WATERSHED BASED PLAN

FOR THE

ELK CITY LAKE

WATERSHED

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PREFACE

The Elk City Lake watershed is located in the west-central part of the state in Beckham County. The lake is designated as a Primary Body Contact Recreation (PBCR) waterbody in the Oklahoma Water Quality Standards (OWQS) and experiences heavy recreational use, particularly swimming, during warm weekend and holiday periods. In addition, the lake has use designations for Aesthetics, Agriculture, Fish and Wildlife Propagation--Warm Water Aquatic Community (FWP--WWAC), Industrial and Municipal Process and Cooling Water (I&M), and Fish Consumption. The lake is also designated as a nutrient limited watershed (NLW), which denotes watersheds with waterbodies that are adversely impacted by excess nutrients. In the 2004 Beneficial Use Monitoring Program (BUMP) report, Lake Elk City was classified as eutrophic, indicative of high primary productivity and nutrients (OWRB 2004). According to the State's 2006 Integrated Report (pending), the PBCR and FWP designated uses of Elk City Lake are not being supported. Impairments on the pending 303 (d) list include dissolved oxygen, turbidity, and *Enterococcus*.

In late 2006, the City of Elk City, which owns and operates the lake, approached the Oklahoma Conservation Commission Water Quality Division (OCC) about implementing a watershed project to address the sources of the lake's impairments, particularly the pathogen problems. Landuse in the watershed is primarily range, pasture, and cropland with little to no riparian buffer along much of the stream courses and direct access by livestock. Because there are not municipal discharges or feedlot operations in the watershed, it is most probable that the potential sources of bacteria contributing to the lake's impairment are resulting from these landuses.

This plan refers to the initiation of best management practices (BMPs) in the Elk City Lake watershed which are necessary to restore beneficial use support to Elk City Lake. The primary practices envisioned for control of bacteria entering the lake will focus on establishing and protecting riparian areas and providing incentives to livestock producers to move cattle away from streams through such practices as offsite watering, exclusionary fencing and others. A goal of 1,521 acres of riparian buffer will be established and protected, with a large portion of the necessary funding coming from the Conservation Reserve Enhancement Program (CREP). Establishment and promotion of riparian buffers and related BMPs will not only work to significantly reduce delivery of bacteria to the lake, but also sediment and nutrients which are causing the turbidity, eutrophication, and low dissolved oxygen problems.

INTRODUCTION

The Oklahoma Conservation Commission Water Quality Division is the state's technical lead on nonpoint source pollution (NPS) issues, which affect many watersheds in the state. As such, OCC, in a collaborative effort with the state's nonpoint source working group, has prioritized watersheds across the state according to the severity of water quality impairment(s) and the potential for successfully rectifying the problem(s). Although the Elk City Lake watershed is not one of the 150 "Category I" watersheds in Oklahoma, proactive interest from the Elk City community to address water quality impairments indicates fervency of commitment from the principal stakeholder, setting a precedent for local project leadership and participation crucial for effective implementation of a watershed program. Considering this, as well as the manageable size of the watershed, significant water quality improvements are highly probable and thus motivate initiation of this project.

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 guidance defines the 9 key components to be addressed in a watershed-based plan, much of which builds from the strategies outlined in the *Watershed Restoration Action Strategy* (WRAS). These components include: 1) identification of causes and sources 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 NPS 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 loading 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.

The following Elk City Lake WBP has been developed as a dynamic document that will be revised to incorporate the latest information, address new strategies, and define new partnerships between watershed shareholders. In particular, this WBP will be a collaborative effort with the local community of Elk City (principal stakeholder) and will continue to evolve as the partnership develops. It is anticipated that at least biannual revisions may be necessary and that the responsibility for such revisions will rest with the Oklahoma Conservation Commission (OCC), with support from the Office of the Secretary of the Environment (OSE). It is understood that the water quality goals set forth in this WBP, as well as the technical approach to address the goals, may not be comprehensive, so they most certainly will expanded in the future. Federal and state funding allocations for future water quality projects designed to address the Elk City

Lake Watershed problems should not be based solely upon their inclusion in this WBP; rather, the WBP should be considered a focal point for initial planning and strategy development.

CAUSES AND SOURCES

Watershed Characterization

The Elk City Lake watershed is located in Beckham County in far west-central Oklahoma (Figure 1). The watershed drains approximately 15,500 acres (24 sq. mi.) and occurs in the Lower North Fork of the Red River basin (HUC8: 11120303). West Elk Creek (OK311500030110) was impounded in 1970 to form the lake (OK311500030120), originally intended as a flood control structure, but now operated by Elk City for body contact recreation. Numerous smaller tributaries are also present in the watershed (Figure 1). Below the lake, West Elk Creek flows into Elk Creek, which eventually joins the North Fork of the Red River.

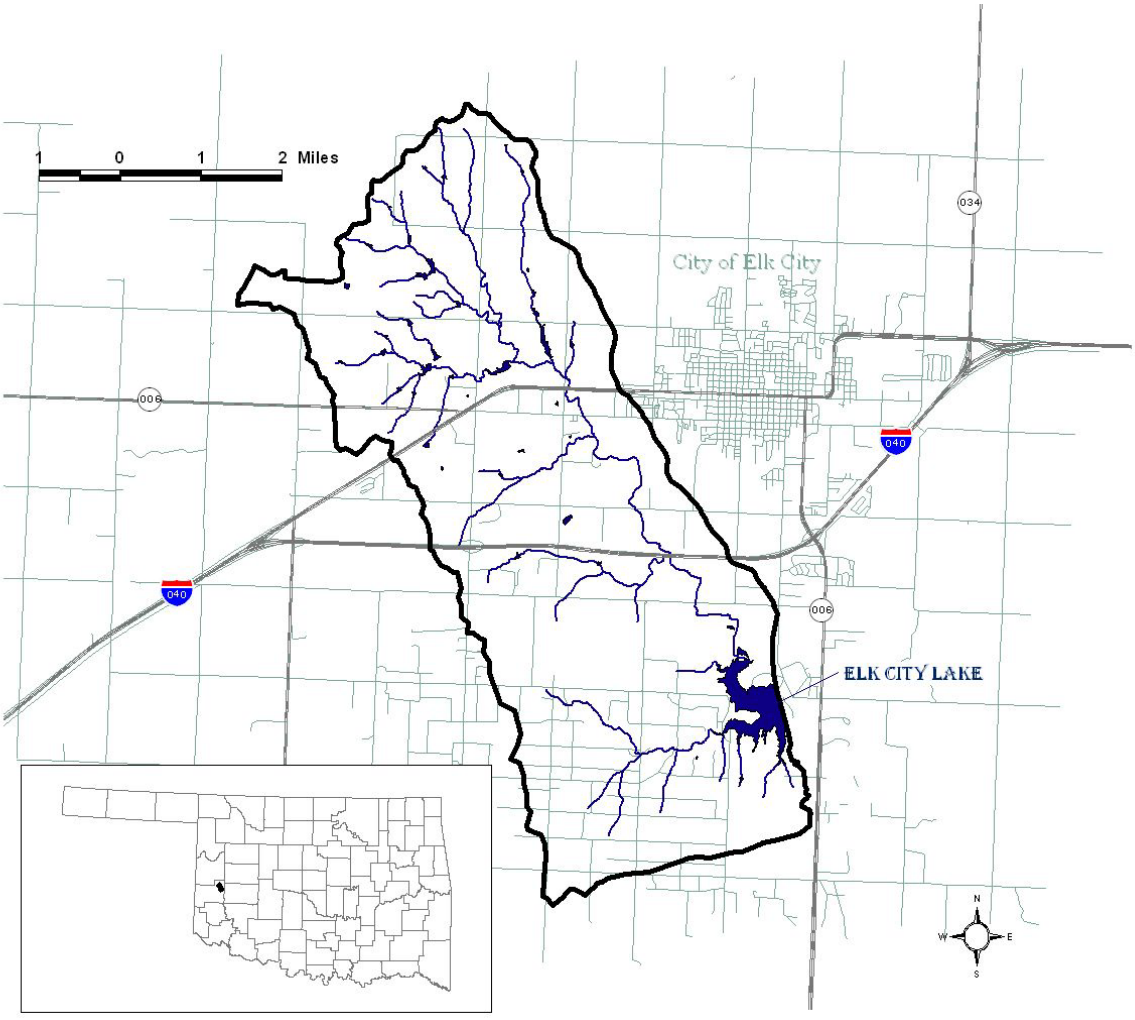

Figure 1. Elk City Lake Watershed.

Physical / natural features: The Elk City Lake watershed lies within the Omernik's Level III Central Great Plains ecoregion and the Rolling Red Plains level IV ecoregion (Woods et al. 2005). "The Rolling Red Plains extend north from the Edwards Plateau in Texas to western sections of Oklahoma. The landscape is flat to rolling plains, with natural vegetation consisting of mixed grass plains, short grass high plains, shinnery oak grasslands, and mesquite grasslands. The mixed grass plains association is the transition zone between the tall grass prairie association and other associations that are located in the western part of the physiographic area. Grasses and forbs are the dominant vegetation. The shinnery oak grasslands are located in broad rolling topographic relief of the western and northern part of the area. Oak mottes occur throughout broad expanses of tall, mixed, or short grasses. The mesquite- grassland type is perhaps the most extensive of communities in the area. This association typically occurs on flat to gently rolling topography, and is characterized by open canopy of short mesquite trees with an understory of prickly pear and thorny scrub" (Pashley et al. 2000).

From OU Climatological Survey website

Average annual precipitation ranges from about 24 inches in western Beckham County to 30 inches in the east. May and June are the wettest months, on average, but much of the spring through fall receives sufficient rainfall. Nearly every winter has at least one inch of snow, with one year in three having ten or more inches. Temperatures average near 60 degrees, with a slight increase from north to south. Temperatures range from an average daytime high of 95 degrees in July to an average low of 24 degrees in January. Winds from the south to southeast are quite dominant, averaging just over nine miles-per-hour (OU Climatological Survey website, 2007).

The elevation of the Elk City Lake watershed ranges from about 1700 ft. to approximately 2000 ft., increasing gradually from east to west. Soils in the watershed are generally fine sandy loam, loam fine sand, and silt loam. Specific soils in proportion include Grandfield-Devol-Altus (13%), Dill-Granfield-Quinlan (75%), and Cordell-Rock Outcrop-Woodward (12%). These well drained soils range from slowly permeable to moderately rapidly permeable (NRCS 2004)

- Grandfield soils are well drained; permeability is moderate. Runoff is negligible on slopes of less than 1 percent, low on 1 to 5 percent slopes and medium on 5 to 15 percent slopes.

- Dill soils are well drained; permeability is moderately rapid. Runoff is negligible on slopes of 0 to 3 percent, very low on 3 to 5 percent slopes, low on 5 to 10 percent slopes and medium on 10 to 12 percent slopes.
- Cordell soils are somewhat excessively drained. Runoff is medium or rapid and permeability is moderately slow.

Land Use: This area of the state is known to have good quality agricultural land. The majority of the landuse in the watershed is distributed between pasture/range (52.5%) and cultivated cropland (23.1%). Other landuses are summarized in Table 1 and visually rendered in Figure 2.

According to the 2002 USDA AG census, farmland accounts for over 500,000 acres in Beckham County. The average farm size is 527 acres, although many farms are smaller than 180 acres. Cattle were the top livestock commodity in the county for 2002, with an inventory of over 60,000 animals (Table 2). Wheat dominated crops grown in the county for the same year, followed by many acres of hay production (Table 3).

Table 1. Landuse summary of the Elk City Watershed.

Land Use	Total Area (ac)	Percentage
GRASSLAND/HERBACEOUS	8157	52.50%
CULTIVATED CROPS	3594	23.14%
SHRUB/SCRUB	984	6.33%
FORESTED	841	5.42%
OPEN WATER	292	1.88%
BARREN LAND	257	1.65%
RESIDENTIAL, COMMERCIAL, INDUSTRIAL	1057	6.80%
TRANSPORTATION	353	2.27%
TOTAL AREA	15536	100.00%

Table 2. Beckham County Livestock Production Statistics (USDA 2002).

Type	# animals
Cattle and calves	63,552
Hogs and pigs	341
Sheep and lambs	622
Goats	896
Quail	1,660
Horses and ponies	1,148

Table 3. Beckham County Crop Production Statistics (USDA 2002).

Crop	No. Farms	Area (ac)	Areas Irrigated (ac)
Cotton	31	7,927	
Soybeans	2	<99	
Peanuts	36	5,332	4,308
Forage for hay, silage, and greenchop	309	31,514	1,005
Sorghum for grain	12	973	
Oats for grain	4	203	
Wheat for grain	162	49,760	536
Rye for grain	26	3,545	

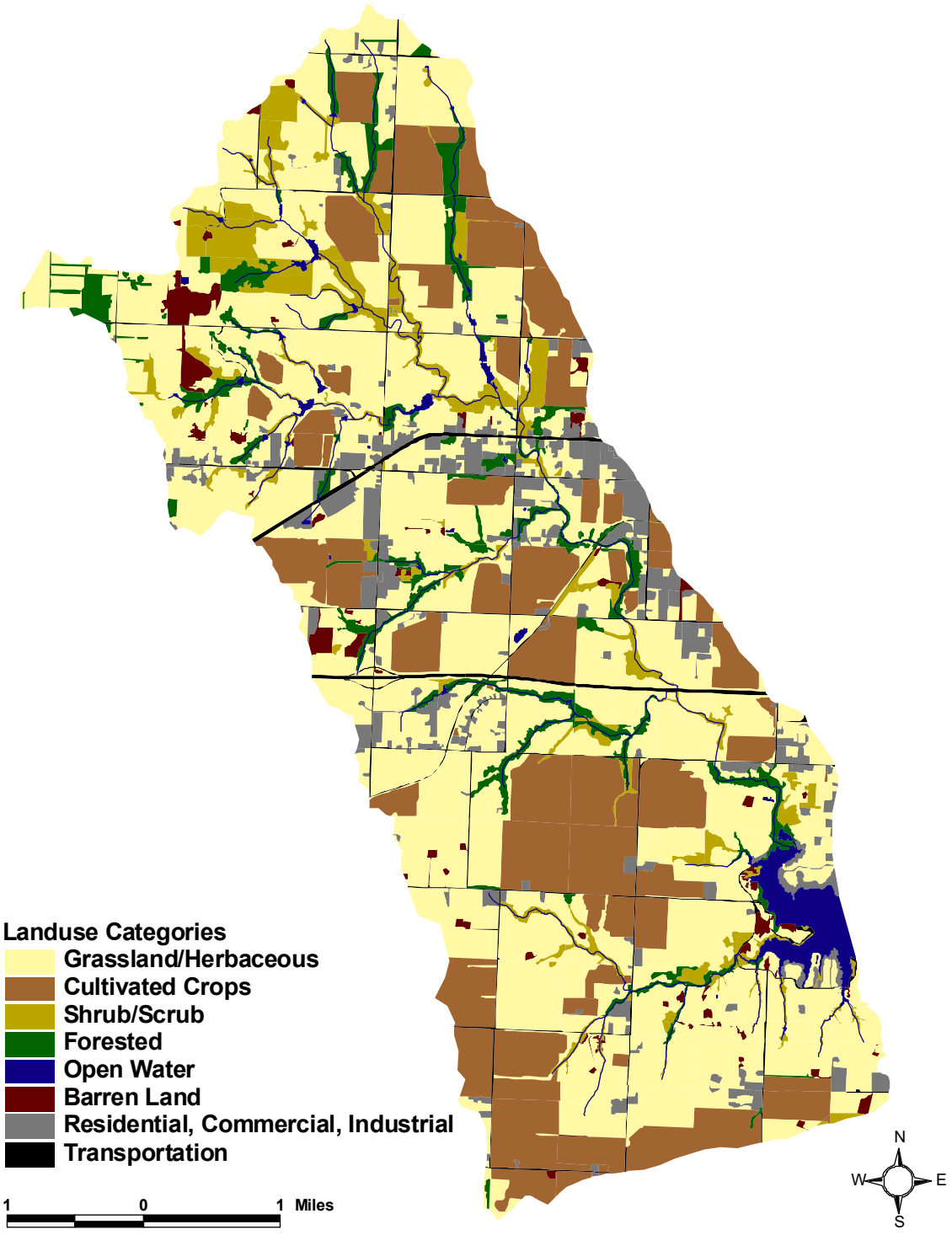

Figure 2. General Landuse/Landcover in the Elk City Lake Watershed.

Human Population: The population of Elk City has remained approximately stable for at least the last 15 years. The population of Elk City based on the 2005 US Census is 10,743; in 1990, the population was 10,428. Fifty-seven percent of the population of Beckham County resides in Elk City. Elk City Lake is a popular recreation site for area residents, particularly on warm weekends and holidays.

Waterbody conditions: The physical attributes of Lake Elk City are as follows:

- Surface area: 240 acres
- Storage volume: 2583 ac/ft
- Shoreline length: 5 miles
- Mean depth: 10.76 ft.
- Watershed area: 24 sq. miles

Causes

Elk City lake is designated as a Primary Body Contact Recreation (PBCR) waterbody in the Oklahoma Water Quality Standards (OWQS) and experiences heavy recreational use, particularly swimming, during warm weekend and holiday periods. In addition, the lake has use designations for Aesthetics, Agriculture, Fish and Wildlife Propagation--Warm Water Aquatic Community (FWP--WWAC), Industrial and Municipal Process and Cooling Water (I&M), and Fish Consumption. The lake is also designated as a nutrient limited watershed (NLW), which denotes watersheds with waterbodies that are adversely impacted by excess nutrients. In the 2005 Beneficial Use Monitoring Program (BUMP) report, Lake Elk City was classified as eutrophic, indicative of high primary productivity and nutrient rich conditions (OWRB 2005). According to the State's 2006 Integrated Report (pending), the PBCR and FWP designated uses of Elk City Lake are not being supported. Impairments on the pending 303 (d) list include dissolved oxygen, turbidity, and *Enterococcus*.

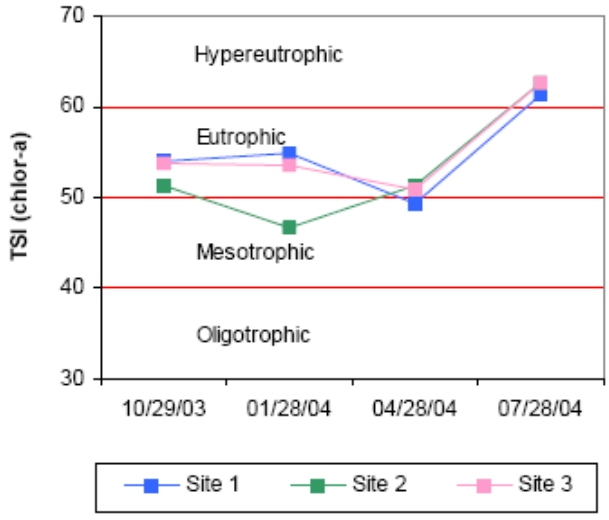

Figure 3. Seasonal TSI for Elk City Lake (OWRB 2005).

The designated beneficial uses of West Elk Creek, the lake's mainstem tributary, include primary body contact recreation (PBCR), fish and wildlife propagation--warm water aquatic community (FWP-WWAC), aesthetics, agriculture, fish consumption, and industrial and municipal process and cooling water (I&M). Little monitoring data is available for this waterbody thus precluding any beneficial use attainment evaluation.

One of the results of this project will be collection of the data necessary to fulfill this task.

Sources

Since there are no point sources in the Elk City Lake watershed, all of the sources contributing to the water quality impairments are from nonpoint sources. Nonpoint sources are those which deliver pollutants to surface waters diffusely, rather than as a definite, measurable quantity from a single location. These sources typically result from land activities that contribute pollutants such as sediment, nutrients, and/or bacteria to surface water as a result of runoff during and following rainfall.

Rural Land Use

Livestock in streams, tillage agriculture, and lack of riparian areas are the most likely sources of NPS pollution in the Elk City Lake watershed. Pasture and range comprise approximately 53% of the landuse in the watershed. Livestock grazing in pastures deposit manure containing fecal bacteria onto land surfaces, making it possible for both bacteria and nutrients to enter surface water with runoff. In addition, livestock often have direct access to waterbodies providing a concentrated source of fecal loading directly into streams. Direct access by livestock also promotes bank trampling/destabilization and trail formation which serve as direct conduits of pollutants through the little riparian area that might be present. In areas of depauperate riparian area, cultivated cropland and streambank erosion are the likely contributors of sediment and associated nutrient loads.

Urban Land Use

The City of Elk City has a municipal landfill in the watershed. It is possible that in heavy rain events, pollutants from this area could be washed into the streams of the watershed and end up in the lake. Commercial fertilizer, pet waste, and soil erosion from developed areas are other potential urban sources of NPS loading to streams.

The Elk City Golf Course is located adjacent to the lake, on the east side, and could be supplying some nutrient load. In addition, the lake is a popular recreational site, so it is possible that some raw human waste may enter the lake directly during recreational activities.

Septic Systems

Failing septic systems can contribute to pathogen and nutrient problems in both groundwater and surface waters if leakage or illicit discharge occurs. Any loading of bacteria into the groundwater can enter surface water through seeps or springs. However, given the small population size (53 systems estimated from STEPL website), poorly functioning private septic systems are expected to contribute a relatively small portion of the load.

Wildlife

Wild animals which produce fecal bacteria and have direct access to streams include

deer, feral hogs, raccoons, other small mammals, and avian species. While it is likely that wildlife sources are contributing, they are not anticipated to be a significant portion of the load.

Source Loads

Due to the lack of stream data in the watershed, pollutant loads from the general landuse types were determined using EPA's *Spreadsheet Tool for Estimating Pollutant Loads* (STEPL) model. To improve accuracy and update coverage, general landuse/landcover was hand digitized at a 1:6000 scale using 2003 Natural Resource Conservation Service (NRCS) Color Orthophotos. Landuse/landcover categorization was delineated in accordance with categories listed in the 2001 National Land Cover Dataset (NLCD). Relevant information beyond landuse/landcover required for input into the model was derived from the webbased STEPL server located at the following URL: http://bering.tetratech-ffx.com/website/stepl/viewer.htm.

The STEPL model uses simple algorithms in a spreadsheet environment to render nutrient and sediment loads from general land uses, and the load reductions that might result from the implementation of various best management practices (BMPs) using cited efficiencies. In general, STEPL computes watershed surface runoff, nutrient loads (including nitrogen and phosphorus), 5-day biological oxygen demand (BOD5), and sediment delivery. The model's basic computational schema involves calculation of a watershed's annual nutrient loading based on the runoff volume and associated pollutant concentrations as driven by land use and management practices. The annual sediment load (sheet and rill erosion only) is calculated based on the Universal Soil Loss Equation (USLE) and the sediment delivery ratio (adapted from the EPA STEPL website at http://it.tetratech-ffx.com/stepl/default.htm).

Total pollutant loads were determined from the STEPL model for each landuse/landcover type (Table 4). Landuse categories were collated to render standardization with categories outlined in the model. Most of the watershed acreage is represented except for the "open water" category which was not accounted for in the model.

As expected, cropland dominated total loading estimates for both sediment and the closely related total phosphorus. Model estimates predict the greatest delivery of total

Table 4. STEPL Total Pollutant Load Estimates for Each Landuse Category.

Sources	N Load (lb/yr)	P Load (lb/yr)	BOD Load (lb/yr)	Sediment Load (t/yr)
Urban	6202	952	20791	149
Cropland	18552	4718	38227	2462
Pastureland	36542	3829	114371	1097
Forest	151	72	363	8
Shrub/Scrub	2657	517	7436	285
Septic	141	55	576	0
Total	64244	10144	181763	4001

nitrogen and BOD from pastureland, which is the predominate landuse in the watershed. Since STEPL does not model bacteria delivery, pathogen loading estimates were not performed, but were assumed to emulate loading dynamics of the other NPS parameters, particularly sediment, and this dependent upon landuse type. Although applicable during winter grazing of wheat pasture, bacterial delivery from cropland would not be expected to be as consistently correlated to sediment loads as in pastureland and would thus differentiate reduction expectations between the two landuses.

LOAD REDUCTIONS

BMP trials and associated load reductions were accomplished using the STEPL 4.0 spreadsheet model. The model was employed using the BMPs and associated load reduction efficiencies provided, except for the pastureland category for which BMPs were not included and had to be obtained from the user manual of a similar model, PRedICT (Evans et al 2006). Similarly, none of the STEPL BMPs listed a removal efficiency for BOD, which was obtained from the literature (Karr and Schlosser 1977) and input where applicable in order to model potential impacts of BMPs on BOD loading.

BMP trials were executed for each landuse separately and then using combinations thereof until greatest reductions were achieved for all modeled pollutants. For all iterations, the most substantive load reductions were rendered by adjusting area of BMPs applied to both pastureland and cropland. Application of BMPs to other landuses, even at a 100% rate of coverage, rendered little to no change in loading (<5% for all parameters). In all scenarios, establishment and/or protection of riparian areas for both the major landuses achieved the greatest reductions for all pollutants modeled and were thus the focus of implementation planning. Because it is difficult to know the level of participation and thus final implementation effort achievable, results are presented in incremental levels of application at equivalent rates for both the major landuses combined (Table 5, below).

As stated previously, STEPL has no provision for direct modeling of pathogen loading; thus, reductions will be inferred from an assumed correlation with sediment (Cormier 2006). In agricultural scenarios, filters strips have been shown to reduce fecal coliform concentrations from 34 to 87 percent (Coyne et al 1995, Karr and Schlosser 1977). There is no reason not to expect similar reductions in the Elk City Lake watershed using filter strips and/or streambank fencing to create/protect these riparian filter zones throughout the watershed.

CRITERIA

Reduction goals for this and related projects are ultimately the restoration of all assigned beneficial uses for the waterbodies of concern. Designated beneficial uses for Elk City Lake and its mainstem tributary West Elk Creek include primary body contact recreation (PBCR), fish and wildlife propagation--warm water aquatic community (WWAC), aesthetics, agriculture, fish consumption, and industrial and municipal process and cooling water. The watershed is also designated a "nutrient limited watershed" (NLW), thus denoting a particular sensitivity to and impact by nutrients on the recipient waterbody. Elk City Lake exceeds dissolved oxygen, turbidity, and *Enterococcus* criteria and is thus not supporting its WWAC and PBCR beneficial uses. Restorational goals of this project will be set in accordance with criteria necessary to achieve a fully attaining status for these waterbody impairments. The criteria and procedures used to assess the associated uses are presented below (adapted from both the *2002 Oklahoma Continuing Planning Processs* and the *2006 Implementation of Oklahoma's Water Quality Standards*):

To attain **Fish and Wildlife Propagation--Warm Water Aquatic Community** use (based upon a minimum of 10 samples):

- Dissolved oxygen (DO)
  a) A minimum of 50% of the lake water column must have a DO concentration of at least 2.0 mg/L
  AND
  b) At least 90% of the surface samples, defined as the top 5 to 10 percent of the water column, must have a DO concentration of at least 5 mg/L (or 4.0 mg/L from June 16-October 15)

- Turbidity
  a) No more than 10% of the samples can have greater than 25 Nephelometric Turbidity Units (NTUs)

To attain the **Primary Body Contact Recreation** use (based upon a minimum of 10 samples taken during the recreation season, May 1-September 30):

- *Enterococcus*
  a) The geometric mean of the samples does not exceed 33 colonies/100 mL
  OR
  b) no sample exceeds 406 colonies/100 mL (61 colonies/100 mL for Scenic Rivers and lakes)

NPS MANAGEMENT MEASURES

One of the primary goals in modeling is to perform scenario iterations where practices are implemented singularly and then in combination over the landscape to determine which scenarios are most effective and efficient in reducing loads. For the Elk City watershed, BMPs which establish and/or protect riparian areas were always the most effective in reducing loads from the two highest contributing landuses, pastureland and cropland, which will be the initial focus of pollution abatement measures outlined in this watershed plan (Table 5). The riparian area is the land immediately adjacent to waterbodies such as streams, wetlands, and lakes that plays a critical role in the amount of pollution entering those waterbodies. Research has shown that maintenance of a natural buffer or riparian zone between agricultural or otherwise developed land and a stream can reduce pollution to that stream by up to 90% (Wenger 1999).

Table 5. Pollutant Loads/Reductions for Combined BMP-Landuse Applications at Varying Rates.

STEPL Landuse Category	BMP	% Area BMP Applied	Removal Efficiencies				N Load (lb/yr)	P Load (lb/yr)	BOD (lb/yr)	Sediment Load (lb/yr)	% N Red.	% P Red.	% BOD Red.	% Sed Red.
			N	P	BOD	Sed								
Cropland	Filter Strip	25.00%	0.18	0.19	0.16	0.16								
Pastureland	Streambank Fencing	25.00%	0.14	0.20	0.16	0.19	55805	8595	157747	3393	13	15	13	15
Cropland	Filter Strip	50.00%	0.35	0.38	0.31	0.33								
Pastureland	Streambank Fencing	50.00%	0.28	0.39	0.31	0.38	47365	7047	133730	2784	26	31	26	30
Cropland	Filter Strip	75.00%	0.53	0.56	0.47	0.49								
Pastureland	Streambank Fencing	75.00%	0.42	0.59	0.47	0.57	38926	5498	109713	2176	39	46	40	46
Cropland	Filter Strip	100.00%	0.70	0.75	0.62	0.65								
Pastureland	Streambank Fencing	100.00%	0.56	0.78	0.62	0.76	30486	3949	85697	1567	53	61	53	61

Because of the lack of data, it was not feasible to determine exact load reductions necessary to restore the lake to full attainment of its WWAC and PBCR beneficial uses. Therefore, the initial approach of this plan will be to set minimum reduction goals that seem to be both significant and attainable and then adjust them as monitoring data becomes available. Toward this end, OCC proposes an initial implementation strategy (first grayed row in Table 5) to achieve an NPS sediment reduction goal of 30 percent with similar reductions in TP, TN, and BOD. Such reductions in both sediment and nutrient delivery to the lake will have a direct impact on water quality by decreasing particulate concentrations and nutrients, both of which will serve to decrease turbidity and reduce eutrophication processes taxing dissolved oxygen in the system. Although not modeled in STEPL directly, reduction in *Enterococcus* bacteria will be assumed to be similar to that for sediment, and based upon removal efficiencies listed for filter strips in the literature, could actually be higher (Coyne et al 1995, Karr and Schlosser 1977).

This project will attempt to establish and protect an ultimate goal of 1,060 acres of riparian land (45 m buffer) through implementation and conservation easements (via CREP) around Elk City Lake and West Elk Creek. Per STEPL, BMPs affording the most significant reductions include establishment of riparian vegetative filter strips for

cropland and streambank fencing to protect/promote riparian area and prevent direct cattle access to streams in pastureland. Implementation will target priority areas, which have little to no riparian area established and/or protected (Figure 4). Although implementation of riparian BMPs will be the focus, additional BMPs will also be offered and in some cases necessary to facilitate the primary strategy. These would include but not be limited to offsite watering, planting of herbaceous species for riparian establishment, and possibly stream crossings.

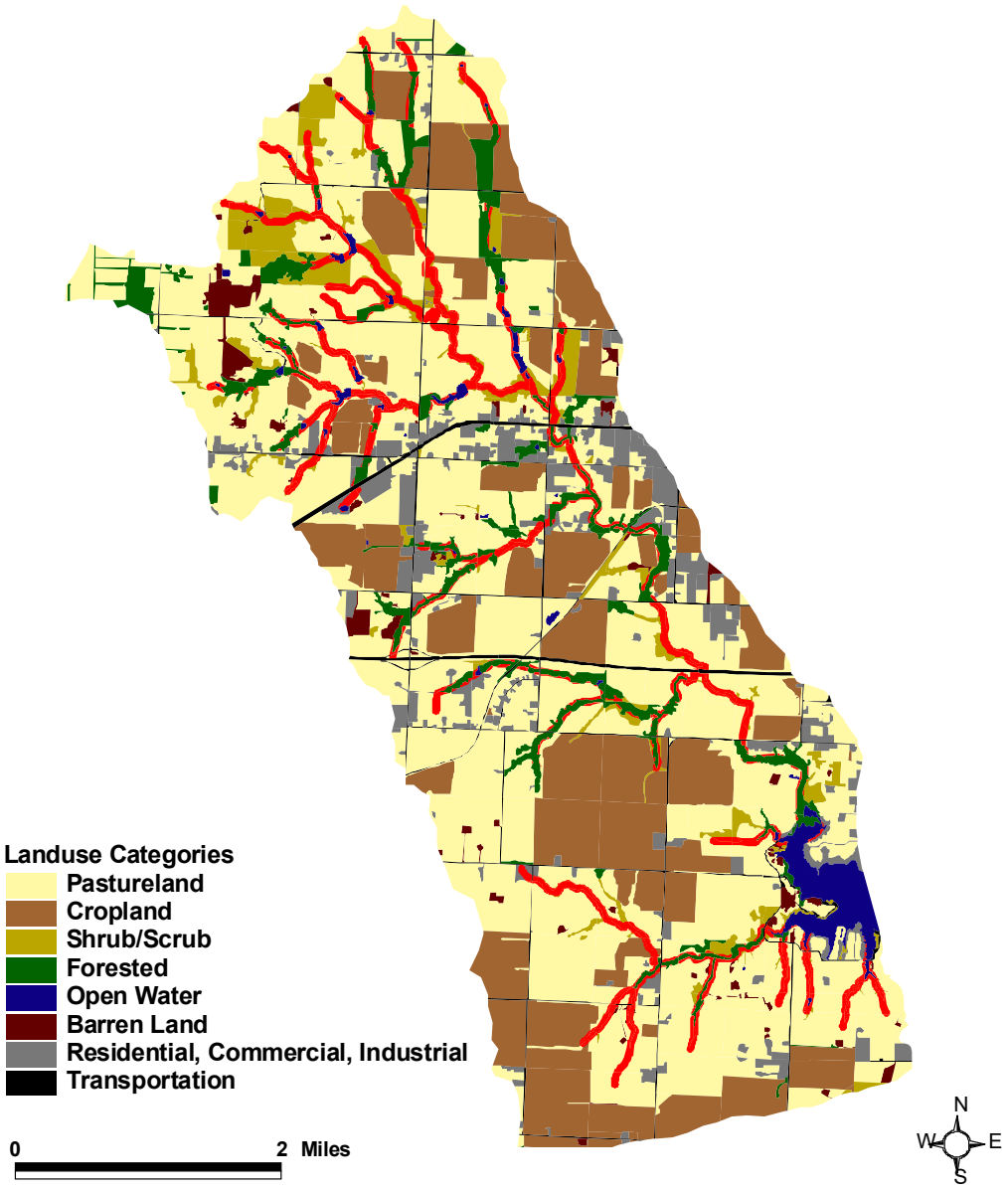

Figure 4. Priority Riparian Areas in the Elk City Watershed (delineated in red).

The ultimate goal of this project is to reduce pollutant loading to Elk City Lake to levels that will allow the lake to meet the water quality standards. In accomplishing this, it is hoped that the target goal of 1,060 acres of riparian buffer will be established and protected. A secondary goal of this project is to achieve a situation where producers and other landowners view riparian protection as a standard part of land management, much the way they have come to accept practices such as terracing or septic tanks. The OCC has shown with similar BMP implementation programs that landowners are receptive to protecting their riparian areas and this program will allow us to demonstrate to landowners the short and long-term benefits of riparian protection. Again, past performance has shown us that once landowners see real benefits, they will begin to adopt the practice on their own and we could see even greater load reductions.

It is anticipated that these programs and the goals themselves will change over time. Therefore, the management measures outlined in this section are not intended as the final, formalized plan. Addition of new and/or amendment of currently planned BMPs should be expected to reflect new information and new resources as the plan is implemented and evolves.

TECHNICAL AND FINANCIAL ASSISTANCE NEEDED

The OCC proposes to implement a watershed wide implementation project to reduce sediment, nutrient, BOD, and bacterial loading to Elk City Lake to levels that will allow the lake to once again attain its assigned WWAC and PBCR beneficial uses. To accomplish this, OCC proposes to leverage, through 319 program, City of Elk City, and state matching dollars, adequate funding for best management practice (BMP) implementation through the Conservation Reserve Enhancement Program (CREP). The CREP program is a partnership between State (including local and state government, nonprofit groups and industry) and Federal partners (USDA, FSA and NRCS) to protect and improve water quality by retiring riparian land from agricultural production for fifteen years[1]. Again, the primary practices envisioned for control of sediment, nutrients, and bacteria entering the lake will focus on establishing and protecting riparian areas and providing incentives to livestock producers to move cattle away from streams.

In general, this project (holistically a CREP project) will provide incentives to farmers and ranchers to remove streamside pasture and/or cropland from production activities for at least fifteen years. In return, the landowners will receive 90% to 100% of the cost of installation of practices such as fencing of riparian area, grass planting, alternative water supply, livestock stream crossings, and tree planting. The landowner will also receive an annual rental payment for the fifteen year period based on the average area rental rate, a signing bonus payment, and an annual practice maintenance payment. The project will be conducted over a fifteen plus year period allowing adequate time for

1 As of April 23, 2007 Farm Service Agency (FSA) officials approved and ratified through signing a state CREP program for Oklahoma. Upon approval of 319 funding for this project, OCC will submit a proposal for the CREP portion by late summer 2007.

pre and post implementation monitoring and a two year sign up period for BMP installation; fifteen years is the period of reserve time for CREP enrolled lands, which will require administrative and monitoring costs to be budgeted over this period.

Table 6. General Budget for Implementation and Monitoring Costs for the Elk City Lake Watershed Project.

Riparian Area in the Elk City Lake Watershed		1,522
Estimated Percent Degradation		80%
Estimated Restoration Area (Degraded buffer)		1,217
	Estimated Degraded buffer Area that is CRP eligible (acres)	1,060
	Non-CRP eligible degraded buffer area	157
Establishment Costs per acre		
	Cost-share to install practices (50% of $900)- fencing, off-site watering, site prep.	$450.00
	PIP (practice incentive payment) (40% of $900)	$360.00
	Total Cost to Establish per acre	$810.00
	Anticipated Coverage (assume 100% participation)	1060
Total Cost to Establish		$858,744.50
Cost to Maintain Fifteen Year Contract – cost per acre per year		
	Rental Payment	$100.00
	Riparian Buffer Installation (20% of rental payment)	$20.00
	Subtotal	$120.00
	SIP (signing incentive payment)	$10.00
	Maintenance payment ($7, $9, or $10)	$10.00
	Total cost per acre	$140.00
Cost to maintain 15 year contract per acre		$2,100.00
Anticipated Coverage in Acres (assumes 100% participation)		1,060
Total Maintenance for 15 years		$2,226,374.64
Total Implementation Costs (Establishment and 15 yr maintenance)		$3,085,119.14
FSA (CREP) Total for Establishment and 15 years maintenance		**2,946,895.32**
State Match Required (319 program funding)		
	Technical Support	***407,500.00***
	Monitoring Costs	***191,000.00***
Local Match Required (from City of Elk City over 15 yr period)		***368,361.91***
PROGRAM TOTAL		**$3,913,757.23**

The project will be funded largely (80%) by CREP as the bulk of the cost will comprise the actual funding of BMP implementation on agricultural lands and rental payments for land withdrawn from production. The remaining 20% of the funds will be a match of 319 program and non-federal dollars and will cover costs associated with personnel, monitoring, and implementation in targeted areas not qualified for participation in the CREP program (i.e., lands not used for agricultural production). By rule, 319 dollars require a 40% nonfederal match which will be met through in-kind services and hard dollar input from the City of Elk City and the State of Oklahoma.

Although exact funding needs are difficult to anticipate and will likely change over time, OCC has determined a very approximate costing of project activities (Table 6). Based upon current landuse in the watershed and projected implementation goals, USDA will contribute through CREP approximately $2,946,895 towards implementation and maintenance of BMPs in the watershed over a fifteen year period from 2008 – 2023. In support of this program, the City of Elk City will contribute $368,362 over a fifteen year period, which the State will use to match 319 funds to support water quality monitoring in the watershed, and fund upland practices such as winter feeding facilities or practices such as streambank stabilization to compliment the riparian protection implemented through CREP. OCC has identified immediate funding priorities for the first two years including monitoring, technical assistance, and some upland BMP implementation costs, which are outlined in OCC's FY07/08 319(h), Project 11 Workplan being submitted concurrently with this WBP. The estimated costs associated with the various implementation strategies outlined in this WBP are highly conservative and will likely change as targeting of the watershed is finalized and further information becomes available.

PUBLIC OUTREACH

The education and outreach component of the Elk City Lake Watershed Implementation Project will be guided and implemented by a full-time project coordinator employed by the OCC. The project coordinator will work closely with the City of Elk City and the North Fork of the Red River Conservation District to coordinate education and outreach activities. Specific educational goals at this time include:

(1) Organize at least two educational events targeted at livestock producers in the watershed. These events would emphasize the benefits of riparian establishment and protection as well as other priority BMP activities included in the overall management plan.

(2) Offer a Blue Thumb and/or Oklahoma Water Watch program training to promote local awareness of watershed issues through volunteer monitoring and education. The ultimate goal would be to establish a monitoring team that would take interest in the lake and perhaps contribute to monitoring efforts (e.g., lake bacterial sampling) where appropriate.

(3) Produce educational pamphlets (e.g., project outline, related BMP catalog) and distribute these in strategic areas (e.g., Conservation District office, public library, schools, banks)

The success of the program in the Elk City Lake watershed depends upon widespread public support and buy-in of stakeholders. An initial planning meeting will be convened with purpose of recruiting additional stakeholders and potential cooperators in an effort to form a watershed advisory group (WAG). This group should include representatives from OCC, City of Elk City, North Fork of the Red River Conservation District, NRCS,

Farm Services Agency and local producers and citizens. This group will serve a major role in building upon and refining this general watershed plan and coordinating the outreach activities to promote and implement it.

IMPLEMENTATION SCHEDULE / INTERIM MILESTONES

Because the Elk City Lake Watershed project is CREP based, the overall project timeline will occur over a fifteen year period. The implementation portion of the project funded through 319 is expected to conclude within three years but could continue beyond this time (Table 7). Maintenance of practices will occur from practice establishment through the programmatic life of the easement. Effects of implementation programs in the watershed on pollutant loadings to the lake will be evaluated every two years to determine the future strategy to be followed. Following that evaluation, this Watershed Based Plan will be revised to reflect new information and address short-comings identified with earlier plans.

The initial goal is that at least a thirty percent load reduction will be measured during the first three years. This load reduction will be demonstrated with water quality data collected throughout this period. Table 8 details the schedule of the general goals and actions of the WBP, as well as the interim milestones (within two years of implementation) and long-term load reductions associated with each. Trend analyses will be performed on various data sets (i.e., lake TSIs; bacteria and D.O. in both the lake and stream) and will be evaluated at two year intervals with the revisions of the WBP to determine whether measurable changes have occurred in water quality.

Table 7. Schedule for the 319 portion of the Elk City Lake project.

Milestone Description	Due Date
Pre-Implementation Plan written to provide greater detail on practices to be implemented as part of this project and expected results	December 2008
Organize WAG and prioritize BMPs	July 2008
BMP Implementation	July 2008 – June 2010
Tracking of BMP Implementation / Water Quality Monitoring	July 2008 – June 2010
Photodocumentation of BMPs	Throughout the project
Final Report	September 2010
Revise WBP	September 2010 and every two years after

Table 8. Schedule and load reduction goals associated with activities planned.

Goal	Action	Parameter to address	Load Reduction of Primary Parameters to Attain within 5 Years of Implementation	Ultimate Total Load Reduction to Attain	Year to Begin	Year to Evaluate and Make Necessary Adjustments	Year to Complete
Characterize NPS contributions	Targeting	Sediment, Bacteria, Nutrients, BOD	NA	_____	2008	2010	Repeat at five year intervals
Develop education and outreach programs	OCC 319 Program, OCC BT Program, Oklahoma Water Watch	Bacteria, Nutrients, Sediment, BOD	30% bacteria	30% bacteria	2008	Semiannually throughout project period	2010
Implement BMPs and establish easements	OCC 319 Program	Bacteria, Sediment, Low DO, Nutrients	10%	30%	2008	Semi-annually	2010
	EQIP		10%	30%	2003		Ongoing
	CREP		10%	30%	2008	2010 and then every 2 years	2023
Long term water quality monitoring programs	OCC 319 Program	Bacteria, Nutrients, Sediment, DO	NA	NA	2008	Annually	2023
	OWRB BUMP monitoring				2008	Biannually	Ongoing
	Blue Thumb				2008	Annually	Ongoing
	Oklahoma Water Watch Program				2008	Annually	Ongoing

MONITORING PLAN

Every Watershed Based Plan requires a monitoring component to gage overall success of restoration and remediation efforts. The goal of the monitoring plan for this WBP is to develop a long-range program with clearly defined goals that will guide the restoration of the beneficial use support in the watershed and preserve its natural resources for future generations. Monitoring efforts will be based on Oklahoma's Water Quality Standards and Use Support Assessment Protocols which define the process by which beneficial use support must be determined. All procedures carried out directly by OCC will proceed in accordance with *Standard Operating Procedures for Water Quality Monitoring and Measurement Activities* (OCC 2006).

Methodologies developed for use in this WBP will be selected to provide: 1) quantifiable measure of changes in parameters of concern, 2) success measures that can be easily

understood by cooperators and stakeholders with a variety of technical backgrounds, and 3) consistent, compatible information throughout the watershed. As the WBP evolves, it is anticipated that this list will be amended. A monitoring schedule and Quality Assurance Project Plan (QAPP) will be developed and baseline conditions will be monitored prior to implementation.

At this time, the following parameters will be monitored in the Elk City Lake watershed:

- Water quality: nutrients, total suspended solids, fecal bacteria, dissolved oxygen, temperature, pH, conductivity, alkalinity, hardness, turbidity, chlorophyll-a, metals, BOD, in-stream flow
- Landuse/Land cover: acreage in different landuses, quality and type of land cover, timing and other variables of associated management practices
- Riparian Condition: extent and quality of riparian zones in the watershed; includes quality and type of vegetation, degree of impact or stability, condition of streambanks, and primary source of threat or impact
- Aquatic Biological Communities: assessment of the condition of fish and benthic macroinvertebrate communities related to reference streams and biocriteria
- BMP and other implementation efforts: type, extent, and specific location of practices to include an estimate of the potential load reduction effected by implementation
- Behavioral Change: participation in Watershed Based Plan-related activities and behavioral changes of affected communities

Baseline Data

Water Quality

Very little water quality data has been collected in this watershed with the exception of the lake itself. Until more data is collected, water quality in this WBP will be guided by the following:

- ***Oklahoma Integrated Report***- CWA Section 303(d) List of Waters needing a TMDL (DEQ 2006 draft). Elk City Lake is listed on the 2006 303(d) list for bacteria, dissolved oxygen, and turbidity. The data used for listing was obtained by the OWRB as part of the BUMP. Data collected from the lake by OWRB also supported the listing of Elk City Lake as a Nutrient Limited Watershed (NLW).

Landuse/Land Cover

- ***NRCS and OCC*** - Color digital orthophotos (2003)

Riparian Condition

- ***NRCS and OCC*** - Color digital orthophotos (2003)

Best Management Practices and Other Implementation Efforts (Coverages)

- ***NRCS/FSA*** - records of locations, specific practices installed and associated costs of programs such as EQIP, WRP, CRP, etc. (ongoing)

Data Collection Responsibilities

Monitoring will occur on a monthly basis from the beginning of the project through the entire project. Responsibility for the collection of additional data of the types described above will reside with project managers of the individual projects as spelled out in their individual work plans. These project managers will be responsible for ensuring that the data is submitted to the ODEQ for inclusion in the Oklahoma State Water Quality Database, which is ultimately uploaded to the National STORET database on an annual basis.

The following groups will be involved or are planned for in monitoring activities:

- Oklahoma Conservation Commission (OCC): Priority Watershed Project Monitoring, Rotating Basin Monitoring Program, and Blue Thumb Project Monitoring
- Oklahoma Water Resources Board (OWRB): Lakes Beneficial Use Monitoring Program and Oklahoma Water Watch Monitoring Program

Monitoring Details

Stream Monitoring

OCC field staff will monitor two sites (West Elk Creek above the lake and the outlet of a control watershed) on a minimum of a monthly basis throughout the entire project period. OCC will implement two automatic samplers (one test and one control) to collect continuous, flow weighted samples for nutrient parameters. In addition, OCC will conduct routine physico-chemical monitoring at autosamplers sites upon sample pickup, along with collection of bacteriological samples bi-weekly during the recreation season. Parameters to be assessed and sampling frequency may be found below (Table 9). Habitat monitoring and biological monitoring will also occur as part of this project to directly measure any change in riparian condition and potential improvements in aquatic communities that may result. Monitoring will begin once the QAPP is approved, and continue throughout the length of the project. Again, all sampling procedures to be used are described in OCC's 2006 Master SOP document (OCC 2006). Flow-weighted water quality samples will be collected continuously during periods of flow using ISCO auto-samplers or monthly as grab samples at all sites.

Table 9. Parameters and sampling frequency for OCC stream monitoring.

Parameter	Collection Frequency
Dissolved Oxygen, Conductivity, pH, Temperature, Alkalinity, Turbidity, Instantaneous Discharge	Weekly with sample pickup from autosamplers; monthly at minimum (during periods of no flow)
Total Phosphorus, Ortho-Phosphorus, Ammonia-Nitrogen, Nitrite-Nitrogen, Nitrate-Nitrogen, Total Kjeldahl Nitrogen, TSS	Flow weighted collection (weekly pickup); monthly at minimum (during periods of no flow)
CBOD5	Monthly
Benthic Macroinvertebrates	Twice yearly (summer / winter)
Fish	Once a year every other year
Habitat	Once a year every other year
E. coli, and *Enterococcus spp.*	Bi-weekly from May 1 – September 30 every year

Lake Monitoring

The OWRB will continue monitoring Elk City Lake as part of the Beneficial Use Monitoring Program (BUMP), with at least quarterly sampling every other year. Due to its NLW designation, the lake may be monitored more frequently than every three months. Three sites will be monitored in the lake to represent the riverine, transitional, and lacustrine zones of the reservoir. All sampling activities will proceed according to OWRB Standard Operating Procedures.

Samples will be collected from the lake surface at all sites, with an additional sample collected at 0.5 meters from the lake bottom at the dam site. Vertical water quality profiles will be recorded at one meter intervals from the lake surface to the lake bottom for the following parameters: temperature, pH, dissolved oxygen, salinity, dissolved oxygen (% saturation), oxidation-reduction potential (redox), specific conductance, and total dissolved solids (TDS). Other OWRB parameters that will be analyzed at each site include turbidity and true color. Laboratory analysis of each sample will include: nitrate-nitrogen, nitrite-nitrogen, ammonia-nitrogen, total kjeldahl nitrogen, ortho-phosphorus, total phosphorus, true color, chloride, sulfate, and total alkalinity. Bacteria (fecal coliform, *E. coli*, and *Enterococcus*) will be assessed from samples collected during the recreational season from May 1 through September 30 of each year.

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