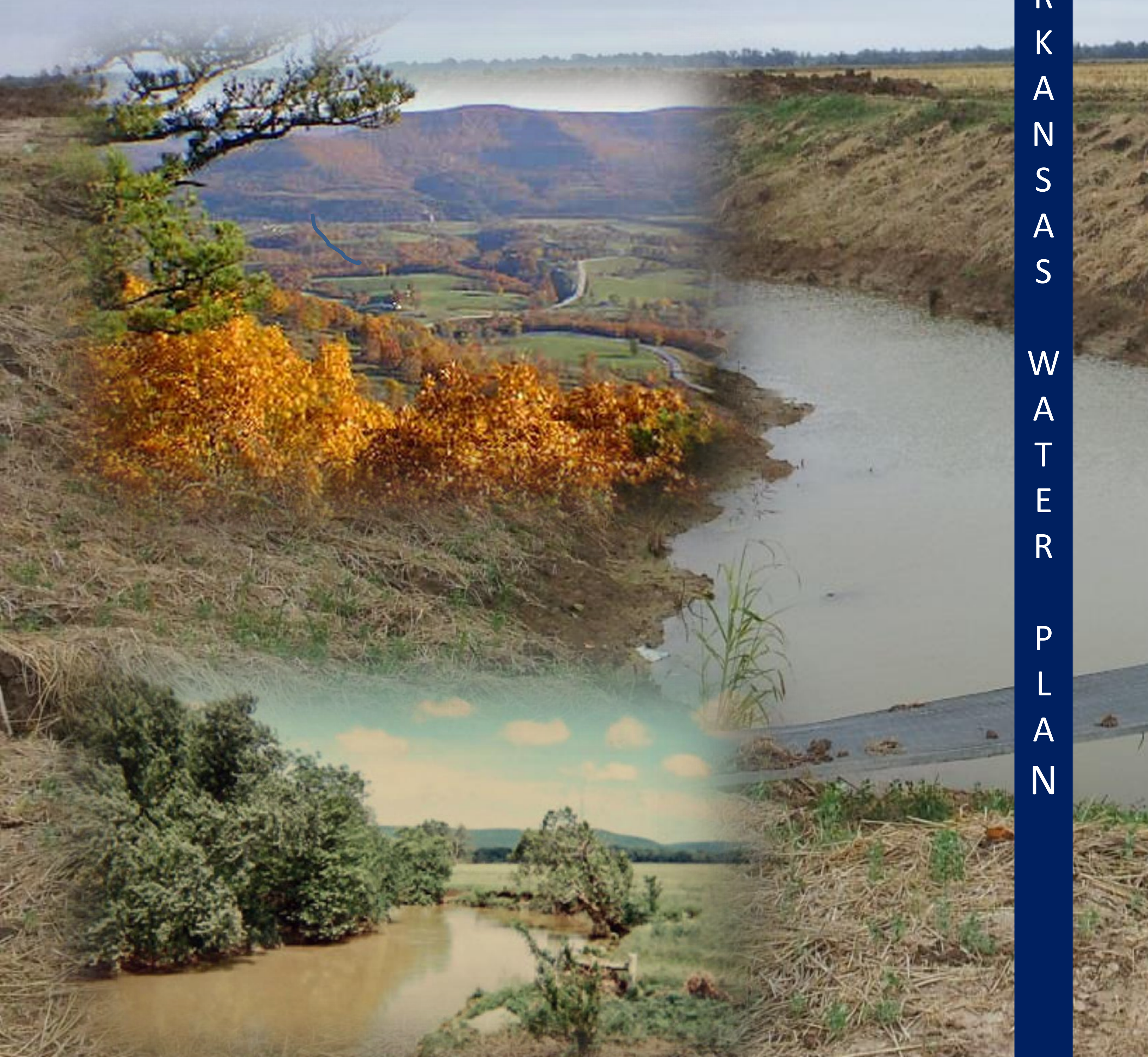
STATE OF ARKANSAS
NUTRIENT REDUCTION STRATEGY



ARKANSAS WATER PLAN

EXECUTIVE SUMMARY

Nitrogen and phosphorus are nutrients necessary to support all life forms. However, when excessive nutrient loading or enrichment occurs in streams and lakes, beneficial uses in those waters can be detrimentally impacted. Impact to water quality from excessive nutrients is a common challenge faced by many states, including Arkansas. Often the solutions to ameliorate the nutrient impacts are complex and dependent on a multitude of uncertainties. To address these uncertainties and complexities require nutrient reduction strategies that recognize social, physical, biological, and cultural landscapes, and that promote solutions supported by local stakeholders and the public.

Initiated by the 2014 Arkansas Water Plan update and Arkansas' participation on the Gulf of Mexico Hypoxia Task Force, the Arkansas Nutrient Reduction Strategy (ANRS) is a strategic framework that outlines opportunities, both regulatory and voluntary, which are available to improve overall aquatic health and viability in Arkansas waters for recreational, economic, environmental, and human health benefits. The ANRS is not a regulatory document and does not supersede existing water laws governing water quality issues in Arkansas. Rather, it focuses on outreach and "grass-roots" implementation of nutrient reduction activities. Arkansas has invested significant effort to address point and non-point source nutrient loading through state, federal, and private partnerships. **Partnerships with local, county, state, federal, non-profit, academic, and for-profit private sector entities are necessary** for: a) mobilization and coordination of available resources, b) consistent interpretation and implementation of water management policies, c) long-term support at the national, state, and local levels, and d) advancement of science-based technologies, methods, and new nutrient reduction techniques.

The strategic framework recognizes that achievement of water quality goals requires iterative and collaborative processes which, when implemented over time, result in incremental progress toward improvement goals. Those processes must be adaptable to changing conditions and should adhere to the following guiding principles:

- **Strengthening existing programs;**
- **Promoting voluntary, incentive-based, cost-effective nutrient reduction measures;**
- **Incorporating adaptive management and flexible strategic planning;**
- **Leveraging available financial and technical resources;**
- **Pursuing market-based opportunities and solutions.**

An integrated approach, as defined in this strategic framework, represents a "*sustained multi-discipline, multi-sector effort to reduce point and non-point nutrient loading and improve water*

quality through publicly supported strategies." These efforts require consistent cooperation and communication on the "ground-level" and represent a "bottoms-up" versus "top-down" approach to nutrient reduction. Arkansas' Soil and Water Conservation Districts are on the "ground-level," active in local communities, and pioneer the implementation of innovative practices. These "grass-root" connections are essential to working with private, state, and federal entities to improve water quality through public policy, public outreach and education, research, project implementation, and water quality monitoring in priority watersheds.

Priority Watersheds

Ten watersheds have been prioritized to direct limited resources and provide nutrient reduction assistance. These watersheds were identified through evaluation of Integrated Water Quality Monitoring and Assessment Program data, priorities of conservation programs, interstate water quality issues and agreements, watershed models such as SPARROW, local Conservation District goals, and a qualitative risk-based assessment as outlined in Arkansas' Nonpoint Source Pollution Management Plan.

Designated priority watersheds are listed below:

- Bayou Bartholomew
- Cache River
- Lake Conway-Point Remove
- Lower Ouachita Smackover
- Strawberry River
- Upper White River-Beaver Lake
- Illinois River
- L'Anguille River
- Poteau River
- Upper Saline River

Watershed Goals

Removal of nutrient impairment and delisting of 303d water bodies is the long-term nutrient reduction goal for priority watersheds. Interim target reduction levels may be identified on a watershed specific basis but must be based on sufficient data, i.e. physical, chemical, and biological; existing policies, regulations, and public support; watershed planning, and any other factors appropriate for establishing the reduction goal. In the Illinois River watershed, the Arkansas-Oklahoma Arkansas River Compact Commission established a 40% reduction in baseline nutrient loading, reported as the 5-year rolling average from monitoring stations in Arkansas and Oklahoma.

Protecting economic and environmental benefits for the land and water users in the watersheds should be a priority for all nutrient reduction efforts. Protection of these benefits provides an opportunity to better understand conditions within individual watersheds and the stressors that are most affecting those conditions. Understanding these interactions at the

watershed scale will help identify solutions that reduce nutrient loading and leverage limited financial resources.

Point Source Reduction

Depending on location and site-specific conditions during low flow, loadings from point sources may be a significant portion of the total nutrient load contributing to impairment. For this reason, point source loadings need to be assessed regularly through stream and effluent water quality data analyses and evaluation of existing treatment systems and their reduction capabilities. Existing stream flow and water quality monitoring stations should be reviewed to leverage multiple sources of funding and opportunity to support water quality sampling and analyses wherever possible.

In nutrient surplus watersheds, the National Pollutant Discharge Elimination System (NPDES) permitting requirements for phosphorus removal have been strengthened by the Arkansas Department of Environmental Quality (ADEQ). Because treatment costs for phosphorus removal can be high and prohibitive in some cases, the potential for multi-system collection and waste flow to regionally operated treatment facilities should be explored where it is improbable that NPDES nutrient reduction limits will be achieved at individual treatment facilities. New wastewater treatment facilities financed with state funds must be certified and comply with the Arkansas Water Plan. This certification process allows evaluation of factors affecting nutrient reduction, environmental, and economic needs on a regional level.

Other opportunities such as nutrient trading programs offer an alternative to higher treatment costs. Natural and artificially created **wetlands can increase nutrient assimilation and uptake and provide a measure of reduction** at lower costs compared to conventional treatment unit processes. Local participation and involvement in urban pollution prevention activities such as low-impact development, subdivision stormwater management, local ordinances, and other reduction methods should be fostered through public workshops and training, field days, advertisements, restoration and demonstration projects.

Implementation strategies for <u>point source reduction</u> include the following:

- **Adopt effective, innovative, and economical treatment technologies.**
- **Monitor and assess watershed impacts from point sources.**
- **Incorporate NPDES nutrient standards for major treatment facilities in priority watersheds.**
- **Increase knowledge of available treatment processes and reduction effectiveness.**
- **Expand watershed-based monitoring networks where possible.**
- **Enhance reporting and analysis of trends in nutrient loading and reduction.**
- **Increase public participation in urban nutrient reduction programs and practices.**

- **Improve nutrient assimilation and uptake capacities in riparian, lake, and wetland areas.**
- **Incorporate regional planning when developing new or upgraded treatment systems.**
- **Promote and increase implementation of effective urban stormwater management programs.**

Nonpoint Source Reduction

Nonpoint sources of nutrients can originate from commercial fertilizers, animal manure and litter, urban stormwater runoff, home sewage, sediment, or other in-situ contributing sources. Managing nutrient inputs (fertilizer, manure, and litter application) and potential runoff, as well as increasing the assimilation capacity of land and aquatic environments (riparian buffers, wetlands), is necessary to effect measurable reduction at the watershed-level scale.

Agricultural landscapes provide the greatest opportunity for significant nonpoint nutrient and sediment reduction, and agriculture specific initiatives are a big component of Arkansas' overall nutrient reduction effort. It is known that implementation of single reduction practices alone may not yield the desired reductions at the watershed or basin-level scale. Proving to be more effective are advanced farm planning and land management **techniques that reduce, control, and trap nutrients by utilizing combinations of practices** to sustain long-term reduction. Whole farm planning, which encourages farmers to identify long-term farm, environmental and production goals, is helping to focus on longer-term planning objectives. The 4R nutrient stewardship concept advocates the use of the right fertilizer, at the right rate, at the right time, and in the right place, in combination with best management practices on the land, to minimize nutrient loss and to meet crop requirements.

Knowledge gained from implementing these types of farm planning strategies and reduction practices should be used to guide future incentives and reduction activities while protecting the **economic livelihood of local stakeholders,** whose voluntary actions over time are critical to successful nutrient reduction. Innovative methods and technologies that optimize nutrient reduction and water efficiencies should be promoted and incorporated wherever possible.

Financial support for comprehensive monitoring is sometimes inadequate and in direct competition for limited monies available for "on-the-ground" reduction practices. **How much monitoring is needed should be based on watershed specific characteristics,** water quality data, observation, and professional judgment. Data policies should be adopted that allow aggregation of monitoring and program data and that can be made available for use by resource professionals without compromising the integrity of personal information.

Implementation strategies for nonpoint source reduction include the following:

- **Incorporate sediment retention, erosion control measures with improved water management.**
- **Promote research of innovative and effective market-based nutrient reduction practices.**
- **Demonstrate farming practices that increase reduction effectiveness and economic viability.**
- **Expand the use of nutrient inhibiting supplements.**
- **Increase riparian buffer zones and functioning wetland areas.**
- **Increase adoption of improved grazing and pasture management practices.**
- **Enhance watershed assessment and modeling tools, web-based information and reporting.**
- **Establish regular reporting on nutrient reduction activities and progress.**
- **Explore the feasibility and viability of nutrient trading programs.**
- **Promote manure management programs.**
- **Increase participation in nutrient reduction activities and practices.**
- **Promote public and private sector partnerships.**
- **Promote LID and other nutrient reduction strategies and programs in urban areas.**

Nutrient Numeric Criteria

EPA's National Strategy for the Development of Regional Nutrient Criteria is a "one number fits all" approach. Regional Nutrient Criteria do not take into account the dynamic characteristics of streams and rivers and their ability to assimilate nutrient impacts. Generalized nutrient criteria do not have a mechanism for predicting or differentiating in-stream total nitrogen and total phosphorus concentrations attributed to non-point source and point source of nutrients. In response to EPA's guidance, the Arkansas Department of Environmental Quality (ADEQ) has adopted the following approaches to nutrient criteria development:

- ***Develop nutrient criteria that fully recognize localized conditions and protect specific designated uses, using the process outlined in the EPA technical guidance manuals.***

- ***Use other scientifically defensible methods and appropriate water quality data to develop criteria protective of designated uses.***

ADEQ has two ongoing nutrient criteria projects for streams, each focused in Extraordinary Resource Watersheds (ERW). The Ozark Highland ERW project began in 2013 and the Boston Mountain ERW project began in 2014. Nutrient numeric criteria for Beaver Lake has been developed and adopted into Regulation #2 by the Arkansas Pollution Control & Ecology Commission in February 2014.

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A. INTRODUCTION

Nitrogen and phosphorus are nutrients necessary to support all life forms in our natural environments. However, when excessive nutrient loading and enrichment occurs in Arkansas streams and lakes, beneficial uses in those waters can be detrimentally impacted. Impacts to beneficial uses resulting from excessive nitrogen and phosphorus loading is a common issue being experienced by many states across the country. The solutions to ameliorate those nutrient impacts are often complex and dependent on a multitude of uncertainties. To address these uncertainties and complexities requires nutrient reduction strategies that recognize diversities in social, physical, biological, and cultural landscapes and formulate solutions that can be supported by stakeholders and the public.

Initiated by the current update of the 2014 Arkansas Water Plan and Arkansas' participation on the Gulf of Mexico Hypoxia Task Force, the Arkansas Nutrient Reduction Strategy (ANRS) has been drafted for public review and comment. The ANRS is a strategic framework that outlines opportunities, both regulatory and voluntary, which are available to improve overall aquatic health and viability of Arkansas waters for recreational, economic, environmental, and human health benefits. ANRS is not a regulatory document and does not supersede existing water laws governing water quality issues in Arkansas. Rather, it focuses on initiatives and activities to reduce loading through outreach and "grass-roots" implementation of nutrient reduction activities.

A.1 Existing State Authority

The State of Arkansas has invested significant voluntary, incentive-based and regulatory effort to address point and non-point source pollution in Arkansas' streams, rivers, and lakes. These multi-agency efforts have been implemented through state and federal partnerships for the protection and maintenance of aquatic resource function and environmental benefit enjoyed by all citizens. While affordable and good quality water is generally abundant throughout Arkansas for a multitude of purposes, impacts to beneficial uses caused by excessive nutrient loading exists in some of Arkansas' streams and lakes. The State, through the Arkansas Department of Health, Arkansas Department of Environmental Quality, and Arkansas Natural Resources Commission, exercises jurisdiction and management of water as it relates to beneficial uses, i.e. environment, economy, public health. Through coordination of regulatory and voluntary programs, these agencies provide the foundation for implementing water quality improvement activities at the

state level. In addition, **partnership and collaboration with other local, county, state, federal, non-profit, academic, and private sector entities is absolutely essential** to the protection, maintenance, and enhancement of all beneficial water uses in Arkansas.

A.2 Purpose

Discussions regarding the development of nutrient numeric standards illustrate one of the many public policy issues regarding nutrient reduction. Determining numeric nutrient standards can be problematic, particularly for streams, because many scientific and statistical uncertainties exist. Variability in nutrient assimilation and lack of direct correlation between "causes and effect" lead many to conclude that a single numeric value is not appropriate for application over a variety of differing aquatic conditions. For example, if base-level in-situ concentrations were to exceed established numeric criteria, the nutrient standard might never be met by any level of effort or expense. This example illustrates **the need for coordinated and adaptive management strategies** that leverage collaborative, integrated approaches to nutrient reduction and goal setting. The Arkansas Nutrient Reduction Strategy (ANRS) is a framework which identifies potential opportunities for nutrient reduction and water quality improvement.

A key to long-term water quality improvement is commitment from both public and private sectors. This commitment can be realized through a variety of means such as: a) mobilization and coordination of available resources, b) consistent interpretation and implementation of water management policies, c) long-term support at local, state, and national levels, and d) improvement in science-based assessment of nutrient reduction techniques and practices. To maximize benefits from these commitments necessitates that limited resources be targeted for water quality improvement activities that provide the most environmental, social, and economic "bang-for-the-buck".

A.3 National Water Quality Consideration

The Gulf of Mexico is experiencing water quality degradation in the form of hypoxia (low dissolved oxygen levels) which negatively affects aquatic communities in the zone of hypoxia. The hypoxic zone in the Gulf of Mexico is caused by nutrient loadings from tributary streams and river basins which flow into the Mississippi River and subsequently to the Gulf of Mexico. Seasonal stratification (layering) of waters in the Gulf of Mexico prevents mixing of oxygen-rich surface water with oxygen-poor

water on the bottom of the Gulf. Without mixing, oxygen in the bottom water is limited and a hypoxic condition exists. Arkansas' efforts specific to national nutrient loading and impairment of the Gulf of Mexico has been participation on the Gulf of Mexico Hypoxia Task Force, coordinated research, and implementation of nutrient reduction activities in Arkansas. The Task Force is co-chaired by individual states and the Environmental Protection Agency (EPA) and convenes to discuss ongoing nutrient reduction activities which can potentially decrease Mississippi River nutrient concentrations and subsequent nutrient loadings to the Gulf of Mexico.

A.4 Guiding Principles

Implementing changes in land-use or increasing investment in wastewater treatment processes **require clearly defined examples of effective and economically viable opportunities**. Those opportunities should demonstrate measurable or assumed benefits to the individual and surrounding watershed community. The question that must withstand scrutiny is: "Are the environmental, social, or human health benefits worth the economic costs of implementation?" This question depends heavily on perspective because the "benefit" is determined by the "value" placed on the resource. Even if measurable water quality benefits are identified with a particular practice, there is no guarantee that implementation of that practice will be realized. The strategic framework recognizes that reaching water quality goals requires collaborative processes, when implemented over time, result in incremental progress toward the desired improvement goal. Those processes must be adaptable to changing conditions and should adhere to the following set of guiding principles:

- **Strengthening existing programs;**
- **Promoting voluntary, incentive-based, cost-effective conservation and protection measures;**
- **Incorporating adaptive management and flexible strategic planning;**
- **Leveraging available financial and technical resources;**
- **Pursuing market-based opportunities and solutions**.

A.5 Public Participation

Implementation of nutrient reduction strategies is primarily voluntary and thus requires sustained public interest and support. Public and stakeholder support of these guiding principles and strategic opportunities referenced in the Arkansas Nutrient Reduction Strategy is crucial to nutrient reduction in Arkansas. Stakeholders include all public and private sector interests that are involved in or affected by water resources decision-making. The Arkansas Nutrient Reduction Strategy is a component of the 2014 Arkansas Water Plan update. State and regional planning groups, including a diversified cross-section of public and private interests, were tasked with identifying statewide water issues/concerns, formulating solutions, and reviewing recommended strategies. Involvement specific to water quality issues include state water plan subgroups and the Nonpoint Source Pollution Management Plan Stakeholder Group listed in Table 5 on page 19. These diverse groups includes academic and technical research institutions, county, state, and federal agencies, private sector consultants, industry, federations, non-governmental organizations (NGOs), and individual watershed group representatives. There are numerous other active committees and groups involved in watershed-level planning in Arkansas and represent strategic opportunities to promote and implement reduction activities.

A.6 Integrated Approach

The integrated approach, as defined in this framework, represents a "**sustained multi-discipline, multi-sector effort to reduce point and non-point nutrient loading and improve water quality through publicly supported strategies**." This effort requires cooperation and communication on the "ground-level" level and represents a "bottoms-up" versus "top-down" approach to nutrient reduction. The framework promotes enhanced outreach and educational efforts to bolster engagement of local stakeholders in reduction activities, regular evaluation of reduction goals, and advancement of science-based technologies.

B. STRATEGIC FRAMEWORK

B.1 Institutional Setting

▪ 1a. Watershed-Level

Arkansas' Soil and Water Conservation Districts are the life-blood of conservation activity at the watershed-level. District board members are usually active leaders in the local community and are often pioneers in implementing innovative conservation practices. This "grass-roots" connection is an important element in achieving sustainable nutrient reduction in priority watersheds. Conservation Districts, along with many other watershed-level stakeholder groups and organizations, work with state and federal agencies to improve water quality through public policies, public outreach and education, project implementation, and water quality monitoring.

▪ 1b. State-Level

Arkansas' statutory authority to directly impact water quality resides primarily in three agencies: the Arkansas Natural Resources Commission (ANRC), Arkansas Department of Environmental Quality (ADEQ), and Arkansas Department of Health (ADH). Other state agencies, including the Arkansas Forestry Commission (AFC), Arkansas Game & Fish Commission (AGFC), Arkansas Natural Heritage Commission (ANHC), and the University of Arkansas Research and Extension Service provide technical assistance in design and implementation of best management practices. Coordination among these agencies and associated programs is essential.

<u>Arkansas Natural Resources Commission</u> (ANRC)

Arkansas' nonpoint management and pollution prevention program is administered by the ANRC. The program includes voluntary implementation of nonpoint pollution abatement and management activities. Activities and projects are coordinated through local Soil & Water Conservation Districts whenever possible. ANRC has authority to establish nutrient surplus watersheds (green area shown in Figure 1.) In nutrient surplus watersheds, special limitations govern poultry, livestock, forage, and crop production operations that involve land-application of litter, sewage sludge, and commercial fertilizer. All operations are required to: a) have nutrient management plans developed by approved nutrient management planners, b) register with ANRC, and c) limit nutrient application rates according to

<u>Nutrient Surplus Watersheds</u>

Figure 1.

phosphorus index developed for the region. All nutrient management planners and applicators must receive training and become certified in accordance with ANRC rules. ANRC provides water quality technicians in select conservation districts to help landowners implement water quality improvement and conservation planning activities. Water quality technicians work closely with USDA Natural Resources Conservation Service (NRCS) District Conservationists.

Arkansas Department of Environmental Quality (ADEQ)
Point sources from municipal wastewater, industrial waste, some storm water runoff, and liquid animal waste systems are regulated by ADEQ. Water quality standards are ecoregion-based; water within each of the six ecoregions of the state has standards that were developed from data from the least-disturbed streams within each ecoregion. State and federal designated uses are listed in Table 1 below.

Table 1. Designated Uses

Arkansas Designated Uses	Federal Designated Uses
1) Extraordinary Resource Waters	1) Primary Contact
2) Ecologically Sensitive Waterbodies	2) Secondary Contact
3) Natural and Scenic Waterways	3) Fisheries
	4) Domestic Water Supply
	5) Industrial Water Supply
	6) Agricultural Water Supply

Impairment of a waterbody from excess nutrients is dependent on natural characteristics such as stream flow, residence time, stream slope, substrate type, canopy, riparian vegetation, primary use, season of the year and ecoregion water chemistry. Because nutrient water column concentrations do not always correlate directly with stream impairments, impairments will be assessed by a combination of factors such as water clarity, periphyton or phytoplankton production, dissolved oxygen values, dissolved oxygen saturation, diurnal dissolved oxygen fluctuations, pH values, aquatic-life community structure or other factors as identified by ADEQ. Point source discharges into the watersheds containing ADEQ's 303d listed waters (due to phosphorus) shall be governed by limits listed in Table 2 on page 7.

Waters in existing or subsequently designated nutrient surplus watersheds may be included if discharges provide a significant phosphorus contribution in the nutrient surplus watersheds. For discharges from point sources which are greater than 15 million gallons per day (mgd), reduction of phosphorus below 1 mg/L may be required based on the magnitude of the phosphorus load (mass) and

the type of downstream waterbodies (e.g., reservoirs, Extraordinary Resource Waters). Additionally, any discharge limits listed in Table 2 may be further reduced if it is determined that these values are causing impairments to special waters such as domestic water supplies, lakes or reservoirs or Extraordinary Resource Waters.

Table 2. Point Source Phosphorus Discharge Limits

Facility Design Flow	Total Phosphate as Phosphorus discharge limit
Equal or greater than 15mgd	Case by case
3 to less than 15mgd	1.0 mg/l
1 to less than 3mgd	2.0 mg/l
0.5 to less than 1mgd	5.0 mg/l
Less than 0.5mgd	Case by case

ADEQ establishes minimum qualifications, standards and procedures for issuance of permits for **Confined Animal Feeding Operations (CAFOs)** using liquid animal waste management systems and for the issuance of permits for land application sites. Individual and general permitting exists to regulate the operation of hog, poultry, and dairy farms or other confined animal operations. Individual permitting may be required if technical or other concerns regarding proposed management, operation, and maintenance are determined to be significant by ADEQ. Both state NPDES and CAFO regulations stipulate additional nutrient management planning and certification requirements in nutrient surplus watersheds. Continual monitoring and reporting is necessary to ensure individual permit conditions are being met.

Urban Stormwater Runoff has been identified as a source of contamination in ADEQ's most current List of Impaired Waterbodies. ADEQ regulates this runoff through issuance of: NPDES General Permits for construction, industrial, and municipal separate storm sewer systems (MS4), Non-Stormwater NPDES General Permits for car washes, water treatment, and No-Discharge Permits for land application, oil, and gas activities. All permitted MS4s (1 medium and 48 small) must develop and implement **Storm Water Management Plans** which **address these minimum control measures**:

1) Public education and outreach,
2) Public participation/involvement,
3) Illicit discharge detection and elimination,
4) Construction site runoff control, and
5) Post construction stormwater management and pollution prevention.

For urban areas, development and landscaping techniques which reduce or slow rates of runoff are well publicized and documented. These techniques and practices help mitigate the effects of impermeable surfaces by incorporating filtration and retention capacities within the urban setting. Urban pollution prevention programs can become more effective by incorporating initiatives that: a) advance planning and establishment of runoff pollution prevention goals; b) increase government and community interaction; c) prioritize pollution prevention over source treatment; d) establish sustainable funding sources; e) increase public education, monitoring and reporting, and enforcement participation; f) develop strategies relevant to local issues; and g) adapt policies and programs as needed to improve pollution prevention.

<u>Arkansas Department of Health</u> (ADH)
Individual collection, treatment, and operation of facilities for domestic wastes, excluding industrial discharge, is permitted and regulated by the Arkansas Department of Health. Application and detailed plans and specifications for the collection, treatment and/or renovation facilities for all wastes of a domestic nature, containing a predominance of human excreta and exclusive of industrial wastes shall be submitted to and receive the approval of the Arkansas Department of Health or its authorized agent, prior to construction of a building or residence. On-site wastewater systems must be planned, designed and constructed in accordance with the Arkansas Department of Health's "*Rules and Regulations Pertaining to General Sanitation*" and the "*Rules and Regulations Pertaining to Onsite Wastewater Systems.*" It is unlawful for any person, firm, corporation, association, municipality or governmental agency to begin construction, alteration, repair or extension of any on-site wastewater system, owned by any other person, firm, corporation, association, municipality or governmental agency until the owner first obtains a valid Permit for Construction from the Arkansas Department of Health. Owners of holding tanks or wastewater systems requiring secondary treatment that discharges into reduced absorption areas are required to maintain a Monitoring Contract with a Monitoring Person registered by the Arkansas Department of Health for the life of the system. All systems operating under ADEQ NPDES general permits are required to monitor twice a year, with sampling and testing conducted in accordance with federal regulations. Regulations for individual treatment units issued by the Arkansas Department of Health require the operator to enter into a maintenance agreement with the vendor or other qualified person to ensure the treatment unit functions satisfactorily throughout the life of the unit and remains capable of meeting effluent limitations. It is also required that the operator employ the services of a commercial laboratory for sampling and analysis required by the general permit.

B.2 Implementation Strategies

Implementation strategies are opportunities that may exist or become available for nutrient reduction at the watershed and statewide level. These strategies emphasize steps that can result in incremental progress toward reduction goals. **Voluntary support and participation is the key factor affecting these strategies and overall nutrient reduction.** This fact cannot be overstated or overlooked.

The adaptive management approach assumes knowledge will be gained through implementation and observation of nutrient reduction strategies. These strategies should be evaluated on a watershed-by-watershed basis to determine "what can feasibly be achieved and maintained" through regulatory processes and voluntary "grass-roots" participation and support. Not all available opportunities will be realized in every watershed, but reduction practices and policies should be implemented wherever feasible.

2a. Point Source

Point source nutrient loading is small relative to statewide nonpoint source contributions. However, during low stream flow conditions, loadings from point sources can be a significant portion of the total nutrient load. Depending on location and specific conditions, a point source may be the primary contributor to nutrient impairment on a seasonal or year-round basis. Point source nutrient loading can be reduced in influent to treatment facilities, in wastewater effluent, in stormwater discharges, or in other concentrated discharge sources. The **costs of improvement must be measured against the costs (affordability) of achieving the reduction** and the "value" of the benefit supported by those paying for the improvement.

Point source loadings and associated impairments to beneficial uses should be assessed regularly through stream and effluent water quality data, along with evaluations of existing treatment systems, reduction capacities, and new technologies. Additional watershed and hydrologic modeling, water quality and mass balance analysis, and other assessments may be necessary to understand the stream and lake environments where improvement efforts are ongoing or being considered. The assessments for point source loading should be led by state water quality regulators in cooperation with other water resource agencies involved in nutrient reduction. Where nutrient impairment is present, the necessary level of water quality monitoring should be determined on an individual watershed basis and may vary based on site specific conditions. Monitoring may be appropriate at both the discharge point (end of pipe) and further downstream in order to assess overall nutrient effects on the aquatic environment from the point source(s). Locations of **existing stream flow and water quality monitoring stations should be evaluated to take advantage of opportunities to add water quality sampling at stream flow stations and to leverage multiple sources of funding**.

In nutrient surplus watersheds, NPDES permitting requirements for phosphorus removal have been strengthened in Arkansas Department of Environmental Quality regulations based on treatment capacity of the facility. **NPDES phosphorus limits are referenced in Table 2 on page 7** of this report. Treatment costs for phosphorus removal can be costly and prohibitive in some cases. Smaller wastewater treatment systems which don't have adequate nutrient reduction capacity or revenue sufficient to support expensive nutrient removal processes may benefit from regionalization of treatment capacity. The potential for multi-system collection and waste flow to regionally operated treatment facilities should be analyzed where there is little opportunity for smaller, individual treatment facilities to meet NPDES requirements and nutrient reduction goals. **New wastewater treatment facilities**, whether partially or fully financed through state funded low-interest loan and grant programs, **must be approved and receive certification of compliance with the Arkansas Water Plan**. This certification process provides an opportunity to review factors that can affect nutrient reduction, environmental, and economic needs on a regional basis.

Other opportunities such as nutrient trading programs offer an alternative to higher treatment costs. This alternative requires regulatory approval, available land for restoration or enhancement, and entities willing to participate in a trading program. **Natural and artificially created wetlands can increase nutrient assimilation and uptake and provide a measure of reduction at lower costs** compared to conventional treatment unit processes. Restoration of aquatic resources and functions within stream and lake environments and riparian areas is high priority for many programs administered by local, state and federal entities. Streams types should be assessed to determine sediment transport capabilities as not all streams transport sediment equally. Thus, transport of nutrient loads will vary with stream type. These programs should be fully leveraged wherever possible to mitigate and lessen nutrient point source impacts.

Local participation and **involvement in urban pollution prevention** activities such as low-impact development which includes rain gardens, infiltration and open space areas, riparian buffers, residential and subdivision stormwater management, local ordinances, and other reduction methods should be **fostered through public workshops and educational training, field days, advertisements, restoration and demonstration projects.** Local watershed groups should be supported and encouraged as they can positively influence public participation and interest in pollution prevention activities. Opportunities to involve youth in local pollution prevention projects and education programs should be promoted to local administrators and program managers as a necessary component for long-term nutrient reduction success.

Implementation strategies for point source reduction are listed in Table 3. The long-term reduction goal in priority watersheds is to remove impairment caused by nutrient point sources and maintain beneficial uses. Potential interim target or percent reduction goals are to be evaluated on a watershed-by-watershed basis.

Table 3. Point Source Nutrient Reduction Strategies

STRATEGIC OBJECTIVES	
	▪ **Monitor and assess watershed impacts** from point source nutrient loading.
	▪ **Incorporate NPDES nutrient reduction standards** for major point sources in priority watersheds.
	▪ **Increase knowledge base** of available treatment processes, reduction effectiveness, and associated costs.
	▪ **Incorporate effective, innovative, and economical treatment technologies and reduction practices**.
	▪ **Expand watershed-based monitoring networks**.
	▪ **Enhance reporting and analysis of trends** in water quality, nutrient loading and reduction.
	▪ **Increase public participation and implementation** of urban nutrient reduction practices and programs.
	▪ **Improve nutrient assimilation and uptake capacities** in riparian, lake, & wetland areas.
	▪ **Research and evaluate benefits of regional treatment systems**.
	▪ **Incorporate regional planning** into the development of new and upgraded treatment systems.
	▪ **Promote and increase implementation** of effective urban stormwater management programs.

Figure 2 on page 12 illustrates examples of strategic opportunities and major components of reduction management. This diagram is intended to conceptualize potential opportunities available to implement as individual or as combinations of strategies, all contributing to incremental progress toward a future reduction goal. It is important to understand that implementation of any single or combination of strategies is dependent on local factors specific to the individual watershed. Some opportunities may be available and appropriate in some watersheds but not in others.

As with point source strategies, public education and support is vital to long-term nonpoint nutrient reduction. Of critical importance is coordination of effort among the many agencies offering incentives to implement reduction practices. **Leveraging financial support and resources from multiple programs** where beneficial opportunities exist **is basic to the state's** multi-discipline, multi-agency **strategic approach to nutrient reduction**.

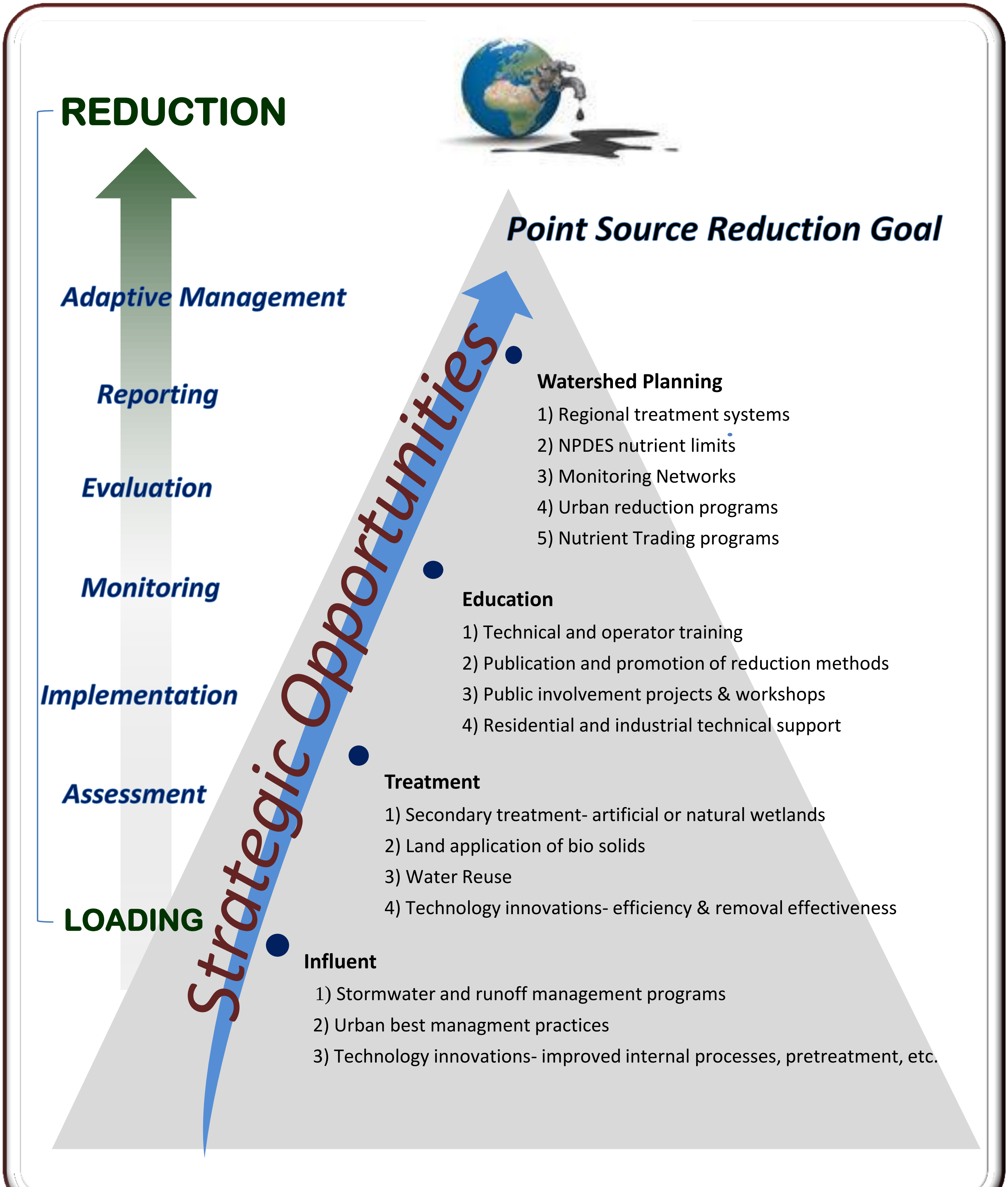


Figure 2. Strategic Opportunities- Point Source Diagram

▪ 2b. Nonpoint Source

There are many state, federal, and private voluntary programs available to reduce nonpoint nutrient pollution and runoff. These programs are initiated in areas where water quality impairment, loss of a beneficial use, or general degradation of the aquatic ecosystem has been identified either through regulation or conservation planning as a priority to be addressed. Whereas reduction of point sources such as municipal discharge is fairly straightforward, achieving significant and documentable nutrient reduction from diffuse runoff sources across varying landscapes is both challenging and complex.

Nonpoint sources of nutrients can originate from commercial fertilizers, animal manure and litter, urban stormwater runoff, home sewage, sediment, and other in-situ contributing sources. Phosphorus can attach to suspended solids, become dissolved in the water column, or bind up in streambed and field sediments which make determination of its fate and transport in a watershed especially difficult. Nevertheless, it is understood that **managing nutrient inputs** (fertilizer, manure, and litter application) **and potential runoff**, as well as **increasing the assimilation capacity** of land and aquatic environments (riparian buffers and wetlands), is necessary to effect measurable reduction.

On the agricultural landscape, implementation of individual edge of field or farm scale reduction practices may not translate to immediate and measurable water quality improvements downstream. The larger the watershed the greater the potential for localized reduction effects to become distorted (immeasurable) downstream. Potential lag times between initial implementation of reduction practices and improvement of water quality downstream, along with the environment's capacity to assimilate the nutrient load, has to be understood when evaluating reduction progress. To fully evaluate and document reduction progress requires a network of monitoring locations determined by analyses of conditions in the watershed. A **comprehensive monitoring network should include edge of field, sub-watershed, watershed, and basin level** sampling locations. However, financial support for such comprehensive monitoring is often inadequate and can be in competition with limited funding for implementation of "on-the-ground" reduction practices. The amount of monitoring effort adequate to document impacts and reduction progress will be based on watershed characteristics, water quality data, previous observation, and professional judgment from water quality and natural resource professionals.

Landscape features such as land use, land cover, soils, hydrography and inundation, wetlands, geology, geomorphic setting, conservation practices, etc. influence lag time, assimilation capacity, and overall reduction. **Demonstration projects and technical studies can provide valuable insight** regarding lag time and the chemical and biological processes that are influencing nutrient uptake and assimilation. Similarly, **GIS decision-support programs and watershed models can identify landscape influences beyond the individual farm-leve**l and can serve as powerful tools for resource managers and

regulators. These tools should be fully utilized wherever possible to establish realistic and achievable reduction goals, and, to track the progress of implementation and nutrient reduction efforts.

Data on local, state and federal programs involving permitting and incentive-based, voluntary activities is not always readily available or easily transferred to a compatible format for use. In some instances, policies designed to protect private landowner information prevents the sharing of data related to the location and extent of "on-the-ground" changes resulting from regulatory and voluntary conservation programs. Lack of data on these changes can severely limit the scope of watershed planning. **Data policies should be adopted which allow aggregation of program information** for use by resource managers without compromising the privacy of individual, personal information.

Nutrient reduction often involves changing historic land use practices and the value of these changes may or may not be initially understood or embraced by local communities. For this reason, benefits of nutrient reduction must be clearly defined and demonstrable. Showcasing successful projects and programs can be an effective way to promote reduction benefits and increase participation in reduction activities. Universities and research centers should not only study those factors that impact reduction and reduction effectiveness, but also the economic consequences to individuals participating in reduction activities. The **economic livelihood of stakeholders has to be protected** because they are part of the local economy, and their voluntary actions over time are critical to successful nutrient reduction.

Maximizing single reduction practices has previously been promoted and perceived as desirable, but today it is better understood that implementation of single reduction practices alone may not yield desired reduction results at the watershed or basin-level scale. Proving to be more effective are advanced farm planning and land management techniques that reduce, control, and trap nutrients by **utilizing a combination of complimentary reduction practices to sustain long-term reduction**. Whole farm planning, which encourages farmers to identify long-term farm, environmental and production goals, is changing the focus to longer-term planning objectives and identifying those participants who are most likely to implement water quality improvement and protection practices. The 4R nutrient stewardship concept advocates the use of the right fertilizer, at the right rate, at the right time, and in the right place, in combination with best management practices on the land, to minimize nutrient loss and to meet crop requirements. Data is available on application rates, crop yields, assimilation capacity, and land use techniques, but research should be supported as needed. Knowledge gained from implementing these types of farm planning strategies and reduction practices should be used to guide future incentives and reduction activities.

Because nutrients can be transported in a dissolved form, proper application combined with water management can reduce loading and increase water efficiency, outcomes which are supported by many local, state, and federal programs. Capture, storage, and reuse of surface water and retention of sediment is a priority component of comprehensive water resources planning efforts ongoing in agriculture areas of East Arkansas. The most **current and innovative technologies that optimize nutrient reduction and water efficiencies should be widely promoted and incorporated into normal agricultural practices** wherever possible.

Implementation strategies for nonpoint source reduction are listed in Table 4. The long-term reduction goal in priority watersheds is to remove impairment caused by nutrient nonpoint sources and maintain beneficial uses. Potential interim target or percent reduction goals are to be evaluated on a watershed-by-watershed basis.

Table 4. Nonpoint Source Reduction Strategies

STRATEGIC OBJECTIVES	▪ **Incorporate sediment retention, erosion control measures with improved water management practices.**
	▪ **Promote research and implementation of innovative and effective market-based nutrient reduction practices.**
	▪ **Demonstrate farming practices that increase reduction effectiveness and economic viability.**
	▪ **Promote long-term stewardship goals through "whole farm" planning or other watershed planning methods.**
	▪ **Promote manure management programs.**
	▪ **Increase overall participation in nutrient reduction activities and practices.**
	▪ **Expand the use of nutrient inhibiting supplements.**
	▪ **Increase adoption of nutrient reduction grazing and pasture management practices.**
	▪ **Increase riparian buffer zones and functioning wetland areas.**
	▪ **Explore the feasibility and viability of nutrient trading programs.**
	▪ **Increase riparian buffer zone and functioning wetland areas.**
	▪ **Increase adoption of agricultural best management practices.**
	▪ **Enhance watershed assessment and modeling tools, web-based information and reporting.**
	▪ **Expand public outreach and education efforts.**
	▪ **Establish regular reporting on nutrient reduction activities and progress.**
	▪ **Promote private and public sector partnerships.**
	▪ **Promote LID and other nutrient reduction strategies and programs in urban areas.**

Figure 3 on page 17 illustrates examples of strategic opportunities and major components of non-point source reduction management. This diagram is intended to conceptualize potential opportunities available to implement as individual or as combinations of strategies, all contributing to incremental progress toward a future reduction goal. Implementation of any single or combination of strategies is dependent on local factors specific to the individual watershed. Some opportunities will be available and appropriate in some watersheds but not in others.

As with point source strategies, public education and support is vital to long-term nonpoint nutrient reduction. Of critical importance is coordination of effort among the many agencies offering incentives to implement reduction practices. **Leveraging financial support and resources from multiple programs** where beneficial opportunities exist **is basic to the state's** multi-discipline, multi-agency **strategic approach to nutrient reduction**.

Figure 3. Strategic Opportunities- Nonpoint Source Diagram

B.3 Priority Watersheds

In general terms, Arkansas can be described in terms of regional nutrient causes and impacts. In northwest, north, and southwest Arkansas, excess nutrients (phosphorus) from animal agriculture and increased sediment loading from urbanization are the primary sources of loading. Throughout east Arkansas, nutrient loads are the result of increased sediment and runoff from row crop agricultural areas. The selection of priority watersheds was based on the Arkansas 2011-2016 Non-Point Source Pollution Management Plan, which incorporates data from programs such as the Integrated Water Quality Monitoring and Assessment Program (305b reporting and 303d listing), NRCS conservation program priorities, interstate water quality cooperative efforts, and local Conservation District goals. Watersheds in Figure 4 were identified according to a qualitative risk-based assessment conducted by the Nonpoint Source Pollution (NPS) Management Plan Stakeholder Group. The risk-based assessment categories listed below were evaluated and assigned a value of 0 to 10 based on the type of impairment and relative importance as determined by stakeholders in Table 5 on page 19.

Arkansas Priority Watersheds

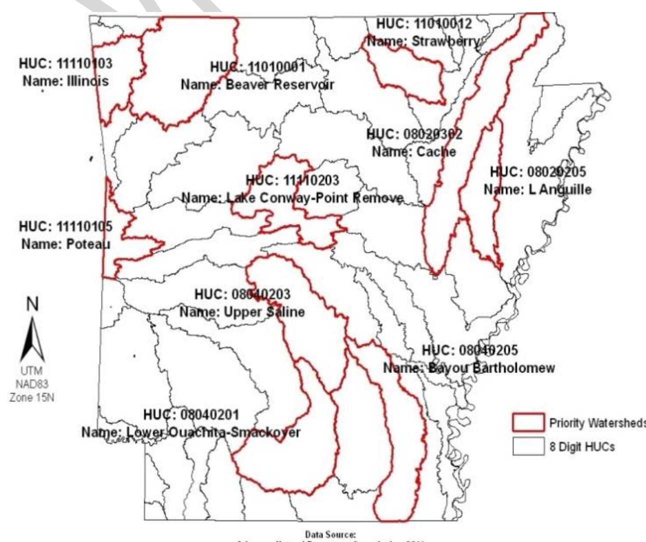


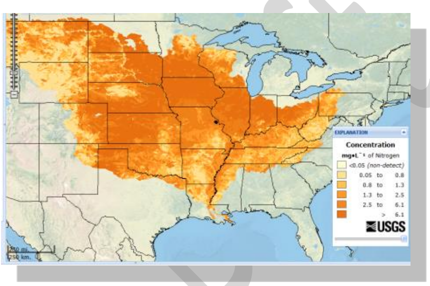
Figure 4.

Risk-based Assessment Categories

- Water body impairment
- Designated use impacts
- Urban population
- Impervious surface
- Unpaved roads
- Priority of Bordering State
- T & E Species
- Cropland
- Forestry
- Biotic impacts
- Economic activity
- Livestock and pasture
- Potential human exposure

Table 5. NPS Management Plan Stakeholder Group

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



Results from the United States Geological Survey SPARROW (**SPA**tially **R**eferenced **R**egressions **O**n **W**atershed attributes) model were also used in prioritizing watersheds. The SPARROW model estimates nutrient loads to the Mississippi River from tributary watersheds across the Mississippi River Basin. Preliminary results from the basin-wide model were based on coarse and limited data sets. More robust data sets are currently available and being utilized by the United States Geological Survey to develop regional SPARROW tools for the lower Mississippi River basin. Data from SPARROW and other available models will continue to be utilized in future efforts when appropriate.

These priority watersheds have been the focus of nutrient and sediment reduction initiatives such as USDA's Mississippi River Basin Healthy Watersheds Initiative (MRBI), National Water Quality Initiative (NWQI), and state nonpoint pollution programs. Priority watersheds are listed below:

- Bayou Bartholomew
- Cache River
- Lake Conway-Point Remove
- Lower Ouachita Smackover
- Strawberry River
- Upper White River-Beaver Lake
- Illinois River
- L'Anguille River
- Poteau River
- Upper Saline River

B.4 Watershed Goals

Removal of nutrient impairment and delisting of 303d water bodies is the long-term nutrient reduction goal in priority watersheds. Interim target reduction levels may be identified on a watershed specific basis but must be based on sufficient data; i.e. physical, chemical, and biological; existing policies, regulations, and public support; watershed planning, and any other factors appropriate for establishing a reduction goal. If numeric nutrient reduction goals cannot be established at present or are undeterminable due to insufficient data, qualitative goals which describe implementation of nutrient reduction activities and water quality improvements will be used to track incremental progress resulting from reduction efforts.

Technical and non-technical factors affecting nutrient goals are to be fully discussed and disclosed to all local stakeholders. Protecting the economic and environmental benefits for land and water users should be a priority for all entities involved in nutrient reduction efforts and activities. Focusing on the protection of these benefits provides the opportunity to better understand conditions within individual watersheds and the stressors that are most affecting those conditions. Increased understanding of land uses and water quality relationships in the watershed will help **identify solutions that more effectively reduce nutrient loading and leverage limited financial resources.**

▪ 4a. Illinois River Watershed

The Illinois River originates in northwest Arkansas and flows westerly into and through Oklahoma before joining the Arkansas River downstream of Gore, Oklahoma. The river is a source of tourism, water supply, and controversy for the states of Arkansas and Oklahoma. Excessive nutrient loading

from wastewater discharge point sources, urbanization, and livestock production nonpoint sources led both public and private sector leaders to initiate a comprehensive nutrient reduction effort within the watershed. Baseline nutrient loading levels were agreed upon for major streams in the Illinois River watershed and a **reduction goal of 40% of the baseline level was adopted**.

Illinois River Basin Monitoring

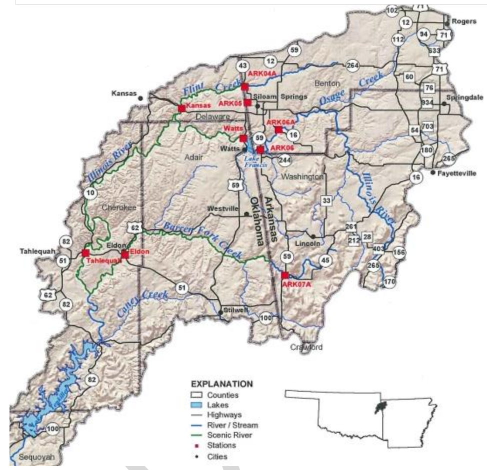


Figure 5.

Figure 5 shows the Illinois River watershed and stream monitoring locations. Reporting of reduction and water quality improvements on these streams is provided every year to the Arkansas-Oklahoma Arkansas River Compact Commission. Both point and nonpoint source reduction efforts over many years has resulted in downward trends in the 5-year rolling averages at most stream monitoring locations. Figure 6 shows data from the 2012 Water Quality Monitoring Report for the Illinois River Basin at the Illinois River South of Siloam Springs.

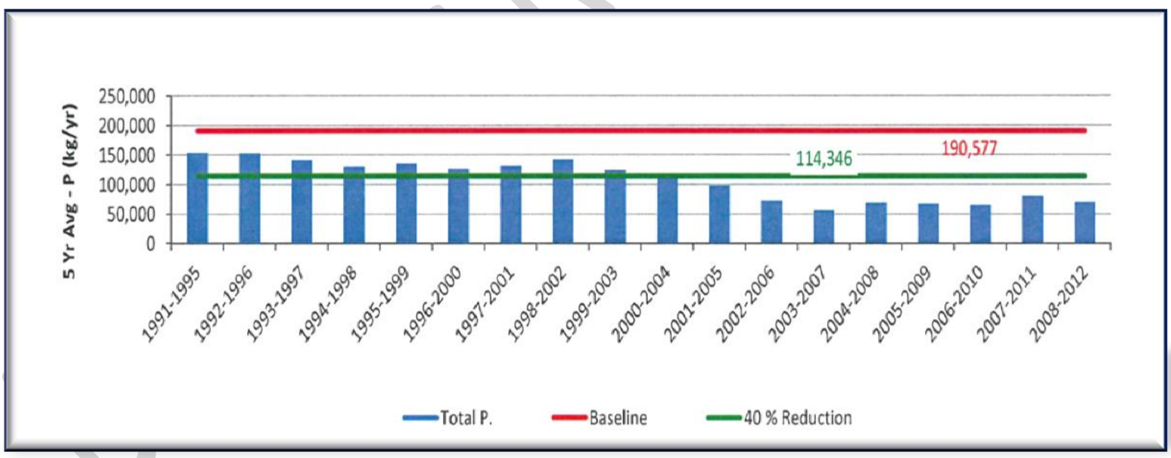


Figure 6. Illinois River South of Siloam Springs

The coordinated efforts in the Illinois River watershed consist of legal, regulatory, and voluntary reduction activities that are proving effective in nutrient reduction and water quality improvement. City, county, state, federal, and private industry partnerships have been formed to address nutrient management issues "on-the-ground" in local communities and have resulted in positive changes to existing policies and legal mechanisms available to support nutrient reduction.

A few highlights of reduction efforts in the Illinois River watershed include:

- NPDES nutrient limits for wastewater dischargers,
- Increased water quality monitoring and reporting,
- Registration of all poultry and livestock production operations, on-farm nutrient management planning, certification of nutrient management planners and applicators,
- Increased funding for USDA conservation and state nonpoint programs,
- Research and study of new nutrient markets and market-based solutions,
- Development of watershed phosphorus nutrient index, and
- Creation of proactive non-profit watershed groups and stakeholder involvement.

Reduction activities will continue in the Illinois River watershed as long as nutrient impairment remains a threat to beneficial water uses.

B.5 Reporting and Verification

Reporting the progress of nutrient reduction efforts is an important component of the strategic framework. **Communication among entities involved in reduction activities and the public is essential to maintaining transparency of program implementation and to evaluating and reporting progress toward reaching reduction goals**. There are numerous ways to report the status of new and ongoing reduction activities. Traditional reports on program activities, geospatial data and other web-based information, presentations at conferences and workshops, or discussions at routine meetings are all acceptable ways to provide updates and report status. Existing reporting methods should be reviewed to verify that the most efficient methods for compilation of data are being utilized. Where better methods of reporting are identified, procedures should be developed for easy compilation and regular reporting of implementation activities and progress toward individual watershed reduction goals.

B.6 Agricultural Initiatives

Agricultural landscapes provide the greatest opportunity for significant nonpoint nutrient and sediment reduction and agriculture specific initiatives are a big component of Arkansas' overall nutrient reduction effort. Some initiatives are unique to Arkansas while others are being implemented in other states as well. **The Arkansas Conservation Partnership, comprised of eight member organizations**: USDA Natural Resources Conservation Service (NRCS), Arkansas Natural Resources Commission (ANRC), Arkansas Association of Conservation Districts (AACD), Arkansas Association of Conservation District Employees, Arkansas Forestry Commission (AFC); Arkansas Resource Conservation and Development

Councils, Inc., University of Arkansas Cooperative Extension Service, University of Arkansas at Pine Bluff (UAPB); along with many other entities, has been instrumental in supporting statewide efforts to improve water quality, address soil erosion and sediment transport, and reduce nutrient loading.

6a. USDA Conservation Initiatives

According to its 2013 annual report, the USDA's Natural Resources Conservation Service (NRCS) in Arkansas ranked first in the nation for financial assistance offered to agricultural producers. Many of the conservation practices and systems implemented through this assistance served to enhance water quality in local watersheds. Figure 7 shows NRCS's ongoing water quality initiative projects in Arkansas. These conservation initiatives restore wetlands, enhance bottomland forest and wildlife habitats, protect groundwater resources, increase control of nutrient runoff, and conserve water resources. A summary of NRCS financial obligations is listed below:

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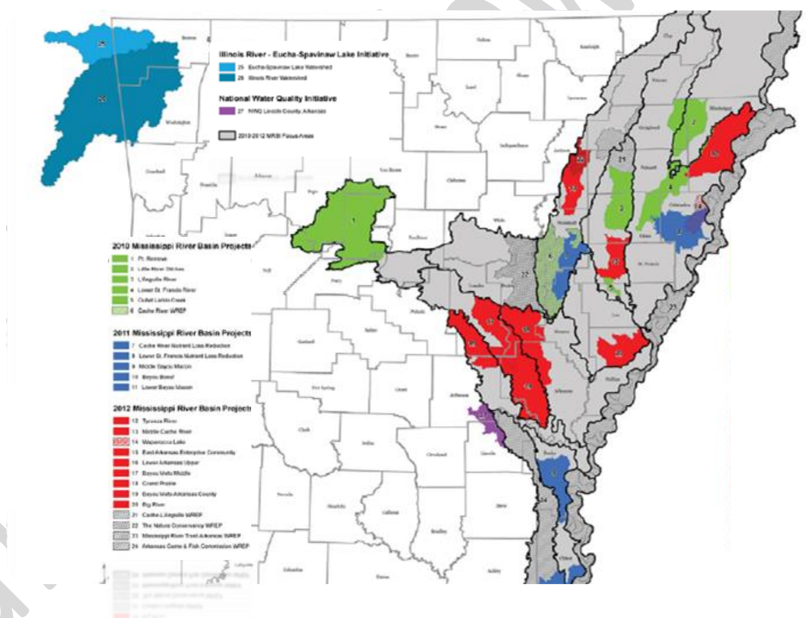

Figure 7. NRCS Water Quality Initiatives in Arkansas

NRCS has identified the Mississippi River Basin as a top priority due to water quality concerns, primarily those related to the effects of nutrient loading on the health of local water bodies and, eventually, the Gulf of Mexico. The Mississippi River Basin Healthy Watersheds Initiative (MRBI) is a 13-state water quality initiative which builds on the cooperative work of NRCS and its conservation partners in the basin and offers agricultural producers in priority watersheds the opportunity for voluntary technical and financial assistance. The participating States are Arkansas, Kentucky, Illinois, Indiana, Iowa, Louisiana, Minnesota, Mississippi, Missouri, Ohio, South Dakota, Tennessee and Wisconsin. NRCS uses a conservation systems approach to help producers avoid, control and trap nutrients and sediment to address water quality concerns. This is accomplished by optimizing nitrogen and phosphorus use efficiency in agricultural fields, minimizing nutrient and water runoff and improving soil health. MRBI uses key conservation practices, such as nutrient management, conservation crop rotation, cover crops, and residue and tillage management, to address critical water quality concerns. There are currently 24 MRBI watershed projects ongoing in Arkansas. Descriptions of the current NRCS conservation programs being implemented in Arkansas are listed on the following pages.

Agricultural Water Enhancement Program (AWEP)

The Little Red River Irrigation District AWEP project addresses water quantity and quality concerns in the Little Red River Watershed in White County. The project area encompasses approximately 83,838 acres southeast of Searcy containing approximately 34,000 acres of irrigated cropland. The area has been designated as a critical ground water use area by the Arkansas Natural Resources Commission. Financial assistance is offered to agricultural producers to implement irrigation practices to enhance their water conservation efforts and improve irrigation efficiency.

Conservation Stewardship Program (CSP)

The Conservation Stewardship Program (CSP) encourages agricultural and forestry producers who are already implementing conservation practices and managing their land in a sustainable manner to undertake additional conservation activities while improving and maintaining the existing conservation on their land. The program provides financial and technical assistance to conserve and enhance soil, water, air and related natural resources. Total CSP payments in 2013 were $58 million, the most in the country.

Environmental Quality Incentives Program (EQIP)

The Environmental Quality Incentives Program (EQIP) promotes agricultural production and environmental quality as compatible goals. NRCS provides financial and technical assistance to install or implement structural and management conservation practices on agricultural land. EQIP priorities in Arkansas are to reduce erosion; reduce pollution from animal wastes; improve water quality by decreasing nutrient and sediment loads; improve irrigation and reduce dependence on ground water

for irrigation; enhance forest conditions; improve grazing lands; and improve wildlife habitat. Other initiatives under EQIP include Energy, Organic, and Seasonal High-Tunnels.

USDA StrikeForce Initiative

The USDA StrikeForce initiative is helping relieve persistent poverty in high-poverty counties by accelerating USDA assistance while working closely with Community Based Organizations. Forty-eight counties in Arkansas are eligible to participate in these StrikeForce activities. The Arkansas StrikeForce team is composed of representatives from USDA agencies: the Natural Resources Conservation Service (NRCS), Farm Services Agency (FSA), Rural Development (RD), Agricultural Marketing Service (AMS), Food & Nutrition Service (FNS), Food Safety (FS), and Risk Management Agency (RMA). The team works with Community Based Organizations (CBOs) to provide assistance to local farmers to enhance their production and increase the marketability of their crops.

Water Quality Monitoring

Edge-of-field water quality monitoring on agricultural lands in targeted watersheds throughout the state is available through MRBI and NWQI. Producers can use the data from water quality monitoring and evaluation to measure the effectiveness of conservation practices and systems such as nutrient management, cover crop, and irrigation water management. Evaluation of conservation practice effectiveness through edge-of-field monitoring will lead to a better understanding of nutrient and sediment loading and will assist NRCS and participants in adapting or validating the application of conservation measures.

Wetlands Reserve Enhancement (WRE)

The Wetland Reserve Enhancement (WRE) is a voluntary program offering landowners the opportunity to protect, restore and enhance wetlands on their property. NRCS provides easement payments and restoration costs to agricultural producers in this effort. Arkansas ranks third in the nation in the number of acres enrolled with more than 225,000.

▪ 6b. Arkansas Phosphorus Index

The term "phosphorus index" is used to describe the level of risk for potential movement of phosphorus across the landscape. On January 1, 2010, the Arkansas Natural Resources Commission (ANRC) adopted a revised Arkansas Phosphorus Index and requires it be used when preparing nutrient management plans in designated nutrient surplus watersheds (see Figure 1 on page 5). The USDA Natural Resources Conservation Service (NRCS) has also adopted the Arkansas Phosphorus Index as part of the 590 nutrient management conservation practice standard. The Arkansas Phosphorus Index assesses the risk of phosphorus loss in runoff from pastures and hayland as a function of source potential (phosphorus from the soil and manure application), transport potential (risk of phosphorus movement offsite as affected by runoff and erosion, field slope, grazing intensity and proximity to streams) and any additional best management practices implemented between the application site and potential receiving waters. For a specific set of field conditions, the index associates a phosphorus (P) runoff risk value to a specific manure or biosolids application rate. The classification of this value into a risk range determines if the application is environmentally acceptable. If acceptable, the nutrient management plan specifies this application rate as the maximum rate for the combination of P source and field in question. During the implementation of a nutrient management plan, application rates up to the specified maximum can be applied. Lower application rates are generally assumed to have lower environmental P runoff risk and therefore also acceptable. The University of Arkansas: Division of Agriculture's publication "*Using the 2010 Arkansas Phosphorus Index*" describes the API and how to interpret the assigned risk and provides example calculations. The Arkansas Phosphorus Index addresses seven site characteristics which are grouped into either Source or Transport Factors. The Phosphorus Source Factors are: (1) soil test P and (2) soluble P application rate. The Phosphorus Transport Factors include: (3) soil erosion, (4) soil runoff class, (5) flooding frequency, (6) application method and (7) timing of P application. In addition to management practices that influence site characteristics, there are nine additional BMPs that can be considered to reduce P runoff risk. The landowner has the option to implement a combination of diversions, terraces, ponds, filter strips, grassed waterways, paddock fencing, riparian forest buffers, riparian herbaceous buffers and field borders.

▪ 6c. Discovery Farms

Arkansas farmers are under increasing pressure to manage nutrients in an environmentally sustainable manner. In order to remain economically viable and competitive in today's global market place in the long-term, on-farm nutrient management techniques being implemented on Discovery Farms are being monitored and evaluated to determine nutrient reduction efficiency and effectiveness. Discovery Farms are privately-owned, demonstration projects that represent common agriculture operations in Arkansas and are being monitored for a five to seven year time period. Initial data that is collected will be analyzed to establish baseline values for nitrate, phosphate, and sediment content of runoff water associated with current farm management methods. As more information is collected during the monitoring period, management techniques will be evaluated and if deemed desirable by the farm owner can be modified to promote more efficient and effective nutrient management.

The objectives of the Arkansas Discovery Farm Program are to:

- ***Conduct on-farm research and monitoring which assesses the need for and effectiveness of best management practices.***
- ***Provide on-farm verification and documentation of conservation practices which ensure sound environmental land stewardship.***
- ***Develop and deliver educational programs from data collected on-farm that will assist producers in achieving both production and environmental goals, thus increasing the overall sustainability of Arkansas' farming enterprises.***

There are currently six Discovery Farm sites at five different locations around the state (see Figure 8) with three more sites being developed. Production systems selected for study are crop and livestock-based, representing the diversity of operations in Arkansas. Knowledge gained from the Arkansas Discovery Farm Project will help farmers, natural resource managers, and decision-makers develop more effective science-based practices to address water resources issues. The Arkansas Discovery Farm Program is supported by a host of sponsors and industry stakeholders who ensure research addresses the needs of Arkansas farmers in a proactive manner.

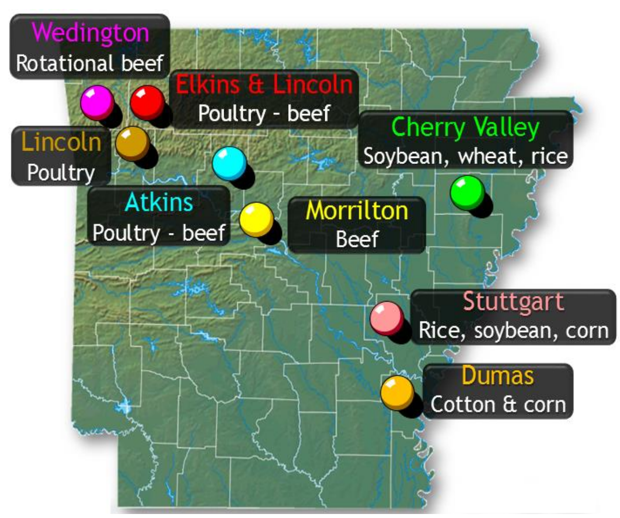

Figure 8. Arkansas Discovery Farms

▪ 6d. Water Management

Because nutrients can be transported in dissolved forms into streams and lakes, water management is as important as traditional erosion and sediment control measures to reduce potential nutrient runoff. Control of runoff in areas with significant topographic relief is a required component of on-farm nutrient and manure management planning in nutrient surplus watersheds. Control structures, vegetation, farm, manure, and pasture management, and other methods designed to control liquid runoff are promoted and incentivized through local Conservation Districts and existing programs. In East Arkansas where there is little topographic relief and the land is highly ditched, extensive row crop agriculture research and experimentation has shown that water management can be critical in mitigating nutrient flush from ditches and water storage systems. Evapotranspiration increases nutrient concentrations in standing water, thus the first flush of these systems can create a greater potential for downstream nutrient impacts. Managing the flow of water across the delta landscape for the reduction of nutrient loading is somewhat counter-intuitive to a traditional drainage mindset, but water management scenarios should be explored as a way to help mitigate nutrient mobilization and transport across the delta ecoregion. Water reuse and storage, restoration of wetland and riparian areas can provide relief for both groundwater overdraft and reduction in nutrient runoff. The significance of sustaining water supplies in the delta to support Arkansas' agricultural economy has focused efforts on water efficiency and water quality issues. Water management will continue to evolve with advancements in cropping, equipment and control technologies.

▪ 6e. Research & Outreach

Research and demonstration projects provide insight on the economics and effectiveness of nutrient reduction activities and programs. Such organizations as the University of Arkansas' Division of Agriculture, the USDA Agricultural Research Service, the Arkansas Water Resources Center, the Center for Advanced Spatial Technologies, and others contribute invaluable knowledge through research and demonstration of agricultural practices, watershed modeling, economic and GIS analysis. These efforts will continue to inform nutrient reduction work in the future. Education is provided to landowners and public officials by many levels of government. However, the local Conservation Districts are and should remain the primary network for coordination of outreach efforts.

▪ 6f. Nutrient Surplus Watersheds

Three laws were enacted in Arkansas that affect Arkansas' agricultural producers. The goal of this legislation is to preserve water quality in the state without creating an unnecessary burden on agricultural interests. Arkansas' commercial poultry farmers, as well as any livestock, forage and crop production operations utilizing poultry litter, are required to follow provisions of Acts 1059, 1060 and 1061. Others impacted by the regulations are agricultural operators and landowners of more than 2.5

acres operating in nutrient surplus areas and any agricultural producers using state or federal funds for creating or implementing nutrient management plans, whether or not they are within designated nutrient surplus areas. Specifically, the new regulations require:

- **Certifying all those who apply nutrients to crops or pasture land,**
- **Certifying nutrient management plan writers,**
- **Registering all poultry feeding operations, and**
- **Developing and implementing nutrient and poultry litter management plans for those operating in nutrient surplus areas.**

Designated nutrient surplus areas as identified in the enabling Arkansas legislation include the following watersheds:

Illinois River	Spavinaw Creek
Honey Creek	Little Sugar Creek
Poteau River	Mountain Fork of the Little River
Upper Arkansas River----	includes Lee Creek and Massard Creek
Upper White River-------	above its confluence with the Buffalo River

B.7 Nutrient Criteria Development

In 2001, the US EPA published recommended water quality criteria for nutrients under section 304(a) of the Clean Water Act (66 FR 1671). This document was to serve as a starting point for states, tribes, interstate commissions, and others to develop refined nutrient criteria (US EPA 2001). According to the EPA, nutrients cause adverse effects on humans and domestic animals; impairment to aesthetics; interference with human use; negatively affect aquatic life; and impacts to downstream systems. The challenge with EPA's National Strategy for the Development of Regional Nutrient Criteria is that the strategy is a "one number fits all" approach. The Regional Nutrient Criteria does not take into account the dynamic characteristics of streams and rivers and their ability to assimilate nutrient impacts. These characteristics include but are not limited to: flow, gradient, canopy cover, substrate type, water clarity, pH, DO, channel stability, temperature, season, trophic status, and other factors. In addition, large, generalized data sets, such as EPA's Nutrient Ecoregions Approach, do not account for the natural state of streams and rivers, nor do they determine levels for predicting excessive levels of benthic algae. Generalized nutrient criteria do not have a mechanism for predicting or differentiating in-stream total nitrogen and total phosphorus concentrations attributed to non-point source and point source of nutrients.

In response to EPA's guidance, the Arkansas Department of Environmental Quality (ADEQ) has adopted the following approaches to nutrient criteria development:

- ***Develop nutrient criteria that fully recognize localized conditions and protect specific designated uses, using the process outlined in the EPA technical guidance manuals.***

- ***Use other scientifically defensible methods and appropriate water quality data to develop criteria protective of designated uses.***

The Upper Saline watershed was used as a pilot study to test methods for developing and utilizing a three level nutrient criteria development approach for Arkansas' rivers/streams. The Level I Assessment was performed to screen sites for potential nutrient impairment. The Level II and Level III Assessments were performed at sites where potential nutrient impairment exists. It was meant after completion of the pilot study and verification of assessment methodology that the approach derived from the Upper Saline Watershed pilot project transfer to other rivers/streams in Arkansas. Completion of the Upper Saline River Pilot Study brought forth intrinsic study design flaws. During the pilot study, lack of severely nutrient impacted reaches and modified calculation of 25^{th} and 75^{th} percentiles, macroinvertebrate assemblages exhibited little spatial or temporal differences, while fish assemblages among groups were highly variable. The small sample size of the Upper Saline Pilot Study prevented identification of nutrient concentration thresholds among biotic assemblages through the use of regression modeling.

Beaver Reservoir, a large drinking water source for Northwest Arkansas, was a pilot study area for development of nutrient criteria for Arkansas' lakes/reservoirs. It was meant that after completion of the pilot study and verification of assessment methodology, tools and processes derived for the Beaver Reservoir pilot project would be transferable to other lakes/reservoirs in the State. Completed in 2008 and based on weight-of-evidence approach, findings from the study recommend effects based numeric water criteria for Hickory Creek on Beaver Lake for growing season geometric mean chlorophyll a concentration of 8 µg/L, annual average Secchi depth of 1.1m, and nutrient targets for total phosphorus and total nitrogen of 0.04mg/L and 0.4mg/L, respectively.

The ADEQ has two ongoing nutrient criteria projects for streams, each focused in Extraordinary Resource Watersheds (ERW). The Ozark Highland ERW project began in January 2013 with the majority of biological parameters being collected during the spring, summer, and fall 2013 seasons. Water chemistry samples will continue to be collected through the end of 2014, while data analysis and organism identifications are ongoing. Streams sampled in the Ozark Highland ERW were Gut Creek, Big Creek, Field Creek, English Creek, Myatt Creek, Spring River, South Fork Spring River, Strawberry River, Kings River, and North Sylamore Creek.

The Boston Mountain ERW project began in January 2014 and biological collections are ongoing. Water chemistry collections will continue through December 2015. Streams sampled in the Boston Mountain ERW were Lee Creek, Richland/Falling Water Creek, Mulberry River, Big Piney Creek, Hurricane Creek, North Fork Illinois Bayou, Illinois Bayou, Middle Fork Little Red River, Archey Fork Little Red River, Devils Fork Little Red River and tributaries, and Salado Creek.

Several large rivers (Eleven Point and Current rivers) and one reservoir (Beaver Lake) are listed as ERWs in the Ozark Highlands, however the current studies focus only on wadeable ERWs. Lake criteria have been developed for Beaver Lake only. This criterion was adopted February 2014 into Regulation #2 by the Arkansas Pollution Control & Ecology Commission.

Table 6. Lake Site-Specific Nutrient Standard

Lake	Chlorophyll a (ug/L) **	Secchi Transparency (m) ***
Beaver Lake *	8	1.1

** These standards are for measurement at the Hickory Creek site over the old thalweg, below the confluence of War Eagle Creek and the White River in Beaver Lake.*

*** Growing season geometric mean (May - October)*

**** Annual Average*

Currently, Arkansas maintains the following narrative nutrient standard, Reg. 2.509 in Regulation # 2, "Regulation Establishing Water Quality Standards for Surface Waters of the State of Arkansas."

> Materials stimulating algal growth shall not be present in concentrations sufficient to cause objectionable algal densities or other nuisance aquatic vegetation or otherwise impair any designated use of the waterbody. Impairment of a waterbody from excess nutrients is dependent on the natural waterbody characteristics such as stream flow, residence time, stream slope, substrate type, canopy, riparian vegetation, primary use of waterbody, season of the year and ecoregion water chemistry. Because nutrient water column concentrations do not always correlate directly with stream impairments, streams will be assessed by a combination of factors such as water clarity (secchi depth), periphyton or phytoplankton production, dissolved oxygen values, dissolved oxygen saturation, diurnal dissolved oxygen fluctuations, pH values, aquatic life community structure and possibly others. However, when excess nutrients result in impairment based on ADEQ's assessment methodology, by any established, numeric water quality standard, the waterbody will be determined to be impaired by nutrients. All point source discharges into the watershed of waters officially listed on Arkansas' impaired waterbody list (303d) with phosphorus as the major cause shall have monthly average

discharge permit limits no greater than those listed in Table 7 below (also referenced in Table 2 on page 7). Additionally, waters in nutrient surplus watersheds as determined by Act 1061 of 2003 Regular Session of the Arkansas 84th General Assembly and subsequently designated nutrient surplus watersheds may be included under this Regulation if point source discharges are shown to provide a significant phosphorus contribution to waters within the listed nutrient surplus watersheds.

Table 7. Point Source Phosphorus Discharge Limit (mg/l)

Facility Design Flow	Total Phosphate as Phosphorus discharge limit
Equal or greater than 15mgd	Case by case
3 to less than 15mgd	1.0 mg/l
1 to less than 3mgd	2.0 mg/l
0.5 to less than 1mgd	5.0 mg/l
Less than 0.5mgd	Case by case

For discharges from point sources which are greater than 15 mgd, reduction of phosphorus below 1 mg/l may be required based on the magnitude of the phosphorus load (mass) and the type of downstream waterbodies (e.g., reservoirs, Extraordinary Resource Waters). Additionally, any discharge limits listed above Facility Design Flow may be further reduced if it is determined that these values are causing impairments to special waters such as domestic water supplies, lakes or reservoirs, or Extraordinary Resource Waters (ADEQ 2004).

B.8 Adaptive Management

The adaptive management approach assumes knowledge will be gained through implementation and observation of nutrient reduction strategies, projects, and programs. These activities should be evaluated on a watershed-by-watershed basis to determine “what can feasibly be achieved and maintained” through regulatory processes and voluntary “grass-roots” participation and support. Reduction goals will be attained through iterative processes and activities that have to be regularly assessed to determine what practices and programs are “working”, what improvements should be implemented that will “work” better, and what policies are or will be supported by the public. These factors will change over time as technology and programs evolve to improve nutrient management and adapt to social, political, and economic changes in the future.

C. EXAMPLES OF REDUCTION INITIATIVES