

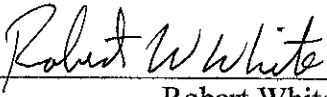
**ORDER DESIGNATING THE CACHE CRITICAL GROUND WATER AREA**

The Commission hereby adopts the "Commission Staff's Recommendation for the Designation of a Critical Ground Water Area" signed by Water Resources Management Chief Earl T. Smith on November 16, 2009.

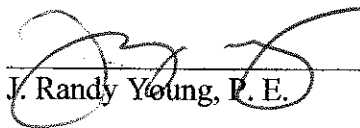
Adopted this 8<sup>th</sup> day of December, 2009.

(SEAL)

ARKANSAS NATURAL  
RESOURCES COMMISSION

  
Robert White, Chair

ATTEST:

  
J. Randy Young, P. E.

# **BEFORE THE ARKANSAS NATURAL RESOURCES COMMISSION**

**In the Matter of:**

**The Designation of the Mississippi River Valley alluvial aquifer and Memphis Sand aquifer within portions of Clay, Craighead, Cross, Greene, Poinsett, St. Francis, and Lee Counties lying west of Crowley's Ridge as a Critical Ground Water Area.**

**CGWA 2009-1.**

## **COMMISSION STAFF'S RECOMMENDATION FOR THE DESIGNATION OF A CRITICAL GROUND WATER AREA.**

### **INTRODUCTION**

As a function of the Arkansas Natural Resources Commission's ('Commission') comprehensive ground water protection program required by Arkansas Code Ann. § 15-22-906, Commission staff acting upon petitions from Clay, Craighead, Cross, Greene, Poinsett, and St. Francis Counties as well as concern expressed by Lee County residents, completed a scientific investigation of reported ground water problems in the Cache Study Area, which includes portions of Clay, Craighead, Cross, Greene, Poinsett, St. Francis, and Lee Counties lying west of Crowley's Ridge. Based on that investigation and comments obtained from citizens within the Cache Study Area, Commission staff members recommend that the Commission enter Findings of Fact and Conclusions of Law, and Order substantially similar to that presented below.

### **PROPOSED FINDINGS OF FACT AND CONCLUSIONS OF LAW.**

#### **I. Introduction.**

1. The proposed Cache Critical Ground Water Area includes the alluvial and Memphis Sand aquifers in portions of Clay, Craighead, Cross, Greene, Poinsett, St. Francis, and Lee Counties lying west of the base of Crowley's Ridge. In making a determination whether to include

territory in the proposed Cache Critical Ground Water Area, the Commission must answer this question:

**What areas, if any, in the Cache Study Area have developed, or trends indicate areas may develop, significant ground water depletion or degradation?**

To arrive at its answer, the staff made an analysis under Rule 403.1 with the aid of guidelines set out in part A of that rule. In addition, as required by part B of the rule, "specific geologic and hydrologic characteristics of the area judged by the Commission staff to warrant inclusion" were considered.

2. The criteria listed in part A of the rule are non-exclusive criteria provided as guidelines for addressing ground water quantity and quality. Though analysis using the criteria is required, the criteria are not litmus tests for designation. It is not necessary to show, for example, a one-foot per year decline over five years in a given area to include it in the designation.

Rule 403.1 reads as follows:

**DESIGNATION.**

Using all pertinent data, an analysis will be made to determine those areas that have developed, or trends indicate they may develop, significant ground water depletion or degradation. Designating an area indicates that limitation of withdrawals through the use of water rights may be necessary in order to maximize the present and continued beneficial use of the area's remaining ground water resources.

A. Indicators to be used in an analysis leading to a recommendation of a critical ground water area will consist of, but not be restricted to, the following parameters:

**1. Water Quantity:**

(a) For water table conditions (unconfined aquifer): Average declines of one foot or more have occurred annually for a minimum of five years and/or water levels have been reduced such that 50% or less of the formation is saturated.

(b) For artesian conditions (confined aquifer): Average declines of one foot or more have occurred annually for a minimum of five years and/or the potentiometric surface is at or below the top of the formation.

2. Water Quality: Ground water quality has been degraded or trends indicate probable future degradation that would render the water unusable for the beneficial uses of the aquifer.

3. Projections/Hydrologic Boundaries: Consideration will be given to a safe yield of ground water pumping strategy for the aquifer including the utilization of a ground-water flow model, the natural hydrologic boundaries of the aquifer, and projected water-level declines.

B. A report shall be prepared based on the indicators in Section 403.1(A) as well as on

specific geologic and hydrologic characteristics of the area judged by Commission staff to warrant inclusion. The report shall contain a map showing recommended boundaries and the explanation of proposed action.

C. A public hearing will then be conducted within each county of the proposed area in accordance with the Administrative Procedure Act.

D. After consideration of all evidence, public comments, and recommendations of

Commission staff, the Commission may issue an order designating the critical ground water areas and the boundaries thereof.

3. While the General Assembly provided for regulation in the Arkansas Ground Water Protection and Management Act, it is not the intent of the Commission to take this step at this time. The recommended designation is a non-regulatory means of focusing educational and conservation efforts on a serious resource threat. The designation will focus resources of conservation districts, the University of Arkansas Division of Agriculture Cooperative Extension Service, and the Commission, on resolving ground water depletion within the Cache Study Area.

4. After designation, the Commission will make enhanced tax credits available for reduction of ground water use, thus encouraging area-wide conservation and reducing stress on the entire aquifer while avoiding additional stress on the underlying Memphis Sand aquifer. Once the area is designated, persons who convert from ground to surface water use within the area can receive tax credits amounting to 50% percent of project costs through the Water Resource Conservation and Development Incentives Act (Arkansas Code Ann. § 26-51-1001 - 1014). Landowners converting to surface water use outside critical areas are limited to a 10% credit.

## **II. Boundaries of the Proposed Cache Critical Ground Water Area.**

The proposed Cache Critical Ground Water Area includes portions of Clay, Craighead, Cross, Greene, Poinsett, St. Francis, and Lee Counties lying west of Crowley's Ridge as defined and illustrated in the Geologic Map of Arkansas (Haley, B.R.; assisted by Glick, E.E., Bush, W.V., Clardy, B.F., Stone, C.G., Woodward, M.B., and Zachry, D.L., 1993, Geologic Map of Arkansas: U.S. Geol. Survey, Special Geologic Map, scale 1:500,000.).

Crowley's Ridge does not extend all the way across Lee County. Therefore, the portion of Lee County subject to the critical ground water area designation is that portion of Lee County lying west of Crowley's Ridge and that portion of Lee County lying west of Range 3 East beginning at the Southeast Corner of Section 24, Township 2 North, Range 3 East and extending North to the Northeast corner of Section 12, Township 3 North, Range 3 East. A representation of the proposed Cache Critical Ground Water Area is attached as Exhibit 1.

## **III. Description of the Aquifers.**

The natural hydrogeologic boundary for the Mississippi River Valley alluvial aquifer in this area is the White River and the Black River to the west and Crowley's Ridge to the east. The Quaternary alluvium generally consists of 60 to 140 feet of sand and gravel and underlies all of the Cache Study Area. The Mississippi River Confining Unit, composed of up to 80 feet of fine-grained sand, silt, and clay, overlies it. Under this aquifer there are less permeable aquifers and confining units of the Mississippi Embayment. The Quaternary alluvium is connected hydraulically to several rivers (including the White, Black, and Cache), streams, and other bodies of water. Rainfall infiltration and inflow of surface water recharge the aquifer, while water is removed from the aquifer by pumping and outflow to surface water bodies.

The Memphis Sand aquifer is composed mainly of sand with considerable amounts of silt, clay, and some lignite. The aquifer in eastern Arkansas is part of a thick sand section in the middle and lower portions of the Claiborne Group. This aquifer is underlain by a layer of clay that is part of the Wilcox Group. Lithologically, it varies considerably both vertically and laterally. The Memphis Sand aquifer includes the Sparta Sand, the predominantly sandy facies of the Cane River formation, and the Carrizo Sand. It is a confined aquifer with a very low storage coefficient when compared to the overlying alluvial aquifer.

A very general comparison of the alluvial and the Memphis Sand aquifers can be made by considering the volume of water stored in each formation. One square mile of confined Memphis Sand aquifer with a thickness of one foot (with a specific yield of 0.0001) can provide 0.06 acre-feet (19,554 gallons) of water. By contrast, a similar volume, one mile square by one foot thick, of the Quaternary alluvium yields approximately 192 acre-feet of water (with a specific yield of 0.3). Therefore, the alluvial aquifer can supply 3000 times the amount of water as the same volume of confined Memphis Sand aquifer. Transmissivity of the alluvium ranges from 30,000 to 45,000 feet squared per day as compared with the Memphis Sand aquifer that has a transmissivity of 4,000 to 17,000 feet squared per day. Water is transmitted through the alluvium at a rate ranging from 1.76 to 11.25 times faster than through the Memphis Sand. It is vital that this difference in the two aquifers' ability to provide water is understood.

The alluvial and Memphis Sand aquifers have been pumped in ever-increasing amounts for agricultural irrigation since the early 1900s. From 1985 to 2005, use from the alluvial aquifer in the proposed Cache Critical Ground Water Area increased from 1278.8 million gallons per day (mgd) to 2864.5 mgd. (Holland 1985, 2005). This represents a 124.0% increase in water use. Each county reported the following increase: Clay 165.0%, Craighead 72.6%, Cross 126.9

%, Greene 65.1%, Lee 175.2%, Poinsett 126.2%, and St. Francis 166.3% (percentages derived from Holland 1985, 2005). Similarly, water use in the Memphis Sand aquifer for this area has increased from 2.14 mgd to 23.38 mgd, which is an approximately 992.5% increase.

#### **IV. Rule 403.1 Analysis of Cache Study Area.**

The alluvial aquifer in the Cache Study Area has developed significant ground water depletion, and trends indicate that significant depletion will continue and degradation of water quality may occur. Similarly, declining water levels for the Memphis Sand aquifer in the Cache Study indicate significant depletion. From 2003 to 2008, average declines by county ranged from 2.08 feet to 5.14 feet, with the entire Cache Critical Ground Water Area showing an average decline of 2.61 feet. Wells measured in both 2007 and 2008 exhibited average county declines from 1.03 to 2.58 feet, with an increase of 0.63 feet in one county and an average decline in the study area of 1.36 feet. Areas of greatest decline overlap portions of all the counties proposed to be designated. These aquifers meet the requirements of Commission Rule 403.1 and should be declared a Critical Ground Water Area.

##### **1. Water Level Declines.**

Long-term, water-level declines have been observed in the Cache Study Area for the alluvial and the Memphis Sand aquifers. Water levels monitored in the Cache River Study Area from 1998 to 2008 indicated a decline of 10.55 feet with 9 of 9 wells showing declines. The five year change from 2003 to 2008 for the area was a decline of 1.79 feet, with declines over five feet in Cross and Poinsett counties. In the alluvial aquifer, water levels declined from 0.21 to 0.94 feet per year for the period from 1982 to 2006. Water levels in the Memphis Sand aquifer in the proposed critical area have declined 10.6 feet from 1998 to 2008, a rate slightly over 1 foot

per year. From 1981 to 2005, the water levels in the Memphis Sand aquifer declined 0.8, 0.91, 0.55, and 1.23 feet per year in Craighead, Cross, Lee, and Poinsett counties respectively

As water levels decline, the potentiometric surface, or hydraulic pressure head, of the formation is lowered. Where removal of water lowers the potentiometric surface to below the top of the formation, the aquifer may compact under the weight of overlying formations. This compaction can permanently reduce the aquifer's storage capacity, reducing the yield of wells drilled into the formation. Not only is the aquifer's capacity to store water affected, but its transmissivity, the ability of the aquifer to allow water to move through the aquifer, will be reduced, thereby lowering the volume of water available to wells.

Declines in the proposed Cache Critical Ground Water Area have led to the development of a cone of depression in the potentiometric surface of the Mississippi River Valley alluvial aquifer. In 1995, a small cone of depression in the Memphis Sand was first documented in southwestern Poinsett County. That cone of depression has spread northward to the border of Craighead County, and southward through western Cross County and into northern St. Francis County. Cones of depression which indicate that these aquifers are not reaching equilibrium and are being pumped at an unsustainable rate. As noted in the "Technical Presentation of the Cache Critical Ground Water Area" generated by the Commission's Geology Supervisor Todd Fugitt, withdrawals from the alluvial aquifer are above the estimated sustainable yield for all six counties. Commission staff estimates that withdrawals are 9.9 to 98.7% above sustainable yields with an average withdrawal at 43.1% above the sustainable yield for the proposed critical area.

As water levels continue to decline, the aquifers will not be able to sustain either the quantity or the quality of ground water supplied in the past. This decline will result in increased pumping costs, decreased well yields, and increased well interference as well as the threat of



degradation in the form of salt water intrusion, land subsidence, and reduced recharge to streams and wetlands. In addition, many wells will need to be deepened at great cost to water users.

The supply of water available for irrigation will not be the only loss. Rivers and streams that are hydraulically connected to the alluvial aquifer and their base flows depend on ground water levels. Excessive withdrawals near the rivers, streams, and wetlands can adversely affect surface water levels. Both wildlife and navigation will be affected by lower surface water levels.

Water-level decline data supporting this proposed designation are found in the “Arkansas Ground Water Protection and Management Reports” for 2007 & 2008 published by the Commission, the “Technical Presentation for the Cache Critical Ground Water Area”, as well as United States Geological Survey (USGS) Scientific Investigations Report Numbers 2007-5029, 2008-5092, 2003-4230, 2003-4231, 2008-5138, 2009-5040, 2007-5241, and 2006-5052.

## **2. Decreased Saturated Thickness.**

The “saturated thickness” of an unconfined aquifer is the portion of the aquifer that is filled with water. The immediate effect of a loss of saturated thickness is an inability to acquire water from the aquifer. Stored water also helps support the structure of the aquifer. As pumping removes water, the aquifer can be damaged by collapse of that structure, causing loss of storage capacity and possibly land subsidence. The typical irrigation well requires a minimum of 20 to 40 feet of saturated thickness to provide adequate water for the well.

As early as 1984, alarming trends were documented in the Cache Study Area. Data indicated areas in central St. Francis, Cross, Poinsett, and Craighead Counties west of Crowley's Ridge with a saturated thickness of only 20 to 40 feet. At the time there were already areas in south-central Craighead County west of Crowley's Ridge with a saturated thickness of less than

20 feet. USGS models predict that the saturated thickness of the Quaternary alluvium will dwindle to between 40 and 20 feet in the area by 2040 based on current rates of decline.

### **3. Degradation of Water Quality.**

Excessive pumping of the Quaternary alluvium can cause salt-water intrusion. If over-pumping of the Quaternary alluvium continues at current rates, salt-water intrusion may render the water unsuitable for drinking and ultimately, for agricultural purposes.

### **4. Geologic and Hydrologic Characteristics Warranting Inclusion of the Counties in the Cache Critical Ground Water Area.**

The entire hydrogeologic system must be viewed as a whole, because withdrawals and recharge in any part of the hydrogeologic system affect water levels elsewhere. Though some areas of the Cache Study Area exhibit less serious declines than others, there is an area-wide trend of increased water use and decreasing water levels. Throughout the study area, withdrawals continue to exceed recharge.

Though areas of greatest decline are not conterminous with counties, established county lines provide the most reliable means to delineate some boundaries of the Cache Critical Ground Water Area. Water level contour maps indicating water levels, flow direction, and areas of significant declines must be revised annually to track dynamic ground water system changes in response to environmental factors and withdrawals from wells. Contour lines vary year to year, sometimes by a great amount; therefore, they do not offer a practical way to define the Area. The established and familiar boundary provided by county lines are the most readily available and logical method of defining the proposed Cache Critical Ground Water Area.

Though the Memphis Sand aquifer underlies much of the study area, it is not a viable alternative to the declining alluvial aquifer. Where the Memphis Sand aquifer underlies the study area, its thickness averages from approximately 100 to 900 feet. Increasing declines in the

overlying alluvium have forced some water users in the Cache Study Area to drill into the deeper Memphis Sand to obtain sufficient water. Declines are accelerating and indicate that withdrawals are exceeding recharge in the aquifer.

Municipal water systems have historically been the primary users of Memphis Sand aquifer water, since the high quality water requires minimal treatment. At the same time, agricultural ground water users have depended on water from the alluvial aquifer, which can provide a much greater volume of water at a much lower cost. Historic patterns are changing as the alluvial aquifer is depleted. Though water users continue to turn to the Memphis Sand aquifer, it does not have the storage capacity or ability to transmit water and cannot be relied upon as a replacement for the alluvium.

### **PROPOSED ORDER**

Based on the Proposed Findings of Fact and Conclusions of Law, the staff recommends adoption of the following Order:

**Section 1.** Having met the requirements of Commission Rule 403.1(A), the Mississippi River Valley alluvial aquifer and the Memphis Sand aquifer, as defined and illustrated in the Geologic Map of Arkansas within parts of Clay, Craighead, Cross, Greene, Poinsett, St. Francis, and Lee Counties lying west of Crowley's Ridge are designated the Cache Critical Ground Water Area pursuant to the Arkansas Ground Water Protection and Management Act. This designation also includes that portion of Lee County lying west of Range 3 East beginning at the Southeast Corner of Section 24, Township 2 North, Range 3 East and extending North to the Northeast corner of Section 12, Township 3 North, Range 3 East. See Exhibit 1.

**Section 2.** **This designation does not include institution of regulatory authority.**

**Section 3.** The Commission and staff will take the following actions:

(a) Water Plan Compliance review of projects under Arkansas Code Ann. §15-22-503(e) and Title VI of the Commission's rules that make additional use of the Quaternary alluvium within the Cache Critical Ground Water Area should be approved only when there is no other economically or technically feasible alternative, or when human health requires.

(b) The Commission's financial assistance programs will give priority to projects within the Cache Critical Ground Water Area that use surface water or other less stressed aquifers, avoid use of the Memphis Sand aquifer, and implement ground water conservation.

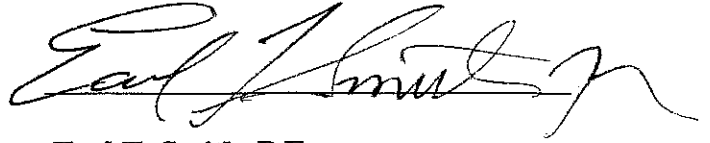
(c) The Commission's conservation, education, and information program required pursuant to Arkansas Code Ann. § 15-22-907, will focus its efforts within the Cache Critical Ground Water Area on technology transfer, training, technical assistance, research, and demonstration projects. A portion of the water use fees collected pursuant to Arkansas Code Ann. § 15-22-913 and 914 should be used to encourage conjunctive water use including, when appropriate, the substitution of surface water, use of less stressed aquifers, avoidance of the Memphis Sand aquifer, and water conservation for Quaternary alluvium water within the Cache Critical Ground Water Area.

(d) The Commission's staff will encourage the use of state income tax credits available under the Water Resources Conservation and Development Incentives Act (Arkansas Code Ann. § 26-51-1001 - 1014).

(e) As required by Commission Rule 403.2(A), the staff is directed to continue monitoring the situation within the Cache Critical Ground Water Area and to report back to the Commission periodically.

(f) The Commission shall maintain jurisdiction over this matter and shall enter additional orders as it deems necessary.

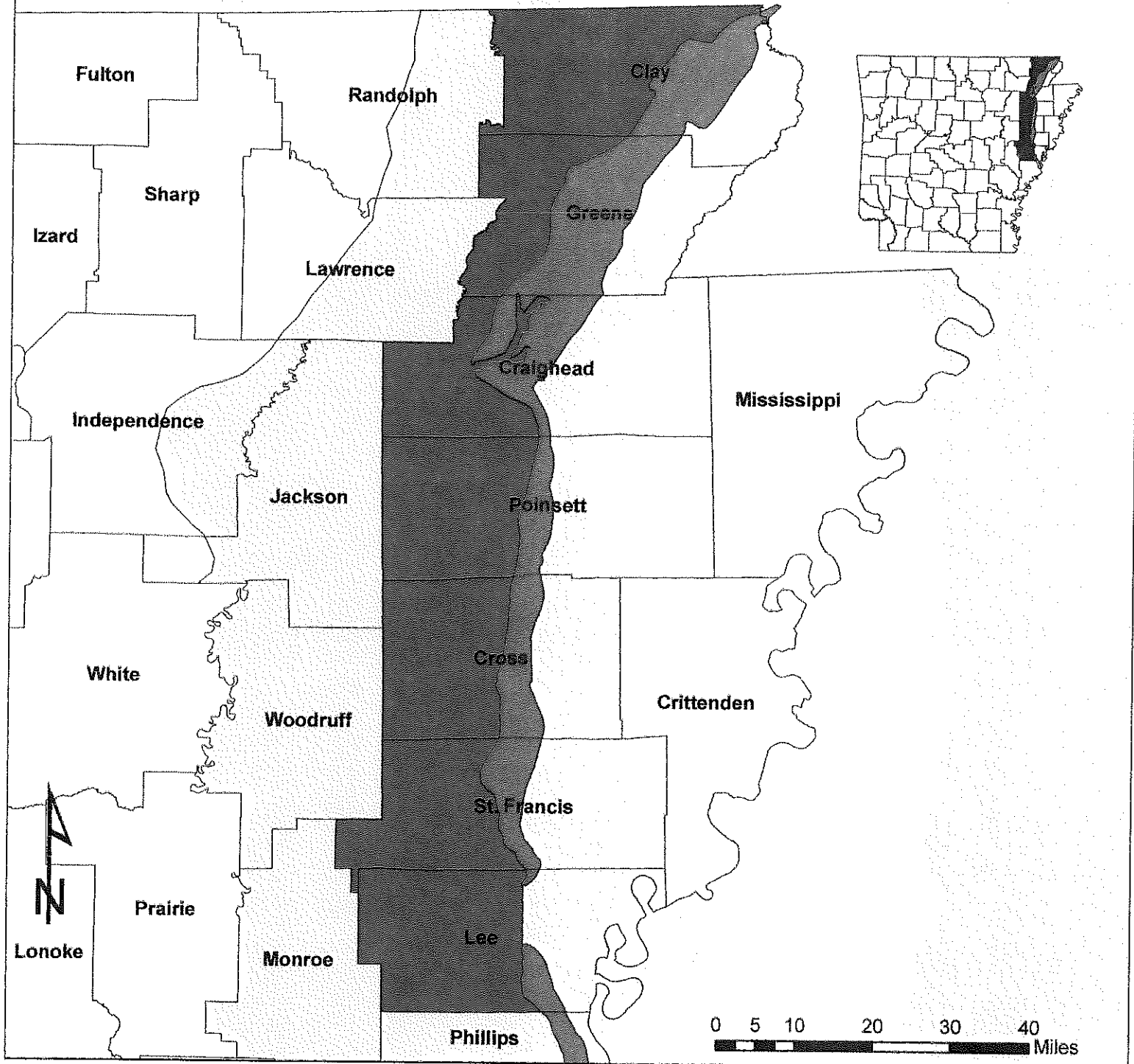
Respectfully submitted this 16 day of Nov, 2009.

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


**Earl T. Smith, P.E.**  
**Chief, Water Resources Management**

Exhibit 1.

# Cache Critical Ground Water Area



## Legend

-  Crowley's Ridge
-  Cache Critical Ground Water Area
-  Current Study Areas

The Cache Critical Ground Water Area includes those parts of Clay, Greene, Craighead, Poinsett, Cross, St. Francis, and Lee Counties which are West of Crowley's Ridge.

Where Crowley's Ridge is absent in Lee County, the proposed designation boundary is the eastern boundary of Range 3 East.

