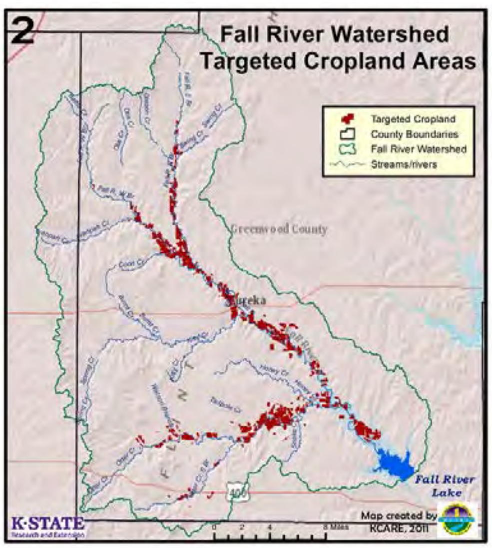
Fall River Reservoir – 9 Element Watershed Plan Summary

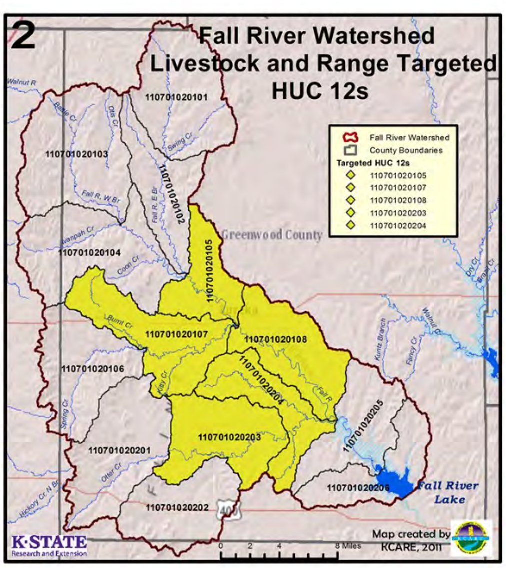
<u>Impairments to be addressed:</u>

<u>Directly impacted</u>
Fall River Reservoir – High Priority TMDL for Eutrophication/ Dissolved Oxygen/ Siltation

<u>Positively affected</u>
Fall River – High Priority TMDL for Fecal coliform bacteria

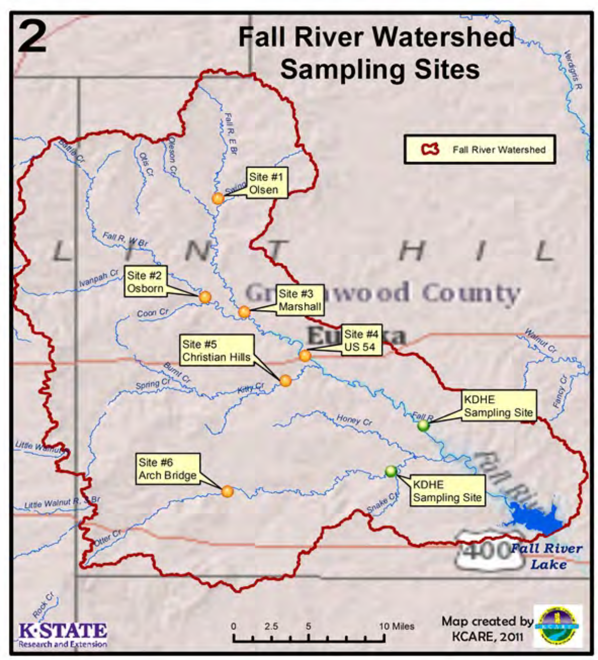
<u>Prioritized Critical Areas for Targeting BMPs</u>





<u>Targeting considerations:</u>

- Rangeland targeted areas were chosen by identifying using 2008 and 2010 NAIP aerial imagery.
- Livestock targeted areas were chosen by talking to local SLT members and results from the water quality sampling completed in the watershed.
- Cropland BMP Targeted areas were identified as any cropland field contiguous fields, bordering either branch of Fall River or Otter Creek that is contained in the watershed.
- Streambank targeted areas were determined based on a 2006 watershed assessment prepared by the Kansas Alliance for wetland and Stream and a 2010 Fall River watershed assessment prepared by the Kansas Water Office.



Fall River Reservoir – 9 Element Watershed Plan Summary

Best Management Practices and Load Reduction Goals

Best Management Practices (BMPs) to address phosphorus and sediment in the watershed where chosen by the SLT based on local acceptance/adoptability and the amount of load reduction gained per dollar spent.

Phosphorus/Sediment Reducing Cropland BMPs

- Terraces & Waterways
- Riparian Buffers
- Vegetative Buffers
- Water Retention Structures
- Wetlands
- No-Till

Phosphorus/Sediment Reducing Livestock BMPs

- Relocate Feeding Pens
- Relocate Pasture Feeding Site
- Off Stream Watering System
- Grazing Mgt plans

Phosphorus/Sediment Reducing Rangeland BMPs

- Repair Grazing Land Gullies
- Brine Site Repair

Sediment Reduction:

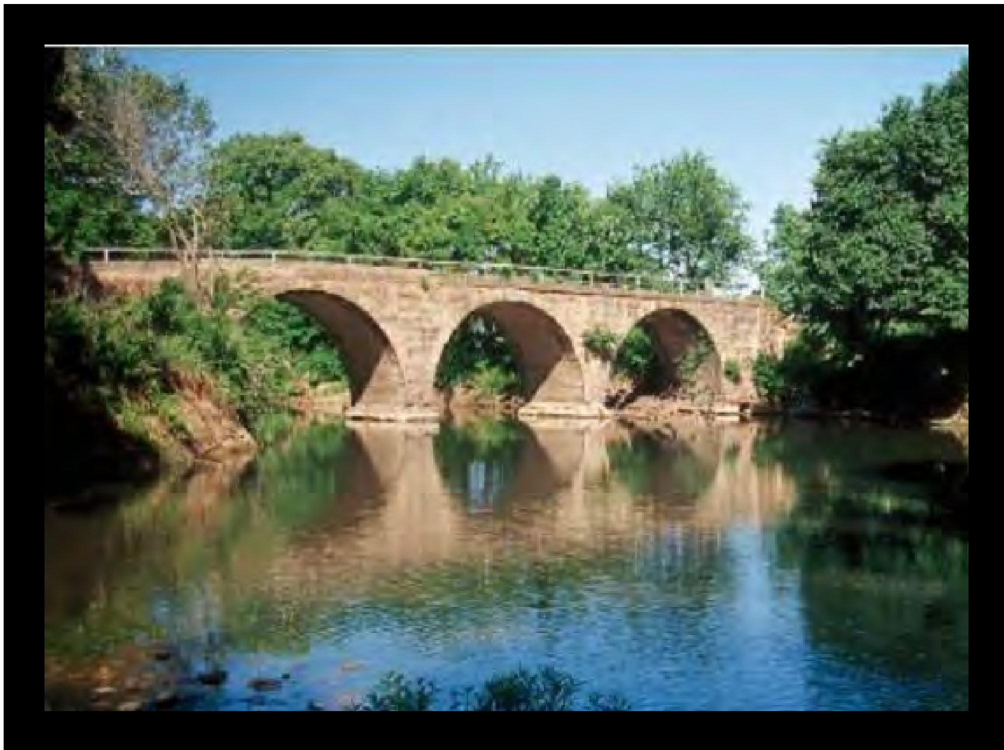
Required load reduction for the Fall River high prioroity siltation TMDL.

163,800 tons annual sediment load − 100,200 tons TMDL = 63,600 tons sediment to be reduced by BMPs

Phosphorus Reducation:

Required load reduxtion for the Fall River high prioirty dissolved oxygen and eutrophication TMDL.

90,850 pounds annual phosphorus load − 58,480 pounds annual phosphorus = 32,370 pounds phosphorus to be reduced by BMPs



FALL RIVER RESERVOIR

Watershed Restoration and Protection Strategy

March 8, 2013

FALL RIVER WRAPS

K-STATE Research and Extension
Kansas State University

K-State Research and Extension Project Staff

Robert Wilson, Watershed Planner, Office of Local Government
Josh Roe, Watershed Economist, Department of Agricultural Economics
Susan Brown, Kansas Center for Agricultural Resources and the Environment
Aleksey Sheshukov, Watershed Modeler, Department of Biological and Agricultural Engineering

Stakeholder Leadership Team

Watershed Representatives
Ed Buckle (Landowners/Producer/Local Government),
Dale Kirkham (Landowners/Producer/Kansas Rural Center),
Faith Butler (Landowner),
John Cowley, Landowner),

Project Management Team
Lexie Biering, Greenwood County Conservation District
Jeff Davidson, K-State Watershed Specialist
Terry Lyons, U.S. Army Corps of Engineers
Brian Meiwes, Kansas Department of Wildlife and Parks
Dennis Carlson, Kansas Forest Service
Bernie Obermeyer, Flint Hills Research, Conservation and Development
Dale Kirkham, Kansas Rural Center
Luke Westerman, USDA Natural Resources Conservation Service
Joe Beeman, Greenwood County Emergency Services Director

Kansas Department of Health and Environment Project Officer
Ann D'Alfonso, Watershed Management Section

Additional Technical Assistance Provided by:
Debra Baker, Kansas Water Office
Rich Basore, Kansas Department of Health and Environment

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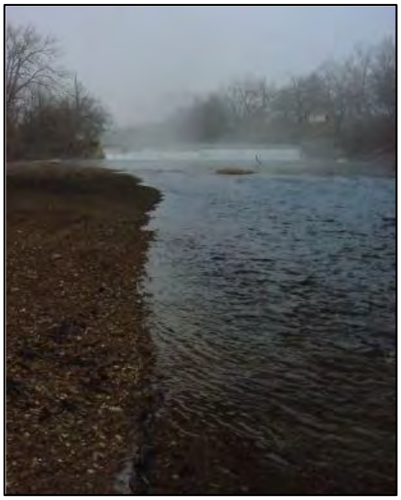
Glossary of Terms

Best Management Practices (BMP): Environmental protection practices used to control pollutants, such as sediment or nutrients, from common agricultural or urban land use activities.
Biological Oxygen Demand (BOD): Measure of the amount of oxygen removed from aquatic environments by aerobic microorganisms for their metabolic requirements.
Biota: Plant and animal life of a particular region.
Chlorophyll a: Common pigment found in algae and other aquatic plants that is used in photosynthesis.
Designated Uses: Recognized uses by KDHE that should be attained in a water body.
Dissolved Oxygen (DO): Amount of oxygen dissolved in water.
E. coli bacteria: Bacteria normally found in gastrointestinal tracts of animals. Some strains cause diarrheal diseases.
Eutrophication (E): Excess of mineral and organic nutrients that promote a proliferation of plant life in lakes and ponds.
Fecal coliform bacteria (FCB): Bacteria that originate in the intestines of all warm-blooded animals.
Municipal Water System: Water system that serves at least 25 people or has more than 15 service connections.
National Pollutant Discharge Elimination System (NPDES) Permit: Required by Federal law for all point source discharges into waters.
Nitrates: Final product of ammonia's biochemical oxidation. Primary source of nitrogen for plants. Contained in manure and fertilizers.
Nitrogen(N or TN): Element that is essential for plants and animals. TN or total nitrogen is a chemical measurement of all nitrogen forms in a water sample.
Nutrients: Nitrogen and phosphorus in water source.
Phosphorus (P or TP): Element in water that, in excess, can lead to increased biological activity.
Riparian Zone: Margin of vegetation within approximately 100 feet of waterway.
Sedimentation: Deposition of slit, clay or sand in slow moving waters.
Secchi Disk: Circular plate 10-12" in diameter with alternating black and white quarters used to measure water clarity by measuring the depth at which it can be seen.
Stakeholder Leadership Team (SLT): Organization of watershed residents, landowners, farmers, ranchers, agency personnel and all persons with an interest in water quality.
Total Maximum Daily Load (TMDL): Maximum amount of pollutant that a specific body of water can receive without violating the surface water-quality standards, resulting in failure to support their designated uses.
Total Suspended Solids (TSS): Measure of the suspended organic and inorganic solids in water. Used as an indicator of sediment or silt.
Water Quality Standard (WQS): Mandated in the Clean Water Act. Defines goals for a waterbody by designating its uses, setting criteria to protect those uses and establishing provisions to protect waterbodies from pollutants.

1.0 Preface



This 9-element Watershed Restoration and Protection Strategy (WRAPS) plan for Fall River Reservoir Watershed outlines a blueprint of restoration and protection goals and actions for the surface waters of the watershed. Watershed goals are characterized as “restoration” or “protection”. Watershed restoration is for surface waters that do not meet Water Quality Standards (WQS), 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 WQS, but are in need of protection from future degradation.

The WRAPS development process involves local communities and governmental agencies working together toward the common goal of a healthy environment. Local participants or stakeholders provide valuable grass roots leadership, responsibility and management of resources in the process. They have the most “at stake” in ensuring the water quality existing on their land is protected. Agencies bring science-based information, communication, and technical and financial assistance to the table. Together, several steps can be taken towards watershed restoration and protection. These steps involve building awareness and education, engaging local leadership, monitoring and evaluation of watershed conditions, in addition to assessment, planning, and implementation of the WRAPS process at the local level. Final goals for the watershed at the end of the WRAPS process are to provide a sustainable water source for drinking and domestic use while preserving food, fiber, and timber production. Other crucial objectives are to maintain recreational opportunities and biodiversity while protecting the environment from flooding, and negative effects of urbanization and industrial production. The ultimate goal is watershed restoration and protection that will be “locally led and driven” in conjunction with government agencies in order to better the environment for everyone.

This plan is intended to serve as an overall strategy to guide watershed restoration and protection efforts by individuals, local, state, and federal agencies and organizations. At the end of the WRAPS process, the Stakeholder Leadership Team (SLT) will have the capability, capacity and confidence to make decisions that will restore and protect the water quality and watershed conditions of the Fall River Reservoir Watershed.

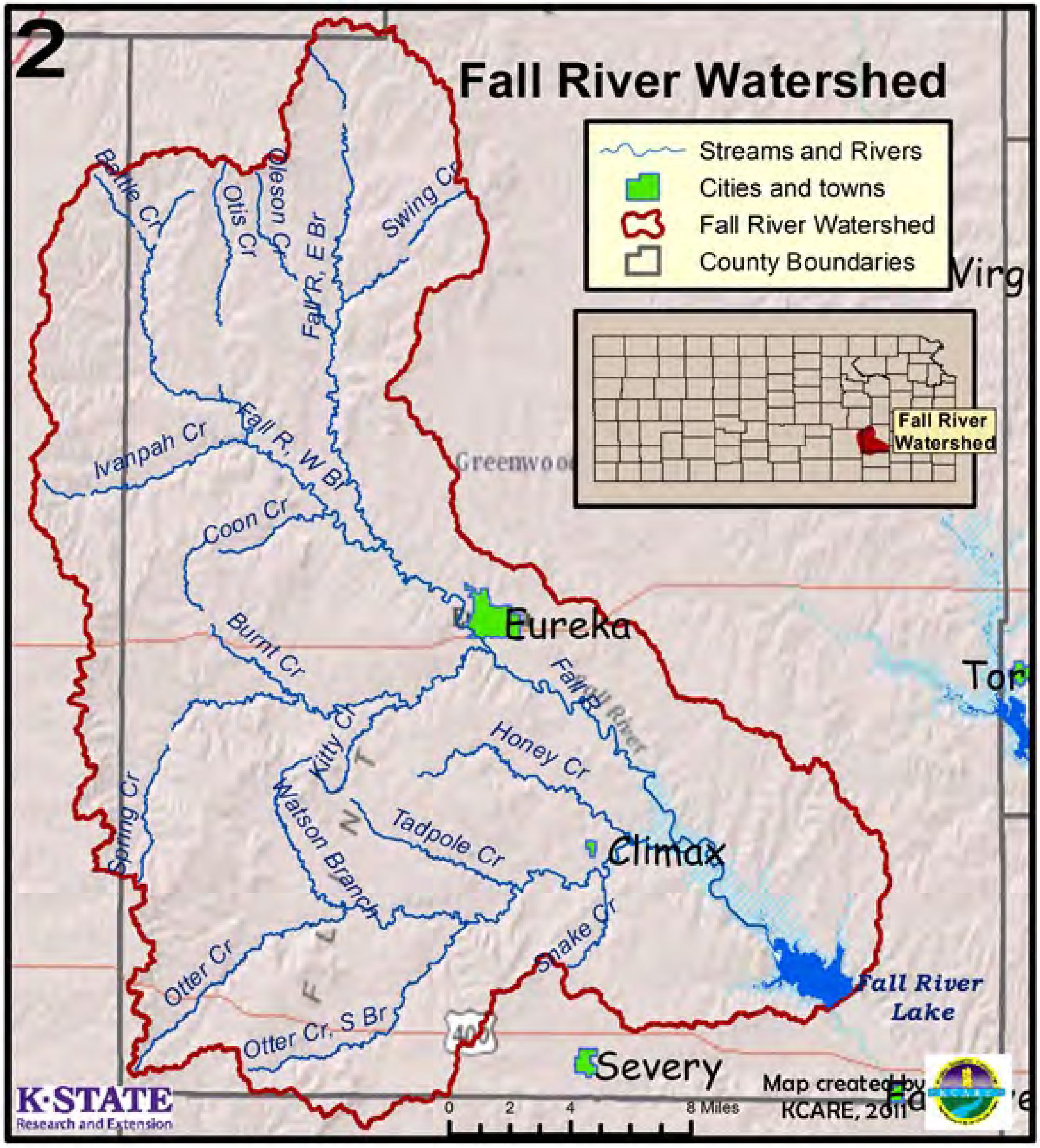


Figure 1 Map of Fall River Watershed

2.0 Watershed Goals

The Stakeholder Leadership Team (SLT) was formed out of concern for the health and lifespan of Fall River Reservoir. Construction of the dam began in 1946 by the U.S. Army Corps of Engineers, Tulsa District (USACE) and the multipurpose pool was filled in 1949. In 1949, the reservoir had a storage capacity of 30,401 acre feet. The estimated current capacity from the latest survey year (1990) is 19,433 acre feet. This represents a loss of 36 percent due to sediment that has entered the Reservoir from the watershed with a calculated sedimentation rate of 188 acre feet per year. A bathymetric survey performed in 1990 indicated that storage capacity in the multi-purpose pool, which contains public water supply storage, had been reduced by approximately 38% since the reservoir was filled in 1949.

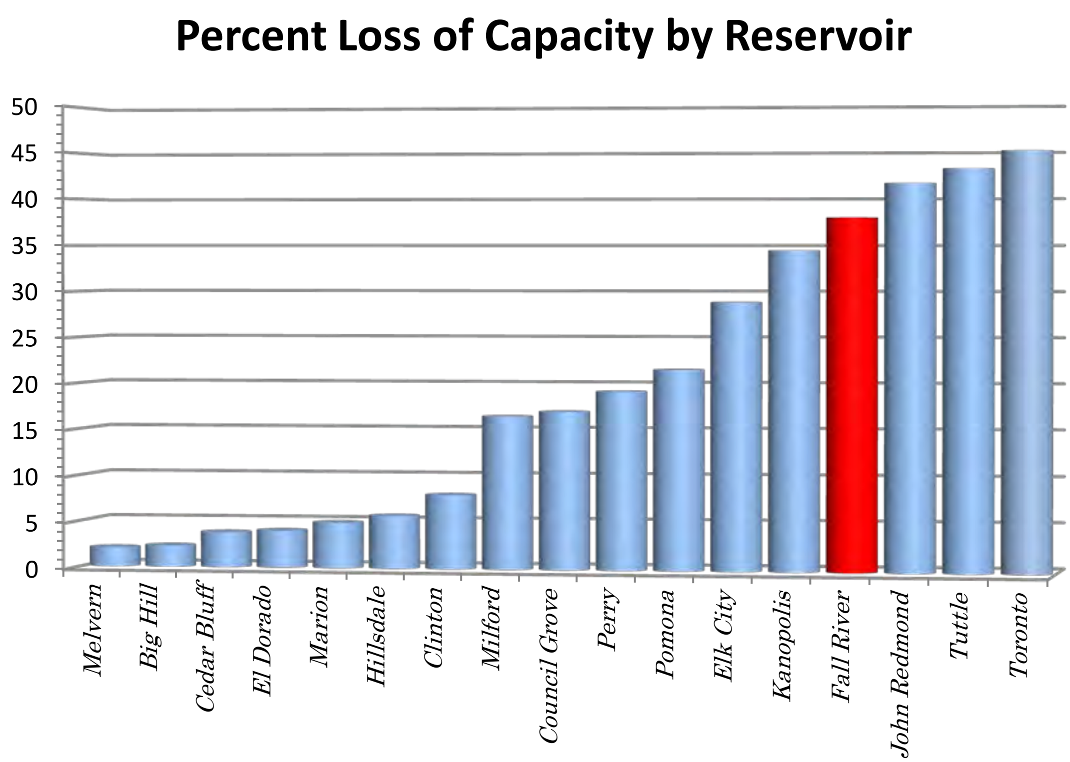


Figure 2 Percent of Reservoir Loss Due to Sedimentation (1990) [1]

The SLT hopes to slow this rate of sedimentation by improving conditions in the watershed through implementation of this watershed plan. Improved watershed conditions will also help water quality, increase agricultural yields and benefit the health of wildlife and natural ecosystems.

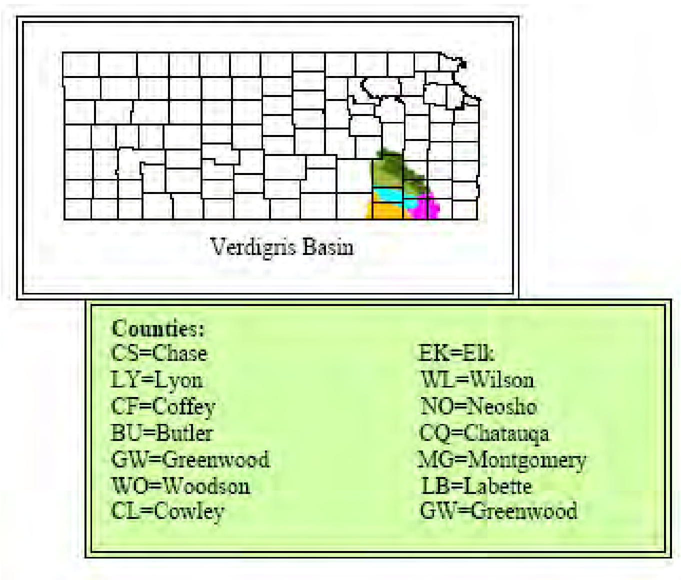
Currently, the SLT have set their **watershed restoration and protection goals** as**:**

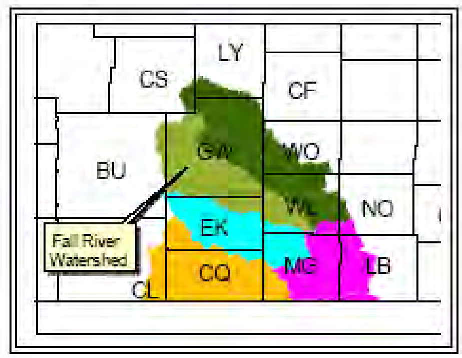
1. protect public drinking water and livestock watering supplies,
2. protect and restore recreational uses at Fall River Reservoir,
3. promote economic development through water quality improvement,
4. protect the agricultural productivity of grassland and pastureland,
5. continue sustainability of land conservation, and
6. increase public awareness and education about watershed/water quality issues.

3.0 Watershed Review

Watershed Description

The Upper Fall River Watershed is one of five watersheds that make up the Verdigris River Basin in southeast Kansas. The geographic focus of this WRAPS project is the upper portion of the Fall River watershed (i.e. the area above Fall River Reservoir.)





A watershed is an area of land that catches precipitation and funnels it to a particular creek, stream, and river and so on, until the water drains into an ocean. A watershed has distinct elevation boundaries that do not follow political “lines” such as county, state and international borders. Watersheds come in all shapes and sizes, with some only covering an area of a few acres while others are thousands of square miles across.

HUC is an acronym for **H**ydrologic **U**nit **C**odes. HUCs are an identification system for watersheds. Each watershed has a unique HUC number in addition to a common name. As watersheds become smaller, the HUC number will become larger. For example, the Verdigris Basin is one of twelve basins in the state of Kansas. Within the Verdigris Basin are five HUC 8 classifications. The Fall River watershed, which contains Fall River Reservoir, covers approximately one-half of the HUC 8 numbered 11070101 (named Upper Verdigris). HUC 8s can further be split into smaller watersheds that are given HUC 10 numbers and HUC 10 watersheds can be further divided into smaller HUC 12s. The Fall River Watershed is comprised of 14 HUC 12 delineations.

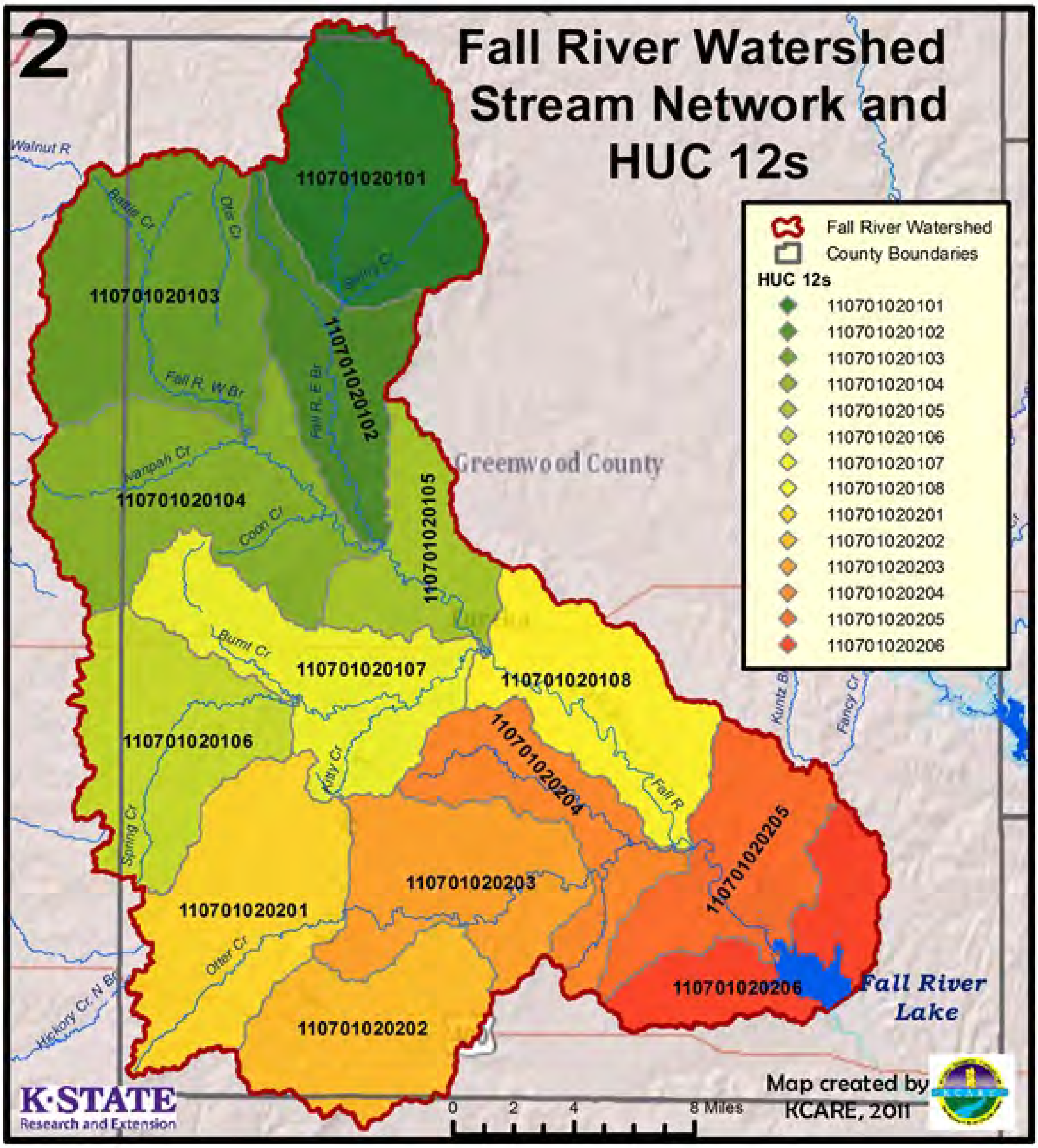


Figure 3 HUC 12 Delineations and Classified Stream Network

The headwaters of Fall River (East and West branches) originate in the upper northwest corner of Greenwood County, and the river flows southeast draining numerous tributaries before merging with the Verdigris River near the City of Neodesha. The upper half of the Fall River watershed drains approximately 374,400 acres within the Flint Hills ecoregion of southeastern Kansas and is located primarily in Greenwood County.

The landscape is dominated by gently sloping hills of limestone and shale, with elevations ranging from 1000 to 1600 feet above sea level. (See Figure 4.)

Tributaries in the upper portion of the Fall River watershed include Oleson, Swing, Ivanpah, Spring, Burnt, Kitty, and Otter Creeks.

Figure 4 “Flint Hills” landscape

Headwaters of these tributaries are characterized as high gradient streams with mostly gravel substrate and are bordered by deciduous woodlands intermixed with grassland along the alluvial floodplain.

Intense, short duration thunderstorms are responsible for about 70% of the average annual precipitation (37 inches) falling between April and September. The nature of these thunderstorms and the relatively steep grade between the top and bottom of the watershed result in flashy flows characterized by flooding during storm events followed by low flows during dry weather.

Rivers and streams in the watershed support aquatic life (fish), and provide water for domestic uses (drinking water), recreation (fishing, boating, swimming), and water for livestock.

Fall River is dammed approximately 4 miles northeast of the City of Fall River, creating Fall River Reservoir. It is an important component of the Verdigris basin’s public water supply and drought management programs. The purpose of the program is to allow for coordinated operation of state-owned or controlled water storage space in federal reservoirs in the basin to satisfy downstream municipal and industrial water rights during drought conditions. Water right holders are therefore allowed to receive enhanced stream flow during times of drought while the state operates the reservoirs in the basin as a system for increased efficiency in water delivery.

In January 2006, an updated *Memorandum of Agreement (MOA) between the Kansas Water Office and the Kansas State Board of Agriculture [Kansas Department of Agriculture, Division of Water Resources] to Manage and Protect Releases from Storage in the Verdigris River Basin* was signed by the Kansas Water Office and the Division of Water Resources. This MOA was developed to implement a *Memorandum of Agreement between the Kansas Water Office and* *the Tulsa District, Corps of Engineers, U.S. Department of Army in Regards to Operation of Reservoirs in the Verdigris Basin*, signed in 1989. The updated State MOA includes drought planning for the basin and incorporates lessons learned from past low flow events.

Because of the role of Fall River Reservoir in these coordinated operations for the Verdigris Basin, the Fall River watershed is high priority for implementation of watershed management practices that will reduce the inflow of sediment into the reservoir. Sediment accumulation in the reservoir results in reduced storage capacity, which shortens the usable life of the reservoir and will ultimately impact the ability to store enough water to meet the requirements of the Memorandum of Agreement.

In this report, the term BMP (Best Management Practice) will be used frequently. A BMP is defined as an environmental protection practice used to control pollutants, such as sediment or nutrients, from common agricultural or urban land use activities. Common agricultural BMPs are buffer strips, terraces, grassed waterways, utilizing no-till or minimum tillage, conservation crop rotation and nutrient management plans. Definitions of each of these BMPs are found in the appendix of this report.

Another major lake in the watershed and water source for the city of Eureka is Otis Creek Reservoir, located in the hilly northwestern part of Greenwood County. The Fall River Wetland is also located north of Fall River Reservoir along Fall River. Most of the lakes and wetlands in the Fall River watershed are designated for aquatic life support, industrial water supply, domestic water supply, and recreation. Recreational visits to Fall River Reservoir average 99,663 people annually.

The watershed is an important source of drinking water for area residents. There are 13 public water supplies, or public water diversion points, in the entire watershed; however, Eureka is the only public water supply that draws from surface water in the upper part of the watershed. Otis Creek Reservoir is the source of water for Eureka.

There is one municipal and industrial wastewater treatment facility that currently discharges into the upper part of the watershed. This facility, located near Eureka, is regulated by KDHE through a National Pollutant Discharge Elimination System (NPDES) permit that specifies the maximum amount of pollutants allowed to be discharged into surface waters. There are three other NPDES sites in the watershed.

Groundwater resources in the watershed include portions of alluvial (river and stream bed) aquifers of the many tributaries. There are approximately 115 groundwater wells in the watershed. Water from these wells is used for monitoring, domestic uses, irrigation, lawn and garden, artificial recharge, public water supplies, and industrial uses.

The main stems (East Branch, and West Branch) of Fall River are classified as "Exceptional State Waters" by KDHE. Exceptional state waters are defined as any of the surface waters or surface water segments that are of remarkable quality or of significant ecological or recreational value, and are afforded the highest level of water quality protection. Wherever state surface waters constitute exceptional state waters, point source discharges shall be allowed only if existing uses and existing water quality are maintained and protected. These tributaries support high quality populations and communities of native fish and mussels. One mussel species found in Fall River, the Neosho mucket, is a candidate for federal listing as threatened.

3.1 Land Cover and Land Use

Pollution in a watershed can be a result of land use practices, the proximity of land use practices to waterways, and the runoff characteristics of the soils and pollutants. Land use in this watershed is typical of the Flint Hills ecoregion where cultivation has been minimal due to shallow, rocky soils, resulting in largely unbroken native tallgrass prairie. Grazing land or grassland is the predominant land use, covering 88% of the watershed. Few ranchers have cow/calf herds. Instead, most graze yearling cattle for a limited summer season; overwintering relatively few cattle. Grazing density for the watershed is considered medium at 30 to 45 animal units or AUs (equal standards for all animals based on size and manure production; 1AU=700 pound animal) per square mile. Even though it may not be an obvious conclusion, grassland can be a major contributor of **sediment**. Gullies in rangeland are a major source of erosion and sedimentation in this watershed. Numerous factors contribute to gully formation including overgrazing, double-stocking yearling cattle on grass during high flow rain events, and the invasion of trees. Sericea lespedeza, a state-listed noxious plant, has become a common and expensive threat in range management.

Row crop agriculture, which occurs primarily in the floodplains of creeks and the river, makes up 6% of the land use. If cropland is under conventional tillage practices and/or lacks maintenance of agricultural BMP structures, there can be an increase in runoff which will carry nitrogen and phosphorus into streams and lakes. Cropland in the Fall River Watershed is planted mainly to sorghum for grain, soybeans, wheat and corn.

Wooded areas 4%, urban areas 1%, and water resources occupy the remaining 1% of the watershed. Land use activities have a significant impact on the types and quantity of pollutants in the watershed. A horse-race track—Eureka Downs—and a livestock sale barn are located within Eureka's city limits.

Nutrients can also originate from grasslands through overgrazing and allowing livestock access to streams and creeks. Cropland nutrients can originate from application of fertilizers prior to a rainfall event or over application of fertilizers and manure used as a fertilizer. Silage leach aid can cause quick eutrophication and fish kills if not controlled. Eroding soil from streambanks can contribute to the eutrophication. Humans can contribute to nutrients through failing or inadequately constructed septic systems.

E. coli bacteria can originate from manure applied before a rainfall event, livestock and wildlife in the streams and failing septic systems.

Brine scar sites are also prevalent in the northern region of this watershed. Brine scar sites, a side effect of oil and gas drilling, are areas where natural vegetation has been eliminated and the ground is bare, which leaves the area prone to greater erosion. Drilling for oil and gas production has occurred in the watershed since the middle 1900s. Much of this was done before regulations were developed by the Kansas Corporation Commission (KCC) to minimize pollution resulting from salt water used/generated in the drilling process. Disposal of the salt brine on the landscape was a common activity before regulations mandated proper disposal techniques. Due to excessive salt levels, plants cannot colonize the soil in brine scar areas, leaving it exposed to erosion and runoff (photo at right). This unregulated activity has resulted in approximately 1,348 acres of the landscape that has barren soil, assuming one acre of brine scarred soil per oil or gas well. This number of oil and gas wells is a best estimate of current and past oil and gas wells in the watershed.

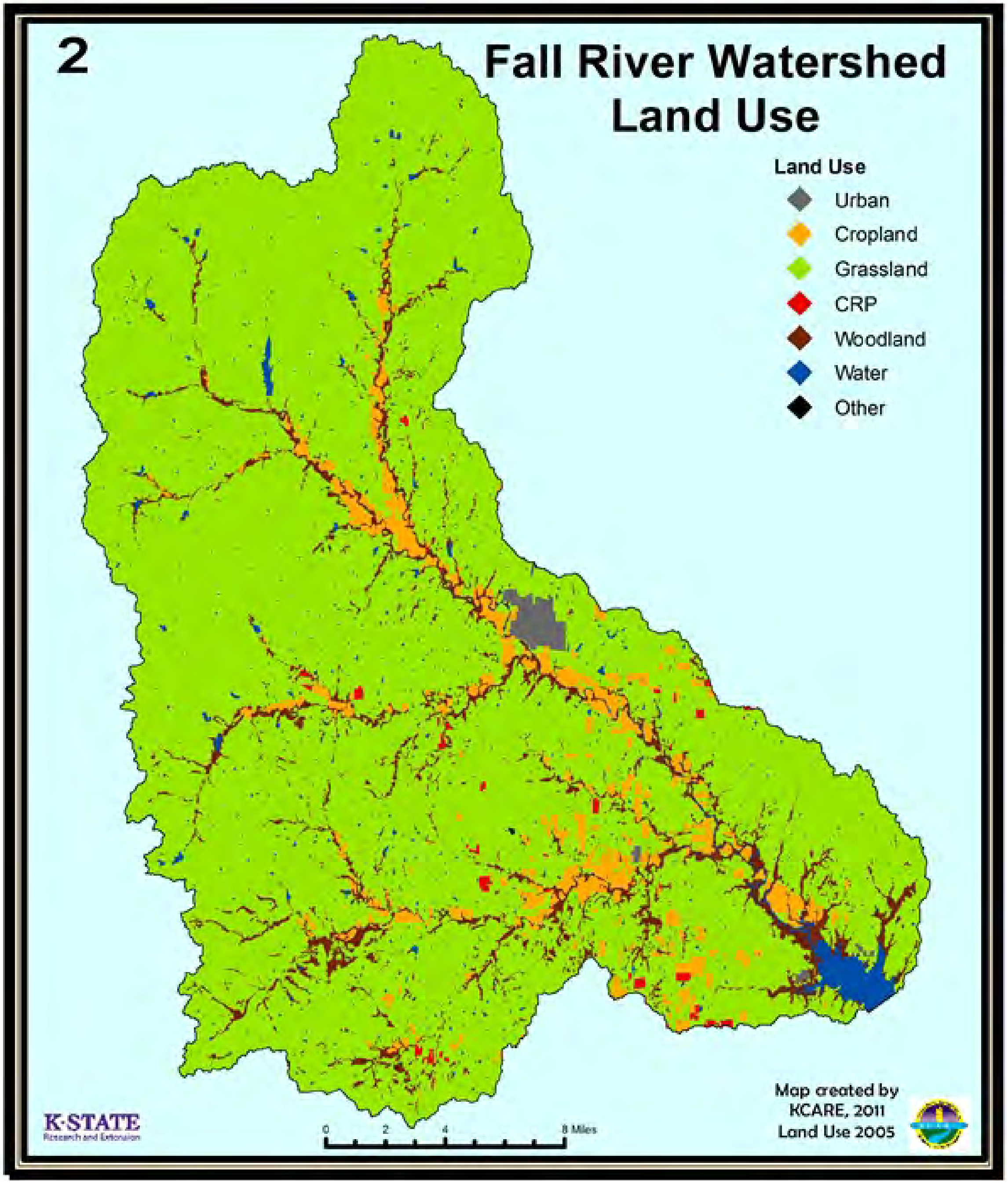


Figure 5 Land Cover of the Watershed [2]

Table 1 Land Use Calculations [3]

Fall River Watershed		
Land Use	***Acres***	***Percentage***
Range-Grasses	329,472	88
Agricultural Land-Row Crops	22,464	6
Woodland-Mixed	14,976	4
Urban	3,744	1
Water	3,100	>1
CRP	1,360	>1
Other	1,120	>1
Total	374,400	100.00

3.2 Designated Uses

The Fall River Reservoir is a Class A primary contact recreational water for public swimming. All other surface waters in this watershed are generally used for aquatic life support (fish), human health purposes, domestic water supply, recreation (fishing, boating, swimming), groundwater recharge, industrial water supply, irrigation and livestock watering. These are commonly referred to as "designated uses" as stated in the Kansas Surface Water Register, 2004, issued by KDHE.

Table 2 Designated Water Uses for the Fall River Watershed [4]

Designated Uses Table								
Stream Name	**AL**	**CR**	**DS**	**FP**	**GR**	**IW**	**IR**	**LW**
Battle Cr, Burnt Cr, Kitty Cr, Oleson Cr, Snake Cr, Spring Cr, Swing Cr	E							X
Honey Cr, Ivanpah Cr	E			X				X
Otis Cr	E		X					X
Fall River East Branch,	E	C	X	X	X	X	X	X
Fall River West Branch	E	C	X	X	X	X	X	X
Fall River	E	C	X	X	X	X	X	X
Otter Creek	E	C	X	X	X	X	X	X
Otter Creek South Branch	S	C	X	X	X	X	X	X
Fall River Lake	E	A	X	X		X		
Fall River Wildlife Area	E	A		X				
Otis Creek Reservoir	E	B	X	X		X		

AL = Aquatic Life Support   GR = Groundwater Recharge
CR = Contact Recreation Use   IW = Industrial Water Supply
DS = Domestic Water Supply   IR = Irrigation Water Supply
FP = Food Procurement   LW = Livestock Water Supply
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
b=Secondary contact recreation stream segment is not open to and accessible by the public under Kansas law
C=Primary contact recreation lakes that are not open to and accessible by the public under Kansas law
S=Special aquatic life use water
E = Expected aquatic life use water
X = Referenced stream segment is assigned the indicated designated use
O = Referenced stream segment does not support the indicated beneficial use
Blank=Capacity of the referenced stream segment to support the indicated designated use has not been determined by use attainability analysis

3.3 Special Aquatic Life Use 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".

These tributaries have been selected due to the presence of a threatened or endangered species of mussels in the river as identified by KDHE. Although not addressed by this WRAPS project, lack of stream flow especially during periods of drought, also stresses these sensitive populations of mussels.

The special aquatic life use waters are located in an area that is primarily grassland, as can be seen by the figure below. Pollutants that might threaten the health of these waters and the threatened and endangered mussel habitat would be livestock related. Manure in the streams would deposit nutrients. Livestock traffic paths or access to the streams and subsequent bank erosion would lead to sediment deposition in the streams.

The Main stem, East Branch, and West Branch of Fall River are classified as "Exceptional State Waters" by KDHE. The tributaries support high quality populations and communities of native fish and mussels.

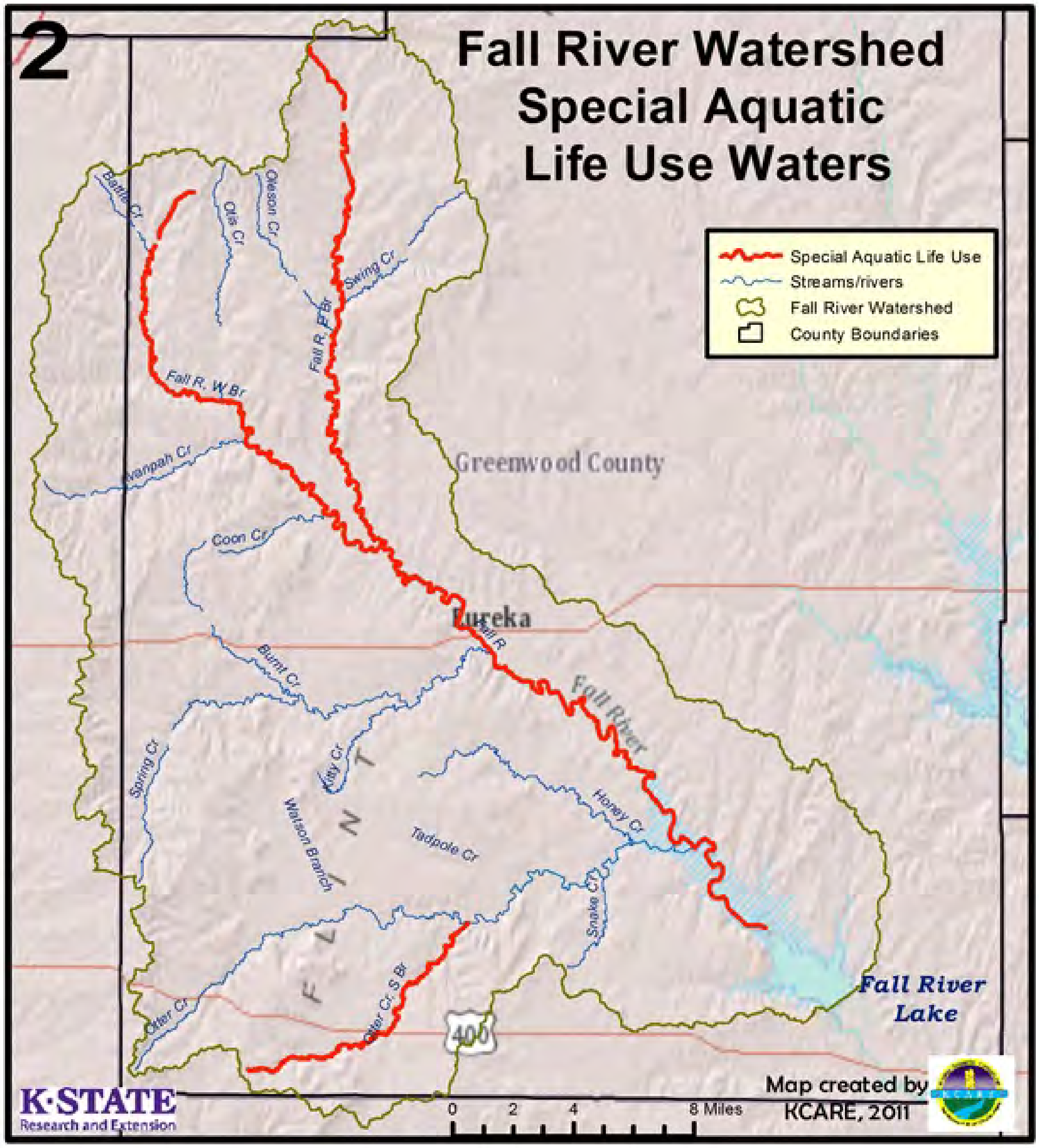


Figure 6 Special Aquatic Life Use Waters in the Watershed [5]

3.4 Public Water Supply (PWS) and National Pollutant Discharge Elimination System (NPDES)

A PWS that derives its water from a surface water supply can be affected by sediment – either in difficulty at the intake in accessing the water or in treatment of the water prior to consumption. Nutrients and fecal coliform bacteria will also affect surface water supplies causing excess cost in treatment prior to public consumption.

Table 3 Waterbodies in the Fall River Watershed.[6]

	Drainage area acres	Surface area acres	Date Constructed	Public Water Sup
Fall River Reservoir	374,400	2,540	1946	None
Otis Creek Reservoir	8,960	300 (approximate measurement)	1971	City of Eureka

The Fall River and the Otis Creek watersheds are important sources of drinking water for area residents. There are 13 public water supplies, or public water diversion points, in the entire watershed (Figure 2, page 11), however, Eureka is the only public water supply that draws from surface water in the upper part of the watershed. Otis Creek Reservoir is the source of water for Eureka. Many sources of groundwater originate in the Fall River alluvium (groundwater located adjacent to rivers and streams).

Table 4 Public Water Supplies of Fall River Watershed.

Water Supplier	County	Source of Water	Population Served
Greenwood County RWD 01	GW	Eureka	1,271
Greenwood County RWD 02	GW	Eureka	1,000
Severy City Lake	GW	Severy	290
Total Population Served			2,561

Wastewater treatment facilities are permitted and regulated through KDHE. They are considered point sources of pollutants. National Pollutant Discharge Elimination System (NPDES) permits specify the maximum amount of pollutants allowed to be discharged to surface waters. Having these point sources located on streams or rivers may impact water quality in the waterways. For example, municipal waste water can contain suspended solids, biological pollutants that reduce oxygen in the water column, inorganic compounds or bacteria. Waste water will be treated to remove solids and organic materials, disinfected to kill bacteria and viruses, and discharged to surface water. Treatment of municipal waste water is similar across the country.[7] Any pollutant discharge from point sources that is allowed by the state is considered to be Wasteload Allocation (WLA).

There are five NPDES permitted facilities lying within the Fall River Lake watershed. Only one, the City of Eureka, discharges continuously to the watershed. Since it uses a lagoon system, Eureka's monitoring is limited to BOD, TSS, ammonia, pH and fecal coliform bacteria.

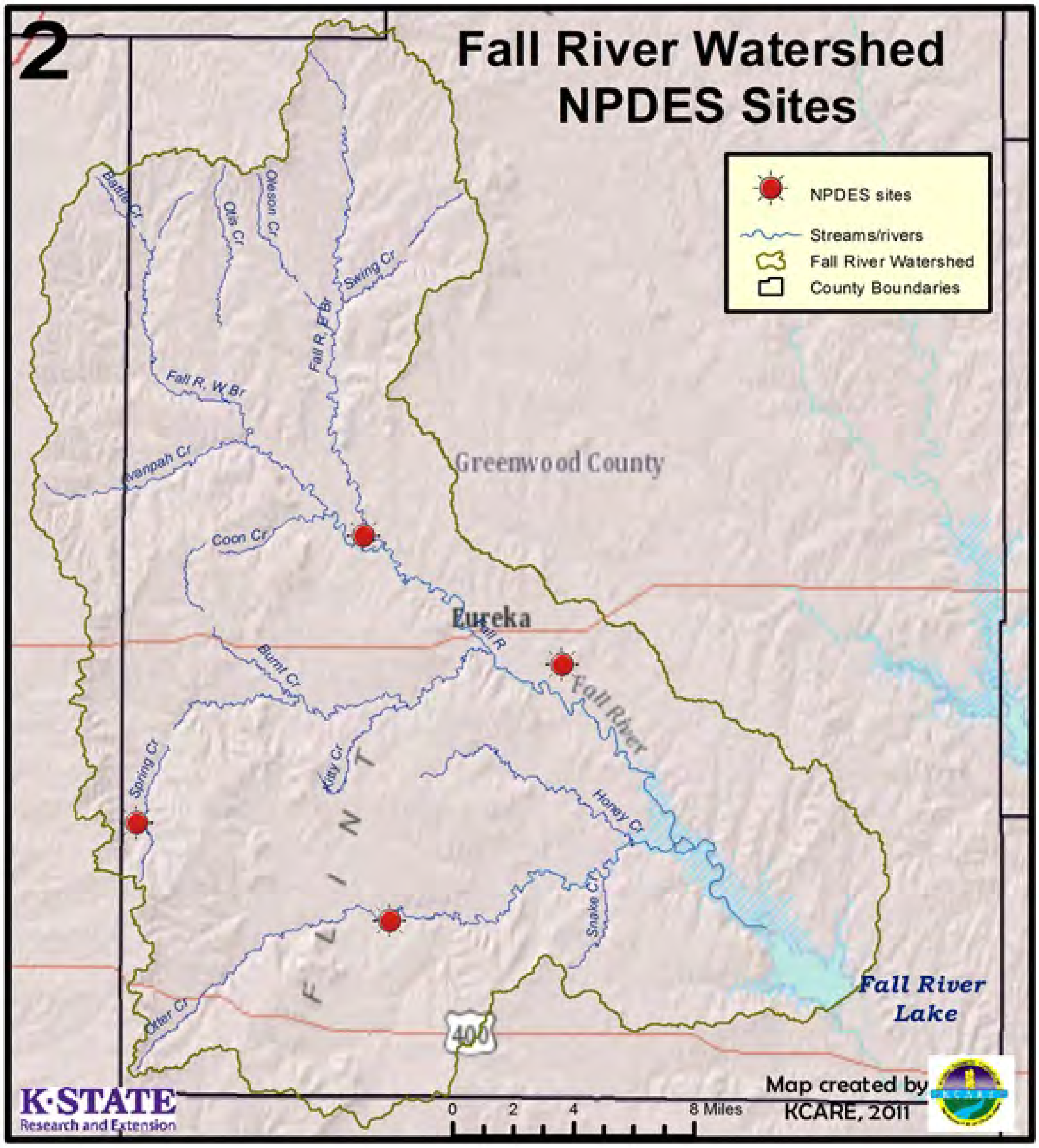


Figure 7 Fall River Watershed NPDES Permits.[8]

Numerous onsite wastewater systems exist in the watershed. There is no accurate number of these systems and their operational condition is generally unknown. Best guess is that ten percent of onsite wastewater systems are either failing or inadequately constructed.[9] All counties in the watershed are covered by sanitary codes.

3.5 Aquifers [10]

Groundwater resources in the watershed include portions of alluvial (river and stream bed) aquifers of the many tributaries. There are approximately 115 groundwater wells in the watershed. Water from these wells is used for monitoring, domestic uses, irrigation, lawn and garden, artificial recharge, public water supplies, and industrial uses.

3.6 Total Maximum Daily Loads (TMDLs) in the Watershed

A TMDL designation sets the maximum amount of pollutant that a specific body of water can receive without violating the surface water-quality standards, resulting in failure to support their designated uses. TMDLs provide a tool to target and reduce point and nonpoint pollution sources. TMDLs established by Kansas may be done on a watershed basis and may use a pollutant-by-pollutant approach or a biomonitoring approach or both as appropriate. TMDL establishment means a draft TMDL has been completed, there has been public notice and comment on the TMDL, there has been consideration of the public comment, any necessary revisions to the TMDL have been made, and the TMDL has been submitted to EPA and approved by EPA. The desired outcome of the TMDL process is indicated, using the current situation as the baseline. Deviations from the WQS will be documented. The TMDL will state its objective in meeting the appropriate water quality standard by quantifying the degree of pollution reduction expected over time. Interim objectives will also be defined for midpoints in the implementation process.[11] In summary, TMDLs provide a tool to target and reduce point and nonpoint pollution sources. The goal of the WRAPS process is to address high priority TMDLs.

KDHE reviews TMDLs assigned in each of the twelve basins of Kansas every five years on a rotational schedule. The table below includes the review schedule for the Verdigris Basin.

Table 5 TMDL Review Schedule for the Verdigris Basin. [12]

Year Ending in September	Implementation Period	Possible TMDLs to Revise	TMDLs to Evaluate
2013	2014-2023	2002	2002
2018	2019-2028	2000, 2004, 2005, 2008	2000, 2004, 2005, 2008

Table 6 TMDLs in the Watershed.[13] The Fall River 9 element plan will directly address the high priority TMDL for eutrophication, dissolved Oxygen and Siltation through BMP implementation. The High priority TMDL for Bacteria will be positively affected by BMP implementation. There are no 303d listed waters in this watershed.

Water Segment	TMDL Pollutant	Endgoal of TMDL	Priority	Sampling Station
High Priority TMDLs				
Fall River Reservoir	**Eutrophication/ Dissolved Oxygen/Siltation**	**Summer chlorophyll a concentrations < 10 ug/L** **Secchi disk depth >0.7 meters** **DO > 5mg/L**	**High**	**LM023001**
Fall River E Branch Fall River W Branch Fall River Spring Creek Kitty Creek Burnt Creek Coon Creek Ivanpah Creek Otis Creek Battle Creek Oleson Creek Swing Creek	Fecal coliform bacteria	< 200cfu/100ml water	High	575

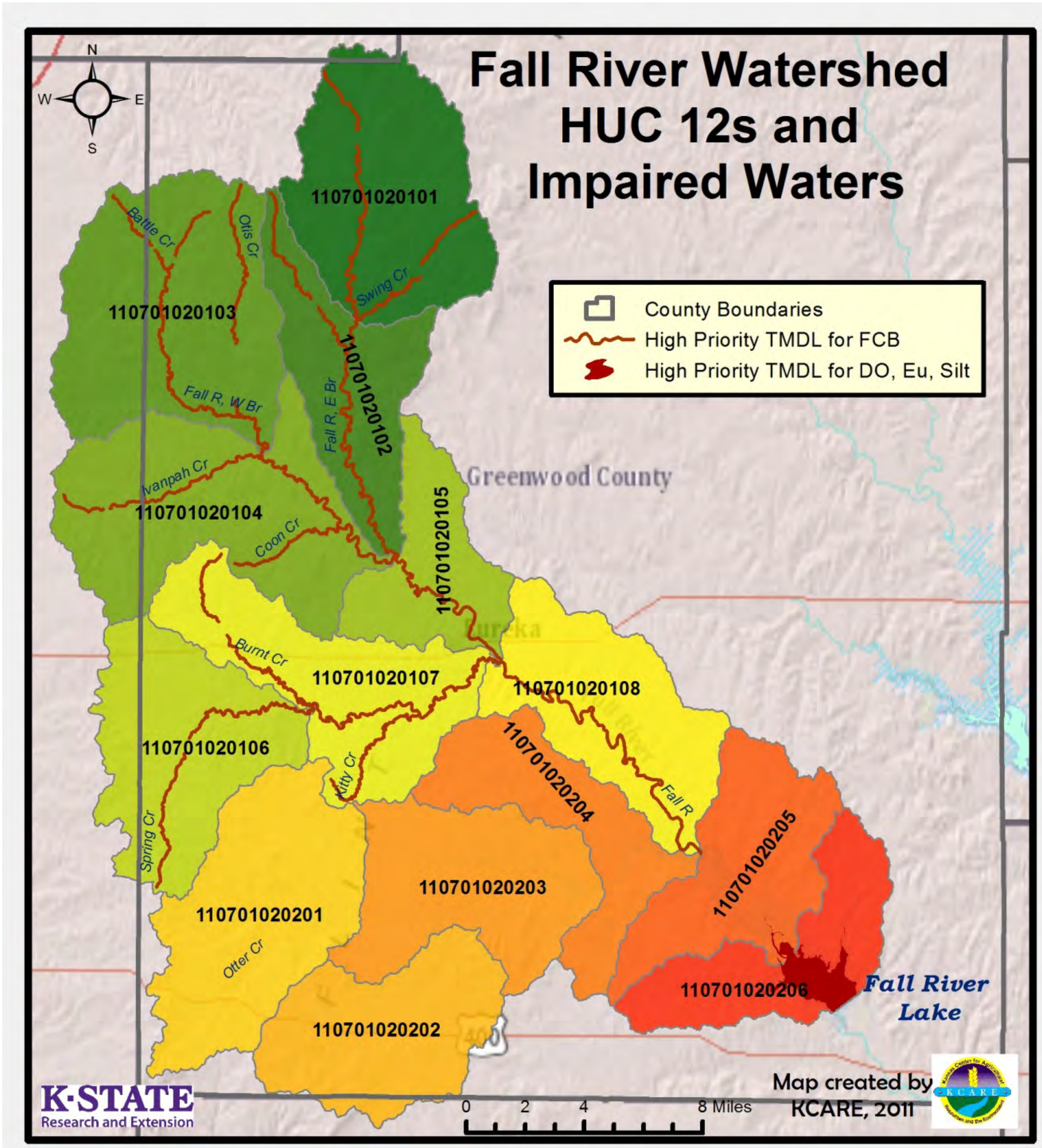


Figure 8 TMDLs in the Watershed. [14]

3.7 TMDL Load Allocations [15]

TMDL loading is based on several factors. A total load is derived from the TMDL. Part of this total load is Waste Load Allocation (WLA). This portion comes from point sources in the watershed: NPDES facilities, CAFOs or other regulated sites. Some TMDLs will have a natural or background Load Allocation, which might be atmospheric deposition or natural mineral content in the waters.

After removing all the point source and natural contributions, the amount of load left is the TMDL load allocations. This is the amount that originates from nonpoint sources (pollutants originating from diffuse areas, such as agricultural or urban areas that have no specific point of discharge) and is the amount that this WRAPS project is directed to address. All Best Management Practices (BMPs) derived by the SLT will be directed at this load allocations by nonpoint sources.

3.7.1 Eutrophication

BATHTUB is an empirical receiving water quality model that was developed by the USACE. The BATHTUB model was utilized for the eutrophication assessment of Fall River Reservoir. According to the model, load reductions to achieve the TMDL endpoints of 9.5 ug/l chlorophyll a was accomplished by reducing the inflow phosphorus and nitrogen concentrations until the endpoints were reached. Additional reductions in phosphorus loading were determined in order to reach the ultimate endpoint of an in-lake TP concentration of 35 ug/l. Reducing phosphorus alone requires a load reduction of 35% from current levels in order to maintain chlorophyll a concentrations below 10 ug/l. If nitrogen loading is also reduced by 9%, the necessary phosphorus loading reduction is only 16% to achieve the same result. A long-term phosphorus load reduction of 49% is necessary to reduce in-lake phosphorus levels to 35 ug/l and corresponding chlorophyll concentrations of 8.2 ug/l.

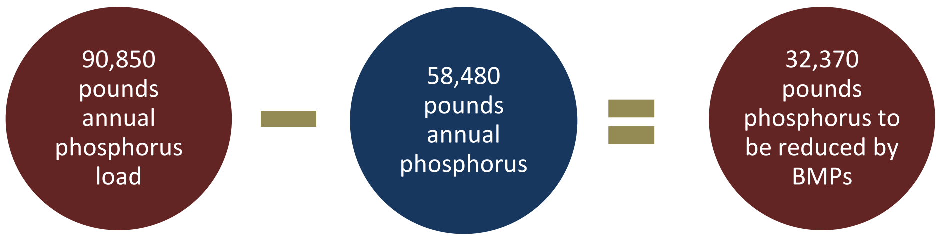
BATHTUB calculates that the lake retains 44% of incoming phosphorus, but only 15% of the nitrogen load is retained. The linkage between phosphorus and sediment and the overriding sedimentation issue at Fall River Lake likely causes the disparity in retention.

Nonpoint sources are the main contributor for the nutrient input and impairment in Fall River Reservoir. Background levels may be attributed to nutrient recycling and leaf litter. The assessment suggests that runoff transporting nutrient loads associated with animal wastes and cultivated crops where fertilizer has been applied, to include pasture and hay, contribute to the eutrophic condition of the Reservoir. Nutrient load allocations for Fall River Reservoir were calculated using the BATHTUB model. Total phosphorus currently entering the Reservoir annually, as calculated in the TMDL, is 90,850 pounds.

3.7.1. A Pollutant Loads and Load Reductions

All BMPs for phosphorus, nitrogen and E. coli bacteria will be expressed with a focus on phosphorus only. Sampling for phosphorus improvements in water quality is currently being monitored by KDHE and changes in concentrations will be determined. All phosphorus BMPs will have a positive effect on E. coli bacteria and nitrogen concentrations.

The current estimated phosphorus load in the Fall River Watershed is **90,850 pounds** per year according to the TMDL section of KDHE. **Taking the current loading less the TMDL plus the margin of safety leaves 32,370 pounds** of phosphorus per year that needs to be reduced in order to meet the TMDL. This is the amount of phosphorus reduction that will have to be met by implemented BMPs in the watershed.



It is to be noted that the phosphorus related BMPs also support the E. coli bacteria and sediment TMDLs. The SLT has laid out specific BMPs that they have determined will be acceptable to watershed residents. **These BMPs will be implemented in the livestock and rangeland, cropland and streambank targeted areas.** Implementation of these BMPs is necessary to meet the required load reduction. These BMPs are listed later in the plan. The acres and number of projects needed annually have been approved by the SLT.

Table 7 Fall River Reservoir TMDL Summary for TP.

TP Load	TP pounds/year
Load Allocation	90,850
Margin of Safety	58,480
TSS Nonpoint Load that needs to be Reduced	***32,370***

3.7.2 Siltation and Sediment

Siltation loading comes predominantly from nonpoint sources. Based on the soil characteristics of the watershed, overland runoff can easily carry sediment to the stream segments and eventually to the reservoir. TSS and secchi depth show a strong relationship for Fall River Reservoir. A 40 percent TSS reduction is necessary to reach the endpoint, a secchi depth of 1.29 m. The sediment currently entering the reservoir annually, as calculated in the TMDL, is 163,800 tons/year of TSS.

3.7.2. A Sediment Pollutant Loads and Load Reductions

The current estimated Total Suspended Solids load in the Fall River Watershed is **163,800** tons per year according to the TMDL section of KDHE. The TMDL for TSS (WLA + load allocations + margin of safety) equals 100,200 tons. **Taking the current loading less the TMDL plus the margin of safety leaves 63,600 tons** of sediment per year that needs to be reduced in order to meet the TMDL.

The SLT has laid out specific BMPs that they have determined will be acceptable to watershed residents. **These BMPs will be implemented in the cropland, rangeland and streambank targeted areas.** Specific acreages or projects that need to be implemented per year have been determined through modeling and economic analysis and approved by the SLT.

Table 8 Fall River Reservoir TMDL Summary for TSS.

TSS Load	TSS tons/year
Load Allocation	163,800
Margin of Safety	100,200
TSS Nonpoint Load that needs to be Reduced	***63,600***

4.0 Critical Targeted Areas and Load Reduction Methodology

4.1 Critical Targeted Areas

Fall River Watershed WRAPS has been implementing Best Management Practices (BMPs) with local stakeholders to protect the quality of water in Fall River, all of its tributaries and Fall River Reservoir—the whole watershed. When the time came for the SLT to update the old WRAPS plan into a 9-element plan, it became apparent that more monitoring information was needed if target areas were to be identified. In spring and summer, 2011, Fall River WRAPS undertook water quality monitoring at six new sites throughout the whole watershed with guidance from KDHE and an approved Quality Assurance Project Plan (QUAP). In addition, Kansas Department of Health and Environment (KDHE) has 2 monitoring sites in Fall River watershed; one on Otter Creek at 99 Bridge and one on Fall River at Rice Bridge.

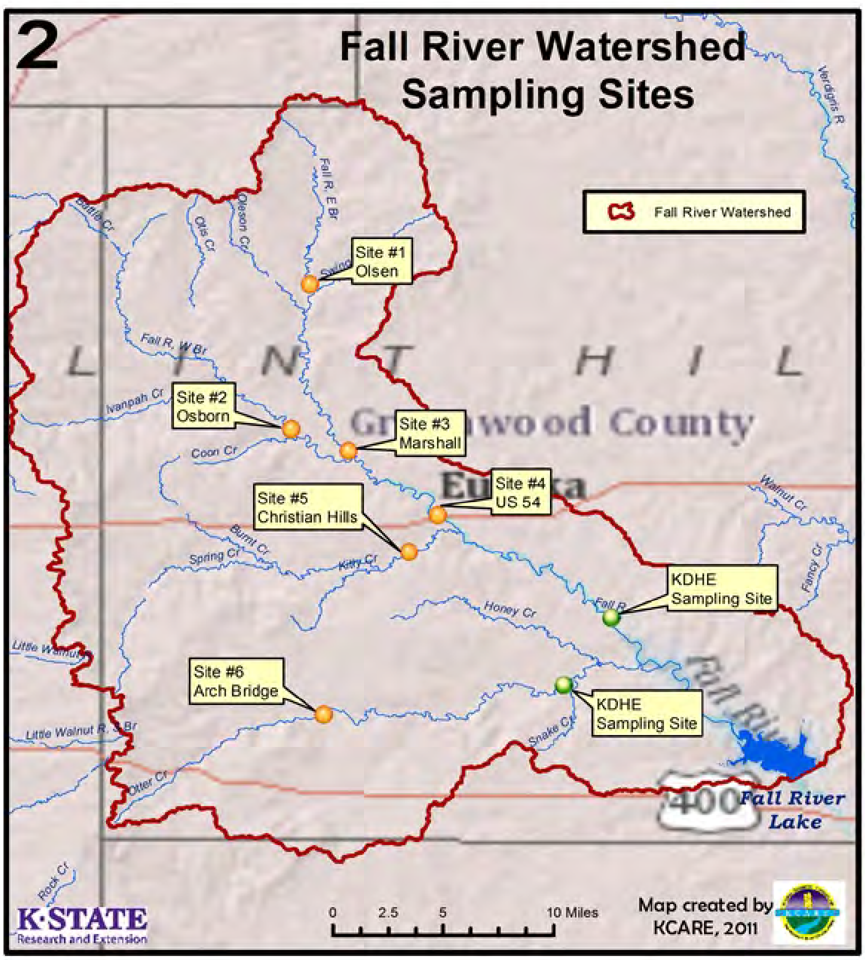


Figure 9 Fall River WRAPS Monitoring Sites

All samples collected during the sampling period were processed by students at Butler County Community College under the supervision of Dr. William Langley for nitrates, reactive phosphates, E. coli, and total suspended solids. Four normal flow samples were collected at each sampling site, one each at the beginning, middle, and two at the end of the sampling period (May 15 – October 1). One or more of the Fall River WRAPS Project Management Team members collected samples from each of the 6 designated monitoring sites and stored them in a non-contaminating location for pickup by the lab. The lab recorded the data from all samples collected as shown in the table below.

	5/25/2011				**7/14/2011**				**8/24/2011**				**9/18/2011**			
Site #	$N0_3$	*o*-P	Ec	TSS	$N0_3$	*o*-P	Ec	TSS	$N0_3$	*o*-P	Ec	TSS	$N0_3$	*o*-P	Ec	TSS
Site 1	0.50	0.18	300	10	0.20	0.33	1900	5	0.2	0.1	1000	12	1.1	0.29	1400	12
Site 2	0.40	0.06	1300	16	0.40	0.26	1600	15	0.7	0.56	0	5	0.4	0.06	1700	0.5
Site 3	0.50	0.12	200	80	0.20	0.22	1200	7	0.25	0.7	900	9	1.2	0.12	2700	10
Site 4	0.50	0.28	800	20	0.30	0.12	3700	5	0.3	0.07	1300	5	0.4	0.13	1800	10
Site 5	0.80	0.15	4700	130	0.20	0.16	900	35	0.7	0.15	200	35	0.8	0.15	600	40
Site 6	0.80	0.06	3200	54	0.30	0.07	1200	10	0.7	0.2	800	10	1	0.15	2000	40
Duplicate Sample Site	5	5	5	5	5	5	5	5	1	1	1	1	4	4	4	4
Duplicate Value	0.80	0.07	3300	84	0.30	0.17	1700	10	0.2	0.05	800	10	0.6	0.45	300	20
Duplicate RPD %	0	73	35	43	40	6	62	111	0	67	23	18	40	110	143	67
Blank	0.00	0	0	1	0.00	0.01	0	0	0	0.01	0	9	0	0.06	0	10

Table 9 2011 Data Collected and Analyzed for Fall River Watershed

Nitrates (N)-Data are given in mg/l.
Data range from 0 to 1.2 mg/l. A zero reading was only found for the blank samples. The duplicate for July 14 showed a 0.1 mg/l difference. Even though this represents a 50% greater in the duplicate, the absolute difference was small. There are too few data to calculate a mean or show overall trends. All values =

Phosphates (P)-Data are given in mg/l.
Data ranged from 0 to 0.70 mg/l of reactive phosphorus. Only 1 reading for the blank was 0 as it should have been. The other 3 readings were low and probably indicated a lack of cleanliness, but the amount was relatively low.

E. coli (Ec)-Data are given in number of colonies per100 ml.
Data on colony counts ranged from zero to 4700. The blank samples all showed counts of zero as expected. Relative percent difference in the duplicate E. coli samples ranged from 23% to 143% due in part to the large dilution factor (1:100) and in part to the lack of experience in discerning E. coli colonies by the students at Butler County Community College.
The main segments of Fall River are subject to Primary Contact Recreation 'B' E. coli Criteria which sets a limit of 262 CFU/100 mL for April 1 – October 31 in the river and 1,310 CFU/100 mL for November 1- December 31. As all of these samples were collected during the April – October 31 time frame they are subject to the 262 CFU/100 mL criterion with sites 1, 4 and 6 showing colony counts above the criterion level on all four collection dates and sites 2, 3 and 5 showing colony counts above the criterion level on all but one sampling date.

Total Suspended SolidsTSS)-Data are given in mg/l.
Data range from 0 to 130 mg/l. The blank only had one sample with 0 as expected the other three measurements ranged from 1 to 10 mg/l. The percent difference of the duplicate samples varied from 18% for the sample taken in August to 111% for the sample taken in July. High percent difference in the duplicates is likely caused by the dilution (1:100) and the lack of experience by the students performing the analysis.

This monitoring data helped determine specific priority areas in the watershed that might be contributing more sediment and nutrients to the streams which flow into Fall River Reservoir. The information was limited somewhat by an ongoing severe drought throughout the area. Fall River's PMT decided that more sampling information was important for the watershed and the monitoring should continue after more normal rainfalls occur.

Information based on the 2006 Fall River Watershed Assessment prepared by Kansas Alliance of Wetlands and Streams and the 2010 Fall River Watershed Assessment prepared by the Kansas Water Office was also used for targeting streambanks. The Kansas Water Office (KWO) 2011 assessment quantifies annual tons of sedimentation from streambanks between 1991 and 2006 within the Upper Fall River watershed in Kansas, and estimates about 40,364 tons of sediment is transported from the Upper Fall River watershed to the reservoir annually. This calculated amount accounts for only 12% of the total sediment load estimated in the KDHE determined Total Maximum Daily Load (TMDL). It should be noted that this 12% of sedimentation identified in the streambank erosion assessment accounts for only a portion of all streambank erosion locations within the Upper Fall River watershed. Only those streambank erosion sites observed as having streambank movement that covered an area about 1,500 sq. feet or more were identified within the assessment.

A bathymetric survey performed by the Kansas Biological Survey in 1990 indicated that storage capacity in the multi-purpose pool, which contains public water supply storage, had been reduced by approximately 38% since the reservoir was filled in 1949; the original storage capacity was 30,401 acre-ft. A substantial portion of this sediment is transported from the main stem Fall River and its tributaries East and West Branch Fall River, Otter Creek and Spring Creek. Based on estimated stabilization costs of $71.50 per linear foot from an assessment conducted by The Watershed Institute, Inc. (TWI), streambank stabilization for the entire watershed from the 2011 assessment, identifying erosion between 1991 and 2006, would cost approximately $1.4 million. The streambank and rangeland gully erosion assessment did not quantify annual tons of soil loss. However, locations of gully erosion were identified for prioritization purposes using 2008 and 2010 NAIP aerial imagery.

The KWO completed this assessment for the Fall River Watershed Restoration and Protection Strategy (WRAPS) Stakeholder Leadership Team (SLT). Information contained in this assessment can be used by the Fall River WRAPS SLT to target streambank stabilization and riparian restoration efforts toward high priority stream reaches or HUC12s in the Upper Fall River watershed. Most of the Fall River SLT members have many years of experience in the watershed and this assessment will be of great assistance in the final determination of the target areas.

In every watershed, there are specific locations that contribute a greater pollutant load due to soil type, proximity to a stream and land use practices. By focusing BMPs in these areas; pollutants can be reduced at a more efficient rate. Through research at the University of Wisconsin, it has been shown that there is a “bigger bang for the buck” with streamlining BMP placement in contrast to a “shotgun” approach of applying BMPs in a random nature throughout the watershed. Therefore, the SLT has targeted areas in the watershed to focus BMP placement for sediment runoff, nutrients and E.coli bacteria from livestock production and streambank erosion. Targeting for this watershed will be accomplished in three different areas:

1.) Cropland will be targeted for sediment and nutrients.
2.) Rangeland will be targeted for sediment and the same geographic area will be targeted for livestock related phosphorus, and E.coli.
3.) Streambanks will be targeted for sediment.

After locating initial critical targeted areas, the SLT reviewed information regarding the *need* for BMP implementation.

Table 10 Kansas NPS Needs Inventory by County

Kansas NPS Needs Inventory By County		
Greenwood County		
Acres Cropland Needing Treatment (a)	**Avg. Treatment Cost (Cropland) (g)**	**Total County Treatment Cost (Cropland)**
26,600	$125	$3,325,000
Acres Pasture/Rangeland Needing Treatment (b)	**Avg. Treatment Cost (Range/Pasture) (h)**	**Total County Treatment Cost (Pasture/Rangeland)**
273,416	$25	$6,835,400
Livestock Facilities Requiring Treatment (Cattle) (c)	**Avg. Treatment Cost Per Facility (i)**	**Total County Treatment Cost (Livestock Facilities)**
780	$7,500	$5,850,000
Failing Septic Systems (d)	**Avg. Cost For Upgrade/Replacement (j)**	**Total County Septic System Upgrade/Replacement Cost**
650	$4,500	$2,925,000
Hydromodification (Stream Miles Needing Treatment) (e)	**Avg. Cost For Stream Bank Stabilization (k)**	**Total County Hydromodification Cost**
63	$79,200	$4,989,600
Active 319 Projects (f)	**Cost Per 319 Project (l)**	
None		**Total County 319 Project Cost**
		$0
	Total County NPS Need	$23,925,000

Source: The land cover type* and estimate of acres needing treatment information were developed using the Kansas Non-Point Source Needs Inventory. The Kansas Department of Health and Environment (KDHE) surveyed the county conservation districts for land treatment “needs” in 2005. The districts completed a spreadsheet indicating the number of acres for each land use type that were in need of structural and/or nonstructural land treatment. Total square miles in the watershed = 585.

Fall River Reservoir Watershed consists of 353,842 acres; Greenwood County holds 91.1% of the watershed or 322,338 acres, while 8.5% or 30,195 acres lie in Butler County. The remainder of the watershed, 0.4% or 1,309 acres, lies in Elk County.

Rangeland and pastures represent 88% of the land use in Fall River Reservoir watershed and, for the most part, represent the same percentage of land use in the five Livestock and Rangeland Targeted HUC 12s in the watershed. Numerous acres of these rangelands contain ephemeral streams, eroded gullies, brine scars and stream bank erosion.

Many of the upper reaches of the streams in the targeted croplands are ephemeral in nature (flow only on runoff events) and traverse the farmers fields. In some of these situations the farmers acually farm through the streams. The problem with this action is that runoff events wash any loose soil that has been tilled into the stream, carrying the nutrients with the runoff. If additional runoff upslope from this stream is carrying sediment and nutrients they are dropped into the stream.

Streambank erosion in the Fall River watershed, exacerberated by high gradients and high flows, is prevalent throughout the entire watershed. In 2010, the Kansas Water Office assessed streambank erosion in the watershed, pinpointing Spring Creek and Otter Creek as the primary contributors of sediment to the Fall River Reservoir.

In working with best management practices, the Stakeholder Leadership Team has several sources of funds they can access to help farmers and ranchers implement these practices. Funding sources include the Natural Resources Conservation Service (NRCS-Federal), Kansas Department of Agriculture, and the Division of Conservation (formerly SCC-State), KDHE WRAPS (EPA 319-State). These funds vary from year to year, with most of the effort focused on improving and protecting water quality.

4.2 Cropland Erosion

In late 2011, the Fall River WRAPS SLT established priority areas for Cropland Erosion in the watershed based on 2011 water monitoring and personal and professional knowledge of many of the SLT.

Cropland BMP targeted areas are:

- those fields, including contiguous fields, bordering either branch of Fall River that is contained in the watershed and
- those fields, including contiguous fields, bordering either branch of Otter Creek.

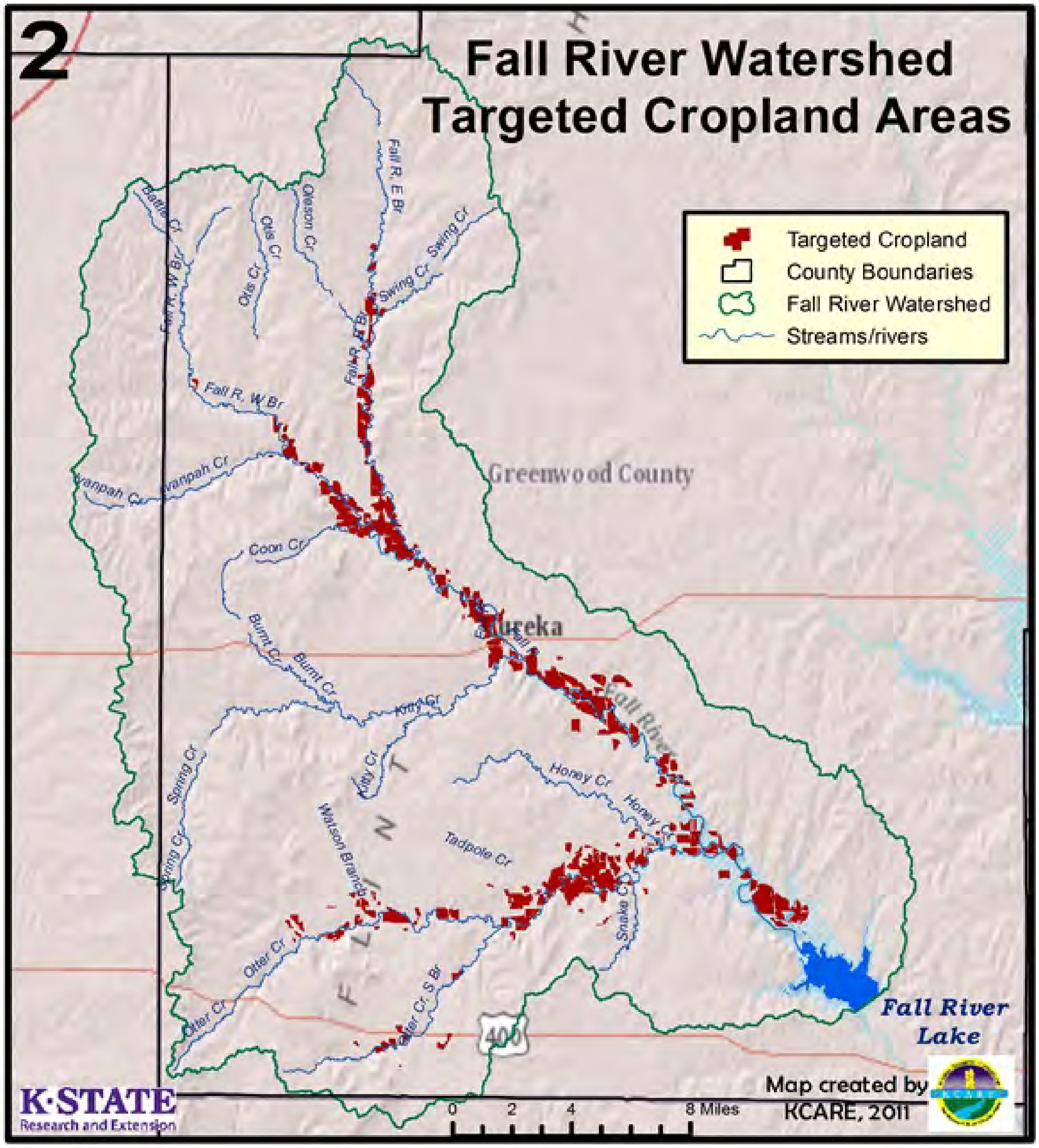


Figure 10 Fall River Cropland Priority Map

4.3 Rangeland and Livestock Targeted Areas

The streamside and rangeland gully erosion portion of the 2010 Kansas Water Office assessment of Fall River reservoir watershed did not quantify annual tons of soil loss. However, locations of erosion were identified for targeting purposes using 2008 and 2010 NAIP aerial imagery. These areas of erosion are defined as:

- cow paths,
- winter feeding areas,

- blown-out grassed waterways,
- eroding landscape due to precipitation and overland flow, and
- sand pits.

The SLT has determined the areas for targeting **rangeland** erosion in the watershed. This area will also be targeted for **livestock** related phosphorus pollutants and rangeland BMPs will be placed in these areas which encompass the following HUC numbers:

- Sub-HUCs 11070102010050 and 11070102010080, and
- Sub-HUCs 11070102010070, 11070102020040, and 11070102020030.

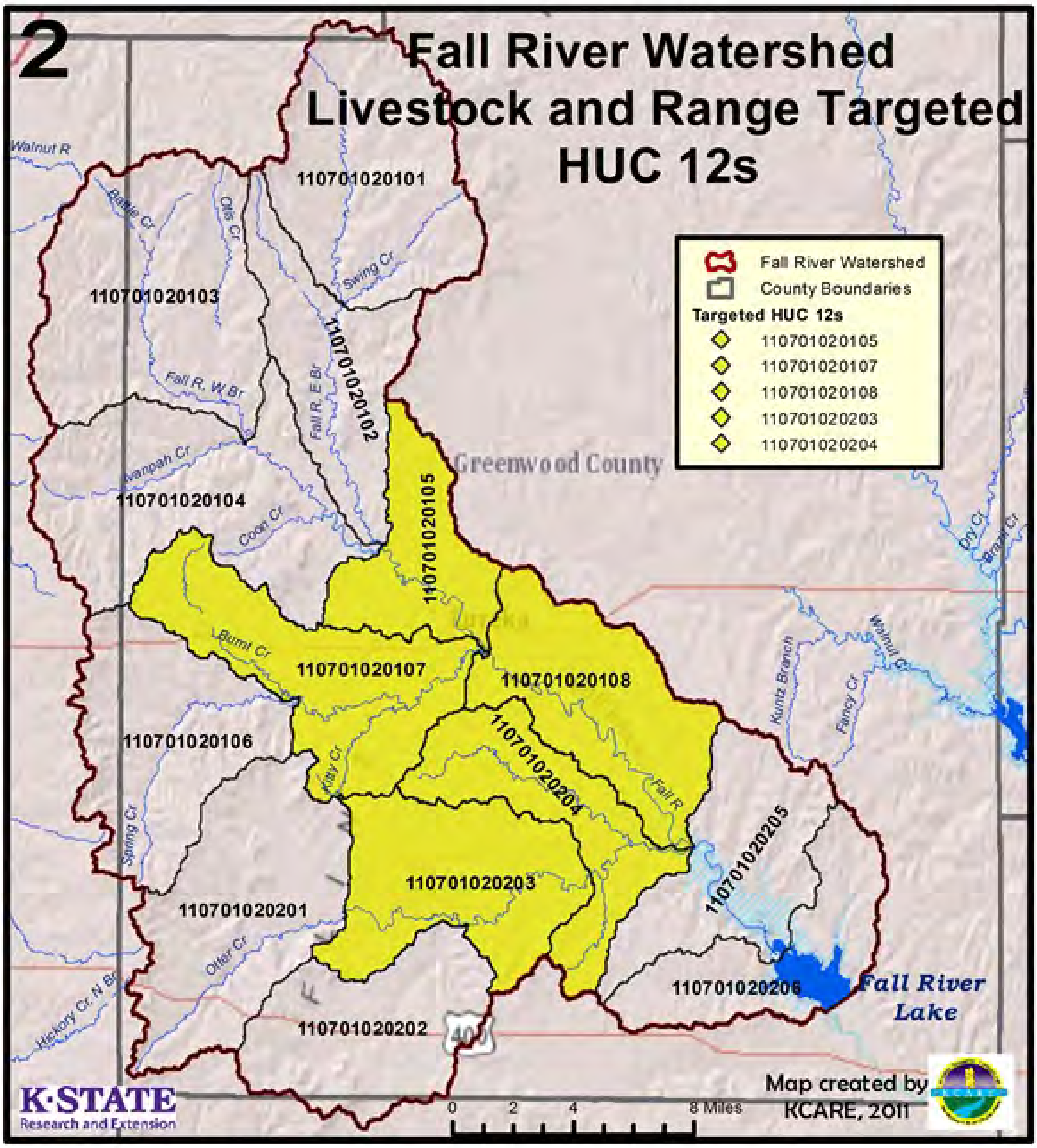


Figure 11 Rangeland and Livestock Targeted Areas.

Table 11 Land Use in the Range and Livestock Targeted Area [16]

HUC 12	Urban Industrial/ Commercial	Urban Residential	Urban Openland	Urban Woodland	Cropland	Grassland	CRP	Woodland	Water	Other	**Total**
110701020106	0	0	0	0	332	24667	20	1192	345	0	**26555**
110701020202	0	0	0	0	435	20619	140	1512	187	0	**22893**
110701020107	0	0	0	0	849	24044	201	1696	266	0	**27055**
110701020205	0	0	0	0	1703	17038	19	2294	583	0	**21637**
110701020204	0	19	61	2	1511	15566	192	1676	180	0	**19207**
110701020103	0	0	0	0	141	35088	0	904	536	0	**36668**
110701020206	11	63	75	8	804	13202	240	1604	2242	4	**18252**
110701020104	0	0	0	0	1351	31811	3	1484	334	0	**34982**
110701020201	0	0	0	0	586	27330	0	2763	297	0	**30976**
110701020102	0	0	0	0	1507	16953	47	1194	218	0	**19920**
110701020203	0	0	0	0	3177	19503	185	1996	252	19	**25132**
110701020108	209	227	257	5	3130	18477	143	1681	483	0	**24612**
110701020101	0	0	0	0	192	29695	5	674	292	0	**30857**
110701020105	157	422	473	22	891	12284	19	904	302	0	**15474**
Total	**377**	**730**	**866**	**36**	**16610**	**306274**	**1212**	**21574**	**6518**	**23**	**354220**
Area	***0.1%***	***0.2%***	***0.2%***	***0.0%***	***4.7%***	***86.5%***	***0.3%***	***6.1%***	***1.8%***	***0.0%***	***100.0%***

4.4 Streambank Erosion

The Fall River WRAPS SLT has determined that streambank stabilization practices will be implemented on any eroded banks of Otter Creek and Spring Creek. This decision was based on the 2006 Watershed Assessment prepared by Kansas Alliance of Wetlands and Streams and the 2010 Fall River Watershed Assessment prepared by the Kansas Water Office.

The Kansas Water Office 2010 Assessment quantifies annual tons of sediment from streambanks between 1991 and 2006 within the Fall River Reservoir Watershed, and estimates about 40,364 tons of sediment is transported from the Fall River Reservoir watershed to the reservoir itself annually. A substantial portion of this sediment is transported from the main stem of Fall River and its tributaries East and West Branch Fall River, Otter Creek and Spring Creek.

Private Drive along Otter Creek

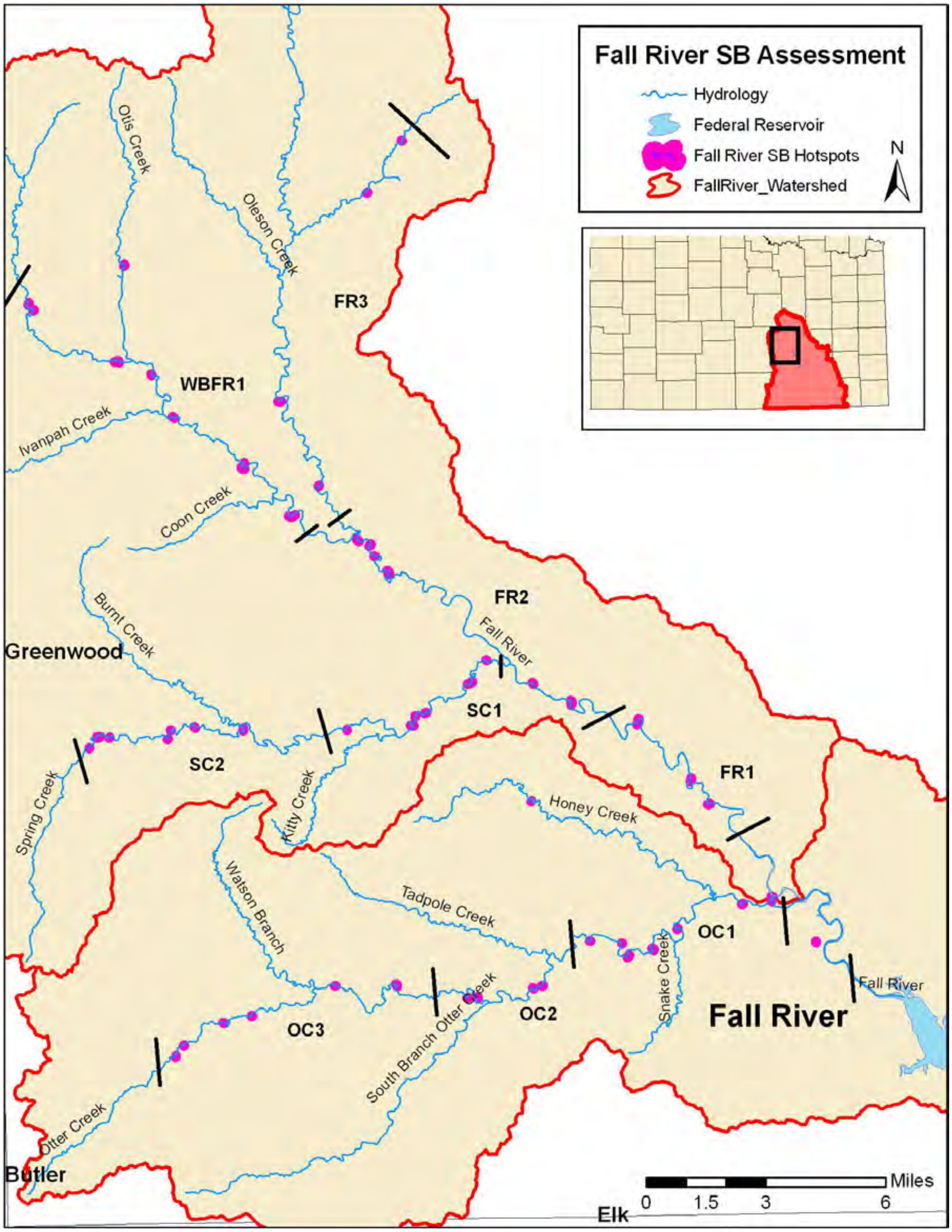


Figure 12 Streambank Targeted Areas.

Streambank erosion hotspots were analyzed for prioritization purposes by stream reach sections initially. The reaches are delineated by black bars on the map.

4.5 Load Reduction Estimate Methodology

4.5.1 Cropland

Baseline loadings are calculated by agency staff familiar with the watershed. Best management practice (BMP) load reduction efficiencies are derived from K-State Research and Extension Publication MF-2572.[17] Load reduction estimates are the product of baseline loading and the applicable BMP load reduction efficiencies.

4.5.2 Livestock

Baseline nutrient loadings per animal unit are calculated using the Livestock Waste Facilities Handbook.[18] Livestock management practice load reduction efficiencies are derived from numerous sources including K-State Research and Extension Publication MF-2737 and MF-2454.[19] Load reduction estimates are the product of baseline loading and the applicable BMP load reduction efficiencies.

4.5.3 Estimating Annual Loads [20]

Baseline soil erosion values were arrived at assuming a soil erosion value of 1.9 tons per linear foot of degraded buffer taken from KWO assessments on the Fall Rivers.

4.5.4 Rangeland Load Reduction Estimates:

Soil erosion from brine sites that kill vegetation and allow gullies to form as well as gullies formed by cattle trails in pastures are converted to tons via the following NRCS formula:

Soil Loss Equation for Gullies

$$\frac{\text{(Bottom Width+Top Width) X Depth X Length X Soil Weight (lbs/ft}^3\text{)}}{\text{2 X 2,000}} = \text{Tons of Soil}$$

Where: Average soil weight for the watershed= 85 lbs/ft^3

Cost estimates for brine site and ephemeral gully repair are from the Greenwood County Conservation District and Flint Hills RC&D.

4.5.5 Streambank Cost Estimates:

A 2009 study conducted by KSU Agricultural Economists calculated the cost of stabilizing streambank sites in the Fall River watershed at an average of $71.50 per linear foot, including all engineering and design costs.

Refer to Section 7, "Costs of BMP Implementation" for specific BMP costs in order to meet the TMDL.

NOTE: The SLT of the Fall River Watershed has determined that the focus of this WRAPS process will be on three key concerns of the watershed listed in order of importance:

1. **Sedimentation,**
   a. Cropland erosion,
   b. Rangeland, gully, and brine scar erosion, and
   c. Streambank erosion
2. **Livestock related pollutants**
   a. Nutrients and
   b. E. coli bacteria
3. **Natural resources**
   a. Prairie chicken habitat
   b. Communities of native fish and mussels

All goals and best management practices will be aimed at restoring water quality or protecting the watershed from further degradation. The following sections in this report will address these concerns.

5.0 Impairments Addressed by the SLT

5.1 Sediment

Silt or sediment accumulation in lakes and wetlands reduces reservoir volume and therefore, therefore reducing the pool level used for public water supply, limits public access to the lakes because of inaccessibility to boat ramps, beaches and the water side. In addition to the problem of sediment loading in lakes, pollutants can be attached to the suspended soil particles in the water column causing higher than normal concentrations. Reducing erosion is necessary for a reduction in sediment. Agricultural best management practices (BMPs) such as continuous no-till, conservation tillage, grass buffer strips around cropland, terraces, grassed waterways and reducing activities within the riparian areas will reduce erosion and improve water quality. BMPs have been selected by the SLT (and will be discussed later in this section) based on acceptability by the landowners, cost effectiveness and pollutant load reduction effectiveness.

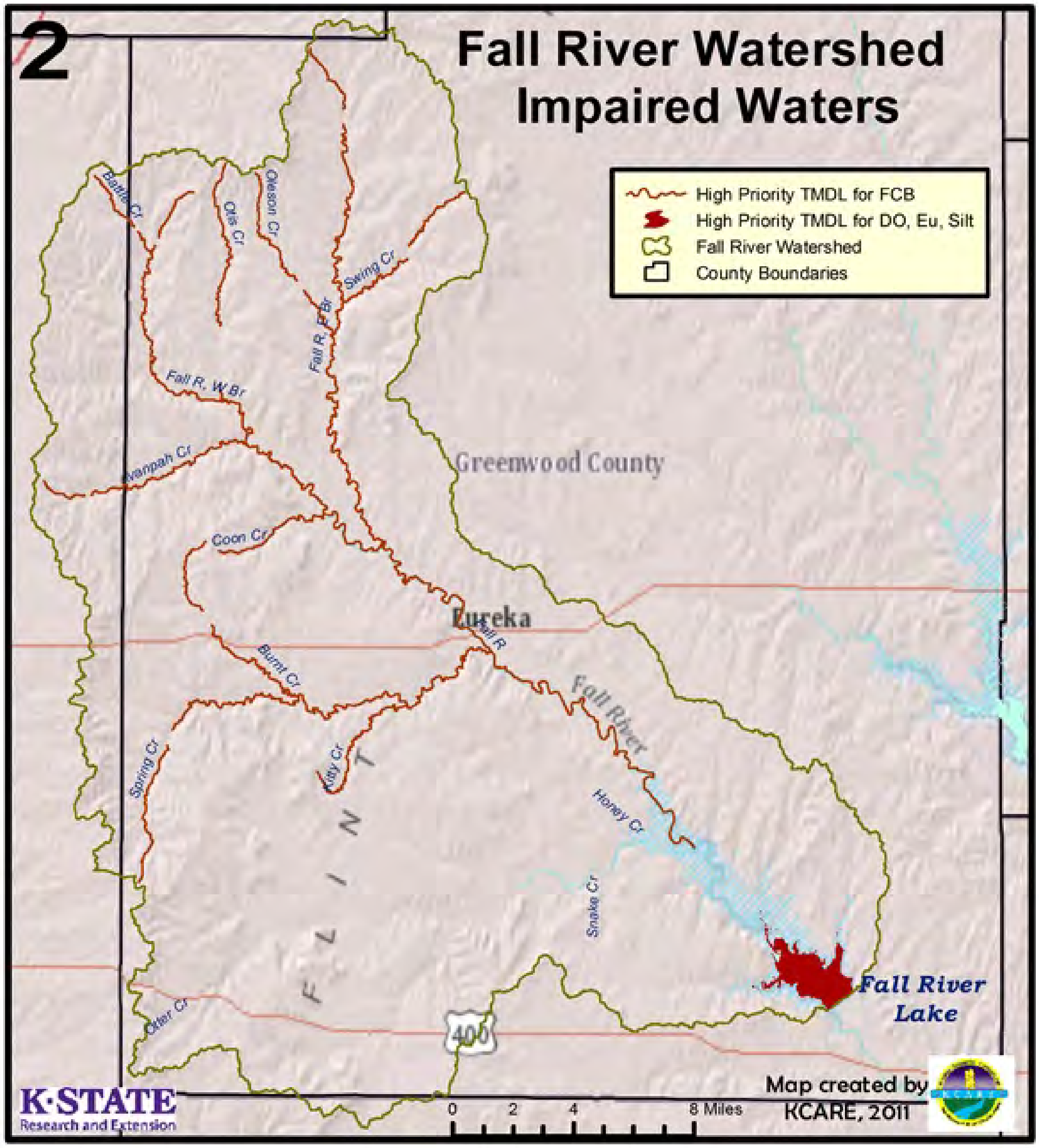


Figure 13 Impaired Waters Map [21]

Possible Sources of the Impairment

Activities performed on the land affect sediment that is transported downstream to the lakes. Physical components of the terrain are important in sediment movement. The slope of the land, the propensity to generate runoff and the soil type all contribute to the amount of sediment movement. Sediment can also come from streambank erosion and sloughing of the sides of the river and stream bank. A lack of riparian cover can cause washing on the banks of streams or rivers and enhance erosion. Animal movement, such as livestock that regularly cross the stream, can cause pathways that will erode. Another source of sediment is silt that is present in the stream from past flow events and is resuspended and may move downstream with each high intensity rainfall event.

5.1.1 Cropland Erosion

Cropland erosion BMPs have been targeted by the SLT along the valleys of both branches of the Fall River and both branches of Otter Creek. Most cropland in Fall River watershed is located in these areas. Causes of erosion are discussed in more detail in the rest of this section.

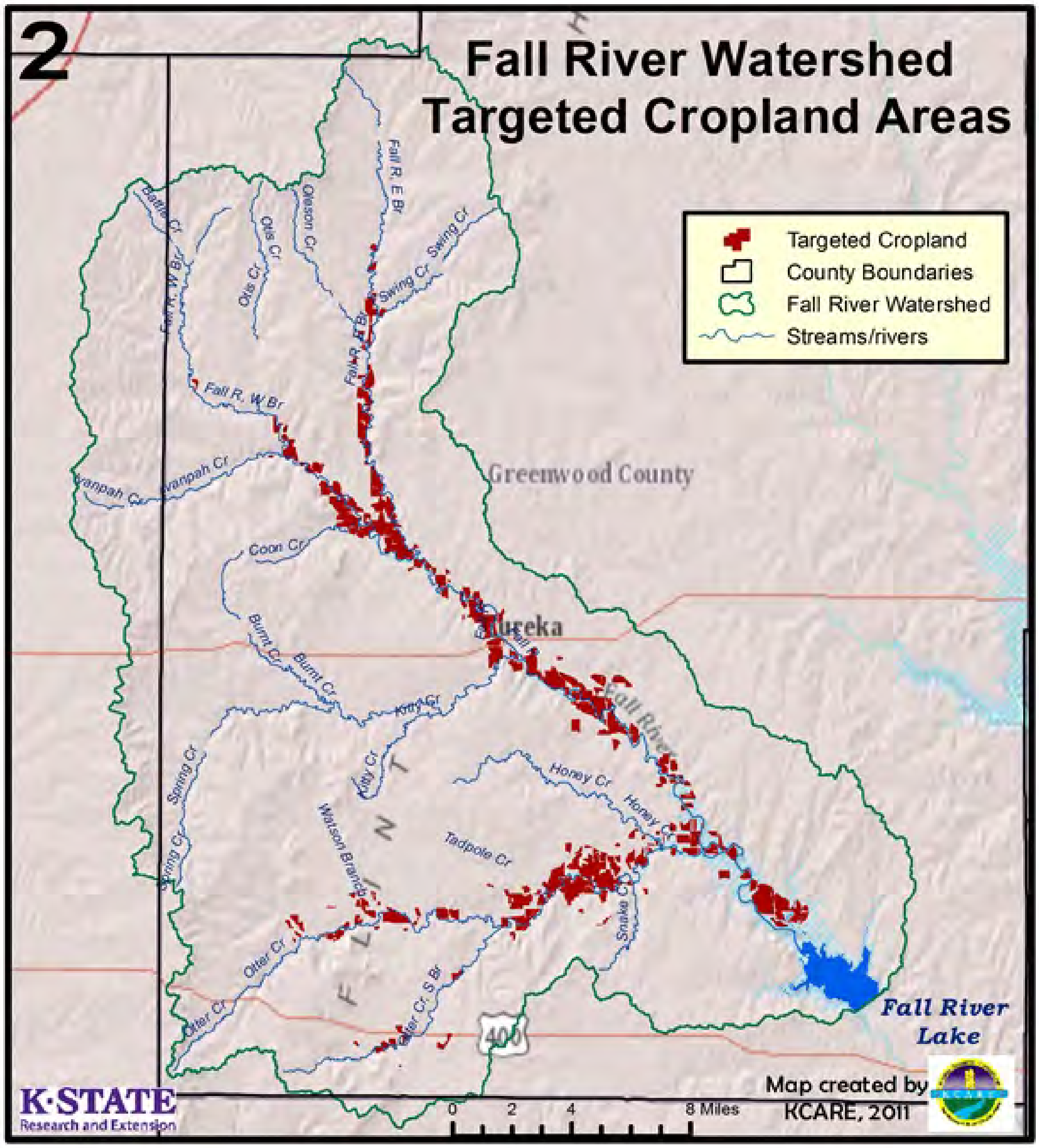


Figure 14 Targeted areas for cropland

5.1.1. A Soil erosion influenced by soil type and runoff potential

Soil type has an influence on runoff potential and erosion throughout the watershed. Soils are classified into four hydrologic soil groups (HSG). The soils within each of these groups have the same runoff potential after a rainfall event if the same conditions exist, such as plant cover or storm intensity. Soils are categorized into four groups: A, B, C and D. The cropland targeted area of the watershed is predominantly (79%) soil group C. This group has the second highest potential for runoff.

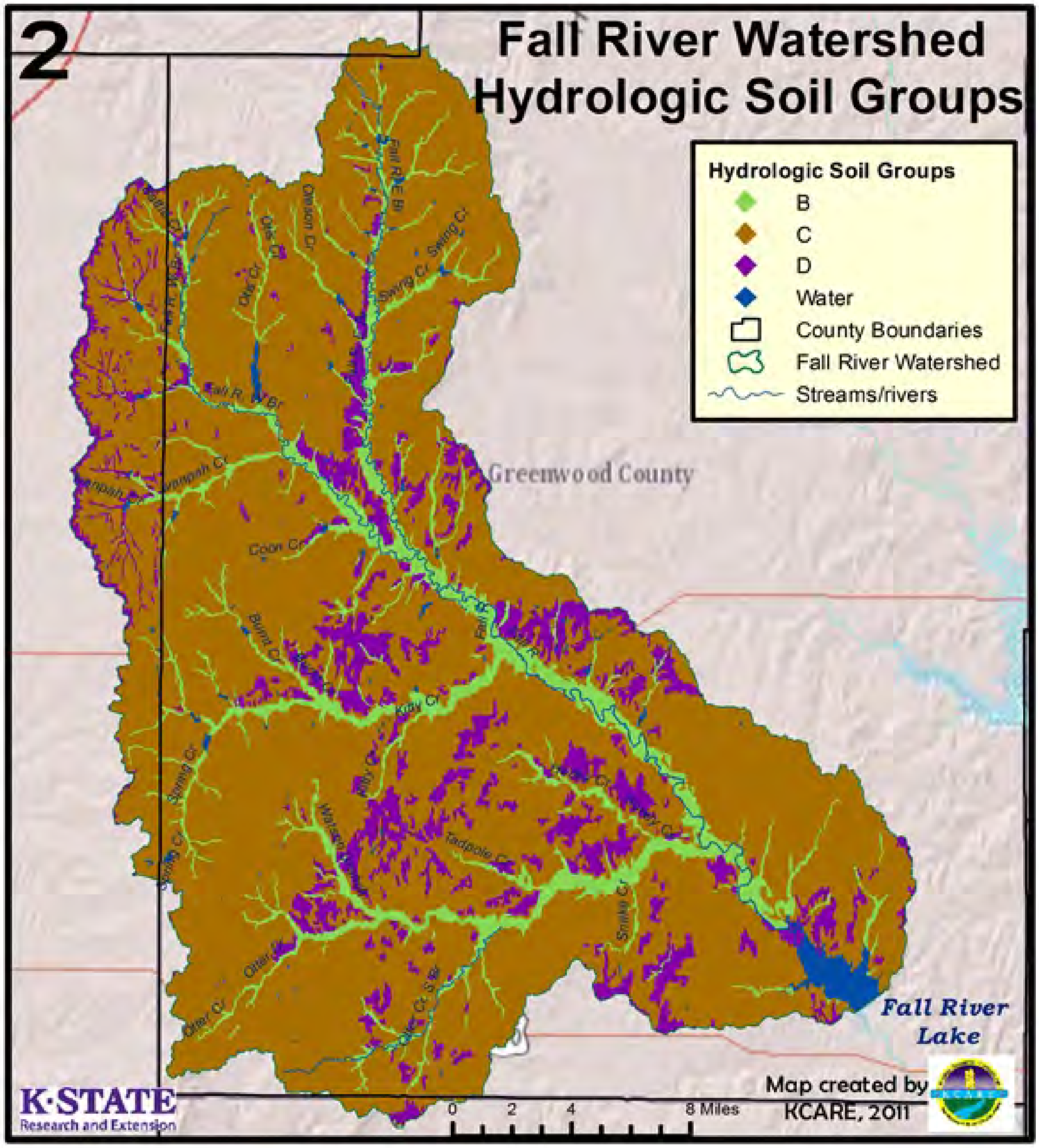


Figure 15 Hydrologic Soil Groups in Watershed [22]

Table 11 Hydrologic Soil Groups Table [23]

Hydrologic Soil Group	Definition	Acres of Watershed in HSG	Percentage of Watershed in HSG
A	Soils with low runoff potential. Soils having high infiltration rates even when thoroughly wetted and consisting chiefly of deep well drained to excessively well-drained sands or gravels.	0	0
B	Soils having moderate infiltration rates even when thoroughly wetted and consisting chiefly of moderately deep to deep, moderately well drained to sell drained soils with moderately fine to moderately coarse textures.	34,191	9.6
C	Soils having slow infiltration rates even when thoroughly wetted and consisting chiefly of soils with a layer that impedes downward movement of water, or soils with moderately fine to fine textures.	280,495	79.2
D	Soils with high runoff potential. Soils having very slow infiltration rates even when thoroughly wetted and consisting chiefly of clay soils with a high swelling potential, soils with a permanent high water table, soils with a clay pan or clay layer at or near the surface, and shallow soils over nearly impervious material.	34,948	9.9
Other	Water, dams, pits, sewage lagoons	7,732	1.3

5.1.2 Rangeland Erosion

Much of the rangeland erosion can be attributed to ephemeral gullies formed by livestock trails.

The SLT would like to repair these gullies to prevent further degradation. In addition to gullies, brine scar sites that originated with oil wells are a source of erosion. Drilling for oil and gas production has occurred in the watershed since the early 1900s. Much of this was done before regulations were developed by the Kansas Corporation Commission (KCC) to minimize pollution resulting from salt water used/generated in the drilling process. Disposal of the salt brine on the landscape was a common activity before regulations mandated proper disposal techniques. Due to excessive salt levels, plants cannot grow and thrive in the brine scar areas, leaving it exposed to erosion and runoff. This past unregulated activity has resulted in an unknown number of acres of the landscape that has barren soil. Hundreds of oil and gas wells exist in the watershed today. They are regulated by KCC and follow strict guidelines in disposal of salt brine into injection wells, therefore, the new wells do not pose a surface water pollutant hazard.

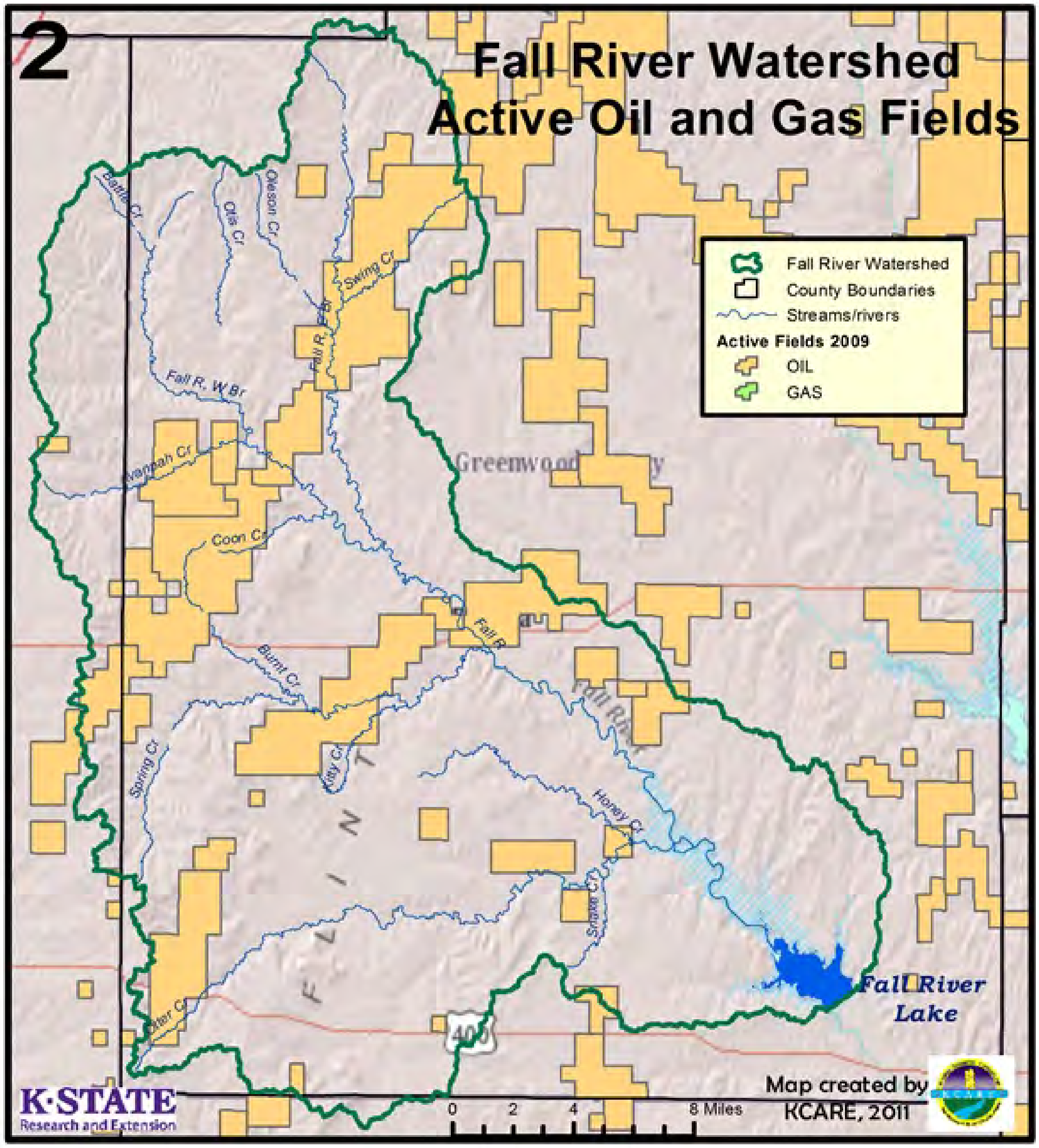


Figure 16 Active Oil and Gas Wells in Fall River Watershed [24]

The SLT is concerned about brine scars that exist in the watershed. These scars are non-vegetated areas that are susceptible to erosion and each individual scar will enlarge over time. Rehabilitation of these areas will require sloping and grading of the area, the addition of soil amendments and plantings of salt tolerant plants. A demonstration project has been conducted in the Fall River Watershed by the local WRAPS SLT which includes grading, addition of compost to the soil and salt tolerant plantings. Another demonstration brine scar project was installed just west of Climax, Kansas, with a water control structure. The purpose of the newest project is to observe whether a wetland can over time re-vegetate a salt scar.

5.1.3 Streambank Erosion

Sediment may also originate from stream channel and be resuspended during high flow events. A lack of riparian cover can cause washing on the banks of streams or rivers and enhance erosion.

Rainfall amounts and subsequent runoff can affect sediment delivery from agricultural areas and urban areas into streams and Fall River Reservoir. High rainfall events can cause cropland erosion, rangeland gully erosion and sloughing of streambanks. High intensity rainfall events usually occur in late spring and early summer.

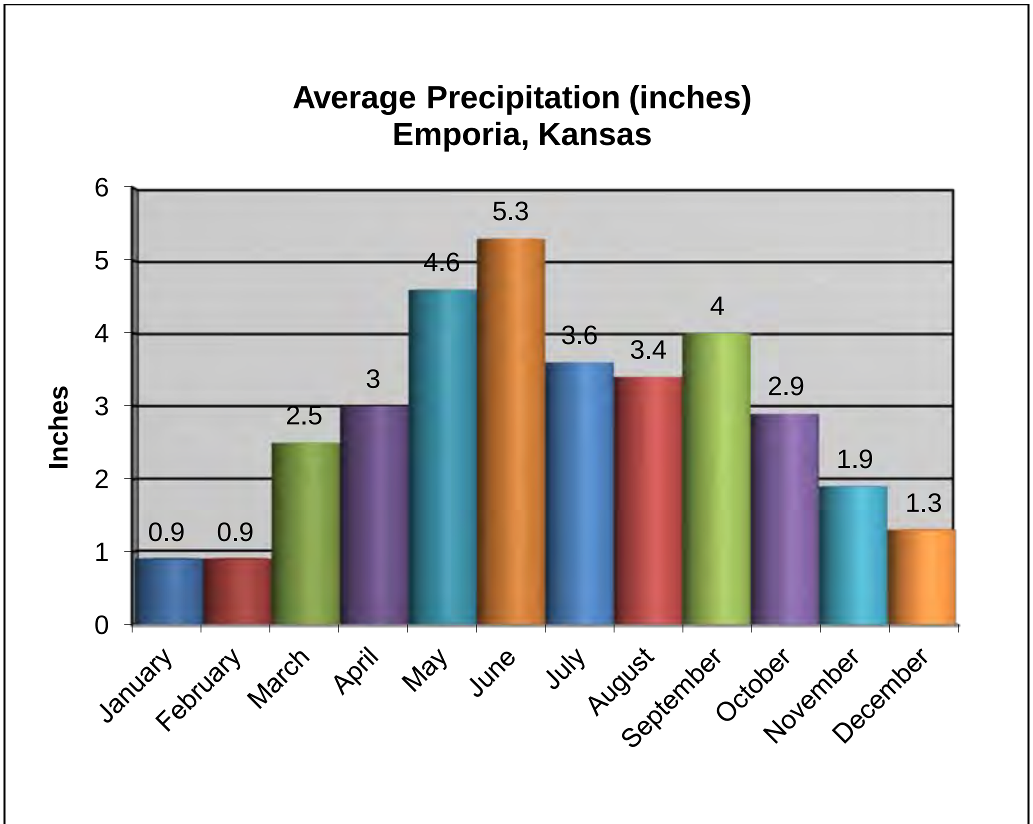


Figure 17 Average precipitations by month.[25] Emporia, Kansas.

Emporia rainfall statistics are used for Fall River watershed since that city has the nearest official rain gauge.

5.1.4 Sediment Pollutant Loads and Load Reductions

The current estimated Total Suspended Solids load in the Fall River Watershed is **163,800** tons per year according to the TMDL section of KDHE. The TMDL for TSS (WLA + load allocations + margin of safety) equals 100,200 tons. **Taking the current loading less the TMDL plus the margin of safety leaves 63,600 tons** of sediment per year that needs to be reduced in order to meet the TMDL. This is the amount of sediment reduction that will have to be met by implemented BMPs in the watershed.

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, rangeland and streambank targeted areas.** Specific acreages or projects that need to be implemented per year have been determined through modeling and economic analysis and approved by the SLT as listed.

Table 13 BMPs in Support of the Management Practices to Reduce Sediment Contribution Aimed at Meeting the Sediment TMDL in Fall River Reservoir.

Protection Measures	Best Management Practices and Other Actions	Acres or Projects to be Implemented
1.0 Prevention of sediment contribution from **cropland**	1.1 Establish riparian buffers along streams	20 acres per year
	1.2 Encourage no-till cultivation practice	200 acres per year
	1.3 Establish terraces and waterways	30 acres per year
	1.4 Build water retention structures	40 acres per year
	1.5 Establish wetlands	1 acres per year
	1.6 Establish vegetative buffers	75 acres per year
2.0 Prevention of sediment contribution from **rangeland**	2.1 Repair ephemeral gullies	20 acres per year
	2.2 Repair brine scar sites	20 acres per year
3. Prevention of sediment contribution from **streambank** erosion	3.1 Repair streambanks	1,250 feet of streambank per year

The table below lists the cropland BMPs and acres implemented with the associated load reductions attained by implementing all of these BMPs.

Table 14 Estimated Sediment Load Reductions for Implemented BMPs on Cropland Aimed at Meeting the Sediment TMDL in Fall River Reservoir.

Annual Soil Erosion Reduction (tons), Cropland BMPs							
Year	Terraces & Waterways	Riparian Buffers	Vegetative Buffers	Water Retention Structures	Wetlands	No-Till	Total Load Reduction
1	73	30	113	60	1	450	**726**
2	146	60	225	120	2	900	**1,452**
3	219	90	338	180	3	1,350	**2,179**
4	292	120	450	240	4	1,800	**2,905**
5	365	150	563	300	5	2,250	**3,631**
6	437	179	675	360	5	2,700	**4,357**
7	510	209	788	420	6	3,150	**5,083**
8	583	239	900	480	7	3,600	**5,810**
9	656	269	1,013	540	8	4,050	**6,536**
10	729	299	1,125	600	9	4,500	**7,262**
11	802	329	1,238	660	10	4,950	**7,988**
12	875	359	1,350	720	11	5,400	**8,714**
13	948	389	1,463	780	12	5,850	**9,441**
14	1,021	419	1,575	840	13	6,300	**10,167**
15	1,094	449	1,688	900	14	6,750	**10,893**
16	1,166	479	1,800	960	14	7,200	**11,619**
17	1,239	508	1,913	1,020	15	7,650	**12,346**
18	1,312	538	2,025	1,080	16	8,100	**13,072**
19	1,385	568	2,138	1,140	17	8,550	**13,798**
20	1,458	598	2,250	1,200	18	9,000	**14,524**

The table below lists the sediment load reductions attained by implementing all of the rangeland BMPs.

Table 15 Estimated Sediment Load Reductions for Implemented BMPs on Rangeland Aimed at Meeting the Sediment TMDL in Fall River Reservoir.

Annual Rangeland BMP Erosion Reduction (tons per year)			
Year	**Repair Grazing Land Gullies**	**Brine Site Repair**	**Total**
1	100	25	**125**
2	200	50	**250**
3	300	75	**375**
4	400	100	**500**
5	500	125	**625**
6	600	150	**750**
7	700	175	**875**
8	800	200	**1,000**
9	900	225	**1,125**
10	1,000	250	**1,250**
11	1,100	275	**1,375**
12	1,200	300	**1,500**
13	1,300	325	**1,625**
14	1,400	350	**1,750**
15	1,500	375	**1,875**
16	1,600	400	**2,000**
17	1,700	425	**2,125**
18	1,800	450	**2,250**
19	1,900	475	**2,375**
20	2,000	500	**2,250**

The table below lists the sediment load reductions attained by implementing streambank BMPs.

Table 16 Sediment Load Reductions for Implemented Streambank BMPs Aimed at Meeting the Sediment TMDL in Fall River Reservoir.

Year	Streambank* Reduction (tons per year)
1	2,375
2	4,750
3	7,125
4	9,500
5	11,875
6	14,250
7	16,625
8	19,000
9	21,375
10	23,750
11	26,125
12	28,500
13	30,875
14	33,250
15	35,625
16	38,000
17	40,375
18	42,750
19	45,125
20	47,500

**Assume 1.9 tons per year per linear foot of degraded streambank.*

The table below shows the combined load reduction for sediment that is attained by implementing all cropland, rangeland, gully, brine site and streambank BMPs annually. The percent of TMDL achievement is illustrated in the right column. At the end of twenty years, if all BMPs are implemented, the Fall River Reservoir Sediment TMDL will be reached.

Table 17 Combined Cropland, Brine Site, Rangeland Gully and Streambank Sediment Reductions Aimed at Meeting the Sediment TMDL in Fall River Reservoir in Twenty Years.

Combined Cropland, Brine Site, Rangeland Gully and Streambank Sediment Reductions Aimed at Meeting the Sediment TMDL in Fall River Reservoir						
Year	Streambank Reduction (tons)	Cropland Reduction (tons)	Brine Site Repair (tons)	Rangeland Gully Repair (tons)	Total Reduction (tons)	% of TMDL
1	2,375	726	25	100	3,226	5%
2	4,750	1,452	50	200	6,452	10%
3	7,125	2,179	75	300	9,679	15%
4	9,500	2,905	100	400	12,905	20%
5	11,875	3,631	125	500	16,131	25%
6	14,250	4,357	150	600	19,357	30%
7	16,625	5,083	175	700	22,583	36%
8	19,000	5,810	200	800	25,810	41%
9	21,375	6,536	225	900	29,036	46%
10	23,750	7,262	250	1,000	32,262	51%
11	26,125	7,988	275	1,100	35,488	56%
12	28,500	8,714	300	1,200	38,714	61%
13	30,875	9,441	325	1,300	41,941	66%
14	33,250	10,167	350	1,400	45,167	71%
15	35,625	10,893	375	1,500	48,393	76%
16	38,000	11,619	400	1,600	51,619	81%
17	40,375	12,346	425	1,700	54,846	86%
18	42,750	13,072	450	1,800	58,072	91%
19	45,125	13,798	475	1,900	61,298	96%
20	47,500	14,524	500	2,000	64,524	101%
Load Reduction to meet Sediment TMDL:						**63,600**

Table18 Annual Sediment Load Reduction by Category Aimed at Meeting the Sediment TMDL in Fall River Reservoir.

Best Management Practice Category	Total Annual Load Reduction (tons)	Percent of Sediment TMDL
Cropland (acres)	14,524	23%
Brine Sites	500	1%
Gullies	2,000	3%
Streambank (feet)	47,500	75%
	64,524	**101%**

Refer to Section 7, "Costs of BMP Implementation" for specific BMP costs in order to meet the TMDL.

5.2 Livestock Related Pollutants

Livestock can cause certain pollutants in the water. E. coli bacteria are present in livestock manure and can be transported into waterways if livestock have access to streams. Nutrients, primarily phosphorus, are also present in manure. Soluble phosphorus can easily be transported in runoff from fields where livestock gather. Other nutrient issues can arise from fertilizers. Nitrogen and phosphorus can originate from fertilizer runoff caused by either excess application or a rainfall event immediately after application. ***It must be noted that not all E. coli bacteria can be attributed to livestock. Wildlife has a contribution to E. coli loads. In addition, failing septic systems can be a source of E. coli bacteria from humans. A similar notation is that not all phosphorus and nitrogen contributions can be attributed to agricultural practices. Excess fertilization of lawns, golf courses and urban areas can easily transport nitrogen and phosphorus downstream. However, for this WRAPS process, targeting will be for livestock.***

5.2.1 E. coli Bacteria

The Fall River near Climax is listed on the 303d list **E. coli bacteria**. Fecal coliform bacteria (FCB) are a broad spectrum of bacteria species which includes E. coli bacteria. Since FCB is present in the digestive tract of all warm blooded animals including humans and animals (domestic and wild), its presence in water indicates that the water has been in contact with human or animal waste. FCB is not itself harmful to humans, but its presence indicates that disease causing organisms, or pathogens, may also be present. A few of these are Giardia, Hepatitis, and Cryptosporidium. In the past, KDHE has measured FCB in determination of issuance of a TMDL. Currently, however, KDHE is transitioning to the use of E. coli bacteria as it is a more reliable indicator of human health risk. Consequently, the new methodology for assessing E. coli bacteria levels in waterbodies requires the average of five samples taken over a month's time to exceed the criteria level. This is much more stringent than the former FCB methodology which required a single exceedance to indicate impairment. Presence of E. coli in waterways can originate from failing septic systems, runoff from livestock production areas, close proximity of any mammals to water sources, and manure application to agricultural fields.

E. coli can originate in both rural and urban areas. It can be caused by both point and nonpoint sources. Urban sources could include pet waste, public waste water treatment plants. Failing onsite wastewater systems, manure runoff from livestock operations, improper manure disposal and livestock or wildlife access to streams can contribute to FCB in streams.

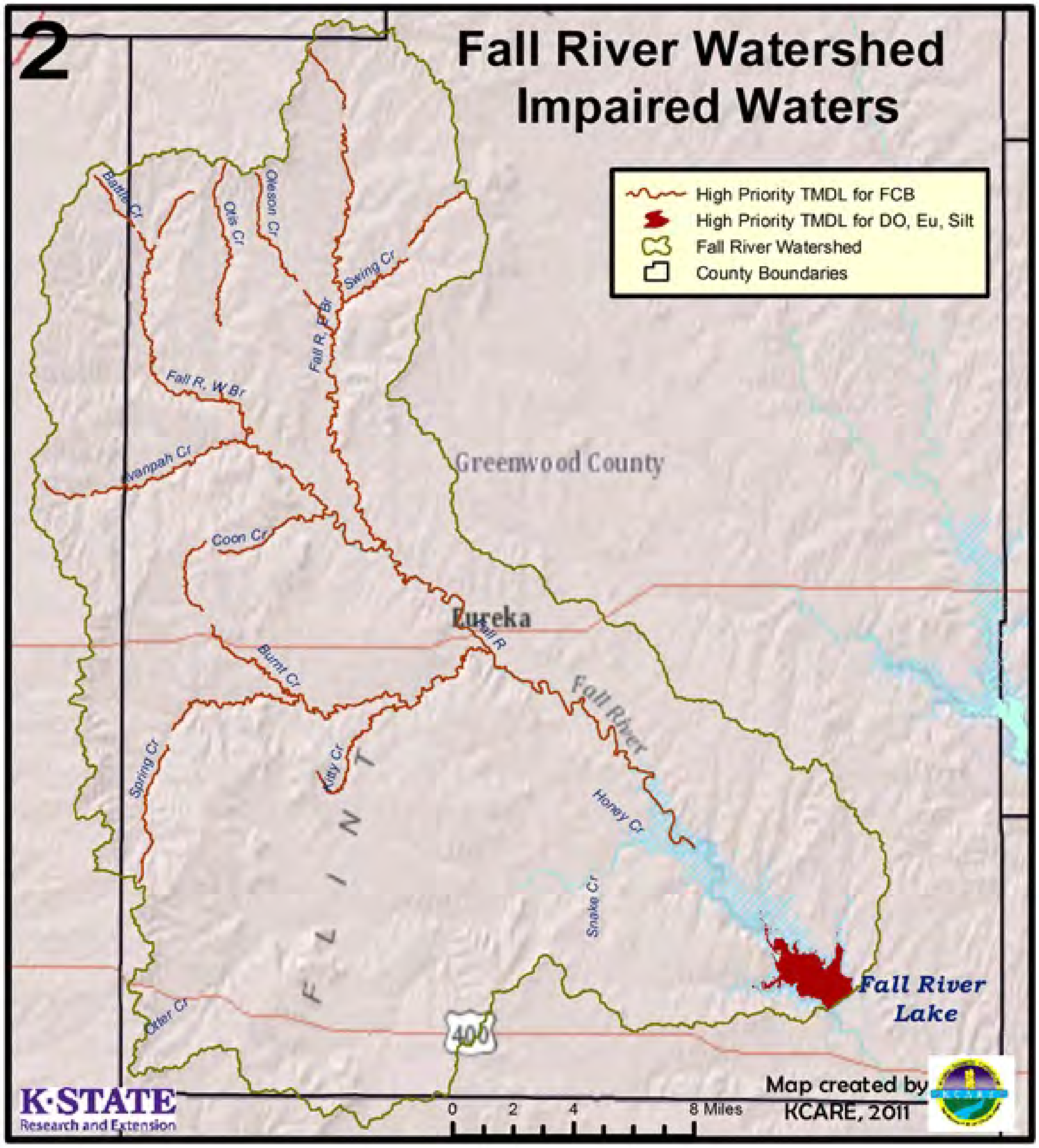


Figure 18 Impaired Waters of Fall River Watershed [26]

5.2.1.A Manure Runoff from Fields and Livestock Operations

In Kansas, animal feeding operations (AFOs) with greater than 300 animal units must register with KDHE. Confined animal feeding operations (CAFOs), those with more than 999 animal units, must option a federal NPDES permit with KDHEbe permitted with EPA. An animal unit or AU is an equal standard for all animals based on size and manure production. For example: 1 AU=one animal weighing 1,000 pounds. The watershed contains several CAFOs. (This data is derived from KDHE, 2003. It may be dated and subject to change). CAFOs are not allowed to release manure from the operation. However, they are allowed to spread manure on cropland fields for distribution. If this application is followed by a rainfall event or the manure is applied on frozen ground, it can run off into the stream. Smaller operations are not regulated by the state. Many of these operations are located along streams because of historic preferences by early settlers. Movement of feeding sites away from the streams and providing alternate watering sites is logistically important to prevention of FCB entering the stream. Grazing density is an important factor in manure runoff due to the common practice of cattle loafing in ponds and streams during the hot summer months and frequently defecating directly into the water source.

Courtesy of Luke Westerman

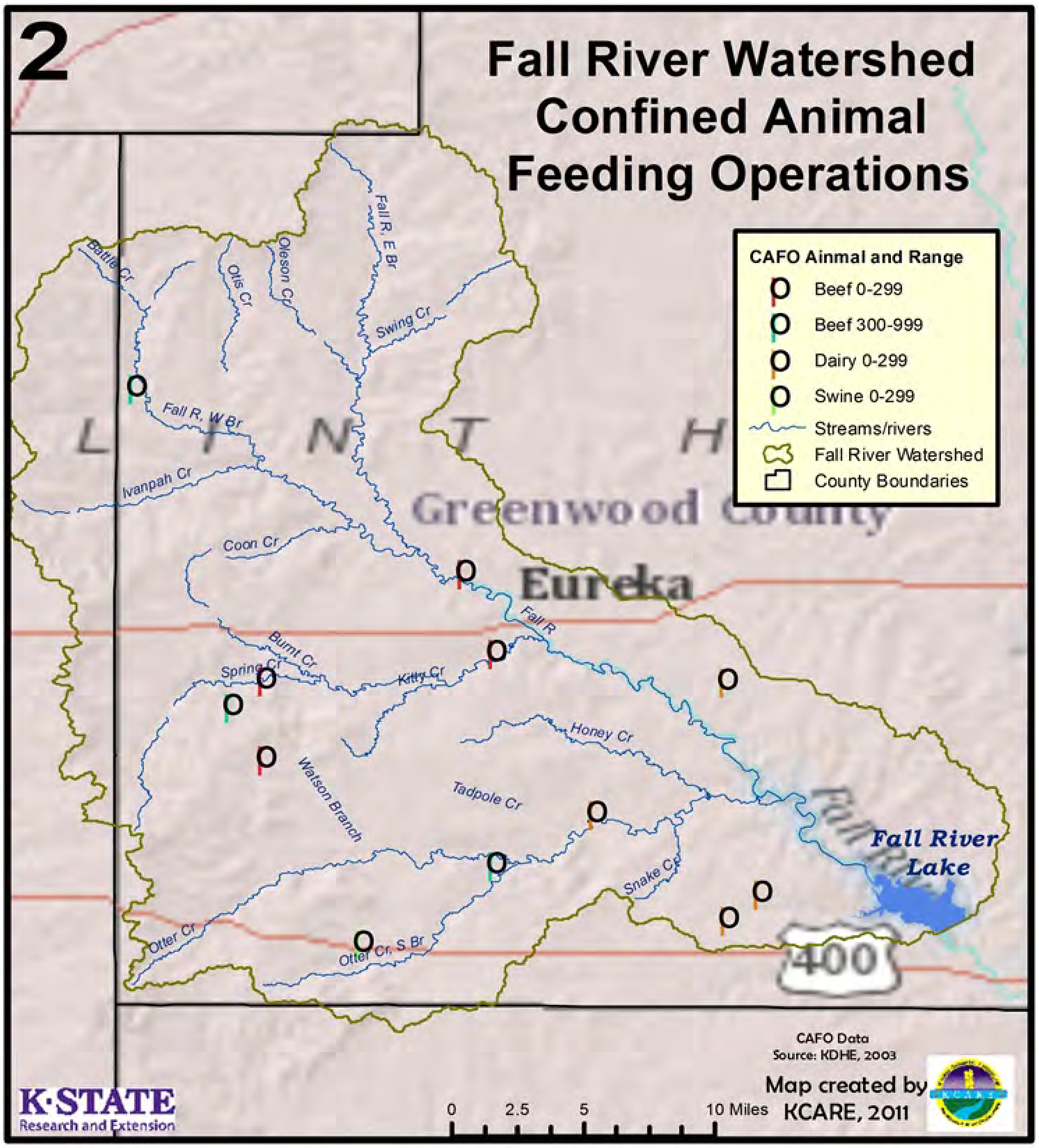


Figure 19 Confined Animal Feeding Operations in the Watershed [27]

5.2.1.B Land Use and Manure Transport

Livestock production areas are a source of FCB even though manure generated by any mammal can contain FCB. Livestock that are housed in close proximity to a stream or allowed to loaf in the water source can shed FCB. Wild animals are also contributors in streams and lakes. However, the wild animal population is not as easily controlled as limiting livestock from water sources. Alternative water supplies allow the livestock to have access to fresh water while limiting the time they spend in surrounding areas. This not only reduces FCB, but provides a clean drinking water source. Manure runoff from grasslands close to waterways can add to FCB in the waterways. The SLT has chosen to target high livestock areas for manure BMPs. The primary land use in the range and livestock targeted areas is pasture (86.5 percent).

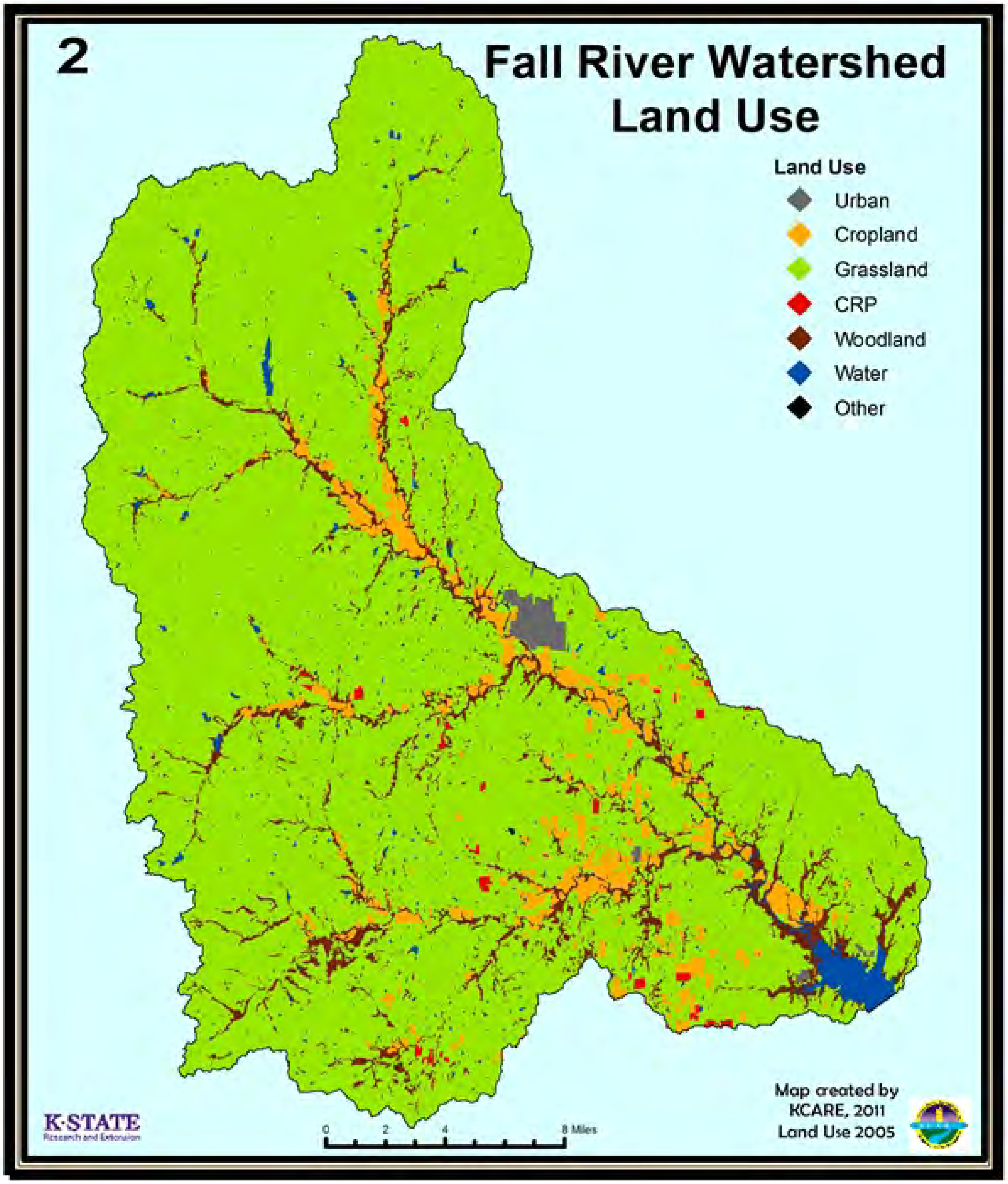


Figure 20 Land Use Map [28]

Table 19 Land Use in the Range and Livestock Targeted Area. [29]

HUC 12	Urban Industrial/ Commercial	Urban Residential	Urban Openland	Urban Woodland	Cropland	Grassland	CRP	Woodland	Water	Other	**Total**
110701020106	0	0	0	0	332	24667	20	1192	345	0	**26555**
110701020202	0	0	0	0	435	20619	140	1512	187	0	**22893**
110701020107	0	0	0	0	849	24044	201	1696	266	0	**27055**
110701020205	0	0	0	0	1703	17038	19	2294	583	0	**21637**
110701020204	0	19	61	2	1511	15566	192	1676	180	0	**19207**
110701020103	0	0	0	0	141	35088	0	904	536	0	**36668**
110701020206	11	63	75	8	804	13202	240	1604	2242	4	**18252**
110701020104	0	0	0	0	1351	31811	3	1484	334	0	**34982**
110701020201	0	0	0	0	586	27330	0	2763	297	0	**30976**
110701020102	0	0	0	0	1507	16953	47	1194	218	0	**19920**
110701020203	0	0	0	0	3177	19503	185	1996	252	19	**25132**
110701020108	209	227	257	5	3130	18477	143	1681	483	0	**24612**
110701020101	0	0	0	0	192	29695	5	674	292	0	**30857**
110701020105	157	422	473	22	891	12284	19	904	302	0	**15474**
Total	**377**	**730**	**866**	**36**	**16610**	**306274**	**1212**	**21574**	**6518**	**23**	**354220**
Area	***0.1%***	***0.2%***	***0.2%***	***0.0%***	***4.7%***	***86.5%***	***0.3%***	***6.1%***	***1.8%***	***0.0%***	***100.0%***

5.2.1.C Population and Wastewater Systems

Failing, improperly installed or lack of an onsite wastewater system can contribute FCB to the watershed. There is no way of knowing how many failing or improperly constructed systems exist in the watershed. Thousands of onsite wastewater systems may exist in this watershed and the functional condition of these systems is generally unknown. However, best guess would be that twenty percent of the wastewater systems in the watershed are insufficient or nonexistent. Therefore, the exact number of systems is directly tied to population.

Most of the watershed would be considered low population. The Kansas average for persons per square mile is 32.9, whereas, the average for the watershed is 7.2.

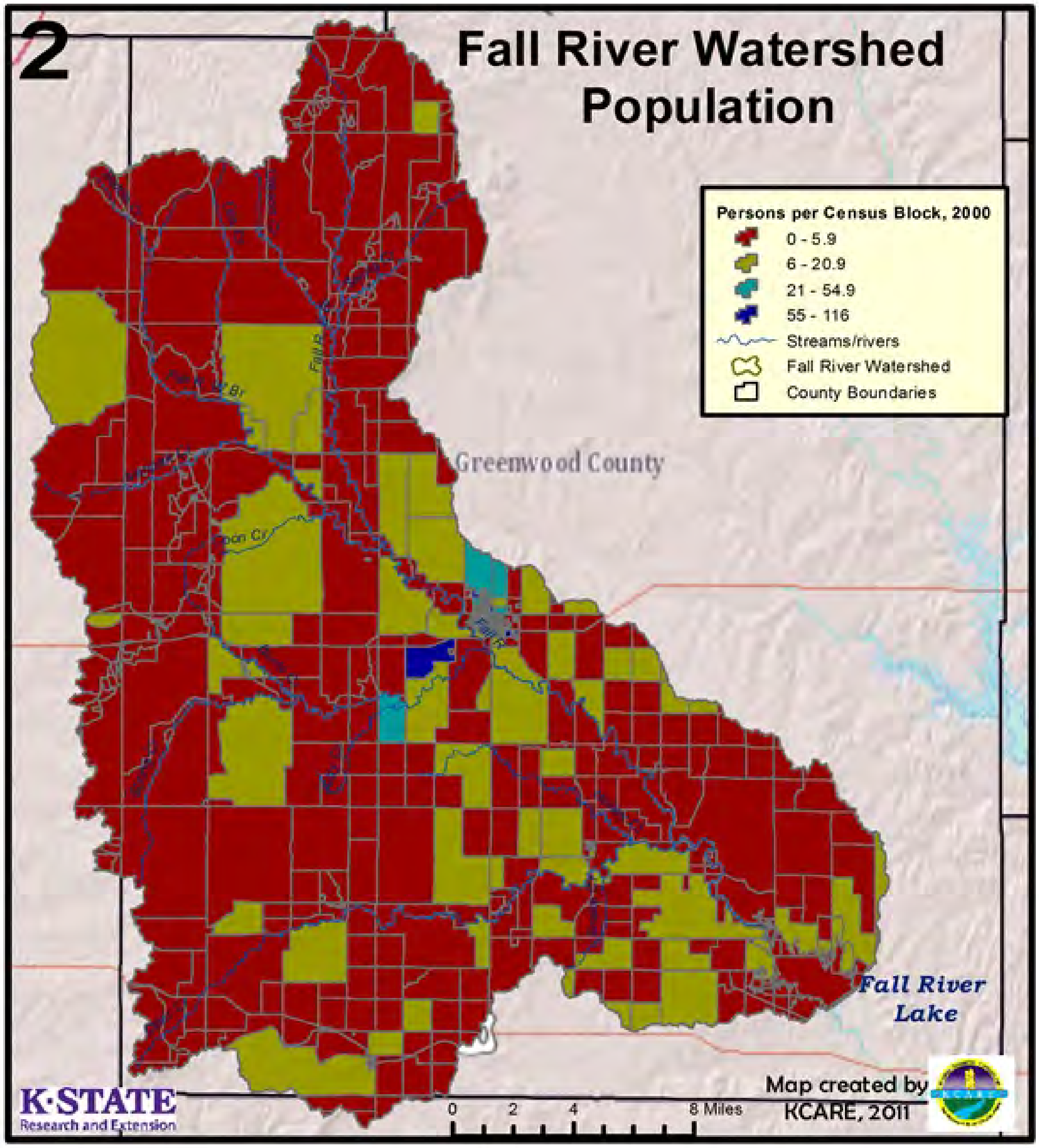


Figure 21 Census Count, 2000.[30]

5.2.1.D Rainfall and Runoff

Rainfall amounts and subsequent runoff along with flooding outside the stream channel can affect FCB concentrations in rivers and Fall River Reservoir. Manure in streams can originate from livestock that are allowed access to wade or loaf directly in the stream. Manure from cropland can originate from fields where the manure that has been applied either before a rainfall event or on frozen ground. Manure and livestock management is important in preventing FCB or phosphorus runoff from the targeted area.

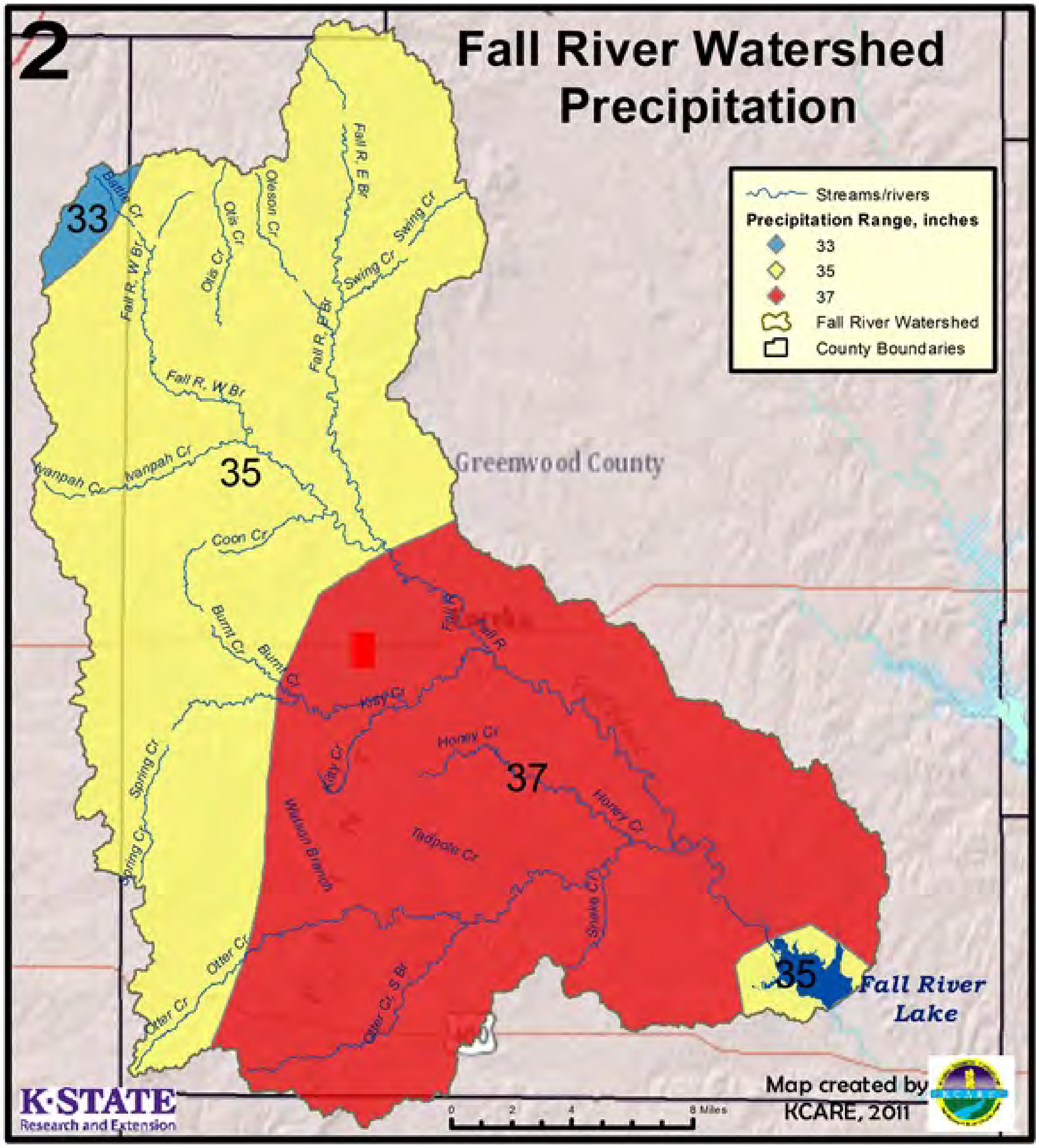


Figure 22 Average Yearly Precipitation in the Watershed.[31]

5.2.1.E Pollutant Load and Load Reduction

The current pollutant load for E. coli bacteria cannot be estimated. E. coli concentrations are difficult to model. The scope of this WRAPS project does not include modeling for E. coli bacteria. Environmental factors affect the viability of the bacteria since it is a living organism. The fate of E. coli is affected by variations in initial bacteria loading, ambient temperature, amount of sunlight or UV rays, and a decrease in survivability over time are all factors that affect the viability of FCB. All FCB BMPs are grouped with phosphorus targeted BMPs.

The BMPs delineated by the SLT for phosphorus, discussed in the next section, will reduce FCB simultaneously.

5.2.2 Nutrients

Fall River Reservoir has a TMDL for low **dissolved oxygen**. Dissolved oxygen is related to other pollutant issues: eutrophication, biological oxygen demand, excessive aquatic plants and pH.

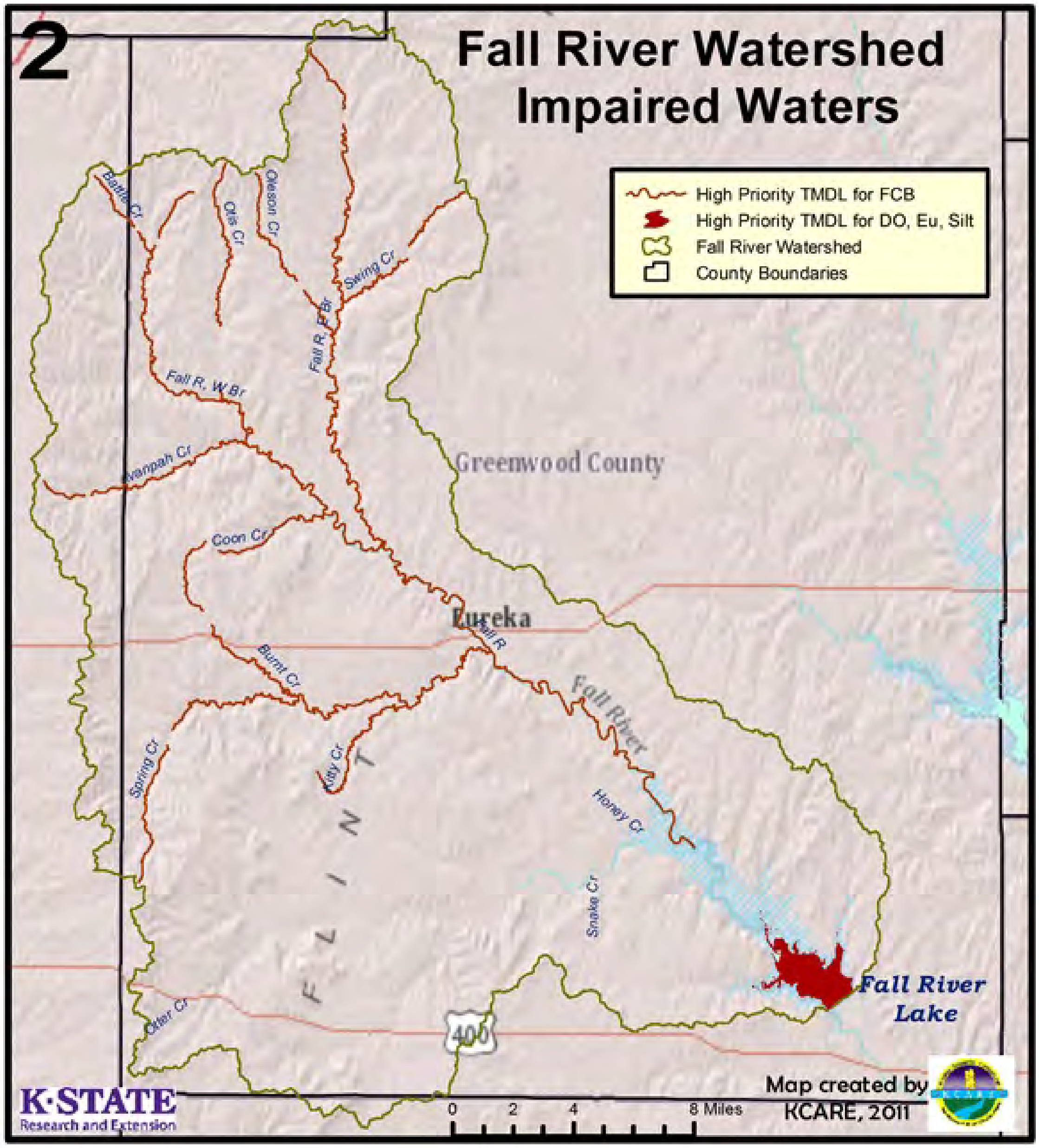


Figure 23 Dissolved Oxygen TMDLs in the Watershed, 2006. [32]

Eutrophication is a natural process that occurs when a water body receives excess nutrients. These excess nutrients, primarily nitrogen and phosphorus, create optimum conditions that are favorable for algal blooms and plant growth. Fall River Reservoir has a TMDL for eutrophication. Proliferation of algae and subsequent decomposition depletes available dissolved oxygen in the water profile. This lack of oxygen is devastating for aquatic species and can lead to fish kills. Fall River Reservoir has a TMDL for low dissolved oxygen. Desirable criteria for a healthy water profile include dissolved oxygen rates greater than 5 milligrams per liter and biological oxygen demand (BOD) less than 3.5 milligrams per liter. BOD is a measure of the amount of oxygen removed in water while stabilizing biodegradable organic matter. It can be used to indicate organic pollution levels. Excess nutrients can originate from failing septic systems and manure and fertilizer runoff in rural and urban areas.

An excess in nutrients can be caused by any land practice that will contribute to nitrogen or phosphorus in surface waters. Examples are (but not limited to):

- Fertilizer runoff from agricultural and urban lands,
- Manure runoff from domestic livestock and wildlife in close proximity to streams and rivers,
- Failing septic systems, and
- Phosphorus recycling from lake sediment as sediment bound phosphorus is slowly released.
- Streambank Erosion

Activities performed on the land affects nutrient loading in the lakes of the watershed. Land use in this watershed is primarily agricultural related; therefore, agricultural BMPs are necessary for reducing nitrogen and phosphorus. Some examples of nitrogen and phosphorus BMPs include:

- Soil sampling and appropriate fertilizer recommendations,
- Minimum and no-till farming practices,
- Filter and buffer strips installed along waterways,
- Reduce contact to streams from domestic livestock,
- Develop nutrient management plans for manure management, and
- Replace failing septic systems.
- Streambank repair

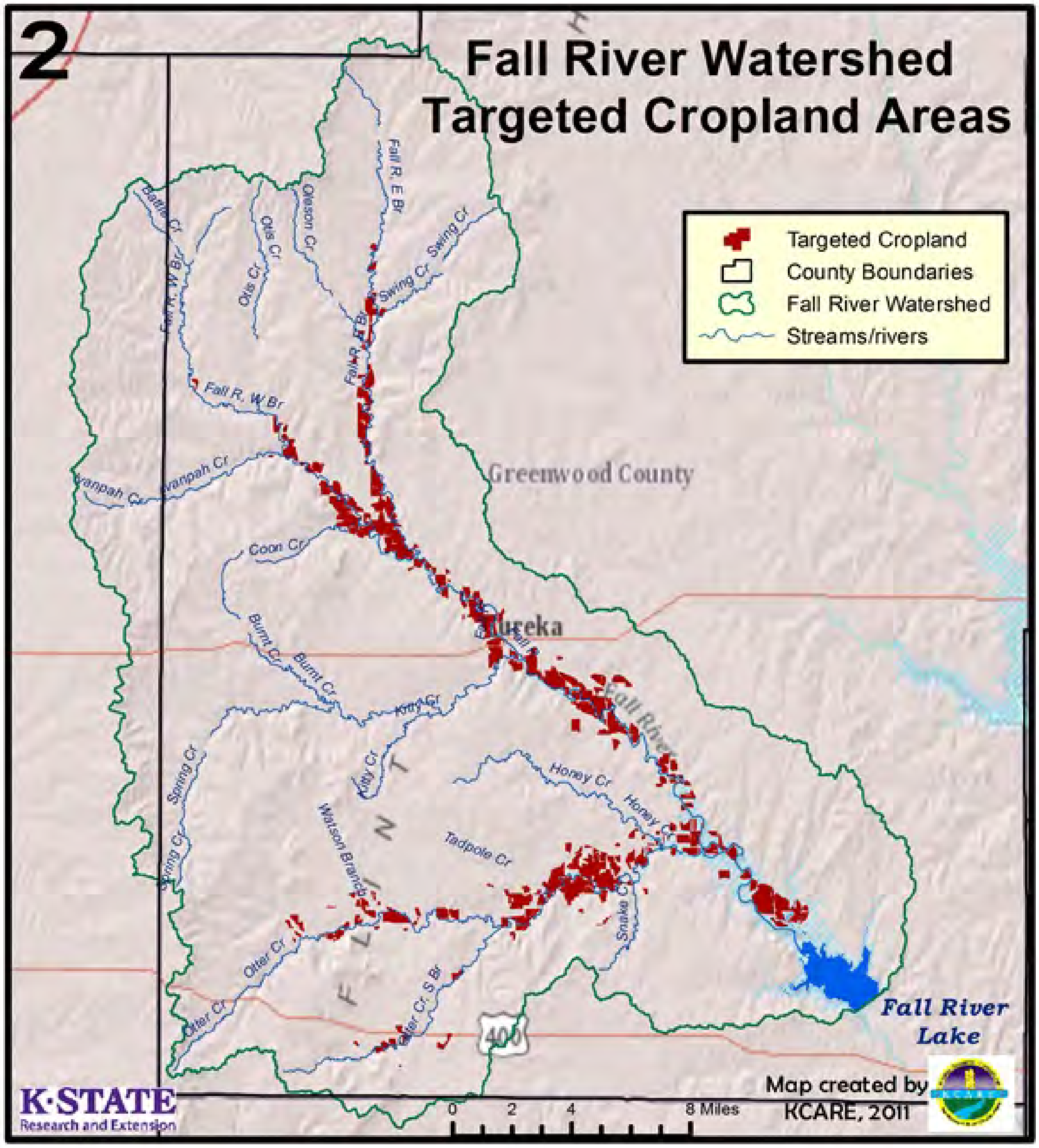


Figure 24 Cropland Target Areas

5.2.2.A Population and Onsite Wastewater Facilities

Population has an effect on the number of onsite wastewater system failures. Older systems or systems that are not functioning properly can leak nitrogen and phosphorus into surface water or ground water. Best guess is that twenty percent of all wastewater systems are either failing or inadequate. Therefore, tracking population is important when considering remediation measures for nutrient loading. The watershed has seen a decrease in population in the counties that it occupies. Population in the counties of the watershed (excluding the city of Emporia which is not located in the watershed) is 19,039 (according to the US Census Bureau, population estimate 2008). This represents a 10.5 percent decrease in population across the watershed from 2000 to 2008. Additionally, population density is much lower than the statewide average of 32.9 persons per square mile. The population density of the counties of the watershed (excluding Emporia) is 7.2 persons per square mile. Refer to Section 5.2.1.C.

5.2.2.B Grazing Density

Grasslands consist of approximately 88 percent of the watershed. This area is a highly productive forage source for beef cattle. Grazing density will affect grass cover and potential manure runoff. Overgrazing will decrease the grass cover that slows down runoff and allows nutrients to drop out, thus allowing more manure to reach a stream or pond.

5.2.2.C Concentrated Animal Feeding Operations

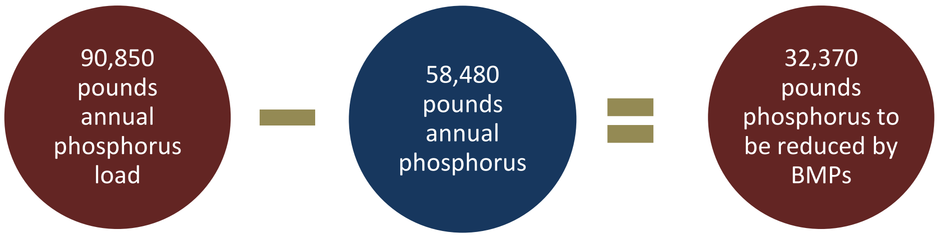
In Kansas, animal feeding operations (AFOs) with greater than 300 animal units must register with KDHE. Confined animal feeding operations (CAFOs), those with more than 999 animal units, must obtain a federal permit through KDHE. An animal unit or AU is an equal standard for all animals based on size and manure production. For example: 1 AU=one animal weighing 1,000 pounds. The watershed contains numerous CAFOs. (This data is derived from KDHE, 2003. It may be dated and subject to change). Number of and location of CAFOs is important in nutrient reduction because of the manure that is generated and must be disposed of by the CAFOs. Most farmers haul manure to cropland and incorporate it to be used as fertilizer for the crops. However, due to hauling costs, fields close to the feedlot tend to receive more manure over the course of time than fields that are at a more distant location. These close fields will have a higher concentration of soil phosphorus and therefore, a higher incidence of runoff potential as phosphorus can be attached to the soil particles. Prevention of erosion is a part of reduction of phosphorus in surface water. Refer to Section 5.2.1.A.

5.2.2.D Rainfall and Runoff

Rainfall amounts and subsequent runoff can affect nutrient runoff from agricultural areas and urban areas into streams and lakes. Manure runoff from livestock that are allowed access to stream or manure applied before a rainfall or on frozen ground is affected by the amount and timing of rainfall events. Refer to Section 5.2.1.D.

5.2.3 Pollutant Loads and Load Reductions

All BMPs for phosphorus, nitrogen and E. coli bacteria will be expressed with a focus on phosphorus only. Sampling for phosphorus improvements in water quality is currently being monitored and changes in concentrations will be determined. All phosphorus BMPs will have a positive effect on E. coli bacteria and nitrogen concentrations



The current estimated phosphorus load in the Fall River Watershed s **90,850 pounds** per year according to the TMDL section of KDHE. **Taking the current loading less the TMDL plus the margin of safety leaves 32,370 pounds** of phosphorus per year that needs to be reduced in order to meet the TMDL. This is the amount of phosphorus reduction that will have to be met by implemented BMPs in the watershed.

It is to be noted that the phosphorus related BMPs also support the E. coli bacteria and sediment TMDLs. The SLT has laid out specific BMPs that they have determined will be acceptable to watershed residents. **These BMPs will be implemented in the livestock and rangeland, cropland and streambank targeted areas.** Implementation of these BMPs is necessary to meet the required load reduction. These BMPs are listed in the table below. The acres and number of projects needed annually have been approved by the SLT.

Table 20 BMPs in Support of the Management Practices Aimed at Meeting the Eutrophication and Dissolved Oxygen TMDLs in Fall River Reservoir.

Protection Measures	Best Management Practices and Other Actions	Number of Acres or Projects to be Installed
1.0 Prevention of phosphorus contribution from **livestock** sources	1.1 Relocate Feeding Pens	10 sites
	1.2 Grazing Management Plans	60 sites
	1.3 Relocate pasture feeding sites	20 sites
	1.4 Provide off-stream watering systems	100 sites
2.0 Prevention of phosphorus contribution from **cropland**	2.1 Establish riparian buffers	20acres per year
	2.2 Encourage no-till cultivation practice	200 acres per year
	2.3 Establish terraces and waterways	30 acres per year
	2.4 Establish vegetative buffers	75acres per year
	2.5 Establish water retention structures	40 acres per year
	2.6 Establish wetlands	1 acre per year
3.0 Prevention of phosphorus contribution from **streambank** erosion	3.1 Repair streambank	1,250 feet per year
4.0 Prevention of phosphorus contribution from **rangeland**	4.1 Repair ephemeral gullies	20 sites per year
	4.2 Repair brine scar sites	20 sites per year

The table below lists the livestock BMPs and the associated phosphorus load reductions attained by implementing all of these BMPs.

Table 21 Estimated Phosphorous Load Reductions for Implemented Livestock BMPs Aimed at Meeting the Eutrophication and Dissolved Oxygen TMDLs in Fall River Reservoir.

Annual Phosphorous Load Reduction(Pounds), Livestock BMPs					
Year	Relocate Feeding Pens	Relocate Pasture Feeding Site	Off-Stream Watering System	Grazing Mgmt Plans	Total
1	638	60	298	843	1,839
2	1,276	119	596	1,686	3,677
3	1,914	179	895	2,529	5,516
4	2,552	239	1,193	3,372	7,355
5	3,189	298	1,491	4,215	9,194
6	3,827	358	1,789	5,058	11,032
7	4,465	417	2,087	5,901	12,871
8	5,103	477	2,386	6,744	14,710
9	5,741	537	2,684	7,587	16,549
10	6,379	596	2,982	8,430	18,387
11	7,017	656	3,280	9,273	20,226
12	7,655	716	3,578	10,116	22,065
13	8,292	775	3,877	10,959	23,903
14	8,930	835	4,175	11,802	25,742
15	9,568	895	4,473	12,645	27,581
16	10,206	954	4,771	13,488	29,420
17	10,844	1,014	5,070	14,331	31,258
18	11,482	1,074	5,368	15,174	33,097
19	12,120	1,133	5,666	16,017	34,936
20	12,758	1,193	5,964	16,860	36,774

The table below lists the cropland BMPs and associated phosphorus load reductions attained by implementing all of these BMPs.

Table 22 Estimated Phosphorus Load Reductions for Implemented Cropland BMPs Aimed at Meeting the Eutrophication and Dissolved Oxygen TMDLs in Fall River Reservoir.

Annual Phosphorus Reduction (pounds), Cropland BMPs							
Year	Terraces & Waterways	Riparian Buffers	Vegetative Buffers	Water Retention Structures	Wetlands	No-Till	Total Load Reduction
1	39	22	82	44	1	174	**361**
2	78	43	164	87	1	349	**723**
3	118	65	245	131	2	523	**1,084**
4	157	87	327	174	3	698	**1,446**
5	196	109	409	218	3	872	**1,807**
6	235	130	491	262	4	1,046	**2,168**
7	275	152	572	305	5	1,221	**2,530**
8	314	174	654	349	5	1,395	**2,891**
9	353	196	736	392	6	1,570	**3,252**
10	392	217	818	436	7	1,744	**3,614**
11	432	239	899	480	7	1,918	**3,975**
12	471	261	981	523	8	2,093	**4,337**
13	510	283	1,063	567	9	2,267	**4,698**
14	549	304	1,145	610	9	2,442	**5,059**
15	589	326	1,226	654	10	2,616	**5,421**
16	628	348	1,308	698	10	2,790	**5,782**
17	667	369	1,390	741	11	2,965	**6,143**
18	706	391	1,472	785	12	3,139	**6,505**
19	746	413	1,553	828	12	3,314	**6,866**
20	785	435	1,635	872	13	3,488	**7,228**

The table below lists the streambank phosphorus load reductions attained by implementing streambank restoration BMPs.

Table 23 Estimated Phosphorus Load Reductions for Implemented Streambank BMPs Aimed at Meeting the Eutrophication and Dissolved TMDs in Fall River Reservoir.

Year	Streambank Repair Reduction* (lbs/yr)
1	143
2	285
3	428
4	570
5	713
6	855
7	998
8	1,140
9	1,283
10	1,425
11	1,568
12	1,710
13	1,853
14	1,995
15	2,138
16	2,280
17	2,423
18	2,565
19	2,708
20	2,850

*Assume average Phosphorous content in floodplain soil is 20 ppm.

The table below lists the rangeland BMPs and associated phosphorus load reductions attained by implementing all of these BMPs.

Table 24 Estimated Phosphorus Load Reductions for Implemented Rangeland BMPs Aimed at Meeting the Eutrophication and Dissolved Oxygen TMDLs in Fall River Reservoir.

Year	Repair Grazing Land Gullies	Brine Site Repair
1	6	2
2	12	3
3	18	5
4	24	6
5	30	8
6	36	9
7	42	11
8	48	12
9	54	14
10	60	15
11	66	17
12	72	18
13	78	20
14	84	21
15	90	23
16	96	24
17	102	26
18	108	27
19	114	29
20	120	30

The table below shows the combined load reduction for phosphorus that is attained if all livestock, cropland, streambank and rangeland BMPs are implemented annually. The percent of TMDL achievement is illustrated in the right column. At the end of twenty years (the life of the plan), phosphorus will be reduced which will include the goal of meeting the Eutrophication and Dissolved Oxygen TMDLs in Fall River Reservoir.

Table 25 Combined Livestock, Cropland, Streambank, Rangeland, Gully and Brine Site Phosphorus Reductions Aimed at Meeting the Eutrophication and Dissolved Oxygen TMDLs in Fall River Reservoir within 20 years.

Combination of Livestock, Cropland, Streambank, Rangeland, and Brine Site BMPs to Meet the Fall River Reservoir Phosphorus TMDL							
Year	Streambank Reduction (lbs)	Cropland Reduction (lbs)	Livestock Reduction (lbs)	Brine Site Repair (lbs)	Rangeland Gully Repair (lbs)	Total Reduction (lbs)	% of TMDL
1	143	361	1,839	2	6	2,350	7%
2	285	723	3,677	3	12	4,700	15%
3	428	1,084	5,516	5	18	7,050	22%
4	570	1,446	7,355	6	24	9,400	29%
5	713	1,807	9,194	8	30	11,750	36%
6	855	2,168	11,032	9	36	14,101	44%
7	998	2,530	12,871	11	42	16,451	51%
8	1,140	2,891	14,710	12	48	18,801	58%
9	1,283	3,252	16,549	14	54	21,151	65%
10	1,425	3,614	18,387	15	60	23,501	73%
11	1,568	3,975	20,226	17	66	25,851	80%
12	1,710	4,337	22,065	18	72	28,201	87%
13	1,853	4,698	23,903	20	78	30,551	94%
14	1,995	5,059	25,742	21	84	32,901	102%
15	2,138	5,421	27,581	23	90	35,251	109%
16	2,280	5,782	29,420	24	96	37,602	116%
17	2,423	6,143	31,258	26	102	39,952	123%
18	2,565	6,505	33,097	27	108	42,302	131%
19	2,708	6,866	34,936	29	114	44,652	138%
20	2,850	7,228	36,774	30	120	47,002	145%
Load Reduction to meet Phosphorous TMDL:							**32,370**

P TMDL has been met.

Table 26 Annual Phosphorus Load Reductions by Category Aimed at Meeting the Eutrophication and Dissolved Oxygen TMDLs in Fall River Reservoir.

Best Management Practice Category	Total Annual Load Reduction (pounds)	Percent of Phosphorus TMDL
Cropland (acres)	7,228	22%
Livestock (practices)	36,774	114%
Rangeland (acres)	120	0.4%
Streambank (feet)	2,850	9%
Brine Sites	30	0.1%
Total	**47,002**	**145%**

*Assume average Phosphorous content in floodplain soil is 20 ppm.

Refer to Section 7, "Costs of BMP Implementation" for specific BMP costs.

5.3 Preservation of Natural Resources

5.3.1 Decline of Prairie Chicken Habitat

The Greater Prairie Chicken is a wildlife species that was once common in their native habitat of the Flint Hills Ecoregion of Kansas. The Flint Hills Ecoregion covers most of the Fall River Watershed. Threats to the survival and proliferation of this species are human encroachment, traditional annual burning of native pastures, conversion of pastureland to cropland and invasion of trees, such as red cedar, into traditional prairies. Local landowners in the Fall River Watershed can have a large impact on prairie chicken populations. Any advances made in providing better prairie chicken habitat will also be an advantage for water quality.

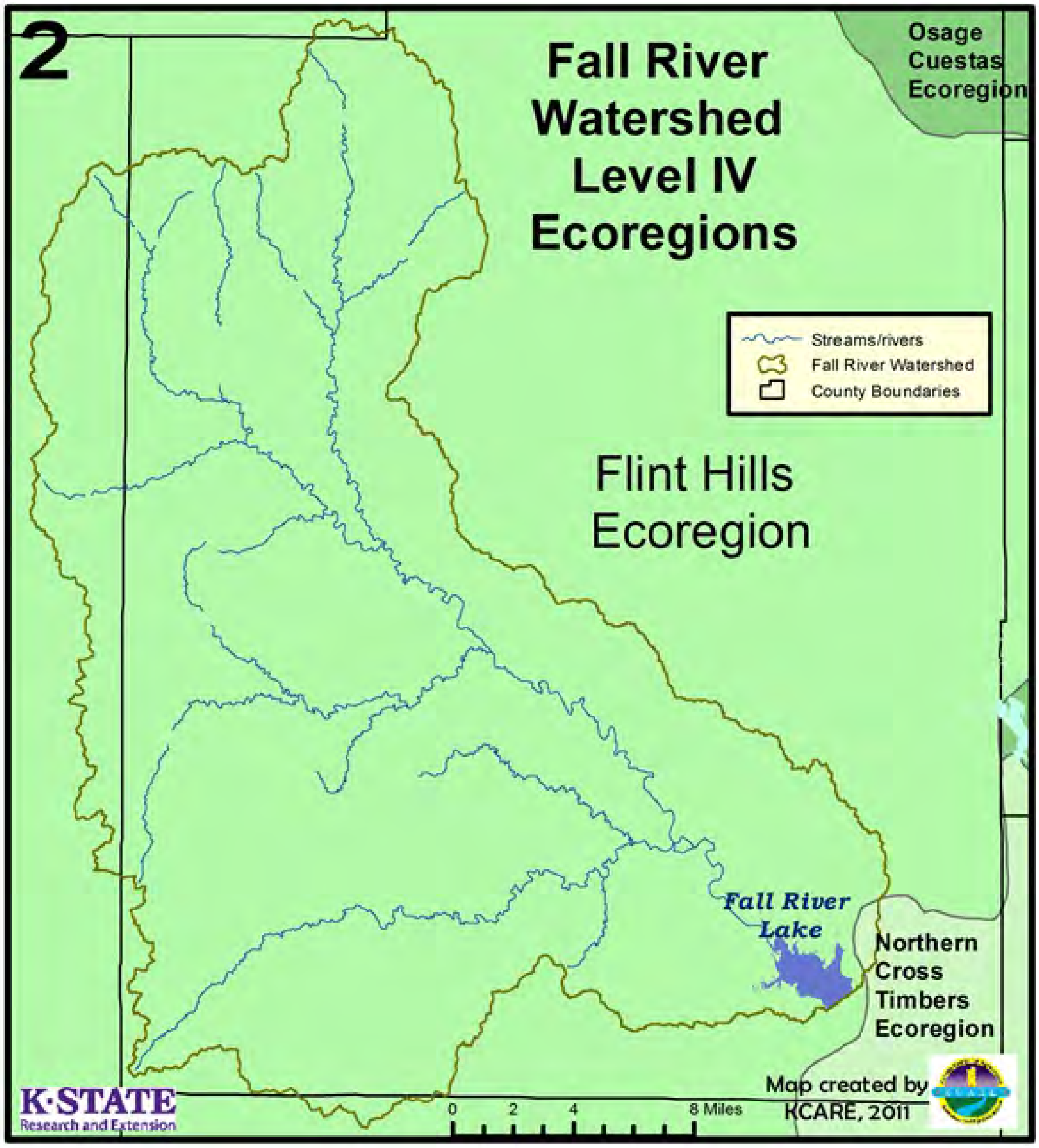


Figure 25 Fall River Watershed Ecoregions [33]

5.3.2 Management of Riparian Forests

Management of the riparian forest resource provides economic benefits to landowners, provides recreational opportunities and habitat for many stream and woodland wildlife species. Riparian forests are defined as those woodlands located near perennial streams, river bottoms and growing in soil suitability groups of one and two as identified by the Natural Resources Conservation Service (NRCS) in Kansas Forestry Technical note KS-10.[34] These woodlands often have occasional flooding. These forests have a species mix of black walnut, bur oak, green ash, hackberry and several other mixed hardwood trees.

Riparian forests are located adjacent to perennial streams and rivers primarily being bordered by cropland and to a lesser degree, rangeland. They provide a vegetative buffer for streams and rivers. Riparian forests help filter nutrients and sediment moving off cropland and rangeland areas. These forested areas also provide buffers to maintain stream bank stability during floods.[35]

Historically, riparian forests areas are not actively managed. In many cases, two or three cycles of timber harvesting have occurred without follow up practices to re-forest or improve the forest with commercially viable species since settlement. In rangeland areas, forests are sometimes grazed and cattle congregate in the riparian areas resulting in increased soil compaction and placing manure near the streams.

The SLT believes management of these riparian forests is important to protect rivers and streams. It is also important to help landowners realize the importance of management to sustain riparian forests for future generations. Best management practices for riparian forests includes technology transfer along with methods to establish, manage and harvest woodlands along rivers, streams, and lakes in Kansas.[36] Any sound management activities made in improving the riparian forests will also be an advantage for water quality.

6.0 Information and Education in Support of BMPs

6.1 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. Listed below are the activities and events along with their costs and possible sponsoring agencies.

Table 27 Information and Education Activities and Events as Requested by the SLT.

BMP	Target Audience	Information/Education Activity/Event	Time Frame	Estimated Costs	Sponsor/Responsible Agency
Cropland BMP Implementation					
Riparian and Vegetative Buffers	Landowners and Farmers	Demonstration Project	Annual	$5,000 per demonstration project	Kansas Rural Center Conservation District
		Tour/Field Day to Highlight Grassed Buffers	Annual	$500 per tour or field day	Flint Hills RC&D Conservation District
		Newspaper Articles	Annual - Ongoing	No Charge	Conservation Districts Flint Hills RC&D
		Newsletter Article	Quarterly	$500	Flint Hills RC&D Conservation Districts KS State Research & Extension
		One on One Meetings with Producers	Annual - Ongoing	Cost included in Technical Assistance for Coordinator	Flint Hills RC&D Conservation Districts, KS Research &Ext.

No-till	Farmers and Rental Operators	No-Till Workshop	Annual - Spring	$1,000 per meeting	Flint Hills RC&D Conservation Districts KS State Research and Extension
		Newsletter Article	Annual	$500	Flint Hills RC&D Conservation Districts KS State Research and Extension
		One on One Meetings with Producers	Annual - Ongoing	Cost included with Technical Assistance for Coordinator	Flint Hills RC&D Conservation District KS State Research and Extension
		Scholarships for producers to attend No-Till Winter Conference	Annual – Winter	$150 per person	No-till on the Plains
Terraces and Waterways	Landowners and Operators	Demonstration Project	Annual	Cost included with Technical Assistance for Coordinator	Flint Hills RC&D Conservation District KS State Research and Extension NRCS
Water Retention Structures	Landowners and Operators	Field Day	Once in 2 Years	Cost included with Technical Assistance for Coordinator	Flint Hills RC&D Conservation District KS State Research and Extension NRCS
Wetlands	Landowners	Field Day or Tour	Once in 2 Years	Combine w/ another practice field day	KAWS NRCS Conservation District Wildlife & Parks Flint Hills RC&D

Nutrient Management	Farmers	Cost Share for 600 Soil Tests	Annual - Ongoing	$3,000 ($5 per test)	Conservation District KS State Research and Extension Flint Hills RC&D
		Newsletter Article	Annual	$500	Flint Hills RC&D Conservation Districts KS St Research &Ext.
		One on One Meetings with Producers	Annual - Ongoing	Cost included with Technical Assistance for Coordinator	Flint Hills RC&D NRCS Conservation District KS State Research and Extension

BMP	Target Audience	Information/Education Activity/Event	Time Frame	Estimated Costs	Sponsor/Responsible Agency
Livestock BMP Implementation					
Off-Stream Watering Systems	Landowners and Ranchers	Demonstration Project	Annual	Combine with/another demonstration	Flint Hills RC&D Kansas Rural Center KS State Research and Extension
		Tour/Field Day	Annual	Combined with another practice field day	Flint Hills RC&D Kansas Rural Center KS State Research and Extension
		Workshop/Tour	Annual	$500 per workshop	Flint Hills RC&D Kansas Rural Center KS State Research and Extension
		Demonstration/Tour	Annual	$300 per demonstration or tour	Flint Hills RC&D Conservation Districts NRCS
Relocated Feedlot	Landowners and Small Feedlot Operators	Demonstration Project	Once in 2 Years	$5,000 per demonstration project	Flint Hills RC&D Kansas Rural Center Ks State Research and Extension NRCS

		Tour/Field Day	Annual	$500 per tour or field day	Flint Hills RC&D Kansas Rural Center Ks State Research and Extension
		Cost-Share Program Promotion	Annual	No Charge	Flint Hills RC&D Kansas Rural Center Ks State Research and Extension NRCS
Relocate Pasture Feeding Site	Ranchers	Demonstration Project	Annual – Spring	$5,000 per demonstration project	Kansas Rural Center Flint Hills RC&D Ks State Research & Extension
		Tour/Field Day	Annual - Summer	$500 per tour or field day	Kansas Rural Center Conservation Districts NRCS Flint Hills RC&D
		Grazing Informational Meeting	Annual - Fall	$250 per meeting	Conservation Districts Kansas Rural Center KS State Research & Extension
Grazing and Rangeland Management	Ranchers	Demonstration Project	Annual	TBD	Conservation Districts Kansas Rural Center NRCS
		Tour/Field Day	Annual	TBD	Flint Hills RC&D Conservation Districts NRCS

Off-Stream Watering System	Ranchers	Demonstration Project	Annual – Spring	$5,000 per demonstration project	Kansas Rural Center Flint Hills RC&D NRCS
		Tour/Field Day	Annual - Summer	$500 per tour or field day	Kansas Rural Center Conservation Districts NRCS
		Grazing Informational Meeting	Annual - Fall	Combined with relocating pasture feeding site meeting	Conservation Districts Kansas Rural Center NRCS
		Demonstration project for pond construction and spring developments	Annual - Fall	$10,000 per project	Conservation Districts NRCS Flint Hills RC&D
BMP	Target Audience	Information/Education Activity/Event	Time Frame	Estimated Costs	Sponsor/Responsible Agency
Rangeland BMP Implementation					
Repair Ephemeral Gullies	Landowners and Ranchers	Tour/Field Day	Annual	Combined with another practice field day	Flint Hills RC&D Kansas Rural Center KS State Research and Extension
Restore Brine Scar Sites	Landowners and Ranchers	Tour/Field Day	Annual	Combined with another practice field day	Flint Hills RC&D Kansas Rural Center KS State Research and Extension

BMP	Target Audience	Information/Education Activity/Event	Time Frame	Estimated Costs	Sponsor/Responsible Agency
Streambank BMP Implementation					
Streambank Stabilization and Restoration	Landowners	One on one technical assistance	Annual – Ongoing	Included with Technical Assistance for Coordinator	Flint Hills RC&D NRCS KWO SCC TWI Wild Horse Conservation Districts
		Demonstration project focusing on streambank assessment methodology	Annual - Summer	$3,000 per project	Flint Hills RC&D NRCS KWO SCC TWI Wild Horse Conservation Districts KS Forest Service

BMP	Target Audience	Information/Education Activity/Event	Time Frame	Estimated Costs	Sponsor/Responsible Agency
Watershed Wide Information and Education					
Education of Youth	Educators, K-12 Students	Day on the Farm	Annual – Spring	$500 per event	Conservation Districts Kansas Farm Bureaus Kansas FFA KS State Research and Extension
		Poster, essay and speech contests	Annual – Spring	$200	Conservation Districts
		Envirothon	Annual - Spring	$250	Conservation Districts
Education of Adults	Educators, Adult Education	Newsletter Article	Annual	$500	Flint Hills RC&D Conservation Districts KS State Research and Extension
		Presentation at annual meeting	Annual – Winter	No charge	Conservation District NRCS
		River Friendly Farms producer notebook	Annual – Ongoing	$250 per notebook	Flint Hills RC&D Kansas Rural Center
		Media campaign to promote healthy watersheds (brochures, news releases, TV, radio, web-based)	Ongoing	$1,000 per year	Flint Hills RC&D

		Meeting with Soil and Grassland Awards	Annual – Ongoing	No charge	Conservation Districts KS State Research and Extension
		Media campaign to promote healthy watersheds (brochures, news releases, TV, radio, web-based)	Ongoing	$1,000 per year	Flint Hills RC&D
		Media campaign to address urban nutrient runoff (flyers or handouts addressing phosphate and nitrate pollution from urban areas)	Annual – Ongoing		Local Environmental Protection Program
		Watershed display for area events	Annual – Ongoing	No charge	Flint Hills RC&D Conservation Districts Kansas State Research and Extension
Total annual cost for Information and Education if all events are implemented				**$45,400**	

6.2 Evaluation of Information and Education Activities

All service providers conducting Information and Education (I&E) activities funded through the Fall River 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.

7.0 Costs of Implementing BMPs and Possible Funding Sources

The SLT has reviewed all the recommended BMPs listed in Section 5 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 each category (cropland, livestock and streambank). Most of the BMPs that are targeted will be advantageous to more than one impairment, thus will be more efficient.

Summarized Derivation of Cropland BMP Cost Estimates

Riparian Vegetative Buffer: The cost of $1,000 per acre was arrived at using average cost of installation figures from the conservation districts within the watershed and cost estimates from the KSU Vegetative Buffer Tool developed by Craig Smith.

No-Till: After being presented with information from K-State Research and Extension (Craig Smith and Josh Roe) on the costs and benefits of no-till, the SLT decided that a fair price to entice a producer to adopt no-till would be to pay them $10 per acre for 10 years, or a net present value of $77.69 per acre upfront assuming the NRCS discount rate of 4.75%.

Terraces: In consulting with numerous conservation districts it was determined by Josh Roe that the average cost of building a terrace at this time is $1.25 per foot.

Conservation Crop Rotation: After being presented with information from K-State Research and Extension (Josh Roe) on the costs and benefits of conservation crop rotations, the SLT decided that a fair price to entice a producer to adopt a conservation crop rotation would be to pay them $5 an acre for 10 years, or a net present value of $38.84 per acre upfront assuming the NRCS discount rate of 4.75%

Grassed Waterway: $2,200 per acre was arrived at using average cost of installation figures from the conservation districts within the watershed and updated costs of brome grass seeding from Josh Roe.

Summarized Derivation of Livestock BMP Cost Estimates
Vegetative Filter Strip: The cost of $714 an acre was calculated by Josh Roe and Mike Christian figuring the average filter strip in the watershed will require four hours of bulldozer work at $125 an hour plus the cost of seeding one acre in permanent vegetation estimated by Josh Roe.

Ponds: In consulting with numerous conservation districts it was determined by Josh Roe that the average cost of constructing a pond at this time is $12,000.

Relocated Pasture Feeding Site: The cost of moving a pasture feeding site of $2,203 was calculated by Josh Roe figuring the cost of building ¼ mile of fence, a permeable surface, and labor.

Off-Stream Watering System: The average cost of installing an alternative watering system of $3,500 was estimated by Herschel George, Marais des Cygnes Watershed Specialist, who has installed numerous systems and has detailed average cost estimates.

Rotational Grazing: The average cost of implementing a rotational grazing system for $7,000 was estimated by Herschel George, Marais des Cygnes Watershed Specialist, who has installed numerous systems and has detailed average cost estimates. More complex systems that require significant cross fencing and buried water lines will come with a much higher price.

Prices below reflect current prices (2011) for implementation and also include technical assistance costs such as NRCS planning and engineering design in the case of streambank stabilization.

Table 28 Annual Cost* Before Cost-Share, Cropland BMPs Expressed in 2011 dollar amounts. 3 percent Annual Cost Inflation.

Annual Cost* Before Cost-Share, Cropland BMPs							
Year	**Terraces & Waterways**	**Riparian Buffers**	**Vegetative Buffers**	**Water Retention Structures**	**Wetlands**	**No-Till**	**Total Cost**
1	$7,350	$4,386	$5,000	$12,000	$82	$15,600	**$44,418**
2	$7,571	$4,518	$5,150	$12,360	$84	$16,068	**$45,751**
3	$7,798	$4,653	$5,305	$12,731	$87	$16,550	**$47,123**
4	$8,032	$4,793	$5,464	$13,113	$90	$17,047	**$48,537**
5	$8,272	$4,937	$5,628	$13,506	$92	$17,558	**$49,993**
6	$8,521	$5,085	$5,796	$13,911	$95	$18,085	**$51,493**
7	$8,776	$5,238	$5,970	$14,329	$98	$18,627	**$53,038**
8	$9,040	$5,395	$6,149	$14,758	$101	$19,186	**$54,629**
9	$9,311	$5,557	$6,334	$15,201	$104	$19,762	**$56,268**

10	$9,590	$5,723	$6,524	$15,657	$107	$20,354	**$57,956**
11	$9,878	$5,895	$6,720	$16,127	$110	$20,965	**$59,695**
12	$10,174	$6,072	$6,921	$16,611	$114	$21,594	**$61,485**
13	$10,479	$6,254	$7,129	$17,109	$117	$22,242	**$63,330**
14	$10,794	$6,442	$7,343	$17,622	$120	$22,909	**$65,230**
15	$11,118	$6,635	$7,563	$18,151	$124	$23,596	**$67,187**
16	$11,451	$6,834	$7,790	$18,696	$128	$24,304	**$69,202**
17	$11,795	$7,039	$8,024	$19,256	$132	$25,033	**$71,278**
18	$12,148	$7,250	$8,264	$19,834	$136	$25,784	**$73,417**
19	$12,513	$7,467	$8,512	$20,429	$140	$26,558	**$75,619**
20	$12,888	$7,692	$8,768	$21,042	$144	$27,355	**$77,888**
**3% Inflation*							

Table 29 Annual Cost* After Cost-Share, Cropland BMPs

Annual Cost* After Cost-Share, Cropland BMPs							
Year	**Terraces & Waterways**	**Riparian Buffers**	**Vegetative Buffers**	**Water Retention Structures**	**Wetlands**	**No-Till**	**Total Cost**
1	$3,675	$439	$500	$6,000	$41	$9,516	**$20,171**
2	$3,785	$452	$515	$6,180	$42	$9,801	**$20,776**
3	$3,899	$465	$530	$6,365	$43	$10,096	**$21,399**
4	$4,016	$479	$546	$6,556	$45	$10,398	**$22,041**
5	$4,136	$494	$563	$6,753	$46	$10,710	**$22,702**
6	$4,260	$508	$580	$6,956	$48	$11,032	**$23,383**
7	$4,388	$524	$597	$7,164	$49	$11,363	**$24,085**
8	$4,520	$539	$615	$7,379	$50	$11,703	**$24,807**
9	$4,655	$556	$633	$7,601	$52	$12,055	**$25,552**
10	$4,795	$572	$652	$7,829	$53	$12,416	**$26,318**
11	$4,939	$589	$672	$8,063	$55	$12,789	**$27,108**
12	$5,087	$607	$692	$8,305	$57	$13,172	**$27,921**
13	$5,240	$625	$713	$8,555	$58	$13,568	**$28,759**
14	$5,397	$644	$734	$8,811	$60	$13,975	**$29,621**
15	$5,559	$663	$756	$9,076	$62	$14,394	**$30,510**
16	$5,726	$683	$779	$9,348	$64	$14,826	**$31,425**
17	$5,897	$704	$802	$9,628	$66	$15,270	**$32,368**
18	$6,074	$725	$826	$9,917	$68	$15,728	**$33,339**
19	$6,256	$747	$851	$10,215	$70	$16,200	**$34,339**
20	$6,444	$769	$877	$10,521	$72	$16,686	**$35,369**
**3% Inflation*							

Table 30 Annual Cost* Before Cost-Share, Livestock BMPs Expressed in 2011 dollar amounts. 3 percent Annual Cost Inflation.

Annual Cost* Before Cost-Share, Livestock BMPs					
Year	Relocate Feeding Pens	Relocate Pasture Feeding Site	Off-Stream Watering System	Grazing Mgmt Plans	Total
1	$3,311	$2,203	$18,975	$4,800	$29,289
2	$3,410	$2,269	$19,544	$4,800	$30,023
3	$3,512	$2,337	$20,131	$4,800	$30,780
4	$3,617	$2,407	$20,734	$4,800	$31,559
5	$3,726	$2,479	$21,357	$4,800	$32,362
6	$3,838	$2,554	$21,997	$4,800	$33,189
7	$3,953	$2,630	$22,657	$4,800	$34,041
8	$4,071	$2,709	$23,337	$4,800	$34,918
9	$4,194	$2,791	$24,037	$4,800	$35,821
10	$4,319	$2,874	$24,758	$4,800	$36,752
11	$4,449	$2,961	$25,501	$4,800	$37,710
12	$4,583	$3,049	$26,266	$4,800	$38,698
13	$4,720	$3,141	$27,054	$4,800	$39,715
14	$4,862	$3,235	$27,865	$4,800	$40,762
15	$5,007	$3,332	$28,701	$4,800	$41,841
16	$5,158	$3,432	$29,562	$4,800	$42,952
17	$5,312	$3,535	$30,449	$4,800	$44,097
18	$5,472	$3,641	$31,363	$4,800	$45,276
19	$5,636	$3,750	$32,304	$4,800	$46,490
20	$5,805	$3,863	$33,273	$4,800	$47,741
**3% Inflation Rate*					

Table 31 Annual Cost* After Cost-Share, Livestock BMPs Expressed in 2011 dollar amounts. 3 percent Annual Cost Inflation.

Annual Cost* After Cost-Share, Livestock BMPs					
Year	Relocate Feeding Pens	Relocate Pasture Feeding Site	Off-Stream Watering System	Grazing Mgmt Plans	Total
1	$1,655	$1,102	$9,488	$2,400	$14,644
2	$1,705	$1,135	$9,772	$2,400	$15,012
3	$1,756	$1,169	$10,065	$2,400	$15,390
4	$1,809	$1,204	$10,367	$2,400	$15,780
5	$1,863	$1,240	$10,678	$2,400	$16,181
6	$1,919	$1,277	$10,999	$2,400	$16,594
7	$1,976	$1,315	$11,329	$2,400	$17,020
8	$2,036	$1,355	$11,668	$2,400	$17,459
9	$2,097	$1,395	$12,018	$2,400	$17,911
10	$2,160	$1,437	$12,379	$2,400	$18,376
11	$2,225	$1,480	$12,750	$2,400	$18,855
12	$2,291	$1,525	$13,133	$2,400	$19,349
13	$2,360	$1,570	$13,527	$2,400	$19,857
14	$2,431	$1,618	$13,933	$2,400	$20,381
15	$2,504	$1,666	$14,351	$2,400	$20,921
16	$2,579	$1,716	$14,781	$2,400	$21,476
17	$2,656	$1,768	$15,225	$2,400	$22,048
18	$2,736	$1,821	$15,681	$2,400	$22,638
19	$2,818	$1,875	$16,152	$2,400	$23,245
20	$2,902	$1,931	$16,636	$2,400	$23,870

**3% Inflation Rate*

Table 32 Estimated Costs of Implementing Streambank BMPs.
A 2009 study conducted by KSU Agricultural Economists calculated the cost of stabilizing streambank sites at an average of $71.50 per linear foot.

Year	Streambank
1	$89,375
2	$92,056
3	$94,818
4	$97,662
5	$100,592
6	$103,610
7	$106,718
8	$109,920

9	$113,218
10	$116,614
11	$120,113
12	$123,716
13	$127,427
14	$131,250
15	$135,188
16	$139,243
17	$143,421
18	$147,723
19	$152,155
20	$156,720

Table 33 Estimated Costs of Implementing Rangeland BMPs. Expressed in 2011 dollar amounts. 3 percent Annual Cost Inflation.

Annual Cost of Implementing Rangeland BMPs			
Year	Repair Ephemeral Gullies	Brine Site Repair	Total
1	$3,000	$3,000	$6,000
2	$3,090	$3,090	$6,180
3	$3,183	$3,183	$6,366
4	$3,278	$3,278	$6,556
5	$3,377	$3,377	$6,754
6	$3,478	$3,478	$6,956
7	$3,582	$3,582	$7,164
8	$3,690	$3,690	$7,380
9	$3,800	$3,800	$7,600
10	$3,914	$3,914	$7,828
11	$4,032	$4,032	$8,064
12	$4,153	$4,153	$8,306
13	$4,277	$4,277	$8,554
14	$4,406	$4,406	$8,812
15	$4,538	$4,538	$9,076
16	$4,674	$4,674	$9,348
17	$4,814	$4,814	$9,628
18	$4,959	$4,959	$9,918
19	$5,107	$5,107	$10,214
20	$5,261	$5,261	$10,522

Table 34 Technical Assistance Needed to Implement BMPs.

BMP		*Technical Assistance*	*Projected Annual Cost*
Cropland	1. Buffers	Div of Conservation Technician WRAPS Coordinator KRC River Friendly Farms Technician NRCS	**Division of Conservation Technician No Charge** **NRCS No charge** **WRAPS Coordinator $25,000** **KRC River Friendly Farms Technician $20,000** **Watershed Specialist $4,000**
	2. Continuous No-till	WRAPS Coordinator KRC River Friendly Farms Technician NRCS	
	3. Terraces & Waterways	Div of Conservation Technician KRC River Friendly Farms Technician NRCS	
	4. Water Retention Structures	Div of Conservation Technician KRC River Friendly Farms Technician NRCS	
	5. Wetlands	Div of Conservation Technician KRC River Friendly Farms Technician NRCS	
Livestock	1. Relocate Feeding Pens	Div of Conservation Technician KRC River Friendly Farms Technician NRCS	
	2. Relocate pasture feeding sites	KRC River Friendly Farms Technician Watershed Specialist NRCS	
	3. Establish off stream watering systems	KRC River Friendly Farms Technician Watershed Specialist NRCS	
	4. Grazing Management Plans	KRC River Friendly Farms Technician Div of Conservation Technician NRCS	
Streambank	1. Streambank restoration	WRAPS Coordinator Div of Conservation Technician KRC River Friendly Farms Technician Wildhorse Riverworks, Inc. NRCS	
Rangeland	1. Repair ephemeral gullies	KRC River Friendly Farms Technician Div of Conservation Technician NRCS	
	2. Repair brine scars	KRC River Friendly Farms Technician Div of Conservation Technician NRCS	
Total			**$49,000**

Table 35 Total Annual Costs for Implementing Entire WRAPS Plan in Support of Attaining TMDLs.

Total Annual WRAPS Cost after Cost-Share by BMP Category							
Year	Streambank	Cropland	Livestock	Brine Site	Range Gullies	I&E and TA	Total Annual Cost
1	$89,375	$20,171	$14,644	$3,000	$3,000	$45,400	**$175,590**
2	$92,056	$20,776	$15,012	$3,090	$3,090	$46,762	**$180,786**
3	$94,818	$21,399	$15,390	$3,183	$3,183	$48,165	**$186,137**
4	$97,662	$22,041	$15,780	$3,278	$3,278	$49,610	**$191,649**
5	$100,592	$22,702	$16,181	$3,377	$3,377	$51,098	**$197,327**
6	$103,610	$23,383	$16,594	$3,478	$3,478	$52,631	**$203,175**
7	$106,718	$24,085	$17,020	$3,582	$3,582	$54,210	**$209,198**
8	$109,920	$24,807	$17,459	$3,690	$3,690	$55,836	**$215,402**
9	$113,218	$25,552	$17,911	$3,800	$3,800	$57,511	**$221,792**
10	$116,614	$26,318	$18,376	$3,914	$3,914	$59,237	**$228,374**
11	$120,113	$27,108	$18,855	$4,032	$4,032	$61,014	**$235,153**
12	$123,716	$27,921	$19,349	$4,153	$4,153	$62,844	**$242,135**
13	$127,427	$28,759	$19,857	$4,277	$4,277	$64,730	**$249,327**
14	$131,250	$29,621	$20,381	$4,406	$4,406	$66,671	**$256,735**
15	$135,188	$30,510	$20,921	$4,538	$4,538	$68,672	**$264,365**
16	$139,243	$31,425	$21,476	$4,674	$4,674	$70,732	**$272,224**
17	$143,421	$32,368	$22,048	$4,814	$4,814	$72,854	**$280,319**
18	$147,723	$33,339	$22,638	$4,959	$4,959	$75,039	**$288,656**
19	$152,155	$34,339	$23,245	$5,107	$5,107	$77,290	**$297,244**
20	$156,720	$35,369	$23,870	$5,261	$5,261	$79,609	**$306,090**

Potential funding sources for these BMPs are (but are not limited to) the following organizations:

Table 36 Potential 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 KDHE WRAPS Funding Clean Water Neighbor Grants
Kansas Department of Wildlife and Parks	Partnering for Wildlife
Kansas Alliance for Wetlands & Streams	

Division of Conservation	
Conservation Districts	
No-till on the Plains	
Kansas Forest Service	
US Fish and Wildlife	

Table 37 Potential Service Providers for BMP Implementation. *

BMP		Services Needed to Implement BMP		Service Provider **
		Technical Assistance	*Information and Education*	
Cropland	1. Buffers	Design, cost share and maintenance	BMP workshops, tours, field days	NRCS KRC DOC No-Till on the Plains KSRE CD RC&D KDWP
	2. Continuous No-till	Design, cost share and maintenance	BMP workshops, tours, field days	
	3. Terraces and Waterways	Design, cost share and maintenance	BMP workshops	
	4. Water Retention Structures	Design, cost share and maintenance	BMP workshops, field days, tours	
	5. Wetlands	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 DOC KRC CD RC&D KDWP
	2. Grazing Management Plans	Design, cost share and maintenance	BMP workshops, field days, tours	
	3. Relocate pasture feeding sites	Design, cost share and maintenance	BMP workshops, field days, tours	
	4. Establish off-stream watering systems	Design, cost share and maintenance	BMP workshops, field days, tours	
	5. Relocate Feeding Pens	Design, cost share and maintenance	BMP workshops, field days, tours	
Streambank	1. Streambank restoration	Design, cost share and maintenance	BMP workshops, field days, tours	KAWS NRCS KFS KSRE CD RC&D WILDHORSE

Rangeland	1.Ephemeral gullies	Design, cost share and maintenance	BMP workshops, field days, tours	KAWS NRCS DOC FSA KRC KSRE CD RC&D KDWP
	2.Brine scars	Design, cost share and maintenance	BMP workshops, field days, tours	

***** *All service providers are responsible for evaluation of the installed or implemented BMPs and/or other services provided and will report to SLT for completion approval.*
***** See Appendix for service provider directory***

8.0 Timeframe

The plan will be reviewed every five years starting in 2017. In 2012, the SLT will request a review of data by KDHE for the Verdigris Basin. It is this year that the TMDLs will officially be reviewed for additions or revisions. The timeframe of this document for BMP implementation to meet both sediment and phosphorus TMDLs would be twenty years from the date of publication of this report. Sediment and phosphorus reductions in the water column will not be noticeable by the year 2017 due to a lag time from implementation of BMPs and resulting improvements in water quality. Therefore, the SLT will review sediment and phosphorus concentrations in year 2022. They will examine BMP placement and implementation in 2017 and every subsequent five years after.

Table 38 Review Schedule for Pollutants and BMPs.

Review Year	Sediment	Phosphorus	BMP Placement
2017			X
2022	X	X	X
2027	X	X	X
2032	X	X	X
2037	X	X	X

Targeting and BMP implementation might shift over time in order to achieve TMDLs.

- The timeframe for meeting the **sediment TMDL** will be twenty years if all BMPs are implemented in the watershed. After the sediment TMDL is met, the BMPs directed at sediment will be considered “protection measures” instead of “restoration measures”. At this point, the SLT may decide to redirect their funding to phosphorus related BMPs.
- The timeframe for meeting the **phosphorus TMDL** will be twenty years if all BMPs are implemented in the watershed.

9.0 Interim Measureable Milestones

9.1 Adoption Rates

Milestones will be determined by number of acres treated, projects installed, contacts made to residents of the watershed or load reductions at the end of five, ten, and twenty years for cropland. The SLT will examine the number of acres treated or the load reduction to determine if adequate progress has been made from the current BMP implementations.

Table 39 Short, Medium and Long Term Goals for BMP Cropland Adoption Rate in the Cropland Targeted Area.

	Annual Adoption (treated acres), Cropland BMPs							
	Year	Terraces & Waterways	Riparian Buffers	Vegetative Buffers	Water Retention Structures	Wetlands	No-Till	Total Adoption
Short-Term	1	30	20	75	40	1	200	366
	2	30	20	75	40	1	200	366
	3	30	20	75	40	1	200	366
	4	30	20	75	40	1	200	366
	5	30	20	75	40	1	200	366
Total		***150***	***100***	***375***	***200***	***5***	***1,000***	***1,830***
Medium-Term	6	30	20	75	40	1	200	366
	7	30	20	75	40	1	200	366
	8	30	20	75	40	1	200	366
	9	30	20	75	40	1	200	366
	10	30	20	75	40	1	200	366
Total		***300***	***200***	***750***	***400***	***10***	***2,000***	***3,660***
Long-Term	11	30	20	75	40	1	200	366
	12	30	20	75	40	1	200	366
	13	30	20	75	40	1	200	366
	14	30	20	75	40	1	200	366
	15	30	20	75	40	1	200	366
	16	30	20	75	40	1	200	366
	17	30	20	75	40	1	200	366
	18	30	20	75	40	1	200	366
	19	30	20	75	40	1	200	366
	20	30	20	75	40	1	200	366
Total		***600***	***400***	***1,500***	***800***	***20***	***4,000***	***7,320***

Table 40 BMP Livestock Adoption Rate in the Livestock Targeted Areas.

Livestock BMPs Adopted Each Year (number)						
	Year	Relocate Feeding Pens	Relocate Pasture Feeding Site	Off Stream Watering System	Grazing Management Plans	Total Adoption
Short Term	1	0.5	1	5	3	9.5
	2	0.5	1	5	3	9.5
	3	0.5	1	5	3	9.5
	4	0.5	1	5	3	9.5
	5	0.5	1	5	3	9.5
Total		***2.5***	***5***	***25***	***15***	***47.5***
Medium Term	6	0.5	1	5	3	9.5
	7	0.5	1	5	3	9.5
	8	0.5	1	5	3	9.5
	9	0.5	1	5	3	9.5
	10	0.5	1	5	3	9.5
Total		***5***	***10***	***50***	***30***	***95***
Long Term	11	0.5	1	5	3	9.5
	12	0.5	1	5	3	9.5
	13	0.5	1	5	3	9.5
	14	0.5	1	5	3	9.5
	15	0.5	1	5	3	9.5
	16	0.5	1	5	3	9.5
	17	0.5	1	5	3	9.5
	18	0.5	1	5	3	9.5
	19	0.5	1	5	3	9.5
	20	0.5	*1*	5	3	9.5
Total		***10***	***20***	***100***	***60***	***190***

Table 41 BMP Streambank Adoption Rate in the Streambank Targeted Areas

	Year	Repair Streambanks (feet)
Short Term	1	1,250
	2	1,250
	3	1,250
	4	1,250
	5	1,250
Total		***6,250***
Medium Term	6	1,250
	7	1,250
	8	1,250
	9	1,250
	10	1,250
Total		***12,500***
Long Term	11	1,250
	12	1,250
	13	1,250
	14	1,250
	15	1,250
	16	1,250
	17	1,250
	18	1,250
	19	1,250
	20	1,250
Total		***25,000***

Milestones for rangeland BMPs will be examined at the end of ten and twenty years.

Table 42 Short and Long Term Goals for BMP Rangeland Adoption Rate in the Rangeland Targeted Area.

Rangeland BMPs Adopted Each Year (number)			
	Year	**Repair Grazing Land Gullies**	**Brine Site Repair**
Short Term	1	1	1
	2	1	1
	3	1	1
	4	1	1
	5	1	1
	6	1	1
	7	1	1
	8	1	1
	9	1	1
	10	1	1
Total		***10***	***10***
Long Term	11	1	1
	12	1	1
	13	1	1
	14	1	1
	15	1	1
	16	1	1
	17	1	1
	18	1	1
	19	1	1
	20	1	1
Total		***20***	***20***

Table 43 Short, Medium and Long Term Goals for Information and Education Adoption Rates in the Entire Watershed.

	Year	Demo Projects	Workshops	Tours and Field Days	Presentations	Newsletter Inserts	One on One Meetings	Conference Attendees	Educational Events	Media Campaign	Contacts made by Tech
Short Term	1	5	4	5	1	1	3	6	7	2	250
	2	5	4	5	1	1	3	6	7	2	250
	3	5	4	5	1	1	3	6	7	2	250
	4	5	4	5	1	1	3	6	7	2	250
	5	5	4	5	1	1	3	6	7	2	250
	Total	***25***	***20***	***25***	***5***	***5***	***15***	***30***	***35***	***10***	***1,250***
Medium Term	6	5	4	5	1	1	3	6	7	2	250
	7	5	4	5	1	1	3	6	7	2	250
	8	5	4	5	1	1	3	6	7	2	250
	9	5	4	5	1	1	3	6	7	2	250
	10	5	4	5	1	1	3	6	7	2	250
	Total	***50***	***40***	***50***	***10***	***10***	***30***	***60***	***70***	***20***	***2,500***
Long Term	11	5	4	5	1	1	3	6	7	2	250
	12	5	4	5	1	1	3	6	7	2	250
	13	5	4	5	1	1	3	6	7	2	250
	14	5	4	5	1	1	3	6	7	2	250
	15	5	4	5	1	1	3	6	7	2	250
	16	5	4	5	1	1	3	6	7	2	250
	17	5	4	5	1	1	3	6	7	2	250
	18	5	4	5	1	1	3	6	7	2	250
	19	5	4	5	1	1	3	6	7	2	250
	20	5	4	5	1	1	3	6	7	2	250
	Total	***100***	***80***	***100***	***20***	***20***	***60***	***120***	***140***	***40***	***5,000***

9.2 Phosphorus and Sediment Milestones

9.2.1 Water Quality Milestones to Determine Improvements

The goal of the Fall River WRAPS plan is to restore water quality for uses supportive of aquatic life, domestic water supply, irrigation, livestock watering, and recreation for Fall River Reservoir. The plan specifically addresses the high priority eutrophication, siltation and dissolved oxygen TMDL for Fall River Lake. In order to reach the load reduction goals associated with the Fall River Lake impairments, a BMP implementation schedule spanning 20 years has been developed.

In addition to the lake impairment, a high priority bacteria TMDL has been developed for Fall River. While this plan is not directly addressing this impairment, it is anticipated that the bacteria impairment for Fall River will be positively affected by the BMP implementation plan that has been developed as part of this WRAPS plan.

Separate water quality milestones have been developed for both Fall River Lake and Fall River, 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. In addition to the water quality measures derived from the sampling data, the lake sedimentation rate will also be utilized to determine the effectiveness of the BMPs being implemented as part of this plan.

9.2.2 Water Quality Milestones for Fall River

As previously stated, this plan estimates that it will take 20 years to implement the planned BMPs necessary to meet the load reduction goals for the impairments being addressed in the Fall River Lake watershed. The table below includes 10-year and long term water quality goals for total phosphorus (TP) and total suspended solids (TSS) for Fall River.

Table 44 TP and TSS Milestones for Fall River

Water Quality Milestones for Fall River - Total Phosphorus (TP) & Total Suspended Solids (TSS)						
	Current Condition (1990 - 2008) Average TP (average of data collected during indicated period), ppb		10-Year Goal		Long Term Goal	
			Improved Condition Average TP (average of data collected during indicated period), ppb		Improved Condition Average TP (average of data collected during indicated period), ppb	
	All Flows	30% - 99% Flows	All Flows	30% - 99% Flows	All Flows	30% - 99% Flows
Sampling Sites	(1990 - 2008) Average TP	(1990 - 2008) Average TP	Average TP	Average TP	Average TP	Average TP
Fall River SC575	109	63	95	56	83	51

	Current Condition (1990 - 2008) Average TSS (average of data collected during indicated period), ppm		10-Year Goal Improved Condition Average TSS (average of data collected during indicate period), ppm		Long Term Goal Improved Condition Average TSS (average of data collected during indicated period), ppm	
	All Flows	30% - 99% Flows	All Flows	30% - 99% Flows	All Flows	30% - 99% Flows
Sampling Sites	(1990 - 2008) Average TSS	(1990 - 2008) Average TSS	Average TSS	Average TSS	Average TSS	Average TSS
Fall River SC575	80	29	64	24	54	19

9.2.3 Water Quality Milestones for Fall River Lake

As previously stated, in order to reach the sediment and phosphorus reduction goals for Fall River Lake, a BMP implementation schedule spanning 20 years has been developed. Several water quality milestones and indicators have been developed for Fall River Lake, as included herein. In addition to water quality measures, such as concentrations of total phosphorus and secchi depth measurements, the lake sedimentation rate for Fall River Lake will be utilized to determine the effectiveness of the BMPs implemented as part of the sediment load reduction goals outlined in the plan.

The current sedimentation rate, as provided in the TMDL, is approximately 188 acre-feet/year. As part of the water quality assessment, the sedimentation rate will continue to be analyzed throughout the life of this plan. A movement toward the desired sedimentation rate of 115 acre-feet/year is considered a water quality goal associated with the sediment load reductions goals of this plan.

The table below includes 10-year water quality goals, as well as long term water quality goals for total phosphorus (TP), chlorophyll a (phosphorus indicators), and secchi depth (TSS indicator) monitored in Fall River Lake.

Table 45 Water Quality Milestones for Fall River Lake

Water Quality Milestones for Fall River Lake								
	Current Condition (1995 - 2007) Average TP	10-Year Goal		Long Term Goal		Current Condition (1995 - 2007) Secchi (Avg)	10-Year Goal	Long Term Goal
		Improved Condition Average TP	Total Reduc-tion Needed	Improved Condition Average TP	Total Reduc-tion Needed		Improved Condition Secchi (Avg)	Improved Condition Secchi (Avg)
Sampling Site	Total Phosphorus (average of data collected during indicated period), ppb					Secchi (average of data collected during indicated period), m		
Fall River Lake LM023001	54	45	9	35	19	0.43	Secchi depth > 0.6	Maintain Secchi depth > 0.7

	Current Condition (1995 - 2007) Chlorophyll a	10-Year Goal		Long Term Goal				
		Improved Condition Chlorophyll a	Total Reduc-tion Needed	Improved Condition Chlorophyll a	Total Reduc-tion Needed			
Sampling Site	Chlorophyll a (average of data collected during indicated period), ppb							
Fall River Lake LM023001	10.6	10	0.6	9.5	1.1			

9.2.4 Additional Water Quality Indicators

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

- Occurrence of algal blooms in watershed lakes and reservoirs
- Visitor traffic to watershed lakes and reservoirs, including Fall River Lake
- Boating traffic in watershed lakes and reservoirs, including Fall River Lake
- Trends of quantity and quality of fishing in watershed lakes and reservoirs, including Fall River Lake

9.2.5 Monitoring Water Quality Progress

KDHE continues to monitor water quality in the Fall River Watershed by maintaining the monitoring stations located within the watershed. The map included in this section shows the monitoring stations located within the Fall River Watershed. The map has been color-coded to indicate the sub-watersheds that have been targeted for BMP implementation and water quality monitoring by this plan.

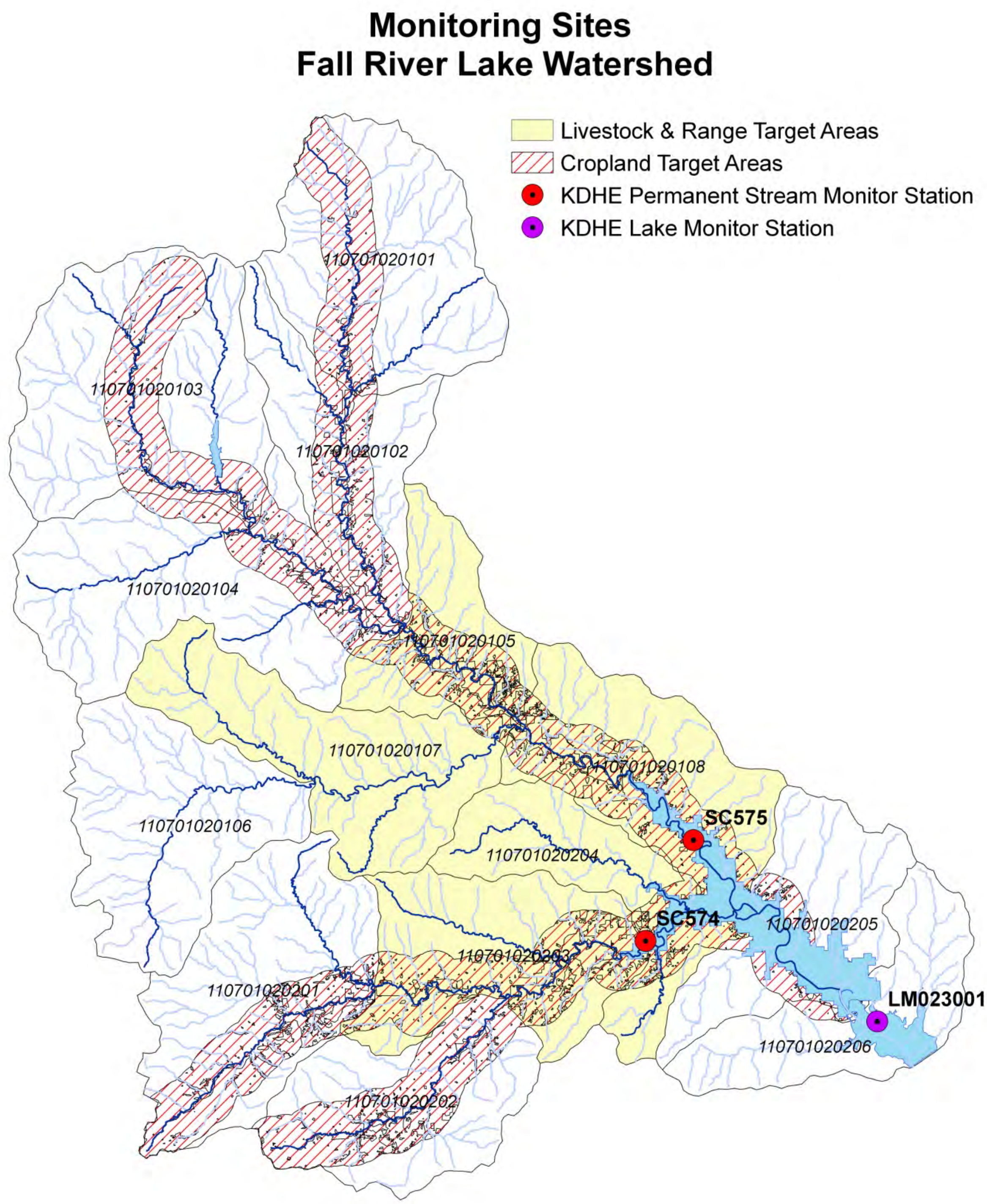


Fig 24 KDHE Monitoring Stations in Fall River Lake Watershed

The map shows the KDHE monitoring stations located in streams and lakes. The rotational sites are typically sampled every four years, and the KDHE lake monitoring sites are typically sampled every 3 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.

9.2.6 Evaluation of Monitoring Data

Monitoring data in the Fall River watershed 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.

The BMP implementation schedule and water quality milestones for the Fall River watershed extend through a twenty-year period from 2012 to 2032. Throughout the plan 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 2032, at the end of the plan, a determination can be made as to whether the water quality standards have been attained.

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

Table 46 BMP Implementation Milestones from 2017 to 2032.

	Cropland					Livestock					Rangeland		Stream bank	Information and Education	
Year	Buffers, acres	No –till, acres	Terraces & Waterways, acres	Water Retention Structures, acres	Wetlands, acres		Relocate Feeding Pens, number	Relocate Pasture Feeding Sites, number	Off-stream Watering Systems, number	Grazing Management Plans, number	Repair Ephemeral Gullies, number	Repair Brine Scars, number	Restoration, feet	Demonstrations/Workshops/ Tours/Field Days. number	I&E and Technical Assistance Contacts/Participants, number
2017	475	1,000	150	200	5		2.5	5	25	15	5	5	6,250	70	1,250
2022	950	2,000	300	400	10		5	10	50	30	10	10	12,500	140	2,500
2027	1,425	3,000	450	600	15		7.5	15	75	45	15	15	18,750	210	3,750
2032	1,900	4,000	600	800	20		10	20	100	60	20	20	25,000	280	5,000

9.3 BMP Implementation Milestones

The SLT will review the number of acres, projects or contacts made in the watershed every five years until the end of this WRAPS plan, which is the year 2032. At the end of each five year period, the SLT will have the option to reassess the goals and alter BMP implementations as they determine is best. Above is the outline of BMP implementations over a twenty year period.

10.0 Monitoring Water Quality Progress

The KDHE and the USACE sampling data will be reviewed by the SLT every year. Data collected in the Targeted Areas will be of special interest. A composite review of BMPs implemented and monitoring data will be analyzed for effects resulting from the BMPs. The SLT will also ask KDHE to review analyzed data from all monitoring sources on a yearly basis.

KDHE has ongoing monitoring sites in the watershed. There are two types of monitoring sites utilized by KDHE: permanent and rotational. Permanent sites are routinely sampled, whereas rotational sites are only sampled every fourth year. All sampling sites will be continued into the future. Each site is tested for nutrients, metals, ammonia, solid fractions, turbidity, alkalinity, pH, dissolved oxygen, e. coli bacteria 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.

There is one USGS stream flow data station in the Fall River watershed near Climax, Kansas. Much of the evaluative information can be obtained through the existing networks and sampling plans of KDHE and USACE. Public engagement can be obtained through observations of lake clarity, ease of boating and the physical appearance of Fall River Reservoir. Some communications with USACE will supplement any information on the conditions in the Fall River drainage and on Fall River Reservoir.

Fall River Watershed WRAPS has been implementing Best Management Practices (BMPs) with local stakeholders to protect the quality of water in Fall River, all of its tributaries and Fall River Reservoir. They have supported producer education and student education events to promote conservation practices within the watershed. The spring and summer of 2011, Fall River WRAPS undertook water quality monitoring at six new sites throughout the whole watershed. Kansas Department of Health and Environment (KDHE) has 2 monitoring sites the watershed; one on Otter Creek at 99 Bridge and one on Fall River at Rice Bridge.

All samples collected during the sampling period were processed by a water testing lab at Butler Community College in El Dorado, Kansas. Three normal flow samples were collected at each sampling site, one each at the beginning, middle, and end of the sampling period (May 15 – October 1). One of the Fall River WRAPS Project Management Team members collected 1 high flow sample from each of the 6 designated monitoring sites in late summer. The samples were stored on ice in a non-contaminating location for pickup by the lab (usually the next day). The lab recorded the data from all samples collected. The data collected in 2011 helped determine specific priority areas in the watershed that might be contributing more sediment and nutrients to the streams which flow into Fall River Reservoir. The information was limited somewhat by an ongoing severe drought throughout the area. Fall River's PMT decided that more sampling information was important for the watershed and the monitoring should continue at the same sites when more normal rainfalls occur. Fall River Reservoir exceeds the Total Maximum Daily Loads (TMDLs) for Siltation and Dissolved Oxygen established by KDHE. Fall River WRAPS will be focusing on the determined priority areas to establish the Best Management Practices with their grant funds.

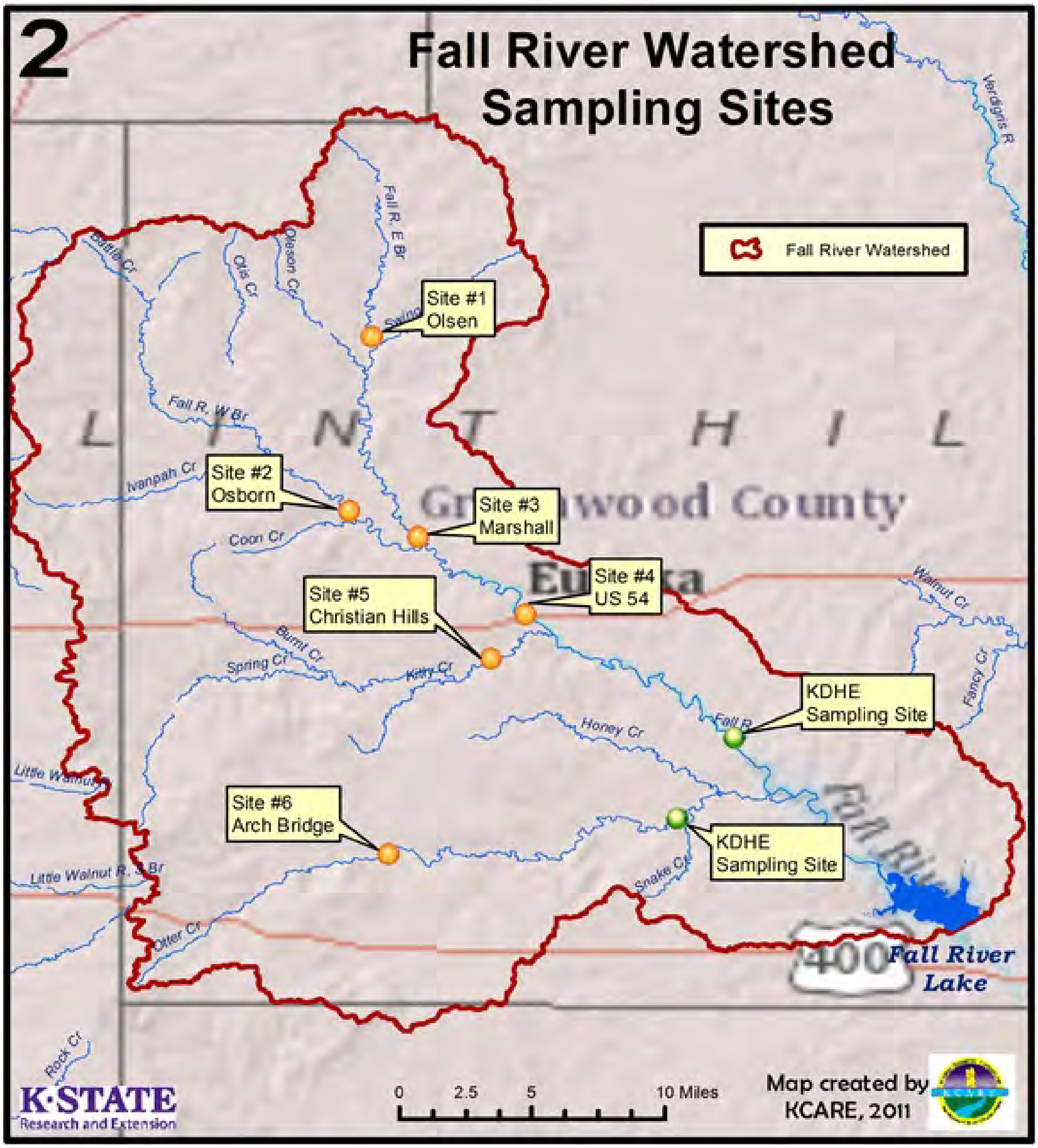


Figure 26 Fall River WRAPS Monitoring Sites in the Watershed.

Monitoring data will be used to direct the SLT in their evaluation of water quality progress. The table below indicates which current monitoring sites data will be used by the SLT in determination of effectiveness of BMP implementation. KDHE will be requested to provide any additional monitoring sites that need to be installed. The cost and implementation of these sites will be dependent on KDHE funding.

Monitoring site data that is being generated at this time will be helpful to the SLT. Many of the existing monitoring sites will benefit multiple Targeted Areas and the sites in Fall River Reservoir will benefit all Targeted Areas. Additional monitoring in the six new sites developed by the Fall River SLT will help determine the water quality progress after implementation of practices in the targeted areas. Analysis of the data generated will be used to determine effectiveness of implemented BMPs. If the SLT decides at some point in the future that more data is required, they can discuss this with KDHE. All KDHE and COE data will be shared with the SLT and can then be passed on to the watershed residents by way of the information and education efforts discussed previously.

Monitoring data will be used to direct the SLT in their evaluation of water quality progress. KDHE will be requested to meet with the SLT to review the monitoring data accumulated by their sites on a yearly basis. However, the overall strategy and alterations of the WRAPS plan will be discussed with KDHE immediately after each update of the 303d list and subsequent TMDL designation. The upcoming years for this in the Fall River Watershed is 2017 and 2022. At this time, the plan can be altered or modified in order to meet the water quality goals as assigned by the SLT in the beginning of the WRAPS process.

11.0 Review of the Watershed Plan in 2017

In the year 2017, the plan will be reviewed and revised according to results acquired from monitoring data. At this time, the SLT will review the following criteria in addition to any other concerns that may occur at that time:
They will examine BMP placement and implementation in 2017 and every subsequent five years after.

1. The SLT will request from KDHE a report on the milestone achievements in **sediment** and **phosphorus** load reductions in 2022. Sediment and phosphorus reductions in the water column will not be noticeable by the year 2017 due to a lag time from implementation of BMPs and resulting improvements in water quality. Therefore, the SLT will review sediment and phosphorus concentrations in year 2022. The timeframe of this document for BMP implementation to meet both sediment and phosphorus TMDLs would be twenty years from the date of publication of this report.
2. The SLT will request a report from KDHE concerning the revisions of the TMDLs from 2017.
3. The SLT will request a report from KDHE, USCOE Kansas Department of Wildlife and Parks on trends in water quality in Fall River Reservoir.
4. The SLT will report on progress towards achieving the adoption rates listed in Section 9.1 of this report.
5. The SLT will report on progress towards achieving the benchmarks listed in Section 9.2 of this report.
6. The SLT will report on progress towards achieving the BMP implementations in Section 9.3 of this report.
7. The SLT will discuss necessary adjustments and revisions needed in the targets listed in this plan.

12.0 Appendix

12.1 Service Providers

Table 47 Potential Service Provider Listing.

Organization	Programs	Purpose	Technical or Financial Assistance	Phone	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	913-551-7003 913-551-7003	www.epa.gov
Flint Hills RC&D	Natural resource development and protection	Plan and Implement projects and programs that improve environmental quality of life.	Technical	620-340-0113 ext. 9	www.flinthillsrcd.com/
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	785-463-5804 NE Chapter	www.kaws.org
Kansas Dept. of Agriculture	Watershed structures permitting.	Available for watershed districts and multipurpose small lakes development.	Technical and Financial	785-296-2933	www.accesskansas.org/kda

Organization	Programs and Technical Assistance	Purpose	Technical or Financial Assistance	Phone	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	785-296-5500	www.kdhe.state.ks.us

Kansas Department of Wildlife and Parks	Land and Water Conservation Funds	Provides funds to preserve develop and assure access to outdoor recreation.		620-672-5911	www.kdwp.state.ks.us/about/grants.html
	Conservation Easements for Riparian and Wetland Areas	To provide easements to secure and enhance quality areas in the state.		785-296-2780	
	Wildlife Habitat Improvement Program	To provide limited assistance for development of wildlife habitat.		620-672-5911	
	North American Waterfowl Conservation Act	To provide up to 50 percent cost share for the purchase and/or development of wetlands and wildlife habitat.		620-342-0658	
	MARSH program in coordination with Ducks Unlimited	May provide up to 100 percent of funding for small wetland projects.	Technical and Financial	620-672-5911	
	Chickadee Checkoff	Projects help with eagles, songbirds, threatened and endangered species, turtles, lizards, butterflies and stream darters. Funding is an optional donation line item on the KS Income Tax form.			
	Walk In Hunting Program	Landowners receive a payment incentive to allow public hunting on their property.			
	F.I.S.H. Program	Landowners receive a payment incentive to allow public fishing access to their ponds and streams.			

Organization	Programs and Technical Assistance	Purpose	Technical or Financial Assistance	Phone	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	785-532-3312 785-532-3310	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	785-873-3431	http://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	785-336-3760	http://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	785-532-7108 785-532-5813 785-532-2643 785-532-0416 785-532-2732 785-532-3039 785-532-1443	www.kcare.ksu.edu www.ksre.ksu.edu/kelp www.ksre.ksu.edu/olg www.k-state.edu/waterlink/ www.kansasprideprogram.ksu.edu/healthyecosystems/ www.ksre.ksu.edu/kswater/

Organization	Programs and Technical Assistance	Purpose	Technical or Financial Assistance	Phone	Website address
Kansas Water Office	Public Information and Education	Provide information and education to the public on Kansas Water Resources	Technical and Financial	785-296-3185	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	888-330-5142	www.notill.org

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

Organization	Programs and Technical Assistance	Purpose	Technical or Financial Assistance	Phone	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	816-983-3157 816-983-3157	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	785-539-3474 785-539-3474	www.fws.gov
The Watershed Institute					
Wild Horse Riverworks					

12.2 BMP Definitions

12.2.1 Cropland

Riparian 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. $2.27 per linear foot, 30 feet wide, $3,300 per acre, 90% cost-share available from NRCS.

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, 90% cost-share available from NRCS.

Grassed Waterway w/Terraces
-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.
-81% erosion reduction efficiency, 60% phosphorous reduction efficiency.
-$1,200 an acre, 50% cost-share available from NRCS.

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.
-$1.02 per linear foot, 50% cost-share available from NRCS.

Water Retention Structure
-Water impoundment made by constructing an earthen dam.
-Traps sediment and nutrients from leaving edge of field.
-Provides source of water.
-50% erosion reduction efficiency, 50% phosphorous reduction efficiency.
-Approximately $12,000, treats 40 acres

Wetland
-Areas where water covers the soil and serves as a natural erosion and nutrient runoff filter.
-30% erosion reduction efficiency, 30% phosphorous reduction efficiency.
-$82 an acre, 50% cost-share available

No-Till

-A management system in which chemicals may be used for weed control and seedbed preparation.
-Cover crops can be part of a no-till system since it keeps the soil covered thereby retaining moisture and by adding desirable nutrients to the soil.
-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.
-$78 an acre, 75% erosion reduction efficiency, 40% phosphorous reduction efficiency.

12.2.2 Livestock

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.

Move Pasture Feeding Sites

-Move feeding sites 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.

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.

Grazing Management Plans include:

-Type and number of livestock being grazed in a pasture.
-Approximate period of use for each pasture.
-Map of grazing areas w/ existing conditions.
-Soils map

Preventing Invasive Plants in Pastures and Range
-Invasive plants such as blackberry, Sericea Lezpedeza, hedge trees, cedars, locust trees, and other undesirable, spreading plants should be treated with chemicals or cut, as necessary, to retain the good health of the native prairies and rangeland.
-EQIP, WHIP, and WRAPS programs provide some assistance with these problems.

Average Stocking Rates for Fall River Watershed
-One pair on 6.75 acres of native grass.
-Average grazing dates: April 20-October 15.

12.2.3 Streambanks

-Stabilizing streambanks to decrease erosion includes a design by a certified engineer that calls for installation of weirs or similar structures to keep the stream's current away from the banks, then grading the banks and installing grass or plants or both on the newly sloped banks.
-A 2009 study conducted by the KSU Agricultural Economists calculated the cost of stabilizing sites in Fall River Watershed at an average of $71.50 per linear foot, including all engineering and design costs.

12.3 Appendix Tables

The tables below are for subbasins in the livestock and range targeted areas only. The targeted areas for cropland BMPs are within a relatively small and well defined area. With the restrictions of only spending WRAPS funds within these areas on BMP implementation the SLT required the freedom to be able to implement BMPs wherever there are willing land owners within this area. Hence, we have not broken down specific BMP implementation goals by sub-watershed, only goals for the entire targeted area to give the SLT more freedom. When this plan is reviewed in five years the SLT will inventory BMPs implemented and will then determine if they need to focus on a single targeted area with more intensity.

12.3.1 Annual Adoption Rates for Livestock/Rangeland HUC 12s

Table 48 Annual Adoption Rates for Livestock in Priority HUC 12s

Annual Livestock BMP Adoption by Priority Area				
HUC 12	Relocate Feeding Pens	Relocate Pasture Feeding Site	Off-Stream Watering System	Grazing Mgmt Plans
11070102010050	3	5	25	15
11070102010080	2	5	25	15
11070102010070	2	3	17	10
11070102020030	2	3	17	10
11070102020040	1	4	16	10
Total	***10***	***20***	***100***	***60***

Table 49 Annual Adoption Rates and Costs for Priority Rangeland Gully BMPs w/ Erosion and Phosphorous Reduction

Fall River Watershed Rangeland Gully Repair by HUC 12s				
HUC 12	Gully Repair (number)	Cumulative Erosion Reduction (tons)	Cumulative P Load Reduction (lbs)	Cost*
11070102010050	5	500	30	$15,000
11070102010080	5	500	30	$15,000
11070102010070	3	300	18	$9,000
11070102020030	3	300	18	$9,000
11070102020040	4	400	24	$12,000
Total	***20***	***2,000***	***120***	***$60,000***

Table 50 Annual Adoption Rates and Costs for Priority Rangeland Brine Site BMPs w/ Erosion and Phosphorous Reduction

Fall River Watershed Brine Site Repair by HUC 12s				
HUC 12	**Brine Site Repair (number)**	**Cumulative Erosion Reduction (tons)**	**Cumulative P Load Reduction (lbs)**	**Cost***
11070102010050	5	125	8	$15,000
11070102010080	5	125	8	$15,000
11070102010070	3	75	5	$9,000
11070102020030	3	75	5	$9,000
11070102020040	4	100	6	$12,000
Total	***20***	***500***	***30***	***$60,000***
**2010 Dollars*				

Table 51 Livestock BMP Cost before Cost-Share by Priority Areas

Livestock BMP Cost* Before Cost-Share by HUC 12				
HUC 12	**Relocate Feeding Pens**	**Relocate Pasture Feeding Site**	**Off-Stream Watering System**	**Grazing Management Plans**
11070102010050	$19,863	$11,015	$94,875	$24,000
11070102010080	$13,242	$11,015	$94,875	$24,000
11070102010070	$13,242	$6,609	$64,515	$16,000
11070102020030	$13,242	$6,609	$64,515	$16,000
11070102020040	$6,621	$8,812	$60,720	$16,000
Total	***$66,210***	***$44,060***	***$379,500***	***$96,000***

Table 52 Livestock BMP Cost* After Cost-Share by Priority Areas

Livestock BMP Cost* After Cost-Share by HUC 12				
HUC 12	**Relocate Feeding Pens**	**Relocate Pasture Feeding Site**	**Off-Stream Watering System**	**Grazing Management Plans**
11070102010050	$9,932	$5,508	$47,438	$12,000
11070102010080	$6,621	$5,508	$47,438	$12,000
11070102010070	$6,621	$3,305	$32,258	$8,000
11070102020030	$6,621	$3,305	$32,258	$8,000
11070102020040	$3,311	$4,406	$30,360	$8,000
Total	***$33,105***	***$22,030***	***$189,750***	***$48,000***

Table 53 Livestock BMP Phosphorous Load Reduction by Priority Areas

Livestock BMP Phosphorous Load Reduction by HUC 12				
HUC 12	**Relocate Feeding Pens**	**Relocate Pasture Feeding Site**	**Off-Stream Watering System**	**Grazing Management Plans**
11070102010050	3,827	298	1,491	4,215
11070102010080	2,552	298	1,491	4,215
11070102010070	2,552	179	1,014	2,810
11070102020030	2,552	179	1,014	2,810
11070102020040	1,276	239	954	2,810
Total	***12,758***	***1,193***	***5,964***	***16,860***

Table 54 Livestock BMP Nitrogen Load Reduction by Priority Areas

Livestock BMP Nitrogen Load Reduction by HUC 12				
HUC 12	**Relocate Feeding Pens**	**Relocate Pasture Feeding Site**	**Off-Stream Watering System**	**Grazing Management Plans**
11070102010050	7,209	562	2,808	7,939
11070102010080	4,806	562	2,808	7,939
11070102010070	4,806	337	1,910	5,293
11070102020030	4,806	337	1,910	5,293
11070102020040	2,403	449	1,797	5,293
Total	***24,029***	***2,247***	***11,233***	***31,756***

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