

Arkansas Natural Resources Commission

2011-2016 Nonpoint Source Pollution Management Plan

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The 2011-2016 Nonpoint Source Pollution Management Plan was created in cooperation with the University of Arkansas Division of Agriculture's Public Policy Center and Department of Biological and Agricultural Engineering faculty. All figures were created by the faculty of the Biological and Agricultural Engineering Department.

For additional information on Arkansas' NPS Pollution Management Plan and other water issues, visit www.arkansaswater.org.

August 2012

University of Arkansas Division of Agriculture Cooperative Extension Service
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Arkansas Natural Resources Commission

Ed Swaim

Water Resources Division Manager

Nonpoint Source Pollution Management Program Staff

Tony Ramick

Supervisor/Grants Manager

Allen Brown

Program Coordinator/Project Manager

Steve Stake

Program Coordinator/Project Manager

Kevin McGaughey

Program Coordinator/Project Manager

Robbie Alberson

Program Coordinator/Project Manager

www.anrc.arkansas.gov

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Cover photo source: Getty Images

Section One

Introduction

The Arkansas 2011-2016 Nonpoint Source (NPS) Pollution Management Plan is intended to serve as a statewide reference. The 2011-2016 NPS Pollution Management Plan is to be used in conjunction with the List of Impaired Waterbodies (303(d) report) and Water Quality Assessment Report (305(b) report) prepared every other year by the Arkansas Department of Environmental Quality (ADEQ).

Nonpoint Source Pollution is defined as rainfall or snowmelt moving over and through the ground. As the runoff moves, it picks up and carries away natural and human-made pollutants, finally depositing them into lakes, rivers, streams, wetlands and even underground sources of drinking water.

The plan's purpose is to provide an overarching guide to develop, coordinate and implement plans and programs to reduce, manage or abate NPS pollution. This 2011-2016 NPS Pollution Management Plan provides a focal point for public agencies, nonprofit organizations, interest groups and citizens to discuss and address NPS pollution together.

The plan provides the basis (a decision support matrix) that allows stakeholders to evaluate and rank risk factors influencing the potential outcome of alternative NPS investment strategies. This systematic approach encourages engagement and professional investment by participants. The product is a consensus-built, science-based priority ranking of watersheds in which investment holds the greatest promise for results.

The process is agile and reactive to the changing circumstance of available resources, demonstrated need, capacity to deliver and measures of new knowledge.

The planning process builds on the most recent update of the plan (2010) and continues the concept of addressing changing conditions in the state and adapting the plan to best serve identified needs. Examples of changing circumstances range from the creation of new watershed organizations and partnerships to the implementation of the new Mississippi River Basin Initiative sponsored by the U.S. Department of Agriculture (USDA) and related programs implemented in Delta watersheds.

The plan's core components and stakeholder involvement methodologies are strategic in their design. They provide for a systematic analysis of program objectives and the scientific basis for prioritizing limited resources. Stakeholders participate in the priority-setting process and expect the management plan to continue evolving as the nonpoint source circumstances dictate. Stakeholders also expect a measurable product from their participation. To that end, progress reports and newsletters will be periodically posted on www.arkansaswater.org.

Arkansas' current NPS Pollution Management Plan began its development in 2005 and covered the period 2006 through 2011. An amendment was prepared in 2002 that provided interim guidance for 2003-2004. The Arkansas Natural Resources Commission (ANRC) undertook a major review and update of the NPS Pollution Management Plan after reviewing the significant changes in policy, process, technology and needs that have occurred since the initial 1997 plan, as well as changes in state and regional perceptions of NPS pollution issues. That review and the subsequent creation of a stakeholder-approved and validated watershed prioritization matrix resulted in the current and continuing adaptive management plan.

Significant policy and regulatory changes have occurred in the ensuing years since the 2006-2011 plan.

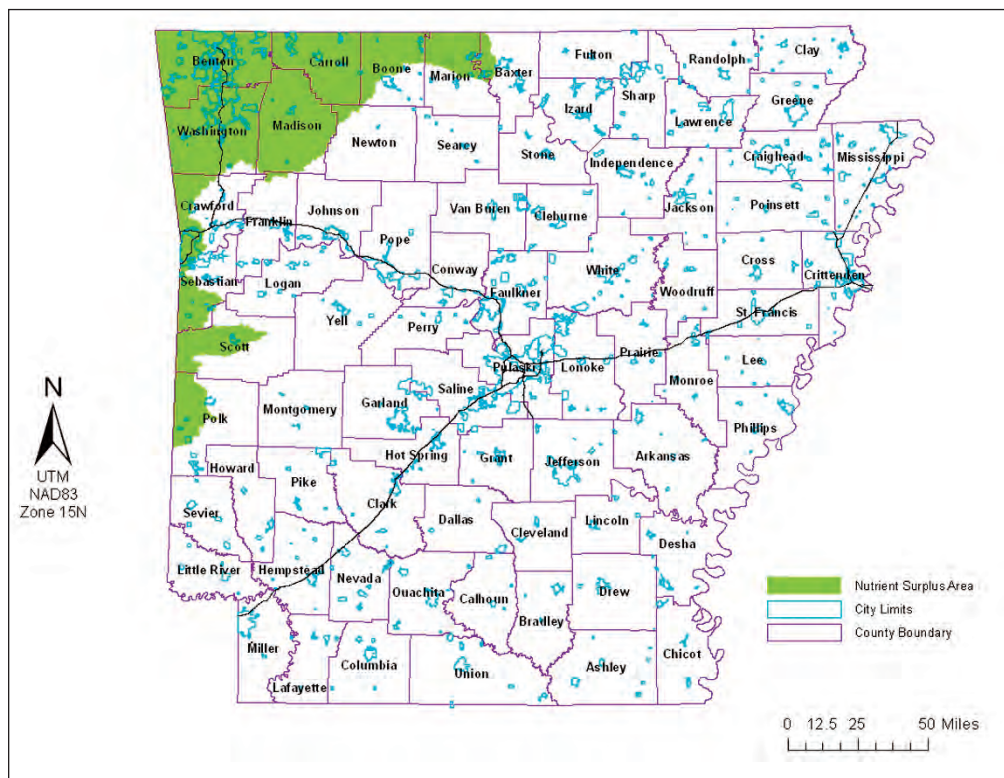
- ADEQ's initiative to implement U.S. Environmental Protection Agency (EPA)-based rules for confined animal feeding operations (CAFOs).
- EPA's Phase II stormwater regulations went into effect, increasing substantially the number of municipalities and construction sites required to obtain National Pollutant Discharge Elimination System (NPDES) permits.
- EPA accelerated implementation of the total maximum daily load (TMDL) program nationwide.
- EPA's direct intervention in the development of a TMDL for the Illinois River in Arkansas and Oklahoma.
- USDA-based programs at a landscape level such as the Wildlife Habitat Improvement Program (WHIP) and a program for resting/feeding

migratory waterfowl water capture on agriculture fields in response to the Deep Water Horizon oil spill disaster.

- The Arkansas General Assembly's modified statutory language enabling ANRC to create nutrient surplus area designations in the state, to register poultry production operations, to require nutrient management planning in nutrient surplus areas, to train nutrient management planners and nutrient applicators and to provide the basis for new authority to issue bonds for water development and water quality protection. Figure 1.1 shows areas designated as nutrient surplus areas, where new regulations are being implemented.
- The 2008 Farm Bill further expanded conservation programs and broadened the application to rural communities and businesses. It also enabled new partnerships between USDA agencies and state-based public and private interests.
- Farm Bill-based energy components afforded opportunity to leverage conservation programs with bio-energy initiatives and new crop management systems with a water quality friendly footprint.
- EPA is poised to enact new pesticide permit rules and new spill prevention control and countermeasures (SPCC) for farm-based fuel storage facilities.
- Arkansas enacted significant new regulations requiring analysis and reporting of constituents in natural gas drilling operations. The state has also significantly increased oversight of land farms used as disposal sites for fracturing fluids used in natural gas production in the Fayetteville Shale gas play. The Arkansas Game and Fish Commission (AGFC) provided ADEQ with the financial capacity to employ several new inspectors to follow up on Best Management Practice effectiveness associated with pipeline, road and pad construction and other water quality issues associated with the Fayetteville Shale gas play.
- Arkansas combined several agencies to form the Arkansas Agriculture Department during the 2005 legislative session. Included under the umbrella of the new administrative agency are the Arkansas State Plant Board, the Arkansas Forestry Commission (AFC), the Arkansas Livestock and Poultry Commission, the Arkansas Aquaculture Division and the Arkansas State Land Surveyor.

Figure 1.1
Arkansas nutrient surplus areas

Source: Arkansas Natural Resources Commission, 2009
Map Created: March 2011



In addition to regulatory changes, a wide range of programs have been implemented to promote voluntary use of Best Management Practices (BMPs).

- Arkansas has developed guidelines for silviculture BMPs. AFC monitors and reports implementation of these BMPs every other year. Implementation has remained positive and steadily defensible since monitoring began. Importantly, monitoring gives ANRC direction in attending to areas that need improvement.
- Arkansas has developed BMPs for resource extraction. ADEQ monitors implementation of these BMPs.
- A multiagency group developed a BMP guide for natural gas exploration in the Fayetteville Shale gas play in north central Arkansas.
- Entities providing training on BMPs for animal agriculture meet regularly and work together to promote consistency of their messages and coordination of efforts.
- The Environmental Task Force of the University of Arkansas Division of Agriculture developed and distributed a phosphorus index as a tool for guiding phosphorous management in overall nutrient management plans for livestock operations.
- The University of Arkansas Division of Agriculture also provided the resources and oversight needed to create the new Watershed Research and Education Center (WREC) at a location in Fayetteville (Washington County), allowing watershed research and education at the urban/rural interface.
- New modeling efforts and data management systems have enabled a much more robust range of planning tools and evaluation strategies.
- The University of Arkansas Center for Advanced Spatial Technologies' (CAST) and the Arkansas Geographic Information Office's (AGIO) support in the development and use of Geographic Information System (GIS) data has aided in both watershed delineation and the certification of a new certified 12-digit watershed data set for Arkansas.
- New sensory equipment and attention to project implementation and evaluation allows for a better understanding of BMP alternatives and their relative efficiencies.

Appendix D provides a brief overview of the regulatory framework. In addition, Arkansas' landscape has undergone significant changes since the current plan was developed. NPS management measures and BMPs have improved as well. Taken together, these changes point to an urgent need to review and update Arkansas' NPS Pollution Management Plan.

The Changing Landscape

Arkansas' NPS pollution landscape is changing rapidly.

- Land use evolves with changing population and economic conditions. Figure 1.2 shows land uses in 2006.
- Population continues to grow rapidly in Northwest Arkansas. Figure 1.3 shows population change from 2000-2010.
- Population decline has accelerated in the Delta and many other rural counties of the state since 2000. Figure 1.4 shows estimated population change from 2004-2010.
- Value of construction remained higher in Pulaski County than any other county in 2010 (Figure 1.5).
- Figure 1.6 shows row crop agriculture area harvested in 2006.
- Marginal croplands in the Mississippi Alluvial Plain are being placed in conservation programs and easements at an increasing pace.
- A growing number of acres of wetlands have been restored and bottomland hardwoods replanted since 1997.
- The number of Arkansas farms raising broilers declined from 3,660 in 1997 to 3,520 in 2002, while the number of chicks placed on farms increased from 1.3 billion to 1.4 billion over the same period (NASS, 1997, 2002). Figure 1.7 shows poultry production in 2008 while Figure 1.8 shows pastureland.
- Some industrial forests are being sold to investor groups and private landowners, creating growing land fragmentation. Figure 1.9 shows public lands in Arkansas.

A series of maps provides a snapshot of the changing landscape in which the NPS Pollution Management Plan will be implemented.

Figure 1.2
Arkansas land use
in 2006

Source: Center for Advanced Spatial
Technologies (CAST), Land Use/Land
Cover, 2006
Map Created: March 2011

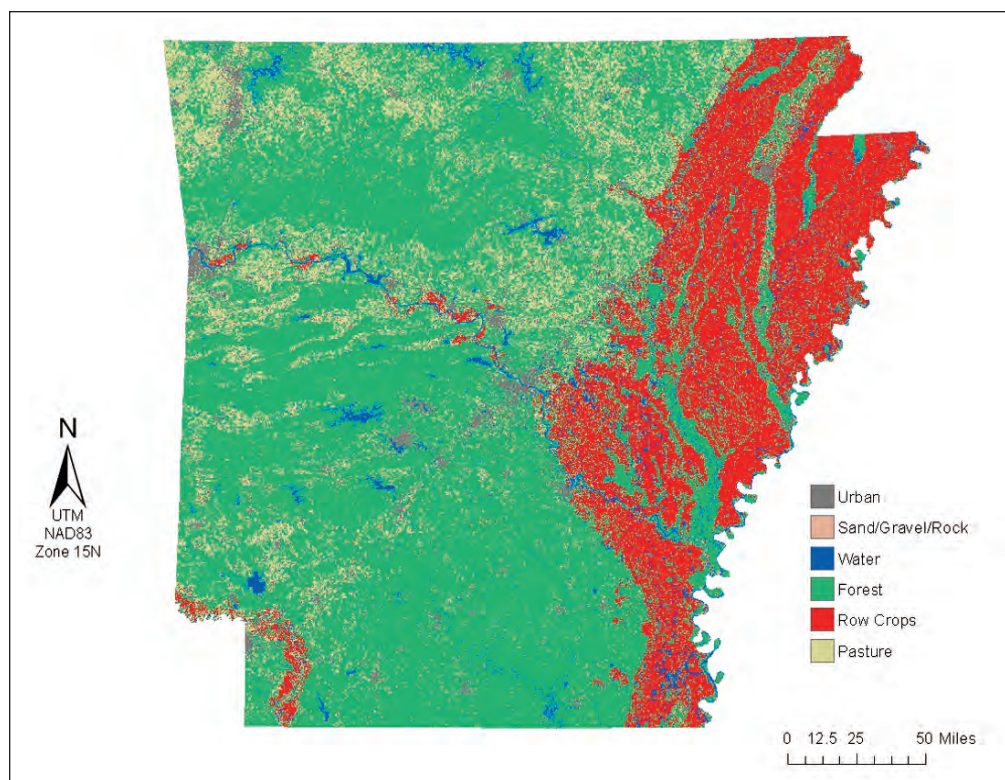


Figure 1.3
Population change,
2000-2010,
Arkansas

Source: United States Census
Bureau, 2000 and 2010
Map Created: March 2011

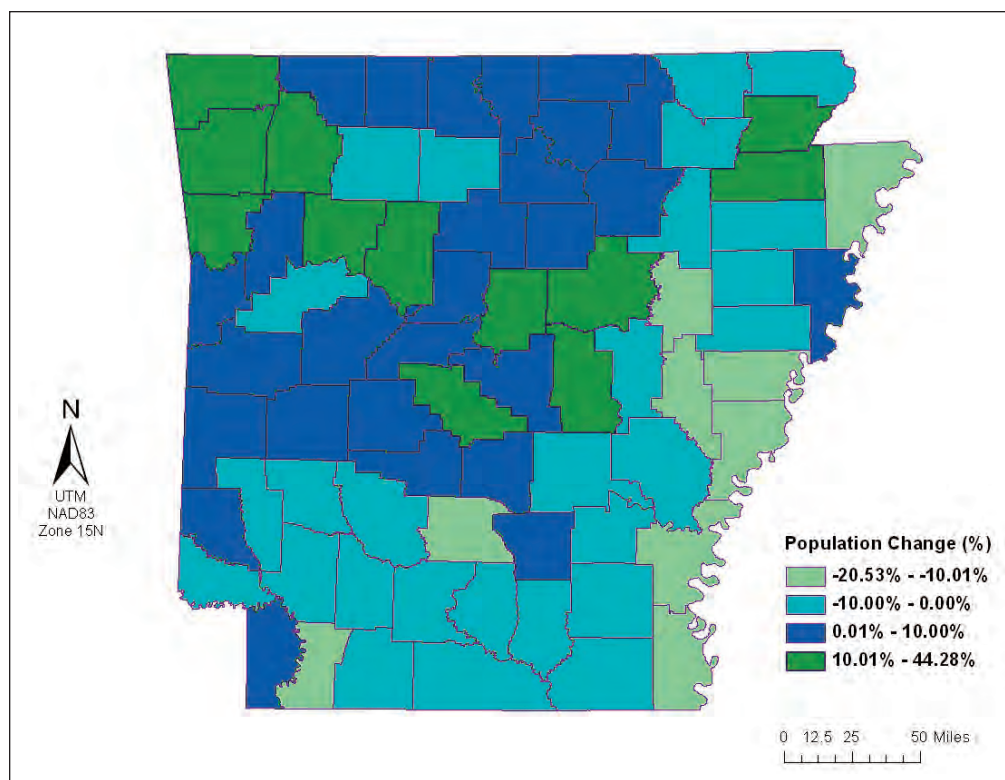


Figure 1.4
Estimated
population change,
2004-2010,
Arkansas

Source: United States Census
Bureau, 2004 and 2010
Map Created: March 2011

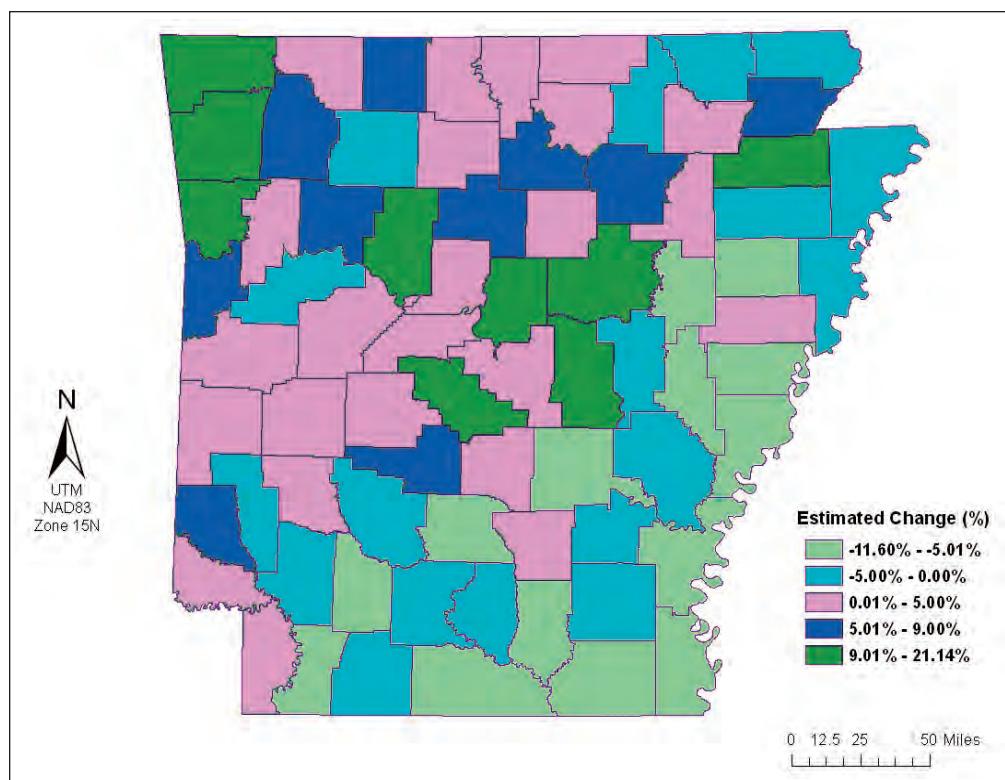


Figure 1.5
Arkansas
construction
receipts in
millions of dollars

Source: United States Census Bureau
(Statistics of U.S. Business, 2007)
Data Source: GeoStor
Map Created: March 2011

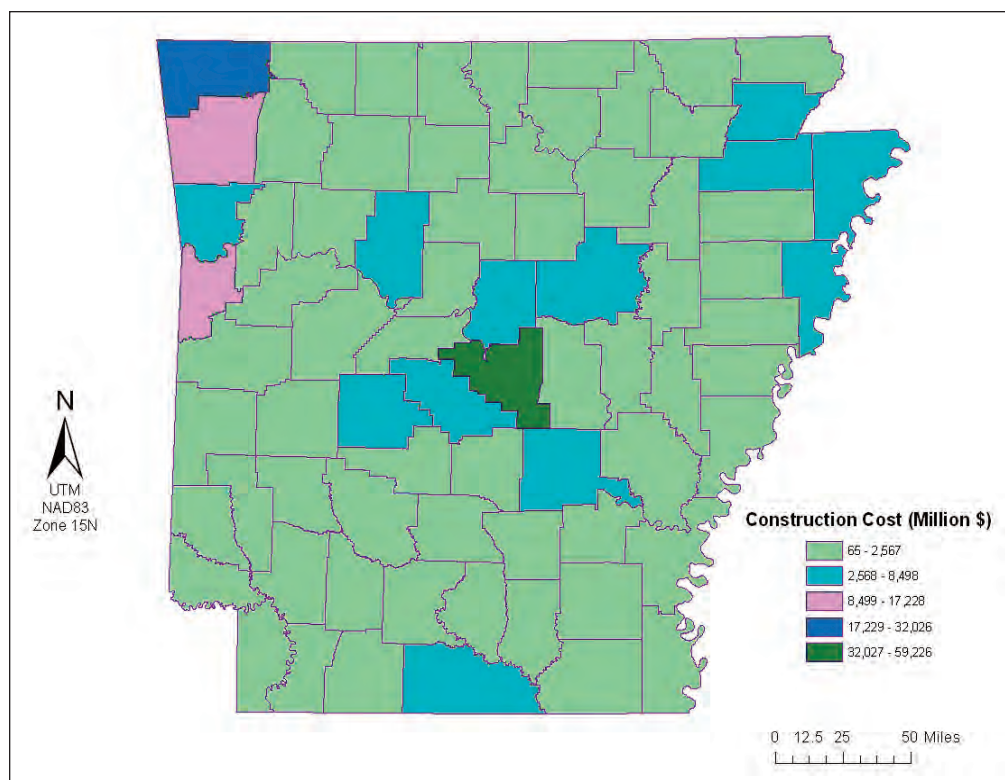


Figure 1.6
Arkansas crop land
in 2006

Source: Center for Advanced Spatial Technologies (CAST), Land Use/Land Cover, 2006
Data Source: GeoStor
Map Created: March 2011

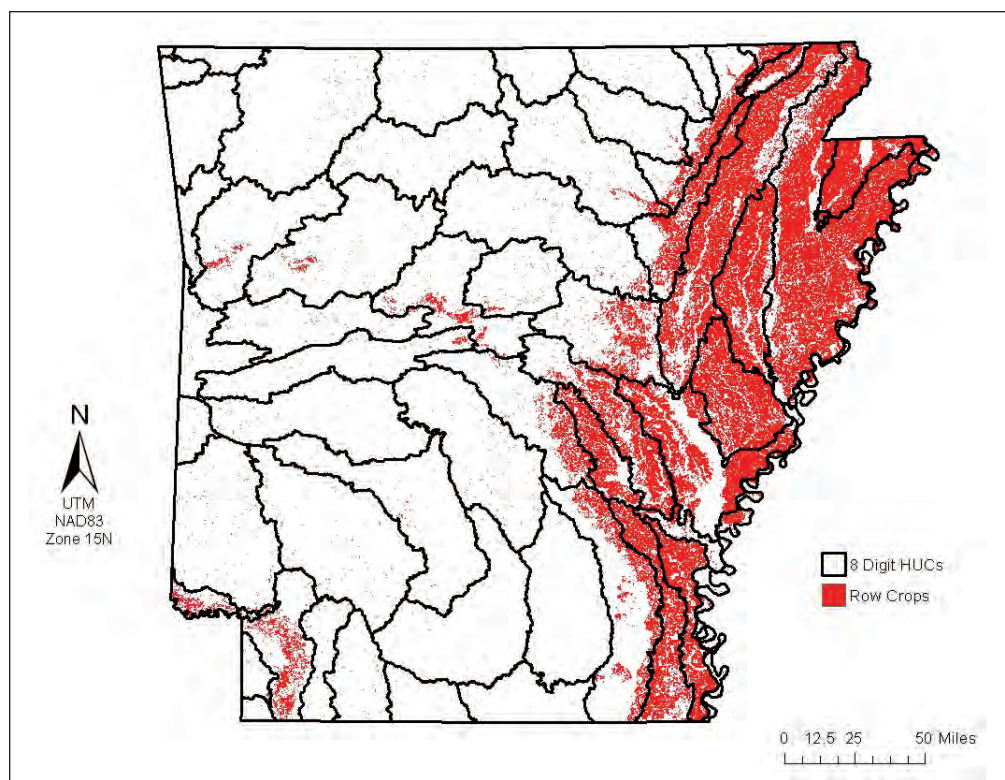


Figure 1.7
Arkansas poultry
production in 2008

Source: Arkansas Natural Resources Commission, 2008
Data Source: GeoStor
Map Created: March 2011

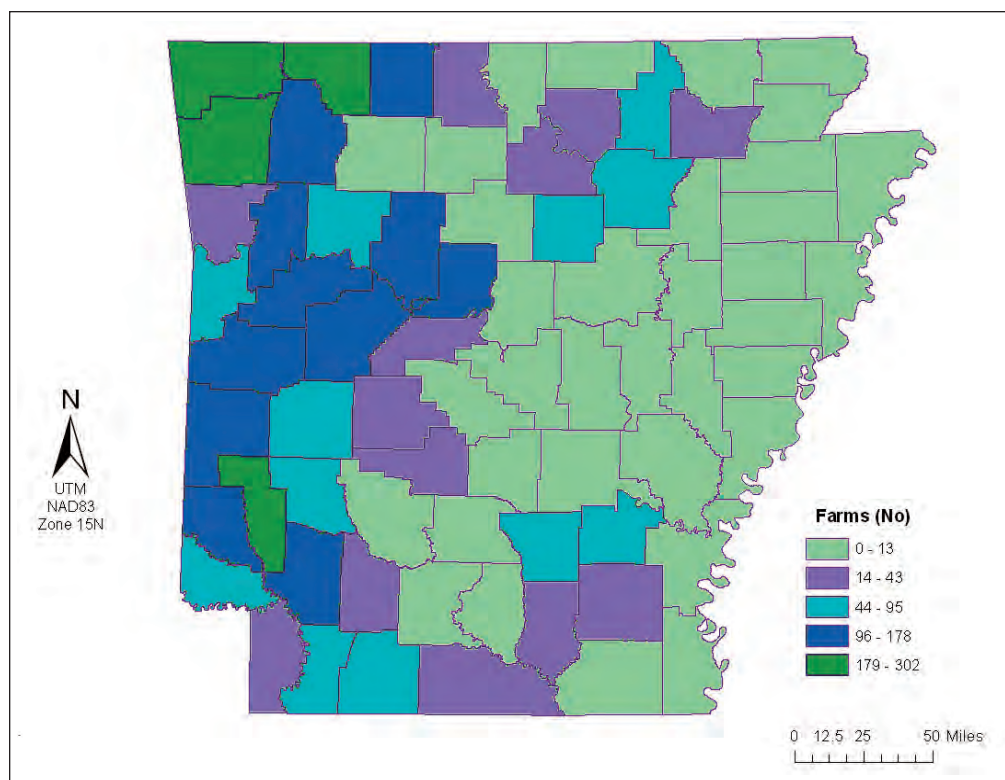


Figure 1.8
Arkansas
pastureland, 2008

Source: Center for Advanced Spatial Technologies (CAST), Land Use/Land Cover, 2006
Data Source: GeoStor
Map Created: March 2011

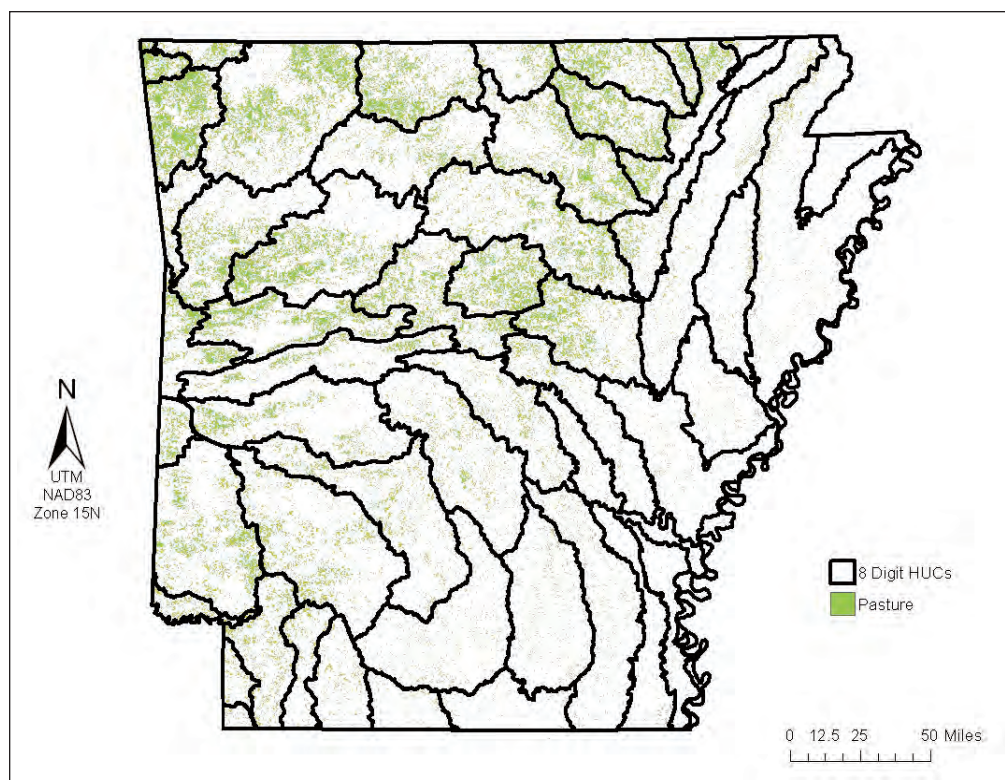
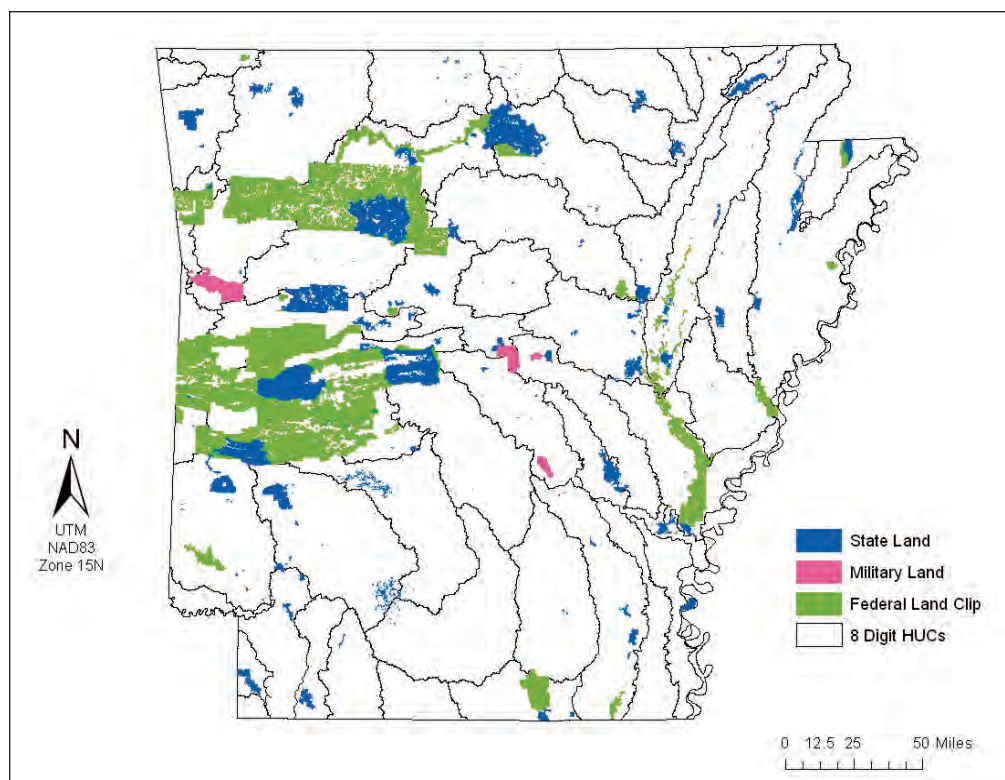


Figure 1.9
Arkansas public
lands

Sources: Center for Advanced Spatial Technologies (CAST), 1995, and Arkansas State Highway and Transportation Department, 2009
Data Source: GeoStor
Map Created: March 2011



Surface and Groundwater Management in Arkansas

The 2011-2016 NPS Pollution Management Plan is closely aligned with Arkansas' List of Impaired Waterbodies and the Water Quality and 305(b) report. ANRC is responsible for the NPS Pollution Management Plan, and ADEQ is responsible for developing water quality standards, monitoring water quality and developing the biennial List of Impaired Waterbodies.

Section 303(d) of the Clean Water Act (CWA) requires that states identify waters that do not meet or are not expected to meet applicable water quality standards. These waterbodies are compiled in even-numbered years into a document known as the List of Impaired Waterbodies and prepared pursuant to Sections 305(b) and 303(d) of the Federal Water

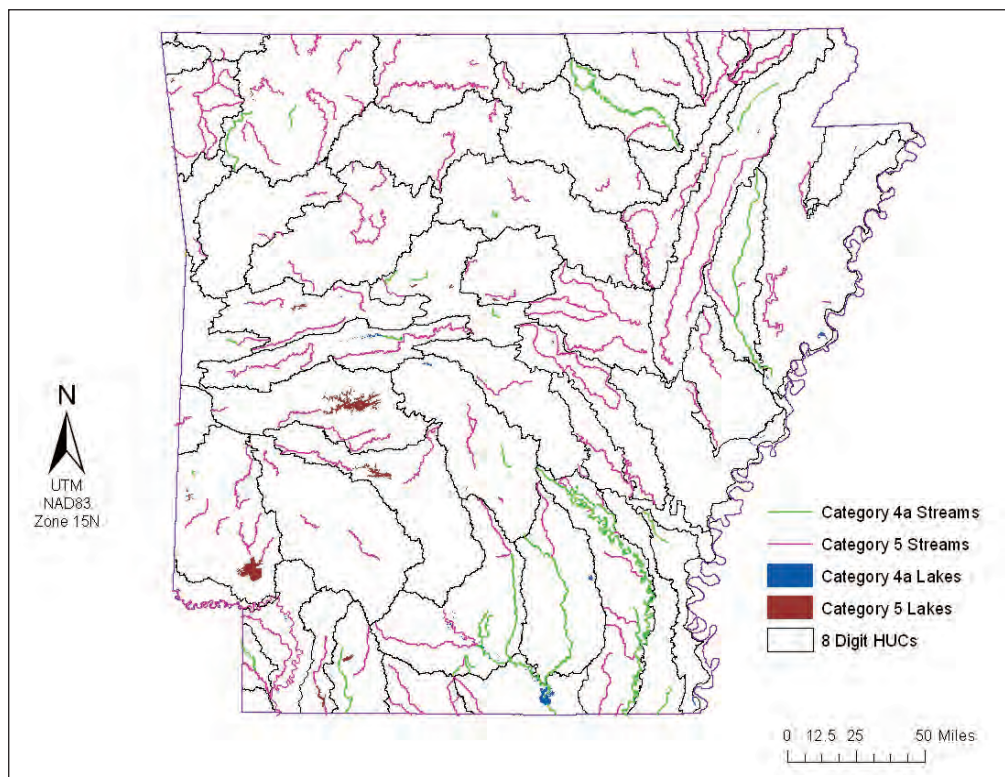
Pollution Control Act. The regulation (40 CFR 130.7) requires that each 303(d) list be prioritized and identify waters targeted for TMDL development. More than 100 TMDLs have been completed on Arkansas stream segments and waterbodies in the last 10 years. Figure 1.10 shows streams identified as impaired in the 2008 List of Impaired Waterbodies. This document was prepared before the 2010 list was developed. Data from the 2008 list is used throughout this plan.

The 2008 List of Impaired Waterbodies can be accessed at:

- http://arkansaswater.org//index.php?option=com_content&task=view&id=14&Itemid=30
- www.adeq.state.ar.us/water/branch_planning/pdfs/303d_list_2008.pdf

Figure 1.10
Arkansas impaired waterbodies, 2008

Source: Arkansas Department of Environmental Quality, 2008
Data Source: GeoStor
Map Created: March 2011



Arkansas Designated Uses

State Designated Uses

1. Extraordinary Resource

Waters: Some 16 percent of Arkansas' total stream miles have been designated as Extraordinary Resource Waters (ERW). ERW are characterized by scenic beauty, aesthetics, scientific values, broad scope recreation potential and intangible social values. The ERW designation gives ADEQ the responsibility of providing extra protection to those waters. Figure 1.11 shows ERW waters.

2. Ecologically Sensitive

Waterbodies: Ecologically Sensitive Waters (ESW) include segments known to provide habitat within the existing range of threatened, endangered or endemic species of aquatic or semiaquatic life forms. Figure 1.12 shows streams designated as ESW.

3. Natural and Scenic

Waterways: Arkansas has designated parts of five rivers as Natural and Scenic Rivers – Cossatot River, Little Missouri River, Saline River and the Strawberry River in addition to the federally designated

Natural and Scenic Rivers, which include Big Piney Creek, Buffalo River, Cossatot River, Hurricane Creek, Little Missouri River, Mulberry River, North Sylamore Creek and Richland Creek.

Federally Designated Uses

4. Primary Contact Recreation: Suitable for swimming

5. Secondary Contact Recreation: Suitable for wading.

6. Fisheries: Suitable for fishing

7. Domestic Water Supply

8. Industrial Water Supply

9. Agricultural Water Supply

Figure 1.11
Extraordinary
Resource Waters,
Arkansas

Source: Arkansas Department of
Environmental Quality, 2009
Data Source: GeoStor
Map Created: March 2011

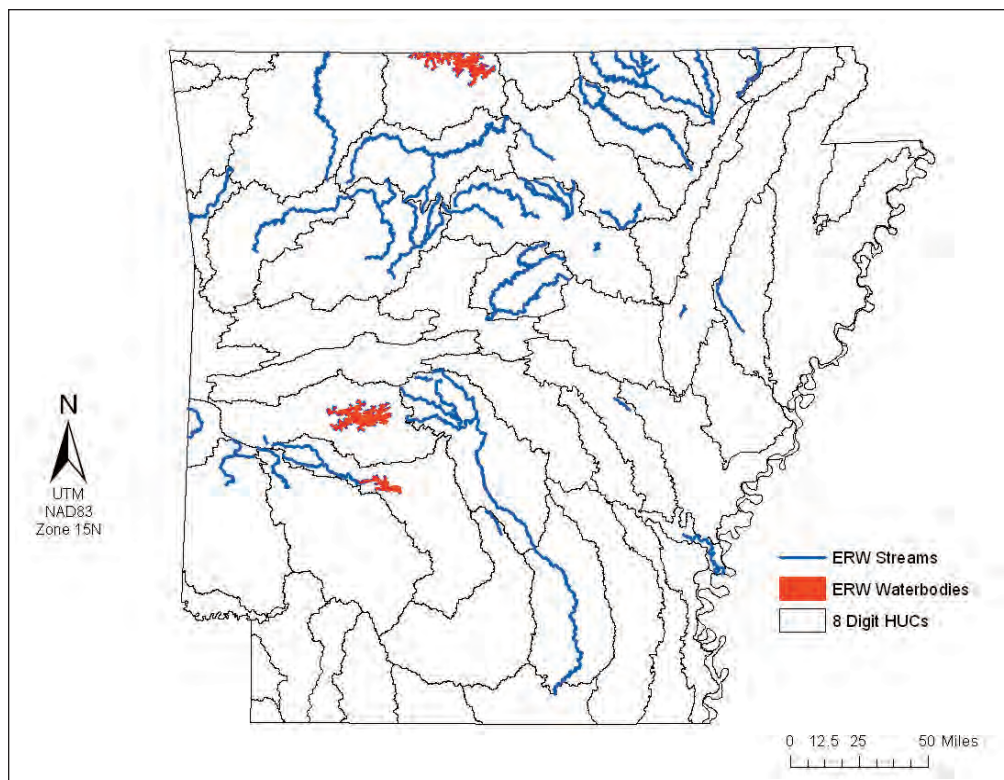
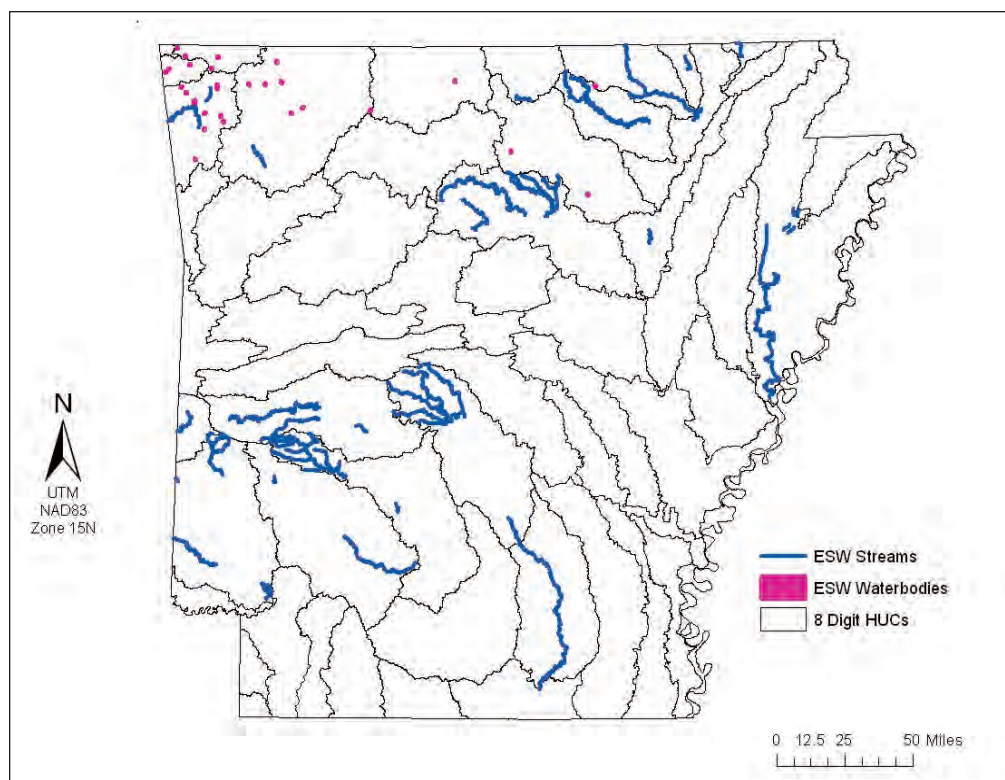


Figure 1.12
Ecologically
Sensitive Waters,
Arkansas

Source: Arkansas Department of
 Environmental Quality, 2009
 Data Source: GeoStor
 Map Created: March 2011



Arkansas' surface waters are managed through Regulation 2 – Arkansas' Surface Water Quality Standards (APCEC, 2001). The standards include designation of uses for all waters of the state, narrative or numeric criteria designed to prevent impairment of those designated uses and a policy to prohibit degradation of waters of the state (antidegradation policy). The water quality standards are ecoregion-based; waters within each of the six ecoregions of the state have standards that were developed from data from least-disturbed streams within each ecoregion. The data was developed during an intensive statewide study of the physical, chemical and biological characteristics of least-disturbed streams during 1983-1986.

Designations 4 through 9 are federally mandated designations. Virtually all of the waters of the state are designated for uses 4 through 9. Waterways in categories 1 through 3 are considered worthy of the highest level of protection by the state because of their beauty, value or beneficial use.

Arkansas' groundwater quality programs are administered by ADEQ's Ground Water Protection Program. The responsibilities of the program include budgeting and grant administration, groundwater quality planning, water quality monitoring and addressing gaps in groundwater protection through

the development of guidelines and regulations. The Ground Water Protection Program conducts water quality monitoring, including ambient and research-oriented monitoring.

The ambient groundwater monitoring program was developed in order to document existing groundwater quality in various aquifers throughout the state on a three-year rotating schedule. Because each area of the state is sampled every three years, the data is used to document trends and changes in water quality over time. Ambient groundwater monitoring in Arkansas has traditionally been performed by four organizations – the United States Geological Survey (USGS), ADEQ, the Arkansas Department of Health (ADH) and ANRC.

In cooperation with ANRC, USGS monitors 25 master wells (or springs) in 14 aquifers throughout the state. These wells are monitored for a variety of constituents, including nutrients, metals, radioactivity, organics and selected primary and secondary drinking water constituents. Specific conductance analysis is also performed in certain years for the alluvial and Sparta aquifers. ANRC also monitors ambient water-quality conditions from a network of springs and 51 dedicated monitoring wells. These wells are monitored based on available funding.

ADEQ maintains the Arkansas Ambient Ground Water Quality Program, which was initiated in 1986. The monitoring program currently consists of 195 well and spring sites in nine different monitoring areas within the state. A full suite of inorganic parameters is analyzed for the samples, including all major cations and anions and trace metals. In addition, in areas where industry, landfills and other facilities that store, manufacture or dispose organic chemicals, semi-volatile and volatile organic analyses are performed on the samples. Areas with row crop agriculture commonly include pesticide analyses. ADH monitors public water supply wells (treated water only) in Arkansas. Analyses by ADH include bacteriological, nitrate and other basic water quality parameters. Published reports for each area of the state are produced following each sampling event.

Targeted research-oriented monitoring examples include the investigation of pesticides in groundwater in eastern Arkansas, nutrient and bacteria transport in shallow aquifer systems in northwestern Arkansas and salt-water intrusion into shallow aquifers in southeastern Arkansas. Nonpoint sources of pollutants, although regional in scope, generally result in low level contamination below established health standards. Point source or site-specific sources result in higher levels of contamination but are restricted to smaller areas (commonly onsite boundaries). Program personnel work together with other ADEQ divisions and other agencies in crafting guidelines and regulations to address both point source and nonpoint sources of pollution. Although the state does not have a formal set of groundwater standards, ADEQ's Water Division uses federal standards and health advisory limits to establish cleanup levels at contaminated sites.

Arkansas' Approach to Addressing EPA's Nine Key Elements

In light of the progress achieved in controlling point sources and the growing national awareness of the increasingly dominant influence of NPS pollution on water quality, Congress amended the CWA in 1987 to focus greater national efforts on nonpoint sources. Congress enacted Section 319 of CWA, establishing a national program to control nonpoint sources of water pollution. Under Section 319, states address NPS pollution by assessing NPS pollution problems and causes within the state, adopting management programs to control the NPS pollution and implementing the

management programs. Section 319 authorizes the EPA to issue grants to assist them in implementing those management programs or portions of management programs that have been approved by the agency. Section 319(h) directs states to develop NPS pollution programs.

The EPA issued guidance for Section 319(h) in May 1996. Arkansas developed the current NPS Pollution Management Plan based on that guidance. On October 23, 2003, EPA published a new guidance for implementing Section 319(h) that built on and replaced previous guidance. The guidance gave direction for NPS pollution management plans including the Nine Key Elements that states must address. The nine elements are discussed below.

Element 1

Explicit short- and long-term goals, objectives and strategies to protect surface and groundwater.

The ultimate long-term goal of the NPS Pollution Management Plan is to restore designated uses to waterbodies identified as impaired by ADEQ and to prevent waterbodies that are threatened due to changing or intensifying land uses from becoming impaired.

Arkansas has made substantial progress in protecting water quality. Many point sources have been or are being addressed. However, NPS pollution remains a special concern because it is often difficult and expensive to determine specific sources and causes, management measures are voluntary and funding and other resources are insufficient to address problems holistically.

A. Program Strategies

1. **Pollution Prevention and Source Reduction:** NPS pollution is a significant contributor to the impairment of Arkansas' waterbodies. It represents the dominant fraction of surface water pollution to lakes, streams and rivers. Reducing NPS pollution is complex and involves a large number of stakeholders representing important sectors of the economy taking voluntary, coordinated action to implement BMPs over a sustained period of time. Moreover, the amount and distribution of NPS pollution are also highly variable in both time and space as land use patterns and shifts in population result in increasing and changing nonpoint source pollution stressors upon limited natural resources and land.

As a result, Arkansas' NPS management measures and programs will focus, for the most part, on *pollution prevention* or *source reduction*. Regardless of the pollution source (for example, agriculture, silviculture, resource extraction, surface erosion, urban runoff or road construction and maintenance) or the cause (for example, sediment, nutrients, pathogens, pesticides, etc.), the Arkansas NPS Pollution Management Plan supports cost-effective and environmentally-protective management practices that efficiently reduce or abate runoff of the targeted pollutant.

2. **Watershed-Based Implementation:** Limited funds make it impossible to effectively manage all causes of NPS pollution from all sources in all watersheds of the state. Arkansas will focus watershed implementation on priority 8-digit hydrologic unit code (HUC) watersheds where there are known impairments or significant threats to water quality from present and future activities and have an EPA-accepted Nine Element Plan or are in development of a Nine Element Plan. Only watersheds selected as priority watersheds will be eligible for Section 319(h) funding from EPA "incremental funds." In addition, ANRC will encourage other state agencies to target their efforts toward these same watersheds. To further focus limited resources to achieve measurable results, Arkansas will give preference to implementation projects that focus on sub-watersheds within identified priority watersheds. To aid in better defining and targeting sub-watershed level investment, ANRC will continue efforts to model watersheds and water quality processes at the 12-digit level. A watershed's HUC is a unique identification code describing where that watershed is in relation to other watersheds. The longer the HUC, for example, 8-digit versus 12-digit, the more specific the location being identified.

3. **A Voluntary Plan:** Arkansas' NPS Pollution Management Plan promotes voluntary action to improve water quality. Unlike point source pollution, which may be relatively easily identified, collected and treated, Arkansas primarily addresses NPS pollution through citizen education and outreach coupled with voluntary adoption of practical and cost-effective BMPs. BMPs are generally designed to allow for the continuation of everyday activities while reducing or preventing NPS pollution.

While BMP alternatives and options are often found as lists of choices and management options as part of the voluntary NPS menu available to land and water managers, they are constantly changing. New technologies, understanding, science, etc., informs a changing road map of BMP choice and implementation. Attention to these changes and new opportunities and a willingness to adapt is now a basic component of Arkansas' plan.

4. **Building Local Capacity to Address Local Concerns:** Since the program's inception, watersheds in which there are active, resourceful groups have been the most motivated to develop and implement watershed action plans. Given this, Arkansas helps build local capacity to address concerns through watershed groups and watershed planning.

Since NPS pollution is primarily a "people problem," the Arkansas NPS Pollution Management Plan advocates building local capacity to affect changes by providing many and varied opportunities for volunteer involvement at the local level. When NPS pollution problems do occur, it is generally because of a lack of knowledge or a perception problem. Although it is difficult at times to measure or quantify management program implementation "successes," especially in the short-term (one to five years), citizen education, outreach and involvement are and will remain primary tools for all NPS Pollution Management Plan endeavors in Arkansas.

Successes are being identified and documented. A part of the continuing plan is an annual two-day project review conference, held in conjunction with an annual stakeholder review of the NPS science and planning adaptations. Project reports are archived as a part of the www.arkansaswater.org web portal.

B. Program-Wide Short-Term Objectives

Short-term objectives for specific statewide programs and priority watersheds are identified in Sections 3 through 15. The short-term objectives below apply to the overall NPS Pollution Management Plan.

- Continue to make available competitive grants on an annual basis for statewide programs and watershed-based implementation projects, giving emphasis to priority watersheds that are consistent with goals and objectives in this plan.

- Give preference to implementation projects that defensibly target sub-watersheds, thus improving the opportunity to achieve measurable improvements in the timeframe of this plan.
- Continue to focus on increasing implementation of BMPs and other related behavioral changes that have the cumulative effect of improving water quality.
- Continue to improve mechanisms for tracking, measuring and reporting implementation of BMPs.
- Continue to strengthen education, outreach and involvement activities to move individuals and businesses from awareness to advocacy (see model described below).
- Update the Qualitative Risk Assessment Matrix every other year or within six months after ADEQ publishes its List of Impaired Waterbodies, whichever comes first, to identify emerging priority watersheds. Present new and emerging needs to the NPS Pollution Management Plan stakeholders at its annual review.
- Meet with the NPS Pollution Management Plan stakeholders every year to review and update the NPS Pollution Management Plan, including the list of priority watersheds.
- Continue to develop local capacity of watershed groups to affect behavioral change, giving emphasis to priority watersheds.
- Strengthen existing and develop new working partnerships among cooperating entities in order to better leverage limited resources available to improve water quality.
- Foster improved sharing of data, GIS layers, assessments, research and other analytic tools to enable improved targeting of NPS resources by all cooperating entities.
- Promote and support strengthened cooperation at the state and local levels to more effectively and efficiently target and coordinate resources to improve water quality.

Element 2

A balanced approach that emphasizes both statewide NPS programs and on-the-ground management of individual watersheds where waters are impaired and threatened.

Watershed-based implementation has been a goal of the nation's NPS Pollution Management Plan from its inception. Section 319 of CWA mandates:

A state shall, to the maximum extent practicable, develop and implement a management program under this subsection on a watershed-by-watershed basis...

In 1997, EPA increased its commitment to watershed implementation with publication of *Picking Up the Pace*. The publication established policy to target risk by enhancing the TMDL program and improving identification of waters impaired by nonpoint sources. Supplemental program guidance encourages states to use a balanced approach that emphasizes both statewide NPS programs and on-the-ground management of individual watersheds where waters are impaired or threatened.

The EPA has continued to strengthen its commitment to use the incremental funds for restoration of impaired waters. Supplemental guidance published in Section 319(h) grants states:

The priority objective for the use of Section 319 grant funds is to implement the national policy, set forth in section 101(a) of CWA that nonpoint source programs be implemented expeditiously to achieve the goals of the CWA, including the restoration and maintenance of the chemical, physical and biological integrity of the nation's waters.

To achieve this objective, the guidance places top priority on implementing on-the-ground measures and practices that will reduce pollutant loads and contribute to the restoration of impaired waters. The approaches described strive to balance between statewide programs and watershed-based implementation projects. They also address CWA objectives by directing the use of Section 319 incremental funds for the development and implementation of watershed-based plans designed to restore waters that ADEQ lists as impaired under Section 303(d) of CWA.

Statewide Programs

Arkansas' 2011-2016 NPS Pollution Management Plan balances statewide programs focused on specific land uses with watershed-based projects that seek to restore designated uses or prevent waters from

becoming impaired. Statewide programs will be implemented in the following areas:

Table 1.1. Statewide programs

Section	Statewide Program
4	Agriculture, including both row crop agriculture and animal agriculture
5	Silviculture
6	Resource Extraction
7	Surface Erosion, including construction, hydrologic modification and roads
8(a)	Road Construction and Maintenance
8(b)	Urban Runoff

Statewide programs have been redefined for the 2011-2016 NPS Pollution Management Plan in discussion with ADEQ, ADH and AFC to more effectively integrate program responsibilities among the lead agencies. The categories, including the newly defined Section Eights, Road Construction and Maintenance (8a) and Urban Runoff (8b), correspond to new sources of impairment defined in ADEQ's List of Impaired Waterbodies. Table 1.2 identifies the lead agencies for each statewide program.

Each statewide program section (Sections 4 through 8) includes a list of potential pollutants, program goals, objectives and milestones, a brief summary of the institutional context, a discussion of federal consistency and BMPs.

Priority Watershed Programs

Arkansas has emphasized watershed-based management in its NPS Pollution Management Plan since 1998. At that time, the Illinois River, Kings River, Yocum and Longs Creeks, Buffalo River, Big Piney

Creek, Poteau River, Cossatot River, Smackover Creek and Bayou Bartholomew were identified as priority watersheds for program implementation (ANRC, 1999). These priorities have since been updated to include streams identified in the Arkansas Unified Watershed Assessment and those watersheds for which TMDLs have been developed.

Arkansas will continue to treat all watersheds with NPS TMDLs, excluding phosphorus from unknown sources and mercury TMDLs, as priority waters for 319(h) funding.

The list of TMDLs can be found in the 2008 ADEQ List of Impaired Waterbodies at:

- http://arkansaswater.org//index.php?option=com_content&task=view&id=14&Itemid=30
- www.adeq.state.ar.us/water/branch_planning/pdfs/303d_list_2008.pdf

To identify additional priority watersheds for the 2011-2016 plan, the NPS Pollution Management Plan continues to update and employ a qualitative risk assessment matrix to select 8-digit watersheds eligible for incremental funds. While the analysis includes all watersheds in the state, watersheds with reaches on the state's 303(d) List of Impaired Waterbodies are given the most weight. The NPS Pollution Management Plan stakeholders identified 11 additional parameters to be considered and a scoring system for each parameter. Based on the resulting scores, watersheds were grouped into quintiles. Appendix A describes the qualitative risk assessment matrix in more detail. In 2011, ANRC designated 10 priority 8-digit HUC watersheds from the top quintile. The selected watersheds are listed below. Table 1.3 lists priority watersheds and identifies those with NPS-related TMDLs. Figures 1.13a and 1.13b show the location of priority watersheds.

Table 1.2. Lead agencies with primary responsibilities for statewide programs

	Agriculture	Silviculture	Resource Extraction	Surface Erosion	Road Construction and Maintenance	Urban Runoff
Arkansas Natural Resources Commission	Lead			Lead	Lead	
Arkansas Department of Environmental Quality			Lead			Co-Lead
Arkansas Forestry Commission		Lead				
Arkansas Department of Health						Co-Lead

Table 1.3. Priority watershed programs, 2011

Section	Priority Watershed	TMDL Year
10	Bayou Bartholomew	2002/03
11	Upper White River (Beaver Reservoir)	2006
12	Cache River	2006
13	Illinois River	2011
14	Lake Conway Point Remove	2006
15	L'Anguille River	2002
16	Lower Ouachita Smackover	2002
17	Poteau River	2005
18	Strawberry River	2006
19	Upper Saline River	2002

**Figure 1.13a
Location of
Arkansas 8-digit
HUC priority
watersheds**

Source: Arkansas Natural Resources
Commission, 2011
Data Source: GeoStor
Map Created: March 2011

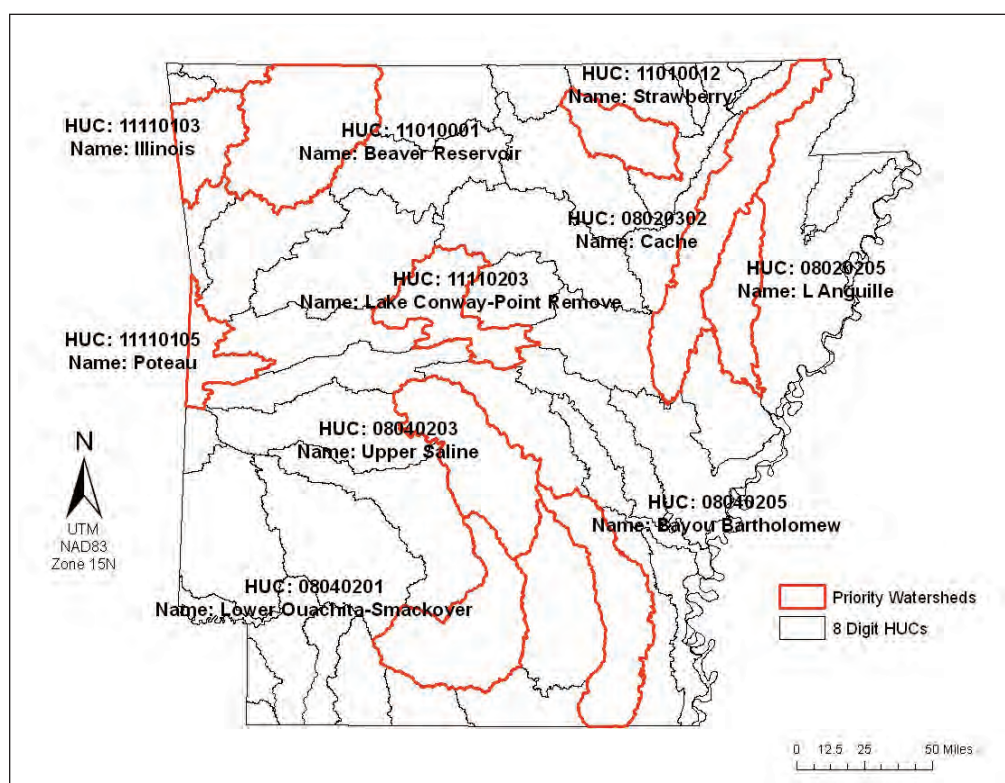
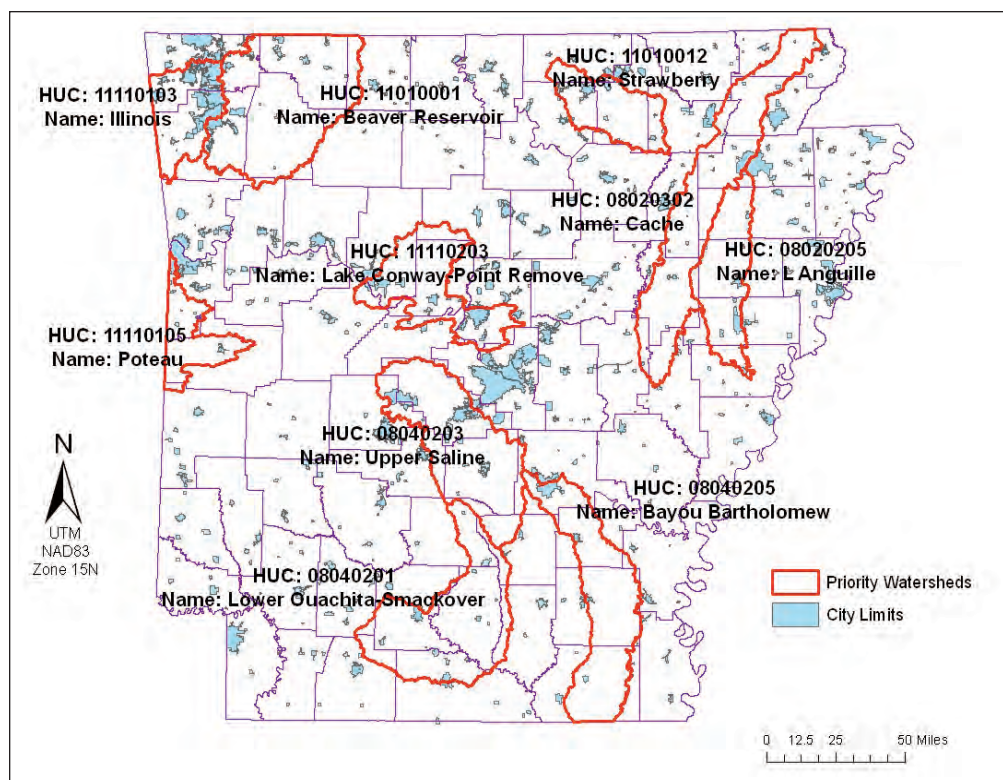


Figure 1.13b
Location of
Arkansas 8-digit
HUC priority
watersheds

Source: Arkansas Natural Resources Commission, 2011
 Data Source: GeoStor
 Map Created: March 2011



Targeted Implementation

Water quality protection efforts can be better targeted using inclusive stakeholder-developed plans and strategies to achieve shared goals and objectives. However, development and adoption of well-designed watershed protection plans continue to be challenging tasks in state and local efforts to protect water quality. Limited availability of staff and other resources are program constraints. Substantial efforts and resources will be expended to develop and implement Nine Element Plans for these priority watersheds with clearly stated, achievable and measurable goals and objectives. Table 2.2 in Program Description shows the status of development of Nine Element Plans.

Funding through the EPA and other programs is not likely to be sufficient to fully treat any 8-digit HUC watershed. Therefore, the state will target its efforts toward sub-watersheds within identified priority 8-digit HUC watersheds with EPA-accepted Nine Element Plans. Only watersheds selected as priority watersheds will be eligible for Section 319(h) funding from EPA incremental funds. In addition, ANRC will encourage other state and federal agencies and nonprofit environmental interest groups to target their efforts toward these same watersheds.

Implementation projects that focus on sub-watersheds where there is demonstrated potential for measurable results in the short run will be given preference for watershed implementation grants. The Program Description, Section Two, includes a detailed description of how sub-watershed priorities will be reviewed.

Watersheds not designated as priority watersheds are not excluded from funding under the 319(h) grant program. They will continue to compete for the non-incremental funds.

Element 3

Strong working partnerships with appropriate state, tribal, regional, and local entities, private sector groups, citizens groups and federal agencies.

The ANRC has been the lead agency responsible for Arkansas' NPS Pollution Management Plan since 1990. The agency has made it a priority to develop strong working partnerships with appropriate state and federal agencies, regional and local entities, nonprofit organizations and watershed groups. In addition, ANRC works closely with industry associations and other private sector groups to promote implementation of voluntary BMPs.

State, federal and local agencies along with state, regional and local associations, nonprofit organizations and watershed groups will cooperate to provide education, outreach, technical assistance, cost-share and other programs targeted to one or more sources or pollutants. More than 100 cooperating entities have some responsibility for addressing NPS pollution in Arkansas.

The process of preparing this 2011-2016 NPS Pollution Management Plan reflects a continued commitment to cooperation and substantive planning and implementation involvement by NPS pollution stakeholders. The plan provides a mechanism for regular review and updates. ANRC invited more than 225 individuals and organizations with an interest in NPS pollution to be represented as a part of the continuing NPS Management Plan Stakeholder Group. The stakeholders have met annually since 2006, averaging more than 75 participants attending the planned meetings. Additional meetings to review components of the plan, build new tools in support of the prioritization matrix and sub-watershed Soil and Water Assessment Tool (SWAT) modeling have also been held. More than 50 people participated in these more targeted meetings. A total of 610 individuals representing 19 different organizations receive regular updates and are afforded a direct opportunity to participate in the planning process. Approximately 175 individuals have participated in one or more stakeholder or project review meetings. This cooperative process continues to build the participation network. Data sharing, project planning and cooperative project development are all examples of the stronger collaborative basis for NPS efforts.

New initiatives ranging from Conservation Reserve Enhancement Program (CREP) project proposals and the Discovery Farm investment to cooperative stormwater management projects are examples of the growing network. The GeoStor data resource and cooperation with the state's Geographic Information Office provide opportunities to explore new modeling and mapping efforts, with a goal of improved targeting of resources. The challenge for resource agencies, policy makers and citizens is to cooperatively implement NPS pollution management tools and techniques with measurable success. At the same time, this cooperative effort must find ways to integrate new, unique or emerging needs into the update and employ the most effective and efficient tools.

Section Three, Cooperating Entities, describes entities that are working together to manage NPS pollution in Arkansas. Appendix C describes in more detail how the NPS Pollution Management Plan Stakeholder Group was created and its role in the

planning process. The adaptive management discussion describes how the NPS Pollution Management Plan Stakeholder Group will be used for regular review and update of this plan.

Element 4

The state plan (a) abates water quality impairments from existing sources and (b) prevents significant threats to water quality from present and future activities.

ADEQ is responsible for monitoring and assessing water quality. The Arkansas NPS Pollution Management Plan administered by ANRC utilizes the 305(b) report and List of Impaired Waterbodies (303(d)) as the basis for information to determine if waterbodies are affected by NPS pollution. Both evaluative and monitored data have historically been utilized to assist in making this determination.

The Arkansas NPS Pollution Management Plan is directed at abatement of known water quality problems (as identified in the section 305(b) report and List of Impaired Waterbodies) and significant threats to water quality from present and future activities. Statewide programs are developed to prevent and address the different causes of impairment and their sources for abatement activities. The state NPS Pollution Management Plan is reviewed on an annual basis by the NPS Pollution Management Plan Stakeholder Group and can be modified to address new problems as they arise.

Element 5

An identification of waters and watersheds impaired or threatened by NPS pollution and a process to progressively address these waters.

ADEQ's List of Impaired Waterbodies includes waters not supporting all designated uses and identifies the most likely source of pollution and causes for the impairment. The inventory is based on monitoring and evaluative data collected by ADEQ as well as data from other sources, if the data meets EPA specifications. The state NPS Pollution Management Plan uses this assessment report as a guide in developing action plans for statewide programs and for identifying priority watersheds for special assistance.

Once a watershed is identified as a priority watershed for the purposes of the NPS Pollution Management Plan, it is identified for further assessment work and development of a Nine Element Plan involving local

watershed groups with support from state and federal agencies and other cooperating entities. As appropriate, SWAT modeling or other watershed analysis of nonpoint sources is initiated and action plans are developed for addressing water quality conservation needs of the watershed. BMP implementation in priority watersheds will be monitored to the extent possible given confidentiality requirements enacted by Congress in the 2008 Farm Bill. Best Management Practice monitoring, together with ongoing water quality and environmental monitoring, can be used to determine the effectiveness of the watershed plans. Evaluation and revision of the plans will be conducted by local planning and technical support partners on a regular basis.

Element 6

The state reviews, upgrades and implements all program components required by Section 319 of the Clean Water Act, and establishes flexible, targeted, iterative approaches to achieve and maintain beneficial uses of water as expeditiously as practicable. The state programs include (a) a mix of water quality-based and/or technology-based programs designed to achieve and maintain beneficial uses of water and (b) a mix of regulatory, nonregulatory, financial and technical assistance as needed to achieve and maintain beneficial uses of water as expeditiously as practicable.

Arkansas' NPS Pollution Management Plan utilizes a voluntary approach to achieve and maintain designated uses. To promote voluntary effort, the NPS Pollution Management Plan makes available competitive grants to eligible public agencies, universities, and nonprofit organizations on an annual basis for statewide programs and watershed-based implementation projects. The grants program is described in Section Two, Program Description, of this plan.

As the lead agency, ANRC prepares an annual report that documents the state's implementation of the NPS Pollution Management Plan. The annual reporting process is described in Section Two of this plan. In addition to meeting CWA reporting requirements, the annual report is used to communicate program status to the NPS Pollution Management Plan Stakeholder Group, thus enabling them to participate in evaluating programs and recommending mid-course corrections to the NPS Pollution Management Plan on an ongoing basis.

Arkansas will continue to employ an adaptive management approach to keep the NPS Pollution Management Plan current. The role of the NPS

Pollution Management Plan Stakeholder Group in the adaptive management process is described in Section Two. For all statewide and priority watershed programs, the overall program strategy is to promote voluntary BMPs using a cooperative process whereby federal and state programs cooperate in priority areas of the state where water quality problems have been identified. As long as voluntary implementation of BMPs and cooperative processes result in the incremental reduction of nonpoint source pollutant loads, it will be viewed as successful. However, if the voluntary, cooperative process does not result in the incremental reduction of NPS pollution and/or water quality improvements, then state and local entities will need to investigate additional cost-effective steps needed to enable waterbodies to meet their designated uses over the long term.

Element 7

Efficient and effective management and implementation of the state's NPS plan, including necessary financial management.

Efficiency and effectiveness are achieved in the following ways:

- The NPS Pollution Management Plan Stakeholder Group will review the plan on an annual basis. Through review of the program, progress toward achieving milestones reported in annual reports, the stakeholders will provide independent assurance that NPS Pollution Management Plan funds are used effectively, are targeted toward state priorities and truly address NPS issues affecting the waters of Arkansas.
- Many agencies represented in the Stakeholder Group are also represented on various other state and federal committees and task forces, such as the Environmental Quality Incentives Program (EQIP) Technical Committee or the Multi-Agency Wetlands Protection Team. This cross representation promotes greater coordination and leveraging of limited funds to more adequately meet the needs of the NPS Pollution Management Plan.
- Proposals for competitive grants that will use CWA Section 319(h) funds are reviewed and ranked by a peer review committee representative of cooperating entities as appropriate.
- ANRC provides technical assistance to the agency, university or nonprofit organization that submitted the proposal to develop a detailed work plan that meets the needs of the proposing entity, the NPS Pollution Management Plan and the

requirements set by the CWA. This process helps shape projects so that they are more likely to achieve the intended results efficiently and effectively.

- ANRC follows Generally Accepted Accounting Principles (GAAP) guidelines issued by the Governmental Accounting Standards Board and undergoes an annual audit consistent with government audit standards laid out in various Office of Management and Budget and Government Accountability Office guidance. Entities that expend Section 319(h) funds are subject to audit requirements that assure compliance with state and federal laws and regulations. This financial oversight provides both EPA and the public with confidence in the integrity of ANRC's financial management.

Element 8

Identification of federal lands and objectives that are not managed consistently with state program objectives.

A list of federal lands in the state is included in the update along with the agency responsible. ANRC will provide copies of this 2011-2016 Arkansas NPS Pollution Management Plan to the director of each federal agency. The U.S. Forest Service (USFS) manages more federal lands in Arkansas than any other federal agency. AFC monitors and reports implementation of BMPs on USFS lands through a biennial survey.

Element 9

A feedback loop whereby the state reviews, evaluates and revises its NPS assessment and its management plan at least every five years.

The current Arkansas NPS Pollution Management Plan was developed in 1998 and updated in 2002 and in 2005. Experience has shown that the plan needs to be updated on a regular basis in order to integrate new, unique or emerging needs and programs. The NPS Pollution Management Plan Stakeholder Group was formed to develop the 2006-2011 NPS Pollution Management Plan and continues in the development of the 2011-2016 plan. The stakeholders continue to meet every year to review the plan and recommend updates. This stakeholder update process began in 2006. The continuing goal is an incrementally updated plan, adapting to the changing opportunity, knowledge and needs of the state. This adaptive management process acts as a scoping mechanism that keeps the plan relevant and open to the state's changing NPS pollution

circumstance. It also helps avoid the need for major updates that are time-consuming and disruptive to ongoing effort.

The Qualitative Risk Assessment Matrix will continue to be updated as soon as practical after each new List of Impaired Waterbodies is finalized. The NPS Pollution Management Plan stakeholders considered the updated matrix at its meeting in September 2010. They made recommendations regarding updates needed for the Silviculture section of the plan and encouraged the development of Section Nine, Developing Issues: Adapting the NPS Program to New and Changing Policies, Resources and Technologies. Section Nine is intended to provide a clearer picture of the plan's intent to provide regular evaluation and adjustment opportunities within the planning design.

The Silviculture Committee held a follow-up meeting to reach consensus on a weighting issue for private vs. public-state vs. public-federal land management. The committee made recommendations to the management team, and the factors were included in the new matrix iteration. The current list of watershed priorities (2011) includes the new weighting factors. As the NPS Pollution Management Plan stakeholders continue to review the 2011-2016 plan in subsequent years, they will be presented with the updated matrix that reflects the most current List of Impaired Waterbodies. In the meantime, emerging needs are an identified component of the plan and will continue to be watched closely in coordination with NPS Pollution Management Plan cooperating entities and individual stakeholders.

References Cited

- ADEQ, 2002. 2002 Integrated Water Quality Monitoring and Assessment Report. Prepared pursuant to Sections 305(b) and 303(d) of the Federal Water Pollution Control Act.
- Arkansas Department of Environmental Quality, Water Division: Little Rock, Ark. ADEQ, 2005. EPA 2004 Proposed 303(d) List of Impaired Waterbodies. Arkansas Department of Environmental Quality: Little Rock, Ark.
- EPA, 1977. Doc. Number 600/377105: Nonpoint Source: Stream Nutrient Level Relationships – A Nationwide Study. United States Environmental Protection Agency: Washington, D.C.
- EPA, 1989. Federal Register, 54 FR 22062, May 22. United States Environmental Protection Agency: Washington, D.C.
- EPA, 2004. Doc. Number EPA-841-B-03-004: National Management Measures for the Control of Nonpoint Pollution From Agriculture. United States Environmental Protection Agency, Office of Water: Washington, D.C.

- Kleiss, B. A., R. H. Coupe, G. J. Gonthier and B. J. Justus, 2000. Water Quality in the Mississippi Embayment, Mississippi, Louisiana, Arkansas, Missouri, Tennessee and Kentucky, 1995-98: U.S. Geological Survey Circular 1208, 36 pages, on-line at <http://pubs.water.usgs.gov/circ1208/>.
- Kresse, T., E. Van Schaik, J. Wise and T. Huetter, 1997. Report WQ97-10-1: Occurrence of Pesticides in Alluvial Aquifer of Eastern Arkansas. Arkansas Department of Environmental Quality: Little Rock, Ark.
- Kresse, T., and John A. Fazio, 2002. Report WQ02-05-1: Pesticides, Water Quality and Geochemical Evolution of Groundwater in the Alluvial Aquifer Bayou Bartholomew Watershed, Arkansas. Arkansas Department of Environmental Quality: Little Rock, Ark.
- Maas, R., 1984. Best Management Practices for Agricultural Nonpoint Sources: IV. Pesticides. Biological and Agricultural Engineering Department, North Carolina State University: Raleigh, N.C.
- Nelson, D., 1985. "Minimizing Nitrogen Losses in Non-Irrigated Eastern Areas." Proceedings of the Plant Nutrient Use and the Environment Symposium, Plant Nutrient Use and the Environment, October 21-23, 1985. The Fertilizer Institute: Kansas City, Mo., pages 173-209.
- North Carolina State University, 1984. Best Management Practices for Agricultural Nonpoint Source Control: IV. Pesticides. National Water Quality Evaluation Project, North Carolina State University: Raleigh, N.C.
- Novais, R., and E. J. Kamprath, 1978. "Phosphorus Supplying Capacities of Previously Heavily Fertilized Soils." Soil Science Society of America Journal 42:931-935.
- NRCS, 2002. Arkansas Field Office Technical Guide. Arkansas Natural Resources Conservation Service: Little Rock, Ark.
- NRCS, 2002. National Conservation Practice Standards – NHCP. Natural Resources Conservation Service: Washington, D.C. Available at www.nrcs.usda.gov/technical/Standards/nhcp.html.
- Popp, J., H. L. Goodwin and W. Miller, 2003. Research Report 975: Impact of the Agricultural Sector on the Arkansas Economy in 2001. Arkansas Agricultural Experiment Station, University of Arkansas Division of Agriculture: Fayetteville, Ark.
- Sharpley, Andrew, Mike Daniels, Karl VanDevender and Nathan Slaton, 2010. Soil Phosphorus Management and Recommendations. University of Arkansas Division of Agriculture Cooperative Extension Service. Fact Sheet 1029. Major Revision.
- Sharpley, Andrew, Mike Daniels, Karl VanDevender P. A. Moore, Jr., B. Haggard, Nathan Slaton and Chuck West, 2010. Using the 2010 Arkansas P-Index. University of Arkansas Division of Agriculture Cooperative Extension Service. Miscellaneous Publication 487.
- Sharpley, Andrew, P. A. Moore, Jr., Karl VanDevender, Mike Daniels, Walt Delp, B. Haggard, Tommy Daniel and Adrian Baber, 2010. The Arkansas P-Index. University of Arkansas Division of Agriculture Cooperative Extension Service. Fact Sheet 9531.

Section Two

Program Description

Introduction

The Arkansas Natural Resources Commission (ANRC) is the lead agency responsible for Arkansas' Nonpoint Source Pollution Management Plan. The plan provides a broad framework and aspirational objectives.

Program Structure

Arkansas' NPS Pollution Management Plan includes two major components: a statewide program consisting of issue-specific areas of concern and a select group of priority watersheds identified and proposed by engaged stakeholders.

Statewide programs focus prevention and, to a lesser extent, abatement activities on a particular land use or group of land and water uses. Typical activities may include identification and/or development of appropriate Best Management Practices (BMPs), BMP monitoring, demonstration projects, training and outreach. Table 2.1 lists the 2011-2016 statewide programs and identifies the section where the program description can be found.

Table 2.1. 2011-2016 statewide programs

Section	Statewide Program
4	Agriculture, including row crop agriculture and animal agriculture
5	Silviculture
6	Resource Extraction
7	Surface Erosion, including construction, hydrologic modification and roads
8(a)	Road Construction and Maintenance
8(b)	Urban Runoff
9	Developing Issues: Adapting the NPS Program to New and Changing Policies, Resources and Technologies

The priority watershed program focuses on priority 8-digit hydrologic unit code (HUC) watersheds where there are known impairments or significant threats to water quality from present and potential future activities. Waterbodies with an approved total maximum daily load (TMDL) will automatically be considered a

priority watershed, except in cases in which the TMDL does not have an NPS component or the source cannot be identified (for example, TMDLs for phosphorus or mercury).

Typical priority watershed program activities may include assessments to identify target sub-watersheds, development of a Nine Element Plan and implementation projects. Implementation projects that target sub-watersheds where measurable water quality improvements can be expected in a specified timeframe will be given preference. The Arkansas NPS Pollution Management Plan recognizes that water quality improvements most often occur where there are active and effective local watershed groups involved. Table 2.2 shows the status of local institutional capacity and planning in each of the identified priority watersheds as well as the section where the priority watershed program is described.

Funds Allocated on a Project Basis

Funds are allocated on a project basis. Watershed projects promote understanding of the full range of stressors in a watershed – physical, chemical and biological – that may be affecting aquatic life and human health. When all significant sources and stressors are understood, the program is better able to focus on those controls that are more likely to produce measurable improvements in ecosystem health.

Administratively, watershed projects are highly efficient. They encourage local and statewide cooperating entities to focus staff and financial resources on prioritized geographic locations and facilitate coordination of resources among interested parties. Also, they provide local agencies with an opportunity to take leadership roles in ecosystem protection. Individual watershed projects provide a statewide proving ground for innovative approaches as new models are developed and new watershed-level management approaches are tested. Finally, watershed projects encourage local agencies and citizen groups to get involved either by participating in state or federal projects or by starting their own watershed projects. Successful projects create a sense of ownership within the project area and engender enthusiasm that will carry forward to new initiatives.

Table 2.2. Status of priority watersheds, 2011

Section	Priority Watershed	Watershed Group	Action Plan	Nine Element Plan	Reaches With NPS TMDL ¹
10	Bayou Bartholomew	Bayou Bartholomew Alliance	X	Update 2009	8
11	Beaver Reservoir	Ozark Water Watch West Fork of the White River Group ABLE – Association for Beaver Lake Environment Beaver Lake Watershed Partnership Kings River Watershed Partnership	X	January 2004	3
12	Cache River	Cache River Watershed Group			5
13	Illinois River	Illinois River Watershed Partnership	X	Update 2010	In Process
14	Lake Conway-Point Remove				3
15	L'Anguille River	L'Anguille Watershed Group	X	March 2009	5
16	Lower Ouachita Smackover	Region III Stream Team			8
17	Poteau River				2
18	Strawberry River	Strawberry River Watershed Group			8
19	Upper Saline River	Alliance for an Improved Middle Fork	X	January 2006	2

¹ Completed NPS-related TMDLs only.

The elements of an effective watershed project are:

- **Building a Project Team and Public Support:** Developing effective institutional arrangements and ownership of the project by stakeholders.
- **Defining the Problem:** Developing an inventory of the watershed and its problems and conducting baseline monitoring.
- **Setting Goals and Identifying Solutions:** Developing project goals, a list of management measures and a detailed plan for their implementation.
- **Implementing Controls:** Obtaining funding, securing commitments and installing controls.
- **Measuring Success and Making Adjustments:** Documenting success in meeting goals, monitoring, changing management measures as needed and ensuring project continuity.

Incremental Funds

Arkansas will focus watershed implementation on priority 8-digit HUC watersheds where there are known impairments or significant threats to water quality from present and future activities. Only watersheds selected as priority watersheds will be eligible for Section 319(h) funding from the U.S.

Environmental Protection Agency's (EPA) incremental funds. In addition, ANRC will encourage other state agencies to target their efforts toward these same watersheds. To further focus limited resources to achieve measurable results, Arkansas will give preference to implementation projects that focus defensibly on sub-watersheds within identified priority watersheds and effectively leverage limited available resources.

Prioritization of Sub-Watersheds

Project proposals for implementation projects will include a description of the data and the analytic methodology used to prioritize sub-watersheds. The prioritization methodology will be reviewed on a number of criteria including, but not limited to:

- what data were used (quantitative analyses will be given preference, analyses that provide comparative rankings of sub-watersheds will be given preference);
- methodology used to analyze the data (for example, land use change from Geographic Information System (GIS), Soil and Water Assessment Tool (SWAT) models, Water Erosion Prediction Project (WEPP), etc.);
- validation methodology and assumptions used in setting modeling parameters;

- how the data were collected (rigorous methods of data collection will be given preference);
- how complete and up-to-date the data used are;
- whether there is meta-data (GIS) or a data dictionary (databases) that enables the data to be shared with other analysts/researchers (data that can be shared will be given preference); and the
- degree to which the data/analyses have been or can be verified through analytic methods or through other objective means.

ANRC will review the prioritization methodology used before a proposal is forwarded for peer review (see process description). If the prioritization methodology is determined to be inadequate, the proposal will not receive further consideration.

Cost-Share as a Project Component

Recognizing that agriculture is consistently listed as the most frequent nonpoint source of impairment to Arkansas waterbodies in the state's 303(d) List of Impaired Waterbodies, watershed-based implementation projects may include cost-share to encourage agricultural producers to implement and maintain specific BMPs as one component of a project proposal. Proposals that include cost-share for other types of entities will not be considered.

BMPs to be cost-shared are selected and approved on a project-by-project basis from BMPs identified in the statewide program sections of this update (or the best available BMPs at the time the proposal is submitted).

ANRC works with cooperating entities to identify appropriate and economical BMPs that producers will be able and willing to implement. Projects that include cost sharing are targeted at a single watershed. Where practical, the U.S. Department of Agriculture (USDA) Environmental Quality Incentive Program (EQIP), the Conservation Reserve Program (CRP), the Conservation Reserve Enhanced Program (CREP), the Wildlife Habitat Improvement Program (WHIP), the Wetland Reserve Program (WRP), Mississippi River Basin Initiative (MRBI), Discovery Farm Projects, conservation easements and other state and local cost-share (both public and private) are coordinated with the NPS Pollution Management Plan's cost-share. However, many of the USDA programs, EQIP for example, are not targeted by watershed. The available opportunities to leverage program funds are limited.

Proposal Review Process

Project Selection: Projects are selected through a competitive process. Eligible entities are invited to submit proposals. Proposals are reviewed through a structured process, and projects are selected for funding consistent with the funds available. NPS Pollution Management Plan staff work with potential grantees on a continual basis to encourage a pool of proposals that address the most critical needs of the NPS Pollution Management Program as identified by ANRC. The following is a narrative description of the competitive grant process.

Eligibility: Entities eligible to receive Section 319(h) grants include state and local government agencies, 501(c)(3) nonprofit organizations and universities. Other entities are not eligible. ANRC may, at its discretion, waive eligibility requirements on a case-by-case basis when it is in the best interests of the Arkansas NPS Pollution Management Plan.

Call for Work Plans: Arkansas' NPS Pollution Management Program staff issues a call for work plans on an annual basis. The ANRC management team maintains an active list of interested stakeholders (both entities and individuals are included). Any eligible entity may request to be added to the e-mail distribution list to receive the call for work plans. The call for work plans provide a format for proposal submission and a due date for proposals. ANRC may, at its discretion, solicit additional project work plans during the course of the year or accept unsolicited project work plans for consideration if it is in the best interests of the Arkansas NPS Pollution Management Plan.

Work Plan Review and Project Selection: Work plans must pass through multi-stage review. ANRC staff review submitted work plans for completeness. Staff may return incomplete work plans for additional work or reject incomplete work plans from further consideration, at their discretion, based on the merits of the work plan and the needs of the NPS Pollution Management Plan.

Completed work plans are forwarded to a peer-review team for evaluation. The peer-review team includes representatives of current or past Section 319 grant recipients selected by ANRC. No grant recipient may have more than one representative on the peer-review team. Members of the peer-review team independently rank all proposals as high, medium or low priority. NPS Pollution Management Program staff also independently review and rank work plans.

After all rankings are submitted, the peer-review team and NPS management staff meet as a group to discuss the strengths and weaknesses of work plans relative to the NPS Pollution Management Program objectives. This group may recommend changes to the project design in order to strengthen project outcomes.

A committee of NPS Pollution Management Program staff then reviews all rankings as well as other input to make funding recommendations to ANRC management. ANRC management reviews staff recommendations to make the final determination for project funding.

Work Plan Development: Entities with projects selected for funding will be notified and asked to develop a detailed work plan. ANRC may, at its discretion, ask for project modifications in order to strengthen project outcomes.

Project Reporting

Projects generate quarterly reports that describe progress toward task completion and expenditure reporting, and annual reports that provide implementation data to estimate load reduction as well as a discussion of successes and failures and mid-course adjustments to the scope of work. All projects submit a final report.

Sponsors of active projects will be invited every year to participate in a peer-review meeting as a way to provide input into the adaptive management process. Project holders will present information and respond to questions about their project from peers and members of the NPS Pollution Management Program Stakeholder Group. In addition, all participants in the peer-review process will work together to identify lessons learned, which will be provided to the Stakeholder Group and ANRC staff to guide the adaptive management process.

Program-Level Annual Reporting

As the lead agency, ANRC prepares an annual report that documents the state's implementation of the NPS Pollution Management Plan. The Clean Water Act details the requirements for the annual report. Specifically:

Section 319(h) (11) Reporting and Other Requirements. Each State shall report to the Administrator on an annual basis concerning:

- a. its progress in meeting the schedule of milestones submitted pursuant to subsection (b)(2)(C) of this section; and
- b. to the extent that appropriate information is available, reductions in nonpoint source pollutant loading and improvements in water quality for those navigable waters or watersheds within the state which were identified pursuant to subsection (a)(1)(A) of this section resulting from the implementation of the management program.

In Arkansas, responsibility for (a) and (b) above is divided between two state agencies.

- a. ANRC administers the NPS Pollution Management Plan and reports on progress toward meeting the schedule of milestones; and
- b. The Arkansas Department of Environmental Quality (ADEQ) is responsible for monitoring and assessing the waters of the state "to the extent that appropriate information is available." ADEQ issues two major reports on a roughly biennial basis: the Water Quality Inventory Report (also called the 305(b) report) and the List of Impaired Waterbodies (also called the 303(d) report). ADEQ has responsibility for assessing the waters of the state.

In addition to ADEQ's monitoring activities, ANRC maintains a limited long-term supplemental monitoring program that is included in the annual report. ANRC's long-term monitoring stations supplement but do not duplicate ADEQ monitoring.

On the project level, ANRC estimates load reduction utilizing the Region 5 and STEPL models, which are entered into the Grants Reporting and Tracking System (GRTS). When project monitoring is included as a component of a funded project, it is typically done for the purpose of BMP demonstration. These data are only useful and available at the completion of the project.

In addition to meeting reporting requirements to the EPA, the annual report will be used to communicate program status to the NPS Pollution Management Program Stakeholder Group, thus enabling the stakeholders to participate in evaluating programs and recommending mid-course corrections or new projects on an ongoing basis.

Adaptive Management Approach

The 2011-2016 NPS Pollution Management Plan will continue to use an adaptive management approach.

The NPS Pollution Management Plan Stakeholder Group will meet every other year to review the NPS Pollution Management Plan. The stakeholders include individuals and organizations that have an interest in identifying and solving water quality problems and in monitoring the effectiveness of these solutions over time. Entities represented in the Stakeholder Group include but are not limited to:

- Alliance for an Improved Middle Fork
- Arkansas Association of Conservation District Employees
- Arkansas Association of Conservation Districts
- Arkansas Canoe Club
- Arkansas Cattlemen's Association
- Arkansas Chapter, Associated General Contractors
- Arkansas Department of Environmental Quality
- Arkansas Department of Health
- Arkansas Department of Heritage
- Arkansas Department of Parks and Tourism
- Arkansas Environmental Federation
- Arkansas Farm Bureau
- Arkansas Forestry Association
- Arkansas Game and Fish Commission
- Arkansas State Highway and Transportation Department
- Arkansas Homebuilders Association
- Arkansas League of Women Voters
- Arkansas Municipal League
- Arkansas Natural Resources Commission
- Arkansas Office of the Governor
- Arkansas Oil and Gas Commission
- Arkansas Pork Producers Association
- Arkansas Poultry Federation
- Arkansas Public Policy Panel
- Arkansas River Valley RC&D Council
- Arkansas Rural Water Association
- Arkansas State Plant Board
- Arkansas State University
- Arkansas Tech University
- Arkansas Water Resource Center
- Association of Arkansas Counties
- Audubon Arkansas
- Bayou Bartholomew Alliance
- Beaver Water District
- Central Arkansas Water
- East Arkansas Planning and Development District
- Friends of North Fork/White River
- FTN Associates
- Fulton County Conservation District
- Illinois River Watershed Partnership
- Kings River Watershed Group
- L'Anguille River Watershed Coalition
- Lake Fayetteville Watershed Partnership
- Leatherwood Creek Watershed
- Little Red River Action Team
- Livestock and Poultry Association
- Lower Little River Watershed Coalition
- McGeorge Construction
- National Park Service
- National Weather Service
- Northwest Arkansas RC&D Council
- Ouachita Watch League
- Ozark Foothills RC&D Council
- Plum Creek Timber Company
- Scott County Organization to Protect the Environment
- Southwest Arkansas Planning and Development District
- Southwest Arkansas RC&D Council
- St. Francis County Conservation District
- The Nature Conservancy
- U.S. Army Corps of Engineers
- U.S. Environmental Protection Agency
- U.S. Fish and Wildlife Service
- U.S. Geological Survey
- University of Arkansas
- University of Arkansas at Little Rock
- University of Arkansas at Monticello
- University of Arkansas Division of Agriculture Cooperative Extension Service
- University of Arkansas Division of Agriculture Public Policy Center
- University of Arkansas Division of Agriculture Research Stations
- University of Arkansas Watershed Research and Education Center
- University of Central Arkansas
- Upper White River Basin Foundation
- USDA Farm Service Agency
- USDA Forest Service
- USDA Natural Resources Conservation Service
- Watershed Conservation Resource Center
- West Center Arkansas Planning and Development District
- West Fork-White River Watershed
- Western Arkansas Planning and Development District
- White County Conservation District
- White River Planning and Development District

The stakeholder review will include:

- lessons learned from the annual project review process;
- NPS annual reports and estimated load reductions;
- review changes in water quality as reported by ADEQ in its 305(b) water quality report and 303(d) list of impaired waterbodies, monitoring data from implementation projects in sub-watersheds and water quality data from other sources;
- review the updated Qualitative Risk Assessment Matrix. The Qualitative Risk Assessment Matrix will be updated prior to each task force meeting,

(using the most recent information available from ADEQ, USGS and other resource entities, new NPS-related TMDLs, most recent land use data, etc.); and

- review objectives and milestones for priority watersheds and statewide programs.

Based on this review, the stakeholders will make a recommendation to ANRC about proposed modifications to the NPS Pollution Management Plan. The stakeholders may recommend changes to the list of priority watersheds, objectives or milestones. Based on this review, ANRC will determine whether or not to submit a program update to the EPA for consideration.

Section Three

Cooperating Entities

Introduction

The Arkansas Nonpoint Source (NPS) Pollution Management Plan is implemented through working partnerships with state and federal agencies, educational institutions, local units of government including, but not limited to, municipalities, counties, conservation districts, regional planning commissions, 501(c)(3) nonprofit organizations and other nonprofit entities. These partners are represented on the NPS Pollution Management Plan Stakeholder Group, which convenes every year to assess progress toward goals and objectives. The group also identifies strategies to improve coordination of statewide programs and watershed implementation activities and recommends to the Arkansas Natural Resources Commission (ANRC) whether there is a need to update the program. Additional partners will be added in order to implement the 2011-2016 NPS Pollution Management Plan.

ANRC will continue to seek and develop memoranda of understanding with the lead agencies of each statewide program in order to define more clearly each agency's roles and responsibilities with respect to the NPS Pollution Management Plan. Table 3.1 indicates the lead agencies for each statewide program. Table 3.2 (page 46) identifies the statewide programs to which the cooperating entities may contribute directly or indirectly over the course of the 2011-2016 NPS Pollution Management Plan. Table 3.3 (page 48) identifies cooperating entities that may contribute directly or indirectly in the implementation of priority watershed programs.

Arkansas Natural Resources Commission (ANRC)

ANRC manages and protects water and land resources for the health, safety and economic benefit of the state of Arkansas. A nine-member commission appointed by the governor provides direction for ANRC. The governor also appoints the ANRC executive director. ANRC is divided into three operating divisions: the Conservation Division, the Water Management Division and the Water Development Division.

Since 1990, ANRC has been the lead agency for planning, coordinating and implementing the NPS Pollution Management Plan, including the development and maintenance of the plan's updates submitted to the U.S. Environmental Protection Agency (EPA) for approval every five years. In addition, ANRC manages wide-ranging programs that address NPS pollution, both directly and indirectly, across its three divisions. The list below highlights a few of those programs.

Nonpoint Source Pollution Grants Program:

ANRC offers competitive grants, funded through Section 319(h) of the Clean Water Act (CWA), to support statewide programs and implementation projects on an annual cycle. Special emphasis is given to watersheds prioritized by the NPS Pollution Management Plan Stakeholder Group. ANRC provides assistance to eligible entities on preparation of grant applications, including conceptual project design, development of a work plan and budget preparation.

Table 3.1. Lead agencies for statewide programs

Statewide Program	Lead Agency
Agriculture	Arkansas Natural Resources Commission
Silviculture	Arkansas Forestry Commission
Resource Extraction	Arkansas Department of Environmental Quality
Surface Erosion	Arkansas Natural Resources Commission
Road Construction and Maintenance	Arkansas Department of Environmental Quality
Urban Runoff	Arkansas Department of Environmental Quality and the Arkansas Department of Health

ANRC accepts work plans for projects to manage, reduce or abate NPS pollution. Projects are funded for one to three years.

Support for Conservation Districts: ANRC provides significant support for Arkansas' 75 conservation districts in collaboration with the U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS).

Arkansas Association of Conservation Districts: The purpose of the Arkansas Association of Conservation Districts is to help conservation districts increase their capacity to effectively and efficiently conserve soil and water. Conservation districts are political subdivisions of the State of Arkansas. They are a creation by popular vote of resident landowners for the purpose of conserving land and water resources as authorized by Act No. 197 of the Arkansas General Assembly of 1937, the nation's first conservation district law. ANRC appoints two members of each local conservation district; three members are elected locally.

Technical Assistance: ANRC, the Arkansas Department of Environmental Quality (ADEQ), the Arkansas Forestry Commission (AFC), the Arkansas Game and Fish Commission (AGFC), NRCS and other entities may provide technical assistance to conservation districts through their staffs of professional engineers, geologists and/or biologists in the design and implementation of Best Management Practices (BMPs) for the purpose of improving or maintaining water quality.

Water Quality Technicians: ANRC provides state funding to some local conservation districts for water quality technicians. The technicians provide assistance to landowners in the implementation of farm management plans and in the implementation of water quality and conservation plans. ANRC, in cooperation with NRCS, oversees ongoing training of technicians on management techniques and practices. NRCS provides daily supervision for conservation district technicians.

Poultry Registration: Poultry feeding operations, in which 2,500 or more poultry are housed or confined on any given day, must register annually in accordance with the Arkansas Poultry Feeding Operations Registration Act.

While confined animal feeding operations (CAFO) regulations at a national level are being developed, CAFOs in Arkansas under the General Permit No. ARG590000 that have no discharge other than stormwater and that do not propose to discharge are not required to seek permit coverage.

Along with Poultry Registration, ANRC became responsible for other programs authorized by the Arkansas General Assembly in 2003. Implementation began in 2005, and with amendments continued through 2010. They are:

Nutrient Management Planner Certification Program – These rules govern ANRC's Nutrient Management Planner Certification Program for individuals who prepare nutrient management plans. Planners prepare nutrient management plans to indicate how nutrients should be applied to fields and other land for crop production while protecting groundwater and surface water from excessive nutrient enrichment. Plans contain operating procedures based on expected crop type, existing nutrient levels in the soil, organic residuals, optimum timing and placement of nutrients, environmental resource protection and agronomic practices such as liming, tillage and crop rotation. ANRC certifies the competence of individuals to prepare these plans and determines information to be contained in nutrient management plans.

Nutrient Management Applicator Certification Program – These rules govern ANRC's Nutrient Management Applicator Certification Program for individuals who apply nutrients to land. ANRC certifies the competence of individuals to apply nutrients and provides training relating to nutrient application. The training must, at a minimum, meet the NRCS conservation practice standards for Arkansas. To maintain certification, nutrient planners must develop plans consistent with certified nutrient planner training. ANRC may issue distinct classifications of certification. Persons making nutrient application to Nutrient Surplus Areas (NSAs) on or after the effective date of Title 22, Rules Governing the Arkansas Soil Nutrient and Poultry Litter Application and Management Program, must become certified. Persons making nutrient application outside NSAs are not required to become certified.

Soil Nutrient and Poultry Litter Application and Management Program – This program encourages prudent practices regarding the application and management of soil nutrients and poultry litter to protect and enhance the state's surface water quality while allowing for optimum soil fertility and proper plant growth. The program's primary goal is to maintain the benefits derived from the wise use of poultry litter, commercial fertilizers and other soil nutrients while avoiding unwanted effects from excess nutrient applications on the waters within the state.

To further this goal, the program provides requirements applicable to NSAs, nutrient management plans and poultry litter management plans.

Wetland and Riparian Zones Tax Credit

Program: This program, created by the Arkansas Private Wetland Riparian Zone Creation and Restoration Incentive Act of 1995, allows a credit against the tax imposed by the Arkansas Income Tax Act for any taxpayer engaged in the development or restoration of wetlands and riparian zones. The program is designed to encourage private landowners to restore and enhance existing wetlands and riparian zones and, when possible, create new wetlands and riparian zones because the state continues to experience significant loss of wetlands and most lands suitable for wetlands are privately owned. This program benefits the landowners through tax credits and the state by increasing wetlands and riparian zones, which provide flood control, water quality enhancement, fish and wildlife habitat, recreation and groundwater recharge.

Wetland Mitigation Bank Program: The Arkansas Wetland Mitigation Bank Program is a state-sponsored initiative to reestablish wetland hydrology and vegetation with compensatory funds from Section 404 permit recipients for impacts of approved wetland projects in selected areas that meet program criteria. Within these areas, site selection takes into consideration current and potential contributions to groundwater quality and other factors.

Ground Water Protection Program: ANRC is responsible for state level planning, management and protection of groundwater resources. This is accomplished through monitoring aquifer water levels and NPS-related water quality concerns, implementation of BMPs, conservation, enforcement of the proper construction of water wells and education. These goals are accomplished through a strong working relationship with the public and with other agencies. ANRC works closely with other state and federal agencies to monitor a water well network of more than 1,200 sites for water level and water quality information. Pursuant to the Arkansas Ground Water Protection and Management Act of 1991, ANRC produces an annual groundwater report on the condition of the state's groundwater resources, makes recommendations on critical areas, participates in the Arkansas Conservation Partnership and enforces Water Well Construction Commission rules and regulations.

Arkansas Water Plan: In 1969, the Arkansas General Assembly passed Act 217 making ANRC responsible for water planning at the state level and the development of the first Arkansas Water Plan. Since its completion and publication in 1975, the plan has served as a guide for efficient development of land and water resources. In 1985, the Arkansas General Assembly enacted Act 1051 directing ANRC to update the plan so it will remain a valid and reliable document addressing current issues. The most recent data and research provide the basis for meeting planning objectives and finding potential solutions. The Arkansas Water Plan, in accordance with Acts 217 of 1969 and Act 1051 of 1985, consists of 12 basin reports. Each basin report includes a land resource inventory (land use and soil resources), identifies quantity and quality problems for surface and groundwater and provides solutions and recommendations.

Arkansas Act 469 of 1989, A.C.A. 15-22-503(e)(1) provides that water development projects in Arkansas are implemented consistent with the Arkansas Water Plan. The statute states:

No political subdivision or agency of the state shall spend any state funds on or engage in any water development project...until a preliminary survey and report therefore which sets forth the purpose of the project, the benefits to be expected, the general nature of the works of improvement, the geographic area to be served by the project, the necessity, feasibility, and the estimated cost thereof is filed with the commission and is approved by the commission to be in compliance with the plan.

ANRC provides the structure for which water plan compliance can be achieved.

Additional Financial Assistance Programs: The Arkansas General Assembly authorized ANRC to create seven financial assistance programs that use the state's bonding authority to assist local units of government to finance water-related facilities and projects including the:

- Water Development Fund;
- Water, Sewer and Solid Waste Fund;
- Water Resources Cost-Share Revolving Fund;
- Safe Drinking Water Revolving Fund;
- Water, Waste Disposal and Pollution Abatement Facilities General Obligation Bond Program;
- Water Plan Compliance; and
- Clean Water Revolving Loan Fund Program.

Arkansas Department of Environmental Quality (ADEQ)

ADEQ protects, enhances and restores the natural environment for the well-being of all Arkansans. A 13-member commission provides oversight. The governor appoints seven of the members, and six agencies are represented by their director or a designee. The agencies are the:

- Arkansas Department of Health (ADH);
- Arkansas Game and Fish Commission (AGFC);
- Arkansas Forestry Commission (AFC);
- Arkansas Natural Resources Commission (ANRC);
- Arkansas Oil and Gas Commission (AOGC); and
- Arkansas Geology Commission (AGC).

The governor appoints the ADEQ director, who oversees 12 operating divisions. Two divisions are particularly related to the NPS Pollution Management Plan: the Water Division and the Surface Mining and Reclamation Division. ADEQ develops, monitors and determines both long- and short-term impacts of land use management practices on water quality standards for surface and groundwater and develops waste load allocations. Among other responsibilities, ADEQ is charged with:

- protecting, enhancing and restoring the natural environment for the well-being of all Arkansans;
- maintaining a network of ambient water quality monitoring stations, roving monitoring sites and a program for biological monitoring;
- producing special studies and mandated reports, including the 303(d) List of Impaired Waterbodies and the 305(b) Integrated Water Quality Monitoring and Assessment Report;
- issuing permits under the National Pollution Discharge Elimination System (NPDES) including pretreatment, individual and stormwater permits for water discharge of any sort within the state of Arkansas;
- issuing permits relating to “no-discharge” waste disposal systems (those that do not discharge directly into waters of the state) and saltwater disposal systems including industrial septic tank systems and animal waste facilities such as hog farms and chicken operations with wet waste disposal systems;
- managing the Underground Injection Control (UIC) Program;
- issuing 401 Water Quality Certifications for any water project requiring a federal permit or license;

- enforcing compliance with permits described above through district field office inspectors and supervisors including:
 - conducting permit compliance evaluation inspections for NPDES facilities permitted for surface water discharges, primarily municipal wastewater treatment plants and industrial discharges for process wastewater and for subsurface or no discharge facilities, including industrial septic tank systems, animal waste facilities such as hog farms and chicken operations with wet waste disposal systems and oil- and gas-related inspections that address deep well injection of brine from oil production;
 - conducting stormwater inspections which address stormwater runoff from construction and industrial sites;
 - investigating citizen complaints against municipalities, industries, other citizens or agricultural facilities;
 - responding to spills of materials from industries, transportations and municipalities to assure protection of the environment;
 - investigating fish kills related to environmental causes; collecting routine water samples from a network of sampling stations to monitor ambient water quality of waters of Arkansas; and
- Regulating surface mining and reclamation, which includes two programs.
 - **Non-Coal Program:** Act 827 of 1991, as amended, deals with the reclamation of land affected by the mining of non-coal minerals such as bauxite, clay, sand and gravel using open-cut mining methods. An amendment to the law, passed in 1995, authorized the regulation of the practice of removing sand and gravel from the beds of streams within Arkansas. A 1999 amendment authorized the regulation of soil and shale pits with some exemptions based on the size of the pit and the distance from adjacent property lines. Regulation 15, the Arkansas Open Cut Mining and Land Reclamation Code, set performance standards that must be followed during mining and during the process of reclaiming land to a beneficial use. Act 1166 of 1997 provided a regulatory framework for the operation, reclamation and safe closure of new stone quarries and any land purchased or leased for a quarry.
 - **Coal Program:** Active coal mines must comply with Rule 20, the Arkansas Surface Coal Mining and Reclamation Code (ASCMRC). Active coal mining sites are inspected on a monthly basis for compliance.

- Providing technical, administrative and professional assistance to citizen groups and state and federal agencies.

The Arkansas Watershed Advisory Group (AWAG) is a consortium of state and federal agency personnel and private citizens who promote local voluntary approaches to watershed management and conservation. AWAG provides direction to organize watershed groups, such as where to seek technical assistance, and facilitates quarterly discussion of voluntary approaches. AWAG also organizes and hosts an annual water quality conference. ADEQ provides staff support for AWAG. Project WET is a national water education program for educators and grades K-12 that promotes awareness, appreciation, knowledge and stewardship of water resources through the development and dissemination of classroom-ready teaching aids. AWAG coordinates the program in Arkansas.

Arkansas Forestry Commission (AFC)

AFC promotes forest resource health, conservation and stewardship of forests. The governor appoints the nine-member AFC Board of Commissioners and also selects the state forester, who oversees day-to-day operations. The following is a partial list of AFC programs that relate to silvicultural NPS pollution management.

BMPs: AFC develops and maintains BMPs, a set of voluntary techniques and practices that forest managers can use to control nonpoint sources of pollution at a given site.

BMP Monitoring: AFC collects and analyzes survey data on the implementation of recommended forestry BMPs in Arkansas' nonpoint water source silvicultural program. AFC collaborates with forest industry associations and the University of Arkansas Division of Agriculture Cooperative Extension Service to provide training and technical assistance to help loggers, landowners and forest managers implement recommended silvicultural BMPs to control nonpoint sources of pollution.

Pollution Abatement: Through a memorandum of understanding, ADEQ refers citizen complaints about pollution from silvicultural activities to AFC for investigation and voluntary resolution before taking enforcement action.

Forest Management Incentives: AFC helps landowners apply for federal cost-share assistance for improving management of their forestland, including

the Environmental Quality Incentives Program (EQIP), the Conservation Reserve Program (CRP), the Wildlife Habitat Incentives Program (WHIP) and other related programs administered by NRCS and the Farm Service Agency (FSA).

Forest Land Enhancement Program (FLEP):

This is a cost-share program administered by the Arkansas Forestry Commission with federal funds.

Forest Stewardship Program: The stewardship program recognizes and rewards landowners who are managing their forestlands according to a multiple-use concept. Landowners have access to resource professionals who assist them in obtaining a written forest management plan addressing multiple-use management.

Forest Legacy Program (FLP): The legacy program uses conservation easements and fee-simple acquisitions to protect environmentally important, privately owned forest areas threatened by conversion to non-forest uses.

Forest Inventory and Analysis: AFC, in cooperation with the USDA Forest Service Southern Research Station, is responsible for collecting scientific data from permanently established plots located all over the state. The plots, each representing 5,937 acres, are strategically located on a three-mile by three-mile grid. Natural resource managers use the data to make management decisions. The inventory plots have been generating data since they were established in the 1950s. The forest survey allows resource managers to monitor Arkansas' natural resource trends through time.

Urban and Community Forestry Program: AFC provides technical assistance and grants for urban forestry through a cooperative agreement with the USDA Forest Service. Communities, non-federal government agencies, educational institutions and 501(c)(3) nonprofit organizations may apply for these competitive grants.

Arkansas Department of Health (ADH)

As it relates to NPS pollution, ADH protects the health of all Arkansas citizens by providing technical assistance, analytical services, training, regulation and public education related to public and private water, waste disposal and other systems. The 22-member Board of Health provides policy oversight and is appointed by the governor. The governor also appoints the director of the Department of Health.

Public Water Systems Regulation and

Enforcement: ADH regulates and provides oversight of public water systems throughout the state. This program consists of plan review of new water system facility construction, inspection of water system facilities, troubleshooting water treatment and distribution problems, investigating complaints and collecting and analyzing samples to determine water quality. ADH also performs related functions such as review of new sewer system construction plans, inspection of proposed cemetery sites and provision of water system operator training and certification. ADH promulgates rules to ensure public water systems adhere to EPA regulations.

Wellhead Protection Program (WHPP): This program is a pollution prevention and management program used to protect underground sources of drinking water. The federal Safe Drinking Water Act (SDWA) Amendments of 1986 specified that certain program activities – delineation, contaminant source inventory and source management – be incorporated into state Wellhead Protection Programs, which are approved by EPA prior to implementation.

Source Water Assessment Program (SWAP): The Safe Drinking Water Act (SDWA) Amendments of 1996 required states to develop and implement Source Water Assessment Programs (SWAP) to analyze existing and potential threats to the quality of the public drinking water sources throughout the state. States were given considerable flexibility in the design of their programs. A state SWAP includes delineating the source water assessment areas, conducting contaminant source inventories, determining the susceptibility of each public water supply source to contamination from the inventoried sources and releasing the results of the assessments to the public.

Individual Sewage Disposal Systems: ADH approves and inspects individual disposal systems including alternate and experimental sewage system applications and subdivisions. ADH also issues annual licenses for septic tank manufacturers, installers and pumpers, provides training for professional staff and industry personnel and provides education materials for rural homeowners.

Subdivisions: ADH consults with developers on proper sewage disposal plans for proposed subdivisions, provides information on soil suitability determinations, which may determine lot size and the number of lots, and reviews plans for drinking water supply and sewage disposal.

Septic Tank Cleaning: Septic tank cleaners are required to pass a test and pay an annual fee for each vehicle in order to be licensed. ADH conducts an annual inspection of all pumping vehicles and monitors documentation of the legal sites where tank cleaners dispose of septage waste.

Outdoor Bathing Places and Swimming

Beaches: ADH consults with the U.S. Army Corps of Engineers, the U.S. Forest Service, the Arkansas Department of Parks and Tourism and private individuals concerning the development and operation of swimming beaches. ADH monitors bacteriological water quality throughout the swimming season. ADH administers regulations in compliance with the EPA recommendations.

Environmental Complaints: ADH responds to environmental complaints involving vectors, marine sanitation, garbage, sewage and other basic sanitation regulations.

Arkansas State Highway and Transportation Department (AHTD)

Through its Environmental Division, AHTD provides multidisciplinary review and analysis of project development and operations to ensure compliance with environmental laws, regulations and policies. Federal environmental legislation includes the National Environmental Policy Act (NEPA), CWA, the Endangered Species Act, the National Historic Preservation Act and others. AHTD is committed to environmental stewardship and mitigation of environmental and cultural impacts. The partial list of programs below describes how AHTD participates directly and indirectly in the NPS Pollution Management Plan.

National Environmental Policy Act Project Review: The 1969 environmental legislation established procedures that all federal agencies are required to implement to make environmental consideration a necessary part of their decision-making processes, including approval and construction of federally funded highway projects. To this end, AHTD produces environmental documentation for all federally funded construction projects for the Federal Highway Administration's review and approval. Full disclosure of environmental issues includes scoping with resource agencies and a public engagement process that consists of early public involvement meetings and public hearings. NPS-related activities routinely undertaken include

geographic information systems analysis, wetland impact assessments and stormwater permitting. In addition, the Environmental Division monitors water quality and implements wetland mitigation property management strategies.

Stormwater Management: AHTD has a statewide small municipal separate storm sewer system (MS4) NPDES permit. The agency works under a Stormwater Management Plan that addresses minimum control measures, including public education and outreach, public participation/involvement, illicit discharge detection and elimination, construction site runoff control, post-construction runoff control and pollution prevention/good housekeeping. The Environmental Division provides training to AHTD personnel on stormwater management and permit requirements. In February 2010, AHTD instituted an erosion and sediment control training and certification course through the University of Arkansas Center for Training Transportation Professionals (CTTP) to train and certify construction and maintenance personnel. This certified training program is offered to AHTD contractors.

Resource Agency Permit Facilitation: AHTD obtains all required environmental permits for state and federally funded highway projects including filing Notices of Intent, preparing permit applications and obtaining permits.

Highway Construction BMPs: AHTD maintains a manual of BMPs for construction stormwater management and provides training to its contractors and staff on BMPs. The CTTP training program is offered to AHTD contractors.

Technology Transfer Program (T2): This program is responsible for assisting cities and counties with obtaining information and training on transportation-related technology. While the program focuses on construction and maintenance, materials, administration and computer programs, cities and counties have also benefited from training on stormwater BMPs. The Arkansas Technology Transfer Program is a cooperative effort of AHTD, the Federal Highway Administration's Local Technical Assistance Program (LTAP) and the University of Arkansas.

Arkansas Game and Fish Commission (AGFC)

AGFC controls, manages, restores, conserves and regulates bird, fish, game and wildlife resources of the state, including acquiring and establishing hatcheries, sanctuaries, refuges, reservations and all property now

owned or used for these purposes under the auspices of a seven-member commission appointed by the governor for seven-year terms. Some of the AGFC programs related directly and indirectly to the NPS Pollution Management Program are listed.

Water Development Projects: AGFC coordinates with federal, state and other interests to protect fish and wildlife resources on private and public lands associated with federal water development activities including:

- reviewing and evaluating federally permitted projects such as Section 404 Permits (CWA) and Section 10 Permits (Rivers and Harbors Act) administered by the U.S. Army Corps of Engineers;
- identifying and recommending opportunities for fish and wildlife restoration and enhancement features associated with planning of federal and state water development projects; and
- coordinating with federal assistance programs (Section 1135, Section 206 and Section 22 programs) administered by the U.S. Army Corps of Engineers.

Stream Teams are voluntary groups of citizens interested in working on water conservation efforts sponsored by a coalition of agencies and private groups, including the AGFC, Keep Arkansas Beautiful, ADEQ, Audubon Arkansas, NRCS, the Arkansas Bass Association, ANRC, the Arkansas Cattlemen's Association, the Arkansas Department of Parks and Tourism, the Arkansas Chapter of the Sierra Club and approximately two dozen other agencies and groups. Stream Teams help control litter, work on streambank stabilization projects, improve fish habitat and monitor water quality. Approximately 500 Stream Teams are active in Arkansas.

Threatened and Endangered Species

Conservation: In cooperation with U.S. Fish and Wildlife Service (USFWS), AGFC has developed and maintains conservation programs for resident federally listed threatened and endangered species.

Wildlife Conservation State Grants Program:

AGFC offers competitive grants to public agencies, universities and nonprofit organizations to conserve non-game species of concern and their habitats, including aquatic species and habitats.

Nature Centers: The Governor Mike Huckabee Delta Rivers Nature Center located in Pine Bluff opened in 2001, followed by the Forrest L. Wood Crowley's Ridge Nature Center in Jonesboro.

The Janet Huckabee Arkansas River Valley Nature Center opened in Fort Smith in 2005. The final center, the Witt Stephens Jr. Central Arkansas Nature Center, is located in Little Rock and opened in 2008. These nature centers offer an opportunity to expand water quality education for the general public; for example, the Pine Bluff center focuses on wetlands education.

Lakes and Wildlife Management Areas: AGFC manages more than 100 lakes and wildlife management areas spanning thousands of acres in Arkansas.

Arkansas State Plant Board (ASPB)

ASPB is primarily responsible for regulating pesticides and other agricultural chemicals used in Arkansas. ASPB has primacy under the federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) and the authority to regulate the proper labeling, distribution, storage, transportation, use, application and disposal of pesticides within the state. Some of the ASPB programs that directly or indirectly relate to the NPS Pollution Management Plan, particularly the Agriculture Statewide Program, are listed below.

Groundwater Protection: In February 1992, ASPB implemented a generic Pesticide Management Plan (PMP). The goal of the plan is to prevent the state's groundwater from becoming contaminated by agricultural chemicals and to respond appropriately if contamination is found. Additionally, the PMP provides for the protection of public health and welfare, the propagation and protection of terrestrial and aquatic life, the protection of the environment, the operation of existing industries and agriculture and the maintenance and enhancement of long-term economic health of the state. The PMP also recognizes that preserving groundwater quality is far less costly and more ecologically sound than restoring groundwater to its natural state.

Groundwater Monitoring: ASPB monitors groundwater wells for NPS contamination of pesticides.

Pesticide Registration: Before a pesticide can be sold in Arkansas, it must first be registered with ASPB in accordance with the Arkansas Pesticide Control Act and Regulations. This allows ASPB to confirm that the product meets all state and federal requirements to provide for both human and environmental protection. Each year ASPB registers approximately 10,000 pesticides for use in the state.

Dealer Licensing: Dealers who wish to sell or distribute those pesticides designated by the EPA as restricted-use pesticides must first obtain a license from ASPB to do so, in accordance with Arkansas Pesticide Use Regulations. ASPB processes more than 400 dealer applications annually.

User and Applicator Training/Certification: Both users and applicators of restricted use pesticides must be trained in the proper handling of such pesticides and then licensed by ASPB, in accordance with the Arkansas Pesticide Use and Application Act and Regulations. Those applicators who will apply pesticides commercially must also be tested before a license can be issued. Each year ASPB issues approximately 15,000 private applicator licenses, 900 commercial applicator licenses, 2,000 non-commercial applicator licenses, 500 commercial firm licenses (ground and air) and 250 custom applicator licenses.

Enforcement: ASPB is also responsible for taking enforcement action against persons and businesses that fail to comply with pesticide laws and regulations. Penalties can range from a warning letter to a monetary assessment of up to \$1,000 and license revocation.

Worker Protection: The ASPB Pesticide Division is responsible for enforcement of the worker protection standard in Arkansas as it applies to the use of pesticides.

Arkansas Livestock and Poultry Commission (ALPC)

ALPC was created by Act 87 of 1963 and has authority for the control, suppression and eradication of livestock and poultry diseases and pests and supervision of sanitation related to livestock and poultry production. In addition, ALPC is responsible for promoting development of Arkansas livestock and poultry industries and administering regulations pertaining to livestock and poultry production. With respect to the NPS Pollution Management Plan, ALPC is responsible for regulation of carcass disposal. ALPC regulates carcass disposal under two sets of regulations: Carcass Disposal – Poultry (Act 87 of 1963, Act 150 of 1985, Act 168 of 1985 and Act 20 of 1989) and Regulation for the Disposal of Large Animal Carcasses, Excluding Dogs and Cats (Act 87 of 1963 – Arkansas Code Annotated 2-33-101 and Act 150 of 1985 – Arkansas Code Annotated 19-6-448).

Arkansas Geological Commission (AGC)

Dating back to 1857, AGC's mission is to develop and provide knowledge of the geology and hydrogeology of the state, to stimulate orderly development and to encourage effective management and utilization of the state's mineral, fossil-fuel and water resources while protecting the environment. This is accomplished through services that include consultation on water well and septic tank inquiries and water well construction records. AGC has on file more than 145,000 water well construction records filed by county and township/range dating from the early 1970s.

Other services include geologic mapping on areas of the state where the State Mapping Advisory Committee determines need. AGC also provides topographic maps and interpretation as well as many publications. Mineral occurrences are developed to the benefit of the state and nation while keeping economic development to the benefit of Arkansas' citizens. Service is provided to mineral and fossil fuel companies through geologic interpretation of the state. Natural hazards are identified and noted where protection can be developed and instituted.

Arkansas Oil and Gas Commission (AOGC)

AOGC's mission is regulation of the Arkansas oil, gas and brine industries to prevent waste, encourage conservation and protect the correlative rights of mineral ownership associated with the production of oil, natural gas, brine and associated products. AOGC has issued more than 38,000 permits to drill oil, gas and brine wells since its creation in 1939. AOGC maintains well-specific permitting, drilling, plugging and abandonment and production records for these wells. A nine-member commission appointed by the governor provides oversight.

Arkansas Department of Parks and Tourism (ADPT)

As indicated in its mission statement, ADPT is committed to enhancing the quality of life for all citizens by providing facilities and skilled leadership for the development and safeguarding of natural resources. Conservation of valuable state resources through ADPT policy plays an indirect role in the management of NPS pollution in the following ways:

Arkansas State Parks: The planning and development (P&D) section of Arkansas State Parks designs and reviews designs of professional architectural and/or engineering consultants for renovations and new construction within the state park system. P&D also cooperates with regulatory agencies (i.e., ADEQ, ADH, the Arkansas Building Authority, the International Building Council and others) for compliance with environmental laws, rules and regulations. Some of the regulations considered are the National Environmental Policy Act of 1969, the Clean Air Act, CWA, Executive Order 115114, Protection and Enhancement of Environmental Quality, Executive Order 11288 Concerning Prevention, Control and Abatement of Water Pollution, the Wild and Scenic Rivers Act of 1968, Executive Order 11990, Protection of Wetlands and the Fish and Wildlife Coordination Act.

SCORP: The Outdoor Recreation Grants section of ADPT prepares the Statewide Comprehensive Outdoor Recreation Plan (SCORP) that identifies outdoor recreation concerns and goals. ADPT seeks the input of all interested federal and state agencies when updating the SCORP. A section of the plan is dedicated to the conservation of natural and cultural resources. Special consideration is given to wetlands, consistent with the Emergency Wetlands Resources Act of 1986, Section 303. The Arkansas Multi-Agency Wetland Planning Team (MAWPT) has contributed valuable wetland information for publication in the SCORP. Applicants seeking grant monies to assist in the development of parks and trails address SCORP issues.

Grant Applications: Staff members of the Outdoor Recreation Grants Program (ORGP) administer grants for the development of local parks and trails. ORGP coordinates grant projects with the statewide clearing house by requiring matching grant applicants to submit an environmental review with their applications. Any proposed park or trail development project near a lake, stream or other water resource must contact the AGFC's Stream Team for environmental examination before consideration for a grant award.

Environmental Review: Projects subject to environmental review are examined by ADPT for consideration and commentary. Projects impacting parks, streams and wetlands raise concern. Onsite visits are conducted when concerns warrant. Comments and recommendations are sent to project applicants and the Arkansas Technical Review Committee.

University of Arkansas Division of Agriculture

The University of Arkansas Division of Agriculture is divided into two groups: the Cooperative Extension Service and the Agricultural Research Stations. The Cooperative Extension Service develops research-based education and training programs and delivers programs through faculty located in every county of the state. The Agricultural Research Stations support research, including highly applied demonstration projects with direct application to NPS pollution management. Faculty members are located on five university campuses, seven research stations and five research and extension centers around the state. Many faculty with joint research and extension responsibilities contribute to the NPS Pollution Management Plan. Working closely with ANRC and the Arkansas Conservation Partnership (ACP), the University of Arkansas Division of Agriculture conducts applied research on new and innovative agricultural BMPs, provides soil testing services to the state's land users and works with state agencies in the development of effective policy for the management of agricultural NPS pollution. Specific to the 2011-2016 NPS Pollution Management Plan Agriculture Statewide Program, the University of Arkansas Division of Agriculture Cooperative Extension Service is the primary agency for development and delivery of agricultural education and training programs, including NPS management. With respect to the NPS Pollution Management Plan, some of the University of Arkansas Division of Agriculture Cooperative Extension Service's education and training programs include:

- in-service training for multiagency personnel;
- program planning and leadership for community and natural resource leaders;
- water quality awareness curriculum for school children;
- training on BMPs, regulatory frameworks and the relationship between production/biological processes that impact water quality for agricultural producers;
- Farm*A*Syst, Urban*A*Syst and Home*A*Syst programs help agricultural producers as well as urban and rural dwellers identify and reduce sources of NPS pollution in their environments;
- urban stormwater management education;
- certification programs for pesticide applicators, nutrient applicators, etc.;
- sources of cost-share and other financial assistance;

- regulatory requirements and required training mandated in regulation (for example, Regulation 5 requires training for permitted liquid animal waste management systems);
- BMP training for landowner and logger education for private nonindustrial forestlands; and
- Discovery Farm and Farm Production Verification Program Demonstrations as on-farm examples of BMP implementation and results.

Extension also maintains an extensive library of up-to-date, research-based fact sheets, applied research publications and BMP manuals and guidelines. Content of these educational materials is carefully coordinated with ANRC, NRCS, AFC and other members of ACP.

The University of Arkansas Division of Agriculture research stations maintain research and demonstration farms where farmers learn about the most recent information available to them on production and environmental methods in all the major agricultural areas of the state. Arkansas' NPS Pollution Management Plan works with the University of Arkansas Division of Agriculture to utilize these research and demonstration farms to evaluate the effectiveness of BMPs and to educate farmers and landowners about how BMPs can be beneficial to them in reducing the loss of sediment, nutrients and organic material from their farms. In addition, faculty is involved in modeling watersheds, evaluating alternative products and markets to utilize poultry litter, designing streambank restoration projects, geomorphological assessment, evaluating technologies to improve stormwater management and other critical projects.

University of Arkansas Arkansas Water Resources Center (AWRC)

AWRC is one of 54 water research institutes in the United States established through the Water Resources Research Act of 1964. AWRC's mission is to:

- plan and conduct water resource research, cooperating closely with colleges, universities and other institutes in Arkansas to address the state's water- and land-related problems; promote the dissemination and application of research results;
- provide for the training of scientists in water resources;
- formulate a research program that is responsive to state water issues; and
- work closely with state and federal agencies.

AWRC has contributed substantially to Arkansas' water resources via research and educational outreach activities through established partnerships with federal, state and local entities. AWRC also provides one of the primary mechanisms in the state for technology transfer and has over the years trained a large pool of students who eventually move into the work force that targets water resource concerns throughout Arkansas. Through these collaborative partnerships, AWRC provides effective coordination between the university research community and watershed-based implementation projects by providing technical assistance that is delivered to land users throughout the state, especially within the priority watersheds. AWRC's Water Quality Lab provides analytical, field and technical support to the water quality investigative community, which includes university researchers, state agencies, federal agencies and private groups or individuals. The Water Quality Lab is accredited for microbiological examination of drinking water by ADH, for surface water examination by ADEQ and for trace level drinking water examination by the Louisiana Department of Health. The lab is the only lab in the state accredited under EPA National Environmental Laboratory Accreditation Conference (NELAC) standards.

Other Universities

Faculty at nearly every public and private university in Arkansas are involved in activities that directly and indirectly improve the results of the NPS Pollution Management Plan, including education and training of professionals, applied research, project design and management and public outreach. Universities that are represented on the NPS Management Plan Stakeholder Group include:

- Arkansas Tech University;
- University of Arkansas at Monticello;
- Arkansas State University;
- University of Arkansas at Little Rock;
- University of Central Arkansas;
- University of Arkansas at Pine Bluff; and
- Southern Arkansas University.

U.S. Department of Agriculture Natural Resources Conservation Service (NRCS)

NRCS helps landowners and communities conserve, maintain and improve the state's natural resources and environment. NRCS coordinates with its partners

through the State Technical Committee. The State Technical Committee is composed of individuals who represent a variety of natural resource sciences and occupations, including soil, water, plants, wetlands and wildlife. NRCS employees provide information and technical assistance to private landowners and land users. In addition, NRCS provides financial assistance to landowners to implement conservation measures through the following programs authorized in the Farm Security and Rural Investment Act of 2002, also known as the 2002 Farm Bill.

Conservation Security Program (CSP): CSP is a voluntary program that provides financial and technical assistance to producers who advance the conservation and improvement of soil, water, air, energy, plant and animal life and other conservation purposes on private working lands. Such lands include cropland, grassland, prairie land, improved pasture and range land as well as forested land and other non-cropped areas that are an incidental part of the agriculture operation. NRCS annually selects priority watersheds where the CSP program is targeted. For example, NRCS selected the Cadron, Lower Neosho, Lower St. Francis and Lower White-Bayou Des Arc watersheds for focus in FY2005.

Environmental Quality Incentives Program (EQIP): EQIP offers financial and technical help to assist eligible participants install or implement structural and management practices on eligible agricultural land. Persons engaged in livestock or agricultural production on eligible land may participate in EQIP. EQIP activities are carried out according to a plan of operations developed in conjunction with the producer who identifies the appropriate conservation practice or practices to address the resource concerns. The practices are subject to NRCS technical standards adapted for local conditions. EQIP offers contracts with a minimum term that ends one year after the implementation of the last scheduled practices and a maximum term of 10 years. These contracts provide incentive payments and cost-shares to implement conservation practices. EQIP may cost-share up to 75 percent of the costs of certain conservation practices. Incentive payments may be provided for up to three years to encourage producers to carry out management practices they may not otherwise use without the incentive. However, limited-resource producers may be eligible for cost-shares up to 90 percent. Farmers and ranchers may elect to use a certified third-party provider for technical assistance. In FY2003, Arkansas allocated approximately \$11 million for 570 EQIP projects, while eligible producers requested \$76 million.

Wetlands Reserve Project (WRP): WRP is a voluntary program that provides incentives to landowners to restore, protect or enhance the functions of wetland ecosystems. In Arkansas, the program focuses on restoring bottomland hardwood forest ecosystems and restoring water quality in the Lower Mississippi River Valley, Arkansas River Valley and Red River Valley through reforestation and hydrology restoration. Arkansas is currently ranked second in the nation in enrolled WRP acres. The program annually results in reforestation of 8,000 acres of bottomland hardwoods and restoration of hydrology on more than 6,000 acres.

Watershed Protection and Flood Prevention Program (PL 83-566): The objective of this program is for NRCS to cooperate with state and local agencies to carry out works of improvement for soil conservation and other purposes, including flood prevention, conservation, development, utilization and disposal of water and conservation and proper utilization of the land. NRCS implements the Watershed Protection and Flood Prevention Act through two program areas: Watershed Survey and Planning and Watershed Protection and Flood Prevention Operations. NRCS in Arkansas has approximately 63 watershed projects either completed or actively being implemented and has completed 14 river basin surveys.

Emergency Watershed Protection (EWP): The purpose of this program is to undertake emergency measures, including the purchase of flood plain easements (see next item) for runoff retardation and soil erosion prevention to safeguard lives and property from floods, drought and the products of erosion on any watershed whenever fire, flood or any other natural occurrence is causing or has caused a sudden impairment of the watershed. EWP provides funding to project sponsors for work such as clearing debris from clogged waterways, restoring vegetation and stabilizing river banks. The measures that are undertaken must be environmentally and economically sound and generally benefit more than one property owner. NRCS provides up to 75 percent of the funds needed to restore the natural function of a watershed. The community or local sponsor of the work pays the remaining 25 percent, which can be provided by cash or in-kind services. The joint efforts of NRCS, the Clark County Conservation District and AFC provided land users in Arkansas with technical and financial assistance to establish or refurbish firebreaks damaged by ice storms.

Emergency Watershed Protection-Floodplain Easement Program: The goal of this program is to reduce the recurring cost of flood damage in areas

prone to flooding while restoring or protecting fish and wildlife habitat, especially wetland habitat. The program accomplishes this by acquiring perpetual easements from interested landowners and, where necessary, restoring the hydrology and vegetation of the floodplain. NRCS has designated the following rivers or watersheds as priority areas in Arkansas in order to maximize environmental benefits: L'Anguille River and Departee Creek Watersheds, Bayou Bartholomew, St. Francis River/Little River Floodway and Mississippi River, White River, Black River and Buffalo River. L'Anguille, Bayou Bartholomew and the Upper White River watersheds are priorities for the 2011-2016 NPS Pollution Management Plan.

NRCS is providing technical and financial assistance in Arkansas through the Buffalo River Tributaries Land Treatment Watershed Project.

Grassland Reserve Program (GRP): This is a voluntary program that offers landowners easements, long-term rental agreements or restoration agreements to protect, restore and enhance grasslands, including grassland, rangeland, pastureland, shrubland and certain other lands. The program is jointly administered by NRCS, FSA and USFS. The program conserves vulnerable grasslands from conversion to cropland or other uses and conserves valuable grasslands by helping maintain viable ranching operations. The first GRP sign-up period in Arkansas ended in late 2004.

Grazing Lands Conservation Initiative (GLCI): Funded in 2003, this program provides technical and educational assistance to owners of private grazing lands to improve management. In its first year, the program conducted more than 25 workshops, field days and presentations for more than 600 farmers and purchased 11 easements. The program is not a cost-share program. The Arkansas Grazing Lands Advisory Committee provides oversight, and the University of Arkansas Division of Agriculture Cooperative Extension Service and NRCS carry out the program.

Wildlife Habitat Incentives Program (WHIP): This is a voluntary program that provides cost-share to implement practices that improve habitat for game and non-game species. NRCS and AGFC biologists work with the applicant to conduct a sound habitat evaluation of the proposed area, carefully prioritize the habitat needs and meet those needs by planning and timely installation of the appropriate management practices.

Resource Conservation and Development Councils (RC&Ds): RC&Ds are independent regional nonprofit organizations staffed with NRCS employees

and partially funded by NRCS. RC&Ds improve the capability of state and local units of government in rural areas to plan, develop and carry out resource conservation and development projects designed to meet unique needs of rural communities. The councils often convene wide-ranging partners and develop resources to implement important projects that otherwise might not be undertaken. For example, one RC&D was instrumental in the creation of the Lower Little River Watershed Coalition, while another RC&D pulled together a partnership to implement an extensive education program for private nonindustrial landowners in an area of the state where BMP compliance was less than desirable.

Mississippi River Basin Initiative (MRBI): To improve the health of the Mississippi River Basin, including water quality and wildlife habitat, NRCS announced the Mississippi River Basin Healthy Watersheds Initiative (MRBI). Through this initiative, NRCS and partners help producers in selected watersheds in the Mississippi River Basin voluntarily implement conservation practices and systems that avoid, control and trap nutrient runoff, improve wildlife habitat and maintain agricultural productivity.

The initiative builds on the past efforts of producers, NRCS, partners and other state and federal agencies in the 12-state initiative area, including Arkansas, to address nutrient loading in the Mississippi River Basin. MRBI is implemented through the Cooperative Conservation Partnership Initiative (CCPI), the Wetlands Reserve Enhancement Program (WREP), Conservation Innovation Grants (CIG) and other programs.

The initial project watersheds selected in Arkansas are Lake Conway-Point Remove, L'Anguille, Cache, Lower St. Francis, Bayou Macon, Boeuf River and Little River Ditches.

U.S. Department of Agriculture Farm Service Agency (FSA)

FSA is dedicated to achieving an economically and environmentally sound future for American agriculture. In the 1930s, Congress set up a unique system under which federal farm programs are administered locally. Farmers eligible to participate elect a three- to five-person county committee, which reviews county office operations and makes decisions on how to apply the programs. This grassroots approach gives farmers a say in how federal actions affect their communities and their individual operations. After more than 60 years, it

remains a cornerstone of FSA's efforts to preserve and promote American agriculture. FSA administers three conservation programs authorized in the Food, Conservation and Energy Act of 2008, also known as the 2008 Farm Bill.

Conservation Reserve Program (CRP): This is a voluntary program for agricultural landowners. Through CRP, producers can receive annual rental payments and cost-share assistance to establish long-term resource-conserving land cover on eligible farmland. CRP is administered by the Commodity Credit Corporation (CCC) through FSA. Program support is provided by NRCS, the University of Arkansas Division of Agriculture Cooperative Extension Service, state forestry agencies and local conservation districts.

Conservation Reserve Enhancement Program (CREP): FSA and Arkansas launched a \$10 million CREP program to improve water quality of the Bayou Meto watershed and wildlife habitat in five central Arkansas counties in 2001. Producers enrolled in CREP remove lands from agricultural production and plant native grasses, trees and other vegetation to improve water quality, soil and wildlife habitat under voluntary 10- to 15-year contracts. The Arkansas CREP targets riparian areas along streams and rivers in the Bayou Meto, Illinois and Cache river watersheds.

Emergency Conservation Program (ECP): This program provides emergency funding and technical assistance for farmers and ranchers to rehabilitate farmland damaged by natural disasters.

U.S. Department of Agriculture Forest Service (USFS)

The mission of USFS is to sustain the health, diversity and productivity of the nation's forests and grasslands to meet the needs of present and future generations. In addition to managing national forests and grasslands, USFS is also among the largest forestry research organizations in the world and provides technical and financial assistance to state and private forestry agencies.

The Ouachita National Forest covers 1.8 million acres in central Arkansas and southeastern Oklahoma. The Ouachita National Forest includes land in three priority watersheds for the 2006-2010 NPS Management Program, including the Poteau River watershed, the Upper Saline River watershed and the Lower Little River watershed.

The Ozark-St. Francis National Forest is actually two distinct forests. The Ozark National Forest covers 1.2 million acres, mostly in the Ozark Mountains of northern Arkansas. A small section of the forest is in the Upper White River watershed, which is a 2006-2010 NPS Management Program priority watershed. The St. Francis National Forest covers 22,600 acres in eastern Arkansas, one of the smallest and most diverse forests in the country. Some of the USFS programs are listed.

Forest Planning: Each forest in the National Forest System operates under a Forest Plan. The Amended Forest Plan for the Ouachita National Forest was signed in March 1990. The current plan for the Ozark-St. Francis National Forest was signed in July 1986. Both of Arkansas' national forests are in the process of developing new plans that will provide direction for the next 10 to 15 years. In its capacity as the lead silviculture agency for the 2011-2016 NPS Pollution Management Plan, AFC will participate in these planning processes to encourage federal consistency. In addition, local watershed groups will also participate in these planning processes.

Forest Service Research and Development (R&D): Scientists carry out basic and applied research to study biological, physical and social sciences related to diverse forests and rangelands. USFS research promotes ecologically sound management of national forestlands as well as private forestlands. Examples of relevant research products include:

- forest inventory and analysis reports on status and trends in forest area and location. The program is managed in cooperation with state and private forestry and National Forest System.
- fish and water research that enhances understanding of organisms, populations, ecosystems and ecological processes that are essential for managing forests and rangelands to sustain water quality and biological diversity. This research is crucial to the agency's ability to comply with requirements of key environmental statutes, including CWA.
- Ozark-Ouachita Highlands Assessment of Aquatic Conditions provides an interdisciplinary comparative assessment of 73 watersheds in portions of three states that make up the Ozark-Ouachita Highlands.

U.S. Geological Survey (USGS)

USGS is the principal federal agency for generating hydrologic information and appraising the nation's

water resources. Water resources of Arkansas consist of numerous streams, springs, lakes and aquifer systems. USGS collects stream flow, groundwater levels and water quality data throughout the state. These hydrologic data and other data are used in research and hydrologic studies to describe the quantity, quality and location of Arkansas' water resources. The collection, analysis and interpretation of these data are done in cooperation with other federal, state and local agencies, universities and research centers. The USGS Arkansas Water Resources web site at <http://ar.water.usgs.gov> provides a wealth of data and links to research publications.

U.S. Fish and Wildlife Service (USFWS)

USFWS's mission is to conserve, protect and enhance fish and wildlife and their habitats through consultation, cooperation and communication for the continuing benefit of the American people. In partnership with the state, USFWS provides a range of environmental services programs to protect endangered and threatened species, conserve habitat and reduce environmental contaminants. In cooperation with USFWS, AGFC has developed and maintains conservation programs for resident federally listed threatened and endangered species.

Endangered Species Act (ESA): This act requires all federal agencies to conserve threatened and endangered species. While managing federal lands or engaging in other federal business that could affect listed species, agencies must first consult with USFWS to ensure that their actions will not harm a listed species or damage or destroy its habitat. These actions include the issuing of federal permits, licenses granting approval to certain private activities or federally funded actions. In the relatively few cases where USFWS determines a proposed action will harm a species, the agency suggests ways for landowners to modify their proposals to conserve listed species. USFWS also works with agencies to minimize potential harm to protected species, allowing projects to continue. Private landowners who develop and implement an approved habitat conservation plan providing for conservation of threatened or endangered species can receive an "incidental take permit" that allows the development project to go forward.

Habitat Conservation and Environmental Contaminants Programs: These programs are responsible for providing information and consultative services for the protection and conservation of fish and wildlife species and their habitats to a widely

diverse audience, including federal, state and local governments, businesses and private individuals. Consultations include:

- mapping of wetlands;
- habitat restoration and management;
- contaminant risk assessment, restoration and remediation; and
- public outreach and education.

The programs provide USFWS with internal and external review to ensure compliance with a variety of federal environmental and resource laws.

Federal Permits and Projects: USFWS evaluates federally constructed, licensed or permitted water resource development projects and provides recommendations to reduce impacts to fish and wildlife resources. Under the provisions of the Fish and Wildlife Coordination Act, CWA and other legislation, federal agencies permitting or constructing these projects must consult with USFWS during the planning of projects. USFWS provides technical support to the agencies in the planning process, providing fish and wildlife resources information and analyses while recommending measures to mitigate impacts.

National Wetlands Inventory (NWI): The NWI prepares and distributes maps showing the location and types of wetlands found throughout the region. It also provides technical assistance in wetland delineation, wetland soils, wetland plants, wetland hydrology, wetland trends and wetland values to individuals, other USFWS programs and other federal and state agencies.

Partners for Fish and Wildlife Program: This program provides financial and technical assistance to restore, improve and protect fish and wildlife habitat on private lands through partnerships with private landowners and other organizations while leaving the land in private ownership.

Land Management: USFWS manages 10 national wildlife refuges, three national fish hatcheries, two ecological service offices, a law enforcement office and a migratory bird field station in Arkansas.

U.S. Army Corps of Engineers (USACE)

The mission of USACE is to provide quality, responsive engineering services to the nation for planning, designing, building and operating water resources and other civil works projects for navigation, flood control, environmental protection and disaster response as well as providing engineering support for the armed forces and federal agencies. Its workforce

includes biologists, engineers, geologists, hydrologists, natural resource managers and other professionals. Through its centers of expertise, USACE provides environmental consulting services to federal, state, local and private entities. In granting or denying permits to developers, USACE strives to prevent environmental damage. Evaluating public interest, regulatory experts balance the needs of economic development with environmental considerations. USACE forms numerous partnerships with other agencies, state and federal governments, environmental groups and private citizens to help solve ecological problems. The following are a few of USACE programs that relate to the NPS Pollution Management Plan.

Wetlands and Waterways Regulation and Permitting: Passage of CWA in 1972 greatly broadened this role by giving USACE authority over filling and dredging in the waters of the United States, including many wetlands. A major aspect of the regulatory program is determining which areas qualify for protection as wetlands. In reaching these decisions, USACE uses its 1987 Wetland Delineation Manual. Working toward a national goal of no net loss of wetlands, the Civil Works program is undertaking projects to restore existing wetlands or to create new ones.

Ecosystem Restoration: Since passage of the National Environmental Policy Act in 1969, environmental protection has been an important component of the civil works planning process. Legislation passed in 1990 established environmental protection as one of the primary missions of water resources projects along with navigation and flood control. Over the last 10 years, small ecosystem restoration projects have grown increasingly popular throughout the country. This new direction has allowed USACE to expand its traditional environmental activities and enhance or restore natural resources as part of USACE projects.

Environmental Stewardship: USACE carries out environmental and natural resource management programs through its projects by managing forest and wildlife habitat, monitoring water quality at its dams and operating fish hatcheries in cooperation with AGFC.

Nonprofit Organizations

Statewide, regional and local nonprofit organizations are key partners in the 2011-2016 NPS Pollution Management Plan. Examples of these organizations include, but are not limited to:

The Nature Conservancy (TNC): The mission of TNC is to preserve the plants, animals and natural

communities that represent the diversity of life on earth by protecting the lands and waters they need to survive. The Arkansas Chapter of TNC has field offices in Northwest and east Arkansas. This chapter has been actively providing assistance to the NPS Pollution Management Plan by providing training to local professionals in stream geomorphology assessment and restoration practices. The Nature Conservancy works collaboratively with state, federal and local agencies to achieve its mission and is providing staff support for planning and implementation of NPS management assessments, Nine Element Plans and projects in the Upper Saline River, the Strawberry River, the Spring River and other rivers. Priority rivers include the Strawberry River, the Kings River, the Mulberry River, the Little Red River, Spavinaw Creek, the Buffalo River, the Eleven Point River and the Spring River.

Audubon Arkansas: Audubon's national mission is "to conserve and restore natural ecosystems, focusing on birds, other wildlife and their habitats for the benefit of humanity and the earth's biological diversity." Audubon Arkansas' vision is "to inspire and lead environmental education, resource management, habitat restoration, bird conservation, and enlightened advocacy." Audubon Arkansas is providing staff leadership for planning and implementation of NPS pollution management programs in two watersheds – the West Fork of the White River in Northwest Arkansas and the Fourche River in and around Little Rock.

Watershed Organizations: Nonprofit watershed organizations exist in some watersheds. Those that exist are in different stages of development and maturation. New groups form even as existing groups cease to exist. The NPS Pollution Management Plan will support the development of effective and sustainable watershed groups where there is local leadership and potential for effective implementation of Nine Element Plans in priority watersheds. The following is a partial list of watershed groups. Groups working in priority watersheds are noted with an asterisk.

- Alliance for an Improved Middle Fork - AIM*
- Bayou Bartholomew Alliance*
- Beaver Lake Watershed Partnership*
- Cache River Watershed Partnership
- Friends of the North Fork and White River
- Fourche Creek Watershed Group
- Illinois River Watershed Partnership
- Kings River Watershed Partnership*
- L'Anguille River Watershed Coalition*
- Lake Fayetteville Watershed Partnership*

- Leatherwood Creek Watershed Group
- Little Red River Action Team
- Lower Little River Watershed Coalition*
- Lower Mississippi River Conservation Committee
- Lower White River Watershed Group
- Strawberry River Watershed Group
- Save Our Spring River
- Upper White River Basin Foundation*
- West Fork of the White River Watershed*

Local Government and the Entities That Serve Them

Local government including municipalities, counties and conservation districts as well as the entities that serve them are key partners in the 2011-2016 NPS Pollution Management Plan. Examples of local government partners include but are not limited to:

Municipalities and Counties: Phase I Municipal Stormwater Program and municipal NPDES permits cover and regulate municipalities with populations over 100,000 people, drainage systems interconnected with these municipalities' systems or municipalities determined to be significant contributors of pollutants. In Arkansas, Little Rock was the only "large" MS4 permitted under Phase I. Phase II of the Stormwater Program regulates municipalities with populations less than 100,000 people, including urbanized areas (typically areas with a population of 10,000 or greater and density greater than 1,000 people per square mile), cities and county areas designated by the state based on site-specific criteria and various state and federal facilities (for example, universities, state highway system, Pine Bluff Arsenal, etc.). Municipalities work together to develop education programs, model ordinances and obtain technical assistance through the Arkansas Municipal League. Counties work together in a similar fashion through membership in the Arkansas Association of Counties.

Regional Planning Commissions: Local government and other facilities required to obtain permits for municipal separate storm sewer systems (MS4) are finding it beneficial to work together in collaborative efforts in order to reduce the cost and increase the effectiveness of their education and outreach programs. Regional planning commissions, working in cooperation with the University of Arkansas Division of Agriculture Cooperative Extension Service, are at the forefront of pulling together these innovative partnerships.

- **Northwest Arkansas Regional Planning Commission** – This commission coordinates a regional education effort among the 15 small MS4s in Benton and Washington counties affected by EPA Phase II stormwater regulations. By contracting with the University of Arkansas Division of Agriculture Cooperative Extension Service to develop and conduct stormwater public education and involvement efforts, the Northwest Arkansas partnership benefits from a comprehensive, cost-effective outreach program that will improve water quality on a watershed-scale. Cooperating entities include the cities of Bentonville, Bethel Heights, Elkins, Elm Springs, Farmington, Fayetteville, Greenland, Johnson, Little Flock, Lowell, Springdale and Rogers along with Benton and Washington counties and the University of Arkansas.
- **Southeast Arkansas Regional Planning Commission** – With leadership and coordination from the Southeast Arkansas Regional Planning Commission, the University of Arkansas Division of Agriculture Cooperative Extension Service has entered into an agreement with Pine Bluff, White Hall, the University of Arkansas at Pine Bluff and a portion of Jefferson County, identified as small municipal separate storm sewer systems (MS4s) under the new EPA Phase II stormwater regulations. The University of Arkansas Division of Agriculture Cooperative Extension Service will provide public education and outreach, encourage public involvement and participation and train municipal employees in pollution prevention and good housekeeping.

Conservation Districts: Conservation districts are the front line for technical assistance to agricultural producers when it comes to implementation of BMPs on their farms. They are political subdivisions of the State of Arkansas, created by a popular vote of resident landowners for the purpose of conserving land and water resources as authorized by Act 197 of the Arkansas General Assembly of 1937. The act was the nation's first conservation district law. A five-person board of directors governs each district. ANRC appoints two directors, while resident landowners elect three directors. Arkansas' 75 conservation districts establish natural resource priorities at the local level and provide support and input into how soil and water conservation programs are implemented at the local level, working cooperatively with landowners and federal and state government agencies. Conservation districts coordinate at the state level through membership in the Association of Arkansas Conservation

Districts. Conservation district employees coordinate at the state level through involvement in the Arkansas Association of Conservation District Employees.

Other Entities That Serve Local Government:

Municipalities and counties also rely on other organizations for education, information and technical assistance including, but are not limited to:

- Planning and development districts;
- Arkansas Municipal League;
- Arkansas Association of Counties;
- Association of Conservation Districts; and
- Association of Conservation District Employees.

Membership Associations and Organizations

Industry associations and farm groups can be important partners in the 2011-2016 NPS Pollution Management Plan. These associations and organizations are in a unique position to pull together audiences of their members, help deliver education and training programs through their meetings, newsletters and web sites, participate in the development of BMPs where appropriate, promote increased implementation of BMPs and assist in the monitoring of BMP implementation and evaluation of BMP effectiveness. Examples of associations and organizations that have been involved in the NPS Pollution Management Plan development process include:

- Arkansas Farm Bureau;
- Arkansas Poultry Federation;
- Arkansas Environmental Federation;
- Arkansas Homebuilders Association;
- Arkansas General Contractors;
- Arkansas Forestry Association;
- Arkansas Pork Producers Association; and
- Others.

Water Districts and Associations

Water districts and associations are also partners in implementing the 2011-2016 NPS Pollution Management Plan. Examples of their involvement include, but are not limited to:

- **Beaver Reservoir Water District:** The water district provides, treats and sells drinking water to five municipal customers. The district recently hired a director of environmental quality and a

director of public affairs to provide education and work with land users in the watersheds of Beaver Reservoir to improve water quality. A representative of Beaver Reservoir Water District serves on the NPS Management Program Stakeholder Group.

- **Southwest Arkansas Water District:** The water district sells water from Millwood Lake to municipalities in a five-county area of Arkansas and Texas. The water district is represented on the board of the Lower Little River Watershed Coalition, sponsors water education days and helps develop curriculum for school-aged children aimed at increasing awareness of water quality.
- **Fort Smith Water Utility:** The utility is a regional water supplier for 200,000 people in western Arkansas and eastern Oklahoma. The utility has an extensive watershed monitoring program and partners with multiple entities to research water quality related topics. The utility's watershed management efforts are key components of assuring the effective and long-term protection of important drinking water sources. Watershed management activities include land purchases, resource management, watershed easements, water education programs and shoreline clean-up events for the protection of water quality in the Frog Bayou and Lee Creek watersheds. A representative of Fort Smith Water Utility serves on the NPS Pollution Management Plan Stakeholder Group.
- **Central Arkansas Water (CAW):** The water district is a regional water supplier for 400,000 people in the central Arkansas region. The district has taken a comprehensive approach to protecting Lake Maumelle, one of its sources of drinking water. The utility adopted a comprehensive Watershed Management Plan in 2007. The intent of the plan is to protect the lake from increased pollution that results from development and other land disturbances, provide for the equitable sharing of costs and benefits associated with the protection and minimize land-use restrictions on long-time land owners surrounding the water source.
- **Arkansas Rural Water Association:** The Arkansas Rural Water Association is working with a watershed organization in the Upper Saline Watershed to develop strategies to reduce sedimentation.

Interagency Cooperation

There are a number of interagency teams and work groups that bring together not only different agencies but also teams of scientists and practitioners from different disciplines. Efforts will be made to develop effective working partnerships among these groups in order to gain efficiencies. For example, the Multi-Agency Wetland Planning Team (MAWPT) is in the process of posting critical wetlands data to the Internet and making it available to the public. Much of this geographically referenced data would also be useful to watershed groups. The Comprehensive Wildlife Strategy Steering Committee is assessing habitat threats to non-game species of concern. There may be mutual benefit in sharing data. Coordination can be strengthened between the NRCS Technical Committee and the NPS Pollution Management Plan Stakeholder Group (for example, meetings could be held back-to-back and agendas coordinated). Six examples of groups created to promote interagency cooperation are briefly described below.

- **NPS Pollution Management Plan Stakeholder Group:** The NPS Pollution Management Plan Stakeholder Group expands and builds on previous collaborative planning. Organized in July 2004, the group met four times in preparation of the 2011-2016 NPS Pollution Management Plan. The stakeholders will continue to meet every year to review progress toward achieving the goals and objectives of the plan, to assess the need to update the plan and to identify ways to improve coordination of implementation activities within statewide programs and between priority watersheds and statewide programs.
- **NRCS Technical Committee:** NRCS coordinates with its partners through the State Technical Committee. The State Technical Committee is composed of individuals who represent a variety of natural resource sciences and occupations, including soil, water, plants, wetlands and wildlife. The State Technical Committee includes representatives of federal, state and local agencies as well as nonprofit organizations and others.
- **Arkansas Conservation Partnership (ACP):** A formal relationship known as the ACP was formed in 1992 between key local partners and state and federal agencies with a statewide focus. The ACP includes ANRC, the Arkansas Association of Conservation Districts (AACD), the Arkansas

Association of Conservation District Employees (AACDE), NRCS, the University of Arkansas Division of Agriculture Cooperative Extension Service, the University of Arkansas at Pine Bluff, AFC and the Arkansas Resource Conservation and Development Council, Inc.

The partnership is committed to locally led conservation of natural resources by providing a unique combination of coordinated educational, financial and technical assistance to landowners. While each partner offers unique services, the partnership is committed to teamwork, consensus, joint decision making and sharing of successes and failures. The partnership strives to break down interagency barriers, eliminate duplication of effort and improve communication so that landowners are better served. Partners in the ACP also work closely with ADEQ, ARWC and other entities within the University of Arkansas Division of Agriculture (for example, the research station at Arkansas State University).

- **Arkansas Watershed Advisory Group (AWAG):** AWAG is a consortium of state and federal agency personnel and private citizens that promotes local voluntary approaches to watershed management and conservation. AWAG provides technical assistance to organize watershed groups, facilitates quarterly discussion of voluntary approaches and hosts an annual water quality conference. ADEQ provides staff support for AWAG.
- **Multi-Agency Wetland Planning Team (MAWPT):** The Arkansas MAWPT is comprised of state agency representatives promoting wetland conservation through implementation of goals and objectives contained in the Arkansas Wetland Strategy. The Arkansas MAWPT, formed through the governor's office, has developed statewide and watershed-level strategies that

encourage voluntary, incentive-based conservation initiatives and consistent planning efforts. The hydrogeomorphic classification and assessment of wetlands, Geographical Information Systems (GIS) watershed analyses, restoration and protection of unique wetlands and educational outreach are key components to successful conservation and management of the wetland resources of Arkansas.

- **Comprehensive Wildlife Strategy Steering Committee:** An interagency multidisciplinary team of professionals representing public agencies and private organizations are contributing to the development of a strategy for conserving Arkansas non-game wildlife. The interagency team will identify species of concern, identify the habitats where these species are located, assess habitat conditions and identify management practices and financial assistance programs to protect those species and habitats, including aquatic life and habitats. Guidance for developing the strategy is provided by USFWS. This interagency team includes biologists, hydrologists, land use managers and others. Agencies represented include AGFC, USFS, USFWS, Arkansas Natural Heritage Commission (ANHC), Audubon Arkansas and TNC.
- **Stream Teams:** These teams are made up of voluntary groups of citizens interested in working on water conservation efforts sponsored by a coalition of agencies and private groups, including AGFC, Keep Arkansas Beautiful, ADEQ, Audubon Arkansas, NRCS, the Arkansas Bass Association, ANRC, the Arkansas Cattlemen's Association, ADPT, the Arkansas Chapter of the Sierra Club and approximately two dozen other agencies and groups. Stream Teams help control litter, work on streambank stabilization projects, improve fish habitat and monitor water quality. Approximately 500 stream teams are active in Arkansas.

Table 3.2. Cooperating entities contributing directly or indirectly to statewide NPS Pollution Management Plan

	Agriculture	Silviculture	Resource Extraction	Surface Erosion	Road Construction and Maintenance	Urban Runoff
State Agencies						
Arkansas Natural Resources Commission	Lead	x	x	Lead		Lead
Arkansas Department of Environmental Quality	x	x	Lead	x	Lead	x
Arkansas Forestry Commission	x	Lead	x	x	x	x
Arkansas Department of Health	x	x	x	x	x	x
Arkansas State Highway and Transportation Department				x	x	x
Arkansas Game and Fish Commission	x	x	x	x		
Arkansas State Plant Board	x				x	
Arkansas Livestock Commission	x					x
Arkansas Geological Commission			x	x	x	
Arkansas Oil and Gas Commission			x	x		
Arkansas Department of Parks and Tourism	x	x		x	x	
Universities						
University of Arkansas Division of Agriculture						x
Cooperative Extension Service	x	x		x	x	x
Research Station	x	x		x		x
University of Arkansas, Arkansas Water Resource Center	x	x	x	x	x	x
Other Public and Private Universities (e.g., Arkansas State University, Arkansas Tech, University of Central Arkansas, Ouachita Baptist, University of Arkansas at Monticello)	x	x	x	x	x	
Federal Agencies						
USDA Natural Resources Conservation Service	x	x		x		x
USDA Farm Service Agency	x	x		x		
USDA Forest Service		x		x	x	
U.S. Geological Survey	x		x	x		
U.S. Fish and Wildlife Service	x	x	x	x	x	
U.S. Corps of Engineers				x	x	x
Local Government Entities and Entities That Serve Them						
Municipalities				x	x	x
Counties				x	x	x
Conservation Districts and Related Associations	x	x		x		x
Regional Planning Commissions				x	x	

Table 3.2. Cooperating entities contributing directly or indirectly to statewide NPS Pollution Management Plan (cont.)

	Agriculture	Silviculture	Resource Extraction	Surface Erosion	Road Construction and Maintenance	Urban Runoff
Local Government Entities and Entities That Serve Them (cont.)						
Planning and Development Districts			X	X	X	X
Associations (e.g., Municipal League, Association of Counties)	X	X	X	X	X	X
Others (e.g., Arkansas Chapter, American Public Works Association)	X	X	X	X	X	
Nonprofit Organizations (IRS 501(c)(3) Tax Exempt Status)						
Statewide (e.g., The Nature Conservancy, Audubon Arkansas)	X	X	X	X	X	
Watershed Groups	X	X	X	X	X	X
Resource Conservation and Development Councils (RC&D)	X	X		X	X	X
Other Local, Regional or Statewide Nonprofits	X	X	X	X	X	X
Membership Associations and Organizations						
Arkansas Farm Bureau	X	X		X		X
Arkansas Poultry Federation	X			X		X
Arkansas Environmental Federation			X	X		
Arkansas Home Builders Association				X	X	
Arkansas General Contractors				X	X	X
Arkansas Forestry Association		X		X	X	
Arkansas Pork Producers Association	X			X		
Others	X	X	X	X	X	
Water Districts and Related Associations						
Water Districts	X	X	X	X	X	X
Arkansas Rural Water Association	X	X	X	X	X	X
Others (e.g., professional organizations)	X	X	X	X	X	X
Interagency Coordination Teams						
NPS Management Program Task Force	X	X	X	X	X	X
NRCS State Technical Committee	X	X		X		
Arkansas Conservation Partnership	X	X		X	X	X
ADEQ Watershed Outreach	X	X	X	X	X	X
Multiagency Wetlands Planning Team	X	X	X	X	X	
Comprehensive Wildlife Conservation Steering Committee	X	X	X	X	X	
Others	X	X	X	X	X	

Table 3.3. Cooperating entities contributing directly or indirectly to NPS Pollution Management Plan in priority watersheds

	Beaver Reservoir	Poteau River	Bayou Bartholomew	Illinois River	Lake Conway–Point Remove	Lower Ouachita–Smackover	Strawberry River	Upper Saline River	L'Anguille River	Cache River
State Agencies										
Arkansas Natural Resource Commission	x	x	x	x	x	x	x	x	x	x
Arkansas Department of Environmental Quality	x	x	x	x	x	x	x	x	x	x
Arkansas Forestry Commission	x	x	x	x	x	x	x	x	x	x
Arkansas Department of Health	x	x	x	x	x	x	x	x	x	x
Arkansas State Highway and Transportation Department	x	x	x	x	x	x	x	x	x	x
Arkansas Game and Fish Commission	x	x	x	x	x	x	x	x	x	x
Arkansas State Plant Board	x	x	x	x	x	x	x	x	x	x
Arkansas Livestock Commission	x	x	x	x	x	x	x	x	x	x
Arkansas Geological Commission	x	x	x	x	x	x	x	x	x	x
Arkansas Oil and Gas Commission	x				x	x				
Arkansas Department of Parks and Tourism	x	x	x	x	x	x	x	x	x	x
Universities										
University of Arkansas, Division of Agriculture										
• Cooperative Extension Service	x	x	x	x	x	x	x	x	x	x
• Research Station	x	x	x	x	x	x	x	x	x	x
University of Arkansas, Arkansas Water Resource Center	x	x	x	x	x	x	x	x	x	x
Other Public and Private Universities (e.g., Arkansas State University, Arkansas Tech, University of Central Arkansas, Ouachita Baptist, University of Arkansas at Monticello)	x	x	x	x	x	x	x	x	x	x
Federal Agencies										
USDA Natural Resource Conservation Service	x	x	x	x	x	x	x	x	x	x
USDA Farm Service Agency	x	x	x	x	x	x	x	x	x	x
USDA Forest Service	x	x		x	x			x		x
U.S. Geological Survey	x	x	x	x	x	x	x	x	x	x
U.S. Fish and Wildlife Service	x	x	x	x	x	x	x	x	x	x
U.S. Corps of Engineers	x	x	x	x	x	x	x	x	x	x

Table 3.3. Cooperating entities contributing directly or indirectly to NPS Pollution Management Plan in priority watersheds (cont.)

	Beaver Reservoir	Poteau River	Bayou Bartholomew	Illinois River	Lake Conway–Point Remove	Lower Ouachita–Smackover	Strawberry River	Upper Saline River	L'Angeuille River	Cache River
Local Government Entities and Entities That Serve Them										
Municipalities	x	x	x	x	x	x	x	x	x	x
Counties	x	x	x	x	x	x	x	x	x	x
Conservation Districts and Related Associations	x	x	x	x	x	x	x	x	x	x
Regional Planning Commissions	x		x	x	x					x
Planning and Development Districts	x	x	x	x	x	x	x	x	x	x
Associations (e.g., Arkansas Municipal League, Arkansas Association of Counties)	x	x	x	x	x	x	x	x	x	x
Others (e.g., Arkansas Chapter, American Public Works Association)	x	x	x	x	x	x	x	x	x	x
Nonprofit Organizations (IRS 501(c)(3) Tax Exempt Status)										
Statewide (e.g., The Nature Conservancy, Audubon Arkansas)	x	x	x	x	x	x	x	x	x	x
Watershed Groups	x	x	x	x	x	x	x	x	x	x
Resource Conservation and Development Councils (RC&D)	x	x		x	x		x	x		
Other Local, Regional or Statewide nonprofits	x	x	x	x	x	x	x	x	x	x
Membership Associations and Organizations										
Arkansas Farm Bureau	x	x	x	x	x	x	x	x	x	x
Arkansas Poultry Federation	x	x	x	x	x	x	x	x		x
Arkansas Environmental Federation	x	x	x	x	x	x	x	x	x	x
Arkansas Home Builders Association	x			x	x			x		x
Arkansas General Contractors	x			x	x			x		x
Arkansas Forestry Association	x	x	x	x	x	x	x	x	x	x
Arkansas Pork Producers Association	x	x		x	x		x			x
Others	x	x	x	x	x	x	x	x	x	x
Water Districts and Related Associations										
Water Districts	x	x		x	x		x	x		
Arkansas Rural Water Association	x	x	x	x	x	x	x	x	x	x
Others (e.g., professional organizations)	x	x	x	x	x	x	x	x	x	x

Table 3.3. Cooperating entities contributing directly or indirectly to NPS Pollution Management Plan in priority watersheds (cont.)

	Beaver Reservoir	Poteau River	Bayou Bartholomew	Illinois River	Lake Conway–Point Remove	Lower Ouachita–Smackover	Strawberry River	Upper Saline River	L'Anguille River	Cache River
Interagency Coordination Teams										
NPS Management Program Task Force	x	x	x	x	x	x	x	x	x	x
NRCS State Technical Committee	x	x	x	x	x	x	x	x	x	x
Arkansas Conservation Partnership	x	x	x	x	x	x	x	x	x	x
ADEQ Watershed Outreach	x	x	x	x	x	x	x	x	x	x
Multi-Agency Wetlands Planning Team	x	x	x	x	x	x	x	x	x	x
Comprehensive Wildlife Conservation Steering Committee	x	x	x	x	x	x	x	x	x	x
Others	x	x	x	x	x	x	x	x	x	x

Section Four

Agriculture Statewide Programs

Introduction

Crop and animal agriculture is a major industry in Arkansas, accounting for \$16.3 billion of value added to the Arkansas economy in 2008. Arkansas farmers provide jobs and produce food and fiber for domestic and international markets. In addition, agricultural lands provide environmental benefits of value to all citizens of the state.

Agricultural activities can also result in polluted runoff entering waterbodies when Best Management Practices (BMPs) are not properly implemented. Potential nonpoint source pollutants include sediment, nutrients, oxygen-demanding organic matter and pesticides. Figures 4.1 show the estimated distribution and concentration of row crop and animal agriculture.

The Arkansas Department of Environmental Quality's (ADEQ) 2008 List of Impaired Waterbodies identifies streams in which agriculture is identified as the primary or secondary source of pollution. The ADEQ List of Impaired Waterbodies categorizes waters of the state. These are described in the introduction of this plan. The List of Impaired Waterbodies can be accessed at:

- http://arkansaswater.org//index.php?option=com_content&task=view&id=14&Itemid=30
- www.adeq.state.ar.us/water/branch_planning/pdfs/303d_list_2008.pdf

Note that under the "Sources" descriptions, waters impaired by agriculture are designated as "AG."

Pollutants Associated With Agriculture

Sediment: Soil erosion is the detachment and movement of soil particles from the soil surface. Soil loss by erosion is not sediment yield; however, it creates a potential for sediment yield. Sediment yield is the amount of eroded soil material that actually enters bodies of water. Soil loss is equal to the tonnage of soil being moved by erosion and redeposited in other

locations, such as in ends of field rows, drainage ditches, adjacent land road ditches and other locations. Frequently, some of these eroded soil materials, along with the undesirable chemicals dissolved in runoff water or attached to soil particles, are transported by the runoff water from land surfaces into bodies of water. The percentage of soil that moves into bodies of water from eroding lands is quite variable. Sediment yield depends on the size of soil particles being transported, slope of the land, distance to the nearest waterbody, density of the vegetation the sediment has to move through, the shape of the drainage way and the intensity of the rain event.

The quantity of soil loss from cropland can be calculated by using several models, including the most recent version of the Revised Universal Soil Loss Equation (RUSLE), which was developed by the Agricultural Research Service in cooperation with the U.S. Department of Agriculture Natural Resources Conservation Service (NRCS). Predictions of areas with the potential for water quality problems can be made using this type of information in combination with land use, climatological data, etc.

Sediment can smother benthic organisms. It can also cover critical stages of fish eggs and early life stages causing increased mortality. Sediment can interfere with photosynthesis by reducing light penetration and may fill in waterways, hindering navigation and increasing flooding. Sediment particles from agricultural lands typically can carry nutrients, pesticides and other organic compounds into the waterbodies.

The U.S. Geological Survey (USGS) found higher concentrations of phosphorus in surface waters of the Lower Mississippi River Delta than in other parts of the Mississippi River Basin (see phosphorus discussion). One hypothesis for the high yields and concentrations of phosphorus in the watersheds of the Delta involves a combination of factors, such as soils, rainfall and agricultural drainage. The sediment in the rivers of the Delta is composed of fine, clay-sized particles to which phosphorus can sorb. Heavy rainfalls increase the potential for erosion and the movement of these fine clay-sized particles from agricultural fields into streams. Additionally, because of the large amount of rain, the tight clays that decrease infiltration of water and the relatively flat terrain, much of the Delta has

Figure 4.1a
Estimated
distribution and
concentration of
livestock and
poultry
production

Sources: National Agricultural
 Statistics Service (NASS), 2009, and
 Arkansas Natural Resources
 Commission, 2008
 Data Source: GeoStor
 Map Created: March 2011

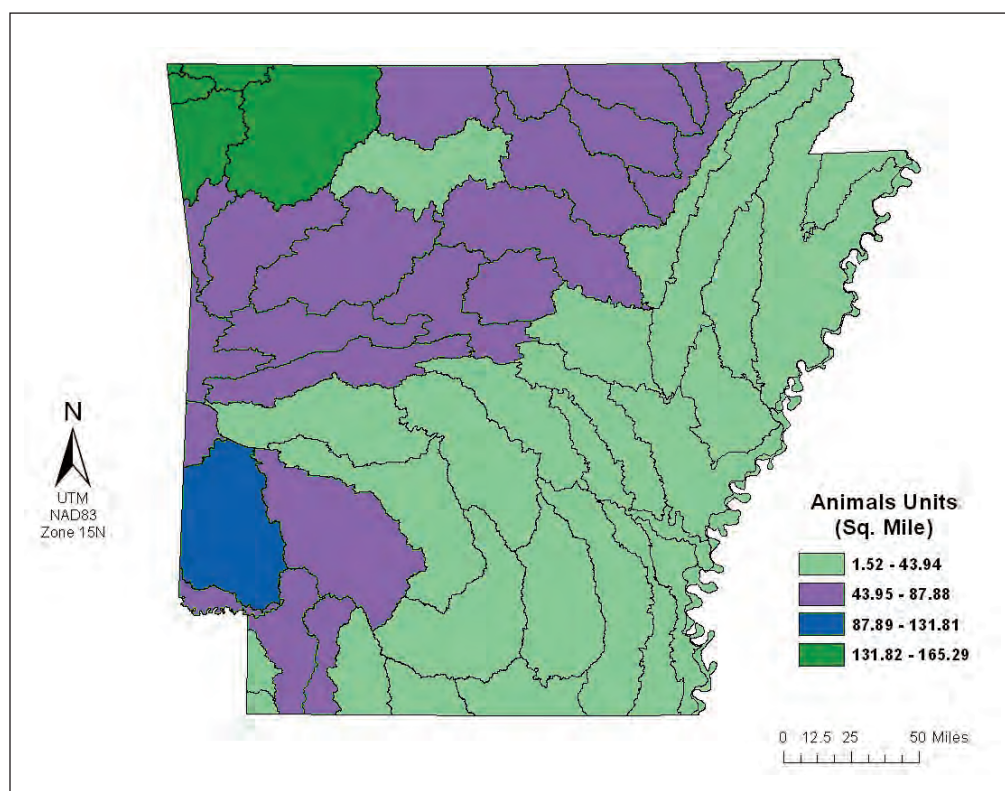
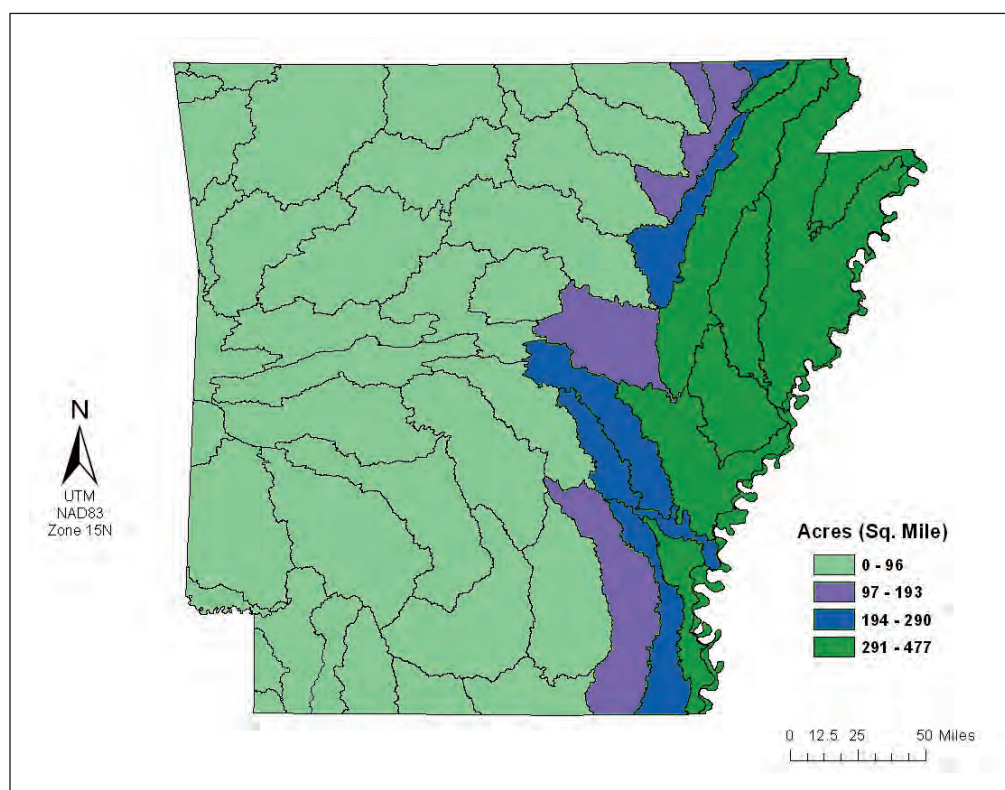


Figure 4.1b
Distribution and
concentration of
row crops

Source: National Agricultural
 Statistics Service (NASS), 2009
 Data Source: GeoStor
 Map Created: March 2011



artificial drainage to expedite the movement of water. Most of this artificial drainage is surface drainage, which has been shown to decrease nitrate concentrations but to increase total phosphorus concentrations.

Nutrients: In general, runoff from watersheds in areas of agricultural use has significantly higher nutrient concentrations than drainage waters from forested watersheds. Increased nutrient levels may result from fertilizer application and animal wastes. In a nationwide U.S. Environmental Protection Agency (EPA) study, it was determined that nutrient concentrations are generally proportional to the percentage of land in agricultural use and inversely proportional to the percentage of land in forested use (EPA, 1977). Additional carcinogens produced by algae may be found on EPA's web site.

Soluble nutrients may reach surface and groundwater through runoff or percolation. Others may be adsorbed onto soil particles and reach surface waters with eroding soil. Nutrients are necessary to plant growth in a waterbody, but over-enrichment leads to excessive algae growth, an imbalance in natural nutrient cycles, changes in water quality (especially dissolved oxygen) and a decline in the number of desirable fish and macroinvertebrate species. Factors influencing nutrient losses are precipitation, temperature, soil type, kind of crop, nutrient mineralization and denitrification.

The 2003 Arkansas General Assembly defined Nutrient Surplus Areas (NSAs) and identified regions where the soil concentration of one or more nutrients is so high or the physical characteristics of the soil or area are such that continued application of specified nutrients to the soil could result in oversaturated soils and impair water quality. In these areas, special efforts are being made to manage all sources of nutrient application. The Arkansas Natural Resources Commission (ANRC) is charged with administering statutes that apply to NSAs, including:

- certifying applicators who apply nutrients to crops or pasture land;
- certifying nutrient management plan writers;
- registering all poultry feeding operations;
- requiring development and implementation of nutrient management and poultry litter management plans; and
- for any nutrient management taking place on a scale larger than 5 acres in NSAs.

Nutrients of concern include:

Nitrogen: Excessive nitrogen, in addition to contributing to eutrophication, causes other water quality problems. Dissolved ammonia may be toxic to fish depending on the concentration of ammonia in the water, the pH of the water and the temperature of the water. Nitrates in drinking water are potentially dangerous, especially to infants. Nitrate is converted to nitrite in the digestive tract, reducing the oxygen-carrying capacity of the blood (methemoglobinemia) and resulting in brain damage or even death. The Environmental Protection Agency has set a limit of 10 mg/L nitrate-nitrogen in water used for human consumption (EPA, 1989). Nitrogen is naturally present in soils within organic matter but must be added to increase crop production.

Nitrogen is added to the soil primarily by applying commercial fertilizers and manure and by growing legumes (biological nitrogen fixation) and incorporating crop residues. Not all nitrogen present in or on the soil is taken up for plant use at any one time. For example, in the eastern Corn Belt, it is normally assumed that about 50 percent of applied nitrogen is assimilated by crops during the year of application (Nelson, 1985). Organic nitrogen normally constitutes the majority of the soil nitrogen. It is slowly converted (2 to 3 percent per year) to the more readily plant-available inorganic ammonium or nitrate. Organic nitrogen occurs as particulate matter in living organisms and as detritus. It occurs in dissolved form in compounds such as amino acids, amines, purines and urea. Inorganic forms of nitrogen are ammonium (NH_4), nitrate (NO_3) and nitrite (NO_2). All forms of nitrogen from soil can affect water quality, but the chemical forms of nitrogen are generally most mobile in the soil and, thus, of most concern as pollutants. Nitrate is highly mobile and can move readily below the crop root zone, especially in sandy soils. It can also be transported with surface runoff, but not usually in large quantities. Ammonium can become adsorbed by the soil and lost primarily with eroding sediment. Even if nitrogen is not in a readily available form as it leaves the field, it can be converted to an available form either during transport or after delivery to waterbodies.

Excessive amounts of nitrogen may contribute to nutrient enrichment of waterbodies, stimulating algae blooms. Large blooms can result in reduced dissolved oxygen levels. This process, termed *eutrophication*, depletes the dissolved oxygen that aquatic organisms need to survive.

Phosphorus: Phosphorus can also contribute to the eutrophication of waterbodies, and in freshwater, it often is the limiting factor for eutrophication. Algae consume dissolved inorganic phosphorus and convert it to the organic form. Phosphorus is rarely found in concentrations high enough to be toxic to higher organisms. Manure and fertilizers increase the level of available phosphorus in the soil to promote plant growth, but many soils now contain higher phosphorus levels than plants need (NovaisEECC1) (Kamprath, 1978). Phosphorus can be found in the soil in dissolved, colloidal or particulate forms. Runoff and erosion can carry some of the applied phosphorus to nearby waterbodies. Dissolved inorganic phosphorus (orthophosphate phosphorus) is generally the only form directly available to algae. Particulate and organic phosphorus delivered to waterbodies may later be released and made available to algae if the bottom sediment of a stream becomes anaerobic, which can result in eutrophication or negatively affect aquatic life.

Concentrations of nitrogen and phosphorus were measured from weekly to at least monthly at nine stream-sampling sites in the USGS National Water Quality Assessment Program's MISE Study Unit, which roughly corresponds to row crop areas of the Delta (1994). Nitrate concentrations never exceeded the drinking-water standard of 10 mg/L in any sample, and ammonia concentrations did not exceed aquatic-life guidelines. However, the EPA goal of 0.1 mg/L or less total phosphorus for streams not entering reservoirs was exceeded in every sample from the urban stream and in more than 50 percent of the samples from five streams located in the Mississippi Alluvial Plain. Samples from the streams located in the Gulf Plains exceeded the recommended goal of 0.1 mg/L or less total phosphorus in less than 50 percent of the samples. Phosphorus yields from watersheds within the MISE Study Unit were the highest in the Mississippi River Basin. These high phosphorus yields probably are related to several factors such as soils, amounts of rainfall and artificial drainage of agricultural fields. In contrast, total nitrogen yields in streams in the Mississippi Embayment were less than those from the agriculturally productive Midwest, but more than those in the drier western part of the basin or the cooler Upper Mississippi River Basin, and about the same as streams in the Ohio River Basin (Kleiss et al., 2000). Based on limited information, it appears that nutrient concentrations and yields might be greatest from urban areas in the Delta (Kleiss et al., 2000). A nationwide survey of streams showed that nitrogen concentrations were generally greater from agricultural areas, whereas phosphorus concentrations were greatest from urban and agricultural areas (Dubrovsky et al., 2010).

Organic Material: Animal waste and crop debris are the primary organic pollutants that result from agricultural activities. In addition, estrogenic compounds (17 β estradiol) have been identified as a contaminant associated with animal waste and has been measured in groundwater in north Arkansas while antibiotics associated with land application of animal waste have been reported in surface water. Studies conducted by the University of Arkansas Division of Agriculture and USDA Agricultural Research Service (ARS) have focused on the presence and concentration of 17 β estradiol in runoff water from small plots and fields that have received animal manure applications. These studies have focused on surface waters, particularly surface runoff from natural precipitation and artificial rainfall simulations (Haggard et al., 2005). Other studies have shown that pharmaceuticals, particularly antibiotics, were found most often in streams below effluent discharges from municipal wastewater treatment plants. The one site that drained a predominately agricultural basin, Spavinaw Creek, was the only site where none of the 100-plus pharmaceuticals and personal care products were found. Two of these chemicals were found in North Sylamore Creek, which is considered a forested reference stream (Haggard et al., 2006). These materials place an oxygen demand on receiving waters upon decomposition. If dissolved oxygen levels decrease and remain low, fish and other aquatic species will be stressed and/or die.

Animal production byproducts include the fecal and urinary wastes of livestock and poultry, process water (such as from a milking parlor) and the feed, bedding, litter and soil with which they become intermixed. Proper land application of these byproducts provides nutrients for crop production and also reduces surface runoff by promoting increased plant growth, which creates groundcover or develops root mass to hold soil in place. Land application of these byproducts can also be a potential source of NPS pollution that degrades water quality. Runoff and percolation can transport organic matter and nutrients to surface and groundwater in the absence of properly implemented BMPs. Appropriate animal and land management practices should be followed.

The following pollutants may be contained in manure and associated bedding materials and could be transported by runoff water and process wastewater from confined animal facilities:

- oxygen-demanding substances;
- nitrogen, phosphorus and many other major and minor nutrients or other deleterious materials;

- organic solids;
- salts;
- bacteria, viruses and other microorganisms; and
- sediments.

Fish kills may result when runoff, wastewater or manure enter surface waters, due to ammonia or dissolved oxygen depletion. The decomposition of organic materials can deplete dissolved oxygen supplies in water, resulting in or anaerobic conditions. Methane, amines and sulfide are produced in anaerobic waters, causing the water to acquire an unpleasant odor, taste and appearance. Such waters can be unsuitable for drinking, fishing and other recreational uses.

Solids deposited in waterbodies can accelerate eutrophication through the release of nutrients over extended periods of time. Because of the high nutrient and salt content of manure and runoff from manure-covered areas, contamination of groundwater can be a problem if storage structures are not built to minimize seepage. Animal feces may carry pathogens with the potential to cause diseases in humans. Runoff from fields receiving manure may contain extremely high numbers of bacteria if the manure has not been incorporated or the bacteria have not been subject to stress.

The method, timing and rate of manure application are significant factors in determining the likelihood that water quality contamination may occur. Manure is generally more likely to be transported in runoff when applied to the soil surface than when incorporated into the soil.

Conditions that cause a rapid die-off of bacteria are low soil moisture, low pH, high temperatures and direct solar radiation. Manure storage generally promotes die-off, although pathogens can remain dormant at certain temperatures. Composting the wastes can be quite effective in decreasing the number of pathogens.

When application rates of manure for crop production are based on nitrogen (N), the phosphorus (P) and potassium (K) rates normally exceed plant requirements (Westerman et al., 1985), with the possible exception of forage production. The soil generally has the capacity to absorb much of the phosphorus leached from manure applied on land. However, phosphorus attached to soil particles is lost to runoff in the erosion process, and a portion of the phosphorus in animal wastes is soluble and directly enters rainfall runoff. Nitrates are easily leached through soil into groundwater or in return flows while phosphorus can be transported by eroded soil.

Pesticides: The term *pesticide* includes any substance or mixture of substances intended for preventing, destroying, repelling or mitigating any pest or intended for use as a plant regulator, defoliant or desiccant. The principal pesticide pollutants that may be detected in surface water and in groundwater are active and inert ingredients and any persistent degradation products. Pesticides and their degradation products may enter ground and surface water in solution, in emulsion or bound to soil colloids. For simplicity, the term *pesticides* will be used to represent “pesticides and their degradation products” in the following sections.

Despite the documented benefits of using pesticides (insecticides, herbicides, fungicides, miticides, nematocides, etc.) to control plant and animal pests and enhance production, these chemicals may cause impairments to the uses of surface water and groundwater. Some types of pesticides are resistant to degradation and may persist and accumulate in aquatic ecosystems.

Pesticides may harm the environment by eliminating or reducing populations of desirable organisms, including endangered species. Sub-lethal effects include behavioral and structural changes of an organism that jeopardize its survival. For example, certain pesticides have been found to inhibit bone development in young fish or to affect reproduction by inducing abortion.

Herbicides in the aquatic environment can destroy the food source for higher organisms, which may then starve. Herbicides can also reduce the amount of vegetation available for protective cover and the laying of eggs by aquatic species. Also, the decay of plant matter exposed to herbicide-containing water can cause reductions in dissolved oxygen concentration (North Carolina State University, 1984).

Pesticide detections in water typically occur as a mixture with other pesticides. The mixtures can have enhanced toxicity through additivity, potentiation or synergistic effects, which are difficult to predict because of the lack of data that currently exists.

Bioconcentration is a process that results in an organism having a higher concentration of a substance than is in its surrounding environmental media, such as stream water. *Bioaccumulation* is a general term for the accumulation of chemicals in an organism or part of an organism. The accumulation process involves the biological sequestering of substances that enter the organism through respiration, food intake, epidermal (skin) contact with the substance and/or other means.

Biomagnification refers to the process that incorporates bioconcentration and bioaccumulation, where tissue concentrations of accumulated chemicals increase as the chemical passes through several trophic levels. Through these processes, pesticides present in relatively low concentrations in sediments and water may be present in high concentrations in fish tissue.

A source of contamination from pesticide use is the result of normal application. Other sources of pesticide contamination are atmospheric deposition, spray drift during the application process, misuse, spills, leaks, and discharges that may be associated with pesticide storage, handling and waste disposal.

The primary routes of pesticide transport to aquatic systems are (Maas et al., 1984):

- direct application;
- in runoff;
- aerial drift;
- volatilization and subsequent atmospheric deposition; and
- uptake by biota and subsequent movement in the food cycle.

The amount of field-applied pesticide that leaves a field in the runoff and enters a stream primarily depends on the:

- intensity and duration of rainfall or irrigation;
- length of time between pesticide application and rainfall occurrence;
- amount of pesticide applied and its soil/water partition coefficient;
- length and degree of slope and soil composition;
- extent of exposure to bare (vs. residue or crop-covered) soil;
- proximity to streams;
- method of application; and
- extent to which runoff and erosion are controlled with agronomic and structural practices.

Pesticide losses are generally greatest when rainfall is intense and occurs shortly after pesticide application, a condition for which water runoff and erosion losses are also greatest.

Pesticides can be transported to receiving waters either in dissolved form or attached to sediment. Dissolved pesticides may be leached to groundwater supplies. Both the degradation and adsorption characteristics of pesticides are highly variable.

Many investigations of losses of various agricultural pesticides in runoff from treated land have been reported. Nearly all led to the same general conclusion: if they are applied properly, except when heavy rainfall occurs shortly after treatment, concentrations are low and the total amount of pesticide that runs off the land during the crop year is less than 5 percent of the application. Nevertheless, some chemicals are highly toxic to fish or other aquatic fauna and can persist in the aquatic environment so that even very low levels of these pesticides in runoff may be of environmental concern. On the other hand, some of the agricultural chemicals have not been proven to be acutely toxic to animal life, do not persist from one crop season to the next and do not accumulate in food chain organisms. However, because of the extensive acreage involved in agriculture, the potential movement of chemical pesticides into the waterbodies, particularly groundwater, still continues to be an environmental concern.

During 1995 and 1996, ADEQ monitored for pesticides in surface water. Analyses for approximately 50 pesticides were completed from the 133 monthly monitored stations from one sampling event. All quarterly sample sites were sampled for these pesticides during the July 1995 sample event. After the initial screening, 33 sites located in the state's Delta ecoregion were selected for additional sampling. These sites were sampled on two additional occasions, October 1995 and October 1996. This provided a total of 285 analyses for the 50 pesticides targeted during this survey. Approximately 50 percent of the total numbers of pesticides analyzed were measured at detectable levels. The three pesticides that had the highest incidence of occurrence above the detection level were herbicides atrazine, metolachlor and molinate (Ordram). The detection level of all three compounds was generally less than 0.009 µg/L. Atrazine was detected in about 68 percent of the samples and at 102 of the samples sites. Metolachlor was detected in approximately 73 percent of the samples and at 82 sample sites, and molinate was detected in approximately 62 percent of the samples and at 62 samples sites. The highest values found were 1.09 µg/L for atrazine in DePartee Creek near Bradford, 6.87 µg/L for metolachlor in Bayou Bartholomew near McGehee, and 332.65 µg/L for molinate in Glaise Creek near Worden (ADEQ 305(b) report, 2002).

In 1999 and 2000, 23 stations were sampled three to four times and analyzed for pesticides in the water column. These analyses were performed at stations established in southeast Arkansas in conjunction with the Bayou Bartholomew NPS Assessment.

During 2001, water samples were collected for pesticide analyses at 35 stations in the Delta previously established for ADEQ's Roving Monitoring Network. These analyses consisted of the same parameters utilized in the 1995-1996 sampling with the addition of bentazon (Basagran) and acifluorfen (Blazer). Bentazon and acifluorfen are commonly used post-emergent herbicides and were added to the parameter list because of their wide use in Delta agriculture. Only 28 of the 52 pesticides tested were found in detectable levels. The three pesticides with the highest incidence of occurrence above the detection level were metolachlor, molinate and bentazon. The detection level of these three pesticides was generally less than 0.01 µg/L (ADEQ, 2002). The effect on aquatic life to multiple low level pesticide exposures is currently unknown.

The Arkansas Water Resources Center (AWRC) and ADEQ monitor wells in eastern Arkansas. Data from the pesticide monitoring in eastern Arkansas indicates there is a difference in the detection frequency between AWRC and ADEQ. The rate of detection for AWRC is approximately 5 percent of total wells; whereas the detection rate for ADEQ is probably closer to 30 percent or more for all samples analyzed to date. In spite of these differences, both organizations have noted that bentazon accounts for the highest percentage of total detected pesticides, accounting for more than 45 percent of the total detections by both organizations. Because there is a difference in both the laboratory equipment and protocol for qualifying the detections for the Bayou Bartholomew, the study was 55 percent for bentazon. Although not the highest-use pesticide, bentazon apparently is problematic from the standpoint of its high solubility and relatively low sorption properties (Kresse et al., 1997).

The source of the pesticide contamination is not completely understood at the present time, and point sources (spills, well contamination, etc.) versus nonpoint sources (general application and soil infiltration) as the principal source and transport mechanism for delivery to the groundwater table is a topic of debate both nationwide and within Arkansas. One of the more promising aspects of the monitoring to present date is that the concentrations are low and all detections have been below federal requirements and recommendations (MCLs and HALs). Most all of the detections are in the low µg/L range and are predominantly between three to five orders of magnitude below the EPA Maximum Contaminant Levels (MCL) and Health Advisory Levels (HAL) (Kresse et al., 2002).

Several weeds and grasses have been identified that are becoming or are now resistant to control by glyphosate herbicide. To control these herbicide-resistant weeds, namely teaweed (*Sida spinosa*), horseweed (*Erigeron canadensis*), common ragweed (*Ambrosia artemisiifolia*), and some grassy type weeds, there is likely to be more use of soil-applied herbicides with higher application rates and increased tillage. This could lead to a potential water quality problem, including impact from turbidity, total suspended solids (TSS) and leaching. The effect on water quality from increased use of tillage and use of soil-applied chemicals will need to be addressed. BMPs will need to be developed, and the use of riparian buffer strips may be needed so that spraying in riparian areas is not necessary.

Water Quality/Program Goals

In its most current List of Impaired Waterbodies, ADEQ has identified waters of the state that are not fully supporting of designated uses and in which the major source of the pollutant causing the impairment to the use is agriculture.

The ultimate long-term goal of the agriculture statewide program is for agriculture not to be identified as contributing to impairment of Arkansas waters. This can be achieved through targeted awareness, BMP training, monitoring and other voluntary programs.

More specifically, long-term goals that can be achieved within 15 to 20 years include:

- achieving a net gain of management practices for water quality, such as riparian buffers in Arkansas agricultural lands, especially in areas where animal wastes are applied in floodplains and where widespread aerial application of agricultural chemicals is a common production practice;
- reduce agriculture's contribution of sediment, nutrient or other pollutants to streams in such amounts as to cause impairment of the waters of the state;
- pesticides will not be found in the waters of the state in concentrations that cause impairment to the designated use of the waters, through effective application of pesticide training and certification programs and continued development of BMPs for pesticide management; and
- pesticides, including herbicides and fungicides, will not be detected in groundwater in concentrations higher than those set by the EPA as MCLs and HALs.

Short-term measurable goals for the next five years include:

- maintain highly erodible land in accordance with NRCS standards;
- have 90 percent of poultry and livestock producers operate within the conditions of a nutrient management plan (NMP) prepared by a certified nutrient planner;
- establish a detectable trend toward reduced nutrient loading for selected streams within NSAs as a result of implementation of NMPs; and
- develop effective BMPs for management of identified chemical-resistant weeds or pests and the use of chemicals for control.

Agriculture Logic Model

To better plan how program goals would be achieved, the teams who did the initial research to prepare the NPS Pollution Management Plan also created logic models for each section.

A logic model is a planning tool that helps establish how an intervention, such as a project or program, is understood or what results it is intended to produce. The team discussed long-term, medium-term and short-term behavior changes it hoped to cause through the NPS plan and what actions would be most effective to achieve those changes.

As mentioned previously, one long-term goal is to prevent agriculture practices from being a contributing source of pollution found in Arkansas' waterbodies and

to ensure systematic monitoring. The team believes these goals can be accomplished through better BMPs and more frequent utilization of BMPs, as well as making helpful technology readily available in watersheds with impaired waters. Systematic monitoring also plays a role, not only as an end product but as an evaluation tool necessary to review the impact of BMPs in watersheds with impaired waterbodies.

In the short-term, the team believes more BMP research and implementation is needed, as well as having involved parties take advantage of cost-share programs. New data tracking systems are needed in the short-term to help track and aggregate data.

These outcomes require an investment of money and time, as well as having stakeholders involved. Some of these outcomes can be achieved through workshops, field days, conferences and the sharing of information by stakeholders. Tool development, such as data tracking, would also be a necessary activity.

Producers, agencies, industry representatives, government units, researchers, politicians and the general public must be involved to achieve these outcomes. It needs to be recognized that external forces may make it difficult to achieve all these outcomes, because some producers may never buy in to government programs or pollution reductions from agriculture may be masked by increased urbanization.

Long and short-term programmatic objectives for the elements of this statewide program are given in the section following the Program Logic Model (Table 4.1).

Table 4.1. PROGRAM LOGIC MODEL – Agriculture

SITUATION
Agriculture is currently listed as the source of impairment for several bodies of water in Arkansas. If reasonable progress toward removing agriculture sources from contributing pollutants to waters of Arkansas is not made or measured, then voluntary implementation of steps to reduce pollution leading to surface water impairments may become mandatory in the future.
PRIORITIES
Maintain current voluntary status of nonpoint pollution abatement. Achieve milestones for pollution reduction goals as listed in Section 4. Reduce potential pollution to surface waters from agricultural activities. Maintain or improve the quality of waters of Arkansas.

Table 4.1. PROGRAM LOGIC MODEL – Agriculture (cont.)

INPUTS	OUTPUTS		OUTCOMES		
	Activities	Participants	Short-term	Medium-term	Long-term
Money Time People	<ul style="list-style-type: none"> – Workshops – Tool development – Field days – Conferences – Data tracking – Info/data sharing by stakeholders 	<ul style="list-style-type: none"> – Producers/agencies – Nonprofits/industry – Local/state/federal governments – Researchers/politicians/public – Municipal staff 	<ul style="list-style-type: none"> – BMP research – BMP implementation – Cost share programs utilized – Cost share programs tweaked – New data tracking systems – Tracked and aggregated data (STORET) – Systematic monitoring – Pollutant load partitioning 	<ul style="list-style-type: none"> – Better BMPs – Increased BMP use – Increased cost-share use – Transfer of technology to other counties, regions or watersheds with impaired waters – Targeted and more efficient approaches and resource use – Integrated components (discovery farm) – Systematic monitoring 	<ul style="list-style-type: none"> – No impairments from agriculture – Systematic monitoring

ASSUMPTIONS	EXTERNAL FACTORS
<ol style="list-style-type: none"> 1. Producers will utilize existing cost-share or conservation programs. 2. BMPs implemented are not all tracked through NRCS or Conservation Districts. 3. If all government programs are used, BMPs are implemented, and so forth, impairments may still exist from other sources. 4. Arkansas devotes more money to nonpoint pollution abatement. 5. EPA will keep up with data, remember successes and not disregard data, such as is currently done in the Illinois River Watershed. 	<ol style="list-style-type: none"> 1. Some conservation programs are undesirable and restrict progress. 2. Some producers may never buy into government programs. 3. Pollution reductions in agriculture may be masked by increasing urbanization. 4. State of Arkansas' resources toward pollution abatement are limited. 5. EPA may not be accepting regardless.

Table 4.1. PROGRAM LOGIC MODEL – Agriculture (cont.)

EVALUATION PLAN
<p>See progress made over five years and make adjustments in the needed areas if acceptable and measured progress has not occurred (i.e., CREP program in the Illinois River is not used, rework the program details to make it more acceptable to producers and landowners.)</p> <p>Identify and separate portions of impaired watersheds that are in good condition, and focus on portions of watersheds where a majority of the impairment stems.</p> <p>Chart or graph improvements as compared to previous baseline conditions.</p> <p>Note sources of confounding data or factors; better partition impairment sources. (A lot of pastureland in Northwest Arkansas is no longer farmed but is developed commercially. Sediment and phosphorus in runoff no longer come from agriculture but instead from urbanization and bank erosion.)</p> <p>Rely on soil testing rather than NMPs for cattle producers since manure application NMPs takes priority over commercial NMPs. Manure availability is limited to most beef producers due to export processes currently in place. Note that over 90 percent of poultry producers in Arkansas are likely already operating with NMPs.</p>

Objectives and Milestones

ANRC is the lead agency for implementation of the agriculture statewide program. For all statewide programs, the overall program strategy is to continue the voluntary process whereby federal and state programs cooperate in priority areas of the state where water quality problems have been identified. As long as this cooperative process results in improved implementation of BMPs and reductions in nonpoint source pollutant loads, it will be viewed as successful. However, if the cooperative process does not result in nonpoint source reductions and water quality improvements, then state and local entities will investigate additional steps needed to ensure waterbodies meet their designated uses, using an adaptive management approach described in the introduction to this section.

Specific objectives and milestones:

4.1. Continue to encourage and provide technical assistance for the development of conservation plans, nutrient management plans and comprehensive nutrient management plans as well as implementation of BMPs through wide-ranging education and outreach programs. Due to the demand for technical assistance in developing conservation plans, nutrient management plans and comprehensive nutrient management plans, there is a need to recruit and train more technical assistance providers. To guarantee there is not a backlog of requests for developing plans for farmers, additional technical assistance providers are essential.

Timeline for Milestones: October 2011 through September 2016

4.2. Improve measures of behavior change and analyze factors that influence behavior change in order to more effectively target education and outreach programs as well as other incentives.

Timeline for Milestones: October 2011 through September 2016

4.3. Develop tools that enable measurement of the combined effect of implementing multiple BMPs in order to better evaluate the effectiveness of farming systems on the water quality of a watershed or sub-watershed.

Timeline for Milestones: October 2011 through September 2016

4.4. As resources allow, develop an economic and risk assessment tool for agricultural producers to assist with decisions on management systems related to water quality protection. USDA has developed an assessment tool for use by agricultural producers for decision making on management systems related to water quality protection.

Timeline for Milestones: October 2011 through September 2016

4.5. Identify additional sources of funding for projects that demonstrate systematic approaches that enable farmers to achieve multiple goals (for example, conserve water supply and protect water quality while achieving profitability goals).

Timeline for Milestones: October 2011 through September 2016

4.6. Improve the availability of and access to information on agricultural and other land uses at the watershed and sub-watershed levels in order to better

target implementation projects. While maintaining mandated confidentiality, make available information on the types, extent and distribution of land uses, BMPs in use, riparian buffers and total acres enrolled in conservation programs.

Timeline for Milestones: October 2011 through September 2016

4.7. Seek additional sources of funding to increase and improve the effectiveness of technical assistance to agricultural producers in planning resource management and with the implementation of BMPs, with special emphasis on NSAs.

Timeline for Milestones: October 2011 through September 2016

4.8. Coordinate conservation planning to take full advantage of cost-share programs for riparian habitat improvement, the Wetland Reserve Program (WRP), the Conservation Reserve Program (CRP), the Wetland and Riparian Zone Tax Credit Program (through ANRC) and other programs.

Timeline for Milestones: October 2011 through September 2016

4.9. Encourage plans for alternative irrigation water supply, management and supplemental stream augmentation, including off-stream storage of surplus flows.

Timeline for Milestones: October 2011 through September 2016

4.10. Continue to focus on BMP implementation to improve conservation practices for erosion control, sediment retention, irrigation management and nutrient management on row crop and animal agriculture lands and farm forests. As appropriate, direct technical assistance to landowners in targeted watersheds, giving emphasis to developing new conservation plans and riparian areas, especially those that connect established riparian corridors.

Timeline for Milestones: October 2011 through September 2016

4.11. Continue to provide and improve education and training to promote BMP implementation (for example, risk management, demonstrations to acquaint landowners with the conservation practices most effective in reducing runoff, sediment detachment and transport including, but not limited to, no-till, conservation-till, ridge-till, pipe drop outlets, riparian zone management and wetland restoration).

Timeline for Milestones: October 2011 through September 2016

4.12. Continue to encourage landowners to establish riparian buffers, vegetated filter strips, grass drainage ways and stabilize streambanks and restore riparian areas.

Timeline for Milestones: October 2011 through September 2016

4.13. Continue to provide technical assistance and make available financial assistance to agricultural operations where cost-share is a component of approved Section 319(h) implementation projects.

Timeline for Milestones: October 2011 through September 2016

4.14. Develop strategies to more effectively assess the contribution of agriculture as a source of impairment in relationship to other sources of impairment in order to more effectively target resources at the watershed and sub-watershed levels. (For example, in the Illinois River, 53 percent of phosphorus load is nonpoint source. How much of the nonpoint phosphorus load comes from agriculture?)

Timeline for Milestones: October 2011 through September 2016

4.15. Identify nutrient deficit areas more precisely to facilitate export of surplus poultry litter and develop a system for tracking where surplus litter is utilized. Continue to research and develop programs to remove surplus poultry litter from NSAs.

Timeline for Milestones: October 2011 through September 2016

4.16. Work with major integrators and farm workers as well as landowners to encourage input from and cooperation with nutrient management planning and implementation.

Timeline for Milestones: October 2011 through September 2016

4.17. Promote nutrient planning for farms that are below the threshold for classification as a Confined Animal Feeding Operation with dry manure.

Timeline for Milestones: October 2011 through September 2016

4.18. Expand education for poultry producers with a special focus on the role that the producer plays in the big picture of NPS pollution management (for example, the relationship between biological processes and agricultural production processes as they relate to water quality).

Timeline for Milestones: October 2011 through September 2016

4.19. Provide educational and technical assistance to support full implementation of nutrient application rules promulgated by ANRC.

Timeline for Milestones: October 2011 through September 2016

4.20. Continue to promote positive relationships between state and federal agencies and agricultural producers in order to cultivate open communication and an environment of trust.

Timeline for Milestones: October 2011 through September 2016

Program Tracking and Evaluation

The agricultural nonpoint source management plan can be tracked and evaluated on three levels: short-term inputs, intermediate processes and long-term outcomes. Tracking and evaluation will be based upon program activities, behavioral change and delisting of streams from the ADEQ List of Impaired Waterbodies.

The first measure of the program is tracking program activities (for example, what activities are implemented, how many farmers participated, how many fact sheets were developed, how many newspaper articles were published, etc.). These input measures track effort expended, which is a first and necessary step toward effecting change.

Timeline for Milestones: October 2011 through September 2016

The second measure of the program focuses on whether program activities result in behavioral changes (i.e., BMP implementation and regulatory compliance). Compliance with National Pollution Discharge Elimination System (NPDES) and Liquid Animal Waste Permit requirements is tracked through review of ADEQ inspection records. Both the number and nature of permit violations can be tracked. Evaluation of inspection records should not be based on the number of violations but rather on the nature of the violation. A shift from serious violations, such as direct discharges, to minor violations, such as record keeping, would be considered a major success.

Historically, data on BMP implementation has been compiled into Arkansas' NPS Pollution Management Annual Report published by ANRC. Congressionally mandated confidentiality requirements are making it difficult to obtain the data needed to analyze and report BMP implementation. New strategies will need to be developed in order to comply with confidentiality requirements while also tracking and reporting BMP implementation. The NPS Pollution Management Plan Stakeholder Group will evaluate the program every other year to determine whether changes are needed.

Timeline for Milestones: October 2011 through September 2016

The ultimate measure of the program is whether or not streams impacted by pollutants from agricultural sources are improved to the point that they can be removed from Arkansas' 303(d) List of Impaired Waterbodies. Sources of data for tracking interim water quality improvements are ADEQ's ambient monitoring network and synoptic surveys, USGS monitoring sites, AWRC dedicated monitoring sites and research by the University of Arkansas and others. Ultimately, this data is compiled into the state's 305(b) report, which is published by ADEQ every other year.

Timeline for Milestones: October 2011 through September 2016

Brief Institutional Context

The 2011-2016 NPS Pollution Management Plan will support voluntary efforts by wide-ranging partners. Partners include federal, state and local agencies that provide funding through cost-share assistance, expertise through technical assistance and education through outreach programs to farmers, as well as state regulatory agencies through administration of existing and proposed rules and regulations. Commodity groups, farm organizations and nonprofit organizations also participate in the planning and targeting of this statewide agricultural program through participation in the NPS Pollution Management Plan Stakeholder Group and also through participation and support for local NPS implementation projects.

Key partners for implementation of this statewide agricultural program include local agencies such as conservation districts, University of Arkansas Division of Agriculture faculty, RC&D Councils and local nonprofit organizations. These key local players provide a coordinated and organized process for disseminating and implementing BMPs to reduce erosion and manage pesticide and fertilizer use on agricultural lands. These partners reside in the watershed where farmers and landowners live. They have both the expertise and experience that is crucial to give farmers sound advice on land management decisions. The trust built over the past 50 years between these partners and landowners is the foundation that makes the implementation process work smoothly. They provide day-to-day advice on conservation tillage practices, pesticide and fertilizer management, recordkeeping and animal waste management plans.

A formal relationship known as the Arkansas Conservation Partnership (ACP) has been formed between these key local partners and state and federal agencies with a statewide focus. The ACP includes

ANRC, the Arkansas Association of Conservation Districts (AACD), the Arkansas Association of Conservation District Employees (AACDE), NRCS, the University of Arkansas Division of Agriculture Cooperative Extension Service, the University of Arkansas at Pine Bluff, the Arkansas Forestry Commission and the Arkansas Resource Conservation and Development Council, Inc. The partnership is committed to locally led conservation of natural resources by providing a unique combination of coordinated educational, financial and technical assistance to landowners. While each partner offers unique services, the partnership is committed to teamwork, consensus, joint decision making and sharing of successes and failures. The partnership strives to break down interagency barriers, eliminate duplication of efforts and improve communication so that landowners are better served.

Partners in ACP also work closely with ADEQ, AWRC and other entities within the University of Arkansas Division of Agriculture, such as the research station at Arkansas State University.

Some examples of conservation partnership programs are discussed below.

Arkansas Discovery Farm

The Arkansas Discovery Farm (ADF) program uses a unique approach based on agriculture producers, scientists and natural resource managers working jointly to identify issues and potential solutions. It strives to collect economic and environmental data to better define sustainability issues and find solutions that promote agricultural profitability and natural resource protection. While the University of Arkansas Division of Agriculture provides leadership and expertise to ensure that data is collected in a scientifically rigorous and valid manner, the program is led by the ADF Stakeholder Committee (Table 4.2). The committee consists of leaders from agricultural organizations, and one seat is reserved for environmental organizations. It is supported by the Technical Advisory Committee consisting of representatives from state and federal agencies that assist agriculture (Table 4.3). Several partners have stepped forward with financial contributions through grants, gifts and contracts to help fund this program (Table 4.4).

The program uses extensive and state-of-the-art water quality monitoring systems equipment and protocol installed on real working farms to document environmental and natural resource impact and to investigate solutions to reduce off-farm impacts. The overall goal of the program is to document sustainable

and viable farming systems that remain cost-effective and environmentally sound. The following objectives would be applied to each farm:

- Conduct on-farm research and monitoring to assess the need for and the effectiveness of Best Management Practices. This will also help determine individual and synergistic nutrient and sediment-loss reduction efficiencies and water conservation.
- Provide on-farm verification and documentation of nutrient and sediment-loss reductions and water conservation in support of nutrient management planning and sound environmental farm stewardship.
- Develop and deliver educational programs from on-farm data that will assist producers in achieving both production and environmental goals in support of sustainable farming in Arkansas.

In 2011, the statewide program consisted of four farms in four different physiographic farming regions of Arkansas (Figure 4.2). The program targets dominant farming systems in Arkansas, and its extension to a cotton-management system is vital to cover all major crops important to Arkansas's agricultural economy. The following is a brief description of the four current locations.

1. **Northwest Arkansas Poultry-Beef Operation (Elkins, Washington County):** This effort focuses on monitoring runoff originating around production houses. Under the new CAFO regulations, the EPA is becoming concerned with "discharge" waters that interact with litter spilled during house clean-out, litter temporarily stored uncovered during cleanout, and dust that accumulates from tunnel fan ventilation. This farm has six houses (equipped with tunnel ventilation) located at one site where runoff flows to a farm pond from two houses and where runoff flows from four houses across a pasture and into an ephemeral creek that flows directly to the White River. Monitoring stations will quantify nutrient and sediment loadings captured by the pond. The stations will collect data on nutrient and sediment loadings immediately before entering the pasture and immediately before reaching the creek to determine if, when and how much nutrients and particulates are transferred to runoff water from around the poultry houses. Monitoring also will quantify the nutrient and particulate trapping efficiencies of the pond and pasture.

2. Point Remove Beef and Row Crop Farm

(Morrliton, Conway County): This farm raises beef on pastures immediately adjacent to Point Remove Creek and the Arkansas River. These pastures are fertilized with litter purchased from other farms. Many of the pastures are utilized to produce irrigated, high-quality Bermuda hay and are underlain by poorly drained soils that stay saturated for portions of the winter months and are prone to intermittent flooding. In one pasture, runoff drains into a natural wetland. The University of Arkansas and other stakeholders will determine the effect of poultry litter application management (for example, rate, timing and placement) on nutrient runoff from pasture and quantify the wetland's ability to capture and store nutrients and sediment by monitoring runoff entering and exiting the wetland.

3. Cherry Valley Rice-Soybean Rotation

(Cherry Valley, Cross County): Two farms adjacent to the L'Anguille River, one on the east side and one on the west side of the river, were selected as they offer a contrast in conservation practices. One uses conventional tillage and water management for the area, while the other uses conservation tillage and has implemented switchgrass filters between the river and fields via Conservation Reserve Program (CRP). These farms are located in an area recently declared as a Critical Groundwater Area by ANRC. Flood irrigation is still the preferred irrigation method for soybeans because fields in the study region are not candidates for leveling, due to cost and the risk of exposing underlying soil horizons that are detrimental to crop production. The conventional site uses groundwater as an irrigation source, while the conservation site uses a combination of surface sources (re-lift from the L'Anguille) and

wells. Through the Mississippi River Basin Initiative (MRBI), the conservation site has been approved for reservoir construction. Runoff from two fields on the this farm will be monitored; one uses traditional flood irrigation for both rice and soybean and drains through a switchgrass border and one uses furrow irrigation for soybeans and runoff will be captured by a tail-water recovery system and reservoir. By monitoring runoff, nutrients and sediment from the two adjacent rice-soybean systems, the University of Arkansas and other stakeholders will be able to determine the effect of conservation management on nutrient and sediment losses.

4. Rice-Soybean Rotation (Stuttgart, Arkansas County):

This farm has been in a critical ground-water decline area for several years. The farm no longer has active irrigation wells in the shallow alluvial aquifer. It does have one well in the deeper (> 600 feet) Sparta aquifer, but pumping costs render it for emergency-use only. The entire farm is irrigated using an onsite reservoir, and all water draining from the farm is captured via tail-water recovery systems and returned to the reservoir. This farm represents a unique opportunity to highlight reuse of water, an issue of national prominence across all sectors of society across the nation. The University of Arkansas is establishing five monitoring stations to monitor water use and runoff water quality of 1) rice-soybean rotation on a zero-grade field; 2) rice-soybean rotation on non-graded field (conventional); 3) corn production on precision-graded field; 4) rice-soybean rotation on a precision-graded field; and 5) at the central drain for the entire farm, where runoff drains back to the reservoir, so that we can get a feel for water reuse and nutrient and sediment loss at a farm scale.

Table 4.2. Arkansas Discovery Farm Stakeholder Committee members

Member	Affiliation
Don Alexander (Chair)	Arkansas Agricultural Council
Woody Bryant (Vice Chair)	Arkansas Dairy Producer
Andrew Wargo (Liaison)	Arkansas Association of Conservation Districts
Terry Dabbs	Arkansas Farm Bureau
Jennifer James	USA Rice Federation
Adam McClung	Arkansas Cattlemen's Association
Scott Simon	Arkansas Nature Conservancy
Gene Pharr	Poultry Producers
Dennis Sternberg	Arkansas Rural Water Association
Steve Stephan	Arkansas Pork Producers Association
Brad Doyle	Arkansas Soybean Association
Max Braswell	Arkansas Forestry Association

Table 4.3. Arkansas Discovery Farm Technical Advisory Committee

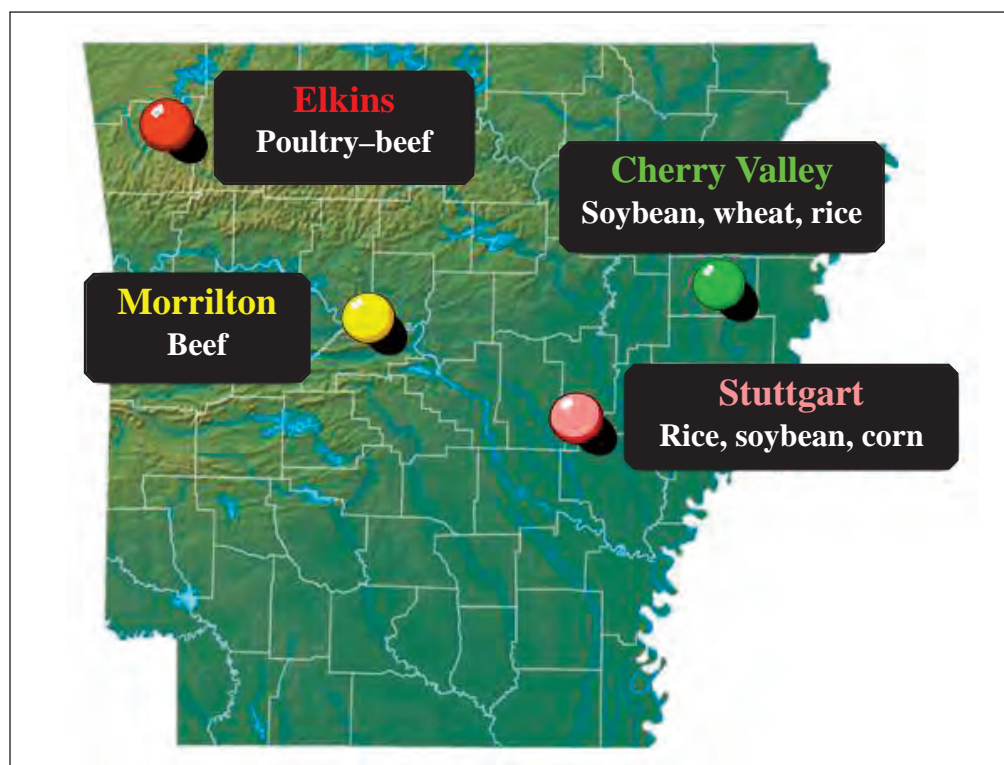
Member	Affiliation
Adrian Baber (Chair)	Arkansas Natural Resources Commission
Debbie Moreland (Liaison)	Arkansas Association of Conservation Districts
Teresa Marks	Arkansas Department of Environmental Quality
Nancy Young	Natural Resources Conservation Service
Jamey Johnson	Arkansas State Plant Board
Lewis Wray	Arkansas Livestock and Poultry Commission
David Long	Arkansas Game and Fish Commission
Cliff Snyder	International Plant Nutrition Institute
Larry Nance	Arkansas Forestry Commission
Billy Justus	U.S. Geological Survey

Table 4.4. Financial partners

University of Arkansas Division of Agriculture	Arkansas Natural Resources Commission (Section 319 program, federal stimulus funds)
Arkansas Farm Bureau	Natural Resources Conservation Service – MRBI – Cooperative Conservation Partnership Initiative program
Monsanto	State of Arkansas
Arkansas Soybean Promotion Board	
Arkansas Rice Research Promotion Board	
Arkansas Corn and Grain Sorghum Promotion Board	
United Soybean Board	
Cotton Incorporated	
Total funding: \$1.2 million. Nearly half of the funding came from competitive grants.	

**Figure 4.2
Location of
Arkansas
Discovery Farms,
2011**

Source: Dr. Michael Daniels,
University of Arkansas Division of
Agriculture



The Mississippi River Basin Initiative (MRBI)

To improve the health of the Mississippi River Basin, including water quality and wildlife habitat, NRCS has launched the Mississippi River Basin Healthy Watersheds Initiative (MRBI). Through MRBI, NRCS provides assistance to producers in developing conservation plans to meet producers' objectives and implement a suite of practices that will reduce the impacts of nutrients and sediment leaving agricultural fields. Key conservation practices include nutrient management, conservation crop rotation and residue and tillage management. Farmers and landowners can use other conservation practices such as restoring wetlands, planting trees along streams to filter nutrients out of water draining off the farm and water management. Financial assistance is also available to install edge-of-field monitoring systems in specific locations within the selected watersheds.

The initiative will build on the past efforts of producers, NRCS, partners and other state and federal agencies in the 12-state initiative area, including Arkansas, to address nutrient loading in the Mississippi River Basin. Nutrient loading contributes to both local water quality problems and the hypoxic zone in the Gulf of Mexico. The MRBI will be implemented by NRCS through the Cooperative Conservation Partnership Initiative (CCPI), the Wetlands Reserve Enhancement Program (WREP), Conservation Innovation Grants (CIG) and other programs.

Due to the hard work of the sponsoring organizations and Arkansas' NRCS staff, 51 contracts on 24,871 acres for more than \$5.33 million in financial assistance was funded during the first year of MRBI. Additional funding for the six Arkansas projects could exceed \$30 million over the five-year project's life.

Arkansas' MRBI projects include:

1. **L'Anguille River Watershed Coalition:** The L'Anguille River has been designated as an impaired watershed by EPA due to excessive siltation and turbidity from agricultural sources. The project utilizes funding from the Environmental Quality Incentives Program (EQIP), the Wildlife Habitat Incentive Program (WHIP) and the Conservation Stewardship Program (CSP). In Fiscal Year 2010, 13 applications were funded on 11,538 acres for \$626,602. Edge-of-field monitoring is being conducted on two farms in conjunction with the University of Arkansas Division of Agriculture's Discovery Farm program.
2. **Point Remove Wetlands Reclamation and Irrigation District:** The project partners are assisting agricultural producers in 15 sub-watersheds of the Lake Conway-Point Remove basin to adopt a systems approach with a variety of core and supporting conservation practices addressing natural resource concern of water quality pertaining to nutrient runoff and water management. The project utilizes EQIP funding. In FY2010, 25 contracts were funded on 10,447 acres for more than \$2.2 million. Edge-of-field monitoring is being conducted on one farm in conjunction with the University of Arkansas Division of Agriculture's Discovery Farm program.
3. **St. Francis County and Lee County Conservation Districts, Outlet Larkin Creek:** The project assists agricultural producers in the area manage runoff from agricultural fields by helping them install core conservation practices that will ensure proper application of nutrients and irrigation water, reduce the amount of excessive runoff from fields and use filter strips to trap sediment and nutrients before they leave the field. The project utilizes EQIP funding. In FY2010, nine contracts were funded on 1,028 acres for \$454,603.
4. **Northeast Arkansas Association of Conservation Districts, Little River Ditches:** The five-year project is reducing the nutrient loss from agricultural land (primarily cotton) through improved nutrient use efficiency and reduced runoff from agricultural fields. The project utilizes EQIP funding beginning in FY2011.
5. **Northeast Arkansas Association of Conservation Districts, Lower St. Francis:** The project is reducing the nutrient loss from agricultural land (primarily rice and soybeans) through improved nutrient use efficiency and reduced runoff from agricultural fields. The project utilizes EQIP FY2011 funding.
6. **Wetlands Restoration in the Cache River Watershed to Reduce Nutrient and Sediment Loading:** Conservation partners are working in 15 sub-watersheds of the Cache River in Clay, Greene, Lawrence, Craighead, Jackson, Poinsett, Woodruff, Cross, Prairie and Monroe counties. The partners are focusing on reforestation of riparian areas associated with croplands. In FY2010, four contracts were funded on 1,859 acres for more than \$2 million.

7. Illinois River Sub-Basin and Eucha-Spavinaw Lake Watershed Initiative:

NRCS has received funding for a water quality initiative in the Illinois River Sub-Basin and the Eucha-Spavinaw Lake Watershed in northwestern Arkansas and northeastern Oklahoma.

The purpose of the project is to improve water quality of the Illinois River Sub-Basin and Eucha-Spavinaw Lake Watershed (which includes Lake Tenkiller, Lake Eucha and Lake Spavinaw in Oklahoma) while maintaining the food and fiber production in the area.

Water quality enhancement is crucial to ensuring an adequate supply of drinkable water for the urban center of Tulsa, Oklahoma, as well as the many smaller municipalities and individuals who rely on these water resources for their water supply.

Improving water quality will also benefit recreational industries since the Illinois River is a designated scenic river. The project is located in portions of Benton and Washington counties in Arkansas and parts of Adair, Cherokee, Delaware, Mayes and Sequoyah counties in Oklahoma.

Funding will be used to assist landowners in the 1.32 million acre area over an eight-year period. The area includes 576,517 acres in Arkansas and 739,156 acres in Oklahoma.

8. Conservation Reserve Enhancement

Program (CREP): This is a voluntary land retirement program that helps agricultural producers protect environmentally sensitive land, decrease erosion, restore wildlife habitat and safeguard ground and surface water.

The program is a partnership among producers, tribal, state and federal governments and, in some cases, private groups. CREP is an offshoot of the country's largest private-lands environmental improvement program – the Conservation Reserve Program (CRP).

Like CRP, CREP is administered by USDA's Farm Service Agency (FSA). By combining CRP resources with state, tribal and private programs, CREP provides farmers and ranchers with a sound financial package for conserving and enhancing the natural resources of farms.

CREP addresses high-priority conservation issues of both local and national significance, such as impacts to water supplies, loss of critical habitat for threatened and endangered wildlife species, soil erosion, and reduced habitat for fish populations such as salmon. CREP is a

community-based, results-oriented effort centered around local participation and leadership.

Currently, Arkansas has CREP projects in the Bayou Meto, Illinois River and Bayou Lagrue (within the Cache River Basin) watersheds.

SPARROW Modeling

SPARROW is a watershed modeling technique for relating water-quality measurements made at a network of monitoring stations to attributes of the watersheds, such as contaminant sources and environmental factors that affect rates of delivery to streams and in-stream processing. The core of the model consists of a nonlinear regression equation describing the non-conservative transport of contaminants from point and nonpoint (or "diffuse") sources on land to rivers and through the stream and river network.

USGS scientists developed SPARROW (Smith and others, 1997) to (a) utilize monitoring data and watershed information to better explain the factors that affect water quality, (b) examine the statistical significance of contaminant sources, environmental factors and transport processes in explaining predicted contaminant loads and (c) provide a statistical basis for estimating stream loads in unmonitored locations.

The SPARROW model builds on actual stream monitoring by using spatially comprehensive geospatial data in a calibrated SPARROW model to predict water quality conditions at unmonitored stream locations. The geospatial data sets describe fertilizer and manure applications, atmospheric deposition to the land surface and urban sources.

There are several geospatial data sets used to develop explanatory variables in SPARROW models. Some are listed below.

Contaminant Source Data Sets:

Agriculture, NASS, Permit Compliance System (PCS), Sewered Population, Atmospheric Deposition, NRI, CENSUS, Land acres.

Contaminant Delivery Data Sets:

SSURGO, STATSCO, National Soil Survey, PRISM, NCDC.

The SPARROW model is run by USGS.

Partnering and Planning

At the federal level, the Water Quality Information Center (WQIC) is a USDA working group on water resources. It is composed of representatives from

USDA agencies involved with various water issues. The group fosters communication and collaboration among USDA agencies and other organizations on water-related topics. Offices at the federal level communicate and work with state, regional, and county offices to plan and implement water quality projects and programs throughout the United States. USDA agencies, state agencies, educational institutions and private groups, organizations and foundations work together to implement water quality programs in Arkansas.

Cooperating Entities

Cooperating entities are listed and described in the cooperating entities section of the 2011-2016 NPS Pollution Management Plan.

Federal Consistency

ANRC will work with NRCS on consistency of BMPs being recommended for statewide agricultural concerns through EQIP and other farm bill programs they administer. NRCS serves on the NPS Pollution Management Plan Stakeholder Group and ANRC will continue to participate in targeting of priority watersheds and BMPs for USDA programs through participation and involvement with the State Technical Committee.

Common Best Management Practices

The EPA identifies six management measures for agricultural NPS pollution management (EPA, 2004).

1. Nutrient management
2. Pesticide management
3. Erosion and sediment control
4. Animal feeding operations
5. Grazing management
6. Irrigation water management

The agricultural NPS pollution management practices discussed below are organized into these six management measures. The majority of management practices utilized in the NPS program for agriculture are identified by NRCS in their National Conservation Practice Standards (NRCS) and the State Field Office Technical Guide (ANRCS, 2002), which is regularly updated. NRCS practices deemed most effective in management of NPS pollution (at the time this update was drafted) are listed below. Other NRCS approved practices may be used in Arkansas' NPS Pollution

Management Plan provided those practices are part of an overall farm plan developed by or under the direction of the NRCS. In addition, Arkansas continues the process of implementing regulations on the application of nutrients and poultry litter and for certification and training of nutrient applicators.

The following is a summary of management measures and practices to be utilized by the statewide agricultural NPS Pollution Management Plan:

Nutrient Management

Develop, implement and periodically update a nutrient management plan to (1) apply nutrients at rates necessary to achieve realistic crop yields, (2) improve the timing of nutrient application and (3) use agronomic crop production technology to increase nutrient use efficiency. When the source of the nutrients is something other than commercial fertilizer, determine the nutrient value and the rate of availability of the nutrients. Determine and credit the nitrogen contribution of any legume crop. Soil and plant tissue testing should be used routinely.

Practices to implement nutrient management include:

- **Nutrient Applicator Certification Program:** ANRC shall certify the competence of individuals to apply nutrients and provide training relating to nutrient application. The training shall, at a minimum, allow individuals to meet all requirements of the NRCS conservation practice standards for waste utilization and related practices for Arkansas as listed in the NRCS Field Office Technical Guide. All persons making nutrient application in NSAs, as defined by the Arkansas General Assembly, must be certified.
- **Nutrient Management Planner Certification Program:** ANRC will implement a program to train and certify persons who prepare nutrient management plans. Nutrient management plans will indicate how nutrients should be applied to fields and other land for crop production while protecting ground and surface water from excessive nutrient enrichment.
- **Nutrient and Poultry Litter Application and Management Plan:** ANRC will encourage prudent practices regarding the application and management of soil nutrients and poultry litter to protect and enhance the state's surface water quality while allowing for optimum soil fertility and proper plant growth. The primary goal is to

maintain the benefits derived from the wise use of poultry litter, commercial fertilizers and other soil nutrients while avoiding unwanted effects from excess nutrient applications on the waters of the state. In furtherance of this goal, these rules provide requirements applicable to NSAs. These rules are designed to protect the waters within the state from adverse effects of excess nutrients while allowing for maximum soil fertility and proper plant growth.

- **Nutrient and Poultry Litter Application and Management Plan:** ANRC will encourage prudent practices regarding the application and management of soil nutrients and poultry litter to protect and enhance the state's surface water quality while allowing for optimum soil fertility and proper plant growth. The primary goal is to maintain the benefits derived from the wise use of poultry litter, commercial fertilizers and other soil nutrients while avoiding unwanted effects from excess nutrient applications on the waters of the state. In furtherance of this goal, these rules provide requirements applicable to NSAs. These rules are designed to protect the waters within the state from adverse effects of excess nutrients while allowing for maximum soil fertility and proper plant growth.

Refer to NRCS Technical List and apply BMPs as appropriate.

In 2010, NPS partners, led by ANRC, the University of Arkansas Division of Agriculture and NRCS finalized revisions to the Arkansas Phosphorus Index. The major changes included expanding the index to include liquid swine and poultry litter, and biosolids from wastewater treatment plants. Changes also include better accounting for the soluble phosphorus in applied manure/biosolids and mineralization of the organic phosphorus fraction. Transport changes included improved handling of pasture condition and grazing. The biggest changes were giving credit for phosphorus reduction from implementing several NRCS-approved conservation practices (Sharpley et al., 2010).

Pesticide Management

To reduce contamination of ground and surface water from pesticides:

1. List pest problems, previous pest control measures, and cropping history;
2. Evaluate the soil and physical characteristics of the site including mixing, loading and storage areas for potential leaching or runoff of pesticides;
3. If leaching or runoff is found, steps should be taken to prevent further contamination, use integrated pest management (IPM) strategies that apply pesticides only when an economic benefit to the producer will be achieved (i.e., applications based on economic thresholds) and apply pesticides efficiently and at times when runoff losses are least likely;
4. When pesticide applications are necessary and a choice of registered materials exists, consider the persistence, toxicity, runoff potential and leaching potential of products in making a selection;
5. Periodically calibrate pesticide application equipment; and
6. Use anti-backflow devices on the water supply hose in addition to other safe mixing and loading practices such as a solid pad for mixing and loading and various new technologies for reducing mixing and loading risks.

Refer to NRCS Technical List and apply BMPs as appropriate.

Erosion and Sediment Control

Apply the erosion component of a resource management system (RMS) as defined in the Field Office Technical Guide of NRCS to minimize the delivery of sediment from agricultural lands to surface waters, or design and install a combination of management and physical practices to settle the settleable solids and associated pollutants in runoff delivered from the contributing area for storms of up to and including a 10-year, 24-hour frequency.

Refer to NRCS Technical List and apply BMPs as appropriate.

Animal Feeding Operations Management

Animal feeding operations (AFOs) should be managed to minimize impacts on water quality and public health. To meet this goal, management of AFOs should address the following eight components:

1. Divert clean water. Siting or management practices should divert clean water (run-on from uplands, water from roofs) from contact with feedlots and holding pens, animal manure or manure storage systems.
2. Prevent seepage. Buildings, collection systems, conveyance systems and storage facilities should be designed and maintained to prevent seepage to ground and surface water.

3. Provide adequate storage. Liquid manure storage systems should be:
 - a. designed to safely store the quantity and contents of animal manure and wastewater produced, contaminated runoff from the facility and rainfall from the 25-year, 24-hour storm.
 - b. consistent with planned utilization or utilization practices and schedule. Dry manure, such as that produced in certain poultry and beef operations, should be stored in production buildings, storage facilities or otherwise covered to prevent precipitation from coming into direct contact with the manure.
4. Apply manure in accordance with a nutrient management plan that meets the performance expectations of the nutrient management measure.
5. Address lands receiving wastes. Areas receiving manure should be managed in accordance with the erosion and sediment control, irrigation, and grazing management measures as applicable, including practices such as crop and grazing management practices to minimize movement of nutrient and organic materials applied and buffers or other practices to trap, store and process materials that might move during precipitation events.
6. Recordkeeping. AFO operators should keep records that indicate the quantity of manure produced and its utilization or disposal method, including land application.
7. Mortality management. Dead animals should be managed in a way that does not adversely affect ground or surface water.
8. Consider the full range of environmental constraints and requirements. When siting a new or expanding facility, consideration should be given to the proximity of the facility to:
 - surface waters;
 - areas of high leaching potential;
 - areas of shallow groundwater; and
 - sink holes or other sensitive areas.

Additional factors to consider include siting to minimize off-site odor drift and the land base available for utilization of animal manure in accordance with the nutrient management measure. Manure should be used or disposed of in ways that reduce the risk of environmental degradation, including air quality and wildlife impacts, and comply with federal, state and local law.

Programs and practices to be used in implementing animal feeding operations and management include:

Nutrient Applicator Certification Program:

ANRC shall certify the competence of individuals to apply nutrients and provide training relating to nutrient application. The training shall, at a minimum, meet NRCS conservation practice standards for Arkansas. All persons making nutrient application in NSAs, as defined by the Arkansas General Assembly, must be certified.

Nutrient Management Planner Certification

Program: ANRC will implement a program to train and certify persons who prepare nutrient management plans. Nutrient management plans will indicate how nutrients should be applied to fields and other land for crop production while protecting ground and surface water from excessive nutrient enrichment.

Nutrient and Poultry Litter Application and Management Plan: ANRC will encourage prudent practices regarding the application and management of soil nutrients and poultry litter to protect and enhance the state's surface water quality while allowing for optimum soil fertility and proper plant growth. The primary goal is to maintain the benefits derived from the wise use of poultry litter, commercial fertilizers, and other soil nutrients while avoiding unwanted effects from excess nutrient applications on the waters of the state. In furtherance of this goal, these rules provide requirements applicable to NSAs. These rules are designed to protect the waters within the state from adverse effects of excess nutrients while allowing for maximum soil fertility and proper plant growth.

Poultry Feeding Operations Registration

Program: Persons in the state of Arkansas who own or operate poultry feeding operations where 2,500 or more poultry are housed or confined on any given day will be required to register annually with ANRC. Such registration will include:

- the number and type of birds housed or maintained by the operation;
- the location of the operation by latitude and longitude and county, township, range and section;
- the business address of the owner of the facility;
- the address of the facility if different from the owner's business address;
- the type of waste handling system;
- the type of litter management system and the amount of litter stored;
- the method used for carcass disposal;

- the acreage owned, controlled or used by the poultry feeding operation and used for landlord application of litter;
- tons of litter produced, removed, transferred or otherwise used by the poultry feeding operation and the type of transfer or usage;
- the poultry integrator or integrators with which the poultry feeding operation has contracted to provide poultry litter; and
- any other relevant information deemed necessary by ANRC.

Approved Disposal of Poultry and Large

Animal Carcasses: The Arkansas Livestock and Poultry Commission (ALPC) regulations specify the acceptable disposal methods that address disease control concerns as well as environmental concerns. In addition, other organizations such as NRCS and the University of Arkansas Division of Agriculture Cooperative Extension Service maintain current recommendations for proper mortality disposal.

Approved Burial of Large Animal Carcasses:

Carcasses may be buried at a site at least 100 yards away from a well and in a place where a stream cannot be contaminated. Anthrax carcasses are to be covered with one inch of lime. Other carcasses may be covered with lime, particularly to control odors. All carcasses are to be covered with at least two feet of dirt. Carcasses are not to be buried in a landfill without prior approval of the state veterinarian.

Commercial Dead Animal Disposal Services:

Commercial services may collect, process and dispose of animal carcasses, provided that all applicable rules and regulations of the ALPC are followed.

Approved Disposal of Poultry Carcasses:

Disposal of on-farm die-off of poultry may be through any method approved by ALPC including extrusion, composting, freezing, incineration, rendering or cooking for swine feed. All handling and movement of carcasses must be in conformance with the regulations of ALPC.

Emergency Disposal of Poultry Carcasses:

In the event of a major die-off, rendering will be the method of choice for disposal, except when death is caused by a disease entity. Alternately, a ditch may be used when dug two to four feet deep and covered by at least two feet of dirt. Lime may be used to control odor if needed.

Refer to NRCS Technical List and apply BMPs as appropriate.

Grazing Management

Manage rangeland, pasture and other grazing lands to protect water quality and aquatic and riparian habitat by:

1. Improving or maintaining the health and vigor of selected plants and maintaining a stable and desired plant community while, at the same time, maintaining or improving water quality and quantity, reducing accelerated soil erosion and maintaining or improving soil condition for sustainability of the resource. These objectives should be met through the use of one or more of the following practices:
 - maintain enough vegetative cover to prevent accelerated soil erosion due to wind and water;
 - manipulate the intensity, frequency, duration and season of grazing in such a manner that the impacts to vegetative and water quality will be positive;
 - ensure optimum water infiltration by managing to minimize soil compaction or other detrimental effects;
 - maintain or improve riparian and upland area vegetation;
 - protect streambanks from erosion;
 - manage for deposition of fecal material away from waterbodies and to enhance nutrient cycling by better manure distribution and increased rate of decomposition; and
 - promote ecological and stable plant communities on both upland and bottom land sites.
2. Excluding livestock, where appropriate, and/or controlling livestock access to and use of sensitive areas, such as streambanks, wetlands, estuaries, ponds, lake shores, soils prone to erosion and riparian zones, through the use of one or more of the following practices:
 - use of improved grazing management systems (e.g., herding) to reduce physical disturbance of soil and vegetation and minimize direct loading of animal waste and sediment to sensitive areas;
 - installation of alternative drinking water sources;
 - installation of hardened access points for drinking water consumption where alternatives are not feasible;
 - placement of salt and additional shade, including artificial shelters, at locations and distances adequate to protect sensitive areas;

- where necessary, provide stream crossings in areas selected to minimize the impacts of the crossings on water quality and habitat; and
 - use of exclusionary practices, such as fencing (conventional and electric), hedgerows, moats and other practices as appropriate.
3. Achieving either of the following on all rangeland, pasture and other grazing lands not addressed above:
- apply the planning approach to implement the grazing land components in accordance with one or more of the following from NRCS: a Grazing Land Resource Management System (RMS); National Range and Pasture Handbook (USDA-NRCS, 1997); and NRCS Field Office Technical Guide, including NRCS Prescribed Grazing 528; or
 - maintain or improve grazing lands in accordance with activity plans or grazing permit requirements established by the Bureau of Land Management, the National Park Service, the Bureau of Indian Affairs of the U.S. Department of Interior, the USDA Forest Service or other federal land managers.

Refer to NRCS Technical List and apply BMPs as appropriate.

Irrigation Water Management

To reduce NPS pollution of ground and surface waters caused by irrigation:

1. Operate the irrigation system so that the timing and amount of irrigation water applied match crop water needs. This will require as a minimum (a) the accurate measurement of soil-water depletion volume and the volume of irrigation water applied and (b) uniform application of water.
2. When chemigation is used, include backflow prevention device(s) for wells, minimize the harmful amounts of chemigated waters that discharge from the edge of the field and control deep percolation. In cases where chemigation is performed with furrow irrigation systems, a tail water management system may be needed.

The following limitations and special conditions apply:

1. In some locations, irrigation return flows are subject to other water rights or are required to maintain stream flow. In these special cases, onsite reuse could be precluded and would not be

considered part of the management measure for such locations. In these locations, improvements to irrigation systems and their management should still occur.

2. By increasing the water use efficiency, the discharge volume from the system will usually be reduced. While the total pollutant load may be reduced somewhat, there is the potential for an increase in the concentration of pollutants in the discharge. In these special cases, where living resources or human health may be adversely affected and where other management measures (nutrients and pesticides) do not reduce concentrations in the discharge, increasing water use efficiency would not be considered part of the management measure.
3. In some irrigation districts, the time interval between the order for and the delivery of irrigation water to the farm may limit the irrigator's ability to achieve the maximum on-farm application efficiencies that are otherwise possible.
4. In some locations, leaching is necessary to control salt in the soil profile. Leaching for salt control should be limited to the leaching requirement for the root zone.
5. Where leakage from delivery systems or return flows supports wetlands or wildlife refuges, it may be preferable to modify the system to achieve a high level of efficiency and then divert the saved water to the wetland or wildlife refuge. This will improve the quality of water delivered to wetlands or wildlife refuges by preventing the introduction of pollutants from irrigated lands to such diverted water.
6. In some locations, sprinkler irrigation is used for frost or freeze protection or for crop cooling. In these special cases, applications should be limited to the amount necessary for crop protection and applied water should remain onsite.

Refer to NRCS Technical List and apply BMPs as appropriate.

References Cited

- ADEQ, 2002. 2002 Integrated Water Quality Monitoring and Assessment Report. Prepared pursuant to Section 305(b) and 303(d) of the Federal Water Pollution Control Act.
- Arkansas Department of Environmental Quality, Water Division: Little Rock, Ark. ADEQ, 2005. EPA 2004 Proposed 303(d) List of Impaired Waterbodies. Arkansas Department of Environmental Quality: Little Rock, Ark.

- EPA, 1977. Doc. Number 600/377105: Nonpoint Source: Stream Nutrient Level Relationships – A Nationwide Study. United States Environmental Protection Agency: Washington, D.C.
- EPA, 1989. Federal Register. 54 FR 22062, May 22. United States Environmental Protection Agency: Washington, D.C.
- EPA, 2004. Doc. Number EPA-841-B-03-004. National Management Measures for the Control of Nonpoint Pollution from Agriculture. United States Environmental Protection Agency, Office of Water: Washington, D.C.
- Kleiss, B. A., R. H. Coupe, G. J. Gonthier and B. J. Justus, 2000. Water Quality in the Mississippi Embayment, Mississippi, Louisiana, Arkansas, Missouri, Tennessee and Kentucky, 1995-98: U.S. Geological Survey Circular 1208, 36 pages, on-line at <http://pubs.water.usgs.gov/circ1208/>.
- Kresse, T., E. Van Schaik, J. Wise and T. Huetter, 1997. Report WQ97-10-1: Occurrence of Pesticides in Alluvial Aquifer of Eastern Arkansas. Arkansas Department of Environmental Quality: Little Rock, Ark.
- Kresse, T., and John A. Fazio, 2002. Report WQ02-05-1: Pesticides, Water Quality and Geochemical Evolution of Groundwater in the Alluvial Aquifer Bayou Bartholomew Watershed, Arkansas. Arkansas Department of Environmental Quality: Little Rock, Ark.
- Maas, R., 1984. Best Management Practices for Agricultural Nonpoint Sources: IV. Pesticides. Biological and Agricultural Engineering Department, North Carolina State University: Raleigh, N.C.
- Nelson, D., 1985. "Minimizing Nitrogen Losses in Non-Irrigated Eastern Areas." Proceedings of the Plant Nutrient Use and the Environment Symposium, Plant Nutrient Use and the Environment, October 21-23, 1985. The Fertilizer Institute: Kansas City, Mo., pages 173-209.
- North Carolina State University, 1984. Best Management Practices for Agricultural Nonpoint Source Control: IV. Pesticides. National Water Quality Evaluation Project. North Carolina State University: Raleigh, N.C.
- Novais, R., and E. J. Kamprath, 1978. "Phosphorus Supplying Capacities of Previously Heavily Fertilized Soils." Soil Science Society of America Journal 42:931-935.
- NRCS, 2002. Arkansas Field Office Technical Guide. Arkansas Natural Resources Conservation Service: Little Rock, Ark.
- NRCS, 2002. National Conservation Practice Standards – NHCP. Natural Resources Conservation Service: Washington, D.C. Available at www.nrcs.usda.gov/technical/Standards/nhcp.html.
- Popp J., H. L. Goodwin and W. Miller, 2003. Research Report 975: Impact of the Agricultural Sector on the Arkansas Economy in 2001. Arkansas Agricultural Experiment Station, University of Arkansas Division of Agriculture: Fayetteville, Ark.
- Sharpley, Andrew, Mike Daniels, Karl VanDevender and Nathan Slaton, 2010. Soil Phosphorus Management and Recommendations. University of Arkansas Division of Agriculture Cooperative Extension Service. Fact Sheet 1029. Major Revision.
- Sharpley, Andrew, Mike Daniels, Karl VanDevender, P. A. Moore, Jr., B. Haggard, Nathan Slaton and Chuck West, 2010. Using the 2010 Arkansas P-Index. University of Arkansas Division of Agriculture Cooperative Extension Service. Miscellaneous Publication 487.
- Sharpley, Andrew, P. A. Moore, Jr., Karl VanDevender, Mike Daniels, Walt Delp, B. Haggard, Tommy Daniel and Adrian Baber, 2010. The Arkansas P-Index. University of Arkansas Division of Agriculture Cooperative Extension Service. Fact Sheet 9531.
- USDA-NRCS, 1997. National Range and Pasture Handbook. Natural Resources Conservation Service, Grazing Lands Technology Institute: Washington D.C. Available at <http://policy.nrcs.usda.gov/viewersFS.aspx?id=1333>.
- Westerman, P. W., L. M. Safley, J. C. Barker and G. M. Chescheir, 1985. "Available Nutrients in Livestock Waste." Proceedings of the Fifth International Symposium on Agricultural Wastes, Agricultural Waste Utilization and Management. American Society of Agricultural Engineers: St. Joseph, Mich., pages 295-307.

Section Five

Silviculture Statewide Programs

Introduction

More than half – 53.6 percent – of Arkansas' land area is forested, according to the most recent Forest List Data collected by the Arkansas Forest Commission (AFC) and the U.S. Department of Agriculture (USDA) Forest Service (USFS). Private landowners, including farmers, ranchers and other individuals, own more than 58 percent of the forest land in the state and many actively manage their forestlands. National forests account for 12.4 percent of Arkansas' total forested acreage. Forest resource companies own or lease 25 percent of the state's forestland.

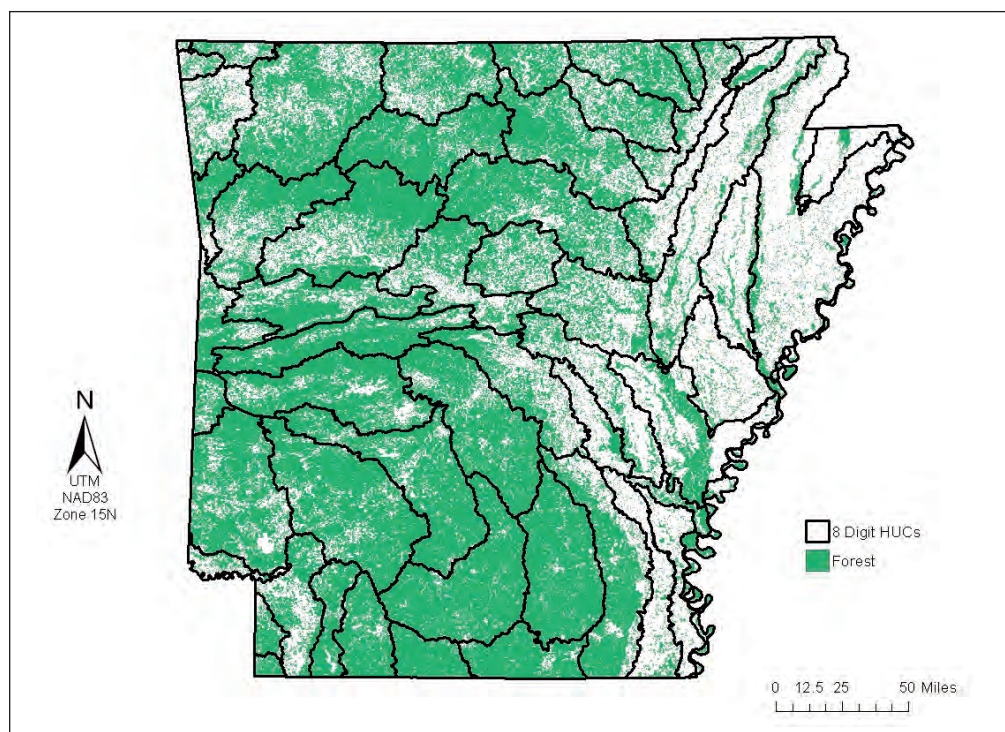
The Arkansas Department of Environmental Quality's (ADEQ) current List of Impaired Waterbodies does not identify silviculture as a primary or secondary source of impairment for any Arkansas waterbodies. By comparison, the U.S. Environmental Protection Agency (EPA) reported to Congress in March 2002 a list of 1,040 waterbodies it identified as impaired by silviculture nationwide (EPA, 2002).

The state's 1997 water quality list identified silviculture as a major source of "impact," not necessarily impairment (ADEQ, 1997). The only mention of silviculture in ADEQ's 2002 305(b) report is general concern about the impact on water quality by forests converted to pastureland in the Ouachita Mountains and Boston Mountains ecoregions. Those concerns are addressed in Agriculture (Section 4) of this update (ADEQ, 2002). Impacts to aquatic habitats, biota and water quality by silviculture in southeastern United States streams, including Arkansas, have been itemized and described in an American Fisheries Society publication (Filipek, 1993).

The AFC maintains guidelines for silvicultural Best Management Practices (BMPs) in the publication *Best Management Practices for Water Quality Protection* (AFC, 2002). Although the use of silvicultural BMPs is voluntary in the state of Arkansas, AFC performs a biennial statewide assessment of the implementation of BMPs. Direct comparison between the latest survey and those done prior to 2005 is not possible because of changes in the monitoring instrument and protocol

Figure 5.1
Distribution of
forestland in
Arkansas, 1999

Source: University of Arkansas,
Center for Advanced Spatial
Technologies, Land Use-Land Cover,
1999
Data Source: GeoStor
Map Created: March 2011



since BMP implementation surveys began in 1998. In 2002, a new survey instrument was adopted to conform to the updated BMP guidelines. Likewise, in 2005, aerial reconnaissance was adopted as the new method for identifying potential tracts to be included in the survey.

The most recent survey was completed in July 2008, with the statewide BMP implementation rate being 86 percent, 2 percentage points lower than the rate determined in the 2005 survey (AFC, 2008). Private nonindustrial forestlands scored 81 percent, a significantly lower implementation rate than any other ownership group. Federal lands scored 99 percent BMP implementation, while state lands scored 93 percent and industrial lands scored 89 percent. The 2008 survey groups silvicultural BMPs into four major categories:

- streamside management zones (SMZs), which rated 80 percent;
- harvesting, which rated 87 percent;
- roads, which rated 82 percent; and
- regeneration, which rated 87 percent.

By physiographic region, the Delta scored 88 percent; the Ozark region scored 87 percent; the Ouachita region scored 86 percent; and the Southwest region scored 86 percent for BMP implementation.

The 2008 Implementation Survey also indicated that improvements needed on all ownership classes during the survey were as follows:

- water bars on skid trails, fire lines and inactive roads;
- seeding and mulching where needed to stabilize soil;
- temporary crossing structure removed and bank stabilization; and
- mechanical site preparation in ephemeral stream channels.

Potential Pollutants From Silviculture

Compared to agriculture, the magnitude of nonpoint source (NPS) pollution from silvicultural activities is generally small. Silviculture is included as a statewide program in the latest NPS Pollution Management Plan because forestry operations have the potential to degrade several water quality characteristics in localized waterbodies receiving drainage from forestlands when BMPs are not followed, particularly in vulnerable headwater streams. These potential increases in water quality contaminants discussed below are usually proportional to the severity of site disturbance.

Sediment: Sediment is typically the primary pollutant associated with forestry activities. Soil erosion is the detachment and movement of soil particles from the soil surface. Soil loss by erosion is not sediment yield; however, it creates a potential for sediment yield. Sediment yield is the amount of eroded soil material that actually enters bodies of water. Sediment that reaches waterbodies can be particularly detrimental to benthic organisms and many fish species when it covers food sources and spawning sites and smothers bottom-dwelling organisms and periphyton. Suspended sediments increase turbidity, adversely affecting aquatic vegetation photosynthesis and aquatic organism respiration. Turbid waters tend to have higher temperatures and lower dissolved oxygen concentrations. A decrease in dissolved oxygen levels can stress and/or kill aquatic vegetation, fish and benthic invertebrates.

Siltation/turbidity is the greatest cause of impairment to Arkansas streams. While forestry contributes sediment, it is not listed as a primary or secondary source of impairment in any Arkansas waterbody. The local impact of sediment from timber harvesting and road construction on water quality can be significant when BMPs are not followed, especially in smaller headwater streams. Gravel, dirt and other roads are considered to be the major source of erosion from forested lands, contributing up to 90 percent of the total sediment production from forestry operations, according to studies (Rothwell, 1983). These effects are of greatest concern where forestry activity occurs in high-quality watershed areas that provide municipal water supplies or support fisheries. Roads that are constructed and maintained without use of recommended BMPs, especially those with steep gradients, deep cut-and-fill sections, poor drainage, erodible soils and poorly or improperly constructed road-stream crossings, contribute to most of this sediment load, with road-stream crossings being the most direct source of erosion and sediment.

The USFS estimated potential erosion rates in the Ozark-Ouachita Highlands from various land uses by river basin and watershed by using 1992 U.S. Department of Agriculture Natural Resources Conservation Service (NRCS) data from the National Resource List. In this highly forested region, forestland's share of potential erosion was less than 3 percent in most watersheds and exceeded 10 percent in just one watershed. By comparison, pastureland had the highest rates of total potential erosion, ranging from 6 to 99 percent (USFS, 1999).

Nutrients: Nutrients from forest fertilizers, such as nitrogen and phosphorus adsorbed to sediments, in solution or transported by aerial deposition, can cause harmful effects in receiving waters. Excessive amounts of nutrients may cause enrichment of waterbodies, stimulating algae blooms. Large blooms can result in reduced dissolved oxygen levels. This process, termed *eutrophication*, depletes the dissolved oxygen aquatic organisms need to survive.

In general, runoff from forested watersheds has a significantly lower nutrient concentration than drainage water from watersheds under agricultural use. In a nationwide EPA study, it was determined that nutrient concentrations are generally proportional to the percentage of land in agricultural use and inversely proportional to the percentage of land in forested use (EPA, 1977).

Pesticides: Herbicides, insecticides and fungicides used to control forest pests and undesirable plant species can be toxic to aquatic organisms. Pesticides applied to foliage or soils are most readily transported to surface waters and groundwaters. Some pesticides with high solubility and persistent pesticides that tend to absorb onto particulates are of greatest environmental concern. Other chemicals that may be released during forestry operations include fuel, oil and coolants used in equipment for harvesting and road-building operations.

Organic Debris: Organic debris includes residual logs, slash, litter and soil organic matter generated by forestry activities. These materials place an oxygen demand on receiving waters upon decomposition. If dissolved oxygen levels decrease to low levels and remain low, fish and other aquatic species may be stressed and/or die. In addition, logging slash and debris dumped into streams can alter stream flows, increasing bank cutting and resulting sedimentation. However, in some ecosystems, small amounts of naturally occurring organic material can be beneficial to fish production.

Temperature: Increased temperatures in streams and waterbodies can result from vegetation removal in the riparian zone from either harvesting or herbicide use. Temperature increases can be dramatic in smaller headwater streams, adversely affecting aquatic species and habitat. Increased water temperatures can also decrease the dissolved oxygen-holding capacity of a waterbody.

Stream Flow: Increased stream flow may result from vegetation removal in some situations. Tree removal reduces evapotranspiration, which may

increase water availability to stream systems. The amount of stream flow increase is related to the total area harvested, topography, soil type and harvesting practices. Increased stream flows can scour channels, erode streambanks, increase sedimentation and increase peak flows.

Water Quality/Program Goals

Siltation/turbidity of reservoirs and streams has been identified as the largest source of NPS pollution. While silviculture is not currently identified as a source of these pollutants in the waters of the state, activities associated with silviculture may contribute to sediment and other pollutant loads, particularly in small, high-quality headwater streams.

The ultimate goal of the silviculture statewide program is that through targeted awareness, BMP training, monitoring and other voluntary programs, silviculture will never be identified as contributing to impairment of the waters of the state.

Silviculture Logic Model

As in the previous section, teams that did the initial research to prepare the NPS Pollution Management Plan also created logic models for each section to better plan how program goals would be achieved. The team discussed long-term, medium-term and short-term behavior changes it hoped to cause through the NPS plan and what actions would be most effective to achieve those changes.

For silviculture, the AFC and its partners must continue to work proactively to ensure that stakeholders understand and value the role of proper forest management in protecting the state's water resources. The long-term goal is for everyone to minimize potential impacts on water quality through the use of adaptive management approaches and following the NPS management plan. The continued use of BMP survey information to guide outreach and training is also a desired long-term outcome.

In the mid-term, desired outcomes include incorporating site-specific BMP recommendations in forest management plans for landowners and providing any necessary changes to BMPs to ensure effective water protection. Of course, this would require continued or increased BMP implementations. All three would lend themselves toward ensuring silviculture never being identified as a source of water impairment.

To accomplish these goals, there is a need to increase the knowledge, awareness and skills of watershed stakeholders. It is also important to evaluate results of any implementation surveys to gauge that knowledge and awareness.

These outcomes can be achieved through the use of a series of BMP workshops aimed at loggers, landowners and professionals, as well as through the development of demonstration areas such as a Discovery Farm forestry component. BMP research will need to be reviewed and evaluated to determine whether the BMP effectiveness is accurate.

The team putting together the logic model also believed it necessary to continue to promote incentives for landowners and/or loggers to voluntarily increase BMP implementation, as well as continue to offer courtesy exams to increase landowners' knowledge about BMPs.

Those overseeing the process need to use workshop surveys to improve the quality of training and information dissemination as well as assess the BMP Implementation Survey methodology to improve the timelines and quality of BMP monitoring. Along this line of thinking, forestry professionals and landowners need to be surveyed to determine why there are deficiencies in BMP scoring or barriers to implementation.

Throughout the process, loggers, professional foresters, family forest landowners and the forest industry will need to be engaged, as will nonprofit watershed groups, municipal water suppliers, corporate forest landowners, universities and state and federal agencies.

Partners, both state and federal and nongovernment entities, will need to be engaged in order to achieve any of the outcomes. Grants such as Section 319(h) will also be needed.

This cooperation and the necessary funding are priorities of the silviculture program, as is ensuring that training and education efforts are clear and offer easily transferable knowledge.

The logic model was put together with the assumption that partners will continue to participate and that increased implementation of BMPs will improve water quality. Other assumptions include the continued funding for water quality programs, BMPs will remain voluntary and water quality and quantity remain important to society.

That said, a lack of funding is an external factor to be considered when reviewing the logic model. There are also staffing limitations, a lack of equipment, changes in federal and state water quality standards and shifts in public perception/interest. There is also the forest certification movement.

With these external factors in mind, it is important to incorporate surveys and tests in workshops for forestry professionals and landowners to serve as an evaluation of partners' efforts to prevent silviculture from contributing to the pollution of waterbodies. The state's 303(d) list needs to be continually reviewed and trends of BMP implementation should be analyzed. And at the basic level, surveys of comprehensive forest management plans should be done to determine if site specific BMPs are included.

Long- and short-term programmatic objectives for the elements of this statewide program are given in the section following the Program Logic Model (Table 5.1).

Table 5.1. PROGRAM LOGIC MODEL – Silviculture

SITUATION
Although silviculture is not currently listed as a major or minor cause of impairment for a waterbody in the state, the AFC and its partners must continue to work proactively to ensure that all stakeholders understand and value the role of proper forest management and forests in general, have in protecting the state's water resources. To that end, program leaders must assess deficiencies in water quality protection, target training to address those deficiencies and educate and disseminate knowledge to all stakeholders to promote proper forest management and collaboration among partners.
PRIORITIES
Strengthen the program through securing funding and building cooperation among various partners. Ensure that training and education efforts, and all supporting tasks, have clarity of vision and are able to transfer knowledge lucidly.

Table 5.1. PROGRAM LOGIC MODEL – Silviculture (cont.)

INPUTS	OUTPUTS		OUTCOMES		
	Activities	Participants	Short-term	Medium-term	Long-term
<ul style="list-style-type: none"> – Partners, including state and federal agencies, NGOs such as Arkansas Timber Producers Association and Arkansas Forestry Association, and universities such as University of Arkansas Division of Agriculture – Grants such as 319(h) – Time 	<ul style="list-style-type: none"> – BMP logger workshops – BMP landowner workshops – BMP professional development workshops – Development of demonstration areas such as a Discovery Farm forestry component, Poison Springs State Forest and/or Central Arkansas Water – Review and evaluate BMP research to ensure BMP effectiveness is accurate – Continue to promote incentives for landowners and/or loggers to increase voluntary BMP implementation – Use workshop surveys to improve the quality of training and information dissemination – Continue to use courtesy exams to increase landowners' knowledge about BMPs – Assess the BMP Implementation Survey methodology, giving special consideration to new technology, concerns and techniques, to improve the timeliness and quality of BMP implementation monitoring – Survey forestry professionals and landowners to determine why there are deficiencies in BMP scoring (barriers to implementation) – Support professional development concerning BMPs – Continue Implementation survey and report findings of survey 	<ul style="list-style-type: none"> – Loggers – Foresters – Family forest landowners – Forest industry – Watershed nonprofits – Municipal water supply landowners – Corporate forest landowners – Universities – State and federal agencies (non-landowners) 	<ul style="list-style-type: none"> – Increase knowledge, awareness and skills of watershed stakeholders – Evaluate results of implementation survey 	<ul style="list-style-type: none"> – Maintain or increase BMP implementation – Silviculture will never be identified as contributing to the impairment of the waters of the state – Provide needed changes to BMPs to ensure effective protection of water quality – Incorporate site-specific BMP recommendations in forest management plans for landowners 	<ul style="list-style-type: none"> – Manage natural resource base including working forests to minimize potential impacts on water quality – Continue to use NPS Management Plan Update as guidance to improve water quality – Continue to use results of BMP survey to guide outreach and training – Use adaptive management approach to ensure continued protection of water quality, quantity and habitat

Table 5.1. PROGRAM LOGIC MODEL – Silviculture (cont.)

ASSUMPTIONS	EXTERNAL FACTORS
<ol style="list-style-type: none"> 1. Partners will continue to participate. 2. Increased implementation of BMPs improves water quality. 3. Funding will continue for water quality programs. 4. Water quality and quantity remain important to society. 5. BMPs will remain voluntary. 	<ol style="list-style-type: none"> 1. Lack of funds – fluctuating state and federal budgets. 2. Staffing limitations. 3. Lack of equipment. 4. Forest certification movement. 5. Shifts in public perception/interest. 6. Changing federal and state water quality standards.
EVALUATION PLAN	
<p>Incorporate surveys and tests in workshops for forestry professionals and landowners.</p> <p>Review state 303d list to determine if silviculture is a contributing factor.</p> <p>Analyze trends of BMP implementation as determined through BMP Implementation Survey, and report findings.</p> <p>Survey Comprehensive Forest Management Plans to determine if site-specific BMPs are included.</p>	

Objectives and Milestones

The AFC is the lead agency for implementation of the silviculture statewide program. For all statewide programs, the overall strategy is to continue the voluntary process whereby federal and state programs cooperate in priority areas of the state where water quality problems have been identified. As long as this cooperative process results in improved implementation of BMPs and reductions in NPS pollutant loads, it will be viewed as successful. However, if the cooperative process does not result in nonpoint source reductions and water quality improvements, then state and local entities will investigate additional steps needed to enable waterbodies to meet their designated uses using an adaptive management approach described in the introduction to this update.

Specific objectives and milestones:

5.1. Continue to strengthen outreach and training programs in BMP implementation for landowners and loggers by:

- Developing additional mechanisms for delivering BMP implementation training targeted at private nonindustrial landowners (e.g., educational workshops, expanded local partnerships in areas where there are high concentrations of private nonindustrial landowners and increasing emphasis on woodland management in farm planning).
- Placing BMP outreach and training programs aimed at private nonindustrial forestland owners in the broader economic context on the assumption that landowners will better manage a resource they value.

Timeline for Milestones: October 2011 through September 2016

5.2. Continue to partner with the Arkansas Forestry Association and its Forest Practices Committee as well as the Arkansas Timber Producers Association to deliver and evaluate the effectiveness of BMP training to effect behavioral change as measured by BMP implementation, trainings and technologies.

Timeline for Milestones: October 2011 through September 2016

5.3. Continue to promote incentives for landowners and/or loggers to increase voluntary BMP implementation. Review options to increase landowner incentives to adopt BMPs.

Timeline for Milestones: October 2011 through September 2016

5.4. Continue to improve the quality of BMP implementation monitoring (for example, increasing the sample size to improve the validity of subgroup results, identifying sites in riparian areas and investigating alternatives to better identify the universe of harvest sites).

Timeline for Milestones: October 2011 through September 2016

5.5. Continue assessing the effectiveness of silviculture BMPs to protect Arkansas water quality (for example, reduce sedimentation), building on ongoing evaluation and recognizing that such assessment is a long-term, ongoing process. Consider conducting special assessments of high-quality headwater streams using synoptic surveys or other methods as resources allow.

Timeline for Milestones: October 2011 through September 2016

5.6. Continue to review new research as it becomes available to re-evaluate AFC silviculture BMP guidelines, involving both scientists and stakeholders in the dialogue.

Timeline for Milestones: October 2011 through September 2016

5.7. The state will participate in and support regional forest conferences, workshops or outreach trainings when appropriate.

Timeline for Milestones: October 2011 through September 2016

5.8. Provide or support specialized technical assistance, outreach, supplies and equipment when needed to address NPS issues related to silvicultural activities and deemed appropriate by AFC and ANRC. Requests for “specialized” services or equipment will be evaluated by AFC and ANRC on a case-by-case basis.

Timeline for Milestones: October 2011 through September 2016

5.9. During or after catastrophic events, appropriate assessment will be conducted as to how water quality has been affected. BMP implementation(s) will be prioritized when appropriate to maintain water quality.

Timeline for Milestones: October 2011 through September 2016

Program Tracking and Evaluation

The silviculture section of the NPS Pollution Management Plan can be tracked and evaluated on three levels: short-term inputs, intermediate processes and long-term outcomes. The program will track program activities (for example, how many landowners, loggers, foresters or purchasers participated in education and training programs; how many fact sheets were developed; how many newspaper articles were published, etc.). These input measures track effort expended, a first and necessary step toward affecting change.

Timeline for Milestones: October 2011 through September 2016

The second measure of the program focuses on whether program activities result in behavioral changes (i.e., BMP implementation). AFC will continue to monitor BMP implementation and is taking steps to improve the effectiveness of its monitoring. Results are published in a biennial report available on the AFC web site.

Timeline for Milestones: October 2011 through September 2016

The ultimate measure of the program is whether streams are removed from the 303(d) list of impaired waters. The most current List of Impaired Waterbodies did not identify silviculture as a primary or secondary source contributing to impairment. The desired evaluation outcome is that silviculture will not be listed as a primary or secondary contributing source in future List of Impaired Waterbodies.

Timeline for Milestones: October 2011 through September 2016

Brief Summary of Institutional Context

The Arkansas Forestry Commission is the lead agency for the implementation of the statewide silviculture program in the NPS Pollution Management Plan. The commission seeks to reduce sediment concentrations and loading in priority watersheds and statewide through proper and consistent voluntary implementation of silvicultural BMPs on private and public forestlands.

The AFC began providing BMP training and education programs for nonindustrial forestland owners in 1998-99, with training continuing. The Arkansas Timber Producers Association and the Best Management Practices Committee of the Arkansas Forestry Association launched a logger BMP education program in 1995. Since then, more than 12,500 logging contractor employees and procurement foresters from Arkansas have been trained in water quality BMP implementation.

In 1996, AFC adopted a BMP implementation monitoring framework protocol as recommended by the BMP Monitoring Task Force for the Southern Group of State Foresters. Additional modifications to the survey were made in 2002 and 2005. In 2002, the survey instrument was amended to comply with updated AFC BMP guidelines, and in 2005, aerial reconnaissance became the method of selecting tracts for the survey. The AFC monitors and reports silviculture BMP implementation every two to three years. The AFC completed the first survey in May 1998. The second monitoring survey was completed in July 1999, third in 2001-02, fourth in 2004, fifth in 2005-06 and sixth in July 2007-08.

The previous three surveys can be found on the AFC BMP Program web site at www.forestry.arkansas.gov/Services/ManageYourForests/Pages/bestManagementPractices.aspx.

The AFC published its *Arkansas Forestry Best Management Practices for Water Quality Protection* in March 2002, after two years of reviewing the available research and discussion among wide-ranging stakeholders. The latest version, *Voluntary Forestry Best Management Practices for Water Quality Protection in Arkansas* can be found at www.forestry.arkansas.gov/Services/ManageYourForests/Documents/OnlineBMPImplementationReport0708.pdf.

Through a memorandum of understanding, ADEQ refers citizen complaints about pollution from silvicultural activities to AFC for investigation and voluntary resolution before taking enforcement action.

In addition, AFC assists landowners obtain financial assistance for managing their forestlands through several programs, including the Environmental Quality Incentives Program (EQIP), the Conservation Reserve Program (CRP) and the Wildlife Habitat Incentives Program (WHIP)). The Forest Stewardship Program recognizes and rewards landowners who manage their forestlands for multiple uses and provides professionals to assist them in obtaining a written forest management plan. The Forest Legacy Program (FLP) uses conservation easements and fee-simple acquisitions to protect environmentally important, privately owned forestlands that are threatened by conversion to non-forest uses.

Cooperating Entities

Cooperating entities are listed and described in the cooperating entities section of the 2011-2016 NPS Pollution Management Plan.

Federal Consistency

The USFS and NRCS have pledged to work with AFC and ANRC on federal consistency with the silviculture statewide program. The USFS' standards and guidelines for management activities are designed to meet or exceed all state BMPs. The AFC monitors and reports USFS BMP implementation. The ANRC works with NRCS on consistency of BMPs that are being recommended through WHIP, EQIP and other Farm Bill programs it administers. The ANRC strives to coordinate targeting of priority watersheds and BMPs through involvement in the NRCS State Technical Committee as well as NRCS representation on the NPS Pollution Management Plan Stakeholder Group.

Common Best Management Practices

The AFC is the lead agency for interpreting, monitoring and updating forestry BMPs and management measures in Arkansas. In 2002, AFC completed a major update of its BMP guidelines. This effort included extensive public input and comment. The guidelines have subsequently been updated. The latest version of the publication can be found at www.forestry.arkansas.gov/Services/ManageYourForests/Documents/OnlineBMPImplementationReport0708.pdf.

These management measures closely resemble EPA's *National Management Measures to Control Nonpoint Source Pollution From Forestry* (EPA, 2005[ECC1]). The measures and practices given below are excerpted from AFC's *Best Management Practice Guidelines*.

Planning: Careful planning is an essential first step to environmentally sound forest management. Seeking professional assistance during planning can be critical in protecting water quality. The selection of silvicultural operators, such as loggers, site preparation contractors, foresters and others who have received BMP training, can help ensure that BMP plans are prepared and understood before starting silvicultural activities.

- **Site Assessment:** Use available topographic maps, aerial photographs and site visits to locate and plan protection for the following:
 - streams, drainage and crossings;
 - critical areas subject to rutting and/or erosion;
 - existing roads and trails;
 - proposed haul roads and skid trails;
 - log landing locations; and
 - buffer zones for streams.
- **Timing:** Determination of the best time of year for specific forestry activities.
- **Timber Sale Contract Requirements:** Inclusion of requirements for proper BMP implementation, installation and maintenance in the timber harvest contract.
- **Special Planning for Wetlands, Obstructions and Areas to Avoid:** Identification of environmentally sensitive areas and provision to avoid impact from forestry activities on these areas.

Streamside Management Zones (SMZs):

Vegetation and soils adjacent to waterbodies are critical for maintaining healthy aquatic systems. SMZs are

buffer areas, strips of land immediately adjacent to waterbodies where timber management activities are specifically designed to protect water quality. SMZs are established on both sides of streams.

Streamside management zones:

- slow and spread the flow of water;
- serve as a filter, which reduces movement of sediment and nutrients into waterbodies;
- stabilize streambanks;
- minimize logging debris from reaching a waterbody;
- act as a buffer strip;
- maintain cooler stream water temperatures and can cool down elevated temperatures; and
- provide an allochthonous energy source for aquatic biota and flora in the associated stream.

AFC categorizes streams as ephemeral, non-ephemeral, braided, lakes and ponds. Standards for SMZs for each category are given as BMPs, except ephemeral streams which do not require SMZs.

In all SMZs, the following activities are discouraged:

- harvesting trees growing directly on banks or overhanging a waterbody;
- prescribed fires that burn to mineral soil. Light cool burns are permitted;
- locating portable sawmills or log decks in SMZs;
- creating excessive rutting, especially where ruts run perpendicular to a stream; and
- leaving logging debris in front of cave entrances and in sinkholes if the effect is to change the natural flow of water.

Non-Ephemeral SMZs: SMZ width is based on percent of the adjacent slope of the forest area:

- Slope < 7 percent – minimum SMZ 35 feet;
- 7 percent < Slope < 20 percent – minimum SMZ 50 feet; and
- Slope > 20 percent – minimum SMZ 80 feet.

Retain a minimum of 50 square foot basal area per acre. Trees should be evenly spaced throughout the SMZ to maintain bank stability and protect water quality. Fell trees away from the stream except where safety is a concern.

Ephemeral SMZs: Maintain an overstory of vegetation or trees if possible, if not, then maintain lower lying vegetation and intact forest floor. Mechanical site preparation should not disrupt the ephemeral stream channel. No SMZ required.

Braided Streams: Consider multiple channels as one stream. The SMZ includes all land between the channels as well as the prescribed SMZ width adjacent to the most exterior channels. Follow other applicable SMZ guidelines for non-ephemeral streams.

Lakes and Ponds: Minimum SMZ is 35 feet measured beginning at the break in slope at the top of the shoreline. Follow SMZ guidelines for non-ephemeral streams.

Road Construction and Maintenance: Proper road construction and maintenance protects water quality during and after silvicultural activities. BMP Implementation Surveys conducted by AFC indicate that practitioners should focus more attention on implementing forest road BMPs.

Road Location/Planning: Use soil surveys, topographic maps, aerial photographs or site visits to plan road locations to protect water quality. Design roads to minimize stream crossings. Where stream crossings are required, cross at right angles to the stream, locate roads along the contour or along the crest of long ridges and maintain sufficient distance between the road and the SMZ to allow right-of-way maintenance.

Road Construction: Use at least the minimum design standard that provides a road sufficient to carry the anticipated traffic load with minimum environmental damage. Remove timber from rights-of-way and deck it outside SMZs. Design roads no wider than necessary. Balance cuts and fills to minimize excess excavated material. Place sidecast or fill material above the ordinary high-water mark of any stream except where necessary to stabilize stream crossings. Plan and conduct work so that water quality is protected during heavy rain. When needed, use seeding and mulching in a timely manner to reduce erosion. Implement appropriate BMPs during road construction.

Road Drainage: Ensure good road drainage with a combination of properly constructed and spaced wing ditches, broad-based dips, rolling dips, culverts and bridges. Wing ditches should be constructed so water will be dispersed and not cut channels across the SMZ. At cross drains (culverts or dips), install rip-rap or other devices at the outlets to absorb and spread water.

Use brush barriers or check dams along road fill areas or other sensitive areas.

Install ditches, culverts, cross drains and wing ditches at low points in the road. Use crowning, ditching, culverts and/or outsloping to drain roads naturally.

Provide cross drainage on temporary roads. Provide outfall protection if cross drains, relief culverts and wing ditches discharge onto erodible soils or over erodible fill slopes. Use diversion or wing ditches wherever possible to carry road drainage water onto the undisturbed forest floor. Use adequate sized culverts to carry the anticipated flow of water

A road grade of less than 10 percent is preferred. Changing grade frequently, with rolling or broad-based dips, protects water quality better than by using long, straight, continuous grades. On highly erodible soils, grades should not exceed 8 percent. Grades exceeding 8 percent for 150 feet may be acceptable as long as appropriate BMPs are implemented. Graveling the road surface can help maintain stability. Install water turnouts, broad-based dips or rolling dips before a stream crossing to direct road runoff water into undisturbed areas of the SMZ. With the exception of stream crossings, roads should be located outside the SMZ.

Out-slope the entire width of the road where road gradient and soil type permit. Use cross drainage on in-sloped or crowned roads to limit travel distance of runoff water. Where roads are in-sloped or crowned and gradients begin to exceed 2 percent for more than 200 feet, broad-based dips or rolling dips should be placed within the first 25 feet of the upgrade.

Road bank cuts normally should not exceed 5 feet in height, should be sloped and the soil stabilized to prevent erosion. Cuts may need to be fertilized, limed, seeded and mulched to establish cover.

Road Maintenance: Crown or out-slope the road surface to disperse surface runoff and minimize erosion of the roadbed. Keep wing ditches free of blockages and keep culverts open and clean to allow unrestricted passage of water. Revegetate or stabilize erodible areas where natural vegetation is not sufficient to stabilize the soil. Minimize traffic on roads during wet conditions. Consider using geomat or rock to reduce road damage. Periodically inspect roads to see if BMPs remain effective. Reestablish vegetation as needed. Minimize traffic following maintenance work on sensitive road sections to allow them to stabilize. Keep roads free of obstructions to allow free flow of water from the road to the forest floor. Rework roads if road conditions deteriorate and may harm water quality.

Stream Crossings: Cross streams only if the harvest site cannot reasonably be accessed otherwise. Remove temporary crossing structures after use. Stabilize and restore the streambanks. Permanent stream

crossing should use bridges, culverts, shelf-rock fords, geoweb, concrete slabs or other materials. Low water fords may be used if excessive turbidity is not created.

Design bridges to protect stream-crossing approaches from erosion. The streambank, stream channel and adjacent SMZ should have minimum disturbance. Construct stream crossings during periods of dry weather when stream flow is low and the chance of erosion is minimal. Concrete slabs should be excavated so the surface is level with the stream bottom and at the same slope. Concrete slab approaches should extend beyond the stream channel to prevent scour around the ends of the slab.

Streambanks should be stable, and stream bottoms should be hard. If not naturally stable, use materials such as geotextiles or temporary bridges. Use planking, geoweb, rock or other nonerosive material to reduce disturbance to unstable streambeds and streambed approaches.

Remove from streams excess material and woody debris generated during road construction. Deposit this material above the ordinary high-water mark. Stabilize the material. Use head walls, wing walls, rip-rap or geomat if necessary.

Inspect stream crossings frequently during operations to determine if erosion is being controlled. Streambanks should be stable and soil movement into the stream should be minimal. Correct erosion problems by implementing the BMPs.

Except for crossings, equipment should stay out of streambeds.

Broad-Based Dips: Broad-based dips are recommended for roads with less than 10 percent grade. Installation should take place after basic clearing and grading for roadbed construction. An energy absorber such as rip-rap and, in some cases, a level area where the water can spread can be installed at the outfall of the dip to reduce water velocity. On some soils the dip and reverse grade section may require bedding with crushed stone to avoid rutting the road surface. Broad-based dips should be placed cross the road in the direction of water flow. Broad-based dips are not recommended for constantly flowing water.

Rolling Dips: Rolling dips are a cross between water bars and broad-based dips. Like broad-based dips, they have a reverse grade (except it is shorter) and they tip water off the road. Like water bars, they may also rely on a mound of soil at the downhill side.

Rolling dips can be used on haul roads having a slope of 10 percent and greater.

Rolling dips can be used after basic clearing and grading for roadbed construction after logging is completed. A 10- to 15-foot long, 3 to 8 percent reverse grade is constructed into the roadbed by cutting from upgrade to the dip location and then using cut material to build the mound for the reverse grade. In hills, locate rolling dips to fit the terrain as much as possible. They should be spaced according to the slope of the planned roadbed. Rolling dips are not suitable for constantly flowing water.

Wing Ditches: Wing ditches collect and direct road surface runoff from one or both sides of the road away from the roadway and into undisturbed areas. Wing ditches move water from roadside ditches and disperse it onto undisturbed areas adjacent to the road.

Pipe Culverts: Road and stream crossing culverts collect and transmit water safely from side ditches, seeps, natural drains or streams under haul roads and skid trails without eroding the drainage system or road surface.

The pipe should be long enough so both ends extend at least one foot beyond the side slope of fill material. Design culverts to carry the anticipated flow. The culvert should be placed with a 1 to 2 percent downgrade to prevent clogging. Lay the bottom of the culvert as close as possible to the natural grade of the ground or drain. Provide erosion protection for culverts. Lay aggregate or other suitable material on approaches to fords, bridges and culvert crossings if needed to ensure a stable roadbed approach and reduce sediment in the stream. Fill for temporary culverts can be washed rock. Washed rock can remain in the channel when the culvert is removed. Remove culverts, bridges and fill material, other than washed rock, from temporary stream crossings when operations are complete. Return the crossing as close as possible to its original condition. Install erosion protection measures at the culvert outlet as needed to minimize downstream erosion.

On larger streams and/or streams having substantial fisheries, box culverts utilizing the natural substrate as the culvert's bottom may be a good substitute for pipe culverts, since the stream substrate makes up the bottom of the culvert. This allows for migration of fish above and below the culvert due to stream velocity refugia being provided by the natural substrate. Using box culverts with a natural substrate bottom also alleviates any problem caused by high drops at the downstream end of the culvert (outlet).

Inactive Road Stabilization: Waterbars are recommended for stabilizing inactive roads, firelines, and trails. Logging slash may also be effective. They act to divert side ditch and surface runoff, which minimizes erosion and provides conditions suitable for revegetation.

Inactive Road Revegetation: Covering bare soil is the first line of defense in preventing erosion. Revegetation is recommended for bare soil. Schedule revegetation when soil and weather conditions promote rapid germination of seeds and development of the plants. Plant seed to the proper depth, fertilize where needed and use adequate seeding rates. To ensure successful reestablishment of the intended ground cover, periodically inspect areas of revegetation.

Inactive Road Protection: Waterbars are essential to controlling soil erosion due to excessive water volume and velocity of road's runoff. Successful stabilization depends upon water control. Block vehicular traffic at entrances and exits of retired roads, firebreaks and trails where vehicular traffic is expected. Use gating, large earthen berms, ditching, fencing and similar barricades.

Harvesting: Harvesting timber is more than cutting trees. It includes layout and construction of access roads, skid trails for moving logs and strategic location of landings for transporting products out of the woods. Timber harvesting activities should be conducted to minimize the effects on soil and water. Special care should be taken on steeper slopes and near bodies of water. If possible, schedule harvests during periods of dry weather to reduce sedimentation.

Design of Harvest Site: Plan harvest size, skid trails and landing locations to reduce the area of ground disturbed. For areas subject to excessive erosion, plan harvest activities to encourage revegetation efforts during times of the year that favor successful revegetation. Sites should be inspected frequently during harvesting to identify soil movement into waterbodies. If erosion is occurring, promptly implement corrective BMPs. When harvesting is completed, disperse water from landings and skid trails using water bars, logging slash or vegetative cover. Be prepared to control and limit off-site soil movement. If revegetation or stabilization is needed, do this work as soon as possible after harvesting is complete. Compacted soils may need to be disked or scarified to improve water infiltration and create a suitable seedbed. Construct water bars on skid trails and firelines as needed. Pay attention to slope and soil type as it pertains to type of structure and

spacing requirements. Where skid trails cross streams install water bars or turnouts to divert all runoff away from stream channel. All areas to be seeded and/or mulched should be stable. Install traffic barriers to prevent off-road vehicle damage to recently stabilized areas.

Log Landings: Log landings or log decks are areas of concentrated equipment use and traffic. Well-planned and managed log landings will protect water quality. Take precautions to reduce rutting, soil compaction and/or interference with water flow in order to reduce erosion. For example, if soils are wet, use special techniques such as logging mats and mulch. Locate landings to avoid or reduce stream crossings. Locate landings as part of planning the road system. Minimize the size and number of log landings. Locate landings on dry sites so natural drainage disperses water onto the forest floor but not into a stream.

Storage and Handling of Fuel, Oil, Coolants and

Products: Restrict fueling and equipment maintenance work to designated areas of landings. Do not do this work near streams. Properly store fuel, oil, coolants and other products.

Felling and Bucking: Fell trees away from a stream and keep debris out of the stream whenever possible. If a tree is felled into a stream, protect the streambanks during tree removal. Fell trees so the butts face the direction of skid whenever possible. Promptly remove significant logging debris from streams. Significant debris can alter the flow of the water and scour banks. However, some woody debris let into streams can be beneficial, since it acts as a macroinvertebrate colonization medium and provides fish cover, so balance needs to be found on an individual site basis.

Skidding: Skid trails serve as transport routes for equipment moving trees, logs or other material from the place of felling to a log landing or deck where they are stored or loaded for transport. Because heavy equipment is usually used in skidding, soil disturbance may occur. Plan skid trail layout to protect water quality. Follow the contour to the greatest extent possible. Timber should be skidded uphill either to a contour skid trail or more level ground. On slopes of 20 percent or greater, skid uphill. Skid trails on slopes should have occasional breaks in grade or logging slash that disperse water. Where stream crossings are planned, use portable crossing structures, culverts, poles or natural fords with firm bottoms, stable banks and gentle slopes.

Do not use soil as a temporary fill material when water is in the stream. If a ford or crossing will cause excessive rutting or turbidity, then bridges, culverts, concrete slabs or other constructed fords should be used. Minimize the number of stream crossings. Skid across a stream only at stable locations identified during harvest planning. Upon completion of skidding, remove all temporary fill material from stream beds. If the banks are crushed or if soil is eroding, stabilize the streambanks. Do not use stream channels as skid trails.

Wet Weather Skidding: Avoid logging in excessively wet areas or during excessively wet weather. If skidding in wet weather, take the following precautions to protect water quality: Stabilize bare areas during any temporary shut-downs in logging operation if needed to protect water quality; minimize skid trail construction at grades greater than 30 percent. With grades greater than 30 percent, install frequent rolling dips and follow contours. Stabilize these skid trails. If off-site soil movement occurs, control it with rolling dips and prompt revegetation. Minimize straight runs of 300 feet or more at grades greater than 20 percent.

Harvest Site Closeout: A helpful final step is an onsite examination of the harvest area to ensure proper implementation of BMPs. This procedure is referred to as a "walkout." Review contracts or other documents that set-out BMPs required for the harvest area. Stabilize roads, skid trails, and log landings by using revegetation techniques if needed. Clean up spills. Haul litter, such as oil cans, grease containers, crankcase oil filters, old tires and used fluids, to a proper disposal facility. Remove significant logging debris from streams. Significant debris can alter the flow of the water and scour banks. Scatter woody debris above the high-water mark of streams. Perform closeout erosion control on erodible areas before equipment is moved off the site.

Mechanical Site Preparation: Mechanical site preparation involves the use of ground contact equipment to manipulate vegetation and soil conditions before reforestation. Methods most commonly used are shearing, raking, subsoiling, disking, chopping, windrow/piling and bedding. Shearing, raking, bedding, windrow/piling and disking are high-intensity methods of mechanical site preparation that expose a greater percentage of the soil on the treated site. Subsoiling and chopping are lower-intensity methods. Erosion potential increases with the higher-intensity methods, especially in areas with steep slopes.

Choose a site preparation method that exposes and disturbs the minimum mineral soil necessary to meet the desired reforestation objective. The boundaries of all SMZs should be defined before site preparation begins. Do not conduct mechanical site preparation in SMZs. Minimize crossing streams. If crossings are necessary, they should be kept to a minimum and made at right angles to the stream. Avoid intensive site preparation on soils NRCS has identified as highly erodible. Do not damage water control devices (that is, culverts, wing ditches). When damage occurs, repair or replace the device promptly. Avoid heavy equipment operations in wet soil conditions. Intensive site preparation should always follow contour of land.

Forest Chemicals: Pesticides/herbicides and fertilizers are forest chemicals. The following guidelines for the handling and application of forest chemicals will help prevent their translocation to open water sources.

If any hazardous chemical of reportable quantity is accidentally spilled during normal working hours, notify ADEQ. Outside of normal working hours, notify the Department of Emergency Management at (501-682-0716). Take immediate measures to contain all chemical spills. Communicate spills to appropriate supervisors, landowners and authorities.

Forest Chemical Management – Follow label instructions. Do not aerially apply forest chemicals to SMZs unless labeled for open water application or during a forest health emergency (e.g., gypsy moth). Chemicals should not be allowed to leak from equipment. Do not service equipment near streams or other water sources. Properly dispose of empty containers. Minimize the use of streams, lakes, ponds or rivers as water sources. When this water is used to mix chemicals, do not contaminate water source. Chemicals should not be applied when water contamination is likely to occur from physical spray drift. Chemicals should not be applied immediately before precipitation or after a rain if there still is runoff. Consider upcoming storm predictions to time chemical application. Label containers according to state and federal regulations. Apply fertilizer at appropriate rates. Seek professional advice on application rates. Applicators should be properly licensed and trained and/or certified if applicable.

Reforestation – Reforestation should be completed as soon as practical after harvesting. Seek professional advice on reforestation options.

Machine plant along the contour of the land. Repair and stabilize any damage from machine planting that will cause erosion. Machine planting equipment should avoid crossing or turning around in roads, road ditches and wing ditches. Use existing access and stream crossing areas when planting. Preserve and replace all BMP harvesting or site preparation installations.

Fire: If a fire becomes “too hot,” the entire humus layer can be consumed, exposing the underlying mineral soil to erosion. Arkansas Forest Commission BMP Implementation Surveys have found that the erosion potential from sites burned too hot increases as slope increases. Extreme caution should be used when burning on slopes exceeding 20 percent.

Prescribed Fire – Before ignition, moisture levels within the soil, forest fuels, and the air should be sufficient to prevent major exposure or damage to the mineral soil, especially on moderate to severely erosive soils. Install firelines parallel to streams outside the SMZ. Do not plow firelines through the SMZ. Firelines within the SMZ should be constructed by hand. On final harvest cuts, when slopes of the site exceed 20 percent, individual fire strips should not exceed 300 feet in width between ignition and burnout. Buffers or breaks are recommended on slopes exceeding 20 percent.

Wildfire Suppression and Reclamation – During wildfire emergencies, firefighting activities are not restricted by BMPs. Potential erosion problems should be corrected as soon as a wildfire is suppressed. Actively eroding gullies should be stabilized as part of wildfire reclamation. Inspect fire lines periodically and stabilize as needed to minimize runoff entering streams.

Firelines – Control practices can be implemented during fireline construction to prevent erosion. Periodic inspection and proper maintenance can prevent erosion on established firelines. Use barriers such as roads, rights of way, and plowed fields as firelines. Install firelines on the contour as much as possible. Use bladed or harrowed firelines instead of plowed firelines whenever possible. On slopes exceeding 5 percent and at approaches to streams and roads, install water bars with water turnouts in firelines according to the BMP recommendations for skid trails. Use hand tools or back blade firelines away from the edge of gullies, streams or roads.

Fireline Maintenance – Mowing or disking, rather than blading, should be used to maintain firelines to reduce exposing mineral soil.

References Cited

- Arkansas Forestry Commission: Little Rock, Ark. 2007 Forest List Data. www.forestry.arkansas.gov/Services/ManageYourForests/Documents/ARK_2007_TABLES.PDF.
- AFC, 2004. National Forest List, Cycle 3, Panels 2, 3, and 4. U.S. Forest Service in cooperation with Arkansas Forestry Commission (Unpublished).
- AFC, 2008. Forestry Best Management Practices for Water Quality Protection in Arkansas: Implementation report. Arkansas Forestry Commission: Little Rock, Ark. Available at www.forestry.arkansas.gov/Services/ManageYourForests/Documents/OnlineBMPImplementationReport0708.pdf.
- EPA, 1977. Nonpoint Source: Stream Nutrient Level Relationships – A Nationwide Study. Doc. Number 600377105, U.S. Environmental Protection Agency: Washington, D.C.
- EPA, 2005. National Management Measures to Control Nonpoint Source Pollution From Forestry (EPA-841-B-05-001). U.S. Environmental Protection Agency, Office of Water: Washington, D.C.
- Filipek, S. P. 1993. "Impacts on warmwater streams: Guidelines for evaluation." In Timber Harvest. Bryan and D. A. Rutherford, eds. Southern Division, American Fisheries Society, Bethesda, Md.
- Popp, J., H. L. Goodwin and W. Miller. 2003. "Impact of the Agricultural Sector on the Arkansas Economy in 2001." Research Report 975. Arkansas Agricultural Experiment Station, University of Arkansas Division of Agriculture: Fayetteville, Ark.
- Rothwell, R. L., 1983. "Erosion and Sediment Control at Road-Stream Crossings (Forestry)." *The Forestry Chronicle*, 59(2):62-66.
- USFS, 1999. "Ozark-Ouachita Highlands Assessment: Aquatic Conditions." Report No. 3 of 5. U.S. Department of Agriculture, Forest Service. Gen. Tech. Rep. SRS-34. Southern Research Station: Asheville, N.C.
- University of Arkansas Division of Agriculture Cooperative Extension Service: Little Rock, Ark. www.arnatural.org/forestry.htm.
- EPA, 2002. National Water Quality List: 2000 Report to Congress (EPA-841-R-02-001). U.S. Environmental Protection Agency, Office of Water: Washington, D.C.

Section Six

Resource Extraction Statewide Programs

Introduction

Resource extraction is an expansive and multifaceted industry in Arkansas. The Arkansas Department of Environmental Quality (ADEQ) has record of 301 permitted and authorized mine sites across the state (Figure 6.1). There are an estimated 50 additional active quarry sites that were grandfathered after passage of the Arkansas Quarry Operation, Reclamation and Safe Closure Act. ADEQ has also estimated that upwards of 500 abandoned mine sites that range from under an acre in size to more than 1,100 acres in size may exist. To date, the Arkansas Oil and Gas Commission (AOGC) has issued more than 44,400 permits for oil, gas and brine wells. However, efforts to accurately locate and investigate all of these sites for potential stormwater pollution problems remain a difficult challenge. It should be noted that the Arkansas Game and Fish Commission (AGFC) provided a two-year grant (2010-2011) allowing the addition of 17 inspectors to the ADEQ employee ranks. Though a

valuable contribution to the effort, it remains a short-term fix to the long-term needs of funding, personnel and time. For the purposes of the Nonpoint Source (NPS) Pollution Management Plan, categories of resource extraction include surface mining, subsurface mining, dredge mining, abandoned mine sites and petroleum extraction activities (including both natural gas and crude oil).

The 2008 List of Impaired Waterbodies identifies 284.5 stream miles where the primary or secondary source of impairment is resource extraction (ADEQ, 2008). Table 6.1 identifies the streams listed as impaired due to resource extraction with a total maximum daily load (TMDL). Table 6.2 lists waterbodies that may be impaired or have one or more designated uses that may not be attained due to resource extraction. Specific pollutants identified as causing impairment due to resource extraction activities were chloride (Cl), sulfates (SO₄), total dissolved solids (TDS), copper (Cu), lead (Pb), zinc (Zn) and beryllium (Be).

Figure 6.1
Location of ADEQ
permitted mines

Source: Arkansas Department of
Environmental Quality
Data Source: GeoStor
Map Created: March 2011

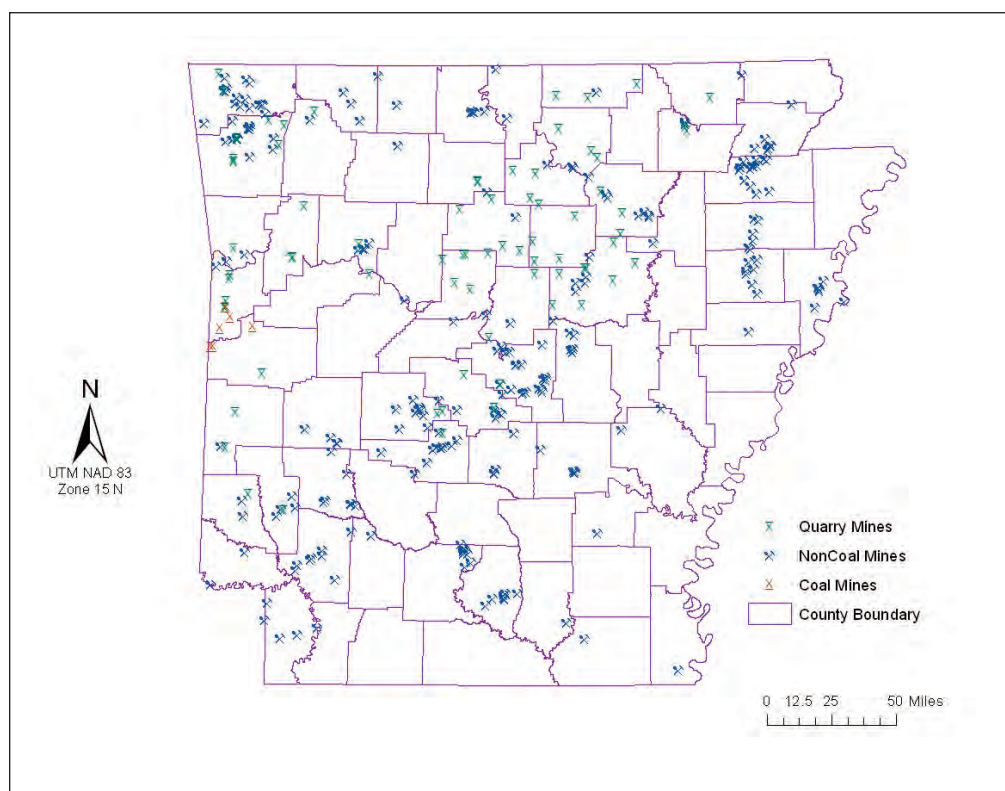


Table 6.1. Streams impaired by resource extraction with TMDLs by hydrologic unit code (HUC)

Stream Name	HUC	Reach	Planning Segment	Miles	Major Cause	TMDL Date
Flat Creek	8040201	-706	2D	16.0	Cl	2003
Flat Creek	8040201	-706	2D		SO ₄	2003
Flat Creek	8040201	-706	2D		TDS	2003
Salt Creek	8040201	-806	2D	8.0	Cl	2003
Salt Creek	8040201	-806	2D		TDS	2003
Total Miles				24.0		

Table 6.2. Streams that may be impaired by resource extraction without TMDLs by hydrologic unit code (HUC)

Stream Name	HUC	Reach	Planning Segment	Miles	Cause			Cat
					1	2	3	
Cove Creek	8040101	-970	2F	9.6	SO ₄	TDS	Zn	5a
Cove Creek	8040101	-970	2F		Be			5a
Smackover Creek	8040201	-6	2D	14.8	Zn			5d
Smackover Creek	8040201	-7	2D	29.1	Zn			5d
Bayou De L'outre	8040202	-006	2D	32.4	Zn			5a
Bayou De L'outre	8040202	-006	2D		TDS	SO ₄		5a
Bayou De L'outre	8040202	-007	2D	6.9	Zn			5a
Bayou De L'outre	8040202	-007	2D		TDS	SO ₄		5a
Bayou De L'outre	8040202	-008	2D	10.6	Zn			5a
Bayou De L'outre	8040202	-008	2D		TDS	SO ₄		5a
Saline River	8040203	-10	2C	29.8	TDS	SO ₄		5b
Little Cornie Bayou	8040206	-816	2E	3.0	Zn	SI		5c
Little Cornie Bayou	8040206	-816	2E		SO ₄			5d
Little Cornie Bayou	8040206	-716	2E	5.0	Zn	SI		5c
Little Cornie Bayou	8040206	-716	2E		SO ₄			5d
Little Cornie Creek	8040206	-016	2E	18.0	Zn	SI		5c
Little Cornie Creek	8040206	-016	2E		SO ₄			5d
Big Cornie Creek	8040206	-015	2E	15.0	Zn	SI		5c
Big Cornie Creek	8040206	-015	2E		SO ₄			5d
Chamberlain Creek	8040102	-971	2F	2.5	pH	Cl	SO ₄	5a
Chamberlain Creek	8040102	-971	2F		Cd	Cu	Zn	5a
Lucinda Creek	8040102	-975	2F	2.2	pH	SO ₄	Zn	5a
Walker Branch	8040206	-916	2E	3.0	Zn	SI		5c
Walker Branch	8040206	-916	2E		SO ₄			5d

Table 6.2. Streams that may be impaired by resource extraction without TMDLs by hydrologic unit code (HUC) cont.

Stream Name	HUC	Reach	Planning Segment	Miles	Cause			Cat
					1	2	3	
S. Fork Caddo	8040102	-023	2F	16.6	Cu	Zn		5a
Caddo River	8040102	-019	2F	7.7	Zn			5c
Caddo River	8040102	-018	2F	4.1	Zn			5c
D.C. Creek	8040102	-923	2F	5.0	Be	Zn		5c
Caddo River	8040102	-016	2F	13.5	Zn			5c
Caddo River	8040102	-016	2F		Be			5d
Crooked Creek	11010003	-048	4I	31.7	Temp			5a
Total Stream Miles				260.5				

Potential Pollutants

NPS pollution may occur in a number of forms. Specifically, NPS pollution may occur from stormwater runoff from open-cut mine sites and quarry operations; turbidity and siltation due to in-stream gravel mining; Acid Mine Drainage (AMD) from surface coal mining operations; and surface and groundwater contamination due to petroleum extraction activities. Three of these operations are described in detail.

Surface Mining Operations: Surface mining operations are required to address point and NPS-pollution issues through the application process, performance standards contained in the regulations and through a combination of Best Management Practices (BMPs). Surface mining operations, coal and non-coal, are particularly prone to the erosive forces of wind and water because of the availability of loose, exposed soil with no vegetative cover or proximity of the operation to a waterbody. The regulatory requirements addressing runoff issues regarding open-cut mining and in-stream gravel mining operations have become more restrictive since the 1998 Arkansas NPS Pollution Management Plan addressed resource extraction. Specifically, Regulation 15 requires the maintenance of an undisturbed buffer zone of 100 feet between the permit boundary and ordinary high-water mark of a waterway for open-cut mining operations. Siltation (SI) and turbidity issues for in-stream gravel mining are addressed through the requirement that any material removal below the ordinary high-water mark may not create a violation of the state's water quality standards. Additionally, material removal must not be conducted below an elevation of

one (1) foot above the elevation of the surface of the water at the time of removal. If the stream is dry, material removal may proceed to a depth equivalent to one (1) foot above the lowest point of a cross section of the stream in that location. Material removal must not create conditions that will cause the stream to change course or alter the location of the deepest part of the stream channel or cause bank or channel instability.

Bituminous Coal and Lignite Mining: Acid Mine Drainage is the primary concern associated with runoff issues with bituminous coal mining in Arkansas. AMD may occur when surface mining activities expose spoil materials to an oxidizing environment; AMD may also occur from subsurface coal mining operations. Under normal circumstances, the erosive forces of wind and water would weather the surface of the ground; however, the process of mining accelerates the reaction rates of the materials contained in the soil and facilitates pyrite weathering (Office of Surface Mining and Reclamation, 2005). AMD, with its low pH, facilitates the extraction of heavy metals such as lignite, copper, nickel and zinc. AMD intrusion into surrounding surface and groundwater can be a source of contaminants.

Oil and Gas Extraction: Oil and gas resource extraction operations (exploration, development and production activities) can contribute NPS pollutants. Discharges associated with these oil and gas resource activities may be considered point source discharges (produced water, drill cutting, drilling fluid discharges, etc.) and can be significant localized contributions. Possible contributions to the NPS

pollution load are seeping and overflowing drilling site reserve pits (drilling fluids) and production pits (produced water, hydrocarbons, radium), contaminated stormwater runoff from drilling and pipeline right-of-ways, workover, production sites, silt, etc. (Louisiana DEQ, 1999). It is important to note that different aspects of oil and gas extraction fall under different agency authority (OGC/ADEQ) and different departments within the responsible agencies (Mining/Hazardous Waste/Water Divisions of ADEQ).

Water Quality/Program Goals

ADEQ's 2008 List of Impaired Waterbodies indicates 284.5 miles of streams in Arkansas are not fully supporting their designated uses due to resource extraction activities. The ultimate water quality goal is to have no impairment listed due to resource extraction activities and to prevent any potential sources of impairment from occurring due to resource extraction activities.

Resource Extraction Logic Model

As mentioned previously, teams that did the initial research to prepare the NPS Pollution Management Plan also created logic models for each section to better plan how program goals would be achieved. The team discussed long-term, medium-term and short-term behavior changes it hoped to cause through the NPS Management Plan and what actions would be most effective to achieve those changes.

For resource extraction, the team established that the preferred long-term outcome be that resource extraction not be a cause of waterbody impairment. Prevention is the key to meeting the long-term objective.

Prevention can be accomplished through improved decision-making and the creation of a Geographical Information System database of all resource extraction operations. It can also be achieved through the creation of BMPs.

In the short-term, BMPs should be revised to fill gaps and remain consistent with any changing research and practices. Surface mining BMPs should be updated as needed, and BMPs for oil and gas extraction should be developed.

These behaviors can be accomplished through the development and implementation of education programs on resource extraction and the need for BMPs

to reduce NPS pollution. They can also be accomplished through the encouragement of participation in existing workshops, Stream Teams and other education programs. These activities would be aimed at permittees, watershed groups, Stream Team volunteers and county and city government officials.

For any of the goals to be achieved, agencies and organizations must put in staff time, research and money. Volunteers are also needed, as is the support of residents and environmental/natural resource groups.

Compliance remains a voluntary process, so the logic model team assumed this would continue. The state of the economy, program funding for education and monitoring and changes in federal or state regulations are external factors that could sway the program's outcome, as are any new discoveries of energy sources or improved extraction methods.

The resource extraction section of the NPS Pollution Management Plan can be tracked and evaluated on its various outcomes.

Short-term outcomes or impact can be tracked from program activities by looking at how many people participated in education programs, how many fact sheets were developed, how many BMP manuals were distributed, etc. Effort expended can also be tracked as part of the grant process.

Medium-term changes in behavior can be tracked through the analysis of BMP implementation data. Long-term outcomes of the program would be evaluated by whether streams are removed from ADEQ's List of Impaired Waterbodies.

Long- and short-term programmatic objectives for the elements of this statewide program are given below. The Program Logic Model (Table 6.3) begins on page 92.

Objectives and Milestones

The Arkansas Department of Environmental Quality is the lead agency for implementation of the resource extraction statewide program. For all statewide programs, the overall program strategy is to continue the voluntary process whereby federal and state programs cooperate in priority areas of the state where water quality problems have been identified. As long as this cooperative process results in improved implementation of BMPs and reductions in NPS pollutant loads, it will be viewed as successful. If the cooperative process does not result in NPS reductions and water quality improvements, then ADEQ will investigate additional steps needed to enable waterbodies to meet their designated uses.

Table 6.3. PROGRAM LOGIC MODEL – Resource Extraction

SITUATION					
<p>Resource extraction is an expansive and multifaceted industry in Arkansas. For the purposes of the Nonpoint Source (NPS) Pollution Management Plan, categories of resource extraction include surface mining, subsurface mining, dredge mining, abandoned mine sites and petroleum extraction activities (including both natural gas and crude oil). Arkansas Department of Environmental Quality (ADEQ) has 301 permitted and authorized mine sites across the state. There are an estimated 50 additional active quarry sites that were grandfathered after passage of the Arkansas Quarry Operation, Reclamation and Safe Closure Act. ADEQ has also estimated that upwards of 500 abandoned mine sites may exist that range from under an acre in size to more 100 acres in size. To date, the Arkansas Oil and Gas Commission has issued more than 44,400 permits for oil, gas and brine wells. However, efforts to accurately locate and investigate all of these sites for potential stormwater pollution problems remain a difficult challenge. It should be noted that the Arkansas Game and Fish Commission provided a two-year grant (2010/2011) allowing the addition of 17 inspectors to the ADEQ employee ranks. Though a valuable contribution to the effort, it remains a short-term fix to the long-term needs of funding, personnel and time.</p>					
INPUTS	OUTPUTS		OUTCOMES		
	Activities	Participants	Short-term	Medium-term	Long-term
<ul style="list-style-type: none"> – Staff, volunteers, education, research, time and monetary investments from the following agencies and organizations: Arkansas Department of Environmental Quality Arkansas Oil and Gas Commission Arkansas Natural Resources Commission Arkansas Game and Fish Commission U.S. Army Corps of Engineers U.S. Department of Agriculture Natural Resources Conservation Service U.S. Environmental Protection Agency Environmental/natural resource nongovernment agencies and organizations Citizens 	<ul style="list-style-type: none"> – Develop and implement education program on resource extraction and BMPs to reduce NPS pollution – Encourage participation in existing education workshops, Stream Teams and other educational programs 	<ul style="list-style-type: none"> – Permittees – Watershed groups – Stream Team volunteers – County government officials – City government officials 	<ul style="list-style-type: none"> – Revise BMPs to fill gaps and remain consistent with changing research and practices – Update Surface Mining BMPs Manual as needed – Develop BMPs for oil and gas extraction 	<ul style="list-style-type: none"> – Improve decision-making by creating and maintaining a Geographical Information System database of all resource extraction operations – Monitor implementation of BMPs and estimate benefits of implementing BMPs 	<ul style="list-style-type: none"> – No impairment listed due to resource extraction activities – Prevent any potential sources of impairment from occurring due to resource extraction activities

Table 6.3. PROGRAM LOGIC MODEL – Resource Extraction (cont.)

ASSUMPTIONS	EXTERNAL FACTORS
<p>1. Compliance remains a voluntary process whereby federal and state programs cooperate in priority areas of the state, where water quality problems have been identified. As long as this cooperative process results in improved implementation of BMPs and reductions in NPS pollutant loads, it will be viewed as successful. However, if the cooperative process does not result in NPS reductions and water quality improvements, then ADEQ will investigate additional steps needed to enable waterbodies to meet their designated uses.</p>	<p>1. State of the economy; 2. Program funding for education and monitoring; 3. Changes in federal or state regulations; 4. New discoveries of energy sources or improved extraction methods.</p>

EVALUATION PLAN

The program will track short-term outcomes/impacts from program activities through a variety of methods including recording of how many individuals participated in education and training programs, how many fact sheets were developed, how many BMP manuals were distributed, etc.

Measures of medium-term outcomes/impacts of the program focus on whether program activities result in behavioral changes (i.e., BMP implementation at mine sites).

The long-term outcome/impact of the program is whether or not streams are removed from the ADEQ List of Impaired Waterbodies. The desired evaluation outcome is that resource extraction will not be listed as a primary or secondary source contributing to impairment of waterbodies in future lists.

Short- and long-term objectives are described below.

6.1. Develop and implement an educational program for permittees on BMPs to reduce NPS pollution. Encourage participation in educational workshops, Stream Teams, and other educational programs through outreach and watershed groups.

Timeline for Milestones: October 2011 through September 2016

6.2. Continue to educate county and city government officials on resource extraction issues related to NPS pollution so they may identify and appropriately report non-permitted resource extraction activities.

Timeline for Milestones: October 2011 through September 2016

6.3. Continue to strengthen BMPs to fill gaps and remain consistent with changing research and practices. Update Surface Mining BMP Manual as needed. Develop BMPs for oil and gas extraction.

Timeline for Milestones: October 2011 through September 2016

6.4. Create and maintain Geographical Information Systems (GIS) database of all resource extraction operations. Explore methods to use GIS to improve monitoring of BMP implementation and estimate the benefits of BMP implementation.

Timeline for Milestones: October 2011 through September 2016

Program Tracking and Evaluation

As stated in the Logic Model section, the resource extraction section of the NPS Pollution Management Plan can be tracked and evaluated on three levels: short-term inputs, intermediate processes and long-term outcomes.

The program will track program activities and effort expended, which is a first and necessary step toward effecting change. ANRC will require grantees to incorporate these measures into their project requests.

The second measure of the program focuses on whether program activities result in behavioral changes (i.e., BMP implementation at mine sites). ADEQ inspectors started monitoring implementation of NPS pollution BMPs at mine sites in 2003. Data from inspection reports are entered into a database. As funding becomes available, ADEQ will explore options for analyzing and reporting BMP implementation data.

Timeline for Milestones: October 2011 through September 2016

The ultimate measure of the program is whether or not streams are removed from the ADEQ List of Impaired Waterbodies. The desired evaluation outcome is that resource extraction will not be listed as a primary or secondary source contributing to impairment of waterbodies in future lists.

Timeline for Milestones: October 2011 through September 2016

Brief Summary of Institutional Context

Nonpoint source pollution issues are currently addressed through the implementation of ADEQ, United States Army Corps of Engineers (USACE), U.S. Department of Agriculture Natural Resources Conservation Service (NRCS) and U.S. Environmental Protection Agency (EPA) requirements for resource extraction activities. ADEQ Regulations 1, 6, 15, 17 and 20, summarized below, regulate point and nonpoint source pollution from resource extraction activities in Arkansas. In 2001, the ADEQ Mining Division published *Conservation Practices for the Reclamation of Surface Mines in Arkansas*, addressing a number of nonpoint source issues through the framework of ADEQ regulations and BMPs (ADEQ, 2001). Specifically, stormwater issues are addressed through permitting requirements, administrative conservation practices, erosion control conservation practices and reclamation conservation practices.

The ADEQ regulates the surface runoff associated with these activities by authority delegated by the EPA to the state of Arkansas to oversee a permitting program in lieu of the Federal National Pollution Discharge Elimination System (NPDES). In addition to implementing the NPDES permitting system, ADEQ has direct permitting authority over several types of resource extraction activities that could contribute to NPS pollution. Surface mining is regulated by the ADEQ Surface Mining and Reclamation Division and consists of three programs.

1. **Coal, Non-Coal and Quarries:** The Arkansas Surface Coal Mining and Reclamation Code, or Regulation 20, provides the regulatory framework for the Coal Program. Regulation 20 was adopted to provide coal mining operations with a set of performance standards that must be followed during mining and the process of reclaiming the land for beneficial use. Currently, there are three active permitted coal mining operations in the Arkansas Valley Coal Field, which can be found in the Arkansas River Valley between Fort Smith and Russellville. The Arkansas Valley Coal Field, which contains bituminous coal, is estimated to be approximately 60 miles long and 33 miles wide and includes parts of Crawford, Franklin, Johnson, Logan, Pope, Sebastian and Scott counties.

An important aspect of the Coal Program is the Abandoned Mine Land (AML) program, which provides federal funding for reclamation of high priority abandoned coal mines that existed before the passage of the Federal Surface Mining Control and Reclamation Act of 1977. Coal mining operations permitted since then are required to secure funds through a reclamation bond instrument, which will fund reclamation activities should the facility be unable to reclaim the site.

2. **The Arkansas Open-Cut Mining and Land Reclamation Code:** Regulation 15 is the regulatory framework for the Non-Coal Program. Regulation 15 provides the state's mining operations with a set of performance standards that must be followed during open-cut mining and during the process of reclaiming the land to a beneficial use. Regulation 15 defines open-cut mining as the surface extraction of clay, bauxite, sand, gravel, soil, shale or other materials for commercial purposes. In 2008, 292 permitted non-coal mining operations, including quarry and in-stream gravel mining operations, were permitted through the ADEQ Surface Mining and Reclamation Division Non-Coal Program.
3. **The Arkansas Quarry Operation, Reclamation, and Safe Closure Act, Act 1166 of 1997:** As amended, this act does not provide for a separate set of regulations; all the requirements are in the law. The quarry law defers stormwater runoff issues to the NPDES permit for the quarry site. As of 2005, there were 73 active Notifications of Intent (NOI) to quarry on file with ADEQ (ADEQ, 2005).

Regulation 17, the Arkansas Underground Injection Control Code, and Regulation 1, the Regulation for the Prevention of Pollution of Salt Water and Other Oil Field Wastes Produced by Wells in All Fields or Pools, provide the regulatory framework for the ADEQ Water Division, State Permits Branch to provide oversight of the petroleum industry regarding the disposal aspect of petroleum extraction activities.

Regulation 1 regulates disposal of salt water and liquid wastes associated with oil and gas wells. Regulation 17 classifies underground injection wells and regulates well injection. As of 2005, 488 disposal wells for oil and gas facilities have been permitted through the ADEQ's Water Division, State Permits Branch (ADEQ, 2005). The Arkansas Oil and Gas Commission (AOGC) issues permits for the drilling and operational components of active oil and gas wells.

Cooperating Entities

Cooperating entities are listed and described in cooperating entities section of the 2011-2016 NPS Pollution Management Plan.

Federal Consistency

The Arkansas Surface Coal Mining and Reclamation Code, Regulation 20, was adopted to be no more stringent than federal regulations. Act 134 of 1979, as amended by Act 647 of 1979, authorized the state to adopt, issue and amend rules and regulations pertaining to surface coal mining and reclamation. The regulations are required to be consistent with, but no more restrictive than, the regulations issued by the U.S. Secretary of the Interior. Oversight for this program is provided by the Office of Surface Mining Reclamation and Enforcement (OSMRE), Department of the Interior. No federal oversight exists for surface non-coal mining operations. Existing non-coal mining regulations have been adopted and amended by ADEQ.

The ADEQ Water Division receives grant oversight from the EPA for the implementation of the Underground Injection Control Code program, Regulation 17, in accordance with the Safe Drinking Water Act. The ADEQ Water Division receives no oversight or monies for the implementation of Regulation 1. The AOGC permits the production wells for oil and gas facilities. The U.S. Army Corps of Engineers regulates dredging of navigable rivers and harbors under the Rivers and Harbors Act.

Common Best Management Practices

The following BMPs were taken from the *Conservation Practices for the Reclamation of Surface Mines in Arkansas*. The handbook was designed to be a reference guide for anyone conducting or who wants to conduct surface mining operations in Arkansas. BMPs have not been developed for oil and gas extraction.

Erosion Control Conservation Practices

Silt Fences: Appropriate for use below affected areas where sheet and rill erosion may be encountered. Installation must occur so that the fence fabric extends below the ground's surface when it is anchored and the fence is constructed perpendicular to the water's flow direction. Proper and timely maintenance of silt fences is necessary to keep this BMP from becoming overloaded with sediment and blown out.

Hay Bales: Effectiveness relies on proper ground preparation, placement of the bales and proper staking. After silt accumulates on the bales, maintenance is required to prevent water from bypassing the bale.

Grading: Proper grading reduces the velocity and ability of the water to erode slopes during storm events. Non-coal mining operations are required to maintain a slope of no greater than 3:1.

Vegetation: The establishment of vegetation on properly graded slopes is effective in preventing NPS pollution from rain events. Self-sustaining vegetative cover reduces the ability of the slopes to erode.

Diversion Ditches and Berms: The decision of where to place ditches and berms should be an integral part of the planning phase of mining operations.

Sediment Ponds: Sediment ponds are a highly effective means to collect stormwater runoff and allow the suspended particles to settle. As with other BMPs, inspections of the structure should be conducted routinely to determine if it has maintained its structural integrity.

Rip-Rap: A term for loose, large, angular rocks that can be used to create erosion-resistant structures to protect the soil at locations where high velocity may occur. Rip-rap is commonly used in conjunction with other BMPs to boost the overall performance of the practice. Rip-rap should normally be underlaid with filter fabric or an erosion-control matting so that

underlying sediment will not be pulled out by water flowing over the rip-rap, causing the bank to collapse on itself.

Mulching: This refers to the application of organic or other materials to the soil surface to prevent erosion and retain soil moisture for seed germination. Mulching is highly recommended during all reclamation efforts for mined land. Hay or straw, wood chips and wood fibers are commonly used for mulching purposes. Mulch may be applied by hand or blower system. Mulching with erosion control mats and blankets provide soil stabilization after seeding.

Chemical Soil Binders: Effective when properly tailored for the specific soil conditions of the site. The binder is usually in the form of a long chain polymer and acts to bind the soil together long enough for seed germination.

Check Dams: Structures designed to slow or impede the flow of water through drainage channels. The rate of channel erosion may be decreased, allowing the channel time to stabilize with vegetation. As with other sediment control structures, maintenance is required to keep the sediment from bypassing the structure. Check dams are commonly made from sand and gravel, rip-rap, logs or brush.

Reclamation Conservation Practices

Preservation of Topsoil: Topsoil should be stripped as a separate layer and stored for future use during reclamation. During storage, topsoil should be protected from unnecessary compaction and from the erosion forces of wind and water. Once the soil has been stockpiled, temporary vegetative cover should be established on the stockpile before seeding.

Topsoil Replacement: The replacement of the topsoil is dependent on the final use proposed for the reclaimed site. When appropriate, consider amending top soil with poultry litter or other animal production byproducts from nutrient surplus areas.

Soil Analysis: Once the topsoil has been replaced, a soil analysis should be prepared to determine the correct necessary soil amendments. These amendments include the nutrients and fertilizer needed for proper vegetative growth. The tests are provided by local conservation districts or state-operated universities at little or no cost to the operator.

Coverage of Acid-Forming Materials: Surface coal mining can potentially expose acid-forming materials to the erosion forces of wind and water and

cause the formation of acid mine drainage. AMD is caused by the exposure of acid-forming materials such as iron pyrite (FeS_2) to conditions where oxygen and water are present. The chemical reaction of these compounds produces a strong acid. To minimize the production AMD, the operator must be able to identify the acid-producing materials present and plan to separate the spoil that contains these materials for immediate disposal. The common method of disposal is to place these materials in a location that allows for the covering of the material with a cap that prevents the chemical reaction from taking place. Additionally, seams of acid-forming materials that may remain in the final highwall must be covered. Commonly, the seam exposure is covered by water in a permanent impoundment. This method, however, does allow for the creation of a limited amount of AMD while the acid forming material is leached from the highwall until the chemical reaction stabilizes.

Overburden Storage: Vegetative cover should be established on overburden materials to prevent heavy sediment loads from occurring due to the exposure of the overburden with water.

Excessive Refuse/Spoil Disposal: Excess spoil, which should be disposed of, will not be implemented in the reclamation efforts at the mine site. Options include commercially marketing the spoil, or if that is not an option, constructing permanent disposal areas within the permitted site.

Other Mining-Related Conservation Practices

Acid Mine Drainage Treatment:

- Active AMD treatment consists of applying chemicals to precipitate metals and neutralize the acidity found in AMD.
- Passive AMD treatment is designed for long-term, usually 20 to 40 years, treatment of AMD. The four basic passive methods used are wetlands (aerobic and anaerobic), anoxic limestone drains (ALD), successive alkalinity-producing systems (SAPs) and limestone-lined ponds. These methods may be combined to increase the overall effectiveness of the treatment.

Geotextiles: Permeable textiles used for geotechnical engineering purposes when dealing with soil stability, rock stability and erosion control. Geotextiles can be used to reinforce, filter and direct planar water flow over the soil surface.

Drop Structures: Provide transportation conduit for water to be moved vertically down a slope without creating erosion. Drop structures are commonly combined with diversion ditches to manage water flow across a slope. A spillway on a dam and a simple vertical rock-lined ditch are both a type of drop structure.

References Cited

ADEQ, 2001. Stephens, J. F., R. S. Rogers and P. K. Fields. Conservation Practices for the Reclamation of Surface Mines in Arkansas. Arkansas Department of Environmental Quality, Surface Mining and Reclamation Division: Little Rock, Ark.

ADEQ, 2005. 2004 Proposed 303(d) List of Impaired Waterbodies. Arkansas Department of Environmental Quality: Little Rock, Ark.

ADEQ, 1999. Nonpoint Source Management Plan. Louisiana Department of Environmental Quality.
<http://nonpoint.deq.state.la.us/99manplan/99resource.pdf>.

OSMRE, 2005. "Factors Controlling Acid Mine Drainage Formation." Office of Surface Mining Reclamation and Enforcement. www.techtransfer.osmre.gov/NTTMainSite/Initiatives/ADTI/ACID%20MINE%20DRAINAGE%20INFO.pdf.

Surface Erosion Statewide Programs

Introduction

The Arkansas Department of Environmental Quality (ADEQ) introduced a new category of pollution called “surface erosion” in its 2004 draft List of Impaired Waterbodies (ADEQ, 2005). This category includes erosion from agriculture activities, construction activities, unpaved road surfaces and in-stream erosion mainly from unstable streambanks (ADEQ, 2010). Surface erosion resulting from agricultural and silviculture practices are addressed in Sections 4 and 5 of this update. This section addresses some issues associated with paved and unpaved roads, including forestry roads; construction at sites that do not require a National Pollution Discharge Elimination System (NPDES) permit, such as construction sites of less than one acre and not part of a common plan; and hydro-modification. Additional components may be added as the need arises.

The ADEQ’s 2008 List of Impaired Waters identifies 24 stream segments totaling 299.7 miles that are impaired because of siltation/turbidity where surface erosion is identified as the source. The list can be accessed at the following sites:

- http://arkansaswater.org//index.php?option=com_content&task=view&id=14&Itemid=30
- www.adeq.state.ar.us/water/branch_planning/pdfs/303d_list_2008.pdf

Note that under the “Causes” descriptions, waters impaired by siltation/turbidity are designated by “SI,” and under the “Sources” description, surface erosion is listed as “SE².”

Paved and Unpaved Roads

Paved Roads: Arkansas’ highway system totals 16,438 miles (AHTD, 2009). Paved county and municipal roads are not inventoried but affect large areas. The U.S. Environmental Protection Agency (EPA) stated that nonpoint source (NPS) pollution problems are increased in urban and suburban areas because paved surfaces cause runoff to occur at higher velocities and in greater quantities (EPA, 2010). Paved roads and highways, bridges and other transportation infrastructure can be sources of heavy metals, oils, other toxins and debris. In addition, they alter hydrologic

regimes by increasing the area of impervious surfaces and modified drainage structures. Finally, pesticides and fertilizers used along road rights-of-way can pollute surface waters through runoff, application drift or attachment to soil that is then blown into surface waters.

Unpaved Roads: The EPA defines unpaved roads as any road, equipment path or driveway that is not paved, and which is open to public access and owned or operated by any federal, state, county, municipal, or other governmental or quasi-governmental agencies (EPA, 2010). Approximately 88 percent of rural roads in Arkansas are unpaved (The Nature Conservancy, Arkansas Chapter, 2010) (Figure 7.1). The main pollutant associated with unpaved roads is sediment. Stream crossings can also cause alterations to stream hydrology and habitat. In a study of the West Fork of the White River, unpaved roads accounted for an estimated 4,500 tons per year of sediment from a 124 square mile area, making it the second highest source of sediment after streambank erosion (Formica et. al., 2004). This area has a normal density of unpaved roads when compared to other parts of the state.

The Arkansas Forestry Commission (AFC) surveyed the implementation of voluntary forestry Best Management Practices (BMPs) on 274 sites totaling 24,230 acres. These sites were randomly selected from a pool of 3,339 candidate sites representing final harvest forest operations that occurred statewide between March 2007 and July 2008.

Overall BMP implementation was 86 percent on sites monitored. In general, implementation was highest on public and forest industry sites and lowest on private, nonindustrial sites. Federal tracts averaged 99 percent, state sites averaged 93 percent, industrial sites averaged 89 percent and private nonindustrial forest landowners averaged 81 percent (AFC, 2008).

Erosion can come from many sources on an unpaved road including, but not limited to, construction activity and routine maintenance of road surface, ditches, culverts and bank slopes. In addition, unpaved shoulders and informal conveyances such as skid trails, utilities easements, horse trails, all-terrain vehicle (ATV) trails and fire lanes can be sources of sediments. These surfaces may be very similar to unpaved roads, except that they are often not planned in the traditional engineering sense and are more likely immediately adjacent to the stream.

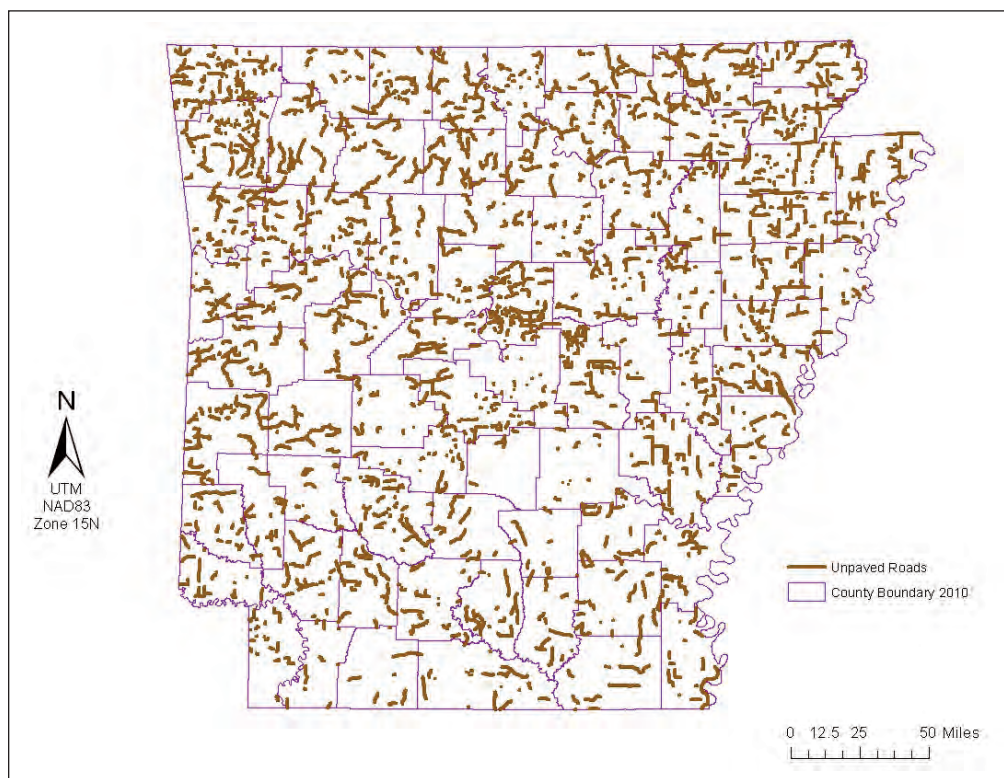
Table 7.1. Typical pollutants found in runoff from roads and highways

	Pollutant	Source
Sedimentation	Particulates	Pavement wear, vehicles, the atmosphere and maintenance activities
Nutrients	Nitrogen and phosphorus	Atmosphere and fertilizer application
Heavy Metals	Lead	Leaded gasoline from auto exhausts and tire wear
	Zinc	Tire wear, motor oil and grease
	Iron	Auto body rust, steel highway structures such as bridges and guardrails and moving engine parts
	Copper	Metal plating, bearing and brushing wear, moving engine parts, brake lining wear, fungicides and insecticides
	Cadmium	Tire wear and insecticide application
	Chromium	Metal plating, moving engine parts and brake lining wear
	Nickel	Diesel fuel and gasoline, lubricating oil, metal plating, brushing wear, brake lining wear and asphalt paving
	Manganese	Moving engine parts
	Cyanide	Anticaking compounds used to keep deicing salt granular
	Sodium, calcium and chloride	Deicing salts
	Sulphates	Roadway beds, fuel and deicing salts
Hydrocarbons	Petroleum	Spills, leaks, antifreeze and hydraulic fluids and asphalt surface leachate

Source: EPA, 2010

**Figure 7.1
Unpaved roads in
Arkansas**

Source: Arkansas State Highway and
Transportation Department, 2010
Data Source: GeoStor
Map Created: March 2011



Construction

Construction is an important economic activity in Arkansas. The Bureau of Economic Analysis (BEA) estimates that 2009 Gross Domestic Product in the state's construction industry totaled \$4.2 billion. Major construction activities include the development of residential, commercial and industrial facilities as well as highways, streets and other infrastructure. Construction sites greater than one acre, including smaller sites that are part of a larger common plan of development that disturbs more than one acre, are regulated through ADEQ's NPDES stormwater program.

ADEQ included new buffer zone requirements in its Stormwater Construction General Permit in 2008. The following is the language as it appears in the ADEQ document:

An undisturbed buffer zone as stated below shall be maintained at all times. Exceptions from this requirement for areas, such as water crossings, limited water access, and restoration of the buffer, are allowed if the permittee fully documents in the Stormwater Pollution Prevention Plan (SWPPP) the circumstances and reasons for the buffer zone encroachment. Additionally, this requirement is not intended to interfere with any other ordinance, rule or regulation, statute or other provision of law.

- a. For construction projects where clearing and grading activities will occur, the SWPPP must provide at least twenty-five (25) feet of buffer zone, as measured horizontally from the top of the bank to the disturbed area, from any named or unnamed streams, creeks, rivers, lakes or other waterbodies. The 25-foot buffer zone needs to be vegetated and/or capable of reducing and filtering sediment-laden flows.
- b. The Department may also require up to fifty (50) feet of buffer zone, as measured from the top of the bank to the disturbed area, from established TMDL waterbodies, streams listed on the 303 (d)-list, an Extraordinary Resource Water (ERW), Ecologically Sensitive Waterbody (ESW), Natural and Scenic Waterway (NSW) and/or any other uses at the discretion of the Director.
- c. Linear projects will be evaluated individually by the Department to determine buffer zone setbacks.

Construction sites can generate NPS pollution that threatens water quality if BMPs are not used. Pollutants associated with construction activities are so localized, compared to agricultural or forest production, that it is often difficult to correlate construction activity with water quality for a watershed. At a more local level, however, the amount of pollutant loading that can be delivered to a waterbody from a single construction site can be significant and clearly measured. Therefore, this program component will focus on developing and delivering education on BMPs and installation and maintenance at construction sites of all sizes, aimed at reducing the amount of NPS pollution leaving construction sites, thereby reducing the pollutants that could potentially enter the waters of the state.

Hydromodification

In-stream erosion of streambanks or beds results from structures, activities and land uses that affect natural stream flow. These activities may be designed and planned or can be unintended, as a result of various land-use activities. Direct hydromodifications that affect stream flow include channel alterations, high-flow cutoff devices, instream construction, water withdrawal, dredging, instream mining, locks and dams, levees, spillways, bridges and culverts, impoundments and other water control structures. Indirect hydromodification is often associated with land use changes in a watershed, such as resource extraction, urbanization and some silvicultural practices. For example, conversion of mixed deciduous forests to pine through clear cutting and reseedling has the potential to decrease stream flow and groundwater recharge in the affected watershed due to higher evapotranspiration rates of pines (Swank and Douglass, 1974). Infilling of the floodplain for development and other purposes can alter the hydrology of a system dramatically as well.

Accelerated lateral erosion of streambanks from introduced river channel instability results in excessive amounts of sediment entering the system, loss of riparian zone vegetation and can contribute additional nutrients to the system when pasturelands are being eroded. Siltation/turbidity, typically associated with sedimentation, is the greatest cause of impairment to streams in Arkansas. This erosion, coupled with resource extraction such as gravel mining, disturbs the natural flow and increases turbidity levels causing greater impairment.

Accelerated streambank erosion is symptomatic of river or stream channel instability. The cause of stream

instability is complex and can result from the cumulative effect of direct and indirect hydromodifications over a period of time. Causes include:

- change in the flow regime due to an overall change in infiltration rates and increase in surface runoff from forest conversion to pasture; construction of roads (includes filling in headwater streams with fill material); and creation of urban environments (includes paving, filling in headwater streams and wetlands, forest removal, building construction);
- changes in channel pattern and profile from resource extraction and/or straightening of stream;
- increases of sediment load from other sources of sediment in the watershed, such as unpaved roads, ditches, gullies that form at construction sites and fill disposal sites;
- cross channel obstruction; and
- grazing practices, including cattle stream access.

Fish passage may also be a related concern.

Resource extraction of gravel from within the bankfull channel and floodplains of streams can also contribute to stream instability and turbidity, due to separation of fines from the gravel aggregate as well as sedimentation from destabilized streambanks.

Routine dredging, a direct hydromodification, by the U.S. Army Corps of Engineers (USACE) is performed at a number of sites within Arkansas for the purpose of flood control. The number and duration of high flow periods, the intended use of the dredged waterway and other factors determine dredging frequency. Dredging typically increases turbidity in the waterbody by disturbing bottom sediments. In addition to resuspending sediments and other accumulated materials, resuspension of benthic sediments often results in the organic material attached or stored with the sediments also being suspended within the water column, potentially adding to the oxygen depletion of the river or stream. Dredging spoils may reenter the stream if not properly placed or removed from the stream or ditch banks. Floodgate pulsing and flow regime changes associated with hydroelectric power generation are also a source of hydrologic modification.

Changing channel configurations has the potential to introduce streambank instability. Channel modifications occur through various methods such as:

- clearing and snagging;
- physical modification; and
- new channel excavation.

These practices are used as a way to initially improve the hydraulic conveyance of the stream. Unless sediment conveyance of the stream is also accounted for, the same practices may result in unstable channels and increased surface erosion.

Hydraulic modification that is designed and planned can introduce potential problems to fluvial systems. However, it is often the case that unpermitted facilities, or facilities not following their permit, create greater disturbances than those designed and planned. The types of water quality problems associated with these activities include disturbances to vegetation and soil during construction, channel scour due to increased water velocities and increased water temperature if overhanging riparian vegetation is removed.

Pollutants Associated With Surface Erosion

Sediment

Soil erosion is the detachment and movement of soil particles from the soil surface. Soil loss by erosion is not sediment yield; however, it creates a potential for sediment yield. Sediment yield is the amount of eroded soil material that actually enters bodies of water. Soil loss is equal to the tonnage of soil being moved by erosion and redeposited in other locations, such as in ends of field rows, drainage ditches, adjacent land road ditches and other locations. Frequently, some of these eroded soil materials, along with the undesirable chemicals dissolved in runoff water or attached to soil particles, are transported by the runoff water from land surfaces into bodies of water. The percentage of soil that moves into bodies of water from eroding lands is quite variable. Sediment yield depends on the size of soil particles being transported, slope of the land and distance to the nearest waterbody, density of the vegetation the sediment has to move through, the shape of the drainage way and the intensity of the rain event.

The quantity of soil loss from unpaved roads can be estimated by use of the water erosion prediction model (<http://forest.moscowsl.wsu.edu/cgi-bin/fswepp/wr/wepproad.pl>), developed by the U.S. Department of Agriculture (USDA). Predictions of areas with the potential for water quality problems can be made in combination with land use, climatological data, etc.

Sources of sediment from in-stream erosion include material eroded by the sheer stress of the flow and mass wasting of streambanks as the bank-toe is eroded.

In the West Fork of the White River, streambank erosion can contribute 60 percent or more of the sediment load to fluvial systems (Formica et al., 2004). Another source of sediment can come from a stream that is downcutting. Disturbances within the bank-full channel can also be a source. Activities such as resource extraction, in-stream construction and dredging can introduce fine sediment by dislodging sediments, making it available for transport in the stream. Sediment from these sources can increase the stream turbidity concentrations and increase the potential for siltation, which in turn affects the aquatic habitat and the quality of downstream impoundments. Sediment can smother benthic organisms and cover critical stages of fish eggs and early life stages, causing increased mortality. It can also interfere with photosynthesis by reducing light penetration and may fill waterways, hindering navigation and increasing flooding. Sediment particles often carry nutrients, pesticides and other pollutants adsorbed onto the sediment particles into the waterbodies.

Nutrients

Soluble nutrients may reach surface water and groundwater through runoff or percolation. Others may be adsorbed onto soil particles and reach surface waters with eroding soil. Nutrients are necessary to plant growth in a waterbody, but over-enrichment leads to excessive algae growth; an imbalance in natural nutrient cycles; changes in water quality, especially dissolved oxygen concentrations; and a decline in the number of desirable fish species. Factors influencing nutrient losses include precipitation, temperature, soil type, kind of vegetation, nutrient mineralization, denitrification, distance to waterbodies, percent of vegetative cover and the presence and size of riparian buffers. For a more detailed discussion of specific nutrients, such as phosphorous and nitrogen, refer to the agriculture section in this plan.

Pesticides

The term *pesticide* includes any substance or mixture of substances intended for preventing, destroying, repelling or mitigating any pest or intended for use as a plant regulator, defoliant or desiccant. The principal pesticide pollutants that may be detected in surface water and in groundwater are active and inert ingredients and any persistent degradation products. Pesticides and their degradation products may enter ground and surface water in solution, in emulsion or bound to soil colloids. For simplicity, the term *pesticides* will be used to represent “pesticides and their degradation products.”

Despite the documented benefits of using pesticides (insecticides, herbicides, fungicides, etc.) to control plant pests and enhance production, these chemicals may, in some instances, cause impairments to the uses of surface water and groundwater. Some types of pesticides are resistant to degradation and may persist and accumulate in aquatic ecosystems.

Pesticides may harm the environment by eliminating or reducing populations of desirable organisms, including endangered species. Sub-lethal effects include the behavioral and structural changes of an organism that jeopardize its survival. For example, certain pesticides have been found to inhibit bone development in young fish or to affect reproduction by inducing abortion.

Herbicides in the aquatic environment can destroy the food source for higher organisms, which may then starve. Herbicides can also reduce the amount of vegetation available for protective cover and the laying of eggs by aquatic species. Also, the decay of plant matter exposed to herbicide-containing water can cause reductions in dissolved oxygen concentration (North Carolina State University, 1984).

Often a pesticide is not toxic by itself but is lethal in the presence of other pesticides. This is referred to as a synergistic effect, and it may be difficult to predict or evaluate. Bioconcentration is a phenomenon that occurs if an organism ingests more of a pesticide than it excretes. During its lifetime, the organism will accumulate a higher concentration of that pesticide than is present in the surrounding environment. When the organism is eaten by another animal higher in the food chain, the pesticide will then be passed to that animal, and on up the food chain to even higher-level animals.

Household Chemicals and Fertilizers

Everyday household activities are a major contributor to polluted runoff, which is among the most serious sources of water contamination. When it rains, fertilizer from lawns, oil from driveways, paint and solvent residues from walls and decks and pet waste are all washed into storm sewers or nearby lakes, rivers and streams (NRDC, 2001).

All-purpose cleaner, ammonia-based cleaners, bleach, brass or other metal polishes, dishwashing detergent, disinfectant, drain cleaner, floor wax or polish, glass cleaner, oven cleaner and scouring powder contain dangerous chemicals. Some examples are:

- **sodium hypochlorite (in chlorine bleach):** If mixed with ammonia, it releases toxic chloramine gas. Short-term exposure may cause mild asthmatic symptoms or more serious respiratory problems;

- **petroleum distillates (in metal polishes):** short-term exposure can cause temporary eye clouding. Longer exposure can damage the nervous system, skin, kidneys and eyes;
- **ammonia (in glass cleaner):** eye irritant, can cause headaches and lung irritation;
- **phenol and cresol (in disinfectants):** corrosive; can cause diarrhea, fainting, dizziness and kidney and liver damage;
- **nitrobenzene (in furniture and floor polishes):** can cause skin discoloration, shallow breathing, vomiting and death. It is also associated with cancer and birth defects; and
- **formaldehyde (a preservative in many products):** a suspected human carcinogen, it is a strong irritant to eyes, throat, skin and lungs.

If improperly disposed of, or accidentally spilled, these chemicals may end up in surface or groundwater.

Pathogens

Pathogens are disease-causing bacteria, viruses, protozoan parasites and other organisms. Fecal coliforms and/or *E. coli* are indicators that fecal pathogens may be present. Pathogens and pathogen indicators associated with animal and human fecal wastes are carried in water and can move through the environment via stormwater runoff, groundwater and surface waters such as rivers. Nonpoint source pollution is assisted by rainfall or snowmelt moving over and through the ground where there are many diffuse sources of fecal contamination, including manure, pet feces, wildlife feces, etc. As the runoff moves, it picks up and carries pollutants and transports them to lakes, rivers, wetlands, coastal waters and groundwater. Understanding pathogen transport pathways is critical for identifying effective management strategies. This can be understood by connecting the sources of fecal pathogens to climate and the hydrodynamic conditions, including how the water flows from rainfall to the land, to runoff to the river, or to the groundwater.

Water Quality/Program Goals

ADEQ uses assessment criteria to determine “designated use impairment” from long-term, frequent exceedance of the water quality standards that may be linked to discernible and correctable sources (ADEQ, 2008). Siltation/turbidity of reservoirs and streams has been identified as the largest cause of NPS pollution.

ADEQ has identified surface erosion as a source of siltation/turbidity.

The ultimate goal of the surface erosion statewide program is to reduce surface erosion and instream erosion through public awareness, education, training and other voluntary programs to a point where it is not causing impairment of the waters of the state.

Surface Erosion Logic Model

As mentioned previously, teams that did the initial research to prepare the NPS Pollution Management Plan also created logic models for each section to better plan how program goals would be achieved. The surface erosion team discussed long-term, medium-term and short-term behavior changes it hoped to cause through the NPS Management Plan and what actions would be most effective to achieve those changes.

For surface erosion, the team established that the desired long-term outcome was for surface erosion and instream erosion to be reduced to the point it is not an impairment of state waters, which would lead to reduced spending on pollution control for watersheds.

Surface erosion is a relatively new category of pollution, first introduced by ADEQ in its 2004 draft List of Impaired Waterbodies. The 2008 list identifies 32 stream segments totaling 444.9 miles impaired because of surface erosion.

The ultimate goal is to reduce surface erosion and sedimentation from rural roads and recreational trails, construction activities not covered by NPDES permits and other land use activities, as well as instream erosion/hydromodification through public awareness, education, training and other voluntary programs to a point where erosion is not causing impairment in waterbodies.

To get to that end goal, the team believes stream reaches and sites for restoration need to be prioritized and a shift in focus is needed from bank stabilization to restoration. New sources of funding would be secured, and federal and state programs would cooperate in priority areas of the state where water quality issues have been identified. As this takes place, so would the implementation of a watershed-based assessment protocol.

Before all those steps could be taken, there would need to be a greater understanding of how sediment pollutants enter waterways and a better understanding of how drainage designs affect sedimentation.

This understanding and subsequent outcomes require the participation of various local watershed entities, landowners, homeowners, recreationists, several state and county agency representatives and developers.

Together they can compile and analyze current road conditions and usage, enact public awareness education and training programs and develop models to be used to estimate sedimentation reduction from restoration projects. Other possible activities include updating and modifying BMP manuals and reviewing BMP manuals for low-volume and unpaved roads.

To accomplish these activities, it will take access to BMP manuals, GIS data, hydrological data and The Nature Conservancy (TNC) flow model, as well as a review of regional discharge curves information. It will require the effort and time of staff from the Arkansas Natural Resources Commission, ADEQ, Arkansas Game and Fish Commission (AGFC) and the University of Arkansas Division of Agriculture Cooperative Extension staff.

Modeling may be used as an evaluation tool to estimate sedimentation reduction from restoration projects. The success of hydromodification projects in restoring fisheries can be measured through documenting changes in biological communities with various biological assessment protocols and matrices.

Another important evaluation tool would be to produce updated land use maps every five years of priority watersheds to analyze any increases in riparian zones. And of course, the evaluation plan would include tracking the number of training program participants, fact sheets produced and any news coverage or distributed materials.

Long- and short-term programmatic objectives for the elements of this statewide program begin below. Program Logic Model (Table 7.2) follows objectives and milestones.

Objectives and Milestones

The Arkansas Natural Resources Commission (ANRC), in collaboration with ADEQ, is the lead agency for implementation of the surface erosion statewide program. For all statewide programs, the overall program strategy is to continue the voluntary process whereby federal and state programs cooperate in priority areas of the state where water quality problems have been identified. As long as this cooperative process results in improved implementation of BMPs and

reductions in NPS pollutant loads, it will be viewed as successful. However, if the cooperative process does not result in nonpoint source reductions and water quality improvements, then state and local entities will investigate additional steps needed to enable water-bodies to meet their designated uses using an adaptive management approach described in the introduction to this update.

Specific objectives and milestones:

Paved and Unpaved Roads

7.1. Partner with various local and watershed entities to compile and analyze current road conditions and usage, providing information on the number of miles of unpaved roads, surface materials, stream crossings and road density using analysis of existing data, survey of county officials and other methods.

Timeline for Milestones: October 2011 through September 2016

7.2. Review available construction and maintenance BMP manuals for low-volume and unpaved roads. Update and modify manuals as necessary and make available to county road crews and others upon request.

Timeline for Milestones: October 2011 through September 2016

7.3. Use construction and maintenance BMP manual for low-volume and unpaved roads for targeted education programs for county judges, quorum courts, maintenance workers and other interested county/city personnel on pollution prevention for rural roads, including construction techniques, preferred surface materials, drainage practices, ditch maintenance and erosion and sediment control.

Timeline for Milestones: October 2011 through September 2016

Construction

7.4. Continue to revise, as necessary, BMP manuals to address prevention, management and maintenance of runoff from surface erosion, including construction.

Timeline for Milestones: October 2011 through September 2016

7.5. Develop an ongoing program to disseminate surface erosion BMPs and information through a variety of means (e.g., distribution of the surface erosion manual, training workshops, web site content and demonstration projects).

Timeline for Milestones: October 2011 through September 2016

Instream Erosion/Hydromodification

7.6. Seek new sources of funding, leverage existing funding and promote increased cooperation aimed at shifting focus from bank stabilization to reach restoration.

Timeline for Milestones: October 2011 through September 2016

7.7. Continue to implement a watershed-based assessment protocol and BMPs for streambank erosion as funds allow.

Timeline for Milestones: October 2011 through September 2016

7.8. Prioritize stream reaches and sites for restoration within priority watersheds as funds allow.

Timeline for Milestones: October 2011 through September 2016

7.9. Develop and promote education programs for landowners concerning streamside and lakeside property management to reduce sources of NPS pollution.

Timeline for Milestones: October 2011 through September 2016

7.10. Develop and promote education programs for landowners and developers concerning proper stream corridor management and for professionals concerning stream corridor restoration practices.

Timeline for Milestones: October 2011 through September 2016

7.11. Promote tax credits, cost-share and other incentive programs that are available for riparian

zone and stream corridor restoration projects and conservation easements.

Timeline for Milestones: October 2011 through September 2016

7.12. Improve coordination of existing data among cooperating entities. Current data available to help with understanding and addressing this problem include gauging stations/flow data for many streams; ADEQ West Fork White River Watershed Assessment Report, which provides local erosion prediction curves for streambanks; area rainfall data; Geographical Information Systems data; U.S. Forest Service hydrological data; The Nature Conservancy flow model; regional discharge curves for the Ozark and Ouachita mountain areas; and ADEQ and Nature Conservancy eco-regional assessments.

Timeline for Milestones: October 2011 through September 2016

7.13. As funds allow, develop data and conduct analysis to fill information gaps. Examples include 1) geological survey of groundwater, 2) fish and macroinvertebrate data and changes over time, 3) regional erosion prediction curves and streambank erosion potential data, 4) regional discharge curves for the Delta, Arkansas River Valley and Coastal Plains areas, 5) evaluation of riparian areas within critical watersheds, 6) change in stream length over time and 7) sediment transport data throughout the state.

Timeline for Milestones: October 2011 through September 2016

Table 7.2. PROGRAM LOGIC MODEL – Surface Erosion

SITUATION
<p>ADEQ introduced a new category of pollution called “surface erosion” in its 2004 draft List of Impaired Waterbodies (ADEQ, 2005).</p> <p>This category includes erosion from agriculture activities, construction activities, unpaved road surfaces and instream erosion mainly from unstable streambanks (ADEQ, 2010).</p> <p>This section addresses some issues associated with paved and unpaved roads (including forestry roads), construction at sites that do not require a National Pollution Discharge Elimination System (NPDES) permit, such as construction sites of less than one acre and not part of a common plan, and hydromodification.</p> <p>ADEQ’s most current List of Impaired Waters identifies 32 stream segments totaling 444.9 miles that are impaired because of siltation/turbidity where surface erosion is identified as the source.</p>
PRIORITIES
<p>The ultimate goal is to reduce surface erosion and sedimentation from rural roads and recreational trails, construction activities (not covered by NPDES permits) and other land use activities, as well as in-stream erosion/hydromodification through public awareness, education, training and other voluntary programs to a point where it is not causing impairment of the waters of the state.</p>

Table 7.2. PROGRAM LOGIC MODEL – Surface Erosion (cont.)

INPUTS	OUTPUTS		OUTCOMES		
	Activities	Participants	Short-term	Medium-term	Long-term
<ul style="list-style-type: none"> – BMP manuals – ANRC staff – ADEQ staff – AGFC staff – UA Cooperative Extension staff – Gauging Stations – GIS data – US Forest Service hydrological data – Nature Conservancy flow model – Regional discharge curves 	<ul style="list-style-type: none"> – Compile and analyze current road conditions and usage – Public awareness, education and training programs – Review available BMP manuals for low-volume and unpaved roads – Estimate quantity of soil loss using water erosion prediction models – Update and modify BMP manuals – Develop models to be used to estimate sediment reduction from restoration projects 	<ul style="list-style-type: none"> – Various local watershed entities – Landowners – Developers – ATV owners and other recreationists – ANRC – ADEQ – AGFC – County road crews – UA Cooperative Extension staff 	<ul style="list-style-type: none"> – Better knowledge of how sediment pollutes waterways – Better grasp of how drainage designs affect sediment deposits – Changing attitudes and behavior for homeowners, landowners and recreationists to the causes of erosion and settling of sediment 	<ul style="list-style-type: none"> – Prioritize stream reaches and sites for restoration within priority watersheds – Shift focus from bank stabilizing to restoration – Secure new sources of funding – Begin using watershed-based assessment protocol – Federal and state programs cooperate in priority areas of the state, where water quality problems have been identified 	<ul style="list-style-type: none"> – Reduce surface erosion and instream erosion to reduce impairment of the waters of the state – Reduce pollution of waterbodies by water quality constituents by sediment movement – Reduce funds spent on pollution control for watersheds

ASSUMPTIONS	EXTERNAL FACTORS
<ol style="list-style-type: none"> 1. Activities such as resource extraction, instream construction and dredging can introduce fine sediment by dislodging of sediments, making it available for transport in the stream. 2. Factors influencing the movements of nutrients to water bodies include precipitation, temperature, soil type, kind of vegetation, nutrient mineralization, denitrification, distance to waterbodies, percent of vegetative cover and the presence and size of riparian buffers. 3. Pesticides, fertilizers, pathogens and their degradation products may enter ground and surface water in solution, in emulsion or bound to soil colloids. 	<ol style="list-style-type: none"> 1. Political climate including political changes. 2. Budget cuts. 3. Legislative changes (laws) including TMDLs. 4. Lobbyists on permitting changes. 5. Additional funding partners. 6. Lawsuits. 7. Increased NPDES construction regulation with next permit cycle.

Program Tracking and Evaluation

The surface erosion statewide management can be tracked and evaluated on three levels: short-term inputs, intermediate processes and long-term outcomes.

The program will track program activities such as the number of participants in education and training programs, the number of fact sheets developed and the number of newspaper articles, brochures or other materials that are distributed. In addition, the program can maintain an informal inventory of assessments and restoration projects in planning, underway and completed among cooperating entities. These input measures track effort expended, which is a first and necessary step toward affecting change.

Timeline for Milestones: October 2011 through September 2016

The second measure of the program focuses on whether program activities result in behavioral changes (i.e., BMP implementation).

Currently, there are no systematic mechanisms for measuring behavioral change. Given the wide-ranging sources of surface erosion, measuring behavioral change will need to be project specific. For example, to evaluate behavioral change after training county road crews to reduce erosion from unpaved roads, a survey could be conducted to determine the miles of roads paved with alternate materials and the miles of ditch maintained by alternative methods as a result of the training. Similar follow-up surveys could be constructed as a component of training for construction contractors.

Modeling may be used to estimate sediment reduction from restoration projects. The success of hydromodification projects in restoring fisheries can be measured through documenting changes in biological communities with various biological assessment protocols and matrices. The extent of intact riparian zone vegetation can be interpreted by GIS analysis land use and hydrography. Arkansas updates land use coverage approximately every five years, which creates the opportunity for periodic evaluation of riparian zones in priority watersheds. Where practical and cost effective, ANRC will require grantees to describe how they will measure behavioral change in their project requests.

Timeline for Milestones: October 2011 through September 2016

The ultimate measure of the program is whether or not streams are removed from ADEQ's List of Impaired Waterbodies. The desired evaluation outcome is that

surface erosion will not be listed as a primary or secondary source contributing to impairment in future impaired waterbodies lists.

Timeline for Milestones: October 2011 through September 2016

Brief Description of Institutional Context

Rural Roads and Recreational Trails

County judges and their respective road maintenance departments are responsible for construction and maintenance of roads in unincorporated areas of their counties. The USDA Forest Service (USFS) maintains BMPs for construction of forestry roads in national forests. AFC has developed voluntary BMP guidelines for private and industry use including construction of forest harvest roads and monitors and reports on compliance with those guidelines biennially. The Arkansas Conservation Partnership and the University of Arkansas have cooperated to develop and deliver rural road maintenance training programs in some regions of the state. The Arkansas Water Resources Center is currently conducting research on the impact of rural roads in the West Fork of the White River.

Construction

ADEQ regulates construction sites one acre or greater and smaller construction sites that are a part of a common plan (e.g., a subdivision). In collaboration with regional planning commissions, the University of Arkansas Division of Agriculture Cooperative Extension Service is working with communities subject to Phase II small municipal separate storm sewer systems (MS4s) NPDES permit requirements to help conduct construction education and technical assistance programs in Northwest Arkansas and the Pine Bluff area.

Instream Erosion

Stream restoration and design has become an increasingly important activity in both the public and private sectors for minimizing NPS pollution. Nonprofit organizations, higher education institutions and municipalities provide technical assistance and help secure funding for surface erosion assessment, restoration and education opportunities.

Instream gravel mining is regulated by ADEQ under Regulation No. 15.

The USACE regulates direct changes of a stream channel. Section 404 of the Federal Water Pollution Control Act (FWPCA) establishes a permit program, administered by the Secretary of the Army, acting through the Chief of Engineers. USACE reviews project plans and issues permits for altering stream channels. ADEQ also reviews project plans and must issue certification short-term activity authorization permit before USACE can issue a 404 permit.

The Arkansas Game and Fish Commission implemented a Stream Teams Program in 1996. Stream Teams are groups of residents who form or join a team and adopt a stream or other waterbody in the state for the purpose of keeping it clean and healthy. There are now more than 500 Stream Teams statewide that carry out a variety of activities including litter pickups, repair of eroding streambanks on willing owners' lands and tree plantings to restore degraded riparian areas. They also work with local leaders to better manage their watersheds and a variety of other activities aimed at conserving the natural resource.

To the extent possible, coordinators incorporate natural channel design techniques to maximize aquatic and terrestrial habitat restoration. AGFC assists with implementation costs through their Stream Team mini-grants. Along with private landowners, groups that have provided funding include the Multi-Agency Wetlands Protection Team (MAWPT), Conservation Districts, the U.S. Department of Agriculture Natural Resources Conservation Service (NRCS), USFS, ANRC and municipalities.

ADEQ has provided assessment data, project review and technical assistance in the area of stream stability and restoration designs. ADEQ developed erosion prediction curves for the West Fork of the White River and used assessment methodologies to estimate sediment loading rates from lateral streambank erosion. ADEQ has also used assessment data to prioritize sites for restoration. ADEQ collected geomorphological data at several USGS gauge station sites to develop Ozark regional discharge curves and collected reference reach data to develop reference reach geometry curves.

NRCS has provided technical assistance and cost-share, through its EQIP program, for stream stabilization projects. The NRCS National Water Management Center has been working with ANRC to collect geomorphological data at USGS gauge station sites in the Ouachita Mountains to develop regional discharge curves. The national NRCS office also provides technical assistance in the area of natural channel design for stream restoration.

Through its Environmental Division, the Arkansas State Highway and Transportation Department (AHTD) provides multidisciplinary review and analysis of project development and operations to ensure compliance with environmental laws, regulations and policies. NPS-related activities routinely undertaken include geographic information systems analysis, wetland impact assessments and stormwater permitting. In addition, the division monitors water quality and implements wetland mitigation property management strategies. AHTD maintains a manual of best management practices for construction stormwater management and provides training to its contractors and staff on BMPs. More information about AHTD's role in NPS reduction and abatement is in the road construction and maintenance section of the plan.

The ANRC provides technical and financial assistance for streambank stabilization, sediment reduction projects and prevention initiatives. In addition, ANRC is cooperating with the National Water Management Center on the development of Ouachita Mountain regional stream geometry curves. Upon completion of the Ouachita Mountain curves, ANRC will focus on developing regional discharge hydraulic geometry curves for another ecoregion in the state. ANRC provides training opportunities in the state on stream restoration.

Several nonprofit organizations provide technical assistance and help secure funding for assessment, restoration and education opportunities. Watershed assessment projects that were conducted resulted in erosion prediction curves for sub-watersheds of the Illinois River and Upper Saline River. Also, a regional education program, Mid-South Watershed Training Program (MSWTP), was started. The program, funded by EPA's national office, includes training for environmental professionals and watershed coordinators in the area of applied fluvial geomorphology, watershed assessment and natural channel design for reach restoration. Audubon Arkansas, The Nature Conservancy and the Upper White River Foundation (UWRF) have all partnered in support of the training program.

The Nature Conservancy conducted a watershed assessment in northeastern Arkansas, with the assessment resulting in erosion prediction curves in the Delta. Audubon Arkansas was granted EPA funding to perform geomorphological assessment work and for reach restoration on College Branch inside the city limits of Fayetteville.

Cooperating Entities

Cooperating entities are listed and described in the cooperating entities section of the 2011-2016 NPS Pollution Management Program Update.

Federal Consistency

Rural Roads

The principal federal agency involved with construction of unpaved roads in Arkansas is USFS. AFC works with USFS and reviews the Forest Services' forest management plans for consistency.

Construction

ADEQ will be responsible for working with federal partners as needed to ensure federal consistency as it relates to construction.

Instream Erosion

ANRC will work with NRCS and other federal agencies to seek federal consistency for the instream erosion program. The NRCS national office is revising its stream corridor and restoration manual to focus on reach restoration, instead of bank stabilization, and to provide consistent stream restoration design criteria that enhances aquatic and terrestrial habitat.

Common Best Management Practices

Roads

Forestry Road BMPs: Individuals responsible for construction and/or maintenance of forest roads should refer to the silviculture section of this plan for forest road management measures and BMPs.

Non-forestry unpaved road management measures and BMPs were adapted from The Massachusetts Unpaved Road BMP Manual, the AFC BMP Manual, and TNC's Road Maintenance Manual.

Road Surfaces

Unpaved roads generally carry local traffic between rural lands and towns and provide connecting links between paved collector roads. In many rural areas, much of the local road system has an unpaved/gravel surface that requires routine maintenance. The top layer of gravel on these roads must be shaped,

compacted and smoothed to ensure a good riding surface and to allow runoff to move quickly from the road surface to established drainageways.

Surface water that is not effectively conveyed from the road surface to a drainage channel can result in deterioration of the road surface and various erosion problems. Immediate removal of runoff from the road surface will prevent many of the problems associated with surface deterioration. This will lengthen the life of the road surface, as well as lessen maintenance frequency and costs. It will also decrease the amount of sediment carried by road runoff into waterways.

Ditches

Ditches are used to convey water from storm runoff to an adequate outlet without causing erosion or sedimentation. They are ideal for collecting and dispersing surface water in a controlled manner. A good ditch design incorporates and requires proper shaping and lining (using the appropriate vegetative or structural material) and maintenance. Constructed properly, ditches will remove runoff quickly and reduce seepage into the road subgrade.

Well-designed ditches provide an opportunity for sediments and other pollutants to be removed from runoff water before it enters surface waters or groundwater. Ditches work by controlling, slowing and filtering road runoff through vegetation or rock lining. Efficient removal of runoff from the roadway will help preserve the roadbed and banks. A stable ditch will not become an erosion problem itself.

Culverts

A culvert is a closed conduit used to convey water from one area to another, usually from one side of a road to the other side. Culverts preserve the road base by draining water from ditches along the road, keeping the sub-base dry. Culvert installation is a simple operation, yet it is a process that is notorious for being done incorrectly and haphazardly. Proper installation and routine maintenance are necessary to ensure the safety of the roadway.

Properly placed culverts along paved or unpaved roads will help alleviate ditch maintenance problems by outletting water in a timely manner. Significant erosion problems can develop at the outlets of culverts if they have not been properly designed or installed. Placing culverts and other outlets based upon road slope will control volume and velocity of discharges, reducing erosion and undermining and preventing

sediment from entering surface waters. Culverts can act as barriers to fish migration and movement, and dozens of them have had to be retrofitted in the national forests to minimize the drop at the outflow and the extremely high velocities in the pipe. The USFS has BMPs for culverts in streams that are large enough to have significant fish populations (Standage, 2005).

Outlet Protection

Outlet protection is important for controlling erosion at the outlet of a channel or culvert. Outlet protection works by reducing the velocity of water and dissipating the energy. Protections should be installed at every pipe, culvert, swale, diversions or other water conveyances where the velocity of flow may cause erosion at the pipe outlet and in the receiving channel. There are a number of outlet structures that can be used in a variety of situations. Several types of outlet protection techniques are detailed below.

Outlet structures reduce the velocity of water carried by road ditches and culverts, therefore helping to control erosion and limit sedimentation. After passing through an outlet structure, water should outlet to areas with moderate slopes and vegetative filter zone before entering surface waters. This type of outlet, often referred to as daylighting, will allow for most of the sediments and other pollutants to be removed before runoff enters surface waters.

Bank Stabilization

Bank stabilization is the vegetative or structural means used to reduce or prevent erosion or failure of any slope. Erosion occurs when soil particles at the bank's surface are carried away by wind, water, ice or gravity. It can also be caused by stream currents and waves, obstacles in a stream, overbank drainage, heavy rainfall on unprotected land, freeze-thaw and dry cycles, seepage and changes in land use. Bank failure occurs when an entire section of the bank slides to the toe of the slope. It can be caused by an increase of load on top of the bank, swelling of clays due to absorption of water, pressure of groundwater from within the bank, minor movements of the soil and changes in stream channel shape.

Stabilization of banks along roads and streams will prevent erosion and failure, both of which may contribute considerable amounts of sediment to surface waters. Preventing erosion and bank failure can also alleviate the need for expensive road repairs. Because such work may involve anything from vegetative plantings to complex construction of stone walls and rip-rap slopes, it is often difficult to determine what, if

anything, needs to be done. Care should be taken when choosing a method. There are a number of trained biologists, hydrologists and engineers in public and private agencies who can provide technical assistance on bank stabilization in Arkansas, including AGFC, ANRC, ADEQ, TNC, NRCS, USACE, the U.S. Fish and Wildlife Service and others.

Sediment Control

Erosion occurs when individual soil particles are carried away from the road surface, ditch or road base by water, wind, ice or gravity. These soil particles are often transported by runoff to streams, ponds and lakes where they can alter the water chemistry, affecting the quality of water and fish habitat. Sediments can impact surface water ecosystems by adding excess nutrients that deplete oxygen supplies. This can lead to smothering of spawning and the feeding habitat of fish and contaminating drinking water supplies. By using BMPs and following accepted guidelines, erosion from roadways and road-related projects can be controlled.

Construction

Comprehensive best management practices can be found at the following and other sites:

- *California Construction BMP Handbook*, www.cabmphandbooks.com.
- Field, Jerald S. (2001). *Designing for Effective Sediment and Erosion Control on Construction Sites*. Forrester Press.
- *2009 Erosion and Sediment Control Design and Construction Manual*, Arkansas State Highway and Transportation Department www.arkansashighways.com/stormwater/erosion_sediment_manual.aspx.

Instream Erosion

Restoration Approach and Prevention:

Addressing unintended hydromodification resulting from land use changes and stream alteration requires a holistic approach in which entire reaches of stream instability are evaluated and restoration designs are developed that will address not only streambank erosion but aggradation or degradation. Habitat restoration should also be considered when developing a reach restoration design. Restoration designs include a multitude of factors and contain specified BMPs. In general, restoration designs should be based on an assessment of the stream's ability to transport its flow and sediment, while maintaining its dimension, pattern and profile. Reach restoration BMPs will include

installation of grade control structures and rock veins, development of bankfull benches and reestablishing riparian areas. Other approaches that could foster interest in restoration include:

- encouraging the development of riparian buffer conservation easements through nonprofit organizations and local source water protection programs;
- encouraging government agencies and nonprofit organizations to include streambank and other stream restoration techniques as elements of their conservation easement programs;
- conducting an evaluation of stream restoration projects that have been implemented in the state and report on successes and failures; and
- using the ANRC's wetland and riparian zone tax credit program to help finance streambank restoration projects. At this time, these programs are not funded and, therefore, cannot finance restoration.

Demonstrate off channel gravel mining techniques. In priority watersheds, identify road crossings that are causing geomorphic changes in streams and develop alternatives for crossing. Research and demonstrate practices that hydraulically disconnect impervious areas from streams (low impact development practices, bioretention swales, water gardens, etc.).

References Cited

- Arkansas Department of Environmental Quality: North Little Rock, Ark. 2006 List of Impaired Waterbodies (303(d) List). www.adeq.state.ar.us/water/branch_planning/pdfs/303d_list_2006.pdf.
- Arkansas Department of Environmental Quality: North Little Rock, Ark. 2008 List of Impaired Waterbodies (303(d) List). www.adeq.state.ar.us/water/branch_planning/pdfs/303d_list_2008.pdf.
- Arkansas Department of Environmental Quality: North Little Rock, Ark. Authorization to Discharge Stormwater Under the National Pollutant Discharge Elimination System and the Arkansas Water and Air Pollution Control Act. www.adeq.state.ar.us/water/branch_permits/general_permits/stormwater/construction/pdfs/ARR150000_permit.pdf.
- Arkansas Forestry Commission: Little Rock, Ark. *Voluntary Forestry Best Management Practices for Water Quality Protection in Arkansas: Results of the 2007-2008 BMP Implementation Survey*. <http://forestry.arkansas.gov/Services/ManageYourForests/Documents/OnlineBMPImplementationReport0708.pdf>.
- Arkansas State Highway and Transportation Department: Little Rock, Ark. 2007 Annual Report of the Arkansas Highway and Transportation Department. www.arkansashighways.com/annual_report/annual_reports.aspx.
- Arkansas State Highway and Transportation Department: Little Rock, Ark. 2008 Annual Report of the Arkansas Highway and Transportation Department. www.arkansashighways.com/annual_report/annual_reports.aspx.
- Arkansas State Highway and Transportation Department: Little Rock, Ark. 2009 Annual Report of the Arkansas State Highway and Transportation Department. www.arkansashighways.com/annual_report/annual_reports.aspx.
- Arkansas State Highway and Transportation Department: Little Rock, Ark. 2009 Erosion and Sediment Control Design and Construction Manual. www.arkansasinterstates.com/stormwater/content/E%20SC%20Manual%2004%2030%2009.pdf.
- Bureau of Economic Analysis: Washington, D.C. www.bea.gov.
- Formica, S. J., M. A. Van Epps, M. A. Nelson, A. S. Cotter, T. L. Morris and J. M. Beck, 2004. West Fork White River Watershed-Sediment Source Inventory and Evaluation. Sustaining Solutions for Streams, Wetlands and Watersheds proceedings of the September 2004 conference ASAE. St. Joseph, Mich., pages 125-132.
- Moscow Forestry Sciences Laboratory: Idaho. <http://forest.moscowfsl.wsu.edu>.
- Natural Resources Defense Council: New York, N.Y. 2001 How to Clean Up Our Water: Twelve Simple Ways You Can Help Stem the Tide of Polluted Runoff. www.nrdc.org/water/pollution/gsteps.asp.
- Transport of Pathogens From Fecal Sources to Beaches and Drinking Water. http://cws.msu.edu/documents/Factsheet5_transport.pdf.
- Watershed Conservation Resource Center: Fayetteville, Ark. <http://watershedconservation.org/proj.html>.

Section Eight(a)

Road Construction and Maintenance Statewide Programs

Introduction

Regulatory oversight exists for road construction in many instances. Road construction projects that affect one acre or more must receive a National Pollutant Discharge Elimination System (NPDES) permit, which is issued by the Arkansas Department of Environmental Quality (ADEQ). When road construction may affect the quality of a waterbody, Section 404 and Section 401 permits from the U.S. Army Corps of Engineers (USACE) and ADEQ may need to be obtained. Finally, drilling pad construction and pipeline rights-of-way are permitted components of resource extraction permits issued by the Arkansas Oil and Gas Commission.

Road construction, road maintenance, recreational vehicle road and trail use and heavy equipment use of rural roads have been identified as threats to water quality. State highway construction projects are regulated under both the National Environmental Protection Act (NEPA) and the NPDES Construction Stormwater Permit program administered by ADEQ. Significant types of road construction remain unpermitted, exempted from stormwater protection rules and a source of nonpoint water quality degradation concern.

The local impact of sediment from timber harvesting and unregulated road construction on water quality can be significant when Best Management Practices (BMPs) are not followed, especially in smaller headwater streams. Gravel, dirt and other types of roads are considered to be the major source of erosion from forested lands, contributing up to 90 percent of the total sediment production from forestry operations, according to studies (Rothwell, 1983).

These effects are of greatest concern where forestry activity occurs in high-quality watershed areas that provide municipal water supplies or support fisheries. Use of rural roads by heavy trucks involved in resource extraction take a toll on roadway integrity, resulting in significant potential for erosion and sediment impacts on receiving streams. Roads constructed and maintained without use of recommended BMPs, especially those with steep gradients, deep cut-and-fill sections, poor drainage, erodible soils and poorly or improperly constructed road-stream crossings, contribute to most of this sediment load, with road stream crossings being the most direct source of erosion and sediment.

Improperly installed or undersized culverts increase energy in stormwater delivered to receiving streams, resulting in increased headcutting and streambank destabilization. This adds significant sediment loads, especially in flashy upland headwater stream circumstances. While ADEQ's 2008 List of Impaired Waterbodies does not indicate any stream segments or waters identified with road construction (RC) as the cause, there were several segments listed with siltation/turbidity (SI) as the cause of impairment with the source being unknown (UN).

Water Quality/Program Goals

Roads, highways and bridges are sources of significant contributions of pollutants to our nation's waters. Contaminants from vehicles and activities associated with road construction and maintenance are washed from roads and roadsides when it rains or snow melts. Road construction and maintenance that is not required to follow or do not adequately follow NPDES permitting requirements may cause a further discharge of pollutants into waterbodies.

Runoff controls are essential to preventing polluted runoff from reaching surface waters. Construction and maintenance projects that do not install or adhere to proper BMPs and erosion controls during and after construction of roads, highways and bridges can contribute large amounts of sediment and silt to runoff waters. This sediment can deteriorate water quality and lead to fish kills and other ecological problems. Heavy metals, oils, toxic substances and debris from construction traffic and spillage can be absorbed by soil at poorly maintained construction sites and carried off in runoff water to lakes, rivers and other waterbodies.

Runoff control measures can be installed before construction starts to reduce runoff pollution both during and after construction. Such measures can effectively limit the entry of pollutants into surface waters and groundwaters and protect their quality, fish habitats and public health. Pesticides and fertilizers used along rights-of-way and adjoining land can pollute surface waters and groundwater when they filter into the soil or are blown by wind from the area where they are applied.

Road Construction and Maintenance Logic Model

As mentioned previously, teams that did the initial research to prepare the NPS Pollution Management Plan also created logic models for each section to better plan how program goals would be achieved. The team discussed long-term, medium-term and short-term behavior changes it hoped to cause through the NPS Management Plan and what actions would be most effective to achieve those changes.

The team believes there is a need for education and implementation of BMPs and/or regulatory oversight of road construction and maintenance activities that could pose a threat to water quality in high-quality watershed areas.

For the long term, the team would like to see a significant reduction in noncompliance enforcement activities and in development and construction's impact on waterbodies. This would mean full compliance with all environmental laws, regulations and policies. Another long-term change would be for all cities and counties to have an effective stormwater management plan in place.

Before that can happen, BMPs must be implemented appropriately and training should be provided for contractors on BMPs and their role in maintaining water quality. Ultimately, cities and counties would have to develop or improve stormwater management plans. Those plans, or a master plan for new road construction, could provide information on how to avoid water pollution.

Plans could be developed, but only after there is an increase in awareness of water pollution from road construction and maintenance activities. Clients need to be educated about the use of BMPs and the importance of water quality and quantity. It may prove helpful to evaluate county and city road department standard practices for stormwater management or to review projects for noncompliance.

A successful road maintenance and construction program would involve contractors from the timber industry and road and highway construction industry. Policy makers, watershed groups, road department staff, nature conservancies and land managers should also be involved in any outreach or training.

Staff from various state agencies should hold workshops, industry meetings and field days for participants. Fact sheets and newsletters should also be prepared on the subject, as well as efforts made to reach

the news media to broadcast important information or meeting notices. It is also important to gauge stakeholders' interest and reaction to methods through stakeholder input meetings.

These activities will require time and effort from staff of ADEQ, ANRC, AFC, USFS, AGFC and the AHTD. It would also require input from the Farm Bureau, University of Arkansas Division of Agriculture attorneys, watershed volunteers and local governments.

All this would be done assuming that regulatory oversight is not in place for all road construction and maintenance activities in the state and that there is a lack of knowledge of BMP use by contractors. Water quality is also taken for granted by many people, but there is an assumption that there is general interest in water quality/quantity.

The logic model team believed external factors could also influence the outcome of any efforts, including lobbying against regulation policies by groups, economic conditions, the weather or an increasing demand for water.

Long- and short-term programmatic objectives for the elements of this statewide program are given below. The Program Logic Model (Table 8a.1) begins after objectives and milestones.

Objectives and Milestones

8(a).1. Reduce the impact that development and construction have on waterbodies.

Timeline for Milestones: October 2011 through September 2016

8(a).2. Continue to collaborate with the Arkansas State Highway and Transportation Department's Environmental Division to ensure compliance with environmental laws, regulations and policies.

Timeline for Milestones: October 2011 through September 2016

8(a).3. Continue to collaborate with AHTD, which maintains a manual of BMPs for construction stormwater management and provides training to its contractors and staff on BMPs.

Timeline for Milestones: October 2011 through September 2016

8(a).4. Continue to ensure the most current List of Impaired Waterbodies does not indicate any stream segments or waters identified with Road Construction (RC) as the cause.

Timeline for Milestones: October 2011 through September 2016

Table 8a.1. PROGRAM LOGIC MODEL – Road Construction and Maintenance

SITUATION					
Some areas of road construction and maintenance are not permitted, are exempt from stormwater rules or BMPs aren't implemented and are a potential threat of nonpoint water quality degradation.					
PRIORITIES					
There is a need for education and implementation of BMPs and/or regulatory oversight of road construction and maintenance activities that could pose a threat to water quality in high-quality watershed areas.					
INPUTS	OUTPUTS		OUTCOMES		
	Activities	Participants	Short-term	Medium-term	Long-term
<ul style="list-style-type: none"> – Time – ADEQ staff – Farm Bureau – ANRC staff – UA Division of Agriculture – Watershed volunteers – UA attorneys – U.S. Geological Survey – NRCS staff – Media – AFC staff – U.S. Forest Service staff – AGFC staff – AHTD – County judges – City government 	<ul style="list-style-type: none"> – Workshops – Timber industry meetings – Field days – News articles – Television spots and programs – Radio programs – Fact sheets and newsletters – Citizen input meetings – Current BMP handbook 	<ul style="list-style-type: none"> – Timber contractors – Road and highway contractors – Policy makers – Watershed groups – Highway department – County road departments – City street departments – TNC – Land managers 	<ul style="list-style-type: none"> – Increase the awareness of water pollution from road construction and maintenance activities – Increase knowledge and use of BMPs – Educate clients on importance of water quality and quantity – Evaluate county and city road department standard practices for stormwater management – Review road construction and maintenance projects for noncompliance letters for minor and major violations and summarize the structural BMP deficiencies associated with the noncompliance 	<ul style="list-style-type: none"> – Use appropriate BMPs – Develop master plan for new road building that addresses means to avoid water pollution – Provide training for contractors on BMPs and maintaining water quality – Develop and improve stormwater plans for county and city road departments – Develop training programs that address deficiencies that resulted in enforcement activities – Develop a field guide for structural BMPs for road building 	<ul style="list-style-type: none"> – Reduction in impact of development and construction on state's waterbodies – Periodic monitoring for success – Full compliance with all environmental laws, regulations and policies – All cities and counties will have an effective stormwater management plan in place – Reduction in noncompliance enforcement activities

Table 8a.1. PROGRAM LOGIC MODEL – Road Construction and Maintenance (cont.)

ASSUMPTIONS	EXTERNAL FACTORS
<ol style="list-style-type: none"> 1. There are nonpoint source threats to the state's water quality. 2. Regulatory oversight is not in place for all road construction and maintenance activities in the state. 3. There is a lack of knowledge of BMP use by contractors. 4. Water quality is taken for granted by many people. 5. General interest in water quality/quantity. 	<ol style="list-style-type: none"> 1. Politics or lobbying against regulation policies by groups. 2. Economic conditions. 3. Increasing demand for water. 4. Weather.
EVALUATION PLAN	
<p>Monitor water quality before and after implementation of new road construction and maintenance policies and BMPs. Conduct monitoring and reporting over a five-year period. Evaluate to determine if a reduction in major and minor violations has occurred. Evaluate BMP utilization on non-regulatory road construction and maintenance projects.</p>	

Cooperating Entities

Cooperating entities are listed and described in the cooperating entities section of the 2011-2016 NPS Pollution Management Plan.

Federal Consistency

Federal consistency is not anticipated to be an issue with this statewide program. If there are federal consistency issues, the Arkansas Department of Health and/or ADEQ will work with the relevant federal agency to achieve consistency.

Contaminants in Runoff Pollution from Roads, Highways and Bridges

Oils and Grease

Oil and grease can leak onto road surfaces from car and truck engines, be spilled at fueling stations or be discarded directly onto pavement or into storm sewers instead of being taken to recycling stations.

Heavy Metals

Heavy metals come from some natural sources such as minerals in rocks, vegetation, sand and salt. They also come from weathered paint, rust, worn tires and engine parts, car and truck exhaust and brake linings. Heavy metals are toxic to aquatic life and can potentially contaminate groundwater.

Deicing Materials

Deicing materials can be a major pollutant. Snow runoff containing deicing materials may concentrate in waterbodies and potentially degrade water quality.

Fertilizers, Pesticides and Herbicides

If fertilizers, pesticides or herbicides are applied improperly or in excess, they can be carried by rainwaters from rights-of-way. In rivers, streams, lakes and other waterbodies, fertilizers contribute to algal blooms and excessive plant growth and can lead to eutrophication. Pesticides and herbicides can be harmful to human and aquatic life.

Common Best Management Practices

The U.S. Environmental Protection Agency (EPA) has developed a list of general maintenance BMPs. A variety of practices are used at construction sites to control both erosion and polluted runoff. These are identified as Construction Site BMPs. Practices developed as permanent erosion and sediment-control devices are both structural and nonstructural. Several of these BMPs are listed below as long-term or Permanent Control BMPs (EPA, 1995).

Construction Site BMPs

- Straw bale barriers should be bound, entrenched, and securely anchored to prevent deterioration. A row of straw bales slows runoff flow and creates a

pond behind the barrier where sediment can settle out. Straw bale barriers are most effective for filtering low to moderate storm flows, where structural strength is not required.

- Filter fabrics are engineering fabrics designed to retain sediment particles larger than a certain size and allow water to pass through. Filter fabrics can be used in silt fences (see below) or erosion control mats. Erosion control mats protect soil and seed from erosion and can be designed to allow vegetation to grow through the material.
- Silt fences are vertical fences of filter fabric stretched across and attached to support poles. The fabric retains sediment on the construction site and allows relatively sediment-free water to pass through. Silt fences are placed to protect streams and surrounding property from sediment-laden runoff.
- Sediment basins are ponds created by excavation or the construction of a dam or barrier. Sediment basins primarily serve to retain or detain runoff to allow excessive sediment to settle out during construction. Sediment basins can be converted into permanent detention ponds or wetlands after construction.
- Stabilized entrances reduce the amount of sediment carried off a construction site by vehicles when pressure-washed on site. These entrances are designed to include stabilized pads of aggregate underlain with a filter fabric. Stabilized construction site entrances should be located at any point in the construction zone where vehicles enter and leave. Wheels and undercarriages of vehicles should be washed before leaving the site.

Operation and Maintenance BMPs

Inspection and maintenance of erosion and sediment-control BMPs, both during and after construction, are important to ensure that the BMPs are operating properly and effectively.

- Prepare and adhere to a schedule of regular maintenance for temporary erosion and runoff control BMPs. Two critical maintenance operations that must be performed regularly are cleaning out accumulated sediment and replacing worn-out or deteriorated materials, such as silt fence fabrics, so that the effectiveness of the controls is maintained. Maintenance can include dredging and reshaping sediment basins and revegetating the slopes of grassed swales.

- Remove temporary BMPs from construction areas when they are no longer needed and replace them, where appropriate, with permanent BMPs.
- Schedule and periodically inspect and maintain permanent erosion and runoff controls. This should include a periodic visual inspection of permanent BMPs during runoff conditions to ensure that the controls are operating properly.
- Clean, repair and replace permanent erosion and runoff control BMPs when necessary.

General Maintenance BMPs

- Seeding with grass and fertilizing to promote strong growth provides long-term stabilization of exposed surfaces. Disturbed areas can be seeded and fertilized during construction and after construction is completed. Sufficient watering and refertilizing 30 to 40 days after the seeds germinate help establish dense growth.
- Seeding with grass and overlaying with mulch or mats is done to stabilize cleared or freshly seeded areas. Types of mulches include organic materials, straw, wood chips, bark or other wood fibers, or decomposed granite and gravel. Mats are made of natural or synthetic material and are used to temporarily or permanently stabilize soil.
- Wildflower cover has been successfully used by many state and county highway departments to provide attractive vegetation along roadways and erosion control. Careful consideration must be given to visibility, access, soil condition, climate and maintenance when choosing sites for wildflower cover.
- Sodding with established grass blankets on prepared soil provides a quick vegetative cover to lessen erosion. Proper watering and fertilizing are important to ensure the vitality of newly placed sod.

Permanent Control BMPs

- Grassed swales are shallow, channeled grassed depressions through which runoff is conveyed. The grass slows the flow of runoff water, which allows sediment to settle out and water to infiltrate into the soil. Grassed swales can remove small amounts of pollutants such as nutrients and heavy metals. Check dams (see page 117) can be added to grassed swales to further reduce flow velocity and promote infiltration and pollutant removal.

- Filter strips are wide strips of vegetation located to intercept overland sheet flows of runoff. They can remove organic material, sediment and heavy metals from runoff. Filter strips can consist of any type of dense vegetation from woods to grass, but they cannot effectively treat high-velocity flows. They are, therefore, best suited to low-density developments.
- Terracing breaks a long slope into many flat surfaces where vegetation can become established. Small furrows are often placed at the edge of each terraced step to prevent runoff from eroding the edge. Terracing reduces runoff velocity and increases infiltration.
- Check dams are small, temporary dams made of rock, logs, brush, limbs or another durable material placed across a swale or drainage ditch. By reducing the velocity of storm flows, sediment in runoff can settle out and erosion in the swale or ditch is reduced.
- Detention ponds or basins temporarily store runoff from a site and release it at a controlled rate to minimize downstream flooding. Well-designed basins are highly effective pollutant removal tools. Effectiveness is greatest for suspended sediments (80 percent or more removal) and related pollutants such as heavy metals.
- Infiltration trenches are shallow, 3- to 8-feet deep (.91 to 2.44 m) excavated trenches that are backfilled with stone to create underground reservoirs. Runoff is diverted into the trenches, from which it percolates into the subsoil. Properly designed infiltration trenches effectively remove sediment from runoff and can remove some other runoff pollutants.
- Infiltration basins are relatively large, open depressions produced by either natural site topography or excavation. When runoff enters an infiltration basin, the water percolates through the bottom or the sides and the sediment is trapped in the basin. The soil where an infiltration basin is built must be permeable enough to provide adequate infiltration. Some pollutants other than sediment are also removed in infiltration basins.
- Constructed wetlands are areas inundated by water for a sufficient time to support vegetation adapted for life in saturated soil conditions. Wetlands effectively filter sediment, nutrients and some heavy metals from runoff waters.

BMP Implementation Surveys conducted by the Arkansas Forestry Commission (AFC) indicate that practitioners should focus more attention on

implementing forest road BMPs. Below are several BMPs developed by AFC.

Road Location/Planning

Use soil surveys, aerial photographs, topographic maps or site visits to plan road locations to protect water quality. Design roads to minimize stream crossings. Where stream crossings are required, cross at right angles to the stream, locate roads along the contour or along the crest of long ridges and maintain sufficient distance between the road and the Streamside Management Zones (SMZs) to allow right-of-way maintenance.

Road Construction

Use at least the minimum design standard that provides a road sufficient to carry the anticipated traffic load with minimum environmental damage. Remove timber from rights-of-way and deck it outside SMZs. Design roads no wider than necessary. Balance cuts and fills to minimize excess excavated material. Place side-cast or fill material above the ordinary high-water mark of any stream except where necessary to stabilize stream crossings. Plan and conduct work so water quality is protected during heavy rain. When needed, use seeding and mulching in a timely manner to reduce erosion. Implement appropriate BMPs during road construction.

Outslope the entire width of the road where road gradient and soil type permit. Use cross drainage on insloped or crowned roads to limit travel distance of runoff water. Where roads are insloped or crowned and gradients begin to exceed 2 percent for more than 200 feet, broad-based dips or rolling dips should be placed within the first 25 feet of the upgrade.

Road bank cuts normally should not exceed 5 feet in height, should be sloped and the soil stabilized to prevent erosion. Cuts may need to be fertilized, limed, seeded and mulched to establish cover.

Road Maintenance

Crown or outslope the road surface to disperse surface runoff and minimize erosion of the roadbed. Keep wing ditches free of blockages, and keep culverts open and clean to allow unrestricted passage of water. Revegetate or stabilize erodible areas where natural vegetation is not sufficient to stabilize the soil. Minimize traffic on roads during wet conditions. Consider using geomat or rock to reduce road damage. Periodically inspect roads to see if BMPs remain effective. Reestablish vegetation as needed. Minimize traffic following maintenance work on sensitive road sections to allow them to stabilize. Keep roads free of obstructions to allow free flow of water from the road to the forest floor. Rework roads if road conditions deteriorate and may harm water quality.

Road Drainage

Ensure good road drainage with a combination of properly constructed and spaced wing ditches, broad-based dips, rolling dips, culverts and bridges. Wing ditches should be constructed so water will be dispersed and not cut channels across the SMZ. At cross drains (culverts or dips), install rip-rap or other devices at outlets to absorb and spread water. Use brush barriers or check dams along road fill areas or other sensitive areas. Install ditches, culverts, cross drains and wing ditches at low points in the road. Use crowning, ditching, culverts and/or outsloping to drain roads naturally. Provide cross drainage on tempo-rary roads. Provide outfall protection if cross drains, relief culverts and wing ditches discharge onto erodible soils or over erodible fill slopes. Use diversion or wing ditches wherever possible to carry road drainage water onto the undisturbed forest floor. Use adequate sized culverts to carry the anticipated flow of water.

A road grade of less than 10 percent is preferred. Changing grade frequently, with rolling or broad-based dips, protects water quality better than by using long, straight, continuous grades. On highly erodible soils, grades should not exceed 8 percent. Grades exceeding 8 percent for 150 feet may be acceptable as long as appropriate BMPs are implemented. Graveling the road surface can help maintain stability. Install water turnouts, broad-based dips or rolling dips before a stream crossing to direct road runoff water into undisturbed areas of the SMZ. With the exception of stream crossings, roads should be located outside the SMZ.

- **Broad-Based Dips:** Broad-based dips are recommended for roads with less than 10 percent grade. Installation should take place after basic clearing and grading for roadbed construction. An energy absorber such as rip-rap and, in some cases, a level area where the water may spread can be installed at the out-fall of the dip to reduce water velocity. On some soils, the dip and reverse grade section may require bedding with crushed stone to avoid rutting the road surface. Broad-based dips should be placed cross the road in the direction of water flow. Broad-based dips are not recommended for constantly flowing water.
- **Rolling Dips:** Rolling dips are a cross between water bars and broad-based dips. Like broad-based dips, they have a reverse grade (except it is shorter) and they tip water off the road. Like water bars, they may also rely on a mound of soil at the downhill side. Rolling dips can be used on haul roads having a slope of 10 percent and greater.

Rolling dips can be used after basic clearing and grading for roadbed construction after logging is completed. A 10- to 15-foot long, 3 to 8 percent reverse grade is constructed into the roadbed by cutting from upgrade to the dip location and then using cut material to build the mound for the reverse grade. In hills, locate rolling dips to fit the terrain as much as possible. They should be spaced according to the slope of the planned roadbed. Rolling dips are not suitable for constantly flowing water.

- **Wing Ditches:** Wing ditches collect and direct road surface runoff from one or both sides of the road away from the roadway and into undisturbed areas. Wing ditches move water from roadside ditches and disperse it onto undisturbed areas adjacent to the road.
- **Pipe Culverts:** Road and stream crossing culverts collect and transmit water safely from side ditches, seeps, natural drains or streams under haul roads and skid trails without eroding the drainage system or road surface.

The pipe should be long enough so both ends extend at least one foot beyond the side slope of fill material. Culverts should be designed to carry the anticipated flow. The culvert should be placed with a 1 to 2 percent downgrade to prevent clogging. Lay the bottom of the culvert as close as possible to the natural grade of the ground or drain. Provide erosion protection for culverts. Lay aggregate or other suitable material on approaches to fords, bridges and culvert crossings if needed to ensure a stable roadbed approach and reduce sediment in the stream. Fill for temporary culverts can be washed rock. Washed rock may remain in the channel when the culvert is removed. Remove culverts, bridges and fill material other than washed rock from temporary stream crossings upon completion of operations, and return the crossing as close as possible to its original condition. Install erosion protection measures at the culvert outlet as needed to minimize downstream erosion.

References Cited

Controlling Nonpoint Source Runoff Pollution From Roads, Highways and Bridges EPA, Office of Water, August 1995 (EPA-841-F-95-008a). www.epa.gov/owow/NPS/roads.html.

Erosion, Sediment and Runoff Control for Roads and Highways, EPA. <http://water.epa.gov/polwaste/nps/runoff.cfm>.

Section Eight(b)

Urban Runoff Statwide Programs

Introduction

The Arkansas Department of Environmental Quality (ADEQ) identifies urban runoff as a source of contamination in its most current List of Impaired Waterbodies. As the Arkansas Natural Resources Commission's (ANRC) Nonpoint Source (NPS) Pollution Management Plan is to be used in conjunction with ADEQ's List of Impaired Waterbodies, the agency has changed the title from "Household and Business Activities" to "Urban Runoff" to reflect ADEQ's terminology.

The Urban Runoff Statewide Program addresses pollutants that can be generated by households and businesses not required to obtain National Pollution Discharge Elimination System (NPDES) permits, whether they are located in rural or urban counties. The most recent National Water Quality Inventory reports that runoff from urban areas is the leading source of impairments to surveyed estuaries and the third largest source of water quality impairments to surveyed lakes (EPA, 2004).

Potential Pollutants

The potential NPS pollutants for urban activities are pathogens, nutrients, a variety of household chemicals, sediment and litter. Suspended sediment is the primary pollutant in urban runoff, which also contains oil, grease, chemicals from turf management, road salts, metals, pathogens and toxic chemicals from automobiles among others.

Common behaviors that have the potential to generate stormwater pollution include littering, disposing of trash and recyclables, disposing of pet waste, applying lawn chemicals, washing cars, changing motor oil on impervious driveways and improper disposal of leftover paint and household chemicals.

In more detail:

Pathogens

While most microorganisms in wastewater are harmless, many pathogenic (disease-causing) organisms may be present. The interactions of these organisms with soil are more complex and less understood than the reactions of nitrogen and phosphate.

Pathogens in wastewater include bacteria, viruses, protozoa and helminthes (worms). Helminthes are approximately the size of sand particles, protozoa the size of silt particles, bacteria the size of fine silt and coarse clay and viruses the size of very fine clay. Due to the relatively large size of helminthes and protozoa, their movement through soil pores is usually limited. Bacteria and viruses have a much greater potential for movement and have been the principal causes of disease outbreaks related to groundwater contamination by septic systems (Cogger, 1995).

One route of pathogens to humans from onsite wastewater systems is contamination of wells through groundwater. Wastewater systems must be located an appropriate distance from wells and property boundaries. Systems must also be designed so that they are compatible with the geological attributes of the area. If the groundwater level is high (less than 4 feet below the surface) or if the soil is extremely permeable, the soil will not be effective in removing pollutants and the groundwater may become contaminated, resulting in a public health hazard. Many diseases, including infectious hepatitis, typhoid fever, dysentery and some forms of diarrhea, are caused by water and food contaminated with sewage and can easily be spread by flies. Septage solids pumped from systems must also be disposed of in a proper fashion to avoid contamination of surface water or transfer of pathogens to humans via animals and insects.

Pet waste and co-mingling (the unintended mixing of sanitary sewer flows with storm sewer flows infrastructure) are other potential sources of pathogens.

Runoff From Homes and Businesses

Runoff from home and business land surfaces can carry sediment and suspended solids to streams, along with fertilizers and organic carbon. These sources of sediment can impair designated water uses. In addition, toxics such as petroleum residues, exhaust products, pesticides/herbicides and metals may all be transported in runoff from lawn maintenance or improper handling of chemicals used by households and businesses, parking lots, commercial areas or other disparate sources during storm events. These pollutants, along with litter, typically enter surface waters via runoff without undergoing treatment or removal.

Sediment: Soil erosion is the detachment and movement of soil particles from the soil surface. Soil loss by erosion is not sediment yield; however, it creates a potential for sediment yield. Sediment yield is the amount of eroded soil material that actually enters bodies of water. Soil loss is equal to the tonnage of soil being moved by erosion and redeposited in other locations, such as in parking areas, drains, yards or other locations. These eroded soil materials, along with the undesirable chemicals dissolved in runoff water or attached to soil particles, are often transported by the runoff water from land surfaces into waterbodies. The percentage of soil that moves into waterbodies from eroding urban lands varies and depends on the:

- size of soil particles being transported;
- slope of the land;
- distance to the nearest waterbody;
- density of the vegetation the sediment has to move through;
- shape of the drainage way; and
- intensity of the rain event.

Sediment can smother benthic organisms, interfere with photosynthesis by reducing light penetration and may fill waterways, hindering navigation and increasing flooding. Sediment particles often carry nutrients, pesticides and other organic compounds into the waterbodies, including:

- Nutrients:** The problems resulting from elevated levels of phosphorus and nitrogen are well known and discussed in detail in the agriculture section of this plan. Excessive amounts of nutrient loading to aquatic ecosystems can result in extreme plant and algae growth in a waterbody, changes in water quality, and a decline in the number of desirable fish species. Nutrients are a particular concern in areas defined as Nutrient Surplus Areas (NSAs). The agriculture section of this plan has a more detailed description of NSAs.
- Oxygen-Demanding Substances:** Proper levels of dissolved oxygen are critical to maintaining water quality and aquatic life. Decomposition of organic matter from lawn waste, construction waste and other sources by microorganisms may deplete dissolved oxygen levels and result in the impairment of a waterbody. Data shows that runoff with high concentrations of decaying organic matter can severely depress dissolved oxygen levels after storm events (EPA, 1983).

- Petroleum Products:** Petroleum hydrocarbons are derived from oil products. Automobile engines that drip oil are a common source of this type of pollution. Many do-it-yourself auto mechanics also dump used oil directly into storm drains (Klein, 1985). Concentrations of petroleum-based hydrocarbons are often high enough to cause mortalities in aquatic organisms.

- Other Household Chemicals:** Potentially hazardous household products include paints, cleaning solvents, polishes, pool chemicals, pesticides and other chemicals. Many of these products contain substances such as sodium hypochlorite, petroleum distillates, phenol, cresol, ammonia and formaldehyde (NRDC, 2001). If improperly disposed of or accidentally spilled, these chemicals may end up in surface or groundwater. The impact of these chemicals on water quality varies depending on the chemical, but can be significant.

Litter: Along with sediment, runoff can transport litter into waterways. Litter is considered a pollutant associated with urban areas. Litter includes discarded material or objects; refuse or rubbish that are not intended for reuse. Many items such as plastic and paper products enter streams and can endanger wildlife, limit designated uses and degrade water quality.

Onsite Waste Disposal

The Arkansas Department of Health (ADH) regulates onsite wastewater treatment systems. ADEQ delegates a portion of its regulatory authority for the Underground Injection Control (UIC) Program to ADH under a memorandum of agreement. The memorandum covers septic tanks and subsurface distribution systems, excluding household systems, which are considered Class V injection wells. Rules and regulations pertaining to Sewage Disposal System Designated Representatives and Installers (Act 402 of 1994) provide standards for installation of septic systems and certification requirements for system designers and installers. Some types of systems may also require a NPDES permit from ADEQ. ADH has also developed an Alternate Systems Manual to complement these rules and regulations, which provide for the installation of alternatives to the standard septic tank system in special situations. This NPS Pollution Management Plan supports implementation of those rules and regulations using education and other voluntary activities.

Ground and surface water pollution are major considerations when septic tanks are used. The main pollutants from septic tanks are pathogens such as viruses, nutrients and organics. Systems used in under-sized lots or where soils are unsuitable for proper treatment of wastewater are subject to undesirable conditions such as widespread saturation of the soil and malfunction of the treatment system. Malfunctioning systems may result in untreated sewage leaching into groundwater or running into streams or roadside ditches contaminating surface water.

Currently, ADEQ does not identify any streams or lakes in Arkansas as being impaired by pollutants from onsite wastewater treatment.

Water Quality/Program Goals

ADEQ has identified Arkansas waterways that are not fully supporting their designated uses in the agency's most recent List of Impaired Waterbodies. Siltation/turbidity of reservoirs and streams has been identified as the largest source of NPS pollution.

The most recent draft of the Impaired Waterbodies List identified urban runoff NPS pollution as a source of impairment. The 2012 draft shows waterways in Jefferson and Washington counties as being impaired by this source of pollution. Additionally, any malfunctioning or improperly installed onsite wastewater treatment system may contribute to pathogen contamination, especially around lakes surrounded by many residences and businesses. Other activities that take place in and around urban households and businesses may also contribute to sediment/turbidity.

The ultimate goal of the urban runoff pollution prevention statewide program is that through public awareness, education, training and other voluntary programs, household and business sources of NPS pollution will never be identified as contributing to impairment of the waters of the state.

Urban Runoff Logic Model

Logic models were prepared for each section of the NPS Pollution Management Plan to better identify how program goals would be achieved. Teams discussed long-term, medium-term and short-term behavior changes they hoped to cause through the NPS Management Plan and what actions would be most effective to achieve those changes.

For the urban runoff pollution prevention statewide program, the team established that their desired long-term outcome was for household and business sources of NPS pollution not to be identified as contributing to impairment of Arkansas waterways.

It is necessary to identify areas where urban runoff is a critical issue so staff resources and funding are best used. Increasing stakeholders' knowledge about funding sources to help them with improvement would also be beneficial toward reaching the long-term goal.

To accomplish this section's long-term outcome, education about Best Management Practices (BMPs) and implementation of BMPs is critical. Education can be accomplished through outreach projects, such as BMP workshops and hands-on training exercises. Information sharing between cities, counties and states is also important to ensure the most current and effective BMPs are passed on to the public.

Reducing runoff and preventing it in the first place will require the involvement of not only state and city agencies and governments, but the effort of business owners and homeowners. Business owners will need to pass on BMP knowledge to their employees, either through workshops or their own programming and policies. Another good party to involve would be regional solid waste districts, which may be able to hold localized training sessions for the public.

Long- and short-term programmatic objectives for the elements of this statewide program follows the Program Logic Model (Table 8b.1).

Table 8b.1. PROGRAM LOGIC MODEL – Urban Runoff

SITUATION
Urban runoff is currently listed as the source of impairment for several bodies of water in Arkansas. Siltation/turbidity of reservoirs and streams has been identified as the largest source of NPS pollution. The most recent National Water Quality Inventory reports that runoff from urban areas is the leading source of impairments to surveyed estuaries and the third largest source of water quality impairments to surveyed lakes.

Table 8b.1. PROGRAM LOGIC MODEL – Urban Runoff (cont.)

PRIORITIES					
Achieve milestones for pollution reduction goals as listed in Section 8(b); reduce and prevent pollution to surface waters from urban runoff; maintain or improve the quality of waters of Arkansas. Household and business sources of NPS pollution will never be identified as contributing to impairment of the waters of the state.					
INPUTS	OUTPUTS		OUTCOMES		
	Activities	Participants	Short-term	Medium-term	Long-term
<ul style="list-style-type: none">– Money– Time– People (state and local government staff, general public, business owners)	<ul style="list-style-type: none">– BMP workshops– BMP training– Info/data sharing by stakeholders– Identify critical areas– Education programs– Podcasts– News releases/PSA	<ul style="list-style-type: none">– Homeowners– Business owners– Business employees– Municipal staff– CES staff– State agencies– Solid waste district– Property owner associations– Master Gardeners– Corporate store/chain management	<ul style="list-style-type: none">– Awareness of BMPs– Critical areas identified– Increased awareness of available repair funds	<ul style="list-style-type: none">– Better BMPs– Increased BMP use– Sharing technology with other counties, regions and watersheds with impaired waters	<ul style="list-style-type: none">– No impairments from urban runoff– BMPs in use– Less polluted runoff
ASSUMPTIONS			EXTERNAL FACTORS		
1. ADEQ continues to not identify any streams or lakes in Arkansas as being impaired by pollutants from onsite wastewater treatment.			1. Pollution reductions in Agriculture may be masked by increasing urbanization and Urban Runoff. 2. State of Arkansas resources toward pollution abatement are limited. 3. The Urban Runoff Statewide Program addresses pollutants that can be generated by households and businesses not required to obtain National Pollution Discharge Elimination System permits.		
EVALUATION PLAN					
Review progress made over five years and make adjustments in the needed areas if acceptable and measured progress has not occurred. Hazardous waste collection programs can be evaluated by the volume or mass of hazardous waste collected by the program administrators. Track education programs through the use of attendance logs and program evaluation.					

Objectives and Milestones

Onsite Wastewater Treatment Systems

8(b).1. Assist ADH in evaluating and demonstrating promising alternatives to the standard septic tank/leach field systems as resources allow.

Timeline for Milestones: October 2011 through September 2016

8(b).2. Use Geographical Information Systems (GIS) analysis and special assessments to identify critical areas. Use the information to target additional education opportunities for onsite wastewater treatment system outreach and awareness programs in cooperation with ADH.

Timeline for Milestones: October 2011 through September 2016

8(b).3. Assist ADH in the development and implementation of awareness programs to reach home owners and businesses about onsite wastewater disposal system BMPs related to proper operation and maintenance.

Timeline for Milestones: October 2011 through September 2016

8(b).4. Work with ADH to increase awareness of funding sources available for repairing malfunctioning or improperly installed septic systems.

Timeline for Milestones: October 2011 through September 2016

Household and Businesses Use of Chemicals and Fertilizers

8(b).5. Assess the impact of household and business use of fertilizers, pesticides and other common products that do not require permits but can affect water quality, in order to more effectively target outreach and awareness programs aimed at increasing use of BMPs as resources allow.

Timeline for Milestones: October 2011 through September 2016

8(b).6. Encourage cooperating entities to work together to maintain a shared library of BMPs for the use, handling, storage and disposal of chemicals, oils and grease, cleaning agents, adhesives, lawn products, etc., that is readily accessible to households, municipalities, employers and others.

Timeline for Milestones: October 2011 through September 2016

8(b).7. Continue to develop and implement targeted education programs for specific products and high-impact audiences as resources allow (for example, fertilizer and pesticide use, storage, handling and disposal for street and road crews, public utilities, golf course managers and independent lawn maintenance crews).

Timeline for Milestones: October 2011 through September 2016

8(b).8. Continue to maintain and implement broad-based educational programs aimed at increasing awareness and disseminating BMPs to urban and rural households and businesses (e.g., HOME*A*SYST, URBAN*A*SYST).

Timeline for Milestones: October 2011 through September 2016

8(b).9. Encourage existing hazardous waste and pesticide container collection programs aimed at agricultural producers to also accept containers from households and businesses.

Timeline for Milestones: October 2011 through September 2016

Program Tracking and Evaluation

Onsite Wastewater Treatment Systems

Currently, no stream segments are identified as being impaired by onsite wastewater disposal. In the interim, the effectiveness of the onsite waste disposal component of this statewide program can be tracked by the agencies conducting educational programs through the use of attendance logs and program evaluation. Program evaluation methods will be specified in grant agreements as appropriate. ANRC may require pre- and post-project evaluation in project agreements as resources allow.

Household Chemicals and Fertilizers

Educational programs concerning household chemicals and fertilizers can be evaluated by the agencies conducting the education programs through attendance logs and attendee post-program evaluations. Hazardous waste collection programs can be evaluated by the volume or mass of hazardous wastes collected by the program administrators. ANRC may require pre- and post-project evaluation in project agreements as resources allow.

Brief Summary of Institutional Context

Onsite Wastewater Treatment Systems

ADH is the regulatory agency for onsite wastewater treatment systems. To install or repair septic systems in Arkansas, a person must be licensed by ADH. Site inspections by an ADH representative for new septic systems are mandatory. Property owners are responsible for the assurance of proper function of onsite wastewater treatment systems. Problems are dealt with in a site-specific manner following property-specific complaints. After a complaint is filed, a check is performed on the property in question. If a violation of law is found, then a notice of violation is issued.

The University of Arkansas Division of Agriculture Cooperative Extension Service, as the educational arm of the Division of Agriculture, promotes public awareness and provides information and training programs to residents concerning proper operation and maintenance of onsite wastewater treatment systems through its HOME*A*SYST program.

Household Chemicals and Fertilizers

Management of household chemical and pesticide NPS pollution can best be achieved by an effective information, education and public awareness program concerning the potential hazards of such chemicals. In addition, local hazardous chemical pickup and disposal programs have been successful in preventing hazardous chemicals from ending up in the environment. Continuation of these programs is necessary for the successful prevention of water quality degradation resulting from household chemicals and fertilizers.

U.S. Environmental Protection Agency (EPA) requires operators of large, medium and regulated small municipal separate storm sewer systems (MS4s) to obtain authorization to discharge pollutants under an NPDES permit. Under Phase II requirements, permitted small MS4s are required to develop plans for public education and outreach in order to implement a public education program. These programs should include components to distribute educational materials to the public, such as flyers inserted with municipal water bills, or equivalent outreach activities about the impact of stormwater discharges on waterbodies and the steps the public can take to reduce pollutants in stormwater runoff. The materials and activities planned under this statewide program help regulated cities and other rural communities with public education and outreach.

In collaboration with regional planning commissions, the University of Arkansas Division of Agriculture Cooperative Extension Service is working with communities subject to Phase II small MS4s NPDES permit requirements to conduct construction education and technical assistance programs in Arkansas.

Cooperating Entities

Cooperating entities are listed and described in the cooperating entities section of the 2011-2016 NPS Pollution Management Plan.

Federal Consistency

Federal consistency is not anticipated to be an issue with this statewide program. If there are federal consistency issues, ADH and/or ADEQ will work with the relevant federal agency to achieve consistency.

Onsite Wastewater Disposal System

Management Measures and BMPs: The following management measures and BMPs are recommended for onsite wastewater disposal systems. However, first and foremost, onsite disposal systems must be in conformance with the rules and regulations of ADH.

Permitting Requirements: Contact the county health department for regulations and a list of currently approved designated representatives and installers.

Planning and Designing Onsite Wastewater Treatment Systems: Site planning, design, installation, operation and maintenance must be focused on reducing the environmental impact of the release of treated domestic wastewater into the environment.

Complete a layout of the site, including dimensions and locations of roads, buildings, neighboring residences, wells and drainageways.

Identify Critical Properties: As the properties are identified, decisions regarding the design and construction can be made. These properties include:

- topography;
- soil conditions;
- geology; and
- drainage.

To avoid contamination of drinking water systems and other problems, soil absorption systems must be situated at prescribed distances from wells, surface waters, springs and property boundaries.

Locate Adequate Absorption Field: Critical to the location of the absorption field is the topography of the site. Depression areas and floodplains must be avoided because these areas may become saturated and be unable to adequately treat the effluent flow. A “useable area” of soil absorption should be located in an area of diverging flow. Practices associated with absorption field placement are:

- avoiding where water naturally converges;
- placing absorption field parallel to contour; and
- determining exact slope of the site.

Pretreat effluent – When adequate pre-treatment is provided, the overall level of treatment is improved in the soil system and absorption field.

Selection of onsite wastewater system based on minimum technical standards – Septic system design, construction requirements (in relation to the minimum depth of groundwater, minimum distances from water sources and maximum percolation rates for soils for absorption fields) and alternative systems are established by ADH.

Installation of Appropriate System: There are several designs of onsite wastewater treatment systems. Alternatives to conventional gravity-flow septic systems may be considered in the case of system failure or substandard site conditions.

Gravelless and chamber systems [e.g., low pressure pipes (LPP) systems] – These systems have the following design features:

- shallow placement;
- narrow trenches;
- continuous trenching;
- pressure-dosed with uniform distribution of the effluent;
- design based on aerial loading; and
- resting and re-aeration between doses.

Mound systems – Their main purpose is to provide additional treatment to the wastewater before it enters the natural environment. Mound systems are designed to overcome site restrictions such as:

- slow or fast permeability soils;
- shallow soil cover over creviced or porous bedrock; and
- high water table.

Intermittent sand filters – They are a viable alternative to conventional methods when soil conditions are not conducive for proper treatment

and disposal of wastewater through percolation beds/trenches. Sand filters may be considered in sites that have:

- shallow soil cover;
- inadequate permeability;
- high groundwater; and/or
- limited land area.

Recirculating sand filters (RSFs) – Because they require less land area than intermittent (single-pass) sand filters and do not require highly trained operators, RSFs are often used to treat wastewater collected from clustered residences and small communities.

Home aerobic systems – Aerobic systems are similar to septic systems in that they both use natural processes to treat wastewater. But unlike septic (anaerobic) treatment, the aerobic treatment process requires oxygen. Aerobic treatment units, therefore, use a mechanism to inject and circulate air inside the treatment tank. This mechanism requires electricity to operate. For this reason, aerobic systems cost more to operate and need more routine maintenance than most septic systems. However, when properly operated and maintained, aerobic systems can provide a high-quality wastewater treatment alternative to septic systems. Aerobic systems should only be used in conjunction with a maintenance contract.

Fine bubble aeration – Fine bubble aeration is a subsurface form of diffusion in which air is introduced in the form of small bubbles to aid or enhance the treatment of wastewater.

Composting toilet systems – A composting (or biological) toilet system contains and processes excrement, toilet paper, carbon additive and sometimes food wastes. Unlike a septic system, a composting toilet system relies on unsaturated conditions where aerobic or air-requiring bacteria and fungi break down wastes. Tightening wastewater regulations, growing awareness of pollution sources, compatible gray-water systems and micro-flush toilets are making them a viable alternative to septic systems and central sewage treatment plants in many areas, particularly those with poor soil drainage and close proximity to surface water and groundwater.

Alternative sewers – Alternative sewers should be considered as a possible option for groups of homes and businesses in areas where they can cost effectively fulfill the health and environmental goals of the community.

Decentralized wastewater treatment – A decentralized system employs a combination of onsite and/or cluster systems and is used to treat and dispose of wastewater from dwellings and businesses close to the source. Decentralized wastewater systems allow for flexibility in wastewater management. Different parts of the system may be combined into “treatment trains,” or a series of processes to meet treatment goals, to overcome site conditions and to address environmental protection requirements.

Maintenance of Onsite Wastewater System:

Proper management ensures functional septic design, cleaning and repair.

Reduce Flow Into the Wastewater Treatment System: Keep water usage well below the septic system’s “daily designed flows.” Consistently exceeding these flows impacts both the volume and quality of wastewater that enters an absorption field.

Minimize the Amount of Solids Deposited Into the Wastewater Treatment System: Overburdening a septic system with solids will, at best, necessitate more frequent pumping of a tank. At worst, such overloading will cause the carry-over of particulate solids into an absorption field, leading to premature absorption field failure.

Avoid Putting Chemicals in the Treatment System: Adding chemicals, such as household cleaners and toxic substances (paint, solvents and pesticides), kills the bacteria whose life activities purify wastewater. Chemicals can also clog the absorption field and damage soil structure.

Regularly Pump Out Septic Tanks: All septic tanks need to be pumped out on a regular basis. Pumping is essential to maintaining a well-functioning system and preventing premature system failure.

Routine Onsite Wastewater System

Self-Inspection: Septic system inspections are necessary to assess the current condition of the system, to uncover potential or emerging problems and to predict future system performance. Homeowners should routinely self-inspect their systems and maintain records on their systems.

Helpful steps include:

- **Maintain adequate records** – The homeowner should keep the following documents: permit application and any attached reports (for

example, soil tests), the permit itself, age of the septic system, a record of all maintenance (for example, pumping) and ADH inspection reports.

- **Keep the septic tank accessible** – The homeowner should know the location of the septic tank cover and keep it free from being covered by soil or debris.
- **Inspect the absorption field** – The homeowner should regularly perform visual inspections of the absorption field for:
 - signs of system failure (odors, mushy spots, surfacing effluent);
 - surface water (indicative of poor location);
 - proper effluent distribution; and the
 - existence of potentially harmful trees/shrubs in the absorption field vicinity or other absorption field hazards (for example, heavy equipment, patios, blacktopped areas, etc.).

Common Best Management Practices

BMPs for Gas Stations, Auto Repair Shops, Auto Body Shops, Car Dealerships, Mobile Fleet Managers, Airplane Maintenance and Mobile Fleet Washing Services

Many common vehicle maintenance and washing routines contribute to environmental pollution. Washing a vehicle or pouring used motor oil into a gutter or storm drain pollutes the environment. Water runoff from streets, parking lots and driveways picks up oil and grease dripped from cars, asbestos worn from brake linings, zinc from tires and organic compounds and metals from spilled fuels. These chemicals drain into surface waters, harming aquatic life. Oil and grease, for example, clog fish gills and block oxygen from entering the water. If oxygen levels in the water become too low, aquatic animals die.

Cleaning/Degreasing Engines and Equipment, Auto and Truck Drive Trains and Airplanes (including landing gear): Washwater should not be disposed of in storm drains. Typically this wash-water requires treatment before discharge into the sanitary sewer system. Cleaning should take place on a wash pad, with or without soap. It would be best to discuss runoff needs with the facility operator.

Truck Trailer and Boat Cleaning (exterior only – food related): Sweep, collect and dispose of debris. Use dry cleaning methods as much as possible. Food residue must be disposed of as garbage or sent to the sanitary sewer. Avoid hosing down trailer. Washwater should not be discharged to the storm drain; it should be pumped to the sanitary sewer.

Truck Trailer Cleaning (interior only – where toxic substances may be encountered): If toxic materials have been shipped in the trailer and there has been a spill, do not hose down the spill. Take immediate action to prevent the spread of the material and protect nearby storm drains.

Fleet Vehicle Washing (exterior only removing mainly soil) – With Soap: Use wash pads that capture the washwater and discharge it to the sanitary sewer. Solids separation is required before disposal. Ideally, a separate wash area that captures washwater should be established. Use of temporary wash pads that can be drained to the sanitary sewer is also acceptable.

Storm Drains: In areas near storm drains and an increased likelihood of wastewater entering the drains, washwater runoff and excess soapy water should be collected and pumped or otherwise discharged as follows:

- Pump into sanitary sewer system clean-out opening or sink or into an onsite private sanitary sewer manhole. Verify with the facility manager that it is not a storm drain manhole;
- Solids separation will be required before disposal to prevent clogging system;
- Washwater may be discharged onto soil or landscaped areas. Note that soapy washwater may adversely affect landscaping.
- Discharge should be directly to an area sufficient to contain all washwater; and
- Acceptable for minimal discharge flows only.

Repetitive use of the same area or excessive wash volume to the same area may be regulated. Discuss this practice with the property owner. If disposal to the sanitary sewer and/or a landscaped area is not possible, then contract with a company capable of hauling the washwater off-site to an authorized disposal site.

Mobile Auto Detailing and Cleaning Boat (infrequent, light cleaning, rarely at same

location; removing mainly soil, with minimum water volume) – With Soap: Minimal runoff may remain on paved surfaces to evaporate. If there is insufficient water volume to reach the storm drain, seal the storm drain and pump the water to the sanitary sewer. For soil or landscaped areas, discharge should be directed to an area sufficient to contain the water. Discuss this practice with the property owner. Acceptable for minimal discharge flows. Repetitive use of the same area or excessive wash volume to the same area may be regulated.

Boat Cleaning (where paint chips are being removed in preparation for painting): Filtered washwater must be discharged to sanitary sewer. Contact the local wastewater treatment plant for more information. Dispose of paint particles appropriately according to paint type (for example, if paint is lead-based, copper-based, or contains Tributyltin or PCBs, consult the local wastewater treatment plant and hazardous waste for information on disposal of hazardous waste). If non-hazardous, material may be disposed of as solid waste after filtered paint particles have dried. This BMP is not intended to address the disposal of paint waste.

Shop Area Cleaning (interior cleaning of vehicle shop areas and paint booths): Do not hose down shop floor into streets or parking lots. It is best to dry sweep regularly. Use nontoxic cleaning products. Baking soda paste works well on battery heads, cable clamps and chrome. Mix the baking soda with a mild biodegradable dishwashing soap to clean wheels and tires. For windows, mix white vinegar or lemon juice with water. To reduce or eliminate the generation of waste, fix sources of drips or leaks where possible. Routinely inspect the engine compartment and regularly replace worn seals on equipment.

To avoid or control spills and leaks do the following:

- Prepare and use easy-to-find spill containment and cleanup kits. Include safety equipment and cleanup materials appropriate to the type and quantity of materials that could spill;
- Pour clay-based cat litter, sawdust or cornmeal on spills;
- Change fluids carefully. Use a drip pan to avoid spills. Prevent fluid leaks from stored vehicles. Drain fluids such as unused gas, transmission and hydraulic oil, brake and radiator fluid from vehicles or parts kept in storage. Implement simple work practices to reduce the chance of spills;

- Use a funnel when pouring liquids (for example, lubricants or motor oil) and place a tray underneath to catch spills. Place drip pans under the spouts of liquid storage containers; and
- Clean up spills immediately.

BMPs for Building Maintenance Departments, Property Owners, Service Stations, Fast Food Restaurants, Auto Repair Shops, Window Washing Services and Mobile Washing Services

Many common surface cleaning and washing routines contribute to environmental pollution. Washing buildings or paved surfaces into a gutter or storm drain pollutes the environment. Water runoff from buildings, streets, parking lots and driveways can pick up sediment, debris and oil. These pollutants drain into surface waters, harming aquatic life. Oil and grease, for example, clog fish gills and block oxygen from entering the water. If oxygen levels in the water become too low, aquatic animals die.

Pressure Washing Drive-Throughs, Driveways, Parking Garages and Service Stations: Storm drains must be protected from water runoff. Sweep, collect and dispose of debris. Dry clean oil spots with absorbent and dispose of absorbent in a legal manner. Vacuum/pump washwater to the sanitary sewer. Washwater disposal options should be discussed with the facility's operator/site manager.

It is best to discharge through an oil/water separator. Do not use an oil/water separator intended to capture cooking oil. Although pretreatment may not be required, contact the local wastewater treatment plant for more information.

Washing Painted Buildings (where lead-based or mercury additive paints are of concern): Storm drains must be protected from water runoff. Vacuum/pump washwater to a holding tank.

Washing Painted Buildings (to remove paint or prepare surface for painting): These BMPs do not address the disposal of paint.

Masonry Efflorescence (where acid wash is used to remove mineral deposits on masonry): Storm drains must be protected from water runoff. Rinse treated area with alkaline soap to neutralize acid residue. Direct rinse water to a landscaped area or soil.

Collect Wastewater: Neutralize washwater to a pH between 6 and 11. Pump to a sanitary sewer clean-out opening at the site, into a sink or toilet or contact the local wastewater treatment plant.

Wash Down of Restaurant Alleys, Grocery Dumpster Areas (outdoors): No discharge from this activity is allowed to enter storm drains. Dry sweep and clean only, if possible. Use rags, absorbents or dry sweeping compound. Dry sweep first. Seal storm drains. Wash area, then vacuum or pump washwater to the sanitary sewer. Screen washwater to prevent clogging system.

Wash Down Sidewalks and Plazas (with soap): Washwater must go to sanitary sewer. Sweep, collect and dispose of debris and/or absorbent. Wash area, then vacuum or pump washwater to the sanitary sewer. The BMPs in this section do not apply if there has been oil or other hazardous material spilled onsite. In case of a spill, contact the local fire department for guidance.

Wash Down Sidewalks, Plazas, Driveways, Drive-Through Window Areas with Light Oil Build Up (frequently cleaned, without soap): Sweep, collect and dispose of debris and/or absorbent. Dry sweep oil spots with absorbent and dispose of absorbent in garbage. Place oil-absorbent boom around storm drain. Washwater may go into storm drain through oil-absorbing boom. No oil sheen may be visible on the water flowing into the storm drain.

Washing Building Exteriors and Walls (with soap): No storm drain disposal of washwater is permitted. It must be discharged to sanitary sewer or soil. There may be some unavoidable evaporation from paved surfaces. Use wash pads that capture the washwater and discharge to the sanitary sewer. Solids separation is required before disposal. Ideally, a separate wash area that captures the washwater should be established, or the use of temporary wash pads that can be drained to the sanitary sewer is also acceptable.

Graffiti Removal, Using Wet Sand Blasting Methods: Minimize quantity of water used. Runoff should be directed to landscaped or soil area. Filter runoff through the boom to keep sand out of storm drains. Sweep debris and sand. Dispose of all waste to avoid future runoff contamination.

Graffiti Removal, Using High-Pressure Washing and Cleaning Compound: Washwater runoff should be directed to soil or landscaped area. No runoff can go into storm drain. Seal storm drains and vacuum/pump washwater to the sanitary sewer. Contact the local wastewater treatment plant for guidance, as harsh cleaning compounds may require pretreatment.

Wash Sidewalks and Plazas (with no oil deposits) – Without Soap: Sweep, collect and dispose of debris. Washwater may go to storm drain.

Washing Building Exteriors and Walls – Without Soap: Direct washwater runoff to soil or landscaped areas. Washwater may go to storm drain. Sealing the storm drain with a fabric filter is recommended to capture soil in the washwater.

Washing Painted Buildings (paint intact) – Without Soap: If painted after 1978, direct washwater runoff to soil or landscaped areas. Seal the storm drain with a fabric filter to capture paint particles in the washwater. Never allow direct discharge to storm drain. Dispose of all collected particles in garbage. These BMPs do not address washing buildings with paint prior 1978.

Car Lot Rinsing for Dust Removal – Without Soap: If rinsing dust from exterior surfaces using water only and no soap/solvent, discharge runoff to storm drain or to soil or landscaped areas. Prevent contamination of runoff by not allowing it to run through oil deposits on the pavement or in the gutter.

BMPs for Bakeries, Food Producers and Distributors, Grocery Stores and Restaurants

The byproducts of food-related cleaning can harm the environment if they enter the storm drain system. Food businesses can cause harm by putting food waste in leaky dumpsters, not cleaning up outdoor food or chemical spills or by washing outdoor spills into the storm drain system. Other routine activities such as cleaning oily vents and operating and maintaining delivery trucks are sources of pollution, unless proper precautions are taken. When it rains, oil and grease not properly disposed of may be washed into the storm drain system. Oil and grease that makes its way into the environment can block oxygen from entering the water. Additionally, toxins found in oven and floor cleaners can, in high concentrations, harm aquatic life.

Conduct Employee and Client Education:

Employees can help prevent pollution when you include water quality training in employee orientation and reviews. Promote these BMPs:

- Storage containers should be regularly inspected and kept in good condition;
- Place materials inside rigid, durable, water-tight and rodent-proof containers with tight-fitting covers;

- store materials inside a building or build a covered area that is paved and designed to prevent runoff from entering storm drains;
 - place plastic sheeting over materials or containers and secure the cover with ties and weighted objects (not appropriate for storing liquids);
 - post BMPs where employees and customers can see them. Showing customers you protect the environment is conducive to good public relations;
 - explain BMPs to other food businesses through merchant associations or chambers of commerce; and
 - raise employee and customer awareness by stenciling storm drains near the work place.

Cleaning Restaurant Floor Mats, Exhaust Filters, Etc.: Do not wash restaurant or food industry-related equipment outdoors. Clean floor mats, filters, etc., inside building with discharge to a sanitary sewer (sink or floor drain). Cover, repair or replace leaky dumpsters and compactors and/or drain the pavement beneath them to the sewer. Rain can wash oil, grease and substances into storm drains. Wash greasy equipment such as vents and vehicles in designated wash areas with an appropriate oil/water separator before storing outside. Ensure that designated wash areas are properly connected to the sewer system.

Kitchen Grease – Kitchen Recyclable Oil, Grease and Meat Fat: Save oil, grease and meat fat for recycling in tallow bin or other sealed containers. Never pour into sink, floor drain or storm drain. Do not contaminate recyclable fats with waste grease from an oil/water interceptor or grease trap.

See “Grease” and/or “Tallow” in the yellow pages for a recycling/hauling company.

Kitchen Waste Grease From Interceptor or Trap: Never dispose of waste grease in the storm drain or storm channel or into the sanitary sewer system. For waste grease disposal, see “Grease Traps” or “Septic” in the yellow pages.

Trash Disposal: Trash includes all items that are discarded from a business with no intent for reuse. When trash is not properly placed in a trash bag and securely closed, it is vulnerable to being blown away and becoming litter. The litter can end up in storm-water that is transported to waterbodies, which is the opposite of the desired outcome.

Dumpster Use: Dumpsters should always have the lids closed, as trash easily and frequently blows away from uncovered waste containers and into the environment. Rainfall that interacts with trash can leach and transport hazardous materials and other potential pollutants from the trash to surface waters.

Toxic Waste Disposal: Toxic waste includes used cleaners, rags (soaked with solvents, floor cleaners and detergents) and automotive products (such as anti-freeze, brake fluid, radiator flush and used batteries). Contact ADEQ for information about proper disposal.

Kitchen Waste Disposal: Purchase recycled products. By doing so, you help ensure a use for recyclable materials. Recycle the following materials:

- food waste (non-greasy, non-animal food waste can be composted);
- paper and cardboard;
- glass, aluminum and tin containers;
- pallets and drums; and
- oil and grease.

Keep recyclable waste in separate containers according to the type of material. They are easier to recycle if separated. Serve food on ceramic dishware rather than paper, plastic or Styrofoam™, and use cloth napkins rather than paper ones. If one must use disposable products, use paper instead of Styrofoam™. Buy the least toxic products available. Look for “nontoxic,” “non-petroleum based,” “free of ammonia, phosphates, dye or perfume” or “readily biodegradable” on the label. Avoid chlorinated compounds, petroleum distillates, phenols and formaldehyde. Use water-based products and look for and use “recycled” and “recyclable” containers.

Washing Grocery Carts – With Soap: Washwater must be captured, filtered for particulates and pumped or drained to the sanitary sewer.

Washing Grocery Carts – Without Soap: Washwater must be captured, filtered for particulates and pumped or drained to the sanitary sewer. If hot water is used, hot/warm water discharge to a storm drain or channel is prohibited. Washwater may be discharged to the storm drain through a filter barrier (for example, booms) to filter out debris.

Wash Down of Lunch Wagons/Food Carts: Washwater must be discharged at a commissary equipped to accept and discharge wastewater to the sanitary sewer system. Never discharge any washwater (except melted ice) to gutters or storm drains. Trucks

and carts and any equipment should be cleaned on a properly equipped wash pad.

BMPs for Boarding Stables, Equestrian Centers, Small Farms, Urban Horse Owners and Kennels

Animal waste contributes to water pollution when it is improperly stored or left uncovered near small streams and storm drains. During rainfall, it is washed into storm drains and flows untreated directly into surface waters.

Animal waste contains some nutrients – phosphorus and nitrogen – as well as bacteria. The nutrients fertilize the aquatic plants causing their proliferation, which depletes oxygen in the water, killing water life. The high bacteria levels in the water can cause gastrointestinal disorders and other medical problems.

Sediment is also a common pollutant washed from pastures and hobby farms. It creates multiple problems once it enters surface waters. It harms water life by clogging the gills of fish, blocking light transmission and increasing water temperature.

Corral Location and Facilities Design: Locate barns, corrals or other high-use areas on the portion of property that drains away from the nearest street or storm channel. Install gutters that will divert runoff away from livestock area.

Design diversion terraces that drain into areas with sufficient vegetation to filter the flow. Protect manure storage facilities from rainfall and surface runoff.

Pasture Management: Confine horses in properly fenced areas except for exercise and grazing time. Corrals, stables and barns should be located on higher ground when possible and surrounded by pasture to act as a natural filtration system.

Use fencing to keep horses away from environmentally sensitive areas and protect stream banks from contamination. Use manure and soiled bedding sparingly to fertilize pastures and croplands.

Grazing Management: Establish healthy and vigorous pastures with at least 3 inches of leafy material present. Subdivide grazing areas into three or more units of equal size. Clip tall weeds and old grass to control weeds and stimulate grass growth. Rotate animals to clean pasture when grass is grazed down to 3 to 4 inches. Let pasture regrow to 8 to 10 inches before allowing another grazing. Keep animals away

from wet fields when possible. During heavy rainfall, consider indoor feeding or constructing protective heavy-use areas, which keeps more manure under a roof and away from runoff.

Manure Collection and Storage: Collect soiled bedding and manure on a daily basis from stalls and paddocks and place in temporary or long-term storage units. Store in sturdy, insect-resistant and seepage-free units such as:

- plastic garbage cans with lids;
- fly-tight wooden or concrete storage sheds;
- composters; and
- pits or trenches lined with an impermeable layer.

Manure Use and Disposal: Compost soiled bedding and manure for own use. Give away composted material to local greenhouses, nurseries and botanical parks. Transport manure to topsoil companies or composting centers. Fertilize pastures, cropland and lawns with manure and soiled bedding. Pasture fertilization should be in accordance with a nutrient management plan if application site is in a nutrient surplus zone.

Pesticide Alternatives: Integrated Pest Management is a more common sense approach for a long-term solution. Plan an “IPM” strategy in this order:

- pheromone traps;
- tarps;
- bug zappers;
- fly-tight storage sheds; and
- chemical controls;

Use these least-toxic products:

- pyrethrin-based insecticides;
- dehydrating dusts (e.g., silica gel);
- insecticidal soaps;
- horticultural oils; and
- landscaping, gardening and pest control.

BMPs for Commercial Fertilizer and Pesticide Application for Lawn Services, Commercial Landscapers, Golf Courses, Local Governments and Others

Soil test before fertilizing to prevent over application.

Calibrate application equipment prior to application to prevent over application.

Prevent overspray of fertilizers and pesticides onto sidewalks and streets. If overspray occurs, vacuum oversprayed fertilizers and pesticides to prevent runoff into the storm drain during storm events. Do not apply fertilizer just before or during rainstorms.

Rinse empty pesticide containers and treat the rinse water as you would the product. Dispose of empty containers in the trash. Dumping toxics into the street, gutter or storm drain violates federal storm-water regulations. Non-recyclable materials must be taken to an appropriate landfill or disposed of as hazardous waste.

Do not apply fertilizers or pesticides in streamside buffers of waterbodies.

Follow USDA guidelines and label requirements when applying, storing and disposing of fertilizers and pesticides.

BMPs for Residences, Businesses, Landscapers, Golf Courses, Etc.

Landscaping and garden maintenance activities can be major contributors to pollution and stream bank erosion. Soils, yard wastes, over watering and garden chemicals become part of the urban runoff mix that winds its way through streets, gutters and storm drains before entering surface waters. Poorly functioning sprinklers and over watering, for example, waste water and increase the number of pollutants flowing into storm drains.

Fertilizers, pesticides and herbicides are washed off lawns and landscaped areas. These chemicals not only kill garden invaders, they also harm useful insects and contaminate ground and surface water. Leaves, grass clippings and tree trimmings that are swept or blown into the street and gutter are also pollutants. These wastes clog catch basins, increasing the risk of flooding on streets and carry garden chemicals into surface waters. As they decompose, they also absorb oxygen aquatic life need to survive.

Clearing or removing stream bank vegetation also is a contributor to stream bank erosion problems in the state of Arkansas.

Garden Location and Site Design: Protect stockpiles and materials from wind and rain by storing them under tarps or secured plastic sheeting. Schedule grading and excavation projects for dry weather. Prevent erosion by planting fast-growing annual and perennial grasses. These will shield and bind the soil.

Garden and Lawn Maintenance: In communities with curbside yard waste pickup, place clippings and pruning waste in approved containers for pickup, or take clippings to a landfill that composts yard waste.

Do not blow or rake leaves into the street, gutter or storm drains. Use organic or non-toxic fertilizers. Do not over-fertilize and do not fertilize near streets, storm drains or other waterbodies. Store pesticides, fertilizers, and other chemicals in covered areas to prevent runoff. Seed over bare spots in the landscape to prevent soil erosion.

Pesticide Use: The “chemicals-only” approach to pest control is only a temporary fix. A more common sense approach is needed for a long-term solution: Integrated Pest Management. Plan an “IPM” strategy in this order:

1. **Physical Controls**
 - caulking holes or hand-picking; and
 - barriers or traps
2. **Biological Controls**
 - predatory insects (for example, green lacewings eat aphids); and
 - bacterial insecticides (for example, *Bacillus thuringiensis* kills caterpillars)
3. **Chemical Controls – Last Resort**

Use these least-toxic products:

- dehydrating dusts (for example, silica gel);
- insecticidal soaps;
- boric acid powder;
- horticultural oils; and
- pyrethrin-based insecticide.

Safe Substitutes for Pest Control

Garden aphids and mites – Mix 1 tablespoon of liquid soap and 1 cup of vegetable oil. Add 1 teaspoon of this mixture to a cup of water and spray. (Oil may harm vegetable plants in the cabbage family.)

Caterpillars – When caterpillars are eating, apply products containing *Bacillus thuringiensis* to leaves.

Ants – Place hydramethylnon baits or boric acid powder in problem areas, cracks and insect walkways. It is a mild poison, so be sure it is inaccessible to children and pets.

Roaches – Apply boric acid powder to cracks and entry points (see ants above). Place bay leaves on pantry shelves.

If a pesticide must be applied, use one that is specifically designed to control the pest. The insect should be listed on the label. Approximately 90 percent of the insects on a lawn and garden are not harmful. Use pesticides only as directed. In their zeal to control the problem, many gardeners use pesticides at more than 20 times the rate that farmers do.

Pesticide Disposal: Household toxins such as pesticides, cleansers and motor oil can pollute surface and groundwater if disposed of in storm drains or gutters. Rinse empty pesticide containers and use rinse water as you would the product. Dispose of empty rinsed containers in the trash. To dispose of household hazardous waste, contact local solid waste district officials or the University of Arkansas Division of Agriculture Cooperative Extension Service for instructions.

BMPs for Residences

Household hazardous waste is defined as common everyday products that people use in and around their homes including paint, paint thinner, herbicides and pesticides that, due to their chemical nature, can be hazardous if not properly disposed.

As a rule, people who generate household hazardous wastes should not pour them down the sink or put them in the regular trash unless they are certain that the wastes are non-hazardous to humans or the environment. In general, only non-hazardous solids should be disposed of in the regular trash.

When possible, buy only the amount of product needed so there are no leftovers to store or to dispose of. Read the label before purchasing a product. Many times two products will do the same job, but one requires special disposal and the other does not.

For example, latex paint versus solvent-based paint. Latex paint is water-based and is not classified as hazardous, while solvent-based paints are considered a hazardous material. In addition, other hazardous materials, such as turpentine or mineral spirits, are required for clean up when using a solvent-based paint. Soap and water are all that are needed to clean up after using latex paint. The clear choice from an environmental perspective is latex paint. When possible, avoid purchasing products with POISON, DANGER, WARNING, FLAMMABLE, TOXIC, CORROSIVE or CAUTION on the label.

If potentially hazardous products must be purchased, read and follow the label directions. Store these items in their original container and never remove the label. Keep all hazardous products stored in a location away from children, and out of their reach.

Disposal Options: Many products offer toll-free numbers with operators that can provide information on properly disposing of their product, or the label itself may provide instructions on proper disposal. Share unused material. Give it away to friends, relatives or neighbors who can use it. Never share materials that are not in their original containers or that have been tampered with in any way.

Household Hazardous Waste Collection

Events: Take leftover hazardous materials to household hazardous waste collection events. Contact local solid waste district officials or the University of Arkansas Division of Agriculture Cooperative Extension Service to find out the schedule for household hazardous waste events. Materials should be tightly sealed in its original container, if possible, and placed in a cardboard box. Glass containers should be wrapped in towels, cloth or packaged in some other way to prevent breakage. Materials should be transported to the event in the trunk or bed of a vehicle.

Items generally accepted at collection events include:

- photo chemicals;
- automotive fluids;
- household cleaners;
- pool acids/chlorine;
- solvents and thinners;
- paints/stains/varnishes; and
- household and car batteries.

Items generally not accepted at collection events include:

- ammunition;
- medical waste;
- explosive material; and
- radioactive material.

BMPs for Residential Use, Pool Owners and Carpet Cleaners

The wastewater generated from cleaning homes, driveways, patios and decks can harm the environment if they enter the storm drain system. Washing the exterior of homes or paved surfaces into a gutter or storm drain pollutes the environment. Water runoff

from these activities can pick up sediment, debris and oil. These pollutants drain into surface waters, harming aquatic life. Oil and grease, for example, clog fish gills and block oxygen from entering the water. If oxygen levels in the water become too low, aquatic animals die. And, toxins found in degreasers and cleaners can, in high concentrations, harm aquatic life.

Washing Mobile Homes, Decks, Roofs/Shingles, Awnings, Pool Decks and Patios: Discharge washwater to soil or landscaped area. Be aware that soapy water may adversely affect landscaping. Discharge should be directed to an area large enough to contain all the water. Discuss this practice with the property owner.

If washwater doesn't go to soil/landscaping or if soap is used, washwater must go to the sanitary sewer. If no soap is used, washwater may be discharged to the gutter or storm drain through a filtering apparatus (for example, boom to capture debris and particles).

Treated wood shingles are often treated with a toxic material. Treated shingles should be dry swept only. Runoff from cleaning may be toxic to plants in a landscaped area and should never be discharged to the storm drain or sanitary sewer.

Pool Draining: Pool water must be discharged to the sanitary sewer via an onsite sewer manhole or through a resident's sewer clean-out opening. Pool draining into the street or storm drain may be against city and county ordinances. Contact local wastewater or solid waste district officials for requirements and additional information.

Carpet Cleaning: Wastewater from carpet cleaning must be discharged to the sanitary sewer via an onsite sewer manhole or through a resident's sewer clean-out opening. Wastewater draining into the street or storm drain is against city and county ordinance. Contact local wastewater officials for requirements and additional information.

Lawn Watering: Discharging irrigation water to the storm drain system should be avoided. Over watering can transport pollutants like pet waste, fertilizers, and pesticides into the streets and eventually into the stormwater system. Help protect stormwater by following these simple lawn and household water guidelines.

- Adding or removing one minute from the watering time will change the amount of water you use by 25 percent.
- Don't water when it's windy or rainy.

- Schedule start times at least one hour apart. Use the cycle and soak method of watering.
- If the timer has a “skip day” mode, water lawns four to five days apart in the winter and two to three days apart in the spring and fall.

References Cited

- Arkansas Department of Environmental Quality: North Little Rock, Ark. 1995 Water Quality, Macroinvertebrate and Fish Community Survey of the Upper White River Watershed, Northwest Arkansas, West Fork, Middle Fork and Main Fork White River, Brush Creek, Richland Creek, War Eagle Creek, Kings River, Osage Creek, Long Creek and Yocum Creek.
- Arkansas Department of Environmental Quality: North Little Rock, Ark. 2012 Draft List of Impaired Waterbodies (303(d) List). www.adeq.state.ar.us/water/branch_planning/303d/303d.htm.
- Arkansas Department of Environmental Quality: North Little Rock, Ark. 2008 List of Impaired Waterbodies (303(d) List). www.adeq.state.ar.us/water/branch_planning/pdfs/303d_list_2008.pdf.
- Arkansas Department of Environmental Quality: North Little Rock, Ark. 2006 List of Impaired Waterbodies (303(d) List). www.adeq.state.ar.us/water/branch_planning/pdfs/303d_list_2006.pdf.
- Arkansas Department of Environmental Quality: North Little Rock, Ark. Authorization to Discharge Stormwater Under the National Pollutant Discharge Elimination System and the Arkansas Water and Air Pollution Control Act. www.adeq.state.ar.us/water/branch_permits/general_permits/stormwater/construction/pdfs/ARR150000_permit.pdf.
- Clark County Stormwater Quality Management Committee, 2005. Best Management Practices. Stormwater Quality Management Committee: www.lvstormwater.com/bmps.htm.
- Cogger, C. G., 1995. Clean Water for Washington, Septic System Treatment in Soil. Washington State University Cooperative Extension Service: Puyallup, Wash.
- Environmental Protection Agency: Washington, D.C. 2004 National Water Quality Inventory: Report to Congress. http://water.epa.gov/lawsregs/guidance/cwa/305b/upload/2009_01_22_305b_2004report_2004_305Breport.pdf.
- Environmental Protection Agency: Washington, D.C. Public Education and Outreach on Stormwater Impacts, 2008. http://cfpub1.epa.gov/npdes/stormwater/menuofbmps/index.cfm?action=min_measure&min_measure_id=1.
- Environmental Protection Agency: Washington, D.C. Managing Urban Runoff, 2009. <http://water.epa.gov/polwaste/nps/outreach/point7.cfm>.
- Formica, S. J., M. A. Van Epps, M. A. Nelson, A. S. Cotter, T. L. Morris and J. M. Beck, 2004. “West Fork White River Watershed-Sediment Source Inventory and Evaluation.” Self-Sustaining Solutions for Streams, Wetlands and Watersheds. Proceedings of the September 2004 Conference ASAE. St. Joseph, Mich., pages 125-132.
- Novais, R., and E. J. Kamprath, 1978. “Phosphorus Supplying Capacities of Previously Heavily Fertilized Soils.” Soil Science Society of America Journal 42:931-935.
- NRDC, 2001. “How to Clean Up Our Water: Twelve Simple Ways You Can Help Stem the Tide of Polluted Runoff.” Natural Resources Defense Council: www.nrdc.org/water/pollution/gsteps.asp.

Section Nine

Developing Issues: Adapting the NPS Program to New and Changing Policies, Resources and Technologies

Introduction

A basic premise of the Arkansas Nonpoint Source (NPS) Pollution Management Plan is found in its adaptive management design. The annual review process along with attention to new knowledge and experiences of stakeholders and new technical capabilities are all components of the current philosophy of having a flexible plan – a plan that is adaptive to change and sensitive to the developments taking place in the state. The 2006-2011 NPS Pollution Management Plan identifies a number of needs, but is not inclusive of the full range of possible projects important to a successful statewide NPS pollution management effort. Deliberately, the plan does not address every specific possibility. The omission of distinct issues and challenges is not an oversight; rather, the authors of the plan understood that they could not anticipate how dynamic and transformative the changes would be.

The intent to adapt the plan was not well understood beyond the core team of planners and not well conveyed to the U.S. Environmental Protection Agency (EPA) Region 6 administrators. Stakeholders and the Arkansas Natural Resources Commission (ANRC) management team meet on a regular basis to review the science of NPS modeling and the support matrix. Past meetings, however, have not gone far enough to explore:

- the changing nature of NPS policy;
- public and private investments in the state (e.g., for-profit carbon sequestration entities and the Fayetteville Shale Gas Play);
- the full potential of cross-program fund leveraging;
- new and emerging technologies;
- new organizational development and support;
- new data and interpretation of said data;
- educational opportunities associated with the program; or
- nontraditional partnership opportunities.

This situation made the Arkansas NPS Pollution Management Plan appear to be a more static document than intended by the authors. The plan's endeavor is to

truly be an adaptive document focused on the future, changing as appropriate to represent the Arkansas circumstance, investment and priority needs.

The dynamic elements found in the Arkansas NPS Pollution Management Plan include:

- activities of local conservation districts, watershed groups and partners in implementation, education and outreach have expanded greatly over the past five years;
- advanced technologies continue to play a major role in NPS planning, detection and remediation;
- the Fayetteville Shale Gas Play and associated water quality issues were not a consideration;
- political and legal hurdles encountered in pursuit of new policies, such as Low Impact Development (LID) and Riparian Buffer Ordinances;
- the completion of total maximum daily loads (TMDLs) for more than 100 stream segments and waterbodies in the state;
- the expanded role of regional water supply systems in source water protection; and
- EPA's choice of the Illinois River watershed for implementation of a regionally-sponsored project and TMDL.

Furthermore, new design strategies, understanding of stream geomorphology and adaptations of Best Management Practices (BMPs) introduce the state to management options not thought of at the plan's inception. One such management strategy, LID, encourages systematic understanding of stormwater as an effective component of the landscape, both as an important resource and as a risk to the downstream ecosystem. New knowledge of stream geomorphology and landscape design features allows the use of the landscape and natural system-emulating remediation tools to enhance water quality. These tools mimic natural systems and employ naturally occurring plant materials and geophysical features. This approach steps back from the human-centric system control designs of the past and works to employ the processes of natural landscapes and bioremediation to reduce the natural energy of stormwater and thereby capture and reduce

the NPS pollution impact. These are but a few of the innovations helping the state adapt to the natural world.

When the NPS Pollution Management Plan was originally written, the authors did not envision the investment of public utilities, municipalities and private organizations such as Dogwood Alliance, C2I, or the Delta Institute's carbon sequestration activities as tools for NPS pollution management efforts. Activities and investments by these organizations include:

- establishing riparian forest buffers;
- forest management schemes and reforestation complementary to the USDA conservation programs;
- carbon sequestration efforts as tools for NPS pollution management and as additional incentives for landowners to better manage riparian zones and wetlands; and
- land acquisition, easements and ordinances initiated by public utilities and municipalities for the purpose of water quality improvement and enhancement.

Issues, investments and management strategies not in the plan when it was written include:

- state rules creating nutrient surplus areas, requiring nutrient management plans for farms in nutrient surplus areas and training requirements for nutrient applicators;
- state-based incentives for transporting poultry litter out of nutrient surplus areas; and
- municipal ordinances and policies for stormwater management and urban riparian zones.

These activities were not included in the original NPS Pollution Management Plan because they had not been developed or were not being actively pursued at the time. These developments further strengthen the argument for the 2011-2016 NPS Pollution Management Plan to be flexible, constantly adapting to changing circumstances.

ANRC and its partners must have the potential to capture and quantify these and other activities taking place in the state. For the plan to be truly adaptive, it must be able to respond to new opportunities, resources, investments and priorities as they arise. To do this, ANRC must continue to collaborate with municipalities, public and private organizations, local watershed groups, nontraditional partners and others to address NPS pollution management in Arkansas. Continued engagement by these partners requires a process that remains relevant to their perceived needs

and benefits, adapting to their changing knowledge and situations.

The intent of this section is to give voice to the true nature of Arkansas' adaptive NPS Pollution Management Plan, making clear the planners' purpose of constant vigilance and attention to the immediate and future potential of NPS program needs. ANRC, as the lead agency, will remain in constant search of opportunities for strategic investment and partnerships, working in collaboration with stakeholders. The agency will seek the best possible science, data, public policy, education and economic tools to support and inform its management decisions while taking public perception into consideration.

Water Quality/Program Goals

The current plan lists state and federal agencies, nonprofit organizations and local government entities as key partners in the updating of the NPS Pollution Management Plan. The goal of this section is to encourage such organizations to expand their roles from simply being voices in the planning process to that of active partners in broader program implementation. Implementation is more than conservation projects. It may also include such activities as:

- surveys;
- education;
- outreach;
- public policy initiatives;
- planning and organizational development;
- monitoring;
- implementation; and
- other projects.

The NPS Pollution Management Program will put in place a mechanism for identifying partners, quantifying the investments being made, assessing needs and outcomes and encouraging continued investments.

Objectives and Milestones

In this section, objectives and milestones of pertinent work conducted by key partners will be identified and reported. Multiple tools will be used and may include one or more of the following:

- surveys;
- stakeholder interviews;
- facilitated information exchange at the annual Stakeholder and Project Review meetings;
- post-meeting evaluations;

- project reports;
- water quality monitoring, training and data collection; and/or
- invested resources (e.g., financial, FTEs, consultation, in-kind donations).

Milestones will be used to identify measurable outcomes from project inputs provided by key partners.

ANRC and its partner organizations may initiate one or more of the following objectives prior to September 2011:

- assess programmatic investments, financial contributions and FTEs invested by key partners;
- determine available measurable results in reducing NPS pollution through the water quality sampling protocols;
- assess public perception of water quality and knowledge of NPS pollution; and/or
- assess perceptions of stakeholders and other partners regarding their role and satisfaction with the plan and implementation progress.

ANRC will solicit from its partner organizations milestones related to the above objectives prior to September 2011.

Timeline for Milestones

The survey of partners and public perception will take place biennially or as dictated by the plan. Current milestones will be revisited annually throughout the life of the plan.

Summary of Context

The NPS Pollution Management Plan will remain consistent with guidance from the professional NPS pollution management community such as the Arkansas Department of Environmental Quality, the Natural Resources Conservation Service, the Farm Service Agency, the Arkansas Forestry Commission and the University of Arkansas Division of Agriculture. Scientifically accepted survey techniques, stakeholder feedback methods and program assessment methodologies will be used.

Cooperating Entities

Cooperating entities will include those stakeholders already identified and involved in the NPS Pollution Management Plan development as well as newly

engaged public and private organizations and individuals. This emphasis in such system approaches can be found in the:

- Arkansas Biosciences Institute, a joint venture of Arkansas State University, the University of Arkansas for Medical Sciences and the University of Arkansas;
- Arkansas Conservation Partnership, a memorandum of agreement based effort that brings state and federal conservation agencies and private nonprofit organizations together for a common purpose; and
- Arkansas Green Building Council, a membership-based organization with strong interest in LID.

These are but a sampling of the recent water quality associated collaborative efforts in Arkansas.

Additional active partners will include, among others, ADEQ's watershed outreach group, the Illinois River Watershed Partnership, Ducks Unlimited, the Central Arkansas Land Trust, Central Arkansas Water, the Beaver Water District, Audubon Arkansas, the University of Arkansas Community Design Center, the Arkansas Oil and Gas Commission, the Arkansas Department of Environmental Quality, the Arkansas Department of Heritage, the Arkansas Game and Fish Commission, the Arkansas Geological Commission, the Arkansas State Highway and Transportation Department, the Center for Agriculture and Rural Sustainability, the Biological and Agriculture Engineering Department at the University of Arkansas and the Arkansas Forest Resources Center at the University of Arkansas at Monticello.

These programs and centers are but a few examples of incubators and idea generators engaged in the work of water quality protection in Arkansas. This bodes well for the future of the science behind Arkansas' NPS program efforts. This list is not intended to be exclusive, but rather examples of the various collaborations available to ANRC.

System Limitations and Alternatives

It is impossible to know every group and/or individual engaged in some degree in nonpoint source management. It is also difficult to anticipate the municipal policy preference best suited to improve water quality and mitigate NPS pollution. For example, the city of Fayetteville has made a large investment of city

revenues, personnel time and expertise to develop a riparian buffer ordinance. Other variables include the content of the latest Farm Bill and the ways in which EPA rule-making and court decisions can change the circumstances within the state. In addition, state budget concerns may limit total program capacity from traditional sources while an expanding role by nonprofit organizations could completely change local investment and the ultimate outcome of NPS programs. The challenge is to stay engaged with networks and stakeholders already working with ANRC to identify work being done and application of new knowledge and technologies in Arkansas while encouraging new involvement and investment by stakeholders.

Maintenance

This section will fulfill the original objective of maintaining the adaptability of the plan and focusing attention to the needs of the state and the plan as it relates to those needs.

It is the intent of the section to more accurately capture the myriad actions taking place in Arkansas that have a direct or indirect impact on the NPS pollution management of the state. Following are examples of Arkansas investments in NPS pollution management that have not been appropriately accounted for in previous NPS Pollution Management Plans.

- The city of Fayetteville spent \$22,500 toward NPS education and outreach efforts.
- Conservation districts provided technical assistance to thousands of landowners across the state and developed conservation plans in which conservation practices were applied. Many of the prescribed conservation practices and BMPs were implemented with private funds.
- The Arkansas Forestry Commission is also involved with purchasing 775 additional acres on the north slope of Lake Maumelle in collaboration with Central Arkansas Water at a cost of \$9.275 million. The commission has requested \$6 million from the Forestry Legacy funds to be used toward this project. The project is focused on protecting the Maumelle Watershed from nonpoint source pollution. Lake Maumelle is the Little Rock metro area's main source of drinking water.
- GreenTrees, a privately managed forest restoration program created and managed by C2I, has secured approximately 1,700 acres in Arkansas. In exchange for the landowners' long-term

conservation lease, GreenTrees offers a variety of short- and long-term income opportunities. Landowners can simultaneously enroll the same qualified acres into GreenTrees, CRP and other conservation practices, thus receiving multiple financial incentives and incomes together. GreenTrees' efforts are focused on the Delta region of Arkansas and are directly involved in converting row crop land (formerly bottom land hardwood) into forested riparian buffers and forested wetlands.

- The University of Arkansas Division of Agriculture works collaboratively with three counties (Benton, Washington and Jefferson) and identified MS4 cities within their boundaries to assist in efforts to effectively manage stormwater. Combined, the projects contribute more than \$220,000 annually toward community-based education, awareness and NPS pollution management.
- The University of Arkansas Division of Agriculture's Arkansas Water Resources Center annually funds faculty members or affiliates at institutions of higher education in Arkansas to conduct water resources research in the state. Each grantee must match every federal dollar provided with no less than two dollars from non-federal sources.
- The Arkansas Stream Team, a citizen-based effort managed by the Arkansas Game and Fish Commission, has spent annually an average of \$75,000 to \$100,000 working with landowners to reduce NPS pollution and improve fish habitat in the state's waterbodies. They also conduct education and outreach programs statewide to improve residents' knowledge in respect to NPS pollution.

Non 319-Funded Federal Activities

Federally funded activities outside the realm of the Section 319 program are not identified or counted against the state's NPS effort. It is not the intent of this section to in any way account for federal investment outside that of EPA. However, federal funding from sources such as the U.S. Fish and Wildlife Service, the U.S. Forest Service, the U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) and the USDA Farm Service Agency has been significant in the past five years. It would be a mistake to say that these funding sources and projects have not influenced the state's 319 management program.

It would also be a mistake for the planning process to ignore these investments as the stakeholders review and direct the plan's implementation. These new federal investments support and complement the NPS Pollution Management Plan. Most, if not all, of the federal programs require supplementary investments from both the public and private sectors, and ANRC often plays a role in helping identify additional funding opportunities or partners.

Examples of collaborative federal activities that supplement ANRC's 319 efforts that were not in place when the previous NPS Pollution Management Plan was developed include the Mississippi River Basin Initiative (MRBI) by USDA NRCS. MRBI is a multi-state project targeting seven of Arkansas' 54 8-digit watersheds.

Another state and federal partnership is for the creation of four Discovery Farms. These farms offer the opportunity to conduct long-term analysis of farm-scaled NPS pollution management BMPs for both cost effectiveness and efficacy. These Discovery Farms will continue to receive funding, technical support and assessment for NPS water quality protection purposes for many years to come.

Another major federal investment in Arkansas is through three CREP projects. These projects occur in three major 8-digit watersheds in the state – Bayou Meto, Cache River and Illinois River. These federal programs alone have brought millions of dollars into the state and provided occasions for unique partnerships. They have also required significant investment from state, local and private sources.

Section Ten

Bayou Bartholomew Priority Watershed

ADEQ Planning Segment 2B • HUC 8040205

Introduction

Bayou Bartholomew begins near Pine Bluff, Arkansas, and flows generally southward towards its confluence with the Ouachita River west of Bastrop, Louisiana. The Arkansas portion of the watershed encompasses nearly one million acres in a seven-county area of southeast Arkansas, including parts of Jefferson, Cleveland, Drew, Chicot, Lincoln, Desha and Ashley counties. The main tributaries of Bayou Bartholomew in Arkansas are Deep Bayou, Ables Creek, Cutoff Creek, Bearhouse Creek, Overflow Creek and Chemin-A-Haut Creek. Figure 10.1 shows a map of the watershed.

Assessment

The summary of water quality condition is described from the current 305(b) report from the Arkansas Department of Environmental Quality (ADEQ) and other sources as cited appropriately. The following was stated in the most recent 305(b) report:

The waters within this segment have been designated as suitable for the propagation of fish, wildlife, primary and secondary contact recreation, as well as public, industrial and agricultural water supplies. This segment contains a total of 453.5 stream miles, all of which are being assessed using monitoring data.

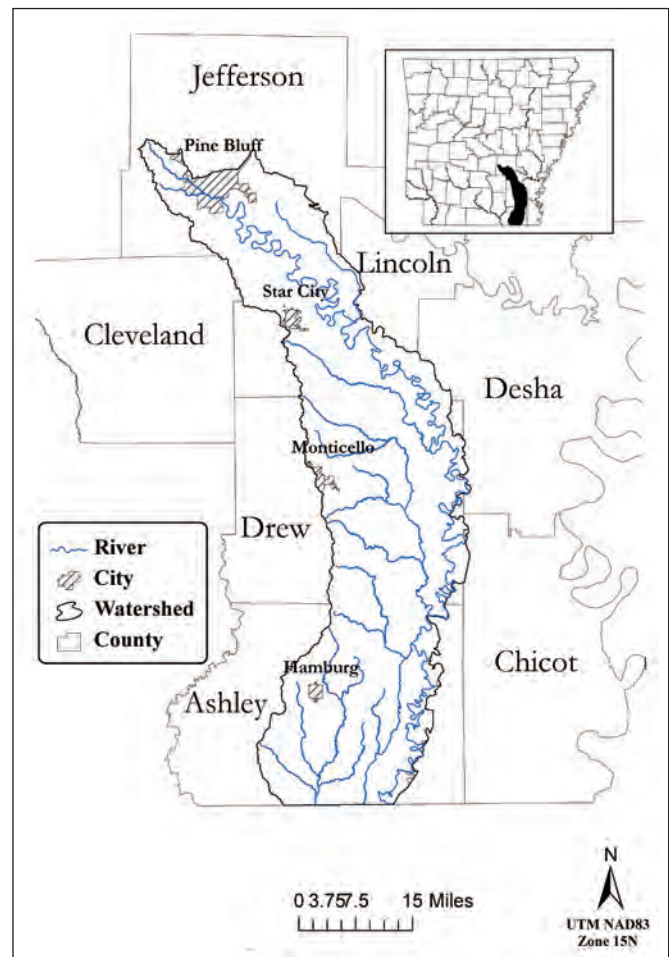
Water quality is impacted in much of this segment by nonpoint pollution generated by row crop agriculture. Silt loads and turbidity are consistently very high, thus causing degradation to the aquatic life within many of these streams. Over the past 10 years, the Bayou Bartholomew Alliance has been addressing these concerns through the implementation of Best Management Practices (BMPs) on a watershed scale. Even though the 10-year trend analysis for turbidity at OUA0013 indicates an increasing trend, the 5-year trend analysis, which might better reflect the recent implementation of BMPs, indicates a noticeable decline in the in-stream turbidity in Bayou Bartholomew.

Historically, fecal coliform data were used to list several streams as impaired for primary contact recreation. Recently, at the request of U.S. Environmental Protection Agency (EPA), ADEQ adopted *Escherichia coli* as the assessment parameter for primary contact recreation into the State's water quality regulations.

In 2002, EPA contracted with FTN Associates, Ltd., to prepare a total maximum daily load (TMDL) for Bayou Bartholomew in Arkansas.

Figure 10.1
Map of Bayou Bartholomew watershed

Data Source: GeoStor
Map Created: March 2011



FTN recommended reductions in turbidity in all analyzed reaches of the watershed. Necessary reductions were targeted from 29 to 37 percent during December 2001 through June 2002, the period exhibiting the highest historical flows. The EPA published the draft TMDL for turbidity for Bayou Bartholomew, Arkansas, on October 8, 2002, for comment. A TMDL for mercury is also being developed for this basin (ADEQ, 2002).

During the second half of FY2005, ADEQ started an intensive sampling program by sampling approximately one well per square mile in the upper Bayou Bartholomew watershed to assess the aerial distribution of arsenic with respect to geology and other attributes (IWQMR, 2008 Integrated Water Quality Monitoring and Assessment Report 305(b)). A total of 109 water samples were collected from irrigation wells in the upper portion of the Bayou Bartholomew watershed in Jefferson County. The investigation demonstrated that elevated arsenic ($> 10 \mu\text{g/L}$) occurred almost solely in stream channel deposits (Qcm), with low arsenic concentrations in the over bank deposits (Qso). Groundwater from the Qso deposits contained significantly higher sulfate concentrations than groundwater in the Qcm deposits. A strong inverse relationship between arsenic and sulfate concentrations tends to support an earlier theory of sulfide formation as a solubility control on soluble arsenic in groundwater.

Nutrient enrichment of the waterbodies in this watershed is a concern. Elevated total phosphorus has been identified in some segments of Bayou Bartholomew and Deep Bayou (ADEQ, 2002). However, detecting and determining the contribution and impact of nutrients from nonpoint sources is a challenge. Land use in the watershed is probably the best indicator of where nutrients have the greatest potential to impact water quality. Confined animal operations in high concentrations within a watershed may result in application of animal manures at nutrient rates greater than can be assimilated, thus resulting in the nutrients being transported into adjacent streams during storm events. However, poultry production in the watershed is limited in scope compared to other areas of the state. Improper management of nutrients (for example, irrigation water) may also result in adjacent streams receiving nutrient inputs during storm events.

The U.S. Geological Survey (USGS) has done extensive monitoring and analysis of surface and groundwater quality in the Mississippi Embayment study area as part of the National Water Quality Assessment Program (NAWQA). A summary of these findings is available at:

- <http://permanent.access.gpo.gov/water.usgs.gov/pubs/circ/circ1208/abstract.html>

The University of Arkansas Division of Agriculture Department of Biological and Agricultural Engineering has used the Soil and Water Assessment Tool (SWAT) to model selected priority watersheds for the 2011-2016 NPS Pollution Management Plan under contract with the Arkansas Natural Resources Commission (ANRC). Appendix B describes SWAT modeling process and the data used to estimate sediment and nutrient concentration for 12-digit hydrologic unit code (HUC) sub-watersheds. Figure 10.2 shows relative concentration of sediment and nutrients in quintiles for each sub-watershed.

Figure 10.2a
Relative concentration of sediment in quintiles for sub-watersheds of Bayou Bartholomew

Data Source: GeoStor, SWAT simulations between 2006 and 2008
Map Created: March 2011

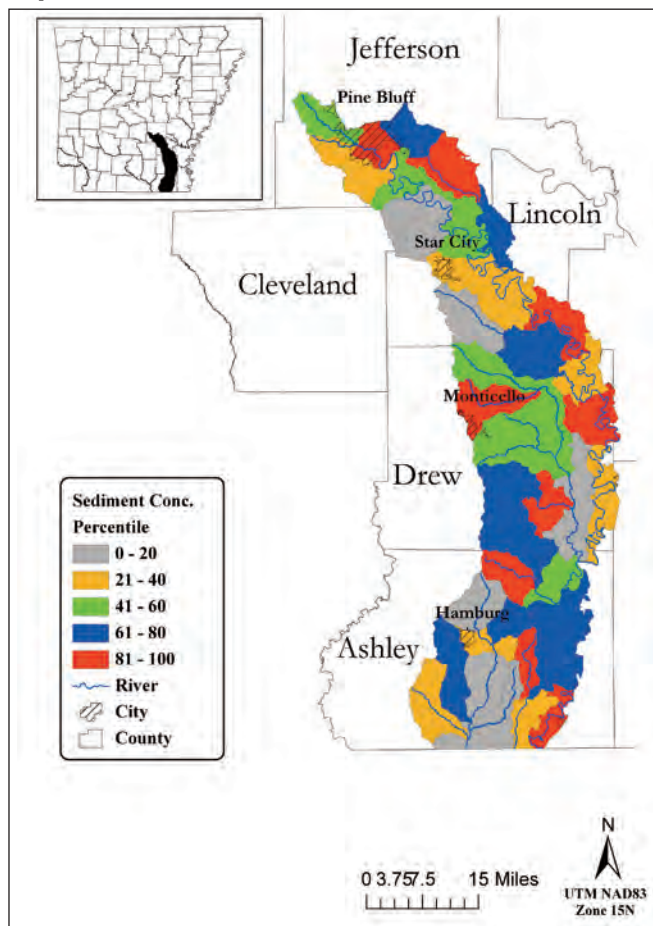


Figure 10.2b
Relative concentration of total phosphorus in quintiles for sub-watersheds of Bayou Bartholomew

Data Source: GeoStor, SWAT simulations between 2006 and 2008
 Map Created: March 2011

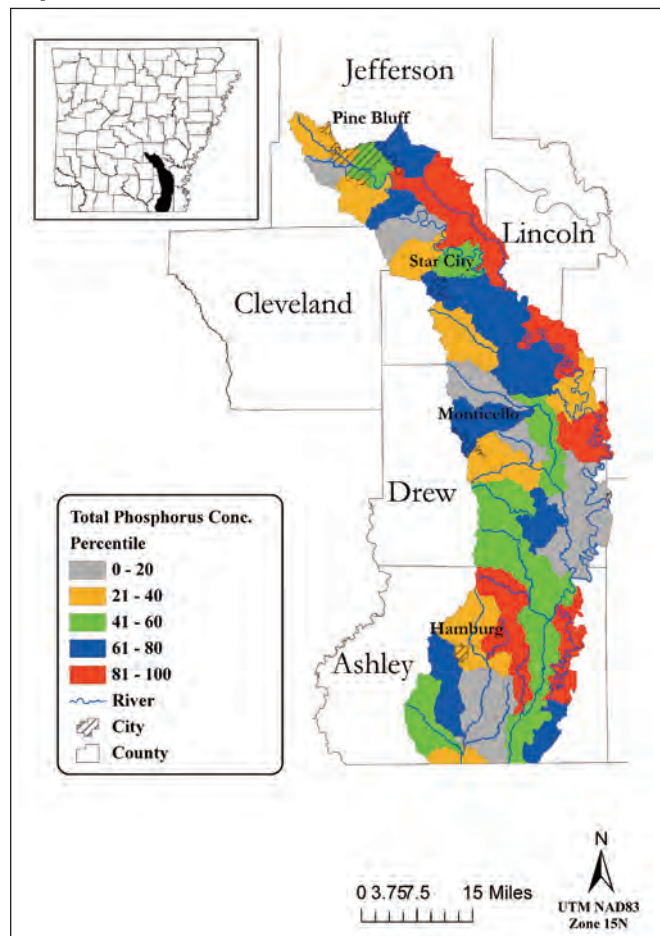
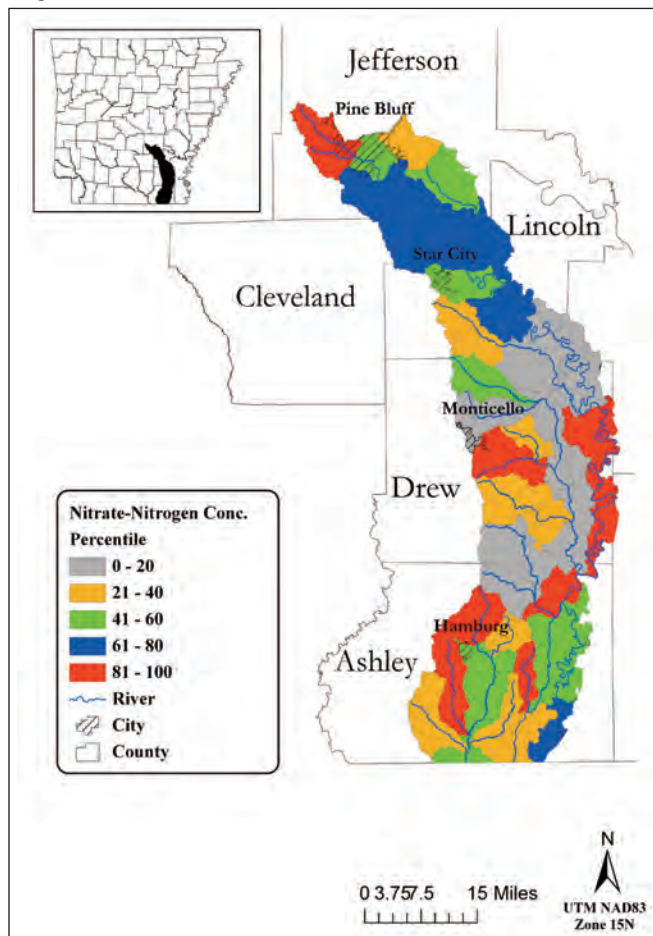


Figure 10.2c
Relative concentration of nitrate-nitrogen in quintiles for sub-watersheds of Bayou Bartholomew

Data Source: GeoStor, SWAT simulations between 2006 and 2008
 Map Created: March 2011



Brief Description of Land Uses in the Watershed

Figure 10.3 shows land use in the Bayou Bartholomew watershed in 2006.

The following provides a partial snapshot of the watershed:

- Bayou Bartholomew contains a variety of landscapes ranging from rolling forested hills in the western portions to relatively flat farmland along much of the eastern section. Especially fertile farmland is located along Bayou Bartholomew and other areas lying in the ancient

floodplain of the Arkansas and Mississippi rivers. Much of the land west of Bayou Bartholomew is used for the production of timber (Layher and Phillips, 2002).

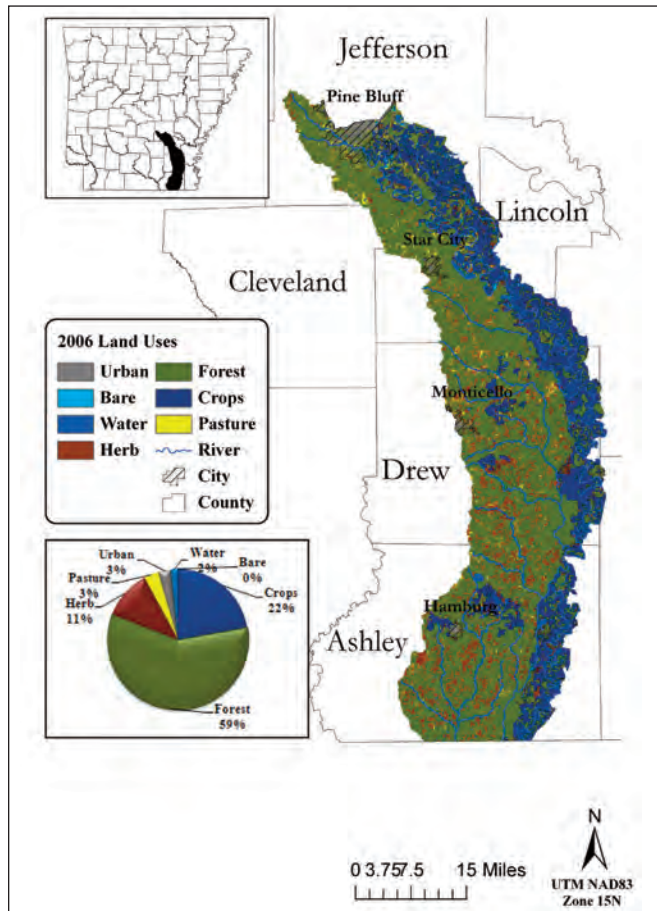
- Nearly 22 percent of the watershed's land area is cultivated in row crops, primarily rice and soybeans (CAST, 2006). Cropland is predominantly found in the alluvial soils along the eastern portion of the watershed.
- Forests dominate in the western Gulf Plains portion of the watershed. Some 59 percent of the land is in forests and 3 percent is in pasture (CAST, 2006). The forests range from naturally

diverse bottomland hardwoods and mixed pine/upland hardwoods to industrial stands of loblolly pine.

- Some poultry production occurs in and around Star City in Lincoln County.
- The Nature Conservancy and Winrock International piloted an EPA-funded project to create markets for conservation credits as an incentive for replanting bottomland hardwoods in order to reclaim environmentally sensitive croplands.
- The stream now known as Bayou Bartholomew resides in a former course of the Arkansas River, which explains the numerous oxbow lakes along Bayou Bartholomew.

Figure 10.3 Bayou Bartholomew watershed land uses, 2006

Source: Center for Advanced Spatial Technologies (CAST), Land Use/Land Cover, 2006
Data Source: GeoStor
Map Created: March 2011



- While the main stem of Bayou Bartholomew has escaped channelization, many of its tributaries have been altered through the addition of weirs and dams and other channel or flow alterations.
- Approximately 47,640 people live in the watershed (BAEG, 2011). Most of the city of Pine Bluff drains into the Bayou Bartholomew watershed. Other municipalities in the watershed are Star City, a portion of Monticello and Hamburg. Throughout much of the watershed, population is declining at an accelerated rate. For example, Jefferson County's population declined 8.1 percent from 2000 to 2010. Chicot County's population decreased 16.4 percent over the 10-year period (UALR, 2011).
- Pine Bluff and a portion of Jefferson County are subject to Phase II stormwater requirements and have filed a notice of intent for a small municipal separate storm sewer system (MS4) NPDES permit. Municipalities subject to the MS4 permit are cooperating through a contract with the University of Arkansas Division of Agriculture Cooperative Extension Service.

Resource extraction occurs on a limited scale in the watershed, primarily removal of topsoil.

Water Quality/Program Goals

The Bayou Bartholomew watershed has been a priority of the Arkansas NPS Pollution Management Plan since 1998. ANRC is again designating the Bayou Bartholomew watershed as a priority watershed for the 2011-2016 NPS Pollution Management Plan. Pollutants of concern within this hydrologic unit area include siltation/turbidity, pathogens, total dissolved solids (TDS), chlorides and low dissolved oxygen. Some of these pollutants cause some waterbodies to not fully meet their designated uses for aquatic life on the most current List of Impaired Waterbodies.

The impaired segments of the Bayou Bartholomew watershed can be viewed at:

- http://arkansaswater.org//index.php?option=com_content&task=view&id=14&Itemid=30.
- www.adeq.state.ar.us/water/branch_planning/pdfs/303d_list_2008.pdf.

The long-term goal of the priority watershed program is to reduce pollutants to levels that will restore all designated uses. The short-term goal of the

program is to measurably reduce pollutants of concern that reach waters of the Bayou Bartholomew watershed, targeting sub-watersheds where implementation can have the greatest impact. These goals will be achieved through implementation of the Nine Element Plan, which will complement the locally led implementation of a Watershed Restoration Action Strategy (WRAS), published September 8, 1999, by ANRC and developed by the Bayou Bartholomew Alliance (BBA). A Nine Element Plan was developed in 2005 by the BBA and was updated by ANRC in 2009. It will replace the WRAS when the EPA determines it is acceptable to meet the nine elements. In order to reach the short-term goal, wide-ranging partners will continue to build public support for implementation of management measures to restore designated uses in the watershed.

Objectives and Milestones

Based on the SWAT model and other available analysis, ANRC will review available data and select sub-watersheds for targeting of implementation funds.

Data that may be considered in targeting include, but is not limited to, the modeled loads for sediment and phosphorus, percentage of intact woody riparian vegetation, density of unpaved roads, number of stream road crossings, rural population density, intensity of row crop agriculture, degree of urbanization and potential sources of pollutants. Other factors may also be considered at the discretion of ANRC including, but not limited to, local institutional capacity, input from the NPS Pollution Management Plan Stakeholder Group, local watershed groups or other agencies, availability of funds and other factors.

The 2011-2016 NPS Pollution Management Plan includes statewide programs aimed at reducing pollutant loads from land uses that have the potential to impact water quality. These land uses and programs to reduce their water quality impacts are described in more detail in earlier sections of the 2011-2016 NPS Pollution Management Plan. Statewide programs that will be implemented in the Bayou Bartholomew watershed and their relative level of priority are summarized in Table 10.1.

Table 10.1. Relative priority of statewide programs to effect improvements in water quality in the Bayou Bartholomew watershed

Description of Land Use	Statewide Program	Intensity of Land Use/Potential Impact
Animal agriculture	Agriculture	
• Confined animals		Low to moderate
• Pasture (e.g., application of poultry litter to pasture, unconfined livestock)		Low to moderate
Row crop agriculture	Agriculture	Very high
Forestry	Silviculture	
• Public lands		Low to moderate
• Industrial		Low to moderate
• Private nonindustrial		Moderate to high
Urban	Urban Runoff	Moderate to high
• Rapidly urbanizing area subject to Phase II small separate municipal storm sewer system (MS4) NPDES permit requirements for stormwater management		Moderate to high
Construction	Surface Erosion	
• Road and other infrastructure		Low to moderate
• Residential development		Low to moderate
• Commercial/industrial		Low to moderate
Onsite waste disposal	Urban Runoff	Moderate to high
Streambank modification	Surface Erosion	High
Surface mining (e.g., topsoil removal, gravel mining)	Resource Extraction	Low to moderate

The following objectives and milestones were identified with input from the NPS Pollution Management Plan Stakeholder Group. Table 3.1 (page 27) identifies cooperating entities that will partner to implement the NPS program in the Bayou Bartholomew watershed.

10.1. Continue development of the Nine Element Plan until EPA's acceptance is obtained.

Timeline for Milestones: October 2011 through September 2016

10.2. Continue to develop support for implementation of the Nine Element Plan among potential cooperating entities and the general public.

Timeline for Milestones: October 2011 through September 2016

10.3. Provide technical and financial assistance to local cooperating entities to implement the Nine Element Plan as resources allow.

Timeline for Milestones: October 2011 through September 2016

10.4. As resources allow, use remote sensing and geographic information systems (GIS) analysis to identify sub-watersheds where more extensive assessment is needed. Conduct targeted geomorphological and bioassessment to identify and target implementation of streambank stabilization projects for high impact sites (for example, a geomorphologic study of logjams and assess beaver populations to determine their impact on streambank erosion and other studies).

Timeline for Milestones: October 2011 through September 2016

10.5. Continue to refine models as new data becomes available to represent sediment and nutrient loads in the watershed and in-stream processes to enable prioritization of implementation projects in sub-watersheds.

Timeline for Milestones: October 2011 through September 2016

10.6. Continue to focus on BMP implementation to improve conservation practices for erosion control, sediment retention, irrigation management and nutrient management on row crop and animal agriculture and forestland. As appropriate, direct technical assistance to landowners in targeted watersheds giving emphasis to developing new conservation plans and areas that connect established riparian corridors.

Timeline for Milestones: October 2011 through September 2016

10.7. Continue to provide and improve extensive education and training to promote BMP implementation (for example, risk management, demonstrations to acquaint landowners and municipalities with the conservation practices most effective in reducing runoff, sediment detachment and transport including, but not limited to, no-till, conservation till, ridge till, pipe drop outlets, riparian zone management and wetland restoration).

Timeline for Milestones: October 2011 through September 2016

10.8. Continue to encourage landowners to establish riparian buffer strips and grass drainageways, stabilize streambanks and restore riparian areas.

Timeline for Milestones: October 2011 through September 2016

10.9. Continue to secure conservation easements through donations, as the opportunity arises, in an effort to protect lands along Bayou Bartholomew and its tributaries from development that would result in further NPS pollution.

Timeline for Milestones: October 2011 through September 2016

10.10. Continue to increase public awareness and provide education to build support for citizen action to improve water quality in the watershed.

Timeline for Milestones: October 2011 through September 2016

10.11. Build constituency for improved water quality by increasing volunteerism and promoting recreational use of the river (for example, recruiting volunteers for cleanups, streambank restoration and other activities utilizing the Arkansas Stream Team program and other conservation groups as well as increasing public recreational access to the river with trails and boat ramps).

Timeline for Milestones: October 2011 through September 2016

10.12. Encourage county and municipal elected officials as well as contractors, home builders and consulting engineers to participate in construction and urban education programs to improve stormwater management.

Timeline for Milestones: October 2011 through September 2016

10.13. Coordinate conservation planning within a watershed area to take full advantage of cost-share programs for riparian habitat improvement – the Wetland Reserve Program (WRP), the Conservation Reserve Program (CRP), the Wetland and Riparian Zone Tax Credit Program (through ANRC) and other programs.

Timeline for Milestones: October 2011 through September 2016

10.14. Encourage plans for alternative irrigation water supply and supplemental stream augmentation, including off-stream storage of surplus flows.

Timeline for Milestones: October 2011 through September 2016

10.15. Continue aquatic life assessments to assess response of waterbodies to NPS control measures as resources allow.

Timeline for Milestones: October 2011 through September 2016

10.16. Continue to provide public education on proper application, storage and disposal of pesticides, regulations and potential hazards of misuse (for example, encourage use of FARM*A*SYST and HOME*A*SYST programs to assess potential pollution hazards).

Timeline for Milestones: October 2011 through September 2016

10.17. Continue to provide education to rural homeowners and builders on proper construction and maintenance of onsite waste disposal systems.

Timeline for Milestones: October 2011 through September 2016

10.18. Continue to provide technical assistance and make available financial assistance to agricultural operations where cost-share is a component of approved 319(h) implementation projects.

Timeline for Milestones: October 2011 through September 2016

Timeline for Milestones

Provided sufficient financial and human resources are available to the cooperating state and local agencies and nonprofit organizations working together in Bayou Bartholomew, the short-term objectives of this program can be met within five years of program initiation. Fully implementing management measures within the watershed to restore all designated uses is a longer-term endeavor. A goal of this program is to fully meet designated uses within 15 years.

Program Coordination

There is currently no single entity in the Bayou Bartholomew watershed with the authority to implement the Nine Element Plan. The ANRC will work with cooperating entities in the watershed to promote voluntary coordination and incorporate conditions requiring

cooperation in grant agreements, as appropriate. A high degree of voluntary coordination already exists in the agriculture program through the Arkansas Conservation Partnership (ACP) as well as local coordination groups already in place.

Significant local coordination is achieved through the Bayou Bartholomew Alliance. The alliance is a 501(c)3 nonprofit organization governed by a board of directors. Board members represent the range of stakeholders in the watershed, including farmers, private and industrial forest landowners, municipalities and sportsmen. The board meets regularly to set goals, review progress, adapt plans as needed and provide broad oversight. The board of directors is committed to retaining the watershed coordinator, who has extensive knowledge of the watershed.

The alliance developed the watershed action strategy and coordinates projects at the watershed level consistent with the watershed action strategy. The alliance is supported by a technical committee composed of individuals who represent state and federal agencies as well as local governmental organizations and nonprofit groups with an interest in the watershed. It is gathering public input and providing leadership for the development of a Nine Element Plan.

Federal Consistency

The lead agency for each statewide program is responsible for working with federal partners to promote federal consistency. Statewide programs and their lead agencies are identified in the Cooperating Entities section of the 2011-2016 NPS Pollution Management Plan.

Program Tracking and Monitoring

Water quality monitoring data will be used to evaluate the effectiveness of NPS pollution management activities in the Bayou Bartholomew watershed. ADEQ is responsible for maintaining the state's water quality inventory. ADEQ, USGS and the Arkansas Water Resources Center (AWRC) maintain monitoring stations in Bayou Bartholomew. ADEQ maintains a network of water quality monitoring stations in the Bayou Bartholomew watershed. ADEQ monitors two sites roughly on a monthly basis for a suite of water quality parameters. Four sites are part of ADEQ's Roving Monitoring Network. In 1994, ADEQ identified the major waters of the state that had never been

monitored or had not been monitored within the last 10 years. An extensive network of approximately 100 stations was established to monitor the water quality of these "unassessed" waters. Quarterly sampling began at these sites in May 1994 and continued through October 1996. In October 1998, these stations were divided into four groups. Each group would be sampled for one year on a bimonthly basis. Additional sites are added to each group to bring the total number of stations to near 40 for each sampling event. These stations make up the "Roving Monitoring Network." In addition, Bayou Bartholomew was part of a special monitoring project from 1997-2000 that included sampling at 26 monitoring stations. The goal of these special projects is to get a synoptic picture of a

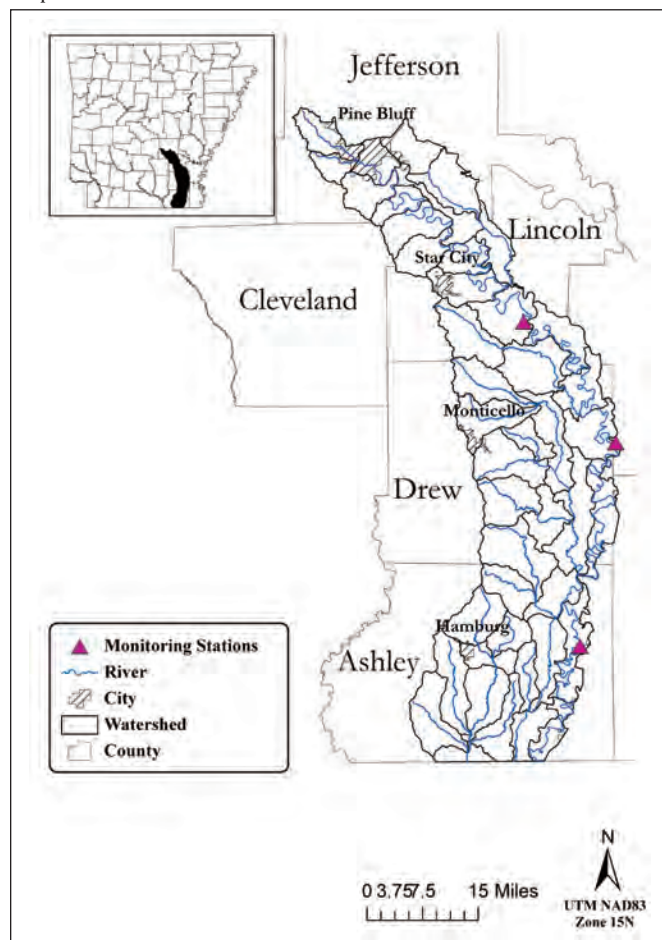
designated watershed over a limited period of time. In addition, USGS operates monitoring stations and ANRC contracts with AWRC to maintain monitoring sites in Bayou Bartholomew. Figure 10.4 shows the monitoring stations in the watershed.

The University of Arkansas' Department of Biological and Agricultural Engineering has compiled GIS databases and developed SWAT models of the Bayou Bartholomew watershed. These models are helpful in selecting sub-watersheds for more intensive implementation activities and also for evaluating the effectiveness of implementation within a sub-watershed or basin-wide.

The NPS Pollution Management Plan may include as a condition of funding pre- and post-project measurements of changes in water quality. The NPS Pollution Management Plan encourages cooperating entities working in the watershed to meet annually to report on their activities of the previous year and discuss their successes, failures and future needs of their programs. The local watershed group is a logical convener for these discussions. Local cooperators are encouraged to compile this information, along with a summary of available water data and land use trends, into an annual watershed status report published and distributed in the watershed and to interested parties outside the watershed.

Figure 10.4 Monitoring stations in the Bayou Bartholomew watershed

Sources: U.S. Geological Survey, Ecological Conservation Organization
Data Source: GeoStor
Map Created: March 2011



References Cited

- ADEQ, 2002. 2002 Integrated Water Quality Monitoring and Assessment Report. Arkansas Department of Environmental Quality, Water Division: Little Rock, Ark.
- BAEG, 2011. County-Wise Population Data. Biological and Agricultural Engineering Department. University of Arkansas: Fayetteville, Ark.
- CAST, 2006. Land Use/Land Cover Data. Biological and Agricultural Engineering Department. University of Arkansas: Fayetteville, Ark.
- EPA, 2002. TMDLS for Turbidity for Bayou Bartholomew, AR. Prepared by FTN Associates, Ltd., under Contract No. 68-C-99-249, Work Assignment #2-109. EPA Region VI, Watershed Management Section: Dallas, Texas.
- Integrated Water Quality Monitoring and Assessment Report (IWQMAR). 2008. Arkansas Department of Environmental Quality: Little Rock, Ark. Available at www.arkansaswater.org/Documents/305b/2008_305b.pdf.
- Layher, W. G., and J. W. Phillips, 2002. Bayou Bartholomew Wetland Planning Area Report. Arkansas Multi-Agency Wetland Planning Team: Little Rock, Ark.
- UALR, 2011. Percent Change in Total Population. Available at http://argis.ualr.edu/2010Census/Change_in_Pop_2000_to_2010_by_County.pdf.

Section Eleven

Beaver Reservoir (Upper White River) Priority Watershed

ADEQ Planning Segment 4K • HUC 11010001

Introduction

The Upper White River watershed (HUC 11010001) consists of portions of Washington, Benton, Madison and Carroll counties in Northwest Arkansas. This segment encompasses Beaver Reservoir, a 66-mile reach of the White River and its tributaries, and an 85-mile reach of the Kings River and its tributaries. It also includes Long Creek and Yocum Creek. Figure 11.1 shows the location of the Upper White River watershed.

Assessment

The summary of water quality condition is described from the current 305(b) report from the Arkansas Department of Environmental Quality (ADEQ) and other sources as cited appropriately. The following was stated in the most current 305(b) report:

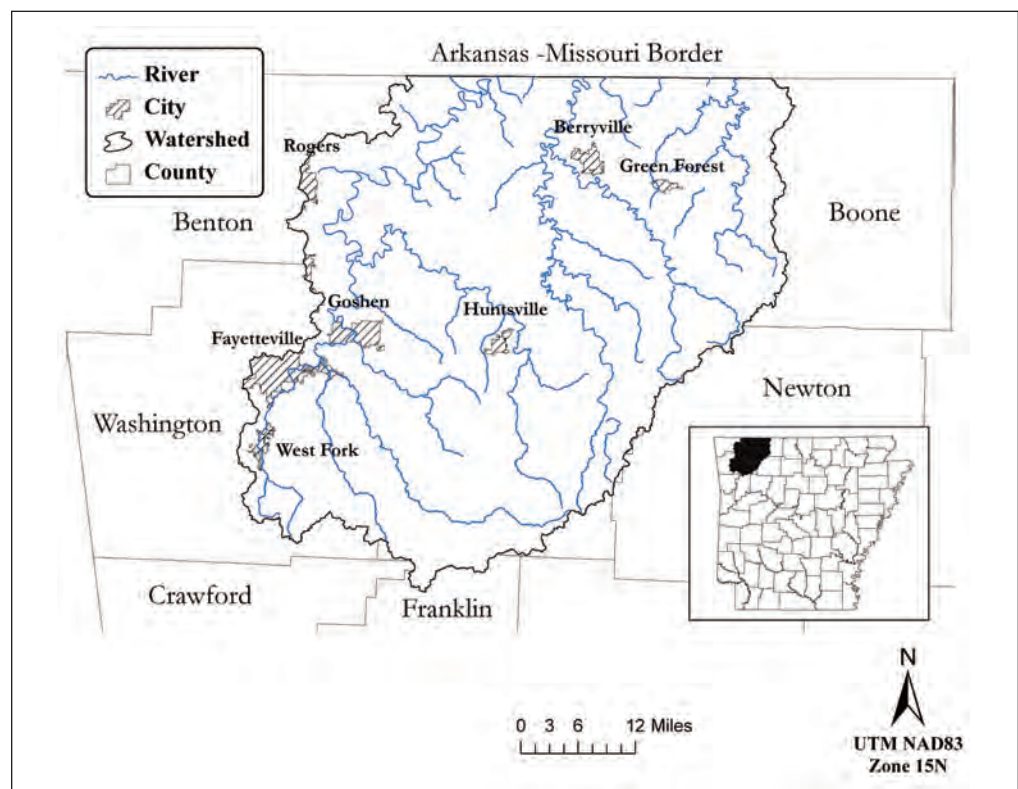
All waters within this segment are designated for propagation of fish and wildlife, primary and secondary contact recreation, and domestic, agricultural, and industrial water supplies. Also, about 20 percent of these waters are designated as outstanding state or national resources waters. A total of 327.3 miles of streams were monitored for use support and an additional 138.7 miles were evaluated.

Aquatic life use was assessed as not supported in the West Fork of the White River and the White River downstream of the West Fork. The major cause was high turbidity levels and excessive silt loads. A TMDL to address this issue was completed in 2006.

The Middle Fork of the White River and the White River occasionally failed to meet the dissolved oxygen standard of 6.0 mg/L. The exact cause of the impairment is unknown at this time.

Figure 11.1
Map of Beaver
Reservoir
watershed

Data Source: GeoStor
Map Created: March 2011



Several stream segments in this planning segment were listed as not supporting the drinking water use because of beryllium concentrations. Additional monitoring and an investigation into the proper standard are required.

A point source discharge to Holman Creek had impaired the drinking water use of the lower section of this stream by discharges of excessive levels of total dissolved solids. Additional investigations are needed to address this problem.

Total phosphorus levels in the Kings River and Osage Creek below the Berryville WWTP have decreased significantly over the past six years.

In the West Fork of the White River and in the White River between its confluence with the West Fork and Beaver Lake, the cause of non-support of the aquatic life use was exceedances of numeric criteria for turbidity (FTN, 2006). In ADEQ's 2008 List of Impaired Waterbodies (303(d) List, the cause of this impairment was listed as sediment. The total maximum daily load (TMDL) prepared for these streams used total suspended solids (TSS) as a surrogate for turbidity (FTN, 2006). In development of the TMDL, statistically significant relationships were found between turbidity and TSS (FTN, 2006). The completed TMDL called for a 32 to 58 percent reduction in TSS (Table 11.1). As can be seen from Table 11.1, the TMDL attributed the entire load of TSS to nonpoint sources. In its 2008 List of Impaired Waterbodies, ADEQ identified the major source of sediment in these two streams as surface erosion (ADEQ, 2008).

In 2002, ADEQ listed probable sources of sediment in these streams as 1) agricultural land clearing, 2) road construction and maintenance and 3) gravel removal from stream beds (ADEQ, 2002). ADEQ conducted a survey of sediment sources in the West Fork of the White River in 2004 (Formica et al., 2004). The

relative and estimated contribution from streambanks, paved and unpaved roads, urban areas, pasture, gullies and construction was considered. A simulation model developed by Purdue University, the Water Erosion Prediction Project (WEPP), was used to estimate sediment loads from pastures and unpaved roads. The study estimated sediment load to the West Fork totaling 35,795 tons per year. Streambank load was estimated to be 66.1 percent of the total. One 0.7-mile reach accounted for 25 percent of this load. Roadways and ditches accounted for 17.1 percent, and urban areas including construction were 10.9 percent. Pasture and other sources were 4.8 and 1.1 percent, respectively.

Brown et al. (2003) found decreased diversity of fish in the West Fork of the White River and that the macroinvertebrate community was composed mostly of pollution-tolerant taxa. Disturbed riparian corridors and physical conditions in the stream were identified as the causes of the impact.

In 2008, the uppermost 1,500 acres of Beaver Reservoir were identified by ADEQ as not supporting the aquatic life designated use because of sediment. The source of this sediment was identified as surface erosion (ADEQ, 2008). The impaired reach of Beaver Lake extended from its headwater on the White River near Goshen downstream to near the confluence with War Eagle Creek.

A U.S. Forestry Service (USFS) comparative assessment of 50 watersheds in Arkansas, Oklahoma and Missouri estimates potential erosion by land use for the Upper White River watershed. Based on 1992 National Resource Inventory data, pastureland had the highest potential erosion rate at 86 percent, compared to other lands (including urban) with a 13 percent potential erosion rate and forestry with a 2 percent potential erosion rate. Compared to 1982, potential erosion rates increased for other lands and decreased slightly for pasturelands (USFS, 1999).

Table 11.1. Summary of turbidity TMDLs for the West Fork of the White River and the White River (FTN, 2006)

Reach ID	Stream Name	Flow Category	Loads (tons/day of TSS)				Percent Reduction Needed
			WLA	LA	MOS	TMDL	
110100001-023	White River	Base flow	0	0.606	0	0.606	32%
		Storm-flow	0	19.3	0	19.3	40%
110100001-024	West Fork White River	Base flow	0	0.111	0	0.111	53%
		Storm-flow	0	4.31	0	4.31	58%

Holman Creek (reach 059) was also identified in the 2008 List of Impaired Waterbodies as impaired for nitrates (ADEQ, 2008). In this case, a municipal point source was identified as the cause. A TMDL was completed for Holman Creek in 2001 (ADEQ, 2008).

One reach of the Kings River (reach 042) is identified by ADEQ as not supporting the designated uses of aquatic life, domestic water supply and agricultural and industrial water supply because of excessive beryllium, total dissolved solids (TDS) and low dissolved oxygen (ADEQ, 2008). The sources of the beryllium and TDS were not known. ADEQ has placed this reach in category 5d, meaning additional data is needed to verify the use impairment before a TMDL or other corrective action is scheduled (ADEQ, 2008). The Dry Fork (reach 043) and Osage Creek (reach 047) tributaries of Kings River were listed as not supporting the drinking water designated use because of beryllium (ADEQ, 2008). The source was unknown. Yocum Creek (reach 052), a tributary to Table Rock Lake, also did not support the drinking water designated use (ADEQ, 2008). The source of this impairment also was unknown. Dry Fork, Osage and Yocum Creeks were all category 5d streams in the 303(d) list.

Nutrient enrichment of the waterbodies in this watershed is a concern, both from point and nonpoint sources. In 2003, the Arkansas General Assembly established nutrient surplus areas, including the Upper White River watershed, and enacted a package of laws requiring nutrient management plans, certifying nutrient planners and applicators and regulating nutrient application. These regulations were enacted in 2005. See the Introduction for a map of all nutrient surplus areas (page 2).

Nutrients, nitrogen and phosphorus, may be produced by either point sources or nonpoint sources. In the Beaver Lake portion of the watershed, point sources represent about 14 percent of the total phosphorus load (Morgan, 2007). The majority of the load of phosphorus into Beaver Lake is from nonpoint sources.

ADEQ identified nutrient enrichment in Osage Creek in its 2002 305(b) report, reporting a mean total phosphorus concentration of 1.85 mg/L. ADEQ also identified nutrient enrichment in the Kings River, reporting a mean total phosphorus concentration of 0.35 mg/L, which is influenced by Osage Creek. The 2002 305(b) report also identified nutrient enrichment in Long Creek, with a mean total phosphorus concentration of 0.29 mg/L (ADEQ, 2002).

Eutrophic conditions in the headwater reaches of Beaver Reservoir have been experienced for many years (Haggard et al., 1999). The Beaver Water District (BWD) commissioned Black and Veatch (1982) to study water quality problems in the reservoir.

The study found that the problems experienced by the district were almost entirely due to high concentrations of algae and low dissolved oxygen at the intake. They concluded that phosphorus loading to the reservoir from both point and nonpoint sources (NPS) was the greatest impact on water quality at the time. The city of Fayetteville expanded its wastewater treatment facility in 1988 to add phosphorus removal capabilities. However, nonpoint source (NPS) pollution and/or recycling of nutrients sequestered in bottom sediments have increased to a point where little improvement has been noted.

The study by Haggard et al. (1999) found the condition of the reservoir was still eutrophic in the headwaters, although the trophic status of the reservoir depended somewhat on the lake level. They also found a relationship between nutrients and algae concentration in the reservoir.

Taste and odor problems also have been reported by BWD, the major provider of domestic water in Northwest Arkansas (personal communication). The taste and odor in BWD's water is caused by Geosmin and Methylisoborneo (MIB), which are byproducts of algae metabolism. The presence of algae in the reservoir indicates a potential nutrient enrichment problem.

The U.S. Geological Survey has done extensive monitoring and analysis of surface and groundwater quality in the Ozark Plateau study area as part of the National Water Quality Assessment Program (NAWQA). Major findings for the Ozark Plateau study area are available at:

- <http://ar.water.usgs.gov/nawqa/ozark/findings.html>.

Under contract with the Arkansas Natural Resources Commission (ANRC), the University of Arkansas' Department of Biological and Agricultural Engineering has used the Soil and Water Assessment Tool (SWAT) to model selected priority watersheds for the 2011-2016 NPS Pollution Management Plan. Figure 11.2 uses SWAT estimates of sediment and nutrient concentrations for 12-digit hydrologic unit code (HUC) sub-watersheds in the Beaver Reservoir watershed to show the relative concentration in quintiles for each sub-watershed.

Figure 11.2a
Relative concentration
of sediment in
quintiles for
sub-watersheds in
the Beaver Reservoir
watershed

Data Source: GeoStor, SWAT simulations
between 2006 and 2008
Map Created: March 2011

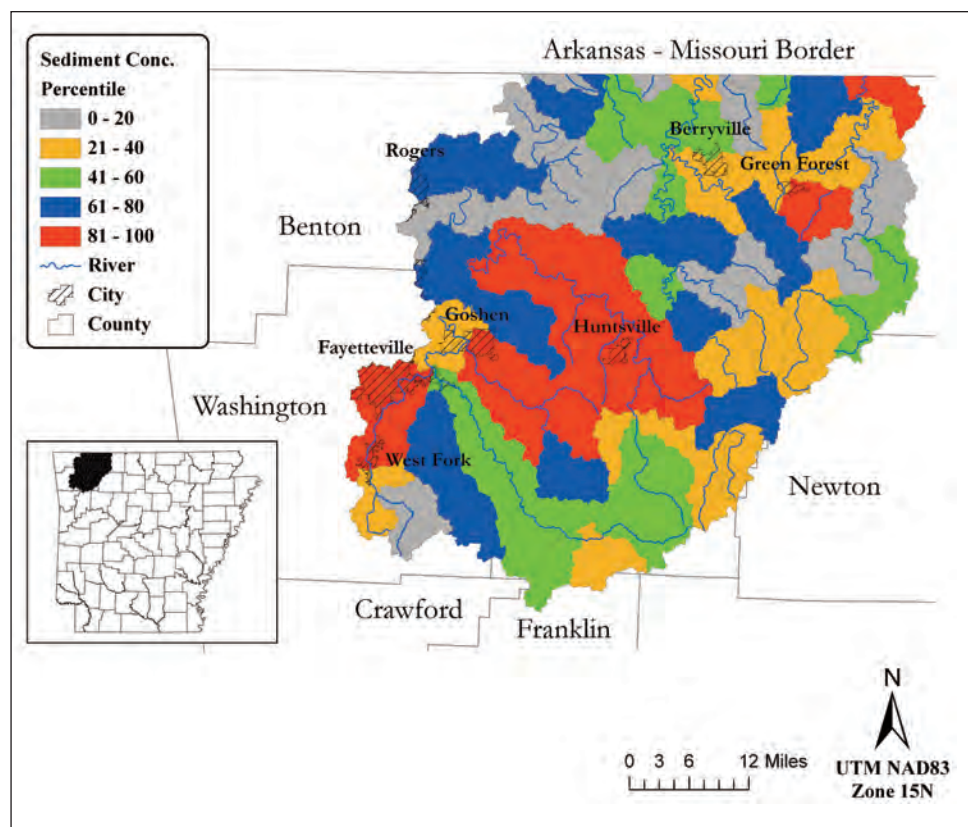


Figure 11.2b
Relative concentration
of total phosphorus
in quintiles for
sub-watersheds in
the Beaver Reservoir
watershed

Data Source: GeoStor, SWAT simulations
between 2006 and 2008
Map Created: March 2011

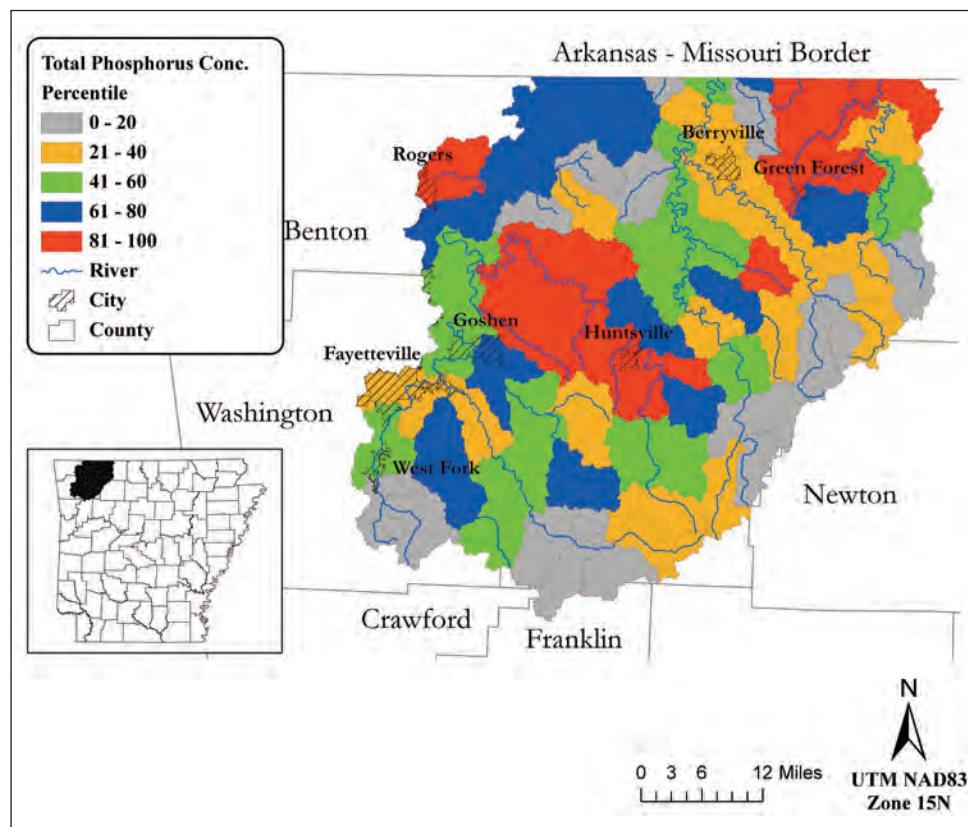
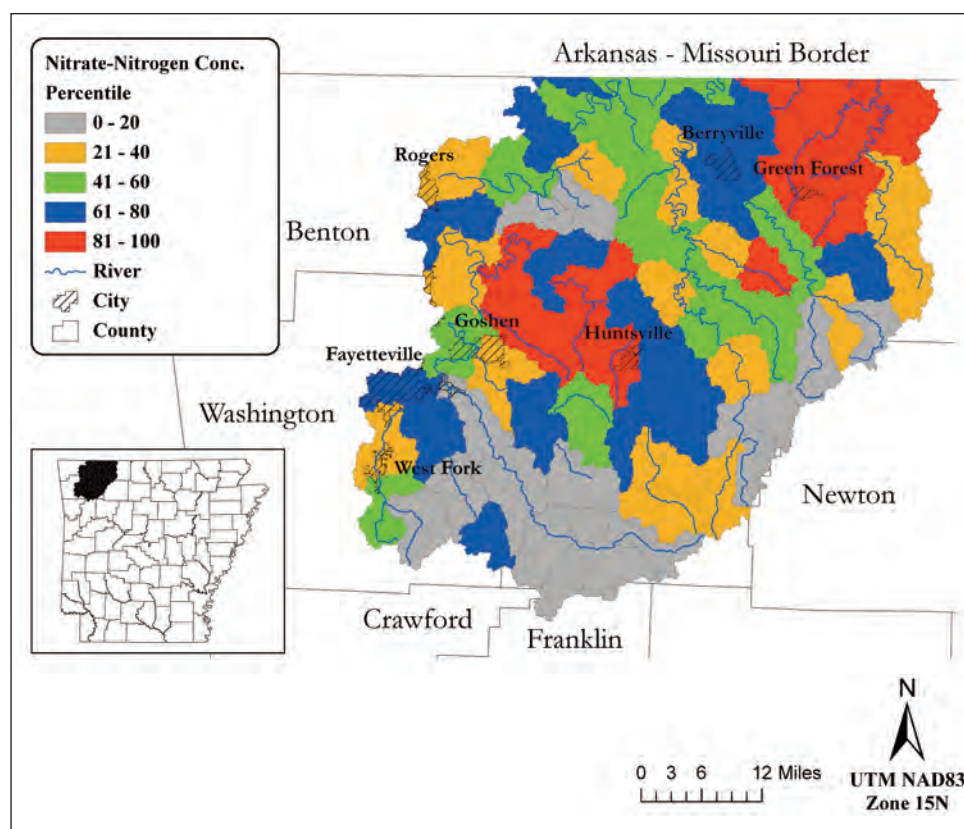


Figure 11.2c
Relative concentration
of nitrate-nitrogen
in quintiles for
sub-watersheds in
the Beaver Reservoir
watershed

Data Source: GeoStor, SWAT simulations
 between 2006 and 2008
 Map Created: March 2011



Brief Description of Land Uses in the Watershed

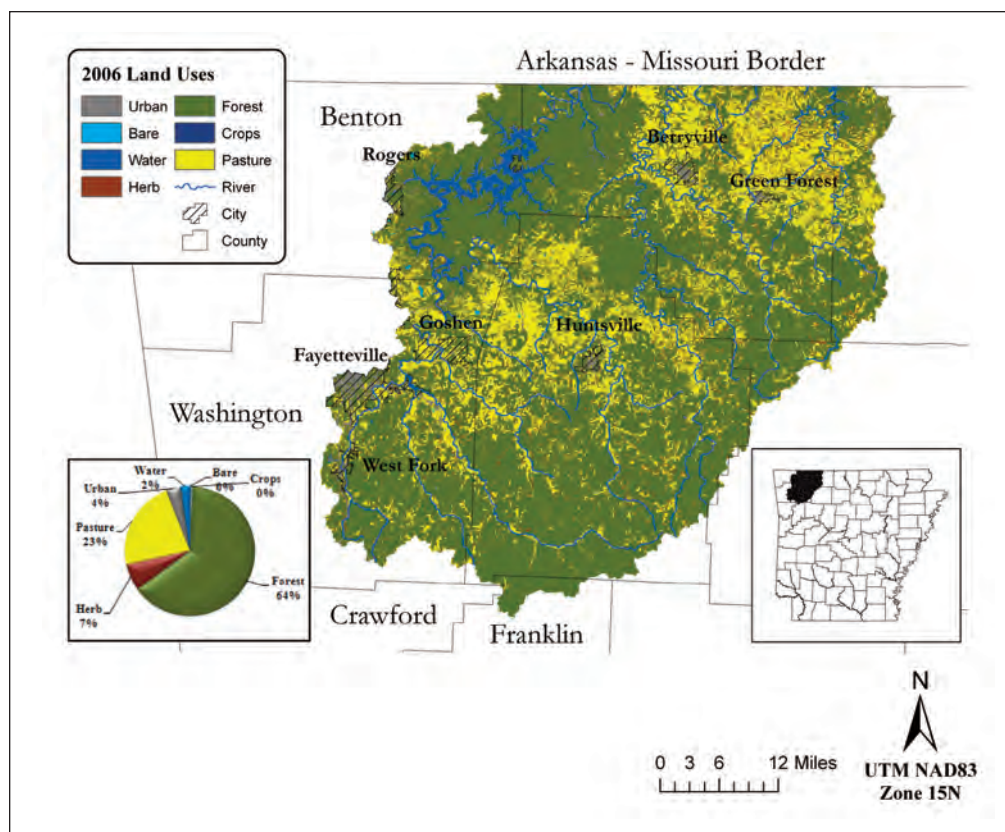
Figure 11.3 shows land use in the Beaver Reservoir watershed in 2006.

The following provides a partial snapshot of the watershed:

- Beaver Water District is a major wholesale supplier of drinking water for municipalities and industry in Northwest Arkansas, providing water to Bentonville, Rogers, Springdale and Fayetteville. Each of these in turn sell BWD water to communities such as Farmington, Elkins, Greenland, Tontitown, Lowell, Bethel Heights, Cave Springs and Bella Vista.
- There is significant growth in rural residential subdivisions, particularly in aesthetically attractive areas surrounding Beaver Reservoir.
- Major municipalities include portions of Fayetteville, Greenland and Lowell as well as West Fork, Eureka Springs, Berryville and Oak Grove. Twelve municipalities (some of which are in the Upper White River watershed) and portions of Washington and Benton counties, as well as the University of Arkansas, are subject to Phase II requirements for a small municipal separate storm sewer system (MS4) National Pollution Disposal Elimination System (NPDES) permit. With leadership from the Northwest Arkansas Regional Planning Commission, all of these entities have joined together to contract with the University of Arkansas Division of Agriculture Cooperative Extension Service to provide education and technical assistance.
- The population of Washington and Benton counties grew 28.8 percent and 44.3 percent, respectively, from 2000 to 2010 (UALR, 2011). Madison and Carroll counties also grew substantially over the decade, growing 10.3 percent and 8.2 percent, respectively (UALR, 2011).
- As a result of this population growth, there is significant new construction, including residential, commercial and industrial, roads and other infrastructure. Construction can be found both within municipal boundaries and in rural areas of the watershed where onsite waste disposal is used.

Figure 11.3
Land use in the
Beaver Reservoir
watershed, 2006

Source: Center for Advanced Spatial Technologies (CAST), Land Use/Land Cover, 2006
 Data Source: GeoStor
 Map Created: March 2011



- An estimated 176,517 individuals live in the watershed (BAEG, 2011).
- Forest and pasture are the dominant agricultural land uses in the watershed (CAST, 2006).
- The entire watershed is designated as a nutrient surplus area subject to new regulations for nutrient planning, nutrient application and certification of nutrient planners.
- Most forestland in the watershed is owned by private nonindustrial landowners and the national forest.
- Resource extraction (for example, topsoil removal, gravel mining) primarily supports local construction projects.

Water Quality/Program Goals

The Beaver Reservoir watershed has been a priority of the Arkansas NPS Pollution Management Plan since the comprehensive update of the program completed in 1998. ANRC is again designating the Beaver Reservoir watershed as a priority watershed for the 2011-2016

NPS Pollution Management Plan. Pollutants of concern within this hydrologic unit area include:

- total suspended solids;
- siltation/turbidity;
- dissolved oxygen; and
- nutrients.

Some of these pollutants cause some waterbodies to not fully meet their designated uses for aquatic life on the most current 303(d) List of Impaired Waterbodies (ADEQ, 2008).

The impaired segments of Beaver Reservoir watershed can be viewed at the following links:

- http://arkansaswater.org//index.php?option=com_content&task=view&id=14&Itemid=30.
- www.adeq.state.ar.us/water/branch_planning/pdfs/303d_list_2008.pdf.

The long-term goal in this priority watershed is to reduce pollutants to levels that will restore all designated uses. The short-term goal of the program is to measurably reduce the pollutant loading from the land

uses in the watershed. This goal is to be met through the implementation of the Nine Element Watershed Management Plan when EPA determines it is acceptable to them. A draft Nine Element Plan was submitted to EPA for review in the spring of 2003. EPA commented and ANRC submitted a revised plan in February 2004. Additional revisions are ongoing.

In the interim, short-term goals of the program will be addressed through the Beaver Reservoir Watershed Action Strategy developed by the local watershed technical support group and published by ANRC in December 2002. In addition, other watershed groups in the Upper White River watershed are working on watershed action strategies (for example, Kings River Watershed Partnership). Public support will have to be further developed to implement the proposed activities to achieve short- and long-term goals for the identified pollutants.

Objectives and Milestones

Based on SWAT and other available analyses, ANRC will review available data and select sub-watersheds for

targeting of implementation funds. Data that may be considered in targeting includes, but is not limited to, the modeled loads/concentrations for sediment and phosphorus, percentage of intact woody riparian vegetation, density of unpaved roads, number of stream road crossings, rural population density, density of animal feeding operations, degree of urbanization, potential sources of pollutants and population served by water supply intakes in the watershed. Other factors may also be considered at the discretion of ANRC including, but not limited to, local institutional capacity, input from the NPS Pollution Management Plan Stakeholder Group, local watershed groups or other agencies, availability of funds and other factors.

The 2011-2016 NPS Pollution Management Plan includes statewide programs aimed at reducing pollutant loads from land uses that have the potential to impact water quality. These land uses and programs to reduce their water quality impacts are described in more detail in earlier sections of the 2011-2016 NPS Pollution Management Plan. Statewide programs that will be implemented in the Beaver Reservoir watershed and their relative level of priority are included in Table 11.2.

Table 11.2. Relative priority of statewide programs to effect improvements in water quality in the Upper White River watershed

Description of Land Use	Statewide Program	Intensity of Land Use/Potential Impact
Animal agriculture	Agriculture	
• Confined animals		Very high
• Pasture (e.g., application of poultry litter to pasture, unconfined livestock)		Very high
Row crop agriculture	Agriculture	Not applicable
Forestry	Silviculture	
• Public lands		Low to moderate
• Industrial		Not applicable
• Private nonindustrial		Low to moderate
Urban	Urban Runoff	
• Rapidly urbanizing area subject to Phase II small separate municipal storm sewer system (MS4) NPDES permit requirements for stormwater management		Very high
Construction	Surface Erosion	
• Road and other infrastructure		Moderate to high
• Residential development		Very high
• Commercial/industrial		Very high
Onsite waste disposal	Urban Runoff	Very high
Streambank modification	Surface Erosion	High

The following objectives and milestones were identified with input from the NPS Pollution Management Plan Stakeholder Group. Table 3.1 (page 27) identifies cooperating entities that will partner to implement the watershed program in the Beaver Reservoir watershed.

11.1. Continue development of the Nine Element Plan until EPA's acceptance of the plan is obtained.

Timeline for Milestones: October 2011 through September 2016

11.2. Continue to develop support for implementation of the Nine Element Plan among potential cooperating entities and the general public.

Timeline for Milestones: October 2011 through September 2016

11.3. Provide technical and financial assistance to local cooperating entities to implement the Nine Element Plan as resources allow.

Timeline for Milestones: October 2011 through September 2016

11.4. Promote and support strengthening of local capacity to implement the Nine Element Plan. Encourage local review of a range of options to identify the most effective institutional mechanism to lead/coordinate its implementation.

Timeline for Milestones: October 2011 through September 2016

11.5. Identify sub-watersheds where more extensive assessment is needed. Conduct targeted geomorphological and bioassessment to identify and target high-impact restoration sites (for example, streambank stabilization projects). Promote use of riparian tax credits and other cost-sharing programs to fund restoration projects and develop conservation easements.

Timeline for Milestones: October 2011 through September 2016

11.6. Continue to refine models as new data become available to represent sediment and nutrient loads in the watershed, in-stream processes and lake response to enable prioritization of implementation projects in sub-watersheds.

Timeline for Milestones: October 2011 through September 2016

11.7. Continue to encourage the development of comprehensive nutrient management plans (CNMPs) or nutrient management plans (NMPs), provide technical assistance and make available financial assistance to animal agricultural operations where cost-share is a component of approved implementation projects.

Timeline for Milestones: October 2011 through September 2016

11.8. Continue and strengthen ongoing comprehensive education and training programs to help poultry and livestock producers meet the requirements of new ANRC poultry litter and nutrient application regulations and ADEQ confined animal feeding operations (CAFO) regulations.

Timeline for Milestones: October 2011 through September 2016

11.9. Continue to develop and provide coordinated, comprehensive education for city planners, elected officials, developers, contractors, property owners and others using workshops, print and electronic materials, demonstration projects and other methods on topics such as stormwater pollution prevention plans, proper installation and maintenance of erosion and sediment control, planning tools to improve stormwater management (for example, low impact development (LID), greenways, cluster development) and other related topics.

Timeline for Milestones: October 2011 through September 2016

11.10. Cooperate with and support the efforts of local nonprofit organizations, municipalities and other cooperating entities to develop and deliver a coordinated water quality education program with a local emphasis.

Timeline for Milestones: October 2011 through September 2016

11.11. Identify groups for targeted education on specific high-impact activities (for example, develop fact sheets for boaters about proper waste disposal and the impact of that at boat ramps and marinas; provide training to county elected officials, road departments and property owners associations on how to reduce erosion from rural roads; or provide education to home builders, developers and homeowners on methods and activities to reduce NPS pollution).

Timeline for Milestones: October 2011 through September 2016

11.12. Carry out comprehensive information and education program quality for community leaders, including mayors, county judges, quorum courts, planning boards and commissions, conservation district directors and others. Emphasize the need to protect water and the benefits of clean water for the economy, quality of life and the environment.

Timeline for Milestones: October 2011 through September 2016

11.13. Identify severe erosion sites at rural road crossings, and work with county government to develop and implement erosion control plans for high-impact sites (for example, promote use of conservation district hydromulcher for treatment).

Timeline for Milestones: October 2011 through September 2016

11.14. Encourage development of urban forestry projects in municipalities within the watershed.

Timeline for Milestones: October 2011 through September 2016

11.15. Continue to provide training to earth-moving contractors and their employees, public works department employees, county employees and others regarding operation and maintenance of construction and post-construction Best Management Practices (BMPs) through the partnership with the Northwest Arkansas Regional Planning Commission and the University of Arkansas Division of Agriculture Cooperative Extension Service in order to help them meet the requirements of EPA phase II stormwater regulations for construction and municipal separate storm sewer systems (MS4s).

Timeline for Milestones: October 2011 through September 2016

11.16. Review tax code to determine possible mechanisms to use tax incentives for water quality BMP implementation in nutrient surplus areas, especially for practices that minimize the direct impact of cattle on streams.

Timeline for Milestones: October 2011 through September 2016

11.17. Work with elementary and secondary school teachers to develop teaching modules regarding water quality protection and conservation that meet curriculum requirements of the Arkansas Department of Education.

Timeline for Milestones: October 2011 through September 2016

11.18. Build constituency for improved water quality by increasing volunteerism for cleanups, streambank restoration and other activities utilizing the Arkansas Stream Team program and other conservation groups, conducting water awareness days, building working relationships with groups that represent recreational users (for example, bird watchers, paddlers, hunters, etc.) and other means.

Timeline for Milestones: October 2011 through September 2016

11.19. Continue to promote LID and retrofit as applicable to reduce NPS pollution.

Timeline for Milestones: October 2011 through September 2016

Program Coordination

No single entity currently possesses the authority to fully implement the Beaver Reservoir Watershed Action Strategy. The Upper White River Basin Foundation acts as an umbrella through which other watershed groups in the basin can leverage their efforts and cooperate to achieve mutual goals. Watershed groups include the Kings River Watershed Partnership, which has initiated a watershed planning process to address NPS issues, the newly formed Beaver Watershed Alliance, the West Fork Watershed Partners, the Association for Beaver Lake Environment and the Audubon Arkansas' West Fork Watershed project. Efforts are underway to develop a watershed group in Longs Creek. In addition, BWD hired a manager of environmental quality in 2005 to help develop and implement watershed protection projects to protect the drinking water supply. Local leaders have identified a need for a coordinating body that can provide day-to-day leadership and coordination of resources.

The NPS Pollution Management Plan stakeholders identified the lack of a single entity with authority to implement a coordinated watershed action strategy as a critical missing link in effective management of the watershed. Local governments, watershed alliances and others local interests in the watershed will cooperate to determine potential legal mechanisms to establish an authority, preferably within existing statutory authorities. Until such an authority is established, ANRC can help facilitate coordination by continuing a discussion on priorities and proposals with the cooperating entities listed in this plan.

Timeline for Milestones

When sufficient financial and human resources are available to cooperating entities, we believe the short-term objectives of this plan can be met within five years of program initiation. Fully implementing management measures within the watershed to restore all designated uses is a longer-term endeavor. A goal of this plan is to fully meet designated uses within 15 years.

Federal Consistency

ANRC and other state agencies are members of the U.S. Department of Agriculture Natural Resources Conservation Service (NRCS) State Technical Committee. In addition, NRCS serves on the NPS Pollution Management Plan Stakeholder Group. Through this committee and the stakeholders, consistent review of NRCS programs with the nonpoint management plan is accomplished.

The Ozark-St. Francis National Forest initiated development of a forest management plan update on May 1, 2002. The Arkansas Forestry Commission and other state agencies will work with the Ozark-St. Francis National Forest in the development of the plan to obtain consistency with the 2011-2016 NPS Pollution Management Plan, particularly with respect to how it could affect the Upper White River watershed.

Program Tracking and Evaluation

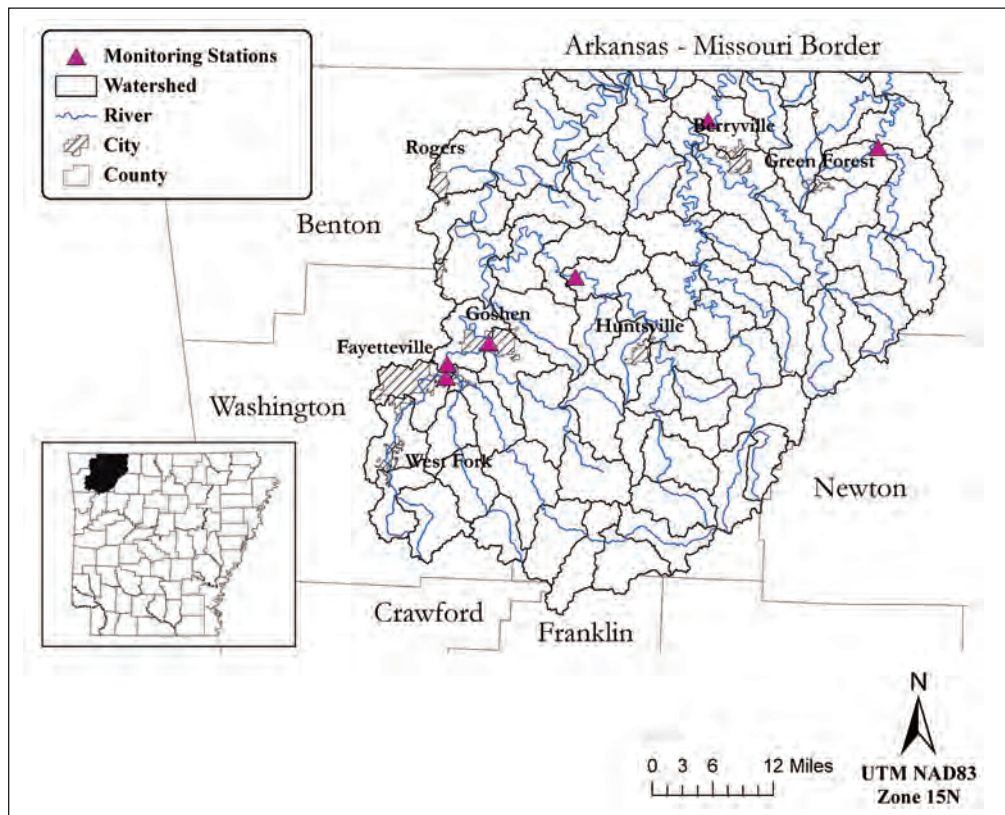
ADEQ maintains a network of 11 ambient water quality monitoring stations in the Upper White River watershed. These stations are monitored monthly for a suite of water quality parameters. In addition, the Arkansas Water Resources Center (AWRC) water quality lab maintains continuous monitoring stations on the West Fork of the White River and the White River. The Beaver Water District, in a cooperative program with USGS, collects water quality data during base flow and storm events at tributaries to Beaver Reservoir. In addition, the BWD/USGS program

collects data six times annually at seven in-lake stations. ADEQ evaluates data from these stations and from periodic synoptic surveys to determine water quality limited waters. The data will continue to be collected for the foreseeable future and can be used to track long-term changes in water quality in the watershed. In addition, the USGS and ANRC, through a contract with AWRC, maintain monitoring sites in the watershed. Figure 11.4 shows monitoring stations in the watershed.

The NPS Pollution Management Plan may include pre- and post-project measurements of changes in water quality as a condition of funding. An effective evaluation of the watershed program could be implemented by an annual meeting of the cooperating entities where each reports on their activities of the previous year and discusses the successes, failures and future needs of their programs. This information, along with a summary of available water quality data and land use trends, could be assembled into an annual watershed status report published and distributed in the watershed and to interested parties outside the watershed.

Figure 11.4
Monitoring
stations in the
Beaver Reservoir
watershed

Sources: Arkansas Water Resources Center, U.S. Geological Survey
Data Source: GeoStor
Map Created: March 2011



References Cited

- ADEQ, 2002. 2002 Integrated Water Quality Monitoring and Assessment Report. Arkansas Department of Environmental Quality, Water Division: Little Rock, Ark.
- APCEC, 2001. Regulation Number 2: Regulation Establishing Water Quality Standards for Surface Waters of the State of Arkansas. Arkansas Pollution Control and Ecology Commission: Little Rock, Ark.
<http://www.adeq.state.ar.us/regs/default.htm>.
- BAEG, 2011. County-Wise Population Data. Biological and Agricultural Engineering Department. University of Arkansas Division of Agriculture: Little Rock, Ark.
- Black and Veatch, 1982. Consulting report submitted to the Beaver Water District. Black and Veatch, Overland Park, Kansas.
- Brown, A. V., A. J. Radwell and R. A. Reese, 2003. Bioassessment of the West Fork of the White River, Northwest Arkansas. University of Arkansas, Fayetteville, Arkansas Water Resources Center, Department of Biological Sciences. MSC-307.
- Formica, S. J., M. A. Van Eps, M. A. Nelson, A. S. Cotter, T. L. Morri and J. M. Beck, 2004. West Fork White River Watershed – Sediment Source Inventory and Evaluation. ASAE, Pub. Date September 12, 2004. ASAE Pub #701P0504. [https://elibrary.asabe.org/abstract.asp?aid=17387&t=1&redir=aid=17387&redir=\[confid=sww2004\]&redirType=conference.asp&redirType=conference.asp](https://elibrary.asabe.org/abstract.asp?aid=17387&t=1&redir=aid=17387&redir=[confid=sww2004]&redirType=conference.asp&redirType=conference.asp).
- Haggard, Brian E., P. A. Moore, T. C. Daniel and D. R. Edwards, 1999. Trophic Conditions and Gradients of the Headwater Reaches of Beaver Lake, Arkansas. Proceedings, Oklahoma Academy of Science 79:73-84.
- Integrated Water Quality Monitoring and Assessment Report (IWQMAR), 2008. Arkansas Department of Environmental Quality: Little Rock, Ark. Available at www.arkansaswater.org/Documents/305b/2008_305b.pdf.
- Morgan, Robert. Personal communication with Missouri DNR.
- UALR, 2011. Percent Change in Total Population. Available at http://argis.ualr.edu/2010Census/Change_in_Pop_2000_to_2010_by_County.pdf.
- USFS, 1999. Ozark-Ouachita Highlands Assessment: Aquatic Conditions. Southern Research Station, U.S. Forest Service: Hot Springs, Ark. www.srs.fs.usda.gov/pubs/viewpub.jsp?index=2037.

Section Twelve

Cache River Priority Watershed

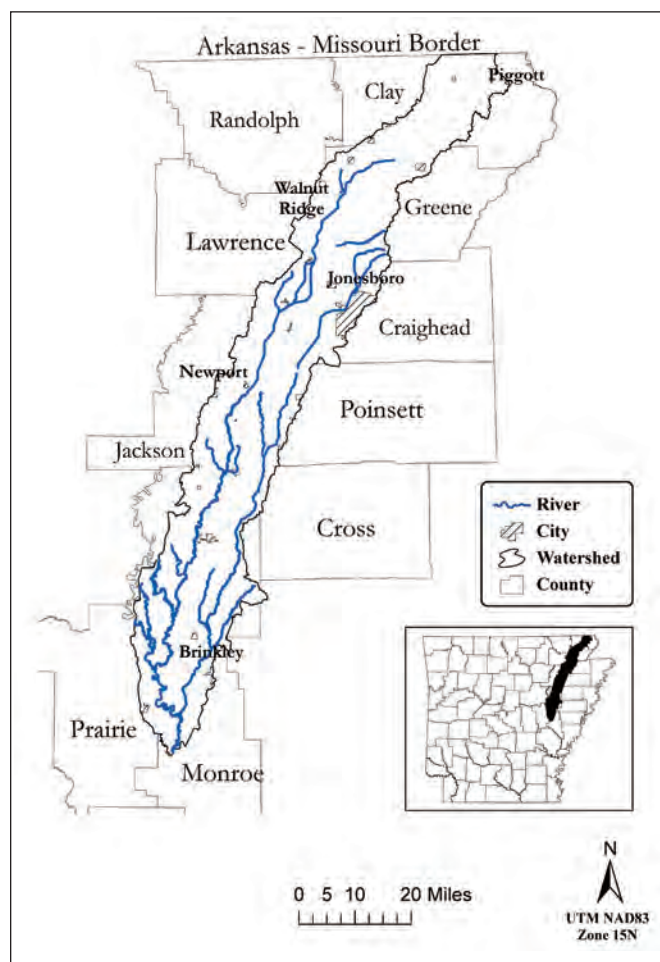
ADEQ Planning Segment 4B • HUC 08020302

Introduction

Segment 4B, located in the northeastern part of Arkansas, is a long, narrow segment that includes parts of Greene, Craighead, Poinsett, Jackson, Woodruff, Monroe, Prairie, Lawrence and Clay counties. The segment includes Bayou DeView and Cache River and their major tributaries including Cow Ditch, Buffalo Creek and Flag Slough. Figure 12.1 shows a map of the watershed.

Figure 12.1
Map of Cache River watershed

Data Source: GeoStor
Map Created: March 2011



Assessment

The summary of water quality condition is described from the current 305(b) report from the Arkansas Department of Environmental Quality (ADEQ) and other sources as cited appropriately. The following was stated in 2008 305(b) report:

The 599.1 miles of streams in this segment are designated for propagation of fish and wildlife, primary and secondary contact recreation, and domestic, agricultural and industrial water supplies. None of these are designated as outstanding state or national resource waters. Water sampling stations allowed for the monitoring of 129.8 stream miles in this segment. An additional 114.6 miles of this stream were evaluated.

The upper section of Bayou DeView and Lost Creek Ditch are not meeting the aquatic life use because of toxic metals including aluminum, beryllium, copper, lead and zinc. In addition, elevated levels of chlorides and total dissolved solids are also listed as causes. Potential sources include an industrial point source discharge and row crop agriculture activities.

Several segments of the Cache River and Bayou DeView have been listed because of lead contamination. It is thought that most of the elevated metals detections are associated with the large winter and spring storm events that carry large amounts of clay particles into the River. Additional investigation is needed to more accurately assess this problem.

The University of Arkansas' Department of Biological and Agricultural Engineering has used the Soil and Water Assessment Tool (SWAT) to model selected priority watersheds for the 2011-2016 Nonpoint Source (NPS) Pollution Management Plan under contract with the Arkansas Natural Resources Commission (ANRC). Appendix B describes SWAT modeling process and the data used to estimate sediment and nutrient concentration for 12-digit hydrologic unit code (HUC) sub-watersheds.

Brief Description of Land Uses in the Watershed

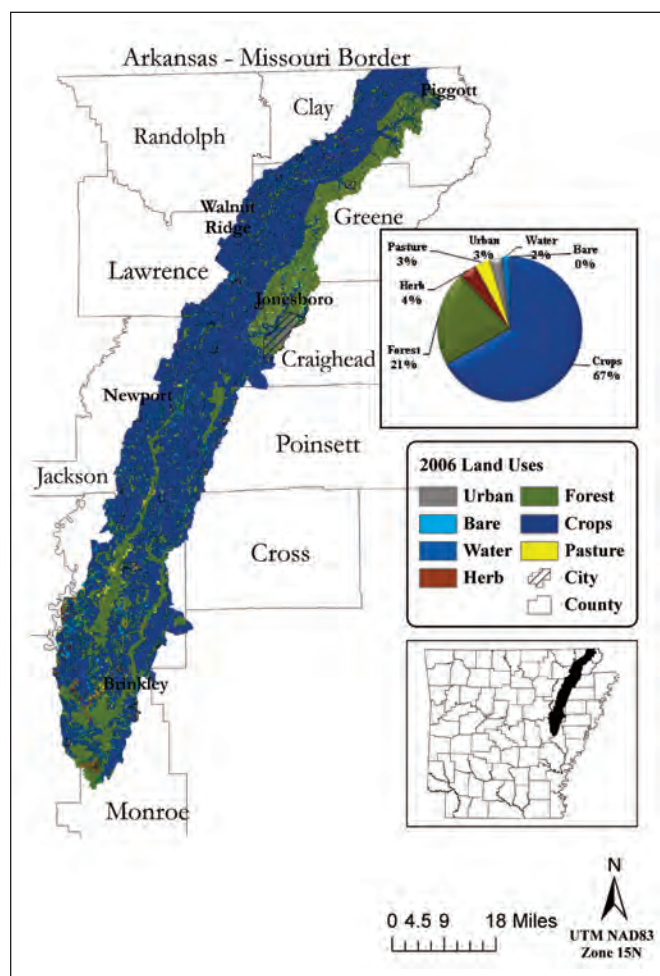
Figure 12.2 shows land use in the Cache River watershed in 2006.

The following provides a partial snapshot of the watershed:

- Nearly 67 percent of the watershed's land area is cultivated in row crops. Approximately 21.5 and 3.5 percent of the land is under forest and pastureland uses, respectively (CAST, 2006).

Figure 12.2 Land use in the Cache River watershed, 2006

Source: Center for Advanced Technologies (CAST), Land Use/Land Cover, 2006
Data Source: GeoStor
Map Created: March 2011



- Approximately 87,733 people live in the watershed (BAEG, 2011). Throughout much of the watershed, population is declining at an accelerated rate. Most decline took place in Monroe County (-20.5 percent), whereas the most gain in population took place in Craighead County (17.4 percent) from 2000 to 2010 (UALR, 2011).

Water Quality/Program Goals

ANRC is designating the Cache River watershed as a priority watershed for the first time in the 2011-2016 Nonpoint Source Pollution Management Plan.

The impaired segments of the Cache River watershed can be viewed at the following links:

- http://arkansaswater.org//index.php?option=com_content&task=view&id=14&Itemid=30.
- www.adeq.state.ar.us/water/branch_planning/pdfs/303d_list_2008.pdf.

The long-term goal of the priority watershed program is to reduce pollutants to levels that will restore all designated uses. The short-term goal of the program is to measurably reduce pollutants of concern that reach waters of the Cache River watershed, targeting sub-watersheds where implementation can have the greatest impact. These goals will be achieved through implementation of a Nine Element Plan.

Objectives and Milestones

Based on SWAT and other available analysis, ANRC will review available data and select sub-watersheds for targeting of implementation funds. Data that may be considered in targeting includes, but is not limited to, the modeled loads for sediment and phosphorus, percentage of intact woody riparian vegetation, density of unpaved roads, number of stream road crossings, rural population density, intensity of row crop agriculture, degree of urbanization and potential sources of pollutants. Other factors may also be considered at the discretion of ANRC including, but not limited to, local institutional capacity, input from the NPS Pollution Management Plan Stakeholder Group, local watershed groups or other agencies, the availability of funds and other factors.

The 2011-2016 NPS Pollution Management Plan includes statewide programs aimed at reducing pollutant loads from land uses that have the potential to impact water quality. These land uses and programs

to reduce their water quality impacts are described in more detail in earlier sections of the 2011-2016 NPS Pollution Management Plan.

The following objectives and milestones were identified with input from the NPS Pollution Management Plan Stakeholder Group. Table 3.1 (page 27) identifies cooperating entities that will partner to implement the NPS program in the Cache River watershed.

12.1. Initiate development of the Nine Element Plan until the U.S. Environmental Protection Agency's acceptance is obtained.

Timeline for Milestones: October 2011 through September 2016

12.2. Continue to develop support for implementation of the Nine Element Plan among potential cooperating entities and the general public.

Timeline for Milestones: October 2011 through September 2016

12.3. Provide technical and financial assistance to local cooperating entities to implement the Nine Element Plan as resources allow.

Timeline for Milestones: October 2011 through September 2016

12.4. As resources allow, use remote sensing and geographic information systems (GIS) analysis to identify sub-watersheds where more extensive assessment is needed. Conduct targeted geomorphological and bioassessment to identify and target implementation of streambank stabilization projects for high impact sites (for example, a geomorphologic study of logjams and assess beaver populations to determine their impact on streambank erosion and other studies).

Timeline for Milestones: October 2011 through September 2016

12.5. Continue to develop models to represent sediment and nutrient loads in the watershed and in-stream processes to enable prioritization of implementation projects in sub-watersheds.

Timeline for Milestones: October 2011 through September 2016

12.6. Continue to focus on BMP implementation to improve conservation practices for erosion control, sediment retention, irrigation management and nutrient management on row crop, animal agriculture and forestland. As appropriate, direct technical assistance to landowners in targeted watersheds giving emphasis to developing new conservation plans and areas that connect established riparian corridors.

Timeline for Milestones: October 2011 through September 2016

12.7. Continue to provide and improve extensive education and training to promote Best Management Practice (BMP) implementation (for example, risk management, demonstrations to acquaint landowners and municipalities with the conservation practices most effective in reducing runoff, sediment detachment and transport including, but not limited to, no-till, conservation till, ridge till, pipe drop outlets, riparian zone management and wetland restoration).

Timeline for Milestones: October 2011 through September 2016

12.8. Continue to encourage landowners to establish riparian buffer strips, grass drainageways, stabilize streambanks and restore riparian areas.

Timeline for Milestones: October 2011 through September 2016

12.9. Continue to secure conservation easements through donations as the opportunity arises in an effort to protect lands along the Cache River and its tributaries from development that would result in further NPS pollution.

Timeline for Milestones: October 2011 through September 2016

12.10. Continue to increase public awareness and provide education to build support for citizen action to improve water quality in the watershed.

Timeline for Milestones: October 2011 through September 2016

12.11. Build constituency for improved water quality by increasing volunteerism and promoting recreational use of the river (for example, recruiting volunteers for cleanups, streambank restoration and other activities utilizing the Arkansas Stream Team program and other conservation groups as well as increasing public recreational access to the river with trails and boat ramps).

Timeline for Milestones: October 2011 through September 2016

12.12. Encourage county and municipal elected officials as well as contractors, home builders and consulting engineers to participate in construction and urban education programs to improve stormwater management.

Timeline for Milestones: October 2011 through September 2016

12.13. Coordinate conservation planning within a watershed area to take full advantage of cost-share programs for riparian habitat improvement such as the Wetland Reserve Program (WRP), the Conservation

Reserve Program (CRP), the Wetland and Riparian Zone Tax Credit Program (through ANRC) and other programs.

Timeline for Milestones: October 2011 through September 2016

12.14. Encourage plans for alternative irrigation water supply and supplemental stream augmentation, including off-stream storage of surplus flows.

Timeline for Milestones: October 2011 through September 2016

12.15. Continue aquatic life assessments to assess response of waterbodies to NPS control measures as resources allow.

Timeline for Milestones: October 2011 through September 2016

12.16. Continue to provide public education on proper application, storage and disposal of pesticides, regulations and potential hazards of misuse (for example, encourage use of FARM*A*SYST and HOME*A*SYST programs to assess potential pollution hazards).

Timeline for Milestones: October 2011 through September 2016

12.17. Continue to provide education to rural homeowners and builders on proper construction and maintenance of onsite waste disposal systems.

Timeline for Milestones: October 2011 through September 2016

12.18. Continue to provide technical assistance and make available financial assistance to agricultural operations where cost-share is a component of approved 319(h) implementation projects.

Timeline for Milestones: October 2011 through September 2016

Timeline for Milestones

Provided sufficient financial and human resources are available to the cooperating state and local agencies and nonprofit organizations working together in the Cache River watershed, the short-term objectives of this program can be met within five years of program initiation. Fully implementing management measures within the watershed to restore all designated uses is a longer-term endeavor. A goal of this program is to fully meet designated uses within 15 years.

Program Coordination

There is currently no single entity in the Cache River watershed with the authority to implement a Nine Element Plan. ANRC will work with cooperating entities in the watershed to promote voluntary coordination and incorporate conditions requiring cooperation in grant agreements, as appropriate. A high degree of voluntary coordination already exists in the agriculture program through the Arkansas Conservation Partnership (ACP) as well as through local coordination groups already in place.

Significant local coordination is achieved through the Cache River Partnership.

Federal Consistency

The lead agency for each statewide program is responsible for working with federal partners to promote federal consistency. Statewide programs and their lead agencies are identified in the Cooperating Entities section of the 2011-2016 NPS Pollution Management Plan.

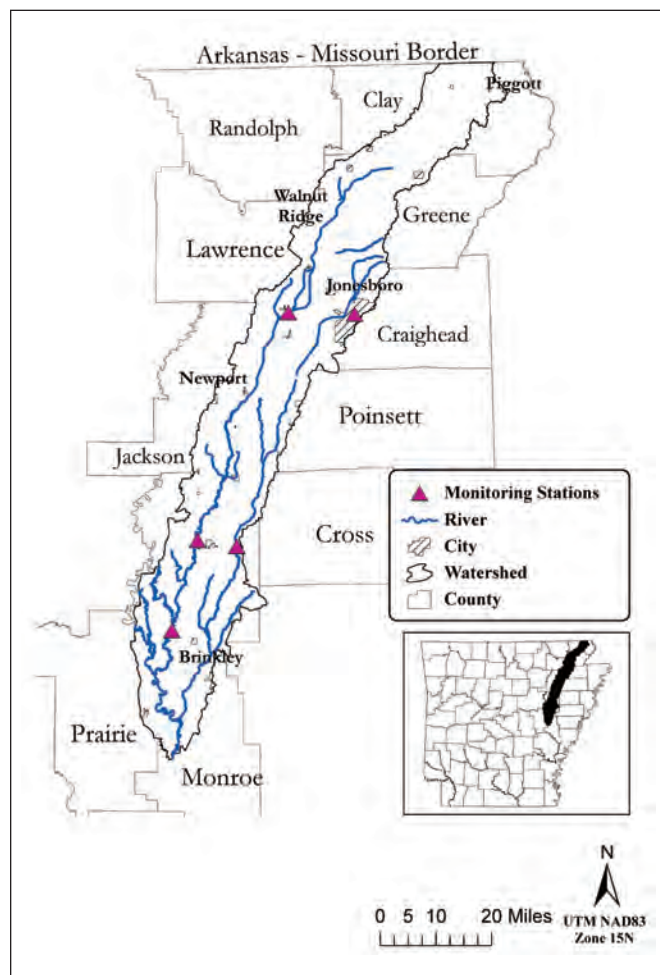
Program Tracking and Monitoring

Water quality monitoring data will be used to evaluate the effectiveness of NPS management activities in the Cache River watershed. ADEQ is responsible for maintaining the state's water quality inventory. Figure 12.3 shows monitoring stations in the watershed.

The NPS Pollution Management Plan may include as a condition of funding pre- and post-project measurements of changes in water quality. The NPS Pollution Management Plan encourages cooperating entities working in the watershed to meet annually to report on their activities of the previous year and discuss their successes, failures and future needs of their programs. The local watershed group is a logical convener for these discussions. Local cooperators are encouraged to compile this information, along with a summary of available water data and land use trends, into an annual watershed status report published and distributed in the watershed and to interested parties outside the watershed.

Figure 12.3 Monitoring stations in the Cache River watershed

Source: U.S. Geological Survey
Data Source: GeoStor
Map Created: March 2011



References Cited

- BAEG, 2011. County-Wise Population Data. Biological and Agricultural Engineering Department. University of Arkansas Division of Agriculture: Little Rock, Ark.
- CAST, 2006. Land Use/Land Cover Data. Biological and Agricultural Engineering Department. University of Arkansas: Fayetteville, Ark.
- Integrated Water Quality Monitoring and Assessment Report (IWQMAR). 2008. Arkansas Department of Environmental Quality: Little Rock, Ark. Available at www.arkansaswater.org/Documents/305b/2008_305b.pdf.
- UALR, 2011. Percent Change in Total Population. Available at http://argis.ualr.edu/2010Census/Change_in_Pop_2000_to_2010_by_County.pdf.

Section Thirteen

Illinois River Priority Watershed

A Portion of ADEQ Planning Segment 3J • HUC 11110103

Introduction

The Illinois River Watershed contains approximately 1.1 million acres, of which approximately 493,500 acres (46 percent) are in Arkansas and approximately 576,000 acres (54 percent) are in Oklahoma. The Illinois River Watershed portion of segment 3J (HUC 11110103) occupies the northwestern corner of Arkansas and covers part of Benton County, a large part of Washington County and a small section of Crawford County. This segment includes the Illinois River and its tributaries within Arkansas and is often labeled as the Illinois River Drainage Area in Arkansas, or IRDAA. The main tributaries in Arkansas are Osage Creek, Flint Creek and Spring Creek (Figure 13.1).

Assessment

The summary of water quality condition is described from the current 305(b) report from the Arkansas

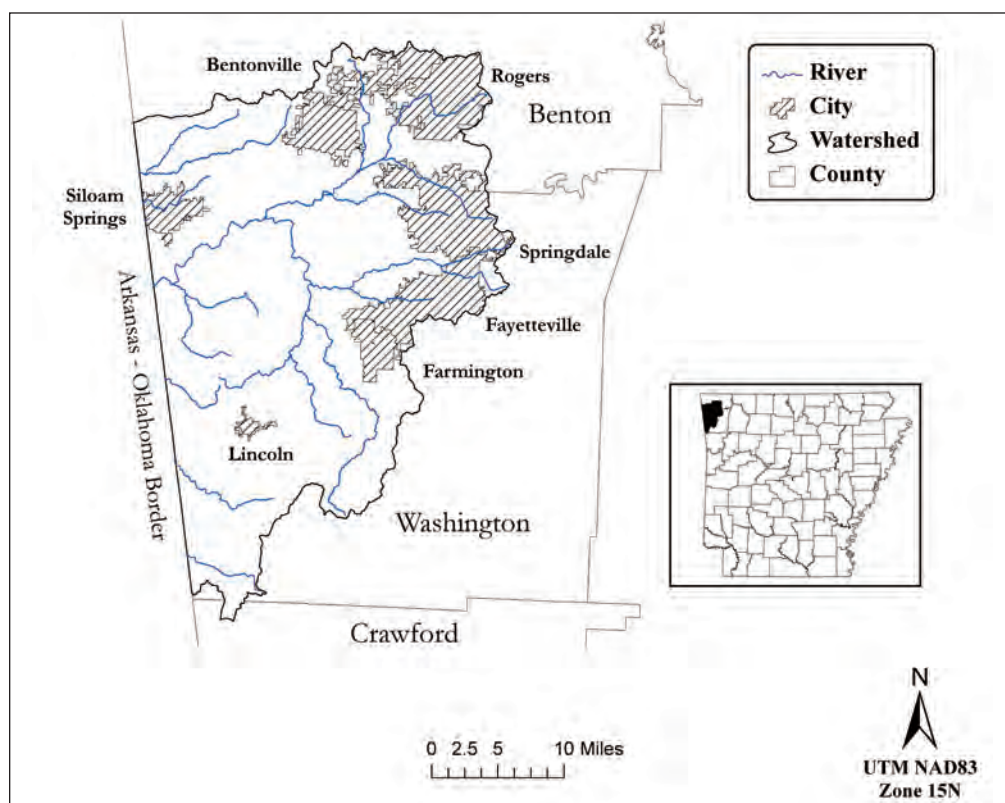
Department of Environmental Quality (ADEQ) and other sources as cited appropriately. The following was stated in 2008 305(b) report:

All waters within this segment have been designated as suitable for the propagation of fish and wildlife, primary and secondary contact recreation, and public, industrial, and agricultural water supplies. This segment contains 211.3 stream miles. Eleven permanent monitoring stations and several temporary stations in this planning segment were utilized by ADEQ to monitor 179.2 stream miles. An additional 17.9 stream miles were evaluated for a total 197.1 stream miles monitored in the Illinois River watershed.

Nonpoint source (NPS) pollution impacts affecting waters in this segment are primarily from urban development, and pastureland which generally receives applications of poultry waste products. In addition, in-stream gravel removal

Figure 13.1
Map of the Illinois
River watershed
in Arkansas

Data Source: GeoStor
Map Created: March 2011



destabilizes the streambed, causing excessive bank erosion. Road construction and maintenance is also contributing to siltation problems.

Three major municipal, point source discharges enter the Illinois River via Osage Creek and Clear Creek, and a minor municipal discharge enters the Illinois River from Muddy Fork of the Illinois River.

Several of the waste treatment facilities in Segment 3J have upgraded their facilities for advanced phosphorus removal. Analysis of phosphorus data over the past 10 years indicates a significant decrease trend in phosphorus concentrations in the Illinois River near Siloam Springs, Sager Creek near Siloam Springs, and Little Sugar Creek near Bentonville.

A municipal point source discharge is impairing the aquatic life use in Town Branch Creek from excessive nutrient discharges. In addition, the drinking water use was listed as impaired in Sager Creek because of the municipal point source discharge. Both of these issues will be addressed through the NPDES program.

The impaired segments of the Illinois River watershed can be viewed at the following links:

- http://arkansaswater.org//index.php?option=com_content&task=view&id=14&Itemid=30.
- www.adeq.state.ar.us/water/branch_planning/pdfs/303d_list_2008.pdf.

The U.S. Geological Survey (USGS) and the Arkansas Natural Resources Commission (ANRC) cooperated on a project to collect and analyze water quality samples to estimate nutrient loads for nitrogen and phosphorus for 1997-1999 using regression analysis. Total estimated phosphorus and nitrogen annual loads for calendar year 1997-1999 using the regression techniques on 35 samples were similar to estimated loads derived from integration techniques on 1,033 samples. Nitrogen and phosphorus estimates were higher than for comparable undeveloped watersheds (Green and Haggard, 2001).

ADEQ surveyed macroinvertebrate and fish communities in the Illinois River in 1995 and 1996 to assess the impact of municipal wastewater treatment facilities on water quality and aquatic life communities. In addition, the study characterized the effects of point source and NPS pollution on seasonal water quality

(ADEQ, 1997). USGS collected periphyton samples at 51 stream sites in the Ozark Plateaus to determine the effect of different land uses. Results indicate that periphyton communities are affected by natural and land-use related factors, including nutrients, dissolved organic carbon, alkalinity, canopy shading, suspended sediment, embeddedness, stream morphometry and velocity (Peterson and Femmer, 2002).

The U.S. Department of Agriculture Natural Resources Conservation Service (NRCS) and the U.S. Forest Service (USFS) completed a Cooperative River Watershed study for the Illinois River and published its Resource Base Report. The study found the Illinois River and many of the lakes on its tributaries were eutrophic from excessive nutrients (USFS and NRCS, 1992).

The Arkansas Water Resources Center (AWRC) prioritized sub-basins in the watershed in 1996 based on total phosphorus, total nitrogen and total suspended solids. Each sub-basin was given a low, medium or high prioritization for each of the three factors (AWRC, 1996).

A USFS comparative assessment of 50 watersheds in Arkansas and Oklahoma estimates potential erosion by land use for the Illinois River watershed. Based on 1992 National Resource Inventory (NRI) data, pasture land had the highest potential erosion rate at 72 percent compared to other lands (including urban) with a 15 percent potential erosion rate and forestry with a 2 percent potential erosion rate. Compared to 1982, potential erosion rates increased for pasturelands and decreased for other lands (USFS, 1999).

USGS has done extensive monitoring and analysis of surface and groundwater quality in the Ozark Plateau study area as part of the National Water Quality Assessment Program (NAWQA). Major findings for the Ozark Plateau study area are available at <http://ar.water.usgs.gov/nawqa/ozark/findings.html>.

Under contract with ANRC, the University of Arkansas' Department of Biological and Agricultural Engineering has used the Soil and Water Assessment Tool (SWAT) to model priority watersheds for the 2011-2016 NPS Pollution Management Plan. Figure 13.2 uses SWAT estimates of sediment and nutrient concentration for 12-digit hydrologic unit code (HUC) sub-watersheds in the Illinois River Drainage Area in Arkansas watershed to show the relative concentration in quintiles for each sub-watershed.

Figure 13.2a
Relative concentration
of sediment in
quintiles for
sub-watersheds in
the Illinois River
watershed

Data Source: GeoStor, SWAT simulations
between 2006 and 2008
Map Created: March 2011

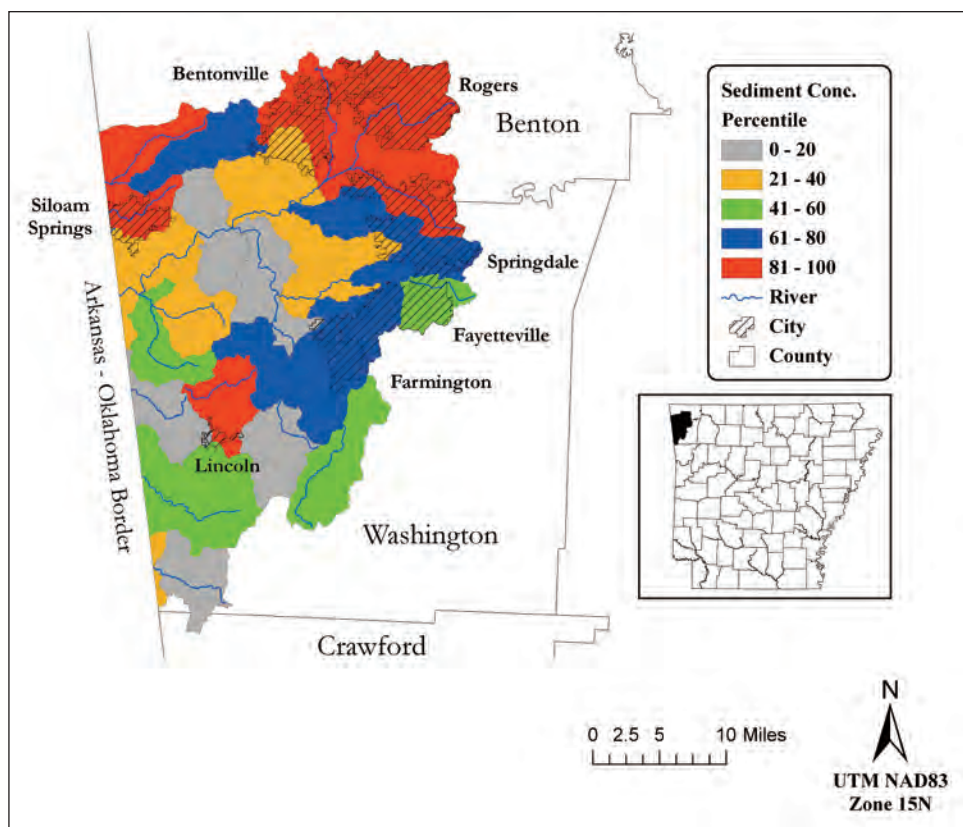


Figure 13.2b
Relative concentration
of total phosphorus
in quintiles for
sub-watersheds in
the Illinois River
watershed

Data Source: GeoStor, SWAT simulations
between 2006 and 2008
Map Created: March 2011

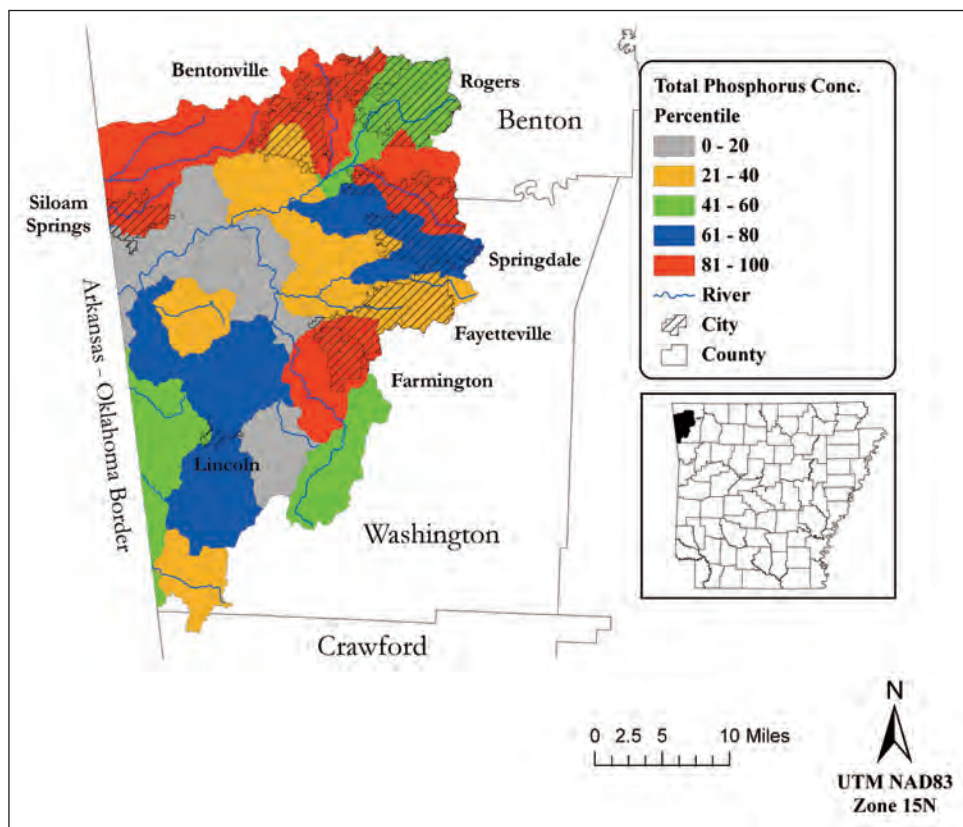
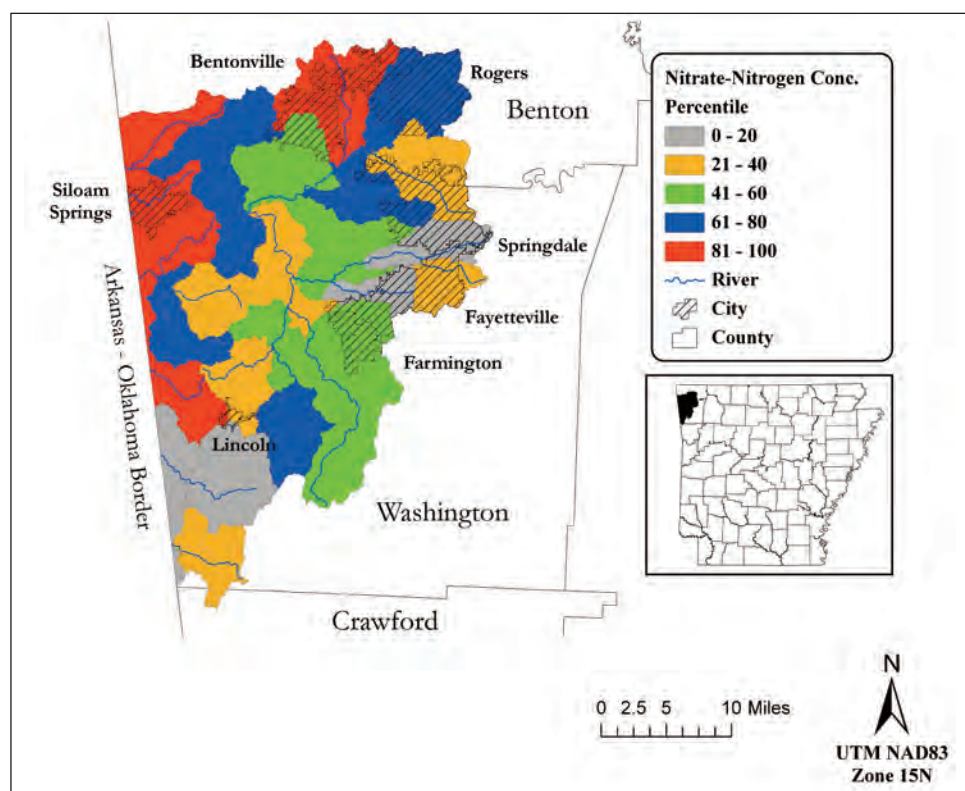


Figure 13.2c
Relative concentration
of nitrate-nitrogen
in quintiles for
sub-watersheds in
the Illinois River
watershed

Data Source: GeoStor, SWAT simulations
 between 2006 and 2008
 Map Created: March 2011



Brief Description of Land Uses That Can Impact Water Quality

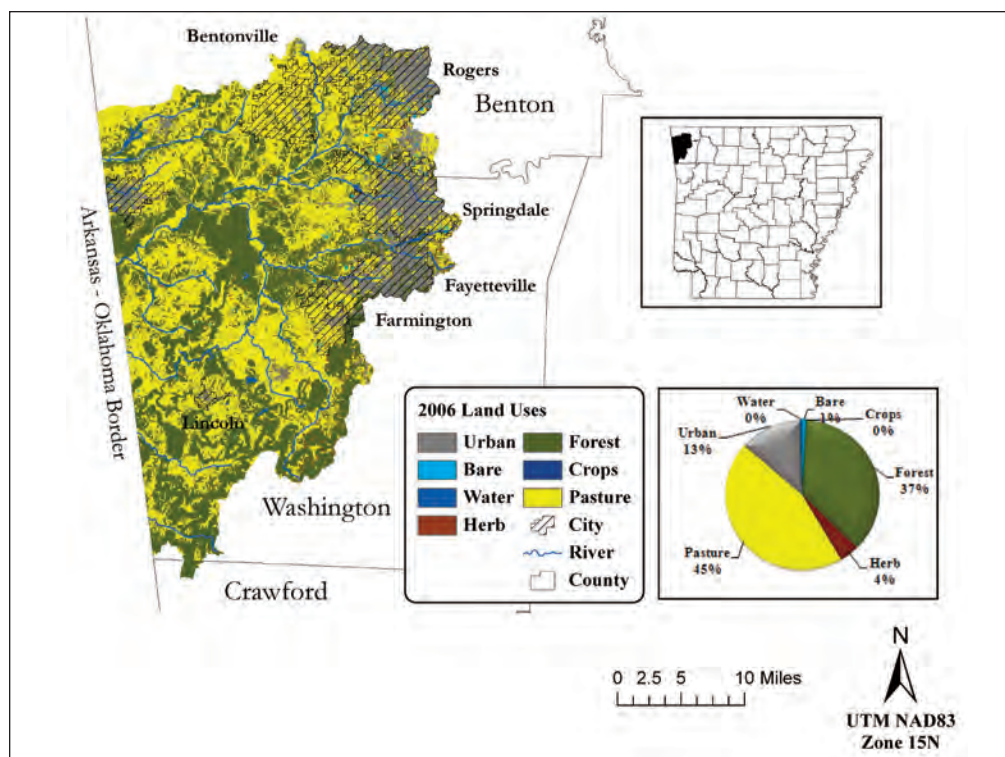
Figure 13.3 shows land use in the Illinois River watershed in 2006.

The following provide a partial snapshot of land uses in the watershed:

- There are seven drinking water sites in the Arkansas and Oklahoma portions of watershed (USFS, 1999).
- The population of Washington and Benton counties grew 28.8 percent and 44.3 percent from 2000 to 2010 (UALR, 2011). As a result, there is significant new construction, including residential, commercial and industrial, roads and other infrastructure. Construction can be found both within municipal boundaries and in rural areas of the watershed where onsite waste disposal is used.
- An estimated 172,428 individuals live in the Arkansas portion of the watershed (BAEG, 2010).
- Twelve municipalities and portions of Washington and Benton counties as well as the University of Arkansas are subject to Phase II requirements for a small municipal separate storm sewer system (MS4) National Pollution Discharge Elimination System (NPDES) permit. With leadership from the Northwest Arkansas Regional Planning Commission, all of these entities have joined together to contract with the University of Arkansas Division of Agriculture Cooperative Extension Service to provide education and technical assistance.
- The entire watershed is designated as a nutrient surplus area subject to new regulations for nutrient planning, nutrient application and certification of nutrient planners.
- Approximately 45 percent of the land area in the watershed was pasture in 2006, while 37 percent was in forest and 13 percent was urban.
- The watershed provides habitat for four federally protected aquatic species.
- Most forestland in the watershed is owned by private nonindustrial landowners and the national forest.
- Resource extraction (for example, topsoil removal, gravel mining) primarily supports local construction projects.
- The state of Oklahoma lists the Illinois River watershed on its List of Impaired Waterbodies.

Figure 13.3
Land use in the
Illinois River
watershed, 2006

Source: Center for Advanced Spatial Technologies (CAST), Land Use/Land Cover, 2006
 Data Source: GeoStor
 Map Created: March 2011



Water Quality/Program Goals

The Illinois River watershed has been a priority of the Arkansas Nonpoint Source (NPS) Pollution Management Plan since the comprehensive update of the program completed in 1998. ANRC is again designating the Illinois River watershed as a priority watershed for the 2011-2016 NPS Pollution Management Plan. Pollutants of concern within this hydrologic unit area include turbidity, siltation, nutrients and pathogens. Though all the waterbodies in this segment have been designated as suitable for the various identified uses, some pollutants can threaten a waterbody's ability to fully meet the designated use (ADEQ, 2008).

The impaired segments of the Illinois River watershed can be viewed at the following links:

- http://arkansaswater.org//index.php?option=com_content&task=view&id=14&Itemid=30.
- www.adeq.state.ar.us/water/branch_planning/pdfs/303d_list_2008.pdf.

The long-term goal of the priority watershed program is to reduce pollutants to levels that will restore all designated uses. The short-term goal of the program is to measurably reduce turbidity, nutrients and pathogens that reach waters of the Illinois River

watershed, targeting sub-watersheds where implementation can have the greatest impact. These goals will be achieved through implementation of a Nine Element Plan, which replaces a previous Watershed Restoration Action Strategy (WRAS). ANRC submitted a draft Nine Element Plan to the U.S. Environmental Protection Agency (EPA) in March 2004 (ANRC, 2004). The plan is being revised and will be resubmitted for EPA acceptance. Public support will have to be further developed to implement the proposed activities.

Objectives and Milestones

Based on SWAT and other available analyses, ANRC will review available data and select sub-watersheds for targeting of implementation funds. Data that may be considered in targeting includes, but is not limited to, the modeled loads for sediment and phosphorus, percentage of intact woody riparian vegetation, density of unpaved roads, number of stream road crossings, rural population density, density of animal feeding operations, degree of urbanization, potential sources of pollutants and population served by water supply intakes in the watershed. Other factors may also be considered at the discretion of ANRC including, but not limited to, local institutional capacity, input from the NPS Pollution Management Stakeholder Group, local watershed groups or other agencies, availability of funds and other factors.

The 2011-2016 NPS Pollution Management Plan includes statewide programs aimed at reducing pollutant loads from land uses that have the potential to impact water quality. These land uses and programs to reduce their water quality impacts are described in more detail in earlier sections of the 2011-2016 NPS Pollution Management Plan. Statewide programs that will be implemented in the Illinois River watershed and their relative level of priority are included in Table 13.1.

The following objectives and milestones were identified with input from the NPS Pollution Management Plan Stakeholder Group. Table 3.1 (page 27) identifies cooperating entities that will partner to implement the watershed program in the Illinois River.

13.1. Initiate development of the Nine Element Plan until the U.S. Environmental Protection Agency's acceptance is obtained.

Timeline for Milestones: October 2011 through September 2016

13.2. Continue to develop support for implementation of the Nine Element Plan among potential cooperating entities and the general public.

Timeline for Milestones: October 2011 through September 2016

13.3. Provide technical and financial assistance to local cooperating entities to implement the Nine Element Plan as resources allow.

Timeline for Milestones: October 2011 through September 2016

13.4. Promote and support strengthening of local capacity to implement the Nine Element Plan, encouraging local review of a range of options to identify the most effective institutional mechanism to lead implementation.

Timeline for Milestones: October 2011 through September 2016

13.5. Use remote sensing and geographic information systems (GIS) analysis to identify sub-watersheds where more extensive assessment is needed. Conduct targeted geomorphological and bioassessment to identify and target implementation of streambank stabilization projects for high-impact sites. Promote use of riparian tax credits and cost-sharing programs to fund restoration projects and develop conservation easements.

Timeline for Milestones: October 2011 through September 2016

Table 13.1. Relative priority of statewide programs to effect improvements in water quality in the Illinois River watershed

Description of Land Use	Statewide Program	Intensity of Land Use/Potential Impact
Animal agriculture	Agriculture	
• Confined animals		Very high
• Pasture (e.g., application of poultry litter to pasture, unconfined livestock)		Very high
Row crop agriculture	Agriculture	Not applicable
Forestry	Silviculture	
• Public lands		Low to moderate
• Industrial		Not applicable
• Private nonindustrial		Low to moderate
Urban	Urban Runoff	
• Rapidly urbanizing area subject to Phase II small separate municipal storm sewer system (MS4) NPDES permit requirements for stormwater management		Very high
Construction	Surface Erosion	
• Road and other infrastructure		Moderate to high
• Residential development		Very high
• Commercial/industrial		Very high
Onsite waste disposal	Urban Runoff	Very high
Streambank modification	Surface Erosion	High
Surface mining (e.g., topsoil removal, gravel mining)	Resource Extraction	Moderate to high

13.6. Continue to develop models to represent sediment and nutrient loads in the watershed, in-stream processes and lake response to enable prioritization of implementation projects in sub-watersheds.

Timeline for Milestones: October 2011 through September 2016

13.7. Continue to encourage the development of comprehensive nutrient management plans (CNMPs) or nutrient management plans (NMPs), provide technical assistance and make available financial assistance to animal agricultural operations where cost-share is a component of approved implementation projects.

Timeline for Milestones: October 2011 through September 2016

13.8. Continue and strengthen ongoing comprehensive education and training programs to help poultry and livestock producers meet the requirements of new ANRC poultry litter and nutrient application regulations and new ADEQ confined animal feeding operations (CAFO) regulations.

Timeline for Milestones: October 2011 through September 2016

13.9. Continue to develop and provide coordinated, comprehensive education for city planners, elected officials, developers, contractors, property owners and others using workshops, print and electronic materials, demonstration projects and other methods on topics such as stormwater pollution prevention plans, proper installation and maintenance of erosion and sediment control, planning tools to improve stormwater management (for example, low impact development, greenways, cluster development) and other related topics.

Timeline for Milestones: October 2011 through September 2016

13.10. Cooperate with and support the efforts of local nonprofit organizations, municipalities and other cooperating entities to develop and deliver a coordinated environmental education program with a local emphasis.

Timeline for Milestones: October 2011 through September 2016

13.11. Identify groups for targeted education on specific high-impact activities (for example, develop and post fact sheets for boaters on proper waste disposal and the potential impact at boat ramps and marinas; provide training to county elected officials, road departments and property owners associations on how to reduce erosion from rural roads; or provide education to home builders, developers and homeowners on methods and activities to reduce NPS pollution) as resources allow.

Timeline for Milestones: October 2011 through September 2016

13.12. Identify severe erosion sites at rural road crossings and work with county government to develop and implement erosion control plans for high-impact sites (for example, promote use of conservation district hydromulcher for treatment).

Timeline for Milestones: October 2011 through September 2016

13.13. Encourage development of urban forestry projects in municipalities within the watershed.

Timeline for Milestones: October 2011 through September 2016

13.14. Carry out comprehensive information and education program quality for community leaders, including mayors, county judges, quorum courts, planning boards and commissions, conservation district directors and others. Emphasize the need to protect water and the benefits of clean water for the economy, quality of life and the environment.

Timeline for Milestones: October 2011 through September 2016

13.15. Continue to provide training to earth-moving contractors and their employees, public works department employees, county employees and others regarding operation and maintenance of construction Best Management Practices (BMPs) through the partnership with the Northwest Arkansas Regional Planning Commission and the University of Arkansas Division of Agriculture Cooperative Extension Service in order to help them meet the requirements of EPA Phase II stormwater regulations for construction and municipal separate storm sewer systems.

Timeline for Milestones: October 2011 through September 2016

13.16. Review tax code to determine possible mechanisms to use tax incentives for water quality BMP implementation in nutrient surplus areas, especially for practices that minimize the direct impact of cattle on streams.

Timeline for Milestones: October 2011 through September 2016

13.17. Work with elementary and secondary schoolteachers to develop teaching modules regarding water quality protection and conservation that meet curriculum requirements of the Arkansas Department of Education.

Timeline for Milestones: October 2011 through September 2016

13.18. Investigate the use of the Clean Water Revolving Loan Fund for alternative onsite wastewater systems.

Timeline for Milestones: October 2011 through September 2016

13.19. Build constituency for improved water quality by increasing volunteerism for cleanups and streambank restoration and other activities utilizing the Arkansas Stream Team program and other conservation groups, conducting water awareness days, building working relationships with groups that represent recreational users (for example, bird watchers, paddlers, hunters, etc.) and other means.

Timeline for Milestones: October 2011 through September 2016

Timeline for Milestones

Provided sufficient human and financial resources are available to the cooperating entities working together in the Illinois River watershed, the short-term objectives of this program can be met within five years of implementation of this update. Fully implementing management measures within the watershed to restore all designated uses is a longer-term endeavor. A goal of this program is to fully meet designated uses within 15 years.

Program Coordination

There is currently no single entity in the Illinois River watershed with the authority to implement the Nine Element Plan. ANRC will work with cooperating entities in the watershed to promote voluntary coordination and incorporate conditions requiring cooperation in grant agreements, as appropriate. A high degree of voluntary coordination already exists in the agriculture program, through the Arkansas Conservation Partnership (ACP). In the construction and urban programs, there is significant coordination through a voluntary contractual agreement among municipalities, counties, the University of Arkansas Division of Agriculture Cooperative Extension Service and the Northwest Arkansas Regional Planning Commission to provide education and training on stormwater management.

Federal Consistency

The lead agency for each statewide program is responsible for working with federal partners to promote federal consistency. Statewide programs and their lead agencies are identified in the Cooperating Entities section of the 2011-2016 NPS Pollution

Management Plan. Watershed specific consistency issues may be addressed in other venues, such as the Arkansas-Oklahoma Compact Commission.

Program Tracking and Evaluation

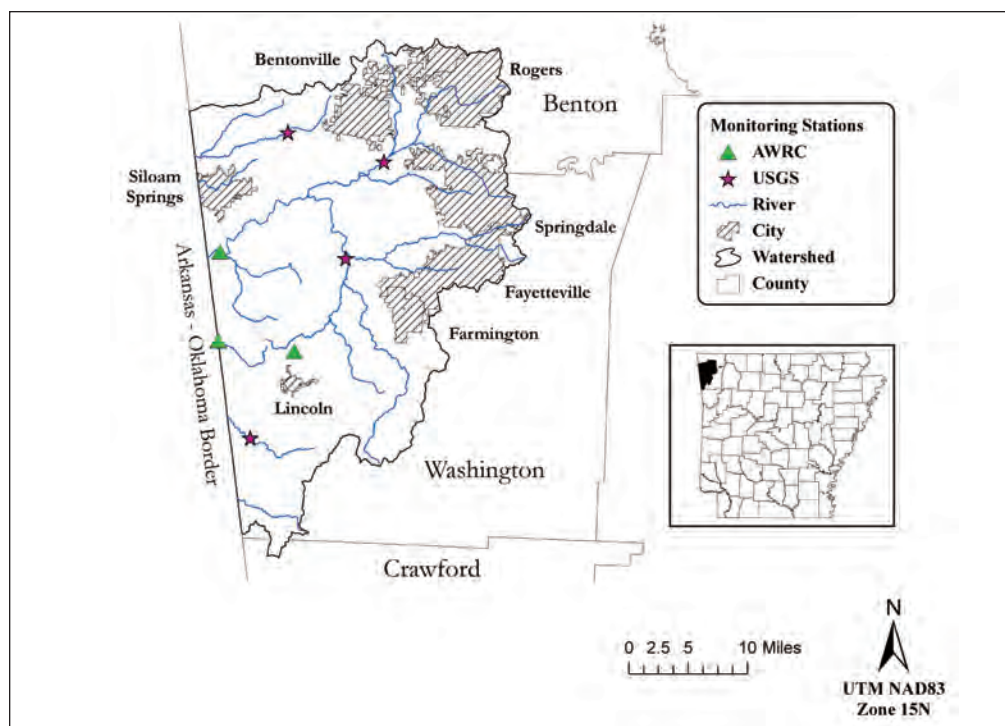
Water quality monitoring data will be used to evaluate the effectiveness of nonpoint source pollution management activities in the Illinois River watershed. ADEQ is responsible for maintaining the state's water quality inventory. They maintain eight monthly monitoring stations within the Illinois River Watershed. In addition, USGS and ANRC maintain monitoring sites in the watershed. Real-time flow data are available at the USGS stations as well as some water quality data. ANRC monitoring stations focus on sediment, nitrogen and phosphorus-related parameters which are most significant in assessing nonpoint source pollution. Figure 13.4 shows all of the monitoring stations in the watershed.

BMP implementation data will be tracked for ANRC projects. New biosecurity provisions included in subsequent Farm Bills may make it difficult to obtain data files for NRCS cost-share projects to monitor implementation of agriculture BMPs. Implementation data for NRCS cost-share projects are available from the national NRCS web site; however, data must be downloaded separately for each BMP, making the effort labor intensive and prone to human errors. Potentially, Conservation Districts could report aggregate BMP implementation by sub-watershed, thus maintaining confidentiality of landowners while still providing information needed for evaluation. Arkansas Forestry Commission (AFC) monitors silviculture BMP implementation biennially. ADEQ will monitor inspection and complaint data for related regulatory programs it administers (for example, surface mining, NPDES permits, etc.).

The NPS Pollution Management Plan may include pre- and post-project measurements of changes in water quality as a condition of funding. The NPS Pollution Management Plan encourages cooperating entities working in the watershed to meet annually to report on their activities of the previous year and frankly discuss their successes, failures and future needs of their programs. Local cooperators are encouraged to compile this information, along with a summary of available water data and land use trends, into an annual watershed status report published and distributed in the watershed and to interested parties outside the watershed.

Figure 13.4
Monitoring stations
in the Illinois River
watershed

Sources: Arkansas Water Resources Center, U.S. Geological Survey
Data Source: GeoStor
Map Created: March 2011



References Cited

- ADEQ 1997. "Illinois River Water Quality, Macroinvertebrate and Fish Community Survey, Benton and Washington Counties, Arkansas." WQ97-03-1, Arkansas Department of Environmental Quality Water Division: Little Rock, Ark. www.adeq.state.ar.us/water/branch_planning/publications.htm.
- ADEQ, 2002. Integrated Water Quality Monitoring and Assessment Report. Arkansas Department of Environmental Quality: Little Rock, Ark.
- ADEQ, 2005. 2004 Proposed 303(d) List of Impaired Water Bodies. Arkansas Department of Environmental Quality: Little Rock, Ark.
- ANRC, 2004. Watershed Management Strategy for the Illinois River Watershed. Arkansas Natural Resources Commission: Little Rock, Ark.
- APCEC, 2001. Regulation Number 2: Regulation Establishing Water Quality Standards for Surface Waters of the State of Arkansas. Arkansas Pollution Control and Ecology Commission: Little Rock, Ark. <http://www.adeq.state.ar.us/regs/default.htm>.
- AWRC, 1996. Watershed Prioritization. Arkansas Water Resources Center, University of Arkansas: Fayetteville, Ark.
- BAEG, 2011. County-Wise Population Data. Biological and Agricultural Engineering Department. University of Arkansas: Fayetteville, Ark.
- CAST, 2006. Land Use/Land Cover Data. Biological and Agricultural Engineering Department. University of Arkansas: Fayetteville, Ark.
- Green, R., and B. E. Haggard. 2001. "Phosphorus and Nitrogen Concentrations and Loads at Illinois River South of Siloam Springs, Arkansas, 1997-1999." Water-Resources Investigations Report 01-4217, USGS in cooperation with Arkansas Natural Resources Commission: Little Rock, Ark. http://ar.water.usgs.gov/LOCAL_REPORTS/WRIR_01-4217.pdf.
- NASS, 2002. 2002 Census of Agriculture. National Agricultural Statistics Service: Washington, D.C.
- Peterson, J. C., and S. R. Femmer, 2002. "Periphyton Communities in Streams of the Ozark Plateaus and Their Relations to Selected Environmental Factors." Water-Resources Investigations Report 02-4210, U.S. Geological Survey: Little Rock, Ark. http://ar.water.usgs.gov/LOCAL_REPORTS/WRIR_02-4210.pdf.
- UALR, 2011. Percent Change in Total Population. Available at http://argis.ualr.edu/2010Census/Change_in_Pop_2000_to_2010_by_County.pdf.
- U.S. Census, 2000. Population Estimates accessed at www.aiea.ualr.edu/population-estimates-a-projections.html.
- USFS and NRCS, 1992. Illinois River Cooperative River Basin-Resource Base Report. United States U.S. Forest Service and Natural Resources Conservation Service: Washington, D.C.
- USFS, 1999. Ozark-Ouachita Highlands Assessment: Aquatic Conditions. Southern Research Station, U.S. Forest Service: Hot Springs, Ark. www.srs.fs.usda.gov/pubs/viewpub.jsp?index=2037.
- University of Arkansas, 2005. Rural Profile, 2005. University of Arkansas Division of Agriculture: Little Rock, Ark.

Section Fourteen

Lake Conway-Point Remove Priority Watershed

ADEQ Planning Segment 3F • HUC 11110203

Introduction

Segment 3F is located in the central portion of Arkansas and covers parts of Faulkner, Conway, Perry, Pope and Van Buren counties. This segment contains the Arkansas River and its tributaries; East and West Forks of Point Remove Creek, Overcup Creek, Gum Log Creek, Palarm Creek and Galla Creek. Figure 14.1 shows a map of the watershed.

Assessment

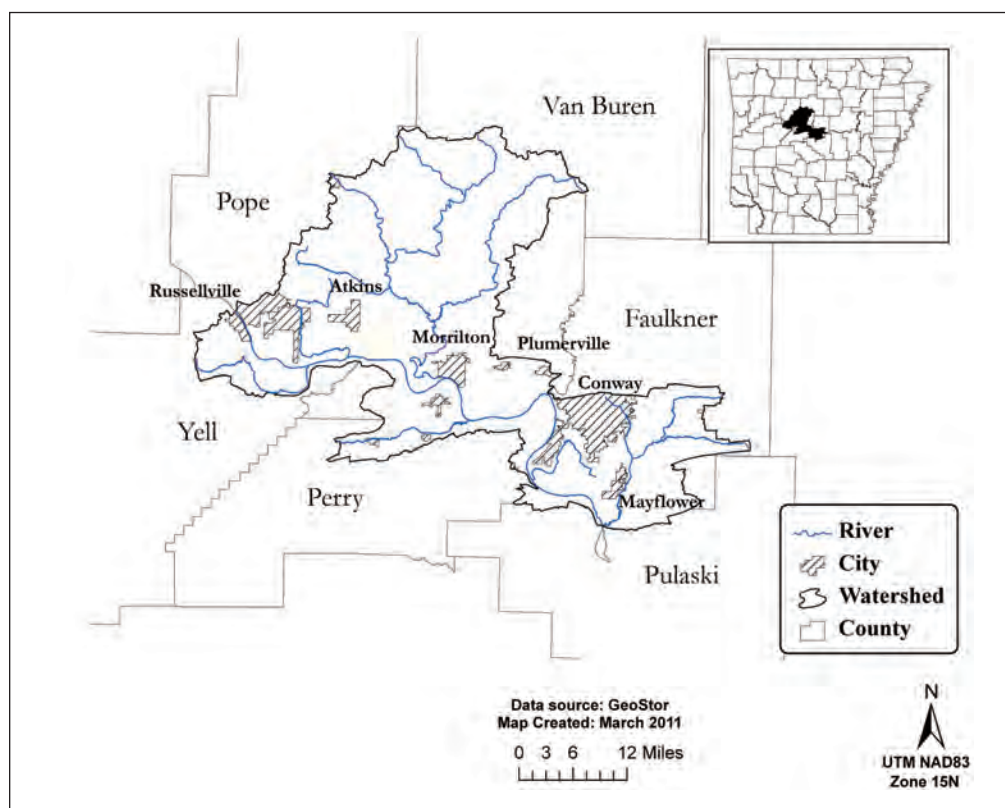
The summary of water quality condition is described from the current 305(b) report from the Arkansas Department of Environmental Quality (ADEQ) and other sources as cited appropriately. The following was stated in the most current 305(b) report:

The waters within this segment have been designated as suitable for the propagation of fish and wildlife, primary and secondary contact recreation, and public, industrial, and agricultural water supplies. This segment contains a total of 310.8 streams miles. Ten monitoring stations within this segment allow for the assessment of 92.8 streams miles with an additional 99.1 miles of stream being evaluated. The remaining stream segments were not assessed.

Stone Dam Creek is impaired by a municipal point source discharge. Chronic ammonia toxicity and elevated nitrate levels exceeded the drinking water maximum contaminant level. A total maximum daily load (TMDL), to address these issues was completed in 2003.

Figure 14.1
Map of Lake
Conway-Point
Remove watershed

Data Source: GeoStor
Map Created: March 2011



Whig Creek continues to be impaired by municipal and industrial point source discharges. Elevated levels of nutrients and copper are the cause of the impairment. A TMDL has been completed for this waterbody.

White Oak Creek continues to be listed for high silt and turbidity levels. Nonpoint sources appear to be the major problem. A TMDL addressing this issue was completed in 2006.

An approximate two mile segment of the Arkansas River below Dardanelle Reservoir occasionally had dissolved oxygen (D.O.) values below the standard during the summer period. This is related to hydropower releases from the upstream reservoir when very low D.O. values exist in the deeper levels of the reservoir. These low values seem to recover quickly downstream of the reservoir under low to moderate generation flows and in the presence of photosynthesis activity from planktonic algae.

Several segments of the Arkansas River had total dissolved solid concentrations above the standard. Most of the exceedances occurred over a five- to six-month span during the winter months of 2002 and 2003. This suggests that this was a one-time, weather-related event and not a chronic problem. In addition, trend analysis indicates that there is a decreasing concentration trend over the past ten years.

The University of Arkansas' Department of Biological and Agricultural Engineering has used the Soil and Water Assessment Tool (SWAT) to model selected priority watersheds for the 2011-2016 Nonpoint Source (NPS) Pollution Management Plan under contract with the Arkansas Natural Resources Commission (ANRC). Appendix B describes SWAT modeling process and the data used to estimate sediment and nutrient concentration for 12-digit hydrologic unit code (HUC) sub-watersheds. Figure 14.2 shows relative concentration of sediment and nutrients in quintiles for each sub-watershed.

Figure 14.2a
Relative concentration
of sediment in
quintiles for
sub-watersheds in
the Lake Conway-Point
Remove watershed

Data Source: GeoStor, SWAT simulations
between 2006 and 2008
Map Created: March 2011

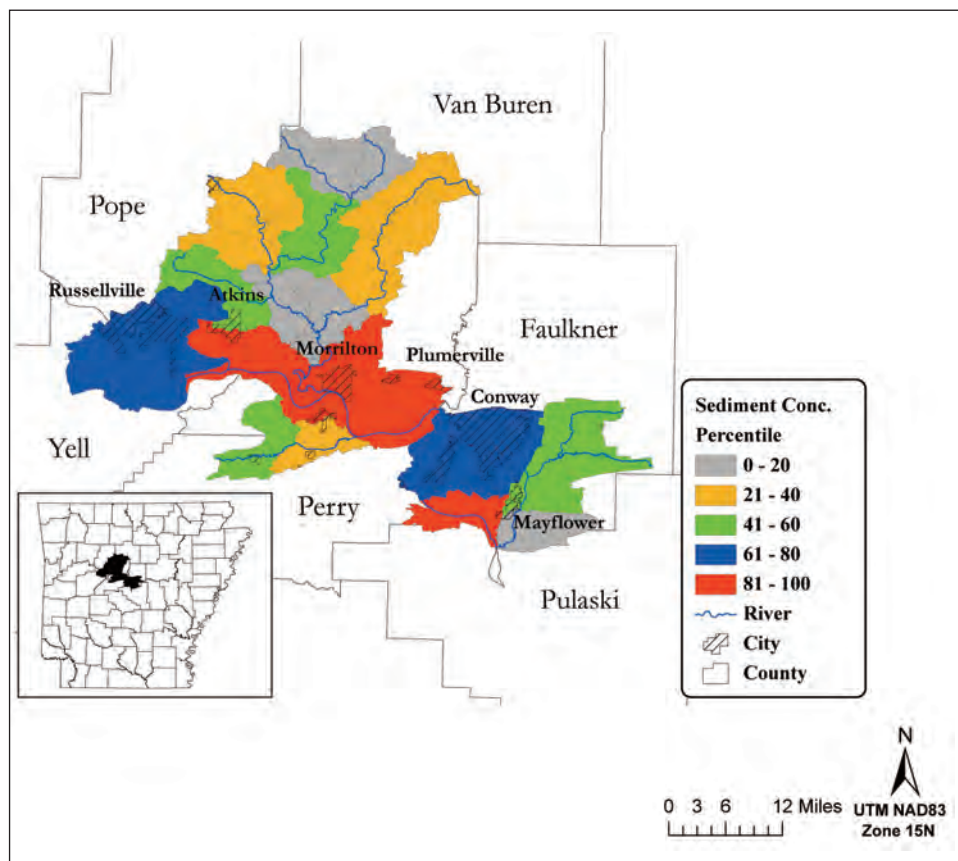


Figure 14.2b
Relative concentration
of total phosphorus
in quintiles for
sub-watersheds in
the Lake Conway-Point
Remove watershed

Data Source: GeoStor, SWAT simulations
 between 2006 and 2008
 Map Created: March 2011

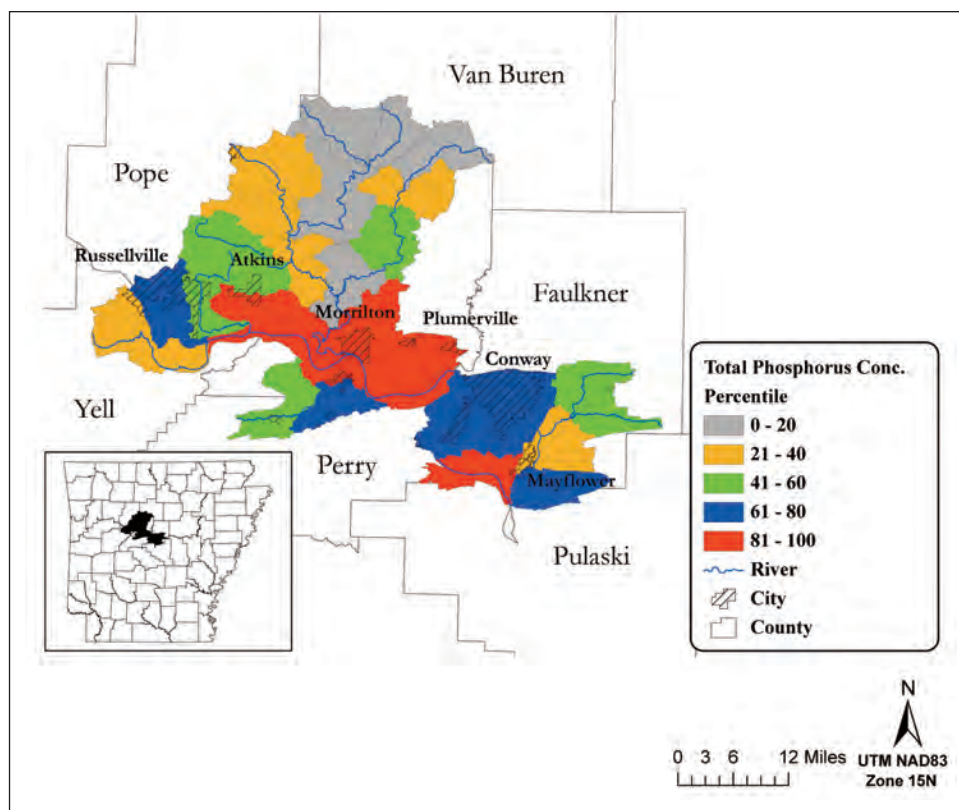
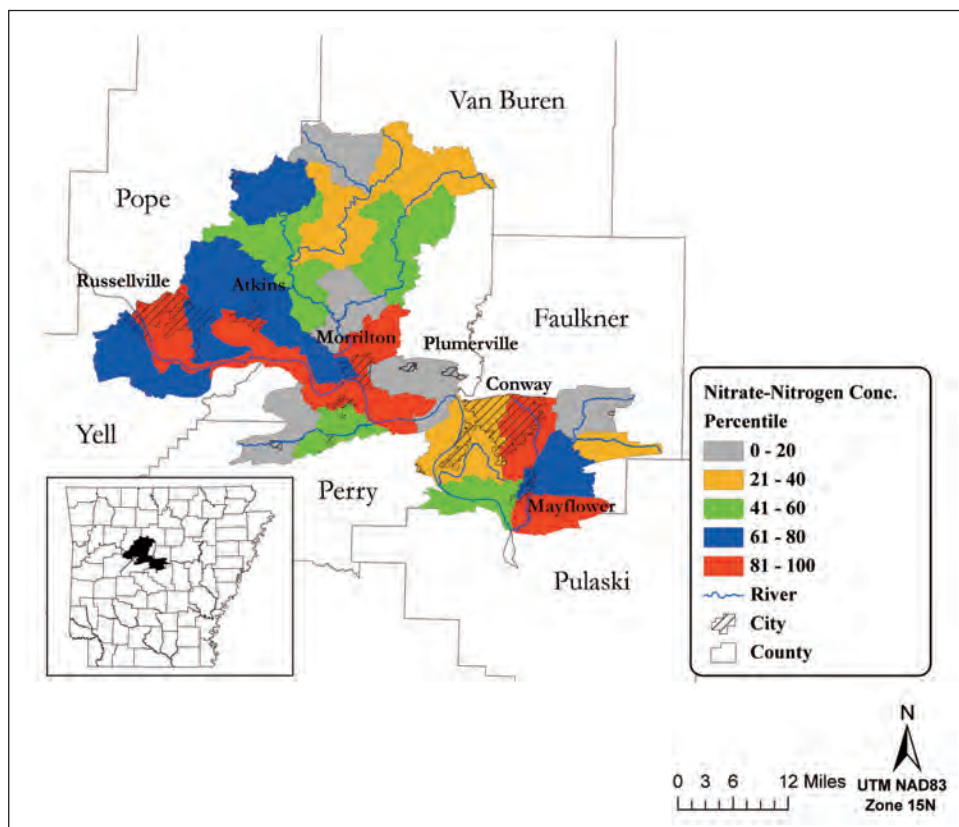


Figure 14.2c
Relative concentration
of total nitrate-
nitrogen in quintiles
for sub-watersheds in
the Lake Conway-Point
Remove watershed

Data Source: GeoStor, SWAT simulations
 between 2006 and 2008
 Map Created: March 2011



Brief Description of Land Uses in the Watershed

Figure 14.3 shows land use in the Lake Conway-Point Remove watershed in 2006.

The following provides a partial snapshot of the watershed:

- Nearly 6 percent of the watershed's land area is cultivated in row crops. Approximately 54 percent of the land is in forests and 22 percent is in pasture (CAST, 2006). The remainder of the land is covered by construction, water, etc.
- Approximately 88,278 people live in the watershed (BAEG, 2011). Throughout the watershed, population is increasing at an accelerating rate. The largest increase took place in Faulkner County (31.6 percent), whereas the least gain in population took place in Perry County (2.3 percent) from 2000 to 2010 (UALR, 2011).

Water Quality/Program Goals

The Lake Conway-Point Remove watershed was designated as a priority by ANRC during 2006-2011 NPS Pollution Management Plan and is again being designated as a priority watershed for the 2011-2016 NPS Pollution Management Plan.

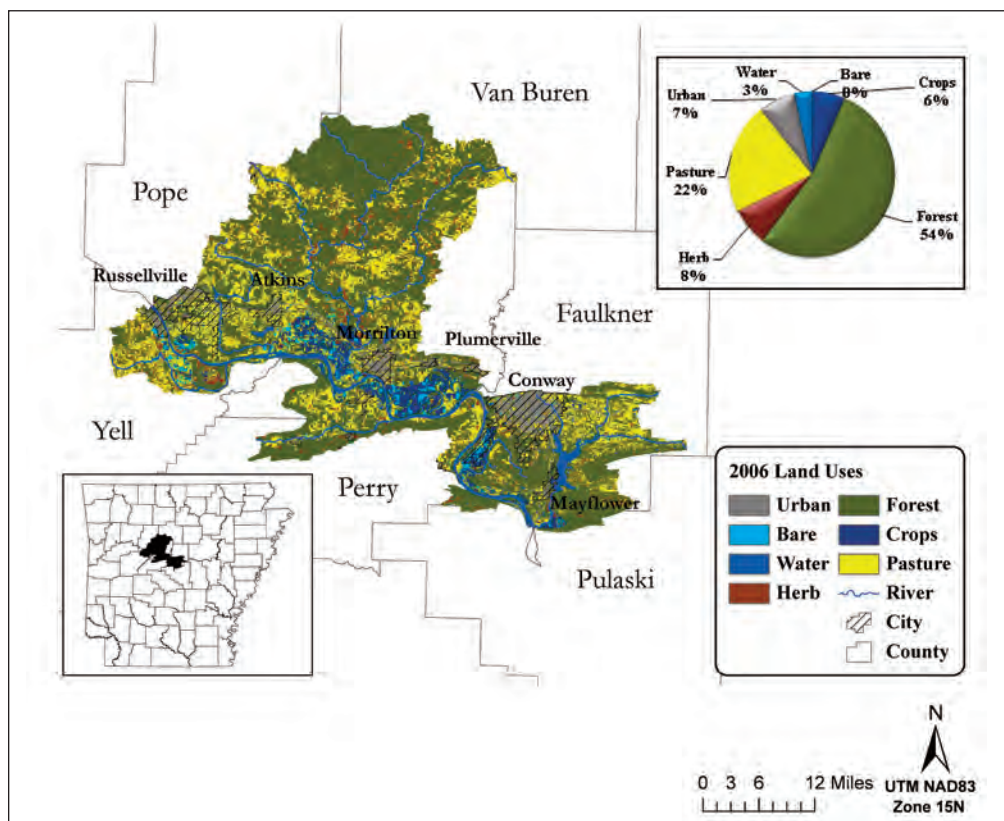
The impaired segments of the Lake Conway-Point Remove watershed can be viewed at the following links:

- http://arkansaswater.org//index.php?option=com_content&task=view&id=14&Itemid=30.
- www.adeq.state.ar.us/water/branch_planning/pdfs/303d_list_2008.pdf.

The long-term goal of the priority watershed program is to reduce pollutants to levels that will restore all designated uses. The short-term goal of the program is to measurably reduce pollutants of concern that reach waters of the Lake Conway-Point Remove

Figure 14.3
Land use in the
Lake Conway-Point
Remove watershed,
2006

Source: Center for Advanced Spatial Technologies (CAST), Land Use/Land Cover, 2006
Data Source: GeoStor
Map Created: March 2011



watershed, targeting sub-watersheds where implementation can have the greatest impact. These goals will be achieved through implementation of a Nine Element Plan.

Objectives and Milestones

Based on SWAT and other available analysis, ANRC will review available data and select sub-watersheds for targeting of implementation funds. Data that may be considered in targeting includes, but is not limited to, the modeled loads for sediment and phosphorus, percentage of intact woody riparian vegetation, density of unpaved roads, number of stream road crossings, rural population density, intensity of row crop agriculture, degree of urbanization and potential sources of pollutants. Other factors may also be considered at the discretion of ANRC including, but not limited to, local institutional capacity, input from the NPS Pollution Management Plan Stakeholder Group, local watershed groups or other agencies, the availability of funds and other factors.

The 2011-2016 NPS Pollution Management Plan includes statewide programs aimed at reducing pollutant loads from land uses that have the potential to impact water quality. These land uses and programs to reduce their water quality impacts are described in more detail in earlier sections of the 2011-2016 NPS Pollution Management Plan.

The following objectives and milestones were identified with input from the NPS Pollution Management Plan Stakeholder Group. Table 3.1 (page 27) identifies cooperating entities that will partner to implement the NPS program in the Lake Conway-Point Remove watershed.

14.1. Initiate development of the Nine Element Plan until the U.S. Environmental Protection Agency's acceptance is obtained.

Timeline for Milestones: October 2011 through September 2016

14.2. Continue to develop support for implementation of the Nine Element Plan among potential cooperating entities and the general public.

Timeline for Milestones: October 2011 through September 2016

14.3. Provide technical and financial assistance to local cooperating entities to implement the Nine Element Plan as resources allow.

Timeline for Milestones: October 2011 through September 2016

14.4. As resources allow, use remote sensing and geographic information systems (GIS) analysis to identify sub-watersheds where more extensive assessment is needed. Conduct targeted geomorphological and bioassessment to identify and target implementation of streambank stabilization projects for high impact sites (for example, a geomorphologic study of logjams and assess beaver populations to determine their impact on streambank erosion and other studies).

Timeline for Milestones: October 2011 through September 2016

14.5. Continue to refine models as new data becomes available to represent sediment and nutrient loads in the watershed and in-stream processes to enable prioritization of implementation projects in sub-watersheds.

Timeline for Milestones: October 2011 through September 2016

14.6. Continue to focus on Best Management Practices (BMPs) implementation to improve conservation practices for erosion control, sediment retention, irrigation management and nutrient management on row crop and animal agriculture and forestland. As appropriate, direct technical assistance to landowners in targeted watersheds giving emphasis to developing new conservation plans and areas that connect established riparian corridors.

Timeline for Milestones: October 2011 through September 2016

14.7. Continue to provide and improve extensive education and training to promote BMP implementation (for example, risk management, demonstrations to acquaint landowners and municipalities with the conservation practices most effective in reducing runoff, sediment detachment and transport including, but not limited to, no-till, conservation till, ridge till, pipe drop outlets, riparian zone management and wetland restoration).

Timeline for Milestones: October 2011 through September 2016

14.8. Continue to encourage landowners to establish riparian buffer strips, grass drainageways, stabilize streambanks and restore riparian areas.

Timeline for Milestones: October 2011 through September 2016

14.9. Continue to secure conservation easements through donations as the opportunity arises in an effort to protect lands along the Arkansas River and its tributaries from development that would result in further NPS pollution.

Timeline for Milestones: October 2011 through September 2016

14.10. Continue to increase public awareness and provide education to build support for citizen action to improve water quality in the watershed.

Timeline for Milestones: October 2011 through September 2016

14.11. Build constituency for improved water quality by increasing volunteerism and promoting recreational use of the river (for example, recruiting volunteers for cleanups, streambank restoration and other activities utilizing the Arkansas Stream Team program and other conservation groups as well as increasing public recreational access to the river with trails and boat ramps).

Timeline for Milestones: October 2011 through September 2016

14.12. Encourage county and municipal elected officials as well as contractors, home builders and consulting engineers to participate in construction and urban education programs to improve stormwater management.

Timeline for Milestones: October 2011 through September 2016

14.13. Coordinate conservation planning within a watershed area to take full advantage of cost-share programs for riparian habitat improvement such as the Wetland Reserve Program (WRP), the Conservation Reserve Program (CRP), the Wetland and Riparian Zone Tax Credit Program (through ANRC) and other programs.

Timeline for Milestones: October 2011 through September 2016

14.14. Encourage plans for alternative irrigation water supply and supplemental stream augmentation, including off-stream storage of surplus flows.

Timeline for Milestones: October 2011 through September 2016

14.15. Continue aquatic life assessments to assess response of waterbodies to NPS pollution control measures as resources allow.

Timeline for Milestones: October 2011 through September 2016

14.16. Continue to provide public education on proper application, storage and disposal of pesticides, regulations and potential hazards of misuse (for example, encourage use of FARM*A*SYST and HOME*A*SYST programs to assess potential pollution hazards).

Timeline for Milestones: October 2011 through September 2016

14.17. Continue to provide education to rural homeowners and builders on proper construction and maintenance of onsite waste disposal systems.

Timeline for Milestones: October 2011 through September 2016

14.18. Continue to provide technical assistance and make available financial assistance to agricultural operations where cost-share is a component of approved 319(h) implementation projects.

Timeline for Milestones: October 2011 through September 2016

Timeline for Milestones

Provided sufficient financial and human resources are available to the cooperating state and local agencies and nonprofit organizations working together in the Lake Conway-Point Remove watershed, the short-term objectives of this program can be met within five years of program initiation. Fully implementing management measures within the watershed to restore all designated uses is a longer-term endeavor. A goal of this program is to fully meet designated uses within 15 years.

Program Coordination

There is currently no single entity in the Lake Conway-Point Remove watershed with the authority to implement the Nine Element Plan. ANRC will work with cooperating entities in the watershed to promote voluntary coordination and incorporate conditions requiring cooperation in grant agreements as appropriate.

Federal Consistency

The lead agency for each statewide program is responsible for working with federal partners to promote federal consistency. Statewide programs and their lead agencies are identified in the Cooperating Entities section of the 2011-2016 NPS Pollution Management Plan.

Program Tracking and Monitoring

Water quality monitoring data will be used to evaluate the effectiveness of NPS pollution management activities in the Lake Conway-Point Remove

watershed. ADEQ is responsible for maintaining the state's water quality inventory. Figure 14.4 shows monitoring stations in the watershed.

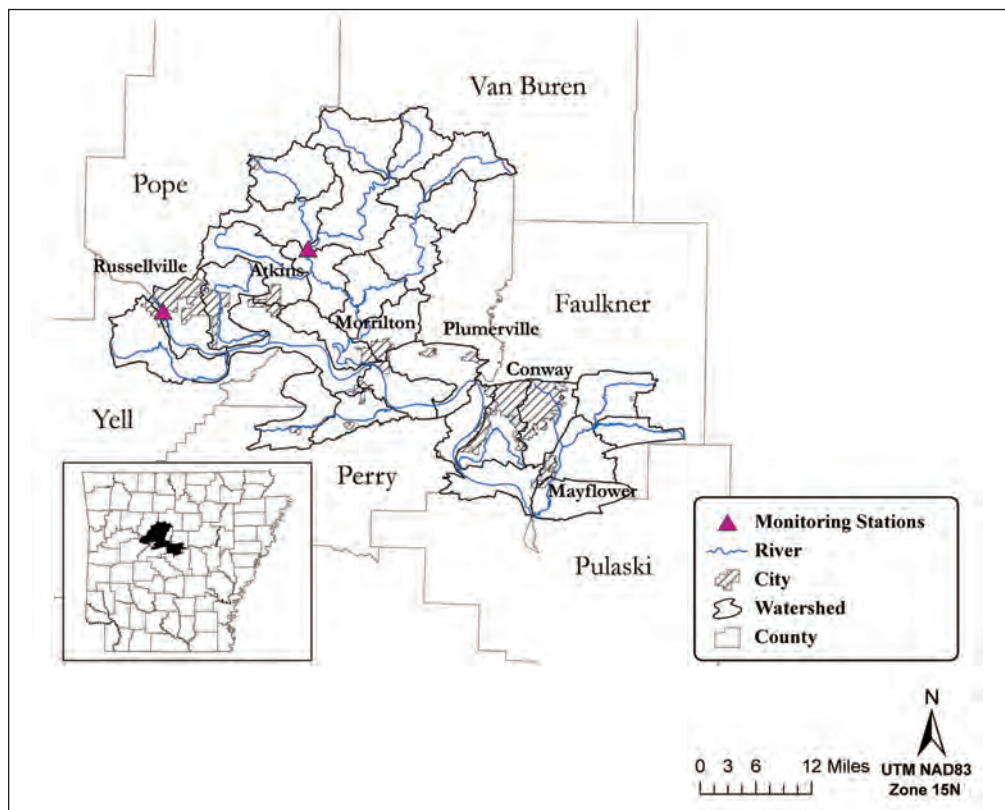
The NPS Pollution Management Plan may include as a condition of funding pre- and post-project measurements of changes in water quality. The NPS Pollution Management Plan encourages cooperating entities working in the watershed to meet annually to report on their activities of the previous year and discuss their successes, failures and future needs of their programs. The local watershed group is a logical convener for these discussions. Local cooperators are encouraged to compile this information, along with a summary of available water data and land use trends, into an annual watershed status report published and distributed in the watershed and to interested parties outside the watershed.

References Cited

- BAEG, 2011. County-Wise Population Data. Biological and Agricultural Engineering Department. University of Arkansas Division of Agriculture: Little Rock, Ark.
- CAST, 2006. Land Use/Land Cover Data. Biological and Agricultural Engineering Department. University of Arkansas: Fayetteville, Ark.
- Integrated Water Quality Monitoring and Assessment Report (IWQMAR), 2008. Arkansas Department of Environmental Quality: Little Rock, Ark. Available at www.arkansaswater.org/Documents/305b/2008_305b.pdf.
- UALR, 2011. Percent Change in Total Population. Available at http://argis.ualr.edu/2010Census/Change_in_Pop_2000_to_2010_by_County.pdf.

Figure 14.4
Monitoring stations
in the Lake
Conway-Point
Remove watershed

Source: U.S. Geological Survey
Data Source: GeoStor
Map Created: March 2011



Section Fifteen

L'Anguille River Priority Watershed

ADEQ Planning Segment 5B • HUC 08020205

Introduction

The L'Anguille River watershed is located in northeast Arkansas and covers parts of Craighead, Poinsett, Cross, Woodruff, St. Francis and Lee counties. The L'Anguille River begins south of Jonesboro and flows generally southward to its confluence with the St. Francis River near Marianna. This segment includes the entire 98-mile length of the L'Anguille River. The principal tributaries are Brushy Creek, First Creek, Second Creek and Larkin Creek. Second Creek, a tributary of the L'Anguille, has been designated as an Extraordinary Resource Water (ERW). Figure 15.1 provides a map showing the location of the watershed.

Assessment

The summary of water quality condition is described from the most current 305(b) report from the Arkansas Department of Environmental Quality (ADEQ) and other sources as cited appropriately. The following was stated in most current 305(b) report (IWQMAR, 2008):

The waters within these segments have been designated as suitable for the propagation of fish and wildlife, primary and secondary contact recreation, and public, industrial, and agricultural water supplies. The overriding impact of land use on water quality is evident in this segment. The entire L'Anguille River Watershed contains 933.1 stream miles of which approximately 14 percent are designated as outstanding resources. Approximately 74 percent of the waters within this basin were assessed, 482.8 miles were monitored and 204.1 miles evaluated. The assessment concludes that essentially all of the streams within these segments have high turbidity and silt loads carried into the streams from row crop agriculture activities. This condition was encouraged by the drainage of lowland areas and by ditching and the channelization of streams to facilitate the runoff. The continuation of such activities and the continuous maintenance dredging of the ditches and streams has aggravated and further deteriorated the conditions.

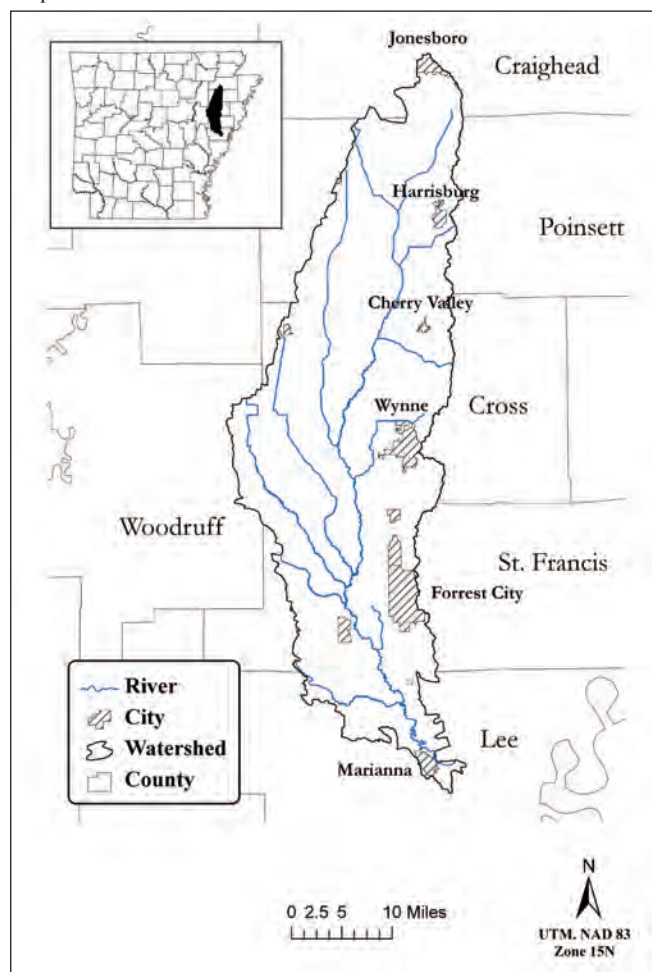
Because of the very high levels of turbidity during high flows and consistently elevated values during other flows, the entire length of the

L'Anguille River was assessed as not supporting the aquatic life uses. A total maximum daily load (TMDL) has been completed for siltation/turbidity in the L'Anguille River basin.

Some reaches of the L'Anguille River were assessed as not supporting the aquatic life and/or agricultural and industrial uses as a result of low dissolved oxygen, chlorides, sulfates and total dissolved solids (ADEQ, 2005).

Figure 15.1
Map of L'Anguille River watershed

Data Source: GeoStor
Map Created: March 2011



Nutrient enrichment of the waterbodies in this watershed is a concern. However, detecting and determining the extent of impacts of the contributions of nutrients from nonpoint sources is difficult. Land use in the watershed is probably the best indicator of where nutrients have the greatest potential to impact water quality. Improper management of nutrients can result in adjacent streams receiving nutrient inputs during storm events.

The U.S. Geological Survey (USGS) has done extensive monitoring and analysis of surface and groundwater quality in the Mississippi Embayment study area as part of the National Water Quality Assessment Program (NAWQA). A summary of these findings is available at:

- <http://permanent.access.gpo.gov/waterusgsgov/water.usgs.gov/pubs/circ/circ1208/abstract.html>.

The University of Arkansas' Department of Biological and Agricultural Engineering has used the Soil and Water Assessment Tool (SWAT) to model L'Anguille watershed for the 2011-2016 NPS Pollution Management Plan under contract with the Arkansas Natural Resources Commission (ANRC). Appendix B describes SWAT and the data used to estimate sediment, runoff and nutrient concentration for sediment and nutrients for 12-digit hydrologic unit code (HUC) sub-watersheds in Arkansas watersheds.

Brief Description of Land Uses in the Watershed

Figure 15.2 shows land use in the L'Anguille River watershed in 2006.

The following provides a partial snapshot of the watershed:

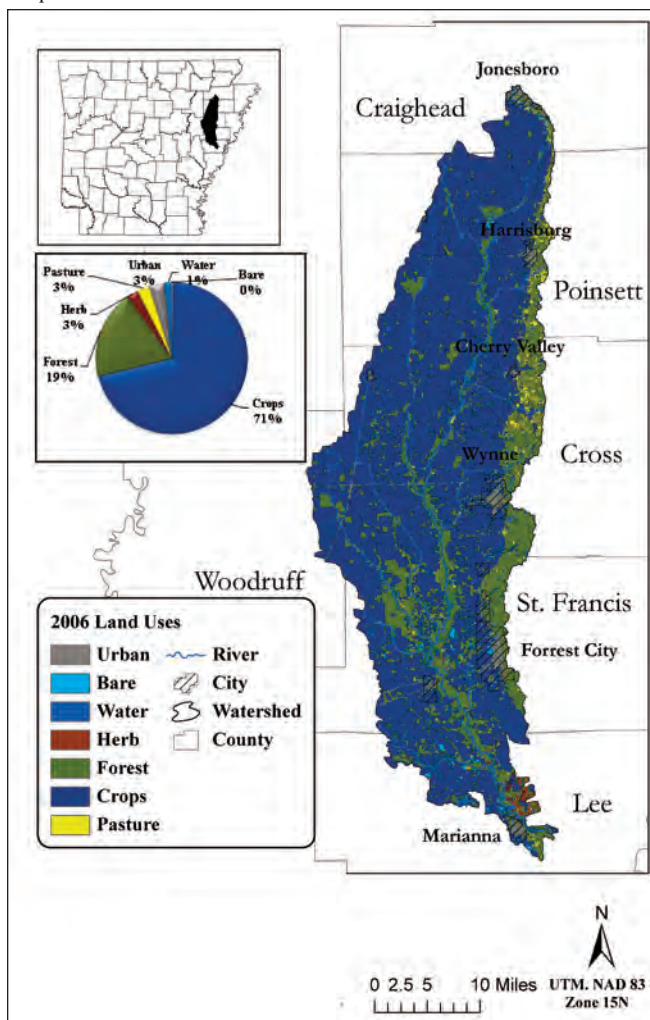
- Land use in the L'Anguille River watershed is predominantly agricultural. Nearly 71 percent of the land is cultivated in row crops, primarily rice and soybeans (CAST, 2006). Approximately 60 percent of the cropland is irrigated in the northern counties of the watershed (for example, Craighead, Poinsett, Cross and Woodruff), while 30 to 40 percent of the cropland is irrigated in Lee and St. Francis counties.
- Some 19 percent of the land is in forests and 3 percent is in pasture. Most of the land along Crowley's Ridge is in pasture or forest, which makes it an attractive area for rural residential development and raises the possibility of

increased runoff of sediment from new home construction sites into adjacent streams after storm events (CAST, 2006).

- While most of the main stem of the L'Anguille River is a meandering channel that has not been straightened, the majority of the tributaries and headwater streams have been dredged and channelized, particularly in the northern and western parts of the watershed. Much of the lower portion of the main stem has forested floodplains on both sides of the channel. Portions of the lower half of the L'Anguille River also have a braided channel.

Figure 15.2
Land use in the L'Anguille River watershed, 2006

Source: Center for Advanced Spatial Technologies (CAST), Land Use/Land Cover, 2006
Data Source: GeoStor,
Map Created: March 2011



- Approximately 33,116 people live in the watershed (BAEG, 2011). The largest city entirely within the watershed is Forrest City in St. Francis County with a population of 13,281, followed by Wynne with a population of 8,437 (U.S. Census Bureau, 2009).
- While only a small portion of Jonesboro drains into the watershed, suburban expansion is primarily southward into the L'Anguille River watershed. Jonesboro is subject to Phase II stormwater requirements and has filed a notice of intent for a small municipal separate storm sewer system (MS4) National Pollution Discharge Elimination System (NPDES) permit.
- Resource extraction occurs primarily on or near Crowley's Ridge.

Water Quality/Program Goals

The L'Anguille River watershed has been a priority of the Arkansas NPS Pollution Management Plan since the development of a TMDL in 2001. ANRC is again designating the L'Anguille River watershed as a priority watershed for the 2011-2016 NPS Pollution Management Plan. Pollutants of concern within this hydrologic unit area include siltation/turbidity and nutrients as well as low dissolved oxygen, total dissolved solids, chlorides and sulfates. Some of these pollutants cause some waterbodies to not fully meet their designated uses for aquatic life on the most current List of Impaired Waterbodies.

The impaired segments of the L'Anguille River watershed can be viewed at the following links:

- http://arkansaswater.org//index.php?option=com_content&task=view&id=14&Itemid=30.
- www.adeq.state.ar.us/water/branch_planning/pdfs/303d_list_2008.pdf.

The long-term goal of the priority watershed program is to reduce pollutants to levels that will restore all designated uses. The short-term goal of the program is to measurably reduce pollutants of concern that reach waters of the L'Anguille River watershed, targeting sub-watersheds where implementation can have the greatest impact. These goals will be achieved through implementation of a Nine Element Plan, which will complement the locally led development of a Watershed Restoration Action Strategy (WRAS) (Layher, 2004). ANRC contracted with Audubon Arkansas for preparation of a draft Nine Element Plan. The plan was submitted in March 2005 to the U.S.

Environmental Protection Agency (EPA) for approval. The plan was updated in 2009 by ANRC and resubmitted to EPA. Public support will have to be further developed to implement the proposed plans' activities.

Objectives and Milestones

Based on SWAT and other available analysis, ANRC will review available data and select sub-watersheds for targeting of implementation funds. Data that may be considered in targeting includes, but is not limited to, the modeled loads for sediment and phosphorus, percentage of intact woody riparian vegetation, density of unpaved roads, number of stream road crossings, rural population density, intensity of row crop agriculture, degree of urbanization and potential sources of pollutants. Other factors may also be considered at the discretion of ANRC including, but not limited to, local institutional capacity, input from the NPS Pollution Management Plan Stakeholder Group, local watershed groups or other agencies, availability of funds and other factors.

The 2011-2016 NPS Pollution Management Plan includes statewide programs aimed at reducing pollutant loads from land uses that have the potential to impact water quality. These land uses and programs to reduce their water quality impacts are described in more detail in earlier sections of the 2011-2016 NPS Pollution Management Plan. Statewide programs that will be implemented in the L'Anguille River watershed and their relative level of priority are given in Table 15.1.

The following objectives and milestones were identified with input from the NPS Pollution Management Plan Task Force. Table 3.1 (page 27) identifies cooperating entities that will partner to implement the NPS program in the L'Anguille River watershed.

15.1. Continue development of the Nine Element Plan until EPA's acceptance is obtained.

Timeline for Milestones: October 2011 through September 2016

15.2. Continue to develop support for implementation of the Nine Element Plan among potential cooperating entities and the general public.

Timeline for Milestones: October 2011 through September 2016

15.3. Provide technical and financial assistance to local cooperating entities to implement the Nine Element Plan as resources allow.

Timeline for Milestones: October 2011 through September 2016

Table 15.1. Relative priority of statewide programs to effect improvements in water quality in the L'Anguille River watershed

Description of Land Use	Statewide Program	Intensity of Land Use/Potential Impact
Animal agriculture	Agriculture	
• Confined animals		Low
• Pasture (e.g., application of poultry litter to pasture, unconfined livestock)		Low
Row crop agriculture	Agriculture	Very high
Forestry	Silviculture	
• Public lands		Low to moderate
• Industrial		Low to moderate
• Private nonindustrial		Moderate to high
Urban	Urban Runoff	Moderate to high
• Rapidly urbanizing area subject to Phase II small separate municipal storm sewer system (MS4) NPDES permit requirements for stormwater management		Low to moderate
Construction	Surface Erosion	
• Road and other infrastructure		Low to moderate
• Residential development		Low to moderate
• Commercial/industrial		Low to moderate
Onsite waste disposal	Urban Runoff	Moderate to high
Streambank modification	Surface Erosion	High
Surface mining (e.g., topsoil removal, gravel mining)	Resource Extraction	Moderate to high

15.4. As resources allow, use remote sensing and geographic informational systems (GIS) analysis to identify sub-watersheds where more extensive assessment is needed. Conduct targeted geomorphological and bioassessment to identify and target implementation of streambank stabilization projects for high-impact sites (for example, a geomorphologic study of logjams and assess beaver populations to determine their impact on streambank erosion and other studies).

Timeline for Milestones: October 2011 through September 2016

15.5. Continue to refine models as new data become available to represent sediment and nutrient loads in the watershed and in-stream processes to enable prioritization of implementation projects in sub-watersheds.

Timeline for Milestones: October 2011 through September 2016

15.6. Consider obtaining conservation easements through donations as the opportunity arises in an effort to protect lands along the L'Anguille and its tributaries from development that would result in further NPS pollution.

Timeline for Milestones: October 2011 through September 2016

15.7. Continue to increase public awareness and provide education to build support for citizen action to improve water quality in the watershed.

Timeline for Milestones: October 2011 through September 2016

15.8. Build constituency for improved water quality by increasing volunteerism and promoting recreational use of the river (for example, recruiting volunteers for cleanups and streambank restoration and other activities utilizing the Arkansas Stream Team program and other conservation groups as well as increasing public recreational access to the river with trails and boat ramps).

Timeline for Milestones: October 2011 through September 2016

15.9. Encourage county and municipal elected officials as well as contractors, home builders and consulting engineers to participate in construction and urban education programs to improve stormwater management.

Timeline for Milestones: October 2011 through September 2016

15.10. Coordinate conservation planning within a watershed area to take full advantage of cost-share programs for riparian habitat improvement such as the Wetland Reserve Program (WRP), the Conservation Reserve Program (CRP), the Wetland and Riparian Zone Tax Credit Program (through ANRC) and other programs.

Timeline for Milestones: October 2011 through September 2016

15.11. Encourage plans for alternative irrigation water supply and supplemental stream augmentation, including off-stream storage of surplus flows.

Timeline for Milestones: October 2011 through September 2016

15.12. Continue to provide public education on proper application, storage and disposal of pesticides, regulations and potential hazards of misuse (for example, encourage use of FARM*A*SYST and HOME*A*SYST programs to assess potential pollution hazards).

Timeline for Milestones: October 2011 through September 2016

15.13. Continue to provide education to rural homeowners and builders on proper construction and maintenance of onsite waste disposal systems.

Timeline for Milestones: October 2011 through September 2016

15.14. Continue to provide technical assistance and make available financial assistance to agricultural operations where cost-share is a component of approved 319(h) implementation projects.

Timeline for Milestones: October 2011 through September 2016

Timeline for Milestones

Provided sufficient human and financial resources are available to the cooperating entities working together in the L'Anguille River watershed, the short-term objectives of this plan can be met within five years of implementation of this plan. Fully implementing management measures within the watershed to restore all designated uses is a longer-term endeavor. A goal of this plan is to fully meet designated uses within 15 years.

Program Coordination

There is currently no single entity in the L'Anguille River watershed with the authority to implement

the Nine Element Plan. ANRC will work with cooperating entities in the watershed to promote voluntary coordination and incorporate conditions requiring cooperation in grant agreements, as appropriate. A high degree of voluntary coordination already exists in the agriculture program, through the Arkansas Conservation Partnership (ACP) as well as local coordination groups already in place.

Local coordination is achieved through two voluntary groups. The L'Anguille River Watershed Coalition in coordination with conservation districts and other entities developed a watershed action strategy and coordinates projects at the watershed level. To support development of this WRAS plan, the L'Anguille River Technical Support Group was formed. The Technical Support Group is composed of individuals who represent various agencies, both state and federal, as well as local governmental organizations and nonprofit groups who have an interest in the watershed and/or represent entities that have either technical expertise or programs which may provide financial assistance to address specific problems. The coalition has held public meetings throughout the basin to obtain input and develop support for plans to improve water quality in the L'Anguille River.

Federal Consistency

The lead agency for each statewide program is responsible for working with federal partners to promote federal consistency. Statewide programs and their lead agencies are identified in the Cooperating Entities section of the 2011-2016 NPS Pollution Management Plan.

Program Tracking and Evaluation

Water quality monitoring data will be used to evaluate the effectiveness of NPS Pollution Management activities in the L'Anguille River watershed. ADEQ is responsible for maintaining the state's water quality inventory. They maintain eight monthly monitoring stations within the L'Anguille River Watershed. In addition, the U.S. Geological Survey and the Arkansas Water Resource Center (AWRC) each maintain a monitoring site in the watershed. Real-time flow data is available at the USGS stations as well as some water quality data. Figure 15.3 shows monitoring stations in the watershed.

Figure 15.3 Monitoring stations in the L'Anguille River watershed

Source: U.S. Geological Survey
Data Source: GeoStor
Map Created: March 2011



The NPS Pollution Management Plan may include pre- and post-project measurements of changes in water quality as a condition of funding. The NPS Pollution Management Plan encourages cooperating entities working in the watershed to meet annually to report on their activities of the previous year and discuss their successes, failures and future needs of their programs. The local watershed group is a logical convener for these discussions. Local cooperators are encouraged to compile this information, along with a summary of available water data and land use trends, into an annual watershed status report published and distributed in the watershed and to interested parties outside the watershed.

References Cited

- BAEG, 2011. County-Wise Population Data. Biological and Agricultural Engineering Department. University of Arkansas Division of Agriculture: Little Rock, Ark.
- CAST, 2006. Land Use/Land Cover Data. Biological and Agricultural Engineering Department. University of Arkansas: Fayetteville, Ark.
- Integrated Water Quality Monitoring and Assessment Report (IWQMAR), 2008. Arkansas Department of Environmental Quality: Little Rock, Ark. Available at www.arkansaswater.org/Documents/305b/2008_305b.pdf.
- Layher, W., 2004. The L'Anguille River Watershed Restoration Action Strategy (WRAS). Layher Biologics RTEC, Inc.: Pine Bluff, Ark.
- U.S. Census Bureau, 2009. Available at http://factfinder.census.gov/servlet/DownloadDatasetServlet?_lang=en.

Section Sixteen

Lower Ouachita Smackover Priority Watershed

ADEQ Planning Segment 2D • HUC 08040201

Introduction

Segment 2D occupies the south central part of Arkansas and covers two 8-digit hydrologic unit code (HUC) watersheds, Lower Ouachita Smackover (08040201) and Lower Ouachita-Bayou De Loutre (08040202). The Lower Ouachita Smackover watershed covers Bradley, Dallas, Ouachita, Cleveland, Columbia, Nevada and Union counties. Segment 2D encompasses the lower Ouachita River and its tributaries from the confluence of the Little Missouri and Ouachita Rivers to the Louisiana state line. The major tributaries are Moro Creek, Camp Creek, Champagnolle Creek and Smackover Creek. Figure 16.1 shows a map of the watershed.

Assessment

The summary of water quality condition is described from the most current 305(b) report from the Arkansas Department of Environmental Quality (ADEQ) and

other sources as cited appropriately. The following was stated in the 2008 305(b) report (IWQMAR, 2008):

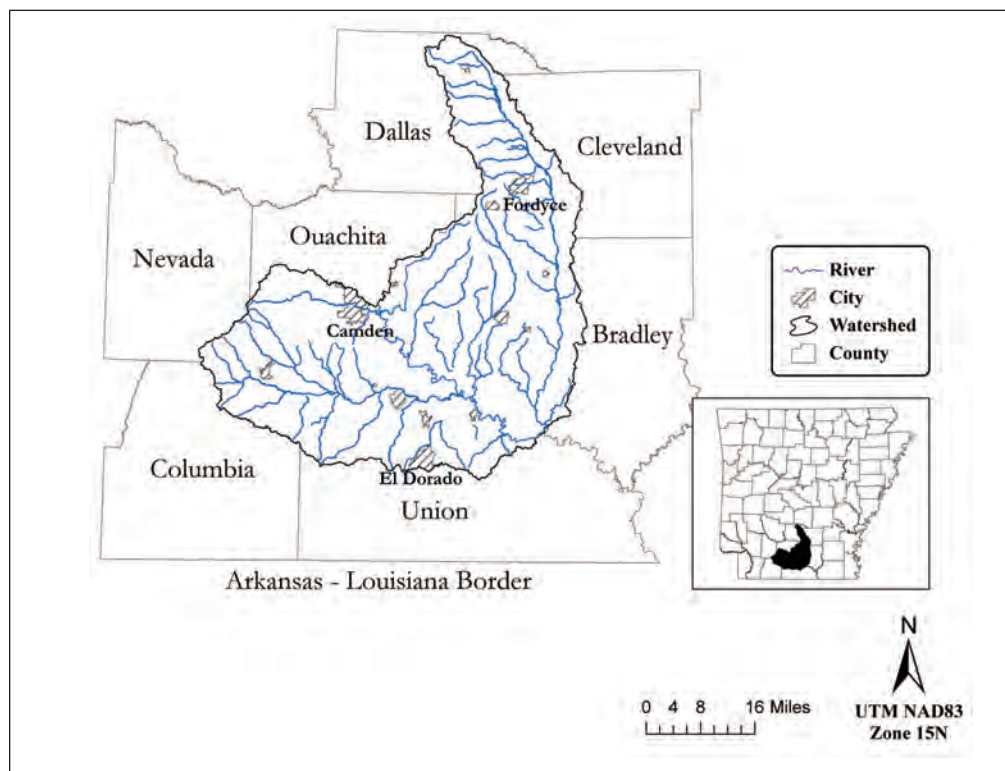
The waters within this segment have been designated as suitable for fish propagation, wildlife, primary and secondary contact recreation, as well as public, industrial and agricultural water supplies. Monitored data were used as the basis of assessing 220.2 miles of stream. An additional 125.4 miles were evaluated bringing the total number of miles assessed within this segment to 345.6 stream miles.

The Lower Ouachita River, Champagnolle and Moro Creeks have fish consumption advisories due to mercury contamination. A consumption advisory has been placed on 66.3 miles of the Ouachita River, 20.0 miles of Champagnolle Creek and 12 miles of Moro Creek.

Some of the most severe water quality problems exist in the unnamed tributary from El Dorado

Figure 16.1
Map of Lower
Ouachita
Smackover
watershed

Data Source: GeoStor
Map Created: March 2011



Chemical Company (ELCC), in Flat Creek and Salt Creek. The ELCC tributary contains toxic ammonia levels, very high nitrates, high minerals (SO_4/TDS), and metals (copper and zinc); the source is from the El Dorado Chemical Company discharge. Flat Creek and Salt Creek have very high minerals ($\text{CL}/\text{SO}_4/\text{TDS}$) and metals (copper and zinc).

The exact source is unknown, but these drainage basins are from the northern edge of El Dorado where numerous oil and brine processing and storage facilities exist along with numerous abandoned pumping facilities. These streams enter Smackover Creek below the ambient monitoring station. TMDLs were completed in October 2002 and in October 2003. Additional point source controls are also needed to address these issues.

The University of Arkansas' Department of Biological and Agricultural Engineering has used the Soil and Water Assessment Tool (SWAT) to model selected priority watersheds for the 2011-2016 Nonpoint Source (NPS) Pollution Management Plan under contract with the Arkansas Natural Resources Commission (ANRC). Appendix B describes

SWAT modeling process and the data used to estimate sediment and nutrient concentration for 12-digit HUC sub-watersheds.

Brief Description of Land Uses in the Watershed

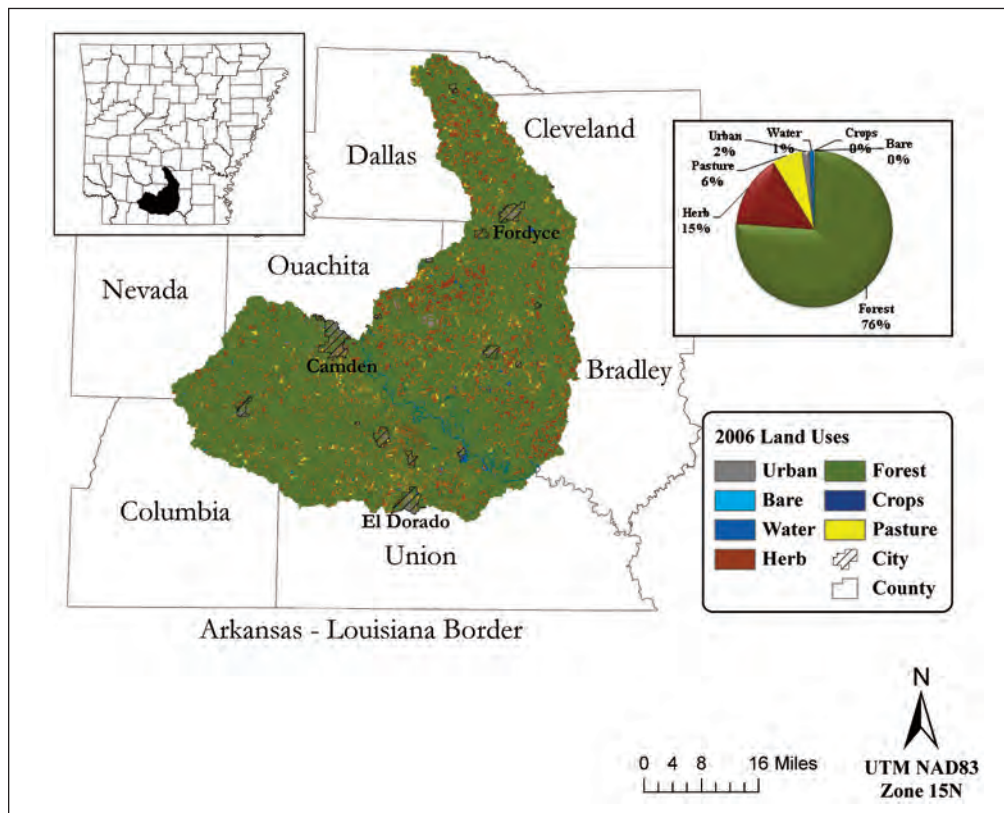
Figure 16.2 shows land use in the Lower Ouachita Smackover watershed in 2006.

The following provides a partial snapshot of the watershed:

- Nearly 6 percent of the watershed's land area is under pasture, and 76 percent of the watershed is under forest (CAST, 2006.) The remaining land usage includes construction, waterbodies, etc.
- Approximately 39,809 people live in the watershed (BAEG, 2011). Throughout the watershed, population decreased between 2000 and 2010, with the exception of Cleveland County. Most of the decrease took place in Dallas County (-11.9 percent), whereas the smallest decrease was in Columbia County (-4.1 percent) (UALR, 2011).

Figure 16.2
Land use in the
Lower Ouachita
Smackover
watershed, 2006

Source: Center for Advanced Spatial Technologies (CAST), Land Use/Land Cover, 2006
Data Source: GeoStor
Map Created: March 2011



Water Quality/Program Goals

The Lower Ouachita Smackover watershed has been designated as a priority for the first time by ANRC for the 2011-2016 NPS Pollution Management Plan.

The impaired segments of the Lower Ouachita Smackover watershed can be viewed at the following links:

- http://arkansaswater.org//index.php?option=com_content&task=view&id=14&Itemid=30.
- www.adeq.state.ar.us/water/branch_planning/pdfs/303d_list_2008.pdf.

The long-term goal of the priority watershed program is to reduce pollutants to levels that will restore all designated uses. The short-term goal of the program is to measurably reduce pollutants of concern that reach waters of the Lower Ouachita Smackover watershed, targeting sub-watersheds where implementation can have the greatest impact. These goals will be achieved through implementation of a Nine Element Plan.

Objectives and Milestones

Based on SWAT and other available analysis, ANRC will review available data and select sub-watersheds for targeting of implementation funds. Data that may be considered in targeting includes, but is not limited to, the modeled loads for sediment and phosphorus, percentage of intact woody riparian vegetation, density of unpaved roads, number of stream road crossings, rural population density, intensity of row crop agriculture, degree of urbanization and potential sources of pollutants. Other factors may also be considered at the discretion of ANRC including, but not limited to, local institutional capacity, input from the NPS Pollution Management Plan Stakeholder Group, local watershed groups or other agencies, availability of funds and other factors.

The 2011-2016 NPS Pollution Management Plan includes statewide programs aimed at reducing pollutant loads from land uses that have the potential to impact water quality. These land uses and programs to reduce their water quality impacts are described in more detail in earlier sections of the 2011-2016 NPS Pollution Management Plan.

The following objectives and milestones were identified with input from the NPS Pollution Management Plan Stakeholder Group. Table 3.1 (page 27) identifies cooperating entities that will partner to implement the NPS program in the Lower Ouachita Smackover watershed.

16.1. Initiate development of the Nine Element Plan until the U.S. Environmental Protection Agency's acceptance is obtained.

Timeline for Milestones: October 2011 through September 2016

16.2. Continue to develop support for implementation of the Nine Element Plan among potential cooperating entities and the general public.

Timeline for Milestones: October 2011 through September 2016

16.3. Provide technical and financial assistance to local cooperating entities to implement the Nine Element Plan as resources allow.

Timeline for Milestones: October 2011 through September 2016

16.4. As resources allow, use remote sensing and geographic information systems (GIS) analysis to identify sub-watersheds where more extensive assessment is needed. Conduct targeted geomorphological and bioassessment to identify and target implementation of streambank stabilization projects for high-impact sites (for example, a geomorphologic study of logjams and assess beaver populations to determine their impact on streambank erosion and other studies).

Timeline for Milestones: October 2011 through September 2016

16.5. Continue to develop models to represent sediment and nutrient loads in the watershed and in-stream processes to enable prioritization of implementation projects in sub-watersheds.

Timeline for Milestones: October 2011 through September 2016

16.6. Continue to focus on Best Management Practices (BMP) implementation to improve conservation practices for erosion control, sediment retention, irrigation management and nutrient management on row crop and animal agriculture and forestland. As appropriate, direct technical assistance to landowners in targeted watersheds giving emphasis to developing new conservation plans and areas that connect established riparian corridors.

Timeline for Milestones: October 2011 through September 2016

16.7. Continue to provide and improve extensive education and training to promote BMP implementation (for example, risk management, demonstrations to acquaint landowners and municipalities with the conservation practices most effective in reducing runoff, sediment detachment and transport including, but not limited to, no-till, conservation till, ridge till, pipe drop outlets, riparian zone management and wetland restoration).

Timeline for Milestones: October 2011 through September 2016

16.8. Continue to encourage landowners to establish riparian buffer strips and grass drainageways, stabilize streambanks and restore riparian areas

Timeline for Milestones: October 2011 through September 2016

16.9. Continue to secure conservation easements through donations as the opportunity arises in an effort to protect lands along Arkansas River and its tributaries from development that would result in further NPS pollution.

Timeline for Milestones: October 2011 through September 2016

16.10. Continue to increase public awareness and provide education to build support for citizen action to improve water quality in the watershed.

Timeline for Milestones: October 2011 through September 2016

16.11. Build constituency for improved water quality by increasing volunteerism and promoting recreational use of the river (for example, recruiting volunteers for cleanups, streambank restoration and other activities utilizing the Arkansas Stream Team program and other conservation groups as well as increasing public recreational access to the river with trails and boat ramps).

Timeline for Milestones: October 2011 through September 2016

16.12. Encourage county and municipal elected officials as well as contractors, home builders and consulting engineers to participate in construction and urban education programs to improve stormwater management.

Timeline for Milestones: October 2011 through September 2016

16.13. Coordinate conservation planning within a watershed area to take full advantage of cost-share programs for riparian habitat improvement such as the Wetland Reserve Program (WRP), the Conservation Reserve Program (CRP), the Wetland and Riparian Zone Tax Credit Program (through ANRC) and other programs.

Timeline for Milestones: October 2011 through September 2016

16.14. Encourage plans for alternative irrigation water supply and supplemental stream augmentation, including off-stream storage of surplus flows.

Timeline for Milestones: October 2011 through September 2016

16.15. Continue aquatic life assessments to assess response of waterbodies to NPS control measures as resources allow.

Timeline for Milestones: October 2011 through September 2016

16.16. Continue to provide public education on proper application, storage and disposal of pesticides, regulations and potential hazards of misuse (for example, encourage use of FARM*A*SYST and HOME*A*SYST programs to assess potential pollution hazards).

Timeline for Milestones: October 2011 through September 2016

16.17. Continue to provide education to rural homeowners and builders on proper construction and maintenance of onsite waste disposal systems.

Timeline for Milestones: October 2011 through September 2016

16.18. Continue to provide technical assistance and make available financial assistance to agricultural operations where cost-share is a component of approved 319(h) implementation projects.

Timeline for Milestones: October 2011 through September 2016

Timeline for Milestones

Provided sufficient financial and human resources are available to the cooperating state and local agencies and nonprofit organizations working together in the Lower Ouachita Smackover watershed, the short-term objectives of this plan can be met within five years of program initiation. Fully implementing management measures within the watershed to restore all designated uses is a longer-term endeavor. A goal of this plan is to fully meet designated uses within 15 years.

Program Coordination

There is currently no single entity in the Lower Ouachita Smackover watershed with the authority to implement the Nine Element Plan. ANRC will work with cooperating entities in the watershed to promote voluntary coordination and incorporate conditions requiring cooperation in grant agreements as appropriate.

Federal Consistency

The lead agency for each statewide program is responsible for working with federal partners to promote federal consistency. Statewide programs and their lead agencies are identified in the Cooperating Entities section of the 2011-2016 NPS Pollution Management Plan.

Program Tracking and Monitoring

Water quality monitoring data will be used to evaluate the effectiveness of NPS pollution management activities in the Lower Ouachita Smackover watershed. ADEQ is responsible for maintaining the state's water quality inventory. Figure 16.3 shows monitoring stations in the watershed.

The NPS Pollution Management Plan may include as a condition of funding pre- and post-project measurements of changes in water quality. The NPS Pollution Management Plan encourages cooperating entities working in the watershed to meet annually to report on their activities of the previous year and discuss their

successes, failures and future needs of their programs. The local watershed group is a logical convener for these discussions. Local cooperators are encouraged to compile this information, along with a summary of available water data and land use trends, into an annual watershed status report published and distributed in the watershed and to interested parties outside the watershed.

References Cited

BAEG, 2011. County-Wise Population Data. Biological and Agricultural Engineering Department. University of Arkansas Division of Agriculture: Little Rock, Ark.

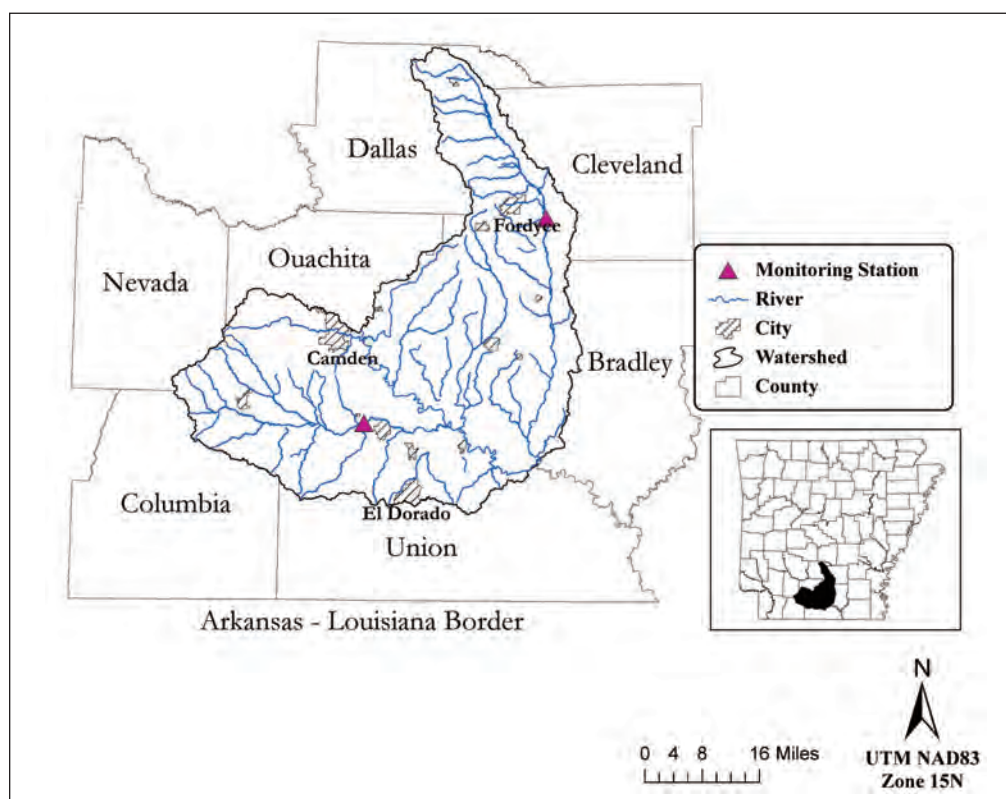
CAST, 2006. Land Use/Land Cover Data. Biological and Agricultural Engineering Department. University of Arkansas: Fayetteville, Ark.

Integrated Water Quality Monitoring and Assessment Report (IWQMAR). 2008. Arkansas Department of Environmental Quality: Little Rock, Ark. Available at www.arkansaswater.org/Documents/305b/2008_305b.pdf.

UALR, 2011. Percent Change in Total Population. Available at http://argis.ualr.edu/2010Census/Change_in_Pop_2000_to_2010_by_County.pdf.

Figure 16.3
Monitoring
stations in the
Lower Ouachita
Smackover
watershed

Source: U.S. Geological Survey
Data Source: GeoStor
Map Created: March 2011



Section Seventeen

Poteau River Priority Watershed

ADEQ Planning Segment 3I • HUC 11110105

Introduction

Segment 3I is located on the western edge of Arkansas, just south of the Arkansas River. The Arkansas portion of the Poteau River watershed includes large portions of Scott and Sebastian counties and a small part of northwestern Polk County, covering an area of 1,889 square miles. The waters of this segment include the Poteau River from its headwaters to the Oklahoma state line as well as the tributary streams. Major tributaries in Arkansas include Jones Creek and James Fork. The largest share of the watershed is located in Oklahoma. Figure 17.1 shows the watershed.

Assessment

The summary of water quality condition is described from the most current 305(b) report from the Arkansas Department of Environmental Quality (ADEQ) and

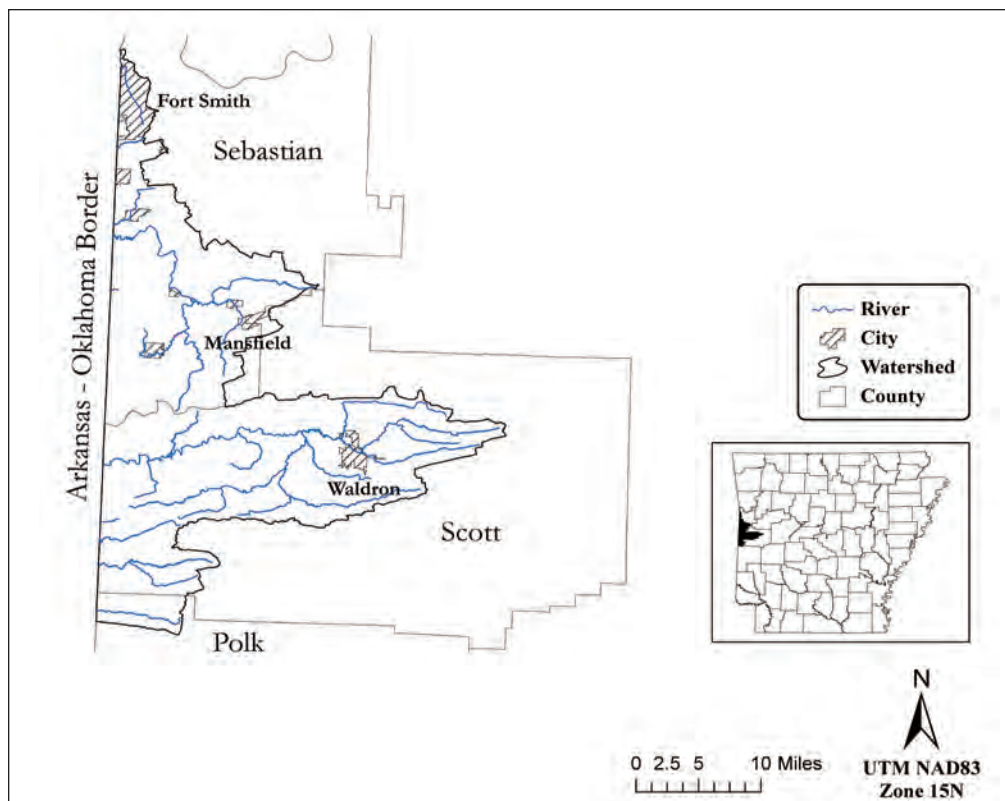
other sources as cited appropriately. The following was stated in the most current 305(b) report (IWQMAR, 2008):

The waters within this segment have been designated as suitable for the propagation of fish and wildlife, primary and secondary contact recreation, and public, industrial, and agricultural water supplies. This planning segment contains 105.3 stream miles. Five monitoring stations, including one operated by the U.S. Geological Survey (USGS), are located within this segment and were utilized to assess 55.8 stream miles. The remaining 49.5 miles were not assessed.

A short section of the Poteau River below Waldron was listed as not supporting aquatic life uses due to elevated metals and total phosphorus. Both a municipal and industrial discharge occurs in this segment. In addition, a short section of the

Figure 17.1
Map of Poteau
River watershed

Data Source: GeoStor
Map Created: March 2011



Poteau River just above its confluence with the Arkansas River was listed as not supporting the aquatic life use because of excessive turbidity. A total maximum daily load (TMDL) to address these issues was completed in 2006.

Nutrient enrichment of the waterbodies in this watershed is a concern, both from point and nonpoint sources. Known problems below wastewater treatment facilities do occur and are easily documented. However, detecting and determining the extent and impact of nutrients contributed from nonpoint sources (NPS) is more of a challenge. Land use in the watershed is probably the best indicator of where nutrients have the greatest potential to impact water quality. Confined animal feeding operations (CAFO) in high concentrations within a watershed can result in application of animal manures at nutrient rates greater than can be assimilated, potentially resulting in nutrients being transported into adjacent streams during storm events. In addition, improper management of nutrients can also result in adjacent streams receiving nutrient inputs during storm events (ANRC, 2006).

A U.S. Forestry Service (USFS) comparative assessment of 50 watersheds in Arkansas, Oklahoma and Missouri estimated potential erosion by land use

for the Poteau River watershed. Based on 1992 National Resource Inventory data, pastureland had the highest potential erosion rate at 67 percent compared to other lands (including urban), which had a 22 percent potential erosion rate. Cropland had a 7 percent potential erosion rate and forestry was at 2 percent. Potential erosion rates for pastureland and other lands increased from 1982 (USFS, 1999).

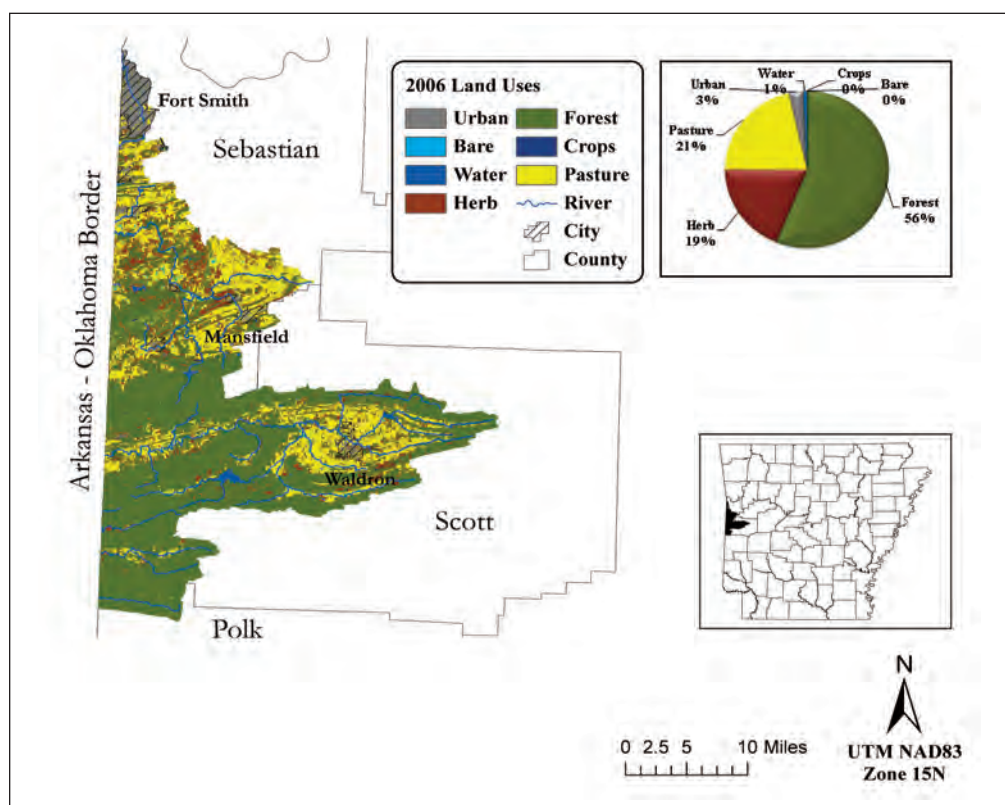
The University of Arkansas' Department of Biological and Agricultural Engineering has used the Soil and Water Assessment Tool (SWAT) to model selected priority watersheds for the 2011-2016 NPS Pollution Management Plan under contract with the Arkansas Natural Resources Commission (ANRC). Appendix B describes SWAT and the data used to estimate sediment and nutrient concentration for 12-digit hydrologic unit code (HUC) sub-watersheds. Similar data and methods will be used to model the Poteau River watershed as resources allow.

Brief Description of Land Uses in the Watershed

Figure 17.2 shows land use in the Poteau River watershed in 2006.

Figure 17.2
Land use in the
Poteau River
watershed, 2006

Source: Center for Advanced Spatial Technologies (CAST), Land Use/Land Cover, 2006
Data Source: GeoStor
Map Created: March 2011



The following provide a partial snapshot of the watershed:

- An estimated 56 percent of the land area is forested and 21 percent is pasture (CAST, 2006). The remainder of land is accounted for by construction, waterbodies, etc.
- The Poteau River watershed forests are comprised of a mix of pine, upland and bottomland forest types, and include private nonindustrial, industrial and public ownership.
- Poultry production and small cattle operations dominate agricultural production in the three-county area. Some 468 farms raised and sold 90 million birds in 2002 in the three-county area where the Poteau River watershed is located (NASS, 2002).
- The entire watershed is designated as a nutrient surplus area subject to new regulations for nutrient planning, nutrient application and certification of nutrient planners.
- Approximately 55,471 people live in the watershed (BAEG, 2011).
- The city of Fort Smith and a portion of Sebastian County are subject to Phase II requirements for a small municipal separate storm sewer system (MS4) (ADEQ, 2005).
- There are public drinking water sites located in the Arkansas portion of the watershed.
- Significant communities in the watershed include Fort Smith and Waldron as well as a number of smaller towns. A portion of Fort Smith drains into the Poteau River watershed.
- Fort Smith grew from 2000 to 2010, while Waldron lost population during the same period. Sebastian and Scott counties added population between 2000 and 2010. Sebastian County's population grew 9.3 percent, while Scott County added 2.2 percent population over the 10-year period (UALR, 2011).
- The state of Oklahoma lists the Poteau River watershed on its List of Impaired Waterbodies.

Water Quality/Program Goals

The Poteau River Watershed has been a priority of the Arkansas Nonpoint Source Pollution Management Plan since the comprehensive update completed in 1998. ANRC is again designating the Poteau River watershed as a priority watershed for the 2011-2016 NPS Pollution Management Plan. Pollutants of

concern within this hydrologic unit area include sediment/turbidity, nitrogen, total phosphorous, copper and zinc. Some of these pollutants cause some waterbodies to not fully meet their designated uses for aquatic life.

The long-term goal of the priority watershed program is to reduce pollutants to levels that will restore all designated uses. The short-term goal of the program is to measurably reduce pollutants of concern that reach waters of the Poteau River watershed, targeting sub-watersheds where implementation can have the greatest impact. These goals will be achieved through implementation of a Nine Element Plan. It will take at least three to five years to develop the Nine Element Plan. There is currently no watershed group to provide coordination and leadership for development of a plan or its implementation. This institutional capacity and public support will have to be developed in order to implement proposed plans and implementation activities.

Objectives and Milestones

Using SWAT and other available analyses, ANRC will review available data and select sub-watersheds for targeting of implementation funds. Data that may be considered in targeting include, but are not limited to, the modeled loads for sediment and nutrients, percentage of intact woody riparian vegetation, density of unpaved roads, number of stream road crossings, rural population density, intensity of agricultural production, degree of urbanization and potential sources of pollutants. Other factors may also be considered at the discretion of ANRC including, but not limited to, local institutional capacity, input from the NPS Pollution Management Plan Stakeholder Group, local watershed groups or other agencies, the availability of funds and other factors.

The impaired segments of the Poteau River watershed can be viewed at:

- http://arkansaswater.org//index.php?option=com_content&task=view&id=14&Itemid=30.
- www.adeq.state.ar.us/water/branch_planning/pdfs/303d_list_2008.pdf.

The 2011-2016 NPS Pollution Management Plan includes statewide programs aimed at reducing pollutant loads from land uses that have the potential to impact water quality. These land uses and programs to reduce their water quality impacts are described in more detail in earlier sections of the 2011-2016 NPS

Pollution Management Plan. Statewide programs that will be implemented in the Poteau River watershed and their relative level of priority are shown in Table 17.1.

The following objectives and milestones were identified with input from the NPS Pollution Management Plan Stakeholder Group. Table 3.1 (page 27) identifies cooperating entities that will partner to implement the 2011-2016 NPS Pollution Management Plan in the Poteau River watershed.

17.1. Begin development of a Nine Element Plan.

Timeline for Milestones: October 2011 through September 2016

17.2. Begin to develop support for implementation of the Nine Element Plan among potential cooperating entities and the general public.

Timeline for Milestones: October 2011 through September 2016

17.3. Provide technical and financial assistance to local cooperating entities to implement the Nine Element Plan as resources allow.

Timeline for Milestones: October 2011 through September 2016

17.4. Begin to develop local institutional capacity to implement the Nine Element Plan (for example, watershed groups).

Timeline for Milestones: October 2011 through September 2016

17.5. As resources allow, identify sub-watersheds where more extensive assessment is needed. Conduct targeted geomorphological and biological assessment to identify and target high impact restoration projects (for example, streambank stabilization).

Timeline for Milestones: October 2011 through September 2016

17.6. Continue to strengthen models to represent sediment and nutrient loads in the watershed and in-stream processes to enable prioritization of implementation projects in sub-watersheds.

Timeline for Milestones: October 2011 through September 2016

Table 17.1. Relative priority of statewide programs to effect improvements in water quality in the Poteau River watershed

Description of Land Use	Statewide Program	Intensity of Land Use/Potential Impact
Animal agriculture	Agriculture	
• Confined animals		Very high
• Pasture (e.g., application of poultry litter to pasture, unconfined livestock)		Very high
Row crop agriculture	Agriculture	Low
Forestry	Silviculture	
• Public lands		Low to moderate
• Industrial		Low to moderate
• Private nonindustrial		Moderate to high
Urban	Urban Runoff	Moderate to high
• Rapidly urbanizing area subject to Phase II small separate municipal storm sewer system (MS4) NPDES permit requirements for stormwater management		High
Construction	Surface Erosion	
• Road and other infrastructure		Low to moderate
• Residential development		Moderate to high
• Commercial/industrial		Low to moderate
Onsite waste disposal	Urban Runoff	Moderate to high
Streambank modification	Surface Erosion	High
Surface mining (e.g., topsoil removal, gravel mining)	Resource Extraction	Moderate to high

17.7. Promote Best Management Practice implementation to improve conservation practices for erosion control, sediment retention and nutrient management on lands used for row crop and animal agriculture as well as timber production. As appropriate, direct technical assistance to landowners in targeted sub-watersheds giving emphasis to developing new conservation plans.

Timeline for Milestones: October 2011 through September 2016

17.8. Continue to promote the development of comprehensive nutrient management plans (CNMPs) or nutrient management plans (NMPs).

Timeline for Milestones: October 2011 through September 2016

17.9. Continue and strengthen ongoing comprehensive education and training programs to help poultry and livestock producers meet the requirements of ADEQ's confined animal feeding operations regulations.

Timeline for Milestones: October 2011 through September 2016

17.10. Encourage landowners to establish riparian buffer strips and grass drainageways, stabilize streambanks and restore riparian areas.

Timeline for Milestones: October 2011 through September 2016

17.11. Consider obtaining conservation easements through donations as the opportunity arises in an effort to protect lands along the Poteau River and its tributaries from development that would result in further NPS pollution.

Timeline for Milestones: October 2011 through September 2016

17.12. Increase public awareness and provide education to build support for citizen action to improve water quality in the watershed.

Timeline for Milestones: October 2011 through September 2016

17.13. Build constituency for improved water quality by promoting volunteerism and recreational use of the river (for example, recruiting volunteers for cleanups, streambank restoration and other activities utilizing the Arkansas Stream Team program and other conservation groups).

Timeline for Milestones: October 2011 through September 2016

17.14. Coordinate conservation planning within a watershed area to take full advantage of cost-share programs for riparian habitat improvement such as the Wetland Reserve Program (WRP), the Conservation

Reserve Program (CRP) and Wetland and Riparian Zone Tax Credit Program (through ANRC).

Timeline for Milestones: October 2011 through September 2016

17.15. Continue to provide public education on proper application, storage and disposal of pesticides, regulations and potential hazards of misuse (for example, encourage use of FARM*A*SYST, URBAN*A*SYST and HOME*A*SYST programs to assess potential pollution hazards).

Timeline for Milestones: October 2011 through September 2016

17.16. Continue to provide education to rural homeowners and builders on proper construction and maintenance of onsite waste disposal systems.

Timeline for Milestones: October 2011 through September 2016

17.17. Continue to provide technical assistance and make available financial assistance to agricultural operations where cost-share is a component of approved 319(h) implementation projects.

Timeline for Milestones: October 2011 through September 2016

Timeline for Milestones

Provided sufficient human and financial resources are available to the cooperating entities working together in the Poteau River watershed, the short-term objectives of this plan can be met within five years of program initiation. Fully implementing management measures within the watershed to restore all designated uses is a longer-term endeavor. One goal of this plan is to fully meet designated uses within 15 years.

Program Coordination

There is currently no single entity in the Poteau River watershed with the authority to develop or implement a Nine Element Plan. The ANRC will work with cooperating entities in the watershed to promote voluntary coordination and incorporate conditions requiring cooperation in grant agreements, as appropriate. A high degree of voluntary coordination already exists in the agriculture program, through the Arkansas Conservation Partnership (ACP) as well as local coordination groups already in place. In addition, ANRC will promote the development and strengthening of local watershed groups to implement the watershed protection plan.

Federal Consistency

The lead agency for each statewide program is responsible for working with federal partners to promote federal consistency. Statewide programs and their lead agencies are identified in the Cooperating Entities section of the 2011-2016 NPS Pollution Management Plan.

Program Tracking and Evaluation

Water quality monitoring data will be used to evaluate the effectiveness of NPS pollution management activities in the Poteau River watershed. ADEQ is responsible for maintaining the state's water quality inventory. They maintain four monitoring stations within the watershed. In addition, USGS maintains one monitoring site in the watershed. Real-time flow data is available at the USGS station as well as some water quality data. Figure 17.3 shows the monitoring stations in the watershed.

The NPS Pollution Management Plan may include pre- and post-project measurements of changes in water quality as a condition of funding. The NPS Pollution Management Plan also encourages cooperating entities working in the watershed to meet annually

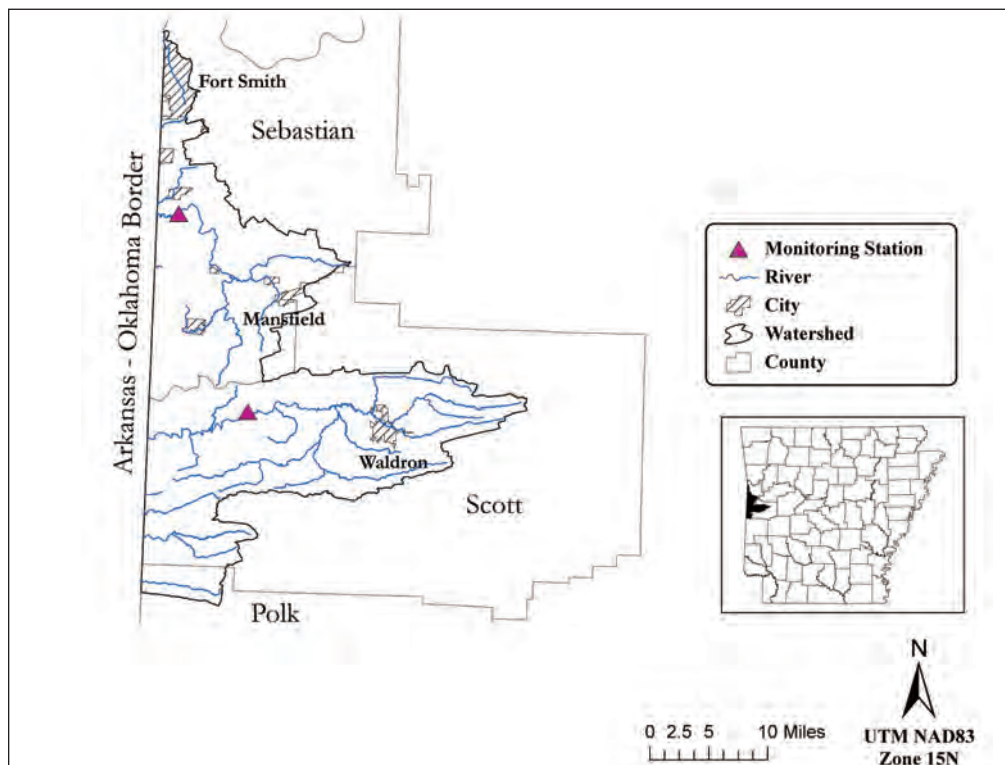
to report on their activities of the previous year and discuss their successes, failures and future needs of their programs. Local cooperators are encouraged to compile this information, along with a summary of available water data and land use trends, into an annual watershed status report published and distributed in the watershed and to interested parties outside the watershed.

References Cited

- BAEG, 2011. County-Wise Population Data. Biological and Agricultural Engineering Department. University of Arkansas Division of Agriculture: Little Rock, Ark.
- CAST, 2006. Land Use/Land Cover Data. Biological and Agricultural Engineering Department. University of Arkansas: Fayetteville, Ark.
- Integrated Water Quality Monitoring and Assessment Report (IWQMAR), 2008. Arkansas Department of Environmental Quality: Little Rock, Ark. Available at www.arkansaswater.org/Documents/305b/2008_305b.pdf.
- UALR, 2011. Percent Change in Total Population. Available at http://argis.ualr.edu/2010Census/Change_in_Pop_2000_to_2010_by_County.pdf.
- USFS, 1999. Ozark-Ouachita Highlands Assessment: Aquatic Conditions. Southern Research Station, U.S. Forest Service: Hot Springs, Ark. www.srs.fs.usda.gov/pubs/viewpub.jsp?index=2037.

Figure 17.3
Monitoring stations
in the Poteau River
watershed

Source: U.S. Geological Survey
Data Source: GeoStor
Map Created: March 2011



Section Eighteen

Strawberry River Priority Watershed

ADEQ Planning Segment 4G • HUC 11010012

Introduction

Segment 4G includes Strawberry River, a tributary of the Black River, located in the Ozark Highland ecoregion in north central Arkansas. The headwaters arise near the town of Salem in Fulton County. The watershed covers parts of Fulton, Independence, Izaard, Lawrence and Sharp counties. The segment includes Caney Creek, Coopers Creek, Little Strawberry Creek, North Big Creek, Piney Fork and Reeds Creek. Figure 18.1 shows a map of the watershed.

Assessment

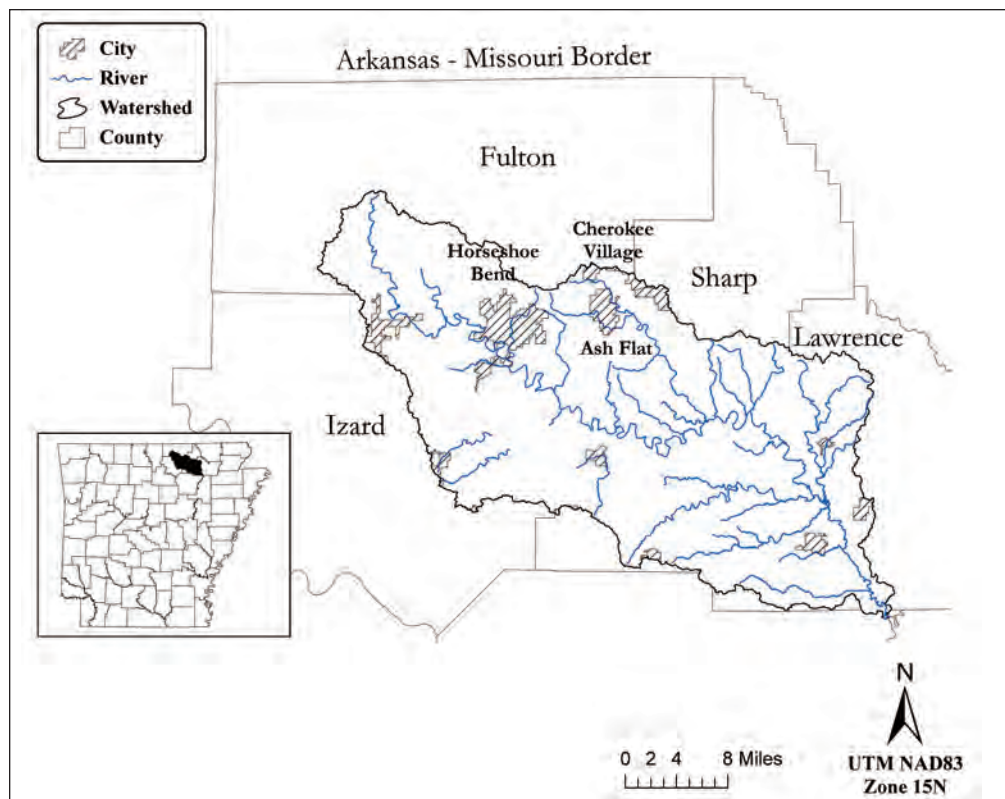
The summary of water quality condition is described from the most current 305(b) report from the Arkansas Department of Environmental Quality (ADEQ) and other sources, as cited appropriately. The following was stated in the most current 305(b) report (IWQMAR, 2008):

Fish and wildlife propagation, primary and secondary contact recreation, and domestic, agricultural, and industrial water supplies are the designated uses for all waters within this segment. Also, 112.2 miles of these streams are designated as outstanding state or national resource waters. The water quality monitoring stations allowed for the monitored assessment of 389.5 miles of streams in the segment and the evaluation of 51.2 miles.

ADEQ completed a physical, chemical, and biological water quality assessment of the Strawberry River watershed in December 2003. Results from the survey indicated that seven stream segments were not fully supporting the aquatic life designated use because of excessive in-stream turbidity (i.e., exceeding 10 NTU - "primary value," 17 NTU - "storm-flow" value; Source: EPA, 2006) and that eight stream segments were not fully supporting the primary contact recreation use

Figure 18.1
Map of Strawberry
River watershed

Data Source: GeoStor
Map Created: March 2011



because of excessive fecal coliform bacteria concentrations. The main source of the turbidity was thought to be from unpaved county roads, streambank erosion, and adjacent pasture land. The main source of the fecal coliform bacteria was thought to be from adjacent agriculture land use activities. A total maximum daily load (TMDL) for silt was completed in 2006.

Almost 40 miles of extraordinary resource waters in this segment were assessed as not supporting aquatic life uses due to excessive turbidity levels. The total suspended solids and total phosphorus levels show peaking values way above normal. This is most likely from agriculture activities probably associated with pasturing and animal grazing to the edge of the streambank.

The University of Arkansas' Department of Biological and Agricultural Engineering has used the Soil and Water Assessment Tool (SWAT) to model selected priority watersheds for the 2011-2016 Nonpoint Source (NPS) Pollution Management Plan under contract with the Arkansas Natural Resource Commission (ANRC). Appendix B describes SWAT

modeling process and the data used to estimate sediment and nutrient concentration for 12-digit hydrologic unit code (HUC) sub-watersheds.

Brief Description of Land Uses in the Watershed

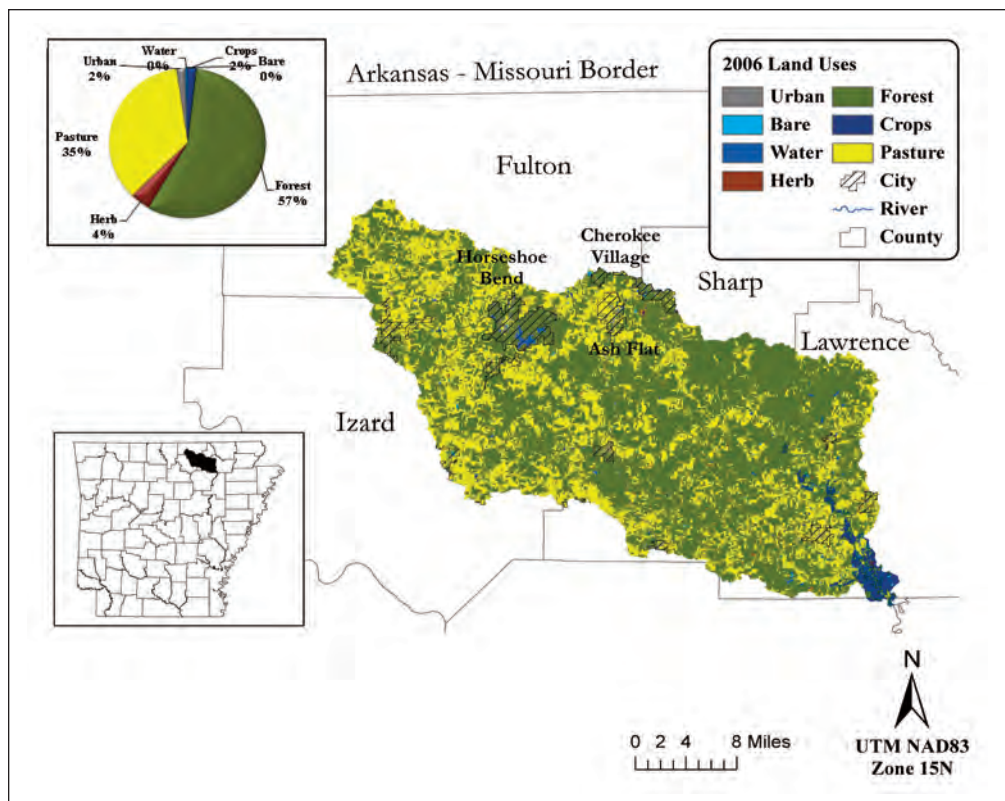
Figure 18.2 shows land use in the Strawberry River watershed in 2006.

The following provides a partial snapshot of land uses in the watershed:

- Nearly 57 percent of the watershed's land area is in forests and 35 percent is under pasture (CAST, 2006). The remainder of the land is accounted for by construction projects, waterbodies, etc.
- Approximately 20,027 people live in the watershed (BAEG, 2011). Throughout much of the watershed, population increased from 2000 to 2010, with the exception of Lawrence County (-2.0 percent). Most of the increase took place in Independence County (7.5 percent), whereas the least gain in population was in Sharp County (17.4 percent) (UALR, 2011).

Figure 18.2
Land use in the
Strawberry River
watershed, 2006

Source: Center for Advanced Spatial Technologies (CAST), Land Use/Land Cover, 2006
Data Source: GeoStor
Map Created: March 2011



Water Quality/Program Goals

ANRC is designating Strawberry River watershed as a priority watershed for the first time in 2011-2016 NPS Pollution Management Plan.

The impaired segments of the Strawberry River watershed can be viewed at the following links:

- http://arkansaswater.org//index.php?option=com_content&task=view&id=14&Itemid=30.
- www.adeq.state.ar.us/water/branch_planning/pdfs/303d_list_2008.pdf.

The long-term goal of the priority watershed program is to reduce pollutants to levels that will restore all designated uses. The short-term goal of the program is to measurably reduce pollutants of concern that reach waters of the Strawberry River watershed, targeting sub-watersheds where implementation can have the greatest impact. These goals will be achieved through implementation of a Nine Element Plan.

Objectives and Milestones

Based on SWAT and other available analysis, ANRC will review available data and select sub-watersheds for targeting of implementation funds. Data that may be considered in targeting includes, but is not limited to, the modeled loads for sediment and phosphorus, percentage of intact woody riparian vegetation, density of unpaved roads, number of stream road crossings, rural population density, intensity of row crop agriculture, degree of urbanization and potential sources of pollutants. Other factors may also be considered at the discretion of ANRC including, but is not limited to, local institutional capacity, input from the NPS Pollution Management Plan Stakeholder Group, local watershed groups or other agencies, the availability of funds and other factors.

The 2011-2016 NPS Pollution Management Plan includes statewide programs aimed at reducing pollutant loads from land uses that have the potential to impact water quality. These land uses and programs to reduce water quality impacts are described in more detail in earlier sections of the 2011-2016 NPS Pollution Management Plan.

The following objectives and milestones were identified with input from the NPS Pollution Management Plan Stakeholder Group. Table 3.1 (page 27) identifies cooperating entities that will partner to implement the 2011-2016 NPS Pollution Management Plan in the Strawberry River watershed.

18.1. Initiate development of the Nine Element Plan until the U.S. Environmental Protection Agency's acceptance is obtained.

Timeline for Milestones: October 2011 through September 2016

18.2. Continue to develop support for implementation of the Nine Element Plan among potential cooperating entities and the general public.

Timeline for Milestones: October 2011 through September 2016

18.3. Provide technical and financial assistance to local cooperating entities to implement the Nine Element Plan as resources allow.

Timeline for Milestones: October 2011 through September 2016

18.4. As resources allow, use of remote sensing and geographic information systems (GIS) analysis to identify sub-watersheds where more extensive assessment is needed. Conduct targeted geomorphological and bioassessment to identify and target implementation of streambank stabilization projects for high-impact sites (for example, a geomorphologic study of logjams and assess beaver populations to determine their impact on streambank erosion and other studies).

Timeline for Milestones: October 2011 through September 2016

18.5. Continue to develop models to represent sediment and nutrient loads in the watershed and in-stream processes to enable prioritization of implementation projects in sub-watersheds.

Timeline for Milestones: October 2011 through September 2016

18.6. Continue to focus on Best Management Practice (BMP) implementation to improve conservation practices for erosion control, sediment retention, irrigation management and nutrient management on row crop and animal agriculture and forestland. As appropriate, direct technical assistance to landowners in targeted watersheds giving emphasis to developing new conservation plans and areas that connect established riparian corridors.

Timeline for Milestones: October 2011 through September 2016

18.7. Continue to provide and improve extensive education and training to promote BMP implementation (for example, risk management, demonstrations to acquaint landowners and municipalities with the conservation practices most effective in reducing runoff, sediment detachment and transport including, but not limited to, no-till, conservation till, ridge till,

pipe drop outlets, riparian zone management and wetland restoration).

Timeline for Milestones: October 2011 through September 2016

18.8. Continue to encourage landowners to establish riparian buffer strips, grass drainageways, stabilize streambanks and restore riparian areas

Timeline for Milestones: October 2011 through September 2016

18.9. Continue to secure conservation easements through donations as the opportunity arises in an effort to protect lands along Strawberry River and its tributaries from development that would result in further NPS pollution.

Timeline for Milestones: October 2011 through September 2016

18.10. Continue to increase public awareness and provide education to build support for citizen action to improve water quality in the watershed.

Timeline for Milestones: October 2011 through September 2016

18.11. Build constituency for improved water quality by increasing volunteerism and promoting recreational use of the river (for example, recruiting volunteers for cleanups, streambank restoration and other activities utilizing the Arkansas Stream Team program and other conservation groups as well as increasing public recreational access to the river with trails and boat ramps).

Timeline for Milestones: October 2011 through September 2016

18.12. Encourage county and municipal elected officials as well as contractors, home builders and consulting engineers to participate in construction and urban education programs to improve stormwater management.

Timeline for Milestones: October 2011 through September 2016

18.13. Coordinate conservation planning within a watershed area to take full advantage of cost-share programs for riparian habitat improvement, Wetland Reserve Program (WRP), Conservation Reserve Program (CRP), the Wetland and Riparian Zone Tax Credit Program (through ANRC) and other programs.

Timeline for Milestones: October 2011 through September 2016

18.14. Encourage plans for alternative irrigation water supply and supplemental stream augmentation, including off-stream storage of surplus flows.

Timeline for Milestones: October 2011 through September 2016

18.15. Continue aquatic life assessments to assess response of waterbodies to NPS control measures as resources allow.

Timeline for Milestones: October 2011 through September 2016

18.16. Continue to provide public education on proper application, storage and disposal of pesticides, regulations and potential hazards of misuse (for example, encourage use of FARM*A*SYST and HOME*A*SYST programs to assess potential pollution hazards).

Timeline for Milestones: October 2011 through September 2016

18.17. Continue to provide education to rural homeowners and builders on proper construction and maintenance of onsite waste disposal systems.

Timeline for Milestones: October 2011 through September 2016

18.18. Continue to provide technical assistance and make available financial assistance to agricultural operations where cost-share is a component of approved 319(h) implementation projects.

Timeline for Milestones: October 2011 through September 2016

Timeline for Milestones

Provided sufficient financial and human resources are available to the cooperating state and local agencies and nonprofit organizations working together in the Strawberry River watershed, the short-term objectives of this plan can be met within five years of program initiation. Fully implementing management measures within the watershed to restore all designated uses is a longer-term endeavor. A goal of this plan is to fully meet designated uses within 15 years.

Program Coordination

There is currently no single entity in the Strawberry River watershed with the authority to implement the Nine Element Plan. ANRC will work with cooperating entities in the watershed to promote voluntary coordination and incorporate conditions requiring cooperation in grant agreements, as appropriate. A high degree of voluntary coordination already exists in the agriculture program through the Arkansas Conservation Partnership (ACP) as well as local coordination groups already in place.

Federal Consistency

The lead agency for each statewide program is responsible for working with federal partners to promote federal consistency. Statewide programs and their lead agencies are identified in the Cooperating Entities section of the 2011-2016 NPS Pollution Management Plan.

Program Tracking and Monitoring

Water quality monitoring data will be used to evaluate the effectiveness of NPS Pollution Management activities in the Strawberry River watershed. ADEQ is responsible for maintaining the state's water quality inventory. Figure 18.3 shows monitoring stations in the watershed.

The NPS Pollution Management Plan may include as a condition of funding pre- and post-project measurements of changes in water quality. The NPS Pollution Management Plan encourages cooperating entities working in the watershed to meet annually to report on their activities of the previous year and discuss their

successes, failures and future needs of their programs. The local watershed group is a logical convener for these discussions. Local cooperators are encouraged to compile this information, along with a summary of available water data and land use trends, into an annual watershed status report published and distributed in the watershed and to interested parties outside the watershed.

References Cited

BAEG, 2011. County-Wise Population Data. Biological and Agricultural Engineering Department. University of Arkansas Division of Agriculture: Little Rock, Ark.

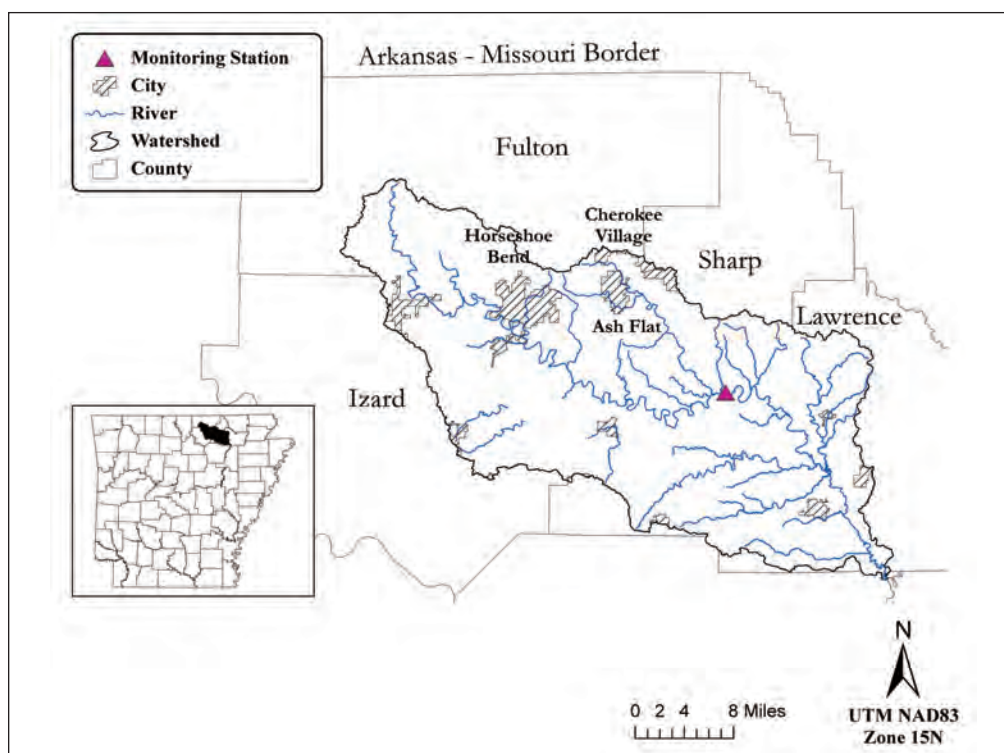
CAST, 2006. Land Use/Land Cover Data. Biological and Agricultural Engineering Department. University of Arkansas: Fayetteville, Ark.

Integrated Water Quality Monitoring and Assessment Report (IWQMAR). 2008. Arkansas Department of Environmental Quality: Little Rock, Ark. Available at www.arkansaswater.org/Documents/305b/2008_305b.pdf.

UALR, 2011. Percent Change in Total Population. Available at http://argis.ualr.edu/2010Census/Change_in_Pop_2000_to_2010_by_County.pdf.

Figure 18.3
Monitoring stations
in the Strawberry
River watershed

Source: U.S. Geological Survey
Data Source: GeoStor
Map Created: March 2011



Section Nineteen

Upper Saline River Priority Watershed

A Portion of ADEQ Planning Segment 2C • HUC 08040203

Introduction

The Upper Saline River watershed consists of portions of Grant, Saline, Garland, Perry, Hot Springs, Jefferson, Cleveland, Dallas and Pulaski counties and has a total drainage area of approximately 1,716 square miles. This segment encompasses the main stem of the Saline River and its tributaries and includes the North, South, Middle and Alum Forks. Figure 19.1 shows the location of the watershed.

The Middle Fork and other headwaters of the Saline River are designated as Extraordinary Resource Waters (ERW) and Ecologically Sensitive Waters (ESW) under the Arkansas Department of Environmental Quality (ADEQ) Regulation 2. The Upper Saline River watershed provides habitat for one or more species listed as threatened by the U.S. Fish and Wildlife Service.

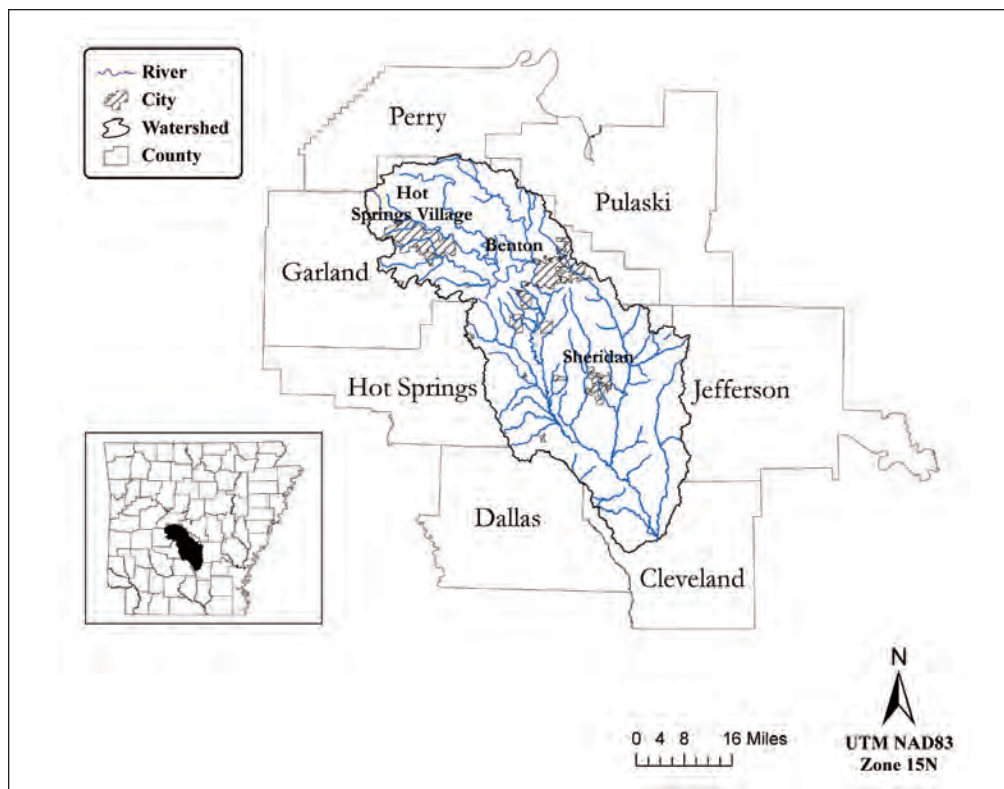
Assessment

The summary of water quality condition is described from the most current 305(b) report from the Arkansas Department of Environmental Quality (ADEQ) and other sources as cited appropriately. The following was stated in the most current 305(b) report (IWQMAR, 2008):

The waters within this segment have been designated as suitable for the propagation of fish and wildlife, primary and secondary contact recreation, and public, industrial, and agricultural water supplies. Slightly over one-half of the total stream miles within this segment are designated as extraordinary resource waters. This includes the Saline River and its primary headwater tributaries. Monitored data were used to assess 367.8 miles of stream and another 208.5 miles were evaluated.

Figure 19.1
Map of Upper
Saline River
watershed

Data Source: GeoStor
Map Created: March 2011



The domestic water supply use has been removed from 83.8 miles in the Hurricane Creek sub-watershed because of excessive mineral content. Mineral content (chlorides, sulfates, and other dissolved minerals) originates in this basin from open-pit bauxite mining activities.

Water quality in Big Creek below the city of Sheridan effluent has improved, yet dissolved oxygen violations still occur as well as elevated BOD and TOC levels. A total maximum daily load (TMDL) was completed for dissolved oxygen (D.O.) in Big Creek in 2007. This stream is classified as a seasonal fishery, and the critical season D.O. standard is 2 mg/L to prevent nuisance conditions. Many small seasonal streams in this ecoregion have D.O. levels below 2 mg/L during the critical season. A fish consumption advisory has been placed on much of the lower Saline River because of mercury contamination. A TMDL was completed in September 2002 for these waters.

Under contract with the Arkansas Natural Resources Commission (ANRC), the University of Arkansas' Department of Biological and Agricultural Engineering used the Soil and Water Assessment Tool (SWAT) to

model priority watersheds for the 2011-2016 Nonpoint Source (NPS) Pollution Management Plan as per resource availability. Appendix B describes the SWAT modeling process and the data used to estimate sediment and nutrient concentration for 12-digit hydrologic unit code (HUC) sub-watersheds for selected priority watersheds for the 2011-2016 NPS Pollution Management Plan.

Brief Description of Land Uses in the Watershed

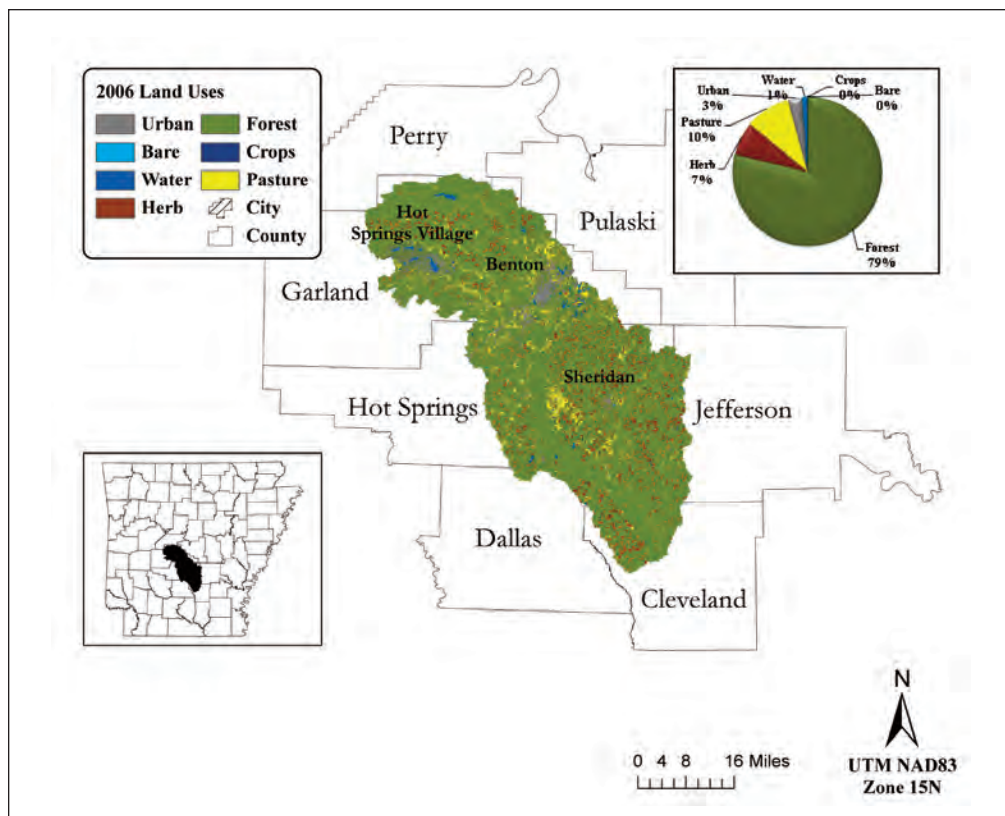
Figure 19.2 shows land use in the Upper Saline River watershed in 2006.

The following provides a partial snapshot of land uses in the watershed:

- An estimated 79 percent of the land area is forested and 10 percent is in pasture (CAST, 2006). The remaining land is identified as construction projects, waterbodies, etc.
- Upper Saline Watershed forests are comprised of a mix of pine, upland and bottomland forest types. Three-quarters of the forestlands are owned by industrial firms.

Figure 19.2
Land use in the
Upper Saline River
watershed, 2006

Source: Center for Advanced Spatial Technologies (CAST), Land Use/Land Cover, 2006
Data Source: GeoStor
Map Created: March 2011



- Small cattle operations dominate agricultural production in the nine-county area, with poultry production playing a lesser role.
- Approximately 139,699 people lived in the watershed in 2010 (BAEG, 2011). The population is growing rapidly in the upper portion of the watershed. Saline County grew 28.2 percent from 2000 to 2010 (UALR, 2011), while the population declined in Jefferson County (-8.1 percent), which is towards the lower portion of the watershed.
- The cities of Benton and Bryant and a portion of Saline County are subject to Phase II requirements for a small municipal separate storm sewer system (MS4) (ADEQ, 2004).
- There are four drinking water sites in the watershed (USFS, 1999).
- Major communities in the watershed include Benton, Bryant, Bauxite, Sheridan and Hot Springs Village (a gated retirement community with seven lakes and numerous golf courses).
- There are significant and varied resource extraction activities in the watershed, including both active and abandoned mine sites.

Water Quality/Program Goals

ANRC is designating the Upper Saline River watershed as a priority watershed for the 2011-2016 NPS Pollution Management Plan. With input from the NPS Pollution Management Plan Stakeholder Group, a qualitative risk assessment matrix was developed to identify priority watersheds. The process and matrix are summarized in Section One and described in greater detail in Appendix A.

The impaired segments of the Upper Saline River watershed can be viewed at:

- http://arkansaswater.org//index.php?option=com_content&task=view&id=14&Itemid=30
- www.adeq.state.ar.us/water/branch_planning/pdfs/303d_list_2008.pdf

The long-term goal of the priority watershed program is to reduce pollutants to levels that will restore all designated uses. The short-term goal of the program is to measurably reduce pollutants of concern that reach waters of the Upper Saline River watershed, targeting sub-watersheds where implementation can have the greatest impact. These goals will be achieved through implementation of a Nine Element Plan.

Objectives and Milestones

Based on SWAT and other available analyses, ANRC will review available data and select sub-watersheds for targeting of implementation funds. Data that may be considered in targeting include, but are not limited to, the modeled loads for sediment and nutrients, percentage of intact woody riparian vegetation, density of unpaved roads, number of stream road crossings, rural population density, intensity of agricultural production, degree of urbanization and potential sources of pollutants. Other factors may also be considered at the discretion of ANRC, including but not limited to, local institutional capacity, input from the NPS Pollution Management Plan Stakeholder Group, local watershed groups or other agencies, the availability of funds and other factors.

The 2011-2016 NPS Pollution Management Plan includes statewide programs aimed at reducing pollutant loads from land uses that have the potential to impact water quality. These land uses and programs to reduce their water quality impacts are described in more detail in earlier sections of the 2011-2016 NPS Pollution Management Plan. Statewide programs that will be implemented in the Upper Saline River watershed and their relative level of priority are shown in Table 19.1.

The following objectives and milestones were identified with input from the NPS Pollution Management Plan Stakeholder Group. Table 3.1 (page 27) identifies cooperating entities that will partner to implement the 2011-2016 NPS Pollution Management Plan in the Upper Saline River watershed.

19.1. Continue to develop a Nine Element Plan until the U.S. Environmental Protection Agency's acceptance is obtained.

Timeline for Milestones: October 2011 through September 2016

19.2. Develop support for implementation of the Nine Element Plan among potential cooperating entities and the general public.

Timeline for Milestones: October 2011 through September 2016

19.3. Provide technical and financial assistance to local cooperating entities to implement the Nine Element Plan as resources allow.

Timeline for Milestones: October 2011 through September 2016

19.4. Develop local institutional capacity to implement the Nine Element Plan (for example, watershed groups).

Table 19.1. Relative priority of statewide programs to effect improvements in water quality in the Upper Saline River watershed

Description of Land Use	Statewide Program	Intensity of Land Use/Potential Impact
Animal agriculture	Agriculture	
• Confined animals		Moderate to high
• Pasture (e.g., application of poultry litter to pasture, unconfined livestock)		Very high
Row crop agriculture	Agriculture	Low to moderate
Forestry	Silviculture	
• Public lands		High to very high
• Industrial		High to very high
• Private nonindustrial		High to very high
Urban	Urban Runoff	High to very high
• Rapidly urbanizing area subject to Phase II small separate municipal storm sewer system (MS4) NPDES permit requirements for stormwater management		High
Construction	Surface Erosion	
• Road and other infrastructure		High
• Residential development		High
• Commercial/industrial		High
Onsite waste disposal	Household and Small Business	Moderate to high
Streambank modification	Surface Erosion	High
Surface mining (e.g., topsoil removal, gravel mining)	Resource Extraction	Moderate to high

Timeline for Milestones: October 2011 through September 2016

19.5. As resources allow, use remote sensing and Geographical Information Systems (GIS) analysis to identify sub-watersheds where more extensive assessment is needed. Conduct targeted geomorphological and bioassessment to identify and target implementation of streambank stabilization projects for high-impact sites.

Timeline for Milestones: October 2011 through September 2016

19.6. Continue to develop models to represent sediment and nutrient loads in the watershed and in-stream processes to enable prioritization of implementation projects in sub-watersheds.

Timeline for Milestones: October 2011 through September 2016

19.7. Promote Best Management Practice implementation to improve conservation practices for erosion control, sediment retention and nutrient management on lands used for row crop and animal

agriculture as well as timber production. As appropriate, direct technical assistance to landowners in targeted watersheds giving emphasis to developing new conservation plans.

Timeline for Milestones: October 2011 through September 2016

19.8. Encourage county, municipal and Hot Springs Village Property Owners' Association elected officials as well as contractors, home builders and consulting engineers to participate in construction and urban education programs to improve stormwater management, erosion control and other conservation and pollution prevention measures.

Timeline for Milestones: October 2011 through September 2016

19.9. Encourage landowners to establish riparian buffer strips and grass drainageways, stabilize streambanks and restore riparian areas. Maintain streamside management zones (SMZs).

Timeline for Milestones: October 2011 through September 2016

19.10. Consider obtaining conservation easements through donations, as the opportunity arises, in an effort to protect lands along the Upper Saline River and its tributaries from development that would result in further NPS pollution.

Timeline for Milestones: October 2011 through September 2016

19.11. Increase public awareness and provide education to build support for citizen action to improve water quality in the watershed.

Timeline for Milestones: October 2011 through September 2016

19.12. Build constituency for improved water quality by promoting volunteerism and recreational use of the river (for example, recruiting volunteers for cleanups, streambank restoration and other activities utilizing the Arkansas Stream Team program and other conservation groups).

Timeline for Milestones: October 2011 through September 2016

19.13. Coordinate conservation planning within a watershed area to take full advantage of cost-share programs for riparian habitat improvement such as the Wetland Reserve Program (WRP), the Conservation Reserve Program (CRP), the Wetland and Riparian Zone Tax Credit Program (through ANRC) and other programs).

Timeline for Milestones: October 2011 through September 2016

19.14. Encourage plans for alternative irrigation water supply and supplemental stream augmentation, including off-stream storage of surplus flows.

Timeline for Milestones: October 2011 through September 2016

19.15. Continue to provide public education on proper application, storage and disposal of pesticides, regulations and potential hazards of misuse (for example, encourage use of FAM*A*SYST, URBAN*A*SYST and HOME*A*SYST programs to assess potential pollution hazards).

Timeline for Milestones: October 2011 through September 2016

19.16. Continue to provide education to rural homeowners and builders on proper construction and maintenance of onsite waste disposal systems.

Timeline for Milestones: October 2011 through September 2016

19.17. Continue to provide technical assistance and make available financial assistance to agricultural operations where cost-share is a component of approved 319(h) implementation projects.

Timeline for Milestones: October 2011 through September 2016

Timeline for Milestones

Provided sufficient human and financial resources are available to the cooperating entities working together in the Upper Saline River watershed, the short-term objectives of this plan can be met within five years of program initiation. Fully implementing management measures within the watershed to restore all designated uses is a longer-term endeavor. One goal of this plan is to fully meet designated uses within 15 years.

Program Coordination

There is currently no single entity in the Upper Saline River watershed with the authority to implement the Nine Element Plan. ANRC will work with cooperating entities in the watershed to promote voluntary coordination and incorporate conditions requiring cooperation in grant agreements, as appropriate. The Arkansas Conservation Partnership (ACP) provides an institutional vehicle for coordination of education and technical assistance. In addition, ANRC will promote the development and strengthening of local watershed groups (for example, Alliance for an Improved Middle Fork (AIM) to implement the watershed protection plan).

Federal Consistency

The lead agency for each statewide program is responsible for working with federal partners to promote federal consistency. Statewide programs and their lead agencies are identified in the Cooperating Entities section of the 2011-2016 NPS Pollution Management Plan.

Program Tracking and Evaluation

Water quality monitoring data will be used to evaluate the effectiveness of nonpoint source pollution management activities in the Upper Saline River

watershed. The ADEQ is responsible for maintaining the state's water quality inventory. They maintain 15 monitoring stations within the Upper Saline River watershed. In addition, the U.S. Geological Survey (USGS) maintains six monitoring sites in the watershed. Real-time flow data is available at the USGS stations as well as some water quality data. Figure 19.3 shows the monitoring stations in the watershed.

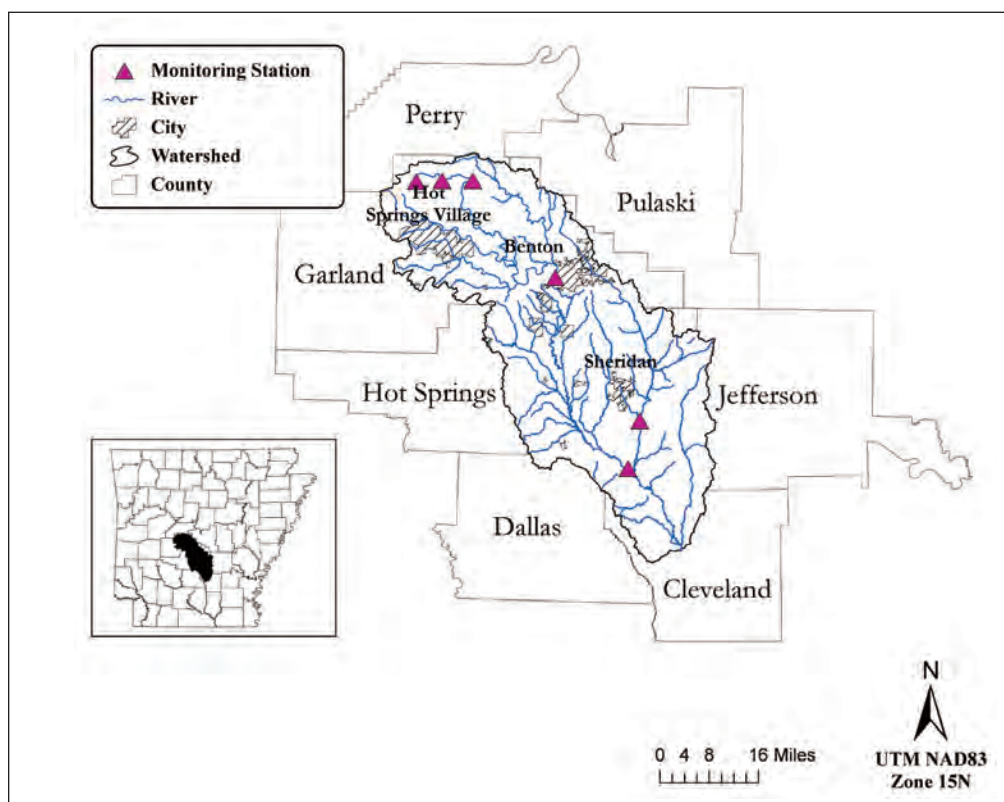
The NPS Pollution Management Plan may include as a condition of funding pre- and post-project measurements of changes in water quality. The NPS Pollution Management Plan encourages cooperating entities working in the watershed to meet annually to report on their activities of the previous year and discuss their successes, failures and future needs of their programs. Local cooperators are encouraged to compile this information, along with a summary of available water data and land use trends, into an annual watershed status report published and distributed in the watershed and to interested parties outside the watershed.

References Cited

- ADEQ, 2004. MS4 Letter of Intent. Arkansas Department of Environmental Quality, Water Division: Little Rock, Ark.
- BAEG, 2011. County-Wise Population Data. Biological and Agricultural Engineering Department. University of Arkansas Division of Agriculture: Little Rock, Ark.
- CAST, 2006. Land Use/Land Cover Data. Biological and Agricultural Engineering Department. University of Arkansas: Fayetteville, Ark.
- Integrated Water Quality Monitoring and Assessment Report (IWQMAR), 2008. Arkansas Department of Environmental Quality: Little Rock, Ark. Available at www.arkansaswater.org/Documents/305b/2008_305b.pdf.
- UALR, 2011. Percent Change in Total Population. Available at http://argis.ualr.edu/2010Census/Change_in_Pop_2000_to_2010_by_County.pdf.
- USFS, 1999. Ozark-Ouachita Highlands Assessment: Aquatic Conditions. Southern Research Station, U.S. Forest Service: Hot Springs, Ark. www.srs.fs.usda.gov/pubs/viewpub.jsp?index=2037.

Figure 19.3
Monitoring stations
in the Upper Saline
River watershed

Source: U.S. Geological Survey
Data Source: GeoStor
Map Created: March 2011



Appendices

Appendix A

Watershed-Based Implementation

A Two-Step Approach to the Select Priority Watersheds

Watershed-based implementation has been a goal of the nation's Nonpoint Source (NPS) Pollution Management Plan from its initiation. In Section 319 of the Clean Water Act (CWA), it was stated:

A State shall, to the maximum extent practicable, develop and implement a management program under this subsection on a watershed-by-watershed basis within such State. (USC Section §1329)

This emphasis has been consistent in guiding the development of state management programs ever since. In 1997, the U.S. Environmental Protection Agency (EPA) increased its commitment to watershed implementation with the publication of *Picking Up the Pace* (EPA, 1997a), which established specific policy to target risk through enhancing the total maximum daily load (TMDL) program and improving identification of waters impaired by nonpoint sources. The supplemental guidance for the program published that year stated:

(States are to use) a balanced approach that emphasizes both statewide nonpoint source programs and on-the ground management of individual watersheds where waters are impaired or threatened. (EPA, 1997b).

In 1997, Congress made an additional \$100 million available to states for implementing projects that addressed identified water quality impairments.

Since 1997, the EPA has strengthened its stance on the use of the incremental \$100 million for restoration of impaired waters. Supplemental grant guidance issued in 2003 for Section 319(h) grants stated:

The priority objective for the use of Section 319(h) grant funds is to implement the national policy, set forth in section 101(a) of the CWA, that nonpoint source programs be implemented expeditiously to achieve the goals of the CWA, including the restoration and maintenance of the chemical, physical and biological integrity of the Nation's waters.

To achieve this objective, the guidance places top priority on implementing on-the-ground measures and practices that will reduce pollutant loads and

contribute to the restoration of impaired waters. The process achieves this objective by directing the use of incremental Section 319 funds to the development and implementation of watershed-based plans that are designed to restore waters that have been listed by states as impaired under Section 303(d) of CWA.

Arkansas has also emphasized watershed-based management in its NPS Pollution Management Plan. In 1998, the Illinois River, Kings River, Yocum and Longs Creeks, Buffalo River, Big Piney Creek, Poteau River, Cossatot River, Smackover Creek and Bayou Bartholomew were identified as the priority watersheds for program implementation (ASWCC, 1999). These priorities have since been updated to include streams identified in the Arkansas Unified Watershed Assessment and those watersheds in which TMDLs have been developed. Since 1998, changes have been made in Arkansas' regulatory environment because of new EPA requirements to focus efforts on known impairments and because of a need to reevaluate priorities as NPS pollution issues evolve.

Funding through EPA and other programs has not been sufficient to fully treat any 8-digit hydrologic unit code (HUC) watershed in Arkansas. Therefore, the Arkansas Natural Resources Commission (ANRC) supported development of a two-phase qualitative risk assessment process to target nonpoint source efforts toward sub-watersheds within identified priority 8-digit HUC watersheds. Watersheds that were selected as priority watersheds through the risk assessment process are eligible for Section 319(h) funding from EPA incremental funds. In addition, ANRC also encouraged other state agencies to target their efforts towards these same watersheds.

Phase I of the process, initiated in 2004 for the development of 2006-2011 Arkansas' NPS Pollution Management Plan, was a qualitative risk-based assessment of all of the 8-digit HUC watersheds in the state. In this risk assessment, the NPS Plan Stakeholder Group selected 11 categories relevant to NPS pollution after a series of meetings and facilitated discussions. Categories used for the risk assessment were those that had readily available data or were computed from the readily available data. The relative importance of each

category/sub-category was determined through discussion of the stakeholders. The appropriate data for each selected category/sub-category were compiled in an ArcView (ESRI, Inc., Redlands, Calif.) database, assigned a value of 0 to 10 based on the type of impairment and relative importance to develop a risk assessment matrix on watershed basis. Using a quintile classification approach, watersheds were ranked according to the values assigned by the risk assessment matrix (Morgan and Matlock, 2008). Finally, eight watersheds falling in the top quintile were selected by the executive director of ANRC as priority watersheds. ANRC intended to develop a watershed management plan (Nine Element Plan) in each of the selected priority watersheds in cooperation with local agencies and working partners.

In preparation for developing the 2011-2016 NPS Pollution Management Plan, the stakeholder group began deliberations in 2008. The recommendations in 2008 led to the revision of the assessment matrix as shown in Table A.1 and also in the scoring criteria for a few categories/sub-categories (discussed later as appropriate).

The data under each category/sub-category has been continuously updated since 2008, based on the biennial water quality inventory published by the Arkansas Department of Environmental Quality (ADEQ). Following the same procedure that was adopted for the selection of priority watersheds in the 2006-2011 NPS Pollution Management Plan, 10 watersheds falling in the top quintile were selected by the executive director of ANRC as priority watersheds for the 2011-2016 plan.

The University of Arkansas Division of Agriculture Biological and Agricultural Engineering Department completed development of Soil and Water Assessment Tool (SWAT) models for four of the priority watersheds identified in the 2006-2011 plan and the 2011-2016 plan. These models have generated 12-digit HUC sub-watersheds of the 8-digit watersheds. For each 12-digit HUC sub-watershed, the relative contribution of sediment, phosphorus and nitrogen concentration has been generated. The sub-watersheds have then been divided into quintiles by the relative concentration, and this data was provided to the stakeholder group for consideration in preparation of the watershed elements of the NPS Pollution Management Plan update.

Phase II of the risk assessment will continue and be finalized as the Nine Element Plans for priority 8-digit HUC watersheds are completed. Information generated through modeling of the priority 8-digit HUC watersheds on sediment and nutrient concentration and a second risk assessment based on 12-digit HUC sub-watersheds within the priority 8-digit HUC watersheds are to be used to identify target areas within the 8-digit HUC watershed. The 12-digit HUC sub-watersheds that have the highest risk of impairment, as indicated by SWAT model, other studies or locally available information, will become the target areas for implementation of nonpoint source management measures and programs.

Watersheds not included in the top priority list are not excluded from funding under the 319(h) grant program; they are only restricted to competing for the non-incremental funds (57 percent of the total funding).

Table A.1. Categories used for watershed prioritization

Categories selected for 2006-2010 NPS Pollution Management Plan		Categories selected for 2011-2016 NPS Pollution Management Plan	
1	Waterbody Impairment	1	Waterbody Impairment
2	Human Health Impact	2	Designated Use Impact
3	Biotic Impacts	3	Biotic Impacts
4	Potential Human Exposure	4	Potential Human Exposure
5	Construction	5	Urban Suburban Population
6	Rural Roads	6	Impervious Surface
7	Non-Row Crop Agriculture	7	Economic Activity
8	Row Crop Agriculture	8	Cropland
9	Urban	9	Livestock and Pasture
10	Forestry	10	Unpaved Roads
11	Priority of a Bordering State	11	Forestry
		12	Priority of a Bordering State

Phase I Watershed Assessment

Selection of priority 8-digit HUC watersheds using a risk-based approach (submitted to the NPS Pollution Management Plan Stakeholder Group for discussion)

Phase I of the watershed assessment and prioritization was to select the top priorities from among the 8-digit HUC watersheds within the state.

The list of categories used for conducting risk assessment follows:

1. Waterbody Impairment
2. Designated Use Impact
3. Biotic Impacts
4. Potential Human Exposure
5. Urban Suburban Population
6. Impervious Surface
7. Economic Activity
8. Cropland
9. Livestock and Pasture
10. Unpaved Roads
11. Forestry
12. Priority of a Bordering State

Individual categories/sub-categories were assigned weights ranging from 0 to 10. The top 10 8-digit HUC watersheds for the 2011-2016 NPS Pollution Management Plan were determined by excluding Ouachita Headwaters and Upper Ouachita (identified among the top 10 8-digit HUC watersheds by a risk matrix approach) because a majority of the affected streams in these two watersheds had pH issues, attributed to sources such as unspecified, unknown or resource extraction. Based on the feedback received from the stakeholder group on February 23, 2011, it was decided to drop these two watersheds from the priority list and instead include the eleventh- and twelfth-ranked watersheds in the top 10 list.

Parameters 1 through 4 and 12 were ranked using values assigned from 0 to 10 based on weights of various sub-parameters (see individual sub-parameters for details). For parameters 5 through 11, the percentile of the criteria of interest in those parameters was calculated and multiplied by a weight of 10 or 5 (as appropriate for concerned parameter) to obtain a final score for updating the risk assessment matrix. The algorithm for computing the priority rankings for 8-digit HUC watersheds was:

Value of category 1* sum of the weights for categories 2 through 12.

Waters with no identified impairments were given a value of 0 for category 1, so they dropped out of the ranking process, as their value was 0 by definition. The remaining watersheds were ranked by score and then divided into quintiles. The top quintile of watersheds was provided to the executive director of ANRC as a recommendation. The executive director then made the final choice of priorities.

The criteria by which each category was evaluated were:

Category I: Waterbody Impairment

An impaired waterbody (stream and lake) is defined as one that does not support all of its designated uses. Category 1 was divided into five sub-categories that assess the impairment of a waterbody. Each sub-category maintained a unique weight that was used in the final risk matrix calculation, depending on whether or not the sub-category's criteria were met. When a waterbody met several criteria, only the highest weight was used in the risk matrix computations. For example, the Little Red watershed contained NPS-related impairment (sub-category 1a) and was also a nutrient sensitive watershed (sub-category 1e). Based on default weights, Little Red received a weight of 10 for category 1. This is because the higher weight of sub-category 1a overrode the lower weight of sub-category 1e. The default weights are given in Table A.2.

Table A.2. Waterbody impairment weights

Criteria	Weight
1 (a) NPS-Related 2010 Impairment, Approved TMDL	10 (this assures that TMDLs are priority)
1 (b) ADEQ 2010 "High" Priority	8
1 (c) ADEQ 2010 "Medium" Priority	6
1 (d) ADEQ 2010 "Low" Priority	2
1 (e) Nutrient Sensitive Watershed	5
Waters With No Identified Impairment or Impacts	0

The primary source of the data for categories 1 to 3 was the most recent ADEQ List of Impaired Waterbodies. The list identifies waterbodies in Arkansas that do not comply with state quality standards. The list is used to prioritize watersheds based on the findings and is updated every two years.

Category 2: Designated Use Impact

Category 2 rankings are based on the designated use impairments found on ADEQ's List of Impaired Waterbodies. Category 2 was divided into six sub-categories that assess the designated use impairment of a waterbody. Each sub-category was assigned a unique weight that was used in the final risk matrix computation, depending on whether or not the sub-category's criteria for inclusion in the risk matrix were met. If a waterbody met several criteria, only the sub-category with the highest weight was used in the risk matrix computations. For example, the Lower Little watershed had a designated use impairment caused by both aquatic life use (sub-category 2a) and drinking water (sub-category 2c). Lower Little would, based on the default weights, receive a weight of 10 for category 2. This was because the higher weight of sub-category 2a overrode the lower weight of sub-category 2c. The default weights are given in Table A.3.

Table A.3. Designated use impact weights

Criteria	Weight
2 (a) Aquatic Life Use (FSH)	10
2 (b) Primary or Secondary Use	9
2 (c) Drinking Water	8
2 (d) Environmentally Sensitive Water	5
2 (e) Ecological Resource Waters	4
2 (f) Agricultural or Industrial Use	2

Category 3: Biotic Impacts

Category 3 uses ADEQ's List of Impaired Waterbodies to rank the potential biotic impact of a waterbody. Category 3 was divided into five sub-categories that assess the biotic impact of a waterbody. Each sub-category was assigned a unique weight that was used in the final risk matrix calculation, depending on whether or not the sub-category's criteria were met. If a waterbody met more than one criterion, only the highest weight assigned was used in the risk matrix computations. The default weights are given in Table A.4. For example the Strawberry watershed had a

biotic impact caused by both aquatic life (sub-category 3a) and dissolved oxygen (sub-category 3c). The Strawberry watershed, based on the default weights, received a weight of 10 for category 3. This is because the higher weight of sub-category 3a overrode the lower weight of sub-category 3c.

Table A.4. Biotic impact weights

Category	Weight
3 (a) Aquatic Life (FSH)	10
3 (b) Sedimentation (Tb)	10
3 (c) Dissolved Oxygen (DO)	9
3 (d) Priority Organics (PO)	8
3 (e) Ammonia (AM)	4

Category 4: Potential Human Exposure

The risk to an individual from an environmental pollutant is the product of the effect of exposure to that pollutant and the chance of an exposure occurring. Pollutants that have a high chance of exposure were given more attention than pollutants to which humans generally are not exposed. The chance of exposure was measured by examination of the uses of a waterbody and determination of potential routes of exposure for persons making that use. Category 4 was divided into four sub-categories that assessed the risk of potential human exposure to the waterbody. Each sub-category was assigned a unique weight that was used in the final risk matrix calculation, depending on whether or not the sub-category's criteria for inclusion in the risk matrix were met. If a waterbody met several criteria, only the highest value was used in the risk matrix calculations. The default weights are given in Table A.5.

Table A.5. Potential human exposure weights

Category	Weight
4 (a) Tributary to Public Water Surface	10
4 (b) Tributary to or Part of Recreational Lake	8
4 (c) Natural and Scenic River or Urban Stream	8
4 (d) All Other Waters	2

For example, Upper Ouachita watershed had potential human exposure risks caused by both a tributary to a public water surface (sub-category 4a) and a tributary to, or part of, a recreational lake (sub-category 4b). Upper Ouachita watershed, based on the

default weights, received a weight of 10 for category 4. This was because the higher weight of sub-category 4a, (i.e., a 10 overrides the lower weight of sub-category 4b, which scored an 8.)

Category 5: Urban Population

NPS pollution can potentially increase with high population density in urban areas compared to less populated rural areas. Because watershed boundaries, in general, cover more than one county, a weighted average was calculated for each watershed based on the percentage area occupied by the watershed in each county. The data was based on 2009 population estimates obtained from the U.S. Census Bureau's "American FactFinder" (2010) web site. The final score for each watershed was obtained by multiplying the percentile of the density of population by the default weight of 10.

Category 6: Impervious Surface

Impervious surface in urban areas could become a potential source for NPS pollution. Impervious surfaces include asphalt, concrete, compacted soils and rooftops, among others. The 2006 Land Use/Land Cover (LULC, 2006) map prepared by the University of Arkansas Center for Advanced Spatial Technologies (CAST) (2007) was used to calculate area under urban land use (categories 11, 12, 13 and 14 of 2006 LULC layer) in each of the 58 8-digit HUC watersheds. The urban land use was used as a surrogate for impervious surface. The final score for each watershed was obtained by multiplying the percentile of the impervious surface by the default weight of 10.

Category 7: Economic Activity

Economic activity is usually accompanied by urbanization and construction. It could indirectly become a potential source for NPS pollution. This category was represented in the risk assessment matrix using three sub-categories: change in construction (7a), shale development (7b) and other economic activity (7c). The default weights for these sub-categories are given in Table A.6.

Table A.6. Economic activity weights

Category	Weight
7 (a) Change in Construction	5
7 (b) Shale Development	4
7 (c) Other Economic Activity	1

Category 8: Cropland

Runoff from dry and irrigated croplands could be a potential source for surface and groundwater pollution. The U.S. Department of Agriculture's (USDA) 2007 Census of Agriculture was used to find out the acreage of harvested cropland in each county. Many of the watersheds span several counties, so a weighted county-area average based on a watershed's percent within a county was produced for each watershed. The weighted average was used to obtain density of harvested cropland in each watershed. The final score for each watershed was obtained by multiplying the percentile of density of harvested cropland by the default weight of 10.

Category 9: Livestock and Pasture

Livestock and pasture have been reported to be potential sources for surface and groundwater pollution. Many livestock operators in Arkansas fall below the minimum animal unit criteria to be covered by EPA confined animal feeding operations (CAFOs) (Morgan and Matlock, 2008). These smaller operations are therefore managed as NPS pollution. Morgan and Matlock (2008) have also reported that improper management of poultry and livestock waste and direct access of cattle to streambanks could contribute to NPS pollution. Thus, Category 9 was broken down into two sub-categories: pasture (9a) and livestock (9b). Both these sub-categories were assigned a default weight of 5 each. A percentile rank for each sub-category was assigned to each watershed, and the ranks were multiplied by the default weight of 5 for all watersheds.

Category 10: Unpaved Roads

Several reports have discussed the potential for sediment loading from unpaved roads (EPA, 2002; ADEQ, 2002b). The Arkansas State Highway and Transportation Department's 2006 road data was downloaded from GeoStor, and information about length of unpaved roads was extracted from the attribute "ROAD_TYPE." The length of unpaved road in each watershed was divided by watershed area to calculate the density of unpaved roads in the watershed. A final score for each watershed was obtained by multiplying the percentile of density of unpaved roads by the default weight of 10.

Category 11: Forestry

EPA, state and local authorities in recent years have realized the impact of forestry activities on NPS pollution. There is a correlation between forest

ownership and an increase in NPS pollution. Morgan and Matlock (2008) found that public forests tend to be better managed and maintained than private forests and, therefore, have less NPS pollution. In order to determine each watershed's percentage of public (federal and state) and private forests, the following process was performed.

- Statewide areas under forest cover were obtained from 2006 LULC map.
- The area under national and state forests was subtracted from the total statewide area under forest.
- Density of forest areas in each of the three categories was then obtained on 8-digit HUC watershed basis by dividing by the total watershed area.
- The ranking of density of forest area under each of the three categories was obtained using percentile criteria.
- The Stakeholder Group assigned weights of 2, 3 and 5, respectively, to density of federal, state and private forests.
- The final score for forestry category was the sum of scores obtained by multiplying percentile rank of density of federal forest, density of state forest and density of private forest with their respective weights.

Category 12: Priority of a Bordering State

Along the western, northern and southern borders of Arkansas, streams frequently flow into adjacent states. When those waters have been made a priority watershed for NPS implementation by the adjacent state, Arkansas has acknowledged that commitment by the adjacent state. In addition, some of the waters leaving Arkansas fail to meet the water quality standard of the adjacent state. Those waters that have been made priorities by adjacent states were given a weight of 10 points in recognition of that adjacent state's needs.

References Cited

- ADEQ, 2002. 2002 Integrated Water Quality Monitoring and Assessment Report prepared pursuant to Section 305(b) and 303(d) of the Federal Water Pollution Control Act, Arkansas Department of Environmental Quality: Little Rock, Ark.
- ADEQ, 2004a. 2004 Integrated Water Quality Monitoring and Assessment Report. Arkansas Department of Pollution Control and Ecology: Little Rock, Ark.
- ADEQ, 2004b. 2004 Proposed 303(d) List of Impaired Waterbodies. Arkansas Department of Environmental Quality: Little Rock, Ark.
- APC&EC, 2001. Regulation Establishing Water Quality Standards for Surface Waters of the State of Arkansas. Arkansas Pollution Control and Ecology Commission: Little Rock, Ark.
- ASWCC, 1999. Arkansas Nonpoint Source Pollution Management Program, 1998 through 2002. Arkansas Soil and Water Conservation Commission: Little Rock, Ark.
- ATSDR, 1999. ToxFAQs for Mercury. Agency for Toxic Substances and Disease Registry. www.atsdr.cdc.gov/.
- City of Boulder/USGS. BASIN, General Information on Fecal Coliform. <http://bcn.boulder.co.us/basin/data/FECAL/info/FColi.html>.
- Novotny, Vladimir, and Harvey Olem, 1994. Water Quality Prevention, Identification and Management of Diffuse Pollution. Van Nostrand Reinhold, New York, N.Y., page 29.
- Ritter, William F., and Adel Shiromohammadi, 2001. Agricultural Nonpoint Source Pollution, Watershed Management and Hydrology. Lewis Publishers, Boca Raton, Fla.
- United States Code, Section 1313, Water Quality Standards and Implementation Plans, TITLE 33 > CHAPTER 26 > SUBCHAPTER III > Sec. 1313.
- United States Code, Section 1329. January 24, 1994. Nonpoint Source Management Programs. <http://www.epa.gov/owow/NPS/sec319cwa.html>.
- USDA, 2007. 2007 Census of Agriculture. National Agricultural Statistics Service, Arkansas Statistical Office. www.nass.usda.gov/ar/.
- USEPA, 1992. Secondary Drinking Water Regulations: Guidance for Nuisance Chemicals. Document EPA 810/K-92-001 available at www.epa.gov/safewater/consumer/2ndstandards.html.
- USEPA, 1997A. *Picking Up the Pace*, EPA's Draft Proposed Strategy for Strengthening Nonpoint Source Management. Presented to the Wye River Conference, October 14, 1997. www.epa.gov/owow/nps/nsfnsnm/index.html.
- USEPA, 1997B. Nonpoint Source Program and Grants Guidance for Fiscal Year 1997 and Future Years. www.epa.gov/OWOW/NPS.
- USEPA, 2001. National Management Measures to Control Nonpoint Source Pollution From Forestry, Draft. United States Environmental Protection Agency.
- USEPA, 2002. Draft Management Measures to Control Nonpoint Source Pollution From Urban Areas. United States Environmental Protection Agency.
- USEPA, 2004a. National Agriculture Compliance Assistance Center, Rural Roads. www.epa.gov/agriculture/trur.html#Air%20Pollution%20from%20Paved%20and%20Unpaved%20Roads.
- USEPA, 2004b. Concentrated Animal Feeding Operations (CAFO) – Final Rule. www.epa.gov/agriculture/anafoidx.html.

Introduction

The following describes the conceptual 2009 version of the Soil and Water Assessment Tool (SWAT) and how the model was implemented and calibrated for selected priority watersheds: Bayou Bartholomew, Beaver Reservoir (Upper White River), Illinois River Drainage Area in Arkansas (IRDAA) and Lake Conway-Point Remove.

The Conceptual Model

The SWAT model was developed by the U.S. Department of Agriculture – Agriculture Research Service (USDA-ARS). It is a conceptual model that functions on a continuous time step. Model components include weather, hydrology, erosion/sedimentation, plant growth, nutrients, pesticides, agricultural management, channel routing and pond/reservoir routing. Agricultural components in the model include fertilizer, crops, tillage options, grazing and the capability to include point source loads (Neitsch et al., 2009). The SWAT model predicts the influence of land management practices on constituent yields from a watershed. SWAT is the continuation of more than 30 years of development within the USDA-ARS. The CREAMS, GLEAMS and EPIC models (Knisel, 1980; Leonard et al., 1987; Williams et al., 1984) have each contributed to the scaling up of past field-scale models to one that includes large river basins. SWAT is a public-domain model that is actively supported by USDA-ARS at the Grassland, Soil, and Water Research Laboratory in Temple, Texas. At this time, there are more than 700 publications in peer-reviewed scientific journals that report development and applications of the SWAT model.

SWAT is a theoretical model that operates on a daily time step. In order to adequately simulate hydrologic processes, the watershed is divided into sub-watersheds through which streams are routed. The sub-units of the sub-watersheds are referred to as “hydrologic response units” or HRUs. HRUs are the unique combination of soil, land use and slope characteristics and are considered to be hydrologically homogeneous. Both sub-watersheds and HRUs are user defined, providing model users with some control over the resolution

considered in the SWAT model (Neitsch et al., 2005). The model calculations are performed on a HRU basis and flow. Water quality variables are routed from HRU to sub-watersheds and subsequently to the watershed outlet. The SWAT model simulates hydrology as a two-component system, composed of land hydrology and channel hydrology. The land portion of the hydrologic cycle is based on a water mass balance. Soil-water balance is the primary consideration by the model in each HRU, which is represented as (Arnold et al., 1998):

$$SW_t = SW + \sum_{i=1}^t (R_i - Q_i - ET_i - P_i - QR_i) \quad (1)$$

where SW is the soil water content; i is time in days for the simulation period t ; and R , Q , ET , P and QR , respectively, are the daily precipitation, runoff, evapotranspiration, percolation and return flow. The hydrologic cycle simulation by SWAT is shown in Figure B.1.

Water enters the SWAT model's watershed system boundary predominantly in the form of precipitation. Precipitation inputs for hydrologic calculations can either be measured data or simulated with the weather generator available in the SWAT model. Precipitation is partitioned into different water pathways depending on system characteristics. The water balance of each HRU in the watershed contains four storage volumes: snow, the soil profile (0-2 m), the shallow aquifer (2-20 m) and the deep aquifer (> 20 m). The soil profile can contain several layers. The soil-water processes include infiltration, percolation, evaporation, plant uptake and lateral flow. Surface runoff is estimated using the SCS curve number or the Green-Ampt infiltration equation. Percolation is modeled with a layered storage routing technique combined with a crack flow model. Potential evaporation can be calculated using Hargreaves, Priestly-Taylor or Penman-Monteith method (Arnold et al., 1998).

Loadings of flow, sediment, nutrients, pesticides and bacteria from the upland areas to the main channel are routed through the stream network of the watershed using a process similar to the hydrological model (HYMO) (Williams and Hann, 1972). The stream processes modeled by SWAT are shown in Figure B.2 and include channel sediment routing and nutrient and pesticide routing and transformation.

Figure B.1
Hydrologic cycle consid-
ered by SWAT
model (from
Neitsch et al.,
2005)

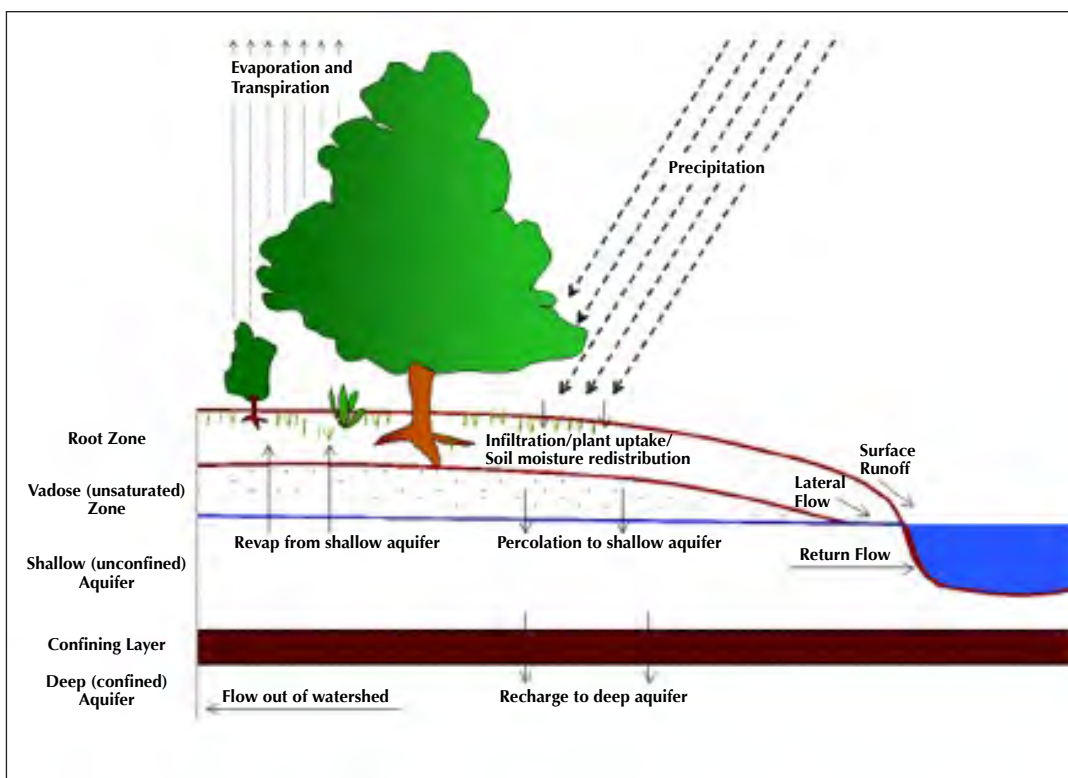
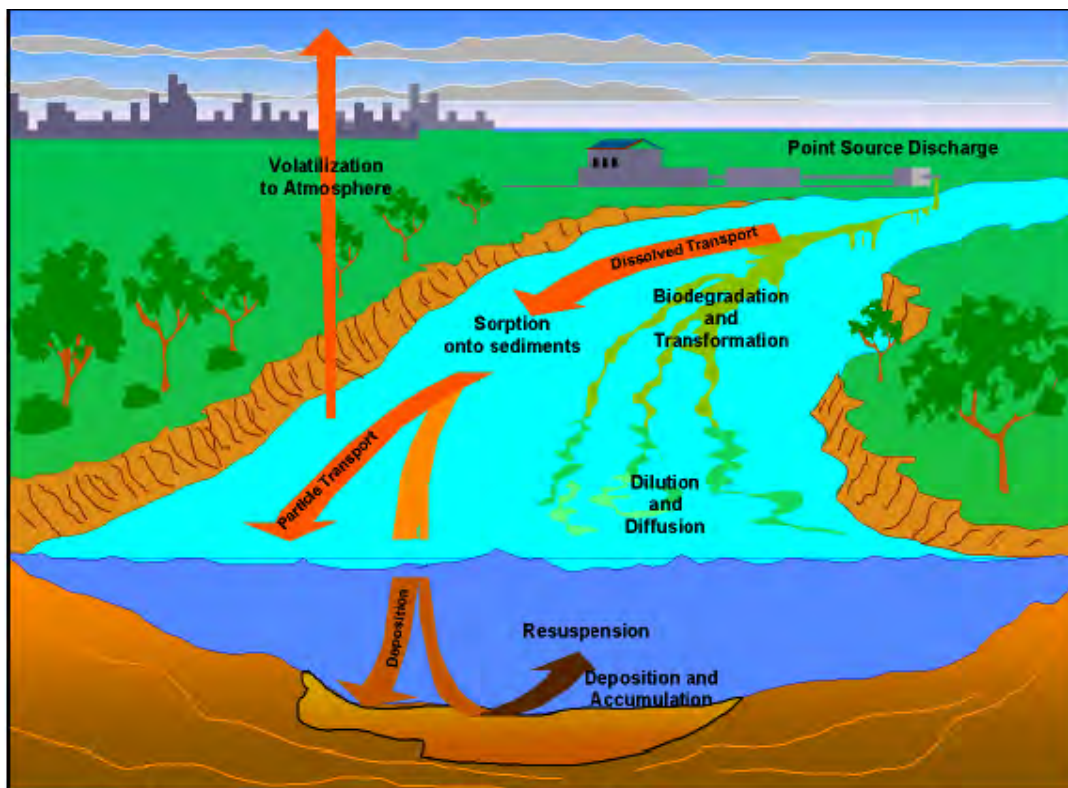


Figure B.2
In-stream
processes
considered by
the SWAT
model (from
Neitsch et al.,
2005)



The pond/reservoir routing allows for sediment settling and simplified nutrient and pesticide transformation routines. The command structure for routing runoff and chemicals through a watershed is similar to the structure for routing flows through streams and reservoirs.

The SWAT watershed model also contains algorithms for simulating erosion from the watershed. Erosion is estimated using the Modified Universal Soil Loss Equation (MUSLE). The equation estimates sediment yield from the surface runoff volume, the peak runoff rate, the area of the HRU, the Universal Soil Loss Equation (USLE) soil erodibility factor, the USLE cover and management factor, the USLE support practice factor, the USLE topographic factor and a coarse fragment factor.

After the sediment yield is evaluated using the MUSLE equation, the SWAT model further corrects this value, considering snow cover effect and sediment lag in surface runoff. The SWAT model also calculates the contribution of sediment to channel flow from lateral and groundwater sources. Eroded sediment that enters channel flow is simulated in the SWAT model to move downstream by deposition and degradation (Neitsch et al., 2005).

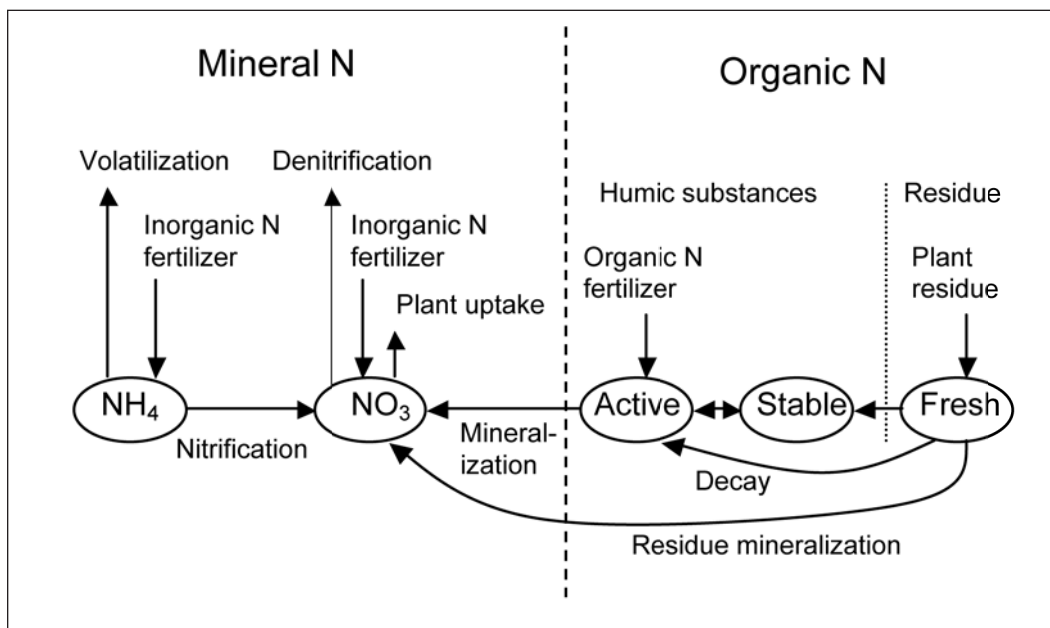
Soil nitrogen (N) is also simulated in the SWAT model. Soil nitrogen is partitioned into five nitrogen pools with two being inorganic [ammonium-N ($\text{NH}_4\text{-N}$) and nitrate-N ($\text{NO}_3\text{-N}$)] and three being organic

(active, stable and fresh) (Figure B.3). The SWAT model simulates movement between nitrogen pools, such as mineralization, decomposition/immobilization, nitrification, denitrification and ammonia volatilization. Other soil nitrogen processes, such as nitrogen fixation by legumes and $\text{NO}_3\text{-N}$ movement in water, are also included in the model. All soil nitrogen processes are simulated in the SWAT model using relationships described in the model's theoretical documentation (Neitsch et al., 2005).

Once nitrogen enters channel flow, the SWAT model partitions nitrogen into four pools: organic nitrogen, $\text{NH}_4\text{-N}$, nitrite-N ($\text{NO}_2\text{-N}$) and $\text{NO}_3\text{-N}$. The SWAT model simulates changes in nitrogen that results in movement of nitrogen between pools. The algorithms used to describe nitrogen transformations in channel flow were adapted from the QUAL2E model by SWAT model developers (Neitsch et al., 2005).

Large-area simulations are possible because of the advances in computer software and hardware, including speed and storage, geographical information system/spatial analysis and debugging tool software. SWAT model development primarily emphasizes 1) climate and management impacts, 2) water quality loadings and fate, 3) flexibility in basin discretization, 4) land use change impacts and 5) evaluation of conservation practices, also called Best Management Practices effectiveness.

Figure B.3
Flow chart of
the soil
nitrogen cycle
simulated in the
SWAT model
(modified from
Neitsch et al.,
2005)



Another nutrient simulated in the soil profile of the SWAT model is phosphorus (P). Soil phosphorus is divided into six phosphorus pools. Three of the pools are characterized as mineral phosphorus, and three are characterized as organic phosphorus (Figure B.4). Transformations of soil phosphorus between these six pools are regulated by algorithms that represent mineralization, decomposition and immobilization. Other soil phosphorus processes included in the SWAT model are inorganic phosphorus sorption and leaching. The algorithms describing soil phosphorus dynamics are available in the SWAT model theoretical documentation (Neitsch et al., 2005).

Phosphorus that enters stream channels is evaluated in the SWAT model similar to nitrogen. Two pools of phosphorus are simulated for channel processes: organic phosphorus and inorganic/soluble phosphorus. The algorithms used in channel phosphorus calculations by the SWAT model were adapted from the QUAL2E model and are available in the SWAT model theoretical documentation (Neitsch et al., 2005).

While the SWAT model provides algorithms for calculating different watershed constituent dynamics, the ability of the SWAT model to depict processes in a particular watershed is partially dependant on the quality of input data. The input data that describe the physical structure of a watershed are generally incorporated into the model using the ArcSWAT interface. ArcSWAT is an extension to the ArcGIS (ESRI Inc., Redlands, Calif.) geographical information system (GIS) software. Mandatory GIS input files for ArcSWAT

include the Digital Elevation Map (DEM), land use and soil layer. Other data that are not in GIS format are optional. Such additional data includes spatially referenced fertilizer, animal production, land management, weather and point source data.

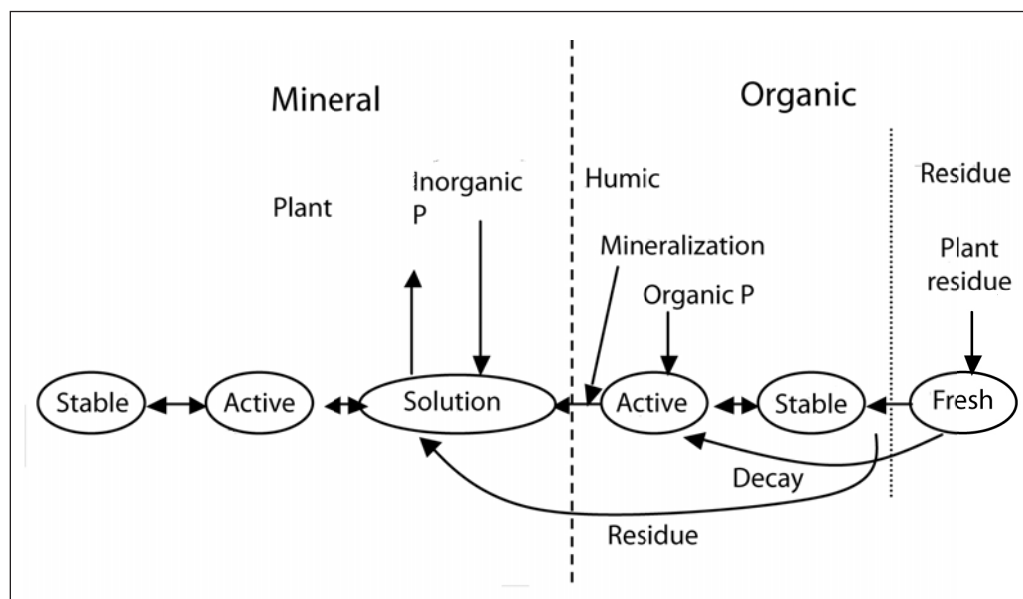
Inputs entered into the SWAT model are organized to have spatial characteristics. The SWAT model provides three spatial levels: the watershed, the sub-watersheds and the HRUs. Each level is characterized by a parameter set and input data. The largest spatial level, the watershed, refers to the entire area being represented by the model.

Although the SWAT model simulates on a daily time step, the user can print aggregated output at a daily, monthly or annual time scale. Key output variables include flow volume, nutrient yields, sediment yield and plant biomass yields. These variables are provided on the sub-watershed or HRU spatial level, depending on the output time step selected. The output files generated by the SWAT model are created in text and database file formats.

Model Limitations

It's a fact that watershed models are regarded overall as efficient and feasible because of the potential time and expense savings involved in assessing the impact of land management practices on water quality (Arnold et al., 1998). However, all models, including SWAT, are simplified representations of reality; therefore, model outputs reflect uncertainties in the available spatial and

Figure B.4
Flow chart
of the soil
phosphorus
cycle simulated
in the SWAT
model
(modified from
Neitsch et al.,
2005)



monitoring data sets. In most watershed modeling projects, model output is compared to corresponding measured data with the assumption that all error variance is contained within the predicted values and that observed values are error free (Moriassi et al., 2007). Though Willmott (1981) and ASCE (1993) recognize that measured data are not error free, due to the relative lack of data on measurement uncertainty, measurement error was not considered in their recommendations. Uncertainty estimates for measured streamflow and water quality data have recently become available (Harmel et al., 2006), and we recognize the importance of evaluating all related uncertainties in a modeling framework. Consequently, it is advisable that users of the model become aware of the causes of uncertainty, which can broadly be classified into model uncertainty and data uncertainty. The quantification of uncertainty is an area of research and is desirable to understand the limits of model predictions.

A major limitation to large area hydrologic modeling is the spatial detail required to correctly simulate environmental processes. For example, it is difficult to capture the spatial variability associated with precipitation within a watershed. Another limitation is the accuracy of hydrologic response units simulating field variations including conservation practices. SWAT is being altered to account for landscape spatial positioning so that conservation practices such as riparian buffers and vegetative filter strips can be adequately simulated.

Data files also can be difficult to manipulate and can contain several missing records. The model simulations can only be as accurate as the input data. SWAT does not simulate detailed event-based floods and, hence, may not adequately capture pollutant loading during episodic events.

The user is encouraged to recognize both the promise and the limitations of watershed models and to constantly subject the modeling products to rigorous scrutiny.

SWAT Model Input

The latest version of the SWAT model – SWAT2009, which was officially released in January 2010 – was used in this application. Mandatory GIS input files needed for the SWAT model include the Digital Elevation Model (DEM), LULC and soil layers. One of the useful features of the SWAT2009 model is that it can simulate LULC change. LULC change was input into the model using multi-year land cover image files. Mandatory GIS data used to develop the watershed models are listed in Table B.1 and Table B.2. Based on threshold specifications and the DEM, the SWAT ArcSWAT interface was used to delineate the watershed into sub-watersheds. Subsequently, sub-watersheds were divided into HRUs by the user specified land use, soil and slope percentages (Neitsch et al., 2005). Certified 12-digit HUC boundaries were used to create sub-watersheds in each model. The point source data for each watershed was obtained from ADEQ.

The ability of the SWAT model to include specific fertilizer types, fertilizer spreading, cattle grazing and tillage operations adds to the model's utility in representing a particular watershed (Neitsch et al., 2005, 2009). These nonpoint components were integrated into the model based on best available information. Animal production was simulated in the SWAT model at the HRU level. Production animals in the watershed included chickens, turkeys, pigs and cows (beef and dairy). For each animal type, a fertilizer file was created in the SWAT model fertilizer database using standard

Table B.1. Temporal and/or spatial resolution of mandatory input data for SWAT modeling

Data Input	Bayou Bartholomew	Beaver Reservoir	Illinois River	Lake Conway Point Remove
DEM [♦]	10 meter	30 meter	10 meter	10 meter
Land use land cover (LULC) [♦]	28.5 meter 1992, 1999, 2001, 2004 and 2006	28.5 meter 1992, 1999, 2001, 2004 and 2006	28.5 meter 1992, 1993, 1999, 2001, 2004 and 2006	28.5 meter 1999, 2004 and 2006
Soil	1:24,000 SSURGO soils shape file	1:24,000 SSURGO soils shape file	1:24,000 SSURGO soils shape file	1:24,000 SSURGO soils shape file

[♦]10 meter DEM were resampled from 5 meter DEM (CAST) due to SWAT database size constraints.

[♦]1992 and 2001 layers were developed by National Land Cover Database (NLCD), while 1993, 1999, 2004 and 2006 layers were developed by the Center for Advanced Spatial Technologies (CAST).

Table B.2. Sources of input data for SWAT modeling

Name	Input data for SWAT modeling	Source
Beaver Reservoir (Upper White)	DEM map	www.geostor.arkansas.gov
	Soils data – SSURGO	http://soildatamart.nrcs.usda.gov/
	Land use/land cover	www.geostor.arkansas.gov
	Stream networks (high resolution NHD)	http://nhd.usgs.gov/
	Weather data (precipitation and temperature)	www.ncdc.noaa.gov/oa/ncdc.html
	Management data	Local extension agents/literature review
	Watershed (HUC8) and sub-watershed (HUC12)	http://datagateway.nrcs.usda.gov/
	Point source	ADEQ and/or local authorities
Illinois River	DEM map	www.geostor.arkansas.gov
	Soils data – SSURGO	http://soildatamart.nrcs.usda.gov/
	Land use/land cover	www.geostor.arkansas.gov
	Stream networks (high resolution NHD)	http://nhd.usgs.gov/
	Weather data (precipitation and temperature)	www.ncdc.noaa.gov/oa/ncdc.html
	Management data	Local extension agents/literature review
	Watershed (HUC8) and sub-watershed (HUC12)	http://datagateway.nrcs.usda.gov/
	Point source	ADEQ and/or local authorities
Lake Conway-Point Remove	DEM map	www.geostor.arkansas.gov
	Soils data – SSURGO	http://soildatamart.nrcs.usda.gov/
	Land use/land cover	www.geostor.arkansas.gov
	Stream networks (high resolution NHD)	http://nhd.usgs.gov/
	Weather data (precipitation and temperature)	www.ncdc.noaa.gov/oa/ncdc.html
	Management data	Local extension agents/literature review
	Watershed (HUC8) and sub-watershed (HUC12)	http://datagateway.nrcs.usda.gov/
	Point source	ADEQ and/or local authorities
Bayou Bartholomew	DEM map	www.geostor.arkansas.gov
	Soils data – SSURGO	http://soildatamart.nrcs.usda.gov/
	Land use/land cover	www.geostor.arkansas.gov
	Stream networks (high resolution NHD)	http://nhd.usgs.gov/
	Weather data (precipitation and temperature)	www.ncdc.noaa.gov/oa/ncdc.html
	Management data	Local extension agents/literature review
	Watershed (HUC8) and sub-watershed (HUC12)	http://datagateway.nrcs.usda.gov/
	Point source	ADEQ and/or local authorities

manure compositions. Annual animal production rates for turkeys, pigs, and cows were obtained from National Agricultural Statistical Services (NASS). Animal production numbers were available from NASS on head-per-county basis. To accommodate for the county level animal production data, the animals were partitioned by county into watershed numbers using the following steps:

1. Determine the land area within each county that is designated as agriculture (CA);
2. Determine the land area of the watershed within each county that is designated as agriculture (WA);
3. Calculate a proportion (PR) within each county (WA/CA); and
4. Multiply PR by each animal production type to determine the number of animals in the watershed. Based on these calculations, chicken, turkey and pig manures were simulated annually in the SWAT model at the HRU level as a mass per area.

Urban lawn management operations were represented through fertilization, lawn mowing and irrigation. Details for these operations, including the dates and amount of mowing, fertilization and irrigation, were based on personal communications with extension agents/specialists and recommendations in University of Arkansas Division of Agriculture Cooperative Extension Service publications.

Weather data from multiple stations within the region were incorporated to provide the most representative precipitation and temperature data available. Precipitation estimates from the Next Generation Radar (NEXRAD) were incorporated, whenever available, because of its higher spatial resolution. Other meteorological data required by SWAT (solar radiation, wind speed and relative humidity) were estimated using the SWAT weather generator.

Initial values that were not available for SWAT model inputs, such as soil chemical composition, were established by simulating the model for four years. This warm-up period allows the model to "stabilize" or calculate values that become initial values for the period of interest. Therefore, after the warm-up period, the model was considered to represent conditions in the watershed. Specific data sets were identified to perform calibration and validation of the SWAT model. Measured flow and water-quality data were acquired from available gauging stations within the watershed

during the time period of interest. Whenever possible given the time constraints, the model was calibrated for flow, sediment and nutrients data at annual and monthly time scales.

References Cited

- American Society of Civil Engineers (ASCE), 1993. Criteria for Evaluation of Watershed Models. *J. Irrig. Drainage Engineering*. 119(3): 429-442.
- Arnold, J. G., R. Srinivasan, R. S. Muttiah and J. R. Williams, 1998. Large Area Hydrologic Modeling and Assessment Part I: Model Development. *Journal of the American Water Resources Association* 34: 73-89.
- Harmel, R. D., R. J. Cooper, R. M. Slade, R. L. Haney and J. G. Arnold, 2006. Cumulative Uncertainty in Measured Streamflow and Water Quality Data for Small Watersheds. *Trans. ASABE* 49(3): 689-701.
- Knisel, W. G., 1980. CREAMS: A Field-Scale Model for Chemicals, Runoff and Erosion from Agricultural Management Systems. USDA Conservation Research Report 640 pages.
- Leonard, R., W. Knisel and D. Still, 1987. GLEAMS: Groundwater Loading Effects of Agricultural Management Systems. *Trans. ASABE* 30(5): 1403-1428.
- Moriasi, D. N., J. G. Arnold, M. W. VanLiew, R. L. Binger, R. D. Harmel and T. L. Veith, 2007. Model Evaluation Guidelines for Systematic Quantification of Accuracy in Watershed Simulations. *Trans. ASABE*. 50(3): 885-900.
- Neitsch, S. L., J. G. Arnold, J. R. Kiniry and J. R. Williams, 2005. Soil and Water Assessment Tool Theoretical Documentation Version 2005. Available at <http://swatmodel.tamu.edu/documentation>.
- Neitsch, S. L., J. G. Arnold, J. R. Kiniry, R. Srinivasan and J. R. Williams, 2009. Soil and Water Assessment Tool Input/Output Documentation Version 2009. Available at <http://swatmodel.tamu.edu/documentation>.
- Williams, J. R., and R. W. Hann, 1973. HYMO: Problem-Oriented Language for Hydrologic Modeling – User's Manual. USDA, ARS-S-9.
- Williams, J. R., C. A. Jones and P. T. Dyke, 1984. A Modeling Approach to Determining the Relationship Between Erosion and Soil Productivity. *Transactions of the ASAE* 27(1): 129-144.
- Willmott, C. J., 1981. On the Validation of Models. *Physical Geography* 2: 184-194.

Appendix C

Description of Public Participation and Development of Management Program Update

Introduction

Section 319 of the Clean Water Act (CWA) requires the states to:

- assess their waters for impairment caused by nonpoint source (NPS) pollution, including identification of statewide sources of that pollution;
- submit to the U.S. Environmental Protection Agency (EPA) a management program addressing each identified category of NPS pollution identified in the assessment; and
- report annually on their progress in implementing that program.

Arkansas' NPS Pollution Management Program was first completed in 1994 for the period of 1994 through 1998. In 1998, a major update of the program was completed that addressed the "key elements" of NPS management as identified in the Clean Water Action Plan. This update provided milestones for the years 1998 through 2002. A minor update was completed in 2002 extending the milestones through 2004.

Since the completion of the 1998 management program, significant changes have been made in EPA's NPS pollution program, in Arkansas' regulatory framework for pollution management and in conditions of the waters of the state. As a result, this project was initiated to provide a major update to the management program addressing these new conditions. The goal of this project was to develop, in cooperation with all applicable local, state, and federal agencies, and other stakeholders, an updated Arkansas NPS Pollution Management Plan for the years 2011 through 2016. Objectives of this project were to:

- develop a management program that met all relevant regulations and guidance;
- address categories of NPS pollution as identified by the ADEQ's assessment reports; and
- effectively target resources at high-priority stream segments.

Methodology

Arkansas' 2011-2016 NPS Pollution Management Plan was developed through a series of collaborative exercises. The objective of these exercises was to develop an effective management program that will reduce NPS pollution from known sources, that is implementable and that is acceptable to the entire range of stakeholders. In the collaboration process, a core team of scientists, engineers and policy makers collect and analyze data and prepare that data for presentation to the stakeholders. The stakeholders then deliberate and interpret the data and, in turn, provide direction for the core team for further data collection and analysis. Through repeated cycles of the analysis/deliberation process, informed decisions are made that lead to effective and implementable policy.

The analysis/deliberation cycle was extended to include an additional step of consultation with individual agencies and interest groups. Thus, the core team was able to learn directly of the special needs of different agencies, professional associations and interest groups. While no process can meet all of the needs of every interest group, this process provided for input from representatives of the interested parties during the formation of the program. As a result, the recommendations, goals and objectives of this plan represent the collective thought of local, state and federal agencies, agricultural commodity groups, professional associations, environmental organizations and watershed partnerships.

The core team for the collaborative process consisted of scientists and engineers from the Biological and Agricultural Engineering Department (BAEG) at the University of Arkansas, the University of Arkansas Division of Agriculture Cooperative Extension Service and the director of Arkansas' NPS Pollution Management Plan at the Arkansas Natural Resource Commission (ANRC). BAEG was responsible for literature reviews, data compilation, geographic information system databases and water quality modeling. The University of Arkansas Division of Agriculture Cooperative Extension Service provided analysis of policy proposals, input into Best Management Practices

(BMPs) and management measures and assisted with stakeholder meetings. ANRC reviewed all material for conformance with agency policy.

To complete the collaborative process, two stakeholder meetings were held. Each meeting had specific goals and objectives to be accomplished. Successive meetings built on information provided by the stakeholders and decisions from the previous meeting (see Table C.1). One-on-one consultations were held between a member or members of the core team and individual interest groups (agencies, professional associations, commodity groups and environmental groups) between the stakeholder meetings (see Table C.2).

Individual consultations with agencies and interest groups were conducted where it seemed their input was most needed. The initial focus of these meetings was federal agencies that had responsibilities for natural resource management. These meetings provided improved understanding by the core team of what resources are available from these agencies and how those resources could be tapped for the NPS Pollution Management Plan. The second focus for the consultations was commodity groups, professional associations, environmental organizations and watershed groups. Through this series of meetings, the special needs of these groups were identified along with what resources they could provide to improve implementation of statewide NPS pollution management measures.

Table C.1. Summary of stakeholder meetings

Meeting 1: September 21, 2010

Objectives:

- Make the stakeholders aware of the current laws, rules, regulations and policies concerning the NPS Pollution Management Plan.
- Identify additional sources of data for use in evaluation of specific nonpoint sources of pollution.
- Identify criteria for prioritizing watersheds for nonpoint source pollution program implementation (see Appendix B, Watershed-Based Implementation).

Preparation:

- Summarize current state and federal laws, rules, regulations and policies concerning the NPS pollution program.
- Summary of current water quality assessment reports and independent water quality research projects.
- Development of draft watershed prioritization criteria.

Results:

- 72 people attended.
- Criteria were selected for use in the qualitative risk assessment watershed prioritization tool.
- NPS issues related to row crop and livestock agriculture, silviculture, construction, urban, onsite wastewater, resource extraction and hydromodification were listed.
- Additional sources of data for watershed assessments were provided.
- The results of the revised qualitative risk assessment were presented.
- Subgroups were formed for each of the proposed categories and priority watersheds. For each category and priority watershed, facilitated discussions among the subgroups lead to development of long- and short-term goals and measurable indicators.
- Some subgroups were able to develop a set of management measures for implementation over the period of the management program. An additional category for rural roads was proposed.

Table C.1. Summary of stakeholder meetings (cont.)**Meeting 1: September 23, 2011****Objectives:**

- Review results of the watershed prioritization matrix.
- Develop short- and long-term goals and objectives for statewide programs and priority watersheds.
- Review and update plan by priority areas.

Preparation:

- Criteria were entered into the prioritization matrix; based on the criteria; eight top priority watersheds were selected for implementation programs.
- Initial Soil and Water Assessment Tool (SWAT) models were selected for each priority watershed indicating sources of sediment, phosphorus and nitrogen.
- Other pertinent data were collected for the priority watersheds.
- Literature reviews of management measures and BMPs were developed for each statewide program.
- Illustrative goals and measurable indicators were prepared for each category in order to promote discussion.

Results:

- More than 50 people attended the second meeting also, but not entirely the same group as in the first meeting.
- The results of the revised qualitative risk assessment were presented.
- Subgroups were formed for each of the proposed categories and priority watersheds. For each category and priority watershed, facilitated discussions among the subgroups led to development of long- and short-term goals and measurable indicators.
- Some subgroups were able to develop a set of management measures for implementation over the period of the management program. An additional category for rural roads was proposed.

Table C.2. Summary of individual consultations

Date	Organization	Summary
Jan. 25, 2010	U of A Division of Agriculture Environmental Task Force	Completion and validation of the SWAT Watershed Model
Jan. 28, 2010	U of A Division of Agriculture Environmental Task Force	Completion and validation of the SWAT Watershed Model
Feb. 8, 2010	U of A Division of Agriculture Environmental Task Force	Completion and validation of the SWAT Watershed Model
Feb. 17, 2010	U of A Division of Agriculture Environmental Task Force	Completion and validation of the SWAT Watershed Model
Feb. 24, 2010	U of A Division of Agriculture Environmental Task Force	Completion and validation of the SWAT Watershed Model

Finally, the focus turned to state agencies. These agencies have the ultimate responsibility for implementation of the various statewide elements of the program. Meetings with these agencies provided review of what was and wasn't applicable policy, according to their authorizing legislation. Overall, 23 individual consultations were conducted in preparation of this program. The meetings included several formats from one-on-one consultation with key individuals at the agency to group discussions with the boards of commodity groups and watershed councils.

After completion of the two stakeholder meetings and all of the individual consultations, a final draft of the management program was compiled with revisions as per the comments provided. This final draft was distributed to the stakeholders for a final review and comment. Revisions to the document were made with respect to the comments as deemed appropriate by the lead agencies. The completed 2011-2016 NPS Pollution Management Plan was then reviewed by ANRC's attorney and public comments accepted. After consideration of the public comments, the final document was prepared and submitted to EPA Region VI for review and approval.

Results

More than 75 people representing 36 different organizations participated in the development of the NPS Pollution Management Plan through meetings of the NPS Stakeholder Group. Many additional people were represented in the individual agency consultations and in the Conservation District survey. While it required extensive investment of time and resources, this stakeholder involvement in collaborative decision making provided for comprehensive public participation in the development of the program rather than

merely public comment at the end of the process. As a result, the current NPS Pollution Management Program Update should lead to more effective implementation and quicker improvement of the quality of the waters of the state.

The final draft of Arkansas' 2011-2016 NPS Pollution Management Plan has been completed and posted for review by the Nonpoint Source Stakeholder Group. This draft contains the statewide elements of Agriculture, Silviculture, Resource Extraction, Surface Erosion, Road Maintenance and Construction and Urban Runoff. Priorities selected for implementation during 2005 through 2009 based on the qualitative risk assessment are the Illinois River, Upper White River, L'Anguille River, Lake Conway/Point Remove, Upper Saline River, Bayou Bartholomew, Poteau River and Little River watersheds.

After a period for the NPS Stakeholder Group to review and comment on the final draft, a final document will be prepared and submitted to EPA Region 6 for review. The final document will be completed after EPA's review of the draft.

Comment on the Draft Plan

The draft 2011-2016 NPS Pollution Management Plan was posted on the Internet for comment on March 15, 2011. An e-mail was sent to all members of the Stakeholder Group encouraging them to review the draft 2011-2016 Plan and submit comments. Specifically, the plan was outlined and numbered and explicit instructions provided for those comments. Nearly 50 pages were received, a total of 36 comments. The comments were reviewed and incorporated into the plan that has been submitted to EPA for review and approval.

Appendix D

Overview of Selected Authorities and Regulations

Agency	General Authority
ADEQ	Act 134 of 1979, as amended, the Arkansas Surface Coal Mining and Reclamation Act of 1979, ACA 15-58-101 et seq. gave ADEQ the authority to permit and regulate coal mining operations under a state program as provided in Public Law 95-87, the Surface Mining Control and Reclamation Act of 1977.
ADEQ	Act 827 of 1991, as amended, the Arkansas Open-Cut Land Reclamation Act, ACA 15-57-301 et seq. gave ADEQ the authority to permit and regulate open-cut mining operations and stream bed mining operations.
ADEQ	Act 472 of 1949, as amended, the Arkansas Water and Air Pollution Control Act, ACA 8-4-101 et seq. gave ADEQ the authority to protect the quality of the air and waters of the state of Arkansas.
ADEQ	Act 406 of 1979, as amended, the Arkansas Hazardous Waste Management Act, ACA 8-7-201 et seq. gave ADEQ the authority to protect the public health, safety and environment from the effects of improper, inadequate or unsound management of hazardous wastes.
ADEQ	Act 237 of 1971, as amended, the Arkansas Solid Waste Management Act, ACA 8- 2-701 et seq. gave ADEQ the authority to regulate the collection and disposal of solid wastes in a manner that will (a) protect the public health and welfare; (b) prevent water and air pollution; (c) conserve natural services; and (d) enhance the beauty and quality of the environment.
ADEQ	Act 454 of 1991, ACA 8-1-106 et seq., the “Disclosure Law,” gives ADEQ the authority to deny permits, licenses, certifications or operational authorizations to applicants who have a record of environmental noncompliance.
ADEQ	Act 1076 of 1991, ACA 8-1-106 et seq., gives ADEQ the authority for administrative searches.
AFC	Act 234 of 1931 provided the authority to create the Arkansas State Forestry Commission.
AFC	On June 13, 1933, the Arkansas Forestry Commission and the Secretary of Agriculture of the United States entered into an agreement to cooperate in the prevention and suppression of forest fires under provisions of Section 2 of the Clarke-McNary Law.
AFC	Act 85 of 1935, the Cole-Crutchfield Forest Fire Law, was passed to regulate the setting of fires and to provide for notification of intent to burn to AFC.
AFC	Act 136 of 1947 was passed to levy a tax on severed timber to provide additional funds to operate the Arkansas Forestry Commission. Act 136 repealed a previous tax act, Act 158 of 1937.
AFC	Act 409 of 1947 provided the authority to create State Forests.
AFC	Act 163 of 1947 authorized the Arkansas Forestry Commission to conduct management services for small landowners and to charge up to 5 percent of the fair market value of the forest products marked for removal and sale.
AFC	Act 472 of 1949, as amended, ACA 8-4-104, made the director of the Arkansas Forestry Commission a member of the Arkansas Pollution Control and Ecology Commission.
AFC	Act 99 of 1955 provided additional authority to the Arkansas Forestry Commission to originate and conduct forest research.

Agency	General Authority
AFC	The Arkansas Statewide Water Quality Management Plan, submitted to EPA Region VI and certified by the governor of Arkansas on Dec. 18, 1980, pursuant to the provisions of Section 208 of the Clean Water Act (PL 95-217), named the Arkansas Forestry Commission as the Designated Management Agency for the silviculture component of the Statewide Water Quality Management Plan. By resolution enacted on Sept. 2, 1980, between itself and the Arkansas Department of Environmental Quality, the Arkansas Forestry Commission accepted such designation. EPA approved the Management Plan on March 13, 1981.
AFC	A Memorandum of Understanding executed March 9, 1981, between the Arkansas Department of Environmental Quality and the Arkansas Forestry Commission established policies and procedures both agencies would follow in carrying out their respective responsibilities under state and federal law in respect to Water Quality Management.
AFC	A Cooperative Agreement executed February 12, 1996, between the Arkansas Natural Resources Commission and the Arkansas Forestry Commission defined the respective responsibilities of each agency in respect to preventing degradation of the waters of the State of Arkansas through preparation of the Arkansas Nonpoint Source Pollution Management Program for 1998-2002. AFC will continue to serve as the lead agency for the silviculture portion of the 2006-2011 Nonpoint Source Pollution Management Program Update.
ANRC	Act 197 of 1937, as amended, ACA 14-125101 et seq., gives authority to create Conservation Districts; gives the Arkansas Natural Resources Commission financial and managerial authority.
ANRC	Act 329 (Section 2) of 1949, as amended, ACA 14-117-102, provides for the Arkansas Natural Resources Commission to cooperate with and approve drainage projects of districts.
ANRC	Act 472 of 1949, as amended, ACA 8-4-104, made the Arkansas Natural Resources Commission's executive director a member of the Pollution Control and Ecology Commission.
ANRC	Act 81 of 1957, as amended, ACA 15-22-201 et seq., gives ANRC authority to issue dam construction permits, register surface water diversions and allocate water to users in times of shortage.
ANRC	Act 114 of 1957, as amended, ACA 14-116101 et seq., gives ANRC authority to establish Regional Water Distribution Districts.
ANRC	Act 14 of 1963, as amended, ACA 15-20-201 et seq., created the Soil and Water Conservation Commission (Arkansas Natural Resource Commission).
ANRC	Act 217 of 1969, as amended, ACA 15-22501 et seq., created the Water Development Fund and directed the preparation of the Arkansas Water Plan. Authority to construct water resource projects and responsibility to coordinate all water resource development is also in this act.
ANRC	Act 629 of 1969, as amended, ACA 14-268101 et seq., authorizes cities and counties to enact ordinances to regulate flood plain areas.
ANRC	Act 641 of 1969, ACA 17-43-101, made the Arkansas Natural Resources Commission's executive director a member of the Arkansas Water Well Construction Commission.
ANRC	Act 16 of 1971, ACA 15-23-401, approved the Arkansas-Oklahoma Compact on the Arkansas River. The Arkansas Natural Resources Commission's executive director is a member of the Compact Commission.
ANRC	Act 38 of 1971, (repealed), transferred the Soil and Water Conservation Commission to the Department of Commerce (Type 1 transfer), Division of Soil and Water Resources.
ANRC	Act 274 of 1975, as amended, ACA 14-230101 et seq., created the Water Sewer and Solid Waste Revolving Fund.
ANRC	Act 460 of 1975, ACA 17-40-101 et seq., created the Soil Classifiers Registration Board; the Arkansas Natural Resources Commission provides administrative support to the board.

Agency	General Authority
ANRC	Act 524 of 1975, as amended, ACA 22-5-801 et seq., created the Natural Resources Committee of which the Soil and Water Conservation Commission's executive director is a member.
ANRC	Act 201 of 1979, ACA 15-23-501 et seq., approved the Red River Compact. The Soil and Water Conservation Commission's executive director is a member of the Compact Commission.
ANRC	Act 257 of 1979, as amended, ACA 15-23301 et seq., created the Natural and Scenic Rivers Commission. The Arkansas Natural Resources Commission selects one member of the advisory council.
ANRC	Act 496 of 1981, as amended, ACA 15-23301 et seq., authorizes the Arkansas Natural Resources Commission to issue Arkansas Water Resources Development General Obligation Bonds. Bond proceeds are used to construct water projects.
ANRC	Act 746 of 1981, (not codified), assigned the administration of the Water, Sewer and Solid Waste fund to the Soil and Water Conservation Commission.
ANRC	Act 691 of 1983, (not codified), eliminated the Department of Commerce and returned the Soil and Water Conservation Commission (ANRC) to the status of an independent agency of state government.
ANRC	Act 417 of 1985, as amended, ACA 26-511001 et seq., created tax incentives for Water Resource Conservation and Development.
ANRC	Act 1051 of 1985, as amended, ACA 15-22301 et seq., requires the registration of groundwater use, the inventory of surface and groundwater resources and the delineation of surplus or excess surface water; permits the transportation of excess surface water to nonriparians; and permits transfer of surface water out of state.
ANRC	Act 686 of 1987, ACA 15-22-701 et seq., authorizes the Soil and Water Conservation Commission to issue Arkansas Waste Disposal and Pollution Abatement Facilities Financing General Obligation Bonds. Bond proceeds are used to construct waste disposal and pollution abatement facilities.
ANRC	Act 257 of 1989, ACA 15-22-801 et seq., created the Arkansas Water Resources Cost Share Revolving Fund. Proceeds from the fund may be used to assist local entities with their portion of costs for water projects shared with the federal government.
ANRC	Act 469 of 1989, ACA 15-22-301 et seq., (not codified), allows ANRC to establish minimum stream flows and delegate authority over water management. ACA 15-22-503(e) mandates that all water development projects receive certification of compliance with the Arkansas Water Plan from ANRC.
ANRC	Act 154 of 1991 (also Act 342), as amended, ACA § 15-22-901 et seq., Arkansas Groundwater Protection and Management Act enables ANRC designation of critical groundwater use areas, establishes the authority for groundwater withdrawals, establishes groundwater rights, establishes fees and establishes a mechanism for local groundwater management.
ANRC	Act 648 of 1991, ACA 15-20-208 allows state treasurer to withhold from city and county turnback funds any delinquent amount owed to the Arkansas Natural Resources Commission.
ALPC	Act 224 of 1925, as amended, ACA 2-40-101 et seq., gave the authority relating to the control and eradication of diseases in livestock and poultry and the disposal of dead animals.
ALPC	Act 66 of 1953, as amended, ACA 2-37-101 et seq., gives the commission authority over commercial feedstuffs.
ALPC	Act 87 of 1963, as amended, ACA 2-33-101 et seq., created the Arkansas Livestock and Poultry Commission, empowered.
AHD	Act 402 of 1977 and Act 708 of 1983 provided authority to the Arkansas Health Department to issue rules and regulations pertaining to domestic sewage disposal systems.

Agency	General Authority
ADEQ	Regulation 1; Regulation for the Prevention of Pollution by Salt Water and Other Oil Field Wastes Produced by Wells in All Fields or Pools.
ADEQ	Regulation 2; Regulation Establishing Water Quality Standards for Surface Waters of the State of Arkansas.
ADEQ	Regulation 3; Licensing of Wastewater Treatment Plant Operators.
ADEQ	Regulation 4; Regulation to Require a Disposal Permit for Real Estate Subdivisions in Proximity to Lakes and Streams.
ADEQ	Regulation 5; Liquid Animal Waste Management Systems.
ADEQ	Regulation 6; Regulations for State Administration of the National Pollutant Discharge Elimination System (NPDES).
ADEQ	Regulation 7; Civil Penalties.
ADEQ	Regulation 8; Administrative Procedures.
ADEQ	Regulation 9; Regulation for the Fee System for Environmental Permits
ADEQ	Regulation 10; The Regulation Governing the Revolving Loan Fund Program.
ADEQ	Regulation 11; Solid Waste Management Fees and Grants.
ADEQ	Regulation 12; Storage Tank Regulations.
ADEQ	Regulation 13; Laboratory Certification Fees.
ADEQ	Regulation 14; Regulations and Administrative Procedures for the Waste Tire Program.
ADEQ	Regulation 15; The Arkansas Open-Cut Mining and Land Reclamation Code.
ADEQ	Regulation 16; Rules and Administrative Procedures for the Certification of Taxpayer Eligibility for Arkansas Income Tax Credit for the Purchase of Equipment Used to Reduce, Reuse or Recycle Solid Waste Material.
ADEQ	Regulation 17; Arkansas Underground Injection Control Code.
ADEQ	Regulation 20; The Arkansas Surface Coal Mining and Reclamation Code.
ADEQ	Regulation 22; Solid Waste Management.
ADEQ	Regulation 27; Licensing of Operators of Solid Waste Management Facilities.
ADEQ	Regulation 28; Rules and procedures for the establishment or designation of adequate Recyclable materials collection centers or systems in counties in the State of Arkansas.
ANRC	Title IXX rules governing the Arkansas poultry feeding operations registration program.
ANRC	Title XX rules governing the Arkansas nutrient management planner certification program.
ANRC	Title XXI rules governing the Arkansas nutrient management applicator certification program.
ANRC	Title XXII rules governing the Arkansas soil nutrient and poultry litter application and management program.
APB	Arkansas regulations on pesticide use: The purpose of these regulations is to provide additional mechanisms, other than denying registration of a product in Arkansas, to minimize the adverse effects of certain pesticides to plants, including forage plants, or adjacent or nearby lands; wildlife in the adjoining or nearby areas; fish and other aquatic life in waters in reasonable proximity to the area to be treated; and humans, animals, or beneficial insects.

Agency	General Authority
APB	Arkansas Pesticide Control Act. The purpose of this subchapter is to regulate in the public interest the labeling, distribution, storage, transportation, and disposal of pesticides as defined in this subchapter.
APB	"Arkansas Pesticide Use and Application Act." The purpose of this subchapter is to regulate in the public interest the distribution, use, and application of pesticides to control pests as hereinafter defined.
APB	"Pesticide enforcement response regulations." The purpose of the regulation is to provide a fair and consistent mechanism by which compliance with the Pesticide Use and Application Act, as amended, and the Pesticide Control Act, as amended, and the regulations written pursuant thereto can be achieved.
ALPC	Act 87 of 1963-Code 2-33-101 and Act 150 of 1985-Code 19-6-448 Regulation for the disposal of large animal carcasses, excluding dogs and cats.
OCC	Annotated, Title 15, Chapter 72 General Rules of statewide application, applying to the conservation and prevention of waste of crude oil and natural gas in the state of Arkansas and protection of the vested, co-equal or correlative rights of owners of crude oil and natural gas.

Appendix E

Short-Term NPS Pollution Management Program Milestones

One goal of the NPS Pollution Management Program is to achieve the various short-term milestones listed. The program management team will continue to use the adaptive management process to adjust objectives and measure progress toward identified short-term milestones. Project partners supported by 319 funds will meet in September of each year to review progress toward project objectives and established program milestones. The NPS Pollution Management Plan Stakeholder Group will meet in close coordination with the annual project review conference. The stakeholders will review progress toward program milestones and discuss possible additions, deletions and/or revisions as appropriate. This process will be repeated annually.

Arkansas proposes the following short-term milestones for the NPS Pollution Management Plan for the period FY 2011-2016:

1. Continue the process of identifying 12-digit hydrologic unit areas for priority watersheds for program management purposes. This will occur in concert with a thorough analysis of the modeling assumptions and metrics and be accompanied by significant validation efforts.
2. Prioritize 12-digit hydrologic unit areas for baseline monitoring based on land use intensity and other appropriate NPS-related concerns (for example, row crop agriculture, animal agriculture, urban and forestry).
3. Continue to update for the purposes of the NPS Pollution Management Program the function, capabilities and definition of what constitutes a "local watershed group."
4. Identify local watershed groups consistent with the definition above and evaluate local capacity to develop and undertake CWA 319-funded water quality improvement projects.
5. Continue to conduct strategic baseline monitoring in selected high-priority, 12-digit hydrologic unit areas within matrix identified priority watersheds.
6. Evaluate and update as appropriate memorandums of understanding with partner agencies participating in the standardized statewide reporting system for NPS-related programs, projects and activities.
7. Continue to publish statistically valid district-level results of annual statewide evaluation of voluntary silviculture Best Management Practices (BMPs) implementation. Support the Arkansas Forestry Commission's random assessment of all final harvest silvicultural operations, one year of age or less, occurring within the state.
8. Continue to support appropriate natural resource conservation curriculum development and distribution.
9. Continue to use various methods to measure the understanding of the public's knowledge of water resource management. Continue to develop and assess tools aimed at improving the effectiveness of water quality education in affecting behavior change.
10. Continue to employ a formal annual review process of all NPS projects funded with CWA 319 funds aimed at improving project effectiveness.
11. Convene NPS Pollution Management Plan Stakeholder Group to review progress toward short-term milestones and to provide input into the biennial NPS Pollution Management Program Update.
12. Update NPS Pollution Management Plan in Federal Fiscal Year 2012 as new data and knowledge informs the adaptive management process.
13. Continue to review Arkansas Department of Environmental Quality's available ambient water quality monitoring data for priority watersheds to identify water quality trends. Continue to support management efforts, local funding and increased local institutional capacity dealing with NPS pollution in all identified priority watersheds.

14. Continue to support measures that reduce the listed water quality impacts of NPS pollution in each of the matrix identified priority watersheds.
15. As resources allow, continue cooperation with the Arkansas State Plant Board and the Abandoned Pesticide Program in the collection of data associated with the environmental risk reductions related to farmer participation in abandoned pesticide collection. Since 2005, the program has been conducted in 25 counties, successfully recovering more than 660,000 pounds of unwanted agriculture pesticides.
16. Document the impacts of Discovery Farms as a component of the NPS pollution education, demonstration outreach and BMP evaluation process in Arkansas.