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Arkansas Watersheds

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Introduction

During the last two decades, there has been a tremendous increase in efforts to protect the quality of our nation's water resources. This stems from the recent changes in philosophy of addressing impaired water bodies by trying to find and treat the source rather than the problem, which became increasingly expensive. Many of these efforts, especially local ones, have begun utilizing the concept of watersheds as a basis for defining the geographical scope of protection activities. Watersheds provide the natural catchment boundaries for isolating geographical areas with similar hydrological influence. Watershed protection efforts range from federal regulations to voluntary efforts such as local watershed organizations consisting of concerned citizens.

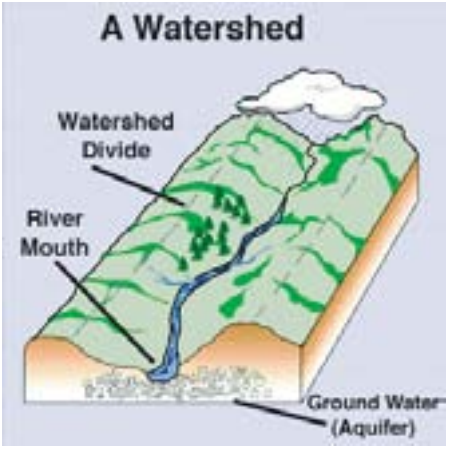
Future water quality protection efforts will be implemented on a watershed basis. For example, the Arkansas Natural Resource Commission's Title 22 (*Rules Governing the Arkansas Soil Nutrient and Poultry Litter Application and Management Program*) defines nutrient-sensitive watersheds where residents must meet certain requirements before applying nutrients to land. A nutrient-sensitive watershed is defined as "an area in which the soil concentration of one or more nutrients is so high or the physical characteristics of the soil or area is such that continued application of the nutrient to the soil could negatively impact soil fertility and the waters within the state." Thus, monitoring efforts are aimed increasingly at determining the status of soil and water resources within an entire watershed and establishing a better understanding of how land use within the watershed affects the quality and biodiversity of water in streams and rivers.

Everyone lives in a watershed, and everyone can play a part in watershed protection. It is important to understand the concepts associated with watersheds: how they are designated and named, how their boundaries differ from political boundaries and why they are important to the protection of water resources. This fact sheet will address these items as well as provide information on the watersheds of Arkansas.

What Is a Watershed?

The United States Environmental Protection Agency (EPA) defines a watershed as *"the area of land where all of the water that is under it or drains off of it goes into the same place."* A watershed, catchment or drainage basin catches precipitation that falls within its boundaries and funnels it to a particular creek, stream, river or groundwater formation (Figure 1).

Figure 1. Graphical representation of a watershed. *(Courtesy of the Arkansas Department of Environmental Quality)*



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Watershed boundaries divide one drainage area from another. Some characteristics of watersheds include:

- Boundaries are defined by natural hydrology. For surface drainage boundaries, physical geographic features such as elevation and relief can be used to define the location of boundaries.
- Surface drainage boundaries can be estimated from a topographical map.
- Surface drainage within the watershed boundaries is to a central outlet or collection point unique to that drainage area.
- While it is easy to observe surface drainage in many watersheds, most water (60%-80%) can move below ground and thus be more difficult to measure and influence (remedial control).
- Larger watersheds can be divided into smaller sub-watersheds.
- Boundaries can cross political boundaries such as county or state lines.
- No two watersheds are the same. Watersheds have unique topographic and geologic properties which define water flow pathways and the quantity and quality of water moving within them.

Why Watersheds?

Because watersheds are defined by natural hydrology, they represent the most logical basis for managing water resources. Basically, any land use activity within a watershed, be it large or small, can impact water resources. Some activities can improve or maintain water quality, increasing biological diversity, wildlife habitat, recreational value, fish production, drinking water supply, etc. On the other hand, we know other activities can negatively impact or damage these resources. A key issue in addressing these activities and keeping watersheds healthy is protecting the economic and environmental sustainability of both land and water resource users in a watershed. These resources become the focal point, and managers are able to gain a more complete understanding of overall conditions in an area and the stressors that affect those conditions. In this manner, water quality issues can be addressed in a more systematic, comprehensive approach that may be unique to an individual watershed.

Because surface drainage is to a unique, central outlet, the potential source area for pollutants derived from the landscape (known as nonpoint source pollution) can be defined by the watershed boundaries. Even though the exact location of the origin of nonpoint source pollutants within a watershed may not easily be determined, knowing the watershed area helps foster understanding of the land use relationships to in-stream water quality conditions. This understanding can help watershed managers develop better, more applicable solutions to the issue. In this manner, addressing water quality issues can be more efficient in terms of resource protection and resource allocation. For example, upgrading water treatment facilities in New York City was going to cost $10 billion. However, upon considering the condition of the watershed of the city's drinking water source, it was determined that spending $20 million helping watershed stakeholders improve certain aspects of watershed management could achieve the same benefit as the more costly alternative.

How Are Watersheds Identified?

Because larger watersheds are made up of smaller sub-watersheds, it can be difficult to identify or separate watersheds from one another. A watershed is usually identified by its name, which is usually based on the major drainage or collection feature of the area such as a stream, river or lake. But names alone do not tell us much about the characteristics of a watershed. Drainage basins, or watersheds, come in all shapes and sizes, with some only covering an area of a few acres while others are thousands of square miles.

To overcome this, the United States Geological Survey has developed a classification scheme known as **Hydrologic Unit Code** (HUC). This system is a way of identifying all of the watersheds in the United States in a nested number arrangement from largest (regions) such as the Mississippi River to smallest watersheds (sub-basins). The United States is divided and subdivided into successively smaller hydrologic units which are classified into four major levels: regions, sub-regions, basins and sub-basins. Each hydrologic unit is identified by a unique HUC consisting of digits ranging from two to eight digits based on the four levels of classification (Figure 2).

What Do the Numbers in a HUC Represent?

The first level of classification divides the nation into 21 major geographic areas or regions. Eighteen of the regions occupy the land area of the conterminous United States. Alaska is region 19, the Hawaii Islands constitute region 20 and Puerto Rico and other outlying Caribbean areas are region 21 (Figure 3). These numbers represent the first two digits of the HUC (Figure 2).

The second level of classification divides the 21 regions into 222 sub-regions. A sub-region includes the area drained by a river system, a reach of a river and its tributaries in that reach, a closed basin(s) or a group of streams

forming a coastal drainage area. The sub-region is represented by the third and fourth digits on the HUC (Figure 2).

The third level of classification subdivides many of the sub-regions into basins. These 352 hydrologic basins nest within the sub-regions. They are represented by the fifth and sixth digits of the HUC (Figure 2). For HUC purposes, basins are referred to as accounting units.

The fourth level of classification is the sub-basin, the smallest element in the hierarchy of hydrologic units. A sub-basin unit is a geographic area representing part or all of a surface drainage basin, a combination of drainage basins or a distinct hydrologic feature. There are 2,150 sub-basins in the nation, and they are represented by the seventh and eighth digits in the HUC (Figure 2). Sub-basins are often called "eight-digit watersheds." For HUC purposes, basins are referred to as accounting units.

The eight-digit watershed is the most widely used hydrological unit in water resource planning, management and policy. Hydrologic unit codes can contain more than eight digits; however, until recently, the techniques to easily delineate watershed boundaries beyond eight digits were impractical. With the advent of geographic information systems (computer programs that integrate mapping and spatial databases), efforts are now underway by state and federal agencies to delineate eight-digit watersheds into twelve- and fourteen-digit watersheds.

Figure 2. The hierarchy of the components of the 8-digit Hydrologic Unit Code.

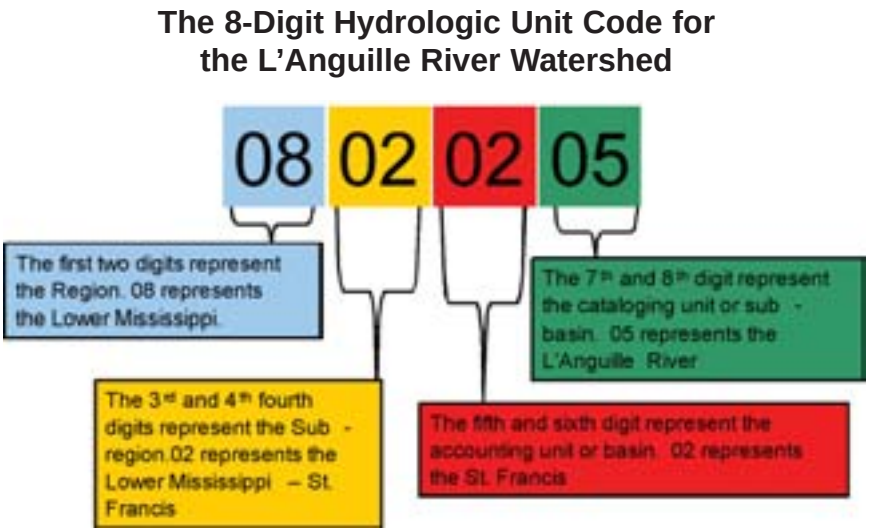


Figure 3. The twenty-one hydrologic regions of the United States. Arkansas has two hydrologic regions: the Lower Mississippi (08) and the Arkansas-White-Red (11). *Source: The United States Geological Survey*

Arkansas Hydrologic Unit Codes

In Arkansas, there are only two major hydrologic regions (two-digit watersheds): the Lower Mississippi (08) and the Arkansas-Red-White Rivers (11) drainage systems (Figure 3). This means all hydrologic unit codes (watersheds) begin with either the digits 08 or 11. Sometimes the "0" in 08 is left out of the HUC.

The two hydrological regions in Arkansas contain nine sub-regions or nine four-digit watersheds (Figure 4 and Table 1). Arkansas contains five river basins (Figure 5). The hydrological unit code for basins contains six digits. In Arkansas, the HUC for basins will begin with one of the nine four-digit codes listed in Table 1 and end in the two-digit accounting code assigned to the basin.

Arkansas has 57 eight-digit watersheds (Figure 6 and Table 2). These watersheds serve as a good starting point for knowing the watershed in which you live and for local water resource protection planning. The Arkansas Natural Resources Commission used eight-digit watersheds as the basis for defining nutrient-sensitive

watersheds in Title 22, *Rules Governing the Arkansas Soil Nutrient and Poultry Litter Application and Management Program*. They also used eight-digit watersheds as a basis for determining the state's priority watersheds for nonpoint source abatement as required by the Environmental Protection Agency under the Federal Clean Water Act.

The Arkansas Department of Environmental Quality (ADEQ) has used eight-digit watersheds as the structure for defining impaired waters within the state, which it is required to report to Congress every two years to fulfill its obligation to federal regulations defined under the Clean Water Act.

The eight-digit watersheds have been used by concerned citizens as the local geographical basis for organizing nonprofit groups whose goals are to protect the water resources in their watershed. Two examples include the Bayou Bartholomew (08040205) Alliance and the Little River Watershed (11140109) Coalition.

To assist watershed protection organizations, the ADEQ has developed the Arkansas Watershed Advisory Group (www.awag.org) made up of representatives from state and federal agencies as well as universities and natural resource organizations. Their mission is to "assist interested citizens and organizations by promoting local voluntary approaches to watershed management and conservation."

Another good source of information about watersheds is the Environmental Protection Agency's "Adopt your Watershed" program (http://www.epa.gov/adopt/) and "Surf your Watershed Program" (http://www.epa.gov/surf). The Adopt program provides information about things you can do to help protect your watershed including financial resources, while the Surf program helps you determine which eight-digit watershed you are in by providing your ZIP code. It also catalogues information about your watershed and provides the HUC. Perhaps the best source of information for Arkansas can be found at http://arkansaswater.org/ where information is catalogued for each eight-digit watershed.

Figure 4. Sub-regions of Arkansas

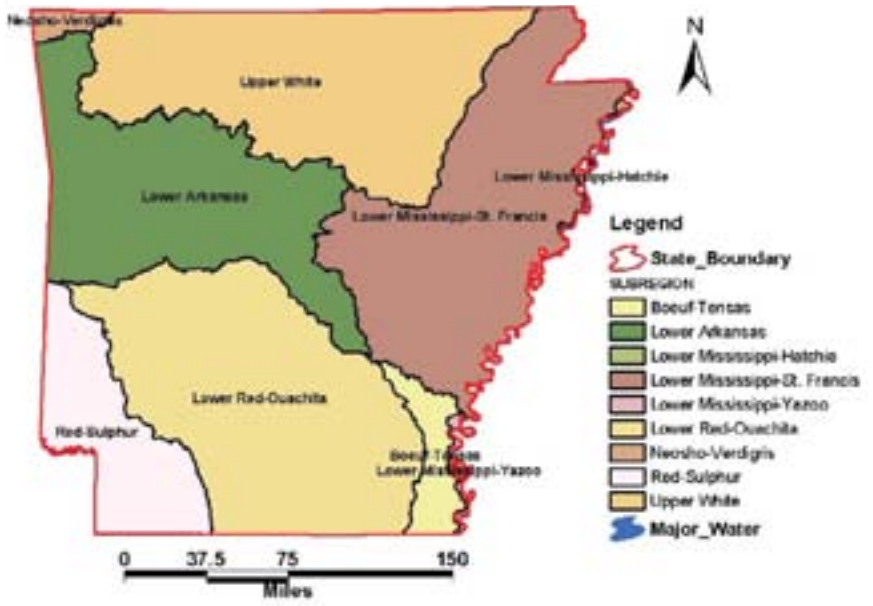
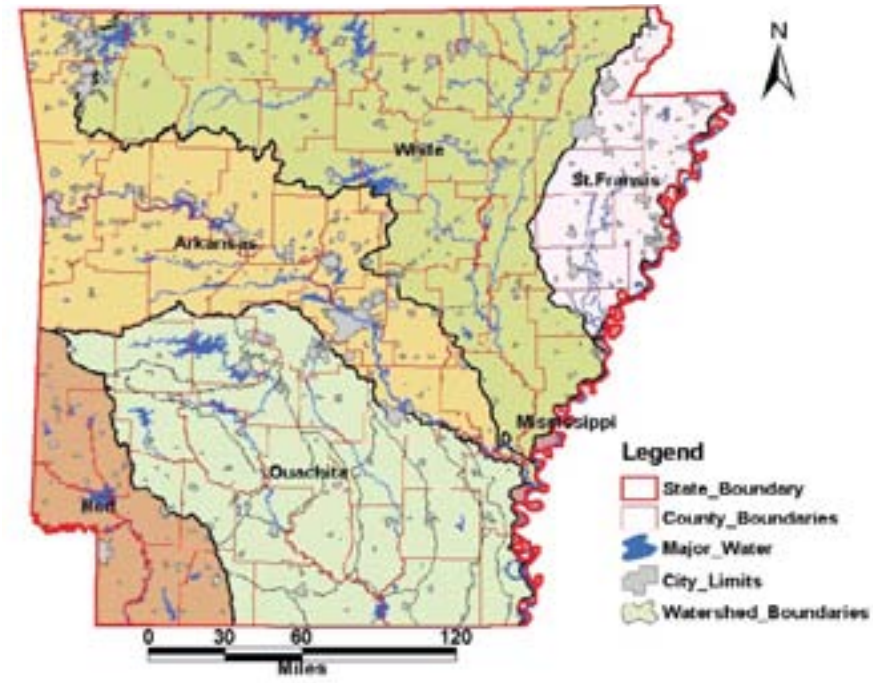


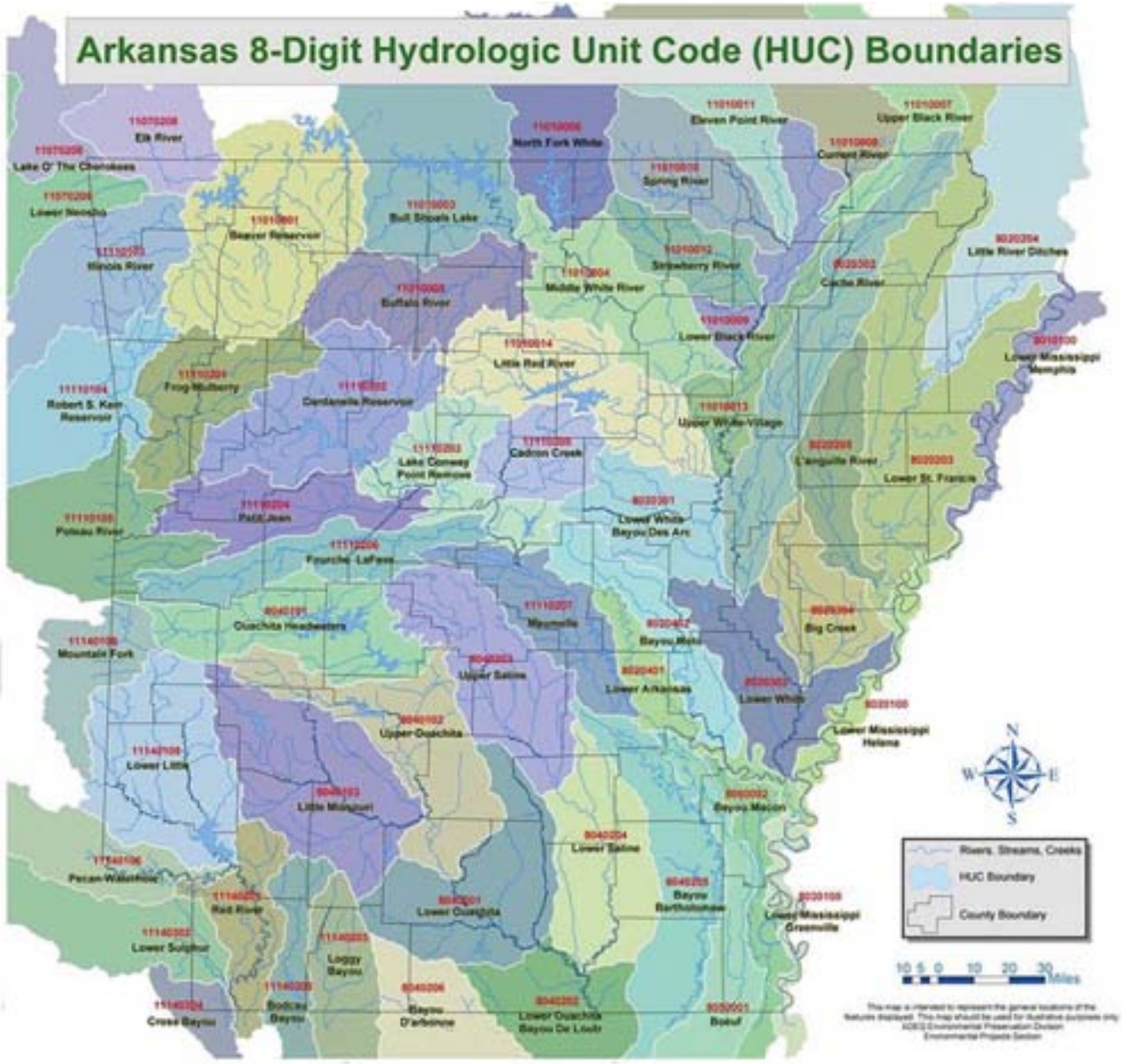
Figure 5. Basins of Arkansas.



Watersheds and Water Quality

Water quality standards for nutrients have been set on a watershed basis by the U.S. EPA Office of Water as part of its National Regional Nutrient Criteria Program. To do this, reference conditions or background

Figure 6. Eight-digit watersheds (cataloguing units) of Arkansas. *(Courtesy of the Arkansas Department of Environmental Quality)*



levels found in pristine streams, lakes, reservoirs and other surface waters in a given geographical area have been identified (Figure 7). Waters where there is the least amount of human impact were monitored for total P, total N, chlorophyll-a and clarity. These values become a benchmark against which similar watercourses in the area can be compared (Figure 7; Gibson et al., 2000). The difference between the reference condition for a given nutrient and current measurement indicates the relative extent of management required to protect or restore the nutrient quality of that water to an approximately "natural" state. Pristine waters of the type existing before European settlement are almost impossible to achieve, but a reasonably natural condition reflecting reduced cultural impacts of human activities can be identified. The reference condition approach makes it possible to demonstrate that such minimally impacted waters do in fact exist for that type and locale, so that management efforts are based on realistic background conditions for a watershed in each geographic (ecoregional) area.

The significance of these regional nutrient criteria to watersheds and their management is that resource managers and concerned farmers have an attainable target of nutrient

reduction to aim for in planning conservation farming practices within a watershed. While these criteria have application to the regulatory function of EPA, in that nutrient standards and permit limits can be derived, criteria values are also suitable for voluntary watershed planning programs and evaluation purposes.

With these target values in mind, a given watershed can be divided into constituent sub-watershed land units and the goal of a particular nutrient level parceled out among the tributary systems. Subsequently, individual farmers can target nutrient load amounts as their equitable share of the water quality protection objective. This, of course, is subject to considerable variability including an understanding of watershed hydrology as it influences water flow pathways, the nutrient delivery rate from soils and slopes draining to those streams as well as seasonal changes in precipitation.

Table 1. Sub-regions in Arkansas and their associated four-digit Hydrologic unit code (HUC).

Hydrological Region (HUC)	Sub-Region	HUC
Lower Mississippi (08)	Lower Mississippi-Hatchie	0801
	Lower Mississippi-St. Francis	0802
	Lower Mississippi-Yazoo	0803
	Lower Red-Ouachita	0804
	Boeuf-Tensas	0805
Arkansas-White-Red (11)	Lower Arkansas	1111
	Red-Sulphur	1114
	Upper White	1101
	Neosho-Vergidris	1107

Figure 7. Draft aggregations of level III ecoregions for the National Nutrient Strategy.
(Adapted from Gibson et al., 2000)

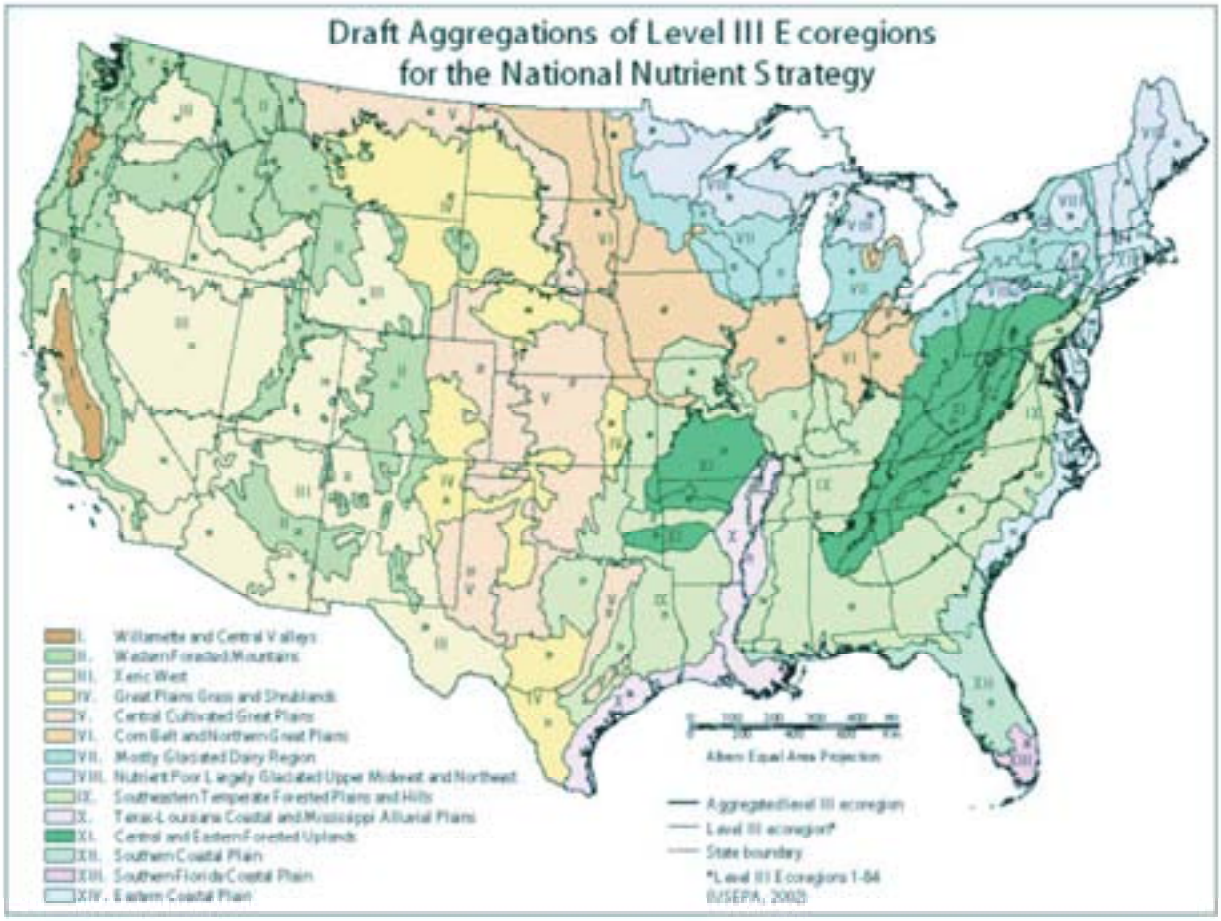


Table 2. Arkansas eight-digit watersheds (cataloguing units) by region.

Lower Mississippi River Region		Arkansas-White-Red Region	
HUC	Watershed Name	HUC	Watershed Name
08010100	Lower Mississippi-Memphis	11010001	Beaver Reservoir
08020100	Lower Mississippi-Helena	11010003	Bull Shoals Lake
08020203	Lower St. Francis	11010004	Middle White
08020204	Little River Ditches	11010005	Buffalo
08020205	L'Anguille	11010006	North Fork White
08020301	Lower White-Bayou Des Arc	11010007	Upper Black
08020302	Cache	11010008	Current
08020303	Lower White	11010009	Lower Black
08020304	Big Creek	11010010	Spring
08020401	Lower Arkansas	11010011	Eleven Point
08020402	Bayou Meto	11010012	Strawberry
08030100	Lower Mississippi-Greenville	11010013	Upper White-Village
08030207	Big Sunflower	11010014	Little Red
08030209	Deer-Steele	11070206	Lake O' The Cherokees
08040101	Ouachita Headwaters	11070208	Elk
08040102	Upper Ouachita	11070209	Lower Neosho
08040103	Little Missouri	11110103	Illinois
08040201	Lower Ouachita-Smackover	11110104	Robert S. Kerr Reservoir
08040202	Lower Ouachita-Bayou De Loutre	11110105	Poteau
08040203	Upper Saline	11110201	Frog-Mulberry
08040204	Lower Saline	11110202	Dardanelle Reservoir
08040205	Bayou Bartholomew	11110203	Lake Conway-Point Remove
08040206	Bayou D'arbonne	11110204	Petit Jean
08050001	Boeuf	11110205	Cadron
08050002	Bayou Macon	11110206	Fourche La Fave
08010100	Lower Mississippi-Memphis	11110207	Lower Arkansas-Maumelle
08020100	Lower Mississippi-Helena	11140105	Kiamichi
08020203	Lower St. Francis	11140106	Pecan-Waterhole
08020204	Little River Ditches	11140108	Mountain Fork
08020205	L'Anguille	11140109	Lower Little
08020301	Lower White-Bayou Des Arc	11140201	Mckinney-Posten Bayous
		11140203	Loggy Bayou
		11140205	Bodcaw Bayou
		11140302	Lower Sulphur
		11140304	Cross Bayou

Summary

Water resource protection is increasingly being done on a watershed basis. This will only continue to expand. Understanding how watersheds function will be vital to more efficient and effective protection efforts. New technology is allowing us to separate eight-digit watersheds into progressively smaller sub-watersheds that will be easier to characterize and manage. This move to smaller watersheds will allow for better understanding of those factors that degrade watershed resources and, in turn, more targeted watershed protection approaches. The University of Arkansas Division of Agriculture has announced plans for a Watershed Research and Education Center to help all of us better understand what watersheds are, how they function, how they can be managed to everyone's benefit and, most importantly, that everyone can contribute to watershed protection.

The Watershed Research and Education Center will be created to specifically target a variety of stakeholder groups from cow/broiler/pasture producers to urban dwellers and stakeholders

from ages K-12 to adult. The Center will serve as a forum to transfer evolving and innovative sustainable management strategies to these groups. A key component of the Center will involve a stakeholder Executive Council to ensure stakeholder input to WREC activities. The Council will advise the project director and co-investigators on which Best Management Practices (BMPs) should be implemented, demonstrated and educated.

Once BMPs are established, the Council will guide the focus of field days, walking tours, educational activities and demonstrations. This involvement will facilitate stakeholder ownership in evolving WREC as a nationally recognized forum for technology transfer to this underserved clientele.

References

Gibson, G.R., R. Carlson, J. Simpson, E. Smeltzer, J. Gerritson, S. Chapra, S. Heiskary, J. Jones, R. Kennedy. 2000. Nutrient criteria technical guidance manual: lakes and reservoirs (EPA-822-B00-001). U.S. Environmental Protection Agency, Washington, D.C.

The Arkansas Natural Resource Commission. 2006. www.aswcc.arkansas.gov/

The Arkansas Department of Environmental Quality. 2006. http://www.adeq.state.ar.us/

The United States Geological Survey. 2006. http://water.usgs.gov/GIS/huc.html

U.S. Environmental Protection Agency. 2001a. Ecoregional Nutrient Criteria. EPA-822-F-01-010. USEPA, Office of Water (4304), U.S. Govt. Printing Office, Washington, D.C. http://www.epa.gov/waterscience/criteria/nutrient/9docfs.pdf

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