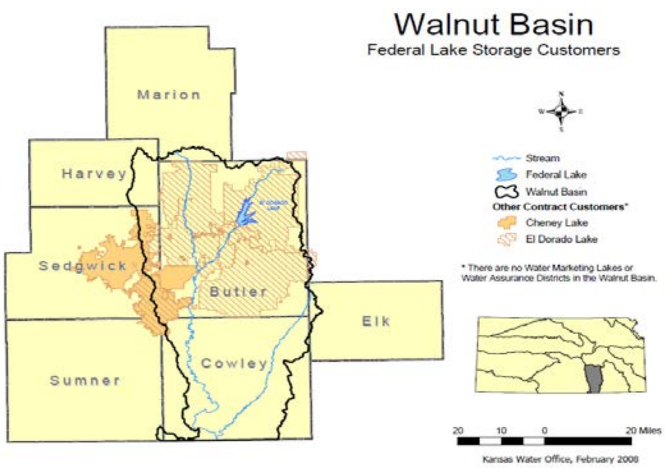
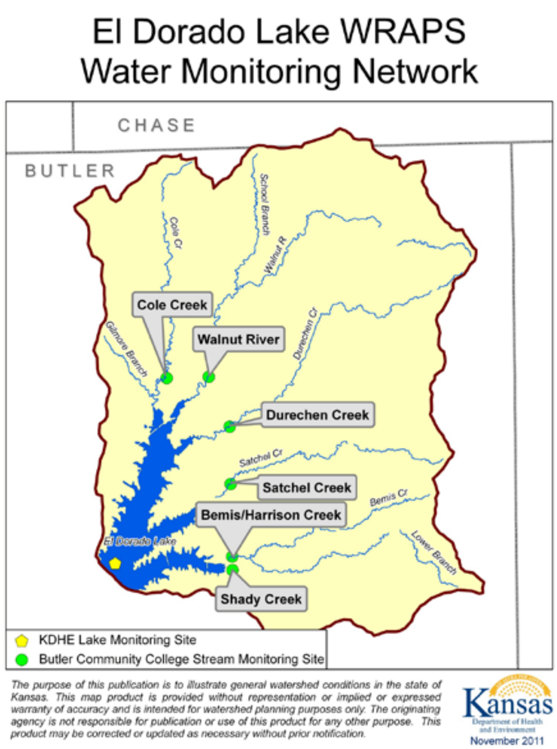
Upper Walnut/El Dorado Lake WRAPS 9 Element Plan Overview

The overall goal of the Upper Walnut/El Dorado Lake WRAPS 9 Element Plan is to provide a blueprint of protection and restoration strategies and activities to protect and restore surface waters in the El Dorado Lake WRAPS Project Area.



TMDLs within Upper Walnut/El Dorado Lake WRAPS Project Area		
	TMDL Pollutant	Priority
	Siltation	High
	Eutrophication	High

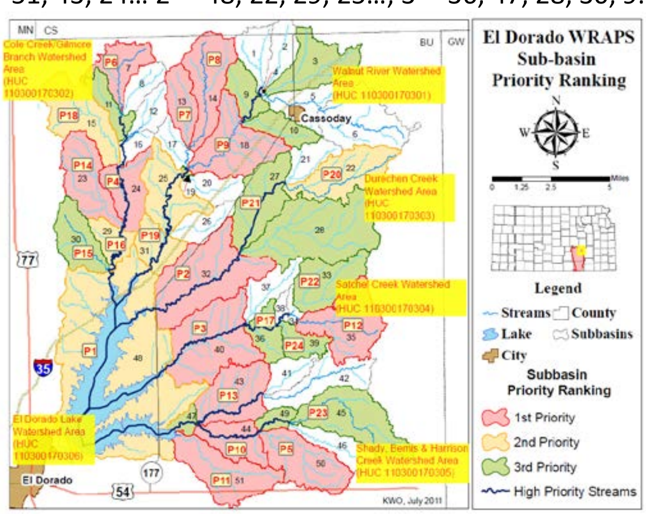
The primary pollutant concern of this watershed's lake is siltation and eutrophication which impacts aquatic life support, drinking water and recreation. Note Butler County Conservation District (BCCD) and Butler County Community College (BCCC) have been monitoring Duerschen and Cole Creek plus Walnut River watersheds since 1995. Bacteria, nutrients and sediment are the focus in streams.



Other Assessments and Service Providers:

- Ecosystem Restoration & Protection Feasibility Assessment- US Army Corps of Engineers
    - SWAT Model
    - Assessment of water quality, quantity aquatic Life support impacts from sedimentation
    - Dredging/reservoir management for sediment
- Stream bank & riparian assessment-Wildhorse River Works
- KS River Friendly Farmer Assessment- KS Rural Center

Prioritization:1st- Sub-basins 40, 35, 50, 44, 23,18,14 51, 43, 24… 2nd- 48, 22, 29, 25…; 3rd- 36, 47, 28, 30, 9…



Best Management Practices and Load Reduction Goals

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

Bacteria /Phosphorus Reducing BMPs for the El Dorado Lake Watershed:

- Vegetative filter strip
- Relocate feeding pens
- Alternative (Off-Stream) watering system
- Relocate pasture feeding site
- Grazing management plan

-Strategically fence ponds or stream sites

Sediment Reducing BMPs

-No-till farming

-Terraces

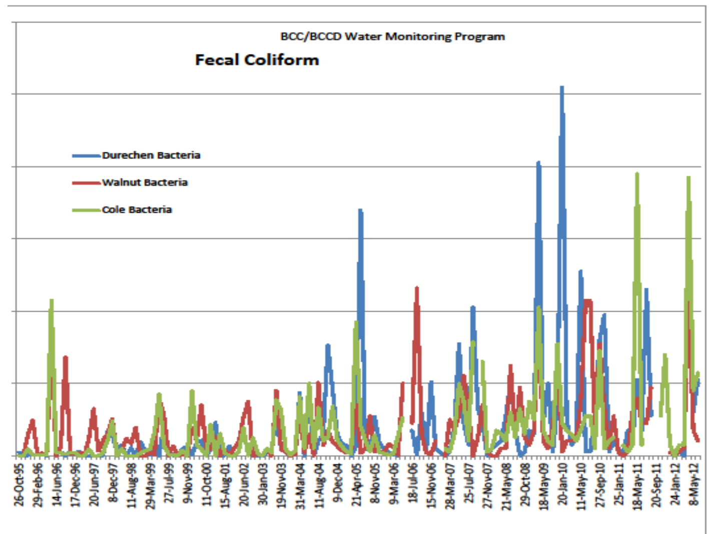
-Grassed Waterways

-Buffers and field borders

-Permanent Vegetation

-Grade stabilization structures

-Stream bank stabilization/weirs/planting



*Fecal coliform bacteria has been identified by the Butler Community College /Butler County Conservation District Water Monitoring Program as a pollutant in the tributaries above El Dorado Lake. Although no TMDL or pollutant reduction has been established for fecal coliform bacteria specifically, best management practices used for eutrophication will also reduce fecal coliform bacteria counts.

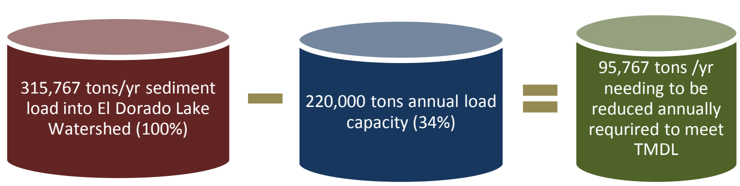
Current Targeted HUC 12 Watersheds:

Durechen Creek

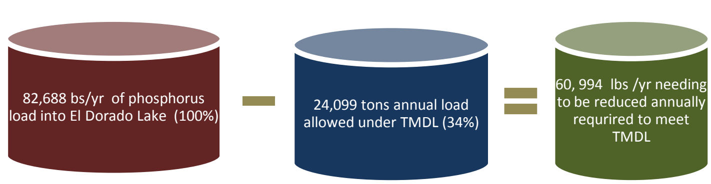
Walnut River/School Branch

Cole Creek/Gilmore Branch

The current estimated sediment load from nonpoint sources in the El Dorado Lake is 315,767 tons per year according to the Watershed Planning Section (TMDL) of KDHE. **The total annual load reduction allocated to El Dorado Lake needed to meet the sediment TMDL is 95,767 tons of sediment**. This is the amount of sediment that needs to be removed from the watershed and is the target of the BMP installations that will be placed in the watershed. These BMPs have been determined as feasible and approved by the SLT.



The current estimated sediment load from nonpoint sources in the El Dorado Lake is 82,668 pounds per year according to the Watershed Planning Section (TMDL) of KDHE. **The total annual load reduction allocated to El Dorado Lake needed to meet the sediment TMDL is 60,994 lbs/yr of phosphorus**. This is the amount of sediment that needs to be removed from the watershed and is the target of the BMP installations that will be placed in the watershed. These BMPs have been determined as feasible and approved by the SLT.



Upper Walnut/El Dorado Lake Nine Element Plan

Watershed Restoration and Protection Strategy (WRAPS)

August 2012

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Introduction

In 1918, Rolla Clymer moved his young family to El Dorado, Kansas, where he became editor and manager of the El Dorado Republican, (now known as the El Dorado Times). He served Butler County, El Dorado and the Flint Hills in that capacity for 59 years. In his later years Clymer devoted much of his time to efforts to preserve the Kansas Flint Hills region which he dearly loved. In addition to newspaper editorials, he wrote and published numerous widely circulated articles and poems about the Flint Hills. Perhaps his best known tribute was his poem "Majesty of the Hills."

"The Flint Hills are changeless and unchanging-and have so stood since their limestone ridges first broke from beneath the surface of prehistoric seas. All modern development, the growing complexity of civilization's advance have surrounded and hemmed them in but have failed to alter their essential character. They vie not in grandeur with the mighty Rockies, nor do they aspire to eminence among the nation's fondly cherished landmarks. Yet they possess unique glory and appeal, which stems from their gentle and healing moods. For ones bowed by worldly discouragement and disillusion, they offer spiritual enchantment through eyes opened to their beauty and constancy."

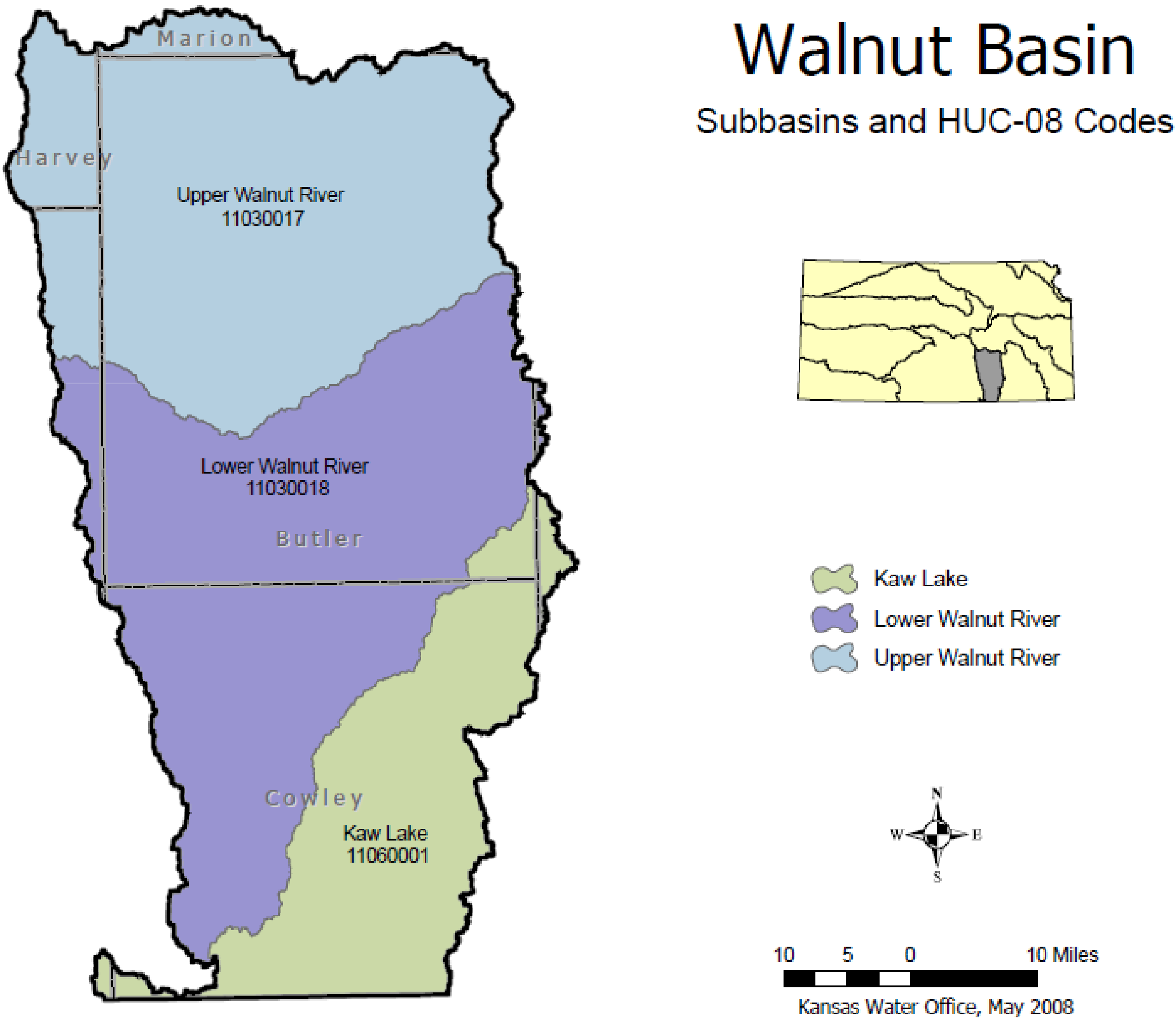
Statement of Goals:

Keeping in mind farmers and ranchers living in this watershed have an enduring connection to this region of the Flint Hills, make their living off the land and its' resources and wish to pass on this way of life to their sons and daughters; knowing they have a responsibility to others to manage their resources wisely for their families as well as all the families who rely on El Dorado Lake and their tributaries for their water supply; it is our mission to provide long term support through conservation education and information to assist them in decision making and offer technical and financial assistance for practices that reduce sediment and nutrients; with the ultimate goal of guaranteeing their way of life is protected while we work to assure water from El Dorado Lake is available for our children and their children and beyond.

This Watershed Plan will address El Dorado Lake and its tributaries as a high priority watershed in this region and offer ways to reduce sediment and eutrophication which are currently identified as impairments in the watershed. As pollutant reductions are achieved, the Plan will address ways to maintain those reductions to meet current water quality standards. This Plan will remain flexible to allow for changes that may take place in the watershed in addition to providing updates and revisions as new information on water quality, impairments or improvements occur.

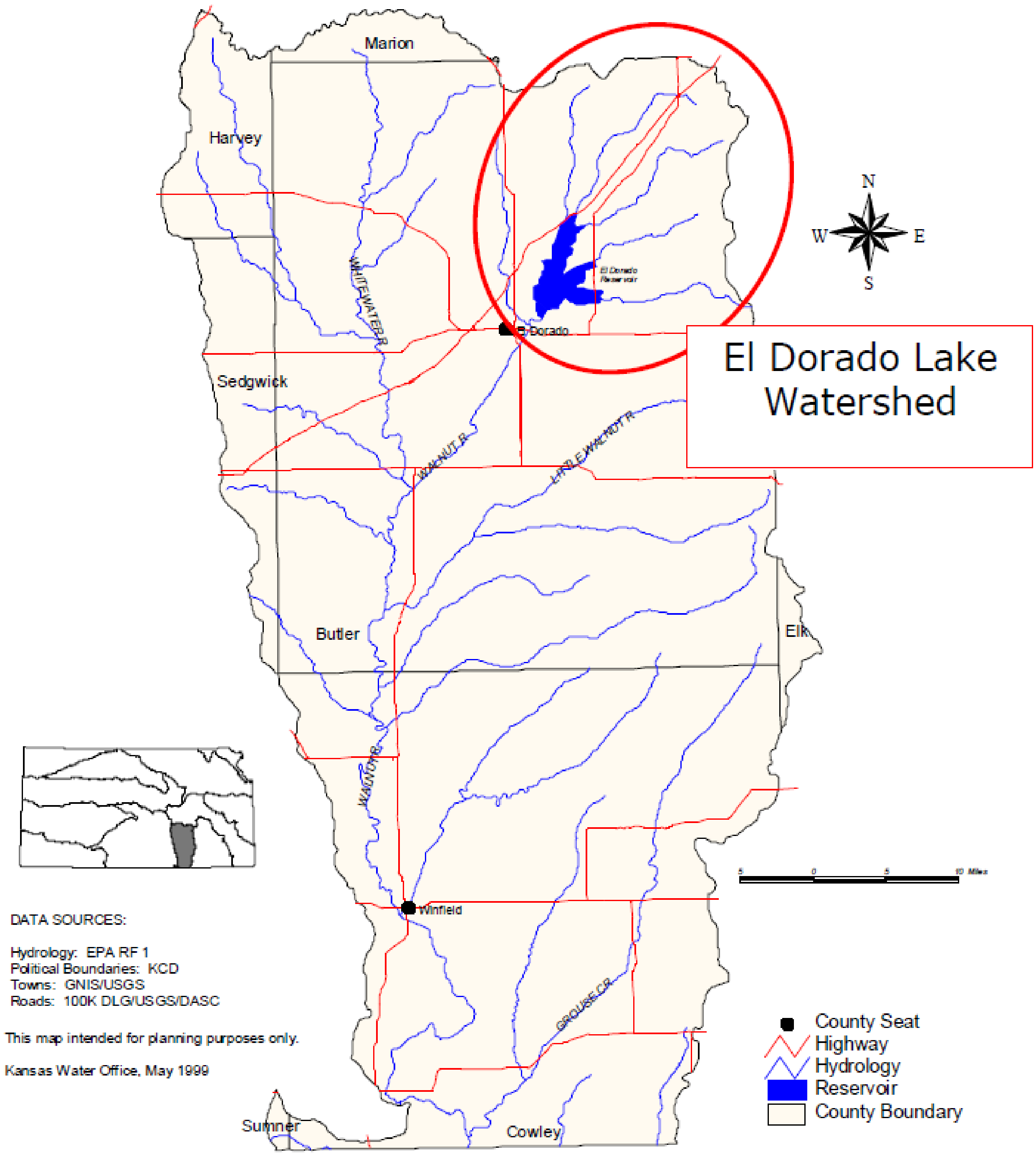
A. Watershed Map/Stream Network and HUC 12 Boundaries

The Upper Walnut Watershed (HUC 11030017) is part of the Walnut Basin Watershed, the smallest of the 12 major river basins in Kansas.

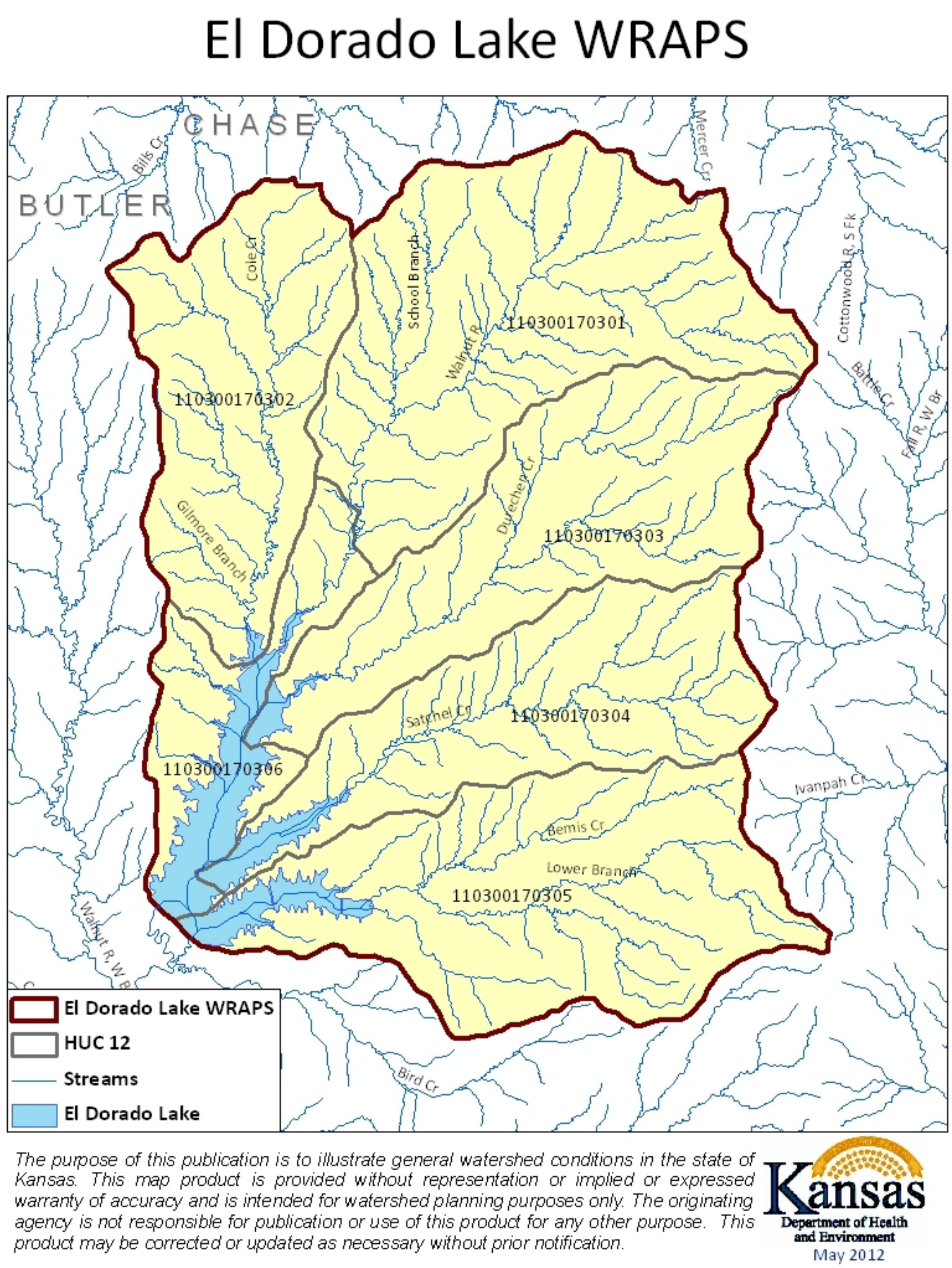


Nestled in the beautiful Flint Hills Region of Kansas, the Upper Walnut/El Dorado Lake Watershed is located in the northeast corner of the Walnut Basin. The Upper Walnut/El Dorado Lake Watershed, which drains into El Dorado Lake, covers 242 square miles and includes a small portion of Chase County.

Walnut Basin



There are six sub-watersheds (HUC 12) located in the Upper Walnut Watershed. They include Shady Creek, Bemis Creek and Harrison Creek, (HUC 110300170305) Satchel Creek (HUC 110300170304), Durechen Creek (HUC 110300170303), Walnut River and School Branch (HUC 110300170301), Cole Creek and Gilmore Branch (HUC 110300170302) and El Dorado Lake, (HUC 110300170306).

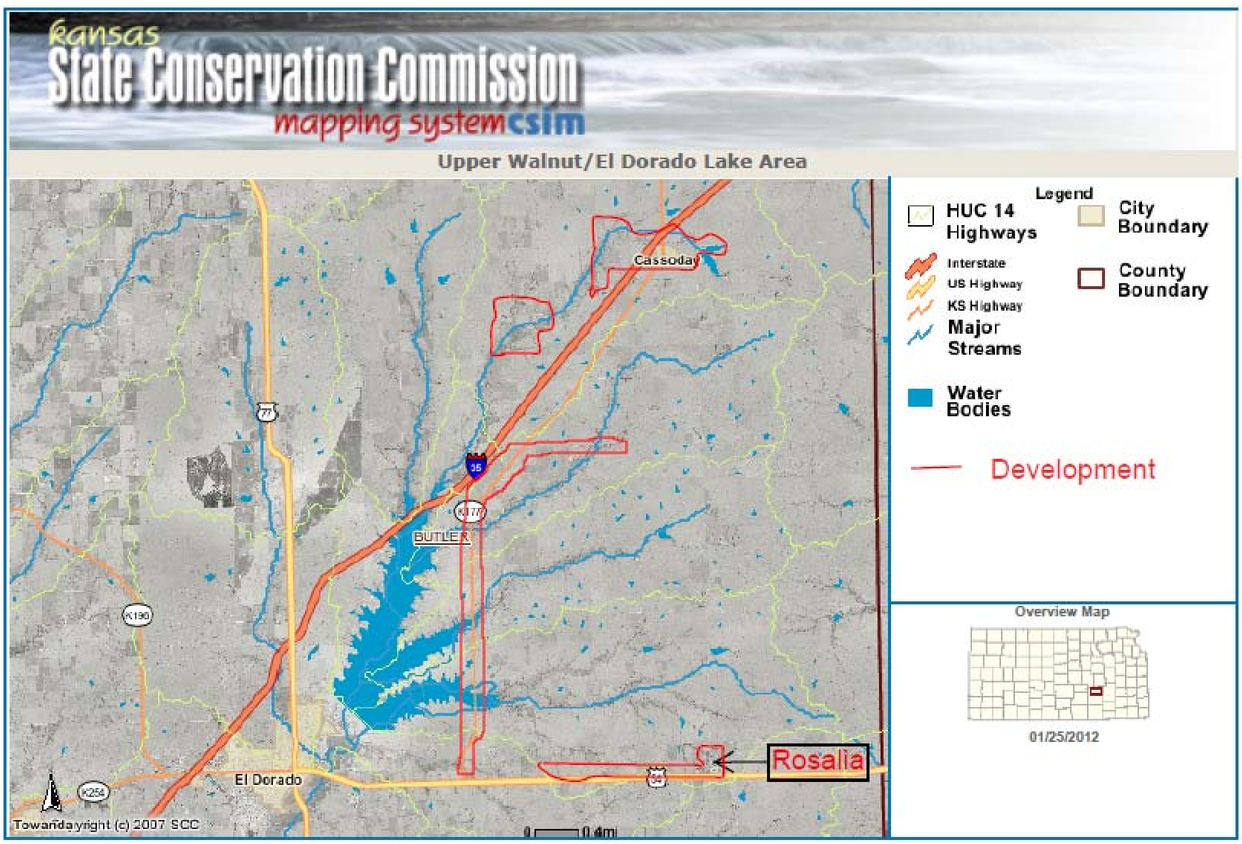


B. General Description of Plan Area

Demographics

The 2010 Census Bureau population estimate for Butler County is 64,084. El Dorado Lake is a main source of water for Butler County residents.

There are approximately 372 homes scattered throughout the watershed. The population of Cassoday is 95; Rosalia is 87. Fox Lake has approximately 34 weekend cabins and summer homes, but there are a few people who live there year round. There are many absentee landowners in the watershed as well. From Butler County Mapping Department's parcels data, there are 1,132 separate parcels in the UWW. These parcels are owned by 541 different landowners. Fifty seven (57) landowners are out of state and 97 landowners are out of county and do not actually live on the property they own. These landowners (28%) are considered absentee landowners.



Geology

Butler County is located almost entirely in the Flint Hills physiographic region. The Flint Hills were formed by the erosion of Permian-age limestone and shale. Much of the limestone in the Flint Hills contains numerous bands of chert, or flint. Because chert is much less soluble than the limestone around it, the weathering of the limestone has left behind clayey hilltops in this region that are capped with cherty gravel. Such residual chert is responsible for maintaining high topographic relief and gives the Flint Hills their name. Unconsolidated sediments are common, especially within river valleys and on some upland areas. Soils are developed in residual (weathered) bedrock material, alluvial deposits, and loess sediment. The Flint Hills includes the largest region of native tall-grass prairie remaining in North America, and the surface geology and geomorphology are readily visible in the landscape.

Soil Characteristics *(From the Butler County Soil Survey (1975) General Soil Map):*

The majority of soils in the UWW fall into the Dwight-Labette Association: Nearly level to sloping, moderately deep soils that have a silt loam or silty clay loam surface layer and a silty clay subsoil; on uplands.

The second most prominent soil association is Irwin-Ladysmith: Nearly level to sloping, deep soils that have a silty clay loam surface layer and a silty clay subsoil; on uplands.

The third most prominent soil association is Florence-Benfield: Gently sloping to strongly sloping, moderately deep and deep soils that have a cherty silty clay loam or cherty silt loam surface layer and a cherty silty clay or cherty clay supsoil; on uplands.

Fourth is Verdigris-Brewer-Norge Association: Nearly level to sloping, deep soils that have a silt loam or silty clay loam surface layer and a silty clay loam or silty clay subsoil; on flood plains and terraces.

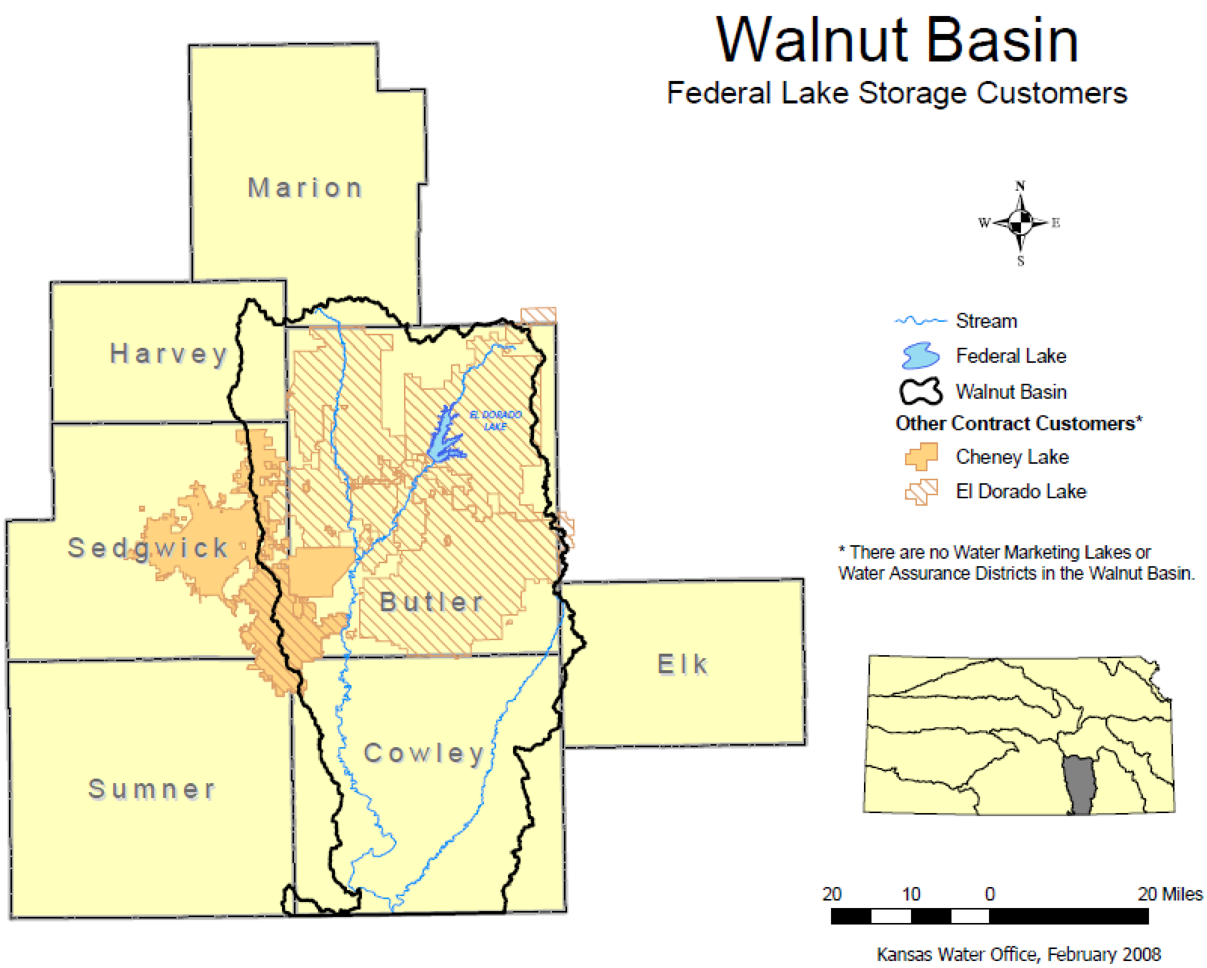
Fifth is Labette-Sogn Association: Gently sloping to sloping, moderately deep soils that have a silty clay loam surface layer and a silty clay subsoil, and shallow soils that are silty clay loam throughout; on uplands.

El Dorado Lake Characteristics

El Dorado Lake is a multi-purpose facility with the major uses of flood control, water supply, fish and wildlife management and recreation. The U. S. Government owns the dam, and the operation and regulation of the facility is the responsibility of the U. S. Army Corps of Engineers, Tulsa District. El Dorado Lake is operated for optimal flood control benefits as part of the Arkansas River System. It has 98 miles of shoreline with an average depth of 19 feet. The deepest part of the Lake is 63 feet. Kansas Department of Wildlife and Parks maintain the 3,891 acres surrounding El Dorado Lake, making it the largest state park in Kansas.

The City of El Dorado holds a contract with the USACE, Tulsa District, for 142,900 acre feet of storage from the conservation pool of the Lake. Water is treated by the City of El Dorado Water Treatment Plant and provided to City of El Dorado residents and sold to Rural Water Districts. Raw water is sold to the City of Augusta and treated at their water treatment plant.

Public Water Supply (PWS) Information – Besides El Dorado Lake which the City of El Dorado Water Treatment Plant uses as their public water supply for its residents and several rural water districts and the City of Augusta in Butler County, there are no other public water supply systems in the Upper Walnut/El Dorado Lake Watershed.



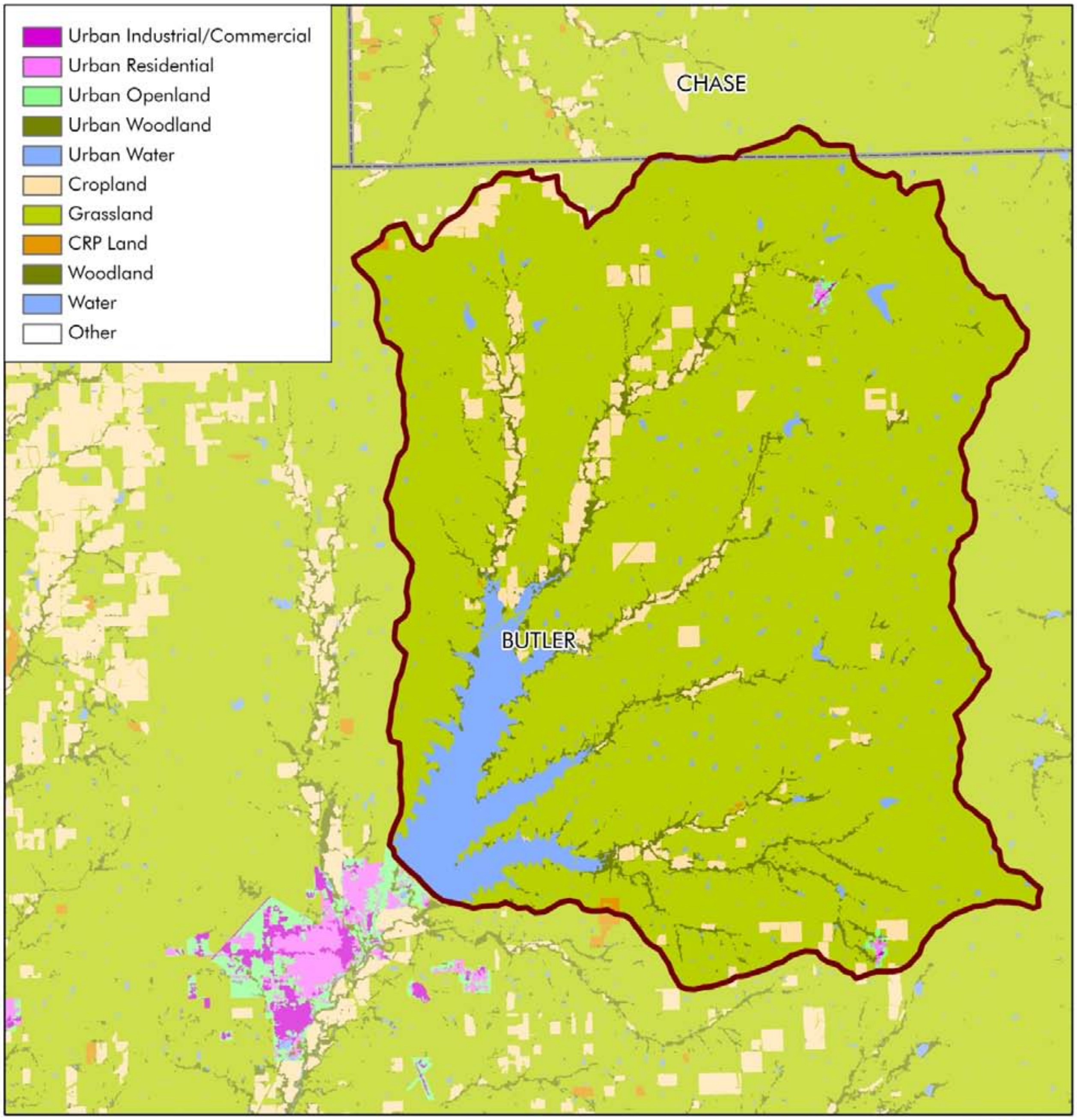
C. Land Use/Cover

Agriculture is the leading land use in the Upper Walnut Watershed above El Dorado Lake. Rangeland activities rank #1 followed by pasture and hayland then row crops; small grains rank 6th. Approximately 12% of the watershed is currently being farmed (KDHE, 2002). The majority of cropland in the Upper Walnut Watershed is located adjacent to tributaries that drain into El Dorado Lake.

El Dorado Lake Watershed Land-Cover		
Land Use/Cover	**Acres**	**Percent Cover**
Open Water	9,372.6	5.98
Low Density Residential	65.2	0.04
High Density Residential	26.0	0.02
Commercial/Industrial Transportation	572.7	0.37
Bare Rock/Sand/Clay	19.4	0.01
Quarries/Strip Mines/Gravel Pits	20.2	0.01
Deciduous Forest	371.0	0.58
Evergreen Forest	21.1	0.01
Mixed Forest	64.1	0.04
Shrubland	4,169.8	2.66
Grasslands/Herbaceous	113,970.7	72.69
Pasture/Hay	16,556.9	10.55
Row Crops	8,306.5	5.30
Small Grains	1,236.3	0.79
Urban/Recreational Grasses	197.5	0.13
Woody Emergents	30.3	0.02
Emergent Herbaceous Wetlands	1,263.8	0.81
Total	156,780.1	100.10

(El Dorado Lake Watershed SWAT model, 2006)

El Dorado Lake WRAPS
Land Cover (KLCP 2005)



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

Kansas Department of Health and Environment
April 2011

D. Description of Potential NPS Sources and Water Quality Impacts

Cropland Sources of NPS Pollution:

- Conventional tillage operations – these operations leave minimal residue on the soil surface causing an increase in soil erosion/sediment runoff during a hard rain or runoff event.
- Lack of any conservation practices on fields – conservation practices such as waterways, terraces and grade stabilization structures help control erosion by water. Soil loss is greater on fields where no conservation practices are installed or implemented.
- Maintenance of installed conservation practices – conservation practices must be properly maintained in order for them to control erosion. Practices that are not maintained or practices that have come to the end of their useful lifespan can begin to erode thus causing extensive gullies or erosion problems allowing additional sediment into water sources.
- Gullies formed in No-till fields due to no-till operations – the creation of gullies in no-till fields due to the fact they are not "farmed in" causes gullies that farm equipment cannot go through anymore. Conservation practices are needed for these gullies to control erosion and sediment loss.
- Farming too close to riparian areas – farming practices that encroach on riparian areas allows sediment and nutrients to flow into tributaries because of the reduced filter area.
- Lack of nutrient management plans for spreading livestock/commercial waste – livestock producers who don't have a nutrient management plan that includes soil/manure testing do not know how much manure or commercial fertilizer they are actually applying to the land. Land application rates may be too high causing additional runoff of nutrients. Also, with manure applications, manure should be tested to determine nutrient value for proper application rates.

Rangeland Sources of NPS Pollution:

- Cattle allowed in sensitive riparian areas – applies to cattle drinking water from tributaries and also loafing by cattle during the summer months or using riparian areas for winter protection. Degradation of streambanks is one concern, increase in nutrients and fecal coliform bacteria is another concern. In addition, animals congregating under trees can be a source of erosion especially when grasses are shaded or trampled out.
- Cattle trailing – Cattle trails along fence lines or in sensitive riparian areas can become large gullies if not addressed by the rancher. Large amounts of sediment can enter tributaries as a result of gully erosion.
- Overgrazing – overgrazing pastures allows additional nutrients to wash off the area as well as increases gully erosion, weed and noxious weed pressure and ultimately makes the pasture less productive.
- Brush Control – Noxious weeds such as sericea lespedeza, hedge, locust and cedar trees decrease a pasture's productivity as well as use nutrients and water needed for forage production. Handling of chemicals used in brush control is important. If chemicals are not used properly, they have the potential to impact aquatic life.

Urban

- Failing on-site waste systems – on-site waste systems that don't function properly can contribute nutrients and fecal coliform bacteria to water sources, especially if they are within 500 feet of the tributary.
- Illegal dumping – household trash and large items such as refrigerators, washing machines, furniture, etc. are sometimes dumped in sensitive riparian areas or off bridges. Some of these items contain harmful substances such as Freon which can enter tributaries. Household trash such as spoiled food or soiled diapers can be a source of bacteria.
- Improper disposal of household hazardous waste or farm chemicals in or near tributaries can pollute the water source.

Wildlife and Parks/Lake

- Shoreline erosion – shorelines not protected by rock or vegetation contribute sediment directly to El Dorado Lake. Shorelines that are south facing are the most susceptible due to the prevailing wind.
- Noxious weeds – sericea lespedeza and other noxious weeds are a concern in go back filter strips along riparian areas because they out complete more desirable filtering and soil stabilizing vegetation.

Woodland/Riparian Areas

- Improper woodland management – woodland along streams that is not managed properly can cause problems in the tributary including log jams and stream bank erosion. Timber that has reached maturity is an income farmers and ranchers don't always think about.

Livestock

- Livestock manure management – improperly stored manure has the potential to run off into water sources causing nutrient loading.
- Runoff from confined animal operations, particularly older operations, has the potential to reach water sources causing nutrient loading and an increase in fecal coliforms and ecoli bacteria.
- Outdated livestock waste systems that don't meet current standards have the potential to pollute water sources.
- Livestock allowed complete stream access for water causes degradation of stream banks and denuding of riparian vegetation.
- Cattle allowed in sensitive riparian areas to provide shade in the summer and protection from the wind in winter causes denuding of vegetation, degradation of the streambanks and nutrient loading.

Streambank Erosion

- Erosion of stream banks due to cattle access, tillage operations that create hard pan and reduce filter widths along riparian areas, improper woodland management or by watershed dams that allow for longer duration higher flows can dramatically increase sediment loading into El Dorado Lake.

E. Other Relevant Assessment Information as it Pertains to Identification of Sources and Targeting

Assessment Needs – Completed

1. Kansas Water Office, El Dorado Lake Watershed Streambank Erosion Assessment, June 2011

The Kansas Water Office (KWO) completed an assessment for the El Dorado Lake Watershed Restoration and Protection Strategy (WRAPS) Stakeholder Leadership Team (SLT) in 2011. This comparison study was designed to guide prioritization of streambank restoration by identifying reaches of streams where erosion is most severe in the watershed above El Dorado Lake.

Land use has considerable effect on sediment loading in a reservoir. Intense agricultural use in the watershed, with limited or ineffective erosion prevention methods, can contribute large loads of sediment along with contaminants (such as phosphorus) to downstream reservoirs (Mau, 2001).

The El Dorado Lake Watershed streambank erosion assessment was performed using ArcGIS® software. The purpose of the assessment is to identify locations of streambank instability to prioritize restoration needs and slow sedimentation rates into El Dorado Lake through implementation of streambank stabilization projects. The streambank erosion assessment was performed by overlaying 2008 NAIP county aerial imagery onto 1991 DASC county aerial imagery. Using ArcMap® tools, only those areas having "aggressive movement" of the streambank between 1991 DASC and 2008 NAIP aerial photos were identified, at a 1:6,000 scale, as a site of streambank erosion. "Aggressive movement" represents an area of roughly 1,500 sq. feet or more of streambank movement based on changes from 1991 DASC and 2008 NAIP aerial photos. Ninety-six percent of the identified streambank erosion sites were identified as having a poor riparian condition (riparian area identified as having cropland or grass/crop streamside vegetation).

The assessment quantifies annual tons of sediment eroding from the El Dorado Lake Watershed over a 17 year period between 1991 and 2008 within the upper Walnut basin in southeastern Kansas. Streambank erosion sites were analyzed by stream reach. A total of 15 streambank erosion sites covering an area of 1500 square feet or more were identified, amounting to 3,772 linear feet of unstable streambank. This assessment shows that these 15 sites alone are transporting 740 tons of sediment downstream per year; accounting for roughly 0.47 acre-feet per year of sediment accumulation in El Dorado Lake each year. A substantial quantity of the identified eroded sediment in the watershed is transported annually from the School Branch, accounting for roughly 1,591 tons of sediment annually or 42 percent of sediment eroding from all identified streambank erosion sites.

Based on the calculated sedimentation rate from the bathymetric survey, sediment from the identified streambank erosion sites contributes roughly 0.2 percent of the estimated 219 acre-feet/yr. It is probable that high flow event runoffs from rangelands and agricultural lands via ephemeral gullies, and bridge crossings that are continually undercut by high flow events could be contributing to the sedimentation rate. These occurrences were not a part of this assessment but should be assessed in the future.

The SLT also identified PL566 and State Funded Watershed Dams constructed through organized watershed districts as also contributing to an increase in streambank erosion below these dams.

See Appendix A for the entire report completed by the Kansas Water Office, "El Dorado Lake Watershed Streambank Erosion Assessment, June 2011"

2. Kansas Rural Center River Friendly Farm Environmental Assessment

On March 8, 2011, a River Friendly Farm Workshop was held at the Butler County Conservation District Office. Dale Kirkham of the Kansas Rural Center introduced the River Friendly Farm Environmental Assessment notebook to 28 people from above El Dorado Lake who attended the workshop. Developed by Kansas State University and the Kansas Rural Center to assist farmers and ranchers in assessing the environmental strengths and weaknesses on their farms, the notebook helps identify family and farm goals, problems or potential problems and helps prioritize a plan of action to address the identified concerns. The assessment consists of a series of worksheets with questions to help farmers assess and score the status of soil conservation, nutrient management, pest management and livestock waste utilization on their farm.

On March 29, 2011, Dale and I met with 14 landowners to review their notebooks and set up field visits. Of those 14, eleven have completed their notebooks. We have been in contact with 11 other landowners who still have some work to do to complete their notebooks, but intend to do so when their schedules allow. Field visits were made to these 11 landowners to see erosion and other conservation issues they have on their farms.

Our field visits around the watershed listening to landowner concerns and seeing the effects of erosion first hand has confirmed for us; gully erosion and stream bank erosion continue to be key issues for landowners and definite contributors to sediment loading in Upper Walnut streams and El Dorado Lake. Soil erosion is the most mentioned issue landowners deal with. Soil erosion is not only a factor in crop fields but native grass pastures as well. Erosion in native grass pastures is not something we have addressed much in the past but should be looked at more closely in the future.

During our field visits, we asked landowners what factors persuaded them to follow through on the completion of their notebooks. Many said the extra $250 incentive from the City of El Dorado made them take a closer look at the notebook in the first place and made it worth the effort to complete. Several mentioned it opened up communication between family members on how their farm operation was run. With the notebook, they were able to work through each aspect of their farming operation and come up with an action plan that will help them prioritize erosion issues or other natural resource concerns they have on their farm. Others said the notebook provided education, awareness and a deeper understanding of how farm management decisions can impact and affect their neighbors and those living downstream. Ultimately, by completing the Environmental Assessment, they will be able to prioritize best management practices that will protect water quality and benefit their farming operation.

3. El Dorado Lake Ecosystem Restoration and Protection Feasibility Study

The U S Army Corps of Engineers-Tulsa District, Kansas Water Office and City of El Dorado provided funding for a feasibility study on the Upper Walnut/El Dorado Lake Watershed. The study was completed in January 2007.

SWAT Model

A Soil and Water Assessment Tool (SWAT) basin scale model was used to predict the impact of land management practices on water and soil. The SWAT model shows:

Highest sediment export rates are estimated for subbasin 13 (1.07 t/ha, Walnut river Arm), subbasin 24 (0.99 t/ha, Cole Creek Arm), and subbasin 19 (0.91 t/ha, Walnut River Arm). Ranking of all subbasins (51) based on sediment export rate shows that of the ten highest rates six are attributed to subbasins in the Walnut River Arm (subbasins 13,19, 4, 18, 17, and 9) of the watershed, three in the Cole/Gilmore Creek Arm (subbasins 24, 16, and 7), and one in the Durechen Creek Arm (subbasin 32) .

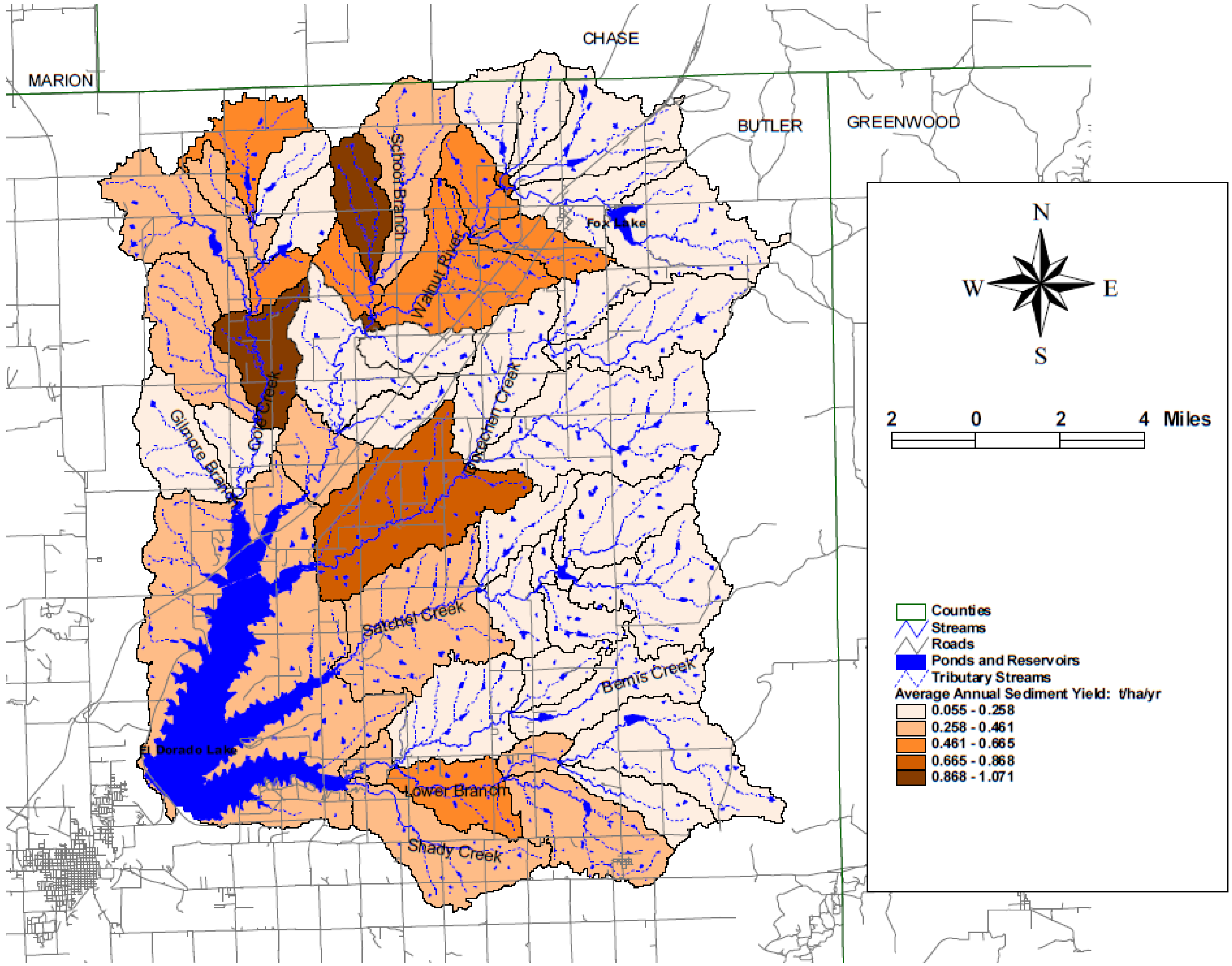
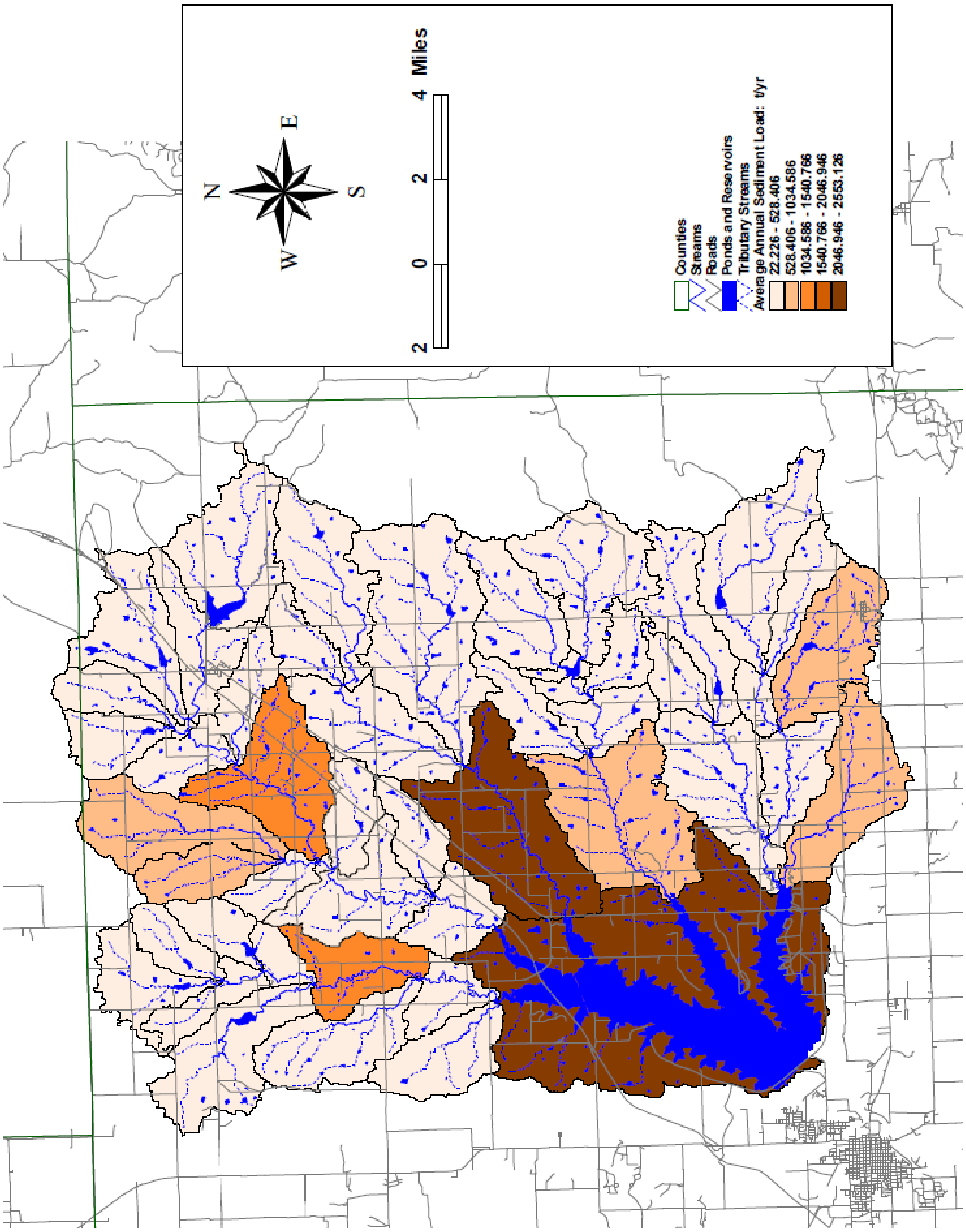


Figure 13. **Simulated average annual sediment export rate in metric tons per hectare (t/ha) by subbasin.**

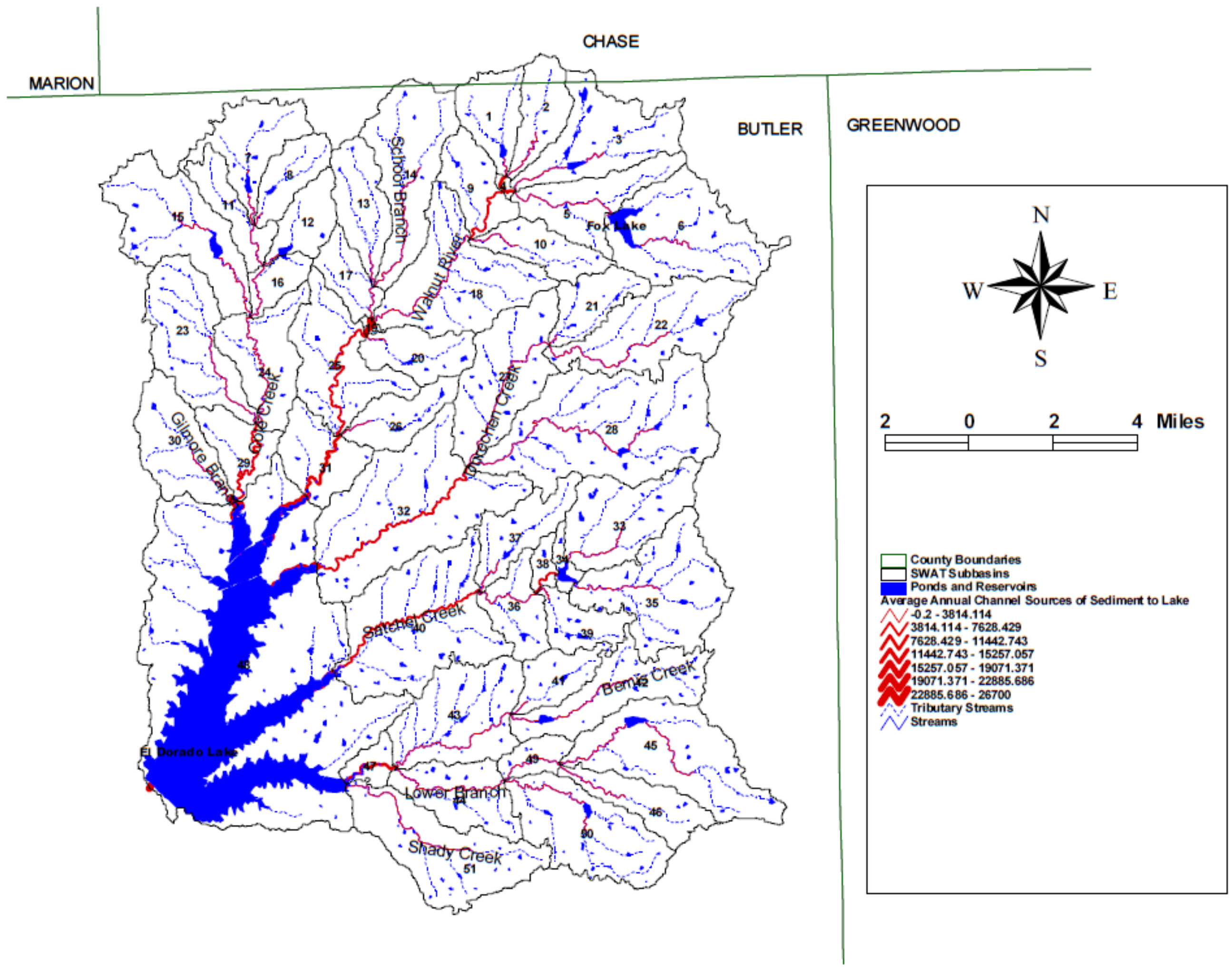
Highest rates of sediment and nutrient yields are predicted for row crop agriculture (3.88 t/ha sediment, 13.72 kg/ha total nitrogen, and 2.93 kg/ha total phosphorus) and urban commercial/industrial/transportation (1.40 t/ha sediment, 5.30 kg/ha total nitrogen, and 1.23 kg/ha total phosphorus) land uses. Lowest export rates for sediment and nutrients are predicted for forested areas and wetlands. Land uses receiving fertilizers as either manure or commercial fertilizers contribute significant quantities of soluble nutrients (nitrate and soluble phosphorus).



Simulated average annual sediment load in metric tons per year (t/yr) by subbasin.

The SWAT model allows extraction of estimated sediment and nutrient export rates by land use for each individual subbasin. The simulated highest ten sediment export rates by subbasin and land use are all row crop agriculture, with two in the Walnut River Arm (subbasins 13, and 26), two in the Cole Creek Arm (subbasins 24 and 30), one in the Durechen Creek Arm (subbasin 32), three in the Satchel Creek Arm (subbasins 33, 35, and 40), the El Dorado Lake subbasin (48), and one in the Bemis Creek Arm (subbasin 51).

Average annual loads are calculated as export rate multiplied by area of the land use within the watershed. Highest average annual sediment loads are estimated from row crop agriculture (13,111 t/yr or 69% of the total watershed upland sediment load) and range (4,833 t/yr, 25% of the total watershed upland sediment load). Average annual loads of sediment and nutrients were calculated for each subbasin. The highest average annual subbasin sediment load is 2,555 t/yr for subbasin 48, the subbasin including El Dorado Lake and adjacent area. The next highest average annual sediment load is attributed to subbasin 32 (2,062 t/yr, at the mouth of the Durechen Creek Arm). The third highest average annual sediment load, 1,081 t/yr, is attributed to subbasin 24 in the Cole Creek Arm. Based on average annual subbasin loading calculations, the Walnut River Arm delivers 5,475 t/yr sediment to El Dorado Lake from upland sources; the Cole Creek Arm delivers 3,570 t/yr; the Durechen Creek Arm delivers 2,895 t/yr; Bemis Creek Arm 2,723 t/yr; Satchel Creek Arm 1,819 t/yr; and the El Dorado Lake area 2,555 t/yr.



Model estimated annual average reach (channel) sediment contribution (t/yr) to average annual sediment load delivered to El Dorado Lake.

The model predicts an average annual sediment load of 19,037 t/yr delivered to El Dorado Lake from upland areas in the watershed with 28.75% from the Walnut River Arm, 18.76% from the Cole Creek Arm, 15.21% from the Durechen Creek Arm, 14.32 % from the Bemis Creek Arm, 9.56% from the Satchel Creek Arm, and the remaining 13.41% from the El Dorado Lake subbasin. The highest sediment load contributing land use, by subbasin, is row crop agriculture in subbasin 32 (1,845 t/yr in the Durechen Creek Arm) followed closely row crop agriculture in subbasin 48 (1,555 t/yr in the El Dorado Lake subbasin). Nine of the highest ten average annual sediment load contributions by land use, by subbasin, are from row crop agriculture. The single exception is range land in subbasin 48 (El Dorado Lake area) contributing 881 t/yr.

Filter Strips on Cropland

The effect of various filter-strip widths around crop lands, the land uses with the highest estimated sediment yield per unit area (3.6 t/ha), was modeled to estimate the potential reduction of net sediment load to the lake. The SWAT model assumes these filter strips are standard grass buffer areas capable of filtering out a fraction of pollutant loads passing over/through them with trapping efficiency varying with width. Based on conversations with local and national NRCS personnel, filter (buffer) strip widths likely to be implemented in the El Dorado Lake watershed range from 30 to 120 feet. SWAT model runs were implemented using 30, 60, 90, and 120 foot filter strip widths around crop land uses and results of each were compared to the base-case scenario of net sediment load delivered to the lake. The modeled effect of filter strips around crop lands showed a fairly dramatic reduction of the rate of sediment and nutrient yields. Thirty (30) foot filter strips were predicted to reduce cropland sediment yield by about 70% (3.62 t/ha in the base scenario to 1.07 t/ha with 30 ft. filter strips). Nutrient export rates from crop land were similarly reduced with 30 ft filter strips (Table 22). Applying filter strips to crop lands was predicted to reduce sediment mass delivered to El Dorado Lake, with greater reductions given wider filter strip widths. Modeled reductions of sediment loads to the lake for filter strip widths of 30, 60, 90, and 120 feet were 4.10%, 5.05%, 5.72%, and 5.85%, respectively. Included in Table 23 are estimates of El Dorado Lake conservation volume storage loss under each of these scenarios, and estimates of extended reservoir life compared to USACE 100 year life design. Maximum annual average conservation volume storage loss reduction (~ 7 ac-ft) and extended reservoir life (~7 years) were associated with 120 foot filter strip widths.

A notable effect of modeling the variable filter width strips was that while upland sediment load contribution to lake sediment loading was dramatically reduced with increasing filter strip width (19,039 t/yr in the base scenario compared to 5,344 t/yr with 120 foot filter strips), channel sediment (degradation) contributions to lake sediment load increased, both in proportion and mass delivered to the lake. As surface runoff sediment concentration is reduced via effective application of filter strips, water reaching the stream channel is capable of carrying more sediment, and channel degradation occurs. Sediment basin location and design would require intensive study to determine physical characteristics of the sediment, hydraulic characteristics of the basin(s), inflow sediment graph, inflow hydrograph, basin geometry, and chemistry of the water and sediment. A host of factors can affect sediment basin performance including particle size distribution, basin hydraulic response, detention storage time, basin shape, dead storage, basin type (permanent or non-permanent pool), water chemistry, and sediment scour (Haan et al., 1994).

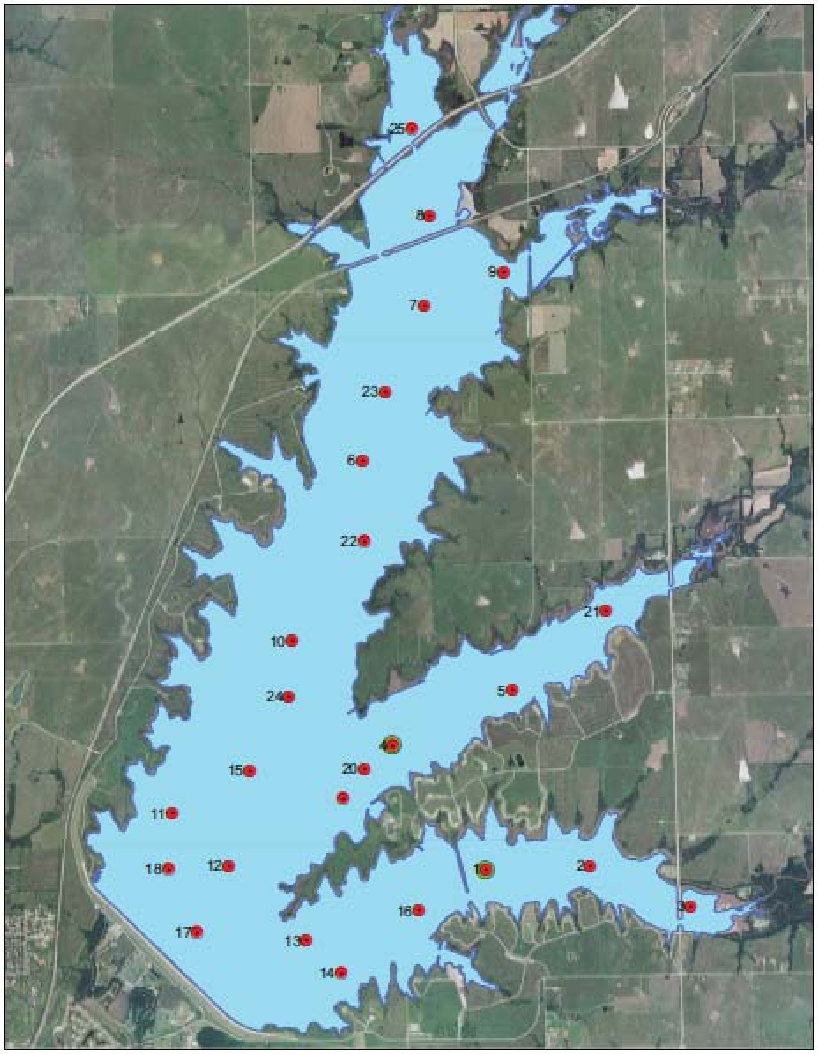
Assessment of water quantity, quality and aquatic life impacts of sedimentation in El Dorado Lake.

The water quantity estimates were updated by the 2004 bathymetric survey. This survey provides the most accurate estimate of water supply (conservation pool) storage to date. The 2004 survey shows virtually no impact to water supply storage. The differences in storage estimating techniques and the differences in estimated volumes among the volume estimating methodologies make it impractical to revise the rate of sedimentation until an additional bathymetric survey (or in-lake sediment sampling) is completed.

The conservation pool storage volume measured by the 2004 survey was found to be slightly greater than the volume estimated during project design. Therefore revising the sedimentation rate will not be possible until an additional bathymetric survey is conducted (following subsequent measurable sediment accumulation) or until other sedimentation studies are conducted that will allow a determination of the volume of sediment deposited in El Dorado Lake. Until additional sediment studies are complete the TMDL siltation reduction rate has a high uncertainty because the siltation rate has a high uncertainty. The recommended siltation reduction implementation activities include three agricultural best management practices which are applicable regardless of the sedimentation rate. All soil erosion increased by agricultural practices (farming and ranching) should be minimized through the use of best management practices. Grass filter strips are especially effective in filtering soil from upland runoff.

The Kansas Biological Survey did sediment core sampling in El Dorado Lake in the summer of 2011; however, not all the samples have been analyzed to date. The map below shows where core samples were taken in El Dorado Lake:

El Dorado Reservoir - Sediment Coring Sites 2011



This data will be useful in determining amount of sediment deposited since the last study was completed in 2000. The data may also be useful in comparing to the bathymetric survey completed by the US Army Corps of Engineers in 2004 for a more accurate account of sediment accumulation in El Dorado Lake since recently completed data cannot be compared to old data when the Lake was built.

Dredging options for managing sediment accumulation in and around El Dorado Lake

Several dredging options were examined through the Feasibility Study:

Dredging sediment from the conservation pool would restore water supply storage for the benefit of the City of El Dorado who has contracted with the government for the storage.

Dredging would restore the lost aquatic habitat for the benefit of the environment and public recreation. The dredging project costs would include: planning, permits and studies, land acquisition, dredged material disposal area and dewatering area construction, dredging, and disposal area management. The cost of dredging using 24 to 30 inch dredges would range from $2 to $4 per cubic yard or $3,200 to $6,500 per acre foot. Problem contaminants could increase the cost range by one or two orders of magnitude – i.e., $20 to $40 per cubic yard or $200 to $400 per cubic yard.

Dredging to restore shorelines was found to be technically viable but is not recommended because the potential volume of conservation pool storage that could be recovered would be minor compared to total reservoir sedimentation. This concept also has the negative benefit of reducing flood control storage.

Dredging of upper reservoir arms was found to be impractical for reducing sedimentation in the conservation pool.

Other Sediment Reducing Practices

Low flow sediment traps were suggested early in the formulation process as a concept to trap sediments just upstream of the reservoir pool. The concept would use a "created wetland" to simulate the sediment trapping function of a natural wetland. As the study progressed a general review of sediment load versus stream flow data (for other reservoirs with sediment flow data) showed that low stream flows transport only a small portion of the total sediment load that enters a reservoir. Although the ecosystem value of created wetlands could be beneficial, low flow sediment traps were not recommended because there would be minimal reservoir sediment reduction. The relatively small storage capacity compared to the large volume of flood waters carrying the sediment load would make the concept infeasible. Natural or created wetlands distributed throughout the El Dorado Lake watershed would typically occur within riparian areas and would be below small drainage areas. In this more natural situation wetlands are very effective in retaining eroded soils and nutrients.

Sediment storage reservoirs (watershed dams) were reviewed as a management concept but were not specifically sited or designed as part of the management plan. The Soil and Water Assessment Tool developed for the management plan provides initial information for use in locating potential sediment storage reservoirs. While a few small reservoirs could effectively trap large volumes of sediment, those reservoirs will eventually be filled. Determining whether building additional sediment trap reservoirs or dealing with sedimentation issues at El Dorado Lake is the more viable course of action will require additional sediment source and sediment transport rate data. The Natural Resources Conservation Service may be able to assist with additional data.

Restoration of altered stream banks is supported by the state's Kansas Water Plan position on wetland and riparian management. Specifically, "The primary policy of the state regarding wetland and riparian management is to facilitate the protection of these areas from conversion or channel modifications, and to stabilize streams which have been adversely affected by channel modification activities." Application of this policy through the implementation of the best management practices has the potential to reduce higher erosion caused by agricultural practices in or near the stream and riparian areas.

Shoreline erosion was suspected to be a source of sediment that was impacting the conservation pool storage. Preliminary field investigations were made of erosion areas around the lake. Subsequently an evaluation of the potential volume of shoreline material was conducted. The average annual volume of shoreline erosion was found to be less than 5 acre-feet, using assumptions that resulted in higher volume estimates. One estimate of average annual total sediment transported to the lake (including shoreline erosion) is about 180 acre-feet per year. The shoreline contribution (a conservatively high estimate) is minimal compared to the total estimated sediment load to the lake. However, there are a number of other justifications for minimizing shoreline erosion. The park areas, access roads, project utilities, camping facilities, and a variety of recreation facilities are important Federal investments in public recreation resources. Shoreline erosion alters and may often degrade the local terrestrial and aquatic environment. The loss of park lands from erosion and reduction in the quality of the recreation experience represents a quantifiable loss of a public resource. The loss of native shoreline vegetation due to erosion from wave action decreases the value of recreation activities and impacts the aesthetic qualities of the lake and park facilities. To the extent possible, the destructive impacts of shoreline erosion should be minimized.

See Appendix B for more information on the El Dorado Lake Ecosystem Restoration and Protection Feasibility Study.

4. Innovative Green Infrastructure Project Proposal, 2009 - El Dorado Lake Identification of Stream Bank Restoration Needs in the Watershed

A proposal was submitted to Kansas Department of Health and Environment for funds through the Innovative Green Infrastructure Project in 2009 for stream bank restoration projects above El Dorado Lake. The proposal was a cooperative effort between the City of El Dorado and Butler County Conservation District with assistance from Wildhorse Riverworks for survey and design costs and cost estimates for rock, rock placement, shaping, reseeding and planting trees. Although our project was not funded, we did come up with additional assessment information on stream banks above El Dorado Lake. The Project Description was to: Reduce erosion coming from unstable stream banks to decrease sediment load in El Dorado Lake, a public water supply. Stream bank restoration measures would include rock veins, riprap, rock chutes and bioengineering (vegetation), hardened crossings across streams and alternative watering supplies for livestock.

This was an in-office survey. We used Arc View mapping through the Natural Resources Conservation Service to identify sites with evident stream bank erosion. A measurement tool on Arc View was used to determine length of erosion and bank height was estimated based on prior observation and work in the field. Phil Balch with Wildhorse Riverworks inputted that information onto a spreadsheet to come up with quantities and then he was able to provide cost estimates for each site. The cost estimates included surveying and engineering services for each site, rock veins, riprap, rock chutes or other approved practices, bioengineering (vegetation), hardened crossings and alternative watering supplies for livestock.

The primary water quality benefit to be achieved through this project was the reduction of sediment in El Dorado Lake with a secondary benefit of reducing nutrients (eutrophication).

Long term benefits included extending the useable life of El Dorado Lake and reducing water treatment costs.

The creeks highlighted in red were deemed highest priorities for the Innovative Grant; however there were additional sites identified which are also in need of stabilization and are included in the table below:

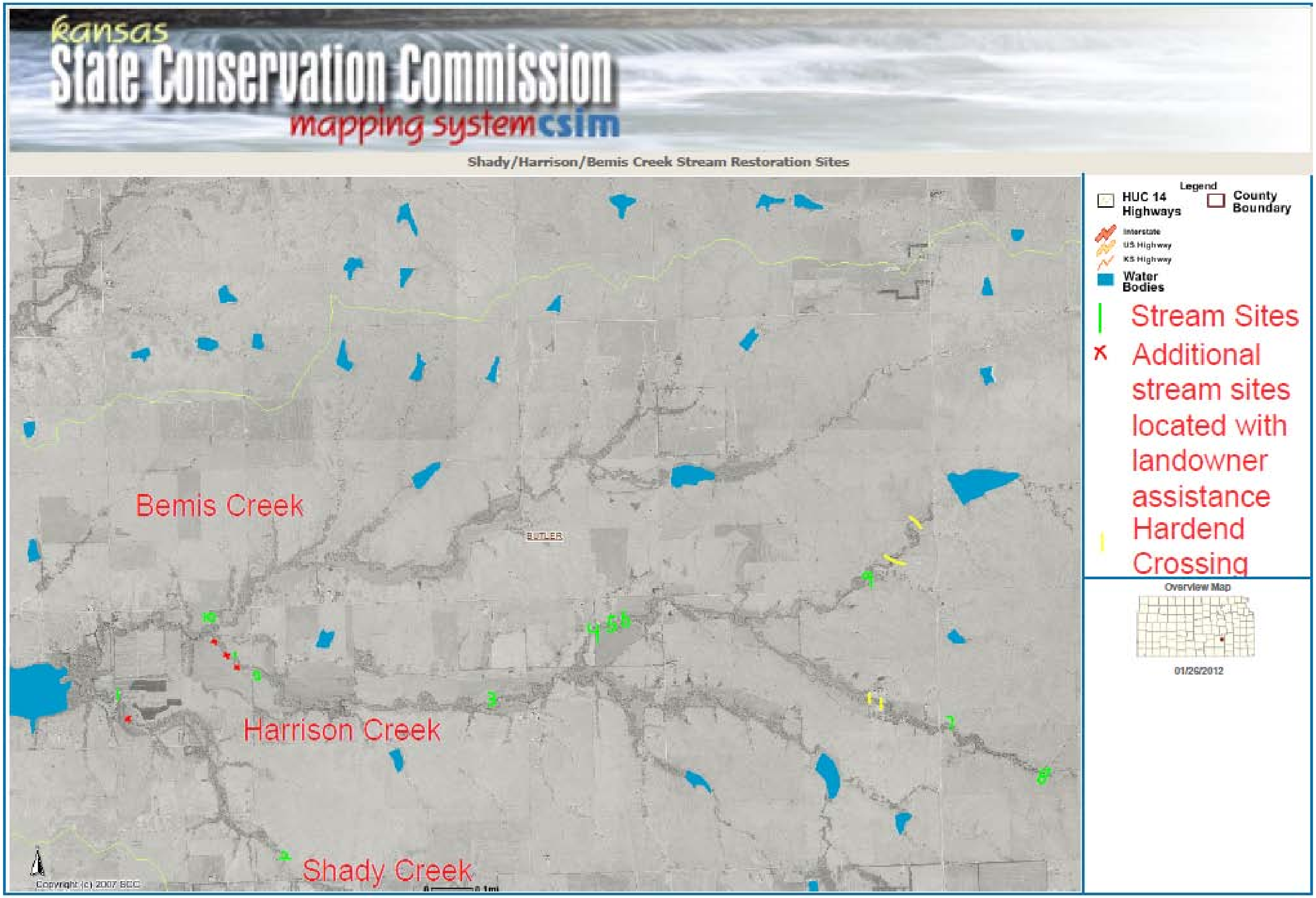
Creek/River	Construction Costs	Surveying/Design/ Checkout Costs	Permit Fees	Total Cost
Cole Creek #1	$ 13,557.12	$5,207.00	$ 200.00	$ 18,964.12
Cole Creek #2	$ 3,435.50	$3,914.00	$ 200.00	$ 7,549.50
Cole Creek #3	$ 15,501.04	$5,207.00	$ 200.00	$ 20,908.04
Cole Creek #4	$ 5,752.63	$5,207.00	$ 200.00	$ 11,159.63
Cole Creek #5	$ 24,141.40	$5,643.00	$ 200.00	$ 29,984.40
Cole Creek #6	$ 33,723.01	$6,143.00	$ 200.00	$ 40,066.01
Cole Creek #7	$ 33,342.39	$5,643.00	$ 200.00	$ 39,185.39
Cole Creek #8	$ 2,582.19	$3,914.00	$ 200.00	$ 6,696.19
Cole Creek #9	$ 7,687.13	$4,057.00	$ 200.00	$ 11,944.13
Cole Creek #10	$ 9,856.27	$4,057.00	$ 200.00	$ 14,113.27
Cole - Hardened Crossings - 1	$ 7,500.00	$ -	$ 200.00	$ 7,700.00
Cole - Alternative Watering Facilities - 3	$ 12,750.00	$ -	$ -	$ 12,750.00
Walnut River #1	$ 26,417.55	$5,850.00	$ 200.00	$ 32,467.55
Walnut River #2	$ 37,107.20	$5,850.00	$ 200.00	$ 43,157.20
Walnut River #3	$ 40,920.54	$5,350.00	$ 200.00	$ 46,470.54
Walnut River #4	$ 63,622.44	$7,500.00	$ 200.00	$ 71,322.44
Walnut River #5	$ 16,981.73	$4,707.00	$ 200.00	$ 21,888.73
Walnut River #6	$ 22,881.33	$4,707.00	$ 200.00	$ 27,788.33
Walnut River #7	$ 27,092.09	$5,207.00	$ 200.00	$ 32,499.09
Walnut River #8	$ 12,871.77	$5,850.00	$ 200.00	$ 18,921.77
Walnut River #9	$ 18,657.76	$5,207.00	$ 200.00	$ 24,064.76
Walnut River #10	$ 7,659.85	$5,207.00	$ 200.00	$ 13,066.85
Walnut River #11	$ 8,452.76	$5,207.00	$ 200.00	$ 13,859.76
Walnut River #12	$ 21,193.65	$5,207.00	$ 200.00	$ 26,600.65
Walnut River #13	$ 26,484.48	$5,207.00	$ 200.00	$ 31,891.48
Walnut River #14	$ 39,535.75	$5,850.00	$ 200.00	$ 45,585.75
Walnut River #15	$ 13,605.05	$4,564.00	$ 200.00	$ 18,369.05
Walnut River #16	$ 10,048.69	$4,564.00	$ 200.00	$ 14,812.69
Walnut River #17	$ 33,665.17	$5,207.00	$ 200.00	$ 39,072.17
Walnut River #18	$ 43,165.40	$5,207.00	$ 200.00	$ 48,572.40
Walnut River #19	$ 26,528.22	$5,850.00	$ 200.00	$ 32,578.22
Walnut - Hardened Crossings - 2	$ 15,000.00	0	$ 200.00	$ 15,200.00
Walnut - Alternative Watering Facilities - 3	$ 12,750.00	0	0	$ 12,750.00

Durechen Creek #1	$ 13,101.02	$4,414.00	$ 200.00	$ 17,715.02
Durechen Creek #2	$ 18,542.76	$5,993.00	$ 200.00	$ 24,735.76
Durechen Creek #3	$ 12,648.77	$4,057.00	$ 200.00	$ 16,905.77
Durechen Creek #4	$ 20,823.04	$5,493.00	$ 200.00	$ 26,516.04
Durechen Creek #5	$ 30,452.00	$5,493.00	$ 200.00	$ 36,145.00
Durechen Creek #6	$ 13,222.66	$4,850.00	$ 200.00	$ 18,272.66
Durechen Creek #7	$ 17,272.01	$5,350.00	$ 200.00	$ 22,822.01
Durechen Creek #8	$ 7,804.79	$3,914.00	$ 200.00	$ 11,918.79
Durechen Creek #9	$ 18,544.06	$5,350.00	$ 200.00	$ 24,094.06
Durechen Creek #10	$ 36,279.63	$5,993.00	$ 200.00	$ 42,472.63
Durechen Creek #11	$ 39,795.35	$5,493.00	$ 200.00	$ 45,488.35
Durechen Creek #12	$ 17,267.10	$4,850.00	$ 200.00	$ 22,317.10
Durechen Creek #13	$ 10,090.29	$4,207.00	$ 200.00	$ 14,497.29
Durechen Creek #14	$ 13,442.04	$5,350.00	$ 200.00	$ 18,992.04
Durechen - Hardened Crossings - 7	$ 52,500.00	0	$ 200.00	$ 52,700.00
Durechen - Alternative Watering Facilities - 3	$ 12,750.00	0	0	$ 12,750.00
Bemis/Harrison Creek #1	$ 2,855.08	$3,914.00	$ 200.00	$ 6,969.08
Bemis/Harrison Creek #2	$ 2,931.07	$3,914.00	$ 200.00	$ 7,045.07
Bemis/Harrison Creek #3	$ 4,341.60	$3,914.00	$ 200.00	$ 8,455.60
Bemis/Harrison Creek #4	$ 5,234.61	$3,914.00	$ 200.00	$ 9,348.61
Bemis/Harrison Creek #5	$ 7,896.12	$3,914.00	$ 200.00	$ 12,010.12
Bemis/Harrison Creek #6	$ 5,483.89	$4,707.00	$ 200.00	$ 10,390.89
Bemis/Harrison Creek #7	$ 16,460.17	$5,493.00	$ 200.00	$ 22,153.17
Bemis/Harrison Creek #8	$ 7,475.09	$4,850.00	$ 200.00	$ 12,525.09
Bemis/Harrison Creek #9	$ 8,958.35	$5,350.00	$ 200.00	$ 14,508.35
Bemis/Harrison Creek #10	$ 2,212.21	$2,914.00	$ 200.00	$ 5,326.21
Bemis/Harrison - Hardened Crossings - 4	$ 30,000.00	$ -	$ 200.00	$ 30,200.00
Bemis/Harrison - Alternative Watering Facilities - 0	$ -		$ -	
Satchel Creek #1	$ 17,918.40	$4,850.00	$ 200.00	$ 22,968.40

Satchel Creek #2	$ 17,543.39	$5,350.00	$ 200.00	$ 23,093.39
Satchel Creek #3	$ 14,428.46	$5,350.00	$ 200.00	$ 19,978.46
Satchel Creek #4	$ 3,268.37	$4,414.00	$ 200.00	$ 7,882.37
Satchel Creek #5	$ 6,959.99	$5,350.00	$ 200.00	$ 12,509.99
Satchel Creek #6	$ 6,986.08	$5,350.00	$ 200.00	$ 12,536.08
Satchel Creek #7	$ 9,505.36	$5,350.00	$ 200.00	$ 15,055.36
Satchel Creek #8	$ 2,781.36	$4,414.00	$ 200.00	$ 7,395.36
Satchel Creek #9	$ 6,935.97	$5,207.00	$ 200.00	$ 12,342.97
Satchel - Hardened Crossings - 5	$ 37,500.00	$ -	$ 200.00	$ 37,700.00
Satchel - Alternative Watering Facilities - 2	$ 8,500.00	$ -	$ -	$ 8,500.00
Shady Creek #1	$ 7,398.58	$5,350.00	$ 200.00	$ 12,948.58
Shady Creek #2	$ 41,227.92	$7,429.00	$ 200.00	$ 48,856.92
Shady - Hardened Crossings - 0	$ -	0	0	
Shady - Alternative Watering Facilities - 0	$ -	0	0	
	$ 1,303,807.70	$323,395.00	$ 13,800.00	$ 1,641,002.70

The total cost of this project is $1,641,002.70.

The following maps show locations of stream sites identified in the data above:


kansas
State Conservation Commission
mapping system csim
Shady/Harrison/Bemis Creek Stream Restoration Sites
Legend
HUC 14
Highways
County Boundary
Interstate
US Highway
KS Highway
Water Bodies
Stream Sites
Additional stream sites located with landowner assistance
Hardend Crossing
Overview Map
01/26/2012
Bemis Creek
BUTLER
Harrison Creek
Shady Creek
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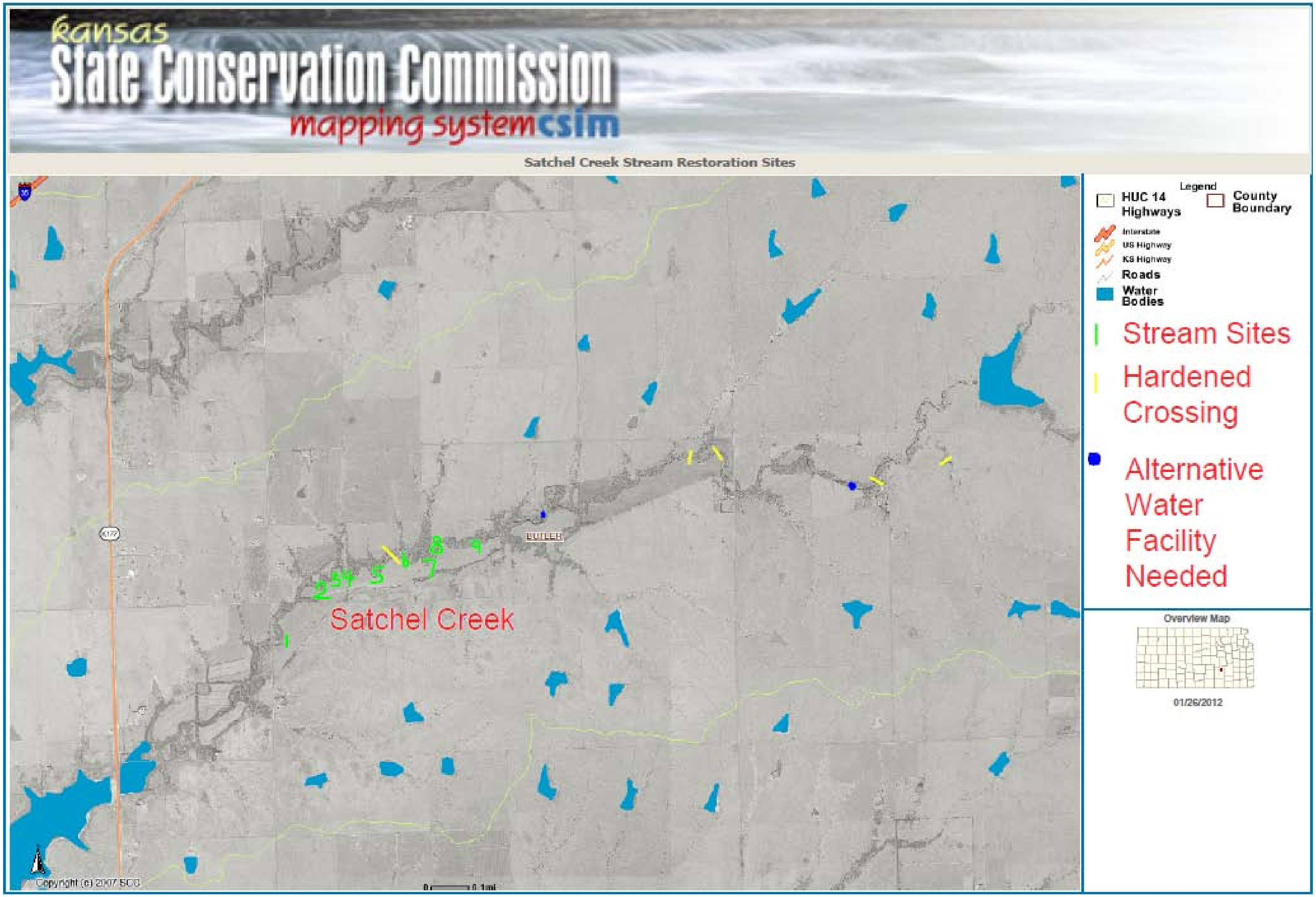
kansas
State Conservation Commission
mapping system csim
Satchel Creek Stream Restoration Sites
Legend
HUC 14
Highways
County Boundary
Interstate
US Highway
KS Highway
Roads
Water Bodies
Stream Sites
Hardened Crossing
Alternative Water Facility Needed
Satchel Creek
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Overview Map
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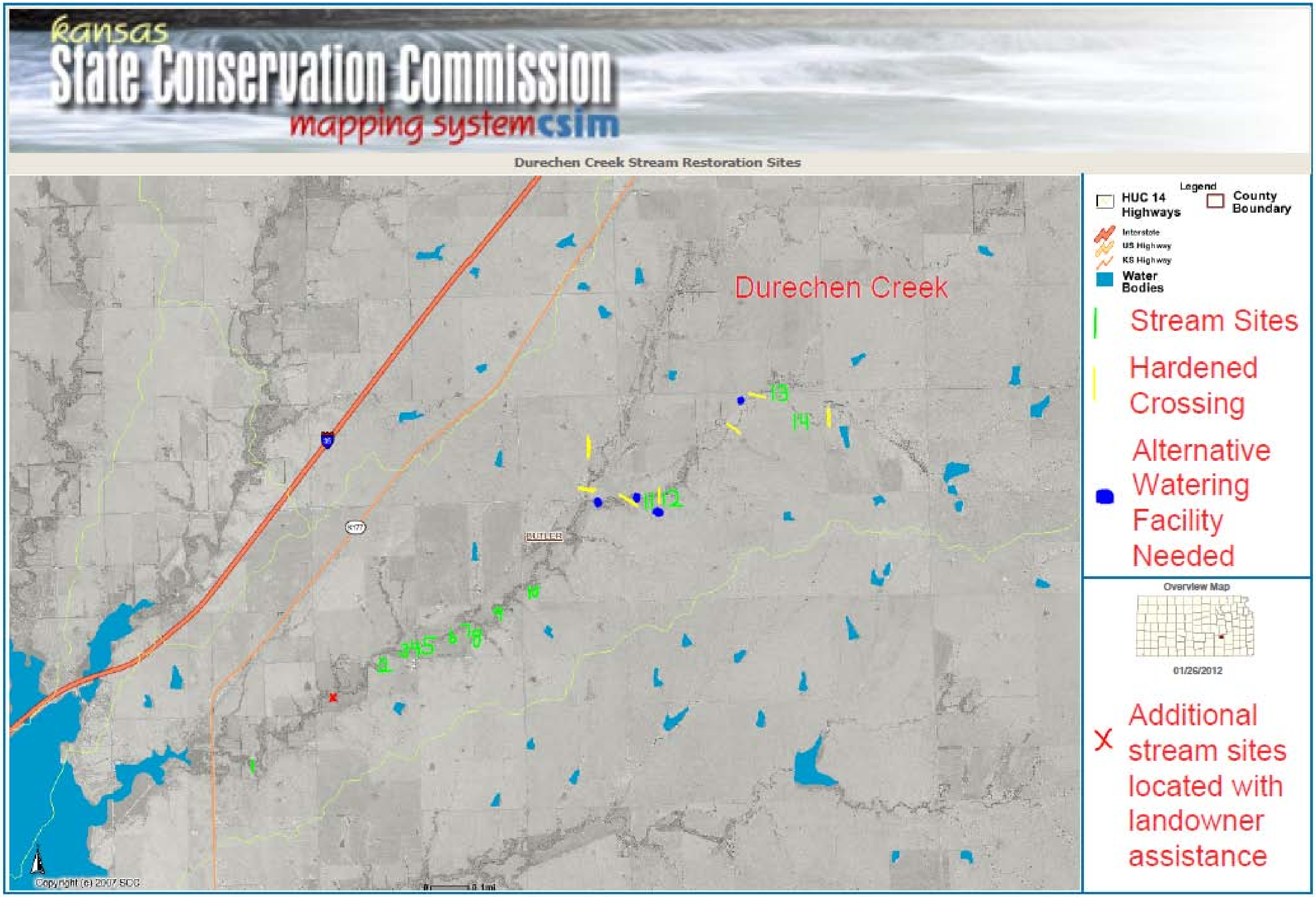
Kansas
State Conservation Commission
mapping system csim
Durechen Creek Stream Restoration Sites
Durechen Creek
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Highways
County Boundary
Interstate
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KS Highway
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Stream Sites
Hardened Crossing
Alternative Watering Facility Needed
Overview Map
01/26/2012
Additional stream sites located with landowner assistance
BUTLER
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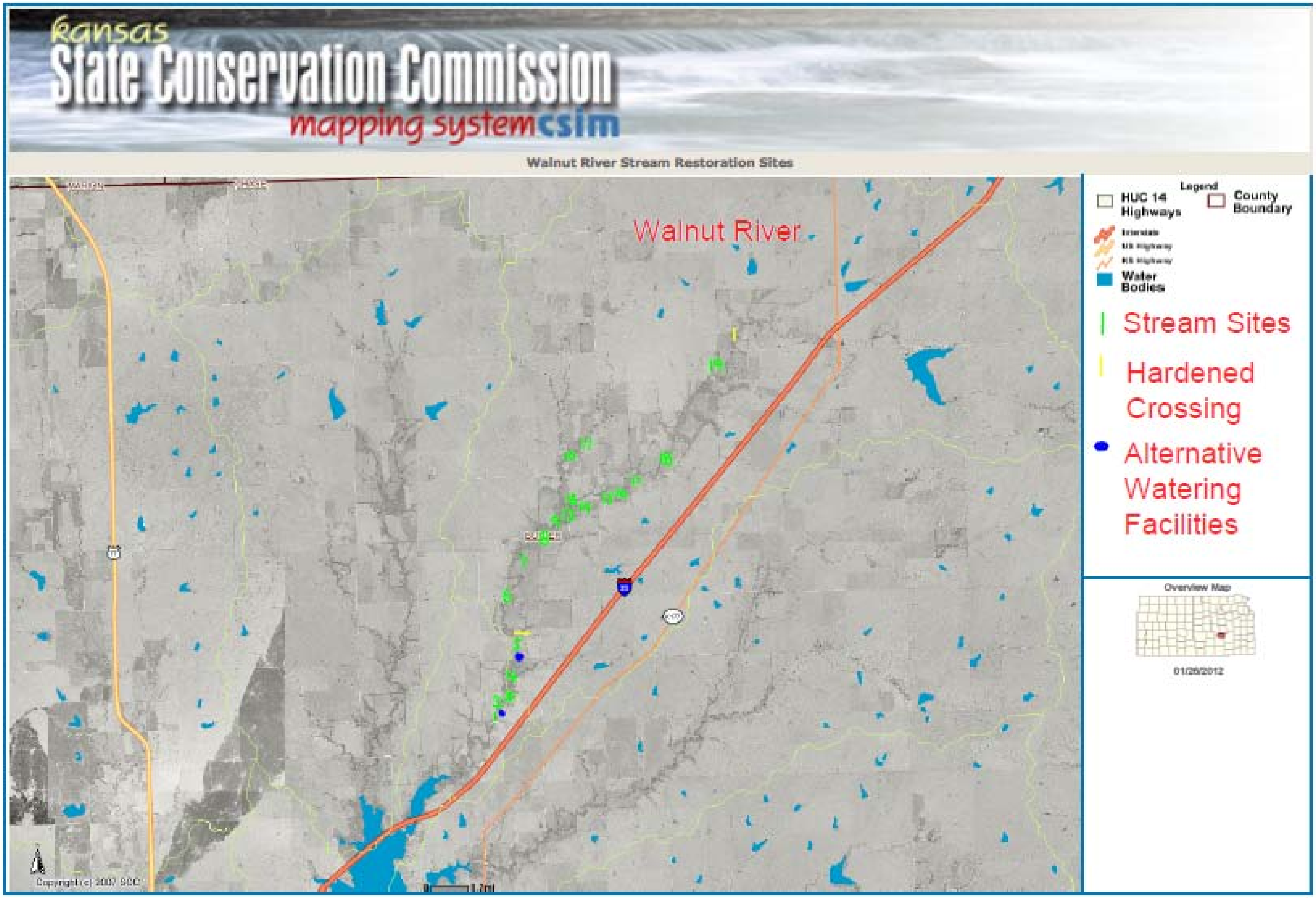
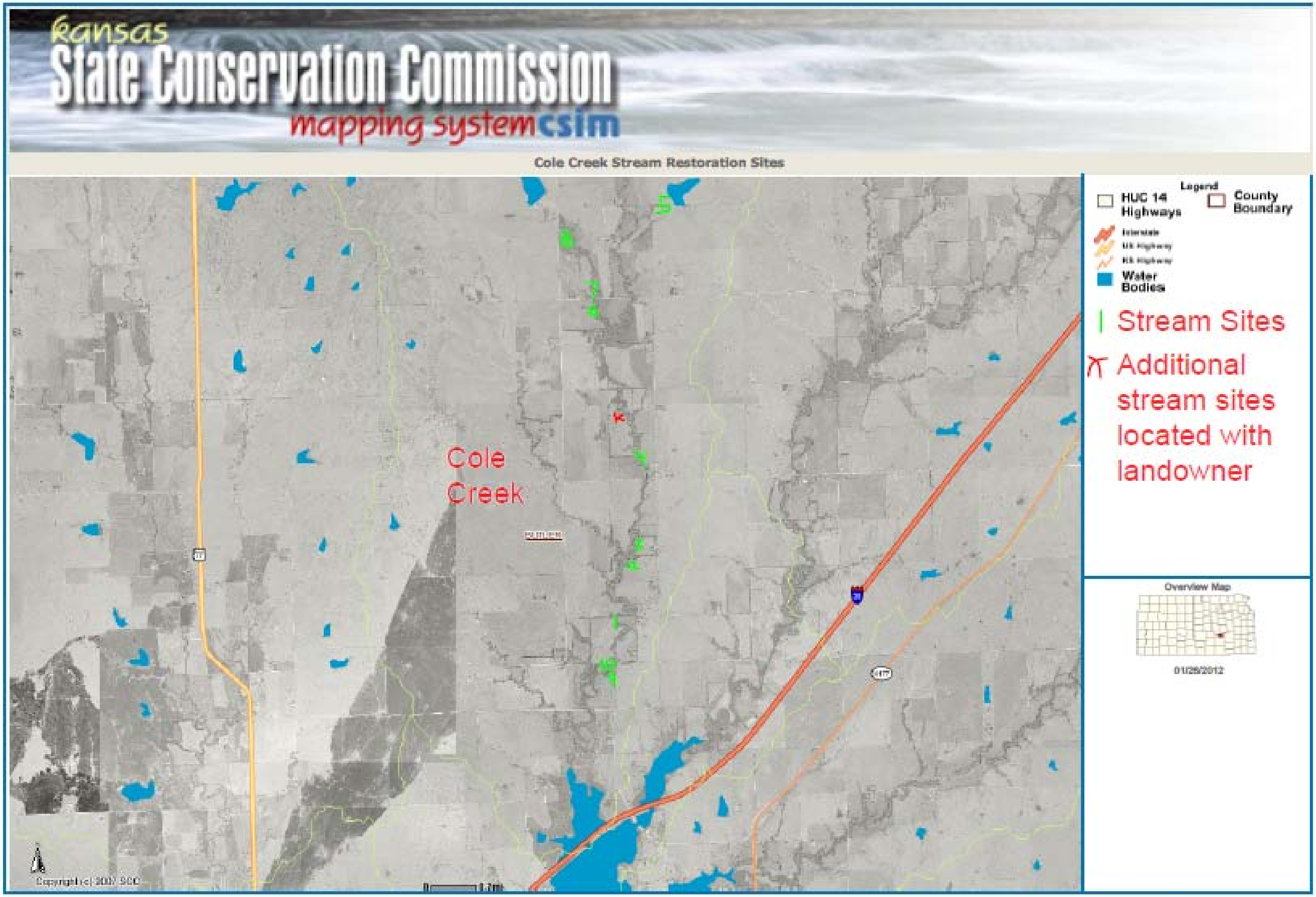

kansas
State Conservation Commission
mapping system csim
Walnut River Stream Restoration Sites
Walnut River
Legend
HUC 14
Highways
County Boundary
Water Bodies
Stream Sites
Hardened Crossing
Alternative Watering Facilities
Overview Map
01/26/2012
Copyright (c) 2007 SCC


kansas
State Conservation Commission
mapping system csim
Cole Creek Stream Restoration Sites
Legend
HUC 14
Highways
County Boundary
Water Bodies
Stream Sites
Additional stream sites located with landowner
Cole Creek
Overview Map
Copyright (c) 2007 SCC

5. Americorps Riparian Buffer Inventory

In 1994, an Americorps Team color-coded riparian areas in Butler County on maps to show land uses adjacent to riparian areas. In January 2004, Butler County Conservation District staff compiled the color-coded data in a more useable format for the Upper Walnut Watershed. Americorps broke down the riparian areas in 7 different categories; 1. Forestland, 2. Forest/Grass Mix, 3. Forest/Crop Mix, 4. Forest/Urban Mix, 5. Grassland, 6. Cropland, 7. Urban Land. Conservation District staff compiled the Americorps data by stream name, legal description (to the quarter section when possible), number of feet of stream that could use treatment, land use and USGS Map number. It was determined cropland and forestland/cropland mix would have the most impact on the Upper Walnut Watershed as far as impacting El Dorado Lake with sediment and nutrients. From the maps, staff estimated the length in feet from forest/cropland mix and then cropland mix. Based on those estimates, it was determined there were 54 miles of forestland/cropland mix adjacent to streams above El Dorado Lake and 60 miles of cropland adjacent to streams above El Dorado Lake.

6. State Conservation Commission TMDL Inventory on livestock, cropland, and on site waste systems.

In January/February 2003, the State Conservation Commission requested that an inventory be completed to help them target Kansas Water Plan Funds for high priority TMDL areas.

Livestock Waste Systems – a windshield survey was completed in February 2003 to estimate livestock waste systems in the Upper Walnut Watershed. A total of 84 livestock operations were identified in the watershed.

A cropland survey was completed using in-office data. Total estimated cropland in the Upper Walnut Watershed is 18,516 acres. The percent cropland needing treatment was estimated at 52%. Structural practices needed such as terraces and waterways are estimated at 36%.

On Site Septic Systems – A survey was conducted using data from Butler County Planning and Environmental Services and Butler County Mapping Department. It was determined there were 208 households in the Upper Walnut Watershed that used private wastewater systems.

7. Selling Water to Wichita

Currently, over 51,000 people rely on El Dorado Lake for their water supply. That number will continue to grow as urbanization and population increases. As such, El Dorado Lake is of major importance to Butler County and surrounding areas. In fact, The City of El Dorado and The City of Wichita have begun to discuss the possibility of El Dorado selling water to Wichita. Some preliminary studies have already been done.

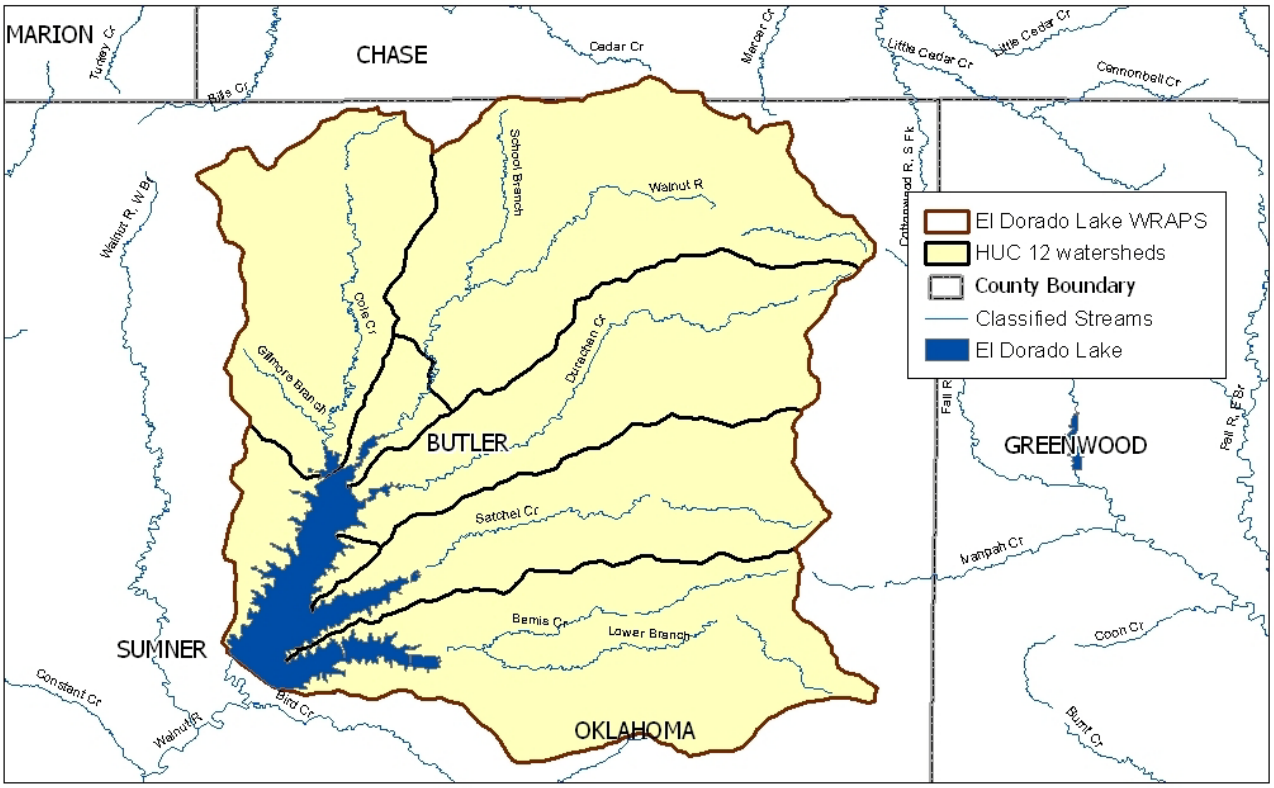
As reported in *The El Dorado Times*, June 14, 2011, with excerpts included here, *"The city has already had an Oasis Model completed for the lake, which predicts what the lake will produce over a period of time, looking at precipitation, evaporation, inflow and outflow. The model looks at the lake in the year 2050, taking into account continued sedimentation. For the purpose of the study, the Kansas Water Office needed to know the maximum amount the city would allow the lake to drop, which the city decided to provide as five feet. Five feet was an arbitrary number used for the purpose of the model.*

According to the model, in the year 2050 after another 40 years of sedimentation, the lake could yield and the city sell 50 million gallons per day (MGD) of additional water 63 percent of the time, 40 MGD 69 percent of the time, 25 MGD 78 percent of the time and 10 MGD 88 percent of the time without dropping lake levels more than five feet. The model also assumed a base use of 12.2 MGD for the City of El Dorado's existing customers. According to the model, in the last 60 years, there were about a dozen times when they would not have been able to meet a 30 to 40 MGD water demand, which is what they would expect from Wichita." Kurt Bookout, City Public Works Director, *"Explained that Corp lakes were built with a life of 100 years, but with work, he thought they could extend that. He said they could come up with multiple long-term strategies to extend the life of the lake. Bookout said they were already putting some money back for such work, but additional money would be beneficial. It also would guarantee a revenue stream to pay off the lake. Bookout also addressed the amount they would draw down the lake. He said rather than looking at drawing the lake down five feet, he gave an example of how selling additional water would only drop lake levels four inches over the course of a month. That was figured using the fact the lake covers 8,000 acres at conservation pool. There is about 325,800 gallons in one acre of water, one foot deep, which totals 2.6 billion gallons in one foot of water over 8,000 acres. Bookout said if they sold 30 million gallons a day for 30 days, that's 900 million gallons, which would be four inches of water a month."*

El Dorado Lake is located on the optimal site in this region. There are no plans for another lake when El Dorado Lake is full of sediment and no longer able to supply water for the population. Future generations will rely on the water El Dorado Lake supplies provided actions are taken now to protect the Lake and its watershed from pollutants, erosion and sedimentation. Our generation has the opportunity and the potential to extend the life of El Dorado Lake far beyond its anticipated lifespan.

F. Map of Classified Streams in the Upper Walnut/El Dorado Lake Watershed

El Dorado Lake WRAPS Classified Streams



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

January 2012

G. Table of Designated Uses for All Classified Streams and El Dorado Lake

Explanation of Designated Uses for Surface Waters

Surface waters in the Upper Walnut Watershed are used for aquatic life support, food procurement, domestic water supply, recreational use, groundwater recharge, industrial water supply, irrigation and livestock watering. Surface waters are given certain "designated uses" based on what the waters will be used for as stated in the Kansas Surface Water Register, 2009, issued by KDHE. As an example, waters that will come into contact with human skin should be of higher quality than waters used for watering livestock. Therefore, each "designated use" category has a different water quality standard associated with it. When water does not meet its "designated use" water quality standard then the water is considered "impaired."

There are no Special Aquatic Life Use Waters (SALU), Exceptional State Waters (ESW) or Outstanding National Resource Waters (ONRW) in the Upper Walnut/El Dorado Lake Watershed.

STREAM SEGMENT NAME	LATITUDE/LONGITUDE UPPER LOWER	SEG	CLASS	AL	CR	DS	FP	GR	IW	IR	LW
Bemis Cr	37.8856 96.5870 37.8504 96.7327	8	GP	E	b	X	X	X	X	X	X
Cole Cr	38.0789 96.7543 37.9387 96.7856	15	GP	E	C	X	X	X	X	X	X
Durechen Cr	38.0125 96.5597 37.9202 96.7532	12	GP	E	C	X	X	X	X	X	X
Gilmore Branch	37.9775 96.8192 37.9455 96.7851	39	GP	E	a	X	X	X	X	X	X
Satchel Cr	37.9058 96.5766 37.8800 96.7500	10	GP	E	a	X	O	X	X	X	X
School Branch	38.0829 96.7070 38.0061 96.7234	45	GP	E	b	O	O	O	O	O	X
Walnut River	38.0215 96.5533 37.9427 96.7589	14	GP	E	B	X	X	X	X	X	X

Designations apply only to unimpounded reaches of the specified stream segments. Use designations assigned to classified streams not listed in this table are determined by the Department on a case-by-case basis in accordance with K.A.R. 28-16-28d(d).

Abbreviations:
HUC = hydrologic unit code
SEG = stream segment
CLASS = antidegradation category
GP = general purpose waters
EX = exceptional state waters
ON = outstanding national resource waters
AL = designated for aquatic life use
S = special aquatic life use water
E = expected aquatic life use water
R = restricted aquatic life use water
CR = designated for contact recreational use
A = Primary contact recreation stream segment is a designated public swimming area
B = Primary contact recreation stream segment is by law or written permission of the landowner open to and accessible by the public
C = Primary contact recreation stream segment is not open to and accessible by the public under Kansas law
a = Secondary contact recreation stream segment is by law or written permission of the landowner open to and accessible by the public
b = Secondary contact recreation stream segment is not open to and accessible by the public under Kansas law
DS = designated for domestic water supply use
FP = designated for food procurement use
GR = designated for ground water recharge
IW = designated for industrial water supply use
IR = designated for irrigation use
LW = designated for livestock watering use
X = referenced stream segment is assigned the indicated designated use
O = referenced stream segment does not support the indicated designated use
blank = capacity of the referenced stream segment to support the indicated designated use has not been determined by use attainability analysis
Br = branch
Cr = creek
Fk = fork
M = middle
R = river

Lake Name	Project Name	Type	Class	AL	CR	DS	FP	GR	IW	IR
El Dorado Lake (Butler County)	LM033001	L	GP	E	A	X	X	X	X	X

Abbreviations:
HUC = hydrologic unit code
CLASS = antidegradation category
GP = general purpose waters
EX = exceptional state waters
ON = outstanding national resource waters
AL = designated for aquatic life use
S = special aquatic life use water
E = expected aquatic life use water
R = restricted aquatic life use water
CR = designated for contact recreational use
A = Primary contact recreation lakes that have a posted public swimming area
B = Primary contact recreation lakes that are by law or written permission of the landowner open to and accessible by the public
C = Primary contact recreation lakes that are not open to and accessible by the public under Kansas law
a = Secondary contact recreation lakes that are by law or written permission of the landowner open to and accessible by the public
b = Secondary contact recreation lakes that are not open to and accessible by the public under Kansas law
DS = designated for domestic water supply use
FP = designated for food procurement use
GR = designated for ground water recharge
IW = designated for industrial water supply use
IR = designated for irrigation use
LW = designated for livestock watering use
X = referenced lake is assigned the indicated designated use
O = referenced lake does not support the indicated designated use
blank = capacity of the referenced lake to support the indicated designated use has not been determined by use attainability analysis.
KWP = Kansas Wildlife and Parks
LK/ L = lake
NWR = National Wildlife Refuge
RES = reservoir
SFL = State Fishing Lake
W = wetland
W.A. = Wildlife Area

H. Explanation of Designated Uses and Relevance to the Plan

Designated Uses – El Dorado Lake: Primary and Secondary Contact Recreation; Expected Aquatic Life Support; Drinking Water; Industrial Water Supply Use; Food Procurement.

Impaired Use (Eutrophication): Primary and Secondary Contact Recreation; Expected Aquatic Life Support; Drinking Water; Industrial Water Supply Use; Food Procurement are all impaired to a degree by eutrophication.

Bioassays preformed by the Kansas Biological Survey indicate the lake is co-limited by phosphorus and nitrogen. The chlorophyll a to total phosphorus yield is low; the algal production is reduced because light cannot penetrate through the turbid water. The chlorophyll a levels will rise when the turbidity decreases and the Secchi disc depth increases, if current phosphorus and nitrogen levels in the lake are not reduced simultaneously. Because the nutrient concentrations in the lake are so elevated, algal blooms may form as the clarity improves even though measures are being taken to decrease the nutrient load. If the clarity (Secchi Disc Depth) of the lake does not improve, then a gradual decline in the chlorophyll a concentration will be seen.

Impaired Use (Siltation): Expected Aquatic Life Support and Primary and Secondary Contact Recreation are impaired by siltation.

Sediment accumulation in the lake reduces the reservoir volume and limits accessibility to portions of the lake which have silted in. Additionally, accumulated sediment contributes to recycling of nutrients within the lake. Surface water in El Dorado Lake has high turbidity and is dominated by inorganic materials because the lake receives a steady inflow of silt. Therefore, reduction of the sediment accumulation rate improves the quality of the lake and extends the utility as a water supply and recreation facility.

Aquatic life impacts are not expected to vary greatly unless large nutrient or sediment loadings occur.

Designated Uses – Shady Creek, Bemis/Harrison Creek, Satchel Creek, Durechen Creek, Walnut River/School Branch and Cole Creek: Primary and Secondary Contact Recreation; Expected Aquatic Life Support; Drinking Water; Industrial Water Supply Use; Food Procurement; Livestock Watering. Note: School Branch only supports Expected Aquatic Life Support, Secondary Contact Recreation and Livestock Watering.

Impaired Use (Not Determined): No data from KDHE is available on impaired uses of tributaries above El Dorado Lake; however, the water monitoring program through Butler Community College/Butler County Conservation District show fecal coliform bacteria counts as well as nutrients increasing in the tributaries above El Dorado Lake over the past few years. The SWAT Model provided through the US Army Corps of Engineer's Feasibility Study also indicates sediment and nutrients as targeted pollutants from upland sub-basins above El Dorado Lake.

This plan will directly address siltation, eutrophication and fecal coliform bacteria pollutants by implementing best management practices that reduce the impacts of these non-point source pollutants.

I. Description of Impaired Streams and El Dorado Lake

Impaired Waters - 303(d) Listed Waters

Under section 303(d) of the 1972 Clean Water Act, states, territories, and authorized tribes are required to develop lists of impaired waters. Impaired waters are those that do not meet water quality standards that have been set for them by states, territories, and authorized tribes, even after point sources of pollution have been controlled by the minimum required levels of pollution control technology. The law requires that these jurisdictions establish priority rankings for waters on the lists and develop Total Maximum Daily Loads (TMDL) for these waters. A TMDL specifies the maximum amount of a pollutant that a water body can receive and still meet water quality standards, and allocates pollutant loadings among point and nonpoint pollutant sources. By law, EPA must approve or disapprove lists and TMDLs established by states, territories, and authorized tribes. In response, Kansas prepared lists of water quality impaired stream segments, wetlands, and lakes in 1994, 1996, 1998, 2002, 2004, 2008 and 2010.

There are no monitoring stations available on tributaries above El Dorado Lake; therefore, it is impossible to determine which streams are contributing to the sediment and eutrophication TMDL's in El Dorado Lake. Consequently, there are no TMDLs or 303d impairments credited to those tributaries.

J. Description and Map of Impaired Lake

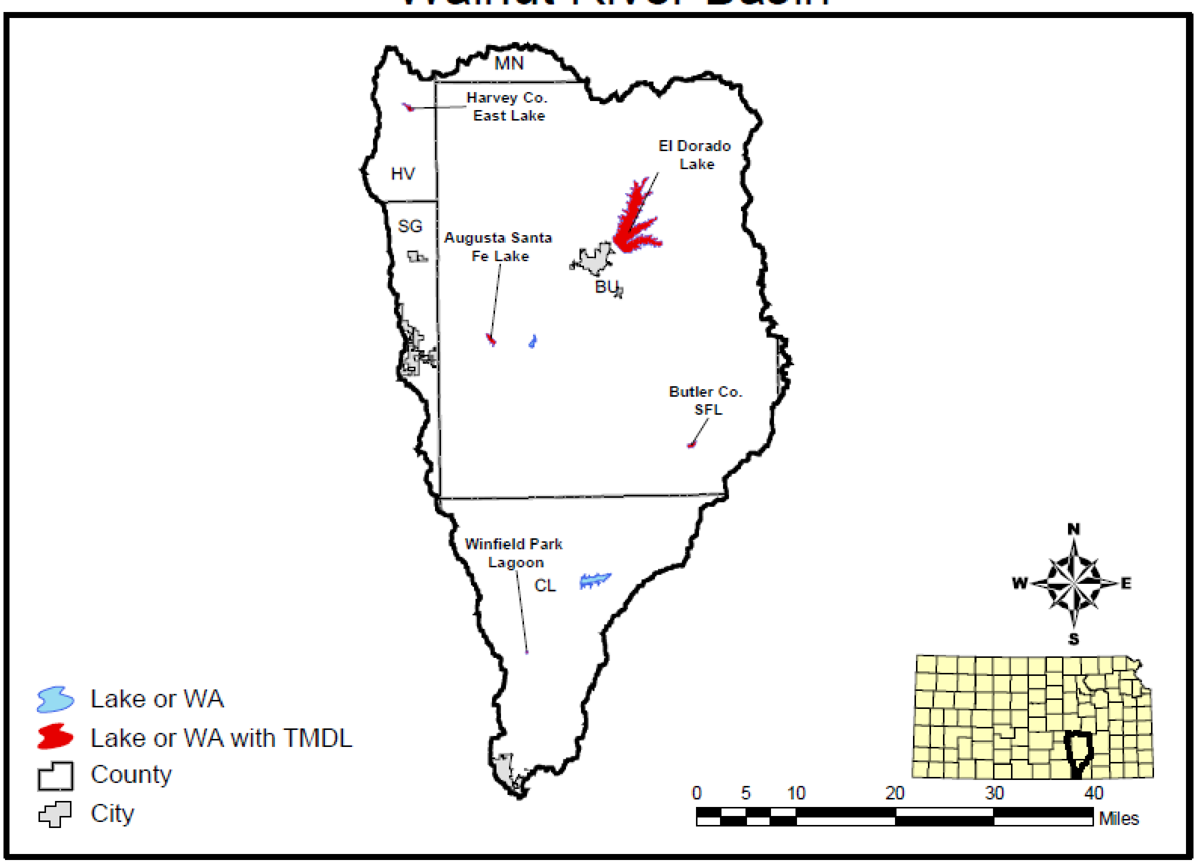
According to the 303 (d) Report, aquatic life is impaired by eutrophication and water supply is impaired by siltation in El Dorado Lake, making them both high priorities for TMDL implementation.

Walnut Basin (HUC 110300170300) 2010 303(d) List of All Impaired/
Upper Walnut River Potentially Impaired Waters

Stream/Lake	Impaired Use	Impairment	Station	County	Body Type	Priority	Comment
El Dorado Lake	Aquatic Life	Eutrophication	LM033001	BU	Lake	High	TMDL Approved on 9/30/2002
El Dorado Lake	Water Supply	Siltation	LM033001	BU	Lake	High	TMDL Approved on 9/30/2002

Thursday, September 23, 2010

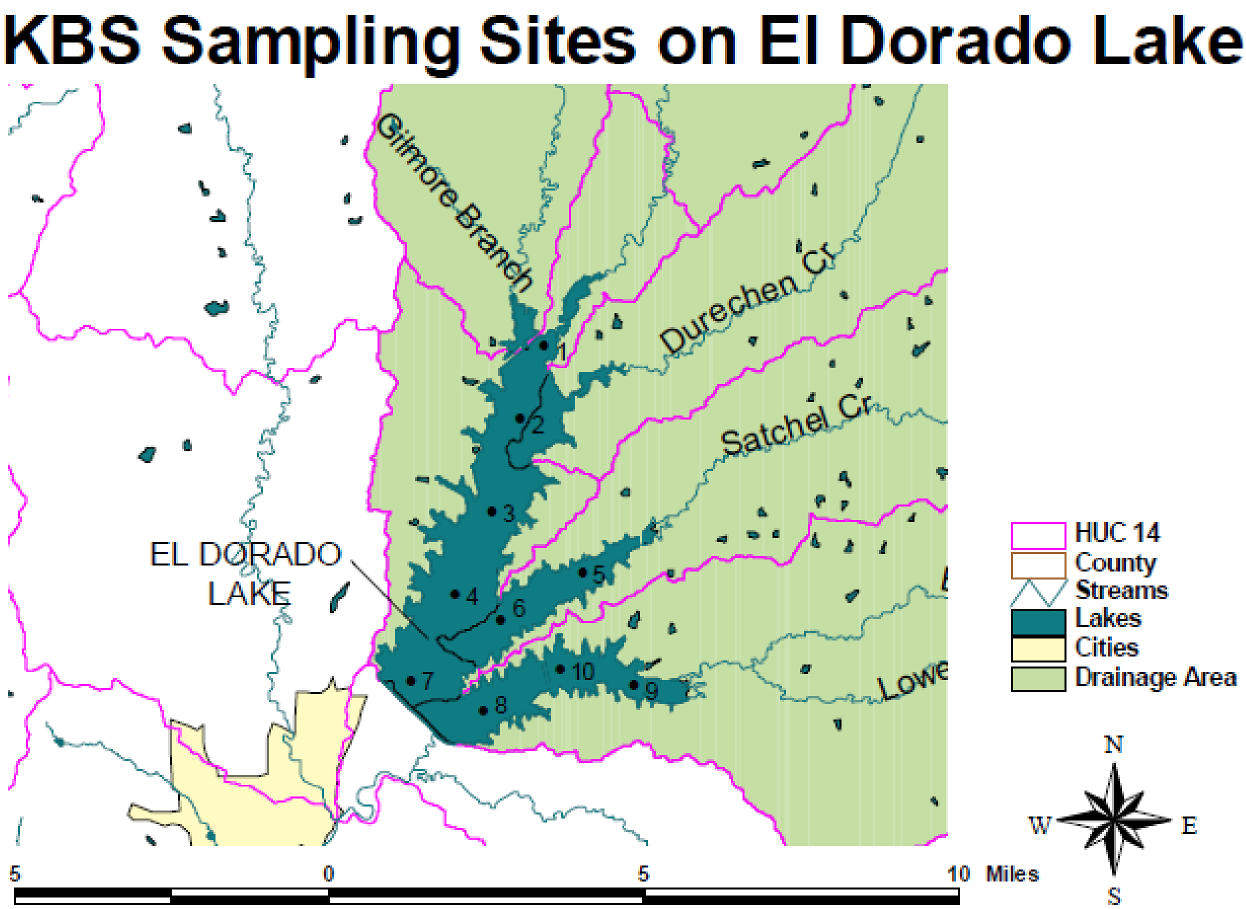
Lakes and Wildlife Areas with TMDLs in the Walnut River Basin



KDHE.BOW.WPS.051407

K. Identification of TMDL's and High Priority Waters to be Directly Addressed in the Upper Walnut/El Dorado Lake Watershed

According to the Kansas Department of Health and Environmental (KDHE) Walnut River Basin TMDL report approved September 30, 2002, El Dorado Lake is classified as impaired for sedimentation and eutrophication. KDHE conducted five surveys during 1987 through 1999 and the Kansas Biological Survey conducted monthly surveys during 2000 at designated monitoring stations on El Dorado Lake. As of 2002, El Dorado Lake was argillotrophic with a chlorophyll a concentration of 3.45 ppb corresponding to a trophic state of 42.7. Sampling conducted by KDHE indicates total phosphorus concentrations increased during the survey period with light being the primary limiting factor due to high inorganic turbidity caused by the steady inflow of silt into the lake. Bioassays performed by the Kansas Biological Survey in 2000 indicate the lake is co-limited by phosphorus and nitrogen.



Sediment accumulation in the lake reduces the conservation storage for water supply and aquatic habitat and limits accessibility to portions of the lake which have silted in. Reservoir construction was completed in 1981 and had a conservation storage capacity of 163,929 acre-feet. A survey was taken of the lake bathymetry in 1989, indicating a conservation storage capacity of 161,929 acre-feet. The loss of 2,000 acre-feet of storage over 8 years represents an average annual loss of 250 acre-feet per year.

The Tulsa District of the Corps of Engineers indicates the sediment storage of the lake is 17,400 acre-feet, designed to be filled over 100 years. At the initial rate of sedimentation, the sediment storage will be filled in 70 years.

In 2008, TMDL's were reviewed. No revisions or changes were recommended because no improvement or further degradation of water quality had occurred; therefore, sedimentation and eutrophication remain high priorities in the Upper Walnut/El Dorado Lake Watershed.

The water monitoring program through Butler Community College/Butler County Conservation District show fecal coliform bacteria counts as well as nutrients increasing in the tributaries above El Dorado Lake over the past few years. The SWAT Model provided through the US Army Corps of Engineer's Feasibility Study also indicates sediment and nutrients as targeted pollutants from upland sub-basins above El Dorado Lake.

See Appendix C for the complete TMDL report from KDHE.

Prioritization

Assessments mentioned in Section E above are the basis for prioritization in addressing erosion, sediment and eutrophication issues in the Upper Walnut Watershed.

The Kansas Water Office's Streambank Erosion Assessment shows the 15 sites studied in that assessment are transporting 740 tons of sediment downstream per year; accounting for roughly 0.47 acre-feet per year of sediment accumulation in El Dorado Lake each year. The study concluded that it is probable that high flow event runoffs from rangelands and agricultural lands via ephemeral gullies, and bridge crossings that are continually undercut by high flow events could be contributing to the sedimentation rate and this is verified by landowner contacts as well as from observation of aerial photographs and personal visits. The SLT also identified PL566 and State Funded Watershed Dams constructed through organized watershed districts as also contributing to an increase in streambank erosion below these dams.

The Innovative Green Project Proposal also confirms the need for streambank restoration measures to reduce erosion coming from unstable stream banks and decrease sediment load in El Dorado Lake. The primary water quality benefit to be achieved through this project was the reduction of sediment in El Dorado Lake with a secondary benefit of reducing nutrients (eutrophication). Long term benefits included extending the useable life of El Dorado Lake and reducing water treatment costs.

The Kansas Rural Center's River Friendly Farm Environmental Assessment also validates the Kansas Water Office Assessment. Our field visits around the watershed listening to landowner concerns and seeing the effects of erosion first hand has confirmed for us; gully erosion and stream bank erosion continue to be key issues for landowners and definite contributors to sediment loading in Upper Walnut streams and El Dorado Lake.

Soil erosion is the most mentioned issue landowners deal with. Soil erosion is not only a factor in crop fields but native grass pastures as well. Erosion in native grass pastures is not something we have addressed much in the past but should be looked at more closely in the future.

Finally, the Corps Feasibility Study provided us with a SWAT model to help target those areas where best management practices should be implemented to do the most good in reducing sediment and nutrients from entering El Dorado Lake.

To identify high priority areas for BMP implementation, data was gleaned from the *Walnut River Basin, Kansas - Feasibility Report – El Dorado Lake, Kansas - Watershed Management Plan – January 2007.* Information was also used from the Butler Community College/Butler County Conservation District Water Monitoring Program.

Prioritization was determined using data from the Feasibility Study:

Sub-basins were prioritized using Tables 18, 19 and 21 from the Feasibility Study SWAT model. Table 18 refers to average annual sediment and nutrient loads; Table 19 refers to distribution of estimated annual upland sediment loads within tributary arms; Table 21 refers to estimates of annual average contributions of sediment loads to El Dorado Lake from upland and channel sources. From each table, sub-basins were ranked based upon highest sediment loss and highest nutrient loading for each pollutant. Those sub-basins that ranked highest in all 3 categories (based upon the tables) are considered highest priority followed by sub-basins placing in 2 categories and then those sub-basins that placed in 1 category.

The SWAT model divided the watershed into 51 sub-basins. Using the data from Tables 18, 19 and 21, the sub-basins were further prioritized based upon the highest contribution of pollutants in tons/yr of sediment or kg/ha of nitrogen, nitrate and phosphorus. This ranking is identified on the map as P1, P2, etc.

L. Map of TMDL's/HP Waters in the Upper Walnut Watershed to be Directly Addressed by the Plan

Sub-watersheds in the Upper Walnut/El Dorado Lake Watershed

Below is a base map showing the Upper Walnut/El Dorado Lake area sub-basins used in the Feasibility Study. The next color coded map highlights sub-basins which are high priority followed by the second and third priorities. Corresponding data from the Feasibility Study is highlighted in yellow in the pages that follow the maps for each pollutant.

For the sediment TMDL, sub-basins 7, 9, 10, 11, 13, 14, 15, 18, 19, 22, 23, 24, 25, 27, 29, 30, 31, 32, 33, 35, 36, 39, 40, 43, 44, 47, 48, 49, 50 and 51 are priority areas for best management practices.

For the eutrophication TMDL, sub-basins 7, 13, 14, 18, 23, 24, 28, 29, 32, 35, 40, 43, 44, 45, 48, 50 and 51 are the priority areas for best management practices.

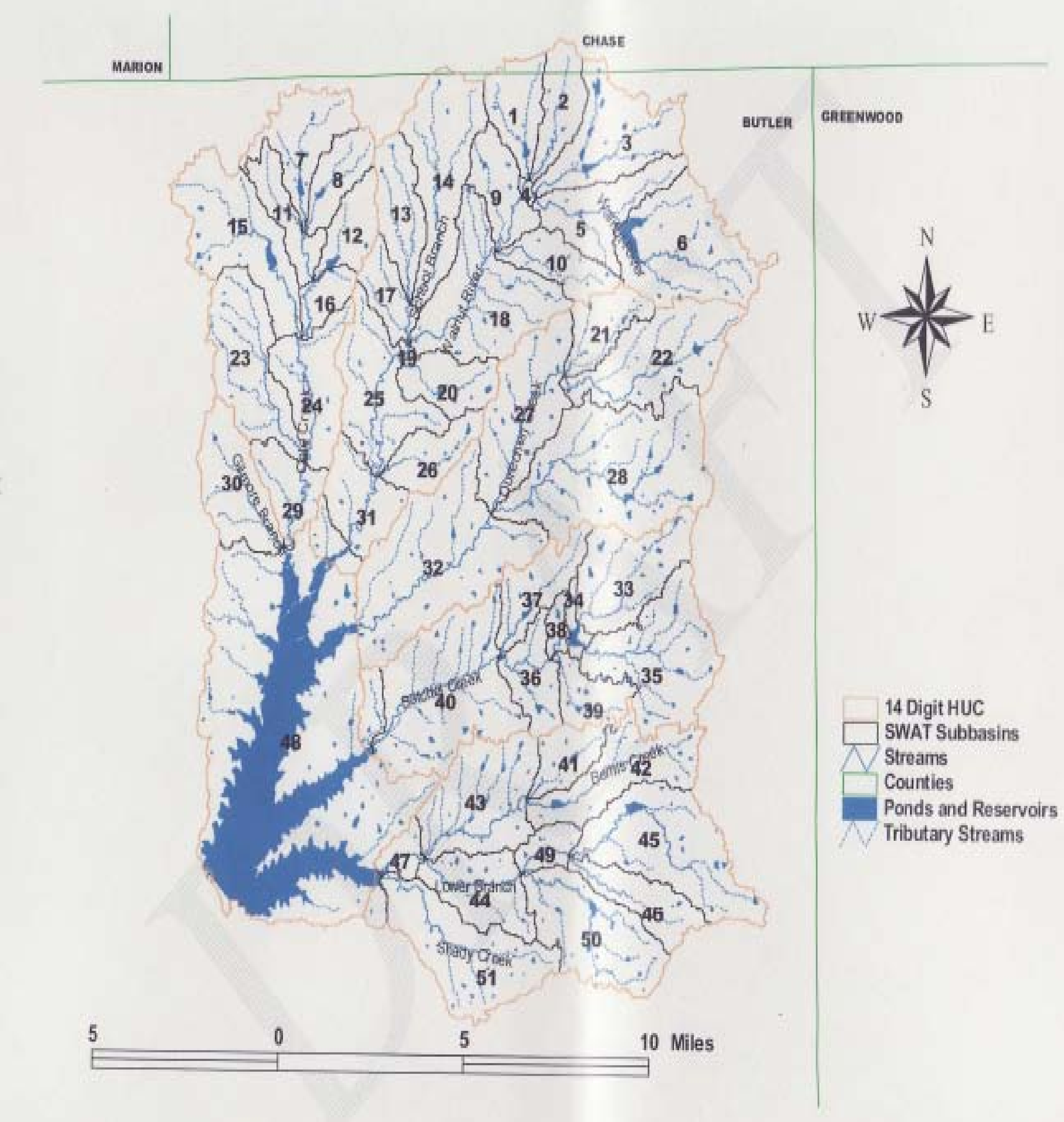
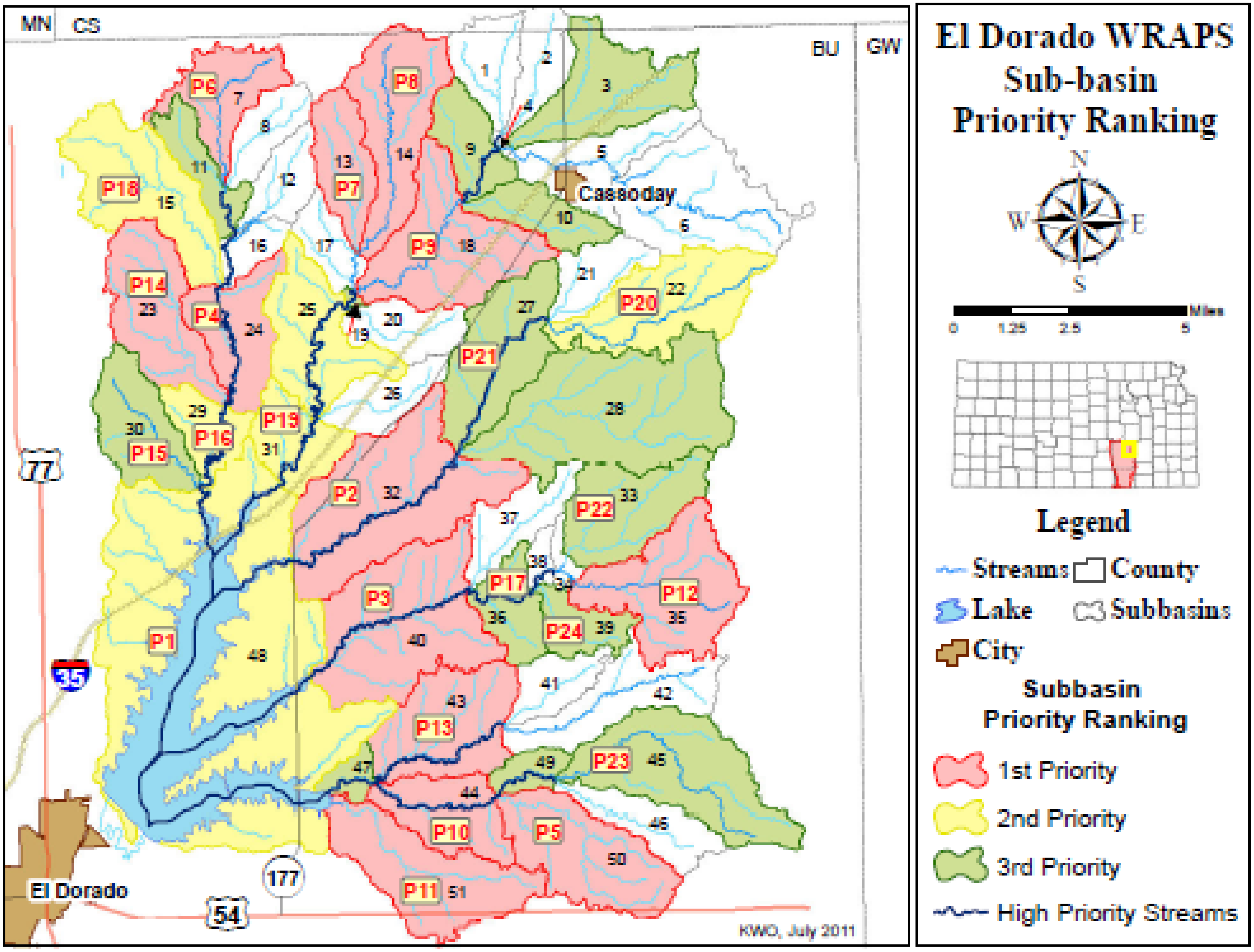


Figure 7. Modeled subbasins in the El Dorado Lake Watershed.



El Dorado WRAPS
Sub-basin
Priority Ranking
Legend
Streams
County
Lake
Subbasins
City
Subbasin
Priority Ranking
1st Priority
2nd Priority
3rd Priority
High Priority Streams
Cassoday
El Dorado
KWO, July 2011
MN
CS
BU
GW

Top 10 Sub-basins for Eutrophication

Table 18. Model predicted average annual sediment and nutrient loads for the El Dorado Lake Watershed by subbasin.

Tributary Arm	Subbasin #	Area ha	Runoff m^3/yr	Sediment t/ha	Org. N kg/ha	Org. P kg/ha	Sed. P kg/ha	Nitrate kg/ha	Sol. P kg/ha
WR	1	713.79	10,430	81	305	39	9	476	2
WR	2	667.16	9,080	90	391	62	14	597	7
WR	3	1,442.52	21,410	360	1,215	193	59	971	13
WR	4	42.94	390	33	143	24	8	31	1
WR	5	1,031.58	14,960	263	913	156	44	941	17
WR	6	1,879.47	27,390	125	563	83	14	1,718	12
CC	7	961.65	17,110	520	1,921	279	98	899	15
CC	8	570.95	9,890	145	592	86	22	575	5
WR	9	691.84	8,020	364	1,348	223	75	541	13
WR	10	664.30	9,340	344	1,161	203	67	632	10
CC	11	573.84	9,440	234	948	156	48	734	13
CC	12	563.31	8,610	62	301	39	5	463	3
WR	13	821.17	9,560	879	3,253	542	180	699	13
WR	14	1,610.24	18,860	577	2,320	387	124	1,314	24
CC	15	1,695.14	29,490	471	1,738	260	73	1,554	13
CC	16	354.15	5,390	227	844	135	41	401	6
WR	17	486.99	5,620	271	929	159	53	423	6
WR	18	1,917.61	22,030	1,074	3,768	634	225	1,413	24
WR	19	37.27	230	34	131	21	8	17	1
WR	20	707.84	10,540	95	347	56	14	567	5
DC	21	637.56	9,430	80	330	54	14	619	11
DC	22	1,686.22	25,460	327	1,232	203	61	1,531	19
CC	23	1,488.96	27,860	397	1,547	249	67	1,817	17
CC	24	1,095.58	14,950	1,081	3,613	616	204	1,201	29
WR	25	1,420.73	14,490	364	1,347	218	69	940	12
WR	26	662.31	10,130	140	458	76	20	523	6
DC	27	1,558.70	20,970	251	1,002	154	42	1,118	13
DC	28	3,148.78	44,230	174	722	103	18	2,348	22
CC	29	631.81	8,060	149	600	99	29	615	20
CC	30	1,129.33	19,180	285	1,082	172	43	1,398	19
WR	31	837.55	8,700	379	1,508	250	82	615	12
DC	32	2,937.98	38,760	2,062	6,188	1,066	337	2,502	32
SC	33	1,340.56	18,440	252	920	150	40	1,144	12
SC	34	158.76	2,520	22	91	13	2	149	1
SC	35	1,837.79	29,870	335	1,351	219	50	1,954	27
SC	36	665.08	10,460	112	476	72	15	639	7
SC	37	771.75	11,780	61	251	36	6	661	5
SC	38	164.98	2,860	24	105	15	2	171	1
SC	39	536.75	8,890	122	488	81	22	533	10
SC	40	2,566.17	41,180	892	2,930	484	134	2,293	36
BC	41	554.58	8,910	54	247	40	9	568	14
BC	42	1,318.78	20,640	84	341	44	7	986	11
BC	43	1,604.61	27,060	324	1,184	188	45	1,581	21
BC	44	992.42	15,610	485	1,693	280	82	825	15
BC	45	2,031.20	30,760	140	657	89	11	1,660	14
BC	46	751.59	11,900	62	404	61	8	828	13
BC	47	259.92	3,090	117	447	73	21	203	4
ED	48	9,526.68	98,160	2,555	9,603	1,574	418	7,036	106
BC	49	326.86	4,250	116	409	70	22	256	6
BC	50	1,649.53	27,370	539	1,853	293	83	1,220	24
BC	51	1,801.52	31,500	804	2,613	448	134	1,954	37

Walnut River Basin, Kansas, Feasibility Report - El Dorado Lake, Kansas Watershed Management Plan - January 2007

Top Sediment Loads for Each Sub-Basin

Table 19. Distribution of estimated average annual upland sediment loads within tributary arms and the full El Dorado Lake Watershed.

Tributary Arm	Subbasin #	Sediment t/yr	Tributary Arm Total	% Tributary Arm Total	% Watershed Total	% Watershed From Tributary Arm
Bemis Creek	41	54.3	2,726.0	1.99%	0.29%	14.32%
	42	84.4		3.10%	0.44%	# 4 Rank
	43	324.1		11.89%	1.70%	
	44	485.3		17.80%	2.55%	
	45	140.2		5.14%	0.74%	
	46	62.4		2.29%	0.33%	
	47	116.4		4.27%	0.61%	
	49	116.0		4.26%	0.61%	
	50	539.4		19.79%	2.83%	
	51	803.5		29.47%	4.22%	
Cole Creek	7	520.3	3,570.8	14.57%	2.73%	18.76%
	8	144.5		4.05%	0.76%	# 2 Rank
	11	234.7		6.57%	1.23%	
	12	62.0		1.74%	0.33%	
	15	471.2		13.20%	2.48%	
	16	227.0		6.36%	1.19%	
	23	396.1		11.09%	2.08%	
	24	1,080.3		30.25%	5.67%	
	29	149.1		4.18%	0.78%	
	30	285.7		8.00%	1.50%	
Durechen Creek	21	80.3	2,895.8	2.77%	0.42%	15.21%
	22	328.8		11.35%	1.73%	# 3 Rank
	27	251.0		8.67%	1.32%	
	28	173.2		5.98%	0.91%	
	32	2,062.5		71.22%	10.83%	
El Dorado Lake	48	2,553.1	2,553.1	100.00%	13.41%	13.41% # 5 Rank
Satchel Creek	33	252.0	1,820.1	13.85%	1.32%	9.56%
	34	22.2		1.22%	0.12%	# 6 Rank
	35	334.5		18.38%	1.76%	
	36	112.4		6.18%	0.59%	
	37	60.2		3.31%	0.32%	
	38	23.9		1.31%	0.13%	
	39	121.8		6.69%	0.64%	
	40	893.0		49.06%	4.69%	
Walnut River	1	80.7	5,473.0	1.47%	0.42%	28.75%
	2	90.1		1.65%	0.47%	# 1 Rank
	3	359.2		6.56%	1.89%	
	4	33.4		0.61%	0.18%	
	5	263.1		4.81%	1.38%	
	6	125.9		2.30%	0.66%	
	9	363.9		6.65%	1.91%	
	10	344.1		6.29%	1.81%	
	13	879.5		16.07%	4.62%	
	14	576.5		10.53%	3.03%	
	17	271.2		4.96%	1.42%	
	18	1,073.9		19.62%	5.64%	
	19	34.1		0.62%	0.18%	
	20	95.6		1.75%	0.50%	
	25	363.7		6.65%	1.91%	
	26	139.7		2.55%	0.73%	
	31	378.6		6.92%	1.99%	
Totals		19,039	19,039		100%	100%

Walnut River Basin, Kansas, Feasibility Report - El Dorado Lake, Kansas Watershed Management Plan - January 2007

Top Upland and Channel Sediment Sources for Each Sub-Basin

Table 21. **Estimates of annual average contributions of sediment loads to El Dorado Lake from upland and channel sources by modeled subbasin/reach.**

Tributary Arm	Subbasin/ Reach #	Upland Sediment t/yr	Channel Sediment t/yr	Tributary Arm Total t/yr	% Lake Input from Tributary Arm
Bemis Creek	41	54	0	21,633	14.5%
	42	84	0		# 3 Rank
	43	324	1,855		
	44	485	3,254		
	45	140	0		
	46	62	0		
	47	116	10,901		
	49	116	2,899		
	50	539	0		
	51	803	0		
Cole Creek	7	520	0	17,096	11.4%
	8	144	0		# 4 Rank
	11	235	2,754		
	12	62	0		
	15	471	0		
	16	227	2,381		
	23	396	0		
	24	1,080	3,146		
	29	149	5,240		
	30	286	0		
Durechen Creek	21	80	0	9,212	6.2%
	22	329	0		# 6 Rank
	27	251	2,154		
	28	173	0		
	32	2,062	4,163		
El Dorado Lake	48	2,553	26,676	29,229	19.5% # 2 Rank
Satchel Creek	33	252	0	16,190	10.8%
	34	22	-1,337		# 5 Rank
	35	334	0		
	36	112	3,514		
	37	60	0		
	38	24	7,286		
	39	122	0		
	40	893	4,907		
Walnut River	1	81	0	56,340	37.6%
	2	90	0		# 1 Rank
	3	359	0		
	4	33	10,173		
	5	263	1,922		
	6	126	0		
	9	364	4,100		
	10	344	0		
	13	879	0		
	14	576	0		
	17	271	2,067		
	18	1,074	3,130		
	19	34	17,000		
	20	96	0		
	25	364	3,960		
	26	140	0		
	31	379	8,530		
Totals		19,039	130,661	149,700	100%

Walnut River Basin, Kansas, Feasibility Report - El Dorado Lake, Kansas Watershed Management Plan - January 2007

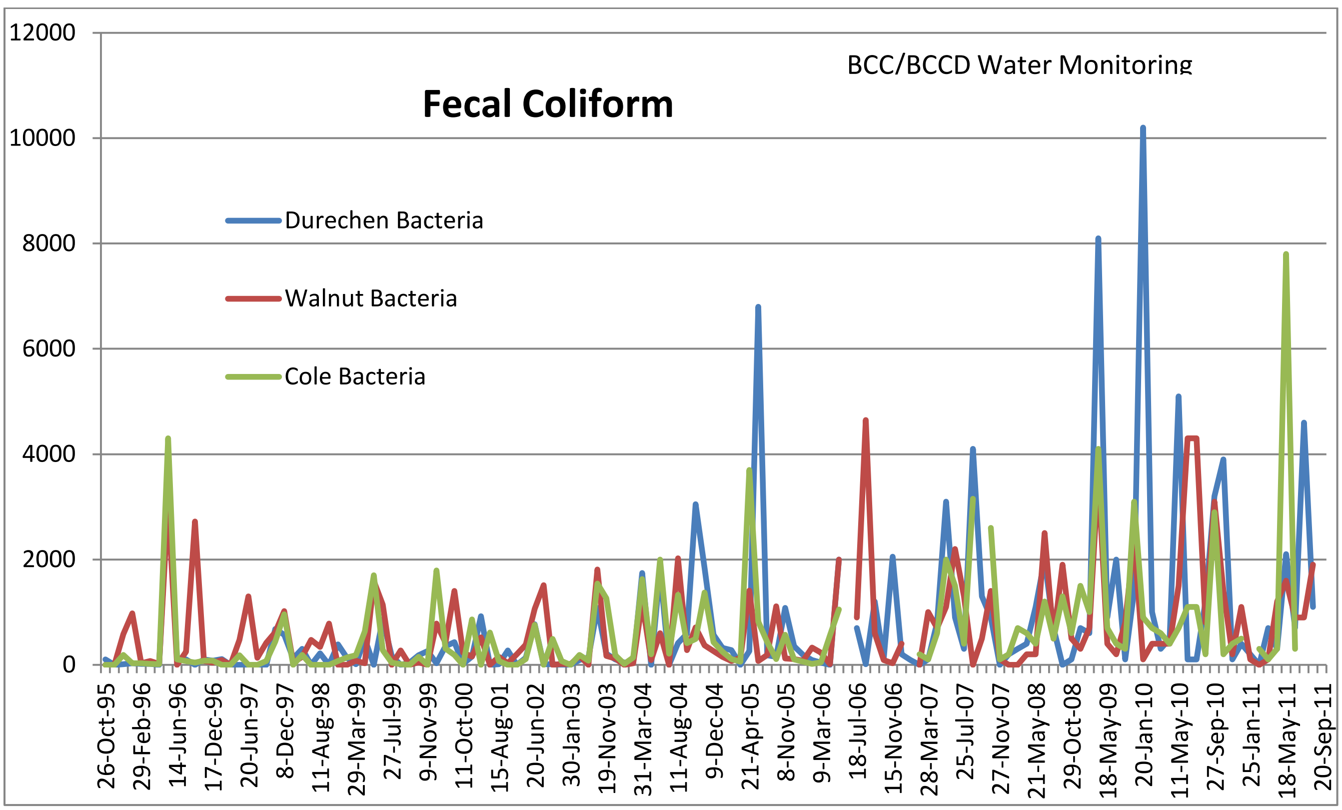
Fecal Coliform Bacteria (Data from Butler CC/BCCD Water Monitoring Program)

Fecal Coliform bacteria found in the water are serious since fecal coliform bacteria are considered an indicator of the level of pathogenic (disease causing) bacteria in the water.

The water monitoring program through Butler Community College/Butler County Conservation District shows bacteria counts increasing over the past few years. The increase may be due to more cattle in the area, manure being spread in different areas or at increased application rates or possibly an increase in rainfall amounts during peak cattle grazing season.

Tributaries affected by fecal coliform bacteria include:

- Shady Creek
- Bemis Creek/Harrison Creek
- Satchel Creek
- Durechen Creek
- Walnut River/School Branch
- Cole Creek/Gilmore Branch

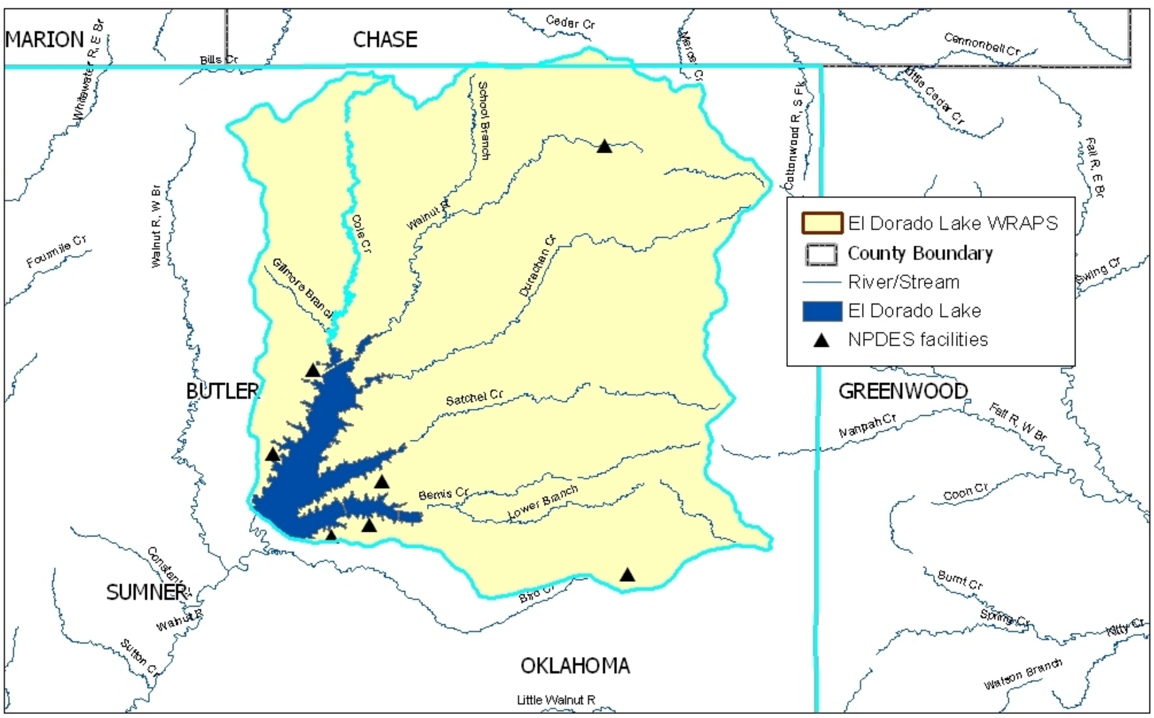


M. Description of NPDES, Point and Non-Point Source (NPS) Pollution Sources Applicable to the Selected TMDL's/High Priority Waters and Determination of BMP Needs Within Watersheds of Priority Waters

National Pollutant Discharge Elimination Systems (NPDES)

Seven NPDES permitted facilities are located in the Upper Walnut Watershed. Three are non-overflowing lagoons for the City of Cassoday, Butler Rural Sewer District #9 (Rosalia) and Sewer District #16. Four others are located around El Dorado Lake and are managed by Kansas Department of Wildlife and Parks. These sites are used mainly during spring, summer and fall with peak use during the summer months and holidays.

El Dorado Lake WRAPS
NPDES Facilities



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Kansas Department of Health and Environment

January 2012

Point Sources

Point sources of pollution fall under different permitting requirements and regulations. Livestock facilities of 1,000 animal units or more, known as Confined Animal Feeding Operations (CAFOs), must obtain an NPDES Livestock Waste Management Permit and then are federally regulated. Those sources will not be addressed with this plan.

Non Point Sources

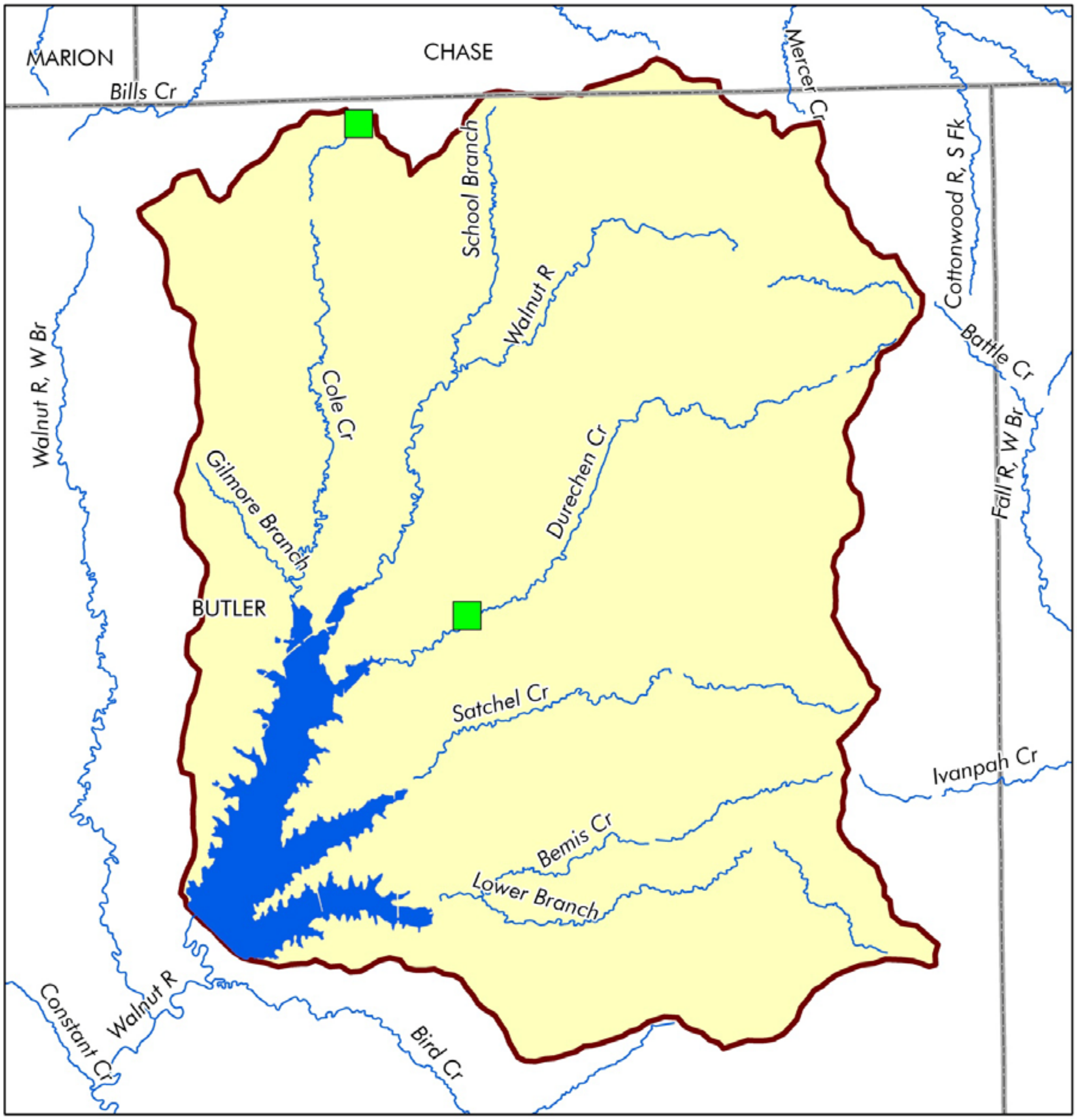
Anything that does not require a federal permit to discharge is considered a Nonpoint Source (as defined in the Kansas Surface Water Quality Standards K.A.R. 28-16-28 (oo)). The following categories fall under Non-Point Sources and will be addressed in this plan:

Confined Livestock

Any livestock facility with an animal unit capacity of 300 or more or a facility with a daily discharge regardless of size must register with the Kansas Department of Health and Environment (KDHE). Any facility, no matter what animal capacity, is required to register if KDHE investigates them due to a complaint and the facility is found to pose a significant pollution potential. Facilities which register with KDHE will be site-inspected for significant pollution potential. If facility is found to not be a significant pollution potential by KDHE, they can be certified if they follow management practices recommended and approved by KDHE. These include but are not limited to: regular cleaning of stalls, managing manure storage areas, etc. Facilities with 300 animal units up to 999 (known as Confined Feeding Facilities (CFFs) identified with a significant pollution potential must obtain a State of Kansas Livestock Waste Management Permit. Operations with a daily discharge, such as a dairy operation that generate an outflow from the milking barn on a daily basis, are required to have a permit.

There are two confined livestock facilities located in the Upper Walnut Watershed; a certified beef facility on Cole Creek and a state permitted hog facility on Durechen Creek. There are no dairies in the Upper Walnut Watershed.

El Dorado Lake WRAPS Active CAFOs



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Kansas Department of Health and Environment
June 2011

Unconfined Concentrated Animal Areas

Unconfined areas of animal concentration such as watering areas, loafing areas or feeding areas can also pose a pollution potential if not managed properly. These are potential sources of nutrients, sediment, and bacteria. Management practices for these areas can include alternative water supplies, rotational grazing, proper mineral and feed placement, and proper manure application to cropland.

Determination of BMP Needs Within Watersheds of Priority Waters

Eutrophication *(From the KDHE TMDL Report, Walnut Basin, El Dorado Lake)*
Desired Implementation Activities:

There is a very good potential that agricultural best management practices will allow full use support to take place in El Dorado Lake. Some of the recommended agricultural practices are:

a. Nutrient management – crop fields, rangeland and riparian areas.
b. Apply conservation farming practices, including terraces and waterways, sediment control basins, and constructed wetlands.
c. Provide sediment control practices to minimize erosion and sediment and nutrient transport.
d. Implement soil sampling to recommend appropriate fertilizer applications on cropland
e. Maintain conservation tillage and contour farming to minimize cropland erosion.
f. Establish or re-establish natural riparian systems, including vegetative filter strips and streambank vegetation.
g. Develop riparian restoration projects.
h. Reduce activities within riparian areas.
i. Promote wetland construction to assimilate nutrient loadings.
j. Install grass buffer strips near streams.
k. Leverage Conservation Reserve Enhancement Program to hold riparian land out of production.

Sediment *(From the KDHE TMDL Report, Walnut Basin, El Dorado Lake)*
Desired Implementation Activities:

There is a very good potential that agricultural best management practices will improve the water quality in El Dorado Lake. Some of the recommended agricultural practices are:

a. Maintain conservation tillage and contour farming to minimize cropland erosion.
b. Install grass buffer strips along streams.
c. Reduce activities within riparian areas.
d. Nutrient management - crop fields, rangeland and riparian areas.

e. Apply conservation farming practices, including terraces and waterways, sediment control basins and constructed wetlands.
f. Provide sediment control practices to minimize erosion and sediment and nutrient transport.
g. Establish or reestablish natural riparian systems, including vegetative filter strips and streambank vegetation.
h. Develop riparian restoration projects.
i. Leverage Conservation Reserve Enhancement Program to hold riparian land out of production.

Fecal Coliform Bacteria *(From Stakeholder Leadership Team)*
Desired Implementation Activities:

Activities to reduce fecal pollution should be directed toward the smaller, unpermitted livestock operations and rural homesteads and farmsteads along the tributaries above El Dorado Lake.

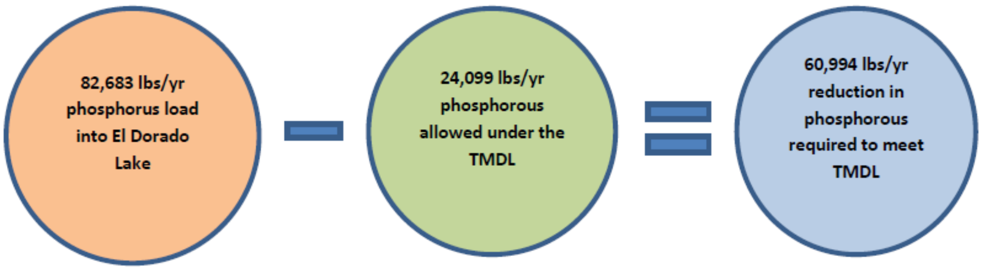
Implementation of non-point source pollution control practices should be taken within one mile of the listed stream segments.

N. NPS Load Reduction Targets to Meet Water Quality Goals for Each Selected TMDL or High Priority Water

Eutrophication - Allocation of Pollutant Reduction Responsibility

From the (KDHE) Walnut River Basin TMDL report: While light is the limiting factor in El Dorado Lake, Total Phosphorus is allocated under this TMDL because a phosphorus reduction will have a large effect on managing the algal community. The Load Capacity is 70,798 pounds per year of phosphorus and was calculated using the CNET model. Because of atmospheric deposition, initial allocations of nitrogen will be based on a proportional decrease in nitrogen between the current condition and the desired endpoint. The assessment suggests that cropland and animal waste contribute to the elevated total phosphorus concentrations in the lake. Generally, a Load Allocation of 63,718 pounds of total phosphorus per year, leading to an 80.8% reduction, is necessary to reach the endpoint. A proportional decrease of 6% in nitrogen loading will allow the total nitrogen endpoint to be achieved. The margin of safety will be 7,080 pounds per year of total phosphorus taken from the load capacity subtracted to compensate for the lack of knowledge about the relationship between the allocated loadings and the resulting water quality.

Phosphorus



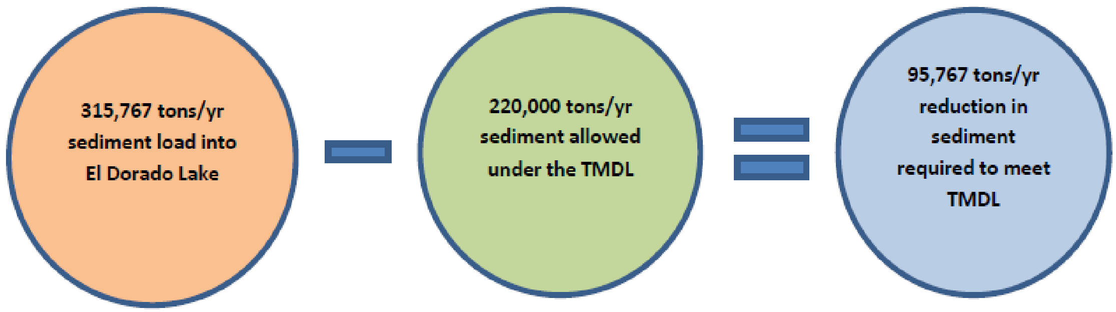
Total Phosphorus reduction in El Dorado Lake
(KDHE, 2002, El Dorado Lake Eutrophication TMDL)

	Total Phosphorus (lb/year)
2011 CNET Re-Model with '02 TMDL Data	
Current Condition	82,683
Load Allocation	21,689
Margin of Safety	2,410
TMDL	24,099
Reduction Needed	60,994
Percent Reduction Needed	73.80%

Sedimentation - Allocation of Pollutant Reduction Responsibility

From the (KDHE) Walnut River Basin TMDL report: The goal of this TMDL is to reduce the current sedimentation rate to its original design rate, and therefore the Load Capacity of El Dorado Lake, will be reduced from 250 acre-feet per year to 174 acre-feet. Assuming a bulk density of the sediment of 58 pounds per cubic foot, the load capacity is about 220,000 tons per year. Siltation loading comes predominantly from nonpoint sources. Given the runoff characteristics of the watershed, overland runoff can easily carry sediment into the lake. The Load Allocation will be set at 220,000 tons per year, a 30 percent reduction from the initial sediment loading seen between 1981-1989.

Sediment



Sediment reduction in El Dorado Lake
(KDHE, 2002, El Dorado Lake Siltation TMDL)

	Sediment (ton/year)
Current Condition	315,767
Load Allocation	220,000
Margin of Safety	Implicit
TMDL	220,000
Reduction Needed	95,767
Percent Reduction Needed	30%

It can be anticipated that reduction in sediment loading to the lake will be most prevalent during the spring runoff events. This endpoint can be reached as a result of expected reductions in loading from the various sources in the watershed resulting from implementation of corrective actions and Best Management Practices, as directed by this TMDL. Because of the unknown relationship between actual sediment loading and resulting in-lake water clarity and because the annual loading rate will vary greatly over time, the Margin of Safety will be implicit based on the assumption that watershed treatment will effect a 30% reduction over the long term, but will be more effective during the moderate or low rainfall years and this should offset the occasional major runoff event.

Fecal Coliform Bacteria - Allocation of Pollutant Reduction Responsibility

Fecal coliform bacteria has been identified by the Butler Community College/Butler County Conservation District Water Monitoring Program as a pollutant in the tributaries above El Dorado Lake. Although no TMDL or pollutant reduction has been established for fecal coliform bacteria specifically, the best management practices used for eutrophication will also reduce fecal coliform bacteria counts.

O. Identification and Justification of Priority Sub-Basins in HUC 12s (w/map) for Focused BMP Implementation to Address El Dorado Lake TMDL.

According to the map on page 65, sub-basins colored in pink are 1st priority, in yellow, second priority and in green third priority (from the US Army Corps of Engineers Feasibility Study partially funded by Kansas Water Office). Therefore in this plan, the pink colored sub-basins will be the top priority sub-basins. Efforts to implement BMPs in these areas will be exhausted at which point the yellow colored sub-basins will become the focus of BMP implementation. And finally the last years of the plan will be spent implementing BMPs in the green colored sub-basins. Therefore, generally speaking, the plan efforts will focus on the pink colored sub-basins and will be the 1st priority for at least the first 5 years of the project. See list below:

For Eutrophication: (Phosphorus and Nitrogen)

1st Priority Area

HUC 12 110300170304 -Satchel Creek-
Sub-basin 40; Sub-basin 35
HUC 12 110300170305 - Shady Creek, Bemis and Harrison Creeks
Sub-basin 50; Sub-basin 44; Sub-basin 51; Sub-basin 43
HUC 12 110300170303- Durechen Creek
Sub-basin 32
HUC 12 110300170302- Cole Creek, Gilmore Branch
Sub-basin 23; Sub-basin 24; Sub-basin 7
HUC 12 110300170301- Walnut River, School Branch
Sub-basin 14; sub-basin 18

2nd Priority Area

HUC 12 110300170306- El Dorado Lake perimeter
Sub-basin 48; Sub-basin 31
HUC 12 110300170303- Durechen Creek
Sub-basin 22
HUC 12 110300170302- Cole Creek, Gilmore Branch

Sub-basin 29; Sub-basin 15; Possibly Sub-basin 30 (even though map shows green, proximity to lake raises priority)
HUC 12 110300170301- Walnut River, School Branch
Sub-basin 25; Sub-basin 19

3rd Priority Area

HUC 12 110300170304-Satchel Creek-
Sub-basin 36; Sub-basin 39; Sub-basin 33;
HUC 12 110300170305- Shady Creek, Bemis and Harrison Creeks
Sub-basin 47; Sub-basin 49; Sub-basin 45
HUC 12 110300170303- Durechen Creek
Sub-basin 28; Sub-basin 27
HUC 12 110300170302- Cole Creek, Gilmore Branch
Sub-basin 11; Sub-basin 30
HUC 12 110300170301- Walnut River, School Branch
Sub-basin 10; Sub-basin 9; Sub-basin 3

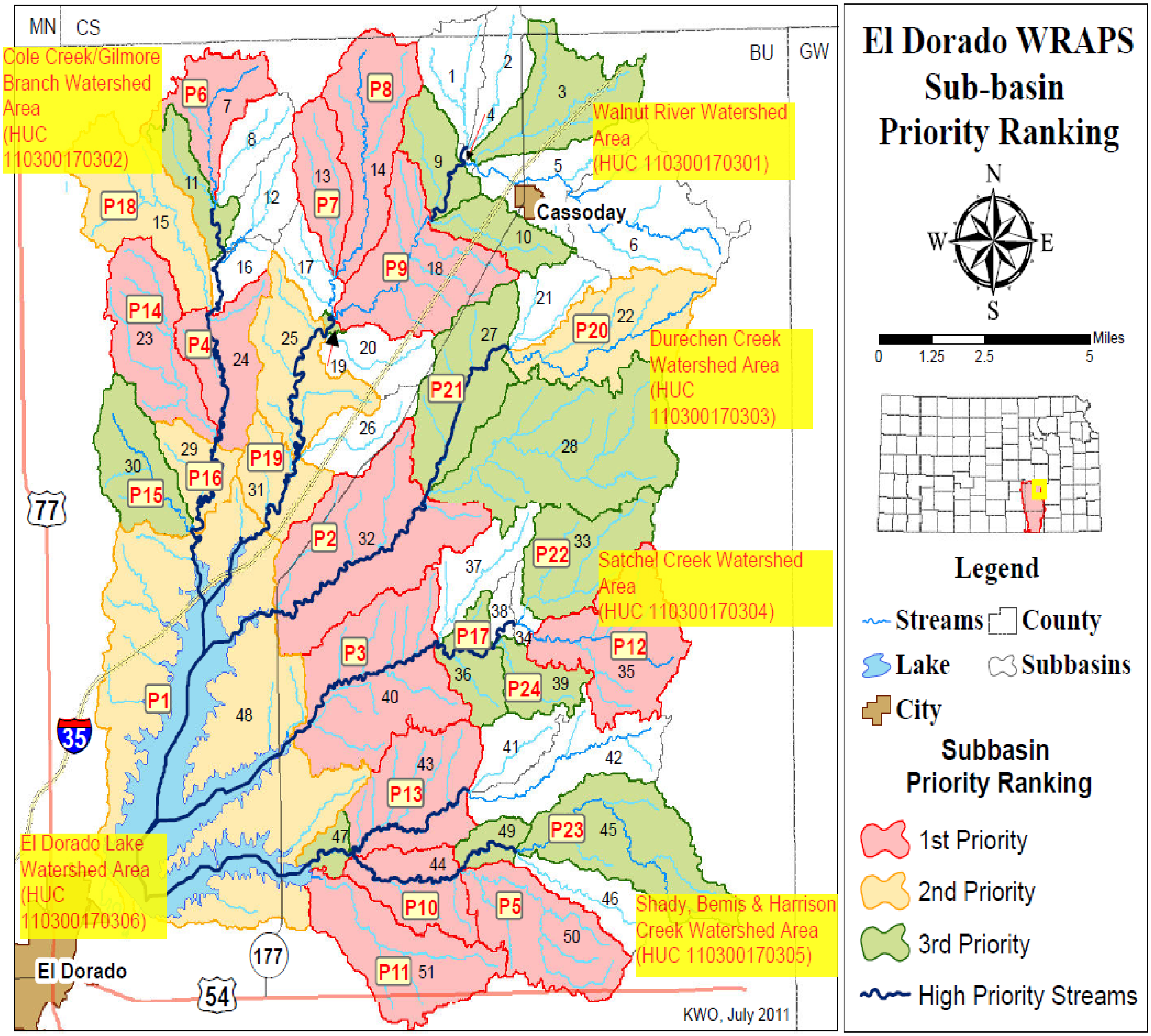
Deviation will only occur if new data or significant land use changes reveals the goal would be achieved faster by realigning priorities. For example if the area (yellow sub-basin 48) land use makes its sub-basin much more likely to contribute pollutants directly to the lake, it may need to have a higher priority. The other aspect this plan recognizes is that the areas around the lake (including the shoreline and operations) are owned by the US Army Corps of Engineers. The land use practices and water level manipulation, (which may lead to accelerated shoreline erosion and siltation), are outside the framework and ability for the SLT to make an impact through BMP implementation. This is not to say the SLT cannot play a role in assisting and persuading the US Army Corps of Engineers to change their management practices or operations. However, BMP implementation through the traditional and proven cost share, technical assistance services, may not be feasible.

Other results from the SWAT model prioritization includes the following and may be utilized for further targeting if goals aren't following earlier prioritization scheme.

For Streambank/Channel Stabilization:

Sub-basin 4; Sub-basin 9; Sub-basin 11; Sub-basin 16; Sub-basin 19; Sub-basin 24; Sub-basin 25; Sub-basin 27; Sub-basin 29; Sub-basin 31; Sub-basin 32; Sub-basin 36; Sub-basin 38; Sub-basin 40; Sub-basin 43; Sub-basin 44; Sub-basin 47; Sub-basin 48; Sub-basin 49.

For all pollutants combined based upon total tons/yr and kg/ha (greatest pollutant loading to least): Sub-basin 48; Sub-basin 32; Sub-basin 40; Sub-basin 24; Sub-basin 50; Sub-basin 7; Sub-basin 13; Sub-basin 14; Sub-basin 18; Sub-basin 44; Sub-basin 51; Sub-basin 35; Sub-basin 43; Sub-basin 23; Sub-basin 30; Sub-basin 29; Sub-basin 36; Sub-basin 15; Sub-basin 31; Sub-basin 22; Sub-basin 27; Sub-basin 33; Sub-basin 45; Sub-basin 39.


El Dorado WRAPS Sub-basin Priority Ranking
Cole Creek/Gilmore Branch Watershed Area (HUC 110300170302)
Walnut River Watershed Area (HUC 110300170301)
Durechen Creek Watershed Area (HUC 110300170303)
Satchel Creek Watershed Area (HUC 110300170304)
El Dorado Lake Watershed Area (HUC 110300170306)
Shady, Bemis & Harrison Creek Watershed Area (HUC 110300170305)
Cassoday
El Dorado
MN
CS
BU
GW
KWO, July 2011
Miles
0 1.25 2.5 5
Legend
Streams
County
Lake
Subbasins
City
Subbasin Priority Ranking
1st Priority
2nd Priority
3rd Priority
High Priority Streams

P. Determination and Description of BMP's to be Implemented Within Watersheds of Priority Waters

Best management practices recommended by the Walnut River Basin, Kansas - Feasibility Report – El Dorado Lake, Kansas - Watershed Management Plan – January 2007:

1. Erosion in the watershed from cropland – Nutrients such as phosphorus and nitrogen originating from applied chemicals are transported by runoff and stream flow. A portion of these and other nutrients are trapped with sediments deposited in El Dorado Lake. The SWAT (Soil and Water Assessment Tool) model shows in most cases, row crop agriculture in the watershed contributes the most sediment into El Dorado Lake. Tillage practices have evolved over the years from deep plowing to conservation tillage and now to no-till farming. Not all farmers no-till; however, the practice is becoming more popular since no till requires less passes through a field thereby reducing fuel costs. One tradeoff with no-till requires the use of more herbicides for weed control; however, with more residue left on the ground, runoff of pollutants is minimized. One concern with no-till is the problem of gullies forming in no-till fields that can increase sediment load into tributaries.

2. Erosion in the watershed from stream channels - The SWAT model determined that a majority of the sediment that reaches El Dorado Lake is due to channel degradation. Of the estimated 149,700 t/yr sediment reaching El Dorado Lake, 130,660 t/yr or (87.3%) is attributed to degradation of the stream channels themselves. Upland sources contribute an estimated 19,040 t/yr (12.7%) to El Dorado Lake.

3. Erosion in the watershed from rangeland - Nutrients such as phosphorus and nitrogen originating from animal wastes are transported by runoff and stream flow. A portion of these and other nutrients are trapped with sediments deposited in El Dorado Lake. Fecal coliform bacteria are also present in runoff from livestock operations. Pastures may be over grazed and/or associated with easily eroded cattle trails. Over grazed pasture is susceptible to higher runoff rates and erosion, and is also more susceptible to field cuts (short disconnected areas of erosion). The initial formation of field cuts is often related to cattle trails. Worst case conditions occur when over grazed pasture adjoins riparian areas subjected to cattle browsing, water access, and over wintering. Reduced pasture and riparian vegetation allows eroded soil and cattle wastes to flow directly across fields, through the riparian area, and into streams. Cattle trailing in rangeland areas can cause gullies to form and increase sediment load into tributaries of El Dorado Lake. Backgrounding cattle is still a popular practice in the watershed. In some areas, cattle are allowed access to sensitive riparian areas, year round in some cases. In winter, cattle are fed in riparian areas for protection from the weather. Watering cattle from creeks is also a common practice. Concentrated "hoof action" by livestock in areas such as stream banks, trails, watering points, salting and feeding sites causes compaction of wet soils and mechanically disrupts dry and exposed soils. Compacted and/or impermeable soils can have decreased infiltration rates, and therefore increased volume and velocity of runoff. Soils loosened by livestock during the dry season are a source of sediments. Some suggested best management practices include: Fencing to exclude cattle from a continuous riparian corridor including a 120-foot grass filter strip, stock tanks for watering or limited, fenced, stream access points, reduced cattle stock density and conservation of grazing lands.

4. Livestock Operations - Nutrients such as phosphorus and nitrogen originating from animal wastes are transported by runoff and stream flow. A portion of these and other nutrients are trapped with sediments deposited in El Dorado Lake. Fecal coliform bacteria are also present in runoff from livestock operations. Along with this, nutrient management planning is needed to assist farm operators with proper placement, timing and amount of manure spread on cropland fields.

5. Grass Buffers/Filter Strips. From the stream bank outward, grass buffers were modeled using SWAT for 30, 60, 90, and 120 foot filter strips for all crop lands combined. The 120 foot filter strips would keep about 72% of the eroded sediment from leaving the property. However, that crop land erosion reduction does not translate into an equivalent sediment reduction at El Dorado Lake. As the surface runoff sediment concentration is reduced by filter strips, water reaching the stream channel is capable of carrying more sediment. The sediment carrying capacity is then met by sediments scoured from the stream channel (bank or channel bottom). The condition is sometimes called "sediment hungry" flow. Filter strips serve the following purposes:
    - Field runoff rates are restored to a slower and more natural condition that tends to result in lower peak flows downstream; and lower peak flows causes less channel erosion and flooding.
    - Applied agricultural nutrients are captured and utilized within the filter strip instead of being carried downstream and stored in El Dorado Lake. The rate of capture is dependent on the slope and width of the filter strip and the vegetation types and soil infiltration rates.
    - The capture rate for total suspended solids can range from 40% to 90%. The effectiveness also depends on the slope and width of the filter strip and the vegetation types and soil infiltration rates.
    - Filter strips can also be designed to effectively restore the terrestrial ecosystem functions of lost natural buffers. Existing state and Federal programs financially support the implementation of filter strips along crop lands meeting multi-year requirements.

6. Stream Bank Restoration. In many cases land use changes in the watershed (such as urbanization or agricultural practices) will increase runoff rates and upland erosion. Consequently the upland changes will tend to result in accelerated stream bank erosion. However, stream bank erosion is only a symptom of the greater runoff rate. The most appropriate and effective response would be the application of best management practices at the site of the land use changes or between the land use changes and the nearest waterway. When land use changes cause a higher rate of runoff the collector streams will gain a higher level of power. It is important to evaluate the potential impacts of bank restoration (or any other stream changes that affect water resources) when considering actions that would alter the natural erosion and sediment transport processes in a watershed.

7. Reservoir Management Measures.

   Management measures are presented in the order of identification during the study. No ranking or prioritization is implied. The evaluated reservoir management measures consist of:

   For the purpose of reducing sedimentation, the financial, material, and human resources required for shoreline restoration would be more effectively applied to other sediment reduction efforts in the watershed. While having identified that the sediment contribution from shoreline erosion is a limited contributor to the total sediment in El Dorado Lake, there are a number of justifications for minimizing shoreline erosion.

   - The park areas, access roads, project utilities, camping facilities, and a variety of recreation facilities are important Federal investments in public recreation resources.
   - Shoreline erosion alters and may often degrade the local terrestrial and aquatic environment.
   - The loss of park lands from erosion and reduction in the quality of the recreation experience represents a quantifiable loss of a public resource.
   - The loss of native shoreline vegetation due to erosion from wave action decreases the value of recreation activities and impacts the aesthetic qualities of the lake and park facilities.

8. Sediment reservoirs. Sedimentation reservoirs upstream of El Dorado Lake, similar to NRCS multiple purpose reservoirs, were identified as an option for consideration to intercept sediment. The construction of one or more dams on the tributaries of El Dorado Lake would reduce sedimentation in the Lake. The Watershed Protection and Flood Prevention Act (PL 83-566), August 4, 1954, as amended, authorized NRCS to cooperate with states and local agencies to carry out works of improvement for soil conservation and for other purposes including flood prevention; conservation, development, utilization and disposal of water; and conservation and proper utilization of land. The Walnut River tributary is forecast by the SWAT model to contribute about 37.6% of the total watershed sediments that are transported to El Dorado Lake. An NRCS type reservoir located on the Walnut River would capture a percentage of the total sediment load. The percentage of captured sediment would be dependent on the location and storage volume of the reservoir, the type and operation of primary outlet works, and the type and operation of emergency spillway outlets. The SWAT model developed in this watershed management plan would be a valuable tool in the evaluation of those reservoirs. While the sedimentation reservoirs would be effective in prolonging the storage available for water supply in El Dorado Lake (and the flood control storage), the sediment reservoirs will eventually fill. Decisions and issues similar to those discussed for El Dorado Lake would in due course apply to sedimentation reservoirs.

9. Operational opportunity to reduce sedimentation. Flood flows are known to transport a large percentage of the sediment that is trapped by a reservoir. An ongoing evaluation of data collected for a study of the Oologah Lake Watershed, Oklahoma and Kansas, suggests that sediment laden flood flows do not immediately mix upon entering Oologah Lake with stored water. The higher density of the flood waters (due to the sediment load and possibly lower water temperature) may cause the flood waters to run along the bottom of the reservoir to the reservoir's dam. A portion of the sediment that would otherwise be deposited in a lake might be released to flow downstream if the outlet works included a low level intake. Transporting sediments downstream would also partially restore the natural function of stream sediment transport. Further study at Oologah Lake is required, but there may be an opportunity to modify project operations (flood water releases) at many reservoirs. The outlet works at El Dorado Lake were designed and constructed to release flows from low in the pool. If sediment laden flood flows do reach the El Dorado dam, then they have been (and will continue to be) released as part of normal flood operations. The in-lake studies at Oologah Lake were possible because continuous stream flow and sediment load data had been collected in that basin. No such data exists for the El Dorado Lake watershed. If sediment stream flow gauges were installed in the watershed, further studies might determine operational changes that could better balance the project purposes of flood damage reduction and water supply storage.

Q. Estimate of BMP Needs for the Priority HUC 12s Identified for Each TMDL/HP Water Addressed in the Plan

The Natural Resources Conservation Service Field Office Technical Guide lists practices which, when installed to standards and specifications, will reduce erosion and runoff of nutrients. *See Appendix D for additional information on Natural Resources Conservation Service Conservation Practices.*

BMP's were selected for implementation as a result of the conclusions of the Feasibility Study as well as local NRCS Staff and Conservation District input. To determine the quantity of BMP's needed in the watershed, each section of land in the watershed was reviewed by using aerial photos available through NRCS's ArcView program. Personal contacts, field visits and NRCS office staff expertise were used to verify numbers from the aerial photos where applicable. The Natural Resources Conservation Service provided advice on types of BMP's to add to the list that would assist in sediment, fecal coliform bacteria and nutrient reduction. Urban practices are also listed.

The following list provides examples of best management practices needed to reduce sediment, fecal coliform bacteria and nutrients in El Dorado Lake.

Cropland, Rangeland and Livestock practices that help reduce erosion, fecal coliform bacteria and runoff of nutrients:

- NRCS Code No. 342, 512 and 550 – Permanent Vegetation – 3487 acres
- NRCS Code No. 412 and 468 – Grassed/Lined Waterways – 340 acres

- NRCS Code No. 329A, 340 and 595 – No-Till and Reduced Tillage – 13854 acres
- NRCS Code No. 356, 362, 600 and 620 – Terraces – 753,470 feet
- NRCS Code No. 590 – Nutrient Management Plans – 13331 acres
- NRCS Code No. 410 and 587 – Grade Stabilization/Water Control Structures – 268
- NRCS Code No. 332, 386, 391 and 393 – Buffers and Field Borders – 607 acres
- NRCS Code No. 635 – Vegetative Filter Strip – 22 acres
- NRCS Code No. 312, 466 and 561 – Relocation of Feeding Pens – 5
- NRCS Code No. 312, 466 and 561 – Relocation of Pasture Feeding Sites – 27
- NRCS Code No. 378, 516, 533, 574, 614 and 642 – Off Stream Watering Systems – 411
- NRCS Code No. 382 and 528 – Rotational Grazing – 108,527 acres
- NRCS Code No. 382, 561 and 578 – Livestock Exclusion from Ponds/Streams – 156,680 feet
- NRCS Code No. 314, 315, 338, 528, 561, 595 – Grazing Management Plans – 127,215 acres
- NRCS Code No. 322, 326, 395, 484, 578, 580, 666 – Streambank Protection/Shoreline Protection – 2,530 acres
- NRCS Code No. 332, 342, 386, 391, 393, 412 and 512 – Cropland Reduction – 1538 acres
- NRCS Code No. 410 and 587 and 638 – Rangeland Gully Repair 63,360 feet
- NRCS Code No. 410 and 587 and 638 – Cropland Gully Repair – 21,120 feet
- NRCS Code No. 402 – Installation of Watershed Dams – 8
- NRCS Code No. 110 – On Site Wastewater Systems – 187
- NRCS Code No. 120 – Unpermitted Dump Site Remediation – 6

R. Annual BMP Implementation Schedule for Each TMDL/HP Water with Short, Mid and Long Term Milestones Including Associated Load Reductions to Meet the Load Reduction Targets Established.

Cropland Scenario

Eldorado WRAPS, Targeted Area BMP Scenario						
			Priority Area			
			1	2	3	Total
Acres of Cropland			5,286	1,975	1,290	**8,551**
BMP Implementation (treated acres)		**Increased Adoption**				**Total**
Permanent Vegetation		10%	529	198	129	**855**
Grassed Waterways		5%	264	99	65	**428**
No-Till		20%	1,057	395	258	**1,710**
Terraces		15%	793	296	194	**1,283**
Nutrient Mgmt Plan		5%	264	99	65	**428**
Buffers/Field Borders		10%	529	198	129	**855**
Grade Stabilization Structures		15%	793	296	194	**1,283**
	Total	80%	4,229	1,580	1,032	**6,841**
Estimated Cost						**Total**
Total Investment Cost			$549,075	$205,150	$133,997	**$888,222**
Available Cost-Share			$282,900	$105,699	$69,039	**$457,638**
Net Cost			$266,175	$99,451	$64,958	**$430,584**
Estimated Annual Runoff Reduction						**Total**
Soil Erosion (tons)			3,983	1,411	831	**6,226**
Phosphorus (pounds)			4,969	1,789	1,096	**7,854**
Nitrogen (pounds)			20,133	7,159	4,447	**31,739**
Estimated Average Annual Runoff						
Soil Erosion (tons/acre)			1.68	1.60	1.44	
Phosphorus (pounds/acre)			2.49	2.40	2.25	
Nitrogen (pounds/acre)			11.81	11.24	10.69	
Percent Reduction						**Average**
Soil Erosion			45%	45%	45%	45%
Phosphorus			38%	38%	38%	38%
Nitrogen			32%	32%	32%	32%

Eldorado WRAPS Livestock BMPs, Costs, and Estimated Phosphorous Reduction.

BMP	Approximate P Reduction Efficiency	Unit Cost	After Cost Share*	Estimated P Reduction (Pounds)	Average Annual Installations	Total Additional Installations	Total Estimated P Reduction	Total Estimated N Reduction
Vegetative Filter Strip (acres)	50%	$714	$357	638	2.0	50	31,894	60,072
Relocate Feeding Pens	95%	$6,621	$3,311	1276	0.2	5	6,380	12,017
Relocate Pasture Feeding Site	50-90%	$2,203	$1,102	60	2.0	50	3,000	5,651
Off-Stream Watering System	85%	$3,795	$1,898	60	2.0	50	3,000	5,651
Rotational Grazing	25%	$7,000	$3,500	140	1.0	25	3,500	6,592
Fence off Stream/Pond	95%	$6,000	$3,000	80	0.2	5	400	753
Grazing Mgmt Plan	25%	$1,600	$800	281	2.0	50	14,050	26,463

Total Cost After Cost Share	$326,853	
Year 1 Cost	$13,074.10	
Year 25 Cost	$27,374	
Total Estimate of P Reduction (lbs.)		47,774
Cost of P Reduction over Project Life (25 Years)		
Dollars per pound of P	$0.49	

**50% Cost-Share from EQIP*

Eldorado WRAPS Cropland BMPs, Costs, and Reduction Efficiencies

Best Management Practice	Cost per Acre	Available Cost-Share	Erosion Reduction Efficiency	Phosphorous Reduction Efficiency	Nitrogen Reduction Efficiency
Permanent Vegetation	$150	50%	95%	95%	95%
Grassed Waterways*	$160	50%	40%	40%	40%
No-Till	$78	39%	75%	40%	25%
Terraces**	$100	50%	30%	30%	30%
Nutrient Mgmt Plan	$57	25%	25%	25%	25%
Buffers/Field Borders***	$100	90%	50%	50%	25%
Grade Stabilization Structures****	$250	50%	50%	50%	50%

**10 treated acres/acre of waterway*

***100 linear feet of terrace/acre*

*** 15 treated acres/acre of buffer

****One structure treats 40 acres

Annual Adoption (treated acres), Cropland BMPs

Year	Permanent Vegetation	Grassed Waterways	No-Till	Terraces	Nutrient Mgmt Plan	Buffers & Field Borders	Grade Stabilization Structures	Total Adoption
1	34	17	68	51	17	34	51	274
2	34	17	68	51	17	34	51	274
3	34	17	68	51	17	34	51	274
4	34	17	68	51	17	34	51	274
5	34	17	68	51	17	34	51	274
6	34	17	68	51	17	34	51	274
7	34	17	68	51	17	34	51	274
8	34	17	68	51	17	34	51	274
9	34	17	68	51	17	34	51	274
10	34	17	68	51	17	34	51	274
11	34	17	68	51	17	34	51	274
12	34	17	68	51	17	34	51	274
13	34	17	68	51	17	34	51	274
14	34	17	68	51	17	34	51	274
15	34	17	68	51	17	34	51	274
16	34	17	68	51	17	34	51	274
17	34	17	68	51	17	34	51	274
18	34	17	68	51	17	34	51	274
19	34	17	68	51	17	34	51	274
20	34	17	68	51	17	34	51	274
21	34	17	68	51	17	34	51	274
22	34	17	68	51	17	34	51	274
23	34	17	68	51	17	34	51	274
24	34	17	68	51	17	34	51	274
25	34	17	68	51	17	34	51	274

	Year	Permanent Vegetation	Grassed Waterways	No-Till	Terraces	Nutrient Mgmt Plan	Buffers & Field Borders	Grade Stabilization Structures	Total Adoption
Short Term	1	34	17	68	51	17	34	51	274
	2	34	17	68	51	17	34	51	274
	3	34	17	68	51	17	34	51	274
	4	34	17	68	51	17	34	51	274
	5	34	17	68	51	17	34	51	274
Total		*171*	*86*	*342*	*257*	*86*	*171*	*257*	*1,368*
Medium Term	6	34	17	68	51	17	34	51	274
	7	34	17	68	51	17	34	51	274
	8	34	17	68	51	17	34	51	274
	9	34	17	68	51	17	34	51	274
	10	34	17	68	51	17	34	51	274
Total		*342*	*171*	*684*	*513*	*171*	*342*	*513*	*2,736*
Long Term	11	34	17	68	51	17	34	51	274
	12	34	17	68	51	17	34	51	274
	13	34	17	68	51	17	34	51	274
	14	34	17	68	51	17	34	51	274
	15	34	17	68	51	17	34	51	274
	16	34	17	68	51	17	34	51	274
	17	34	17	68	51	17	34	51	274
	18	34	17	68	51	17	34	51	274
	19	34	17	68	51	17	34	51	274
	20	34	17	68	51	17	34	51	274
	21	34	17	68	51	17	34	51	274
	22	34	17	68	51	17	34	51	274
	23	34	17	68	51	17	34	51	274
	24	34	17	68	51	17	34	51	274
	25	34	17	68	51	17	34	51	274
Total		*855*	*428*	*1,710*	*1,283*	*428*	*855*	*1,283*	*6,841*

Annual Soil Erosion Reduction

Year	Permanent Vegetation	Grassed Waterways	No-Till	Terraces	Nutrient Mgmt Plan	Buffers & Field Borders	Grade Stabilization Structures	Total
1	53	11	83	25	7	28	42	249
2	106	22	167	50	14	56	83	498
3	159	33	250	75	21	83	125	747
4	211	45	334	100	28	111	167	996
5	264	56	417	125	35	139	209	1,245
6	317	67	501	150	42	167	250	1,494
7	370	78	584	175	49	195	292	1,743
8	423	89	668	200	56	223	334	1,992
9	476	100	751	225	63	250	376	2,241
10	529	111	835	250	70	278	417	2,490
11	582	122	918	275	77	306	459	2,739
12	634	134	1,002	301	83	334	501	2,988
13	687	145	1,085	326	90	362	543	3,237
14	740	156	1,169	351	97	390	584	3,486
15	793	167	1,252	376	104	417	626	3,736
16	846	178	1,336	401	111	445	668	3,985
17	899	189	1,419	426	118	473	710	4,234
18	952	200	1,503	451	125	501	751	4,483
19	1,004	211	1,586	476	132	529	793	4,732
20	1,057	223	1,670	501	139	557	835	4,981
21	1,110	234	1,753	526	146	584	876	5,230
22	1,163	245	1,836	551	153	612	918	5,479
23	1,216	256	1,920	576	160	640	960	5,728
24	1,269	267	2,003	601	167	668	1,002	5,977
25	1,322	278	2,087	626	174	696	1,043	6,226

Annual Phosphorus Runoff Reduction

Year	Permanent Vegetation	Grassed Waterways	No-Till	Terraces	Nutrient Mgmt Plan	Buffers & Field Borders	Grade Stabilization Structures	Total
1	79	17	67	37	10	42	62	314
2	158	33	133	75	21	83	125	628
3	237	50	200	112	31	125	187	942
4	316	67	266	150	42	166	250	1,257
5	395	83	333	187	52	208	312	1,571
6	474	100	399	225	62	250	374	1,885
7	553	117	466	262	73	291	437	2,199
8	632	133	533	300	83	333	499	2,513
9	712	150	599	337	94	374	562	2,827
10	791	166	666	374	104	416	624	3,142
11	870	183	732	412	114	458	687	3,456
12	949	200	799	449	125	499	749	3,770
13	1,028	216	865	487	135	541	811	4,084
14	1,107	233	932	524	146	583	874	4,398
15	1,186	250	999	562	156	624	936	4,712
16	1,265	266	1,065	599	166	666	999	5,026
17	1,344	283	1,132	637	177	707	1,061	5,341
18	1,423	300	1,198	674	187	749	1,123	5,655
19	1,502	316	1,265	712	198	791	1,186	5,969
20	1,581	333	1,331	749	208	832	1,248	6,283
21	1,660	350	1,398	786	218	874	1,311	6,597
22	1,739	366	1,465	824	229	915	1,373	6,911
23	1,818	383	1,531	861	239	957	1,436	7,225
24	1,897	399	1,598	899	250	999	1,498	7,540
25	1,976	416	1,664	936	260	1,040	1,560	7,854

Annual Nitrogen Runoff Reduction

Year	Permanent Vegetation	Grassed Waterways	No-Till	Terraces	Nutrient Mgmt Plan	Buffers & Field Borders	Grade Stabilization Structures	Total
1	374	79	197	177	49	98	295	1,270
2	748	157	394	354	98	197	591	2,539
3	1,122	236	591	531	148	295	886	3,809
4	1,496	315	787	709	197	394	1,181	5,078
5	1,870	394	984	886	246	492	1,476	6,348
6	2,244	472	1,181	1,063	295	591	1,772	7,617
7	2,618	551	1,378	1,240	344	689	2,067	8,887
8	2,992	630	1,575	1,417	394	787	2,362	10,157
9	3,366	709	1,772	1,594	443	886	2,657	11,426
10	3,740	787	1,968	1,772	492	984	2,953	12,696
11	4,114	866	2,165	1,949	541	1,083	3,248	13,965
12	4,488	945	2,362	2,126	591	1,181	3,543	15,235
13	4,862	1,024	2,559	2,303	640	1,279	3,838	16,504
14	5,236	1,102	2,756	2,480	689	1,378	4,134	17,774
15	5,610	1,181	2,953	2,657	738	1,476	4,429	19,044
16	5,984	1,260	3,149	2,834	787	1,575	4,724	20,313
17	6,358	1,338	3,346	3,012	837	1,673	5,019	21,583
18	6,732	1,417	3,543	3,189	886	1,772	5,315	22,852
19	7,106	1,496	3,740	3,366	935	1,870	5,610	24,122
20	7,480	1,575	3,937	3,543	984	1,968	5,905	25,392
21	7,854	1,653	4,134	3,720	1,033	2,067	6,200	26,661
22	8,228	1,732	4,330	3,897	1,083	2,165	6,496	27,931
23	8,602	1,811	4,527	4,074	1,132	2,264	6,791	29,200
24	8,976	1,890	4,724	4,252	1,181	2,362	7,086	30,470
25	9,350	1,968	4,921	4,429	1,230	2,460	7,381	31,739

Total Annual Cost Before Cost-Share, Cropland BMPs

Year	Permanent Vegetation	Grassed Waterways	No-Till	Terraces	Nutrient Mgmt Plan	Buffers & Field Borders	Grade Stabilization Structures	Total
1	$5,131	$2,736	$5,315	$5,131	$970	$3,420	$12,827	$35,529
2	$5,285	$2,818	$5,474	$5,285	$999	$3,523	$13,211	$36,595
3	$5,443	$2,903	$5,638	$5,443	$1,029	$3,629	$13,608	$37,693
4	$5,606	$2,990	$5,807	$5,606	$1,060	$3,738	$14,016	$38,823
5	$5,775	$3,080	$5,982	$5,775	$1,092	$3,850	$14,436	$39,988
6	$5,948	$3,172	$6,161	$5,948	$1,124	$3,965	$14,869	$41,188
7	$6,126	$3,267	$6,346	$6,126	$1,158	$4,084	$15,316	$42,423
8	$6,310	$3,365	$6,536	$6,310	$1,193	$4,207	$15,775	$43,696
9	$6,499	$3,466	$6,732	$6,499	$1,229	$4,333	$16,248	$45,007
10	$6,694	$3,570	$6,934	$6,694	$1,265	$4,463	$16,736	$46,357
11	$6,895	$3,677	$7,142	$6,895	$1,303	$4,597	$17,238	$47,748
12	$7,102	$3,788	$7,357	$7,102	$1,343	$4,735	$17,755	$49,180
13	$7,315	$3,901	$7,577	$7,315	$1,383	$4,877	$18,288	$50,656
14	$7,534	$4,018	$7,805	$7,534	$1,424	$5,023	$18,836	$52,175
15	$7,760	$4,139	$8,039	$7,760	$1,467	$5,174	$19,401	$53,741
16	$7,993	$4,263	$8,280	$7,993	$1,511	$5,329	$19,983	$55,353
17	$8,233	$4,391	$8,528	$8,233	$1,556	$5,489	$20,583	$57,013
18	$8,480	$4,523	$8,784	$8,480	$1,603	$5,653	$21,200	$58,724
19	$8,735	$4,658	$9,048	$8,735	$1,651	$5,823	$21,836	$60,486
20	$8,997	$4,798	$9,319	$8,997	$1,701	$5,998	$22,491	$62,300
21	$9,266	$4,942	$9,599	$9,266	$1,752	$6,178	$23,166	$64,169
22	$9,544	$5,090	$9,887	$9,544	$1,804	$6,363	$23,861	$66,094
23	$9,831	$5,243	$10,183	$9,831	$1,858	$6,554	$24,577	$68,077
24	$10,126	$5,400	$10,489	$10,126	$1,914	$6,750	$25,314	$70,119
25	$10,429	$5,562	$10,804	$10,429	$1,972	$6,953	$26,074	$72,223

Total Annual Cost After Cost-Share, Cropland BMPs

Year	Permanent Vegetation	Grassed Waterways	No-Till	Terraces	Nutrient Mgmt Plan	Buffers & Field Borders	Grade Stabilization Structures	Total
1	$2,565	$1,368	$3,242	$2,565	$727	$342	$6,413	$17,223
2	$2,642	$1,409	$3,339	$2,642	$749	$352	$6,606	$17,740
3	$2,722	$1,451	$3,439	$2,722	$772	$363	$6,804	$18,272
4	$2,803	$1,495	$3,543	$2,803	$795	$374	$7,008	$18,820
5	$2,887	$1,540	$3,649	$2,887	$819	$385	$7,218	$19,385
6	$2,974	$1,586	$3,758	$2,974	$843	$397	$7,435	$19,967
7	$3,063	$1,634	$3,871	$3,063	$869	$408	$7,658	$20,566
8	$3,155	$1,683	$3,987	$3,155	$895	$421	$7,887	$21,183
9	$3,250	$1,733	$4,107	$3,250	$921	$433	$8,124	$21,818
10	$3,347	$1,785	$4,230	$3,347	$949	$446	$8,368	$22,473
11	$3,448	$1,839	$4,357	$3,448	$978	$460	$8,619	$23,147
12	$3,551	$1,894	$4,488	$3,551	$1,007	$473	$8,877	$23,841
13	$3,658	$1,951	$4,622	$3,658	$1,037	$488	$9,144	$24,556
14	$3,767	$2,009	$4,761	$3,767	$1,068	$502	$9,418	$25,293
15	$3,880	$2,069	$4,904	$3,880	$1,100	$517	$9,701	$26,052
16	$3,997	$2,132	$5,051	$3,997	$1,133	$533	$9,992	$26,833
17	$4,117	$2,195	$5,202	$4,117	$1,167	$549	$10,291	$27,638
18	$4,240	$2,261	$5,358	$4,240	$1,202	$565	$10,600	$28,468
19	$4,367	$2,329	$5,519	$4,367	$1,238	$582	$10,918	$29,322
20	$4,498	$2,399	$5,685	$4,498	$1,275	$600	$11,246	$30,201
21	$4,633	$2,471	$5,855	$4,633	$1,314	$618	$11,583	$31,107
22	$4,772	$2,545	$6,031	$4,772	$1,353	$636	$11,931	$32,041
23	$4,915	$2,622	$6,212	$4,915	$1,394	$655	$12,288	$33,002
24	$5,063	$2,700	$6,398	$5,063	$1,436	$675	$12,657	$33,992
25	$5,215	$2,781	$6,590	$5,215	$1,479	$695	$13,037	$35,012

Eldorado WRAPS Annual Cropland Gully Repair From Grade Stabilization

Year	Gully Repair	Soil Load Reduction (tons)	Cumulative Erosion Reduction (tons)	Phosphorus Reduction (lbs)	Cumulative P Load Reduction (lbs)
1	1	325	325	20	20
2	2	650	975	39	59
3	1	325	1,300	20	78
4	2	650	1,950	39	117
5	1	325	2,275	20	137
6	2	650	2,925	39	176
7	1	325	3,250	20	195
8	2	650	3,900	39	234
9	1	325	4,225	20	254
10	2	650	4,875	39	293
11	1	325	5,200	20	312
12	2	650	5,850	39	351
13	1	325	6,175	20	371
14	2	650	6,825	39	410
15	1	325	7,150	20	429
16	2	650	7,800	39	468
17	1	325	8,125	20	488
18	2	650	8,775	39	527
19	1	325	9,100	20	546
20	2	650	9,750	39	585
21	1	325	10,075	20	605
22	2	650	10,725	39	644
23	1	325	11,050	20	663
24	2	650	11,700	39	702
25	1	325	12,025	20	722

**3% Inflation*

Eldorado WRAPS Rangeland Gully Repair by Sub-Watershed

Priority Area	Gully Repair (Number)	Cumulative Erosion Reduction (tons)	Cumulative P Load Reduction (lbs)	Cost*
1	83	13,944	837	$249,000
2	83	13,944	837	$249,000
3	84	14,112	847	$252,000
Total	**250**	**42,000**	**2520**	**$750,000**

**2011 Dollars*

Eldorado WRAPS Annual Streambank Load Reductions and Cost

Year	Streambank Stabilization (feet)	Soil Load Reduction (tons)	Cumulative Erosion Reduction (tons)	Phosphorus Reduction (lbs)	Cumulative P Load Reduction (lbs)	Cost*
1	1,000	500	500	30	30	$96,580
2	1,000	500	1,000	30	60	$99,477
3	1,000	500	1,500	30	90	$102,462
4	1,000	500	2,000	30	120	$105,536
5	1,000	500	2,500	30	150	$108,702
6	1,000	500	3,000	30	180	$111,963
7	1,000	500	3,500	30	210	$115,322
8	1,000	500	4,000	30	240	$118,781
9	1,000	500	4,500	30	270	$122,345
10	1,000	500	5,000	30	300	$126,015
11	1,000	500	5,500	30	330	$129,795
12	1,000	500	6,000	30	360	$133,689
13	1,000	500	6,500	30	390	$137,700
14	1,000	500	7,000	30	420	$141,831
15	1,000	500	7,500	30	450	$146,086
16	1,000	500	8,000	30	480	$150,468
17	1,000	500	8,500	30	510	$154,983
18	1,000	500	9,000	30	540	$159,632
19	1,000	500	9,500	30	570	$164,421
20	1,000	500	10,000	30	600	$169,354
21	1,000	500	10,500	30	630	$174,434
22	1,000	500	11,000	30	660	$179,667
23	1,000	500	11,500	30	690	$185,057
24	1,000	500	12,000	30	720	$190,609
25	1,000	500	12,500	30	750	$196,327

**3% Inflation*

Annual Livestock BMP Adoption							
Year	Vegetative Filter Strip	Relocate Feeding Pens	Relocate Pasture Feeding Site	Off Stream Watering System	Rotational Grazing	Fence off Stream or Pond	Grazing Mgmt Plan
1	2	1	2	2	1	1	2
2	2	0	2	2	1	0	2
3	2	0	2	2	1	0	2
4	2	0	2	2	1	1	2
5	2	1	2	2	1	0	2
6	2	0	2	2	1	0	2
7	2	0	2	2	1	0	2
8	2	0	2	2	1	1	2
9	2	0	2	2	1	0	2
10	2	1	2	2	1	0	2
11	2	0	2	2	1	0	2
12	2	0	2	2	1	1	2
13	2	0	2	2	1	0	2
14	2	0	2	2	1	0	2
15	2	1	2	2	1	0	2
16	2	0	2	2	1	0	2
17	2	0	2	2	1	1	2
18	2	0	2	2	1	0	2
19	2	0	2	2	1	0	2
20	2	1	2	2	1	0	2
21	2	0	2	2	1	1	2
22	2	0	2	2	1	0	2
23	2	0	2	2	1	0	2
24	2	0	2	2	1	0	2
25	2	0	2	2	1	0	2
Total	**50**	**5**	**50**	**50**	**25**	**6**	**50**

Annual Cost* Before Cost-Share of Implementing Livestock BMPs

Year	Vegetative Filter Strip	Relocate Feeding Pens	Relocate Pasture Feeding Site	Off Stream Watering System	Rotational Grazing	Fence off Stream or Pond	Grazing Mgmt Plan	Annual Cost
1	$714	$3,311	$2,203	$3,795	$3,500	$3,000	$1,600	**$18,123**
2	$735	$0	$2,269	$3,909	$3,605	$0	$1,648	**$12,166**
3	$757	$0	$2,337	$4,026	$3,713	$0	$1,697	**$12,531**
4	$780	$0	$2,407	$4,147	$3,825	$3,278	$1,748	**$16,185**
5	$804	$3,726	$2,479	$4,271	$3,939	$0	$1,801	**$17,021**
6	$828	$0	$2,554	$4,399	$4,057	$0	$1,855	**$13,693**
7	$853	$0	$2,630	$4,531	$4,179	$0	$1,910	**$14,104**
8	$878	$0	$2,709	$4,667	$4,305	$3,690	$1,968	**$18,217**
9	$904	$0	$2,791	$4,807	$4,434	$0	$2,027	**$14,963**
10	$932	$4,319	$2,874	$4,952	$4,567	$0	$2,088	**$19,731**
11	$960	$0	$2,961	$5,100	$4,704	$0	$2,150	**$15,874**
12	$988	$0	$3,049	$5,253	$4,845	$4,153	$2,215	**$20,503**
13	$1,018	$0	$3,141	$5,411	$4,990	$0	$2,281	**$16,841**
14	$1,049	$0	$3,235	$5,573	$5,140	$0	$2,350	**$17,346**
15	$1,080	$5,007	$3,332	$5,740	$5,294	$0	$2,420	**$22,874**
16	$1,112	$0	$3,432	$5,912	$5,453	$0	$2,493	**$18,403**
17	$1,146	$0	$3,535	$6,090	$5,616	$4,814	$2,568	**$23,769**
18	$1,180	$0	$3,641	$6,273	$5,785	$0	$2,645	**$19,523**
19	$1,216	$0	$3,750	$6,461	$5,959	$0	$2,724	**$20,109**
20	$1,252	$5,805	$3,863	$6,655	$6,137	$0	$2,806	**$26,517**
21	$1,290	$0	$3,979	$6,854	$6,321	$5,418	$2,890	**$26,752**
22	$1,328	$0	$4,098	$7,060	$6,511	$0	$2,976	**$21,974**
23	$1,368	$0	$4,221	$7,272	$6,706	$0	$3,066	**$22,633**
24	$1,409	$0	$4,348	$7,490	$6,908	$0	$3,158	**$23,312**
25	$1,451	$0	$4,478	$7,714	$7,115	$0	$3,252	**$24,011**

3% Annual Cost Inflation

Annual Cost* After Cost-Share of Implementing Livestock BMPs

Year	Vegetative Filter Strip	Relocate Feeding Pens	Relocate Pasture Feeding Site	Off Stream Watering System	Rotational Grazing	Fence off Stream or Pond	Grazing Mgmt Plan	Annual Cost
1	$357	$1,655	$1,102	$1,898	$1,750	$1,500	$800	**$9,061**
2	$368	$0	$1,135	$1,954	$1,803	$0	$824	**$6,083**
3	$379	$0	$1,169	$2,013	$1,857	$0	$849	**$6,266**
4	$390	$0	$1,204	$2,073	$1,912	$1,639	$874	**$8,093**
5	$402	$1,863	$1,240	$2,136	$1,970	$0	$900	**$8,510**
6	$414	$0	$1,277	$2,200	$2,029	$0	$927	**$6,847**
7	$426	$0	$1,315	$2,266	$2,090	$0	$955	**$7,052**
8	$439	$0	$1,355	$2,334	$2,152	$1,845	$984	**$9,108**
9	$452	$0	$1,395	$2,404	$2,217	$0	$1,013	**$7,482**
10	$466	$2,160	$1,437	$2,476	$2,283	$0	$1,044	**$9,866**
11	$480	$0	$1,480	$2,550	$2,352	$0	$1,075	**$7,937**
12	$494	$0	$1,525	$2,627	$2,422	$2,076	$1,107	**$10,252**
13	$509	$0	$1,570	$2,705	$2,495	$0	$1,141	**$8,421**
14	$524	$0	$1,618	$2,787	$2,570	$0	$1,175	**$8,673**
15	$540	$2,504	$1,666	$2,870	$2,647	$0	$1,210	**$11,437**
16	$556	$0	$1,716	$2,956	$2,726	$0	$1,246	**$9,201**
17	$573	$0	$1,768	$3,045	$2,808	$2,407	$1,284	**$11,884**
18	$590	$0	$1,821	$3,136	$2,892	$0	$1,322	**$9,762**
19	$608	$0	$1,875	$3,230	$2,979	$0	$1,362	**$10,055**
20	$626	$2,902	$1,931	$3,327	$3,069	$0	$1,403	**$13,259**
21	$645	$0	$1,989	$3,427	$3,161	$2,709	$1,445	**$13,376**
22	$664	$0	$2,049	$3,530	$3,256	$0	$1,488	**$10,987**
23	$684	$0	$2,111	$3,636	$3,353	$0	$1,533	**$11,317**
24	$705	$0	$2,174	$3,745	$3,454	$0	$1,579	**$11,656**
25	$726	$0	$2,239	$3,857	$3,557	$0	$1,626	**$12,006**

3% Annual Cost Inflation

Annual Phosphorus Load Reductions (lbs)

Year	Vegetative Filter Strip	Relocate Feeding Pens	Relocate Pasture Feeding Site	Off Stream Watering System	Rotational Grazing	Fence off Stream or Pond	Grazing Mgmt Plan	Annual Load Reduction
1	1,276	1,276	120	120	140	80	562	**3,574**
2	2,552	1,276	240	240	280	80	1,124	**5,792**
3	3,827	1,276	360	360	420	80	1,686	**8,009**
4	5,103	1,276	480	480	560	160	2,248	**10,307**
5	6,379	2,552	600	600	700	160	2,810	**13,801**
6	7,655	2,552	720	720	840	160	3,372	**16,019**
7	8,930	2,552	840	840	980	160	3,934	**18,236**
8	10,206	2,552	960	960	1,120	240	4,496	**20,534**
9	11,482	2,552	1,080	1,080	1,260	240	5,058	**22,752**
10	12,758	3,828	1,200	1,200	1,400	240	5,620	**26,246**
11	14,033	3,828	1,320	1,320	1,540	240	6,182	**28,463**
12	15,309	3,828	1,440	1,440	1,680	320	6,744	**30,761**
13	16,585	3,828	1,560	1,560	1,820	320	7,306	**32,979**
14	17,861	3,828	1,680	1,680	1,960	320	7,868	**35,197**
15	19,136	5,104	1,800	1,800	2,100	320	8,430	**38,690**
16	20,412	5,104	1,920	1,920	2,240	320	8,992	**40,908**
17	21,688	5,104	2,040	2,040	2,380	400	9,554	**43,206**
18	22,964	5,104	2,160	2,160	2,520	400	10,116	**45,424**
19	24,239	5,104	2,280	2,280	2,660	400	10,678	**47,641**
20	25,515	6,380	2,400	2,400	2,800	400	11,240	**51,135**
21	26,791	6,380	2,520	2,520	2,940	480	11,802	**53,433**
22	28,067	6,380	2,640	2,640	3,080	480	12,364	**55,651**
23	29,342	6,380	2,760	2,760	3,220	480	12,926	**57,868**
24	30,618	6,380	2,880	2,880	3,360	480	13,488	**60,086**
25	31,894	6,380	3,000	3,000	3,500	480	14,050	**62,304**

Annual Nitrogen Load Reduction (lbs)

Year	Vegetative Filter Strip	Relocate Feeding Pens	Relocate Pasture Feeding Site	Off Stream Watering System	Rotational Grazing	Fence off Stream or Pond	Grazing Mgmt Plan	Annual Load Reduction
1	2,403	2,403	226	226	264	151	1,059	**6,731**
2	4,806	2,403	452	452	527	151	2,117	**10,908**
3	7,209	2,403	678	678	791	151	3,176	**15,085**
4	9,612	2,403	904	904	1,055	301	4,234	**19,413**
5	12,014	4,807	1,130	1,130	1,318	301	5,293	**25,994**
6	14,417	4,807	1,356	1,356	1,582	301	6,351	**30,171**
7	16,820	4,807	1,582	1,582	1,846	301	7,410	**34,348**
8	19,223	4,807	1,808	1,808	2,110	452	8,468	**38,676**
9	21,626	4,807	2,034	2,034	2,373	452	9,527	**42,853**
10	24,029	7,210	2,260	2,260	2,637	452	10,585	**49,433**
11	26,432	7,210	2,486	2,486	2,901	452	11,644	**53,611**
12	28,835	7,210	2,712	2,712	3,164	603	12,702	**57,938**
13	31,237	7,210	2,938	2,938	3,428	603	13,761	**62,115**
14	33,640	7,210	3,164	3,164	3,692	603	14,819	**66,293**
15	36,043	9,613	3,390	3,390	3,955	603	15,878	**72,873**
16	38,446	9,613	3,616	3,616	4,219	603	16,936	**77,050**
17	40,849	9,613	3,842	3,842	4,483	753	17,995	**81,378**
18	43,252	9,613	4,068	4,068	4,746	753	19,053	**85,555**
19	45,655	9,613	4,294	4,294	5,010	753	20,112	**89,732**
20	48,058	12,017	4,520	4,520	5,274	753	21,171	**96,313**
21	50,460	12,017	4,746	4,746	5,537	904	22,229	**100,641**
22	52,863	12,017	4,972	4,972	5,801	904	23,288	**104,818**
23	55,266	12,017	5,198	5,198	6,065	904	24,346	**108,995**
24	57,669	12,017	5,424	5,424	6,329	904	25,405	**113,172**
25	60,072	12,017	5,651	5,651	6,592	904	26,463	**117,349**

Eldorado WRAPS Annual Rangeland Gully Repair Load Reductions and Cost

Year	Gully Repair	Soil Load Reduction (tons)	Cumulative Erosion Reduction (tons)	Phosphorus Reduction (lbs)	Cumulative P Load Reduction (lbs)	Cost*
1	10	1,680	1,680	101	101	$30,000
2	10	1,680	3,360	101	202	$30,900
3	10	1,680	5,040	101	302	$31,827
4	10	1,680	6,720	101	403	$32,782
5	10	1,680	8,400	101	504	$33,765
6	10	1,680	10,080	101	605	$34,778
7	10	1,680	11,760	101	706	$35,822
8	10	1,680	13,440	101	806	$36,896
9	10	1,680	15,120	101	907	$38,003
10	10	1,680	16,800	101	1,008	$39,143
11	10	1,680	18,480	101	1,109	$40,317
12	10	1,680	20,160	101	1,210	$41,527
13	10	1,680	21,840	101	1,310	$42,773
14	10	1,680	23,520	101	1,411	$44,056
15	10	1,680	25,200	101	1,512	$45,378
16	10	1,680	26,880	101	1,613	$46,739
17	10	1,680	28,560	101	1,714	$48,141
18	10	1,680	30,240	101	1,814	$49,585
19	10	1,680	31,920	101	1,915	$51,073
20	10	1,680	33,600	101	2,016	$52,605
21	10	1,680	35,280	101	2,117	$54,183
22	10	1,680	36,960	101	2,218	$55,809
23	10	1,680	38,640	101	2,318	$57,483
24	10	1,680	40,320	101	2,419	$59,208
25	10	1,680	42,000	101	2,520	$60,984

**3% Inflation*

Eldorado WRAPS Rangeland Gully Repair by Sub-Watershed

Priority Area	Gully Repair (Number)	Cumulative Erosion Reduction (tons)	Cumulative P Load Reduction (lbs)	Cost*
1	83	13,944	837	$249,000
2	83	13,944	837	$249,000
3	84	14,112	847	$252,000
Total	**250**	**42,000**	**2520**	**$750,000**

**2011 Dollars*

Total Phosphorus Reduction

Year	Cropland Reduction	Livestock Reduction	Rangeland Gully Repair	Cropland Gully Repair	Streambank Stabilization	WS Dams (8)	Total Reduction (lbs)	% of TMDL
1	314	3,574	101	20	30	2,133	6,171	10%
2	628	5,792	202	59	60	4,266	11,006	18%
3	942	8,009	302	78	90	6,399	15,821	26%
4	1,257	10,307	403	117	120	8,532	20,736	34%
5	1,571	13,801	504	137	150	10,665	26,827	44%
6	1,885	16,019	605	176	180	12,798	31,662	52%
7	2,199	18,236	706	195	210	14,931	36,477	60%
8	2,513	20,534	806	234	240	17,064	41,392	68%
9	2,827	22,752	907	254	270	17,064	44,074	72%
10	3,142	26,246	1,008	293	300	17,064	48,052	79%
11	3,456	28,463	1,109	312	330	17,064	50,734	83%
12	3,770	30,761	1,210	351	360	17,064	53,515	88%
13	4,084	32,979	1,310	371	390	17,064	56,198	92%
14	4,398	35,197	1,411	410	420	17,064	58,899	97%
15	4,712	38,690	1,512	429	450	17,064	62,858	103%
16	5,026	40,908	1,613	468	480	17,064	65,559	107%
17	5,341	43,206	1,714	488	510	17,064	68,321	112%
18	5,655	45,424	1,814	527	540	17,064	71,023	116%
19	5,969	47,641	1,915	546	570	17,064	73,705	121%
20	6,283	51,135	2,016	585	600	17,064	77,683	127%
21	6,597	53,433	2,117	605	630	17,064	80,445	132%
22	6,911	55,651	2,218	644	660	17,064	83,147	136%
23	7,225	57,868	2,318	663	690	17,064	85,829	141%
24	7,540	60,086	2,419	702	720	17,064	88,531	145%
25	7,854	62,304	2,520	722	750	17,064	91,213	150%

Phosphorous TMDL: **60,994** **Pounds**

Total Sediment Reduction

Year	Cropland Reduction	Rangeland Gully Repair	Cropland Gully Repair	Streambank Stabilization	WS Dams (8)	Total Reduction (tons)	% of TMDL
1	249	1,680	325	500	1,407	**4,161**	4%
2	498	3,360	975	1,000	2,814	**8,647**	9%
3	747	5,040	1,300	1,500	4,221	**12,808**	13%
4	996	6,720	1,950	2,000	5,628	**17,294**	18%
5	1,245	8,400	2,275	2,500	7,035	**21,455**	22%
6	1,494	10,080	2,925	3,000	8,442	**25,941**	27%
7	1,743	11,760	3,250	3,500	9,849	**30,102**	31%
8	1,992	13,440	3,900	4,000	11,256	**34,588**	36%
9	2,241	15,120	4,225	4,500	11,256	**37,342**	39%
10	2,490	16,800	4,875	5,000	11,256	**40,421**	42%
11	2,739	18,480	5,200	5,500	11,256	**43,175**	45%
12	2,988	20,160	5,850	6,000	11,256	**46,254**	48%
13	3,237	21,840	6,175	6,500	11,256	**49,008**	51%
14	3,486	23,520	6,825	7,000	11,256	**52,087**	54%
15	3,736	25,200	7,150	7,500	11,256	**54,842**	57%
16	3,985	26,880	7,800	8,000	11,256	**57,921**	60%
17	4,234	28,560	8,125	8,500	11,256	**60,675**	63%
18	4,483	30,240	8,775	9,000	11,256	**63,754**	67%
19	4,732	31,920	9,100	9,500	11,256	**66,508**	69%
20	4,981	33,600	9,750	10,000	11,256	**69,587**	73%
21	5,230	35,280	10,075	10,500	11,256	**72,341**	76%
22	5,479	36,960	10,725	11,000	11,256	**75,420**	79%
23	5,728	38,640	11,050	11,500	11,256	**78,174**	82%
24	5,977	40,320	11,700	12,000	11,256	**81,253**	85%
25	6,226	42,000	12,025	12,500	11,256	**84,007**	88%

Sediment TMDL: 95,767 Tons

S. Description and Table of Estimated annual Financial and Technical Assistance Costs for BMP Implementation Including Anticipated Sources of Assistance

Additional Assessment Work

Kansas Water Office, El Dorado Lake Watershed Streambank Erosion Assessment

The Kansas Water Office (KWO) completed an assessment for the El Dorado Lake Watershed Restoration and Protection Strategy (WRAPS) Stakeholder Leadership Team (SLT) in 2011. The study identified reaches of streams where erosion is most severe in the watershed above El Dorado Lake. This comparison study was designed to guide prioritization of streambank restoration. The study concluded probable high flow event runoffs from rangelands and agricultural lands via ephemeral gullies, and bridge crossings that are continually undercut by high flow events could be contributing to the sedimentation rate. The study concluded these occurrences were not a part of this assessment but should be assessed in the future.

Assessment Need: Surveying of ephemeral gullies in rangeland, cropland and bridge crossings to estimate sediment loss from these areas. Identify 2 sites in each sub-basin for a total of 12 sites, surveying sites, calculating soil loss. Propose surveying for baseline data first year, then re-surveying at least once a year for 5 years provided a flood event occurs.

Stream Bank Erosion

The SWAT model (From the *Walnut River Basin, Kansas - Feasibility Report – El Dorado Lake, Kansas - Watershed Management Plan – January 2007)* details information for each reach in the watershed and indicates that a majority of the sediment that reaches El Dorado Lake is due to channel degradation. Of the estimated annual average 149,700 t/yr sediment reaching El Dorado Lake, 130,660 t/yr (87.3%) is attributed, in the SWAT modeling effort, to sediment transport within (degradation of) stream channels. The model, as constructed, is not capable of precisely identifying locations where degradation occurs, but can identify approximate subbasin reaches susceptible to degradation.

As a result of the SWAT model findings, a stream channel sediment survey/assessment was initiated in the WRAPS 2010 grant for the purpose of verifying the SWAT model prediction as well as to determine whether sediment is coming from stream banks and/or channels and determining the tons of sediment/year that can be attributed to stream banks and channels. Seven surveys were completed in the watershed; however, no significant rainfall has occurred since October 2010 for us to return to the sites to re-survey for the calculations.

Need: Hire Phil Balch to return to Watershed to re-survey sites after several flood events, then calculate soil loss from channel and streambanks.
$5,000.00 for time, travel and lodging expenses. 50 hours x $100/hour

Need: Students to assist with resurveying.
15 students training/surveying – total hours=240 at $12/hr = $2,880.00.

Sediment survey of El Dorado Lake. (From the *Walnut River Basin, Kansas - Feasibility Report – El Dorado Lake, Kansas - Watershed Management Plan – January 2007)*

One of the objectives of the Feasibility Study was to determine the amount and location of sediment accumulation and evaluate if the sedimentation rate is higher or lower than the design rate projection. That update could not be accomplished during the study period. The November/December 2004 bathymetric survey utilized a different and more accurate method of determining the sediment surface in the reservoir when compared to previous sediment surveys. The results of the survey indicate that the conservation pool volume originally estimated for the reservoir prior to construction was still available in 2004. While the updated storage estimate is encouraging, the results do not provide information useful for updating the sedimentation rate or projecting points in time where sedimentation will impact water supply or other project purposes. The purposes of conducting a new survey include determining the current reservoir volume and updating the projection of the sedimentation rate. A future bathymetric survey or other sediment assessment will be required before the sedimentation rate can be updated. The 2004 data will be the baseline for estimating a sedimentation rate in the future.

The timing of the next survey is important. If conducted prior to the occurrence of several large flood events, the survey will not provide information useful in forecasting sedimentation because the depth of additional sediment will likely be less than the accuracy of a bathymetric survey (current technology). For a survey to be effective in aiding in the forecasting of sedimentation rates, the deposition of sediment above the 2004 sediment surface should exceed a minimum of one foot in depth across a majority of the reservoir area. Most of the sediment that enters a reservoir occurs during flood events. Therefore, several large flood events would have to occur before an additional foot of sediment would be deposited. The overall thickness of the sediment layer is also influenced by the weight of the water column, the characteristics of the sediment particles, and compaction of the sediment layer. To be economically mindful, a resurvey would be conducted when enough sediment was deposited so that a measurable change in lake volume would be meaningful for monitoring and forecasting water supply storage. Resurvey schedules based solely on time intervals pose risks of conducting surveys (too soon) that provide minimal information and of conducting surveys (too late) where sediment volumes have accumulated faster than expected and may be impacting project purposes. To be reliable an additional accumulation of sediment that exceeded one to two foot of depth and covered a large percentage of the reservoir area would be required. (Note: A two foot layer of sediment uniformly deposited in the conservation pool would represent about a 10 percent reduction in conservation pool storage based on the 2004 bathymetric survey.) The Oklahoma Water Resources Board recommended a ten year survey period or a large interim flood event. According to the Tulsa Corps of Engineers rainfall and elevation data at El Dorado dam, there were 4 months where water behind the dam was 5' or more above conservation pool, August 2005, September 2008, and April and May 2009. This data would indicate major flooding in the watershed above the Lake.

Need: To determine whether enough sediment has accumulated, flood data could be further researched by Kansas Biological Survey to assure at least one foot of sediment has entered the Lake since December 2004, AND/OR periodic sampling by KBS at defined lake locations would provide an economical approach to monitor sediment accumulation and plan for the next bathymetric resurvey. Core samples provide a method to gauge the accumulation of sediment. The Kansas Biological Survey (KBS) conducts core sampling in association with state bathymetric surveys to estimate pre-survey sediment accumulations and to aid in scheduling resurveys. The KBS concurs with the general approach of bathymetric resurvey only after one to two feet of additional sediment have been deposited. For about $3,000 (a one day effort), a series of sediment cores could be acquired and measured by KBS staff.

Sediment Source Evaluation

Another evaluation that can guide watershed planning and help in calibration of the SWAT model (From the *Walnut River Basin, Kansas - Feasibility Report – El Dorado Lake, Kansas - Watershed Management Plan – January 2007)* is a sediment source evaluation. The purpose of the evaluation is to estimate how much of the sediment being transported in a stream (or to a reservoir) originated from surface erosion (fields, crops, pasture, and prairie) and how much is contributed from channel erosion (channel sides and channel bottom). A sediment source evaluation requires that soil and sediment samples from fields, streams banks, and reservoir sediments be collected at several locations within the watershed. Using laboratory tests the sources of reservoir sediments can be determined and the relative amounts contributed from surface soil or channel erosion can be estimated.

Need: Although this option may be duplicating efforts with the stream bank erosion assessment proposal for which Phil Balch, Wildhorse Riverworks is recruited, it may help to more accurately calibrate the SWAT model to test upland and channel sediments as well. According to the Feasibility Study, a study of the El Dorado Lake watershed could be conducted by the USGS. No cost proposal has been prepared by the USGS, but a cost range of $200,000 to $300,000 is estimated for a similar study of sediment source evaluation of the El Dorado Lake watershed. Supporting funds from the USGS may be available to assist in conducting this type of evaluation.

Determine reasonable levels of reduction for suspended sediments entering the lake from the watershed and from in lake erosion.

Calibration of the SWAT model (From the *Walnut River Basin, Kansas - Feasibility Report – El Dorado Lake, Kansas - Watershed Management Plan – January 2007)* relied on an estimate of the sedimentation rate in El Dorado Lake. Because the sedimentation rate could not be updated using the latest bathymetric survey, the value used to calibrate the model was the original 1960's sedimentation forecast. When the sedimentation rate is eventually updated following another bathymetric survey the SWAT model can also be updated. Having a revised sedimentation rate will appreciably improve the reliability of watershed forecasting for upland and stream erosion rates. In general the model will reflect similar relative contributions from the five reservoir arms whether future sedimentation rates are higher or lower than the design sedimentation rate used to calibrate the model.

Results from the SWAT model indicate that grass filter strips could reduce a high percentage of sediments from lands used for row crop agriculture. However the model indicates that channel erosion would tend to offset the sediment reduction provided by grass buffers. If reducing reservoir sedimentation were the only concern, then the investment in grass buffers might not be viewed as justified. Grass buffers provide many other beneficial functions that are highly valuable.

Need: Update the SWAT model using latest assessment information collected since 2010.

Service Providers/Estimated Costs

Service Provider	Technical Assistance Needs	Assessment Need	Estimated Costs/Year	Total Costs
Kansas Rural Center	River Friendly Farm Workshops/Field Visits	KRC will assist the Eldorado Lake WRAPS Watershed in the identification/implementation of Best Management Practices in Livestock Management and Cropland Management in identified targeted sub-watersheds, and assist producers with RFFP completions. 12 Workshops in 25 years.	$ 4,000.00	$ 48,000.00
Wildhorse Riverworks - Phil Balch	Stream Erosion Assessment Survey	As a result of the SWAT model findings, a stream channel sediment survey/assessment was initiated in the WRAPS 2010 grant for the purpose of verifying the SWAT model prediction as well as to determine whether sediment is coming from stream banks and/or channels and determining the tons of sediment/year that can be attributed to stream banks and channels. Seven surveys were completed in the watershed; however, no significant rainfall has occurred since October 2010 for us to return to the sites to re-survey for the calculations. One assessment every 5 years.	$ 5,500.00	$ 27,500.00
United States Geological Survey	Sediment Source Evaluation	A sediment source evaluation would guide watershed planning and help in calibration of the SWAT model to show which areas are contributing the most sediment. It requires that soil and sediment samples from fields, streams banks, channel sides, channel bottoms and reservoir sediments be collected at several locations within the watershed then laboratory tested to estimate sediment contributed from surface soil or channel erosion. Although this option may be duplicating efforts with the stream bank erosion assessment proposal for which Phil Balch, Wildhorse Riverworks is recruited, it may help to more accurately calibrate the SWAT model to test upland and channel sediments as well.	$ 300,000.00	$300,000.00
Kansas Biological Survey	Core Sampling	Core Sampling and Bathymetric Survey update. The City of El Dorado had KBS conduct another Bathymetric survey in 2010. Not all the samples have been tested to date. Data from the most recent survey needs to be completed then correlated to the 2004 survey to determine a more accurate sedimentation rate.	$ 2,500.00	$ 2,500.00
Kansas Water Office/KDHE	Update SWAT Model	Update the SWAT model using latest assessment information collected since 2010.	$ 5,500.00	$ 5,500.00
Natural Resources Conservation Service	Technical/Financial Assistance to Farmers and Ranchers	Provide technical and surveying assistance to farmers and ranchers on cropland and rangeland conservation/erosion issues in the watershed and provide information on available USDA finanical assistance programs.	NA	NA
Farm Services Agency	USDA Program Assistance	Provide assistance with Conservation Reserve Program (CRP) and other USDA programs offered to farmers and ranchers in the watershed.	NA	NA
City of El Dorado	Water Testing	Provide assistance with the Water Quality Monitoring Program by testing water samples collected monthly by the WRAPS Coordinator. Tests to be run: nitrogen, phosphorus, fecal coliform or e-coli bacteria and total suspended solids. Three major streams tested once/month = 144 tests per year at $15/test.	$2,160.00	$ 54,000.00
K-State Research and Extension	Education/Information	Provide landowners and operators the latest educational information to help them run their operations as effectively as possible.	NA	NA
Kansas State University/City of El Dorado	Dredged Material Land Application Research Project	Research project to determine best suited land application of dredged material taken from upper ends of El Dorado Lake when lake level is low and material can be excavated.	$ 7,900.00	$ 7,900.00
Kansas Forest Service	Riparian/Forestland Management	Provide landowners advice on riparian management, tree harvesting and riparian buffers.	NA	NA
Kansas Department of Wildlife, Parks and Tourism	Wildlife/Habitat Management and management of Corps owned property around El	Assist landowners with wildlife/habitat management and assist farm operators of Corps owned property around the lake to implement brush management measures, establish buffers, control erosion and control noxious weeds.	NA	NA
US Army Corps of Engineers	Provide information regarding El Dorado Lake, Feasibiltiy Study and SWAT model Update.	Background information needed to update or incorporate into other assessments conducted through the grant period.	NA	NA
		Total Service Provider Costs for 25 Years		$445,400.00

Assessment Needs, Additional Costs

Assessment Need	Technical Assistance Needed	Financial Assistance Needed	Associated Costs	Total Cost
Surveying of ephemeral gullies in rangeland, cropland and bridge crossings to estimate sediment loss from these areas.	36 hours/year for 5 years	$720.00 per year	Mileage - $350.00	$3,950.00
As a result of the SWAT model findings, a stream channel sediment survey/assessment was initiated in the WRAPS 2010 grant for the purpose of verifying the SWAT model prediction as well as to determine whether sediment is coming from stream banks and/or channels and determining the tons of sediment/year that can be attributed to stream banks and channels. Seven surveys were completed in the watershed; however, no significant rainfall has occurred since October 2010 for us to return to the sites to re-survey for the calculations.	1. Hire Phil Balch to return to Watershed to re-survey sites after several flood events, then calculate soil loss from channel and streambanks. 2. Hire students to assist with re-surveying.	Students' Time - 15 students; training/surveying - 240 hours x $12/hour = $2,880.00	Surveying Equipment Rental - $300.00, Misc. Supplies - $250.00	$ 17,150.00

T. Description of I and E Activities and Estimated I and E Costs

Development of an Information and Education Program

Education and Information – Most residents of Butler County don't live in the Upper Walnut Watershed; however a majority of those residents rely on El Dorado Lake for the water that comes out of their faucet at home. A drop of water goes on an incredible journey from the time it drops out of the sky until it reaches the faucet at home, but there is an environmental disconnect between the water supply and the quality of water that comes out of our taps. Even though the majority of us don't live in the watershed where our water supply comes from, we all benefit from practices that reduce sediment and pollutants in our water supply, including cheap and good tasting water. It stands to reason then, that all of us should take ownership in the water we drink. The challenge for those who must portray this message is this: what relationship should we cultivate to bring together the landowners and homeowners who live in the watershed to the rest of us who don't but who benefit from (or pay for) a safe, clean, dependable and long lived water supply. The responsibility belongs to all of us. We can choose to not do anything and hope there's water for our kids and grandkids in 40 years, or we can be realistic and insist that practices and programs be put in place now to protect our water supply for future generations. The problem with informing and educating everyone is that each of us learns differently. A newsletter or brochure for one individual is great, but another individual likes the one on one contact to discuss programs or options. Others prefer tours or workshops or field days to learn how practices protect water quality. Still others prefer their information come from a different agency or association before they will really start to listen. Sometimes change in thinking occurs because a child has learned something at school or on a field trip and the child teaches the parents. There will always be those who are complacent no matter what the issue. Many times a crisis has to occur before anyone takes action. With water, that is not a good option. The goal should be to inform and educate as many people as possible by whichever methods work best. Below are methods used in previous grant s with some additions to inform and educate the general public. It will be important to include partner agencies in this program to assure that all services are offered: Partner agencies include NRCS, K-State Research and Extension, Farm Services Agency, City of El Dorado, Kansas Rural Center, Farm Bureau, Kansas Livestock Association.

U. Information and Education For General Project Awareness

Information and Educational Activity	Time Frame	Estimated Cost	Target Audience	Cooperators
One on One Contacts	Ongoing	Mileage $300/year	Farmers and Ranchers	Stakeholder Leadership Team, Natural Resources Conservation Service, K-State Research and Extension, Kansas Rural Center, Butler County Conservation District, City of El Dorado
Newsletter	Quarterly	$650/ Newsletter	All Residents	Natural Resources Conservation Service, K-State Research and Extension, Kansas Rural Center, Butler County Conservation District, City of El Dorado
Educational Brochures, Pamphlets, etc	As Needed	$100/year	All Residents	Natural Resources Conservation Service, K-State Research and Extension, Kansas Rural Center, Butler County Conservation District, City of El Dorado
River Friendly Farm Workshops	Odd Years	$500/ Workshop	Farmers and Ranchers	Stakeholder Leadership Team, Natural Resources Conservation Service, K-State Research and Extension, Kansas Rural Center, Butler County Conservation District, City of El Dorado
Walnut River Water Festival	Yearly	None	4th and 5th Graders	Natural Resources Conservation Service, K-State Research and Extension, Kansas Rural Center, Butler County Conservation District, City of El Dorado
Educational Presentations	Yearly	Mileage $300/year	All Residents	Natural Resources Conservation Service, K-State Research and Extension, Kansas Rural Center, Butler County Conservation District, City of El Dorado
Show me the Money Workshop – to highlight cost share programs, resources available.	Even Years	$200/ Workshop	All Residents	Stakeholder Leadership Team, Natural Resources Conservation Service, K-State Research and Extension, Kansas Rural Center, Butler County Conservation District, City of El Dorado
Tours and watershed events for non-watershed residents such as a water quality geocaching search, bicycle/5k race/run, journey of water fair, day on the farm.	Yearly	$1000/Event	All Residents	Stakeholder Leadership Team, Natural Resources Conservation Service, K-State Research and Extension, Kansas Rural Center, Butler County Conservation District, City of El Dorado
Special Events such as Women's Breakfast and Donuts and Coffee in Cassoday or Rosalia to talk about cost share programs, etc.	Quarterly	$150/ Quarter	All Residents	Stakeholder Leadership Team, Natural Resources Conservation Service, K-State Research and Extension, Kansas Rural Center, Butler County Conservation District, City of El Dorado

V. Information and Education Activities to Address Adoption, Operation and Maintenance of Rangeland, Cropland, Livestock and Stream Bank Activities

General BMP Addressed	BMP Specific Practices	Information and Educational Activity	Time Frame	Estimated Cost	Target Audience	Cooperators
Cropland	Permanent Vegetation, Grassed Waterways, No-Till and Reduced Till, Terraces, Nutrient Management Plans, Grade Stabilization Structures, Buffers and Field Borders, Cropland Gully Erosion, Cropland Reduction	No-till, Cropland Management Tour, Workshop or Field Day	Odd Years	$725 per event	Farmers and Ranchers	Natural Resources Conservation Service, K-State Research and Extension, Kansas Rural Center, Butler County Conservation District, City of El Dorado
Rangeland and Livestock	Vegetative Filter Strips, Relocation of Feeding Pens, Relocation of Pasture Feeding Sites, Off Stream Watering Systems, Rotational Grazing, Livestock Exclusion from Ponds and Streams, Grazing management Plans, Rangeland Gully Repair	Rangeland Management and/or Livestock/Nutrient Management Tour, Workshop or Field Day	Even Years	$675.00 per event	Farmers and Ranchers	Natural Resources Conservation Service, K-State Research and Extension, Kansas Rural Center, Butler County Conservation District, City of El Dorado
Streambank and Shoreline Protection	Streambank Stabilization, Shoreline Protection, Riparian Area Management	Stream Bank Stabilization Tour, Workshop or Field Day	Every 3 Years (odd)	$350 per event	Farmers, Ranchers and General I & E	Natural Resources Conservation Service, K-State Research and Extension, Kansas Rural Center, Butler County Conservation District, City of El Dorado

Financial and Technical Assistance Needed for Information and Education Program (25 Year Estimates)

Information and Education	Technical Assistance Needed	Financial Assistance Needed	Associated Costs	Total Costs
Education and Information - Promotion of BMP's, Cost Share Programs, Tours, Workshops, Field Days	Implementation of Rangeland, No-till, Stream Bank Stabilization and Livestock Management Tours, Workshops and Field Days for the 25 year plan.	$24,400.00 for tours, workshops and field days	WRAPS Coordinator Time - 632 hours/year @ $20/hr x 25 years = $316,000.00; Mileage - 500 miles/year x 25 yrs @ $0.55/mile = $6,875.00	$347,275.00
One on One Contacts	NRCS, Kansas Rural Center	Mileage $300 miles/year x 25 years = $4,125.00	WRAPS Coordinator Time - 150 hours/year @ $20/hr x 25 years = $75,000.00	$79,125.00
Newsletter	None	Four newsletters/yr = 100 newsletters x $650/newsletter = $65,000.00	WRAPS Coordinator Time - 96 hours/year @ $20/hr x 25 years = $48,000.00	$113,000.00
Brochures, Pamphlets, etc	None	$100/year x 24 years = $2,500.00	None	$2,500.00
River Friendly Farm Workshops	Kansas Rural Center Field Coordinator Time and Mileage - $2,500.00 x 12 years = $30,000.00	$500/Workshop every other year (12 workshops) = $6,000.00; Six Incentive Payments/Workshop @ $250 each x 12 years = $18,000.00	Water Quality Coordinator Time - 70 hours/year @ $20/yr x 12 workshops = $16,800.00; Mileage = 400 miles/year x 12 years x $0.55/mile = $2,640.00	$73,440.00
Walnut River Water Festival	None	None	None	None
Educational Presentations	None	Educational Supplies - $300/yr x 25 years = $7,500.00	Coordinator Time - 40 hours/year @ $20/hr x 25 years = $20,000.00	$27,500.00

Financial and Technical Assistance Needed for Information and Education Program (Continued)

Information and Education	Technical Assistance Needed	Financial Assistance Needed	Associated Costs	Total Costs
Show me the Money Workshop – to highlight cost share programs, resources available.	NRCS, FSA, Kansas Rural Center, K-State Research and Extension, City of El Dorado, etc. to explain cost share and other finanical assistance programs available.	$200/ Workshop x 12 workshops = $2,400.00	Water Quality Coordinator Time - 20 hours/year x $20/hr x 12 years = $4,800.00	$7,200.00
Tours and watershed events for non-watershed residents such as a water quality geocaching search, bicycle/5k race/run, journey of water fair, day on the farm.	None	$1,000/Event x 25 years = $25,000.00	Water Quality Coordinator Time - 60 hours/year x $20/hr x 25 years = $30,000.00	$55,000.00
Special Events such as Women's Breakfast and Donuts and Coffee in Cassoday or Rosalia to talk about cost share programs, etc.	Representatives from NRCS, FSA, Kansas Rural Center, K-State Research and Extension, City of El Dorado, etc. to explain cost share and other finanical assistance programs available.	$50/ Quarter x 25 years = $5,000.00	Water Quality Coordinator Time - 32 hours/year x $20/hr x 25 years = $16,000.00; Mileage = 400 miles/year x 25 years = 10,000 miles x $0.55/mile = $5,500.00	$26,500.00
Totals	**$45,000.00**	**$140,725.00**	**541,615.00**	**$731,540.00**

Estimated Financial and Technical Assistance Table

Total Annual WRAPS Cost after Cost-Share

Year	Cropland	Livestock	Streambank	Range Gullies	I&E	Technical Assistance	Total Annual Cost
1	$17,223	$9,061	$96,580	$30,000	$22,248	$8,492	$183,605
2	$17,740	$6,083	$99,477	$30,900	$22,915	$8,747	$185,863
3	$18,272	$6,266	$102,462	$31,827	$23,603	$9,009	$191,439
4	$18,820	$8,093	$105,536	$32,782	$24,311	$9,279	$198,821
5	$19,385	$8,510	$108,702	$33,765	$25,040	$9,558	$204,960
6	$19,967	$6,847	$111,963	$34,778	$25,792	$9,845	$209,190
7	$20,566	$7,052	$115,322	$35,822	$26,565	$10,140	$215,466
8	$21,183	$9,108	$118,781	$36,896	$27,362	$10,444	$223,775
9	$21,818	$7,482	$122,345	$38,003	$28,183	$10,757	$228,588
10	$22,473	$9,866	$126,015	$39,143	$29,029	$11,080	$237,605
11	$23,147	$7,937	$129,795	$40,317	$29,899	$11,413	$242,509
12	$23,841	$10,252	$133,689	$41,527	$30,796	$11,755	$251,860
13	$24,556	$8,421	$137,700	$42,773	$31,720	$12,108	$257,278
14	$25,293	$8,673	$141,831	$44,056	$32,672	$12,471	$264,996
15	$26,052	$11,437	$146,086	$45,378	$33,652	$12,845	$275,450
16	$26,833	$9,201	$150,468	$46,739	$34,662	$13,230	$281,134
17	$27,638	$11,884	$154,983	$48,141	$35,702	$13,627	$291,975
18	$28,468	$9,762	$159,632	$49,585	$36,773	$14,036	$298,255
19	$29,322	$10,055	$164,421	$51,073	$37,876	$14,457	$307,203
20	$30,201	$13,259	$169,354	$52,605	$39,012	$14,891	$319,322
21	$31,107	$13,376	$174,434	$54,183	$40,182	$15,337	$328,621
22	$32,041	$10,987	$179,667	$55,809	$41,388	$15,798	$335,689
23	$33,002	$11,317	$185,057	$57,483	$42,629	$16,272	$345,760
24	$33,992	$11,656	$190,609	$59,208	$43,908	$16,760	$356,132
25	$35,012	$12,006	$196,327	$60,984	$45,226	$17,262	$366,816

W. Water Quality Milestones to Determine Improvements

The primary goal that is focused on within the El Dorado Lake WRAPS Watershed Plan is restoration of water quality of El Dorado Lake for designated uses supportive of aquatic life, domestic water supply, recreation, and other designated uses for the El Dorado Lake watershed. The plan specifically addresses TMDLs and 303(d) listings for El Dorado Lake. The following is a list of the impairments being directly addressed by the plan:

El Dorado Lake (KDHE Station LM030001)

- High Priority Eutrophication TMDL
- High Priority Siltation TMDL

In order to reach the load reduction goals associated with the El Dorado Lake WRAPS Project Area impairments, an implementation schedule for BMP implementation spanning 25 years has been developed.

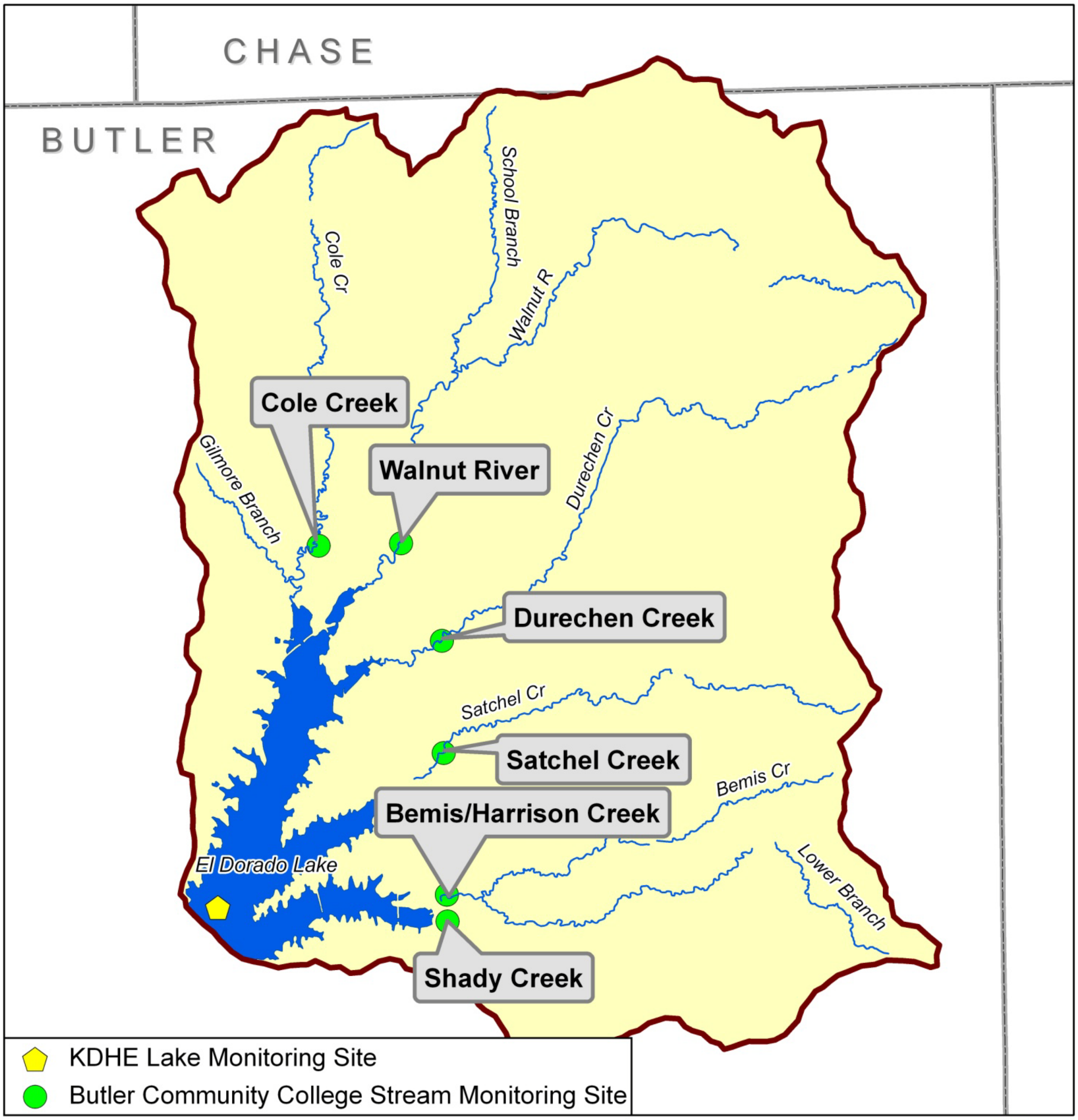
The selected practices included in the plan will be implemented throughout the targeted areas within the El Dorado Lake watershed. Water quality milestones have been developed for El Dorado Lake as well as contributing tributaries within the watershed. The purpose of the milestones and indicators is to measure water quality improvements associated with the implementation schedule contained in this plan.

Monitoring Sites in the El Dorado Lake WRAPS Project Area

Water quality milestones contained in this section are tied to the KDHE monitoring station on El Dorado Lake as well as stream monitoring sites which Butler Community College has monitored within the watershed. These milestones were developed as a mechanism to monitor water quality conditions within El Dorado Lake was well as contributing streams which will be positively affected by the BMP implementation schedule included in this plan. The stations listed below will be utilized to measure water quality improvements throughout the implementation of the plan.

Station ID	Water Body	Type of Station
LM030001	El Dorado Lake	KDHE - Lake
	Cole Creek	Butler C.C.
	Walnut River	Butler C.C.
	Durechen Creek	Butler C.C.
	Satchel Creek	Butler C.C.
	Bemis/Harrison Creek	Butler C.C.
	Shady Creek	Butler C.C.

El Dorado Lake WRAPS Water Monitoring Network



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

Kansas Department of Health and Environment
November 2011

The previous map shows both El Dorado Lake as well as the stream monitoring network from which Butler Community College collected water quality monitoring data dating back from 1995 to 2007. The Butler Community College stream monitoring sites were sampled for various water quality parameters including bacteria, total suspended solids, and phosphorus. Sampling took place every two to four weeks during the period of sampling for these sites. With the absence of KDHE stream monitoring data within the El Dorado Lake watershed, the El Dorado Lake WRAPS project hopes to utilize this stream monitoring data to help establish baseline water quality conditions for the tributaries feeding El Dorado Lake. Future stream monitoring efforts within the watershed could be compared to this data set to evaluate progress being made on reduction of nutrient and sediment loads entering El Dorado Lake.

The KDHE lake monitoring sites are typically sampled once every 3 years between April and October. KDHE lake monitoring sites are sampled for chlorophyll a, total nitrogen (TN), total phosphorus (TP), total suspended solids (TSS), turbidity, dissolved oxygen, and secchi disk depth. The pollutant indicators tested for at each site may vary depending on the season at collection time and other factors.

In addition to the KDHE water quality monitoring, the U.S. Army Corps of Engineers conducts periodic sampling of El Dorado Lake. This monitoring typically takes place between April and October and includes chlorophyll a, total nitrogen (TN), total phosphorus (TP), total suspended solids (TSS), turbidity, dissolved oxygen, and secchi disk depth. This water quality monitoring data can be utilized as another dataset to evaluate improvements in water quality noted for El Dorado Lake over the duration of the watershed plan.

Water Quality Milestones for El Dorado Lake WRAPS Project Area

As previously stated, this plan estimates that it will take 25 years to implement the planned BMPs necessary to meet the load reduction goals for the impairments being addressed in the El Dorado Lake WRAPS Project Area. Several water quality milestones and indicators have been developed, as included herein. The tables below include water quality goals for various parameters monitored in the watershed. It should be noted that stream monitoring data utilized for development of water quality milestones as included within the plan were not evaluated by the KDHE TMDL Section to make a determination as to whether or not the monitored water bodies are impaired or not. These data are to be utilized as a tool for local stakeholders to evaluate general improvements in water quality conditions for the tributaries feeding El Dorado Lake.

Phosphorus and total suspended solids data were evaluated to develop water quality milestones for El Dorado Lake watershed tributaries. These data indicate that the majority of phosphorus and sediment loading originating from the watershed results from high precipitation/high streamflow events. Minimizing sediment and nutrient runoff originating from grazed land as well as cropland during high precipitation events will help to mitigate silt and phosphorus loading contributing to the eutrophication and siltation TMDLs for El Dorado Lake.

Water Quality Milestones for El Dorado Lake				
	Current Condition (1996 - 2010) Chlorophyll a	10-Year Goal		Long Term Goal
		Improved Condition (2011 - 2020) Chlorophyll a	Total Reduction Needed	Improved Condition Chlorophyll a
Sampling Site	Chlorophyll a (average of data collected during indicated period), ppb			
El Dorado Lake LM030001	13	12	7.7%	**Maintain Average Chlorophyll a ≤ 10**
	Current Condition (1996 - 2010) Secchi (Avg)	10-Year Goal		Long Term Goal
		Improved Condition (2011 - 2020) Secchi (Avg)		Improved Condition Secchi (Avg)
Sampling Site	Secchi (average of data collected during indicated period), m			
El Dorado Lake LM030001	0.83	**Secchi depth > 1.0**		**Maintain Secchi depth > 1.0**

Water Quality Milestones for El Dorado Lake Tributaries					
	Current Condition (1995-2007 Butler C.C.)	10-Year Goal		Long Term Goal	
		Improved Condition (2012 - 2021) Median	Total Reduction Needed	Improved Condition Median	Total Reduction Needed
Sampling Site	**Phosphorus (median value of dataset), µg/L**				
Cole Creek	400	360	10%	200	50%
Walnut River	260	234	10%	182	30%
Durechen Creek	300	270	10%	200	33%
Satchel Creek	400	360	10%	200	50%
Bemis/Harrison Creek	295	266	10%	200	32%
Shady Creek	300	270	10%	200	33%

Water Quality Milestones for El Dorado Lake Tributaries					
	Current Condition (1995-2007 Butler C.C.)	10-Year Goal		Long Term Goal	
		Improved Condition (2012 - 2021)	Total Reduction Needed	Improved Condition	Total Reduction Needed
Sampling Site	**Total Suspended Solids (90th percentile value of dataset), mg/L**				
Cole Creek	111	100	10%	78	30%
Walnut River	68	61	10%	48	30%
Durechen Creek	69	62	10%	48	30%
Satchel Creek	96	86	10%	67	30%
Bemis/Harrison Creek	91	82	10%	64	30%
Shady Creek	75	68	10%	53	30%

Additional Water Quality Indicators

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

- Taste and odor issues from public water supplies utilizing water from El Dorado Lake
- Occurrence of algal blooms in El Dorado Lake
- Visitor traffic to El Dorado Lake
- Boating traffic in El Dorado Lake
- Trends of quantity and quality of fishing in El Dorado Lake
- Beach closings

Evaluation of Monitoring Data

Monitoring data in the El Dorado Lake watershed will be used to determine water quality progress, track water quality milestones, and to determine the effectiveness of the implementation of conservation practices outlined in the plan. The schedule of review for the monitoring data will be tied to the water quality milestones that have been developed, as well as the frequency of the sampling data.

The implementation schedule and water quality milestones for the El Dorado Lake watershed extend through a 25-year period from 2011 to 2037. Throughout that period, KDHE will continue to analyze and evaluate the monitoring data collected. After the first ten years of monitoring and implementation of water quality protection best management practices, KDHE will evaluate the available water quality data to determine whether the water quality milestones have been achieved. If milestones are not achieved, KDHE will assist the El Dorado Lake WRAPS group to analyze and understand the context for non-achievement, as well as the need to review and/or revise the water quality milestones included in the plan. KDHE and the SLT can address any necessary modifications or revisions to the plan based on the data analysis. In 2037, at the end of the plan, a final determination can be made as to whether the water quality standards have been attained for El Dorado Lake.

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

X. Description of Existing Water Quality Monitoring Network or Other Related Data Gathering that will be used to Evaluate Plan Success.

The existing water quality monitoring network includes KDHE's Lake Monitoring Program which is typically done on a 3 year rotation. Much of the evaluation and review of the sediment and eutrophication TMDL's will be based on water quality data collected by KDHE.

No permanent stream monitoring stations are located in the watershed above El Dorado Lake; therefore, no data except for the Butler County Conservation District / Butler Community College water monitoring program is available from streams. BCCD, in cooperation with BCC continues to take samples in the streams above El Dorado Lake and tests for fecal coliform bacteria using the membrane filtration technique. Test strips are used for nitrate and phosphorus. This monitoring program is more of an educational tool used to familiarize students with water monitoring. For evaluation, it might be beneficial to have a certified lab test samples from streams above El Dorado Lake for accurate reporting and WRAPS accountability.

One cost effective option for water sampling might be to have Conservation District Staff collect the samples and have City of El Dorado Water Department analyze the samples in their lab. There are 5 main tributary arms with specific outlets at El Dorado Lake. Water samples could be collected from these tributaries for testing on a monthly basis. Additional samples (for a total of 10 samples monthly) could be taken in high priority sub-watersheds as the WRAPS program progresses to help evaluate Best Management Practices and their effectiveness in controlling sediment and nutrient runoff from those areas. It would also be beneficial to move current water sampling collection points off bridges as these areas can skew the data collected. This information would be useful in updating or amending the WRAPS plan and further target practices that reduce nutrients and sediment.

As this is a small watershed, visual monitoring of stream and lake water resources by stakeholders, recreational users and agency personnel will be useful to identify and report algal blooms, fish kills, pipeline breaks, etc.

Y. Supplemental Monitoring if Applicable and Estimate of Costs

1. KDHE's Lake Monitoring Program will continue to be used for assessment.
2. Work with the Kansas Biological Survey to complete the 2011 survey with the City of El Dorado.
3. Explore partnering with the City of El Dorado to analyze samples in their certified lab with Conservation District staff collecting the samples on a regular basis. (BCCD staff time to collect samples = 4 hours per month x $20/hour = $960.00/year; City of El Dorado Staff time to analyze samples = 1 hour/month x $30/hour = $360.00/year; lab supplies for bacteria, total suspended solids, nitrate and phosphorus testing = $5/test x 4 tests/month x 12 months = $240.00/year; Total Cost = $1,560.00.
4. Rainfall varies widely from the north end of the watershed to the south end, and from the east to the west. Establishing rain gauges in several areas of the watershed will help us determine flooding in specific areas of the watershed, such as where we have surveyed and set stream bank pins, so that we can show what amount of rainfall causes the majority of stream bank erosion as it occurs in the watershed. Rainfall data would also be useful for determining if additional water testing would need to be conducted. The National Weather Service has a voluntary rainfall collection project called CoCoRahs. This project requires volunteers to report precipitation via internet as it occurs.

This would not only give us valuable data, but it would allow stakeholders an opportunity to assist with the project in a non-threatening, helpful way. The cost of the rain gauges is $26.25 plus shipping and we would need a minimum of 5 with an optimal number of 10. Five gauges plus shipping and handling is estimated to cost $156.25; ten gauges plus shipping and handling is estimated to cost $312.50.

Appendix A

http://www.kwo.org/projects_programs/Steambank_Assessments/Rpt_Draft_WAL_ED_SBErosionAssessment_052611_ap.pdf

Appendix B

http://www.kwo.org/reports_publications/Reports/rpt_final_FS_COE_020808_db.pdf

Appendix C

http://www.kdheks.gov/tmdl/watmdl.htm

Appendix D

http://efotg.sc.egov.usda.gov/treemenuFS.aspx

Appendix E

Additional data compiled by Josh Roe, Watershed Economist, KSU Office of Local Government, Agriculture Economics. This data reflects information for each priority area in the Watershed above El Dorado Lake.

Livestock BMP Adoption by Priority Area

Priority Area	Vegetative Filter Strip	Relocate Feeding Site	Relocate Pasture Feeding Site	Off-Stream Watering System	Rotational Grazing	Fence Out Stream or Pond	Grazing Mgmt Plans
1	20	2	20	20	10	2	15
2	20	2	20	20	10	2	15
3	10	1	10	10	5	1	20
Total	50	5	50	50	25	5	50

Livestock BMP Cost Before Cost-Share by Priority Area

Priority Area	Vegetative Filter Strip	Relocate Feeding Site	Relocate Pasture Feeding Site	Off-Stream Watering System	Rotational Grazing	Fence Out Stream or Pond	Grazing Mgmt Plans
1	$14,280	$13,242	$44,060	$75,900	$70,000	$12,000	$24,000
2	$14,280	$13,242	$44,060	$75,900	$70,000	$12,000	$24,000
3	$7,140	$6,621	$22,030	$37,950	$35,000	$6,000	$32,000
Total	$35,700	$33,105	$110,150	$189,750	$175,000	$30,000	$80,000

Livestock BMP Cost After Cost-Share by Priority Area

Priority Area	Vegetative Filter Strip	Relocate Feeding Site	Relocate Pasture Feeding Site	Off-Stream Watering System	Rotational Grazing	Fence Out Stream or Pond	Grazing Mgmt Plans
1	$7,140	$6,621	$22,030	$37,950	$35,000	$6,000	$12,000
2	$7,140	$6,621	$22,030	$37,950	$35,000	$6,000	$12,000
3	$3,570	$3,311	$11,015	$18,975	$17,500	$3,000	$16,000
Total	$17,850	$16,553	$55,075	$94,875	$87,500	$15,000	$40,000

Livestock BMP Phosphorous Load Reduction by Priority Area

Priority Area	Vegetative Filter Strip	Relocate Feeding Site	Relocate Pasture Feeding Site	Off-Stream Watering System	Rotational Grazing	Fence Out Stream or Pond	Grazing Mgmt Plans
1	12,758	2,552	1,200	1,200	1,400	160	4,215
2	12,758	2,552	1,200	1,200	1,400	160	4,215
3	6,379	1,276	600	600	700	80	5,620
Total	31,894	6,380	3,000	3,000	3,500	400	14,050

Livestock BMP Nitrogen Load Reduction by Priority Area

Priority Area	Vegetative Filter Strip	Relocate Feeding Site	Relocate Pasture Feeding Site	Off-Stream Watering System	Rotational Grazing	Fence Out Stream or Pond	Grazing Mgmt Plans
1	24,029	4,807	2,260	2,260	2,637	301	7,939
2	24,029	4,807	2,260	2,260	2,637	301	7,939
3	12,014	2,403	1,130	1,130	1,318	151	10,585
Total	60,072	12,017	5,651	5,651	6,592	753	26,463

Priority Area #1 Annual Adoption (treated acres), Cropland BMPs

Year	Permanent Vegetation	Grassed Waterways	No-Till	Terraces	Nutrient Mgmt Plan	Buffers & Field Borders	Grade Stabilization Structures	Total Adoption
1	21	11	42	32	11	21	32	169
2	21	11	42	32	11	21	32	169
3	21	11	42	32	11	21	32	169
4	21	11	42	32	11	21	32	169
5	21	11	42	32	11	21	32	169
6	21	11	42	32	11	21	32	169
7	21	11	42	32	11	21	32	169
8	21	11	42	32	11	21	32	169
9	21	11	42	32	11	21	32	169
10	21	11	42	32	11	21	32	169
11	21	11	42	32	11	21	32	169
12	21	11	42	32	11	21	32	169
13	21	11	42	32	11	21	32	169
14	21	11	42	32	11	21	32	169
15	21	11	42	32	11	21	32	169
16	21	11	42	32	11	21	32	169
17	21	11	42	32	11	21	32	169
18	21	11	42	32	11	21	32	169
19	21	11	42	32	11	21	32	169
20	21	11	42	32	11	21	32	169
21	21	11	42	32	11	21	32	169
22	21	11	42	32	11	21	32	169
23	21	11	42	32	11	21	32	169
24	21	11	42	32	11	21	32	169
25	21	11	42	32	11	21	32	169

Priority Area #2 Annual Adoption (treated acres), Cropland BMPs

Year	Permanent Vegetation	Grassed Waterways	No-Till	Terraces	Nutrient Mgmt Plan	Buffers & Field Borders	Grade Stabilization Structures	Total Adoption
1	8	4	16	12	4	8	12	63
2	8	4	16	12	4	8	12	63
3	8	4	16	12	4	8	12	63
4	8	4	16	12	4	8	12	63
5	8	4	16	12	4	8	12	63
6	8	4	16	12	4	8	12	63
7	8	4	16	12	4	8	12	63
8	8	4	16	12	4	8	12	63
9	8	4	16	12	4	8	12	63
10	8	4	16	12	4	8	12	63
11	8	4	16	12	4	8	12	63
12	8	4	16	12	4	8	12	63
13	8	4	16	12	4	8	12	63
14	8	4	16	12	4	8	12	63
15	8	4	16	12	4	8	12	63
16	8	4	16	12	4	8	12	63
17	8	4	16	12	4	8	12	63
18	8	4	16	12	4	8	12	63
19	8	4	16	12	4	8	12	63
20	8	4	16	12	4	8	12	63
21	8	4	16	12	4	8	12	63
22	8	4	16	12	4	8	12	63
23	8	4	16	12	4	8	12	63
24	8	4	16	12	4	8	12	63
25	8	4	16	12	4	8	12	63

Priority Area #3 Annual Adoption (treated acres), Cropland BMPs

Year	Permanent Vegetation	Grassed Waterways	No-Till	Terraces	Nutrient Mgmt Plan	Buffers & Field Borders	Grade Stabilization Structures	Total Adoption
1	5	3	10	8	3	5	8	41
2	5	3	10	8	3	5	8	41
3	5	3	10	8	3	5	8	41
4	5	3	10	8	3	5	8	41
5	5	3	10	8	3	5	8	41
6	5	3	10	8	3	5	8	41
7	5	3	10	8	3	5	8	41
8	5	3	10	8	3	5	8	41
9	5	3	10	8	3	5	8	41
10	5	3	10	8	3	5	8	41
11	5	3	10	8	3	5	8	41
12	5	3	10	8	3	5	8	41
13	5	3	10	8	3	5	8	41
14	5	3	10	8	3	5	8	41
15	5	3	10	8	3	5	8	41
16	5	3	10	8	3	5	8	41
17	5	3	10	8	3	5	8	41
18	5	3	10	8	3	5	8	41
19	5	3	10	8	3	5	8	41
20	5	3	10	8	3	5	8	41
21	5	3	10	8	3	5	8	41
22	5	3	10	8	3	5	8	41
23	5	3	10	8	3	5	8	41
24	5	3	10	8	3	5	8	41
25	5	3	10	8	3	5	8	41

Priority Area #1 Annual Adoption (treated acres), Cropland BMPs

	Year	Permanent Vegetation	Grassed Waterways	No-Till	Terraces	Nutrient Mgmt Plan	Buffers & Field Borders	Grade Stabilization Structures	Total Adoption
Short Term	1	21	11	42	32	11	21	32	169
	2	21	11	42	32	11	21	32	169
	3	21	11	42	32	11	21	32	169
	4	21	11	42	32	11	21	32	169
	5	21	11	42	32	11	21	32	169
Total		*106*	*53*	*211*	*159*	*53*	*106*	*159*	*846*
Medium Term	6	21	11	42	32	11	21	32	169
	7	21	11	42	32	11	21	32	169
	8	21	11	42	32	11	21	32	169
	9	21	11	42	32	11	21	32	169
	10	21	11	42	32	11	21	32	169
Total		*211*	*106*	*423*	*317*	*106*	*211*	*317*	*1,692*
Long Term	11	21	11	42	32	11	21	32	169
	12	21	11	42	32	11	21	32	169
	13	21	11	42	32	11	21	32	169
	14	21	11	42	32	11	21	32	169
	15	21	11	42	32	11	21	32	169
	16	21	11	42	32	11	21	32	169
	17	21	11	42	32	11	21	32	169
	18	21	11	42	32	11	21	32	169
	19	21	11	42	32	11	21	32	169
	20	21	11	42	32	11	21	32	169
	21	21	11	42	32	11	21	32	169
	22	21	11	42	32	11	21	32	169
	23	21	11	42	32	11	21	32	169
	24	21	11	42	32	11	21	32	169
	25	21	11	42	32	11	21	32	169
Total		*529*	*264*	*1,057*	*793*	*264*	*529*	*793*	*4,229*

Priority Area #2 Annual Adoption (treated acres), Cropland BMPs

	Year	Permanent Vegetation	Grassed Waterways	No-Till	Terraces	Nutrient Mgmt Plan	Buffers & Field Borders	Grade Stabilization Structures	Total Adoption
Short Term	1	8	4	16	12	4	8	12	63
	2	8	4	16	12	4	8	12	63
	3	8	4	16	12	4	8	12	63
	4	8	4	16	12	4	8	12	63
	5	8	4	16	12	4	8	12	63
Total		*40*	*20*	*79*	*59*	*20*	*40*	*59*	*316*
Medium Term	6	8	4	16	12	4	8	12	63
	7	8	4	16	12	4	8	12	63
	8	8	4	16	12	4	8	12	63
	9	8	4	16	12	4	8	12	63
	10	8	4	16	12	4	8	12	63
Total		*79*	*40*	*158*	*119*	*40*	*79*	*119*	*632*
Long Term	11	8	4	16	12	4	8	12	63
	12	8	4	16	12	4	8	12	63
	13	8	4	16	12	4	8	12	63
	14	8	4	16	12	4	8	12	63
	15	8	4	16	12	4	8	12	63
	16	8	4	16	12	4	8	12	63
	17	8	4	16	12	4	8	12	63
	18	8	4	16	12	4	8	12	63
	19	8	4	16	12	4	8	12	63
	20	8	4	16	12	4	8	12	63
	21	8	4	16	12	4	8	12	63
	22	8	4	16	12	4	8	12	63
	23	8	4	16	12	4	8	12	63
	24	8	4	16	12	4	8	12	63
	25	8	4	16	12	4	8	12	63
Total		*198*	*99*	*395*	*296*	*99*	*198*	*296*	*1,580*

Priority Area #3 Annual Adoption (treated acres), Cropland BMPs

	Year	Permanent Vegetation	Grassed Waterways	No-Till	Terraces	Nutrient Mgmt Plan	Buffers & Field Borders	Grade Stabilization Structures	Total Adoption
Short Term	1	5	3	10	8	3	5	8	41
	2	5	3	10	8	3	5	8	41
	3	5	3	10	8	3	5	8	41
	4	5	3	10	8	3	5	8	41
	5	5	3	10	8	3	5	8	41
Total		*26*	*13*	*52*	*39*	*13*	*26*	*39*	*206*
Medium Term	6	5	3	10	8	3	5	8	41
	7	5	3	10	8	3	5	8	41
	8	5	3	10	8	3	5	8	41
	9	5	3	10	8	3	5	8	41
	10	5	3	10	8	3	5	8	41
Total		*52*	*26*	*103*	*77*	*26*	*52*	*77*	*413*
Long Term	11	5	3	10	8	3	5	8	41
	12	5	3	10	8	3	5	8	41
	13	5	3	10	8	3	5	8	41
	14	5	3	10	8	3	5	8	41
	15	5	3	10	8	3	5	8	41
	16	5	3	10	8	3	5	8	41
	17	5	3	10	8	3	5	8	41
	18	5	3	10	8	3	5	8	41
	19	5	3	10	8	3	5	8	41
	20	5	3	10	8	3	5	8	41
	21	5	3	10	8	3	5	8	41
	22	5	3	10	8	3	5	8	41
	23	5	3	10	8	3	5	8	41
	24	5	3	10	8	3	5	8	41
	25	5	3	10	8	3	5	8	41
Total		*129*	*65*	*258*	*194*	*65*	*129*	*194*	*1,032*

Priority Area #1 Annual Soil Erosion Reduction

Year	Permanent Vegetation	Grassed Waterways	No-Till	Terraces	Nutrient Mgmt Plan	Buffers & Field Borders	Grade Stabilization Structures	Total
1	34	7	53	16	4	18	27	159
2	68	14	107	32	9	36	53	319
3	101	21	160	48	13	53	80	478
4	135	28	214	64	18	71	107	637
5	169	36	267	80	22	89	134	797
6	203	43	320	96	27	107	160	956
7	237	50	374	112	31	125	187	1,115
8	271	57	427	128	36	142	214	1,275
9	304	64	481	144	40	160	240	1,434
10	338	71	534	160	45	178	267	1,593
11	372	78	588	176	49	196	294	1,753
12	406	85	641	192	53	214	320	1,912
13	440	93	694	208	58	231	347	2,071
14	474	100	748	224	62	249	374	2,231
15	507	107	801	240	67	267	401	2,390
16	541	114	855	256	71	285	427	2,549
17	575	121	908	272	76	303	454	2,709
18	609	128	961	288	80	320	481	2,868
19	643	135	1,015	304	85	338	507	3,027
20	677	142	1,068	320	89	356	534	3,187
21	710	150	1,122	336	93	374	561	3,346
22	744	157	1,175	353	98	392	588	3,505
23	778	164	1,228	369	102	409	614	3,665
24	812	171	1,282	385	107	427	641	3,824
25	846	178	1,335	401	111	445	668	3,983

Priority Area #2 Annual Soil Erosion Reduction

Year	Permanent Vegetation	Grassed Waterways	No-Till	Terraces	Nutrient Mgmt Plan	Buffers & Field Borders	Grade Stabilization Structures	Total
1	12	3	19	6	2	6	9	56
2	24	5	38	11	3	13	19	113
3	36	8	57	17	5	19	28	169
4	48	10	76	23	6	25	38	226
5	60	13	95	28	8	32	47	282
6	72	15	114	34	9	38	57	339
7	84	18	132	40	11	44	66	395
8	96	20	151	45	13	50	76	452
9	108	23	170	51	14	57	85	508
10	120	25	189	57	16	63	95	564
11	132	28	208	62	17	69	104	621
12	144	30	227	68	19	76	114	677
13	156	33	246	74	20	82	123	734
14	168	35	265	79	22	88	132	790
15	180	38	284	85	24	95	142	847
16	192	40	303	91	25	101	151	903
17	204	43	322	96	27	107	161	960
18	216	45	341	102	28	114	170	1,016
19	228	48	359	108	30	120	180	1,072
20	240	50	378	114	32	126	189	1,129
21	252	53	397	119	33	132	199	1,185
22	264	55	416	125	35	139	208	1,242
23	276	58	435	131	36	145	218	1,298
24	288	61	454	136	38	151	227	1,355
25	300	63	473	142	39	158	236	1,411

Priority Area #3 Annual Soil Erosion Reduction

Year	Permanent Vegetation	Grassed Waterways	No-Till	Terraces	Nutrient Mgmt Plan	Buffers & Field Borders	Grade Stabilization Structures	Total
1	7	1	11	3	1	4	6	33
2	14	3	22	7	2	7	11	67
3	21	4	33	10	3	11	17	100
4	28	6	45	13	4	15	22	133
5	35	7	56	17	5	19	28	166
6	42	9	67	20	6	22	33	200
7	49	10	78	23	7	26	39	233
8	56	12	89	27	7	30	45	266
9	64	13	100	30	8	33	50	299
10	71	15	111	33	9	37	56	333
11	78	16	123	37	10	41	61	366
12	85	18	134	40	11	45	67	399
13	92	19	145	43	12	48	72	432
14	99	21	156	47	13	52	78	466
15	106	22	167	50	14	56	84	499
16	113	24	178	53	15	59	89	532
17	120	25	189	57	16	63	95	565
18	127	27	201	60	17	67	100	599
19	134	28	212	64	18	71	106	632
20	141	30	223	67	19	74	111	665
21	148	31	234	70	20	78	117	698
22	155	33	245	74	20	82	123	732
23	162	34	256	77	21	85	128	765
24	169	36	267	80	22	89	134	798
25	176	37	279	84	23	93	139	831

Priority Area #1 Annual Phosphorous Runoff Reduction

Year	Permanent Vegetation	Grassed Waterways	No-Till	Terraces	Nutrient Mgmt Plan	Buffers & Field Borders	Grade Stabilization Structures	Total
1	50	11	42	24	7	26	39	199
2	100	21	84	47	13	53	79	397
3	150	32	126	71	20	79	118	596
4	200	42	168	95	26	105	158	795
5	250	53	211	118	33	132	197	994
6	300	63	253	142	39	158	237	1,192
7	350	74	295	166	46	184	276	1,391
8	400	84	337	190	53	211	316	1,590
9	450	95	379	213	59	237	355	1,789
10	500	105	421	237	66	263	395	1,987
11	550	116	463	261	72	290	434	2,186
12	600	126	505	284	79	316	474	2,385
13	650	137	548	308	86	342	513	2,584
14	700	147	590	332	92	369	553	2,782
15	750	158	632	355	99	395	592	2,981
16	800	168	674	379	105	421	632	3,180
17	850	179	716	403	112	448	671	3,379
18	900	190	758	426	118	474	711	3,577
19	950	200	800	450	125	500	750	3,776
20	1,000	211	842	474	132	526	790	3,975
21	1,050	221	884	498	138	553	829	4,174
22	1,100	232	927	521	145	579	869	4,372
23	1,150	242	969	545	151	605	908	4,571
24	1,200	253	1,011	569	158	632	948	4,770
25	1,250	263	1,053	592	165	658	987	4,969

Priority Area #2 Annual Phosphorous Runoff Reduction

Year	Permanent Vegetation	Grassed Waterways	No-Till	Terraces	Nutrient Mgmt Plan	Buffers & Field Borders	Grade Stabilization Structures	Total
1	18	4	15	9	2	9	14	72
2	36	8	30	17	5	19	28	143
3	54	11	46	26	7	28	43	215
4	72	15	61	34	9	38	57	286
5	90	19	76	43	12	47	71	358
6	108	23	91	51	14	57	85	429
7	126	27	106	60	17	66	100	501
8	144	30	121	68	19	76	114	573
9	162	34	137	77	21	85	128	644
10	180	38	152	85	24	95	142	716
11	198	42	167	94	26	104	156	787
12	216	46	182	102	28	114	171	859
13	234	49	197	111	31	123	185	930
14	252	53	212	119	33	133	199	1,002
15	270	57	228	128	36	142	213	1,074
16	288	61	243	137	38	152	228	1,145
17	306	64	258	145	40	161	242	1,217
18	324	68	273	154	43	171	256	1,288
19	342	72	288	162	45	180	270	1,360
20	360	76	303	171	47	190	284	1,431
21	378	80	319	179	50	199	299	1,503
22	396	83	334	188	52	209	313	1,575
23	414	87	349	196	55	218	327	1,646
24	432	91	364	205	57	228	341	1,718
25	450	95	379	213	59	237	356	1,789

Priority Area #3 Annual Phosphorous Runoff Reduction

Year	Permanent Vegetation	Grassed Waterways	No-Till	Terraces	Nutrient Mgmt Plan	Buffers & Field Borders	Grade Stabilization Structures	Total
1	11	2	9	5	1	6	9	44
2	22	5	19	10	3	12	17	88
3	33	7	28	16	4	17	26	131
4	44	9	37	21	6	23	35	175
5	55	12	46	26	7	29	44	219
6	66	14	56	31	9	35	52	263
7	77	16	65	37	10	41	61	307
8	88	19	74	42	12	46	70	351
9	99	21	84	47	13	52	78	394
10	110	23	93	52	15	58	87	438
11	121	26	102	57	16	64	96	482
12	132	28	111	63	17	70	104	526
13	143	30	121	68	19	75	113	570
14	154	33	130	73	20	81	122	614
15	165	35	139	78	22	87	131	657
16	176	37	149	84	23	93	139	701
17	188	39	158	89	25	99	148	745
18	199	42	167	94	26	104	157	789
19	210	44	176	99	28	110	165	833
20	221	46	186	104	29	116	174	877
21	232	49	195	110	30	122	183	920
22	243	51	204	115	32	128	192	964
23	254	53	214	120	33	134	200	1,008
24	265	56	223	125	35	139	209	1,052
25	276	58	232	131	36	145	218	1,096

Priority Area #1 Annual Nitrogen Runoff Reduction

Year	Permanent Vegetation	Grassed Waterways	No-Till	Terraces	Nutrient Mgmt Plan	Buffers & Field Borders	Grade Stabilization Structures	Total
1	237	50	125	112	31	62	187	805
2	474	100	250	225	62	125	375	1,611
3	712	150	375	337	94	187	562	2,416
4	949	200	499	449	125	250	749	3,221
5	1,186	250	624	562	156	312	936	4,027
6	1,423	300	749	674	187	375	1,124	4,832
7	1,661	350	874	787	218	437	1,311	5,637
8	1,898	400	999	899	250	499	1,498	6,443
9	2,135	449	1,124	1,011	281	562	1,686	7,248
10	2,372	499	1,249	1,124	312	624	1,873	8,053
11	2,609	549	1,373	1,236	343	687	2,060	8,858
12	2,847	599	1,498	1,348	375	749	2,247	9,664
13	3,084	649	1,623	1,461	406	812	2,435	10,469
14	3,321	699	1,748	1,573	437	874	2,622	11,274
15	3,558	749	1,873	1,686	468	936	2,809	12,080
16	3,796	799	1,998	1,798	499	999	2,997	12,885
17	4,033	849	2,123	1,910	531	1,061	3,184	13,690
18	4,270	899	2,247	2,023	562	1,124	3,371	14,496
19	4,507	949	2,372	2,135	593	1,186	3,558	15,301
20	4,745	999	2,497	2,247	624	1,249	3,746	16,106
21	4,982	1,049	2,622	2,360	655	1,311	3,933	16,912
22	5,219	1,099	2,747	2,472	687	1,373	4,120	17,717
23	5,456	1,149	2,872	2,585	718	1,436	4,308	18,522
24	5,693	1,199	2,997	2,697	749	1,498	4,495	19,328
25	5,931	1,249	3,121	2,809	780	1,561	4,682	20,133

Priority Area #2 Annual Nitrogen Runoff Reduction

Year	Permanent Vegetation	Grassed Waterways	No-Till	Terraces	Nutrient Mgmt Plan	Buffers & Field Borders	Grade Stabilization Structures	Total
1	84	18	44	40	11	22	67	286
2	169	36	89	80	22	44	133	573
3	253	53	133	120	33	67	200	859
4	337	71	178	160	44	89	266	1,145
5	422	89	222	200	55	111	333	1,432
6	506	107	266	240	67	133	400	1,718
7	590	124	311	280	78	155	466	2,005
8	675	142	355	320	89	178	533	2,291
9	759	160	400	360	100	200	599	2,577
10	844	178	444	400	111	222	666	2,864
11	928	195	488	440	122	244	733	3,150
12	1,012	213	533	479	133	266	799	3,436
13	1,097	231	577	519	144	289	866	3,723
14	1,181	249	622	559	155	311	932	4,009
15	1,265	266	666	599	166	333	999	4,296
16	1,350	284	710	639	178	355	1,066	4,582
17	1,434	302	755	679	189	377	1,132	4,868
18	1,518	320	799	719	200	400	1,199	5,155
19	1,603	337	844	759	211	422	1,265	5,441
20	1,687	355	888	799	222	444	1,332	5,727
21	1,771	373	932	839	233	466	1,399	6,014
22	1,856	391	977	879	244	488	1,465	6,300
23	1,940	408	1,021	919	255	511	1,532	6,586
24	2,025	426	1,066	959	266	533	1,598	6,873
25	2,109	444	1,110	999	277	555	1,665	7,159

Priority Area #3 Annual Nitrogen Runoff Reduction

Year	Permanent Vegetation	Grassed Waterways	No-Till	Terraces	Nutrient Mgmt Plan	Buffers & Field Borders	Grade Stabilization Structures	Total
1	52	11	28	25	7	14	41	178
2	105	22	55	50	14	28	83	356
3	157	33	83	74	21	41	124	534
4	210	44	110	99	28	55	165	712
5	262	55	138	124	34	69	207	889
6	314	66	165	149	41	83	248	1,067
7	367	77	193	174	48	97	290	1,245
8	419	88	221	199	55	110	331	1,423
9	472	99	248	223	62	124	372	1,601
10	524	110	276	248	69	138	414	1,779
11	576	121	303	273	76	152	455	1,957
12	629	132	331	298	83	165	496	2,135
13	681	143	359	323	90	179	538	2,313
14	734	154	386	348	97	193	579	2,490
15	786	165	414	372	103	207	621	2,668
16	838	177	441	397	110	221	662	2,846
17	891	188	469	422	117	234	703	3,024
18	943	199	496	447	124	248	745	3,202
19	996	210	524	472	131	262	786	3,380
20	1,048	221	552	496	138	276	827	3,558
21	1,100	232	579	521	145	290	869	3,736
22	1,153	243	607	546	152	303	910	3,914
23	1,205	254	634	571	159	317	952	4,092
24	1,258	265	662	596	165	331	993	4,269
25	1,310	276	690	621	172	345	1,034	4,447

Priority Area #1 Total Annual Cost Before Cost-Share, Cropland BMPs

Year	Permanent Vegetation	Grassed Waterways	No-Till	Terraces	Nutrient Mgmt Plan	Buffers & Field Borders	Grade Stabilization Structures	Total
1	$3,172	$1,692	$3,285	$3,172	$600	$2,114	$7,929	$21,963
2	$3,267	$1,742	$3,384	$3,267	$618	$2,178	$8,167	$22,622
3	$3,365	$1,795	$3,485	$3,365	$636	$2,243	$8,412	$23,301
4	$3,466	$1,848	$3,590	$3,466	$655	$2,310	$8,664	$24,000
5	$3,570	$1,904	$3,698	$3,570	$675	$2,380	$8,924	$24,720
6	$3,677	$1,961	$3,809	$3,677	$695	$2,451	$9,192	$25,461
7	$3,787	$2,020	$3,923	$3,787	$716	$2,525	$9,468	$26,225
8	$3,901	$2,080	$4,041	$3,901	$737	$2,600	$9,752	$27,012
9	$4,018	$2,143	$4,162	$4,018	$759	$2,678	$10,044	$27,822
10	$4,138	$2,207	$4,287	$4,138	$782	$2,759	$10,346	$28,657
11	$4,262	$2,273	$4,415	$4,262	$806	$2,842	$10,656	$29,516
12	$4,390	$2,341	$4,548	$4,390	$830	$2,927	$10,976	$30,402
13	$4,522	$2,412	$4,684	$4,522	$855	$3,015	$11,305	$31,314
14	$4,658	$2,484	$4,825	$4,658	$880	$3,105	$11,644	$32,253
15	$4,797	$2,559	$4,969	$4,797	$907	$3,198	$11,993	$33,221
16	$4,941	$2,635	$5,118	$4,941	$934	$3,294	$12,353	$34,218
17	$5,089	$2,714	$5,272	$5,089	$962	$3,393	$12,724	$35,244
18	$5,242	$2,796	$5,430	$5,242	$991	$3,495	$13,105	$36,302
19	$5,399	$2,880	$5,593	$5,399	$1,021	$3,600	$13,499	$37,391
20	$5,561	$2,966	$5,761	$5,561	$1,051	$3,708	$13,904	$38,512
21	$5,728	$3,055	$5,934	$5,728	$1,083	$3,819	$14,321	$39,668
22	$5,900	$3,147	$6,112	$5,900	$1,115	$3,933	$14,750	$40,858
23	$6,077	$3,241	$6,295	$6,077	$1,149	$4,051	$15,193	$42,083
24	$6,259	$3,338	$6,484	$6,259	$1,183	$4,173	$15,649	$43,346
25	$6,447	$3,439	$6,678	$6,447	$1,219	$4,298	$16,118	$44,646

Priority Area #2 Total Annual Cost Before Cost-Share, Cropland BMPs								
Year	Permanent Vegetation	Grassed Waterways	No-Till	Terraces	Nutrient Mgmt Plan	Buffers & Field Borders	Grade Stabilization Structures	Total
1	$1,185	$632	$1,228	$1,185	$224	$790	$2,963	$8,206
2	$1,221	$651	$1,264	$1,221	$231	$814	$3,051	$8,452
3	$1,257	$670	$1,302	$1,257	$238	$838	$3,143	$8,706
4	$1,295	$691	$1,341	$1,295	$245	$863	$3,237	$8,967
5	$1,334	$711	$1,382	$1,334	$252	$889	$3,334	$9,236
6	$1,374	$733	$1,423	$1,374	$260	$916	$3,434	$9,513
7	$1,415	$755	$1,466	$1,415	$267	$943	$3,537	$9,798
8	$1,457	$777	$1,510	$1,457	$275	$972	$3,644	$10,092
9	$1,501	$801	$1,555	$1,501	$284	$1,001	$3,753	$10,395
10	$1,546	$825	$1,602	$1,546	$292	$1,031	$3,865	$10,707
11	$1,593	$849	$1,650	$1,593	$301	$1,062	$3,981	$11,028
12	$1,640	$875	$1,699	$1,640	$310	$1,094	$4,101	$11,359
13	$1,690	$901	$1,750	$1,690	$319	$1,126	$4,224	$11,700
14	$1,740	$928	$1,803	$1,740	$329	$1,160	$4,351	$12,051
15	$1,792	$956	$1,857	$1,792	$339	$1,195	$4,481	$12,412
16	$1,846	$985	$1,912	$1,846	$349	$1,231	$4,615	$12,785
17	$1,902	$1,014	$1,970	$1,902	$359	$1,268	$4,754	$13,168
18	$1,959	$1,045	$2,029	$1,959	$370	$1,306	$4,897	$13,563
19	$2,017	$1,076	$2,090	$2,017	$381	$1,345	$5,043	$13,970
20	$2,078	$1,108	$2,152	$2,078	$393	$1,385	$5,195	$14,389
21	$2,140	$1,141	$2,217	$2,140	$405	$1,427	$5,351	$14,821
22	$2,204	$1,176	$2,284	$2,204	$417	$1,470	$5,511	$15,266
23	$2,271	$1,211	$2,352	$2,271	$429	$1,514	$5,676	$15,724
24	$2,339	$1,247	$2,423	$2,339	$442	$1,559	$5,847	$16,195
25	$2,409	$1,285	$2,495	$2,409	$455	$1,606	$6,022	$16,681

Priority Area #3 Total Annual Cost Before Cost-Share, Cropland BMPs

Year	Permanent Vegetation	Grassed Waterways	No-Till	Terraces	Nutrient Mgmt Plan	Buffers & Field Borders	Grade Stabilization Structures	Total
1	$774	$413	$802	$774	$146	$516	$1,935	$5,360
2	$797	$425	$826	$797	$151	$531	$1,993	$5,521
3	$821	$438	$851	$821	$155	$547	$2,053	$5,686
4	$846	$451	$876	$846	$160	$564	$2,114	$5,857
5	$871	$465	$902	$871	$165	$581	$2,178	$6,033
6	$897	$479	$929	$897	$170	$598	$2,243	$6,214
7	$924	$493	$957	$924	$175	$616	$2,310	$6,400
8	$952	$508	$986	$952	$180	$635	$2,380	$6,592
9	$980	$523	$1,016	$980	$185	$654	$2,451	$6,790
10	$1,010	$539	$1,046	$1,010	$191	$673	$2,525	$6,993
11	$1,040	$555	$1,077	$1,040	$197	$693	$2,600	$7,203
12	$1,071	$571	$1,110	$1,071	$203	$714	$2,678	$7,419
13	$1,104	$589	$1,143	$1,104	$209	$736	$2,759	$7,642
14	$1,137	$606	$1,177	$1,137	$215	$758	$2,842	$7,871
15	$1,171	$624	$1,213	$1,171	$221	$780	$2,927	$8,107
16	$1,206	$643	$1,249	$1,206	$228	$804	$3,015	$8,351
17	$1,242	$662	$1,287	$1,242	$235	$828	$3,105	$8,601
18	$1,279	$682	$1,325	$1,279	$242	$853	$3,198	$8,859
19	$1,318	$703	$1,365	$1,318	$249	$878	$3,294	$9,125
20	$1,357	$724	$1,406	$1,357	$257	$905	$3,393	$9,399
21	$1,398	$746	$1,448	$1,398	$264	$932	$3,495	$9,681
22	$1,440	$768	$1,492	$1,440	$272	$960	$3,600	$9,971
23	$1,483	$791	$1,536	$1,483	$280	$989	$3,708	$10,270
24	$1,528	$815	$1,582	$1,528	$289	$1,018	$3,819	$10,578
25	$1,573	$839	$1,630	$1,573	$297	$1,049	$3,933	$10,896

Priority Area #1 Total Annual Cost After Cost-Share, Cropland BMPs

Year	Permanent Vegetation	Grassed Waterways	No-Till	Terraces	Nutrient Mgmt Plan	Buffers & Field Borders	Grade Stabilization Structures	Total
1	$1,586	$846	$2,004	$1,586	$450	$211	$3,965	$10,647
2	$1,633	$871	$2,064	$1,633	$463	$218	$4,083	$10,966
3	$1,682	$897	$2,126	$1,682	$477	$224	$4,206	$11,295
4	$1,733	$924	$2,190	$1,733	$491	$231	$4,332	$11,634
5	$1,785	$952	$2,256	$1,785	$506	$238	$4,462	$11,983
6	$1,838	$980	$2,323	$1,838	$521	$245	$4,596	$12,343
7	$1,894	$1,010	$2,393	$1,894	$537	$252	$4,734	$12,713
8	$1,950	$1,040	$2,465	$1,950	$553	$260	$4,876	$13,094
9	$2,009	$1,071	$2,539	$2,009	$570	$268	$5,022	$13,487
10	$2,069	$1,104	$2,615	$2,069	$587	$276	$5,173	$13,892
11	$2,131	$1,137	$2,693	$2,131	$604	$284	$5,328	$14,309
12	$2,195	$1,171	$2,774	$2,195	$622	$293	$5,488	$14,738
13	$2,261	$1,206	$2,857	$2,261	$641	$301	$5,652	$15,180
14	$2,329	$1,242	$2,943	$2,329	$660	$311	$5,822	$15,636
15	$2,399	$1,279	$3,031	$2,399	$680	$320	$5,997	$16,105
16	$2,471	$1,318	$3,122	$2,471	$701	$329	$6,177	$16,588
17	$2,545	$1,357	$3,216	$2,545	$722	$339	$6,362	$17,085
18	$2,621	$1,398	$3,312	$2,621	$743	$349	$6,553	$17,598
19	$2,700	$1,440	$3,412	$2,700	$766	$360	$6,749	$18,126
20	$2,781	$1,483	$3,514	$2,781	$788	$371	$6,952	$18,670
21	$2,864	$1,528	$3,620	$2,864	$812	$382	$7,160	$19,230
22	$2,950	$1,573	$3,728	$2,950	$836	$393	$7,375	$19,807
23	$3,039	$1,621	$3,840	$3,039	$862	$405	$7,596	$20,401
24	$3,130	$1,669	$3,955	$3,130	$887	$417	$7,824	$21,013
25	$3,224	$1,719	$4,074	$3,224	$914	$430	$8,059	$21,643

Priority Area #2 Total Annual Cost After Cost-Share, Cropland BMPs

Year	Permanent Vegetation	Grassed Waterways	No-Till	Terraces	Nutrient Mgmt Plan	Buffers & Field Borders	Grade Stabilization Structures	Total
1	$593	$316	$749	$593	$168	$79	$1,481	$3,978
2	$610	$325	$771	$610	$173	$81	$1,526	$4,097
3	$629	$335	$794	$629	$178	$84	$1,571	$4,220
4	$647	$345	$818	$647	$184	$86	$1,619	$4,347
5	$667	$356	$843	$667	$189	$89	$1,667	$4,477
6	$687	$366	$868	$687	$195	$92	$1,717	$4,612
7	$707	$377	$894	$707	$201	$94	$1,769	$4,750
8	$729	$389	$921	$729	$207	$97	$1,822	$4,892
9	$751	$400	$949	$751	$213	$100	$1,876	$5,039
10	$773	$412	$977	$773	$219	$103	$1,933	$5,190
11	$796	$425	$1,006	$796	$226	$106	$1,991	$5,346
12	$820	$437	$1,036	$820	$233	$109	$2,050	$5,507
13	$845	$451	$1,068	$845	$240	$113	$2,112	$5,672
14	$870	$464	$1,100	$870	$247	$116	$2,175	$5,842
15	$896	$478	$1,133	$896	$254	$119	$2,241	$6,017
16	$923	$492	$1,167	$923	$262	$123	$2,308	$6,198
17	$951	$507	$1,202	$951	$270	$127	$2,377	$6,384
18	$979	$522	$1,238	$979	$278	$131	$2,448	$6,575
19	$1,009	$538	$1,275	$1,009	$286	$134	$2,522	$6,772
20	$1,039	$554	$1,313	$1,039	$295	$139	$2,597	$6,975
21	$1,070	$571	$1,352	$1,070	$303	$143	$2,675	$7,185
22	$1,102	$588	$1,393	$1,102	$313	$147	$2,756	$7,400
23	$1,135	$605	$1,435	$1,135	$322	$151	$2,838	$7,622
24	$1,169	$624	$1,478	$1,169	$332	$156	$2,923	$7,851
25	$1,204	$642	$1,522	$1,204	$342	$161	$3,011	$8,087

Priority Area #3 Total Annual Cost After Cost-Share, Cropland BMPs

Year	Permanent Vegetation	Grassed Waterways	No-Till	Terraces	Nutrient Mgmt Plan	Buffers & Field Borders	Grade Stabilization Structures	Total
1	$387	$206	$489	$387	$110	$52	$968	$2,598
2	$399	$213	$504	$399	$113	$53	$997	$2,676
3	$411	$219	$519	$411	$116	$55	$1,026	$2,757
4	$423	$226	$534	$423	$120	$56	$1,057	$2,839
5	$436	$232	$550	$436	$124	$58	$1,089	$2,924
6	$449	$239	$567	$449	$127	$60	$1,122	$3,012
7	$462	$246	$584	$462	$131	$62	$1,155	$3,103
8	$476	$254	$601	$476	$135	$63	$1,190	$3,196
9	$490	$261	$620	$490	$139	$65	$1,226	$3,291
10	$505	$269	$638	$505	$143	$67	$1,262	$3,390
11	$520	$277	$657	$520	$147	$69	$1,300	$3,492
12	$536	$286	$677	$536	$152	$71	$1,339	$3,597
13	$552	$294	$697	$552	$156	$74	$1,379	$3,705
14	$568	$303	$718	$568	$161	$76	$1,421	$3,816
15	$585	$312	$740	$585	$166	$78	$1,463	$3,930
16	$603	$322	$762	$603	$171	$80	$1,507	$4,048
17	$621	$331	$785	$621	$176	$83	$1,553	$4,170
18	$640	$341	$808	$640	$181	$85	$1,599	$4,295
19	$659	$351	$833	$659	$187	$88	$1,647	$4,423
20	$679	$362	$858	$679	$192	$90	$1,697	$4,556
21	$699	$373	$883	$699	$198	$93	$1,747	$4,693
22	$720	$384	$910	$720	$204	$96	$1,800	$4,834
23	$742	$395	$937	$742	$210	$99	$1,854	$4,979
24	$764	$407	$965	$764	$217	$102	$1,909	$5,128
25	$787	$420	$994	$787	$223	$105	$1,967	$5,282