Pomona Lake Watershed

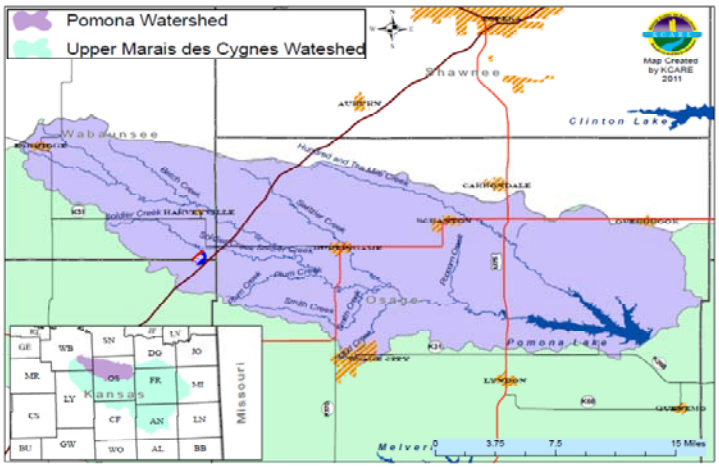
9 Element Watershed Plan Overview

Water Quality Impairments Directly Addressed:

- Pomona Lake Eutrophication TMDL (High Priority)
- Pomona Lake Siltation TMDL (High Priority)

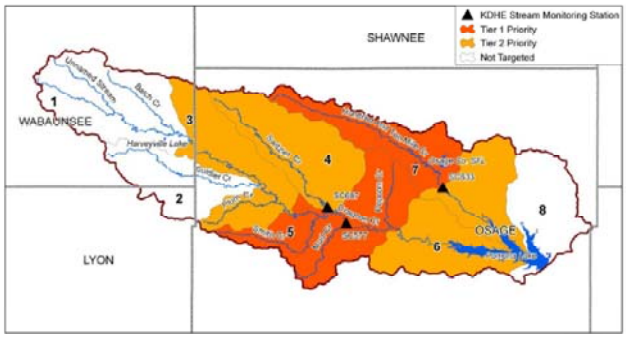
Other Impairments Which Stand to Benefit from Watershed Plan Implementation:

- Dragoon Creek Dissolved Oxygen TMDL (High Priority)
- 110 Mile Creek Dissolved Oxygen TMDL (High Priority)
- Switzler Creek Dissolved Oxygen TMDL (High Priority)



Determination of Priority Areas

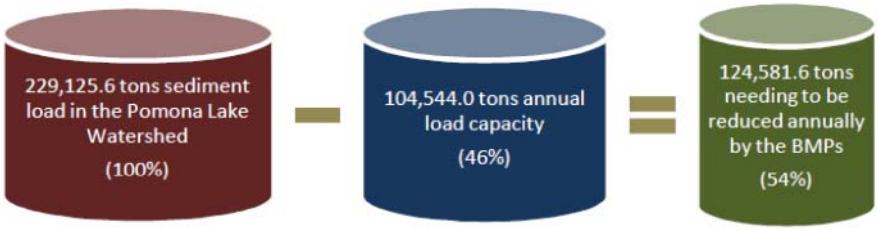
- Cropland BMP Targeted Areas were identified through SWAT (Soil and Water Assessment Tool) modeling to determine areas of high overland runoff contributing sediment and nutrients to the watershed and Pomona Lake.
- Livestock BMP Targeted Areas were identified by targeting the same high nutrient contributing areas as identified by SWAT.
- Streambank and Riparian Targeted Areas were identified through assessment activities conducted by the Kansas Alliance of Wetlands and Streams (KAWS) as well as the Kansas Water Office (KWO)



Cropland and Livestock Target Areas

Streambank and Riparian Targeted Areas

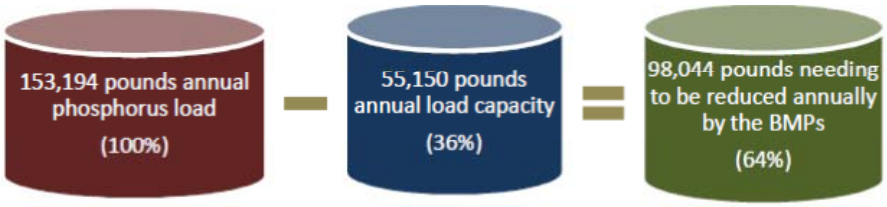
Best Management Practice and Load Reduction Goals



Sediment Reducing BMPs:

- Cropland
  - No-Till
  - Nutrient Management
  - Vegetative Buffers
  - Terraces
  - Grassed Waterways
  - Grade Stabilization
  - Permanent Vegetation
- Streambank
  - Streambank Stabilization
- Riparian Area
  - Riparian/Vegetative Buffers

Total sediment load reduction from implementing above BMPs over 30 years = 147,771 tons



Phosphorus Reducing BMPs:

- Cropland
  - No-Till
  - Nutrient Management
  - Vegetative Buffers
  - Terraces
  - Grassed Waterways
  - Grade Stabilization
  - Permanent Vegetation
- Livestock
  - Vegetative Filter Strip
  - Relocate Feeding Pens
  - Relocate Pasture Feeding Sites
  - Off Stream Watering Systems
- Streambank
  - Streambank Stabilization
- Riparian Area
  - Riparian/Vegetative Buffers

Total phoshorus load reduction from implementing above BMPs over 30 years = 160,071 pounds

Pomona lake WaTERSHED

Watershed Restoration and Protection Strategy

Final Draft Plan November 2, 2011

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Kansas Center for Agricultural Resources and the Environment
KCARE

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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

Dissolved Oxygen (DO): Amount of oxygen dissolved in water.

E. coli bacteria (ECB): 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. Originates from 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.

Nonpoint Sources (NPS): Sources of pollutants from a disperse area, such as urban areas or agricultural areas

Nutrients: Nitrogen and phosphorus in water source.

Phosphorus (P or TP): Element in water that, in excess, can lead to increased biological activity in water. TP or total phosphorus is a chemical measurement of all phosphorus forms in a water sample.

Point Sources (PS): Pollutants originating from a single localized source, such as industrial sites, sewerage systems, and confined animal facilities

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

The purpose of this Watershed Restoration and Protection Strategy (WRAPS) report for the Pomona Lake Watershed is to outline a plan 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, and for areas of the watershed that need improvement in habitat, land management, or other attributes. Watershed protection is needed for surface waters that currently meet water quality standards, but are in need of protection from future degradation.

The 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 evaluating 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 report 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 Pomona Lake Watershed.

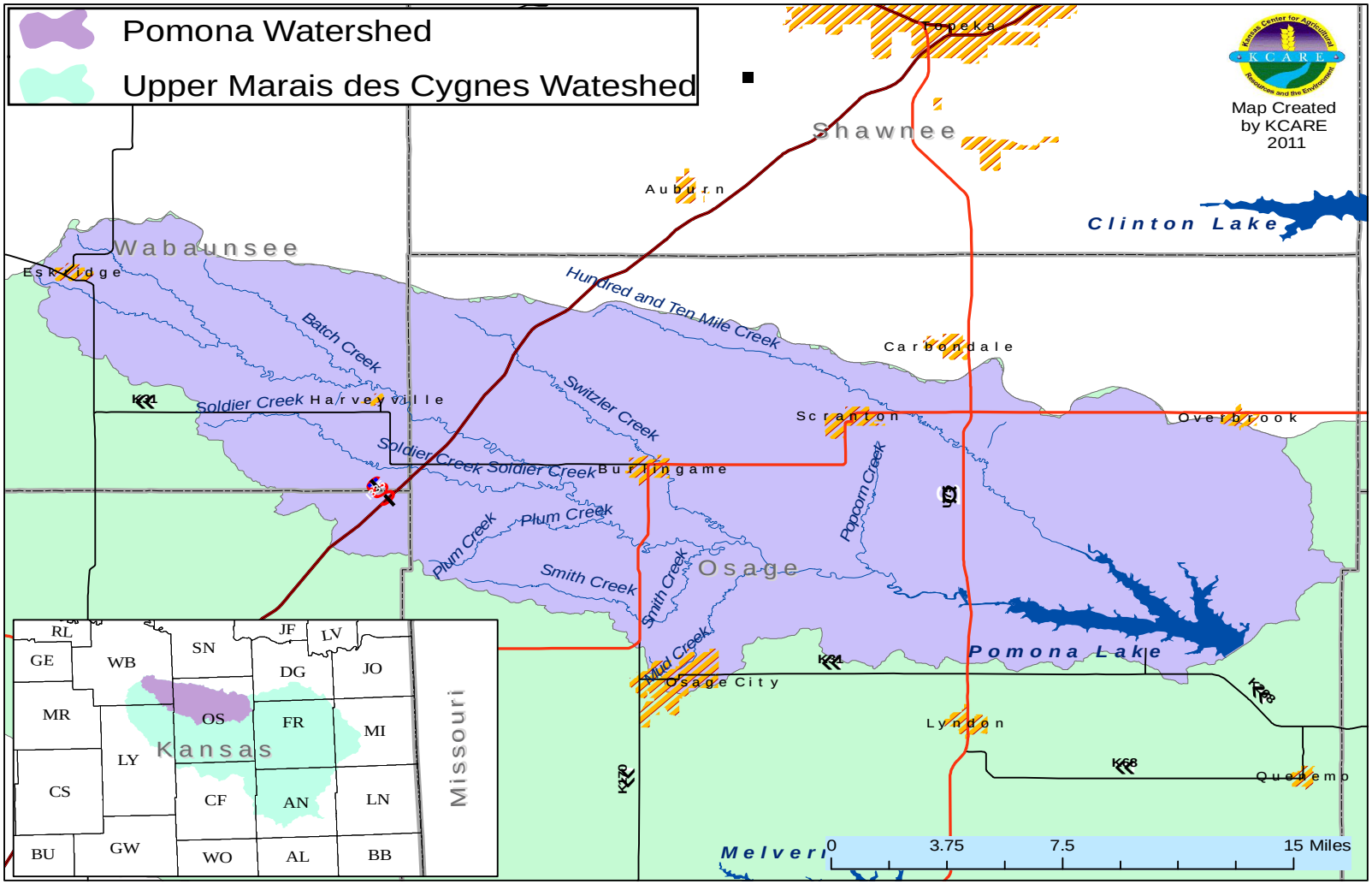
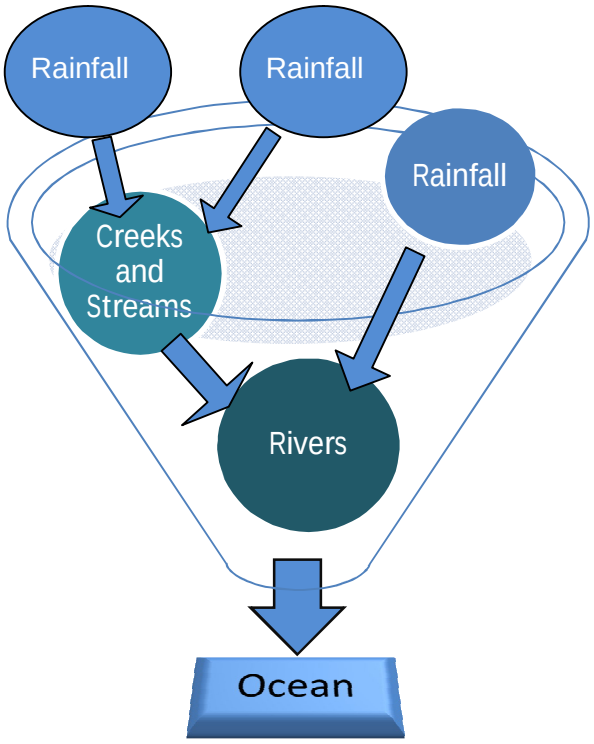


Figure 1. Map of the Pomona Watershed

2.0 Background Information

2.1 What is a Watershed?

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.



Elevation determines watershed boundaries. The upper boundary of the Pomona Watershed has an elevation of 678 meters (2,223 feet) and the lowest point of the watershed has an elevation of 200 meters (657 feet) above sea level.

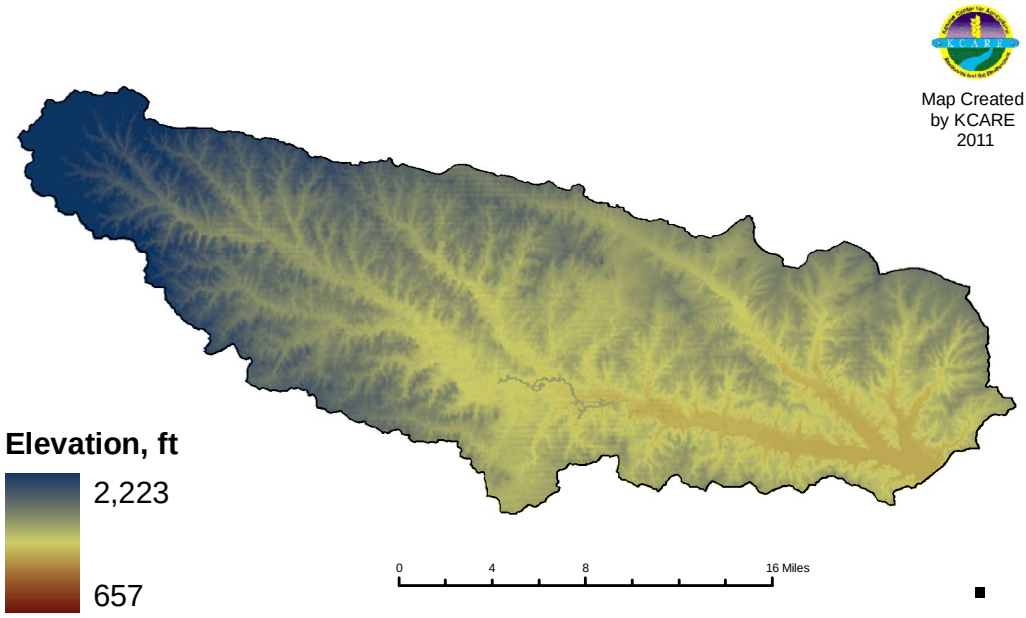


Figure 2 Relief Map of the Pomona Watershed. [1]

2.2 Where is the Pomona Watershed?

There are twelve river basins located in Kansas. The Pomona Watershed is a portion of the Upper Marais des Cygnes Watershed which is located in the Marais des Cygnes Basin.

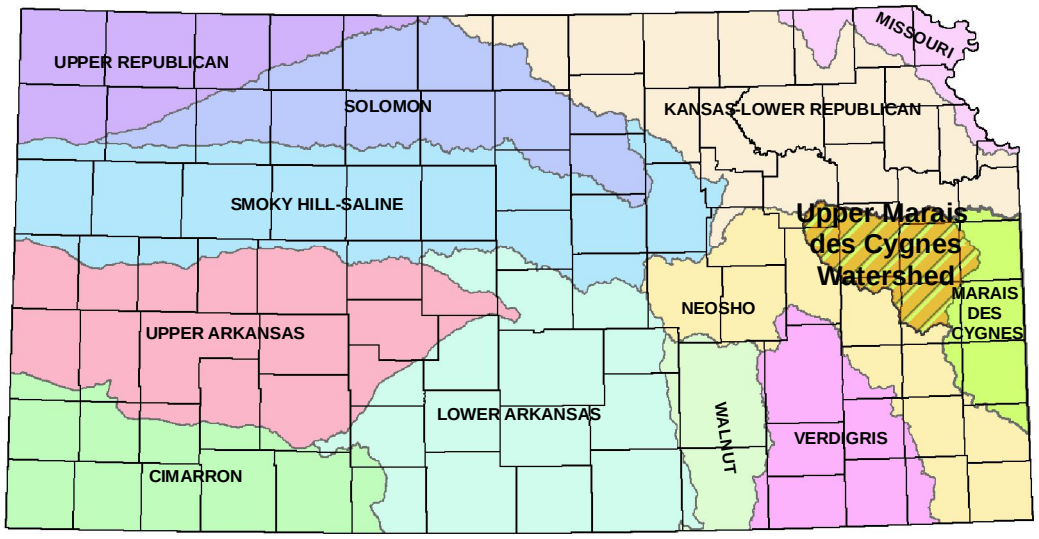


Figure 3 Twelve Basins with Upper Marais des Cygnes Watershed Highlighted

The Marais des Cygnes Basin drains the Marmaton River, the Little Osage River, and the Marais des Cygnes River. In Missouri, the Marmaton River flows into the Little Osage and the confluence of the Little Osage and the Marais des Cygnes creates the Osage River. This river eventually flows into the Missouri River in eastern Missouri. It is impounded twice to form the Harry S. Truman Reservoir and the Lake of the Ozarks.

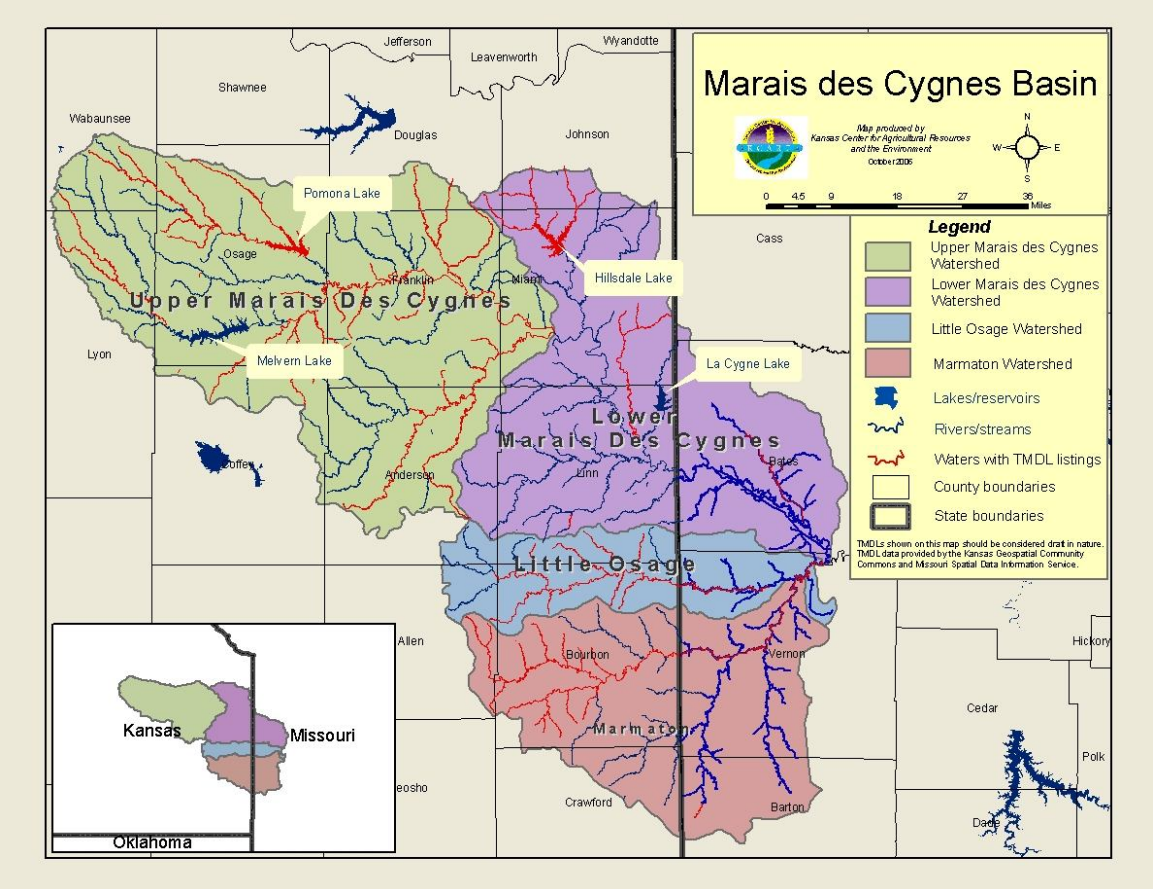


Figure 4 Watersheds of the Marais des Cygnes Basin.

2.3 What is a HUC?

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. The Upper Marais des Cygnes Watershed is composed of the HUC8 (meaning an 8 digit identifier code) numbered 10290101. The first 2 numbers in the code refer to the drainage region, the second 2 digits refer to the drainage subregion, the third 2 digits refer to the accounting unit and the fourth set of digits is the cataloging unit. For example:

10290101 = Region drainage of the Missouri River, the Saskatchewan River and several small closed basins (Area = 509,547 sq. miles)
10**29**0101 = Subregion drainage of the Gasconade and Osage Rivers in Kansas and Missouri (Area = 18,400 sq. miles)
1029**01**01 = Accounting unit drainage of the Osage River basin in Kansas and Missouri (Area = 14,800 sq. miles)
102901**01** = Cataloging unit drainage of the section of the Marais des Cygnes River (Area = 2,150 sq. miles)

As watersheds become smaller, the HUC number will become larger. HUC 8s are further divided into smaller watersheds with HUC 10 delineations and HUC 12s are HUC 10 watersheds that have been even further divided into smaller watersheds. The Pomona Watershed consists of the HUC 10 1029010102 indicating the drainage area of Pomona Lake. The Pomona Watershed is further divided into eight HUC 12 delineations.

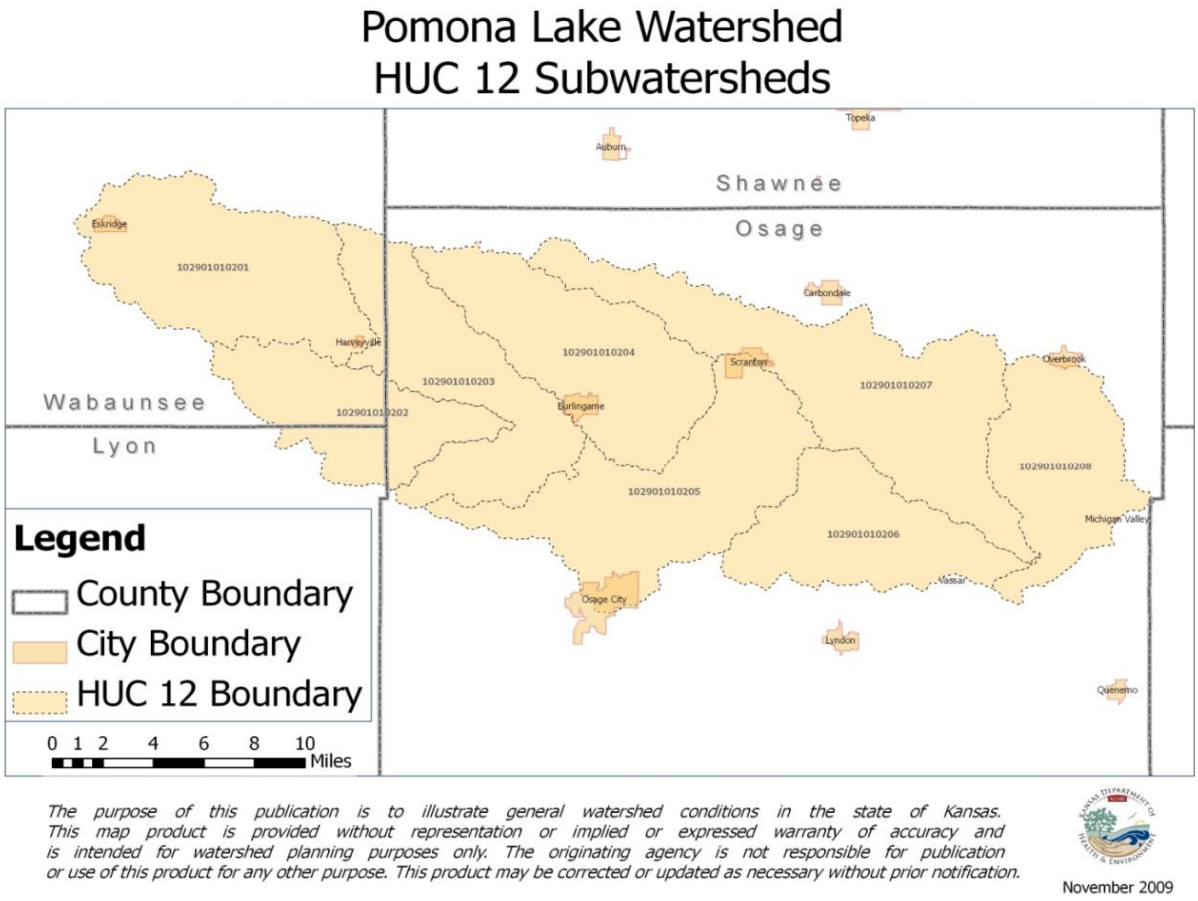


Figure 5 HUC 12 Delineations in the Pomona Watershed

3.0 Watershed History

3.1 Stakeholder Leadership Team (SLT) History

The Pomona WRAPS SLT consists of 5 members. All current members are also supervisors for the Osage County Conservation District, the sponsor of the grant. This is very convenient for landowners since they are familiar with the supervisors and who to contact when they have a water quality concern.

During the first two and on half to three years of the grant, the SLT sought the advice of the "advisory board". The advisory board had technical experience and was more familiar with grants. The advisory board consisted of representatives from: Natural Resources and Conservation Service, K-State Research and Extension, U S Army Corps of Engineers, Kansas State University Kansas Center for Agriculture and Resources and the Environment, Kansas Department of Health and Environment, Kansas Water Office and Lake Region Resource Conservation and Development.

The project manager would meet with the advisory board during the day to discuss key issues and what needed to be done. She would then meet with the SLT in the evening and report what the advisory board had suggested. This worked very well. The SLT was able to make independent decisions.

The current SLT keeps up to date on the issues within the county and the watershed. They have full support from the county commissioners. They seek input from landowners and the advisory board.

3.2 Overview

According to the Kansas Unified Watershed Assessment prepared by KDHE (Kansas Department of Health and Environment) and NRCS (Natural Resources Conservation Service) [2], the Upper Marais des Cygnes Watershed is rated as a Category I watershed indicating it is in need of restoration and protection to sustain water quality. A Category I watershed does not meet state water quality standards or fails to achieve aquatic system goals related to habitat and ecosystem health. Category I watersheds are also assigned a priority for restoration. It is ranked 5th out of 92 watersheds in the state for restoration priority.

The Pomona Lake Watershed is located primarily in Osage county with the headwaters originating in the Flint Hills of Wabaunsee County in east central Kansas. It contains numerous creeks and tributaries including Hundred and Ten Mile (110) Creek, Dragoon Creek and Switzler Creek. All surface waters in the

watershed drain into Pomona Lake. Pomona Lake was impounded in 1963 and covers approximately 4,000 acres.

The Pomona water system is formed from the 110-Mile Creek and two tributary creeks, Dragoon and Valley Brook. As the 3 creeks come together they combine and form the lake. The 110-Mile Creek continues down the outlet channel where it meets the Marais des Cygnes River approximately 8 miles downstream.

Pomona Lake's 7 parks, 2 marinas, 4,000 acres of water and 6,500 acres provide space for outdoor recreation activities. Camping, sightseeing, fishing, boating, picnicking and hunting are favorite activities. Bald eagles, white-tailed deer, Canada geese, and wild turkey can be found at Pomona Lake. Some of the sports fishing species in the lake are crappie, walleye, and channel catfish. The lake's fish and wildlife resources provide sightseers, fishermen, and hunters ample opportunities for their sports.

There are two designated swimming beaches located at Pomona Lake. One is located in Michigan Valley, and one is located in Pomona State Park. Designated beaches are designed and constructed to eliminate hazards and underwater obstructions. These beaches are buoyed each summer to delineate the usable portion and to exclude boats.

Just east of Scranton lies another lake in the watershed: Osage State Fishing Lake. The Kansas Fish and Game Commission purchased 506 acres in 1955. The area is being used as a combination wildlife and fishing area. Construction of an earthen dam created a lake approximately 140 acres in size. The remaining 366 acres consist mainly of tall grass prairie with numerous wooded draws and slopes. Soils are thin with rock layers below much of the area. Wildlife species under management are quail and other small game. Camping, fishing piers, fish feeders, a boat ramp and dock are provided for fishermen on the west side of the lake.

Special features of Osage State Fishing Lake are wagon ruts. The Santa Fe Trail crossed the northeast corner of the area. Several of the wagon ruts are still visible just east of the north entry road.

Many models have been utilized for targeting in the Pomona Watershed. The purpose of modeling is to obtain information regarding watershed conditions which can be evaluated as a tool to help restore the health of the water resources in the watershed that do not meet water quality standards. Model results can also be utilized to ensure that water resources in the watershed that currently meet water quality standards are protected.

Potential baseline sediment loads exiting land units were estimated in the models. Since reducing sediment entering Pomona Lake is the main goal of the SLT; the models were used to determine which areas of the watershed have the

greatest potential for sediment runoff. This area was then determined to be a targeted area for BMP placement.

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.

An area just east of Burlingame that runs from the north edge of the watershed to the south edge was determined to have the highest potential for sediment runoff. This was not surprising to the SLT as they have local knowledge of the watershed. Priority weighting in the BMP Auction was given to this area of the watershed.

A BMP Auction was utilized to distribute funds. This approach was intended to provide the greatest water quality improvements in the Pomona Lake watershed per dollar spent. Producers and landowners will benefit by having the flexibility to choose which BMP will work best for their operation. They also will be allowed to indicate the exact amount of money needed before they adopt certain BMPs, something that isn't allowed in current conservation programs.

Also by utilizing the BMP auction, the SLT determined what types of projects landowners were most willing to install. The majority of the bids were for terraces and waterways – both new and rebuilt. There was no indicated interest in switching to no-till. The SLT decided that more education about no-till cultivation should be a priority in order to encourage this conservation practice. Landowners seem to understand the conservation benefits of terraces and waterways; therefore, education for these practices should be secondary.

Since the beginning of the Pomona WRAPS grant in 2007, the SLT has held four BMP auctions in the Pomona Watershed. The four auctions combined have resulted in 71 bids for practices requesting $113,258 in funding. Of the 56 bids that were accepted due to availability of funds, a total of $77,300 was used for auctions. Once all projects are implemented, approximately 3,700 tons of soil will be kept in the field and out of Pomona Lake.

Last grant cycle, the SLT transitioned to a new method of distributing BMP funds. The SLT used a ranking process similar to the Conservation District ranking for

their State Cost Share applications. The SLT decided to try this method for two reasons:

- The first reason was the SLT determined it would a better utilization of time for the technician. Ten to twenty hours are spent by the technician to figure soil loss. The Conservation District's State Cost Share program utilized a different method of calculating soil loss than the Pomona WRAPS. If a landowner didn't get funded through State Cost Share and then decided to apply for Pomona WRAPS, the technician had to recalculate soil loss (and visa-versa). The SLT thought it made more sense to use the same method to figure soil loss for both programs.
- The second reason was landowners were starting to ask what the county average cost was for different practices and then they would bid the same amount they would have received through State Cost Share. With landowners bidding this way, the effectiveness of the auction was lost.

The ranking process will give points for close proximity to stream, distance to public water supply, HEL determination, and soil saved per acre by installing the BMP. Also 50 additional points will be given for projects above KDHE monitoring station SC 633 in the highest priority watershed (HUC 102901010307), 40 additional points in the next highest priority watershed (HUC 102901010305), and 30 additional points for projects below the monitoring station in HUC 102901010307. There will be 20 additional points for the 3 medium priority HUCS (102901010303, 102901010304, 102901010306). No additional points will be given for the other two HUCS (102901010302 and 102901010308).

Potential pollutants of concern for surface waters include eutrophication (phosphorous) and sedimentation. Contributing sources to phosphorous loading within the lake are cropland and animal waste. Overland runoff also collects soil during heavy rainfall events, contributing to sediment loading in the lake. Water quality improvements resulting from implementation of this watershed plan will help to maintain the viability of Pomona Lake as a public water supply source.

3.3 Issues and Goals of the SLT

The charge of the SLTs has been to create a plan of restoration and protection measures for the watershed. During the time period that they have been meeting, they have had speakers and discussions to review and study watershed issues and concerns. The SLT then set **priority watershed issues and concerns.**

The **priority issues** of the watershed determined by the SLT are (in no particular order)

- Erosion on cropland,
- Nutrient and bacteria runoff from livestock operations,
- Eroding streambanks and degraded riparian areas,
- Flooding,

- Bacteria contamination from failing septic systems,
- Illegal dumping, and
- Proliferation of noxious weeds.

The **watershed goals** that will be utilized to meet the priority issues are:

- Restore degraded water quality in Pomona Lake (achieve TMDLs), and
- Educate watershed community about water quality practices and benefits.

What is a Total Maximum Daily Load (TMDL)?

Every state assigns ***designated uses*** for each water body. These designated uses provide for:

- healthy aquatic life,
- safe contact recreation (swimming and boating),
- safe drinking water,
- safe food procurement, and
- adequate ground, irrigation, industrial, and livestock water usage.

Not meeting these uses indicates a failure to meet the Kansas ***Water Quality Standard*** (WQS). When this happens, a ***TMDL*** is developed. TMDL is a regulatory term derived from the US Clean Water Act. The TMDL will set a maximum amount of pollutant that can be discharged into a waterbody while still providing for its designated uses. It is an assessment tool that helps to identify pollutant impairments and determine the amount of pollutant in the water.

TMDLs consist of 3 parts: wasteload allocation (WLA) from point sources, load allocation (LA) from nonpoint sources, and a built in margin of safety (MOS). In this WRAPS report, we will address the LA from nonpoint sources.

The purpose of this WRAPS plan is to address the issues and concerns of the SLT, to address and mitigate current TMDLs in the watershed and to proactively improve conditions so that the impairments on the current 303d list will not reach the stage of TMDL development.

4.0 Watershed Review

4.1 Land Cover/Land Uses

Land use activities have a significant impact on the types and quantity of nutrient and sediment transfer in the watershed which has an influence on the Eutrophication and Siltation TMDLs for Pomona Lake. Construction projects in the watershed and in communities can leave disturbed areas of soil and unvegetated roadside ditches that can wash in a rainfall event. In addition, agricultural cropland that is under conventional tillage practices and a lack of maintenance of agricultural BMP structures can have cumulative effects on land transformation through sheet and rill erosion. The Pomona Watershed covers 205,359 acres. Grassland is the predominant land usage (56 percent) for the watershed. Grassland can contribute *E. coli* bacteria from livestock manure if the livestock have access to streams and ponds. Erosion can occur from pathways made by livestock in creeks or gullies in pastures. Crop production land usage is also 26 percent. Cropland is the source of sediment from overland flow, nutrients from overuse or application of fertilizers prior to a rainfall event, and E. coli bacteria from manure applied before a rainfall event. Woodland, water, and urban areas constitute the remaining 16 percent of land cover. Properly managed woodland with a good understory does not contribute much sediment or nutrients to the watershed. Woodland located along rivers and streams provides a good buffer to prevent streambank erosion.

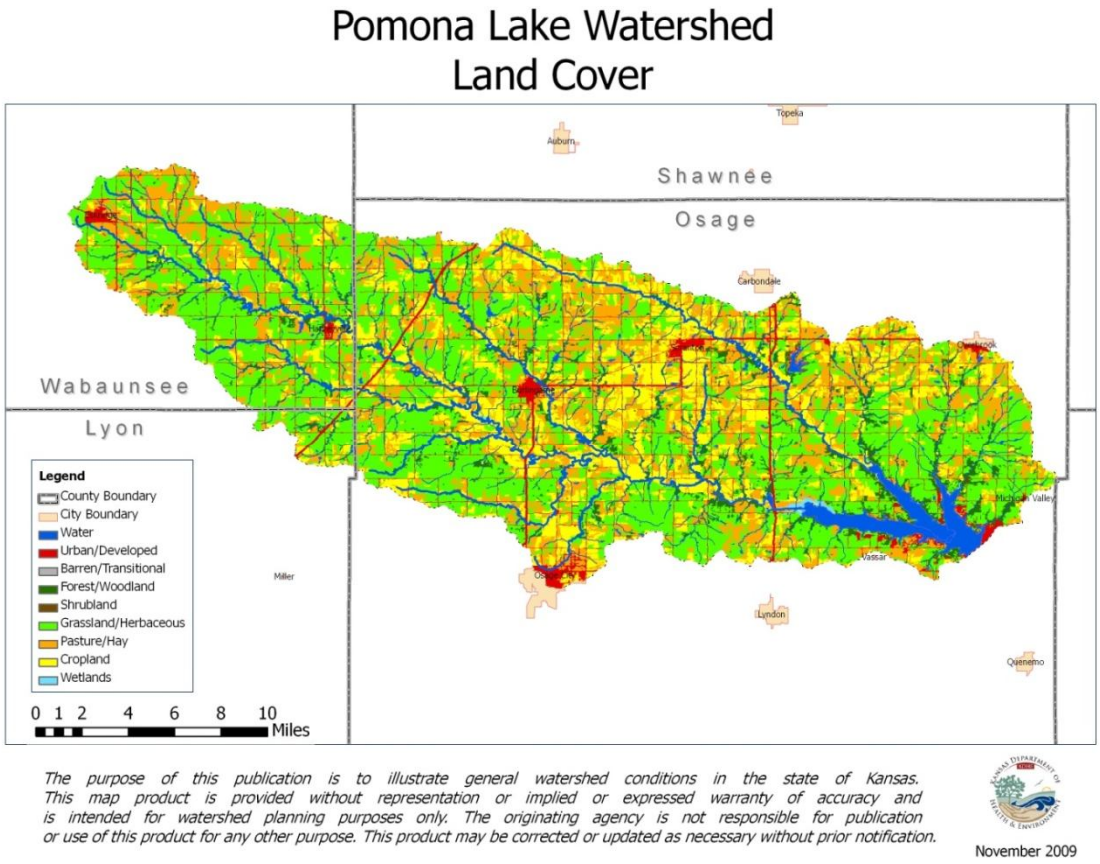


Figure 6 Land Use of the Pomona Watershed.

Table 1 Land Use in the Watershed. [3]

Land Use	*Acres*	*Area*
Grassland	113,779	55.4%
Cropland	53,441	26.0%
Woodland	18,577	9.0%
CRP	11,351	5.5%
Water	5,251	2.6%
Urban	2,768	1.3%
Other	193	0.1%
Total	**205,360**	

4.2 Designated Uses

The streams and lakes in Pomona Watershed have many designated uses according to the Kansas Surface Water Register prepared and maintained by Kansas Department of Health and Environment, Division of Environment, Bureau of Environmental Field Services. Designated uses for the Pomona Lake Watershed include domestic water supply use, food procurement, ground water recharge, industrial water supply, irrigation and livestock watering. Pomona Lake

is a general purpose water also designated for aquatic life use and contact recreational use – primarily swimming and boating.

Waters that will come into contact with human skin should be of higher quality than waters used for watering livestock. Therefore, each "designated use" category has a different water quality standard associated with it. When water does not meet its "designated use" water quality standard then the water is considered "impaired."

Table 2 Designated Water Uses for the Pomona Watershed, 2009. [4]

Designated Water Uses								
Lake Name	AL	CR	DS	FP	GR	IW	IR	LW
Harveyville Lake	E	A	X	X	X	X	X	X
Osage Co. S.F.L.	E	B	X	X	O	X	X	X
Pomona Lake	E	A	X	X	X	X	X	X
Scranton City Lake	E	B		X				
Stream Name	AL	CR	DS	FP	GR	IW	IR	LW
Batch Creek	E	b	X	O	X	X	X	X
Dragoon Creek	E	C	X	X	X	X	X	X
110 Mile Creek (Seg 25)	E	b	X	O	X	X	X	X
110 Mile Creek (Seg 20)	E	B	X	X	X	X	X	X
Mud Creek (Seg 49)	E	b	O	O	X	O	X	X
Mud Creek (Seg 78)	E	b	X	X	X	X	X	X
Mud Creek (Seg 91)	E	b	X	O	X	X	X	X
Plum Creek	E	b	O	O	X	O	O	X
Popcorn Creek	E	b	X	X	X	X	X	X
Smith Creek	E	b	O	O	O	O	X	X
Soldier Creek	E	b	X	X	X	X	X	X
Switzler Creek	E	b	X	O	X	X	X	X
Unnamed Stream	E	b	X	X	X	X	X	X

AL = Aquatic Life Support
CR = Contact Recreation Use
DS = Domestic Water Supply
FP = Food Procurement
GR = Groundwater Recharge
IW = Industrial Water Supply
IR = Irrigation Water Supply
LW = Livestock Water Supply
A=Primary contact recreation lakes that have a posted public swimming area
b=Secondary contact recreation stream segment is not open to and accessible by the public under Kansas law
B=Primary contact recreation lakes that are by law or written permission of the landowner open to and accessible by the public
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

4.3 Special Aquatic Life Use and Exceptional State Waters

Special Aquatic Life Use (SALU) waters are defined as "surface waters that contain combinations of habitat types and indigenous biota not commonly found in the state, or surface waters that contain representative populations of threatened or endangered species". The Pomona Watershed does not have any listings of SALU waters in the watershed. **Exceptional State Waters (ESW)** are defined as "any of the surface waters or surface water segments that are of remarkable quality or of significant recreational or ecological value". There are no ESW in this watershed.

4.4 Rainfall and Runoff

Rainfall rates and duration will affect sediment and nutrient runoff during high rainfall events. The Pomona Watershed averages 42 inches of rainfall yearly. Most high intensity rainfall events will occur in late spring and early summer. This is the time when crop ground is either bare or crop biomass is small. Also, grassland is short and does not catch runoff. Both of these situations can lead to pollutants entering the waterways.

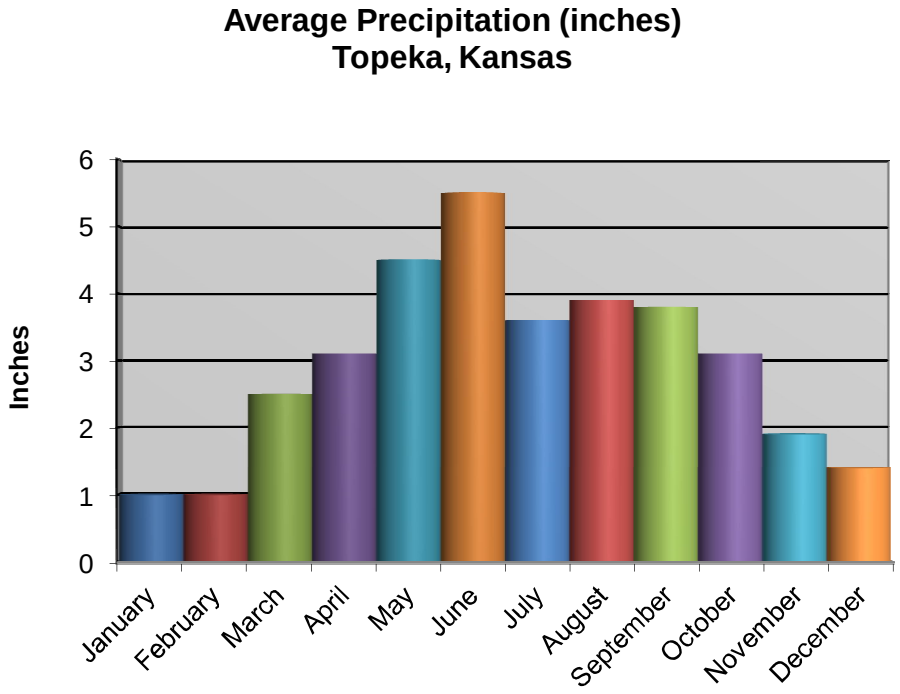


Figure 7. Average Precipitation by Month. [5]

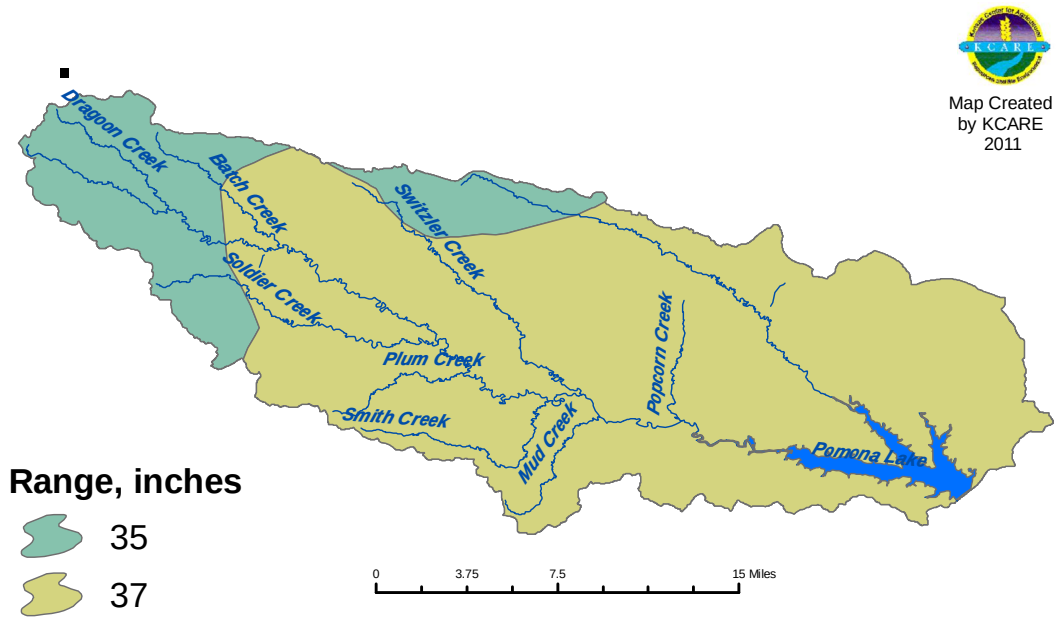


Figure 8 Average Yearly Precipitation in the Watershed. [6]

4.5 Population and Wastewater Systems

The number of wastewater treatment systems is directly tied to population, particularly in rural areas that do not have access to municipal wastewater treatment facilities. Failing, improperly installed or lack of an onsite wastewater system can contribute *E. coli* Bacteria or nutrients to the watershed through leakage or drainage of untreated sewage. 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 ten percent of wastewater systems in the watershed are failing or insufficient. [7] Therefore, the exact number of systems is directly tied to population.

Table 3. Population in the Major Counties of the Watershed. [8]

County	Population, 2009	Persons per square mile, 2009	Population Change (2000 to 2009), %
Lyon	35,562	42.2	-1.0
Osage	16,104	23.7	-3.6
Wabaunsee	6,922	8.6	0.5
Watershed Counties	**58,588**	**Average: 24.8**	**Average: -1.4**

Most of the watershed would be considered below average population. There are no major urban areas in the watershed. The Kansas average population density represented as persons per square mile is 32.9, whereas, the average for the watershed is 24.8.

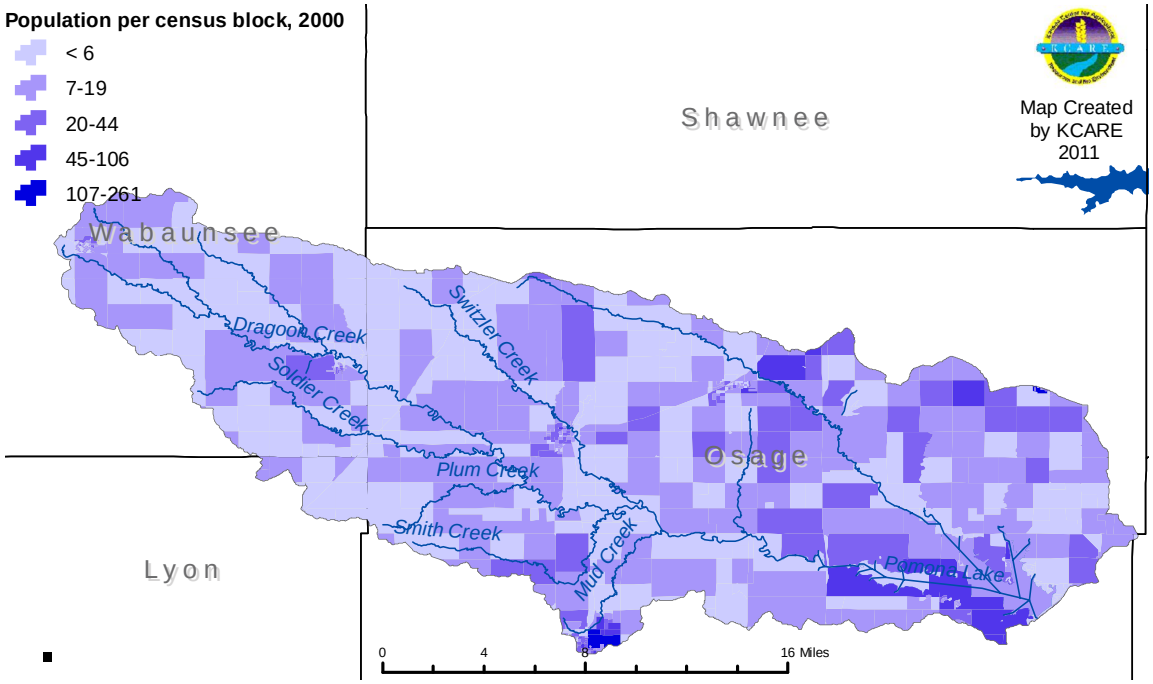


Figure 9 Census Count, 2000. [9]

4.6 Aquifers

One aquifer underlies the watershed:

- Alluvial Aquifer - An alluvial aquifer is a part of and connected to a river system and consists of sediments deposited by rivers in the stream valleys. Creeks that have alluvial aquifers are One Hundred Ten Mile Creek, Switzler Creek and Dragoon Creek.

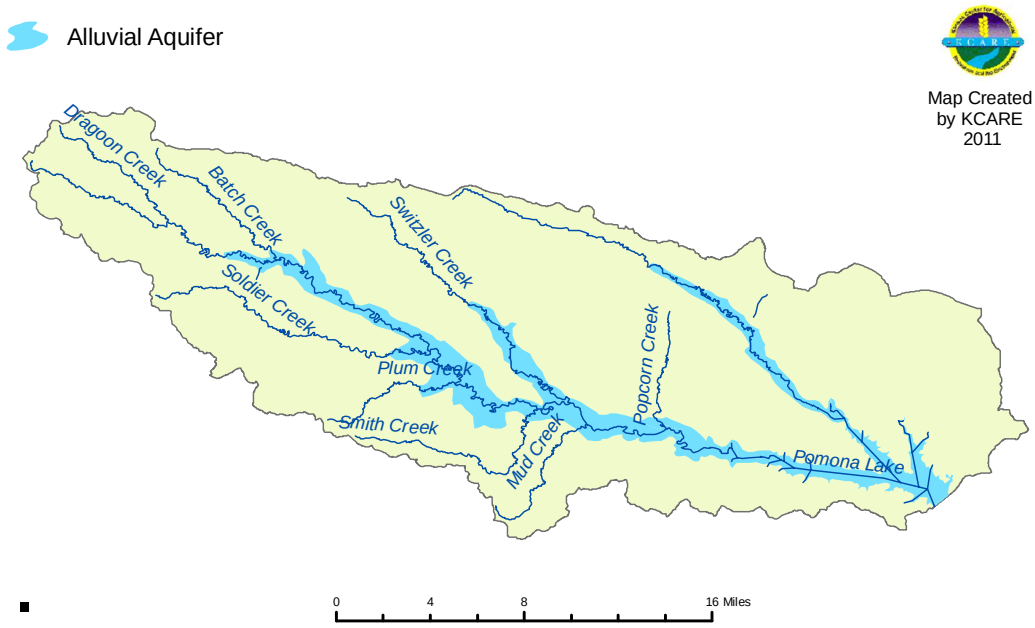


Figure 10 Alluvial Aquifers in the Watershed. [10]

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

A Public Water Supply (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 bacteria will also affect surface water supplies causing excess cost in treatment prior to public consumption.

Pomona Lake serves as a public water supply. The State of Kansas water assurance district #3 has purchased storage from Pomona Lake for use in the basin. Osage County Rural Water Districts #3 and #9 utilize Pomona Lake for the water source to supply to their users. Pomona Lake also serves or has the potential to serve Douglas County Rural Water District's #2, #3 and #5 and Osage County Rural Water Districts #2 and #8 and Shawnee County Rural Water District #8 as well as the City of Overbrook according to Kansas Department of Health and Environment, Division of Environment, Bureau of Water, Public Water Supply Section. Burlingame and Harveyville also have public water supply intakes in the watershed.

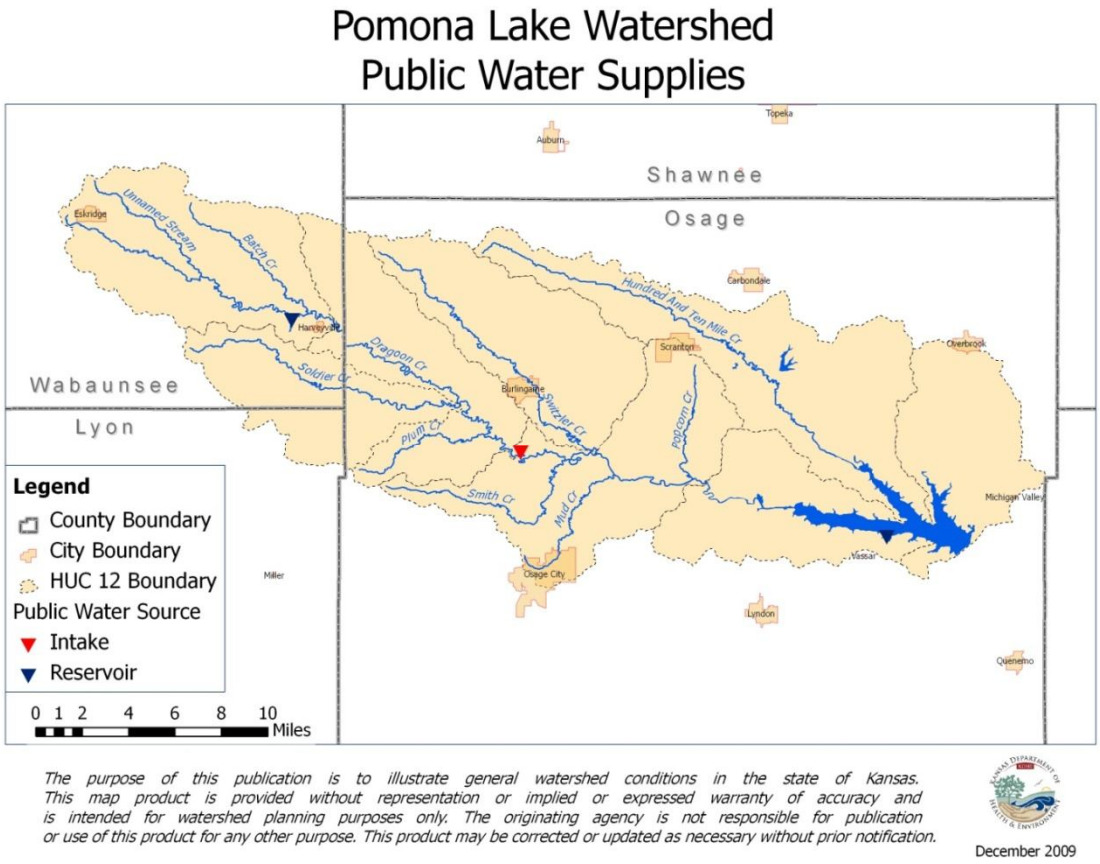


Figure 11. PWS in the Pomona Watershed. [11]

Wastewater treatment facilities are permitted and regulated through KDHE. 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 wastewater can contain suspended solids, biological pollutants that reduce oxygen in the water column, inorganic compounds or bacteria. Wastewater will be treated to remove solids and organic materials, disinfected to kill bacteria and viruses, and discharged to surface water. Treatment of municipal wastewater is similar across the country. Industrial point sources can contribute toxic chemicals or heavy metals. Treatment of industrial wastewater is specific to the industry and pollutant discharged. [12] Any pollutant discharge from point sources that is allowed by the state is considered to be Wasteload Allocation.

Table 4 Permitted Point Source Facilities. [13]

Facility Name	Ownership	Description	City	County
Pomona Lake – Michigan Valley	Public	Rec Vehicle Parks and Campsites	Vassar	Osage
Gloss Quarry #6	Private	Crushed and Broken Limestone	Perry	Jefferson

Burlingame	Public	Sewerage System	Burlingame	Osage
Scranton	Public	Sewerage System	Scranton	Osage
Harveyville	Public	Sewerage System	Harveyville	Wabaunsee
Eskridge	Public	Sewerage System	Eskridge	Wabaunsee

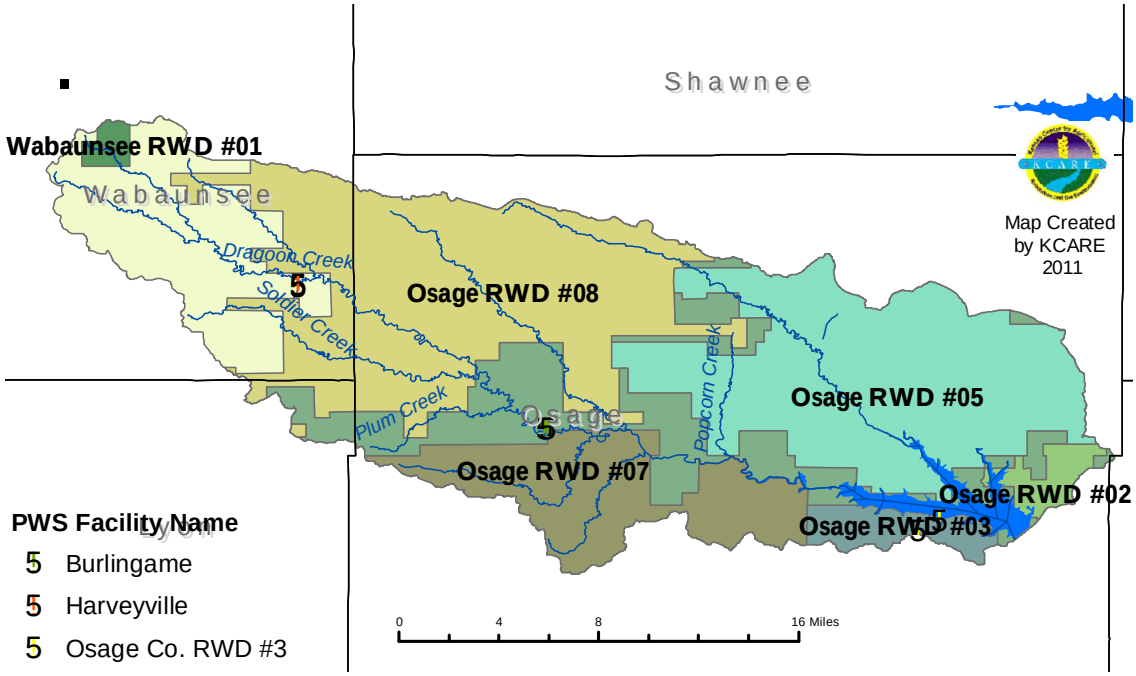


Figure 12 Rural Water Districts, Public Water Supply Diversion Points and NPDES Wastewater Treatment Plants (WTP). [14]

The 1990 Population and Sewerage by Census Tract can be used to examine specific areas for population density and the prevalence of septic systems, which can be significant sources of pathogens, household chemicals, and nutrients (especially nitrate) escaping into groundwater and nearby receiving water bodies.

Table 5. 1990 Population and Sewerage by Census Tract. [15]

ID	Tract	Population	House Units	Sewerage Public	Sewerage Septic	Sewerage Other
0	9,832	2,554	1,205	384	767	54
1	101	4,156	1,533	945	565	23
2	102	2,908	1,185	694	479	12
3	105	3,210	1,474	698	740	36
4	6	2,595	1,047	297	693	57
5	103	2,181	891	198	675	18
6	104	2,793	1,241	1,177	64	0

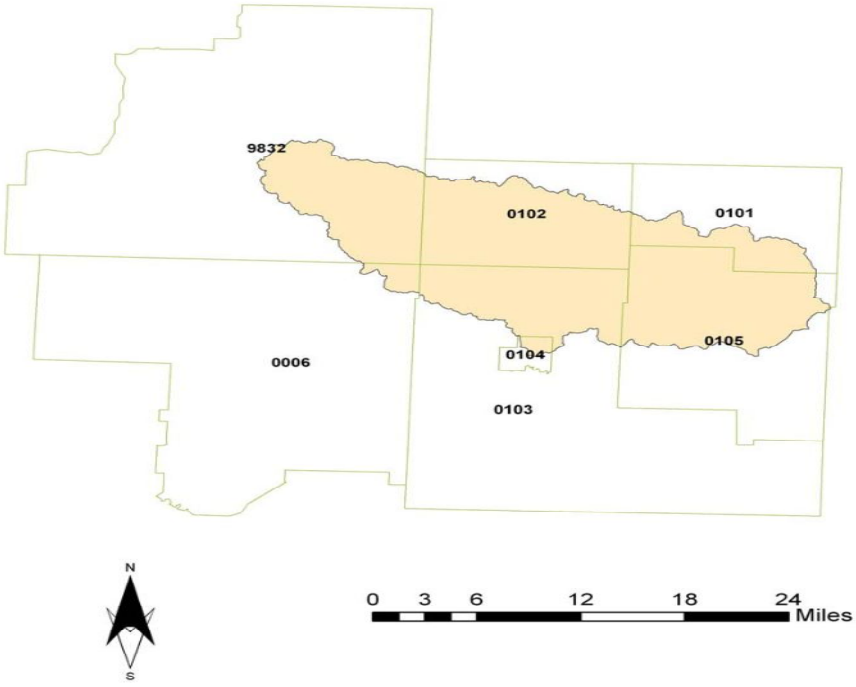


Figure 13. Reference Map for Population and Sewerage by Census Tract.

4.8 Total Maximum Daily Loads in the Watershed

A Total Maximum Daily Load (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 for approval. The desired outcome of the TMDL process is indicated, using the current situation as the baseline. Deviations from the water quality standards 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. [16] 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 Marais des Cygnes Basin.

Table 6. TMDLs Review Schedule for the Marais des Cygnes Basin. [17]

Year Ending in September	Implementation Period	Possible TMDLs to Revise	TMDLs to Evaluate
2012	2013-2022	2001	2001
2017	2018-2027	2001, 2007	2001, 2007

Pollutants are assigned "categories" depending on stage of TMDL development: [18]

- Category 5 – Waters needing TMDLs
- Category 4a – Waters that have TMDLs developed for them and remain impaired
- Category 4b – NPDES permits addressed impairment or watershed planning is addressing impairment
- Category 4c – Pollution (typically insufficient hydrology) is causing impairment
- Category 3 – Waters that are indeterminate and need more data or information
- Category 2 – Waters that are now compliant with certain water quality standards
- Category 1 – All designated uses are supported, no use is threatened

TMDLs in the watershed are listed in the table below.

Table 7. TMDLs in the Watershed. [19] The table below indicates high priority TMDLs within the Pomona Lake Watershed (there are no medium or low priority TMDLs at the time of this report). The **bold** impairments indicate ones that will be directly addressed by this WRAPS plan, and those in *italics* indicate impairments which will benefit from implementation of this plan.

Water Segment	TMDL Pollutant	End Goal of TMDL	Priority	Sampling Station
High Priority				
Dragoon Creek	*Dissolved Oxygen*	*Average BOD < 3.2 mg/l No excursions < 5mg/l*	*High*	*SC577*
One Hundred Ten Mile Creek	*Dissolved Oxygen*	*DO > 5mg/l Average BOD < 2.6 mg/l*	*High*	*SC633*
Switzler Creek	*Dissolved Oxygen*	*Average BOD < 3.2 mg/l No excursions < 5mg/l*	*High*	*SC687*
Pomona Lake	**Eutrophication**	**Summer Chlorophyll a ≤ 12 ug/l**	**High**	**LM028001**
Pomona Lake	**Siltation**	**Secchi Disc Depth ≥ 0.85m**	**High**	**LM028001**

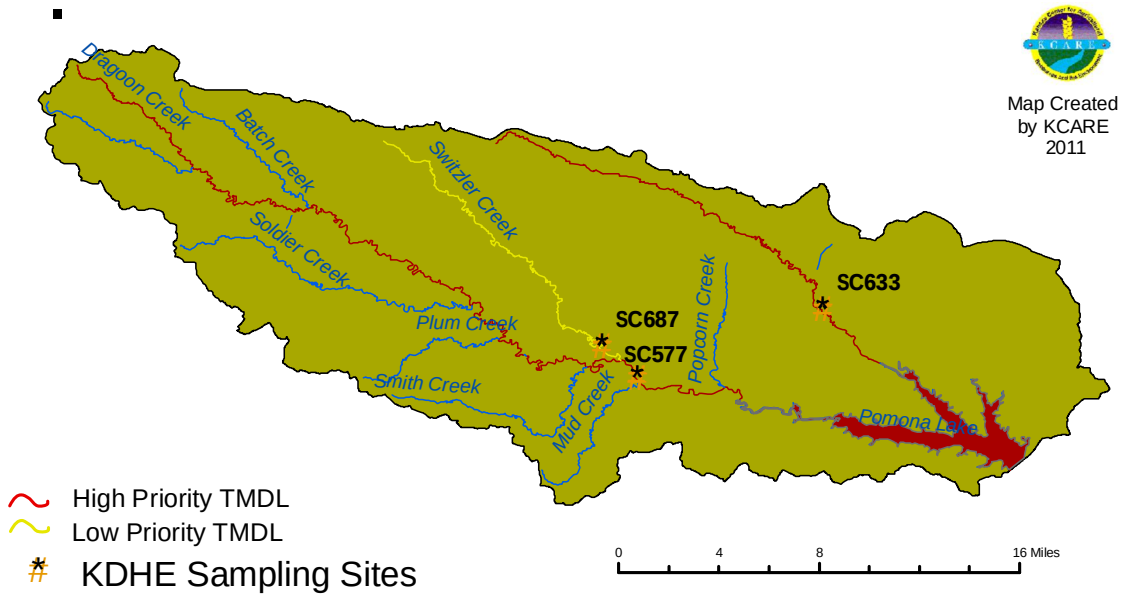


Figure 14 TMDLs in the Watershed. [20]

4.9 303d Listings in the Watershed

The Pomona Watershed has new listings on the 2010 "303d list". A 303d list of impaired waters is developed biennially and submitted by KDHE to EPA. To be included on the 303d list, samples taken during the KDHE monitoring program must show that water quality standards are not being met. This in turn means that designated uses (refer to page 24) are not met. TMDL development and revision for waters of the Pomona Watershed is scheduled for 2012. TMDLs will be developed over the subsequent two years for "high" priority impairments. Priorities are set by work schedule and TMDL development timeframe rather than severity of pollutant. If it will be greater than two years until the pollutant can be assessed, the priority will be listed as "low".

Table 8. 2010 303d List of Impaired Waters in the Pomona Watershed. [21]

Category	Water Segment	Impairment	Priority	Sampling Station
Low Priority				
5 – Waters needing TMDL	110 Mile Creek	Atrazine	Low – recent trends do not indicate concern	SC633
5 – Waters needing TMDL	Switzler Creek	Atrazine	Low	SC687

Table 9. 2010 303d Delisted Waters in the Pomona Watershed. [22]

Category	Water Segment	Impairment	Comment	Sampling Station
2 – Waters now compliant	Dragoon Creek	Fecal Coliform	Cat 2 – HB2219	SC577
2 – Waters now compliant	Switzler Creek	Lead	Cat 2 – Unstable flow analysis	SC687
2 – Waters now compliant	Switzler Creek	Selenium	No longer impaired	SC687
2 – Waters now compliant	110 Mile Creek	Zinc	No longer impaired	SC633
2 – Waters now compliant	Switzler Creek	Zinc	No longer impaired	SC687

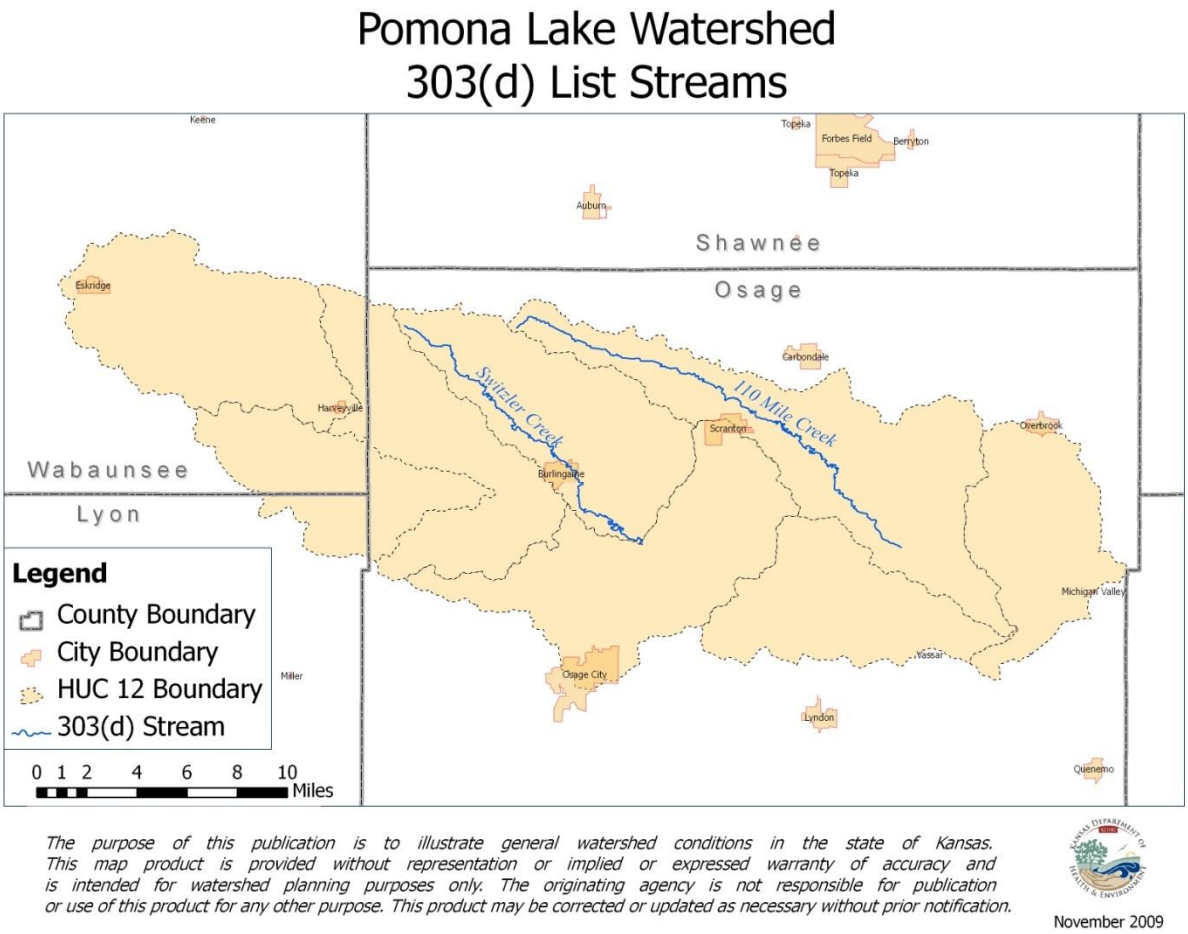


Figure 15. 303d List Impaired Streams in the Watershed. [212]

4.10 Load Reductions [23]

TMDL loading is based on several factors. A total load is derived from the TMDL. Part of this total load is wasteload allocation. This portion comes from point sources in the watershed: NPDES facilities, Confined Animal Feeding Operation (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 Allocation. 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 BMPs derived by the SLT will be directed at this Load Allocation by nonpoint sources.

4.10.1 Load Reductions to Meet the Siltation TMDL in Pomona Lake

KDHE has set a required load reduction goal for sediment in Pomona Lake originating from nonpoint sources. It is derived from subtracting the TMDL from the current loading in the watershed. This is the amount that the Pomona Watershed will need to remove through BMP installations, conservation practices and streambank and riparian restorations.

Table 10. Load Reductions to Meet Siltation TMDL Pomona Lake. [24]

	Annual Loading of Sediment (tons)
Current Condition	229,125.6
Less TMDL	104,544.0
Required Load Reduction from Nonpoint Sources	**124,581.6**

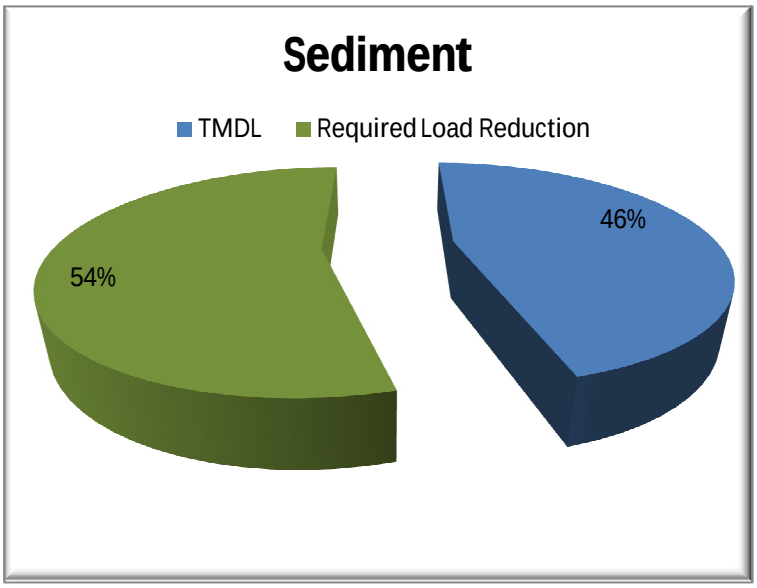


Figure 16. Sediment Load Reduction for Pomona Lake Watershed.

4.10.2 Load Reductions to Meet Eutrophication TMDL for Pomona Lake

KDHE has set a required load reduction goal for phosphorus for Pomona Lake originating from nonpoint sources. It is derived from subtracting the TMDL from the current loading in the lake. This is the amount that the Pomona Lake Watershed will need to remove through BMP installations and conservation practices.

Table 11. Load Reductions to Meet Eutrophication TMDL for Pomona Lake. [25]

	Annual Loading of Phosphorus (pounds)
Current Condition (SWAT calculated)	153,194
Less TMDL	55,150
Required Load Reduction from Nonpoint Sources	**98,044**

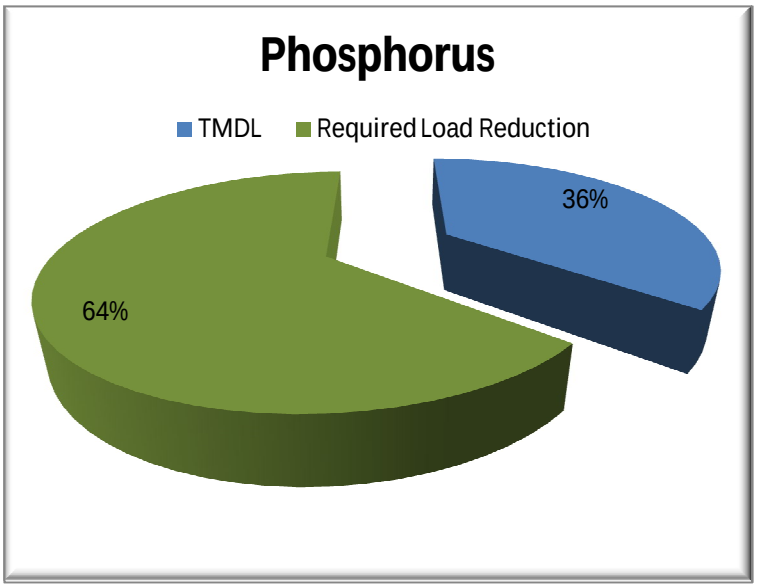


Figure 17. Phosphorus Load Reduction for Pomona Lake.

5.0 Critical and Targeted Areas, and Load Reduction Methodology

5.1 Critical Areas

In the Pomona Watershed, "Critical Areas" have been identified as areas that need to be protected or restored, such as areas that have TMDLs, emerging pollutant threats, on the 303d list or contain a public water supply. Critical areas are defined by EPA as geographic areas that are critical to implement management practices in order to achieve load reductions. [26] Three areas have been identified as Critical Areas in this WRAPS:

1. Sub watersheds that have been identified by Watershed Assessment Tools as a potential source of pollutants,
2. Sub watersheds with high priority TMDLs
3. Sub watersheds that contain lakes that are public water supplies and/or provide public recreation.

5.2 Targeted Areas

"Targeted Areas" are those specific areas in the Critical Areas that require BMP placement in order to meet load reductions. The Targeted Areas that have been identified in this WRAPS are:

1. Cropland areas targeted for sediment and nutrient runoff
2. Livestock areas targeted for nutrient runoff
3. Streambank and riparian areas for sedimentation and nutrients
4. High Priority TMDL area targeted for sediment and nutrient runoff

There is significant overlap in these targeted areas which is to the benefit of water quality in that applying BMPs for one pollutant will also positively affect other pollutants. Detailed discussion of each Targeted Area follows in the next sections of this report.

Table 12. Overlapping Targeted Areas for Cropland, Livestock and High Priority TMDLs.

Targeted Areas	Cropland Sediment	Cropland Nutrients	Livestock Nutrients	Streambank and Riparian	High Priority TMDLs
Dragoon Creek	X	X	X	X	X
Pomona Lake	X	X	X		X
110 Creek	X	X	X	X	X
Switzler Creek	X	X	X		X

The following map displays the Targeted Areas of the watershed. For simplification, these areas will be labeled in this report by the last digit in the HUC 12 number, as follows"

- 102901010201 – label #1
- 102901010202 – label #2
- 102901010203 – label #3
- 102901010204 – label #4
- 102901010205 – label #5
- 102901010206 – label #6
- 102901010207 – label #7
- 102901010208 – label #8

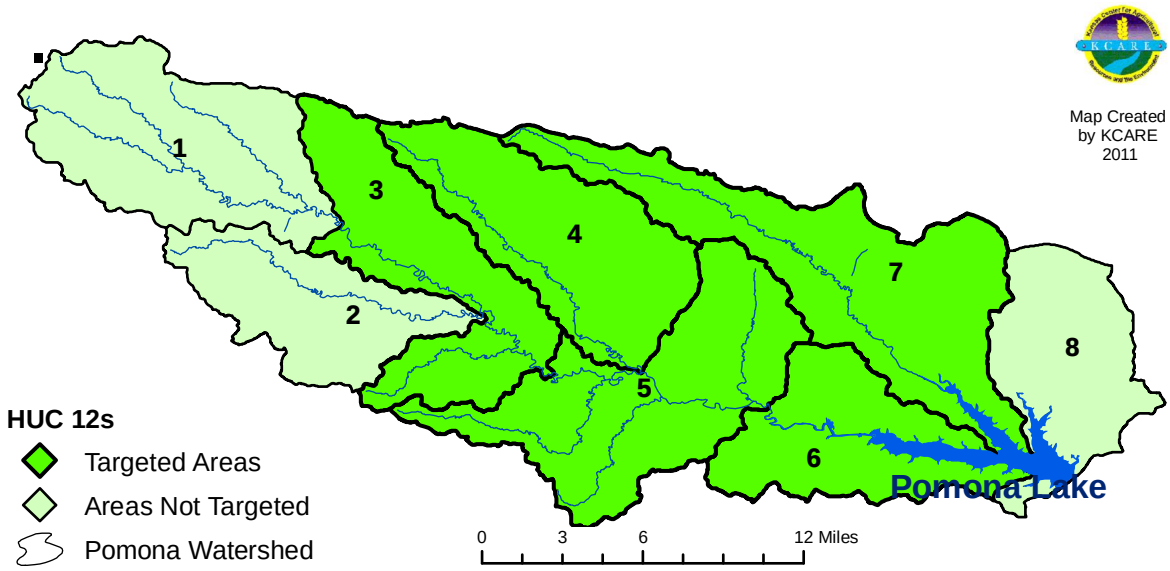


Figure 18. Targeted Areas for Cropland, Livestock and High Priority TMDLs.

5.2.1 Cropland Targeted Areas

The Pomona Lake Watershed was assessed using the Soil and Water Assessment Tool (SWAT) by Kansas State University Department of Biological and Agricultural Engineering. SWAT was used as an assessment tool to estimate annual average pollutant loadings such as nutrients and sediment that are coming from the land into the stream. At the end of simulation runs the average annual loads are calculated for each sub watershed. Some areas have higher loads than the others. Based on experience and technical knowledge, the areas or sub watersheds with the top 20 to 30 percent of the highest loads among all areas within the watershed are selected as critical (targeted) areas for cropland and livestock BMPs implementation.

The SWAT model was developed by USDA-ARS from numerous equations and relationships that have evolved from years of runoff and erosion research in combination with other models used to estimate pollutant loads from animal feedlots, fertilizer and agrochemical applications, etc. The SWAT model has been tested for a wide range of regions, conditions, practices, and time scales. Evaluation of monthly and annual stream flow and pollutant outputs indicate SWAT functioned well in a wide range of watersheds. The model directly accounts for many types of common agricultural conservation practices, including terraces and small ponds; management practices, including fertilizer applications; and common landscape features, including grass waterways. The model incorporates various grazing management practices by specifying amount of manure applied to the pasture or grassland, grazing periods, and amount of biomass consumed or trampled daily by the livestock. Septic systems, NPDES discharges, and other point-sources are considered as combined point-sources and applied to inlets of sub watersheds. These features made SWAT a good tool for assessing rural watersheds in Kansas.

The SWAT model is a physically based, deterministic, continuous, watershed scale simulation model developed by the USDA Agricultural Research Service. ArcGIS interface of ArcSWAT version 9.2 was used. It uses spatially distributed data on topography, soils, land cover, land management, and weather to predict water, sediment, nutrient, and pesticide yields. A modeled watershed is divided spatially into sub watersheds using digital elevation data according to the drainage area specified by the user. Sub watersheds are modeled as having non-uniform slope, uniform climatic conditions determined from the nearest weather station, and they are further subdivided into lumped, non-spatial hydrologic response units (HRUs) consisting of all areas within the sub watershed having similar soil, land use, and slope characteristics. The use of HRUs allows slope, soil, and land-use heterogeneity to be simulated within each sub watershed, but ignores pollutant attenuation between the source area and stream and limits spatial representation of wetlands, buffers, and other BMPs within a sub watershed.

The model includes sub basin, reservoir, and channel routing components.

1. The sub basin component simulates runoff and erosion processes, soil water movement, evapotranspiration, crop growth and yield, soil nutrient and carbon cycling, and pesticide and bacteria degradation and transport. It allows simulation of a wide array of agricultural structures and practices, including tillage, fertilizer and manure application, subsurface drainage, irrigation, ponds and wetlands, and edge-of-field buffers. Sediment yield is estimated for each sub basin with the Modified Universal Soil Loss Equation (MUSLE). The hydrology model supplies estimates of runoff volume and peak runoff rates. The crop management factor is evaluated as a function of above ground biomass, residue on the surface, and the minimum C factor for the crop.

2. The reservoir component detains water, sediments, and pollutants, and degrades nutrients, pesticides and bacteria during detention. This component was not used during the simulations.
3. The channel component routes flows, settles and entrains sediment, and degrades nutrients, pesticides and bacteria during transport. SWAT produces daily results for every sub watershed outlet, each of which can be summed to provide daily, monthly, and annual load estimates. The sediment deposition component is based on fall velocity, and the sediment degradation component is based on Bagnold's stream power concepts. Bed degradation is adjusted by the USLE soil erodibility and cover factors of the channel and the floodplain. This component was utilized in the simulations but not used in determining the critical areas.

Data for the Pomona Lake SWAT model were collected from a variety of reliable online and printed data sources and knowledgeable agency personnel within the watershed. Input data and their online sources are:

1. NLCD 2001 land cover data layer (USDA-NRCS)
2. NLCD 1992 land cover data layer (USDA-NRCS)
3. USDA-NRI, 1997 resource inventory (NRCS)
4. Point sources (KDHE)
5. Crop rotation (local knowledge)
6. Septic system (National Environmental Service Center, NESC) Collected database (as described below)
7. Crop rotations
8. Grazing management practices (local knowledge)

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, 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 and nutrient runoff. Targeting for this watershed will be accomplished in three different areas:

1. Cropland areas will be targeted for sediment and nutrients (phosphorus and nitrogen),
2. Livestock areas will be targeted for nutrients (phosphorus),
3. Streambank and riparian areas will be targeted for sediment and nutrients (phosphorus), and
4. High priority TMDL areas will be targeted for sediment and nutrients (phosphorus).

The maps produced by the modeling are displayed below. It is noted that the darker or brighter the color on the map, the higher the pollutant load potential.

The watersheds in the central portion of the watershed show the greatest potential for erosion, phosphorus and nitrogen runoff. As stated earlier, this model accounts for land use, soil type, slope, and current conservation practices.

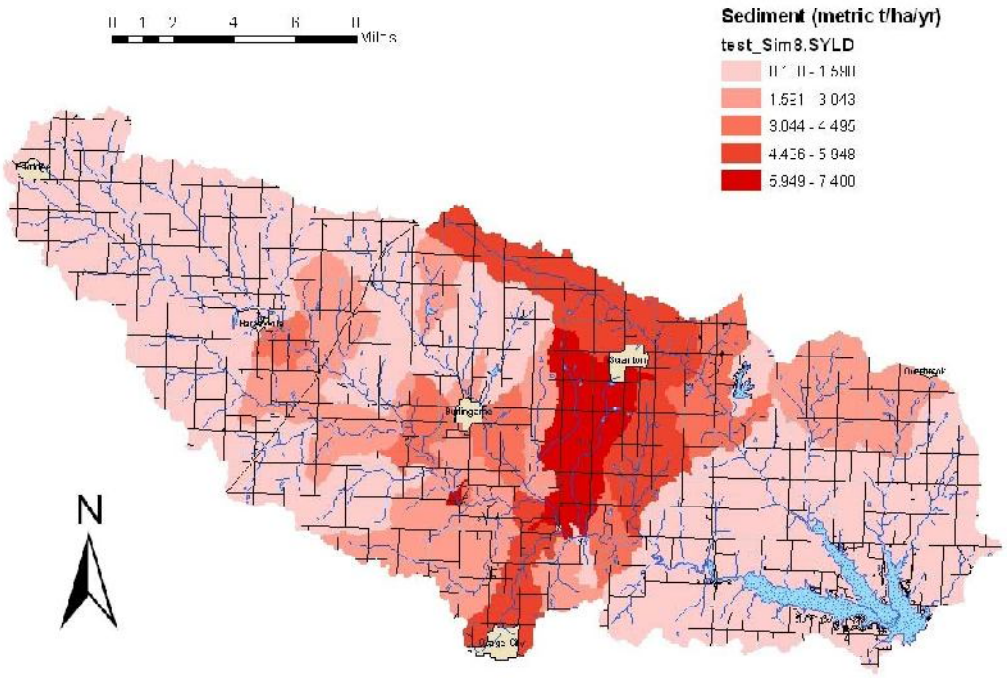


Figure 19. Sediment Yield (tons/acre) as Determined by SWAT.

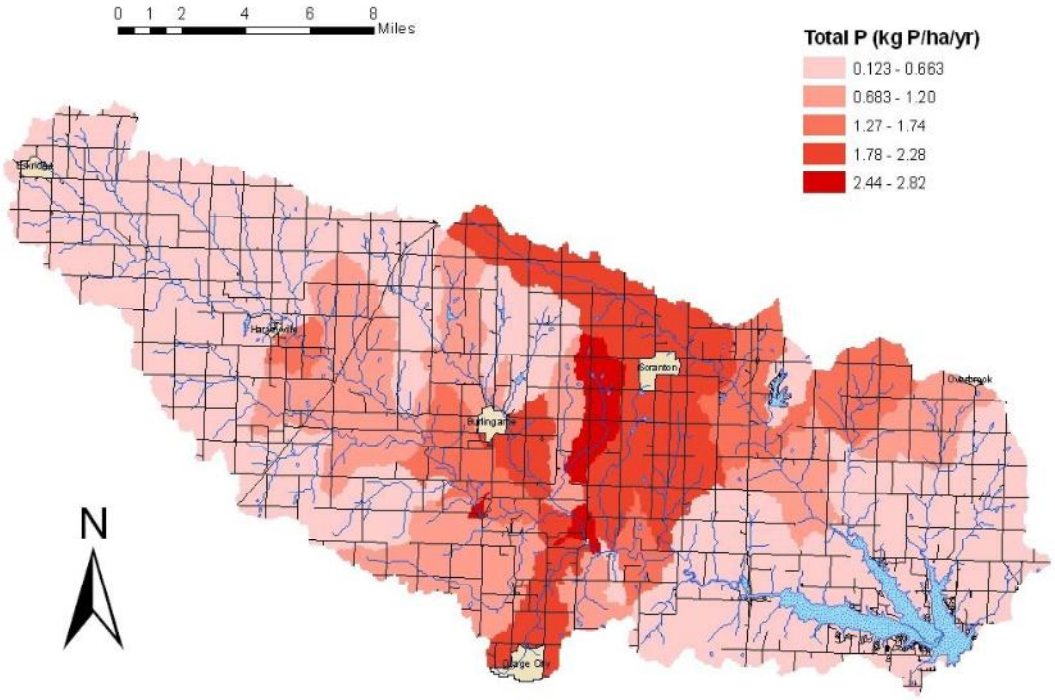


Figure 20. Phosphorus Yield (kg/ha/yr) as Determined by SWAT.

5.2.1.A Ground Truthing

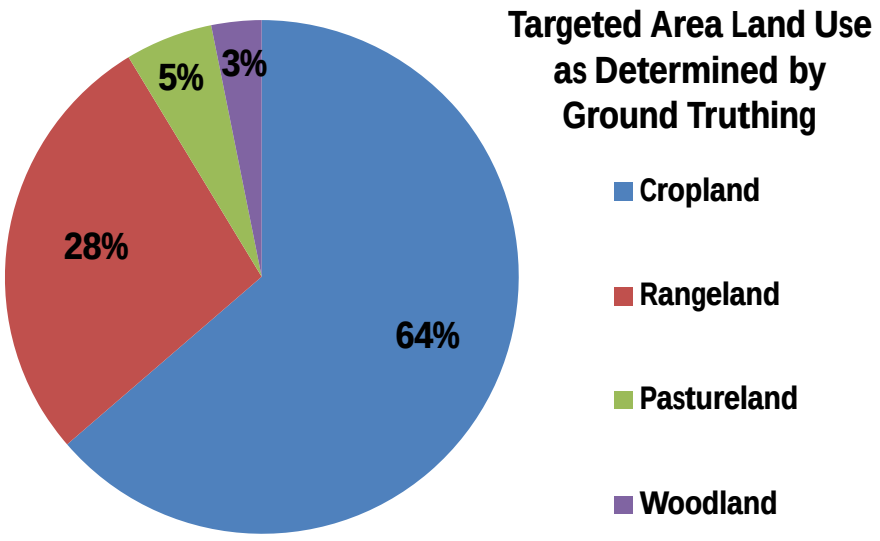
After locating initial critical targeted areas, the area was groundtruthed. Groundtruthing is a method used to determine what BMPs are currently being utilized in the targeted areas. It involves conducting windshield surveys throughout the targeted areas identified by the watershed models to determine which BMPs are currently installed. These surveys are conducted by local agency personnel and members of the SLT that are familiar with the area and its land use history. Groundtruthing provides the current adoption rate of BMPs, pictures of the targeted areas, and may bring forth additional water quality concerns not captured by watershed modeling.

Four members of the advisory board: Lori Kuykendall, District Manager, Rod Schaub, Extension Agent, Hershel George, Watershed Specialist and Tim

Gogolski, Natural Resources Conservation Service, drove a portion of the watershed that is in the high priority area to conduct “ground truthing”. They stopped at half-mile intervals and recorded what they saw on the NW, NE, SE and SW corners. Four hundred and seven points were recorded overall. Current and previous crops were noted. Residue cover, grassland condition, and farming practices (no-till or contour) were recorded. Also the presence of erosion was noted and the type of erosion. The percentages for this area were applied to the whole watershed when modeling was done. For instance, since 4 percent of the farmers in this area used no-till farming practices it was assumed that 4 percent of the entire watershed used no-till farming practices.

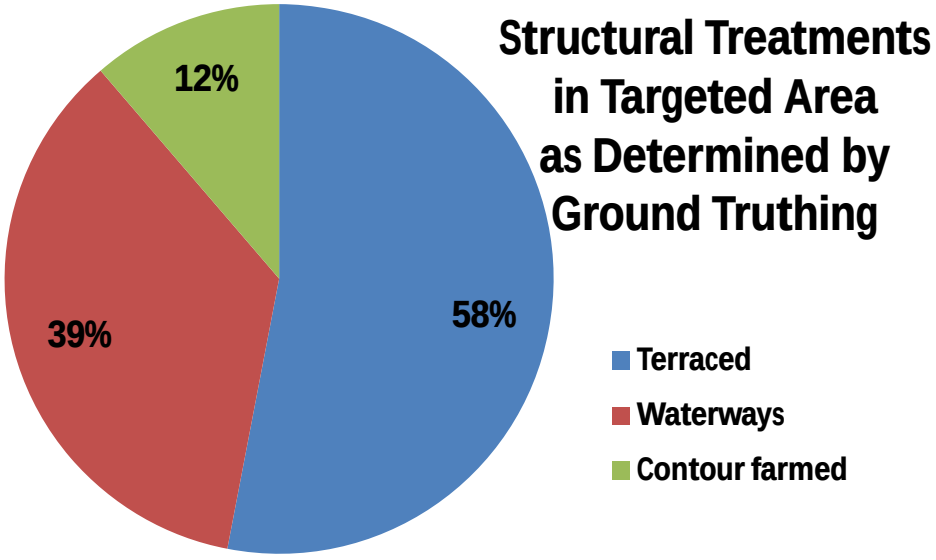
In 2007, of the 380 sites surveyed the following percentages and numbers apply to land use:

- **Cropland:** 64% (242 sites)
- **Rangeland:** 27% (105 sites)
- **Pastureland:** 6% (21 sites)
- **Woodland:** 3% (12 sites)



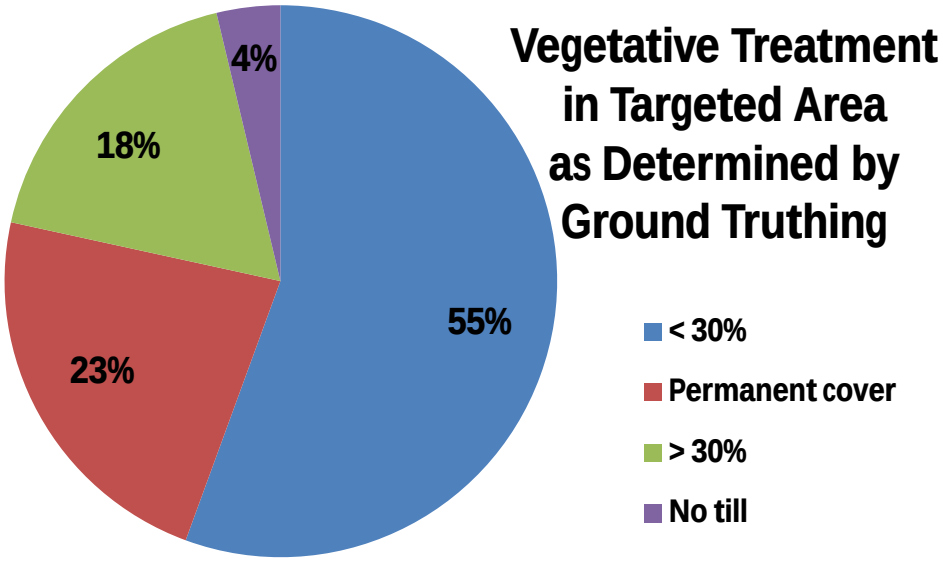
Of the 242 cropland sites surveyed the following information was also noted:

- **<u>Cropland with structural treatment</u>**
  - Terraced: 58% (141)
  - Waterways: 39% (95)
  - Contour farmed: 12% (30)



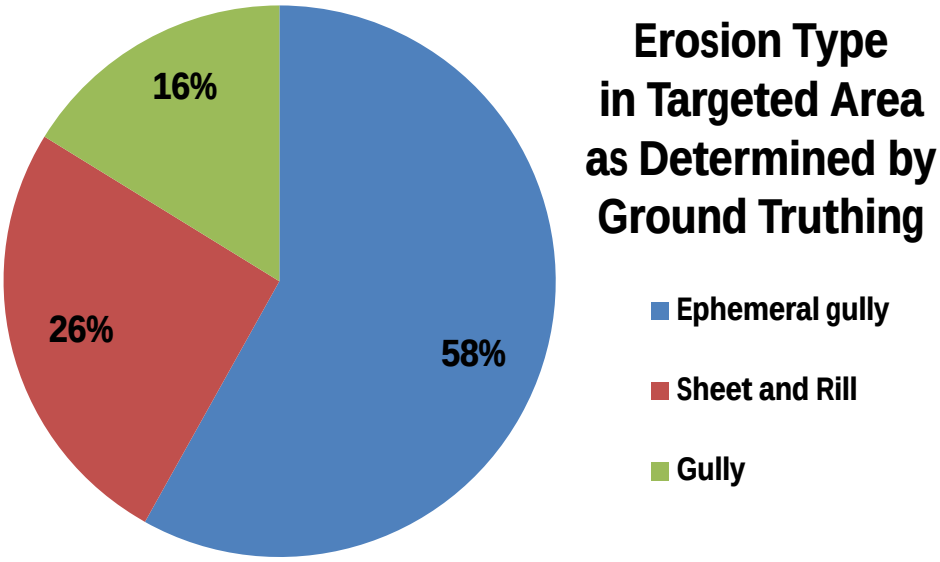
❖ **Cropland with vegetative treatment**

- Less than 30% crop residue: 55% (134)
- Permanent cover: 23% (55)
- Greater than 30% residue: 18% (43)
- No-till: 4% (9)



❖ **Erosion**

- Ephemeral gully: 28% (68)
- Sheet & Rill 12% (30)
- Gully: 8% (19)



The SWAT model was revised using the ground truthing information. This allows the SWAT model to develop a more accurate determination of appropriate targeted areas. The SWAT model then determined number of acres needed to be implemented for each BMP.

The SWAT model results were presented to the SLT. After discussion by the SLT, HUC 12 Targeted Areas were decided upon. The four HUC12s the SLT decided to target lie along the 110 Creek, Switzler Creek and portions of Dragoon Creek. It also includes the immediate area surrounding Pomona Lake. This provides a greater potential for improvement in water quality. After determining the Targeted Areas, the SLT decided upon BMPs that they felt would be beneficial to improving water quality and, using their knowledge of the watershed, would be acceptable to producers and landowners. The BMPs that will be implemented in the Cropland Targeted Area for this watershed are:

- Implement no-till cropping
- Implement nutrient management plans
- Install vegetative buffers
- Install terraces
- Install grassed waterways
- Establish grade stabilization
- Establish permanent vegetation

The SWAT model distinguished high priority areas and secondary areas for implementation. As indicated on the map below, areas 5 and portions of area 7 are high priority areas, and 3, 4, 6, and portions of 7 are secondary areas for focused BMP implementation. The SLT will focus BMP installation within these areas.

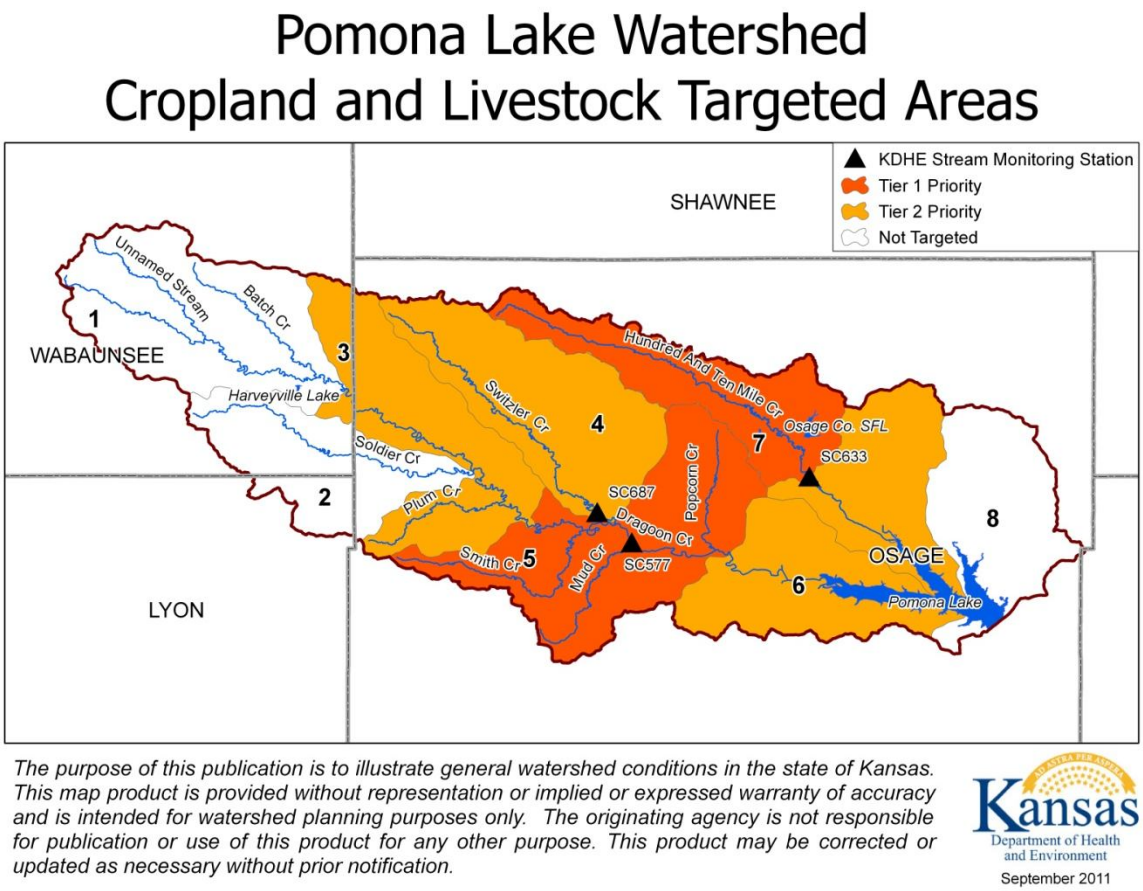


Figure 21. Cropland and Livestock Targeted Areas of the Pomona Watershed.

5.2.2 Livestock Targeted Area and High Priority TMDL Targeted Area

The Livestock Targeted Area and the High Priority TMDL Targeted Area cover the same geographic regions as the cropland targeted area; therefore, they will be addressed together. The livestock and high priority areas are targeted because of water monitoring results. Both areas will be targeted for nutrients.

Based on SLT opinion of landowner and producer acceptability, the BMPs that will be implemented over the 30 year period of this watershed plan are:

- Establish 30 acres of vegetative filter strips
- Relocate 30 feeding pens
- Relocate 75 pasture feeding sites
- Install 90 off stream watering systems

Staff from the Osage County Conservation District decided on these numbers based off the need they saw in the watershed as well as past adoption rates for these types of livestock BMPs.

5.2.3 Streambank and Riparian Targeted Area

The Streambank and Riparian Targeted Area cover HUCs 3, 5 and 7. These are the areas that include portions of Dragoon Creek and all of 110 Mile Creek. Several different streambank/riparian area assessments have been conducted within the Pomona Lake Watershed. The results of these assessment activities were used as the basis to determine amounts of streambank stabilization and riparian restoration needed within the watershed over the duration of the watershed plan.

In October 2010, the Kansas Alliance of Wetlands and Streams (KAWS) conducted a GIS assessment of the Dragoon Creek and 110 Mile Creek subwatersheds within the Pomona Lake Watershed. Aerial photography and land cover datasets were evaluated along the main stem of both of the previously mentioned streams to evaluate major streambank erosion sites that are in need of stabilization. This assessment activity also noted areas within 100 feet of either side of these streams that are in need of protection or restoration based off of the prevailing land cover type identified by the assessment. The final results of this assessment indicate that approximately 7,800 linear feet of streambank on the main stems of Dragoon and 110 Mile Creeks are potentially in need of rehabilitation/stabilization. Further information regarding this assessment can be found at the following web address:

http://www.kaws.org/files/kaws/Dragoon%20Creek%20+%20110%20Mile%20Creek%20Stream%20Assessment.pdf

The Kansas Water Office (KWO) recently completed a streambank and gully assessment for the Pomona Lake Watershed. KWO staff used GIS techniques to evaluate changes in streambank within the watershed as observed from aerial photography over a 17 year period between 1991 and 2008. Areas where noticeable changes were detected over this period were delineated using GIS software, and then field verification took place to attempt to quantify sediment loads originating from areas of failing streambank and or gullies. In addition to areas in need of streambank stabilization, areas where gullies were observed were also delineated. In total there were 82 gullies identified from this assessment activity which could be contributing a higher sediment load to Pomona Lake than what can be quantified at this time. Numerous other gullies could be present within the watershed, thus the need for additional assessment activities to characterize the contribution of gullies to the sediment loading of Pomona Lake could be viewed as justified. Riparian area restoration activities will help to address many of the gullies identified within the KWO assessment. This assessment is still in draft status as of July 2011. A pdf of the draft assessment can be found at the following location:

http://www.kwo.org/projects_programs/Steambank_Assessments/Rpt_MDC_Pomona_SBAssessment&Gully_071911_ap.pdf

Taking into consideration the results of both of the previously mentioned assessment activities, the SLT wishes to address 260 feet of streambank stabilization/restoration annually and 458 acres of riparian area restoration annually. BMP implementation work in both of these categories will help to address sedimentation issues currently noted for Pomona Lake.

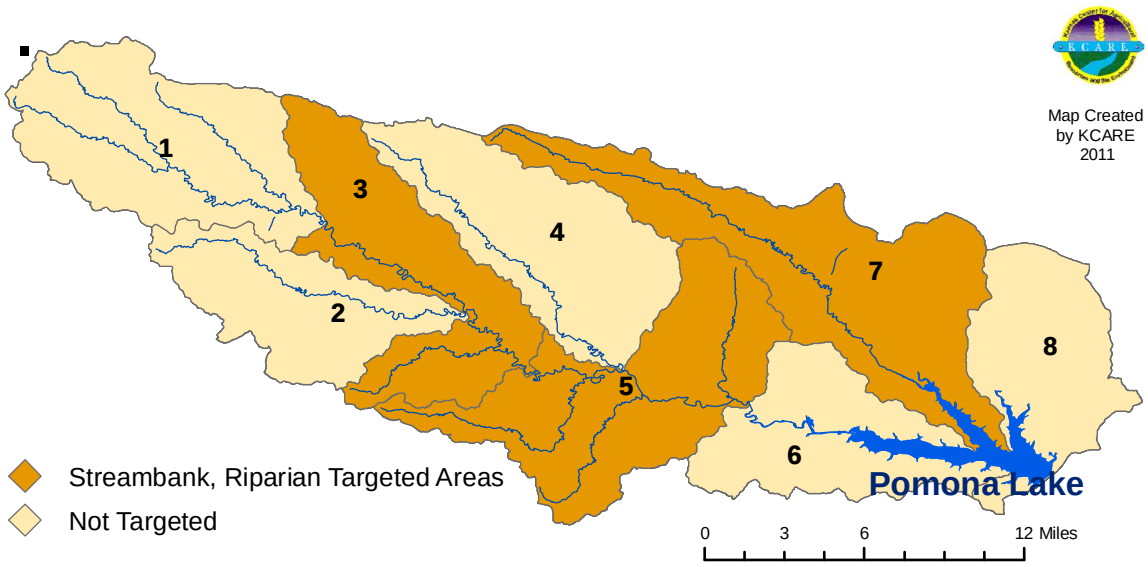


Figure 22.. Streambank and Riparian Targeted Areas.

5.3 Load Reduction Estimate Methodology

5.3.1 Cropland

Baseline loadings are calculated using the AnnAGNPS model delineated to the HUC 12 watershed scale. BMP load reduction efficiencies are derived from K-State Research and Extension Publication MF-2572. [27] Load reduction estimates are the product of baseline loading and the applicable BMP load reduction efficiencies.

5.3.2 Livestock

Baseline nutrient loadings per animal unit are calculated using the Livestock Waste Facilities Handbook.[28] Livestock management practice load reduction efficiencies are derived from numerous sources including K-State Research and Extension Publication MF-2737 and MF-2454.[29] Load reduction estimates are the product of baseline loading and the applicable BMP load reduction

efficiencies. Stocking rates in Osage County are less than 9 head of cattle per 100 acres and in Wabaunsee County greater than 13 head of cattle per 100 acres.

5.3.3 Streambank

A 2009 study of thirteen Neosho River restoration sites conducted by the KSU Agricultural Economists calculated the cost of stabilizing these sites at $710,011.38 or an average of $41.66 per linear foot, including all engineering and design costs. Additional assessments to finely tune streambank targeting and to derive more accurate streambank erosion estimates might be needed.

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

1. **Sedimentation caused by:**
    a. **Cropland erosion**
    b. **Streambank erosion**
    c. **Riparian area erosion**
2. **Nutrients runoff caused by:**
    a. **Livestock**
    b. **Cropland**
    c. **Streambank**
    d. **Riparian areas**

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.

6.0 Impairments Addressed by the SLT

6.1 Sediment

Pomona Lake has a high priority TMDL for **siltation**. The siltation TMDL can also be related to the eutrophication TMDL in the lake due to pollutants, particularly phosphorus, which can be attached to the suspended soil particles in the water column. BMP implementation and load reductions in this report will refer to sediment and sedimentation, the TMDL will refer to siltation. The SLT hopes that the sediment BMPs that will be incorporated in the watershed will reduce excess silt and improve clarity in the lake.

Sediment that originates in this watershed will eventually accumulate in lakes and wetlands downstream. This reduces reservoir volume and therefore, limits public access to the lakes because of inaccessibility to boat ramps, beaches and the water. Also, a decrease in storage in the lake affects domestic and industrial uses of the lake water. Sediment can originate from streambank erosion and sloughing of the sides of the streams due to erosion and a lack of riparian cover. Sheet and rill erosion from cropping and pasture systems contributes sediment in the ecosystem. Therefore, reducing erosion is necessary for accomplishing a reduction in sediment. Agricultural BMPs such as 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. These are some of the BMPs that will be the focus of this WRAPS plan.

Physical components and activities performed on the land affects sediment movement. Some are:

- Slope of the land, propensity to generate runoff and soil type
- Streambank erosion and sloughing or undercutting of the sides of the stream bank. A lack of riparian cover can cause washing on the banks of streams and enhance erosion.
- Animal movement, such as livestock that regularly cross the stream or follow trails in pastures, can cause pathways that will erode.
- Silt that is present in the stream from past activities and is gradually moving downstream with each high intensity rainfall event.

Agricultural BMPs that will help reduce sediment deposition in waterways are (in no particular order, many other BMPs exist):

- No-till
- Minimum tillage
- Vegetative buffers in riparian areas
- Grassed waterways
- Grassed terraces
- Wetland creation
- Establishing permanent vegetative cover
- Farming on the contour
- Conservation crop rotation

Cropland BMPs that have been selected by the SLT based on projected acceptability by landowners, cost effectiveness and pollutant load reduction effectiveness are:

- Implement no-till cultivation
- Implement nutrient management plans
- Install terraces
- Establish grade stabilization
- Establish permanent vegetation on cropland
- Establish vegetative buffers
- Install grassed waterways

This section will review several potential sources or environmental actions that have the potential of increasing sediment in the waters. They are (in no particular order of importance):

Cropland Erosion

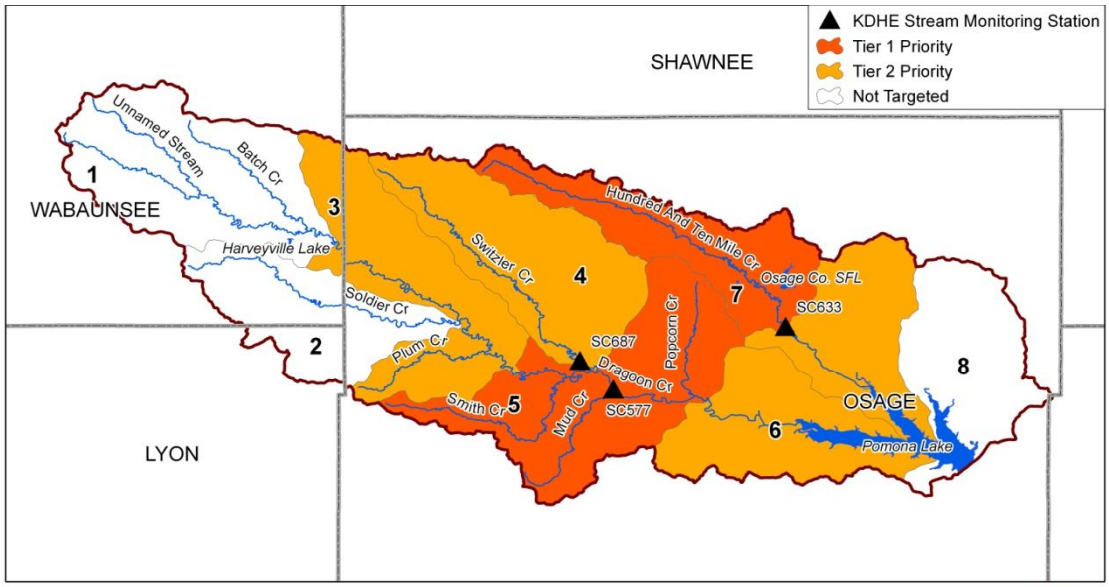
- Land use
- T-factor or soil loss
- Hydrologic soil groups
- Type of crops in the watershed

Streambank and Riparian Degradation

- Riparian quality
- Precipitation distribution

6.1.1 Cropland Erosion

Cropland BMPs have been assigned by the SLT. The Targeted Areas for cropland are prioritized into Tier 1 and Tier 2 areas. These are the areas that contain the most potential for sediment runoff as determined by the SWAT model. Causes of erosion are discussed in more detail in the rest of this section.



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

Kansas Department of Health and Environment

September 2011

Figure 23. Targeted Area for Cropland as Determined by SWAT.

6.1.1.A Land Use

Land use activities have a significant impact on the types and quantity of sediment transfer in the watershed. Construction projects in the watershed and in communities can leave disturbed areas of soil and unvegetated roadside ditches that can wash in a rainfall event. In addition, agricultural cropland that is under conventional tillage practices as well as a lack of maintenance of agricultural BMP structures can have cumulative effects on land transformation through sheet and rill erosion. The primary land uses in the Cropland Targeted Area are croplands and grasslands (both at 42 percent of the watershed) with woodlands and all other (16percent). Total acreage in the Pomona Watershed is

205,359 acres. Size of the Tier 1 Targeted Area is 67,259 acres. Size of the Tier 2 Targeted Area is 71,119 acres.

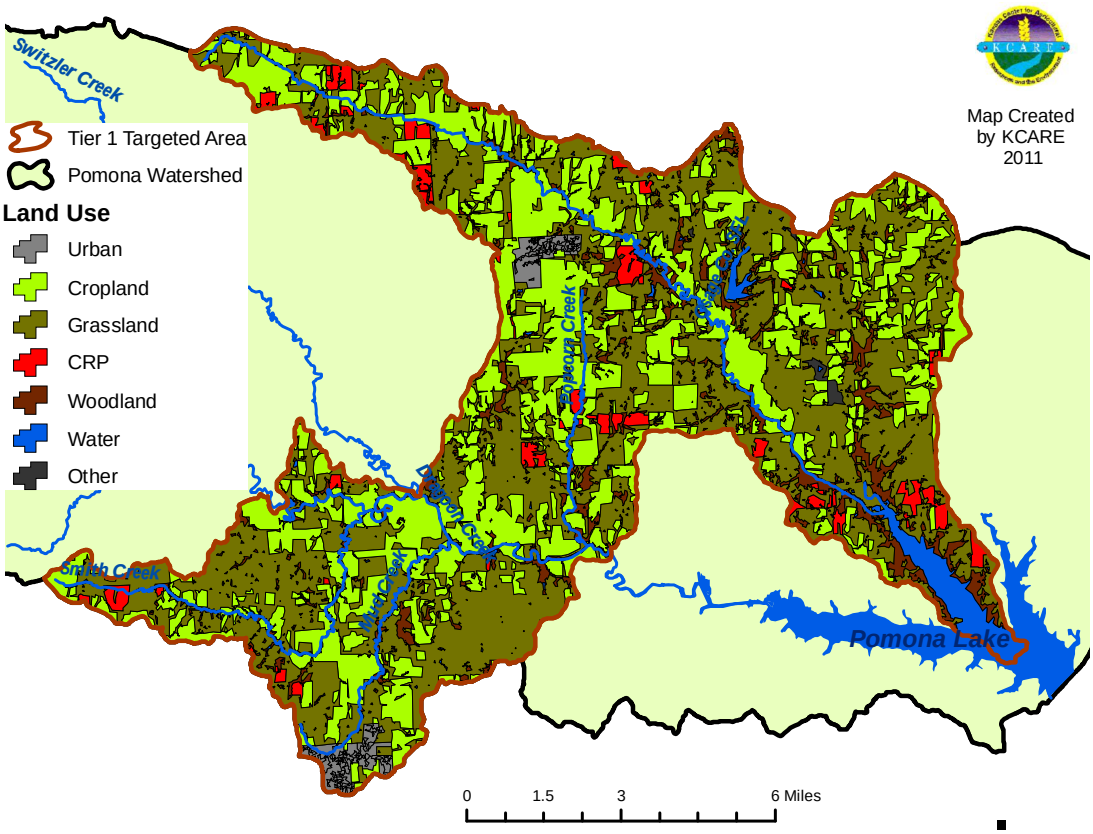


Figure 24. Cropland Tier 1 HUC 12 Watersheds Land Use. [3]

Table 13. Land Use in the Tier 1 HUC 12 Watersheds, 2005. [3]

Land Use	*Acres*	*Percentage*
Cropland	31,526	46.9
Grassland	20,759	30.9
Woodland	6,219	9.2
Water	4,660	6.9
CRP	2,726	4.1
Urban	1,209	1.8
Other	160	0.2
Total	**67,259**	**100.0**

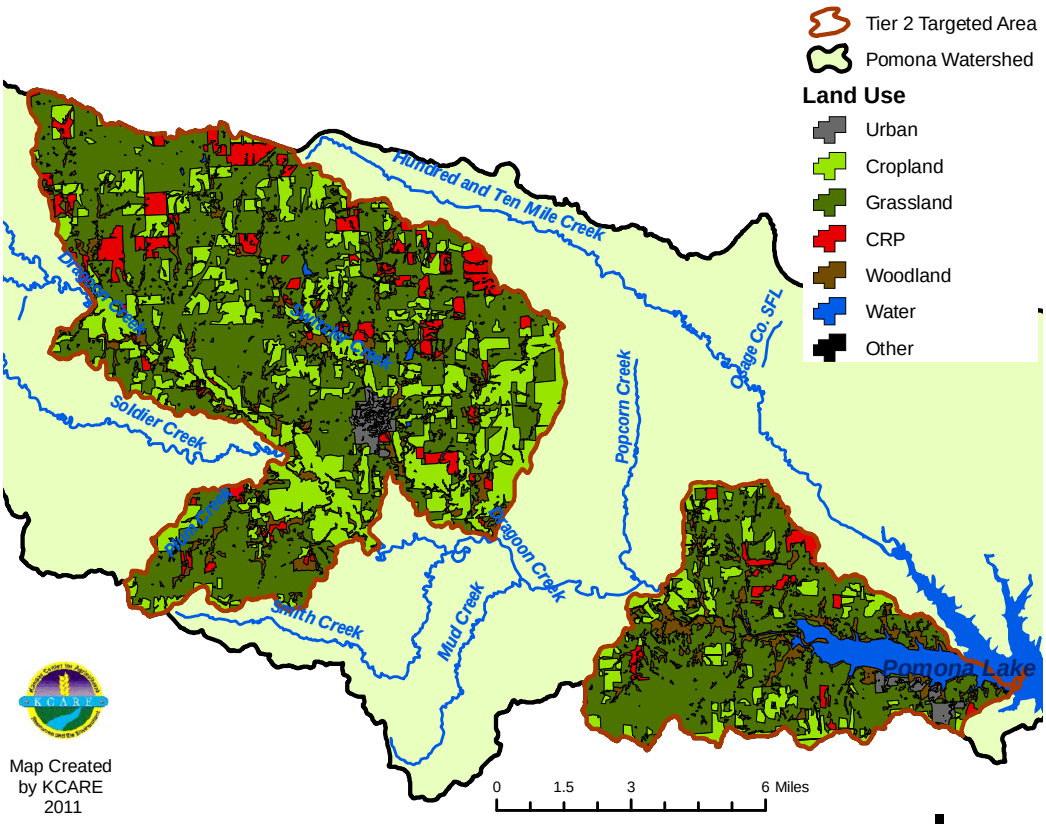


Figure 25. Cropland Tier 2 Targeted Area Land Use. [3]

Table 14. Land Use in the Tier 2 Targeted Area, 2005. [3]

Land Use	*Acres*	*Percentage*
Grassland	29,457	41.4
Cropland	24,768	34.8
Woodland	6,619	9.3
Water	4,663	6.6
CRP	4,579	6.4
Urban	1,029	1.4
Other	4	0.0
Total	**71,119**	**100.0**

6.1.1.B Soil Erosion Caused by Wind and/or Water

NRCS has established a "T factor" in evaluating soil erosion. T is the soil loss tolerance factor. It is defined as the maximum rate of annual soil loss that will permit crop productivity to be sustained economically and indefinitely on a given soil. It is assigned to soils without respect to land use or cover and ranges from 1 ton per acre for shallow soils to 5 tons per acre for deep soils that are not as affected by loss of productivity by erosion. T factor represents the goal for maximum annual soil loss in sustaining productivity of the land use. Erosion is considered to be greater than T if either the water (sheet and rill) erosion or the wind erosion rate exceeds the soil loss tolerance rate. [30]

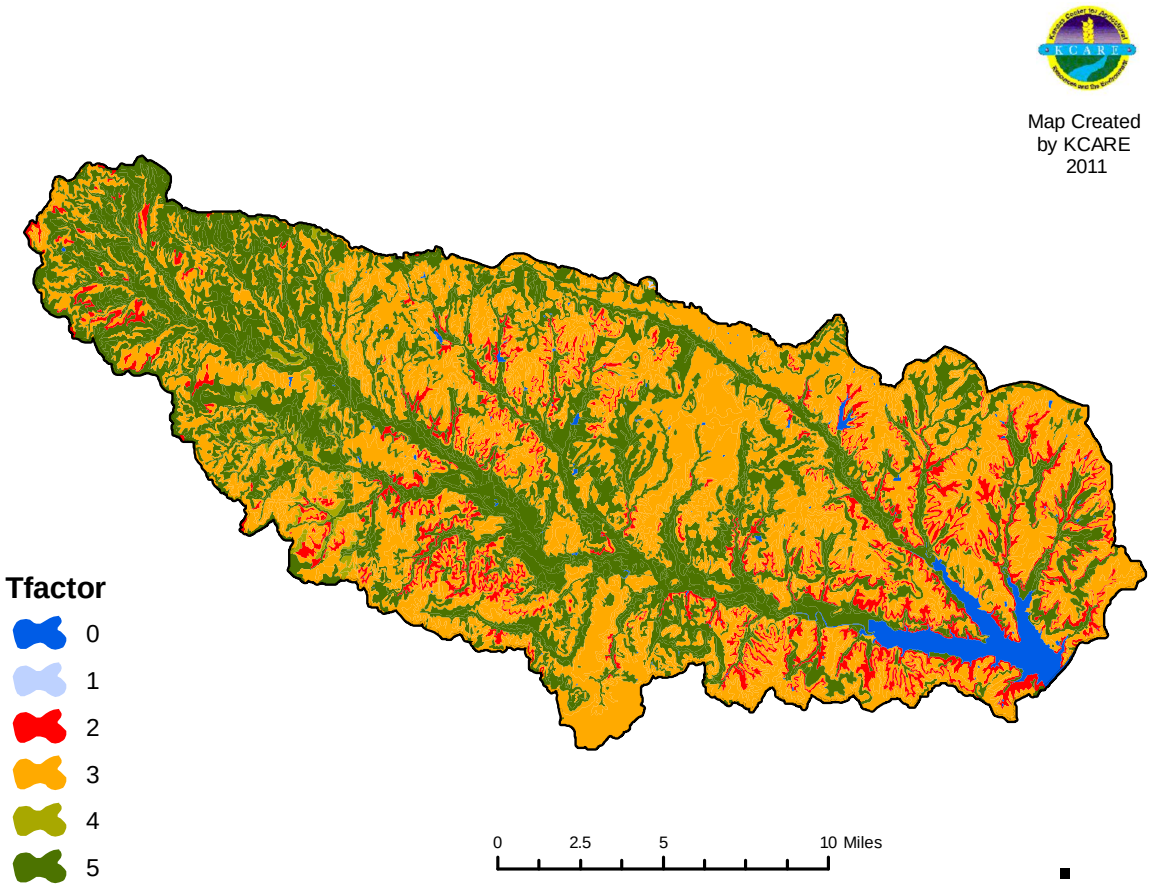


Figure 26. T Factor in the Watershed. [31]

The primary percentage ranking T Factor for this watershed is 3. T factors of 3 and 5 make up 90 percent of the watershed. Five constitutes the deepest soils in the ranking system. This demonstrates the need for conservation practices in the watershed to protect against soil erosion.

Table 15. T Factor in the Watershed. [31]

T Factor	Acres	Percent of Watershed
3	101,054	49.2
5	82,580	40.2
2	15,640	7.6
0	4,518	2.2
4	1,552	0.8
1	15	0.0

6.1.1.C 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.

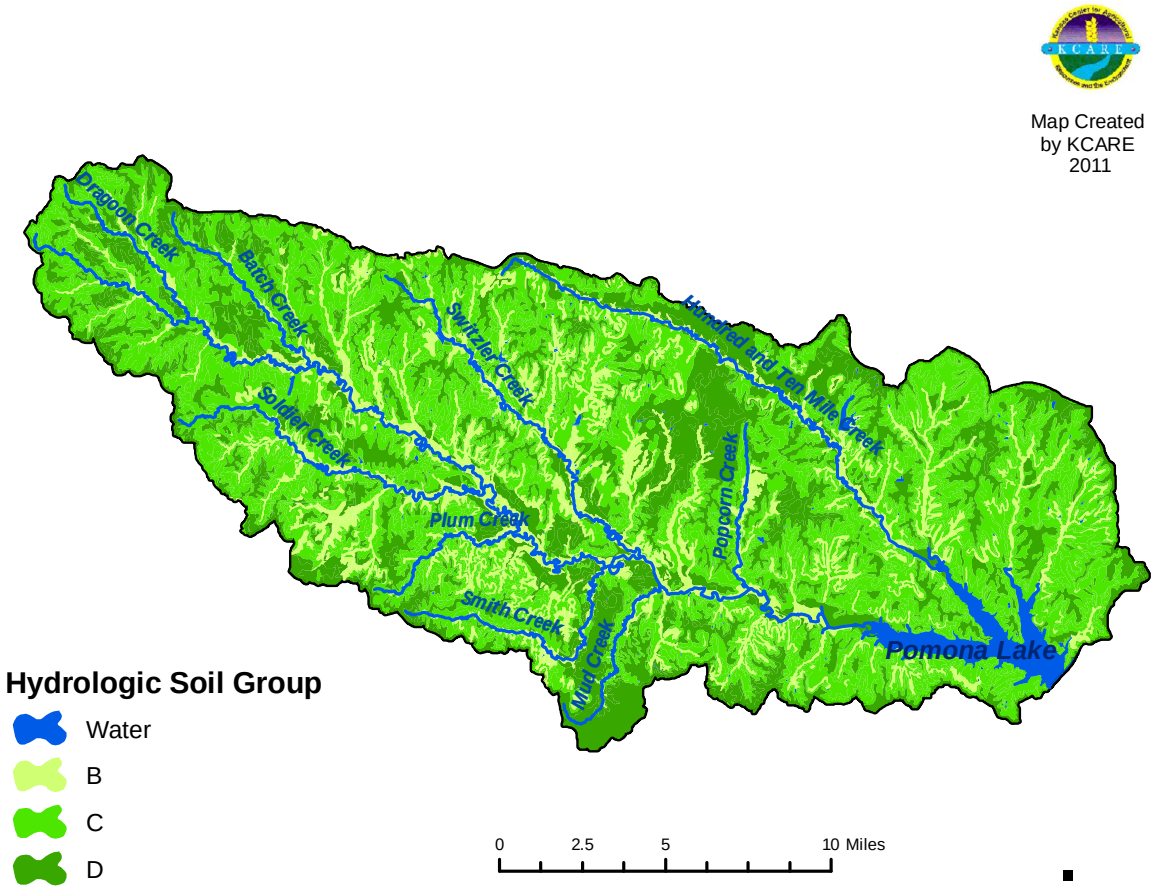


Figure 27. Hydrologic Soil Groups of the Watershed. [31]

One half of the watershed (53 percent) is characterized as soil group C, which is the soil group that has a slow filtration rate and a layer that impedes downward movement of water. Almost one third of the watershed (29 percent) is soil group D with the highest potential for runoff. D can mainly be detected in the Tier 1 Targeted Area running north and south in the middle of the watershed. Conservation practices and BMP installations are vital to help to protect this fragile soil.

Table 16. Hydrologic Soil Groups of the Watershed. [31]

Hydrologic Soil Group	Definition	Acres of Watershed in HSG	Percentage of Watershed in HSG
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.	108,135	52.7
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.	58,604	28.5
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.	34,123	16.6
Other	Water, dams, pits, sewage lagoons	4,497	2.2
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

6.1.1.D Sericea Lespedeza Control

Sericea lespedeza was declared a county option noxious weed in 1988. Osage County Commissioners recognized the need to control this noxious weed. Osage County was one of the first counties in the state to declare sericea lespedeza a noxious weed. The legislature declared sericea a state wide noxious weed on July 1, 2000.

Landowners struggle to control sericea lespedeza on their grassland. Individual stems of a sericea lespedeza plant can produce in excess of 1,000 seeds. Seed can remain viable in the soil for 20 years or longer. Excellent control of sericea lespedeza can be obtained with Remedy applied in June and July or Escort applied in September.

Noxious weed control, especially sericea lespedeza control, is an ongoing fight for Osage County landowners. Established sericea lespedeza plants will reduce or eliminate competing vegetation. Sericea requires more water to produce foliage than other warm-season plants, creating a “drought” for competing vegetation. In addition to competing for light, water, and nutrients, sericea plants also produce allelopathic chemicals, which inhibit seed germination and growth of some plants, such as big bluestem, Indian grass, Kentucky bluegrass, bermudagrass, fescue, and ryegrass.

The cheapest way to control sericea lespedeza is to convert the grassland to cropland. The land is worked and sprayed for other weeds so sericea is not allowed to go to seed. The land still produces a marketable crop.

The Pomona WRAPS SLT would like to provide an incentive to landowners to control sericea lespedeza and leave their land in grass. It is their hope that by providing an incentive for landowners to keep their ground in grass that fewer landowners will convert their grassland to cropland. More ground will be left in grass thereby improving water quality.

Land in grass provides better sediment control than cropland. Part of the WRAPS process is protection. It is imperative that we protect the water quality we currently have. By providing landowners an incentive by means of spray to control sericea lespedeza, more ground could be kept in grass and help control sedimentation of streams and Pomona Lake.

There is currently 86,674 acres of grassland and 49,196 acres of pasture/hay land. At least 60%, or 81,522 acres, is infested with sericea lespedeza. The priority area has 24,263 acres of grass/pasture/hay. At least 14,550 acres are infested with sericea lespedeza. There are 3 main chemicals used to control sericea lespedeza. Current costs are $8 per acre for Escort, $19 per acre for Remedy and $15.75 per acre for Pasture Guard. Remedy and Pasture Guard are sprayed in the spring (usually June) and Escort is sprayed in the fall (September). The fall spraying of Escort is not as detrimental to the forbs (wild flowers).

Listed below is some information regarding sericea lespedeza control. When examining this data from a load reduction and financial needs standpoint, this reinforces the need to utilize the P in WRAPS to protect existing grassland in the Pomona Lake watershed as well as others across the state.

A quick STEPL was done for one of the priority watersheds in Pomona to see what changing grassland into cropland would mean in terms of increased nutrient and sediment load.

- Before (still in grass)
    - Nitrogen load = 367,744 lbs/yr
    - Phosphorus load = 78,469 lbs/yr
    - Sediment load = 29,543 tons/yr
- After (grassland tilled up and put back into agricultural tillage)
    - Nitrogen load = 370,716 lbs/yr
    - Phosphorus load = 79,905 lbs/yr
    - Sediment load = 30,157 tons/yr
- Load Increase for 400 acres of grassland going back into cropland
    - Nitrogen 2,972 lbs/yr
    - Phosphorus = 702 lbs/yr

- Sediment = 614 tons/yr

If $2,000 of Escort is applied, this equates to 0.35/lb of phosphorus and $0.31/ton of sediment saved from reintroduction to the watershed. On the flip side, the plan has a reduction goal in Year 1 through cropland BMPs of 2,173 tons per year for sediment and 1,421 lbs/yr of phosphorus. The price tag on cropland BMPs within year 1 of the plan is $118,656…which translates to spending $54.60 per ton of sediment and $83.50 per pound of phosphorus saved from potential loading within the Pomona Lake watershed.

6.1.2 Streambank Erosion

Sediment can originate 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.

6.1.2.A Riparian Quality

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

This WRAPS project has targeted portions of Dragoon Creek and all of 110 Creek and their tributaries for streambank stabilization and riparian enhancement projects. According to the USDA/NRCS GIS mapping data, the riparian 100 foot buffer land use is almost evenly divided between crop land, pasture land and forest land with a small amount of water, urban and barren land.

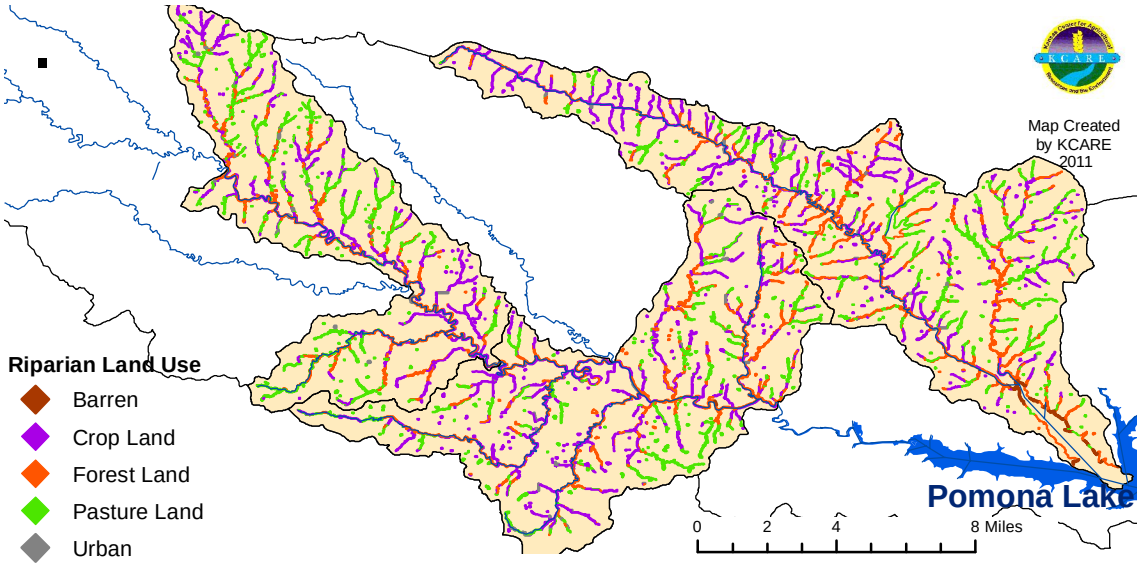


Figure 28. Land Use Within a 100 Ft. Buffer Along the Streambank Targeted Area. [32]

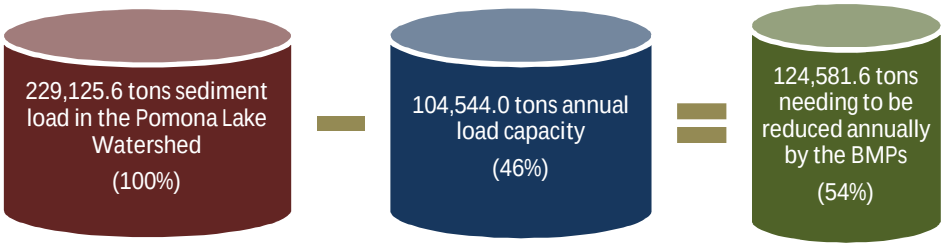
6.1.2.B Rainfall and Runoff

Rainfall amounts and subsequent runoff can affect sediment delivery from agricultural areas and urban areas into Dragoon Creek and 110 Creek. High water flows will cause swirling and under cutting of the stream banks with subsequent sloughing. Sloughing of stream and river banks is a major contributor of sediment downstream.

In cropland, high rainfall events can cause sheet and rill erosion and lead to water channel outlets in the riparian areas. High intensity rainfall events (rainfall rates that overwhelm soil adsorptive capacity) usually occur in late spring and early summer. Extended duration of rainfall events that causes soil saturation and subsequent runoff also usually occurs in late spring and early summer. For these reasons it is important to utilize conservation practices such as no-till that provide a “cover” on bare soil during the spring and into the summer.

6.1.3 Sediment BMPs with Acres or Projects Needed

The current estimated sediment load in Pomona Lake is 229,125.6 tons per year according to the TMDL section of KDHE. **The total annual load reduction in the Pomona Lake Watershed needed to meet the siltation TMDL is 124,581.6 tons of sediment annually**. This is the amount of sediment that needs to be removed from the watershed and is the target of the BMP installations that will be placed in the watershed. Specific acreages or projects that need to be implemented per year have been determined through modeling and economic analysis and approved by the SLT.



The SLT has laid out specific BMPs that they have determined will be acceptable to watershed residents as listed below. **These BMPs will be implemented in the Cropland Targeted Area.** An added bonus of implementing cropland BMPs aimed at sediment reduction is a positive effect on nutrient/phosphorus runoff (will be discussed in the next section). Specific acreages or projects that need to be implemented per year have been determined through modeling, cost-effectiveness and producer acceptability and approved by the SLT. This plan calls for 49,280 acres of practices and total cropland acres in the targeted area is estimated at 40,033 acres. Therefore, all buffers and waterways were assumed to go on land that is terraced. All other BMPs are considered independent projects and stand alone in their load reductions.

Table 17. BMPs and Acres or Projects Needed to Reduce Sediment Contribution in the Pomona Lake Siltation TMDL.

Protection Measures	Best Management Practices and Other Actions	Total Treated Acres Needed to be Implemented Annually
Prevention of sediment contribution from **cropland**	1. No-Till	360 acres
	2. Nutrient Management	334 acres
	3. Vegetative Buffers	133 acres
	4. Terraces	294 acres
	5. Grassed Waterways	187 acres
	6 Grade Stabilization	9 acres
	7 Permanent Vegetation	9 acres
Prevention of sediment contribution from **streambank erosion**	Streambank stabilization	260 feet
Prevention of sediment contribution from **riparian areas**	Installation of riparian/vegetative buffers (66 feet wide)	30.5 acres

6.1.4 Sediment Load Reductions

The table below lists the cropland BMPs and acres implemented with the associated load reductions attained by implementing all of these BMPs. The percent of sediment reduction achievement is illustrated in the right column.

Table 18. Estimated Sediment Load Reductions for Implemented BMPs on Cropland Aimed at Meeting the Pomona Lake Siltation TMDL.

Cumulative Soil Erosion Reduction (tons), Cropland BMPs								
Year	No-Till	Nutrient Management	Terraces	Grade Stabilization	Permanent Vegetation	Vegetative Buffers and Terraces	Grassed Waterways and Terraces	Total Load Reduction
1	946	292	308	17	18	271	321	**2,173**
2	1,893	584	617	33	36	542	641	**4,346**
3	2,839	876	925	50	53	813	962	**6,519**
4	3,786	1,168	1,234	66	71	1,084	1,282	**8,692**
5	4,732	1,461	1,542	83	89	1,355	1,603	**10,865**
6	5,679	1,753	1,851	99	107	1,626	1,924	**13,038**
7	6,625	2,045	2,159	116	124	1,898	2,244	**15,211**
8	7,572	2,337	2,468	132	142	2,169	2,565	**17,384**
9	8,518	2,629	2,776	149	160	2,440	2,886	**19,557**
10	9,464	2,921	3,085	165	178	2,711	3,206	**21,730**
11	10,411	3,213	3,393	182	195	2,982	3,527	**23,903**
12	11,357	3,505	3,702	198	213	3,253	3,847	**26,076**
13	12,304	3,797	4,010	215	231	3,524	4,168	**28,249**
14	13,250	4,090	4,319	231	249	3,795	4,489	**30,422**
15	14,197	4,382	4,627	248	266	4,066	4,809	**32,595**
16	15,143	4,674	4,936	265	284	4,337	5,130	**34,768**
17	16,090	4,966	5,244	281	302	4,608	5,451	**36,941**
18	17,036	5,258	5,552	298	320	4,879	5,771	**39,114**
19	17,982	5,550	5,861	314	337	5,151	6,092	**41,287**
20	18,929	5,842	6,169	331	355	5,422	6,412	**43,460**
21	19,875	6,134	6,478	347	373	5,693	6,733	**45,634**
22	20,822	6,426	6,786	364	391	5,964	7,054	**47,807**
23	21,768	6,719	7,095	380	408	6,235	7,374	**49,980**
24	22,715	7,011	7,403	397	426	6,506	7,695	**52,153**
25	23,661	7,303	7,712	413	444	6,777	8,016	**54,326**
26	24,608	7,595	8,020	430	462	7,048	8,336	**56,499**
27	25,554	7,887	8,329	446	480	7,319	8,657	**58,672**
28	26,500	8,179	8,637	463	497	7,590	8,977	**60,845**
29	27,447	8,471	8,946	479	515	7,861	9,298	**63,018**
30	28,393	8,763	9,254	496	533	8,132	9,619	**65,191**

Table 19. Estimated Sediment Load Reductions for Implemented BMPs on Streambanks Aimed at Meeting the Pomona Lake Siltation TMDL.

Pomona Watershed Annual Streambank Load Reductions			
Year	**Streambank Stabilization (feet)**	**Soil Load Reduction (tons)**	**Cumulative Erosion Reduction (tons)**
1	260	390	**390**
2	260	390	**780**
3	260	390	**1,170**
4	260	390	**1,560**
5	260	390	**1,950**
6	260	390	**2,340**
7	260	390	**2,730**
8	260	390	**3,120**
9	260	390	**3,510**
10	260	390	**3,900**
11	260	390	**4,290**
12	260	390	**4,680**
13	260	390	**5,070**
14	260	390	**5,460**
15	260	390	**5,850**
16	260	390	**6,240**
17	260	390	**6,630**
18	260	390	**7,020**
19	260	390	**7,410**
20	260	390	**7,800**
21	260	390	**8,190**
22	260	390	**8,580**
23	260	390	**8,970**
24	260	390	**9,360**
25	260	390	**9,750**
26	260	390	**10,140**
27	260	390	**10,530**
28	260	390	**10,920**
29	260	390	**11,310**
30	260	390	**11,700**

Table 20. Estimated Sediment Load Reductions for Implemented BMPs on Riparian Areas Aimed at Meeting the Pomona Lake Siltation TMDL.

Pomona Watershed Riparian Restoration and Management				
Year	Acres of Riparian Restoration and Management	Treated Acres	Soil Load Reduction (tons)	Cumulative Erosion Reduction (tons)
1	30.5	458	802	**802**
2	30.5	458	802	**1,603**
3	30.5	458	802	**2,405**
4	30.5	458	802	**3,206**
5	30.5	458	802	**4,008**
6	30.5	458	802	**4,809**
7	30.5	458	802	**5,611**
8	30.5	458	802	**6,412**
9	30.5	458	802	**7,214**
10	30.5	458	802	**8,015**
11	30.5	458	802	**8,817**
12	30.5	458	802	**9,618**
13	30.5	458	802	**10,420**
14	30.5	458	802	**11,221**
15	30.5	458	802	**12,023**
16	30.5	458	802	**12,824**
17	30.5	458	802	**13,626**
18	30.5	458	802	**14,427**
19	30.5	458	802	**15,229**
20	30.5	458	802	**16,030**
21	30.5	458	802	**16,832**
22	30.5	458	802	**17,633**
23	30.5	458	802	**18,435**
24	30.5	458	802	**19,236**
25	30.5	458	802	**20,038**
26	30.5	458	802	**20,839**
27	30.5	458	802	**21,641**
28	30.5	458	802	**22,442**
29	30.5	458	802	**23,244**
30	30.5	458	802	**24,045**

It will require 23 years to meet the sediment reduction goal in Pomona Lake if all BMPs are implemented. Load reductions from BMP implementation which took place within the watershed from 2001-2009 are also included within the necessary reductions needed to meet the Sediment TMDL. The life of the WRAPS plan is 30 years. After 23 years, the sediment portion of this plan will switch from being “restoration” to “protection” of the watershed.

Table 21. Sediment Load Reductions for Cropland, Streambank and Riparian Area BMPs Aimed at Meeting the Pomona Lake Siltation TMDL.

Combination of Cropland and Streambank* BMPs to Meet the Sediment TMDL					
Year	**Streambank Reduction (tons)**	**Cropland Reduction (tons)**	**Riparian Restoration (tons)**	**Total Reduction (tons)**	**% of TMDL**
2001-2009	***N/A***	***46,835***	***N/A***	***46,835***	***38%***
1	390	49,008	802	50,200	**40%**
2	780	51,181	1,603	53,564	**43%**
3	1,170	53,354	2,405	56,929	**46%**
4	1,560	55,527	3,206	60,293	**48%**
5	1,950	57,700	4,008	63,658	**51%**
6	2,340	59,873	4,809	67,022	**54%**
7	2,730	62,046	5,611	70,387	**56%**
8	3,120	64,219	6,412	73,751	**59%**
9	3,510	66,392	7,214	77,116	**62%**
10	3,900	68,565	8,015	80,480	**65%**
11	4,290	70,738	8,817	83,845	**67%**
12	4,680	72,911	9,618	87,209	**70%**
13	5,070	75,084	10,420	90,574	**73%**
14	5,460	77,257	11,221	93,938	**75%**
15	5,850	79,430	12,023	97,303	**78%**
16	6,240	81,603	12,824	100,667	**81%**
17	6,630	83,776	13,626	104,032	**84%**
18	7,020	85,949	14,427	107,396	**86%**
19	7,410	88,122	15,229	110,761	**89%**
20	7,800	90,295	16,030	114,125	***92%***
21	8,190	92,469	16,832	117,490	**94%**
22	8,580	94,642	17,633	120,855	**97%**
23	8,970	96,815	18,435	124,219	**100%**
24	9,360	98,988	19,236	127,584	**102%**
25	9,750	101,161	20,038	130,948	**105%**
26	10,140	103,334	20,839	134,313	**108%**
27	10,530	105,507	21,641	137,677	**111%**
28	10,920	107,680	22,442	141,042	**113%**
29	11,310	109,853	23,244	144,406	**116%**
30	11,700	112,026	24,045	147,771	**119%**
Load Reduction to meet Siltation TMDL:			**124,581**		

Siltation TMDL has been met

Table 22. Sediment Load Reduction by Category at the End of 30 Years Aimed at Reducing Sediment Contribution in the Pomona Lake Siltation TMDL.

Best Management Practice Category	Total Load Reduction (tons)	% of Siltation TMDL
Cropland	112,026	89.9%
Riparian	24,045	19.3%
Streambank	11,700	9.4%
Total	**147,771**	**118.6%**
Sediment Reduction Goal 124,581 Tons		

Refer to Section 8, "Costs of BMP Implementation" for specific BMP costs in order to meet the TMDL.

6.2 Nutrients

An excess of nutrients in water bodies can cause water impairments that are detrimental to aquatic life and water quality. The terminology "nutrients" primarily encompasses phosphorus and nitrogen as the two main contributors. An excess in nutrients can be caused by any land practice that will contribute to nutrients 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.

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 agricultural practices.

The impairments that are caused by excess nutrients are:

- **Eutrophication (E).** E is a natural process that occurs when a water body receives excess nutrients. These excess nutrients create optimum conditions that are favorable for algal blooms and plant growth. Pomona Lake has a high priority TMDL for E.
- **Dissolved oxygen (DO).** 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. Dragoon and 110 Creeks have high priority TMDLs for low DO. Desirable criteria for a healthy water profile include DO rates greater than 5 milligrams per liter.

Activities performed on the land affects nutrient loading in 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.

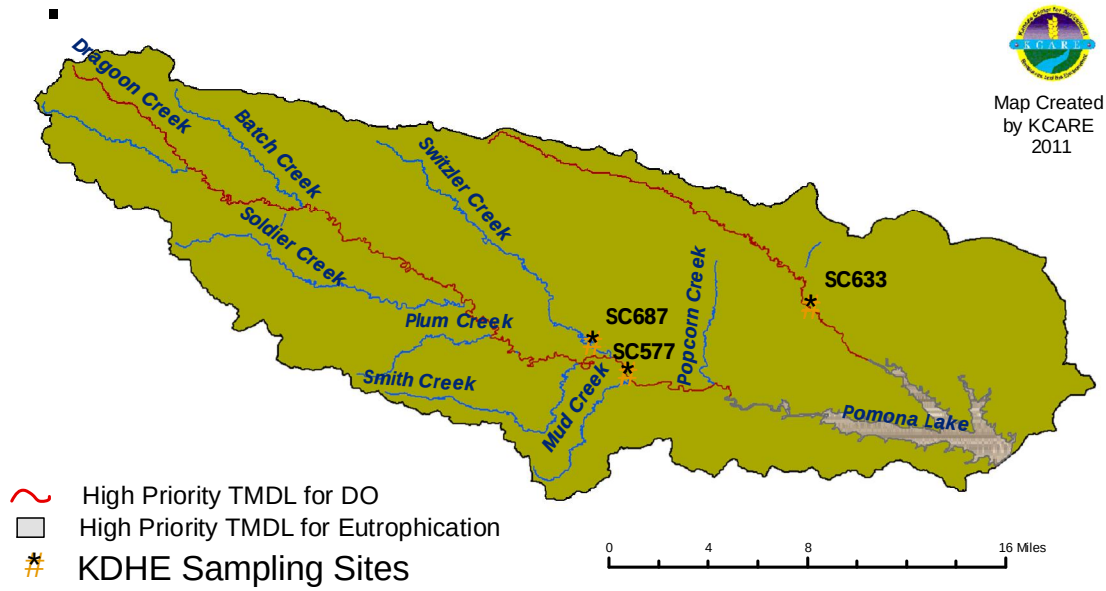


Figure 29. Nutrient Related TMDLs.

6.2.1 Livestock Related Impairments

Livestock can contribute to nutrients in surface water through manure runoff. Soluble phosphorus can easily be transported in runoff from fields where livestock gather. Preventing manure runoff into streams is important in avoiding elevated phosphorus concentrations. A few BMPs that can assist are restricting cattle access to streams, maintaining adequate buffer areas, providing an alternate watering system and managing optimal grass cover. Other nutrient issues can arise from fertilizers applied to non-native pastures used for livestock

grazing. Nitrogen and phosphorus can originate from fertilizer runoff caused by either excess application or a rainfall event immediately after application.

As mentioned earlier in this report, the Livestock Targeted Area, the Cropland Targeted Area and the High Priority TMDL Targeted Area cover the same geographic region. This area will be targeted for nutrients. In addition to nutrients, the Cropland Targeted Area is also targeted for sediment as has been mentioned in the previous section of this report.

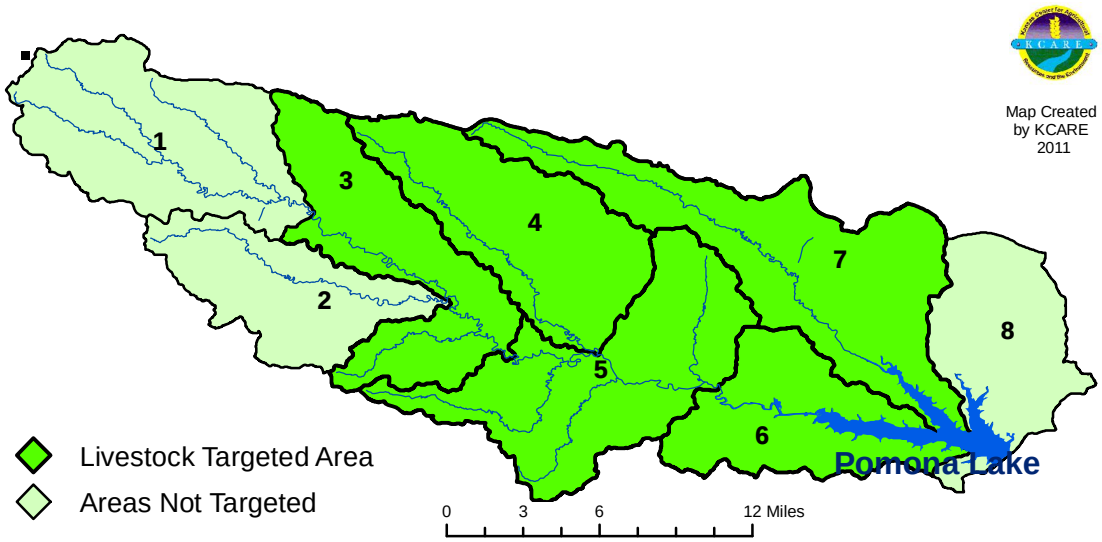


Figure 30. Targeted Areas for Livestock BMPs in the Watershed.

6.2.1.A. Manure Runoff from Fields and Livestock Operations

Manure from livestock contains phosphorus. If the manure is present in the stream, phosphorus will then be released into the water. 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 be 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= 1,000 pounds of live animal weight (steer = 1 AU, dairy cow = 1.4 AU, swine = 0.4 AU). 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 the prevention of manure 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. Also, overgrazed pastures do not retain manure as well as moderately grazed pastures. This allows for runoff to a greater extent. Manure management is a key component in the WRAPS plan.

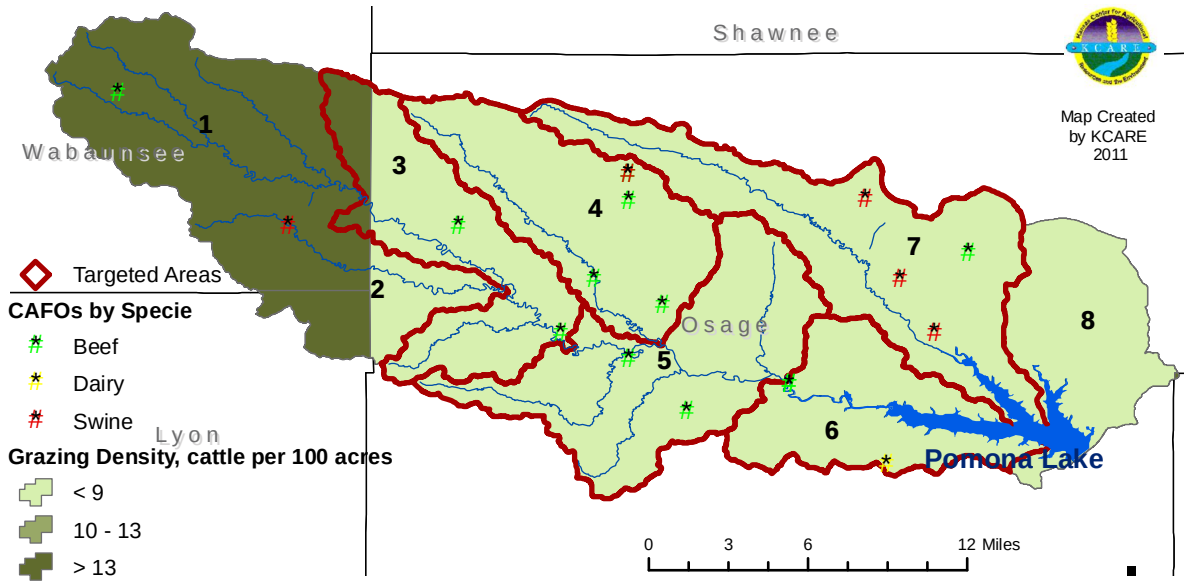


Figure 31. Confined Animal Feeding Operations and Grazing Density in the Watershed. [33]

6.2.1.B Land Use

Land use activities have a significant impact on the types and quantity of livestock related nonpoint source pollutants in the watershed. Agricultural activities and lack of maintenance of agricultural structures can have cumulative effects on land transformation. Manure runoff from grasslands close to waterways can add to phosphorus in the waterways. The primary land uses in the livestock targeted area of the watershed are cropland (40%) and grassland (36%).

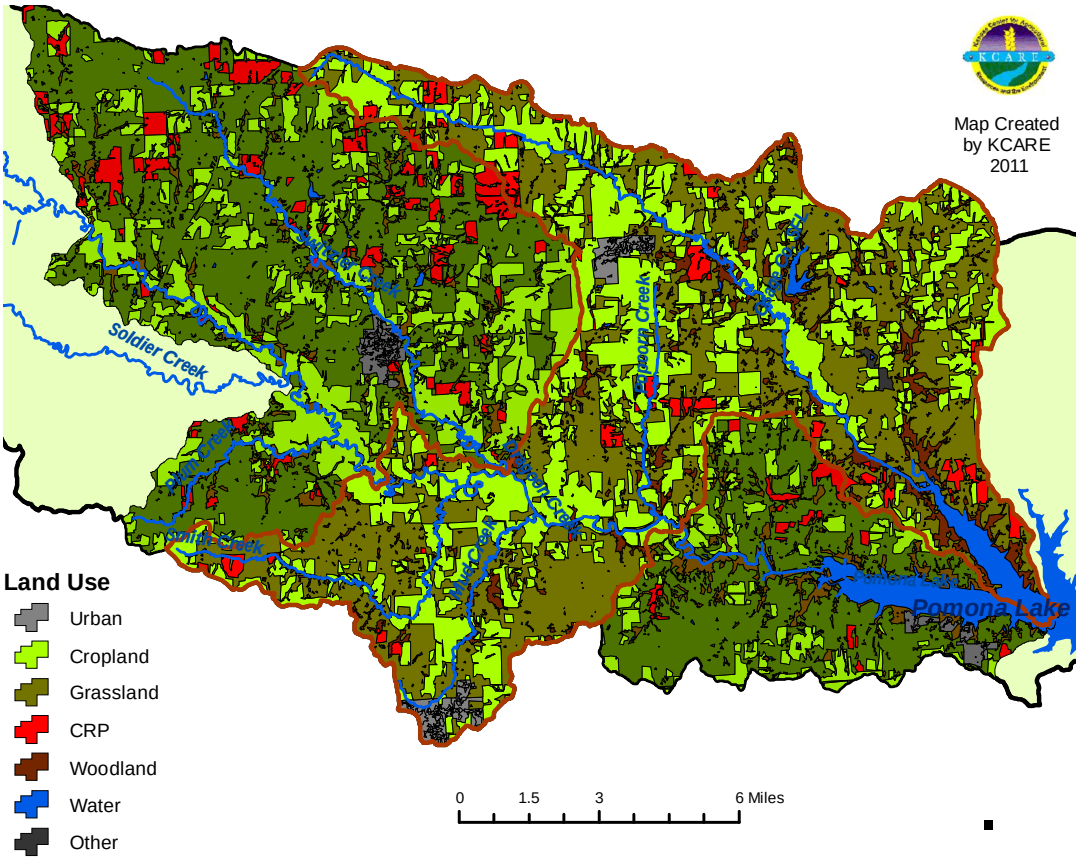


Figure 32. Land Cover of the Livestock Targeted Area of the Watershed. [34]

Table 23. Land Use in the Livestock Targeted Area. [34]

Land Use	*Acres*	*Percentage*
Cropland	56,294	40.7
Grassland	50,216	36.3
Woodland	12,838	9.3
Water	9,323	6.7
CRP	7,305	5.3
Urban	2,238	1.6
Other	164	0.1
Total	138,378	100

6.2.1.C Rainfall and Runoff

Rainfall amounts and subsequent runoff along with flooding outside the stream channel can affect nutrient concentrations in the streams. 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 was applied either before a rainfall event or on frozen ground. Manure and livestock management is important in preventing phosphorus runoff from the targeted area. Rainfall in this watershed occurs primarily in the late spring and early summer. This occurs when grass is short and runoff potential is greatest.

6.2.2 Cropland Related Nutrient Pollutants

6.2.2.A Land Uses

Land use activities have a significant impact on the types and quantity of nutrient runoff in the watershed. Agricultural cropland in the watershed primarily lies along and adjacent to the creeks and their tributaries. If this 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. According to groundtruthing which was conducted in the watershed, only four percent of the cropland is under no-till conservation practice. No-till is a good way to minimize erosion and nutrient runoff.

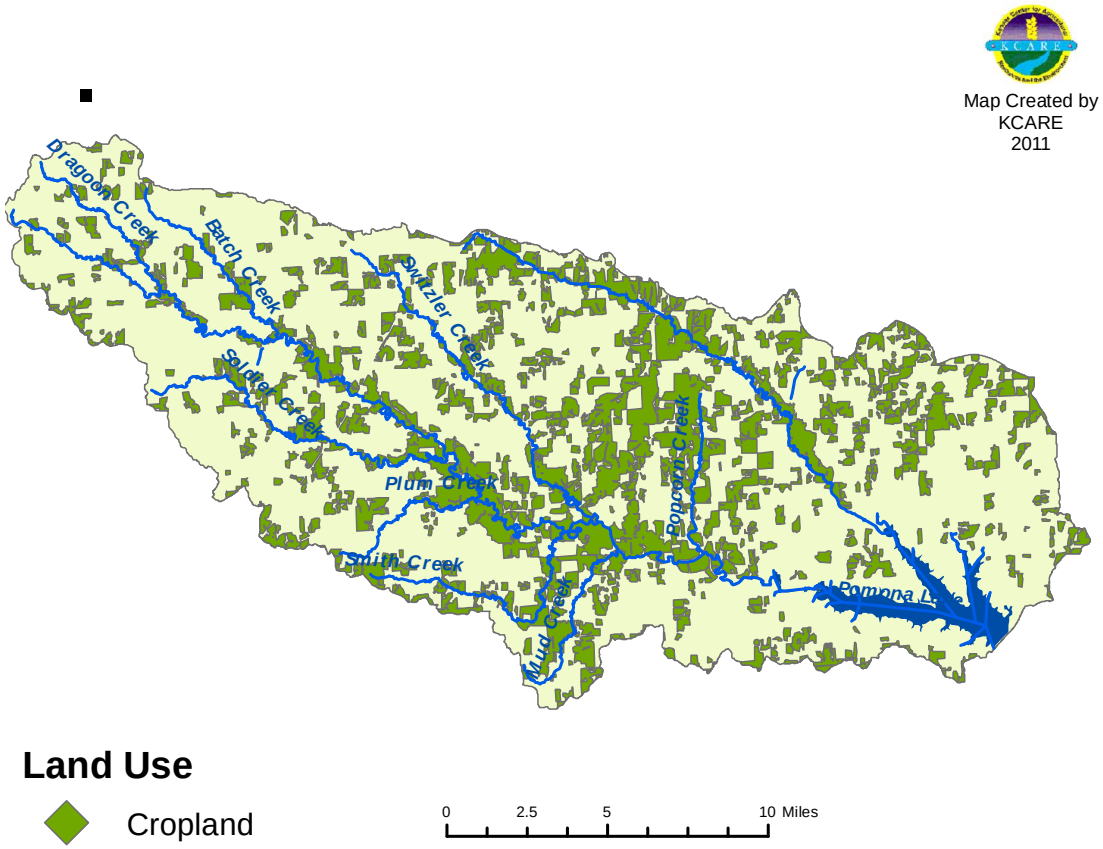


Figure 33. Cropland in the Watershed. [35]

Crop type grown has an effect on possible nutrient runoff due to differing fertilizer requirements for individual crops. According to the National Agricultural Statistics Service, records from 2008 to 2010 indicate that 193,900 acres were planted to crops in Osage and Wabaunsee counties. While the exact individual crop acreages grown in the Pomona Watershed is not known, it is assumed that

the percentage of individual crops is uniform across the counties. The type of crop grown will have an effect on nutrient runoff since different crops have different nutrient requirements. The main crop grown in the watershed was soybeans (54 percent). Soybeans are a legume and as such, do not require nitrogen fertilizer. Corn, which is 32 percent of the crops harvested in the watershed, is a heavy user of nitrogen fertilizer in order to support the large amount of biomass produced. Wheat (13 percent) is a moderate user of nitrogen, as is sorghum. Some farms apply nitrogen on wheat fields in the fall as anhydrous ammonia. This is usually dependent on whether the crop will be used for winter grazing of stocker calves. Nitrogen may also be applied in the spring. All farm ground should be soil tested for the proper amount of phosphorus available in the soil and phosphorus fertilizer should be applied only when needed.

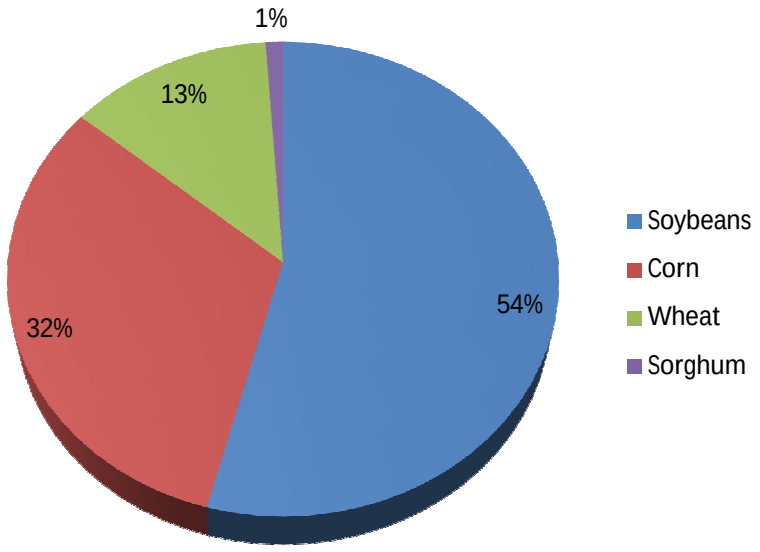


Figure 34. Farm Crops in the Watershed by percentage. [35]

6.2.2.B CRP

CRP (Conservation Reserve Program) land is marginal farm ground that has been removed from production and planted to grass cover. The owner of the land receives a government payment as incentive for allowing the land to be removed from production. This is the best way to stop runoff of nutrients as well as sediment through erosion. CRP lands are scattered throughout the watershed. CRP comprised approximately five percent of the farmable land in the watershed. As CRP contracts expire, it is imperative that incentive if provided for landowners to keep the ground in grass. Incentive can be provided in the form of spray for noxious weed control.

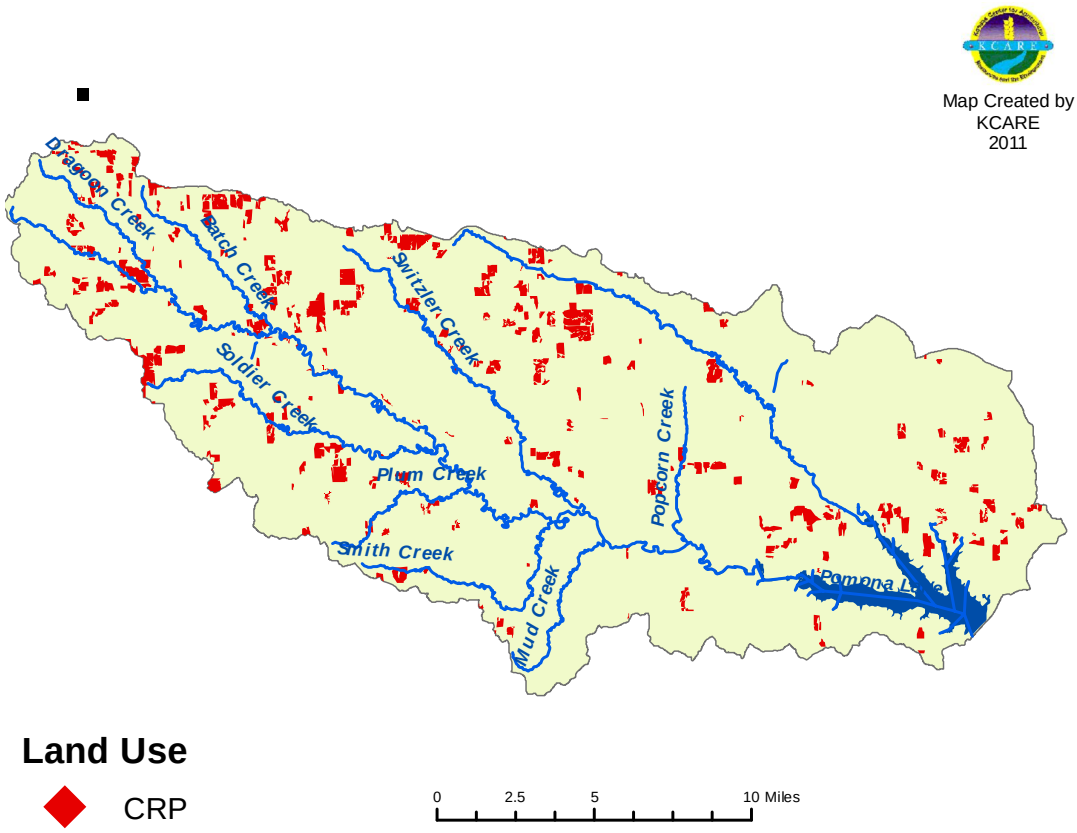


Figure 35. CRP in the Watershed. [34]

6.2.2.C Rainfall and Runoff

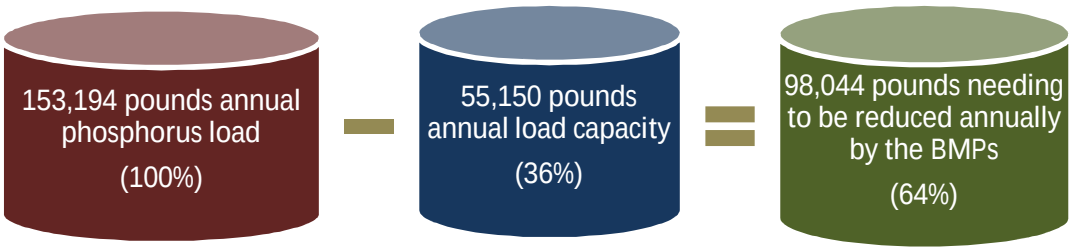
Rainfall amounts and subsequent runoff can affect nutrient runoff from agricultural areas. Fertilizer runoff from crop fields can contribute to elevated phosphorus water concentrations if the fertilizer was applied prior to a rainfall event or on frozen ground.

6.2.2.D Riparian and Cropland Buffer Areas

Stable streambank riparian areas or buffers are important to reduction in phosphorus in the waterways of the watershed. Soil that is lost from the streambanks can have attached phosphorus particles. This soil will then gradually release the phosphorus as it travels downstream. An adequate buffer area along streams and the river with grass and tree cover will protect the banks during events of flooding. The roots of the grass and trees will stabilize the land and catch soil that washes through the buffer area. This will also prevent streambank sloughing and undercutting.

6.2.3 Phosphorus BMPs with Projects Needed

The current estimated phosphorus load from nonpoint sources in the Pomona Lake Watershed is 153,194 pounds per year according to the TMDL section of KDHE. This has been determined by KDHE as a result of sampling data obtained in the watershed. After subtracting the annual load capacity, t**he total annual load reduction allocated to the Pomona Lake Watershed needed to meet the phosphorus reduction goal with implemented BMPs is 98,044 pounds of phosphorus**. This is the amount of phosphorus that needs to be removed from the watershed and is the target of the BMP installations that will be placed in the watershed. These BMPs have been determined as feasible and approved by the SLT.



The SLT has laid out specific BMPs that they have determined will be acceptable to watershed residents as listed below. **These BMPs will be implemented in the Cropland, Livestock, High Priority TMDL targeted areas and in the Streambank and Riparian Targeted Area. All these BMPs will simultaneously have a positive effect on reduction of sediment impairments.** Specific acreages or projects that need to be implemented per year have been determined through modeling, cost-effectiveness and producer acceptability and approved by the SLT. Since this plan calls for 49,280 acres of practices and total cropland acres in the targeted area is estimated at 40,033 acres. Therefore, all buffers and waterways were assumed to go on land that is terraced. All other BMPs are considered independent projects and stand alone in their load reductions.

Table 24. BMPs and Number of Projects to be Installed as Determined by the SLT Aimed at Meeting the E TMDL in Pomona Lake.

Protection Measures	Best Management Practices and Other Actions	Total Treated Acres or Projects Needed to be Implemented
1. Prevention of phosphorus (TP) contribution from **cropland**	1. No-Till	360 acres
	2. Nutrient Management	334 acres
	3. Vegetative Buffers	133 acres
	4. Terraces	294 acres
	5. Grassed Waterways	187 acres
	6 Grade Stabilization	9 acres
	7 Permanent Vegetation	9 acres
2. Prevention of	2.1 Vegetative Filter Strip	1 acre annually

phosphorus (TP) contribution from **livestock**	2.2 Relocate Feeding Pens	1 project annually
	2.3 Relocate Pasture Feeding Sites	2 project annually
	2.4 Off Stream Watering Systems	3 project annually
Prevention of phosphorus (TP) contribution from **streambank erosion**	Streambank stabilization	260 feet
Prevention of phosphorus (TP) contribution from **riparian areas**	Installation of riparian/vegetative buffers (66 feet wide)	30.5 acres

6.2.4 Phosphorus Load Reductions

The table below lists the cropland BMPs installed with the associated phosphorus load reductions.

Table 25. Estimated Phosphorus Load Reductions in the Cropland Targeted Area for All Implemented BMPs Aimed at Meeting the E TMDL in Pomona Lake.

Annual Phosphorus Reduction (pounds), Cropland BMPs								
Year	No-Till	Nutrient Management	Terraces	Grade Stabilization	Permanent Vegetation	Vegetative Buffers and Terraces	Grassed Waterways and Terraces	Total Load Reduction
1	414	240	253	14	15	223	263	**1,421**
2	829	480	506	27	29	445	526	**2,842**
3	1,243	719	760	41	44	668	790	**4,263**
4	1,657	959	1,013	54	58	890	1,053	**5,684**
5	2,072	1,199	1,266	68	73	1,113	1,316	**7,105**
6	2,486	1,439	1,519	81	87	1,335	1,579	**8,526**
7	2,900	1,678	1,772	95	102	1,558	1,842	**9,947**
8	3,315	1,918	2,026	108	117	1,780	2,105	**11,369**
9	3,729	2,158	2,279	122	131	2,003	2,369	**12,790**
10	4,143	2,398	2,532	135	146	2,225	2,632	**14,211**
11	4,558	2,637	2,785	149	160	2,448	2,895	**15,632**
12	4,972	2,877	3,038	162	175	2,670	3,158	**17,053**
13	5,386	3,117	3,292	176	190	2,893	3,421	**18,474**
14	5,801	3,357	3,545	189	204	3,115	3,684	**19,895**
15	6,215	3,597	3,798	203	219	3,338	3,948	**21,316**
16	6,629	3,836	4,051	216	233	3,560	4,211	**22,737**
17	7,043	4,076	4,304	230	248	3,783	4,474	**24,158**
18	7,458	4,316	4,558	243	262	4,005	4,737	**25,579**
19	7,872	4,556	4,811	257	277	4,228	5,000	**27,000**

20	8,286	4,795	5,064	270	292	4,450	5,263	**28,421**
21	8,701	5,035	5,317	284	306	4,673	5,527	**29,842**
22	9,115	5,275	5,570	298	321	4,895	5,790	**31,264**
23	9,529	5,515	5,824	311	335	5,118	6,053	**32,685**
24	9,944	5,754	6,077	325	350	5,340	6,316	**34,106**
25	10,358	5,994	6,330	338	364	5,563	6,579	**35,527**
26	10,772	6,234	6,583	352	379	5,785	6,842	**36,948**
27	11,187	6,474	6,836	365	394	6,008	7,106	**38,369**
28	11,601	6,714	7,090	379	408	6,230	7,369	**39,790**
29	12,015	6,953	7,343	392	423	6,453	7,632	**41,211**
30	12,430	7,193	7,596	406	437	6,675	7,895	**42,632**

Table 26. Estimated Nitrogen Load Reductions in the Cropland Targeted Area for All Implemented BMPs Aimed at Meeting the E TMDL in Pomona Lake.

Annual Nitrogen Reduction (pounds), Cropland BMPs								
Year	**No-Till**	**Nutrient Management**	**Terraces**	**Grade Stabilization**	**Permanent Vegetation**	**Vegetative Buffers and Terraces**	**Grassed Waterways and Terraces**	**Total Load Reduction**
1	2,396	2,219	2,343	125	135	1,598	2,435	**11,251**
2	4,793	4,438	4,686	250	270	3,195	4,871	**22,501**
3	7,189	6,656	7,029	375	405	4,793	7,306	**33,752**
4	9,585	8,875	9,372	499	540	6,390	9,741	**45,003**
5	11,981	11,094	11,715	624	675	7,988	12,177	**56,254**
6	14,378	13,313	14,058	749	809	9,585	14,612	**67,504**
7	16,774	15,531	16,401	874	944	11,183	17,047	**78,755**
8	19,170	17,750	18,744	999	1,079	12,780	19,483	**90,006**
9	21,567	19,969	21,087	1,124	1,214	14,378	21,918	**101,256**
10	23,963	22,188	23,430	1,249	1,349	15,975	24,353	**112,507**
11	26,359	24,407	25,773	1,373	1,484	17,573	26,789	**123,758**
12	28,755	26,625	28,116	1,498	1,619	19,170	29,224	**135,008**
13	31,152	28,844	30,459	1,623	1,754	20,768	31,659	**146,259**
14	33,548	31,063	32,802	1,748	1,889	22,365	34,095	**157,510**
15	35,944	33,282	35,145	1,873	2,024	23,963	36,530	**168,761**
16	38,340	35,500	37,488	1,998	2,158	25,560	38,965	**180,011**
17	40,737	37,719	39,832	2,123	2,293	27,158	41,401	**191,262**
18	43,133	39,938	42,175	2,248	2,428	28,755	43,836	**202,513**
19	45,529	42,157	44,518	2,372	2,563	30,353	46,271	**213,763**
20	47,926	44,376	46,861	2,497	2,698	31,950	48,707	**225,014**
21	50,322	46,594	49,204	2,622	2,833	33,548	51,142	**236,265**
22	52,718	48,813	51,547	2,747	2,968	35,145	53,577	**247,516**

23	55,114	51,032	53,890	2,872	3,103	36,743	56,013	**258,766**
24	57,511	53,251	56,233	2,997	3,238	38,340	58,448	**270,017**
25	59,907	55,469	58,576	3,122	3,373	39,938	60,883	**281,268**
26	62,303	57,688	60,919	3,246	3,507	41,536	63,319	**292,518**
27	64,700	59,907	63,262	3,371	3,642	43,133	65,754	**303,769**
28	67,096	62,126	65,605	3,496	3,777	44,731	68,189	**315,020**
29	69,492	64,345	67,948	3,621	3,912	46,328	70,625	**326,271**
30	71,888	66,563	70,291	3,746	4,047	47,926	73,060	**337,521**

Table 27. Estimated Phosphorus Load Reductions in the Livestock Targeted Area for All Implemented BMPs Aimed at Meeting the E TMDL in Pomona Lake.

Annual Phosphorous Load Reductions (lbs)					
Year	**Vegetative Filter Strip**	**Relocate Feeding Pens**	**Relocate Pasture Feeding Site**	**Off Stream Watering System**	**Annual Load Reduction**
1	638	957	126	189	**1,910**
2	1,276	1,914	315	378	**3,883**
3	1,914	2,870	441	568	**5,793**
4	2,552	3,827	631	757	**7,766**
5	3,189	4,784	757	946	**9,676**
6	3,827	5,741	946	1,135	**11,649**
7	4,465	6,698	1,072	1,324	**13,559**
8	5,103	7,655	1,261	1,513	**15,532**
9	5,741	8,611	1,387	1,703	**17,442**
10	6,379	9,568	1,577	1,892	**19,415**
11	7,017	10,525	1,703	2,081	**21,325**
12	7,655	11,482	1,892	2,270	**23,298**
13	8,292	12,439	2,018	2,459	**25,208**
14	8,930	13,395	2,207	2,649	**27,181**
15	9,568	14,352	2,333	2,838	**29,091**
16	10,206	15,309	2,522	3,027	**31,064**
17	10,844	16,266	2,649	3,216	**32,974**
18	11,482	17,223	2,838	3,405	**34,947**
19	12,120	18,179	2,964	3,594	**36,857**
20	12,758	19,136	3,153	3,784	**38,830**
21	13,395	20,093	3,279	3,973	**40,740**
22	14,033	21,050	3,468	4,162	**42,713**
23	14,671	22,007	3,594	4,351	**44,623**
24	15,309	22,964	3,784	4,540	**46,597**
25	15,947	23,920	3,910	4,730	**48,507**
26	16,585	24,877	4,099	4,919	**50,480**
27	17,223	25,834	4,225	5,108	**52,390**

28	17,861	26,791	4,414	5,297	**54,363**
29	18,498	27,748	4,540	5,486	**56,273**
30	19,136	28,704	4,730	5,675	**58,246**

Table 28. Estimated Phosphorus Load Reductions in the Streambank Targeted Area for Streambank Stabilization BMPs Aimed at Meeting the E TMDL in Pomona Lake.

Pomona Watershed Annual Streambank Phosphorus Load Reductions			
Year	**Streambank Stabilization (feet)**	**Phosphorus Load Reduction (pounds)**	**Cumulative Phoshporus Load Reduction (pounds)**
1	260	23	**23**
2	260	23	**47**
3	260	23	**70**
4	260	23	**94**
5	260	23	**117**
6	260	23	**140**
7	260	23	**164**
8	260	23	**187**
9	260	23	**211**
10	260	23	**234**
11	260	23	**257**
12	260	23	**281**
13	260	23	**304**
14	260	23	**328**
15	260	23	**351**
16	260	23	**374**
17	260	23	**398**
18	260	23	**421**
19	260	23	**445**
20	260	23	**468**
21	260	23	**491**
22	260	23	**515**
23	260	23	**538**
24	260	23	**562**
25	260	23	**585**
26	260	23	**608**
27	260	23	**632**
28	260	23	**655**
29	260	23	**679**
30	260	23	**702**

Table 29. Estimated Phosphorus Load Reductions in the Riparian Targeted Area for Riparian Restoration BMPs Aimed at Meeting the E TMDL in Pomona Lake.

Pomona Watershed Annual Riparian Phosphorus Load Reductions			
Year	Riparian Restoration (acres)	Phosphorus Load Reduction (pounds)	Cumulative Phoshporus Load Reduction (pounds)
1	30.5	664	**664**
2	30.5	664	**1,328**
3	30.5	664	**1,992**
4	30.5	664	**2,656**
5	30.5	664	**3,321**
6	30.5	664	**3,985**
7	30.5	664	**4,649**
8	30.5	664	**5,313**
9	30.5	664	**5,977**
10	30.5	664	**6,641**
11	30.5	664	**7,305**
12	30.5	664	**7,969**
13	30.5	664	**8,633**
14	30.5	664	**9,297**
15	30.5	664	**9,962**
16	30.5	664	**10,626**
17	30.5	664	**11,290**
18	30.5	664	**11,954**
19	30.5	664	**12,618**
20	30.5	664	**13,282**
21	30.5	664	**13,946**
22	30.5	664	**14,610**
23	30.5	664	**15,274**
24	30.5	664	**15,938**
25	30.5	664	**16,603**
26	30.5	664	**17,267**
27	30.5	664	**17,931**
28	30.5	664	**18,595**
29	30.5	664	**19,259**
30	30.5	664	**19,923**

The table below shows the combined load reduction for phosphorus that is attained by implementing all cropland and livestock BMPs annually as well as load reductions from BMPs that were implemented within the watershed from 2001-2009. The percent of TMDL achievement is illustrated in the right column. The timeframe for attaining the TMDL is fifteen years. The life of the WRAPS

plan is thirty years. After fifteen years, the phosphorus portion of this plan will switch from being “restoration” to “protection” of the watershed.

Table 30. Combined Phosphorus Load Reduction Aimed at Meeting the E TMDL in Pomona Lake.

Combination of Cropland, Livestock, and Streambank BMPs to Meet the Phosphorus Portion of the E TMDL						
Year	**Streambank Reduction (pounds)**	**Cropland Reduction (pounds)**	**Livestock Reduction (pounds)**	**Riparian Restoration (pounds)**	**Total Reduction (pounds)**	**% of TMDL**
2001-2009	***N/A***	***38,569***	***N/A***	***N/A***	***38,569***	***39%***
1	23	39,990	1,910	664	42,587	43%
2	47	41,411	3,883	1,328	46,669	48%
3	70	42,832	5,793	1,992	50,687	52%
4	94	44,253	7,766	2,656	54,769	56%
5	117	45,674	9,676	3,321	58,787	60%
6	140	47,095	11,649	3,985	62,869	64%
7	164	48,516	13,559	4,649	66,888	68%
8	187	49,937	15,532	5,313	70,969	72%
9	211	51,358	17,442	5,977	74,988	76%
10	234	52,779	19,415	6,641	79,069	81%
11	257	54,200	21,325	7,305	83,088	85%
12	281	55,621	23,298	7,969	87,170	89%
13	304	57,042	25,208	8,633	91,188	93%
14	328	58,463	27,181	9,297	95,270	97%
15	351	59,885	29,091	9,962	99,288	101%
16	374	61,306	31,064	10,626	103,370	105%
17	398	62,727	32,974	11,290	107,388	110%
18	421	64,148	34,947	11,954	111,470	114%
19	445	65,569	36,857	12,618	115,489	118%
20	468	66,990	38,830	13,282	119,570	122%
21	491	68,411	40,740	13,946	123,589	126%
22	515	69,832	42,713	14,610	127,670	130%
23	538	71,253	44,623	15,274	131,689	134%
24	562	72,674	46,597	15,938	135,771	138%
25	585	74,095	48,507	16,603	139,789	143%
26	608	75,516	50,480	17,267	143,871	147%
27	632	76,937	52,390	17,931	147,889	151%
28	655	78,358	54,363	18,595	151,971	155%
29	679	79,780	56,273	19,259	155,990	159%
30	702	81,201	58,246	19,923	160,071	163%
Load Reduction to meet E TMDL:					**98,043**	

P portion of the E TMDL has been met

Table 31. Phosphorus Load Reduction in Thirty Years by Category Aimed at Meeting the E TMDL in Pomona Lake.

Best Management Practice Category	Total Load Reduction (pounds)	Percent of Phosphorous TMDL
Cropland	81,201	82.8%
Livestock	58,246	59.4%
Riparian	19,923	20.3%
Streambank	702	0.7%
Total	**160,071**	**163.3%**

Refer to Section 8, “Costs of BMP Implementation” for specific BMP costs in order to meet the TMDL.

7.0 Information and Education (I&E) in Support of BMPs

7.1 I&E Activities and Events

The SLT has determined which I&E 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. I&E projects will be emphasized in the Targeted Areas, but are open to the entire watershed. Even though open to the entire watershed, special attention will be paid to residents of the Targeted Areas with supplemental postcards, mailings and contacts.

Table 32. I&E Activities and Events as Requested by the SLT in Support of Meeting the TMDLs.

BMP	Target Audience	I&E Activity/Event	Time Frame	Estimated Cost	Sponsor/Responsible Agency
Cropland BMP Implementation					
No-Till	Farmers and Rental Operators	Newsletter article	Annual – Spring	No Charge	Conservation District and Kansas State Research and Extension
		One on One Meetings with Producers	Annual - Ongoing	No Charge	Conservation District and Kansas State Research and Extension
		Seasonal Informational Meeting (planting)	Annual - Spring	$1,750 per meeting	East Central Kansas No-till
		Seasonal Informational Meeting (harvesting)	Annual - Summer	$1,750 per meeting	East Central Kansas No-till
		Scholarships for 10 producers to attend No-Till Winter Conference	Annual – Winter	$1,500 ($150 per person)	No-till on the Plains
Nutrient Management	Farmers	Cost Share for 100 Soil Tests for Organic Matter and Zinc	Annual - Ongoing	$800 ($8.00 per test)	Conservation District and Kansas State Research and Extension
		Extension Newsletter Article	Annual - Ongoing	No Charge	Conservation District and Kansas State Research and Extension

		One on One Meetings with Producers	Annual - Ongoing	Cost included with Technical Assistance for Watershed Specialist	Kansas State Research and Extension Watershed Specialist
Terraces, Waterways, ponds, diversions	Farmers	Field Day showcasing latest designs, cost share	Annual – Winter	$200 per meeting	Conservation District, NRCS,
Terraces, Waterways, ponds, diversions	Contractors	Meeting highlighting design specifications	Annual – Spring	$200 per meeting	Conservation District, NRCS
Livestock BMP Implementation					
Vegetative Filter Strip Feedlot Relocation	Landowners and Ranchers	Tour/Field Day	Annual - Summer	Combined with buffer tour or field day	Watershed Forester
		Livestock Filter Strip and Feedlot Relocation Demonstration/Tour	Annual – Winter	$700 per demonstration or tour	Conservation Districts NCRS, Watershed Specialist
Relocate Pasture Feeding Site	Ranchers	Tour/Field Day	Annual - Summer	$1500 per tour or field day	Watershed Specialist Conservation Districts
		Grazing Informational Meeting	Annual - Fall	$250 per meeting	Conservation Districts NRCS
Off-Stream Watering System	Ranchers	Tour/Field Day	Annual - Summer	$500 per tour or field day	Watershed specialist, Conservation Districts
		Grazing Informational Meeting	Annual - Fall	Combined with relocating pasture feeding site meeting	Conservation Districts, Watershed Specialist
Streambank BMP Implementation					
Streambank restoration Riparian buffers	Landowners	Demonstration project focusing on streambank assessment methodology	Annual - Summer	$3,000 per project	Kansas Alliance for Wetlands and Streams
		One on one technical assistance	Annual – Ongoing	No charge	Conservation District, Kansas State Research and Extension, NRCS

Field Borders		Field day highlighting completed streambank assessment projects	Annual - Summer	$1,700 per field day	Kansas Forest Service, Watershed Forester
General / Watershed Wide I&E					
Education of Youth	Educators, K-12 Students	National Get Outdoors Day	Annual – Spring	$200	Conservation Districts, Corps of Engineers office
		Summer Program at Library	Annual – Summer	$200	Conservation Districts
		Science fair	Annual – Spring	$100	Conservation Districts
		Arbor day tree planting	Annual – Spring	$250	Conservation Districts, Westar Green Team, Watershed Forester
		EARTH	Annual – ongoing	$7000	Kansas State Research and Extension for administration
		Poster, essay and speech contests	Annual – Spring	$200	Conservation Districts
		Envirothon	Annual - Spring	$250	Conservation Districts
Education of Adults	Educators, Adult Education	Presentation at annual meeting	Annual – Winter	No charge	Conservation Districts
		Newsletter article	Annual – Ongoing	No charge	Conservation Districts
		Scholarship for teachers to KFAC college course	Annual – Ongoing	$600 ($150/hour)	Conservation Districts
		Presentation at Fair	Annual – Summer	$150	Conservation Districts, Watershed Specialist
		Media campaign to promote forestry practices (brochures, news releases, TV, radio, web-based)	Bi-annual – Ongoing	$500 per campaign	Kansas Forest Service
Education of Watershed Residents	Watershed Residents	Meeting with Soil and Grassland Awards	Annual – Ongoing	No charge	Conservation Districts
		Media campaign to promote noxious weed control	Annual – Ongoing	$5,000 per campaign	Conservation Districts
		Scholarships for Women	Annual – Spring	$500	Conservation District

		Managing the Farm conference		($100 each)	
		Watershed display for area garden shows	Annual – Ongoing	No charge	Conservation Districts, Kansas State Research and Extension
Total annual cost for Information and Education if all events are implemented				**$31,500**	

7.2 Evaluation of I&E Activities

All service providers conducting I&E activities funded through the Pomona WRAPS will be required to include an evaluation component in their project proposals and PIPs. 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.

8.0 Costs of Implementing BMPs and Possible Funding Sources

The SLT has reviewed all the recommended BMPs listed in the Section 6 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 high priority TMDLs). Most of the BMPs that are targeted will be advantageous to more than one impairment, thus being more efficient.

Summarized Derivation of Cropland BMP Cost Estimates

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%.

Nutrient Management: After being presented with information from K-State Research and Extension (Craig Smith and Josh Roe) on the costs and benefits of nutrient management plans, the SLT decided that a fair price to entice a producer to adopt nutrient management plans would be to pay them $7.30 per acre for 10 years, or a net present value of $56.71 per acre upfront assuming the NRCS discount rate of 4.75 percent.

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

Establish Permanent Vegetation: The cost of $150 an acre was calculated based on K-State Research and Extension estimates of the cost of planting and maintaining native grass.

Grade Stabilization: Costs for grade stabilization or a water impoundment made by constructing an earthen dam are determined to be approximately $300 per acre that drains into the basin.

Permanent Vegetation: The cost of $150 an acre was calculated based on K-State Research and Extension estimates of the cost of planting and maintaining native grass.

Vegetative Buffer Strips: 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.

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.

Relocate Feeding Pens:
-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 (1 unit equals 1 acre, 100 AU pen).
-Pasture- Move feeding site that is in a pasture away from a stream, waterway, or body of water to increase the filtration and waste removal (e.g. move bale feeders away from stream). Highly variable in price, average of $2,203 per unit (1 unit equals 1 acre, 100 AU pen).
-Average P reduction: 30-80%

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.

8.1 Costs of Implementing BMPs and I&E

Table 33. Estimated Costs Before Cost Share for Cropland Implemented BMPs in the Cropland Targeted Area. Individual sub watershed costs are provided in the Appendix. Expressed in 2010 dollar amounts.

Annual Cropland BMPs Costs Before Cost Share								
Year	No-Till	Nutrient Management	Terraces	Grade Stabilization	Permanent Vegetation	Vegetative Buffers and Terraces	Grassed Waterways and Terraces	Total
1	$27,991	$18,919	$8,896	$29,358	$29,891	$2,800	$801	**$118,656**
2	$28,831	$19,486	$9,163	$30,238	$30,788	$2,884	$825	**$122,216**
3	$29,696	$20,071	$9,438	$31,145	$31,712	$2,971	$849	**$125,882**
4	$30,587	$20,673	$9,721	$32,080	$32,663	$3,060	$875	**$129,659**
5	$31,505	$21,293	$10,013	$33,042	$33,643	$3,151	$901	**$133,549**
6	$32,450	$21,932	$10,313	$34,033	$34,652	$3,246	$928	**$137,555**
7	$33,423	$22,590	$10,623	$35,054	$35,692	$3,343	$956	**$141,682**
8	$34,426	$23,268	$10,941	$36,106	$36,763	$3,444	$985	**$145,932**
9	$35,459	$23,966	$11,269	$37,189	$37,865	$3,547	$1,014	**$150,310**

10	$36,523	$24,685	$11,608	$38,305	$39,001	$3,653	$1,045	**$154,819**
11	$37,618	$25,425	$11,956	$39,454	$40,171	$3,763	$1,076	**$159,464**
12	$38,747	$26,188	$12,314	$40,638	$41,377	$3,876	$1,108	**$164,248**
13	$39,909	$26,974	$12,684	$41,857	$42,618	$3,992	$1,142	**$169,175**
14	$41,106	$27,783	$13,064	$43,113	$43,896	$4,112	$1,176	**$174,251**
15	$42,340	$28,617	$13,456	$44,406	$45,213	$4,235	$1,211	**$179,478**
16	$43,610	$29,475	$13,860	$45,738	$46,570	$4,362	$1,247	**$184,862**
17	$44,918	$30,359	$14,276	$47,110	$47,967	$4,493	$1,285	**$190,408**
18	$46,266	$31,270	$14,704	$48,524	$49,406	$4,628	$1,323	**$196,120**
19	$47,654	$32,208	$15,145	$49,979	$50,888	$4,767	$1,363	**$202,004**
20	$49,083	$33,174	$15,600	$51,479	$52,415	$4,910	$1,404	**$208,064**
21	$50,556	$34,170	$16,068	$53,023	$53,987	$5,057	$1,446	**$214,306**
22	$52,072	$35,195	$16,550	$54,614	$55,607	$5,209	$1,489	**$220,735**
23	$53,635	$36,251	$17,046	$56,252	$57,275	$5,365	$1,534	**$227,357**
24	$55,244	$37,338	$17,557	$57,940	$58,993	$5,526	$1,580	**$234,178**
25	$56,901	$38,458	$18,084	$59,678	$60,763	$5,692	$1,628	**$241,203**
26	$58,608	$39,612	$18,627	$61,468	$62,586	$5,863	$1,676	**$248,440**
27	$60,366	$40,800	$19,186	$63,312	$64,463	$6,038	$1,727	**$255,893**
28	$62,177	$42,024	$19,761	$65,212	$66,397	$6,220	$1,778	**$263,570**
29	$64,042	$43,285	$20,354	$67,168	$68,389	$6,406	$1,832	**$271,477**
30	$65,964	$44,584	$20,965	$69,183	$70,441	$6,598	$1,887	**$279,621**
3% Annual Cost Inflation								

Table 34. Estimated Costs After Cost Share for Cropland Implemented BMPs in the Cropland Targeted Area. Individual sub watershed costs are provided in the Appendix. Expressed in 2010 dollar amounts.

Annual Cropland BMPs Costs After Cost Share								
Year	**No-Till**	**Nutrient Management**	**Terraces**	**Grade Stabilization**	**Permanent Vegetation**	**Vegetative Buffers and Terraces**	**Grassed Waterways and Terraces**	**Total**
1	$17,075	$9,459	$890	$14,679	$14,946	$1,400	$400	**$58,849**
2	$17,587	$9,743	$916	$15,119	$15,394	$1,442	$412	**$60,614**
3	$18,115	$10,036	$944	$15,573	$15,856	$1,485	$425	**$62,433**
4	$18,658	$10,337	$972	$16,040	$16,332	$1,530	$437	**$64,305**
5	$19,218	$10,647	$1,001	$16,521	$16,821	$1,576	$451	**$66,235**
6	$19,794	$10,966	$1,031	$17,017	$17,326	$1,623	$464	**$68,222**
7	$20,388	$11,295	$1,062	$17,527	$17,846	$1,672	$478	**$70,268**
8	$21,000	$11,634	$1,094	$18,053	$18,381	$1,722	$492	**$72,376**
9	$21,630	$11,983	$1,127	$18,595	$18,933	$1,773	$507	**$74,548**
10	$22,279	$12,342	$1,161	$19,152	$19,501	$1,827	$522	**$76,784**
11	$22,947	$12,713	$1,196	$19,727	$20,086	$1,881	$538	**$79,088**

12	$23,636	$13,094	$1,231	$20,319	$20,688	$1,938	$554	**$81,460**
13	$24,345	$13,487	$1,268	$20,928	$21,309	$1,996	$571	**$83,904**
14	$25,075	$13,892	$1,306	$21,556	$21,948	$2,056	$588	**$86,421**
15	$25,827	$14,308	$1,346	$22,203	$22,607	$2,118	$606	**$89,014**
16	$26,602	$14,738	$1,386	$22,869	$23,285	$2,181	$624	**$91,684**
17	$27,400	$15,180	$1,428	$23,555	$23,983	$2,247	$642	**$94,435**
18	$28,222	$15,635	$1,470	$24,262	$24,703	$2,314	$662	**$97,268**
19	$29,069	$16,104	$1,515	$24,990	$25,444	$2,383	$682	**$100,186**
20	$29,941	$16,587	$1,560	$25,739	$26,207	$2,455	$702	**$103,191**
21	$30,839	$17,085	$1,607	$26,511	$26,994	$2,529	$723	**$106,287**
22	$31,764	$17,597	$1,655	$27,307	$27,803	$2,604	$745	**$109,476**
23	$32,717	$18,125	$1,705	$28,126	$28,637	$2,683	$767	**$112,760**
24	$33,699	$18,669	$1,756	$28,970	$29,497	$2,763	$790	**$116,143**
25	$34,710	$19,229	$1,808	$29,839	$30,381	$2,846	$814	**$119,627**
26	$35,751	$19,806	$1,863	$30,734	$31,293	$2,931	$838	**$123,216**
27	$36,823	$20,400	$1,919	$31,656	$32,232	$3,019	$863	**$126,912**
28	$37,928	$21,012	$1,976	$32,606	$33,199	$3,110	$889	**$130,720**
29	$39,066	$21,643	$2,035	$33,584	$34,195	$3,203	$916	**$134,641**
30	$40,238	$22,292	$2,096	$34,591	$35,220	$3,299	$943	**$138,681**
3% Annual Cost Inflation								

Table 35. Annual Costs After Cost Share in the Livestock Targeted Area. Expressed in 2010 dollar amounts.

Livestock BMPs, Annual Cost Before Cost-Share					
Year	**Vegetative Filter Strip**	**Relocate Feeding Pens**	**Relocate Pasture Feeding Site**	**Off-Stream Watering System**	**Total**
1	$357	$3,311	$2,203	$5,693	**$11,563**
2	$368	$3,410	$3,404	$5,863	**$13,044**
3	$379	$3,512	$2,337	$6,039	**$12,267**
4	$390	$3,617	$3,611	$6,220	**$13,839**
5	$402	$3,726	$2,479	$6,407	**$13,014**
6	$414	$3,838	$3,831	$6,599	**$14,682**
7	$426	$3,953	$2,630	$6,797	**$13,807**
8	$439	$4,071	$4,064	$7,001	**$15,576**
9	$452	$4,194	$2,791	$7,211	**$14,648**
10	$466	$4,319	$4,312	$7,427	**$16,524**
11	$480	$4,449	$2,961	$7,650	**$15,540**
12	$494	$4,583	$4,574	$7,880	**$17,531**
13	$509	$4,720	$3,141	$8,116	**$16,486**
14	$524	$4,862	$4,853	$8,360	**$18,598**
15	$540	$5,007	$3,332	$8,610	**$17,490**

16	$556	$5,158	$5,148	$8,869	**$19,731**
17	$573	$5,312	$3,535	$9,135	**$18,555**
18	$590	$5,472	$5,462	$9,409	**$20,932**
19	$608	$5,636	$3,750	$9,691	**$19,685**
20	$626	$5,805	$5,794	$9,982	**$22,207**
21	$645	$5,979	$3,979	$10,281	**$20,884**
22	$664	$6,159	$6,147	$10,590	**$23,560**
23	$684	$6,343	$4,221	$10,907	**$22,156**
24	$705	$6,534	$6,522	$11,235	**$24,994**
25	$726	$6,730	$4,478	$11,572	**$23,505**
26	$747	$6,931	$6,919	$11,919	**$26,517**
27	$770	$7,139	$4,751	$12,276	**$24,937**
28	$793	$7,354	$7,340	$12,645	**$28,132**
29	$817	$7,574	$5,040	$13,024	**$26,455**
30	$841	$7,801	$7,787	$13,415	**$29,845**
3% Annual Cost Inflation					

Table 36. Annual Costs for Implemented Streambank BMPs.

Pomona Watershed Annual Streambank BMP Costs		
Year	**Streambank Stabilization (feet)**	**Cost**
1	260	**$18,590**
2	260	**$19,148**
3	260	**$19,722**
4	260	**$20,314**
5	260	**$20,923**
6	260	**$21,551**
7	260	**$22,197**
8	260	**$22,863**
9	260	**$23,549**
10	260	**$24,256**
11	260	**$24,983**
12	260	**$25,733**
13	260	**$26,505**
14	260	**$27,300**
15	260	**$28,119**
16	260	**$28,963**
17	260	**$29,831**
18	260	**$30,726**
19	260	**$31,648**
20	260	**$32,598**

21	260	**$33,576**
22	260	**$34,583**
23	260	**$35,620**
24	260	**$36,689**
25	260	**$37,790**
26	260	**$38,923**
27	260	**$40,091**
28	260	**$41,294**
29	260	**$42,533**
30	260	**$43,809**
3% Inflation		

Table 37. Annual Costs for Implemented Riparian BMPs.

Pomona Watershed Annual Riparian BMP Costs Before and After Cost Share			
Year	**Riparian Restoration and Management (acres)**	**Cost Before Cost Share**	**Cost After Cost Share**
1	30.5	**$30,533**	**$3,053**
2	30.5	**$31,449**	**$3,145**
3	30.5	**$32,393**	**$3,239**
4	30.5	**$33,365**	**$3,336**
5	30.5	**$34,366**	**$3,437**
6	30.5	**$35,397**	**$3,540**
7	30.5	**$36,458**	**$3,646**
8	30.5	**$37,552**	**$3,755**
9	30.5	**$38,679**	**$3,868**
10	30.5	**$39,839**	**$3,984**
11	30.5	**$41,034**	**$4,103**
12	30.5	**$42,265**	**$4,227**
13	30.5	**$43,533**	**$4,353**
14	30.5	**$44,839**	**$4,484**
15	30.5	**$46,184**	**$4,618**
16	30.5	**$47,570**	**$4,757**
17	30.5	**$48,997**	**$4,900**
18	30.5	**$50,467**	**$5,047**
19	30.5	**$51,981**	**$5,198**
20	30.5	**$53,540**	**$5,354**
21	30.5	**$55,147**	**$5,515**
22	30.5	**$56,801**	**$5,680**
23	30.5	**$58,505**	**$5,851**
24	30.5	**$60,260**	**$6,026**
25	30.5	**$62,068**	**$6,207**

26	30.5	**$63,930**	**$6,393**
27	30.5	**$65,848**	**$6,585**
28	30.5	**$67,823**	**$6,782**
29	30.5	**$69,858**	**$6,986**
30	30.5	**$71,954**	**$7,195**
3% Inflation			

Table 38. Technical Assistance Needed to Implement BMPs.

BMP		***Technical Assistance***	***Projected Annual Cost***
Cropland	1. Buffers	Buffer Coordinator No-Till Coordinator WRAPS Coordinator	Buffer Coordinator $17,500 No-Till Coordinator $17,500 WRAPS Coordinator $35,000 Watershed Specialist $45,000 WRAPS Technician $35,000
	2. Continuous No-till	No-Till Coordinator WRAPS Coordinator	
	3. Nutrient Management	Watershed Specialist WRAPS Coordinator	
	4. Pond	WRAPS Technician WRAPS Coordinator	
	5. Waterways	WRAPS Technician WRAPS Coordinator Buffer Coordinator	
	6. Terrace	WRAPS Technician WRAPS Coordinator	
Livestock	1. Vegetative filter strips	Buffer Coordinator WRAPS Coordinator	
	2. Relocate pasture feeding sites	Watershed Specialist WRAPS Coordinator	
	3. Establish off stream watering systems	Watershed Specialist WRAPS Technician WRAPS Coordinator	
Streambank	1. Riparian buffers	Buffer Coordinator WRAPS Coordinator	
	2. Field borders	Buffer Coordinator WRAPS Coordinator	
	3. Streambank restoration	WRAPS Coordinator WRAPS Techncian Watershed Specialist	
Total			**$150,000**

Table 39. Total Costs for BMPs, I&E and Technical Support if All BMPs and I&E Projects are Implemented.

Annual Cost of Cropland, Livestock, Streambank, and Riparian BMPs, I&E, and Technical Assistance adjusted for Cost Share							
	BMPs Implemented				I&E and Technical Assistance		
Year	Cropland	Livestock	Streambank	Riparian	I&E	Technical Assistance	Total
1	$58,849	$11,563	$18,590	$3,053	$31,500	$150,000	**$273,555**
2	$60,614	$13,044	$19,148	$3,145	$32,445	$154,500	**$282,896**
3	$62,433	$12,267	$19,722	$3,239	$33,418	$159,135	**$290,214**
4	$64,305	$13,839	$20,314	$3,336	$34,421	$163,909	**$300,124**
5	$66,235	$13,014	$20,923	$3,437	$35,454	$168,826	**$307,889**
6	$68,222	$14,682	$21,551	$3,540	$36,517	$173,891	**$318,403**
7	$70,268	$13,807	$22,197	$3,646	$37,613	$179,108	**$326,638**
8	$72,376	$15,576	$22,863	$3,755	$38,741	$184,481	**$337,792**
9	$74,548	$14,648	$23,549	$3,868	$39,903	$190,016	**$346,532**
10	$76,784	$16,524	$24,256	$3,984	$41,100	$195,716	**$358,364**
11	$79,088	$15,540	$24,983	$4,103	$42,333	$201,587	**$367,635**
12	$81,460	$17,531	$25,733	$4,227	$43,603	$207,635	**$380,189**
13	$83,904	$16,486	$26,505	$4,353	$44,911	$213,864	**$390,024**
14	$86,421	$18,598	$27,300	$4,484	$46,259	$220,280	**$403,342**
15	$89,014	$17,490	$28,119	$4,618	$47,647	$226,888	**$413,776**
16	$91,684	$19,731	$28,963	$4,757	$49,076	$233,695	**$427,906**
17	$94,435	$18,555	$29,831	$4,900	$50,548	$240,706	**$438,975**
18	$97,268	$20,932	$30,726	$5,047	$52,065	$247,927	**$453,965**
19	$100,186	$19,685	$31,648	$5,198	$53,627	$255,365	**$465,709**
20	$103,191	$22,207	$32,598	$5,354	$55,235	$263,026	**$481,611**
21	$106,287	$20,884	$33,576	$5,515	$56,893	$270,917	**$494,071**
22	$109,476	$23,560	$34,583	$5,680	$58,599	$279,044	**$510,942**
23	$112,760	$22,156	$35,620	$5,851	$60,357	$287,416	**$524,160**
24	$116,143	$24,994	$36,689	$6,026	$62,168	$296,038	**$542,058**
25	$119,627	$23,505	$37,790	$6,207	$64,033	$304,919	**$556,081**
26	$123,216	$26,517	$38,923	$6,393	$65,954	$314,067	**$575,070**
27	$126,912	$24,937	$40,091	$6,585	$67,933	$323,489	**$589,946**
28	$130,720	$28,132	$41,294	$6,782	$69,971	$333,193	**$610,092**
29	$134,641	$26,455	$42,533	$6,986	$72,070	$343,189	**$625,874**
30	$138,681	$29,845	$43,809	$7,195	$74,232	$353,485	**$647,247**
3% inflation							

8.2 Potential Funding Sources

Table 40. Potential BMP Funding Sources.

Potential Funding Sources	Potential Funding Programs
Natural Resources Conservation Service	Environmental Quality Incentives Program (EQIP) Wetland Reserve Program (WRP) Conservation Reserve Program (CRP) Wildlife Habitat Incentive Program (WHIP) Forestland Enhancement Program (FLEP) State Acres for Wildlife Enhancement (SAFE) Grassland Reserve Program (GRP) Farmable Wetlands Program (FWP)
EPA/KDHE	319 Funding Grants KDHE WRAPS Funding Clean Water Neighbor Grants
Kansas Alliance for Wetlands and Streams	
State Conservation Commission	State Cost Share
Conservation Districts	
No-Till on the Plains	
Kansas Forest Service	
US Fish and Wildlife	
National Wild Turkey Federation	
Quail Unlimited	
Ducks Unlimited	

Table 41. 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 FSA SCC East Central KS no-till Alliance KFS KSRE CD
	2. Continuous No-till	Design, cost share and maintenance	BMP workshops, tours, field days	
	3. Nutrient Management	Development of management plan	BMP workshops	
	4. Pond	Design, cost share and maintenance	BMP workshops, tours, and field days	

	5. Waterways	Design, cost share and maintenance	BMP workshops, field days, tours	RC&D KDWP
	6. Terrace	Design, cost share and maintenance	BMP workshops, field days, tours	
Livestock	1. Vegetative filter strips	Design, cost share and maintenance	BMP workshops, field days, tours	KSRE NRCS SCC East Central KS no-till Alliance KAWS CD RC&D KDWP
	2. Relocate pasture feeding sites	Design, cost share and maintenance	BMP workshops, field days, tours	
	3. Establish off stream watering systems	Design, cost share and maintenance	BMP workshops, field days, tours	
Streambank and Riparian Buffers	1. Riparian buffers	Design, cost share and maintenance	BMP workshops, field days, tours	KAWS NRCS SCC FSA KFS KSRE CD RC&D KDWP
	2. Field borders	Design, cost share and maintenance	BMP workshops, field days, tours	
	3. Streambank restoration	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.*

9.0 Timeframe

The plan will be reviewed every five years starting in 2016. In 2012, the SLT will request a review of data by KDHE for the Marais des Cygnes Basin. 2012 is the 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 thirty years from the date of publication of this report. Sediment and phosphorus reductions in the water column will not be noticeable by the year 2016 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 2021, but possible trends can be reviewed in 2016. They will examine BMP placement and implementation in 2016 and every subsequent five years after.

Table 42. Review Schedule for Pollutants and BMPs.

Review Year	Sediment	Phosphorus	BMP Placement
2016			X
2021	X	X	X
2026	X	X	X
2031	X	X	X

The interim timeframe for all BMP implementation would be ten years from the date of publication of this report. Targeting and BMP implementation might shift over time in order to achieve TMDLs.

- Timeframe for reaching the **siltation TMDL in Pomona Lake** will be attained at year 23 of the plan. After the sediment TMDL is achieved, the process will become one of protection instead of restoration.
- The WRAPS estimate timeframe for reaching the **phosphorus portion of the E TMDL in Pomona Lake** will be year 15 of the plan. After the phosphorus TMDL is achieved, the process will become one of protection instead of restoration.

10.0 Measureable Milestones

10.1 Adoption Rates for BMP Implementation

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

Table 43. Short, Medium and Long Term Goals for BMP Cropland Adoption Rates. Sub watershed adoption rates are provided in the Appendix.

Annual Cropland BMP Adoption (Treated Acres)									
	Year	No-Till	Nutrient Mgmt.	Vegetative Buffers	Terraces	Grassed Waterways	Grade Stabilization	Permanent Vegetation	Total
Short Term	1	360	334	133	294	187	9	5	1,322
	2	360	334	133	294	187	9	5	1,322
	3	360	334	133	294	187	9	5	1,322
	4	360	334	133	294	187	9	5	1,322
	5	360	334	133	294	187	9	5	1,322
Total		***1,801***	***1,668***	***667***	***1,468***	***934***	***47***	***27***	***6,612***
Medium Term	6	360	334	133	294	187	9	5	1,322
	7	360	334	133	294	187	9	5	1,322
	8	360	334	133	294	187	9	5	1,322
	9	360	334	133	294	187	9	5	1,322
	10	360	334	133	294	187	9	5	1,322
Total		***3,603***	***3,336***	***1,334***	***2,936***	***1,868***	***93***	***53***	***13,224***
Long Term	11	360	334	133	294	187	9	5	1,322
	12	360	334	133	294	187	9	5	1,322
	13	360	334	133	294	187	9	5	1,322
	14	360	334	133	294	187	9	5	1,322
	15	360	334	133	294	187	9	5	1,322
	16	360	334	133	294	187	9	5	1,322
	17	360	334	133	294	187	9	5	1,322
	18	360	334	133	294	187	9	5	1,322
	19	360	334	133	294	187	9	5	1,322

	20	360	334	133	294	187	9	5	1,322
	21	360	334	133	294	187	9	5	1,322
	22	360	334	133	294	187	9	5	1,322
	23	360	334	133	294	187	9	5	1,322
	24	360	334	133	294	187	9	5	1,322
	25	360	334	133	294	187	9	5	1,322
	26	360	334	133	294	187	9	5	1,322
	27	360	334	133	294	187	9	5	1,322
	28	360	334	133	294	187	9	5	1,322
	29	360	334	133	294	187	9	5	1,322
	30	360	334	133	294	187	9	5	1,322
Total		***10,809***	***10,008***	***4,003***	***8,807***	***5,605***	***280***	***160***	***39,672***

Table 44. Short, Medium and Long Term Goals for BMP Livestock Adoption Rates.

Annual Livestock BMP Adoption Rates					
	Year	**Vegetative Filter Strips**	**Relocate Feeding Pens**	**Relocate Pasture Feeding Site**	**Off Stream Watering System**
		Acres	**Projects**		
Short-Term	1	1	1	2	3
	2	1	1	3	3
	3	1	1	2	3
	4	1	1	3	3
	5	1	1	2	3
	Total	***5***	***5***	***12***	***15***
Medium-Term	6	1	1	3	3
	7	1	1	2	3
	8	1	1	3	3
	9	1	1	2	3
	10	1	1	3	3
	Total	***10***	***10***	***25***	***30***
Long-Term	11	1	1	2	3
	12	1	1	3	3
	13	1	1	2	3
	14	1	1	3	3
	15	1	1	2	3
	16	1	1	3	3
	17	1	1	2	3
	18	1	1	3	3
	19	1	1	2	3
	20	1	1	3	3
	21	1	1	2	3

	22	1	1	3	3
	23	1	1	2	3
	24	1	1	3	3
	25	1	1	2	3
	26	1	1	3	3
	27	1	1	2	3
	28	1	1	3	3
	29	1	1	2	3
	30	1	1	3	3
	Total	***30***	***30***	***75***	***90***

Table 32. Short, Medium and Long Term Goals for Streambank Stabilization Adoption Rates.

Annual Streambank Adoption Rates		
	Year	**Streambank Stabilization (feet)**
Short Term	1	260
	2	260
	3	260
	4	260
	5	260
	Total	***1,300***
Medium Term	6	260
	7	260
	8	260
	9	260
	10	260
	Total	***2,600***
Long Term	11	260
	12	260
	13	260
	14	260
	15	260
	16	260
	17	260
	18	260
	19	260
	20	260
	21	260
	22	260
	23	260
	24	260

	25	260
	26	260
	27	260
	28	260
	29	260
	30	260
	Total	***78,000***

Table 46. Short, Medium and Long Term Goals for Riparian Restoration Adoption Rates.

Annual Riparian Restoration Adoption Rates		
	Year	**Riparian Restoration (acres)**
Short Term	1	30.5
	2	30.5
	3	30.5
	4	30.5
	5	30.5
	Total	***152.5***
Medium Term	6	30.5
	7	30.5
	8	30.5
	9	30.5
	10	30.5
	Total	***305.0***
Long Term	11	30.5
	12	30.5
	13	30.5
	14	30.5
	15	30.5
	16	30.5
	17	30.5
	18	30.5
	19	30.5
	20	30.5
	21	30.5
	22	30.5
	23	30.5
	24	30.5
	25	30.5
	26	30.5
	27	30.5

	28	30.5
	29	30.5
	30	30.5
	Total	***915.0***

Table 47. Short, Medium and Long Term Goals for I&E Adoption Rates.

	Year	Demo Projects	Informational Meetings/ Workshops	Tours and Field Days	Soil Tests	Brochures, Newsletter Inserts	One on One Meetings	Scholarships	Educational Events	Contacts made by Tech Assistance
Short Term	1	2	7	5	100	3	3	16	11	100
	2	2	7	5	100	3	3	16	11	100
	3	2	7	5	100	3	3	16	11	100
	4	2	7	5	100	3	3	16	11	100
	5	2	7	5	100	3	3	16	11	100
Total		***10***	***35***	***25***	***500***	***15***	***15***	***80***	***55***	***500***
Medium Term	6	2	7	5	100	3	3	16	11	100
	7	2	7	5	100	3	3	16	11	100
	8	2	7	5	100	3	3	16	11	100
	9	2	7	5	100	3	3	16	11	100
	10	2	7	5	100	3	3	16	11	100
Total		***20***	***70***	***50***	***1,000***	***30***	***30***	***160***	***110***	***1,000***
Long Term	11	2	7	5	100	3	3	16	11	100
	12	2	7	5	100	3	3	16	11	100
	13	2	7	5	100	3	3	16	11	100
	14	2	7	5	100	3	3	16	11	100
	15	2	7	5	100	3	3	16	11	100
	16	2	7	5	100	3	3	16	11	100
	17	2	7	5	100	3	3	16	11	100
	18	2	7	5	100	3	3	16	11	100
	19	2	7	5	100	3	3	16	11	100
	20	2	7	5	100	3	3	16	11	100
	21	2	7	5	100	3	3	16	11	100
	22	2	7	5	100	3	3	16	11	100
	23	2	7	5	100	3	3	16	11	100
	24	2	7	5	100	3	3	16	11	100

	25	2	7	5	100	3	3	16	11	100
	26	2	7	5	100	3	3	16	11	100
	27	2	7	5	100	3	3	16	11	100
	28	2	7	5	100	3	3	16	11	100
	29	2	7	5	100	3	3	16	11	100
	30	2	7	5	100	3	3	16	11	100
Total		***60***	***210***	***150***	***3,000***	***90***	***90***	***480***	***330***	***3,000***

10.2 Benchmarks to Measure Water Quality and Social Progress

Over a thirty year time frame, this WRAPS project hopes to improve water quality in Pomona Lake and throughout the watershed. Social indicators will also be examined by tracking traffic in parks throughout the watershed. An example of a healthy ecosystem is frequent visits by the public to enjoy the outdoor recreation of the reservoirs and parks. After reviewing the criteria listed in the table below, the SLT will assess and revise the overall strategy plan for the watershed. New goals will be set and new BMPs will be implemented in order to achieve improved water quality. Coordination with KDHE TMDL staff, Water Plan staff and the SLT will be held every five years to discuss benchmarks and TMDL update plans. Using data obtained by KDHE, NRCS, KSU, OCCD, US Corps of Engineers and USGS, the following indicator and parameter criteria shall be used to assess progress in successful implementation to abate pollutant loads.

Table 48. Benchmarks to Measure Waters Quality Progress.

Impairment Addressed	Criteria to Measure Water Quality Progress	Information Source
Sediment	Fewer high event stream flow rates indicating better retention and slower release of storm water in the upper end of the watershed	USGS
Nutrients	**Pomona Lake:** Summer chlorophyll α concentration ≤ 12 ug/l	KDHE
	Pomona Lake: Secchi Disc Depth > 0.85m	KDHE
	Dragoon Creek: Maintain average BOD concentrations < 3.2 mg/l with no excursions < 5.0mg/l DO > 5mg/l	KDHE
	110 Creek: DO concentrations >5.0mg/l BOD average < 2.6 mg/l	KDHE
Impairment	**Social Indicators to Measure Water Quality Progress**	**Information**

Addressed		Source
Sediment Nutrients	Visitor traffic to Pomona Lake	KDWP
	Boating traffic in Pomona Lake	KDWP
	Trends of quantity and quality of fishing in Pomona Lake	KDWP
	Beach closings at Pomona Lake	KDHE
	Taste and odor issues in public water supply from Pomona Lake	KDHE
	Occurrence of algal blooms in Pomona Lake	KDHE
	No fish kills on Dragoon, 110 or Switzler Creeks	KDHE
	Economic indicators indicating effect of Pomona Lake's impact on local businesses	County Economic Development Organizations
	Survey of water quality issues to determine whether information and education programs are having an effect on public perception	KSRE
	Number of attendees at tours and field days	OCCD
	Number of acres of buffers, grassed waterways and terraces installed in the Cropland Targeted Area	NRCS OCCD

10.3 Water Quality Milestones Used to Determine Improvements [36]

The goal of the Pomona Lake WRAPS plan is to restore water quality for uses supportive of aquatic life, domestic water supply, and recreation for Pomona Lake. The plan specifically addresses the high priority eutrophication and siltation TMDLs for Pomona Lake. In order to reach the load reduction goals associated with the Pomona Lake impairments, a BMP implementation schedule spanning 30 years has been developed.

The selected BMPs included in the plan will be implemented throughout the targeted areas within the Pomona Lake watershed, including the Dragoon Creek and 110 Mile Creek sub watersheds, since these are the two major tributaries to Pomona Lake. While both of these streams have high priority dissolved oxygen TMDLs that this plan does not specifically address, it is anticipated that the water quality impairments will be positively affected by the BMP implementation plan that has been developed as part of this WRAPS plan.

Water quality milestones have been developed for Pomona Lake, 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 schedule contained in this plan. In order to provide additional water quality information associated with this plan, separate water quality milestones are also included for Dragoon Creek, 110 Mile Creek, and Switzler Creek (which is a tributary to Dragoon Creek). These water quality indicators will

enable KDHE and the Pomona Lake WRAPS to measure water quality improvements within the watershed above Pomona Lake, which should directly affect the water quality of the lake itself.

10.3.1 Water Quality Milestones for Pomona Lake

As previously stated, in order to reach the load reduction goals for Pomona Lake, a BMP implementation schedule spanning 30 years has been developed. Several water quality milestones and indicators have been developed for Pomona 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 Pomona 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 by the Kansas Water Office in 2009, is approximately 330 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 294 acre-feet/year is considered a water quality goal associated with the sediment load reductions goals of this plan.

The table on the following page includes 10-year water quality goals, as well as long term water quality goals for various parameters monitored in Pomona Lake. It should be noted that the current TMDLs for Pomona Lake will be up for review by KDHE in the year 2012. At that time, the milestones included herein may be reviewed and revised by Pomona Lake WRAPS, as necessary.

Table 49. Water Quality Milestones for Pomona Lake

Water Quality Milestones for Pomona Lake										
	Current Condition* (2000 - 2010) Average TP	10-Year Goal		Long Term Goal		Current Condition (2000 - 2010) Average TN	10-Year Goal		Long Term Goal	
		Improved Condition (2011 - 2021) Average TP	Total Reduction Needed	Improved Condition Average TP	Total Reduction Needed		Improved Condition (2011 - 2021) Average TN	Total Reduction Needed	Improved Condition Average TN	Total Reduction Needed
Sampling Site	**Total Phosphorus (average of data collected during indicated period), ppb**					**Total Nitrogen (average of data collected during indicated period), ppm**				
Pomona Lake LM028001	41.7	37	**4.7**	30	**11.7**	0.76	0.66	**0.10**	0.45	**0.31**
	Current Condition* (2000 - 2010) Chlorophyll a	10-Year Goal		Long Term Goal		Current Condition (2000 - 2010) Secchi (Avg)	10-Year Goal		Long Term Goal	
		Improved Condition (2011 - 2021) Chlorophyll a	Total Reduction Needed	Improved Condition Chlorophyll a			Improved Condition (2011 - 2021) Secchi (Avg)		Improved Condition Secchi (Avg)	
Sampling Site	**Chlorophyll a (average of data collected during indicated period), ppb**					**Secchi (average of data collected during indicated period), m**				

Pomona Lake LM028001	8.3	7	**1.3**	**Maintain Average Chlorophyll a ≤ 6**	0.82	**Secchi depth > 1.0**	**Maintain Secchi depth > 1.5**

*The lake monitoring site is typically sampled every 3 years. The current conditions listed in the table for Pomona Lake include data from 2000, 2002, 2005 and 2008.

10.3.1 Water Quality Milestones for Dragoon Creek, 110 Mile Creek and Switzler Creek

While the primary focus of this plan is the high priority eutrophication and siltation TMDLs for Pomona Lake, it is anticipated that due to the BMP implementation plan for the targeted areas within the watershed, water quality improvements may also be achieved in the major lake tributaries, including Dragoon Creek, 110 Mile Creek and Switzler Creek. The table below includes 10-year and long term water quality goals for total phosphorus (TP), dissolved oxygen (DO), and total suspended solids (TSS) in Dragoon Creek, 110 Mile Creek and Switzler Creek.

Table 50. Milestones for Dragoon Creek and 110 Creek.

Water Quality Milestones for Dragoon Creek & 110 Mile Creek								
	Current Condition (2000 - 2010)* Median TP	**10-Year Goal**		**Long Term Goal**		**Current Condition (2000 - 2010)* # Samples DO < 5**	**10-Year Goal**	**Long Term Goal**
		Improved Condition (2011 - 2021) Median TP	**Total Reduction Needed**	**Improved Condition Median TP**	**Total Reduction Needed**		**Improved Condition (2011 - 2021) # Samples DO < 5**	**Improved Condition # Samples DO < 5**
Sampling Sites	**Total Phosphorus (median of data collected during indicated period), ppb**					**# Samples with DO < 5 (data collected during indicated period), ppm**		
Dragoon Creek SC577	108	100	**8**	81	**25%**	4	1	**1**
110 Mile Creek SC633	90	80	**10**	63	**30%**	2	1	**1**
Switzler Creek SC687	145	135	**10**	101	**30%**	6	1	**1**
	Current Condition (2000 - 2010)* Median TSS	**10-Year Goal**		**Long Term Goal**				
		Improved Condition (2011 - 2021) Median TSS	**Total Reduction Needed**	**Improved Condition Median TSS**	**Total Reduction Needed**			
Sampling Sites	**TSS (median of data collected during indicated period), ppm**							
Dragoon Creek SC577	30	27	**3**	22.5	**25%**			
110 Mile Creek SC633	16	14	**2**	12	**25%**			
Switzler Creek SC687	24	22	**2**	18	**25%**			

*The Current Conditions for the 110 Mile Creek were calculated using available data from 2000-2009.

10.4 BMP Implementation Milestones from 2011 to 2040

The SLT will review the number of acres, projects or contacts made in the watershed at the end of five, ten and thirty years (2040). At the end of each period, the SLT will have the option to reassess the goals and alter BMP implementations as they determine is best. Below is the outline of BMP implementations over a thirty year period.

Table 51. Cumulative BMP Implementation Milestones from 2011 to 2040.

Cumulative Totals																
	Cropland, treated acres							*Livestock, number of projects*				*Stream-bank, feet*	*Riparian, acres*	*Information and Education, number*		
Year	No-Till	Nutrient Management	Terraces	Grade Stabilization	Permanent Vegetation	Buffers and Terraces	Grassed Waterways	Filter Strip, acres	Relocate Feeding Pens	Relocate Pasture Feeding Site	Off Stream Watering System	Streambank Stabilization	Riparian Restoration	Demos and Field Days	Meetings and Educational Events	Contacts made
2011	360	334	133	292	187	9	5	1	1	2	3	260	30.5	7	21	100
2012	720	668	266	584	374	18	10	2	2	5	6	520	61.0	14	42	200
2013	1,080	1,002	399	876	561	27	15	3	3	7	9	780	91.5	21	63	300
2014	1,440	1,336	532	1,168	748	36	20	4	4	10	12	1,040	122.0	28	84	400
2015	1,800	1,670	665	1,460	935	45	25	5	5	12	15	1,300	152.5	35	105	500
2016	2,160	2,004	798	1,752	1,122	54	30	6	6	15	18	1,560	183.0	42	126	600
2017	2,520	2,338	931	2,044	1,309	63	35	7	7	17	21	1,820	213.5	49	147	700
2018	2,880	2,672	1,064	2,336	1,496	72	40	8	8	20	24	2,080	244.0	56	168	800
2019	3,240	3,006	1,197	2,628	1,683	81	45	9	9	22	27	2,340	274.5	63	189	900
2020	3,600	3,340	1,330	2,920	1,870	90	50	10	10	25	30	2,600	305.0	70	210	1,000
2021	3,960	3,674	1,463	3,212	2,057	99	55	11	11	27	33	2,860	335.5	77	231	1,100
2022	4,320	4,008	1,596	3,504	2,244	108	60	12	12	30	36	3,120	366.0	84	252	1,200

2023	4,680	4,342	1,729	3,796	2,431	117	65	13	13	32	39	3,380	396.5	91	273	1,300
2024	5,040	4,676	1,862	4,088	2,618	126	70	14	14	35	42	3,640	427.0	98	294	1,400
2025	5,400	5,010	1,995	4,380	2,805	135	75	15	15	37	45	3,900	457.5	105	315	1,500
2026	5,760	5,344	2,128	4,672	2,992	144	80	16	16	40	48	4,160	488.0	112	336	1,600
2027	6,120	5,678	2,261	4,964	3,179	153	85	17	17	42	51	4,420	518.5	119	357	1,700
2028	6,480	6,012	2,394	5,256	3,366	162	90	18	18	45	54	4,680	549.0	126	378	1,800
2029	6,840	6,346	2,527	5,548	3,553	171	95	19	19	47	57	4,940	579.5	133	399	1,900
2030	7,200	6,680	2,660	5,840	3,740	180	100	20	20	50	60	5,200	610.0	140	420	2,000
2031	7,560	7,014	2,793	6,132	3,927	189	105	21	21	52	63	5,460	640.5	147	441	2,100
2032	7,920	7,348	2,926	6,424	4,114	198	110	22	22	55	66	5,720	671.0	154	462	2,200
2033	8,280	7,682	3,059	6,716	4,301	207	115	23	23	57	69	5,980	701.5	161	483	2,300
2034	8,640	8,016	3,192	7,008	4,488	216	120	24	24	60	72	6,240	732.0	168	504	2,400
2035	9,000	8,350	3,325	7,300	4,675	225	125	25	25	62	75	6,500	762.5	175	525	2,500
2036	9,360	8,684	3,458	7,592	4,862	234	130	26	26	65	78	6,760	793.0	182	546	2,600
2037	9,720	9,018	3,591	7,884	5,049	243	135	27	27	67	81	7,020	823.5	189	567	2,700
2038	10,080	9,352	3,724	8,176	5,236	252	140	28	28	70	84	7,280	854.0	196	588	2,800
2039	10,440	9,686	3,857	8,468	5,423	261	145	29	29	72	87	7,540	884.5	203	609	2,900
2040	10,800	10,020	3,990	8,760	5,610	270	150	30	30	75	90	7,800	915.0	210	630	3,000

The BMP implementation schedule and water quality milestones for the Pomona Lake watershed extend through a 30-year period from 2011 to 2040. Throughout that period, KDHE will continue to analyze and evaluate the monitoring data collected. After the first ten years of monitoring and BMP implementation, KDHE will evaluate the available water quality data to determine whether the water quality milestones have been achieved. KDHE and the SLT can address any necessary modifications or revisions to the plan based on the data analysis. In 2040, 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.

11.0 Monitoring Water Quality Progress

KDHE continues to monitor water quality in the Pomona Lake watershed by maintaining the monitoring stations located within the watershed. The map below indicates the locations of the monitoring sites located within the Pomona Lake watershed, as well as the BMP targeted areas that have been identified and discussed in previous sections of this plan.

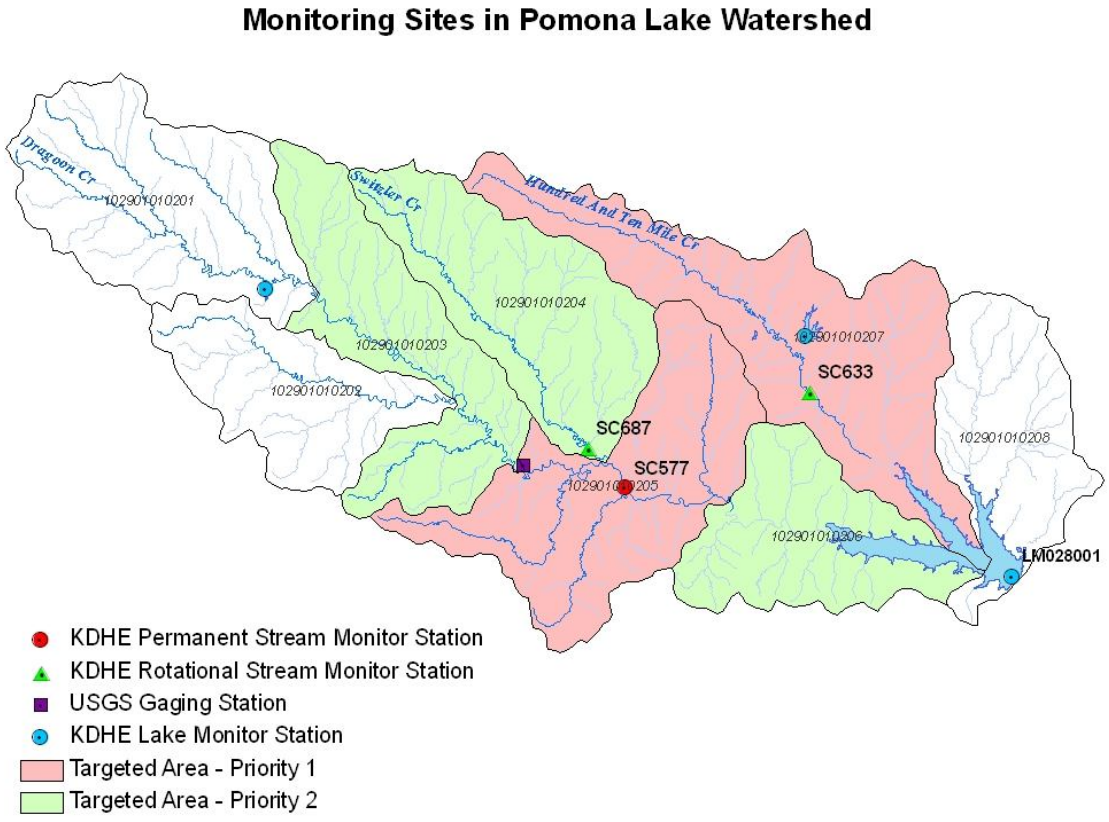


Figure 36. Monitoring Sites in the Watershed.

The map shows both the permanent and rotational KDHE monitoring stations. The permanent monitoring sites are continuously sampled, while the rotational sites are typically sampled every four years. The sites are sampled for nutrients, *E. Coli* bacteria, chemicals, turbidity, alkalinity, dissolved oxygen, pH, ammonia and metals. The pollutant indicators tested for each site may vary depending on the season at collection time and other factors. The KDHE lake monitoring sites are typically sampled every 3 years. The KDHE 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.

The U.S. Army Corps of Engineers conducts regular monitoring on Pomona Lake. Intensive sampling was conducted in 2005. Typically, monitoring takes place May through September. Samples consist of temperature, DO, pH, conductivity and turbidity, nitrogen, phosphorus, chlorophyll α, iron, Secchi disc depth, and atrazine.

Stream flow data is collected by the USGS and will be available for SLT review. At publication time of this report, depending on the sampling site, up to six different parameters are sampled: water temperature, specific conductance, gage height, discharge, precipitation and turbidity. Samples are automatically taken every 15 minutes. Reviewing this data will indicate whether runoff events in the upper reaches of the watershed have been slowed by BMPs such as no-till or terraces.

Much of the evaluative information can be obtained through the existing networks and sampling plans of KDHE, USGS and KSU. 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. Public engagement can be obtained through observations of reservoir or lake clarity, ease of boating and the physical appearance of the reservoir or lake.

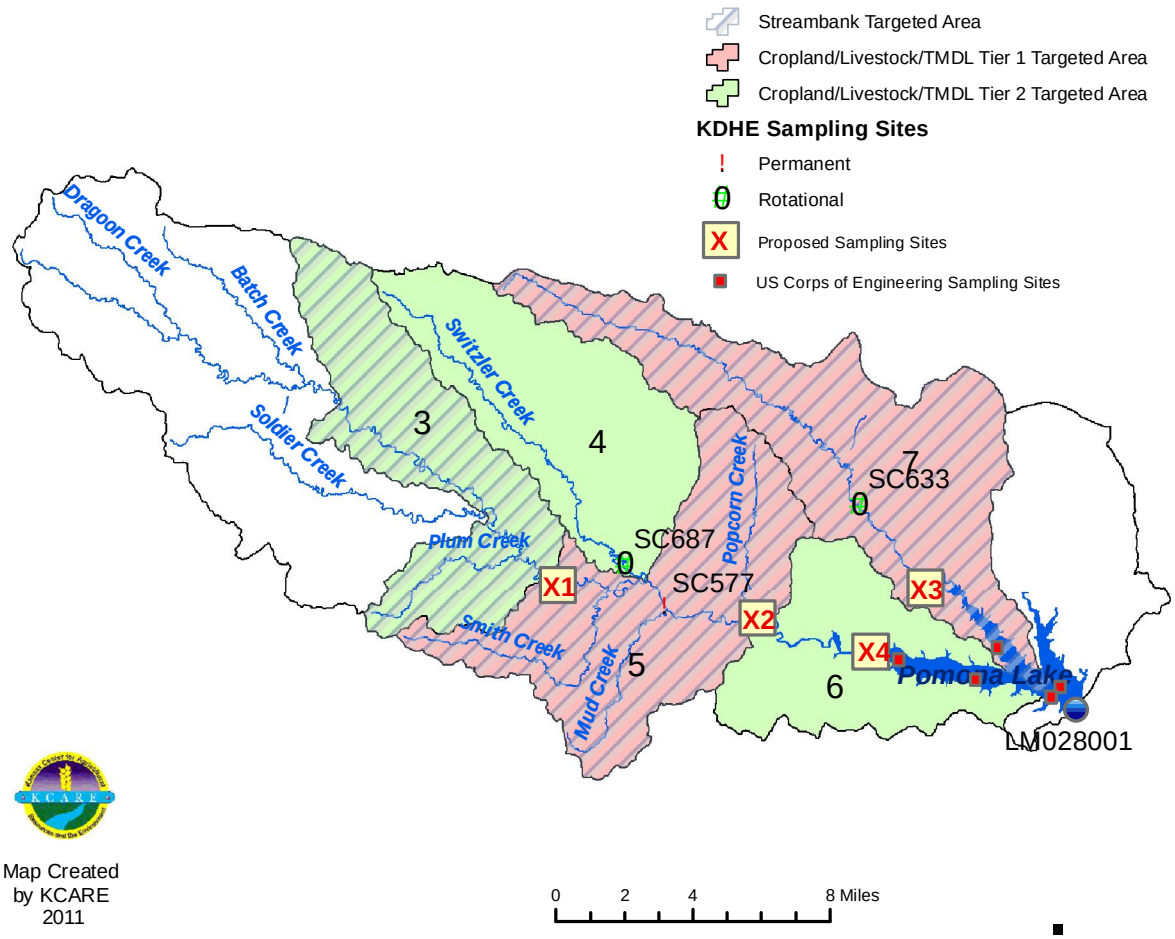


Figure 37. Monitoring Sites in the Watershed with Proposed Sites. [37]

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

Table 53. Monitoring Sites and Tests Needed to Direct the SLT in Water Quality Evaluations.

Cropland/Livestock/TMDL Tier 1 Targeted Area				
Agency	**Site Number or Name**	**Pollutant Target**	**River, Stream or Lake**	**Sampling Tests Needed**
KDHE	577	Sediment, Phosphorus	Dragoon Creek	Turbidity, TSS, pH, DO, Phosphorus, Nitrogen
KDHE	028001	Sediment, Phosphorus	Pomona Lake	Turbidity, TSS, pH, DO, Phosphorus, Nitrogen
KDHE	Proposed Site	Sediment,	Confluence of	Turbidity, TSS,

	X2 (refer to map above)	Phosphorus	Dragoon Creek and Popcorn Creek (end of Targeted Area #5)	pH, DO, Phosphorus, Nitrogen
KDHE	Proposed Site **X3** (refer to map above)	Sediment, Phosphorus	End of 110 Creek	Turbidity, TSS, pH, DO, Phosphorus, Nitrogen
Cropland/Livestock/TMDL Tier 2 Targeted Area				
Agency	**Site Number or Name**	**Pollutant Target**	**River, Stream or Lake**	**Sampling Tests Needed**
KDHE	687	Sediment, Phosphorus	Switzler Creek (end of Targeted Area #4)	Turbidity, TSS, pH, DO, Phosphorus, Nitrogen
KDHE	028001	Sediment, Phosphorus	Pomona Lake	Turbidity, TSS, pH, DO, Phosphorus, Nitrogen
KDHE	Proposed Site **X1** (refer to map above)	Sediment, Phosphorus	Dragoon Creek (end of Targeted Area #3)	Turbidity, TSS, pH, DO, Phosphorus, Nitrogen
KDHE	Proposed Site **X4** (refer to map above)	Sediment, Phosphorus	End of Dragoon Creek	Turbidity, TSS, pH, DO, Phosphorus, Nitrogen
Streambank and Riparian Targeted Area				
Agency	**Site Number or Name**	**Pollutant Target**	**River, Stream or Lake**	**Sampling Tests Needed**
KDHE	028001	Sediment, Phosphorus	Pomona Lake	Turbidity, TSS, pH, DO, Phosphorus, Nitrogen
KDHE	Proposed Site **X1** (refer to map above)	Sediment, Phosphorus	Dragoon Creek (end of Targeted Area #3)	Turbidity, TSS, pH, DO, Phosphorus, Nitrogen
KDHE	Proposed Site **X2** (refer to map above)	Sediment, Phosphorus	Confluence of Dragoon Creek and Popcorn Creek (end of Targeted Area #5)	Turbidity, TSS, pH, DO, Phosphorus, Nitrogen
KDHE	Proposed Site **X3** (refer to map above)	Sediment, Phosphorus	End of 110 Creek	Turbidity, TSS, pH, DO, Phosphorus, Nitrogen

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.

Below is a summary of site placement (existing and proposed) to support BMP evaluation in the targeted areas:

- The *Cropland/Livestock/TMDL Tier 1 Targeted Area* can utilize KDHE sampling sites 577, 633 and Pomona Lake 028001 for sediment and phosphorus determination. Additional monitoring could be added at the endpoint of each targeted HUC 12 in order to determine changes in each HUC. These would be:
  - Site X2 – Dragoon Creek as it exits the Targeted Area #5.
  - Site X3 – End of 110 Creek as it enters Pomona Lake.
- The *Cropland/Livestock/TMDL Tier 2 Targeted Area* can utilize KDHE sampling sites 687 and Pomona Lake 028001 for sediment and phosphorus determination. Additional monitoring could be added at the endpoint of each targeted HUC 12 in order to determine changes in each HUC. These would be:
  - Site X1 – Dragoon Creek as it exits the Targeted Area #3.
  - Site X4 – End of Dragoon Creek as it enters Pomona Lake.
- The *Streambank/Riparian Targeted Area* can utilize KDHE sampling sites 577, 633 and Pomona Lake 028001 for sediment and phosphorus determination. These are site numbers 208 and 559. Additional monitoring could be added at the endpoint of each targeted HUC 12 in order to determine changes in each HUC. These would be:
  - Site X1 – Dragoon Creek as it exits the Targeted Area #3.
  - Site X2 – Dragoon Creek as it exits the Targeted Area #5.
  - Site X3 – End of 110 Creek as it enters Pomona Lake.

Analysis of the data generated will be used to determine effectiveness of implemented BMPs. The SLT would like to add future sampling sites as funding allows. All KDHE and KSU 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.

It is the SLT's desire to have KDHE monitor two sub watersheds within the Pomona WRAPS Project area. However a good site could not be found in Targeted Area 5. So KDHE will monitor one sub watershed (7) located within the Pomona WRAPS Project area by collecting 4 routine water chemistry samples during March-October and one additional water chemistry sample during a major runoff event every year, for a period not to exceed 5 years. Water chemistry sampling will include total suspended solids, nutrients (nitrogen and phosphorous), pH, dissolved oxygen, temperature, atrazine, bacteria and flow. The SLT agrees to target BMP implementation in the 110 Mile Creek sub watershed. This is done by assigning additional points during the ranking process.

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. The schedule of review for the

monitoring data will be tied to the water quality milestones that have been developed for each sub watershed, as well as the frequency of the sampling data. As previously noted, the current TMDLs for Pomona Lake will be up for review by KDHE in 2012. Monitoring data will be utilized at that time to determine necessary modifications to the TMDL.

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 Pomona Watershed is 2012 and 2017. 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.

12.0 Review of the Watershed Plan in 2016

This plan will begin in 2011. In the year 2016, 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:

1. The SLT will ask KDHE for a report on the milestone achievements in **sediment** load reductions. The 2016 milestone for sediment should be based on the available data at the time in the trend of total suspended solids concentration in the watershed.
2. The SLT will request from KDHE a report on the milestone achievements in **phosphorus** load reductions. The 2016 milestone for phosphorus should be based on available data at the time in the trend of the phosphorus concentration in the watershed.
3. The SLT will request a report from KDHE concerning the revisions of the TMDLs from 2012.
4. The SLT will request a report from KDHE and US Corps of Engineers on trends in water quality in Pomona Lake.
5. The SLT will request a report from Kansas Department of Parks and Wildlife on trends in wildlife (aquatic and terrestrial) in Pomona Lake watershed.
6. The SLT will report on progress towards achieving the adoption rates listed in Section 10.1 of this report.
7. The SLT will report on progress towards achieving the benchmarks listed in Section 10.2 of this report.
8. The SLT will report on progress towards achieving the milestones in Section 10.3 of this report.
9. The SLT will discuss impairments on the 303d list and the possibility of addressing these impairments prior to them being listed as TMDLs.
10. The SLT will discuss the effect of implementing BMPs aimed at specific TMDLs on the impairments listed on the 303d list.
11. The SLT will discuss necessary adjustments and revisions needed in the targets listed in this plan.

13.0 Appendix

13.1 Service Providers

Table 54. Potential Service Provider Listing.

Organization	Programs	Purpose	Technical or Financial Assistance	Website address
East Central Kansas N0-Till Alliance	Field days, seasonal meetings, tours and technical consulting	Provide information and assistance concerning continuous no-till farming practices.	Technical	www.notill.org/
Environmental Protection Agency	Clean Water State Revolving Fund Program Watershed Protection	Provides low cost loans to communities for water pollution control activities. To conduct holistic strategies for restoring and protecting aquatic resources based on hydrology rather than political boundaries.	Financial	www.epa.gov
Kansas Alliance for Wetlands and Streams	Streambank Stabilization Wetland Restoration Cost share programs	The Kansas Alliance for Wetlands and Streams (KAWS) organized in 1996 to promote the protection, enhancement, restoration and establishment wetlands and streams in Kansas.	Technical	www.kaws.org
Kansas Dept. of Agriculture	Watershed structures permitting.	Available for watershed districts and multipurpose small lakes development.	Technical and Financial	www.accesskansas.org/kda

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

Kansas Department of Wildlife and Parks	Land and Water Conservation Funds	Provides funds to preserve develop and assure access to outdoor recreation.	Technical and Financial	www.kdwp.state.ks.us/
	Conservation Easements for Riparian and Wetland Areas	To provide easements to secure and enhance quality areas in the state.		
	Wildlife Habitat Improvement Program	To provide limited assistance for development of wildlife habitat.		
	North American Waterfowl Conservation Act	To provide up to 50 percent cost share for the purchase and/or development of wetlands and wildlife habitat.		
	MARSH program in coordination with Ducks Unlimited	May provide up to 100 percent of funding for small wetland projects.		
	Chickadee Checkoff	Projects help with all nongame species. 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	Website address
Kansas Forest Service	Conservation Tree Planting Program Riparian and Wetland Protection Program	Provides low cost trees and shrubs for conservation plantings. Work closely with other agencies to promote and assist with establishment of riparian forestland and manage existing stands.	Technical	www.kansasforests.org
Kansas Rural Center	The Heartland Network Clean Water Farms-River Friendly Farms Sustainable Food Systems Project Cost share programs	The Center is committed to economically viable, environmentally sound and socially sustainable rural culture.	Technical and Financial	www.kansasruralcenter.org
Kansas Rural Water Association	Technical assistance for Water Systems with Source Water Protection Planning.	Provide education, technical assistance and leadership to public water and wastewater utilities to enhance the public health and to sustain Kansas' communities	Technical	www.krwa.net

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

Organization	Programs and Technical Assistance	Purpose	Technical or Financial Assistance	Website address
Kansas Water Office	Public Information and Education	Provide information and education to the public on Kansas Water Resources	Technical and Financial	www.kwo.org
Lake Region RC&D	Natural resource development and protection	Plan and implement projects and programs that improve environmental quality of life	Technical	http://www.lakeregionrcd.org/
Pittsburg State University	Provide water quality monitoring and analysis.	Water quality monitoring	Technical	www.pittstate.edu

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

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

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

13.2 BMP Definitions

(Reduction explanations are provided on pages 88-89)

Cropland

Establish Permanent Vegetation
The cost of $150 an acre was calculated based on K-State Research and Extension estimates of the cost of planting and maintaining native grass.

Grassed Waterway
-Grassed strip used as an outlet to prevent silt and gully formation.
-Can also be used as outlets for water from terraces.
-On average for Kansas fields, 1 acre waterway will treat 10 acres of cropland.
-40% erosion reduction efficiency, 40% phosphorous reduction efficiency.
-$800 an acre, 50% cost-share available from NRCS.

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

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.

Conservation Crop Rotation
-Growing various crops on the same piece of land in a planned rotation.
-High residue crops (corn) with low residue crops (wheat, soybeans).
-Low residue crops in succession may encourage erosion.
-25% Erosion Reduction Efficiency, 25% phosphorous reduction efficiency
-WRAPS groups and KSU Ag Economists have decided $5 an acre for 10 years is an adequate payment to entice producers to convert.

Terraces
-Earth embankment and/or channel constructed across the slope to intercept runoff water and trap soil.

-One of the oldest/most common BMPs
-30% Erosion Reduction Efficiency, 30% phosphorous reduction efficiency
-$1.02 per linear foot, 50% cost-share available from NRCS

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

Livestock

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

Relocate Feeding Pens
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 (1 unit equals 1 acre, 100 AU pen).
-Pasture- Move feeding site that is in a pasture away from a stream, waterway, or body of water to increase the filtration and waste removal (eg. move bale feeders away from stream). Highly variable in price, average of $2,203 per unit (1 unit equals 1 acre, 100 AU pen).
-Average P reduction: 30-80%

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

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

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.

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

13.3 Sub Watershed Tables

13.3.1 Load Reduction Rates by Sub Watershed

Table 55. Sediment Reduction Rates by Sub Watershed.

Sub Watershed #3 Annual Soil Erosion Reduction (tons), Cropland BMPs

Year	No-Till	Nutrient Mgmt	Terraces	Grade Stab.	Perm Veg	Buffers & Terrace	Waterway & Terrace	Total Load Reduction
1	117	36	38	2	2	33	40	268
2	234	72	76	3	4	67	79	536
3	351	108	114	5	7	100	119	804
4	468	144	152	7	9	134	158	1,072
5	585	180	191	9	11	167	198	1,340
6	701	216	229	10	13	201	238	1,609
7	818	253	267	12	15	234	277	1,877
8	935	289	305	14	18	268	317	2,145
9	1,052	325	343	16	20	301	356	2,413
10	1,169	361	381	17	22	335	396	2,681
11	1,286	397	419	19	24	368	436	2,949
12	1,403	433	457	21	26	402	475	3,217
13	1,520	469	495	23	29	435	515	3,485
14	1,637	505	533	24	31	469	554	3,753
15	1,754	541	572	26	33	502	594	4,021
16	1,870	577	610	28	35	536	634	4,289
17	1,987	613	648	29	37	569	673	4,558
18	2,104	649	686	31	39	603	713	4,826
19	2,221	686	724	33	42	636	752	5,094
20	2,338	722	762	35	44	670	792	5,362
21	2,455	758	800	36	46	703	832	5,630
22	2,572	794	838	38	48	737	871	5,898
23	2,689	830	876	40	50	770	911	6,166
24	2,806	866	914	42	53	804	950	6,434
25	2,923	902	953	43	55	837	990	6,702
26	3,039	938	991	45	57	871	1,030	6,970
27	3,156	974	1,029	47	59	904	1,069	7,239
28	3,273	1,010	1,067	49	61	938	1,109	7,507
29	3,390	1,046	1,105	50	64	971	1,148	7,775
30	3,507	1,082	1,143	52	66	1,004	1,188	8,043

Sub Watershed #4 Annual Soil Erosion Reduction (tons), Cropland BMPs

Year	No-Till	Nutrient Mgmt	Terraces	Grade Stab.	Perm Veg	Buffers & Terrace	Waterway & Terrace	Total Load Reduction
1	157	49	51	2	3	45	53	361
2	315	97	103	5	6	90	107	721
3	472	146	154	7	9	135	160	1,082
4	629	194	205	9	12	180	213	1,443
5	786	243	256	11	15	225	266	1,803
6	944	291	308	14	18	270	320	2,164
7	1,101	340	359	16	21	315	373	2,525
8	1,258	388	410	18	24	360	426	2,885
9	1,416	437	461	20	27	405	480	3,246
10	1,573	485	513	23	30	451	533	3,607
11	1,730	534	564	25	32	496	586	3,967
12	1,888	583	615	27	35	541	639	4,328
13	2,045	631	666	29	38	586	693	4,689
14	2,202	680	718	32	41	631	746	5,049
15	2,359	728	769	34	44	676	799	5,410
16	2,517	777	820	36	47	721	853	5,771
17	2,674	825	872	39	50	766	906	6,131
18	2,831	874	923	41	53	811	959	6,492
19	2,989	922	974	43	56	856	1,012	6,853
20	3,146	971	1,025	45	59	901	1,066	7,214
21	3,303	1,020	1,077	48	62	946	1,119	7,574
22	3,461	1,068	1,128	50	65	991	1,172	7,935
23	3,618	1,117	1,179	52	68	1,036	1,226	8,296
24	3,775	1,165	1,230	54	71	1,081	1,279	8,656
25	3,932	1,214	1,282	57	74	1,126	1,332	9,017
26	4,090	1,262	1,333	59	77	1,171	1,385	9,378
27	4,247	1,311	1,384	61	80	1,216	1,439	9,738
28	4,404	1,359	1,436	63	83	1,262	1,492	10,099
29	4,562	1,408	1,487	66	86	1,307	1,545	10,460
30	4,719	1,456	1,538	68	89	1,352	1,599	10,820

Sub Watershed #5 Annual Soil Erosion Reduction (tons), Cropland BMPs

Year	No-Till	Nutrient Mgmt	Terraces	Grade Stab.	Perm Veg	Buffers & Terrace	Waterway & Terrace	Total Load Reduction
1	296	91	97	6	6	85	100	680
2	592	183	193	11	11	170	201	1,361
3	888	274	290	17	17	254	301	2,041
4	1,184	366	386	23	22	339	401	2,722
5	1,481	457	483	29	28	424	502	3,402
6	1,777	548	579	34	33	509	602	4,083

7	2,073	640	676	40	39	594	702	4,763
8	2,369	731	772	46	44	679	803	5,443
9	2,665	823	869	52	50	763	903	6,124
10	2,961	914	965	57	56	848	1,003	6,804
11	3,257	1,005	1,062	63	61	933	1,103	7,485
12	3,553	1,097	1,158	69	67	1,018	1,204	8,165
13	3,849	1,188	1,255	75	72	1,103	1,304	8,846
14	4,146	1,280	1,351	80	78	1,187	1,404	9,526
15	4,442	1,371	1,448	86	83	1,272	1,505	10,206
16	4,738	1,462	1,544	92	89	1,357	1,605	10,887
17	5,034	1,554	1,641	97	94	1,442	1,705	11,567
18	5,330	1,645	1,737	103	100	1,527	1,806	12,248
19	5,626	1,736	1,834	109	106	1,611	1,906	12,928
20	5,922	1,828	1,930	115	111	1,696	2,006	13,609
21	6,218	1,919	2,027	120	117	1,781	2,107	14,289
22	6,514	2,011	2,123	126	122	1,866	2,207	14,970
23	6,811	2,102	2,220	132	128	1,951	2,307	15,650
24	7,107	2,193	2,316	138	133	2,036	2,408	16,330
25	7,403	2,285	2,413	143	139	2,120	2,508	17,011
26	7,699	2,376	2,509	149	144	2,205	2,608	17,691
27	7,995	2,468	2,606	155	150	2,290	2,708	18,372
28	8,291	2,559	2,702	161	156	2,375	2,809	19,052
29	8,587	2,650	2,799	166	161	2,460	2,909	19,733
30	8,883	2,742	2,895	172	167	2,544	3,009	20,413

Sub Watershed #6 Annual Soil Erosion Reduction (tons), Cropland BMPs

Year	No-Till	Nutrient Mgmt	Terraces	Grade Stab.	Perm Veg	Buffers & Terrace	Waterway & Terrace	Total Load Reduction
1	102	31	33	2	2	29	34	234
2	203	63	66	4	4	58	69	468
3	305	94	99	6	6	87	103	701
4	407	126	133	8	8	117	138	935
5	509	157	166	10	10	146	172	1,169
6	610	188	199	12	11	175	207	1,403
7	712	220	232	14	13	204	241	1,637
8	814	251	265	16	15	233	276	1,870
9	916	283	298	18	17	262	310	2,104
10	1,017	314	332	20	19	291	345	2,338
11	1,119	345	365	22	21	321	379	2,572
12	1,221	377	398	24	23	350	414	2,806
13	1,323	408	431	26	25	379	448	3,039
14	1,424	440	464	28	27	408	483	3,273

15	1,526	471	497	30	29	437	517	3,507
16	1,628	502	531	32	31	466	551	3,741
17	1,730	534	564	34	32	495	586	3,975
18	1,831	565	597	36	34	525	620	4,209
19	1,933	597	630	38	36	554	655	4,442
20	2,035	628	663	40	38	583	689	4,676
21	2,136	659	696	42	40	612	724	4,910
22	2,238	691	729	44	42	641	758	5,144
23	2,340	722	763	46	44	670	793	5,378
24	2,442	754	796	48	46	699	827	5,611
25	2,543	785	829	50	48	728	862	5,845
26	2,645	816	862	52	50	758	896	6,079
27	2,747	848	895	54	52	787	931	6,313
28	2,849	879	928	56	53	816	965	6,547
29	2,950	911	962	58	55	845	999	6,780
30	3,052	942	995	60	57	874	1,034	7,014

Sub Watershed #7 Annual Soil Erosion Reduction (tons), Cropland BMPs

Year	No-Till	Nutrient Mgmt	Terraces	Grade Stab.	Perm Veg	Buffers & Terrace	Waterway & Terrace	Total Load Reduction
1	274	85	89	5	5	79	93	630
2	549	169	179	10	10	157	186	1,260
3	823	254	268	14	15	236	279	1,890
4	1,098	339	358	19	21	314	372	2,520
5	1,372	423	447	24	26	393	465	3,150
6	1,646	508	537	29	31	472	558	3,780
7	1,921	593	626	34	36	550	651	4,410
8	2,195	678	715	38	41	629	744	5,040
9	2,470	762	805	43	46	707	837	5,670
10	2,744	847	894	48	51	786	930	6,300
11	3,018	932	984	53	57	865	1,023	6,930
12	3,293	1,016	1,073	58	62	943	1,115	7,560
13	3,567	1,101	1,163	62	67	1,022	1,208	8,190
14	3,842	1,186	1,252	67	72	1,100	1,301	8,820
15	4,116	1,270	1,341	72	77	1,179	1,394	9,450
16	4,390	1,355	1,431	77	82	1,257	1,487	10,080
17	4,665	1,440	1,520	82	88	1,336	1,580	10,710
18	4,939	1,524	1,610	86	93	1,415	1,673	11,340
19	5,214	1,609	1,699	91	98	1,493	1,766	11,970
20	5,488	1,694	1,789	96	103	1,572	1,859	12,600
21	5,762	1,778	1,878	101	108	1,650	1,952	13,230
22	6,037	1,863	1,968	106	113	1,729	2,045	13,860

23	6,311	1,948	2,057	110	118	1,808	2,138	14,490
24	6,585	2,033	2,146	115	124	1,886	2,231	15,120
25	6,860	2,117	2,236	120	129	1,965	2,324	15,750
26	7,134	2,202	2,325	125	134	2,043	2,417	16,380
27	7,409	2,287	2,415	130	139	2,122	2,510	17,010
28	7,683	2,371	2,504	134	144	2,201	2,603	17,640
29	7,957	2,456	2,594	139	149	2,279	2,696	18,270
30	8,232	2,541	2,683	144	154	2,358	2,789	18,900

Table 56. Phosphorus Reduction Rates by Sub Watershed.

Sub Watershed #3 Annual Phosphorous Reduction (tons), Cropland BMPs

Year	No-Till	Nutrient Mgmt	Terraces	Grade Stab.	Perm Veg	Buffers & Terrace	Waterway & Terrace	Total Load Reduction
1	56	32	34	2	2	30	36	191
2	112	65	68	3	4	60	71	383
3	168	97	102	5	6	90	107	574
4	224	129	137	6	8	120	142	766
5	280	162	171	8	10	150	178	957
6	335	194	205	9	12	180	213	1,149
7	391	226	239	11	14	210	249	1,340
8	447	259	273	12	16	240	284	1,532
9	503	291	307	14	18	270	320	1,723
10	559	324	342	16	20	300	355	1,915
11	615	356	376	17	22	330	391	2,106
12	671	388	410	19	24	360	426	2,298
13	727	421	444	20	26	390	462	2,489
14	783	453	478	22	28	420	497	2,680
15	839	485	512	23	30	450	533	2,872
16	894	518	547	25	31	480	568	3,063
17	950	550	581	26	33	510	604	3,255
18	1,006	582	615	28	35	540	639	3,446
19	1,062	615	649	30	37	570	675	3,638
20	1,118	647	683	31	39	600	710	3,829
21	1,174	679	717	33	41	630	746	4,021
22	1,230	712	752	34	43	660	781	4,212
23	1,286	744	786	36	45	690	817	4,404
24	1,342	776	820	37	47	721	852	4,595
25	1,398	809	854	39	49	751	888	4,787
26	1,453	841	888	40	51	781	923	4,978
27	1,509	873	922	42	53	811	959	5,169
28	1,565	906	957	44	55	841	994	5,361
29	1,621	938	991	45	57	871	1,030	5,552
30	1,677	971	1,025	47	59	901	1,065	5,744

Sub Watershed #4 Annual Phosphorous Reduction (tons), Cropland BMPs

Year	No-Till	Nutrient Mgmt	Terraces	Grade Stab.	Perm Veg	Buffers & Terrace	Waterway & Terrace	Total Load Reduction
1	70	40	43	2	2	37	44	239
2	140	81	85	4	5	75	89	478
3	209	121	128	6	7	112	133	717
4	279	162	171	8	10	150	177	956
5	349	202	213	9	12	187	222	1,195
6	419	242	256	11	15	225	266	1,434
7	489	283	299	13	17	262	310	1,674
8	559	323	341	15	20	300	355	1,913
9	628	364	384	17	22	337	399	2,152
10	698	404	427	19	25	375	443	2,391
11	768	444	469	21	27	412	488	2,630
12	838	485	512	23	29	450	532	2,869
13	908	525	555	25	32	487	577	3,108
14	977	566	597	26	34	525	621	3,347
15	1,047	606	640	28	37	562	665	3,586
16	1,117	646	683	30	39	600	710	3,825
17	1,187	687	725	32	42	637	754	4,064
18	1,257	727	768	34	44	675	798	4,303
19	1,327	768	811	36	47	712	843	4,543
20	1,396	808	853	38	49	750	887	4,782
21	1,466	849	896	40	52	787	931	5,021
22	1,536	889	939	42	54	825	976	5,260
23	1,606	929	981	43	57	862	1,020	5,499
24	1,676	970	1,024	45	59	900	1,064	5,738
25	1,745	1,010	1,067	47	61	937	1,109	5,977
26	1,815	1,051	1,109	49	64	975	1,153	6,216
27	1,885	1,091	1,152	51	66	1,012	1,197	6,455
28	1,955	1,131	1,195	53	69	1,050	1,242	6,694
29	2,025	1,172	1,237	55	71	1,087	1,286	6,933
30	2,095	1,212	1,280	57	74	1,125	1,330	7,172

Sub Watershed #5 Annual Phosphorous Reduction (tons), Cropland BMPs

Year	No-Till	Nutrient Mgmt	Terraces	Grade Stab.	Perm Veg	Buffers & Terrace	Waterway & Terrace	Total Load Reduction
1	121	70	74	4	4	65	77	415
2	242	140	148	9	9	130	154	830
3	363	210	222	13	13	195	230	1,245
4	484	280	296	18	17	260	307	1,661

5	605	350	369	22	21	325	384	2,076
6	725	420	443	26	26	390	461	2,491
7	846	490	517	31	30	455	538	2,906
8	967	560	591	35	34	519	614	3,321
9	1,088	630	665	40	38	584	691	3,736
10	1,209	700	739	44	43	649	768	4,151
11	1,330	770	813	48	47	714	845	4,567
12	1,451	840	887	53	51	779	922	4,982
13	1,572	910	961	57	55	844	998	5,397
14	1,693	980	1,034	61	60	909	1,075	5,812
15	1,814	1,050	1,108	66	64	974	1,152	6,227
16	1,935	1,120	1,182	70	68	1,039	1,229	6,642
17	2,055	1,189	1,256	75	72	1,104	1,306	7,057
18	2,176	1,259	1,330	79	77	1,169	1,382	7,473
19	2,297	1,329	1,404	83	81	1,234	1,459	7,888
20	2,418	1,399	1,478	88	85	1,299	1,536	8,303
21	2,539	1,469	1,552	92	89	1,364	1,613	8,718
22	2,660	1,539	1,626	97	94	1,429	1,690	9,133
23	2,781	1,609	1,699	101	98	1,493	1,766	9,548
24	2,902	1,679	1,773	105	102	1,558	1,843	9,963
25	3,023	1,749	1,847	110	106	1,623	1,920	10,379
26	3,144	1,819	1,921	114	111	1,688	1,997	10,794
27	3,265	1,889	1,995	119	115	1,753	2,074	11,209
28	3,385	1,959	2,069	123	119	1,818	2,150	11,624
29	3,506	2,029	2,143	127	123	1,883	2,227	12,039
30	3,627	2,099	2,217	132	128	1,948	2,304	12,454

Sub Watershed #6 Annual Phosphorous Reduction (tons), Cropland BMPs

Year	No-Till	Nutrient Mgmt	Terraces	Grade Stab.	Perm Veg	Buffers & Terrace	Waterway & Terrace	Total Load Reduction
1	48	28	29	2	2	26	30	164
2	95	55	58	4	3	51	61	327
3	143	83	87	5	5	77	91	491
4	191	110	116	7	7	102	121	654
5	238	138	146	9	8	128	151	818
6	286	165	175	11	10	153	182	982
7	333	193	204	12	12	179	212	1,145
8	381	221	233	14	13	205	242	1,309
9	429	248	262	16	15	230	272	1,472
10	476	276	291	18	17	256	303	1,636
11	524	303	320	19	18	281	333	1,799
12	572	331	349	21	20	307	363	1,963

13	619	358	378	23	22	333	393	2,127
14	667	386	408	25	23	358	424	2,290
15	715	414	437	26	25	384	454	2,454
16	762	441	466	28	27	409	484	2,617
17	810	469	495	30	28	435	514	2,781
18	857	496	524	32	30	460	545	2,945
19	905	524	553	33	32	486	575	3,108
20	953	551	582	35	34	512	605	3,272
21	1,000	579	611	37	35	537	635	3,435
22	1,048	606	640	39	37	563	666	3,599
23	1,096	634	670	40	39	588	696	3,762
24	1,143	662	699	42	40	614	726	3,926
25	1,191	689	728	44	42	640	756	4,090
26	1,239	717	757	46	44	665	787	4,253
27	1,286	744	786	47	45	691	817	4,417
28	1,334	772	815	49	47	716	847	4,580
29	1,381	799	844	51	49	742	877	4,744
30	1,429	827	873	53	50	767	908	4,908

Sub Watershed #7 Annual Phosphorous Reduction (tons), Cropland BMPs

Year	No-Till	Nutrient Mgmt	Terraces	Grade Stab.	Perm Veg	Buffers & Terrace	Waterway & Terrace	Total Load Reduction
1	120	69	73	4	4	64	76	412
2	240	139	147	8	8	129	153	824
3	360	208	220	12	13	193	229	1,235
4	480	278	293	16	17	258	305	1,647
5	600	347	367	20	21	322	381	2,059
6	720	417	440	24	25	387	458	2,471
7	840	486	514	28	30	451	534	2,883
8	960	556	587	32	34	516	610	3,294
9	1,081	625	660	35	38	580	686	3,706
10	1,201	695	734	39	42	645	763	4,118
11	1,321	764	807	43	46	709	839	4,530
12	1,441	834	880	47	51	774	915	4,942
13	1,561	903	954	51	55	838	991	5,353
14	1,681	973	1,027	55	59	903	1,068	5,765
15	1,801	1,042	1,101	59	63	967	1,144	6,177
16	1,921	1,112	1,174	63	68	1,032	1,220	6,589
17	2,041	1,181	1,247	67	72	1,096	1,296	7,001
18	2,161	1,251	1,321	71	76	1,161	1,373	7,412
19	2,281	1,320	1,394	75	80	1,225	1,449	7,824
20	2,401	1,390	1,467	79	84	1,290	1,525	8,236

21	2,521	1,459	1,541	83	89	1,354	1,601	8,648
22	2,641	1,529	1,614	87	93	1,418	1,678	9,060
23	2,761	1,598	1,687	91	97	1,483	1,754	9,472
24	2,881	1,667	1,761	95	101	1,547	1,830	9,883
25	3,001	1,737	1,834	98	106	1,612	1,906	10,295
26	3,122	1,806	1,908	102	110	1,676	1,983	10,707
27	3,242	1,876	1,981	106	114	1,741	2,059	11,119
28	3,362	1,945	2,054	110	118	1,805	2,135	11,531
29	3,482	2,015	2,128	114	123	1,870	2,212	11,942
30	3,602	2,084	2,201	118	127	1,934	2,288	12,354

Table 57. Nitrogen Reduction Rates by Sub Watershed.

Sub Watershed #3 Annual Nitrogen Reduction (tons), Cropland BMPs

Year	No-Till	Nutrient Mgmt	Terraces	Grade Stab.	Perm Veg	Buffers & Terrace	Waterway & Terrace	Total Load Reduction
1	345	319	337	15	19	230	350	1,615
2	689	638	674	31	39	459	700	3,230
3	1,034	957	1,011	46	58	689	1,050	4,845
4	1,378	1,276	1,347	61	78	919	1,400	6,459
5	1,723	1,595	1,684	77	97	1,148	1,751	8,074
6	2,067	1,914	2,021	92	116	1,378	2,101	9,689
7	2,412	2,233	2,358	107	136	1,608	2,451	11,304
8	2,756	2,552	2,695	123	155	1,837	2,801	12,919
9	3,101	2,871	3,032	138	175	2,067	3,151	14,534
10	3,445	3,190	3,369	153	194	2,297	3,501	16,149
11	3,790	3,509	3,705	169	213	2,526	3,851	17,764
12	4,134	3,828	4,042	184	233	2,756	4,201	19,378
13	4,479	4,147	4,379	199	252	2,986	4,552	20,993
14	4,823	4,466	4,716	215	272	3,215	4,902	22,608
15	5,168	4,785	5,053	230	291	3,445	5,252	24,223
16	5,512	5,104	5,390	245	310	3,675	5,602	25,838
17	5,857	5,423	5,727	261	330	3,904	5,952	27,453
18	6,201	5,742	6,063	276	349	4,134	6,302	29,068
19	6,546	6,061	6,400	291	368	4,364	6,652	30,683
20	6,890	6,380	6,737	306	388	4,593	7,002	32,297
21	7,235	6,699	7,074	322	407	4,823	7,353	33,912
22	7,579	7,018	7,411	337	427	5,053	7,703	35,527
23	7,924	7,337	7,748	352	446	5,282	8,053	37,142
24	8,268	7,656	8,085	368	465	5,512	8,403	38,757
25	8,613	7,975	8,421	383	485	5,742	8,753	40,372
26	8,957	8,294	8,758	398	504	5,972	9,103	41,987
27	9,302	8,613	9,095	414	524	6,201	9,453	43,602
28	9,646	8,932	9,432	429	543	6,431	9,803	45,216

29	9,991	9,251	9,769	444	562	6,661	10,154	46,831
30	10,335	9,570	10,106	460	582	6,890	10,504	48,446

Sub Watershed #4 Annual Nitrogen Reduction (tons), Cropland BMPs

Year	No-Till	Nutrient Mgmt	Terraces	Grade Stab.	Perm Veg	Buffers & Terrace	Waterway & Terrace	Total Load Reduction
1	405	375	396	18	23	270	411	1,897
2	810	750	792	35	46	540	823	3,795
3	1,215	1,125	1,188	53	68	810	1,234	5,692
4	1,620	1,500	1,584	70	91	1,080	1,646	7,590
5	2,024	1,875	1,980	88	114	1,350	2,057	9,487
6	2,429	2,249	2,375	105	137	1,620	2,469	11,385
7	2,834	2,624	2,771	123	160	1,890	2,880	13,282
8	3,239	2,999	3,167	140	182	2,159	3,292	15,179
9	3,644	3,374	3,563	158	205	2,429	3,703	17,077
10	4,049	3,749	3,959	175	228	2,699	4,115	18,974
11	4,454	4,124	4,355	193	251	2,969	4,526	20,872
12	4,859	4,499	4,751	210	274	3,239	4,938	22,769
13	5,264	4,874	5,147	228	296	3,509	5,349	24,667
14	5,669	5,249	5,543	245	319	3,779	5,761	26,564
15	6,073	5,624	5,939	263	342	4,049	6,172	28,461
16	6,478	5,998	6,334	280	365	4,319	6,584	30,359
17	6,883	6,373	6,730	298	388	4,589	6,995	32,256
18	7,288	6,748	7,126	315	410	4,859	7,407	34,154
19	7,693	7,123	7,522	333	433	5,129	7,818	36,051
20	8,098	7,498	7,918	350	456	5,399	8,230	37,949
21	8,503	7,873	8,314	368	479	5,669	8,641	39,846
22	8,908	8,248	8,710	385	501	5,939	9,053	41,743
23	9,313	8,623	9,106	403	524	6,208	9,464	43,641
24	9,718	8,998	9,502	420	547	6,478	9,876	45,538
25	10,122	9,373	9,898	438	570	6,748	10,287	47,436
26	10,527	9,748	10,293	455	593	7,018	10,699	49,333
27	10,932	10,122	10,689	473	615	7,288	11,110	51,231
28	11,337	10,497	11,085	490	638	7,558	11,522	53,128
29	11,742	10,872	11,481	508	661	7,828	11,933	55,025
30	12,147	11,247	11,877	525	684	8,098	12,345	56,923

Sub Watershed #5 Annual Nitrogen Reduction (tons), Cropland BMPs

Year	No-Till	Nutrient Mgmt	Terraces	Grade Stab.	Perm Veg	Buffers & Terrace	Waterway & Terrace	Total Load Reduction
1	668	619	653	39	38	445	679	3,140
2	1,336	1,237	1,306	78	75	891	1,358	6,280

3	2,004	1,856	1,959	116	113	1,336	2,037	9,421
4	2,672	2,474	2,613	155	150	1,781	2,715	12,561
5	3,340	3,093	3,266	194	188	2,227	3,394	15,701
6	4,008	3,711	3,919	233	226	2,672	4,073	18,841
7	4,676	4,330	4,572	272	263	3,117	4,752	21,982
8	5,344	4,948	5,225	310	301	3,563	5,431	25,122
9	6,012	5,567	5,878	349	338	4,008	6,110	28,262
10	6,680	6,185	6,531	388	376	4,453	6,789	31,402
11	7,348	6,804	7,185	427	414	4,899	7,468	34,542
12	8,016	7,422	7,838	466	451	5,344	8,146	37,683
13	8,684	8,041	8,491	504	489	5,789	8,825	40,823
14	9,352	8,659	9,144	543	526	6,235	9,504	43,963
15	10,020	9,278	9,797	582	564	6,680	10,183	47,103
16	10,688	9,896	10,450	621	602	7,125	10,862	50,244
17	11,356	10,515	11,103	660	639	7,570	11,541	53,384
18	12,024	11,133	11,757	698	677	8,016	12,220	56,524
19	12,692	11,752	12,410	737	714	8,461	12,899	59,664
20	13,360	12,370	13,063	776	752	8,906	13,577	62,805
21	14,028	12,989	13,716	815	790	9,352	14,256	65,945
22	14,696	13,607	14,369	854	827	9,797	14,935	69,085
23	15,364	14,226	15,022	892	865	10,242	15,614	72,225
24	16,032	14,844	15,675	931	903	10,688	16,293	75,365
25	16,700	15,463	16,329	970	940	11,133	16,972	78,506
26	17,368	16,081	16,982	1,009	978	11,578	17,651	81,646
27	18,036	16,700	17,635	1,048	1,015	12,024	18,329	84,786
28	18,704	17,318	18,288	1,086	1,053	12,469	19,008	87,926
29	19,372	17,937	18,941	1,125	1,091	12,914	19,687	91,067
30	20,040	18,555	19,594	1,164	1,128	13,360	20,366	94,207

Sub Watershed #6 Annual Nitrogen Reduction (tons), Cropland BMPs

Year	No-Till	Nutrient Mgmt	Terraces	Grade Stab.	Perm Veg	Buffers & Terrace	Waterway & Terrace	Total Load Reduction
1	287	266	280	17	16	191	291	1,348
2	573	531	561	34	32	382	583	2,696
3	860	797	841	51	48	573	874	4,045
4	1,147	1,062	1,121	68	65	765	1,166	5,393
5	1,434	1,328	1,402	85	81	956	1,457	6,741
6	1,720	1,593	1,682	101	97	1,147	1,748	8,089
7	2,007	1,859	1,963	118	113	1,338	2,040	9,438
8	2,294	2,124	2,243	135	129	1,529	2,331	10,786
9	2,581	2,390	2,523	152	145	1,720	2,623	12,134
10	2,867	2,655	2,804	169	161	1,912	2,914	13,482

11	3,154	2,921	3,084	186	178	2,103	3,206	14,831
12	3,441	3,186	3,364	203	194	2,294	3,497	16,179
13	3,728	3,452	3,645	220	210	2,485	3,788	17,527
14	4,014	3,717	3,925	237	226	2,676	4,080	18,875
15	4,301	3,983	4,206	254	242	2,867	4,371	20,224
16	4,588	4,248	4,486	271	258	3,059	4,663	21,572
17	4,875	4,514	4,766	287	274	3,250	4,954	22,920
18	5,161	4,779	5,047	304	291	3,441	5,245	24,268
19	5,448	5,045	5,327	321	307	3,632	5,537	25,616
20	5,735	5,310	5,607	338	323	3,823	5,828	26,965
21	6,022	5,576	5,888	355	339	4,014	6,120	28,313
22	6,308	5,841	6,168	372	355	4,206	6,411	29,661
23	6,595	6,107	6,448	389	371	4,397	6,702	31,009
24	6,882	6,372	6,729	406	387	4,588	6,994	32,358
25	7,169	6,638	7,009	423	404	4,779	7,285	33,706
26	7,455	6,903	7,290	440	420	4,970	7,577	35,054
27	7,742	7,169	7,570	457	436	5,161	7,868	36,402
28	8,029	7,434	7,850	474	452	5,352	8,160	37,751
29	8,315	7,700	8,131	490	468	5,544	8,451	39,099
30	8,602	7,965	8,411	507	484	5,735	8,742	40,447

Sub Watershed #7 Annual Nitrogen Reduction (tons), Cropland BMPs

Year	No-Till	Nutrient Mgmt	Terraces	Grade Stab.	Perm Veg	Buffers & Terrace	Waterway & Terrace	Total Load Reduction
1	692	641	677	36	39	461	703	3,250
2	1,384	1,282	1,354	73	78	923	1,407	6,500
3	2,076	1,923	2,030	109	117	1,384	2,110	9,750
4	2,769	2,564	2,707	145	156	1,846	2,814	13,000
5	3,461	3,204	3,384	182	195	2,307	3,517	16,250
6	4,153	3,845	4,061	218	234	2,769	4,221	19,500
7	4,845	4,486	4,737	254	273	3,230	4,924	22,750
8	5,537	5,127	5,414	291	312	3,691	5,627	26,000
9	6,229	5,768	6,091	327	351	4,153	6,331	29,249
10	6,921	6,409	6,768	363	390	4,614	7,034	32,499
11	7,614	7,050	7,444	400	429	5,076	7,738	35,749
12	8,306	7,691	8,121	436	468	5,537	8,441	38,999
13	8,998	8,331	8,798	472	507	5,999	9,145	42,249
14	9,690	8,972	9,475	509	546	6,460	9,848	45,499
15	10,382	9,613	10,152	545	584	6,921	10,551	48,749
16	11,074	10,254	10,828	581	623	7,383	11,255	51,999
17	11,767	10,895	11,505	617	662	7,844	11,958	55,249
18	12,459	11,536	12,182	654	701	8,306	12,662	58,499

19	13,151	12,177	12,859	690	740	8,767	13,365	61,749
20	13,843	12,818	13,535	726	779	9,229	14,069	64,999
21	14,535	13,458	14,212	763	818	9,690	14,772	68,249
22	15,227	14,099	14,889	799	857	10,152	15,475	71,499
23	15,919	14,740	15,566	835	896	10,613	16,179	74,749
24	16,612	15,381	16,242	872	935	11,074	16,882	77,999
25	17,304	16,022	16,919	908	974	11,536	17,586	81,249
26	17,996	16,663	17,596	944	1,013	11,997	18,289	84,499
27	18,688	17,304	18,273	981	1,052	12,459	18,993	87,748
28	19,380	17,945	18,949	1,017	1,091	12,920	19,696	90,998
29	20,072	18,585	19,626	1,053	1,130	13,382	20,399	94,248
30	20,764	19,226	20,303	1,090	1,169	13,843	21,103	97,498

13.3.2 Adoption Rates by Sub Watershed

Table 58. Cropland BMP Adoption Rates by Sub Watershed.

Sub Watershed #3 Annual Cropland BMP Adoption (Treated Acres)

Year	No-Till	Nutrient Management	Vegetative Buffers	Terraces	Grassed Waterways	Grade Stabilization	Permanent Vegetation	Total
1	59.95	55.51	22.20	48.85	31.08	1.33	0.89	220
2	59.95	55.51	22.20	48.85	31.08	1.33	0.89	220
3	59.95	55.51	22.20	48.85	31.08	1.33	0.89	220
4	59.95	55.51	22.20	48.85	31.08	1.33	0.89	220
5	59.95	55.51	22.20	48.85	31.08	1.33	0.89	220
6	59.95	55.51	22.20	48.85	31.08	1.33	0.89	220
7	59.95	55.51	22.20	48.85	31.08	1.33	0.89	220
8	59.95	55.51	22.20	48.85	31.08	1.33	0.89	220
9	59.95	55.51	22.20	48.85	31.08	1.33	0.89	220
10	59.95	55.51	22.20	48.85	31.08	1.33	0.89	220
11	59.95	55.51	22.20	48.85	31.08	1.33	0.89	220
12	59.95	55.51	22.20	48.85	31.08	1.33	0.89	220
13	59.95	55.51	22.20	48.85	31.08	1.33	0.89	220
14	59.95	55.51	22.20	48.85	31.08	1.33	0.89	220
15	59.95	55.51	22.20	48.85	31.08	1.33	0.89	220
16	59.95	55.51	22.20	48.85	31.08	1.33	0.89	220
17	59.95	55.51	22.20	48.85	31.08	1.33	0.89	220
18	59.95	55.51	22.20	48.85	31.08	1.33	0.89	220
19	59.95	55.51	22.20	48.85	31.08	1.33	0.89	220
20	59.95	55.51	22.20	48.85	31.08	1.33	0.89	220
21	59.95	55.51	22.20	48.85	31.08	1.33	0.89	220
22	59.95	55.51	22.20	48.85	31.08	1.33	0.89	220

23	59.95	55.51	22.20	48.85	31.08	1.33	0.89	220
24	59.95	55.51	22.20	48.85	31.08	1.33	0.89	220
25	59.95	55.51	22.20	48.85	31.08	1.33	0.89	220
26	59.95	55.51	22.20	48.85	31.08	1.33	0.89	220
27	59.95	55.51	22.20	48.85	31.08	1.33	0.89	220
28	59.95	55.51	22.20	48.85	31.08	1.33	0.89	220
29	59.95	55.51	22.20	48.85	31.08	1.33	0.89	220
30	59.95	55.51	22.20	48.85	31.08	1.33	0.89	220

Sub Watershed #4 Annual Cropland BMP Adoption (Treated Acres)

Year	No-Till	Nutrient Management	Vegetative Buffers	Terraces	Grassed Waterways	Grade Stabilization	Permanent Vegetation	Total
1	61.69	57.12	22.85	50.26	31.99	1.33	0.91	226
2	61.69	57.12	22.85	50.26	31.99	1.33	0.91	226
3	61.69	57.12	22.85	50.26	31.99	1.33	0.91	226
4	61.69	57.12	22.85	50.26	31.99	1.33	0.91	226
5	61.69	57.12	22.85	50.26	31.99	1.33	0.91	226
6	61.69	57.12	22.85	50.26	31.99	1.33	0.91	226
7	61.69	57.12	22.85	50.26	31.99	1.33	0.91	226
8	61.69	57.12	22.85	50.26	31.99	1.33	0.91	226
9	61.69	57.12	22.85	50.26	31.99	1.33	0.91	226
10	61.69	57.12	22.85	50.26	31.99	1.33	0.91	226
11	61.69	57.12	22.85	50.26	31.99	1.33	0.91	226
12	61.69	57.12	22.85	50.26	31.99	1.33	0.91	226
13	61.69	57.12	22.85	50.26	31.99	1.33	0.91	226
14	61.69	57.12	22.85	50.26	31.99	1.33	0.91	226
15	61.69	57.12	22.85	50.26	31.99	1.33	0.91	226
16	61.69	57.12	22.85	50.26	31.99	1.33	0.91	226
17	61.69	57.12	22.85	50.26	31.99	1.33	0.91	226
18	61.69	57.12	22.85	50.26	31.99	1.33	0.91	226
19	61.69	57.12	22.85	50.26	31.99	1.33	0.91	226
20	61.69	57.12	22.85	50.26	31.99	1.33	0.91	226
21	61.69	57.12	22.85	50.26	31.99	1.33	0.91	226
22	61.69	57.12	22.85	50.26	31.99	1.33	0.91	226
23	61.69	57.12	22.85	50.26	31.99	1.33	0.91	226
24	61.69	57.12	22.85	50.26	31.99	1.33	0.91	226
25	61.69	57.12	22.85	50.26	31.99	1.33	0.91	226
26	61.69	57.12	22.85	50.26	31.99	1.33	0.91	226
27	61.69	57.12	22.85	50.26	31.99	1.33	0.91	226
28	61.69	57.12	22.85	50.26	31.99	1.33	0.91	226
29	61.69	57.12	22.85	50.26	31.99	1.33	0.91	226
30	61.69	57.12	22.85	50.26	31.99	1.33	0.91	226

Sub Watershed #5 Annual Cropland BMP Adoption (Treated Acres)

Year	No-Till	Nutrient Management	Vegetative Buffers	Terraces	Grassed Waterways	Grade Stabilization	Permanent Vegetation	Total
1	91.82	85.02	34.01	74.81	47.61	2.67	1.36	337
2	91.82	85.02	34.01	74.81	47.61	2.67	1.36	337
3	91.82	85.02	34.01	74.81	47.61	2.67	1.36	337
4	91.82	85.02	34.01	74.81	47.61	2.67	1.36	337
5	91.82	85.02	34.01	74.81	47.61	2.67	1.36	337
6	91.82	85.02	34.01	74.81	47.61	2.67	1.36	337
7	91.82	85.02	34.01	74.81	47.61	2.67	1.36	337
8	91.82	85.02	34.01	74.81	47.61	2.67	1.36	337
9	91.82	85.02	34.01	74.81	47.61	2.67	1.36	337
10	91.82	85.02	34.01	74.81	47.61	2.67	1.36	337
11	91.82	85.02	34.01	74.81	47.61	2.67	1.36	337
12	91.82	85.02	34.01	74.81	47.61	2.67	1.36	337
13	91.82	85.02	34.01	74.81	47.61	2.67	1.36	337
14	91.82	85.02	34.01	74.81	47.61	2.67	1.36	337
15	91.82	85.02	34.01	74.81	47.61	2.67	1.36	337
16	91.82	85.02	34.01	74.81	47.61	2.67	1.36	337
17	91.82	85.02	34.01	74.81	47.61	2.67	1.36	337
18	91.82	85.02	34.01	74.81	47.61	2.67	1.36	337
19	91.82	85.02	34.01	74.81	47.61	2.67	1.36	337
20	91.82	85.02	34.01	74.81	47.61	2.67	1.36	337
21	91.82	85.02	34.01	74.81	47.61	2.67	1.36	337
22	91.82	85.02	34.01	74.81	47.61	2.67	1.36	337
23	91.82	85.02	34.01	74.81	47.61	2.67	1.36	337
24	91.82	85.02	34.01	74.81	47.61	2.67	1.36	337
25	91.82	85.02	34.01	74.81	47.61	2.67	1.36	337
26	91.82	85.02	34.01	74.81	47.61	2.67	1.36	337
27	91.82	85.02	34.01	74.81	47.61	2.67	1.36	337
28	91.82	85.02	34.01	74.81	47.61	2.67	1.36	337
29	91.82	85.02	34.01	74.81	47.61	2.67	1.36	337
30	91.82	85.02	34.01	74.81	47.61	2.67	1.36	337

Sub Watershed #6 Annual Cropland BMP Adoption (Treated Acres)

Year	No-Till	Nutrient Management	Vegetative Buffers	Terraces	Grassed Waterways	Grade Stabilization	Permanent Vegetation	Total
1	45.22	41.87	16.75	36.84	23.45	1.33	0.67	166
2	45.22	41.87	16.75	36.84	23.45	1.33	0.67	166
3	45.22	41.87	16.75	36.84	23.45	1.33	0.67	166

4	45.22	41.87	16.75	36.84	23.45	1.33	0.67	166
5	45.22	41.87	16.75	36.84	23.45	1.33	0.67	166
6	45.22	41.87	16.75	36.84	23.45	1.33	0.67	166
7	45.22	41.87	16.75	36.84	23.45	1.33	0.67	166
8	45.22	41.87	16.75	36.84	23.45	1.33	0.67	166
9	45.22	41.87	16.75	36.84	23.45	1.33	0.67	166
10	45.22	41.87	16.75	36.84	23.45	1.33	0.67	166
11	45.22	41.87	16.75	36.84	23.45	1.33	0.67	166
12	45.22	41.87	16.75	36.84	23.45	1.33	0.67	166
13	45.22	41.87	16.75	36.84	23.45	1.33	0.67	166
14	45.22	41.87	16.75	36.84	23.45	1.33	0.67	166
15	45.22	41.87	16.75	36.84	23.45	1.33	0.67	166
16	45.22	41.87	16.75	36.84	23.45	1.33	0.67	166
17	45.22	41.87	16.75	36.84	23.45	1.33	0.67	166
18	45.22	41.87	16.75	36.84	23.45	1.33	0.67	166
19	45.22	41.87	16.75	36.84	23.45	1.33	0.67	166
20	45.22	41.87	16.75	36.84	23.45	1.33	0.67	166
21	45.22	41.87	16.75	36.84	23.45	1.33	0.67	166
22	45.22	41.87	16.75	36.84	23.45	1.33	0.67	166
23	45.22	41.87	16.75	36.84	23.45	1.33	0.67	166
24	45.22	41.87	16.75	36.84	23.45	1.33	0.67	166
25	45.22	41.87	16.75	36.84	23.45	1.33	0.67	166
26	45.22	41.87	16.75	36.84	23.45	1.33	0.67	166
27	45.22	41.87	16.75	36.84	23.45	1.33	0.67	166
28	45.22	41.87	16.75	36.84	23.45	1.33	0.67	166
29	45.22	41.87	16.75	36.84	23.45	1.33	0.67	166
30	45.22	41.87	16.75	36.84	23.45	1.33	0.67	166

Sub Watershed #7 Annual Cropland BMP Adoption (Treated Acres)

Year	No-Till	Nutrient Management	Vegetative Buffers	Terraces	Grassed Waterways	Grade Stabilization	Permanent Vegetation	Total
1	101.63	94.10	37.64	82.81	52.70	2.67	1.51	373
2	101.63	94.10	37.64	82.81	52.70	2.67	1.51	373
3	101.63	94.10	37.64	82.81	52.70	2.67	1.51	373
4	101.63	94.10	37.64	82.81	52.70	2.67	1.51	373
5	101.63	94.10	37.64	82.81	52.70	2.67	1.51	373
6	101.63	94.10	37.64	82.81	52.70	2.67	1.51	373
7	101.63	94.10	37.64	82.81	52.70	2.67	1.51	373
8	101.63	94.10	37.64	82.81	52.70	2.67	1.51	373
9	101.63	94.10	37.64	82.81	52.70	2.67	1.51	373
10	101.63	94.10	37.64	82.81	52.70	2.67	1.51	373

11	101.63	94.10	37.64	82.81	52.70	2.67	1.51	373
12	101.63	94.10	37.64	82.81	52.70	2.67	1.51	373
13	101.63	94.10	37.64	82.81	52.70	2.67	1.51	373
14	101.63	94.10	37.64	82.81	52.70	2.67	1.51	373
15	101.63	94.10	37.64	82.81	52.70	2.67	1.51	373
16	101.63	94.10	37.64	82.81	52.70	2.67	1.51	373
17	101.63	94.10	37.64	82.81	52.70	2.67	1.51	373
18	101.63	94.10	37.64	82.81	52.70	2.67	1.51	373
19	101.63	94.10	37.64	82.81	52.70	2.67	1.51	373
20	101.63	94.10	37.64	82.81	52.70	2.67	1.51	373
21	101.63	94.10	37.64	82.81	52.70	2.67	1.51	373
22	101.63	94.10	37.64	82.81	52.70	2.67	1.51	373
23	101.63	94.10	37.64	82.81	52.70	2.67	1.51	373
24	101.63	94.10	37.64	82.81	52.70	2.67	1.51	373
25	101.63	94.10	37.64	82.81	52.70	2.67	1.51	373
26	101.63	94.10	37.64	82.81	52.70	2.67	1.51	373
27	101.63	94.10	37.64	82.81	52.70	2.67	1.51	373
28	101.63	94.10	37.64	82.81	52.70	2.67	1.51	373
29	101.63	94.10	37.64	82.81	52.70	2.67	1.51	373
30	101.63	94.10	37.64	82.81	52.70	2.67	1.51	373

Table 59. Short, Medium and Long Term Goals by Sub Watershed.

	Sub Watershed #3 Annual Cropland BMP Adoption (Treated Acres)								
	Year	No-Till	Nutrient Mgmt	Vegetative Buffers	Terraces	Grassed Waterways	Grade Stabilization	Permanent Vegetation	Total
Short-Term	1	59.95	55.51	22.20	48.85	31.08	1.33	0.89	220
	2	59.95	55.51	22.20	48.85	31.08	1.33	0.89	220
	3	59.95	55.51	22.20	48.85	31.08	1.33	0.89	220
	4	59.95	55.51	22.20	48.85	31.08	1.33	0.89	220
	5	59.95	55.51	22.20	48.85	31.08	1.33	0.89	220
Total		*300*	*278*	*111*	*244*	*155*	*7*	*4*	*1,099*
Medium-Term	6	59.95	55.51	22.20	48.85	31.08	1.33	0.89	220
	7	59.95	55.51	22.20	48.85	31.08	1.33	0.89	220
	8	59.95	55.51	22.20	48.85	31.08	1.33	0.89	220
	9	59.95	55.51	22.20	48.85	31.08	1.33	0.89	220
	10	59.95	55.51	22.20	48.85	31.08	1.33	0.89	220
Total		599	555	222	488	311	13	9	2,198
Long-Term	11	59.95	55.51	22.20	48.85	31.08	1.33	0.89	220
	12	59.95	55.51	22.20	48.85	31.08	1.33	0.89	220
	13	59.95	55.51	22.20	48.85	31.08	1.33	0.89	220
	14	59.95	55.51	22.20	48.85	31.08	1.33	0.89	220
	15	59.95	55.51	22.20	48.85	31.08	1.33	0.89	220
	16	59.95	55.51	22.20	48.85	31.08	1.33	0.89	220

	17	59.95	55.51	22.20	48.85	31.08	1.33	0.89	220
	18	59.95	55.51	22.20	48.85	31.08	1.33	0.89	220
	19	59.95	55.51	22.20	48.85	31.08	1.33	0.89	220
	20	59.95	55.51	22.20	48.85	31.08	1.33	0.89	220
	21	59.95	55.51	22.20	48.85	31.08	1.33	0.89	220
	22	59.95	55.51	22.20	48.85	31.08	1.33	0.89	220
	23	59.95	55.51	22.20	48.85	31.08	1.33	0.89	220
	24	59.95	55.51	22.20	48.85	31.08	1.33	0.89	220
	25	59.95	55.51	22.20	48.85	31.08	1.33	0.89	220
	26	59.95	55.51	22.20	48.85	31.08	1.33	0.89	220
	27	59.95	55.51	22.20	48.85	31.08	1.33	0.89	220
	28	59.95	55.51	22.20	48.85	31.08	1.33	0.89	220
	29	59.95	55.51	22.20	48.85	31.08	1.33	0.89	220
	30	59.95	55.51	22.20	48.85	31.08	1.33	0.89	220
Total		1,798	1,665	666	1,465	933	40	27	6,594

Sub Watershed #4 Annual Cropland BMP Adoption (Treated Acres)

	Year	No-Till	Nutrient Mgmt	Vegetative Buffers	Terraces	Grassed Waterways	Grade Stabilization	Permanent Vegetation	Total
Short-Term	1	61.69	57.12	22.85	50.26	31.99	1.33	0.91	226
	2	61.69	57.12	22.85	50.26	31.99	1.33	0.91	226
	3	61.69	57.12	22.85	50.26	31.99	1.33	0.91	226
	4	61.69	57.12	22.85	50.26	31.99	1.33	0.91	226
	5	61.69	57.12	22.85	50.26	31.99	1.33	0.91	226
Total		*308*	*286*	*114*	*251*	*160*	*7*	*5*	*1,131*
Medium-Term	6	61.69	57.12	22.85	50.26	31.99	1.33	0.91	226
	7	61.69	57.12	22.85	50.26	31.99	1.33	0.91	226
	8	61.69	57.12	22.85	50.26	31.99	1.33	0.91	226
	9	61.69	57.12	22.85	50.26	31.99	1.33	0.91	226
	10	61.69	57.12	22.85	50.26	31.99	1.33	0.91	226
Total		617	571	228	503	320	13	9	2,261
Long-Term	11	61.69	57.12	22.85	50.26	31.99	1.33	0.91	226
	12	61.69	57.12	22.85	50.26	31.99	1.33	0.91	226
	13	61.69	57.12	22.85	50.26	31.99	1.33	0.91	226
	14	61.69	57.12	22.85	50.26	31.99	1.33	0.91	226
	15	61.69	57.12	22.85	50.26	31.99	1.33	0.91	226
	16	61.69	57.12	22.85	50.26	31.99	1.33	0.91	226
	17	61.69	57.12	22.85	50.26	31.99	1.33	0.91	226
	18	61.69	57.12	22.85	50.26	31.99	1.33	0.91	226
	19	61.69	57.12	22.85	50.26	31.99	1.33	0.91	226
	20	61.69	57.12	22.85	50.26	31.99	1.33	0.91	226
	21	61.69	57.12	22.85	50.26	31.99	1.33	0.91	226

	22	61.69	57.12	22.85	50.26	31.99	1.33	0.91	226
	23	61.69	57.12	22.85	50.26	31.99	1.33	0.91	226
	24	61.69	57.12	22.85	50.26	31.99	1.33	0.91	226
	25	61.69	57.12	22.85	50.26	31.99	1.33	0.91	226
	26	61.69	57.12	22.85	50.26	31.99	1.33	0.91	226
	27	61.69	57.12	22.85	50.26	31.99	1.33	0.91	226
	28	61.69	57.12	22.85	50.26	31.99	1.33	0.91	226
	29	61.69	57.12	22.85	50.26	31.99	1.33	0.91	226
	30	61.69	57.12	22.85	50.26	31.99	1.33	0.91	226
Total		1,851	1,714	685	1,508	960	40	27	6,784

Sub Watershed #5 Annual Cropland BMP Adoption (Treated Acres)

	Year	No-Till	Nutrient Mgmt	Vegetative Buffers	Terraces	Grassed Waterways	Grade Stabilization	Permanent Vegetation	Total
Short-Term	1	91.82	85.02	34.01	74.81	47.61	2.67	1.36	337
	2	91.82	85.02	34.01	74.81	47.61	2.67	1.36	337
	3	91.82	85.02	34.01	74.81	47.61	2.67	1.36	337
	4	91.82	85.02	34.01	74.81	47.61	2.67	1.36	337
	5	91.82	85.02	34.01	74.81	47.61	2.67	1.36	337
Total		*459*	*425*	*170*	*374*	*238*	*13*	*7*	*1,686*
Medium-Term	6	91.82	85.02	34.01	74.81	47.61	2.67	1.36	337
	7	91.82	85.02	34.01	74.81	47.61	2.67	1.36	337
	8	91.82	85.02	34.01	74.81	47.61	2.67	1.36	337
	9	91.82	85.02	34.01	74.81	47.61	2.67	1.36	337
	10	91.82	85.02	34.01	74.81	47.61	2.67	1.36	337
Total		918	850	340	748	476	27	14	3,373
Long-Term	11	91.82	85.02	34.01	74.81	47.61	2.67	1.36	337
	12	91.82	85.02	34.01	74.81	47.61	2.67	1.36	337
	13	91.82	85.02	34.01	74.81	47.61	2.67	1.36	337
	14	91.82	85.02	34.01	74.81	47.61	2.67	1.36	337
	15	91.82	85.02	34.01	74.81	47.61	2.67	1.36	337
	16	91.82	85.02	34.01	74.81	47.61	2.67	1.36	337
	17	91.82	85.02	34.01	74.81	47.61	2.67	1.36	337
	18	91.82	85.02	34.01	74.81	47.61	2.67	1.36	337
	19	91.82	85.02	34.01	74.81	47.61	2.67	1.36	337
	20	91.82	85.02	34.01	74.81	47.61	2.67	1.36	337
	21	91.82	85.02	34.01	74.81	47.61	2.67	1.36	337
	22	91.82	85.02	34.01	74.81	47.61	2.67	1.36	337
	23	91.82	85.02	34.01	74.81	47.61	2.67	1.36	337
	24	91.82	85.02	34.01	74.81	47.61	2.67	1.36	337
	25	91.82	85.02	34.01	74.81	47.61	2.67	1.36	337
	26	91.82	85.02	34.01	74.81	47.61	2.67	1.36	337

	27	91.82	85.02	34.01	74.81	47.61	2.67	1.36	337
	28	91.82	85.02	34.01	74.81	47.61	2.67	1.36	337
	29	91.82	85.02	34.01	74.81	47.61	2.67	1.36	337
	30	91.82	85.02	34.01	74.81	47.61	2.67	1.36	337
Total		2,755	2,551	1,020	2,244	1,428	80	41	10,119

Sub Watershed #6 Annual Cropland BMP Adoption (Treated Acres)

	Year	No-Till	Nutrient Mgmt	Vegetative Buffers	Terraces	Grassed Waterways	Grade Stabilization	Permanent Vegetation	Total
Short-Term	1	45.22	41.87	16.75	36.84	23.45	1.33	0.67	166
	2	45.22	41.87	16.75	36.84	23.45	1.33	0.67	166
	3	45.22	41.87	16.75	36.84	23.45	1.33	0.67	166
	4	45.22	41.87	16.75	36.84	23.45	1.33	0.67	166
	5	45.22	41.87	16.75	36.84	23.45	1.33	0.67	166
Total		*226*	*209*	*84*	*184*	*117*	*7*	*3*	*831*
Medium-Term	6	45.22	41.87	16.75	36.84	23.45	1.33	0.67	166
	7	45.22	41.87	16.75	36.84	23.45	1.33	0.67	166
	8	45.22	41.87	16.75	36.84	23.45	1.33	0.67	166
	9	45.22	41.87	16.75	36.84	23.45	1.33	0.67	166
	10	45.22	41.87	16.75	36.84	23.45	1.33	0.67	166
Total		452	419	167	368	234	13	7	1,661
Long-Term	11	45.22	41.87	16.75	36.84	23.45	1.33	0.67	166
	12	45.22	41.87	16.75	36.84	23.45	1.33	0.67	166
	13	45.22	41.87	16.75	36.84	23.45	1.33	0.67	166
	14	45.22	41.87	16.75	36.84	23.45	1.33	0.67	166
	15	45.22	41.87	16.75	36.84	23.45	1.33	0.67	166
	16	45.22	41.87	16.75	36.84	23.45	1.33	0.67	166
	17	45.22	41.87	16.75	36.84	23.45	1.33	0.67	166
	18	45.22	41.87	16.75	36.84	23.45	1.33	0.67	166
	19	45.22	41.87	16.75	36.84	23.45	1.33	0.67	166
	20	45.22	41.87	16.75	36.84	23.45	1.33	0.67	166
	21	45.22	41.87	16.75	36.84	23.45	1.33	0.67	166
	22	45.22	41.87	16.75	36.84	23.45	1.33	0.67	166
	23	45.22	41.87	16.75	36.84	23.45	1.33	0.67	166
	24	45.22	41.87	16.75	36.84	23.45	1.33	0.67	166
	25	45.22	41.87	16.75	36.84	23.45	1.33	0.67	166
	26	45.22	41.87	16.75	36.84	23.45	1.33	0.67	166
	27	45.22	41.87	16.75	36.84	23.45	1.33	0.67	166
	28	45.22	41.87	16.75	36.84	23.45	1.33	0.67	166
	29	45.22	41.87	16.75	36.84	23.45	1.33	0.67	166
	30	45.22	41.87	16.75	36.84	23.45	1.33	0.67	166
Total		1,356	1,256	502	1,105	703	40	20	4,984

	Sub Watershed #7 Annual Cropland BMP Adoption (Treated Acres)								
	Year	No-Till	Nutrient Mgmt	Vegetative Buffers	Terraces	Grassed Waterways	Grade Stabilization	Permanent Vegetation	Total
Short-Term	1	101.63	94.10	37.64	82.81	52.70	2.67	1.51	373
	2	101.63	94.10	37.64	82.81	52.70	2.67	1.51	373
	3	101.63	94.10	37.64	82.81	52.70	2.67	1.51	373
	4	101.63	94.10	37.64	82.81	52.70	2.67	1.51	373
	5	101.63	94.10	37.64	82.81	52.70	2.67	1.51	373
Total		*508*	*471*	*188*	*414*	*263*	*13*	*8*	*1,865*
Medium-Term	6	101.63	94.10	37.64	82.81	52.70	2.67	1.51	373
	7	101.63	94.10	37.64	82.81	52.70	2.67	1.51	373
	8	101.63	94.10	37.64	82.81	52.70	2.67	1.51	373
	9	101.63	94.10	37.64	82.81	52.70	2.67	1.51	373
	10	101.63	94.10	37.64	82.81	52.70	2.67	1.51	373
Total		1,016	941	376	828	527	27	15	3,730
Long-Term	11	101.63	94.10	37.64	82.81	52.70	2.67	1.51	373
	12	101.63	94.10	37.64	82.81	52.70	2.67	1.51	373
	13	101.63	94.10	37.64	82.81	52.70	2.67	1.51	373
	14	101.63	94.10	37.64	82.81	52.70	2.67	1.51	373
	15	101.63	94.10	37.64	82.81	52.70	2.67	1.51	373
	16	101.63	94.10	37.64	82.81	52.70	2.67	1.51	373
	17	101.63	94.10	37.64	82.81	52.70	2.67	1.51	373
	18	101.63	94.10	37.64	82.81	52.70	2.67	1.51	373
	19	101.63	94.10	37.64	82.81	52.70	2.67	1.51	373
	20	101.63	94.10	37.64	82.81	52.70	2.67	1.51	373
	21	101.63	94.10	37.64	82.81	52.70	2.67	1.51	373
	22	101.63	94.10	37.64	82.81	52.70	2.67	1.51	373
	23	101.63	94.10	37.64	82.81	52.70	2.67	1.51	373
	24	101.63	94.10	37.64	82.81	52.70	2.67	1.51	373
	25	101.63	94.10	37.64	82.81	52.70	2.67	1.51	373
	26	101.63	94.10	37.64	82.81	52.70	2.67	1.51	373
	27	101.63	94.10	37.64	82.81	52.70	2.67	1.51	373
	28	101.63	94.10	37.64	82.81	52.70	2.67	1.51	373
	29	101.63	94.10	37.64	82.81	52.70	2.67	1.51	373
	30	101.63	94.10	37.64	82.81	52.70	2.67	1.51	373
Total		3,049	2,823	1,129	2,484	1,581	80	45	11,191

13.3.3 Costs by Sub Watershed

Table 60. Costs Before Cost Share by Sub Watershed.

Sub Watershed #3 Annual Cropland BMP Costs Before Cost-Share

Year	No-Till	Nutrient Management	Vegetative Buffers	Terraces	Grassed Waterways	Grade Stabilization	Permanent Vegetation	Total
1	$4,657	$3,148	$1,480	$4,885	$4,974	$400	$133	$19,677
2	$4,797	$3,242	$1,525	$5,031	$5,123	$412	$137	$20,267
3	$4,941	$3,340	$1,570	$5,182	$5,276	$424	$141	$20,875
4	$5,089	$3,440	$1,617	$5,338	$5,435	$437	$146	$21,502
5	$5,242	$3,543	$1,666	$5,498	$5,598	$450	$150	$22,147
6	$5,399	$3,649	$1,716	$5,663	$5,766	$464	$154	$22,811
7	$5,561	$3,759	$1,767	$5,833	$5,939	$478	$159	$23,495
8	$5,728	$3,871	$1,820	$6,008	$6,117	$492	$164	$24,200
9	$5,900	$3,988	$1,875	$6,188	$6,300	$507	$169	$24,926
10	$6,077	$4,107	$1,931	$6,373	$6,489	$522	$174	$25,674
11	$6,259	$4,230	$1,989	$6,565	$6,684	$538	$179	$26,444
12	$6,447	$4,357	$2,049	$6,762	$6,885	$554	$184	$27,238
13	$6,640	$4,488	$2,110	$6,964	$7,091	$570	$190	$28,055
14	$6,840	$4,623	$2,174	$7,173	$7,304	$587	$196	$28,896
15	$7,045	$4,761	$2,239	$7,389	$7,523	$605	$202	$29,763
16	$7,256	$4,904	$2,306	$7,610	$7,749	$623	$208	$30,656
17	$7,474	$5,051	$2,375	$7,839	$7,981	$642	$214	$31,576
18	$7,698	$5,203	$2,447	$8,074	$8,221	$661	$220	$32,523
19	$7,929	$5,359	$2,520	$8,316	$8,467	$681	$227	$33,499
20	$8,167	$5,520	$2,596	$8,565	$8,721	$701	$234	$34,504
21	$8,412	$5,685	$2,673	$8,822	$8,983	$722	$241	$35,539
22	$8,664	$5,856	$2,754	$9,087	$9,252	$744	$248	$36,605
23	$8,924	$6,032	$2,836	$9,360	$9,530	$766	$255	$37,703
24	$9,192	$6,213	$2,921	$9,640	$9,816	$789	$263	$38,834
25	$9,468	$6,399	$3,009	$9,930	$10,110	$813	$271	$39,999
26	$9,752	$6,591	$3,099	$10,228	$10,414	$838	$279	$41,199
27	$10,044	$6,789	$3,192	$10,534	$10,726	$863	$287	$42,435
28	$10,346	$6,992	$3,288	$10,850	$11,048	$889	$296	$43,708
29	$10,656	$7,202	$3,387	$11,176	$11,379	$915	$305	$45,020
30	$10,976	$7,418	$3,488	$11,511	$11,720	$943	$314	$46,370

Sub Watershed #4 Annual Cropland BMP Costs Before Cost-Share

Year	No-Till	Nutrient Management	Vegetative Buffers	Terraces	Grassed Waterways	Grade Stabilization	Permanent Vegetation	Total
1	$4,792	$3,239	$1,523	$5,026	$5,118	$400	$137	$20,236
2	$4,936	$3,336	$1,569	$5,177	$5,271	$412	$141	$20,843

3	$5,084	$3,436	$1,616	$5,332	$5,429	$424	$145	$21,468
4	$5,237	$3,539	$1,664	$5,492	$5,592	$437	$150	$22,112
5	$5,394	$3,646	$1,714	$5,657	$5,760	$450	$154	$22,775
6	$5,556	$3,755	$1,766	$5,827	$5,933	$464	$159	$23,459
7	$5,722	$3,868	$1,819	$6,002	$6,111	$478	$164	$24,162
8	$5,894	$3,984	$1,873	$6,182	$6,294	$492	$169	$24,887
9	$6,071	$4,103	$1,929	$6,367	$6,483	$507	$174	$25,634
10	$6,253	$4,226	$1,987	$6,558	$6,677	$522	$179	$26,403
11	$6,441	$4,353	$2,047	$6,755	$6,878	$538	$184	$27,195
12	$6,634	$4,484	$2,108	$6,958	$7,084	$554	$190	$28,011
13	$6,833	$4,618	$2,172	$7,166	$7,297	$570	$195	$28,851
14	$7,038	$4,757	$2,237	$7,381	$7,515	$587	$201	$29,717
15	$7,249	$4,899	$2,304	$7,603	$7,741	$605	$207	$30,608
16	$7,466	$5,046	$2,373	$7,831	$7,973	$623	$214	$31,526
17	$7,690	$5,198	$2,444	$8,066	$8,212	$642	$220	$32,472
18	$7,921	$5,354	$2,517	$8,308	$8,459	$661	$227	$33,446
19	$8,159	$5,514	$2,593	$8,557	$8,712	$681	$233	$34,450
20	$8,403	$5,680	$2,671	$8,814	$8,974	$701	$240	$35,483
21	$8,656	$5,850	$2,751	$9,078	$9,243	$722	$248	$36,548
22	$8,915	$6,026	$2,833	$9,350	$9,520	$744	$255	$37,644
23	$9,183	$6,206	$2,918	$9,631	$9,806	$766	$263	$38,773
24	$9,458	$6,393	$3,006	$9,920	$10,100	$789	$271	$39,937
25	$9,742	$6,584	$3,096	$10,217	$10,403	$813	$279	$41,135
26	$10,034	$6,782	$3,189	$10,524	$10,715	$838	$287	$42,369
27	$10,335	$6,985	$3,285	$10,840	$11,037	$863	$296	$43,640
28	$10,645	$7,195	$3,383	$11,165	$11,368	$889	$304	$44,949
29	$10,965	$7,411	$3,485	$11,500	$11,709	$915	$314	$46,298
30	$11,294	$7,633	$3,589	$11,845	$12,060	$943	$323	$47,686

Sub Watershed #5 Annual Cropland BMP Costs Before Cost-Share

Year	No-Till	Nutrient Management	Vegetative Buffers	Terraces	Grassed Waterways	Grade Stabilization	Permanent Vegetation	Total
1	$7,133	$4,821	$2,267	$7,481	$7,617	$800	$204	$30,325
2	$7,347	$4,966	$2,335	$7,706	$7,846	$824	$210	$31,234
3	$7,568	$5,115	$2,405	$7,937	$8,081	$849	$216	$32,172
4	$7,795	$5,268	$2,477	$8,175	$8,324	$874	$223	$33,137
5	$8,029	$5,426	$2,552	$8,420	$8,574	$900	$230	$34,131
6	$8,269	$5,589	$2,628	$8,673	$8,831	$927	$237	$35,155
7	$8,518	$5,757	$2,707	$8,933	$9,096	$955	$244	$36,209
8	$8,773	$5,930	$2,788	$9,201	$9,369	$984	$251	$37,296
9	$9,036	$6,107	$2,872	$9,477	$9,650	$1,013	$258	$38,414

10	$9,307	$6,291	$2,958	$9,762	$9,939	$1,044	$266	$39,567
11	$9,587	$6,479	$3,047	$10,054	$10,237	$1,075	$274	$40,754
12	$9,874	$6,674	$3,138	$10,356	$10,544	$1,107	$282	$41,977
13	$10,170	$6,874	$3,232	$10,667	$10,861	$1,141	$291	$43,236
14	$10,476	$7,080	$3,329	$10,987	$11,187	$1,175	$300	$44,533
15	$10,790	$7,293	$3,429	$11,316	$11,522	$1,210	$309	$45,869
16	$11,114	$7,511	$3,532	$11,656	$11,868	$1,246	$318	$47,245
17	$11,447	$7,737	$3,638	$12,006	$12,224	$1,284	$327	$48,662
18	$11,790	$7,969	$3,747	$12,366	$12,591	$1,322	$337	$50,122
19	$12,144	$8,208	$3,860	$12,737	$12,968	$1,362	$347	$51,626
20	$12,508	$8,454	$3,975	$13,119	$13,357	$1,403	$358	$53,175
21	$12,884	$8,708	$4,095	$13,512	$13,758	$1,445	$369	$54,770
22	$13,270	$8,969	$4,217	$13,918	$14,171	$1,488	$380	$56,413
23	$13,668	$9,238	$4,344	$14,335	$14,596	$1,533	$391	$58,105
24	$14,078	$9,515	$4,474	$14,765	$15,034	$1,579	$403	$59,849
25	$14,501	$9,801	$4,609	$15,208	$15,485	$1,626	$415	$61,644
26	$14,936	$10,095	$4,747	$15,665	$15,949	$1,675	$427	$63,493
27	$15,384	$10,398	$4,889	$16,134	$16,428	$1,725	$440	$65,398
28	$15,845	$10,709	$5,036	$16,618	$16,921	$1,777	$453	$67,360
29	$16,321	$11,031	$5,187	$17,117	$17,428	$1,830	$467	$69,381
30	$16,810	$11,362	$5,343	$17,631	$17,951	$1,885	$481	$71,462

Sub Watershed #6 Annual Cropland BMP Costs Before Cost-Share

Year	No-Till	Nutrient Management	Vegetative Buffers	Terraces	Grassed Waterways	Grade Stabilization	Permanent Vegetation	Total
1	$3,513	$2,374	$1,116	$3,684	$3,751	$400	$100	$14,940
2	$3,618	$2,445	$1,150	$3,795	$3,864	$412	$103	$15,388
3	$3,727	$2,519	$1,184	$3,909	$3,980	$424	$107	$15,849
4	$3,839	$2,594	$1,220	$4,026	$4,099	$437	$110	$16,325
5	$3,954	$2,672	$1,257	$4,147	$4,222	$450	$113	$16,815
6	$4,072	$2,752	$1,294	$4,271	$4,349	$464	$116	$17,319
7	$4,195	$2,835	$1,333	$4,399	$4,479	$478	$120	$17,839
8	$4,320	$2,920	$1,373	$4,531	$4,614	$492	$124	$18,374
9	$4,450	$3,008	$1,414	$4,667	$4,752	$507	$127	$18,925
10	$4,583	$3,098	$1,457	$4,807	$4,895	$522	$131	$19,493
11	$4,721	$3,191	$1,500	$4,951	$5,041	$538	$135	$20,077
12	$4,863	$3,287	$1,545	$5,100	$5,193	$554	$139	$20,680
13	$5,008	$3,385	$1,592	$5,253	$5,348	$570	$143	$21,300
14	$5,159	$3,487	$1,640	$5,410	$5,509	$587	$148	$21,939
15	$5,313	$3,591	$1,689	$5,573	$5,674	$605	$152	$22,597
16	$5,473	$3,699	$1,739	$5,740	$5,844	$623	$157	$23,275

17	$5,637	$3,810	$1,792	$5,912	$6,020	$642	$161	$23,974
18	$5,806	$3,924	$1,845	$6,090	$6,200	$661	$166	$24,693
19	$5,980	$4,042	$1,901	$6,272	$6,386	$681	$171	$25,434
20	$6,160	$4,163	$1,958	$6,460	$6,578	$701	$176	$26,197
21	$6,345	$4,288	$2,016	$6,654	$6,775	$722	$181	$26,982
22	$6,535	$4,417	$2,077	$6,854	$6,978	$744	$187	$27,792
23	$6,731	$4,549	$2,139	$7,059	$7,188	$766	$193	$28,626
24	$6,933	$4,686	$2,203	$7,271	$7,403	$789	$198	$29,484
25	$7,141	$4,826	$2,270	$7,489	$7,626	$813	$204	$30,369
26	$7,355	$4,971	$2,338	$7,714	$7,854	$838	$210	$31,280
27	$7,576	$5,120	$2,408	$7,945	$8,090	$863	$217	$32,218
28	$7,803	$5,274	$2,480	$8,184	$8,333	$889	$223	$33,185
29	$8,037	$5,432	$2,554	$8,429	$8,583	$915	$230	$34,181
30	$8,278	$5,595	$2,631	$8,682	$8,840	$943	$237	$35,206

Sub Watershed #7 Annual Cropland BMP Costs Before Cost-Share

Year	No-Till	Nutrient Management	Vegetative Buffers	Terraces	Grassed Waterways	Grade Stabilization	Permanent Vegetation	Total
1	$7,895	$5,336	$2,509	$8,281	$8,431	$800	$226	$33,479
2	$8,132	$5,497	$2,585	$8,529	$8,684	$824	$233	$34,484
3	$8,376	$5,661	$2,662	$8,785	$8,945	$849	$240	$35,518
4	$8,628	$5,831	$2,742	$9,049	$9,213	$874	$247	$36,584
5	$8,886	$6,006	$2,824	$9,320	$9,490	$900	$254	$37,681
6	$9,153	$6,186	$2,909	$9,600	$9,774	$927	$262	$38,812
7	$9,428	$6,372	$2,996	$9,888	$10,067	$955	$270	$39,976
8	$9,710	$6,563	$3,086	$10,184	$10,370	$984	$278	$41,175
9	$10,002	$6,760	$3,179	$10,490	$10,681	$1,013	$286	$42,410
10	$10,302	$6,963	$3,274	$10,805	$11,001	$1,044	$295	$43,683
11	$10,611	$7,172	$3,372	$11,129	$11,331	$1,075	$304	$44,993
12	$10,929	$7,387	$3,474	$11,463	$11,671	$1,107	$313	$46,343
13	$11,257	$7,608	$3,578	$11,806	$12,021	$1,141	$322	$47,733
14	$11,595	$7,837	$3,685	$12,161	$12,382	$1,175	$332	$49,165
15	$11,943	$8,072	$3,796	$12,525	$12,753	$1,210	$342	$50,640
16	$12,301	$8,314	$3,909	$12,901	$13,136	$1,246	$352	$52,160
17	$12,670	$8,563	$4,027	$13,288	$13,530	$1,284	$362	$53,724
18	$13,050	$8,820	$4,148	$13,687	$13,936	$1,322	$373	$55,336
19	$13,442	$9,085	$4,272	$14,098	$14,354	$1,362	$384	$56,996
20	$13,845	$9,357	$4,400	$14,520	$14,784	$1,403	$396	$58,706
21	$14,260	$9,638	$4,532	$14,956	$15,228	$1,445	$408	$60,467
22	$14,688	$9,927	$4,668	$15,405	$15,685	$1,488	$420	$62,281
23	$15,129	$10,225	$4,808	$15,867	$16,155	$1,533	$433	$64,150

24	$15,582	$10,532	$4,952	$16,343	$16,640	$1,579	$446	$66,074
25	$16,050	$10,848	$5,101	$16,833	$17,139	$1,626	$459	$68,056
26	$16,531	$11,173	$5,254	$17,338	$17,653	$1,675	$473	$70,098
27	$17,027	$11,508	$5,412	$17,858	$18,183	$1,725	$487	$72,201
28	$17,538	$11,854	$5,574	$18,394	$18,728	$1,777	$502	$74,367
29	$18,064	$12,209	$5,741	$18,946	$19,290	$1,830	$517	$76,598
30	$18,606	$12,576	$5,913	$19,514	$19,869	$1,885	$532	$78,896

Table 61. Costs by BMP After Cost Share.

Sub Watershed #3 Annual Cropland BMP Costs After Cost-Share

Year	No-Till	Nutrient Management	Vegetative Buffers	Terraces	Grassed Waterways	Grade Stabilization	Permanent Vegetation	Total
1	$2,841	$1,574	$148	$2,442	$2,487	$200	$67	$9,759
2	$2,926	$1,621	$152	$2,516	$2,561	$206	$69	$10,052
3	$3,014	$1,670	$157	$2,591	$2,638	$212	$71	$10,353
4	$3,104	$1,720	$162	$2,669	$2,717	$219	$73	$10,664
5	$3,198	$1,771	$167	$2,749	$2,799	$225	$75	$10,984
6	$3,294	$1,825	$172	$2,831	$2,883	$232	$77	$11,313
7	$3,392	$1,879	$177	$2,916	$2,969	$239	$80	$11,652
8	$3,494	$1,936	$182	$3,004	$3,058	$246	$82	$12,002
9	$3,599	$1,994	$188	$3,094	$3,150	$253	$84	$12,362
10	$3,707	$2,054	$193	$3,187	$3,245	$261	$87	$12,733
11	$3,818	$2,115	$199	$3,282	$3,342	$269	$90	$13,115
12	$3,933	$2,179	$205	$3,381	$3,442	$277	$92	$13,508
13	$4,051	$2,244	$211	$3,482	$3,546	$285	$95	$13,914
14	$4,172	$2,311	$217	$3,587	$3,652	$294	$98	$14,331
15	$4,297	$2,381	$224	$3,694	$3,761	$303	$101	$14,761
16	$4,426	$2,452	$231	$3,805	$3,874	$312	$104	$15,204
17	$4,559	$2,526	$238	$3,919	$3,991	$321	$107	$15,660
18	$4,696	$2,601	$245	$4,037	$4,110	$331	$110	$16,130
19	$4,837	$2,680	$252	$4,158	$4,234	$340	$113	$16,614
20	$4,982	$2,760	$260	$4,283	$4,361	$351	$117	$17,112
21	$5,131	$2,843	$267	$4,411	$4,491	$361	$120	$17,625
22	$5,285	$2,928	$275	$4,544	$4,626	$372	$124	$18,154
23	$5,444	$3,016	$284	$4,680	$4,765	$383	$128	$18,699
24	$5,607	$3,106	$292	$4,820	$4,908	$395	$131	$19,260
25	$5,775	$3,199	$301	$4,965	$5,055	$407	$135	$19,838
26	$5,949	$3,295	$310	$5,114	$5,207	$419	$139	$20,433
27	$6,127	$3,394	$319	$5,267	$5,363	$431	$144	$21,046
28	$6,311	$3,496	$329	$5,425	$5,524	$444	$148	$21,677
29	$6,500	$3,601	$339	$5,588	$5,690	$458	$152	$22,327

30	$6,695	$3,709	$349	$5,756	$5,860	$471	$157	$22,997

Sub Watershed #4 Annual Cropland BMP Costs After Cost-Share

Year	No-Till	Nutrient Management	Vegetative Buffers	Terraces	Grassed Waterways	Grade Stabilization	Permanent Vegetation	Total
1	$2,923	$1,620	$152	$2,513	$2,559	$200	$69	$10,036
2	$3,011	$1,668	$157	$2,589	$2,636	$206	$71	$10,337
3	$3,101	$1,718	$162	$2,666	$2,715	$212	$73	$10,647
4	$3,194	$1,770	$166	$2,746	$2,796	$219	$75	$10,966
5	$3,290	$1,823	$171	$2,829	$2,880	$225	$77	$11,295
6	$3,389	$1,877	$177	$2,913	$2,966	$232	$79	$11,634
7	$3,491	$1,934	$182	$3,001	$3,055	$239	$82	$11,983
8	$3,595	$1,992	$187	$3,091	$3,147	$246	$84	$12,343
9	$3,703	$2,052	$193	$3,184	$3,241	$253	$87	$12,713
10	$3,814	$2,113	$199	$3,279	$3,339	$261	$89	$13,094
11	$3,929	$2,177	$205	$3,377	$3,439	$269	$92	$13,487
12	$4,047	$2,242	$211	$3,479	$3,542	$277	$95	$13,892
13	$4,168	$2,309	$217	$3,583	$3,648	$285	$98	$14,309
14	$4,293	$2,378	$224	$3,691	$3,758	$294	$101	$14,738
15	$4,422	$2,450	$230	$3,801	$3,870	$303	$104	$15,180
16	$4,554	$2,523	$237	$3,915	$3,987	$312	$107	$15,635
17	$4,691	$2,599	$244	$4,033	$4,106	$321	$110	$16,104
18	$4,832	$2,677	$252	$4,154	$4,229	$331	$113	$16,587
19	$4,977	$2,757	$259	$4,278	$4,356	$340	$117	$17,085
20	$5,126	$2,840	$267	$4,407	$4,487	$351	$120	$17,598
21	$5,280	$2,925	$275	$4,539	$4,622	$361	$124	$18,126
22	$5,438	$3,013	$283	$4,675	$4,760	$372	$128	$18,669
23	$5,601	$3,103	$292	$4,815	$4,903	$383	$131	$19,229
24	$5,769	$3,196	$301	$4,960	$5,050	$395	$135	$19,806
25	$5,943	$3,292	$310	$5,109	$5,202	$407	$139	$20,401
26	$6,121	$3,391	$319	$5,262	$5,358	$419	$144	$21,013
27	$6,304	$3,493	$328	$5,420	$5,518	$431	$148	$21,643
28	$6,494	$3,597	$338	$5,582	$5,684	$444	$152	$22,292
29	$6,688	$3,705	$348	$5,750	$5,854	$458	$157	$22,961
30	$6,889	$3,817	$359	$5,922	$6,030	$471	$162	$23,650

Sub Watershed #5 Annual Cropland BMP Costs After Cost-Share

Year	No-Till	Nutrient Management	Vegetative Buffers	Terraces	Grassed Waterways	Grade Stabilization	Permanent Vegetation	Total

1	$4,351	$2,411	$227	$3,741	$3,809	$400	$102	$15,040
2	$4,482	$2,483	$234	$3,853	$3,923	$412	$105	$15,491
3	$4,616	$2,557	$241	$3,969	$4,041	$424	$108	$15,956
4	$4,755	$2,634	$248	$4,088	$4,162	$437	$111	$16,435
5	$4,897	$2,713	$255	$4,210	$4,287	$450	$115	$16,928
6	$5,044	$2,795	$263	$4,337	$4,415	$464	$118	$17,436
7	$5,196	$2,878	$271	$4,467	$4,548	$478	$122	$17,959
8	$5,352	$2,965	$279	$4,601	$4,684	$492	$125	$18,498
9	$5,512	$3,054	$287	$4,739	$4,825	$507	$129	$19,052
10	$5,678	$3,145	$296	$4,881	$4,970	$522	$133	$19,624
11	$5,848	$3,240	$305	$5,027	$5,119	$538	$137	$20,213
12	$6,023	$3,337	$314	$5,178	$5,272	$554	$141	$20,819
13	$6,204	$3,437	$323	$5,333	$5,430	$570	$145	$21,444
14	$6,390	$3,540	$333	$5,493	$5,593	$587	$150	$22,087
15	$6,582	$3,646	$343	$5,658	$5,761	$605	$154	$22,750
16	$6,779	$3,756	$353	$5,828	$5,934	$623	$159	$23,432
17	$6,983	$3,868	$364	$6,003	$6,112	$642	$164	$24,135
18	$7,192	$3,984	$375	$6,183	$6,295	$661	$169	$24,859
19	$7,408	$4,104	$386	$6,368	$6,484	$681	$174	$25,605
20	$7,630	$4,227	$398	$6,559	$6,679	$701	$179	$26,373
21	$7,859	$4,354	$409	$6,756	$6,879	$722	$184	$27,164
22	$8,095	$4,485	$422	$6,959	$7,085	$744	$190	$27,979
23	$8,338	$4,619	$434	$7,168	$7,298	$766	$195	$28,819
24	$8,588	$4,758	$447	$7,383	$7,517	$789	$201	$29,683
25	$8,845	$4,900	$461	$7,604	$7,742	$813	$207	$30,574
26	$9,111	$5,047	$475	$7,832	$7,975	$838	$214	$31,491
27	$9,384	$5,199	$489	$8,067	$8,214	$863	$220	$32,436
28	$9,666	$5,355	$504	$8,309	$8,460	$889	$227	$33,409
29	$9,956	$5,515	$519	$8,559	$8,714	$915	$233	$34,411
30	$10,254	$5,681	$534	$8,815	$8,976	$943	$240	$35,443

Sub Watershed #6 Annual Cropland BMP Costs After Cost-Share

Year	No-Till	Nutrient Management	Vegetative Buffers	Terraces	Grassed Waterways	Grade Stabilization	Permanent Vegetation	Total
1	$2,143	$1,187	$112	$1,842	$1,876	$200	$50	$7,410
2	$2,207	$1,223	$115	$1,897	$1,932	$206	$52	$7,632
3	$2,273	$1,259	$118	$1,954	$1,990	$212	$53	$7,861
4	$2,342	$1,297	$122	$2,013	$2,050	$219	$55	$8,097
5	$2,412	$1,336	$126	$2,073	$2,111	$225	$57	$8,340
6	$2,484	$1,376	$129	$2,136	$2,174	$232	$58	$8,590
7	$2,559	$1,417	$133	$2,200	$2,240	$239	$60	$8,847

8	$2,635	$1,460	$137	$2,266	$2,307	$246	$62	$9,113
9	$2,714	$1,504	$141	$2,334	$2,376	$253	$64	$9,386
10	$2,796	$1,549	$146	$2,404	$2,447	$261	$66	$9,668
11	$2,880	$1,595	$150	$2,476	$2,521	$269	$68	$9,958
12	$2,966	$1,643	$155	$2,550	$2,596	$277	$70	$10,257
13	$3,055	$1,693	$159	$2,626	$2,674	$285	$72	$10,564
14	$3,147	$1,743	$164	$2,705	$2,754	$294	$74	$10,881
15	$3,241	$1,796	$169	$2,786	$2,837	$303	$76	$11,208
16	$3,338	$1,850	$174	$2,870	$2,922	$312	$78	$11,544
17	$3,439	$1,905	$179	$2,956	$3,010	$321	$81	$11,890
18	$3,542	$1,962	$185	$3,045	$3,100	$331	$83	$12,247
19	$3,648	$2,021	$190	$3,136	$3,193	$340	$86	$12,614
20	$3,757	$2,082	$196	$3,230	$3,289	$351	$88	$12,993
21	$3,870	$2,144	$202	$3,327	$3,388	$361	$91	$13,383
22	$3,986	$2,208	$208	$3,427	$3,489	$372	$93	$13,784
23	$4,106	$2,275	$214	$3,530	$3,594	$383	$96	$14,198
24	$4,229	$2,343	$220	$3,636	$3,702	$395	$99	$14,623
25	$4,356	$2,413	$227	$3,745	$3,813	$407	$102	$15,062
26	$4,487	$2,486	$234	$3,857	$3,927	$419	$105	$15,514
27	$4,621	$2,560	$241	$3,973	$4,045	$431	$108	$15,979
28	$4,760	$2,637	$248	$4,092	$4,166	$444	$112	$16,459
29	$4,903	$2,716	$255	$4,215	$4,291	$458	$115	$16,953
30	$5,050	$2,798	$263	$4,341	$4,420	$471	$118	$17,461

Sub Watershed #7 Annual Cropland BMP Costs After Cost-Share

Year	No-Till	Nutrient Management	Vegetative Buffers	Terraces	Grassed Waterways	Grade Stabilization	Permanent Vegetation	Total
1	$4,816	$2,668	$251	$4,140	$4,216	$400	$113	$16,604
2	$4,961	$2,748	$258	$4,265	$4,342	$412	$116	$17,103
3	$5,110	$2,831	$266	$4,393	$4,472	$424	$120	$17,616
4	$5,263	$2,916	$274	$4,524	$4,607	$437	$123	$18,144
5	$5,421	$3,003	$282	$4,660	$4,745	$450	$127	$18,688
6	$5,583	$3,093	$291	$4,800	$4,887	$464	$131	$19,249
7	$5,751	$3,186	$300	$4,944	$5,034	$478	$135	$19,826
8	$5,923	$3,282	$309	$5,092	$5,185	$492	$139	$20,421
9	$6,101	$3,380	$318	$5,245	$5,340	$507	$143	$21,034
10	$6,284	$3,481	$327	$5,402	$5,501	$522	$147	$21,665
11	$6,473	$3,586	$337	$5,564	$5,666	$538	$152	$22,315
12	$6,667	$3,693	$347	$5,731	$5,835	$554	$156	$22,984
13	$6,867	$3,804	$358	$5,903	$6,011	$570	$161	$23,674
14	$7,073	$3,918	$369	$6,080	$6,191	$587	$166	$24,384

15	$7,285	$4,036	$380	$6,263	$6,377	$605	$171	$25,116
16	$7,504	$4,157	$391	$6,451	$6,568	$623	$176	$25,869
17	$7,729	$4,282	$403	$6,644	$6,765	$642	$181	$26,645
18	$7,961	$4,410	$415	$6,843	$6,968	$661	$187	$27,445
19	$8,199	$4,542	$427	$7,049	$7,177	$681	$192	$28,268
20	$8,445	$4,679	$440	$7,260	$7,392	$701	$198	$29,116
21	$8,699	$4,819	$453	$7,478	$7,614	$722	$204	$29,989
22	$8,960	$4,964	$467	$7,702	$7,842	$744	$210	$30,889
23	$9,228	$5,113	$481	$7,933	$8,078	$766	$216	$31,816
24	$9,505	$5,266	$495	$8,171	$8,320	$789	$223	$32,770
25	$9,790	$5,424	$510	$8,417	$8,570	$813	$230	$33,753
26	$10,084	$5,587	$525	$8,669	$8,827	$838	$236	$34,766
27	$10,387	$5,754	$541	$8,929	$9,091	$863	$244	$35,809
28	$10,698	$5,927	$557	$9,197	$9,364	$889	$251	$36,883
29	$11,019	$6,105	$574	$9,473	$9,645	$915	$258	$37,990
30	$11,350	$6,288	$591	$9,757	$9,935	$943	$266	$39,129

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