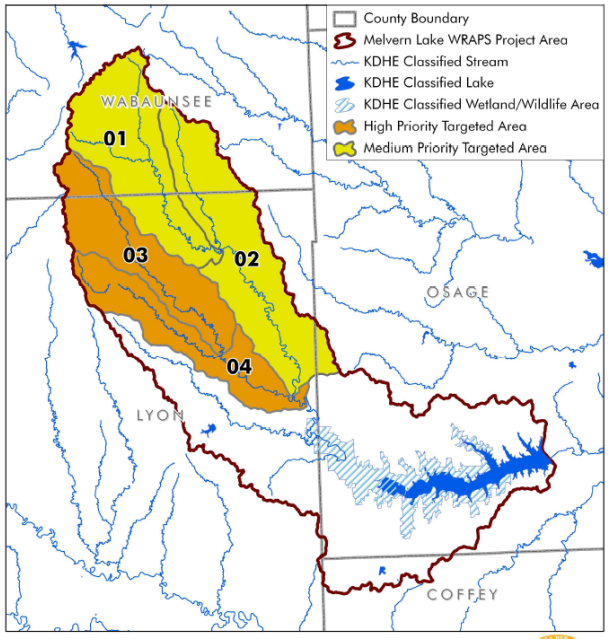
Melvern Watershed – 9 Element Watershed Plan Summary

Impairments to be addressed:

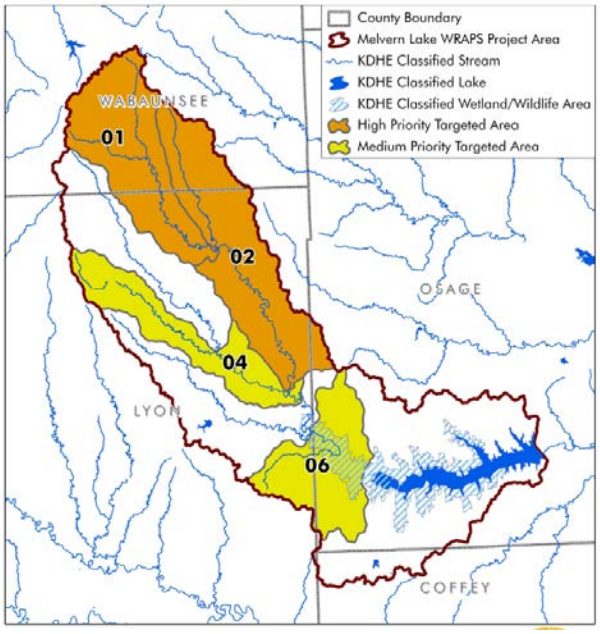
One Hundred Forty Two Mile/ Upper Marais des Cygnes River (Bacteria, DO)

Prioritized Critical Areas for Targeting BMPs

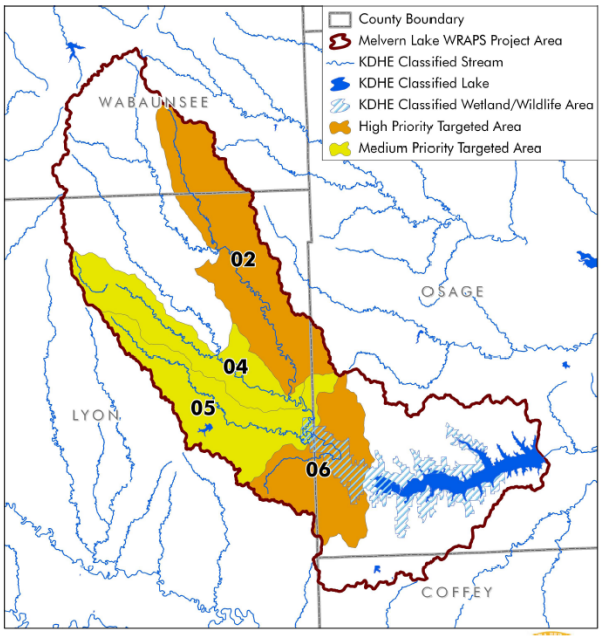
Rangeland/Livestock Targeted areas



Streambank Targeted areas



Cropland Targeted areas



Targeting considerations:

- Livestock and rangeland targeted areas were chosen by identifying the impaired water for bacteria and dissolved oxygen on One Hundred Forty Two Mile Creek.
- Cropland targeted areas were chosen by identifying where the largest amount of cropland is located within each HUC 12. Landowner and agency knowledge was also taken into consideration.
- Streambank targeted areas were determined through a riparian and stream channel assessment conducted by the Kansas Water Office. This assessment identified “hot spots” within the Melvern watershed.

Melvern Watershed – 9 Element Watershed Plan Summary

Best Management Practices and Load Reduction Goals

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

Cropland BMPs

- Grasses Waterways
- No-till cultivation practice
- Vegetative Buffers
- Terraces
- Sediment Basins
- Establish permanent vegetation

Livestock/ BMPs

- Vegetative filter strips
- Relocate feeding sites
- Relocate pasture feeding sites
- Off strem watering sites
- Fence out Streama
- Rotational grazing
- Grazing Management Plans
- Diversion/Terrace

Rangeland BMPs

- Gully repaire

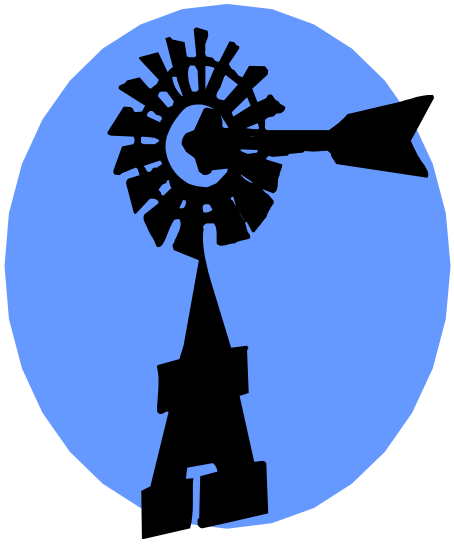
Sediment Reduction:

Required load reduction for the High Priority TMDL for One Hundred Forty Two Mile Creek is a total of 1,360 tons of sediment.

Phosphorus Reducation:

Required load reduction for the High Prioity TMDL for One Hundred Forty Two Mile Creek is a total of 6,464 lbs. Phosphorous.

Melvern Lake



WATERSHED RESTORATION AND PROTECTION PLAN

2012 - 2016

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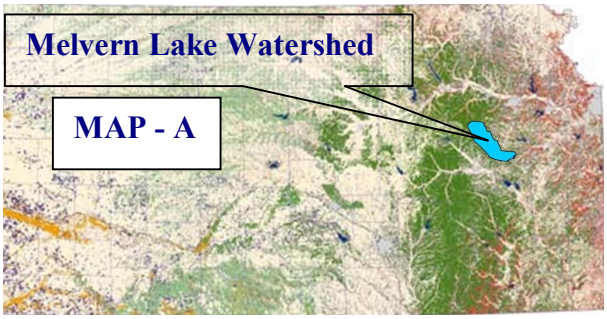
TABLE OF CONTENTS

I. LIST OF MAPS

PAGE #

I. INTRODUCTION

Throughout the 18th century and early 19th century the early European Explorers were visiting what is now Kansas. Among the early explorers were the French who followed the rivers from the Mississippi up into their respective headwaters. One of these rivers was what is known today in Kansas as the Marais des Cygnes. The English translation for this river is the Marsh of Swans. Undoubtedly the early explorers came across abundant marsh lands.



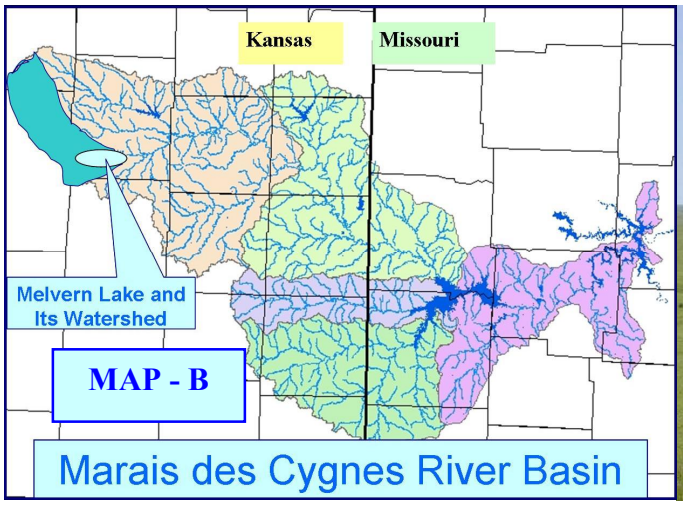
Melvern Lake is located in the headwaters of this river basin (MAP-B), and though the large expanses of marsh lands were in the lower reaches of the basin, remnants of marshy areas can still be found in the headwaters. The Lake watershedôs upper reaches are in the Tallgrass Prairie region of the Kansas Flint Hills Region (MAP-A). Much of this region has never been plowed and is rich in native prairie diversity. One would expect the streams in this region to be pristine, but water quality issues are apparent as will be described in more detail in the TMDL section. Livestock production, stream channelization, and the mining of gravel are three factors which have led to stream degradation. Good productive stream reaches and wet spring fed meadows or ñmarshesò can still be found. As these areas are located, it provides an opportunity study them and learn how other degraded areas can be brought back to a healthy functioning condition. In addition, as the upper reaches are healed, Melvern Lake will reap the benefits. That is the aim of this project, to have Melvern Lake be one of the healthiest lakes in Kansas. Following is a detailed description of the current health of the watershed and a plan of how to bring this dream to reality.

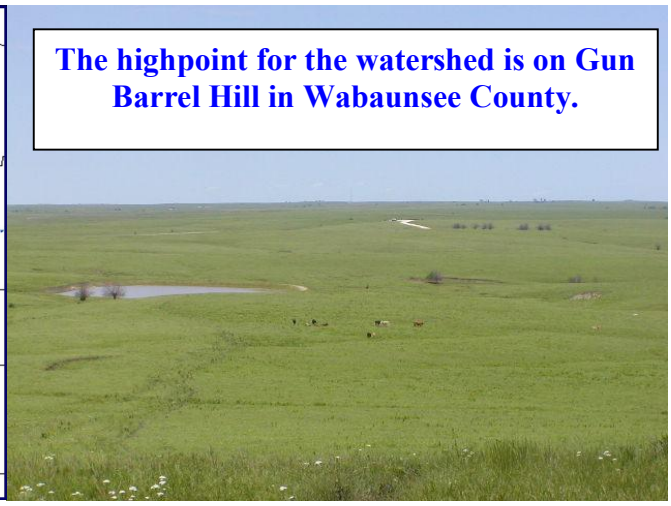
This wet meadow is in the upper reaches of the Melvern Lake/upper Marais des Cygnes watershed.

"We shall never achieve harmony with land, any more than we shall achieve absolute justice or liberty for people. In these higher aspirations the important thing is not to achieve, but to strive."
Aldo Leopold

II. MELVERN LAKE WATERSHED PROFILE

Melvern Lake is a U.S. Corps of Engineers multi-purpose Reservoir on the Upper Marais des Cygnes River. Its Hydrologic Unit Code (HUC) is 1029010101. The lakeôs watershed is the headwaterôs for the Marias des Cygnes River Basin. The highpoint for the watershed is on Gun Barrel Hill in Wabaunsee County with an elevation of 1600 feet. The elevation drops to 1050 feet at the conservation pool level of Melvern Lake; thus it drops 450 feet in elevation over approximately 25 miles. Total drainage area for the Lake is 349 square miles and encompasses portions of four counties Coffey 4% Lyon 46%, Osage34%, and Wabaunsee 16%). (Map G, Page 9)

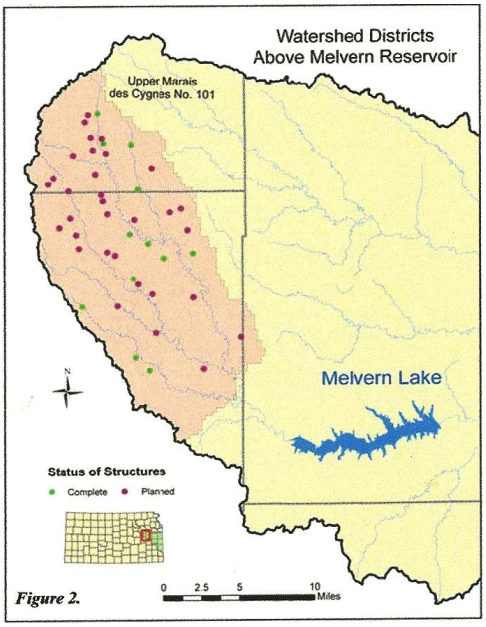




The lake is used primarily for flood control, recreation and public water supply. Congress authorized the Lake in 1954 as a multipurpose project for flood control and water resource development. Construction began in 1968 and was completed in 1973. The Lake itself has 6,930 surface acres of water at 1036 feet of elevation (multipurpose pool). Total acres in the project consist of 29,362 acres, which is managed by the Corps of Engineers and the Kansas Department of Wildlife and Parks (KDWP).

Flood Control - The Lakeôs primary function is flood control. The lake has 7020 acres of surface storage capacity above the conservation pool of the lake at 1057 feet of elevation. At this elevation, the Lake has the capacity to hold 147,420 acre-ft of water for flood control. The record high elevation in the Lake was is 1053 ft and the record low is 1029 ft. The Lake has been directly responsible for $147.5 million in flood damage savings since construction.

There is one watershed district above Melvern Reservoir, Upper Marais des Cygnes No. 101. Twelve structures have been built starting in the early 1980s, with the last structure built in 2005. A total of 44 watershed structures were originally planned for Upper Marais des Cygnes Watershed District No. 101 above the reservoir. If all of the planned structures were built, 18% of the drainage area for Melvern Reservoir would be regulated by impoundments.



MAP - C – Watershed Districts

Public Water Supply - In 1994 the State of Kansas, through the Kansas Water Office, contracted with the U.S. Army Corps of Engineers for water supply storage under the 1958 Federal Water Supply Act. This contract allocates 50,000 acre-ft of the pool storage between the elevations of 975 and 1,036 feet for a public water supply. This is 34.5 percent of the conservation pool volume and is figured after sedimentation through the lake's design life of 100 years. (One acre-ft contains approximately 325,900 gallons of water.)

The Kansas Water Office contracts with public water suppliers and industries for water supply and water assurance from storage in Melvern Lake. Public water suppliers served by state-owned storage space in the Lake include: the City of Osage City, City of Burlingame, Public Wholesale Water Supply District Number 12, and members of the Marias des Cygnes River Water Assurance District Number 2.

Secondary beneficiaries from the City of Osage City include Osage County RWD #6, Osage County RWD #7, the Corps of Engineers, and Eisenhower State Park, and the town of Reading. Public Wholesale Water Supply #12 serves Lebo, Waverly, Williamsburg, Quenemo, Pomona, Melvern, Coffey County RWD #3, Anderson County RWD #4, and Osage RWD #4. Marias des Cygnes River Water Assurance District #2 include Melvern, Ottawa, Franklin County #6, Osawatomie, LaCygne and Kansas City Power and Light Generating Station.

The total estimated population served by withdrawals or releases from Melvern Lake is more than 50,000. (Map D) in the appendices shows all of the public water supply sources in the basin. The current uncommitted water supply remaining available in the Lake is estimated to be 1.259 million gallons per year.

Recreation ï The Lake is used widely for various types of boating, water skiing, and swimming. It also boasts an excellent reputation for its high quality fishing, hunting, and camping activities. The Corps of Engineers operates five recreation areas with two swimming beaches, four boat ramps, 335 campsites, and seven shower buildings. Other attractions include five walking trails, several day use and picnic areas and 100 miles of undeveloped scenic shoreline. These recreation activities enhance the local economy especially during the summer months. In 2000, the Corps collected $189, 647 in recreational fees and recorded 549,579 visitor days. The Kansas Department of Wildlife and Parks manages approximately 10,000 acres for public hunting of quail, geese, ducks, turkeys, dove, rabbits and deer.

Hydrology - Precipitation in the watershed averages 35 inches per year. Average annual runoff ranges from 7 inches annually in the northeast to 8 inches in the southeast. The 24-hour 10-year return storm is about 5.2 inches. The U.S. Geological Survey maintains a stream gauge north of Reading on the Marais des Cygne River (Map E), page 6. Records date back to 1969. Half of this rainfall occurs from May to August, the summer crop growing season. However, it is during springtime thunderstorms, when crops arenôt protecting the ground, that the pesticide atrazine and animal-borne fecal coli form bacteria have been found in Melvern Lake

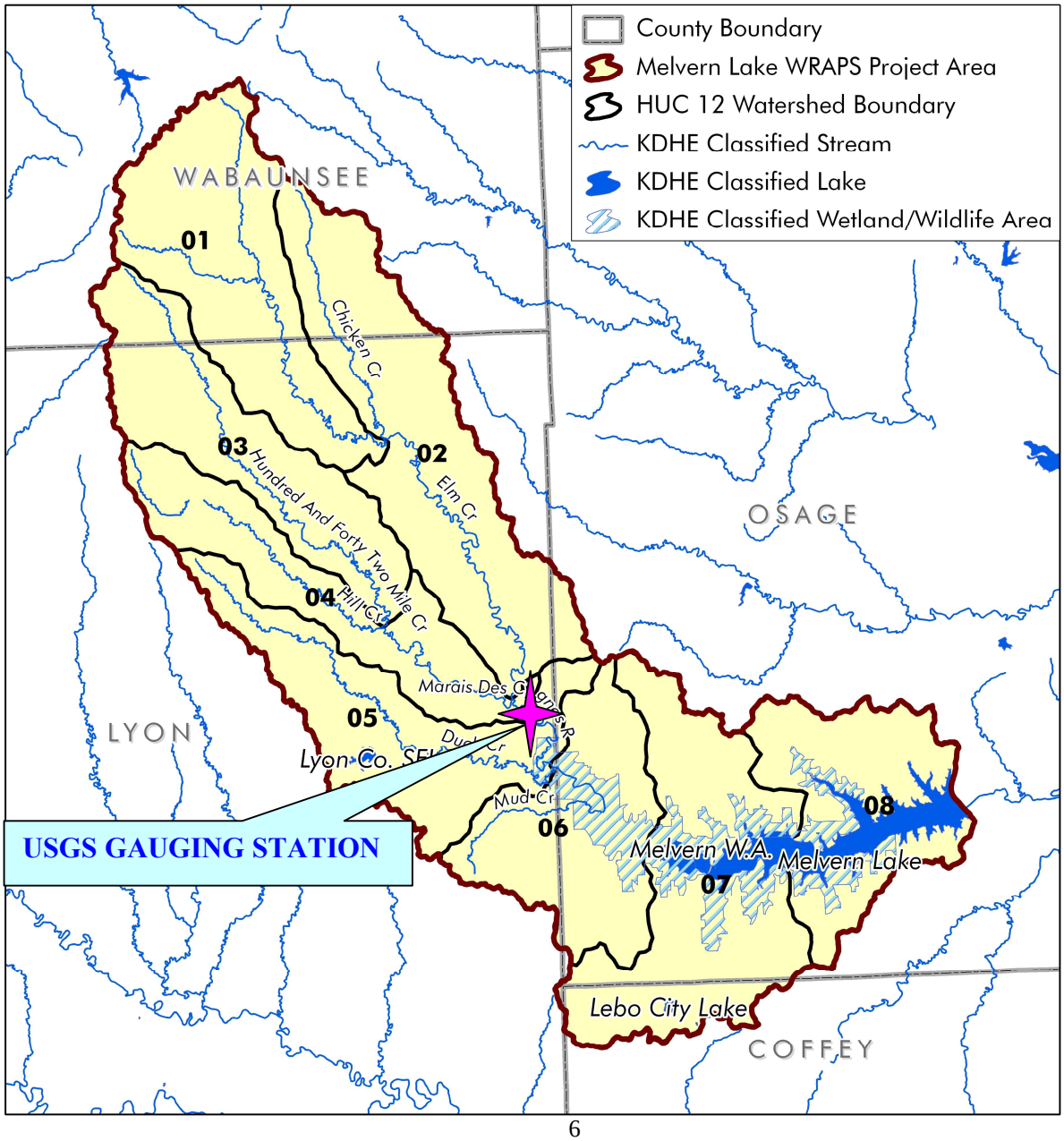
Records are also available on a number of alluvial wells in the watershed. There are three major tributaries, which feed the Lake, Elm Creek, 142-Mile Creek, and Duck Creek, which comprise 30%, 19%, and 10% of the total drainage area. The watershed elevation drops from 1600 feet elevation at the top of the basin to the conservation pool elevation of 1036. There are a number of good springs spread out throughout the watershed, particularly in the upper reaches of the watershed.

Table 1: - Sub-Watersheds and Associated Stream-flows

Stream Segment	Drainage Area	Mean Flow	% of MdC Q @ Lake
Upper Elm Creek	42 sq mi	27 cfs	20.15%
Chicken Creek	22 sq mi	15 cfs	11.19%
Lower Elm Creek	94 sq mi	61 cfs	45.52% (net 14.18%)
Upper 142 Mi Creek	37 sq mi	22 cfs	16.42%
Hill Creek	21 sq mi	13 cfs	9.70%
Lower 142 Mi Creek	69 sq mi	42 cfs	31.34% (net 5.22%)
Upper MdC River	170 sq mi	113 cfs	84.33% (net 7.46%)
Duck Creek	36 sq mi	21 cfs	15.67%
Lower MdC River @ Lake	212 sq mi	134 cfs	100.0%

Elm Creek tends to contribute more flow than 142 Mile Creek because of its greater drainage area; the single greatest contributor is the Upper Elm.

MAP E - Classified Waters and USGS Gauging Station Location.



Designated Uses and Special Aquatic Life Use - Surface waters in this watershed are generally used for aquatic life support (fish), human health purposes, domestic water supply, recreation (fishing, boating, and swimming), groundwater recharge, industrial water supply, irrigation or livestock watering. Surface waters are given certain ñdesignated usesò based on what the waters will be used for as stated in the Kansas Surface Water Register, 2009, issued by KDHE. For example, waters that will come into contact with human skin should be of higher quality than waters used for watering livestock. Therefore, each ñdesignated useò category has a different water quality standard associated with it. When water does not meet its ñdesignated useò water quality standard then that water is considered impaired.

Fishing and boating are two of the designated uses for Melvern Lake.

Based on the Clean Water Act, a water-body that does not meet water quality standards is considered ñimpairedò. The Clean Water Act requires states to develop a plan for restoration and that plan is called a Total Maximum Daily Load (TMDL). A TMDL designation sets the maximum amount of pollutant that a specific body of water can receive without violating the surface water-quality standards, resulting in failure to support their designated uses.

Table 2: - Designated Uses and Special Aquatic Life Use Definitions

ABBREVIATION	EXPLANATION
GP =	General purpose waters
AL =	Designated for aquatic life use
E =	expected aquatic use water
S =	Special aquatic use water
CR =	Designated for contact recreational use
A =	Primary contact recreation open to public (i.e., swimming)
B =	Primary contact recreation by permission only (i.e., swimming)
a =	Secondary contact recreation (i.e. fishing wading) by permission only
b =	Secondary contact recreation (i.e. fishing wading) Not open to public
C =	Primary contact recreation NOT open to public
DS =	designated for domestic water supply use
FP =	designated for food procurement use
GR =	designated for groundwater recharge
IW =	designated for industrial water supply use
IR =	designated for irrigation use
LW =	designated for livestock watering use
X =	stream reach assigned/meets the designated use
O =	stream reach does NOT support the designated or assigned use.

Table 3: - Designated Uses and Special Aquatic Life Use For Melvern Lake Watershed.

STREAMS	CLASS	AL	CR	DS	FP	GR	IW	IR	LW
Chicken Creek	GP	E	b	X	O	X	X	X	X
Duck Creek	GP	E	b	X	O	X	X	X	X
Elm Creek	GP	S	b	X	X	X	X	X	X
Hill Creek	GP	E	b	X	O	X	X	X	X
142-Mile Creek	GP	E	C	X	O	X	X	X	X
Locust Creek	GP	S	C	X	O	X	X	X	X
Marais Des Cygnes	GP	S	C	X	X	X	X	X	X
LAKES	**CLASS**	**AL**	**CR**	**DS**	**FP**	**GR**	**IW**	**IR**	**LW**
Lebo City Lake	GP	E	A	X	X	O	X	X	X
Lyon Co. Lake	GP	E	B	X	X	O	X	X	X
Melvern Lake	GP	E	A	X	X	X	X	X	X

Special Aquatic Life Use Waters Threatened or Endangered Species - Special aquatic life use waters are defined as ñsurface waters that contain combinations of habitat types and indigenous biota not found commonly in the state, or surface waters that contain representative populations of threatened or endangered speciesò. The Melvern Lake Watershed has a special aquatic life use designation for the Hornyhead Chub (Nocomis biguttatus). This habitat occurs in the Upper Elm/Locust Creek HUC-12 sub-watershed (102901010101) (Map-M) page 20.

The Horn head Chub is one of Kansasô largest native minnows, attaining a length of 6-8 inches. This fish is quite similar to the more common creek chub. The Hornyhead Chub formerly occurred in small to medium sized, moderate to low gradient, clear gravelly streams throughout most of the Kansas River and Marais des Cygnes River basins. It prefers pools and slow to moderate runs and is often associated with aquatic plants. The Chub requires gravel areas free of silt for spawning, and spawns from late April through early July.

The special aquatic life use waters are located in an area that is primarily surrounded by grassland however, cropland lies adjacent to the streams. Pollutants that might threaten the health of these waters would be from sediment from cropland or from ephemeral gullies or streambanks. Livestock in riparian areas could also be detrimental to the Chub as well as excessive gravel harvesting.

Soils - The majority of the watershed is covered by deep upland soils and nearly level to moderate slopes. The lowland terraces and floodplains have deep soils with nearly level slopes. The soils in the watershed vary between being well to poorly drained depending on specific site characteristics. Some of the soils in the lower basin are considered ñprime farmlandò soils in areas with level slopes. In general the soils are subject to water erosion if used for cultivation due to moderate slopes of the area, moderate to slow permeability, and the potential intensity of thunderstorms. Most of the K values (susceptibility to sheet and rill erosion) range from low (.05) to High (.69). Soil loss values (T) range from 3 to 5 tons of soil loss per year.

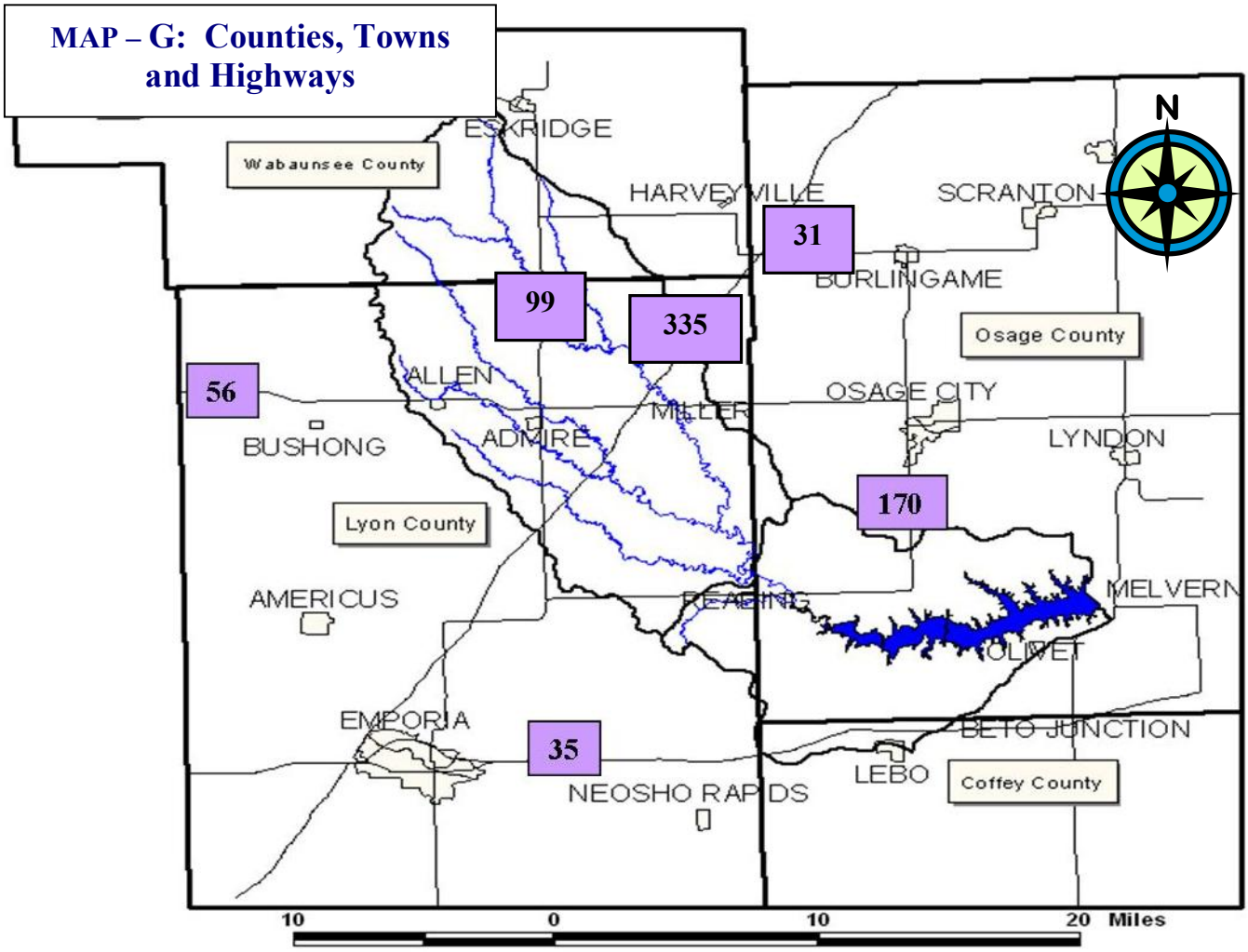
Geology - The watershed is underlain by Pennsylvania System limestone and shale. The eastern portion of the watershed is older around the lake itself and becomes progressively younger to the north and west. Alluvial aquifers are associated with the major streams in the watershed. In addition, there are numerous springs in the upper limestone areas.

Land Use - A majority of the watershed, approximately 80 %, is in grassland used primarily for grazing purposes. The remaining 20% is in cropland or urban land uses. (Map F) shows the land use dispersal in the basin. As a result of the high percentage of grassland in the watershed, sedimentation in the Lake is lower than most lakes in Kansas. However, due to the cropland and streambank erosion, sedimentation into the Lake is still a concern.

Communities - The watershed is very rural with an estimated population of less than 2,000 people. There are six incorporated small towns/communities located within the watershed (Map G) page 9.. They are: Admire, Allen, Lebo, Miller, Olivet, and Reading. It has been estimated that the cattle out number humans 15 to 1. There are four wastewater treatment facilities in the watershed. (Map I) shows all of the sites in the basin, which require a National Pollution Discharge Elimination System (NPDES).. The smaller communities use individual household waste treatment and are a concern as possible sources of pollution as are the rural residential houses. The Lyon County Sanitarian estimates one in ten rural household septic systems fail to meet county specs. A former landfill is located near Reading and is monitored by Kansas Department of Health and Environment (KDHE).

Transportation/Industry - There are five state highways (56, 31, 170, 99, and I-35), the Kansas Turnpike, and two Burlington Northern/Santa Fe rail lines which pass trough the watershed (Map G). Agriculture is the major industry in the watershed. Seventeen confined livestock facilities requiring KDHE permits are located in the basin. The locations of the confined livestock facilities in the watershed are shown in (Map J) appendices. There is a gas line, which also passes through the watershed.

MAP – G: Counties, Towns and Highways



III - PROJECT DEVELOPMENT BACKGROUND

PHASE I - In 1996 a public hearing was held concerning the approval of a confined livestock wastewater treatment permit for a site located less then one mile from the south shore of the Lake. Approximately 110 citizens attended the hearing. In response to the publicsô concern, KDHE developed informational material on the current potential pollution in the watershed. This material was distributed to the citizens and agencies of the area. In July of 1996 another public meeting was held in Lebo to discuss the future of the Lake, and how various interests of the region might work together for mutual benefit in protecting the Lake. Sixty citizens whom attended this meeting expressed their interest in organizing to develop a protection plan for the entire Melvern Lake Watershed.

In response, KDHE (Nonpoint Source Section) allocated funds to hire Kansas State University Department of Ag. Engineering to do a study of the lake. KSU developed an integrated model that assessed the water quality of the Lake and was able to predict future trends in the water quality with changes in the management of the watershed. This became Phase I of the Melvern Reservoir Water Quality Project.

Phase - I Conclusions - The results of the Phase I study concluded that the water quality in Melvern Lake is among the best for Kansas Reservoirs. Conclusions of the study are listed below.

1. There were no ***dominant*** sources of pollution identified.
2. No one area of the watershed can be singled out as prime contributor, and no one area should be targeted for education or financial assistance toward adoption of water quality improvement measures.
3. The lake is eutrophic (nutrient rich) though levels of sediment, phosphorus, and nitrogen loadings are considered to be fairly low. A maintenance plan would keep average loadings of soil and nutrients no greater than current levels.
4. The water quality of the Lake can become better or worse depending upon future watershed management. Commonly used Best Management Practices (BMPs) for small feedlots, cropland, and grassland are recommended, and their use would have an important impact for the future.
5. Several publications summarizing the Phase I study were published and distributed to the public and are still available upon request.

PHASE II – A public meeting was held on May 5, 1999 in the Reading Gymnasium hosted by the Flint Hills and Lake Region Resource Conservation and Development (RC&D) Councils, and the four county conservation districts in the watershed (Osage, Lyon, Coffey, and Wabaunsee). The purpose of this meeting was to present the results of Phase I, and to facilitate discussion on ways to protect long-term water quality of in Melvern Lake. As a result of this meeting, a steering committee was formed and other meetings followed.

Flint Hills RC&D Council became the lead organization. Information from the four countiesô Non-point Source Pollution Control Management Plans was used to develop a grant proposal. This proposal was submitted to KDHE Nonpoint Source Section for an EPA 319 water quality grant to implement Phase II of the Melvern Lake Water Quality Project. The purpose of Phase II is to implement Best Management Practices (BMPs) throughout the watershed with an aggressive information and education campaign to address all potential pollution sources. Funding was approved for the project in July of 2000. A full time coordinator was hired in January of 2001. In 2002 a Quality Protection Plan was written for the watershed. Portions of this original plan are included in this 9-Element Plan.

IV – WATER QUALITY IN THE WATERSHED

To understand the sources of Melvern Lakeôs water and pollutants, it must be understood how the land and its watershed is used. Land from four counties drains into Melvern Lake. Livestock outnumber people by about 20 to 1, and a rural lifestyle is still enjoyed by the 1,500 people within Melvern Lakeôs watershed. Unlike other nearby areas, the watershed has not seen much development, even though the Kansas Turnpike makes it accessible for commuters from Topeka, Kansas City, and Wichita (each within a 90 minute drive). The area remains largely grazing land because of shallow soils and moderately steep topography, particularly the northern portion of the watershed in the scenic and rolling Flint Hills. The flood plains closer to Melvern Lake and bottomlands throughout the basin support crop production.

Due to the fact the watershed is predominantly grassland; the lakeôs water quality is relatively good when compared to other Kansas lakes. It does meet the criteria for being eutrophic (nutrient rich) due to the moderate loading of sediment and nutrients into the lake. The Corps of Engineers annually monitors water quality of the lake on a monthly basis between April and September. The Corps samples the water at five locations during this period. These locations are: the inflow of the Marias des Cygne River into the lake; forebay; midlake; uptake; and the outflow back into the Marias des Cygne. The parameters most responsible for the lake's water quality will continue to be turbidity, suspended solids, metals, and nutrients. However, the greatest potential threat to water quality is pesticide loading derived from agricultural run-off from row crops within the watershed. The concentrations in many periods exceed the EPA maximum contaminant level (MCL) of 3 ug/L, which is the maximum permissible level of a contaminant in public drinking water supplies. Past monitoring has shown that the pesticide levels pose a continuing threat to the drinking water supplies for the project, recreation areas, and rural water districts, since present water treatment is inadequate to significantly reduce these pollutants in the finished water unless costly activated carbon filtration is performed.

The water quality of the Upper Marais des Cygne River and its tributaries, which feed Melvern Lake, are also a concern. The 1999 Kansas Unified Watershed Assessment classified the Upper Marais des Cygne River, Chicken Creek, Hill Creek, and 142-mile Creek as Category I streams. A Category I classification means the watershed is in need of restoration due to having water quality impairments or degradation of other natural resources related to an aquatic habitat, ecosystem health and other factors related to aquatic life resources. The primary pollutant concerns within these streams are fecal coli form bacteria (FCB) and dissolved oxygen (DO). ***As a result, the Melvern Lake Watershed has been targeted for the funding of best management practices (BMPs) throughout the watershed.*** KDHE has written Total Maximum Daily Load (TMDL) allowances for pollutants in the Melvern Watershed (Map K) appendices. These TMDL areas were used as a target for the project. Chicken Creek and Elm Creek were taken off the list in 2000 because data was not available due to a change in watershed delineation and an error in sampling location.

Melvern Lake Water Quality Assessment Summary

The following summary provides an overview of the results and recommendations that were produced by the watershed modeling and assessment process.

Pollutant sources. The water quality in Melvern Lake is among the best for Kansas reservoirs. This results from several factors: a) low-intensity land usage in the watershed ï grassland predominates (80%), and the remainder is mostly cropland (20%); b) low population density ï only about 1,500 people; and c) low-intensity livestock production ï about 30,000 cattle

scattered across hundreds of sites. There were no identifiable, dominant sources of pollution in the Melvern watershed.

Sub-watershed assessment: The results of this project showed that sediment, phosphorus and nitrogen loadings were fairly low throughout the watershed. Because deposition and transformations in buffer areas, streams, wetlands and ponds reduce the impact of distant portions of a watershed on Melvern Lake, sub-watersheds near the lake have a larger net effect on per-acre loading. This may increase the importance to the lake of areas such as the 3,800 acres of cropland managed by the Corps of Engineers. However, the higher delivery efficiency of zones nearer to the lake was offset by lower edge-of-field contributions. Thus, from a watershed management standpoint, we conclude that no one area of the watershed can be singled out as a prime contributor, and no one area should be targeted for education or financial assistance toward adoption of water-quality improvement measures.

Input to TMDL process: Guidelines were provided for determining the appropriate level for annual pollutant loading to Melvern Lake. A maintenance plan would keep average annual loadings of soil and nutrients no greater than current levels, estimated to be 0.48 tons/acre per year sediment, 1.2 lb/acre per year phosphorus, and 2.6 lb/acre per year nitrogen. Further analysis is necessary to refine these estimates from average annual levels to seasonal or monthly recommendations, particularly because runoff-producing rainfall events occurring on the watershed in time and space produce nearly all of the loading to the lake. Runoff producing rainfall events typically occur during the period April - June

BMP recommendations: For Kansas conditions, Melvern Lake is reasonably clean now. Though the modeling assessment shows that it can never become a clear, blue lake, its water quality can become better or worse depending on future watershed management. This is particularly true because nonpoint sources make up a large majority of the influent sediment, nutrient, and chemical loadings. For example, lake loading is estimated to be higher by 65,000 tons of sediment and 140,000 pounds of phosphorus per year than if the watershed were all in native grassland and woodland. Commonly used best management practices (BMPs) for small feedlots, cropland and grassland are recommended and their use would have an important impact. (Kansas State University Agricultural Experiment Station and Cooperative Extension Service - MF-2486 July 2000)

Melvern Lake has no TMDLs for the lake, reflecting low evidence of eutrophication and no other identified in-lake water quality issues. Upstream of Melvern Lake there are two existing TMDLs, and one 303(d) listed station requiring development of a TMDL. Monitoring station SC579, encompassing 142 Mile Creek & Hill Creek drainages, have TMDLs for fecal coli form bacteria and low dissolved oxygen. This monitoring station is currently 303(d) listed for atrazine, and awaits TMDL development. Subsequent to the development of the TMDLs for bacteria and dissolved oxygen an additional monitoring station was added in the Melvern Lake watershed, SC742, on the Marais des Cygnes River below the junction of the Marais des Cygnes River and Duck Creek. This monitoring station also captures the drainage of Elm Creek.

Data collected since the development of the TMDL continues to indicate impairment of 142 Mile Creek with regular low dissolved oxygen events, in-stream nutrient concentrations exceeding regional guidance, and suspended solids concentrations greater than other Flint Hills streams. The Marais des Cygnes River does not show dissolved oxygen impairments, perhaps reflecting greater flow volumes, but has an otherwise similar profile with regards to sediment and nutrients. Since SC742 went online in 2002 the Marais des Cygnes River the monitoring data for E. coli has been largely in compliance with water quality expectations.

However, much of that period was during an extended drought, and since the beginning of 2008 half of all E. coli samples collected at SC742 have exceeded water quality standards, including all samples collected during the recreational season in 2008. This may indicate a distant source of E. coli to the stream that is activated during wet periods and greater than average flows (flows met or exceeded 35% or more of the time), suggesting the pollution sources are located some distance upstream from the monitoring station. Because SC579 was not also sampled during 2008, it is unclear whether the source of the impairment is on 142 Mile Creek, or one of the other tributaries. ***The high priority TMDLs for Bacteria and DO on One-hundred forty-mile creek will be directly targeted by this plan***

Table 4: - Impaired Waters: A Map of these impaired water is on page 52 (Map K)

Melvern Lake Watershed Impaired Waters			
Impaired Waters with EPA Approved TMDLs			
Water Body	Impairment	Priority	KDHE Monitoring Station(s)
One Hundred Forty Two Mile Creek/Upper Marais des Cygnes River	Dissolved Oxygen	High	SC579, SC742
One Hundred Forty Two Mile Creek/Upper Marais des Cygnes River	Bacteria	High	SC579, SC742
Chicken Creek	*Highlighted waters are included within the watershed TMDLs for the One Hundred Forty Two Mile Creek/Upper Marais des Cygnes River Dissolved Oxygen and Bacteria TMDLs*		
Hill Creek			
Duck Creek			
Locust Creek			
Elm Creek			
Lebo City Park Lake	Eutrophication	Low	LM065601
Non-TMDL Impaired Waters (303d List)			
Water Body	Impairment	Priority	KDHE Monitoring Station(s)
One Hundred Forty Two Mile Creek	Atrazine	Low	SC579

The dissolved oxygen (DO) TMDL specifies a 38% reduction in BOD loads to 142 Mile Creek, resulting in an average BOD concentration of less than 3.1 mg/L. E. coli monitoring on 142 Mile Creek occurred during 2006, and no evidence of impairment was documented. This stream monitoring site is rotational, and should be monitored during calendar year 2010. The original TMDL document called for bacteria concentrations to be reduced to concentrations below those described in the water quality standards for secondary contact recreation. This stream is now registered as a Primary C recreation stream, so reductions of E. coli in these streams to less than 427 CFU during the recreation season would be consistent with the intent of the TMDL.

The low DO levels in 142-mile Creek are likely exacerbated by the fact that the upper reaches of the creek has perennial pools, but in dry seasons the riffles are dry. Lack of shade it some of the riparian corridors also increases water temperatures and also reduces levels of DO. As cattle outnumber humans in the watershed by a ratio of 20 to one, it is likely the cattle are a major contributor to the fecal coli form bacteria. There are a number of confined animal feeding operations (CAFOs) in the watershed that may contribute, but also numerous areas where smaller concentrations of livestock are located in the winter, non-grazing months.

In the grazing season if the stream is the primary source for livestock water, then this also can contribute to the problem.

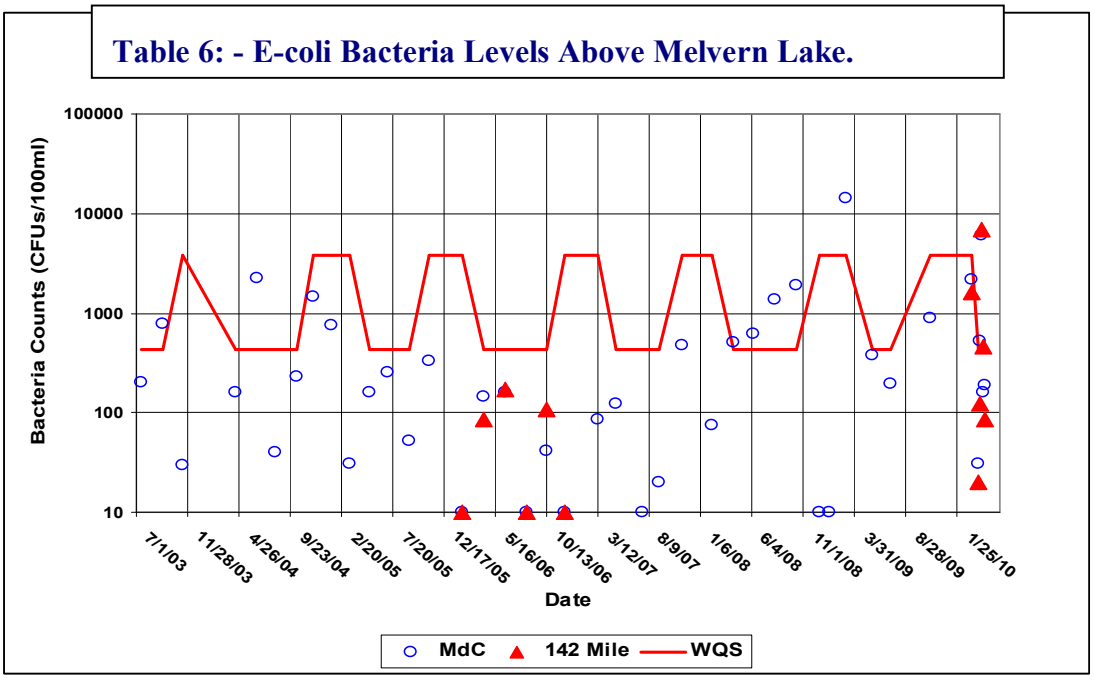
Therefore, the WRAPS should continue to focus and target efforts on improving stream and riparian conditions on 142 Mile Creek to improve low flow DO and to investigate activities along Elm Creek that might be contributing bacteria and other pollutants. These activities might actually be somewhat distant from the creek since it takes higher flows to deliver downstream. Riparian management on the smaller tributaries to Elm Creek and increased buffer widths along Elm Creek may reduce instances of impaired water quality in this watershed. The following tables show the TMDL data along with other pollutants of concern in the watershed.

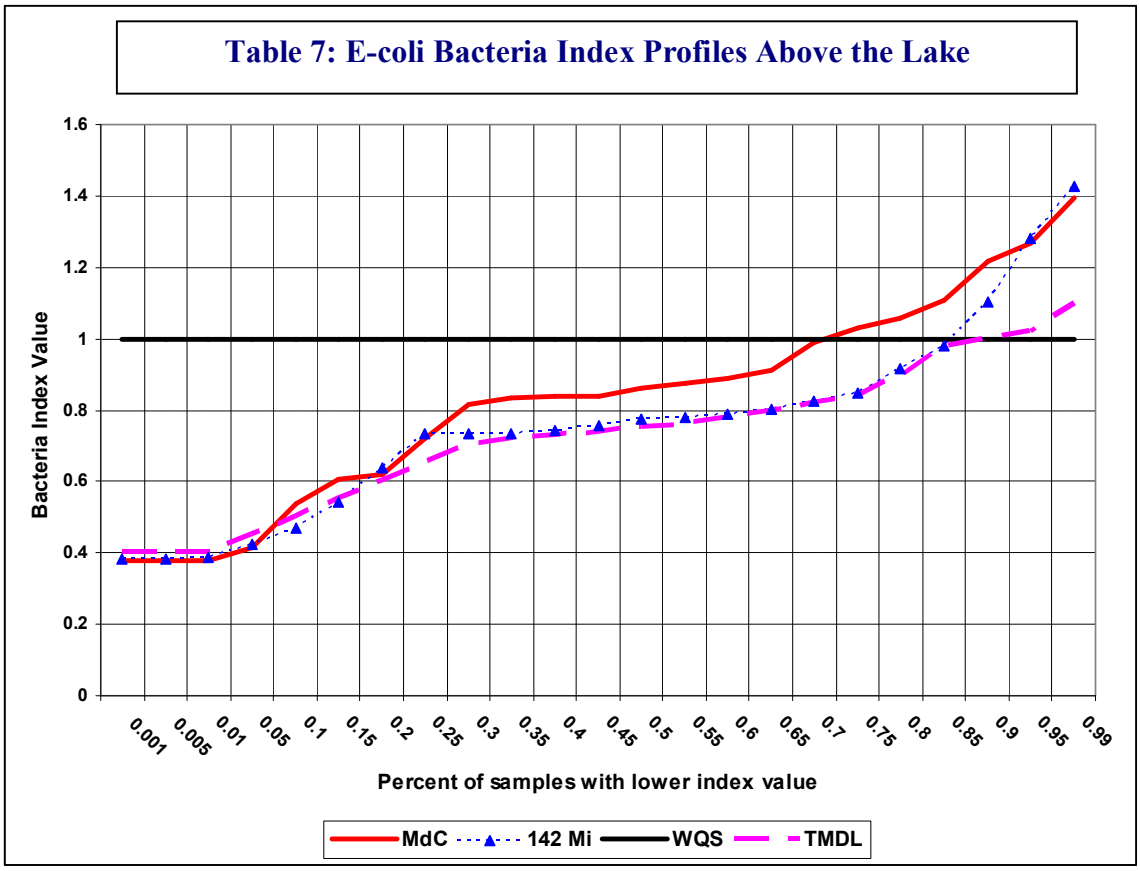
Table 5: - Water Quality Data

Stream	P.O.R.	Avg TP	Med TP	Avg TSS	Med TSS
Phosphorus and Total Suspended Solids					
142 Mile Creek	1990-2002,2006,2010	175 ppb	110 ppb	79 ppm	43 ppm
MdC-Reading	2002-2010	148 ppb	117 ppb	71 ppm	38 ppm
Common Period TP & TSS					
MdC-Reading	2006(+ 1 ea from 02,10)	136 ppb	131 ppb	62 ppm	32 ppm
142 Mile Creek	2006(+ 1 ea from 02,10)	142 ppb*	122 ppb*	48 ppm	32 ppm
		*** ignores high TP value from 2002**			
Dissolved Oxygen					
142 Mile Creek	1990-2002,2006,2010	19 hits of low DO over POR (83 samples)			
MdC-Reading	2002-2010	2 hits of low DO over POR (46 samples)			
Atrazine					
142 Mile Creek	1990-2002,2006,2010	7 hits of high atrazine (51 samples)			
MdC-Reading	2002-2010	2 hits of high atrazine (21 samples)			

Not much difference with the average or median values for 142 Mile or the downstream MdC station; 142 Mile tends to be slightly elevated relative to the downstream station; definite impact of low DO and elevated atrazine recorded on 142 Mile Creek.
The two stations appear to respond in kind, but there may be contributions coming in from Elm Creek to cause some of the elevated bacteria on the MdC

Table 6: - E-coli Bacteria Levels Above Melvern Lake.





Conclusions

1. 142 Mile Creek shows ongoing signs of impairment from atrazine and low dissolved oxygen.
2. The new station located below the confluence of 142 Mile and Elm Creeks shows less overall stress, except for bacteria
3. From a hydrologic perspective, Elm Creek likely contributes more flow because of its greater drainage area than 142 Mile Creek, thus it might provide some significant loads to Melvern Lake at high flow.
4. Both Stations are being intensively sampled this year for E coli (5 samples taken within 30 days on 4 occasions); the April sampling showed compliant conditions at both stations (both Primary Recreation C streams); Note: Elm Creek is a Secondary Recreation b stream.
5. ***From a targeting perspective, 142 Mile Creek is clearly a top priority, but because of hydrologic potential and the presence of facilities, the lower reach of Elm Creek below the confluence of Chicken Creek should also be targeted.***
6. Load reductions should focus on DO on 142 Mile Creek and bacteria on the Marais des Cygnes River first, then look to further protection of Melvern Lake by reducing silt and nutrient loads.

Suggested Load Allocations

1. For dissolved oxygen, key on 142 Mile Creek and reduce organic material (TOC) to below 7 mg/l [290T/yr, reflecting a 110T/yr TOC load reduction for DO. (-27.5%)
2. For bacteria, key on the Marais des Cygnes station and reduce bacteria profile to the desired TMDL profile (below)

3. For phosphorus and total suspended solids, since there is no TMDL for Melvern Lake, there are no load allocations, but if there was one, it would include a margin of safety, typically 10%. So the initial load reduction as measured at the Marais des Cygnes station will be 10% for protection purposes.

Table 8:-Phosphorus and Total Suspended Solids Loads at Marais des Cygnes at Reading

Pollutant	Average Flow*	Current Conc ppm	Current Load**	Desired Conc ppm	Desired Load**	Necessary Reduction	Percent Reduction
Total P	105 cfs	0.15	15.30	0.13	13.80	1.50	10.00%
Total SS	105 cfs	71.00	7346.90	64.00	6612.20	734.70	10.00%

Note: * Avg Annual Flow from USGS gage; **Loads are Annual ï Tons per year

Table 9: Pollutant Reduction Milestones

Pollutant	Current Median	2010-2020 Median	Post-2020 Median	Remarks
TOC	9 mg/l	8 mg/l	7 mg/l	Only on 142 Mile Creek
Total P	148 ug/l	140 ug/l	133 ug/l	On Marais des Cygnes R
Total SS	71 mg/l	67 mg/l	64 mg/l	On Marais des Cygnes R

1. Reductions in median concentrations of TOC, TP and TSS
2. No more than 1 DO violation over 2010 ï 2020 on 142 Mile Creek
3. Reduced profile from current Marais des Cygnes Bacteria Index

Indicators

1. No fish kills
2. Melvern Lake is not listed for eutrophication or siltation
3. No health advisories against swimming in the upper Marais des Cygnes River or upper reaches of Melvern Lake
4. Biological metrics indicate robust, diverse biological communities on Elm and 142 Mile Creeks and the upper Marais des Cygnes River.

The TMDLs will be re-evaluated and revised in 2012 and if necessary again in 2017.

Bathymetric Survey Summary

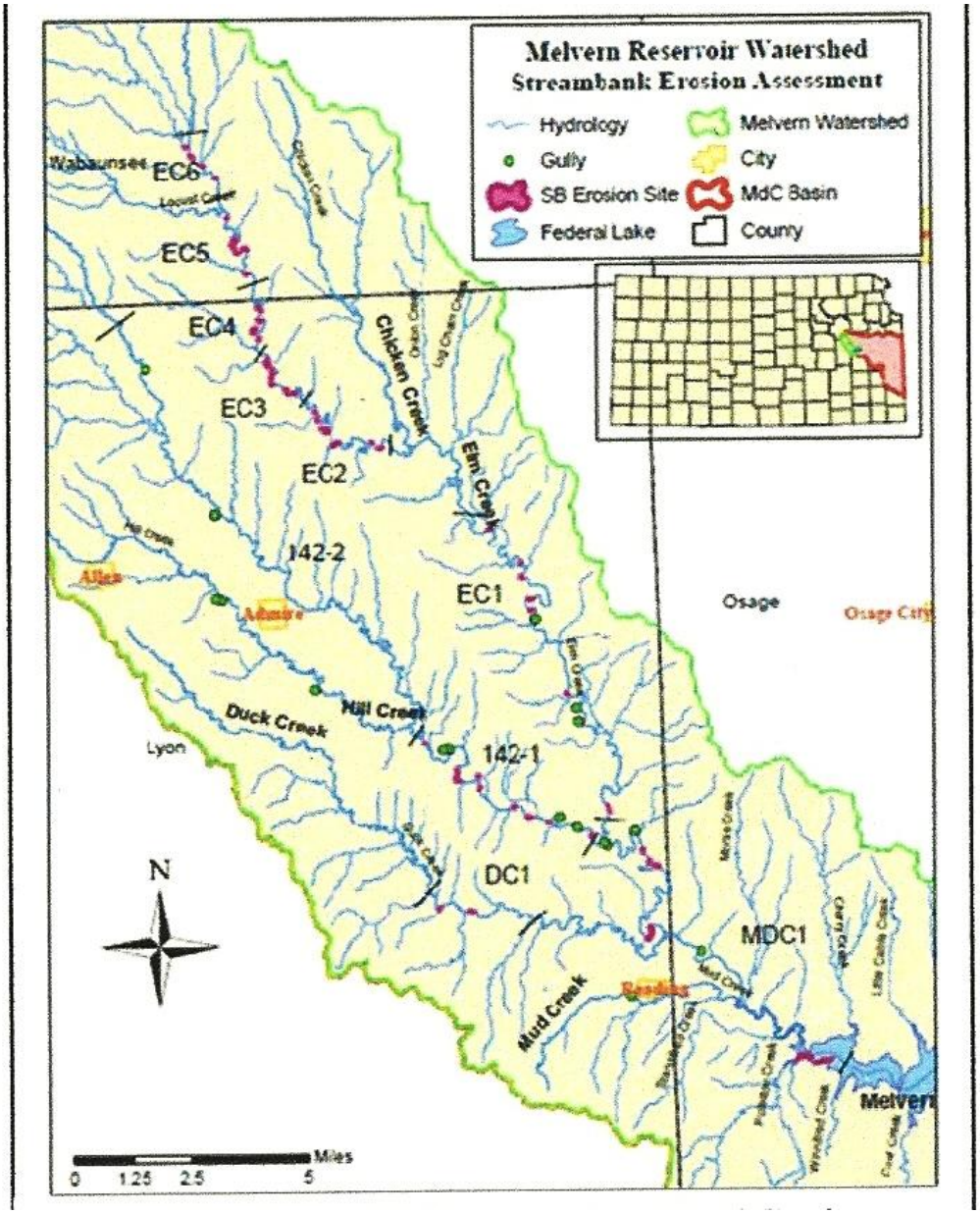
In 2009, the Kansas Biological Survey (KBS) performed a bathymetric survey of Melvern Reservoir in Osage County, Kansas. The survey was carried out using acoustic echo-sounding apparatus linked to a global positioning system. A US Army Corps of Engineers pre-impoundment topographic map with a contour interval of 10 feet (10ô) was obtained in digital form from the University of Kansas Map Library. A digital elevation model of the pre-impoundment surface was created using digitized pre-impoundment contour lines. Comparison of the 2009 bathymetric survey data to the pre-impoundment map suggests that the capacity of ***the reservoir at the 1036' elevation pool has been reduced from 160,910 acre-feet to 151,256 acre-feet (a 6% reduction in storage capacity).*** Sixteen sediment cores were extracted from the lake to determine accumulated sediment thickness at locations distributed across the reservoir.

Sediment samples were taken from the top six inches of each core and analyzed for particle size distributions. Bulk density of the sediment was computed for samples along the length of the core and average to produce mean bulk density (g/cm3) for each site.

Streambank Assessment Summary

In 2010 the Kansas Water Office performed an ArcGIS® Streambank assessment comparison study: 1991 vs. 2008 aerial photography. A summary of this survey is included in the appendices. Map H shows below the identified streambank erosion sites by the study.

MAP ï H: Streambank Erosion Sites Above Melvern Reservoir



V - PROJECT GOAL AND OBJECTIVES

The overall goal is improve and protect the water quality in Melvern Lake and the tributary streams, which feed the Lake.

Specific objectives are:

A. Reduce nonpoint sources of pollution into the Lake and streams, which feed it.

B. Protect public drinking supply, both ground and surface sources

C. Bring all streams in the watershed within accepted state water quality standards.

D. Delist the streams which currently have TMDLs written for them.

Sub-objectives:

1. Minimize water quality impacts from cropland.
2. Decrease runoff and improve the quality of runoff from grassland.
3. Reduce streambank erosion.
4. Reduce, or properly contain manure concentrations near all streams.
5. Reduce pollutants coming from households and towns
6. Reduce pollutants from all commercial, recreational, industrial, and transportation sites located in the watershed.
7. Inform and educate all identified stakeholders in the watershed about water quality.
8. Administer the project in an efficient and timely manner.

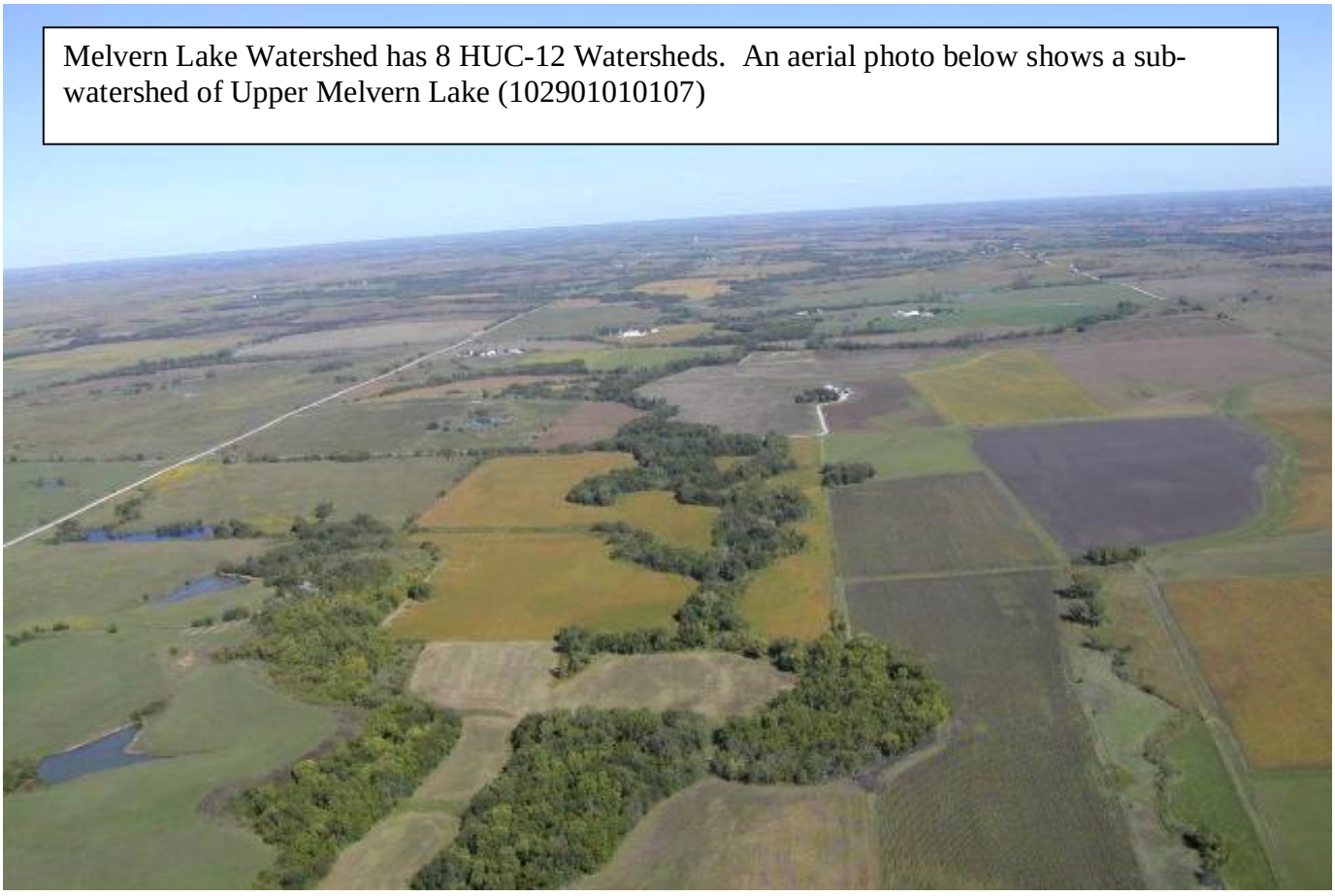
Desired Outcomes ï

1. Protected and improved water quality in Melvern Lake.
2. Improved well being and quality of life.
3. Improved biodiversity and wildlife habitat.
4. Reduced soil loss and resultant sedimentation.

V - PRIORITY AREA SELECTION

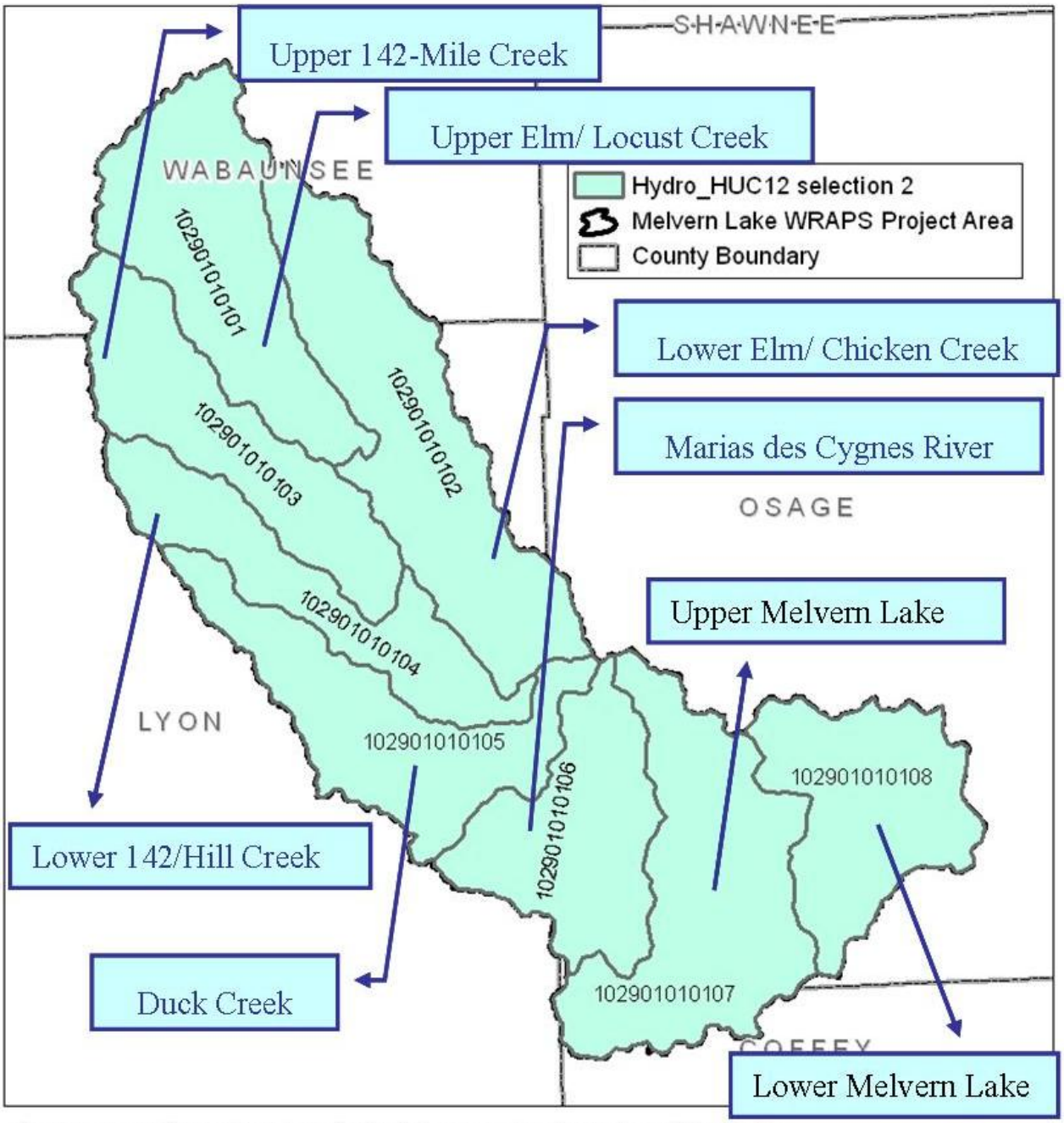
Melvern Lake watershed is comprised of eight HUC-12 watersheds. A table below and map of the Melvern Watershed and its sub-watersheds is given is given on page 20 (Map M). With the advent of the EPA/KDHE 9-Element planning process a ranking of priority areas has been encouraged. Following the map and table is an overview of the process used to justify the ranking of the eight HUC-12 watersheds.

Table 10 - Sub-Watersheds	HUC - 12 #
Upper 142-Mile Creek	102901010103
Hill Creek Lower 142-Mile Creek	102901010104
Upper Elm Creek Locust Creek	102901010101
Lower Elm Creek Chicken Creek	102901010102
Duck Creek	102901010105
Marias Des Cygnes River	102901010106
Upper Melvern Lake	102901010107
Lower Melvern Lake	102901010108



Melvern Lake Watershed has 8 HUC-12 Watersheds. An aerial photo below shows a sub-watershed of Upper Melvern Lake (102901010107)

MAP M – MELVERN LAKE HUC-12 SUB-WATERSHEDS



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

October 2011

1) – In 1998 Kansas State University Department of Ag. Engineering conducted a study of the lake. KSU developed an integrated model that assessed the water quality of the Lake and was able to predict future trends in the water quality with changes in the management of the watershed. This became Phase I of the Melvern Reservoir Water Quality Project.

Phase - I Conclusions - The results of the Phase I study concluded that the water quality in Melvern Lake is among the best for Kansas Reservoirs. Conclusions of the study are listed below.

1. There were no ***dominant*** sources of pollution identified.
2. No one area of the watershed can be singled out as prime contributor, and no one area should be targeted for education or financial assistance toward adoption of water quality improvement measures.
3. The lake is eutrophic (nutrient rich) though levels of sediment, phosphorus, and nitrogen loadings are considered to be fairly low. A maintenance plan would keep average loadings of soil and nutrients no greater than current levels.
4. The water quality of the Lake can become better or worse depending upon future watershed management. Commonly used Best Management Practices (BMPs) for small feedlots, cropland, and grassland are recommended, and their use would have an important impact for the future.

2) - In 2001 two TMDLôs were written for fecal coli form bacteria and dissolved oxygen for Hill Creek and 142-mile Creek. As a result of this determination these two sub-watersheds should be priorities one and two for addressing BMP implementation on grazing lands. Over the last ten years of implementation a great deal of work has been completed in these two watersheds. One large feedlot was totally eliminated and another went through a major renovation. The TMDLôs will be revaluated in 2013.

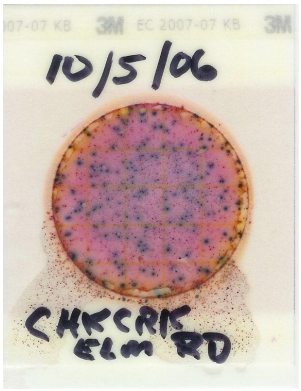
3) - The 1999 Kansas Unified Watershed Assessment classified the Upper Marais des Cygne River, Chicken Creek, Hill Creek, and 142-mile Creek as Category I streams. A Category I classification means the watershed is in need of restoration due to having water quality impairments or degradation of other natural resources related to an aquatic habitat, ecosystem health and other factors related to aquatic life resources. The primary pollutant concerns within these streams are fecal coli form bacteria (FCB) and dissolved oxygen (DO). As a result, the Melvern Lake Watershed has been targeted for the funding of best management practices (BMPs) throughout the watershed. Chicken Creek and Elm Creek were taken off the list in 2000 because data was not available due to an error in the sampling location and due to a change in watershed delineation.

Though there is no empirical data to support Elm and Chicken Creeks there is anecdotal evidence that suggest they should be considered as priority areas. These two watersheds are very similar to Hill Creek, and 142-mile Creek. Both have similar geography, hydrology, and geology. Both have large numbers of livestock spread throughout. Therefore, with similar characteristics it could be assumed the water quality would be similar.

4) - In the spring of 2005 the Melvern Watershed Project Coordinator started using a simple ñPetrifilm©ò product for measuring coli form and *E. coli* bacteria. Water samples can be drawn from a source (pond, stream, well, etc) with a 1 ml pipette and transferred to a Petrifilm© plate. After incubation for 2-3 days, pink dots represent colony forming units (cfu's) of typical coli-

form bacteria, and blue dots are cfuôs of *E. coli*, which indicates fecal contamination of water. These Petrifilm© slides are intended to be used as general indicators of the presence of bacteria by common citizens. If using the Petrifilm© to test drinking water the standard for both coli form and for E. coli is zero dots; general standards for surface water contact recreation are 2 blue dots per slid, and 20 blue dots per slide for non-contact recreation as threshold levels.

Chicken Creek has had an issue with a large feedlot it its upper end that was contributing fecal coli form bacteria. Sampling was conducted one-half mile below the feedlot and showed large concentrations of E Coli bacteria. A copy of the sample is shown on the right and clearly shows the levels of E-Coli far exceeded threshold levels for non-contact recreation. This particular feedlot did voluntarily move livestock out of two pens that contributed runoff directly into Chicken Creek; however the pens have not been removed. In addition, a neighboring feedlot began bringing winter cattle into the area in 2009. This influx of cattle will be monitored.



The lower of the two of Elm Creek HUC 12s has a large federal CAFO cattle operation. It sits right adjacent to Elm Creek and has two large livestock waste lagoons and pens within a stones throw of Elm Creek. Neighbors down stream have expressed concern with this operation.

Another wintering livestock operation is in the Upper Elm Creek and has shown elevated levels of E-Coli. The operator is elderly and has chosen not to make any changes to his operation. If the operator does not retire in the next few years, or if a new operator takes over this site, then changes will need to be made at this site. This sub-watershed also includes Locust Creek which has been classified as a ñhigh qualityò stream. Though it is rich biologically, it has issues with summer grazing abuse in the riparian areas. Landowners have been contacted but thus far have declined to work on remedies at these locations.

5) ï In 2003 the Melvern WRAPS coordinator began conducting stream assessments in throughout the watershed. An adaptation of the NRCS Visual Stream Assessment Protocol, SVAP, was used. A copy of the assessments is provided on page 4. This assessment looks at ten characteristics of a stream reach and results in an overall assessment of excellent, good, fair, or poor condition. It also looks at adjacent land use and provides an opportunity to follow up with landowners when problem areas are indentified. The coordinator has walked over many miles of streams in the watershed. Thus far assessments have been completed in six of the eight sub-watersheds. Based upon this data**,** there is no one sub-watershed that stands out as needing more remediation than any other. All have areas where BMPs could be installed for streambank and gulley erosion, filter strips, livestock watering sites and grazing distribution. Throughout the last ten years of implementation work, BMP implementation has reflected this with work spread out throughout the watershed with the exception of the two lower HUC12s, where there has been little demand for BMP implementation.

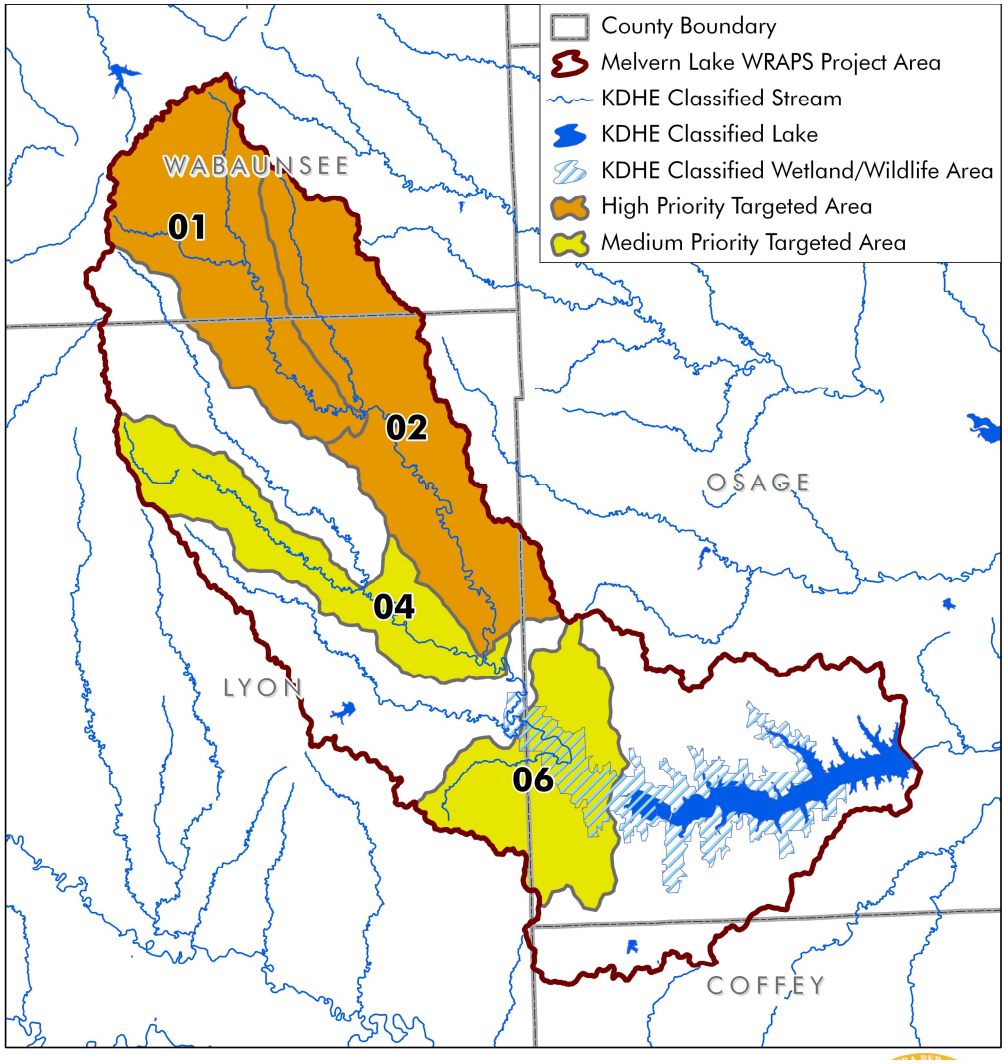
6) This work concurs with a study that was conducted by the Kansas Water Office that looked at identifying areas where streambank erosion is evident. The study looked at aerial photographs

from two time periods (1991 & 2008) and by overlaying the two photos the study identified sixty-eight sites where Streambank erosion has occurred at a rate to cause concern. Of the 68 sites indentified 48 are in the two Elm Creek sub-watersheds; 11 are in the Duck Creek/Marais des Cygnes; and 9 are in 142/Hill Creek watersheds. Therefore, Elm Creek should be considered priority areas for sedimentation. A summary of this study is given in the appendices, and MAP H shows the identified sites on page 17.

Table 11: – Streambank Sub-watershed Priority Areas

Streambank Target Areas	HUC - 12 #	Banks	Length (ft)	Priority
Upper Elm Creek Locust Creek	102901010101	28	10,693	HIGH
Lower Elm Creek Chicken Creek	102901010102	20	6,928	HIGH
Marias Des Cygnes River	102901010106	8	8,012	MEDIUM
Hill Creek Lower 142-Mile Creek	102901010104	9	3,885	MEDIUM
Total Priority Streambank Sites		**65**	**29,518**	

Map N: Streambank Sub-watershed Priority Areas



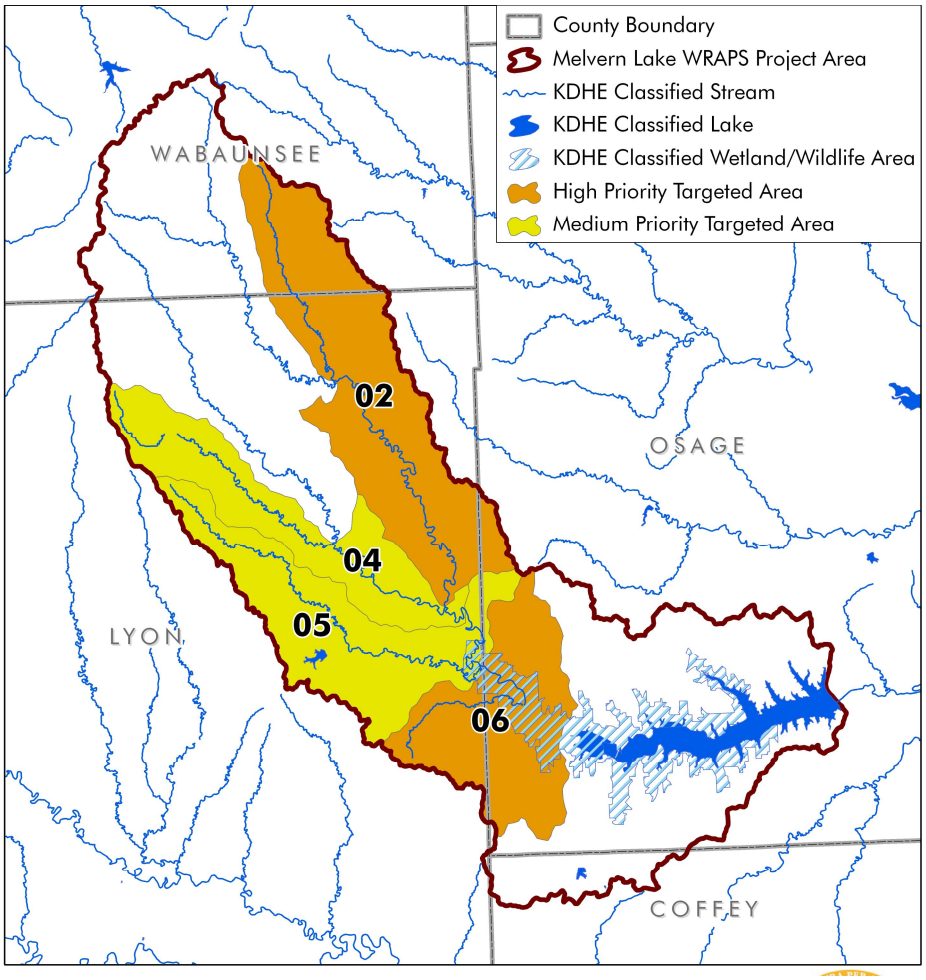
7) - The Project Management WRAPS Team is made up of landowners who have spent their life in the watershed. A discussion was held in regard to priority areas at a WRAPS meeting and the Team voted unanimously that if there are to be priority areas, six of the eight HUC-12s should be included.

8) ï The distribution of rangeland and cropland is not equally distributed across the watershed. The largest percent of land areas in cropland are: Marais des Cygnes River; Lower Elm Creek; Hill Creek; and Duck Creek Therefore, these four sub-watersheds should be the highest priorities for cropland BMPs.

Table 12: – Cropland Sub-watershed Priority Areas

Cropland Priority Areas	HUC-12	Acres/crop	Percent	Priority
Marias Des Cygnes River	102901010106	3,838	16.94%	HIGH
Lower Elm Creek	102901010102	4,744	13.05%	HIGH
Hill /Lower 142-Mile Creek	102901010104	2,464	12.25%	MEDIUM
Duck Creek	102901010105	2,885	11.47%	MEDIUM
Total Priority Crop Acres		**13,931**		

Map O - Cropland Sub-watershed Priority Areas

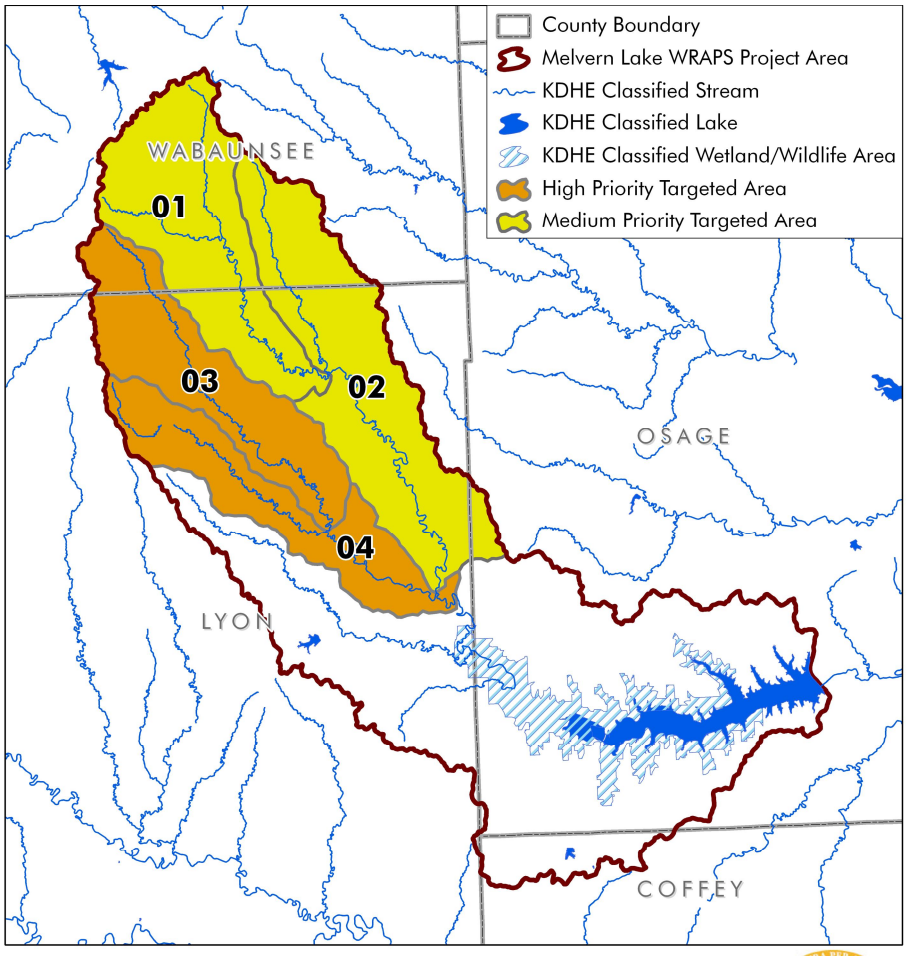


9) The largest percent of land areas in rangeland are the sub-watersheds Upper Elm Creek; Upper 142-Mile Creek; Lower Elm Creek; Duck Creek; and Hill/Lower 142-Mile Creek. However, another factor in prioritizing these watersheds is the TMDLs written for Upper 142-Mile Creek and Hill/Lower 142-Mile Creek for fecal coli form bacteria and dissolved oxygen. These TMDL summaries are given on pages 9-13. Therefore the four priority areas for livestock BMP implementation are listed in the table and map below. This will include the implementation of gully erosion as there tend to be more perennial gullies in rangeland than cropland.

Table 13: - Rangeland Sub-watershed Priority Areas

Rangeland Priority Areas	HUC-12	Acres/Range	Percent	Priority
Upper 142-Mile Creek	102901010103	21,584	87.80%	HIGH
Hill Creek Lower 142-Mile Crk	102901010104	15,420	76.64%	HIGH
Upper Elm Creek Locust Creek	102901010101	26,237	88.86%	MEDIUM
Lower Elm Creek Chicken Crk	102901010102	28,313	77.89%	MEDIUM
Total Priority Range Acres		**91,555**		

Map P: Rangeland/Livestock Sub-watershed priority Areas



10) ï This project has been working on implementation for the last ten years (2001-2010). It has worked under the premise that there would ne NO priority areas and this has proved to be successful. The ñlow hanging fruitò has been plucked and implementing BMPs may become more difficult. By limiting areas where BMPs could be installed, this could hamper work which could be done. Since 2001, the project has used a ranking sheet to score potential projects based upon non-point source reduction effectiveness. It will continue to utilize this scoring sheet when necessary. Based upon the reasoning presented, the Melvern WRAPS Project Management Team has setup the preceding priority lists for BMP implementation. However, the Team may install BMPs anywhere in the watershed when it is deemed a significant reduction in pollution will be achieved and there are not any competing projects in higher priority areas. Extensive efforts will be made to implement BMPs in the higher priority areas before turning to the lower priority areas.

This settling basin was installed at the corner of a crop-field just above Elm Creek in 2004.

IV. METHODS

The Flint Hills RC&D is the chief financial administrator of the EPA-319 Clean Water Act Grant funds. Not withstanding, the project coordinator will be responsible for documenting all expenses incurred for the project and reporting these expenses to the RC&D. Every two weeks the project coordinator shall submit a time sheet for documentation of salary. Every month the coordinator shall submit any other expenses incurred for the month including mileage, benefits expenses, and any other project expenses for the month. The project coordinator shall submit a quarterly report to the RC&D for all activities to be submitted to KDHE.

The project coordinator shall meet quarterly with the project management team. The coordinator shall be responsible for setting up the meeting time, place and agenda. The management team shall be responsible for reviewing all published documents. In addition, the team shall give the project coordinator supervisory oversight and direction in carrying out activities of the project.

The project coordinator shall meet periodically with the four county Conservation Districts in the watershed to report progress and document all activities accomplished in their county. The coordinator will attend the annual meetings of each district every other year to report activities. He shall make an effort to spend time with the staff in each district office on a regular basis. The conservation districts shall be responsible for documenting all non-federal dollars spent in their portion of the watershed. The Conservation Districts, with assistance from their Natural Resources Conservation Service partners, report all activities which occur the Melvern 'Basin elated to water quality throughout the course of this project. The coordinator will meet annually with all project sponsors to discuss funding available for each year, and to facilitate the planning of field days, workshops, demonstrations, and other related information and education activities for the watershed.

This plan will follow a five-year process based on the following elements:

A. Best Management Practices Inventory

B. Recommended Best Management Practices (BMPs)

C. Information and Education (I&E)

D. Monitoring and Evaluation

VII ï A. **BMP NEEDS INVENTORY**

Table 14: - Land Cover Types in the Watershed

*Land Cover Type	Acres	Area %
Mixed Forest, Scrub, or Barren	331	0.16%
Developed, Medium Intensity	333	0.15%
Emergent Herbaceous Wetlands	463	0.22%
Woody Wetlands (Riparian)	1,441	0.67%
Developed, Low Intensity	1,483	0.69%
Developed, Open Space	6,864	3.19%
Open Water	8,078	3.76%
Deciduous Forest	9,331	4.34%
Cultivated Crops	22,479	10.46%
Pasture/Hay	28,589	13.31%
Grassland/Herbaceous	135,470	63.05%
Total	**214,861**	**100.00%**

Source: The land cover type* and estimate of acres needing treatment^ information were developed using the Kansas Non-Point Source Needs Inventory. The Kansas Department of Health and Environment (KDHE) surveyed the county conservation districts for land treatment ñneedsò in 2005. The districts completed a spreadsheet indicating the number of acres for each land use type that were in need of structural and/or nonstructural land treatment. Total square miles in the watershed = 336

Table 15: - Breakdown estimate of acres needing some sort of treatment

Acres in Watershed in need of Treatment*	Percent	Acres
Cropland Acres in Top Four Priority Areas	100.00%	13,931
Acres Cropland needing treatment	53.90%	7,509
Acres needing enhanced Nutrient Management	51.90%	7,230
Acres needing enhanced Pesticide Management	50.60%	7,049
Acres with Nutrient Management Plan	5.50%	766
Acres with Annual Soil Sampling	3.20%	446
Acres in No-Till	12.50%	1,741
Acres in Ridge No-Till	0.40%	56
Acres in Conservation Tillage	42.20%	5,879
Increased Crop Residue Needed	44.90%	6,255
Acres Needing Structural Treatment	31.20%	4,346
Acres Needing New Terraces	12.30%	1,714
Acres Needing Terrace Restoration	8.50%	1,184
Acres of New Waterways	6.70%	933
Acres of New Waterway Restoration	9.10%	1,268
Acres Needing Diversions	1.00%	139
Acres Needing Grade Stabilization	1.20%	167
Acres Needing Water/Sediment Control Basins	0.30%	42
Needing Conversion to Permanent Vegetation	2.20%	306
Needing Conversion to Wetland (swampy areas)	1.50%	209
Rangeland Acres in in Top 4 Priority Areas	100.00%	91,555
Acres of pasture/rangeland needing treatment	58.73%	53,770

VII - B. RECOMMENDED BEST MANAGEMENT PRACTICES

Nonpoint Pollutant Source	Recommended Minimum Practice
Forest Land	1. Maintain good forest conditions 2. Avoid or minimize forest grazing 3. Control gully erosion 4. Use pesticides carefully
Grassland	1. Stock to maintain good grass conditions 2. Rotate grazing 3. Control gully erosion 4. Avoid over fertilization
Cropland	1. Maintain productive capacity of soil 2. Encourage no-till or minimum tillage. 3. Encourage use of cover crops 4. Use vegetated filter strips at edge of fields 5. Construct terraces, waterways, and other erosion control practices. 6. Apply fertilizers at rates designed to achieve realistic yields 7. Pesticides a. Apply according to label b. Incorporate where feasible c. Dispose containers and residues properly 8. In livestock areas promote conversion to grazing land. 9. In hydric areas promote conversion to wetlands
Livestock	1. Feedlot facilities greater than 300 head, comply with KDHE rules and regulations 2. Feedlot facilities less than 300 head ï minimize discharge of pollutants a. Divert uncontaminated runoff b. Provide solids settling c. Discharge runoff through buffer or filter area. d. Clean manure frequently e. Avoid confinement in close proximity to streams and lakes. f. Plant cover vegetation on temporary or intermittent use areas when area is not in use
3. Grazing livestock	a. Maintain good grass conditions b. Avoid or minimize grazing in riparian areas c. Provide alternatives to stream watering sites d. protect farm ponds and supply adequate watering sites.
Streambanks	1. Maintain good perennial vegetation adjacent to streams. 2. Stabilize streambanks when economically feasible.

Urbanized Land	1. Discharge runoff through vegetative filters or sedimentation basins 2. Minimize loss of fertilizers and pesticides used in landscape maintenance
Farmsteads & Non-farm Homes	1. On-site waste waters treatment system ï provide routine maintenance to assure system works as intended 2. Store household chemicals in a secure location 3. Dispose of unwanted chemicals through household waste collection days 4. Minimize use of chemicals in landscape maintenance 5. Stabilize eroding areas with vegetation or other non-polluting materials
Construction Sites	Minimize water quality impacts of runoff from construction sites by ï 1. Minimizing disturbed areas 2. Stabilize disturbed areas expeditiously 3. Discharge runoff through filtering or sedimentation system 4. Dispose of solid wastes according to state or local solid waste rules and regulations
Transportation System	Minimize water quality impacts of runoff from road surfaces and equipment and materials storage areas ï 1. Discourage runoff through vegetative filters or sedimentation basins 2. Minimize use of fertilizers and pesticides for right-of-way maintenance 3. Control ditch erosion 5. Store deicers under cover 6. Institute a spill response and prevention system
Utility Corridors	1. Minimize use of pesticides in right-of-way maintenance 2. Following construction and maintenance activities, expeditiously stabilize disturbed areas
Mineral Extraction (oil wells and quarries)	Minimize water quality impacts of runoff from production sites, equipment maintenance areas, and material stockpiles by ï 1. Treating runoff with vegetative filters or sedimentation basins 2. Diverting uncontaminated runoff away from production sites 3. Expeditiously stabilizing disturbed areas with vegetation or other non-polluting materials

Natural Area Pollution Controls	Take advantage of all existing and naturally occurring features of the watershed that may contribute to protection of water quality including ï 1. Riparian forests 2. Wetlands 3. Ponds 4. Native riparian grassland areas

VII - B. INFORMATION AND EDUCATION

The information and education component of the project includes project-wide information and education activities, one-on-one personal contacts, and demonstration projects. Execution of the information and education component shall be the direct responsibility of the local project coordinator.

1. Project-wide Information and Education

The project-wide information and education activities include a project newsletter, releases to print, radio and television media, coordination with other organization events, signs, self-guided tours; workshops, field days, and tours; and demonstration projects.

a. Project Newsletter - A project newsletter will be established and distributed to all watershed occupants at quarterly intervals. The newsletter will inform watershed occupants of the status of the project, upcoming events, successes and failures, water quality conditions and trends, and promote the use of pollution control practices. The project coordinator will be responsible for assembling and distributing the newsletter.

b. Press Releases and Fact Sheets - Press releases will be prepared whenever appropriate. In addition, the project coordinator will actively solicit interviews on area radio and television talk shows, participate in local civic club meetings, and prepare stories that can be used by other organization newsletters such as the county conservation districts. Fact sheets will be prepared and distributed at public meetings, commercial and institutional sites, and other public access locations such as the Army Corps of Engineers public information desk at the Melvern Lake Project Office.

c. Signs - At the minimum, signs will be established at each water quality-monitoring site and at project demonstration sites. Each sign will summarize project objectives and present information on water quality conditions at the site and project-wide. Water quality condition information will be updated at least quarterly.

d. Self-guided Tours - Self-guided tours using the neighbor-to-neighbor model will be established for each major monitored tributary sub-watershed. The county conservation districts would be encouraged to take the lead in developing a neighbor-to-neighbor tour. They will be invited to provide consultative assistance to the project and initiate a pilot tour on selected areas of the watershed.

e. Workshops, Field Days and Tours - A workshop tour will be held once a year. The project coordinator will be responsible for organizing these events. Workshops, field days and tours will focus on demonstration projects, pollution control maintenance, and management practices.

2. One-on-One Personal Contact

In the one-on-one personal contact activity, each land parcel owner and occupants will be contacted by a representative of the project. The purpose of these contacts is to:

a. Inform the owner of the Melvern Lake water quality project,

b. Inform the owner of water quality conditions and trends and the consequences of the land owner/managerôs decisions,
c. Determine the nonpoint source pollution control practices that are presently being used at the visitation site,
d. Provide the owner or manager recommendations for improvement and maintenance of the pollution control practice, and
e. Identify possible structural pollution controls that may be needed.

The project coordinator is responsible for working with counties to organize and administer this activity. The project coordinator will recruit and train volunteers from area clubs and organizations. Where appropriate, the Kansas Cooperative Extension Serviceôs Farm *A*Syst will be used. During the initial contacts, one-on-one will emphasize water quality conditions and trends, adoption of management practices, maintenance of existing structural and management practices, and determining the need for structural practices. Succeeding contacts will be made to determine if previous recommendations have been implemented.

The project coordinator will provide a wide range of technical assistance to watershed occupants. Where specialized technical assistance is needed, the project coordinator will secure on behalf of the watershed occupant technical assistance from state, federal, and local governmental units and private sector organizations.

3. Demonstration Projects

Projects to demonstrate specific and innovative nonpoint source pollution control measures will be instituted. Local demonstration projects are to be planned for: grassland management options; livestock confinement and winter feeding areas, especially those with less than 300 head; riparian zone improvement/management with emphasis on stream bank erosion control; livestock watering points away from streams; encourage the correct use of pesticides and nutrients; improved waste water management; discourage illegal dumping; encourage alternative pesticide control practices; plus promote general conservation practices for flood and erosion control.

VII - D. MONITORING AND EVALUATION

Monitoring involves tracking pollution control practice adoption, installation, maintenance and land use. The purpose of evaluation is to determine if the project is progressing as planned and achieving water quality objectives. Evaluation provides the project management team an opportunity to modify or adjust the work program if progress is not satisfactory.

a. Work Plan Performance - Work plan performance evaluation answers the following questions:

i. Were all activities identified in the work plan completed as planned?
ii. If not, why not?

b. Water Quality Evaluation -The water quality evaluation determines if the pollution control actions are achieving or likely to achieve the projectôs water quality objectives. The water quality evaluation is based on direct observation of water quality conditions through a designed chemical, physical, and biological sampling system. This project phase will not do any additional sampling to what is already being sampled by the Corps of Engineers and KDHE. The Corps monitors the lake water quality at the upper end of the lake on the Marais des Cygnes River ; at three other lake locations; and at the outlet of the dam. KDHE samples below the confluence of the Marais des Cygnes River and Duck Creek, and samples the Lake at the dam. In addition KDHE has a rotational monitoring site on 142-Mile Creek above itôs confluence with Elm Creek. A map of these monitoring sites is given on page 34. (MAP-Q).

At the end of this implementation plan (2016) if significant water quality improvement has not been achieved, a more extensive monitoring plan will be implemented to narrow down sources of pollution. The SLT has recommended sampling sites as identified on page 35 (MAP-R). These six sites will provide water quality data for six of the eight HUC-12 sub-watersheds and will facilitate indentifying future targeting of BMPs. KDHE will be asked to provide the additional water quality monitoring.

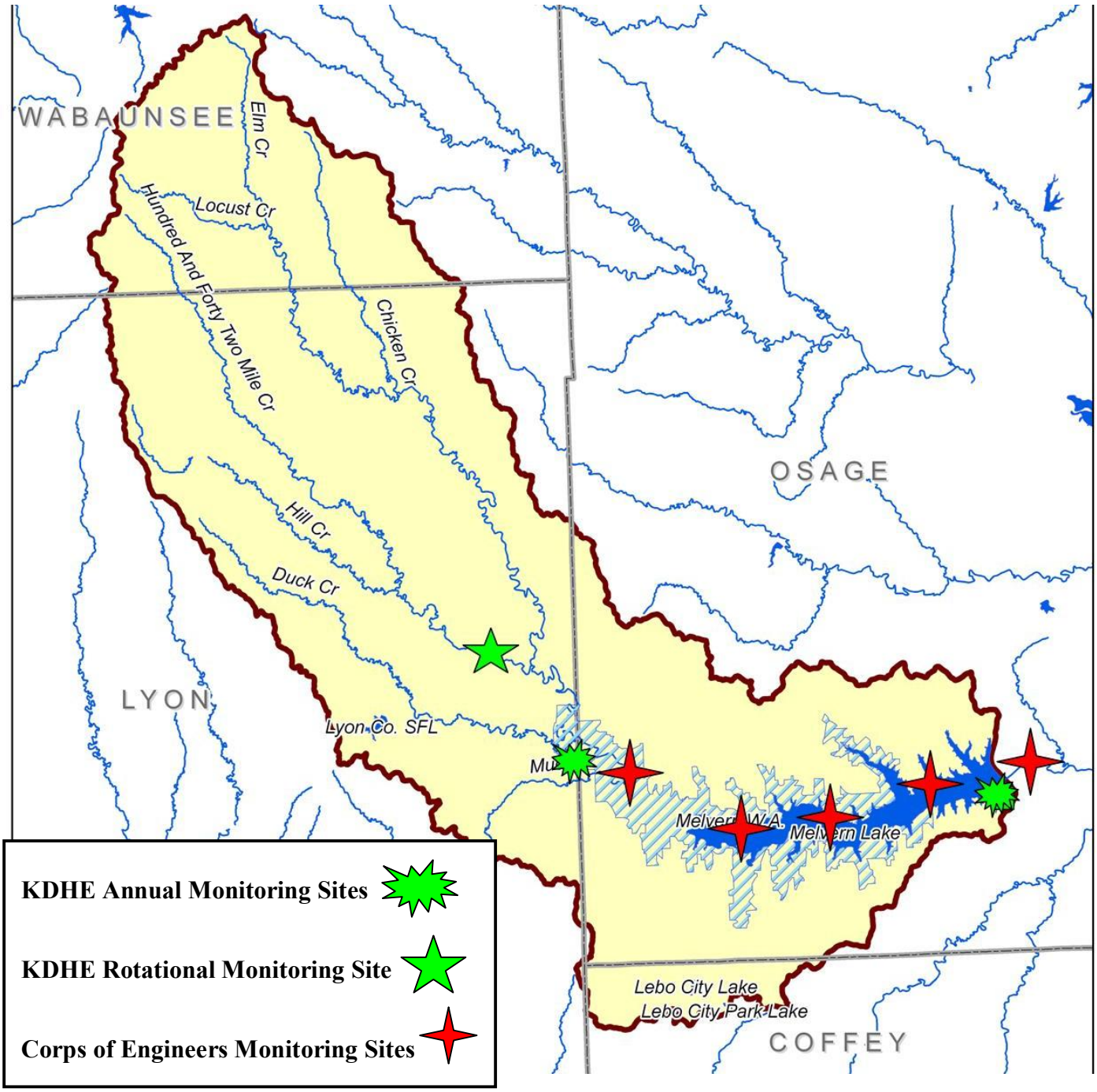
c. Review and revise Project Implementation Plan (PIP) or prepare final project report. The PIP is the basis of all project activities and outlines project tasks required to meet the projectsô goals and objectives. The project management team will review progress quarterly and will conduct a formal review annually. This 9-element plan will be revised at the end of five years of implementation.

d. Personnel –

i. - Project Coordinator - A half-time project coordinator is responsible for overall project coordination and implementation. The duties of the project coordinator will include:

- Making one-on-one contacts with landowners living in the watershed
- Organizing tours, field days, and meetings;
- Developing and publishing a newsletter;
- Publishing news releases; and other informational information;
- Assisting in grant administration;
- Working with and keeping project cooperators informed.
- Coordinating and assisting other technical service providers with the design and implementation of BMPs.
- Pursuing traditional and non-traditional (i.e. grants) funding or project activities.

MAP Q: Current Water Quality Monitoring Sites



MAP – R: Potential Future Water Quality Monitoring Sites

VII – LOAD REDUCTIONS EXPECTED AND COST

Table 16: Sediment Load Reductions

Year	Streambank Reduction (tons)	Cropland Reduction (tons)	Rangeland Gullies (tons)	Total Reduction (tons)
1	240	147	100	487
2	480	293	100	873
3	720	440	200	**1,360**
4	960	586	200	1,746
5	1,200	733	300	2,233

Sediment load reduction goal will be met at this point.

Table 17: Phosphorus Load Reductions

Year	Streambank Reduction (lbs)	Cropland Reduction (lbs)	Livestock Reduction (lbs)	Rangeland Gullies (lbs)	Total Reduction (lbs)
1	14	284	2,996	4	3,299
2	29	568	5,863	4	**6,464**
3	43	852	8,740	8	9,643
4	58	1,136	10,945	8	12,147
5	72	1,420	13,380	12	14,884

Phosphorous load reduction goal will be met at this point.

Table 18: Nitrogen Load Reductions

Year	Cropland Reduction (lbs)	Livestock Reduction (lbs)	Total Reduction (lbs)
1	421	5,644	6,065
2	842	11,043	11,885
3	1,264	16,461	17,725
4	1,685	20,615	22,300
5	2,106	25,202	27,308

Table 19: Total Annual Cost after Cost-Share by BMP Category

Year	Streambank	Cropland	Livestock	Rangeland	Total Annual Cost
1	$21,450	$12,611	$13,319	$1,500	**$47,380**
2	$22,094	$12,990	$12,939	$0	**$48,022**
3	$22,756	$13,379	$10,103	$1,545	**$46,239**
4	$23,439	$13,781	$17,988	$0	**$55,208**
5	$24,142	$14,194	$13,189	$1,591	**$51,526**

Table 20: 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%
Vegetative Buffers	$67	90%	50%	50%	25%
Terraces	$125	50%	30%	30%	30%
Sediment Basins	$300	50%	50%	50%	25%

Table 21: Total Annual Adoption (treated acres), Cropland BMPs							
Year	**Permanent Vegetation**	**Grassed Waterways**	**No-Till**	**Vegetative Buffers**	**Terraces**	**Sediment Basins**	**Total Adoption**
1	20	30	100	75	10	40	275
2	20	30	100	75	10	40	275
3	20	30	100	75	10	40	275
4	20	30	100	75	10	40	275
5	20	30	100	75	10	40	275
Total	100	150	500	375	50	200	1,375

Table 22: Total Annual Soil Erosion Reduction (tons), Cropland BMPs							
Year	**Permanent Vegetation**	**Grassed Waterways**	**No-Till**	**Vegetative Buffers**	**Terraces**	**Sediment Basins**	**Total Load Reduction**
1	21	13	83	41	3	22	**183**
2	42	26	165	83	7	44	**366**
3	63	40	248	124	10	66	**549**
4	84	53	330	165	13	88	**733**
5	105	66	413	206	17	110	**916**

Table 23: Total Annual Phosphorous Reduction (pounds), Cropland BMPs							
Year	**Permanent Vegetation**	**Grassed Waterways**	**No-Till**	**Vegetative Buffers**	**Terraces**	**Sediment Basins**	**Total Load Reduction**
1	51	32	108	101	8	54	**355**
2	103	65	216	203	16	108	**710**
3	154	97	324	304	24	162	**1,065**
4	205	130	432	405	32	216	**1,420**
5	257	162	540	506	41	270	**1,775**

Table 24: Total Annual Nitrogen Reduction (pounds), Cropland BMPs							
Year	Permanent Vegetation	Grassed Waterways	No-Till	Vegetative Buffers	Terraces	Sediment Basins	Total Load Reduction
1	114	72	150	113	18	60	**527**
2	228	144	300	225	36	120	**1,053**
3	342	216	450	338	54	180	**1,580**
4	456	288	600	450	72	240	**2,106**
5	570	360	750	563	90	300	**2,633**

Table 25: Total Annual Cost* Before Cost-Share, Cropland BMPs							
Year	Permanent Vegetation	Grassed Waterways	No-Till	Vegetative Buffers	Terraces	Sediment Basins	Total Cost
1	$3,000	$4,800	$7,769	$5,000	$1,250	$12,000	**$33,819**
2	$3,090	$4,944	$8,002	$5,150	$1,288	$12,360	**$34,834**
3	$3,183	$5,092	$8,242	$5,305	$1,326	$12,731	**$35,879**
4	$3,278	$5,245	$8,489	$5,464	$1,366	$13,113	**$36,955**
5	$3,377	$5,402	$8,744	$5,628	$1,407	$13,506	**$38,064**
**3% Inflation*							

Table 26: Total Annual Cost* After Cost-Share, Cropland BMPs							
Year	Permanent Vegetation	Grassed Waterways	No-Till	Vegetative Buffers	Terraces	Sediment Basins	Total Cost
1	$1,500	$2,400	$4,739	$500	$625	$6,000	**$15,764**
2	$1,545	$2,472	$4,881	$515	$644	$6,180	**$16,237**
3	$1,591	$2,546	$5,028	$530	$663	$6,365	**$16,724**
4	$1,639	$2,623	$5,179	$546	$683	$6,556	**$17,226**
5	$1,688	$2,701	$5,334	$563	$703	$6,753	**$17,743**
**3% Inflation*							

Table 27: 5 Year Cropland BMP Adoption by Sub Watershed (treated acres)							
Sub-watershed	**Permanent Vegetation**	**Grassed Waterways**	**No-Till**	**Vegetative Buffers**	**Terraces**	**Sediment Basins**	**Total Adopted**
Marias des Cygnes River	35	53	175	131	18	70	**481**
Lower Elm	35	53	175	131	18	70	**481**
Hill Creek	15	23	75	56	8	30	**206**
Duck Creek	15	23	75	56	8	30	**206**
Total	**100**	**150**	**500**	**375**	**50**	**200**	**1,375**

Table 28: 5 Year Cropland BMP Soil Erosion Reduction by Sub Watershed (tons)							
Sub-watershed	**Permanent Vegetation**	**Grassed Waterways**	**No-Till**	**Vegetative Buffers**	**Terraces**	**Sediment Basins**	**Total Adopted**
Marias des Cygnes River	37	23	144	72	6	39	**321**
Lower Elm	37	23	144	72	6	39	**321**
Hill Creek	16	10	62	31	2	17	**137**
Duck Creek	16	10	62	31	2	17	**137**
Total	**105**	**66**	**413**	**206**	**17**	**110**	**916**

Table 29: 5 Year Cropland BMP Phosphorous Reduction by Sub Watershed (pounds)							
Sub-watershed	**Permanent Vegetation**	**Grassed Waterways**	**No-Till**	**Vegetative Buffers**	**Terraces**	**Sediment Basins**	**Total Adopted**
Marias des Cygnes River	90	57	189	177	14	95	**621**
Lower Elm	90	57	189	177	14	95	**621**
Hill Creek	38	24	81	76	6	41	**266**
Duck Creek	38	24	81	76	6	41	**266**
Total	**257**	**162**	**540**	**506**	**41**	**270**	**1,775**

Table 30: 5 Year Cropland BMP Nitrogen Reduction by Sub Watershed (pounds)							
Sub-watershed	**Permanent Vegetation**	**Grassed Waterways**	**No-Till**	**Vegetative Buffers**	**Terraces**	**Sediment Basins**	**Total Adoption**
Marias des Cygnes River	200	126	263	197	32	105	**921**
Lower Elm	200	126	263	197	32	105	**921**
Hill Creek	86	54	113	84	14	45	**395**
Duck Creek	86	54	113	84	14	45	**395**
Total	**570**	**360**	**750**	**563**	**90**	**300**	**2,633**

Table 31: 5 Year Cropland BMP Cost Before Cost-Share by Sub Watershed							
Sub-watershed	**Permanent Vegetation**	**Grassed Waterways**	**No-Till**	**Vegetative Buffers**	**Terraces**	**Sediment Basins**	**Total Adoption**
Marias des Cygnes River	$5,575	$8,919	$14,436	$9,291	$2,323	$22,298	**$62,842**
Lower Elm	$5,575	$8,919	$14,436	$9,291	$2,323	$22,298	**$62,842**
Hill Creek	$2,389	$3,823	$6,187	$3,982	$995	$9,556	**$26,932**
Duck Creek	$2,389	$3,823	$6,187	$3,982	$995	$9,556	**$26,932**
Total	**$15,927**	**$25,484**	**$41,247**	**$26,546**	**$6,636**	**$63,710**	**$179,550**

Table 32: 5 Year Cropland BMP Cost After Cost-Share by Sub Watershed							
Sub-watershed	**Permanent Vegetation**	**Grassed Waterways**	**No-Till**	**Vegetative Buffers**	**Terraces**	**Sediment Basins**	**Total Adoption**
Marias des Cygnes River	$2,787	$4,460	$8,806	$929	$1,161	$11,149	**$29,293**
Lower Elm	$2,787	$4,460	$8,806	$929	$1,161	$11,149	**$29,293**
Hill Creek	$1,195	$1,911	$3,774	$398	$498	$4,778	**$12,554**
Duck Creek	$1,195	$1,911	$3,774	$398	$498	$4,778	**$12,554**
Total	**$7,964**	**$12,742**	**$25,160**	**$2,655**	**$3,318**	**$31,855**	**$83,694**

Livestock Tables

Table 33: Annual Livestock BMP Adoption								
Year	Vegetative Filter Strip	Relocate Feeding Site	Relocate Pasture Feeding Site	Off-Stream Watering System	Fence out Streams/ Riparian	Rotational Grazing	Grazing Mgmt Plans	Diversion Terrace
1	1	1	2	2	1	0	2	0
2	1	0	0	2	0	1	2	1
3	1	1	2	0	1	0	2	0
4	0	0	2	2	1	1	2	1
5	1	1	2	2	1	0	0	0
Total	**4**	**3**	**8**	**8**	**4**	**2**	**8**	**2**

Table 34: Annual Livestock Phosphorous Load Reduction									
Year	Vegetative Filter Strip	Relocate Feeding Site	Relocate Pasture Feeding Site	Off-Stream Watering System	Fence out Streams/ Riparian	Rotational Grazing	Grazing Mgmt Plans	Diversion Terrace	Total
1	851	1,276	119	119	70	0	561	0	**2,996**
2	1,701	1,276	119	239	70	60	1,123	1,276	**5,863**
3	2,552	2,552	239	239	140	60	1,684	1,276	**8,740**
4	2,552	2,552	358	358	210	119	2,245	2,552	**10,945**
5	3,402	3,827	477	477	281	119	2,245	2,552	**13,380**

Table 35: Annual Livestock Nitrogen Load Reduction									
Year	Vegetative Filter Strip	Relocate Feeding Site	Relocate Pasture Feeding Site	Off-Stream Watering System	Fence out Streams/ Riparian	Rotational Grazing	Grazing Mgmt Plans	Diversion Terrace	Total
1	1,602	2,403	225	225	132	0	1,057	0	**5,644**
2	3,204	2,403	225	449	132	112	2,115	2,403	**11,043**
3	4,806	4,806	449	449	264	112	3,172	2,403	**16,461**
4	4,806	4,806	674	674	396	225	4,229	4,806	**20,615**
5	6,408	7,209	899	899	529	225	4,229	4,806	**25,202**

Table 36: Annual Cost Before Cost-Share									
Year	Vegetative Filter Strip	Relocate Feeding Site	Relocate Pasture Feeding Site	Off-Stream Watering System	Fence out Streams/ Riparian	Rotational Grazing	Grazing Mgmt Plans	Diversion Terrace	Total
1	$714	$6,621	$4,406	$7,590	$4,106	$0	$3,200	$0	$26,637
2	$735	$0	$0	$7,818	$0	$7,210	$3,296	$6,820	$25,879
3	$757	$7,024	$4,674	$0	$4,356	$0	$3,395	$0	$20,207
4	$0	$0	$4,815	$8,294	$4,487	$7,649	$3,497	$7,235	$35,976
5	$804	$7,452	$4,959	$8,543	$4,621	$0	$0	$0	$26,379

Table 37: Annual Cost After Cost-Share									
Year	Vegetative Filter Strip	Relocate Feeding Site	Relocate Pasture Feeding Site	Off-Stream Watering System	Fence out Streams/ Riparian	Rotational Grazing	Grazing Mgmt Plans	Diversion Terrace	Total
1	$357	$3,311	$2,203	$3,795	$2,053	$0	$1,600	$0	$13,319
2	$368	$0	$0	$3,909	$0	$3,605	$1,648	$3,410	$12,939
3	$379	$3,512	$2,337	$0	$2,178	$0	$1,697	$0	$10,103
4	$0	$0	$2,407	$4,147	$2,243	$3,825	$1,748	$3,617	$17,988
5	$402	$3,726	$2,479	$4,271	$2,311	$0	$0	$0	$13,189

Livestock Sub-watershed Tables

Table 38: 5 Year Livestock BMP Adoption by Sub Watershed								
Sub-watershed	**Vegetative Filter Strip**	**Relocate Feeding Site**	**Relocate Pasture Feeding Site**	**Off-Stream Watering System**	**Fence out Streams/ Riparian**	**Rotational Grazing**	**Grazing Mgmt Plans**	**Diversion Terrace**
Upper 142 Mile Creek	1	1	2	2	1	1	2	1
Lower 142 Mile Creek	1	1	2	2	1	1	2	1
Upper Elm	1	1	2	2	1	0	2	0
Lower Elm	1	0	2	2	1	0	2	0
Total	4	3	8	8	4	2	8	2

Table 39: 5 Year Livestock BMP Cost Before Cost-Share by Sub Watershed								
Sub-watershed	**Vegetative Filter Strip**	**Relocate Feeding Site**	**Relocate Pasture Feeding Site**	**Off-Stream Watering System**	**Fence out Streams/ Riparian**	**Rotational Grazing**	**Grazing Mgmt Plans**	**Diversion Terrace**
Upper 142 Mile Creek	$714	$6,621	$4,406	$7,590	$4,106	$7,000	$3,200	$6,621
Lower 142 Mile Creek	$714	$6,621	$4,406	$7,590	$4,106	$7,000	$3,200	$6,621
Upper Elm	$714	$6,621	$4,406	$7,590	$4,106	$0	$3,200	$0
Lower Elm	$714	$0	$4,406	$7,590	$4,106	$0	$3,200	$0
Total	$2,856	$19,863	$17,624	$30,360	$16,424	$14,000	$12,800	$13,242

Table 40: 5 Year Livestock BMP Cost After Cost-Share by Sub Watershed								
Sub-watershed	**Vegetative Filter Strip**	**Relocate Feeding Site**	**Relocate Pasture Feeding Site**	**Off-Stream Watering System**	**Fence out Streams or Riparian**	**Rotational Grazing**	**Grazing Mgmt Plans**	**Diversion Terrace**
Upper 142 Mile Creek	$357	$3,311	$2,203	$3,795	$2,053	$3,500	$1,600	$3,311
Lower 142 Mile Creek	$357	$3,311	$2,203	$3,795	$2,053	$3,500	$1,600	$3,311
Upper Elm	$357	$3,311	$2,203	$3,795	$2,053	$0	$1,600	$0
Lower Elm	$357	$0	$2,203	$3,795	$2,053	$0	$1,600	$0
Total	$1,428	$9,932	$8,812	$15,180	$8,212	$7,000	$6,400	$6,621

Table 41: 5 Year Livestock BMP Phosphorous Load Reduction by Sub Watershed								
Sub-watershed	**Vegetative Filter Strip**	**Relocate Feeding Site**	**Relocate Pasture Feeding Site**	**Off-Stream Watering System**	**Fence out Streams or Riparian**	**Rotational Grazing**	**Grazing Mgmt Plans**	**Diversion Terrace**
Upper 142 Mile Creek	851	1,276	119	119	70	60	561	1,276
Lower 142 Mile Creek	851	1,276	119	119	70	60	561	1,276
Upper Elm	851	1,276	119	119	70	0	561	0
Lower Elm	851	0	119	119	70	0	561	0
Total	3,402	3,827	477	477	281	119	2,245	2,552

Table 42: 5 Year Livestock BMP Nitrogen Load Reduction by Sub Watershed								
Sub-watershed	**Vegetative Filter Strip**	**Relocate Feeding Site**	**Relocate Pasture Feeding Site**	**Off-Stream Watering System**	**Fence out Streams or Riparian**	**Rotational Grazing**	**Grazing Mgmt Plans**	**Diversion Terrace**
Upper 142 Mile Creek	1,602	2,403	225	225	132	112	1,057	2,403
Lower 142 Mile Creek	1,602	2,403	225	225	132	112	1,057	2,403
Upper Elm	1,602	2,403	225	225	132	0	1,057	0
Lower Elm	1,602	0	225	225	132	0	1,057	0
Total	6,408	7,209	899	899	529	225	4,229	4,806

	Rangeland Gully Implementation		Table 43	
Year	**Gullies Repaired**	**Cost per Gully $**	**Sediment Reduction (tons)**	**Phosphorus reduction (lbs)**
1	1	$1,500	100	4
2	0	$0	100	4
3	1	$1,545	200	8
4	0	$0	200	8
5	1	$1,591	300	12

Table 44: Melvern Watershed Annual Streambank Load Reductions and Cost						
Year	**Streambank Stabilization (feet)**	**Soil Load Reduction (tons)**	**Cumulative Erosion Reduction (tons)**	**Phosphorous Reduction (lbs)**	**Cumulative P Load Reduction (lbs)**	**Cost @ 3% Inflation**
1	300	240	240	14	14	$21,450
2	300	240	480	14	29	$22,094
3	300	240	720	14	43	$22,756
4	300	240	960	14	58	$23,439
5	300	240	1,200	14	72	$24,142

X - INFORMATION & EDUCATION PLAN

BMP	Targets	Information/Edu Activity/Event	Time Frame	Estimated Costs	Responsible Agency
Table 45: Cropland BMP I &E Implementation					
Buffers Grass Waterway New Terraces Diversions, Settling Basins and permanent vegetation.	Land-owners & Farmers	Demonstration Project	Annual	$5,000 per project	FHRC&D NRCS KWPT ECOTONE
		Tour/Field Day	Annual	$500 per event	FHRC&D CDs NRCS
		Newspaper Articles	Annual - Ongoing	No Charge	Any & All
		Newsletter	Quarter	$1000	FHRC&D CDs; KSU-R&E NRCS
		One on One Meetings with Producers	Annual - Ongoing	Cost included with Coordinator salary	FHRC&D CDs; KSU-R&E NRCS KWPT
No-till/ Cover Crop	Farmers & Land Owners	No-Till Workshop	Annual - Spring	$5,000 per meeting	FHRC&D CDs KSU-R&E; NRCS NTOP
		Newsletter Article	Annual	$500	Any & All
		One on One Meetings with Producers	Annual - Ongoing	Cost included with Coordinator salary	FHRC&D CDs KSU-R&E; NRCS NTOP
		Scholarships for producers to attend No-Till Winter Conference	Annual ï Winter	$150 per person	NTOP KDOC

BMP	Targets	Information/Edu Activity/Event	Time Frame	Estimated Costs	Responsible Agency
Table 47: Livestock BMP I&E Implementation					
Grade Stabilization	Farmer/ Land-owners	Newsletter Article	Annual	$500	Any and All
		One on One Meetings with Producers	Annual - Ongoing	Salary	FHRC&D NRCS CDs KSU-R&E KRC
		Demonstration Projects	Annual-Ongoing	$1000	FHRC&D NRCS CDs KSU-R&E KRC
		Tour/ Field Day	Annual-Ongoing	$1000	FHRC&D NRCS CDs KSU-R&E KRC
Grazing Management Riparian Protection & Enhancement	Farmer/ Land-owners	Newsletter Article	Annual	$500	Any and All
		One on One Meetings with Producers	Annual - Ongoing	$10,000	FHRC&D NRCS CDs KSU-R&E KRC
		Demonstration Projects Tour/ Field Day	Annual-Ongoing	$1000	FHRC&D NRCS CDs KSU-R&E KRC
Off-Stream Watering System & move feeding sites	Ranchers	Demonstration Project	Annual ï Spring	$5,000 per demonstration project	FHRC&D NRCS CDs KSU-R&E KRC
		Tour/Field Day	Annual - Summer	$500 per tour or field day	FHRC&D NRCS CDs KSU-R&E KRC

BMP	Targets	Information/Edu Activity/Event	Time Frame	Estimated Costs	Responsible Agency
Table 48: Streambank BMP I & E Implementation					
Streambank Stabilization & Restoration	Land-owners	One on one technical assistance	Annual ï Ongoing	$2,500	FHRC&D; NRCS KWO; KDOC WHRW; CDs
		Demonstration project focusing on streambank assessment methodology	Annual - Summer	$10.000 per project	FHRC&D NRCS KWO; KDOC WHRW CDs KFS ECOTONE
Table 49: Watershed Wide Information & Education					
Education of Youth	Educators; K-12 Students	Day on the Farm	Annual ï Spring	$500 per event	CDs KFB FFA KSU-R&E
		Environthon	Annual - Spring	$250	CDs Any and All
		Curriculum workshop K-12 educators	Annual - Summer	2,000 per workshop	KACEE
		Envirofest / Water Fest.	Annual ï Fall or Spring	$750	CDs KACEE EARTH FHRC&D
Education of Adults	Adults	Newsletter	Quarterly	$2,000 per quarter	FHRC&D CDs KSU-R&E
		Presentations at workshops	Annual ï Winter	No charge	CDs FHRC&D KSU-R&E
		River Friendly Farms producer notebook	Annual ï Ongoing	$500	FHRC&D KRC

BMP	Targets	Information/Edu Activity/Event	Time Frame	Estimated Costs	Responsible Agency
Table 49: Watershed Wide Information & Education (Continued)					
Media Campaign	General Public	Educational campaign about leaking/failing septic systems	Ongoing	$350 per year	LEPP
		Media campaign to promote healthy watersheds (brochures; news releases; TV; radio; web-based)	Ongoing	$1,000 per year	FHRC&D
		Watershed display for area events	Annual ï Ongoing	$500 per event	FHRC&D CDs KSU-R&E
Total annual cost for Information & Education if all events are implemented				**$ 52,000**	

Table 50: Information & Education Abbreviations

ABBREVIATION	ORGANIZATION
Any & All	Any and all credible organization or individual who might contribute
CDs	Conservation Districts
EARTH	Earth Awareness Research Tomorrow's Habitat
ECOTONE	Ecotone Forestry Services
FFA	Future Farmers of America
FHRC&D	Flint Hills Resource Conservation $ Development
KACEE	Kansas Association of Conservation and Environmental Education
KDOC	Kansas Department of Conservation
KDWPT	Kansas Department of Wildlife, Parks, and Tourism
KFB	Kansas Farm Bureau
KFS	Kansas Forest Service
KRC	Kansas Rural Center
KSU-R&E	Kansas State University Research and Extension
KWO	Kansas Water Office
LEPP	Local Environmental Protection Program
NRCS	USDA Natural Resource Conservation Service
NTOP	No-till On the Plains
WHRW	Wild-horse Riverworks

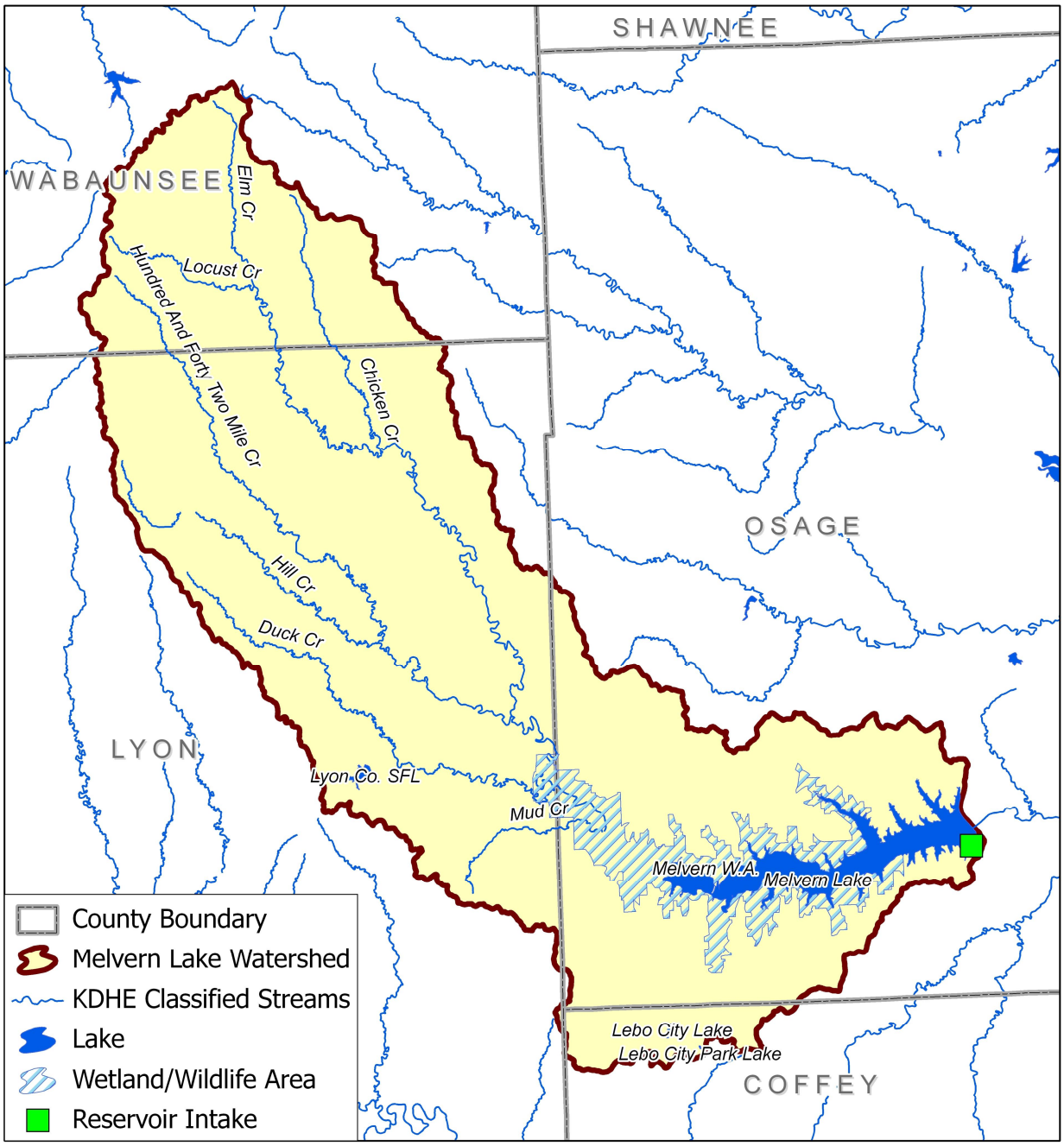
XI - PROJECT PARTNERS AND TECHNICAL SERVICE PROVIDERS

Table 51: Project Partners/ Technical Service Providers and Annual Estimated Costs

AGENCY/ORG	REPRESENTATIVE	TOWN	TELEPHONE	HOURS
ECOTONE FORESTRY	RYAN NEISES	OTTAWA	785-242-2073	40
EPA REGION 7	STEVE SCHAFF	KANSAS CITY	913-551-7447	8
FLINT HILLS RC&D	PAUL INGLE	EMPORIA	785-640-2645	1040
KACEE (ENVIRO-ED)	MELISSA ARTHUR	PERRY	785-597-5452	50
KDHE LIVESTOCK SECTION	ALAN SHARP	CHANUTE	620-431-2390	12
KDHE WATERSHED SECTION	ANN D'ALFONSO	TOPEKA	785-296-3015	80
KS DEPT OF CONSERVATION	ROB RESHKE	TOPEKA	785-296-3600	4
KS DEPT OF WILDLIFE & PARKS	JR GLENN	READING	620-699-3372	80
KS FOREST SERVICE	BILLY BECK	MANHATTAN	785-532-3693	24
KS RURAL CENTER	LYLE KOHLMEIER	STRONG CITY	620-279-4316	133
KS WATER OFICE	BOBBI WENDT	TOPEKA	785-296-0868	16
K-SATE EXTENSION KCARE	HERSCHEL GEORGE	OTTAWA	913-294-6021	167
LYON CO CONS DISTRICT	LISA WAINWRIGHT	EMPORIA	620-343-2813	80
LYON CO HEALTH DEPT	ANN MAYO	EMPORIA	620-342-4864	12
LYON CO KSU EXTENSION	BRIAN REES	EMPORIA	620-341-3220	100
LYON COUNTY NRCS	TRACY KARCHER	EMPORIA	620-343-2813	100
MDC WATERSHED DISTRICT	RON KUHN	ADMIRE	620-528-3710	80
NO-TILL ON PLAINS	BRIAN LINDLEY	WAMEGO	888-330-5142	16
OSAGE CO CONS DISTRICT	LORI KUYKENDALL	LYNDON	785-828-3458	20
OSAGE CO KSU EXTENSION	ROD SCHAUB	LYNDON	785-828-4438	20
OSAGE COUNTY NRCS	DENNIS BRINKMAN	LYNDON	785-828-3458	20
PRIDE HEALTHY TOWNS	SHERRY DAVIS	MANHATTAN	785-532-3039	0
U.S. ARMY CORPS OF ENG	DAVE GREEN	MELVERN	785-549-3318	60
U.S. FISH & WILDLIFE SERVICE	MIKE DISNEY	MANHATTAN	785-539-3474	16
WABAUNSEE CO CONS DIST	ROXANN MAIKE	ALMA	785-765-3836	60
WABAUNSEE CO KSU EXT	KARALINE MAYER	ALMA	785-765-3821	40
WABAUNSEE COUNTY NRCS	TRACY FREEMAN	ALMA	785-765-3836	80
WESTAR ENERGY GREEN TEAM	BRAD LOVELESS	TOPEKA	785-575-8115	16
WILDHORSE RIVERWORKS	PHIL BALCH	TOPEKA	785-478-4886	60
TOAL HOURS	(PER YEAR)			**2434**
TOTAL TA ESTIMATE $	@ $30 PER HOUR			**$ 73,020**

Map D

Melvern Lake Watershed
Active Public Water Supply Sources



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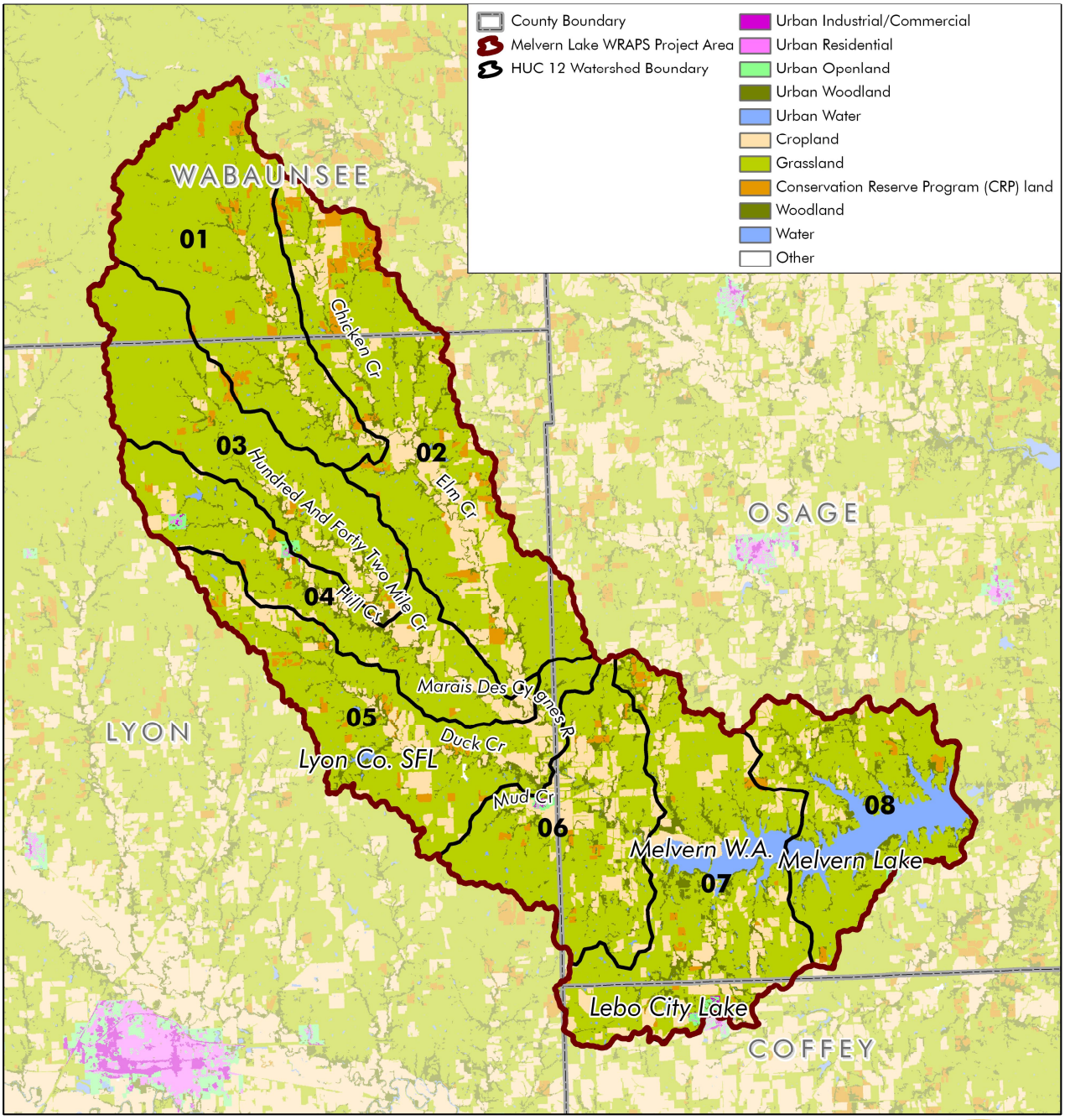
February 2011

Map F

Melvern Lake WRAPS
KLCP 2005 Land Cover



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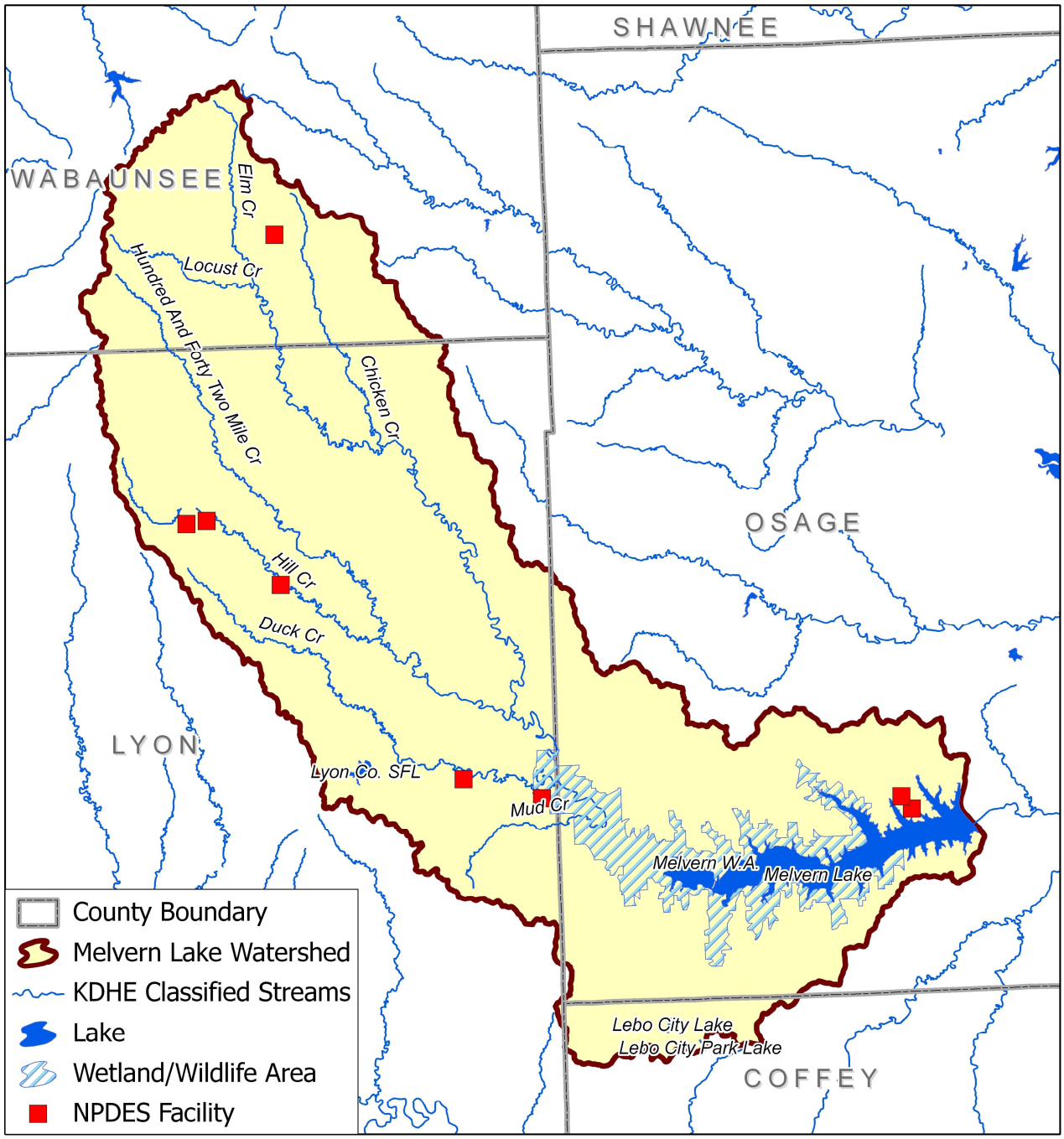
Kansas Department of Health and Environment

January 2012

Map I

Melvern Lake Watershed
National Pollutant Discharge Elimination System Facilities



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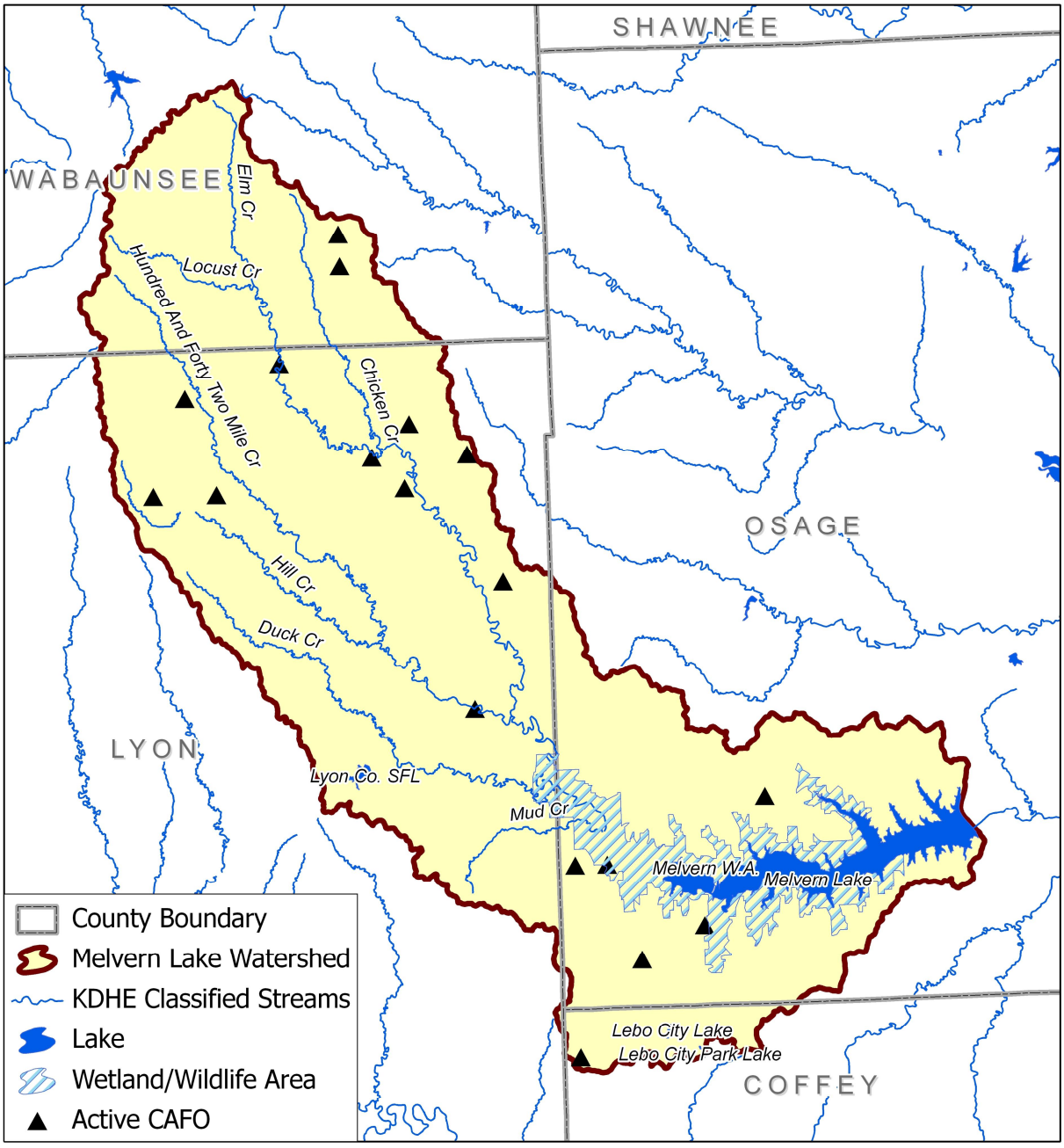
Kansas Department of Health & Environment (KDHE)

February 2011

Map J

Melvern Lake Watershed
Confined Animal Feeding Operations



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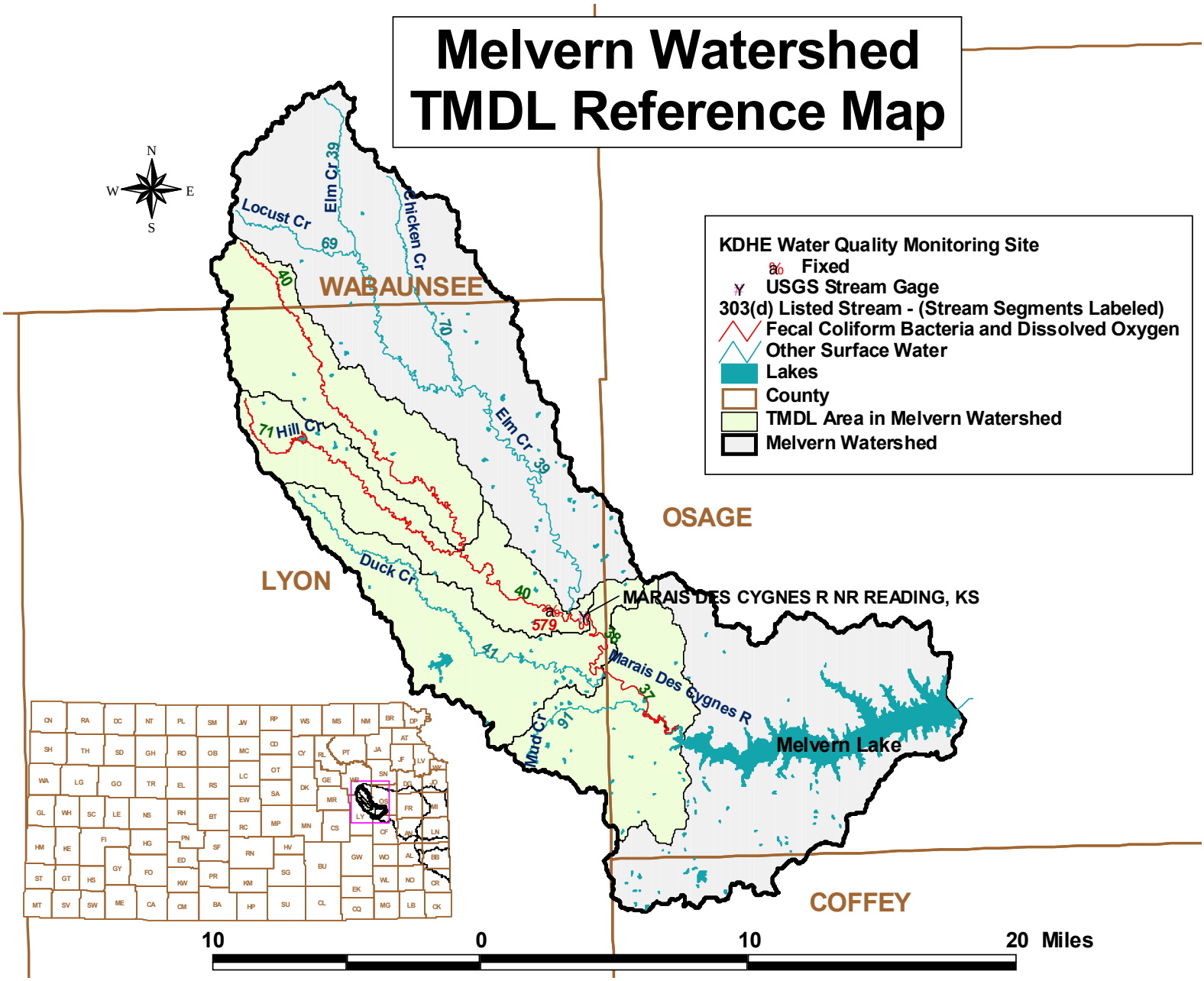
February 2011

Map K


Melvern Watershed
TMDL Reference Map
N
W
E
S
KDHE Water Quality Monitoring Site
Fixed
USGS Stream Gage
303(d) Listed Stream - (Stream Segments Labeled)
Fecal Coliform Bacteria and Dissolved Oxygen
Other Surface Water
Lakes
County
TMDL Area in Melvern Watershed
Melvern Watershed
Locust Cr
Elm Cr 39
Chicken Cr
69
40
WABAUNSEE
70
Elm Cr 39
71 Hill Cr
OSAGE
LYON
Duck Cr
40
579
MARAIS DES CYGNES R NR READING, KS
38
Marais Des Cygnes R
41
37
Mud Cr
91
Melvern Lake
COFFEY
10
0
10
20 Miles

Map L

Melvern Lake Watershed
Impaired Waters

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February 2011

XIII - BMP DEFINITIONS

Cropland

Vegetative Buffer - Area of field maintained in permanent vegetation to help reduce nutrient and sediment loss, reduce runoff, and provide habitat for wildlife.
-On average for Kansas fields, 1 acre buffer treats 15 acres of cropland.
-50% erosion reduction efficiency, 50% phosphorous reduction efficiency
-Approx. $1,000/acre, 90% cost-share available from NRCS.

Grassed Waterway - -Grassed strip used as an outlet to prevent silt and gully formation.
-Can also be used as outlets for water from terraces.
-On average for Kansas fields, 1 acre waterway will treat 10 acres of cropland.
-40% erosion reduction efficiency, 40% phosphorous reduction efficiency.
-$1,600 an acre, 50% cost-share available from NRCS.

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

Terraces - Earth embankment and/or channel constructed across the slope to intercept runoff water and trap soil.
-30% Erosion Reduction Efficiency, 30% phosphorous reduction efficiency
-$1.02 per linear foot, 50% cost-share available from NRCS

Permanent Vegetation - Planting a portion or entire field to perennial vegetation.
-95% erosion reduction efficiency, 95% phosphorous reduction efficiency.
-$150 an acre, 50% cost-share available from NRCS.

Cover Crops ï Planting of annual or biennial plants between cash crops. May be used as green manure crop or could be grazed. Objective is to keep soil covered an improve soil quality.
-50% erosion reduction efficiency, 50% phosphorous reduction efficiency
-$35 to $75 per acres depending on variety of cover crop(s) planted.

Sediment Basin - Water impoundment made by constructing an earthen dam.
-May include grade stabilization structures that control runoff and prevent gully erosion.
-Traps sediment and nutrients from leaving edge of field.
-50% soil erosion and phosphorous reduction efficiency.
-Approximately $12,000 per structure treats 40-80 acres.

Livestock/Rangeland

Vegetative Filter Strip - A vegetated area that receives runoff during rainfall from a confined animal feeding operation.
-10 year lifespan, requires periodic mowing or haying, average P reduction: 50%.
-$714 an acre estimated with four hours of dozer work plus the cost of seeding.

Relocate Feeding Sites ï Relocation of feeding sites or confined pens away from a stream, waterway, or body of water to increase filtration and waste removal of manure.
Highly variable in price, average of $6,600 per unit for a confined pen.
Highly variable in price, average of $2,203 per unit for a pasture feeding area.
-Average P reduction: 30-80%

Alternative (Off-Stream) Watering System -Watering system established away from a stream or body of water.
-Studies show cattle will drink from tank over a stream or pond 80% of the time.
-10-25 year lifespan, average P reduction: 30-98%
-$5,000 installed for solar system, including present value of maintenance costs.

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

Grazing management plan - Grazing management plan to avoid over grazing of pastures and improved grazing distribution..
-Average P reduction: 25-30%
-$1,600 average cost

Diversion Terrace - Embankment to divert runoff around animal feeding pens, or to re-direct runoff from an existing gulley..
-Average P reduction 80-95%.
-$6,800 average cost.

Gulley Rehab ï Structures or protection measures placed in existing gullies to retard gully advancement and erosion.
-Average sediment reduction - ???
- Cost is variable from $500 to $10,000 per gulley depending on severity.

Stream/Riparian Fencing – Fencing out ponds, streams and riparian areas.
-95% P Reduction. Can also reduce sediment entering the stream.
-25 year life expectancy
-Approximately $3 per linear foot of fence (1/4 mile about $4,000) includes materials, labor, and maintenance. May also need to install alternative watering system as described above.

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XV - GLOSSARY OF TERMS

Best Management Practices (BMP): Environmental protection practices used to control pollutants; such as sediment or nutrients; from common agricultural or urban land use activities.

Biological Oxygen Dem& (BOD): Measure of the amount of oxygen removed from aquatic environments by aerobic microorganisms for their metabolic requirements.

Biota: Plant & animal life of a particular region.

Chlorophyll a: Common pigment found in algae & other aquatic plants that is used in photosynthesis.

Designated Uses: Recognized uses by KDHE that should be attained in a water body.

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

E. coli bacteria: Bacteria normally found in gastrointestinal tracts of animals. Some strains cause diarrheal diseases.

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

Fecal coli form bacteria (FCB): Bacteria that originate in the intestines of all warm-blooded animals.

Municipal Water System: Water system that serves at least 25 people or has more than 15 service connections.

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

Nitrates: Final product of ammoniaôs biochemical oxidation. Primary source of nitrogen for plants. Contained in manure & fertilizers.

Nitrogen(N or TN): Element that is essential for plants & animals. TN or total nitrogen is a chemical measurement of all nitrogen forms in a water sample.

Nutrients: Nitrogen & phosphorus in water source.

Phosphorus (P or TP): Element in water that; in excess; can lead to increased biological activity.

Riparian Zone: Margin of vegetation within approximately 100 feet of waterway.

Sedimentation: Deposition of slit; clay or s& in slow moving waters.

Secchi Disk: Circular plate 10-12ò in diameter with alternating black & white quarters used to measure water clarity by measuring the depth at which it can be seen.

Stakeholder Leadership Team (SLT): Organization of watershed residents; Landowners; farmers; ranchers; agency personnel & all persons with an interest in water quality.

Total Maximum Daily Load (TMDL): Maximum amount of pollutant that a specific body of water can receive without violating the surface water-quality standards; resulting in failure to support their designated uses.

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

Water Quality Standard (WQS): Mandated in the Clean Water Act. Defines goals for a waterbody by designating its uses; setting criteria to protect those uses & establishing provisions to protect waterbodies from pollutants.

XVI - LIST OF TABLES

PAGE #

XVI - LIST OF TABLES (CONTINUED)

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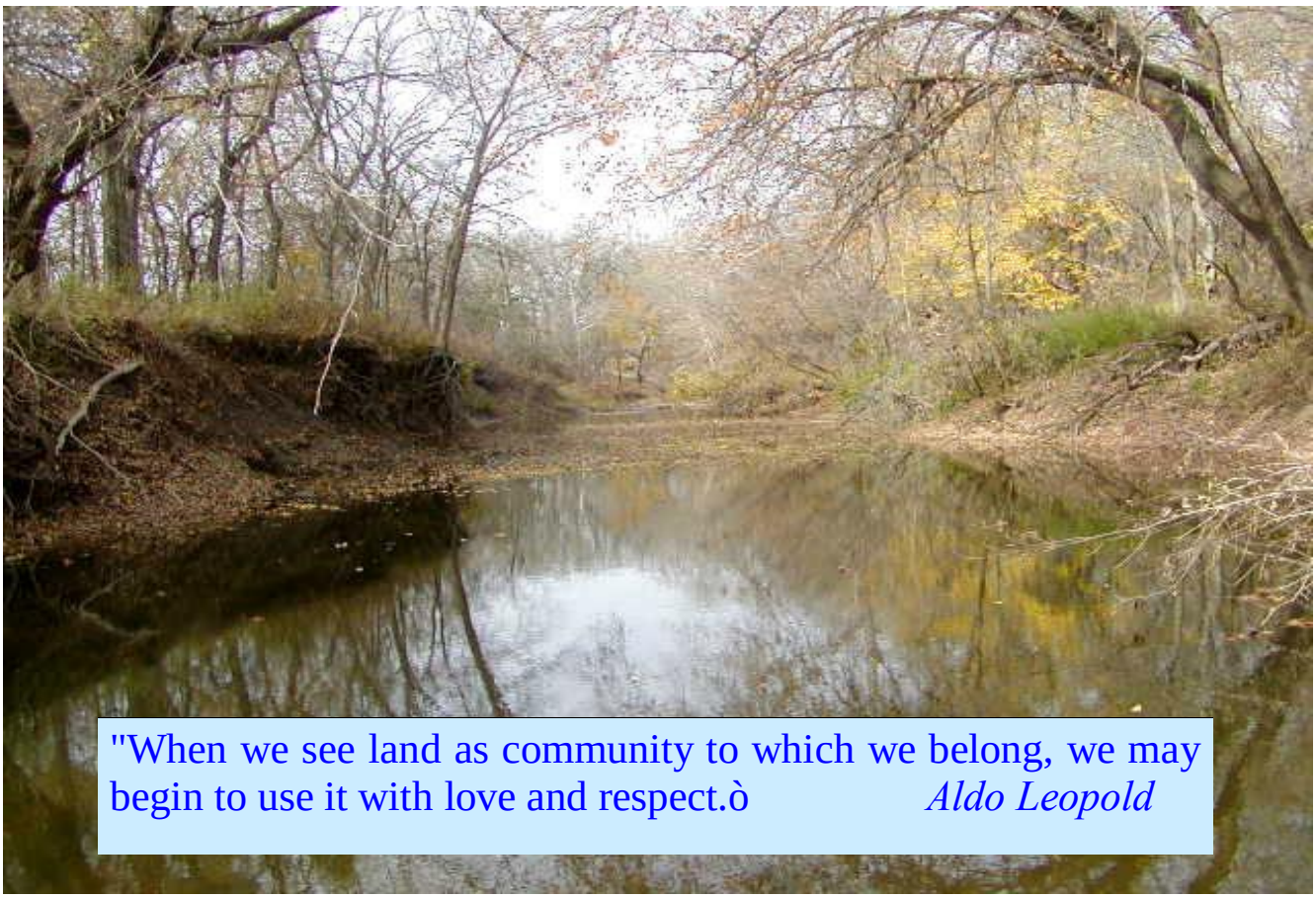
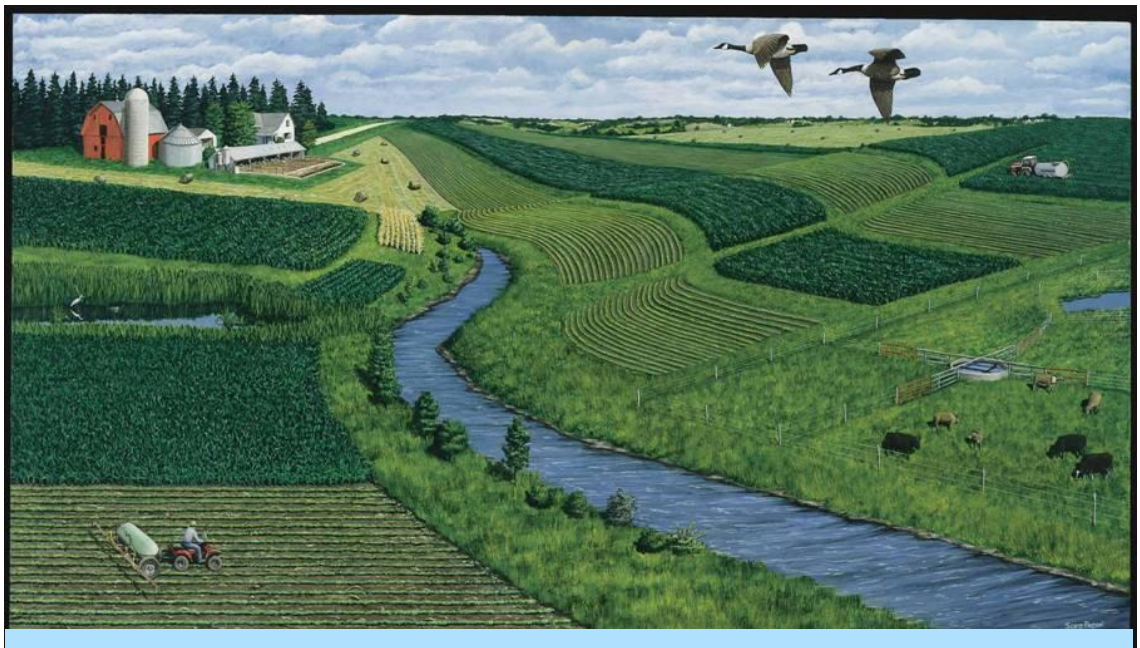


XVII - Appendices

STREAM	ASSESMENT GLOSSARY	
ITEM	**DESCRIPTION**	**DEFINITION**
S-T-R	Section, township, range	
OWNER	landowner at time of assessment	
DATE	date which assessment was performed	
REACH	stream reach code and GIS coordinate	landowners initials plus quarter sections A=NE, B=NW, C=SW, D=SE
CC	channel condition	Channel still in a natural meandering pattern, or has it been straightened?
BS	bank stability	Are the streamôs banks stable or eroding and to what degree?
HO	hydrologic obstructions	Are there any obstructions in the channel such as dams or logjams?
RZ	riparian zone	How wide is the riparian buffer zone?
WC	water clarity	How far can you see under water? Algae blooms?
PR	pools and riffles	Are both riffles and pools present in the reach as well as pool depth?
RE	riffle embeddedness	Are the bars covered with sediment and active or are they well vegetated?
AH	aquatic habitat structure	Woody debris, submerged logs, leaf packs, undercut banks, cobble, gravel.
EC	e-coli potential	Livestock, wildlife and failing septic systems
CP	canopy cover	How well shaded is the stream?
AVG	average score for reach	sum of ten scores divided by 10
PSE	phase in stream evolution	1=stable; 2=downcutting, 3=widening, 4=aggrading, 5=stable
Notes	Areas where follow-up may be needed	stream-side buffers, logjams, and streambank streambank erosion.



A STREAM IS A WINDOW TO ITS' WATERSHED

Melvern - Stream Assessment

Owners name ____________________________: Date _____________________: Time ______________________

Stream _________________________: Reach __________: Legal Description ___________________________

Weather Conditions _________________________: Weather past five days ________________________________

Baseflow Channel width ________: Estimated bank-full depth __________: Dominant substrate __________

SCORE (1 - 10) >>>

1. ***Channel Condition***: Natural _____ Evidence of Alteration _____ Altered Channel _____
2. ***Bank Stability:*** Bank Ht./BFD _____ Root Density Cover % _____ Angle _____
3. ***Hydrologic Obstructions:*** Obstruction within: <3 miles ____ 1-3____ <1____ in reach ____
4. ***Riparian Zone***: Natural Vegetation to Channel Width/ 2W ___ 1W ___.5W ____<.3W___
5. ***Water Clarity***: Clear ____ Murky ____ Greenish ____ Odor____ Turbidity (ft) _______
   Algae: Light _____ Moderate _____ Severe _____ Other ___________________
6. ***Pools & Riffles:*** Pool depth; 3-5' _____ 1-3' _____ <1'____ Absent ____ # of pools _____
   Riffles in reach; 2-3 _____ 1-2 _____ 0 _____ Channel widths between riffles _____
7. ***Riffle Embeddedness***: Percent < 20%____20-40% ____ >40% ____ 100% embedded ____
8. ***Aquatic Habitat:*** # Habitat Types: >5 ____ 3-4____1-2 ____ 0-1 _______
   Woody debris, submerged logs, leaf packs, undercut banks, cobble, boulders, coarse gravel.
9. ***E-Coli potential:*** Livestock present ____Evidence ____ No Evidence ____ Other _____
10. ***Canopy Cover:*** ***East:*** Percent Cover/ >90% ____ 60-90 ____ 30-60 ____ 30% or less_____
    West: >75% ____ 50-75 ____ 25-50 ____ 10-25____ 10% or less ______

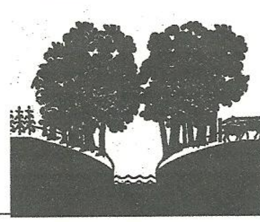
>>>

<6.0 Poor

6.1 - 7.4 Fair

7.5 - 8.9 Good

> 9.0 Excellent



Total Sum of Scores/Ten

Phase in Stream Evolution I_____II_____III_____IV_____V_____ Unable to document_____

Total number of linear feet of streambank that could be treated. __________________Photo #s________

Land use adjacent to the stream reach : Cropland _____ Pastureland ____ Other ___________________

Total number of linear feet of buffer strips that could be planted. _________________Acres _________

Recommendation/Notes:____

Reference: ***Stream Visual Assessment Protocol.*** USDA, NRCS, Technical Note 99-1
http://www.nrcs.usda.gov/technical/ECS/aquatic/svapfnl.pdf

SUB-WATERSHED - UPPER ELM/LOCUST CREEK - HUC-12-# 102901010101																			
STREAM	S	T	R	OWNER	DATE	REACH	CC	BS	HO	RZ	WC	PR	RE	AH	EC	CP	AVG	PSE	NOTES
UPPER-ELM CREEK	20	15	12	MORAN	2-Jul-03	RMBBD	6.0	7.0	7.0	7.0	6.0	7.0	7.0	8.0	8.0	7.0	7.0	3.5	
UPPER-ELM CREEK	20	15	12	CONVERSE	2-Jul-03	VCCBA	7.0	6.0	5.0	4.0	6.0	7.0	7.0	7.0	6.0	5.0	6.1	3.0	BUFFERS
UPPER-ELM CREEK	17	15	12	CONVERSE	8-Jul-03	VCAAC	7.0	8.0	6.0	5.0	6.0	7.0	8.0	8.0	8.0	6.0	7.0	4.0	
UPPER-ELM CREEK	17	15	12	SPARKMAN	18-Jul-03	CSBAB	8.0	6.0	8.0	7.0	7.0	8.0	8.0	7.0	8.0	6.0	7.4	3.0	BUFFERS
UPPER-ELM CREEK	8	15	12	WAUGH	31-Jul-03	JWBCC	7.0	3.0	6.0	5.0	8.0	8.0	8.0	6.0	8.0	4.0	6.6	3.0	STABE
UPPER-ELM CREEK	7	15	12	WAUGH	14-Aug-03	JWBAA	7.5	7.5	6.5	8.0	7.5	8.0	8.0	6.5	8.0	6.5	7.5	3.0	
UPPER-ELM CREEK	6	15	12	BOWERS	9-Sep-03	KBCBA	8.0	6.0	7.0	6.0	7.5	8.0	8.0	7.0	8.5	6.0	7.3	3.0	STABE
UPPER-ELM CREEK	31	14	12	CLARK	21-Oct-03	GCACC	5.0	6.5	7.5	7.0	7.5	7.5	8.0	7.5	5.0	7.0	6.8	3.5	LIVESTK
UPPER-ELM CREEK	3	16	12	STANFORD	15-Jul-04	MSAAB	6.5	7.5	3.0	8.0	8.0	9.0	8.0	8.0	9.0	7.0	7.4	4.0	
UPPER-ELM CREEK	29	15	12	YEAGER	4-Nov-08	STABD	8.0	7.0	7.0	6.0	8.0	7.0	6.0	8.0	7.0	6.0	7.0	3.0	BUFFERS
UPPER-ELM CREEK	33	15	12	COATES	4-Nov-08	GCDDA	6.0	7.0	8.0	7.5	8.0	8.0	8.0	8.0	7.0	7.5	7.5	3.5	BUFFERS
UPPER-ELM CREEK	33	15	12	COATES	4-Nov-08	GCCAB	8.0	7.0	8.0	7.0	8.0	6.0	7.0	7.0	8.0	8.0	7.4	3.0	BUFFERS
UPPER-ELM CREEK	2	16	12	G-STINSON	14-May-09	GSCDA	6.0	7.0	9.0	7.0	8.0	7.0	7.0	9.0	8.0	8.0	7.6	4.0	BUFF
UPPER-ELM CREEK	3	16	12	D-BOLINE	19-May-09	DBDBB	8.0	3.0	7.0	5.0	8.0	7.0	7.5	7.0	8.0	6.5	6.7	3.0	STABE,LJ
UPPER-ELM/LOCUST						**AVERAGE**	**7.0**	**6.3**	**6.8**	**6.4**	**7.4**	**7.5**	**7.5**	**7.4**	**7.6**	**6.5**	**7.1**	**3.3**	
SUB-WATERSHED - LOWER-ELM/CHICKEN CREEK - HUC-12-# 102901010102																			
STREAM	S	T	R	OWNER	DATE	REACH	CC	BS	HO	RZ	WC	PR	RE	AH	EC	CP	AVG	PSE	NOTES
LOWER ELM CREEK	16	17	13	BRIGGS	26-Oct-05	CBABA	7.0	8.0	9.0	7.0	7.0	9.0	8.0	8.0	9.0	8.0	8.0	4.0	BUFFERS
LOWER ELM CREEK	10	17	13	DAVIES	23-Nov-05	DDBCB	8.0	8.0	8.0	6.0	8.0	8.0	8.0	8.0	5.0	7.0	7.4	3.5	BUF&LST
CHICKEN CREEK	26	15	12	CAIN	9-Jan-09	DCACC	8.0	6.0	7.0	7.0	8.0	7.0	7.0	8.0	8.0	8.0	7.4	3.0	BUFF
CHICKEN CREEK	35	15	12	BOLINE	5-May-09	DBCDB	8.0	6.0	8.0	8.0	7.0	6.0	7.0	8.0	8.0	8.0	7.4	3.5	BUF,LJ,LV
CHICKEN CREEK	2	16	12	G-STINSON	19-May-09	GSDBA	7.5	7.5	7.0	7.0	6.0	6.0	7.0	8.0	8.0	8.0	7.2	3.5	LJ
CHICKEN CREEK	35	15	12	STANFORD	19-May-09	MSBDC	7.5	5.0	7.5	8.0	6.0	7.0	6.0	8.0	8.0	8.0	7.1	3.0	
LOWER ELM CREEK	1	16	12	MURPHY	21-May-09	JMCAD	7.5	6.5	7.0	7.0	7.0	8.0	7.0	9.0	8.0	8.0	7.5	3.5	BUFFERS
LOWER ELM CREEK	1	16	12	REED	4-Jun-09	RRCBB	8.0	8.0	4.0	7.0	6.0	5.0	5.0	6.0	9.0	8.0	6.6	4.0	BUFF
LOWER ELM CREEK	7	16	13	KANIPER	4-Jun-09	GCACC	7.5	8.0	5.0	7.5	6.0	5.0	6.0	6.0	6.0	7.0	6.4	4.0	BUFF
LOWER ELM CREEK	18	16	13	R-PORTER	2-Jul-09	RPBDD	3.0	8.0	6.0	6.0	7.0	6.0	6.0	7.0	8.0	7.0	6.4	4.0	Buffers
LOWER ELM CREEK	18	16	13	H-LYNCH	2-Jul-09	HLADB	7.5	8.0	7.5	6.0	7.0	6.0	6.0	7.0	9.0	8.0	7.2	4.0	Buffers
LOWER ELM CREEK	20	16	13	R-PORTER	8-Jul-09	RPBDB	8.0	7.5	7.5	6.0	7.0	6.0	7.0	6.5	6.5	6.0	6.8	4.0	Buffers
LOWER ELM CREEK	20	16	13	R-PORTER	23-Jul-09	RPDCC	7.0	8.0	8.0	4.0	6.0	5.0	5.0	7.0	6.0	6.0	6.2	4.0	Buffers
LOWER ELM CREEK	29	16	13	R-PORTER	16-Sep-09	RPBDB	7.0	7.0	8.0	5.0	8.0	6.0	8.0	8.0	8.0	6.0	7.1	3.5	Buffers
LOWER ELM CREEK	29	16	13	R-PORTER	19-Oct-09	RPBDB	6.0	7.0	7.0	6.0	7.0	6.0	6.0	8.0	8.0	6.0	6.7	3.0	Buffers
LOWER ELM CREEK	33	16	13	D-PETERSON	3-Nov-09	DPCDC	8.0	8.0	7.0	6.5	7.0	5.0	6.0	7.5	6.0	7.5	6.9	4.0	BUFFERS
LOWER ELM CREEK	33	16	13	D-PETERSON	3-Nov-09	DPCBC	8.0	7.0	6.0	4.0	6.0	7.5	8.0	8.0	8.0	7.5	7.0	3.5	STABE
LOWER ELM CREEK	4	17	13	K-STINSON	5-Nov-09	KSDBA	8.0	7.5	7.5	6.0	8.0	8.0	6.0	7.0	8.0	7.0	7.3	4.0	BUFFERS
LOWER ELM CREEK	4	17	13	R-PORTER	5-Nov-09	RPCDB	7.5	6.0	6.0	7.5	8.0	6.0	6.5	8.0	8.0	6.5	7.0	3.0	
LOWER ELM CREEK	6	17	13	C-BRIGGS	20-Nov-09	ABD	6.0	6.0	4.0	5.0	6.0	5.0	6.0	7.0	8.0	7.0	6.0	3.0	buffers
LOWER ELM/CHICKEN						**AVERAGE**	**6.9**	**7.4**	**6.8**	**6.7**	**7.6**	**6.6**	**7.3**	**7.6**	**8.7**	**7.0**	**6.8**	**3.6**	

SUB-WATERSHED - LOWER 142-MILE/HILL CREEK - HUC-12-# 102901010104																		
STREAM	S	T	R	OWNER	DATE	REACH	CC	BS	HO	RZ	WC	PR	RE	AH	EC	CP	AVG	PSE	NOTES
LOWER-142-MILE	17	17	13	C-BRIGGS	2-Nov-06	CBBCB	8.0	7.0	7.5	7.0	8.0	9.0	8.0	8.0	7.5	6.5	7.7	3.5	BUFFERS
LOWER-142-MILE	2	17	12	MALLIEN	2-Aug-07	MMBCA	8.0	8.0	7.0	8.0	7.0	7.0	8.0	7.0	9.0	8.0	7.7	4.0	
HILL CREEK	2	17	12	KIRK	16-Aug-07	PKBCB	6.0	5.0	6.0	7.5	7.5	6.0	6.0	7.0	8.0	8.0	6.6	3.0	BUFFERS
HILL CREEK	33	16	12	ROBINSON	30-Aug-07	MRACA	6.5	7.0	8.0	6.5	7.0	8.0	7.0	7.0	7.0	8.0	7.1	3.5	BUFFRS
HILL CREEK	29	16	12	KIRK	1-Jul-08	PKBAD	8.0	7.0	6.0	9.0	6.0	7.0	7.0	7.0	9.0	9.0	7.3	3.5	
HILL CREEK	29	16	12	WINKLER	10-Jul-08	DWCAB	9.0	6.0	7.0	9.0	8.0	8.0	6.0	8.0	9.0	8.0	7.8	3.5	
HILL CREEK	20	16	12	BATHURST	16-Jul-08	BBACC	8.0	6.0	7.0	6.0	7.0	7.5	7.0	8.0	9.0	8.0	7.4	3.5	
HILL CREEK	19	16	12	LOWDER	29-Sep-08	LLCDA	7.0	7.0	8.0	8.0	7.0	7.0	8.0	7.0	7.0	9.0	7.5	4.0	BUFERS
HILL CREEK	13	16	11	LOWDER	20-Oct-08	LLADD	9.0	7.5	7.0	7.0	8.0	8.0	8.0	9.0	7.5	7.0	7.8	4.0	BUFFERS
LOWER-142-MILE	16	17	13	C-BRIGGS	29-Oct-08	CBACD	9.0	7.0	7.0	5.0	7.0	5.0	7.5	7.0	9.0	7.5	7.1	3.5	BUFFERS
LOWER-142-MILE	2	17	12	MALLIEN	3-Nov-10	MMBAD	7.5	7.5	6.0	7.5	8.0	6.0	6.0	8.0	9.0	8.0	7.3	3.0	
LOWER 142/HILL CREEK						AVERAGE	7.8	7.4	6.8	6.7	7.6	6.6	7.3	7.6	8.7	7.0	7.4	3.5	
SUB-WATERSHED - UPPER 142-MILE/HILL CREEK - HUC-12-# 102901010103																			
STREAM	S	T	R	OWNER	DATE	REACH	CC	BS	HO	RZ	WC	PR	RE	AH	EC	CP	AVG	PSE	NOTES
UPPER-142-MILE	21	16	12	WOOD	11-May-05	DWBAD	8.0	6.5	6.0	6.5	6.5	8.0	7.0	9.0	9.0	7.0	7.4	3.0	BUFFERS
UPPER-142-MILE	1	16	11	WHEAT	3-Aug-05	PWADD	8.0	8.0	4.0	7.5		8.0	8.0	9.0	7.5	6.0	7.6	4.0	LOGJ
UPPER-142-MILE	7	16	12	HEINE	20-Sep-05	HHBBD	8.0	7.0	7.5	7.0	7.5	9.0	8.5	7.0	7.0	6.0	7.6	3.5	
UPPER-142-MILE	17	16	12	OGELBY	13-Oct-05	DODAB	9.0	7.5	6.5	8.0	7.5	8.0	8.0	8.0	8.0	7.5	7.8	3.5	
UPPER-142-MILE	35	16	12	S-WHITMORE	19-Oct-09	SWCAB	6.0	7.5	6.5	6.0	8.0	6.0	7.0	8.0	9.0	5.0	6.9	3.5	BUFFERS
UPPER-142-MILE	7	16	12	G-HIENE	20-Oct-10	GHBAB	8.0	5.0	8.0	6.0	7.0	6.5	6.5	7.0	8.0	6.0	6.8	3.7	SETBACK
UPPER-142-MILE	8	16	12	E-LYDANN	20-Oct-10	ELBCC	8.0	6.0	7.0	6.0	7.5	8.0	7.5	8.0	9.0	6.0	7.3	3.7	BUFFERS
UPPER-142-MILE	1	16	11	B-MARTIN	18-Apr-10	BMDAC	8.0	6.0	6.0	4.0	7.0	8.0	8.0	8.0	4.0	6.0	6.5	3.0	STABE
UPPER-142-MILE	23	15	11	COFFMAN	1-Jul-10	ECCBD	8.0	7.5	6.5	8.0	6.5	7.5	7.5	8.0	5.0	8.0	7.3	4.5	ALT H20
UPPER-142-MILE	21	17	12	J-HUFFMAN	20-Oct-10	JHBCB	5.0	7.0	6.0	7.0	8.0	7.5	7.5	8.0	8.0	7.0	7.1	4.0	
UPPER-142-MILE	17	16	12	L-BOLINE	20-Oct-10	LBCBD	7.0	8.0	7.5	7.5	8.0	7.0	7.5	8.0	9.0	7.5	7.7	4.0	
UPPER-142-MILE	22	16	12	D-WOODS	28-Oct-10	DWBBC	8.0	7.5	7.5	6.5	7.0	5.0	5.0	8.0	8.0	7.5	7.0	3.0	BUFFERS
UPPER-142-MILE	21	17	12	B-HUFFMAN	28-Oct-10	BHCBD	7.5	7.5	7.0	7.0	7.5	7.5	7.0	8.0	8.0	7.5	7.5	3.7	BUFFERS
UPPER-142-MILE	35	16	12	CARPENTER	3-Nov-10	WCBCD	6.5	6.5	8.0	7.0	7.5	6.0	5.0	8.0	9.0	8.0	7.1	3.0	
UPPER-142-MILE	22	16	12	H-PRICE	3-Nov-10	HPCDC	6.5	7.5	8.0	3.0	6.5	5.0	6.0	7.0	9.0	6.0	6.5	4.0	BUFFERS
UPPER-142-MILE	27	16	12	L-BIRCH	3-Nov-10	LBDBB	6.0	6.0	6.0	6.0	6.0	8.0	6.0	8.0	9.0	7.0	6.8	3.0	
UPPER-142-MILE	27	16	12	L-BIRCH	3-Nov-10	LBBBD	8.0	6.5	6.5	6.0	7.5	6.0	6.0	7.0	9.0	6.0	6.9	3.5	BUFFERS
UPPER-142-MILE	11	18	10	P-WHEAT	18-Nov-10	PWBCA	7.0	6.0	8.0	6.0	8.0	7.5	7.5	8.0	8.0	7.0	7.3	3.0	
LOWER 142/HILL CREEK						AVERAGE	7.4	6.9	6.8	6.4	7.3	7.1	7.0	7.9	8.0	6.7	7.2	3.5	

SUB-WATERSHED - DUCK CREEK - HUC-12-# 102901010105																		
STREAM	S	T	R	OWNER	DATE	REACH	CC	BS	HO	RZ	WC	PR	RE	AH	EC	CP	AVG	PSE	NOTES
DUCK CREEK	4	17	12	M-ROBINSON	1-Feb-06	MRCBD	8.0	5.0	6.0	8.0	7.0	8.0	7.0	6.0	8.0	7.0	7.0	3.0	LOGJ
DUCK CREEK	9	17	12	KANIPER	14-Feb-06	RKDDA	6.0	6.5	6.5	7.0	6.5	7.0	7.0	6.5	7.0	7.0	6.7	3.0	
DUCK CREEK	34	17	13	USA	27-Feb-06	DKCDB	8.0	7.0	7.0	7.0	7.0	8.0	7.0	7.0	8.0	8.0	7.3	3.0	BUF,LOGJ
DUCK CREEK	15	17	12	DEDONDER	14-Jun-06	KDBAB	7.0	7.5	6.0	8.0	7.0	7.0	7.0	7.5	6.0	8.0	7.0	3.5	BUF,LST
DUCK CREEK	23	17	12	SIELERT	6-Jul-06	DSDBB	8.0	7.0	7.0	9.0	7.0	7.0	7.0	7.0	9.0	9.0	7.6	3.5	
DUCK CREEK	23	17	12	JONES	8-Aug-06	DJDAD	7.0	7.5	6.5	8.5	7.0	7.0	7.0	7.0	9.0	7.5	7.4	3.5	LOGJ
DUCK CREEK	30	17	13	WILSON	22-Aug-06	DWCAB	8.0	6.5	8.0	7.0	7.0	8.0	8.0	7.0	9.0	7.0	7.6	3.5	BUFFERS
DUCK CREEK	28	17	13	BRIGGS	7-Sep-06	SBBDC	7.5	7.5	7.0	7.0	7.5	7.0	6.5	7.0	6.5	8.0	7.1	3.5	BUFFERS
DUCK CREEK	29	17	13	GRIFFITH	15-Sep-06	BGDBD	8.0	7.5	7.0	9.0	8.0	9.0	7.5	7.5	8.5	8.5	8.0	3.5	BUF&LJ
MARDCYNE RIVER	21	17	13	C-BRIGGS	29-Oct-08	CBAAA	9.0	7.5	8.0	6.0	7.0	8.0	8.0	8.0	9.0	8.0	7.9	4.0	BUFFERS
MARDCYNE RIVER	22	17	13	C-BRIGGS	31-Oct-08	CBBAB	9.0	8.0	7.0	5.0	7.0	6.0	7.0	8.0	9.0	7.0	7.3	3.0	BUFFERS
DUCK CREEK						**AVERAGE**	**7.8**	**7.0**	**6.9**	**7.4**	**7.1**	**7.5**	**7.2**	**7.1**	**8.1**	**7.7**	**7.3**	**3.3**	

MARAIS DES CYGNES – MELVERN RESERVOIR WATERSHED EROSION ASSESSMENT

ArcGIS® Comparison Study: 1991 vs. 2008 Aerial Photography

Executive Summary

Federal reservoirs are an important source of water supply in Kansas for roughly two-thirds of Kansasô citizens. The ability of a reservoir to store water over time is diminished as the capacity is reduced through sedimentation. In some cases reservoirs are filling with sediment faster than anticipated. Whether sediment is filling the reservoir on or ahead of schedule, it is beneficial to take efforts to reduce sedimentation to extend the life of the reservoir.

The Kansas Water Authority has established a *Reservoir Sustainability Initiative* that seeks to integrate all aspects of reservoir input, operations and outputs into an operational plan for each reservoir to ensure water supply storage availability long into the future. Reduction of sediment input is part of this initiative.

The Marais des Cygnes-Melvern Reservoir Watershed Assessment, an ArcGIS® Comparison Study, was initiated to partially implement the *Reservoir Sustainability Initiative*. This assessment identifies areas of streambank erosion and streambank gully erosion concerns to provide a better understanding of the Marais des Cygnes-Melvern Reservoir watershed. This information is provided for mitigation purposes, for application of understanding to watersheds and to reduce excessive sedimentation in reservoirs across Kansas. The comparison study was designed to guide prioritization of streambank restoration by identifying reaches of streams where erosion is most severe in the watershed above Melvern Reservoir.

The Kansas Water Office (KWO) 2011 assessment quantifies annual tons of sedimentation from streambanks between 1991 and 2008 within the Marais des Cygnes-Melvern Reservoir watershed in Kansas. The assessment estimates about 26,671 tons of sediment is transported from the Marais des Cygnes-Melvern Reservoir watershed to the reservoir itself annually. It should be noted that identified areas of sedimentation from the streambank erosion assessment accounts for only a portion of all streambank erosion locations within the Marais des Cygnes-Melvern Reservoir watershed. Only those streambank erosion sites observed as having streambank movement covering an area roughly 1,500 sq. feet or more were identified within the assessment. The latest 2009 bathymetric survey indicated that storage capacity in the multi-purpose pool, which contains public water supply storage, had been reduced by roughly 2.07% since the reservoir was filled in 1975; original storage capacity totaling 154,370 acre-ft. A substantial portion of this sediment is transported from the main stem Marais des Cygnes River and its major tributaries Elm Creek, Mud Creek, 142 Mile Creek, Duck Creek and Chicken Creek.

Based on estimated stabilization costs of $71.50 per linear foot from an assessment conducted by The Watershed Institute, Inc. (TWI), streambank stabilization for the entire watershed based on the 2011 assessment would cost approximately $2.2 million. The streambank gully erosion assessment did not quantify annual tons of soil loss. However, locations of gully erosion were identified for prioritization purposes using 2008 NAIP aerial imagery. The KWO completed this assessment for the Melvern Reservoir Watershed Restoration and Protection Strategy (WRAPS) Stakeholder Leadership Team (SLT). Information contained in this assessment can be used by the Melvern Reservoir WRAPS SLT to target streambank stabilization and riparian restoration efforts toward high priority stream reaches in the Marais des Cygnes-Melvern Reservoir watershed. Similar assessments are ongoing in selected watersheds above reservoirs throughout Kansas and will be made available upon request to agencies and interested parties for the benefit of streambank and riparian restoration projects.