***Section Four***

**Agriculture**

**2011-2016 NPS Pollution Management Plan
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 that accrue to all citizens of the state.

Agricultural activities can also result in runoff of pollutants into receiving 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. Figures can be found at the end of the section.

**Figure 4.1a: Estimated distribution and concentration of livestock and poultry**

**production**

<http://www.arkansaswater.org/NPSmanagementPlan/Images/Chapter%204/Figure%204.1a%20Arkansas%20Distribution%20of%20Livestock.jpg>

Source: National Agricultural Statistics Service (NASS), 2009 and Arkansas Natural Resources Commission, 2008.

**Figure 4.1b: Distribution and concentration of agriculture**

<http://www.arkansaswater.org/NPSmanagementPlan/Images/Chapter%204/Figure%204.1b%20Arkansas%20Distribution%20of%20Row%20Crops.jpg>

Source: National Agricultural Statistics Service (NASS), 2009.

The Arkansas Department of Environmental Quality’s (ADEQ) most current List of Impaired Waterbodies identifies streams where agriculture is listed 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 most current List of Impaired Waterbodies can be accessed at:

[http://arkansaswater.org//index.php?option=com\_content&task=view&id=14&Itemid=30](http://arkansaswater.org/index.php?option=com_content&task=view&id=14&Itemid=30%20)

<http://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 by an 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 re-deposited 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 and cover critical stages of fish eggs and early life stages causing increased mortality, interfering 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 below). 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 the 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 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 under 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 website.

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) 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 all those who apply nutrients to crops or pasture land;
* certifying nutrient management plan writers;
* registering all poultry feeding operations;
* developing and implementing nutrient management and poultry litter management plans; and
* for those operating in NSAs.

Nutrients of concern include:

**Nitrogen:** In addition to contributing to eutrophication, excessive nitrogen 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 newborn 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. EPA 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, but also 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 (NH4), nitrate (NO3), and nitrite (NO2). 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 (date of this study). 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 nation-wide survey of streams showed that nitrogen concentrations were generally grater 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 which result from agricultural activities. In addition, estrogenic compounds (17b estradiol) has been identified as a contaminant associated with animal waste and has been measured in groundwater in north Arkansas and 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 17b estradiol in runoff water from small plots and field 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 stream 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 was 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 ground cover 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 anoxic 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 (pH) 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 to 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, nematicides, 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 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).

Pesticide detections in water typically occur as a mixture with other pesticides. The mixtures can have enhanced toxicity through additivity, potentiation, or syngergistic effects, which are difficult to predict due to 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 that are 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 web.

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 five 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, due to the extensive acreage 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 which had the highest incidence of occurrence above the detection level were atrazine, metolachlor and molinate (Ordram). The detection level of all three compounds was generally less than 0.009 ug/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 ug/L for atrazine in DePartee Creek near Bradford, 6.87 ug/L for metolachlor in Bayou Bartholomew, near McGehee, and 332.65 ug/L for molinate in Glaise Creek near Worden (ADEQ 2002, 305(b) report).

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 data 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 due to 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 ug/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 over 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 the 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 ug/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 now or becoming resistant to control by glyphosate herbicide. In the future, to control these herbicide resistant weeds namely teaweed (sida spinosa), horseweed (erigeron canadenis), 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 increased use of tillage and use of soil applied chemicals will need to be addressed as to the effect on water quality. BMPs will need to be developed and the possible use of riparian buffer strips so that spraying in riparian areas is not necessary.

**Water Quality/Program Goals**

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 have been identified by ADEQ in its most current List of Impaired Waterbodies.

**The ultimate long-term goal of the agriculture statewide**

**program is through targeted awareness, BMP training,**

**monitoring and other voluntary programs, agriculture**

**will not be identified as contributing to impairment of**

**the waters of the state.**

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

* achieve 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;
* agriculture will not contribute sediment, nutrients or other pollutants to streams in such amounts as to cause impairment of the waters of the state;
* through effective application of pesticide training and certification programs, and continued development of BMPs for pesticide management, pesticides will not be
* found in the waters of the state in concentrations that cause impairment to the designated uses of the waters; 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;
* 90 percent of poultry and livestock growers 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 BMP’s for management of identified chemical resistant weeds or pest and the use of chemicals for control.

Long and short term programmatic objectives for the elements of this statewide program are given in the following sections.

**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 enable waterbodies to meet their designated uses using an adaptive management approach described in the introduction to this section.

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 insure there is not a backlog of requests for developing plans for farmers additional technical assistance providers are essential.

**Timeline for Milestones:** October 2011 – 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 – 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 – September 2016

4.4. Develop an economic and risk assessment tool for agricultural producers to assist

with decisions on management systems related to water quality protection, as resources allow. 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 – September 2016

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

**Timeline for Milestones:** October 2011 – September 2016

4.6. Improve the availability 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 – 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 – 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 – 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 – 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 – September 2016

4.11. Continue to provide and improve extensive education and training to promote BMP implementation (e.g., 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 – September 2016

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

Timeline for Milestones: October 2011 – 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 319(h) implementation projects.

**Timeline for Milestones:** October 2011 – 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 (e.g., in the Illinois River 53 percent of phosphorus load is nonpoint source – how much of the nonpoint phosphorous load comes from agriculture?).

**Timeline for Milestones:** October 2011 – 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 – 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 – 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 – 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 (e.g., the relationship between biological processes and agricultural production processes as they relate to water quality).

**Timeline for Milestones:** October 2011 – 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 – September 2016

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

**Timeline for Milestones:** October 2011 – 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, which 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 breakdown 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 1) consisting of leaders from agricultural organizations and one seat reserved for environmental organizations. The Stakeholder Committee is supported by the Technical Advisory Committee consisting of representatives from state and federal agencies that assist agriculture (Table 2). Several partners have stepped forward with financial contributions through grants, gifts, and contracts to help fund this program (Table 3).

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 in an environmentally sound manner. The following objectives would be applied to each farm.

* Conduct on-farm research and monitoring to assess the need for and effectiveness of best management practices (BMPs). 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 consists of four farms in four different physiographic farming regions of Arkansas (Figure 1). The program targets dominant farming systems in Arkansas and its extension to cotton 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 (Washington county):** This effort focuses on monitoring runoff originating around production houses. Under the new CAFO regulations, EPA is becoming concerned with “discharge” waters that interacts 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 and 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 and will quantify the nutrient and particulate trapping efficiencies of the pond and pasture.
2. **Point Remove Beef and Row Crop Farm (Conway county):** This farm raises beef on pastures immediately adjacent to Point Remove Creek and the Arkansas River. These pastures are fertilized with litter that is 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 U of A and other stakeholders will determine the effect of poultry litter application management (i.e., 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 (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 switch grass 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. 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, flood irrigation is still the preferred irrigation method for soybeans. 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 switch grass 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 U of A and other stakeholders will be able to determine the effect of conservation management on nutrient and sediment losses.
4. **Rice-Soybean Rotation (Arkansas county):** This farm has been in a critical groundwater 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 ft) 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 U of A 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 1: Members of the Arkansas Discovery Farm Stakeholder Involvement Committee**

|  |  |
| --- | --- |
| **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 2: Members of the Arkansas Discovery Farm Stakeholder 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 |

**Figure 4.2. Location of Arkansas Discovery Farms**

<http://www.arkansaswater.org/NPSmanagementPlan/Images/Chapter%204/Figure%204.2_Location_of_Arkansas_Discovery_Farm.jpg>

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 producer’s 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 producer, NRCS, partners, and other state and federal agencies in the 12-state initiative area, including Arkansas, to address nutrient loading in the MRB. Nutrient loading contributes to both local water quality problems and the hypoxic zone in the Gulf of Mexico. 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 during the first year of MRBI was funded. Additional funding for the six Arkansas projects could exceed $30 million over the 5-year project’s life.

Arkansas’ MRBI projects include:

**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 the Environmental Quality Incentives Program (EQIP), the Wildlife Habitat Incentive Program (WHIP), and the Conservation Stewardship Program (CSP) funding. In FY 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.

**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 FY 2010, 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.

**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 FY 2010, nine contracts were funded on 1,028 acres for $454,603.

**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 FY 2011.

**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 FY 2011 funding.

**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 FY 2010, four contracts were funded on 1,859 acres for more than $2 million.

**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 include Lake Tenkiller, Lake Eucha, and Lake Spavinaw in Oklahom, 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.

**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. In Arkansas, USDA agencies, state agencies, educational institutions, and private groups, organizations, and foundations work together to implement water quality programs in the state.

**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 that are 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.

**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*** (e.g., 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 – 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. Implementation of Congressionally-mandated confidentiality requirements is 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 – 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 – September 2016

**Agricultural Best Management Practices**

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 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 P-Index. The major changes included extending the Index to include liquid swine and poultry litter, and biosolids from waste-water treatment plants. Changes also include better accounting for the soluble P in applied manure/biosolids and mineralization of the organic P fraction. Transport changes included improved handling of pasture condition and grazing. The biggest changes were giving credit for P 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. If leaching or runoff is found, steps should be taken to prevent further contamination, (3) 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 BMP’s 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:
4. 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.
5. 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.
6. Apply manure in accordance with a nutrient management plan that meets the performance expectations of the nutrient management measure.
7. 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.
8. Recordkeeping. AFO operators should keep records that indicate the quantity of manure produced and its utilization or disposal method, including land application.
9. Mortality management. Dead animals should be managed in a way that does not adversely affect ground or surface water.
10. Consider the full range of environmental constraints and requirements. When citing 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 citing 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 utilized in implementation of animal feeding operations and animal feeding operations management include a:

**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 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 BMP’s 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 plant(s) 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.
1. 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.
1. 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, AR. ADEQ, 2005. EPA 2004 Proposed 303(d) List of Impaired Waterbodies. Arkansas Department of Environmental Quality: Little Rock, AR.

NRCS, 2002. Arkansas Field Office Technical Guide. Arkansas Natural Resources Conservation Service: Little Rock, AR.

EPA. 1977. Doc. Number 600377105: Nonpoint Source: Stream Nutrient Level Relationships – A Nationwide Study. United States Environmental Protection Agency: Washington D.C.

EPA, 1989. Federal Register. 54 FR 22062, 22 May. United States Environmental Protection Agency: Washington, DC.

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., Coupe, R.H., Gonthier, G.J., and Justus, B.J., 2000, Water Quality in the Mississippi Embayment, Mississippi, Louisiana, Arkansas, Missouri, Tennessee, and Kentucky,1995–98: U.S. Geological Survey Circular 1208, 36 p., 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, AR.

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, AR.

Maas, R., 1984. Be Management Practices for Agricultural Nonpoint Sources: IV. Pesticides. Biological and Agricultural Engineering Dept., North Carolina State University: Raleigh, NC.

Nelson, D., 1985. “Minimizing Nitrogen Losses in Non-Irrigated Eastern Areas.” Proceedings of the Plan Nutrient Use and the Environment Symposium, Plant Nutrient Use and the Environment, October 21-23, 1985. The Fertilizer Institute: Kansas City, MO. 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, NC.

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.: National Conservation Practice Standards – NHCP. Natural Resources Conservation Service: Washington D.C. Available at http://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, AR.

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 FSA 1029-PD-9-10RV. 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 MP487-PD-10-10RV.

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 FSA9531-PD-3-10N.

USDA-NRCS, 1997. National Range and Pasture Handbook. Natural Resources Conservation Service, Grazing Lands Technology Institute: Washington D.C. Available at http://www.glti.nrcs.usda.gov/technical/publications/nrph.html.

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 onAgricultural Wastes, Agricultural Was e Utilization and Management. American Society of Agricultural Engineers: St. Joseph, MI. 295-307.