Pomona Lake Watershed Restoration and Protection Strategies (WRAPS) Plan

2019

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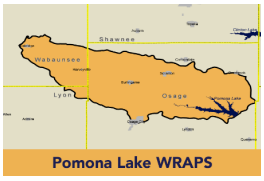

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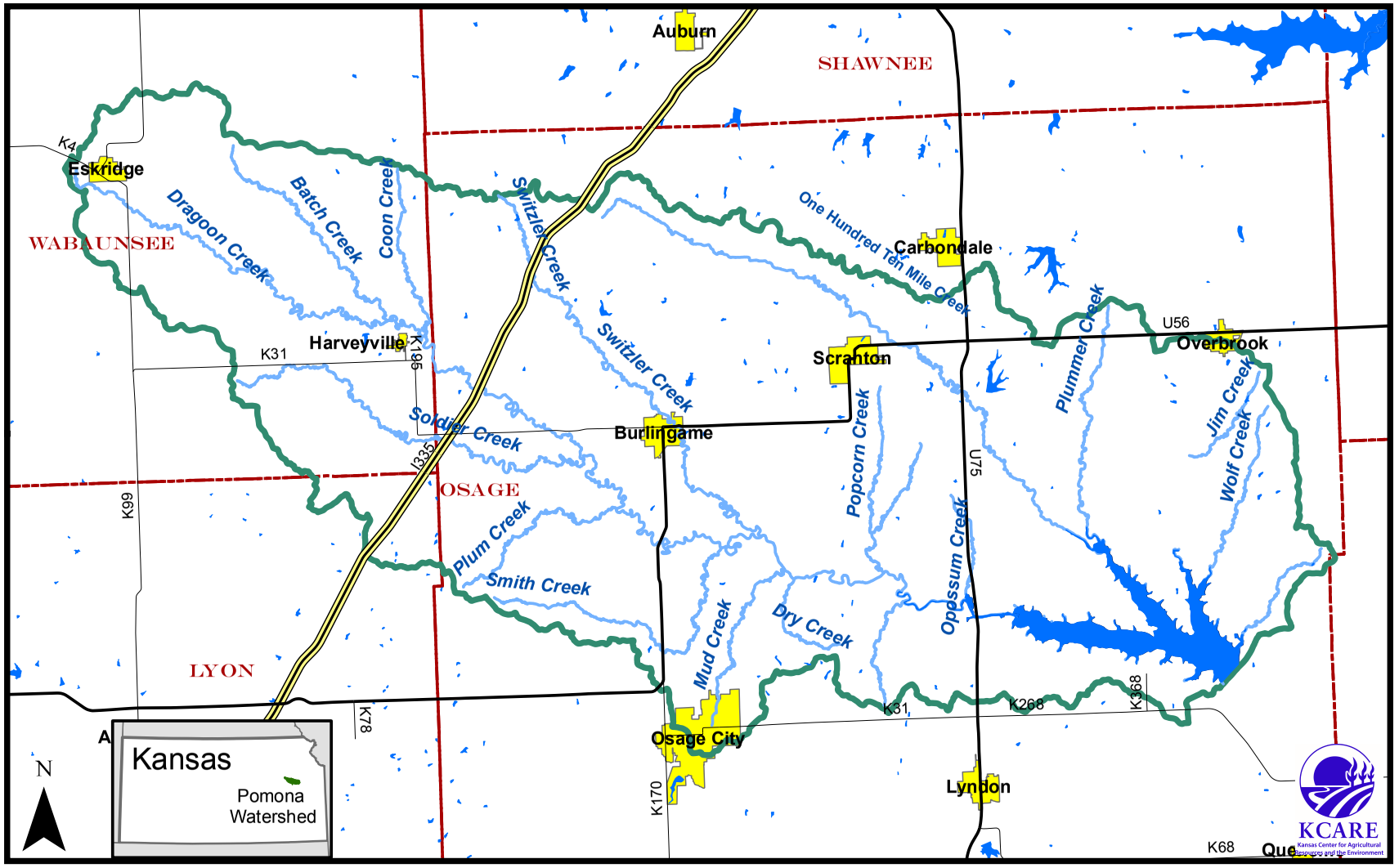
Pomona Watershed



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Glossary of Terms and Acronyms

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 used in photosynthesis, found in algae and other aquatic plants. Can be used for measurement of eutrophication in a water body.

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 and are pathogenic to humans.

Eutrophication (E): Excess of mineral and organic nutrients that promote a proliferation of plant life in lakes and ponds.

Fecal coliform bacteria (FCB): Bacteria originating in the intestines of all warm-blooded animals.

Hydrologic Unit Code (HUC): An identification system using numerical digits for watersheds. The smaller the watershed, the more digits a HUC will have.

KDHE: Kansas Department of Health and Environment.

Municipal water system: A water system having at least 10 service connections or regularly serving an average of at least 25 individuals daily at least 60 days out of the year.

National Pollutant Discharge Elimination System (NPDES) permit: Permit required by federal law for all point source discharges into waters.

Nitrates: Final product of ammonia's biochemical oxidation, originating from manure and fertilizers. Primary source of nitrogen for plants.

Nitrogen (N): Element essential for plants and animals.

Nonpoint sources (NPS): Any activity not required to have a NPDES permit and results in the release of pollutants to waters of the state. This release may result from precipitation runoff, aerial drift and deposition from the air, or the release of subsurface brine or other contaminated groundwaters to surface waters of the state.

Nutrients: Nitrogen and/or phosphorus in a water source.

Phosphorus (P): Element in water that, in excess, can lead to increased biological activity which may cause eutrophication.

Point sources (PS): Any discernible, confined and discrete conveyance from which pollutants are or could be discharged.

RAC: Regional Advisory Committee.

Riparian zone: Areas of interchange between land and water alongside bodies of water.

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.

Sedimentation: Deposition of silt, clay or sand in slow-moving waters.

Stakeholder Leadership Team (SLT): Organization of watershed residents, landowners, farmers, ranchers, agency personnel and any other 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 surface water-quality standards which results in failure to support their designated uses.

Total Nitrogen (TN): A chemical measurement of all nitrogen forms in a water sample.

Total Phosphorus (TP): A chemical measurement of all phosphorus forms in a water sample.

Total Suspended Solids (TSS): Measure of the suspended organic and inorganic solids in water. Used as an indicator of sediment or silt.

WRAPS: Watershed Restoration and Protection Strategy.

1. Preface and Plan Update

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 this watershed's surface waters. Watershed goals can be characterized as either "restoration" or "protection." Watershed restoration refers to surface waters failing to meet water quality standards and for areas of the watershed that need improvement in habitat, land management, or other attributes. Watershed protection refers to surface waters currently meeting water quality standards but requiring protection from future degradation.

In the WRAPS process, local communities and governmental agencies work together toward the common goal of a healthy environment. Local participants, or stakeholders, provide valuable grass-roots leadership, responsibility, and management of resources in this process. Because they have the most at stake, these community members work together to ensure that their lands' water quality is protected. Agencies bring science-based information, communication, and technical and financial assistance to the table. By working as a WRAPS team, communities can take several steps toward watershed restoration and protection. Within the watershed, the team works to build awareness and education, engage local leadership and monitor and evaluate watershed conditions; they also assess, plan and implement the WRAPS process at the local level.

Other crucial objectives for the WRAPS process are to maintain recreational opportunities and biodiversity while protecting the environment from flooding and the negative effects of urbanization and industrial production. Final watershed goals are to provide a sustainable water source for drinking and domestic use while preserving food, fiber, and timber production. The ultimate WRAPS goal is a **restored and protected watershed**: "local hands caring for local lands" in partnership with government agencies to improve the environment for everyone.

This report is intended to serve as an overall strategy to guide WRAPS 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 to restore and protect the water quality and watershed conditions of the Pomona Lake Watershed.

Plan Update: The original Pomona Lake Watershed WRAPS plan was written and approved in 2011. However, a TMDL revision by the Kansas Department of Health and Environment (KDHE) resulted in outdated WRAPS plan implementation goals. Therefore, the Pomona Lake Watershed WRAPS plan was updated and revised in early 2019 by Kansas State University staff and KDHE, with the guidance of the Pomona Lake Watershed SLT.

2. Pomona Lake Watershed WRAPS Introduction

This section includes a discussion about the importance of a WRAPS plan as well as a description of the key collaborators who strive to make it effective. There is a special focus on the specifics of the Pomona Lake Watershed's location and stakeholders.

A. What Is a Watershed?

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

B. What Is a Watershed Restoration and Protection Strategy (WRAPS)?

WRAPS is a planning and management framework built to engage local citizen-stakeholders within a particular watershed. It is a process used to **identify** restoration and protection needs, to **establish** management goals for the watershed community, to **create** an action plan to achieve those goals, and to **implement** the action plan.

The acronym "WRAPS" originated from KDHE in response to the 1998 Clean Water Action Plan issued by the Clinton Administration. The Clean Water Action Plan directed the state environmental agency and the state conservationist of every state to complete a "unified watershed assessment." Upon completion of the assessment, states were directed to develop "watershed restoration action strategies" (WRAS).

The state of Kansas contends that restoring damage to a watershed is not enough because it addresses only part of the need; action to protect water is a necessity, hence the new term WRAPS. Historically, WRAPS refers to the development of action plans that address nonpoint source pollution sources on a watershed basis. WRAPS projects are initiated by watershed stakeholders and receive financial support from KDHE to address Total Maximum Daily Loads (TMDLs) and related water quality concerns.

The WRAPS initiative intends to address priority issues identified in the basin sections of the Kansas Water Plan through the development and implementation of WRAPS in priority watersheds.

C. Watershed Location

There are 12 river basins in Kansas. The scope of this WRAPS project is the Pomona Lake Watershed, a portion of the Upper Marais des Cygnes Watershed, located in the northwestern portion of the Marais des Cygnes River Basin in eastern Kansas (**Figure 1**). This 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 Marias des Cygnes creates the Osage River. The Osage 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.

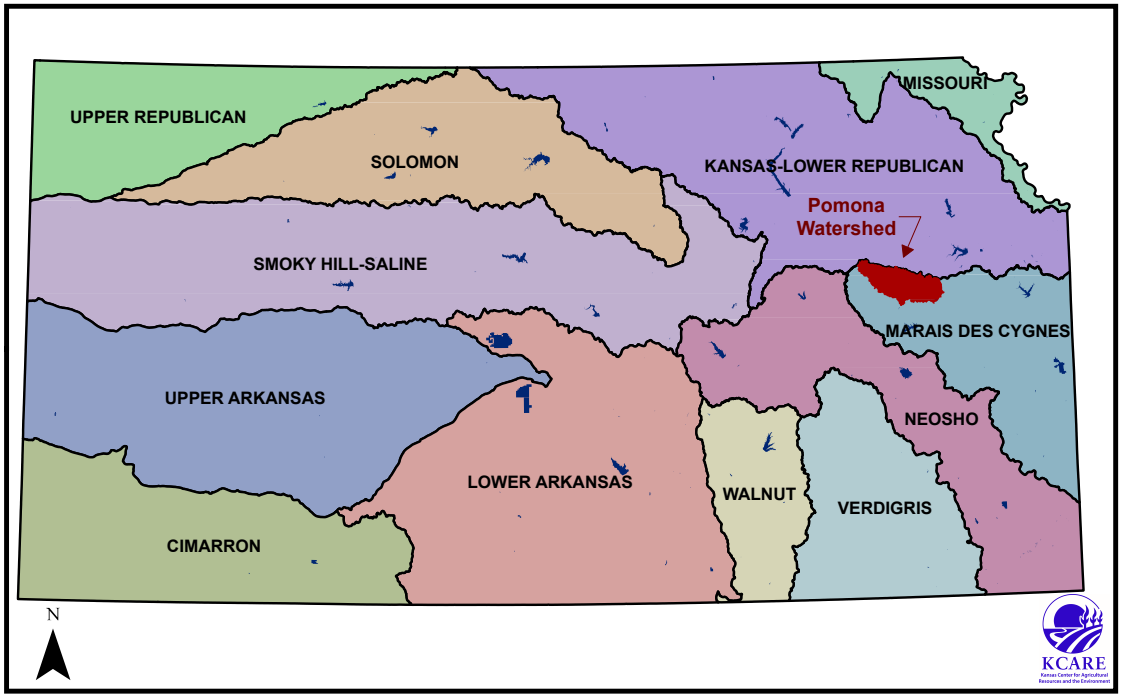


Figure 1. The 12 River Basins of Kansas, Highlighting the Pomona Lake Watershed

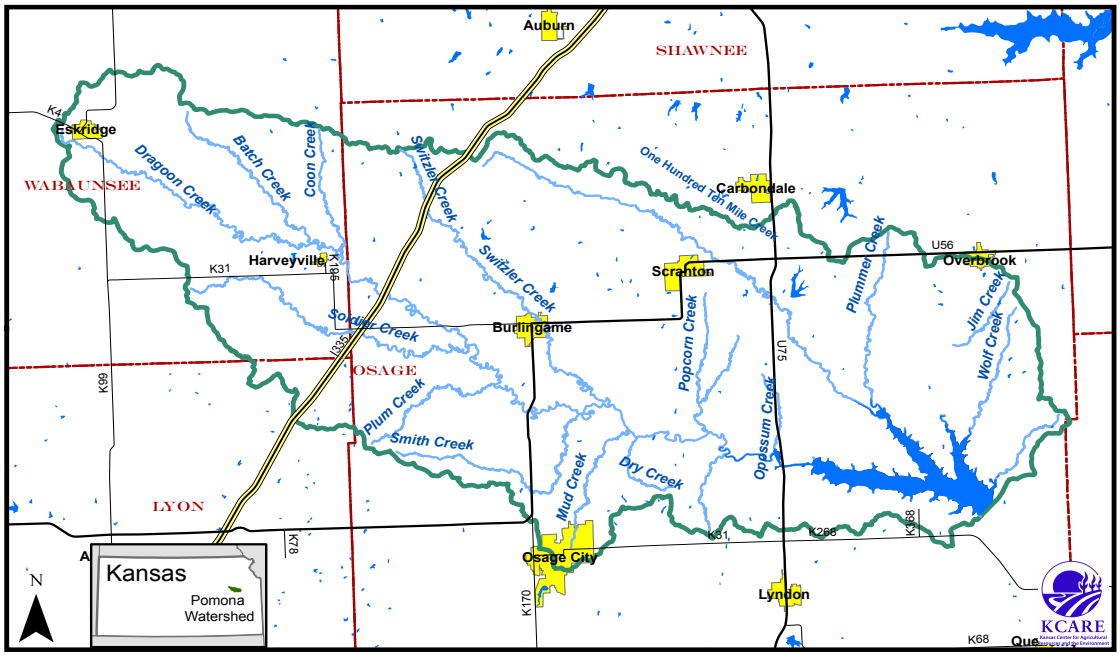


Figure 2. Pomona Lake Watershed

The Pomona Lake Watershed is located in eastern Kansas and overlays portions of three counties (**Figure 2**). The majority of the Pomona Lake Watershed is in Osage County, with a good portion in the southeast corner of Wabaunsee County and a very small portion in northeastern Lyon County.

D. Overview of the Pomona Lake Watershed

The Pomona Lake Watershed covers 206,570 acres, which equates to 322 square miles. Pomona Lake itself is located 30 miles south of Topeka and northeast of Lyndon in Osage County. Pomona Lake is 3,941 acres in size and is surrounded by 490 acres of park land, equating to seven square miles in total. Specific information about land use within the watershed, as well as specific population information, can be found in **Section 3** of this report.

The Pomona Lake Watershed has headwaters originating in the Flint Hills of Wabaunsee County in east central Kansas. It contains numerous creeks and tributaries, including One Hundred Ten (110)-Mile Creek, Dragoon Creek and Switzler Creek. All surface waters in the watershed drain into Pomona Lake. Pomona Lake was impounded in 1963 and covers nearly 4,000 acres.

The Pomona water system is formed from the One Hundred Ten Mile Creek and two tributary creeks, Dragoon and Valley Brook. As the three creeks come together, they combine and form Pomona Lake. The One Hundred Ten Mile Creek continues down the outlet channel where it meets the Marais des Cygnes River approximately eight miles downstream.

Pomona Lake's 3,941 acres of water is home to two marinas and is popular with water-skiers and anglers. Pomona Lake also offers plenty of outdoor recreational space for camping, sightseeing, picnicking and hunting. The area is also home to many different species of birds, animals and fish. Bald eagles, white-tailed deer, Canada geese, and wild turkey can be found at Pomona Lake. Some of the 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 in Michigan Valley and another 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, which is used as a combination wildlife and fishing area. The Kansas Fish and Game Commission purchased 506 acres in 1955. Construction of an earthen dam created a lake approximately 140 acres in size. The remaining 366 acres consist mainly of tallgrass 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. A special feature of the Osage State Fishing Lake is wagon ruts, which are remnants from where the

Santa Fe Trail crossed the northeast corner of the area. Several of these historical wagon ruts are still visible just east of the north entry road.

The Osage State Fishing Lake is not the targeted area of interest in this WRAPS plan. Nonetheless, given that the area surrounding the lake is targeted for cropland and livestock BMP implementation, improvements to lake health will be made as a result of plan implementation.

E. Elevation of the Pomona Lake Watershed

Elevation determines watershed boundaries. As shown in **Figure 3**, the upper boundary of the Pomona Lake Watershed has an elevation of 1,469 feet, and the lowest point of the watershed has an elevation of 974 feet.

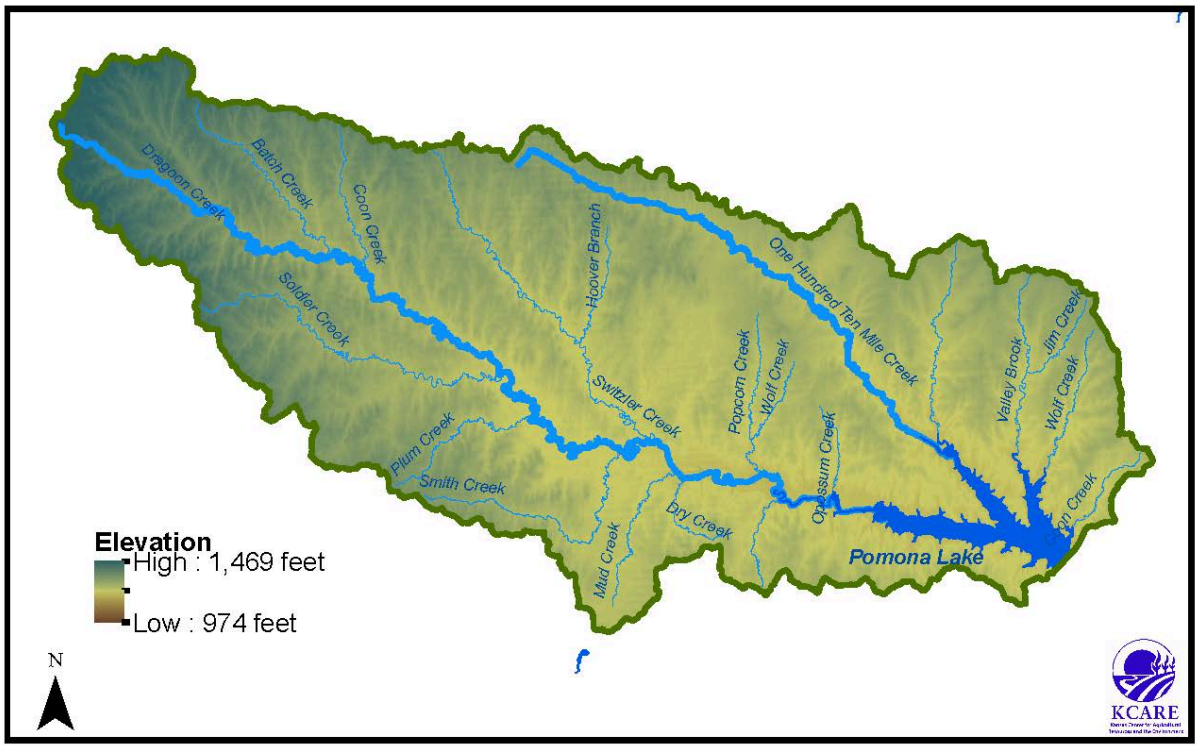


Figure 3. Elevation Relief Map of the Pomona Lake Watershed

F. What is a Hydrologic Unit Code (HUC)?

HUC is an acronym for **H**ydrologic **U**nit **C**ode; HUCs act as an identification system for watersheds. Each watershed is assigned a unique HUC number, in addition to a common name.

The Upper Marais des Cygnes River Basin is composed of the HUC 8 (meaning an 8-digit identifier code) numbered 10290101. The first two numbers in the HUC code refer to the drainage region, the second two digits refer to the drainage sub-region, the third two digits refer to the accounting unit, and the fourth pair of digits is the cataloging unit. For example:

- **10**290101 = Region drainage of the Missouri River, the Saskatchewan River and several small closed basins (Area = 509,547 sq. miles)
- 10**29**0101 = Sub-region 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)
- 10290101 = Cataloging unit drainage of the section of the Marais des Cygnes River (Area = 2,150 sq. miles)

As watersheds become smaller, the HUC number becomes larger. HUC 8s can be split into smaller watersheds that are given HUC 10 numbers, and HUC 10 watersheds can be divided into smaller HUC 12 watersheds. The Pomona Lake Watershed consists of the HUC 10-numbered 1029010102, indicating the drainage area of Pomona Lake. The Pomona Lake Watershed can be divided further into eight HUC 12 delineations to include the following numbers: 102901010**201**, 102901010**202**, 102901010**203**, 102901010**204**, 102901010**205**, 102901010**206**, 102901010**207**, and 102901010**208** (**Figure 4**).

Targeting for BMP implementation within the Pomona Lake Watershed be according to HUC 12 watersheds. *To simplify matters, please note that maps throughout this plan will refer to these HUC 12s primarily by their last three digits.*

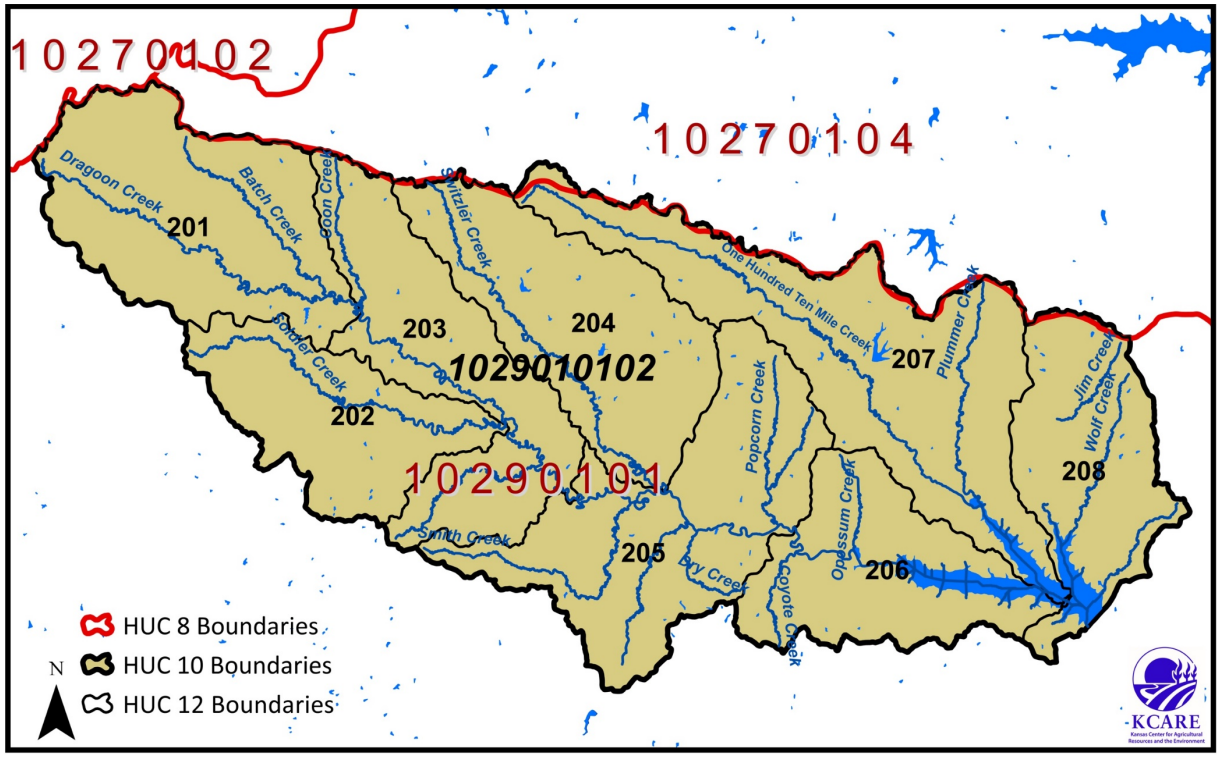


Figure 4. HUC 8, 10, and 12 Delineations in the Pomona Lake Watershed

G. Pomona Lake Watershed WRAPS History

According to the Kansas Unified Watershed Assessment prepared by KDHE and the NRCS (Natural Resources Conservation Service) in 1999, the Upper Marais des Cygnes Watershed is rated as a Category I watershed. This means that the watershed needs restoration and protection to sustain water quality. A Category I watershed either does not meet state water quality standards or fails to achieve aquatic system goals related to habitat and ecosystem health. Category I watersheds also are assigned a priority for restoration. The Pomona Lake Watershed is part of the Upper Marais des Cygnes Watershed, which ranked 5th out of 92 watersheds in the state for restoration priority.

H. Who Are the Stakeholders?

In 2007, a group of concerned citizens established a proactive and voluntary Stakeholder Leadership Team (SLT). This grass-roots task force was comprised of landowners, producers, residents, agency representatives and other stakeholders from the Pomona Lake Watershed who were interested in exploring water quality issues and nonpoint source pollution.

The Pomona Lake Watershed WRAPS SLT consists of eight members. Current members represent the Osage County Conservation District, NRCS, K-State Research and Extension, KDWPT, Army Corps of Engineers, local landowners, and the agricultural industry. A list of current SLT members can be found at the beginning of this report.

The WRAPS Coordinator facilitates a meeting every other month with the SLT in order to facilitate the decision-making process. The current SLT keeps up to date on the issues within both the county and the watershed and seeks advice from landowners. They have the full support from county commissioners and meet with them at least twice a year.

The SLT submitted the original Pomona Lake Watershed WRAPS plan to KDHE in 2011.

I. Goals of the Stakeholder Leadership Team (SLT)

Responsibility for restoration and protection of the watershed rests primarily in the hands of local stakeholders. In cooperation with these local stakeholders, federal and state agencies provide technical and financial assistance for education activities and implementation of BMPs. The SLT has identified specific goals to achieve watershed improvement; it is believed that implementation of BMPs as well as financial incentives and cost-share programs will, over time, lead to decreases in surface and ground water impairments.

The Pomona Lake Watershed SLT has identified the following as **priority issues**:

- protect and restore water quality throughout the watershed;
- reduce erosion on cropland;
- reduce nutrient and bacteria runoff from livestock operations;
- protect eroding streambanks and degraded riparian areas;
- control flooding;

- reduce bacteria contamination from failing septic systems; and
- reduce or eliminate the proliferation of noxious weeds.

The **watershed goals** of the SLT are to:

- restore degraded water quality in Pomona Lake by achieving TMDLs, and
- educate the watershed community about water quality practices and benefits.

To generalize, the SLT hopes that these efforts will protect the productivity of agricultural lands throughout the watershed while improving water quality in nearby streams and in Pomona Lake.

The **main pollutants** for the Pomona Lake Watershed are sediment and nutrients (Phosphorus and Nitrogen).

J. Regional Advisory Committee (RAC)

In 2013, the governor of Kansas issued a call to action to develop a 50-Year Vision Plan for incorporation into the Kansas Water Plan. Regional Advisory Committees (RACs) were developed in 2015 to work in concert with the 50-Year Vision Plan. The Pomona Lake Watershed is part of the **Marais des Cygnes RAC**.[1] The Marais des Cygnes RAC has developed the following two goals for the future of the Marias des Cygnes river basin.

1. Reduce cumulative sediment loads entering public water supply impoundments by 10% in the Marais des Cygnes River Basin over 10 years to extend the life of existing infrastructure.

2. Increase sources of supply, at a minimum of one multipurpose structure, to meet increased demand in specific growth areas by 2035. In addition, ensure that water supply available from storage exceeds projected demand by at least 10% through the year 2050.

The RAC goals are closely aligned with the WRAPS process. To meet these goals, the RAC developed the following five **Action Steps**; methods detailing each action step can be found online.[1]

1. **Partnerships**. A RAC representative will work with each WRAPS group and conservation district within the Marais des Cygnes Region.
2. **Funding**. To reach the goals of the RAC and the state's 50-Year Vision Plan, state funds should not be diverted from efforts to improve water quality, water quantity and water conservation.
3. **Implementation**. RAC members will encourage local support for goal implementation through conservation districts, WRAPS groups, producers, municipalities, etc.

[1] Kansas Water Vision, Regional Goal Action Plans Section. http://kwo.ks.gov/docs/default-source/water-vision-water-plan/vision/rpt-vision-regional-goal-action-plans-section.pdf?sfvrsn=4

4. **Evaluation of water needs**.
5. **Evaluation of implementation**.

In summary, the RAC will work in cooperation and coordination with local WRAPS groups, conservation districts, producers and municipalities. Partnerships will implement goals by leveraging existing financial resources and finding new funding sources, implementing new conservation practices, and providing education and awareness of water quality and quantity issues in the watershed.

3. Watershed Review

This watershed review is an in-depth description of the Pomona Lake Watershed. This section includes descriptions and data about the watershed's land cover and use, special water designations, annual rainfall, aquifers, population, public water supplies and permitted waste water facilities.

A. Land Cover and Land Uses

Land use activities have a significant impact on the types and quantity of nutrient and sediment pollutants in the Pomona Lake Watershed. The three major land uses in the Pomona Lake Watershed are grassland (42%), pasture/hay (24%) and cultivated crops (18%). Grassland and pasture/hay land uses can often contribute livestock manure to streams and ponds, resulting in nutrient and *E. coli* runoff, in addition to sediment runoff from cattle trails and gullies in pastures. Cultivated crops (cropland) are the main source of sediment and nutrient runoff from overland flow. Nutrients leach into sediment during runoff events and end up in nearby streams and, eventually, the lake. In addition, agricultural cropland 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. **Table 1** lists the remaining land uses in the watershed, including: forest (seven percent), developed/urban open space (four percent), open water (two percent) and other (three percent). Properly managed forest/woodland with a good understory does not contribute much sediment or nutrients to the watershed. In fact, forest/woodlands located along rivers and streams provide a good buffer to prevent streambank erosion.

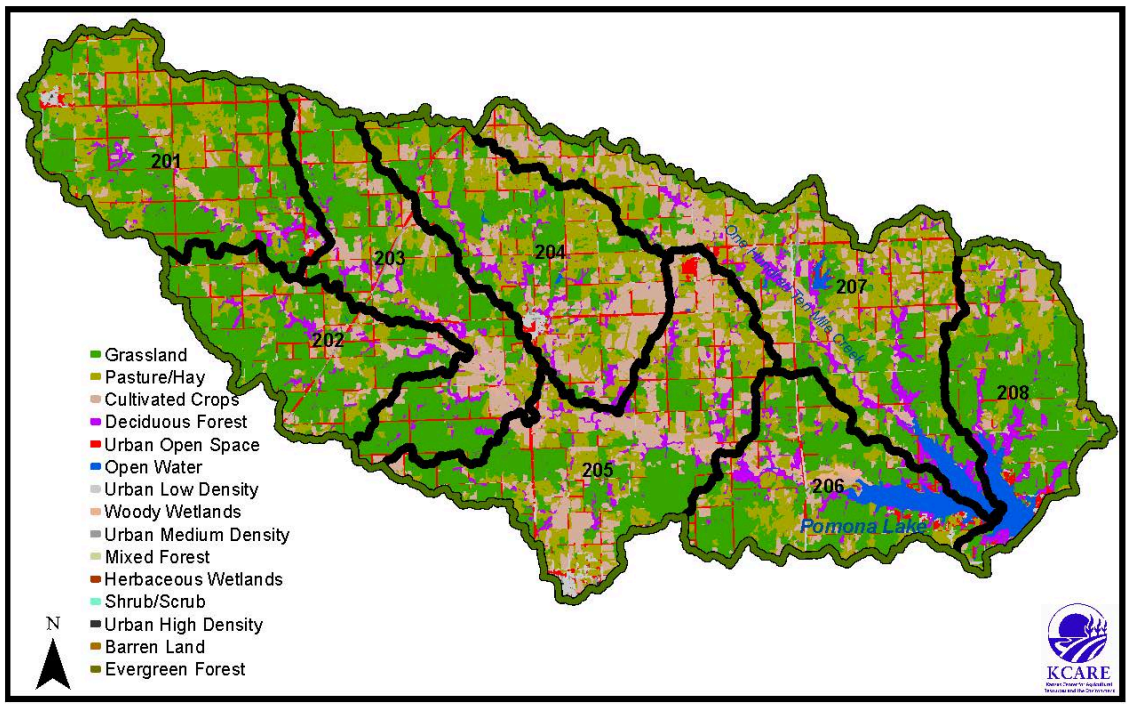


Figure 5. Land Cover and Land Use in the Pomona Lake Watershed

Table 1. Land Use in the Pomona Lake Watershed

Land Use in the Pomona Lake Watershed										
Land Use	Acres in HUC 12: 102901010...								Total Acres	% of Watershed
	201	202	203	204	205	206	207	208		
Grassland/Herbaceous	15,350	10,850	12,754	8,721	10,480	9,196	10,399	9,359	87,108	42.20%
Pasture/Hay	7,885	3,072	4,115	8,054	7,547	3,960	10,800	3,877	49,308	23.90%
Cultivated Crops	2,143	2,556	4,868	5,737	8,736	2,228	9,061	2,100	37,430	18.10%
Deciduous Forest	1,503	1,024	1,597	1,767	2,085	1,756	3,066	1,864	14,661	7.10%
Urban Open Space	1,281	771	956	1,133	1,401	759	1,273	695	8,267	4.00%
Open Water	96	42	71	182	102	1,625	1,339	1,388	4,844	2.30%
Urban Low Density	318	126	110	399	685	297	527	399	2,860	1.40%
Woody Wetlands	243	32	157	29	128	399	114	49	1,152	0.60%
Urban Medium Density	40	80	71	102	106	19	85	39	542	0.30%
Mixed Forest	< 1	8	16	14	6	26	38	13	120	0.10%
Herbaceous Wetlands	7	2	7	12	3	42	12	3	88	< 0.1%
Shrub/Scrub	12	7	6	10	4	9	19	12	79	< 0.1%
Urban High Density	6	< 1	< 1	8	26	3	2	13	58	< 0.1%
Barren Land	< 1	< 1	< 1	1	8	3	19	11	41	< 0.1%
Evergreen Forest	< 1	< 1	< 1	< 1	< 1	3	2	6	11	< 0.1%
Totals	**28,883**	**18,569**	**24,727**	**26,167**	**31,319**	**20,323**	**36,754**	**19,828**	**206,570**	**100.00%**

B. Designated Uses

The streams and lakes in the Pomona Lake Watershed have many designated uses according to the Kansas Surface Water Register, which is prepared and maintained by KDHE, Division of Environment, Bureau of Environmental Field Services. Designated uses for Pomona Lake include domestic water supply use, food procurement, ground water recharge, industrial water supply, irrigation, and livestock watering. Pomona Lake is a general-purpose water body also designated for aquatic life use and contact recreational use – primarily swimming and boating. These "designated uses" are defined and assigned to specific water bodies in the Kansas Surface Water Registry, 2013, issued by KDHE (**Table 3**).

Table 2. Designated Water Uses Abbreviation Key

Designated Uses Abbreviation Key			
AL	Aquatic Life	GR	Groundwater Recharge
CR	Contact Recreational	IW	Industrial Water Supply
DS	Domestic Water Supply	IR	Irrigation
FP	Food Procurement	LW	Livestock Water
a	Secondary contact recreation stream segment is by law or written permission of the landowner open to and accessible by the public	b	Secondary contact recreation stream segment is not open to or accessible by the public under Kansas law
B	Primary contact recreation stream segment is by law or written permission of the landowner open to and accessible by the public	C	Primary contact recreation stream segment is not open to or accessible by the public under Kansas law
E	Expected aquatic life use water	S	Special aquatic life use water
O	Referenced stream segment does not support the indicated designated use	X	Referenced stream segment is assigned the indicated designated use

Table 3. Designated Water Uses in the Pomona Lake Watershed[2]

Designated Water Uses: Pomona Lake Watershed - 10290101								
Stream Name	**AL**	**CR**	**DS**	**FP**	**GR**	**IW**	**IR**	**LW**
Batch Creek, Dry Creek: *Segment 95* , Mud Creek: *Segment 91*	E	b	X	O	X	X	X	X
Mud Creek: *Segment 49*	E	b	O	O	X	O	X	X
Hundred and Ten Mile Creek: *Segment 25,* Mud Creek: Segment 78, Plum Creek: *Segment 2,* Popcorn Creek, Soldier Creek, Switzler Creek	E	b	X	X	X	X	X	X
Smith Creek	E	b	O	O	O	O	X	X
Dragoon Creek	E	C	X	X	X	X	X	X
Hundred and Ten Mile Creek: *Segment 20*	E	B	X	X	X	X	X	X
Plum Creek: *Segment 70*	E	b	O	O	X	O	O	X
Wolf Creek	E	b	X	X	X	X	O	X

C. Special Aquatic Life Use Waters[3]

Special Aquatic Life Use (SALU) waters are defined as "surface waters that contain combinations of habitat types and indigenous biota not found commonly in the state, or surface waters that contain representative populations of threatened or endangered species." The Pomona Lake Watershed does not have any listings of SALU waters in the watershed.

D. Exceptional State Waters[3]

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-listed waters in the Pomona Lake Watershed.

E. Outstanding National Resource Waters[3]

Outstanding National Resource Waters (ONRW) are defined as "any of the surface waters or surface water segments of extraordinary recreational or ecological significance." The Pomona Lake Watershed does not contain any ONRW-listed waters.

F. Rainfall and Runoff

Rainfall amounts and duration affect sediment and nutrient runoff during high-intensity rainfall events, most of which occur in late spring and early summer. This is the time frame when cropland is either bare, or crop biomass is small; likewise, grasses are short and do not catch runoff. Both of these situations can lead to pollutants entering the waterways. The Pomona Lake Watershed averages 36.9 inches of rainfall annually (**Figure 7**). As shown in **Figure 6**,

[2] Kansas Surface Water Registry, 2013. Kansas Department of Health and Environment. https://www.epa.gov/sites/production/files/2014-12/documents/kswqs-register-2009.pdf

[3] List of exceptional state waters (ESW), special aquatic life use waters (SALU) and outstanding national resource waters (ONRW). 2007. Kansas Department of Health and Environment. http://www.kdheks.gov/nps/resources/specwaterinfo.pdf

the cities of Eskridge and Topeka, which is to the north of the Pomona Lake Watershed, were used to calculate the average annual rainfall in the watershed.

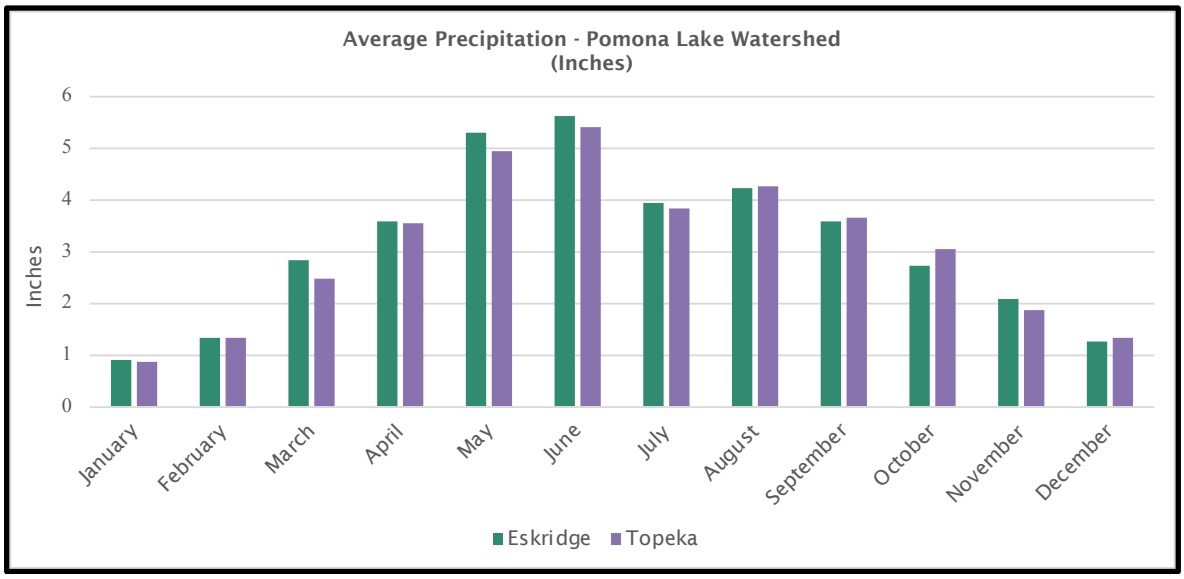


Figure 6. Pomona Lake Watershed Monthly Average Precipitation[4]

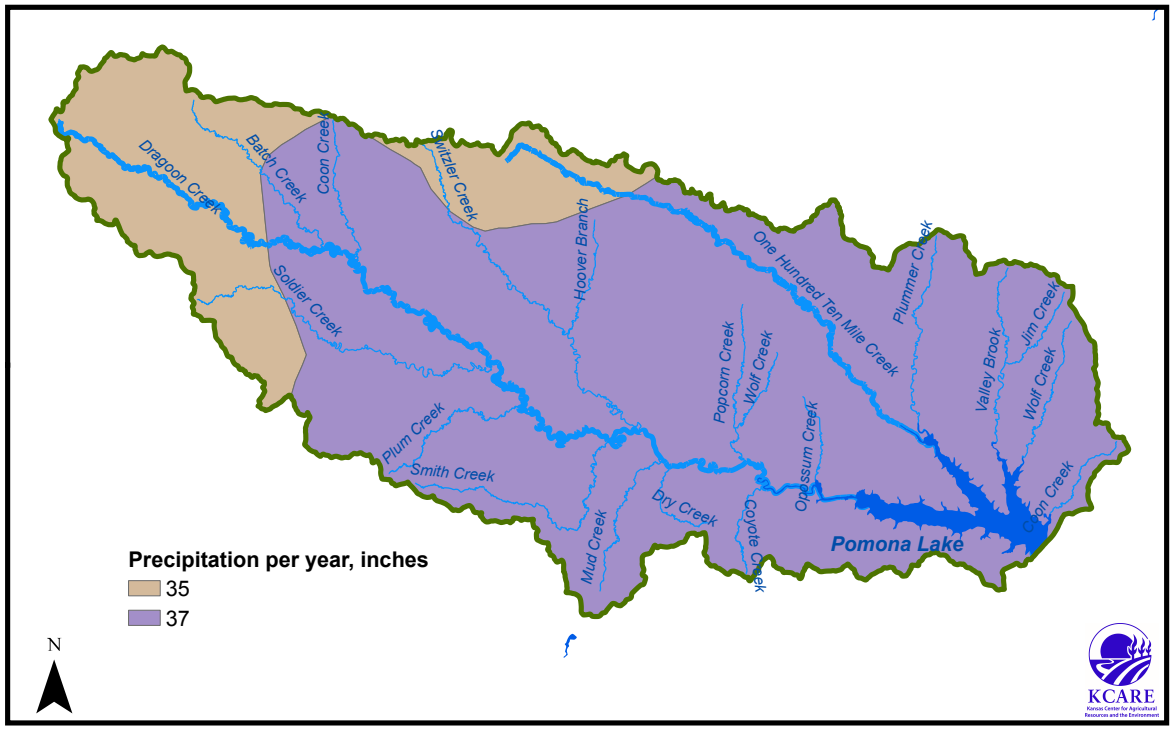


Figure 7. Annual Precipitation in the Pomona Lake Watershed

[4] U.S. Climate Data. https://USClimatedata.com

G. Population and Wastewater Systems

Most of the Pomona Lake Watershed is considered below-average population with no major urban areas located in the watershed (**Figure 8**).

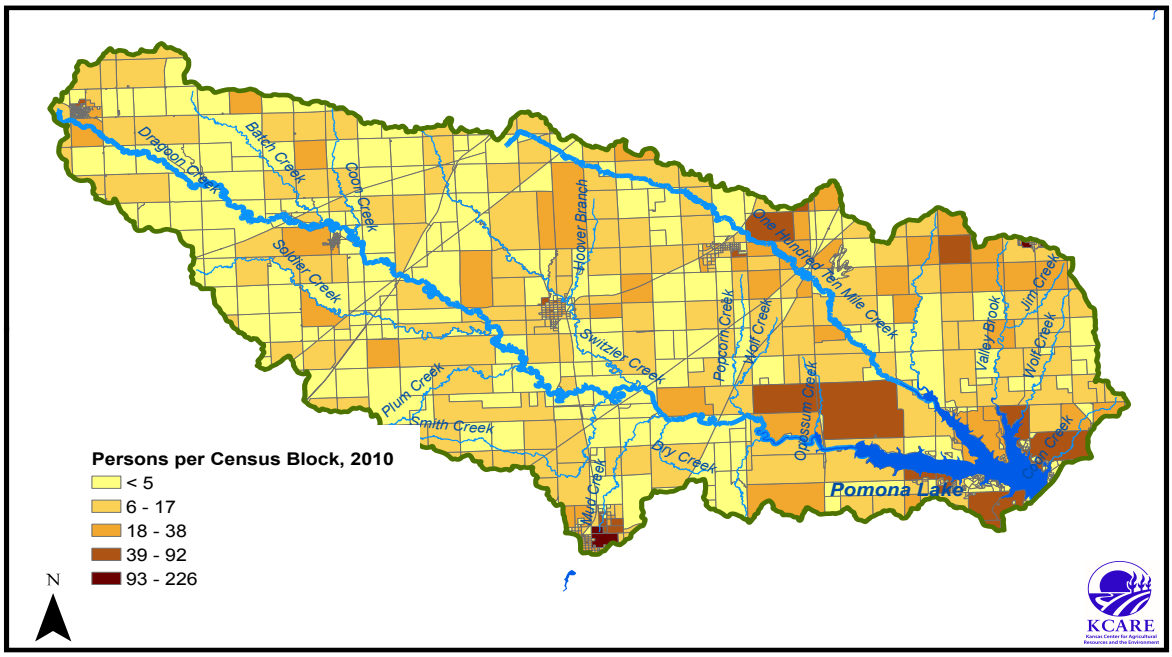


Figure 8. Pomona Lake Watershed Population Map

The Kansas average population density represented as persons per square mile is 32.9; the average for the Pomona Lake Watershed is 24 persons per square mile (**Table 4**). Calculating for 315 square miles in the watershed, the total population for the Pomona Lake Watershed is estimated to be 7,560 (**Table 5**).

Numbers from 2017 and 2018 listed in Tables 4 and 5 are estimates from The League of Kansas Municipalities organization, therefore 2010 U.S. Census data will be utilized to calculate current population and wastewater systems in the watershed.

Table 4. Population in the Major Counties of the Pomona Lake Watershed

Estimating the Pomona Lake Watershed Population			
County	**2010[5]**	**2017[6]**	**Persons per square mile**
Lyon	33,690	33,534	39.4
Osage	16,295	15,772	22.6
Wabaunsee	7,053	6,874	8.8
TOTAL	**57,038**	**56,180**	**24**

[5] The U.S. Census Bureau, 2018. https://www.census.gov/
[6] The League of Kansas Municipalities, 2018. https://www.lkm.org/

Table 5. Rural and Urban Populations Used to Determine Wastewater Systems

Pomona Lake Watershed Municipal Population		
Township	**2010**	**2018**
Burlingame	934	883
Eskridge	534	505
Harveyville	236	245
Osage City	2,943	2,796
Overbrook	1,058	1,014
Scranton	710	682
TOTAL URBAN POPULATION Minus the 50% which includes the southern portion of Osage City, which lies outside the Pomona Lake Watershed and Minus the 50% which includes the northern portion of Overbrook, which lies outside the Pomona Lake Watershed	6,415 (-) 1,471 (-) 529	6,125
URBAN POPULATION within the Pomona Lake Watershed	4,415	
TOTAL RURAL POPULATION	3,145	
Pomona Lake Watershed: TOTAL POPULATION	**7,560**	

The number of wastewater treatment systems is directly tied to population, particularly in rural areas without access to municipal wastewater treatment facilities. Lacking onsite wastewater systems, or those that are failing or improperly installed, can lead to Fecal Coliform Bacteria (FCB) or other nutrients from untreated sewage leaking or draining into the watershed. Even though all the counties in the watershed have county sanitary codes, there is no way of knowing how many failing or improperly constructed systems exist in this watershed. Using a rural population of roughly 3,145 and an estimated 2.29 people per rural Kansas household, it can be determined that there are approximately 1,373 onsite wastewater treatment systems installed in the watershed with an expected failure rate of roughly 20%, or 274 systems.[7]

H. Aquifers

One alluvial aquifer underlies the Pomona Lake Watershed (**Figure 9**). The **alluvial** aquifer is a part of and connected to a river system, consisting of sediment deposited by rivers in the stream valleys. Creeks that have alluvial aquifers are Dragoon Creek, One Hundred Ten Mile Creek and Switzler Creek.

[7] Cooperative Extension Service, University of Kentucky, College of Agriculture. http://www2.ca.uky.edu/agcomm/pubs/HENV/HENV502/HENV502.pdf

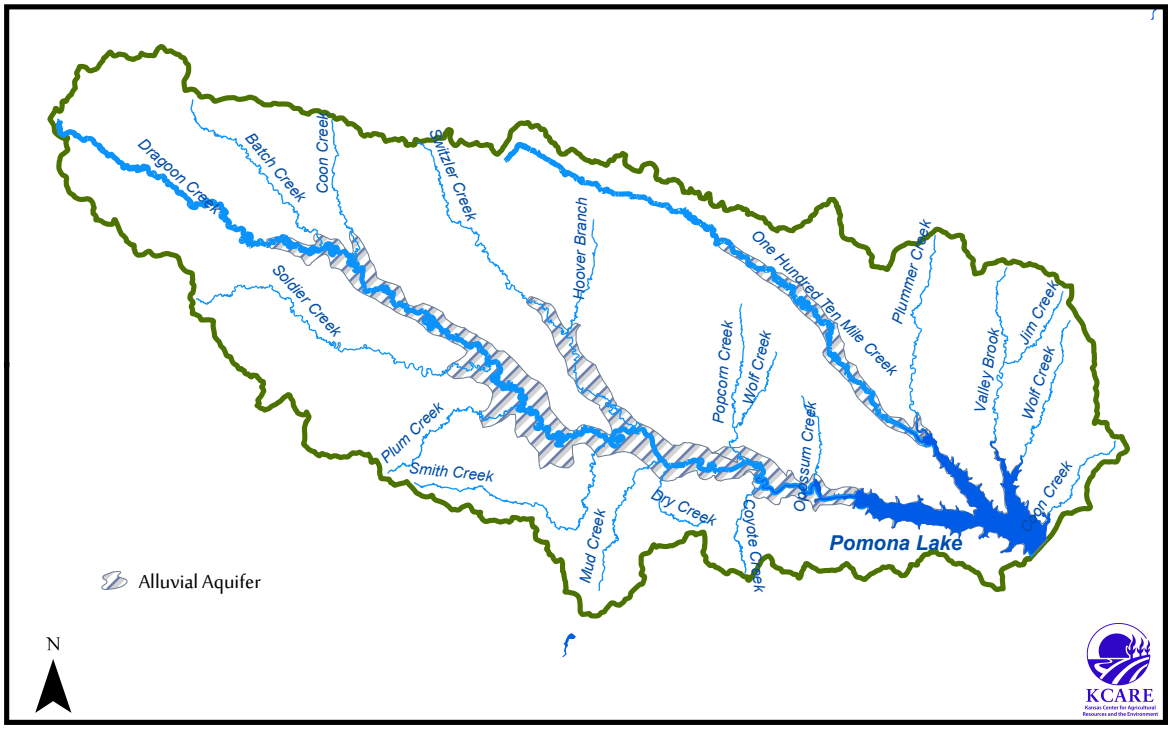


Figure 9. Alluvial Aquifer in the Pomona Lake Watershed[8]

I. Public Water Supplies

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 also will affect surface water supplies causing excess costs in treatment prior to public consumption. This WRAPS project includes PWS that have intakes within the defined project area; these are both surface water intakes and ground water wells. There are two PWS that have intakes within the Pomona WRAPS area: Osage County RWD 3 and the City of Burlingame. Other PWS systems that do not have intakes in the watershed are included in this WRAPS plan because they serve customers within the Pomona Lake Watershed (**Table 6**).

Pomona Lake also 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. There is only one active water intake in the watershed (at Pomona Lake) for Osage County Rural Water Districts.[9] Pomona Lake also serves or has the potential to serve Douglas County Rural Water Districts #2, #3 and #5, Osage County Rural Water District #9, Shawnee County Rural Water District #8, and the City of Overbrook, according to KDHE, Division of Environment, Bureau of Water, Public Water Supply Section.

[8] US Geological Survey, Kansas Geological Survey.
[9] Kansas Department of Health and Environment, January 7, 2019.

Table 6. Pomona Lake Watershed Public Water Suppliers[10]

Public Water Suppliers	County	Intake in the Pomona Lake Watershed	Serves Customers in the Pomona Lake Watershed
Burlingame, City of	Osage	√	
Eskridge, City of	Wabaunsee		√
Harveyville, City of	Wabaunsee		√
*Osage City	Osage		√
Osage County RWD 2	Osage		√
Osage County RWD 3	Osage	√	
Osage County RWD 5	Osage		√
Osage County RWD 8	Osage, Lyon, Wabaunsee		√
*Overbrook, City of	Osage		√
Scranton, City of	Osage		√
Wabaunsee County RWD 1	Wabaunsee		√

RWD - Rural Water District

** Only portions of these rural water districts are located in the Pomona Lake Watershed*

Source water protection

In 1996, every state was required to conduct a Source Water Assessment (SWA) on all public water supplies. In order to protect their source of drinking water, public water supplies were then encouraged by KDHE to develop a Source Water Protection Plan (SWPP). The Pomona Lake Watershed has 14 active PWS sites; two PWS systems with intakes inside the watershed and 12 PWS with intakes outside the watershed. Those PWS with intakes outside the Pomona Lake Watershed still serve customers within the watershed. Three public water suppliers within the Pomona Lake Watershed were required to develop a SWPP[11] in 2003; all three were scored "low" Susceptibility Likelihood Scores (SLS) for each contaminant of concern category. These include the cities of Eskridge, Harveyville and Osage City.

J. National Pollutant Discharge Elimination System (NPDES)

National Pollutant Discharge Elimination System (NPDES) permits specify the maximum amount of pollutants allowed to be discharged to surface waters. Wastewater treatment facilities are permitted and regulated by KDHE, and these facilities are considered point sources for pollutants. Having these PS located on streams or rivers may impact water quality in the waterways. Municipal wastewater can contain suspended solids, biological pollutants that reduce oxygen in the water column, inorganic compounds or bacteria. Treatment of municipal wastewater is similar across the country; wastewater treatment facilities remove

[10] Kansas Department of Health and Environment, January 7, 2019

[11] Kansas Department of Health and Environment, Source Water Assessment Reports. http://www.kdheks.gov/nps/swap/SWreports.html

solids and organic materials, disinfect water to kill bacteria and viruses, and discharge water to surface waterways.

Industrial point sources also can contribute toxic chemicals or heavy metals. Treatment of industrial wastewater is specific to the industry and the pollutant discharged. Any pollutant discharge from PS allowed by the state is considered to be wasteload allocation. There are currently 13 permitted NPDES facilities in the Pomona Lake Watershed (**Table 7**).

Table 7. NPDES Permitted Facilities in the Pomona Lake Watershed[12]

NPDES Permitted Facilities in the Pomona Lake Watershed				
Facility Name	**Facility Type**	**Description**	**City**	**County**
Cross Roads RV Park	Non-Overflowing	Waste-Stabilization Pond	N/A	Osage
Burlingame Waste Water Treatment Facility	3 Cell Lagoon	Waste-Stabilization Pond	Burlingame	Osage
Eskridge Waste Water Treatment Facility	3 Cell Lagoon	Waste-Stabilization Pond	Eskridge	Wabunsee
Four Corners	Non-Overflowing	Waste-Stabilization Pond	N/A	Osage
Harveyville Waste Water Treatment Facility	3 Cell Lagoon	Waste-Stabilization Pond	Harveyville	Wabunsee
Lamont Hill Resort - Motel	Non-Overflowing	Waste-Stabilization Pond	Vassar	Osage
Lamont Hill Resort - Trailer Court	Non-Overflowing	Waste-Stabilization Pond	Vassar	Osage
Mid States Materials	Pit De-watering	Industrial Wastewater	N/A	Osage
Osage County Sewer District No. 1	Non-Overflowing	Waste-Stabilization Pond	N/A	Osage
Overbrook Waste Water Treatment Facility	4 Cell Lagoon	Waste-Stabilization Pond	Overbrook	Osage
Pomona State Park	Non-Overflowing	Waste-Stabilization Pond	N/A	Osage
Scranton Waste Water Treatment Facility	4 Cell Lagoon	Waste-Stabilization Pond	Scranton	Osage
Unified School District #434	Non-Overflowing	Waste-Stabilization Pond Santa Fe Trail High School	N/A	Osage

[12] NPDES Facilities Provided by KDHE on January 9, 2019

4. Impaired Waters in the Pomona Lake Watershed

Water quality in the Pomona Lake Watershed is monitored at nine different sites (**Figure 10**). These sites include two rotational KDHE stream sampling sites, one permanent KDHE stream sampling site and six sites on Pomona Lake (one KDHE site and five USACE sites). Water samples from these monitoring sites are analyzed for nutrients, metals, ammonia, solid fractions, turbidity, alkalinity, chlorophyll, pH, dissolved oxygen, *E. coli* bacteria, and chemicals. Sample analysis determines if the water contains an unacceptable level of the previously mentioned pollutants. If analysis determines that any one pollutant exceeds acceptable limits, the water segment then becomes "impaired" by that pollutant and is reported as a 303d-listed impairment. If the water segment affected by the pollutant is in dire need of reduction and is considered "high priority," it is then listed as a Total Maximum Daily Load (TMDL).

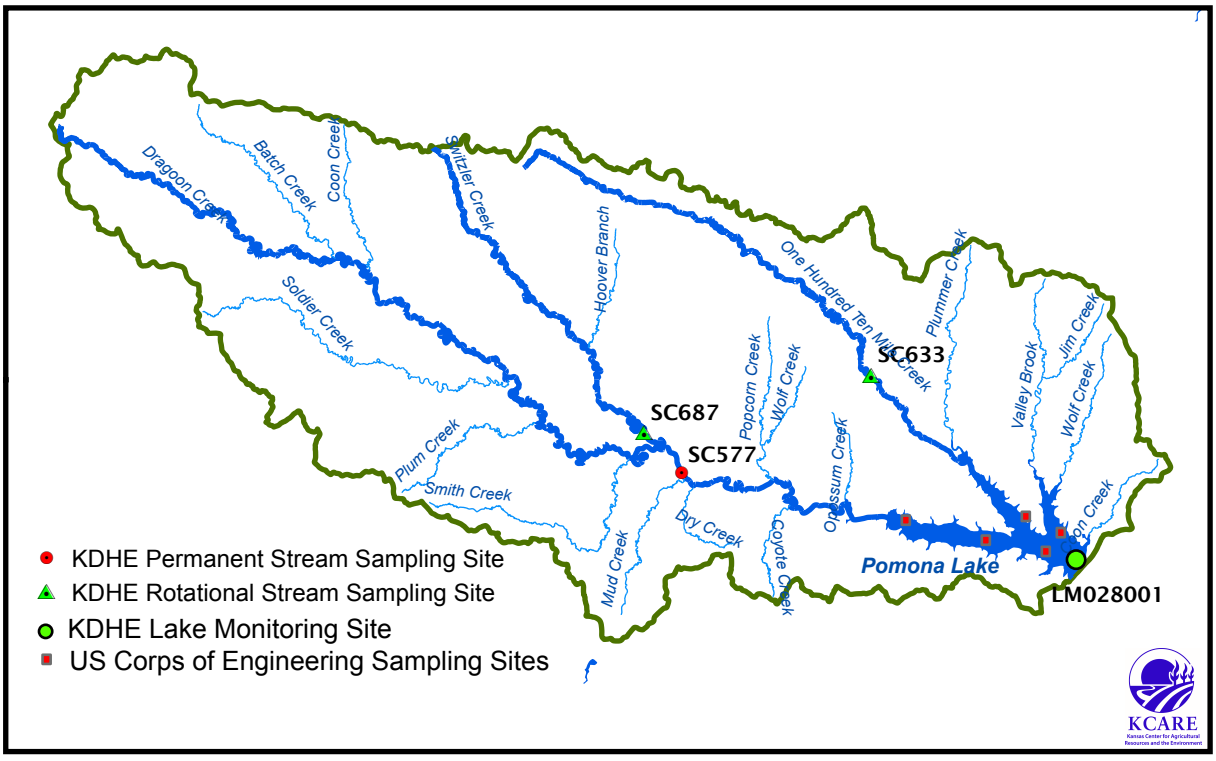


Figure 10. Pomona Lake Watershed Monitoring Sites

Water monitoring analysis has shown chlorophyll with concentrations averaging 7.89 µg/L for the period of record (1976-2012) with more recent samples averaging 11.8 µg/L. Sampling done by KDHE shows elevated total phosphorus concentrations, in fact, 75% of the samples are over 50 ppb. Surface water in Pomona Lake has high turbidity which is dominated by inorganic materials because the lake receives a steady inflow of silt. Turbidity in Pomona Lake averages 21.9 NTU for the period of 1976-2012 and 20.8 NTU for the period of 2008-2012. Total Suspended Solids (TSS) concentration in Pomona Lake reached a high of 34.4 mg/L in May of 2007; this issue appears to be on the decline, with a 9.92 mg/L average in the 2008-2012 period, down from the 11.4 mg/L average from 1976-2012. It appears that the majority of the nutrient and sediment loads

are coming from Dragoon Creek and 110-Mile sub-watersheds[13]. Because sediment is listed as a TMDL for Pomona Lake, there is still sediment work to be done.

A. 303d List of Impaired Waters in the Pomona Lake Watershed

KDHE develops a "303d list" of impaired waters biennially and submits it to EPA. To be included on the 303d list, samples taken during the KDHE monitoring program must show that water quality standards are not met which also means that designated uses are not met. Each water segment is assigned a "Category" to describe and report the condition of the segment. These categories include:

- Category 2: Water was previously listed as impaired but now has water quality sufficient to support its designated uses.
- Category 3: There is insufficient available data and/or information to make a use support designation.
- Category 4a: A Total Maximum Daily Load (TMDL) has been developed for the waterbody/combination.
- Category 4b: NPDES permits are addressing the impairment or an atrazine impairment is being addressed utilizing a watershed plan (an alternative to TMDLs).
- Category 5: Available data and/or information indicate that at least one designated use is not being supported or is threatened, and a TMDL is needed.

Atrazine has been 303d listed in three streams in the Pomona Lake Watershed as a category 5 and *E. coli* for one stream as a category 3 (**Table 8**). *All category 4a (TMDL) listings are described in the following "TMDL" section.*

Table 8. 303d Listed Waters in the Pomona Lake Watershed[14]

303d List of Impaired Waters				
Water Segment	**Category**	**Impairment**	**Priority**	**Sampling Station**
One Hundred Ten Mile Creek	5	Atrazine	Low	SC633
Switzler Creek	5	Atrazine	Low	SC687
Dragoon Creek	5	Atrazine	Low	SC577
Dragoon Creek	3	E. coli		SC577

[13] Marais des Cygnes River Basin Total Maximum Daily Load, http://www.kdheks.gov/tmdl/mc/PomonaE.pdf

[14] Kansas Department of Health and Environment, 2018. http://www.kdheks.gov/tmdl/2018/Approved_2018_303_d)_List_of_All_Impaired_Waters.pdf

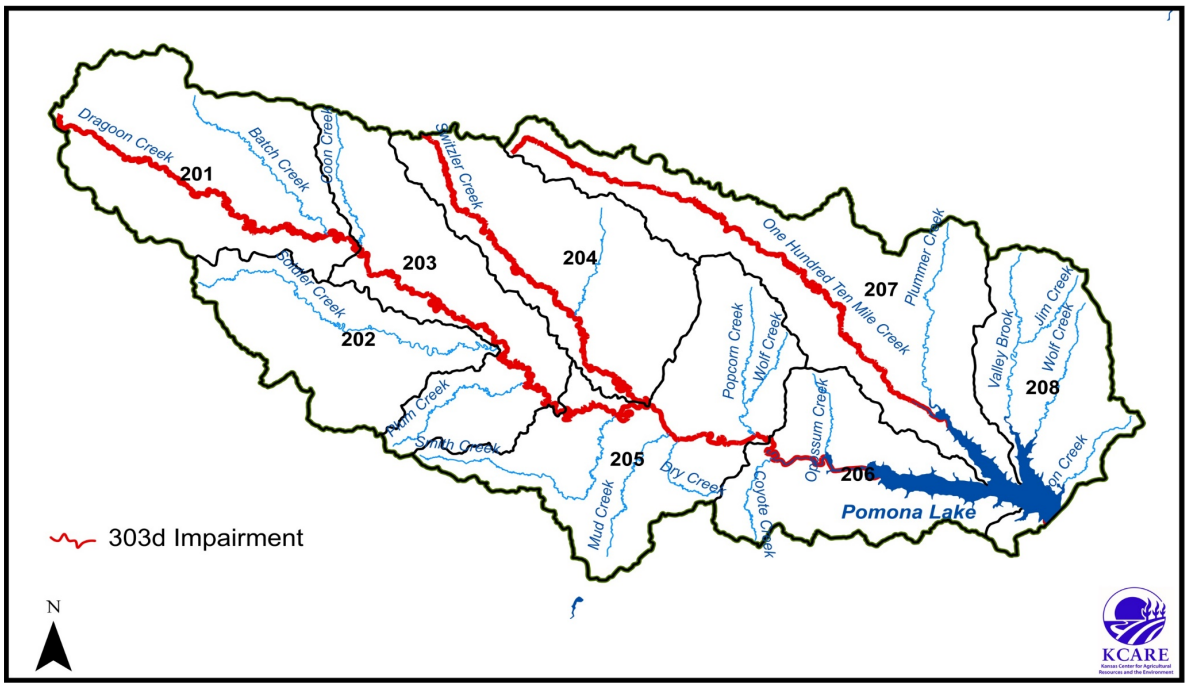


Figure 11. 303d-Listed Waters in the Pomona Lake Watershed

B. Total Maximum Daily Loads (TMDL)

1. What is a TMDL?

A TMDL designation sets the maximum amount of pollutant that a specific body of water can receive without violating the surface water-quality standards, resulting in failure to support their designated uses. TMDLs in Kansas may be established on a watershed basis and may use a pollutant-by-pollutant approach, a biomonitoring approach, or both as appropriate. TMDL establishment means that 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. In a TMDL, the desired outcome of the 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.

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 12 Kansas basins every five years on a rotational schedule. The Pomona Lake Watershed is part of the Upper Marais des Cygnes River Basin and was reviewed in 2012; it is scheduled for review again in 2023.

2. Pomona Lake Watershed TMDLs

To be issued a TMDL, water samples taken during the KDHE monitoring program indicate that water quality standards were/are not being met. This in turn means that designated uses are not met.

The Pomona Lake Watershed has four total TMDLs. The 110- Mile Creek and Switzler Creek both have dissolved oxygen TMDLs, while Pomona Lake has eutrophication and siltation TMDLs (**Table 9)**.

Table 9. TMDLs in the Pomona Lake Watershed[15]

TMDLS in the Pomona Lake Watershed					
Water Segment	**Category**	**Impairment**	**Priority**	**Goal of TMDL**	**Sampling Station**
One Hundred Ten Mile Creek	4a	Dissolved Oxygen	High	Dissolved Oxygen > 5 mg/l Average Biochemical Oxygen Demand (BOD) < 2.6 mg/l	SC633
Switzler Creek	4a	Dissolved Oxygen	High		SC687
Pomona Lake	4a	Siltation	High	Secchi Disc Depth ≥ 0.7m	LM028001
Pomona Lake	4a	Eutrophication	High	Summer Chlorophyll a ≤ 10 ug/l	LM028001

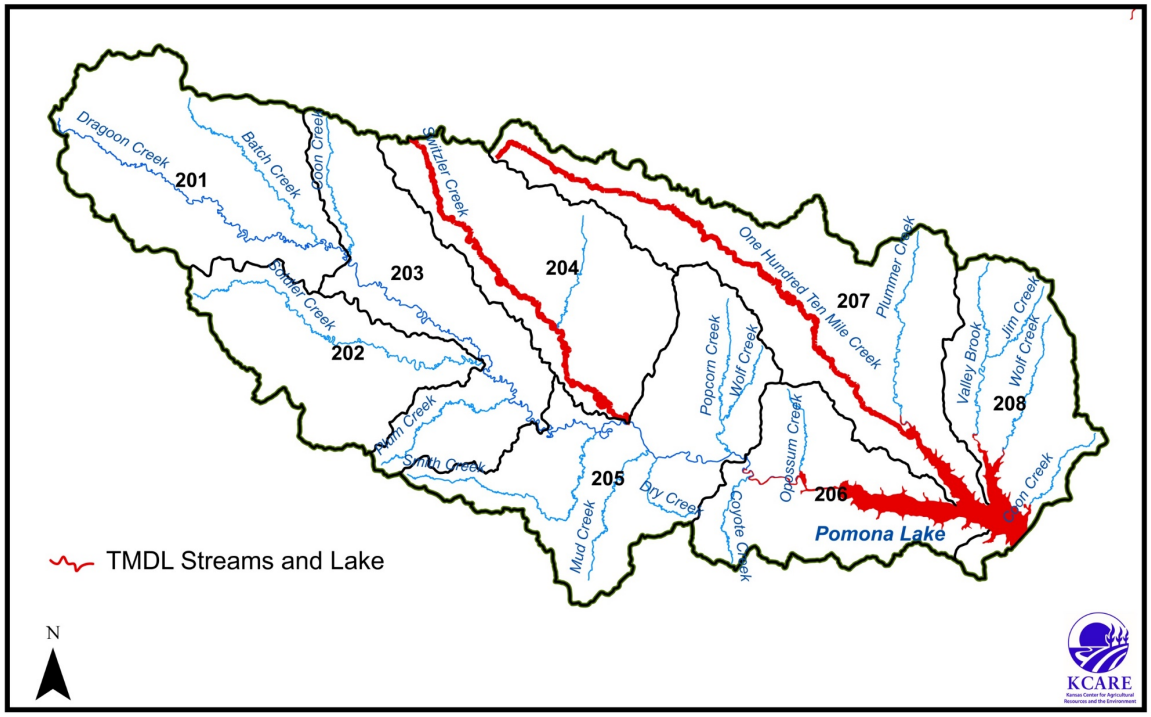


Figure 12. Waters with a TMDL in the Pomona Lake Watershed

Note: Some of the implemented strategies for addressing the current TMDLs as determined by the SLT and outlined in this plan will have additional benefits by proactively addressing the 303d-listed atrazine impairments. The ultimate goal will be to eliminate the need for TMDL development of the current 303d-listed impairments. For the purpose of this plan, focus and priority will be given to current TMDLs in the Pomona Lake Watershed.

[15] Kansas Department of Health and Environment, 2018.
http://www.kdheks.gov/tmdl/2018/Approved_2018_303_d)_List_of_All_Impaired_Waters.pdf

5. Watershed Impairments to be Addressed

The Pomona Lake Watershed SLT acknowledges all TMDL and 303d-listed water segments in the watershed. All goals and BMPs will be aimed at protecting the Pomona Lake Watershed from further degradation (**Table 10**). The SLT will focus this plan on two key TMDL-listed impairments for Pomona Lake Reservoir:

- Silt (Sediment)
- Eutrophication: Nitrogen and Phosphorus

Table 10. Pomona Lake Watershed TMDL Impairment Loads and Goals

Load Allocations for the Pomona Lake Watershed				
Impairment/TMDL		**Current Load**	**Allowed Load**	**Required Annual Reduction**
Silt/Sediment		349,683	104.408	248,275 tons
Eutrophication	**Nitrogen**	917,063	412,416	504,647 pounds
	Phosphorus	124,531	54,815	69,716 pounds

A. Sediment

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

Sediment can originate from streambank erosion and sloughing of streambanks due to erosion and a lack of riparian cover. Sheet and rill erosion from cropping and pasture systems contribute sediment into the ecosystem as well. Once the sediment reaches the lake, it decreases water clarity and can reduce reservoir volume and storage capacity. This limits public access to the lake's boat ramps and beaches. Also, a decrease in storage in the lake affects domestic and industrial uses of the lake water. Therefore, reducing erosion is necessary to reduce sediment in the Pomona Lake. In addition, nutrient pollutants, such as nitrogen and phosphorus, can leach to the sediment particles and cause higher than normal concentrations, thus accelerating the eutrophication problem in the Pomona Lake.

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.

1. Sources of the impairment

Land-based activities affect sediment transported downstream to lakes. Physical components of the terrain, such as slope, propensity to generate runoff, and soil type are important in sediment movement. Sediment also can originate from streambank erosion and sloughing of the sides of rivers and streambanks. A lack of riparian cover can cause washing on the banks of streams or rivers and enhance erosion. Animal movement, such as livestock regularly crossing the stream, can cause pathways that will erode. Silt is another source of sediment present in the stream from past activities which gradually moves downstream with each high-intensity rainfall event.

Land use

Land use activities have a significant impact on the types and quantity of sediment transfer in the watershed. Construction projects can leave both disturbed areas of soil and unvegetated roadside ditches that can erode in a rainfall event. In addition, agricultural cropland using conventional tillage practices and lacking maintenance from agricultural BMP structures can have cumulative effects on land transformation through sheet and rill erosion. Sediment also can be caused by degraded pastureland or streambank sloughing. Primary land uses in the areas this WRAPS plan will target for BMP implementation (see Section 6), are grassland (42%), pasture/hay land (24%) and cropland (18%). Reducing erosion in these areas is necessary for a reduction in sediment.

Agricultural BMPs such as cover crops, no-till, conservation tillage, grass buffer strips around cropland, terraces, grassed waterways and reduced activities within riparian areas will reduce erosion and improve water quality.

Soil erosion by wind and/or water

NRCS has established a "T factor" in evaluating soil erosion. T represents the soil loss tolerance factor. It is defined as the maximum amount of erosion at which soil quality as a medium for plant growth can be maintained. It is assigned to soils without respect to land use or cover and ranges from one ton per acre for shallow soils, to five tons per acre for deep soils that are not as affected by loss of productivity by erosion. T factors represent the goal for maximum annual soil loss in sustaining the productivity of land use.[16]

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 streams and degrading the banks. Cropland needs buffer and filter strips adjacent to streams in order to impede the sediment flow from fields. Conservation tillage practices also are effective for slowing the flow of rain water off of crop fields. In

[16] NRCS T factor. http://www.nrcs.usda.gov/technical/NRI/1997/summary_report/glossary.html and http://www.umbsn.org/watershed_programs/documents/word%20documnets/T-%20featured.htm

the targeted areas, predominant land use in riparian areas is cropland (30%). This is the land that can be most vulnerable to runoff and erosion. The use of buffers and filter strips, along with forested riparian areas, can impede erosion and streambank sloughing.

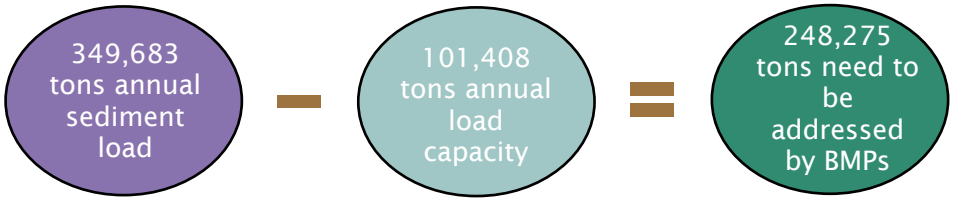
This WRAPS project will target portions of 110 Mile and Switzler Creeks and their tributaries for streambank stabilization and riparian enhancement projects. According to the USDA/NRCS GIS mapping data, the riparian 100-foot buffer land use is almost evenly divided between cropland, pasture land and forest land with a small amount of water, urban and barren land.

Rainfall and runoff

Rainfall amounts and the subsequent runoff can affect the sediment runoff from both agricultural and urban areas into streams and Pomona Lake. In addition, high rainfall events can cause cropland erosion and sloughing of streambanks, adding sediment to streams and rivers that will ultimately flow into Pomona Lake.

2. Pollutant loads

The current estimated sediment load in the Pomona Lake Watershed is 349,683 tons per year, according to the TMDL section of KDHE. The total load reduction needed to meet the sediment TMDL is 248,275 tons of sediment, a reduction of 71%. **If all BMPs have been implemented by the end of this 40-year WRAPS plan, a reduction of 266,795 tons per year of sediment will have been saved.** This exceeds the TMDL goal by seven percent.



3. What BMPs will be implemented to meet the TMDL?

BMPs have been part of the discussion from the beginning of this WRAPS process, when SLT members came to an agreement on a list of acceptable BMPs that would result in progress toward significant pollutant reduction.

Each agricultural BMP on cropland such as no-till, nutrient management plans, cover crops, terraces, waterways, buffers and permanent vegetation will reduce erosion and improve water quality. When the SLT revised and updated this plan in 2019, a **cover crop BMP** was added. Streams and riparian areas also can be major sediment contributors; therefore, the SLT plans to implement streambank stabilization and riparian restoration BMPs as well. Some BMPs utilized for streambank stabilization and riparian restoration may include riparian buffers, field borders and bottomland timberland in wetlands.

Specific acreages or projects that need annual implementation have been determined through modeling and economic analysis and approved by the SLT, as shown in **Table 11**.

Table 11. BMPs to Prevent or Reduce Sediment Runoff and Erosion

BMPs to Reduce Sediment Runoff and Erosion		
Protection Measures	**Best Management Practices and Other Actions**	**Acres or Feet Treated Annually**
Prevention of sediment contribution from **cropland**	No-Till	268 acres
	Nutrient Management Plans	268 acres
	Cover Crops	268 acres
	Terraces	153 acres
	Grassed Waterways	153 acres
	Buffers	77 acres
	Permanent Vegetation	38 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

B. Eutrophication: Nitrogen and Phosphorus

The Pomona Lake Watershed has a "high" priority TMDL for the impairment of **eutrophication** in Pomona Lake. Excess nutrient loading (primarily nitrogen and phosphorus) causes eutrophication which creates conditions favorable for algae blooms and aquatic plant growth. Excess nutrients originate from manure and fertilizer runoff in rural and urban areas. In the Pomona Lake Watershed, urbanization, agricultural land use, and small livestock operations all contribute excess nutrients to the watershed system.

Algae blooms and aquatic plant growth may increase oxygen levels temporarily, but the bloom will die off eventually after the nutrients become scarce. During this die-off, there are reduced dissolved oxygen levels in the water because algal decomposition utilizes the oxygen. This results in an unfavorable habitat for aquatic life. Desirable criteria for healthy water dictate dissolved oxygen rates greater than 5 mg/L and biological oxygen demand (BOD) less than 3 mg/L.

1. Sources of the impairment

Nutrient loading can originate in both rural and urban areas and can be caused by both point and nonpoint sources. This plan focuses primarily on agricultural nonpoint source contributions, even though other possible sources will be included as part of the discussion.

Land Use

Land use activities can affect nutrient runoff into streams. Fertilizer or manure applied to frozen ground or cropland prior to a rainfall event can be transported easily downstream.

Livestock that are allowed access to streams to drink or loaf will contribute manure directly into the stream. Overgrazed pastures do not provide adequate biomass to trap manure runoff.

Agricultural BMPs that will help reduce nutrient runoff include: implementing cover crops, no-till, minimum tillage, vegetative buffers and riparian areas; creating grassed waterways and grassed terraces; establishing permanent vegetative cover and grazing management plans; providing off stream watering sites with fencing of streams and ponds; relocating pasture feeding sites away from streams; relocating feeding pens away from streams; implementing rotational grazing; and placing vegetative filter strips along waterways.

Wastewater treatment facilities

KDHE permits and regulates wastewater treatment facilities. National Pollutant Discharge Elimination System (NPDES) permits specify the maximum amount of pollutants allowed to be discharged to surface waters. There are 12 NPDES wastewater treatment facilities in the Pomona Lake Watershed.

Population

Watershed population can affect nutrient runoff. There are roughly 1,373 domestic onsite wastewater systems estimated in the Pomona Lake Watershed, mainly in rural areas. Although the functional condition of these systems is generally unknown, it is projected that nearly 20% may be failing; onsite wastewater could be an area of possible pollution contribution for evaluation over time.

Confined Animal Feeding Operations

In Kansas, animal feeding operations (AFOs) with greater than 300 animal units (AUs) and less than 1,000 AUs must register with KDHE. An AU is an equal standard for all animals based on size and manure production. For example: one AU equals one animal weighing 1,000 pounds. Confined animal feeding operations (CAFOs) are those with more than 999 AUs, and they must be federally permitted. There are certified or permitted AFOs and CAFOs spread throughout the watershed. There are also numerous small livestock farms (below 300 AUs) that contribute to the nutrient loads. *Note that only a portion of each county is in the Pomona Lake Watershed, therefore actual numbers within the watershed are lower.* In addition to livestock-contributed waste, improperly disposed of pet waste can also be a contributor to the nutrient loads, although at a much smaller quantity.

Grazing density

Approximately 42% of the watershed is grasslands. Grassland in this area of Kansas is a highly productive forage source for beef cattle. Grazing density affects grass cover and potential manure runoff: an overgrazed pasture will not have the needed forage biomass to trap and hold manure in a high rainfall event. Also, allowing cattle to drink and loaf in streams increases the occurrence of nutrients and *E. coli* bacteria in the waterway. Grazing density ranges from 8.4 to 12.2 cattle per 100 acres across the watershed.[17] This is considered to be medium density when compared with statewide density numbers.

[17] https://www.nass.usda.gov/Publications/AgCensus/2017/Online_Resources/County_Profiles/Kansas/index.php

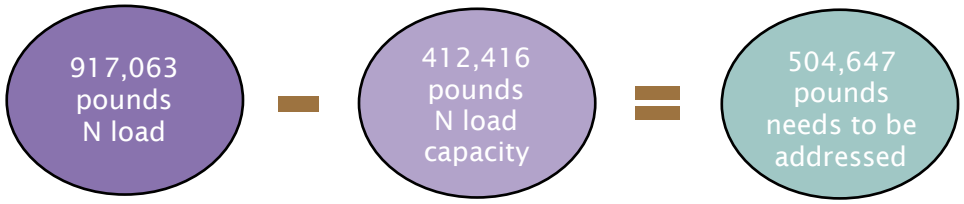
Rainfall and runoff

Rainfall amounts and subsequent runoff affect nutrient runoff from agricultural and urban areas into streams and Pomona Lake. The amount and timing of rainfall events affects manure runoff from livestock that are allowed access to streams, or manure applied before a rainfall or on frozen ground. Therefore, it is important to maintain adequate grass density to slow the runoff of manure over pastures.

2. Pollutant loads

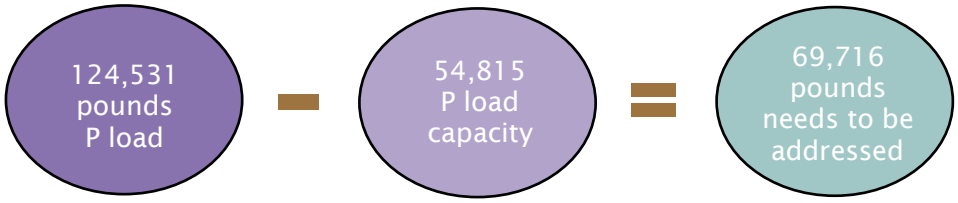
Nitrogen

The current estimated nitrogen load in the Pomona Lake Watershed is 917,063 pounds per year, according to the TMDL section of KDHE.[18] The amount of nitrogen (N) in the watershed contributes to the eutrophication and dissolved oxygen TMDLs in the watershed. It has been determined that a 55% reduction in nitrogen is necessary to meet the TMDL, which equates to a reduction of 504,647 pounds per year. **If all BMPs have been implemented, 542,487 pounds of nitrogen will have been reduced from the watershed at the end of this 40-year nine-element plan.** This exceeds the TMDL goal by seven percent.



Phosphorus

The current estimated phosphorus (P) load in the Pomona Lake Watershed is 124,531 pounds per year, according to the TMDL section of KDHE.[19] The amount of phosphorus in the watershed contributes to the eutrophication and dissolved oxygen TMDLs in the watershed. The total load reduction needed to meet the phosphorus TMDL is 69,716 pounds of phosphorus per year, a reduction of 56%. **If all BMPs have been implemented, 299,058 pounds of phosphorus will have been reduced from the watershed at the end of this 40-year nine-element plan.** This exceeds the required reduction goal by 329%.



[18] Kansas Department of Health and Environment. September 2018.
[19] Kansas Department of Health and Environment. September 2018.

3. What BMPs will be implemented to meet the TMDL?

The SLT has identified specific cropland, livestock, streambank and riparian area BMPs which will result in significant nutrient pollutant reductions and are acceptable to watershed residents. Each agricultural BMP such as no-till, nutrient management plans, cover crops, terraces, waterways, buffers and permanent vegetation will improve water quality by reducing nutrient runoff and leaching. Implementing grazing management plans, planting vegetative filter strips, relocating pasture feeding sites and pens away from streams and providing alternate watering sites all work to reduce nutrient loading from livestock areas. Streambank stabilization and riparian restoration are BMPs that can reduce large quantities of nutrients entering streams. Specific acreages or projects needing annual implementation have been determined through modeling and economic analysis and have been approved by the SLT (**Table 12**).

Table 12. BMPs to Prevent and/or Reduce Nutrient Runoff and Leaching

BMPs to Reduce Nutrient Loading			
Protection Measures	**Best Management Practices and Other Actions**		**Acres or Feet Treated Annually**
Prevention of nutrient contribution from **cropland**	No-Till		268 acres
	Nutrient Management Plans		268 acres
	Cover Crops		268 acres
	Terraces		153 acres
	Grassed Waterways		153 acres
	Buffers		77 acres
	Permanent Vegetation		38 acres
Prevention of nutrient contribution from **livestock**	Vegetative Filter Strip		1 project per year
	Relocate Feeding Pens		1 project per year
	Relocate Pasture Feeding Sites	Native Grass Pasture	1 project every 2 years
		Cool Season Grass Pasture	1 project every 2 years
	Off-Stream Watering System	Native Grass Pasture	1 project every 3 years
		Cool Season Grass Pasture	1 project every 3 years
		Cropland	1 project every 3 years
Prevention of nutrient contribution from **streambank** erosion	Streambank Stabilization		260 feet
Prevention of nutrient contribution from **riparian areas**	Installation of riparian/vegetative buffers (66 feet wide)		30.5 acres

Implementation of cropland BMPs in support of the sediment TMDL also works to reduce nitrogen and phosphorus leaching and loading, thereby positively impacting the watershed by reducing pollutant loads.

C. Dissolved Oxygen

Switzler Creek and the One Hundred Ten Mile Creek both have "high" priority TMDLs for **dissolved oxygen (DO)**.

Excess nutrient loading from the watershed creates accelerated rates of eutrophication followed by decreasing amounts of DO in the water. This results in an unfavorable habitat for aquatic life. Desirable criteria for healthy water dictate DO rates greater than 5 mg/L in 80% of the

water column and biological oxygen demand (BOD) less than 3 mg/L. Both Switzler and 100 Mile Creeks are outside those criteria.

Excess nutrients often come off crop fields by way of sediment leaching during runoff events. Excess nutrients also can originate from failing septic systems, livestock manure, and fertilizer runoff in rural and urban areas.

The SLT will not target DO impairments specifically; however, the implementation of this WRAPS plan for sediment and nutrient BMPs subsequently will reduce the amount of nutrient loading found in runoff, which will have positive effects on the dissolved oxygen TMDLs in the Switzler and One Hundred Ten Mile Creeks.

D. Other Concerns in the Pomona Lake Watershed

1. Atrazine

The Pomona Lake Watershed has three creeks 303d listed as "low" priority for **atrazine**.

Atrazine is a relatively inexpensive herbicide widely used in corn, sorghum and soybean production. Atrazine enters streams and lakes by way of sediment runoff. Once atrazine enters the water, it can linger for a long time as its chemical breakdown is slow. Atrazine is one of the most commonly detected herbicides in groundwater and has been connected to health issues in animals and humans, including reproductive system problems in humans.[20] The chemical is lab-created, requires a license for usage and is considered a health threat in contaminated waters.

a. Sources of the impairment

Land use
Cropland sprayed with atrazine is the only source of herbicide concentration in the surface waters of the Pomona Lake Watershed. Atrazine primarily is used on corn and sorghum crops. Nearly 20% of the acreage in the watershed is cropland, with 32% of those fields in corn and a little over one percent in sorghum. There are smaller areas of other crops produced in the watershed, but corn and sorghum are the crops that primarily utilize atrazine.

Rainfall and runoff
Rainfall duration (defined as extended duration of rainfall events causing soil saturation and subsequent runoff) and intensity (defined as high rainfall rates overwhelming soil adsorptive capacity causing runoff) are key components affecting atrazine leaching and runoff from agricultural cropland. When atrazine is applied to cropland soils in the late spring, the chances are greater that a high-intensity rainfall event will wash away the herbicide on the field. High-intensity rainfall events primarily occur in the late spring

[20] Agency for Toxic Substance and Disease Registry.
https://www.atsdr.cdc.gov/PHS/PHS.asp?id=336&tid=59

in this watershed. Also important is the time before a rainfall event, but after applying atrazine. The longer the time span, the less runoff of this herbicide.

b. Addressing atrazine in the Pomona Lake Watershed WRAPS plan

Atrazine will not be addressed directly by this WRAPS plan, as the plan focuses on high-priority TMDLs for Pomona Reservoir. However, protection of the watershed and future water quality is of utmost importance. Several of the BMPs to be implemented for sediment and nutrients also will reduce atrazine runoff. For example: no-till, cover crops and the establishment of permanent vegetation certainly will reduce erosion and runoff, which will keep atrazine on the crop field and out of nearby water segments. It is the hope of the Pomona Lake SLT to prevent atrazine from ever becoming a TMDL impairment in the watershed.

2. E. coli

Dragoon Creek in the Pomona Lake Watershed is 303d listed for ***E. coli***.

a. Sources of the impairment

Presence of bacteria in waterways can originate from runoff from livestock production areas, close proximity of any mammals to water sources, and manure application to agricultural fields. Bacteria is present in livestock manure and can be transported into waterways if livestock have access to streams. Bacteria can originate in both rural and urban areas. It can be caused by both point and nonpoint sources. It must be noted that not all bacteria can be attributed to livestock. Wildlife has a contribution to bacteria loads as well. In addition, failing septic systems can be a source of bacteria from humans.

b. Addressing* E. coli *in the Pomona Lake Watershed WRAPS plan

Dragoon Creek's *E. coli* listing will not be directly addressed by this WRAPS plan. However, livestock BMPs implemented to address nutrients, will also serve to reduce livestock contributed levels of E. coli in the stream segment.

3. Invasive species in the Pomona Lake Watershed

The SLT is concerned with some watershed issues not directly related to impaired waters. These are issues that the SLT would like to address if funding becomes available in the future. One such issue is the growth of certain varieties of plant life in the watershed that have tend to be invasive and have a negative effect on biodiversity.

Invasive plant species will not be directly addressed by this WRAPS plan as the plan focuses on high-priority TMDLs and water quality issues. However, the Pomona WRAPS SLT does see invasive plants as a major concern in the watershed and would like to address this in the future should another source of funding become available.

a. Sericea lespedeza

The Kansas state legislature declared sericea lespedeza, or Chinese bush clover, a state-wide noxious weed on July 1, 2000. Osage County Commissioners recognized the need to control this plant and already had declared it a noxious weed in 1988. Landowners struggle to control sericea on their grassland. Individual stems of a sericea plant can produce in excess of 1,000 seeds which can remain viable in the soil for 20 years or longer.

Noxious weed control, especially sericea lespedeza control, is an ongoing fight for Osage County landowners. Established sericea 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 the seed germination and growth of some plants, such as big bluestem, Indian grass, Kentucky bluegrass, bermudagrass, fescue, and ryegrass.

The Pomona Lake Watershed has 136,416 acres of grass/pasture/hay. According to NRCS, it is estimated that 60% of the grass/pasture/hay land is infested with sericea lespedeza. There are three main chemicals used to control sericea lespedeza. Current costs are $9.90 per acre for Escort, between $9 and $19 per acre for Remedy Ultra and between $12 and $24 per acre for Pasture Gard HL. Remedy and Pasture Gard 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 (wildflowers). Remedy, applied in June and July, or Escort, applied in September, can provide excellent control of sericea lespedeza.[21]

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, and 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 providing an incentive for landowners to maintain their land in grass will lead to fewer acres converted to cropland. Land in grass provides better sediment control than cropland, thereby protecting nearby streams and lakes from sediment erosion and nutrient leaching.

b. Old world bluestem

Old world bluestem has not been declared a noxious weed, but it can be invasive and can reduce the growth of other grasses that are more nutritious and palatable for livestock. The plant also can have a negative impact on plant biodiversity, insects and wildlife. Old world bluestem is becoming increasingly prevalent in native grasslands commonly used for cattle grazing, particularly in drier regions. The grass was brought

[21] https://www.bookstore.ksre.ksu.edu/pubs/SRP1148.pdf

to the United States as a soil-stabilizing plant and is now found to be troublesome in how it affects the surrounding ecosystem. The SLT would like to provide education on how to treat this invasive plant with herbicides and how to prevent it from spreading.

There are two types of old world bluestem: yellow and Caucasian. Their growth and effects on pastures are similar but have different physical characteristics. Yellow old world bluestem will have a few branches on the seed head and can look similar to silver and native big bluestem. Caucasian old world bluestem has a more branched seed head (with branches throughout) and can resemble an evergreen tree, with the branches of seeds getting shorter toward the top.

Old world bluestem is extremely persistent and does well under dry conditions. It is a prolific seed producer and has seed banks beneath that can result in plants years after herbicide treatment. The old world bluestem is notoriously hard to treat. The most successful remedies include glyphosate treatments at different rates and times or with imazapyr, another herbicide.

According to Kansas State Research and Extension's 2019 Chemical Weed Control publication[21], old world bluestem can be treated using glyphosate or Arsenal. If using glyphosate, apply when the plant is actively growing and before it produces seeds. It is necessary to use the higher rate if the soil is dry. Because glyphosate is a non-selective herbicide, it will damage most green growing plants. Arsenal is an alternate to glyphosate, and because it is a selective herbicide, most native grasses will survive treatment. Like glyphosate, Arsenal also can be used to treat actively growing old world bluestem plants; it may be necessary to treat affected areas two times per year, about eight weeks apart.

According to Keith Harmoney, Range Specialist with Kansas State Agriculture Research Center, a proven way to treat old world bluestem is by treating with 1-2 pounds per acre of glyphosate or imazapyr early in the plant's life when it has around four or five leaves. That should be followed eight weeks later by an application of 1-2 pounds per acre of glyphosate, or once the plant begins early heading. Another way to manage old world bluestem using glyphosate or imazapyr is by doing a one-time herbicide application of 2-3 pounds per acre once the plant begins early heading and repeat eight weeks later using a quarter-pound application. Old world bluestem often has a seed bank underneath, so there is a possibility that the plant will reemerge from seed two to three years after being treated. This means there is a need to reapply herbicide over time to control possible new seed growth. This can become costly.

c. Zebra Mussels

Zebra mussels are native to the Black and Caspian Seas in Europe. They were introduced into the Great Lakes in 1988 from the ballast water of ships. Zebra mussels have become widespread throughout the midwestern US.

Zebra mussels look like small clams, usually less than an inch long with a D-shaped shell. Usually the shell is yellowish-brown with alternating dark and light stripes. Zebra mussels use sticky byssal threads to attach tightly to any hard surface.

They are a problem because they filter water (up to a liter a day) to eat plankton. Although this filtering action may clear up the water, clear water does NOT mean clean water; the clear water zebra mussels leave behind will often lead to algal blooms that are harmful to people. The clear water can also allow UV rays to damage fish eggs laid during the spawn. Larval fish and native mussels rely on the same plankton consumed by zebra mussels to survive. Zebra mussels also clog pipes by forming colonies inside of the pipes, which impedes water flow. Nationwide expenditures to control zebra mussels in electric generating plants are estimated at $145 million annually.

Contrary to some beliefs, zebra mussels are not spread by birds. Transport by people, even though it is illegal, is the primary vector for the spread of zebra mussels to unconnected waters. Zebra mussels will attach to a solid substrate and can be transported easily on recreational equipment. Their larvae (veligers) are so small they cannot be seen without a microscope. The veliger floats in a water column for one to five weeks. As it grows, it begins to sink and search for a hard surface on which to live and grow.

Zebra mussels cannot be controlled in the wild. Chemicals can be used to kill zebra mussels, but if these chemicals were used in an open lake or reservoir, they would affect fish and native mussels. The first successful eradication of zebra mussels in the wild took place in Virginia. It was costly and detrimental to native mussels. The SLT would like to prevent the spread of zebra mussels by encouraging people to drain all of the water from boats, live wells, and bait wells. In addition, lake visitors and boaters should inspect their boat's hull and trailer thoroughly for any zebra mussels and remove them. Boating, skiing and swimming equipment should be washed with 140-degree water and left to sit for five days.[22]

[22] Kansas Department of Wildlife, Parks and Tourism. https://ksoutdoors.com/Fishing/Aquatic-Nuisance-Species/Aquatic-Nuisance-Species-List/Zebra-Mussels

6. Targeted Areas

Implementing BMPs is a necessity for improving a watershed's water quality. All fields, pastures and feed lots are susceptible to runoff waters to some degree; these can contribute sediment, nutrients, herbicides and *E. coli* to nearby water segments. However, some crop fields, pastures, and feed lots are more susceptible than others: areas with close proximity to streams, soils more prone to erosion and nutrient leaching, high water flow areas along streams, etc. Areas such as these are considered "high priority" and are targeted for BMP implementation. It has been determined that focusing BMP implementation in high-priority areas offers a greater improvement in water quality since these areas are generally the major contributors to non-point source pollution and, ultimately, 303d and TMDL listings.

A. Studies Conducted to Determine Targeted Areas

1. Soil and Water Assessment Tool (SWAT)

The SWAT is a physically based, deterministic, continuous watershed-scale simulation model. It was developed by USDA-ARS from numerous equations and relationships 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; an evaluation of monthly and annual streamflow and pollutant outputs indicate that 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. It incorporates various grazing management practices by specifying the amount of manure applied to pasture or grassland, grazing periods, and amount of biomass consumed or trampled daily by livestock. Septic systems as well as NPDES discharges and other point sources are considered combined point sources and applied to inlets of sub-watersheds. These features make SWAT a good tool for assessing rural watersheds in Kansas.

The Pomona Lake Watershed was assessed in 2009 using SWAT by Kansas State University Department of Biological and Agricultural Engineering. The 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 streams. At the end of simulation runs, the average annual loads were calculated for each sub-watershed. Some areas had higher loads than the others. Based on experience and technical knowledge, the areas or sub-watersheds with the top 20-30% of the highest loads among all areas within the watershed were selected as critical (targeted) areas for cropland and livestock BMPs implementation.

The ArcGIS interface of ArcSWAT version 9.2 was utilized to assess the Pomona Lake Watershed. This version 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 and 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.

- 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 estimations of runoff volume and peak runoff rates. The crop management factor is evaluated as a function of aboveground biomass, residue on the surface, and the minimum C factor for the crop.
- The reservoir component detains water, sediments and pollutants, and degrades nutrients, pesticides and bacteria during detention. This component was not used during the simulations.
- 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.

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

- NLCD 2001 land cover data layer (USDA-NRCS)
- NLCD 1992 land cover data layer (USDA-NRCS)
- USDA-NRI, 1997 resource inventory (NRCS)
- Point sources (KDHE)
- Crop rotation (local knowledge)
- Septic system (National Environmental Service Center, NESC) collected database (as described below)

- Crop rotations
- Grazing management practices (local knowledge)

The maps produced by SWAT modeling are displayed below. The darker or brighter the color on the map, the higher the pollutant load potential. The sub-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.

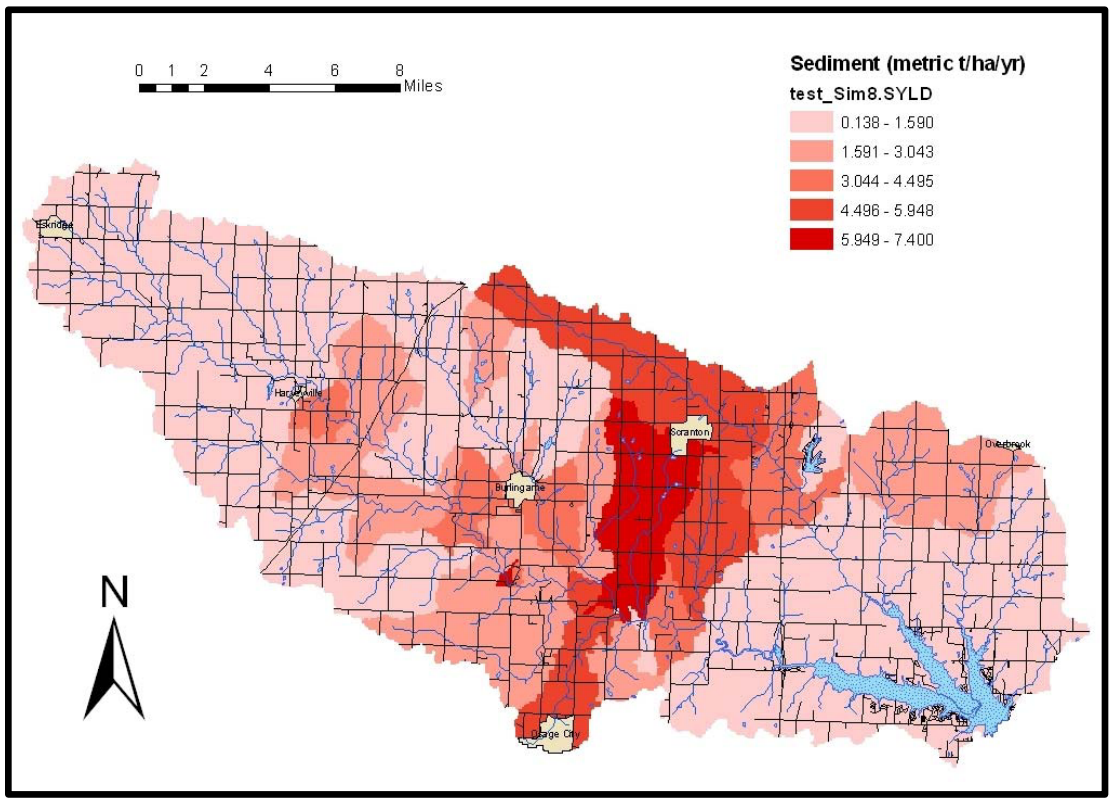


Figure 13. Sediment Yield (tons/acre) as Determined by SWAT

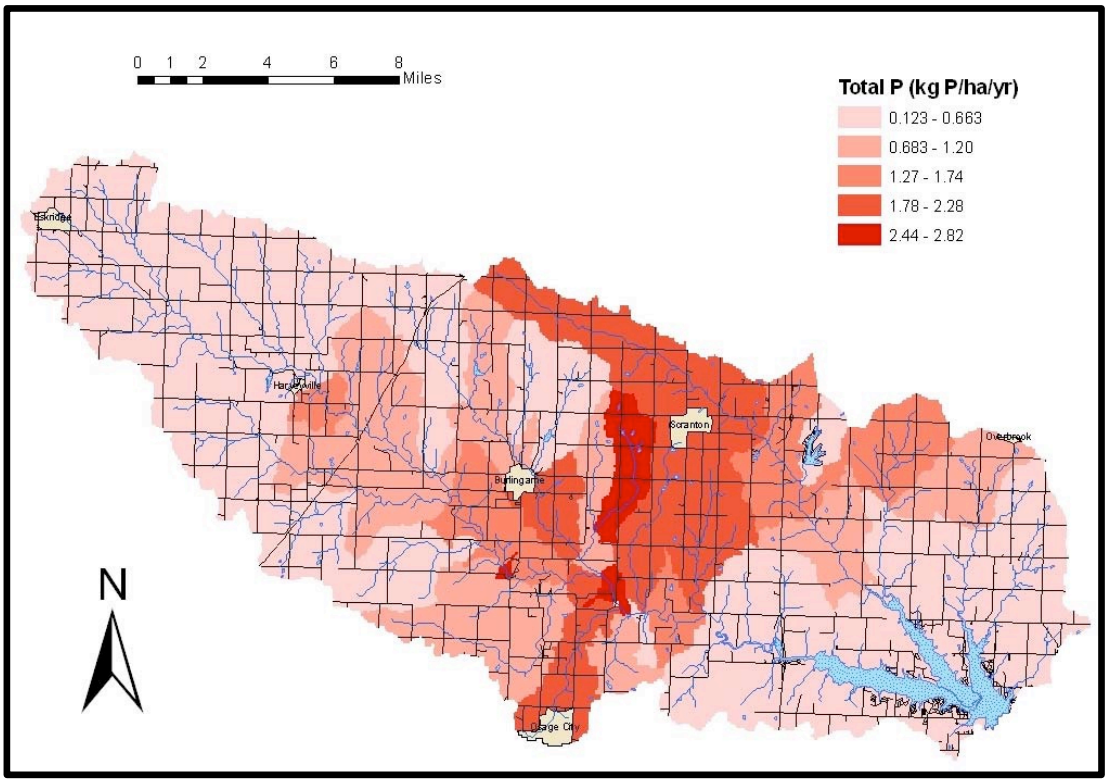


Figure 14. Phosphorus Yield (kg/ha/yr) as Determined by SWAT

2. Ground-truthing and SWAT

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

In 2007, four members of the advisory board drove a portion of the watershed that is in the high priority area to conduct ground-truthing. Team members included: Lori Kuykendall, District Manager; Rod Schaub, Extension Agent; Hershel George, Watershed Specialist; and Tim Gogolski, Natural Resources Conservation Service. They stopped at half-mile intervals and recorded what they saw on the NW, NE, SE and SW corners. Four hundred and seven points on 380 different sites 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 and type of erosion was noted. The percentages for this area were applied to the whole watershed when modeling was complete. For instance, since four percent of the farmers in this area used no-till farming practices, it was assumed that four percent of the entire watershed used no-till farming practices.

Of the 380 sites surveyed in 2007, the following percentages and numbers apply to land use in the Pomona Lake Watershed:

- 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:

- Cropland with structural treatment
  - Terraced: 58% (141 sites)
  - Waterways: 39% (95 sites)
  - Contour farmed: 12% (30 sites)

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

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

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

3. Aerial assessment

KDHE analyzed aerial images and determined areas of interest (**Figure 15**) either in close proximity to a stream or those areas that have been degraded over time. These are crop fields and livestock facilities.

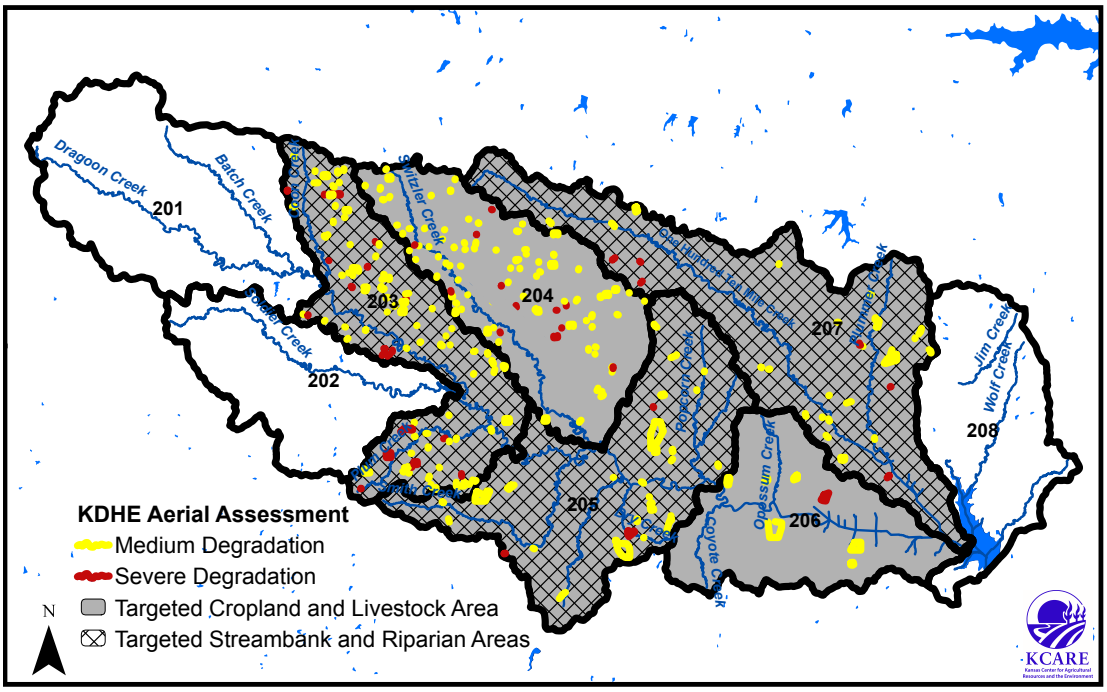


Figure 15. Pomona Lake Watershed Aerial Assessment[23]

B. Targeted Areas

Watersheds get a better value for their money by focusing BMP placement rather than randomly applying BMPs throughout the watershed. Every watershed has specific locations that contribute a greater pollutant load due to soil type, proximity to streams and land use practices. By focusing BMPs in these areas, pollutants can be reduced at a more efficient rate.

The SWAT model, ground-truthing and the KDHE aerial assessment provided data that were used to determine the targeted areas for the Pomona Lake Watershed WRAPS plan. Final targeting assessment results were presented to and considered by the SLT. The SLT decided to target five HUC 12s which lie along Switzler Creek, Dragoon Creek, One Hundred Ten Mile Creek, and the area surrounding and draining into Pomona Lake. Focusing on these areas will affect all TMDLs in the watershed. **The HUC 12s targeted include:**

- 102901010**203**
- 102901010**204**
- 102901010**205**
- 102901010**206**
- 102901010**207**

The SLT will focus BMP placement for sediment and nutrient runoff in the five HUC 12s listed above and will target the following land use areas:

[23] Aerial Assessment figure provided by the Kansas Department of Health and Environment on January 8, 2019.

1. **Cropland areas will be targeted for sediment and nutrients (nitrogen and phosphorus).**
2. **Livestock areas will be targeted for nutrients.**
3. **Streambanks will be targeted for sediment and nutrients.**
4. **Riparian areas will be targeted for sediment and nutrients.**

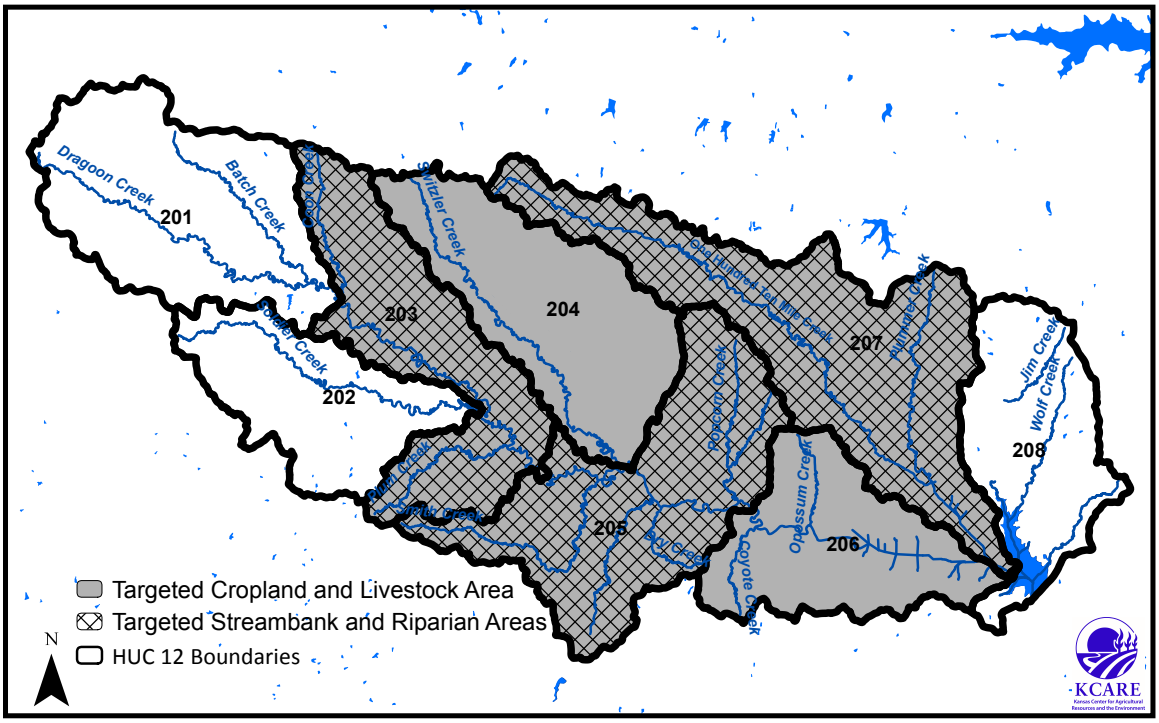


Figure 16. Targeted Areas in the Pomona Lake Watershed

Load reductions will be estimated for each pollutant addressed in each area to measure success at meeting TMDL goals.

C. Load Reduction Estimate Methodology

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.[24] Load reduction estimates are the product of baseline loading and the applicable BMP load reduction efficiencies.

[24] https://www.bookstore.ksre.ksu.edu/pubs/MF2572.pdf

2. Livestock

Baseline nutrient loadings per animal unit are calculated using the Livestock Waste Facilities Handbook.[25] Livestock management practice load reduction efficiencies are derived from numerous sources, including K-State Research and Extension Publication MF-2737 and MF-2454.[26] Load reduction estimates are the product of baseline loading and the applicable BMP load reduction efficiencies. According to the 2017 Ag Census, stocking rates in Osage County are less than nine head of cattle per 100 acres and in Wabaunsee County and greater than 12 head of cattle per 100 acres.

3. Streambanks

A 2009 study of 13 Neosho River restoration sites conducted by Kansas State University 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. In 2001, the State Conservation Commission[27] identified 13 eroded streambank sites along eight miles of the Little Blue River in Washington County, Kansas. It was estimated that approximately 4.66 million tons of soil loss had occurred over the previous 24 years equating to 11.38 tons of sediment per foot per year. Additional assessments to finely tune streambank targeting and to derive more accurate streambank erosion estimates might be needed.

[25] https://www-mwps.sws.iastate.edu/catalog/manure-management/livestock-waste-facilities-handbook

[26] MF-2737 Available at: https://www.bookstore.ksre.ksu.edu/pubs/mf2737.pdf
MF-2454 Available at: https://www.bookstore.ksre.ksu.edu/pubs/mf2737.pdf

[27] Minge, D. 2003. Little Blue River streambank stabilization and riparian restoration project. Natural Resources Conservation Service. Washington, KS

7. Implementation

As mentioned in the previous section, BMP implementation in the Pomona Lake Watershed will take place in HUCs 1029001**203**, **204**, **205**, **206** and **207**. Cropland, livestock, streambanks and riparian areas will be targeted in an effort to improve effectively the following TMDL impairments:

- **Sediment: cropland, streambank and riparian areas**
  The 303d-listed Switzler, Dragoon and One Hundred Ten Mile Creeks will not be targeted with atrazine BMPs. However, atrazine leaches to sediment particles during runoff events and enters nearby water segments; therefore, several of the BMPs implemented to address the sediment TMDL for Pomona Reservoir also will serve to reduce atrazine from entering these creeks.
- **Eutrophication - nutrients (nitrogen and phosphorus): cropland, livestock areas, streambanks and riparian areas**
  The dissolved oxygen TMDLs for Switzler and One Hundred Ten Mile Creeks will not be targeted directly but will be impacted positively by BMPs utilized to address the eutrophication TMDL for Pomona Reservoir.

A. Sediment Loss Reductions in the Pomona Lake Watershed

The Pomona Lake Watershed has a "high" TMDL ranking for sediment in Pomona Lake. The Pomona Lake Watershed contains three targeted areas for sediment loss reductions: **cropland, streambanks and riparian areas**. Adoption and implementation of sediment BMPs will result in a total sediment load reduction (soil saved) of **266,795 tons** at the conclusion of this 40-year WRAPs plan, exceeding the sediment TMDL goal.

The following HUC 12s will be targeted to reduce sediment erosion and runoff in the Pomona Lake Watershed:

- 102901010**203**
- 102901010**204**
- 102901010**205**
- 102901010**206**
- 102901010**207**

There are 30,630 cultivated cropland acres in the sediment targeted areas in Pomona Lake Watershed (**Table 13**). Land use in the sediment targeted area does make a difference in the amount of sediment entering the waterways. Cropland, local streambanks and riparian areas are all highly susceptible to runoff and erosion during rainfall events.

Table 13. Land Use in the Sediment Targeted Areas

Sediment Targeted Area Land Use in the Pomona Lake Watershed							
Land Use	Acres in Targeted HUC 12: 102901010...					Total Acres	% of Targeted Area
	203	204	205	206	207		
Grassland/Herbaceous	12,754	8,721	10,480	9,196	10,399	51,550	37.01%
Pasture/Hay	4,115	8,054	7,547	3,960	10,800	34,476	24.75%
Cultivated Crops	4,868	5,737	8,736	2,228	9,061	30,630	21.99%
Deciduous Forest	1,597	1,767	2,085	1,756	3,066	10,271	7.37%
Urban Open Space	956	1,133	1,401	759	1,273	5,522	3.96%
Open Water	71	182	102	1,625	1,339	3,319	2.38%
Urban Low Density	110	399	685	297	527	2,018	1.45%
Woody Wetlands	157	29	128	399	114	827	0.59%
Urban Medium Density	71	102	106	19	85	383	0.27%
Mixed Forest	16	14	6	26	38	100	0.07%
Herbaceous Wetlands	7	12	3	42	12	76	< 0.1%
Shrub/Scrub	6	10	4	9	19	48	< 0.1%
Urban High Density	< 1	8	26	3	2	39	< 0.1%
Barren Land	< 1	1	8	3	19	31	< 0.1%
Evergreen Forest	< 1	< 1	< 1	3	2	5	< 0.1%
Totals	**24,727**	**26,167**	**31,319**	**20,323**	**36,754**	**139,295**	99.86%

1. Cropland targeted for sediment reductions in the Pomona Lake Watershed

a. Targeted cropland areas for sediment reductions

Cropland BMPs will be implemented in the Pomona Lake Watershed to protect local streams and ultimately Pomona Lake itself, by reducing sediment loss.

Cropland BMPs will be implemented in the following five HUC 12s:

- 102901010**203**
- 102901010**204**
- 102901010**205**
- 102901010**206**
- 102901010**207**

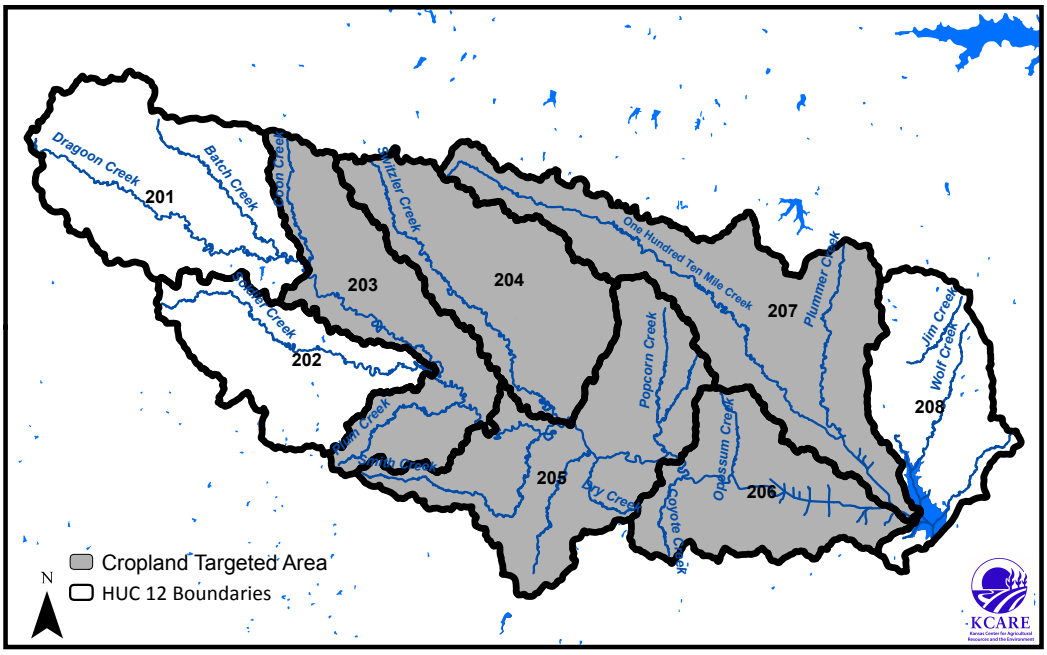


Figure 17. Cropland Targeted Area in the Pomona Lake Watershed

b. Cropland BMPs for sediment reductions in the Pomona Lake Watershed

Within the five HUC 12 areas, the following BMPs will be implemented to reduce soil erosion and sediment loss from crop fields:

- adopt no-till cultivation;
- create nutrient management plans;
- utilize cover crops;
- build new and/or revamp terraces;
- establish grassed waterways;
- establish buffer strips along crop fields; and
- establish permanent vegetation.

Table 14. Cropland BMPs Needed to Reduce Sediment Loss

BMPs to Prevent / Reduce Sediment Runoff and Erosion			
Protection Measures for:	**Best Management Practices and Other Actions**	**Adoption Rate Goal**	**Acres Needing BMPs, (Annually)**
Cropland	No-till cultivation	22%	268
	Nutrient management plans	22%	268
	Utilize cover crops	22%	268
	Build new and revamp old terraces	12.5%	153
	Establish Grass Wateways	12.5%	153
	Establish buffers along crop fields	6%	77
	Establish permanent vegetation	3%	38

Table 15. Adoption Rates for Cropland BMPs to Address Sediment

Total Annual Adoption (treated acres), Cropland BMPs								
Year	No-Till	Nutrient Management Plans	Cover Crops	Terraces	Waterways	Buffers	Permanent Vegetation	Total Adoption
1	268	268	268	153	153	77	38	1,225
2	268	268	268	153	153	77	38	1,225
3	268	268	268	153	153	77	38	1,225
4	268	268	268	153	153	77	38	1,225
5	268	268	268	153	153	77	38	1,225
6	268	268	268	153	153	77	38	1,225
7	268	268	268	153	153	77	38	1,225
8	268	268	268	153	153	77	38	1,225
9	268	268	268	153	153	77	38	1,225
10	268	268	268	153	153	77	38	1,225
11	268	268	268	153	153	77	38	1,225
12	268	268	268	153	153	77	38	1,225
13	268	268	268	153	153	77	38	1,225
14	268	268	268	153	153	77	38	1,225
15	268	268	268	153	153	77	38	1,225
16	268	268	268	153	153	77	38	1,225
17	268	268	268	153	153	77	38	1,225
18	268	268	268	153	153	77	38	1,225
19	268	268	268	153	153	77	38	1,225
20	268	268	268	153	153	77	38	1,225
21	268	268	268	153	153	77	38	1,225
22	268	268	268	153	153	77	38	1,225
23	268	268	268	153	153	77	38	1,225
24	268	268	268	153	153	77	38	1,225
25	268	268	268	153	153	77	38	1,225
26	268	268	268	153	153	77	38	1,225
27	268	268	268	153	153	77	38	1,225
28	268	268	268	153	153	77	38	1,225
29	268	268	268	153	153	77	38	1,225
30	268	268	268	153	153	77	38	1,225
31	268	268	268	153	153	77	38	1,225
32	268	268	268	153	153	77	38	1,225
33	268	268	268	153	153	77	38	1,225
34	268	268	268	153	153	77	38	1,225
35	268	268	268	153	153	77	38	1,225
36	268	268	268	153	153	77	38	1,225
37	268	268	268	153	153	77	38	1,225
38	268	268	268	153	153	77	38	1,225
39	268	268	268	153	153	77	38	1,225
40	268	268	268	153	153	77	38	1,225

c. *Sediment load reductions from cropland BMP implementation*

The implementation of cropland BMPs on 1,225 acres per year in the five HUC 12s will result in a load reduction of 116,363 tons of soil saved at the end of this 40-year WRAPS plan (**Table 16**).

Table 16. Cumulative Sediment Load Reductions from Cropland BMPs

Cropland Sediment Load Reduction (tons)								
Year	No-Till	Nutrient Management Plans	Cover Crops	Terraces	Waterways	Buffers	Permanent Vegetation	Cumulative Load Reduction
1	1,050	350	560	240	320	200	190	2,909
2	2,099	700	1,120	480	640	400	380	5,818
3	3,149	1,050	1,679	720	960	600	570	8,727
4	4,199	1,400	2,239	960	1,280	800	760	11,636
5	5,248	1,749	2,799	1,200	1,599	1,000	950	14,545
6	6,298	2,099	3,359	1,440	1,919	1,200	1,140	17,454
7	7,348	2,449	3,919	1,679	2,239	1,400	1,330	20,363
8	8,397	2,799	4,479	1,919	2,559	1,599	1,520	23,273
9	9,447	3,149	5,038	2,159	2,879	1,799	1,709	26,182
10	10,497	3,499	5,598	2,399	3,199	1,999	1,899	29,091
11	11,546	3,849	6,158	2,639	3,519	2,199	2,089	32,000
12	12,596	4,199	6,718	2,879	3,839	2,399	2,279	34,909
13	13,646	4,549	7,278	3,119	4,159	2,599	2,469	37,818
14	14,695	4,898	7,837	3,359	4,479	2,799	2,659	40,727
15	15,745	5,248	8,397	3,599	4,798	2,999	2,849	43,636
16	16,795	5,598	8,957	3,839	5,118	3,199	3,039	46,545
17	17,844	5,948	9,517	4,079	5,438	3,399	3,229	49,454
18	18,894	6,298	10,077	4,319	5,758	3,599	3,419	52,363
19	19,944	6,648	10,637	4,559	6,078	3,799	3,609	55,272
20	20,993	6,998	11,196	4,798	6,398	3,999	3,799	58,181
21	22,043	7,348	11,756	5,038	6,718	4,199	3,989	61,090
22	23,093	7,698	12,316	5,278	7,038	4,399	4,179	63,999
23	24,142	8,047	12,876	5,518	7,358	4,599	4,369	66,908
24	25,192	8,397	13,436	5,758	7,678	4,798	4,559	69,818
25	26,242	8,747	13,996	5,998	7,997	4,998	4,748	72,727
26	27,291	9,097	14,555	6,238	8,317	5,198	4,938	75,636
27	28,341	9,447	15,115	6,478	8,637	5,398	5,128	78,545
28	29,391	9,797	15,675	6,718	8,957	5,598	5,318	81,454
29	30,440	10,147	16,235	6,958	9,277	5,798	5,508	84,363
30	31,490	10,497	16,795	7,198	9,597	5,998	5,698	87,272
31	32,540	10,847	17,354	7,438	9,917	6,198	5,888	90,181
32	33,589	11,196	17,914	7,678	10,237	6,398	6,078	93,090
33	34,639	11,546	18,474	7,917	10,557	6,598	6,268	95,999
34	35,689	11,896	19,034	8,157	10,877	6,798	6,458	98,908
35	36,738	12,246	19,594	8,397	11,196	6,998	6,648	101,817
36	37,788	12,596	20,154	8,637	11,516	7,198	6,838	104,726
37	38,838	12,946	20,713	8,877	11,836	7,398	7,028	107,635
38	39,887	13,296	21,273	9,117	12,156	7,598	7,218	110,544
39	40,937	13,646	21,833	9,357	12,476	7,797	7,408	113,454
40	41,987	13,996	22,393	9,597	12,796	7,997	7,598	116,363

2. Streambanks targeted for sediment reductions in the Pomona Lake Watershed

a. Targeted streambank areas for sediment reductions

Streambanks will be targeted in the Pomona Lake Watershed to reduce sediment loss. Stabilization BMPs will be implemented to reduce sediment (and nutrient) loading in the following three HUC 12s:

- 102901010**203**
- 102901010**205**
- 102901010**207**

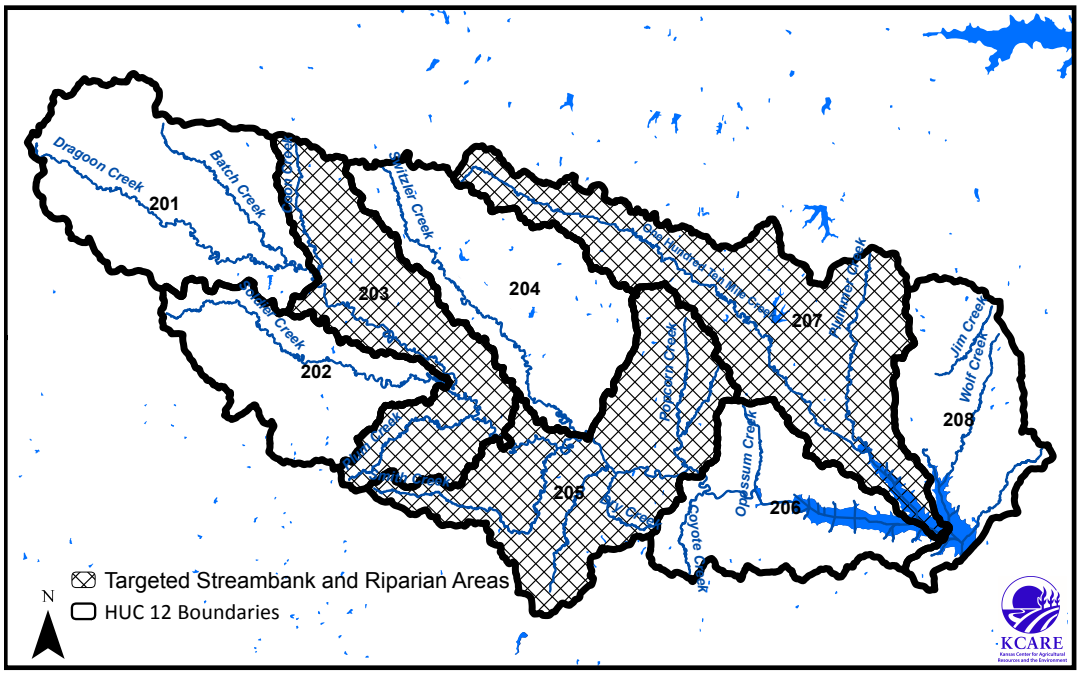


Figure 18. Streambank Targeted Area in the Pomona Lake Watershed

b. Streambank BMPs for sediment reductions in the Pomona Lake Watershed

Streambank Stabilization in the three HUC 12 areas will be implemented to reduce soil erosion and sediment loss from streambanks.

Table 17. Streambank BMPs Needed to Reduce Sediment Loss

BMPs to Prevent / Reduce Sediment Runoff and Erosion		
Protection Measures for:	**Best Management Practices and Other Actions**	**Adoption Rate Goal**
Streambanks	Streambank stabilization	260 feet per year

c. Sediment load reductions from streambank BMP implementation

The annual implementation of 260 feet of streambank stabilization in the three HUC 12s will result in a load reduction (soil saved) of 118,352 tons of soil saved at the end of the 40-year life of this WRAPS plan (**Table 18**).

Table 18. Sediment Load Reductions from Streambank BMPs

Streambank Sediment Load Reductions			
Year	Streambank Stabilization (feet)	Soil Load Reduction (tons)	Cumulative Erosion Reduction (tons)
1	260	2,959	2,959
2	260	2,959	5,918
3	260	2,959	8,876
4	260	2,959	11,835
5	260	2,959	14,794
6	260	2,959	17,753
7	260	2,959	20,712
8	260	2,959	23,670
9	260	2,959	26,629
10	260	2,959	29,588
11	260	2,959	32,547
12	260	2,959	35,506
13	260	2,959	38,464
14	260	2,959	41,423
15	260	2,959	44,382
16	260	2,959	47,341
17	260	2,959	50,300
18	260	2,959	53,258
19	260	2,959	56,217
20	260	2,959	59,176
21	260	2,959	62,135
22	260	2,959	65,094
23	260	2,959	68,052
24	260	2,959	71,011
25	260	2,959	73,970
26	260	2,959	76,929
27	260	2,959	79,888
28	260	2,959	82,846
29	260	2,959	85,805
30	260	2,959	88,764
31	260	2,959	91,723
32	260	2,959	94,682
33	260	2,959	97,640
34	260	2,959	100,599
35	260	2,959	103,558
36	260	2,959	106,517
37	260	2,959	109,476
38	260	2,959	112,434
39	260	2,959	115,393
40	260	2,959	118,352

3. Riparian areas targeted for sediment reductions in the Pomona Lake Watershed

a. Targeted riparian areas for sediment reductions

Riparian areas will be targeted in the Pomona Lake Watershed to reduce sediment loss. Restoration BMPs will take place to reduce sediment (and nutrient) loading in the following three HUC 12s:

- 102901010**203**

- 102901010**205**
- 102901010**207**

These are the same HUC12s targeted for streambank BMPs (**Figure 18**).

b. Riparian area BMPs for sediment reductions in the Pomona Lake Watershed

Riparian and restoration management BMPs will be implemented in the three HUC 12 areas to reduce soil erosion and sediment loss.

Table 19. Riparian Area BMPs Needed to Reduce Sediment Loss

BMPs to Prevent / Reduce Sediment Runoff and Erosion		
Protection Measures for:	**Best Management Practices and Other Actions**	**Adoption Rate Goal**
Riparian Areas	Riparian and Restoration Management: Installation of 66-foot vegetative buffers	30.5 acres per year

c. ***Sediment load reductions from riparian area BMP implementation***

It is assumed that 15 acres of cropland runoff will flow through one acre of the riparian buffer before it enters the stream. The annual implementation of 30.5 acres of riparian restoration in the three HUC 12s will result in a load reduction (soil saved) of 32,080 tons of soil at the end of the 40-year life of this WRAPS plan (**Table 20**).

Table 20. Sediment Load Reductions from Riparian Area BMPs

Riparian Restoration and Management Sediment Load Reduction				
Year	Acres of Riparian Restoration and Management	Treated Acres	Load Reduction (tons)	Cumulative Load Reduction (tons)
1	30.5	458	802	802
2	30.5	458	802	1,604
3	30.5	458	802	2,406
4	30.5	458	802	3,208
5	30.5	458	802	4,010
6	30.5	458	802	4,812
7	30.5	458	802	5,614
8	30.5	458	802	6,416
9	30.5	458	802	7,218
10	30.5	458	802	8,020
11	30.5	458	802	8,822
12	30.5	458	802	9,624
13	30.5	458	802	10,426
14	30.5	458	802	11,228
15	30.5	458	802	12,030
16	30.5	458	802	12,832
17	30.5	458	802	13,634
18	30.5	458	802	14,436
19	30.5	458	802	15,238
20	30.5	458	802	16,040
21	30.5	458	802	16,842
22	30.5	458	802	17,644
23	30.5	458	802	18,446
24	30.5	458	802	19,248
25	30.5	458	802	20,050
26	30.5	458	802	20,852
27	30.5	458	802	21,654
28	30.5	458	802	22,456
29	30.5	458	802	23,258
30	30.5	458	802	24,060
31	30.5	458	802	24,862
32	30.5	458	802	25,664
33	30.5	458	802	26,466
34	30.5	458	802	27,268
35	30.5	458	802	28,070
36	30.5	458	802	28,872
37	30.5	458	802	29,674
38	30.5	458	802	30,476
39	30.5	458	802	31,278
40	30.5	458	802	32,080

4. Meeting the siltation/sediment TMDL in the Pomona Lake Watershed

Adoption and implementation of sediment BMPs on cropland, streambanks and in riparian areas will result in a total sediment load reduction (soil saved) of **266,795 tons** at the conclusion of this 40-year WRAPs plan. The load reduction goal to meet the sediment TMDL is 248,275 tons, therefore the implementation of all sediment BMPs will exceed the goal by seven percent (**Table 21**).

Table 21. Meeting the Pomona Lake Watershed Sediment TMDL

Meeting the Silation/Sediment TMDL		
Best Management Practice	**Total Load Reduction**	**% of Siltation TMDL**
Cropland	116,363	47%
Streambank	118,352	48%
Riparian	32,080	13%
Total	**266,795**	**107%**
Sediment TMDL Reduction Goal: 248,275 tons		

Table 22. Meeting the Sediment TMDL: Load Reductions by Targeted Area

Meeting the Siltation/Sediment TMDL in Pomona Lake					
Year	Cropland (tons)	Streambank (tons)	Riparian (tons)	Total	% of TMDL
1	2,909	2,959	802	6,670	3%
2	5,818	5,918	1,604	13,340	5%
3	8,727	8,876	2,406	20,010	8%
4	11,636	11,835	3,208	26,679	11%
5	14,545	14,794	4,010	33,349	13%
6	17,454	17,753	4,812	40,019	16%
7	20,363	20,712	5,614	46,689	19%
8	23,273	23,670	6,416	53,359	21%
9	26,182	26,629	7,218	60,029	24%
10	29,091	29,588	8,020	66,699	27%
11	32,000	32,547	8,822	73,369	30%
12	34,909	35,506	9,624	80,038	32%
13	37,818	38,464	10,426	86,708	35%
14	40,727	41,423	11,228	93,378	38%
15	43,636	44,382	12,030	100,048	40%
16	46,545	47,341	12,832	106,718	43%
17	49,454	50,300	13,634	113,388	46%
18	52,363	53,258	14,436	120,058	48%
19	55,272	56,217	15,238	126,727	51%
20	58,181	59,176	16,040	133,397	54%
21	61,090	62,135	16,842	140,067	56%
22	63,999	65,094	17,644	146,737	59%
23	66,908	68,052	18,446	153,407	62%
24	69,818	71,011	19,248	160,077	64%
25	72,727	73,970	20,050	166,747	67%
26	75,636	76,929	20,852	173,416	70%
27	78,545	79,888	21,654	180,086	73%
28	81,454	82,846	22,456	186,756	75%
29	84,363	85,805	23,258	193,426	78%
30	87,272	88,764	24,060	200,096	81%
31	90,181	91,723	24,862	206,766	83%
32	93,090	94,682	25,664	213,436	86%
33	95,999	97,640	26,466	220,106	89%
34	98,908	100,599	27,268	226,775	91%
35	101,817	103,558	28,070	233,445	94%
36	104,726	106,517	28,872	240,115	97%
37	107,635	109,476	29,674	246,785	99%
38	110,544	112,434	30,476	253,455	102%
39	113,454	115,393	31,278	260,125	105%
40	116,363	118,352	32,080	266,795	107%
Load Reduction to meet Sediment TMDL (tons):					248,275

B. Nutrient Load Reductions in the Pomona Lake Watershed

The Pomona Lake Watershed has a "high" TMDL ranking for eutrophication (nitrogen and phosphorus) in Pomona Lake. The watershed contains four targeted areas for nutrient load reductions: **cropland, livestock, streambanks and riparian areas**. Adoption and implementation of nutrient BMPs will result in total nutrient load reductions of **504,647 pounds of nitrogen** and **69,717 pounds of phosphorus** at the conclusion of this 40-year WRAPs plan.

The following HUC 12s will be targeted to reduce nutrients from entering water segments in the Pomona Lake Watershed:

- 102901010**203**
- 102901010**204**
- 102901010**205**
- 102901010**206**
- 102901010**207**

There are 30,630 cultivated cropland acres and 86,026 grassland/pasture/hay acres in the nutrient targeted HUC 12s in the Pomona Lake Watershed (**Table 23**). Land use in the nutrient-targeted area does make a difference in the amount of nitrogen and phosphorus entering the water. Nutrients leach to these soil particles and enter nearby water segments. The nearly 62% of grassland/pasture/hay land in the targeted HUC 12s is the reason livestock areas have been added to the nutrient list of targeted areas. Cropland, streambanks and riparian areas are all highly susceptible to runoff and erosion during rainfall events. Variation in load reductions are due to differences in stocking rates and grazing duration in native grass pastures, cool season grass pastures and cropland.

Table 23. Land Use in the Nutrient Targeted Areas

Nutrient Targeted Area Land Use in the Pomona Lake Watershed							
Land Use	Acres in Targeted HUC 12: 102901010...					Total Acres	% of Targeted Area
	203	204	205	206	207		
Grassland/Herbaceous	12,754	8,721	10,480	9,196	10,399	51,550	37.01%
Pasture/Hay	4,115	8,054	7,547	3,960	10,800	34,476	24.75%
Cultivated Crops	4,868	5,737	8,736	2,228	9,061	30,630	21.99%
Deciduous Forest	1,597	1,767	2,085	1,756	3,066	10,271	7.37%
Urban Open Space	956	1,133	1,401	759	1,273	5,522	3.96%
Open Water	71	182	102	1,625	1,339	3,319	2.38%
Urban Low Density	110	399	685	297	527	2,018	1.45%
Woody Wetlands	157	29	128	399	114	827	0.59%
Urban Medium Density	71	102	106	19	85	383	0.27%
Mixed Forest	16	14	6	26	38	100	0.07%
Herbaceous Wetlands	7	12	3	42	12	76	< 0.1%
Shrub/Scrub	6	10	4	9	19	48	< 0.1%
Urban High Density	< 1	8	26	3	2	39	< 0.1%
Barren Land	< 1	1	8	3	19	31	< 0.1%
Evergreen Forest	< 1	< 1	< 1	3	2	5	< 0.1%
Totals	**24,727**	**26,167**	**31,319**	**20,323**	**36,754**	**139,295**	99.86%

It should be noted that nutrient and sediment targeted HUC 12s and BMPs in cropland, streambank and riparian areas are identical. Therefore, any BMPs implemented in those areas will simultaneously reduce both nutrient and sediment loading. The exception is the addition of targeted livestock areas for nutrients.

1. Cropland targeted for nutrient reductions in the Pomona Lake Watershed

a. Targeted cropland areas for nutrient reductions

Cropland BMPs will be implemented in the Pomona Lake Watershed to protect local streams and ultimately Pomona Lake itself, by reducing nutrient leaching and loading.

Cropland BMPs will be implemented in the following five HUC 12s:

- 102901010**203**
- 102901010**204**
- 102901010**205**
- 102901010**206**
- 102901010**207**

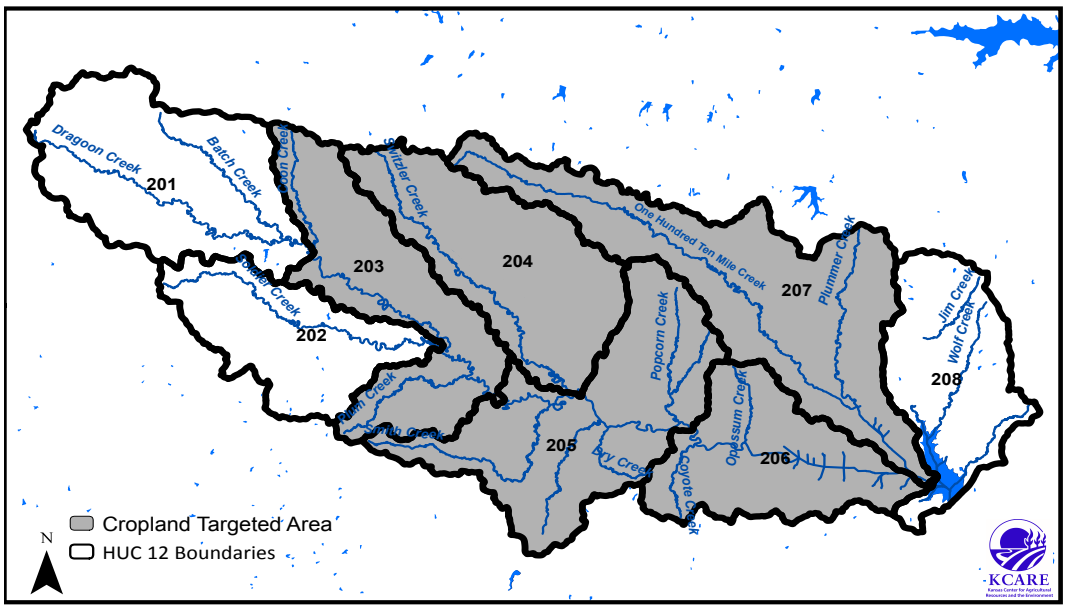


Figure 19. Cropland Targeted Area in the Pomona Lake Watershed

b. Cropland BMPs for nutrient reductions in the Pomona Lake Watershed

Within the five HUC 12 areas, the following BMPs will be implemented to reduce nutrient loading from crop fields:

- adopt no-till cultivation,
- create nutrient management plans,
- utilize cover crops,
- build new and/or restore terraces,
- establish grassed waterways,
- establish buffer strips along crop fields, and
- establish permanent vegetation.

Table 24. Cropland BMPs Needed to Reduce Nutrient Loading

BMPs to Prevent / Reduce Sediment Runoff and Erosion			
Protection Measures for:	**Best Management Practices and Other Actions**	**Adoption Rate Goal**	**Acres Needing BMPs, (Annually)**
Cropland	No-till cultivation	22%	268
	Nutrient management plans	22%	268
	Utilize cover crops	22%	268
	Build new and revamp old terraces	12.5%	153
	Establish grass waterways	12.5%	153
	Establish buffers along crop fields	6%	77
	Establish permanent vegetation	3%	38
Streambank	Streambank stabilization	260 feet per year	
Riparian Areas	Riparian and Restoration Management	30.5 acres per year	

Table 25. Adoption Rates for Cropland BMPs to Address Nutrients

Total Annual Adoption (treated acres), Cropland BMPs								
Year	No-Till	Nutrient Management Plans	Cover Crops	Terraces	Waterways	Buffers	Permanent Vegetation	Total Adoption
1	268	268	268	153	153	77	38	1,225
2	268	268	268	153	153	77	38	1,225
3	268	268	268	153	153	77	38	1,225
4	268	268	268	153	153	77	38	1,225
5	268	268	268	153	153	77	38	1,225
6	268	268	268	153	153	77	38	1,225
7	268	268	268	153	153	77	38	1,225
8	268	268	268	153	153	77	38	1,225
9	268	268	268	153	153	77	38	1,225
10	268	268	268	153	153	77	38	1,225
11	268	268	268	153	153	77	38	1,225
12	268	268	268	153	153	77	38	1,225
13	268	268	268	153	153	77	38	1,225
14	268	268	268	153	153	77	38	1,225
15	268	268	268	153	153	77	38	1,225
16	268	268	268	153	153	77	38	1,225
17	268	268	268	153	153	77	38	1,225
18	268	268	268	153	153	77	38	1,225
19	268	268	268	153	153	77	38	1,225
20	268	268	268	153	153	77	38	1,225
21	268	268	268	153	153	77	38	1,225
22	268	268	268	153	153	77	38	1,225
23	268	268	268	153	153	77	38	1,225
24	268	268	268	153	153	77	38	1,225
25	268	268	268	153	153	77	38	1,225
26	268	268	268	153	153	77	38	1,225
27	268	268	268	153	153	77	38	1,225
28	268	268	268	153	153	77	38	1,225
29	268	268	268	153	153	77	38	1,225
30	268	268	268	153	153	77	38	1,225
31	268	268	268	153	153	77	38	1,225
32	268	268	268	153	153	77	38	1,225
33	268	268	268	153	153	77	38	1,225
34	268	268	268	153	153	77	38	1,225
35	268	268	268	153	153	77	38	1,225
36	268	268	268	153	153	77	38	1,225
37	268	268	268	153	153	77	38	1,225
38	268	268	268	153	153	77	38	1,225
39	268	268	268	153	153	77	38	1,225
40	268	268	268	153	153	77	38	1,225

c. *Nutrient load reductions from cropland BMP implementation*

The implementation of cropland BMPs on 1,225 acres per year in the five HUC 12s will result in a nitrogen load reduction of 56,830 pounds and a phosphorus reduction of 40,729 pounds at the end of this 40-year WRAPS plan (**Tables 26 and 27**).

Table 26. Cumulative Nitrogen Load Reductions from Cropland BMP Implementation

Cropland Nitrogen Load Reduction (pounds)								
Year	No-Till	Nutrient Management Plans	Cover Crops	Terraces	Waterways	Buffers	Permanent Vegetation	Total Load Reduction
1	262	262	262	179	239	75	142	1,421
2	523	523	523	359	479	150	284	2,842
3	785	785	785	538	718	224	426	4,262
4	1,047	1,047	1,047	718	957	299	568	5,683
5	1,309	1,309	1,309	897	1,196	374	710	7,104
6	1,570	1,570	1,570	1,077	1,436	449	852	8,525
7	1,832	1,832	1,832	1,256	1,675	523	995	9,945
8	2,094	2,094	2,094	1,436	1,914	598	1,137	11,366
9	2,355	2,355	2,355	1,615	2,154	673	1,279	12,787
10	2,617	2,617	2,617	1,795	2,393	748	1,421	14,208
11	2,879	2,879	2,879	1,974	2,632	823	1,563	15,628
12	3,141	3,141	3,141	2,154	2,871	897	1,705	17,049
13	3,402	3,402	3,402	2,333	3,111	972	1,847	18,470
14	3,664	3,664	3,664	2,512	3,350	1,047	1,989	19,891
15	3,926	3,926	3,926	2,692	3,589	1,122	2,131	21,311
16	4,187	4,187	4,187	2,871	3,829	1,196	2,273	22,732
17	4,449	4,449	4,449	3,051	4,068	1,271	2,415	24,153
18	4,711	4,711	4,711	3,230	4,307	1,346	2,557	25,574
19	4,973	4,973	4,973	3,410	4,546	1,421	2,699	26,994
20	5,234	5,234	5,234	3,589	4,786	1,496	2,842	28,415
21	5,496	5,496	5,496	3,769	5,025	1,570	2,984	29,836
22	5,758	5,758	5,758	3,948	5,264	1,645	3,126	31,257
23	6,020	6,020	6,020	4,128	5,504	1,720	3,268	32,677
24	6,281	6,281	6,281	4,307	5,743	1,795	3,410	34,098
25	6,543	6,543	6,543	4,487	5,982	1,869	3,552	35,519
26	6,805	6,805	6,805	4,666	6,221	1,944	3,694	36,940
27	7,066	7,066	7,066	4,846	6,461	2,019	3,836	38,360
28	7,328	7,328	7,328	5,025	6,700	2,094	3,978	39,781
29	7,590	7,590	7,590	5,204	6,939	2,169	4,120	41,202
30	7,852	7,852	7,852	5,384	7,179	2,243	4,262	42,623
31	8,113	8,113	8,113	5,563	7,418	2,318	4,404	44,043
32	8,375	8,375	8,375	5,743	7,657	2,393	4,546	45,464
33	8,637	8,637	8,637	5,922	7,896	2,468	4,688	46,885
34	8,898	8,898	8,898	6,102	8,136	2,542	4,831	48,306
35	9,160	9,160	9,160	6,281	8,375	2,617	4,973	49,726
36	9,422	9,422	9,422	6,461	8,614	2,692	5,115	51,147
37	9,684	9,684	9,684	6,640	8,854	2,767	5,257	52,568
38	9,945	9,945	9,945	6,820	9,093	2,842	5,399	53,989
39	10,207	10,207	10,207	6,999	9,332	2,916	5,541	55,410
40	10,469	10,469	10,469	7,179	9,571	2,991	5,683	56,830

Table 27. Cumulative Phosphorus Reductions from Cropland BMP Implementation

Cropland Phosphorus Load Reduction (pounds)								
Year	No-Till	Nutrient Management Plans	Cover Crops	Terraces	Waterways	Buffers	Permanent Vegetation	Total Load Reduction
1	223	139	278	95	127	80	76	1,018
2	445	278	557	191	255	159	151	2,036
3	668	418	835	286	382	239	227	3,055
4	891	557	1,114	382	509	318	302	4,073
5	1,114	696	1,392	477	636	398	378	5,091
6	1,336	835	1,671	573	764	477	453	6,109
7	1,559	974	1,949	668	891	557	529	7,128
8	1,782	1,114	2,227	764	1,018	636	605	8,146
9	2,005	1,253	2,506	859	1,146	716	680	9,164
10	2,227	1,392	2,784	955	1,273	795	756	10,182
11	2,450	1,531	3,063	1,050	1,400	875	831	11,201
12	2,673	1,671	3,341	1,146	1,527	955	907	12,219
13	2,896	1,810	3,620	1,241	1,655	1,034	982	13,237
14	3,118	1,949	3,898	1,336	1,782	1,114	1,058	14,255
15	3,341	2,088	4,176	1,432	1,909	1,193	1,134	15,274
16	3,564	2,227	4,455	1,527	2,036	1,273	1,209	16,292
17	3,787	2,367	4,733	1,623	2,164	1,352	1,285	17,310
18	4,009	2,506	5,012	1,718	2,291	1,432	1,360	18,328
19	4,232	2,645	5,290	1,814	2,418	1,511	1,436	19,346
20	4,455	2,784	5,568	1,909	2,546	1,591	1,511	20,365
21	4,678	2,923	5,847	2,005	2,673	1,671	1,587	21,383
22	4,900	3,063	6,125	2,100	2,800	1,750	1,663	22,401
23	5,123	3,202	6,404	2,196	2,927	1,830	1,738	23,419
24	5,346	3,341	6,682	2,291	3,055	1,909	1,814	24,438
25	5,568	3,480	6,961	2,386	3,182	1,989	1,889	25,456
26	5,791	3,620	7,239	2,482	3,309	2,068	1,965	26,474
27	6,014	3,759	7,517	2,577	3,437	2,148	2,040	27,492
28	6,237	3,898	7,796	2,673	3,564	2,227	2,116	28,511
29	6,459	4,037	8,074	2,768	3,691	2,307	2,192	29,529
30	6,682	4,176	8,353	2,864	3,818	2,386	2,267	30,547
31	6,905	4,316	8,631	2,959	3,946	2,466	2,343	31,565
32	7,128	4,455	8,910	3,055	4,073	2,546	2,418	32,584
33	7,350	4,594	9,188	3,150	4,200	2,625	2,494	33,602
34	7,573	4,733	9,466	3,246	4,328	2,705	2,569	34,620
35	7,796	4,872	9,745	3,341	4,455	2,784	2,645	35,638
36	8,019	5,012	10,023	3,437	4,582	2,864	2,721	36,656
37	8,241	5,151	10,302	3,532	4,709	2,943	2,796	37,675
38	8,464	5,290	10,580	3,627	4,837	3,023	2,872	38,693
39	8,687	5,429	10,859	3,723	4,964	3,102	2,947	39,711
40	8,910	5,568	11,137	3,818	5,091	3,182	3,023	40,729

2. Livestock areas targeted for nutrient reduction in the Pomona Lake Watershed

a. Targeted livestock areas for nutrient reductions

Livestock area BMPs will be implemented in the Pomona Lake Watershed to protect local streams and ultimately Pomona Lake itself, by reducing nutrient leaching and loading.

Livestock area BMPs will be implemented in the following five HUC 12s:

- 102901010**203**
- 102901010**204**
- 102901010**205**
- 102901010**206**
- 102901010**207**

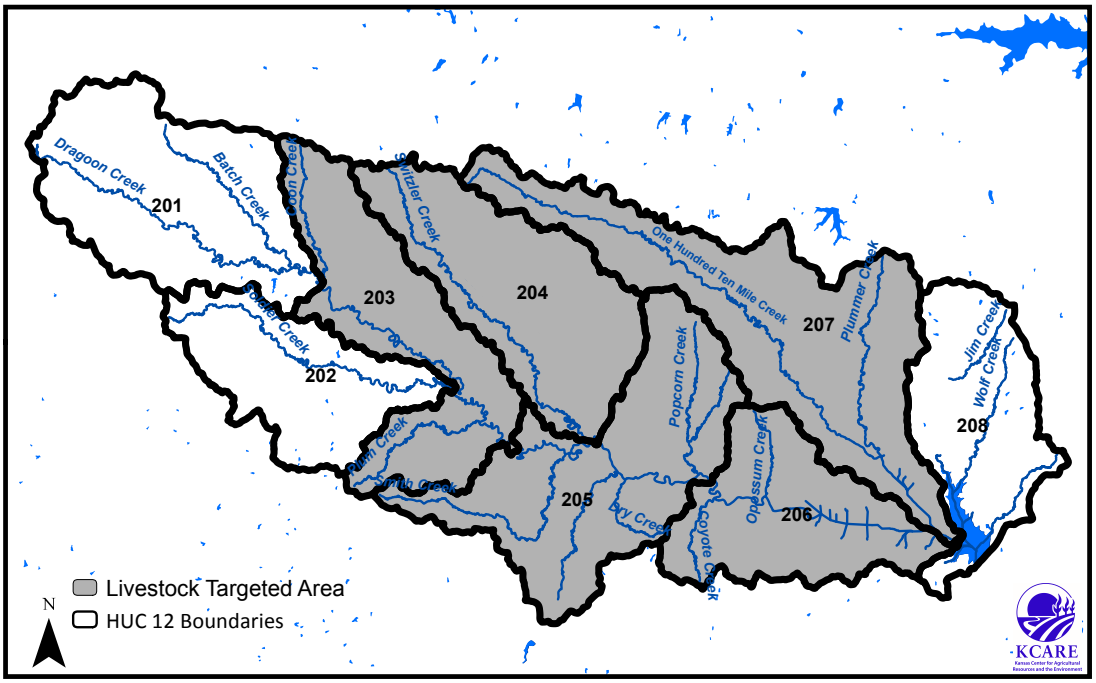


Figure 20. Livestock Targeted Area in the Pomona Lake Watershed

b. Livestock area BMPs for nutrient reductions in the Pomona Lake Watershed

Within the five HUC 12 areas, the following BMPs will be implemented to reduce nutrient loading from crop fields:

- establish vegetative filter strips along creeks,
- relocate small feedlots away from streams,
- relocate pasture feeding sites away from streams, and
- promote alternative watering sites away from streams.

Table 28. Nutrient BMP Adoption Rates in Livestock Areas

BMPs to Prevent / Reduce Nutrient Runoff and Erosion		
Protection Measures for:	**Best Management Practices and Other Actions**	**Adoption Rate Goal**
Livestock	Establish vegetative filter strips along creeks	1 site per year
	Relocate small feedlots away from streams	1 site per year
	Relocate pasture feeding sites away from streams	1 site every other year in cool season pastures
		1 site every other year native grass pastures
	Promote alternative watering sites away from streams	1 site every third year in cropland used for winter grazing of crop stubble
		1 site every third year in cool season pastures
		1 site every third year in native grass pastures

Table 29. Adoption Rates for Livestock BMPs to Address Nutrients

Livestock BMPs Adopted Each Year, projects							
	Vegetative Filter Strip	Relocated Feedlot	Relocate Pasture Feeding Site		Off-Stream Watering System		
Year			Native	Cool Season	Native	Cool Season	Cropland
1	1	1	1		1		
2	1	1		1		1	
3	1	1	1				1
4	1	1		1	1		
5	1	1	1			1	
6	1	1		1			1
7	1	1	1		1		
8	1	1		1		1	
9	1	1	1				1
10	1	1		1	1		
11	1	1	1			1	
12	1	1		1			1
13	1	1	1		1		
14	1	1		1		1	
15	1	1	1				1
16	1	1		1	1		
17	1	1	1			1	
18	1	1		1			1
19	1	1	1		1		
20	1	1		1		1	
21	1	1	1				1
22	1	1		1	1		
23	1	1	1			1	
24	1	1		1			1
25	1	1	1		1		
26	1	1		1		1	
27	1	1	1				1
28	1	1		1	1		
29	1	1	1			1	
30	1	1		1			1
31	1	1	1		1		
32	1	1		1		1	
33	1	1	1				1
34	1	1		1	1		
35	1	1	1			1	
36	1	1		1			1
37	1	1	1		1		
38	1	1		1		1	
39	1	1	1				1
40	1	1		1	1		
Total	**40**	**40**	**20**	**20**	**14**	**13**	**13**

c. *Nutrient load reductions from livestock BMP implementation*

The implementation of four livestock BMP projects per year in the five targeted HUC 12s will result in a nitrogen load reduction of 101,987 pounds and a phosphorus load reduction of 54,248 pounds at the end of this 40-year WRAPS plan (**Tables 30 and 31**).

Table 30. Cumulative Nitrogen Reductions from Livestock BMP Implementation

Livestock Load Reduction for Nitrogen (pounds)								
	Vegetative Filter Strip	Relocated Feedlot	Relocate Pasture Feeding Site		Off-Stream Watering System			Annual Reduction
Year			Native	Cool Season	Native	Cool Season	Cropland	
1	626	1,799	74		74			2,573
2	1,253	3,598		197		197		5,244
3	1,879	5,397	148				25	7,448
4	2,505	7,197		394	148			10,243
5	3,131	8,996	221			394		12,742
6	3,758	10,795		591			49	15,192
7	4,384	12,594	295		221			17,495
8	5,010	14,393		787		591		20,781
9	5,636	16,192	369				74	22,272
10	6,263	17,992		984	295			25,534
11	6,889	19,791	443			787		27,910
12	7,515	21,590		1,181			98	30,384
13	8,141	23,389	517		369			32,416
14	8,768	25,188		1,378		984		36,318
15	9,394	26,987	591				123	37,095
16	10,020	28,787		1,575	443			40,824
17	10,646	30,586	664			1,181		43,077
18	11,273	32,385		1,772			148	45,577
19	11,899	34,184	738		517			47,338
20	12,525	35,983		1,968		1,378		51,854
21	13,151	37,782	812				172	51,918
22	13,778	39,582		2,165	591			56,115
23	14,404	41,381	886			1,575		58,245
24	15,030	43,180		2,362			197	60,769
25	15,656	44,979	960		664			62,259
26	16,283	46,778		2,559		1,772		67,391
27	16,909	48,577	1,033				221	66,741
28	17,535	50,376		2,756	738			71,405
29	18,161	52,176	1,107			1,968		73,413
30	18,788	53,975		2,953			246	75,961
31	19,414	55,774	1,181		812			77,181
32	20,040	57,573		3,149		2,165		82,928
33	20,666	59,372	1,255				271	81,564
34	21,293	61,171		3,346	886			86,696
35	21,919	62,971	1,329			2,362		88,580
36	22,545	64,770		3,543			295	91,153
37	23,171	66,569	1,402		960			92,102
38	23,798	68,368		3,740		2,559		98,464
39	24,424	70,167	1,476				320	96,387
40	25,050	71,966		3,937	1,033			101,987

Table 31. Cumulative Phosphorus Reductions from Livestock BMP Implementation

Livestock Load Reduction for Phosphorus (pounds)								
	Vegetative Filter Strip	Relocated Feedlot	Relocate Pasture Feeding Site		Off-Stream Watering System			Annual Reduction
Year			Native	Cool Season	Native	Cool Season	Cropland	
1	333	957	39		39			**1,369**
2	666	1,914		105		105		**2,790**
3	999	2,871	79				13	**3,962**
4	1,332	3,828		209	79			**5,448**
5	1,666	4,785	118			209		**6,778**
6	1,999	5,742		314			26	**8,081**
7	2,332	6,699	157		118			**9,306**
8	2,665	7,656		419		314		**11,054**
9	2,998	8,613	196				39	**11,847**
10	3,331	9,570		524	157			**13,582**
11	3,664	10,527	236			419		**14,846**
12	3,997	11,484		628			52	**16,162**
13	4,330	12,441	275		196			**17,243**
14	4,664	13,398		733		524		**19,318**
15	4,997	14,355	314				65	**19,731**
16	5,330	15,312		838	236			**21,715**
17	5,663	16,269	353			628		**22,913**
18	5,996	17,226		942			79	**24,243**
19	6,329	18,183	393		275			**25,180**
20	6,662	19,140		1,047		733		**27,582**
21	6,995	20,097	432				92	**27,616**
22	7,328	21,054		1,152	314			**29,848**
23	7,662	22,011	471			838		**30,981**
24	7,995	22,968		1,256			105	**32,324**
25	8,328	23,925	510		353			**33,117**
26	8,661	24,882		1,361		942		**35,846**
27	8,994	25,839	550				118	**35,501**
28	9,327	26,796		1,466	393			**37,982**
29	9,660	27,753	589			1,047		**39,049**
30	9,993	28,710		1,571			131	**40,405**
31	10,326	29,667	628		432			**41,054**
32	10,660	30,624		1,675		1,152		**44,111**
33	10,993	31,581	667				144	**43,385**
34	11,326	32,538		1,780	471			**46,115**
35	11,659	33,495	707			1,256		**47,117**
36	11,992	34,452		1,885			157	**48,486**
37	12,325	35,409	746		510			**48,991**
38	12,658	36,366		1,989		1,361		**52,375**
39	12,991	37,323	785				170	**51,270**
40	13,325	38,280		2,094	550			**54,248**

3. Streambanks targeted for nutrient reductions in the Pomona Lake Watershed

a. Targeted streambank areas for nutrient reductions

Streambanks will be targeted in the Pomona Lake Watershed to reduce nutrient loading in nearby water segments. Stabilization BMPs will be implemented to reduce nutrient loading in addition to sediment erosion in the following three HUC 12s:

- 102901010**203**
- 102901010**205**
- 102901010**207**

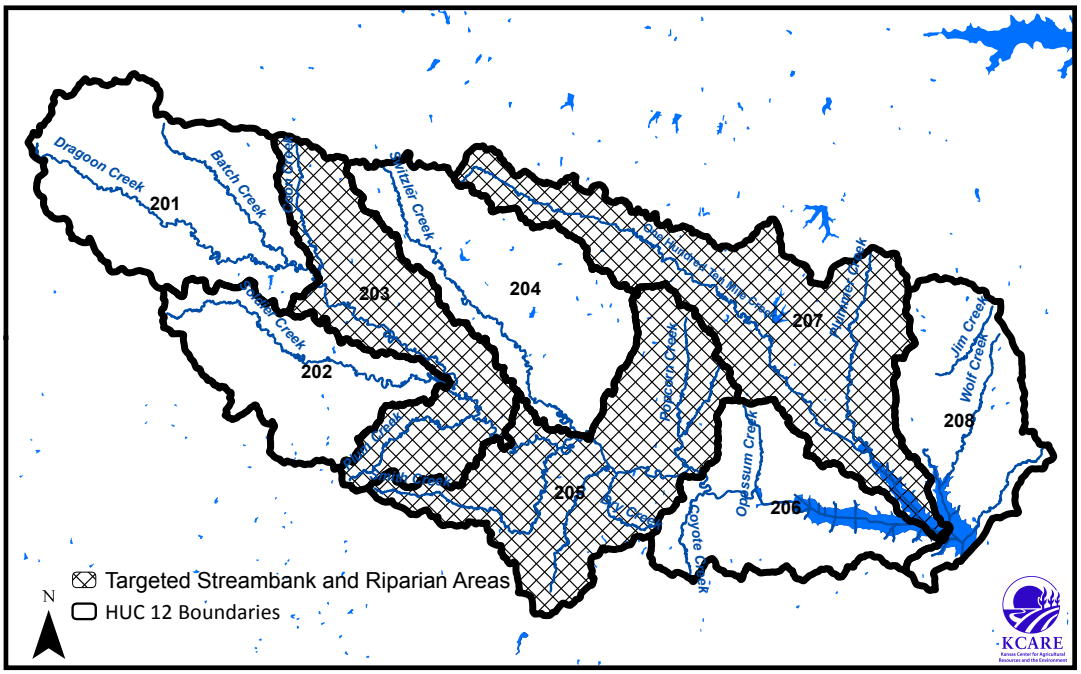


Figure 21. Streambank Targeted Area in the Pomona Lake Watershed

b. Streambank BMPs for nutrient reductions in the Pomona Lake Watershed

Streambank stabilization in the three HUC 12 areas will be implemented to reduce nutrient loading resulting from sediment runoff and streambank erosion.

Table 32. Streambank BMPs Needed to Reduce Nutrient Loading

BMPs to Prevent / Reduce Nutrient Runoff and Erosion		
Protection Measures for:	**Best Management Practices and Other Actions**	**Adoption Rate Goal**
Streambank	Streambank stabilization	260 feet per year

c. Nutrient load reductions from streambank BMP implementation

The annual implementation of 260 feet of streambank stabilization in the three HUC 12s will result in a nitrogen load reduction of 333,738 pounds and a phosphorus load reduction of 177,520 pounds at the end of the 40-year life of this WRAPS plan (**Tables 33 and 34**).

Table 33. Nitrogen Load Reductions from Streambank Stabilization

Streambank Load Reduction for Nitrogen			
Year	Streambank Stabilization (feet)	Nitrogen Reduction (lbs)	Cumulative N Load Reduction (lbs)
1	260	8,343	8,343
2	260	8,343	16,687
3	260	8,343	25,030
4	260	8,343	33,374
5	260	8,343	41,717
6	260	8,343	50,061
7	260	8,343	58,404
8	260	8,343	66,748
9	260	8,343	75,091
10	260	8,343	83,434
11	260	8,343	91,778
12	260	8,343	100,121
13	260	8,343	108,465
14	260	8,343	116,808
15	260	8,343	125,152
16	260	8,343	133,495
17	260	8,343	141,838
18	260	8,343	150,182
19	260	8,343	158,525
20	260	8,343	166,869
21	260	8,343	175,212
22	260	8,343	183,556
23	260	8,343	191,899
24	260	8,343	200,243
25	260	8,343	208,586
26	260	8,343	216,929
27	260	8,343	225,273
28	260	8,343	233,616
29	260	8,343	241,960
30	260	8,343	250,303
31	260	8,343	258,647
32	260	8,343	266,990
33	260	8,343	275,334
34	260	8,343	283,677
35	260	8,343	292,020
36	260	8,343	300,364
37	260	8,343	308,707
38	260	8,343	317,051
39	260	8,343	325,394
40	260	8,343	333,738

Table 34. Phosphorus Load Reductions from Streambank Stabilization

Streambank Load Reduction for Phosphorus			
Year	Streambank Stabilization (feet)	Phosphorous Reduction (lbs)	Cumulative P Load Reduction (lbs)
1	260	4,438	4,438
2	260	4,438	8,876
3	260	4,438	13,314
4	260	4,438	17,752
5	260	4,438	22,190
6	260	4,438	26,628
7	260	4,438	31,066
8	260	4,438	35,504
9	260	4,438	39,942
10	260	4,438	44,380
11	260	4,438	48,818
12	260	4,438	53,256
13	260	4,438	57,694
14	260	4,438	62,132
15	260	4,438	66,570
16	260	4,438	71,008
17	260	4,438	75,446
18	260	4,438	79,884
19	260	4,438	84,322
20	260	4,438	88,760
21	260	4,438	93,198
22	260	4,438	97,636
23	260	4,438	102,074
24	260	4,438	106,512
25	260	4,438	110,950
26	260	4,438	115,388
27	260	4,438	119,826
28	260	4,438	124,264
29	260	4,438	128,702
30	260	4,438	133,140
31	260	4,438	137,578
32	260	4,438	142,016
33	260	4,438	146,454
34	260	4,438	150,892
35	260	4,438	155,330
36	260	4,438	159,768
37	260	4,438	164,206
38	260	4,438	168,644
39	260	4,438	173,082
40	260	4,438	177,520

4. Riparian areas targeted for nutrient reductions in the Pomona Lake Watershed

a. Targeted riparian areas for nutrient reductions

Riparian areas will be targeted in the Pomona Lake Watershed to reduce nutrient loading. Restoration BMPs will take place to reduce nutrient in addition to sediment loading in the following three HUC 12s:

- 102901010**203**
- 102901010**205**
- 102901010**207**

These are the same HUC12s targeted for streambank BMPs (**Figure 21**).

b. Riparian area BMPs for nutrient reductions in the Pomona Lake Watershed

Riparian and restoration management BMPs will be implemented in the three HUC 12 areas to reduce nutrient loading.

Table 35. Riparian Area BMPs Needed to Reduce Nutrient Loading

BMPs to Prevent / Reduce Nutrient Runoff and Erosion		
Protection Measures for:	**Best Management Practices and Other Actions**	**Adoption Rate Goal**
Riparian Areas	Riparian and Restoration Management: Installation of 66-foot vegetative buffers	30.5 acres per year

c. Nutrient load reductions from riparian area BMP implementation

The annual implementation of 30.5 acres of riparian restoration in the three HUC 12s will result in a nitrogen load reduction of 49,933 pounds and a phosphorus load reduction of 26,560 pounds at the end of this 40-year WRAPS plan (**Tables 36 and 37**).

Table 36. Nitrogen Load Reductions from Riparian Area Restoration

Meeting the Nitrogen TMDL for Pomona				
Year	Acres of Riparian Restoration and Management	Treated Acres	Load Reduction (pounds)	Cumulative Load Reduction (pounds)
1	30.5	458	1,248	1,248
2	30.5	458	1,248	2,497
3	30.5	458	1,248	3,745
4	30.5	458	1,248	4,993
5	30.5	458	1,248	6,242
6	30.5	458	1,248	7,490
7	30.5	458	1,248	8,738
8	30.5	458	1,248	9,987
9	30.5	458	1,248	11,235
10	30.5	458	1,248	12,483
11	30.5	458	1,248	13,732
12	30.5	458	1,248	14,980
13	30.5	458	1,248	16,228
14	30.5	458	1,248	17,476
15	30.5	458	1,248	18,725
16	30.5	458	1,248	19,973
17	30.5	458	1,248	21,221
18	30.5	458	1,248	22,470
19	30.5	458	1,248	23,718
20	30.5	458	1,248	24,966
21	30.5	458	1,248	26,215
22	30.5	458	1,248	27,463
23	30.5	458	1,248	28,711
24	30.5	458	1,248	29,960
25	30.5	458	1,248	31,208
26	30.5	458	1,248	32,456
27	30.5	458	1,248	33,705
28	30.5	458	1,248	34,953
29	30.5	458	1,248	36,201
30	30.5	458	1,248	37,450
31	30.5	458	1,248	38,698
32	30.5	458	1,248	39,946
33	30.5	458	1,248	41,195
34	30.5	458	1,248	42,443
35	30.5	458	1,248	43,691
36	30.5	458	1,248	44,940
37	30.5	458	1,248	46,188
38	30.5	458	1,248	47,436
39	30.5	458	1,248	48,684
40	30.5	458	1,248	49,933

Table 37. Phosphorus Load Reductions from Riparian Area Restoration

Riparian Restoration and Management Phosphorus Load Reduction				
Year	Acres of Riparian Restoration and Management	Treated Acres	Load Reduction (pounds)	Cumulative Load Reduction (pounds)
1	30.5	458	664	664
2	30.5	458	664	1,328
3	30.5	458	664	1,992
4	30.5	458	664	2,656
5	30.5	458	664	3,320
6	30.5	458	664	3,984
7	30.5	458	664	4,648
8	30.5	458	664	5,312
9	30.5	458	664	5,976
10	30.5	458	664	6,640
11	30.5	458	664	7,304
12	30.5	458	664	7,968
13	30.5	458	664	8,632
14	30.5	458	664	9,296
15	30.5	458	664	9,960
16	30.5	458	664	10,624
17	30.5	458	664	11,288
18	30.5	458	664	11,952
19	30.5	458	664	12,616
20	30.5	458	664	13,280
21	30.5	458	664	13,944
22	30.5	458	664	14,608
23	30.5	458	664	15,272
24	30.5	458	664	15,936
25	30.5	458	664	16,600
26	30.5	458	664	17,264
27	30.5	458	664	17,928
28	30.5	458	664	18,592
29	30.5	458	664	19,256
30	30.5	458	664	19,920
31	30.5	458	664	20,584
32	30.5	458	664	21,248
33	30.5	458	664	21,912
34	30.5	458	664	22,576
35	30.5	458	664	23,240
36	30.5	458	664	23,904
37	30.5	458	664	24,568
38	30.5	458	664	25,232
39	30.5	458	664	25,896
40	30.5	458	664	26,560

5. Meeting the eutrophication/nutrient TMDL in the Pomona Lake Watershed

Adoption and implementation of nutrient BMPs on cropland and streambanks and in livestock areas and riparian areas will result in a total nitrogen load reduction of 542,487 pounds at the conclusion of this 40-year WRAPs plan. The load reduction goal to meet the nutrient TMDL is 504,647 pounds of nitrogen, therefore the implementation of all nutrient BMPs will exceed the goal by seven percent (**Table 38**). Adoption and implementation of

these BMPs also will result in a total phosphorus load reduction of 299,058 pounds at the conclusion of this 40-year WRAPs plan. The load reduction goal to meet the nutrient TMDL is 69,717 pounds of phosphorus, therefore the implementation of all nutrient BMPs will exceed the goal by 329% (**Table 39**).

Table 38. Meeting the Pomona Lake Watershed Nutrient Goal: Nitrogen

Meeting the Eutrophication/Nutrient TMDL: Nitrogen		
Best Management Practice	**Total Load Reduction**	**% of Nitrogen Reduction**
Cropland	56,830	11%
Livestock	101,987	20%
Streambank	333,738	66%
Riparian	49,933	10%
Total	542,487	107%
Nitrogen Reduction Goal: 504,647 pounds		

Table 39. Meeting the Pomona Lake Watershed Nutrient Goal: Phosphorus

Meeting the Eutrophication/Nutrient TMDL: Phosphorus		
Best Management Practice	**Total Load Reduction**	**% of Phosphorus Reduction**
Cropland	40,729	58%
Livestock	54,248	78%
Streambank	177,520	255%
Riparian	26,560	38%
Total	299,058	429%
Phosphorus Reduction Goal: 69,717 pounds		

Table 40. Meeting the Nutrient TMDL: Cumulative Nitrogen Reductions by Area

Meeting the Nitrogen Portion of the Eutrophication TMDL in Pomona Lake						
Year	Cropland (pounds)	Livestock (pounds)	Streambank (pounds)	Riparian (pounds)	Total	% of TMDL
1	1,421	2,573	8,343	1,248	13,586	3%
2	2,842	5,244	16,687	2,497	27,270	5%
3	4,262	7,448	25,030	3,745	40,486	8%
4	5,683	10,243	33,374	4,993	54,293	11%
5	7,104	12,742	41,717	6,242	67,805	13%
6	8,525	15,192	50,061	7,490	81,267	16%
7	9,945	17,495	58,404	8,738	94,582	19%
8	11,366	20,781	66,748	9,987	108,881	22%
9	12,787	22,272	75,091	11,235	121,384	24%
10	14,208	25,534	83,434	12,483	135,659	27%
11	15,628	27,910	91,778	13,732	149,047	30%
12	17,049	30,384	100,121	14,980	162,535	32%
13	18,470	32,416	108,465	16,228	175,579	35%
14	19,891	36,318	116,808	17,476	190,493	38%
15	21,311	37,095	125,152	18,725	202,282	40%
16	22,732	40,824	133,495	19,973	217,024	43%
17	24,153	43,077	141,838	21,221	230,290	46%
18	25,574	45,577	150,182	22,470	243,802	48%
19	26,994	47,338	158,525	23,718	256,575	51%
20	28,415	51,854	166,869	24,966	272,105	54%
21	29,836	51,918	175,212	26,215	283,181	56%
22	31,257	56,115	183,556	27,463	298,390	59%
23	32,677	58,245	191,899	28,711	311,533	62%
24	34,098	60,769	200,243	29,960	325,069	64%
25	35,519	62,259	208,586	31,208	337,572	67%
26	36,940	67,391	216,929	32,456	353,717	70%
27	38,360	66,741	225,273	33,705	364,079	72%
28	39,781	71,405	233,616	34,953	379,756	75%
29	41,202	73,413	241,960	36,201	392,776	78%
30	42,623	75,961	250,303	37,450	406,336	81%
31	44,043	77,181	258,647	38,698	418,569	83%
32	45,464	82,928	266,990	39,946	435,328	86%
33	46,885	81,564	275,334	41,195	444,977	88%
34	48,306	86,696	283,677	42,443	461,122	91%
35	49,726	88,580	292,020	43,691	474,018	94%
36	51,147	91,153	300,364	44,940	487,604	97%
37	52,568	92,102	308,707	46,188	499,565	99%
38	53,989	98,464	317,051	47,436	516,940	102%
39	55,410	96,387	325,394	48,684	525,875	104%
40	56,830	101,987	333,738	49,933	542,487	107%
Desired Load Reduction for Nitrogen (pounds):						504,647

Table 41. Meeting the Nutrient TMDL: Cumulative Phosphorus Load Reductions by Area

Meeting the Phosphorous Portion of the Eutrophication TMDL for Pomona Lake						
Year	Cropland (pounds)	Livestock (pounds)	Streambank (pounds)	Riparian (pounds)	Total	% of TMDL
1	1,018	1,369	4,438	664	7,489	11%
2	2,036	2,790	8,876	1,328	15,030	22%
3	3,055	3,962	13,314	1,992	22,323	32%
4	4,073	5,448	17,752	2,656	29,929	43%
5	5,091	6,778	22,190	3,320	37,379	54%
6	6,109	8,081	26,628	3,984	44,802	64%
7	7,128	9,306	31,066	4,648	52,147	75%
8	8,146	11,054	35,504	5,312	60,016	86%
9	9,164	11,847	39,942	5,976	66,929	96%
10	10,182	13,582	44,380	6,640	74,784	107%
11	11,201	14,846	48,818	7,304	82,168	118%
12	12,219	16,162	53,256	7,968	89,605	129%
13	13,237	17,243	57,694	8,632	96,806	139%
14	14,255	19,318	62,132	9,296	105,001	151%
15	15,274	19,731	66,570	9,960	111,535	160%
16	16,292	21,715	71,008	10,624	119,639	172%
17	17,310	22,913	75,446	11,288	126,957	182%
18	18,328	24,243	79,884	11,952	134,407	193%
19	19,346	25,180	84,322	12,616	141,464	203%
20	20,365	27,582	88,760	13,280	149,987	215%
21	21,383	27,616	93,198	13,944	156,141	224%
22	22,401	29,848	97,636	14,608	164,493	236%
23	23,419	30,981	102,074	15,272	171,747	246%
24	24,438	32,324	106,512	15,936	179,209	257%
25	25,456	33,117	110,950	16,600	186,122	267%
26	26,474	35,846	115,388	17,264	194,972	280%
27	27,492	35,501	119,826	17,928	200,747	288%
28	28,511	37,982	124,264	18,592	209,348	300%
29	29,529	39,049	128,702	19,256	216,536	311%
30	30,547	40,405	133,140	19,920	224,012	321%
31	31,565	41,054	137,578	20,584	230,781	331%
32	32,584	44,111	142,016	21,248	239,958	344%
33	33,602	43,385	146,454	21,912	245,353	352%
34	34,620	46,115	150,892	22,576	254,203	365%
35	35,638	47,117	155,330	23,240	261,325	375%
36	36,656	48,486	159,768	23,904	268,814	386%
37	37,675	48,991	164,206	24,568	275,439	395%
38	38,693	52,375	168,644	25,232	284,944	409%
39	39,711	51,270	173,082	25,896	289,959	416%
40	40,729	54,248	177,520	26,560	299,058	429%
Desired Load Reduction for Phosphorous (pounds):						69,717

8. Information and Education

The SLT has determined which Information and Education (I&E) activities are needed in the Pomona Lake Watershed. These activities are important because they provide watershed residents with a higher awareness of local watershed issues which leads to increased adoption rates of BMPs. All I&E activities and events are evaluated based on productivity, attendance, and achievement of objectives.

A. I&E Activities and Events Scheduled in the Pomona Lake Watershed

Listed below are the I&E activities and events along with their costs and possible sponsoring agencies. If all listed I&E events and activities take place, the total cost would be **$12,100**. *It is understood that funding from different sources will be needed if these activities are to take place.*

Table 42. I&E: Cropland BMP Education

Cropland BMP Implementation					
BMP	**Target Audience**	**Information/Education Activity/Event**	**Time Frame**	**Estimated Costs** ***(All costs associated with I&E activities must be approved through the Partnership Grant.)***	**Sponsor/Responsible Agency**
No-till and Cover Crops	Landowners and Farmers	Newsletter Article	Annual - Spring	No Charge	Conservation District and Kansas State Research and Extension (KSRE)
		One-on-One Meetings with Producers	Annual - ongoing	No Charge	Conservation District and KSRE
		Seasonal Information Meeting (planting)	Annual - Spring	$500	WRAPS Partnership Grant - Must be Approved
		Seasonal Information Meeting (harvesting)	Annual - Summer	$500	WRAPS Partnership Grant - Must be Approved
		Cover Crop Meeting	Annual	$500	Conservation District and KSRE
		Cover Crop Field Day/Demonstration/Test Plot	Annual - ongoing	$500	KSRE Watershed Specialist
		Scholarships for 5 producers to attend No-Till Water Conference	Annual - Winter	$1,500 ($275 per person)	No-till on the Plains
Nutrient Management	Farmers	Cost Share for 100 Soil Tests	Annual - ongoing	$1,000	Conservation District and KSRE
		Extension Newsletter Article	Annual - ongoing	No Charge	Conservation District and KSRE
		One-on-One Meetings with Producers	Annual - ongoing	Cost included with Technical Assistance for Watershed Specialist	KSRE Watershed Specialist
Terraces, Waterways, Ponds, Diversions	Farmers	Field Day showcasing latest designs, cost share	Annual - Winter	$200	Conservation District, KSRE and NRCS
Terraces, Waterways, Ponds, Diversions	Contractors	Meeting highlighting design specifications	Annual - Spring	$200	Conservation District, KSRE and NRCS

Table 43. I&E: Livestock BMP Education

Livestock BMP Implementation					
BMP	**Target Audience**	**Information/Education Activity/Event**	**Time Frame**	**Estimated Costs** ***(All costs associated with I&E activities must be approved through the Partnership Grant.)***	**Sponsor/Responsible Agency**
Vegetative Filter Strips	Landowners and Ranchers	Tour Field Day	Annual - Summer	Combined with Buffer Tour and Field Day	Watershed Forest Service (KFS), KSRE
Relocated Feedlot		Livestock Filter Strip and Feedlot Relocation Demonstration/Tour	Annual - Winter	$700	Conservation Districts, NRCS, Watershed Specialist
Relocate Pasture Feeding Site	Ranchers	Tour /Field Day	Annual - Summer	$500 per Tour or Field Day	Conservation Districts and Watershed Specialist
		Grazing Information Meeting	Annual - Fall	$250	Conservation Districts, NRCS, Watershed Specialist
Off-Stream Watering System	Ranchers	Tour/Field Day	Annual - Summer	$500 per Tour or Field Day	Conservation Districts and Watershed Specialist
		Grazing Information Meeting	Annual - Fall	Combined with relocating pasture feeding site meeting	Conservation Districts and Watershed Specialist

Table 44. I&E: Streambank and Riparian Area BMP Education

Streambank BMP Implementation					
BMP	**Target Audience**	**Information/Education Activity/Event**	**Time Frame**	**Estimated Costs** ***(All costs associated with I&E activities must be approved through the Partnership Grant.)***	**Sponsor/Responsible Agency**
Streambank Education	Landowners	Demonstration project focusing on streambank assessment methodology	Annual - Summer	$3,000	Kansas Alliance for Wetlands and Streams (KAWS)
Riparian Buffers		One on one technical assistance	Annual - Ongoing	No Charge	Conservation Districts, KSRE, NRCS
Field Borders		Field Day highlighting completed streambank assessment projects	Annual - Summer	$500 per field day	KFS, Watershed Forester

Table 45. I&E: Pomona Lake Watershed Resident Education

Watershed Wide Information and Education					
BMP	**Target Audience**	**Information/Education Activity/Event**	**Time Frame**	**Estimated Costs**	**Sponsor/Responsible Agency**
Education of Youth	Educators, K-12 Students	National Get Outdoors Day	Annual - Spring	$200	Conservation Districts, Corps of Engineers (USACE), KSRE
		Summer Program at Library	Annual - Summer	$200	Conservation Districts, KSRE
		Science Fair	Annual - Spring	$100	Conservation Districts, KSRE
		Arbor Day Tree Planting	Annual - Ongoing	$250	Conservation Districts, Westar Green Team, Watershed Forester
		Water Festivals	Annual - Ongoing	No Charge	Conservation Districts, KSRE
		Poster, essay and speech contests	Annual - Spring	$200	Conservation Districts, KSRE
		Envirothon	Annual - Spring	$250	Conservation Districts
Education of Adults	Educators, Adult Education	Newsletter Article	Annual - Ongoing	No Charge	Conservation Districts, KSRE
		Presentation at annual meeting	Annual – Winter	No Charge	Conservation Districts, KSRE
		Scholarship for teachers to KFAC college course	Annual - Ongoing	$600 ($150/hour)	Conservation Districts, KSRE
		Presentation at fair	Annual - Summer	$150	Conservation Districts, Watershed Specialist
		Media campaign to promote forestry practices (brochures, news releases, TV, radio, web-based)	Semiannnual - Ongoing	No Charge	Kansas Forest Service
Education of Watershed Residents	Watershed Residents	Meeting with Soil and Grassland Awards	Annual - Ongoing	No Charge	Conservation Districts
		Topeka Farm Show	Annual	$100	Conservation Districts
		Mother Earth News Fair	Annual - Fall	$100	Conservation Districts
		Scholarships for Women Managing the Farm Conference	Annual - Spring	$500 ($100 each)	Conservation Districts
		Watershed Display for area garden shows	Annual - Ongoing	No Charge	Conservation Districts, KSRE
		Media campaign to promote noxious weed control	Annual - Ongoing	$100	Conservation Districts, KSRE
Total annual cost for Information and Education if all events are implemented				**$13,100**	

B. Evaluation of Information and Education Activities

All service providers conducting I&E activities funded through the Pomona Lake Watershed WRAPS will be required to include an evaluation component in their project implementation proposals. Evaluation methods will vary based on the 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.

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 or activity, development of a basic logic model identifying long-, medium-, and short-term behavior changes or other expected outcomes 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, usefulness of information, etc.;
- pre- and post-surveys to determine the amount of knowledge gained, anticipated behavior changes, need for further learning, etc.; and
- follow-up interviews (e.g., one-on-one contacts, phone calls, or e-mails) with selected participants to gather more in-depth input regarding the effectiveness of the I&E activity.

9. Cost of Implementing BMPs and Funding Sources

The SLT reviewed all the recommended BMPs listed in this WRAPS plan for each individual impairment and determined which BMPs will receive implementation funding in each category (cropland, livestock, streambank, and riparian areas). An added benefit is that most of the targeted BMPs will be advantageous to more than one impairment. Below are expenses before and after cost share for implementing cropland, livestock, streambank and riparian area BMPs. Costs can be shared with any potential funding sources (**Table 54**). Cost derivations are located in the appendix.

A. Cropland BMP Implementation Costs

Table 46. Implementation Costs: Cropland BMP Costs Before Cost Share

Annual Cost* Before Cost-Share of Implementing Cropland BMPs								
Year	No-Till	Nutrient Management Plans	Cover Crops	Terraces	Waterways	Buffers	Permanent Vegetation	Total Cost
1	$20,822	$15,277	$13,401	$55,134	$19,144	$5,131	$7,275	$136,182
2	$21,447	$15,735	$13,803	$56,788	$19,718	$5,284	$7,493	$140,268
3	$22,090	$16,207	$14,217	$58,492	$20,310	$5,443	$7,718	$144,476
4	$22,753	$16,693	$14,643	$60,246	$20,919	$5,606	$7,949	$148,810
5	$23,435	$17,194	$15,083	$62,054	$21,546	$5,774	$8,188	$153,274
6	$24,138	$17,710	$15,535	$63,915	$22,193	$5,948	$8,433	$157,872
7	$24,862	$18,241	$16,001	$65,833	$22,859	$6,126	$8,686	$162,609
8	$25,608	$18,788	$16,481	$67,808	$23,544	$6,310	$8,947	$167,487
9	$26,377	$19,352	$16,976	$69,842	$24,251	$6,499	$9,215	$172,511
10	$27,168	$19,933	$17,485	$71,937	$24,978	$6,694	$9,492	$177,687
11	$27,983	$20,531	$18,009	$74,095	$25,728	$6,895	$9,776	$183,017
12	$28,822	$21,147	$18,550	$76,318	$26,499	$7,102	$10,070	$188,508
13	$29,687	$21,781	$19,106	$78,608	$27,294	$7,315	$10,372	$194,163
14	$30,578	$22,434	$19,679	$80,966	$28,113	$7,534	$10,683	$199,988
15	$31,495	$23,107	$20,270	$83,395	$28,957	$7,760	$11,004	$205,988
16	$32,440	$23,801	$20,878	$85,897	$29,825	$7,993	$11,334	$212,167
17	$33,413	$24,515	$21,504	$88,474	$30,720	$8,233	$11,674	$218,532
18	$34,415	$25,250	$22,149	$91,128	$31,642	$8,480	$12,024	$225,088
19	$35,448	$26,008	$22,814	$93,862	$32,591	$8,734	$12,385	$231,841
20	$36,511	$26,788	$23,498	$96,678	$33,569	$8,996	$12,756	$238,796
21	$37,607	$27,591	$24,203	$99,578	$34,576	$9,266	$13,139	$245,960
22	$38,735	$28,419	$24,929	$102,565	$35,613	$9,544	$13,533	$253,339
23	$39,897	$29,272	$25,677	$105,642	$36,681	$9,831	$13,939	$260,939
24	$41,094	$30,150	$26,447	$108,812	$37,782	$10,126	$14,357	$268,767
25	$42,327	$31,054	$27,241	$112,076	$38,915	$10,429	$14,788	$276,830
26	$43,596	$31,986	$28,058	$115,438	$40,083	$10,742	$15,231	$285,135
27	$44,904	$32,946	$28,900	$118,902	$41,285	$11,064	$15,688	$293,689
28	$46,251	$33,934	$29,767	$122,469	$42,524	$11,396	$16,159	$302,500
29	$47,639	$34,952	$30,660	$126,143	$43,800	$11,738	$16,644	$311,575
30	$49,068	$36,001	$31,579	$129,927	$45,114	$12,090	$17,143	$320,922
31	$50,540	$37,081	$32,527	$133,825	$46,467	$12,453	$17,657	$330,550
32	$52,056	$38,193	$33,503	$137,839	$47,861	$12,827	$18,187	$340,466
33	$53,618	$39,339	$34,508	$141,975	$49,297	$13,212	$18,733	$350,680
34	$55,227	$40,519	$35,543	$146,234	$50,776	$13,608	$19,295	$361,201
35	$56,883	$41,735	$36,609	$150,621	$52,299	$14,016	$19,874	$372,037
36	$58,590	$42,987	$37,708	$155,139	$53,868	$14,437	$20,470	$383,198
37	$60,348	$44,276	$38,839	$159,794	$55,484	$14,870	$21,084	$394,694
38	$62,158	$45,604	$40,004	$164,587	$57,148	$15,316	$21,716	$406,535
39	$64,023	$46,973	$41,204	$169,525	$58,863	$15,775	$22,368	$418,731
40	$65,943	$48,382	$42,440	$174,611	$60,629	$16,249	$23,039	$431,292
*3% Inflation		Total						$10,268,304

Table 47. Implementation Costs: Cropland BMP Costs After Cost Share

Annual Cost* After Cost-Share of Implementing Cropland BMPs								
Year	No-Till	Nutrient Management Plans	Cover Crops	Terraces	Waterways	Buffers	Permanent Vegetation	Total Cost
1	$12,701	$7,638	$5,360	$27,567	$9,572	$513	$3,637	$66,989
2	$13,082	$7,868	$5,521	$28,394	$9,859	$528	$3,746	$68,999
3	$13,475	$8,104	$5,687	$29,246	$10,155	$544	$3,859	$71,069
4	$13,879	$8,347	$5,857	$30,123	$10,459	$561	$3,975	$73,201
5	$14,295	$8,597	$6,033	$31,027	$10,773	$577	$4,094	$75,397
6	$14,724	$8,855	$6,214	$31,958	$11,096	$595	$4,217	$77,659
7	$15,166	$9,121	$6,400	$32,916	$11,429	$613	$4,343	$79,989
8	$15,621	$9,394	$6,592	$33,904	$11,772	$631	$4,473	$82,388
9	$16,090	$9,676	$6,790	$34,921	$12,125	$650	$4,608	$84,860
10	$16,572	$9,966	$6,994	$35,969	$12,489	$669	$4,746	$87,406
11	$17,070	$10,265	$7,204	$37,048	$12,864	$689	$4,888	$90,028
12	$17,582	$10,573	$7,420	$38,159	$13,250	$710	$5,035	$92,729
13	$18,109	$10,890	$7,642	$39,304	$13,647	$731	$5,186	$95,511
14	$18,652	$11,217	$7,872	$40,483	$14,057	$753	$5,342	$98,376
15	$19,212	$11,554	$8,108	$41,698	$14,478	$776	$5,502	$101,327
16	$19,788	$11,900	$8,351	$42,948	$14,913	$799	$5,667	$104,367
17	$20,382	$12,257	$8,602	$44,237	$15,360	$823	$5,837	$107,498
18	$20,993	$12,625	$8,860	$45,564	$15,821	$848	$6,012	$110,723
19	$21,623	$13,004	$9,125	$46,931	$16,295	$873	$6,192	$114,045
20	$22,272	$13,394	$9,399	$48,339	$16,784	$900	$6,378	$117,466
21	$22,940	$13,796	$9,681	$49,789	$17,288	$927	$6,569	$120,990
22	$23,628	$14,210	$9,972	$51,283	$17,807	$954	$6,766	$124,620
23	$24,337	$14,636	$10,271	$52,821	$18,341	$983	$6,969	$128,358
24	$25,067	$15,075	$10,579	$54,406	$18,891	$1,013	$7,179	$132,209
25	$25,819	$15,527	$10,896	$56,038	$19,458	$1,043	$7,394	$136,175
26	$26,594	$15,993	$11,223	$57,719	$20,041	$1,074	$7,616	$140,261
27	$27,392	$16,473	$11,560	$59,451	$20,643	$1,106	$7,844	$144,468
28	$28,213	$16,967	$11,907	$61,234	$21,262	$1,140	$8,080	$148,802
29	$29,060	$17,476	$12,264	$63,071	$21,900	$1,174	$8,322	$153,266
30	$29,932	$18,000	$12,632	$64,963	$22,557	$1,209	$8,572	$157,864
31	$30,830	$18,540	$13,011	$66,912	$23,233	$1,245	$8,829	$162,600
32	$31,754	$19,097	$13,401	$68,920	$23,930	$1,283	$9,094	$167,478
33	$32,707	$19,669	$13,803	$70,987	$24,648	$1,321	$9,366	$172,503
34	$33,688	$20,259	$14,217	$73,117	$25,388	$1,361	$9,647	$177,678
35	$34,699	$20,867	$14,644	$75,310	$26,149	$1,402	$9,937	$183,008
36	$35,740	$21,493	$15,083	$77,570	$26,934	$1,444	$10,235	$188,498
37	$36,812	$22,138	$15,535	$79,897	$27,742	$1,487	$10,542	$194,153
38	$37,916	$22,802	$16,002	$82,294	$28,574	$1,532	$10,858	$199,978
39	$39,054	$23,486	$16,482	$84,763	$29,431	$1,578	$11,184	$205,977
40	$40,226	$24,191	$16,976	$87,305	$30,314	$1,625	$11,519	$212,157
*3% Inflation		Total						$5,051,070

B. Livestock BMP Implementation Costs

Table 48. Implementation Costs: Livestock BMPs Before Cost Share

Annual Cost* before Cost-Share of Implementing Livestock BMPs								
Year	Vegetative Filter Strip	Relocated Feedlot	Relocate Pasture Feeding		Off-Stream Watering System			Annual Cost
			Native	Cool Season	Native	Cool Season	Cropland	
1	$900	$7,400	$2,900.00		$5,500			**$16,700**
2	$927	$7,622		$2,900.00		$5,500		**$16,949**
3	$955	$7,851	$2,987.00				$5,500	**$17,292**
4	$983	$8,086		$2,987.00	$5,665			**$17,722**
5	$1,013	$8,329	$3,077.00			$5,665		**$18,083**
6	$1,043	$8,579		$3,077.00			$5,665	**$18,364**
7	$1,075	$8,836	$3,169.00		$5,835			**$18,914**
8	$1,107	$9,101		$3,169.00		$5,835		**$19,212**
9	$1,140	$9,374	$3,264.00				$5,835	**$19,613**
10	$1,174	$9,655		$3,264.00	$6,010			**$20,104**
11	$1,210	$9,945	$3,362.00			$6,010		**$20,526**
12	$1,246	$10,243		$3,362.00			$6,010	**$20,861**
13	$1,283	$10,551	$3,463.00		$6,190			**$21,487**
14	$1,322	$10,867		$3,463.00		$6,190		**$21,842**
15	$1,361	$11,193	$3,567.00				$6,190	**$22,311**
16	$1,402	$11,529		$3,567.00	$6,376			**$22,874**
17	$1,444	$11,875	$3,674.00			$6,376		**$23,369**
18	$1,488	$12,231		$3,674.00			$6,376	**$23,768**
19	$1,532	$12,598	$3,784.00		$6,567			**$24,481**
20	$1,578	$12,976		$3,784.00		$6,567		**$24,905**
21	$1,626	$13,365	$3,897.00				$6,567	**$25,455**
22	$1,674	$13,766		$3,897.00	$6,764			**$26,102**
23	$1,724	$14,179	$4,014.00			$6,764		**$26,682**
24	$1,776	$14,605		$4,014.00			$6,764	**$27,159**
25	$1,830	$15,043	$4,135.00		$6,967			**$27,974**
26	$1,884	$15,494		$4,135.00		$6,967		**$28,480**
27	$1,941	$15,959	$4,259.00				$6,967	**$29,126**
28	$1,999	$16,438		$4,259.00	$7,176			**$29,872**
29	$2,059	$16,931	$4,387.00			$7,176		**$30,553**
30	$2,121	$17,439		$4,387.00			$7,176	**$31,122**
31	$2,185	$17,962	$4,518.00		$7,392			**$32,056**
32	$2,250	$18,501		$4,518.00		$7,392		**$32,660**
33	$2,318	$19,056	$4,654.00				$7,392	**$33,418**
34	$2,387	$19,627		$4,654.00	$7,613			**$34,281**
35	$2,459	$20,216	$4,793.00			$7,613		**$35,081**
36	$2,532	$20,823		$4,793.00			$7,613	**$35,762**
37	$2,608	$21,447	$4,937.00		$7,842			**$36,834**
38	$2,687	$22,091		$4,937.00		$7,842		**$37,556**
39	$2,767	$22,753	$5,085.00				$7,842	**$38,448**
40	$2,850	$23,436		$5,085.00	$8,077			**$39,448**
** 3% inflation*		**Total**						**$1,047,449**

Table 49. Implementation Costs: Livestock BMPs After Cost Share

Annual Cost* after Cost Share of Implementing Livestock BMPs								
Year	Vegetative Filter Strip	Relocated Feedlot	Relocate Pasture Feeding		Off-Stream Watering System			Annual Cost
			Native	Cool Season	Native	Cool Season	Cropland	
1	$450	$3,700	$1,450		$2,750			**$8,350**
2	$464	$3,811		$1,450		$2,750		**$8,475**
3	$477	$3,925	$1,494				$2,750	**$8,646**
4	$492	$4,043		$1,494	$2,833			**$8,861**
5	$506	$4,164	$1,538			$2,833		**$9,042**
6	$522	$4,289		$1,538			$2,833	**$9,182**
7	$537	$4,418	$1,584		$2,917			**$9,457**
8	$553	$4,551		$1,584		$2,917		**$9,606**
9	$570	$4,687	$1,632				$2,917	**$9,807**
10	$587	$4,828		$1,632	$3,005			**$10,052**
11	$605	$4,972	$1,681			$3,005		**$10,263**
12	$623	$5,122		$1,681			$3,005	**$10,431**
13	$642	$5,275	$1,731		$3,095			**$10,743**
14	$661	$5,434		$1,731		$3,095		**$10,921**
15	$681	$5,597	$1,783				$3,095	**$11,156**
16	$701	$5,764		$1,783	$3,188			**$11,437**
17	$722	$5,937	$1,837			$3,188		**$11,684**
18	$744	$6,116		$1,837			$3,188	**$11,884**
19	$766	$6,299	$1,892		$3,284			**$12,241**
20	$789	$6,488		$1,892		$3,284		**$12,453**
21	$813	$6,683	$1,949				$3,284	**$12,728**
22	$837	$6,883		$1,949	$3,382			**$13,051**
23	$862	$7,090	$2,007			$3,382		**$13,341**
24	$888	$7,302		$2,007			$3,382	**$13,580**
25	$915	$7,521	$2,067		$3,484			**$13,987**
26	$942	$7,747		$2,067		$3,484		**$14,240**
27	$970	$7,979	$2,129				$3,484	**$14,563**
28	$1,000	$8,219		$2,129	$3,588			**$14,936**
29	$1,030	$8,465	$2,193			$3,588		**$15,276**
30	$1,060	$8,719		$2,193			$3,588	**$15,561**
31	$1,092	$8,981	$2,259		$3,696			**$16,028**
32	$1,125	$9,250		$2,259		$3,696		**$16,330**
33	$1,159	$9,528	$2,327				$3,696	**$16,709**
34	$1,194	$9,814		$2,327	$3,807			**$17,141**
35	$1,229	$10,108	$2,397			$3,807		**$17,541**
36	$1,266	$10,411		$2,397			$3,807	**$17,881**
37	$1,304	$10,724	$2,469		$3,921			**$18,417**
38	$1,343	$11,045		$2,469		$3,921		**$18,778**
39	$1,384	$11,377	$2,543				$3,921	**$19,224**
40	$1,425	$11,718		$2,543	$4,038			**$19,724**
**** 3% inflation***		**Total**						**$523,725**

C. Streambank BMP Implementation Costs

Table 50. Implementation Costs: Streambank BMPs

Annual Costs* of Implementing Streambank BMPs		
Year	Streambank Stabilization (feet)	Cost*
1	260	$25,111
2	260	$25,864
3	260	$26,640
4	260	$27,439
5	260	$28,262
6	260	$29,110
7	260	$29,984
8	260	$30,883
9	260	$31,810
10	260	$32,764
11	260	$33,747
12	260	$34,759
13	260	$35,802
14	260	$36,876
15	260	$37,982
16	260	$39,122
17	260	$40,295
18	260	$41,504
19	260	$42,749
20	260	$44,032
21	260	$45,353
22	260	$46,713
23	260	$48,115
24	260	$49,558
25	260	$51,045
26	260	$52,576
27	260	$54,154
28	260	$55,778
29	260	$57,452
30	260	$59,175
31	260	$60,951
32	260	$62,779
33	260	$64,662
34	260	$66,602
35	260	$68,600
36	260	$70,658
37	260	$72,778
38	260	$74,961
39	260	$77,210
40	260	$79,527
*3% Inflation	Total	$1,893,386

D. Riparian Area BMP Implementation Costs

Table 51. Implementation Costs: Riparian Area BMPs Before and After Cost Share

Annual Costs* before and after Cost Share of Implementing Riparian Restoration and Management BMPs			
Year	Acres of Riparian Restoration and Management	Costs Before Cost Share	Cost After Cost Share
1	30.5	$30,533	$3,053
2	30.5	$31,449	$3,145
3	30.5	$32,392	$3,239
4	30.5	$33,364	$3,336
5	30.5	$34,365	$3,436
6	30.5	$35,396	$3,539
7	30.5	$36,458	$3,645
8	30.5	$37,552	$3,755
9	30.5	$38,678	$3,867
10	30.5	$39,839	$3,983
11	30.5	$41,034	$4,103
12	30.5	$42,265	$4,226
13	30.5	$43,533	$4,353
14	30.5	$44,839	$4,483
15	30.5	$46,184	$4,618
16	30.5	$47,569	$4,756
17	30.5	$48,997	$4,899
18	30.5	$50,466	$5,046
19	30.5	$51,980	$5,198
20	30.5	$53,540	$5,353
21	30.5	$55,146	$5,514
22	30.5	$56,800	$5,679
23	30.5	$58,504	$5,850
24	30.5	$60,260	$6,025
25	30.5	$62,067	$6,206
26	30.5	$63,929	$6,392
27	30.5	$65,847	$6,584
28	30.5	$67,823	$6,782
29	30.5	$69,857	$6,985
30	30.5	$71,953	$7,195
31	30.5	$74,112	$7,410
32	30.5	$76,335	$7,633
33	30.5	$78,625	$7,862
34	30.5	$80,984	$8,098
35	30.5	$83,413	$8,341
36	30.5	$85,916	$8,591
37	30.5	$88,493	$8,848
38	30.5	$91,148	$9,114
39	30.5	$93,882	$9,387
40	30.5	$96,699	$9,669
**3% inflation*	**Total**	**$2,302,227**	**$230,200**

E. Total Costs for BMP Implementation and Education

Table 52. BMP Implementation Total Costs: After Cost Share

Total Annual WRAPS Cost after Cost-Share* by Category						
Year	Cropland	Livestock	Streambank	Riparian	Information and Education	Total Annual Cost
1	$66,989	$8,350	$25,111	$3,053	$13,100	$116,603
2	$68,999	$8,475	$25,864	$3,145	$13,493	$119,975
3	$71,069	$8,646	$26,640	$3,239	$13,898	$123,492
4	$73,201	$8,861	$27,439	$3,336	$14,315	$127,152
5	$75,397	$9,042	$28,262	$3,436	$14,744	$130,881
6	$77,659	$9,182	$29,110	$3,539	$15,186	$134,677
7	$79,989	$9,457	$29,984	$3,645	$15,642	$138,717
8	$82,388	$9,606	$30,883	$3,755	$16,111	$142,743
9	$84,860	$9,807	$31,810	$3,867	$16,595	$146,938
10	$87,406	$10,052	$32,764	$3,983	$17,093	$151,297
11	$90,028	$10,263	$33,747	$4,103	$17,605	$155,746
12	$92,729	$10,431	$34,759	$4,226	$18,133	$160,278
13	$95,511	$10,743	$35,802	$4,353	$18,677	$165,086
14	$98,376	$10,921	$36,876	$4,483	$19,238	$169,894
15	$101,327	$11,156	$37,982	$4,618	$19,815	$174,898
16	$104,367	$11,437	$39,122	$4,756	$20,409	$180,092
17	$107,498	$11,684	$40,295	$4,899	$21,022	$185,399
18	$110,723	$11,884	$41,504	$5,046	$21,652	$190,810
19	$114,045	$12,241	$42,749	$5,198	$22,302	$196,534
20	$117,466	$12,453	$44,032	$5,353	$22,971	$202,275
21	$120,990	$12,728	$45,353	$5,514	$23,660	$208,245
22	$124,620	$13,051	$46,713	$5,679	$24,370	$214,434
23	$128,358	$13,341	$48,115	$5,850	$25,101	$220,765
24	$132,209	$13,580	$49,558	$6,025	$25,854	$227,226
25	$136,175	$13,987	$51,045	$6,206	$26,630	$234,043
26	$140,261	$14,240	$52,576	$6,392	$27,428	$240,898
27	$144,468	$14,563	$54,154	$6,584	$28,251	$248,020
28	$148,802	$14,936	$55,778	$6,782	$29,099	$255,397
29	$153,266	$15,276	$57,452	$6,985	$29,972	$262,951
30	$157,864	$15,561	$59,175	$7,195	$30,871	$270,666
31	$162,600	$16,028	$60,951	$7,410	$31,797	$278,786
32	$167,478	$16,330	$62,779	$7,633	$32,751	$286,971
33	$172,503	$16,709	$64,662	$7,862	$33,734	$295,470
34	$177,678	$17,141	$66,602	$8,098	$34,746	$304,264
35	$183,008	$17,541	$68,600	$8,341	$35,788	$313,278
36	$188,498	$17,881	$70,658	$8,591	$36,862	$322,490
37	$194,153	$18,417	$72,778	$8,848	$37,967	$332,165
38	$199,978	$18,778	$74,961	$9,114	$39,106	$341,938
39	$205,977	$19,224	$77,210	$9,387	$40,280	$352,078
40	$212,157	$19,724	$79,527	$9,669	$41,488	$362,564
*3% Inflation					Total	$8,686,137

10. Technical Assistance and Funding Sources

Technical assistance and various funding sources may be required to implement the BMPs and watershed education programs listed in the Pomona Lake Watershed WRAPS plan. Possible technical assistance providers and funding sources are presented in **Tables 53** and **54**.

Table 53. Potential Technical Assistance Providers for Plan Implementation

Technical Assistance to Aid in BMP Implementation		
BMPs To Be Implemented		**Technical Assistance**
Cropland	No-Till	DOC, FSA, KAWS, KDWPT, KFS, KSRE, Lake Region RC&D, NRCS and Watershed Specialist
	Nutrient Management	
	Cover Crops	
	Terraces	
	Waterways	
	Buffers	
	Establish Permanent Vegetation	
Livestock	Vegetative Filter Strip	
	Relocate Feedlot	
	Relocate Pasture Feeding Sites	
	Alternative Off Stream Watering Sites	
Streambank	Stabilization: Buffers, borders, restoration	
Riparian Areas	Restoration: Buffer implementation, management	

Table 54. Potential Funding Sources for Plan Implementation

Potential BMP Funding Sources	
Potential Funding Sources	**Potential Funding Programs**
Division of Conservation/Conservation Districts	State Cost Share Programs
Ducks Unlimited	
EPA/KDHE	319 Funding Grants
Kansas Alliance for Wetlands and Streams	
Kansas Department of Wildlife, Parks and Tourism	Partnering for Wildlife
Kansas Forest Service	
Kansas Wildlife Department	Kansas Reservoir Protection Initiative
Lake Region RC&D	
Natural Resources Conservation Service (NRCS)	Conservation Reserve Program (CRP)
	Environmental Quality Incentives Program (EQIP)
	Farmable Wetlands Program (FWP)
	Forestland Enhancement Program (FLEP)
	Grassland Reserve Program (GRP)
	State Acres for Wildlife Enhancement (SAFE)
	Regional Conservation Partnership Program (RCPP)
	Wetland Reserve Program (WRP)
	Wildlife Habitat Incentive Program (WHIP)
No-till on the Plains	
Quail Forever	
US Fish and Wildlife	

11. Measurable Milestones

The interim timeframe for all BMP implementation is 10 years from the date of publication of this report. Targeting and BMP implementation might shift over time in order to achieve TMDLs.

The estimated timeframe for meeting the **siltation TMDL** for Pomona Reservoir will be attained at year 38 of the WRAPS plan. After the siltation TMDL is achieved, the process will become one of protection instead of restoration.

The WRAPS estimated timeframe for reaching the **nitrogen portion of the eutrophication TMDL** in Pomona Reservoir will be year 38 of the WRAPS plan. However, the **phosphorus portion of the eutrophication TMDL** in Pomona Reservoir will be met in year 10 of the plan. After the nitrogen and phosphorus goals are achieved, the process will become one of protection instead of restoration.

Implementing the BMPs outlined in this plan to achieve the eutrophication TMDL will subsequently meet the dissolved oxygen TMDLs in Switzler and One Hundred Ten Mile Creeks.

A. Measurable Milestones for BMP Implementation

Milestones will be determined at the end of every five years by number of acres treated, projects installed, contacts made to watershed residents, and water quality parameters. The SLT will examine these criteria to determine if adequate progress has been made on BMP implementations to date. If they determine that adequate progress has not been made, they will readjust the implementation projects in order to achieve the TMDL by the end of 40 years, as stipulated in this WRAPS plan.

Table 55. Short-, Medium-, and Long-Term Goals for Cropland BMP Adoption

	Pomona Targeted Area Cropland BMP Adoption Milestones, acres								
	Year	No-Till	Nutrient Management Plans	Cover Crops	Terraces	Waterways	Buffers	Permanent Vegetation	Total Adoption
Short-Term	1	268	268	268	153	153	77	38	1,225
	2	268	268	268	153	153	77	38	1,225
	3	268	268	268	153	153	77	38	1,225
	4	268	268	268	153	153	77	38	1,225
	5	268	268	268	153	153	77	38	1,225
	Subtotal	*1,340*	*1,340*	*1,340*	*766*	*766*	*383*	*191*	*6,126*
	6	268	268	268	153	153	77	38	1,225
	7	268	268	268	153	153	77	38	1,225
	8	268	268	268	153	153	77	38	1,225
	9	268	268	268	153	153	77	38	1,225
	10	268	268	268	153	153	77	38	1,225
	Subtotal	*2,680*	*2,680*	*2,680*	*1,532*	*1,532*	*766*	*383*	*12,252*
Medium-Term	11	268	268	268	153	153	77	38	1,225
	12	268	268	268	153	153	77	38	1,225
	13	268	268	268	153	153	77	38	1,225
	14	268	268	268	153	153	77	38	1,225
	15	268	268	268	153	153	77	38	1,225
	Subtotal	*4,020*	*4,020*	*4,020*	*2,297*	*2,297*	*1,149*	*574*	*18,378*
	16	268	268	268	153	153	77	38	1,225
	17	268	268	268	153	153	77	38	1,225
	18	268	268	268	153	153	77	38	1,225
	19	268	268	268	153	153	77	38	1,225
	20	268	268	268	153	153	77	38	1,225
	Subtotal	*5,360*	*5,360*	*5,360*	*3,063*	*3,063*	*1,532*	*766*	*24,504*
Long-Term	21	268	268	268	153	153	77	38	1,225
	22	268	268	268	153	153	77	38	1,225
	23	268	268	268	153	153	77	38	1,225
	24	268	268	268	153	153	77	38	1,225
	25	268	268	268	153	153	77	38	1,225
	Subtotal	*6,700*	*6,700*	*6,700*	*3,829*	*3,829*	*1,914*	*957*	*30,630*
	26	268	268	268	153	153	77	38	1,225
	27	268	268	268	153	153	77	38	1,225
	28	268	268	268	153	153	77	38	1,225
	29	268	268	268	153	153	77	38	1,225
	30	268	268	268	153	153	77	38	1,225
	Subtotal	*8,040*	*8,040*	*8,040*	*4,595*	*4,595*	*2,297*	*1,149*	*36,756*
	31	268	268	268	153	153	77	38	1,225
	32	268	268	268	153	153	77	38	1,225
	33	268	268	268	153	153	77	38	1,225
	34	268	268	268	153	153	77	38	1,225
	35	268	268	268	153	153	77	38	1,225
	Subtotal	*9,380*	*9,380*	*9,380*	*5,360*	*5,360*	*2,680*	*1,340*	*42,882*
	36	268	268	268	153	153	77	38	1,225
	37	268	268	268	153	153	77	38	1,225
	38	268	268	268	153	153	77	38	1,225
	39	268	268	268	153	153	77	38	1,225
	40	268	268	268	153	153	77	38	1,225
	Total	***10,721***	***10,721***	***10,721***	***6,126***	***6,126***	***3,063***	***1,532***	***49,008***

Table 56. Short-, Medium-, and Long-Term Goals for Livestock BMP Adoption

	Livestock BMPs Adopted Each Year, projects							
	Year	Vegetative Filter Strip	Relocated Feedlot	Relocate Pasture Feeding Site		Off-Stream Watering System		
				Native	Cool Season	Native	Cool Season	Cropland
Short-Term	1	1	1	1		1		
	2	1	1		1		1	
	3	1	1	1				1
	4	1	1		1	1		
	5	1	1	1			1	
	Subtotal	*5*	*5*	*3*	*2*	*2*	*2*	*1*
	6	1	1		1			1
	7	1	1	1		1		
	8	1	1		1		1	
	9	1	1	1				1
	10	1	1		1	1		
	Subtotal	*10*	*10*	*5*	*5*	*4*	*3*	*3*
Medium-Term	11	1	1	1			1	
	12	1	1		1			1
	13	1	1	1		1		
	14	1	1		1		1	
	15	1	1	1				1
	Subtotal	*15*	*15*	*8*	*7*	*5*	*5*	*5*
	16	1	1		1	1		
	17	1	1	1			1	
	18	1	1		1			1
	19	1	1	1		1		
	20	1	1		1		1	
	Subtotal	*20*	*20*	*10*	*10*	*7*	*7*	*6*
Long-Term	21	1	1	1				1
	22	1	1		1	1		
	23	1	1	1			1	
	24	1	1		1			1
	25	1	1	1		1		
	Subtotal	*25*	*25*	*13*	*12*	*9*	*8*	*8*
	26	1	1		1		1	
	27	1	1	1				1
	28	1	1		1	1		
	29	1	1	1			1	
	30	1	1		1			1
	Subtotal	*30*	*30*	*15*	*15*	*10*	*10*	*10*
	31	1	1	1		1		
	32	1	1		1		1	
	33	1	1	1				1
	34	1	1		1	1		
	35	1	1	1			1	
	Subtotal	*35*	*35*	*18*	*17*	*12*	*12*	*11*
	36	1	1		1			1
	37	1	1	1		1		
	38	1	1		1		1	
	39	1	1	1				1
	40	1	1		1	1		
	Total	**40**	**40**	**20**	**20**	**14**	**13**	**13**

Table 57. Short-, Medium-, and Long-Term Goals for Streambank BMP Adoption

Streambank Measurable Milestones		
	Year	**Streambank Stabilization (feet)**
Short-Term	1	260
	2	260
	3	260
	4	260
	5	260
	Subtotal	*1,300*
	6	260
	7	260
	8	260
	9	260
	10	260
	Subtotal	*2,600*
Medium-Term	11	260
	12	260
	13	260
	14	260
	15	260
	Subtotal	*3,900*
	16	260
	17	260
	18	260
	19	260
	20	260
	Subtotal	*5,200*
Long-Term	21	260
	22	260
	23	260
	24	260
	25	260
	Subtotal	*6,500*
	26	260
	27	260
	28	260
	29	260
	30	260
	Subtotal	*7,800*
	31	260
	32	260
	33	260
	34	260
	35	260
	Subtotal	*9,100*
	36	260
	37	260
	38	260
	39	260
	40	260
	Total	**10,400**

Table 58. Short-, Medium-, and Long-Term Riparian Area BMP Adoption

Riparian Restoration and Management Measurable Milestones			
	Year	Acres of Riparian Restoration and Management	Treated Acres
Short-Term	1	30.5	458
	2	30.5	458
	3	30.5	458
	4	30.5	458
	5	30.5	458
	Subtotal	*152.5*	*2,290*
	6	30.5	458
	7	30.5	458
	8	30.5	458
	9	30.5	458
	10	30.5	458
	Subtotal	*305*	*4,580*
Medium-Term	11	30.5	458
	12	30.5	458
	13	30.5	458
	14	30.5	458
	15	30.5	458
	Subtotal	*457.5*	*6,870*
	16	30.5	458
	17	30.5	458
	18	30.5	458
	19	30.5	458
	20	30.5	458
	Subtotal	*610*	*9,160*
Long-Term	21	30.5	458
	22	30.5	458
	23	30.5	458
	24	30.5	458
	25	30.5	458
	Subtotal	*762.5*	*11,450*
	26	30.5	458
	27	30.5	458
	28	30.5	458
	29	30.5	458
	30	30.5	458
	Subtotal	*915*	*13,740*
	31	30.5	458
	32	30.5	458
	33	30.5	458
	34	30.5	458
	35	30.5	458
	Subtotal	*1,068*	*16,030*
	36	30.5	458
	37	30.5	458
	38	30.5	458
	39	30.5	458
	40	30.5	458
	Total	**1,220**	**18,320**

B. Benchmarks to Measure Water Quality and Social Progress

Over a 10- to 40-year time frame, the Pomona Lake Watershed WRAPS plan hopes to improve water quality throughout the watershed and in Pomona Lake. To monitor these improvements, measurements taken at Pomona Lake are important because the lake is the drainage endpoint of the watershed. Social indicators of success also will be examined by tracking traffic in Pomona Lake Park. A good example of a healthy lake ecosystem is frequent visits by the public to enjoy outdoor recreation at the lake and park.

After reviewing the criteria listed in **Table 59**, the SLT will assess and revise the overall strategy plan for the watershed every five years. 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, KSU or the Kansas City District Army Corps of Engineers, the following indicator and parameter criteria shall be used to assess progress toward successful implementation to abate pollutant loads.

Table 59. Benchmarks to Measure Water Quality Progress

Benchmarks to Measure Water Quality Progress		
Impairment Addressed	**Criteria to Measure Water Quality Progress**	**Information Source**
Sediment	Pomona Lake TSS < 4.66 mg/L and Secchi Disc Depth ≥ 0.7m	KDHE
	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 ≤ 10 µg/L	KDHE
	Pomona Lake: Secchi Disc Depth > 0.7m	KDHE
	Dragoon Creek: Maintain average BOD concentrations < 3.2 mg/L with no excursions < 5.0mg/L DO > 5.0 mg/L	KDHE
	One Hundred Ten Mile Creek: DO concentrations >5.0mg/L BOD average < 2.6 mg/L	KDHE
	Switzler Creek: DO concentrations >5.0mg/L BOD average < 2.6 mg/L	KDHE
Impairment Addressed	**Social Indicators to Measure Water Quality Progress**	**Information 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 in Dragoon, One Hundred Ten Mile 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	KSRE
	Number of acres of buffers, grassed waterways and terraces installed in the Cropland Targeted Area	NRCS

The goals of the Pomona Lake Watershed WRAPS plan will be to restore water quality for uses that support aquatic life, primary contact recreation and public water supply for Pomona Lake, Dragoon, One Hundred Ten Mile and Switzler Creeks and their tributaries. This restoration plan will take 40 years of BMP implementation.

C. Water Quality Milestones Used to Determine Improvements

The goal of the Pomona Lake WRAPS plan is to restore water quality for uses that support aquatic life, domestic water supply, and recreation for Pomona Lake. The plan specifically addresses the high-priority siltation and eutrophication TMDLs for Pomona Lake. In order to

reach the load reduction goals associated with the Pomona Lake impairments, a BMP implementation schedule spanning 40 years has been developed.

The BMPs included in this plan will be implemented throughout the targeted areas within the Pomona Lake watershed, including the Dragoon Creek, One Hundred Ten Mile Creek, and Switzler Creek sub-watersheds, since these are the three major tributaries to Pomona Lake. While two of the three 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 the additional water quality information associated with this plan, separate water quality milestones are also included for Dragoon Creek, One Hundred Ten 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 in the lake itself.

D. Water Quality Milestones for the Pomona Lake

As previously stated, in order to reach the load reduction goals for Pomona Lake, a BMP implementation schedule spanning 40 years has been developed. Several water quality milestones and indicators have been developed for Pomona Lake, as previously discussed. In addition to water quality measures such as concentrations of total nitrogen and 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 334 acre-feet/year. Pomona Lake has lost roughly 15% of its storage capacity in the past 18 years.[28] 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 reduction goals in this plan.

Long term water quality goals for various parameters monitored in Pomona Lake have been calculated by KDHE (**Table 60**). It should be noted that current TMDLs for Pomona Lake are slated to be reviewed by KDHE in the year 2022.

[28] Kansas Water Office, *Sedimentation in our Reservoirs: Causes and Solutions*, 2008. https://www.kwo.ks.gov/docs/default-source/reports-page/water-management/sedimentation-in-our-reservoirs-causes-and-solutions-2008.pdf?sfvrsn=2

Table 60. Water Quality Milestones for Pomona Lake[29]

Water Quality Milestones for Pomona Lake				
Parameter	Current Condition (2006-2015 Average)	Water Quality Milestones		
		Mid-term (2016-2021) Goal Average	Long-term (2022-2030) Goal Average	Current Condition to Long-term Goal
Chlorophyll *a* (µg/L)	12.2	11.6	10	18% Reduction
Total Phosphorus (µg/L)	63	54	45.3	28% Reduction
Total Nitrogen (mg/L)	0.8	0.685	0.571	29% Reduction
Total Suspended Solids (mg/L)	9.8	7.3	4.7	52% Reduction
Secchi Depth (m)	0.62	0.66	0.7	13% Increase

E. Water Quality Milestones for Dragoon, One Hundred Ten Mile and Switzler Creeks

While the primary focus of this plan is the high-priority siltation and eutrophication TMDLs for Pomona Lake, due to the BMP implementation plan for the targeted areas within the Pomona Lake Watershed, it is anticipated that water quality improvements also may be achieved in the major lake tributaries, including: Dragoon Creek, One Hundred Ten Mile Creek and Switzler Creek. The tables below include long-term water quality goals for sediment or total suspended solids (TSS) (**Table 61**), total nitrogen (TN) (**Table 62**), total phosphorus (TP) (**Table 63**) and dissolved oxygen (DO) (**Table 64**) in Dragoon Creek, One Hundred Ten Mile Creek and Switzler Creek[30]. Current TMDLs for the Pomona Lake Watershed tributaries are slated to be reviewed by KDHE in the year 2023.

Table 61. Sediment Water Quality Milestones in Tributaries

Sediment Water Quality Milestones for Dragoon, One Hundred Ten Mile and Switzler Creeks				
Sampling Site	Current Condition Median TSS (1990-2015)	5 Year TSS Goal Immproved Condition Median TSS (2016-2021)	Long-Term TSS Goal Improved Condition Median TSS (2022-2030)	Total TSS Reduction Needed (Current - 2030)
	µg/L (ppb)			
Dragoon Creek SC577	31	24	17.5	44%
One Hundred Ten Mile Creek SC633	18	14	10	44%
Switzler Creek SC687	27	21	15	44%

Table 62. Nitrogen Water Quality Milestones in Tributaries

Nitrogen Water Quality Milestones for Dragoon, One Hundred Ten Mile and Switzler Creeks				
Sampling Site	Current Condition Average TN (2006-2015)	5 Year TN Goal Improved Condition Median TSS (2016-2021)	Long-Term TN Goal Improved Condition Median TSS (2022-2030)	Total TN Reduction Needed (Current - 2030)
	mg/L (ppm)			
Dragoon Creek SC577	1.08	0.928	0.576	55%
One Hundred Ten Mile Creek SC633	1.53	1.44	0.896	55%
Switzler Creek SC687	1.14	1.37	0.851	55%

[29] Pomona Lake Water Quality Milestones provided by KDHE on January 9, 2019.
[30] Tributary Water Quality Milestones provided by KDHE on January 9, 2019.

Table 63. Phosphorus Water Quality Milestones in Tributaries

Phosphorus Water Quality Milestones for Dragoon, One Hundred Ten Mile and Switzler Creeks				
Sampling Site	Current Condition Average TP (2006-2015)	5 Year TP Goal Immproved Condition Median TSS (2016-2021)	Long-Term TP Goal Improved Condition Median TSS (2022-2030)	Total TP Reduction Needed (Current - 2030)
	µg/L (ppb)			
Dragoon Creek SC577	164	118	72	56%
One Hundred Ten Mile Creek SC633	177	127	78	56%
Switzler Creek SC687	248	179	109	56%

Table 64. Dissolved Oxygen Water Quality Milestones in Tributaries

Dissolved Oxygen Water Quality Milestones for Dragoon, One Hundred Ten Mile and Switzler Creeks			
Sampling Site	Current Condition # DO Samples < 5 mg/L (2006-2015)	5 Year DO Goal Improved Condition # DO Samples < 5 mg/L (2016-2021)	Long-Term DO Goal Improved Condition # DO Samples < 5 mg/L (2022-2030)
	# DO Samples < 5 mg/L (ppm)		
Dragoon Creek SC577	2	0	0
One Hundred Ten Mile Creek SC633	0	0	0
Switzler Creek SC687	3	0	0

12. Monitoring Water Quality

KDHE continues to monitor water quality in the Pomona Lake Watershed by maintaining the monitoring stations located within the watershed. **Figure 22** illustrates the locations of the monitoring sites within the Pomona Lake Watershed, as well as the BMP targeted areas that were identified and discussed in previous sections of this plan.

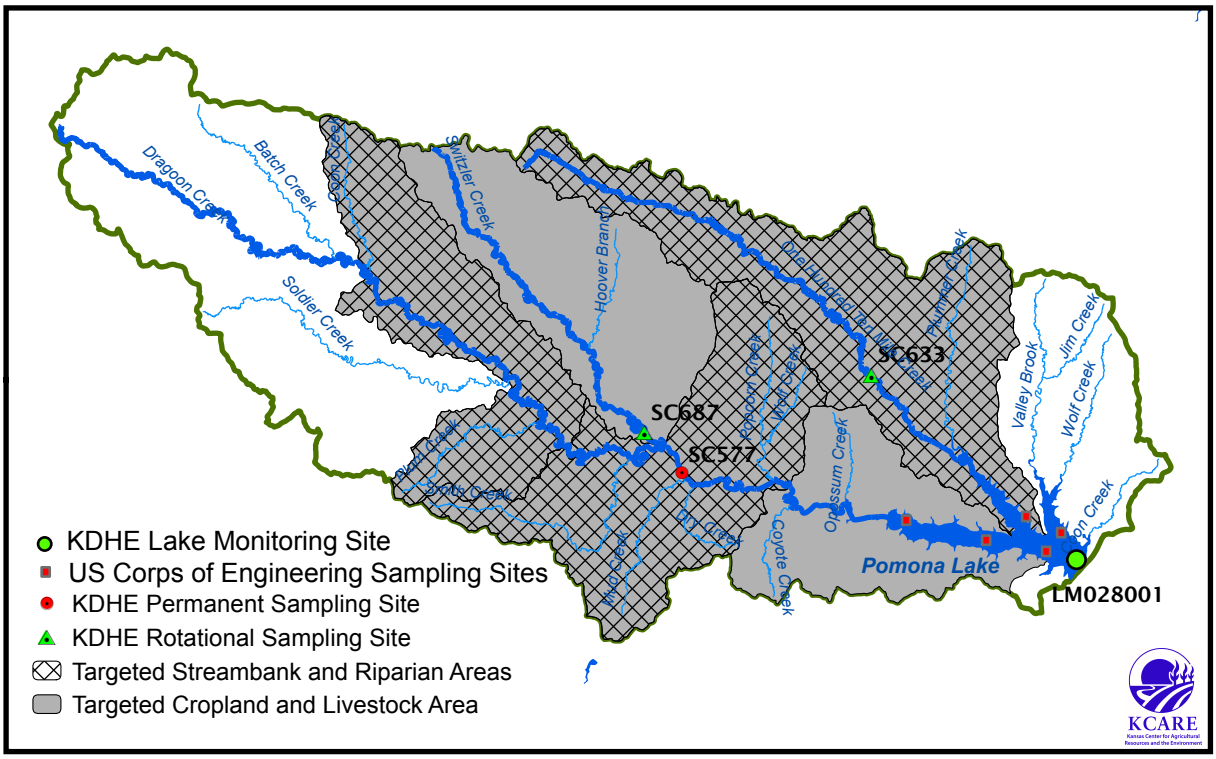


Figure 22. Monitoring Sites and Targeted Areas in the Pomona Lake Watershed

The map shows both permanent and two rotational KDHE monitoring stations. The permanent monitoring sites are continuously sampled, while the rotational sites typically are sampled every four years. The KDHE lake monitoring site typically is sampled every three years. KDHE sampling sites include:

- Station LM028001, in Pomona Lake;
- Station SC577, permanent site on Dragoon Creek near Burlingame;
- Station SC633, rotational site on One Hundred Ten Mile Creek near Scranton;
- Station SC687, rotational site on Switzler Creek near Burlingame;
- Station SPA354, Stream Probability Station, One Hundred Ten Mile Creek (2008);
- Station SPB048, Stream Probability Station: Switzler Creek (2010);
- Station SPB064, Stream Probability Station: Dragoon Creek (2010);
- Station SPB112, Stream Probability Station: Switzler Creek (2011); and
- Station SPB176, Stream Probability Station: Switzler Creek (2012).

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 SLT will request KDHE to review analyzed data from all monitoring sources on a yearly basis. Data collected in the targeted HUC 12s will be of special interest. Monitoring data will be used to direct the SLT in their evaluation of water quality progress.

The U.S. Army Corps of Engineers (USACE) conducts regular monitoring on Pomona Lake. Intensive sampling was conducted in 2005. USACE has five sampling points to include:

- Station PO-2, below the dam on One Hundred Ten Mile Creek (1996-2012 on record);
- Station PO-3, main basin near the dam (1996-2011 on record);
- Station PO-7, Dragoon Creek arm of Pomona Lake (1996-2011 on record);
- Station PO-11, shares Dragoon Creek location with USGS (1996-2011 on record);
- Station PO-12, One Hundred Ten Mile Creek arm of Pomona Lake (1996-2011 on record); and
- Station PO-14, Valley Brook arm of Pomona Lake (2007-2012 on record).

Typically, monitoring takes place May through September. Sampling data include 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, up to six different parameters are sampled, depending on the sampling site: water temperature, specific conductance, gage height, discharge, precipitation and turbidity. Samples are taken automatically 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 Kansas State University. 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 (e.g., 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 the reservoir or lake clarity, ease of boating and the physical appearance of the reservoir or lake.

13. Review of the WRAPS Plan

In the year 2024, this WRAPS plan will be reviewed and revised according to results acquired from monitoring data. At the present time, the SLT will review the following criteria in addition to any other concerns that may occur at the plan's future review:

The SLT will request a report from KDHE on the milestone achievements for sediment, nitrogen and phosphorus load reductions.

- Reports from KDHE on current and desired endpoints for water quality in Pomona Lake:
  - **Sediment:** In order to ensure Pomona Lake maintains the 100-year design capacity, the sedimentation rate must be reduced by over 22% or 77,508 tons/year. At the current sedimentation rate, the area weighted Secchi depth is 53 centimeters and the area weighted total suspended solids (TSS) concentration is 15.8 mg/L. A water quality-based target to meet the TMDL is a 70-centimeter Secchi depth and total TSS target of 4.66 mg/L. This is a 32% increase in Secchi depth and will indicate a 71% reduction in the TSS in the water column which equates to a 71% reduction in sediment loading.[31]
  - **Eutrophication:** The desired outcome will be to maintain summer chlorophyll *a* average concentrations below 10 µg/L, corresponding to a Carlson Trophic State Index of 53.2, with reductions focused on nitrogen and phosphorus. Based on the BATHTUB reservoir eutrophication model, the total nitrogen and total phosphorus entering Pomona Lake must be reduced. **Nitrogen** must be reduced to 412,416 pounds per year, which is a reduction of 55%. Meanwhile, **phosphorus** must be reduced to 54,814 pounds per year, which is a 56% reduction. [32]
- Reports from KDHE concerning revising the watershed TMDLs, including possible nutrient and/or sediment criteria, revised load allocations, and new wasteload allocations defined for point sources.
- Reports from KDHE and USACE on trends in water quality in Pomona Lake.

In turn, the SLT will provide various reports when necessary. These include:

- progress toward achieving the benchmarks listed in this report;
- progress toward achieving the BMP adoption rates in this report; and
- discussion of necessary adjustments and revisions needed for the targets listed in this plan.

[31] Kansas Department of Health and Environment, TMDL Section. Marais des Cygnes TMDL: Pomona Lake.
[32] Kansas Department of Health and Environment, TMDL Section. Marais des Cygnes TMDL: Pomona Lake.

14. Appendix

A. Potential Service Providers

Table 65. Service Provider List

Organization	Programs	Purpose	Technical or Financial Assistance	Phone	Website address
Environmental Protection Agency	Clean Water State Revolving Fund Program	Provides low cost loans to communities for water pollution control activities.	Financial	913-551-7003	www.epa.gov+F2:F18
	Watershed Protection	To conduct holistic strategies for restoring and protecting aquatic resources based on hydrology rather than political boundaries.			
Lake Region RC&D	Natural resource development and protection	Plan and Implement projects and programs that improve environmental quality of life.	Technical	785-945-6292	http://www.lakeregionrcd.com/
Kansas Alliance for Wetlands and Streams	Streambank Stabilization, Wetland Restoration Cost Share Programs	The Kansas Alliance for Wetlands and Streams (KAWS) organized in 1996 to promote the protection, enhancement, restoration and establishment wetlands and streams in Kansas.	Technical	785-463-5804 NE Chapter	www.kaws.org
Kansas Department of Agriculture	Watershed structures permitting.	Available for watershed districts and multipurpose small lakes development.	Technical and Financial	785-296-2933	www.agriculture.ks.gov
Kansas Department of Health and Environment	Nonpoint Source Pollution Program:	Provide funds for projects that will reduce nonpoint source pollution.	Technical and Financial	785-296-5500	www.kdheks.gov
	Municipal and livestock waste				
	Livestock waste Municipal waste	Compliance monitoring.			
	State Revolving Loan Fund	Makes low interest loans for projects to improve and protect water quality.			
Kansas Department of Wildlife, Parks and Tourism	Land and Water Conservation Funds	Provides funds to preserve develop and assure access to outdoor recreation.	Technical Funds	620-672-5911	https://ksoutdoors.com/Services/Private-Landowner-Assistance
	Conservation Easements for Riparian and Wetland Areas	To provide easements to secure and enhance quality areas in the state.		785-296-2780	
	Wildlife Habitat Improvement Program	To provide limited assistance for development of wildlife habitat.		620-672-5911	
	North American Waterfowl Conservation Act	To provide up to 50 percent cost share for the purchase and/or development of wetlands and wildlife habitat.		620-342-0658	
	MARSH program in coordination with Ducks Unlimited	May provide up to 100 percent of funding for small wetland projects.		620-672-5911	
	Chickadee Checkoff	Projects help with eagles, songbirds, threatened and endangered species, turtles, lizards, butterflies, and stream darters. Funding is an optional donation line item on the KS income tax form.			
	Walk In Hunting Program	Landowners receive a payment incentive to allow public hunting on their property.			
	F.I.S.H. Program	Landowners receive a payment incentive to allow public fishing access to their ponds and streams.			

Service Provider List, Continued

Organization	Programs	Purpose	Technical or Financial Assistance	Phone	Website address
Kansas Forest Service	Riparian and Wetland Protection Program	Work closely with other agencies to promote and assist with establishment of riparian forestland and manage existing stands.		785-532-3310	www.kansasforests.otg
Kansas Rural Center	The Heartland Network	The Center is committed to economically viable, environmentally sound and socially sustainable rural culture.	Technical and Financial	785-873-3431	http://www.kansasruralcenter.org
	Clean Water Farms - River Friendly Farms				
	Sustainable Food Systems Project				
	Cost share programs				
Kansas Rural Water Association	Technical assistance for Water Systems with Source Water Protection Planning	Provide education, technical assistance and leadership to public water and wastewater utilities to enhance the public health and to sustain Kansas' communities.	Technical	785-336-3760	http://www.krwa.net
Kansas State Research and Extension	Water Quality Programs	Provide programs, expertise and educational materials that relate to minimizing the impact of rural and urban activities on water quality.	Technical	785-532-7108	www.kcare.ksu.edu
	Waste Management Programs Kansas Center for Agricultural Resources and Environment (KCARE)				
	Kansas Center for Agricultural Resources and Environment (KCARE)				
	Kansas Local Government Water Quality Planning and Management	Provide guidance to local governments on water protection programs.		785-532-0416	www.ksre.ksu.edu/olg
	Rangeland and Natural Area Services (RNAS)	Reduce non-point source pollution emanating from Kansas grasslands.		785-532-2732	www.k- state.edu/waterlink/
Kansas Water Office	Public Information and Education	Provide information and education to the public on Kansas Water Resources	Technical and Financial	785-296-3185	www.kwo.org
No-Till on the Plains	Field days, seasonal meetings, tours and technical consulting.	Provide information and assistance concerning continuous no-till farming practices.	Technical	888-330-5142	www.notill.org

Service Provider List, Continued

Organization	Programs	Purpose	Technical or Financial Assistance	Phone	Website address
Division of Conservation and Conservation Districts	Water Resources Cost Share Program	Provide cost share assistance to landowners for establishment of water conservation practices.	Technical and Financial	Osage County Conservation District 785-828-3458	http://agriculture.ks.gov/divisions-programs/division-of-conservation
	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.			http://www.kacdnet.org/
	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.			
US Army Corps of Engineers	Planning Assistance to states	Assistance in development of plans for development, utilization and conservation of water and related land resources of drainage.	Technical	816-983-3157	www.usace.army.mil
	Environmental Restoration	Funding assistance for aquatic ecosystem restoration.		816-983-3157	
US Fish and and Wildife	Fish and Wildlife Enhancement Program	Supports field operations which include technical assistance on wetland design.	Technica	785-539-3474	www.fws.gov
	Private Lands Program	Contracts to restore, enhance, or create wetlands.		785-539-3474	
USDA Natural Resources Conservation Service (NRCS) and Farm Service Agency (FSA)	Conservation Compliance	Primarily for the technical assistance to develop conservation plans on cropland.	Technical and Financial	Osage County Conservation District 785-828-3458	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.			

B. BMP Definitions

1. Cropland BMPs

a. No-till

- A management system in which chemicals may be used instead of tillage for weed control and seedbed preparation.
- The soil surface is never disturbed, except for planting or drilling operations in a 100% no-till system; this maintains nutrient levels and aids in preventing nutrients from leaving the field due to runoff events.
- This system has 75% erosion reduction efficiency, 40% phosphorous reduction efficiency.

b. Nutrient management plan

- Managing the amount, source, placement, form and timing of the application of nutrients and soil amendments;
- Intensive soil testing; and
- 25% erosion and 25% P reduction efficiency.

c. Cover crops

- A cover crop is a crop of a specific plant grown primarily for the benefit of the soil rather than the crop yield.
- Cover crops commonly are used to suppress weeds, manage soil erosion, help build and improve soil fertility and quality, and control diseases and pests.
- Cover crops are typically grasses or legumes but may be comprised of other green plants.
- Cover crops can reduce erosion from wind and water, sequester carbon in plant biomass and soils to increase soil organic matter content, capture and recycle excess nutrients in the soil profile, promote biological nitrogen fixation, increase biodiversity, promote weed suppression, provide supplemental forage, promote soil moisture management, and reduce particulate emissions into the atmosphere.[33]
- Cover crops have 40% erosion efficiency, 50% phosphorus efficiency, and 25% nitrogen efficiency.

d. Terraces

- Earth embankment and/or channel constructed across the slope to intercept runoff water and trap soil;
- One of the oldest/most common BMPs; and
- 10-year lifespan, 30% erosion reduction efficiency, 30% phosphorous reduction efficiency.

e. Grassed waterways

- Grassed strip used as an outlet to prevent silt and gully formation;

[33] Kansas Department of Health and Environment. http://www.kdheks.gov/nps/downloads/AnnualReport2006.pdf

- Can also be used as outlets for water from terraces;
- On average for Kansas fields, a one-acre waterway will treat 10 acres of cropland; and
- 10-year lifespan, 40% erosion reduction efficiency, 40% phosphorous reduction efficiency.

f. Riparian buffer

- Area of field maintained in permanent vegetation to help reduce nutrient and sediment loss from agricultural fields, improve runoff water quality, and provide habitat for wildlife;
- On average for Kansas fields, a one-acre buffer treats 15 acres of cropland; and
- 50% erosion reduction efficiency, 50% phosphorous reduction efficiency.

g. Establish permanent vegetation

- Establishing permanent vegetation on sites that have or are expected to have high erosion rates, and on sites that have physical, chemical, or biological conditions that prevent the establishment of vegetation using normal practices;
- Establishing permanent vegetation can stabilize areas with existing or expected high rates of soil erosion by water and wind; and
- Establishing permanent vegetation can restore degraded sites that cannot be stabilized through normal methods.
- 95% erosion reduction efficiency, 95% phosphorus efficiency, and 95% nitrogen efficiency.

2. Livestock BMPs

a. Vegetative filter strip

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

b. 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.
- Pasture: move feeding sites in a pasture away from a stream, waterway, or body of water to increase the filtration and waste removal (i.e., move bale feeders away from the stream).
- Average P reduction: 30-80%

c. Alternative (off-stream) watering systems

- Watering system designed 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; and

- 10- to 25-year lifespan, with average P reduction of 30-98%, with greater efficiencies for limited stream access.

3. Streambank

Some streambank BMPs that may be utilized are riparian buffers, field borders, bottomland timber in wetlands and/or streambank restoration.

4. Riparian Area

Riparian area BMPs are 66-foot riparian buffers. Other BMPs, not included in this plan, are field borders and riparian area restoration.

C. Budget Derivations[34]

1. Cropland

Summarized derivation of cropland BMP cost estimates

- No-till: Cost is $78 per treated acre with a 39% cost share.
- Nutrient management plan: Cost is $57 per treated acre with a 50% cost share.
- Cover crops: Cost is $50 per treated acre with a 60% cost share.
- Terraces: Cost is $360 per treated acre with a 50% cost share.
- Grassed waterway: Cost is $125 per treated acre with a 50% cost share.
- Riparian vegetative buffer: Cost is $67 per treated acre with a 90% cost share.
- Establish permanent vegetation: Cost is $190 per treated acre with 50% cost share.

[34] All cost derivations were calculated using rates effective in February 2019.

2. **Livestock**

Summarized derivation of livestock BMP cost estimates

- Vegetative filter strip: Cost is $900 per unit with 50% cost share.
- Relocated feeding pens: Cost is $7,400 with 50% cost share. Cost includes the cost of fencing, a new watering system, concrete, and labor.
- Relocated pasture feeding site: Cost is $2,900 with 50% cost share. Cost includes the cost of building ¼ mile of fence, a permeable surface, and labor.
- Off-stream watering system: Cost is $5,500 with 50% cost share.

3. **Streambanks**

Summarized derivation of streambank BMP cost estimates

A 2009 study conducted by Kansas State University agricultural economists calculated that streambank stabilization costs an average of $95.58 per linear foot, including all engineering and design costs. Sites are extremely variable.

4. **Riparian area**

Summarized derivation of riparian area BMP cost estimates

Riparian vegetative buffer: Cost is $1,001 per treated acre for a 66-foot buffer space with a possible 90% cost share.

D. 40-year Project Tables by Sub-watershed

1. Cropland BMP implementation in the Pomona Lake Watershed

Sub Watershed 203 Annual Adoption (treated acres), Cropland BMPs								
Year	No-Till	Nutrient Management Plans	Cover Crops	Terraces	Waterways	Buffers	Perm Vegetation	Total Adoption
1	43	43	43	24	24	12	6	195
2	43	43	43	24	24	12	6	195
3	43	43	43	24	24	12	6	195
4	43	43	43	24	24	12	6	195
5	43	43	43	24	24	12	6	195
6	43	43	43	24	24	12	6	195
7	43	43	43	24	24	12	6	195
8	43	43	43	24	24	12	6	195
9	43	43	43	24	24	12	6	195
10	43	43	43	24	24	12	6	195
11	43	43	43	24	24	12	6	195
12	43	43	43	24	24	12	6	195
13	43	43	43	24	24	12	6	195
14	43	43	43	24	24	12	6	195
15	43	43	43	24	24	12	6	195
16	43	43	43	24	24	12	6	195
17	43	43	43	24	24	12	6	195
18	43	43	43	24	24	12	6	195
19	43	43	43	24	24	12	6	195
20	43	43	43	24	24	12	6	195
21	43	43	43	24	24	12	6	195
22	43	43	43	24	24	12	6	195
23	43	43	43	24	24	12	6	195
24	43	43	43	24	24	12	6	195
25	43	43	43	24	24	12	6	195
26	43	43	43	24	24	12	6	195
27	43	43	43	24	24	12	6	195
28	43	43	43	24	24	12	6	195
29	43	43	43	24	24	12	6	195
30	43	43	43	24	24	12	6	195
31	43	43	43	24	24	12	6	195
32	43	43	43	24	24	12	6	195
33	43	43	43	24	24	12	6	195
34	43	43	43	24	24	12	6	195
35	43	43	43	24	24	12	6	195
36	43	43	43	24	24	12	6	195
37	43	43	43	24	24	12	6	195
38	43	43	43	24	24	12	6	195
39	43	43	43	24	24	12	6	195
40	43	43	43	24	24	12	6	195

Sub Watershed 204 Annual Adoption (treated acres), Cropland BMPs								
Year	No-Till	Nutrient Management Plans	Cover Crops	Terraces	Waterways	Buffers	Perm Vegetation	Total Adoption
1	50	50	50	29	29	14	7	229
2	50	50	50	29	29	14	7	229
3	50	50	50	29	29	14	7	229
4	50	50	50	29	29	14	7	229
5	50	50	50	29	29	14	7	229
6	50	50	50	29	29	14	7	229
7	50	50	50	29	29	14	7	229
8	50	50	50	29	29	14	7	229
9	50	50	50	29	29	14	7	229
10	50	50	50	29	29	14	7	229
11	50	50	50	29	29	14	7	229
12	50	50	50	29	29	14	7	229
13	50	50	50	29	29	14	7	229
14	50	50	50	29	29	14	7	229
15	50	50	50	29	29	14	7	229
16	50	50	50	29	29	14	7	229
17	50	50	50	29	29	14	7	229
18	50	50	50	29	29	14	7	229
19	50	50	50	29	29	14	7	229
20	50	50	50	29	29	14	7	229
21	50	50	50	29	29	14	7	229
22	50	50	50	29	29	14	7	229
23	50	50	50	29	29	14	7	229
24	50	50	50	29	29	14	7	229
25	50	50	50	29	29	14	7	229
26	50	50	50	29	29	14	7	229
27	50	50	50	29	29	14	7	229
28	50	50	50	29	29	14	7	229
29	50	50	50	29	29	14	7	229
30	50	50	50	29	29	14	7	229
31	50	50	50	29	29	14	7	229
32	50	50	50	29	29	14	7	229
33	50	50	50	29	29	14	7	229
34	50	50	50	29	29	14	7	229
35	50	50	50	29	29	14	7	229
36	50	50	50	29	29	14	7	229
37	50	50	50	29	29	14	7	229
38	50	50	50	29	29	14	7	229
39	50	50	50	29	29	14	7	229
40	50	50	50	29	29	14	7	229

Sub Watershed 205 Annual Adoption (treated acres), Cropland BMPs								
Year	No-Till	Nutrient Management Plans	Cover Crops	Terraces	Waterways	Buffers	Perm Vegetation	Total Adoption
1	76	76	76	44	44	22	11	349
2	76	76	76	44	44	22	11	349
3	76	76	76	44	44	22	11	349
4	76	76	76	44	44	22	11	349
5	76	76	76	44	44	22	11	349
6	76	76	76	44	44	22	11	349
7	76	76	76	44	44	22	11	349
8	76	76	76	44	44	22	11	349
9	76	76	76	44	44	22	11	349
10	76	76	76	44	44	22	11	349
11	76	76	76	44	44	22	11	349
12	76	76	76	44	44	22	11	349
13	76	76	76	44	44	22	11	349
14	76	76	76	44	44	22	11	349
15	76	76	76	44	44	22	11	349
16	76	76	76	44	44	22	11	349
17	76	76	76	44	44	22	11	349
18	76	76	76	44	44	22	11	349
19	76	76	76	44	44	22	11	349
20	76	76	76	44	44	22	11	349
21	76	76	76	44	44	22	11	349
22	76	76	76	44	44	22	11	349
23	76	76	76	44	44	22	11	349
24	76	76	76	44	44	22	11	349
25	76	76	76	44	44	22	11	349
26	76	76	76	44	44	22	11	349
27	76	76	76	44	44	22	11	349
28	76	76	76	44	44	22	11	349
29	76	76	76	44	44	22	11	349
30	76	76	76	44	44	22	11	349
31	76	76	76	44	44	22	11	349
32	76	76	76	44	44	22	11	349
33	76	76	76	44	44	22	11	349
34	76	76	76	44	44	22	11	349
35	76	76	76	44	44	22	11	349
36	76	76	76	44	44	22	11	349
37	76	76	76	44	44	22	11	349
38	76	76	76	44	44	22	11	349
39	76	76	76	44	44	22	11	349
40	76	76	76	44	44	22	11	349

Sub Watershed 206 Annual Adoption (treated acres), Cropland BMPs								
Year	No-Till	Nutrient Management Plans	Cover Crops	Terraces	Waterways	Buffers	Perm Vegetation	Total Adoption
1	19	19	19	11	11	6	3	89
2	19	19	19	11	11	6	3	89
3	19	19	19	11	11	6	3	89
4	19	19	19	11	11	6	3	89
5	19	19	19	11	11	6	3	89
6	19	19	19	11	11	6	3	89
7	19	19	19	11	11	6	3	89
8	19	19	19	11	11	6	3	89
9	19	19	19	11	11	6	3	89
10	19	19	19	11	11	6	3	89
11	19	19	19	11	11	6	3	89
12	19	19	19	11	11	6	3	89
13	19	19	19	11	11	6	3	89
14	19	19	19	11	11	6	3	89
15	19	19	19	11	11	6	3	89
16	19	19	19	11	11	6	3	89
17	19	19	19	11	11	6	3	89
18	19	19	19	11	11	6	3	89
19	19	19	19	11	11	6	3	89
20	19	19	19	11	11	6	3	89
21	19	19	19	11	11	6	3	89
22	19	19	19	11	11	6	3	89
23	19	19	19	11	11	6	3	89
24	19	19	19	11	11	6	3	89
25	19	19	19	11	11	6	3	89
26	19	19	19	11	11	6	3	89
27	19	19	19	11	11	6	3	89
28	19	19	19	11	11	6	3	89
29	19	19	19	11	11	6	3	89
30	19	19	19	11	11	6	3	89
31	19	19	19	11	11	6	3	89
32	19	19	19	11	11	6	3	89
33	19	19	19	11	11	6	3	89
34	19	19	19	11	11	6	3	89
35	19	19	19	11	11	6	3	89
36	19	19	19	11	11	6	3	89
37	19	19	19	11	11	6	3	89
38	19	19	19	11	11	6	3	89
39	19	19	19	11	11	6	3	89
40	19	19	19	11	11	6	3	89

Sub Watershed 207 Annual Adoption (treated acres), Cropland BMPs								
Year	No-Till	Nutrient Management Plans	Cover Crops	Terraces	Waterways	Buffers	Perm Vegetation	Total Adoption
1	79	79	79	45	45	23	11	362
2	79	79	79	45	45	23	11	362
3	79	79	79	45	45	23	11	362
4	79	79	79	45	45	23	11	362
5	79	79	79	45	45	23	11	362
6	79	79	79	45	45	23	11	362
7	79	79	79	45	45	23	11	362
8	79	79	79	45	45	23	11	362
9	79	79	79	45	45	23	11	362
10	79	79	79	45	45	23	11	362
11	79	79	79	45	45	23	11	362
12	79	79	79	45	45	23	11	362
13	79	79	79	45	45	23	11	362
14	79	79	79	45	45	23	11	362
15	79	79	79	45	45	23	11	362
16	79	79	79	45	45	23	11	362
17	79	79	79	45	45	23	11	362
18	79	79	79	45	45	23	11	362
19	79	79	79	45	45	23	11	362
20	79	79	79	45	45	23	11	362
21	79	79	79	45	45	23	11	362
22	79	79	79	45	45	23	11	362
23	79	79	79	45	45	23	11	362
24	79	79	79	45	45	23	11	362
25	79	79	79	45	45	23	11	362
26	79	79	79	45	45	23	11	362
27	79	79	79	45	45	23	11	362
28	79	79	79	45	45	23	11	362
29	79	79	79	45	45	23	11	362
30	79	79	79	45	45	23	11	362
31	79	79	79	45	45	23	11	362
32	79	79	79	45	45	23	11	362
33	79	79	79	45	45	23	11	362
34	79	79	79	45	45	23	11	362
35	79	79	79	45	45	23	11	362
36	79	79	79	45	45	23	11	362
37	79	79	79	45	45	23	11	362
38	79	79	79	45	45	23	11	362
39	79	79	79	45	45	23	11	362
40	79	79	79	45	45	23	11	362

2. Cropland BMP implementation: Cumulative sediment load reductions

Sub Watershed 203 Annual Soil Erosion Reduction, Cropland BMPs (tons)								
Year	No-Till	Nutrient Management Plans	Cover Crops	Terraces	Waterways	Buffers	Perm Vegetation	Total Load Reduction
1	150	50	80	34	46	29	27	417
2	301	100	160	69	92	57	54	833
3	451	150	240	103	137	86	82	1,250
4	601	200	321	137	183	115	109	1,666
5	752	251	401	172	229	143	136	2,083
6	902	301	481	206	275	172	163	2,499
7	1,052	351	561	240	321	200	190	2,916
8	1,202	401	641	275	366	229	218	3,333
9	1,353	451	721	309	412	258	245	3,749
10	1,503	501	802	344	458	286	272	4,166
11	1,653	551	882	378	504	315	299	4,582
12	1,804	601	962	412	550	344	326	4,999
13	1,954	651	1,042	447	596	372	354	5,415
14	2,104	701	1,122	481	641	401	381	5,832
15	2,255	752	1,202	515	687	429	408	6,248
16	2,405	802	1,283	550	733	458	435	6,665
17	2,555	852	1,363	584	779	487	462	7,082
18	2,706	902	1,443	618	825	515	490	7,498
19	2,856	952	1,523	653	870	544	517	7,915
20	3,006	1,002	1,603	687	916	573	544	8,331
21	3,156	1,052	1,683	721	962	601	571	8,748
22	3,307	1,102	1,764	756	1,008	630	598	9,164
23	3,457	1,152	1,844	790	1,054	658	626	9,581
24	3,607	1,202	1,924	825	1,099	687	653	9,998
25	3,758	1,253	2,004	859	1,145	716	680	10,414
26	3,908	1,303	2,084	893	1,191	744	707	10,831
27	4,058	1,353	2,164	928	1,237	773	734	11,247
28	4,209	1,403	2,245	962	1,283	802	762	11,664
29	4,359	1,453	2,325	996	1,328	830	789	12,080
30	4,509	1,503	2,405	1,031	1,374	859	816	12,497
31	4,660	1,553	2,485	1,065	1,420	888	843	12,914
32	4,810	1,603	2,565	1,099	1,466	916	870	13,330
33	4,960	1,653	2,645	1,134	1,512	945	898	13,747
34	5,110	1,703	2,726	1,168	1,557	973	925	14,163
35	5,261	1,754	2,806	1,202	1,603	1,002	952	14,580
36	5,411	1,804	2,886	1,237	1,649	1,031	979	14,996
37	5,561	1,854	2,966	1,271	1,695	1,059	1,006	15,413
38	5,712	1,904	3,046	1,306	1,741	1,088	1,034	15,829
39	5,862	1,954	3,126	1,340	1,787	1,117	1,061	16,246
40	6,012	2,004	3,207	1,374	1,832	1,145	1,088	16,663

Sub Watershed 204 Annual Soil Erosion Reduction, Cropland BMPs (tons)								
Year	No-Till	Nutrient Management Plans	Cover Crops	Terraces	Waterways	Buffers	Perm Vegetation	Total Load Reduction
1	215	72	115	49	66	41	39	596
2	430	143	229	98	131	82	78	1,192
3	645	215	344	148	197	123	117	1,789
4	861	287	459	197	262	164	156	2,385
5	1,076	359	574	246	328	205	195	2,981
6	1,291	430	688	295	393	246	234	3,577
7	1,506	502	803	344	459	287	272	4,173
8	1,721	574	918	393	524	328	311	4,770
9	1,936	645	1,033	443	590	369	350	5,366
10	2,151	717	1,147	492	656	410	389	5,962
11	2,366	789	1,262	541	721	451	428	6,558
12	2,582	861	1,377	590	787	492	467	7,155
13	2,797	932	1,492	639	852	533	506	7,751
14	3,012	1,004	1,606	688	918	574	545	8,347
15	3,227	1,076	1,721	738	983	615	584	8,943
16	3,442	1,147	1,836	787	1,049	656	623	9,539
17	3,657	1,219	1,950	836	1,115	697	662	10,136
18	3,872	1,291	2,065	885	1,180	738	701	10,732
19	4,087	1,362	2,180	934	1,246	779	740	11,328
20	4,303	1,434	2,295	983	1,311	820	779	11,924
21	4,518	1,506	2,409	1,033	1,377	861	817	12,520
22	4,733	1,578	2,524	1,082	1,442	901	856	13,117
23	4,948	1,649	2,639	1,131	1,508	942	895	13,713
24	5,163	1,721	2,754	1,180	1,573	983	934	14,309
25	5,378	1,793	2,868	1,229	1,639	1,024	973	14,905
26	5,593	1,864	2,983	1,278	1,705	1,065	1,012	15,501
27	5,808	1,936	3,098	1,328	1,770	1,106	1,051	16,098
28	6,024	2,008	3,213	1,377	1,836	1,147	1,090	16,694
29	6,239	2,080	3,327	1,426	1,901	1,188	1,129	17,290
30	6,454	2,151	3,442	1,475	1,967	1,229	1,168	17,886
31	6,669	2,223	3,557	1,524	2,032	1,270	1,207	18,482
32	6,884	2,295	3,671	1,573	2,098	1,311	1,246	19,079
33	7,099	2,366	3,786	1,623	2,164	1,352	1,285	19,675
34	7,314	2,438	3,901	1,672	2,229	1,393	1,324	20,271
35	7,529	2,510	4,016	1,721	2,295	1,434	1,362	20,867
36	7,745	2,582	4,130	1,770	2,360	1,475	1,401	21,464
37	7,960	2,653	4,245	1,819	2,426	1,516	1,440	22,060
38	8,175	2,725	4,360	1,869	2,491	1,557	1,479	22,656
39	8,390	2,797	4,475	1,918	2,557	1,598	1,518	23,252
40	8,605	2,868	4,589	1,967	2,622	1,639	1,557	23,848

Sub Watershed 205 Annual Soil Erosion Reduction, Cropland BMPs (tons)								
Year	No-Till	Nutrient Management Plans	Cover Crops	Terraces	Waterways	Buffers	Perm Vegetation	Total Load Reduction
1	350	117	187	80	107	67	63	969
2	700	233	373	160	213	133	127	1,939
3	1,049	350	560	240	320	200	190	2,908
4	1,399	466	746	320	426	266	253	3,877
5	1,749	583	933	400	533	333	316	4,847
6	2,099	700	1,119	480	640	400	380	5,816
7	2,448	816	1,306	560	746	466	443	6,786
8	2,798	933	1,492	640	853	533	506	7,755
9	3,148	1,049	1,679	720	959	600	570	8,724
10	3,498	1,166	1,865	799	1,066	666	633	9,694
11	3,847	1,282	2,052	879	1,173	733	696	10,663
12	4,197	1,399	2,239	959	1,279	799	760	11,632
13	4,547	1,516	2,425	1,039	1,386	866	823	12,602
14	4,897	1,632	2,612	1,119	1,492	933	886	13,571
15	5,247	1,749	2,798	1,199	1,599	999	949	14,540
16	5,596	1,865	2,985	1,279	1,706	1,066	1,013	15,510
17	5,946	1,982	3,171	1,359	1,812	1,133	1,076	16,479
18	6,296	2,099	3,358	1,439	1,919	1,199	1,139	17,449
19	6,646	2,215	3,544	1,519	2,025	1,266	1,203	18,418
20	6,995	2,332	3,731	1,599	2,132	1,332	1,266	19,387
21	7,345	2,448	3,917	1,679	2,239	1,399	1,329	20,357
22	7,695	2,565	4,104	1,759	2,345	1,466	1,392	21,326
23	8,045	2,682	4,291	1,839	2,452	1,532	1,456	22,295
24	8,394	2,798	4,477	1,919	2,558	1,599	1,519	23,265
25	8,744	2,915	4,664	1,999	2,665	1,666	1,582	24,234
26	9,094	3,031	4,850	2,079	2,772	1,732	1,646	25,203
27	9,444	3,148	5,037	2,159	2,878	1,799	1,709	26,173
28	9,794	3,265	5,223	2,239	2,985	1,865	1,772	27,142
29	10,143	3,381	5,410	2,318	3,091	1,932	1,835	28,112
30	10,493	3,498	5,596	2,398	3,198	1,999	1,899	29,081
31	10,843	3,614	5,783	2,478	3,304	2,065	1,962	30,050
32	11,193	3,731	5,969	2,558	3,411	2,132	2,025	31,020
33	11,542	3,847	6,156	2,638	3,518	2,199	2,089	31,989
34	11,892	3,964	6,343	2,718	3,624	2,265	2,152	32,958
35	12,242	4,081	6,529	2,798	3,731	2,332	2,215	33,928
36	12,592	4,197	6,716	2,878	3,837	2,398	2,279	34,897
37	12,942	4,314	6,902	2,958	3,944	2,465	2,342	35,866
38	13,291	4,430	7,089	3,038	4,051	2,532	2,405	36,836
39	13,641	4,547	7,275	3,118	4,157	2,598	2,468	37,805
40	13,991	4,664	7,462	3,198	4,264	2,665	2,532	38,775

Sub Watershed 206 Annual Soil Erosion Reduction, Cropland BMPs (tons)								
Year	No-Till	Nutrient Management Plans	Cover Crops	Terraces	Waterways	Buffers	Perm Vegetation	Total Load Reduction
1	85	28	45	19	26	16	15	235
2	170	57	90	39	52	32	31	470
3	254	85	136	58	78	48	46	705
4	339	113	181	78	103	65	61	940
5	424	141	226	97	129	81	77	1,175
6	509	170	271	116	155	97	92	1,410
7	593	198	316	136	181	113	107	1,645
8	678	226	362	155	207	129	123	1,880
9	763	254	407	174	233	145	138	2,115
10	848	283	452	194	258	161	153	2,349
11	933	311	497	213	284	178	169	2,584
12	1,017	339	543	233	310	194	184	2,819
13	1,102	367	588	252	336	210	199	3,054
14	1,187	396	633	271	362	226	215	3,289
15	1,272	424	678	291	388	242	230	3,524
16	1,356	452	723	310	413	258	245	3,759
17	1,441	480	769	329	439	275	261	3,994
18	1,526	509	814	349	465	291	276	4,229
19	1,611	537	859	368	491	307	291	4,464
20	1,695	565	904	388	517	323	307	4,699
21	1,780	593	949	407	543	339	322	4,934
22	1,865	622	995	426	568	355	337	5,169
23	1,950	650	1,040	446	594	371	353	5,404
24	2,035	678	1,085	465	620	388	368	5,639
25	2,119	706	1,130	484	646	404	384	5,874
26	2,204	735	1,176	504	672	420	399	6,109
27	2,289	763	1,221	523	698	436	414	6,344
28	2,374	791	1,266	543	723	452	430	6,578
29	2,458	819	1,311	562	749	468	445	6,813
30	2,543	848	1,356	581	775	484	460	7,048
31	2,628	876	1,402	601	801	501	476	7,283
32	2,713	904	1,447	620	827	517	491	7,518
33	2,798	933	1,492	639	853	533	506	7,753
34	2,882	961	1,537	659	878	549	522	7,988
35	2,967	989	1,582	678	904	565	537	8,223
36	3,052	1,017	1,628	698	930	581	552	8,458
37	3,137	1,046	1,673	717	956	597	568	8,693
38	3,221	1,074	1,718	736	982	614	583	8,928
39	3,306	1,102	1,763	756	1,008	630	598	9,163
40	3,391	1,130	1,809	775	1,033	646	614	9,398

Sub Watershed 207 Annual Soil Erosion Reduction, Cropland BMPs (tons)								
Year	No-Till	Nutrient Management Plans	Cover Crops	Terraces	Waterways	Buffers	Perm Vegetation	Total Load Reduction
1	250	83	133	57	76	48	45	692
2	499	166	266	114	152	95	90	1,384
3	749	250	399	171	228	143	136	2,076
4	999	333	533	228	304	190	181	2,768
5	1,248	416	666	285	380	238	226	3,460
6	1,498	499	799	342	457	285	271	4,152
7	1,748	583	932	399	533	333	316	4,844
8	1,997	666	1,065	457	609	380	361	5,536
9	2,247	749	1,198	514	685	428	407	6,228
10	2,497	832	1,332	571	761	476	452	6,920
11	2,747	916	1,465	628	837	523	497	7,612
12	2,996	999	1,598	685	913	571	542	8,304
13	3,246	1,082	1,731	742	989	618	587	8,996
14	3,496	1,165	1,864	799	1,065	666	633	9,688
15	3,745	1,248	1,997	856	1,141	713	678	10,380
16	3,995	1,332	2,131	913	1,218	761	723	11,072
17	4,245	1,415	2,264	970	1,294	809	768	11,764
18	4,494	1,498	2,397	1,027	1,370	856	813	12,456
19	4,744	1,581	2,530	1,084	1,446	904	858	13,148
20	4,994	1,665	2,663	1,141	1,522	951	904	13,840
21	5,243	1,748	2,796	1,198	1,598	999	949	14,532
22	5,493	1,831	2,930	1,256	1,674	1,046	994	15,224
23	5,743	1,914	3,063	1,313	1,750	1,094	1,039	15,916
24	5,992	1,997	3,196	1,370	1,826	1,141	1,084	16,608
25	6,242	2,081	3,329	1,427	1,902	1,189	1,130	17,300
26	6,492	2,164	3,462	1,484	1,978	1,237	1,175	17,992
27	6,741	2,247	3,595	1,541	2,055	1,284	1,220	18,684
28	6,991	2,330	3,729	1,598	2,131	1,332	1,265	19,376
29	7,241	2,414	3,862	1,655	2,207	1,379	1,310	20,067
30	7,491	2,497	3,995	1,712	2,283	1,427	1,355	20,759
31	7,740	2,580	4,128	1,769	2,359	1,474	1,401	21,451
32	7,990	2,663	4,261	1,826	2,435	1,522	1,446	22,143
33	8,240	2,747	4,394	1,883	2,511	1,569	1,491	22,835
34	8,489	2,830	4,528	1,940	2,587	1,617	1,536	23,527
35	8,739	2,913	4,661	1,997	2,663	1,665	1,581	24,219
36	8,989	2,996	4,794	2,055	2,739	1,712	1,627	24,911
37	9,238	3,079	4,927	2,112	2,815	1,760	1,672	25,603
38	9,488	3,163	5,060	2,169	2,892	1,807	1,717	26,295
39	9,738	3,246	5,193	2,226	2,968	1,855	1,762	26,987
40	9,987	3,329	5,327	2,283	3,044	1,902	1,807	27,679

3. Cropland BMP implementation: Cumulative nitrogen load reductions

Sub Watershed 203 Annual Nitrogen Reduction, Cropland BMPs (pounds)								
Year	No-Till	Nutrient Management Plans	Cover Crops	Terraces	Waterways	Buffers	Perm Vegetation	Total Load Reduction
1	39	39	39	27	36	11	21	214
2	79	79	79	54	72	23	43	428
3	118	118	118	81	108	34	64	642
4	158	158	158	108	144	45	86	856
5	197	197	197	135	180	56	107	1,070
6	237	237	237	162	216	68	128	1,285
7	276	276	276	189	252	79	150	1,499
8	316	316	316	216	288	90	171	1,713
9	355	355	355	243	325	101	193	1,927
10	394	394	394	270	361	113	214	2,141
11	434	434	434	297	397	124	236	2,355
12	473	473	473	325	433	135	257	2,569
13	513	513	513	352	469	146	278	2,783
14	552	552	552	379	505	158	300	2,997
15	592	592	592	406	541	169	321	3,211
16	631	631	631	433	577	180	343	3,426
17	670	670	670	460	613	192	364	3,640
18	710	710	710	487	649	203	385	3,854
19	749	749	749	514	685	214	407	4,068
20	789	789	789	541	721	225	428	4,282
21	828	828	828	568	757	237	450	4,496
22	868	868	868	595	793	248	471	4,710
23	907	907	907	622	829	259	492	4,924
24	947	947	947	649	865	270	514	5,138
25	986	986	986	676	901	282	535	5,352
26	1,025	1,025	1,025	703	938	293	557	5,566
27	1,065	1,065	1,065	730	974	304	578	5,781
28	1,104	1,104	1,104	757	1,010	316	599	5,995
29	1,144	1,144	1,144	784	1,046	327	621	6,209
30	1,183	1,183	1,183	811	1,082	338	642	6,423
31	1,223	1,223	1,223	838	1,118	349	664	6,637
32	1,262	1,262	1,262	865	1,154	361	685	6,851
33	1,301	1,301	1,301	892	1,190	372	707	7,065
34	1,341	1,341	1,341	919	1,226	383	728	7,279
35	1,380	1,380	1,380	947	1,262	394	749	7,493
36	1,420	1,420	1,420	974	1,298	406	771	7,707
37	1,459	1,459	1,459	1,001	1,334	417	792	7,922
38	1,499	1,499	1,499	1,028	1,370	428	814	8,136
39	1,538	1,538	1,538	1,055	1,406	439	835	8,350
40	1,578	1,578	1,578	1,082	1,442	451	856	8,564

Sub Watershed 204 Annual Nitrogen Reduction, Cropland BMPs (pounds)								
Year	No-Till	Nutrient Management Plans	Cover Crops	Terraces	Waterways	Buffers	Perm Vegetation	Total Load Reduction
1	54	54	54	37	49	15	29	292
2	108	108	108	74	98	31	58	584
3	161	161	161	111	148	46	88	876
4	215	215	215	148	197	61	117	1,168
5	269	269	269	184	246	77	146	1,460
6	323	323	323	221	295	92	175	1,752
7	377	377	377	258	344	108	204	2,044
8	430	430	430	295	393	123	234	2,336
9	484	484	484	332	443	138	263	2,628
10	538	538	538	369	492	154	292	2,920
11	592	592	592	406	541	169	321	3,212
12	646	646	646	443	590	184	350	3,504
13	699	699	699	480	639	200	380	3,796
14	753	753	753	516	689	215	409	4,088
15	807	807	807	553	738	231	438	4,380
16	861	861	861	590	787	246	467	4,672
17	914	914	914	627	836	261	496	4,964
18	968	968	968	664	885	277	526	5,256
19	1,022	1,022	1,022	701	934	292	555	5,548
20	1,076	1,076	1,076	738	984	307	584	5,840
21	1,130	1,130	1,130	775	1,033	323	613	6,132
22	1,183	1,183	1,183	812	1,082	338	642	6,424
23	1,237	1,237	1,237	848	1,131	353	672	6,716
24	1,291	1,291	1,291	885	1,180	369	701	7,008
25	1,345	1,345	1,345	922	1,230	384	730	7,300
26	1,399	1,399	1,399	959	1,279	400	759	7,592
27	1,452	1,452	1,452	996	1,328	415	788	7,885
28	1,506	1,506	1,506	1,033	1,377	430	818	8,177
29	1,560	1,560	1,560	1,070	1,426	446	847	8,469
30	1,614	1,614	1,614	1,107	1,475	461	876	8,761
31	1,668	1,668	1,668	1,143	1,525	476	905	9,053
32	1,721	1,721	1,721	1,180	1,574	492	934	9,345
33	1,775	1,775	1,775	1,217	1,623	507	964	9,637
34	1,829	1,829	1,829	1,254	1,672	523	993	9,929
35	1,883	1,883	1,883	1,291	1,721	538	1,022	10,221
36	1,937	1,937	1,937	1,328	1,771	553	1,051	10,513
37	1,990	1,990	1,990	1,365	1,820	569	1,080	10,805
38	2,044	2,044	2,044	1,402	1,869	584	1,110	11,097
39	2,098	2,098	2,098	1,439	1,918	599	1,139	11,389
40	2,152	2,152	2,152	1,475	1,967	615	1,168	11,681

Sub Watershed 205 Annual Nitrogen Reduction, Cropland BMPs (pounds)								
Year	No-Till	Nutrient Management Plans	Cover Crops	Terraces	Waterways	Buffers	Perm Vegetation	Total Load Reduction
1	84	84	84	58	77	24	46	456
2	168	168	168	115	153	48	91	911
3	252	252	252	173	230	72	137	1,367
4	336	336	336	230	307	96	182	1,822
5	420	420	420	288	384	120	228	2,278
6	504	504	504	345	460	144	273	2,734
7	587	587	587	403	537	168	319	3,189
8	671	671	671	460	614	192	364	3,645
9	755	755	755	518	691	216	410	4,100
10	839	839	839	575	767	240	456	4,556
11	923	923	923	633	844	264	501	5,012
12	1,007	1,007	1,007	691	921	288	547	5,467
13	1,091	1,091	1,091	748	998	312	592	5,923
14	1,175	1,175	1,175	806	1,074	336	638	6,378
15	1,259	1,259	1,259	863	1,151	360	683	6,834
16	1,343	1,343	1,343	921	1,228	384	729	7,289
17	1,427	1,427	1,427	978	1,304	408	775	7,745
18	1,511	1,511	1,511	1,036	1,381	432	820	8,201
19	1,595	1,595	1,595	1,093	1,458	456	866	8,656
20	1,679	1,679	1,679	1,151	1,535	480	911	9,112
21	1,762	1,762	1,762	1,209	1,611	504	957	9,567
22	1,846	1,846	1,846	1,266	1,688	528	1,002	10,023
23	1,930	1,930	1,930	1,324	1,765	552	1,048	10,479
24	2,014	2,014	2,014	1,381	1,842	575	1,093	10,934
25	2,098	2,098	2,098	1,439	1,918	599	1,139	11,390
26	2,182	2,182	2,182	1,496	1,995	623	1,185	11,845
27	2,266	2,266	2,266	1,554	2,072	647	1,230	12,301
28	2,350	2,350	2,350	1,611	2,148	671	1,276	12,757
29	2,434	2,434	2,434	1,669	2,225	695	1,321	13,212
30	2,518	2,518	2,518	1,726	2,302	719	1,367	13,668
31	2,602	2,602	2,602	1,784	2,379	743	1,412	14,123
32	2,686	2,686	2,686	1,842	2,455	767	1,458	14,579
33	2,770	2,770	2,770	1,899	2,532	791	1,503	15,035
34	2,853	2,853	2,853	1,957	2,609	815	1,549	15,490
35	2,937	2,937	2,937	2,014	2,686	839	1,595	15,946
36	3,021	3,021	3,021	2,072	2,762	863	1,640	16,401
37	3,105	3,105	3,105	2,129	2,839	887	1,686	16,857
38	3,189	3,189	3,189	2,187	2,916	911	1,731	17,313
39	3,273	3,273	3,273	2,244	2,993	935	1,777	17,768
40	3,357	3,357	3,357	2,302	3,069	959	1,822	18,224

Sub Watershed 206 Annual Nitrogen Reduction, Cropland BMPs (pounds)								
Year	No-Till	Nutrient Management Plans	Cover Crops	Terraces	Waterways	Buffers	Permanent Vegetation	Total Load Reduction
1	21	21	21	14	19	6	11	114
2	42	42	42	29	39	12	23	229
3	63	63	63	43	58	18	34	343
4	84	84	84	58	77	24	46	457
5	105	105	105	72	96	30	57	572
6	126	126	126	87	116	36	69	686
7	147	147	147	101	135	42	80	800
8	169	169	169	116	154	48	91	915
9	190	190	190	130	173	54	103	1,029
10	211	211	211	144	193	60	114	1,144
11	232	232	232	159	212	66	126	1,258
12	253	253	253	173	231	72	137	1,372
13	274	274	274	188	250	78	149	1,487
14	295	295	295	202	270	84	160	1,601
15	316	316	316	217	289	90	172	1,715
16	337	337	337	231	308	96	183	1,830
17	358	358	358	246	327	102	194	1,944
18	379	379	379	260	347	108	206	2,058
19	400	400	400	274	366	114	217	2,173
20	421	421	421	289	385	120	229	2,287
21	442	442	442	303	404	126	240	2,401
22	463	463	463	318	424	132	252	2,516
23	484	484	484	332	443	138	263	2,630
24	506	506	506	347	462	144	274	2,744
25	527	527	527	361	481	150	286	2,859
26	548	548	548	376	501	156	297	2,973
27	569	569	569	390	520	163	309	3,088
28	590	590	590	404	539	169	320	3,202
29	611	611	611	419	559	175	332	3,316
30	632	632	632	433	578	181	343	3,431
31	653	653	653	448	597	187	354	3,545
32	674	674	674	462	616	193	366	3,659
33	695	695	695	477	636	199	377	3,774
34	716	716	716	491	655	205	389	3,888
35	737	737	737	506	674	211	400	4,002
36	758	758	758	520	693	217	412	4,117
37	779	779	779	534	713	223	423	4,231
38	800	800	800	549	732	229	435	4,345
39	822	822	822	563	751	235	446	4,460
40	843	843	843	578	770	241	457	4,574

Sub Watershed 207 Annual Nitrogen Reduction, Cropland BMPs (pounds)								
Year	No-Till	Nutrient Management Plans	Cover Crops	Terraces	Waterways	Buffers	Perm Vegetation	Total Load Reduction
1	63	63	63	44	58	18	34	345
2	127	127	127	87	116	36	69	689
3	190	190	190	131	174	54	103	1,034
4	254	254	254	174	232	73	138	1,379
5	317	317	317	218	290	91	172	1,723
6	381	381	381	261	348	109	207	2,068
7	444	444	444	305	406	127	241	2,413
8	508	508	508	348	464	145	276	2,758
9	571	571	571	392	522	163	310	3,102
10	635	635	635	435	581	181	345	3,447
11	698	698	698	479	639	200	379	3,792
12	762	762	762	522	697	218	414	4,136
13	825	825	825	566	755	236	448	4,481
14	889	889	889	610	813	254	483	4,826
15	952	952	952	653	871	272	517	5,170
16	1,016	1,016	1,016	697	929	290	552	5,515
17	1,079	1,079	1,079	740	987	308	586	5,860
18	1,143	1,143	1,143	784	1,045	327	620	6,205
19	1,206	1,206	1,206	827	1,103	345	655	6,549
20	1,270	1,270	1,270	871	1,161	363	689	6,894
21	1,333	1,333	1,333	914	1,219	381	724	7,239
22	1,397	1,397	1,397	958	1,277	399	758	7,583
23	1,460	1,460	1,460	1,001	1,335	417	793	7,928
24	1,524	1,524	1,524	1,045	1,393	435	827	8,273
25	1,587	1,587	1,587	1,089	1,451	454	862	8,617
26	1,651	1,651	1,651	1,132	1,509	472	896	8,962
27	1,714	1,714	1,714	1,176	1,567	490	931	9,307
28	1,778	1,778	1,778	1,219	1,626	508	965	9,652
29	1,841	1,841	1,841	1,263	1,684	526	1,000	9,996
30	1,905	1,905	1,905	1,306	1,742	544	1,034	10,341
31	1,968	1,968	1,968	1,350	1,800	562	1,069	10,686
32	2,032	2,032	2,032	1,393	1,858	581	1,103	11,030
33	2,095	2,095	2,095	1,437	1,916	599	1,137	11,375
34	2,159	2,159	2,159	1,480	1,974	617	1,172	11,720
35	2,222	2,222	2,222	1,524	2,032	635	1,206	12,064
36	2,286	2,286	2,286	1,567	2,090	653	1,241	12,409
37	2,349	2,349	2,349	1,611	2,148	671	1,275	12,754
38	2,413	2,413	2,413	1,655	2,206	689	1,310	13,098
39	2,476	2,476	2,476	1,698	2,264	708	1,344	13,443
40	2,540	2,540	2,540	1,742	2,322	726	1,379	13,788

4. Cropland BMP implementation: Cumulative phosphorus load reductions

Sub Watershed 203 Annual Phosphorous Reduction, Cropland BMPs (pounds)								
Year	No-Till	Nutrient Management Plans	Cover Crops	Terraces	Waterways	Buffers	Perm Vegetation	Total Load Reduction
1	34	21	42	14	19	12	11	153
2	67	42	84	29	38	24	23	307
3	101	63	126	43	58	36	34	460
4	134	84	168	58	77	48	46	614
5	168	105	210	72	96	60	57	767
6	201	126	252	86	115	72	68	921
7	235	147	294	101	134	84	80	1,074
8	269	168	336	115	153	96	91	1,228
9	302	189	378	129	173	108	102	1,381
10	336	210	420	144	192	120	114	1,534
11	369	231	462	158	211	132	125	1,688
12	403	252	503	173	230	144	137	1,841
13	436	273	545	187	249	156	148	1,995
14	470	294	587	201	269	168	159	2,148
15	503	315	629	216	288	180	171	2,302
16	537	336	671	230	307	192	182	2,455
17	571	357	713	245	326	204	194	2,608
18	604	378	755	259	345	216	205	2,762
19	638	399	797	273	364	228	216	2,915
20	671	420	839	288	384	240	228	3,069
21	705	441	881	302	403	252	239	3,222
22	738	462	923	316	422	264	251	3,376
23	772	482	965	331	441	276	262	3,529
24	806	503	1,007	345	460	288	273	3,683
25	839	524	1,049	360	479	300	285	3,836
26	873	545	1,091	374	499	312	296	3,989
27	906	566	1,133	388	518	324	307	4,143
28	940	587	1,175	403	537	336	319	4,296
29	973	608	1,217	417	556	348	330	4,450
30	1,007	629	1,259	432	575	360	342	4,603
31	1,041	650	1,301	446	595	372	353	4,757
32	1,074	671	1,343	460	614	384	364	4,910
33	1,108	692	1,385	475	633	396	376	5,063
34	1,141	713	1,427	489	652	408	387	5,217
35	1,175	734	1,468	503	671	420	399	5,370
36	1,208	755	1,510	518	690	432	410	5,524
37	1,242	776	1,552	532	710	444	421	5,677
38	1,275	797	1,594	547	729	456	433	5,831
39	1,309	818	1,636	561	748	468	444	5,984
40	1,343	839	1,678	575	767	479	456	6,138

Sub Watershed 204 Annual Phosphorous Reduction, Cropland BMPs (pounds)								
Year	No-Till	Nutrient Management Plans	Cover Crops	Terraces	Waterways	Buffers	Perm Vegetation	Total Load Reduction
1	46	29	57	20	26	16	16	209
2	92	57	114	39	52	33	31	419
3	137	86	172	59	78	49	47	628
4	183	114	229	78	105	65	62	837
5	229	143	286	98	131	82	78	1,046
6	275	172	343	118	157	98	93	1,256
7	320	200	401	137	183	114	109	1,465
8	366	229	458	157	209	131	124	1,674
9	412	258	515	177	235	147	140	1,884
10	458	286	572	196	262	164	155	2,093
11	504	315	629	216	288	180	171	2,302
12	549	343	687	235	314	196	186	2,511
13	595	372	744	255	340	213	202	2,721
14	641	401	801	275	366	229	217	2,930
15	687	429	858	294	392	245	233	3,139
16	733	458	916	314	419	262	249	3,349
17	778	486	973	334	445	278	264	3,558
18	824	515	1,030	353	471	294	280	3,767
19	870	544	1,087	373	497	311	295	3,976
20	916	572	1,145	392	523	327	311	4,186
21	961	601	1,202	412	549	343	326	4,395
22	1,007	629	1,259	432	576	360	342	4,604
23	1,053	658	1,316	451	602	376	357	4,814
24	1,099	687	1,373	471	628	392	373	5,023
25	1,145	715	1,431	491	654	409	388	5,232
26	1,190	744	1,488	510	680	425	404	5,441
27	1,236	773	1,545	530	706	441	419	5,651
28	1,282	801	1,602	549	733	458	435	5,860
29	1,328	830	1,660	569	759	474	450	6,069
30	1,373	858	1,717	589	785	491	466	6,279
31	1,419	887	1,774	608	811	507	482	6,488
32	1,465	916	1,831	628	837	523	497	6,697
33	1,511	944	1,888	647	863	540	513	6,906
34	1,557	973	1,946	667	889	556	528	7,116
35	1,602	1,001	2,003	687	916	572	544	7,325
36	1,648	1,030	2,060	706	942	589	559	7,534
37	1,694	1,059	2,117	726	968	605	575	7,744
38	1,740	1,087	2,175	746	994	621	590	7,953
39	1,785	1,116	2,232	765	1,020	638	606	8,162
40	1,831	1,145	2,289	785	1,046	654	621	8,371

Sub Watershed 205 Annual Phosphorous Reduction, Cropland BMPs (pounds)								
Year	No-Till	Nutrient Management Plans	Cover Crops	Terraces	Waterways	Buffers	Perm Vegetation	Total Load Reduction
1	71	45	89	31	41	26	24	327
2	143	89	179	61	82	51	48	653
3	214	134	268	92	122	77	73	980
4	286	179	357	122	163	102	97	1,306
5	357	223	446	153	204	128	121	1,633
6	429	268	536	184	245	153	145	1,959
7	500	312	625	214	286	179	170	2,286
8	571	357	714	245	327	204	194	2,612
9	643	402	804	275	367	230	218	2,939
10	714	446	893	306	408	255	242	3,265
11	786	491	982	337	449	281	267	3,592
12	857	536	1,071	367	490	306	291	3,918
13	929	580	1,161	398	531	332	315	4,245
14	1,000	625	1,250	429	571	357	339	4,571
15	1,071	670	1,339	459	612	383	364	4,898
16	1,143	714	1,429	490	653	408	388	5,224
17	1,214	759	1,518	520	694	434	412	5,551
18	1,286	804	1,607	551	735	459	436	5,877
19	1,357	848	1,696	582	775	485	460	6,204
20	1,429	893	1,786	612	816	510	485	6,530
21	1,500	937	1,875	643	857	536	509	6,857
22	1,571	982	1,964	673	898	561	533	7,183
23	1,643	1,027	2,053	704	939	587	557	7,510
24	1,714	1,071	2,143	735	980	612	582	7,836
25	1,786	1,116	2,232	765	1,020	638	606	8,163
26	1,857	1,161	2,321	796	1,061	663	630	8,489
27	1,928	1,205	2,411	826	1,102	689	654	8,816
28	2,000	1,250	2,500	857	1,143	714	679	9,142
29	2,071	1,295	2,589	888	1,184	740	703	9,469
30	2,143	1,339	2,678	918	1,224	765	727	9,796
31	2,214	1,384	2,768	949	1,265	791	751	10,122
32	2,286	1,429	2,857	980	1,306	816	775	10,449
33	2,357	1,473	2,946	1,010	1,347	842	800	10,775
34	2,428	1,518	3,036	1,041	1,388	867	824	11,102
35	2,500	1,562	3,125	1,071	1,429	893	848	11,428
36	2,571	1,607	3,214	1,102	1,469	918	872	11,755
37	2,643	1,652	3,303	1,133	1,510	944	897	12,081
38	2,714	1,696	3,393	1,163	1,551	969	921	12,408
39	2,786	1,741	3,482	1,194	1,592	995	945	12,734
40	2,857	1,786	3,571	1,224	1,633	1,020	969	13,061

Sub Watershed 206 Annual Phosphorous Reduction, Cropland BMPs (pounds)								
Year	No-Till	Nutrient Management Plans	Cover Crops	Terraces	Waterways	Buffers	Perm Vegetation	Total Load Reduction
1	18	11	22	8	10	6	6	82
2	36	22	45	15	20	13	12	164
3	54	34	67	23	31	19	18	246
4	72	45	90	31	41	26	24	328
5	90	56	112	38	51	32	30	410
6	108	67	134	46	61	38	36	492
7	125	78	157	54	72	45	43	574
8	143	90	179	61	82	51	49	656
9	161	101	202	69	92	58	55	738
10	179	112	224	77	102	64	61	820
11	197	123	247	85	113	70	67	902
12	215	134	269	92	123	77	73	983
13	233	146	291	100	133	83	79	1,065
14	251	157	314	108	143	90	85	1,147
15	269	168	336	115	154	96	91	1,229
16	287	179	359	123	164	102	97	1,311
17	305	190	381	131	174	109	103	1,393
18	323	202	403	138	184	115	109	1,475
19	341	213	426	146	195	122	116	1,557
20	359	224	448	154	205	128	122	1,639
21	376	235	471	161	215	134	128	1,721
22	394	247	493	169	225	141	134	1,803
23	412	258	515	177	236	147	140	1,885
24	430	269	538	184	246	154	146	1,967
25	448	280	560	192	256	160	152	2,049
26	466	291	583	200	266	166	158	2,131
27	484	303	605	207	277	173	164	2,213
28	502	314	627	215	287	179	170	2,295
29	520	325	650	223	297	186	176	2,377
30	538	336	672	230	307	192	182	2,459
31	556	347	695	238	318	198	189	2,541
32	574	359	717	246	328	205	195	2,623
33	592	370	740	254	338	211	201	2,705
34	610	381	762	261	348	218	207	2,786
35	627	392	784	269	359	224	213	2,868
36	645	403	807	277	369	230	219	2,950
37	663	415	829	284	379	237	225	3,032
38	681	426	852	292	389	243	231	3,114
39	699	437	874	300	400	250	237	3,196
40	717	448	896	307	410	256	243	3,278

Sub Watershed 207 Annual Phosphorous Reduction, Cropland BMPs (pounds)								
Year	No-Till	Nutrient Management Plans	Cover Crops	Terraces	Waterways	Buffers	Perm Vegetation	Total Load Reduction
1	54	34	68	23	31	19	18	247
2	108	68	135	46	62	39	37	494
3	162	101	203	69	93	58	55	741
4	216	135	270	93	124	77	73	988
5	270	169	338	116	154	96	92	1,235
6	324	203	405	139	185	116	110	1,482
7	378	236	473	162	216	135	128	1,729
8	432	270	540	185	247	154	147	1,976
9	486	304	608	208	278	174	165	2,223
10	540	338	675	232	309	193	183	2,470
11	594	372	743	255	340	212	202	2,717
12	648	405	811	278	371	232	220	2,964
13	703	439	878	301	401	251	238	3,212
14	757	473	946	324	432	270	257	3,459
15	811	507	1,013	347	463	289	275	3,706
16	865	540	1,081	371	494	309	293	3,953
17	919	574	1,148	394	525	328	312	4,200
18	973	608	1,216	417	556	347	330	4,447
19	1,027	642	1,283	440	587	367	348	4,694
20	1,081	675	1,351	463	618	386	367	4,941
21	1,135	709	1,419	486	648	405	385	5,188
22	1,189	743	1,486	510	679	425	403	5,435
23	1,243	777	1,554	533	710	444	422	5,682
24	1,297	811	1,621	556	741	463	440	5,929
25	1,351	844	1,689	579	772	482	458	6,176
26	1,405	878	1,756	602	803	502	477	6,423
27	1,459	912	1,824	625	834	521	495	6,670
28	1,513	946	1,891	648	865	540	513	6,917
29	1,567	979	1,959	672	896	560	532	7,164
30	1,621	1,013	2,026	695	926	579	550	7,411
31	1,675	1,047	2,094	718	957	598	568	7,658
32	1,729	1,081	2,162	741	988	618	587	7,905
33	1,783	1,115	2,229	764	1,019	637	605	8,152
34	1,837	1,148	2,297	787	1,050	656	623	8,399
35	1,891	1,182	2,364	811	1,081	675	642	8,646
36	1,945	1,216	2,432	834	1,112	695	660	8,893
37	1,999	1,250	2,499	857	1,143	714	678	9,140
38	2,054	1,283	2,567	880	1,173	733	697	9,387
39	2,108	1,317	2,634	903	1,204	753	715	9,635
40	2,162	1,351	2,702	926	1,235	772	733	9,882

5. Cropland BMP implementation: Costs before cost share

Sub Watershed 203 Annual Cost* Before Cost-Share, Cropland BMPs								
Year	No-Till	Nutrient Management Plans	Cover Crops	Terraces	Waterways	Buffers	Perm Vegetation	Total Cost
1	$3,309	$2,428	$2,130	$8,762	$3,043	$815	$1,156	$21,643
2	$3,408	$2,501	$2,194	$9,025	$3,134	$840	$1,191	$22,293
3	$3,511	$2,576	$2,259	$9,296	$3,228	$865	$1,227	$22,961
4	$3,616	$2,653	$2,327	$9,575	$3,325	$891	$1,263	$23,650
5	$3,725	$2,733	$2,397	$9,862	$3,424	$918	$1,301	$24,360
6	$3,836	$2,815	$2,469	$10,158	$3,527	$945	$1,340	$25,091
7	$3,951	$2,899	$2,543	$10,463	$3,633	$974	$1,381	$25,843
8	$4,070	$2,986	$2,619	$10,777	$3,742	$1,003	$1,422	$26,619
9	$4,192	$3,076	$2,698	$11,100	$3,854	$1,033	$1,465	$27,417
10	$4,318	$3,168	$2,779	$11,433	$3,970	$1,064	$1,509	$28,240
11	$4,447	$3,263	$2,862	$11,776	$4,089	$1,096	$1,554	$29,087
12	$4,581	$3,361	$2,948	$12,129	$4,212	$1,129	$1,600	$29,959
13	$4,718	$3,462	$3,037	$12,493	$4,338	$1,163	$1,648	$30,858
14	$4,860	$3,565	$3,128	$12,868	$4,468	$1,197	$1,698	$31,784
15	$5,005	$3,672	$3,221	$13,254	$4,602	$1,233	$1,749	$32,737
16	$5,156	$3,783	$3,318	$13,652	$4,740	$1,270	$1,801	$33,720
17	$5,310	$3,896	$3,418	$14,061	$4,882	$1,308	$1,855	$34,731
18	$5,470	$4,013	$3,520	$14,483	$5,029	$1,348	$1,911	$35,773
19	$5,634	$4,133	$3,626	$14,917	$5,180	$1,388	$1,968	$36,846
20	$5,803	$4,257	$3,735	$15,365	$5,335	$1,430	$2,027	$37,952
21	$5,977	$4,385	$3,847	$15,826	$5,495	$1,473	$2,088	$39,090
22	$6,156	$4,517	$3,962	$16,301	$5,660	$1,517	$2,151	$40,263
23	$6,341	$4,652	$4,081	$16,790	$5,830	$1,562	$2,215	$41,471
24	$6,531	$4,792	$4,203	$17,293	$6,005	$1,609	$2,282	$42,715
25	$6,727	$4,935	$4,329	$17,812	$6,185	$1,658	$2,350	$43,996
26	$6,929	$5,084	$4,459	$18,347	$6,370	$1,707	$2,421	$45,316
27	$7,137	$5,236	$4,593	$18,897	$6,561	$1,758	$2,493	$46,676
28	$7,351	$5,393	$4,731	$19,464	$6,758	$1,811	$2,568	$48,076
29	$7,571	$5,555	$4,873	$20,048	$6,961	$1,866	$2,645	$49,518
30	$7,798	$5,722	$5,019	$20,649	$7,170	$1,922	$2,725	$51,004
31	$8,032	$5,893	$5,169	$21,269	$7,385	$1,979	$2,806	$52,534
32	$8,273	$6,070	$5,325	$21,907	$7,606	$2,039	$2,890	$54,110
33	$8,521	$6,252	$5,484	$22,564	$7,835	$2,100	$2,977	$55,733
34	$8,777	$6,440	$5,649	$23,241	$8,070	$2,163	$3,066	$57,405
35	$9,040	$6,633	$5,818	$23,938	$8,312	$2,228	$3,158	$59,127
36	$9,312	$6,832	$5,993	$24,656	$8,561	$2,294	$3,253	$60,901
37	$9,591	$7,037	$6,173	$25,396	$8,818	$2,363	$3,351	$62,728
38	$9,879	$7,248	$6,358	$26,158	$9,083	$2,434	$3,451	$64,610
39	$10,175	$7,465	$6,549	$26,942	$9,355	$2,507	$3,555	$66,548
40	$10,480	$7,689	$6,745	$27,751	$9,636	$2,582	$3,662	$68,545
*3% Inflation								$1,631,933

Sub Watershed 204 Annual Cost* Before Cost-Share, Cropland BMPs								
Year	No-Till	Nutrient Management Plans	Cover Crops	Terraces	Waterways	Buffers	Perm Vegetation	Total Cost
1	$3,900	$2,861	$2,510	$10,327	$3,586	$961	$1,363	$25,507
2	$4,017	$2,947	$2,585	$10,636	$3,693	$990	$1,403	$26,272
3	$4,137	$3,036	$2,663	$10,955	$3,804	$1,019	$1,446	$27,060
4	$4,262	$3,127	$2,743	$11,284	$3,918	$1,050	$1,489	$27,872
5	$4,389	$3,220	$2,825	$11,623	$4,036	$1,082	$1,534	$28,708
6	$4,521	$3,317	$2,910	$11,971	$4,157	$1,114	$1,580	$29,570
7	$4,657	$3,417	$2,997	$12,331	$4,281	$1,147	$1,627	$30,457
8	$4,796	$3,519	$3,087	$12,700	$4,410	$1,182	$1,676	$31,370
9	$4,940	$3,625	$3,180	$13,081	$4,542	$1,217	$1,726	$32,311
10	$5,089	$3,733	$3,275	$13,474	$4,678	$1,254	$1,778	$33,281
11	$5,241	$3,845	$3,373	$13,878	$4,819	$1,291	$1,831	$34,279
12	$5,398	$3,961	$3,474	$14,294	$4,963	$1,330	$1,886	$35,308
13	$5,560	$4,080	$3,579	$14,723	$5,112	$1,370	$1,943	$36,367
14	$5,727	$4,202	$3,686	$15,165	$5,266	$1,411	$2,001	$37,458
15	$5,899	$4,328	$3,797	$15,620	$5,424	$1,454	$2,061	$38,582
16	$6,076	$4,458	$3,910	$16,089	$5,586	$1,497	$2,123	$39,739
17	$6,258	$4,592	$4,028	$16,571	$5,754	$1,542	$2,186	$40,931
18	$6,446	$4,729	$4,149	$17,068	$5,926	$1,588	$2,252	$42,159
19	$6,639	$4,871	$4,273	$17,580	$6,104	$1,636	$2,320	$43,424
20	$6,839	$5,017	$4,401	$18,108	$6,287	$1,685	$2,389	$44,727
21	$7,044	$5,168	$4,533	$18,651	$6,476	$1,736	$2,461	$46,068
22	$7,255	$5,323	$4,669	$19,211	$6,670	$1,788	$2,535	$47,450
23	$7,473	$5,483	$4,809	$19,787	$6,870	$1,841	$2,611	$48,874
24	$7,697	$5,647	$4,954	$20,380	$7,077	$1,897	$2,689	$50,340
25	$7,928	$5,816	$5,102	$20,992	$7,289	$1,953	$2,770	$51,850
26	$8,166	$5,991	$5,255	$21,622	$7,508	$2,012	$2,853	$53,406
27	$8,411	$6,171	$5,413	$22,270	$7,733	$2,072	$2,938	$55,008
28	$8,663	$6,356	$5,575	$22,938	$7,965	$2,135	$3,027	$56,658
29	$8,923	$6,547	$5,743	$23,627	$8,204	$2,199	$3,117	$58,358
30	$9,190	$6,743	$5,915	$24,335	$8,450	$2,265	$3,211	$60,109
31	$9,466	$6,945	$6,092	$25,065	$8,703	$2,332	$3,307	$61,912
32	$9,750	$7,154	$6,275	$25,817	$8,964	$2,402	$3,406	$63,769
33	$10,043	$7,368	$6,463	$26,592	$9,233	$2,475	$3,509	$65,682
34	$10,344	$7,589	$6,657	$27,390	$9,510	$2,549	$3,614	$67,653
35	$10,654	$7,817	$6,857	$28,211	$9,796	$2,625	$3,722	$69,682
36	$10,974	$8,051	$7,063	$29,058	$10,089	$2,704	$3,834	$71,773
37	$11,303	$8,293	$7,274	$29,929	$10,392	$2,785	$3,949	$73,926
38	$11,642	$8,542	$7,493	$30,827	$10,704	$2,869	$4,067	$76,144
39	$11,991	$8,798	$7,718	$31,752	$11,025	$2,955	$4,190	$78,428
40	$12,351	$9,062	$7,949	$32,705	$11,356	$3,043	$4,315	$80,781
*3% Inflation								$1,923,254

Sub Watershed 205 Annual Cost* Before Cost-Share, Cropland BMPs								
Year	No-Till	Nutrient Management Plans	Cover Crops	Terraces	Waterways	Buffers	Perm Vegetation	Total Cost
1	$5,939	$4,357	$3,822	$15,725	$5,460	$1,463	$2,075	$38,841
2	$6,117	$4,488	$3,937	$16,197	$5,624	$1,507	$2,137	$40,006
3	$6,300	$4,622	$4,055	$16,682	$5,793	$1,552	$2,201	$41,206
4	$6,489	$4,761	$4,176	$17,183	$5,966	$1,599	$2,267	$42,442
5	$6,684	$4,904	$4,302	$17,698	$6,145	$1,647	$2,335	$43,715
6	$6,884	$5,051	$4,431	$18,229	$6,330	$1,696	$2,405	$45,027
7	$7,091	$5,203	$4,564	$18,776	$6,520	$1,747	$2,477	$46,378
8	$7,304	$5,359	$4,701	$19,340	$6,715	$1,800	$2,552	$47,769
9	$7,523	$5,519	$4,842	$19,920	$6,917	$1,854	$2,628	$49,202
10	$7,749	$5,685	$4,987	$20,517	$7,124	$1,909	$2,707	$50,678
11	$7,981	$5,856	$5,136	$21,133	$7,338	$1,967	$2,788	$52,198
12	$8,220	$6,031	$5,291	$21,767	$7,558	$2,026	$2,872	$53,764
13	$8,467	$6,212	$5,449	$22,420	$7,785	$2,086	$2,958	$55,377
14	$8,721	$6,399	$5,613	$23,092	$8,018	$2,149	$3,047	$57,039
15	$8,983	$6,590	$5,781	$23,785	$8,259	$2,213	$3,138	$58,750
16	$9,252	$6,788	$5,955	$24,499	$8,507	$2,280	$3,232	$60,512
17	$9,530	$6,992	$6,133	$25,234	$8,762	$2,348	$3,329	$62,328
18	$9,816	$7,202	$6,317	$25,991	$9,025	$2,419	$3,429	$64,198
19	$10,110	$7,418	$6,507	$26,770	$9,295	$2,491	$3,532	$66,123
20	$10,413	$7,640	$6,702	$27,574	$9,574	$2,566	$3,638	$68,107
21	$10,726	$7,869	$6,903	$28,401	$9,861	$2,643	$3,747	$70,150
22	$11,048	$8,105	$7,110	$29,253	$10,157	$2,722	$3,860	$72,255
23	$11,379	$8,349	$7,323	$30,130	$10,462	$2,804	$3,976	$74,423
24	$11,720	$8,599	$7,543	$31,034	$10,776	$2,888	$4,095	$76,655
25	$12,072	$8,857	$7,769	$31,965	$11,099	$2,975	$4,218	$78,955
26	$12,434	$9,123	$8,002	$32,924	$11,432	$3,064	$4,344	$81,324
27	$12,807	$9,396	$8,242	$33,912	$11,775	$3,156	$4,474	$83,763
28	$13,191	$9,678	$8,490	$34,929	$12,128	$3,250	$4,609	$86,276
29	$13,587	$9,969	$8,744	$35,977	$12,492	$3,348	$4,747	$88,864
30	$13,995	$10,268	$9,007	$37,057	$12,867	$3,448	$4,889	$91,530
31	$14,415	$10,576	$9,277	$38,168	$13,253	$3,552	$5,036	$94,276
32	$14,847	$10,893	$9,555	$39,313	$13,650	$3,658	$5,187	$97,105
33	$15,292	$11,220	$9,842	$40,493	$14,060	$3,768	$5,343	$100,018
34	$15,751	$11,556	$10,137	$41,707	$14,482	$3,881	$5,503	$103,018
35	$16,224	$11,903	$10,441	$42,959	$14,916	$3,998	$5,668	$106,109
36	$16,710	$12,260	$10,755	$44,247	$15,364	$4,117	$5,838	$109,292
37	$17,212	$12,628	$11,077	$45,575	$15,825	$4,241	$6,013	$112,571
38	$17,728	$13,007	$11,410	$46,942	$16,299	$4,368	$6,194	$115,948
39	$18,260	$13,397	$11,752	$48,350	$16,788	$4,499	$6,380	$119,426
40	$18,808	$13,799	$12,104	$49,801	$17,292	$4,634	$6,571	$123,009
*3% Inflation								$2,928,629

Sub Watershed 206 Annual Cost* Before Cost-Share, Cropland BMPs								
Year	No-Till	Nutrient Management Plans	Cover Crops	Terraces	Waterways	Buffers	Perm Vegetation	Total Cost
1	$1,515	$1,111	$975	$4,010	$1,393	$373	$529	$9,906
2	$1,560	$1,145	$1,004	$4,131	$1,434	$384	$545	$10,203
3	$1,607	$1,179	$1,034	$4,255	$1,477	$396	$561	$10,509
4	$1,655	$1,214	$1,065	$4,382	$1,522	$408	$578	$10,824
5	$1,705	$1,251	$1,097	$4,514	$1,567	$420	$596	$11,149
6	$1,756	$1,288	$1,130	$4,649	$1,614	$433	$613	$11,484
7	$1,808	$1,327	$1,164	$4,789	$1,663	$446	$632	$11,828
8	$1,863	$1,367	$1,199	$4,932	$1,713	$459	$651	$12,183
9	$1,919	$1,408	$1,235	$5,080	$1,764	$473	$670	$12,548
10	$1,976	$1,450	$1,272	$5,233	$1,817	$487	$690	$12,925
11	$2,035	$1,493	$1,310	$5,390	$1,871	$502	$711	$13,313
12	$2,097	$1,538	$1,349	$5,551	$1,928	$517	$732	$13,712
13	$2,159	$1,584	$1,390	$5,718	$1,985	$532	$754	$14,123
14	$2,224	$1,632	$1,431	$5,889	$2,045	$548	$777	$14,547
15	$2,291	$1,681	$1,474	$6,066	$2,106	$564	$800	$14,983
16	$2,360	$1,731	$1,519	$6,248	$2,169	$581	$824	$15,433
17	$2,430	$1,783	$1,564	$6,436	$2,235	$599	$849	$15,896
18	$2,503	$1,837	$1,611	$6,629	$2,302	$617	$875	$16,373
19	$2,578	$1,892	$1,659	$6,827	$2,371	$635	$901	$16,864
20	$2,656	$1,949	$1,709	$7,032	$2,442	$654	$928	$17,370
21	$2,735	$2,007	$1,761	$7,243	$2,515	$674	$956	$17,891
22	$2,818	$2,067	$1,813	$7,461	$2,590	$694	$984	$18,428
23	$2,902	$2,129	$1,868	$7,684	$2,668	$715	$1,014	$18,980
24	$2,989	$2,193	$1,924	$7,915	$2,748	$737	$1,044	$19,550
25	$3,079	$2,259	$1,981	$8,152	$2,831	$759	$1,076	$20,136
26	$3,171	$2,327	$2,041	$8,397	$2,916	$781	$1,108	$20,740
27	$3,266	$2,396	$2,102	$8,649	$3,003	$805	$1,141	$21,363
28	$3,364	$2,468	$2,165	$8,908	$3,093	$829	$1,175	$22,004
29	$3,465	$2,542	$2,230	$9,176	$3,186	$854	$1,211	$22,664
30	$3,569	$2,619	$2,297	$9,451	$3,282	$879	$1,247	$23,344
31	$3,676	$2,697	$2,366	$9,734	$3,380	$906	$1,284	$24,044
32	$3,787	$2,778	$2,437	$10,026	$3,481	$933	$1,323	$24,765
33	$3,900	$2,861	$2,510	$10,327	$3,586	$961	$1,363	$25,508
34	$4,017	$2,947	$2,585	$10,637	$3,693	$990	$1,403	$26,273
35	$4,138	$3,036	$2,663	$10,956	$3,804	$1,020	$1,446	$27,062
36	$4,262	$3,127	$2,743	$11,285	$3,918	$1,050	$1,489	$27,873
37	$4,390	$3,221	$2,825	$11,623	$4,036	$1,082	$1,534	$28,710
38	$4,521	$3,317	$2,910	$11,972	$4,157	$1,114	$1,580	$29,571
39	$4,657	$3,417	$2,997	$12,331	$4,282	$1,147	$1,627	$30,458
40	$4,797	$3,519	$3,087	$12,701	$4,410	$1,182	$1,676	$31,372
*3% Inflation								$746,908

Sub Watershed 207 Annual Cost* Before Cost-Share, Cropland BMPs								
Year	No-Till	Nutrient Management Plans	Cover Crops	Terraces	Waterways	Buffers	Perm Vegetation	Total Cost
1	$6,160	$4,519	$3,964	$16,310	$5,663	$1,518	$2,152	$40,286
2	$6,344	$4,655	$4,083	$16,799	$5,833	$1,563	$2,217	$41,494
3	$6,535	$4,794	$4,206	$17,303	$6,008	$1,610	$2,283	$42,739
4	$6,731	$4,938	$4,332	$17,822	$6,188	$1,658	$2,352	$44,021
5	$6,933	$5,086	$4,462	$18,357	$6,374	$1,708	$2,422	$45,342
6	$7,141	$5,239	$4,596	$18,908	$6,565	$1,759	$2,495	$46,702
7	$7,355	$5,396	$4,733	$19,475	$6,762	$1,812	$2,570	$48,103
8	$7,575	$5,558	$4,875	$20,059	$6,965	$1,867	$2,647	$49,546
9	$7,803	$5,725	$5,022	$20,661	$7,174	$1,923	$2,726	$51,033
10	$8,037	$5,896	$5,172	$21,281	$7,389	$1,980	$2,808	$52,563
11	$8,278	$6,073	$5,328	$21,919	$7,611	$2,040	$2,892	$54,140
12	$8,526	$6,256	$5,487	$22,577	$7,839	$2,101	$2,979	$55,765
13	$8,782	$6,443	$5,652	$23,254	$8,074	$2,164	$3,068	$57,438
14	$9,046	$6,637	$5,822	$23,951	$8,316	$2,229	$3,160	$59,161
15	$9,317	$6,836	$5,996	$24,670	$8,566	$2,296	$3,255	$60,936
16	$9,596	$7,041	$6,176	$25,410	$8,823	$2,365	$3,353	$62,764
17	$9,884	$7,252	$6,361	$26,172	$9,088	$2,435	$3,453	$64,646
18	$10,181	$7,470	$6,552	$26,958	$9,360	$2,509	$3,557	$66,586
19	$10,486	$7,694	$6,749	$27,766	$9,641	$2,584	$3,664	$68,583
20	$10,801	$7,924	$6,951	$28,599	$9,930	$2,661	$3,774	$70,641
21	$11,125	$8,162	$7,160	$29,457	$10,228	$2,741	$3,887	$72,760
22	$11,459	$8,407	$7,375	$30,341	$10,535	$2,823	$4,003	$74,943
23	$11,802	$8,659	$7,596	$31,251	$10,851	$2,908	$4,123	$77,191
24	$12,156	$8,919	$7,824	$32,189	$11,177	$2,995	$4,247	$79,507
25	$12,521	$9,187	$8,058	$33,154	$11,512	$3,085	$4,375	$81,892
26	$12,897	$9,462	$8,300	$34,149	$11,857	$3,178	$4,506	$84,349
27	$13,284	$9,746	$8,549	$35,174	$12,213	$3,273	$4,641	$86,879
28	$13,682	$10,038	$8,806	$36,229	$12,579	$3,371	$4,780	$89,486
29	$14,093	$10,340	$9,070	$37,316	$12,957	$3,472	$4,924	$92,170
30	$14,515	$10,650	$9,342	$38,435	$13,346	$3,577	$5,071	$94,936
31	$14,951	$10,969	$9,622	$39,588	$13,746	$3,684	$5,223	$97,784
32	$15,399	$11,298	$9,911	$40,776	$14,158	$3,794	$5,380	$100,717
33	$15,861	$11,637	$10,208	$41,999	$14,583	$3,908	$5,542	$103,739
34	$16,337	$11,986	$10,514	$43,259	$15,021	$4,025	$5,708	$106,851
35	$16,827	$12,346	$10,830	$44,557	$15,471	$4,146	$5,879	$110,056
36	$17,332	$12,716	$11,155	$45,894	$15,935	$4,271	$6,055	$113,358
37	$17,852	$13,098	$11,489	$47,270	$16,413	$4,399	$6,237	$116,759
38	$18,388	$13,491	$11,834	$48,688	$16,906	$4,531	$6,424	$120,261
39	$18,939	$13,895	$12,189	$50,149	$17,413	$4,667	$6,617	$123,869
40	$19,507	$14,312	$12,555	$51,654	$17,935	$4,807	$6,815	$127,585
*3% Inflation								$3,037,581

6. Cropland BMP implementation: Costs after cost share

Sub Watershed 203 Annual Cost* After Cost-Share, Cropland BMPs								
Year	No-Till	Nutrient Management Plans	Cover Crops	Terraces	Waterways	Buffers	Perm Vegetation	Total Cost
1	$2,019	$1,214	$852	$4,381	$1,521	$82	$578	$10,647
2	$2,079	$1,250	$877	$4,513	$1,567	$84	$595	$10,966
3	$2,142	$1,288	$904	$4,648	$1,614	$87	$613	$11,295
4	$2,206	$1,327	$931	$4,787	$1,662	$89	$632	$11,634
5	$2,272	$1,366	$959	$4,931	$1,712	$92	$651	$11,983
6	$2,340	$1,407	$988	$5,079	$1,764	$95	$670	$12,342
7	$2,410	$1,450	$1,017	$5,231	$1,816	$97	$690	$12,713
8	$2,483	$1,493	$1,048	$5,388	$1,871	$100	$711	$13,094
9	$2,557	$1,538	$1,079	$5,550	$1,927	$103	$732	$13,487
10	$2,634	$1,584	$1,112	$5,716	$1,985	$106	$754	$13,891
11	$2,713	$1,631	$1,145	$5,888	$2,044	$110	$777	$14,308
12	$2,794	$1,680	$1,179	$6,065	$2,106	$113	$800	$14,737
13	$2,878	$1,731	$1,215	$6,247	$2,169	$116	$824	$15,179
14	$2,964	$1,783	$1,251	$6,434	$2,234	$120	$849	$15,635
15	$3,053	$1,836	$1,289	$6,627	$2,301	$123	$874	$16,104
16	$3,145	$1,891	$1,327	$6,826	$2,370	$127	$901	$16,587
17	$3,239	$1,948	$1,367	$7,031	$2,441	$131	$928	$17,085
18	$3,336	$2,006	$1,408	$7,241	$2,514	$135	$955	$17,597
19	$3,437	$2,067	$1,450	$7,459	$2,590	$139	$984	$18,125
20	$3,540	$2,129	$1,494	$7,682	$2,668	$143	$1,014	$18,669
21	$3,646	$2,193	$1,539	$7,913	$2,748	$147	$1,044	$19,229
22	$3,755	$2,258	$1,585	$8,150	$2,830	$152	$1,075	$19,806
23	$3,868	$2,326	$1,632	$8,395	$2,915	$156	$1,108	$20,400
24	$3,984	$2,396	$1,681	$8,647	$3,002	$161	$1,141	$21,012
25	$4,103	$2,468	$1,732	$8,906	$3,092	$166	$1,175	$21,642
26	$4,227	$2,542	$1,784	$9,173	$3,185	$171	$1,210	$22,291
27	$4,353	$2,618	$1,837	$9,448	$3,281	$176	$1,247	$22,960
28	$4,484	$2,697	$1,892	$9,732	$3,379	$181	$1,284	$23,649
29	$4,618	$2,777	$1,949	$10,024	$3,481	$187	$1,323	$24,359
30	$4,757	$2,861	$2,008	$10,325	$3,585	$192	$1,362	$25,089
31	$4,900	$2,947	$2,068	$10,634	$3,692	$198	$1,403	$25,842
32	$5,047	$3,035	$2,130	$10,953	$3,803	$204	$1,445	$26,617
33	$5,198	$3,126	$2,194	$11,282	$3,917	$210	$1,489	$27,416
34	$5,354	$3,220	$2,260	$11,620	$4,035	$216	$1,533	$28,238
35	$5,515	$3,316	$2,327	$11,969	$4,156	$223	$1,579	$29,085
36	$5,680	$3,416	$2,397	$12,328	$4,281	$229	$1,627	$29,958
37	$5,851	$3,518	$2,469	$12,698	$4,409	$236	$1,675	$30,857
38	$6,026	$3,624	$2,543	$13,079	$4,541	$243	$1,726	$31,782
39	$6,207	$3,733	$2,619	$13,471	$4,678	$251	$1,777	$32,736
40	$6,393	$3,845	$2,698	$13,875	$4,818	$258	$1,831	$33,718
*3% Inflation								$802,762

Sub Watershed 204 Annual Cost* After Cost-Share, Cropland BMPs								
Year	No-Till	Nutrient Management Plans	Cover Crops	Terraces	Waterways	Buffers	Perm Vegetation	Total Cost
1	$2,379	$1,431	$1,004	$5,163	$1,793	$96	$681	$12,547
2	$2,450	$1,474	$1,034	$5,318	$1,847	$99	$702	$12,923
3	$2,524	$1,518	$1,065	$5,478	$1,902	$102	$723	$13,311
4	$2,600	$1,563	$1,097	$5,642	$1,959	$105	$744	$13,711
5	$2,678	$1,610	$1,130	$5,811	$2,018	$108	$767	$14,122
6	$2,758	$1,659	$1,164	$5,986	$2,078	$111	$790	$14,546
7	$2,841	$1,708	$1,199	$6,165	$2,141	$115	$813	$14,982
8	$2,926	$1,760	$1,235	$6,350	$2,205	$118	$838	$15,431
9	$3,014	$1,812	$1,272	$6,541	$2,271	$122	$863	$15,894
10	$3,104	$1,867	$1,310	$6,737	$2,339	$125	$889	$16,371
11	$3,197	$1,923	$1,349	$6,939	$2,409	$129	$916	$16,862
12	$3,293	$1,980	$1,390	$7,147	$2,482	$133	$943	$17,368
13	$3,392	$2,040	$1,431	$7,362	$2,556	$137	$971	$17,889
14	$3,494	$2,101	$1,474	$7,582	$2,633	$141	$1,000	$18,426
15	$3,598	$2,164	$1,519	$7,810	$2,712	$145	$1,030	$18,979
16	$3,706	$2,229	$1,564	$8,044	$2,793	$150	$1,061	$19,548
17	$3,818	$2,296	$1,611	$8,286	$2,877	$154	$1,093	$20,134
18	$3,932	$2,365	$1,659	$8,534	$2,963	$159	$1,126	$20,738
19	$4,050	$2,436	$1,709	$8,790	$3,052	$164	$1,160	$21,361
20	$4,172	$2,509	$1,760	$9,054	$3,144	$169	$1,195	$22,001
21	$4,297	$2,584	$1,813	$9,325	$3,238	$174	$1,230	$22,661
22	$4,426	$2,661	$1,868	$9,605	$3,335	$179	$1,267	$23,341
23	$4,558	$2,741	$1,924	$9,893	$3,435	$184	$1,305	$24,042
24	$4,695	$2,824	$1,981	$10,190	$3,538	$190	$1,345	$24,763
25	$4,836	$2,908	$2,041	$10,496	$3,644	$195	$1,385	$25,506
26	$4,981	$2,995	$2,102	$10,811	$3,754	$201	$1,426	$26,271
27	$5,130	$3,085	$2,165	$11,135	$3,866	$207	$1,469	$27,059
28	$5,284	$3,178	$2,230	$11,469	$3,982	$213	$1,513	$27,871
29	$5,443	$3,273	$2,297	$11,813	$4,102	$220	$1,559	$28,707
30	$5,606	$3,371	$2,366	$12,168	$4,225	$226	$1,605	$29,568
31	$5,774	$3,473	$2,437	$12,533	$4,352	$233	$1,654	$30,455
32	$5,948	$3,577	$2,510	$12,909	$4,482	$240	$1,703	$31,369
33	$6,126	$3,684	$2,585	$13,296	$4,617	$247	$1,754	$32,310
34	$6,310	$3,795	$2,663	$13,695	$4,755	$255	$1,807	$33,279
35	$6,499	$3,908	$2,743	$14,106	$4,898	$263	$1,861	$34,277
36	$6,694	$4,026	$2,825	$14,529	$5,045	$270	$1,917	$35,306
37	$6,895	$4,146	$2,910	$14,965	$5,196	$279	$1,975	$36,365
38	$7,102	$4,271	$2,997	$15,414	$5,352	$287	$2,034	$37,456
39	$7,315	$4,399	$3,087	$15,876	$5,513	$295	$2,095	$38,580
40	$7,534	$4,531	$3,180	$16,352	$5,678	$304	$2,158	$39,737
*3% Inflation								$946,066

Sub Watershed 205 Annual Cost* After Cost-Share, Cropland BMPs								
Year	No-Till	Nutrient Management Plans	Cover Crops	Terraces	Waterways	Buffers	Perm Vegetation	Total Cost
1	$3,623	$2,179	$1,529	$7,862	$2,730	$146	$1,037	$19,106
2	$3,731	$2,244	$1,575	$8,098	$2,812	$151	$1,069	$19,679
3	$3,843	$2,311	$1,622	$8,341	$2,896	$155	$1,101	$20,270
4	$3,958	$2,381	$1,671	$8,591	$2,983	$160	$1,134	$20,878
5	$4,077	$2,452	$1,721	$8,849	$3,073	$165	$1,168	$21,504
6	$4,200	$2,526	$1,772	$9,115	$3,165	$170	$1,203	$22,149
7	$4,326	$2,601	$1,825	$9,388	$3,260	$175	$1,239	$22,814
8	$4,455	$2,679	$1,880	$9,670	$3,358	$180	$1,276	$23,498
9	$4,589	$2,760	$1,937	$9,960	$3,458	$185	$1,314	$24,203
10	$4,727	$2,843	$1,995	$10,259	$3,562	$191	$1,354	$24,929
11	$4,868	$2,928	$2,055	$10,566	$3,669	$197	$1,394	$25,677
12	$5,014	$3,016	$2,116	$10,883	$3,779	$203	$1,436	$26,447
13	$5,165	$3,106	$2,180	$11,210	$3,892	$209	$1,479	$27,241
14	$5,320	$3,199	$2,245	$11,546	$4,009	$215	$1,523	$28,058
15	$5,479	$3,295	$2,312	$11,893	$4,129	$221	$1,569	$28,900
16	$5,644	$3,394	$2,382	$12,249	$4,253	$228	$1,616	$29,767
17	$5,813	$3,496	$2,453	$12,617	$4,381	$235	$1,665	$30,660
18	$5,988	$3,601	$2,527	$12,995	$4,512	$242	$1,715	$31,579
19	$6,167	$3,709	$2,603	$13,385	$4,648	$249	$1,766	$32,527
20	$6,352	$3,820	$2,681	$13,787	$4,787	$257	$1,819	$33,503
21	$6,543	$3,935	$2,761	$14,200	$4,931	$264	$1,874	$34,508
22	$6,739	$4,053	$2,844	$14,626	$5,079	$272	$1,930	$35,543
23	$6,941	$4,174	$2,929	$15,065	$5,231	$280	$1,988	$36,609
24	$7,149	$4,300	$3,017	$15,517	$5,388	$289	$2,047	$37,707
25	$7,364	$4,429	$3,108	$15,983	$5,550	$297	$2,109	$38,839
26	$7,585	$4,561	$3,201	$16,462	$5,716	$306	$2,172	$40,004
27	$7,812	$4,698	$3,297	$16,956	$5,887	$316	$2,237	$41,204
28	$8,047	$4,839	$3,396	$17,465	$6,064	$325	$2,304	$42,440
29	$8,288	$4,984	$3,498	$17,989	$6,246	$335	$2,373	$43,713
30	$8,537	$5,134	$3,603	$18,528	$6,433	$345	$2,445	$45,025
31	$8,793	$5,288	$3,711	$19,084	$6,626	$355	$2,518	$46,375
32	$9,057	$5,447	$3,822	$19,657	$6,825	$366	$2,594	$47,767
33	$9,328	$5,610	$3,937	$20,246	$7,030	$377	$2,671	$49,200
34	$9,608	$5,778	$4,055	$20,854	$7,241	$388	$2,752	$50,676
35	$9,896	$5,952	$4,177	$21,479	$7,458	$400	$2,834	$52,196
36	$10,193	$6,130	$4,302	$22,124	$7,682	$412	$2,919	$53,762
37	$10,499	$6,314	$4,431	$22,787	$7,912	$424	$3,007	$55,375
38	$10,814	$6,503	$4,564	$23,471	$8,150	$437	$3,097	$57,036
39	$11,139	$6,699	$4,701	$24,175	$8,394	$450	$3,190	$58,747
40	$11,473	$6,899	$4,842	$24,900	$8,646	$463	$3,285	$60,509
*3% Inflation								$1,440,619

Sub Watershed 206 Annual Cost* After Cost-Share, Cropland BMPs								
Year	No-Till	Nutrient Management Plans	Cover Crops	Terraces	Waterways	Buffers	Perm Vegetation	Total Cost
1	$924	$556	$390	$2,005	$696	$37	$265	$4,873
2	$952	$572	$402	$2,065	$717	$38	$273	$5,019
3	$980	$589	$414	$2,127	$739	$40	$281	$5,169
4	$1,010	$607	$426	$2,191	$761	$41	$289	$5,325
5	$1,040	$625	$439	$2,257	$784	$42	$298	$5,484
6	$1,071	$644	$452	$2,325	$807	$43	$307	$5,649
7	$1,103	$663	$466	$2,394	$831	$45	$316	$5,818
8	$1,136	$683	$480	$2,466	$856	$46	$325	$5,993
9	$1,170	$704	$494	$2,540	$882	$47	$335	$6,173
10	$1,205	$725	$509	$2,616	$908	$49	$345	$6,358
11	$1,242	$747	$524	$2,695	$936	$50	$356	$6,549
12	$1,279	$769	$540	$2,776	$964	$52	$366	$6,745
13	$1,317	$792	$556	$2,859	$993	$53	$377	$6,947
14	$1,357	$816	$573	$2,945	$1,022	$55	$389	$7,156
15	$1,397	$840	$590	$3,033	$1,053	$56	$400	$7,370
16	$1,439	$866	$607	$3,124	$1,085	$58	$412	$7,592
17	$1,483	$892	$626	$3,218	$1,117	$60	$425	$7,819
18	$1,527	$918	$644	$3,314	$1,151	$62	$437	$8,054
19	$1,573	$946	$664	$3,414	$1,185	$64	$450	$8,296
20	$1,620	$974	$684	$3,516	$1,221	$65	$464	$8,544
21	$1,669	$1,003	$704	$3,622	$1,258	$67	$478	$8,801
22	$1,719	$1,034	$725	$3,730	$1,295	$69	$492	$9,065
23	$1,770	$1,065	$747	$3,842	$1,334	$72	$507	$9,337
24	$1,823	$1,097	$770	$3,957	$1,374	$74	$522	$9,617
25	$1,878	$1,129	$793	$4,076	$1,415	$76	$538	$9,905
26	$1,934	$1,163	$816	$4,198	$1,458	$78	$554	$10,202
27	$1,992	$1,198	$841	$4,324	$1,502	$80	$571	$10,509
28	$2,052	$1,234	$866	$4,454	$1,547	$83	$588	$10,824
29	$2,114	$1,271	$892	$4,588	$1,593	$85	$605	$11,148
30	$2,177	$1,309	$919	$4,725	$1,641	$88	$623	$11,483
31	$2,243	$1,349	$946	$4,867	$1,690	$91	$642	$11,827
32	$2,310	$1,389	$975	$5,013	$1,741	$93	$661	$12,182
33	$2,379	$1,431	$1,004	$5,164	$1,793	$96	$681	$12,548
34	$2,450	$1,474	$1,034	$5,318	$1,847	$99	$702	$12,924
35	$2,524	$1,518	$1,065	$5,478	$1,902	$102	$723	$13,312
36	$2,600	$1,563	$1,097	$5,642	$1,959	$105	$744	$13,711
37	$2,678	$1,610	$1,130	$5,812	$2,018	$108	$767	$14,123
38	$2,758	$1,659	$1,164	$5,986	$2,078	$111	$790	$14,546
39	$2,841	$1,708	$1,199	$6,166	$2,141	$115	$814	$14,983
40	$2,926	$1,760	$1,235	$6,351	$2,205	$118	$838	$15,432
*3% Inflation								$367,411

Sub Watershed 207 Annual Cost* After Cost-Share, Cropland BMPs								
Year	No-Till	Nutrient Management Plans	Cover Crops	Terraces	Waterways	Buffers	Perm Vegetation	Total Cost
1	$3,757	$2,260	$1,586	$8,155	$2,832	$152	$1,076	$19,817
2	$3,870	$2,327	$1,633	$8,400	$2,917	$156	$1,108	$20,411
3	$3,986	$2,397	$1,682	$8,652	$3,004	$161	$1,142	$21,024
4	$4,106	$2,469	$1,733	$8,911	$3,094	$166	$1,176	$21,654
5	$4,229	$2,543	$1,785	$9,178	$3,187	$171	$1,211	$22,304
6	$4,356	$2,619	$1,838	$9,454	$3,283	$176	$1,247	$22,973
7	$4,486	$2,698	$1,893	$9,737	$3,381	$181	$1,285	$23,662
8	$4,621	$2,779	$1,950	$10,029	$3,482	$187	$1,323	$24,372
9	$4,760	$2,862	$2,009	$10,330	$3,587	$192	$1,363	$25,103
10	$4,902	$2,948	$2,069	$10,640	$3,695	$198	$1,404	$25,856
11	$5,050	$3,037	$2,131	$10,960	$3,805	$204	$1,446	$26,632
12	$5,201	$3,128	$2,195	$11,288	$3,920	$210	$1,489	$27,431
13	$5,357	$3,222	$2,261	$11,627	$4,037	$216	$1,534	$28,254
14	$5,518	$3,318	$2,329	$11,976	$4,158	$223	$1,580	$29,102
15	$5,683	$3,418	$2,398	$12,335	$4,283	$230	$1,628	$29,975
16	$5,854	$3,520	$2,470	$12,705	$4,411	$236	$1,676	$30,874
17	$6,029	$3,626	$2,545	$13,086	$4,544	$244	$1,727	$31,800
18	$6,210	$3,735	$2,621	$13,479	$4,680	$251	$1,778	$32,754
19	$6,397	$3,847	$2,700	$13,883	$4,821	$258	$1,832	$33,737
20	$6,588	$3,962	$2,780	$14,300	$4,965	$266	$1,887	$34,749
21	$6,786	$4,081	$2,864	$14,729	$5,114	$274	$1,943	$35,791
22	$6,990	$4,203	$2,950	$15,171	$5,268	$282	$2,002	$36,865
23	$7,199	$4,330	$3,038	$15,626	$5,426	$291	$2,062	$37,971
24	$7,415	$4,459	$3,129	$16,094	$5,588	$300	$2,124	$39,110
25	$7,638	$4,593	$3,223	$16,577	$5,756	$309	$2,187	$40,284
26	$7,867	$4,731	$3,320	$17,075	$5,929	$318	$2,253	$41,492
27	$8,103	$4,873	$3,420	$17,587	$6,107	$327	$2,320	$42,737
28	$8,346	$5,019	$3,522	$18,114	$6,290	$337	$2,390	$44,019
29	$8,596	$5,170	$3,628	$18,658	$6,478	$347	$2,462	$45,339
30	$8,854	$5,325	$3,737	$19,218	$6,673	$358	$2,536	$46,700
31	$9,120	$5,485	$3,849	$19,794	$6,873	$368	$2,612	$48,101
32	$9,394	$5,649	$3,964	$20,388	$7,079	$379	$2,690	$49,544
33	$9,675	$5,819	$4,083	$21,000	$7,292	$391	$2,771	$51,030
34	$9,966	$5,993	$4,206	$21,630	$7,510	$403	$2,854	$52,561
35	$10,265	$6,173	$4,332	$22,278	$7,736	$415	$2,940	$54,138
36	$10,573	$6,358	$4,462	$22,947	$7,968	$427	$3,028	$55,762
37	$10,890	$6,549	$4,596	$23,635	$8,207	$440	$3,119	$57,435
38	$11,216	$6,745	$4,734	$24,344	$8,453	$453	$3,212	$59,158
39	$11,553	$6,948	$4,876	$25,075	$8,706	$467	$3,308	$60,932
40	$11,900	$7,156	$5,022	$25,827	$8,968	$481	$3,408	$62,760
*3% Inflation								$1,494,213