Project: 9

Agency: Oklahoma Conservation Commission

Title: Honey Creek Watershed Implementation Project

INTRODUCTION:

Project Location:

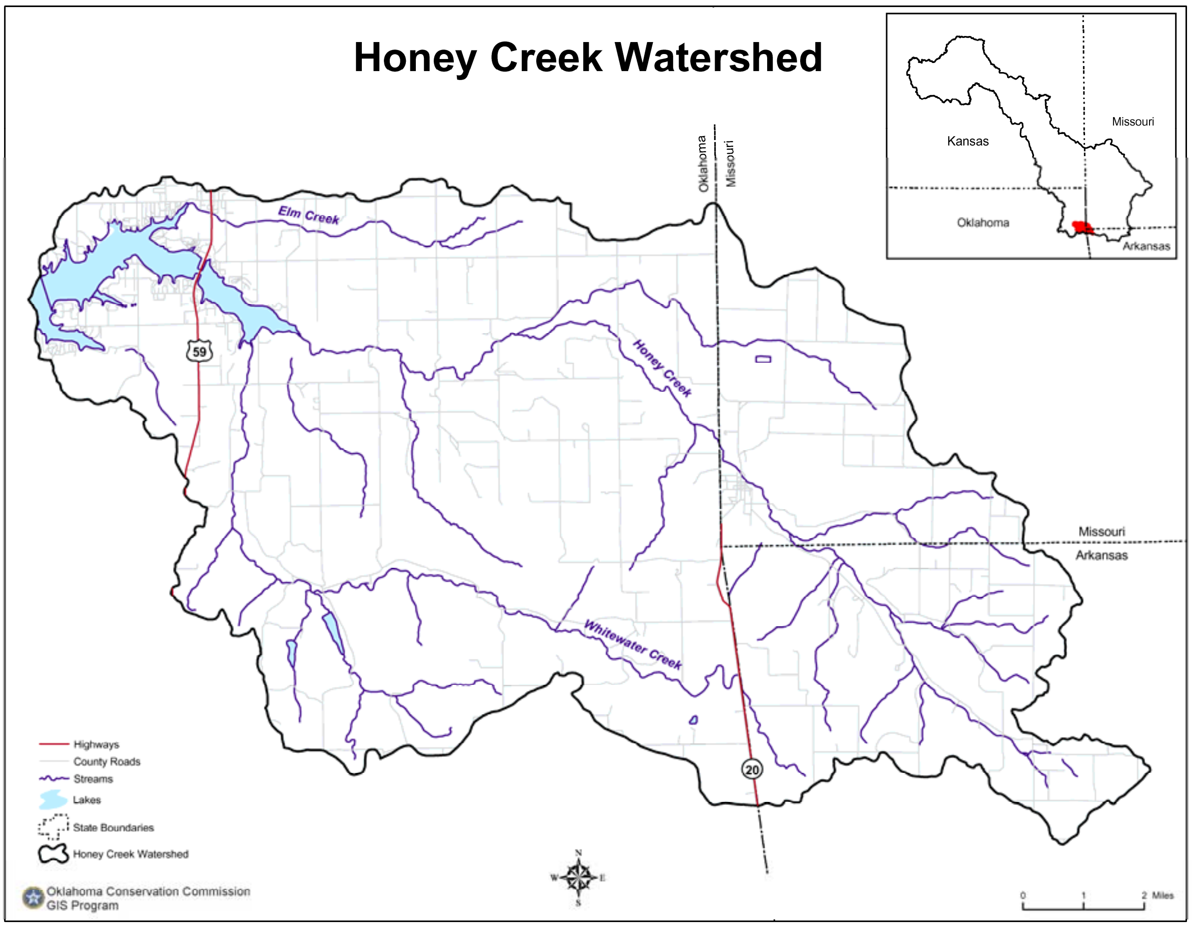

Figure 1. Location of the Honey Creek Watershed.

Honey Creek is located in the Ozark Highlands and Central Irregular Plains Ecoregions in northeastern Oklahoma, southwestern Missouri, and northeastern Arkansas. Approximately seventy percent of the watershed is located in Oklahoma.

Problem Statement[1]

The Honey Creek Watershed is located in a poultry and cattle producing area. As a subwatershed of the Grand Lake Watershed that includes an arm of the lake, Honey Creek is also affected by NPS pollution from residential and development sources. Honey Creek and Grand Lake are of concern because along with a tributary to Honey Creek (Cave Springs Branch), both are listed on the Oklahoma 2002 Integrated Report Category V list for pathogens, low dissolved oxygen, sulfate, TDS, chloride, and unknown causes (based on poor fish collection) (Table 1). In addition, its pollution problems are typical of agricultural areas of northeastern Oklahoma. The 2002 OWRB BUMP report has stated that Grand Lake is impaired by turbidity and TSI for chlorophyll-a collected during the growing season indicates that the lake is hypereutrophic.

Table 1. 2002 303(d) Listed Causes of Impairment in Honey Creek Watershed.

OK Waterbody ID	Name	Cause of Impairment
OK121600030320	Whitewater Creek	Low dissolved oxygen
OK121600030340	Cave Springs Branch of Honey Creek	Cause unknown, chloride, pathogens, sulfates, TDS
OK 121600030445	Honey Creek	pathogens

Many streams and lakes in this area are threatened or impaired by nutrients. Riparian areas in this region are frequently compromised, either through removal of protective vegetation or through uncontrolled access by livestock. The result is streambank erosion, habitat loss, and increased sediment transport in streams. As a tributary to and a major cove on Grand Lake, significant residential development has also occurred in the Honey Creek watershed.

Eutrophication, manifested in low dissolved oxygen and sometimes hypereutrophic algae growth is due to elevated nutrient loading. The 1995 Grand Lake Clean Lakes Study determined that the lake was eutrophic and experiencing nuisance algal blooms in certain areas. The study also determined that phosphorus was the limiting nutrient in the system. The phosphorus in Honey Creek likely originates both from nonpoint source pollution resulting from agricultural practices and residential development and point sources in the watershed.

Another indication of possible nonpoint source contamination and impacts from animal waste is suggested by the elevated levels of bacteria found in Honey Creek. A 1999-2000 USGS reconnaissance study in the Cave Springs Branch watershed of Honey Creek found that bacteria in groundwater and surface water in the basin were from bird, cow, horse, dog, deer, and human sources. Sampling at the state line suggested that much of the bacteria were from cows and horses. Sampling in well water indicated human and dog feces as bacteria sources, suggesting that onsite wastewater treatment may not always be adequate in the region's highly permeable soils.

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[1] This section contains information specific to components (a) and (b) of a watershed based plan, specific to the Honey Creek subwatershed of Grand Lake. Further information on causes, sources, and goals can be found in the Grand Lake Watershed Based Plan.

Groundwater sampling for nitrogen suggested nitrogen sources other than Cave Springs Branch, indicating that animal waste, fertilizer, or human waste is likely contributing to high levels in groundwater. Surface water sampling suggested that the poultry processing plant on Cave Springs Branch contributes significantly to nitrogen[2] loading in the watershed.

Landuse in the watershed is primarily pasture (57% of total) or forested (33%), followed by cropland (7%). As depicted in the landuse map (Figure 2) and table 3, much of the streams run through pasturelands that appear to lack protected riparian zones. Approximately seventy percent of stream miles in the watershed in Oklahoma and seventy eight percent of miles in the total watershed run through pastureland.

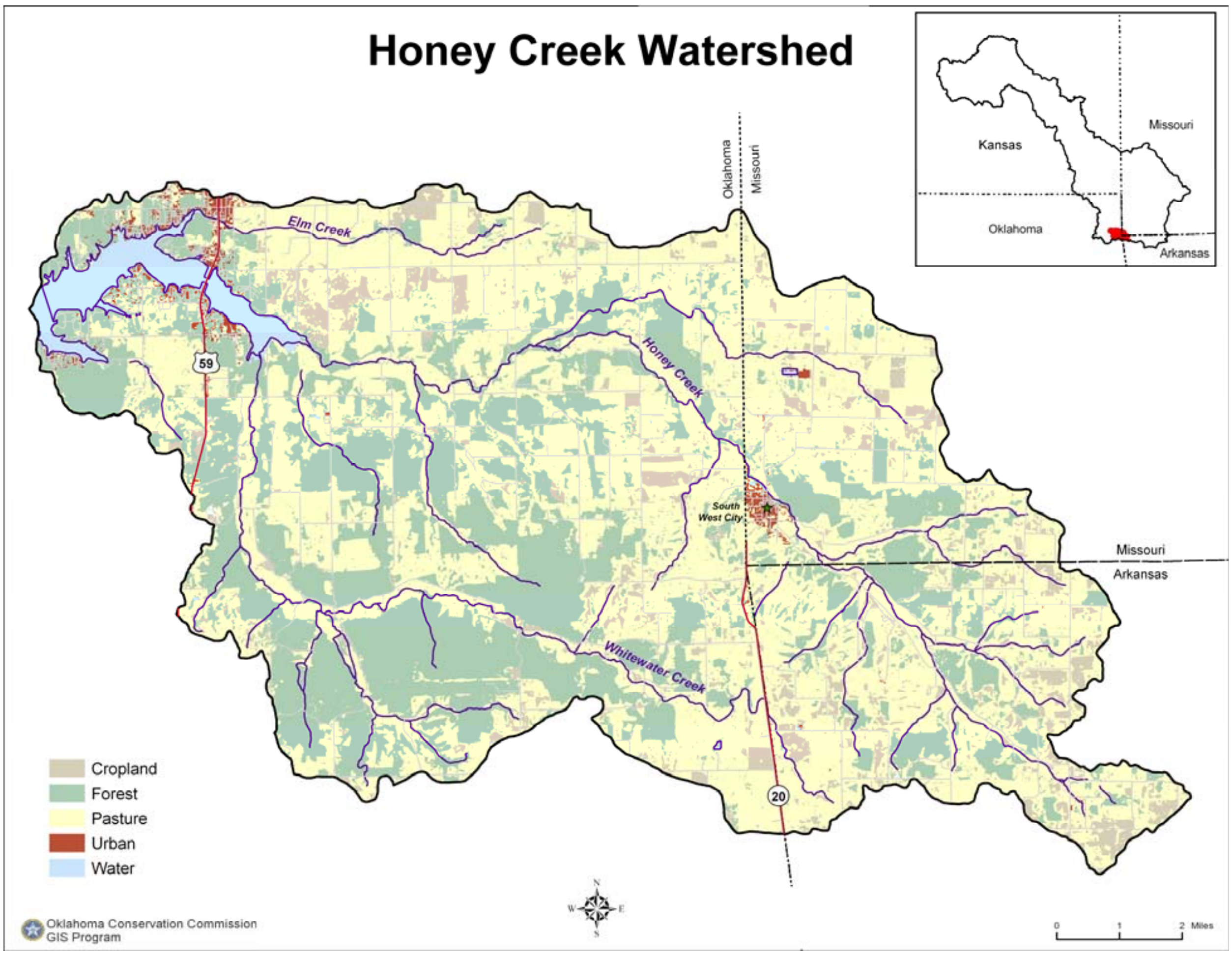

Figure 2. Land use in the Honey Creek Watershed.

[2] The USGS study did not sample for phosphorus; however, additional sampling conducted by the ODEQ suggests that the poultry processing plant also contributes significantly to the phosphorus loading in Cave Springs Branch and Honey Creek.

Table 2. Landuse Distribution in the Watershed.

	Oklahoma Landuse		Outside OK Landuse		Total Landuse	
	Acres	% of Total	acres	% of Total	acres	% of Total
Bare Rock/Sand/Clay	15.50	0.03	5.63	0.02	21.13	0.03
Cropland	3,138.65	5.77	2,617.74	10.85	5,756.39	7.33
Forest	20,973.28	38.55	4,556.30	18.88	25,529.58	32.51
Open Water	1,810.77	3.32	51.79	0.21	1,862.56	2.37
Pasture	27,872.12	51.23	16,707.52	69.25	44,579.64	56.76
Quarries/Strip Mines/Gravel Pits	9.68	0.02	0	0	9.68	0.01
Transitional	5.52	0.01	1.02	0.01	6.54	0.01
Urban	583.45	1.07	188.01	0.78	771.46	0.98
Total	54,408.97	69.28	24,128.01	30.72	78,536.98	

Table 3. Landuse along Stream Channels in the Watershed.

	Oklahoma		Outside OK		Total Watershed	
		% of Total		% of Total		% of Total
Watershed acres	54,408.97	69.28	24,128.01	30.72	78,536.98	
Stream length (miles)	89.84	70.04	37.71	29.96	127.55	
Cropland Stream miles	0	0	18.44	2.64	2.64	2.07
Pasture stream miles	62.89	70.00	37.20	32.05	100.09	78.71

This distribution of landuse throughout the watershed and along stream channels suggests that a significant portion of NPS-derived loading of sediment, nutrients, and pathogens originates in the pastureland of the watershed. In addition, the USGS study suggested that septic tanks also contribute to the nutrients and pathogen loads in the watershed.

NPS-derived phosphorus loading to Honey Creek can be estimated using the unit area loadings from the Honey Creek area predicted through the 1995 Grand Lake Basin Management Plan report (OCC 1995). These estimates (Table 4) also suggest the highest load to the watershed is derived from pastureland. These values may underestimate the loading from urban and residential development (primarily in forested areas of the watershed) because significant development has occurred in the watershed since the 1995 report.

Table 4. NPS Phosphorus Loading to Honey Creek.

	Annual P Load in Oklahoma (kg/yr)	Annual P Load from outside OK	Total Annual P Load to Honey Creek
Cropland	1,144 (	954	2,098
Pasture	3,106	1,861	4,967
Urban	52	17	69

Forest	1,868	406	2,274
Total	6,170	3,238	9,408
% of Total Load	66%	34%	

The 2004 Draft Watershed Based Plan establishes an initial load reduction goal for phosphorus, sediment, and fecal bacteria of 20% within five years, working towards an ultimate goal of an 80% reduction in phosphorus and sediment, and at least a 50% reduction in fecal bacteria. To reach those goals, phosphorus loading in Honey Creek would need to drop to approximately 7,526 kg P/year within five years, and ultimately 1,881 kg P/year[3].

The OCC developed an education project in the Grand Lake Watershed as part of the FY 2004 Program. That project (Phase I) will focus on monitoring, planning, demonstration and education that will compliment the efforts already ongoing in the watershed and those planned for projects such as this FY 2005/2006 project. This FY 2005/2006 project will build on the foundation of the FY 2004 project to demonstrate practices to reduce NPS pollution in the watershed. Both projects will focus on water quality problems associated with eutrophication including sediment, nutrients, and fecal bacteria.

Objective:

A Watershed Based Plan (WBP) has been drafted for the Oklahoma portion of the Grand Lake Watershed. A series of Total Maximum Daily Loads (TMDLs) are in the early stages of development. The TMDLs and future evolutions of the WBP may further define the water quality problems and identify additional measures needed to achieve water quality improvements in the Honey Creek Watershed. This project will focus on the nonpoint source (NPS) water quality problems identified to date. Agricultural and residential development activities appear to be the major NPS sources of impact and therefore this program will focus on these activities. The activities in this work program will become major components of future evolutions of the WBP, which has been modified from the WRAS, and will be revisited once the TMDL or other major activities in the watershed are complete.

Based on the knowledge gained through similar watersheds in this portion of the State, the objective of this project is to initiate a watershed scale effort to reduce NPS loading and eliminate threats and impairments to the Honey Creek Watershed. In accomplishing this goal, loadings as established in the future TMDL and Water Quality Standards will eventually be met. The education, implementation, and monitoring activities outlined in this work plan are only the first step in what should be a long-term effort to achieve the objective.

[3] Contains information relative to components (a) and (b) of a Watershed Based Plan, specifically for Honey Creek. Further information can be found in the Grand Lake Watershed Based Plan.

Overview:

This project will be managed by the OCC with oversight from the Office of the Secretary of Environment. Gayle Bartholomew, OCC's Environmental Project Coordinator will be the overall Project Manager although completion of individual tasks will be the responsibility of various individuals as detailed later. The project activities will be conducted within a four-year period, beginning in October, 2006 and ending in September 2010. Certain activities may be contracted out to insure completion of a quality product in a timely, cost effective manner. Further discussion of the project overview is detailed under each project task.

This project was developed based on the nine key components of a watershed based plan. Although not all components of the WBP are addressed specifically in the workplan, it was developed to explain how the Grand Lake Watershed Based Plan would be implemented in the Honey Creek subwatershed of Grand Lake. Where possible, footnotes identify sections where WBP components specific to Honey Creek are addressed. Other cases, such as components (f) and (g), a schedule for implementation and interim milestones specific to this project, are found throughout the workplan. Additional components not referenced fully in this workplan are contained in the Grand Lake Watershed Based Plan.

Project Tasks:

Task 9.1. Targeting Nonpoint Source Pollution[4]

Task Description: The Honey Creek watershed covers about 79,000 acres in northeastern Oklahoma, southwestern Missouri, and southwestern Arkansas. Past studies have identified causes of impairment and suggested possible sources, but little has been done to pinpoint the location or concentration of those sources or to verify whether or not certain land uses and potential sources contribute to the problem.

Available resources are inadequate to blanket the entire watershed with best management practices to reduce NPS pollution from all sources. Therefore, the program will focus practices, selecting areas where they are needed the most and where the environmental benefit will be maximized. OCC will utilize a two-step targeting process, the first of which has been funded under the FY 2004 program for this effort. The FY 2004 effort will include results specific to the Honey Creek watershed.

Task Objective: The objective of this task is to define the method used to target resources at the most significant sources and in the most cost-effective manner in the Honey Creek watershed. Completion of this task will also identify, more specifically, the critical areas of the watershed in which measures must be implemented to reduce NPS pollution, or a portion of component (c) of a watershed based plan.

[4] Completion of targeting under the FY 2004 grant will further address the second portion of component (c) of a Watershed Based Plan more specifically for the Honey Creek subwatershed, by identifying critical areas for implementation.

Task Activities: The result of the first stage of the targeting effort will be a detailed map of areas in the Honey Creek Watershed most likely producing the greatest nutrient and sediment loading. In addition, estimated loadings from subwatersheds in the Honey Creek watershed will be provided in both a map and tabular form such that the greatest contributing subwatersheds can be targeted first by the Project Coordinator. This will suggest areas of the watershed where the most efficient load reduction can be accomplished.

The second stage will build off of the first in that OCC will use the results to develop a targeting/ranking mechanism such as the one used for the USDA NRCS EQIP Program. The first stage targeting will identify critical areas of the watershed, along with subwatersheds where the greatest loading seems to be derived. Beginning with the subwatersheds contributing most significantly to the loading, individuals who live in a critical area will be contacted by OCC and conservation districts and strongly encouraged to participate in the program. This contact will be in the form of phone calls, site visits, and other means to insure that one-on-one contact is made with individual landowners. Those who are interested will receive a preliminary site visit from our Project Coordinator.

During the preliminary visit, the Coordinator will do an investigation as to the extent to which the particular landowner contributes to the water quality problems in the watershed (develop a conservation plan) and assign a ranking index based on the practices that would need to be implemented, the cost for implementation, and the expected impact on water quality improvement. Those with the highest rankings will be funded first, followed by those with lower rankings. In this manner, we will be able to effectively target those areas where we will receive the greatest water quality benefit for each dollar spent. Individuals willing to implement all the recommended practices will receive considerably higher rankings than individuals who are only interested in some of the recommended practices. In other words, landowners cannot pick and choose which practices they want to implement but rather will have to address all the recommendations of the plan. In addition, an accounting of landowners in critical areas who are unwilling to participate in the program will be made, along with reasons for their lack of participation.

Targeting efforts will be coordinated with the local NRCS office that is actively assisting with the program. The purpose of this coordination includes leveraging of funds to our mutual benefit. If it is determined that an individual does not meet our particular needs for this program, they may still be suited to enroll in one of the many USDA programs. For example, EQIP provides funding for many practices that the 319 program will not. If a landowner cannot participate in 319, then they may choose to pursue an EQIP contract. In this fashion, both agencies will benefit from the relationship and work towards our mutual goals. Targeting results will also be shared with NRCS offices and Conservation Districts in the watershed outside of Oklahoma, although implementation through this project will focus in the Oklahoma portion of the watershed.

Part one of the targeting (GIS targeting) will be contracted out to an organization such as the Oklahoma State University Department of Biosystems and Agricultural Engineering with previous experience conducting similar exercises as part of the FY 2004 project and therefore will not be funded under this project. The OCC Honey Creek Project Coordinator will conduct part two of the targeting.

The Environmental Project Coordinator (Gayle Bartholomew, funded annually under the implementation task of OCC Implementation of NPS Management Program Projects such as FY 2005/2006 Project 6) will be responsible for insuring that the targeting contractors remain on schedule and that reports and tasks are completed in a timely manner.

Task Schedule:

Subtask #	Milestone Description	Completion Date
9.1.1	Receive results of first stage from contractor in report form	July 2006*
9.1.2	Meet with Conservation District to discuss results of first stage	July 2006*
9.1.3	Develop second-stage targeting mechanism for implementation summarized in a pre-implementation report. Pre-implementation report will be updated following completion of cooperator sign-up periods to estimate load reductions that should result from the implementation. These load reductions will be specified on a subwatershed level, as well as for the entire Honey Creek watershed.	December 2006

* No funding for these tasks is provided with this workplan

Deliverables:

Subtask #	Deliverable	Due Date
9.1.1	First Stage Targeting Results	July 2006
9.1.3	Pre-implementation report	December 2006

Task 9.2. Project Local Management[5].

Task Description: Task two involves employing a Project Coordinator and establishing a Watershed Advisory Group. The Project Coordinator will coordinate the planning effort on water quality issues in the Honey Creek Watershed and write conservation

[5] Provides information about the level of technical support (component (d) of a Watershed Based Plan) for implementation of BMPs in Honey Creek. These numbers, divided by four (approximately $60,000), would be an estimate of a minimum annual amount of technical support necessary to implement components of the Grand Lake Watershed Based Plan in Honey Creek. This section also partially addresses component (e) of a WBP.

plans[6]. The coordinator will also work with the various groups in the watershed to reduce duplication of efforts. The coordinator will be responsible for the tasks listed below.

- Identify landowners in need of conservation plans and write conservation plans to address NPS-related water quality problems based on the results of stage one targeting. These plans will include animal waste plans and nutrient management plans, as necessary. Residential landowners who live within the targeted area will also be encouraged to participate.
- Coordinate the Watershed Advisory Group (WAG).
- Coordinate planning efforts with NRCS, Conservation Districts, and other groups as necessary. Participate in the team that drafts the necessary plans based on stage two targeting.
- In coordination with the education coordinator (FY 2004 Project 5), assist with local citizen meetings in the watershed on water quality issues.
- Represent the Project Interests at Conservation District Board Meetings.
- Cooperate with NRCS to insure that water quality concerns are addressed.
- In coordination with the education coordinator, hold periodic meetings with the various groups working in the watershed. In particular, meetings will be held with the OSU personnel and others associated with the FY 2004 project to insure coordination of efforts.
- Participate in the educational programs in the watershed.
- Compile photographs of implementation/demonstration sites, before and after implementation
- Review landowner progress in meeting contracted goals.

The Coordinator's position is a full time position, with duration of four years from October 2006 through September 2010.

The Watershed Advisory Group will be made up of local citizens from the Grand Lake watershed, representing each of the major stakeholder groups such as lakeside residents, cattlemen, poultry growers, etc. The WAG will represent the best interests of the watershed to recommend the practices and cost-share rates that will be offered through this program.

The Delaware County Conservation District will provide substantial support for the implementation of this project. The District will provide clerical support for the demonstration program and participate in the educational activities. The District will also provide office and telephone service for the project staff. Support will be provided to the participating district to help offset the office space, telephone, and clerical workload costs. The Conservation District will also recommend potential WAG members to the OCC.

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[6] Conservation plans or Farm plans are documents that describe the current landuses on a parcel of property and recommend best management practices to reduce pollutants from those landuses. These may or may not include animal waste plans (documents that describe BMPs necessary to reduce the impacts from animal waste produced on the property) and/or nutrient management plans (documents that describe practices necessary to reduce nutrient runoff from the site).

Task Objective: The objective of this task is to insure localized project input and management.

Task Schedule:

Subtask #	Description	Milestones
9.2.1	Establish district support agreements	October 2006
9.2.2	Hire Project Coordinator	October 2006
9.2.3	Select a WAG and hold first meeting	November 2006

Task 9.2 Deliverables

Subtask #	Description	Due Date
9.2.3	WAG and Conservation District Meeting Minutes and Agendas	With final report

Task 9.2 Budget:

Position	Salary	Fringe	Travel	Contractual	Supplies
On-site Coordinator*	$152,000.00	$52,000.00	6,000.00	Lease Vehicle $24,000.00	$22,000.00
District support agreements				$20,000.00	

* Position not included nor funded in FY 2005/2006 319(h) Projects 6 - 8.

Task 9.3. Demonstrate Practices and Achievable Water Quality Improvements

Task 9.3.1 Watershed-Based Plan

A Watershed-Based Plan (WBP), addressing the nine key elements identified in FY 2004 319 guidance has been developed for the Oklahoma portion of the Grand Lake Watershed. *The Nonpoint Source Program and Grants Guidelines for States and Territories for FY 2004 and Beyond* requires a Watershed-Based Plan (WBP) to be completed prior to implementation using incremental funds. The WBP is intended to be an evolving document, revised upon completion of major efforts in the watershed. The WBP will continue to evolve, as the TMDL is completed, and as results of the first phase of activities in the watershed reveal whether or not further implementation is necessary to achieve beneficial use support.

As a component of the WBP, specific areas in the Honey Creek Watershed will be targeted for demonstration of Best Management Practices that can reduce NPS loads related to nutrients (primarily phosphorus), sediment, and fecal bacteria. The location of these critical areas will be selected through the methodology described in Task 9.1. The practices that will be promoted will focus on: 1) implementing the reduction goal for nutrient loading to Honey Creek in accord with the initial goals specified in the watershed based plan (phosphorus, sediment, and fecal bacteria load reductions of

20%[7] within five years, and ultimately 80% for phosphorus and sediment and 50% for bacteria, and 2) implementing additional objectives of the Watershed-Based Plan. Best Management Practices will also be promoted that will reduce pollutants from the sources identified in Oklahoma's Integrated Report and pollutants identified by recent monitoring programs.

Project Conservation Plans and agreements will be developed by the OCC and implemented by the Conservation District and NRCS representatives. Following the development of these plans and agreements, an appendix to the Watershed-Based Plan will be drafted that will detail the location and nature of practices planned for the watershed and to fine-tune the estimate of load reduction potential from those practices

The TMDL may identify additional needs for implementation in the watershed. Those needs will be incorporated into the WBP and the implementation program as soon as possible. TMDL completion may require that this incorporation occurs beyond the life of this project. However, because the information used in the targeting is the same that will go into the development of the TMDL, any activities of this project will work towards the ultimate goal of the TMDL. Additional funds from future 319 programs may be directed to the watershed if the need is justified.

Task 9.3.2 BMP Demonstration[8]

This sub-task describes the implementation of practices projected for the Honey Creek Watershed. The main BMPs that will be implemented in the demonstration area will focus on reduction of nutrient loads. A Watershed Advisory Group will be assembled to suggest practices and cost-share rates. Examples of practices that will be suggested to the WAG include (1) riparian establishment to include fencing, vegetative establishment, off-site watering, livestock shelters and incentive payments; (2) buffers zone establishment to include fencing and incentive payments; (3) streambank stabilization to include fencing and vegetative plantings; (4) animal waste storage facilities and/or composters; (5) pasture establishment; (6) pasture management; (7) proper waste utilization for poultry producers, (8) heavy use areas, (9) nutrient management, (10) bio-retention cells, and (11) on-site wastewater systems (septic systems).

Application of these practices with similar rates of adoption that occurred in the Beaty Creek FY 1998 – 2000 319 projects allowed an estimate of the potential load reduction that might be accomplished from these implementation efforts using the PRedICT model. PRedICT estimated that this implementation, directed at cropland and

[7] This project will be portion of the effort working towards a 20% load reduction goal for the watershed within the four year period. Additional efforts such as point source reductions, adoption of BMPs through USDA programs, and other load reduction efforts will be necessary to meet this goal for the watershed within a four year period.

[8] Describes elements of components (b) and (c) of a Watershed Based Plan more specifically for the Honey Creek subwatershed, by identifying the practices that will be used to reduce NPS pollution in the watershed and the load reduction that could be accomplished with predicted levels of implementation. More information can be found in the Grand Lake Watershed Based Plan.

pastureland (particularly those along streams) and residential development could result in a phosphorus load reduction of over seventeen percent.

Oversight of implementation will be the responsibility of the Delaware County Conservation District, with the assistance of the OCC staff including the Project Coordinator. The OCC staff will draft the farm plans and agreements between the landowner and conservation district to implement approved practices. Distribution of funds will follow the pattern established with previous projects.

Demonstration will occur on cooperator farms, residences, or commercial properties. These landowners, selected through the targeting practices delineated earlier, will implement practices on a cost-share basis. This mechanism will occur much in the same way as in other priority watershed projects.

Demonstration of the success of these practices should help spread the efforts to remaining parts of the watershed. The conservation district, using the locally led State cost-share program, will glean information from the project on the Best Management Practices that will reduce nutrient loading to the streams in the Honey Creek Watershed.

A detailed plan for the initial phase of implementation (pre-implementation report) will be appended to the finalized Watershed-Based Plan, once the initial signup period is complete. This plan will detail the location of needs, the location of the initial cooperators, and the initial planned practices. This plan will also evaluate, on a subwatershed level, the load reduction likely to result from the planned practices. It is likely that not all producers in the critical areas will be willing or able to participate initially in the project. This implementation plan will allow project planners to evaluate the completeness of the initial effort and such that a follow-up effort can be developed as necessary to target producers who did not participate in the initial program but who could have a significant impact on water quality in the watershed. This plan will be presented to NRCS (at the state and local levels) in an attempt to facilitate cooperation between the 319 program and the use of EQIP funds.

Task 9.3.3 Tracking of BMP Implementation

A GIS data layer of farm plans will be created and maintained by the Project Coordinator. BMPs as planned and implemented will be tracked for future watershed modeling and for reporting project performance. Project staff will make regular site visits to assess progress in implementing planned BMPs. Semiannual progress reviews will formally assess cooperator performance. Where implementation problems are identified, the Project Coordinator will follow through with plan revisions or cancellation of the cooperator's agreement and reallocation of the funds to demonstrate practices elsewhere within the project area. Details will be summarized in the project final report.

The final report will attempt, where possible, to report on BMPs implemented in the watershed through other means such as through the EQIP program, the State-funded, locally-led cost-share program, and solely through landowner funding. NRCS does not routinely release this information and therefore, it is unknown to what extent USDA program information can be reported. As possible, implementation data will be presented in a GIS format. At a minimum, financial information concerning EQIP and locally led cost-share funds will be presented. In addition, load reductions expected due to 319 implementation of practices will be estimated using a watershed-based model such as SWAT or StepL.

Task Objective: The purpose of this task is to implement those practices to reduce NPS loading to Honey Creek.

Task Schedule:

Subtask #	Milestone Description	Due Date
9.3.1.a	Appendix to WBP that includes a specific Pre-Implementation Plan (9.1.3) for this project which will provide greater detail on practices to be implemented as part of this project and expected results	September 2008
9.3.1.b	Presentation of specific Pre-Implementation Plan (9.1.3 and 9.3.1.a) to state and local level NRCS to facilitate cooperation between the 319 program and EQIP	January 2007
9.3.2	BMP Demonstration	January 2007 – July 2010
9.3.3	Tracking of BMP Implementation	January 2007 – July 2010

Deliverables:

Subtask #	Description	Due Date
9.3.1	Appendix to WBP that includes specific Pre-Implementation Plan for this project which will provide greater detail on practices to be implemented as part of this project and expected results	September 2008

Task Budget:

Total Demonstration	Producer Input %20	State Funds for BMP Demonstration	Federal Funds for BMP Demonstration
$~~1,224,210~~ $1,143,016.00	$~~244,842~~ $228,603.20	$~~419,482~~ $435,720.80	~~$559,886~~ $478,692.00

Task 9.4 Watershed Education Program[9]

This project is intended to affect long-term behavioral changes of watershed residents and users that will assure continued protection of water quality in the Honey Creek Watershed. Substantial effort in this project is devoted to determining and demonstrating practices essential for this goal. The education program must ensure widespread adoption of these practices over the entire watershed. The education program must also be established in a fashion such that it will continue past the life of the project. The education program will coordinate with ongoing programs in the watershed such as those funded under §319 FY 2004 Project 5.

Task 9.4.A. The education program will be guided and implemented by the Project Coordinator. The Honey Creek education program will be developed around the following goals:

(1) Working with Education Coordinator (FY 2004 Project) to involve landowners in the targeted areas in education programs specified through the FY 2004 project including Master Gardeners, Blue Thumb, Oklahoma Water Watch, Bioretention Cells, and whole-soil profiles.
(2) Utilizing the demonstration farm established under the FY 2003 Spavinaw Creek Project and the FY 2007 Honey Creek Demonstration Farm Project to show producers the benefits of prescribed practices.
(3) The project coordinator will write a monthly article for the tri-county newsletter published and distributed by the Delaware County Conservation District.
(4) Focus a Blue Thumb program in the watershed.
(5) Exhibits – develop a display for the project that can be used to educate the public on the 319 Program. Display should include basic information on the program, its cooperators, and contact people of ongoing programs in the watershed (including 2004 project contacts).
(6) Publish at least one article a month in a newsletter or paper read by local citizens on project details and accomplishments.
(7) Develop a recognition program for project cooperators.
(8) Track how participation in the education program has changed people's behaviors. Project coordinator will follow ten percent of people intercepted through different aspects of this and related project activities and will contact

[9] Addresses component (e) of a Watershed Based Plan for the Honey Creek watershed. Additional information on component (e) can be found under task 9.2 of this workplan and in the Grand Lake Watershed Based Plan.

them on an annual basis throughout the project period to determine whether they have made any changes that would affect NPS pollution.

Task Objective: The purpose of this task is to develop an education program that will help the citizens of the Honey Creek Watershed reduce NPS pollution.

Task Schedule:

Subtask #	Milestone Description	Due Date
9.4.1	Conduct at least semiannual field trips for producers to demonstration farm in Spavinaw Watershed and/or Honey Creek Watershed (minimum of four trips & 16 participants during first two years of project.	March 2007, 2008 September 2007, 2008
9.4.2	Distribute monthly tri-county newsletter to watershed residents (may coordinate with FY 2004 Project activities)	Beginning November 2006 – September 2010
9.4.3	Hold Blue Thumb Training in watershed	March 2007
9.4.4	Develop a display on program that is showcased at a minimum of 4 fairs, home shows, or similar events each year during the project.	March 2007
9.4.5	Begin publishing at least one article a month on program in paper or newsletter read by local citizens	December 2006
9.4.6	Develop a recognition program for local cooperators- articles, certificates, signs, etc. Program must have WAG approval	June 2007
9.4.7	Tracking behavioral change	Throughout project

*Position not included or funded under FY2005/5006 319(h) Projects 6-8.

Deliverables:

Subtask #	Description	Due Date
9.4.1	Three copies of all education materials produced during the project and summary of behavioral change study	Included with final report

Measures of Success

Overall success of this task will be assessed largely by tracking behavioral change. At least thirty percent of people reached through the project will enact some sort of behavioral change to protect water quality and reduce NPS pollution.

Task Budget:

Supplies
$20,600.00

Task 9.5. Measurement of Success[10]

Substantial monitoring has been completed in the Honey Creek and Grand Lake Watershed that has identified numerous water quality problems as shown in the introductory paragraphs of this work plan. In addition, under Task 9.1, critical areas will be identified in the watershed that are suspected to contribute most significantly to NPS loading in the watershed. This information could provide a baseline for comparison to evaluate changes in water quality and potential sources over the project period.

Subtask 9.5.1: Follow-up GIS evaluation of Land Use/Land Cover Changes.
The ultimate measure of success of the project will be restoration of beneficial use support in Honey Creek improvement in the Honey Creek cove of Grand Lake and protection of its natural resources. A monitoring program is proposed below to evaluate this success. However, due to the extent of the problem in Honey Creek and the point source discharger in Missouri, it is unlikely that significant improvements in water quality will be measurable at the end of the project period. Therefore, water quality monitoring to evaluate success of the project will be supplemented by replicating Task 9.1, GIS Targeting at the end of the project, to measure changes in landuse and cover quality. It is anticipated that at least 30% of the landowners in the Oklahoma portion of the watershed will have participated in the project and that the amount of bare soil or chronically overgrazed pasture will decrease by 40%.

Subtask 9.5.2. Water Quality Monitoring
Due to the number of changes ongoing in the watershed relative to past projects, lawsuits, and other factors, it is important to continue to monitor water quality in the system.

OCC will install autosamplers on Honey Creek, one at the state line, one near the mouth of the creek near the lake, and one on Saline Creek as a reference site. These autosamplers will be used to collect continuous phosphorus concentrations. In addition, OCC will conduct routine physico-chemical, biological, and habitat monitoring at these sites. Water Quality Monitoring will begin on a monthly basis once the QAPP is approved, and continue throughout the length of the project.

---

[10] This section contains components (h) and (i) of a WBP specific for the Honey Creek subwatershed. Additional information can be found in the Grand Lake Watershed Based Plan.

To focus on the parameters of concern, and to reduce monitoring expenses, water quality samples will be analyzed only for total phosphorus, nitrate-nitrogen, nitrite-nitrogen, ammonium nitrogen, total coliform, *E. coli*, and *Enterococcus* bacteria. Field parameters to be collected include dissolved oxygen, pH, temperature, turbidity, conductivity and instantaneous discharge, and alkalinity. Periphytometers may be deployed to measure primary productivity. The QAPP will be submitted by June 2006.

The Oklahoma Water Resources Board, Oklahoma Department of Environmental Quality, and the USGS maintain water quality monitoring stations in the Honey Creek Watershed. Data from these stations will also be evaluated according to Oklahoma's water quality standards and Use Support Assessment Protocols to determine whether or not measurable water quality changes have occurred as a result of project efforts.

Due to the concern over potential impacts from septic systems to the watershed, OCC will monitor to estimate the relative impact to areas where septic systems are concentrated. OCC will monitor in two coves of the lake for pollutants indicative of human waste such as but not limited to, caffeine, bacteria, and nitrogen compounds. One cove will have a large number of septic systems, the other, one with fewer septic systems spread farther from the lake, will serve as a reference system. Near shore presence of these compounds in the absence of significant mid-lake concentrations of the same compounds will provide evidence of loading from septic systems. Samples will be collected during different times of the year (summer recreation season vs. winter) and during baseflow vs. runoff conditions in the watershed to determine whether these conditions significantly impact bacteria in the lake. Bacteria monitoring completed by Oklahoma Water Watch and Blue Thumb volunteers under FY 2004 Project 5 may be evaluated to develop sampling strategies relative to number of samples collected, seasonality of sampling efforts, and sampling sites.

Subtask 9.5.3.
In addition, OCC will document success with before and after photos of implementation sites. Initial photos will be taken at the time of farm plan preparation. Secondary Photos will be taken immediately following BMP installation. Final photos will be taken near the end of the project. This documentation will be summarized in the final report.

Additional measures of success include:

- Full implementation of BMPs as planned in task 9.3.
- A substantial part of the project funding is going toward personnel to work in the watershed to establish and or update conservation plans. The goal for this effort is for 80% of the targeted farms in the Honey Creek Watershed to have current conservation plans. We will expect that 60% of those will actively implement the practices recommended in the plans.
- To reach a 20 % reduction in potential load, based on water quality modeling such as SWAT or StepL.

The results of these efforts, along with the project, will be detailed in the project Final Report.

The §319 Honey Creek Demonstration Farm Project, FY '07/Project 5 workplan has been revised to include funding for cost share implementation to extend the work being done in this FY '06 project. One Final Report will be submitted to EPA at the end of the FY 07 Demo Farm timeline, covering both projects and including analytical load reduction data. A Letter Report will be submitted at the end of this project briefly summarizing this project. All deliverables listed in this workplan as being due with the Final Report will be submitted with the FY'07/Project 5 Final Report.

Task Schedule:

Task #	Milestone Description	Due Date
Task 9.5.1	Follow-up GIS evaluation	March – August 2010
Task 9.5.2	Secondary data QAPP and Septic tank monitoring QAPP	December 2006
Task 9.5.3	Photodocumentation of BMPs	Throughout the project

Deliverables[11]:

Subtask #	Description	Due Date
9.5.1	Follow-up GIS evaluation*	September 2010 (in Final Report)
9.5.2	Water quality monitoring QAPP	July 2006
9.5.3	Photodocumentation and Secondary data QAPP and Septic tank monitoring QAPP	December 2006
9.5.4	Letter Report	June 2010
9.5.5	Final Report*	September 2010

*To be submitted with FY 07/8 319 C9-996100-14 Project 5 Final Report

Task Budget:

Subtask #	Contractor*	Subcontractor	Fringe	Supplies	Travel	Total
9.5.1- Follow-up GIS	$16,742	$20,000	$2,258	$500	$500	$40,000*
9.5.2	$52,000			$29,194		$81,194
Septic Impacts Monitoring	$98,000[12]			$2,000		

*total payable to contractor

[11] To be completed by OCC tech writers funded under FY 2006 – 2010 Project 2.
[12] Laboratory analysis to be completed by contract laboratory.

Total Project Outputs:

Task #	Description	Person Responsible	Due Date
9.1.1	First Stage Targeting Results	Contractor	July 2006
9.1.3	Final Targeting Mechanism	Project Coordinator	December 2006
9.2.3	Meeting Minutes and Agendas*	Project Coordinator	With final report
9.3.1	Appendix to WBP that includes specific Implementation Plan for this project which will provide greater detail on practices to be implemented as part of this project and expected results	Project Coordinator	September 2008
9.4.1	Three copies of all education materials produced during the project*	Project Coordinator	Included with final report
9.5.1	Follow-up GIS evaluation*	OCC Tech Writers	September 2010 (in final report)
9.5.2	Water quality monitoring QAPP	OCC Tech Writers	July 2006
9.5.3	Photodocumentation and Secondary data QAPP and Septic tank monitoring QAPP	OCC Tech Writers	December 2006
9.5.4	Letter Report	OCC Tech Writers	June 2010
9.5.5	Final Report*	OCC Tech Writers	September 2010

*To be submitted with FY 07/8 319 C9-996100-14 Project 5 Final Report

Project Management:

This project will be managed by the Oklahoma Conservation Commission in cooperation with the Office of the Secretary of the Environment. The Oklahoma Conservation Commission will provide oversight for all project activities. NRCS will provide technical support and administration of USDA programs.

Project Duration:

Four years.

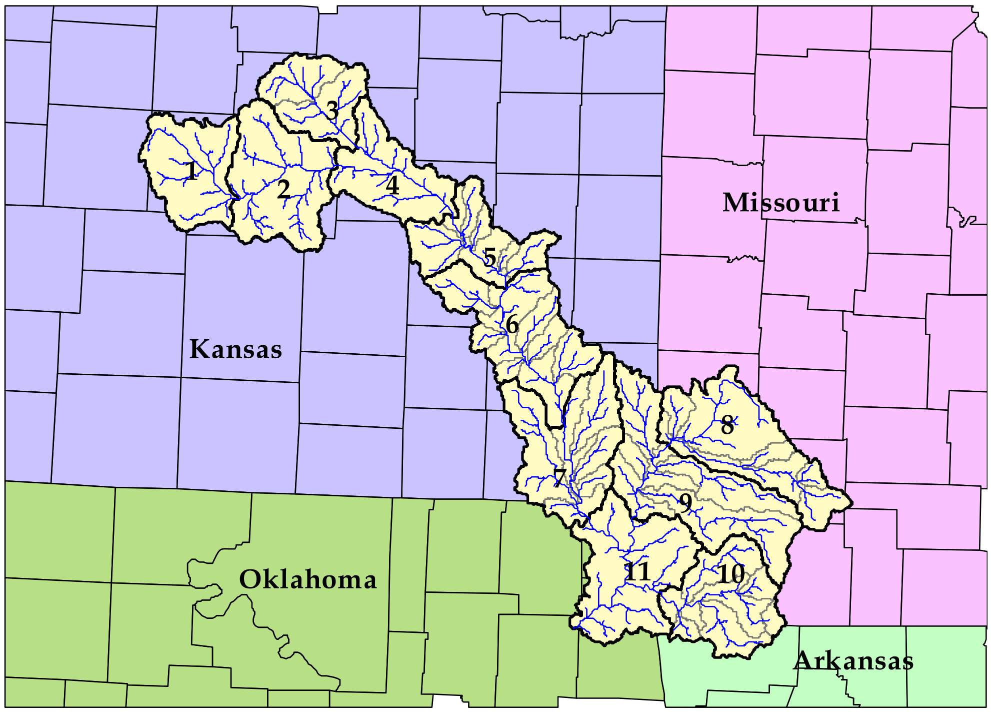
Project Budget[13]:

Project 9. Honey Creek Watershed Project	
State	$664,324
Federal	$996,486
Total	$1,660,810
Object Class Categories	
a. Personnel	$152,000
b. Fringe Benefits	$52,000
c. Travel	$6,000
d. Equipment	$0
e. Supplies	$73,794
f. Contractual	$234,000
g. Construction	0
h. Other	$1,143,016
i. Total Direct Charges (sum of 6a-6h)	$1,660,810.00
j. Indirect Charges	
k. TOTALS (sum of i and j)	$1,660,810.00

[13] This section more specifically identifies additional information relative to component (d) of a Watershed Based Plan. Additional information can be found in under Task 9.2 of this workplan and in the Grand Lake Watershed Based Plan

GRAND LAKE WATERSHED PLAN

For Improving Water Quality Throughout the Grand Lake Watershed



Prepared by:

Grand Lake O' the Cherokees Watershed Alliance Foundation, Inc.

November, 18 2008

"It's All About the Water!"

GRAND LAKE WATERSHED PLAN - 2008

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GRAND LAKE O' THE CHEROKEES ALLIANCE FOUNDATION BOARD 2007-2008

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APPROVED: Foundation Board of Directors

Carl Metcalf, *Foundation Chair*
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John K. Gillette, *Foundation President*

Grand Lake O' the Cherokees Watershed Alliance Foundation Inc.
P.O. Box 451185
Grove, OK 74345-1185

ACRONYMS AND ABBREVIATIONS USED IN THIS DOCUMENT

BMP	Best Management Practice
BOD	Biological Oxygen Demand
DO	Dissolved Oxygen
CAFO	Confined Animal Feeding Operation
Cd	Cadmium
cfs	Cubic feet per second
CERCLA	Comprehensive Environmental Response, Compensation & Liability Act
EPA	US Environmental Protection Agency
ERWIA	Elk River Watershed Improvement Association
FSWC	Four State Watershed Collaborative
GLWAF	Grand Lake O' the Cherokees Watershed Alliance Foundation
GRDA	Grand River Dam Authority
IPI	Improvement Potential Index
KDHE	Kansas Department of Health and Environment
KWO	Kansas Water Office
MoDNR	Missouri Department of Natural Resources
N	Nitrogen
NPS	Nonpoint Source
OCC	Oklahoma Conservation Commission
ODEQ	Oklahoma Department of Environmental Quality
OWRB	Oklahoma Water Resources Board
P	Phosphorus
Pb	Lead
PS	Point Source
SLT	Stakeholder Leadership Team
TMDL	Total Maximum Daily Load
USDA	US Department of Agriculture
USACE	US Army Corps of Engineers
USGS	US Geological Survey
WP	Watershed Plan
WQS	Water Quality Standards
WRAPS	Watershed Restoration and Protection Strategy
WWTP	Wastewater Treatment Plant
Zn	Zinc

EXECUTIVE SUMMARY

The purpose of this Watershed Plan (WP) is to provide an initial assessment and overall strategic plan for the Grand Lake O' The Cherokees 10,298 square mile watershed. A strategic water quality approach is necessary because the watershed is located within the four states of Arkansas, Kansas, Missouri and Oklahoma. It also traverses two separate Environmental Protection Agency Regions, includes numerous Tribal areas, and has many county and local governments within its boundaries.

Impaired waters caused by nutrient (most notably phosphorous) pollution are widespread throughout the Grand Lake watershed. Each of the three major watershed rivers (Neosho River, Spring River, and Elk River) has nutrient impairment and each flows into Grand Lake and other reservoirs.

The Neosho River Subwatershed has three federal reservoirs (Marion Reservoir, Council Grove, and John Redmond), each negatively impacted by nutrients. A 2005 algae bloom occurred on Marion Reservoir that resulted in the beaches being closed and communities prevented from using lake water as their water supply. Beach closings at Marion have occurred in subsequent years. Also, Grand Lake O' The Cherokees is a nutrient rich lake that is receiving an elevated and excess amount of nutrients.

Toxic algal bloom in Marion Reservoir in the headwaters of the Grand Lake Watershed (photo courtesy of Gerard A. Clyde, Jr., US Army Corps of Engineers, Tulsa District).

Nutrients are carried throughout the watershed attached to sediment particles or as organic waste (which may also contain bacteria and pathogens). These issues are linked and well documented throughout the watershed:

> The Neosho River Subwatershed priority impairments include: (1) nutrients (evidenced by low dissolved oxygen/eutrophication), (2) sediment (silt), and (3) bacteria. Sources for these high priority impairments are: agriculture fields, stream banks, pasture, permitted sites, including municipal waste water treatment plant point source discharges, and septic systems. Identified causes include soil erosion, lack of riparian buffers, overgrazing, and failing septic systems.
>
> The Spring River Subwatershed priority impairments include: (1) heavy metals, (2) nutrients (evidenced by low dissolved oxygen in Kansas), and (3) bacteria. The causes of impairment stem from acid mine seepage, soil and bank erosion, animal stream access, and failed septic systems.
>
> The Elk River Subwatershed priority impairments include: (1) nutrients, (2) bacteria, and (3) sediment. The causes of impairment are agricultural activity, failed septic systems, pasture erosion, and permitted sites, specifically municipal waste water treatment plant point source discharges.
>
> The Lake O' The Cherokees Subwatershed, about 888 square miles located mostly in northeast Oklahoma, priority impairments include: (1) nutrients, (2) bacteria, and (3) heavy metals. The sources of impairment stem from livestock, land application of manure, agricultural activity, septic systems, mine waste, and wastewater lagoon discharges.

Reducing total watershed-wide nutrient (phosphorus) pollution requires a strategic collective solution. Pollution risks stemming from elevated nutrient levels will only increase from population increases and other sources unless a four-state coordinated effort is implemented.

This WP advances three priority initiatives each designed to address a strategic problem throughout the watershed:

1. Conduct watershed-wide targeting studies, including sediment and nutrient modeling and stream bank stability studies.
2. Establish signage that designates the watershed boundaries to include the boundaries of subwatersheds
3. Fund four full-time Foundation Executive Vice-president positions to assist in organizing and developing citizen-based groups and to assist in developing individually tailored subwatershed plans.

Watershed-wide targeting studies (modeling and streambank stability) will identify the best locations to establish cost-effective nutrient/sediment reduction projects. These studies will provide important information to citizen groups and water quality related state agencies for developing localized improvement projects.

A large portion of the watershed lacks individual WPs for rivers and their tributaries. This condition represents a major deterrent to successfully improving water quality. Preparing and implementing individual WPs within each of its three major rivers and their tributaries is an essential step necessary to achieve improved water quality.

Strategically, the Grand Lake Watershed has an insufficient number of citizen-based stakeholder groups established. This condition is slowing efforts to prepare and implement localized watershed improvement plans. Measures designed to establish additional active stakeholder groups are given a high priority in this WP.

Steps to improve citizen ownership of their watershed are important. Installing signage throughout the total watershed showing the watershed boundaries is a project advanced in this WP. Also, the newly formed citizen-based non-profit Grand Lake O' The Cherokees Watershed Alliance Foundation intends to establish a full-time Foundation position in each of the four watershed states to assist in organizing and supporting citizen-based organizations.

Increased water pollution pressures from population growth are occurring within the Spring River, Elk River and Lake of the Cherokees sub-watersheds. Each of these sub-watersheds warrant a higher priority in the development of citizen-based organizations and locally targeted river and stream WPs. This WP also advances a proposal that additional nutrient/metal monitoring sites be established in both the Spring River and Elk River sub-watersheds.

Heavy metals, a high priority issue in parts of the watershed, are being managed primarily through a separate process. However, since some heavy metals are transported through sediment erosion, projects aimed at reducing nutrients/sediment will also reduce heavy metal pollution.

The non-profit corporation Grand Lake O' The Cherokees Watershed Alliance Foundation Inc. was formed in late 2007. Its Board of Directors is comprised of citizens from each of the four watershed states. The objectives of this Foundation include:

- Providing private funding to supplement governmental funding
- Assisting in the support and organization of citizen-based organizations
- Funding a full time Foundation staff to work within the watershed
- Supporting a strong public education outreach program
- Assisting with identification and solution of water quality related issues
- Energizing citizens and watershed stakeholders in shaping the watershed
- Interfacing with local, state, Tribal, and federal agencies

The watershed presently has insufficient citizen-based stakeholder organizational infrastructure that is essential to achieve improved water quality. A large portion of the watershed lacks individual subwatershed plans tailored for specific rivers and streams. Consequently, material improvements in water quality during the next ten years do not look promising unless the following occur:

- Organizing and supporting citizen-based stakeholder organizations must receive a high priority for the next five years. This is an imperative strategic element requiring focus by citizens, community leaders, and governmental leaders.
- Citizen-based stakeholder organizations and additional funds are required to prepare subwatershed plans tailored for specific streams.
- A higher priority for funding water quality improvement projects implemented by citizen-based organizations with support from local, state, federal and tribal government is necessary.
- Private funds must be made available to support these water quality improvement efforts.

Degradation of water quality is a real risk within the watershed. Increased pollution risks are expected unless drastic steps are taken and higher priorities are established. One strategic objective is to stop the projected decline in water quality. Clearly, the nutrient rich watershed will continue to affect the four major reservoirs (Marion, Council Grove, John Redmond, and Grand Lake) and the major rivers (Neosho, Spring, and Elk) unless a watershed-wide collective and coordinated effort is adopted and implemented.

PREFACE

The purpose of this Watershed Plan (WP) is to serve as the first general strategic assessment and analysis of the total Grand Lake O' The Cherokees watershed. This large watershed is about 10,298 square miles located in parts of the four states Arkansas, Kansas, Missouri and Oklahoma.

The organizational format follows the nine elements recommended in the United States Environmental Protection Agency (EPA) *Handbook for Developing Watershed Plans to Restore and Protect our Waters* (2008). It is noted the sheer size and complexity of the watershed warrants a more strategic presentation rather than the detail appropriate for a smaller watershed.

The Grand Lake watershed is diverse and complex. This is due not only to its size but also to the separate local, state, federal and tribal governmental jurisdictional boundaries. The impact of mining districts in Missouri, Kansas, and Oklahoma, including the Tar Creek EPA Superfund site (located in the southern portion of the watershed), also compound these water quality issues.

The water quality assessment in this report is organized into four sections corresponding to the four major subwatersheds of the Grand Lake Watershed (Figure 1).

> (1) The Neosho River Subwatershed drains from Kansas into Oklahoma and comprises about 5,830 miles or about 57% in the Kansas portion of the watershed. There are three federal reservoirs in this watershed: Marion, Council Grove, and John Redmond.
>
> (2) The Spring River Subwatershed is located in southwest Missouri, southeast Kansas, and northeast Oklahoma. About 2,577 square miles of the total Spring River watershed or about 25% is located in southwest Missouri, and southeast Kansas. There are no reservoirs on the Spring River.
>
> (3) The Elk River Subwatershed is located in parts of Arkansas, Missouri and Oklahoma and includes about 1,037 square miles, or about 10% of the watershed.
>
> (4) The Lake O' the Cherokees Subwatershed includes the land draining into the Neosho River from about the Kansas border to its convergence with the Spring River in northeast Oklahoma into the Grand River. This subwatershed also includes the land areas around other minor streams draining into the Grand Lake O' the Cherokee reservoir. This subwatershed is about 888 square miles or 8% of the total Grand Lake watershed. Grand Lake covers 46,500 surface acres and holds 1,572,000 acre-feet of water.

Review and analysis of Total Maximum Daily Loads (TMDL) for bodies of water in the watershed served as the analytical foundation for this WP. The methodology used also included a review of published reports and other relevant information. The analysis focused on bodies of water that have been declared impaired by respective state governments.

There have been water quality improvement programs instituted within the watershed, but not pursuant to an overall comprehensive strategic WP. One essential step to achieve improved water quality is to have a strategic WP for the total watershed. This is because the Grand Lake Watershed is so large and complex (with the four states involved having different water quality standards, different methods and different priorities).

In 2007 a non-profit organization, Grand Lake Watershed Alliance Foundation Inc. (GLWAF), was formed to provide a citizen-based focus on the total watershed. The makeup of its Board of Directors includes citizens from each of the four watershed states. This Foundation intends to work closely with other citizen-based organizations within the watershed in order to improve education, communication and coordination among the various watershed stakeholders and governmental entities.

The GLWAF has developed this WP to provide an initial overall watershed strategic assessment. This plan expands upon the 2004 WP developed by the Oklahoma Conservation Commission. There are clear and definitive future actions presented that will advance improvements in water quality. The overall focus of this WP is weighted more heavily on non-point source conditions due to the nature of the watershed and its pollution contributing factors. However, it is recognized that point-sources such as wastewater treatment plants are significant contributors of nutrients/phosphorus and other pollutants and must be addressed by the state and federal agencies that regulate these permitted sites, in conjunction with the Foundation's plans and actions.

This WP has been developed as a dynamic document subject to revision and update as appropriate. It can serve as a framework and reference for more detailed and comprehensive WPs tailored for specific subwatershed streams and bodies of water.

This WP also presents key important steps: further developing subwatershed stakeholder groups, improving watershed wide education efforts, supporting citizen-based watershed groups, assisting in developing subwatershed plans, and generating private and public funding to support water quality improvement efforts.

To reflect the increasing importance of citizen-based watershed groups in shaping and achieving water quality improvements, a portion of this report presents a discussion of these key groups within the watershed and corresponding plans to increase their presence and involvement within the watershed.

This WP confirms the watershed is facing increased water quality risks from population increase and other pollution pressures. This WP for the Grand Lake watershed also points to the present risks associated with sediment, nutrients, and bacteria that are a common pollution threat throughout the watershed. In addition, there are portions of the watershed where heavy metals pose a major concern.

Watershed planning is an emerging process. A considerable portion of the watershed geographical area does not have a WP that is applicable to specific rivers and their tributary streams. This WP also presents the status of watershed planning.

There were many individual and organizational participants in the preparation of this WP. However, the efforts of four individuals are appropriately recognized: Dr. Kevin Gustavson, Oklahoma Conservation Commission; Foundation Board member Dr. Jim Triplett, Pittsburg State University; Foundation Board member Drew Holt, Executive Director Elk River Watershed Improvement Association; and Foundation Committee member Terry Hallauer, Oklahoma Department of Environmental Quality.

INTRODUCTION

The Nonpoint Source Program and Grants Guidelines for States and Territories for 2004 and Beyond requires a *Watershed Plan* to be completed prior to implementation of watershed projects using federal money authorized by the Clean Water Act. The guidance defines the 9 key components to be addressed in a watershed-based plan. These components include: 1) identification of sources and causes that will need to be controlled to achieve load reductions, 2) estimate of load reductions expected from the management measures described, 3) a description of the management measures that will need to be implemented to achieve load reductions, 4) an estimate of the amounts of technical and financial assistance needed, associated costs, and/or the sources or authorities who will bear responsibility, 5) an information/education component that will be used to enhance public understanding of the project and encourage early participation in the overall program, 6) a schedule for implementing the management measures identified in this plan that is reasonably expeditious, 7) a description of interim, measurable milestones for determining whether control actions are being implemented, 8) a set of criteria that can be used to determine whether load reductions are being achieved over time and substantial progress is being made or whether the Watershed Plan or Total Maximum Daily Load (TMDL) needs to be revised, and 9) a monitoring component to evaluate the effectiveness of the implementation efforts over time.

In the US Environmental Protection Agency's (EPA) supplemental guidance "Handbook for Developing Watershed Plans to Restore and Protect our Waters" (2008), it is noted that the detail expected in addressing the above guidelines decreases with larger watersheds, as the challenges of documenting each stream mile becomes a daunting task for these large watersheds. As the Grand Lake Watershed covers a large portion of 4 states, the intent of this document is to provide an overall framework for addressing water quality issues watershed-wide and to support the development and implementation of subwatershed plans led by local stakeholder initiatives.

In order for the watershed plan to become an integral part of the entire watershed restoration program, it must be amenable to revision and update. The Grand Lake Watershed Plan has been developed as a dynamic document that will be revised to incorporate the latest information, address new strategies, and define new partnerships among watershed stakeholders. It is anticipated that at least biannual revisions may be necessary and that the responsibility for such revisions will rest primarily with the Grand Lake O' the Cherokees Watershed Alliance Foundation (GLWAF). It is understood that the water quality goals set forth in this watershed plan, as well as the technical approach to address the goals, may not be comprehensive, so they may be expanded in the future. Federal and state funding allocations for future water quality projects designed to address the Grand Lake Watershed problems should not be based solely upon their inclusion in this watershed plan; rather, the plan should be considered a focal point for initial planning and strategy development.

Watershed Characterization

Hydrology: Grand Lake Watershed comprises over 10,000 square miles and spans parts of four states: Kansas, Missouri, Oklahoma, and Arkansas (Figure 1). The watershed is elongate, oriented northwest-southeast, and drains predominantly southward. The watershed is comprised of 3 major river systems (Figure 1): the Neosho, Spring, and Elk Rivers. All 3 rivers converge in Oklahoma in the upper portion of Grand Lake, the terminal reservoir of the watershed. The Neosho River drains approximately 5800 sq. miles in Kansas and provides about half of the inflow to Grand Lake with a discharge of 5,491 cfs. The Spring River drains about 2500 square miles in Missouri and Kansas with a discharge of 3,417 cfs which is about thirty two percent of the inflow to Grand Lake. The Elk River drains about 900 square miles in Missouri and Arkansas with a discharge of 1,299 cfs to provide about twelve percent of Grand's hydraulic budget. Water from the watershed continues down the Grand River through two other reservoirs before entering the Arkansas River near Muskogee, OK, and flowing through Arkansas toward the Mississippi River.

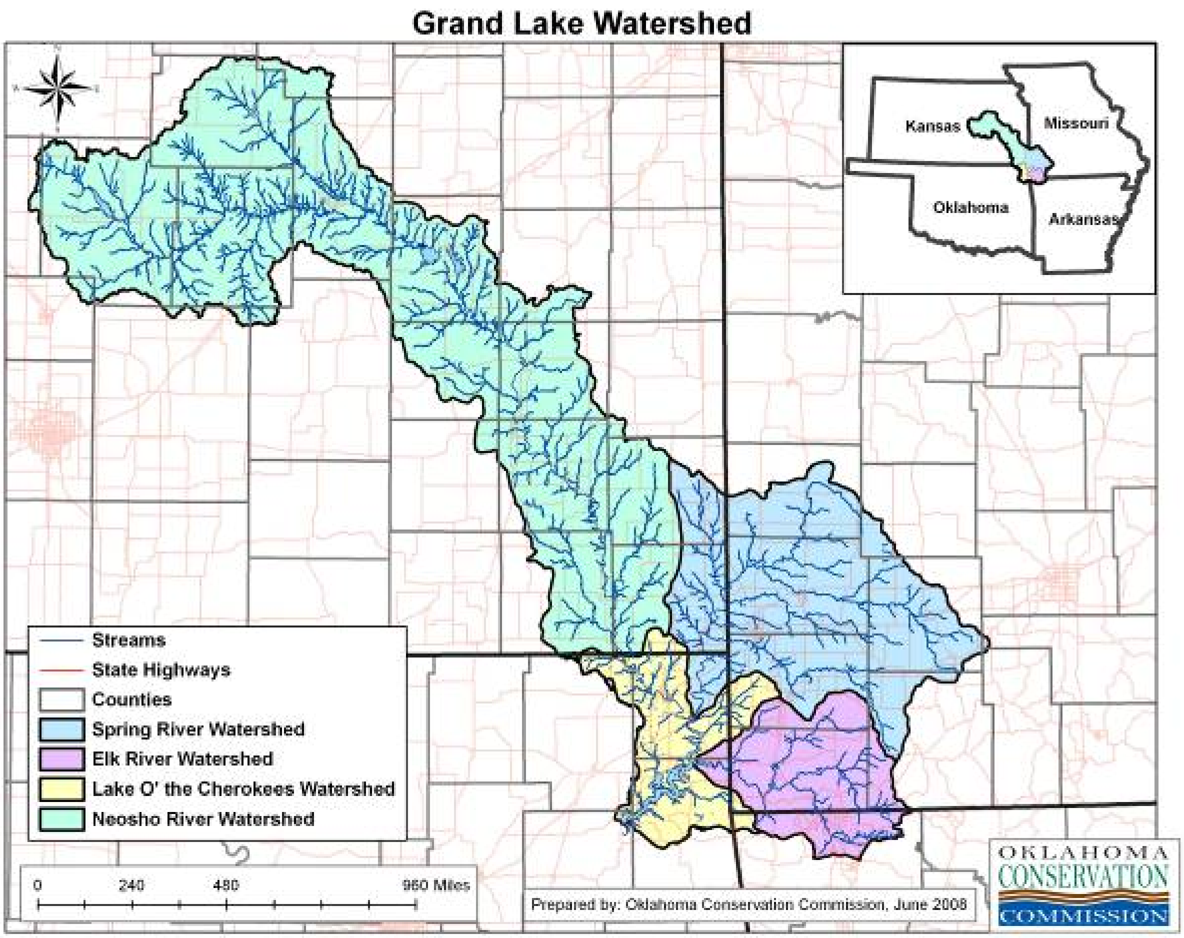

Figure 1: Location of Grand Lake Watershed and its four major divisions corresponding to the 3 major river basins and an area around Grand Lake O' the Cherokees.

There are four major reservoirs in the Grand Lake Watershed. In addition to Grand Lake, these include John Redmond and Council Grove Reservoirs (also on the Neosho River) and Marion Lake (on the Cottonwood) in Kansas. The storage capacity of John Redmond is now about 44,400 acre-feet, Council Grove is about 36,700 acre-feet, and Marion Lake is about 75,100 acre-feet. Grand Lake has a storage capacity of about 1,672,000 acre-feet. Based on the annual volume of water transported by the Neosho River (1,698,000 acre feet at Parsons, KS), water from the Neosho alone is sufficient to "refill" the volume of Grand Lake on an annual basis.

Climate and Precipitation: The Grand Lake Watershed has a continental climate characterized by mild winters and hot summers. Average high temperatures are in the 40's (Fahrenheit) during the coldest winter months and are typically close to 90 degrees Fahrenheit over July and August.

Average annual rainfall in the area increases from the northwest to the southeast: from about 33 inches per year in Lehigh, KS up to about 47 inches per year in Bentonville, Arkansas. Average rainfall throughout the watershed is lowest in the winter months (averaging 0.5 to 2.5 inches per month) and peaks in the spring months (typically over 5 inches in May throughout the watershed). The farther southwest in the watershed, the greater tendency to have another, less pronounced peak in rainfall in early Fall (typically 5 inches in September).

The region is known for its localized, torrential rain storms and its resulting "flashy" stream flows. April, May, and June bring a third of the annual rainfall and about 60% of flooding to the Spring River Watershed with similar patterns elsewhere in the watershed (MoDNR Spring River TMDL, Aber).

High summer temperatures lead to high evapotranspiration (evaporation from the surface plus transpiration of water vapor through vegetation) during the summer months. In the Spring River Watershed, about 75% of the annual rainfall is lost to evapotranspiration with the rest available for streamflow and groundwater recharge (MoDNR Spring River TMDL).

The region experiences over 10 inches of snow on average in portions of the watershed and regular freezing and thawing between the months of November and March. Frost and snows occur as early as September and as late as April.

Ecoregions: Ecoregions are delineated across the United States to help identify areas of common ecological and environmental identity. The Grand Lake Watershed is mostly comprised of 3 level III ecoregions with a fourth making up the extreme northwestern fringe of the watershed. Ecoregion descriptions for this section are taken from the updated level III ecoregion maps (Woods et al. 2004, Woods et al. 2005, Chapman et al. 2001, Chapman et al. 2002).

The extreme northwestern fringe of the Grand Lake Watershed is within the Central Great Plains ecoregion. This ecoregion consists of undulating to hilly topography, originally covered in native tallgrass prairie, much of which has been converted to cropland. Pastureland and cropland are the major land uses with winter wheat the dominant crop (the easternmost region for this crop). Soils are sandy over sandstone bedrock and silty overlying windblown silt deposits.

Much of the upper northwestern portion of the Grand Lake Watershed (most of the land upstream of John Redmond Reservoir) lies in the Flint Hills ecoregion. The rolling hills of this ecoregion are underlain by shale and cherty limestone bedrock. Rocky soils have resulted from the concentration of weathering resistant chert (flint) as the softer Permian limestone weathered over time. These soils are difficult to plow, resulting in limited cropland agriculture. Some cropland, however, has developed in the valleys along the edge of the Flint Hills. This ecoregion contains the largest intact tallgrass prairie that remains in the Great Plains and is mostly used for range and pasture land.

The central portion of the Grand Lake Watershed is part of the Central Irregular Plains ecoregion. This ecoregion is comprised of a band of tallgrass prairie. The topography of this ecoregion is broken by limestone and sandstone cuestas, buttes, hills, and nearby level areas underlain by shale. Fire and grazing is required to maintain the grasslands. In its absence, woody plants such as red cedar, sumac, blackberries, and persimmons will invade the grasslands. This ecoregion supports a variety of land uses from pastureland to cropland to woodland. In addition, oil and gas exploration and coal and limestone mining operations are common in this region.

The southeastern portion of the Grand Lake Watershed is in the Ozark Highlands ecoregion, including the bulk of the Spring River, Elk River, and Lake O' the Cherokees subwatersheds. The Ozark Highlands ecoregion is a karst-rich area characterized by soluble bedrock creating open cavities in the rock (Figure 2). Compared to adjacent ecoregions, this region has more irregular physiography and is generally more forested. The majority of this dissected limestone plateau is predominantly an oak-hickory forest, but stands of oak and pine are also common. Less than one fourth of the core of this region has been cleared for pasture and cropland, but half or more of the periphery, while not as agricultural as bordering ecoregions, is in cropland or pasture.

Figure 2: A cave typical of karst-rich areas in the Ozark Highlands.

Geohydrology and Soils: The Flint Hills portion of the watershed has 3 main types of soils: rocky soils of residual chert on hilltops, silt and clay soils in modern valley floodplains, and older silt and clay soils from windblown deposits found on nearly level uplands. Bedrock structures exert a strong control on stream patterns. Dissolvable bedrock also gives rise to karst features in areas including sinkholes, caves, and springs. This area of surplus water gives rise to perennial spring-fed streams, many of which are deeply entrenched flowing off of the uplands. Groundwater, typically high in dissolved solids, is abundant and generally flows westward with the dip of bedrock. (Aber, Aber)

Geohydrology of the Central Irregular Plains portion of the watershed is characterized by soils derived from shale, sandstone, and limestone. In some nearly level areas, clay pan soils occur. On limestone slopes, exposed limestone slabs and gravels occur. Major streams have low gradients, meander considerably, and develop wide valleys except on areas of very hard rocks. Groundwater in the Central Irregular Plains tends to be saline and is more likely to be anoxic, as opposed to fresh, oxygenated groundwater generally found in the Ozark Highlands.

The Ozark highlands are composed of Springfield plateaus largely underlain by highly soluble and fractured limestone and chert of the Mississippi Boone Formation. Caves, sinkholes, and underground drainage occur, heavily influencing surface water availability, water temperature, and the potential for surface and groundwater pollution. Clear, cold, perennial spring-fed streams with gravel or bedrock bottoms are common. In addition, many small dry valleys occur where overland flow is entirely runoff-driven. Losing streams are common, which allows water to flow directly into the groundwater system through streambeds. During the summer dry period, springs and groundwater recharge sustain stream flows. Springs are a natural resurgence of groundwater, usually on a hillside or the valley floor. Soils are often cherty and have developed from carbonate rocks or interbedded chert, sandstone, and shale.

Natural Vegetation: Potential natural vegetation of the Flint Hills and Central Great Plains in the Grand Lake Watershed is native tallgrass prairie. Much of the native prairie remains in the Flint Hills region due to the poor suitability of the soils for agriculture. Typical vegetation includes tall grasses such as big bluestem and indiangrass with many flowering perennials including coneflowers, prairie rosinweed, lead plant, and others. Occasional fires and managed grazing help preserve these native species.

Potential natural vegetation in the Central Irregular Plains consists of bluestem prairie and oak-hickory forest mosaic. Tall grasses such as big and little bluestem, indiangrass, and switchgrass are dominant species on shales. These are interspersed with a diverse and abundant community of wildflowers. Thin gravelly soils of limestone scarps are populated with a dry prairie of short and tall grasses such as side oats grama, hairy grama, and prickly pear. Dry, open forests on hilltops and in level limestone are composed of post and blackjack oaks and black hickory. Floodplains support elm, spotted oak, pin oak, hackberry, cottonwood, black willow, and sycamore. Poorly drained sites are populated by sedge thickets, willow, and buttonbush.

Potential natural vegetation in the Ozark Highlands is mostly oak-hickory forest. Open forest composed of numerous tree species dominates rugged areas, while pasture and hayland are more common on level areas. Some areas of steep, cherty escarpments and shallow soils derived from limestone support shortleaf pine communities while cool, dry sites on north-facing slopes and in ravines support a closed forest of sugar maple, white oak, chinquapin oak, mockernut hickory, bitternut hickory, and shade-tolerant shrubs. Ridgetops and south-facing slopes are often grassland while floodplains are often an open forest of maples, elms, river birch, sycamore, and cottonwood. Grass and Eastern redcedar are found on shallow, droughty soils especially over dolomite.

Demographics: According to the 2000 census, the population of the Grand Lake Watershed is roughly 500,000 people, about half of which live in Missouri. Population in the region has experienced continued growth over the last half century, especially in NW Arkansas, SW Missouri, and NE Oklahoma. From 1990 to 2000, population in the three Missouri counties within the Elk River Watershed grew an average of 23.3 percent (MoDNR 2004 - Elk River TMDL). Figure 3 clearly shows that despite the larger area, the population in Kansas is very sparse compared to the rest of the watershed.

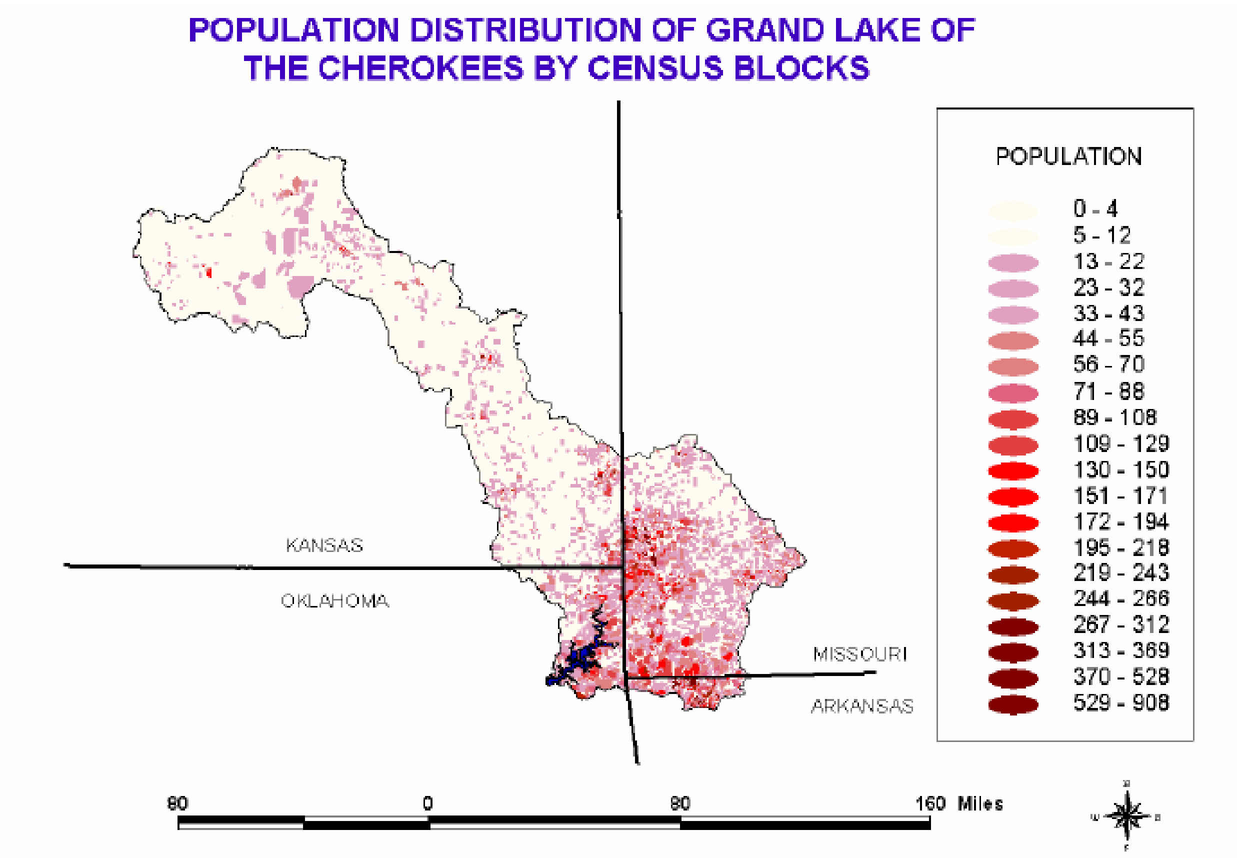

Figure 3: Population concentration map of Grand Lake Watershed (from Oklahoma Water Resources Board 2003).

Land Use: Overall land use in the watershed is 36% planted pasture, 21% natural grassland (which may be grazed), 20% cropland, 14% forest, 6% developed (mostly low intensity or open space such as residential lawns, parks, and golf courses), with the remaining 3% mostly divided between open water and wetlands (Figure 3).

Land use patterns coincide remarkably with ecoregion descriptions (Figure 4). The upper northwestern fringe is mostly cropland and grassland of the Central Great Plains. The Flint Hills Region in the northwest is predominantly grassland. The Irregular Central Plains is a mixture of cropland, pastureland, and grassland. The southeastern part of the watershed, in the Ozark Highlands, is forest and pastureland with cattle and poultry operations prevalent.

The major agricultural industry throughout the watershed is cattle production. Rowcrops produced in the watershed include corn, soybeans, wheat, or sorghum. Poultry operations are most prevalent in the Ozark Highland portion of the watershed to the southeast. In addition to agriculture, land use is becoming increasingly urban and suburban as small cities grow and lakeshore property is developed.

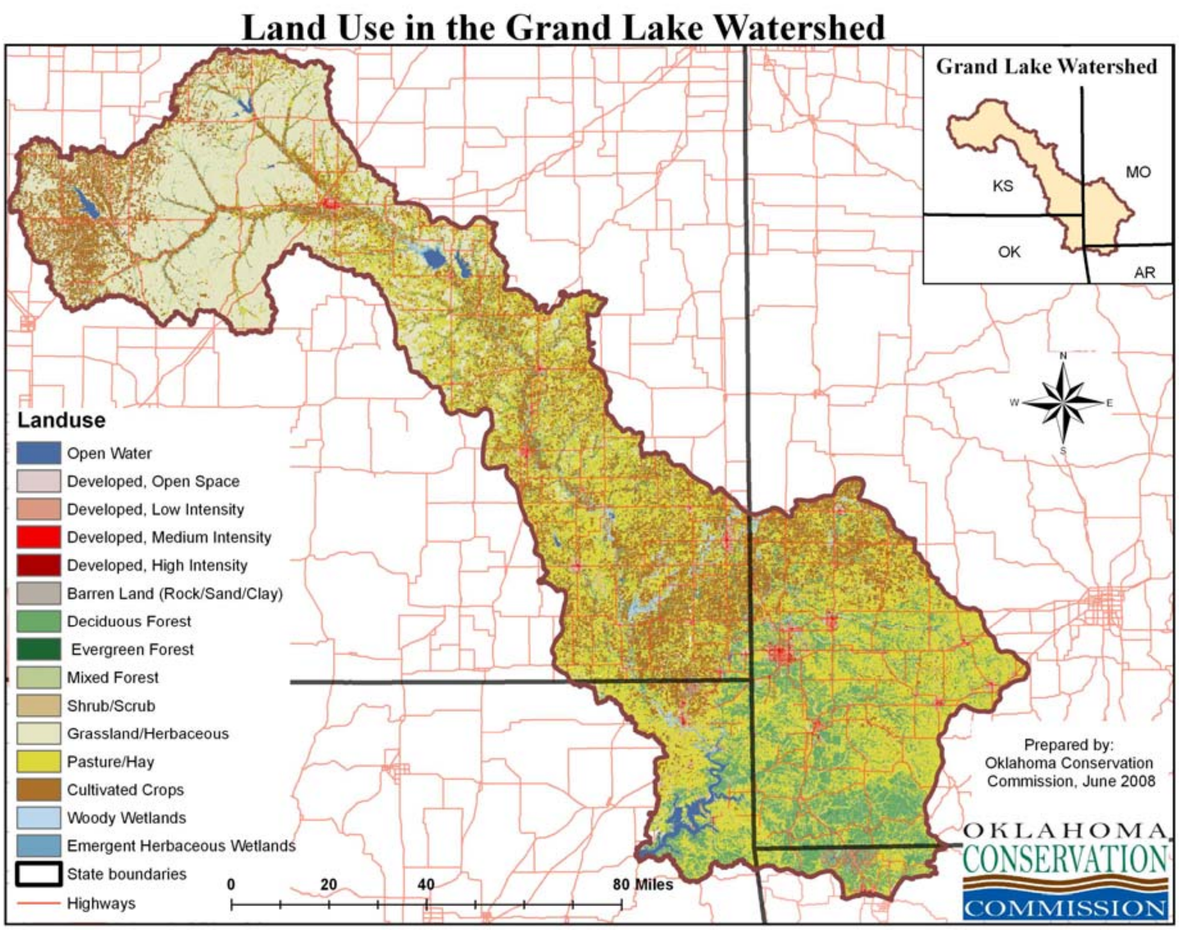

Figure 4: Land use classification for Grand Lake Watershed.

GENERAL IMPAIRMENTS, SOURCES AND CAUSES OF POLLUTION

Process for Determining Impaired Waters

Every state is required by the federal government to set water quality standards, monitor waters of the state, and list all water bodies that do not meet state standards on a 303(d) impaired waters list (named after the section of the Clean Water Act that mandates the process).

Water quality standards are based on the designated uses of the water body. Each state has its own set of designated uses (See Table 1) and associated water quality standards for each use. Water bodies that do not meet the water quality standards for its designated uses are considered "impaired". Not all uses apply to each water body, so water quality standards may be more stringent in some water bodies than in others.

Once the water is listed as impaired, the state has a timeline to develop a Total Maximum Daily Load (TMDL) for the impairment. The TMDL sets how much of a particular pollutant can be in the water and still meet water quality standards (with a margin of safety) and must address how the state plans to meet that goal.

Table 1: Designated uses for water bodies in the States of Grand Lake Watershed

ARKANSAS	KANSAS	MISSOURI	OKLAHOMA
Extraordinary Resource Waters	Aquatic Life	Aquatic Life & Human Health	Emergency Water Supply
Ecologically Sensitive Waterbody	Agriculture	Cold Water Fishery	Public & Private Water Supply
Natural & Scenic Waterways	Domestic Water Supply	Cool Water Fishery	Fish & Wildlife Propagation
Fisheries (fishable)	Food Procurement	Irrigation	Agriculture
Primary Contact Recreation (swimmable)	Groundwater Recharge	Livestock & Wildlife Watering	Recreation
Secondary Contact Recreation (wadable)	Industrial Water Supply	Whole Body Contact Recreation	Navigation
Domestic Water Supply	Recreation	Boating & Canoeing	Aesthetics
Industrial Water Supply		Drinking Water Supply	
Agricultural Water Supply		Industrial Process & Cooling Water	
		Storm & Flood Storage Attenuation	
		Habitat By Resident & Migratory Wildlife Species	
		Waters Having Recreational, Cultural, Educational, Scientific & Aesthetic Values	

Common Impairments in Grand Lake Watershed

Described below are described some of the most common impairments in the Grand Lake Watershed, according to TMDL documents, government reports, and stakeholder input, with an explanation of some impacts of those impairments.

Nutrients / Low dissolved oxygen (DO) / Eutrophication: Low dissolved oxygen can threaten the lives and health of many aquatic species (and humans) and is often the result of eutrophication. Eutrophication results from nutrient-enriched water. Nutrients cause abundant growth and decay of algae and associated feeding organisms. Ultimately, eutrophication results in fluctuating dissolved oxygen (DO) levels in the water that sometimes reach critically low levels for aquatic species survival. Low dissolved oxygen, therefore, is often related to nutrient levels. In fact, the recommended solution for low DO in TMDLs for the watershed is to decrease nutrient loads of phosphorus and nitrogen. These impairments typically lead to poor tasting drinking water, poor ecological quality, fish kills, and unsightly conditions. In extreme cases, algal blooms produce toxins that are a human health threat and which make water unfit for recreation or as a drinking water supply.

Many lakes and streams in the Grand Lake Watershed are impaired by nutrients or nutrient-related issues, including all four of the major reservoirs: Grand Lake, John Redmond Reservoir, Marion Reservoir, and Council Grove Reservoir.

Extreme impairments have been documented in the Grand Lake Watershed. Marion Reservoir, in the upper reaches of the watershed has had enormous algal blooms starting in 2003. These algal blooms have emerged over the course of a few days from previously clear water. Poor taste and odor of the water made it unfit for consumption, forcing communities to haul water from other locations to meet the needs of the local citizens. Testing showed that algal toxins were present in the water, even after treatment. (Marion County Conservation District, 2006)

Sediment / Silt: Sediments are particles of gravel, sand, silt, and clay that can be picked up by flowing water on the landscape and carried downstream. Silt is a sediment size between sand and clay (about the size of grains of flour) that stays suspended in water fairly easily. Sediment is problematic, particularly in reservoirs, for a number of reasons. First, suspended sediment causes water to be turbid (or cloudy) which impedes light penetration into the water column that is necessary for aquatic life. Sediment also fills in reservoirs, decreasing their volume and use as a drinking water source, flood control structure, and recreational facility. In streams, sediment abrades fish gills and fins, and fills in spaces in open gravel where fish lay eggs and aquatic insects live. In addition, much of the phosphorus (as well as pesticides) entering reservoirs is attached to silt particles, therefore sediment contributes to nutrient and other related impairments described above. Sediment from parts of the watershed can also contain heavy metals and contribute to the metals impairment described below (Juracek 2006).

Sediment is impacting many lakes and streams in the Grand Lake Watershed. Sediment is particularly a concern in John Redmond Reservoir and Council Grove Lake where it is reducing the water storage capacity of the lakes. In the first 30 years of their existence, John Redmond Reservoir and Council Grove Reservoir lost over 30% and 22% respectively of their storage capacity to sediment infill (Kansas Department of Health and Environment, John Redmond 2003 and Council Grove 2002 Siltation TMDLs). These rates were faster than the design estimate, indicating that the lifetime of the reservoirs are impacted by high sediment inflow from upstream land use practices. Sediment is also considered a threat to Grand Lake as they bring in heavy metals and decrease water clarity (Oklahoma Office of the Secretary of the Environment 2004, 2005).

Bacteria: Bacteria impairments are potentially hazardous for contact recreation in the impaired waters. High levels of fecal coliform bacteria indicate high levels of human and/or animal fecal material in the waters. Many types of bacteria are harmless, but high levels of animal waste bacteria increase the likelihood of associated harmful bacteria or pathogens in the water that may lead to illness.

Bacteria impairments are found throughout the watershed, primarily in rivers and creeks.

Heavy metals: Heavy metal impairments, including lead, zinc, and cadmium, are hazardous for drinking water, recreational waters, and for wildlife. Heavy metals in high concentrations can be acutely toxic. At lower concentrations, heavy metals bioaccumulate in human and fish tissue, leading to chronic health problems in humans, especially developmental problems in young children. The bioaccumulation problem is especially apparent when the non-fillet portions of fish are consumed because the metals that concentrate in the fatty portions of the fish will then build up in the fatty tissue of the humans or other fish that eat them.

Although not as uniformly spread throughout the watershed, heavy metals impairments are a major concern where they are found. Heavy metals are of particular concern in the Tri-State border region of Kansas, Oklahoma, and Missouri where past heavy metal mining operations has left a myriad of clean-up problems.

Sources and Causes of Pollution

Pollution sources are the origin for pollutants of concern. They come in two main categories: point and nonpoint sources. Point sources of pollution include discharges that are emitted from factories, plants, municipalities (such as stormdrains), or large scale animal operations where pollutants may be concentrated into a small area and discharged to local water bodies through pipes or channels (distinct "points"). Nonpoint sources (NPS) of pollution are those that wash off landscape areas and enter all along a water body rather than from distinct points.

Point source (PS) pollution was generally considered the greatest source of pollution to waterbodies when the US Clean Water Act was developed in the 1970's. Point sources are generally more easily managed by a permitting system, run by state governments, that determines the maximum amount of pollution allowed by each source. Regulating point sources has been effective in cleaning up our nations waters to the extent that many impairments are now predominantly caused by nonpoint sources. Nonpoint sources are more difficult to manage through regulation and permitting, so a cooperative watershed management process has developed, primarily since the 1990's, to create workable solutions through collaboration and cost-share programs to make water quality and land stewardship improvements on a watershed scale.

Causes of pollution are the reasons those sources may become problematic. It is less of a problem for water quality to have a source of pollution if it is prevented or inhibited from reaching a water body. There may be a number of reasons why a particular source of pollution may be problematic and these causes may vary from site to site.

For this document, sources and causes of pollution in the Grand Lake Watershed were determined initially through consultation with stakeholder groups and through water quality reports including TMDL documents.

Throughout the Grand Lake Watershed, there are common sources and causes of pollution. Although the following sources and causes are prevalent in the watershed, the scope and priority of each source and cause varies according to local conditions, concentrations, and stakeholder concerns, many of which are being or will be handled in greater detail through watershed planning on a more local basis. General prioritizations will also be addressed on the subwatershed level in the next section of this document.

Pasture – livestock and domestic animal operations: Pasture land is the most prevalent land use in the Grand Lake watershed (36% of the total watershed area, with another 21% in grassland, some of which is used for grazing). Livestock, grazing in pastures (Figure 5), contribute manure containing fecal bacteria and nutrients onto land surfaces, making it possible for both pollutants to enter surface water when it rains. In addition, livestock often have direct access to waterbodies and may provide a concentrated source of fecal loading directly into streams. This access to streams also contributes sediment loading to streams as the animals trample riparian vegetation and deteriorate bank stability, making these areas susceptible to erosion. Livestock were found to be the primary sources of fecal bacteria in a study conducted in Delaware County (USGS 2005) and in studies in the Upper Shoal Creek Watershed in Missouri (Food and Agricultural Policy Research Institute, 2004).

In addition to cattle production, there are significant areas of other livestock and domestic animals in the watershed including poultry, horses, alpaca, pigs, and dog operations. These operations, although less common than cattle operations, have similar pollution causes. In some cases the fecal contributions from these animals are too great to keep onsite: dog operations, though unregulated, often apply excrement to nearby fields in order to keep their operations sanitary (MoDNR, 2003, Shoal Creek TMDL).

Figure 5: Litter from poultry houses (shown in background) is typically spread on nearby pastures to increase forage production.

Application of poultry litter or other fertilizer to pastures allows increased forage production and, thereby, allows greater numbers of livestock to be produced per acre. Poultry litter ~~contains much more phosphorus than nitrogen in its nutrient balance~~. Plants, however, need nitrogen in greater proportions than phosphorus. Nitrogen is also more mobile in soils and is therefore more necessary to be added to the soil to maximize forage production. As a result, the use of poultry litter and other similar fertilizers commonly lead to build up of phosphorus in soils as more and more is applied to increase nitrogen levels. If the soil erodes during rain events, this can be a significant source of nutrient loading to local waterbodies, especially phosphorus. This is especially the case when the land is freshly fertilized in the Spring just as typically high rainfall events occur with relative frequency in the watershed.

Agricultural fields: Cultivated crops make up close to 20% of the land use in the watershed. The practice is more prevalent in the middle portion of the watershed and is almost absent in the extreme southeast and in the Flint Hills region of Kansas where soils are poor. Typical impairments related to these areas are sediment (from erosion) and low dissolved oxygen (related to nutrients attached to eroded sediments). Soil exposed when a field is plowed or harvested is susceptible to erosion. Local streams are more susceptible when streamside vegetation is removed so that nothing stands between a barren landscape and the water. ~~Overfertilization of~~ the soils can result in excessive nutrients entering waterbodies.

Modeling of an adjacent watershed, the Verdigris River Watershed in Kansas and Oklahoma, showed that rowcrops, although a relatively small percentage of the land use, were the most significant source of sediment and nutrients to the watershed: taking up less than 11% of the overall land use, rowcrops contributed 86% of the sediment, 55% of total nitrogen, and 69% of total phosphorus loading to local waters (USACE, 2006).

Pesticides are also commonly used on agricultural fields. Pesticides can drift directly into waterbodies by wind during application. Pesticides also attach to soil particles and are washed into water bodies through soil erosion.

Ore-bearing bedrock and mine tailings: Ore-bearing bedrock, especially prevalent in the Spring River Watershed, drew extensive mining operations to parts of the watershed from the mid-1800's to the mid-1900's. These rocks contain moderately high concentrations of lead (Pb), zinc (Zn), cadmium (Cd), and other heavy metals that can be highly toxic, produce a number of health impairments, and tend to bioaccumulate in animal flesh with continued exposure. As a result of these mining operations, large amounts of mine tailings (or waste rock, locally referred to as "chat") were extracted from the ground and piled on the surface (Figure 6). Water flowing through ore-bearing rock at the surface, tailings, and abandoned mines below the surface leach heavy metals from the rocks and into local water bodies (Figure 6). In addition, rocks and tailings exposed at the surface wash into local streams by overland erosion and become transported downstream in the form of metal-bearing stream deposits. A US Geological Survey study around Empire Lake, a small reservoir in Cherokee County Kansas, showed that mining sediments transported in streams are accumulating in the lake and are present in nearby river floodplains. These sediments contain heavy metal concentrations that far exceed the background soil conditions in the area (Juracek, 2006).

Problems with heavy metals are severe enough to have resulted in the listing of several Superfund sites in the Tri-State Mining District within Grand Lake Watershed, including Superfund sites located in Jasper and Newton Counties in SW Missouri, the Cherokee County Superfund Site in SE Kansas, and the Tar Creek Superfund Site in NE Oklahoma (See Appendix

A). Established by the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA, U.S. Code Title 42, Chapter 103), Superfund establishes a US Environmental Protection Agency National Priority List for hazardous waste sites and comprises a legal and financial system of handling these sites in the United States.

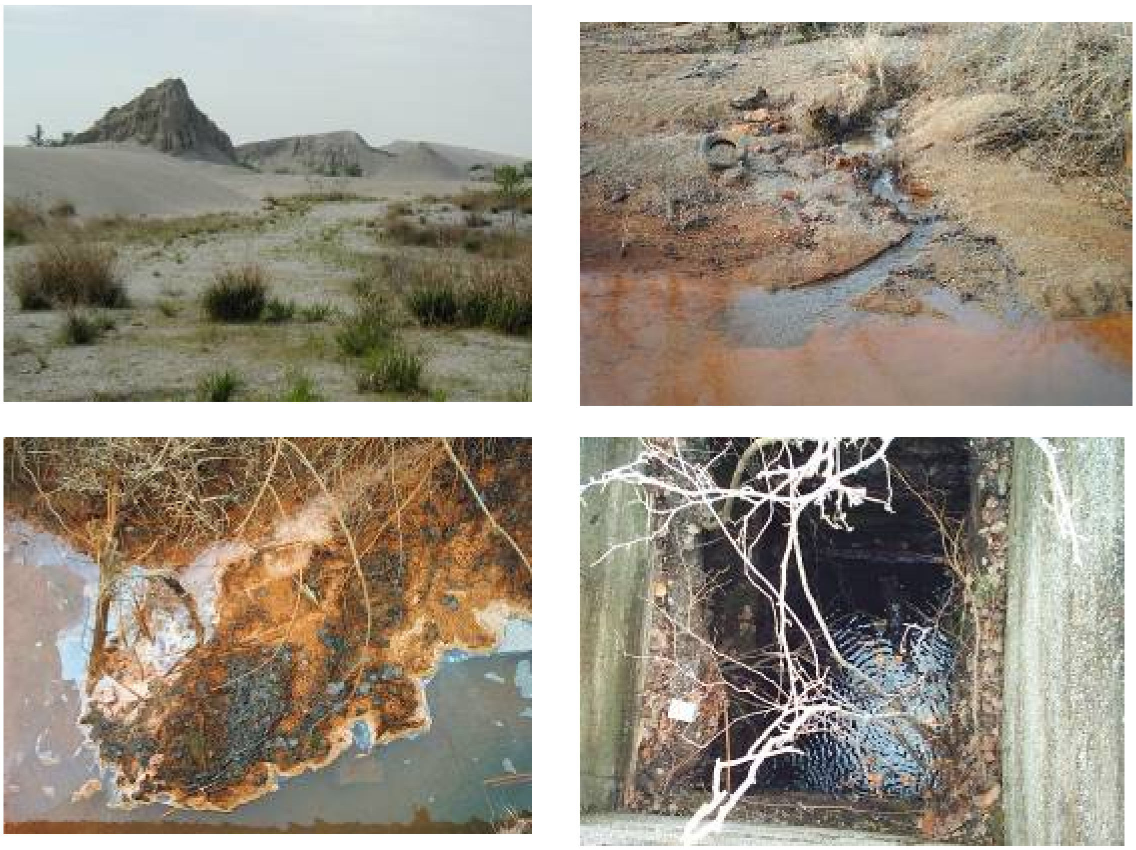

Figure 6: The historical mining industry in the Tri-State Mining District of the Grand Lake Watershed left a host of environmental problems including large piles of metal-bearing mining tailings, and metals contamination in surface water, ground water, and soils. (Photos courtesy of USGS, 2003)

Septic systems: Failing septic systems can contribute to pathogen and nutrient problems in both groundwater and surface waters if leakage or illicit discharge occurs. Improper function of septic systems can especially occur if the systems are poorly maintained or poorly sited or sized in particular soils. Any loading of bacteria into the groundwater can enter surface water through seeps or springs, especially in the southeastern portion of the watershed where common caves and karst bedrock enable rapid movement of subsurface flow.

Urban areas: Urban and suburban areas make up 6% of the watershed (more concentrated in the southern portion of the watershed). High nutrient concentrations stem from overfertilization of residential, commercial, or recreational lawns. Fertilizers are often used more freely on smaller urban lawns than on farms because the cost of fertilizing a small plot is much less than covering large areas, and the sum of many small lawns can have a significant cumulative effect on water quality. Sediment erosion is prevalent where protective vegetation is stripped on construction sites. Concentrated runoff from impervious surfaces contributes to soil erosion. High volumes of runoff from these impervious surfaces also contributes to streambank erosion as the streams fill more quickly and more frequently with rushing water. Runoff from roadway and parking lots also introduce other pollutants such as salt, oil and other fluids that leak from cars, trash, and grease from restaurants (Figure 7). Pesticides and herbicides used on residential, commercial, and recreational lawns and gardens can also wash into streams through soil erosion or wind drift during application (Figure 7). Although these areas take up less space than some other uses, urban pollutants can be particularly concentrated. In addition, future growth is expected that will present future challenges for water quality from these sources.

Figure 7: Lawns and impervious surfaces of urban and suburban areas contribute a range of pollutants to local water bodies.

Streambanks: Much of the landscape throughout the watershed has been altered from pre-settlement days. Converting grasslands and forest to cropland, pasture, or urban/suburban areas all contribute to increased runoff over the land surface during storms and cause flow in streams to increase faster than in pre-settlement times, contributing to accelerated streambank erosion. Straightening of streams from their often meandering pattern may decrease the likelihood of flooding in the adjacent property as floodwaters pass more quickly by, but the increased velocity of the water can increase streambank erosion. In addition, vegetation along the streams has been removed in many places to increase animal access to streams or to allow larger areas for growing crops. The removal of this native vegetation from streambanks weakens the banks and makes them more susceptible to erosion from high flows in the streams (Figure 8). The banks of the Neosho River in Kansas have had significant streambank erosion issues (USGS 1999, KDHE 1995).

Wildlife: Wild animals which have direct access to streams include deer, feral hogs, raccoons, other small mammals, and avian species. These animals contribute fecal bacteria and nutrients to waterbodies in the watershed, but at much smaller rates than livestock, domestic animals, and humans, according to a DNA tracking study in Missouri (Food and Agricultural Policy Research Institute, 2004).

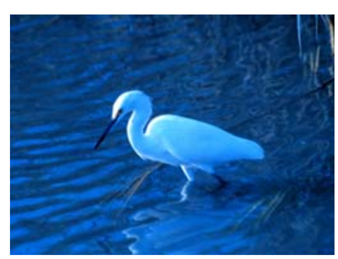

Figure 8: A break in woody vegetation along Honey Creek, OK, has resulted in severe streambank erosion.

Permitted sites: Point sources of pollution include discharges from pipes (points), rather than generally from landscape areas. These sources are typically permitted by state agencies, which means that pollution levels are monitored and mandated not to exceed certain levels. The permitted sites of particular concern in the Grand Lake Watershed are Waste Water Treatment Plants (WWTP) and Confined Animal Feeding Operations (CAFO). WWTPs collect waste water from communities, partially treat the water, and discharge the water into local water bodies. Some CAFOs, have nondischarging permits that require waste management systems to prevent waste from leaving the site uncontrolled in most weather conditions. In Kansas, CAFOs are required to manage all waste runoff in storms up to the 25 year, 24 hour rain fall event (Kansas Department of Health and the Environment 2002, French Creek TMDL). Other permitted point sources include car wash facilities, dry cleaning facilities, warehouses, food processing plants, mining operations, hotels, and other similar operations. Although each type of these sites are regulated for a number of pollutants, many are not limited at all for nutrients such as phosphorus or nitrogen. Although point sources are not the primary concern of this watershed management plan, the importance of handling these sources for the overall health of the watershed cannot be ignored.

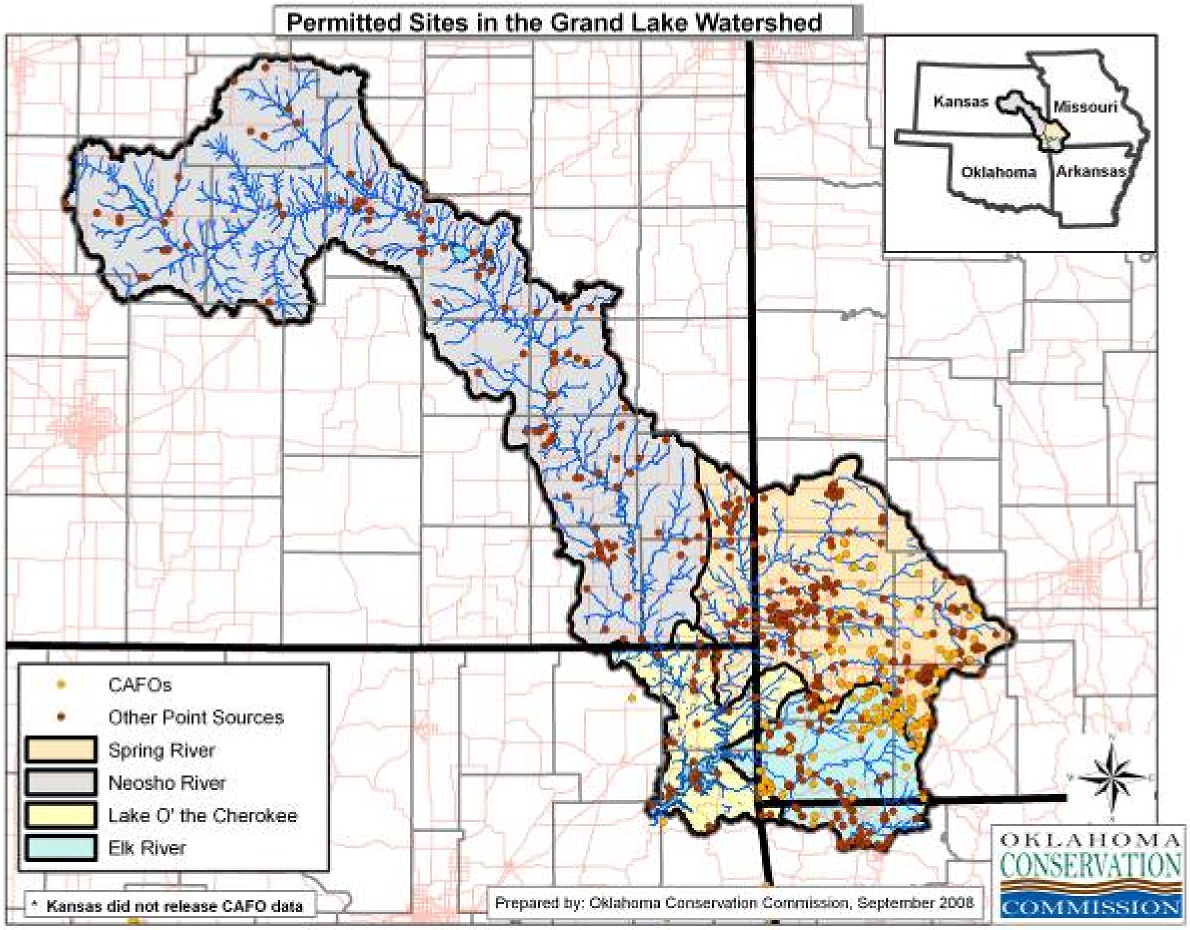

Figure 9: Map of permitted sites in Grand Lake Watershed.

Additional Reports and Studies Documenting Problems

There have been numerous scientific studies and government reports related to the water quality of the Grand Lake Watershed (too numerous to cover in this watershed plan). Some more general studies are worth highlighting that identify water quality issues on a broad scale.

In 1996, the Oklahoma Conservation Commission and Oklahoma State University conducted a crude modeling of phosphorus loads in the watershed by subwatershed as a precursor to watershed planning. The effort suggested that the greatest impact of phosphorus reaching Grand Lake was from the Spring River Watershed, and recommended the formation of an advisory group to develop or guide the development of a watershed plan (Dutnell et al 1996).

The 2004 Kansas Department of Health and the Environment (KDHE) "Surface Water Nutrient Reduction Plan" responds to the US Environmental Protection Agency's (EPA) call for states to handle nutrient-related pollution. Rather than quickly adopting nutrient criteria for surface water, the plan calls for a 30% reduction in nutrients through point and nonpoint sources to meet the goal. The target is the same adopted by Minnesota and Wisconsin, other states in the

Mississippi River Basin, based on estimates by the Mississippi River/Gulf of Mexico Watershed Nutrient Task Force of necessary reductions to potentially eliminate dead zones in the Gulf of Mexico resulting from excessive nutrient delivery to the Gulf. This document indicates that counties in eastern Kansas, including some portions of the Grand Lake Watershed, should be targeted because they contribute the largest nutrient loads in the State.

In 2007, the US Geological Survey published a study of Elk River Watershed in cooperation with the Missouri Department of Natural Resources. The study concluded that local streams had significant increases in nutrients (especially phosphorus) compared to data collected prior to 1985 (Smith et al 2007).

The Oklahoma Office of the Secretary of the Environment (2004, 2005) released the *Comprehensive Study of the Grand Lake Watershed* initial and final reports that document nutrients as the top water quality concern in the watershed impacting Grand Lake. Secondary concerns for Grand Lake were sediments bearing heavy metals and decreasing water clarity.

Other studies further document the heavy metal problems in the watershed. The Oklahoma Department of Environmental Quality released a 2003 and a follow-up 2007 report "Fish Tissue Metals Analysis in the Tri-State Mining Area" that indicates that fish in that area have elevated heavy metals in their flesh that correspond to elevated level of heavy metals in stream sediment (ODEQ 2003, 2007). A US Geological Survey study around Empire Lake, a small reservoir in Cherokee County Kansas, showed that mining sediments transported in streams are accumulating in the lake and are present in nearby river floodplains. These sediments contain heavy metal concentration that far exceed the background soil conditions in the area (Juracek, 2006).

PRIORITY IMPAIRMENTS, SOURCES, CAUSES, LOAD REDUCTIONS AND MANAGEMENT MEASURES FOR SUBWATERSHEDS

Watershed characteristics including land use, soils, and populations vary in significant ways in different portions of the Grand Lake Watershed. Despite common sources and causes of pollution, the relative importance or impact of these factors vary for the separate subwatersheds. To better represent the different priorities throughout the watershed, the Grand Lake Watershed Alliance Foundations (GLWAF) decided that priorities for sources, causes, and load reductions required to meet water quality standards were best presented within the framework of the 4 major subwatersheds: Neosho River, Spring River, Elk River, and Lake O' the Cherokees Watersheds.

Priority impairments, sources, causes and load reductions were largely determined on the basis of TMDL documents produced in the watershed to handle impaired waters, and other local water quality reports, documents, and studies. The TMDL documents include scientific data and public input to determine the amount of impairment, the sources and causes of those impairments, the necessary load reductions to meet water quality standards, and a relative prioritization of addressing each impairment (See Appendix B for a summary of all TMDLs in the Grand Lake Watershed). These documents include the necessary load reductions to meet water quality standards, prioritizations, and recommended strategies to meet them, so they are well suited to meet part of the EPA's 9 elements for watershed plans (listed above). This information was assembled and prioritized by the GLWAF watershed plan committee and the GLWAF board, represented by stakeholders from all 4 states, and with input from local watershed groups and from state and federal agencies with jurisdiction in the 4 states of the watershed.

Note: all completed TMDLs are listed in the references at the end of this document. The list of TMDLs is extensive (over 60 documents) and an attempt to reference each one in the text of this document would be burdensome for the reader. To reference the TMDL from which the information reported in the following sections is derived, look up the reference based on the state, waterbody name, and impairment. In addition, Appendix B is a comprehensive summary of all completed and approved TMDLs in the Grand Lake Watershed including a listing of sources, causes, necessary load reductions (where available), and recommended solutions for meeting standards.

Neosho River Watershed

The Neosho River Watershed (Figure 10) terminates in extreme southeastern Kansas, draining an area that extends northwestward in an elongate pattern encompassing 5,830 square miles, by far the largest subdivision of the Grand Lake Watershed for the purpose of this document. Significant tributaries include Cottonwood and Lightning Rivers. This subwatershed contains a number of significant reservoirs including Marion Lake, Council Grove Lake, and John Redmond Reservoir. Land use in the Neosho River Watershed (Figure 10) is 36% natural grasslands (which may be grazed), 26% planted pasture, 24% cropland, 5% forest, and 5% developed (mostly low intensity or open space), close to 2% wetlands and over 1% open water.

Priority Impairments: Priority impairments are based on the number of impaired water bodies (see tables below), the relative priority given those segments in TMDL documents, and stakeholder impressions and experience with these issues in the watershed.

The highest priority impairments for the Neosho River Watershed are:

1) Nutrients (evidenced by Low dissolved oxygen (DO) / Eutrophication)
2) Sediment (Silt)
3) Bacteria

This above list is consistent with the Neosho River Basin High Priority TMDLs in a document approved by the Neosho Basin Advisory Committee in Kansas in June 2008. That document on "Watershed Restoration and Protection" indicates that the top TMDL concerns in the watershed are DO/eutrophication, silt, and bacteria. The above list was presented to the Neosho Basin Advisory Committee at their June 2008 meeting in Burlington, KS without objection. Representatives of all of the subwatershed groups currently existing or under development in the Kansas portion of the Grand Lake Watershed were also present at that June 2008 meeting.

Bacteria was considered a lower priority than nutrients and sediment because most of the high priority bacteria impairments have been controlled by a permitting process. Sediment only impairs 4 water bodies, but they are all lakes, indicating upstream sources of those problems.

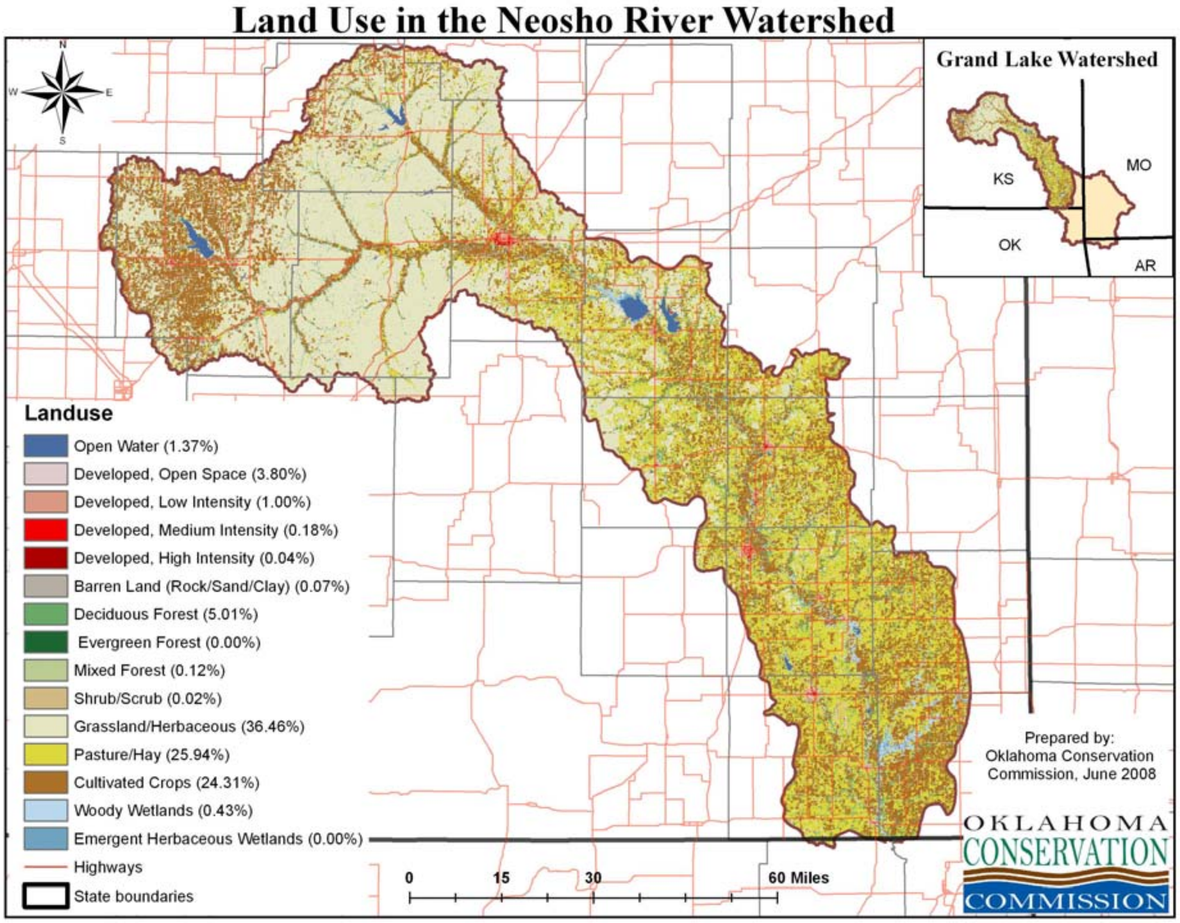

Figure 10: Map of land use in the Neosho River Subwatershed of the Grand Lake Watershed.

Other impairments (details in Appendix B) in the Neosho River Watershed considered lower priority include (all low priority unless otherwise indicated):

1) Biology (poor diversity in streams) – 2 segments medium priority
2) Copper – agricultural uses – 8 segments
3) Mercury – battery recycling, etc – 1 segment
4) DO from cattails – 1 minor wetland area
5) Chlordane (banned pesticide) – 1 segment
6) pH (few violations) – 2 segments (dealt with if nutrient issue is dealt with)
7) Sulfate – Mined Land Lakes (9) and wetland (1)
8) Sulfate (natural from bedrock) – 1 stream segment
9) Methane – 4 segments (high priority, but addressed with permits)
10) Urban Eutrophication II (Phosphorus and Nitrogen) – 1 pond

Water bodies listed as impaired in the Neosho River Watershed without TMDLs developed:

1) Zinc – 53 segments
2) Atrazine (a pesticide) – 7 segments

Priority Sources and Causes: Sources for the high priority impairments of the Neosho River Watershed were identified in TMDL documents and confirmed by stakeholder input as agricultural fields, streambanks, pastures, permitted sites, and septic systems. Causes of impairments are erosion (soil from cropland, pastures, and streambanks), lack of riparian buffers on cropland and pastures, exposed soil on cropland and pastures, animal stream access, overgrazing, and failing septic systems. Problems with permitted sites were to be addressed under a permit review process.

Load reductions: Desired load reductions are as determined in TMDL documents as those needed to meet state water quality criteria. Load reductions were calculated and presented for most impaired stream segments for low DO / Eutrophication and Silt, but none were calculated for fecal coliform bacteria, as shown in the tables below.

Nutrients (Low DO / Eutrophication) - Neosho

WATERBODY	P LOAD REDUCTION	N LOAD REDUCTION	POINT SOURCES?	PRIORITY
Allen/Dows Creek	x	x	x	High
Altamont City Lake	92.4%	0%	None	Low
Bachelor Creek	x	x	x	Medium
Bartlett City Lake	50%	0%	None	Low
Canville Creek	x	x	x	High
Chanute/SF City Lake	89.3%	50%	None	Medium
Cherry Creek	x	x	x	High
Council Grove Lake	94%	58%	WWTP not problem	High
Doyle Creek	x	x	Addressed w/ permit	High
Eagle Creek	x	x	x	High
French Creek	x	x	x	Medium
Gridley City Lake	54.4%	0%	None	Medium
John Redmond Lake	21.2%	60%	WWTP P-22.8% red	Medium
Labette Creek	x	x	x	High
Marion County Lake	21.4%	0%	None	Medium
Marion Lake	75%	x	3 WWTP	High
Neosho County SFL	97.8%	64%	None	Medium
Neosho WMA	77.8%	78%	None	Medium
Olpe City Lake	48%	32%	None	High
Parsons Lake	81%	0%	WWTP not problem	Medium
Turkey Creek	x	x	x	High

x – no information P – phosphorus N - nitrogen

Sediment (Silt / Silt and Lead) - Neosho

WATERBODY	SILT LOAD REDUCTION	LEAD LOAD REDUCTION	POINT SOURCES?	PRIORITY
Bartlett City Lake	61%	None – tied to silt	None	Medium
Council Grove Lake	48%	n/a	WWTP 0% red.	High
John Redmond Lake	Need detailed analysis	n/a	x	Medium
Olpe City Lake	54%	n/a	None	High

x – no information

Fecal Coliform Bacteria - Neosho

WATERBODY	LOAD REDUCTION	ADDRESSED WITH PERMIT?	PRIORITY
Allen/Dows Creek	x	x	Medium
Big Creek	x	x	Medium
Cottonwood River	x	Yes	High
Cottonwood River, South	x	x	Medium
Deer Creek	x	x	Medium
Doyle Creek	x	Yes	High
Labette Creek	x	Yes	High
Little Turkey	x	Yes	High
Mud River	x	x	Medium
Neosho River	x	x	High
Owl Creek	x	x	Medium
Turkey Creek	x	x	Medium

x – no information

Critical Areas: Critical areas for implementation are defined for this document as areas contributing to the impaired segments above. Further refinement of critical area delineation is best done through a targeting effort as 1) proposed watershed-wide later in this document and 2) as is being conducted, or likely to be initiated, on a local level by some Watershed Restoration Protection Strategy (WRAPS) groups, which are local citizen-based watershed planning groups in Kansas.

Management measures: Although the specifics are best handled on a local basis with local stakeholder involvement, TMDL documents recommended a number of solutions, also generally agreed upon by stakeholders, to improve water quality in the impaired segments:

1. Implement soil sampling to recommend appropriate fertilizer applications on cropland: use application rates of chemical fertilizers according to labels.
2. Maintain conservation tillage and contour farming to minimize cropland erosion.
3. Install grass buffer strips along streams.
4. Reduce activities within riparian areas.
5. Restore riparian vegetation along target stream segments.
6. Implement nutrient management plans to manage manure application to land.
7. Renew state and federal permits and inspect permitted facilities for permit compliance.
8. Install pasture management practices, including proper stock density on grasslands.
9. Install proper manure and livestock waste storage.
10. Remove winter feeding sites in proximity to streams.
11. Proper on-site waste system operations in proximity to targeted streams.

Spring River Watershed

The Spring River Watershed (Figure 11) is located in extreme southeastern Kansas, extreme northeastern Oklahoma and a larger area in southwestern Missouri that encompasses 2,577 square miles. Significant tributaries include Upper and Lower Shoal Creek, Turkey Creek, and

Center Creek. Land use in the Spring River Watershed (Figure 11) is 50% planted pasture, 1% natural grassland (which may be grazed), 20% cropland, 18% forest, 8% developed (mostly low intensity or open space), 2% wetlands, and less than 1% open water.

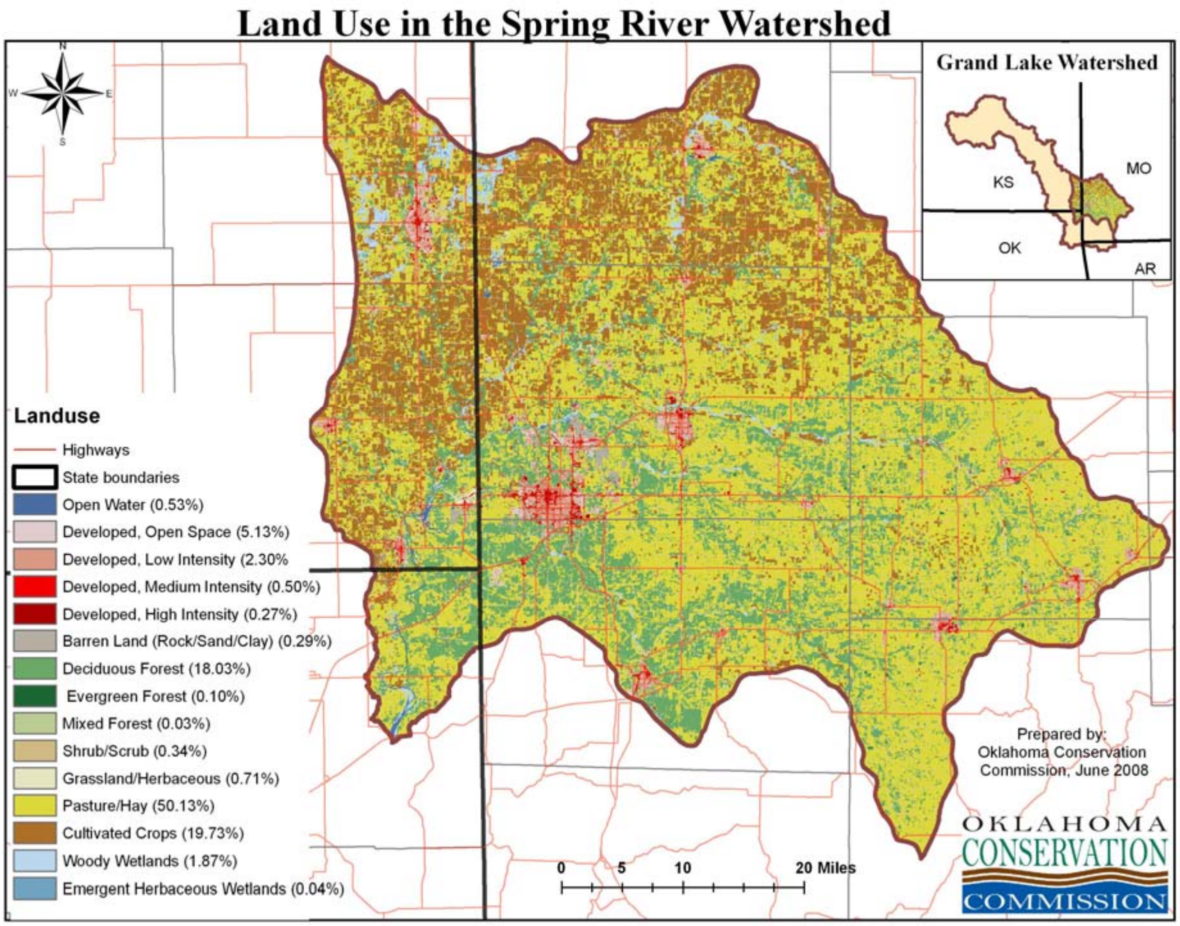

Figure 11: Map of land use in the Spring River Subwatershed of the Grand Lake Watershed.

Priority Impairments: Priority impairments are based on the number of impaired water bodies (see tables below), the relative priority given those segments in TMDL documents, and stakeholder impressions and experience with these issues in the watershed.

The highest priority impairments for the Spring River Watershed are:

1) Heavy metals – many segments throughout Spring River Watershed
2) Nutrients (evidenced by Low DO in Kansas)
3) Bacteria – 13.5 miles along Shoal Creek

This above list is consistent with the Neosho River Basin High Priority TMDLs in a document approved by the Neosho Basin Advisory Committee in Kansas in June 2008. That document on "Watershed Restoration and Protection" indicates that the top TMDL concern in the Spring River watershed is heavy metals. Other concerns were not highlighted in this document as a high priority in Kansas. This list was presented to the Neosho Basin Advisory Committee at the June 2008 meeting without objection.

Other impairments in the Spring River Watershed considered lower priority include (all low priority unless otherwise indicated):

1) Eutrophication/pH (nutrients) – urban lawn overfertilization – 2 lakes
2) Fecal Coliform Bacteria, KS - High priority (addressed with permit) – 1 segment
3) Chlordane (banned pesticide) – 1 segment
4) Sulfate – related to strip mining areas – 1 segment
5) Ammonia, BOD, Suspended Solids, MO – High priority (addressed with permit) – 1 segment
6) Sediment (Missouri) – Cropland erosion – 1 segment (Low priority)

Water bodies listed as impaired in the Spring River Watershed without TMDLs developed:

1) turbidity – 1 segment
2) zinc – 1 segment
3) cadmium – 1 segment

Priority Sources and Causes: Sources for the high priority impairments of the Spring River Watershed were identified in TMDL documents and confirmed by stakeholder input as mining tailings (on land and in streambeds), agricultural fields, streambanks, pastures, permitted sites, and septic systems. Causes of impairments are erosion (soil, animal waste, and streambanks), acid mine seepage, animal stream access, and failing septic systems. Problems with permitted sites were to be addressed under a permit review process.

Load reductions: Desired load reductions are as determined in TMDL documents as those needed to meet state water quality criteria. Load reductions were calculated and presented for most impaired stream segments for metals, low DO / eutrophication, and bacteria, as shown in the tables below.

Heavy Metals - Spring

WATERBODY	LOAD REDUCTION	PRIORITY
Spring River, various branches	Up to 99.3%	High
Turkey Creek	50%	Medium
Center Creek	~10%	Medium

Nutrients (evidenced by Low DO in Kansas) - Spring

WATERBODY	P LOAD REDUCTION	N LOAD REDUCTION	POINT SOURCES?	PRIORITY
Shawnee Creek	x	x	Addressed w/ permit	High
Lamar Lake	65%	x	None	Medium

x – no information P – phosphorus N - nitrogen

Fecal Coliform Bacteria - Spring

WATERBODY	LOAD REDUCTION	ADDRESSED WITH PERMIT?	PRIORITY
Cow Creek	x	Yes	High
Shoal Creek	85% High Flows 53% Moderate Flows 72% Low Flows	x	Medium

x – no information

Critical Areas: Critical areas for implementation are defined for this document as areas contributing to the impaired segments above. Further refinement of critical area delineation is best done through a targeting effort as 1) proposed watershed-wide later in this document and 2) local stakeholder input as is being conducted, or likely to be initiated, on a local level by some watershed groups in this watershed.

Management measures: Although the specifics are best handled on a local basis with local stakeholder involvement, TMDL documents recommended a number of solutions, also generally agreed upon by stakeholders, to improve water quality in the impaired segments:

Management measures in Kansas:

1. Reduce metal loads from tributaries that contribute to the impaired condition seen on the Spring River at Baxter Springs
2. Remove contaminated sediments from the channel bed at selected locations.
3. Install filter strips along edge of agricultural fields.
4. Reduce activities within riparian areas.
5. Restore riparian vegetation along target stream segments.
6. Use application rates of chemical fertilizers according to labels.
7. Renew state and federal permits and inspect permitted facilities for permit compliance.
8. Install proper manure and livestock waste storage.
9. Proper on-site waste system operations in proximity to targeted streams.

Management measures in Missouri:

1. Reevaluate point source permits and require Zn monitoring
2. Continue abandoned mine cleanup including replacing residential soils, installing pipe for delivery of water, closing mine shafts, burying mine waste below highways, etc.
3. Poultry litter application education.
4. Feasibility study of transporting litter out of the watershed.
5. Pump septic systems every 3 yrs, replace some along with public education
6. Possible local ordinances to handle septic system problems.
7. Fence riparian areas, alternative watering sites, rotational grazing, add shade away from streams for cattle, varied diets to lower fescue toxicity.

8) Filter Strips on fields w/ litter application 30 ft for 50% reduction, 40 ft for 66% reduction of bacteria.
9) Shoal Creek Bacterial Goal: remove 50-100% cattle from streams, stop all septic leaks, reduce runoff 66%

Superfund Activities:
A number of remedial actions related to heavy metals are ongoing or have already taken place in the multiple Superfund sites in the Spring River portion of the Grand Lake Watershed including plugging of abandoned wells and mine shafts, surface water diversions, soil remediation, and even public relocation in the Tar Creek Superfund Site (See Appendix A). Any work regarding the Superfund Sites of the Tri-State Mining District must be coordinated with all federal and state regulatory agencies with legal jurisdiction over this area.

Elk River Watershed

The Elk River Watershed (Figure 12) is located in the southwestern corner of Missouri, northwestern corner of Arkansas, and northeastern corner of Oklahoma and encompasses 1,037 square miles. The Elk River is formed where two creeks, Big Sugar Creek and Little Sugar Creek, come together in Pineville, MO. Other tributaries include Indian Creek, Buffalo Creek, and Patterson Creek. Land use in the watershed (Figure 12) is 47% forest, 42% planted pasture, 2% natural grassland (which may be grazed), 7% developed (mostly low intensity or open space), nearly 2% wetlands and under 1% open water and cropland.

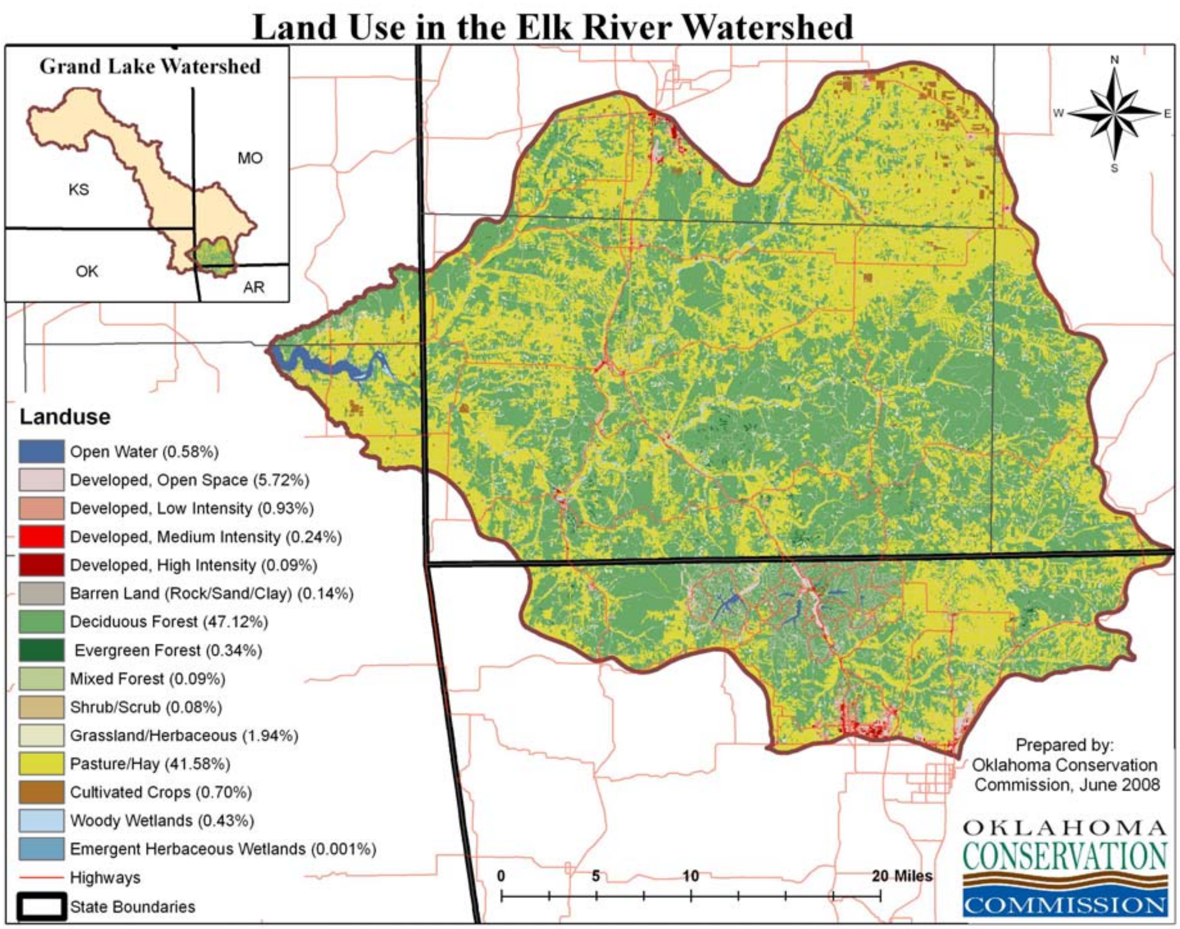

Figure 12: Map of land use in the Elk River Subwatershed of the Grand Lake Watershed.

Priority Impairments: Priority impairments are based on the number of impaired water bodies (see tables below), the relative priority given those segments in TMDL documents, and stakeholder impressions and experience with these issues in the watershed.

The highest priority impairments for the Elk River Watershed are:

1) Nutrients – based on TMDL in Missouri
2) Bacteria – based on one impairment in OK and local concerns in Missouri
3) Sediment – based on local concerns in Missouri

Priority Sources and Causes: Sources for the high priority impairments of the Elk River Watershed were identified in TMDL documents and confirmed by stakeholder input as permitted sites, grazing animals, fertilizer and litter application, and septic systems. Causes of impairments are lack of nutrient limits on permitted sites (such as waste water treatment plants), animal stream access, pasture erosion, over-application of fertilizer/litter and failing septic systems. Problems with permitted sites were to be addressed under a permit review process.

Load reductions: Desired load reductions are as determined in TMDL documents as those needed to meet state water quality criteria. Load reductions were calculated and presented for most impaired stream segments for nutrients and bacteria, as shown below.

Nutrients – Elk River Watershed

WATERBODY	P LOAD REDUCTION	N LOAD REDUCTION	POINT SOURCES?	PRIORITY
11 stream segments in MO	64% (low flows)	42% (low flows)	60% of problem	Medium

P – phosphorus N - nitrogen

Target: 0.06 mg/L Phosphorus and 1mg/L Nitrogen concentrations (the monitored condition before eutrophication problems). Point sources: WWTP and poultry processing plants)

Bacteria – Elk River Watershed

WATERBODY	FC INS	EC INS	EC GEO	ENT INS	ENT GEO	PRIORITY
Elk River, OK				78%	52%	?

FC – Fecal coliform; EC – E. coli; ENT – Enterococci; INS – instantaneous; GEO – geometric mean

Critical Areas: Critical areas for implementation are defined for this document as areas contributing to the impaired segments above. Further refinement of critical area delineation is best done through a targeting effort as 1) proposed watershed-wide later in this document and 2) local stakeholder input as is being conducted, or likely to be initiated, on a local level by some watershed groups in this watershed.

Management measures: Although the specifics are best handled on a local basis with local stakeholder involvement, TMDL documents recommended a number of solutions, also generally agreed upon by stakeholders, to improve water quality in the impaired segments:

Management measures in Oklahoma:
NONE listed in TMDL.

Management measures in Missouri:

1. Phosphorus limits for larger, expanding, and new point source dischargers of monthly avg. 1 mg/L (1.5 mg/L daily). Nitrogen limits 25.5 mg/L monthly average.
2. Voluntary agricultural management practices (not specified).
3. Management plans to deal with NPS pollution.

Lake O' the Cherokees Watershed

The Lake O' the Cherokees Watershed (Figure 13) is located in extreme northeastern Oklahoma with small sections that protrude into Kansas, Missouri, and Arkansas, encompassing 888 square miles. The Oklahoma portions of the Each of the other major subwatersheds drain into the Lake O' the Cherokee Watershed. The Oklahoma portion of the Neosho River is included in this subwatershed. Other significant tributaries include Honey Creek, Horse Creek, Drowning Creek, and Tar Creek. Grand Lake is the terminal water body for this subwatershed and the Grand Lake Watershed as a whole.

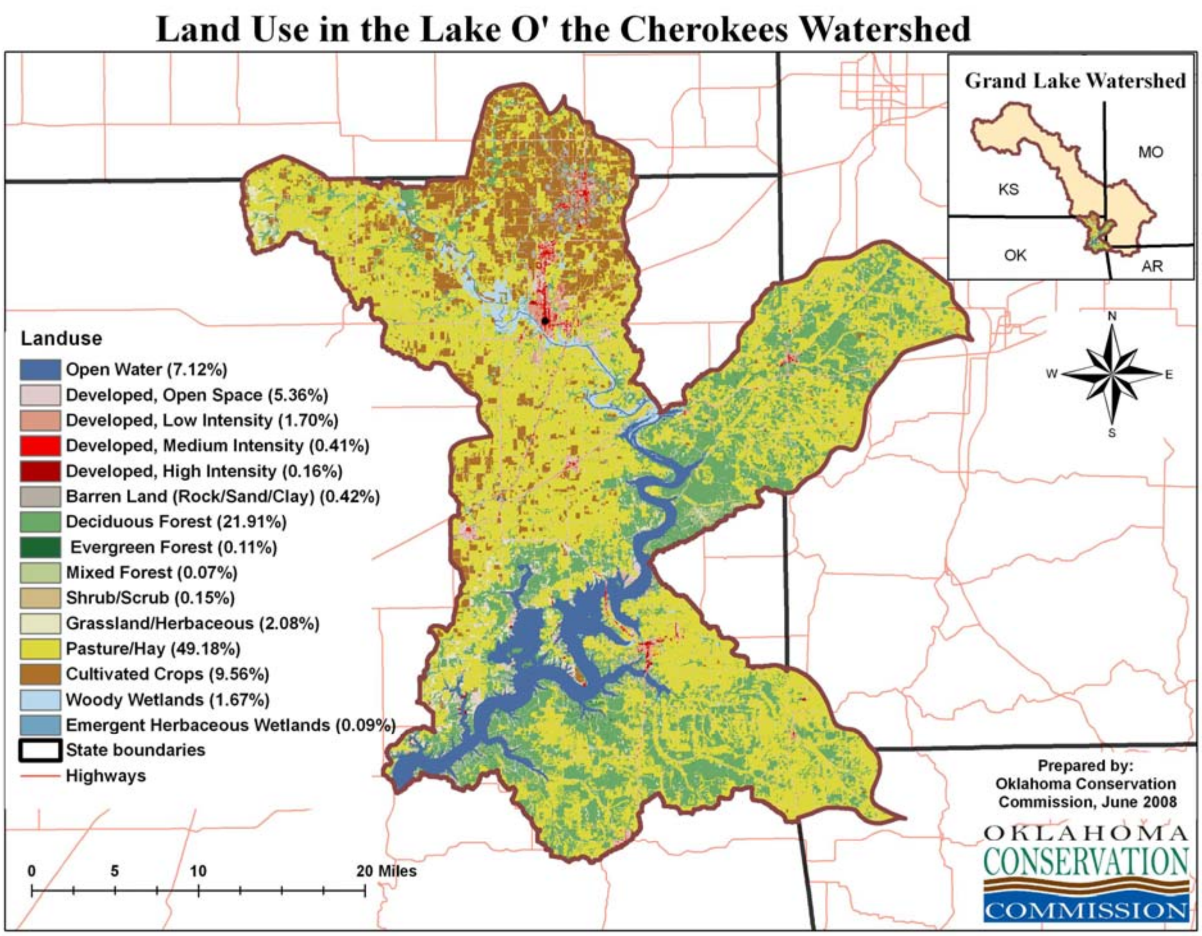

Figure 13: Map of land use in the Lake O' the Cherokees Subwatershed of the Grand Lake Watershed.

Land use in the Lake O' the Cherokees Watershed (Figure 13) is 49% planted pasture, 2% natural grassland (which may be grazed), 22% forest, 10% cropland, and 8% developed (mostly low intensity or open space), 7% open water, and nearly 2% wetlands.

Priority Impairments: Priority impairments are based on the number of impaired water bodies (see tables below), the relative priority given those segments in TMDL documents, and stakeholder impressions and experience with these issues in the watershed.

The highest priority impairments for the Lake O' the Cherokees Watershed are:

1) Nutrients (evidenced by Low DO/organic enrichment/ammonia) – based on 9 impairments in OK (no TMDLs developed).
2) Bacteria – based on 11 segments impaired in OK
3) Heavy metals (Zn, Pb, Cd) – based on 1 impairment in KS (Tar Creek) and stakeholder concerns (no TMDL developed).

Nutrients and bacteria have comparable number of impairments, but recent reports from the Oklahoma Office of the Secretary of the Environment (2004, 2005) document evidence that Grand Lake is becoming increasingly threatened by nutrient enrichment and document nutrients as the greatest threat to Grand Lake water quality. In addition, nutrient impairments in the lake itself suggest a larger impact than the comparable number of local stream segments impaired for bacteria. These considerations led to the conclusion that nutrients are a bigger overall concern for this subwatershed than bacteria, although bacteria are still considered a significant threat to water quality.

Water bodies listed as impaired in the Lake O' the Cherokees Watershed without TMDLs developed:

1) Organic enrichment/Low DO – 8 segments
2) Chlorides – 2 segments
3) Total Dissolved Solids – 1 segment
4) Sulfates – 2 segments
5) Ammonia – 1 segment
6) pH – 1 segment
7) Turbidity – 3 segments

Priority Sources and Causes: Sources for the high priority impairments of the Lake O' the Cherokees Watershed were identified in TMDL documents and confirmed by stakeholder input as livestock, land application, agricultural activities, septic systems, domestic animals, mine waste and a wastewater lagoon. Causes of impairments are animal stream access, overgrazing, erosion (fields and streambanks), failing septic systems, mine waste runoff and lagoon discharges.

Load reductions: Desired load reductions are as determined in TMDL documents as those needed to meet state water quality criteria. Load reductions were calculated and presented for most impaired segments for bacteria, as shown below.

Bacteria – Lake O' the Cherokees Watershed

WATERBODY	FC INS	EC INS	EC GEO	ENT INS	ENT GEO	PRIORITY
Drowning Creek	28%			56%	47%	?
Horse Creek	86%					?
Fly Creek	49%			84%	77%	?
Little Horse Creek	49%	59%	53%			?
Cave Springs Branch	47%	59%	53%			?
Honey Creek	28%			99%	90%	?
Sycamore Creek				3%	26%	?
Tar Creek				84%	80%	?
Cow Creek	60%					?
Fourmile Creek	55%					?
Russell Creek	49%					?

FC – Fecal coliform; EC – E. coli; ENT – Enterococci; INS – instantaneous; GEO – geometric mean

Critical Areas: Critical areas for implementation are defined for this document as areas contributing to the impaired segments above. Further refinement of critical area delineation is best done through a targeting effort as 1) proposed watershed-wide later in this document and 2) local stakeholder input as is being conducted, or likely to be initiated, on a local level by some watershed groups in this watershed.

A limited targeting effort was carried out as part of the Grand Lake Watershed Implementation Project (Oklahoma portion only) headed by Oklahoma Conservation Commission (OCC). The targeting for phosphorus indicated which subwatersheds of the Lake O' the Cherokees Watershed and vicinity that contribute the greatest percentage of phosphorus (Figure 14). These areas can be targeted for future implementation projects to reduce nutrients in this area around Grand Lake. (Oklahoma Conservation Commission 2008)

The targeting effort proposed as a part of this watershed plan will be specific to the field rather than general areas as shown in Figure 14.

Management measures: Although the specifics are best handled on a local basis with local stakeholder involvement, TMDL documents recommended a number of solutions, also generally agreed upon by stakeholders, to improve water quality in the impaired segments:

Management measures in Oklahoma:
Although there are no recommendations in the published TMDL for bacteria, a suite of agricultural practices are recommended for phosphorus and sediment in Oklahoma Conservation Commission (2008) document "Grand Lake Watershed Implementation Recommended Suite of Practices":

1. Riparian Area Establishment and Management
2. Buffer Strip Establishment and Streambank Protection
3. Animal Waste Practices and Structures
4. Pasture Establishment and Management
5. Proper Waste Utilization (Poultry Waste Producers)
6. Heavy Use Areas
7. Rural Waste Septic Systems (Human Waste)

Management measures in Kansas:

1. Where needed, create/restore riparian vegetation along target stream segments.
2. Install grass buffer strips where needed along streams.
3. Explore and enhance opportunities for mined land area reclamation projects.
4. Load allocations for permitted wastewater lagoon.

Superfund Activities:

A number of remedial actions related to heavy metals are ongoing or have already taken place in the multiple Superfund sites in the Lake O' the Cherokees portion of the Grand Lake Watershed including plugging of abandoned wells and mine shafts, surface water diversions, soil remediation, and even public relocation in the Tar Creek Superfund Site (See Appendix A). Any work regarding the Superfund Sites of the Tri-State Mining District must be coordinated with all federal and state regulatory agencies with legal jurisdiction over this area.

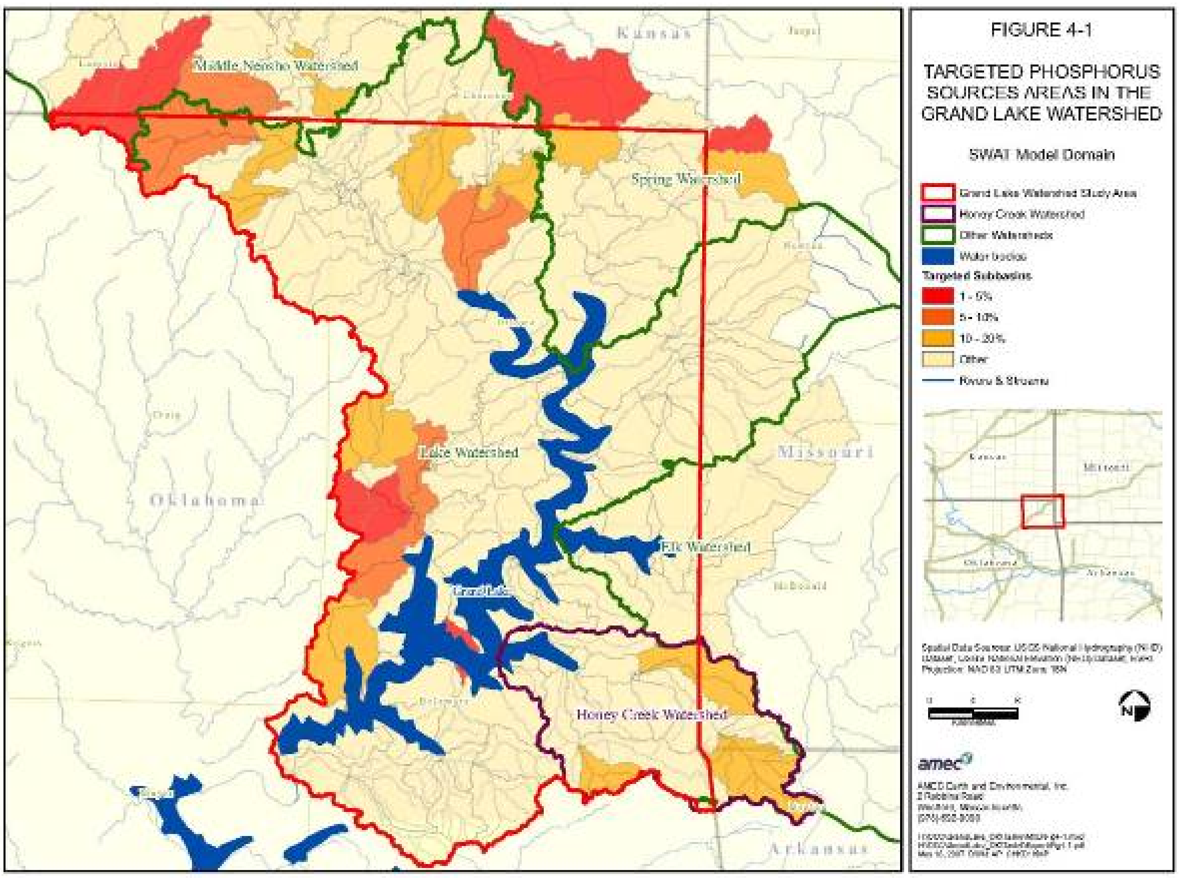

Figure 14: Subwatersheds of the Lake O' the Cherokees Watershed and vicinity with the greatest percentage contribution of phosphorus in the area around Grand Lake (darker color indicates greater contribution of phosphorus). (From Oklahoma Conservation Commission 2008)

SUBWATERSHED PLANNING

Establishing subwatershed plans for lakes and streams is essential for the successful management of water quality improvements within the Grand Lake watershed. The development and implementation of local and regional watershed plans is also linked to engaging local citizens and stakeholders in their portions of the watershed.

The Grand Lake watershed, when viewed in its totality, is characterized as being in an emerging phase of subwatershed planning. A vast majority of the watershed is without benefit of an established subwatershed plan. This means many streams presently lack a watershed approach necessary to coordinate and direct water quality improvements.

Many subwatershed plans should adopt improvement projects that will also address strategic water quality improvement needs. For example, the overall Grand Lake watershed presently is experiencing issues associated with excess nutrients and sediment. Any ultimate watershed strategy to improve nutrient/sediment water pollution is directly dependent upon implementing local and regional projects that target and effectively address these nutrient/sediment issues.

A summary of the status of subwatershed plans follows:

Neosho River Subwatershed Plans: Both the Marion Reservoir Watershed (Marion County Conservation District and Marion Reservoir WRAPS 2006) and the Council Grove Reservoir (Twin Lakes WRAPS 2006) have watershed plans.

Stakeholder organizations, or WRAPS (Watershed Restoration and Protection Strategy), within the Neosho River watershed are in various formative stages and one objective for each of these emerging organizations is to prepare a watershed plan for a specific stream and/or area.

Spring River Subwatershed Plans: A Kansas WRAPS stakeholder group has been organized on the Kansas portion of the Spring River. The Spring River WRAPS organization's objectives include education and outreach strategies, greater stakeholder involvement, developing a watershed plan for the Kansas portion of the Spring River and coordinating with citizen-based watershed organizations, especially for the Spring River watershed in Missouri.

Presently, there are no formal watershed plans that have been adopted that cover~~ing~~ any part of the Spring River itself either in Missouri, Kansas, or Oklahoma. The (upper) Shoal Creek Watershed Improvement Group is completing a watershed management plan and already implementing water quality improvements to address known sources contributing to water quality contamination identified by a TMDL for excess fecal coliform. In addition, the Environmental Task Force of Jasper and Newton Counties is sponsoring the (lower) Shoal Creek Watershed Partnership in completing a Watershed Restoration Action Strategy for lower portion of the Shoal Creek watershed.

Elk River Subwatershed Plans: The Elk River Watershed Improvement Association (ERWIA) has a 319 Subgrant agreement to develop five subwatershed management plans, implement specific water quality improvement and demonstration projects and expand public education and outreach strategies. ERWIA continues to coordinate with neighboring states and citizen-based organizations in the development of watershed plans.

Lake O' the Cherokees Subwatershed Plans: In 2004, the Oklahoma Conservation Commission published the Grand Lake Watershed Plan for the Oklahoma portion of the Grand Lake Watershed that focused on phosphorus reduction in the area immediately around Grand Lake. The implementation efforts focused on water quality and nutrient management education programs, trainings, and demonstration sites for residential, commercial and municipal audiences. In 2005, the Honey Creek Watershed Plan resulted primarily in implementing agricultural practices and developing a demonstration farm with examples of the array of management practices available for cost-share. (Oklahoma Conservation Commission 2004, 2005)

CITIZEN-BASED WATERSHED GROUPS

The Grand Lake Watershed has significant gaps where there are no citizen watershed groups or where organizations are just emerging. Creating additional citizen-based stakeholder groups within the watershed must be a priority for the overall water quality improvement strategy. Supporting and fostering growth of recently formed citizen groups is also a top priority.

Successful citizen-based groups represent a key underpinning necessary to achieve water quality improvement. These groups serve as the core for these essential watershed management functions:

- Education and public outreach
- Shaping the future of the watershed
- Energizing water quality improvement efforts
- Providing stakeholders an active voice in their watershed
- Assisting in preparing subwatershed plans
- Causing voluntarily induced water quality improvements

Generally the Neosho River Subwatershed in Kansas and the Elk River Subwatershed are more advanced in gaining citizen-based group involvement in their watershed. The Spring River Subwatershed has a limited scope of operating citizen-based groups and represents a significant gap within the Grand Lake Watershed. Significantly, however, a citizen stakeholder group has recently been formed on the Kansas portion of the Spring River. The Oklahoma portion of the Grand Lake Watershed is also without a local citizen-based group to assist in water quality improvements for portions of the Spring River, Neosho River, Grand River and Grand Lake. Appendix C lists the current citizen-based watershed groups within the Grand Lake Watershed. Appendix D specifies the geographic extent of all current citizen-based watershed groups in Kansas based on Hydrologic Unit Codes.

Neosho River Subwatershed

Local stakeholders within the Kansas Neosho River watershed participate in watershed management through Watershed Restoration and Protection Strategy groups (WRAPS). The current development stage for each WRAPS organization varies. WRAPS groups operating above each of the three federal reservoirs are more developed and have been functioning for several years. However, WRAPS organizational stakeholder efforts from below the John Redmond Reservoir to the Kansas/Oklahoma border are emerging.

Information provided by the Kansas Department of Health and Environment Watershed Management Section describes the Neosho Headwaters to be in the Assessment and Planning phase and there is a functioning Stakeholder Leadership Team (SLT). This SLT team is addressing sediment and other water quality issues.

The Upper Neosho River WRAPS project, covering the area directly below John Redmond Reservoir, is in the planning phase with a functioning SLT. Modeling options and economic analysis are in progress for this project.

The Middle Neosho River WRAPS project is in the planning phase. This area basically covers the area from the Upper Neosho to the Kansas/Oklahoma state line. This WRAPS project does have a SLT in place. The types of modeling and assessment considerations are in progress.

Two WRAPS projects on the Upper and Lower Cottonwood are in the development, assessment and planning phase. Two WRAPS projects for Marion Reservoir watershed and for the Twin Lakes project (AKA Council Grove watershed) are in the implementation phase. Both of these projects have active SLTs in place. The Eagle Creek WRAPS project, located immediately above John Redmond Reservoir, is currently in the implementation phase.

The Kansas Water Office (KWO) is helping with efforts in the Neosho Headwaters with two supporting projects (more information on the projects below is available at www.kwo.org):

Logjam Study, Sediment Monitoring, and Subwatershed Assessment: KWO is contracting to conduct 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. 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 subwatersheds within the basin to prioritize areas for streambank stabilization and riparian area improvement.

Feasibility Study: KWO is participating in a Feasibility Study with the Tulsa District Corps of Engineers in the Neosho Headwaters (above John Redmond Reservoir). This study will provide information to the WRAPS project stakeholders 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 phosphorus, 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 above.
i. Preserve aquatic habitat essential to the value and function of restored habitat above.
j. Protect public resources, utilities, including power, water, transportation, from the impacts of flooding, bank erosion, and channel changes.
k. Protect wetland and grasslands from invasive plant species.

Elk River Subwatershed

The Elk River Watershed Improvement Association (ERWIA) is an active citizen-based non-profit organization with active stakeholder involvement in the Elk River watershed. The ERWIA was formed in 2003 and its Board of Directors has a broad stakeholder mix. The Elk River watershed includes Buffalo, Big Sugar, Indian and Little Sugar Creeks, as well as the main stem of the Elk River to the Elk River Arm of Grand Lake. The ERWIA includes portions of six counties in Arkansas, Missouri and Oklahoma.

Spring River Subwatershed

There is a large gap on the Missouri portion of the Spring River watershed. A considerable portion of this watershed does not have functioning citizen-based groups involved in watershed management; however, portions of the Spring River watershed have active groups.

The Shoal Creek Watershed Improvement Group (SCWIG) is active in a 150 square mile portion of upper Shoal Creek watershed. In addition the Environmental Task Force of Jasper and Newton Counties has established the Shoal Creek Watershed Partnership for the remaining portion of lower Shoal Creek.

A Kansas WRAPS citizen group has been organized on the Kansas portion of the Spring River. This is an emerging organization that intends to link with the Missouri portions of the Spring River watershed. Some effort has been occurring to engage local stakeholders in watershed planning for the North Fork of the Spring River and the main stem of the Spring River watersheds, but have yet to result in formation of citizen-based groups. This is a priority area for the Foundation to address significant gaps in citizen-based groups to achieve water quality improvement objectives.

Lake O' the Cherokees Subwatershed

No active citizen-based group that has the purpose of planning and implementing a watershed plan is present in this subwatershed.

Grand Lake O' the Cherokees Watershed Alliance Foundation, Inc.

The Grand Lake Watershed Alliance Foundation Inc. (GLWAF) is a non-profit corporation formed in 2007. It focuses on preserving, protecting, and improving water quality within the total Grand Lake Watershed. Stakeholders from each of the four watershed states serve as members of the Foundation Board of Directors.

The Foundation is working with other watershed citizen-based groups to support their efforts to include public education, projects, programs and other actions designed to improve water quality. Importantly, the Foundation will assist in forming other watershed citizen-based groups and will partner with them.

The Foundation recognizes the watershed has a vast range of stakeholders. GLWAF, together with other similar citizen-based groups, will provide stakeholders a means and method for stakeholders to participate in their watershed. A Foundation Stakeholder Advisory Committee also provides an opportunity for stakeholders to participate in improving water quality.

One of the Foundation objectives is to have a full-time Foundation Vice President established and located in each of the four watershed states. These Vice Presidents will work with other citizen-based organizations as well as interface with local, state, federal and tribal organizations. Each Vice President also will be responsible for assisting in the development of localized citizen-based groups for subwatersheds.

Private funding will be needed to supplement public funding for the many programs and projects necessary for water quality stabilization and improvement. An essential Foundation objective is to secure private funds to support water quality improvement.

The Foundation also will host periodic coordinating and information sharing seminars with watershed state agencies, tribal governments, and federal agencies. In addition, the Foundation will host, at least annually, a seminar involving all citizen-based groups within the watershed.

Also, the Foundation will host at least semiannual watershed planning sessions attended by water quality agencies from each of the four watershed states. These sessions will focus on watershed planning and implementation; coordination of programs, monitoring efforts and trends, and activities; exchanging relevant information; and other assessment activities necessary for arresting and improving water quality.

A critical Foundation objective is to establish an effective educational outreach program. The educational outreach program will include:

1. Assisting in developing a Watershed Signage Program
2. Preparing and publishing educational pamphlets
3. Preparing and distribution of watershed and subwatershed videos
4. Developing a Grand Lake Watershed Health Index
5. Developing and publish watershed and subwatershed Fact Sheets
6. Establishing a Public Speaking program
7. Establishing a Public Education section of Foundation web site
8. Publishing periodic Foundation Newsletters
9. Hosting an Annual Meeting for Watershed Groups
10. Supporting other Citizen Group Education programs

Other important Foundation objectives include:

1. Assisting in the identification and recommending solutions to matters that affect water quality.
2. Assisting in improving water quality monitoring within the watershed
3. Publishing a Foundation Strategic Plan
4. Developing the Foundation and obtaining sufficient funding and staffing to achieve positive and sustained impacts on water quality.

WATERSHED-WIDE MANAGEMENT STRATEGIES

The Need for a Watershed-Wide Strategy

Local Support: Specific strategies to implement pollution prevention practices on the ground are best conducted on a local basis, addressing specific concerns of local people. However, local groups often lack the necessary funding or support to make significant inroads on solving pollution problems. A watershed-wide support network can help local groups combine efforts where helpful, such as outreach and education, and can help provide technical or monetary support where needed. A combined watershed-wide effort can also help leverage support of local issues by highlighting their collective impact on a regional level.

Reservoir vs. Stream Pollution: The impact of pollution is different in moving water than in the still water of reservoirs. Conditions that cause impairments of these standing water bodies can arise from upstream conditions that do not manifest themselves as problems in flowing water. In other words, a lake or reservoir could be impaired even though none of the streams feeding the lake are considered impaired. This means that additional efforts to reduce pollution may be necessary in officially unimpaired subwatersheds to provide necessary benefits downstream. This complication is normally particularly difficult to handle when the downstream waterbody is in a different state than the upstream waters.

Conflicting Impairment Designations: Other complications arise when waters that are impaired in one state are not considered impaired in the downstream state, or vice versa. These complications may arise more from a change in the water quality standards from one state to the next rather than a change in the actual condition of the water body. These changes may arise either from a change in designated use of the water body from one state to the next or a change in water quality standards of that use based on a different state's criteria. For example, water quality standards for the same use, such as "recreation", may differ in each state. Similar changes in impairment status can occur within one state as the designated use of the water body changes without a decided change in water quality.

All of the above complications underscore the need for a comprehensive watershed plan and ongoing cooperative planning to help ensure that local improvement efforts contribute to the overall good of the Grand Lake Watershed.

Management Strategies for Grand Lake Watershed

Continue Development of Grand Lake Watershed Alliance Foundation (GLWAF):
GLWAF is a citizens-based, officially recognized 501(c)(3) nonprofit organization with representation from all four states of the Grand Lake Watershed. GLWAF is organized to represent the stakeholders in the total watershed as well as work with local citizen-based organizations.

GLWAF has an active board, a set of bylaws, and several active committees, including the Watershed Plan Committee. GLWAF is taking steps to increase its membership and solidify its organizational structure. This will enable the Foundation to hire support staff to help further the efforts of the organization. In addition, the Foundation is working to complete a more specific Strategic Plan, built upon this watershed plan. Once fully established, GLWAF will be better able to generate private and public funds that will benefit local watershed implementation efforts and raise awareness of and foster solutions for water quality problems in the Grand Lake Watershed.

Help Develop and Support Local Watershed Groups: Local stakeholder involvement is key for successful watershed management and water quality improvements. Local watershed groups are developing in many parts of the Grand Lake Watershed, but other areas lack concerted efforts to develop watershed groups. GLWAF will help foster local watershed groups so that eventually the entire watershed can be represented by local groups. All current and future watershed groups can benefit from financial, organizational, and technical support from GLWAF.

Conduct watershed-wide modeling: A critical element of the management strategy is to help ensure that implementation money is spent in areas where it can make the biggest impact on improving water quality. In order to get the biggest bang for the buck, it is essential to identify and quantify all pollutant sources in the basin, including both nonpoint and point sources. Computer models can use data (soil type, topography, land use practices, climate, etc.) to determine current pollutant loading throughout the watershed. Modeling can also determine the load reductions expected with a change in management practices, thereby ensuring that the most effective practices are recommended for consideration by local adopters.

Some modeling has been initiated in portions of the Grand Lake Watershed, but watershed-wide modeling is important for a number of reasons. First, one set of modeling results will produce a document covering the entire watershed that GLWAF can take to potential funding sources. Those funding sources can be confident that the money provided will go to areas that will make a meaningful impact on water quality and that the efforts are not fragmented. Second, the modeling results will be beneficial to local watershed groups that are attempting to develop a management plan for their subwatershed, especially where there is no plan to conduct such models. The results of the modeling study will allow local groups to meet many of EPA's 9 elements to develop those plans. Third, the modeling results will aid in development of local watershed groups where none exist. Modeling results can be used to energize citizens to form watershed planning groups. Fourth, one set of modeling results, using identical methodology for the entire watershed, will ensure appropriate comparisons will be made from one part of the watershed to another. Finally, the results of the watershed-wide modeling will be used to update this Grand Lake Watershed Management Plan to thoroughly address EPA's 9 elements for successful watershed planning (see below).

The proposed modeling effort will focus on nutrient (phosphorus) and sediment loads in the watershed, including upland, instream and reservoir processes. Watershed-wide, the top concerns are nutrients, sediment, bacteria, and heavy metals. Although these 4 concerns represent distinctive impairments, the sources and causes are often interrelated. For example, heavy metals can be transported with sediment and bacteria may be associated with organic material rich in nutrients. As a result, modeling that focuses on nutrient and sediment issues will not only lead to improvements for those specific impairments, but will lead to a reduction of bacteria and heavy metals as well.

At this point, heavy metals and bacteria are not intended to be directly addressed by watershed-wide modeling. However, a local WRAPS group in Kansas is planning to develop modeling for heavy metal pollution reduction in the Spring River Watershed where those issues are the number one concern. Those and other local modeling efforts that enhance our understanding of the watershed will be supported and encouraged.

Streambank Stability Study: A watershed-wide streambank stability study must be initiated. Streambank erosion is a significant issue throughout the watershed. It is responsible for large amounts of sediment and nutrient pollution downstream and the loss of land along streams. This study would identify key areas to implement bank or channel improvements. Streambank stability studies may take place as a part of some WRAPS projects in Kansas. Although this study is needed watershed-wide, the cost of this study may necessitate a phased implementation.

Data Gap Anaylsis: As part of the watershed-wide modeling project, all existing relevant data will be compiled. As an extension of that project, a data gap analysis will be conducted to determine what kinds of additional data are needed to be collected to further our understanding of the Grand Lake Watershed system.

Website Linking Water Quality Information: A significant amount of data and reports on Grand Lake Watershed are already available online. Developing a website based on Grand Lake Watershed with links to available water quality information would aid citizens and citizen-based groups in finding relevant information on the watershed.

Analyze Point Source Discharge Regulations and State Water Quality Standards: In order to begin dealing with interstate inconsistencies in water quality measures, GLWAF intends to begin compiling and analyzing information and data on point source discharge regulations and state water quality standards. This is a starting point for establishing options for handling conflicting regulations and standards. The results of the modeling effort and continued development of TMDLs will aid in the analysis of these issues.

Regular Meetings of State Water-related Agencies and GLWAF: GLWAF has commitments from several state agencies to meet on a regular basis to address interstate water issues relevant to Grand Lake Watershed and to increase communication about water quality improvement efforts and monitoring in the respective states, including addressing a four state monitoring plan elaborated upon in the "Monitoring" section of this documents.

Update Grand Lake Watershed Plan: This watershed plan will be updated to include the results of the watershed-wide modeling effort and increased input from developed and developing local watershed groups.

INFORMATION AND EDUCATION STRATEGIES

Watershed-wide signage: In order to promote awareness of watersheds and specific watershed boundaries and names, GLWAF will kick-off a watershed-wide signage initiative. Watershed signage helps citizens identify themselves as a stakeholder in Grand Lake Watershed and enhances their ability to understand the impact their actions may have on local and downstream waters. GLWAF intends to work with local watershed groups to develop the plan for watershed signage design and implementation. The first step is to develop a pilot project in each subwatershed for locals to develop an action plan.

Develop Grand Lake Watershed Health Index: In order to publicize and help the public track improvements (or declines) in the watershed, a Watershed Health Index (akin to the Chesapeake Bay Foundation's Health Index) will be developed and publicized. A health index will use monitoring data and watershed statistics (such as % streambanks with vegetative buffer) to indicate the relative progress of planning and implementation efforts. The numeric scale, to be updated and publicized annually, will be a simple tool to aid the public in understanding the state of the watershed.

Help promote regional workshops, conferences, and events: A number of regional workshops and conferences provide valuable information for a variety of audiences, including local officials, land managers, etc. From topics ranging from low impact development to lawn management to agricultural practices, there are numerous events held in or near the Grand Lake Watershed that can be promoted rather than developed from scratch. GLWAF will support (when funds are available) and promote these events throughout the watershed.

Annual Water Meeting for Watershed Groups: Each year GLWAF will organize a gathering of local stakeholder groups to meet and discuss watershed issues. Groups will have the opportunity to update each other on progress, challenges, and initiatives within each subwatershed ranging from water quality improvements to successful outreach events to practices implemented. Most importantly, the annual event should instill a sense of community among stakeholders throughout the watershed. The annual meeting will be held in different parts of the watershed each year.

Quarterly Newsletter: GLWAF will produce a quarterly newsletter to members and member organizations to increase communication about initiatives throughout the watershed. The newsletter can serve to keep watershed groups informed of events, initiatives, and opportunities throughout the watershed and to aid in communication across the watershed.

Watershed and Subwatershed Educational Videos: Educational videos can be used to promote the understanding of watersheds, pollution sources and causes, and ways to make a difference. Produced videos can be used in classrooms, access cable channels, and public venues such as visitor centers and nature centers, to promote watershed education. Educational videos should be produced for the entire watershed as well as more locally focused videos directed toward narrower audiences for each of the 3 major subwatersheds.

Watershed and Subwatershed Fact Sheets: Fact sheets can be used to inform the public about watershed statistics including land use, population, and impaired waters. Fact sheets can be available at watershed events, meetings, and public venues to promote understanding of watershed issues. Fact sheets should be produced for the entire watershed as well as more locally focused subwatersheds.

MONITORING

Current State of Monitoring in Subwatersheds

In general, the Kansas portion of the Neosho River Subwatershed has broader geographical monitoring coverage than either the Spring River or Elk River Subwatersheds outside Kansas. Establishing additional monitoring sites are necessary in these other areas, in particular in the Spring River Subwatershed.

Neosho River Subwatershed: The Kansas Department Health and Environment (KDHE) is the responsible state agency for monitoring of Kansas water quality. According to KDHE, the Neosho River Subwatershed contains a large portion of the state’s surface water. Consequently, this watershed receives an elevated level of monitoring priority and attention.

An important element of the KDHE monitoring program is the use of targeted water chemistry sites within the Kansas portion of the watershed. The location of each chemistry site is shown on a website map (http://www.kdheks.gov/befs/water_quality_disclaimer.htm). Each site displays summary data and a site photograph. KDHE reports 54 targeted stream monitoring locations established within the Neosho River watershed and 21 sites established that monitor public owned (or public accessible) lakes and wetlands.

KDHE is currently developing 23 targeted stream biological monitoring sites within the watershed each having a similar data summary and photograph presentation. In addition, 17 stream fish tissue-monitoring sites are scheduled for the watershed (KDHE works with the Kansas Department of Wildlife on fish tissue matters).

KDHE uses a probabilistic monitoring network to augment the targeted monitoring stream programs. This involves using a random sample site selection process and then application of physical/chemical, biological, and fish tissue sampling procedures.

According to KDHE, historical analysis of water quality trends has focused on heavy metals in streams and the trophic conditions of impounded waters. KDHE does have a historical database that could be used to provide further trend analysis of nutrients and phosphorous.

Spring River Subwatershed: The Missouri Department of Natural Resources (MoDNR) is the Missouri state agency that monitors water quality on the Spring River and its tributary streams. There are five fixed monitoring sites on the Spring River and its streams. One of the sites is monitored for nutrients only. Four of the sites are monitored for nutrients, trace metals, and ions.

KDHE also has four fixed monitoring sites on the Spring River and its streams in Kansas. Two of these sites are located on the Spring River and two sites are located on tributary streams.

Elk River Subwatershed: The U.S. Geological Survey (USGS), in cooperation with MoDNR, recently concluded a study of water and streambed sediment quality in the upper Elk River watershed in southwestern Missouri and northwestern Arkansas (U.S. Geological Survey Water and Streambed-Sediment Quality in the Upper Elk River Basin, Missouri and Arkansas, 2004–06).

There are presently five fixed water monitoring gages operating in the Elk River watershed. These gage sites include:

- Elk River at Tiff City
- Buffalo Creek at Tiff City
- Indian Creek at Lanagan
- Big Sugar Creek at Powell
- Little Sugar Creek at Pineville

These five fixed water monitoring gages measure the following parameters: gage height, discharge and precipitation; and, one of them (Little Sugar Creek gage) also measures the following water quality parameters: temperature, specific conductance, dissolved oxygen, pH, turbidity and dissolved oxygen.

Through its cooperative water resources program in the Elk River watershed for 2009, the MoDNR and USGS will be conducting additional water quality monitoring for the following parameters:

- Nutrients (12 times/year)
- Trace metals and major ions (4 times/year)
- Total residue (8 times/year)

The GLWAF urges continuation of comprehensive water resources monitoring in the Elk River watershed, especially for nutrients, beyond 2009 and budgets $26,000 per site for helping MoDNR and USGS continue monitoring, including monthly sampling for nutrients.

Lake O' the Cherokees Subwatershed: The Missouri Department of Natural Resources has a fixed monitoring site on the Cave Springs Branch located on the Missouri-Oklahoma state line which drains to Honey Creek where there is another fixed monitoring site before merging with the Honey Creek arm of Grand Lake. The Cave Springs site is monitored for nutrients as well as pH, dissolved oxygen and other water quality parameters.

In Oklahoma, wat responsibility is di state agencies. The Conservation Com responsible for mo wetlands and wate nonpoint source p state and agencies er quality monitoring efforts. The Oklahoma Department of Environmental Quality performs point source monitoring and enforcement. It also monitors for TMDL development plus special projects monitoring.

It would be good to have a map or some accounting of the number of sites in the GL watershed monitored by OWRB, USGS, and OCC...

The Oklahoma Water Resources Board (OWRB) is the Oklahoma state agency responsible for monitoring water quality in Grand Lake. The Grand River Dam Authority also conducts water monitoring on the lake.

A citizen-based volunteer monitoring program was established in 1992 on Grand Lake as part of the Oklahoma Water Resources Board Water Watch Program. This monitoring program includes partnerships with three Tribal governments who also participate. Trained and OWRB certified volunteer monitors conduct periodic water sampling at both in water and near shoreline monitoring sites. There are about 45 monitoring sites on Grand Lake and on the Neosho River, Spring River, and Elk River. The test results are reported to the OWRB who retains both the Water Watch collected data and the data collected by OWRB.

A new state-of-the art water quality research laboratory is scheduled to be completed by the Grand River Dam Authority (GRDA) in mid-2009 and will be located on the shores of Grand Lake. This lab will be part of the GRDA Ecosystems & Education Center which will facilitate easy access to Grand Lake for research scientists and will provide unique public education and teaching opportunities. The GRDA lab is expected to support research activities throughout the total Grand Lake watershed. The GRDA also will be monitoring water quality in Grand Lake and will be able to support monitoring efforts elsewhere within the watershed.

Grand Lake, therefore, has historical water quality data from 1992 forward that provides baseline data and also provides a basis for trend analysis. This historical data includes: Dissolved Oxygen, pH, Secchi Disk depths, Orthophosphate, Nitrate Nitrogen and Ammonia Nitrogen. Grand Lake Water Watch Inc., the non-profit parent volunteer monitoring organization, added periodic testing for bacteria in the lake samples sent to OWRB for testing. What is lacking for Grand Lake is a study and analysis of the significant amount of historical data collected by the various agencies and the Water Watch Program.

Monitoring and Data Management Strategies

The widespread occurrence of nutrients/phosphorous is a significant issue and is a high priority water quality concern within the entire watershed. This problem warrants a strategic focus to monitor nutrients and sediment. Currently there are strategic gaps in nutrient monitoring sites and a lack of adequate geographical coverage.

Local subwatershed plans will require project-specific monitoring programs that are designed specifically to track the progress of local water quality improvement projects. However, there are important strategic monitoring aspects applicable to the total Grand Lake watershed.

New and Existing Monitoring Sites: Existing monitoring sites should be continued. Other sites where discharge monitoring is currently underway should be augmented with nutrient and, in some cases, metal monitoring. Finally, where data gaps exist, new sites should be added that monitor discharge, nutrients, metals, and other parameters. Specifically, sites monitored in the Elk River Subwatershed that are currently funded through the first part of 2009 should be maintained in perpetuity in order to track improvements in the watershed. Parts of the Spring River Subwatershed, in particular, would be a good target for new monitoring sites.

Four State Monitoring Plan: The Grand Lake O' The Cherokees Watershed Alliance Foundation Inc. intends to host a four-state effort to craft an overall coordinated watershed nutrient/sediment monitoring plan. This monitoring plan will use existing data collection efforts, but also will fill gaps necessary to obtain adequate strategic geographical coverage. This approach will insure a coordinated and strategic water quality monitoring plan is functioning within the watershed.

Trend Analysis of Water Quality Data: There are instances when scarce resources have been used to collect monitoring data, but the data are not fully subjected to historical trend analysis or further interpretation. Limited budgets and resource allocation decisions contribute to this situation. Additional funding could provide a more thorough analysis of existing data to provide further relevant information that can aid watershed management choices and decisions.

Data Clearing House: No data clearing house for the water quality monitoring data and information exists. Instead, the repository of data and information can be found in many locations and within many different organizations. At the same time, some monitoring information, but not all, is available on web sites. The cost of establishing and operating a data-clearing house for the total watershed may not be warranted based upon cost/benefit criteria. A data clearing house concept should further explored in the future.

Website Linking Water Quality Data: The Grand Lake Watershed Alliance Foundation Inc. intends to establish a web-based site that links all of the websites that publish watershed and water quality data. This website would serve as a one stop web directory that lists an inventory of all the locations having watershed and water quality data and information with an Internet link to each.

Grand Lake Watershed Health Index: The Grand Lake watershed will greatly benefit by having a simple index number that would convey to the public an easy to understand state of the watershed. Therefore, the Grand Lake Watershed Alliance Foundation intends to publish a watershed ***Health Index***. This Index number would be similar in nature to one published by the Chesapeake Bay Foundation and by organizations in other watersheds. Citizens and stakeholders can use the ***Health Index*** as an easy to understand number to chart any improvement, stagnation, or regression in watershed and water quality conditions.

IMPLEMENTATION SCHEDULE AND INTERIM MILESTONES

Short Term Tasks (complete in first 2 years)

- Further development of Grand Lake Watershed Alliance Foundation
- Complete modeling of watershed
- Initiate streambank stability study
- Implement watershed signage:
  pilot project in each major subwatershed plus action plan to complete
- Help develop 3 new watershed groups, one in Spring River Subwatershed
- Develop Grand Lake Watershed Health Index
- Complete data gap analysis
- Promote 10+ local & regional workshops/events to engage stakeholders
- Hold annual meeting for watershed groups
- Assemble and tabulate various water quality standards from each state
- Review and analyze all point source permits in the watershed
- Develop watershed educational video for entire watershed
- Develop watershed and subwatershed fact sheets and distribute
- Develop water quality data linkage website
- Establish three fixed monitoring sites in Spring River system - nutrients, metals & total residue
- Establish three fixed monitoring sites in Elk River system for nutrients & metals

Medium Term Tasks (complete in 2- 5 years)

- Signage throughout watershed
- Help establish watershed groups throughout the watershed
- Support completion of 4 subwatershed plans
- Publicize Grand Lake Watershed Health Index
- Update watershed plan – using modeling results
- Complete Strategic Plan of the Foundation
- Analyze water quality standard variances between states, work on solutions
- Develop action plan for establishing appropriate point source discharge rates for nutrients throughout the watershed (based on needs documented in TMDLs and the watershed modeling effort).
- Develop subwatershed educational videos
- Distribute educational videos and fact sheets to 5+ schools in each state
- Establish 2 additional fixed monitoring sites in Spring River system (Total of 5)
- Establish 1 additional fixed monitoring site in Elk River system (Total of 4)

Long Term Tasks (complete in 5+ years)

- Subwatershed groups throughout the watershed
- Subwatershed plans throughout the watershed
- Implement action plan to improve water quality from point sources
- Determine and implement corrective solutions for conflicting water quality standards on a watershed basis
- Expand plans to cover entire Grand River Basin to the confluence with Arkansas River
- Continue monitoring to demonstrate success of plan implementation.

TECHNICAL AND FINANCIAL ASSISTANCE

The top priority projects of the Grand Lake Watershed plan are 1) conduct watershed-wide targeting studies (modeling and streambank stability), 2) further develop the Grand Lake Watershed Alliance Foundation (GLWAF), and 3) initiate watershed-wide signage pilot projects.

Watershed-wide targeting studies (modeling and streambank stability) will clearly define areas of the watershed to concentrate implementation projects in the future. Watershed targeting is essential to determine where scarce financial resources can best be spent to achieve maximum pollution reduction. Potential nutrient reduction projects, such as bank stabilization, are costly. Therefore, cost effective projects along with their location must be identified and prioritized within the watershed. The streambank stability study is necessary to supplement the modeling efforts, because modeling does not adequately address the streambank stability issues.

The GLWAF will assist with the formation and support to citizen-based groups by funding the staffing of four Foundation Vice-presidents positions within each of the four watershed states. Their job will also include assisting in preparing subwatershed plans and interfacing with local private and governmental entities. The Foundation intends to establish a grant writer/facilitator to assist local citizen-based groups in obtaining the financial resources that are necessary to reduce pollutants.

Watershed signage helps citizens identify themselves as a stakeholder in Grand Lake Watershed and enhances their ability to understand the impact their actions may have on local and downstream waters. By initiating pilot projects in each of the four states, local citizens will take responsibility for their own portion of the watershed. In addition, this project will enable GLWAF to immediately forge a positive relationship with local watershed groups.

The tables below tabulate the financial assistance needed to carry out all of the immediate tasks recommended in the Grand Lake Watershed Plan. The primary responsible party is GLWAF. Technical assistance has and will continue to be provided by two main groups:

State and federal agencies: Several agencies have assigned staff to participate in GLWAF committees and have agreed to meet separately 2-4 times a year with GLWAF to address water issues in Grand Lake Watershed. In addition to technical support, agency support of GLWAF activities are considered financial contributions (personnel time and travel expenses) and are included as costs in the tables below.

Four State Watershed Collaborative (FSWC): A group of university professors, university extension professionals, and state agency professionals from the four Grand Lake Watershed states have formed to provide technical assistance to watershed groups in the Grand Lake Watershed.

TOP PRIORITY TASKS	FUNDS NEEDED	RESPONSIBLE PARTY
Watershed-wide modeling	$600,000	GLWAF, FSWC
Streambank stability study	$850,000 – $4,500,000 (depending on scope)	GLWAF, FSWC
Develop GLWAF 1. Staff stipend and benefits a. 4 Vice Presidents – one for each state b. Grant writer/facilitator (self-supporting after 2 yrs) c. Administrative assistant c. President (lower priority) 2. Travel reimbursement (board meetings, committee meetings, local watershed meetings, etc.) 3. Office supplies and operation 4. Office space and utilities 5. Develop / support local watershed groups	Total: $410,000/yr $240,000/yr $60,000/yr (2 yrs only) $22,000/yr $60,000/yr $60,000/yr $30,000/yr $30,000/yr $0, included above	GLWAF
Watershed-wide signage pilot projects	$100,000	GLWAF, watershed groups

Total cost over 4 years: $3,558,000 – $7,208,000

OTHER TASKS	FUNDS NEEDED	RESPONSIBLE PARTY
DATA ANALYSIS 1. Data gap analysis 2. Website linking water quality data 3. Analyze point source discharge regulations and State water quality standards 4. Trend analysis of water quality data 4. Regular meetings of State water-related agencies and GLWAF	 $108,000 $4,800 $680,000 $500,000 $4,000/yr	 GLWAF, FSWC GLWAF GLWAF, State Agencies GLWAF, State Agencies GLWAF, State Agencies
EDUCATION AND OUTREACH 1. Develop Grand Lake Watershed Health Index 2. Annual meeting for watershed groups 3. Quarterly newsletter printing and mailing 4. Watershed & subwatershed education videos 5. Watershed and subwatershed fact sheets 6. Help promote regional workshops, conferences, and events	 $75,000 $10,000/yr $10,000/yr $40,000 $10,000 $0	GLWAF, FSWC
MONITORING 1. Spring River Watershed monitoring sites a. First 3 sites b. Additional 2 sites (after 2 yrs) 2. Elk River Watershed monitoring sites a. Add parameters to 3 sites b. Additional site (after 2 yrs)	Total: $780,000 $78,000/yr $52,000/yr $78,000/yr $26,000/yr	 GLWAF GLWAF
Update Grand Lake Watershed Plan (after 2+ yrs)	$500,000	GLWAF, State Agencies

Total Cost over 4 years: $2,793,800

CRITERIA TO MEASURE PROGRESS

Criteria to measure progress of watershed plans are generally linked to the actual water quality improvements expected in the watershed. The Grand Lake Watershed Plan is a large scale plan. On such a large scale, one can only expect longer term criteria to appropriately measure water quality progress. This expectation is amplified by the fact that sources of pollution may be cut off in the short term, but the pollutants may still work their way through the watershed for decades to come.

Shorter term water quality criteria are expected to be determined by local groups in local areas as part of subwatershed plans. Shorter term milestones for progress on action items in this watershed plan are included in a previous section of the document.

Ultimate Goals

1) Remove waters of Grand Lake Watershed (eventually also the entire Grand River Watershed) from state impairment lists.

2) Determine corrective solutions for conflicting water quality standards and regulations on a watershed basis.

3) Prevent development of toxic algae blooms in reservoirs of Grand Lake Watershed.

Initial Goals

1) Reduce nutrients, sediment, and bacteria loading by 10% in 10 years (specific load reduction numbers will be determined after watershed modeling is complete).

2) Removal of 5% impaired waters of the Grand Lake Watershed from state impairment lists in 10 years (based available funding and local implementation) – priority given to top impairment concerns: sediment, nutrients, bacteria, and heavy metals.

Corrective actions

If the above initial goals are not reached, the watershed plan will be reevaluated to address shortcomings or reassessed to set more realistic goals. The initial goals are not endpoints and new goals will be set as the first ones are attained.

CONCLUSIONS

The watershed presently has insufficient citizen-based stakeholder organizational infrastructure that is essential to achieve improved water quality. A large portion of the watershed lacks individual subwatershed plans tailored for specific rivers and streams. Consequently, material improvements in water quality during the next ten years do not look promising unless the following occur:

- Organizing and supporting citizen-based stakeholder organizations must receive a high priority for the next five years. This is an imperative strategic element requiring focus by citizens, community leaders, and governmental leaders.
- Citizen-based stakeholder organizations and additional funds are required to prepare subwatershed plans tailored for specific streams.
- A higher priority for funding water quality improvement projects implemented by citizen-based organizations with support from local, state, federal and tribal government is necessary.
- Private funds must be made available to support these water quality improvement efforts.

Degradation of water quality is a real risk within the watershed. Increased pollution risks are expected unless drastic steps are taken and higher priorities are established. One strategic objective is to stop the projected decline in water quality. Clearly, the nutrient rich watershed will continue to affect the four major reservoirs (Marion, Council Grove, John Redmond, and Grand Lake) and the major rivers (Neosho, Spring, and Elk) unless a watershed-wide collective and coordinated effort is adopted and implemented.

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APPENDIX A: TAR CREEK SUPERFUND SITE BACKGROUND

The Tar Creek Superfund Site is located in far northeastern Oklahoma near the Oklahoma/Kansas border in Ottawa County. The Site generally consists of a forty square-mile area; however, it is part of the larger Tri-State Mining District that includes areas of Kansas and Missouri. The Site includes portions of five communities: Picher, Cardin, Quapaw, North Miami, and Commerce and affects a total population of roughly 30,000 residents. A substantial amount of the land in the mining area is owned by the Quapaw Tribe and its members held in trust by the U.S. Department of Interior.

Beginning in the early 1900s and continuing to some degree as late as the 1970s, the Site was extensively mined for lead and zinc ore. Most mines had their own mill, and Oklahoma mills in many cases served as central mills for mines operating in Kansas and Missouri. Milling the lead and zinc ore resulted in a concentrate of the original mined material. The milling process, however, also resulted in mine tailings that were originally considered an unmarketable waste product. Typically, the mine tailings were disposed of by collecting in piles or in flotation tailings ponds. Some piles are as high as 200 feet and contain elevated levels of lead and other heavy metals. The chat has been sold and marketed as a construction product, similar to limestone gravel, for many years. Chat piles are either owned privately or held in trust by the U.S. Department of Interior for members of the Quapaw Tribe.

The U.S. Geological Survey and the U.S. Army Corps of Engineers have estimated that the Site generally contains 75 million tons of chat piles and an additional amount of tailings in flotation ponds that has yet to be quantified. The Environmental Protection Agency and Oklahoma state agencies have determined that the mining and milling of lead and zinc ore left miles of underground tunnels, open mine shafts, and drill holes. The Environmental Protection Agency (EPA) listed the Tar Creek Superfund Site on the National Priorities List in 1983 making it subject to the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA, 42 U.S.C. §9601 et seq.). CERCLA listing, also known as Superfund listing, establishes procedures under that law for clean up of a listed site and reimbursement for such clean up by collecting from responsible parties. In 1984, the EPA began work on its first Operable Unit (OU1) in the Site. Each OU is a portion of a remedial response, and the clean up of a Superfund site can be divided into a number of OUs. OUs may be organized by geographical portions of a site or specific site problems to be remediated. Since its listing in 1983, EPA has designated four different OUs within the Site. The first OU was designated to address surface water contamination in Tar Creek from discharge of mine water and the threat of contamination of the Roubidoux Aquifer beneath the Site from open abandoned wells. The EPA conducted work from 1984 to 1986 to build dikes, plug eighty-three abandoned wells, and divert surface water around abandoned mines and collapsed mine shafts. The result of the work of OU1 was mixed. Surface water quality was not significantly improved. The diking and diversion remedial action was at best only partially effective, and there was insufficient data to evaluate the effectiveness of the well plugging operations. Concentrations of most constituents in the mine water discharges decreased; however, that may have occurred naturally, and the volume of the mine water discharged to Tar Creek was not significantly impacted by the remedial action. Some well plugging continues and the Oklahoma Department of Environmental Quality (ODEQ) continues water monitoring. EPA and ODEQ expenditures totaled just under $10 million for the OU1 work.

The second designated OU occurred in 1995. It began as a result of information obtained from the Indian Health Service (IHS) concerning the concentration levels of lead in the blood of Indian children living in the area. IHS indicated that approximately 35 percent of the Indian children tested showed concentrations of lead in their blood that exceeded the level considered elevated by the Centers for Disease Control and Prevention. Subsequent countywide testing showed that more than 30 percent of children had elevated blood lead levels. EPA found that tailings were located throughout residential properties in the Site. EPA cited that chat was commonly moved to use for fill and to cover driveways, alleyways, roadbeds, yards and home playgrounds. EPA also found that the foundations of area homes and business where local children regularly played were built on chat. In response, the EPA began sampling area soils and subsequently began the yard remediation activities that occurred from 1995 and are scheduled to conclude in 2003. EPA reports that more than 2,000 residential properties, day cares, schools, parks, and business properties in the five-city mining area have been remediated through this work. The EPA reports it has spent more than $100 million to complete this work. Testing has shown a reduction in the percentage of children with elevated blood lead levels. This reduction has been attributed to a combination of the remediation and extensive public education campaigns on the dangers of lead and how to reduce exposures.

The third designated OU began in 1989 and ended in 1999. Pursuant to the request of the Quapaw Tribe, EPA investigated the abandoned Eagle Picher Industries mining laboratory located in Cardin. EPA disposed of 120 deteriorating containers of lead recovering chemicals at the laboratory. EPA estimated the cost of the OU3 work at $55,000.

The fourth OU has only recently been designated. The EPA and U.S. Department of Justice are negotiating a proposed legal consent order and statement of work concerning the remedial investigation and feasibility study (RI/FS) with Department of Interior, Blue Tee Mining Company, and Gold Fields Mining Company. These entities are three of the potentially responsible parties (PRP) involved in the Tar Creek Superfund Site. Although the RI/FS uses terms like “study,” this is not simply another evaluation or study of the Site with no resulting action. An RI/FS is the first necessary action to identify the nature and extent of contamination and evaluate options for clean up. The RI/FS becomes the basis that establishes site remedies. The selected remedy for OU4 was issued in July 2008 and includes voluntary relocation, phased consolidation, chat sales and on-site disposal as presented in the proposed plan, July 30, 2007, with some modifications based on public comment.

APPENDIX B: SUMMARY OF TMDLs FOR GRAND LAKE WATERSHED

The following identifies pollutants causing impairment in Grand Lake Watershed water bodies, their sources and causes, solutions, and necessary load reductions to become unimpaired based on TMDL evaluations developed by state agencies and organized by subwatershed and relative priority. Note: all TMDL references are listed in the Reference section of this watershed plan.

Neosho River Watershed TMDLs

Low DO (Sediment causing low DO), Eutrophication (nutrients)
Source: agricultural fields, stream banks, grasslands, permitted sites (CAFO, WWTP)
Cause: erosion, (at high flows CAFO, WWTP not problem), animal stream access, lack riparian buffer.
Priority: HIGH – 10 segments, MEDIUM – 9 segments, LOW – 2 segments
Solution: 1. Implement soil sampling to recommend appropriate fertilizer applications on cropland. 2. Maintain conservation tillage and contour farming to minimize cropland erosion. 3. Install grass buffer strips along streams. 4. Reduce activities within riparian areas. 5. Implement nutrient management plans to manage manure application to land. 6. Filter strips on edge of agricultural fields 7. Restore riparian vegetation along target stream segments 8. Renew state and federal permits 9. Install proper manure and livestock waste storage 10. Proper on-site waste system operations in proximity to targeted streams 11. Labeled application rates of chemical fertilizers.

- Allen/Dows Creek → HIGH Priority
- Eagle Creek → HIGH Priority
- French Creek → MED Priority (no recommended actions) – attributed to low flow
- Doyle Creek → HIGH Priority (addressed with NPDES permit)
- Bachelor Creek → MED Priority
- Canville Creek → HIGH Priority
- Cherry Creek → HIGH Priority
- Labette Creek → HIGH Priority
- Marion County Lake → Load Reduction: P (21.4%) N(0%) (no point sources) MED Priority
- Marion Lake → Load Reduction: P (75%) (3 WWTP undetermined) HIGH Priority
- Gridley City Lake → Load Reduction: P (54.4%) N(0%) (no point sources) MED Priority
- Council Grove Lake → Load Reduction: P (94%) N(58%) (WWTP less than 1% contribution – no load reduction) HIGH Priority
- John Redmond Lake → Load Reduction: P (21.2%) N(60%) (WWTP P-22.8%) MED Priority
- Olpe City Lake → Load Reduction: P (48%) N(32%) (no point sources) HIGH Priority
- Turkey Creek → HIGH Priority
- Altamont City Lake → Load Reduction: P (92.4%) N(0%) (no point sources) LOW Priority
- Bartlett City Lake→ Load Reduction: P (50%) N(0%) (no point sources) LOW Priority
- Neosho County SFL→ Load Reduction: P (97.8%) N(64%) (no point sources) MED Priority
- Neosho WMA→ Load Reduction: P (77.8%) N(78%) (no point sources) MED Priority
- Parsons Lake→ Load Reduction: P (81%) N(0%) (no red. for 1 WWTP) MED Priority
- Chanute/SF City Lake → Load Reduction: P (89.3%) N(50%) (no point sources) MED Priority

Silt / Silt and Lead (one segment w/ lead in soil)

Source: Cropland, very minor WWTP contribution **Cause:** Exposed soil
Priority: HIGH – 2 lakes, MEDIUM – 1 lake and 1 stream segment (silt and lead)
Solution: 1. conservation tillage and contour farming, 2. grass buffer strips 3. Reduce riparian activities

Council Grove Lake → Load Reduction: 48% (WWTP 0% reduction) HIGH Priority
John Redmond Lake → Load Reduction: more detailed assessment needed MED Priority
Olpe City Lake → Load Reduction: 54% (no point sources) HIGH Priority

Fecal Coliform Bacteria

Point Sources: WWT lagoon, CAFO sites **NPS:** septic systems, smaller livestock operations
Load Reduction: zero permitted from lagoon/CAFO during low flows.
Priority: HIGH – 5 segments (4 addressed with permits), MEDIUM – 8 segments
Solution: 1. Renew state and federal permits and inspect permitted facilities for permit compliance. 2. Install proper manure and livestock waste storage. 3. Install grass buffer strips along tributaries. 4. Install pasture management practices, including proper stock density on grasslands. 5. Remove winter feeding sites in proximity to streams. 6. Reduce livestock use of riparian areas. 7. Insure proper on-site waste system operations in proximity to main streams.

Allen/Dows Creek: → MED Priority
Neosho River → HIGH Priority
Cottonwood River, South → MED Priority (although no recommended action)
Cottonwood River → MOD Priority (although no recommended action)
Mud River → MOD Priority (although no recommended action)
Doyle Creek → HIGH Priority (addressed with NPDES permit)
Big Creek → MED Priority
Deer Creek → MED Priority
Turkey Creek → MED Priority
Owl Creek → MED Priority
Little Turkey Creek → HIGH Priority (addressed with NPDES permit)
Cottonwood River → HIGH Priority (addressed with NPDES permit)
Labette Creek → HIGH Priority (addressed with NPDES permit)

Biology (poor diversity in streams)

Source: livestock waste, crop fertilization (minor) **Cause:** runoff to streams
Priority: MEDIUM priority – 2 segments
Solution: Follow the action plan for Tallgrass Prairie National Reserve; mussel data collection / reintroduction, Assess land use outside of the Tallgrass Prairie National Preserve.

Fox Creek → MED priority
South Fork Cottonwood River → MED Priority

Silt and Lead

Source: Cropland **Cause:** Exposed soil (lead attached to the soil)
Solution: 1. Maintain conservation tillage and contour farming to minimize cropland erosion. 2. Install grass buffer strips along streams. 3. Reduce activities within riparian areas.

Neosho WMA → Load Reduction: Silt - 61% (no point sources) MED Priority
Lead – no load reduction specified (assumed tied to silt problem) – MED Priority

Eutrophication II (Phosphorus and Nitrogen)
Source: Urban lawns **Cause:** Overfertilization
Recommended solutions: Various urban best management practices (not specified)
Jones Park Pond → Load Reduction: P (30%) LOW Priority

Copper
Source: Copper sulfate used for treatment and nutrition of livestock, treatment of orchard diseases, and removal of nuisance aquatic vegetation such as fungi and algae (minor amounts possible naturally in soil or from urban/road areas (1% of watershed)).
Cause: soil erosion
Solution: filter strips, grasses waterways, education on $CuSO_4$ use, investigate Stormwater sources
Allen Creek → Load Reduction: 87% LOW Priority
Eagle Creek → Load Reduction: 93% LOW Priority
Neosho River (Parkerville) → Load Reduction: 72% LOW Priority
North Cottonwood River → Load Reduction: 31.5% LOW Priority
Big Creek → Load Reduction: 86% LOW Priority
Owl Creek → Load Reduction: 86-91% LOW Priority
Neosho River → Load Reduction: 76% LOW Priority
Flat Rock Creek → Load reduction: 82% LOW Priority

Mercury
Source: battery recycling plant, coal burning power plants (outside watershed), trace amount from soils
Cause: discharges from plant, atmospheric deposition
Solution: Monitor anthropogenic contributions of mercury loading.
South Cottonwood River → load reduction: 79.1% LOW Priority

DO
Source: Cattails
Cause: Dense canopy causing high oxygen demand (in a wetland with small input)
Solution: Minimize any additional anthropogenic BOD sources
Minded Land WA Unit #42→ Load Reduction: P (0%) (no point sources) LOW Priority

Chlordane
Source: Found in fish tissue → bioaccumulation of banned chemical **Cause:** sediment erosion?
Solution: banned product TMDL = 0 → uphold fish advisory
Cottonwood River → LOW Priority

pH (few violations)
Source: Neosho - Undetermined **Cause:** Neosho - Undetermined
Solution: None, unless monitoring shows continued problems (Neosho)
Neosho River → LOW priority
Chanute/SF City Lake (nutrient enrichment cause) → MED Priority (address nutrients in separate TMDL)

Sulfate
Source: Pyrite in bedrock and tailings **Cause:** Mining exposed bedrock and tailings to water
Solution: Minimize anthropogenic oriented contributions of loading of sulfate.
Mined Land Lakes (9) and wetland (1) → LOW Priority No specified load reductions, concentrations not to exceed 900 mg/L.

Sulfate
Source: Natural Bedrock (gypsum) **Cause:** Dissolving bedrock
Solution: 1. Monitor any anthropogenic contributions of sulfate loading
2. Establish alternative background criterion. 3. Assess likelihood of river being used for domestic uses.
Cottonwood River → LOW Priority

NH3
Doyle Creek → HIGH Priority (addressed with NPDES permit)
Owl Creek → HIGH Priority (addressed with NPDES permit)
Little Turkey Creek → HIGH Priority (addressed with NPDES permit)
Labette Creek → HIGH Priority (addressed with NPDES permit)

Water bodies listed as impaired (KS) w/o TMDLs developed:
Zinc – 5 in Neosho Headwaters, 7 in Upper Cottonwood, 33 in Upper Neosho, 8 Middle Neosho
Atrazine – 7 in Middle Neosho

Spring River Watershed TMDLs

Zn, Pb, Cu, Cd, Biology, (KS)
Source: Mining tailings on land and in stream substrate **Cause:** Erosion of mine waste
Solution: Reduce metal loads on tributaries, remove contaminated sediments from streambeds
Priority: HIGH – throughout Spring R. system (Load reductions: up to 99.3% needed, esp. high flow)

Zinc (Missouri)
Source: Tri-State Mining waste, point source (some?) **Cause:** Acid mine seepage, soil erosion
Solution: 1) Reevaluate permits / require Zn monitoring 2) abandoned mine cleanup
Priority: MEDIUM – 2 segments (Load Reduction: ~50% in Turkey Cr. & ~10% in Center Cr.)

DO: Sediment causing low DO, (KS)
Source: agricultural fields, stream banks, permitted sites (CAFO, WWTP), septic systems, livestock
Cause: erosion (high flow discharge at CAFO, WWTP not considered problematic).
Solution: Renew permits, Cropland and Livestock BMPs, proper septic systems near streams.
Priority: HIGH – 1 segment (Shawnee Creek)

Nutrients, (Missouri)
Source: Agricultural fields **Cause:** Soil erosion
Solution: Reactivate Source Water Protection Plan; Sediment & animal waste reduction practices
Priority: MEDIUM – Lamar Lake (Load Reduction: Phosphorus 65%)

Bacteria (Missouri)
Source: from DNA testing: cattle, human waste, poultry waste during high flow (runoff events), other domestic animal operations (horse, dog (66 puppy farms), and pig).
Cause: 1) cattle stream access, 2) poultry (etc.) litter erosion (Spring season) 3) failed septic systems.
Solution: 1) Remove cattle from streams, 2) Poultry litter education and possible transport, 3) 319 project, 4) Replace/maintain septic systems.
Shoal Cr → MED Priority (Load reductions: 85% high flows, 53% mod. Flows, 72% low flows)
Goal: remove 50-100% cattle from streams, stop all septic leaks, reduce runoff 66%
TMDL suggest 100% cattle removal a low probability.

Eutrophication/pH (nutrients), (KS)
Source: Urban lawns/gardens **Cause:** overfertilization
Solution: Urban management practices (not specified)
Pittsburg College Lake → Load Reduction: P (55.8%) N(0%) (no point sources) LOW Priority
Plater's Lake→ Load Reduction: P (26.5%) N(0%) (no point sources) LOW Priority

Fecal Coliform Bacteria, (KS)
Cow Creek → HIGH Priority (addressed with NPDES permit)

Chlordane
Source: Found in fish tissue → bioaccumulated from past use of banned chemical
Cause: sediment erosion?
Solution: banned product TMDL = 0 → uphold fish advisory
Cow Creek → LOW Priority

Sulfate
Source: Pyrite in bedrock and mining tailings.
Cause: Pyrite exposed to oxidation due to mining operations
Solution: 1. Monitor any anthropogenic contributions of sulfate loading to river. 2. Minimize irrigation return flows 3. Reclaim strip mining areas
Cow Creek → LOW Priority

Ammonia, Biological Oxygen Demand, Suspended Solids
Source: Wastewaters Treatment Plant
Cause: Mechanical problems, high BOD flows from food processing plants
Solution: Upgrade plant. COMPLETED IN LATE 90's.
Clear Creek → HIGH Priority (although apparently solved)

Sediment

Source: Agricultural fields **Cause:** Erosion during storms

Solution: None provided. Conducting further assessment, including biological assessment of streams to determine true impact. The analysis showed biological impact as well.

N. Fork Spring River → LOW Priority (Load reduction up to 94%, depending on flow)

Water bodies listed as impaired w/o developed TMDLs:

Turbidity (1); Zinc (1); Cadmium (1)

Lake O' the Cherokees Watershed TMDLs

Bacteria (OK)

Sources: livestock (by far largest), land application, agricultural activities, septic systems, domestic animals, wildlife, (no problems from WWTPs or point sources in OK except for minor contributor in Tar Creek Watershed (no CAFOs in OK study area)).

Causes: not specific (presumed cattle access to stream, soil erosion, poorly functioning septics)

Solution: none given (separate process) → however, livestock and cropland BMPs

Priority: not specified (presumed high) - 12 segments

Load reductions: variable (up to 99.7% - see table below)

WATERBODY	FC INS	EC INS	EC GEO	ENT INS	ENT GEO
Drowning Creek	28%			56%	47%
Horse Creek	86%				
Fly Creek	49%			84%	77%
Little Horse Creek	49%	59%	53%		
Cave Springs Branch	47%	59%	53%		
Honey Creek	28%			99%	90%
Sycamore Creek				3%	26%
Tar Creek				84%	80%
Cow Creek	60%				
Fourmile Creek	55%				
Russell Creek	49%				
Elk River				78%	52%

FC – Fecal coliform; EC – E. coli; ENT – Enterococci; INS – instantaneous; GEO – geometric mean

Zn, Pb, Cd (KS)

Sources: Mine waste and wastewater lagoon **Causes:** Mine waste runoff and lagoon discharges

Solution: 1. Create/restore riparian vegetation 2. Grass buffer strips 3. Mined land reclamation. 4. Load allocations for permitted wastewater lagoon.

Priority: MEDIUM – 1 segment (Tar Creek (KS))

Water bodies listed as impaired (OK) w/o developed TMDLs:

Organic enrichment/Low DO (8); Ammonia (1); Chlorides (2); TDS (1); Sulfates (2); Turbidity (3); pH (1)

Elk River Watershed TMDLs

Nutrients (Nitrogen and Phosphorus)
Sources: Point sources (WWTP, poultry processing), septic systems, fertilizer and litter application, grazing animals, wildlife, urban areas
Causes: no nutrient limits for point sources in past, failing septic systems, overapplication of fertilizer, animal access to streams, pasture erosion, unsustainable numbers of livestock.
Solution: 1) Phosphorus limits for larger, expanding, and new point source dischargers, 2) Voluntary agricultural BMPs, 3) Management plans to deal with NPS pollution.
Priority: MEDIUM – 11 stream segments (Load reductions variable with flow (60% problem point sources))

Bacteria (one segment listed in OK, see Lake O' the Cherokees Watershed above)

APPENDIX C: DIRECTORY OF CITIZEN-BASED WATERSHED GROUPS IN GRAND LAKE WATERSHED

Grand Lake O' the Cherokees Watershed

Grand Lake O' the Cherokees Watershed Alliance Foundation Inc.
PO Box 451185, Grove, OK 74345-1185

Neosho River Subwatershed

1. Twin Lakes WRAPS
   Flint Hills RC&D, (620) 767-5111
2. Marion Reservoir WRAPS
   Marion County Conservation District (620) 364-3149
3. Upper Neosho River WRAPS
   Kansas State University (785) 532-2911 & (785) 532-7832
4. Middle Neosho River WRAPS
   Kansas State University (785) 532-2911 & (785) 532-7832
5. Neosho Headwaters WRAPS
   Kansas State University (785) 532-2911 & (785) 532-7832
6. Eagle Creek WRAPS
   Coffey County Conservation District, (620) 364-3149

Spring River Subwatershed

1. Kansas Spring River WRAPS
   See-Kan RC&D, (620) 431-6180
2. Upper Shoal Creek: Shoal Creek Watershed Improvement Group
   Rt 2 Box 230-A, Purdy, MO 65734
3. Lower Shoal Creek: Environmental Task Force of Jasper & Newton Counties
   1 S. Main, Suite 102, Webb City, Missouri 64870

Elk River Subwatershed

Elk River Watershed Improvement Association
P. O. Box 6, Pineville, MO 64856

Lake O' the Cherokees Subwatershed

Grand Lake Water Watch, Inc.
9630 U.S. Highway 59 N, Grove, OK 74344

APPENDIX D: GEOGRAPHIC EXTENT OF KANSAS WRAPS GROUPS IN GRAND LAKE WATERSHED BY HYDROLOGIC UNIT CODE

Hydrologic Unit Codes (HUC) are labels for watershed subdivisions as part of a classification system for the United States. Essentially, the fewer digits in the code, the larger the watershed. One HUC 8 (8 digits) can be divided into several HUC 10s (10 digits) which can be divided into several HUC 12s (12 digits), and so on. For more information on HUCs, visit http://water.usgs.gov/GIS/huc.html.

The Kansas WRAPS groups are organized by HUC areas as shown below:

Spring River WRAPS:
  1 HUC (8) 11070207

Middle Neosho WRAPS:
  1 HUC (8) 11070205

Upper Neosho WRAPS:
  1 HUC (8) 11070204

Neosho Headwaters WRAPS:
  1 HUC (8) 11070201

Eagle Creek WRAPS:
  3 HUC (12) 1107020104 -04, 1107020104-03, 1107020104-05

Twin Lakes WRAPS:
  1 HUC (10) 1107020101

Marion Lake WRAPS:
  1 HUC (10) 1107020201

APPENDIX C: PRE-IMPLEMENTATION PLAN FOR THE HONEY CREEK SUBWATERSHED OF GRAND LAKE

FY 2006 319(h) Project 9, Output 9.3.1
EPA Grant #C9-996100-13
Honey Creek Watershed Implementation Project

Developed by:

Oklahoma Conservation Commission

In Cooperation with:

Delaware County Conservation District
Natural Resource Conservation Service
Honey Creek Watershed Advisory Group

Oklahoma Conservation Commission

***Guidelines
For The
Honey Creek Watershed
319 Non Point Cost-Share Project***

Program Years 1-4 and Approved Practices

I. General

The Oklahoma Conservation Commission hereby declares that the following problems are having a detrimental affect on the state's water resources in the Honey Creek watershed. The Honey Creek watershed is on the Oklahoma 2002 Integrated Report Category V list, The 2002 OWRB BUMP report stated that Grand Lake is impaired by turbidity and that TSI for chlorophyll-a indicates that the lake is hypereutrophic. Parts of the Lake fail the dissolved oxygen criterion.

Oklahoma's water resources are an important foundation of the state's economic infrastructure. Natural climatic events as well as human activity are impacting the state's water resources. As long as farmers and ranchers produce food from the land to feed the world and rain falls, we will continue to see impacts on the state's water. Our task as stewards of the natural resources is to minimize these impacts. Protecting these vital natural resources is paramount in preserving the state's economic future. In order to accomplish this goal, the Commission hereby establishes the following goals and objectives to address these problems affecting our renewable natural resources.

Make cost-share funds available to conservation districts so they can implement cost-share practices, which will protect our natural resource of water.

The Conservation Commission herein establishes the complete list and description of the Conservation Cost-Share Program policies and conservation practices recommended by the Honey Creek Advisory Group (WAG). These policies and practices were approved by the Delaware County Conservation District for use during this four (4) year program (see section II for the approved list of conservation practices). Cost-share rates (unit cost) will be based on the Oklahoma Natural Resources Conservation Service (NRCS) state average unit cost. These unit costs will be updated annually. When a project agreement (contract) has been developed with an applicant, unit cost to be used will be the unit cost in effect at the time the practice is completed. Any variances in the best management practices must be recommended by the Watershed Advisory Group, approved by the conservation district and the Oklahoma Conservation Commission Water Quality Director. These variances must be approved prior to performance agreements being signed.

Allocation of Funds:

To date, the Legislature has appropriated $125,000.00 of the Priority Watershed Conservation Cost-Share Funds for the purpose of matching federal 319 funds. Additional funds ($305,687.46) should be allocated in State FY 2008 and subsequent years.

The Conservation Commission Water Quality Staff, with the concurrence of the Environmental Protection Agency, has designated the following means to be used for targeting methodology: (1) utilization of remotely-sensed and electronically mapped data; (2) on site assessments with the aid of aerial photographs, soil surveys, and the use of a priority ranking system similar to the one used by NRCS for the EQIP program. A concerted effort will be made to identify the areas that are contributing the larger amounts of sediment and nutrients that can be remediated for the lowest amount of money such that the remediation cost per unit mass of pollutant is minimized.

State Funds	Budgeted	$430,687.46
State Funds	FY2007 Appropriated	$125,000.00
State Funds	Still needed in order to utilize all 319(h) funds.	$305,687.46
Federal Funds	Budgeted	$463,592.00
Landowner Contribution	Budgeted	$223,569.87
Total Project Implementation		$1,117,849.33

All agriculture producers and individual rural residents in the Honey Creek Watershed in Delaware County are eligible to receive cost-share assistance regardless of size of land ownership. There will be no minimum cost-share payment to any applicant. The Honey Creek Watershed Advisory Group has installed a cap for the maximum cost-share assistance to any one participant. The cap has been set at $25,000.00 for the first sign up period. If this is deemed too small to meet the water quality needs for the watershed, the Conservation District Board will review this matter and approve any variances.

Funds for the Project:

The funds for the project will become available at various times during the life of the program. The project has $312,500.00 available at the time of the first sign up period. This includes $125,000 of state money and $187,500.00 of federal money. The state money is from FY 2007. Landowner contributions are not included in this total.

The distribution of funds will be re-evaluated as more funds become available. In the event that adjustments are needed, the OCC Water Quality Staff Representative will make the needed adjustments with approval of the Delaware County Conservation District Board.

Policies:

The Watershed Advisory Group (WAG) has recommended the Best Management Practices (BMP) that will be offered to residents in the Honey Creek Watershed. The BMPs have been approved by the Delaware Conservation District Board and the Oklahoma Conservation Commission.

Cost-Share practices shall be implemented according to the standards and specifications of the Natural Resources Conservation Service. The Human Waste Portion of Priority number six will be implemented using the Department of Environmental Quality standards and specifications.

Conservation Commissioners, Conservation Commission Staff, Conservation District Employees, or the spouses of any of these individuals shall not be eligible to participate in the Conservation 319 Cost-Share Program.

Conservation district directors and members of the Watershed Advisory Group are eligible and encouraged to participate in the Honey Creek Watershed Cost-Share Program. If district directors choose to participate, the following OCC policy will apply: In order to provide for an impartial legal majority - no more than two district directors from the Delaware County Conservation District shall participate in the cost share program for the Honey Creek Priority Watershed and 319 Non-Point Source Pollution Program. In addition, the directors who desire to apply for the cost share program shall refrain from discussing or voting on any items or issues pertaining to the cost share program. This includes: rates, practices, maximum payment, and applicants for the program.

The Oklahoma Conservation Commission Water Quality Staff, with the concurrence of the Honey Creek Watershed Advisory Group and approved by the aforementioned conservation district and Oklahoma Conservation Commission, have developed standard forms for the following: (1) CC/HC Project Cost-Share Assistance Pre-Application Form; (2) CC/HC Project Priority Ranking System; (3**) CC/FCR Cost-Share Evaluation Form.**

Sign Up:

A three week sign up period will be established, with concurrence of the participating conservation district and the Watershed Advisory Group, for taking applications for cost-share assistance. Applications will be taken at the district office using the CC/FCR Cost-Share Application Form and at a public meeting to be held as soon as possible after receipt of the targeting report and maps. After the perspective cooperator signs up, the conservation planners will contact each applicant and: (1) determine eligibility; (2) set priority ranking (using the priority ranking form); (3) develop a conservation plan to determine needs; (4) with applicants concurrence, a project agreement will be developed in accordance with the Oklahoma Conservation Commission Cost-Share Program(refer to OCC State Guidelines for Program Year 8); (5) the completed conservation plan and project agreement will be presented for approval to the Delaware County Conservation District ; (6) the final approval will be authorized by the designated OCC representative. The Watershed Advisory Group will be updated on plans and agreements at scheduled meetings. **NOTE: Absolutely no work will begin on any project until the OCC staff representative has approved the plan and project agreement as so indicated by his/her signature on the agreement form.**

As funds become available after the initial sign up period and planning has been completed, additional sign up periods can be conducted as determined by the conservation district and the OCC staff representative. At regular intervals a review/audit of the program will be made by the OCC water quality representative. This will be used to determine compliance with the program objectives and if modifications are necessary.

Eligibility Criteria:

The following criteria must be satisfied for an applicant to participate in the Honey Creek Priority Watershed Cost-Share Program: (1) must own or operate land in the Honey Creek Watershed in Delaware County; (2) must have a need for one of the Priority Best Management Practices; (3) if it is determined that the applicant requires a priority practice, he/she must be willing –with cost-share assistance –to install the needed BMPs; (4) the applicant will be required to maintain the BMP for the life of the practice as specified by NRCS.

Contract Compliance:

The cooperator will be required to sign a project agreement with the Delaware County Conservation District and follow a specified schedule of operations. The schedule of operations form details a year by year plan of the Best Management Practices (BMPs) to be installed and a time frame within which to install them. The project coordinator will conduct annual status reviews on the anniversary of the signing of the Performance Agreement. If a cooperator is found to be out of compliance with the schedule of operations due to circumstances beyond their control, a revision schedule can be discussed and completed. These revisions will not require conservation district board approval. In the event a cooperator is not in compliance due to lack of interest the district board has the discretion to terminate the contract. The idle funds can then be utilized by another cooperator. The importance of the cooperators keeping on schedule must be stressed by the planner. The four year lifespan of the project dictates the need for schedule compliance. All funds for BMP installation must be expended by September 30, 2010.

II. List of Recommended Conservation Practices and Cost-Share Rates

The Honey Creek Watershed Advisory Group convened on September 26, 2006 and approved the following list of Priority and Best Management Practices for recommendation to the Commission Members. The list was approved by the Delaware County Conservation District at their regularly scheduled board meeting on October 12, 2006. The Oklahoma Conservation Commission will review and possibly approve the list at their regularly scheduled Commission meeting on December 4, 2006.

Practices			Cost-Share Rate
Priority #1	Riparian Areas-Management and Establishment		
	Components:	(1) Incentive Payments	100%
		(2) Off-site watering	80%
Priority #2	Buffer Strip Establishment and Streambank Protection		
	Components:	(1) Incentive Payments	100%
		(2) Fencing	80%
		(3) Vegetative Planting	80%
		(4) Critical Area Improvements	80%
		(5) Special BMPs, as Determined by OCC Representatives	
Priority #3	Animal Waste		
	Components:	(1) Composter	75%
		(2) Composter with dry Waste storage	75%
		(3) Cake out storage	75%
		(4) Full clean out storage	75%
		(5) Waste storage/animal Feeding structure	60%
Priority #4	Pasture Establishment/ Management		
	Components	(1) Vegetative Establishment	80%
		(2) Cross Fencing	80%
		(3) Watering Facilities	80%

Priority #5	Proper Waste Utilization (Poultry Waste Producers) Incentive Payments for Proper Utilization		
	Components:	(1) Poultry waste used On producer's farm	6¢/lb P
		(2) Poultry waste off farm but In the Honey Creek Watershed	8¢/lb P
		(3)Poultry waste moved out of the Honey Creek Watershed into a non-Phosphorus threatened or NLW watershed (cannot be moved into Eucha/Spavinaw, Grand Lake, Wister or Illinois Watersheds)	15¢/lb P
Priority #6	Heavy Use Areas		
	Components:	(1) Concrete Pads	75%
		(2) Gravel	75%
		(3) Geotextile fabric	75%
		(4) Grading and shaping	75%
		(5) Terracells	75%
Priority #7	Rural Waste Septic Systems (Human Waste)		80%
	Components	(1) Septic Systems With Tank; pump out (when Needed); installation; Percolation test; lateral lines	
		(2) Soil Profiling	90%

III. Conservation Cost-Share Practice Standards Specifications:

See Natural Resources Conservation Service Standards and Specifications in Section IV of the Field Office Tech Guide.

For the septic systems, see Title 252, Department of Environmental Quality, Chapter 641-Individual and Small Public On-Site Sewage Treatment Systems.

IV. Approved Best Management Practices

To include conservation practices, components, units, cost-share rate and costs. (Attached)

Honey Creek Cost-Share Program
Best Management Practices

Priority Practices

1. Riparian Areas-Management/Establishment

Definition
Riparian areas are the lands adjacent to water bodies-from creeks and rivers to lakes, ponds, and wetlands. Riparian areas consist of trees, trees and shrubs, or trees, shrubs and non-woody vegetation. Buffer zones are strips or small areas of land in permanent vegetation adjacent to water sources or field edges.

Purpose
Reduce excess amounts of sediment, organic material, nutrients, pesticides and pathogens in surface runoff and shallow water flow.

Establishment
The riparian areas and buffer zones will be planned and designed according to NRCS specifications. The conservation water quality planner representing the local districts will complete the plan.

Management
The conservation planner will make recommendations to the applicant on management according to NRCS specifications.
As a part of the management, exclusion incentives will be offered as follows: Total Exclusion-$50.00/acre/yr. for 4 years*
** Hay Production-$45.00/acre/yr. for 4 years*
***Limited Grazing-$40.00/acre/yr for 4 years *
*These exclusion incentives are 100%.
**Hay can only be accomplished in Zone 3 of the riparian area as determined by the conservation planner.
***The grazing periods will be determined by the conservation planner using NRCS standards.
These exclusion incentives will be limited to no more than an average of 150' on each side of the stream bank. To qualify for these incentive payments, one or more practices to improve water quality must be completed and certified by the project coordinator.

Best Management Practices
Off-site watering facilities, riparian fencing, pasture establishment, forest buffer establishment, critical area improvements.

2. Composters, Cake out and Cleanout Storage Buildings and Waste Storage/Animal Feeding Facilities

Definition

Construction of composters, cake out and cleanout storage buildings to store dead poultry (and aid in the decomposition process) and litter until it can be spread onto fields as designated in a waste management plan. Also, construction of animal waste/animal feeding facilities for winter feeding, especially cattle, and storage of waste until weather and soil conditions are acceptable for spreading of the waste.

Purpose

To address the proper disposal of dead animals (poultry) and proper storage of animal waste, as well as to enable winter feeding of animals in a manner that will reduce the potential for erosion and manure associated with the soil around the feeding area.

Establishment

The composter, cake out and cleanout structures will be constructed pursuant to NRCS specifications. The waste storage/animal feeding facility will be constructed pursuant to the specifications used in the Beaty Creek and Spavinaw Creek 319 water quality projects.

3. Pastureland Management

Definition

The proper care and maintenance of pastureland.

Purpose

This priority is aimed at pastures that have been overgrazed or degraded. These pastures need aid in the regeneration of a proper stand and the means to maintain them.

Best Management Practices

Pasture establishment, cross fencing, nutrient management, pest management, water well, pipeline, watering facilities, and heavy use area protection are needed on these pastures.

4. Proper Waste Utilization

Purpose
To insure proper application of animal waste and not to exceed the phosphorus level as established by NRCS and the application plan developed by a nutrient management specialist.

Best Management Practices
An animal waste management plan will be required, along with soil and litter analyses.

5. Human Waste

Purpose
To insure that rural residents have adequate means of disposing of human waste.

Components-Human Waste
Excavation, septic tanks, lateral lines, percolation tests or soil profiling components may be necessary for the safe disposal of human waste.

Qualifications Criteria for Septic Systems
Cost-Share assistance for septic systems will be allowed only for non-commercial single family dwellings that are used for permanent and primary residence. The dwelling must be within 1,000 feet of drainage into a tributary of Honey Creek.
The cost-share funds can not be spent on new homes or new mobile homes. Recreational trailers are not eligible for cost-share assistance.

Honey Creek Cost-Share Program
Best Management Practices

Component Parts List

1. Use Exclusion-472

Definition
The management practice of excluding animals, people, or vehicles from an area.

Purposes
This practice aids in prevention of access to an area to maintain or improve the quality or quantity of natural resources.

Components
The practice requires fences or other natural barriers along with an alternate watering source or limited access watering site.

2. Pond-378

Definition
A water impoundment made by constructing a dam or an embankment or by excavating a pit or dugout.

Purposes
Ponds are used to provide water for livestock, fish, wildlife, recreation, fire control, crop and orchard spraying, and other related uses to maintain or improve water quality.

Components
Excavation or embankment, barrel and/or riser, blanket material, trash guard, and clay liners are needed for a pond.

3. Pipeline-516

Definition
The pipeline is a means of conveying water in a closed conduit to an alternate site. The pipeline must have an inside diameter of 8” or less.

Purposes
Pipelines are used to convey water from a source of supply to points of use for livestock, wildlife, or recreation.

Components
The practice requires pipe (steel or plastic) that meets the NRCS requirements, a trencher, and a water supply.

4. Water Well-642

Definition
A hole that is drilled, dug, driven, bored, or otherwise constructed to an aquifer.

Purposes
The wells provide water for livestock, wildlife, and humans to facilitate proper use of vegetation on pastures.

Components
Water wells require excavation, drilling, casing, and wellhead protection.

5. Trough or Tank-614

Definition
A tank or trough (with needed devices for water control and waste) installed to provide drinking water for livestock.

Purposes
A tank is installed to provide watering facilities for livestock that will protect vegetative cover and eliminate the need for livestock to be in streams.

Components
These watering facilities need concrete, water tank, freeze proof hydrants or other water sources and are used in conjunction with heavy use areas (561).

6. Solar Pump/Windmill-533

Definition
A pumping facility installed to transfer water for a conservation need.

Purpose
Provide a dependable water source for water management for livestock.

Components
These pumping facilities require a storage tank capable of storing water for three days per animal unit. Quotes for electrical hook-ups and the pumping facility must be obtained prior to installation and the lesser amount will be utilized.

7. Fence-382

Definition
A constructed barrier to exclude livestock, wildlife, or people or to provide for rotational grazing of livestock.

Purposes
Fencing is used as part of a conservation management system to aid in treatment of water and other resource concerns.

Components
The proper height, size, spacing, and type of posts should be used to provide the needed protection for the task. Labor, posts, wire, and other equipment are needed to construct this practice.

8. Pasture and Hay Planting-512

Definition
The establishment of native or introduced forage species.

Purposes
This practice may be used as part of a conservation management system to accomplish one or more of the following: reduce soil erosion by wind and water, provide complimentary forage to improve or maintain livestock nutrition or health, and or provide emergency forage production.

Components
The practice needs one or more of the following parts: grass sprigging and/or planting, seed bed preparation, nutrient management, and/or seeding of other grass species.

9. Field Border-386

Definition
A strip of permanent vegetation established at the edge or around the perimeter of a field.

Purposes
A field border assists in reducing erosion from wind and water. They also provide turn and travel areas for equipment at the edge of fields.

Components
Seed bed preparations, nutrient management, pest management, and grass planting are needed for this practice.

10. Riparian Forest Buffer-391

Definition
An area of predominantly trees and/or shrubs located adjacent to and up-gradient from watercourses or water bodies.

Purposes
These buffers reduce sediment and nutrient loading in watercourses. They also create shade to lower water temperatures to improve the habitat for aquatic organisms.

Components
Seed bed preparation, grass planting, tree and shrub planting, nutrient management, and pest management are necessary for establishment.

11, Stream bank and Shoreline Protection

Definition
The structural and managerial treatment used to protect banks of streams, constructed channels, and lakes.

Purposes
The practice is used in preventing the loss of land and improving water quality by reducing erosion and run off.

Components
The practice calls for vegetative planting (grasses, trees, and or shrubs), and/or structural practices.

12. Filter Strip-393

Definition
A strip of vegetation established between cropland, grazing land, or disturbed areas and the streams and water sources.

Purposes
Filter strips reduce sediment, nutrients, and other pollutants from reaching our water sources.

Components
Seed bed preparation, nutrient management, pest management, grass and shrub planting are necessary for filter strips.

13. Tree/Shrub Establishment-612

Definition
The establishment of woody plants by planting seedlings or cuttings, direct seeding, or natural regeneration.

Purposes
The establishment of the woody plants provides for long term erosion control, filter pollutants from run off, provide for wildlife habitat, and improve water quality.

Components
Tree/shrub establishment calls for correct planting dates for seeds or seedlings, exclusion of livestock to allow for growth, and site preparation.

14. Grade Stabilization Structure-410

Definition
A structure used to control the grade and head cutting in natural or artificial channels.

Purposes
The structures are used to stabilize the grade and control erosion in channels to prevent the advance of gullies and enhance the water quality.

Components
Grade stabilization structures require excavation, concrete, drop pipes, vegetative establishment, and or embankment practices.

15. Grassed Waterway-412

Definition
A natural or constructed channel that is shaped or graded to required dimensions and established with suitable vegetation.

Purposes
This practice is applied as part of a conservation management system to support the following: to convey runoff from terraces without causing erosion, reduce gully erosion, and to protect/improve water quality.

Components
Construction/shaping, seed bed preparation, nutrient management, pest management, and grass planting are needed for a waterway.

16. Lined Waterway or Outlet-468

Definition
A waterway or outlet with a erosion resistant lining of concrete, stone, or other permanent material.

Purposes
These provide for safe disposal of runoff from other conservation structures or natural concentrations of flow without damage from erosion.

Components
Construction and/or shaping, concrete, forms, and grass planting are necessary for a lined waterway or outlet.

17. Critical Area Planting-342

Definition
The planting of vegetation, such as trees, shrubs, vines, grasses, or legumes on highly erodible or critically eroding area.

Purposes
This is used to stabilize the soil, reduce damage from sediment and runoff to downstream areas.

Components
Seedbed preparation, nutrient management, mulching, pest management, grass planting, tree and shrub planting, lime are needed for the practice.

18. Composters/Animal Waste Storage Facilities-313

Definition
A waste storage impoundment made by fabricating a structure.

Purposes
To temporarily store wastes such as manure, wastewater and contaminated runoff as a storage function component of an agricultural waste management system.

Components
Construction and/or shaping, concrete, forms, rebar, trusses, sheet metal. NRCS specifications will be followed on all composters, cake-out and cleanout structures. Specifications provided by the Project Coordinator will be followed for animal waste/ animal feeding facilities

19. Proper Waste Utilization-633

Definition
Using agricultural waste such as poultry litter and cattle manure.

Purposes
Protect water and air quality. Provide fertility for crop, forage, fiber production and forest products. Improve or maintain soil structure. Provide a source of energy.

Components
Soil and waste analysis are required prior to removal and application of waste from storage site. An animal waste management plan shall be followed for any application of waste.

20. Heavy Use Area Protection-561

Definition
The stabilization of areas frequently and intensively used by animals. This is accomplished by establishing vegetation, surfacing with suitable materials, and/or installing needed structures.

Purposes
This practice is used as part of a conservation management system to support the following practices: Improve water and air quality, reduce erosion, improve livestock health.

Components
The components needed for this practice include: vegetative establishment, structural practices, and/or installation of materials such as geotextile, geocell, concrete, and/or rock.

21. Septic Systems

Definition
An on-site system designed to treat and dispose of domestic sewage. A typical septic system consists of a tank that receives waste from a residence or business and a drain field or subsurface absorption system consisting of a series of percolation lines for the disposal of the liquid effluent. Solids (sludge) that remain after decomposition by bacteria in the tank must be pumped out periodically.

Purposes
To insure that rural residents have adequate means of disposing of human waste.

Components
The necessities for septic systems are: Septic tank, lateral lines, rock/reed fields, and/or residential sewer lagoons.
The septic systems will be designed according to Department of Environmental Quality (DEQ) bulletin 640-Special Qualification Guidelines for Septic Systems.

22. Nutrient Management-590

Definition
The management of the amount, source, placement, form and timing of the application of nutrients and soil amendments\.

Purposes
Nutrient management minimizes non-point source pollution of surface and ground water by efficiently monitoring vegetative needs. It improves the physical, chemical, and biological condition of soil.

Components
The practice calls for soil sampling, maintaining records, fertilizer and/or lime applications, and management of crop removals.

23. Prescribed Grazing-528a

Definition
The proper treatment and use of pastureland.

Purposes
This practice enhances the prolonged life of desirable species to aid in protection of the soil and production of livestock. This reduction in erosion improves water quality and lowers sediment deposits.

Components
This practice requires establishment of forages, management of grazing practices, nutrient management, and/or cross fencing.

24. Pest Management-595

Definition
The management of agricultural pest infestations to reduce adverse effects on plants, animals, and the environmental resources.

Purposes
The practice develops a management program that is both environmentally acceptable and economically sound.

Components
This practice involves the minimal acceptable elements of cultural, biological, and chemical controls that still maintain a sustainable system.

25. Wildlife Habitat Management

Definition
Provide and manage upland habitats and connectivity within the landscape for wildlife.

Purposes
To treat wildlife habitat concerns identified during the conservation planning process that enables movement, or provides shelter, cover and food in proper amounts, locations and times to sustain wild animals that inhabit uplands during a portion of their life cycle.

Components

Components that may be included, but not required, are fencing, tree/shrub establishment, brush management, riparian forest buffer, prescribed grazing, use exclusion, and forest stand improvement.

Procedures for Implementation
Honey Creek Watershed
Demonstration Cost-Share Program

1. Open Application Period.

2. Keep list of all applications received.

3. Water Quality representatives will determine eligibility, complete farm visits, and prepare a Priority Ranking sheet on each applicant.

4. Develop a case file on each applicant. (Refer to Case File Check List). **Note: If and when the applicant is approved for funding and the conservation plan is developed, all items in the case file should be placed in the cooperator's plan file.**

5. After all evaluations have been completed, the water quality representatives will rank all applicants. These rankings will be based on the priority ranking criteria set in the Honey Creek State Guidelines.

6. Successful applicants will be notified and a Performance Agreement will be signed by applicant, district board, and OCC Water Quality Representative. **Note: Absolutely no work can begin or materials purchased by any applicant until all three signatures have been obtained on the Performance Agreement.**

7. Conservation plans will be developed on all approved applicants using the NRCS Customer Service Toolkit or a comparable program. Three copies of the conservation plan will be made with the landowner receiving one copy and the Water Quality Representative retaining two copies (one copy will be kept at the representative's office with the other going to the Oklahoma Conservation Commission WQ office).

8. Arrangements are then made for the designated NRCS and/or OCC Water Quality Representatives to design the approved conservation practices.

9. Certify work is complete and authorize payment through the Conservation Commission. The notarized cost-share payment claim must be accompanied by a copy of all invoices, Performance Agreement, Consent Form (if applicable), Certification of Completion and Acceptance, Cost-Share Payment Calculation Sheet, the cooperator's Schedule of Operations, and a completed Vendor Form. These will be forwarded to OCC for payment.

10. Upon receipt of payment from OCC, the district will obtain the signature of the participant on the Release of Warrant Form and place in the conservation plan

case file. The disbursement of the funds to the cooperator will be completed to finalize the procedure.

11. Annual Status Reviews will be performed up to two months before and no later than the anniversary of the completion date for the practice.

Case File Checklist

1. Application for allocated funds
2. Copy of Priority Ranking sheet
3. Property map, soils map and soil technical descriptions
4. Farmer-Rancher Conservation Agreement with DCCD
5. Performance Agreement and any amendments
6. Schedule of Operations and any amendments
7. Completed Cultural Resources documentation
8. Vendor form
9. Maintenance Agreement and any amendments
10. Complete copies of all claims and certifications sent to OCC for processing
11. Copies of all vouchers and cost-share payment checks
12. Consent Form, if applicable
13. Release of Warrant Form
14. Any correspondence to and from the participant
15. Any note of relevant conversations with the participant
16. Applicable NRCS standards and specifications
17. Annual Status Reviews

Note: These items can be placed in the conservation plan folder in the district/project office after preparation of the plan.

HONEY CREEK 319 NON-POINT PRIORITY WATERSHED
PRIORITY RANKING SYSTEM 2006

Producer:		Total Acres:	
Legal:	Section ___ Township ___ Range ___	Total Points:	

Water Quality- High Potential Phosphorus Loss on Targeted Riparian Area and Grazing Lands (Maximum Total: 100 pts)		
Poor Condition Pastures as identified on Target Maps (20 pts)		
High Potential Phosphorus Loss areas identified on Target Maps (20 pts)		
Medium Potential Phosphorus Loss areas identified on Target Maps (15 pts)		
Low Potential Phosphorus Loss areas identified on Target Maps (10 pts)		
Land offered will apply a Comprehensive Nutrient Management Plan if applying poultry litter according to an animal waste management plan. (20 pts)		-
Distance from confined livestock facility to USGS Blue Line Stream or other water body. Adjacent (15pts) <1/4 mile (10pts) 1/4-1/2 mile (5pts) >1/2 mile (0pts)		-
General topography between confined livestock facility and USGS Blue line or Water Body. >8% slope (10pts) 3% - 8% slope (5pts) 0% - 3% slope (0pts)		-
319 Project application will develop filter strips for the entire length of land that is adjacent to streams and lakes in offered land units (15pts)		

Plant Condition- Productivity, Health and Vigor (Maximum Total: 20 pts)		
Offer includes implementation of Prescribed Grazing (528A) system that balances forage production with livestock numbers for the period of the contract.		
% of the grazing lands in the operating unit planned for implementation of Prescribed Grazing according to the (528A) standard during the contract period. 100% (10pts) 50%-99% (5pts) <49% (0pts)		-
Practice(s) will facilitate improved grazing distribution. (382, 614, 642, 378)(5pts)		-
Grazing system rotates through 3 or more pastures per grazing season. 3-5 (1pts); 6/7 (3pts); 8 or more (5pts)		-

Rural Waste On-site Disposal Systems - Rural Septic System Concerns (Total: 100 pts)		
Offer includes replacement of existing septic system by installation of 1,000 gallon tank, lateral lines, percolation test, and DEQ permit (100pts)		-
Total Evaluation Points:		

This form will be used to determine priorities for planning and fund distribution. The applicants with the highest number of points, as determined by the planner, will be the first priority for planning and fund allocation.

Progress Report for Honey Creek Watershed Implementation Project – February 2009 (Task 9.3.1)

Signup of the landowners as part of the Honey Creek Watershed Implementation Project has been completed. Currently, installation of Best Management Practices (BMPs) is ongoing. This report will summarize the BMPs which are expected to be installed and provide a rough estimate of the load reductions expected from these BMPs. Figure 1, below, shows the general location of cooperators who have contracts with the OCC as part of this project. A more detailed map of BMP installation will be provided in the project's final report.

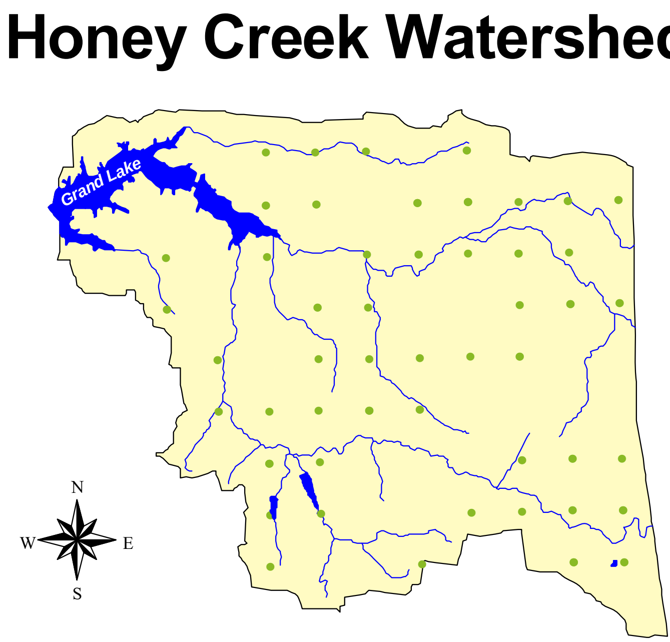

Figure 1. Contracts in the Honey Creek watershed, as indicated by green dots.

As of early 2009, there are 70 total contracts with cooperators, representing BMPs on 15,600 acres. A total of $1,147,017 has been obligated for these contracts, with $447,819.59 having been paid to cooperators for the installation of the following BMPs:

- 170 acres of protected riparian area established;
- 5 ponds, 23 water tanks, and 11 wells installed for alternative water supply;
- 2 cakeout storage facilities;
- 7 feeding / waste storage facilities built;
- 50 acres of grass planting to improve pasture;
- 34,387 feet of cross-fencing to improve pasture;
- 31,363 lbs of poultry litter transported out of the watershed;
- 10 concrete pads and 19 gravel areas for heavy use protection;
- 4 septic systems installed.

Other practices are under contract, but have not yet been completed.

Based on the practices completed, **expected load reductions** were calculated using the STEPL and PreDICT models:

- **total phosphorus load** reduced by 4,995 lbs
- **sediment load** reduction of approximately 111 tons
- **nitrogen load** reduction of about 14,689 lbs

The goal for load reduction in the Honey Creek watershed is 16,592 lbs of phosphorus per year. The expected load reduction based on practices installed **so far** indicates attainment of 30% of this goal. Continued implementation should allow full attainment of the load reduction goal, and actual load reductions will be calculated in the coming years based on monitoring data.