

Neosho Basin High Priority Issue Watershed Restoration and Protection October 2010 Update

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Issue

Watershed Restoration and Protection efforts are needed to address a variety of water quality and water resource concerns such as achieving Total Maximum Daily Loads (TMDL), Nutrient Reduction goals, development of Source Water Protection Plans, reduction of sedimentation in reservoirs and lakes, and protection or restoration of wetland and riparian habitats.

Description

There are three federal reservoirs in the [Neosho basin](#): [Marion](#), [Council Grove](#) and [John Redmond](#). All are operated by the U.S. Army Corps of Engineers (Corps) and all are used for public water supply programs that serve numerous cities and rural water districts. The reservoirs are also managed by the Corps for flood control and recreation. Two additional water supply reservoirs are in the basin: Council Grove City Lake and Parsons City Lake. Both lakes provide localized water supply and have additional benefits including recreation.

All three federal reservoirs, and many streams and tributaries that connect them, are experiencing water quality impairments. Fecal coliform bacteria and low levels of dissolved oxygen (D.O.) are the most prevalent stream impairments. Sedimentation and eutrophication are the most prevalent reservoir and lake impairments.

Sedimentation is a major water quantity concern, particularly in reservoirs where the state owns storage for the Water Marketing Program, or where an assurance district owns storage. See [Surface Water Management Policy](#) for a description of these programs. As sediment accumulates in a reservoir's multi-purpose pool, the capacity for water supply storage is reduced. Figure 1 shows the estimated percent of multipurpose pool capacity lost since construction, including water supply storage, to sediment deposition in federal reservoirs in the Neosho basin.

Reservoir sedimentation is a result of soil erosion from the land surface and from stream channels and banks. In most Kansas watersheds, this natural process has been accelerated due to changes in land cover and the modification of stream channels to accommodate agricultural, urban and other land uses. Growing evidence shows that a significant source of sediment in streams is generated from stream channels and edge of field gullies. Streambank erosion can contribute nutrients, such as phosphorus, which can cause water quality impairments.

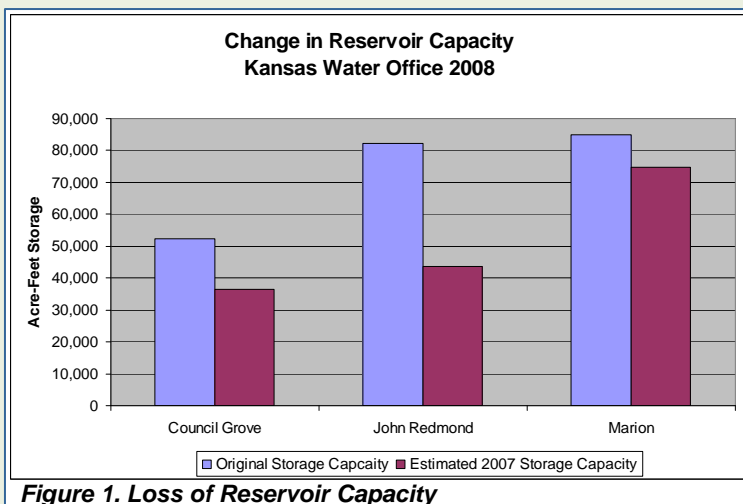


Figure 1. Loss of Reservoir Capacity

Programs are available through state and federal agencies to restore riparian areas and streams. However, more targeted planning is needed to restore the areas with the greatest potential to improve the health of the watershed and extend the life of our reservoirs.

Loss of capacity in John Redmond Reservoir is the most pressing issue among the three federal reservoirs because it provides cooling water to Wolf Creek Nuclear Power Plant. Efforts are underway to determine the sources of sediment and to identify actions most likely to result in improvement in long term reservoir storage capacity. These efforts are described in other parts of this section.

When this basin priority issue was approved in 2009, the following recommendations were made to address watershed restoration and protection needs in the Neosho basin.

Recommended Actions

1. Continue development and support of local Watershed Restoration and Protection (WRAPS) groups, with technical assistance from state and federal agencies to develop management plans. Coordinate funding sources to address highest priority problems first. Focus state resources towards high priority watersheds, particularly those that include high priority TMDLs, high biological priority, and source water protection.
2. Target resources to the improvement and management of riparian areas in priority watersheds.
3. Coordinate with the Kansas Department of Wildlife and Parks and other organizations and agencies to prevent the spread of Zebra mussels in the basin.

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4. Continue cooperative inter-state efforts to improve water resource conditions in the entire Neosho/Grand River Lake of the Cherokees watershed.
5. Complete the Corps John Redmond Feasibility study and incorporate results into WRAPS and other cooperative planning efforts.
6. Work with local governments; including conservation districts, local environmental protection programs, and stormwater utilities to develop and implement comprehensive urban stormwater and source water management plans.
7. Continue public outreach efforts to educate the public and landowners about the benefits of best management practices.
8. Encourage other agencies and entities in partnerships and participation to support WRAPS initiatives, activities and funding.

Since 2009, substantial progress has been made in the implementation of these recommendations. This update provides additional information about recent activities and data acquisition.



Figure 2. John Redmond Boat Ramp. Photo courtesy KWO.

Recommendation: Continue development and support of local Watershed Restoration and Protection (WRAPS) groups, with technical assistance from state and federal agencies to develop management plans. Coordinate funding from among sources to address highest priority problems first. Focus state resources towards high priority watersheds, particularly those that include high priority TMDLs, high biological priority and source water protection.

Water Quality Impairments and Total Maximum Daily Loads

Water quality protection and improvement is most effectively addressed at the watershed level, using regulatory and non-regulatory programs. [Surface water](#) quality monitoring is conducted to assess the level of pollutants in the water and the health of the biological community. If monitoring indicates that a river segment or other water body is consistently violating surface water quality standards, the water is classified as water quality impaired. Water bodies not meeting water quality standards for their designated use(s) are identified on the 303(d) list. The 303(d) list is used to identify those waters targeted for the development of Total Maximum Daily Loads (TMDLs).

A TMDL is the maximum amount of a pollutant that a water body can receive without exceeding water quality standards. Since pollution can arrive via point and non-point sources, the TMDL process distributes responsibility for the pollutant load reductions among both contributing sources. TMDLs are assigned high, medium, or low priority status for implementation. High priority TMDLs are targeted for financial assistance programs. Medium priority TMDLs are addressed if resources are available after high priority TMDL needs are satisfied. Low priority TMDLs are monitored to track their status and are addressed last.⁽⁸⁾

There are 77 approved TMDLs within the Neosho basin that describe the strategies and goals to reduce pollution to achieve water quality standards. Of these, 17 are high priority for implementation. The Kansas Department of Health and Environment (KDHE) develops TMDLs on a basin-by-basin approach and will revisit existing TMDLs and develop new TMDLs within the Neosho basin in 2013.

Among the streams, dissolved oxygen depletion, zinc, total phosphorus and copper cause the greatest numbers of impairments. Among the lakes, eutrophic conditions indicative of excessive algae production are the predominant cause of impairment. Other pollutants limiting use of the Neosho River Basin streams include atrazine, biological stressors, pH, lead, sulfate, total suspended solids and excessive temperatures. Perchlorate, siltation, lead and copper caused additional lake and wetland impairments. Each parameter causing impairment requires a TMDL. Several additional TMDLs were approved in 2009 by the Environmental Protection Agency.

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Spring River Metals TMDL Review

Spring River (HUC 11070207) and its tributaries in the far southeastern part of the basin, including Shoal Creek, Short Creek, Shawnee Creek, Turkey Creek and Center Creek in Cherokee County, are a valuable biological resource in the basin, providing habitat for many unique and some threatened or endangered species. Of particular concern are mussel populations that have been in decline since the start of heavy metal mining. Due to historic mining activities in the area, these waters are contaminated by lead, zinc, copper and cadmium. TMDLs have been developed for these streams. The ultimate endpoint for these TMDLs is to achieve the established metals criteria for the Aquatic Life Use of the Spring River and its tributaries under the Kansas Water Quality Standards. However, because of the interdependency of the water quality criteria, total hardness and flow, the endpoints desired for the metal concentrations seen in the Spring River and its tributaries will vary with flow condition. In addition, biological endpoints are included. See KDHE TMDL website Neosho River basin Total Maximum Daily Load for a complete description of this TMDL.⁽⁷⁾ <http://www.kdheks.gov/tmdl>.

Dissolved Oxygen TMDL Priority Review

KDHE completed a regional study of dissolved oxygen (D.O.) conditions and causes of low levels during 2007. As a result of this evaluation, KDHE recommended that several D.O. TMDLs be moved from high priority to medium priority (Turkey and Mud creeks), the Neosho Basin Advisory Committee (BAC) concurred with this recommendation and priorities have been modified.

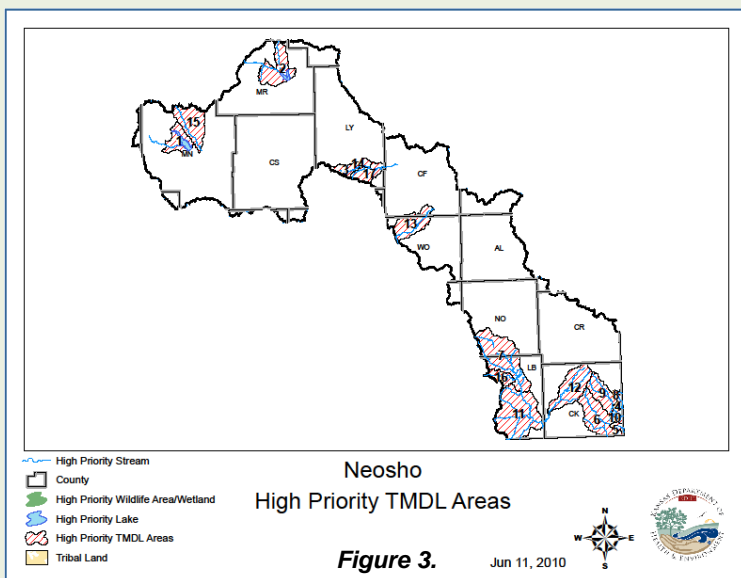
Map ID	Waterbody	Impairments	HUC Watersheds
1	Marion Lake	E	11070202
2	Council Grove Lake	E, Silt	11070201
3	Olpe City Lake	E, Silt	11070201
4	Turkey Creek Near Joplin, MO	Cd, Cu, Pb, Zn	11070204
5	Shoal Creek Near Galena	Pb, Zn	11070207
6	Spring River Near Baxter Springs	Bio, Cu, Pb, Zn	11070207
7	Labette Creek Near Labette	DO	11070205
8	Spring River Near Crestline	Bio, Cu, Pb, Zn	11070207
9	Shawnee Creek Near Crestline	Cd, Cu, DO, Pb, Zn	11070207
10	Short Creek Near Galena	Cd, Cu, Pb, Zn	11070207
11	Labette Creek Near Chetopa	DO	11070205
12	Cherry Creek Near Faulkner	DO	11070205
13	Turkey Creek Near Le Roy	DO, FCB	11070204
14	Eagle Creek Near Olpe	DO	11070201
15	Mud Creek Near Marion	FCB	11070202
16	Bachelor Creek Near Labette	DO	11070205
17	Eagle Creek Near Hartford	DO	11070201

Key:
 DO: Low dissolved oxygen in upper 3 meters of water column over deepest location in water body
 E: Eutrophication, biological community impacts and excessive nutrient/organic loading
 FCB: Fecal Coliform Bacteria
 E. Coli: Indicator bacteria with FCB
 HUC: U.S. Geologic Survey Hydrologic Unit Code
 Silt: Observed siltation and/or chronic turbidity that impacts development of trophic state
 Cd: Cadmium
 Pb: Lead
 Cu: Copper
 Zn: Zinc
 Bio: Biology

Table 1 provides information on rivers and lakes within the basin that are designated high priority for TMDL implementation following the recommendations of moving several of the currently listed high priority D.O. TMDLs to medium priority and the 2009 revisions. Figure 3 shows the location of these watersheds within the basin.

Surface Water Nutrient Reduction

The impacts of nutrients originating in Kansas have been well documented – Gulf of Mexico hypoxia, excessive productivity in Kansas and downstream reservoirs, and taste and odor problems in drinking water from reservoirs. Reduction and control of nutrients is needed to begin mitigating those impacts. Nutrient sources within the basin include both point and nonpoint sources. The major point sources in the basin include large wastewater treatment plants, which are regulated under the National Pollutant Discharge Elimination System (NPDES)



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(Figure 4).⁽⁴⁾ [Neosho basin](#) water quality is also a concern in Oklahoma, particularly for nutrient loading in the Grand River and Grand Lake of the Cherokees. Several interstate watershed groups have been formed to develop regional strategies to implement restoration and protection objectives.

sources through development and implementation of WRAPS. The Nutrient Reduction Plan includes Improvement Potential Index (IPI) maps for Kansas counties for TP and TN reductions (see maps in [Water Quality Policy Section](#)). In the Neosho basin, Cherokee and Labette counties showed the highest improvement potential for TP and TN.

Source Water Assessment Program⁽⁹⁾

Source Water Assessments were completed for all public water supplies across the state, either by the public water supplier or utility, or KDHE, in 2004. Source water may be ground water in the form of wells, [surface water](#) intakes on rivers and streams, or a combination of these. Source water assessments involve delineation of the source water assessment area, an inventory of potential contamination sources within the delineated area, and a susceptibility analysis and score. Assessments use a standardized system to identify all potential sources of pollution to [surface](#) and ground water within the contributing watershed, and conduct a susceptibility analysis to evaluate the threat from each potential pollutant to the water supply. A susceptibility score generated from the susceptibility analysis indicates whether the susceptibility range is low, moderate, or high for potential threats of contamination in an assessment area.

KDHE provided [public water suppliers](#) susceptibility scores in the following contaminant categories: microbiological, nitrates (applicable for ground water only), pesticides, inorganic compounds, synthetic organic compounds, volatile organic compounds, sedimentation (surface water only), and eutrophication-phosphorus (surface water only).

Of the 37 public water suppliers using ground water in the Neosho basin, 68% had low susceptibility scores and 32% had moderate scores. Of public water suppliers using surface water, 32% had low scores, 53% had moderate scores and 16% had high scores. The most commonly identified problems with groundwater were inorganic compounds, pesticides and nitrates. The most commonly identified problems with surface water were pesticides, microbial contamination and inorganic compounds. Of the 56 public water suppliers in the basin which treat raw water, 19 use surface water, 37 use ground water and one uses alluvial wells. Most residents in the basin get their water from the Cottonwood, Neosho, or Spring Rivers, groundwater, or from one of the three major federal reservoirs. Groundwater is a significant source in the southeastern part of the basin.

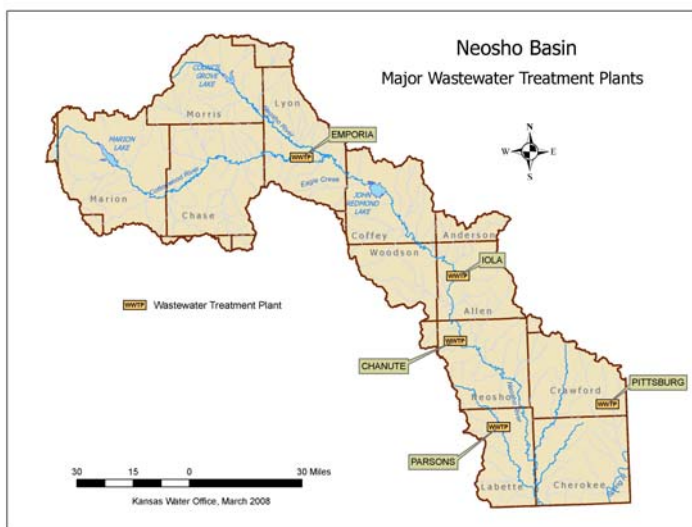


Figure 4. Neosho Basin Major Wastewater Treatment Plants

Nonpoint sources of pollution include agricultural, suburban and urban areas. Table 2 shows the relative contribution of point and nonpoint sources in the Neosho basin for total phosphorus (TP) and total nitrogen (TN) leaving the state. The Kansas Surface Water Nutrient Reduction Plan,⁽¹²⁾ developed by KDHE, outlines a statewide strategy for reducing the export of TN and TP in surface waters leaving the state. This involves additional reductions in nutrients from point source discharges through the NPDES Program and reductions in nonpoint

Table 2 Neosho Nutrient Reduction Data Source: KDHE Bureau of Water – February 14, 2006 Statewide Perspective			
Parameter	State Total	Neosho	% of State Total
TN Leaving State (Ton/yr)	51,000	9,260	18
TP Leaving State (Ton/yr)	7,700	832	11
Point Source TN (Ton/yr)	9,215	583	5
Point Source TP (Ton/yr)	1,925	231	7
Nonpoint Source TN (Ton/yr)	41,785	8,677	22
Nonpoint Source TP (Ton/yr)	5,775	601	12

Basin Perspective					
Parameter	Total	PS	PS %	NPS	NPS%
TN (Ton/yr)	9,260	583	6	8,677	94
TP (Ton/yr)	832	231	28	601	72

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For communities using groundwater, development of a wellhead protection plan is recommended. For communities using surface water, the development of a WRAPS is the best mechanism to ensure water quality protection for their public water supply. The Neosho basin has nine complete and approved source water protection plans in place.

Under the Source Water Assessment Program, about two thirds of the Neosho basin has been designated as critical area for protecting public water supplies, as defined by the stream reaches with a 24-hour or less travel time to a surface water diversion point. Much of the information from the assessment and risk rating can be used to develop WRAPS plans that can work to meet both TMDL goals and protect public water supplies from sources of pollution.

Five public water supplies were recommended by the EPA for participation in a five year, 2003 Atrazine monitoring program. This Atrazine risk reduction program includes runoff prevention in watersheds feeding public water supplies. These types of activities can help reduce pollution loading in the watersheds. As of 2005,⁽¹⁰⁾ the most recent year for which data are available, no system has exceeded the EPA criteria for Atrazine levels in public drinking water supplies.

reduced reservoir sedimentation, riparian and wetland management, and other natural resource objectives.

Watersheds above the three federal reservoirs in the basin that serve public water supply needs have been identified as watersheds of significant state interest for development and implementation of WRAPS. Implementation plans are being developed that will assist local groups to make the best use of existing funds to address the most critical problem areas first. Figure 5 shows the status of WRAPS groups in the basin.

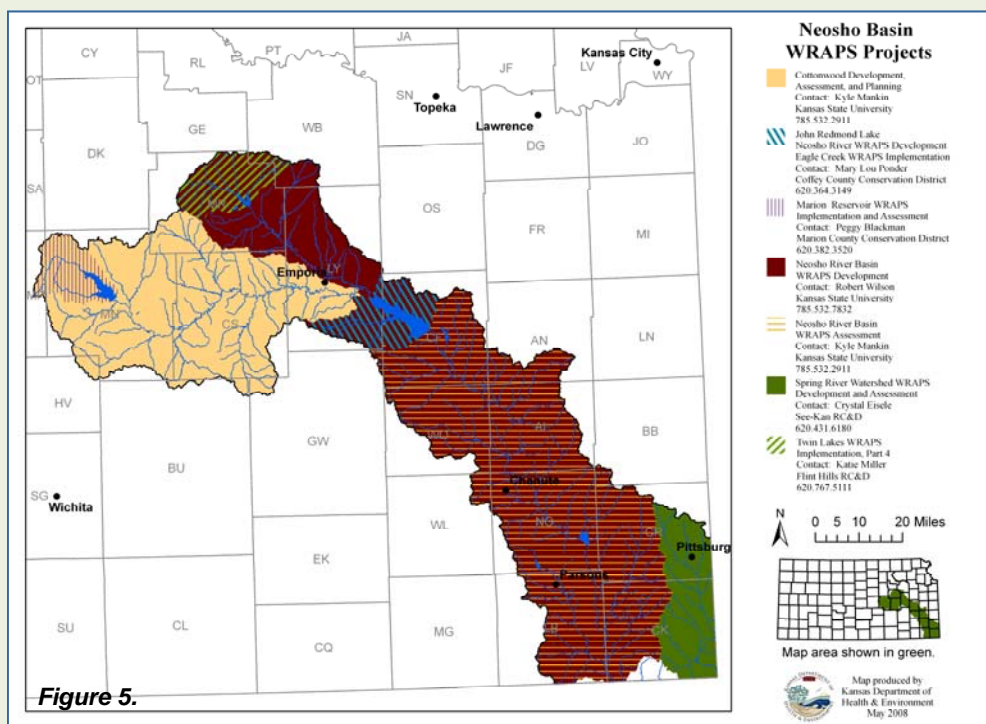


Figure 5.

Recommendation: Encourage other agencies and entities in partnerships and participation to support WRAPS initiatives, activities and funding.

Watershed Restoration and Protection Strategy Groups

Citizens in sub-watersheds of the Neosho basin have formed WRAPS stakeholder leadership teams (SLT) to assess their watersheds, water quality impairments, habitat needs, and other issues, and develop goals and objectives for addressing them. WRAPS groups develop stakeholder driven watershed management plans designed to address multiple water resource issues within a specific watershed. The WRAPS process provides a means to integrate objectives from multiple local, state and federal programs into a comprehensive, coordinated strategy for a specific watershed. This can include TMDL attainment, nutrient reduction, source water protection,

Recommendation: Complete the Corps John Redmond Feasibility study and incorporate results into WRAPS and other cooperative planning efforts.

U.S. Army Corps of Engineers John Redmond Feasibility Study⁽⁶⁾

John Redmond Reservoir was constructed by the U.S. Corp of Engineers (Corps) from 1959-1964 for purposes of flood control, water supply, water quality, and recreation. The reservoir is located on the Neosho River, and drains about 3,000 square miles of mostly grass and cultivated land. KDHE has identified impairments to ecosystem quality because of excessive sediment and nutrient loading into the reservoir. To identify strategies to ensure the long-range availability of habitat, water storage capacity, and ecosystem function within the John Redmond Reservoir and surrounding watershed, the KWO and the Corps developed a watershed feasibility study. Within

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this study, a need was identified to estimate suspended sediment loading into and out of the reservoir, as well as to characterize stream-channel stability.

John Redmond Reservoir provides critical water supply storage and has filled with sediment more quickly than the other reservoirs in the basin, with an estimated 36% of the multipurpose storage capacity lost since the reservoir filled in 1964, 46 years ago. A medium priority TMDL for silt and eutrophication has been developed for the reservoir. Loss of riparian areas to channel modifications and streamside clearing has been extensive in the watershed although estimates of total losses are not readily available.

This study provides information to the WRAPS SLT as they develop their WRAPS plan. Specific objectives of the study include:

- a. Preserve storage in John Redmond Reservoir for flood control, water supply, and other authorized purposes.
- b. Revitalize John Redmond Reservoir for flood control, water supply, and other authorized purposes.
- c. Reduce watershed contributions of sediment and harmful chemicals, such as phosphorous, into John Redmond Reservoir.
- d. Restore riparian habitat (including native grass buffer zones) that improves the value and function of the ecosystem.
- e. Restore wetlands that improve the value and function of the ecosystem.
- f. Restore aquatic riverine habitat that improves the value and function of the ecosystem.
- g. Preserve riparian habitat (including native grass buffer zones) essential to the value and function of restored habitat above.
- h. Preserve wetlands essential to the value and function of restored habitat.
- i. Preserve aquatic habitat essential to the value and function of restored habitat.
- j. Protect public resources, utilities, including power, water, and transportation, from the impacts of flooding, bank erosion, and channel changes.
- k. Protect wetland and grasslands from invasive plant species.

The Neosho Headwaters WRAPS group identified streambank erosion as a concern and funds are being directed at repairing some of these areas. Symptomatic of the sediment problem is an extensive logjam about

two and a half miles long blocking access to the reservoir from a heavily used access point. Because of the importance of this reservoir, KWO contracted with The Watershed Institute (TWI) to complete a riparian area/stream channel assessment for the John Redmond Dam and Reservoir as part of the Feasibility Study. Table 3 below is a list of land uses for the study area. Grassland includes grazing land for livestock and may include Conservation Reserve Program (CRP) lands. The watershed study area is 2,500 square miles. John Redmond Reservoir has a 3,015 square mile watershed, but for the Feasibility Study, the Corps excluded areas above Council Grove and Marion reservoirs.

Urban Area	1%	Wooded area	3%
Row Crop	27%	Water area	3%
Grassland	64%	Other	2%

Table 3. Land Use above John Redmond Reservoir

1991 rectified aerial photography and 2006 or 2008 National Agriculture Imagery Program (NAIP) aerial photography were used to identify areas of actively eroding streambanks (hotspots) in the John Redmond drainage area. The photographic assessment covered the Neosho River from the Morris/Lyon County line to John Redmond Reservoir; the Cottonwood River from Middle Creek confluence to Neosho River confluence; Allen Creek from Neosho River confluence upstream; Dow Creek from the Neosho River confluence upstream; and Plumb Creek from Neosho River confluence upstream.

For the upstream extent on primary tributaries to the Neosho or Cottonwood River main stems, photographs were reviewed until the resolution made it difficult to discern the channel location. Results shown in the Table 4 below are broken down by primary reaches in the drainage area. Those primary reaches can be located using Figure 6. The yield loss per bank length column, in Table

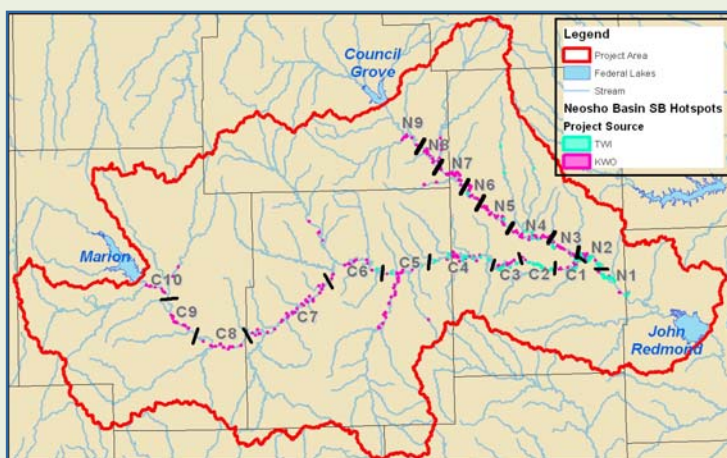


Figure 6. Map of Streambank Erosion Hotspots.

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Reach	Stream Bank Length (ft)	Hot-spots Sed (T/Yr)	Stabilization Cost Est.	Hotspots (number)	Yield Loss/ Bank Length	Poor Riparian Condition Stream Bank Length (ft)
N1	16,794	39,720	\$1,623,607	11	2.4	15,811
N2	24,978	65,662	\$2,414,905	23	2.6	23,548
N3	9,009	15,107	\$870,958	25	1.7	6,923
N4	13,267	18,844	\$1,282,608	27	1.4	12,384
N5	10,941	19,896	\$1,057,763	20	1.8	6,666
N6	7,301	13,213	\$705,887	16	1.8	4,493
N7	9,539	15,305	\$922,252	22	1.6	5,283
N8	4,616	5,881	\$446,281	17	1.3	2,703
N9	2,729	3,191	\$263,799	10	1.2	2,272
C1	9,402	26,541	\$908,940	18	2.8	8,732
C2	12,311	31,977	\$1,190,233	16	2.6	11,321
C3	8,014	13,918	\$774,832	22	1.7	7,339
C4	13,468	26,341	\$1,302,041	27	2.0	12,661
C5	15,675	16,821	\$1,515,471	36	1.1	12,898
C6	5,380	7,708	\$520,129	19	1.4	4,157
C7	10,503	17,652	\$1,015,419	32	1.7	9,230
C8	5,179	10,303	\$500,741	14	2.0	3,656
C9	4,253	11,591	\$411,206	11	2.7	3,890
C10	2,793	5,175	\$270,017	9	1.9	2,583
Subtotal						
Neosho	99,173	196,818	\$9,588,059	171	15.8	80,084
Cottonwood	86,978	168,026	\$8,409,029	204	19.9	76,467
Total	186,151	364,844	\$17,997,088	375	35.6	156,550

Table 4.

4, helps to identify the stream reaches in greatest need of bank stabilization.

A qualitative assessment was also done of the riparian condition along the streambank hotspots using the most recent aerial photography available. In Table 4, the length of streambanks with poor riparian conditions (little to no woodlands adjoining unstable streambanks) are summarized.

Detailed fluvial geomorphology surveys were conducted at ten locations and aerial photographs were interpreted to determine the condition of streambanks and riparian areas. KWO chose the locations of target areas from KDHE stream sediment monitoring data. Survey locations included reaches on the Neosho and Cottonwood rivers, and Allen, Dow and Plumb Creeks. For each sur-

vey, data were compiled on the bankfull dimension, pattern, and profile to classify each reach using the Rosgen stream classification system for natural rivers. Bank erosion potential using the Bank Erodibility Hazard Index (BEHI) and channel health using the Pfankuch stream stability evaluation were estimated. General riparian corridor conditions within the survey reach as well as adjacent reaches upstream and downstream were documented. Detailed information on the findings of the ten field surveys is summarized below.

Most streams have a low bankfull width to depth ratio indicating a narrow and deep channel. In comparing study reaches with equivalent stable reference reaches, similar ratios were found. Deep silt loams are found consistently throughout all reaches. Erosion rates for 27 bank conditions within the ten sites were developed. Based on BEHI scores and near bank stress calculations, an erosion average of 0.20 tons/year/foot was estimated. The Pfankuch stream stability evaluations ranged from fair to poor. In comparison to healthy riparian corridors, survey reaches suffer from excessive cutting, mass wasting, and debris jam potential. Excessive cattle grazing in riparian corridors was also observed. In some locations, the herbaceous understory was in poor condition or missing from grazing and hoof action. As a result, the sediment loading potential is greater from within these riparian corridors.

To address observed instability problems, implementing streambank stabilization using rock vanes and riparian fencing BMPs is recommended. Rock vanes slow down water velocities and redirect flow away from the near bank region. Riparian corridor restoration should be implemented in conjunction with the rock vanes. Riparian restoration will require bank shaping, riparian tree and shrub planting, native grass seeding, and proper maintenance. For cattle disturbances, riparian fencing BMPs to restrict or limit cattle access to the riparian corridor are recommended. Alternative water BMPs may also be needed to supplement water requirements. Healthy riparian areas are an important component in filtering out pollutants and sediment from the streams and lakes and can also control bank erosion, provide habitat and slow

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surface water runoff that leads to flooding. Targeted streambank stabilization and riparian restoration is identified as a need in the 2009 Kansas Water Plan.

Poor riparian conditions are typical for actively eroding streambanks. Eighty-four percent of the total actively eroding banks identified in the assessment had poor riparian conditions. Overall the Cottonwood River had a slightly higher percent of poor riparian condition by unstable streambank than did the Neosho River (88% vs. 81%). To provide the most realistic stabilization/restoration estimate, information from past streambank stabilization projects, distance to the nearest quarry, quarry price quote for estimation only, and NRCS Environmental Quality Improvement Program (EQIP) practice information was used.



Figure 7. Cottonwood River. Photo courtesy KWO

For streambank stabilization, the cost estimate is based on rock vanes and establishment of a wooded riparian corridor. Longitudinal peaked stone toe protection (LPSTP) may be used in some cases, but it is difficult to quantify this amount without information from a detailed survey. LPSTP are typically constructed two to four feet high, requiring 1 to 1.5 tons of rock per linear foot, based on bank height and stream depth. Also not estimated are the rock chutes and alternative watering supplies because not enough information is available to estimate a cost. There are many field drainage ways that discharge directly into the stream systems surveyed. It is difficult to quantify the number of occurrences where the drainage way is degrading from active gully erosion. This potentially could occur in many locations at the watershed scale. Finally, cost estimates incorporate a 10% contingency to help account for additional time and materials increases. This cost estimate is reflective of 2007 prices

and may fluctuate based on material price changes and fuel costs.

Estimated stabilization/restoration cost of \$96.68 per linear foot of streambank is used in the Table 4. In estimating soil volume losses from streambank erosion, field surveys of the Cottonwood, Neosho and primary tributaries were used to assign typical bank heights on the main stem and tributary streams. The surficial change between the streambank location in 1991 to the 2006 or 2008 location multiplied by the estimated bank heights provided an estimate of the soil volume loss from streambanks for the period. Assuming a typical soil weight of 89 lbs/cubic foot of soil for the predominate soil types in the John Redmond drainage area created the estimate for mass of soil loss per year by main stem reach in the Table 4. If the entire average annual streambank loss from erosion was deposited in John Redmond reservoir, streambank hotspot sources of sedimentation would account for just over half of the average annual sediment deposited at the reservoir.

Sediment transport and stability of streambanks were characterized by USGS and TWI. From February 2007-2008, USGS estimated sediment transport to John Redmond Reservoir during an approximately average year of streamflow was 1.12 million tons of sediment (Lee and others, 2008). This study estimated annual erosion rates from surveys at representative channel locations, as well as characterizing "hotspots" of channel erosion based on aerial photography. Using average streambank erosion rates estimated by TWI (0.215 tons/foot of streambank in the Cottonwood River; 0.372 tons/foot in the Neosho River), an estimated that 162,800 tons of sediment are transported from the 210 miles of the mainstem Cottonwood and Neosho Rivers annually. Streambank erosion from 3.5 miles of "hotspots" (#12-25) located along an 8.3 mile stretch of the Neosho River is estimated to contribute 51,800 tons per year (TWI, 2006). KWO is planning to implement streambank stabilization efforts in this reach to reduce sediment transport to John Redmond reservoir. Although streambank stabilization and riparian restoration of all the hotspots identified in this assessment would not be expected to be 100% efficient (there will always be a baseline sediment load from streambank sources in Kansas stream systems), such an effort would substantially reduce the excessive sediment loading to John Redmond from this source and significantly reduce the average annual sedimentation rate of the reservoir. Based on the identified hotspots, a cost of nearly seven million dollars to implement BMPs is estimated.

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Logjam Study, Sediment Monitoring, and Sub-watershed Assessment

KWO contracted a study of a logjam that has developed over more than 20 years at the inflow to John Redmond Reservoir, near the Jacob's Creek landing boat ramp Figure 6. This logjam is largely a result of sedimentation at John Redmond where the Neosho River slows to form the reservoir. Input of large woody material from the watershed has resulted in accumulation of this material over about a 2.5 mile reach, blocking access to the river. Possible options to restore access to the river have been evaluated and recommendations as to the most cost effective solution have been provided and are under consideration. In addition, the USGS has installed several continuous monitoring stations in the watershed to gain a better understanding of sediment delivery dynamics to the reservoir. Efforts are underway to assess sub-watersheds within the basin to prioritize areas for streambank stabilization and riparian area improvement.



Figure 8. Log Jam at Jacobs Creek Landing Boat Ramp.

More information on project activities can be found at www.kwo.org.

Recommendation: Target resources to the improvement and management of riparian areas in priority watersheds.

Wetland and riparian areas are an important focus of watershed protection and restoration. The primary approach to wetland and riparian area management in the basin focuses on providing technical and financial assistance to landowners to protect and restore these resources in priority watersheds through the implementation of best management practices (BMPs). Wetland and riparian areas are transitional lands between aquatic and upland locations. Wetlands include areas with hydric soils where standing water or wet soil conditions pre-

dominate. Riparian areas include streamside and floodplain areas where the vegetation, soils, or topography are distinguishable from that on adjoining uplands. Healthy riparian areas are an important component in filtering out pollutants and sediment from the streams and lakes. They can also control bank erosion, provide habitat and slow surface water runoff that leads to flooding. Wetlands provide unique wildlife habitat, and serve as flood water detention areas. Wetlands and riparian areas also provide aesthetic value.

An emerging concern is management and maintenance of forested riparian areas to prevent the entry of debris (dead and fallen trees, etc.) into the tributary/river system. Due to recent ice storms and catastrophic flooding, along with unstable streambanks, the potential for woody debris to collect in and clog bridges and culverts has been elevated. Preventing entry of woody debris into the system can help manage this. The log jam discussed above is a consequence of this condition.

KWO has adopted a new policy, *Enhanced Stream Corridor and Wetland Management to Address Reservoir Sedimentation* that provides a systematic approach to the assessment, protection and restoration of wetland and riparian areas and for the restoration of stream channels. The policy promotes a comprehensive evaluation of stream reaches and watershed wetland and riparian area condition and is in the *Kansas Water Plan*. KWO has secured an Environmental Protection Agency Wetland Program Development Grant to develop a method to identify wetlands in the watershed above John Redmond. The method to do this will be Geographic Information System (GIS) based and utilize Light Detection and Ranging (LiDAR) data and will assist WRAPS and other groups to identify, prioritize and protect critical wetlands in the watershed.

Condition of Streambanks and Riparian Areas Above Water Supply Reservoirs

The condition of riparian areas and streambanks above water supply reservoirs in the Neosho basin and the potential for their restoration and protection are described below. Estimates of length and cost of riparian area and streambank restoration and protection projects are provided. Detailed riparian and streambank condition assessments have been done in the watersheds of Marion and John Redmond reservoirs. A GIS based assessment has been completed in the Council Grove Reservoir and Council Grove City Lake watershed. No information is available about the condition of riparian areas and streambanks in the Parsons City Lake watershed. As-

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assessments consistently indicate that in areas in which a stable riparian border exists along the stream, streambanks are in good condition. In areas that have been reduced or degraded, the streambanks are typically in poor condition.

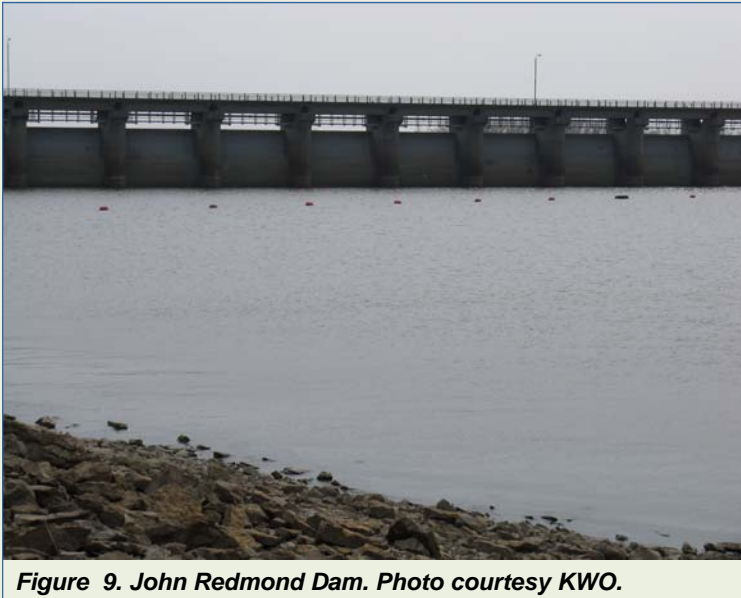


Figure 9. John Redmond Dam. Photo courtesy KWO.

Marion and John Redmond reservoirs have more information available about the condition of streambanks and riparian areas than do Council Grove Reservoir and Council Grove and Parsons City lakes. This is attributed to two main factors: 1) the establishment of Watershed Restoration and Protection Strategy (WRAPS) groups; and 2) concern about long term water supply in the Neosho basin. When a WRAPS group is formed in a watershed, additional funding through government and other programs may become available to assist in assessing watershed condition and implementing programs and projects to restore and protect the watershed. In addition, available funding is directed to areas where assessments have shown the most benefit to the watershed. While Council Grove Reservoir and Council Grove City Lake have a WRAPS group established, funding has not been directed to assessment to the degree that it has been in Marion and John Redmond. A WRAPS group is being formed above Parsons City Lake but little assessment of the watershed has yet been accomplished.

Marion Reservoir

The Corps Tulsa District began construction of the reservoir in March 1964 for flood control, water supply, water quality control, irrigation and fish and wildlife enhancement. Gates were closed in February 1968 and the conservation pool filled May 1969. The cities of Hillsboro, Marion and Peabody currently use the reservoir as their

public water supply source. The Marion Reservoir watershed covers about 200 square miles in northwest Marion County and the eastern edge of McPherson County. Ninety percent of the watershed is located in Marion County. Over 99% of the watershed is used for agricultural purposes. A detailed land use study compiled by the Natural Resources Conservation Service (NRCS) indicated 63% of the watershed is either in grass or is cropland protected by conservation practices. Of the land in conservation practices, there is a nearly even distribution between cropland and grazing land. An analysis of the Neosho basin⁽¹¹⁾ indicates about 23% of the streams have crop land as the riparian land use.

Extensive modeling and assessment have been accomplished for the watershed above Marion Reservoir. Recurring nuisance cyanobacterial blooms in the reservoir have resulted in taste and odor problems and the occurrence of toxic compounds in finished drinking water. A high priority TMDL for eutrophication has been developed. Bathymetric surveys indicate that storage capacity in the multipurpose pool which contains the public water supply storage has been reduced by about 14% since construction. In 2008, the Marion Reservoir WRAPS project used U.S. EPA Section 319 funds and State Water Plan funds to complete a Streambank Stability Assessment. The assessment used the Kansas Riparian Inventory to identify and prioritize sub-watersheds having land uses known to contribute to bank instability, conduct stability analysis of identified priority sub-watersheds, and install bank pins at select areas to monitor streambank erosion rates.

Overall, few stream reaches were found to be contributing excess sediment. Stream channels are typically narrow, deep, and connected to a floodplain, a key characteristic influencing erosive potential of the water during high flows. Most of the riparian corridor is comprised of mature woodlands of varying widths. Trees provide roots down through the bank profile, reinforcing the streambanks. Short segments were identified where bank erosion is accelerated, but more damage would take place within the riparian corridor by attempts to correct the in-channel problems.

One condition found to be negatively affecting stream channels is accumulations of large woody debris. In multiple reaches, large woody debris jams were observed in channels, banks and on floodplains. Most of the wood appears to be from locally fallen trees, but some material is transported from upstream and deposited by high runoff events. Some of the larger debris jams constrict the channel enough to cause water flow around the jam and

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into the streambank. It is recommended that these large debris jams be removed or cut-up. Reducing the material size will increase the likelihood that the material will move through the stream system. In some reaches large woody debris exists on the floodplain potentially contributing to in-channel blockages from future high flow events. Removal of the woody material from the stream-system by burning or chipping is recommended.



Figure 10. Neosho River Logjam. Photo courtesy TWI.

Several gully erosion problems in areas adjacent to the stream reaches were also identified. Gully erosion can contribute a tremendous amount of sediment at the watershed scale. The amount of sediment input is based on rainfall/runoff and gully frequency within a given watershed. In each case, the gullies observed are unstable and will continue to be unless BMPs are implemented. A common BMP for gully erosion is the rock chute. Rock chute designs require bank shaping and the placement of erosion control fabric and sorted rock. Rock chutes are designed to direct flow down through the chute center. The rock creates flow resistance slowing down water velocities.

An additional disturbance is cattle within the riparian corridor. With cyanobacterial blooms a big concern for Marion Reservoir, restricting cattle access to the riparian corridor would help reduce nutrient inputs. Riparian corridors with cattle disturbance usually have low vegetation density and quality. In addition, hoof action degrades the channel bed and banks. There are several BMPs that are effective in controlling cattle disturbances. One is riparian fencing which restricts cattle access to the stream corridor. If some cattle access is needed, cattle can be directed to specific access points. Within the access points, hardened crossings are effective BMPs.

These crossings reduce bed and bank disturbance from hoof action. In many cases, streams are the primary water source for cattle. As a result, alternative water supplies should be integrated with riparian fencing. Alternative water supplies can include spring development and installing livestock water wells.

Only three streambank projects in the Marion watershed assessment were recommended for bank restoration. All are located on the North Fork of the Cottonwood River within five miles of Durham. Each streambank restoration project is approximately 125 feet in length. Two of the projects have been completed at a cost of \$27,743 excluding engineer and design costs. The third project has not had plans developed at this time although funding has been approved. It is a County Road and Bridge Department project that is threatening a county structure.

John Redmond Reservoir Streambank Stabilization Funding from American Recovery and Reinvestment Act

KWO has received funding from the American Recover and Reinvestment Act (ARRA) (\$863,000) and the state's Reservoir Beneficial Use Fund (\$335,000) to address sedimentation in the Neosho River basin. An 8.3-mile reach of the Neosho River was identified in the Neosho Feasibility Study as a high priority area for streambank stabilization to reduce sedimentation. Restoration of the riparian buffer adjacent to the stream is also a goal of this project. Based on estimated sediment transport, this project has the potential to reduce downstream sediment contribution by 50,000 tons/year.

Goal: Protect and restore future water supply capacity in John Redmond Reservoir.

Objectives:

1. Stabilize up to 8.3 miles of streambank of the Neosho River above John Redmond.
2. Demonstrate project effectiveness in reducing stream segment's sediment contribution.
3. Provide public education of the effects of streambank stabilization on sedimentation.

The *Stream and Riparian Restoration in the Upper Neosho River Basin* will:

- Rehabilitate and stabilize up to ten portions of the Neosho River known to contribute significant sediment loads to the watershed and John Redmond Reservoir.
- Restore a riparian buffer adjacent to the stream res-

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toration sites through the Conservation Buffer Initiative, Continuous Conservation Reserve Program (CCRP), or other programs as available.

- Provide funds for maintenance and monitoring of stream stabilization projects (sponsor contribution).
- Install turbidity monitor downstream of restoration reach to assess sediment loads before and after restoration (sponsor contribution).

Surveying and designs were completed in September 2009. Based on the proposed design, an Invitation for Bids (IFB) was issued by the KWO for construction of the streambank stabilization project. Through an agreement with the Corps, KWO and the USGS will be monitoring the changes in turbidity of the Neosho River before, during, and after the streambank restoration project is completed. The purpose of the monitoring is to assess sedimentation, sediment quality, and upstream channel stability, as well as characterize the effect of streambank stabilization on sediment transport.

Estimated Costs:

	CWSRF Request	Sponsor Contribution
Stream Stabilization and Rehabilitation	\$863,000	\$200,000
Monitoring and Maintenance		\$100,000
Stream Turbidity Monitor		TBD
Total	\$863,000	\$300,000

Council Grove Reservoir and Council Grove City Lake

Council Grove Reservoir is important in assuring that the Neosho/Cottonwood Rivers Water Assurance District has sufficient water to supply demand. Constructed on the Cottonwood River, the reservoir has a surface area of 2,928 acres and the watershed draining into it is 246 square miles. The multipurpose pool was filled in 1965 and in the 45 years since then, approximately 30% of the storage capacity has filled with sediment. The reservoir has high priority TMDLs for both eutrophication and siltation.

Council Grove City Lake, a 434 acre multi-use lake, constructed in 1942 on Canning Creek, is surrounded by 348 waterfront cabins and homes. It serves as the primary water supply for the City of Council Grove. The city lake is in the southwest part of the watershed of the reservoir and the outflow from the lake flows into the reser-

voir. According to a 2008 bathymetric survey, about 16% of the reservoir's storage capacity has filled with sediment since construction.

According to a desktop GIS based assessment of the watershed using aerial photographs, there are approximately 518 miles of streams in the HUC unit (11070201010) that drains into the Council Grove Reservoir watershed in Morris County. Most of these streams are bordered by an approximate 200 ft corridor of riparian land cover. Land use in the watershed is approximately 30% cropland and 64% grassland. In the entire watershed of both water bodies, it is estimated that about 77% of the riparian areas are in good to excellent condition and do not need restoration, but should be protected. The remaining approximately 23% of the riparian area is in need of restoration as determined by lack of riparian cover in the aerial photos. As discussed above it is likely that the streambanks associated with these degraded riparian areas are eroded and in need of restoration. More specific field surveys of these sites are needed to develop realistic costs for restoration. An estimated 103 miles of streambanks may be in need of restoration in this watershed but more detailed stream surveys will be needed to determine a more accurate estimate.

Parsons City Lake

Parsons City Lake, owned by the City of Parsons and used as its principal water supply, is located three miles north on highway 59 and three miles west on 20th Road from the City of Parsons. The lake was formed by damming Labette Creek in Labette County in 1959. The surface area is about 800 acres and an additional 1,000 acres of public use land surround the lake. The entire drainage area is about 37 square miles. According to a 2008 bathymetric survey about 15% of the lake has filled with sediment.

Medium priority TMDLs have been established for both siltation and eutrophication. This lake is included within the area of a WRAPS group that is under development in the Middle Neosho watershed. The lake is expected to be a high priority for assessment as the group identifies goals and objectives, due to its public water supply role. Land use in the watershed is about 42% cropland and 49% grassland.

Importance of Riparian Areas in Stabilizing Streambanks

Soil and Water Assessment Tool (SWAT) modeling, sedi-

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ment yield assessment of streams in the Neosho Basin, and evaluation of actively eroding streambanks on the Neosho and Cottonwood Rivers above John Redmond Reservoir all point toward main stem streambank sources, which includes gully erosion, as being the primary source of the excessive sediment loads delivered to John Redmond Reservoir. Unstable streambanks are common when riparian areas are degraded.

If the cost of removing the estimated average annual volume of sediment contributed from streambank hotspot sources vs. dredging the same volume from Redmond (using a conservative \$10/cu yd estimate) is compared to the previously estimated cost of stabilization and riparian restoration, the result is for every \$1 spent in prevention, about \$10 in sediment removal cost is saved.

For the Neosho basin below Marion and Council Grove Reservoirs, KWO continues to recommend streambank stabilization/riparian restoration projects as the most cost effective method of reducing sediment delivery to John Redmond Reservoir from these sources. Streambank stabilization is likely needed in some reaches of streams above Council Grove Reservoir and City Lake and more detailed evaluations should be conducted to determine the extent of degradation. Continued land treatment and streambank protection is recommended for Marion Reservoir. The developing WRAPS group covering Parsons City Lake should use assessment funds to evaluate streambank stabilization and riparian restoration needs in that watershed.

Recommendation: Coordinate with the Kansas Department of Wildlife and Parks and other organizations and agencies to prevent the spread of Zebra mussels in the basin.

Zebra mussels were confirmed to be present in Marion Reservoir in the summer of 2008 and as of July 2010, they have also been confirmed in Council Grove and John Redmond reservoirs and in the Cottonwood and Neosho rivers. Despite efforts by the Kansas Department of Wildlife and Parks, and other agencies and organizations, to prevent infestations of the mussels spread from other reservoirs, this additional infestation is particularly troublesome. John Redmond Reservoir supplements cooling water in the lake used by the Wolf Creek Nuclear Power Plant. Zebra mussels, once established, are almost impossible to eradicate, and cause hundreds of thousands of dollars, and sometimes millions of dollars, worth of damage to public water supply and industrial plant water intakes and other infrastructure. KWO is working with other agencies to inform pub-

lic water suppliers in the drainage area of the infestation and to encourage them to develop plans to mitigate impacts of the mussels on intake and other infrastructure.



Figure 11. Wolf Creek Nuclear Power Station.
Photo courtesy Kansas Geological Survey.

Recommendation: Continue cooperative inter-state efforts to improve water resource conditions in the entire Neosho/Grand River Lake of the Cherokees watershed.

In addition to WRAPS groups in Kansas in the Neosho watershed (see Figure 5) several interstate groups have formed to ensure high quality water in Grand Lake of the Cherokees in Oklahoma. A large part of the watershed draining into this highly used recreational and public water supply reservoir is in Kansas. An interstate effort involving Arkansas, Missouri, Oklahoma and Kansas representatives is cooperatively developing a watershed based plan for the area. The Grand Lake of the Cherokees Watershed Alliance Foundation will use results of the plan to seek federal funding for project implementation. Efforts of WRAPS groups already underway in Kansas serve as a model for plan development and will be incorporated into the implementation plan.

Recommendation: Work with local governments, including conservation districts, local environmental protection programs, and stormwater utilities to develop and implement comprehensive urban stormwater and source water management plans.

A consideration for watershed restoration and protection in this basin is urbanization. As the amount of impervious surface in a watershed (i.e. rooftops, roads, parking lots, etc.) increases, water resources can be adversely impacted from increases in runoff volume and additional pollutants associated with urban environments. Efforts made by local governments and urban residents to minimize these adverse impacts through sound land use

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planning and stormwater management help to address these issues.

Local [land use](#) planning and zoning authorities provide cities and counties effective tools to minimize the potential impacts of development on water resources. Urban stormwater management programs can be implemented to manage the amount of impervious surface in urbanizing watersheds and properly control increased runoff resulting from urbanization. Programs that provide technical assistance and education to urban residents regarding actions that can reduce or eliminate potential pollution sources also play an important role. These programs can be integrated with WRAPS projects to ensure a comprehensive approach to watershed management in urban areas. In the Neosho basin, the cities of Emporia, Parsons and Pittsburg are required by the EPA Phase II Stormwater Program to develop management plans to minimize pollution entering receiving waters from within the boundaries of their municipalities.

Recommendation: Continue public outreach efforts to educate the public and landowners about the benefits of best management practices.

Another consideration for watershed restoration and protection in the basin is the potential for conversion of Conservation Reserve Program (CRP) acreage back to production agriculture as contracts expire. Recently with commodity prices on the rise, this is even more of a concern. In the 12 counties contained wholly or partly in the Neosho basin, contracts on 37,259 acres covering 891 contracts expired on September 30, 2007. Lyon County had the highest number of expired contracts at 10,078 acres. If land is taken out of permanent grass cover, implementation of BMPs will be needed to minimize potential adverse impacts to water resources within the basin. CRP grass cover is very effective at trapping sediment and nutrients. Information and education about CRP and other best management practices is ongoing in the watershed as WRAPS groups solicit input from the public and strive to get their involvement.

Recommendation: Encourage other agencies and entities in partnerships and participation to support WRAPS initiatives, activities and funding.

- All counties, excluding Chase County, either wholly or partly within the basin have adopted local sanitary/environmental codes or participate in the Local Environmental Protection Program.
- Seven of the 12 counties have countywide planning and zoning programs.

- All conservation districts in the basin have adopted nonpoint source pollution control management plans. Grants under the State Water Quality Buffer Initiative have also been awarded in six counties supporting buffer coordinators and facilitating enrollment of stream buffers in continuous CRP in FY 2008.
- As of December 2009, there were 19 active contamination sites being remediated through the State Water Plan Contamination Remediation Program. Most of the contamination is from heavy metals resulting from past mining and smelting activities. Additional contamination is caused by volatile organic compounds, carbon tetrachloride and nitrate.
- There are 15 organized and active [watershed districts](#) in the basin.

Recommended Actions

1. Complete detailed streambank and riparian assessments in all watersheds, with priority given to drinking water supply reservoirs.
2. Continue to target resources to highest priority areas based on assessments.
3. Continue comprehensive WRAPS efforts to achieve water resource protection goals.
4. Continue interstate efforts to protect downstream water quality especially for nutrient reduction.

Resources

1. Kansas Water Authority. July 2003. *Kansas Water Plan, Fiscal Year 2005 Update*. Kansas Water Office. 257 p.
2. Kansas Water Authority. July 2001. *Kansas Water Plan, Fiscal Year 2003 Update, Neosho Basin Section*. Kansas Water Office.
3. Kansas Department of Health and Environment. August 2003. website:<http://www.kdhe.state.ks.us/nps/index.html> for Local Environmental Protection
4. Kansas Department of Health and Environment. National Pollutant Discharge Elimination System Program. http://www.kdheks.gov/water/download/implementation_permitting.pdf
5. Kansas Water Office. 2003. draft *Kansas Priority Riparian and Wetlands Areas Implementation Plan*.
6. U.S. Army Corps of Engineers, 2006. John Redmond Feasibility Study Plan.

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7. Kansas Department of Health and Environment, 2008. http://www.kdheks.gov/tmdl/download/spring_metals.pdf
8. Kansas Department of Health and Environment. 2008. <http://www.kdheks.gov/tmdl/index.htm>
9. Kansas Department of Health and Environment. 2004. Source Water Assessments. <http://www.kdheks.gov/nps/swap/>.
10. EPA Pesticide Monitoring Program in Community Water Systems. 2005. http://www.epa.gov/opp00001/reregistration/atrazine/atrazine_update.htm#cws.
11. Wilson, Brownie, Assessment of Riparian Areas Inventory, State of Kansas, 2003, http://hercules.kgs.ku.edu/geohydro/ofr/2003_55/riparian/ofr_2003_55e.htm.
12. http://www.kdheks.gov/water/download/KS-nutrient_reduction_plan_final.pdf
13. Reservoir Roadmap. Volume III. Neosho River Basin. 2009.
14. American Recovery and Reinvestment Act application. KWO 2009.