

# LAKE OF THE ARBUCKLES WATERSHED RESTORATION PLAN



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Lake of the Arbuckles Watershed Association

April 2018



*Lake of the Arbuckles Watershed Management Study  
USBR WaterSMART Cooperative Management Program, FY-2016*

*Prepared by the Chickasaw Nation and Oka' Institute of East Central University  
in collaboration with Duane Smith & Associates and AquaStrategies, Inc.*

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# Background & Executive Summary

Located some six miles south of the town of Sulphur at the confluence of Buckhorn, Guy Sandy and Rock Creeks, the Lake of the Arbuckles provides uniquely important economic and recreational value to south central Oklahoma. Constructed by the Bureau of Reclamation in the heart of the Chickasaw Nation, the 51-year-old lake consists of 2,350 acres of open water and 36 miles of shoreline. A vital water supply source to the region, the lake impounds 72,400 acre-feet of water reaching depths up to 85 feet.

The scenic Lake of the Arbuckles is widely known for its crystal clear water and looming rock cliffs along its shores, making it one of Oklahoma's most popular destinations for fishing, waterskiing, swimming and scuba-diving. Public amenities include six campgrounds and more than 400 camping sites. Turkey, deer and small game birds are found on nearby hunting grounds.

The lake also occupies the western portion of the Chickasaw National Recreation Area (CNRA), a recreational, historical and cultural attraction in its own right. Established in 1902 as one of America's first national parks, CNRA alone hosts more than 1.5 million people each year.

This frequency of visitors to the lake and surrounding area has made recreation a mainstay of the south central Oklahoma economy. According to the report, "The Economic Impact of Travel on Oklahoma Counties, 2011-2012," travel expenditures in the 22-county Choctaw/Chickasaw Planning Region, which includes the Lake of the Arbuckles, exceeded \$730 million in 2012. This created 5,400 jobs, generating more than \$94 million in payroll and \$57.5 million in state and local tax receipts. Associated revenue is generated through equipment sales, licenses, land ownership and leasing, jobs, salaries, taxes, rents and other trip-related spending. Domestic travel, including tourism, is the third largest industry in Oklahoma; it may be the largest industry in south central Oklahoma.

Aside from being a beautiful amenity and essential source of revenue for the region, the Lake of the Arbuckles is the primary water source for numerous residents and businesses. Through the Arbuckle Master Conservancy District, which controls the operation and maintenance of Arbuckle dam and aqueduct, reliable water supply is provided to the cities of Ardmore, Davis and Wynnewood (and its oil refinery) as well as the Southern Oklahoma Water Corporation.

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*The Chickasaw Nation, through the Bureau of Reclamation's Cooperative Watershed Management Program, facilitated establishment of the Lake of the Arbuckles Watershed Association in 2016 to foster grassroots solutions to local water challenges. Successful implementation of the Association's Watershed Restoration Plan—the product of this collaborative federal/tribal/local partnership—will result in improved water quality and elimination of water impairments, thus ensuring the long-term integrity of the lake and its watershed.*



As is common with many waterbodies, Lake of the Arbuckles has begun to exhibit water quality and quantity issues of concern. The Oklahoma Department of Environmental Quality (ODEQ) had determined that the lake is impaired for failing to meet dissolved oxygen (DO) standards. Municipal, agricultural and other land use practices in the watershed may be a contributing factor, but additional monitoring is required to pinpoint sources. The many springs and streams in the Lake of the Arbuckles watershed are partially sustained by flow from the Arbuckle-Simpson aquifer, so existing quality and quantity impacts to the aquifer are also manifested in the lake.

In 2016, the Chickasaw Nation received a grant from the Bureau of Reclamation—through its Cooperative Watershed Management Program (CWMP)—to develop the Lake of the Arbuckles Watershed Restoration Plan with the express goal of proactively addressing current and future water quality issues impacting the lake. Rather than being a top-down initiative, this program facilitates the development of stakeholder-driven grassroots watershed initiatives to improve water quality and quantity and reduce water conflicts at the local level. Working with the Oka’ Institute at East Central University, the Chickasaw Nation and its consultants helped galvanize community leaders and local stakeholders through formation of the Lake of the Arbuckles Watershed Association (LAWA), a 501(c)3 organization. An associated Board of Directors was subsequently appointed, including officers to fill key roles. The Chickasaw Nation and Oka’ Institute provide administrative support.

Through this Plan, LAWA and its partners promote the implementation of sensible and feasible land management practices within the watershed that will improve soil health and reduce sediment and nutrient runoff. Ultimately, such measures are intended to result in removal of the Lake of the Arbuckles from its current impaired status, thus



*Figure 1. Spring-fed Travertine Creek, Chickasaw Nation Recreation Area*

ensuring long-term sustainability of the lake and preservation of its vital water supply, recreational and related benefits to the local economy.

Specifically, this Plan summarizes existing water quality and quantity in the watershed, issues of concern, ongoing remedial activities and potential best management practices (BMPs) and related actions. It does not identify individual sources of pollution nor target specific actions on defined tracts of land.

This Plan also outlines a process for working with stakeholders to implement BMPs and other watershed improvement strategies, including available technical and financial resources to facilitate the implementation of future projects. And it establishes metrics—quantified through a planned program to expand and enhance monitoring of water quantity and quality in the watershed—to determine the anticipated success of these actions.

A final, yet most important, component of the Plan is education and outreach, especially to area landowners, in implementing strategies beneficial to both the watershed and its economy.

# Introduction

## Background

The Lake of the Arbuckles watershed is located in the State of Oklahoma within Murray, Garvin and Pontotoc Counties (Figure 2). The City of Sulphur is located within the watershed and the cities of Dougherty, Hickory, and Davis are within five miles of watershed boundaries, all within Murray County. The watershed lies within the boundaries of the Gulf Coast Prairie Landscape Conservation Cooperative (LCC) and Cross Timbers eco-region, as defined by the U.S. Environmental Protection Agency (EPA).

The Lake of the Arbuckles has a surface area of 2,350 acres and water storage capacity of 72,400 acre-feet (AF). The Lake was created by the U.S. Bureau of Reclamation (USBR) by construction of the Arbuckle Dam in 1966. Its watershed is delineated by the Hydrologic Unit Code (HUC) Boundary Dataset, inside the HUC-10 watershed (1113030306) that covers an area of 88,590 acres. The Lake of the Arbuckles has 36,440 AF of capacity assigned to flood control. In addition to the considerable revenue the lake brings from tourists, the lake provides substantial flood control benefits—amounting to as

much as \$5 million or more since its construction—to the surrounding region.

The Lake of the Arbuckles serves as a vital source of water supply for some 51,000 citizens in several municipalities. The Arbuckle Master Conservancy District operates and maintains the Arbuckle Lake Dam and water supply infrastructure. The Lake also receives groundwater in the form of springflow from the Arbuckle-Simpson aquifer, which serves as an important supply source for the region.

The Arbuckle-Simpson aquifer, which underlies more than 500 square miles in south central Oklahoma, is the principal water source for the City of Sulphur and is the source of a number of important springs in the region, including those in the Chickasaw National Recreation Area (CNRA), which is operated by the National Park Service (NPS). Stakeholders are concerned that increased withdrawals from the aquifer will result in declining flows in streams and springs.

The Chickasaw Nation's aboriginal homeland in south central Oklahoma is an area rich in water resources, thus water has long been a fundamental

element of the Chickasaw identity. Sustainability and protection of water resources—along with stewardship of the land and environment—has become a central focus of Nation policies and practices in its 13-county territory.

## Purpose and Framework

South central Oklahoma faces an increasing number of water resource challenges. Aging infrastructure, expanding population, depletion of groundwater resources, impaired water quality associated with particular land uses and land covers, growing water

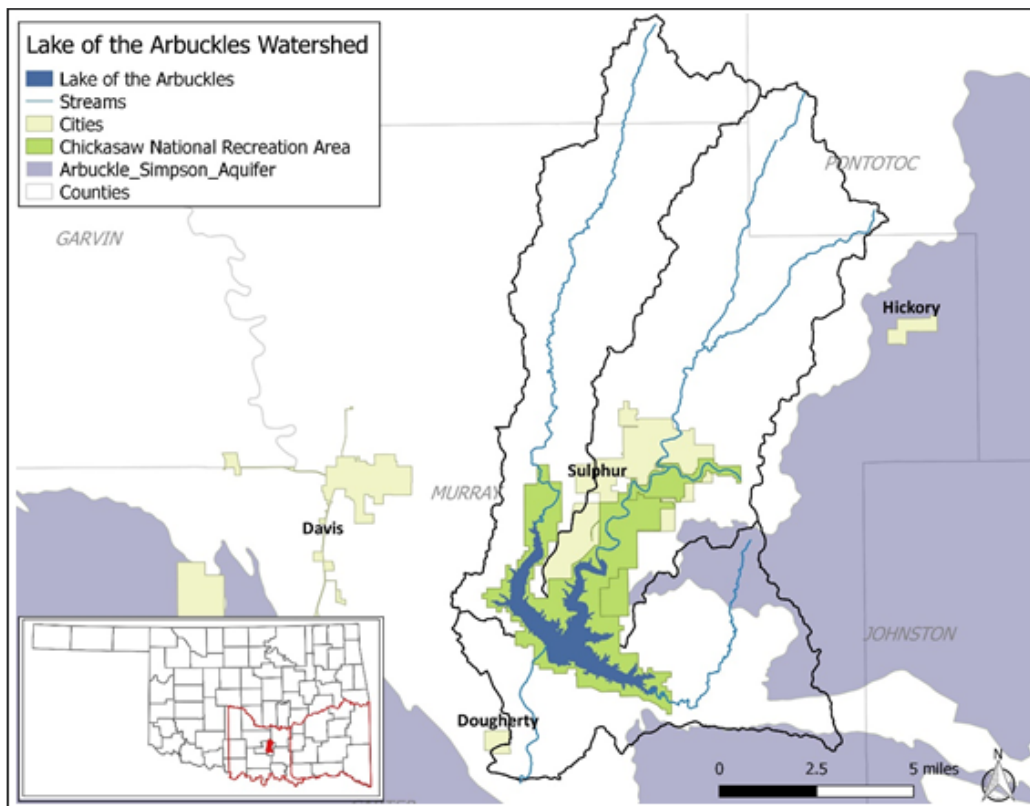


Figure 2. Geographic location of the Lake of the Arbuckles Watershed



requirements for human and environmental needs, drought and climate variability all contribute to water availability concerns. Water shortages and water-use conflicts have become more commonplace in many areas of the country, even in normal water years. As competition for water increases—crop irrigation, municipal requirements, energy production and the environment—the need for accurate data and tools to aid water resource managers also grows.

The U.S. Bureau of Reclamation’s WaterSMART (Sustain and Manage America’s Resources for Tomorrow) Program establishes a framework to pursue multiple watershed goals: provide Federal leadership and assistance on the efficient use of water; integrate water and energy policies to support the sustainable use of all natural resources; form strong diverse partnerships with States, tribes and local entities; and coordinate with other Department bureaus and offices on water conservation activities. The CWMP contributes to the WaterSMART strategy by providing funding to watershed groups to encourage stakeholders to form local solutions to address their collective water management needs.

## Lake of the Arbuckles Watershed Association (Stakeholder Group)

LAWA is composed of a diverse set of stakeholders in the region who are collaborating to identify, evaluate and resolve water quantity and quality issues within the Lake of the Arbuckles watershed. The Chickasaw Nation and Oka’ Institute at East Central University originally identified and organized the stakeholder representatives, mediated development of a cohesive vision and mission, and continue to coordinate regular meetings of the Association.

### Members

LAWA stakeholders include landowners, municipalities, business interests, state and federal agencies, recreational interests, educational and conservation organizations and others, as indicated below:

- Arbuckle Master Conservancy District
- Bureau of Reclamation
- Chickasaw Nation
- Chickasaw National Recreation Area
- City of Sulphur
- Murray County Extension Office
- Oka’ Institute, East Central University

- Oklahoma Conservation Commission
- Oklahoma Department of Agriculture
- Oklahoma Department of Environmental Quality
- Oklahoma Water Resources Board
- Natural Resources Conservation Service
- Noble Research Institute

LAWA is administered by an elected Board of Directors, with officers, and supported by the Oka’ Institute and Chickasaw Nation, including experienced water and planning consultants from Duane Smith and Associates and Aqua Strategies. Additional stakeholders identified to support and strengthen the planning process include:

- Agricultural Irrigators
- Arbuckle Conservation District
- Buckhorn Rural Water District
- Citizens for the Protection of the Arbuckle-Simpson Aquifer
- Continental Resources
- Mahard Egg Farm
- Murray Co. Conservation District
- Murray Co. RWD #1
- Oaks and Prairies Joint Venture
- OGE Energy Corp.
- Oklahoma Biological Survey
- Oklahoma Department of Wildlife Conservation
- Oklahoma Geological Survey
- Oklahoma Historical Society (Research Center)
- Oklahoma Intertribal Agricultural Council
- Oklahoma Mesonet
- Oklahoma Rural Water Association
- Oklahoma State University
- Oklahoma Tourism & Recreation Dept.

## BOARD OF DIRECTORS

### Lake of the Arbuckles Watershed Association

Larry Keenan, President	Kent Cornell
Marilyn Bearden, Vice President	David Earsom
Ronald Trett, Secretary	Roger Kite
Wes Hilliard, Treasurer	Edd McNeil
Ty Albright	Gary Mobly
Don Brown	Charles Rohla
	Roy Oliver

- OU South Central Climate Science Center
- Pontotoc Co. RWD #8
- Rural Development (Ada Office)
- Sierra Club
- South Central Climate Science Center
- The Nature Conservancy
- U.S. Dept. of Agriculture, El Reno Office
- U.S. Fish & Wildlife Ecological Service
- U.S. Geological Survey
- USDA Climate Hub, El Reno
- Wingard Water Corporation

Many of these stakeholders have already indicated an interest in partnering to implement on-the-ground strategies to achieve the Association's goals.

### ***Mission & Goals and Objectives***

As the first order of business, the Board developed priorities, Goals and Objectives and established the following Mission Statement to guide the organization as it seeks to implement this Plan:

*"...to improve water quality and water supply thus promoting economic prosperity in the region through education and development of collaborative best management practices within the Lake of the Arbuckles watershed."*

The mission statement goes hand-in-hand with Goals and Objectives of LAWA, developed and adopted by the Board:

- 1) Ensure Sustainable Management of Surface Water Resources:
  - Identify strategies to remove Arbuckle Lake from the State 303(d) impaired waterbody list for low Dissolved Oxygen levels.
  - Identify strategies to improve the condition of Guy Sandy, Rock and Buckhorn Creeks, which are listed as areas exceeding State thresholds for nutrient parameters.
  - Support municipal water supplies by encouraging existing and future water right holders to adopt sustainable water management practices that minimize impacts to streamflow, springs and lake levels.
- 2) Support Sustainable Stream Water Quality & Quantity Efforts:
  - Focus on reducing instream chemicals, pollutants and bacteria by developing Best Management Practices for the watershed.

- Coordinate ongoing water monitoring efforts to ensure data availability.
  - Support Blue Thumb and other educational outreach projects that will expand water monitoring in the watershed.
- 3) Enhance Economic Prosperity from Water Resources and Outdoor Recreation:
    - Support efforts to provide a unified water tourism voice within Murray County.
    - Showcase water quality and land use practice benefits resulting from initiated Best Management Practices.
  - 4) Promote Educational Opportunities and Activities that lead to a Healthy Watershed:
    - Promote Land Management Practices resulting in healthy soil, allowing for greater production, cleaner water and an improved environment.
    - Facilitate workshops, field days and other educational programs promoting Best Management Practices.
    - Improve and enhance riparian habitat through development of Best Management Practices.
  - 5) Development of an Advisory Committee to the Board:
    - Receive focused strategic advice from area stakeholders on watershed management.
    - Coordinate efforts combating invasive aquatic and land-based species, such as Eastern Red Cedar, Hydrilla and Zebra Mussels.

### ***Meetings***

Initial meetings of the LAWA Board, officially formed in September 2017, focused on inventorying financial and technical resources, and discussion of both watershed issues of concern and general strategies to accomplish watershed restoration and protection. Including early unofficial meetings and regular monthly meetings of the Board, LAWA members have accomplished the following important tasks:

- Developed Mission Statement and clarified project/organization Goals and Objectives.
- Filed with state as a 501(c)3 organization.
- Ensured all relevant interests are adequately represented.
- Provided input on watershed concerns.

- Educated members on watershed issues and prospective strategies.
- Provided input on preferred management strategies.
- Helped develop evaluation criteria for analyzing success of restoration/protection strategies.
- Provided review and comments on draft watershed restoration plan.
- Assisted in conducting community education and outreach.
- Discussed and approved Mission Statement.

*Table 1: LAWA Meeting Schedule and Summary*

Meeting Date	Highlights
<b>2016</b>	
October 10 (Organizational Meeting)	<ul style="list-style-type: none"> <li>• Met with OWRB, ODEQ, OCC, and USDA staff at Governor’s Water Conference to discuss the grant and receive input.</li> </ul>
December 15	<ul style="list-style-type: none"> <li>• Met with key stakeholders.</li> <li>• Discussed proposed draft Bylaws.</li> <li>• Discussed plan outreach activities and identified other stakeholders.</li> </ul>
<b>2017</b>	
January 18	<ul style="list-style-type: none"> <li>• Identified and discussed intersection of stakeholder interests.</li> <li>• Discussed and approved Mission Statement.</li> </ul>
March 28	<ul style="list-style-type: none"> <li>• CNRA discussed watershed management and cedar control in the park.</li> <li>• Department of Agriculture talked about CAFOs and related activities in the watershed.</li> <li>• Aqua Strategies discussed funding opportunities.</li> </ul>
May 22	<ul style="list-style-type: none"> <li>• Developed Watershed Management Concepts.</li> <li>• Identified watershed concerns.</li> <li>• Identified sources and potential solutions for water resource concerns.</li> </ul>
June 30	<ul style="list-style-type: none"> <li>• Chickasaw Nation discussed the status and goals of the project.</li> <li>• Noble Research Institute discussed their work with ranchers.</li> <li>• BOR summarized the grant and planning process.</li> </ul>
July 27	<ul style="list-style-type: none"> <li>• Elected Board members.</li> </ul>
August 11	<ul style="list-style-type: none"> <li>• Met with the Board to discuss the Mission Statement and Bylaws.</li> <li>• Prioritized water resource concerns.</li> <li>• Finalized watershed project concepts for top-ranked water resource concerns.</li> </ul>
September 29 (First Official LAWA Board Meeting)	<ul style="list-style-type: none"> <li>• Elected officers.</li> <li>• OWRB discussed ideas on how to improve water quality.</li> </ul>
October 27 (LAWA Board)	<ul style="list-style-type: none"> <li>• BOR staff discussed Phase I and Phase II of the watershed grant.</li> <li>• The Board discussed the Articles of Incorporation.</li> </ul>
December 1 (LAWA Board)	<ul style="list-style-type: none"> <li>• Arbuckle Master Conservancy District discussed the history of the lake.</li> <li>• Chickasaw Nation discussed their monitoring activities in the watershed.</li> <li>• Developed outline of watershed restoration plan based on watershed project concepts.</li> <li>• Implemented process and evaluation needed to develop watershed restoration plan.</li> </ul>
December 29 (LAWA Board)	<ul style="list-style-type: none"> <li>• Bylaws approved.</li> <li>• Chickasaw Nation discussed the Five Star &amp; Urban Waters grant that is being proposed to accomplish some of the water quality monitoring in the watershed.</li> </ul>
<b>2018</b>	
January 26 (LAWA Board)	<ul style="list-style-type: none"> <li>• Chickasaw Nation discussed the Five Star grant application.</li> <li>• Discussed draft LAWA Watershed Restoration Plan brochure.</li> <li>• Chickasaw Nation summarized the meeting staff had with the Noble Research Institute.</li> </ul>
February 23 (LAWA Board)	<ul style="list-style-type: none"> <li>• Discussed Technical Advisory Group membership.</li> <li>• Barney Austin presented an overview of the draft Watershed Restoration Plan, including timeline for review/submittal to BOR.</li> </ul>

Association meeting dates and brief individual meeting summaries are presented in Table 1.

### ***Technical Advisory Group***

Consistent with LAWA Goals and Objectives, the organization will also utilize a Technical Advisory Group to further inform decisions related to prescribed land use practices, monitoring and other important issues associated with implementation of the Watershed Restoration Plan. Members include representatives of:

- Arbuckle Master Conservancy District
- Buckhorn Rural Water District
- Bureau of Reclamation
- Chickasaw Nation
- Chickasaw National Recreation Area
- City of Davis
- City of Sulphur
- Murray County OSU Cooperative Extension
- Murray County Rural Water District #1
- Natural Resource Conservation Service
- Noble Research Institute
- Oaks and Prairies Joint Venture
- Oka' Institute
- Oklahoma Conservation Commission
- Oklahoma Department of Wildlife Conservation
- Oklahoma Dept. of Agriculture, Food & Forestry
- Oklahoma Dept. of Environmental Quality
- Oklahoma Water Resources Board



# Current Conditions

## Watershed Overview and Sources of Water Supply

Lake of the Arbuckles is fed by five principal creeks: Rock Creek, Guy Sandy Creek, Wilson Creek, Buckhorn Creek and Travertine Creek (Figure 3). All of these creeks are fed by springs in dry weather, with Rock and Travertine Creeks receiving additional flow contributions from artesian springs of the Arbuckle-Simpson aquifer.

## Water Rights and Uses

Table 2 summarizes existing water rights within the Lake of the Arbuckles watershed. Six of the eight rights are vested, having been in existence since 1969. Current water uses for all rights include irrigation, public supply and recreation/fish/wildlife. The 24,000 acre-feet/year (AFY) of storage within the Lake of the Arbuckles is

allotted to the Arbuckle Master Conservancy District, which supplies water to the cities of Ardmore, Davis, Wynnewood and Southern Oklahoma Water

Corporation. The City of Sulphur has also contracted for a portion of the lake's supply but doesn't currently utilize its share nor possess the infrastructure to bring that water to the community.

## Wastewater Treatment Facilities and Discharges

In the past, treated wastewater effluent was discharged into Rock Creek from the City of Sulphur's wastewater treatment plant (WWTP). Occasionally, Sulphur's sewage treatment holding pond would overflow into Rock Creek (Graham, 2015). Degradation to

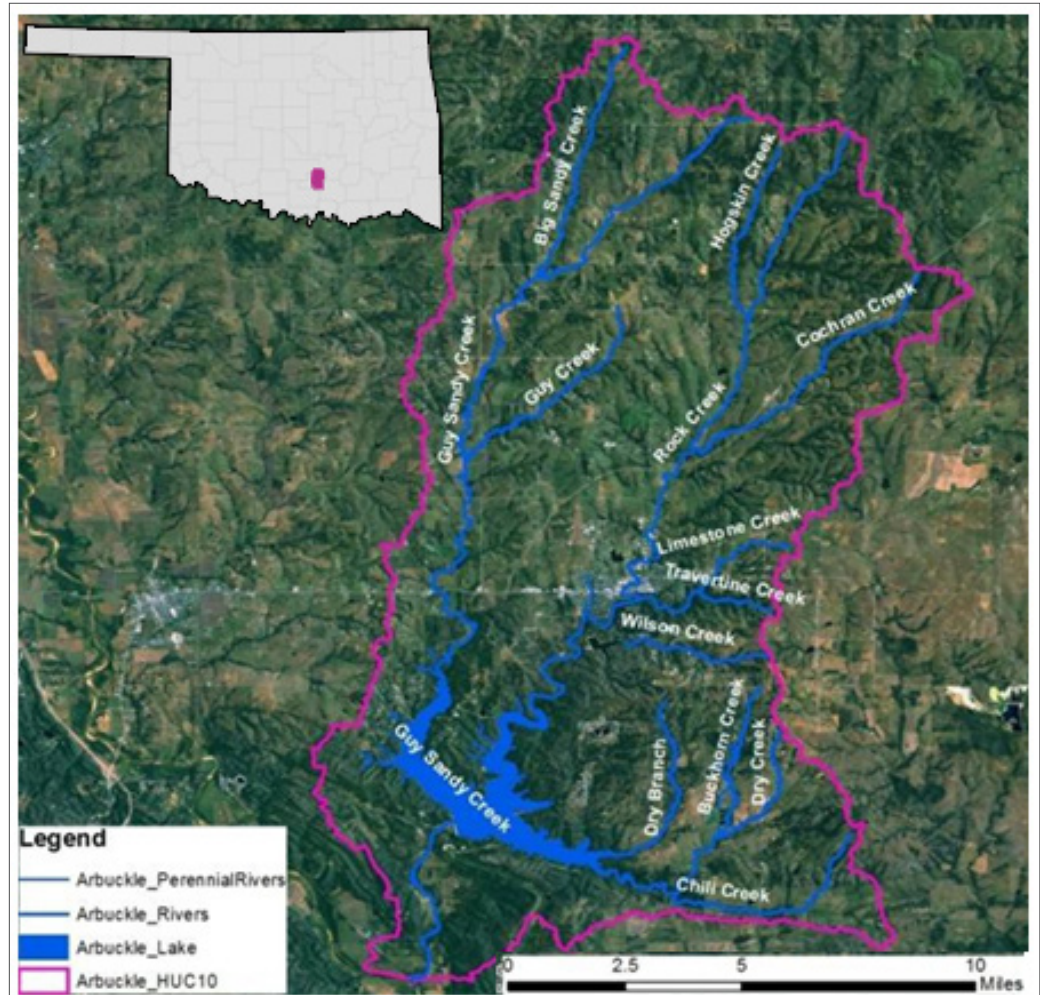


Figure 3. Contributing Creeks to the Lake of the Arbuckles.

Table 2. Water Rights and Uses in the Lake of the Arbuckles Watershed

Permit Number	Owner Name	Date Issued	Total Permitted (AFY)	Primary Purpose
19490043	Buckhorn Sportsman Club LLC	8/11/1969	500	Recreation, Fish & Wildlife
19030003	Oscar Lowrance, Jr.	8/12/1969	342	Irrigation
19540270	Denny Binderman	8/12/1969	1	Irrigation
19560823	Chickasaw National Recreation Area	8/12/1969	100	Public Supply
19610061	Willis H Milton	8/12/1969	63	Recreation, Fish & Wildlife
19570516	Arbuckle Master Conservancy District	8/12/1969	3,127	Public Supply
19820009	Arbuckle Master Conservancy District	5/11/1982	20,873	Public Supply
19980014	Jim Leanard	10/13/1998	160	Irrigation



water quality within the boundaries of the CNRA, which is adjacent to the City of Sulphur, occurred in the summer and autumn of 1994 as a result of a sewage spill, resulting in high fecal coliform levels in Travertine Creek and Rock Creek and large algal blooms in the Lake of the Arbuckles. On at least four separate occasions, a city sewer line backed up and flowed into a storm drain that later emptied into Travertine Creek, which flows into Rock Creek and the lake (Wikle et al., 1998).

Improvements were made to the system in 2007 and 2011, including treatment upgrades, storage lagoon improvements and transmission line replacements. As a result of those improvements, the Sulphur wastewater treatment plant currently discharges about 0.9 million gallons per day (MGD) of treated effluent into Dry Sandy Creek, which is outside of the Arbuckle Lake watershed. Although these upgrades significantly reduced leaks and overflows, CNRA National Park Service staff continue to work closely with the City of Sulphur to monitor and address potential sewer-line blockages and manhole overflows that may impact the water quality of the park's sensitive springs and streams.

Wastewater treatment retention facilities (lagoons) in the watershed exist at the Five Lakes Property Owners Association, Goddard Youth Camp WWTP, and Cedar Blue WWTP. The Cedar Blue WWTP experienced a number of compliance problems that are currently being remedied under an ODEQ consent order. In 2016, significant improvements were made to the system's irrigation field equipment, force mains, pumps and wet wells; a new generator was also installed.

There are currently no conventional treated wastewater dischargers in the watershed.

## Recreation

The Chickasaw National Recreation Area (CNRA), covering an area of 9,899 acres, surrounds the Lake of the Arbuckles and includes a number of springs that attract tourists to the park, Sulphur and Murray County. The National Park Service manages the CNRA along with an additional 2,409 acres in the open water area. In 2012, the CNRA received almost 1.5 million visitors. However, the drought

experienced by the entire state from 2011 to 2015 ultimately impacted lake levels and streamflow, decreasing tourism. The low flows and lake levels have yet to return to previous highs.

The springs, streams, and lakes in the Chickasaw NRA are significant resources for tourism and recreation, aquatic and terrestrial ecosystems, and public water supply. These water features draw visitors to the park to enjoy water-based recreational activities, such as boating, waterskiing, fishing and swimming, and to enjoy the scenic beauty of the Lake. The Lake of the Arbuckles is considered one of the best fishing lakes in Oklahoma for catfish, perch, bass, and crappie, and is a major tourist attraction in south central Oklahoma.

## Water Quality Summary

The following section describes current water quality in the Lake of the Arbuckles watershed as well as potential opportunities for water quality improvements.

### Lake

Oklahoma Department of Environmental Quality (ODEQ) assessments indicate that the Lake of the Arbuckles does not meet state water quality standards. In particular, the reservoir does not meet the dissolved oxygen (DO) portion of Warm Water Aquatic Community standards.<sup>1</sup> The 2015 Oklahoma Beneficial Use Monitoring Program (BUMP) Lakes Report determined that the lake is a phosphorus limited, eutrophic system, so identifying impacts of existing and future phosphorus sources in the watershed should be a priority. [BUMP includes several sites within the lake that are periodically monitored. Additional lake/stream monitoring in the watershed is conducted by the Chickasaw Nation, National Park Service and through Blue Thumb, a voluntary monitoring effort administered by the Oklahoma Conservation Commission.]

In addition, the watershed is considered a Special Provision Watershed with a Sensitive Public and Private Water Supply. The lake is included on the ODEQ priority list for 2019 to conduct a Total Maximum Daily Load (TMDL) evaluation for the DO-related impairment. A bathymetric survey of

<sup>1</sup>The Fish and Wildlife Propagation beneficial use is considered not attained with respect to dissolved oxygen if at least one of two criteria is met - Surface Criteria: More than 10% of the samples from the epilimnion during periods of thermal stratification, or the entire water column when no stratification is present, are less than 4.0 mg/L from June 16 through October 15 (5.0 mg/L during the remainder of the year). Water Column Criteria: 50% or more of the water volume has a DO concentration of less than 2.0 mg/L. Or if no volumetric data is available, more than 70% of the water column at any given sample site has a DO concentration of less than 2 mg/L.

the lake was conducted in 2016 and will help determine if the lake's DO impairment is still applicable (OWRB, 2016).

On a related note, in early 2018 the ODEQ issued an advisory for the lake concerning elevated levels of mercury found in sampled fish tissue. For at least the time-being, "sensitive" individuals (defined as women of child-bearing age, pregnant or nursing mothers, and children up to the age of 15) are advised to limit consumption of flathead catfish and white bass species of certain sizes. There are no restrictions on those fish for the general population. Black crappie, channel catfish, largemouth bass, smallmouth bass and spotted bass were also sampled and found to be safe for general population consumption. The most likely source of this mercury is thought to be atmospheric disposition from coal-fired power plants in nearby states. This issue is not associated with current activities in the Lake of the Arbuckles watershed and is thus outside the scope of this Plan.

The NPS is currently conducting a broad study of mercury occurring in national parks, including the CNRA, which includes sampling of mercury levels in dragonfly larvae. Dragonfly larvae, a popular food source for fish, accumulate higher levels of mercury than other types of aquatic insects. Final data will shed light on ecosystem health by characterizing the risk and potential transfer of mercury around food webs.

### Sub-Watersheds

Available resources were used to delineate and compare the lake's sub-watersheds (HUC12, see Figures 4 and 5). Specifically, the Soil Survey Geographic Database (SSURGO), EPA Hydrologic and Water Quality System (HAWQS) and recent water quality data were investigated to see if significant differences exist between the Guy Sandy and Rock Creek watersheds.

An uncalibrated Soil and Water Assessment Tool (SWAT) model was executed using the EPA HAWQS

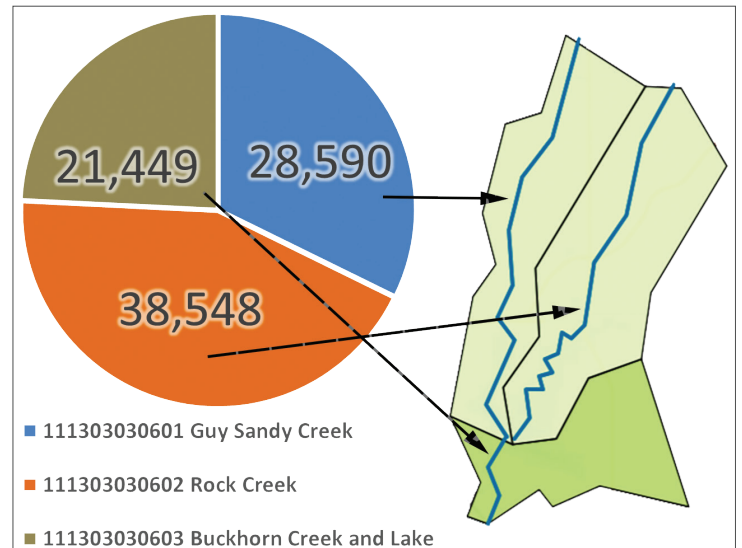


Figure 4. HUC12 sub-basins with watershed size (acres) from EPA HAWQS

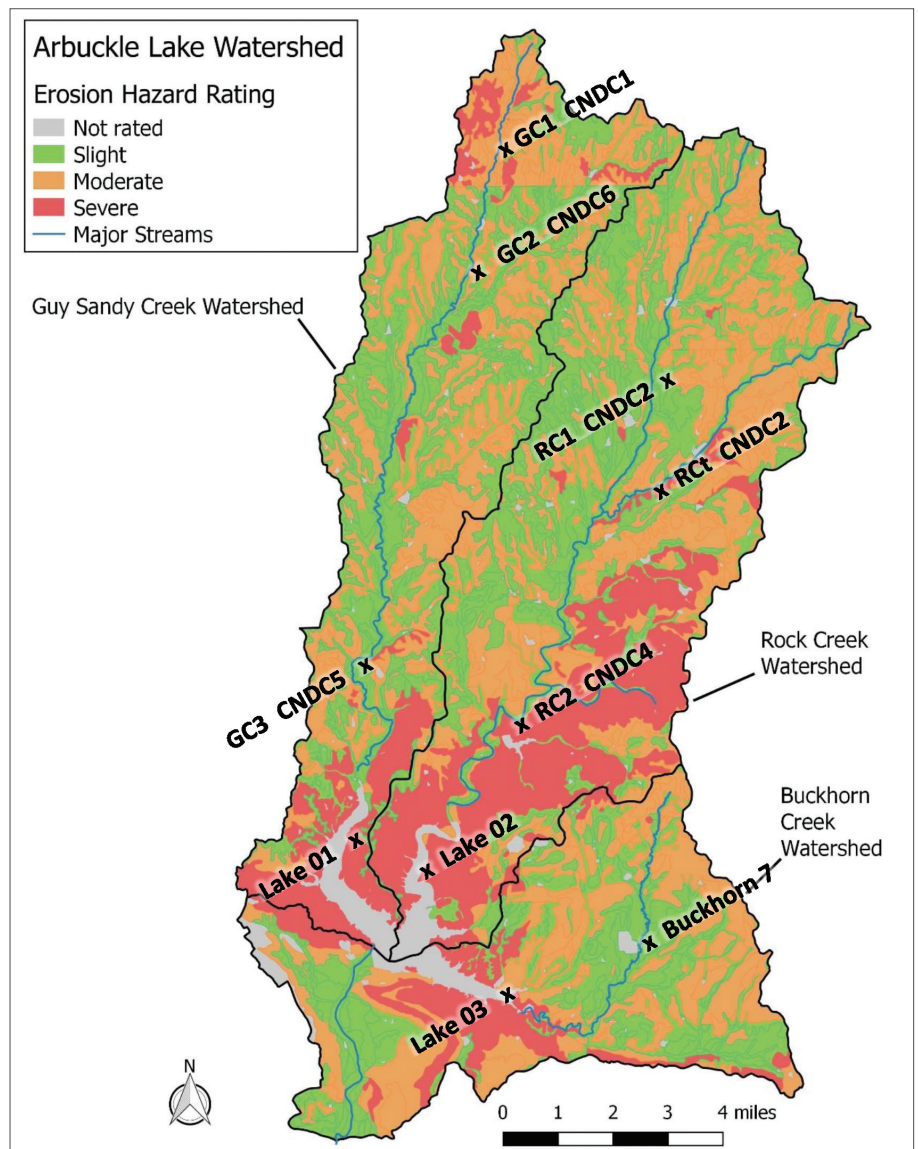


Figure 5. Lake of the Arbuckles SSURGO Erosion Hazard Rating map with Chickasaw Nation water quality sampling sites



system for an eight-year simulation period from January 2003 through December 2010. The preliminary model scenario run utilized available site-specific geospatial soil, slope, land use and precipitation datasets combined with literature values for watershed processes. Because of the relatively large HUC12 watershed area, total flow exiting the Rock Creek watershed is higher than in Guy Sandy Creek (Figures 6 and 7); however, on a per-acre basis, runoff in the Rock Creek watershed is lower than in the Guy Sandy Creek watershed (Figure 8).

Sediment loading per acre (Figure 9) from Rock Creek is higher than in Guy Sandy Creek. This is consistent with the erosion hazard rating map that exhibits higher potential erosion in the Rock Creek sub-watershed than in Guy Sandy or Buckhorn Creek (Figure 4).

Despite sediment loading from the Rock Creek watershed being higher, nutrient loading per acre from Rock Creek is lower than from Guy Sandy Creek for both nitrogen and phosphorus (Figures 10 and 11). Therefore, the Guy Sandy Creek watershed should have increased priority for nutrient (particularly phosphorus) management. Additionally, the model results should be further

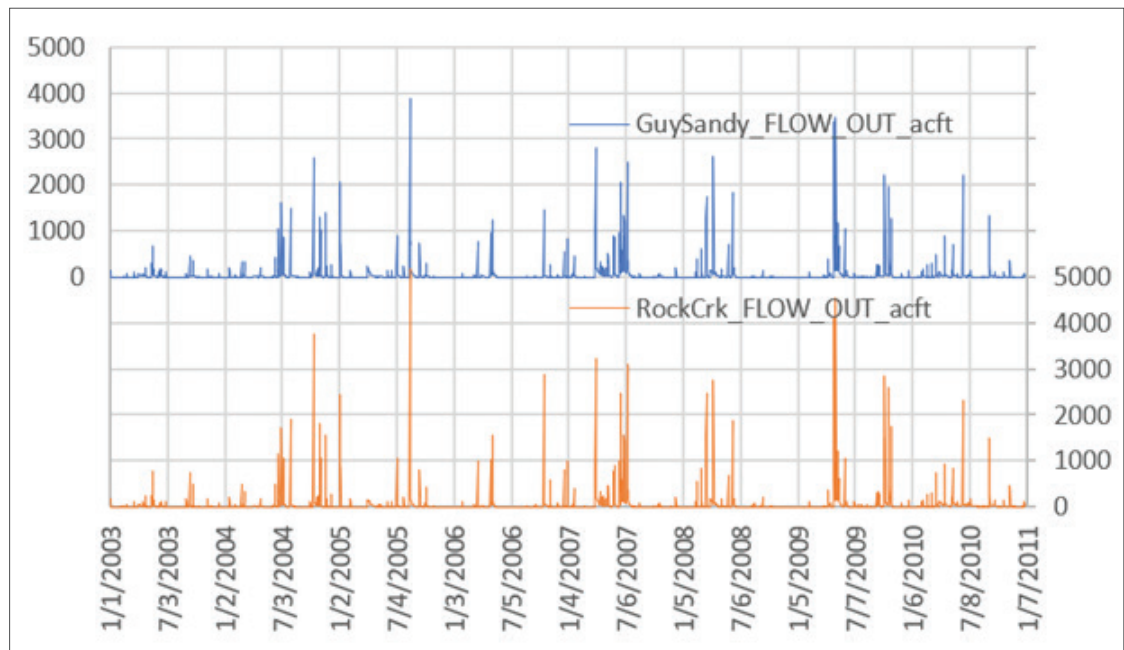


Figure 6. Uncalibrated EPA HAWQS model result for surface water flow exiting watersheds in acre-feet per day

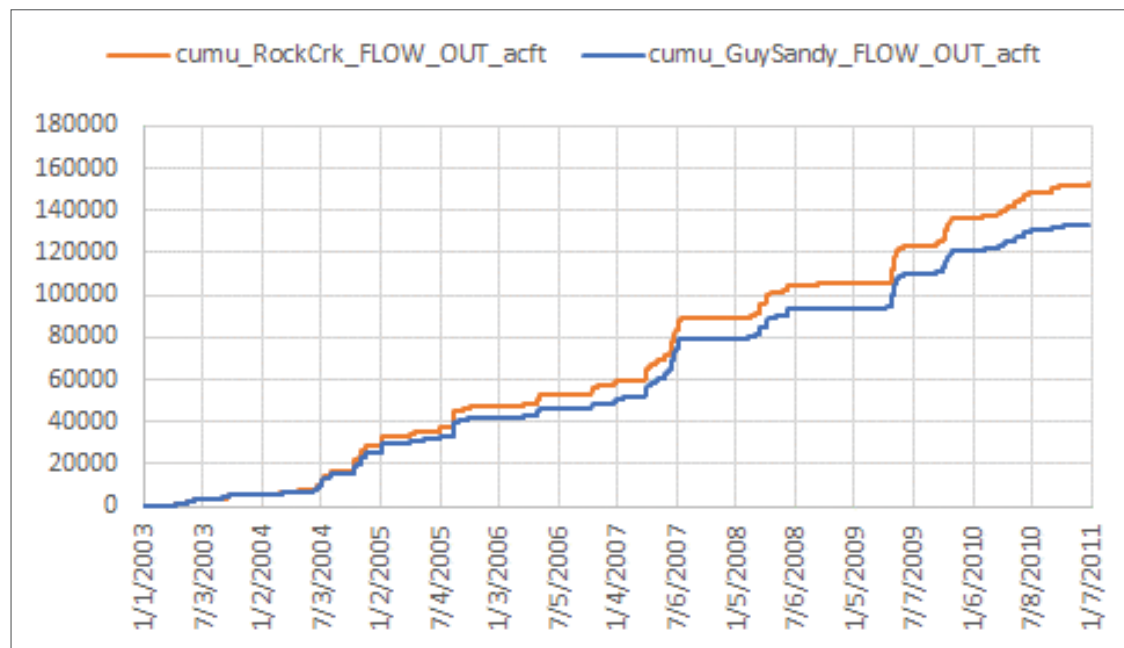


Figure 7. Uncalibrated EPA HAWQS model result for cumulative surface water flow exiting watersheds in acre-feet

investigated, calibrated and validated after incorporating additional site-specific information.

Chickasaw Nation staff collected additional water samples at nine sites during the study period. In addition to field parameters, nutrient concentrations were analyzed (Table 3). Nitrogen concentrations in the stream samples rarely exceeded the Oklahoma screening level of 3 mg/L (Figure 11). Total phosphorus (TN), however, exceeds the EPA screening level and Oklahoma Scenic River standard

of 0.037 mg/L and Oklahoma screening level for streams entering lakes of 0.016 mg/L in nearly all samples across all locations (Figure 12). Therefore, the focus for nutrient control should be on phosphorus in this watershed. Phosphorus, as well as nitrogen, is commonly contributed to streams and lakes through agricultural and municipal runoff. Because phosphorus is transported with sediments, sediment control is also a recommended focus.

Stream flow measurements were conducted during two stream and lake water quality sampling events in October 2017. The coincident flow and concentration measurements allow calculating mass loading of nutrients. Based upon loading calculations and molar ratios of total nitrogen (TN) and total phosphorus, Guy Sandy Creek appears to have higher relative phosphorus loading than Rock Creek (Table 4); this is consistent with SWAT model results and confirms the recommendation that BMP focus on phosphorus and sediment should be within the Guy Sandy Creek watershed.

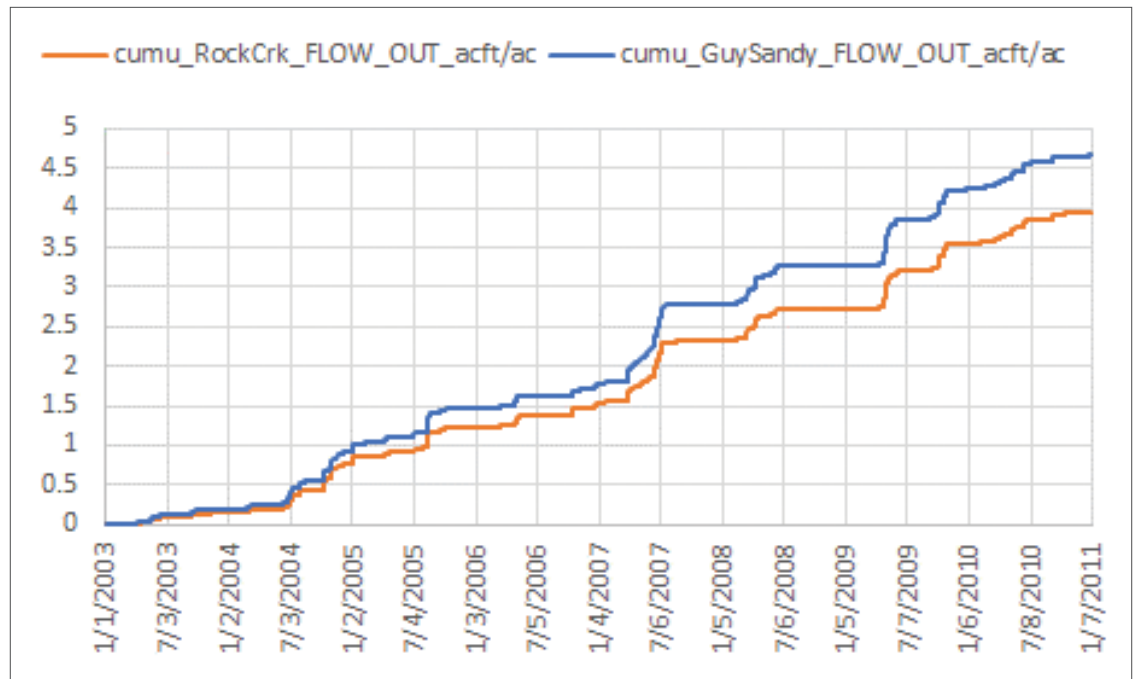


Figure 8. Uncalibrated EPA HAWQS model result for cumulative surface water flow per acre exiting watersheds in acre-feet

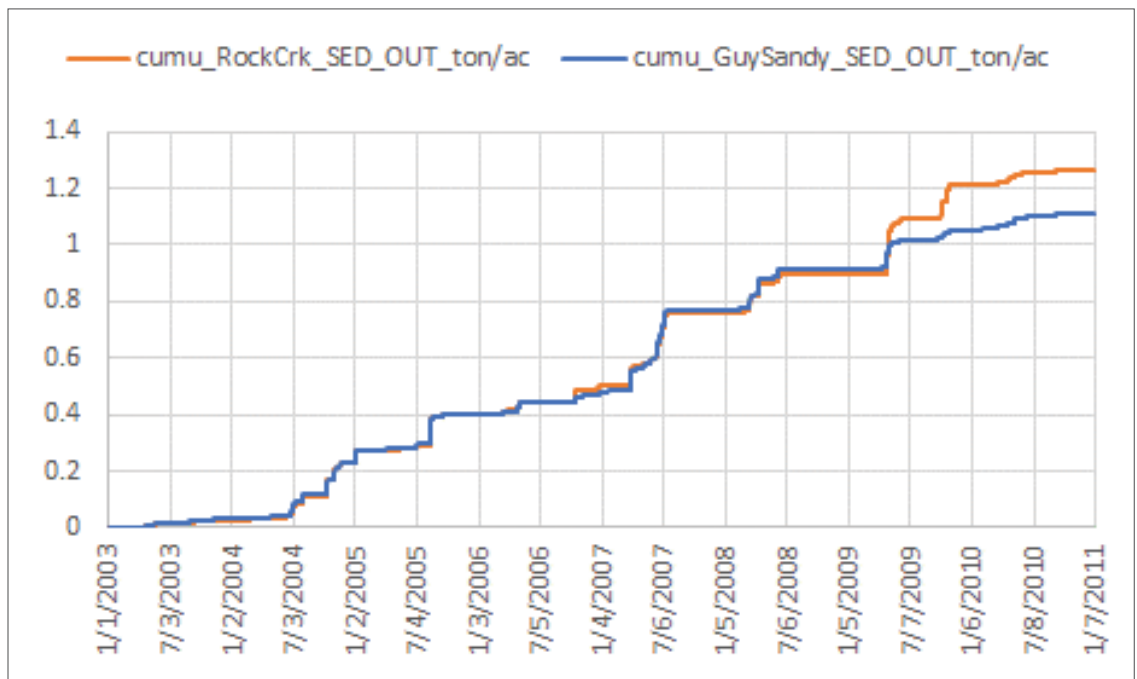


Figure 9. Uncalibrated preliminary EPA HAWQS (SWAT) model result for cumulative Sediment Loading per acre from Guy Sandy and Rock Creek watersheds

As with the stream samples, measurements of lake water quality indicate high phosphorus concentrations (Table 5).

Due to loading characteristics, implementation of management measures, such as conservation plans, in the Guy Sandy watershed are anticipated to have increased beneficial impact on Lake of the Arbuckles. Therefore, Guy Sandy Creek should receive priority

over Rock Creek for remediation and in ultimate removal of the lake from its current impaired status.

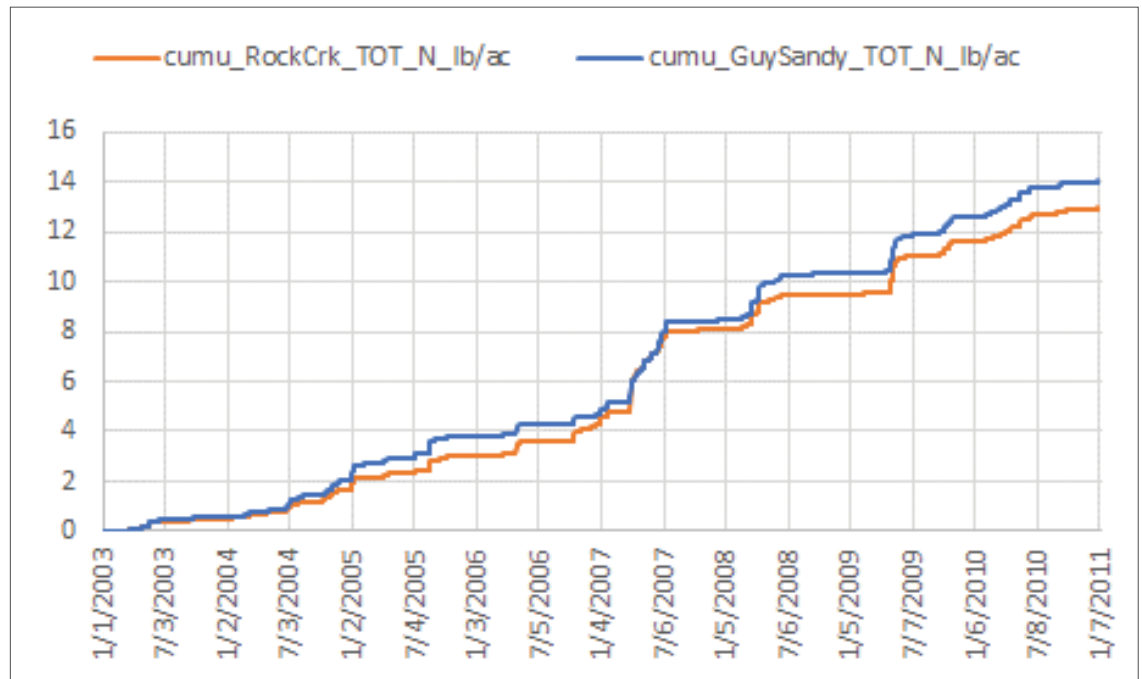


Figure 10. Uncalibrated preliminary EPA HAWQS (SWAT) model result for cumulative Nitrogen Loading per acre from Guy Sandy and Rock Creek watersheds

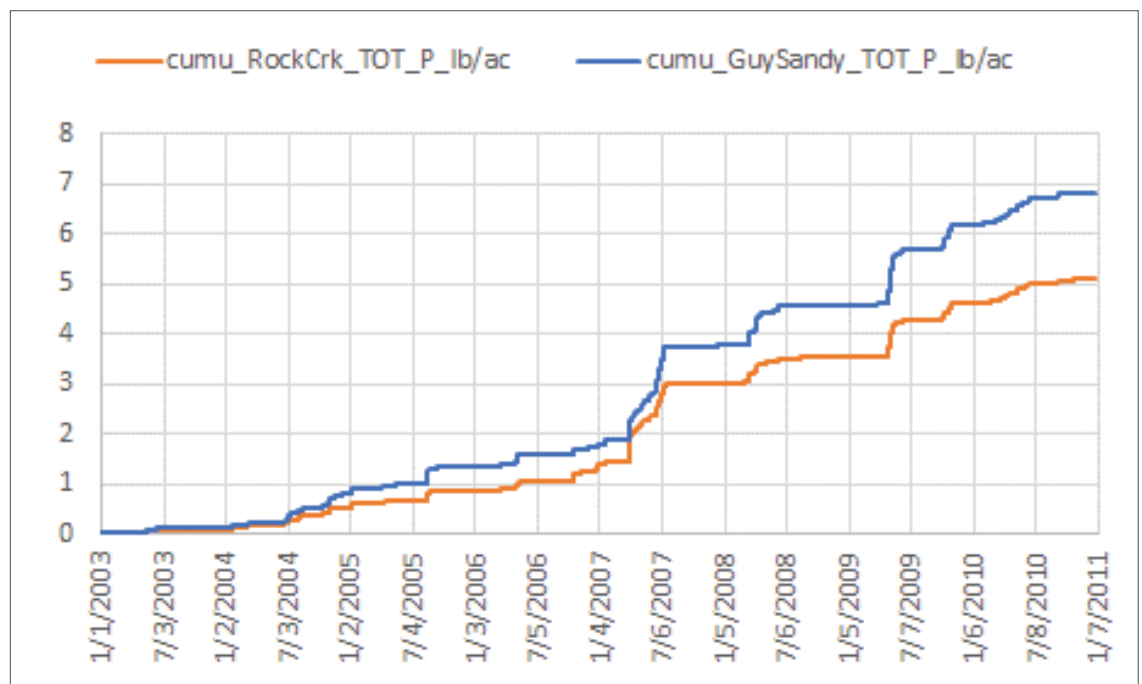


Figure 11. Uncalibrated preliminary EPA HAWQS (SWAT) model result for cumulative Phosphorus Loading per acre from Guy Sandy and Rock Creek watersheds

Table 3. Water quality concentration data in streams measured by Chickasaw Nation

	6/23/2016	7/29/2016	9/27/2016	2/23/2017	3/29/2017	5/12/2017	7/26/2017	10/4/2017	10/24/2017
<b>Total Nitrogen as N (mg/L)</b>									
GS1_Big Guy Sandy 1	NA	Dry	Dry	2.39	1.52	0.45	Dry	0.71	Dry
GS2_South Mayhard 6	NA	NA	NA	NA	1.21	0.29	1.51	0.50	1.94
GS3_Cox Coll 5	NA	1.23	0.77	4.90	0.47	0.84	1.18	0.47	1.19
RC1_Baker 2	NA	0.81	1.01	3.85	1.27	0.30	1.32	0.87	1.98
RCt_Keller 3	NA	1.45	Dry	2.59	4.32	2.36	1.78	0.53	1.57
RC2_Park 4	NA	0.63	0.80	2.10	0.91	0.69	1.44	0.52	1.60
Buckhorn 7	NA	NA	NA	NA	NA	NA	NA	0.80	1.91
<b>Total Phosphorous as P (mg/L)</b>									
GS1_Big Guy Sandy 1	BDL	Dry	Dry	0.139	0.281	0.153	Dry	0.183	Dry
GS2_South Mayhard 6	n/a	n/a	n/a	n/a	0.152	0.105	0.125	0.253	0.900
GS3_Cox Coll 5	0.086	0.051	0.093	0.321	0.330	0.193	0.185	0.210	0.156
RC1_Baker 2	0.040	0.017	0.130	0.273	0.198	0.117	0.126	0.347	BDL
RCt_Keller 3	0.019	0.108	Dry	0.216	1.550	0.782	0.103	0.112	0.032
RC2_Park 4	0.007	BDL	0.034	0.303	0.221	0.098	BDL	0.051	0.036
Buckhorn 7	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0.075	0.009
	Calculated: Phosphate x 0.326 = TP as P								

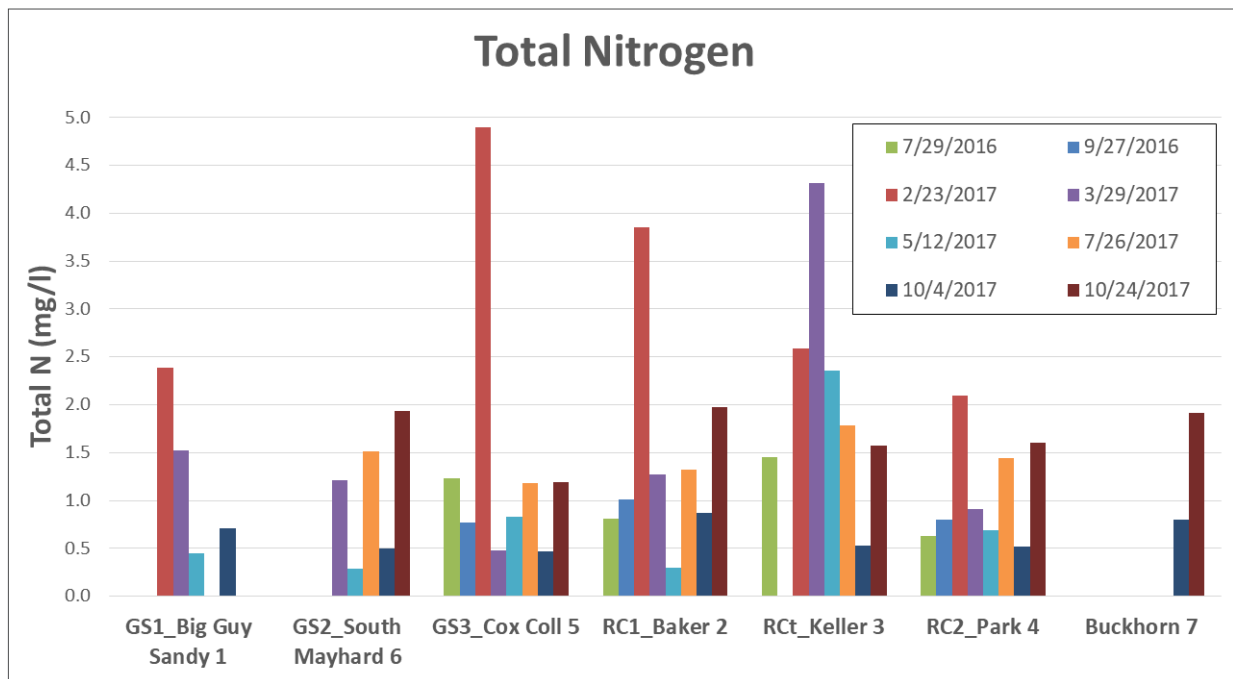


Figure 11. Total Nitrogen (TN) concentration field measurements at seven sites measured by Chickasaw Nation

Table 4. Flow measurements and calculated nutrient loading in streams measured by Chickasaw Nation

Flow (cfs)	10/4/2017	10/24/2017
GS3_Guy Sdy (Cox 5)	1.27	1.05
RC2_Rock Creek (Park 4)	17.04	9.50
Buckhorn 7	4.83	1.99
<b>TN Load (kg/day)</b>		
GS3_Guy Sdy (Cox 5)	1.45	3.06
RC2_Rock Creek (Park 4)	21.47	37.19
Buckhorn 7	9.44	9.30
<b>TP Load (kg/day)</b>		
GS3_Guy Sdy (Cox 5)	0.653	0.401
RC2_Rock Creek (Park 4)	2.126	0.837
Buckhorn 7	0.886	0.044
<b>TN:TP (molar ratio)</b>		
GS3_Guy Sdy (Cox 5)	N:P 4.9	N:P 16.9
RC2_Rock Creek (Park 4)	N:P 22.3	N:P 98.3
Buckhorn 7	N:P 23.4	N:P 469

Table 5. Water quality concentration data in Lake of the Arbuckles measured by Chickasaw Nation

Total Nitrogen (mg/L)	10/4/2017	10/24/2017
Lake 01	1.22	1.96
Lake 02	1.61	1.74
Lake 03	1.73	1.56
<b>Total Phosphorous (mg/L)</b>		
Lake 01	0.101	0.029
Lake 02	0.124	0.039
Lake 03	0.135	0.026
<b>TN:TP (molar ratio)</b>		
Lake 01	N:P 26.7	N:P 149
Lake 02	N:P 28.7	N:P 98.7
Lake 03	N:P 28.3	N:P 133
<b>Visibility (secchi depth, ft)</b>		
Lake 01	4.2	4.0
Lake 02	3.8	3.8
Lake 03	4	3.6

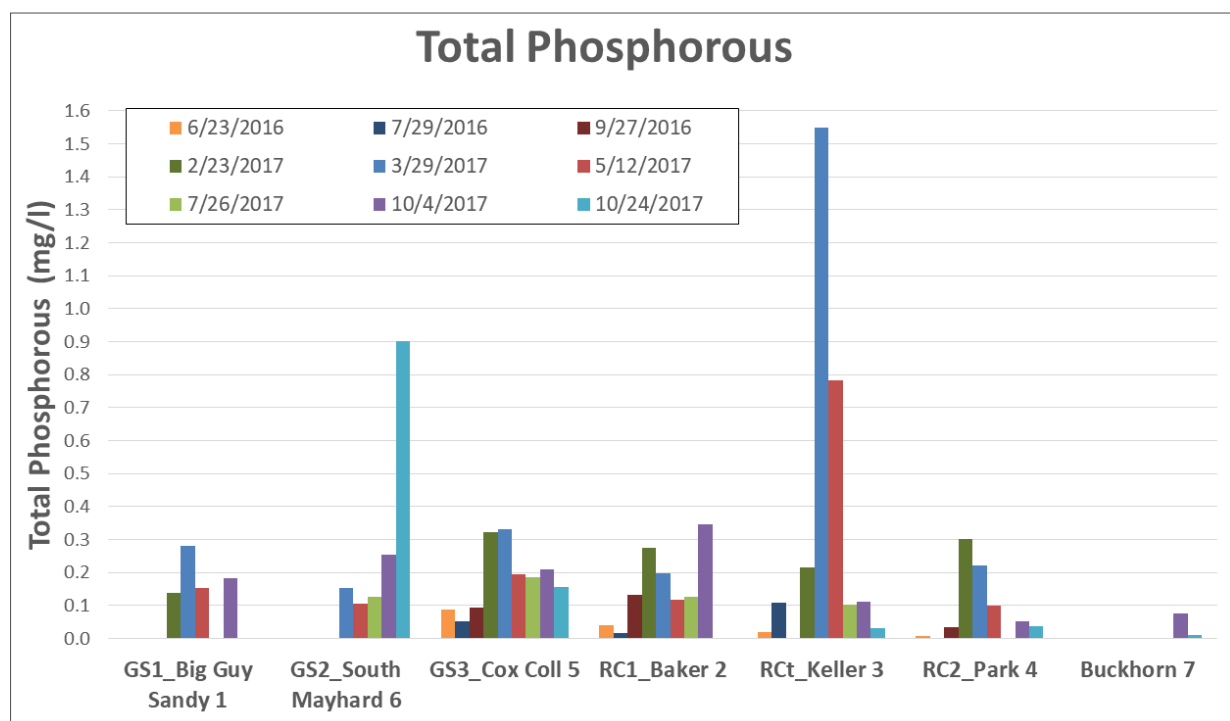


Figure 12. Total Phosphorus (TP) concentration field measurements at seven sites measured by Chickasaw Nation

# Issues of Concern or Impairment

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## Water Issues

As with many lakes, the Lake of the Arbuckles and its watershed is impacted by numerous water quality/quantity issues. Insufficient and inconsistent water supply is a growing concern in light of the recent Arbuckle-Simpson aquifer hydrology study that identified water limitations of the aquifer. This diminishing groundwater resource will put additional stress on the lake's surface supply, which could be compounded by diminished spring flows from the aquifer.

Both potable water and ecological health are impacted by impaired water quality. The EPA has designated specific beneficial use groups for the Lake of the Arbuckles. These include aesthetic value, agricultural, fish and wildlife propagation, recreation and public water supply. As mentioned, the lake is on the EPA's 303(d) list of impaired waters due to dissolved oxygen. A TMDL has not yet been conducted for this watershed because of insufficient funds. Still, removal of the Lake of the Arbuckles from the impaired waters list remains a central focus of this Plan.

Mahard Egg Farm, an egg production facility located in the upper portion of the watershed, was recently under an EPA consent order to remediate discharge violations. Remedial measures and monitoring are underway to gain compliance.

In addition, Cedar Blue RV Park, just east of the lake, was recently required by the Oklahoma Department of Environmental Quality to upgrade its wastewater treatment system, including repair of lift stations and a sewer main. The project is nearing completion.

## Environmental Issues

The springs, streams and lakes in the Lake of the Arbuckles watershed are partly sustained by groundwater-flow from the Arbuckle-Simpson aquifer. However, the quantity and quality of these water resources are threatened by groundwater withdrawals, mining, agriculture runoff, drought and climate variability.

The Lake of the Arbuckles is mesotrophic and phosphorus-limited, and it has periodically not supported the beneficial use of fish and wildlife propagation due to low dissolved oxygen

concentrations. Blue-green algae (Cyanobacteria) blooms have occurred in the lake over the last couple of years and have raised concerns about nutrient loading and the lake's trophic status.

Endangered species identified in Murray County by the U.S. Fish & Wildlife Service include the threatened piping plover (*Charadrius melodus*), endangered whooping crane (*Grus americana*), endangered least tern (*Sterna antillarum*), and the candidate species Sprague's pipit (*Anthus spragueii*).

Finally, as mentioned previously, elevated levels of mercury have been found in certain fish species. While it appears that this issue cannot be addressed by recommended land use strategies because its cause is atmospheric disposition, LAWA will continue to monitor the situation.



# Narrative and Numerical Goals for the Watershed

In improving and preserving the quality and quantity of water in the Lake of the Arbuckles and its watershed, LAWA's focus is to provide leadership and a process for watershed actions, and to ensure the accumulation and comprehensive documentation of relevant data (i.e., a data clearinghouse) to guide those actions. Associated goals are to preserve the purity and prevent contamination of associated groundwater and spring water resources. To achieve groundwater goals, the Watershed Association will promote projects that monitor the quality of groundwater and spring flow as well as minimize contamination.

Specific surface water goals seek to maintain or decrease chlorophyll-a concentrations in the lake and decrease phosphorus and nitrogen concentrations in contributing streams. In this regard, LAWA will promote land management practices in the watershed that reduce sediment and nutrient runoff.

A major focus area is to increase the number of watershed acres under conservation plans.

Monitoring goals include identification of priority areas to focus watershed efforts, identification of current-day baseline conditions and establishment of long-term monitoring to assess improvements in waterbody conditions.

Implementation of a robust water quality and watershed monitoring program will be required to determine the specific sources and magnitudes of pertinent constituents as well as the effectiveness of future watershed actions. Data would also benefit any work related to a TMDL, if necessary, to address the DO impairment. Furthermore, defined indicator values—based upon concentrations of particular constituents associated with relevant state water quality standards common in natural water bodies (Table 6)—will provide essential metrics to quantify the success of future restoration measures.

*Table 6. Relevant Water Quality Standards and Indicator Goals*

Lake			Contributing Streams		
Parameter	Value		Parameter	Value	
Dissolved Oxygen	5.0 mg/L	Oklahoma standard	Total Nitrogen	4.95 mg/L	Oklahoma standard; goal of 3 mg/L screening level
Chlorophyll-a	0.01 mg/L	Long-term average concentration at depth of 0.5 meters	Total Phosphorus	0.037 mg/L	Oklahoma standard for state Scenic Rivers; goal of 0.016 mg/L screening level for streams entering lakes

# Restoration Strategies & Project Prioritization

Effectuating water quality improvements within the Lake of the Arbuckles watershed will require the full engagement of area landowners. Key to this engagement is recognizing the consistency between land use practices commonly utilized to preserve and restore the integrity of waterways and those that increase productivity of the land.

As a result, the primary focus of this plan's implementation is working cooperatively with landowners to develop land conservation plans that sustain or improve production while preserving or enhancing the land. Targeted outreach to landowners while addressing their individual needs and concerns will be imperative to the implementation of conservation plans and related management measures in the watershed.

Consistent with LAWA objectives and priorities summarized earlier, including education, LAWA has also identified specific projects to enhance effectiveness of the Watershed Restoration Plan. Data indicates that management of sediments and nutrients, particularly phosphorus, in sub-watersheds—and especially in Guy Sandy Creek—is essential. Projects identified to date are summarized in Table 7 and organized by priorities, actions and outcomes.

## Ongoing Projects and Activities

LAWA and its partners have identified a number of ongoing projects, studies and activities—in addition to enhanced monitoring—that will impact watershed goals pertaining to water quality and quantity. Brief descriptions follow.

### *Oaks and Prairies Joint Venture Partnership*

The Oaks and Prairies Joint Venture Partnership has conducted three years of bird survey work in Murray County. Oaks and Prairies targets Native Grassland Management or Healthy Grassland Habitats under limited BMPs: Brush Management (mechanical removal), Prescribed Burning, Grassland Restoration (seed mixtures) and Prescribed Grazing. Oaks and Prairies can pay out up to 75 percent of the cost of implementation.

### *Native Grassland Project*

The Oaks and Prairies Joint Venture, National Bobwhite Conservation Initiative, Oklahoma Department of Wildlife Conservation and National Park Service are cooperating on a major grassland restoration project at CNRA that not only influences habitat for grassland bird species, but provides for a healthier watershed. LAWA hopes to encourage other landowners who are interested in returning bobwhite

*Table 7. Identified LAWA Projects, Studies and Activities According to Priorities with Expected Outcomes*

Priorities	LAWA Actions	Expected Outcomes
Education and Outreach	NFWF grant application (submitted)	Outreach materials, training sessions and land owner contacts
Coordination, Technical and Financial Support	Support USGS SCS springs connection study	Ensure water quality of springs
	Continue to follow and update Arbuckle-Simpson Aquifer Drought Contingency Plan	Ensure responsible water management and maintenance of spring flows
	Coordinate with Noble Research Institute to work with land owners on Conservation Plans	Promote watershed health, sediment management and downstream water quality
	Coordinate with Oaks and Prairies JV to improve bird habitat	Promote recreation and endangered bird species
Monitoring and Data Analysis	NFWF grant application (submitted)	Monthly and storm-event data in streams and lake
	Investigate mercury fish consumption advisory and monitor associated studies to confirm mercury sources	Understand current status and needed actions
	Continue monitoring status of Mahard Egg Farm consent actions	Promote water quality of Guy Sandy Creek and lake
	Continue monitoring status of improvements at Cedar Blue WWTP	Promote lake water quality
	Monitor state 305b water quality assessment list (Stream nutrients)	Understand current status of contributing streams
	Monitor state 305b water quality assessment list (lakes DO and chlorophyll-a)	Verify current status of lake

quail and productive native grasslands to their properties to become involved in OPJV BMPs.

**USGS Tracer SCS/Spring Connection Study**

The USGS is attempting to secure funding to determine if a hydrologic connection exists between a sewage line and Big Tom Springs in the CNRA. The USGS plans to perform a tracer test to trace the movement of sewage effluent, then analyze water quality samples to identify bacteria counts and the presence of wastewater compounds in water discharging from the spring, which flows into Rock Creek. If a hydrologic connection is confirmed, the line will need to be repaired or replaced.

**Mahard Egg Farm Consent Order**

In response to an EPA consent order, Mahard Egg Farm has cleaned out barns, closed inactive lagoons, and spread the manure at agronomic rates both within and outside the watershed. Subsequent groundwater monitoring has been conducted in the vicinity to verify that nitrate-N and ammonium-N levels have dropped below 10 mg/L.

**Wastewater Treatment at Cedar Blue RV Park**

Cedar Blue was required to repair and modify their lift stations, add an irrigation field and relocate a forced sewer main by June 2017. When Chickasaw Nation staff last visited the Park, all that remained to be done was to hang signage and have ODEQ conduct a final inspection.

**Arbuckle Rangeland Restoration Association**

The Arbuckle Rangeland Restoration Association, one of 21 Local Prescribed Burn Associations in Oklahoma, oversees such activities in Murray County and adjoining counties in the watershed region. The Association is a partnership between landowners and other local citizens to conduct prescribed burning, a key land management practice used to restore and maintain native plant communities to their former diversity and productivity for livestock production and wildlife habitat, along with reducing fuels and damage from wildfires.

**Oklahoma Department of Wildlife Conservation Fishery and Wildlife Management**

The ODWC maintains the Lake of the Arbuckles Fishery Management Plan, developed to

maintain and improve aquatic resources in the lake, as well as a working Memorandum of Understanding with the NPS concerning the management and regulation of wildlife resources within the CNRA.

**Monitoring**

To help facilitate accomplishment of its monitoring goal, LAWA has submitted a grant application to the National Fish and Wildlife Foundation (NFWF) through its Five Star & Urban Waters Restoration Program. If funded, three additional monitoring sites will be established and monitoring at four existing sites expanded (frequency and parameters) to obtain crucial watershed/water quality data. Current and proposed sites are detailed in Table 8. Grant funds will also be used for education/outreach.

Once sufficient monitoring data is available, additional steps similar to those conducted as part of an EPA watershed-based plan can be conducted in the Lake of the Arbuckles watershed. Typical components of an EPA 319 project include source identification, pollutant loading analysis, load reduction goals, and recommendations of management measures that achieve load reduction goals.

Until additional data is available to make those steps possible, LAWA will promote sustainable watershed practices, including landowner implementation of conservation plans with BMPs, that reduce sediment and nutrients from entering waterways. While these activities lack specific quantitative end targets, they contribute to net reductions in loading and subsequent improvements in water quality.

Table 8. Proposed Monitoring Program

Current/Expanded Sites	Oversight	Proposed New Sites	Oversight
40-Foot Hole on Rock Creek	National Park Service & Chickasaw Nation	Guy Sandy Creek at Oaklawn	Chickasaw Nation
Buckhorn Creek at the Hatchery		Rock Creek at the Turnpike	
Guy Sandy Creek		Travertine Creek at USGS stream gage	
Lake near Dam/ Intake			

Landowner Education and Partnerships

An integral source of LAWA engagement with landowners will be through training and education workshops hosted in concert with local community groups (such as Rotary Clubs), elected bodies and local conservation organizations. LAWA will also take advantage of existing opportunities and programs to disseminate information related to effective land use practices.

Specifically concerning education of youth and the general public, numerous opportunities already exist in the Lake of the Arbuckles watershed region through which to disseminate information about ongoing LAWA watershed efforts and the value of watershed sustainability and protection. Potential youth education opportunities are listed in Table 9. As mentioned, a grant application has been submitted to the National Fish and Wildlife Foundation (NFWF) to fund a portion of Restoration Plan education as well as monitoring. The Oka’ Institute will establish a website to support LAWA, which will also provide an opportunity to share educational materials, such as the “Restoring the Lake of the Arbuckles Watershed” brochure that is currently in development (see Appendix).

Table 9. Youth Education Opportunities

Activity/Event	Target Audience	Potential Funding Source
Water Festival	4 <sup>th</sup> Grade Students	OSU County Extension
EARTH Workshop	K–12 <sup>th</sup> Grade Students	NFWF Grant
Stream Workshop	7 <sup>th</sup> –8 <sup>th</sup> Grade Students	Friends of Chickasaw NRA
Day on the Farm Workshop	3 <sup>rd</sup> Grade Students	Farm Bureau
Water-based Art & Essay Contest	K–12 <sup>th</sup> Grade Students	Chickasaw Nation
Arbuckle Water Eco-Camp	K–12 <sup>th</sup> Grade Students	OSU County Extension

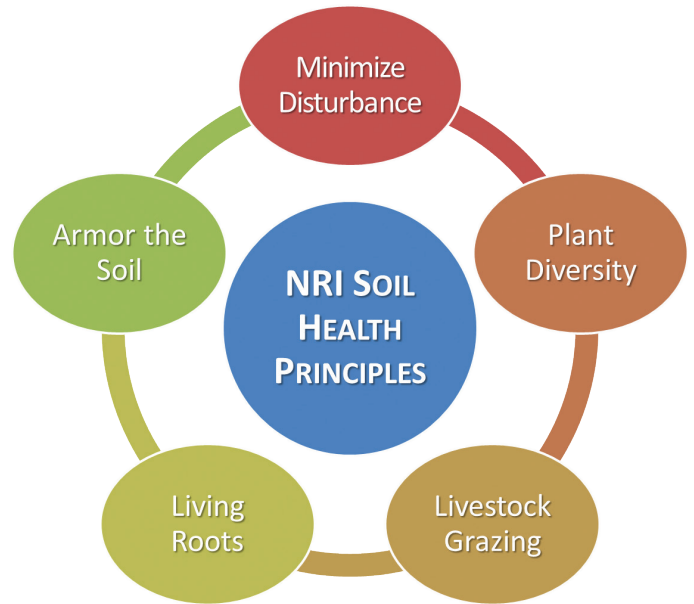
Watershed Restoration Principles

Soil Health

LAWA proposes to address soil health deficiencies within the watershed through promoting landowner utilization of an Oklahoma Conservation Commission initiative that facilitates local non-regulatory, voluntary partnerships to target and

resolve issues. The USDA Natural Resources Conservation Service states that understanding soil health means assessing and managing soil so that it functions optimally and is not degraded. By monitoring changes in soil health, a land manager can determine if a set of practices is sustainable. LAWA will engage landowners through local community workshops, civic organizations and conservation groups to provide soil health training and education to landowners. A key strategic partner in this conservation delivery strategy will be the Noble Research Institute, which builds upon existing soil health initiatives through five proven principles:

- 1) **Armor the Soil:**  
*Bare ground is enemy number one. Insufficient cover can increase soil temperatures, decreasing or killing biological activity. Soil bacteria die at temperatures reaching 140 degrees Fahrenheit. Bare ground must be minimized or avoided through forage, crop residue or related cover methods.*
- 2) **Minimize Soil Disturbance:**  
*Physical soil disturbance such as plowing and overgrazing can result in bare ground and compacted soils that disrupt soil microbial activity. Incorporating reduced tillage methods in cropping systems and proper grazing management in pastures will keep soil covered.*
- 3) **Increase Plant Diversity:**  
*Increasing plant diversity above ground allows for a more diverse underground community. Specific soil microbes require specific plant types. The more diverse the microbial population in the soil, the better the forage will respond, due to increased biological activity.*





#### **4) *Keep Living Roots in the Ground All Year:***

*Soils are most productive when soil microbes have access to living plant material. A living root provides a food source for beneficial bacteria and promotes the symbiotic relationship between plant roots and mycorrhizal fungi. This is aided by increased plant diversity, which can be achieved by incorporating cover crops into your pasture and crop systems.*

#### **5) *Integrate Livestock Grazing:***

*Grasses evolved under grazing pressure. Soil and plant health is improved by grazing, which recycles nutrients through improved manure distribution, reduces plant selectivity and increases plant diversity. The most important factor in grazing systems is to allow adequate rest for the plant to recover before being grazed again.*

A primary goal of a rancher should be to improve soil health. As more grass is grown, more organic matter is available to recycle into the soil for feeding microbes. This captures and holds more water and nutrients, growing more and larger plants that can gather more sunlight to power the process.

The Noble Research Institute provides farmers, ranchers and land managers with no-cost consultation services that engage them in both science-based BMPs for achieving specific goals and creating sustainable outcomes for agriculture and overall watershed health. LAWA will provide educational outreach to watershed landowners promoting the value of Noble Research Institute BMPs and management plans.

### ***Native Grassland Management***

LAWA recognizes the elemental importance of native grasses to the Lake of the Arbuckles watershed. However, these native grassland ecosystems are currently threatened by conversion to urban and pasture land, fragmentation and decreasing land parcel size. Their restoration is essential to the future sustainability of the watershed, resulting in increased water infiltration and yield, reduced erosion and lake sedimentation, augmented water supply, and expected improvements in water quality due to the decreased use of fertilizers, pesticides and herbicides. Aside from watershed protection, native grasslands also provide many direct economic benefits to landowners and producers, such as increased livestock forage and wildlife habitat.

The success of grassland management and restoration in the watershed is in the hands of private

landowners, who own 94.6 percent of the land in Oklahoma. Therefore, LAWA will work closely with landowners and other relevant stakeholders to maintain both the productivity of the land and value of natural habitats—including that required for fish and wildlife populations—while preserving the economic bottom-line of producers.

As mentioned, the Oaks and Prairies Joint Venture, a public/private partnership supporting voluntary bird conservation with an ongoing project in the watershed, could help facilitate LAWA efforts focused on native grassland management. Already, OPJV has completed three years of bird survey work in Murray County, establishing a baseline for bird species richness within the area. OPJV also administers the Grassland Restoration Incentive Program (GRIP), which pays landowners (up to 75 percent of the cost) to implement approved grassland bird habitat improvement practices on their property.

### **Restoration Plan Initiatives**

Presented on the following page are overarching priority initiatives identified by the LAWA Board that should result in the most effective implementation of this Watershed Restoration Plan and, in particular, removal of the Lake of the Arbuckles from the EPA's 303(d) list of impaired waters. The subsequent section outlines implementation of these and related strategies.

# *Lake of the Arbuckles Watershed Restoration Plan*

## *Priority Initiatives*

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### **LAKE OF THE ARBUCKLES WATERSHED ASSOCIATION**

- ◆ The Lake of the Arbuckles Watershed Association will continue as a permanent, voluntary organization which will:
  - ▶ Implement and regularly update the Lake of the Arbuckles Watershed Restoration Plan;
  - ▶ Seek out and secure technical and financial assistance that will contribute to watershed restoration and preservation;
  - ▶ Oversee surface water, spring and groundwater monitoring activities in the watershed and serve as a clearinghouse for both existing and future data; and
  - ▶ Promote landowner education—especially that associated with the benefits of soil health and prescribed land use practices—and conduct public education and outreach in local schools and communities to advance knowledge of watershed sustainability concepts.

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### **RESTORATION STRATEGIES**

- ◆ The Lake of the Arbuckles Watershed Association has determined that implementation of the following strategies is imperative to restoration and long-term preservation of the lake's watershed, including removal of the lake from the EPA's 303(d) list of impaired waters:

#### **SOIL HEALTH**

- ▶ The Noble Research Institute and other relevant partner agencies and organizations will provide technical on-the-ground assistance to individual landowners in the watershed through development and implementation of science-based best management practices. LAWA will serve as the intermediary between soil health experts and landowners, promoting the benefit and importance of voluntary BMPs in relation to general watershed health while ensuring the accomplishment of specific landowner goals.
- ▶ LAWA and partners will promote and advance the recognition of soil health principals in the Lake of the Arbuckles watershed, including land assessments of soil health, the utilization of soil quality indicators and a general understanding of the linkage between overall soil health and related economic benefits to landowners in the watershed. LAWA and partners/experts will utilize land management demonstration projects, workshops and field days to provide educational outreach to landowners and other stakeholders.

#### **NATIVE GRASSLAND MANAGEMENT**

- ▶ LAWA will facilitate the involvement of partner agencies and organizations in providing technical assistance to landowners through development of science-based BMPs specifically targeting native grasslands, including brush management (mechanical removal), prescribed burning, grassland restoration (seed mixtures) and prescribed grazing. LAWA will leverage ongoing grassland management initiatives, such as the Oaks and Prairies Joint Venture Partnership that includes Murray County in its Grassland Bird Restoration Focus Area.

# Implementation

## Timeline and Measurable Milestones

The following are goals and milestones for watershed restoration:

- Within 2 years, LAWA and its partners will ensure development of landowner conservation plans and conduct associated outreach activities that will result in no net increases in nutrient and sediment loading in targeted creeks.
- Within 5 years, LAWA restoration strategies will result in maintenance (i.e., no increase) of chlorophyll-a in the lake and reduction in nutrient and sediment concentrations in contributing streams, thereby reducing loading to the lake.
- Within 10 years, LAWA restoration strategies will result in a noticeable change or reduction in chlorophyll-a in the lake.

## Monitoring

To assist in measuring the success of Restoration Plan implementation, at least once per year, LAWA will provide updates on the following metrics:

- Number of hosted or sponsored educational activities;
- Number of landowners contacted and participating in educational activities;
- Number of landowner soils tests;
- Number of acres under conservation plans;
- Number of acres with implemented BMPs (prescribed burns, fencing, alternative water sources, etc.);
- Birding habitat acres improved or managed; and
- Watershed and lake monitoring indicators (TP, TN, chlorophyll-a and DO).

In addition, each LAWA meeting will include an update on water quality metrics (TP, TN, chlorophyll-a and DO), according to the most recent data.

## Potential Funding Sources

The Natural Resources Conservation Service (NRCS) Environmental Quality Incentives Program (EQIP) is widely used by landowners in Murray County. Additional funding mechanisms are available to conservation partners, including Tribal governments and higher education institutes, to provide financial assistance directly to landowners. The following

section summarizes federal, state and private assistance programs that promote land stewardship, water conservation, wildlife habitat improvement and related efforts in Oklahoma. Programs that seek to improve water quality, quantity and on-farm economics are also included for potential utility in the Lake of the Arbuckles watershed.

Funding sources change annually, so the best way for landowners to take advantage of funding is to develop site-specific conservation plans as well as a beneficial working relationship with NRCS agents, OCC staff and local conservation groups. These experts in the field continually monitor funding opportunities and changes, including sources available from intermediary non-profit conservation partners.

### *U.S. Department of Agriculture/Natural Resources Conservation Service*

#### Conservation Innovation Grants (CIG)/

#### Environmental Quality Incentives Program (EQIP):

Conservation Innovation Grants (CIG) are competitive grants funded by the Environmental Quality Incentives Program (EQIP). They are focused on providing a bridge between research and widespread application of innovative approaches and technologies for conservation on agricultural lands. CIG is used to scale proven, emerging conservation strategies in order to increase adoption including pilot projects, field demonstrations and on-farm conservation research. Resource concerns addressed by CIG grants include water quality, wildlife, soil, grazing, and water quantity.

Focus areas for FY 2017 funding include precision conservation; water management technologies and approaches; and benefitting historically underserved and military farmers, ranchers and private forest landowners. Each year, up to 10 percent of national CIG funds may be set aside for applicants who are beginning or limited resource farmers and ranchers, American Indian Tribes, or community-based organizations that include or represent these producers and private forest landowners. Competitive grant funding with an award ceiling of \$2,000,000. 50 percent non-federal matching funds must be provided by the grantee.

#### Regional Conservation Partnership Program (RCPP):

RCPP projects address resource concerns, including excess/insufficient water/drought, water quality

degradation, soil quality degradation, inadequate habitat for fish and wildlife (and invertebrates), air quality impacts, degraded plant condition, energy and climate uncertainty.

Conservation partners will work together to promote healthy habitat, the sustainable use of water resources and a productive agricultural sector. Individual landowners are not eligible for this funding directly, rather project partners apply for funding that is then distributed to landowners.

Recent example projects selected under RCPP in Oklahoma include the Elk City Lake Watershed RCPP Project and Middle and Lower Neosho River Basin RCPP Project both addressing water quality issues. Both projects will work with landowners in the watershed to install conservation measures that reduce delivery of pollutants (nutrients, sediment, bacteria) contributing to problems in the lake.

Oklahoma is in the Prairie Grasslands Region, which is identified as a Critical Conservation Area (CCA), and is eligible to receive 35% of funding (\$10,000,000 maximum).

#### Agricultural Conservation Easement Program (ACEP)/Wetlands Reserve Easements:

NRCS provides financial assistance to eligible partners for purchasing Agricultural Land Easements that protect the agricultural use and conservation values of eligible land. In the case of working farms, the program helps farmers and ranchers keep their land in agriculture. The program also protects grazing uses and related conservation values by conserving grassland, including rangeland, pastureland and shrub land. Eligible partners include American Indian tribes, state and local governments and non-governmental organizations that have farmland, rangeland or grassland protection programs. Under the Agricultural Land component, NRCS may contribute up to 50 percent of the fair market value of the agricultural land easement. Where NRCS determines that grasslands of special environmental significance will be protected, NRCS may contribute up to 75 percent of the fair market value of the agricultural land easement.

The Agricultural Conservation Easement Program (ACEP) provides financial and technical assistance to help conserve agricultural lands and wetlands and their related benefits. Under the Agricultural Land Easements component, NRCS helps Indian tribes, state and local governments and non-governmental organizations protect working agricultural lands

and limit non-agricultural uses of the land. Under the Wetlands Reserve Easements component, NRCS helps to restore, protect and enhance enrolled wetlands.

#### Conservation Stewardship Program (CSP):

The Conservation Stewardship Program (CSP) helps agricultural producers maintain and improve their existing conservation systems and adopt additional conservation activities to address priority resources concerns. Participants earn CSP payments for conservation performance—the higher the performance, the higher the payment.

Enhancements are management activities that go above and beyond the minimum practice requirements helping the producer achieve a higher level of conservation. Bundles are suites of conservation enhancements designed to address multiple resource concerns. Bundle options are offered at a higher payment rate.

#### Grassland Restoration Incentive Program (GRIP):

GRIP provides financial assistance to landowners for grassland restoration practices such as range planting, prescribed burning and invasive plant control. GRIP is administered by the Oaks and Prairies Joint Venture, a regional partnership of government and non-government organizations in Oklahoma and Texas including the National Wild Turkey Federation, Oklahoma Department of Wildlife Conservation and Texas Parks and Wildlife Department.

#### Working Lands for Wildlife (WLFW):

Through WLFW NRCS works with partners and private landowners to focus voluntary conservation on working landscapes. NRCS provides technical and financial assistance to agricultural producers, helping them plan and implement conservation practices that benefit target species and priority landscapes. The monarch butterfly is a new national priority species of WLFW.

#### Improving Working Lands for Monarch Butterflies:

NRCS offers technical and financial assistance to help landowners manage monarch habitat on farms, ranches and forests. Producers and conservation partners can plant milkweed and nectar-rich plants along field borders, in buffers along waterways or around wetlands, in pastures and other suitable locations. Conservation practices that benefit monarch butterflies and other insects also help reduce erosion, increase soil health, control invasive species, provide quality forage for livestock and



make agricultural operations more resilient and productive. Financial assistance is provided to implement these practices, helping producers improve working lands.

Wildlife Habitat Incentive Program (WHIP):

WHIP was repealed in 2014, but LAWA will monitor potential future reenactment of the Program.

***USDA/Farm Service Agency (FSA)***

Conservation Reserve Program (CRP):

The Conservation Reserve Program (CRP) offers financial incentives to private landowners to help improve water quality, prevent soil erosion, and reduce loss of wildlife habitat by planting trees, grass, and other long-term cover. The CRP is the largest private-lands conservation program in the United States. Land must be agricultural commodity cropland or marginal pastureland that is suitable for one of 42 conservation practices defined by the program such as riparian buffers or filter strips.

Special CRP initiatives with additional funding include:

Clean Lakes, Estuaries and Rivers (CLEAR):

CLEAR will assist landowners with the cost of building bioreactors and saturated buffers that filter nitrates and other nutrients from tile-drained cropland. Early estimates indicate that CLEAR could help to reduce nitrate runoff by as much as 40 percent over traditional conservation methods. CLEAR may cover up to 90 percent of the cost to install these new practices through incentives and cost-share. These new methods are especially important in areas where traditional buffers have not been enough to prevent nutrients from reaching bodies of water.

State Acres for Wildlife Enhancement (SAFE)

Initiative:

Through SAFE, landowners re-establish wetlands, grasses, and trees on their land. These practices are designed to enhance important wildlife populations by creating critical habitat and food sources. They also protect soil and water health by working as a barrier to sediment and nutrient runoff before they reach waterways.

***U.S. Environmental Protection Agency (EPA)***

Section 319 Nonpoint Source Management Program Grants:

The 1987 amendments to the Clean Water Act (CWA) established Section 319 Nonpoint Source Management Program funding to address the need

for greater federal leadership to help focus state and local nonpoint source efforts. Under Section 319, states, territories and tribes receive grant money that supports a wide variety of activities, including technical assistance, financial assistance, education, training, technology transfer, demonstration projects and monitoring to assess the success of specific nonpoint source implementation projects.

Environmental Education Grants:

In 2018 EPA is making available up to \$3 million in funding for locally-focused environmental education grants to support environmental conservation and stewardship. Requests for Proposals are issued in each of EPA's ten Regions in anticipation of awarding three to four grants in each Region of between \$50,000 and \$100,000 each. The program requires a 25% match.

Healthy Watershed Consortium Grants (HWCG):

The Healthy Watersheds Consortium Grant Program goal is the protection of healthy, freshwater ecosystems and their watersheds. This program is in partnership with the U.S. Endowment, and the Natural Resources Conservation Service. The focus for the HWS Grant Program is larger scale watershed protection and land management which ultimately benefits water quality. Up to \$3 million is of funding is available for 2018 with awards ranging from \$50,000 - \$300,000. There is a 25% minimum match requirement.

Pollution Prevention (P2) Grant Program:

This program funds grants/cooperative agreements that implement pollution prevention technical assistance services and/or training for businesses and support projects that utilize pollution prevention techniques to reduce and/or eliminate pollution from air, water and/or land. EPA awarded approximately \$7.94 million in P2 grants in FY2016 and FY2017. There is a match requirement of 50 percent match; for tribal governments that place P2 grant activities into a performance partnership grant (PPG) the match for the federally-recognized tribe gets reduced to 5 percent. Proposed range in FY 2016 is \$40,000 - \$360,000 for a two-year funding period. An average of 40 grants is issued annually.

Source Reduction Assistance Grant Program (SRA):

SRA awards support pollution prevention through source reduction and resource conservation work. Proposed projects must carry out one or more of the following activities: surveys, studies, research, investigation, experimentation, education, training

and/or demonstrations. In FY2016 the 20 grant awards ranged from \$20,000 - \$260,000 for a two-year funding period. There is a 5 percent match requirement.

#### Urban Waters Small Grants:

The Urban Waters Small Grants are competed and awarded every two years. Grant funds are awarded to projects that address local water quality issues related to urban runoff pollution, foster partnerships, and provide community benefits. Since its inception in 2012, the program has awarded approximately \$6.6 million in Urban Waters Small Grants to 114 organizations across the country and Puerto Rico, with individual award amounts of up to \$60,000.

#### ***U.S. Fish and Wildlife Service (USFWS)***

##### Tribal Wildlife Grants:

The purpose of the funding is to provide technical and financial assistance for the development and implementation of programs that benefit fish and wildlife resources and their habitat, including species that are not hunted or fished. Funding is available for projects that initiate, develop or implement activities or programs that benefit wildlife and their habitat, including species of Native American cultural or traditional importance and species that are not hunted or fished. Grants have been awarded for wildlife management activities, conservation easements and habitat restoration and preservation. There is a maximum of \$200,000 grant funding per project with 20 -30 awards anticipated for 2017. Matching funds are not required.

##### Partners for Fish and Wildlife Program:

Partners for Wildlife is designed to form alliances between private landowners and government agencies through technical assistance and cost sharing projects that significantly improve fish and wildlife resources, while promoting compatibility between agriculture and other land uses. The objectives of the program are to promote and implement habitat improvement projects on private lands that benefit Federal trust species including migratory birds, threatened and endangered species. There are 30 such species in the Lake of the Arbuckles watershed.

Regional priorities identified by the Southwest Region Management Team include Native American affairs and strategic habitat conservation/ implementation including short and tall grass prairies, and rare, imperiled and listed species in Oklahoma. Four projects have been funded in

Murray County of the 948 project sites implemented under this program in Oklahoma. This program is a cost-share cooperative agreement or contract for a minimum of 10 years in duration. Funding is limited to \$25,000 per project.

#### ***U.S. Bureau of Reclamation***

##### WaterSMART Cooperative Watershed Management Program Grants:

The Cooperative Watershed Management Program (CWMP) contributes to the WaterSMART strategy by providing funding to watershed groups to encourage diverse stakeholders to form local solutions to address their water management needs. Through CWMP grants, Reclamation promotes the sustainable use of water resources and improves the ecological resilience of rivers and streams using collaborative conservation efforts. Funding is provided on a competitive basis for 1) development of watershed groups (such as LAWA); and 2) implementation of watershed management projects. LAWA's early work has placed the organization in an advantageous position to receive Phase 2 implementation cost-share funding, when available, or additional Phase 1 funding to identify, study and/or design specific watershed restoration projects, or conduct analysis required to comply with the National Environmental Policy Act (NEPA) .

#### ***National Fish & Wildlife Foundation***

##### Five-Star and Urban Waters Restoration Grant Program:

This is a nationwide grant program to support on-the-ground, community-based conservation, outreach and education/training with approximately \$2,000,000 available nationwide for projects meeting program priorities. Most individual grants are about \$30,000 with a minimum 1:1 non-federal requirement match of cash or in-kind goods and services.

#### ***National Environmental Education Foundation***

##### Common/Competitive Grants:

NEEF offers a variety of grants and awards to support work being done across the nation at the local level supporting the environment through education and service. In 2017, NEEF provided nearly \$600,000 in grants and awards to educational (both formal and informal) and public land partners across the country. The grant application process is initiated by submitting a grant application using the Common Grant Application. Grants are awarded twice a year.

## ***Oklahoma Conservation Commission (OCC)***

### **Conservation Cost-Share Program:**

The OCC Cost-Share Program provides funds to county conservation districts to help landowners install conservation practices on the land to reduce soil erosion and improve water quality. Conservation districts administer the program to meet their local needs.

The districts select practices from a state list to offer to landowners, establish cost-share rates, set signup periods, establish application ranking procedures, take applications, and assist landowners complete paperwork for payment. The USDA Natural Resources Conservation Service (NRCS) provides free technical assistance for the conservation practices to landowners. Landowner payments are received through the local conservation district after approval by the Oklahoma Conservation Commission.

Approved Conservation Practices include Brush Management, Livestock Water (new pond or water well), Herbaceous Weed Control, Pasture Planting, Pipeline, Watering Facility and Heavy Use Area Protection. All conservation practices must meet NRCS standards and specifications.

Funding was provided by the Murray County Conservation District in 2016 for conservation practices including brush management, ponds, water wells, pipelines, and pasture planting. \$18,750 was allocated to Murray County for Program Year 16, which was completed in June 2016; \$8,861 was paid to participants with \$9,889 carried over to Program Year 17.

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