation	Grassed Waterways	No-Till	Vegetative Buffers	Terraces	Sediment Basins	Wetlands	Total Adoption
Short-Term	1	55	184	184	184	275	92	9	982
	2	55	184	184	184	275	92	9	982
	3	55	184	184	184	275	92	9	982
	4	55	184	184	184	275	92	9	982
	5	55	184	184	184	275	92	9	982
Total		***275***	***918***	***918***	***918***	***1,376***	***459***	***46***	**4,909**
Medium-Term	6	55	184	184	184	275	92	9	982
	7	55	184	184	184	275	92	9	982
	8	55	184	184	184	275	92	9	982
	9	55	184	184	184	275	92	9	982
	10	55	184	184	184	275	92	9	982
Total		**551**	**1,835**	**1,835**	**1,835**	**2,753**	**918**	**92**	**9,818**
Long-Term	11	55	184	184	184	275	92	9	982
	12	55	184	184	184	275	92	9	982
	13	55	184	184	184	275	92	9	982
	14	55	184	184	184	275	92	9	982
	15	55	184	184	184	275	92	9	982
	16	55	184	184	184	275	92	9	982
	17	55	184	184	184	275	92	9	982
	18	55	184	184	184	275	92	9	982
	19	55	184	184	184	275	92	9	982
	20	55	184	184	184	275	92	9	982
Total		**1,101**	**3,670**	**3,670**	**3,670**	**5,505**	**1,835**	**184**	**19,636**

12.2 Anticipated Livestock BMP Adoption Rates

Table 48: Adoption Rates for BMPs in the Livestock Targeted Area in Rock Creek Watershed.

Rock Creek Livestock BMPs Adoption Rate					
Year	Relocate Feedlot	Vegetative Filter Strip	Relocate Pasture Feeding Site	Alternative Watering System	Total
2011	2	2	2	3	9
2012	2	2	2	3	9
2013	2	2	2	3	9
2014	2	2	2	3	9
2015	2	2	2	3	9
5 Year Total	**10**	**10**	**10**	**15**	**45**
2016	2	2	2	3	9
2017	2	2	2	3	9
2018	2	2	2	3	9
2019	2	2	2	3	9
2020	2	2	2	3	9
10 Year Total	**20**	**20**	**20**	**30**	**90**

12.3 Water Quality Milestones to Determine Improvements

The goal of the Middle Kansas WRAPS plan is to restore water quality for uses supportive of aquatic life and recreation for Upper Soldier Creek and Rock Creek. The plan specifically addresses the high priority TSS/biology TMDL for Upper Soldier Creek and the 303(d) bacteria impairment for Rock Creek near Louisville. The restoration plan includes separate BMP implementation schedules for the two water bodies. In order to reach the sediment reduction goal for Upper Soldier Creek, a BMP implementation schedule spanning 20 years has been developed. For Rock Creek, a 10-year BMP implementation schedule has been developed in order to meet the water quality standard for bacteria.

Separate water quality milestones have been developed for both Upper Soldier Creek and Rock Creek, along with additional indicators of water quality. The purpose of the milestones and indicators is to measure water quality improvements associated with the BMP implementation schedules contained in this plan.

12.4 Water Quality Milestones for Total Suspended Solids - Upper Soldier Creek

KDHE has determined that the high priority biology TMDL that has existed for Upper Soldier Creek since 2007 is due to excessive sediment, or high TSS (total suspended solids). Monitoring in the Soldier Creek watershed has further indicated that of the three KDHE water quality monitoring sites in Soldier Creek, the highest TSS continues to be seen at the Delia sampling site, which is located in the upper portion of the Soldier Creek watershed.

As previously stated, this plan estimates that it will take 20 years to implement the planned BMPs necessary to meet the sediment load reduction goal of 18,452 tons/yr for the TSS TMDL in Upper Soldier Creek. The table below includes midterm (10 years) and long term (20 years) water quality goals for TSS.

Table 49: Water Quality Milestones for Upper Soldier Creek

Water Quality Milestones for Upper Soldier Creek					
	Current Condition (1990 - 2009) Median TSS	Mid Term Goal		Long Term Goal	
		Improved Condition (2011 - 2021) Median TSS	Total Reduction Needed*	Improved Condition (2011 - 2031) Median TSS	Total Reduction Needed*
Sampling Site	Total Suspended Solids (median of data collected during indicated period), ppm				
Soldier Creek (Upper) SC101	64.5	57	**7.5**	50	**14.5**

*The Total Reduction Needed is from the Current Condition based on the period of record 1990 - 2009.

In addition to the water quality milestones listed in the table above for TSS, concurrent biological sampling in Upper Soldier Creek should show improvements in the macroinvertebrate index scores over the same time period. The Macroinvertebrate Biotic Index (MBI) is a biological monitoring metric that can be used to assess compliance with water quality standards. The MBI values can be used to determine the extent to which the monitored water body can support aquatic life, as follows:

MBI ≤ 4.5 → fully supporting
4.5 < MBI < 5.4 → partially supporting
MBI ≥ 5.4 → non-supporting

Based on the biological data collected and sampled from 1985 to 2004 (as included in the TMDL for Upper Soldier Creek), the historical MBI values average 4.83. Of the samples taken during the referenced period of record, 33% had MBI values below 4.5. The end goal for Upper Soldier Creek is for the average MBI to be less than 4.5. An indication of water quality progress would be that at least 50% of MBI values through the monitoring period are less than 4.5, and that no

sample has an MBI value greater than 5.

12.5 Water Quality Milestones for Bacteria - Rock Creek

As noted previously, this plan is addressing the 303(d) bacteria impairment for Rock Creek near Louisville. The water quality goal associated with the bacteria impairment 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.

The East Fork of Rock Creek in the upper reaches of the watershed flows into main Rock Creek, and then into Vermillion Creek, and finally into the Kansas River. In 2000, a high priority TMDL was developed for Vermillion Creek. This plan specifically addresses the 303(d) bacteria impairment for Rock Creek near Louisville, which eventually flows into the Vermillion east of Louisville.

The figure below indicates the frequency of E. Coli bacteria levels seen on Rock Creek and Vermillion Creek since 2003, including 4 intensive samplings taken on each station in 2008. The “Vermillion” series shown in the figure represents samples taken in the lower Vermillion Creek (SC520), and the “Onaga” series represents samples taken in the upper Vermillion Creek near the City of Onaga (SC681). The “Rock” series represents samples taken in Rock Creek at SC645 near Louisville. In order to indicate improved water quality through reduced bacteria loading to the streams, a cumulative frequency curve developed from the bacteria index values of the collected samples should emulate the “Desired” curve shown in the figure below.

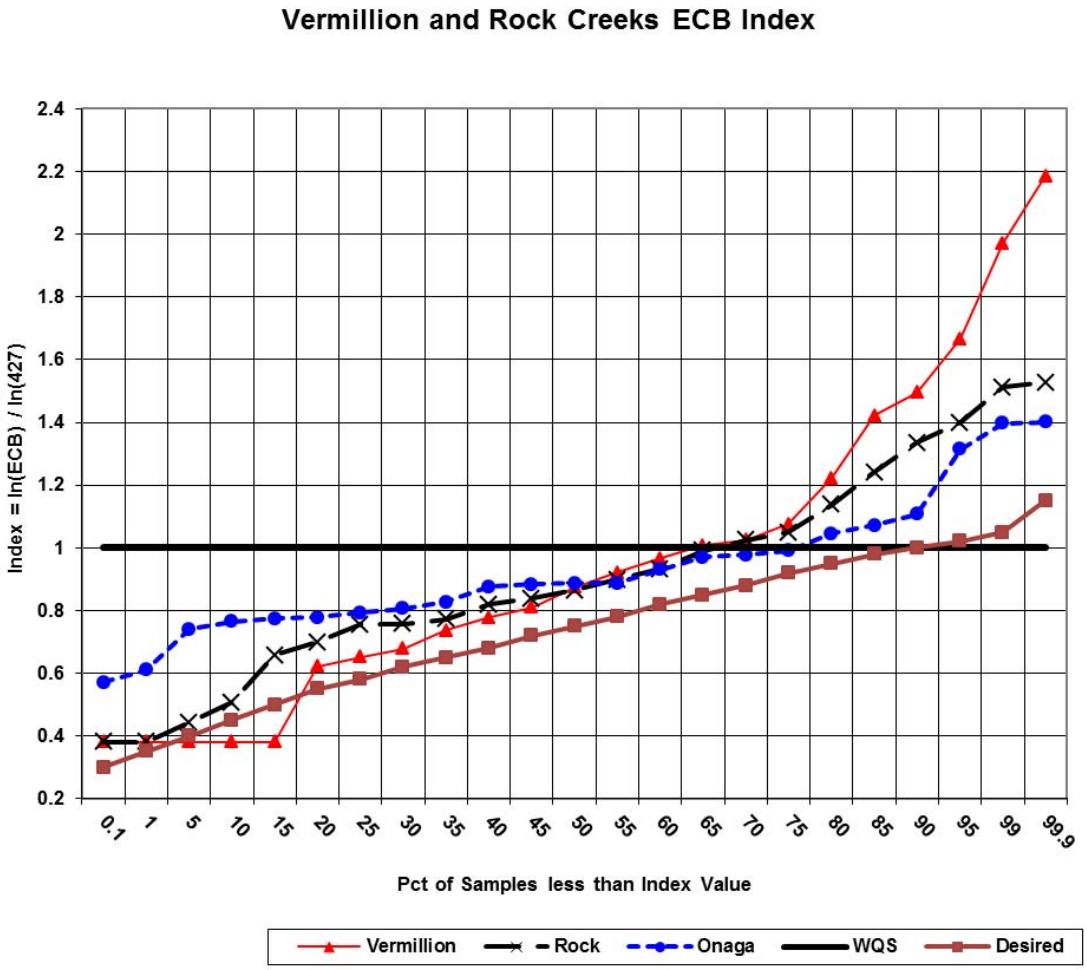


Figure 28 - E coli Bacteria Value Profiles for Vermillion and Rock Creeks since 2003

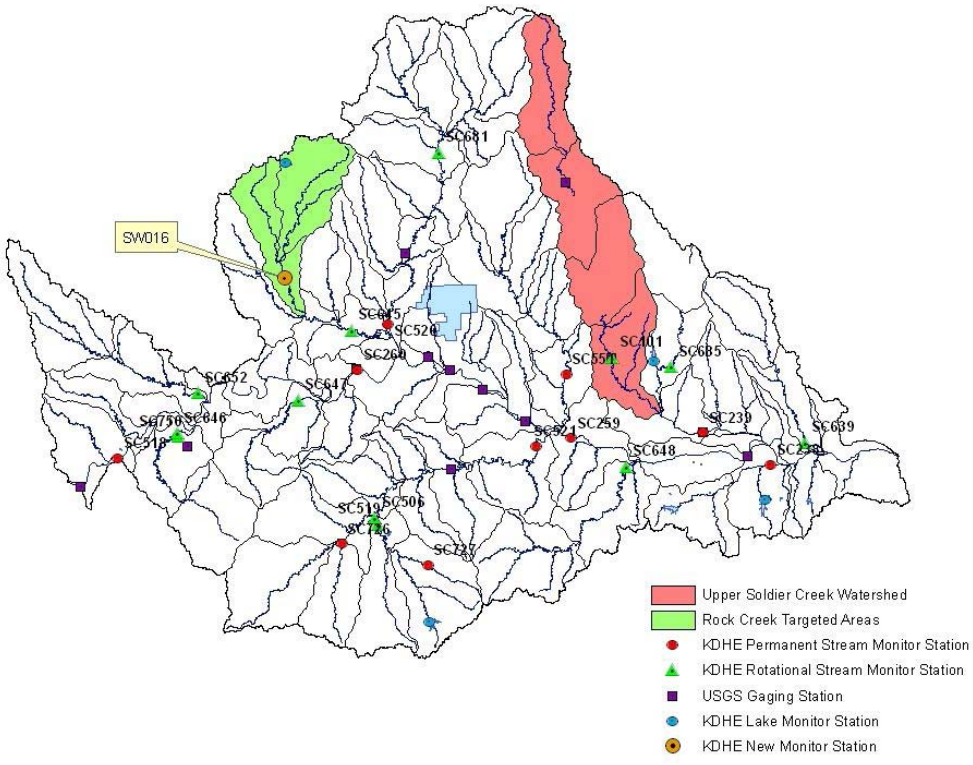
KDHE has stated that the water quality goal for the bacteria impairments in both Rock Creek and Vermillion Creek is for 90% of the samples taken during April through October to be below the water quality criterion of 427 counts, or cfus/100 ml.

13.0 Monitoring Water Quality Progress

KDHE continues to monitor water quality in both the Upper Soldier Creek and Rock Creek by maintaining the monitoring stations located in both of these watersheds. The maps included in this section show the monitoring stations located within the Middle Kansas Watershed as a whole, as well as a detailed view of the locations of the monitoring stations within and downstream of the Upper Soldier Creek and Rock Creek watersheds, both of which have been targeted for BMP implementation and water quality monitoring by this plan.

The map below indicates the locations of the monitoring sites located within the Middle Kansas watershed.

Figure 29: Monitoring Sites in the Middle Kansas Watershed



Monitoring Sites in Middle Kansas Watershed

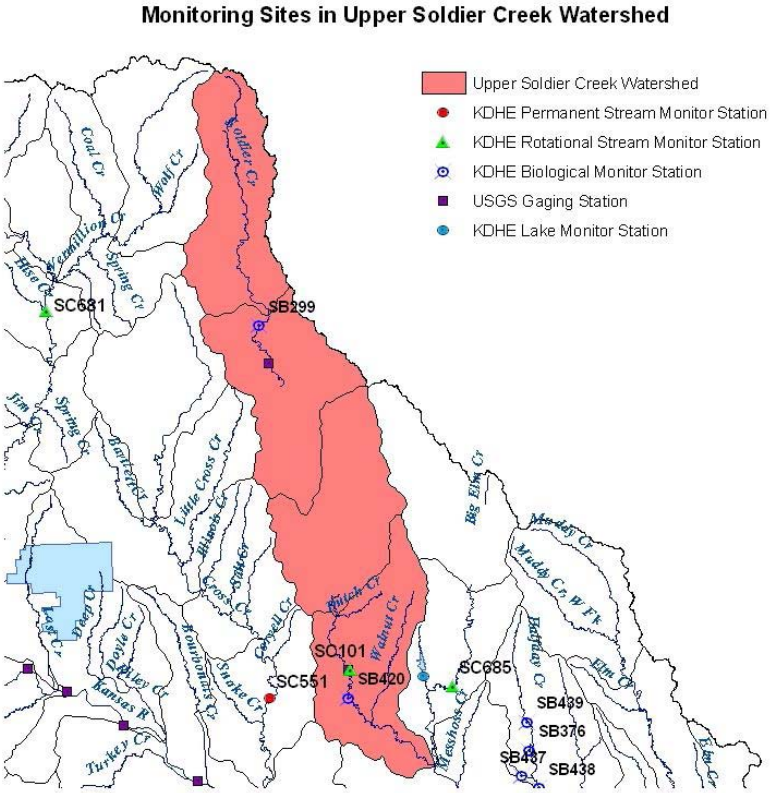
The map shows both the permanent and rotational KDHE monitoring stations. The permanent monitoring sites are continuously sampled, while the rotational sites are typically sampled every four years. The sites are sampled for nutrients, *E. coli* bacteria, chemicals, turbidity, alkalinity, dissolved oxygen, pH, ammonia

and metals. The pollutant indicators tested for each site may vary depending on the season at collection time and other factors.

13.1 Monitoring Network – Upper Soldier Creek

The map below shows the existing monitoring sites located specifically within or downstream of the Upper Soldier Creek watershed. The highlighted area of the watershed is comprised of the four HUC 12s that are being targeted by this plan for sediment load reductions through BMP implementation. The HUC 12s included are 102701020801, 102701020802, 102701020803.

Figure 30: Monitoring Sites in Upper Soldier Creek Watershed

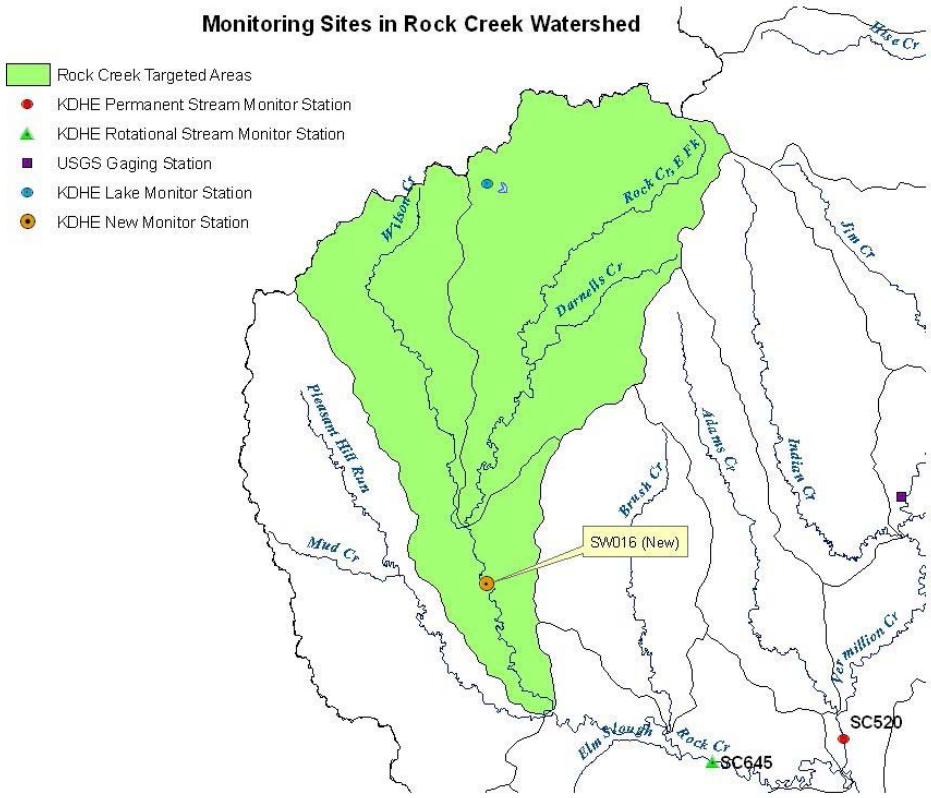


As shown on Figure 30 above, KDHE has a rotational monitoring station SC101 located in Soldier Creek, approximately 5.5 miles southwest of Delia. In addition, there are two biological monitoring sites located within the watershed, SB299 and SB420. Two USGS stream flow data stations (06889170 in the upper portion and 06889200 near Delia) are also located within the targeted Soldier Creek watershed. These sites will continue to be sampled and monitored by KDHE to evaluate the water quality of Upper Soldier Creek.

13.2 Monitoring Network – Rock Creek Targeted Area

The map below shows the existing monitoring sites located within and downstream of the targeted areas of the Rock Creek watershed. The highlighted area of the watershed is comprised of the two HUC 12s that are being targeted by this plan to address the 303(d) bacteria impairment for Rock Creek through BMP implementation. The HUC 12s included are102701020101 and 102701020102.

Figure 31: Monitoring Sites in Rock Creek Watershed



As shown on the above map, KDHE added a new monitoring station SW016, which is located in Rock Creek east of Flush. In addition, KDHE has a rotational monitoring station SC645 located in Rock Creek near Louisville, downstream of the targeted area of the watershed. These sites will continue to be sampled and monitored by KDHE to evaluate the water quality of Rock Creek.

13.3 Evaluation of Monitoring Data and Other Indicators of Water Quality Progress

Monitoring data in both the Upper Soldier Creek and the Rock Creek watersheds will be used to determine water quality progress, track water quality milestones, and to determine the effectiveness of the BMP implementation outlined in the plan. The schedule of review for the monitoring data will be tied to the water quality milestones that have been developed for each watershed, as well as the frequency of the sampling data.

In addition to the monitoring data, other water quality indicators can be utilized by KDHE and the SLT to determine progress. 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 improved water quality. These indicators can provide certain trigger-points which might warrant a reevaluation of the water quality progress and associated BMP implementation plan.

The BMP implementation schedule and water quality milestones for the Upper Soldier Creek TSS load reduction extend through a twenty-year period from 2011 to 2031. Throughout that period, KDHE will continue to analyze and evaluate the monitoring data collected. After the first ten years of monitoring and BMP implementation, KDHE will evaluate the available water quality data to determine whether the water quality milestones have been achieved. KDHE and the SLT can address any necessary modifications or revisions to the plan based on the data analysis. In 2031, at the end of the plan, a determination can be made as to whether the water quality standards have been attained.

For Rock Creek, the implementation schedule and water quality milestones addressing the 303(d) bacteria impairment extend through a ten-year period. Throughout the plan period, the monitoring data will continue to be analyzed in order to track water quality progress. As with the Upper Soldier Creek implementation schedule, the Rock Creek implementation schedule will be evaluated and revised as necessary based on the monitoring data and other water quality indicators.

13.4 Middle Kansas Monitoring

KDHE has ongoing monitoring sites in the watershed. There are two types of monitoring sites utilized by KDHE: permanent and rotational. Permanent sites are continuously sampled, whereas rotational sites are only sampled every fourth year.

Each stream chemistry (SC) site is tested for nutrients, metals, ammonia, solid fractions, turbidity, alkalinity, pH, dissolved oxygen, ECB and chemicals. Not all sites are tested for these pollutant indicators at each collection time. This is dependent upon the anticipated pollutant concern as well as other factors. For example, herbicide analysis would not be necessary in the winter months as there are no applications at that time. Each Stream Biology site (SB) is sampled for macroinvertebrate life as an indicator of water quality. In the map below sample site SB 299 is also SC 299 indicating that it is sampled both for chemistry and biology.

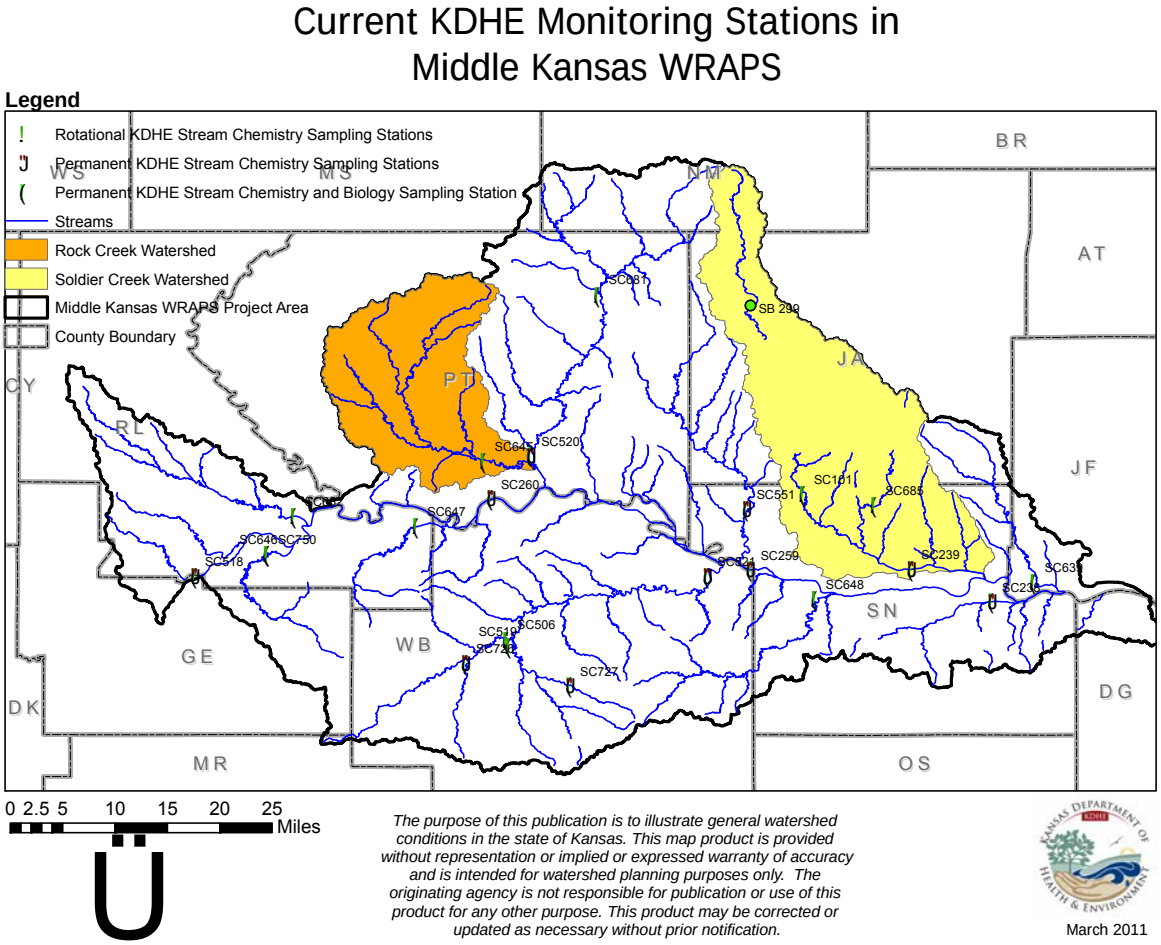


Figure 32: KDHE Monitoring Stations in the Middle Kansas WRAPS

There are10 USGS stream flow data stations in the watershed. The flow data derived from the gaging stations will assist the SLT in determining if streambank restoration sites that can withstand pressure from high flow events.

Monitoring data will be used to direct the SLT in their evaluation of water quality progress. Tables 50 and 51 below indicates which current monitoring sites data will be used by the SLT in determination of effectiveness of BMP implementation.

Table 50: Current Monitoring Sites Used in Livestock Targeted Area

Livestock Targeted Area						
Agency	Station	Permanent	Rotational	Pollutant Target	River or Creek	Sampling Tests Needed
KDHE	SC645		Yes	FCB	Rock Creek Near Louisville	TP, FCB
KDHE	SC520	Yes			Vermillion Creek Near Louisville	TP, FCB
KDHE	SC681		Yes		Vermillion Creek Near Onaga	TP, FCB

Table 51: Current Monitoring Sites Used in Cropland Targeted Area

Cropland Targeted Area						
Agency	**Station**	**Permanent**	**Rotational**	**Pollutant Target**	**River or Creek**	**Sampling Tests Needed**
KDHE	SC239	Yes		**Biology**	Soldier Creek Near Topeka	TSS, TP, TN, DO
KDHE	SC685		Yes		Little Soldier Creek Near Elmont	TSS, TP, TN, DO
KDHE	SC101		Yes		Soldier Creek Near Delia	TSS, TP, TN, DO

14.0 Conclusions

Since September, 2006, the Middle Kansas WRAPS has progressed through the development and assessment/planning stages associated with the Kansas WRAPS, administered by the KDHE- Watershed Management Section. The Middle Kansas WRAPS 9 Element Plan is the most comprehensive effort to date to set the stage for project implementation. The plan will serve as a blueprint for the next five years or whenever significant changes need to be made.

Targeted HUC 12 watersheds in Rock Creek and Upper Soldier Creek, selected by the Middle Kansas SLT in conjunction with the KDHE – Watershed Management and Planning Sections, will initiate the implementation process. EPA Section 319 and KDHE will provide funding for a project coordinator, service providers, and BMP implementation.

The Rock Creek Focus Group, consisting of service providers and the local conservation district, has been formed. A livestock management workshop has been conducted and one demonstration project installed. Livestock producers in the watershed will be contacted to solicit additional projects. The local conservation district in Upper Soldier Creek has submitted applications for demonstration practices converting cropland to native vegetation. The collaborative effort between state, federal and local government, in conjunction with the Middle Kansas SLT and local watershed partners has established a solid base for future watershed activities.

15.0 Appendix

15.1 Service Providers

Table 52: Potential Service Provider Listing.

Organization	Programs	Purpose	Technical or Financial Assistance	Website address
Environmental Protection Agency	Clean Water State Revolving Fund Program Watershed Protection	Provides low cost loans to communities for water pollution control activities. To conduct holistic strategies for restoring and protecting aquatic resources based on hydrology rather than political boundaries.	Financial	www.epa.gov
Kansas Alliance for Wetlands and Streams	Streambank Stabilization Wetland Restoration Cost share programs	The Kansas Alliance for Wetlands and Streams (KAWS) organized in 1996 to promote the protection, enhancement, restoration and establishment wetlands and streams in Kansas.	Technical	www.kaws.org
Kansas Dept. of Agriculture	Watershed structures permitting.	Available for watershed districts and multipurpose small lakes development.	Technical and Financial	www.accesskansas.org/kda

Organization	Programs and Technical Assistance	Purpose	Technical or Financial Assistance	Website address
Kansas Dept. of Health and Environment	**Nonpoint Source Pollution Program** Municipal and livestock waste Livestock waste Municipal waste State Revolving Loan Fund	Provide funds for projects that will reduce nonpoint source pollution. Compliance monitoring. Makes low interest loans for projects to improve and protect water quality.	Technical and Financial	www.kdheks.ks.us

Kansas Department of Wildlife and Parks	Land and Water Conservation Funds Conservation Easements for Riparian and Wetland Areas Wildlife Habitat Improvement Program North American Waterfowl Conservation Act MARSH program in coordination with Ducks Unlimited Chickadee Checkoff Walk In Hunting Program F.I.S.H. Program	Provides funds to preserve develop and assure access to outdoor recreation. To provide easements to secure and enhance quality areas in the state. To provide limited assistance for development of wildlife habitat. To provide up to 50 percent cost share for the purchase and/or development of wetlands and wildlife habitat. May provide up to 100 percent of funding for small wetland projects. Projects help with all nongame species. Funding is an optional donation line item on the KS Income Tax form. Landowners receive a payment incentive to allow public hunting on their property. Landowners receive a payment incentive to allow public fishing access to their ponds and streams.	Technical and Financial	www.kdwp.state.ks.us/

Organization	Programs and Technical Assistance	Purpose	Technical or Financial Assistance	Website address
Kansas Forest Service	Conservation Tree Planting Program Riparian and Wetland Protection Program	Provides low cost trees and shrubs for conservation plantings. Work closely with other agencies to promote and assist with establishment of riparian forestland and manage existing stands.	Technical	www.kansasforests.org
Kansas Rural Center	The Heartland Network Clean Water Farms-River Friendly Farms Sustainable Food Systems Project Cost share programs	The Center is committed to economically viable, environmentally sound and socially sustainable rural culture.	Technical and Financial	www.kansasruralcenter.org
Kansas Rural Water Association	Technical assistance for Water Systems with Source Water Protection Planning.	Provide education, technical assistance and leadership to public water and wastewater utilities to enhance the public health and to sustain Kansas' communities	Technical	www.krwa.net

Kansas State Research and Extension	Water Quality Programs, Waste Management Programs Kansas Center for Agricultural Resources and Environment (KCARE) Kansas Environmental Leadership Program (KELP) Kansas Local Government Water Quality Planning and Management Rangeland and Natural Area Services (RNAS) WaterLINK Kansas Pride: Healthy Ecosystems/Healthy Communities Citizen Science	Provide programs, expertise and educational materials that relate to minimizing the impact of rural and urban activities on water quality. Educational program to develop leadership for improved water quality. Provide guidance to local governments on water protection programs. Reduce non-point source pollution emanating from Kansas grasslands. Service-learning projects available to college and university faculty and community watersheds in Kansas. Help citizens appraise their local natural resources and develop short and long term plans and activities to protect, sustain and restore their resources for the future. Education combined with volunteer soil and water testing for enhanced natural resource stewardship.	Technical	www.ksre.ksu.edu

Organization	Programs and Technical Assistance	Purpose	Technical or Financial Assistance	Website address
Kansas Water Office	Public Information and Education	Provide information and education to the public on Kansas Water Resources	Technical and Financial	www.kwo.org
No-Till on the Plains	Field days, seasonal meetings, tours and technical consulting.	Provide information and assistance concerning continuous no-till farming practices.	Technical	www.notill.org

Organization	Programs and Technical Assistance	Purpose	Technical or Financial Assistance	Website address
Department of Agriculture – Division of Conservation **and** **Conservation Districts**	Water Resources Cost Share	Provide cost share assistance to landowners for establishment of water conservation practices.	Technical and Financial	www.accesskansas.org/kscc www.kacdnet.org
	Nonpoint Source Pollution Control Fund	Provides financial assistance for nonpoint pollution control projects which help restore water quality.		
	Riparian and Wetland Protection Program	Funds to assist with wetland and riparian development and enhancement.		
	Stream Rehabilitation Program	Assist with streams that have been adversely altered by channel modifications.		
	Kansas Water Quality Buffer Initiative	Compliments Conservation Reserve Program by offering additional financial incentives for grass filters and riparian forest buffers.		
	Watershed district and multipurpose lakes	Programs are available for watershed district and multipurpose small lakes.		

Organization	Programs and Technical Assistance	Purpose	Technical or Financial Assistance	Website address
US Army Corps of Engineers	Planning Assistance to States Environmental Restoration	Assistance in development of plans for development, utilization and conservation of water and related land resources of drainage Funding assistance for aquatic ecosystem restoration.	Technical	www.usace.army.mil
US Fish and Wildlife Service	Fish and Wildlife Enhancement Program Private Lands Program	Supports field operations which include technical assistance on wetland design. Contracts to restore, enhance, or create wetlands.	Technical	www.fws.gov
US Geological Survey	National Streamflow Information Program Water Cooperative Program	Provide streamflow data Provide cooperative studies and water-quality information	Technical	ks.water.usgs.gov Nrtwq.usgs.gov

Organization	Programs and Technical Assistance	Purpose	Technical or Financial Assistance	Website address
USDA-Natural Resources Conservation Service and Farm Service Agency	Conservation Compliance	Primarily for the technical assistance to develop conservation plans on cropland.	Technical and Financial	www.ks.nrcs.usda.gov
	Conservation Operations	To provide technical assistance on private land for development and application of Resource Management Plans.		
	Watershed Planning and Operations	Primarily focused on high priority areas where agricultural improvements will meet water quality objectives.		
	Wetland Reserve Program	Cost share and easements to restore wetlands.		
	Wildlife Habitat Incentives Program	Cost share to establish wildlife habitat which includes wetlands and riparian areas.		
	Grassland Reserve Program, EQIP, and Conservation Reserve Program	Improve and protect rangeland resources with cost-sharing practices, rental agreements, and easement purchases.		

15.2 BMP Definitions

Cropland

Vegetative Buffer
-Area of field maintained in permanent vegetation to help reduce nutrient and sediment loss from agricultural fields, improve runoff water quality, and provide habitat for wildlife.
-On average for Kansas fields, 1 acre buffer treats 15 acres of cropland.
-50% erosion reduction efficiency, 50% phosphorous reduction efficiency
-Approx. $1,000/acre. Cost-share from FSA through the CCRP

Grassed Waterway
-Grassed strip used as an outlet to prevent silt and gully formation.
-Can also be used as outlets for water from terraces.
-On average for Kansas fields, 1 acre waterway will treat 10 acres of cropland.
-40% erosion reduction efficiency, 40% phosphorous reduction efficiency.
-The flat rate for NRCS on grassed waterways is $1,429.31 for shaping and $853.07 for topsoiling.

No-Till
-A management system in which chemicals may be used for weed control and seedbed preparation.
-The soil surface is never disturbed except for planting or drilling operations in a 100% no-till system.
-75% erosion reduction efficiency, 40% phosphorous reduction efficiency.
-WRAPS groups and KSU Ag Economists have decided $10 an acre for 10 years is an adequate payment to entice producers to convert, 50% cost-share available from NRCS.

Conservation Crop Rotation
-Growing various crops on the same piece of land in a planned rotation.
-High residue crops (corn) with low residue crops (wheat, soybeans).
-Low residue crops in succession may encourage erosion.
-25% Erosion Reduction Efficiency, 25% phosphorous reduction efficiency

-WRAPS groups and KSU Ag Economists have decided $5 an acre for 10 years is an adequate payment to entice producers to convert.

Terraces
-Earth embankment and/or channel constructed across the slope to intercept runoff water and trap soil.
-One of the oldest/most common BMPs
-30% Erosion Reduction Efficiency, 30% phosphorous reduction efficiency
- $.92 flat rate for gradient terraces
-$1.25 flat rate for tile terraces.
- Underground outlets associated with tile terraces is $4.51/LF flat rate for 4-6" pipe and $7.26/LF for 8-10" Pipe.

Nutrient Management Plan
-Managing the amount, source, placement, form and timing of the application of nutrients and soil amendments.
-Intensive soil testing
-25% erosion and 25% P reduction efficiency.
-WRAPS groups and KSU Ag Economists have decided $7.30 an acre for 10 years is an adequate payment to entice producers to convert, 50% cost-share is available from NRCS.

Subsurface Fertilizer Application
-Placing or injecting fertilizer beneath the soil surface.
-Reduces fertilizer runoff.
-0% soil and 50% P reduction efficiency.
-$3.50 an acre for 10 years, no cost-share.
-WRAPS groups and KSU Ag Economists have decided $3.50 an acre for 10 years is an adequate payment to entice producers to convert, 50% cost-share is available from NRCS.

Livestock

Vegetative Filter Strip
-A vegetated area that receives runoff during rainfall from an animal feeding operation.

-Often require a land area equal to or greater than the drainage area (needs to be as large as the feedlot).
-10 year lifespan, requires periodic mowing or haying, average P reduction: 50%.
-$714 an acre

Relocate Feeding Sites
-Feedlot- Move feedlot or pens away from a stream, waterway, or body of water to increase filtration and waste removal of manure. Highly variable in price, average of $6,600 per unit.
-Pasture- Move feeding site that is in a pasture away from a stream, waterway, or body of water to increase the filtration and waste removal (eg. move bale feeders away from stream). Highly variable in price, average of $2,203 per unit.
-Average P reduction: 30-80%

Alternative (Off-Stream) Watering System
-Watering system so that livestock do not enter stream or body of water.
-Studies show cattle will drink from tank over a stream or pond 80% of the time.
-10-25 year lifespan, average P reduction: 30-98% with greater efficiencies for limited stream access.
-$3,795 installed for solar system, including present value of maintenance costs.

Pond
-Water impoundment made by constructing an earthen dam.
-Traps sediment and nutrients from leaving edge of pasture.
-Provides source of water.
-50% P Reduction.
-Approximately $12,000

Rotational Grazing
-Rotating livestock within a pasture to spread manure more uniformly and allow grass to regenerate.
-May involve significant cross fencing and additional watering sites.
-50-75% P Reduction.
-Approximately $7,000 with complex systems significantly more expensive.
Stream Fencing
-Fencing out streams and ponds to prevent livestock from entering.

-95% P Reduction.
-25 year life expectancy.
-Approximately $4,106 per ¼ mile of fence, including labor, materials, and maintenance

15.3 Sub Watershed Tables

14.3.1 Load Reduction Rates by Sub Watershed

Table 53: Sediment Reduction Rates by Sub Watershed.

Sub Watershed #102701020801 Annual Soil Erosion Reduction (tons), Cropland BMPs

Year	Permanent Vegetation	Grassed Waterways	No-Till	Vegetative Buffers	Terraces	Sediment Basins	Wetlands	Total Load Reduction
1	5	7	13	8	8	4	0	**45**
2	10	14	25	17	15	8	1	**90**
3	14	20	38	25	23	13	1	**135**
4	19	27	51	34	31	17	1	**180**
5	24	34	64	42	38	21	1	**225**
6	29	41	76	51	46	25	2	**270**
7	34	47	89	59	53	30	2	**315**
8	39	54	102	68	61	34	2	**359**
9	43	61	114	76	69	38	2	**404**
10	48	68	127	85	76	42	3	**449**
11	53	75	140	93	84	47	3	**494**
12	58	81	153	102	92	51	3	**539**
13	63	88	165	110	99	55	3	**584**
14	68	95	178	119	107	59	4	**629**
15	72	102	191	127	114	64	4	**674**
16	77	109	203	136	122	68	4	**719**
17	82	115	216	144	130	72	4	**764**
18	87	122	229	153	137	76	5	**809**
19	92	129	242	161	145	81	5	**854**

20	97	136	254	170	153	85	5	**899**

Sub Watershed #102701020802 Annual Soil Erosion Reduction (tons), Cropland BMPs

Year	Permanent Vegetation	Grassed Waterways	No-Till	Vegetative Buffers	Terraces	Sediment Basins	Wetlands	Total Load Reduction
1	2	3	5	3	3	2	0	**18**
2	4	5	10	7	6	3	0	**35**
3	6	8	15	10	9	5	0	**53**
4	8	11	20	13	12	7	0	**71**
5	9	13	25	17	15	8	0	**88**
6	11	16	30	20	18	10	1	**106**
7	13	19	35	23	21	12	1	**123**
8	15	21	40	27	24	13	1	**141**
9	17	24	45	30	27	15	1	**159**
10	19	27	50	33	30	17	1	**176**
11	21	29	55	37	33	18	1	**194**
12	23	32	60	40	36	20	1	**212**
13	25	35	65	43	39	22	1	**229**
14	27	37	70	47	42	23	1	**247**
15	28	40	75	50	45	25	1	**265**
16	30	43	80	53	48	27	2	**282**
17	32	45	85	57	51	28	2	**300**
18	34	48	90	60	54	30	2	**317**
19	36	51	95	63	57	32	2	**335**
20	38	53	100	67	60	33	2	**353**

Sub Watershed #102701020803 Annual Soil Erosion Reduction (tons), Cropland BMPs

Year	Permanent Vegetation	Grassed Waterways	No-Till	Vegetative Buffers	Terraces	Sediment Basins	Wetlands	Total Load Reduction
1	2	3	6	4	4	2	0	**22**
2	5	7	12	8	7	4	0	**44**
3	7	10	19	12	11	6	0	**66**
4	9	13	25	16	15	8	0	**87**
5	12	16	31	21	19	10	1	**109**
6	14	20	37	25	22	12	1	**131**
7	16	23	43	29	26	14	1	**153**
8	19	26	49	33	30	16	1	**175**
9	21	30	56	37	33	19	1	**197**
10	24	33	62	41	37	21	1	**219**
11	26	36	68	45	41	23	1	**240**
12	28	40	74	49	45	25	1	**262**
13	31	43	80	54	48	27	2	**284**
14	33	46	87	58	52	29	2	**306**
15	35	49	93	62	56	31	2	**328**
16	38	53	99	66	59	33	2	**350**
17	40	56	105	70	63	35	2	**372**
18	42	59	111	74	67	37	2	**393**
19	45	63	118	78	71	39	2	**415**
20	47	66	124	82	74	41	2	**437**

Sub Watershed #102701020804 Annual Soil Erosion Reduction (tons), Cropland BMPs

Year	Permanent Vegetation	Grassed Waterways	No-Till	Vegetative Buffers	Terraces	Sediment Basins	Wetlands	Total Load Reduction
1	5	7	12	8	7	4	0	**44**
2	9	13	25	17	15	8	0	**88**
3	14	20	37	25	22	12	1	**132**
4	19	27	50	33	30	17	1	**176**
5	24	33	62	42	37	21	1	**220**
6	28	40	75	50	45	25	1	**264**
7	33	47	87	58	52	29	2	**308**
8	38	53	100	66	60	33	2	**352**
9	43	60	112	75	67	37	2	**396**
10	47	66	125	83	75	42	2	**440**
11	52	73	137	91	82	46	3	**484**
12	57	80	150	100	90	50	3	**528**
13	62	86	162	108	97	54	3	**572**
14	66	93	174	116	105	58	3	**616**
15	71	100	187	125	112	62	4	**660**
16	76	106	199	133	120	66	4	**704**
17	80	113	212	141	127	71	4	**748**
18	85	120	224	150	135	75	4	**793**
19	90	126	237	158	142	79	5	**837**
20	95	133	249	166	150	83	5	**881**

Sub Watershed #102701020805 Annual Soil Erosion Reduction (tons), Cropland BMPs

Year	Permanent Vegetation	Grassed Waterways	No-Till	Vegetative Buffers	Terraces	Sediment Basins	Wetlands	Total Load Reduction
1	2	2	4	3	2	1	0	**15**
2	3	4	8	6	5	3	0	**29**
3	5	7	12	8	7	4	0	**44**
4	6	9	17	11	10	6	0	**59**
5	8	11	21	14	12	7	0	**73**
6	9	13	25	17	15	8	0	**88**
7	11	15	29	19	17	10	1	**102**
8	13	18	33	22	20	11	1	**117**
9	14	20	37	25	22	12	1	**132**
10	16	22	41	28	25	14	1	**146**
11	17	24	46	30	27	15	1	**161**
12	19	26	50	33	30	17	1	**176**
13	20	29	54	36	32	18	1	**190**
14	22	31	58	39	35	19	1	**205**
15	24	33	62	41	37	21	1	**219**
16	25	35	66	44	40	22	1	**234**
17	27	38	70	47	42	23	1	**249**
18	28	40	75	50	45	25	1	**263**
19	30	42	79	52	47	26	2	**278**
20	31	44	83	55	50	28	2	**293**

Sub Watershed #102701020806 Annual Soil Erosion Reduction (tons), Cropland BMPs

Year	Permanent Vegetation	Grassed Waterways	No-Till	Vegetative Buffers	Terraces	Sediment Basins	Wetlands	Total Load Reduction
1	2	3	6	4	3	2	0	**20**
2	4	6	11	7	7	4	0	**39**

3	6	9	17	11	10	6	0	**59**
4	8	12	22	15	13	7	0	**78**
5	11	15	28	18	17	9	1	**98**
6	13	18	33	22	20	11	1	**117**
7	15	21	39	26	23	13	1	**137**
8	17	24	44	29	27	15	1	**156**
9	19	27	50	33	30	17	1	**176**
10	21	29	55	37	33	18	1	**195**
11	23	32	61	41	36	20	1	**215**
12	25	35	66	44	40	22	1	**234**
13	27	38	72	48	43	24	1	**254**
14	29	41	77	52	46	26	2	**274**
15	32	44	83	55	50	28	2	**293**
16	34	47	88	59	53	29	2	**313**
17	36	50	94	63	56	31	2	**332**
18	38	53	100	66	60	33	2	**352**
19	40	56	105	70	63	35	2	**371**
20	42	59	111	74	66	37	2	**391**

Sub Watershed #102701020807 Annual Soil Erosion Reduction (tons), Cropland BMPs

Year	Permanent Vegetation	Grassed Waterways	No-Till	Vegetative Buffers	Terraces	Sediment Basins	Wetlands	Total Load Reduction
1	5	6	12	8	7	4	0	**42**
2	9	13	24	16	14	8	0	**84**
3	14	19	36	24	21	12	1	**126**
4	18	25	48	32	29	16	1	**168**
5	23	32	60	40	36	20	1	**210**
6	27	38	71	48	43	24	1	**253**

7	32	44	83	56	50	28	2	**295**
8	36	51	95	64	57	32	2	**337**
9	41	57	107	71	64	36	2	**379**
10	45	64	119	79	71	40	2	**421**
11	50	70	131	87	79	44	3	**463**
12	54	76	143	95	86	48	3	**505**
13	59	83	155	103	93	52	3	**547**
14	63	89	167	111	100	56	3	**589**
15	68	95	179	119	107	60	4	**631**
16	72	102	191	127	114	64	4	**673**
17	77	108	203	135	122	68	4	**716**
18	81	114	214	143	129	71	4	**758**
19	86	121	226	151	136	75	5	**800**
20	91	127	238	159	143	79	5	**842**

Sub Watershed # 102701020808Annual Soil Erosion Reduction (tons), Cropland BMPs

Year	Permanent Vegetation	Grassed Waterways	No-Till	Vegetative Buffers	Terraces	Sediment Basins	Wetlands	Total Load Reduction
1	1	1	2	1	1	1	0	**6**
2	1	2	4	2	2	1	0	**13**
3	2	3	5	4	3	2	0	**19**
4	3	4	7	5	4	2	0	**25**
5	3	5	9	6	5	3	0	**32**
6	4	6	11	7	6	4	0	**38**
7	5	7	13	8	8	4	0	**44**
8	5	8	14	10	9	5	0	**51**
9	6	9	16	11	10	5	0	**57**

10	7	10	18	12	11	6	0	**63**
11	8	11	20	13	12	7	0	**70**
12	8	11	22	14	13	7	0	**76**
13	9	12	23	16	14	8	0	**82**
14	10	13	25	17	15	8	1	**89**
15	10	14	27	18	16	9	1	**95**
16	11	15	29	19	17	10	1	**101**
17	12	16	31	20	18	10	1	**108**
18	12	17	32	22	19	11	1	**114**
19	13	18	34	23	20	11	1	**121**
20	14	19	36	24	22	12	1	**127**

Table 54: Phosphorus Reduction Rates by Sub Watershed.

Sub Watershed # 102701020801Annual Phosphorous Reduction (pounds), Cropland BMPs

Year	Permanent Vegetation	Grassed Waterways	No-Till	Vegetative Buffers	Terraces	Sediment Basins	Wetlands	Total Load Reduction
1	28	40	40	50	45	25	1	**229**
2	57	80	80	100	90	50	3	**458**
3	85	120	120	149	135	75	4	**687**
4	114	159	159	199	179	100	6	**917**
5	142	199	199	249	224	125	7	**1,146**
6	170	239	239	299	269	149	9	**1,375**
7	199	279	279	349	314	174	10	**1,604**
8	227	319	319	399	359	199	12	**1,833**
9	256	359	359	448	404	224	13	**2,062**
10	284	399	399	498	448	249	15	**2,292**

11	312	438	438	548	493	274	16	**2,521**
12	341	478	478	598	538	299	18	**2,750**
13	369	518	518	648	583	324	19	**2,979**
14	398	558	558	697	628	349	21	**3,208**
15	426	598	598	747	673	374	22	**3,437**
16	454	638	638	797	717	399	24	**3,667**
17	483	678	678	847	762	423	25	**3,896**
18	511	717	717	897	807	448	27	**4,125**
19	540	757	757	947	852	473	28	**4,354**
20	568	797	797	996	897	498	30	**4,583**

Sub Watershed #102701020802 Annual Phosphorous Reduction (pounds), Cropland BMPs

Year	Permanent Vegetation	Grassed Waterways	No-Till	Vegetative Buffers	Terraces	Sediment Basins	Wetlands	Total Load Reduction
1	11	16	16	20	18	10	1	**90**
2	22	31	31	39	35	20	1	**180**
3	33	47	47	59	53	29	2	**270**
4	45	63	63	78	70	39	2	**360**
5	56	78	78	98	88	49	3	**450**
6	67	94	94	117	106	59	4	**540**
7	78	109	109	137	123	68	4	**630**
8	89	125	125	156	141	78	5	**720**
9	100	141	141	176	158	88	5	**809**
10	111	156	156	196	176	98	6	**899**
11	123	172	172	215	194	108	6	**989**
12	134	188	188	235	211	117	7	**1,079**
13	145	203	203	254	229	127	8	**1,169**
14	156	219	219	274	246	137	8	**1,259**

15	167	235	235	293	264	147	9	**1,349**
16	178	250	250	313	282	156	9	**1,439**
17	189	266	266	332	299	166	10	**1,529**
18	201	282	282	352	317	176	11	**1,619**
19	212	297	297	371	334	186	11	**1,709**
20	223	313	313	391	352	196	12	**1,799**

Sub Watershed #102701020803 Annual Phosphorous Reduction (pounds), Cropland BMPs

Year	Permanent Vegetation	Grassed Waterways	No-Till	Vegetative Buffers	Terraces	Sediment Basins	Wetlands	Total Load Reduction
1	14	19	19	24	22	12	1	**111**
2	28	39	39	48	44	24	1	**223**
3	41	58	58	73	65	36	2	**334**
4	55	78	78	97	87	48	3	**446**
5	69	97	97	121	109	61	4	**557**
6	83	116	116	145	131	73	4	**669**
7	97	136	136	170	153	85	5	**780**
8	110	155	155	194	174	97	6	**892**
9	124	174	174	218	196	109	7	**1,003**
10	138	194	194	242	218	121	7	**1,114**
11	152	213	213	267	240	133	8	**1,226**
12	166	233	233	291	262	145	9	**1,337**
13	180	252	252	315	283	157	9	**1,449**
14	193	271	271	339	305	170	10	**1,560**
15	207	291	291	363	327	182	11	**1,672**
16	221	310	310	388	349	194	12	**1,783**
17	235	330	330	412	371	206	12	**1,895**
18	249	349	349	436	392	218	13	**2,006**

19	262	368	368	460	414	230	14	**2,118**
20	276	388	388	485	436	242	15	**2,229**

Sub Watershed #102701020804 Annual Phosphorous Reduction (pounds), Cropland BMPs

Year	Permanent Vegetation	Grassed Waterways	No-Till	Vegetative Buffers	Terraces	Sediment Basins	Wetlands	Total Load Reduction
1	28	39	39	49	44	24	1	**225**
2	56	78	78	98	88	49	3	**449**
3	83	117	117	146	132	73	4	**674**
4	111	156	156	195	176	98	6	**898**
5	139	195	195	244	220	122	7	**1,123**
6	167	234	234	293	264	146	9	**1,347**
7	195	273	273	342	307	171	10	**1,572**
8	223	312	312	390	351	195	12	**1,796**
9	250	351	351	439	395	220	13	**2,021**
10	278	390	390	488	439	244	15	**2,245**
11	306	430	430	537	483	268	16	**2,470**
12	334	469	469	586	527	293	18	**2,694**
13	362	508	508	635	571	317	19	**2,919**
14	389	547	547	683	615	342	20	**3,143**
15	417	586	586	732	659	366	22	**3,368**
16	445	625	625	781	703	390	23	**3,592**
17	473	664	664	830	747	415	25	**3,817**
18	501	703	703	879	791	439	26	**4,041**
19	529	742	742	927	835	464	28	**4,266**
20	556	781	781	976	879	488	29	**4,490**

Sub Watershed #102701020805 Annual Phosphorous Reduction (pounds), Cropland BMPs

Year	Permanent Vegetation	Grassed Waterways	No-Till	Vegetative Buffers	Terraces	Sediment Basins	Wetlands	Total Load Reduction
1	9	13	13	16	15	8	0	**75**
2	18	26	26	32	29	16	1	**149**
3	28	39	39	49	44	24	1	**224**
4	37	52	52	65	58	32	2	**298**
5	46	65	65	81	73	41	2	**373**
6	55	78	78	97	88	49	3	**448**
7	65	91	91	114	102	57	3	**522**
8	74	104	104	130	117	65	4	**597**
9	83	117	117	146	131	73	4	**671**
10	92	130	130	162	146	81	5	**746**
11	102	143	143	178	161	89	5	**821**
12	111	156	156	195	175	97	6	**895**
13	120	169	169	211	190	105	6	**970**
14	129	182	182	227	204	114	7	**1,044**
15	139	195	195	243	219	122	7	**1,119**
16	148	208	208	259	234	130	8	**1,194**
17	157	221	221	276	248	138	8	**1,268**
18	166	234	234	292	263	146	9	**1,343**
19	176	247	247	308	277	154	9	**1,417**
20	185	259	259	324	292	162	10	**1,492**

Sub Watershed #102701020806 Annual Phosphorous Reduction (pounds), Cropland BMPs

Year	Permanent Vegetation	Grassed Waterways	No-Till	Vegetative Buffers	Terraces	Sediment Basins	Wetlands	Total Load Reduction
1	12	17	17	22	19	11	1	**100**
2	25	35	35	43	39	22	1	**199**
3	37	52	52	65	58	32	2	**299**
4	49	69	69	87	78	43	3	**399**
5	62	87	87	108	97	54	3	**498**
6	74	104	104	130	117	65	4	**598**
7	86	121	121	152	136	76	5	**697**
8	99	139	139	173	156	87	5	**797**
9	111	156	156	195	175	97	6	**897**
10	123	173	173	217	195	108	6	**996**
11	136	191	191	238	214	119	7	**1,096**
12	148	208	208	260	234	130	8	**1,196**
13	161	225	225	282	253	141	8	**1,295**
14	173	243	243	303	273	152	9	**1,395**
15	185	260	260	325	292	162	10	**1,495**
16	198	277	277	347	312	173	10	**1,594**
17	210	295	295	368	331	184	11	**1,694**
18	222	312	312	390	351	195	12	**1,793**
19	235	329	329	412	370	206	12	**1,893**
20	247	347	347	433	390	217	13	**1,993**

Sub Watershed #102701020807 Annual Phosphorous Reduction (pounds), Cropland BMPs

Year	Permanent Vegetation	Grassed Waterways	No-Till	Vegetative Buffers	Terraces	Sediment Basins	Wetlands	Total Load Reduction
1	27	37	37	47	42	23	1	**215**

2	53	75	75	93	84	47	3	**429**
3	80	112	112	140	126	70	4	**644**
4	106	149	149	187	168	93	6	**859**
5	133	187	187	233	210	117	7	**1,073**
6	160	224	224	280	252	140	8	**1,288**
7	186	261	261	327	294	163	10	**1,502**
8	213	299	299	373	336	187	11	**1,717**
9	239	336	336	420	378	210	13	**1,932**
10	266	373	373	467	420	233	14	**2,146**
11	293	411	411	513	462	257	15	**2,361**
12	319	448	448	560	504	280	17	**2,576**
13	346	485	485	607	546	303	18	**2,790**
14	372	523	523	653	588	327	20	**3,005**
15	399	560	560	700	630	350	21	**3,220**
16	426	597	597	747	672	373	22	**3,434**
17	452	635	635	793	714	397	24	**3,649**
18	479	672	672	840	756	420	25	**3,863**
19	505	709	709	887	798	443	27	**4,078**
20	532	747	747	933	840	467	28	**4,293**

Sub Watershed # 102701020808 Annual Phosphorous Reduction (pounds), Cropland BMPs

Year	Permanent Vegetation	Grassed Waterways	No-Till	Vegetative Buffers	Terraces	Sediment Basins	Wetlands	Total Load Reduction
1	4	6	6	7	6	4	0	**32**
2	8	11	11	14	13	7	0	**65**
3	12	17	17	21	19	11	1	**97**
4	16	23	23	28	25	14	1	**129**

5	20	28	28	35	32	18	1	**162**
6	24	34	34	42	38	21	1	**194**
7	28	39	39	49	44	25	1	**226**
8	32	45	45	56	51	28	2	**259**
9	36	51	51	63	57	32	2	**291**
10	40	56	56	70	63	35	2	**323**
11	44	62	62	77	70	39	2	**356**
12	48	68	68	84	76	42	3	**388**
13	52	73	73	91	82	46	3	**421**
14	56	79	79	98	89	49	3	**453**
15	60	84	84	105	95	53	3	**485**
16	64	90	90	113	101	56	3	**518**
17	68	96	96	120	108	60	4	**550**
18	72	101	101	127	114	63	4	**582**
19	76	107	107	134	120	67	4	**615**
20	80	113	113	141	127	70	4	**647**

Table 55: Nitrogen Reduction Rates by Sub Watershed.

Sub Watershed #102701020801 Annual Nitrogen Reduction (pounds), Cropland BMPs

Year	Permanent Vegetation	Grassed Waterways	No-Till	Vegetative Buffers	Terraces	Sediment Basins	Wetlands	Total Load Reduction
1	124	175	109	109	197	55	5	**774**
2	249	349	218	218	393	109	11	**1,549**
3	373	524	328	328	590	164	16	**2,323**
4	498	699	437	437	786	218	22	**3,097**
5	622	874	546	546	983	273	27	**3,871**
6	747	1,048	655	655	1,179	328	33	**4,646**
7	871	1,223	764	764	1,376	382	38	**5,420**

8	996	1,398	874	874	1,573	437	44	**6,194**
9	1,120	1,573	983	983	1,769	491	49	**6,969**
10	1,245	1,747	1,092	1,092	1,966	546	55	**7,743**
11	1,369	1,922	1,201	1,201	2,162	601	60	**8,517**
12	1,494	2,097	1,310	1,310	2,359	655	66	**9,291**
13	1,618	2,272	1,420	1,420	2,555	710	71	**10,066**
14	1,743	2,446	1,529	1,529	2,752	764	76	**10,840**
15	1,867	2,621	1,638	1,638	2,949	819	82	**11,614**
16	1,992	2,796	1,747	1,747	3,145	874	87	**12,388**
17	2,116	2,970	1,857	1,857	3,342	928	93	**13,163**
18	2,241	3,145	1,966	1,966	3,538	983	98	**13,937**
19	2,365	3,320	2,075	2,075	3,735	1,037	104	**14,711**
20	2,490	3,495	2,184	2,184	3,931	1,092	109	**15,486**

Sub Watershed #102701020802 Annual Nitrogen Reduction (pounds), Cropland BMPs

Year	Permanent Vegetation	Grassed Waterways	No-Till	Vegetative Buffers	Terraces	Sediment Basins	Wetlands	Total Load Reduction
1	49	69	43	43	77	21	2	**304**
2	98	137	86	86	154	43	4	**608**
3	147	206	129	129	231	64	6	**912**
4	195	274	171	171	309	86	9	**1,216**
5	244	343	214	214	386	107	11	**1,519**
6	293	411	257	257	463	129	13	**1,823**
7	342	480	300	300	540	150	15	**2,127**
8	391	549	343	343	617	171	17	**2,431**
9	440	617	386	386	694	193	19	**2,735**
10	489	686	429	429	772	214	21	**3,039**
11	537	754	471	471	849	236	24	**3,343**

12	586	823	514	514	926	257	26	**3,647**
13	635	892	557	557	1,003	279	28	**3,951**
14	684	960	600	600	1,080	300	30	**4,254**
15	733	1,029	643	643	1,157	321	32	**4,558**
16	782	1,097	686	686	1,234	343	34	**4,862**
17	831	1,166	729	729	1,312	364	36	**5,166**
18	880	1,234	772	772	1,389	386	39	**5,470**
19	928	1,303	814	814	1,466	407	41	**5,774**
20	977	1,372	857	857	1,543	429	43	**6,078**

Sub Watershed #102701020803 Annual Nitrogen Reduction (pounds), Cropland BMPs

Year	Permanent Vegetation	Grassed Waterways	No-Till	Vegetative Buffers	Terraces	Sediment Basins	Wetlands	Total Load Reduction
1	61	85	53	53	96	27	3	**377**
2	121	170	106	106	191	53	5	**753**
3	182	255	159	159	287	80	8	**1,130**
4	242	340	212	212	382	106	11	**1,506**
5	303	425	266	266	478	133	13	**1,883**
6	363	510	319	319	574	159	16	**2,259**
7	424	595	372	372	669	186	19	**2,636**
8	484	680	425	425	765	212	21	**3,013**
9	545	765	478	478	860	239	24	**3,389**
10	605	850	531	531	956	266	27	**3,766**

11	666	935	584	584	1,052	292	29	**4,142**
12	727	1,020	637	637	1,147	319	32	**4,519**
13	787	1,105	690	690	1,243	345	35	**4,895**
14	848	1,190	744	744	1,338	372	37	**5,272**
15	908	1,275	797	797	1,434	398	40	**5,648**
16	969	1,360	850	850	1,530	425	42	**6,025**
17	1,029	1,445	903	903	1,625	451	45	**6,402**
18	1,090	1,530	956	956	1,721	478	48	**6,778**
19	1,150	1,615	1,009	1,009	1,816	505	50	**7,155**
20	1,211	1,700	1,062	1,062	1,912	531	53	**7,531**

Sub Watershed #102701020804 Annual Nitrogen Reduction (pounds), Cropland BMPs

Year	Permanent Vegetation	Grassed Waterways	No-Till	Vegetative Buffers	Terraces	Sediment Basins	Wetlands	Total Load Reduction
1	122	171	107	107	193	53	5	**759**
2	244	342	214	214	385	107	11	**1,517**
3	366	514	321	321	578	160	16	**2,276**
4	488	685	428	428	770	214	21	**3,034**
5	610	856	535	535	963	267	27	**3,793**
6	732	1,027	642	642	1,156	321	32	**4,552**
7	854	1,198	749	749	1,348	374	37	**5,310**
8	976	1,370	856	856	1,541	428	43	**6,069**
9	1,098	1,541	963	963	1,733	481	48	**6,828**
10	1,220	1,712	1,070	1,070	1,926	535	53	**7,586**
11	1,342	1,883	1,177	1,177	2,119	588	59	**8,345**
12	1,464	2,054	1,284	1,284	2,311	642	64	**9,103**
13	1,586	2,226	1,391	1,391	2,504	695	70	**9,862**
14	1,708	2,397	1,498	1,498	2,696	749	75	**10,621**

15	1,830	2,568	1,605	1,605	2,889	802	80	**11,379**
16	1,952	2,739	1,712	1,712	3,082	856	86	**12,138**
17	2,074	2,910	1,819	1,819	3,274	909	91	**12,896**
18	2,196	3,082	1,926	1,926	3,467	963	96	**13,655**
19	2,318	3,253	2,033	2,033	3,659	1,016	102	**14,414**
20	2,440	3,424	2,140	2,140	3,852	1,070	107	**15,172**

Sub Watershed #102701020805 Annual Nitrogen Reduction (pounds), Cropland BMPs

Year	Permanent Vegetation	Grassed Waterways	No-Till	Vegetative Buffers	Terraces	Sediment Basins	Wetlands	Total Load Reduction
1	41	57	36	36	64	18	2	**252**
2	81	114	71	71	128	36	4	**504**
3	122	171	107	107	192	53	5	**756**
4	162	228	142	142	256	71	7	**1,008**
5	203	284	178	178	320	89	9	**1,260**
6	243	341	213	213	384	107	11	**1,512**
7	284	398	249	249	448	124	12	**1,764**
8	324	455	284	284	512	142	14	**2,017**
9	365	512	320	320	576	160	16	**2,269**
10	405	569	356	356	640	178	18	**2,521**
11	446	626	391	391	704	196	20	**2,773**
12	486	683	427	427	768	213	21	**3,025**
13	527	739	462	462	832	231	23	**3,277**
14	567	796	498	498	896	249	25	**3,529**
15	608	853	533	533	960	267	27	**3,781**
16	648	910	569	569	1,024	284	28	**4,033**
17	689	967	604	604	1,088	302	30	**4,285**
18	730	1,024	640	640	1,152	320	32	**4,537**

19	770	1,081	675	675	1,216	338	34	**4,789**
20	811	1,138	711	711	1,280	356	36	**5,041**

Sub Watershed #102701020806 Annual Nitrogen Reduction (pounds), Cropland BMPs

Year	Permanent Vegetation	Grassed Waterways	No-Till	Vegetative Buffers	Terraces	Sediment Basins	Wetlands	Total Load Reduction
1	54	76	47	47	85	24	2	**337**
2	108	152	95	95	171	47	5	**673**
3	162	228	142	142	256	71	7	**1,010**
4	217	304	190	190	342	95	9	**1,347**
5	271	380	237	237	427	119	12	**1,683**
6	325	456	285	285	513	142	14	**2,020**
7	379	532	332	332	598	166	17	**2,357**
8	433	608	380	380	684	190	19	**2,693**
9	487	684	427	427	769	214	21	**3,030**
10	541	760	475	475	855	237	24	**3,367**
11	595	836	522	522	940	261	26	**3,703**
12	650	912	570	570	1,026	285	28	**4,040**
13	704	988	617	617	1,111	309	31	**4,377**
14	758	1,064	665	665	1,197	332	33	**4,713**
15	812	1,140	712	712	1,282	356	36	**5,050**
16	866	1,216	760	760	1,368	380	38	**5,387**
17	920	1,292	807	807	1,453	404	40	**5,723**
18	974	1,368	855	855	1,538	427	43	**6,060**
19	1,028	1,443	902	902	1,624	451	45	**6,396**
20	1,083	1,519	950	950	1,709	475	47	**6,733**

Sub Watershed #102701020807 Annual Nitrogen Reduction (pounds), Cropland BMPs

Year	Permanent Vegetation	Grassed Waterways	No-Till	Vegetative Buffers	Terraces	Sediment Basins	Wetlands	Total Load Reduction
1	117	164	102	102	184	51	5	**725**
2	233	327	205	205	368	102	10	**1,450**
3	350	491	307	307	552	153	15	**2,176**
4	466	655	409	409	736	205	20	**2,901**
5	583	818	511	511	921	256	26	**3,626**
6	700	982	614	614	1,105	307	31	**4,351**
7	816	1,146	716	716	1,289	358	36	**5,076**
8	933	1,309	818	818	1,473	409	41	**5,802**
9	1,049	1,473	921	921	1,657	460	46	**6,527**
10	1,166	1,637	1,023	1,023	1,841	511	51	**7,252**
11	1,283	1,800	1,125	1,125	2,025	563	56	**7,977**
12	1,399	1,964	1,227	1,227	2,209	614	61	**8,702**
13	1,516	2,128	1,330	1,330	2,393	665	66	**9,428**
14	1,632	2,291	1,432	1,432	2,578	716	72	**10,153**
15	1,749	2,455	1,534	1,534	2,762	767	77	**10,878**
16	1,866	2,619	1,637	1,637	2,946	818	82	**11,603**
17	1,982	2,782	1,739	1,739	3,130	869	87	**12,329**
18	2,099	2,946	1,841	1,841	3,314	921	92	**13,054**
19	2,216	3,109	1,943	1,943	3,498	972	97	**13,779**
20	2,332	3,273	2,046	2,046	3,682	1,023	102	**14,504**

Sub Watershed #102701020808 Annual Nitrogen Reduction (pounds), Cropland BMPs

Year	Permanent Vegetation	Grassed Waterways	No-Till	Vegetative Buffers	Terraces	Sediment Basins	Wetlands	Total Load Reduction
1	18	25	15	15	28	8	1	**109**

2	35	49	31	31	55	15	2	**219**
3	53	74	46	46	83	23	2	**328**
4	70	99	62	62	111	31	3	**437**
5	88	123	77	77	139	39	4	**546**
6	105	148	92	92	166	46	5	**656**
7	123	173	108	108	194	54	5	**765**
8	141	197	123	123	222	62	6	**874**
9	158	222	139	139	250	69	7	**984**
10	176	247	154	154	277	77	8	**1,093**
11	193	271	170	170	305	85	8	**1,202**
12	211	296	185	185	333	92	9	**1,312**
13	228	321	200	200	361	100	10	**1,421**
14	246	345	216	216	388	108	11	**1,530**
15	264	370	231	231	416	116	12	**1,639**
16	281	395	247	247	444	123	12	**1,749**
17	299	419	262	262	472	131	13	**1,858**
18	316	444	277	277	499	139	14	**1,967**
19	334	469	293	293	527	146	15	**2,077**
20	351	493	308	308	555	154	15	**2,186**

15.3.2 Adoption Rates by Sub Watershed

Table 56: Adoption Rates by Sub Watershed

Sub Watershed #102701020801 Annual Adoption (treated acres), Cropland BMPs

Year	Permanent Vegetation	Grassed Waterways	No-Till	Vegetative Buffers	Terraces	Sediment Basins	Wetlands	Total Adoption
1	12	39	39	39	59	20	2	209

2	12	39	39	39	59	20	2	209
3	12	39	39	39	59	20	2	209
4	12	39	39	39	59	20	2	209
5	12	39	39	39	59	20	2	209
6	12	39	39	39	59	20	2	209
7	12	39	39	39	59	20	2	209
8	12	39	39	39	59	20	2	209
9	12	39	39	39	59	20	2	209
10	12	39	39	39	59	20	2	209
11	12	39	39	39	59	20	2	209
12	12	39	39	39	59	20	2	209
13	12	39	39	39	59	20	2	209
14	12	39	39	39	59	20	2	209
15	12	39	39	39	59	20	2	209
16	12	39	39	39	59	20	2	209
17	12	39	39	39	59	20	2	209
18	12	39	39	39	59	20	2	209
19	12	39	39	39	59	20	2	209
20	12	39	39	39	59	20	2	209

Sub Watershed #102701020802 Annual Adoption (treated acres), Cropland BMPs

Year	Permanent Vegetation	Grassed Waterways	No-Till	Vegetative Buffers	Terraces	Sediment Basins	Wetlands	Total Adoption
1	5	15	15	15	23	8	1	82
2	5	15	15	15	23	8	1	82
3	5	15	15	15	23	8	1	82
4	5	15	15	15	23	8	1	82
5	5	15	15	15	23	8	1	82

6	5	15	15	15	23	8	1	82
7	5	15	15	15	23	8	1	82
8	5	15	15	15	23	8	1	82
9	5	15	15	15	23	8	1	82
10	5	15	15	15	23	8	1	82
11	5	15	15	15	23	8	1	82
12	5	15	15	15	23	8	1	82
13	5	15	15	15	23	8	1	82
14	5	15	15	15	23	8	1	82
15	5	15	15	15	23	8	1	82
16	5	15	15	15	23	8	1	82
17	5	15	15	15	23	8	1	82
18	5	15	15	15	23	8	1	82
19	5	15	15	15	23	8	1	82
20	5	15	15	15	23	8	1	82

Sub Watershed #102701020803 Annual Adoption (treated acres), Cropland BMPs

Year	Permanent Vegetation	Grassed Waterways	No-Till	Vegetative Buffers	Terraces	Sediment Basins	Wetlands	Total Adoption
1	6	19	19	19	29	10	1	102
2	6	19	19	19	29	10	1	102
3	6	19	19	19	29	10	1	102
4	6	19	19	19	29	10	1	102
5	6	19	19	19	29	10	1	102
6	6	19	19	19	29	10	1	102
7	6	19	19	19	29	10	1	102
8	6	19	19	19	29	10	1	102
9	6	19	19	19	29	10	1	102

10	6	19	19	19	29	10	1	102
11	6	19	19	19	29	10	1	102
12	6	19	19	19	29	10	1	102
13	6	19	19	19	29	10	1	102
14	6	19	19	19	29	10	1	102
15	6	19	19	19	29	10	1	102
16	6	19	19	19	29	10	1	102
17	6	19	19	19	29	10	1	102
18	6	19	19	19	29	10	1	102
19	6	19	19	19	29	10	1	102
20	6	19	19	19	29	10	1	102

Sub Watershed # 102701020804 Annual Adoption (treated acres), Cropland BMPs

Year	Permanent Vegetation	Grassed Waterways	No-Till	Vegetative Buffers	Terraces	Sediment Basins	Wetlands	Total Adoption
1	11	38	38	38	57	19	2	205
2	11	38	38	38	57	19	2	205
3	11	38	38	38	57	19	2	205
4	11	38	38	38	57	19	2	205
5	11	38	38	38	57	19	2	205
6	11	38	38	38	57	19	2	205
7	11	38	38	38	57	19	2	205
8	11	38	38	38	57	19	2	205
9	11	38	38	38	57	19	2	205
10	11	38	38	38	57	19	2	205
11	11	38	38	38	57	19	2	205
12	11	38	38	38	57	19	2	205
13	11	38	38	38	57	19	2	205

14	11	38	38	38	57	19	2	205
15	11	38	38	38	57	19	2	205
16	11	38	38	38	57	19	2	205
17	11	38	38	38	57	19	2	205
18	11	38	38	38	57	19	2	205
19	11	38	38	38	57	19	2	205
20	11	38	38	38	57	19	2	205

Sub Watershed #102701020805 Annual Adoption (treated acres), Cropland BMPs

Year	Permanent Vegetation	Grassed Waterways	No-Till	Vegetative Buffers	Terraces	Sediment Basins	Wetlands	Total Adoption
1	4	13	13	13	19	6	1	68
2	4	13	13	13	19	6	1	68
3	4	13	13	13	19	6	1	68
4	4	13	13	13	19	6	1	68
5	4	13	13	13	19	6	1	68
6	4	13	13	13	19	6	1	68
7	4	13	13	13	19	6	1	68
8	4	13	13	13	19	6	1	68
9	4	13	13	13	19	6	1	68
10	4	13	13	13	19	6	1	68
11	4	13	13	13	19	6	1	68
12	4	13	13	13	19	6	1	68
13	4	13	13	13	19	6	1	68
14	4	13	13	13	19	6	1	68
15	4	13	13	13	19	6	1	68
16	4	13	13	13	19	6	1	68
17	4	13	13	13	19	6	1	68

18	4	13	13	13	19	6	1	68
19	4	13	13	13	19	6	1	68
20	4	13	13	13	19	6	1	68

Sub Watershed #102701020806 Annual Adoption (treated acres), Cropland BMPs

Year	Permanent Vegetation	Grassed Waterways	No-Till	Vegetative Buffers	Terraces	Sediment Basins	Wetlands	Total Adoption
1	5	17	17	17	25	8	1	91
2	5	17	17	17	25	8	1	91
3	5	17	17	17	25	8	1	91
4	5	17	17	17	25	8	1	91
5	5	17	17	17	25	8	1	91
6	5	17	17	17	25	8	1	91
7	5	17	17	17	25	8	1	91
8	5	17	17	17	25	8	1	91
9	5	17	17	17	25	8	1	91
10	5	17	17	17	25	8	1	91
11	5	17	17	17	25	8	1	91
12	5	17	17	17	25	8	1	91
13	5	17	17	17	25	8	1	91
14	5	17	17	17	25	8	1	91
15	5	17	17	17	25	8	1	91
16	5	17	17	17	25	8	1	91
17	5	17	17	17	25	8	1	91
18	5	17	17	17	25	8	1	91
19	5	17	17	17	25	8	1	91
20	5	17	17	17	25	8	1	91

Sub Watershed #102701020807 Annual Adoption (treated acres), Cropland BMPs

Year	Permanent Vegetation	Grassed Waterways	No-Till	Vegetative Buffers	Terraces	Sediment Basins	Wetlands	Total Adoption
1	11	37	37	37	55	18	2	196
2	11	37	37	37	55	18	2	196
3	11	37	37	37	55	18	2	196
4	11	37	37	37	55	18	2	196
5	11	37	37	37	55	18	2	196
6	11	37	37	37	55	18	2	196
7	11	37	37	37	55	18	2	196
8	11	37	37	37	55	18	2	196
9	11	37	37	37	55	18	2	196
10	11	37	37	37	55	18	2	196
11	11	37	37	37	55	18	2	196
12	11	37	37	37	55	18	2	196
13	11	37	37	37	55	18	2	196
14	11	37	37	37	55	18	2	196
15	11	37	37	37	55	18	2	196
16	11	37	37	37	55	18	2	196
17	11	37	37	37	55	18	2	196
18	11	37	37	37	55	18	2	196
19	11	37	37	37	55	18	2	196
20	11	37	37	37	55	18	2	196

Sub Watershed #102701020808 Annual Adoption (treated acres), Cropland BMPs

Year	Permanent Vegetation	Grassed Waterways	No-Till	Vegetative Buffers	Terraces	Sediment Basins	Wetlands	Total Adoption
1	2	6	6	6	8	3	0.3	29.5
2	2	6	6	6	8	3	0.3	29.5
3	2	6	6	6	8	3	0.3	29.5
4	2	6	6	6	8	3	0.3	29.5
5	2	6	6	6	8	3	0.3	29.5
6	2	6	6	6	8	3	0.3	29.5
7	2	6	6	6	8	3	0.3	29.5
8	2	6	6	6	8	3	0.3	29.5
9	2	6	6	6	8	3	0.3	29.5
10	2	6	6	6	8	3	0.3	29.5
11	2	6	6	6	8	3	0.3	29.5
12	2	6	6	6	8	3	0.3	29.5
13	2	6	6	6	8	3	0.3	29.5
14	2	6	6	6	8	3	0.3	29.5
15	2	6	6	6	8	3	0.3	29.5
16	2	6	6	6	8	3	0.3	29.5
17	2	6	6	6	8	3	0.3	29.5
18	2	6	6	6	8	3	0.3	29.5
19	2	6	6	6	8	3	0.3	29.5
20	2	6	6	6	8	3	0.3	29.5

Table 55: Short, Medium and Long Term Goals by Sub Watershed.

Sub Watershed #102701020801 Annual Adoption (treated acres), Cropland BMPs

Year	Permanent Vegetation	Grassed Waterways	No-Till	Vegetative Buffers	Terraces	Sediment Basins	Wetlands	Total Adoption

Short-Term	1	12	39	39	39	59	20	2	209
	2	12	39	39	39	59	20	2	209
	3	12	39	39	39	59	20	2	209
	4	12	39	39	39	59	20	2	209
	5	12	39	39	39	59	20	2	209
Total		*59*	*195*	*195*	*195*	*293*	*98*	*10*	1,045
Medium-Term	6	12	39	39	39	59	20	2	209
	7	12	39	39	39	59	20	2	209
	8	12	39	39	39	59	20	2	209
	9	12	39	39	39	59	20	2	209
	10	12	39	39	39	59	20	2	209
Total		117	391	391	391	586	195	20	2,090
Long-Term	11	12	39	39	39	59	20	2	209
	12	12	39	39	39	59	20	2	209
	13	12	39	39	39	59	20	2	209
	14	12	39	39	39	59	20	2	209
	15	12	39	39	39	59	20	2	209
	16	12	39	39	39	59	20	2	209
	17	12	39	39	39	59	20	2	209
	18	12	39	39	39	59	20	2	209
	19	12	39	39	39	59	20	2	209
	20	12	39	39	39	59	20	2	209
Total		234	781	781	781	1,172	391	39	4,181

Sub Watershed #102701020802 Annual Adoption (treated acres), Cropland BMPs

	Year	Permanent Vegetation	Grassed Waterways	No-Till	Vegetative Buffers	Terraces	Sediment Basins	Wetlands	Total Adoption
[illegible]	1	5	15	15	15	23	8	1	82

	2	5	15	15	15	23	8	1	82
	3	5	15	15	15	23	8	1	82
	4	5	15	15	15	23	8	1	82
	5	5	15	15	15	23	8	1	82
Total		*23*	*77*	*77*	*77*	*115*	*38*	*4*	410
Medium-Term	6	5	15	15	15	23	8	1	82
	7	5	15	15	15	23	8	1	82
	8	5	15	15	15	23	8	1	82
	9	5	15	15	15	23	8	1	82
	10	5	15	15	15	23	8	1	82
Total		46	153	153	153	230	77	8	820
Long-Term	11	5	15	15	15	23	8	1	82
	12	5	15	15	15	23	8	1	82
	13	5	15	15	15	23	8	1	82
	14	5	15	15	15	23	8	1	82
	15	5	15	15	15	23	8	1	82
	16	5	15	15	15	23	8	1	82
	17	5	15	15	15	23	8	1	82
	18	5	15	15	15	23	8	1	82
	19	5	15	15	15	23	8	1	82
	20	5	15	15	15	23	8	1	82
Total		92	307	307	307	460	153	15	1,641

Sub Watershed # 102701020803 Annual Adoption (treated acres), Cropland BMPs

	Year	Permanent Vegetation	Grassed Waterways	No-Till	Vegetative Buffers	Terraces	Sediment Basins	Wetlands	Total Adoption
Short-Term	1	6	19	19	19	29	10	1	102
	2	6	19	19	19	29	10	1	102

	3	6	19	19	19	29	10	1	102
	4	6	19	19	19	29	10	1	102
	5	6	19	19	19	29	10	1	102
Total		*29*	*95*	*95*	*95*	*143*	*48*	*5*	508
Medium-Term	6	6	19	19	19	29	10	1	102
	7	6	19	19	19	29	10	1	102
	8	6	19	19	19	29	10	1	102
	9	6	19	19	19	29	10	1	102
	10	6	19	19	19	29	10	1	102
Total		57	190	190	190	285	95	10	1,017
Long-Term	11	6	19	19	19	29	10	1	102
	12	6	19	19	19	29	10	1	102
	13	6	19	19	19	29	10	1	102
	14	6	19	19	19	29	10	1	102
	15	6	19	19	19	29	10	1	102
	16	6	19	19	19	29	10	1	102
	17	6	19	19	19	29	10	1	102
	18	6	19	19	19	29	10	1	102
	19	6	19	19	19	29	10	1	102
	20	6	19	19	19	29	10	1	102
Total		114	380	380	380	570	190	19	2,033

Sub Watershed #102701020804 Annual Adoption (treated acres), Cropland BMPs

	Year	Permanent Vegetation	Grassed Waterways	No-Till	Vegetative Buffers	Terraces	Sediment Basins	Wetlands	Total Adoption
Short-Term	1	11	38	38	38	57	19	2	205
	2	11	38	38	38	57	19	2	205
	3	11	38	38	38	57	19	2	205

	4	11	38	38	38	57	19	2	205
	5	11	38	38	38	57	19	2	205
Total		*57*	*191*	*191*	*191*	*287*	*96*	*10*	1,024
Medium-Term	6	11	38	38	38	57	19	2	205
	7	11	38	38	38	57	19	2	205
	8	11	38	38	38	57	19	2	205
	9	11	38	38	38	57	19	2	205
	10	11	38	38	38	57	19	2	205
Total		115	383	383	383	574	191	19	2,048
Long-Term	11	11	38	38	38	57	19	2	205
	12	11	38	38	38	57	19	2	205
	13	11	38	38	38	57	19	2	205
	14	11	38	38	38	57	19	2	205
	15	11	38	38	38	57	19	2	205
	16	11	38	38	38	57	19	2	205
	17	11	38	38	38	57	19	2	205
	18	11	38	38	38	57	19	2	205
	19	11	38	38	38	57	19	2	205
	20	11	38	38	38	57	19	2	205
Total		230	766	766	766	1,148	383	38	4,096

Sub Watershed #102701020805 Annual Adoption (treated acres), Cropland BMPs

	Year	Permanent Vegetation	Grassed Waterways	No-Till	Vegetative Buffers	Terraces	Sediment Basins	Wetlands	Total Adoption
Short-Term	1	4	13	13	13	19	6	1	68
	2	4	13	13	13	19	6	1	68
	3	4	13	13	13	19	6	1	68
	4	4	13	13	13	19	6	1	68

	5	4	13	13	13	19	6	1	68
Total		*19*	*64*	*64*	*64*	*95*	*32*	*3*	340
Medium-Term	6	4	13	13	13	19	6	1	68
	7	4	13	13	13	19	6	1	68
	8	4	13	13	13	19	6	1	68
	9	4	13	13	13	19	6	1	68
	10	4	13	13	13	19	6	1	68
Total		38	127	127	127	191	64	6	681
Long-Term	11	4	13	13	13	19	6	1	68
	12	4	13	13	13	19	6	1	68
	13	4	13	13	13	19	6	1	68
	14	4	13	13	13	19	6	1	68
	15	4	13	13	13	19	6	1	68
	16	4	13	13	13	19	6	1	68
	17	4	13	13	13	19	6	1	68
	18	4	13	13	13	19	6	1	68
	19	4	13	13	13	19	6	1	68
	20	4	13	13	13	19	6	1	68
Total		76	254	254	254	382	127	13	1,361

Sub Watershed #102701020806 Annual Adoption (treated acres), Cropland BMPs

	Year	Permanent Vegetation	Grassed Waterways	No-Till	Vegetative Buffers	Terraces	Sediment Basins	Wetlands	Total Adoption
Short-Term	1	5	17	17	17	25	8	1	91
	2	5	17	17	17	25	8	1	91
	3	5	17	17	17	25	8	1	91
	4	5	17	17	17	25	8	1	91

	5	5	17	17	17	25	8	1	91
Total		*25*	*85*	*85*	*85*	*127*	*42*	*4*	454
Medium-Term	6	5	17	17	17	25	8	1	91
	7	5	17	17	17	25	8	1	91
	8	5	17	17	17	25	8	1	91
	9	5	17	17	17	25	8	1	91
	10	5	17	17	17	25	8	1	91
Total		51	170	170	170	255	85	8	909
Long-Term	11	5	17	17	17	25	8	1	91
	12	5	17	17	17	25	8	1	91
	13	5	17	17	17	25	8	1	91
	14	5	17	17	17	25	8	1	91
	15	5	17	17	17	25	8	1	91
	16	5	17	17	17	25	8	1	91
	17	5	17	17	17	25	8	1	91
	18	5	17	17	17	25	8	1	91
	19	5	17	17	17	25	8	1	91
	20	5	17	17	17	25	8	1	91
Total		102	340	340	340	510	170	17	1,818

Sub Watershed #102701020807 Annual Adoption (treated acres), Cropland BMPs

	Year	Permanent Vegetation	Grassed Waterways	No-Till	Vegetative Buffers	Terraces	Sediment Basins	Wetlands	Total Adoption
Short-Term	1	11	37	37	37	55	18	2	196
	2	11	37	37	37	55	18	2	196
	3	11	37	37	37	55	18	2	196
	4	11	37	37	37	55	18	2	196

	5	11	37	37	37	55	18	2	196
Total		*55*	*183*	*183*	*183*	*274*	*91*	*9*	979
Medium-Term	6	11	37	37	37	55	18	2	196
	7	11	37	37	37	55	18	2	196
	8	11	37	37	37	55	18	2	196
	9	11	37	37	37	55	18	2	196
	10	11	37	37	37	55	18	2	196
Total		110	366	366	366	549	183	18	1,958
Long-Term	11	11	37	37	37	55	18	2	196
	12	11	37	37	37	55	18	2	196
	13	11	37	37	37	55	18	2	196
	14	11	37	37	37	55	18	2	196
	15	11	37	37	37	55	18	2	196
	16	11	37	37	37	55	18	2	196
	17	11	37	37	37	55	18	2	196
	18	11	37	37	37	55	18	2	196
	19	11	37	37	37	55	18	2	196
	20	11	37	37	37	55	18	2	196
Total		220	732	732	732	1,098	366	37	3,916

Sub Watershed #102701020808 Annual Adoption (treated acres), Cropland BMPs

	Year	Permanent Vegetation	Grassed Waterways	No-Till	Vegetative Buffers	Terraces	Sediment Basins	Wetlands	Total Adoption
Short-Term	1	2	6	6	6	8	3	0	29.5
	2	2	6	6	6	8	3	0	29.5
	3	2	6	6	6	8	3	0	29.5
	4	2	6	6	6	8	3	0	29.5

	5	2	6	6	6	8	3	0	29.5
Total		*8*	*28*	*28*	*28*	*41*	*14*	*1*	147.5
Medium-Term	6	2	6	6	6	8	3	0	29.5
	7	2	6	6	6	8	3	0	29.5
	8	2	6	6	6	8	3	0	29.5
	9	2	6	6	6	8	3	0	29.5
	10	2	6	6	6	8	3	0	29.5
Total		17	55	55	55	83	28	3	295.1
Long-Term	11	2	6	6	6	8	3	0	29.5
	12	2	6	6	6	8	3	0	29.5
	13	2	6	6	6	8	3	0	29.5
	14	2	6	6	6	8	3	0	29.5
	15	2	6	6	6	8	3	0	29.5
	16	2	6	6	6	8	3	0	29.5
	17	2	6	6	6	8	3	0	29.5
	18	2	6	6	6	8	3	0	29.5
	19	2	6	6	6	8	3	0	29.5
	20	2	6	6	6	8	3	0	29.5
Total		33	110	110	110	165	55	6	590

15.3.3 Costs by Sub Watershed

Table 57: Costs Before Cost Share by Sub Watershed.

Sub Watershed #102701020801 Annual Cost* Before Cost-Share, Cropland BMPs

Year	Permanent Vegetation	Grassed Waterways	No-Till	Vegetative Buffers	Terraces	Sediment Basins	Wetlands	Total Cost
1	$1,758	$6,252	$3,036	$2,605	$7,326	$5,861	$2,149	**$28,986**

2	$1,811	$6,439	$3,127	$2,683	$7,546	$6,037	$2,213	**$29,856**
3	$1,865	$6,632	$3,220	$2,763	$7,772	$6,218	$2,280	**$30,751**
4	$1,921	$6,831	$3,317	$2,846	$8,005	$6,404	$2,348	**$31,674**
5	$1,979	$7,036	$3,417	$2,932	$8,246	$6,596	$2,419	**$32,624**
6	$2,038	$7,247	$3,519	$3,020	$8,493	$6,794	$2,491	**$33,603**
7	$2,099	$7,465	$3,625	$3,110	$8,748	$6,998	$2,566	**$34,611**
8	$2,162	$7,689	$3,733	$3,204	$9,010	$7,208	$2,643	**$35,649**
9	$2,227	$7,919	$3,845	$3,300	$9,280	$7,424	$2,722	**$36,719**
10	$2,294	$8,157	$3,961	$3,399	$9,559	$7,647	$2,804	**$37,820**
11	$2,363	$8,402	$4,080	$3,501	$9,846	$7,877	$2,888	**$38,955**
12	$2,434	$8,654	$4,202	$3,606	$10,141	$8,113	$2,975	**$40,124**
13	$2,507	$8,913	$4,328	$3,714	$10,445	$8,356	$3,064	**$41,327**
14	$2,582	$9,181	$4,458	$3,825	$10,759	$8,607	$3,156	**$42,567**
15	$2,660	$9,456	$4,592	$3,940	$11,081	$8,865	$3,251	**$43,844**
16	$2,739	$9,740	$4,729	$4,058	$11,414	$9,131	$3,348	**$45,159**
17	$2,821	$10,032	$4,871	$4,180	$11,756	$9,405	$3,448	**$46,514**
18	$2,906	$10,333	$5,017	$4,305	$12,109	$9,687	$3,552	**$47,910**
19	$2,993	$10,643	$5,168	$4,435	$12,472	$9,978	$3,658	**$49,347**
20	$3,083	$10,962	$5,323	$4,568	$12,846	$10,277	$3,768	**$50,827**

**3% Inflation*

Sub Watershed #102701020802 Annual Cost* Before Cost-Share, Cropland BMPs

Year	Permanent Vegetation	Grassed Waterways	No-Till	Vegetative Buffers	Terraces	Sediment Basins	Wetlands	Total Cost
1	$690	$2,454	$1,191	$1,022	$2,875	$2,300	$843	**$11,377**
2	$711	$2,527	$1,227	$1,053	$2,962	$2,369	$869	**$11,718**
3	$732	$2,603	$1,264	$1,085	$3,050	$2,440	$895	**$12,069**
4	$754	$2,681	$1,302	$1,117	$3,142	$2,514	$922	**$12,431**

5	$777	$2,762	$1,341	$1,151	$3,236	$2,589	$949	**$12,804**
6	$800	$2,844	$1,381	$1,185	$3,333	$2,667	$978	**$13,188**
7	$824	$2,930	$1,423	$1,221	$3,433	$2,747	$1,007	**$13,584**
8	$849	$3,018	$1,465	$1,257	$3,536	$2,829	$1,037	**$13,992**
9	$874	$3,108	$1,509	$1,295	$3,642	$2,914	$1,068	**$14,411**
10	$900	$3,201	$1,554	$1,334	$3,752	$3,001	$1,100	**$14,844**
11	$927	$3,297	$1,601	$1,374	$3,864	$3,091	$1,134	**$15,289**
12	$955	$3,396	$1,649	$1,415	$3,980	$3,184	$1,168	**$15,748**
13	$984	$3,498	$1,699	$1,458	$4,100	$3,280	$1,203	**$16,220**
14	$1,013	$3,603	$1,750	$1,501	$4,223	$3,378	$1,239	**$16,707**
15	$1,044	$3,711	$1,802	$1,546	$4,349	$3,479	$1,276	**$17,208**
16	$1,075	$3,823	$1,856	$1,593	$4,480	$3,584	$1,314	**$17,724**
17	$1,107	$3,937	$1,912	$1,641	$4,614	$3,691	$1,353	**$18,256**
18	$1,141	$4,055	$1,969	$1,690	$4,753	$3,802	$1,394	**$18,804**
19	$1,175	$4,177	$2,028	$1,740	$4,895	$3,916	$1,436	**$19,368**
20	$1,210	$4,302	$2,089	$1,793	$5,042	$4,034	$1,479	**$19,949**

**3% Inflation*

Sub Watershed #102701020803 Annual Cost* Before Cost-Share, Cropland BMPs

Year	Permanent Vegetation	Grassed Waterways	No-Till	Vegetative Buffers	Terraces	Sediment Basins	Wetlands	Total Cost
1	$855	$3,040	$1,476	$1,267	$3,563	$2,850	$1,045	**$14,097**
2	$881	$3,132	$1,521	$1,305	$3,670	$2,936	$1,076	**$14,520**
3	$907	$3,226	$1,566	$1,344	$3,780	$3,024	$1,109	**$14,956**
4	$934	$3,322	$1,613	$1,384	$3,893	$3,115	$1,142	**$15,404**

5	$962	$3,422	$1,662	$1,426	$4,010	$3,208	$1,176	**$15,866**
6	$991	$3,525	$1,711	$1,469	$4,130	$3,304	$1,212	**$16,342**
7	$1,021	$3,630	$1,763	$1,513	$4,254	$3,403	$1,248	**$16,833**
8	$1,052	$3,739	$1,816	$1,558	$4,382	$3,506	$1,285	**$17,338**
9	$1,083	$3,851	$1,870	$1,605	$4,513	$3,611	$1,324	**$17,858**
10	$1,116	$3,967	$1,926	$1,653	$4,649	$3,719	$1,364	**$18,394**
11	$1,149	$4,086	$1,984	$1,703	$4,788	$3,831	$1,405	**$18,945**
12	$1,184	$4,209	$2,044	$1,754	$4,932	$3,946	$1,447	**$19,514**
13	$1,219	$4,335	$2,105	$1,806	$5,080	$4,064	$1,490	**$20,099**
14	$1,256	$4,465	$2,168	$1,860	$5,232	$4,186	$1,535	**$20,702**
15	$1,293	$4,599	$2,233	$1,916	$5,389	$4,311	$1,581	**$21,323**
16	$1,332	$4,737	$2,300	$1,974	$5,551	$4,441	$1,628	**$21,963**
17	$1,372	$4,879	$2,369	$2,033	$5,718	$4,574	$1,677	**$22,622**
18	$1,413	$5,025	$2,440	$2,094	$5,889	$4,711	$1,727	**$23,300**
19	$1,456	$5,176	$2,513	$2,157	$6,066	$4,853	$1,779	**$23,999**
20	$1,499	$5,331	$2,589	$2,221	$6,248	$4,998	$1,833	**$24,719**

**3% Inflation*

Sub Watershed # 102701020804 Annual Cost* Before Cost-Share, Cropland BMPs

Year	Permanent Vegetation	Grassed Waterways	No-Till	Vegetative Buffers	Terraces	Sediment Basins	Wetlands	Total Cost
1	$1,723	$6,125	$2,974	$2,552	$7,178	$5,742	$2,105	**$28,400**
2	$1,774	$6,309	$3,063	$2,629	$7,393	$5,915	$2,169	**$29,252**
3	$1,828	$6,498	$3,155	$2,708	$7,615	$6,092	$2,234	**$30,129**
4	$1,882	$6,693	$3,250	$2,789	$7,843	$6,275	$2,301	**$31,033**

5	$1,939	$6,894	$3,347	$2,872	$8,079	$6,463	$2,370	**$31,964**
6	$1,997	$7,101	$3,448	$2,959	$8,321	$6,657	$2,441	**$32,923**
7	$2,057	$7,314	$3,551	$3,047	$8,571	$6,857	$2,514	**$33,911**
8	$2,119	$7,533	$3,658	$3,139	$8,828	$7,062	$2,589	**$34,928**
9	$2,182	$7,759	$3,768	$3,233	$9,093	$7,274	$2,667	**$35,976**
10	$2,248	$7,992	$3,881	$3,330	$9,365	$7,492	$2,747	**$37,055**
11	$2,315	$8,232	$3,997	$3,430	$9,646	$7,717	$2,830	**$38,167**
12	$2,385	$8,479	$4,117	$3,533	$9,936	$7,949	$2,915	**$39,312**
13	$2,456	$8,733	$4,240	$3,639	$10,234	$8,187	$3,002	**$40,491**
14	$2,530	$8,995	$4,368	$3,748	$10,541	$8,433	$3,092	**$41,706**
15	$2,606	$9,265	$4,499	$3,860	$10,857	$8,686	$3,185	**$42,957**
16	$2,684	$9,543	$4,634	$3,976	$11,183	$8,946	$3,280	**$44,246**
17	$2,764	$9,829	$4,773	$4,095	$11,518	$9,215	$3,379	**$45,573**
18	$2,847	$10,124	$4,916	$4,218	$11,864	$9,491	$3,480	**$46,940**
19	$2,933	$10,428	$5,063	$4,345	$12,220	$9,776	$3,584	**$48,348**
20	$3,021	$10,740	$5,215	$4,475	$12,586	$10,069	$3,692	**$49,799**

**3% Inflation*

Sub Watershed #102701020805 Annual Cost* Before Cost-Share, Cropland BMPs

Year	Permanent Vegetation	Grassed Waterways	No-Till	Vegetative Buffers	Terraces	Sediment Basins	Wetlands	Total Cost
1	$572	$2,035	$988	$848	$2,385	$1,908	$700	**$9,436**
2	$590	$2,096	$1,018	$873	$2,457	$1,965	$721	**$9,719**
3	$607	$2,159	$1,048	$900	$2,530	$2,024	$742	**$10,011**
4	$625	$2,224	$1,080	$927	$2,606	$2,085	$764	**$10,311**

5	$644	$2,291	$1,112	$954	$2,684	$2,147	$787	**$10,621**
6	$664	$2,359	$1,146	$983	$2,765	$2,212	$811	**$10,939**
7	$683	$2,430	$1,180	$1,013	$2,848	$2,278	$835	**$11,267**
8	$704	$2,503	$1,215	$1,043	$2,933	$2,347	$860	**$11,605**
9	$725	$2,578	$1,252	$1,074	$3,021	$2,417	$886	**$11,954**
10	$747	$2,655	$1,289	$1,106	$3,112	$2,489	$913	**$12,312**
11	$769	$2,735	$1,328	$1,140	$3,205	$2,564	$940	**$12,682**
12	$792	$2,817	$1,368	$1,174	$3,301	$2,641	$968	**$13,062**
13	$816	$2,902	$1,409	$1,209	$3,400	$2,720	$997	**$13,454**
14	$841	$2,989	$1,451	$1,245	$3,502	$2,802	$1,027	**$13,858**
15	$866	$3,078	$1,495	$1,283	$3,607	$2,886	$1,058	**$14,273**
16	$892	$3,171	$1,540	$1,321	$3,716	$2,973	$1,090	**$14,701**
17	$919	$3,266	$1,586	$1,361	$3,827	$3,062	$1,123	**$15,142**
18	$946	$3,364	$1,633	$1,402	$3,942	$3,154	$1,156	**$15,597**
19	$974	$3,465	$1,682	$1,444	$4,060	$3,248	$1,191	**$16,065**
20	$1,004	$3,569	$1,733	$1,487	$4,182	$3,346	$1,227	**$16,547**

**3% Inflation*

Sub Watershed #102701020806 Annual Cost* Before Cost-Share, Cropland BMPs

Year	Permanent Vegetation	Grassed Waterways	No-Till	Vegetative Buffers	Terraces	Sediment Basins	Wetlands	Total Cost
1	$764	$2,718	$1,320	$1,133	$3,185	$2,548	$934	**$12,603**
2	$787	$2,800	$1,359	$1,167	$3,281	$2,625	$962	**$12,981**
3	$811	$2,884	$1,400	$1,202	$3,379	$2,703	$991	**$13,371**
4	$835	$2,970	$1,442	$1,238	$3,481	$2,785	$1,021	**$13,772**

5	$860	$3,059	$1,486	$1,275	$3,585	$2,868	$1,052	**$14,185**
6	$886	$3,151	$1,530	$1,313	$3,693	$2,954	$1,083	**$14,611**
7	$913	$3,246	$1,576	$1,352	$3,804	$3,043	$1,116	**$15,049**
8	$940	$3,343	$1,623	$1,393	$3,918	$3,134	$1,149	**$15,500**
9	$968	$3,443	$1,672	$1,435	$4,035	$3,228	$1,184	**$15,965**
10	$997	$3,547	$1,722	$1,478	$4,156	$3,325	$1,219	**$16,444**
11	$1,027	$3,653	$1,774	$1,522	$4,281	$3,425	$1,256	**$16,938**
12	$1,058	$3,763	$1,827	$1,568	$4,409	$3,527	$1,293	**$17,446**
13	$1,090	$3,875	$1,882	$1,615	$4,542	$3,633	$1,332	**$17,969**
14	$1,123	$3,992	$1,938	$1,663	$4,678	$3,742	$1,372	**$18,508**
15	$1,156	$4,112	$1,996	$1,713	$4,818	$3,855	$1,413	**$19,063**
16	$1,191	$4,235	$2,056	$1,765	$4,963	$3,970	$1,456	**$19,635**
17	$1,227	$4,362	$2,118	$1,817	$5,112	$4,089	$1,499	**$20,224**
18	$1,264	$4,493	$2,182	$1,872	$5,265	$4,212	$1,544	**$20,831**
19	$1,301	$4,628	$2,247	$1,928	$5,423	$4,338	$1,591	**$21,456**
20	$1,341	$4,766	$2,314	$1,986	$5,586	$4,468	$1,638	**$22,100**

**3% Inflation*

Sub Watershed #102701020807 Annual Cost* Before Cost-Share, Cropland BMPs

Year	Permanent Vegetation	Grassed Waterways	No-Till	Vegetative Buffers	Terraces	Sediment Basins	Wetlands	Total Cost
1	$1,647	$5,855	$2,843	$2,440	$6,862	$5,489	$2,013	**$27,149**
2	$1,696	$6,031	$2,928	$2,513	$7,068	$5,654	$2,073	**$27,963**
3	$1,747	$6,212	$3,016	$2,588	$7,280	$5,824	$2,135	**$28,802**
4	$1,800	$6,398	$3,107	$2,666	$7,498	$5,998	$2,199	**$29,666**

5	$1,854	$6,590	$3,200	$2,746	$7,723	$6,178	$2,265	**$30,556**
6	$1,909	$6,788	$3,296	$2,828	$7,955	$6,364	$2,333	**$31,473**
7	$1,966	$6,992	$3,395	$2,913	$8,193	$6,555	$2,403	**$32,417**
8	$2,025	$7,201	$3,497	$3,001	$8,439	$6,751	$2,475	**$33,390**
9	$2,086	$7,417	$3,602	$3,091	$8,692	$6,954	$2,550	**$34,392**
10	$2,149	$7,640	$3,710	$3,183	$8,953	$7,162	$2,626	**$35,423**
11	$2,213	$7,869	$3,821	$3,279	$9,222	$7,377	$2,705	**$36,486**
12	$2,280	$8,105	$3,936	$3,377	$9,498	$7,599	$2,786	**$37,581**
13	$2,348	$8,348	$4,054	$3,478	$9,783	$7,827	$2,870	**$38,708**
14	$2,418	$8,599	$4,175	$3,583	$10,077	$8,061	$2,956	**$39,869**
15	$2,491	$8,857	$4,301	$3,690	$10,379	$8,303	$3,045	**$41,065**
16	$2,566	$9,122	$4,430	$3,801	$10,690	$8,552	$3,136	**$42,297**
17	$2,643	$9,396	$4,562	$3,915	$11,011	$8,809	$3,230	**$43,566**
18	$2,722	$9,678	$4,699	$4,033	$11,341	$9,073	$3,327	**$44,873**
19	$2,804	$9,968	$4,840	$4,153	$11,682	$9,345	$3,427	**$46,219**
20	$2,888	$10,267	$4,985	$4,278	$12,032	$9,626	$3,529	**$47,606**

**3% Inflation*

Sub Watershed #102701020808 Annual Cost* Before Cost-Share, Cropland BMPs

Year	Permanent Vegetation	Grassed Waterways	No-Till	Vegetative Buffers	Terraces	Sediment Basins	Wetlands	Total Cost
1	$248	$882	$428	$368	$1,034	$827	$303	**$4,092**
2	$256	$909	$441	$379	$1,065	$852	$312	**$4,214**
3	$263	$936	$455	$390	$1,097	$878	$322	**$4,341**
4	$271	$964	$468	$402	$1,130	$904	$331	**$4,471**

5	$279	$993	$482	$414	$1,164	$931	$341	**$4,605**
6	$288	$1,023	$497	$426	$1,199	$959	$352	**$4,743**
7	$296	$1,054	$512	$439	$1,235	$988	$362	**$4,886**
8	$305	$1,085	$527	$452	$1,272	$1,017	$373	**$5,032**
9	$314	$1,118	$543	$466	$1,310	$1,048	$384	**$5,183**
10	$324	$1,151	$559	$480	$1,349	$1,079	$396	**$5,339**
11	$334	$1,186	$576	$494	$1,390	$1,112	$408	**$5,499**
12	$344	$1,222	$593	$509	$1,431	$1,145	$420	**$5,664**
13	$354	$1,258	$611	$524	$1,474	$1,180	$432	**$5,834**
14	$364	$1,296	$629	$540	$1,519	$1,215	$445	**$6,009**
15	$375	$1,335	$648	$556	$1,564	$1,251	$459	**$6,189**
16	$387	$1,375	$668	$573	$1,611	$1,289	$473	**$6,375**
17	$398	$1,416	$688	$590	$1,659	$1,328	$487	**$6,566**
18	$410	$1,459	$708	$608	$1,709	$1,367	$501	**$6,763**
19	$423	$1,502	$729	$626	$1,761	$1,408	$516	**$6,966**
20	$435	$1,547	$751	$645	$1,813	$1,451	$532	**$7,175**

**3% Inflation*

Table 57: Costs by BMP After Cost Share.

Sub Watershed #102701020801 Annual Cost* After Cost-Share, Cropland BMPs

Year	Permanent Vegetation	Grassed Waterways	No-Till	Vegetative Buffers	Terraces	Sediment Basins	Wetlands	Total Cost
1	$879	$3,126	$1,852	$260	$3,663	$2,930	$215	**$12,711**
2	$906	$3,220	$1,907	$268	$3,773	$3,018	$221	**$13,092**
3	$933	$3,316	$1,964	$276	$3,886	$3,109	$228	**$13,485**
4	$961	$3,416	$2,023	$285	$4,003	$3,202	$235	**$13,889**

5	$989	$3,518	$2,084	$293	$4,123	$3,298	$242	**$14,306**
6	$1,019	$3,624	$2,147	$302	$4,246	$3,397	$249	**$14,735**
7	$1,050	$3,732	$2,211	$311	$4,374	$3,499	$257	**$15,177**
8	$1,081	$3,844	$2,277	$320	$4,505	$3,604	$264	**$15,632**
9	$1,114	$3,960	$2,346	$330	$4,640	$3,712	$272	**$16,101**
10	$1,147	$4,078	$2,416	$340	$4,779	$3,824	$280	**$16,584**
11	$1,181	$4,201	$2,488	$350	$4,923	$3,938	$289	**$17,082**
12	$1,217	$4,327	$2,563	$361	$5,071	$4,056	$297	**$17,594**
13	$1,253	$4,457	$2,640	$371	$5,223	$4,178	$306	**$18,122**
14	$1,291	$4,590	$2,719	$383	$5,379	$4,303	$316	**$18,666**
15	$1,330	$4,728	$2,801	$394	$5,541	$4,433	$325	**$19,226**
16	$1,370	$4,870	$2,885	$406	$5,707	$4,566	$335	**$19,803**
17	$1,411	$5,016	$2,971	$418	$5,878	$4,702	$345	**$20,397**
18	$1,453	$5,166	$3,061	$431	$6,054	$4,844	$355	**$21,009**
19	$1,497	$5,321	$3,152	$443	$6,236	$4,989	$366	**$21,639**
20	$1,542	$5,481	$3,247	$457	$6,423	$5,139	$377	**$22,288**

**3% Inflation*

Sub Watershed #102701020802 Annual Cost* After Cost-Share, Cropland BMPs

Year	Permanent Vegetation	Grassed Waterways	No-Till	Vegetative Buffers	Terraces	Sediment Basins	Wetlands	Total Cost
1	$345	$1,227	$727	$102	$1,438	$1,150	$84	**$4,989**
2	$355	$1,264	$749	$105	$1,481	$1,185	$87	**$5,138**
3	$366	$1,302	$771	$108	$1,525	$1,220	$89	**$5,292**
4	$377	$1,341	$794	$112	$1,571	$1,257	$92	**$5,451**
5	$388	$1,381	$818	$115	$1,618	$1,294	$95	**$5,615**

6	$400	$1,422	$842	$119	$1,667	$1,333	$98	**$5,783**
7	$412	$1,465	$868	$122	$1,717	$1,373	$101	**$5,957**
8	$424	$1,509	$894	$126	$1,768	$1,415	$104	**$6,135**
9	$437	$1,554	$921	$130	$1,821	$1,457	$107	**$6,319**
10	$450	$1,601	$948	$133	$1,876	$1,501	$110	**$6,509**
11	$464	$1,649	$977	$137	$1,932	$1,546	$113	**$6,704**
12	$478	$1,698	$1,006	$142	$1,990	$1,592	$117	**$6,905**
13	$492	$1,749	$1,036	$146	$2,050	$1,640	$120	**$7,113**
14	$507	$1,802	$1,067	$150	$2,111	$1,689	$124	**$7,326**
15	$522	$1,856	$1,099	$155	$2,175	$1,740	$128	**$7,546**
16	$538	$1,911	$1,132	$159	$2,240	$1,792	$131	**$7,772**
17	$554	$1,969	$1,166	$164	$2,307	$1,846	$135	**$8,005**
18	$570	$2,028	$1,201	$169	$2,376	$1,901	$139	**$8,245**
19	$587	$2,089	$1,237	$174	$2,448	$1,958	$144	**$8,493**
20	$605	$2,151	$1,274	$179	$2,521	$2,017	$148	**$8,748**

**3% Inflation*

Sub Watershed #102701020803 Annual Cost* After Cost-Share, Cropland BMPs

Year	Permanent Vegetation	Grassed Waterways	No-Till	Vegetative Buffers	Terraces	Sediment Basins	Wetlands	Total Cost
1	$428	$1,520	$901	$127	$1,781	$1,425	$105	**$6,182**
2	$440	$1,566	$928	$130	$1,835	$1,468	$108	**$6,367**
3	$454	$1,613	$955	$134	$1,890	$1,512	$111	**$6,558**
4	$467	$1,661	$984	$138	$1,947	$1,557	$114	**$6,755**

5	$481	$1,711	$1,014	$143	$2,005	$1,604	$118	**$6,957**
6	$496	$1,762	$1,044	$147	$2,065	$1,652	$121	**$7,166**
7	$511	$1,815	$1,075	$151	$2,127	$1,702	$125	**$7,381**
8	$526	$1,870	$1,108	$156	$2,191	$1,753	$129	**$7,603**
9	$542	$1,926	$1,141	$160	$2,257	$1,805	$132	**$7,831**
10	$558	$1,984	$1,175	$165	$2,324	$1,860	$136	**$8,066**
11	$575	$2,043	$1,210	$170	$2,394	$1,915	$140	**$8,308**
12	$592	$2,104	$1,247	$175	$2,466	$1,973	$145	**$8,557**
13	$610	$2,167	$1,284	$181	$2,540	$2,032	$149	**$8,814**
14	$628	$2,232	$1,322	$186	$2,616	$2,093	$153	**$9,078**
15	$647	$2,299	$1,362	$192	$2,695	$2,156	$158	**$9,350**
16	$666	$2,368	$1,403	$197	$2,775	$2,220	$163	**$9,631**
17	$686	$2,439	$1,445	$203	$2,859	$2,287	$168	**$9,920**
18	$707	$2,513	$1,488	$209	$2,945	$2,356	$173	**$10,217**
19	$728	$2,588	$1,533	$216	$3,033	$2,426	$178	**$10,524**
20	$750	$2,666	$1,579	$222	$3,124	$2,499	$183	**$10,840**

**3% Inflation*

Sub Watershed #102701020804 Annual Cost* After Cost-Share, Cropland BMPs

Year	Permanent Vegetation	Grassed Waterways	No-Till	Vegetative Buffers	Terraces	Sediment Basins	Wetlands	Total Cost
1	$861	$3,063	$1,814	$255	$3,589	$2,871	$211	**$12,453**
2	$887	$3,154	$1,869	$263	$3,697	$2,957	$217	**$12,827**
3	$914	$3,249	$1,925	$271	$3,807	$3,046	$223	**$13,212**

4	$941	$3,347	$1,982	$279	$3,922	$3,137	$230	**$13,608**
5	$969	$3,447	$2,042	$287	$4,039	$3,231	$237	**$14,016**
6	$999	$3,550	$2,103	$296	$4,161	$3,328	$244	**$14,437**
7	$1,028	$3,657	$2,166	$305	$4,285	$3,428	$251	**$14,870**
8	$1,059	$3,767	$2,231	$314	$4,414	$3,531	$259	**$15,316**
9	$1,091	$3,880	$2,298	$323	$4,546	$3,637	$267	**$15,776**
10	$1,124	$3,996	$2,367	$333	$4,683	$3,746	$275	**$16,249**
11	$1,158	$4,116	$2,438	$343	$4,823	$3,859	$283	**$16,736**
12	$1,192	$4,239	$2,511	$353	$4,968	$3,974	$291	**$17,238**
13	$1,228	$4,366	$2,587	$364	$5,117	$4,094	$300	**$17,756**
14	$1,265	$4,497	$2,664	$375	$5,270	$4,216	$309	**$18,288**
15	$1,303	$4,632	$2,744	$386	$5,429	$4,343	$318	**$18,837**
16	$1,342	$4,771	$2,826	$398	$5,591	$4,473	$328	**$19,402**
17	$1,382	$4,914	$2,911	$410	$5,759	$4,607	$338	**$19,984**
18	$1,424	$5,062	$2,999	$422	$5,932	$4,746	$348	**$20,584**
19	$1,466	$5,214	$3,089	$434	$6,110	$4,888	$358	**$21,201**
20	$1,510	$5,370	$3,181	$448	$6,293	$5,035	$369	**$21,837**

**3% Inflation*

Sub Watershed #102701020805 Annual Cost* After Cost-Share, Cropland BMPs

Year	Permanent Vegetation	Grassed Waterways	No-Till	Vegetative Buffers	Terraces	Sediment Basins	Wetlands	Total Cost
1	$286	$1,018	$603	$85	$1,192	$954	$70	**$4,138**
2	$295	$1,048	$621	$87	$1,228	$983	$72	**$4,262**

3	$304	$1,080	$640	$90	$1,265	$1,012	$74	**$4,390**
4	$313	$1,112	$659	$93	$1,303	$1,042	$76	**$4,522**
5	$322	$1,145	$678	$95	$1,342	$1,074	$79	**$4,657**
6	$332	$1,180	$699	$98	$1,382	$1,106	$81	**$4,797**
7	$342	$1,215	$720	$101	$1,424	$1,139	$84	**$4,941**
8	$352	$1,252	$741	$104	$1,467	$1,173	$86	**$5,089**
9	$363	$1,289	$764	$107	$1,511	$1,208	$89	**$5,242**
10	$373	$1,328	$787	$111	$1,556	$1,245	$91	**$5,399**
11	$385	$1,368	$810	$114	$1,603	$1,282	$94	**$5,561**
12	$396	$1,409	$834	$117	$1,651	$1,321	$97	**$5,728**
13	$408	$1,451	$859	$121	$1,700	$1,360	$100	**$5,900**
14	$420	$1,494	$885	$125	$1,751	$1,401	$103	**$6,077**
15	$433	$1,539	$912	$128	$1,804	$1,443	$106	**$6,259**
16	$446	$1,585	$939	$132	$1,858	$1,486	$109	**$6,447**
17	$459	$1,633	$967	$136	$1,914	$1,531	$112	**$6,640**
18	$473	$1,682	$996	$140	$1,971	$1,577	$116	**$6,839**
19	$487	$1,732	$1,026	$144	$2,030	$1,624	$119	**$7,044**
20	$502	$1,784	$1,057	$149	$2,091	$1,673	$123	**$7,256**

**3% Inflation*

Sub Watershed # 102701020806 Annual Cost* After Cost-Share, Cropland BMPs

Year	Permanent Vegetation	Grassed Waterways	No-Till	Vegetative Buffers	Terraces	Sediment Basins	Wetlands	Total Cost
1	$382	$1,359	$805	$113	$1,593	$1,274	$93	**$5,527**

2	$394	$1,400	$829	$117	$1,640	$1,312	$96	**$5,692**
3	$406	$1,442	$854	$120	$1,690	$1,352	$99	**$5,863**
4	$418	$1,485	$880	$124	$1,740	$1,392	$102	**$6,039**
5	$430	$1,530	$906	$127	$1,793	$1,434	$105	**$6,220**
6	$443	$1,576	$933	$131	$1,846	$1,477	$108	**$6,407**
7	$456	$1,623	$961	$135	$1,902	$1,521	$112	**$6,599**
8	$470	$1,672	$990	$139	$1,959	$1,567	$115	**$6,797**
9	$484	$1,722	$1,020	$143	$2,018	$1,614	$118	**$7,001**
10	$499	$1,773	$1,050	$148	$2,078	$1,662	$122	**$7,211**
11	$514	$1,827	$1,082	$152	$2,140	$1,712	$126	**$7,427**
12	$529	$1,881	$1,114	$157	$2,205	$1,764	$129	**$7,650**
13	$545	$1,938	$1,148	$161	$2,271	$1,817	$133	**$7,880**
14	$561	$1,996	$1,182	$166	$2,339	$1,871	$137	**$8,116**
15	$578	$2,056	$1,218	$171	$2,409	$1,927	$141	**$8,359**
16	$596	$2,117	$1,254	$176	$2,481	$1,985	$146	**$8,610**
17	$613	$2,181	$1,292	$182	$2,556	$2,045	$150	**$8,868**
18	$632	$2,246	$1,331	$187	$2,632	$2,106	$154	**$9,135**
19	$651	$2,314	$1,371	$193	$2,711	$2,169	$159	**$9,409**
20	$670	$2,383	$1,412	$199	$2,793	$2,234	$164	**$9,691**

**3% Inflation*

Sub Watershed #102701020807 Annual Cost* After Cost-Share, Cropland BMPs

Year	Permanent Vegetation	Grassed Waterways	No-Till	Vegetative Buffers	Terraces	Sediment Basins	Wetlands	Total Cost

1	$823	$2,928	$1,734	$244	$3,431	$2,745	$201	**$11,905**
2	$848	$3,016	$1,786	$251	$3,534	$2,827	$207	**$12,262**
3	$874	$3,106	$1,840	$259	$3,640	$2,912	$214	**$12,630**
4	$900	$3,199	$1,895	$267	$3,749	$2,999	$220	**$13,009**
5	$927	$3,295	$1,952	$275	$3,861	$3,089	$227	**$13,399**
6	$955	$3,394	$2,011	$283	$3,977	$3,182	$233	**$13,801**
7	$983	$3,496	$2,071	$291	$4,097	$3,277	$240	**$14,215**
8	$1,013	$3,601	$2,133	$300	$4,220	$3,376	$248	**$14,642**
9	$1,043	$3,709	$2,197	$309	$4,346	$3,477	$255	**$15,081**
10	$1,074	$3,820	$2,263	$318	$4,477	$3,581	$263	**$15,533**
11	$1,107	$3,935	$2,331	$328	$4,611	$3,689	$271	**$15,999**
12	$1,140	$4,053	$2,401	$338	$4,749	$3,799	$279	**$16,479**
13	$1,174	$4,174	$2,473	$348	$4,892	$3,913	$287	**$16,974**
14	$1,209	$4,299	$2,547	$358	$5,038	$4,031	$296	**$17,483**
15	$1,245	$4,428	$2,623	$369	$5,190	$4,152	$304	**$18,007**
16	$1,283	$4,561	$2,702	$380	$5,345	$4,276	$314	**$18,548**
17	$1,321	$4,698	$2,783	$392	$5,506	$4,404	$323	**$19,104**
18	$1,361	$4,839	$2,867	$403	$5,671	$4,537	$333	**$19,677**
19	$1,402	$4,984	$2,953	$415	$5,841	$4,673	$343	**$20,267**
20	$1,444	$5,134	$3,041	$428	$6,016	$4,813	$353	**$20,875**

**3% Inflation*

Sub Watershed #102701020808 Annual Cost* After Cost-Share, Cropland BMPs

Year	Permanent Vegetation	Grassed Waterways	No-Till	Vegetative Buffers	Terraces	Sediment Basins	Wetlands	Total Cost

1	$124	$441	$261	$37	$517	$414	$30	**$1,794**
2	$128	$454	$269	$38	$533	$426	$31	**$1,848**
3	$132	$468	$277	$39	$549	$439	$32	**$1,903**
4	$136	$482	$286	$40	$565	$452	$33	**$1,961**
5	$140	$497	$294	$41	$582	$466	$34	**$2,019**
6	$144	$512	$303	$43	$599	$480	$35	**$2,080**
7	$148	$527	$312	$44	$617	$494	$36	**$2,142**
8	$153	$543	$321	$45	$636	$509	$37	**$2,207**
9	$157	$559	$331	$47	$655	$524	$38	**$2,273**
10	$162	$576	$341	$48	$675	$540	$40	**$2,341**
11	$167	$593	$351	$49	$695	$556	$41	**$2,411**
12	$172	$611	$362	$51	$716	$573	$42	**$2,484**
13	$177	$629	$373	$52	$737	$590	$43	**$2,558**
14	$182	$648	$384	$54	$759	$607	$45	**$2,635**
15	$188	$667	$395	$56	$782	$626	$46	**$2,714**
16	$193	$687	$407	$57	$806	$644	$47	**$2,795**
17	$199	$708	$419	$59	$830	$664	$49	**$2,879**
18	$205	$729	$432	$61	$855	$684	$50	**$2,966**
19	$211	$751	$445	$63	$880	$704	$52	**$3,054**
20	$218	$774	$458	$64	$907	$725	$53	**$3,146**

**3% Inflation*

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