

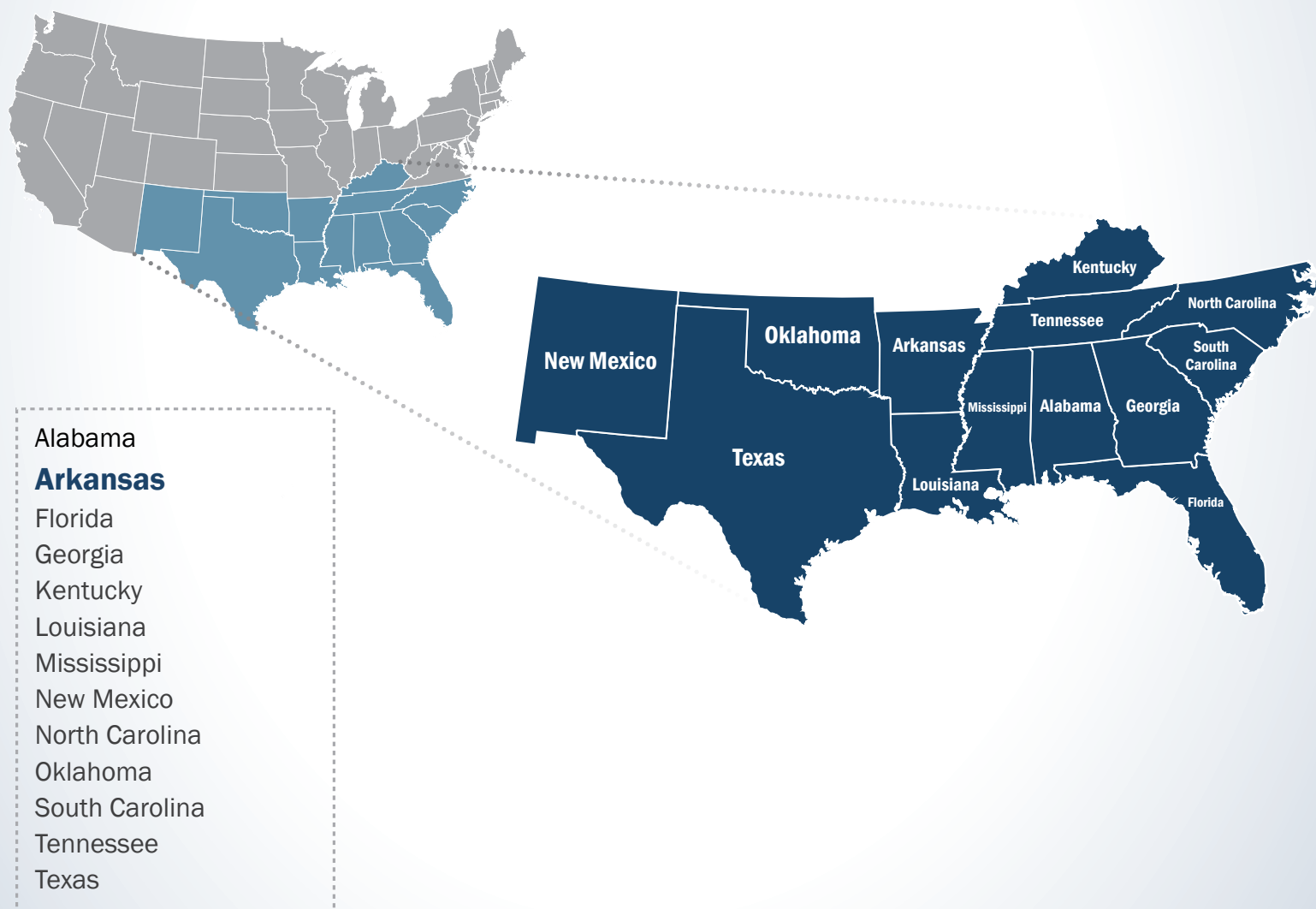


FirstNet[®]

Nationwide Public Safety Broadband Network

Final Programmatic Environmental Impact Statement for the Southern United States

VOLUME 2 - CHAPTER 4



First Responder Network Authority



Nationwide Public Safety Broadband Network **Final Programmatic Environmental Impact Statement for the Southern United States**

VOLUME 2 - CHAPTER 4

Amanda Goebel Pereira, AICP
NEPA Coordinator
First Responder Network Authority
U.S. Department of Commerce
12201 Sunrise Valley Dr. M/S 243
Reston, VA 20192

Cooperating Agencies

Federal Communications Commission
General Services Administration
U.S. Department of Agriculture—Rural Utilities Service
U.S. Department of Agriculture—U.S. Forest Service
U.S. Department of Agriculture—Natural Resource Conservation Service
U.S. Department of Commerce—National Telecommunications and Information Administration
U.S. Department of Defense—Department of the Air Force
U.S. Department of Energy
U.S. Department of Homeland Security

August 2017

Page Intentionally Left Blank.

Contents

4. Arkansas	4-7
4.1. Affected Environment	4-8
4.1.1. Infrastructure	4-8
4.1.2. Soils	4-35
4.1.3. Geology	4-44
4.1.4. Water Resources	4-60
4.1.5. Wetlands	4-72
4.1.6. Biological Resources	4-79
4.1.7. Land Use, Recreation, and Airspace	4-112
4.1.8. Visual Resources	4-136
4.1.9. Socioeconomics	4-148
4.1.10. Environmental Justice	4-166
4.1.11. Cultural Resources	4-172
4.1.12. Air Quality	4-185
4.1.13. Noise and Vibration	4-195
4.1.14. Climate Change	4-199
4.1.15. Human Health and Safety	4-208
4.2. Environmental Consequences	4-222
4.2.1. Infrastructure	4-222
4.2.2. Soils	4-234
4.2.3. Geology	4-242
4.2.4. Water Resources	4-255
4.2.5. Wetlands	4-270
4.2.6. Biological Resources	4-281
4.2.7. Land Use, Recreation, and Airspace	4-334
4.2.8. Visual Resources	4-349
4.2.9. Socioeconomics	4-356
4.2.10. Environmental Justice	4-369
4.2.11. Cultural Resources	4-377
4.2.12. Air Quality	4-385
4.2.13. Noise and Vibration	4-391
4.2.14. Climate Change	4-399
4.2.15. Human Health and Safety	4-411
AR Appendix A – Communities of Concern	4-426
Acronyms	4-427
References	4-431
GIS References	4-469

List of Tables

Table 4.1.1-1: Relevant Arkansas Infrastructure Laws and Regulations.....	4-8
Table 4.1.1-2: Arkansas Interstates.....	4-10
Table 4.1.1-3: Amtrak Train Routes Serving Arkansas.....	4-12
Table 4.1.1-4: Key Arkansas Indicators	4-13
Table 4.1.1-5: Public Safety Infrastructure in Arkansas by Type.....	4-13
Table 4.1.1-6: First Responder Personnel in Arkansas by Type.....	4-13
Table 4.1.1-7: Telecommunications Access Providers and Coverage in Arkansas as of December 31, 2013	4-19
Table 4.1.1-8: Wireless Telecommunications Coverage by Providers in Arkansas.....	4-20
Table 4.1.1-9: Number of Commercial Towers in Arkansas by Type.....	4-26
Table 4.1.1-10: Fiber Provider Coverage	4-29
Table 4.1.2-1: Relevant Arkansas Soils Laws and Regulations	4-36
Table 4.1.2-2: Characteristics of Major Land Resource Areas in Arkansas.....	4-38
Table 4.1.2-3: Major Characteristics of Soil Suborders ^a Found in Arkansas, as depicted in Figure 4.1.2-2.....	4-41
Table 4.1.3-1: Relevant Arkansas Geology Laws and Regulations.....	4-45
Table 4.1.4-1: Relevant Arkansas Water Resources Laws and Regulations	4-60
Table 4.1.4-2: Section 404(d) Impaired Waters of Arkansas, 2014	4-66
Table 4.1.4-3: Description of Arkansas's Principal Aquifers.....	4-70
Table 4.1.5-1: Relevant Arkansas Wetlands Laws and Regulations	4-72
Table 4.1.5-2: Arkansas Wetland Types, Descriptions, Location, and Amount, 2014	4-75
Table 4.1.6-1: Relevant Arkansas Biological Resources Laws and Regulations	4-79
Table 4.1.6-2: Characteristics of Level III Ecoregions in Arkansas.....	4-83
Table 4.1.6-3: Federally Listed Mammal Species of Arkansas	4-95
Table 4.1.6-4: Federally Listed Bird Species of Arkansas	4-99
Table 4.1.6-5: Federally Listed Fish Species of Arkansas.....	4-101
Table 4.1.6-6: Federally Listed Amphibian Species of Arkansas	4-104
Table 4.1.6-7: Federally Listed Invertebrate Species of Arkansas	4-105
Table 4.1.6-8: Federally Listed Plant Species of Arkansas	4-110
Table 4.1.7-1: Major Land Uses in Arkansas by Coverage Type.....	4-114
Table 4.1.7-2: Top Five Developed Metropolitan Areas.....	4-115
Table 4.1.7-3: Federal Land in Arkansas.....	4-118
Table 4.1.7-4: SUA Designations	4-125
Table 4.1.7-5: Other Airspace Designations.....	4-126
Table 4.1.7-6: Type and Number of Arkansas Airports/Facilities.....	4-128
Table 4.1.8-1: Relevant Arkansas Visual Resources Laws and Regulations	4-136
Table 4.1.8-2: Arkansas National Parks and Affiliated Areas.....	4-140
Table 4.1.8-3: National Forests in Arkansas.....	4-141
Table 4.1.8-4: Arkansas USACE Recreation Areas	4-142
Table 4.1.8-5: Examples of Arkansas State Parks and Associated Visual Attributes	4-143
Table 4.1.8-6: Arkansas Wilderness Areas.....	4-145
Table 4.1.8-7: Arkansas National Wild and Scenic Rivers	4-146
Table 4.1.8-8: Arkansas National Wildlife Refuges.....	4-146
Table 4.1.8-9: Arkansas National Natural Landmarks	4-147
Table 4.1.8-10: Arkansas State Byways	4-148

Table 4.1.9-1: Land Area, Population, and Population Density of Arkansas	4-151
Table 4.1.9-2: Recent Population Growth of Arkansas	4-151
Table 4.1.9-3: Projected Population Growth of Arkansas	4-152
Table 4.1.9-4: Population of the 10 Largest Population Concentrations in Arkansas	4-155
Table 4.1.9-5: Selected Economic Indicators for Arkansas.....	4-156
Table 4.1.9-6: Selected Economic Indicators for the 10 Largest Population Concentrations in Arkansas, 2009-2013	4-158
Table 4.1.9-7: Employment by Class of Worker and by Industry, 2013	4-161
Table 4.1.9-8: Employment by Selected Industries for the 10 Largest Population Concentrations in Arkansas, 2009-2013	4-162
Table 4.1.9-9: Selected Housing Indicators for Arkansas, 2013	4-163
Table 4.1.9-10: Selected Housing Indicators for the 10 Largest Population Concentrations in Arkansas, 2009-2013	4-163
Table 4.1.9-11: Residential Property Values in Arkansas, 2013	4-164
Table 4.1.9-12: Residential Property Values for the 10 Largest Population Concentrations in Arkansas, 2009-2013	4-164
Table 4.1.9-13: State and Local Government Revenues, Selected Sources, 2012	4-166
Table 4.1.10-1: Population by Race and Hispanic Status, 2013	4-168
Table 4.1.10-2: Percentage of Population (Individuals) in Poverty, 2013.....	4-169
Table 4.1.11-1: Relevant Arkansas Cultural Resources Laws and Regulations.....	4-173
Table 4.1.11-2: Archaeological Sites on the National Register of Historic Places in Arkansas.....	4-179
Table 4.1.12-1: Major Air Pollutant Source Thresholds.....	4-187
Table 4.1.12-2: De Minimis Levels	4-189
Table 4.1.12-3: Arkansas Nonattainment and Maintenance Areas by Pollutant Standard and County	4-190
Table 4.1.12-4: Relevant Federal Class I Areas	4-193
Table 4.1.13-1: Vibration Source Levels for Select Construction Equipment (VdB)	4-197
Table 4.1.14-1: Arkansas CO ₂ Emissions from Fossil Fuels by Fuel Type and Sector, 2014.....	4-202
Table 4.1.15-1: Relevant Arkansas Human Health and Safety Laws and Regulations	4-209
Table 4.2.1-1: Impact Significance Rating Criteria for Infrastructure at the Programmatic Level	4-224
Table 4.2.2-1: Impact Significance Rating Criteria for Soils at the Programmatic Level.....	4-235
Table 4.2.3-1: Impact Significance Rating Criteria for Geology at the Programmatic Level	4-244
Table 4.2.4-1: Impact Significance Rating Criteria for Water Resources at the Programmatic Level.....	4-257
Table 4.2.5-1: Impact Significance Rating Criteria for Wetlands at the Programmatic Level	4-271
Table 4.2.6-1: Impact Significance Rating Criteria for Terrestrial Vegetation, Wildlife, Fisheries, and Aquatic Habitats at the Programmatic Level.....	4-282
Table 4.2.6-2: Impact Significance Rating Criteria for Threatened and Endangered Species at the Programmatic Level.....	4-320
Table 4.2.7-1: Impact Significance Rating Criteria for Land Use, Recreation, and Airspace at the Programmatic Level.....	4-336

Table 4.2.8-1: Impact Significance Rating Criteria for Visual Resources at the Programmatic Level.....	4-350
Table 4.2.9-1: Impact Significance Rating Criteria for Socioeconomics at the Programmatic Level.....	4-357
Table 4.2.10-1: Impact Significance Rating Criteria for Environmental Justice at the Programmatic Level.....	4-370
Table 4.2.11-1: Effect Significance Rating Criteria for Cultural Resources at the Programmatic Level.....	4-378
Table 4.2.12-1: Impact Significance Rating Criteria for Air Quality at the Programmatic Level	4-386
Table 4.2.13-1: Impact Significance Rating Criteria for Noise and Vibration at the Programmatic Level.....	4-393
Table 4.2.14-1: Impact Significance Rating Criteria for Climate Change at the Programmatic Level.....	4-400
Table 4.2.15-1: Impact Significance Rating Criteria for Human Health and Safety at the Programmatic Level.....	4-413

List of Figures

Figure 4.1.1-1: Arkansas Transportation Networks.....	4-11
Figure 4.1.1-2: Wireless Network Configuration	4-14
Figure 4.1.1-3: Arkansas Wireless Information Network Tower Locations	4-17
Figure 4.1.1-4: Arkansas County Bridge Assets.....	4-18
Figure 4.1.1-5: AT&T and Verizon Wireless Availability in Arkansas	4-21
Figure 4.1.1-6: Sprint and T-Mobile Wireless Availability in Arkansas.....	4-22
Figure 4.1.1-7: Cricket Wireless and Black Sheep Computing Inc. Wireless Availability in Arkansas	4-23
Figure 4.1.1-8: Other Providers Fiber Availability in Arkansas.....	4-24
Figure 4.1.1-9: Types of Towers.....	4-25
Figure 4.1.1-10: FCC Tower Structure Locations in Arkansas	4-27
Figure 4.1.1-11: Typical Fiber Optic Network in Arkansas	4-28
Figure 4.1.1-12: Fiber Availability in Arkansas for CenturyLink and Windstream Arkansas, LLC	4-30
Figure 4.1.1-13: AT&T Southwest's Fiber Availability in Arkansas.....	4-31
Figure 4.1.1-14: Other Provider's Fiber Availability in Arkansas	4-32
Figure 4.1.2-1: Locations of Major Land Resource Areas in Arkansas	4-37
Figure 4.1.2-2: Arkansas Soil Taxonomy Suborders.....	4-40
Figure 4.1.3-1: Physiographic Regions, Provinces, and Sections of Arkansas	4-46
Figure 4.1.3-2: Generalized Surface Geology for Arkansas.....	4-49
Figure 4.1.3-3: Generalized Bedrock Geology for Arkansas	4-51
Figure 4.1.3-4: Arkansas 2014 Seismic Hazard Map	4-55
Figure 4.1.3-5: Richland Creek Landslide.....	4-56
Figure 4.1.3-6: Arkansas Landslide Incidence and Susceptibility Hazard Map.....	4-57
Figure 4.1.3-7: Karst Topography in Arkansas	4-59
Figure 4.1.4-1: Major Arkansas Watersheds, defined by ADEQ, and Surface Waterbodies	4-64

Figure 4.1.4-2: Section 404(d) Impaired Waters of Arkansas, 2014	4-67
Figure 4.1.4-3: Principal Aquifers of Arkansas	4-71
Figure 4.1.5-1: Wetlands by Type, in Arkansas, 2014	4-76
Figure 4.1.5-2: Bottomland Hardwoods along Cache River.....	4-78
Figure 4.1.6-1: USEPA Level III Ecoregions in Arkansas	4-81
Figure 4.1.6-2: Important Bird Areas (IBA) of Arkansas.....	4-90
Figure 4.1.6-3: ESA Designated Critical Habitat in Arkansas	4-96
Figure 4.1.7-1: Major Land Use Distribution by Coverage Type.....	4-116
Figure 4.1.7-2: Land Ownership Distribution.....	4-117
Figure 4.1.7-3: Arkansas Recreation Resources	4-121
Figure 4.1.7-4: National Air Space Classification Profile	4-124
Figure 4.1.7-5: Composite of Arkansas Airports/Facilities	4-129
Figure 4.1.7-6: Public Arkansas Airports/Facilities	4-130
Figure 4.1.7-7: Private Arkansas Airports/Facilities	4-131
Figure 4.1.7-8: SUAs in Arkansas	4-134
Figure 4.1.7-9: MTRs in Arkansas	4-135
Figure 4.1.8-1: Representative Sample of Some Historic and Cultural Resources that May be Visually Sensitive	4-139
Figure 4.1.8-2: Hot Springs National Park	4-141
Figure 4.1.8-3: Devil's Den State Park.....	4-143
Figure 4.1.8-4: Natural Areas that May be Visually Sensitive	4-144
Figure 4.1.8-5: Roaring Branch Research Natural Area.....	4-147
Figure 4.1.10-1: Potential for Environmental Justice Populations in Arkansas, 2009– 2013.....	4-171
Figure 4.1.11-1: Timeline of Prehistoric Human Occupation in Arkansas	4-174
Figure 4.1.11-2: Approximate Historic Boundaries of Major Tribal Nations in Arkansas.....	4-178
Figure 4.1.11-3: National Register of Historic Places Sites in Arkansas	4-184
Figure 4.1.11-4: Representative Architectural Styles of Arkansas.....	4-185
Figure 4.1.12-1: Nonattainment and Maintenance Counties in Arkansas	4-192
Figure 4.1.12-2: Federal Class I Areas with Implications for Arkansas.....	4-194
Figure 4.1.13-1: Sound Levels of Typical Sounds	4-196
Figure 4.1.14-1: Arkansas CO ₂ Emissions from Fossil Fuels by Fuel Type 1980-2013	4-202
Figure 4.1.14-2: Köppen-Geiger Climate Classes for U.S. Counties	4-204
Figure 4.1.15-1: Number of Telecommunication Line Installers and Repairers Employed per State, May 2014.....	4-212
Figure 4.1.15-2: TOXMAP Superfund/NPL and TRI Facilities in Arkansas (2013).....	4-215
Figure 4.1.15-3: Aerial Image of Cedar Chemical Company	4-218
Figure 4.1.15-4: High Priority Abandoned Mine Lands in Arkansas (2015)	4-219
Figure 4.1.15-5: Aerial View of Tornado Path Crossing Interstate 30 (left) and Utility Workers Restoring Grid Infrastructure (right).....	4-221
Figure 4.2.14-1: Arkansas Low Emission Scenario Projected Temperature Change.....	4-401
Figure 4.2.14-2: Arkansas High Emission Scenario Projected Temperature Change	4-402
Figure 4.2.14-3: Predicted Seasonal Precipitation Change for 2071 to 2099 Compared to 1970 to 1999 Baseline in a Low Emissions	4-404

Figure 4.2.14-4: Predicted Seasonal Precipitation Change for 2071 to 2099
Compared to 1970 to 1999 Baseline in a High Emissions Scenario..... 4-405

4. ARKANSAS

American Indian tribes with a rich cultural history lived in what is now the state of Arkansas for centuries before the 1500s.

Arkansas was the site of the first permanent European settlement on the lower Mississippi, Arkansas Post, which was established in 1686. Arkansas was acquired by the United States as part of the 1803 Louisiana Purchase, and was made a territory in 1819. In 1836, Arkansas became the 25th state to enter the Union (Arkansas Department of Parks & Tourism, 2015a). Located in the southern region of the U.S., Arkansas is bordered by Oklahoma to the west, Louisiana to the south, Mississippi and Tennessee to the east, and Missouri to the north. This chapter provides details about the existing environment of Arkansas as it relates to the Proposed Action.



General facts about Arkansas are provided below:

- **Nickname:** The Natural State
- **Land Area:** 52,035 square miles; **U.S. Rank:** 25 (U.S. Census Bureau, 2010)
- **Capital:** Little Rock
- **Counties:** 75 (U.S. Census Bureau, 2015a)
- **2014 Estimated Population:** Over 2.9 million people; **U.S. Rank:** 5 (U.S. Census Bureau, 2015b)
- **Most Populated Cities:** Little Rock, Fort Smith, and Fayetteville (U.S. Census Bureau, 2010)
- **Main Rivers:** Arkansas River, Saline River, Ouachita River, Red River, Fourche Lafave River, White River, Kings River, Buffalo River, Black River, and St. Francis River
- **Bordering Waterbodies:** Mississippi River
- **Mountain Ranges:** Ozark Mountains and Ouachita Mountains
- **Highest Point:** Magazine Mountain (2,753 feet) (USGS, 2001)

4.1. AFFECTED ENVIRONMENT

4.1.1. Infrastructure

4.1.1.1. *Definition of the Resource*

This section provides information on key Arkansas infrastructure resources that could potentially be affected by FirstNet projects. Infrastructure consists of the systems and physical structures that enable a population in a specified area to function. Infrastructure includes a broad array of facilities such as utility systems, streets and highways, railroads, airports, buildings and structures and other manmade facilities. Individuals, businesses, government entities, and virtually all relationships between these groups depend on infrastructure for their most basic needs, as well as for critical and advanced needs (e.g., emergency response, health care, and telecommunications).

Section 4.1.1.3 provides an overview of Arkansas traffic and transportation infrastructure, including road and rail networks and waterway facilities. Arkansas's public safety infrastructure could include any infrastructure utilized by a public safety entity¹ as defined in Title VI of the Middle Class Tax Relief and Job Creation Act of 2012¹ (Public Law [Pub. L.] No. 112-96, Title VI Stat. 156 (codified at 47 United States Code [U.S.C.] 1401 et seq.) (the Act), including infrastructure associated with police, fire, and emergency medical services (EMS). However, other organizations can qualify as public safety services as defined by the Act. Public safety services in the Arkansas are presented in more detail in Section 4.1.1.4. Section 4.1.1.5 describes Arkansas public safety communications infrastructure and commercial telecommunications infrastructure. An overview of Arkansas utilities, such as power, water, and sewer, is presented in Section 4.1.1.6.

4.1.1.2. *Specific Regulatory Considerations*

Multiple Arkansas laws and regulations pertain to the state's public utility and transportation infrastructure and its public safety community. Table 4.1.1-1 identifies the relevant laws and regulations, the affected agencies, and their jurisdiction as derived from the state's applicable statutes and administrative rules referenced in column one. Appendix C, Environmental Laws and Regulations, identifies applicable federal laws and regulations.

Table 4.1.1-1: Relevant Arkansas Infrastructure Laws and Regulations

State Laws/Regulation	Regulatory Agency	Applicability
2014 Arkansas Code: Title 12 - Law Enforcement, Emergency Management, and Military Affairs	Arkansas Department of Emergency Management	Establishes minimum selection and training standards for law enforcement; assists in the apprehension of criminals; enforces the motor vehicle, traffic, and state highway laws; coordinates the development of the state's emergency operations plan; establishes preparedness measures and conducts emergency planning, training, response, and recovery activities.

¹ The term 'public safety entity' means an entity that provides public safety services (7 U.S. Code [U.S.C.] § 1401(26)).

State Laws/Regulation	Regulatory Agency	Applicability
2014 Arkansas Code: Title 23 - Public Utilities and Regulated Industries	Arkansas Public Service Commission	Regulates rates and service of state's electricity, natural gas, water, and telephone utilities and pipeline safety services; oversees the operations of common carriers; railroads; express companies; car companies; freight lines; toll bridges; ferries; steamboats; street railroads; telegraph companies; telephone companies; pipeline companies; gas companies; electric lighting companies; hydroelectric companies; water companies; and all navigable water crossings. (Does not regulate commercial mobile telecommunications services or commercial mobile service providers, Voice over Internet Protocol services or providers.)
2014 Arkansas Code: Title 27 - Transportation	Arkansas State Highway and Transportation Department	Coordinates the state's transportation planning; oversees the state highway system; constructs, maintains and operates turnpike projects; oversees public transit service including freight and passenger; promotes the development of the navigable streams; encourages the development of river port and harbor facilities; governs rail transportation and services; regulates the transportation of hazardous materials; regulates aeronautics.

Sources: (JUSTIA, 2014a), (JUSTIA, 2014b), (JUSTIA, 2014c)

^a Because there is no single online source for Arkansas's rules and regulations and many departments' web sites do not include regulations, administrative rules are likely to be incomplete.

4.1.1.3. *Transportation*

This section describes the transportation infrastructure in Arkansas, including specific information related to the road networks, airport facilities, rail networks, and harbors (this PEIS defines "harbor" as a body of water deep enough to allow anchorage of a ship or boat). The movement of vehicles is commonly referred to as traffic, as well as the circulation along roads. Roadways in the state can range from multilane road networks with asphalt surfaces, to unpaved gravel or private roads. The information regarding existing transportation systems in Arkansas are based on a review of maps, aerial photography, and federal and state data sources.

The Arkansas Highway and Transportation Department (AHTD) has jurisdiction over freeways and major roads, railroads, and mass transit in the state; local counties have jurisdiction for smaller streets and roads. The mission of the AHTD is to "provide a safe, efficient aesthetically pleasing and environmentally sound intermodal transportation system for the user" (AHTD, 2015).

Arkansas has an extensive and complex transportation system across the entire state. The state's transportation network consists of:

- 101,656 miles of public roads (FHWA, 2014) and 12,806 bridges (FHWA, 2015a);
- 2,750 miles of rail network that includes passenger rail and freight (AHTD, 2002);
- 305 aviation facilities, including airstrips and heliports (FAA, 2015a); and
- Nine river ports and 5 harbors (Arkansas Waterways Commission, 2016a).

Road Networks

As identified in Figure 4.1.1-1, the major urban centers of the state from north to south are Fayetteville, Jonesboro, West Memphis, Little Rock, and Hot Springs-Malvern. Arkansas has three major interstates connecting its major metropolitan areas to one another, as well as to other

states. Travel outside the major metropolitan areas is conducted on interstates, and state and county roads. Table 4.1.1-2 lists the interstates and their start/end points in Arkansas. Per the national standard, even numbered interstates run from west to east with the lowest numbers beginning in the south; odd numbered interstates run from north to south with the lowest numbers beginning in the west (FHWA, 2014).

Table 4.1.1-2: Arkansas Interstates

Interstate	Southern or western terminus in AR	Northern or eastern terminus in AR
I-30	TX line at Texarkana	US-65 in Little Rock
I-40	OK line at Dora	TN line at Marion
I-49	I-40 in Alma	MO line at Bella Vista
I-55	I-40 in West Memphis	MO line in Blytheville

Source: (FHWA, 2014)

In addition to the Interstate System, Arkansas has both National Scenic Byways and State Scenic Byways (FHWA, 2013). National and State Scenic Byways are roads that are recognized for one or more archaeological, cultural, historic, natural, recreational, and scenic qualities (FHWA 2013). Figure 4.1.1-1 illustrates the major transportation networks, including roadways, in Arkansas. Section 4.1.8, Visual Resources, describes the National and State Scenic Byways found in Arkansas from an aesthetic perspective.

National Scenic Byways are roads with nationwide interest; the U.S. Department of Transportation's Federal Highway Administration (FHWA) designates and maintains byways. Arkansas has three National Scenic Byways (FHWA, 2015c):

- Crowley's Ridge Parkway: 212 miles through Arkansas and Missouri.
- Great River Road: 2,069 miles through Arkansas, Illinois, Iowa, Kentucky, Louisiana, Minnesota, Mississippi, Missouri, Tennessee, and Wisconsin.
- Talimena Scenic Drive: 54 miles through Arkansas and Oklahoma.

State Scenic Byways are roads with statewide interest; AHTD designates and manages State Scenic Byways. Some State Scenic Byways may be designated on portions of National Scenic Byways. Arkansas has seven State Scenic Byways that crisscross the entire state (AHTD 2014):²

- Arkansas Scenic Highway 7
- Boston Mountains Scenic Loop
- Mount Magazine
- Ozark Highlands
- Pig Trail
- Sylamore
- I-530 Byway

² The total number of State Scenic Byways may not include those segments of National Scenic Byways that are also designated as State Scenic.

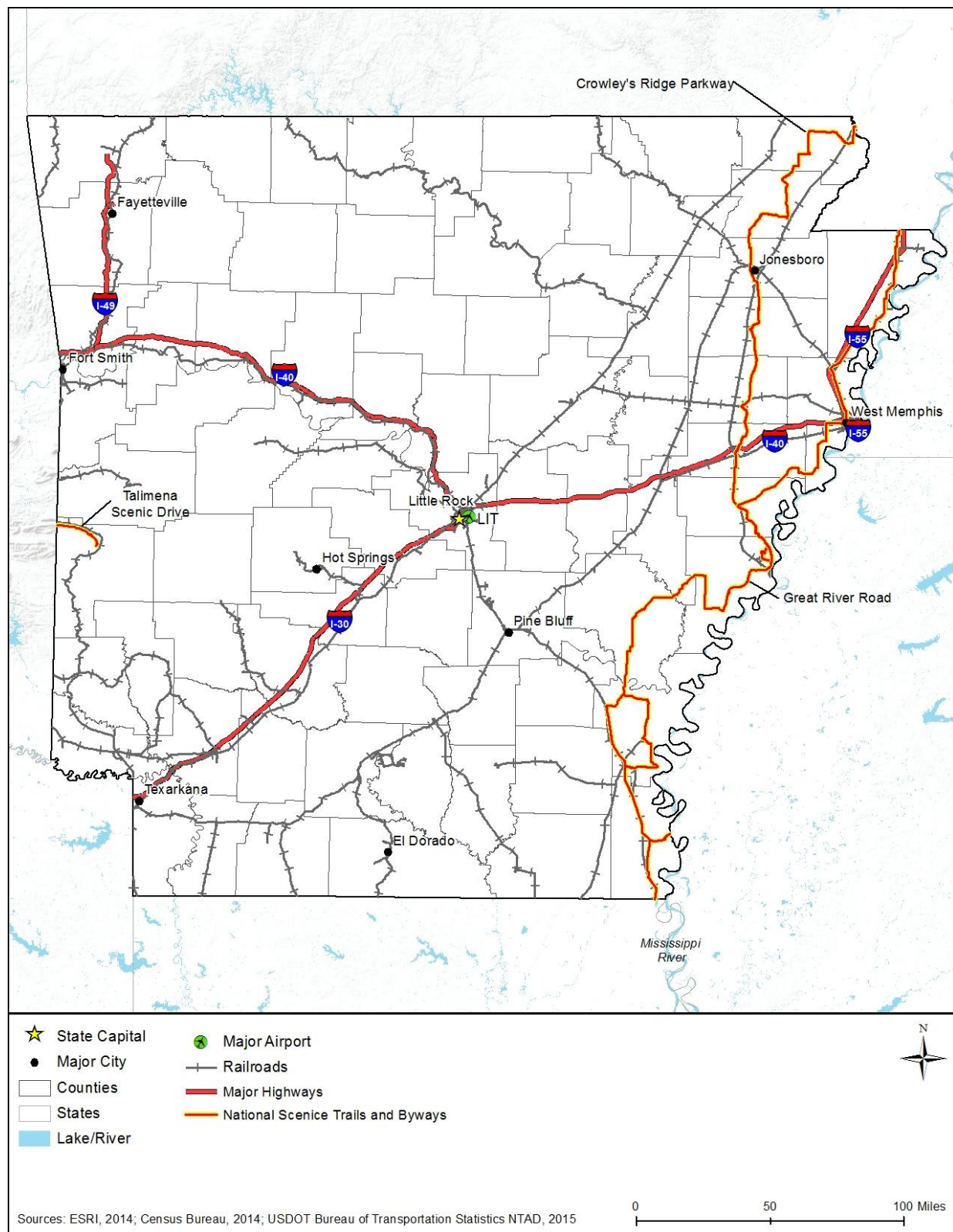


Figure 4.1.1-1: Arkansas Transportation Networks

Airports

The Bill and Hillary Clinton National Airport (LIT) in Little Rock provides air service to the state. The airport is operated by the Little Rock Municipal Airport Commission (LIT, 2015). In 2014, LIT served 2,076,551 passengers (LIT, 2014) and handled 146,588,078 pounds of cargo, making it the 102nd busiest airport in terms of pounds of cargo moved (FHWA, 2015b). Figure 4.1.1-1 illustrates the major transportation networks, including airports, in the state. Section 4.1.7, Airspace, provides detail on airports and airspace in Arkansas.

Rail Networks

Arkansas is connected to a network of passenger rail (Amtrak) and freight rail. Figure 4.1.1-1 illustrates the major transportation networks, including rail lines, in Arkansas. Amtrak runs one line through Arkansas: the Texas Eagle, which runs daily from Chicago to San Antonio. Table 4.1.1-3 provides a complete list of Amtrak lines that run through Arkansas.

Table 4.1.1-3: Amtrak Train Routes Serving Arkansas

Route	Starting Point	Ending Point	Length of Trip	Cities Served in Arkansas
Texas Eagle	Chicago, IL	San Antonio, TX	32 hours 25 minutes	Walnut Ridge, Little Rock, Malvern, Arkadelphia, Hope, Texarkana

Source: (Amtrak, 2015a) (Amtrak, 2015b)

All 2,750 miles of track in Arkansas are owned and operated by freight rail companies. Twenty-six railroad companies operate in the state, but three Class I freight rail companies own and operate on 69 percent of all railroad tracks, or 1,893 miles, in the state. The other 857 miles of track, or 31 percent, are owned and operated by 23 Class III railroads. Union Pacific Railroad, BNSF Railway, and Kansas City Southern Railway are the three Class I freight rail companies in Arkansas; Union Pacific is the largest rail operator in the state, with 1,464 miles of track. Of all freight traveling to Arkansas, 45 percent travels by rail, and 48 percent travels by truck; conversely, of all freight traveling out of Arkansas, only 27 percent travels by rail and 66 percent travels by truck. (AHTD, 2002)

Ports and Harbors

Arkansas has nine river ports and five harbors to provide river transportation in the state. The Arkansas River has three ports—Port of Little Rock, Port of Pine Bluffs/Jefferson County, and Fort Smith—provide cargo transport along the riverway with railroads, terminals, warehousing, and storage (Arkansas Waterways Commission, 2016b). The Mississippi River crosses through Arkansas with four river ports and three harbors—Philips County Port Authority for Helena-West Helena, Port of Osceola, Port of West Memphis, and Yellow Bend Port (Arkansas Waterways Commission, 2016c). The Ouachita River has two river ports—the Port of Camden and Port of Crossett (Arkansas Waterways Commission, 2016c).

4.1.1.4. Public Safety Services

Arkansas public safety services generally consist of public safety infrastructure and first responder personnel aligned with the demographics of the state. Table 4.1.1-4 presents

Arkansas's key demographics including population (estimated); land area; population density; and number of counties, cities/towns, and municipal governments. More information about these demographics is presented in Section 4.1.9, Socioeconomics; however, these demographics are key to understanding the breadth of public safety services throughout the state.

Table 4.1.1-4: Key Arkansas Indicators

Arkansas Indicators	
Estimated Population (2014)	2,966,369
Land Area (square miles) (2010)	52,035
Population Density (persons per sq. mile) (2010)	56.0
Municipal Governments (2013)	502

Sources: (U.S. Census Bureau, 2015a) (U.S. Census Bureau, 2013a) (National League of Cities, 2007)

Table 4.1.1-5 presents Arkansas's public safety infrastructure, including fire and police stations.

Table 4.1.1-5: Public Safety Infrastructure in Arkansas by Type

Infrastructure Type	Number
Fire and Rescue Stations ^a	1,188
Law Enforcement Agencies ^b	367
Fire Departments ^c	679

Sources: (U.S. Fire Administration, 2015) (U.S. Bureau of Justice Statistics, 2011)

^a Data collected by the U.S. Fire Administration in 2015.

^b Number of agencies from state and local law enforcement include: local police departments, sheriffs' offices, primary state law enforcement agencies, special jurisdictional agencies, and other miscellaneous agencies, collected by the U.S. Bureau of Justice Statistics in 2008.

^c Data collected by the U.S. Fire Administration in 2015.

Table 4.1.1-6 identifies first responder personnel including dispatch, fire and rescue, law enforcement, and emergency medical personnel in the state.

Table 4.1.1-6: First Responder Personnel in Arkansas by Type

First Responder Personnel	Number
Police, Fire and Ambulance Dispatchers ^a	1,100
Fire and Rescue Personnel ^b	13,474
Law Enforcement Personnel ^c	11,165
Emergency Medical Technicians and Paramedics ^{d,e}	2,220

Sources: (U.S. Fire Administration, 2015) (U.S. Bureau of Justice Statistics, 2011) (BLS, 2015a)

^a BLS Occupation Code: 43-5031.

^b BLS Occupation Codes: 33-2011 (Firefighters), 33-2021 (Fire Inspectors and Investigators), 33-1021 (First-Line Supervisors of Fire Fighting and Prevention Workers), and 53-3011 (Ambulance Drivers and Attendants, Except Emergency Medical Technicians). Volunteer firefighters reported by the U.S. Fire Administration.

^c Full-time employees from state and local law enforcement agencies which include: local police departments, sheriffs' offices, primary state law enforcement agencies, special jurisdictional agencies, and other miscellaneous agencies, collected by the U.S. Bureau of Justice Statistics in 2008.

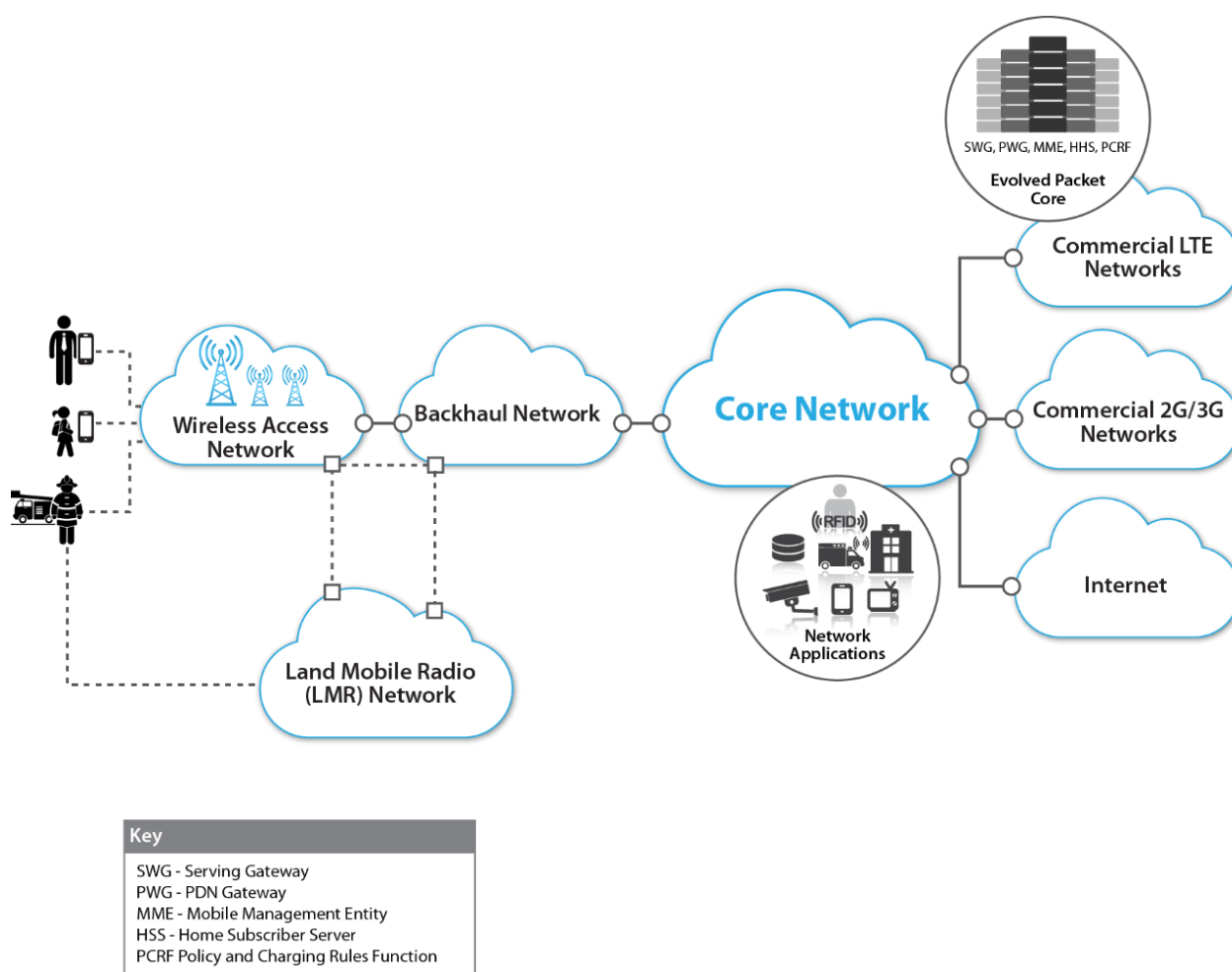
^d BLS Occupation Code: 29-2041.

^e All BLS data collected in 2015.

4.1.1.5. Telecommunications Resources

There is no central repository of information for public safety communications infrastructure and commercial telecommunications infrastructure; therefore, the following information and data are combined from a variety of sources, as referenced.

Communications throughout the state are based on a variety of publicly and commercially owned technologies. Figure 4.1.1-2 presents a typical wireless configuration including both a narrowband public safety land mobile radio network (traditional radio network) and a commercial broadband access network (wireless technology); backhaul (long-distance wired or wireless connections), core, and commercial networks including a Long Term Evolution (LTE) evolved packet core (modern broadband cellular networks); and network applications (software) delivering voice, data, and video communications. (FCC, 2016a)



Prepared by: Booz Allen Hamilton

Figure 4.1.1-2: Wireless Network Configuration

Public Safety Communications

In order to protect and best serve the public interest, first responder and law enforcement communities must be able to communicate effectively. The evolution of the communications networks used by public safety stakeholders toward a broadband wireless technology, such as LTE (see Section 2.1.1), has the potential to provide users with better coverage, while offering additional capacity and enabling the use of new applications that would likely make their work safer and more efficient. Designing such a network presents several challenges due to the uniqueness of the deployment, the requirements, and the nationwide scale. (NIST 2015)

Historically, there have been many challenges and impediments to timely and effective sharing of information. Chief among these factors impacting information sharing are: network coverage gaps, land mobile radio system infrastructure diversity, insufficient budgets, and diverse radio frequencies. Communication interoperability has also been a persistent challenge, along with issues concerning spectrum availability, embedded infrastructure, and differing standards among stakeholders (NTFI, 2005). This has caused a fragmented approach to communications implementation across the U.S. and in Arkansas. There are five key reasons why public safety agencies often cannot connect through existing communications (NTFI, 2005):

- Incompatible and aging communications equipment;
- Limited and fragmented funding;
- Limited and fragmented planning;
- A lack of coordination and cooperation; and
- Limited and fragmented radio spectrum.

To help enable the public safety community to incorporate disparate Land Mobile Radio networks with a nationwide public safety LTE broadband network, the U.S. Department of Commerce Public Safety Communications Research (PSCR) prepared a locations-based services (LBS) R&D roadmap to examine the current state of location-based technologies. The program forecast the evolution of LBS capabilities and gaps, and identify potential research and development opportunities that would improve the public safety community's use of LBS within operational settings. This is the first of several technology roadmaps that PSCR plans to develop over the next few years. (PSCR, 2015)

Public safety network communications in Arkansas reflect a combination of legacy (or predecessor) analog Very High Frequency (VHF),³ and Ultra High Frequency (UHF),⁴ radios operating across multiple frequencies bands as well as a statewide digital Project 25 (P-25) 700 MHz/800 MHz network called the Arkansas Wireless Information Network (AWIN). In 2004, Arkansas initiated operations of AWIN which provides interoperability for Public Safety users and serves as the core statewide Public Safety and State Agency wireless network in the state. The 2014 Arkansas Statewide Interoperability Communication Plan summarized the AWIN background and interoperability benefits as follows:

³ VHF band covers frequencies ranging from 30 MHz to 300 MHz (NTIA, 2005).

⁴ UHF band covers frequencies ranging from 300 MHz to 3000 MHz (NTIA, 2005).

Arkansas has made significant progress toward statewide interoperability with the expanded use of their statewide communication system, AWIN. The P-25 compliant 700/800 megahertz (MHz) system was first deployed in 2004, leveraging the assets of the Arkansas State Police. AWIN provides standards based platform to improve interoperability and compatibility for State and local agencies, and allows access to a tactical level of connectivity for every county's incident command structure (Arkansas Wireless Information Network, 2014).

A total of six Phase 1 Frequency Division Multiplexing P-25 systems are deployed in Arkansas (as of mid-2015), as follows:

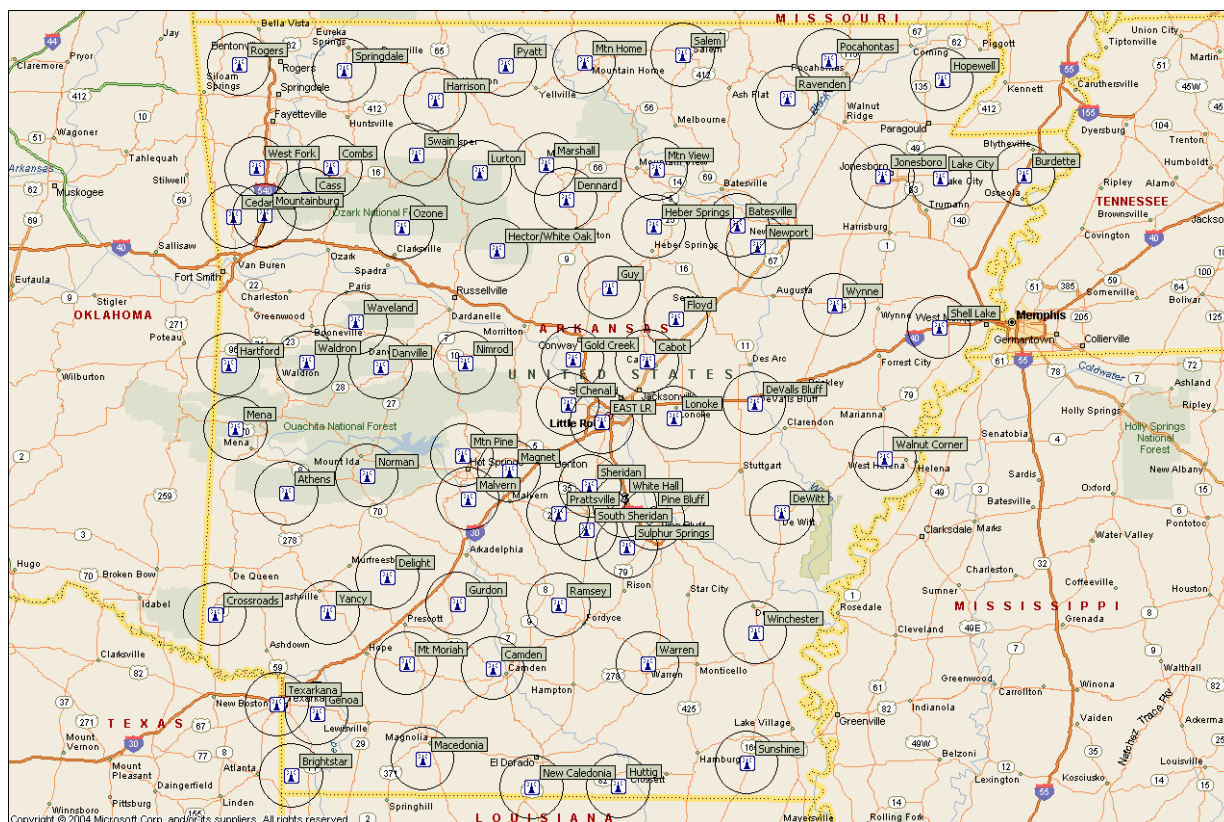
- One system is the AWIN 700 MHz system;
- Three systems are county systems;
- Two systems include Conway, and Faulkner operating at 800 MHz; and
- One Arkansas P-25 System 187 is in Sebastian County (with the three remaining Phase 1 P-25 systems serving the Arkansas National Guard, the Federal Correctional Complex, and the Little Rock Air Force Base) (P25.org, 2015).

In Arkansas, multiple organizations contribute to the governance, oversight, and operations of the AWIN. According to AWIN, their "Steering Committee provides direction and guidance to AWIN Program Management. The AWIN Local Leadership Council provides the local point-of-view and provides advice and guidance to the AWIN Steering Committee" (Arkansas Wireless Information Network, 2015c). In addition, Arkansas has formed an interoperability committee, the Arkansas Interoperability Executive Committee; the group provides executive oversight as well as financial and strategic planning input to the enhancement and extensibility of the AWIN system and other State Public Safety modernization initiatives (Arkansas Wireless Information Network, 2015a). Arkansas Interoperability Executive Committee is made up with diverse public safety agency and practitioner representation including state police, emergency management, and local representation.

Statewide Public Safety Networks

The AWIN is the primary wireless communications network used by Public Safety Agencies (police, fire, and EMS) and state Agencies such as the Emergency Management Agency, the Department of Corrections, and the AHTD for statewide communications (RadioReference.com, 2015a). Figure 4.1.1-3 displays the broad network coverage of the AWIN towers in the state (RadioReference.com, 2015b).

The Arkansas State Police use the AWIN 700 MHz/800MHz networks as their primary communications network (RadioReference.com, 2015a). Statewide Mutual Aid in Arkansas is provided at VHF frequencies (37.1-37.24 MHz) for inter-county communications and VHF frequencies (154.23 -158.74 MHz) for fire and other Mutual Aid users (RadioReference.com, 2015c).



Source: (RadioReference.com, 2015b)

Figure 4.1.1-3: Arkansas Wireless Information Network Tower Locations

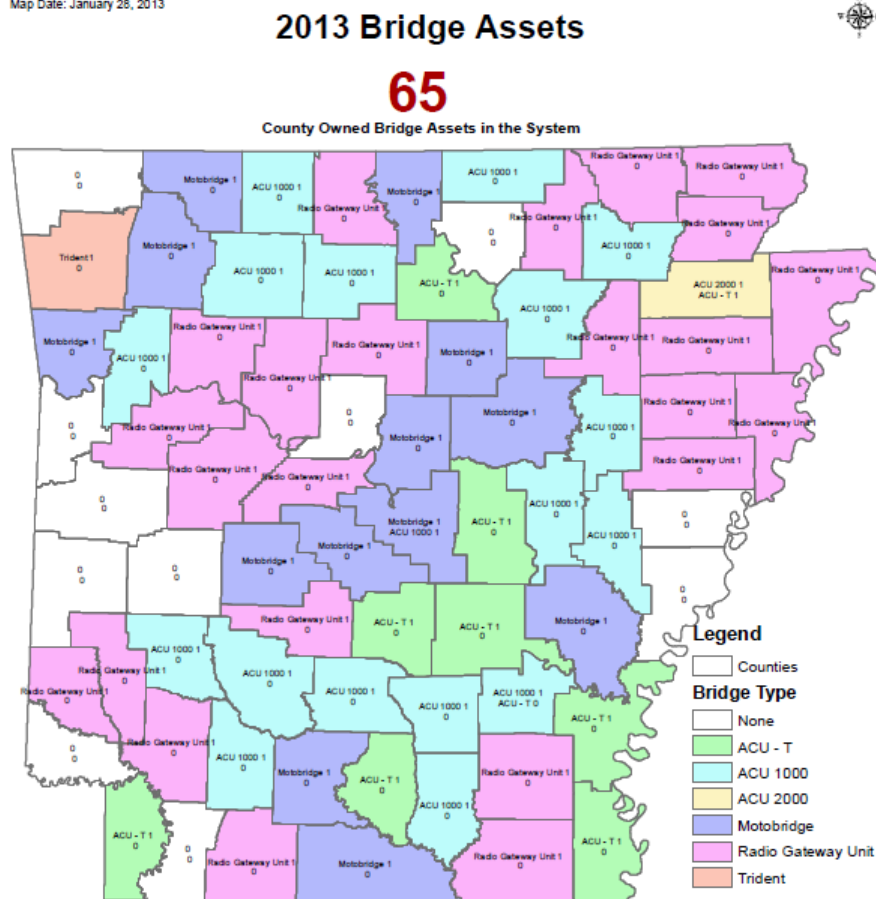
City and County Public Safety Networks

Arkansas's city and county public safety networks serving police, fire, and EMS users are diverse with a large number of legacy VHF and UHF systems reflecting a mix of legacy analog and newer digital systems such as P-25. In Arkansas, counties depend upon the AWIN system as a core communications network, but continue to use legacy systems for such applications as tactical communications, UHF backup, and mutual aid. County and city fire agencies, the Arkansas Fire Academy, EMS, and hospital dispatch as well as EMS tactical communications all continue to use VHF systems (RadioReference.com, 2015a).

An important aspect of the Arkansas Public Safety communications landscape is the presence of a dispersed network of bridge or bridging assets and communications equipment strategically located throughout the state (Figure 4.1.1-3) (Arkansas Wireless Information Network, 2015b). To facilitate the interoperability of public safety and city/county users in Arkansas, there were 65 bridge assets⁵ owned by counties in 2013; Figure 4.1.1-4 provides locations and vendors for these county-owned communications assets.

⁵ A bridge system provides interconnection between different radio and other communications systems; in Land Mobile Radio its purpose is to cross band and facilitate communications across two or more radio networks.

Map Date: January 28, 2013



Source: (Arkansas Wireless Information Network, 2015b)

Figure 4.1.1-4: Arkansas County Bridge Assets

Public Safety Answering Points (PSAPs)

According to the Federal Communication Commission's (FCC) Master PSAP registry, there are 50 PSAPs in Arkansas serving Arkansas's 75 counties (FCC, 2016d).

Commercial Telecommunications Infrastructure

Arkansas's commercial telecommunications industry and infrastructure is robust with multiple service providers, offering products and services via the full spectrum of telecommunications technologies (FCC, 2014a) (FCC, 2014b). The following sub-sections present information on Arkansas's commercial telecommunications infrastructure, including information on the number of carriers and technologies deployed; geographic coverage; voice, Internet access, and wireless subscribers; and the quantity and location of telecommunications towers, fiber optic plant, and data centers.

Carriers, Coverage, and Subscribers

Arkansas's commercial telecommunications industry provides the full spectrum of telecommunications technologies and networks, including coaxial cable (traditional copper

cable), fiber optics, hybrid fiber optics/coaxial cable, microwave, wireless, and satellite systems. Table 4.1.1-7 presents the number of providers of switched access⁶ lines, Internet access,⁷ and mobile wireless services including coverage.

Table 4.1.1-7: Telecommunications Access Providers and Coverage in Arkansas as of December 31, 2013

Commercial Telecommunications Access Providers	Number of Service Providers	Coverage of Households
Switched access lines ^a	117	97% of households ^b
Internet access ^c	56	36% of households
Mobile wireless ^d	5	96% of population

Sources: (FCC, 2014a) (FCC, 2014b) (NTIA, 2014)

^a Switched access lines are a service connection between an end user and the local telephone company's switch (the basis of older telephone services); this number of service providers was reported by the FCC as of December 31, 2013 in Table 17 in "Local Telephone Competition: Status as of December 31, 2013" as the total of ILEC and non-ILEC providers (FCC, 2014b).

^b Household coverage data provided by the FCC in "Universal Service Monitoring Report" as a Voice Penetration percentage (percentage of household with a telephone in the unit) and is current as of 2013.

^c Internet access providers are presented in Table 21 by technology provided; the number of service providers is calculated by subtracting the reported Mobile Wireless number from the total reported number of providers. Household coverage is provided in Table 13 (FCC, 2014a).

^d Mobile wireless provider data was retrieved from the FCC National Broadband Map website (www.broadbandmap.gov/data-download). The process of the data collection is explained in the broadband footnote.

Table 4.1.1-8 shows the wireless providers in Arkansas along with their geographic coverage. The following four maps: Figure 4.1.1-5, Figure 4.1.1-6, Figure 4.1.1-7, and Figure 4.1.1-8 show: the combined coverage for the top two providers; Sprint and T-Mobile's coverage; Cricket Wireless and Black Sheep Computing Inc.'s coverage; and the coverage of all other providers with less than 5 percent coverage area, respectively.⁸

⁶ "A service connection between an end user and the local telephone company's switch; the basis of plain old telephone services (POTS)" (FCC, 2014b).

⁷ Internet access includes Digital Subscriber Line (DSL), cable modem, fiber, satellite, and fixed wireless providers.

⁸ The broadband map utilized data collected as part of the broadband American Recovery and Reinvestment Act initiative. The data was retrieved from the FCC National Broadband Map website (www.broadbandmap.gov/data-download). Each state's broadband data was downloaded accordingly. The data pertaining to broadband data/coverage for census blocks, streets, addresses, and wireless were used. Census blocks, roads, and addresses were merged into one file and dissolved by similar business and provider names. Square miles were calculated for each provider. The maps show all providers over 5% on separate maps; providers with areas under 5% were merged and mapped as "Arkansas Other Fiber Providers." All Wireless providers were mapped as well; those with areas under 5% were merged and mapped as "Arkansas Other Wireless Providers." Providers under 5% were denoted in their respective tables.

Table 4.1.1-8: Wireless Telecommunications Coverage by Providers in Arkansas

Wireless Telecommunications Providers	Coverage
AT&T Mobility LLC	98.43%
Verizon Wireless	91.58%
Sprint	26.45%
T-Mobile	9.80%
Cricket Wireless	6.24%
Black Sheep Computing Inc.	5.91%
Other ^a	24.77%

Source: (NTIA, 2014)

^a Other: Provider with less than 5 percent coverage area. Providers include: Mo-Ark Communications; The Computer Works; Direct; Connect 1; Vineyard Media; City-Wireless Inc.; Dlux Information Systems; RCC Wireless, LLC; PC Solutions, Inc.; HillBilly Wireless; Lonoke Broadband; Aristotle.Net Inc.; WestWeb; Vue Wireless; Nexus Systems; Wireless Etc.; SkyNet DataCom, LLC; G5 Internet, LLC; Data Technology Internet Service Provider; HBE Internet; Total Highspeed Internet; Indco.net; Batesville Computing; Velocity Broadband Internet Inc.; Bps Networks; Horton TV and Electronics; Bluebird Wireless Broadband Services.

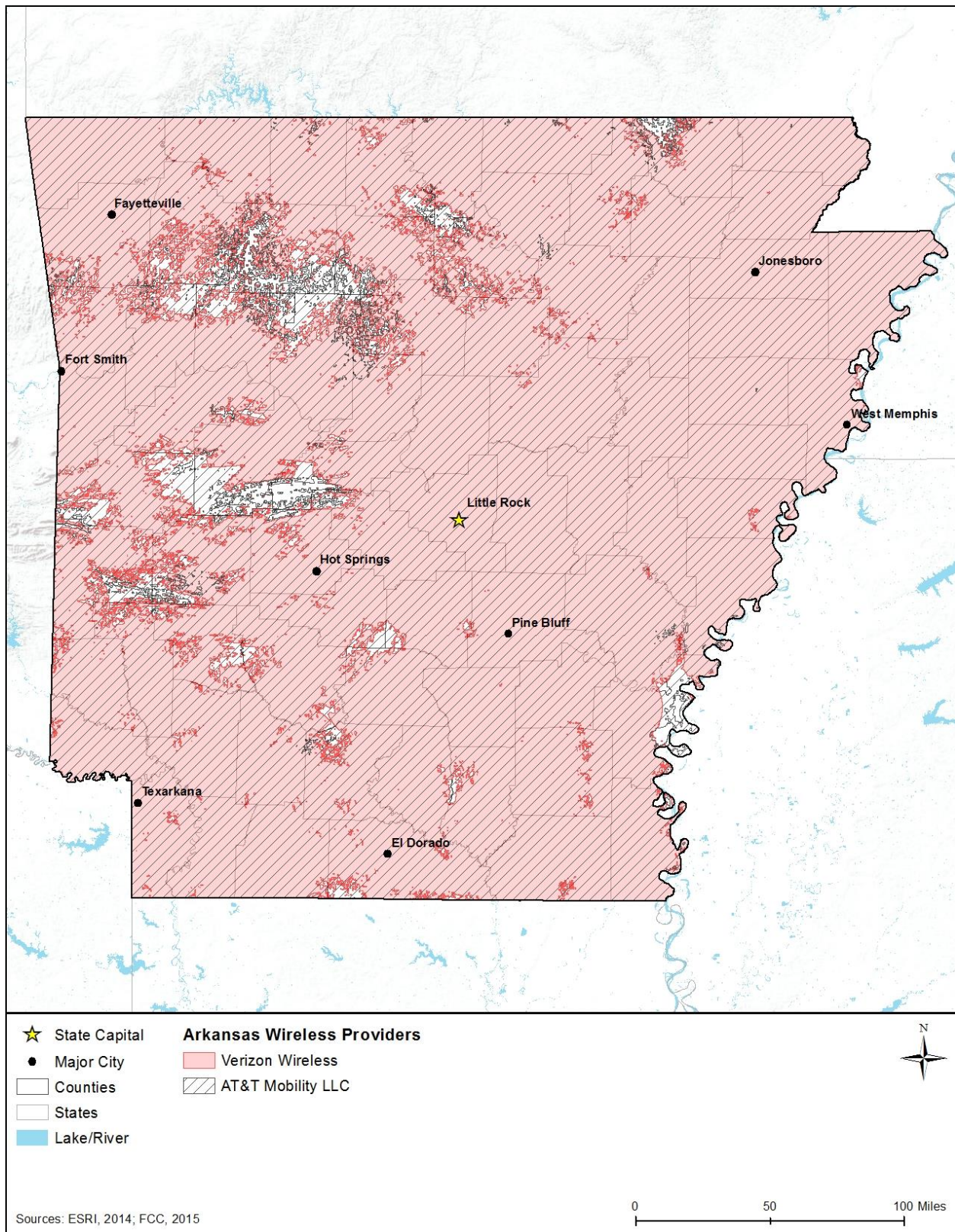


Figure 4.1.1-5: AT&T and Verizon Wireless Availability in Arkansas

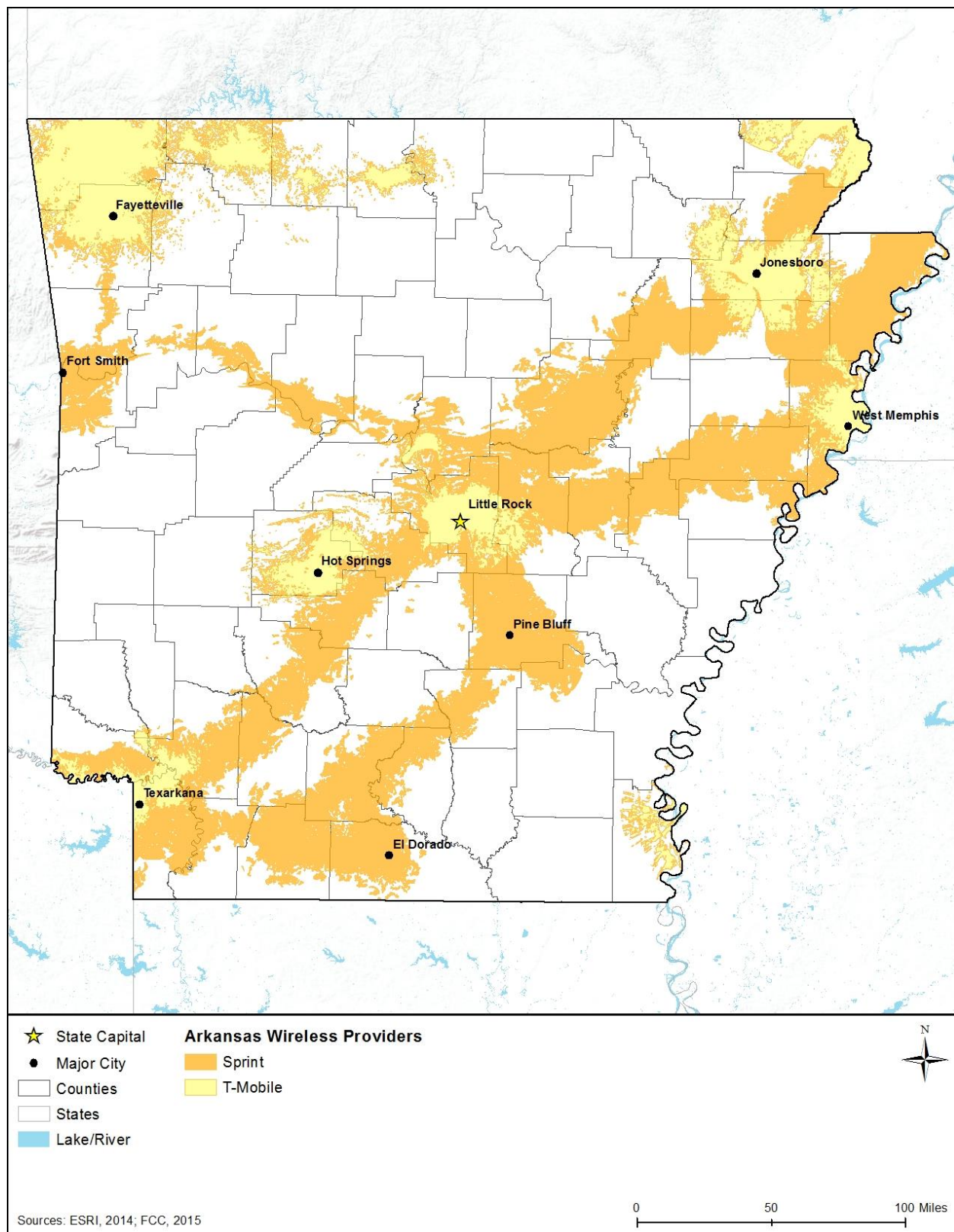


Figure 4.1.1-6: Sprint and T-Mobile Wireless Availability in Arkansas

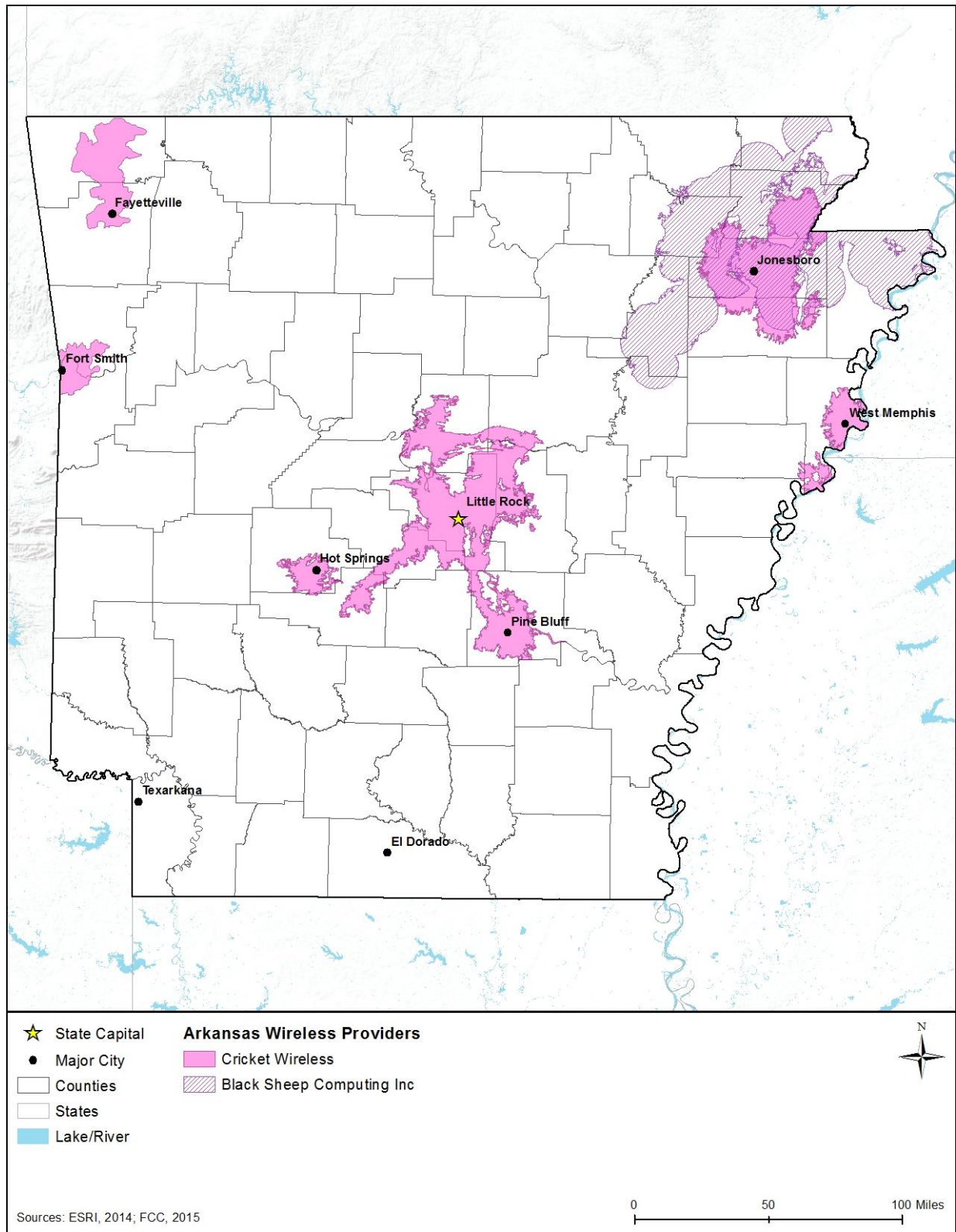


Figure 4.1.1-7: Cricket Wireless and Black Sheep Computing Inc. Wireless Availability in Arkansas

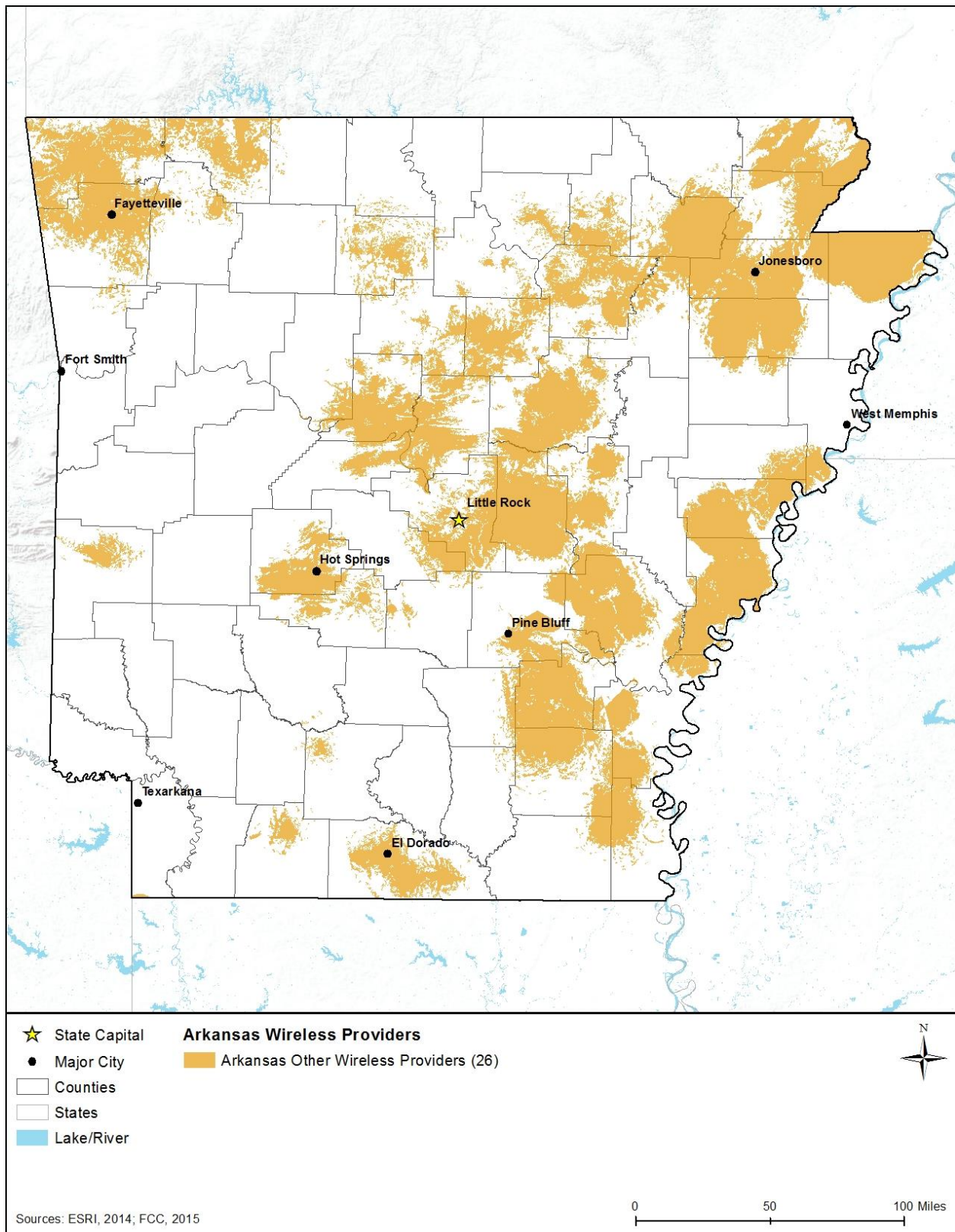


Figure 4.1.1-8: Other Providers Fiber Availability in Arkansas

Towers

There are many types of domestic towers employed today by the telecommunications industry, government agencies, and other owners. Towers are designed and used for a variety of purposes, and the height, location, and supporting structures and equipment are all designed, constructed, and operated according to the technical specifications of the spectrum used, the type of equipment mounted on the tower, geographic terrain, need for line-of-sight transmissions to other towers, radio frequency (RF) needs, and other technical specifications. There are three general categories of stand-alone towers: monopole, lattice, and guyed. Typically, monopole towers are the smallest, followed by lattice towers at a moderate height, and guyed towers at taller heights (with the guyed wires providing tension support for the taller heights) (CSC, 2007). In general, taller towers can provide communications coverage over larger geographic areas, but require more land for the actual tower site, whereas shorter towers provide less geographic coverage and require less land for the tower site (USFS, 2009a). Figure 4.1.1-9 presents representative examples of each of these categories or types of towers.



Monopole
100–200 feet

Source:
http://laps.noaa.gov/birk/laps_intranet/site_photos/Monarch/tower.jpg



Lattice
200–400 feet

Source: Personal Picture



Guyed
200–2,000 feet

Source:
<http://www.esrl.noaa.gov/gmd/ccgg/insitu/>

Prepared by: Booz Allen Hamilton

Figure 4.1.1-9: Types of Towers

Telecommunications tower infrastructure proliferates throughout Arkansas, although tower infrastructure is concentrated in the higher and more densely populated areas of Arkansas; Fayetteville, Fort Smith, Jonesboro, West Memphis, Little Rock, Pine Bluff, Hot Springs, Texarkana, and El Dorado. Owners of towers and some types of antennas are required to register those infrastructure assets with the FCC (FCC, 2016b).⁹ Table 4.1.1-9 presents the number of

⁹ An antenna structure must be registered with the FCC if the antenna structure is taller than 200 feet above ground level or may interfere with the flight path of a nearby airport (FCC, 2016b).

towers (including broadcast towers) registered with the FCC in Arkansas, by tower type, and Figure 4.1.1-10 presents the location of those 2,109 structures, as of June 2016.

Table 4.1.1-9: Number of Commercial Towers in Arkansas by Type

Constructed^a Towers^b		Constructed Monopole Towers	
100ft. and over	355	100ft. and over	355
75ft. – 100ft.	766	75ft. – 100ft.	766
50ft. – 75ft.	409	50ft. – 75ft.	409
25ft. – 50ft.	240	25ft. – 50ft.	240
25ft. and below	43	25ft. and below	43
Subtotal	1,813	Subtotal	1,813
Constructed Guyed Towers		Buildings with Constructed Towers	
100ft. and over	18	100ft. and over	18
75ft. – 100ft	36	75ft. – 100ft.	36
50ft. – 75ft	11	50ft. – 75ft.	11
25ft. – 50ft	7	25ft. – 50ft.	7
25ft. and below	1	25ft. and below	1
Subtotal	73	Subtotal	73
Constructed Lattice Towers		Multiple Constructed Structures^c	
100ft. and over	8	100ft. and over	8
75ft. – 100ft.	68	75ft. – 100ft.	68
50ft. – 75ft.	25	50ft. – 75ft.	25
25ft. – 50ft.	25	25ft. – 50ft.	25
25ft. and below	7	25ft. and below	7
Subtotal	133	Subtotal	133
Constructed Tanks^d			
Tanks	15		
Subtotal	15		
Total All Tower Structures		2,109	

Source: (FCC, 2015)

^a Planned construction or modification has been completed. Results will return only those antenna structures that the FCC has been notified are physically built or planned modifications/alterations to a structure have been completed (FCC, 2015).

^b Free standing or guyed structure used for communication purposes (FCC, 2012).

^c Multiple constructed structures per antenna registration (FCC, 2016c).

^d Any type of tank – water, gas, etc. with a constructed antenna (FCC, 2016c).

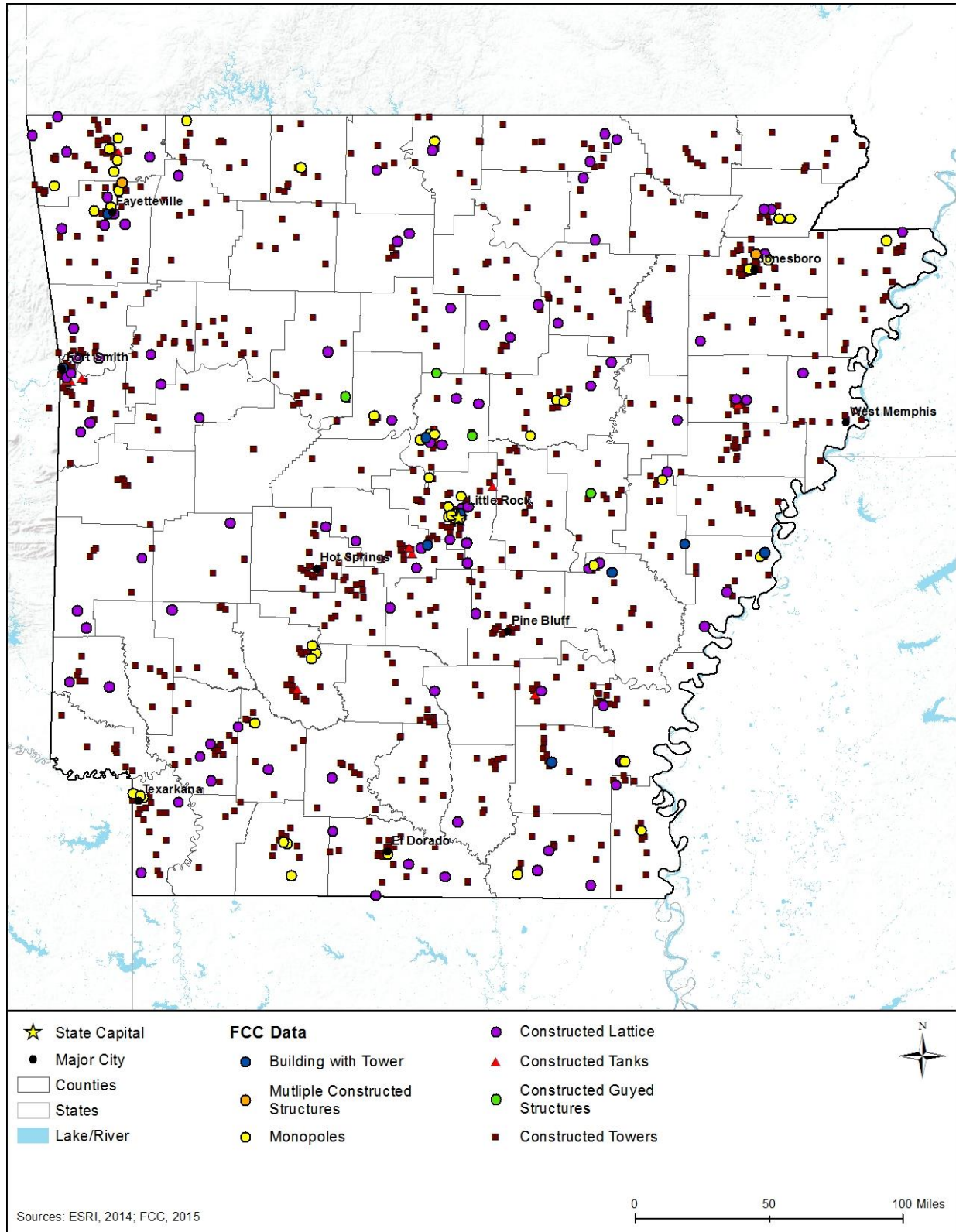
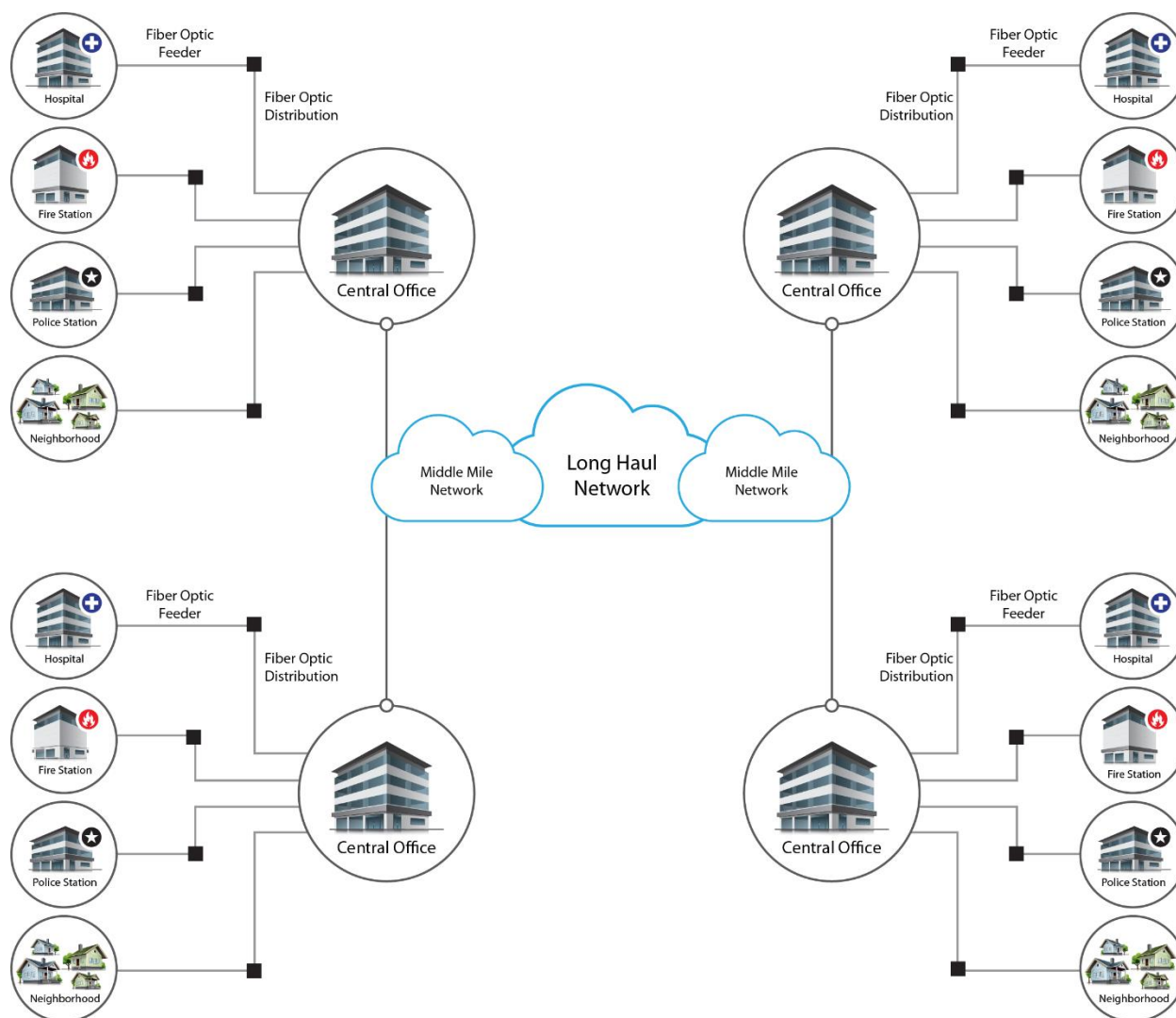


Figure 4.1.1-10: FCC Tower Structure Locations in Arkansas

Fiber Optic Plant (Cables)

Fiber optic plant, or cables, can be buried directly in the ground; pulled, blown, or floated into ducts, conduits, or innerduct (flexible plastic protective sleeves or tubes); placed under water; or installed aerially between poles, typically on utility rights-of-way (ROWs). A fiber optic network includes an access network consisting of a central office, distribution and feeder plant (cables of various sizes directly leaving a central office and splitting to connect users to the network), and a user location, as shown in Figure 4.1.1-11. The network also may include a middle mile component (shorter distance cables linking the core network between central offices or network nodes across a region) and a long haul network component (longer distance cables linking central offices across regions). (FCC, 2000)



Source: (ITU-T 2012)

Prepared by: Booz Allen Hamilton

Figure 4.1.1-11: Typical Fiber Optic Network in Arkansas

Last Mile Fiber Assets

In Arkansas, fiber access networks are concentrated in the highest population centers as shown in the figures below. As listed in Table 4.1.1-10, 43 fiber providers offer service in Arkansas. Figure 4.1.1-12 shows coverage for CenturyLink and Windstream Arkansas LLC. Figure 4.1.1-13 shows coverage for AT&T Southwest, and Figure 4.1.1-14 shows coverage for all other providers with less than 5 percent coverage area, respectively.

Table 4.1.1-10: Fiber Provider Coverage

Fiber Provider	Coverage
CenturyLink	14.28%
AT&T Southwest	9.66%
Windstream Arkansas, LLC	5.34%
Other ^a	19.25%

Source: (NTIA, 2014)

^a Other: Provider with less than 5 percent coverage area. Providers include: Suddenlink Communications; Cox Communications; Ritter Communications; South Arkansas Telephone Company; Walnut Hill Telephone Co; Southwest Arkansas Telephone Cooperative, Inc.; ALLEGIANCE COMMUNICATIONS LLC; Yelcot Telephone Company; Fidelity Communications; NATCO; Comcast; INDCO.NET; PGTELCO INTERNET; Arkansas Telephone Co.; Arkwest Communications; TDS TELECOM; Madison County Telephone Company, Inc.; Central Arkansas Telephone Cooperative, Inc.; Resort TV; Fusion Media; Cable ONE; Rice Belt Telephone Co; East AR Video; Clinton Cable Inc.; White County Cable TV; Hope Community TV; Newwave Communications; Pine Bluff Cable TV; Level 3 Communications, LLC; Magazine Telephone Company; Cam Tel Co; Conway Corporation; Pinnacle Communications; PLWC; Crystal Broadband Networks; Scott County Telephone Company; CableSouth Media III, LLC; Ozark Telephone Company; Bayou Cable, Inc.; Community Cablevision.

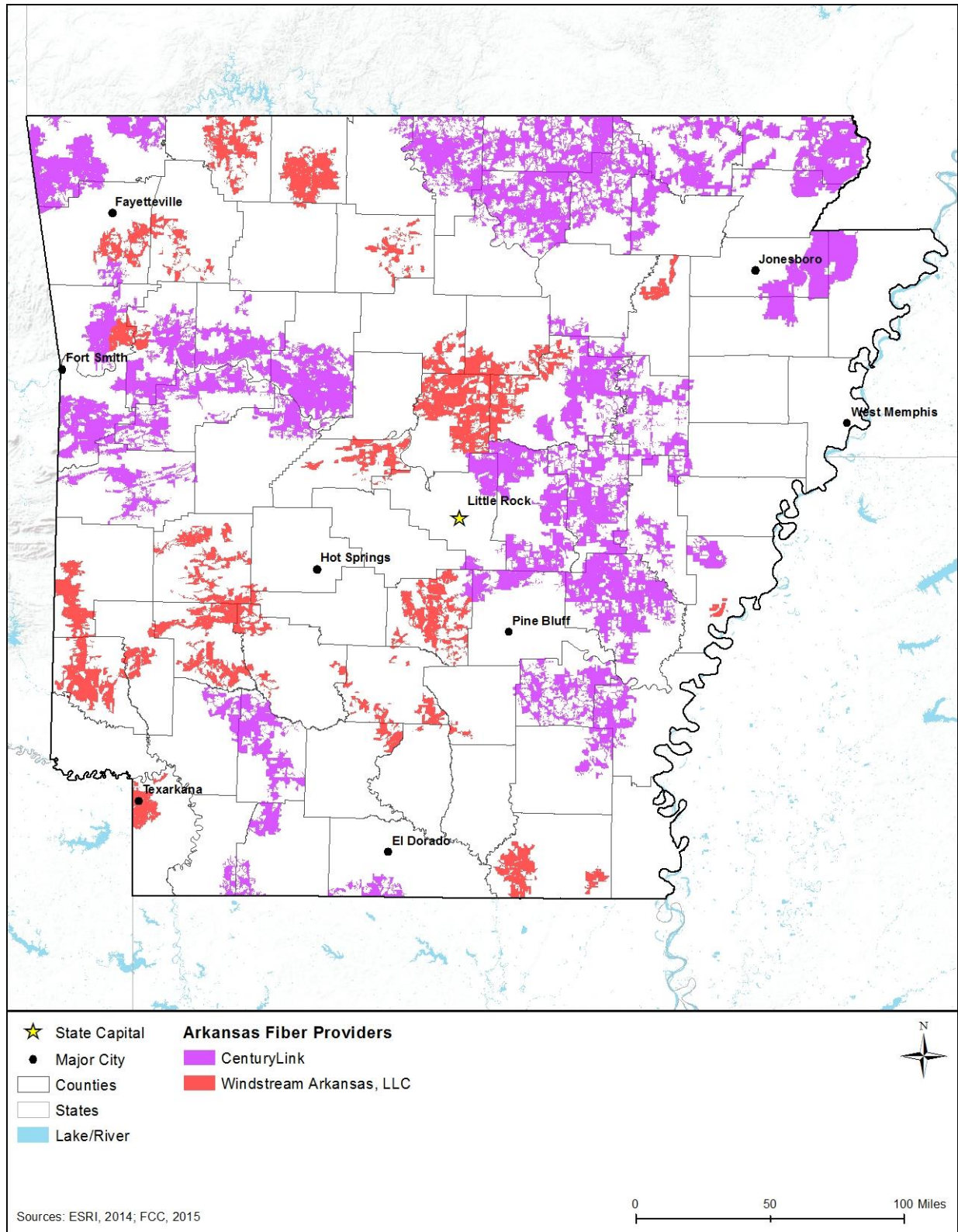


Figure 4.1.1-12: Fiber Availability in Arkansas for CenturyLink and Windstream Arkansas, LLC

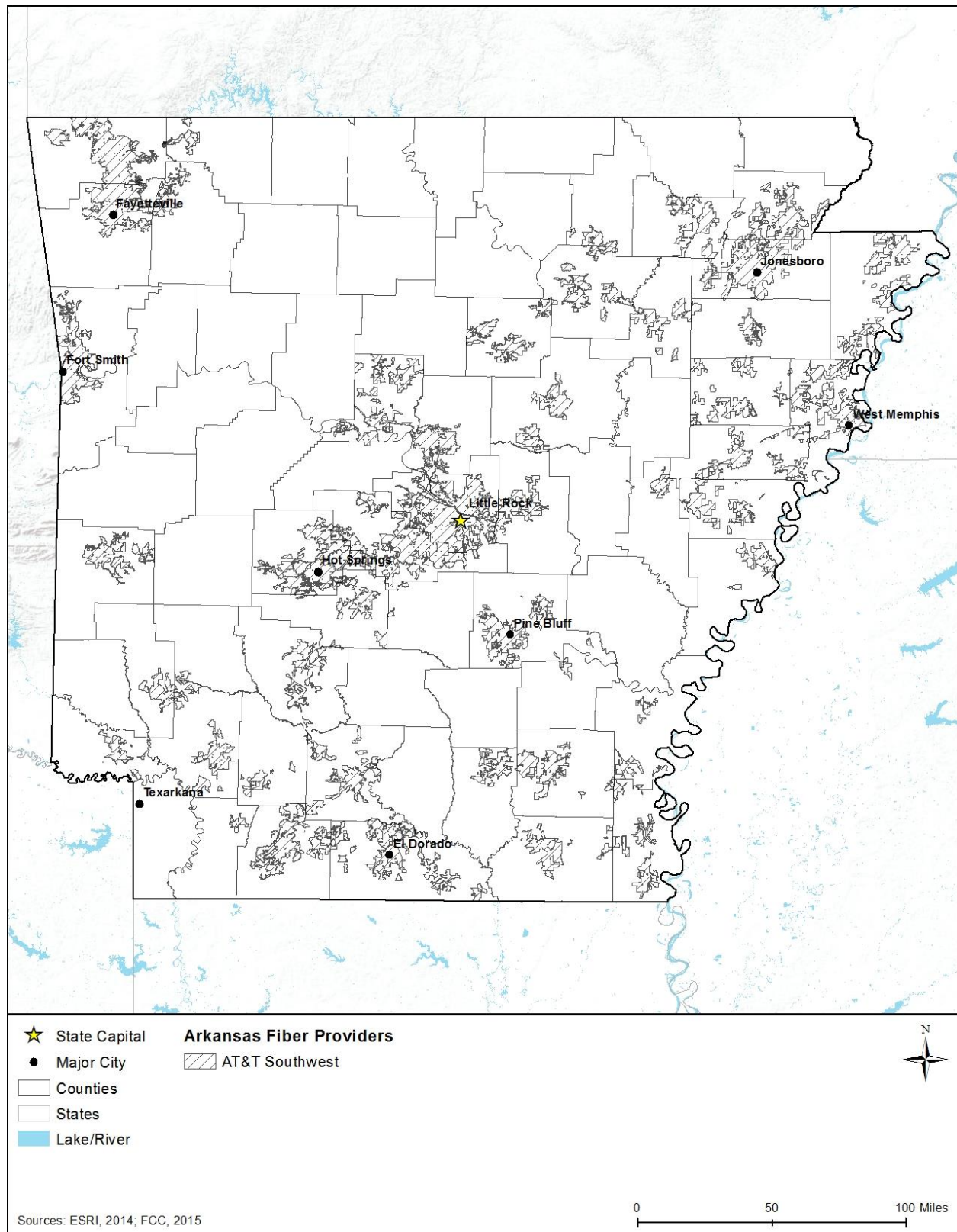


Figure 4.1.1-13: AT&T Southwest's Fiber Availability in Arkansas

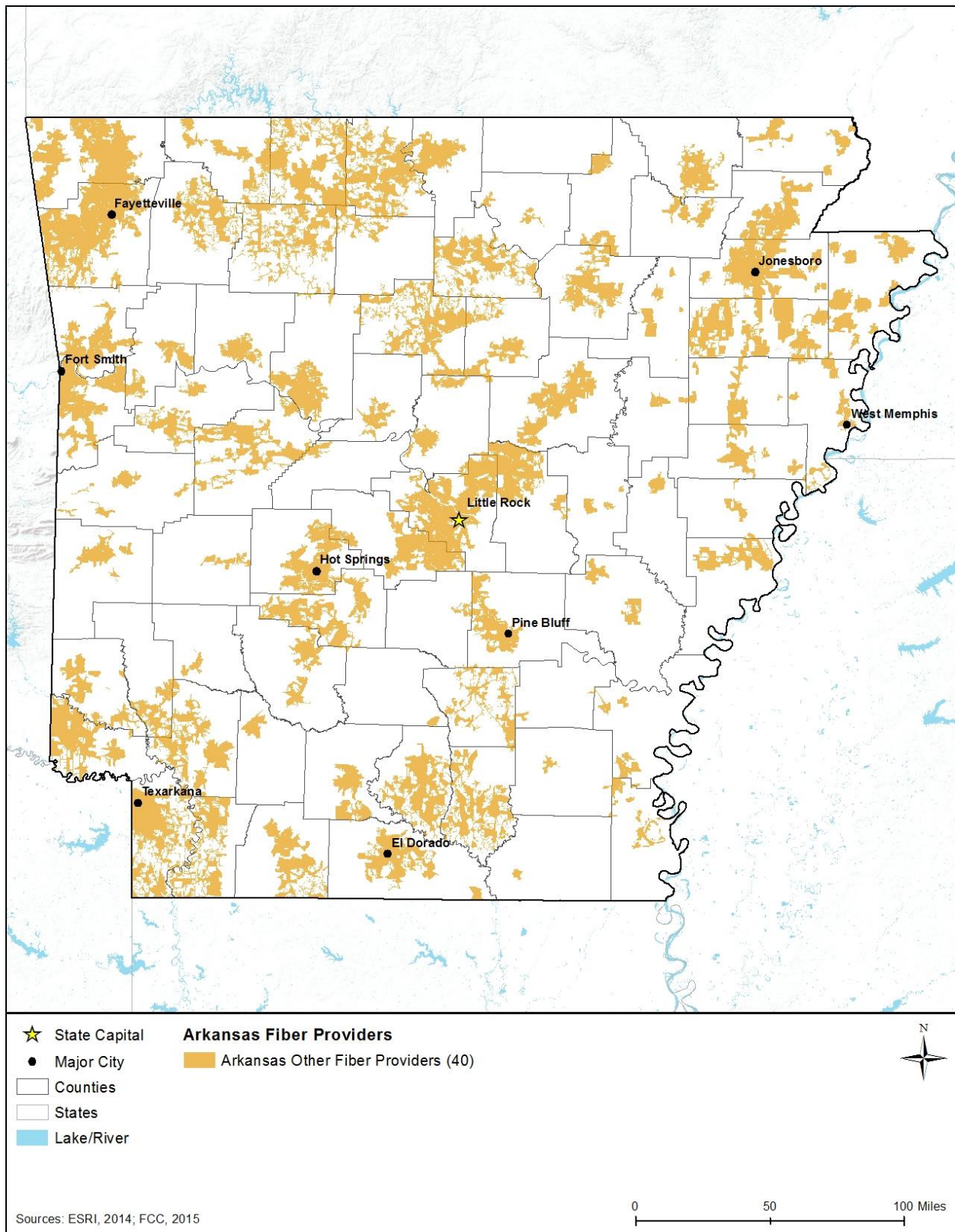


Figure 4.1.1-14: Other Provider's Fiber Availability in Arkansas

Data Centers

Data centers (also known as network access points, collocation facilities, hosting centers, carrier hotels, and Internet exchanges) are large telecommunications facilities that house routers, switches, servers, storage, and other telecommunications equipment. These data centers facilitate efficient network connectivity among, between telecommunications carriers, and between carriers and their largest customers. These facilities also provide racks and cages for equipment, power and cooling, cabling, physical security, and 24x7 monitoring (CIO Council, 2015; GAO, 2013). Ownership of data centers may be public or private; comprehensive information regarding data centers may not be publicly available as some are related to secure facilities.

4.1.1.6. Utilities

Utilities are the essential systems that support daily operations in a community and cover a broad array of public services, such as electricity, water, wastewater, and solid waste. Section 4.1.4, Water Resources, describes the potable water sources in the state.

Electricity

Electric utilities in Arkansas have their service quality and rates regulated by the Arkansas Public Service Commission (APSC). There are 24 electric utilities within their jurisdiction, “including four investor-owned utilities, one generation and transmission cooperative utility, seventeen distribution cooperative utilities, and two Regional Transmission Organizations.” Municipal utilities, wholesale electric generators, and public power agencies are not regulated by the APSC (APSC, 2015a). Generation plants fueled by coal produce most of the state’s electricity (EIA, 2016a). Out of the 60,417 thousand megawatthours (MWh)¹⁰ of electricity generated in 2016, 23,800 thousand MWh came from coal-fueled plants (EIA, 2017a). Nuclear power and natural gas contributed 13,421 thousand MWh and 18,259 thousand MWh each (EIA, 2016a). Respectively, these accounted for roughly 22 percent and 30 percent of the total. When combined, renewable energy produced about 8 percent of Arkansas’s power, though hydroelectric accounted for the larger portion of this (EIA, 2017b) (EIA, 2017a). While coal has long been the most used source of electricity in the state, large amounts of it are brought to Arkansas from Wyoming. A large portion (36.4 percent) of the state’s electricity is used by its industrial sector. The transportation sector uses 25.2 percent, while the residential and commercial sectors use only 22.1 percent and 16.3 percent, respectively (EIA, 2017c).

Water

The APSC has regulatory authority over the rates and service quality for some types of water utilities. Currently their reach extends to just one company: Liberty Utilities Inc. also called Pine Bluff Water. It does not have authority over municipal utilities, which make up a large portion of the state’s water providers. The APSC also does not regulate “any Class B or lower

¹⁰ One megawatthour is defined as one thousand kilowatthours or 1 million watthours; where one watthour is “the electrical energy unit of measure equal to one watt of power supplied to, or taken from, an electric circuit steadily for one hour.” (EIA, 2015b)

water and sewer companies (less than \$999,999 per year in water or sewer revenues) or property owners' associations whose facilities are enjoyed only by members of that association or residents of the community governed by that association" (APSC, 2015b). The quality of the water provided by public water systems is subject to the authority of Arkansas State Board of Health, part of the Arkansas Department of Health (ADH). This organization implements the regulations set forth in the federal Safe Drinking Water Act (SDWA). Public water systems are defined here as "system for the provision to the public of water for human consumption through pipes or other constructed conveyances, if such system has at least fifteen service connections or serves an average of at least twenty-five individuals daily at least 60 days per year" (ADH, 2014). Programs operated by the ADH are designed to identify and protect sources of drinking water, both above and below ground (ADH, 2011). The public water systems are required to provide reports, called consumer confidence reports, to their consumers. These reports detail water sources and possible contaminants. Monitoring the quality of water in private wells and other private systems is the responsibility of the system's owner (USEPA, 2015a).

Wastewater

Arkansas wastewater is managed through permits and licenses for treatment facilities and their operators. Facilities wishing to treat or discharge wastewater must obtain a National Pollutant Discharge Elimination System (NPDES) (ADEQ, 2015a). Separate permits are issued for wastewater needs, including stormwater, underground injections, or the construction of a new facility (ADEQ, 2015b). The Enforcement Branch of the Arkansas Department of Environmental Quality (ADEQ) is responsible for monitoring individual NPDES permits (ADEQ, 2015c). Wastewater operators must also be licensed by the ADEQ. Much like NPDES permits, these licenses are specific to the facilities or types of treatment. ADEQ offers four classes of general licenses, as well as multiple industrial licenses. Training for these licenses is offered by the Arkansas Environmental Training Academy and the Arkansas Rural Water Association (ADEQ, 2015d).

Solid Waste Management

ADEQ Solid Waste Management Division oversees the management of Arkansas's solid waste. The state is divided into 18 solid waste management districts, to better facilitate the disposal of waste. Roughly, 75 percent of waste generated in the state is sent to landfills (ADEQ, 2015e). As of July 2016, the state is home to 31 landfills for municipal or commercial solid waste, as well as 26 non-commercial industrial landfills and two tire monofills. Thirty-three facilities exist for composting of materials such as organic, yard or solid waste (ADEQ, 2015f). In addition to all of these, there are 87 facilities in Arkansas dedicated to material recovery. The United States Environmental Protection Agency (USEPA) estimates that over 70 percent of the waste sent to Arkansas landfills is recyclable. In 2010, the state was able to recycle 32 percent of its solid waste, about 1,603,137 tons of material. An additional 7,265 tons of electronic waste was also collected (ADEQ, 2014a).

4.1.2. Soils

4.1.2.1. *Definition of the Resource*

The Soil Science Society of America defines soil as:

- i. “The unconsolidated mineral or organic material on the immediate surface of the Earth that serves as a natural medium for the growth of land plants.” (Natural Resources Conservation Service 2015a)
- ii. “The unconsolidated mineral or organic matter on the surface of the Earth that has been subjected to and shows effects of genetic and environmental factors of: climate (including water and temperature effects), and macro- and microorganisms, conditioned by relief, acting on parent material over a period of time. A product-soil differs from the material from which it is derived in many physical, chemical, biological, and morphological properties and characteristics.” (Natural Resources Conservation Service 2015a)

Five primary factors account for soil development patterns. A combination of the following variables contributes to the soil type in a particular area (University of Minnesota, 2001):

- *Parent Material*: The original geologic source material from the soil formed affects soil aspects, including color, texture, and ability to hold water.
- *Climate*: Chemical changes in parent material occur slowly in low temperatures. However, hot temperatures evaporate moisture, which also facilitates chemical reactions within soils. The highest degree of reaction within soils occurs in temperate, moist climates.
- *Topography*: Steeper slopes produce increased runoff, and, therefore, downslope movement of soils. Slope orientation also dictates the microclimate to which soils are exposed, because different slope faces receive more sunlight than others.
- *Biology*: The presence/absence of vegetation in soils affects the quantity of organic content of the soil.
- *Time*: Soil properties are dependent on the period over which other processes act on them.

4.1.2.2. *Specific Regulatory Considerations*

The Proposed Action must meet the requirements of the National Environmental Policy Act (NEPA) and other applicable laws and regulations. Applicable federal laws and regulations that apply for Soils, such as the Farmland Protection Policy Act of 1981, are in Appendix C, Environmental Laws and Regulations. A list of applicable state laws and regulations is included in Table 4.1.2-1 below.

Table 4.1.2-1: Relevant Arkansas Soils Laws and Regulations

State Law/Regulation	Regulatory Agency	Applicability
Arkansas Water and Air Pollution Control Act (Arkansas Code Annotated 8-4-101 et. seq.)	ADEQ	Discharges to surface waters resulting from construction activities that disturb one or more acre of surface soil.

Source: (ADEQ, 2017a)

4.1.2.3. Environmental Setting

Arkansas is composed of three Land Resource Region (LRR),¹¹ as defined by the Natural Resources Conservation Service (NRCS) (Natural Resources Conservation Service, 2006a):

- East and Central Farming and Forest Region;
- Mississippi Delta Cotton and Feed Grains Region; and
- South Atlantic and Gulf Slope Cash Crops, Forest, and Livestock Region.

Within and among Arkansas's three LRRs are 11 Major Land Resource Areas (MLRA),¹² which are characterized by patterns of soils, climate, water resources, land uses, and type of farming (Natural Resources Conservation Service, 2006a). The locations and characteristics of Arkansas's MLRAs are presented in Table 4.1.2-2.

Soil characteristics are an important consideration for FirstNet inasmuch as soil properties could influence the suitability of sites for network deployment. Soil characteristics can differ over relatively short distances, reflecting differences in parent material, elevation, and position on the landscape, biota¹³ such as bacteria, fungi, biological crusts, vegetation, animals, and climatic variables such as precipitation and temperature. For example, expansive soils¹⁴ with wet and dry seasons alternately swell and shrink, which presents integrity risks to structural foundations (Rogers, Olshansky, & Rogers, 2004). Soils can also be affected by a variety of surface uses that loosen topsoil and damage or remove vegetation or other groundcover, which may result in accelerated erosion, compaction, and rutting¹⁵ (discussed further in the subsections below).

¹¹ Land Resource Region: "A geographical area made up of an aggregation of Major Land Resource Areas (MLRA) with similar characteristics" (Natural Resources Conservation Service, 2006a).

¹² Major Land Resource Area: "A geographic area, usually several thousand acres in extent, that is characterized by a particular pattern of soils, climate, water resources, land uses, and type of farming" (Natural Resources Conservation Service, 2006a).

¹³ All living organisms of an area. (USGS, 2013a)

¹⁴ Expansive soils are characterized by "the presence of swelling clay minerals" that absorb water molecules when wet and expand in size or shrink when dry leaving "voids in the soil" (Rogers, Olshansky, & Rogers, 2004).

¹⁵ Rutting is indentations in soil from operating equipment in moist conditions or soils with lower bearing strength (USFS, 2009b).

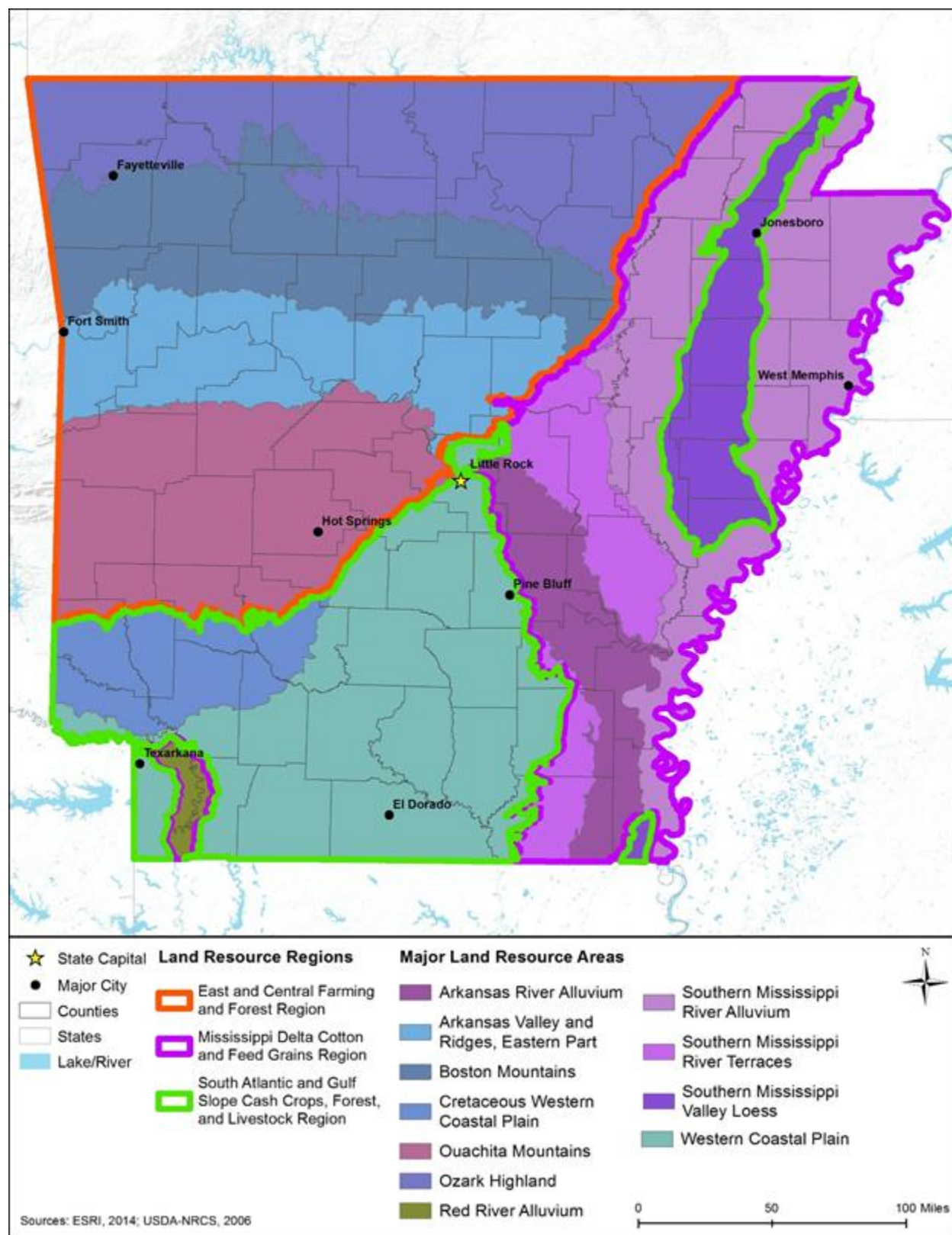


Figure 4.1.2-1: Locations of Major Land Resource Areas in Arkansas

Table 4.1.2-2: Characteristics of Major Land Resource Areas in Arkansas

MLRA Name	Region of State	Soil Characteristics
Arkansas River Alluvium	Southeastern Arkansas	Alfisols, ^a Entisols, ^b Inceptisols, ^c and Vertisols ^d are the dominant soil orders. These clayey or loamy soils ^e typically range from poorly drained to well drained, and are very deep.
Arkansas Valley and Ridges, Eastern Part	Central Arkansas	Ultisols ^e are the dominant soil order. These soils are well drained and range from shallow to deep.
Boston Mountains	Northern Arkansas	Inceptisols and Ultisols are the dominant soil orders. These loamy soils are typically well drained, and range from shallow to very deep.
Cretaceous Western Coastal Plain	Southwestern Arkansas	Alfisols, Entisols, Inceptisols, and Vertisols are the dominant soil orders. These soils range from shallow to very deep, and range from poorly drained to well drained.
Ouachita Mountains	West Central Arkansas	Inceptisols and Ultisols are the dominant soil orders. These loamy soils range from shallow to very deep. They typically range from somewhat poorly drained to somewhat excessively drained.
Ozark Highland	Northern Arkansas	Alfisols and Ultisols are the dominant soil orders. These soils are moderately well drained to excessively drained and range from shallow to very deep.
Red River Alluvium	Southwestern Arkansas	Alfisols, Entisols, Inceptisols, and Vertisols are the dominant soil orders. These clayey or loamy soils typically range from poorly drained to moderately well drained, and are very deep.
Southern Mississippi River Alluvium	Eastern Arkansas	Alfisols, Entisols, Inceptisols, and Vertisols are the dominant soil orders. These generally clayey or loamy soils range from poorly drained to somewhat poorly drained, and are very deep.
Southern Mississippi River Terraces	Eastern Arkansas	Alfisols are the dominant soil order. These silty soils are typically moderately well drained to well drained, and are very deep.
Southern Mississippi Valley Loess	Eastern Arkansas	Alfisols, Entisols, Inceptisols, and Ultisols are the dominant soil orders. These deep or very deep soils range from well drained to poorly drained and are loamy or silty.
Western Coastal Plain	Northern Arkansas	Alfisols and Ultisols are the dominant soil orders. These clayey or loamy soils typically range from poorly drained to well drained, and are very deep.

Source: (Natural Resources Conservation Service, 2006a)

^a Alfisols: “Soils found in semiarid to moist areas that are formed from weathering processes that leach clay minerals and other constituents out of the surface layer and into the subsoil. They are productive for most crop, are primarily formed under forest or mixed vegetative cover, and make up nearly 10 percent of the world’s ice-free land surface.” (Natural Resources Conservation Service, 2015b)

^b Entisols: “Soils that show little to no pedogenic horizon development. They occur in areas of recently deposited parent materials or in dunes, steep slopes, or flood plains where erosion or deposition rates are faster than rate of soil development. They make up nearly 16% of the world’s ice-free land surface.” (Natural Resources Conservation Service, 2015b)

^c Inceptisols: “Soils found in semiarid to humid environments that exhibit only moderate degrees of soil weathering and development. They have a wide range of characteristics, can occur in a wide variety of climates, and make up nearly 17 percent of the world’s ice-free land surface.” (Natural Resources Conservation Service, 2015b)

^d Vertisols: “Vertisols have a high content of expanding clay minerals. They undergo pronounced changes in volume with changes in moisture, and have cracks that open and close periodically, and that show evidence of soil movement. Vertisols transmit water very slowly, have undergone little leaching, and tend to be high in natural fertility. They make up about 2 percent of the world’s ice-free land surface.” (Natural Resources Conservation Service, 2015b)

^e Loamy Soil: “[A soil] that combines [sand, silt, and clay] in relatively equal amounts.” (Purdue University Consumer Horticulture, 2006)

^e Ultisols: “Soils found in humid environments that are formed from fairly intense weathering and leaching processes. This results in a clay-enriched subsoil dominated by minerals. They have nutrients concentrated in the upper few inches and make up 8 percent of the world’s ice-free land surface.” (Natural Resources Conservation Service, 2015b)

4.1.2.4. Soil Suborders

Soil suborders are part of the soil taxonomy (a system of classification used to make and interpret soil surveys). Soil orders are the highest level in the taxonomy;¹⁶ there are twelve soil orders in the world and they are characterized by both observed and inferred¹⁷ properties, such as texture, color, temperature, and moisture regime. Soil suborders are the next level down, and are differentiated within an order by soil moisture and temperature regimes, as well as dominant physical and chemical properties (Natural Resources Conservation Service, 2015c). FirstNet used the STATSGO2 database to obtain soils information at the programmatic level to ensure consistency across all the states and territories. This regional information provides a sufficient level of detail for a programmatic analysis. The best available soils data and information, including the use of the more detailed SSURGO database, will be used, as appropriate, during subsequent site-specific assessments. The STATSGO2¹⁸ soil database identifies 13 different soil suborders in Arkansas (Natural Resources Conservation Service, 2015d). Figure 4.1.2-2 depicts the distribution of the soil suborders, and Table 4.1.2-3 provides a summary of the major physical-chemical characteristics of the various soil suborders found.

¹⁶ “A formal representation of relationships between items in a hierarchical structure” (USEPA, 2013a).

¹⁷ “Soil properties inferred from the combined data of soil science and other disciplines (e.g., soil temperature and moisture regimes inferred from soil science and meteorology)” (Natural Resources Conservation Service, 2015b).

¹⁸ STATSGO2 is the Digital General Soil Map of the United States that shows general soil association units across the landscape of the nation. Developed by the National Cooperative Soil Survey, STATSGO2 supersedes the State Soil Geographic (STATSGO) dataset. (Natural Resources Conservation Service, 2015d)

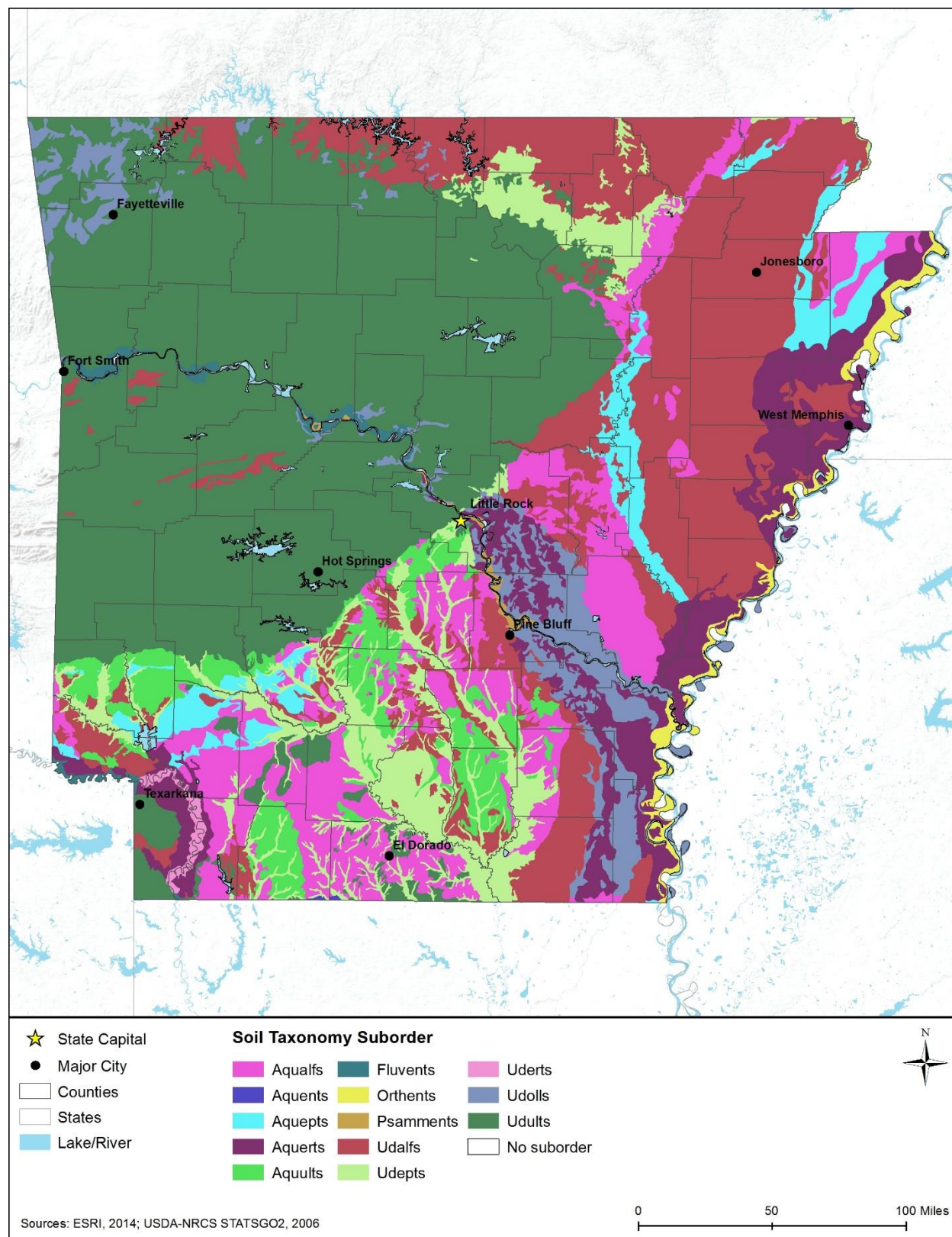


Figure 4.1.2-2: Arkansas Soil Taxonomy Suborders

Table 4.1.2-3: Major Characteristics of Soil Suborders^a Found in Arkansas, as depicted in Figure 4.1.2-2

Soil Order	Soil Suborder	Ecological Site Description	Soil Texture	Slope (%)	Drainage Class	Hydric Soil ^b	Hydrologic Group	Runoff Potential	Permeability ^c	Erosion Potential	Compaction and Rutting Potential
Alfisols	Aqualfs	Generally have warm and aquic (saturated with water long enough to cause oxygen depletion) conditions. Aqualfs are used as cropland for growing corn, soybeans, and rice, and most have some artificial drainage or other water control. Nearly all Aqualfs have likely supported forest vegetation in the past.	Sandy clay loam, Silt loam	0-1	Poorly drained	Yes	D	High	Very Low	High	High, due to hydric soil and poor drainage conditions
Entisols	Aquents	Widely distributed, with some forming in sandy deposits, and most forming in recent sediments. Aquents support vegetation that tolerates either permanent or periodic wetness, and are mostly used for pasture, cropland, forest, or wildlife habitat.	Clay	0-3	Somewhat poorly drained	No	C	Medium	Low	Medium	Low
Inceptisols	Aquepts	Aquepts have poor or very poor natural drainage. If these soils have not been artificially drained, groundwater is at or near the soil surface at some time during normal years (although not usually in all seasons). They are used primarily for pasture, cropland, forest, or wildlife habitat. Many Aquepts have formed under forest vegetation, but they can have almost any kind of vegetation.	Silty clay, Silty clay loam, Stratified very fine sandy loam to silty clay	0-1	Poorly drained to somewhat poorly drained	No, Yes	C, D	Medium, High	Low, Very Low	Medium to High, depending on slope	High, due to hydric soil and poor drainage conditions
Vertisols	Aquerts	Aquerts are wet soils, with prolonged moisture at or near the soil surface. Their natural vegetation includes savanna, grass, and forest. They are used as forest, rangeland, and cropland, although drainage for cropland can be difficult due to poor drainage.	Clay	0-5	Poorly drained	Yes	D	High	Very Low	High	High, due to hydric soil and poor drainage conditions
Ultisols	Aquults	Aquults are found in wet areas where groundwater is very close to the surface during part of each year, usually in winter and spring. Their slopes are gentle, with many soils formerly and currently supporting forest vegetation.	Loam	0-1	Poorly drained	Yes	D	High	Very Low	High	High, due to hydric soil and poor drainage conditions
Entisols	Fluvents	Fluvents are mostly freely drained soils that form in recently deposited sediments on flood plains, fans, and deltas located along rivers and small streams. Unless protected by dams or levees, these soils frequently flood. Fluvents are normally utilized as rangeland, forest, pasture, or wildlife habitat, with some also used for cropland.	Gravelly loam, Silt loam, Stratified loamy very fine sand to silt loam, Very fine sandy loam	0-3	Well drained to somewhat excessively drained	No	B	Medium	Moderate	Medium	Low
Entisols	Orthents	Orthents are commonly found on recent erosional surfaces and are used primarily as rangeland, pasture, or wildlife habitat.	Variable	0-15	NA ^d	No	NA ^c	NA ^c	NA ^c	NA ^c	Low
Entisols	Psamments	Psamments are sandy in all layers. In some arid and semi-arid climates, they are among the most productive rangeland soils, and are primarily used as rangeland, pasture, or wildlife habitat. Those Psamments that are nearly bare are subject to wind erosion and drifting, and do provide good support for wheeled vehicles.	Loamy fine sand	0-1	Excessively drained	No	A	Low	High	Low	Low
Alfisols	Udalfs	Udalfs have an udic (humid or subhumid climate) moisture regime, and are believed to have supported forest vegetation at some time during development.	Clay loam, Extremely gravelly silt loam, Fine sandy loam, Sandy loam, Silt loam, Silty clay, Silty clay loam, Stratified sandy clay loam to clay, Very gravelly loam, Very gravelly silt loam	0-40	Somewhat poorly drained to well drained	No	B, C, D	Medium, High	Moderate, Low, Very Low	Medium to High, depending on slope	Low

Soil Order	Soil Suborder	Ecological Site Description	Soil Texture	Slope (%)	Drainage Class	Hydric Soil ^b	Hydrologic Group	Runoff Potential	Permeability ^c	Erosion Potential	Compaction and Rutting Potential
Inceptisols	Udepts	Udepts have an udic or perudic (saturated with water long enough to cause oxygen depletion) moisture regime, and are mainly freely drained. Most of these soils currently support or formerly supported forest vegetation, with mostly coniferous forest in the Northwest and mixed or hardwood forest in the East. Some also support shrub or grass vegetation, and in addition to being used as forest, some have been cleared and are used as cropland or pasture.	Loam, Sand, Silt loam, Unweathered bedrock, Very fine sandy loam	0-20	Somewhat poorly drained to somewhat excessively drained	No, Yes	B, C, D	Medium, High	Moderate, Low, Very Low	Medium to High, depending on slope	High, due to hydric soil and poor drainage conditions
Vertisols	Uderts	Uderts are found in humid areas, and primarily used as cropland, forest, or pasture. They have low permeability, and water usually must be drained from the surface of cropland.	Clay	0-1	Somewhat poorly drained	No	D	High	Very Low	High	Low
Mollisols	Udolls	Udolls are found in humid climates. They are more or less freely drained, and have historically supported tall grass prairie. They are used as pasture or rangeland, and as cropland in areas with little slope.	Clay, Silty clay, Silty clay loam	0-3	Somewhat poorly drained to well drained	No	B, C, D	Medium, High	Moderate, Low, Very Low	Medium to High, depending on slope	Low
Ultisols	Udults	Udults are more or less freely drained, relatively humus poor, and have an udic moisture regime. Most of these soils currently support or formerly supported mixed forest vegetation, and many have been cleared and used as cropland (mostly with the use of soil amendments).	Clay, Clay loam, Cobbly fine sandy loam, Extremely gravelly silt loam, Gravelly fine sandy loam, Gravelly sandy clay, Gravelly sandy clay loam, Loam, Sandy clay loam, Sandy loam, Silty clay, Stratified fine sandy loam to clay, Stratified sandy loam to sandy clay loam, Very cobbly loam, Very flaggy fine sandy loam	0-45	Moderately well drained to well drained	No	B, C, D	Medium, High	Moderate, Low, Very Low	Medium to High, depending on slope	Low

Source: (Natural Resources Conservation Service, 2015d) (Natural Resources Conservation Service, 1999)

^a Soil suborders constitute a broad range of soil types. Within each suborder, the range of soil types may have a range of properties across the state, which result in multiple values being displayed in the table for that suborder.

^b Hydric Soil: “A soil that formed under conditions of saturation, flooding or ponding long enough during the growing season to develop anaerobic conditions in the upper part” (Natural Resources Conservation Service, 2015e). Soil suborders constitute a broad range of soil types. Within each soil suborder, some specific soil types are hydrive while others are not.

^c Based on Runoff Potential, described in Section 4.1.2.5.

^d This information was not available from NRCS data.

4.1.2.5. *Runoff Potential*

The NRCS uses four Hydrologic Soil Groups (A, B, C, and D) that are based on a soil's runoff potential.¹⁹ Group A generally has the smaller runoff potential, whereas Group D generally has the greatest (Purdue University, 2015). Table 4.1.2-3 (above) provides a summary of the runoff potential for each soil suborder in Arkansas.

Group A. Sand, loamy sand or sandy loam soils. This group of soils has “low runoff potential and high infiltration rates²⁰ even when thoroughly wetted. They consist chiefly of deep, well to excessively drained sands or gravels and have a high rate of water transmission” (Purdue University, 2015). Psamments fall into this category in Arkansas.

Group B. Silt loam or loam soils. This group of soils has a “moderate infiltration rate when thoroughly wetted and consists chiefly or moderately deep to deep, moderately well to well drained soils with moderately fine to moderately coarse textures” (Purdue University, 2015). This group has medium runoff potential. Fluvents, Udalfs, Udepts, Udolls, and Udufts fall into this category in Arkansas.

Group C. Sandy clay loam soils. This group of soils has “low infiltration rates when thoroughly wetted and consist chiefly of soils with a layer that impedes downward movement of water and soils with moderately fine to fine structure” (Purdue University, 2015). This group has medium runoff potential. Aquents, Aquepts, Udalfs, Udepts, Udolls, and Udufts fall into this category in Arkansas.

Group D. Clay loam, silty clay loam, sandy clay, silty clay, or clay soils. This group of soils “has the highest runoff potential. They have very low infiltration rates when thoroughly wetted and consist chiefly of clay soils with a high swelling potential, soils with a permanent high water table, soils with a claypan or clay layer at or near the surface and shallow soils over nearly impervious material” (Purdue University, 2015). Aqualfs, Aquepts, Aquerts, Aquults, Udalfs, Udepts, Uderts, Udolls, and Udufts fall into this category in Arkansas.

4.1.2.6. *Soil Erosion*

“Soil erosion involves the breakdown, detachment, transport, and redistribution of soil particles by forces of water, wind, or gravity” (Natural Resources Conservation Service, 2015f). Water-induced erosion can transport soil into streams, rivers, and lakes, degrading water quality and aquatic habitat. When topsoil is eroded, organic material is depleted, creating loss of nutrients available for plant growth. Soil particles displaced by wind can cause human health problems and reduced visibility, creating a public safety hazard (Natural Resources Conservation Service, 1996a). Table 4.1.2-3 provides a summary of the erosion potential for each soil suborder in

¹⁹ Classifying soils is highly generalized and it is challenging to differentiate orders as soil properties can change with distance or physical properties. The soil suborders are at a high level, therefore soil groups may be found in multiple hydrologic groups within a state, as composition, topography, etc. varies in different areas.

²⁰ Infiltration Rate: “The rate at which a soil under specified conditions absorbs falling rain, melting snow, or surface water expressed in depth of water per unit time.” (FEMA, 2010)

Arkansas. Soils with medium to high erosion potential in Arkansas include those in the Aqualfs, Aquents, Aquepts, Aquerts, Aquults, Fluvents, Udalfs, Udepts, Uderts, Udolls, and Udufts suborders, which are found throughout most of the state (Figure 4.1.2-2).

4.1.2.7. Soil Compaction and Rutting

Soil compaction and rutting occurs when soil layers are compressed by machinery or animals, which decreases both open spaces in the soil, as well as water infiltration rates (Natural Resources Conservation Service, 1996b). Moist soils with high soil water content are most susceptible to compaction and rutting, as they lack the strength to resist deformation caused by pressure. When rutting occurs, channels form and result in downslope erosion (USFS, 2009b). Other characteristics that factor into compaction and rutting risk include soil composition (i.e., low organic soil is at increased risk of compaction), amount of pressure exerted on the soil, and repeatability (i.e., the number of times the pressure is exerted on the soil). Machinery and vehicles that have axle loads greater than ten tons can cause soil compaction of greater than 12 inches (Natural Resources Conservation Service, 1996b) (Natural Resources Conservation Service, 2003).

Loam, sandy loam, and sandy clay loam soils are most susceptible to compaction and rutting; silt, silty clay, silt loam, silty clay loam, and clay soils are more resistant to compaction and rutting (Natural Resources Conservation Service, 1996b). Table 4.1.2-3 provides a summary of the compaction and rutting potential for each soil suborder in Arkansas. Soils with the highest potential for compaction and rutting in Arkansas include those in the Aqualfs, Aquepts, Aquerts, Aquults, and Udepts suborders, which are found primarily in southern and eastern areas of the state.

4.1.3. Geology

4.1.3.1. Definition of the Resource

The U.S. Geological Survey (USGS) is the primary government organization responsible for the nation's geological resources. USGS defines geology as an interdisciplinary science with a focus on the following aspects of earth sciences: geologic hazards and disasters, climate variability and change, energy and mineral resources, ecosystem and human health, and ground-water availability. Several of these elements are discussed in other sections of this PEIS, including Water Resources (Section 4.1.4), Human Health and Safety (Section 4.1.15), and Climate Change (Section 4.1.14).

This section covers the six aspects of geology most relevant to the Proposed Action and Alternatives:

- Section 4.1.3.3, Environmental Setting: Physiographic Regions²¹ and Provinces;²²
- Section 4.1.3.4, Surface Geology;

²¹ Physiographic regions: Areas of the United States that share commonalities based on topography, geography, and geology (Fenneman, 1916).

²² Physiographic provinces: Subsets within physiographic regions (Fenneman, 1916).

- Section 4.1.3.5, Bedrock Geology;²³
- Section 4.1.3.6, Paleontological Resources;²⁴
- Section 4.1.3.7, Fossil Fuel and Mineral Resources; and
- Section 4.1.3.8, Geologic Hazards.²⁵

4.1.3.2. Specific Regulatory Considerations

The Proposed Action must meet the requirements of NEPA and other applicable laws and regulations. A list of applicable state laws and regulations is included in Table 4.1.3-1.

Table 4.1.3-1: Relevant Arkansas Geology Laws and Regulations

State Law/Regulation	Regulatory Agency	Applicability
Arkansas Building Authority Minimum Standards and Criteria	Arkansas Building Authority	Guidelines for seismic design.

Source: (Arkansas Building Authority, 2012)

4.1.3.3. Environmental Setting: Physiographic Regions and Provinces

Geologist Nevin Fenneman as a way to describe areas of the United States based on common landforms (i.e., not climate or vegetation) created the concept of physiographic regions in 1916. Physiographic regions are areas of distinctive topography, geography, and geology. “Important physiographic differences between adjacent areas are, in a large proportion of cases, due to differences in the nature or structure of the underlying rocks.” There are eight distinct physiographic regions in the continental United States: 1) Atlantic Plain, 2) Appalachian Highlands, 3) Interior Plains, 4) Interior Highlands, 5) Laurentian Upland, 6) Rocky Mountain System, 7) Intermontane Plateaus, and 8) Pacific Mountain System. Regions are further subdivided into physiographic provinces based on differences observed on a local scale. (Fenneman, 1916)

Arkansas is within two physiographic regions: the Atlantic Plain Region (Coastal Plain Province) and Interior Highlands Region (Ouachita and Ozark Plateaus Provinces) (USGS, 2003a) (Figure 4.1.3-1). Each region and their general characteristics summarized in the following subsections.

²³ Bedrock: Solid rock beneath the soil and superficial rock (USGS, 2015b).

²⁴ Paleontology: “Study of life in past geologic time based on fossil plants and animals” (USGS, 2015c).

²⁵ Geologic Hazards: Any geological or hydrological process that poses a threat to people and/or their property, which includes but is not limited to volcanic eruptions, earthquakes, landslides, sinkholes, mudflows, flooding, and shoreline movements (NPS, 2013).

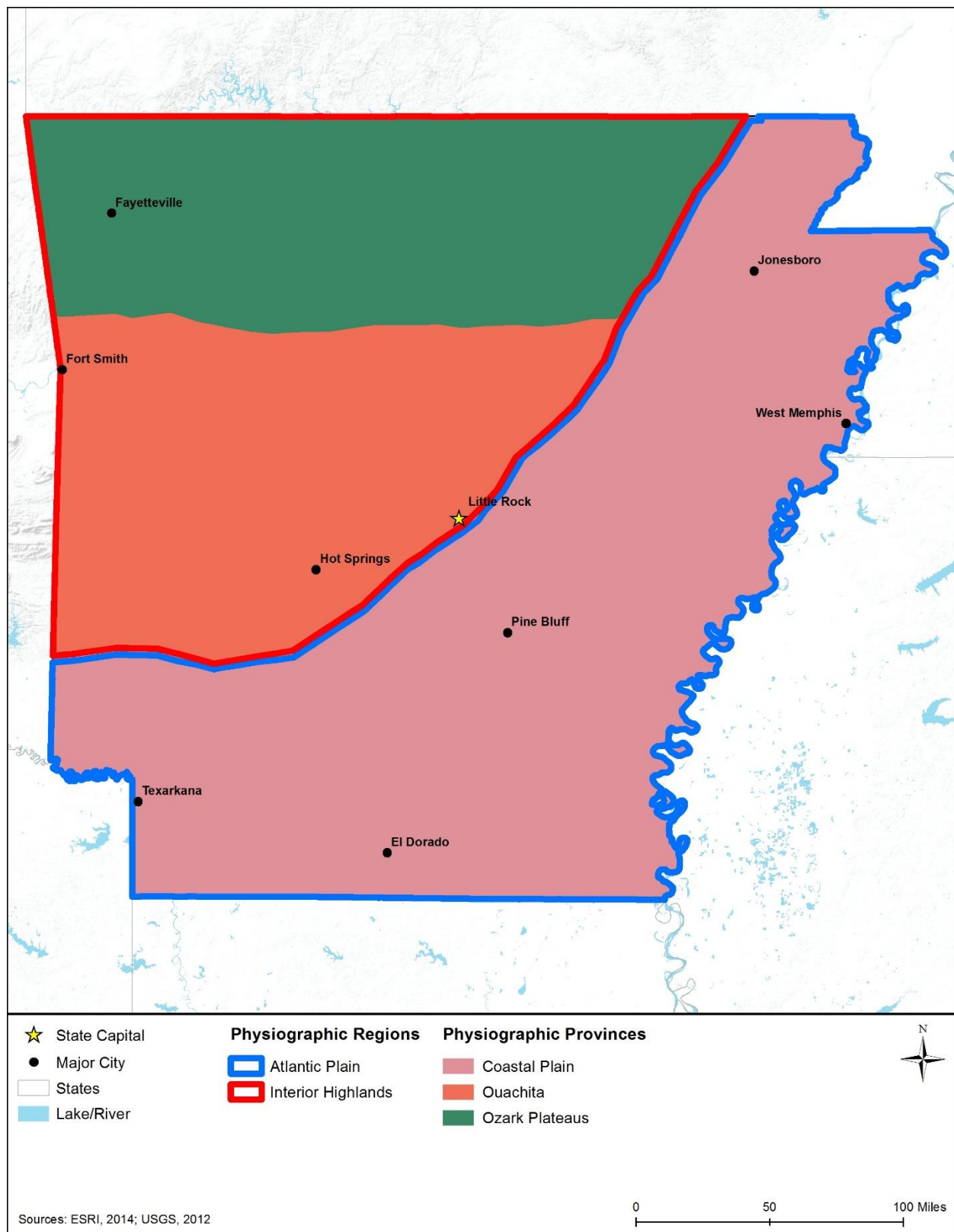


Figure 4.1.3-1: Physiographic Regions, Provinces, and Sections of Arkansas

Atlantic Plain Region

The Atlantic Plain Region includes the Continental Shelf and the Gulf and Atlantic Coast plains stretching from New York south to Florida and west to Texas. The Atlantic Plain Region formed through the repetitive rise and fall of the oceans over the last 150 million years. Sedimentary²⁶ strata become thinner moving westward through the region, and thicken to several thousand feet thick along the coastline. Erosion from the Appalachian Mountains were subsequently deposited by rivers to form the Atlantic Plain.²⁷ (NPS, 2015a)

As reported above, the Atlantic Plain Region within Arkansas is composed of one physiographic province: the Coastal Plain Province. (USGS, 2003a).

Coastal Plain Province – The Coastal Plain Province includes portions of eastern and southern Arkansas. The Coastal Plain is separated from the Piedmont Province to the north and west by the Fall Line.²⁸ Eastern Arkansas “is characterized by a coastal plain of low hills, low cuesta ridges, and gentle lowlands. Fine-grained strata of clay, chalk, and mudstone underlie the low-lying areas; coarse sand and gravel underlie low ridges and hills.” Southwestern Arkansas is noted for having a “southward-facing plain of low, rolling, slightly hilly terrain.” In general, topography throughout the Arkansas Coastal Plain is between 200 and 400 feet above sea level (ASL). (USGS, 2015d)

Interior Highlands Region

The Interior Highlands Region includes the elevated portions of Illinois, Missouri, Arkansas and Oklahoma, and stand in contrast to the flat-lying surrounding areas of the Interior Plains and Atlantic Plains Regions. The Interior Highlands are composed of Paleozoic (542 to 241 MYA) sedimentary rocks. Beginning about 340 MYA, these rocks were uplifted and deformed to form a large mountain range, much of which has subsequently eroded. The remnants of this mountain range are seen today in the Ouachita-Ozark Highlands. (USGS, 2014a)

The Interior Highlands Region within Arkansas is composed of two physiographic provinces: the Ouachita and Ozark Plateaus Provinces (USGS, 2003a).

Ouachita Province – The Ouachita Province includes portions of central and west-central Arkansas; this province is separated from the Coastal Plain to the south and east by the Fall Line. The Ouachita Province is noted for having parallel ridges and valleys (NPS, 2014a) that increase in height to the west. The area is underlain by marine sedimentary deposits that were subsequently uplifted and deformed (Arkansas Geological Survey, 2015a). Ridge elevations are generally between 1,000 and 2,000 feet ASL, though some peaks surpass 2,000 feet ASL

²⁶ Sedimentary Rock: “Rocks that formed from pre-existing rocks or pieces of once-living organisms. They form from deposits that accumulate on the Earth’s surface. Sedimentary rocks often have distinctive layering or bedding.” (USGS, 2014b)

²⁷ For consistency, this PEIS uses the University of California Berkeley Geologic Time Scale for all of the FirstNet PEIS state documents. Time scales differ among universities and researchers; FirstNet utilized a consistent time scale throughout, which may differ slightly from other sources. (University of California Museum of Paleontology, 2011)

²⁸ Fall Line: “A somewhat indefinite line which derives its name from the falls or rapids in the rivers at the places where they pass from the Piedmont crystalline rocks to the softer and less resistant rocks of the Coastal Plain.” (Geological Survey of Georgia, 1911)

(USGS, 2015d). “Surface rocks from this region are mostly shales,²⁹ sandstone,³⁰ novaculite,³¹ chert³² and minor limestone”³³ (Arkansas Geological Survey, 2015b). The Arkansas Valley generally has elevations between 300 and 600 ASL (USGS, 2015d).

Ozark Plateaus Province – Within the Interior Highlands Region, the Ozark Plateaus Province covers about 40,000 square miles, including all of northern Arkansas west of the Fall Line. The Ozark Plateaus Province is a “high, hilly landscape on stratified rocks that is bounded by topographic lowlands” (NPS, 2014a). The Arkansas portion of the Ozark Plateaus Province is underlain by Paleozoic (542 to 251 MYA) sedimentary rocks (USGS, 1995a). Within Arkansas, the Boston Mountains are noted for their flat ridges that rise to between 1,900 and 2,500 ASL; topographic relief is generally 300 to 1,000 feet above the valley bottoms (USGS, 2015d).

4.1.3.4. Surface Geology

Surficial geology is characterized by materials such as till,³⁴ sand and gravel, or clays that overlie bedrock. The surface terrain, which can include bedrock outcrops, provides information on the rock compositions and structural characteristics of the underlying geology. Because surface materials are exposed, they are subject to physical and chemical changes due to weathering from precipitation (rain and snow), wind and other weather events, and human-caused interference. Depending on the structural characteristics and chemical compositions of the surface materials, heavy precipitation can cause slope failures,³⁵ subsidence,³⁶ and erosion (Thompson, 2015).

Most of the surficial materials within Arkansas include stream and river valley deposits. These alluvial³⁷ deposits include “a thin drape of younger unconsolidated clays, sands, and gravel” (Arkansas Geological Survey, 2015c). Arkansas was not impacted by the Pleistocene Ice Age (USGS, 1992). Figure 4.1.3-2 depicts the main surficial composition of Arkansas.

²⁹ Shale: “Sedimentary rock derived from mud. Commonly finely laminated (bedded). Particles in shale are commonly clay minerals mixed with tiny grains of quartz eroded from pre-existing rocks.” (USGS, 2015e)

³⁰ Sandstone: “Sedimentary rock made mostly of sand-sized grains.” (USGS, 2015e)

³¹ Novaculite: “A sedimentary rock composed mostly of microcrystalline (1-5 micron) quartz and is a crystallized variety of chert.” (State Parks of Arkansas, 2015a)

³² Chert: “A very fine-grained sedimentary rock made of quartz. Usually made of millions of globular siliceous skeletons of tiny marine plankton called radiolarians.” (USGS, 2015e)

³³ Limestone: “A sedimentary rock made mostly of the mineral calcite (calcium carbonate). Limestone is usually formed from shells of once-living organisms or other organic processes, but may also form by inorganic precipitation.” (USGS, 2015e)

³⁴ Till: “An unsorted and unstratified accumulation of glacial sediment, deposited directly by glacier ice. Till is a heterogeneous mixture of different sized material deposited by moving ice (lodgement till) or by the melting in-place of stagnant ice (ablation till). After deposition, some tills are reworked by water.” (USGS, 2013b)

³⁵ Slope failure, also referred to as mass wasting, is the downslope movement of rock debris and soil in response to gravitational stresses. (Idaho State University 2000)

³⁶ Subsidence: “Gradual settling or sudden sinking of the Earth’s surface owing to subsurface movement of earth materials.” (USGS, 2000)

³⁷ Alluvium: “Sand, gravel, and silt deposited by rivers and streams in a valley bottom.” (USGS, 2015e)

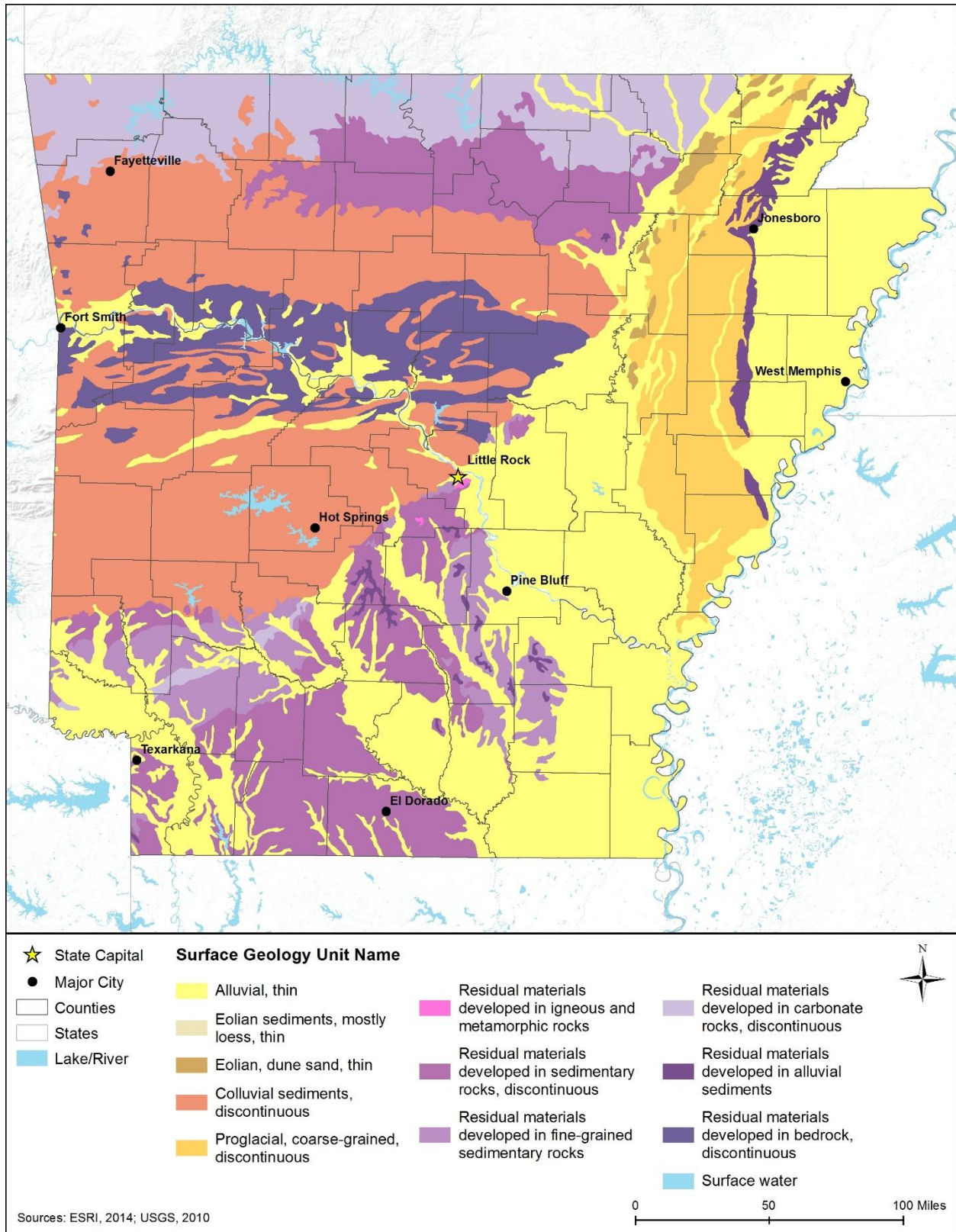


Figure 4.1.3-2: Generalized Surface Geology for Arkansas

4.1.3.5. *Bedrock Geology*

Bedrock geology analysis, and “the study of distribution, position, shape, and internal structure of rocks” (USGS, 2015f) reveals important information about a region’s surface and subsurface characteristics (i.e., three-dimensional geometry), including dip (slope of the formation),³⁸ rock composition, and regional tectonism.³⁹ These structural aspects of bedrock geology are often indicative of regional stability, as it relates to geologic hazards such as landslides, subsidence, earthquakes, and erosion (New Hampshire Department of Environmental Services, 2014).

Bedrock geology in Arkansas is divided according to the state’s physiographic regions. The “well-lithified sandstones, shales, limestones, and dolostones⁴⁰ of Paleozoic age” underlie the Interior Highlands. These rocks were deposited in a marine environment and subsequently uplifted. The Ozark Mountains were uplifted with minimal deformation, while the Ouachita Mountains were considerably folded⁴¹ and faulted.⁴² Rocks within the Coastal Plain Province are underlain by “unconsolidated clay, sand, and gravel of Quaternary age, poorly consolidated deposits of clay, sand, silt, limestone, and lignite of Tertiary age, and consolidated (to a limited extent) deposits of Cretaceous marl, chalk, limestone, sand, and gravel.” Igneous rocks reach the ground surface at only about 0.1 percent of the state. (Arkansas Geological Survey, 2015c) Figure 4.1.3-3 displays the general bedrock geology for Arkansas.

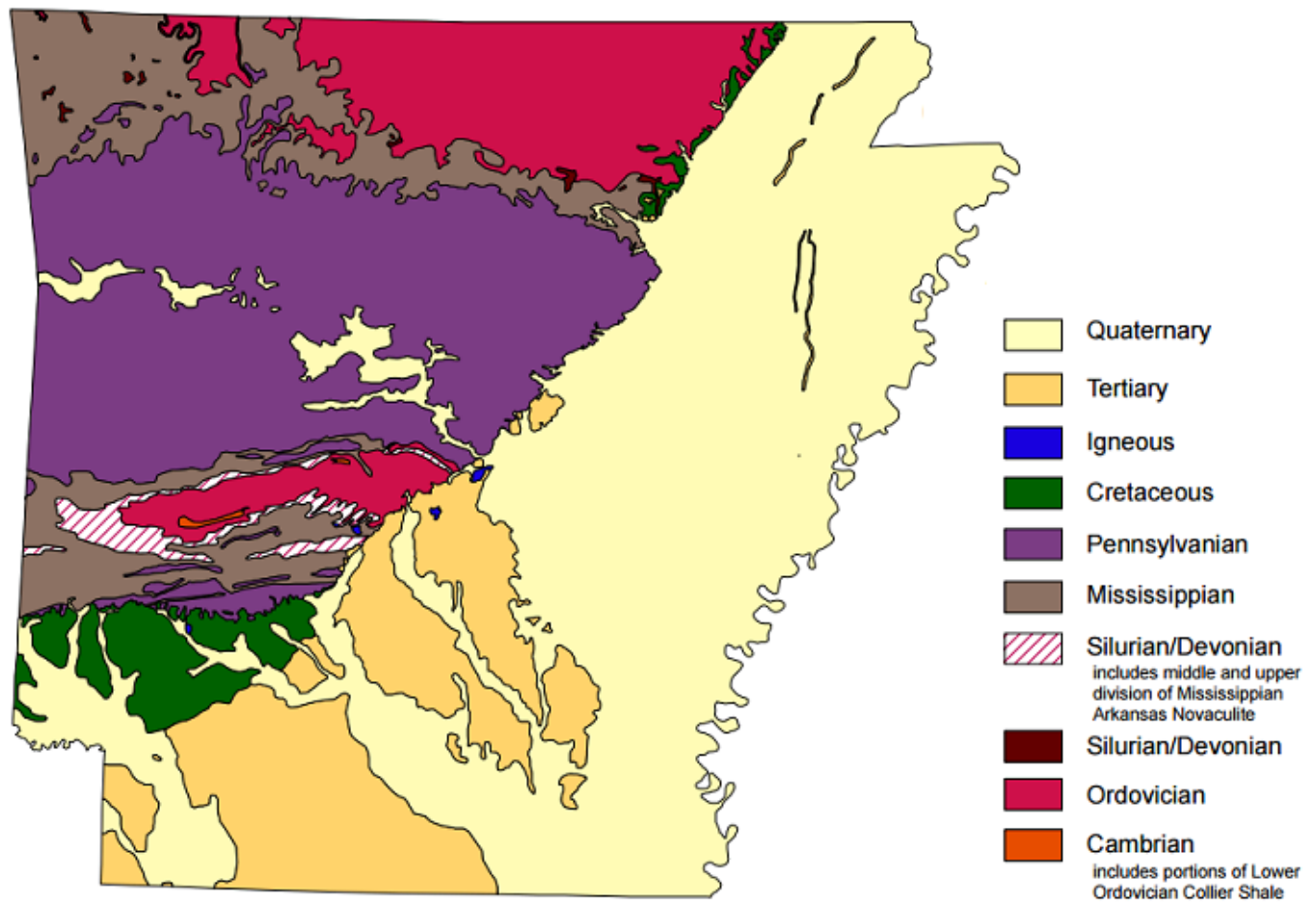
³⁸ Dip: “A measure of the angle between the flat horizon and the slope of a sedimentary layer, fault plane, metamorphic foliation, or other geologic structure.” (NPS, 2000)

³⁹ Tectonism: “Structure forces affecting the deformation, uplift, and movement of the earth’s crust.” (USGS, 2015e)

⁴⁰ Dolostone: “A magnesium-rich carbonate sedimentary rock. Also, a magnesium-rich carbonate mineral (CaMgCO₃).” (USGS, 2015e)

⁴¹ Fold: “A bend or flexure in a rock.” (USGS, 2005)

⁴² Fault: “A surface along which a rock body has broken and been displaced.” (USGS, 2005)



Source: (Arkansas Geological Survey, 2015d)

Figure 4.1.3-3: Generalized Bedrock Geology for Arkansas

4.1.3.6. *Paleontological Resources*

Arkansas was covered by seas from the beginning of the Paleozoic Era (542 MYA) until the late Carboniferous period (359 to 299 MYA). Fossils that have been recovered from this time include brachiopods,⁴³ corals, gastropods,⁴⁴ crinoids,⁴⁵ bryozoans,⁴⁶ trilobites,⁴⁷ graptolites,⁴⁸ and sponges. As the sea levels dropped in the late Paleozoic Era (299 to 251 MYA), land exposures became prevalent resulting in the preservation of terrestrial plants. Northern and central Arkansas remained above sea level during the Mesozoic Era (251 to 66 MYA), while the south was still covered by shallow sea. An abundance of marine fossils have been recorded in Cretaceous Period (146 to 66 MYA) deposits in the southern part of the state, including oysters, echinoids, clams, snails, shark teeth, and large reptiles such as crocodiles, mosasaurs, and plesiosaurs. Dinosaur tracks have also been found in southwestern Arkansas. Shallow seas still existed into the early Cenozoic Era (beginning 66 MYA). By the early Quaternary Period (beginning 2.6 MYA), rivers, and swamps covered southern Arkansas, resulting in the preservation of mammals such as mastodons, mammoths, and giant ground sloths (The Paleontology Portal, 2015). There is no official state fossil for Arkansas (NPS, 2010).

4.1.3.7. *Fossil Fuel and Mineral Resources*

Oil and Gas

As of the 1920s, Arkansas was one of the nation's leading crude oil producers. However, Arkansas's present-day oil production is minimal with most production coming from wells that produce less than 10 barrels of crude oil per day. In 2014, Arkansas produced approximately 65M barrels of crude oil from 12 rotary rigs (EIA, 2016b). Most oil is sourced from reservoirs containing sandstone and limestone from the Jurassic (200 to 146 MYA) and Cretaceous Periods (AGS, 2017).

In 2015, Arkansas produced 1,010,274 million cubic feet of natural gas from 9,965 natural gas producing wells. This production accounted for 3.5 percent of total nationwide production for natural gas. The state is also a producer of coalbed methane, "and, although the state is not a major producer of coalbed methane, coal gas wells yielded more than 27 billion cubic feet of

⁴³ Brachiopod: "Any member of a phylum of marine invertebrate animals called Brachiopoda. Brachiopods are sessile, bivalved organisms, but are more closely related to the colonial Bryozoa than the bivalved mollusks. Brachiopod diversity peaked in the Paleozoic, but some species survive." (Smithsonian Institution, 2016)

⁴⁴ Gastropods: "Any member of a large class of mollusks (Gastropoda), commonly called snails. Gastropods live in marine, freshwater, and terrestrial habitats. They have a univalve, often spiral shell (or none at all), a muscular foot for locomotion, and distinctive sensory organs." (Smithsonian Institution, 2016)

⁴⁵ Crinoid: "The common name for any echinoderm of the class Crinoidea, including sea lilies, feather stars, etc. Crinoids are common fossils in the Paleozoic and persist to the present. Many species have stalks and radiating arms and feed on particles in the water column." (Smithsonian Institution, 2016)

⁴⁶ Bryozoan: "Common name for any member of the phylum Bryozoa. Bryozoans are invertebrate aquatic organisms most commonly found in large colonies." (Smithsonian Institution, 2016)

⁴⁷ Trilobite: "Any member of Trilobita, an extinct class of marine arthropods. Trilobites are known from the Cambrian to the Permian. They had segmented, oval-shaped bodies and were the first animals to have complex eyes (similar to the compound eyes in modern insects)." (Smithsonian Institution, 2016)

⁴⁸ Graptolite: "Any member of the Graptolithina, a class of extinct marine invertebrate animals. Graptolites are believed to have been planktonic and are especially prevalent in Ordovician and Silurian rocks." (Smithsonian Institution, 2016)

natural gas from 2001 to 2014” (EIA, 2016b). The majority of natural gas comes from the Arkoma Basin,⁴⁹ and there are additional wells in the Gulf Coastal Plain (EIA, 2016b). Within the Arkoma Basin, the Pennsylvanian (318 to 299 MYA) Atoka formation, which is composed of sandstone and shale, is the primary focus of gas producing wells (AGS, 2017).

Minerals

In 2015, Arkansas’s total nonfuel mineral production was valued at \$991M, which ranked 26th nationwide. This level of production accounted for just over 1 percent of the country’s total nonfuel mineral production. Arkansas was the only state to produce bromine compounds and special silica stone in 2012 and 2013 and was third in production of tripoli. As of 2016, Arkansas’s leading nonfuel mineral commodities were crushed stone, bromine, industrial sand and gravel, Portland cement, and construction sand and gravel (USGS, 2016a). Other minerals produced in the state include abrasives, bauxite, gemstones, diamonds, graphite, perlite, vanadium, noviculite, tripoli, bromine, quartzite, gypsum, lime, hydrated lime, quicklime, pulverized limestone, nepheline syenite, clays (kaoline), slate, granite, vermiculite, limestone, and dolomite (USGS, 2016d).

In addition, Arkansas produced 91 thousand short tons of coal in 2015, which ranked 25th nationwide and second lowest among coal-producing states. Arkansas’s two small bituminous⁵⁰ coal mines are in the Arkansas River Valley in the western portion of the state (EIA, 2016b).

4.1.3.8. *Geologic Hazards*

The three major geologic hazards of concern in Arkansas are earthquakes, landslides, and subsidence. Volcanoes do not occur in Arkansas and therefore do not present a hazard to the state (USGS, 2015g). The subsections below summarize current geologic hazards in Arkansas.

Earthquakes

In 2015, 64 earthquakes were recorded within Arkansas, the largest of which measured 2.6 on the Richter scale⁵¹ (Arkansas Geological Survey, 2015e). Earthquakes are the result of large masses of rock moving against each other along fractures called faults. Earthquakes occur when landmasses on opposite sides of a fault suddenly slip past each other; the grinding motion of each landmass sends out shock waves. The vibrations travel through the Earth and, if they are strong enough, they can damage manmade structures on the surface (USGS, 2012a).

The shaking due to earthquakes can be significant many miles from its point of origin depending on the type of earthquake and the type of rock and soils beneath a given location. Crustal earthquakes, the most common, typically occur at depths of 6 to 12 miles; these earthquakes typically do not reach magnitudes higher than 6.0 on the Richter scale. Subduction zone

⁴⁹ The Arkoma Basin is in the western portion of the state and stretches into Oklahoma.

⁵⁰ Bituminous Coal: “A rank class of coals defined by the American Society for Testing and Materials (ASTM) high in carbonaceous matter, having less than 86 percent fixed carbon, and more than 14 percent volatile matter on a dry, mineral-matter-free basis and more than 10,500 Btu on a moist mineral-matter-free basis.” (USGS, 1981)

⁵¹ The Richter scale is a numerical scale for expressing the magnitude of an earthquake on the basis of seismograph oscillations. The more destructive earthquakes typically have magnitudes between about 5.5 and 8.9; the scale is logarithmic and a difference of one represents an approximate thirtyfold difference in magnitude. (USGS, 2014d)

earthquakes happen where tectonic plates converge. “When these plates collide, one plate slides (subducts) beneath the other, where it is reabsorbed into the mantle of the earth.” Convergence boundaries between two tectonic plates can result in earthquakes with magnitudes that exceed 8.0 on the Richter scale. (Oregon Department of Geology, 2015)

Figure 4.1.3-4 depicts the seismic risk throughout Arkansas; the box surrounding the range of colors shows the seismic hazards in the state. The map indicates levels of horizontal shaking (measured in Peak Ground Acceleration) that have a 2 percent chance of being exceeded in a 50-year period. Units on the map are measured in terms of acceleration due to gravity (% g). Most pre-1965 buildings are likely to experience damage with exceedances of 10 % g. Post-1985 buildings (in California) have experienced only minor damage with shaking of 60 % g (USGS, 2010). Arkansas is not located near any convergence or other tectonic plate boundaries (Arkansas Geological Survey, 2015f).

Areas of greatest seismicity in Arkansas are concentrated in the northeastern portions of the state. Arkansas is one of the most tectonically active⁵² states in the country that is not along a plate boundary (Arkansas Geological Survey, 2015f). The largest earthquake ever recorded in Arkansas occurred in December 1811, and measured 7.5 on the Richter scale (USGS, 2014c). In total, three damaging earthquakes occurred during 1811 and 1812. These earthquakes measured between 7.3 and 7.5 on the Richter scale. Arkansas is at risk to damaging earthquakes (greater than magnitude 6.3 on the Richter scale) due to its proximity to the New Madrid Seismic Zone, which includes portions of Illinois, Missouri, Kentucky, Tennessee, and Arkansas (USGS, 2012b). “The [New Madrid Seismic Zone] appears to be about 30 years overdue for a magnitude 6.3 quake because the last quake of this size occurred 100 hundred years ago at Charleston, Missouri, on Oct. 31, 1895 (it was a magnitude 6.7). About 75 percent of the estimated recurrence time for a magnitude 7.6 earthquake has elapsed since the last quake of this size occurred in 1812” (Missouri Department of Natural Resources, 2015).

⁵² Tectonically Active: “A term used to describe regions that are strongly affected by movement of Earth’s tectonic plates.” (USGS, 2015e)

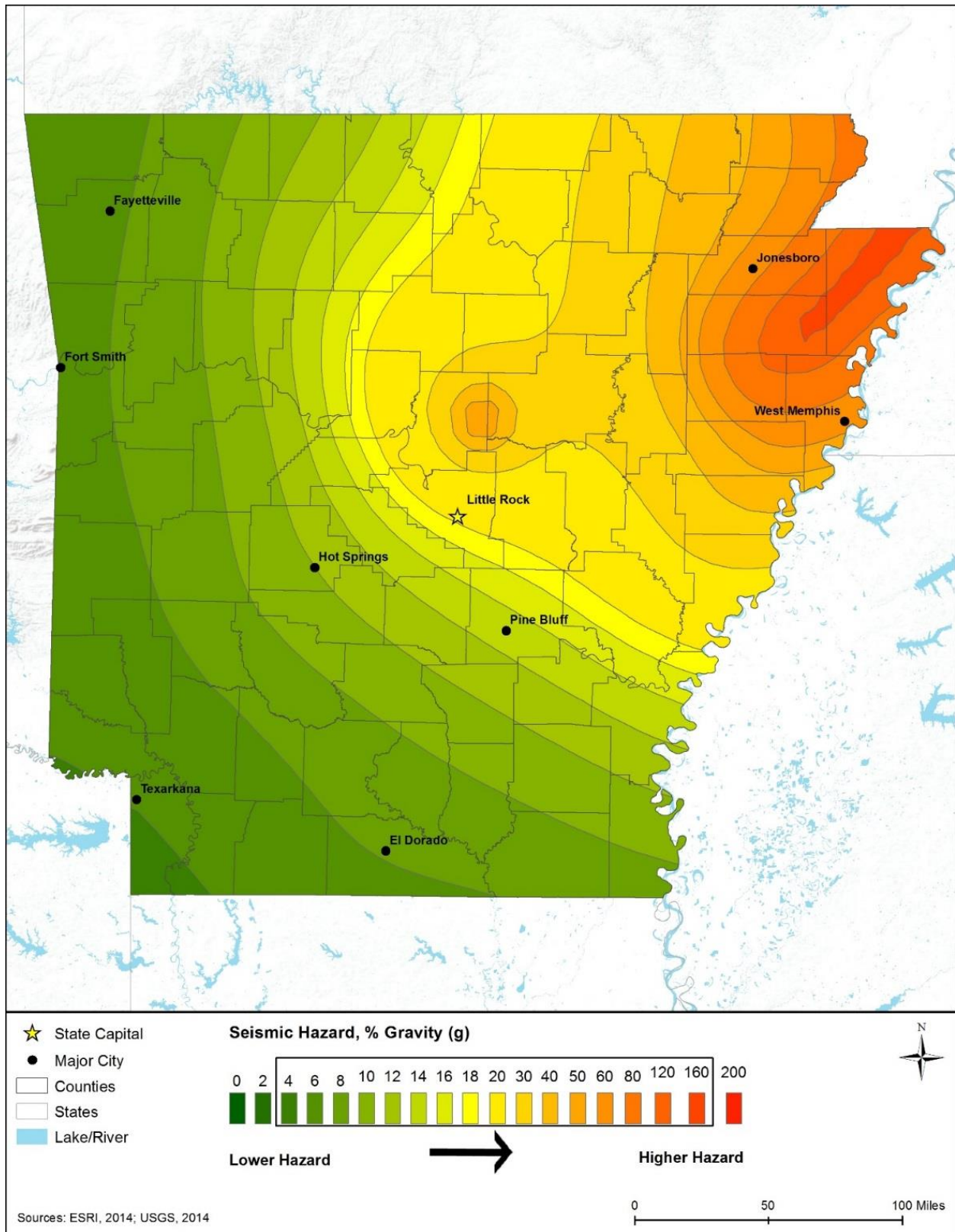


Figure 4.1.3-4: Arkansas 2014 Seismic Hazard Map

Landslides

The potential for landslides in Arkansas is moderate to high, particularly in western portions of the state within the Ouachita and Ozark Plateaus Provinces (Figure 4.1.3-6). “The term ‘landslide’ describes many types of downhill earth movements, ranging from rapidly moving catastrophic rock avalanches and debris flows in mountainous regions to more slowly moving earth slides and other ground failures” (USGS, 2003b). Geologists use the term “mass movement” to describe a great variety of processes such as rock fall, creep, slump, mudflow, earth flow, debris flow, and debris avalanche regardless of the time scale. (USGS, 2003b)

Landslides can be triggered by a single severe storm or earthquake, causing widespread damage in a short period. Most landslide events are triggered by water infiltration that decomposes and loosens rock and soil, lubricates frictional surfaces, adds weight to an incipient landslide, and imparts buoyancy to the individual particles. Intense rainfall, rapid snowmelt, freeze/thaw cycles, earthquakes, volcanic eruptions, and human alterations to the natural landscape can trigger mass land movements. Large landslides can dam rivers or streams, and cause both upstream and downstream flooding. (USGS, 2003b)



Source: (Chandler & Doerr, 2008)

Figure 4.1.3-5: Richland Creek Landslide

Landslides are common occurrences in parts of Arkansas (Arkansas Geological Survey, 2015g). Figure 4.1.3-6 shows landslide incidence and susceptibility throughout Arkansas. Landslides are most common in western Arkansas. Landslides are typically associated with human causes, including “road building, where excavations into the hillsides have over-steepened, and reduced natural slope stability. Over-steepening of slope and removal of vegetation combined with large amounts of rainfall contribute to landslide development” (Arkansas Geological Survey, 2015h). One notable landslide event in Arkansas occurred in 2008, when soil saturation and excessive stormwater runoff caused a landslide that blocked Richland Creek Road in Searcy County (in northern Arkansas about 75 miles north of Little Rock). Shale- and clay-based units moved 100 feet during the slide (Chandler & Doerr, 2008). A list of recent landslide events in Arkansas is provided by the Arkansas Geological Survey (Arkansas Geological Survey, 2015g).

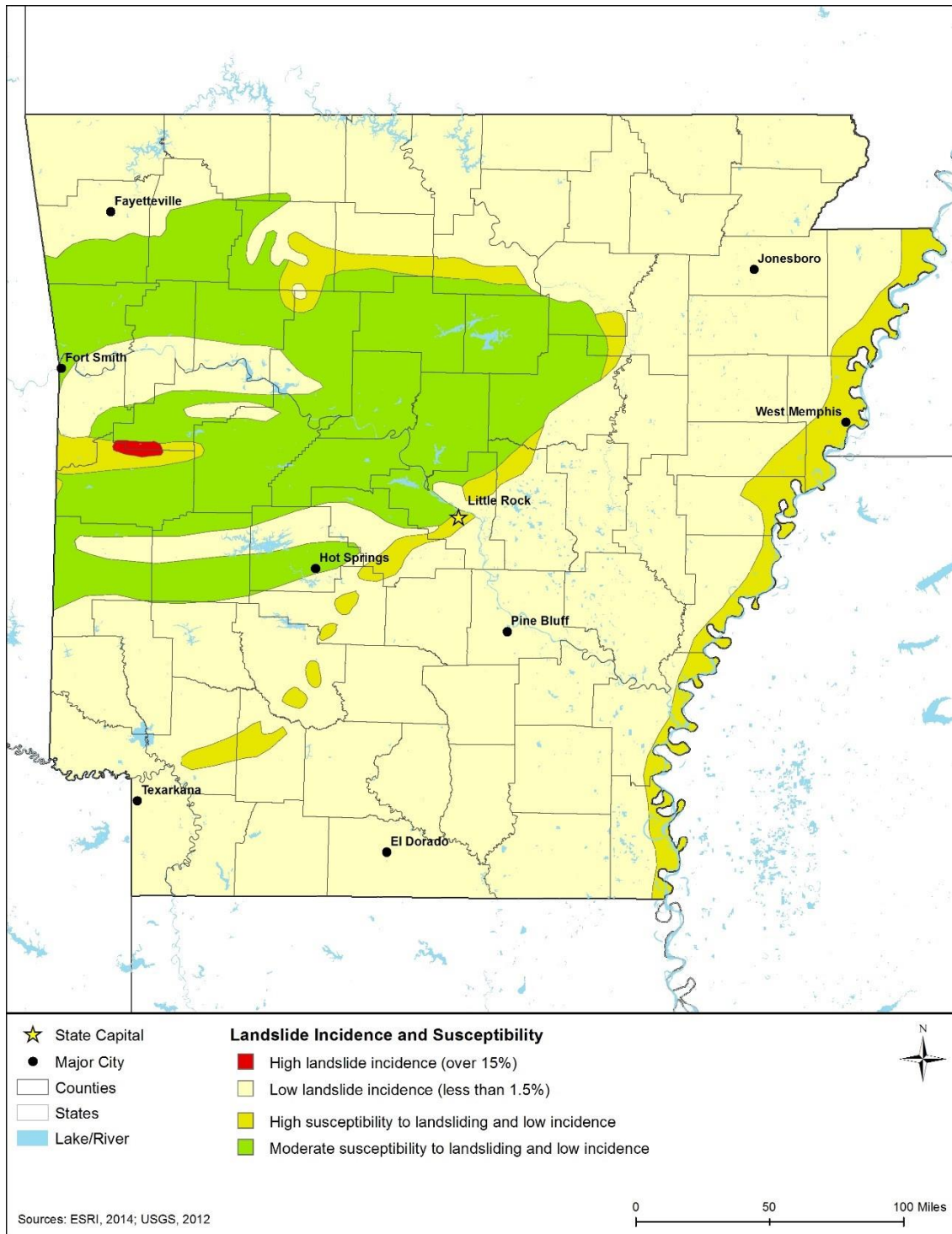


Figure 4.1.3-6: Arkansas Landslide Incidence and Susceptibility Hazard Map⁵³

⁵³ Susceptibility hazards not indicated in Figure 4.1.3-6 where same or lower than incidence. Susceptibility to landslides is defined as the probable degree of response of areal rocks and soils to natural or artificial cutting or loading of slopes, or to anomalously high precipitation. High, moderate, and low susceptibility are delimited by the same percentages used in classifying the incidence of landslides. Some generalization was necessary at this scale, and several small areas of high incidence and susceptibility were slightly exaggerated. (USGS, 2016d)

Land Subsidence

Land subsidence is a “gradual settling or sudden sinking of the Earth’s surface owing to subsurface movement of earth materials.” Land subsidence has been observed in Arkansas due to karst⁵⁴ topography and liquefaction (Arkansas Geological Survey, 2015i).⁵⁵ Nationwide, the main triggers of land subsidence can be aquifer compaction, drainage of organic soils, underground mining, and sinkholes. More than 80 percent of subsidence in the United States is due to over-withdrawal of groundwater. In many aquifers, which are subsurface soil layers through which groundwater moves, water is pumped from pore spaces between sand and gravel grains. If layers of silt or clay, which do not transport groundwater, confine an aquifer the lowered water pressure in the sand and gravel causes slow drainage of water from the clay and silt beds. The reduced water pressure compromises support for the clay and silt beds, causing them to collapse on one another. The effects of this compression are seen in the permanent lowering of the land surface elevation (USGS, 2000).

Land subsidence can result in altered stream elevations and slopes; detrimental effects to infrastructure and buildings; and collapse of wells due to compaction of aquifer sediments. Subsided areas can become more susceptible to inundation, both during storm events and non-events. Lowered terrain is more susceptible to inundation during high tides. Additionally, land subsidence can affect vegetation and land use. (USGS, 2013c)

In Arkansas, karst topography is most common in northern portions of the state in areas that are underlain by limestone and dolostone, which are both subject to slow dissolution when infiltrated by groundwater. “In most areas of north Arkansas, the carbonate bedrock is not directly exposed at the surface, but is covered by a variable thickness of clay, silt, and sand. A thicker clay-rich overburden may bridge subsurface cavities for long periods. Eventually a catastrophic collapse of the overburden into the subsurface cavity may occur, forming a cover-collapse sinkhole” (Arkansas Geological Survey, 2015i). Figure 4.1.3-6 displays the location of karst topography throughout Arkansas.

Parts of Arkansas are susceptible to earthquake-induced land subsidence (i.e., liquefaction) due to the state’s proximity to the New Madrid Seismic Zone. In particular, the northeastern corner of the state (i.e., the area of Arkansas that is closest to the New Madrid Seismic Zone) is most susceptible to land subsidence via liquefaction (Arkansas Geological Survey, 2010). The 1811 and 1812 New Madrid Seismic Zone earthquakes resulted in ground failure that dropped the land surface so much that two new lakes, Big Lake and St. Francis Lake formed (Arkansas Geological Survey, 2015k).

⁵⁴ Karst topography: “A distinctive landscape (topography) that can develop where the underlying bedrock, often limestone or marble, is partially dissolved by surface or ground water.” (USGS, 2015e)

⁵⁵ Liquefaction: “A process by which water-saturated sediment temporarily loses strength and acts as a fluid... This effect can be caused by earthquake shaking.” (USGS, 2012d)

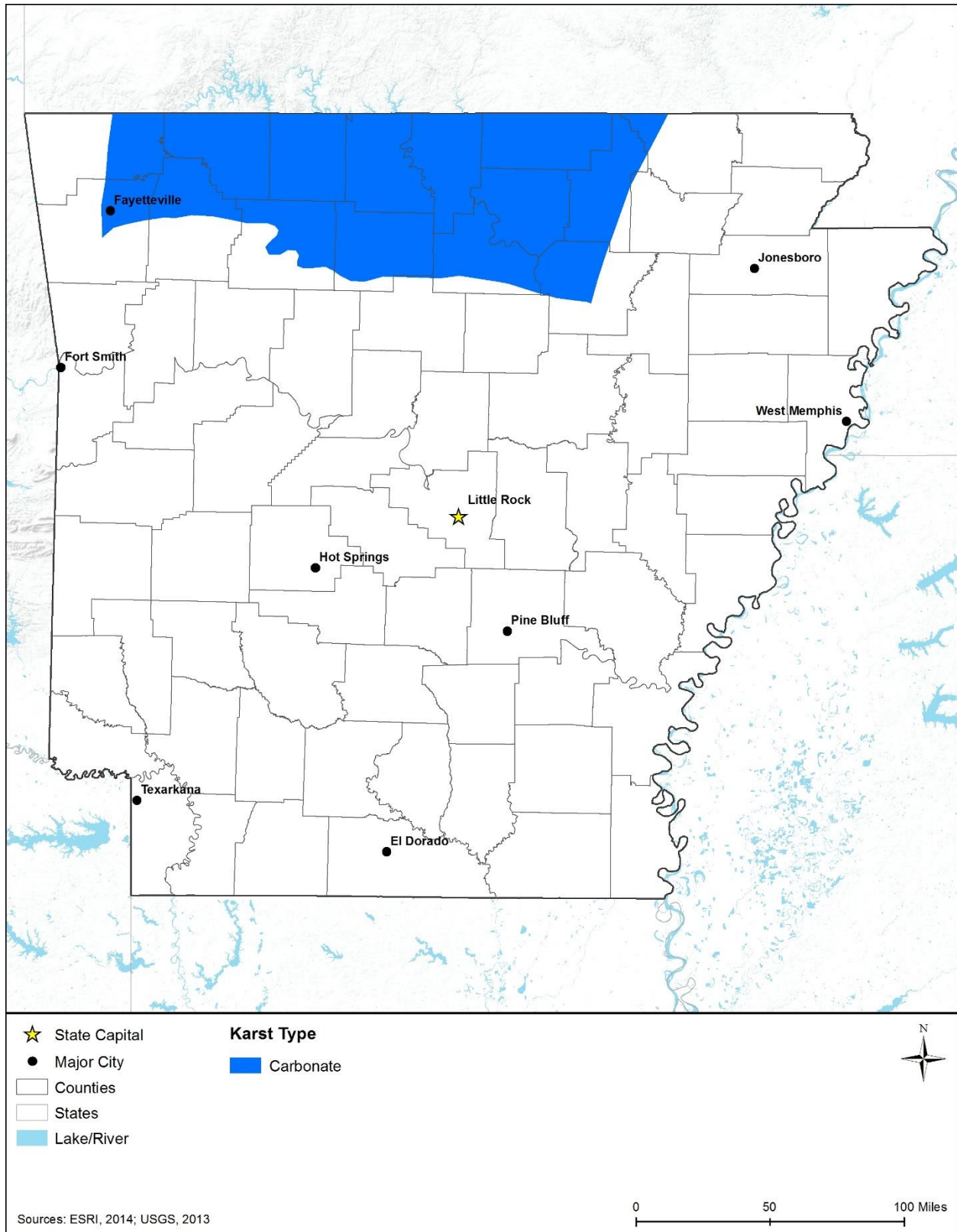


Figure 4.1.3-7: Karst Topography in Arkansas

4.1.4. Water Resources

4.1.4.1. Definition of the Resource

Water resources are defined as all surface water bodies and groundwater systems including streams, rivers, lakes, canals, ditches, estuarine waters, floodplains, aquifers, and other aquatic habitats (wetlands are discussed separately in Section 4.1.5, Wetlands). These resources can be grouped into watersheds, which are defined as areas of land whose flowing water resources (including runoff from rainfall) drain to a common outlet such as a river or ocean. The value and use of water resources are influenced by the quantity and quality of water available for use and the demand for available water. Water resources are used for drinking, irrigation, industry, recreation, and as habitat for wildlife. Some water resources that are particularly pristine, sensitive, or of great economic value enjoy special protections under federal and state laws. An adequate supply of water is essential for human and ecological health and wellbeing. (USGS, 2014e)

4.1.4.2. Specific Regulatory Considerations

Federal laws relevant to protecting the quality and use of water resources are summarized in Appendix C, Environmental Laws and Regulations, and Section 1.8, Overview of Relevant Federal Laws and Executive Orders. Table 4.1.4-1 summarizes the major Arkansas laws and permitting requirements relevant to the state's water resources.

Table 4.1.4-1: Relevant Arkansas Water Resources Laws and Regulations

State Law/Regulation	Regulatory Agency	Applicability
Water Quality Standards for Surface Waters of the State of Arkansas (ADEQ Regulation No. 2, Section 2.302(A))	ADEQ	Defines Arkansas water permit requirements.
Arkansas Water and Air Pollution Act	ADEQ	Discharges to surface waters resulting from construction activities that disturb one or more acre of surface soil require a permit.
Clean Water Act (CWA) Section 404 permit, Nationwide Permits Arkansas regional conditions	US Army Corps of Engineers (USACE), Little Rock District	The USACE must be notified before initiation of a project in the following waterbodies: Alum Fork Saline, Antoine, Arkansas, Black, Caddo, Cossatot, Current, Devils Fork Little Red, Dry Fork Fourche LaFave, Eleven Point, Fourche Lafave, Irons Fork, Irons Fork Ouachita, Kings, L'anguille, Left hand Chute Little, Little Missouri, Little, Middle Fork Saline, Middle Fork Little Red, Mississippi, Mountain Fork, North Fork Ouachita, North Fork Saline, Ouachita, Poteau, Red, Right Hand Chute Little, Saline, South Fork Little Red, South Fork Ouachita, South Fork Saline, South Fork Spring, South Fourche Lafave, Spring, St. Francis, Strawberry, and Tyronza Rivers and Beech, Big, Buffalo, Fiddler's, Iron Mines, Lewis, Muddy, Myatt, North Fork, Rainy, Robinson, and Turkey Creek.

State Law/Regulation	Regulatory Agency	Applicability
CWA Section 401 permit	ADEQ	In accordance with Section 401 of the CWA, activities that may result in a discharge to waters of the U.S. require a Water Quality Certification from ADEQ indicating that the proposed activity will not violate water quality standards.
Arkansas Code Annotated, Title 15, Chapter 22	Arkansas Natural Resources Commission (ANRC)	Established ANRC as the state water resources planning and management agency with the authority, among others, to: • Allocate surface water during shortages • Develop a groundwater protection program • Designate critical groundwater areas • Cost-share installation of water conservation practices • Establish groundwater rights in critical areas • Develop an educational program • Delegate management powers to regional districts

Sources: (Arkansas Pollution Control and Ecology Commission, 2007), (ADEQ, 2017a), (USACE, 2017), (ADEQ, 2017b), (JUSTIA, 2010a)

4.1.4.3. *Environmental Setting: Surface Water*

Surface water resources are lakes, ponds, rivers, and streams, as well as estuarine⁵⁶ and coastal waters. According to the ADEQ, Arkansas has approximately 87,618 miles of rivers and streams and approximately 110,500 lakes, reservoirs, and ponds covering 806 square miles (ADEQ, 2014b) (ANRC, 1981). These surface waters supply drinking water; provide flood control and aquatic habitat; and support recreation, tourism, agriculture, fishing, and power generation across the state (ADEQ, 2014b).

Watersheds

Watersheds, or drainage areas, consist of surface water and all underlying groundwater, and encompass an area of land that drains all the streams and rainfall to a common outlet (e.g., reservoir, bay). Arkansas's waters (lakes, rivers, and streams) are divided into 6 major watersheds, or drainage basins (Figure 4.1.4-1). The ADEQ website www.adeq.state.ar.us/poa/watershed/ provides additional information and additional maps about each ADEQ watershed's location, size, and water quality. (ADEQ, 2014b)

Red River Basin occupies a small area in the far southwestern corner of the Arkansas. The Ouachita River Basin borders the basin on the east. This basin occupies most of the southern half of the state and contains several major reservoirs, including Lake Ouachita and De Gray Reservoir. Major rivers within the basin drain south into Louisiana. The Arkansas River Basin spans the state extending from the far northwestern corner to the Mississippi River in southeast Arkansas. The White River Basin covers an area that extends from the norther border of the state south-southeast to the Arkansas River. The St. Francis River Basin lies in the far northeastern corner of Arkansas. The major waterbodies within this basin flow south and empty into the Mississippi River. The Mississippi River Basin extends along the eastern border of Arkansas. (ADEQ, 2014b)

⁵⁶ Estuarine: related to an estuary, or a "partially enclosed body of water where fresh water from rivers and streams mixes with salt water from the ocean. It is an area of transition from land to sea." (USEPA, 2015c)

Freshwater

As shown in Figure 4.1.4-1, there are 10 major rivers in Arkansas: Arkansas, Saline, Ouachita, Red, Fourche Lafave, White, Kings, Buffalo, Black, and St. Francis. The eastern border of Arkansas is formed by the Mississippi River. The Arkansas River enters western Arkansas from Oklahoma and flows by the Mississippi River. The Arkansas River enters western Arkansas from Oklahoma and flows in a southeasterly direction toward its confluence with the Mississippi River. The river extends 320 miles in length within Arkansas and offers many recreational opportunities, such as boating and fishing (ADPT, 2015a). In northeastern Arkansas, the Black River enters the state from Missouri and flows southwest to join the White River. The White River flows southward and joins the Mississippi River in southeast Arkansas. Within Arkansas, there have been 79 publicly owned lakes ranging from 60 to over 45,000 acres, totaling 357,896 acres. Some of the state's large lakes and dammed reservoirs provide flood control, hydropower⁵⁷ generation, and drinking water sources. (ADEQ, 2014b)

Arkansas has nine major lakes and reservoirs: Norfolk Lake, Greens Ferry Lake, Lake Ouachita, DeGray Lake, Lake Jack Lee, Beaver Lake, Bulls Shoals Reservoir, Dardanette Reservoir, and Millwood Reservoir. Lake Ouachita is the largest lake in Arkansas and is approximately 40 miles in length and 970 miles of shoreline. The lake was created by constructing the Blakely Mountain Dam on the Ouachita River (ADPT, 2015b). Beaver Lake is approximately 44 square miles and located in northwest Arkansas along the White River. The lake has 487 miles of shoreline and offers many recreational opportunities (ADPT, 2015c). Bull Shoals Reservoir and Norfolk Lake are located east of Beaver Lake in northern Arkansas. Construction of the state's longest earthen dam across the Little River in southwest Arkansas formed the Millwood Reservoir. The lake is a popular bass fishing site, and is home to many bird species. (ADPT, 2015d)

4.1.4.4. *Environmental Setting: Sensitive or Protected Waterbodies*

Wild and Scenic Rivers

Eight rivers within Arkansas are federally designated as National Wild and Scenic Rivers. These rivers include Big Piney Creek, Buffalo River, Cossatot River, Hurricane Creek, Little Missouri River, Mulberry River, North Sylamore Creek, and Richland Creek (Figure 4.1.4-1) (WSR, 2017).

- Big Piney Creek, located in northwest Arkansas, includes a 45.2-mile segment designated as scenic. "Sandstone bluffs, waterfalls, still pools and stands of oak, hickory, and pine," characterize the river. The river is a popular area for a variety of recreational activities, including fishing and canoeing, and is home to diverse plant communities. (National Wild and Scenic River System, 2015a)
- Buffalo River in northwestern Arkansas includes 9.4 miles designated as wild and 6.4 miles designated as scenic. Additionally, Buffalo River was established as the first U.S. National River in 1972. Uneven, sharp ridges and cliffs characterize the river with areas exhibiting

⁵⁷ Hydropower: "electrical energy produced by falling or flowing water" (USEPA, 2004).

rapids. Buffalo River offers an abundance of recreational opportunities including whitewater.

- Rafting and fishing, and provides habitats for a variety of plants and animals. (National Wild and Scenic Rivers System, 2015b)
- Cossatot River in southwest Arkansas includes 26.6 miles of scenic river and 4.2 miles of recreational river. The river flows through forestland and areas of jagged bedrock, and is known throughout the state for its challenging whitewater canoeing courses. (National Wild and Scenic Rivers System, 2015c)
- Hurricane Creek in northwestern Arkansas includes 2.4 miles of wild river and 13.1 miles of scenic river. The river is a tributary of Big Piney Creek and is characterized by “sharp ridges and cliffs, unusual rock formations and clear reflecting pools.” Hurricane Creek flows through diverse vegetation including beeches and ferns. (National Wild and Scenic Rivers System, 2015d)
- Little Missouri River in southwest Arkansas includes 4.4 miles of wild river and 11.3 miles of scenic river. The river is characterized by several stretches of rapids and offers many recreational opportunities, such as swimming and floating. (National Wild and Scenic Rivers System, 2015e)
- Mulberry River in northwest Arkansas includes 19.4 miles of scenic river and 36.6 miles of recreational river. The river offers areas for canoeing, swimming, and camping, and is well known throughout Arkansas as a premier smallmouth and spotted bass fishery. (National Wild and Scenic Rivers System, 2015f)
- North Sylamore Creek includes 14.5 miles designated as scenic river in northcentral Arkansas. The river flows through a recreational area that offers recreational opportunities such as swimming and camping, and provides a habitat for a variety of fish species in Arkansas, particularly the smallmouth bass. (National Wild and Scenic Rivers System, 2015g)
- Richland Creek includes 5.3 miles of wild river and 11.2 miles of scenic river in northwestern Arkansas. The river is characterized by exposed bedrock (limestones and shales), and provides many recreational opportunities, such as kayaking, swimming, and fishing. (National Wild and Scenic Rivers System, 2015h)

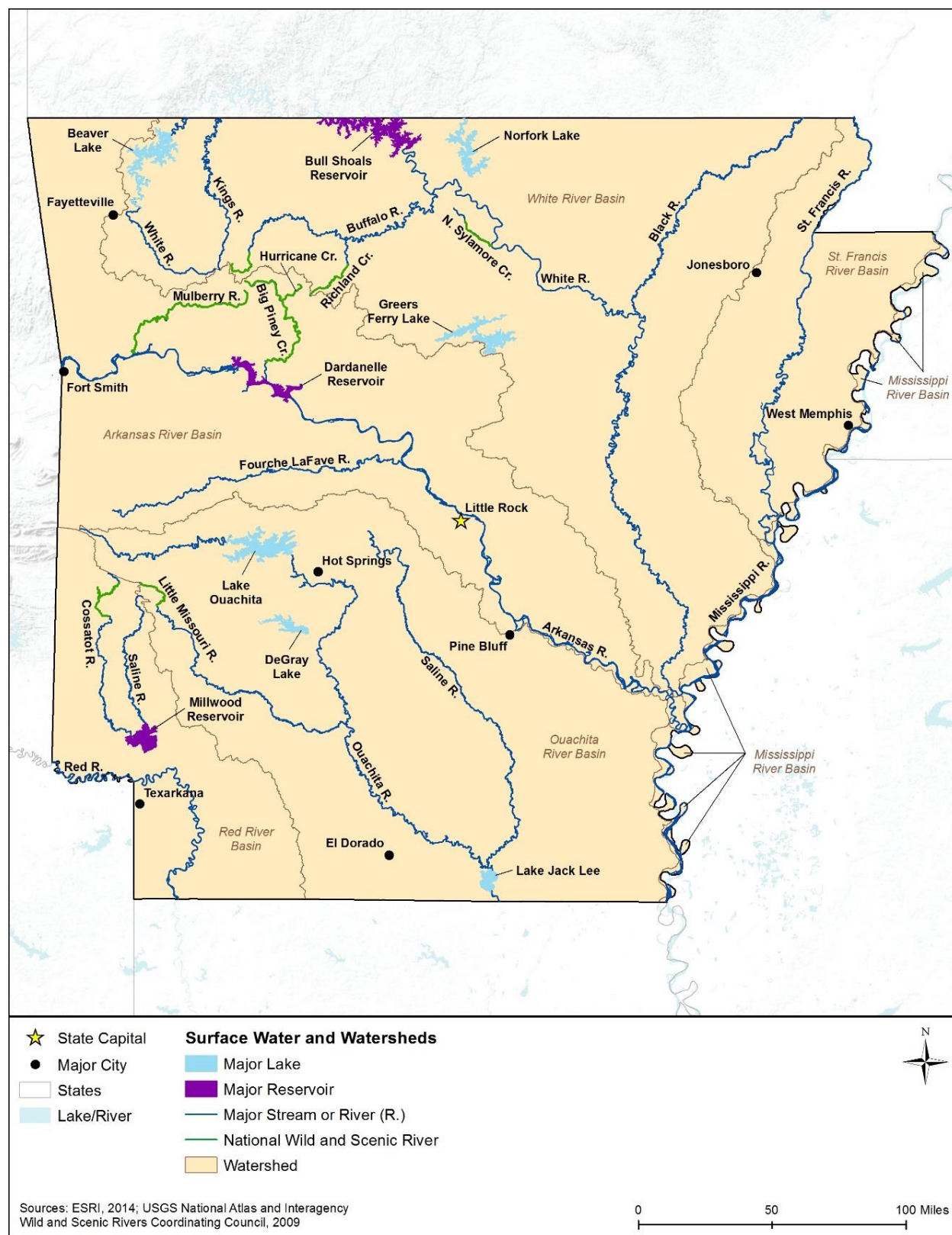


Figure 4.1.4-1: Major Arkansas Watersheds, defined by ADEQ, and Surface Waterbodies

Special Resource Waters

Specific waterbodies in Arkansas are protected under the USACE Nationwide Permit Regional Conditions. USACE must be notified before initiation of a construction project within these waterbodies to address potential impacts. A complete list of the permitted waterbodies can be found on the USACE website at

(www.swl.usace.army.mil/Portals/50/docs/regulatory/ARRC.pdf). (USACE, 2015a)

The Arkansas Pollution Control and Ecology Commission designates specific waterbodies as Extraordinary Resource Waters, Ecologically Sensitive Waterbodies, and Natural Scenic Waterways. The uses and water quality of these waterbodies are preserved through implementation of water quality controls, protection of instream habitats, maintenance of natural flow regime, and land management practices within watersheds. (APCEC, 2014)

Extraordinary Resource Waters, Ecologically Sensitive Waterbodies, and Natural Scenic Waterways are further described below:

- Extraordinary Resource Waters include waterbodies “characterized by scenic beauty, aesthetics, scientific values, broad scope recreation potential, and intangible social values.”
- Ecologically Sensitive Waterbodies include waters that “provide habitat within the existing range of threatened, endangered, or endemic species of aquatic or semiaquatic life forms.”
- Natural and Scenic Waterways include waters which have been legislatively adopted into a state or federal system. (USACE, 2015b)

A complete list of these waterbodies can be found at the USACE website (www.swl.usace.army.mil/Missions/Regulatory/ArkansasSpecialResourceWaters.aspx). (USACE, 2015b)

4.1.4.5. *Impaired Waterbodies*

Several elements, including temperature, dissolved oxygen, suspended sediment, nutrients, metals, oils, observations of aquatic wildlife communities, and sampling of fish tissue, are used to evaluate water quality. Under Section 303(d) of the Clean Water Act, states are required to assess water quality and report a listing of impaired waters,⁵⁸ the causes of impairment, and probable sources.

Table 4.1.4-2 summarizes the water quality of Arkansas’s assessed major waterbodies by category, percent impaired, designated use,⁵⁹ cause, and probable sources. Figure 4.1.4-2 shows the Section 404(d) waters in Arkansas as of 2014.

As shown in Table 4.1.4-2, various sources affect Arkansas’s waterbodies, causing impairments. For example, mercury in segments of the Ouachita River have resulted in fish consumption advisories (ADEQ, 2014b). Additionally, more than half of assessed lakes, reservoirs, and ponds in Arkansas are impaired due to pollutants, such as excess nutrients (e.g., phosphorus) and sediments. Sediments and siltation are the cause for impairment in lakes located in the north and

⁵⁸ Impaired waters: waterways that do not meet state water quality standards. Under the CWA, Section 303(d), states, territories, and authorized tribes are required to develop prioritized lists of impaired waters (USEPA, 2015c).

⁵⁹ Designated Use: an appropriate intended use by humans and/or aquatic life for a waterbody. Designated uses may include recreation, shellfishing, or drinking water supply (USEPA, 2015c).

west-central Arkansas. Statewide, the primary designated use for Arkansas's impaired waterbodies is agricultural water supply. (ANRC, 2014a)

Table 4.1.4-2: Section 404(d) Impaired Waters of Arkansas, 2014

Water Type^a	Amount of Waters Assessed^b (Percent)	Amount Impaired (Percent)	Designated Uses of Impaired Waters	Top Causes of Impairment	Top Probable Sources for Impairment
Rivers and Streams	11%	44.5%	Agricultural water supply, domestic water supply, fish consumption, fisheries, industrial water supply, recreation	Sediment, mercury, oxygen depletion, total dissolved solids, metals, pathogens ^c	Agriculture, construction, municipal discharges/ sewage, industrial, resource extraction, urban-related runoff/ stormwater, hydromodifications (e.g., impacts from flow regulations/modification)
Lakes, Reservoirs, and Ponds	13%	54%	Agricultural water supply, domestic water supply, fish consumption, fisheries, industrial water supply, recreation	Mercury, nutrients such as phosphorus, sediment, and metals	Industrial

Source: (USEPA, 2015b)

^a Some waters may be considered for more than one water type.

^b Arkansas has not assessed all waterbodies within the state.

^c Pathogen: a bacterium, virus, or other microorganism that can cause disease (USEPA, 2015c).

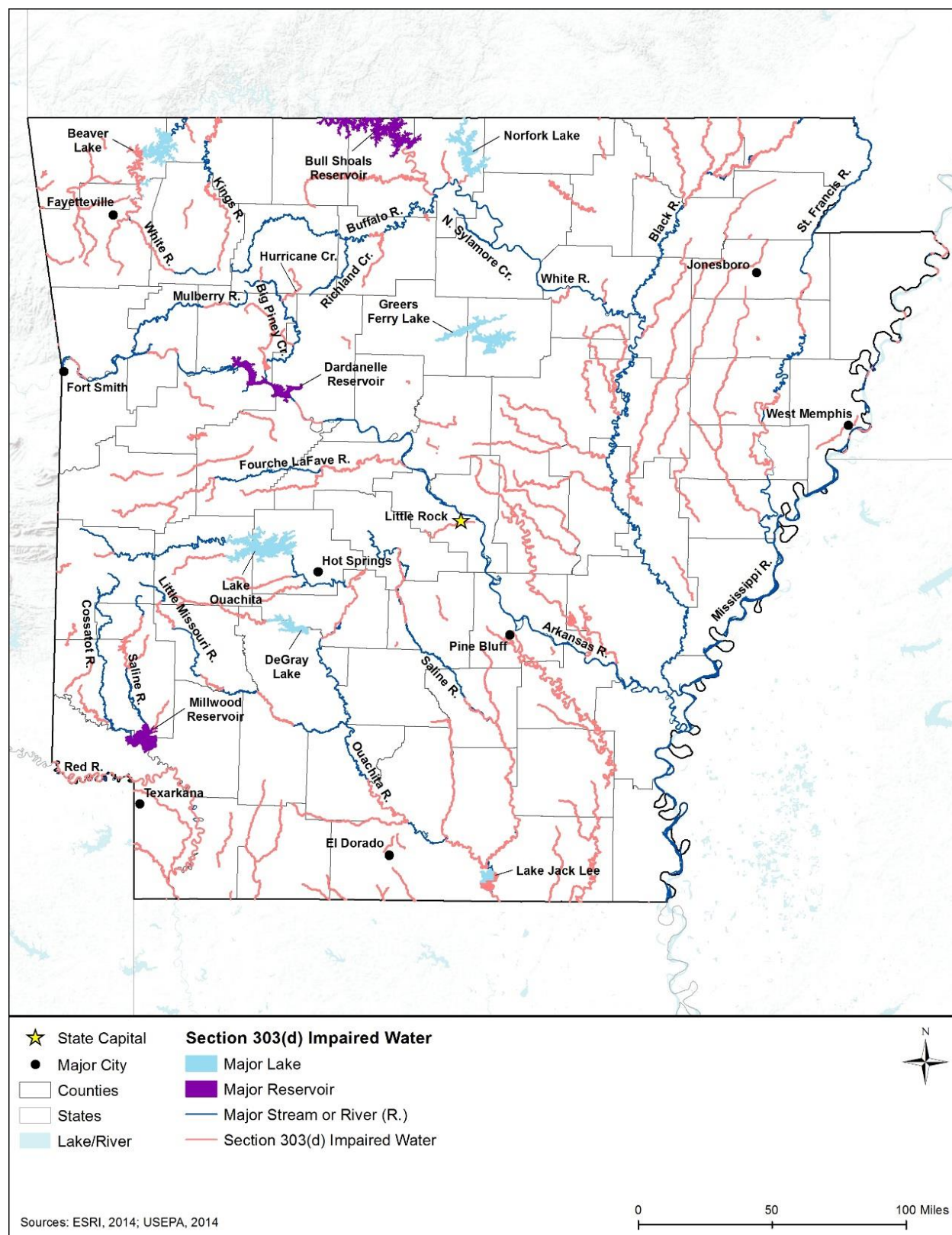


Figure 4.1.4-2: Section 404(d) Impaired Waters of Arkansas, 2014

ADEQ works closely with federal and state agencies to implement programs to maintain and restore water quality across the state. One of the leading causes of impairment in Arkansas's river and streams is sediment from nonpoint sources (USEPA, 2015b). ADEQ works with the Arkansas Natural Resources Commission (ANRC) to develop strategies to manage nonpoint source pollution. ANRC has developed a Task Force and the Arkansas Watershed Prioritization tool to address issues within the state's watershed. (University of Arkansas, 2015) Agriculture is also a source of impairment for Arkansas rivers and streams. ADEQ and the Natural Resources Conservation Service work with Arkansas farmers and ranchers within targeted watersheds, such as the Mississippi River Basin, to implement conservation practices, such as nutrient management. These practices reduce sediment, phosphorus, and nitrogen releases from agricultural land, and help to restore water quality for local water bodies and, ultimately, the Gulf of Mexico. Erosion and siltation from agricultural crops contribute high levels of sediment into the St. Francis River. ADEQ and conservation groups within Arkansas work to restore St. Francis River through implementation of agricultural Best Management Practices (BMPs). (ANRC, 2014b)

4.1.4.6. Floodplains

The Federal Emergency Management Agency (FEMA) defines a floodplain or flood-prone area as "any land area susceptible to being inundated by water from any source" (44 Code of Federal Regulations [CFR] 59.1)⁶⁰ (FEMA, 2000). Through FEMA's flood hazard mapping program, the agency identifies flood hazards and risks associated with the 100-year flood, which is defined as "a flood that has a 1 percent chance of occurring in any given year," to allow communities to prepare and protect against flood events (FEMA, 2013).

Floodplains provide suitable and sometimes unique habitat for a wide variety of plants and animals, and are typically more biologically diverse than upland areas due to the combination of both terrestrial and aquatic ecosystems. Vegetation along stream banks provides shade, which helps to regulate water temperature for aquatic species. During flood events, sediment and debris settle out and collect on the floodplain, enriching the soil with additional nutrients. Pollutants from floodwater runoff are also filtered by floodplain vegetation and soils; thereby improving water quality. Furthermore, floodplains protect natural and built infrastructure by providing floodwater storage, erosion control, water quality maintenance, and groundwater recharge. Historically, floodplains have been favorable locations for agriculture, aquaculture, and forest production due to the relatively flat topography and nearby water supply. Floodplains can also offer recreational activities, such as boating, swimming, and fishing, as well as hiking and camping. (FEMA, 2014a)

Riverine and lake are the primary types of floodplain in Arkansas, found occurs along rivers, streams, or lakes where overbank flooding may occur, and inundating adjacent land areas. In steep river valleys found in hilly areas, floodwaters can floodwaters can build and recede quickly, with fast moving and deep water. Flooding in these areas can cause greater damage than typical riverine flooding due to the high velocity of water flow, the amount of debris

⁶⁰ To search for and locate CFR records, see the Electronic Code of Federal Regulations (e-CFR): www.ecfr.gov.

carried, and the broad area affected by floodwaters. Whereas, flatter floodplains may remain inundated for days or weeks, covered by slow-moving and shallow water. (FEMA, 2014b)

Flooding is the leading cause for disaster declaration by the President in the U.S. and results in significant damage throughout the state annually (NOAA, 2015a). There are several causes of flooding in Arkansas, often resulting in loss of life and damage to property, infrastructure, agriculture, and the environment. These include severe winter storms, heavy rain events, and dam failure. Although some areas, such as floodplains, are more prone to flooding than others, no area in the state is exempt from flood hazards. Since 1957, every county in Arkansas has been part of a declared flooding event. Of the 58 FEMA declared disaster events, 33 have involved flooding. (ADEM, 2010)

Local communities often have floodplain management or zoning ordinances that restrict development within the floodplain. FEMA provides floodplain management assistance, including mapping of 100-year floodplain limits, to approximately 419 communities in Arkansas through the National Flood Insurance Program (NFIP) (FEMA, 2014c). Established to reduce the economic and social cost of flood damage by subsidizing insurance payments, the NFIP encourages communities “to adopt and enforce floodplain management regulations and to implement broader floodplain management programs” and allows property owners in participating communities to purchase insurance protection against losses from flooding (FEMA, 2015). As an incentive, communities can voluntarily participate in the NFIP Community Rating System (CRS), which is a program that rewards communities by reducing flood insurance premiums in exchange for doing more than the minimum NFIP requirements for floodplain management. As of May 2014, Arkansas had 19 communities participating in the CRS (FEMA, 2014d).⁶¹

Albert Pike Flash Flooding

The most catastrophic flash flood in Arkansas history in terms of fatalities and injuries occurred in June 2010. Excessive rain in the Ouachita National Forest in western Arkansas caused a flood in the Albert Pike Recreation Area. This area is “characterized by steep terrain, limited access, and poor communication.” The flooding resulted in 20 deaths, 24 injuries, and more than 60 rescues. The six to seven inches that fell in the Little Missouri River basin caused flood waters to rise more than 20 feet in four hours, with many local creeks overflowing their banks. Arkansas reported an estimated \$9 million in property damage. (NOAA, 2015b)



Source: (NOAA 2010)

⁶¹ A list of the 19 CRS communities can be found in the most recent FEMA CRS report dated May 1, 2014 (http://www.fema.gov/media-library-data/1398878892102-5cbcaa727a635327277d834491210fec/CRS_Communities_May_1_2014.pdf) and additional program information is available from FEMA’s NFIP CRS website (www.fema.gov/national-flood-insurance-program-community-rating-system).

4.1.4.7. Groundwater

Groundwater systems are sources of water that result from precipitation infiltrating the ground surface, and includes underground water that occupies pore spaces between sand, clay, or rock particles. An aquifer is a permeable geological formation that stores or transmits water to wells and springs. Groundwater is contained in either confined (bound by clays or nonporous bedrock) or unconfined (no layer to restrict the vertical movement of groundwater) aquifers. When the water table reaches the ground surface, groundwater will reappear as either streams, surface bodies of water, or wetlands. This exchange between surface water and groundwater is an important feature of the water cycle. Table 4.1.4-3 provides details on aquifer characteristics in the state; Figure 4.1.4-3 shows Arkansas's principal aquifers. No sole source aquifers exist in Arkansas. (USGS, 1999)

Arkansas's principal aquifers consist of carbonate-rock⁶² and sandstone aquifers.⁶³ Approximately 71 percent of the water supply in Arkansas is provided from groundwater sources. Generally, the water quality of Arkansas's aquifers is adequate for existing uses. (ANRC, 2014a) Most serious threats to groundwater quality include nutrients, pesticides, and bacteria from agricultural activities, urban runoff, and home septic systems (ANRC, 2014a) (Arkansas Geological Survey, 2015j).

Table 4.1.4-3: Description of Arkansas's Principal Aquifers

Aquifer Type and Name	Location in State	Groundwater Quality
Mississippi Embayment Aquifer System Composed of thick sands, clays, and shales.	Extends from central to south and southwest Arkansas, and includes a small band in northeast Arkansas.	High concentrations of iron. Unsuitable for human consumption but can be used for irrigation and some domestic uses.
Mississippi River Valley Alluvial System Consists of sand, gravel, silt, and minor clay.	Covers eastern Arkansas, extending from the northern border to the southern border.	Suitable for most uses. Water contains calcium bicarbonate with dissolved solid concentrations usually less than 500 mg/L in most areas. Some areas exhibit large concentrations of iron manganese.
Ozark Plateaus Aquifer System Consists of limestone and dolomite with sandstone, shale, and chert.	Underlies the northern portion of the state.	Suitable for most uses at greater depths. Shallow wells may not be suitable for human consumption without treatment.
Edwards-Trinity Aquifer System Consists of interbedded sandstone, sand, limestone, and shale.	Small band in southwest Arkansas.	Occurrence of freshwater in this aquifer system is limited within Arkansas.

Sources: (USGS, 1995b) (USGS, 1995c) (USGS, 1995d) (USGS, 1995e) (USGS, 1995f)

⁶² Carbonate-rock aquifers typically consist of limestone with highly variable water-yielding properties (some yield almost no water and others are highly productive aquifers) (Olcott, 1995a).

⁶³ Sandstone aquifers form from the conversion of sand grains into rock caused by the weight of overlying soil/rock. The sand grains are rearranged and tightly packed, thereby reducing or eliminating the volume of pore space, which results in low-permeability rocks such as shale or siltstone. These aquifer types are highly productive in many places and provide large volumes of water. (Olcott, 1995b)

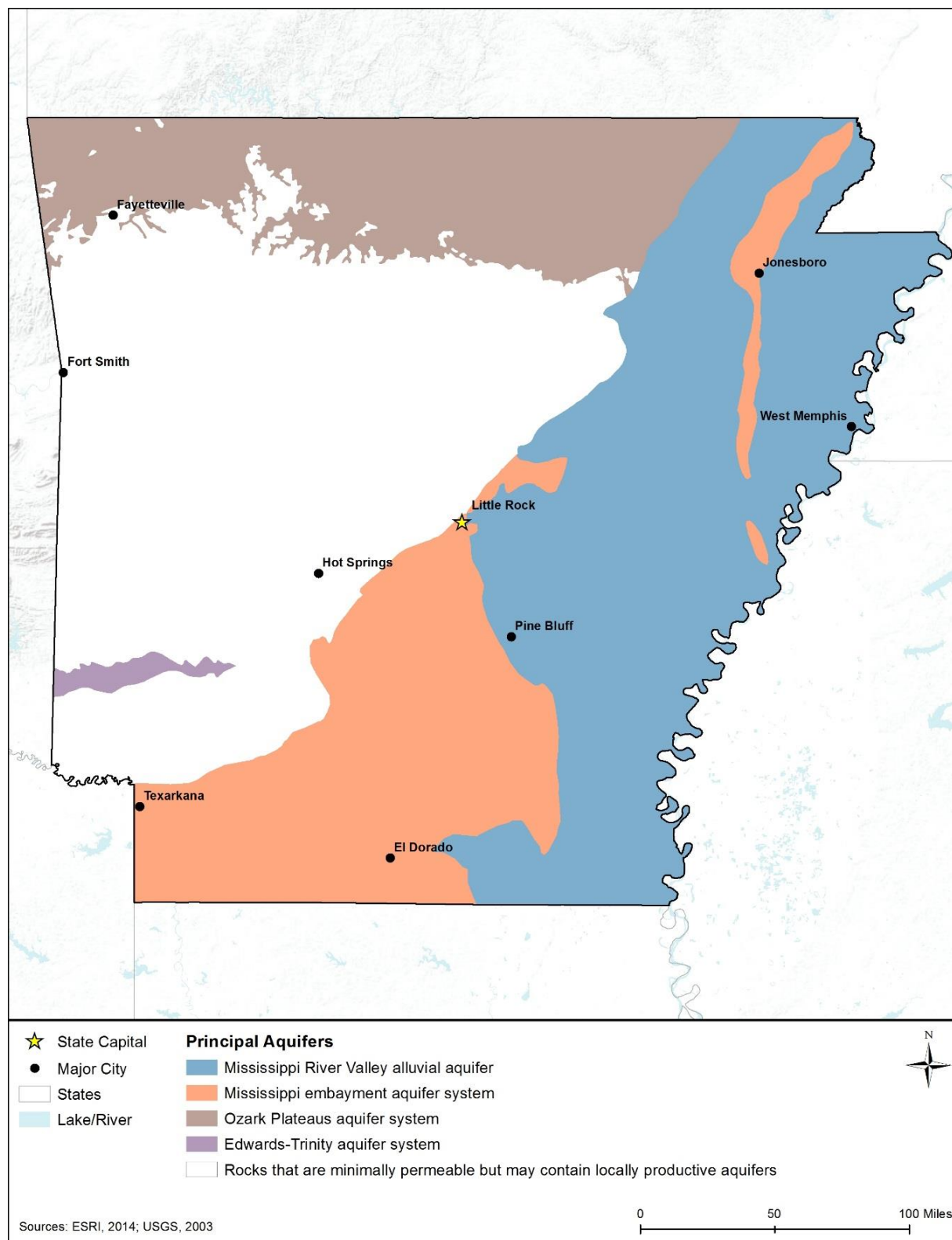


Figure 4.1.4-3: Principal Aquifers of Arkansas

4.1.5. Wetlands

4.1.5.1. Definition of the Resource

The Clean Water Act (CWA) defines wetlands as “those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs and similar areas” (40 CFR 230.3(t), 1993).

The USEPA estimates that “more than one-third of the United States’ threatened and endangered species live only in wetlands, and nearly half of such species use wetlands at some point in their lives” (USEPA, 1995). In addition to providing habitat for many plants and animals, wetlands also provide benefits to human communities. Wetlands store water during flood events, improve water quality by filtering polluted runoff, help control erosion by slowing water velocity and filtering sediments, serve as points of groundwater recharge, and help maintain base flow in streams and rivers. Additionally, wetlands provide recreation opportunities for people, such as hiking, bird watching, and photography (USEPA, 1995).

4.1.5.2. Environmental Laws and Regulations

Appendix C, Environmental Laws and Regulations, describes the pertinent federal laws protecting wetlands in detail. Table 4.1.5-1 summarizes the major Arkansas state laws and permitting requirements relevant to the state’s wetlands.

Table 4.1.5-1: Relevant Arkansas Wetlands Laws and Regulations

State Law/Regulation	Regulatory Agency	Applicability
CWA Section 404 permit, Nationwide Permit (NWP) Arkansas regional conditions	USACE, Little Rock District	USACE must be notified before initiation of activities covered under the NWPs in fens, ^a bogs, ^b groundwater seeps, ^c dune depression wetlands, ^d and wetlands adjacent to the Cache River.
CWA Section 401 permit	ADEQ	In accordance with Section 401 of the CWA, activities that may result in a discharge to waters of the U.S. require a Water Quality Certification from ADEQ indicating that the proposed activity will not violate water quality standards.
Arkansas Water and Air Pollution Act	ADEQ	Discharges to surface waters resulting from construction activities that disturb one or more acre of surface soil.

Sources: (ADEQ, 2017a), (USACE, 2017), (ADEQ, 2017b)

^a Fens: “Peat-accumulating wetland that receives some drainage from surrounding mineral soil and usually supports marshlike vegetation” (USACE, 2015a).

^b Bogs: “Peat-accumulating wetland that has no major inflows or outflows and supports acid-loving mosses, particularly sphagnum” (USACE, 2015a).

^c Groundwater Seeps: “Wetlands at the base of steep slopes where the groundwater surface intersects with the land surface” (USACE, 2015a).

^d Dune depressional wetlands: “Wetlands in shallow depressions that have no major outflows but receive runoff from the surrounding land, located between sandy ridges in northeast Arkansas and southeast Missouri. These wetlands often support pondberry (*Lindera melissifolia*), a federally listed endangered plant” (USACE, 2015a).

4.1.5.3. Environmental Setting: Wetland Types and Functions

The U.S. Fish and Wildlife Service (USFWS) National Wetlands Inventory (NWI) mapping adopted a national Wetlands Classification Standard that classifies wetlands according to shared environmental factors, such as vegetation, soils, and hydrology, as defined by (Cowardin, Carter, Golet, & LaRoe, 1979). The Wetlands Classification System includes five major wetland Systems: Marine, Estuarine, Riverine, Lacustrine, and Palustrine. Arkansas has four of these Systems, as detailed in Table 4.1.5-2.⁶⁴ The first four of these include both wetlands and deepwater habitats but the Palustrine includes only wetland habitats. (USFWS, 2017a)

- “The Marine System consists of the open ocean overlying the continental shelf and its associated high-energy coastline. Marine habitats are exposed to the waves and currents of the open ocean and the Water Regimes are determined primarily by the ebb and flow of oceanic tides. Salinities exceed 30 parts per thousand (ppt), with little or no dilution except outside the mouths of estuaries.” Where wave energy is low, mangroves or mudflats may be present.
- “The Estuarine System consists of deepwater tidal habitats and adjacent tidal habitats that are usually semi-enclosed by land but have open, partly obstructed, or sporadic access to the open ocean and the ocean water is at least occasionally diluted by freshwater runoff from the land.”
- “Riverine System includes all wetlands and deepwater habitats contained within a channel with two exceptions (1) wetlands dominated by trees, shrubs, persistent emergents, emergent mosses, or lichens, and (2) habitats with water containing ocean-derived salts in excess of 0.5 ppt.”
- Lacustrine System includes inland water bodies that are situated in topographic depressions, lack emergent trees and shrubs, have less than 30 percent vegetation cover, and occupy greater than 20 acres. Includes lakes, larger ponds, sloughs, lochs, bayous, etc.
- “Palustrine includes all nontidal wetlands dominated by trees, shrubs, persistent emergents, or emergent mosses or lichens, and all such wetlands that occur in tidal areas where salinity due to ocean-derived salts is below 0.5 percent.” The system is characterized based on the type and duration of flooding, water chemistry, vegetation, or substrate characteristics (soil types) (Cowardin, Carter, Golet, & LaRoe, 1979) (FGDC, 2013).

In Arkansas, palustrine (freshwater) wetlands found on river and lake floodplains across the state (mostly on the eastern half of the state), are the main type of wetlands, as shown in Figure 4.1.5-1. Riverine wetlands (18,538 acres) and lacustrine wetlands (57,426 acres) comprise approximately one percent and three percent, respectively, of the total wetlands in the state. Therefore, they are not discussed in this PEIS.

⁶⁴ The wetland acreages were obtained from the USFWS (2014) National Wetlands Inventory. Data from this inventory was downloaded by state at <https://www.fws.gov/wetlands/>. The wetlands data contains a wetlands classification code, which are a series of letter and number codes, adapted to the national wetland classification system in order to map from (e.g., PFO). Each of these codes corresponds to a larger wetland type; those wetland areas are rolled up under that wetlands type. The codes and associated acres that correspond to the deepwater habitats (e.g., those beginning with M1, E1, L1) were removed. The wetlands acres were derived from the geospatial datafile, by creating a pivot table to capture the sum of all acres under a particular wetland type. The maps reflect/show the wetland types/classifications and overarching codes; the symbolization used in the map is standard to these wetland types/codes, per the USFWS and Federal Geographic Data Committee.

Table 4.1.5-2 uses 2014 NWI data to characterize and map Arkansas wetlands on a broad-scale. The data is not intended for site-specific analyses and is not a substitute for field-level wetland surveys, delineations, or jurisdictional determinations, which may be required depending on the site conditions, the type of deployment, or any other permits or permissions necessary to perform the work, at the site-specific level once those locations are known. The map codes and colorings in Table 4.1.5-2 correspond to the wetland types in the figures.

Palustrine Wetlands

In Arkansas, palustrine wetlands include the majority of vegetated freshwater wetlands (freshwater marshes, swamps, bogs, and ponds). These include bottomland hardwood forests, terraces, isolated depressional wetlands, and slope wetlands. Bottomland hardwood forests occur within the floodplains of the Mississippi Rivers and its tributaries. Common tree types found in these palustrine forested wetlands (PFO) in are sweetgum (*Liquidambar styraciflua*), tupelo (*Nyssa* spp.), and oak species (willow (*Quercus phellos*), water (*Q. nigra*), and overcup (*Q. lyrata*). Terraces occur in areas that once contained rivers and contain a mixture of wet flatwoods and prairies, and isolated depressional wetlands (Arkansas MAWPT, 2001a). Precipitation is the main source of water for most of the palustrine emergent wetlands (PEM). Terrace wetlands have alkali (salty) soils and support mostly lichens and mosses. Stunted trees (commonly post oak (*Q. stellata*) and shortleaf (*Pinus echinata*) or loblolly pines (*P. taeda*)), and shrubs occur on deeper, less alkali soils (Arkansas MAWPT 2001b). Isolated depressional wetlands can be fed by precipitation or by groundwater and support rare plant species, such as pondberry (*Lindera melissifolia*). Slope wetlands occur on sloping land surfaces, where groundwater discharge or shallow subsurface flow creates saturated conditions. They provide habitat to ferns, sedges, and orchids. (Arkansas MAWPT, 2001a)

Around 1870, Arkansas had approximately 9.8 million acres of wetlands, and by the by the mid-1980s there were approximately 2.8 million acres (72 percent loss) (Arkansas MAWPT, 2001c). Based on the USFWS NWI 2014 analysis, there are currently approximately 2.05 million acres of palustrine (freshwater) wetlands in the state (USFWS, 2017b). Of those, PFO/PSS wetlands are the dominant wetland type (89 percent), followed by PEM wetlands (5 percent), PUB/PAB (ponds) (7 percent), and other palustrine wetlands (less than 1 percent) (USFWS, 2017b). Main threats to palustrine wetlands in Arkansas include agricultural conversion and urbanization and associated impacts (road construction) (Arkansas MAWPT, 2001c).

4.1.5.4. Wetlands of Special Concern or Value

In addition to protections under the state's wetlands regulations, and national CWA, Arkansas considers certain wetland communities as areas of special value due to their global or regional scarcity, unusual local importance, or habitat they support. These include bogs and fens and wetlands associated with critical resource waters. The USACE must be notified before initiation of activities covered under Nationwide Permits in fens, bogs, groundwater seeps, dune depression wetlands, and wetlands adjacent to the Cache River. (USACE, 2015a)

Table 4.1.5-2: Arkansas Wetland Types, Descriptions, Location, and Amount, 2014

Wetland Type	Map Code and Color	Description ^a	Occurrence	Amount (acres) ^b
Palustrine forested wetland	PFO	PFO wetlands contain woody vegetation that are at least 20 feet tall. Floodplain forests, hardwood swamps, and silver maple-ash swamps are examples of PFO wetlands.	Along the floodplains of the Mississippi River and its tributaries	1,825,449
Palustrine scrub-shrub wetland	PSS	Woody vegetation less than 20 feet tall dominates PSS wetlands. Thickets and shrub swamps are examples of PSS wetlands.		
Palustrine emergent wetlands	PEM	PEM wetlands have erect, rooted, green-stemmed, annual, water-loving plants, excluding mosses and lichens, present for most of the growing season in most years. PEM wetlands include freshwater marshes, wet meadows, fens, ^c prairie potholes, and sloughs. ^d	Eastern part of the state	93,355
Palustrine unconsolidated bottom	PUB	PUB and PAB wetlands are commonly known as freshwater ponds, and includes all wetlands with at least 25% cover of particles smaller than stones and a vegetative cover less than 30%.	Throughout the state	134,171
Palustrine aquatic bed	PAB	PAB wetlands include wetlands vegetated by plants growing mainly on or below the water surface line.		
Other Palustrine wetland	Misc. Types	Farmed wetland, saline seep, ^e and other miscellaneous wetlands are included in this group.	Abandoned fields, depressions (seeps), along hillsides and highways	1,402
Riverine wetland	R	Riverine wetlands include rivers, creeks, and streams. They are contained in natural or artificial channels periodically or continuously containing flowing water.	Throughout the state	18,538
Lacustrine wetland	L2	L2 wetlands are lakes or shallow reservoir basins generally consisting of ponded waters in depressions or dammed river channels, with sparse or lacking persistent emergent vegetation, but including any areas with abundant submerged or floating-leaved aquatic vegetation. These wetlands are less than 8.2 feet deep.	Throughout the state	57,426
TOTAL				2,130,341

Source: (Cowardin, Carter, Golet, & LaRoe, 1979) (USFWS, 2015a) (FGDC, 2013), (USFWS, 2017b)

^a The wetlands descriptions are based on information from the Federal Geographic Data Committee (FGDC)'s Classification of Wetland and Deepwater Habitats of the United States. Based on Cowardin, et.al, 1979, some data has been revised based on the latest scientific advances. The USFWS uses these standards as the minimum guidelines for wetlands mapping efforts. (FGDC, 2013)

^b All acreages are rounded to the nearest whole number. The maps are prepared from the analysis of high altitude imagery. A margin of error is inherent in the use of imagery. The accuracy of image interpretation depends on the quality of the imagery, the experience of the image analysts, the amount and quality of the collateral data and the amount of ground truth verification work conducted. (USFWS, 2015b)

^c Fens are nutrient-rich, grass and sedge-dominated emergent wetlands that are recharged from groundwater and have continuous running water. (Edinger, et al., 2014)

^d Slough: "swamp or shallow lake system, usually a backwater to a larger body of water" (NOAA, 2014)

^e Saline seep is an area where saline groundwater discharges at the soil surface. Saline soils and salt tolerant plants characterize these wetland types (City of Lincoln, 2015).

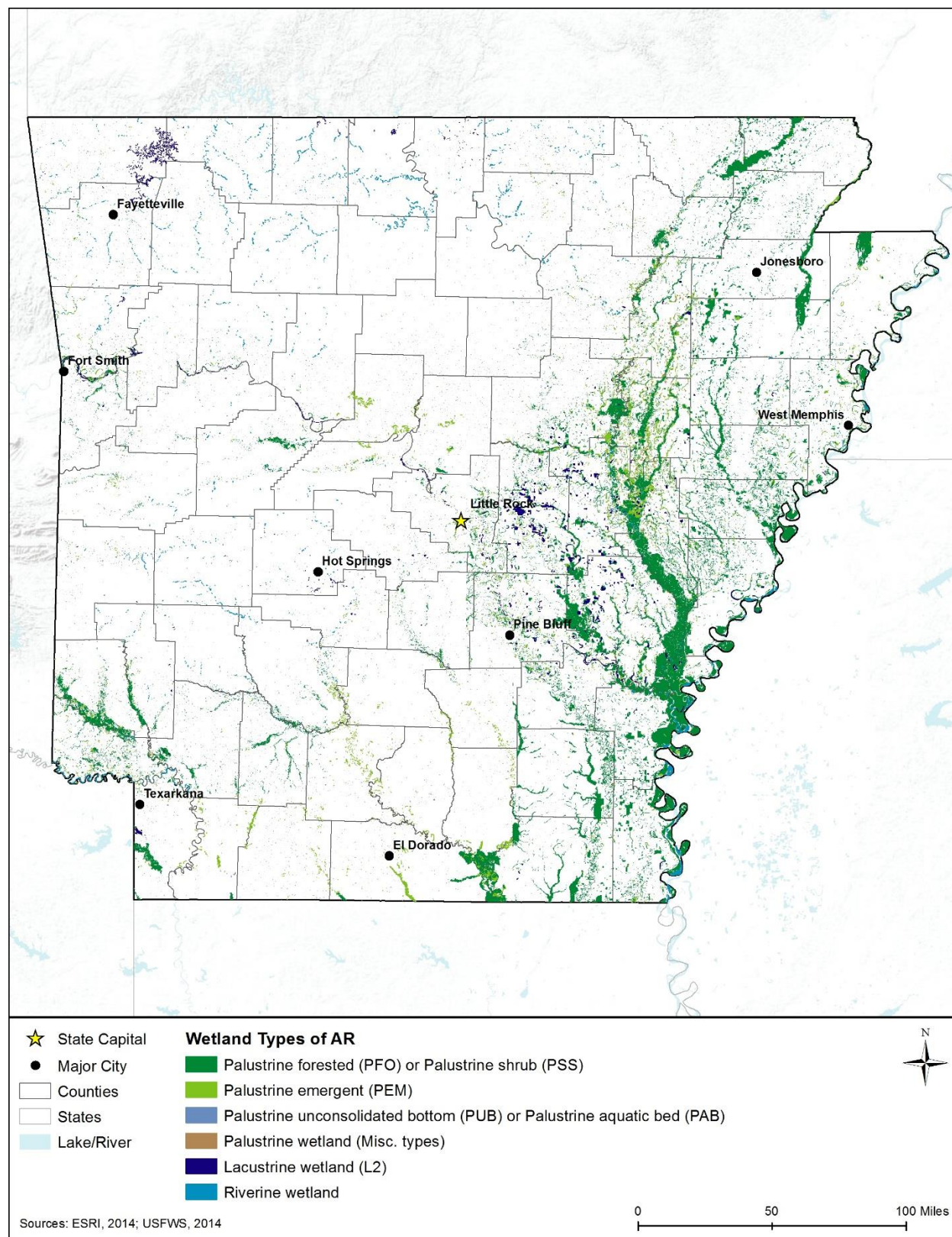


Figure 4.1.5-1: Wetlands by Type, in Arkansas, 2014

Fens and Bogs

In Arkansas, areas classified as a bog or fen are protected under the USACE Nationwide permit. Bogs are acidic wetlands that form thick organic (peat) deposits of 50 feet deep or more. They have little groundwater influence and are recharged through precipitation. The stagnant, nutrient-poor, acidic water slows all processes in a bog, including nutrient recycling, making bogs very sensitive to external disturbance (APA, 2013) (Edinger, et al., 2014). Fens, unlike bogs, are nutrient-rich, grass, and sedge⁶⁵-dominated emergent wetlands that are recharged from groundwater and have continuous running water. This wet meadow habitat supports distinctive plant communities, including many species that are restricted to Arkansas.

Groundwater Seeps and Dune Depression Wetlands

Groundwater seeps occur along streams or in headwaters and on sandy and gravelly soils (to allow the groundwater to reach the surface). Common plants found in seepage wetlands could be forests with red maple (*Acer rubrum*), loblolly pine, tupelo, and sweet gum; shrubs with spicebush (*Lindera benzoin*), sweet pepperbush (*Clethra alnifolia*), and poison sumac (*Toxicodendron vernix*); or sedge- and fern-dominated meadows. (Arkansas MAWPT, 2001d) Dune depressional wetlands, sometimes called sand ponds, occur in low points among sand dunes where water collects and remains for extended periods. Sources of water include precipitation, runoff, groundwater, and stream flooding. The wetlands are usually isolated, poorly drained depressions that contain shrub species pondberry, a federally listed endangered plant, and corkwood (*Duboisia* spp.), which do not commonly occur in any other habitat in Arkansas. Many of the sand ponds have been drained or filled for agriculture. (Arkansas MAWPT, 2001e)

Wetlands Adjacent to the Cache River

The Cache-Lower White River area is an example of regional bottomland hardwood wetlands. It provides internationally important wintering habitat for migratory waterbirds and has recognized by Ramsar Convention⁶⁶ as one of the 17 Wetlands of International Importance in the United States. Approximately one-third of the remaining bottomland hardwoods are found within the Cache-Lower White Rivers 10-year floodplain. The 550,000-acre area is also home to the only “remaining population of black bears native to Arkansas, and not reintroduced.” The entire wetlands area includes a mix of wetlands, “forested flats, shallow sloughs, meandering channels, lakes, and other wetlands, reforested lands, and farmed sanctuaries.” (Arkansas MAWPT, 2001a)

⁶⁵ Sedge: an herbaceous plant with triangular cross-sectional stems and spirally arranged leaves (grasses have alternative leaves) typically associated with wetlands or poor soils.

⁶⁶ The Ramsar Convention is the “oldest of the modern global intergovernmental environmental agreements. The treaty was negotiated through the 1960s by countries and non-governmental organizations concerned about the increasing loss and degradation of wetland habitat for migratory waterbirds.” (Ramsar Convention, 2014)



Source: (USFWS, 2012h)

Figure 4.1.5-2: Bottomland Hardwoods along Cache River

Other Important Wetland Sites in Arkansas

- Wildlife Management Areas are designated for outdoor recreation, many of which are wetlands. The Arkansas Game and Fish Commission (AGFC) manages over 66,000 acres of wetland-management units on state-owned or cooperatively managed Wildlife Management Areas. (AGFC, 2015a). A list of all state Wildlife Management Areas is at the following website: www.agfc.com/hunting/pages/wmalist.aspx.
- National Natural Landmarks (NNLs) in Arkansas range in size from 28 acres to over 6,600 acres, and are owned by Arizona State Parks, USFWS, universities, counties, municipalities, and other conservation organizations and individuals (NPS, 2012a). Section 4.1.8, Visual Resources, describes Arkansas's NNLs.
- Other wetlands protected under easements or agreements through voluntary government programs and resource conservation groups are found across the state, including Natural Resources Conservation Service (NRCS) Agricultural Conservation Easement Program, easements managed by natural resource conservation groups such as state land trusts, Ducks Unlimited, Arkansas Natural Heritage Commission (ANHC), and USFWS. According to the National Conservation Easement Database, a national electronic repository of government and privately held conservation easements (<http://conservationeasement.us/>), NRCS holds more than 231,500 acres in conservation easements in Arkansas. (NCED, 2015)

4.1.6. Biological Resources

4.1.6.1. Definition of the Resource

This chapter describes the biological resources of Arkansas. Biological resources include terrestrial⁶⁷ vegetation, wildlife, fisheries and aquatic habitats,⁶⁸ threatened⁶⁹ and endangered⁷⁰ species as well as communities and species of conservation concern. Wildlife habitat and associated biological ecosystems are also important components of biological resources. Due to the significant topographic variation within the state, Arkansas supports a wide diversity⁷¹ of biological resources ranging from upland forest settings in the northern and central portion of the state, to flooded bottomland forests and cypress swamps in the Mississippi plain region of eastern and southeast Arkansas. Each of these topics is discussed in more detail below.

4.1.6.2. Specific Regulatory Considerations

The federal laws relevant to the protection and management of biological resources in Arkansas are summarized in detail in Appendix C, Environmental Laws and Regulations, and Section 1.8, Overview of Relevant Federal Laws and Executive Orders. Table 4.1.6-1 summarizes major state laws relevant to Arkansas's biological resources.

Table 4.1.6-1: Relevant Arkansas Biological Resources Laws and Regulations

Law/ Regulation	Regulatory Agency	Summary
Arkansas Plant Act (A.C.A. 2-16 - 201 et seq.)	Arkansas State Plant Board	Deems it illegal for any person collect, transport, import, export, move, buy, sell, distribute, propagate or transplant any living and viable portion of any plant species listed as prohibited; illegal for any person to collect, transport, import, export, move, buy, sell, distribute, propagate or release any living insect species listed as prohibited.
AGFC Code 26.12-26.14	AGFC	Deems it unlawful to possess, sell, import, or release any aquatic species listed as prohibited.

Sources: (AAD, 2016), (AGFC, 2017)

⁶⁷ Terrestrial: "Pertaining to the land" (USEPA, 2015d)

⁶⁸ Habitat: "The environment in which an organism or population of plants or animals lives; the normal kind of location inhabited by a plant or animal" (USEPA, 2015d)

⁶⁹ Threatened species are "any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range" (16 U.S.C §1532(20))

⁷⁰ Endangered species are "any species which is in danger of extinction throughout all or a significant portion of its range" (16 U.S.C §1532(6))

⁷¹ Diversity: "An ecological measure of the variety of organisms present in a habitat." (USEPA, 2015d)

4.1.6.3. *Terrestrial Vegetation*

The distribution of flora within the state is a function of the characteristic geology,⁷² soils, climate,⁷³ and water of a given geographic area and correlates with distinct areas identified as ecoregions.⁷⁴ Ecoregions are broadly defined areas that share similar characteristics, such as climate, geology, soils, and other environmental conditions and represent ecosystems contained within a region. The boundaries of an ecoregion are not fixed, but rather depict a general area with similar ecosystem types, functions, and qualities (National Wildlife Federation, 2015) (USDA, 2015a) (World Wildlife Fund, 2015). Ecoregion boundaries often coincide with physiographic regions of a state. In Arkansas, the two main physiographic regions include the Interior Highlands and the Mississippi Plain. The ecoregions mapped by the USEPA are the most commonly referenced, although individual states and organizations have also developed ecoregions that may differ slightly from those designated by the USEPA. The USEPA divides North America into 15 broad Level I ecoregions. These Level I ecoregions are further divided into 50 Level II ecoregions. These Level II ecoregions are further divided into 182 smaller Level III ecoregions (USEPA, 2016a). This section provides an overview of the terrestrial vegetation resources for Arkansas at USEPA Level III (USEPA, 2016a).

As shown in Figure 4.1.6-1, the USEPA divides Arkansas into seven Level III ecoregions. The seven ecoregions support a variety of different plant communities, all predicated on their general location within the state. Communities range from upland deciduous broadleaf forests in the Ozark Highlands Ecoregion in western Arkansas, to prairie communities, flooded bottomland forests, and cypress swamps in the Mississippi Alluvial Plain Ecoregion within the eastern portion of the state. Table 4.1.6-2 provides a summary of the general abiotic⁷⁵ characteristics, vegetative communities, and the typical vegetation found within each of the seven Arkansas ecoregions.

⁷² USGS defines geology as an interdisciplinary science with a focus on the following aspects of earth sciences: geologic hazards and disasters, climate variability and change, energy and mineral resources, ecosystem and human health, and ground-water availability.

⁷³ Climate: “The average weather conditions in a particular location or region at a particular time of the year. Climate is usually measured over a period of 30 years or more.” (USEPA, 2015d)

⁷⁴ Ecoregion: “A relatively homogeneous ecological area defined by similarity of climate, landform, soil, potential natural vegetation, hydrology, or other ecologically relevant variables.” (USEPA, 2015d)

⁷⁵ Abiotic: “Characterized by absence of life; abiotic materials include non-living environmental media (e.g., water, soils, sediments); abiotic characteristics include such factors as light, temperature, pH, humidity, and other physical and chemical influences.” (USEPA, 2016e)

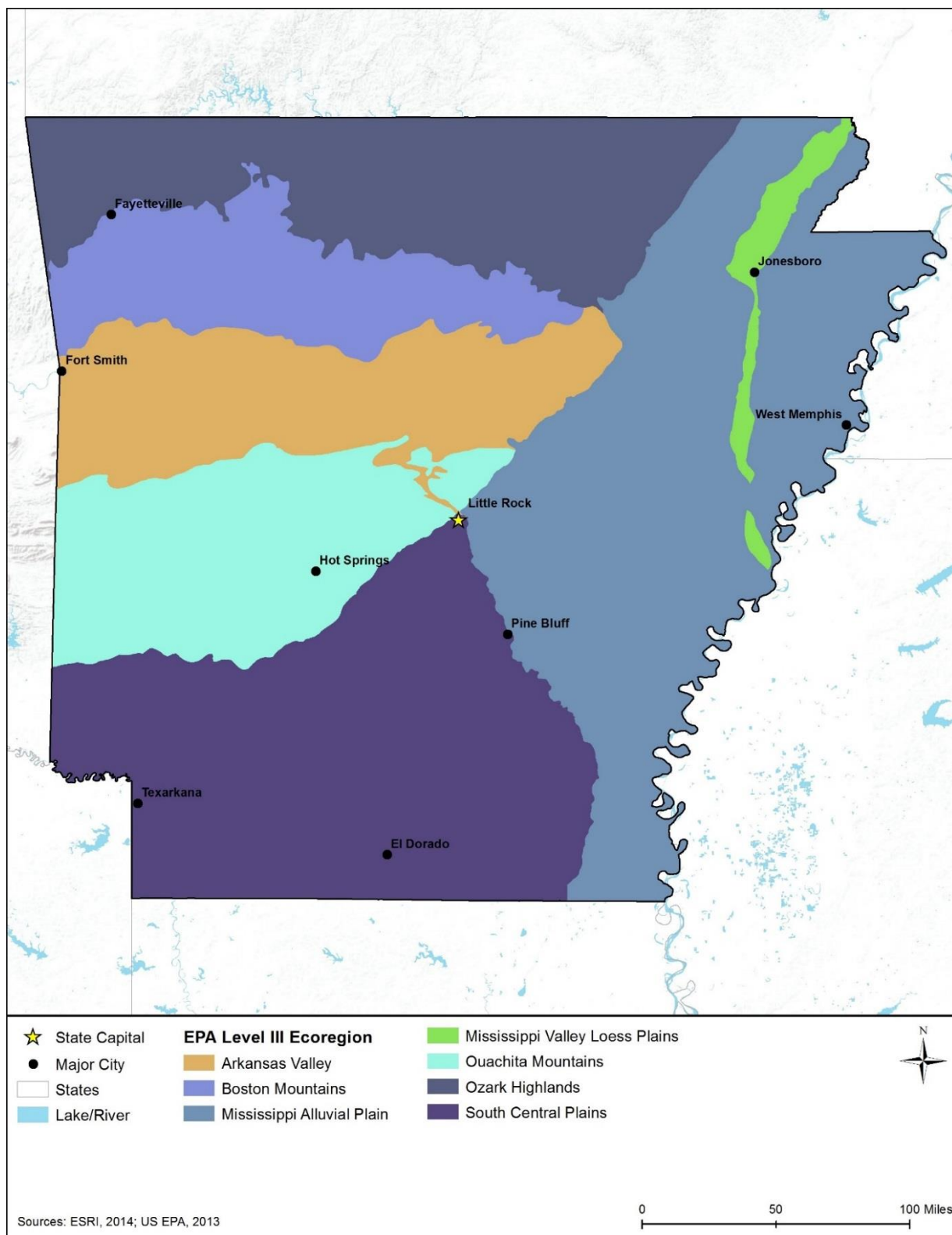


Figure 4.1.6-1: USEPA Level III Ecoregions in Arkansas

Communities of Concern

Arkansas contains vegetative communities of concern that include rare natural plant communities, plant communities with greater vulnerability or sensitivity to disturbance, and communities that provide habitat for rare plant and wildlife species. The ranking system for these communities gives an indication of the relative rarity, sensitivity, uniqueness, or vulnerability of these areas to potential disturbances. This ranking system also gives an indication of the level of potential impact to a particular community⁷⁶ that could result from implementation of an action. (AGFC, 2006a) (ANHC, 2014)

The ANHC statewide inventory includes lists of all types of natural communities known to occur, or that have historically occurred, in the state. Historical occurrences are important for assessing previously undocumented occurrences or re-occurrences of previously documented species. Each natural community is assigned a rank based on its rarity and vulnerability. As with most state heritage programs, the ANHC ranking system assesses rarity using a state rank (S1, S2, S3, S4, S5) that indicates its rarity within Arkansas. Communities ranked as an S1 by the ANHC are of the greatest concern. This rank is typically based on the range of the community, the number of occurrences, the viability of the occurrences, recent trends, and the vulnerability of the community. As new data become available, ranks are revised as necessary to reflect the most current information. (ANHC, 2014)

Ten vegetative communities are ranked as S1 communities⁷⁷ in Arkansas; these communities represent the rarest terrestrial habitat in the state. These communities occur in both the Interior Highlands and Mississippi Plain regions of the state (AGFC, 2006a) (ANHC, 2014). Arkansas Appendix A, Table A-1 provides a description of the communities of conservation concern in Arkansas along with their state rank, distribution, abundance, and the associated USEPA Level III ecoregions.

⁷⁶ Community: "In ecology, an assemblage of populations of different species within a specified location in space and time. Sometimes, a particular subgrouping may be specified, such as the fish community in a lake or the soil arthropod community in a forest." (USEPA, 2015d)

⁷⁷ S1: "Extremely rare. Typically 5 or fewer estimated occurrences in the state, or only a few remaining individuals, may be especially vulnerable to extirpation." (ANHC, 2014)

Table 4.1.6-2: Characteristics of Level III Ecoregions in Arkansas

Ecoregion Number	Ecoregion Name	Abiotic Characterization	General Vegetative Communities	Typical Dominant Vegetation
Physiographic Region: Interior Highlands				
35	South Central Plains	Rolling plains that represent the western edge of the southern coniferous forests. Today 75 percent of this region is forested with a large portion of forest cover attributed to commercial loblolly and short leaf pine plantations.	Oak-Hickory-Pine Forest, Loblolly and Shortleaf Pine Forest, and Southern Floodplain Forest	Hardwood Trees – southern red oak (<i>Quercus falcata</i>), white oak (<i>Quercus alba</i>), bald cypress (<i>Taxodium distichum</i>), black gum (<i>Nyssa sylvatica</i>), sweet gum (<i>Liquidambar styraciflua</i>), and shagbark hickory (<i>Carya ovata</i>) Conifer Trees – shortleaf pine (<i>Pinus echinata</i>) and loblolly pine (<i>Pinus taeda</i>)
36	Ouachita Mountains	A region of sharply defined east-west oriented ridges. Commercial loblolly and short leaf pine plantations are the dominant forest cover.	Oak-Hickory-Pine Forest and Loblolly and Shortleaf Pine Forest	Hardwood Trees – southern red oak, white oak, and shagbark hickory Conifer Trees – shortleaf pine and loblolly pine
37	Arkansas Valley	A region of forested valleys and ridges. Streams in this region are characterized by considerably low dissolved oxygen levels.	Oak-Hickory-Pine Forest and Oak Savanna	Hardwood Trees – southern red oak, white oak, post oak, blackjack oak, sycamore, sweetgum, willow, eastern cottonwood, green ash, elm, and shagbark hickory Conifer Trees – shortleaf pine and loblolly pine
38	Boston Mountains	A mountainous region characterized by oak-hickory forest cover and streams of exceptional water quality.	Oak-Hickory Forest	Hardwood Trees – southern red oak, white oak, red oak, post oak, blackjack oak, eastern red cedar, sugar maple, beech, basswood, and shagbark hickory
39	Ozark Highlands	Caves, springs, and spring-fed streams are common throughout this region. Oak-hickory forests are dominant in rugged areas.	Oak-Hickory Forest	Hardwood Trees – southern red oak, white oak, black oak, blackjack oak, eastern red cedar, little bluestem, big bluestem, Indiangrass, and shagbark hickory Conifer Trees – shortleaf pine and loblolly pine

Ecoregion Number	Ecoregion Name	Abiotic Characterization	General Vegetative Communities	Typical Dominant Vegetation
Physiographic Region: Mississippi Plain				
73	Mississippi Alluvial Plain	A broad flat alluvial plain with mild winters and hot summers. Southern floodplain forest are the dominant native vegetation, but today a large portion of this region has been converted to cropland.	Southern Floodplain Forest	Hardwood Trees – bald cypress, black gum, sweet gum, overcup oak (<i>Quercus lyrata</i>), water oak (<i>Quercus nigra</i>), water hickory, water tupelo, red maple, green ash, river birch, sweetgum, sycamore, and willow oak (<i>Quercus phellos</i>)
74	Mississippi Valley Loess Plains	A region of loess capped hills surrounded by the lower Mississippi Alluvial Plain. Oak-hickory forest is the dominant land cover.	Oak-Hickory Forest	Hardwood Trees – southern red oak, white oak, loblolly and shortleaf pine, beech, maples, tulip poplar, basswood, southern magnolia, American holly, and shagbark hickory

Sources: (AGFC, 2005) (USEPA, 2015e) (Fenneman, 1916) (CEC, 2011)

Nuisance and Invasive Plants

There are a large number of undesirable plant species that are considered nuisance and invasive⁷⁸ plants. Noxious weeds are typically non-native species that have been introduced into an ecosystem inadvertently; however, on occasion native species can be considered a noxious weed. Noxious weeds greatly affect agricultural areas, forest management, natural, and other open areas (GPO, 2011). The U.S. government has designated certain plant species as noxious weeds in accordance with the Plant Protection Act of 2000 (7 U.S.C. 7701 et seq.). As of September 2014, 112 federally recognized noxious weed species have been catalogued in the U.S., 88 of which are terrestrial, 19 of which are aquatic, and 5 of which are parasitic (USDA, 2014).

Noxious weeds and other invasive plants pose a large threat to Arkansas's agricultural and natural resources. Noxious weeds can have adverse ecological and economic impacts to these resources by displacing native species, degrading wildlife habitat, and increasing soil erosion.⁷⁹ There are seven state-listed noxious weeds that are prohibited in Arkansas recognized by the Federal Seed Act: balloonvine (*Cardiospermum halicacabum*), field bindweed (*Convolvulus arvensis*), Crotalaria (*Crotalaria* spp.), itchgrass (*Rottboellia cochinchinesis*), nutgrass (*Cyperus rotundus*), tropical soda apple (*Solanum viarum*) and serrated tussock (*Nassella trichotoma*). Restricted species include: barnyardgrass (*Echinochloa crusgalli*), bermudagrass (*Cynodon dactylon*), blueweed (*Helianthus ciliaris*), buckhorn plantain (*Plantago lanceolata*), cheat or chess (*Bromus secalinus*) and/or (*Bromus commutatus*), corncockle (*Agrostemma githago*), cocklebur (*Xanthium* spp.), coffee bean or tall indigo (*Sesbania exaltata*), curly indigo (*Aeschynomene indica*), darnel (*Lolium temulentum*), docks and sorrels (*Rumex* spp.), dodder (*Cuscuta* spp.), field bindweed (*Convolvulus arvensis*), giant foxtail (*Setaria faberi*) hedge bindweed (*C. sepium*), horsenettle (*Solanum carolinense*), Johnsongrass (*Sorghum halapense*), moonflower (*Calonyction muricatum*), morning glory (*Ipomea* spp.), nut grass (*Cyperus rotundus*), purple nightshade (*Solanum elaeagnifolium*), red rice (*Oryza sativa* var.), and wild onion and/or wild garlic (*Allium* spp.). (USDA, 2015c)

The Arkansas Plant Act (A.C.A. 2-16 - 201 et seq.) deems it illegal for any person collect, transport, import, export, move, buy, sell, distribute, propagate or transplant any living and viable portion of any plant species listed as prohibited. The following 35 Noxious weeds, under the provisions of the Arkansas Plant Act (A.C.A. 2-16 - 201 et seq) are declared to be a public nuisance, including anything infected, infested or contaminated therewith: Field bindweed (*Convolvulus arvensis*), Nut grass (*Cyperus rotundus*), Wild onion and/or wild garlic (*Allium* spp.), Johnson grass (*Sorghum halapense*), Dodder (*Cuscuta* spp.), Bermudagrass (*Cynodon dactylon*), Cheat or Chess (*Bromus secalinus*) and/or (*Bromus commutatus*), Darnel (*Lolium temulentum*), Corncockle (*Agrostemma githago*), Horsenettle (*Solanum carolinense*), Purple nightshade (*Solanum elaeagnifolium*), Buckhorn plantain (*Plantago lanceolata*), Bracted

⁷⁸ Invasive: "These are species that are imported from their original ecosystem. They can out-compete native species as the invaders often do not have predators or other factors to keep them in check." (USEPA, 2015d)

⁷⁹ Erosion: "The general process or the group of processes whereby the materials of Earth's crust are loosened, dissolved, or worn away and simultaneously moved from one place to another, by natural agencies, which include weathering, solution, corrosion, and transportation." (USEPA, 2015d)

plantain (*Plantago aristata*), docks and sorrels (*Rumex* spp.), Blueweed (*Helianthus ciliaris*), Morning Glory (*Ipomea* spp.), Hedge Bindweed (*C. sepium*), Red rice (*Oryza sativa* var.), Curly indigo (*Aeschynomene indica*), Tall indigo or coffee bean (*Sesbania exaltata*), Giant foxtail (*Setaria faberi*), Witchweed (*Striga* spp.), Crotalaria (*Crotalaria* spp.), Cocklebur (*Xanthium* spp.), Moonflower (*Calonyction muricatum*), Alligatorweed (*Alternanthera* spp.), Balloonvine (*Cardiospermum halicacabum*), Itchgrass (*Rottboellia exaltata*), Thistle (*Carduus*, *Cirsium*, *Onopordum*, *Silybum*, *Scolymus*, *Salsola* and other genera), Serrated Tussock (*Nassella trichotoma*), Purple Loosestrife (*Lythrum salicaria*), Barnyardgrass (*Echinochloa crusgalli*), Water Hyacinth (*Eichornia crassipes*, *E. azurea*), Japanese Blood Grass (*Imperata cylindrica*), Tropical Soda Apple (*Solanum viarum*). Circular 11, June 2014, Agency Number 209.02, of the Arkansas State Plant Board further stipulates that, “Any foreign insect, plant disease or weed which may be brought into Arkansas and whose habits and injuriousness under the conditions of agriculture in Arkansas are unknown, is regarded as dangerous, and is declared to be a public nuisance.” Circular 11 also states that, “Plants contained on the following list present such a danger to the natural ecosystems in the state that they are hereby declared prohibited. No plant, seed, or any reproductive structure may be sold or utilized in plantings in Arkansas.” The prohibited plants include: Purple Loosestrife (*Lythrum salicaria*), Giant salvinia (*Salvinia molesta*), Water Hyacinth (*Eichornia crassipes*, *E. azurea*), Japanese Blood Grass (*Imperata cylindrica*). (AKSOS, 2014)

4.1.6.4. Terrestrial Wildlife

This section discusses the terrestrial wildlife species in Arkansas, divided among mammals⁸⁰, birds⁸¹, reptiles and amphibians⁸², and invertebrates⁸³. Terrestrial wildlife consists of those species, and their habitats, that live predominantly on land. Terrestrial wildlife includes common big game species, small game animals, furbearers,⁸⁴ nongame animals, game birds, waterfowl, and migratory birds as well as their habitats within Arkansas. A discussion of non-native and/or invasive terrestrial wildlife species is also included within this section. Information regarding the types and location of native and non-native/invasive wildlife is useful for assessing the importance of any impacts to these resources or the habitats they occupy. Arkansas is home to approximately 70 mammal species, 59 reptile species, 54 amphibian species, and 405 resident and migratory bird species (ADPT, 2015e) (AGFC, 2011a) (Arkansas Audubon Society, 2009a).

⁸⁰ Mammals: “Warm-blooded vertebrates that give birth to and nurse live young; have highly evolved skeletal structures; are covered with hair, either at maturity or at some stage of their embryonic development; and generally have two pairs of limbs, although some aquatic mammals have evolved without hind limbs.” (USEPA, 2015d)

⁸¹ Birds: “Warm-blooded vertebrates possessing feathers and belonging to the class Aves.” (USEPA, 2015d)

⁸² Amphibian: “A cold-blooded vertebrate that lives in water and on land. Amphibians’ aquatic, gill-breathing larval stage is typically followed by a terrestrial, lung-breathing adult stage.” (USEPA, 2015d)

⁸³ Invertebrates: “Animals without backbones: e.g., insects, spiders, crayfish, worms, snails, mussels, clams, etc.” (USEPA, 2015d)

⁸⁴ Furbearer is the name given to mammals that traditionally have been hunted and trapped primarily for fur.

Mammals

Common and widespread mammalian species in Arkansas include the white-tailed deer (*Odocoileus virginianus*), raccoon (*Procyon lotor*), Virginia opossum (*Didelphis virginiana*), eastern cottontail (*Sylvilagus floridana*), woodchuck (*Marmota monax*), and eastern chipmunk (*Tamias striatus*). Mammals such as the elk (*Cervus elaphus*), black bear (*Ursus americanus*), and black-tailed jackrabbit (*Lepus californicus*) are uncommon or rare in Arkansas due to restricted habitat or secretive behavior. A number of threatened and endangered mammals are located in Arkansas. Section 4.1.6.6, Threatened and Endangered Species and Species of Conservation Concern, identifies these protected species (AGFC, 2011a).

In Arkansas, white-tailed deer are classified as big game species, whereas small game species include small mammals (e.g., squirrels and rabbits), furbearers, and upland and migratory game bird. The following nine species of furbearers may be legally hunted or trapped in the Arkansas: raccoon, red fox (*Vulpes vulpes*), gray fox (*Urocyon cinereoargenteus*), mink (*Mustela vison*), muskrat (*Ondatra zibethicus*), beaver (*Castor canadensis*), coyote (*Canis latrans*), bobcat (*Lynx rufus*), and river otter (*Lontra canadensis*) (Arkansas Secretary of State, 2016) (AGFC, 2015a).

Arkansas has identified 19 mammals as Species of Greatest Conservation Need (SGCN). Seven of these species are bats. The SGCN list consists of at-risk species that are rare or declining. State Wildlife Grants administered by the Arkansas Fish and Game Commission can fund efforts to reduce the potential of SGCN to be listed as endangered. Although these species have been targeted for conservation, they are not currently under legal protection. The SGCN list is updated periodically and is used by Arkansas to focus their conservation efforts and as a basis for implementing their state Wildlife Action Plan. (AGFC, 2006a) (AGFC, 2006c). There are four federally listed mammal species in Arkansas. Section 4.1.6.6, Threatened and Endangered Species and Species of Conservation Concern, identifies these protected species.

Birds

The number of native bird species documented in Arkansas varies according to the timing of the data collection effort, changes in bird taxonomy,⁸⁵ and the reporting organization's method for categorizing occurrence and determining native versus non-native status. Further, the diverse ecological communities (e.g., extensive forests, large rivers and lakes, plains) found in Arkansas support a large variety of bird species.

Approximately 405 species of resident and migratory birds have been documented in Arkansas, with 300 of those species known to have breeding populations⁸⁶ in Arkansas (Arkansas Audubon Society, 2009b). Among these extant⁸⁷ species in Arkansas, 78 SGCN have been identified (AGFC, 2006a).

Arkansas is located within both the Mississippi Flyway. Covering the entire state of Arkansas, the Mississippi Flyway spans from the Gulf of Mexico to the Canadian boreal forest. Large

⁸⁵ Taxonomy: "A formal representation of relationships between items in a hierarchical structure" (USEPA, 2015d)

⁸⁶ Population: "Aggregate of individuals of a biological species that are geographically isolated from other members of the species and are actually or potentially interbreeding." (USEPA, 2015d)

⁸⁷ Extant: "A species that is currently in existence (the opposite of extinct)." (USEPA, 2015d)

numbers of migratory birds utilize this flyways and other migration corridors and pathways throughout the state each year during their annual migrations northward in the spring and southward in the fall (The Nature Conservancy, 2016). “The Migratory Bird Treaty Act (MBTA) makes it illegal for anyone to take, possess, import, export, transport, sell, purchase, barter, or offer for sale, purchase, or barter, any migratory bird, or the parts, nests, or eggs of such a bird except under the terms of a valid permit issued pursuant to federal regulations” (USFWS, 2013a). The USFWS is responsible for enforcing the MBTA and maintaining the list of protected species. The migratory bird species protected under the MBTA are listed in 50 CFR 10.13 (USFWS, 2013a).

Bald eagles (*Haliaeetus leucocephalus*) and golden eagles (*Aquila chrysaetos*) are protected under the Bald and Golden Eagle Protection Act. Bald eagles are generally found near large rivers and lakes in the entire state during the winter season (eBird, 2015a). Golden eagles are found in the northwestern parts of the state during the winter season (eBird, 2015b).

A number of Important Bird Areas (IBAs) have also been identified in Arkansas, as shown in Figure 4.1.6-2. The IBA program is an international bird conservation initiative with a goal of identifying the most important places for birds and to conserve these areas. These IBAs are identified according to standardized, scientific criteria through a collaborative effort among state, national, and international conservation-oriented non-governmental organizations, state and federal government agencies, local conservation groups, academics, and birders. These IBAs link global and continental bird conservation priorities to local sites that provide critical habitat for native bird populations. IBA priority areas are based on a number of specific criteria. Generally, global IBAs are sites determined important for globally rare species or support bird populations at a global scale. Continental IBAs are sites determined important for continentally rare species or support bird populations at a continental scale, but do not meet the criteria for a global IBA. State IBAs are sites determined important for state rare species or support local populations of birds (NAS, 2015a).

According to the National Audubon Society (NAS), a total of 28 IBAs have been identified in Arkansas, including breeding,⁸⁸ migratory stop-over, feeding, and over-wintering areas, encompassing a variety of habitats such as bottomland hardwood forest, prairies, pine woodlands, and cypress-tupelo swamps. These IBAs, which cover approximately 255,000 acres and are widely distributed throughout the state. These habitats are an important migration stop and breeding ground for many waterfowl species (NAS, 2015b). There are four federally listed bird species in Arkansas. Section 4.1.6.6, Threatened and Endangered Species, identifies these protected species.

Reptiles and Amphibians

Approximately 113 native reptile and amphibian species occur in Arkansas, including 28 salamanders, 25 frogs and toads, 16 turtles, 12 lizards, and 38 snakes. These species occur in a wide variety of habitats from the upland hardwoods in the northwest to Mississippi Alluvial

⁸⁸ Breeding range: “The area utilized by an organism during the reproductive phase of its life cycle and during the time that young are reared” (USEPA, 2015d).

Plain in the southeast. A few examples include the Wood frog (*Rana sylvatica*), Sequoyah slimy salamander (*Plethodon sequoyah*), Great plains narrowmouth toad (*Gastrophryne olivacea*), timber rattlesnake (*Crotalus horridus*), Spiny Softshell Turtle (*Apalone Spinifera*), Collard lizard, (*Crotaphytus collaris*), and the Ornate box turtle (*Terrapene ornate oornat*). Many of these species are widespread throughout the state. Of the 113 native reptile and amphibian species, 39 SGCN have been identified, including 14 reptiles and 25 amphibians. Fifteen of the amphibian SGCN species are salamanders (ADPT, 2015e) (AGFC, 2006a) (AGFC, 2011a).

In Arkansas, the American alligator (*Alligator mississippiensis*) is classified as a game animal and is allowed to be taken in accordance with AGFC state hunting regulations. In addition, the American bullfrog (*Lithobates catesbeianus*) and several aquatic turtles are classified as aquatic wildlife and may also be taken in accordance with the AGFC state hunting and fishing regulations (AGFC, 2015a). All other reptile and amphibian species in Arkansas are classified as nongame species. There are four federally listed bird species in Arkansas. Section 4.1.6.6, Threatened and Endangered Species, identifies these protected species.

Invertebrates

Arkansas is home to a large number of invertebrates, including a wide variety of bees, hornets, wasps, butterflies, moths, beetles, flies, dragonflies, damselflies, spiders, mites, and nematodes. These invertebrates provide an abundant food source for mammals, birds, reptiles, amphibians, and other invertebrates. Of the invertebrates that occur in Arkansas, 107 have been listed as SGCN, including 63 insects and 44 other invertebrates. In the U.S., one third of all agricultural output depends on pollinators⁸⁹. In natural systems, the size and health of the pollinator population is linked to ecosystem health, with a direct relationship between pollinator diversity and plant diversity. “As a group, native pollinators are threatened by habitat loss, pesticides, disease, and parasites” (Natural Resources Conservation Service, 2009). It is estimated that several hundred species of bees occur in Arkansas, but the official number is unknown. Of the butterflies that exist in the state, 155 species have been documented (ADPT, 2015e).

Thirteen terrestrial invertebrate species are threatened or endangered in Arkansas. Section 4.1.6.6, Threatened and Endangered Species, identifies these protected species.

⁸⁹ Pollinators: “Animals or insects that transfer pollen from plant to plant.” (USEPA, 2015d)

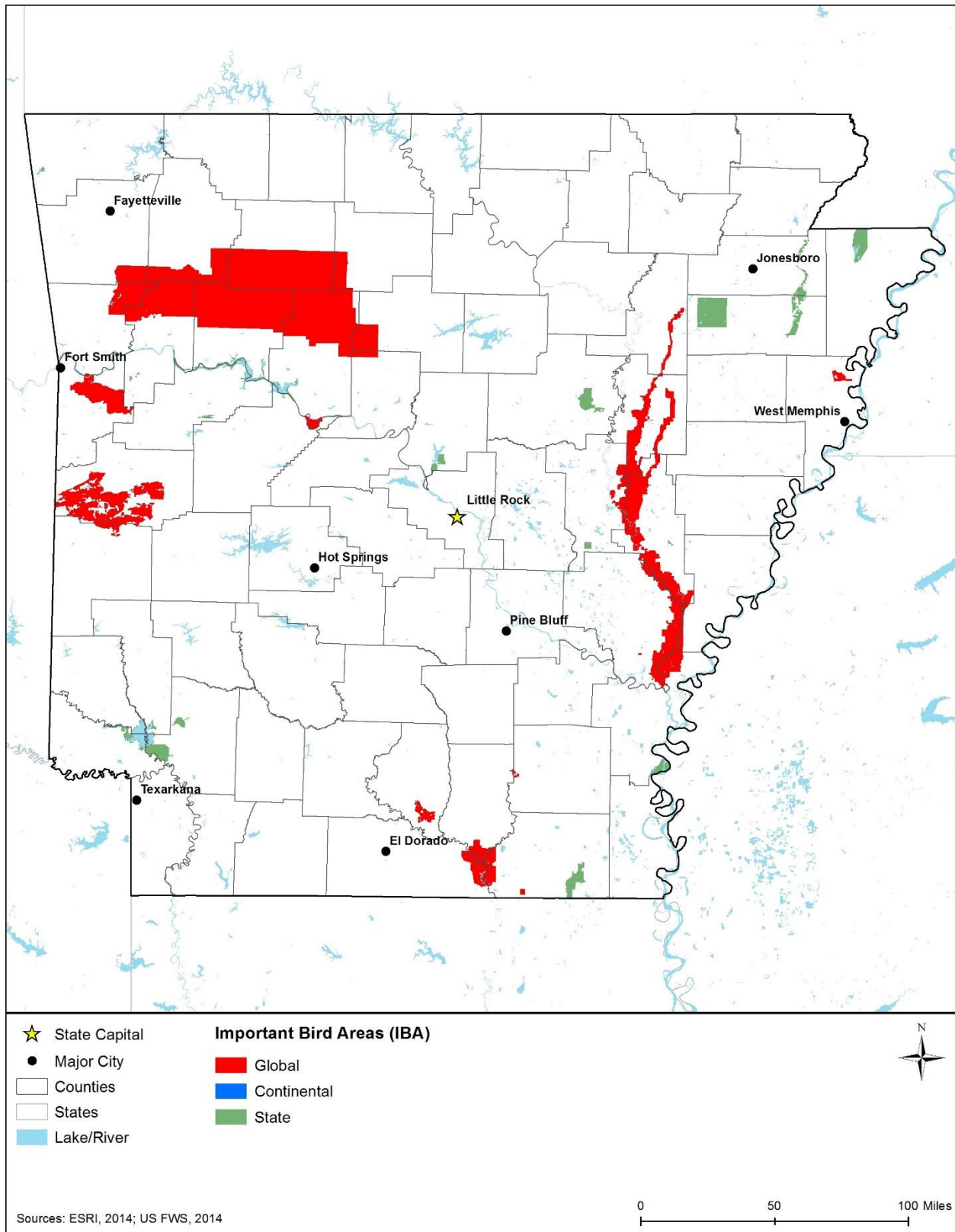


Figure 4.1.6-2: Important Bird Areas (IBA) of Arkansas

Invasive Wildlife Species

Arkansas has adopted regulations that prohibit or regulate the possession, transport, importation, sale, purchase, and introduction of select terrestrial wildlife species. AGFC maintains a list of species that are restricted in the state, as presented in AGFC Codes 09.03, 09.10, and 09.11, respectively. There is one mammal species identified as invasive in Arkansas: the feral hog (*Sus scrofa*). Feral hogs cause massive damage to agricultural land and wildlife habitat (AGFC, 2013). There is also one bird species identified as invasive in Arkansas: the mute swan (*Cygnus olor*). Mute swans are aggressive toward native waterfowl and wetland birds and destroy up to 20 pounds of aquatic vegetation per day (AGFC, 2015b).

Invasive insects pose a large threat to Arkansas's forest and agricultural resources. Thirty-one species of terrestrial invertebrates are regulated in Arkansas. According to the Arkansas Plant Act (A.C.A. 2-16 - 201 et seq.), it is illegal to collect, transport, import, export, move, buy, sell, distribute, propagate or release any of the insect species listed below. Species such as the gypsy moth (*Lymantria dispar*), hemlock woolly adelgid (*Adelges tsugae*), emerald ash borer (*Agrilus planipennis*), and Asian longhorn beetle (*Anoplophora glabripennis*) are known to cause irreversible damage to native forests. In addition, quarantines have been enacted in an effort to reduce the spread of many plant pests. Currently, federal quarantines are in place that restrict the transport of plant materials with the potential to contain the emerald ash borer (USDA, 2015b). The following insect species are prohibited in Arkansas per (A.C.A. '2-16 - 201 et seq.).

Insects – Pink bollworm (*Pectinophora gossypiella*), sweet potato weevil (*Cylas formicarius*), fruit flies (*Drosophila* spp.), Khapra beetle (*Trogoderma granarium*) and other stored grain insects, Bruchid and other pest of seeds, Japanese beetle (*Popillia japonica*), gypsy moth (*Lymantria dispar dispar*), browntail moth (*Euproctis chrysorrhoea*) and other leaf-feeding insects, Fire ant (*Solenopsis invicta*), Argentine ant (*Linepithema humile*), carpenter ant (*Camponotus* spp.) and other injurious ants, vegetable weevil (*Listroderes difficilis*), white-fringed beetle (*Naupactus* spp.), European chafer (*Rhizotrogus majalis*), Termites (*Isoptera* spp.), Powderpost beetles (*Lyctinae* spp.), San Jose scale (*Quadraspidiotus perniciosus*) and other scale insects, woolly aphid (*Eriosomatidae* spp.), white flies (*Aleyrodidae* spp.), strawberry crown borer (*Tylocladia fragariae*), pine tip moth (*Rhyacionia frustrana*) and other insects attacking pine shoots, Oriental fruit moth (*Grapholitha molesta*), borers of all kinds, European red mite (*Panonychus ulmi*) and other spider mites, Bagworms (*Psychidae* spp.) and other leaf-eating insects, thrips, aphids, harlequin bugs (*Murgantia histrionica*), roaches and other household insect pests, elm leaf beetle (*Xanthogaleruca luteola*), cereal leaf beetle (*Oulema melanopus*), Southern pine beetle (*Dendroctonus frontalis*), Brown garden snail (*Cornu aspersum*) or any other plant destroying snail, and Asian ambrosia beetle (*Xylosandrus crassiusculus*).

4.1.6.5. Fisheries and Aquatic Habitats

This section discusses the aquatic wildlife species in Arkansas, including freshwater fish and invertebrates. A summary of non-native and/or invasive aquatic species is also presented. A distinctive feature of the Arkansas landscape with regard to aquatic wildlife are the flooded

bottomland forests and cypress swamps. These water bodies provide habitat for a variety of aquatic wildlife. No essential fish habitat (EFH) identified by the Magnuson-Stevens Fishery Conservation and Management Act exists in Arkansas (NOAA, 2015f).⁹⁰ Critical habitat for threatened and endangered fish species, as defined by the ESA, does exist within Arkansas and is discussed in Section 4.1.6.6, Threatened and Endangered Species.

Freshwater Fish

Arkansas is home to 20 percent of the fish species found in North America. The state is home to 215 species of freshwater fish, ranging in size from small darters and minnows to larger species, such as those in the gar family. Fifty fish species are listed as SGCN. These species are grouped into approximately 22 families, as follows: lampreys, freshwater eels, paddlefish, gar, mooneye, cavefish, pirate perch, pygmy sunfish, drums, herrings, freshwater catfishes, bowfins, killifishes, livebearers, minnows/carps, perches, pikes, sculpins, sturgeons, suckers, temperate basses, sunfishes, and trout. A brief description of those families that contain common species, notable sport fish species, or species of concern, are listed below. (AGFC, 2006a) (AGFC, 2006b) (AGFC, 2011b)

According to the AGFC, “Arkansas is home to six major catfish species. Other, smaller species swim in Arkansas waters, but the top six are generally the only ones large enough to be targeted by anglers” (AGFC, 2011e). The Brown bullhead (*Ameiurus nebulosus*), black bullhead (*Ameiurus melas*), and the yellow bullhead (*Ameiurus natalis*) are among the prominent catfish species of Arkansas. In addition, three species of madtom are listed as SGCN in Arkansas. All are smaller members of the catfish family that rarely reach an adequate size to be targeted by fishermen. Larger members of the catfish family include the channel catfish (*Ictalurus punctatus*), flathead catfish (*Pylodictis olivaris*), and the blue catfish (*Ictalurus furcatus*). These species are widespread throughout the state and can be found in almost any habitat. (AGFC, 2006a) (AGFC, 2006b) (AGFC, 2011b)

The minnow/carp family contains the largest number of species in Arkansas. Several of these species, including 12 species of shiner and 2 species of chub, are listed as SGCN. Common and widely distributed minnow species in Arkansas include the common carp (*Cyprinus carpio*), creek chub (*Semotilus atromaculatus*), and common shiner (*Notropis cornutus*). Minnows are not typically a popular sportfish, but are a commercially important fish and an important prey source for larger fish and other wildlife. (AGFC, 2006a) (AGFC, 2006b) (AGFC, 2011b)

Approximately 45 species of perches occur in Arkansas, with 43 of these species being darters. Fourteen species of darter are listed as SGCN. Darters are small members of the perch family that are not considered to be sport fish sought after by fishermen. Walleye (*Etheostoma fusiforme*) and sauger (*Sander canadensis*) are larger members of the perch family and are

⁹⁰ NOAA’s Essential Fish Habitat Mapper v 3.0 was used to identify “EFH areas of particular concern” and “EFH areas protected from fishing.” As of July 2016, the procedure to use this interactive tool is as follows: 1) Visit <http://www.habitat.noaa.gov/protection/efh/habitatmapper.html>. 2) Select “EFH Mapper” under Useful Links. 3) After closing the opening tutorial, select the “Region” of interest from the drop-down menu. 4) Select the species under “Essential Fish Habitat” to view the areas in the selected region protected for the various life states (i.e., eggs, larvae, juvenile, adult, or all).

important sport fish in Arkansas. These species are common in the large rivers, lakes, and reservoirs throughout the state. (AGFC, 2006a) (AGFC, 2006b) (AGFC, 2011b)

Four species of pike occur in Arkansas waters: the muskellunge (*Esox masquinongy*), northern pike (*Esox Lucius*), grass pike (*Pomoxis nigromaculatus*), and chain pickerel (*Esox niger*). Chain pickerel and grass pike are smaller member of the pike family and are the only native pike species to the state. Northern pike and muskellunge were introduced to Arkansas to create fishing opportunities, and are now found in bays of lakes and reservoirs with dense weed growth, and submerged logs. The northern pike's voracious predatory nature has made it an excellent sport fish avidly sought after by fishermen. (AGFC, 2006a) (AGFC, 2006b) (AGFC, 2011b)

The sunfish family includes 20 species, many of which are common throughout the state and are highly popular with sport fishermen. The most commonly encountered species are the bluegill (*Lepomis macrochirus*), black crappie (*Pomoxis nigromaculatus*), largemouth bass (*Micropterus salmoides*), and smallmouth bass (*Micropterus dolomieu*). These sunfish species live in a wide variety of habitats, including rocky, cool lakes streams and reservoirs. (AGFC, 2006a) (AGFC, 2006b) (AGFC, 2011b)

Arkansas waters are home to four species of the trout family, including the brook trout (*Salvelinus fontinalis*), brown trout (*Salmo trutta*), rainbow trout (*Oncorhynchus mykiss*), and cutthroat trout (*Oncorhynchus clarkii*). Trout are among the most popular game fish in Arkansas, and fishing for them has become valuable to the state's economy, providing many recreational benefits. In Arkansas, trout are stocked in the White River, below Bull Shoals Dam, below Norfork Dam, and in the Spring River. (AGFC, 2006a) (AGFC, 2006b) (AGFC, 2011b)

The American eel (*Anguilla rostrata*), is the only member of the eel family in the state Arkansas. American eels were once found throughout much of eastern and central North America, but their current distribution is limited by the construction of dams. In Arkansas, American eels are found primarily in deep pools of large rivers and streams. American eels spend the majority of their life in freshwater but they migrate to the Atlantic Ocean to spawn. (AGFC, 2006a) (AGFC, 2006b) (AGFC, 2011b)

There are three species of the sturgeon family in Arkansas: the shovelnose sturgeon (*Scaphirhynchus platyrhynchus*), the lake sturgeon (*Acipenser fulvescens*), and the endangered pallid sturgeon (*Scaphirhynchus albus*). The pallid sturgeon and the lake sturgeon are both listed as a SGCN because of their scarcity and sturgeon are no longer an important commercial fish species. The depression in populations of sturgeon is the result of over-collection of these species for caviar beginning in early colonial times and loss of habitat. (AGFC, 2006a) (AGFC, 2006b) (AGFC, 2011b)

The gar family contains four species in Arkansas: the alligator gar (*Atractosteus spatula*), lognose gar (*Lepisosteus osseus*), spotted gar (*Lepisosteus oculatus*), and shortnose gar (*Lepisosteus platostomus*). The alligator gar is listed as a SGCN in Arkansas. Historically, alligator gar were an important sport and commercial fish species. Populations have declined rapidly in the last 50 years, but alligator gar are still avidly sought after by sport fishermen due their size and behavior. (AGFC, 2006a) (AGFC, 2006b) (AGFC, 2011b)

Shellfish and Other Invertebrates

Arkansas is home to an unknown number of mollusk and crustacean species, including a multitude of freshwater mussels and crayfish. Fifty-two species of freshwater mussels and 24 species of crayfish are listed as SGCN. Many of these species are found in the Mississippi River. River diversions and impoundments are a primary threat to Arkansas's native mussel species. Aside from a multitude of freshwater invertebrates whose adult forms are terrestrial insects (e.g., flies, beetles), other well-known Arkansas freshwater invertebrates include a variety of fairy shrimp, amphipods, and pillbug species. (AGFC, 2006a) (AGFC, 2006b) (AGFC, 2011a)

Invasive Aquatic Species

Arkansas has adopted regulations that prohibit or regulate the possession, transport, importation, sale, purchase, and introduction of select aquatic invasive species. AGFC maintains a list of prohibited exotic species. According to AGFC Code 26.12-26.14 (AGFC, 2016), it is illegal to import, transport, or possess the following species.

- Fish – walking catfish (*Clarias batrachus*), snakeheads (Family: *Channidae*), stickleback (Family: *Gasterosteidae*), Mexican banded terra (*Astyanax mexicanus*), and piranha (Family: *Characidae*).
- Aquatic Invertebrates – rusty crayfish (*Orconectes rusticus*).

4.1.6.6. Threatened and Endangered Species

The USFWS is responsible for administering the ESA (16 U.S.C. §1531 et seq.) in Arkansas and has identified 25 federally endangered and 9 federally threatened species known to occur in Arkansas (USFWS, 2014a) (USFWS, 2016), five of which have designated critical habitat⁹¹ (USFWS, 2015c). Three candidate species are identified as occurring in Arkansas (USFWS, 2015d). Candidate species are not afforded statutory protection under the ESA; however, the USFWS recommends considering these species during environmental planning because they could be listed in the future (USFWS, 2014b). The 34 federally listed species include 4 mammals, 4 birds, 7 fishes, 1 amphibian, 13 invertebrates, and 5 plants (USFWS, 2016), and are discussed in detail under the following sections. Federal land management agencies maintain lists of species of concern for their landholdings; these lists are not discussed below as they are maintained independently from the ESA. For future site-specific analysis on those lands, consultation with the appropriate land management agency might be required.

Mammals

Three endangered and one threatened mammal species are federally listed and known to occur in Arkansas as summarized in Table 4.1.6-3. Information on the habitat, distribution, and threats to the survival and recovery of each of these species in Arkansas is provided.

⁹¹ Critical habitat includes “the specific areas (i) within the geographic area occupied by a species, at the time it is listed, on which are found those physical or biological features (I) essential to conserve the species and (II) that may require special management considerations or protection; and (ii) specific areas outside the geographic area occupied by the species at the time it is listed upon determination that such areas are essential to conserve the species” (16 U.S.C §1532(5)(A)).

Table 4.1.6-3: Federally Listed Mammal Species of Arkansas

Common Name	Scientific Name	Federal Status	Critical Habitat in Arkansas	Habitat Description
Gray Bat	<i>Myotis grisescens</i>	Endangered	No	Limestone karst in the northern regions of Arkansas.
Indiana Bat	<i>Myotis sodalist</i>	Endangered	No	Trees and snags, caves, and abandoned mines; found in the northern regions of Arkansas.
Northern Long-eared Bat	<i>Myotis septentrionalis</i>	Threatened	No	Trees and snags, caves, and abandoned mines; found throughout the state.
Ozark Big-eared Bat	<i>Corynorhinus townsendii ingens</i>	Endangered	No	Limestone karst within mature hardwoods located in northwestern and north-central Arkansas.

Sources: (USFWS, 2014a) (USFWS, 2016)

Gray Bat. The grey bat is an insectivorous bat that weighs approximately 7 to 16 grams and it is longer than any other species in the genus *Myotis*. The gray bats have dark gray fur after molt in July or August and then the fur transitions to a chestnut brown. This species was federally listed as endangered in 1976 (41 FR 17736 17740, April 28, 1976). Regionally, this species is known to occur in limited geographic regions of limestone karst within southeastern states from Kansas and Oklahoma east to Virginia and North Carolina (USFWS, 1997a) (USFWS, 2015e). In Arkansas, the gray bat is known to occur in 24 counties in the northern regions of the state (USFWS, 2015e).

The gray bat lives in caves all year. This species hibernates in deep vertical caves during the winter and inhabits caves along rivers the rest of the year. Most caves are in limestone karst regions and near rivers where these bats could feed on flying aquatic and terrestrial insects. Current threats to this species include human disturbance, habitat loss and degradation due to flooding, and commercialization of caves such as adding gates that alter the air flow, humidity, and temperature of caves (USFWS, 1997a).

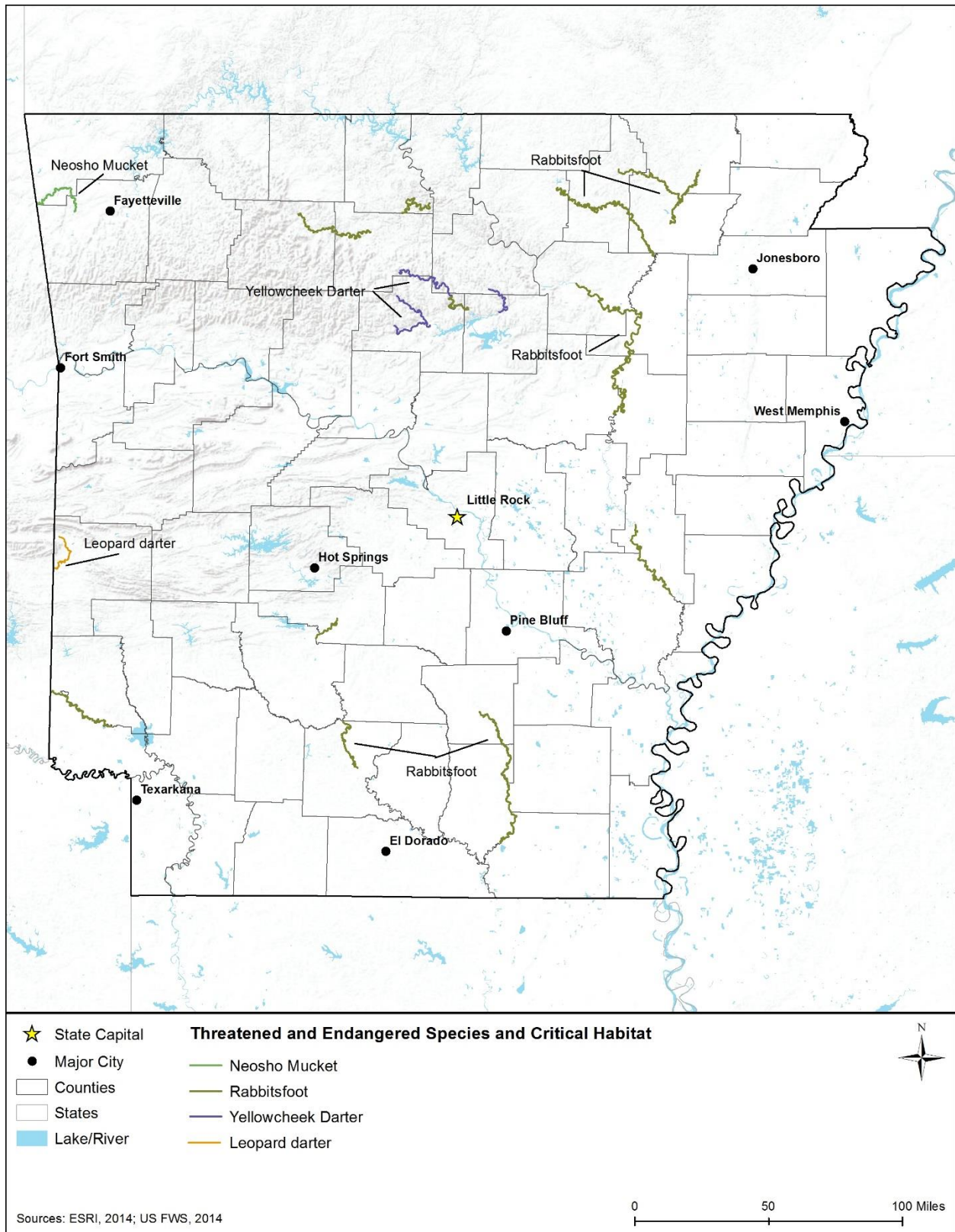


Figure 4.1.6-3: ESA Designated Critical Habitat in Arkansas

Indiana Bat. The Indiana bat is a small, insectivorous mammal measuring approximately 3.0 to 3.5 inches in length with a wingspan of 9.5 to 10.5 inches. The Indiana bats have dull grayish chestnut fur and strongly resembles the more common little brown bat (*Myotis lucifugus*). (USFWS, 2006) The Indiana bat was originally federally listed as “in danger of extinction” under early endangered species legislation in 1967 (32 FR 4001, March 11, 1967) and was incorporated into the ESA as an endangered species (16 U.S.C. §1531 et seq.). In 2009, only 387,000 Indiana bats were known to exist in its range, less than half of the population of 1967 (USFWS, 2015f). Regionally, this species is currently found in the central portion of the eastern United States, from Vermont west to Wisconsin, Missouri, and Arkansas, and south and east to northwest Florida. In Arkansas, the Indiana bat is known to occur in ten counties in the northern regions of the state (USFWS, 2015g).



Indiana bat

Photo credit: USFWS

In the fall, the Indiana bats migrate to their hibernation sites in caves and abandoned mines in order to mate and build up fat reserves for hibernation season in the winter. Upon emerging from hibernation, the bats feed near their hibernations sites (within 10 miles) before they migrate to their summer habitats, where the females roost (USFWS, 2006). Some of these summer habitats can be as far as 300 miles away from their hibernation areas (USFWS, 2004a) *Carya ovata*), white oak (*Quercus alba*), silver maple (*Acer saccharinum*), sugar maple (*Acer saccharum*), green ash (*Fraxinus pennsylvanica*), eastern cottonwood (*Populus deltoides*), and American elm (*Ulmus rubra*). (USFWS, 2012a)

The threats to this species include the disturbance and intentional killing of hibernating and maternity colonies, disturbances to air flow in caves from the improper installation of security gates, habitat fragmentation and degradation, the use of pesticides or other environmental contaminants, and White Nose Syndrome (USFWS, 2004a) (USFWS, 2015f). White Nose Syndrome is a rapidly spreading fungal disease that afflicts hibernating bats (USFWS, 2015f).

Northern Long-eared Bat. The northern long-eared bat is a medium-sized, brown furred, insectivorous bat. This bat is medium-sized, reaching a length of 3 to 3.7 inches, with long ears relative to other members of the genus *Myotis*. (USFWS, 2015h). The northern long-eared bat was listed as endangered in 2013 (78 FR 72058 72059, December 2, 2013) and was relisted as threatened in 2015 (80 FR 17973 18033, April 2, 2015). In the U.S., its range includes most of the eastern and north central states. In Arkansas, the Northern long-eared bat is known to occur in all seventy-five counties of the state. (USFWS, 2015i)

This species hibernates during winter in caves and mines that exhibit constant temperatures and high humidity which do not have air currents. In the summer, this species will inhabit live or dead trees, roosting beneath the bark or in crevices. Although mating occurs in the fall,

fertilization occurs following hibernation, from which pregnant females then migrate to their summer habitat to give birth in small colonies. (USFWS, 2015h)

White Nose Syndrome is the leading cause for the decline of this species. The numbers of northern long-eared bats in hibernacula has decreased by 99 percent in the northeast United States. (USFWS, 2015i). Other threats include temperature or air flow impacts to their hibernating habitat, forest management practices that are incompatible with this species' habitat needs, habitat fragmentation, and wind farm operations (USFWS, 2015h).

Ozark Big-eared Bat. The Ozark big-eared bat is a medium-sized bat, weighing approximately 7 to 12 grams with distinguishing facial glands near the snout and long ears (>2.5 centimeters). The Ozark big-eared bats have light to dark brown fur, but the shade varies based on age and subspecies. This species was federally listed as endangered in 1979 (44 FR 69206 69208, November 30, 1976). Regionally, this species is known to occur in limited geographic regions of limestone karst in Arkansas, Missouri, and Oklahoma. In Arkansas, the Ozark big-eared bat is known to occur in five counties in the northwestern and north-central regions of the state. (USFWS, 2015j)

The Ozark big-eared bats live in caves all year. This species prefers to inhabit karst caves that are located in mature hardwood forests dominated by hickory (*Carya* spp.), beech (*Fagus* spp.), maple (*Acer* spp.), and hemlock (*Tsuga* spp.) trees. Hibernation caves are generally located in areas where wind exposure is minimal, whereas maternity caves are located close to food sources. Although mating occurs in the fall, fertilization occurs following hibernation, from which pregnant females then move to their maternity caves to give birth and raise their young. In Arkansas, hibernation and maternity caves have been identified in the Ozark National Forest, Ozark Highlands, and Boston Mountains. (USFWS, 2008)

A major threat to this species is the disturbance of hibernating and maternity colonies. Disturbance is caused by cave exploration and commercialization, fragmentation of foraging habitat, and encroaching development (USFWS, 2008). Prior to hibernation, Ozark big-eared bats store just enough fat to sustain them until spring. When the bats are disturbed during hibernation, their fat reserves are burned more quickly and can result in the bats starving to death before spring arrives. (USFWS, 1997b)

Birds

There are four federally listed bird species known to occur in Arkansas as summarized in Table 4.1.6-4: the least tern (*Sterna antillarum*), piping plover (*Charadrius melodus*), red-cockaded woodpecker (*Picoides borealis*), and ivory-billed woodpecker (*Campephilus principalis*) (USFWS, 2016). The Sprague's pipit (*Anthus spragueii*) is a candidate species found in grasslands in the southwestern and northwestern regions of the state (USFWS, 2015d). Information on the habitat, distribution, and threats to the survival and recovery of each of the listed species in Arkansas is provided below.

Table 4.1.6-4: Federally Listed Bird Species of Arkansas

Common Name	Scientific Name	Federal Status	Critical Habitat in Arkansas	Habitat Description
Ivory-billed Woodpecker	<i>Campephilus principalis</i>	Endangered	No	Mature, contiguous forests in the eastern regions of Arkansas.
Interior Least Tern	<i>Sterna antillarum</i>	Endangered	No	Unvegetated sandbars in the Red and Arkansas rivers in Arkansas.
Piping Plover	<i>Charadrius melodus</i>	Threatened	No	Sandy Shorelines throughout Arkansas.
Red-cockaded Woodpecker	<i>Picoides borealis</i>	Endangered	No	Mature pine forests in the central and southern regions of Arkansas.

Source: (USFWS, 2014a) (USFWS, 2016)

Ivory-billed Woodpecker. The ivory-billed woodpecker is a large, black-and-white woodpecker with yellow eyes and a pointed crest. Females exhibit only white and black plumage, while males are black and white with red plumage on their crest. This species is approximately 18 to 20 inches in total length with a wingspan up to 31 inches (USFWS, 2015k). The ivory-billed woodpecker was originally federally listed as “in danger of extinction” under early endangered species legislation in 1967 (32 FR 4001, March 11, 1967) and was incorporated into the ESA as an endangered species (16 U.S.C. §1531 et seq.).

Historically, it is believed that the ivory-billed woodpecker occurred the southeastern and south-central regions of the United States (USFWS, 2010a). Currently, populations have only been confirmed in six counties in Arkansas (USFWS, 2015k). Some sightings have occurred in Florida but they have not been confirmed (USFWS, 2010a). Critical habitat has not been designated for this species. Threats to this species include habitat loss and degradation. The major threat to this species is the lack of information related to the habitat requirements and of the ivory-billed woodpecker (USFWS, 2010a).

Least Tern. The least tern is a 9-inch long, grey, and white gull, with black markings on its head. The species was federally listed as endangered in 1985 (50 FR 21784 21792, May 28, 1985). The tern is a summer resident in Arkansas and breeds along several major river systems in the U.S., which include the Missouri, Mississippi, Ohio, Red, and Rio Grande River. Specifically in Arkansas, the Red and Arkansas Rivers have been known to host breeding populations (USFWS, 1990). In Arkansas, the least tern is known to occur in twenty-five counties throughout the state (USFWS, 2015l).

Suitable habitat for least terns consists of relative unvegetated sandbars near rivers, reservoirs and other open water habitat. The primary threat to this species is the destruction and degradation of habitat. Nest disturbance and predation can also be factors (USFWS, 2014c). The primary causes of habitat loss historically have been dam construction, recreational activities, and the alteration of flow regimes along major river systems (USFWS, 2013b)

Piping Plover. The piping plover is a small, pale brown-colored migratory shorebird with a short beak and black band across its forehead, measuring approximately 7.25 inches in length (USFWS, 2015m). It was first listed as endangered in 1985 for the Great Lakes watershed of both the U.S. and Canada, and as threatened in the remainder of its range in the United States (50 FR 50726 50734, December 11, 1985).

Regionally, the piping plover occurs in the Northern Great Plains, along the Atlantic Coast, and in the Great Lakes Area within the U.S. (USFWS, 2001a). Barrier islands and coastal beaches from North Carolina to Texas are a major wintering area for this species. During migration, plovers use sites throughout Arkansas as stopover habitat. Stopover sites consist of shorelines that occur throughout the state along reservoirs, lakes, ponds, rivers, and wetlands (USFWS, 2014d). In Arkansas, the piping plover is known or believed to occur in 27 counties throughout the state (USFWS, 2015m).

This species feeds on worms, fly larvae, beetles, crustaceans, and other marine macroinvertebrates (USFWS, 1996a). Preferred habitat is wide, open, sandy beaches with little vegetation. Current threats to this species include habitat loss and degradation, human disturbance, harassment by pets, predation, and environmental contaminants (USFWS, 2001a) (USFWS, 1996a).

Red-cockaded Woodpecker. The red-cockaded woodpecker is a small black-and-white woodpecker that grows approximately seven inches tall and has a wingspan of about 15 inches. Its black cap and white cheek patches characterizes it (USFWS, 2015n). The red-cockaded woodpecker was listed as endangered in 1970 under early endangered species legislation (35 FR 16047 16048, October 13, 1970) and was incorporated into the ESA as an endangered species (16 U.S.C. §1531 et seq.). Regionally, this species is known to occur in open pine forests in the southeast from Virginia south to Florida and west to Oklahoma and Texas. In Arkansas, the red-cockaded woodpecker is known or believed to occur in 15 counties across the central and southern regions of Arkansas (USFWS, 2015o). The majority of red-cockaded woodpeckers in Arkansas can be found in the Felsenthal National Wildlife Refuge and in the Ouachita National Forest (USFS, 2015a) (USFWS, 2015o).



Photo credit: USFWS
Red-cockaded woodpecker

The preferred habitat for the red-cockaded woodpecker is mature pine forests, with the preferred pine species being the longleaf pines (*Pinus palustris*). This species forages on pine trunks, branches, and flakes away bark in search of insects. Its diet is primarily composed of insects including beetles, ants, spiders, other insect found on pine trees, with occasional wild fruits and pine seeds. Current threats to the red-cockaded woodpecker include lack of suitable habitats. (USFWS, 2003a)

Fish

There are seven federally listed and known to occur fish species in Arkansas as summarized in Table 4.1.6-5. The candidate species in the state is the Arkansas darter (*Etheostoma cragini*) found in clear and shallow streams in the northwestern part of the state (USFWS, 2015d). Information on the habitat, distribution, and threats to the survival and recovery of each of the listed species in Arkansas is provided below.

Table 4.1.6-5: Federally Listed Fish Species of Arkansas

Common Name	Scientific Name	Federal Status	Critical Habitat in Arkansas	Habitat Description
Arkansas River Shiner	<i>Notropis girardi</i>	Threatened	No	Braided channels in Logan County, Arkansas.
Benton County Cave Crayfish	<i>Cambarus aculabrum</i>	Endangered	No	Caves with low light and temperature in northwestern Arkansas.
Hell Creek Crayfish	<i>C. zophonastes</i>	Endangered	No	Groundwater habitats in north-central Arkansas.
Leopard Darter	<i>Percina pantherina</i>	Threatened	Yes	Pools and riffles of the Little River basin in southwestern Arkansas.
Ozark Cavefish	<i>Amblyopsis rosae</i>	Threatened	No	Groundwater habitats of the Springfield Plateau Aquifer in northwestern Arkansas.
Pallid Sturgeon	<i>Scaphirhynchus albus</i>	Endangered	No	Bottom of dynamic channels of the Mississippi River in eastern Arkansas.
Yellowcheek Darter	<i>Etheostoma moorei</i>	Endangered	Yes	Devil's Fork, Middle Fork, South Fork, and Archery Fork of the Little Red River in north-central Arkansas

Source (USFWS, 2014a) (USFWS, 2016)

Arkansas River Shiner. The Arkansas River shiner (*Notropis girardi*) is a small minnow, measuring up to 2 inches in length. This species has a light tan back, silvery sides, and a white belly. Distinguishing features include a rounded snout and a dark mark at the base of the tail fin (USFWS, 2001b). The Arkansas River shiner was federally listed as threatened in 1998 (63 FR 64772 64799, November 23, 1998).

Regionally, this species is known to occur in Arkansas, Kansas, New Mexico, Oklahoma, and Texas. In Arkansas, this species is known to occur in Logan County (USFWS, 2015p). Critical habitat has been designated for the Arkansas River shiner but no habitat was designated in Arkansas. Critical habitat consists of portions of the Cimarron River in Kansas and Oklahoma and a section of the Canadian River in Oklahoma (70 FR 59808 59846, October 13, 2005).

The preferred habitat for the Arkansas River shiner is a shallow, braided channel with a primarily sandy bottom, where pools and riffles are also present. The primary threat to this species is stream modification and reduction caused by impoundments, water diversion, groundwater mining, channelization, and non-native species (USFWS, 2001b).

Benton County Cave Crayfish. The Benton County cave crayfish (*Cambarus aculabrum*) is a small crayfish, with a total body length of approximately 1.8 inches. This species lacks pigment in its body and reduced eyes. Reproductive males of this species can be distinguished from *Cambarus zophonastes* by the first set of swimming legs (pleopods), which have longer central projections than those of *C. zophonastes* (USFWS, 2015q). This cave crayfish was federally listed as endangered in 1993 (58 FR 25742 25746, April 27, 1993).



Photo credit: USFWS
Benton County cave crayfish

Regionally, this species is known to occur in northwestern Arkansas and southwestern Missouri (USFWS, 2015q). In Arkansas, the Cave crayfish is known to inhabit Logan Cave, Bear Hollow Cave, Elm Springs, and Old Pendergrass Cave (USFWS, 2013c). This species is a habitat specialist and prefers caves with low light, low temperature, and stable conditions (USFWS, 1996b).

The major threat to this species is water contamination. Developments, roads, agricultural operations, and mining operations that occur in the cave recharge areas can contaminate the groundwater through runoff, spills, septic leaks, and sediment displacement. The cave crayfish is adapted to pristine groundwater conditions and contaminants act as a constant stressor to a population. (USFWS, 2013c)

Hell Creek Crayfish. The Hell Creek Crayfish, *C. zophonastes*, is a medium-sized crayfish, with a total body length of 2.5 to 3 inches. This species lacks eyes and pigment (USFWS, 2015r). This cave crayfish was federally listed as endangered in 1987 (52 FR 11170 11172, April 7, 1987).

Regionally, this species is known to occur in Marion County and Stone County in north-central Arkansas. In Stone County, this species is known to inhabit the Hell Creek Cave and the Nesbitt Spring Cave. In Marion County, this species has been found in a groundwater upwelling adjacent to the Town Branch Creek System (USFWS, 2012b). Preferred habitat has not been studied; however, individuals were found in groundwater habitats with muddy bottoms.

Potential threats to this species include groundwater contamination and trampling or disturbance caused by people entering the caves. Additionally, the small size of these isolated populations can exacerbate the impacts of these threats (USFWS, 2012b).

Leopard Darter. The leopard darter (*Percina pantherina*) is a small fish, with a total body length of up to 8.7 centimeters. This species ranges from tan to olive in color and is distinguishable by the 11 to 14 black spots along each of its sides (USFWS, 2012c). The leopard darter was federally listed as threatened in 1978 (43 FR 3711 3716, January 27, 1978).

Regionally, this species is endemic to the Little River basin in Arkansas and Oklahoma. In Arkansas, this species is known to occur in three counties in the southwest regions of the state (USFWS, 2015s). Critical habitat has been designated for the leopard darter in Oklahoma and Arkansas. In Arkansas, Mountain Fork River in Polk County has been established as critical habitat (43 FR 3711 3716, January 27, 1978). From June to early February this species typically inhabits pools with rocky bottoms. During the reproductive season, from February to April, this species will inhabit riffles (USFWS, 2012c).

The major threats to this species include habitat loss, fragmentation, and degradation. The primary cause of these threats is the creation and operation of dams and reservoirs, which alter hydrology and isolate populations. Agricultural and logging operations contribute to habitat degradation through spills, runoff, and increased erosion. (USFWS, 2012c)

Ozark Cavefish. The Ozark cavefish (*Amblyopsis rosae*) is a small fish, pinkish-white in appearance, with a total body length of approximately 2.25 inches. This species lacks eyes, pigment, and pelvic fins (USFWS, 2011a) (USFWS, 2015t). The Ozark cavefish was first federally listed as threatened in 1984 (49 FR 43965 43969, November 1, 1984).

Regionally, the Ozark cavefish is restricted to the Springfield Plateau in northeast Oklahoma, northwest Arkansas, and southwest Missouri. In Arkansas, this species is known to occur in nine caves in Benton County. Logan Cave and Cave Springs Cave are important sites in Arkansas, and 80 percent of known Ozark cavefish populations occur in these systems. Suitable habitat for this species includes cave streams, sinkholes, and underground aquifers where light is always absent. (USFWS, 2011a)

The major threat to this species is habitat loss or degradation. The primary cause of these threats is agricultural operations and development, which can cause spills, runoff, changes in hydrology, and increased groundwater withdrawals. Human disturbance caused by exploration of caves is also a threat to this species. (USFWS, 2011a)

Pallid Sturgeon. The pallid sturgeon (*Scaphirhynchus albus*) is one of two species of sturgeon found east of the Continental Divide; it is the larger of the two species, and weighs up to 60 pounds. The pallid sturgeon has a flattened snout and the part of the body just before the tail is armored with cartilage plates. (USFWS, 2015u) This species was federally listed as endangered in 1990 (55 FR 36641 36647, September 6, 1990).

The species' range extends the length of the Missouri and Mississippi Rivers. In Arkansas, the pallid sturgeon is found in the Mississippi River, which runs through seven counties along the eastern edge of the state (USFWS, 2015u). The Pallid sturgeon prefers large rivers with strong currents; they can withstand a wide range of turbidity conditions. The key reason for this species' decline has been habitat fragmentation and alteration from the damming of major rivers and other large tributaries (USFWS, 2014e).

Yellowcheek Darter. The yellowcheek darter (*Etheostoma moorei*) is a small fish, measuring up to 2.5 inches in length. This species has a laterally flattened body and a sharp snout. The yellowcheek darter is grayish brown with dark lateral lines. During the breeding season, males exhibit a blue throat and a green belly, while females have orange spots. (USFWS, 2015v) The

yellowcheek darter was federally listed as endangered in 2011 (76 FR 48722 48741, August 9, 2011).

The yellowcheek darter is endemic to the Devil’s Fork, Middle Fork, South Fork, and Archery Fork of the Little Red River in north-central Arkansas. These four units of the Little Red River have been designated as critical habitat for the yellowcheek darter (77 FR 63603 63668, October 16, 2012). Suitable habitat for this species consists of headwater tributaries that exhibit constant flow, abundant riffle habitat, rapidly changing gradient, clear water, and rocky bottoms (USFWS, 2012d).

Major threats to this species include habitat alteration and degradation. Natural gas developments, roads, agricultural operations, and mining operations can potentially impact the stream ecology and water quality of current yellowcheek darter habitats (USFWS, 2012d).

Amphibians

One federally listed endangered amphibian species is known to occur in Arkansas, as listed in Table 4.1.6-6. The Ozark hellbender (*Cryptobranchus alleganiensis bishopi*) is found throughout the White River watershed in northeastern Arkansas (USFWS, 2015x). Information on the habitat, distribution, and threats to the survival and recovery of each of these species in Arkansas is provided below.

Table 4.1.6-6: Federally Listed Amphibian Species of Arkansas

Common Name	Scientific Name	Federal Status	Critical Habitat in Arkansas	Habitat Description
Ozark Hellbender	<i>Cryptobranchus alleganiensis bishopi</i>	Endangered	No	Clear and cool waters in northeastern Arkansas.

Source: (USFWS, 2014a) (USFWS, 2016)

Ozark Hellbender. The Ozark hellbender is an aquatic salamander that can have a total body length of up to 2 feet. This subspecies has a laterally flattened body, keeled tail, small eyes and can be distinguished by the dark blotches on its back and chin (USFWS, 2015w). The Ozark hellbender was listed as endangered in 2011 (76 FR 61956 61978, November 7, 2001).

Regionally, this Ozark hellbender is found in the White River watershed in Arkansas and Missouri. In Arkansas, this species is known to occur in the north fork of the White River, Spring River, Eleven Point River, and Current River. The preferred habitat is cool, clear waters where large rocks are present. (USFWS, 2015x)

Major threats to this species include habitat loss, nest degradation, and disease. Hellbenders are habitat specialists and are therefore sensitive to changes in water quality, water flow, and temperature. Additionally, chytrid fungus (*Batrachochytrium dendrobatidis*) is an infectious disease that has been found in every Ozark hellbender population in Missouri. (USFWS, 2015x)

Invertebrates

Thirteen federally listed endangered and threatened invertebrate species are known to occur in Arkansas as summarized in Table 4.1.6-7. The rattlesnake-master borer moth (*Papaipema*

eryngii) is a candidate species that can be found in the center of Arkansas (USFWS, 2015d). Information on the habitat, distribution, and threats to the survival and recovery of each of the listed species in Arkansas is provided below.

Table 4.1.6-7: Federally Listed Invertebrate Species of Arkansas

Common Name	Scientific Name	Federal Status	Critical Habitat in Arkansas	Habitat Description
American Burying Beetle	<i>Nicrophorus americanus</i>	Endangered	No	Forest habitats in western Arkansas.
Arkansas Fatmucket	<i>Lampsilis powellii</i>	Threatened	No	Pools and backwater ponds of the Ouachita Mountain region in Arkansas
Curtis Pearlymussel	<i>Epioblasma florentina curtisii</i>	Endangered	No	Riffles and runs within transitional streams in northeastern Arkansas.
Fat Pocketbook	<i>Potamilus capax</i>	Endangered	No	Streams, tributaries, and channels in eastern Arkansas.
Neosho Mucket	<i>Lampsilis rafinesqueana</i>	Endangered	Yes	Riffles and runs within the Arkansas River system in northeastern Arkansas.
Ouachita Rock Pocketbook	<i>Arkansia wheeleri</i>	Endangered	No	Shallow riffle areas throughout Arkansas.
Pink Mucket (pearlymussel)	<i>Lampsilis abrupta</i>	Endangered	No	Riffle areas, with a moderate current and mud or sand substrates, throughout Arkansas.
Rabbitsfoot (mussel)	<i>Quadrula cylindrical</i>	Threatened	Yes	Shallow areas of streams and rivers, with sand and gravel along the banks, throughout Arkansas.
Scaleshell Mussel	<i>Leptodea leptodon</i>	Endangered	No	Stable riffles and runs, where freshwater drum is present; throughout Arkansas.
Speckled Pocketbook	<i>Lampsilis streckeri</i>	Endangered	No	Pools and runs with boulders, sand, and gravel in north-central Arkansas.
Spectaclecase (mussel)	<i>Cumberlandia monodonta</i>	Endangered	No	Sheltered areas in large rivers in western Arkansas.
Turgid Blossom (pearlymussel)	<i>Epioblasma turgidula</i>	Endangered	No	Shallow riffles or shoals that exhibit sand or gravel substrates and a rapid current in eastern Arkansas.
Winged Mapleleaf	<i>Quadrula fragosa</i>	Endangered	No	Large streams with mud or gravel bottoms in southern Arkansas.

Source: (USFWS, 2014a) (USFWS, 2016)

American Burying Beetle. The American burying beetle is the largest carrion beetle in North America with a total length of one to two inches. This species has a shiny black shell, smooth shiny black legs, pronounced orange markings on its body, and orange club shaped antennae. (USFWS, 1991a) The species was listed as endangered in 1989 (54 FR 29652 29655, July 13, 1989).

The American burying beetle can be found in flat topography with forest litter and decomposing plant matter in the top layers of well-drained soil. Historically, the species ranged in more than 150 counties in 35 states of the eastern and central U.S., but today this species is known to occur in only 10 states. In Arkansas, this species is primarily found in the Ouachita National Forest, the Ozark-St. Francis National Forest, and Fort Chaffee. (USFWS, 2014f) Threats to the species

include habitat loss, fragmentation, and overall loss or reduction of small vertebrates to host the species (USFWS, 1991a).

Arkansas Fatmucket. The Arkansas fatmucket is a medium-sized mussel, up to 4 inches in length. Males have a pointed posterior, while females have a “broadly rounded to truncate” posterior. The shell of this species is typically elliptical or obovate in shape and exhibits a shiny yellow or yellowish tan color (USFWS, 2015y). The Arkansas fatmucket was federally listed as threatened in 1990 (55 FR 12797 12801, April 5, 1990).

The Arkansas fatmucket is endemic to streams in the Ouachita Mountain region of Arkansas. Suitable habitat for this species consists of pools and backwater ponds with cobble, rock, and sand substrate. This species prefers areas with enough flow to keep silt and organic debris from settling and is frequently found near islands of American water willow (*Justicia americana*) (USFWS, 1992) (USFWS, 2013d). The major threat to this species is habitat loss and degradation. The construction of lakes and reservoirs in the Ouachita Basin has limited the range of this species (USFWS, 2013d).

Curtis Pearlymussel. The Curtis pearlymussel is a small-sized mussel. Males on average are 1.25 inches long, while females on average are 1.1 inches long. Males have oval shells that exhibit a pointed posterior. Females have obovate shells that exhibit a broadly rounded posterior. Both males and females have shells that are yellowish brown to light brown, occasionally with rays occurring (USFWS, 1986). The Curtis pearlymussel was listed as endangered in 1976 (41 FR 24062 24067, June 14, 1976).

Historically, this species occurred in Missouri and Arkansas. Historical records indicate that the Curtis pearlymussel was previously located in the White River, Black River, Little Black River, Castor River, Spring River, and Cane Creek. However, despite several surveys, this species has not been seen alive or dead since 1993. (USFWS, 2010c)

Suitable habitat for the Curtis pearlymussel consists of shallow, stable riffles and runs within transitional streams that occur between headwaters and lowland stream reaches. The major threat to this species is habitat alteration. Channelization, impoundments, and dredging have impacted several areas of this species’ historic range. (USFWS, 2010c)

Fat Pocketbook. The fat pocketbook is a mussel with a globose shell. This species has a smooth shell that is typically yellowish brown and lacks rays (USFWS, 1989a). This species was listed as endangered in 1976 (41 FR 24062 24067, June 14, 1976).

Regionally, this species is known or believed to occur in Arkansas, Illinois, Indiana, Kentucky, Louisiana, Mississippi, and Missouri. In Arkansas, the fat pocketbook occurs in 12 counties in the eastern region of the state (USFWS, 2015z). This species is typically found in streams, tributaries, and channels with sand, mud, or gravel, or substrates (USFWS, 2007a).

Threats to this species includes habitat loss and degradation due to water impoundment, channel maintenance, and dredging. The creation of impoundments in the fat pocketbook’s range has inundated habitats and altered water flow. Dredging may lead to the accidental removal of individuals, increased erosion, and reduce habitat stability. (USFWS, 2007a)

Neosho Mucket. The Neosho mucket is a medium-sized mussel, measuring up to 3.7 inches in length. The shell of this species is olive-yellow to brown with green rays that are usually discontinuous. Males have an elliptical shell, while females have an ovate. (USFWS, 2015aa) This species was listed as endangered in 2013 (78 FR 57076 57097, September 17, 2013).

This species is endemic to the Arkansas River system and is known to occur in Arkansas, Kansas, Missouri, and Oklahoma. In Arkansas, this species is known to occur in two counties in the northeastern region of the state. The Neosho mucket is commonly found in riffles and runs with fast currents and gravel bottoms. Occasionally, this species is found close to shore, out of the main current. (USFWS, 2015aa)

Critical habitat has been designated for the Neosho mucket and consists of seven stream segments throughout its range (80 FR 24691 24774, April 30, 2015). The only critical habitat in Arkansas is a segment of the Illinois River, beginning at the Muddy Fork and Illinois River confluence and extending down the river into Oklahoma where it ends in Cherokee County. Threats to this species include habitat loss and degradation due to development, agricultural operations, and treated wastewater releases. (USFWS, 2015ab)

Ouachita Rock Pocketbook. The Ouachita rock pocketbook is a medium-sized mussel, measuring up to 4.4 inches in length (USFWS, 2004b). This species has a shiny shell that is brown to black in color. The Ouachita rock pocketbook was federally listed as endangered in 1991 (56 FR 54950 54957, October 23, 1991). Regionally, this species is known or believed to occur in Arkansas and Oklahoma (USFS, 2015b). In Arkansas, this species can be found within the Red River system and the Ouachita River system in nine counties in the southwestern region of the state (USFWS, 2004b).

The Ouachita rock pocketbook inhabits stable substrates within pools, backwaters, and side channels. This species is typically found in mussel beds where several other mussel species are also present. The major threat to this species is habitat loss and degradation due to water impoundment, channelization, and reduced water quality. (USFWS, 2004b)

Pink Mucket. The pink mucket has a smooth yellowish-brown colored round shell that is approximately 4 inches long. The shell is yellow to yellowish-brown in color. Females have a broadly rounded posterior, while males have a slightly pointed posterior (USFWS, 1985a). This species was federally listed as endangered in 1976 (41 FR 24062 24067, June 14, 1976).

Regionally, the pink mucket occurs in Arkansas, Alabama, Illinois, Kentucky, Louisiana, Missouri, Ohio, and Virginia. In Arkansas, this species is known or believed to occur in 31 counties throughout the state (USFWS, 2015ac). Suitable habitat for the pink mucket consists of riffle areas in rivers that exhibit a moderate current and mud or sand substrates (USFWS, 1985a) (USFWS, 2015ad). Threats to the survival of this species include habitat loss and degradation due to water impoundment, increased erosion, and agricultural/industrial runoff (USFWS, 2015ad).

Rabbitsfoot. The rabbitsfoot can grow up to 6 inches in length. The shell of the rabbitsfoot mussel is generally yellowish, greenish, or olive in color and turns yellowish brown with age

(USFWS, 2015ae). The rabbitsfoot was federally listed as threatened in 2013 (78 FR 57076 57097, September 17, 2013).

Regionally, this species occurs from Kansas to Pennsylvania and from Oklahoma to Alabama. In Arkansas, this species is known or believed to occur in 31 counties throughout the state. The rabbitsfoot prefers shallow areas of streams and rivers with sand and gravel along the banks. These mussels seldom burrow and instead use the gravel along the banks as refuge in fast moving rivers and streams. For reproduction, this species prefers stable and undisturbed habitats with a sufficient population of host fish. (USFWS, 2015ae)

A critical habitat designation was recorded in 2015 at 31 stream segments where the mussels are known to occur (80 FR 24691 24774, April 30, 2015). Critical habitat for rabbitsfoot mussel in Arkansas is located in the Ouachita River, Saline River, Little River, Middle Fork Little Red River, White River, Black River, Spring River, Strawberry River, and Buffalo River (USFWS, 2015ab). The current threats to the rabbitsfoot mussels include the loss of habitat, isolation of populations, range restrictions, sedimentation, and presence of non-native species (USFWS, 2012e).

Scaleshell Mussel. The scaleshell mussel is a smooth, brownish green mussel. This species is approximately 4 inches in length, with paper thin shell and light brown markings (USFWS, 2010b). The scaleshell was federally listed as endangered in 2001 (66 FR 54808 54832, October 30, 2001). Historically, the scaleshell mussel occurred in 56 rivers throughout the Mississippi River Basin, but in the last 25 years it has only been documented in 18 streams (USFWS, 2010b). In Arkansas, the species is known to occur in 16 counties throughout the state (USFWS, 2015af).

Though each mussel produces more than 400,000 larvae, the scaleshell has specific host requirements met by the freshwater drum (*Aplodinotus grunniens*) and requires specific ranges for temperature, flow, and oxygen in its habitat, which limit species populations. The scaleshell mussel is typically found in a variety of substrates within the stable riffles and runs of medium to large rivers (USFWS, 2010b).

Present threats to the scaleshell include: declining oxygen levels in streams (eutrophication), sedimentation from mining and dredging operations, contamination from municipal and industrial wastes or agricultural run-off, competition from non-native species (such as the Asian clam and zebra mussel), and impoundment of rivers which modify stream and river hydrology. (USFWS, 2010b)

Speckled Pocketbook. The speckled pocketbook is a thin mussel with an elliptical to obovate shell, measuring approximately 3.5 inches in length (USFWS, 1989b). The shell of this species is typically tan to yellowish brown in color and exhibits rays that are green to black in color and vary in shape. Females will have shells that exhibit a more broadly rounded posterior (USFWS, 2015ag). This species was federally listed as endangered in 1989 (54 FR 8339 8342, February 28, 1989).

The speckled pocketbook is only known to occur in Arkansas within the Middle Fork Little Red River, South Fork Little Red River, Archery Fork Little Red River, lower Turkey Creek, and Big

Creek. Suitable habitat for this species includes pools and runs where boulders, sand, and gravel are present. (USFWS, 2015ah)

Threat to this species include habitat loss and degradation. These threats are caused by mining operations, agricultural operations, and development. Previously, habitat was permanently lost and populations of speckled pocketbooks were isolated due to the construction of Greers Ferry Reservoir. (USFWS, 2015ah)

Spectaclecase. The spectaclecase mussel is a large mussel, measuring up to at least 9 inches in length. This species has an elongated shell that is brownish to black in color, with a somewhat curved appearance and moderate inflation (USFWS, 2012f). This species was first listed as federally endangered in 2012 (77 FR 14914 14949, April 12, 2012).

The spectaclecase mussel has suffered a 55 percent decrease in distribution and occurs in 20 of the 44 streams it once inhabited. Most populations are now fragmented and limited to short reaches of streams in the twelve states it occurs: Alabama, Arkansas, Illinois, Iowa, Kansas, Kentucky, Minnesota, Missouri, Tennessee, Virginia, West Virginia, and Wisconsin (USFWS, 2012f) (USFWS, 2015ai). In Arkansas, the interspersed populations are found within six counties in the western half of the state (USFWS, 2015ai).

Suitable habitat for the spectaclecase mussel includes sheltered areas in large rivers. This species seeks out areas that are sheltered from the force of the river current, such as beneath rock slabs, firm mud banks, and in-between tree roots. Threats to the survival of this species are alterations to their habitats, mainly from dams. Dams alter the natural flow and temperature regime of rivers and block fish passage, which is necessary to prevent fragmentation of populations. Sedimentation of rivers, pollution, channelization, and invasive zebra mussels also pose threats to the spectaclecase mussel. (USFWS, 2012f)

Turgid Blossom. The turgid blossom is a small-sized mussel, measuring up to 1.5 inches in length. The species has a shiny, yellowish green shell with irregular growth lines and numerous thin green rays. Females have a broadly rounded posterior, while males have a pointed posterior (USFWS, 1985b). This species was first listed as federally endangered in 1976 (41 FR 24062 24067, June 14, 1976).

Historically, this species was known or believed to occur in Alabama, Arkansas, Missouri, and Tennessee (USFWS, 1999). In Arkansas, historical records indicate that the turgid blossom was previously located in the Spring Creek, White River, and Black River (USFWS, 1985b). Despite several surveys, this species has not been seen alive or dead within its known range since 1965 (USFWS, 2007b). In 2001, USFWS created a non-essential experimental population rule for the turgid blossom, with the purpose of reintroducing the turgid blossom if it is ever found again and can be propagated (66 FR 32250 32264, June 14, 2001).

Suitable habitat for the turgid mussel includes shallow riffles or shoals that exhibit sand or gravel substrates and a rapid current. The decline in this species is not entirely understood, but major threats to this species are believed to be habitat fragmentation, alteration, and destruction caused by impoundments, siltation, and pollution. (USFWS, 1985b)

Winged Mapleleaf. The winged mapleleaf is a generally round, reddish-brown, green-accented mussel which grows up to approximately 4 inches in length and may have two rows of bumps which lead from the rear hinge to the shell opening (Vaughn, 1997). The species was federally listed as endangered in 1991 (56 FR 28345 28349, June 20, 1991).

Historically, it was reported that the winged mapleleaf occurred in 34 rivers throughout the Mississippi River drainage (USFWS, 1999). However, there is speculation that all reports of the winged mapleleaf occurring from the Tennessee River below Wilson Dam may have actually been the mapleleaf mussel (*Quadrula quadrula*) (Vaughn, 1997) (USFWS, 1999). In 2001, USFWS created a non-essential experimental population rule for the winged mapleleaf to be reintroduced to the Wilson Dam tailwater (66 FR 32250 32264, June 14, 2001). However, USFWS stated that the winged mapleleaf would not be released into the Wilson Dam tailwater until the speculation of the previously identified populations is resolved. In Arkansas, the species is known or believed to occur in 16 counties in the southern half of the state (USFWS, 2015aj).

Habitat for the winged mapleleaf consists of large freshwater streams on mud, muddy-gravel, or gravel bottoms, and may be found in fast flowing, shallow areas with clear, and high-quality water (USFWS, 1991b). Threats and cause of decline for the winged mapleleaf consist of reduced reproduction rates in most populations, opportunistic predation, competitors from species such as zebra mussels (*Dreissena polymorpha*), and habitat loss due to reduced water quality and hydrological alterations (Vaughn, 1997).

Plants

Five federally listed endangered and threatened plant species are known to occur in Arkansas, as summarized in Table 4.1.6-8. Information on the habitat, distribution, and threats to the survival and recovery of each of these species in Arkansas is provided below.

Table 4.1.6-8: Federally Listed Plant Species of Arkansas

Common Name	Scientific Name	Federal Status	Critical Habitat in Arkansas	Habitat Description
(No common name)	<i>Geocarpon minimum</i>	Threatened	No	Sparsely vegetated areas with a high concentration of magnesium and sodium in the soils; southeastern and northwestern Arkansas.
Harperella	<i>Ptilimnium nodosum</i>	Endangered	No	Shallow rocky areas with saturated substrates that experience seasonal flooding; central Arkansas.
Missouri Bladderpod	<i>Physaria filiformis</i>	Threatened	No	Shallow soils of limestone glades in northern Arkansas.
Pondberry	<i>Lindera melissifolia</i>	Endangered	No	Seasonally flooded wetlands, sandy sinks, pond margins, and swampy depressions in southeastern and northeastern Arkansas.
Running Buffalo Clover	<i>Trifolium stoloniferum</i>	Endangered	No	Disturbed mesic habitats with filtered sunlight in central Arkansas.

Source: (USFWS, 2014a) (USFWS, 2016)

Geocarpon minimum. *Geocarpon minimum*, for which there is no common name, is a small annual species that is only easily visible for a few weeks during spring (USFWS, 2015ak). This species has opposite leaves and branches that measure approximately 0.4 to 1.5 inches long (USFWS, 1993a). *Geocarpon minimum* was listed as threatened in 1987 (52 FR 22930 22933, June 16, 1987). This species is known to or believed to occur in Arkansas, Louisiana, Missouri, and Texas. In Arkansas, this species is known to occur in five counties in the southeastern and northwestern regions of the state (USFWS, 2015ak).

Throughout most of its range, this species is found in areas with sparse vegetation and soils that have high concentrations of magnesium and sodium. Threats to the species include alteration or destruction of its habitat due to climate change, competition with other plant species, and changes in soil due to development. (USFWS, 1993a)

Harperella. *Harperella* is a perennial herb that grows between half a foot and three feet tall. Its thin stalks have quill-like leaves and end in small white flowers with typically five petals each (USFWS, 2015al). The species was listed as federally endangered in 1988 (53 FR 37978 37982, September 28, 1988). *Harperella*'s range reaches down the east coast from Maryland down to Georgia and extends across to Oklahoma. In Arkansas, *harperella* is known or believed to exist in six counties in the central portion of the state (USFWS, 2015am).

Habitat for *harperella* consists of shallow rocky areas with saturated substrates that experience seasonal flooding because it reduces competition. Threats to *harperella* consist of water changes in flow, depth, and quality, along with human factors such as damming, hydrologic alterations, and development. (USFWS, 1988a)

Missouri Bladderpod. The Missouri bladderpod is an annual species that grows between 4 and 8 inches tall. This species exhibits many hairy stems connected to the base. Each stem has leaves occurring in a rosette form at the base and then scattered along the entire length of the stem. The flowers of this species exhibit four yellow petals that are densely covered in hairs (USFWS, 1988b). The Missouri bladderpod was reclassified from endangered to threatened in 2003 (52 FR 59337 59345, October 15, 2003).

Regionally, this species occurs in Missouri and Arkansas. In Arkansas, the Missouri bladderpod is known or believed to occur in three counties in the northern half of the state (USFWS, 2015an). This species is typically found in shallow soils of limestone glades. Major threats to this species include habitat loss and degradation due to development, as well as competition with non-native plants. (USFWS, 2003b)

Pondberry. The pondberry "is a deciduous shrub, growing from less than 1 foot (30 cm) to, infrequently, more than 6 feet (2 m) in height. Leaves are aromatic, alternate, elliptical, somewhat thin and membranaceous, with entire margins. Shrubs usually are sparsely branched, with fewer branches on smaller plants. Plants are rhizomatous, frequently propagating by vegetative sprouts and forming colonies. Plants are dioecious, each plant is a male or a female, and produce clusters of small, yellow flowers in early spring prior to leaf development, from buds on branches produced from the growth during the preceding year. Immature fruits are

drupes, green, and ripen to red by fall” (USFWS, 2015ao). Pondberry was federally listed as endangered in 1986 (51 FR 27495 27500, July 31, 1986).

The species is known from Alabama, Arkansas, Georgia, Mississippi, Missouri, North Carolina, and South Carolina; in Arkansas, the species is known or believed to occur in seven counties in the southeastern and northeastern regions of the state (USFWS, 2015ao). Suitable habitat for this species includes in seasonally flooded wetlands, sandy sinks, pond margins, and swampy depressions. Threats to the species include alteration or destruction of its habitat through land clearing, drainage modification, timber harvesting, and disturbance from domestic animals (USFWS, 1993b).

Running Buffalo Clover. The running buffalo clover is a perennial species with leaves exhibiting three leaflets and white flowers that are about 1 inch wide. This species produces runners, which extend horizontally from the base of stems and can produce roots at every node (USFWS, 2015ap). The running buffalo clover was federally listed as endangered in 1987 (52 FR 21478 21481, June 5, 1987).

The running buffalo clover is known or believed to occur in Arkansas, Indiana, Kentucky, Missouri, Ohio, and West Virginia. In Arkansas, the running buffalo clover is known to occur in two counties in the center of the state (USFWS, 2015aq). This species prefers disturbed mesic habitats with filtered sunlight, however this species has been located in a variety of other habitat types. The main threat to this species is direct and indirect human disturbance (USFWS, 2011b). Human disturbance that impacts this species includes development, removal of wildlife, and the introduction of non-native species.

4.1.7. Land Use, Recreation, and Airspace

4.1.7.1. Definition of the Resources

The following summarizes major land uses, recreational venues, and airspace considerations in Arkansas, characterizing existing, baseline conditions for use in evaluating the potential environmental consequences resulting from implementing the Proposed Action or Alternatives.

Land Use and Recreation

Land use is defined as “the arrangements, activities, and inputs people undertake in a certain land cover type to produce, change, or maintain it” (FAO, 2017). A land use designation can include one or more pieces of land, and multiple land uses may occur on the same piece of land. Land use also includes the physical cover, observed on the ground or remote sensing and mapping, on the earth’s surface; land cover includes vegetation and manmade development (Anderson, Hardy, Roach, & Witmer, 2001).

Recreational uses are activities in which residents and visitors participate. They include outdoor activities, such as hiking, fishing, boating, athletic events (e.g., golf), and other attractions (e.g., historic monuments and cultural sites) or indoor activities, such as museums and historic sites. Recreational resources can include trails, lakes, forests, beaches, recreational facilities, museums,

historic sites, and other areas/facilities. Federal, state, county, or local governments typically manage recreational resources.

Descriptions of land uses are presented in three primary categories: forest and woodlands, agricultural, and developed. Descriptions of land ownership are presented in four main categories: private, federal, state, and tribal. Descriptions of recreational opportunities are presented in a regional fashion, highlighting areas of recreational significance within 4 identified regions.

Airspace

Airspace is generally defined as the space lying above the earth, above a certain area of land or water, or above a nation and the territories that it controls, including territorial waters (Merriam Webster Dictionary, 2015a). Airspace is a finite resource that can be defined vertically and horizontally, as well as temporally, when discussing it in relation to aircraft activities. Airspace management addresses how and in what airspace aircraft fly. Air flight safety considers aircraft flight risks, such as aircraft mishaps and bird/animal-aircraft strikes. The Federal Aviation Administration (FAA) is charged with the safe and efficient use of the nation's airspace and has established criteria and limits to its use.

The FAA operates a network of airport towers, air route traffic control centers, and flight service stations. The FAA also develops air traffic rules, assigns use of airspace, and controls air traffic in U.S. airspace. "The Air Traffic Organization is the operational arm of the FAA responsible for providing safe and efficient air navigation services to approximately 30.2 million square miles of airspace. This represents more than 17 percent of the world's airspace and includes all of the U.S. and large portions of the Atlantic and Pacific Oceans and the Gulf of Mexico" (FAA 2014a). The Air Traffic Organization is comprised of Service Units (organizations) that support the operational requirements.

The FAA Air Traffic Services Unit manages the National Airspace System (NAS) and international airspace assigned to U.S. control and is responsible for ensuring efficient use, security, and safety of the nation's airspace. FAA field and regional offices (e.g., Aircraft Certification Offices, Airports Regional Offices, Flight Standards District Offices [FSDOs], Regional Offices & Aeronautical Center, etc.) assist in regulating civil aviation to promote safety, and develop and carry out programs that control aircraft noise and other environmental effects (e.g., air pollutants) attributed from civil aviation (FAA, 2015b) (FAA, 2016a)⁹². The FAA works with state aviation officials and airport planners, military airspace managers, and other organizations in deciding how best to use airspace.

4.1.7.2. Specific Regulatory Considerations

Land use planning in Arkansas is the primary responsibility of local governments (i.e., county). The main planning tools for local governments include the comprehensive plan, zoning ordinance, and subdivision ordinance. The land use code for each county sets forth the authority for each of these tools, as granted to the counties by state-enabling legislation. The

⁹² Environmental and Noise complaints are initially handled at the HQ level

comprehensive plan proposes land uses and locations of public facilities and utilities and projects long-term population growth. The zoning ordinance sets forth the rules used to govern the land by dividing localities into zoning districts and establishes allowable uses within the districts (e.g., agriculture, industry, commercial use). The subdivision ordinance manages the process for dividing large land parcels into smaller lots. Because federal laws govern the Nation’s airspace, there are no specific Arkansas state laws that would alter the existing conditions relating to airspace for this PEIS.

4.1.7.3. Land Use and Ownership

For the purposes of this analysis, Arkansas is classified into primary land use groups based on coverage type as forest and woodlands, agricultural, and developed land. Land ownership within Arkansas is classified into four main categories: private, federal, state, and tribal land.

Land Use

Table 4.1.7-1 identifies the major land uses in Arkansas. Forest and woodlands comprise the largest portion of land use, with 58 percent of the land area in Arkansas occupied by this category. Agriculture is the second largest area of land use, with 35 percent of the total land area. Developed areas account for approximately five percent of the total land area in Arkansas. The remaining percentage of land (2 percent) includes public land and other land covers, shown in Figure 4.1.7-1 that are not associated with specific land uses (USGS, 2017).

Table 4.1.7-1: Major Land Uses in Arkansas by Coverage Type

Land Use	Square Miles	Percent of Land
Forest and Woodland	30,161	58%
Agricultural Land	18,315	35%
Developed Land	2,512	5%
Other	1,047	2%

Source: (USGS, 2017)

Forest and Woodland

Forest and woodland areas are throughout the state (58 percent of total land area), many of which are interspersed with, and adjacent to, agricultural areas. The largest concentrations of forest are throughout the western and central portions of the state within the Ozark Plateau (rugged, forested hills in northwest region), Arkansas River Valley (sporadic evergreen cover in south region), Ouachita Mountains (pine forests in west-central region), and West Gulf Coastal Plain (pine forests in south-west region) (Figure 4.1.7-1). (USGS, 2017) Section 4.1.6 presents additional information about terrestrial vegetation.

National Forests

National forests in Arkansas comprise approximately 12 percent of the state’s total forestland, and include three national forests: Ozark, Ouachita, and Saint Francis National Forests. These National Forests occur in the west and central portions (Ozark and Ouachita National Forests) and eastern portion (Saint Francis National Forest) of the state, covering 3,735 square miles. The

forests are managed for multiple uses and values, including recreation activities (e.g., camping, hiking), timber production, and maintenance of fish and wildlife habitat.

State Forests

The Arkansas Forestry Commission manages the Poison Springs State Forest, which is a 34-square mile pine forest in the south-central portion of the state. The forest is managed for multiple uses and values, including timber production, recreation, research, and water quality and wildlife habitat protection (Arkansas Forestry Commission, 2015b).

Private Forest and Woodland

The large majority of Arkansas's forest and woodlands (approximately 85 percent) are owned by private landowners and companies (USGS, 2014f). Private forestlands indirectly provide some public benefit, including forest products, wildlife habitat, scenic beauty, and outdoor recreation opportunities. Scattered throughout the state, forests and woodlands on private lands often border agricultural fields, suburban neighborhoods, and national forests. For additional information regarding forest and woodland areas, see Section 4.1.6, Biological Resources, and Section 4.1.8, Visual Resources.

Agricultural Land

Agricultural land exists throughout the state on 18,315 square miles (35 percent of total land area) (Figure 4.1.7-1) (USGS, 2017). Approximately 45,071 farms exist in Arkansas, with an average size of 0.5 square miles (USDA, Census of Agriculture, 2012a). Arkansas's top agricultural products (by total agricultural receipts) are grains, oilseeds, beans, and peas (43 percent); poultry and eggs (41 percent); cattle and calves (8 percent); and cotton and cottonseed (5 percent) (USDA, Census of Agriculture, 2012b).

Developed Land

Developed land in Arkansas is concentrated within major metropolitan areas and surrounding cities, towns, and suburbs (Figure 4.1.7-1). Although only five percent of Arkansas land is developed, these areas are highly utilized for residential, commercial, industrial, recreational, and government purposes. Table 4.1.7-2 lists the top five developed metropolitan areas within the state and their associated population estimates.

Table 4.1.7-2: Top Five Developed Metropolitan Areas

Metropolitan Area	Population Estimate
Little Rock, AR	431,388
Fayetteville/Springdale/Rogers, AR-MO	295,081
Fort Smith, AR-OK	120,714
Jonesboro, AR	65,419
Conway, AR	65,277
Total Population of Metropolitan Areas	977,879
Total Estimated State Population	2,966,369

Source: (U.S. Census Bureau, 2010) (U.S. Census Bureau, 2015b), (U.S. Census Bureau, 2016a)

^a Estimated 2016 population of 2,988,248

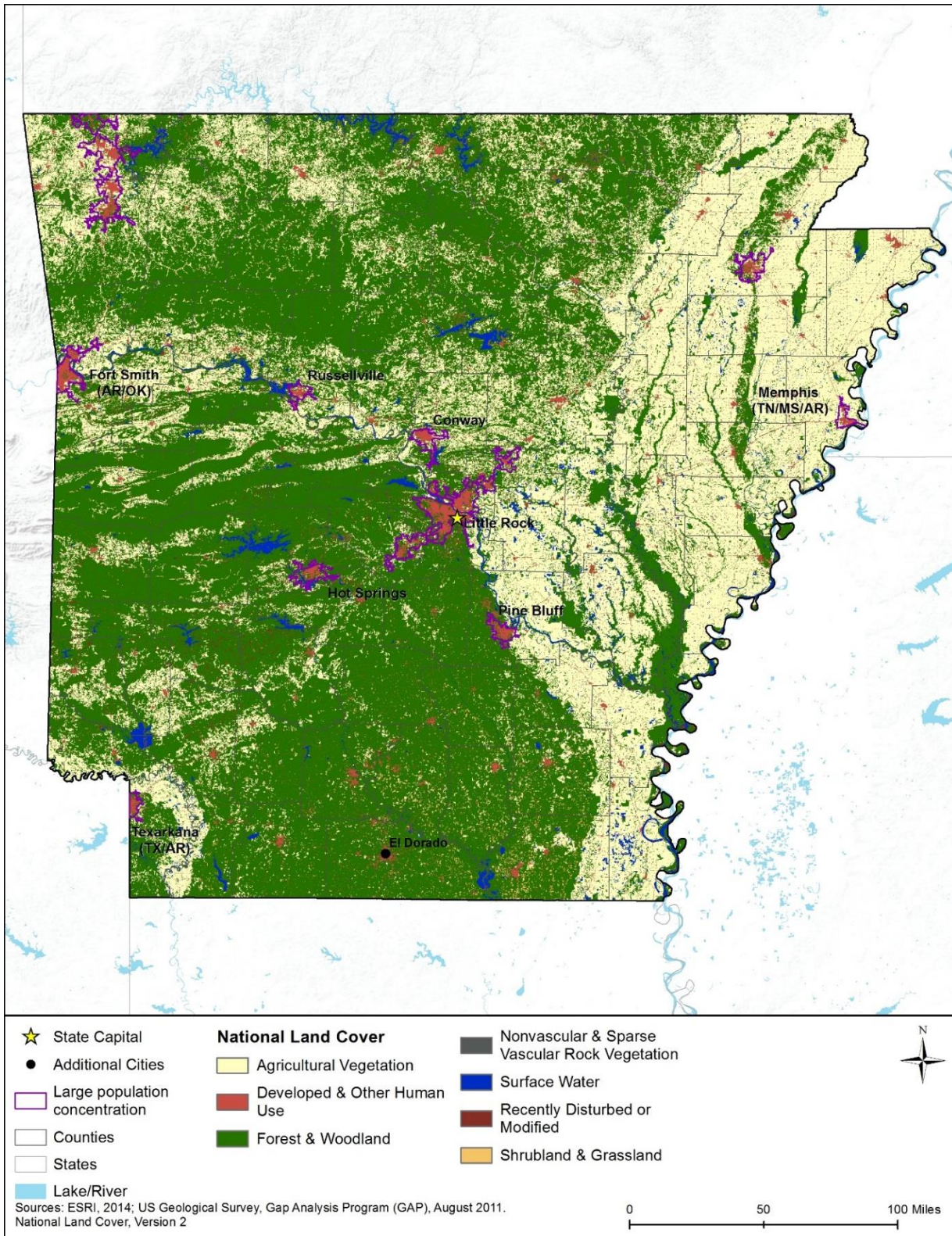


Figure 4.1.7-1: Major Land Use Distribution by Coverage Type

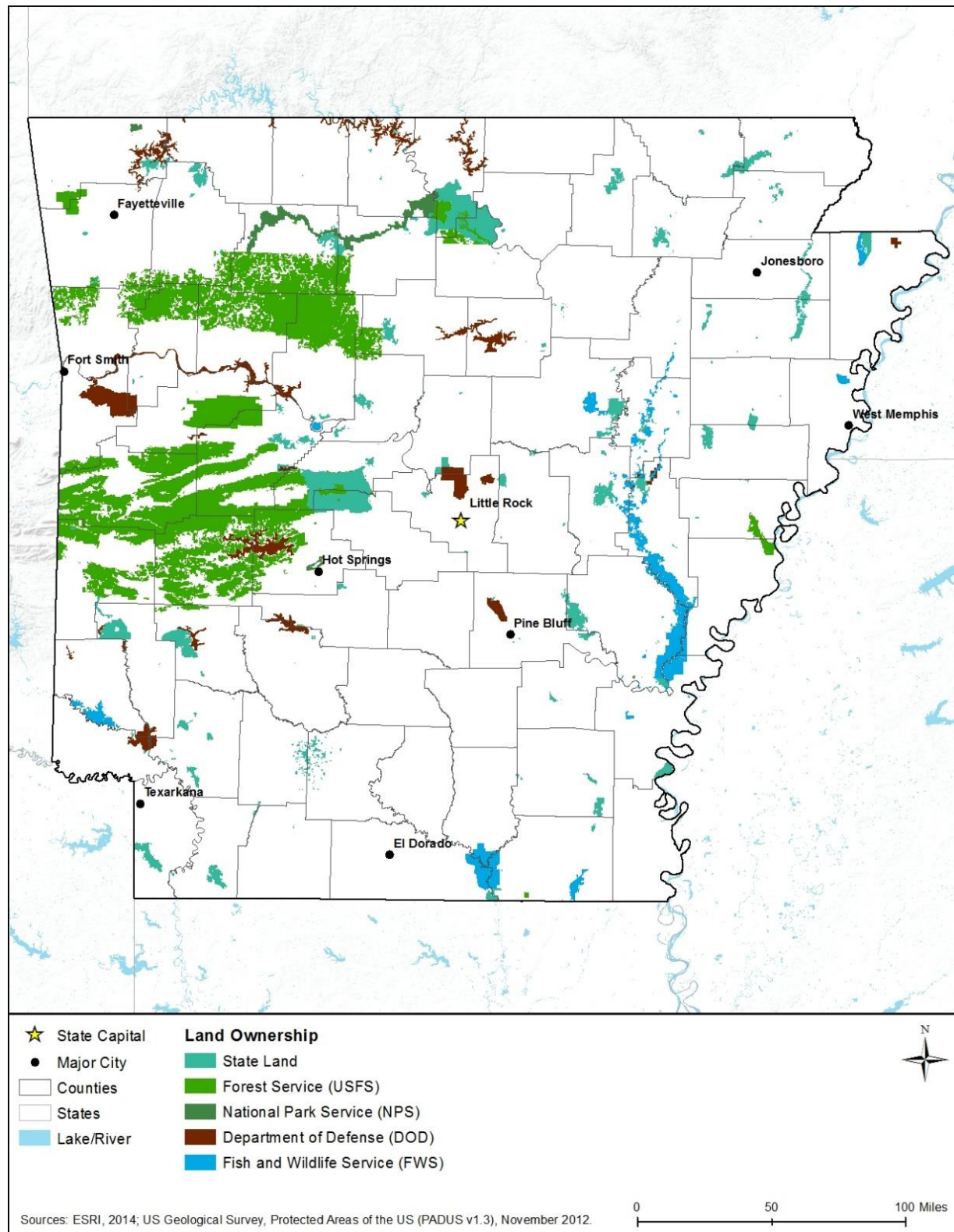


Figure 4.1.7-2: Land Ownership Distribution

Land Ownership

Land ownership within Arkansas has been classified into four main categories: private, federal, state, and tribal (Figure 4.1.7-2).⁹³

Private Land

The majority of land in Arkansas is privately owned (approximately 47,000 square miles or 90 percent of the total land in the state) (Figure 4.1.7-2), with most of this land falling under the land use categories of agricultural, forest and woodland, and developed (Figure 4.1.7-1). Highly developed, urban, metropolitan areas transition into suburban, agriculture, shrub, and woodland areas, which then transition into more wild and remote areas.

Federal Land

The federal government manages 5,142 square miles, or approximately ten percent, of land in Arkansas, including national forests, national wildlife refuges (NWRs), and military facilities (Figure 4.1.7-2) (USGS, 2014g). Four federal agencies manage the majority of federal lands throughout the state (Table 4.1.7-3 and Figure 4.1.7-2). There may be other federal lands, but they are not shown on the map due to their small size relative to the entire state. Some federal agencies only have small areas of federal lands scattered throughout the state⁹⁴ (USGS, 2014f).

Table 4.1.7-3: Federal Land in Arkansas

Agency ^a	Square Miles	Representative Type
US Forest Service	3,732	Forests and Wilderness
Department of Defense	682	Military Installations
USFWS	563	Wildlife Refuges
National Park Service	165	Park, River, Memorial and Military Park

Source: (USGS, 2014f)

^a Table identifies land wholly managed by the Agency; additional properties may be managed by or affiliated with the Agency.

- The US Forest Service (USFS) manages 3,732 square miles of land comprised of three national forests: Ozark, Ouachita, and Saint Francis National Forests (USGS, 2014f).
- The Department of Defense (including the USACE) manages 682 square miles of land and surface water. This includes Little Rock Air Force Base, Fort Chaffee, Camp Joseph T. Robinson, Pine Bluff Arsenal, the Cache River Mitigation Project, DeQueen Reservoir, and 12 lakes (Beaver, Bull Shoals, Norfolk, Ozark, Greers Ferry, Dardanelle, Blue Mountain, Ouachita, DeGray, Greeson, Gillham, and Millwood Lakes) (USGS, 2014f). The USACE manages 28 recreation areas within Arkansas (USACE, 2015c).

⁹³ Land ownership data were retrieved from the Protected Areas Database of the United States (PAD-US), produced by USGS (<http://gapanalysis.usgs.gov/padus/>). This dataset categorizes lands across the U.S. by conservation, land management, planning, recreation, and ownership, as well as other uses. It is an extensive dataset that contains large quantities of information relevant to the Proposed Action. The data was queried to show Owner and used USGS' PAD-US ownership symbolization for consistency. The PADUS 1.3 geodatabase was downloaded in the summer of 2015, and used consistently throughout all these maps for each state and D.C.

⁹⁴ Not all federal agency land is depicted in Figure 4.1.7-2 given the small size of some of the land acreage.

- The USFWS manages 563 square miles of land composed of ten NWRs: Holla Bend, Pond Creek, Felsenthal, Logan Cave, Overflow, White River, Cache River, Bald Knob, Wapanocca, and Big Lake NWRs (USGS, 2014f).
- The National Park Service (NPS) manages 165 square miles of land and surface water containing natural, historic, cultural, visual, ecological, and recreational resources of significance to the nation. In Arkansas, there are seven NPS units and one affiliated area. This includes Hot Springs National Park (Figure 4.1.8-2), Arkansas Post National Memorial, Buffalo National River, Fort Smith National Historic Site, Little Rock Central High School National Historic Site, Pea Ridge National Military Park, President William Jefferson Clinton Birthplace Home National Historic Site, and the Trail of Tears National Historic Trail. (NPS, 2015b) (USGS, 2014f)

State Land⁹⁵

Arkansas owns and manages approximately 1,224 square miles of land, or two percent of the total land in the state (Figure 4.1.7-2). The Arkansas Forestry Commission manages the Poison Springs State Forest, which is a 34-square mile pine forest in the south-central portion of the state. The forest is managed for multiple uses and values, including timber production, recreation, research, and water quality and wildlife habitat protection (Arkansas Forestry Commission 2015a). The remaining areas of state land primarily occur in 52 state parks, scattered across the state and managed by the Arkansas Department of Parks and Tourism (Arkansas Department of Parks & Tourism, 2015b).

Tribal Land

There are no federally recognized American Indian Tribes or reservations in Arkansas.

4.1.7.4. Recreation

Two mountain ranges, the Ozarks and the Ouachita in north and central Arkansas, as well as the Mississippi River, which makes up its eastern border, characterize Arkansas. Recreational activities within the state focus these resources: hiking, mountain climbing, fishing, and water activities are popular. On the community level, towns, cities, and counties provide an assortment of indoor and outdoor recreational facilities, including athletic fields and courts, playgrounds, picnicking areas, indoor and outdoor pools, and dog runs. Availability of community-level facilities is typically commensurate to the population's needs.

This section discusses recreational opportunities available at various locations throughout Arkansas. For information on visual resources, see Section 4.1.8, Visual Resources, and for information on the historical significance of locations, see Section 4.1.11, Cultural Resources.

⁹⁵ State land use data for tables and narrative text were derived from specific state sources and may not correspond directly with USGS data that was used for developing maps and figures.

Northern Region

Missouri border Arkansas's Northern Region to the north and Oklahoma to the west (see Figure 4.1.7-3).⁹⁶ The Northern Region is made up of the Ozark Mountains and the Ozark Plateau. The Ozark National Forest is known for recreational areas including White Rock Mountain, the Glory Hole Waterfall and Trail, and Blanchard Springs Caverns. The Ozark Highlands Trail, considered one of the most important trails in the Midwest, is a 196-mile trail crossing the Ozark National Forest from the Oklahoma border to the Buffalo National River. Activities within the forest include: hiking, bicycling, horseback riding, caving, rock climbing, and other trail use; rock hounding; camping and picnicking; lake and river fishing, boating, swimming, beachcombing, and other water activities; and licensed, seasonal big game, small game, game bird, and waterfowl hunting. (USFS, 2015c)

Central Region

The Central Region is bordered to the west by Oklahoma, and consists of the Arkansas River Valley and the Ouachita Mountains (see Figure 4.1.7-3). The Hot Springs National Park is known for the 47 hot springs out of Hot Spring Mountain; although the spring water is too hot for bathing, historic bathhouses provide traditional baths or spa facilities. Other activities within the park include hiking, picnicking, and camping. (NPS, 2015c)

The Ouachita National Forest is mostly in Central Arkansas, with some lands in Oklahoma, encompassing the majority of the Ouachita Mountains. Activities within the forest include hiking, bicycling, horseback riding, and other trail use; rock hounding and mineral collection; camping and picnicking; lake and river fishing, boating, swimming, and other water activities; and licensed, seasonal small game, game bird, and waterfowl hunting. (USFS, 2015b)

Southern Region

Southern Arkansas, with its rolling hills, is bordered by Oklahoma and Texas to the west and Louisiana to the south (see Figure 4.1.7-3). State parks in this region are known for fishing; historic and other museums are also prevalent in the Southern Region.

White Oak Lake State Park has a marina for boating and fishing, hiking and bicycling, and wildlife viewing (State Parks of Arkansas, 2015b). Moro Bay State Park is a popular fishing and water sport area, with a marina, camping, and picnicking (State Parks of Arkansas, 2015c).

Logoly State Park is the state's first educational park, specializing in ecological and environmental workshops, with a visitor's center and indoor classrooms (State Parks of Arkansas, 2015d). The South Arkansas Arboretum features native coastal plain plant species, and has paved walking trails and picnic facilities (State Parks of Arkansas, 2015e). The

⁹⁶ Recreational area data was retrieved from the Protected Areas Database of the United States (PAD-US), produced by USGS (<http://gapanalysis.usgs.gov/padus/>). This dataset categorizes lands across the U.S. by conservation, land management, planning, recreation, and ownership, as well as other uses. It is an extensive dataset that contains large quantities of information relevant to the Proposed Action. The data was queried to show the Primary Designation Type of area. To show these in the map, recognizable symbols (e.g., varying shades of green for National Parks and Forests) were used as PAD-US does not have a standard symbolization for recreational resources. The PADUS 1.3 geodatabase was downloaded in the summer of 2015, and used consistently throughout all these maps for each state and D.C.

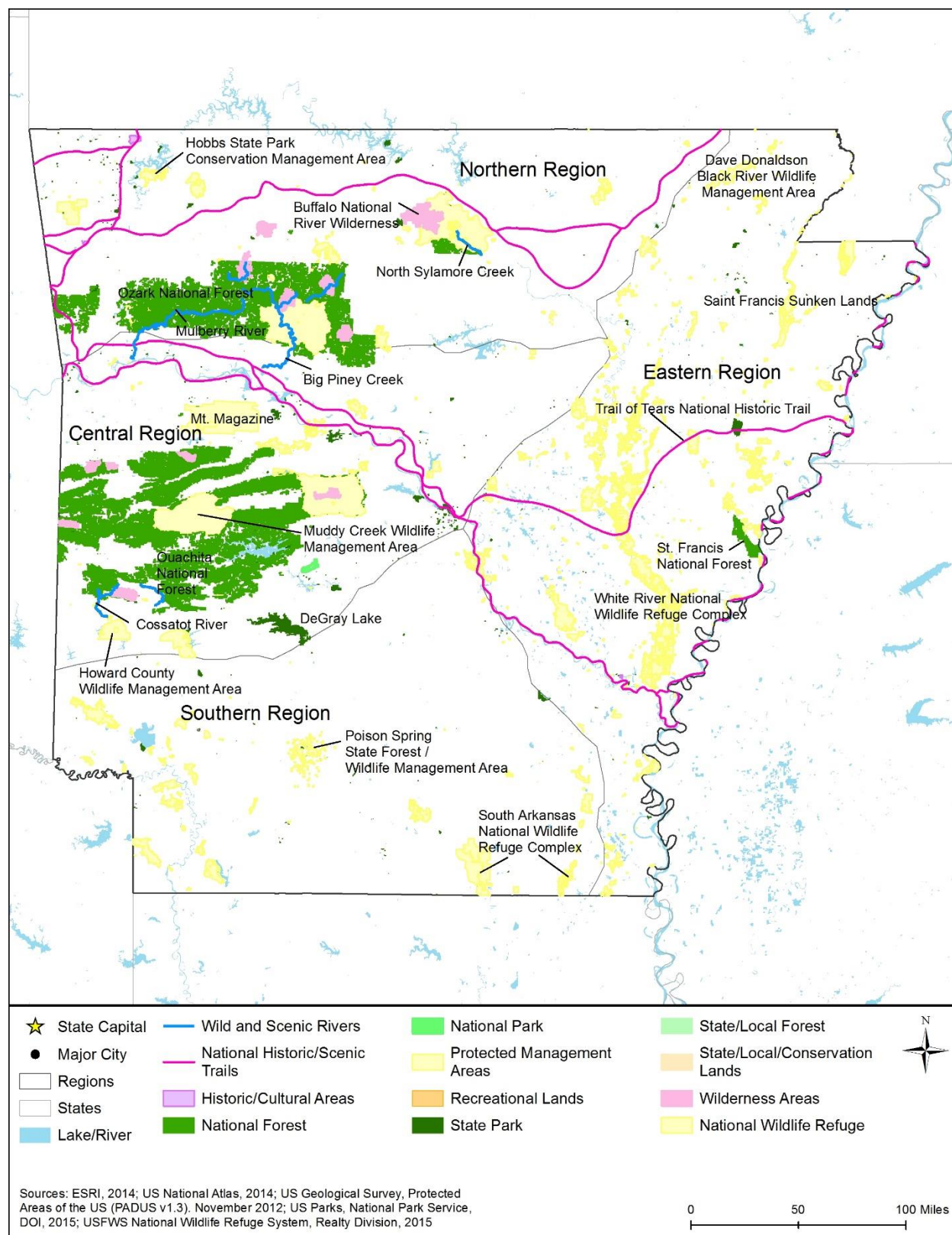


Figure 4.1.7-3: Arkansas Recreation Resources

Arkansas Museum of Natural Resources focuses on oil and brine, two of Arkansas's natural resources, as well as the state's oil boom history in the 1920s (State Parks of Arkansas, 2015f). Poison Springs Battleground, Marks' Mills Battleground, and Jenkins Ferry Battleground State Parks commemorate Civil War battles; the parks all have both exhibits and picnic sites, Jenkins Ferry also has swimming and boating (State Parks of Arkansas, 2015g) (State Parks of Arkansas, 2015h) (State Parks of Arkansas, 2015i).

Eastern Region

Arkansas's Eastern Region stretches along the Mississippi River the length of the state, bordered to the north by Missouri and to the south by Louisiana (see Figure 4.1.7-3). The region consists of the Mississippi River Alluvial Plain with few elevated areas.

The St. Francis National Forest is known for the Bear Creek Reservoir and the St. Francis Walk-in Turkey Hunting Area. Activities within the forest include hiking and other trail use; camping and picnicking; lake and river fishing, kayaking and canoeing, swimming, beachcombing, and other water activities; and licensed, seasonal game bird hunting. (USFS, 2015d)

State parks in the Eastern Region cater to the recreational needs of both locals and tourists. The Delta Heritage Trail State Park, part of the national Rails to Trails initiative, is being developed along the Union Pacific Railroad, and is currently a bicycle and pedestrian trail with a visitor's center and wildlife viewing locations (State Parks of Arkansas, 2015j). Lake Chicot State Park has fishing, boating, and birdwatching throughout the year (State Parks of Arkansas, 2015a). Crowley's State Park is visited for camping, picnicking, multi-use trails, as well as a lake for fishing and a lake for swimming and other water-based recreation (Arkansas Department of Parks & Tourism, 2015b).

4.1.7.5. *Airspace*

The FAA uses the NAS to provide for aviation safety. The NAS includes Special Use Airspace (SUA) consisting of Restricted Areas, Warning Areas, and Military Operation Areas (MOAs). The FAA controls the use of the NAS with various procedures and practices (such as established flight rules and regulations, airspace management actions, and air traffic control procedures) to ensure the safety of aircraft and protection of the public.

Airspace Categories

There are two categories of airspace or airspace areas:

1. Regulatory airspace consists of controlled airspace (Class A, B, C, D, and E airspace areas in descending order of restrictive operating rules), and restricted and prohibited areas.
2. Non-regulatory airspace consists of MOAs, warning areas, alert areas, and controlled firing areas.

Within each of these two categories, there are four types of airspace: controlled, uncontrolled, special use, and other airspace. The categories and types of airspace are dictated by the complexity or density of aircraft movements, the nature of the operations conducted within the airspace, the level of safety required, and the national and public interest. Figure 4.1.7-4 depicts

the different classifications and dimensions for controlled airspace. Air Traffic Control (ATC)⁹⁷ service is based on the airspace classification (FAA, 2008).

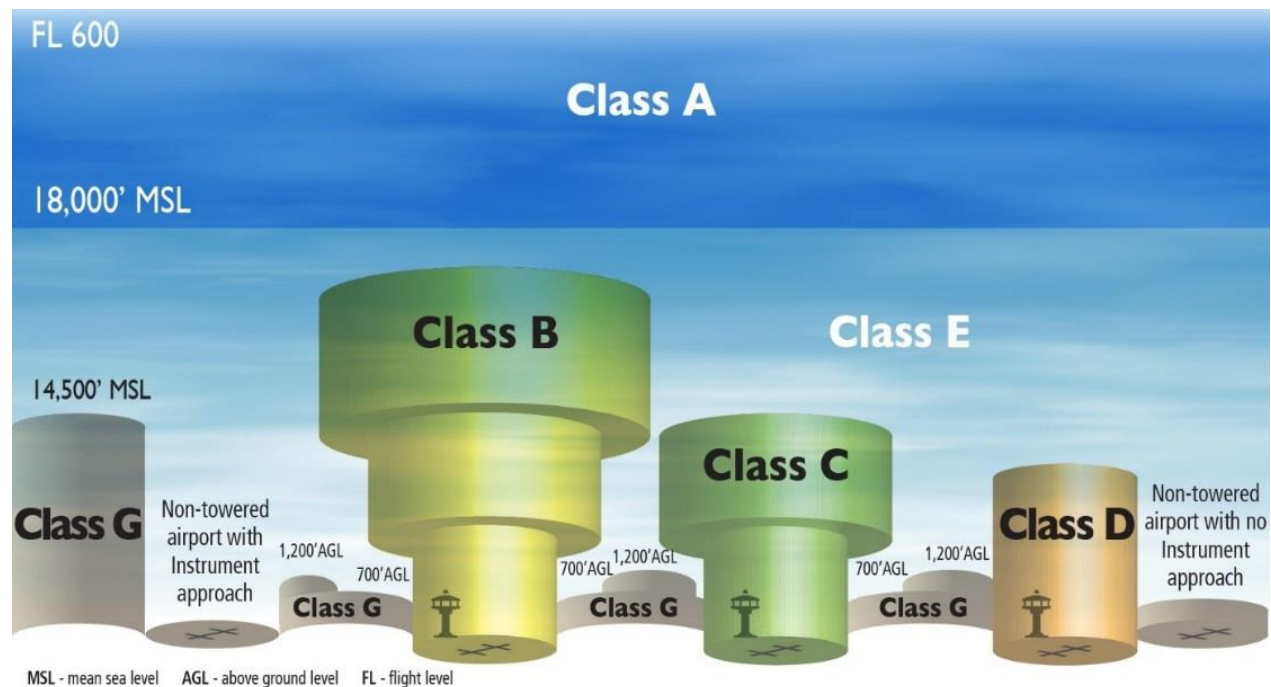
Controlled Airspace

- **Class A:** Airspace from 18,000 feet to 60,000 feet Mean Sea Level (MSL)⁹⁸. Includes the airspace over waters off the U.S. coastlines (48 contiguous States and Alaska) within 12 Nautical Miles (NM). All operations must be conducted under Instrument Flight Rules (IFR).⁹⁹
- **Class B:** Airspace from the surface, up to 10,000 feet MSL, near the busiest airports with heavy traffic operations. The airspace is tailored to the specific airport in several layers. An ATC clearance is required for all aircraft to operate in this area.
- **Class C:** Airspace from the surface to 4,000 feet above the airport elevation surrounding the airport. Applies to airports with an operational control tower, serviced by a radar approach control, and certain number of IFR operations or total number of passengers boarding aircrafts. Airspace is tailored in layers, but usually extends out to 10 NM from 1,200 feet to 4,000 feet above the airport elevation. Entering Class C airspace requires radio contact with the controlling ATC authority, and an ATC clearance is ultimately required for landing.
- **Class D:** Airspace from the surface to 2,500 feet above the airport elevation surrounding airports with an operational control tower. Airspace area is tailored. Aircraft entering the airspace must establish and maintain radio contact with the controlling ATC.
- **Class E:** Controlled airspace not designated as Class A, B, C, or D. Class E airspace extends upward from the surface or a designated altitude to the overlying or adjacent controlled airspace (FAA, 2008).

⁹⁷ ATC – Approved authority service to provide safe, orderly, and expeditious flow of air traffic operations. (FAA, 2015c)

⁹⁸ MSL – The average level of for the surface of the ocean; “The height of the surface of the sea midway between the average high and low tides.” (Merriam Webster Dictionary, 2015b).

⁹⁹ IFR – Rules for the conduct of flights under instrument meteorological conditions (FAA, 2015c).



Source: Derived from (FAA, 2008)

Figure 4.1.7-4: National Air Space Classification Profile

Uncontrolled Airspace

Class G: No specific definition. Refers generally to airspace not designated as Class A, B, C, D, or E. Class G airspace is from the surface to the base of Class E airspace.

Special Use Airspace

SUA designates specific airspace that confines or imposes limitations on aircraft activities (See Table 4.1.7-4).

Table 4.1.7-4: SUA Designations

SUA Type	Definition
Prohibited Areas	“Airspace of defined dimensions identified by an area on the surface of the earth within which the flight of aircraft is prohibited. Such areas are established for security or other reasons associated with the national welfare. These areas are published in the Federal Register and are depicted on aeronautical charts.”
Restricted Areas	“Airspace identified by an area on the surface of the earth within which the flight of aircraft, while not wholly prohibited, is subject to restrictions. Activities within these areas must be confined because of their nature or limitations imposed upon aircraft operations that are not a part of those activities or both. Restricted areas denote the existence of unusual, often invisible, hazards to aircraft such as artillery firing, aerial gunnery, or guided missiles. Penetration of restricted areas without authorization from the using or controlling agency may be extremely hazardous to the aircraft and its occupants. Restricted areas are published in the Federal Register and constitute 14 CFR Part 73.”
Warning Areas	“Airspace of defined dimensions, extending from three NM from the U.S. coast, which contains activity that may be hazardous to nonparticipating aircraft. The purpose of such warning areas is to warn non-participating pilots of the potential danger. A warning area may be located over domestic or international waters or both.”
MOAs	“Airspace of defined vertical and lateral limits established for separating certain military activities (e.g., air combat maneuvers, air intercepts, testing, etc.) from IFR traffic. Whenever an MOA is in use, non-participating IFR traffic may be cleared through a MOA if IFR separation can be provided by ATC. Otherwise, ATC will reroute or restrict nonparticipating IFR traffic.”
Alert Areas	“Depicted on aeronautical charts to inform non-participating pilots of areas that may contain a high volume of pilot training or an unusual type of aerial activity. Pilots should be particularly alert when flying in these areas. All activity within an alert area must be conducted in accordance with CFRs, without waiver, and pilots of participating aircraft and pilots transiting the area are responsible for collision avoidance.”
Controlled Firing Areas (CFAs)	“Activities that, if not conducted in a controlled environment, could be hazardous to nonparticipating aircraft. The distinguishing feature of the CFA, as compared to other special use airspace, is that its activities are suspended immediately when spotter aircraft, radar, or ground lookout positions indicate an aircraft might be approaching the area. There is no need to chart CFAs since they do not cause a nonparticipating aircraft to change its flight path.”
National Security Areas (NSA)	“Airspace of defined vertical and lateral dimensions established at locations where there is a requirement for increased security and safety of ground facilities. Pilots are requested to voluntarily avoid flying through the depicted NSA. When it is necessary to provide a greater level of security and safety, flight in NSAs may be temporarily prohibited by regulation under the provisions of 14 CFR Section 99.7. Regulatory prohibitions are issued by System Operations, System Operations Airspace and Aeronautical Information Manual Office, Airspace and Rules, and disseminated via Notices to Airmen (NOTAM). Inquiries about NSAs should be directed to Airspace and Rules.”

Source: (FAA, 2015c) (FAA, 2008)

Other Airspace Areas

Other airspace areas, explained in Table 4.1.7-5, include Airport Advisory, Military Training Routes (MTRs), Temporary Flight Restrictions (TFRs), Parachute Jump Aircraft Operations, published Visual Flight Rules (VFR) and IFRs, and Terminal Radar Service Areas.

Table 4.1.7-5: Other Airspace Designations

Type	Definition
Airport Advisory	There are three types: • Local Airport Advisory – Operated within 10 statute miles of an airport where there is a Flight Service Station located on an airport, but no operational control tower. The Flight Service Station advises the arriving and departing aircraft on particular conditions. • Remote Airport Advisory – Operated within 10 statute miles for specific high activity airports with no operational control tower. • Remote Airport Information Service – Used for short-term special events.
MTRs	MTRs are for use by the military for training, specifically low level combat tactics where low altitudes and high speed are needed.
TFRs	TFRs are established to: • Protect people and property from a hazard; • Provide safety for disaster relief aircraft during operations; • Avoid unsafe aircraft congestion associated with an incident or public interest event; • Protect the U.S. President, Vice President, and other public figures; • Provide safety for space operations; and • Protect in Hawaii declared national disasters for humanitarian reasons. Only those TFRs annotated with an ending date and time of “permanent” are included in this Final PEIS, since it indicates a longer, standing condition of the airspace. Other TFRs are typically a shorter duration of for a one-time specific event.
Parachute Jump Aircraft Operations	Parachute jump area procedures are in 14 CFR Part 105, while the U.S. parachute jump areas are contained in the regional Airport/Facility Directory.
Published VFRs and IRs	These are established routes for moving around and through complex airspace, like Class B airspace. VFRs are procedures used to conduct flights under visual conditions. IFRs are procedures used to conduct flights with instruments and meteorological conditions.
Terminal Radar Service Areas	Airspace areas that are not one of the established U.S. airspace classes. These areas provide additional radar services to pilots.

Sources: (FAA, 2015c) (FAA, 2008)

4.1.7.6. Aerial System Considerations

Unmanned Aircraft Systems

Unmanned Aircraft Systems (UASs) are widely used by the military, private entities, public service, educational institutions, federal/state/local governments, and other agencies. The FAA’s Unmanned Aircraft Systems Integration Office integrates UAS into the NAS. The *Integration of Civil Unmanned Aircraft Systems (UAS) in the National Airspace System (NAS) Roadmap of 2013* addresses the actions and considerations needed to integrate UAS into the NAS “without reducing existing capacity, decreasing safety, negatively impacting current operators, or increasing the risk to airspace users or persons and property on the ground any more than the integration of comparable new and novel technologies” (FAA, 2013 First Edition).

UAS at airports is a complex operational challenge with the need to separate UAS flight operations from mainstream air traffic. Separation can be achieved with specific UAS launch windows, special airports, or off-airport locations that allow the UAS to easily launch and recover. Special aviation procedures are applied to UAS flights. There must be the capability of Sense and Avoid and Control and Communication (C2) during UAS operations. An Unmanned Aircraft (UA) must be able to see (or sense) other aircraft in the area and avoid the aircraft

through corrected flight path changes. General equipment and operational requirements can include aircraft anti-collision lights, an altitude encoding transponder, cameras, sensors, and collision avoidance maneuvers. The C2 of the UA occurs with the pilot/operator, the UAS control station, and ATC. Research efforts, a component of the FAA's UAS roadmap, continue to mature the technology for both Sense and Avoid and C2 capabilities.

Balloons

Moored balloons and unmanned free balloons cannot be operated in a prohibited or restricted area unless approval is obtained from the controlling agency. Balloons also cannot be operated if they pose a hazard to people and their property.

4.1.7.7. Obstructions to Airspace Considerations

The Airports Division of the FAA is responsible for the evaluation and analysis of proposed construction or alterations on airports. The FAA Air Traffic Office is responsible for determining obstructions to air navigation as a result of construction off airports that may affect the safe and efficient use of navigable airspace and the operation of planned or existing air navigation and communication facilities. Such facilities include air navigation aids, communication equipment, airports, federal airways, instrument approach or departure procedures, and approved off-airway routes. An Obstruction Evaluation and Airport Airspace Analysis (OE/AAA) is required when there is the potential for airport construction/alteration of a facility that may impinge upon the NAS. Per 14 CFR Part 77.9, the FAA is to be notified about construction or alterations when:

- “Any construction or alteration exceeding 200 feet above ground level.
- Any construction or alteration:
 - within 20,000 feet of a public use or military airport which exceeds a 100:1 surface from any point on the runway of each airport with its longest runway more than 3,200 feet
 - within 10,000 feet of a public use or military airport which exceeds a 50:1 surface from any point on the runway of each airport with its longest runway no more than 3,200 feet
 - within 5,000 feet of a public use heliport which exceeds a 25:1 surface
- Any highway, railroad, or other traverse way whose prescribed adjusted height would exceed the above noted standards
- When requested by the FAA
- Any construction or alteration located on a public use airport or heliport regardless of height or location” (FAA, 2015d).

Construction or alternative facilities (such as towers) that are subject to FCC licensing requirements are also required to have an OE/AAA performed by the FAA Airport Division.

4.1.7.8. Arkansas Airspace

The Arkansas Department of Aeronautics mission is to “create a safer, more desirable atmosphere for the Pilot and at the same time, create, and improve airports to better serve Arkansas communities and industry” (Arkansas Department of Aeronautics, 2015). The Department is responsible for aviation safety, licensing of airports and air navigation facilities,

planning oversight for airport infrastructure, and serving as liaison to federal and state agencies. There is one FAA FSDO for Arkansas located in Little Rock (FAA, 2015b) .

Arkansas airports are classified as those included in the State Aviation System Plan (SASP) and those that are not part of the SASP. The SASP addresses the strategic planning and future development for the state’s airport system, as well as addressing key associated with their airports. (National Association of State Aviation Officials, 2015) Figure 4.1.7-5 presents the different aviation airports/facilities residing in Arkansas, while Figure 4.1.7-6 and Figure 4.1.7-7 present the breakout by public and private airports/facilities. There are approximately 306 airports within Arkansas as presented in Table 4.1.7-6 and Figure 4.1.7-6 through Figure 4.1.7-7 (DOT, 2015).

Table 4.1.7-6: Type and Number of Arkansas Airports/Facilities

Type of Airport or Facility	Public	Private
Airport	101	119
Heliport	0	80
Seaplane	0	0
Ultralight	0	4
Balloonport	0	0
Gliderport	0	2
Total	101	205

Source: (DOT, 2015)

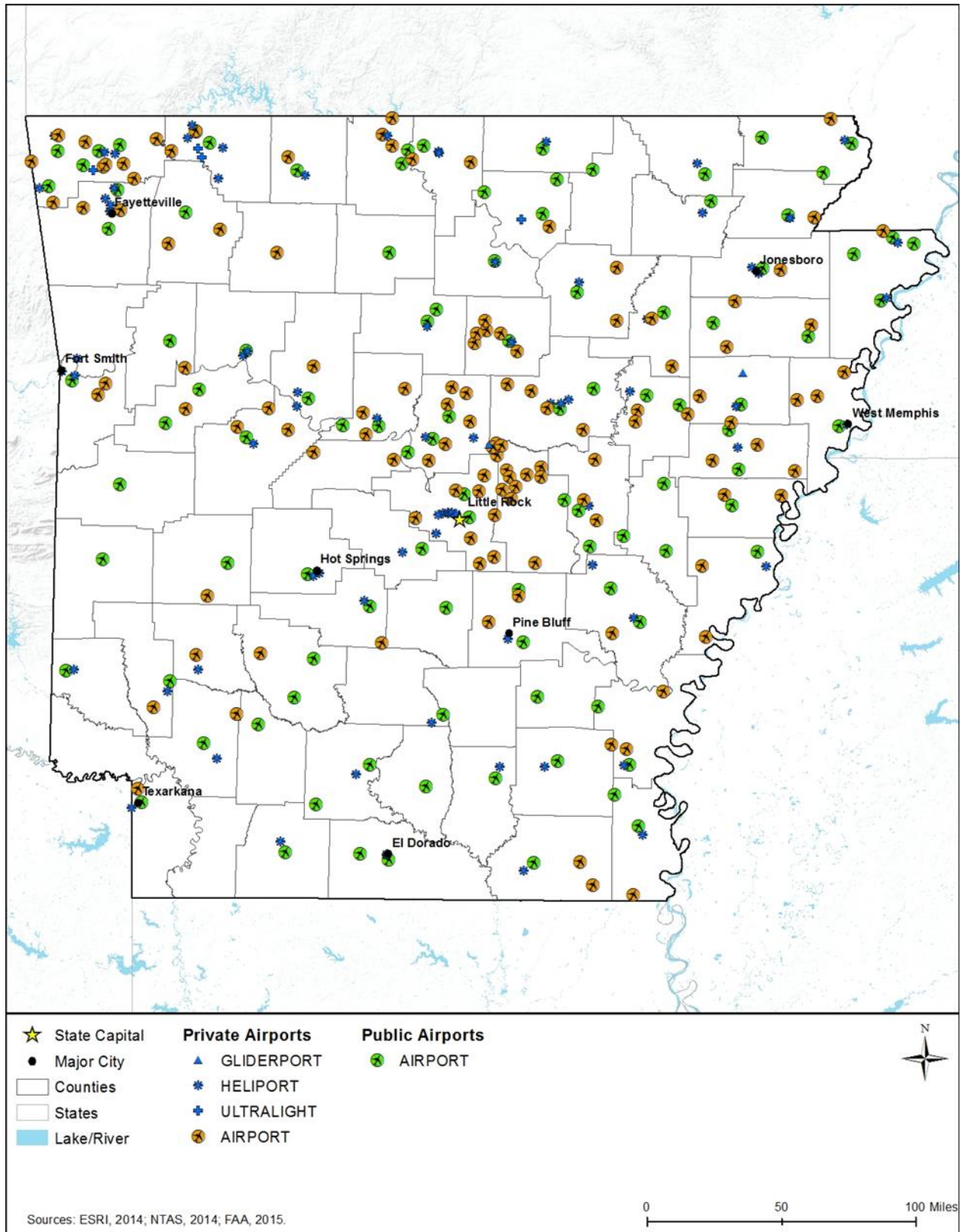


Figure 4.1.7-5: Composite of Arkansas Airports/Facilities

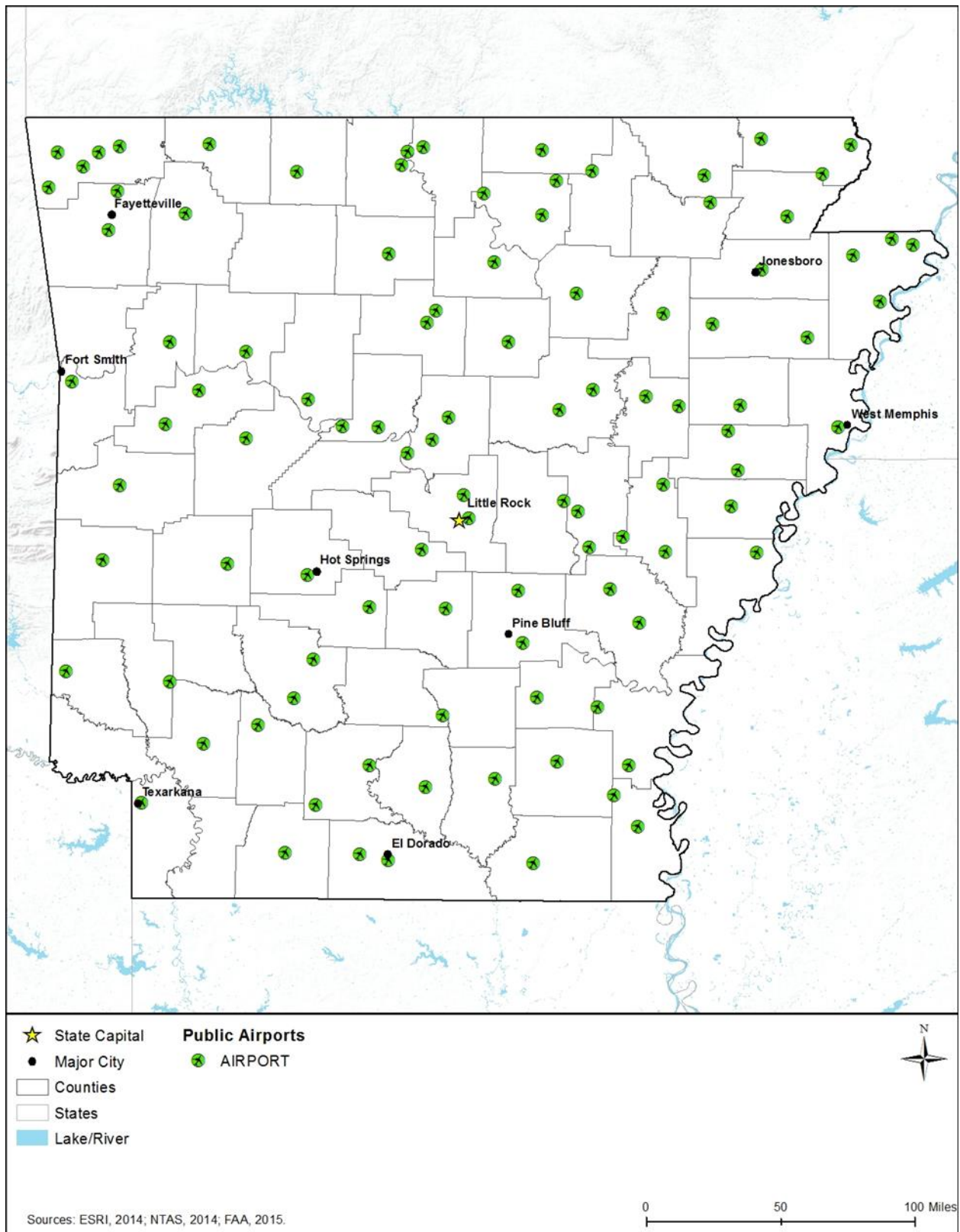


Figure 4.1.7-6: Public Arkansas Airports/Facilities

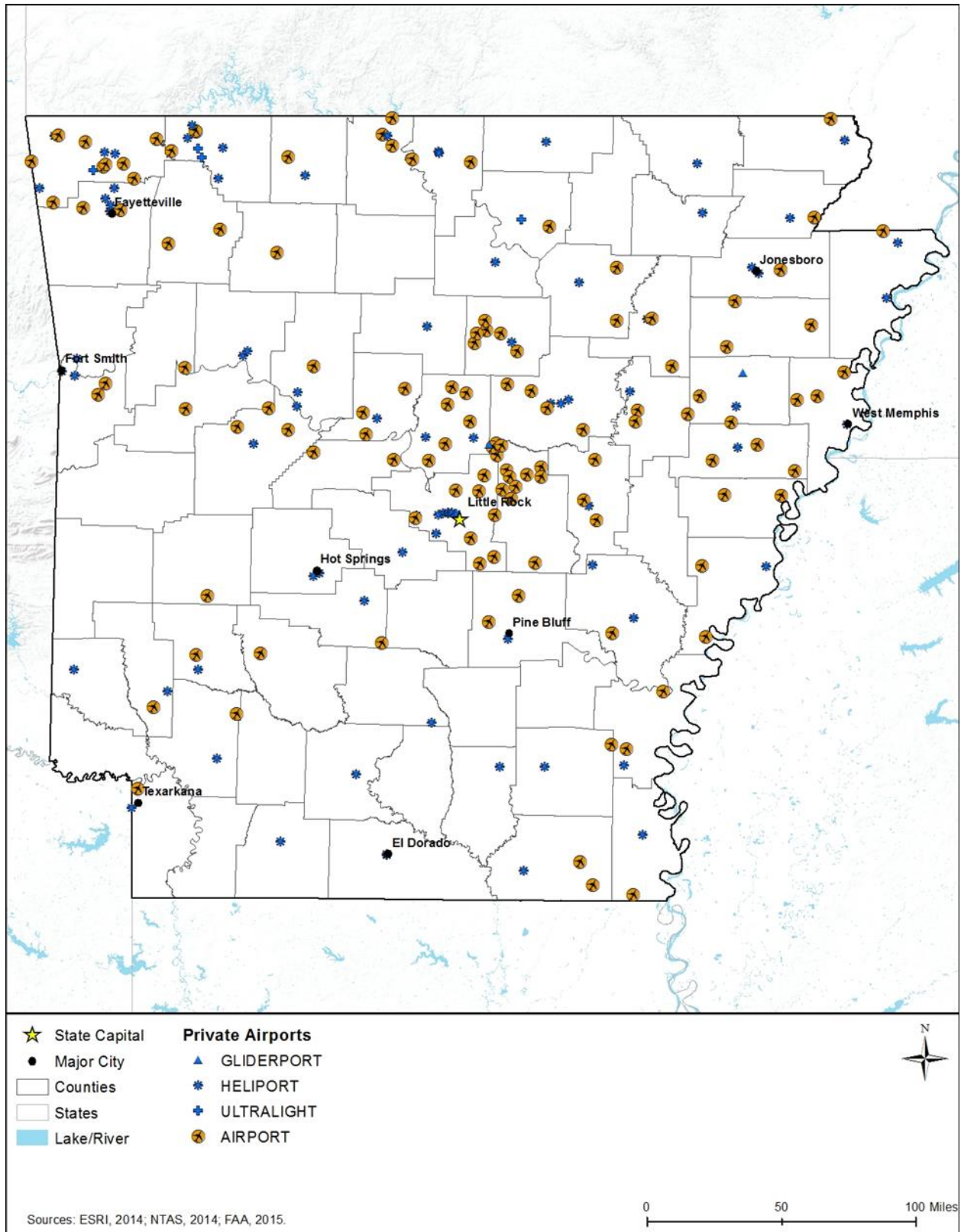


Figure 4.1.7-7: Private Arkansas Airports/Facilities

There are Class C and D controlled airports for Arkansas as follows:

- Two Class C –
 - Little Rock, Adams Field
 - Northwest Arkansas Regional Airport
- Six Class D –
 - Fayetteville, Drake Field
 - Fort Smith Municipal
 - Little Rock Air Force Base
 - Rogers Municipal/Carter Field, Rogers
 - Springdale Municipal
 - Texarkana Regional Webb Field (FAA, 2014b)

SUAs (i.e., seven restricted and ten MOAs) located in Arkansas are as follows:

- Fort Chaffee (Restricted)
 - R-2401A Surface to but not including 30,000 feet MSL
 - R-2401B Surface to and including 30,000 feet MSL
 - R-2402A Surface to and including 30,000 feet MSL
 - R-2402B 10,000 feet MSL to, but not including, FL 220
 - R2402C 13,000 feet MSL to, but not including, FL 220
- Little Rock (Restricted)
 - R-2403A Surface to 16,000 MSL
 - R- 2403B Surface to 16,000 MSL (FAA, 2015e)

The ten MOAs for Arkansas are as follows:

- Anne –
 - High – 7,000 feet MSL to, but not including, FL 180
 - Low – 100 feet above ground level (AGL) to, but not including, 7,000 feet; Excluding that airspace 1,500 feet AGL and below within the Magnolia Municipal Airport, Magnolia, Arkansas
- Arrowhead – 100 feet AGL to, but not including, FL 180
- Hog –
 - High North – 6,000 feet MSL to, but not including, FL 180
 - High South – 6,000 feet MSL to, but not including, FL 180
 - Low North – 100 feet AGL to, but not including, 6,000 feet MSL
 - Low South – 100 feet AGL to, but not including, 6,000 feet MSL
- Shirley –
 - A – 11,000 feet MSL to, but not including, FL 180
 - B – 11,000 feet MSL to, but not including, FL 180
 - C – 11,000 feet MSL to, but not including, FL 180 (FAA, 2015e)

The SUAs for Arkansas are presented in Figure 4.1.7-8. There are no TFRs for Arkansas; however, there is a National Security Area (NSA 0012)¹⁰⁰ located north of Pine Bluff (See Figure 4.1.7-8) with an altitude restriction of surface to 5,000 feet AGL within a three NM radius from the centered latitude and longitude points (FAA, 2015f). The restrictions associated with this NSA may impact the airspace in the area. MTRs in Arkansas, presented in Figure 4.1.7-9, consist of eight Visual Routes, eight Instrument Routes, and twenty Slow Routes.

UAS Considerations

The NPS signed a policy memorandum on June 24, 2014 that “directs superintendents nationwide to prohibit launching, landing, or operating unmanned aircraft on lands or waters administered by the National Park Service” (NPS, 2014b). There are seven national parks within Arkansas that have to comply with this agency directive (NPS, 2015b).

¹⁰⁰ National Security Area consists of defined vertical and lateral dimensions in the airspace where there is increased security of ground facilities. Pilots are expected to voluntarily avoid flying through the NSA. Additional security levels may result in further restrictions of the NSA, which FAA Headquarters would issue and disseminate with a NOTAM. (FAA, 2015g)

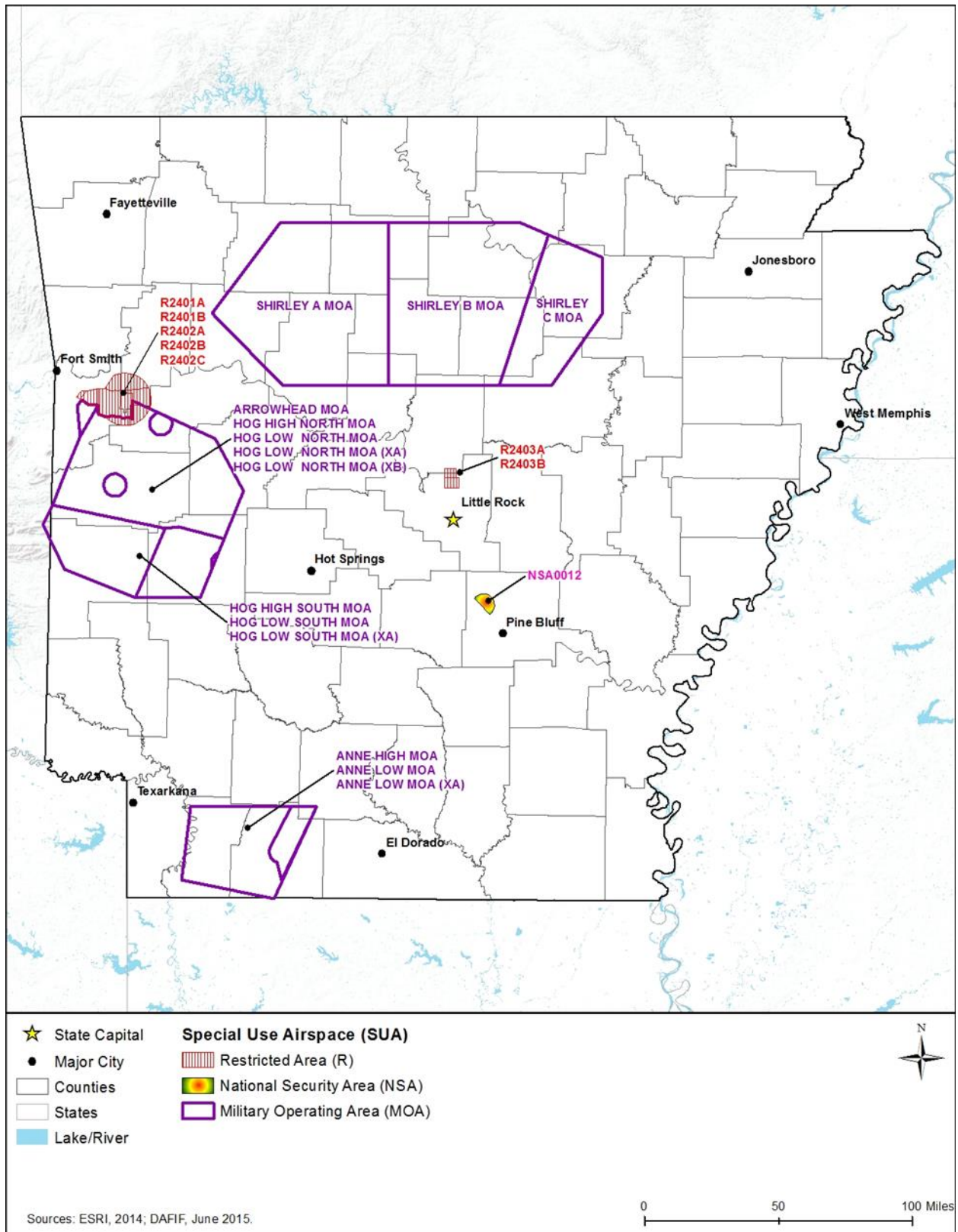


Figure 4.1.7-8: SUAs in Arkansas

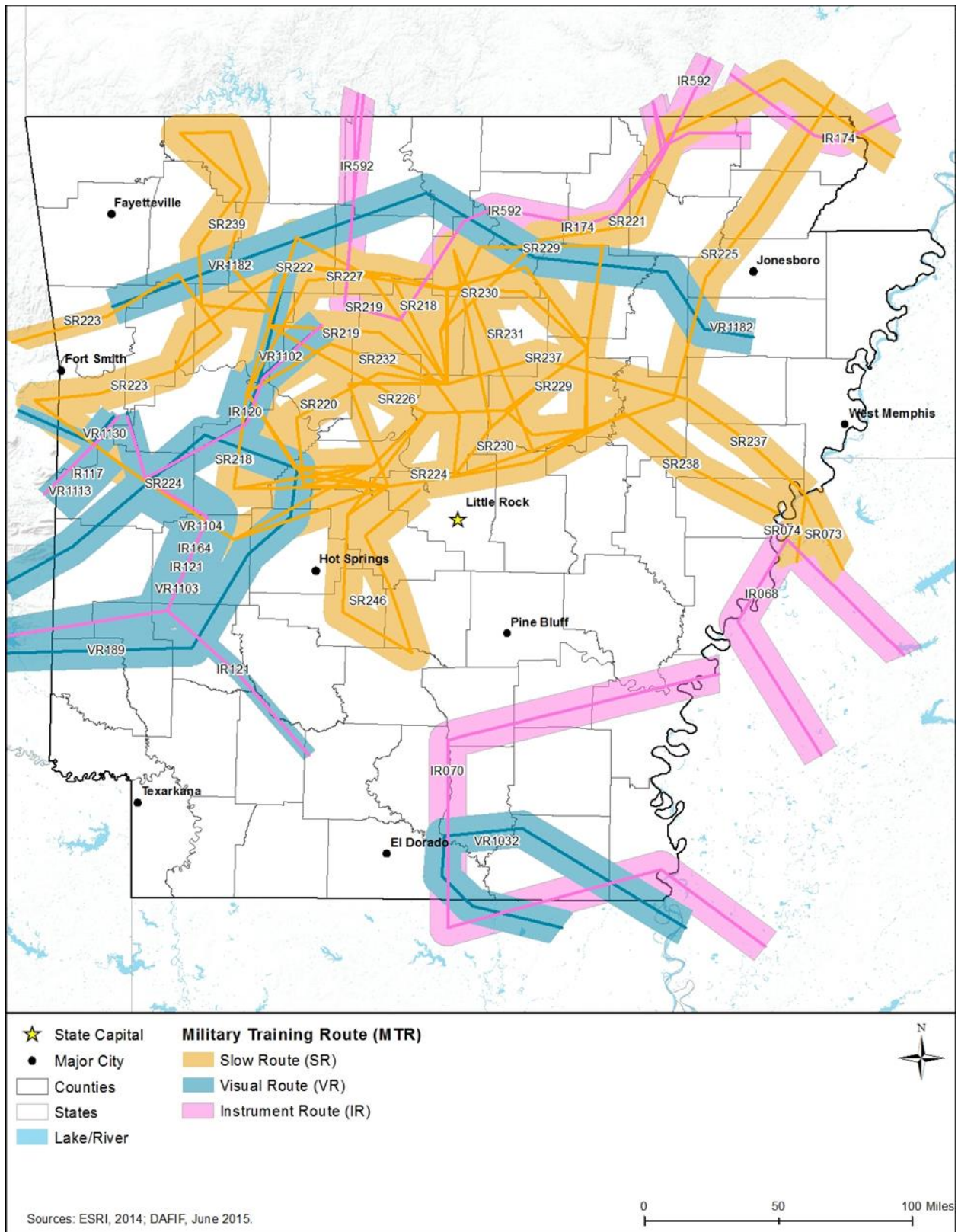


Figure 4.1.7-9: MTRs in Arkansas

4.1.8. Visual Resources

4.1.8.1. Definition of the Resource

Visual resources influence the human experience of a landscape. Various aspects combine to create visual resources, such as color, contrast, texture, line, and form. Features (e.g., mountain ranges, city skylines, ocean views, unique geological formations, rivers) and constructed landmarks (e.g., bridges, memorials, cultural resources, or statues) are considered visual resources. For some, cityscapes are valued visual resources, whereas others prefer natural areas. While many aspects of visual resources are subjective, evaluating potential impacts on the character and continuity of the landscape is a consideration when evaluating proposed actions for NEPA and NHPA compliance. The federal government does not have a single definition of what constitutes a visual resource; therefore, this PEIS will use the general definition of visual resources used by the Bureau of Land Management (BLM), “the visible physical features on a landscape (e.g., land, water, vegetation, animals, structures, and other features)” (BLM, 1984) .

4.1.8.2. Specific Regulatory Considerations

Table 4.1.8-1 presents state and local laws and regulations that relate to visual resources.

Table 4.1.8-1: Relevant Arkansas Visual Resources Laws and Regulations

State Law/Regulation	Regulatory Agency	Applicability
Arkansas Code Annotated § 15-20-304	ANHC	Considers the following areas as Natural Areas: undisturbed areas of natural quality; habitats for rare or endangered species; areas of unusual aesthetic or ecological quality along the banks of rivers, lakes, or streams; areas in private ownership within national forests, wildlife refuges, or state wildlife management areas; swamps, overflow lands, floodplains, or exceptional wetlands; buffer zone areas; and any other lands, waters, or interests therein listed in the Registry of Natural Areas.
Arkansas Code § 15-20-7 Arkansas Scenic Resources Act of 1991	Department of Parks and Tourism; State Parks, Recreation, and Travel Commission	Provides for the creation of the Arkansas Scenic Resources Preservation Coordinating Committee and provides for the identification, inventory, and promotion of an Arkansas State Registry of Scenic Resources.

Sources: (FindLaw, 2017), (JUSTIA, 2015a)

In addition to the state laws and regulations, local jurisdictions may have the authority to designate and prevent destruction of historic and cultural resources, which contain important visual resources. Additionally, local jurisdictions determine zoning laws and regulations for development, which may or may not restrict impacts to the state’s visual resources.

4.1.8.3. Character and Visual Quality of the Existing Landscape

Arkansas has a diversity of visual resources and is known as the “Natural State” for its abundance of undeveloped natural areas and landscapes (Arkansas Department of Parks & Tourism, 2015c). The state is home to mountainous regions, dense forests, and eastern lowlands and prairies. The highlands of Arkansas include the Ozark Mountains in the northwestern

portion of the state and the Ouachita Mountains in the west. The eastern part of the state is lowland, Mississippi delta (World Atlas, 2015). Arkansas's landscape consists of 57 percent forest, and caves, plains, and springs are also found in the state (Figure 4.1.7-1 in Section 4.1.7, Land Use, Recreation, and Airspace) (USDA Economic Research Service, 2015) (Arkansas Department of Parks & Tourism, 2015c). Visual resources within forested areas are generally comprised of continuous, natural looking cover with gradual transitions of line and color. They are typically characterized by the lack of disturbance or disruption of the landscape. Croplands are the second most dominant landscape in the state with 90 percent of Arkansas's cropland cultivated as "row crops or close-grown crops" (USDA Economic Research Service, 2015) (Natural Resources Conservation Service, 2015g).

While the state and many municipalities have some regulation of scenic and visual resources, not all scenic areas within the state have been identified or have policy or regulations for management or protection by the state. The areas listed below have some measure of management, significance, or protection through state or federal policy, as well as being identified as a visually significant area.

4.1.8.4 Visually Important Historic Properties and Cultural Resources

Visual and aesthetic qualities of historic properties can contribute to the overall importance of a particular site. Such qualities relate to the integrity of the appearance and setting of these properties or resources. Viewsheds (the natural and manmade environment visible from one or more viewing points) can also contribute to the significance of historic properties or cultural resources (NASA, 2013). Viewsheds containing historic properties and cultural resources may be considered important because of their presence in the landscape. Figure 4.1.8-1 shows areas that are included in the National Register of Historic Places (NRHP) that may be considered visually sensitive. In Arkansas, there are 2,586 NRHP listed sites, which include 1 National Historic Trail, 3 National Historic Sites, and 1 National Military Park (NPS, 2015b). Seventeen of the state parks contain NRHPs (Arkansas State Parks History & Heritage, 2015a). Some state historic sites and state historic districts may also be included in the NRHP, whereas others are not designated at this time (NPS, 2015d).

The Secretary of the Interior's Standards for the Treatment of Historic Properties addresses four aspects: preservation, rehabilitation, restoration, and reconstruction, whereas The Guidelines for the Treatment of Cultural Landscapes, both authored by the NPS, provides guidance for applying protections to all aspects of the historic and cultural landscape, such as forests, gardens, trails, structures, ponds, and farming areas, to meet the Standards (NPS, 1995). The Standards "require retention of the greatest amount of historic fabric, including the landscape's historic form, features, and details as they have evolved over time," which directly protects historic properties and the visual resources therein (NPS, 1995).

National Historic Landmarks

National Historic Landmarks (NHLs) are defined as "nationally significant historic places designated by the U.S. Secretary of the Interior because they possess exceptional value or quality in illustrating or interpreting the heritage of the United States" (NPS, 2015e). NHLs may include

“historic buildings, sites, structures, objects, and districts” (NPS, 2016b). Other types of historic properties include battlefields and canals. The importance of NHL-designated properties can be attributed to scenic or aesthetic qualities, among other attributes, that may be considered visual resources or visually sensitive at these sites. In Arkansas, there are 16 NHLs, including sites such as Daisy Bates House, Fort Smith, Little Rock Central High School, Parkin Indian Mound, and Toltec Mounds Site (Figure 4.1.8-1) (NPS, 2015f). Four of the NHLs in Arkansas are within the state park system and maintained by the Arkansas Department of Parks & Tourism’s Division of State Parks (Arkansas State Parks History & Heritage, 2015a). By comparison, there are over 2,500 NHLs in the United States (NPS, 2015l). Figure 4.1.8-1 provides a representative sample of some historic and cultural resources that may be visually sensitive.

National Historic Trail

The National Trails System Act defines National Historic Trails as “extended trails which follow as closely as possible and practicable the original trails or routes of travel of national historic significance” (NPS, 2012b). One National Historic Trail passes through Arkansas and surrounding states: the Trail of Tears National Historic Trail (Figure 4.1.8-1). The Trail of Tears National Historic Trail commemorates the survival of the Cherokee people removed from Georgia, Arkansas, and Tennessee to Indian Territory in Oklahoma (NPS, 2016a).

National Historic Sites and Military Park

Arkansas has three National Historic Sites and one National Military Park, which are preserved by the NPS to “commemorate persons, events, and activities important in the nation’s history” (NPS, 2003). Parks are generally larger in size and complexity than sites (NPS, 2003). The two National Historic Sites in Arkansas are Fort Smith and Little Rock Central High School, and the National Military Park is Pea Ridge (Figure 4.1.8-1). These sites and parks may contain aesthetic and scenic values associated with history (NPS, 2015b).

State Historic Sites and Museums

The Arkansas Department of Parks and Tourism’s Division of State Parks preserves “the state’s diverse beauty and history” through the administration of historic homes, towns, museums, and archaeological sites. The Division of State Parks maintains 12 historic homes and buildings, 3 historic towns, 14 museums (11 within the state parks), 6 archaeological sites at state parks, and the Ozark Folk Center. The Ozark Folk Center continues the traditions of the Ozark through song, dance, and crafts. These historic sites and parks may contain aesthetic and scenic values associated with history including log and stone cabins, springs, river valleys, schoolhouse, bluffs, waterfalls, mountain vistas, battlefields, and archaeological ruins. (Arkansas State Parks History & Heritage, 2015b)

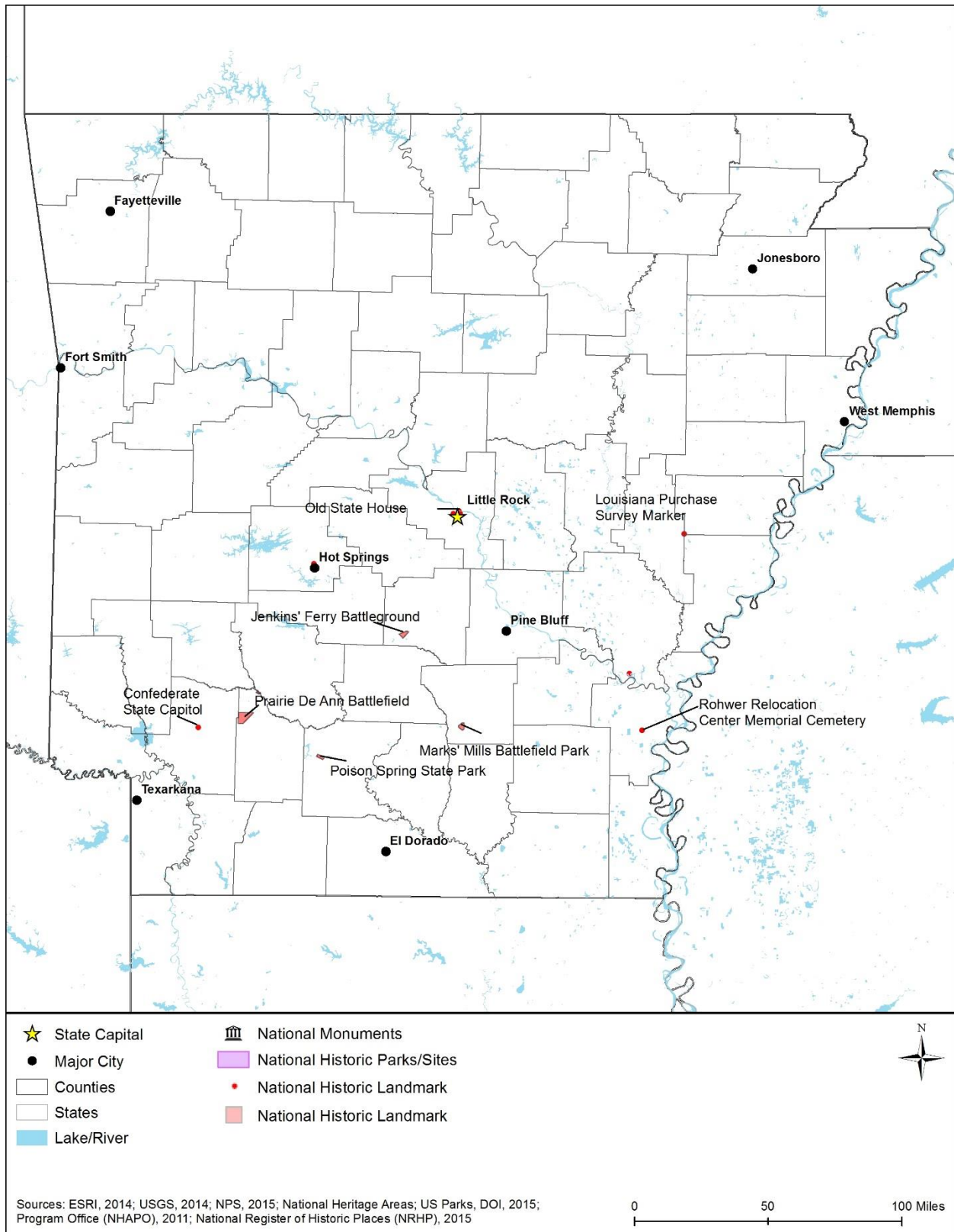


Figure 4.1.8-1: Representative Sample of Some Historic and Cultural Resources that May be Visually Sensitive

4.1.8.5 Parks and Recreation Areas

Parks and recreation areas include state parks, National Recreation Areas, National Forests, and National and State Trails. Parks and recreation areas often contain scenic resources and tend to be visited partly because of their associated visual or aesthetic qualities. Figure 4.1.7-1 in Section 4.1.7, Land Use, Recreation, and Airspace, identifies parks and recreational resources that may be visually sensitive in Arkansas. For additional information about recreation areas, including national and state parks, see Section 4.1.7, Land Use, Recreation, and Airspace.

National Park Service

National Parks are managed by the NPS, and contain natural, historic, cultural, visual, ecological, and recreational resources of significance to the nation and are maintained for the public's use. In Arkansas, there are seven¹⁰¹ officially designated National Parks in addition to other NPS affiliated areas, such as National Memorials. There are 1 National Park, 1 National Memorial, 1 National River, 3 National Historic Sites, 1 National Military Park, and 1 National Historic Trail (NPS, 2015b). Table 4.1.8-2 identifies the National Parks and affiliated areas located in Arkansas (see Figure 4.1.8-4).¹⁰² For additional information regarding parks and recreation areas, see Section 4.1.7, Land Use, Recreation, and Airspace.

Table 4.1.8-2: Arkansas National Parks and Affiliated Areas

Area Name	
Arkansas Post National Memorial	Pea Ridge National Military Park
Buffalo National River	President William Jefferson Clinton Birthplace Home
Fort Smith National Historic Site	Trail of Tears National Historic Trail
Hot Springs National Park (Figure 4.1.8-2)	Little Rock Central High School National Historic Site

Source: (NPS, 2015b)

National Forests

Several agencies manage forested areas in Arkansas, including the two USFS managed National Forests (USFS, 2015e). The USFS conducts inventories of the forestlands and assigns scenic resource categories from which they manage for scenic and visual resources. The scenic inventories are used to manage the forest landscape and to protect areas of high scenic integrity. (USFS, 1995) Table 4.1.8-3 identifies the USFS units located in Arkansas (see Figure 4.1.8-1). For additional information regarding parks and recreation areas, see Section 4.1.7, Land Use, Recreation, and Airspace.

¹⁰¹ This count is based on the NPS website "by the numbers" current as of 9/30/2014 (NPS, 2015b). Actual lists of parks and NPS affiliated areas may vary here depending on when areas are designated by Congress.

¹⁰² The natural areas data were retrieved from the Protected Areas Database of the United States (PAD-US), produced by USGS (<http://gapanalysis.usgs.gov/padus/>). This dataset categorizes lands across the U.S. by conservation, land management, planning, recreation, and ownership, as well as other uses. It is an extensive dataset that contains large quantities of information relevant to the Proposed Action. The data was queried and further combined by the Primary Designation Type into classifications that fit the multiple types of land applicable for Natural Areas. For this map, recognizable symbols (e.g., varying shades of green for National Parks and Forests) were used as PAD-US does not have a standard symbolization for natural areas. The PADUS 1.3 geodatabase was downloaded in the summer of 2015, and used consistently throughout all these maps for each state and D.C.

Table 4.1.8-3: National Forests in Arkansas

National Forest Name	Acres	Visual Resources
Ouachita National Forest	1.8M	Ouachita Mountain Range, rugged landscape, flora, streams, lakes, wildlife, rivers
Ozark-St. Francis National Forest	1.2M	Hardwood trees, oak-hickory stands, woody plants, rivers, flatlands, flora

Source: (USFS, 2015d) (USFS, 2015b)



Source: (NPS, 2015g)

Figure 4.1.8-2: Hot Springs National Park

Army Corps of Engineers Recreation Areas

There are 28 USACE recreation areas within Arkansas (see Table 4.1.8-4 and Figure 4.1.8-4) (USACE, 2015c). These lakes and recreation areas are specifically managed by the USACE for scenic and aesthetic qualities in their planning guidance in addition to managing risks for floods (USACE, 1997).

Table 4.1.8-4: Arkansas USACE Recreation Areas

Arkansas USACE Recreation Areas	
Arkansas River – Murray Lock and Dam	Dequeen Lake
Arkansas River – Norrell Pool	Dierks Lake
Arkansas River – Pool 3	Gillham Lake
Arkansas River – Pool 4	Greers Ferry Lake
Arkansas River – Pool 5	Greeson Lake
Arkansas River – Rockefeller Lake	John Paul Hammerschmidt Lake
Arkansas River – Terry Lock and Dam	Millwood Lake
Arkansas River – Toad Suck Ferry Pool	Nimrod Lake
Arkansas River – Wilbur D. Mills Pool	Norfolk Lake
Beaver Lake	Ouachita Lake
Blue Mountain Lake	Ouachita – Black River – Calion Pool
Bull Shoals Lake	Ouachita – Black River – Felsenthal Pool
Dardanelle Lake	Ozark Lake
Degray Lake	Table Rock Lake

Source: (USACE, 2015c)

Federal and State Trails

Designated under Section 5 of the National Trails System Act (16 U.S.C. 1241-1251, as amended), National Scenic Trails are defined as extended trails that “provide for maximum outdoor recreation potential and for the conservation and enjoyment of the nationally significant scenic, historic, natural, or cultural qualities of the areas through which they pass” (NPS, 2012b). There are no National Scenic Trails in Arkansas (NPS, 2015b).

In addition to National Scenic Trails, the National Trails System Act authorized the designation of National Recreational Trails near urban areas by either the Secretaries of the Interior or Agriculture, depending upon the ownership of the designated land (American Trails, 2015a). In Arkansas, there are 489 miles on 38 National Recreation Trails administered by USFS, USACE, NPS, local and state governments, and non-profit organizations (American Trails, 2015b).

Arkansas maintains a network of trails in the state parks for recreational purposes including hiking, all-terrain vehicle riding, and mountain biking (State Parks of Arkansas, 2015k). Due to their locations in the state parks, these trails contain visual resources similar to those in the state park in which they reside.

State Parks

State parks contain natural, historic, cultural, and/or recreational resources of significance to Arkansas residents and visitors. There are 52 state parks in Arkansas (Figure 4.1.8-4), most of which contain scenic or aesthetic areas considered to be visual resources or visually sensitive. Table 4.1.8-5 contains a sampling of state parks and their associated visual attributes.



Source: (State Parks of Arkansas, 2015m)

Figure 4.1.8-3: Devil's Den State Park

Table 4.1.8-5: Examples of Arkansas State Parks and Associated Visual Attributes

State Park	Visual Attributes
Devil's Den State Park (Figure 4.1.8-3)	Lee Creek Valley, Lee Creek, Ozark National Forest, oak-hickory forest, native stone dam, Lake Devil, backcountry, caves, crevices, bluff overlooks, hills, hollows, mountain ridges
Millwood State Park	Submerged timber, marshes, oxbow cutoffs, Millwood Lake, birds/waterfowl
Mississippi River State Park	St. Francis National Forest, Bear Creek Lake, wooded peninsula, wildlife, lake beach, Storm Creek Lake, Hornor Neck Lake, St. Francis River, Mississippi River
Wolly Hollow State Park	Lake Bennett, rolling terrain, Ozark Mountain foothills, gentle valleys, pristine creeks, ridges, rolling hills, hardwood forests, evergreen groves

Source: (State Parks of Arkansas, 2015l)

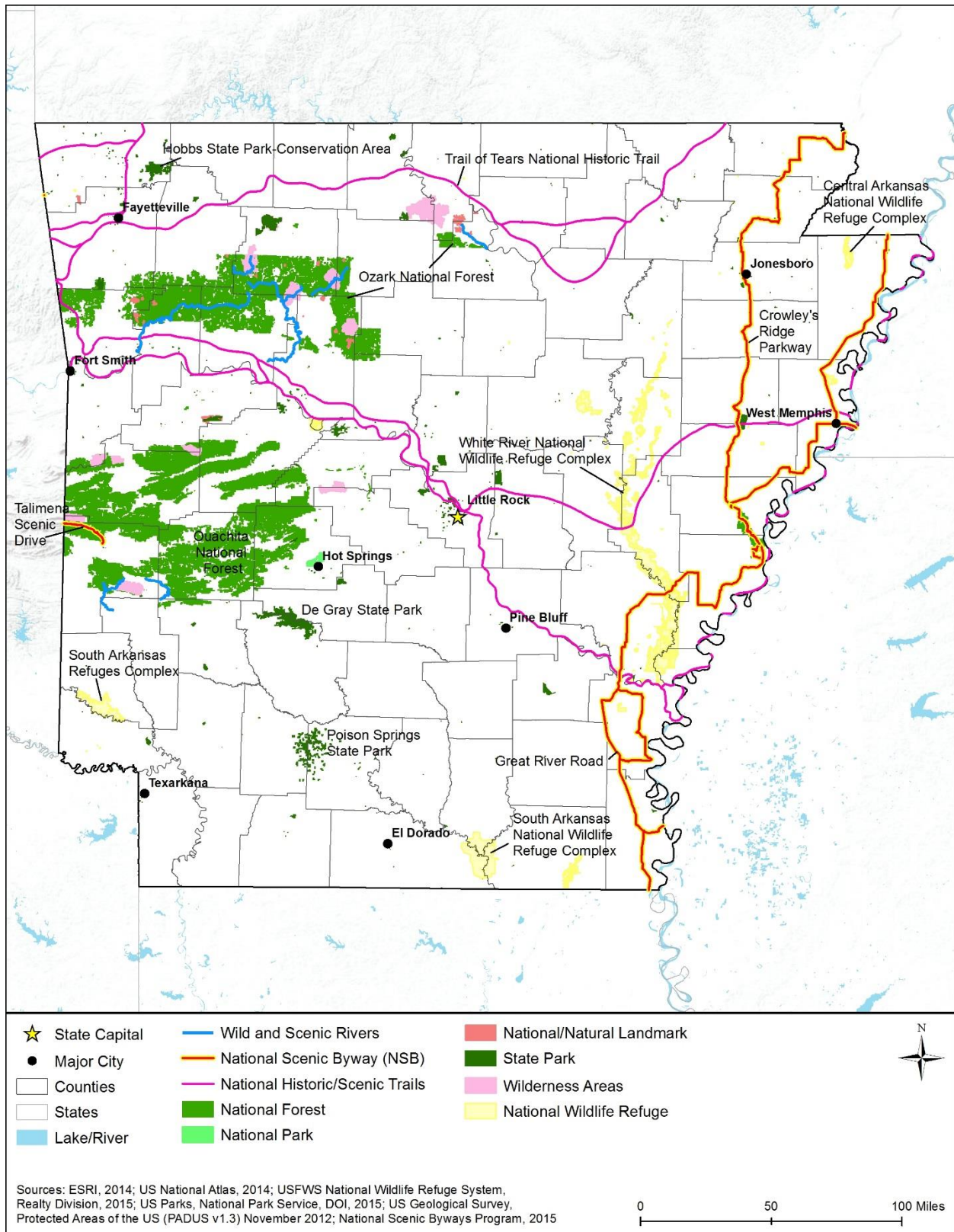


Figure 4.1.8-4: Natural Areas that May be Visually Sensitive

State Forests

There is one state forest in Arkansas, the Poison Springs State Forest, which is managed by the Arkansas Forestry Commission for good forest practices, timber production, and research, as well as for wildlife and recreation (see Figure 4.1.8-4) (Arkansas Forestry Commission, 2015b). Poison Springs State Forest is more than 21,000 acres of scenic landscapes of woods, wildlife, and historic exhibits (State Parks of Arkansas, 2015g).

4.1.8.6 Natural Areas

National Wilderness Areas

In 1964, Congress enacted the Wilderness Act of 1964 as “an area where the earth and its community of life are untrammelled by man, where man himself is a visitor who does not remain.” A designation as a National Wilderness Area is the highest level of conservation protection given by Congress to federal lands. This Act defined wilderness as land untouched by man and primarily affected only by the “forces of nature” and as that which “may also contain ecological, geological, or other features of scientific, education, scenic, or historical value.” Over 106 million acres of federal public lands have been designated as wilderness areas in the United States. Twenty-five percent of these federal lands are in 47 national parks (44 million acres) and part of National Park System. These designated wilderness areas are managed by USFS, BLM, USFWS, and NPS (NPS, 2015h). Arkansas is home to 12 federally managed Wilderness Areas (see Figure 4.1.8-4 and Table 4.1.8-6) (Wilderness.net, 2015).

Table 4.1.8-6: Arkansas Wilderness Areas

Arkansas Wilderness Areas	
Big Lake Wilderness	Flatside Wilderness
Black Fork Mountain Wilderness	Hurricane Creek Wilderness
Buffalo National River Wilderness	Leatherwood Wilderness
Caney Creek Wilderness	Poteau Mountain Wilderness
Dry Creek Wilderness	Richland Creek Wilderness
East Fork Wilderness	Upper Buffalo Wilderness

Source: (Wilderness.net, 2015)

State Conservation Areas and Preserves

The ANHC works “to conserve Arkansas’s natural landscape” through its System of Natural Areas (Arkansas Natural Heritage Commission, 2015a). ANHC maintains 40 conservation areas in the state for scientific research, low-impact recreation and, minimal hunting (Arkansas Natural Heritage Commission, 2015b). Additionally, private organizations maintain some private lands for the purposes of conserving wildlife and habitat individually and/or in concert with other public and private institutions. The Nature Conservancy protects 300,000 acres of critical lands on 19 preserves in Arkansas (The Nature Conservancy, 2015).

Rivers Designated as National or State Wild, Scenic or Recreational

National Wild, Scenic, or Recreational Rivers are those rivers designated by Congress or the Secretary of the Interior in accordance with the Wild and Scenic Rivers Act of 1968 (16 U.S.C. 1271-1287). These rivers have outstanding natural, cultural, and recreational values, including potential visual resources. Arkansas has 210 miles from 8 designated rivers (see Figure 4.1.8-4 and Table 4.1.8-7) (National Wild and Scenic Rivers System, 2015i). Additionally, the Buffalo River is also NPS designated a National River but is managed by the USFS as part of the Ozark-St. Francis National Forest (National Wild and Scenic Rivers System, 2015b). Arkansas does not designate separate state wild, scenic, or recreational rivers.

Table 4.1.8-7: Arkansas National Wild and Scenic Rivers

National Wild and Scenic Rivers	
Big Piney Creek	Little Missouri River
Buffalo River	Mulberry River
Cossatot River	North Sylamore Creek
Hurricane Creek	Richland Creek

Source: (National Wild and Scenic Rivers System, 2015i)

National Wildlife Refuges

NWRs are a network of lands and waters managed by USFWS. These lands and waters are “set aside for the conservation, management and, where appropriate, restoration of fish, wildlife, and plant resources and their habitats” (USFWS, 2015ar). There are 10 NWRs in Arkansas (USFWS, 2015as) (see Figure 4.1.8-4 and Table 4.1.8-8), including the Holla Bend NWR. This refuge contains 7,000 acres of agricultural fields, bottomland forest, and open water for migratory ducks and geese in winter and songbirds in the spring. Visual resources within this NWR include farm fields, river, tall and short grass areas, waterfowl, and water impoundments. (USFWS, 2015at)

Table 4.1.8-8: Arkansas National Wildlife Refuges

National Wildlife Refuges	
Bald Knob NWR	Logan Cave NWR
Big Lake NWR	Overflow NWR
Cache River NWR	Pond Creek NWR
Felsenthal NWR	Wapanocca NWR
Holla Bend NWR	White River NWR

Source: (USFWS, 2015as)

State Wildlife Management Areas

The AGFC oversees 130 Wildlife Management Areas, Conservation Areas, and Special Use Areas “to conserve and enhance Arkansas’s fish and wildlife and their habitats while promoting sustainable use, public understanding, and support” (AGFC, 2011c) (AGFC, 2011d).

National Natural Landmarks

NNLs are sites designated by the U.S. Secretary of the Interior that “contain outstanding biological and/or geological resources, regardless of land ownership, and are selected for their outstanding condition, illustrative value, rarity, diversity, and value to science and education” (NPS, 2012a). These landmarks may be considered visual resources or visually sensitive. In Arkansas, there are five NNLs (Table 4.1.8-9 and Figure 4.1.8-4). Some of the natural features located within these areas include “examples of bottomland hardwood forest types, the third largest spring in the Ozark Mountains, a large virgin shortleaf pine forest” (NPS, 2012a). One of these NNLs is Roaring Branch Research Natural Area (Figure 4.1.8-5), which includes a steep ravine, waterfalls, and a forest type that is unusual for the area (NPS, 2012c). Additionally, Mammoth Spring NNL is contained within Mammoth Spring State Park and administered by the Arkansas Department of Parks and Tourism’s Division of State Parks (Arkansas State Parks History & Heritage, 2015a).



Source: (NPS, 2012c)

Figure 4.1.8-5: Roaring Branch Research Natural Area

Table 4.1.8-9: Arkansas National Natural Landmarks

National Natural Landmarks	
Big Lake Natural Area	Roaring Branch Research Natural Area
Lake Winona Research Natural Area	White River Sugarberry Natural Area
Mammoth Spring	

Source: (NPS, 2012a)

4.1.8.7 Additional Areas

National and State Scenic Byways

National Scenic Byways are resources designated specifically for scenic or aesthetic areas or qualities which would be considered visual resources or visually sensitive. The U.S. Department of Transportation, FHWA, manages the National Scenic Byways Program. Arkansas has three designated National Scenic Byways: Crowley’s Ridge Parkway (212 miles), Great River Road (2,069 miles), and Talimena Scenic Drive (54 miles) (see Figure 4.1.8-4) (FHWA, 2015c).

Similar to National Scenic Byways, the AHDT administers the Arkansas Scenic Byway program. There are seven State Scenic Byways in Arkansas (see Figure 4.1.8-4 and Table 4.1.8-10). The Arkansas Scenic 7 traverses the state from north to south and provides scenic views of the Ozark and Ouachita mountains and forests (see Figure 4.1.8-4 and Table 4.1.8-10) (Arkansas Department of Parks & Tourism, 2015d).

Table 4.1.8-10: Arkansas State Byways

State Byway Name	Miles	Visual Resources
Arkansas Scenic 7	290	West Gulf Coastal Plain, rolling terrain, dense pine forests, stream valleys, bottomland hardwoods forests, level terrain, historic towns/districts, historic homes and sites
Boston Mountains	60	Mountain Range, rugged terrain, mountain streams, valleys, ridges, mountain vistas, countryside, mountain towns, farms
Mount Magazine	45	Blue Mountain Lake views, Ouachita Mountains, Arkansas River Valley, Ozark Mountains, Cove Lake, pastureland, hayfields, hardwood shade trees, natural gas wells
Ozark Highlands	35	Rugged forest, Boston Mountains, Buffalo National River
Pig Trail	19	Foliage, Boston Mountains, Ozark Mountains, wildflowers, Mulberry River
Sylamore	26.5	White oak-hickory forests, shortleaf pine stands, Ozark National Forest, limestone cliffs, mountain vistas, caverns
I-530 State Scenic Byway	15	Rolling woodlands, wildflowers, waterfowl, birds, Bayou Bartholomew, flatlands, ponds, borrow pits, cypress trees

Source: (State Parks of Arkansas, 2015a)

4.1.9. Socioeconomics

4.1.9.1. Definition of the Resource

NEPA requires consideration of socioeconomics in NEPA analysis; specifically, Section 102(A) of NEPA requires federal agencies to “insure the integrated use of the natural and social sciences...in planning and in decision making” (42 U.S.C. § 4332(A)).¹⁰³ Socioeconomics refers to a broad, social science-based approach to understanding a region’s social and economic conditions. It typically includes population, demographic descriptors, economic activity indicators, housing characteristics, property values, and public revenues and expenditures. When applicable, it includes qualitative factors such as community cohesion. Socioeconomics provides

¹⁰³ See https://ceq.doe.gov/laws_and_executive_orders/the_nepa_statute.html.

important context for analysis of FirstNet projects, and in addition, FirstNet projects may affect the socioeconomic conditions of a region.

The choice of socioeconomic topics and depth of their treatment depends on the relevance of potential topics to the types of federal actions under consideration. FirstNet's mission is to provide public safety broadband and interoperable emergency communications coverage throughout the nation. Relevant socioeconomic topics include population density and growth, economic activity, housing, property values, and state and local taxes. The financial arrangements for deployment and operation of the FirstNet network may have socioeconomic implications. This socioeconomic section provides some additional, broad context, including data and discussion of state and local government revenue sources that FirstNet may affect.

The financial arrangements for deployment and operation of the FirstNet network may have socioeconomic implications. Section 1.1 frames some of the public expenditure and public revenue considerations specific to FirstNet; however, this is not intended to be either descriptive or prescriptive of FirstNet's financial model or anticipated total expenditures and revenues associated with the deployment of the Nationwide Public Safety Broadband Network (NPSBN). This socioeconomic section provides some additional, broad context, including data and discussion of state and local government revenue sources that FirstNet may affect.

Environmental justice is a related topic that specifically addresses the presence of minority populations (defined by race and Hispanic ethnicity) and low-income populations, in order to give special attention to potential impacts on those populations, per Executive Order 12898¹⁰⁴ (see Section 1.8, Overview of Relevant Federal Laws and Executive Orders). This PEIS addresses environmental justice in a separate section (Section 4.1.10, Environmental Justice). This PEIS also addresses the following topics, sometimes included within socioeconomic, in separate sections: land use and recreation (Section 4.1.7, Land Use and Recreation), infrastructure and public services (Section 4.1.1, Infrastructure), and aesthetic considerations (Section 4.1.8, Visual Resources).

Wherever possible, this section draws on nationwide datasets from federal sources such as the U.S. Census Bureau (Census Bureau) and U.S. Bureau of Labor Statistics (BLS). This ensures consistency of data and analyses across the states examined in this PEIS. In all cases, this section uses the most recent data available for each geography at the time of writing. At the county, state, region, and United States levels, the data are typically for 2013 or 2014. For smaller geographic areas, this section uses data from the Census Bureau's American Community Survey (ACS). The ACS is the Census Bureau's flagship demographic estimates program for years other than the decennial census years. This PEIS uses the 2009-2013 ACS, which is based on surveys (population samples) taken across that five-year period; thus, it is not appropriate to attribute its data values to a specific year. It is a valuable source because it provides the most accurate and consistent socioeconomic data across the nation at the sub-county level (U.S. Census Bureau, 2016b).¹⁰⁵

¹⁰⁴ See <http://www.archives.gov/federal-register/executive-orders/pdf/12898.pdf>.

¹⁰⁵ For U.S. Census Bureau sources, a URL (see references section) that begins with "http://factfinder.census.gov" indicates that the American FactFinder (AFF) interactive tool can be used to retrieve the original source data via the following procedure. If

The remainder of this section addresses the following subjects: regulatory considerations specific to socioeconomics in the state, communities and populations, economic activity, housing, property values, and taxes.

4.1.9.2. *Specific Regulatory Considerations*

Research for this section did not identify any specific state, local, or tribal laws or regulations that are directly relevant to socioeconomics for this PEIS.

4.1.9.3. *Communities and Populations*

This section discusses the population and major communities of Arkansas (AR). It includes the following topics:

- Recent and projected statewide population growth;
- Current distribution of the population across the state; and
- Identification of the largest population concentrations in the state.

Statewide Population and Population Growth

Table 4.1.9-1 presents the 2014 population and population density of Arkansas in comparison to the South region¹⁰⁶ and the nation. The estimated population of Arkansas in 2014 was 2,966,369. The population density was 57 persons per square mile (sq. mi.), which is lower than the population density of both the region (114 persons/sq. mi.) and the nation (90 persons/sq. mi.). In 2014, Arkansas was the 32nd largest state by population among the 50 states and the District of

the reference's URL begins with "http://dataferrett.census.gov," significant socioeconomic expertise is required to navigate this interactive tool to the specific data. However, the data can usually be found using AFF. As of May 24, 2016, the AFF procedure is as follows: 1) Go to <http://factfinder.census.gov>. 2) Select "Advanced Search," then "Show Me All." 3) Select from "Topics" choices, select "Dataset," then select the dataset indicated in the reference; e.g., "American Community Survey, 2013 1-Year Estimates" or "2012 Census of Governments." Click "Close." Note: ACS is the abbreviation in the AFF for the American Community Survey. SF is the abbreviation used with the 2000 and 2010 "Summary Files." For references to the "2009-2013 5-Year Summary File," choose "2013 ACS 5-year estimates" in the AFF. 4) Click the "Geographies" box. Under "Select a geographic type," choose the appropriate type; e.g., "United States – 010" or "State – 040" or "...County – 050" then select the desired area or areas of interest. Click "Add to Your Selections," then "Close." For Population Concentration data, select "Urban Area - 400" as the geographic type, then select 2010 under "Select a version" and then choose the desired area or areas. Alternatively, do not choose a version, and select "All Urban Areas within United States." Regional values cannot be viewed in the AFF because the regions for this PEIS do not match Census Bureau regions. All regional values were developed by downloading state data and using the most mathematically appropriate calculations (e.g., sums of state values, weighted averages, etc.) for the specific data. 5) In "Refine your search results," type the table number indicated in the reference; e.g., "DP04" or "LGF001." The dialogue box should auto-populate with the name of the table(s) to allow the user to select the table number/name. Click "Go." 6) In the resulting window, click the desired table under "Table, File, or Document Title" to view the results. If multiple geographies were selected, it is often easiest to view the data by clicking the "Download" button above the on-screen data table. Choose the desired comma-delimited format or presentation-ready format (includes a Microsoft Excel option). In some cases, the structure of the resulting file may be easier to work with under one format or another. Note that in most cases, the on-screen or downloaded data contains additional parameters besides those used in the FirstNet PEIS report table. Readers must locate the FirstNet PEIS-specific data within the Census Bureau tables. Additionally, the data contained in the FirstNet tables may incorporate data from multiple sources and may not be readily available in one table on the Census site.

¹⁰⁶ The South region is comprised of the states of Alabama, Arkansas, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, New Mexico, Oklahoma, South Carolina, Tennessee, and Texas. Throughout the socioeconomics section, figures for the South region represent the sum of the values for all states in the region, or an average for the region based on summing the component parameters. For instance, the population density of the South region is the sum of the populations of all its states, divided by the sum of the land areas of all its states.

Columbia, 25th largest by land area, and had the 35th greatest population density. (U.S. Census Bureau, 2015b; U.S. Census Bureau, 2010)

Table 4.1.9-1: Land Area, Population, and Population Density of Arkansas

Geography	Land Area (sq. mi.)	Estimated Population 2014	Population Density 2014 (persons/sq. mi.)
Arkansas	52,035	2,966,369	57
South Region	914,471	104,109,977	114
United States	3,531,905	318,857,056	90

Sources: (U.S. Census Bureau, 2015b; U.S. Census Bureau, 2010)

Population growth is an important subject for this PEIS given FirstNet’s mission. Table 4.1.9-2 presents the population growth trends of Arkansas from 2000 to 2014 in comparison to the South region and the nation. The state’s annual growth rate decreased slightly in the 2010 to 2014 period compared to 2000 to 2010, from 0.87 percent to 0.43 percent. The growth rate of Arkansas in the 2010 to 2014 period was lower than the growth rate of the region, at 1.14 percent, and the nation, at 0.81 percent.

Table 4.1.9-2: Recent Population Growth of Arkansas

Geography	Population			Numerical Population Change		Rate of Population Change (AARC) ^a	
	2000	2010	2014 (estimated)	2000 to 2010	2010 to 2014	2000 to 2010	2010 to 2014
Arkansas	2,673,400	2,915,918	2,966,369	242,518	50,451	0.87%	0.43%
South Region	86,516,862	99,487,696	104,109,977	12,970,834	4,622,281	1.41%	1.14%
United States	281,421,906	308,745,538	318,857,056	27,323,632	10,111,518	0.93%	0.81%

Sources: (U.S. Census Bureau, 2015c) (U.S. Census Bureau, 2012a)

^a AARC = Average Annual Rate of Change (compound growth rate)

Demographers prepare future population projections using various population growth modeling methodologies. For this nationwide PEIS, it is important to use population projections that apply the same methodology across the nation. It is also useful to consider projections that use different methodologies, since no methodology is a perfect predictor of the future. The Census Bureau does not prepare population projections for the states. Therefore, Table 4.1.9-3 presents projections of the 2030 population from two sources that are national in scope and use different methodologies: the University of Virginia’s Weldon Cooper Center for Public Service and ProximityOne, a private sector demographic and economic data and analysis service. The table provides figures for numerical change, percentage change, and annual growth rate based on averaging the projections from the two sources. The average projection indicates Arkansas’s population will increase by approximately 421,000 people, or 14.2 percent, from 2014 to 2030. This reflects an average annual projected growth rate of 0.83 percent, which is approximately twice the historical growth rate from 2010 to 2014 of 0.43 percent. The projected growth rate of the state is lower than that of the region (0.97 percent) and somewhat higher than the projected growth rate of the nation (0.80 percent).

Table 4.1.9-3: Projected Population Growth of Arkansas

Geography	Population 2014 (estimated)	Projected 2030 Population			Change Based on Average Projection		
		UVA Weldon Cooper Center Projection	Proximity One Projection	Average Projection	Numerical Change 2014 to 2030	Percent Change 2014 to 2030	Rate of Change (AARC) ^a 2014 to 2030
Arkansas	2,966,369	3,312,022	3,462,622	3,387,322	420,953	14.2%	0.83%
South Region	104,109,977	122,323,551	120,794,020	121,558,786	17,448,809	16.8%	0.97%
United States	318,857,056	360,978,449	363,686,916	362,332,683	43,475,627	13.6%	0.80%

Sources: (ProximityOne, 2015; UVA Weldon Cooper Center, 2015) (U.S. Census Bureau, 2012a)

^a AARC = Average Annual Rate of Change (compound growth rate)

Population Distribution and Communities

Figure 4.1.9-1 presents the distribution and relative density of the population of Arkansas. Each brown dot represents 500 people, and massing of dots indicates areas of higher population density. The map uses ACS estimates based on samples taken from 2009 to 2013 (U.S. Census Bureau, 2013b). This map also presents the 10 largest population concentrations in the state, outlined in purple. These population concentrations reflect contiguous, densely developed areas as defined by the Census Bureau based on the 2010 census (U.S. Census Bureau, 2012a) (U.S. Census Bureau, 2013b). These population concentrations often include multiple incorporated areas as well as some unincorporated areas.

Other groupings of brown dots on the map represent additional, but smaller, population concentrations. The map shows that Arkansas has several densely settled areas besides those specifically identified as the top 10 population concentrations. Dispersed dots indicate dispersed population across the less densely settled areas of the state. The sparsely populated area in the west central portion of the state, north and west of Hot Springs, is the Ouachita Mountains area, part of a major range in the United States. For more information about the Ouachita Mountains, see Section 4.1.7, Land Use, Recreation, and Airspace.

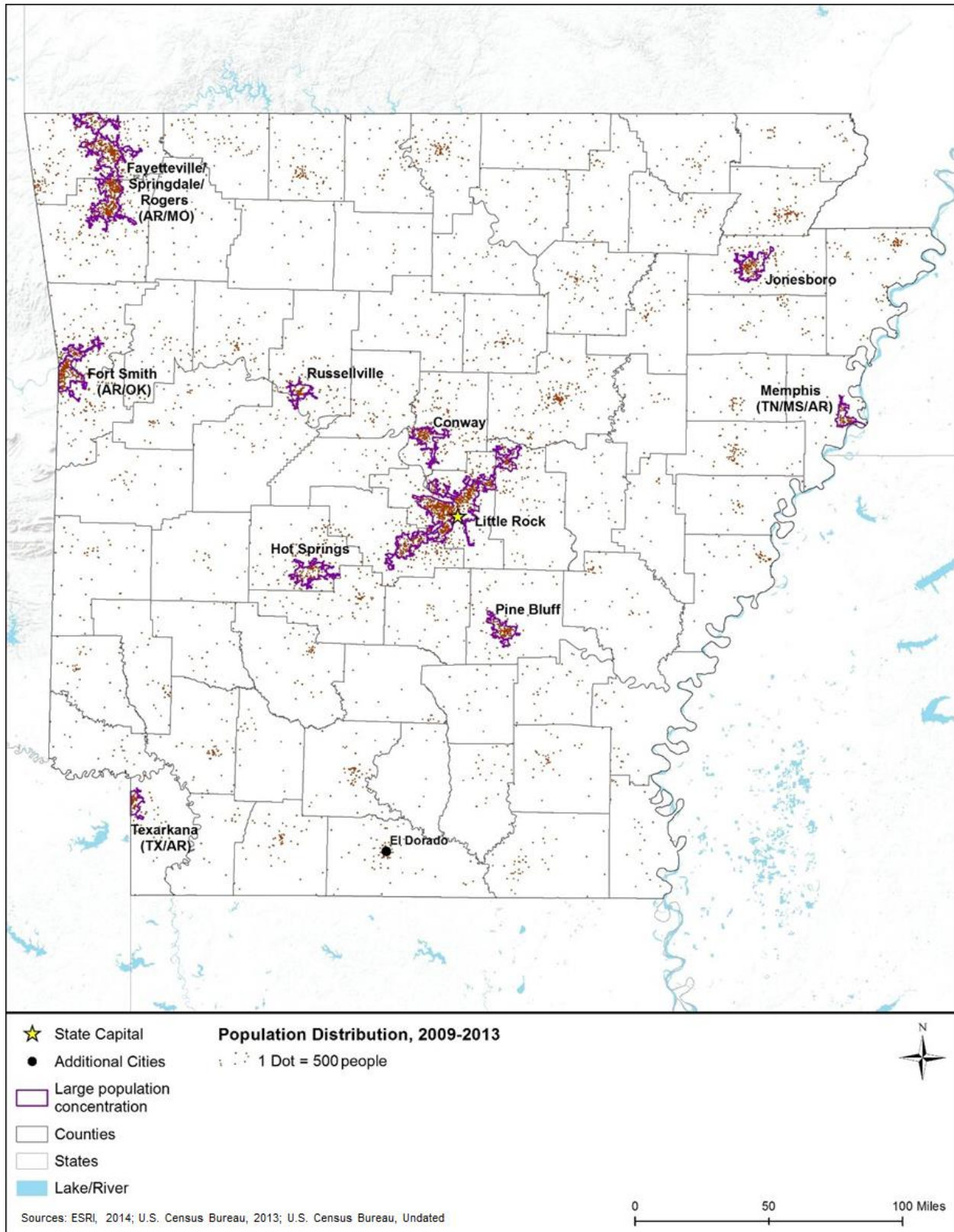


Figure 4.1.9-1: Population Distribution in Arkansas, 2009–2013

Table 4.1.9-4 provides the populations of the 10 largest population concentrations in Arkansas, based on the 2010 census, and also shows population changes for these areas between the 2000 and 2010 censuses.¹⁰⁷ In 2010, the largest population concentration was the Little Rock area, which had 431,388 people. Two other population concentrations are over 100,000, the Arkansas portions of the Fort Smith and Fayetteville/Springdale/Rogers areas. The smallest of these 10 population concentrations was the Arkansas portion of the Texarkana area, with a 2010 population of 26,072. The fastest growing areas, by average annual rate of change from 2000 to 2010, were the Arkansas portion of the Fayetteville/Springdale/Rogers, and the Conway area, with annual growth rates of 5.51 percent and 4.05 percent, respectively. These population increases reflect correspondingly large increases in the area definition for these two areas. Only one of these population concentrations (i.e., Pine Bluff area) experienced a population decline during this period.

Table 4.1.9-4 shows that the top 10 population concentrations in Arkansas accounted for 40.7 percent of the state's population in 2010. The population growth in the 10 areas from 2000 to 2010 amounted to 104.9 percent of the entire state's growth. Being over 100 percent indicates that the population of the remainder of the state, as a whole, declined from 2000 to 2010.

¹⁰⁷ Census Bureau boundaries for these areas are not fixed. Area changes from 2000 to 2010 may include accretion of newly developed areas into the population concentration, Census Bureau classification of a subarea as no longer qualifying as a concentrated population due to population losses, and reclassification by the Census Bureau of a subarea into a different population concentration. Thus, population change from 2000 to 2010 reflects change within the constant area and change as the overall area boundary changes. Differences in boundaries in some cases introduce anomalies in comparing the 2000 and 2010 populations and in calculation of the growth rate presented in the table.

Table 4.1.9-4: Population of the 10 Largest Population Concentrations in Arkansas

Area	Population				Population Change 2000 to 2010	
	2000	2010	2009–2013	Rank in 2010	Numerical Change	Rate (AARC) ^a
Conway ^b	43,891	65,277	66,787	5	21,386	4.05%
Fayetteville/Springdale/Rogers (AR/MO) (AR Portion) ^b	172,585	295,081	303,231	2	122,496	5.51%
Fort Smith (AR/OK) (AR Portion)	104,198	120,714	121,056	3	16,516	1.48%
Hot Springs	51,763	55,121	53,415	6	3,358	0.63%
Jonesboro	51,804	65,419	67,399	4	13,615	2.36%
Little Rock	360,331	431,388	437,135	1	71,057	1.82%
Memphis (TN/MS/AR) (AR Portion)	37,961	40,270	40,315	8	2,309	0.59%
Pine Bluff	58,584	53,495	52,695	7	(5,089)	-0.90%
Russellville	26,635	32,733	32,901	9	6,098	2.08%
Texarkana (TX/AR) (AR Portion)	23,521	26,072	25,594	10	2,551	1.04%
Total for Top 10 Population Concentrations	931,273	1,185,570	1,200,528	NA	254,297	2.44%
Arkansas (statewide)	2,673,400	2,915,918	2,933,369	NA	242,518	0.87%
Top 10 Total as Percentage of State	34.8%	40.7%	40.9%	NA	104.9%	NA

Sources: (U.S. Census Bureau, 2012a; U.S. Census Bureau, 2015d; U.S. Census Bureau, 2015e)

^a AARC = Average Annual Rate of Change (compound growth rate)

^b The large population increases from 2000 to 2010 for the Conway and Fayetteville/Springdale/Rogers areas reflect correspondingly large increases in the area definition for these two areas.

4.1.9.4. Economic Activity, Housing, Property Values, and Government Revenues

This section addresses other socioeconomic topics that are potentially relevant to FirstNet.

These topics include:

- Economic activity;
- Housing;
- Property values; and
- Government revenues.

Social institutions – educational, family, political, public service, military, and religious – are present throughout the state. The institutions most relevant to FirstNet projects are public services such as medical and emergency medical services and facilities. This PEIS addresses public services in Section 4.1.1, Infrastructure. Project-level NEPA analyses may need to examine other institutions, depending on specific locations and specific types of actions.

Economic Activity

Table 4.1.9-5 compares several economic indicators for Arkansas to the South region and the nation. The table presents two indicators of income¹⁰⁸ – per capita and median household – as income is a good measure of general economic health of a region.

Per capita income is total income divided by the total population. As a mathematical average, the very high incomes of a relatively small number of people tend to bias per capita income figures upwards. Nonetheless, per capita income is useful as an indicator of the relative income level across two or more areas. As shown in Table 4.1.9-5, the per capita income in Arkansas in 2013 (\$21,927) was \$3,084 lower than that of the region (\$25,011), and \$6,257 lower than that of the nation (\$28,184).

Household income is a useful measure, and often used instead of family income, because in modern society there are many single-person households and households composed of non-related individuals. Median household income (MHI) is the income at which half of all households have higher income, and half have lower income. Table 4.1.9-5 shows that in 2013, the MHI in Arkansas (\$40,605) was \$5,957 lower than that of the region (\$46,562), and \$11,645 lower than that of the nation (\$52,250).

Employment status is a key socioeconomic parameter because employment is essential to the income of a large portion of the adult population. The federal government calculates the unemployment rate as the number of unemployed individuals who are looking for work divided by the total number of individuals in the labor force. Table 4.1.9-5 compares the unemployment rate in Arkansas to the South region and the nation. In 2014, Arkansas’s statewide unemployment rate of 6.1 percent matched the rate for the region (6.1 percent) and was somewhat lower than the nation’s (6.2 percent).¹⁰⁹

Table 4.1.9-5: Selected Economic Indicators for Arkansas

Geography	Per Capita Income 2013	Median Household Income 2013	Average Annual Unemployment Rate 2014
Arkansas	\$21,927	\$40,605	6.1%
South Region	\$25,011	\$46,562	6.1%
United States	\$28,184	\$52,250	6.2%

Sources: (BLS, 2017; U.S. Census Bureau, 2013c; U.S. Census Bureau, 2013d; U.S. Census Bureau, 2013e)

¹⁰⁸ The Census Bureau defines income as follows: “‘Total income’ is the sum of the amounts reported separately for wage or salary income; net self-employment income; interest, dividends, or net rental or royalty income or income from estates and trusts; Social Security or Railroad Retirement income; Supplemental Security Income (SSI); public assistance or welfare payments; retirement, survivor, or disability pensions; and all other income. Receipts from the following sources are not included as income: capital gains, money received from the sale of property (unless the recipient was engaged in the business of selling such property); the value of income “in kind” from food stamps, public housing subsidies, medical care, employer contributions for individuals, etc.; withdrawal of bank deposits; money borrowed; tax refunds; exchange of money between relatives living in the same household; gifts and lump-sum inheritances, insurance payments, and other types of lump-sum receipts.” (U.S. Census Bureau, 2013f)

¹⁰⁹ The timeframe for unemployment rates can change quarterly.

Figure 4.1.9-2 and Figure 4.1.9-3 show how MHI in 2013 (U.S. Census Bureau, 2013c) and unemployment in 2014 (BLS, 2017) varied by county across the state. These maps also incorporate the same population concentration data as Figure 4.1.9-1 (U.S. Census Bureau, 2012a) (U.S. Census Bureau, 2013b). Following these two maps, Table 4.1.9-6 presents MHI and unemployment for the 10 largest population concentrations in the state. The table reflects survey data taken from 2009 to 2013. Thus, its figures are not directly comparable to those on the maps. Nonetheless, both the maps and the table help portray differences in income and unemployment across Arkansas.

Figure 4.1.9-2 shows that, at the county level, MHI in 2013 had a variable distribution across the state, with low MHI levels occurring throughout the state. Only three counties, located near the two largest population concentrations in the state (i.e., Little Rock area and the Arkansas portion of the Fayetteville/Springdale/Rogers area) had MHI values above the national average. The counties classified as having the lowest MHI levels were all in sparsely populated areas, relatively away from the top 10 population concentrations, with the exception of the Pine Bluff area. Table 4.1.9-6 shows that MHI was above the state average in seven of the 10 population concentrations, and was highest in the Little Rock area and the Arkansas portion of the Fayetteville/Springdale/Rogers area. MHI was lowest in the Palm Coast/Daytona Beach/Port Orange and Pensacola (Arkansas portion) areas.

Figure 4.1.9-3 presents variations in the 2014 unemployment rate across the state, by county. Similar to the figure for MHI, this figure shows a highly variable distribution of unemployment rates throughout the state. It shows that the majority of counties with unemployment rates below the national average (that is, better employment performance) are generally around the three largest population concentrations (i.e., Little Rock area, the Arkansas portion of the Fayetteville/Springdale/Rogers area, and the Fort Smith area). When comparing unemployment in the population concentrations to the state average (Table 4.1.9-6), five of the 10 areas had a 2009–2013 unemployment rate that was higher than the state average. Unemployment was highest in the Pine Bluff area (16.4 percent) and lowest in the Arkansas portion of the Fayetteville/Springdale/Rogers area (6.5 percent).

The percentage of private wage and salary workers (by class and type of worker: private industry, government, self-employed, etc.) was slightly lower in Arkansas than in the South region and the nation. The percentage of government workers was slightly higher in the state than in the region and nation. Self-employed workers were a somewhat higher percentage in the state than in the region and nation. Detailed employment data provides useful insights into the nature of a local, state, or national economy. Table 4.1.9-6 provides figures on employment percentages by type of worker and by industry based on surveys conducted in 2013 by the Census Bureau.

By industry, Arkansas has a mixed economic base and some notable figures in the table are as follows. Arkansas in 2013 had a similar percentage (within two percentage points) of workers in most industries compared to the region and nation. It had a considerably lower percentage of persons working in “professional, scientific, management, administrative, and waste

management services” than did the region or the nation. Arkansas had a notably higher percentage of workers in “manufacturing” compared to both the region and nation.

Table 4.1.9-6: Selected Economic Indicators for the 10 Largest Population Concentrations in Arkansas, 2009-2013

Area	Median Household Income	Average Annual Unemployment Rate
Conway	\$46,737	7.9%
Fayetteville/Springdale/Rogers (AR/MO) (AR Portion)	\$48,065	6.5%
Fort Smith (AR/OK) (AR Portion)	\$37,064	7.2%
Hot Springs	\$35,030	10.4%
Jonesboro	\$39,041	10.4%
Little Rock	\$47,669	8.1%
Memphis (TN/MS/AR) (AR Portion)	\$36,687	11.8%
Pine Bluff	\$32,129	16.4%
Russellville	\$32,155	8.7%
Texarkana (TX/AR) (AR Portion)	\$38,745	10.5%
Arkansas (statewide)	\$40,768	8.9%

Source: (U.S. Census Bureau, 2013f)

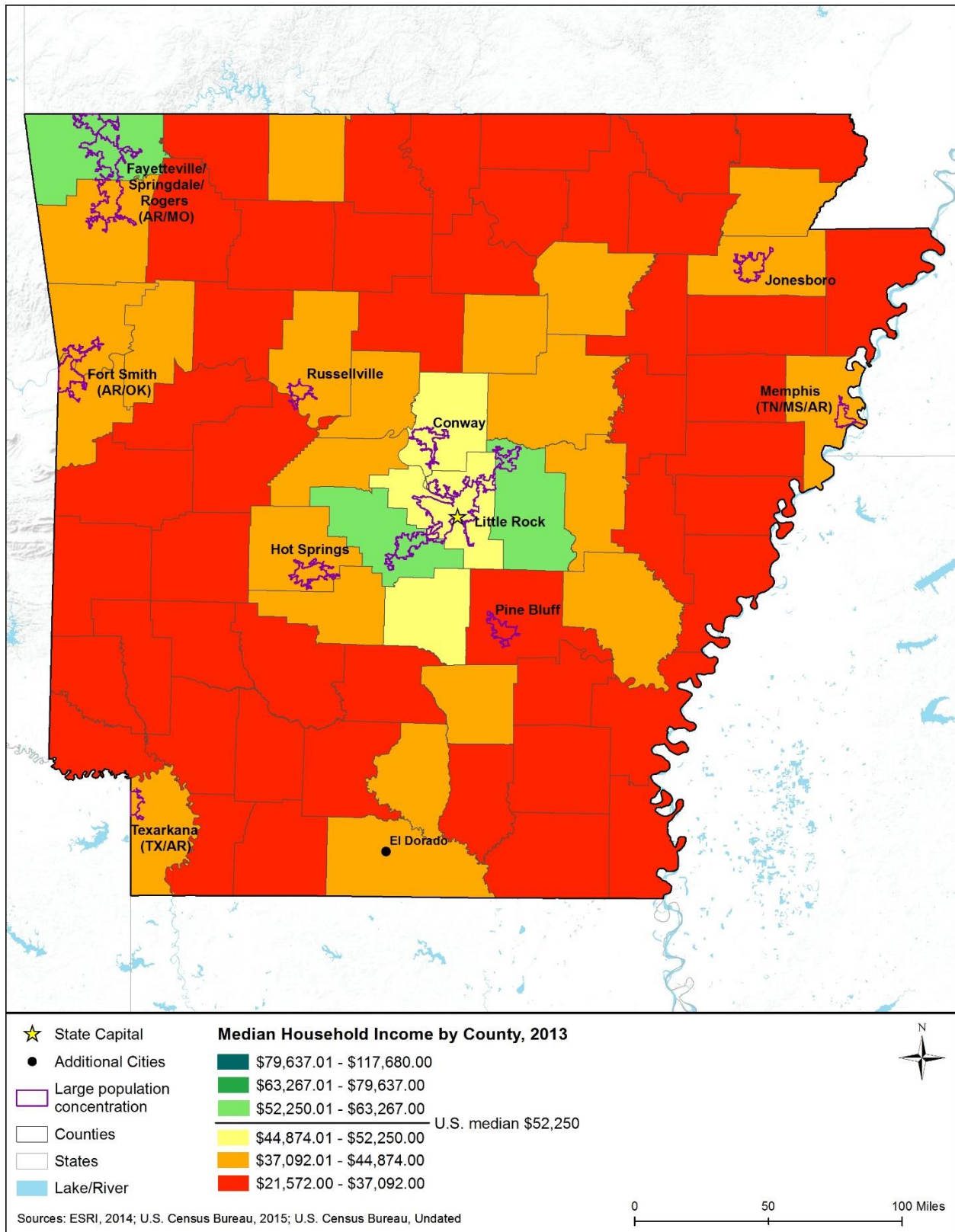


Figure 4.1.9-2: Median Household Income in Arkansas, by County, 2013

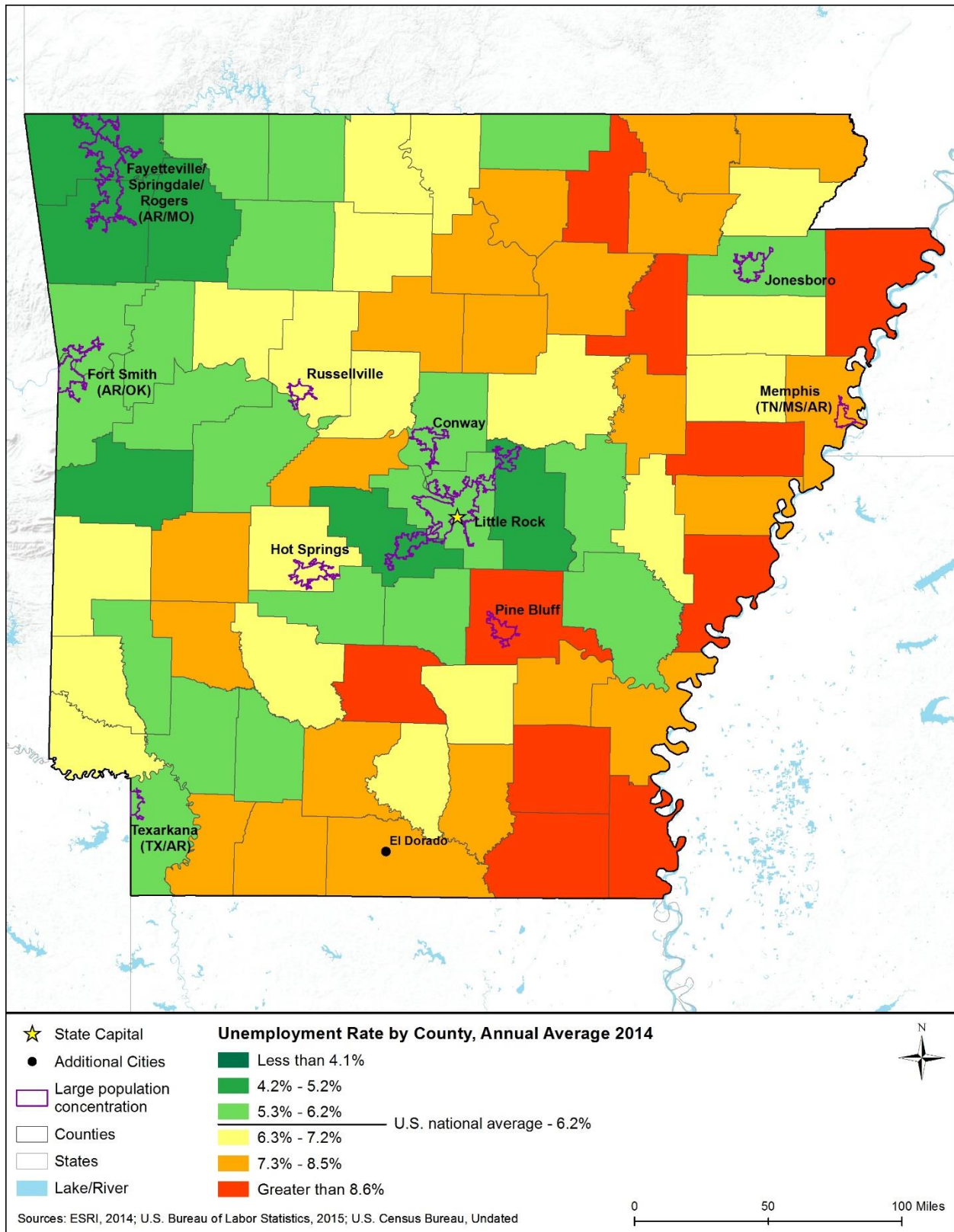


Figure 4.1.9-3: Unemployment Rates in Arkansas, by County, 2014

Table 4.1.9-7: Employment by Class of Worker and by Industry, 2013

Class of Worker and Industry	Arkansas	South Region	United States
Civilian Employed Population 16 Years and Over	1,241,828	45,145,155	145,128,676
Percentage by Class of Worker			
Private wage and salary workers	77.8%	79.4%	79.7%
Government workers	16.0%	14.5%	14.1%
Self-employed in own not incorporated business workers	6.1%	5.9%	6.0%
Unpaid family workers	0.1%	0.2%	0.2%
Percentage by Industry			
Agriculture, forestry, fishing and hunting, and mining	3.0%	2.4%	2.0%
Construction	6.6%	6.9%	6.2%
Manufacturing	13.6%	9.9%	10.5%
Wholesale trade	2.4%	2.8%	2.7%
Retail trade	13.5%	12.1%	11.6%
Transportation and warehousing, and utilities	5.5%	5.2%	4.9%
Information	1.7%	1.9%	2.1%
Finance and insurance, and real estate and rental and leasing	4.7%	6.3%	6.6%
Professional, scientific, management, administrative, and waste management services	7.2%	10.5%	11.1%
Educational services, and health care and social assistance	24.3%	22.0%	23.0%
Arts, entertainment, and recreation, and accommodation and food services	8.3%	9.9%	9.7%
Other services, except public administration	4.9%	5.2%	5.0%
Public administration	4.4%	4.8%	4.7%

Source: (U.S. Census Bureau, 2013)

Table 4.1.9-8 presents employment shares for selected industries for the 10 largest population concentrations in the state. The table reflects survey data taken by the Census Bureau from 2009 to 2013. Thus, its figures for the state are slightly different from those in Table 4.1.9-8 for 2013.

Table 4.1.9-8: Employment by Selected Industries for the 10 Largest Population Concentrations in Arkansas, 2009–2013

Area	Construction	Transportation and Warehousing, and Utilities	Information	Professional, Scientific, Management, Administrative and Waste Management Services
Conway	6.2%	3.2%	3.1%	9.2%
Fayetteville/Springdale/Rogers (AR/MO) (AR Portion)	6.0%	4.6%	1.3%	9.5%
Fort Smith (AR/OK) (AR Portion)	4.9%	4.3%	1.2%	7.1%
Hot Springs	8.1%	4.4%	1.5%	7.3%
Jonesboro	5.6%	3.4%	1.2%	6.6%
Little Rock	5.4%	4.9%	3.0%	8.8%
Memphis (TN/MS/AR) (AR Portion)	4.6%	8.8%	0.8%	6.4%
Pine Bluff	3.1%	4.5%	1.1%	6.0%
Russellville	7.7%	4.5%	1.7%	7.8%
Texarkana (TX/AR) (AR Portion)	4.7%	5.7%	1.0%	7.0%
Arkansas (statewide)	6.8%	5.5%	1.6%	6.8%

Source: (U.S. Census Bureau, 2013f)

Housing

The housing stock is an important socioeconomic component of communities. The type, availability, and cost of housing in an area reflect economic conditions and affect quality of life. Table 4.1.9-9 compares Arkansas to the South region and nation on several common housing indicators.

As shown in this table, in 2013 Arkansas had a lower percentage of housing units that were occupied (84.7 percent) than the region (85.2 percent) or nation (87.6 percent). Of the occupied units, Arkansas had a slightly higher percentage of owner-occupied units (65.7 percent) than the region (64.6 percent) and nation (63.5 percent). Arkansas had a higher percentage of detached single-unit housing (also known as single-family homes) in 2013 (69.3 percent) compared to the region (63.8 percent) and nation (61.5 percent). The homeowner vacancy rate in Arkansas (2.9 percent) was somewhat higher than the rate for the region (2.2 percent) and was slightly higher than the rate for the nation (1.9 percent). This rate reflects, “vacant units that are ‘for sale only’” (U.S. Census Bureau, 2013f). The vacancy rate among rental units was higher in Arkansas (9.7 percent) than in the region (8.5 percent) and nation (6.5 percent).

Table 4.1.9-9: Selected Housing Indicators for Arkansas, 2013

Geography	Total Housing Units	Housing Occupancy & Tenure				Units in Structure
		Occupied Housing	Owner-Occupied	Homeowner Vacancy Rate	Rental Vacancy Rate	1-Unit, Detached
Arkansas	1,329,777	84.7%	65.7%	2.9%	9.7%	69.3%
South Region	44,126,724	85.2%	64.6%	2.2%	8.5%	63.8%
United States	132,808,137	87.6%	63.5%	1.9%	6.5%	61.5%

Source: (U.S. Census Bureau, 2012b)

Table 4.1.9-10 provides housing indicators for the largest population concentrations in the state. The table reflects survey data taken from 2009 to 2013. Thus, its figures are not directly comparable to the more recent data in the previous table. However, it does present variation in these indicators for population concentrations across the state and compared to the state average for the 2009 to 2013 period.

Table 4.1.9-10 shows that during this period the percentage of occupied housing units ranged from 77.00 to 92.1 percent across these population concentrations.

Table 4.1.9-10: Selected Housing Indicators for the 10 Largest Population Concentrations in Arkansas, 2009–2013

Area	Total Housing Units	Housing Occupancy & Tenure				Units in Structure
		Occupied Housing	Owner-Occupied	Homeowner Vacancy Rate	Rental Vacancy Rate	1-Unit, Detached
Conway	27,802	90.1%	54.1%	2.0%	12.7%	59.4%
Fayetteville/Springdale/Rogers (AR/MO) (AR Portion)	127,245	88.9%	55.8%	3.2%	9.7%	62.9%
Fort Smith (AR/OK) (AR Portion)	52,983	89.3%	57.2%	3.1%	9.3%	68.8%
Hot Springs	29,188	77.0%	58.3%	4.5%	12.0%	62.5%
Jonesboro	28,322	91.1%	51.4%	3.2%	8.0%	64.8%
Little Rock	196,243	87.7%	60.9%	3.7%	13.9%	67.3%
Memphis (TN/MS/AR) (AR Portion)	17,037	87.1%	53.2%	4.3%	9.4%	67.2%
Pine Bluff	22,624	85.9%	56.7%	2.7%	9.2%	72.2%
Russellville	12,805	92.1%	50.5%	0.6%	9.1%	65.0%
Texarkana (TX/AR) (AR Portion)	11,744	85.4%	55.1%	3.2%	12.4%	65.9%
Arkansas (statewide)	1,320,772	85.5%	66.7%	2.5%	9.8%	69.6%

Sources: (U.S. Census Bureau, 2013g)

Property Values

Property values have important relationships to both the wealth and affordability of communities. Table 4.1.9-11 provides indicators of residential property values for Arkansas and compares these values to values for the South region and nation. Median values of owner-occupied units are from the Census Bureau's ACS, based on owner estimates of how much their property (housing unit and land) would sell for if it were for sale. (U.S. Census Bureau, 2013f)

The table shows that the median value of owner-occupied units in Arkansas in 2013 (\$109,500) was lower than the corresponding value for the South region (\$137,752) and considerably lower than that for the nation (\$173,900).

Table 4.1.9-11: Residential Property Values in Arkansas, 2013

Geography	Median Value of Owner-Occupied Units
Arkansas	\$109,500
South Region	\$137,752
United States	\$173,900

Source: (U.S. Census Bureau, 2012b)

Table 4.1.9-12 presents residential property values for the largest population concentrations in the state. The table reflects survey data taken from 2009 to 2013. Thus, its figures are not directly comparable to the more recent data in the previous table. However, it does show variation in property values for population concentrations across the state and compared to the state average for the 2009 to 2013 period. Only 2 of the 10 areas had median values lower than the state median value (\$137,752), including the Pine Bluff area and the Arkansas portion of the Texarkana area. The lowest median value area (Pine Bluff area, \$78,600) also had the lowest median household income relative to the state average and most other population concentrations.

Table 4.1.9-12: Residential Property Values for the 10 Largest Population Concentrations in Arkansas, 2009–2013

Area	Median Value of Owner-Occupied Units
Conway	\$143,100
Fayetteville/Springdale/Rogers (AR/MO) (AR Portion)	\$148,400
Fort Smith (AR/OK) (AR Portion)	\$110,900
Hot Springs	\$130,300
Jonesboro	\$129,500
Little Rock	\$138,500
Memphis (TN/MS/AR) (AR Portion)	\$102,800
Pine Bluff	\$78,600
Russellville	\$115,600
Texarkana (TX/AR) (AR Portion)	\$94,600
Arkansas (statewide)	\$107,300

Sources: (U.S. Census Bureau, 2013g)

Government Revenues

State and local governments obtain revenues from many sources. FirstNet projects may affect flows of revenue sources between different levels of government due to program financing and intergovernmental agreements for system development and operation. Public utility taxes are a subcategory of selective sales taxes that includes taxes on providers of land and mobile telephone, telegraph, cable, and internet services (U.S. Census Bureau, 2006). These service providers may obtain new taxable revenues from operation of components of the public safety broadband network. These revenue streams are typically highly localized and therefore are best considered in the deployment phase of FirstNet.

Table 4.1.9-13 presents total and selected state and local government revenue sources as reported by the Census Bureau's 2012 Census of Governments. It provides both total dollar figures (in millions of dollars) and figures per capita (in dollars), based on total population for each geography. The per capita figures are particularly useful in comparing the importance of certain revenue sources in the state relative to other states in the region and the nation. State and local governments may obtain some additional revenues related to telecommunications infrastructure. General and selective sales taxes may change, reflecting expenditures during system development and maintenance.

Table 4.1.9-13 shows that state government in Arkansas received more total revenue in 2012 on a per capita basis than its counterpart governments in the region and nation. Local governments in Arkansas, on the other hand, received less total revenue in 2012 on a per capita basis than their counterpart governments in the region and nation. Likewise, the state government in Arkansas had higher levels per capita of intergovernmental revenue¹¹⁰ from the federal government in 2012 on a per capita basis than its counterpart governments in the region and nation, while local governments had lower levels per capita when compared to counterparts in both the region and nation. Arkansas's state government obtained considerably higher levels of property taxes per capita than state governments in the region and nation. Local governments in Arkansas obtained substantially lower levels of property taxes per capita than local governments in the region and nation. State and local governments in Arkansas obtained more revenue from general sales taxes, per capita, than their counterparts in both the region and nation. The state government in Arkansas reported lower revenue from selective sales taxes, on a per capita basis, than its counterparts in the region, and nation. The state government in Arkansas reported no revenue from public utility taxes, while local governments reported similar revenue from public utility taxes than their regional and national counterparts. The state government in Arkansas reported higher levels of individual and corporate income tax revenues, on a per capita basis, than its counterparts in the region and nation. Arkansas local governments received no revenue from individual or corporate income taxes.

¹¹⁰ Intergovernmental revenues are those revenues received by one level of government from another level of government, such as shared taxes, grants, or loans and advances (U.S. Census Bureau, 2006).

Table 4.1.9-13: State and Local Government Revenues, Selected Sources, 2012

Type of Revenue	Arkansas		Region		United States	
	State Govt. Amount	Local Govt. Amount	State Govt. Amount	Local Govt. Amount	State Govt. Amount	Local Govt. Amount
Total Revenue (\$M)	\$18,434	\$9,820	\$524,374	\$449,683	\$1,907,027	\$1,615,194
Per capita	\$6,251	\$3,330	\$5,148	\$4,414	\$6,075	\$5,145
Intergovernmental from Federal (\$M)	\$5,901	\$368	\$160,706	\$18,171	\$514,139	\$70,360
Per capita	\$2,001	\$125	\$1,578	\$178	\$1,638	\$224
Intergovernmental from State (\$M)	\$0	\$4,744	\$0	\$115,088	\$0	\$469,147
Per capita	\$0	\$1,608	\$0	\$1,130	\$0	\$1,495
Intergovernmental from Local (\$M)	\$9	\$0	\$2,815	\$0	\$19,518	\$0
Per capita	\$3	\$0	\$28	\$0	\$62	\$0
Property Taxes (\$M)	\$1,009	\$941	\$2,073	\$109,687	\$13,111	\$432,989
Per capita	\$342	\$319	\$20	\$1,077	\$42	\$1,379
General Sales Taxes (\$M)	\$2,809	\$934	\$82,651	\$25,836	\$245,446	\$69,350
Per capita	\$953	\$317	\$811	\$254	\$782	\$221
Selective Sales Taxes (\$M)	\$1,173	\$196	\$41,447	\$9,394	\$133,098	\$28,553
Per capita	\$398	\$66	\$407	\$92	\$424	\$91
Public Utilities Taxes ^a (\$M)	\$0	\$149	\$5,101	\$4,745	\$14,564	\$14,105
Per capita	\$0	\$51	\$50	\$47	\$46	\$45
Individual Income Taxes (\$M)	\$2,402	\$0	\$38,637	\$1,226	\$280,693	\$26,642
Per capita	\$814	\$0	\$379	\$12	\$894	\$85
Corporate Income Taxes (\$M)	\$404	\$0	\$8,099	\$114	\$41,821	\$7,210
Per capita	\$137	\$0	\$80	\$1	\$133	\$23

Sources: (U.S. Census Bureau, 2012c; U.S. Census Bureau, 2012d)

^a Public utility taxes are a subcategory of selective sales taxes that includes taxes on providers of land and mobile telephone, telegraph, cable, and internet services (U.S. Census Bureau, 2006).

Note: This table does not include all sources of government revenue. Summation of the specific source rows does not equal total revenue.

4.1.10. Environmental Justice

4.1.10.1. Definition of the Resource

EO 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, issued in 1994, sets out principles of environmental justice and requirements that federal agencies should follow to comply with the EO (see Section 1.8.12, Executive Order 12898 – Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations).¹¹¹ The fundamental principle of environmental justice “fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies” (USEPA, 2016b). Under the EO, each federal

¹¹¹ See <https://www.epa.gov/laws-regulations/summary-executive-order-12898-federal-actions-address-environmental-justice>.

agency must “make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations” (Executive Office of the President, 1994). In response to the EO, the Department of Commerce developed an Environmental Justice Strategy in 1995, and published an updated strategy in 2013 (U.S. Department of Commerce, 2013).

In 1997, the Council on Environmental Quality (CEQ) issued *Environmental Justice: Guidance under the National Environmental Policy Act (NEPA)* to assist federal agencies in meeting the requirements of the EO (CEQ, 1997). Additionally, the USEPA Office of Environmental Justice (USEPA, 2015f) offers guidance on Environmental Justice issues and provides an “environmental justice screening and mapping tool,” EJSCREEN (USEPA, 2015g).

The CEQ guidance provides several important definitions and clarifications that this PEIS utilizes:

- Minority populations consist of “Individual(s) who are members of the following population groups: American Indian or Alaskan Native; Asian or Pacific Islander; Black, not of Hispanic origin; or Hispanic.”
- Low-income populations consist of individuals living in poverty, as defined by the Census Bureau.
- Environmental effects include social and economic effects. Specifically, “Such effects may include ecological, cultural, human health, economic, or social impacts on minority communities, low-income communities, or Indian tribes when those impacts are interrelated to impacts on the natural or physical environment.” (CEQ, 1997)

In 2014, the USEPA issued the *Policy on Environmental Justice for Working with Federally Recognized Tribes and Indigenous Peoples*, which establishes principles to ensure that achieving environmental justice is part of the USEPA's work with federally recognized tribes and Indigenous Peoples in all areas of the U.S. and its territories and possessions, the District of Columbia, the Commonwealth of Puerto Rico, and the Commonwealth of the Mariana Islands, and others living in Indian country. The policy, which is based on Executive Order 12898 as well as USEPA strategic plan and policy documents, contains 17 principles pertaining to the policy's four focus areas. These four focus areas are:

- Direct implementation of federal environmental programs in Indian country, and throughout the U.S.;
- Work with federally recognized tribes/tribal governments on environmental justice;
- Work with Indigenous Peoples (state recognized tribes, tribal members, etc.) on environmental justice; and
- Coordinate and collaborate with federal agencies and others on environmental justice issues of tribes, Indigenous Peoples, and others living in Indian country.

The policy includes accountability for the implementation of the policy, a definitions section, and an appendix that contains a list of implementation tools available.

4.1.10.2. *Specific Regulatory Considerations*

In 1993, Arkansas enacted legislation, the Arkansas Environmental Equity Act, to “prevent communities from becoming involuntary hosts to a proliferation of high impact solid waste management facilities.” This law recognized that these high impact facilities tend to be located near minority or low-income communities. As of 2010, the ADEQ did not have a formal environmental justice policy in place. However, some ADEQ staff members have addressed environmental justice issues as part of ADEQ’s broader public outreach program (University of California, Hastings College of Law, 2010). The federal laws relevant to environmental justice in Arkansas are summarized in detail in Section 1.8, Overview of Relevant Federal Laws and Executive Orders.

4.1.10.3. *Environmental Setting: Minority and Low-Income Populations*

Table 4.1.10-1 presents 2013 data on the composition of Arkansas’s population by race and by Hispanic origin. The state’s population has a lower percentage of individuals who identify as Black/African American (15.7 percent) than the population of the South region (18.4 percent), and a higher percentage than in the nation’s population (12.6 percent). In comparison to both the South region and the nation, Arkansas has a population with slightly lower percentages of individuals who identify as Asian (1.3 percent) and Some Other Race (2.3 percent). Those percentages are, for Asian, 2.6 percent for the region and 5.1 percent for the nation, and for Some Other Race, 3.3 percent and 4.7 percent, respectively. The proportion of the state’s population identifying as White (77.9 percent) is larger than that of the South region (72.3 percent) and the nation (73.7 percent).

The percentage of the population in Arkansas that identifies as Hispanic (6.9 percent) is smaller than in the South region (18.8 percent) and the nation (17.1 percent). Hispanic origin is a different category than race; persons of any race may identify as also being of Hispanic origin. The category All Minorities consists of all persons who consider themselves Hispanic or of any race other than White. Arkansas’s All Minorities population percentage (26.4 percent) is lower than that of the South region (42.3 percent) and the nation (37.6 percent).

Table 4.1.10-1: Population by Race and Hispanic Status, 2013

Geography	Total Population (estimated)	Race							Hispanic	All Minorities ^a
		White	Black/African Am	Am. Indian/Alaska Native	Asian	Native Hawaiian/Pacific Islander	Some Other Race	Two or More Races		
Arkansas	2,959,373	77.9%	15.7%	0.6%	1.3%	0.0%	2.3%	2.2%	6.9%	26.4%
South Region	102,853,019	72.3%	18.4%	0.9%	2.6%	0.1%	3.3%	2.4%	18.8%	42.3%
United States	316,128,839	73.7%	12.6%	0.8%	5.1%	0.2%	4.7%	3.0%	17.1%	37.6%

Source: (U.S. Census Bureau, 2013h)

^a “All Minorities” is defined as all persons who consider themselves Hispanic or of any race other than White. Because some Hispanics identify as both Hispanic and of a non-White race, “All Minorities” is less than the sum of Hispanics and non-White races.

Table 4.1.10-2 presents the percentage of the population living in poverty in 2013, for the state, region, and nation. The figure for Arkansas (19.7 percent) is slightly higher than that for the South region (18.2 percent) and higher than the figure for the nation (15.8 percent).

Table 4.1.10-2: Percentage of Population (Individuals) in Poverty, 2013

Geography	Percent Below Poverty Level
Arkansas	19.7%
South Region	18.2%
United States	15.8%

Source: (U.S. Census Bureau, 2013i)

4.1.10.4. Environmental Justice Screening Results

Analysis of environmental justice in a NEPA document typically begins by identifying potential environmental justice populations in the project area. Appendix D presents the methodology used in this PEIS to screen each state for the presence of potential environmental justice populations. The methodology builds on CEQ guidance and best practices used for environmental justice analysis. It uses data at the census-block group level; block groups are the smallest geographic units for which regularly updated socioeconomic data are readily available at the time of writing.

Figure 4.1.10-1 visually portrays the results of the environmental justice population screening analysis for Arkansas. The analysis used block group data from the Census Bureau’s American Community Survey 2009-2013 5-Year Estimates (U.S. Census Bureau, 2013b) (U.S. Census Bureau, 2015f; U.S. Census Bureau, 2015g; U.S. Census Bureau, 2015h) and Census Bureau urban classification data (U.S. Census Bureau, 2010) (U.S. Census Bureau, 2012a).

Figure 4.1.10-1 shows that a high proportion of Arkansas has high potential for environmental justice populations. The distribution of these high potential areas is fairly even across the state, and occurs both within and outside of the 10 largest population concentrations. The distribution of areas with moderate potential for environmental justice populations is also fairly even across the state.

It is important to understand how the data behind Figure 4.1.10-1 affect the visual impact of this map. Block groups have similar populations (hundreds to a few thousand individuals) regardless of population density. In sparsely populated areas, a single block group may cover tens or even hundreds of square miles, while in densely populated areas, block groups each cover much less than a single square mile. Thus, while large portions of the state outside the areas defined as large population concentrations show moderate or high potential for environmental justice populations, these low density areas reflect modest numbers of minority or low-income individuals compared to the potential environmental justice populations within densely populated areas. The overall effect of this relative density phenomenon is that the map visually shows large areas of the state having environmental justice potential, but this over-represents the presence of environmental justice populations.

It is also very important to note that Figure 4.1.10-1 does not definitively identify environmental justice populations. It indicates *degrees of likelihood of the presence* of populations of potential concern from an environmental justice perspective. Two caveats are important. First, environmental justice communities are often highly localized. Block group data may under- or over-represent the presence of these localized communities. For instance, in the large block groups in sparsely populated regions of the state, the data may represent dispersed individuals of minority or low-income status rather than discrete, place-based communities. Second, the definition of the moderate potential category draws a wide net for potential environmental justice populations. As discussed in Appendix D, the definition includes some commonly used thresholds for environmental justice screening that tend to over-identify environmental justice potential. Before FirstNet deploys projects, additional site-specific analyses to identify specific, localized environmental justice populations may be warranted. Such analyses could tier-off the methodology of this PEIS.

This map also does not indicate whether FirstNet projects would have actual impacts on environmental justice populations. An environmental justice effect on minority or low-income populations only occurs if the effect is harmful or significant (according to significance criteria), and “appreciably exceeds or is likely to appreciably exceed the risk or rate to the general population or other appropriate comparison group” (CEQ, 1997). The Environmental Consequences section (Section 4.2) addresses the potential for disproportionately high and adverse environmental or human health impacts on environmental justice populations.

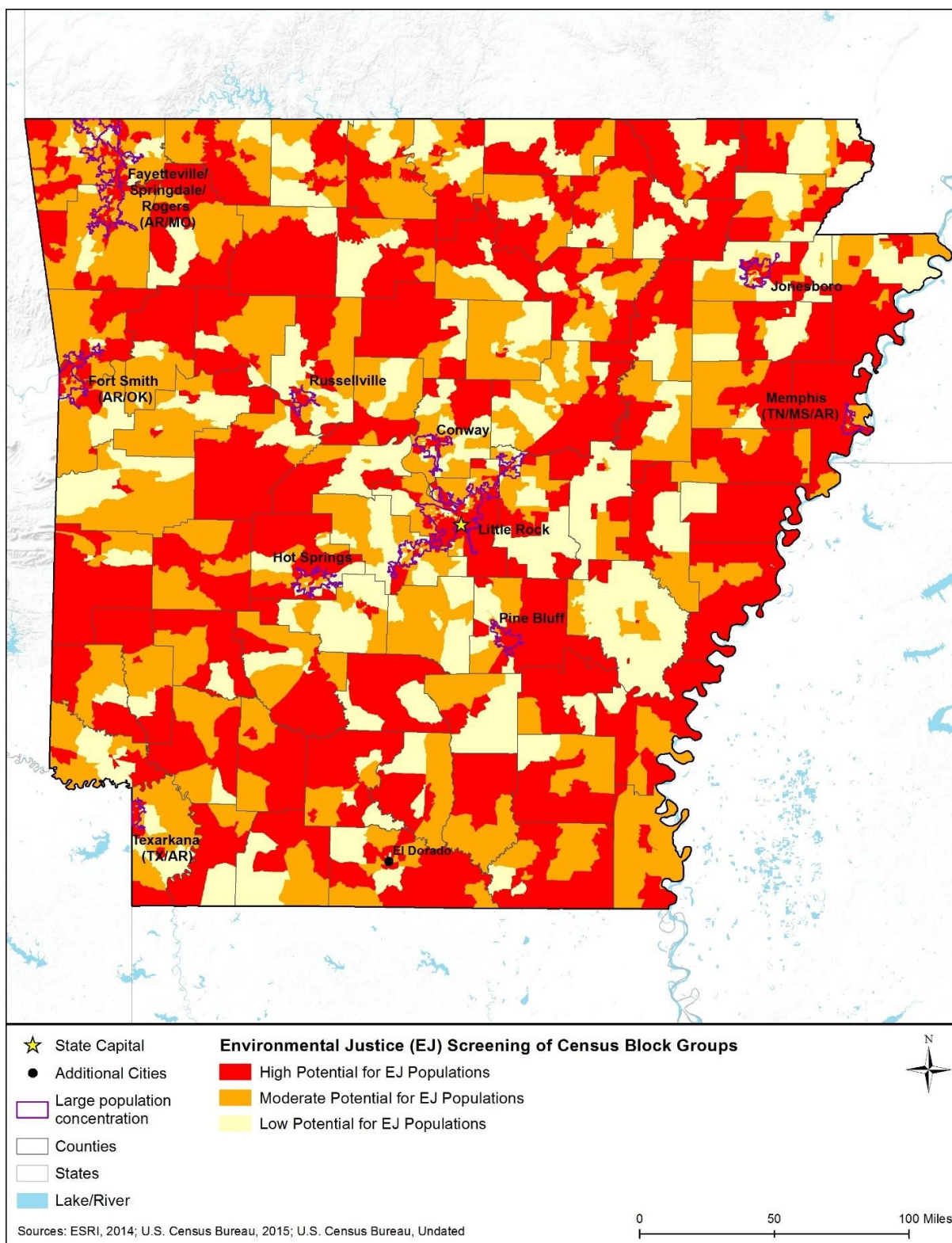


Figure 4.1.10-1: Potential for Environmental Justice Populations in Arkansas, 2009–2013

4.1.11. Cultural Resources

4.1.11.1. Definition of Resource

For the purposes of this PEIS, cultural resources are defined as:

Natural or manmade structures, objects, features, locations with scientific, historic, and cultural value, including those with traditional religious or cultural importance and any prehistoric or historic district, site, or building included in, or eligible for inclusion in, the NRHP.

This definition is consistent with the how cultural resources are defined in the:

- Statutory language and implementing regulations for Section 106 of the National Historic Preservation Act of 1966, as amended, formerly 16 U.S.C. 470a(d)(6)(A) (now 54 U.S.C. 306131(b)) and 36 CFR 800.16(l)(1);
- Statutory language and Implementing regulations for the Archaeological Resources Protection Act of 1979, 16 U.S.C. 470cc(c) and 43 CFR 7.3(a);
- Statutory language and implementing regulations for the Native American Graves Protection and Repatriation Act, 25 U.S.C. 3001(3)(D) and 43 CFR 10.2(d);
- NPS program support of public and private efforts to identify, evaluate, and protect America's historic and archeological resources (NPS, 2015i); and
- Advisory Council on Historic Preservation's guidance for protection and preservation of sites and artifacts with traditional religious and cultural importance to American Indian tribes or Native Hawaiian organizations (Advisory Council on Historic Preservation, 2004).

4.1.11.2. Specific Regulatory Considerations

The Proposed Action must meet the requirements of NEPA and other applicable federal laws and regulations. Federal laws and regulations that apply to Cultural Resources include the NHPA (detailed in Section 1.8, Overview of Relevant Federal Laws and Executive Orders), the American Indian Religious Freedom Act (AIRFA), Archaeological Resources Protection Act (ARPA), and Native American Graves Protection and Repatriation Act (NAGPRA). Appendix C, Environmental Laws and Regulations, summarizes these pertinent federal laws. Arkansas does not have state regulations that are comparable to the NHPA or NEPA. While federal agencies may take into account compatible state laws and regulations, their actions that are subject to federal environmental review under NEPA and NHPA are not subject to compliance with such state laws and regulations. Table 4.1.11-1 presents state and local laws and regulations that relate to cultural resources.

Table 4.1.11-1: Relevant Arkansas Cultural Resources Laws and Regulations

State Law/Regulation	Regulatory Agency	Description
Arkansas Historic Preservation Program, A.C.A. § 13-7-101 et seq.	Department of Arkansas Heritage (SHPO)	Establishes the Department of Arkansas Heritage, Historic Preservation program, as the State Historic Preservation Office for Arkansas.
Arkansas State Burial Site Statutes, A.C.A. § 13-6-201-216 and 13-6-401-409	SHPO and local law enforcement	These laws prohibit the physical abuse or mistreatment of human remains, burials, grave markers, and associated objects. If a burial is uncovered during development or construction, work must stop immediately in the area and local law enforcement should be notified. Following determination that the site does not constitute a crime scene and the remains are a prehistoric or historic human burial, the SHPO may assist the project proponent, developer, and/or landowner in contacting appropriate parties, considering options to avoid the burial(s), and advising on the legal process for potentially moving the remains.

Sources: (Department of Arkansas Heritage, 2016), (JUSTIA, 2015b)

4.1.11.3. Cultural and Natural Setting

Human beings have inhabited the Arkansas region for more than 13,500 years. The last ice age created many waterways and drainage areas throughout the state, which provided an abundance of natural resources for early habitation, and the means for transportation and trade by later cultures. The temperate climate and abundance of water and fertile land throughout the region has supported productive agricultural practices since prehistoric times, which continue to be developed and expanded throughout the state. (Jennings, 2008; Rolingson & Howard, 1997; Gillam, 1996) (NPS, 2015j)

The geology of the region also has provided an abundance of raw materials that ancient American Indians used to make tools. Since the beginning of human settlement in Arkansas, the advancement of tool technology was crucial in the development and resilience of societies throughout the region. (NPS, 2015j)

Most archeological evidence in Arkansas is found in relatively shallow deposits on the surface or within one to two feet of the surface. However, in some cases, natural factors have buried sites beneath multiple layers of sediment or organic materials, such as in floodplain deposits found along streams and rivers or peat deposits in wetlands. These alluvial deposits can range from 1 to 10 feet below the current surface, with older sites typically in the deeper sediments. Disturbed ground, including urban areas, may contain archaeological resources in deeper or shallower strata than undisturbed areas (Harris, 1979). In addition to the hundreds of archaeological sites listed in the state's inventory, there are 71 archaeological sites listed on the NRHP (NPS, 2015b).

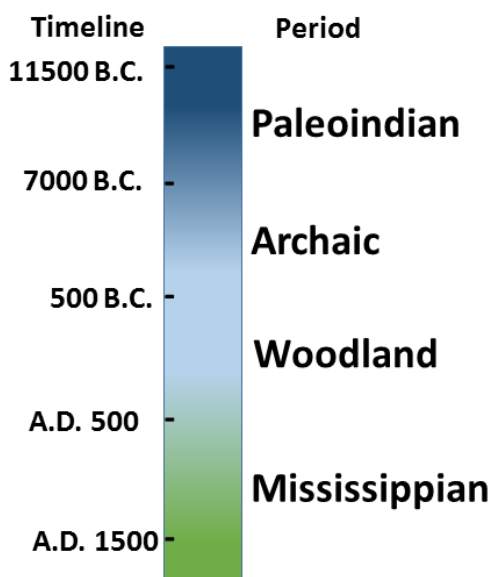
Archaeologists typically divide large areas into regions to concentrate their studies. As depicted in Figure 4.1.3-1, there are two physiographic region in Arkansas: the Interior Highlands and Atlantic Plain. The Atlantic Plain encompasses the southeastern half of the state and is made up of the Coastal Plain region. The Interior Highlands spans the northwestern half of Arkansas and contains two provinces. The Ouachita province is comprised of the southern area of the Interior

Highlands, while the north is made up of the Ozark Plateau (commonly called “the Ozarks”). The Atlantic Plain is composed entirely of the Coastal Plain physiographic province.

The following sections provide additional detail about Arkansas’s prehistoric periods (approximately 11500 B.C. to A.D.1541) and the historic period since European contact and exploration in the mid-1500s. Section 4.1.11.4 presents an overview of the initial human habitation in Arkansas and the cultural development that took place prior to European contact. Section 4.1.11.5 discusses the federally recognized American Indian Tribes with a cultural affiliation to the state. Section 4.1.11.6 provides a current list of significant archaeological sites in Arkansas and tools that the state has developed to ensure their preservation. Section 4.1.11.7 summarizes the historic context of the state since European contact, and Section 4.1.11.8 addresses the architectural context of the state during the historic period.

4.1.11.4. Prehistoric Setting

There are four distinct periods associated with the prehistoric human populations that inhabited present day Arkansas: The Paleoindian period (11500 to 7000 B.C.), Archaic (7000 to 500 B.C.), Woodland (500 B.C. to A.D. 500), and Mississippian (A.D. 500 to 1541). Figure 4.1.11-1 shows a timeline representing these periods of early human habitation in Arkansas. It is important to note that there is potential for undiscovered archaeological remains representing every prehistoric period throughout the state. Evidence of human occupation has been discovered in every physiographic region of Arkansas (Anderson, D., 1995).



Sources: (Institute of Maritime History, 2015)
(Arkansas Archeological Society, 2015)

Figure 4.1.11-1: Timeline of Prehistoric Human Occupation in Arkansas

Paleoindian Period (11500 – 7000 B.C.)

The Paleoindian Period represents the earliest human habitation of the southeastern United States. Paleoindians lived in small groups of nomadic hunters and gatherers that used chipped-stone tools, including the “fluted javelin head” arrow and spear projectile points (Clovis or Folsom projectile points). Studies show that that similar technology was prevalent in northeastern Asia, the Arabian Peninsula, and Spain prior to human arrival into North America (Charpentier, Inizan, & Feblot-Augustins, 2002). The people who occupied Arkansas during the Paleoindian Period are believed to have descended from those that arrived in North America via a land bridge that existed in the Bering Strait during the latter part of the last ice age (Late Pleistocene epoch) (Gillam, 1996; Jennings, 2008).

Paleoindians of the Arkansas region hunted large mammals that are now extinct, such as giant bison, mammoths, and ground sloths (Ritterbush, 2002; Ritterbush & Logan, 2000). As the climate changed and large migratory mammals decreased in numbers, the people began to change their hunting technologies as well as exploit other plant and animal species for sustenance, including small mammals and fish (Redmond & Tankersley, 2015; Sciulli & Aument, 1987; Waters, Stafford, Redmond, & Tankersley, 2009) (Anderson, et al., 2010).

Paleoindian artifacts are not distributed evenly throughout the state; the majority that have been recovered come from in northeast Arkansas, although some Clovis points and other period artifacts have been found in the northwest portion of the state (Gillam, 1996).

Archaic Period (7000 – 500 B.C.)

The climate of the Archaic Period was becoming very similar to that of the present and various flora and fauna now found in Arkansas began to be established. The American Indian people continued the hunter-gather lifestyle of their Paleoindian Period forbears, while developing cohesive family based units. Their diet was predominantly wild plants and animals, but there is evidence of early horticulture and then agriculture. (NPS, 2015j)

Archaic Period people manufactured stone arrow points, drills, choppers, flake knives, scrapers, gouges, and hammerstones. They began to develop permanent settlements adjacent to streams and rivers where potable water could be found and the soils were conducive for food plants. Based on the relative number of archaeological sites, the population of Arkansas grew substantially during the early Archaic Period. (Haag, 1961) (NPS, 2015j)

By the middle of the Archaic Period, societies across Arkansas became more regionalized, tools became more sophisticated, and the discovery of grinding implements throughout the state provides evidence that successful agriculture was starting (NPS, 2015j). Most food was obtained though hunting of game, harvesting wild plants, and shellfishing along the coast. Archaeology of middle Archaic Period sites show storage pits, remains of house floors, and the burying of deceased members, which are indications of people transitioning toward sedentary lifestyles. (NPS, 2015j) (Alvey, 2005)

Increasing cultural regionalization and sedentary societies occurred through the late Archaic Period throughout the southeastern United States, including Arkansas. The first sign of fiber-

tempered fired and decorated ceramic technology becomes evident in the archaeological record, which gave way to the beginning of the Woodland and Mississippian cultures that would follow. (Rothschild, Turner, & DeLuca, 1988)

Also in the late Archaic Period was the so-called Gulf Formational Period (2500 to 500 B.C.) in Arkansas, middle Tennessee, and eastern Mississippi. The Gulf Formational Period is distinguished by the development of fiber-tempered ceramic technology, which was invented as a result of “trade between the Stallings Island and Orange cultures of the South Atlantic coast and the Poverty Point culture of the lower Mississippi River Valley.” Prior to fiber-tempered pottery, the varieties were undecorated. At the end of the Archaic Period and throughout the Woodland Period pottery progressed from plain types, to fire-tempered, to fabric impressed, and finally to cord-marked sand-tempered ceramics, including a number of decorated types. (NPS, 2015j)

Woodland Period (500 B.C. – ca. A.D. 500)

During the course of the Woodland Period, there is an increasing shift from semi-nomadic to more sedentary lifestyles, and a continued expansion of agriculture or crop growing practices (Arkansas Archeological Society, 2015). Hunting, fishing, and shellfishing remained the predominant form of subsistence. Maize, beans, and squash cultivation increased along with more variations in types of this important subsistence. Most archaeological sites of this period that have been discovered are smaller than in prior periods; however, there is a significant increase of numbers of sites (NPS, 2015j).

The introduction of widespread pottery manufacturing took place in Arkansas during this period (as opposed to the limited production and trade-obtained ceramics of the Gulf Formational period), and most Early Woodland Period sites show evidence of this. The appearance of fiber-tempered pottery begins to appear in the archaeological record. Identifying different types of pottery is typically how archaeologists differentiate between early, middle and late Woodland periods. (NPS, 2015j)

The practice of mound building existed throughout the Middle Woodland period, and the mounds continued to become more elaborate. The ceremonial earthen mounds contained graves of elite individuals. Graves containing exotic gifts presumably to accompany the dead into the afterlife are prevalent throughout the state (Giles, Bauder, & Alfonso-Durruty, 2010). The bow and arrow also replaced the atlatl during the Middle Woodland period in Arkansas, which allowed for greater efficiency in hunting (NPS, 2015j).

A number of dart points as well as shell-tempered pottery was prevalent during the Late Woodland Period of Arkansas. An example of a Late Woodland Period site in Arkansas is the Spradley Field site in Newton County, where trash pit assemblages contain plant and animal remains, projectile points, and shell tempered pottery sherds. The Spradley Field site yielded an entire shell tempered vessel that was successfully reconstructed (Sabo & Hilliard, 2008), and contained the only known Woodland Period human burial site found in Arkansas. The burial site included shell-tempered pottery, a ceramic pipe, stone tools, knives, and other funerary objects (Hilliard & Mainfort, 2007).

Mississippian Period (A.D. 500 – 1541)

Most Mississippian period archaeological research has been focused on the Chiefdom cultures that dominated most of the region. Mississippian chiefdoms were typified by leaders who controlled profits from interregional trade parlaying their influence into control of larger areas. Distinguishing artifacts of the Mississippian Period Chiefdom culture were the elaborately engineered “large platform mounds ... concentrated in civic-ceremonial centers at the political capital” (Bense, 1996). The Caddo tribes in the Red River Valley (southwestern Arkansas) built compounds “distinguished by the presence of one or more platform mounds supporting temples and mortuary structures” (Sabo III, 2013). Successful large-scale maize cultivation, exploitation of coastal resources, and storage of food for future use became commonplace in Louisiana during the Mississippian Period. Other substance was provided by deer, fish, wild plants, and nuts (Bense, 1996).

4.1.11.5. Federally Recognized Tribes of Arkansas

According to the Bureau of Indian Affairs and the National Conference of State Legislators, there are no federally recognized American Indian Tribes in Arkansas (National Conference of State Legislators, 2015) (GPO, 2015). Figure 4.1.11-2 shows the general historic location of officially federally recognized tribes that were known to exist in this region of the United States, but are no longer present in the state.

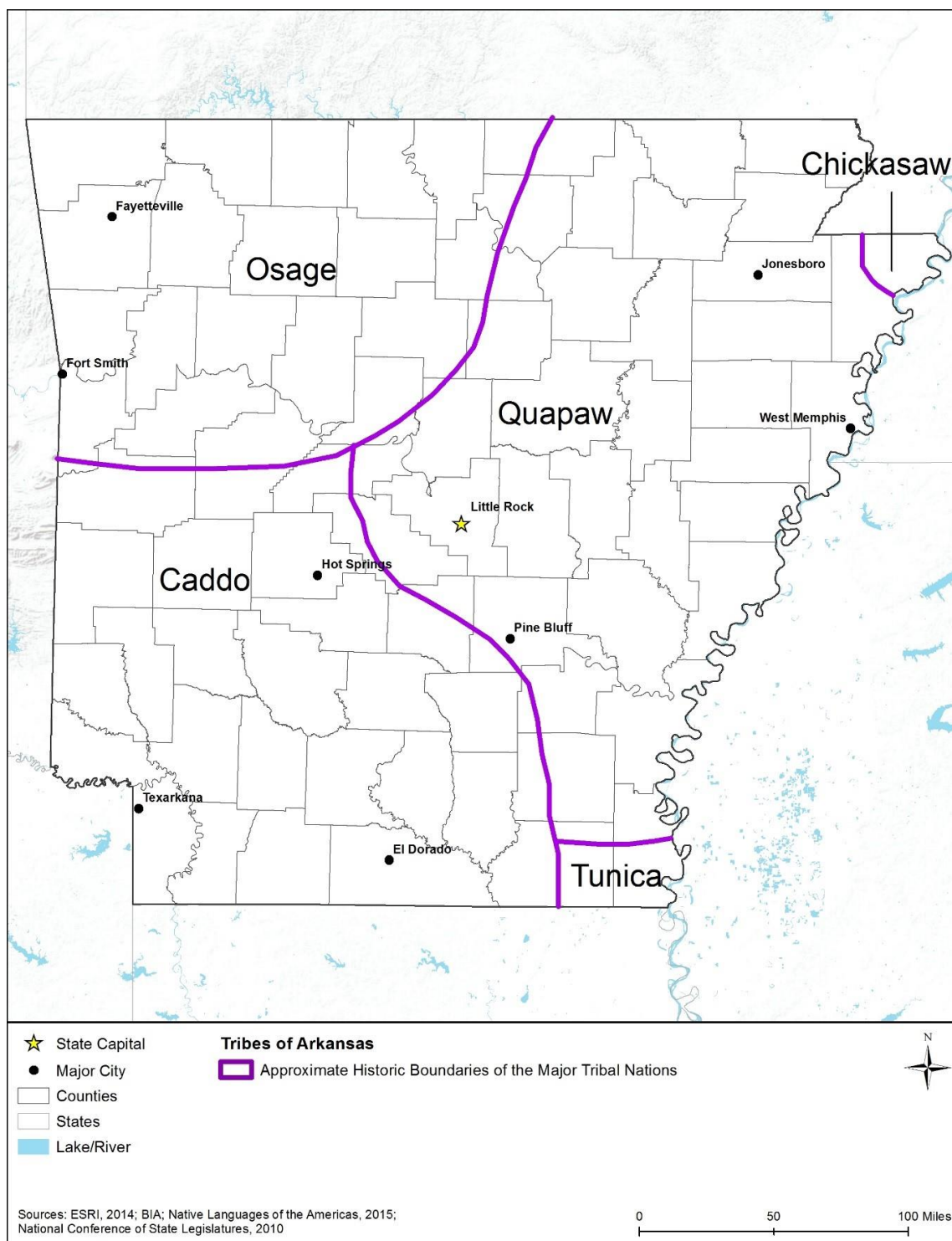


Figure 4.1.11-2: Approximate Historic Boundaries of Major Tribal Nations in Arkansas¹¹²

¹¹² Figure 4.1.11-2 is provided for context and is not intended to be exact as the various sources that were consulted contain varying ancestral territory boundaries. Instead, this figure and corresponding ancestral territory boundaries are provided to show that the historic ancestral territories and the current ancestral interests of a given tribe within a given state are often times complex as ancestral territory boundaries shifted and overlapped over time.

Arkansas State Cultural Resources Database and Tools

Arkansas Historic Preservation Program (AHHP)

The Arkansas Historic Preservation Program, which functions as the State Historic Preservation Office (SHPO), is a division of the Arkansas Department of Heritage. The AHHP oversees matters of historic preservation, as well as providing community outreach and education. AHHP sponsors monthly workshops, lectures, and tours free to the public. A database to catalog the state's cultural resources is currently under construction (Arkansas Historic Preservation Program, 2015b).

Preserve Arkansas

Preserve Arkansas advocates for the preservation of historic sites and artifacts. The organization is well known for its annual "Rambles" in which participants tour a particular region of Arkansas to learn about its cultural and historical relevance. Preservation Arkansas also publishes *Arkansas's Most Endangered Historic Places* (Historic Preservation Alliance of Arkansas, 2015).

Arkansas Archeological Society (AAS)

The Arkansas Archeological Society works to preserve local historic and prehistoric sites in Arkansas through its "Site Stewardship Program" and publishes a bimonthly newsletter and an annual bulletin, which highlight the latest and most relevant work in the state. (Arkansas Archeological Society, 2015)

4.1.11.6. Significant Archaeological Sites of Arkansas

There are 71 archaeological sites in Arkansas listed on the NRHP. Table 4.1.11-2 lists the names of the sites, the city they are closest to, and type of site. Both prehistoric and historic archaeological sites are listed. The number of archaeological sites increase as new sites are discovered. A current list of NRHP sites can be found on the NPS NRHP website at <http://www.nps.gov/nr/> (NPS, 2015d).

Table 4.1.11-2: Archaeological Sites on the National Register of Historic Places in Arkansas

Closest City	Site Name	Type of Site
Arkadelphia	Bayou Sel	Historic - Aboriginal, Prehistoric
Atkins	Archeological Site 3PP141	Prehistoric
Atkins	Archeological Site 3PP142	Prehistoric
Batesville	Ruddell Mill Site	Historic
Bay	Bay Mounds	Prehistoric
Benton	Hughes Mound Site (3SA11)	Prehistoric
Blytheville	Chickasawba Mound (3M55)	Historic, Prehistoric
Blytheville	Eaker Site	Historic - Aboriginal, Prehistoric
Brownsville	Memphis to Little Rock Road--Bayou Two Prairie Segment	Historic, Military, Historic - Aboriginal
Brownsville	Memphis to Little Rock Road--Brownsville Segment	Historic, Military, Historic - Aboriginal
Buckeye	Zebree Homestead	Prehistoric

Closest City	Site Name	Type of Site
Calion	Boone's Mounds	Prehistoric
Calion	Keller Site	Historic, Historic - Aboriginal, Prehistoric
Camden	HOMER, The (Shipwreck)	Shipwreck
Clarksville	King's Canyon Petroglyphs	Prehistoric
Clarksville	Serpent Cave	Prehistoric
Columbus	Mounds Cemetery	Historic
Conway	Cadron Settlement	Historic, Historic - Aboriginal, Prehistoric
Conway	Military Road--Cadron Segment	Historic, Historic - Aboriginal
Cotter	Fort Smith to Jackson Road--Talbert's Ferry Segments	Historic - Aboriginal
Cowell	Archeological Site 3NW79	Prehistoric
Coy	Coy Mound Site	Prehistoric
Dardanelle	Archeological Site 3YE958	Prehistoric
Desha	Desha, Franklin, House	Historic
Desha	Wyatt Petroglyphs	Prehistoric
Dover	Crow Mountain Petroglyph	Prehistoric
Eureka Springs	Blue Spring Shelter	Prehistoric
Fairfield Bay	Lynn Creek Shelter	Prehistoric
Fox	Fox Pictograph	Prehistoric
Helena	Battery A Site, Battle of Helena	Military
Helena	Battery B Site, Battle of Helena	Military
Helena	Battery C Site	Military
Hervey	Crenshaw Site	Prehistoric
Indian Bay	Baytown Site	Prehistoric
Jeanette	Memphis to Little Rock Road--Strong's Ferry Segment	Historic, Military
Jones Mill	Jones Mill Site (3HS28)	Prehistoric
Malvern	Lake Catherine Quarry	Prehistoric
Mountain View	Pictograph Cave	Prehistoric
Nady	Menard--Hodges Mounds (3AR4)	Historic, Historic - Aboriginal, Prehistoric
New Shady Grove	Blackfish Lake Ferry Site	Historic - Aboriginal
Norfolk	Old Joe	Prehistoric
Oppelo	Grotto, Petit Jean No. 8	Prehistoric
Oppelo	Hardison Shelter, Petit Jean No. 3	Prehistoric
Oppelo	Indian Cave, Petit Jean No. 1	Prehistoric
Oppelo	Petit Jean No. 10	Prehistoric
Oppelo	Petit Jean No. 11	Prehistoric
Oppelo	Petit Jean No. 4	Prehistoric
Oppelo	Petit Jean No. 5	Prehistoric
Oppelo	Petit Jean No. 6	Prehistoric
Oppelo	Petit Jean No. 7	Prehistoric
Oppelo	Petit Jean No. 9	Prehistoric

Closest City	Site Name	Type of Site
Oppelo	Rockhouse Cave, Petit Jean No. 2	Prehistoric
Parkin	Parkin Indian Mound	Historic - Aboriginal, Prehistoric
Rogers	Van Winkle's Mill Site	Historic
Rudy	High Rock Petroglyph Shelter	Prehistoric
Salado	Goff Petroglyph Site	Prehistoric
Sand Gap	Archeological Site 3PP614	Prehistoric
Scott	Toltec Mounds	Prehistoric
Shirley	Edgemont Shelter	Prehistoric
Siloam Springs	Goforth--Saindon Mound Group	Prehistoric
Silver Hill	3SE33	Prehistoric
Snowballs	Cooper's Bluff	Prehistoric
Spring Hill	Dooley's Ferry Fortifications Historic District	Military
Summit	Sunburst Shelter	Prehistoric
Tichnor	Roland Site	Prehistoric
Webb City	Shelton-Rich Farmstead	Historic
Whelen Springs	Ross Site (3CL401)	Prehistoric
Wilson	Nodena Site	Prehistoric
Winchester	Taylor Log House and Site	Historic
Winrock	Seven Hollows--Petit Jean Mountain Site #1	Historic - Aboriginal, Prehistoric
Woolsey	Brown Bluff (3WA10)	Prehistoric

Source: (NPS, 2015b)

4.1.11.7. Historic Context

Arkansas was first explored by Hernando de Soto in 1541, as he pressed into North America in search of gold. In 1673, the French Jesuit priest Jacques Marquette and the French-Canadian fur trader Louis Jolie traveled south on the Mississippi River from Canada, reaching its juncture with the Arkansas River, but did not establish a permanent settlement. French exploration attempts continued with Rene-Robert Cavelier, Sieur de La Salle, in 1682 (Arkansas Secretary of State, 2015a). In 1686, with a land grant from La Salle, the Italian-French military officer and explorer Henri de Tonti set up the Arkansas Post ("Poste aux Arkansas") as the first successful European trading post and settlement in the state; as a result he is often referred to as the "Father of Arkansas." Arkansas was part of the French colony of Louisiana, "La Louisiane," as a result of La Salle's exploration of 1682 and the establishment of trading posts and the creation of an administrative capital at Fort Maurepas in Mississippi in 1699. During the French and Indian War (1753-1765), France fought with England over territorial control of this region of America and was ultimately forced to abandon its American claims. As a part of the Treaty of Paris, Arkansas came under Spanish control in 1762 (Arkansas Secretary of State, 2015b).

Arkansas was not affected directly by the American Revolution, as it was under Spanish control during the conflict (Arkansas Secretary of State, 2015b). On October 1, 1800, France and Spain signed a secret accord that transferred control of Spanish Louisiana back to France; however, this was short-lived. In 1803, President Thomas Jefferson negotiated the Louisiana Purchase, which

brought the land that is comprised of Arkansas under U.S. control. In 1804, William Hunter and George Dunbar explored Arkansas, which was at the time still a part of the District of Louisiana. In 1812, the Missouri Territory, which contained Arkansas, was created, and in 1813, Arkansas County was created within the Missouri Territory (Arkansas Secretary of State, 2015c).

In 1821, the territorial government moved to Little Rock, and on June 15, 1836, Arkansas entered the Union as the 25th state (Arkansas Secretary of State, 2015c). In 1838 and 1839, as part of Andrew Jackson's Indian removal policy, the Cherokee nation, as well as other Southern and Southeastern tribes, were forced to give up lands east of the Mississippi River and migrate to areas in present-day Oklahoma. This journey, parts of which traversed the state, is known as the "Trail of Tears," and became a cultural memory for the Cherokee and other removed tribes because of its devastating physical and cultural effects. (NPS, 2017) While Arkansas seceded during the Civil War, politics within the state remained conflicted and the state actually supplied troops to both Union and Confederate forces. Union forces occupied much of the state during the conflict. In 1874, Arkansas rejoined the Union after several years under Reconstruction. Beginning in the latter part of the 19th century, Arkansas began enacting segregationist Jim Crow laws, which led to racial conflict that lasted well into the 20th century. (Arkansas Secretary of State, 2015c)

During World War I (WWI), Arkansas men enlisted to serve in the armed forces, while those at home contributed domestically. Like most states, Arkansas suffered during the Great Depression, with many businesses and banking institutions closing. During World War II (WWII), thousands of Arkansas men volunteered to fight, while domestically, multiple internment camps for Japanese-Americans were set up within the state. In 1957, Little Rock came under a national spotlight as a result of the controversy surrounding the desegregation of the city's schools system. (Arkansas Secretary of State, 2015d) Such tension arose that the first African American students to enter Little Rock Central High School had to be escorted inside under the protection of the Army's 101st Airborne Division.

Arkansas has 2,586 NRHP listed sites, as well as 16 NHLs (NPS, 2015b). Arkansas does not contain any National Heritage Areas (NPS, 2015k). Figure 4.1.11-3 shows the location NRHP sites within Arkansas.¹¹³

4.1.11.8. Architectural Context

"Residences are the most common type of historic building and are usually found in metropolitan areas and other densely populated regions of the state" (Arkansas Historic Preservation Program, 2013). Early residential structures were built of logs and ranged in type from single pen dwellings to larger two story structures. The Jacob Wolf House (1825) in Norfolk is an example of a 2-story log dogtrot that still exists today. Other structures were built of heavy timbers, joined in traditional methods of heavy timber framing. Structures that are more prominent were built of local stone, with manufactured materials such as brick, iron, and steel becoming available as settlements grew during the 19th century. Other Southern vernacular architectural styles, such as I-houses and saddlebacks, were common house types as well, with bungalow,

¹¹³ See Section 4.1.7 for a more in-depth discussion of additional historic resources as they relate to recreational resources.

minimal traditional, and ranch houses being built during the 20th century. (Arkansas Historic Preservation Program, 2015a)

Architectural styles in Arkansas progressed similarly to elsewhere in the country. French Colonial architecture was built during the 18th century, lasting into the 19th century; Estevan Hall (1826) is an example of this style. Federal architecture was popular starting in the late 18th century and lasting until approximately the 1840s. Greek Revival became popular starting in the second quarter of the 19th century, remaining popular in Arkansas as late as the 1870s. Picturesque styles, such as Gothic Revival and Italianate were popular during the second half of the 19th century, with Victorian Era styles supplanting them in the latter part of the 19th century and lasting into the beginning of the 20th century. During the early 20th century, Colonial Revival and Neoclassical Revival were popular, along with other early 20th century styles such as Prairie and Craftsman. Modern styles gained popularity in the 1920's, and included Art Deco and Art Moderne, with the International style remaining popular well into the 20th century. (Arkansas Historic Preservation Program, 2015a) Ozark Giraffe, a significant style of the Ozark region, was popular between 1920 and 1940 during the Arts and Crafts movement. The style promoted the use of natural building materials. Some of the best examples of the Ozark Giraffe style can be found along Route 66 in Arkansas, Kansas, Missouri, and Oklahoma . Figure 4.1.11-4 shows examples of the various architectural styles found in Arkansas.

Commercial buildings are common, generally more so in areas that have experienced heavier concentration of population. Common commercial types “include small storefront buildings, rural country stores, large city blocks, and early urban skyscrapers. Brick and wood, as well as locally quarried stone in Northern Arkansas, were popular building materials for these types of properties” (Arkansas Historic Preservation Program, 2013). Arkansas also features a collection of civic and community buildings, ranging in type from “courthouses, churches, jails, schools, city halls, post offices, libraries, depots, and meeting lodges” (Arkansas Historic Preservation Program, 2013). The Old State House (1836) in Little Rock is an excellent example of Greek Revival architecture executed in a 19th century civic building, while Little Rock Central High School is an example of stripped Gothic Revival from the early 20th century.

Agricultural resources are common in Arkansas and were significant to the development of the state. Common agricultural resources include “farmhouses, barns, tenant houses, silos, and cotton gins” (Arkansas Historic Preservation Program, 2013). Industrial buildings are less common, as the state has been dominated by agriculture throughout most of its history; however, historic industrial buildings do exist. These were generally more common near active or former rail lines, usually date to the late 19th or early 20th centuries, and include “grist mills from the nineteenth century and the large lumber mills of the turn of the century period” (Arkansas Historic Preservation Program, 2013). The Three States Lumber Company Powerhouse/Burdette Plantation (1909) is an existing example of this type of building (Arkansas Historic Preservation Program, 2015b). Arkansas also includes a collection of historic structures, including “bridges, water towers, agricultural outbuildings (such as corn cribs), locomotives, ships, dams, roads, and fortifications” (Arkansas Historic Preservation Program, 2013).

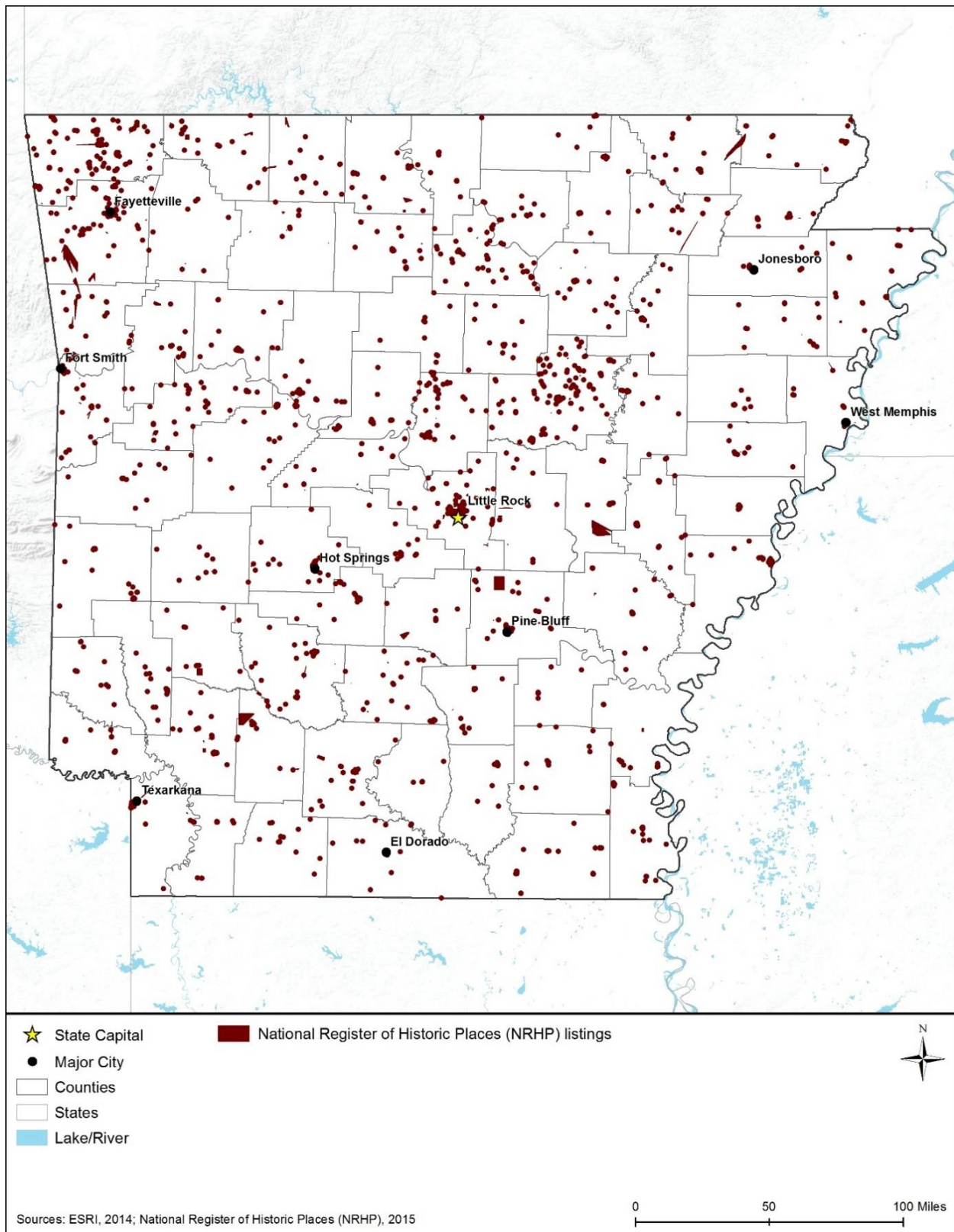
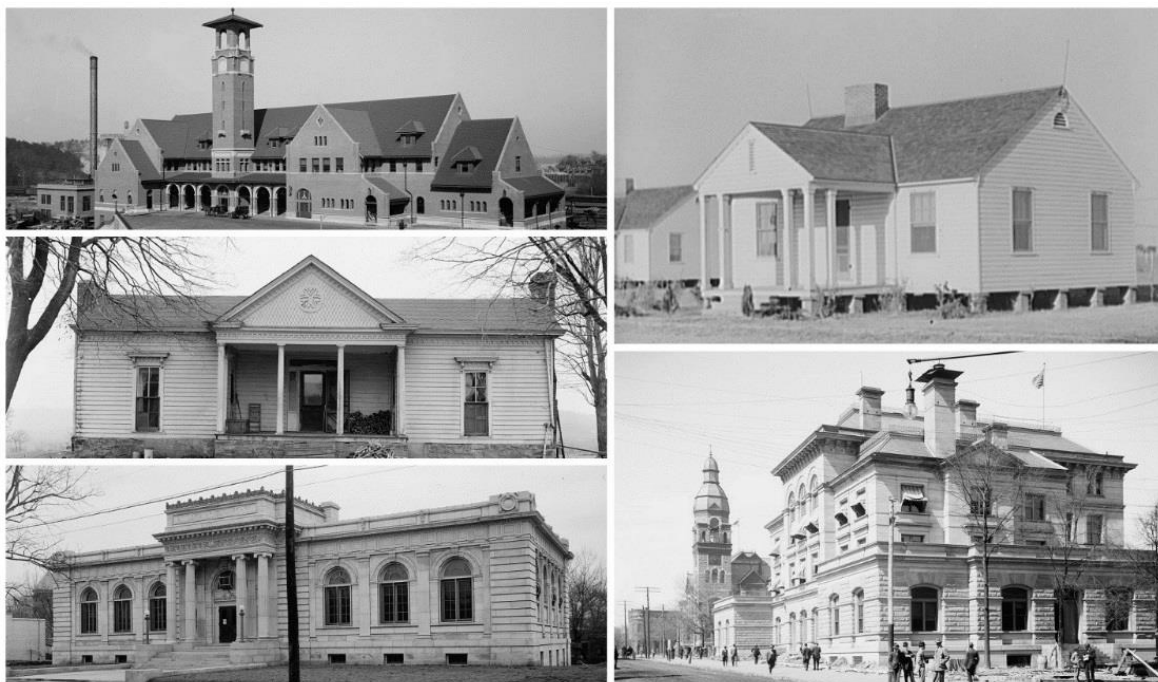


Figure 4.1.11-3: National Register of Historic Places Sites in Arkansas



Top Left – New Union Station (Little Rock, AR) – (Detroit Publishing Company, 1905a)
Middle Left – Archibald Yell House (Fayetteville, AR) – (Historic American Buildings Survey, 1933)
Bottom Left – Little Rock Public Library (Little Rock, AR) – (Detroit Publishing Company, 1905b)
Top Right – House from Lake Dick Project (Lake Dick, AR) – (Lee, 1938)
Bottom Right – Post Office and Court House (Little Rock, AR) – (Detroit Publishing Company, 1905c)

Figure 4.1.11-4: Representative Architectural Styles of Arkansas

4.1.12. Air Quality

4.1.12.1. Definition of the Resource

Air Quality in a geographic area is determined by the type and amount of pollutants emitted into the atmosphere, the size, and topography¹¹⁴ of the area, and the prevailing weather and climate conditions. The levels of pollutants and pollutant concentrations in the atmosphere are typically expressed in units of parts per million (ppm)¹¹⁵ or micrograms per cubic meter ($\mu\text{g}/\text{m}^3$) determined over various periods of time (averaging time).¹¹⁶ This section discusses the existing air quality in Arkansas. USEPA designates areas within the United States as attainment,¹¹⁷

¹¹⁴ Topography: The unique features and shapes of the land (e.g., valleys and mountains).

¹¹⁵ Equivalent to 1 milligram per liter (mg/L).

¹¹⁶ Averaging Time: “The period over which data are averaged and used to verify proper operation of the pollution control approach or compliance with the emissions limitation or standard.” (USEPA, 2015h)

¹¹⁷ Attainment areas: Any area that meets the national primary or secondary ambient air quality standard for the pollutant. (USEPA, 2015i)

nonattainment,¹¹⁸ maintenance,¹¹⁹ or unclassifiable¹²⁰ depending on the concentration of air pollution relative to ambient air quality standards. Information is presented regarding national and state ambient air quality standards and nonattainment areas that would be potentially more sensitive to impacts from implementation of the Proposed Action or alternatives.

4.1.12.2. Specific Regulatory Considerations

National and State Ambient Air Quality Standards

The Clean Air Act (CAA) establishes National Ambient Air Quality Standards (NAAQS) for six criteria pollutants: Carbon monoxide (CO), lead, nitrogen dioxide (NO₂), particulate matter (PM_{2.5} and PM₁₀), ozone (O₃), and sulfur dioxide (SO₂). The NAAQS establish various standards, either primary¹²¹ or secondary,¹²² for each pollutant with varying averaging times. Standards with short averaging times (e.g., 1-hour, 8-hour, and 24-hour) were developed to prevent the acute health effects from short-term exposure at high concentrations. Longer averaging periods (e.g., 3 months or annual) are intended to prevent chronic health effects from long-term exposure (USEPA, 2016g). A description of the NAAQS is presented in Appendix E, Air Quality. Arkansas has not established its own ambient air quality standards. Instead, the state implements the NAAQS, pursuant to Arkansas Pollution Control & Ecology Commission Regulation (APCECR) No. 19, Chapter 3 (ADEQ, 2014c).

In addition to the NAAQS, there are standards for hazardous air pollutants (HAP), which are those typically associated with specific industrial processes such as chromium electroplating (hexavalent chromium), dry cleaning (perchloroethylene), and solvent degreasing (halogenated solvents) (USEPA, 2016c). HAPs can have severe adverse impacts on human health and the environment, including increased risk of cancer, reproductive issues, or birth defects. HAPs are federally regulated under the CAA via the National Emission Standards for Hazardous Air Pollutants (NESHAPs). USEPA developed the NESHAPs for sources and source categories emitting HAPs that pose a risk to human health (USEPA, 2015j). Appendix E, Air Quality, presents a list of federally regulated HAPs.

Title V Operating Permits/State Operating Permits

Arkansas has authorization to issue CAA Title V operating permits on behalf of the USEPA, as outlined in 40 CFR 70. The Title V program refers to Title V of the CAA that governs permitting requirements for major industrial air pollution sources and consolidates all CAA requirements for the facility into one permit (USEPA, 2015k). The overall goal of the Title V

¹¹⁸ Nonattainment areas: Any area that does not meet (or that contributes to ambient air quality in a nearby area that does not meet) the national primary or secondary ambient air quality standard for the pollutant. (USEPA, 2015i)

¹¹⁹ Maintenance areas: An area that was previously nonattainment, but has met the national primary or secondary ambient air quality standards for the pollutant, and has been designated as attainment. (USEPA, 2015i)

¹²⁰ Unclassifiable areas: Any area that cannot be classified on the basis of available information as meeting the national primary or secondary air quality standard for a pollutant. (USEPA, 2015i)

¹²¹ Primary standard: The primary standard is set to provide public health protection, including protecting the health of sensitive populations such as asthmatics, children, and the elderly (USEPA, 2014a).

¹²² Secondary standards: The secondary standard is set to provide public welfare protection, including protection against decreased visibility and damage to animals, crops, vegetation, and buildings (USEPA, 2014a).

program is to “reduce violations of air pollution laws and improve enforcement of those laws” (USEPA, 2015k). APCECR No. 26, Chapter 3 describes the applicability of Title V operating permits (ADEQ, 2012). Arkansas requires Title V operating permits for any major source if it emits or has the potential to emit pollutants in excess of the major source thresholds (see Table 4.1.12-1). The permit issued to a facility contains both state and federal portions and incorporates a reporting schedule (USEPA, 2014b).

Table 4.1.12-1: Major Air Pollutant Source Thresholds

Pollutant	Tons per Year (TPY)
Any Pollutant	100
Single Hazardous Air Pollutant (HAP)	10

Source: (USEPA, 2014b)

Exempt Activities

Under APCECR No. 18.308, the following activities are defined as “insignificant and will not require a [minor source] permit” (ADEQ, 2010a). For emission sources located in major facilities, certain insignificant activities must be reported in the facilities’ permits to model air emissions. “The following emission units, operations, or activities must either be listed as insignificant or included in the permit application as sources to be permitted...

- Fuel burning equipment with a design rate less than 10 million British thermal units (MMBtu) per hour, provided that the aggregate air pollutant specific emissions from all such units listed as insignificant do not exceed 5 tons per year (tpy) of any combination of HAPs and 10 tpy of any other air pollutant...
- ...Emergency use generators, boilers, or other fuel burning equipment that is
 - of equal or smaller capacity than the primary operating unit;
 - cannot be used in conjunction with the primary operating unit; and
 - does not emit or have the potential to emit regulated air pollutants in excess of the primary operating unit and not operated more than 90 days a year.
- This does not apply to generators which provide electricity to the distribution grid...

The following emission units, operations, or activities need not be included in a permit application:

- Combustion emissions from propulsion of mobile sources and emissions from refueling these sources unless regulated by Title II and required to obtain a permit under Title V of the federal Clean Air Act, as amended. This does not include emissions from any transportable units, such as temporary compressors or boilers. This does not include emissions from loading racks or fueling operations covered under any applicable federal requirements...
- ...portable electrical generators that can be ‘moved by hand’¹²³ from one location to another...” (ADEQ, 2010a).

¹²³ Moved by Hand: “means it can be moved by one person without assistance of any motorized or non-motorized vehicle, conveyance, or device” (ADEQ, 2010).

Temporary Emissions Sources Permits

Major temporary sources, under APCECR No. 26.706 “may [be] issue[d] a single permit authorizing emissions from similar operations by the same source owner or operator at multiple temporary locations. The operation must be temporary and involve at least one change of location during the term of the permit” (ADEQ, 2012).

State Preconstruction Permits

Under APCECR No. 18.301 and 19.401, emission units subject to minor source permitting requirements must obtain a permit prior to beginning construction or modification of the unit (ADEQ, 2010a; ADEQ, 2014c).

General Conformity

Established under Section 176(c)(4) of the CAA, the General Conformity Rule ensures that the actions taken by federal agencies in nonattainment and maintenance areas do not interfere with a state’s plans to meet national standards for air quality outlined in the state implementation plan (SIP) (USEPA 2013b). An action in designated nonattainment and maintenance areas would be evaluated for the emission of those particular pollutants under the General Conformity Rule through an applicability analysis. Pursuant to Title 40 CFR 93.153(d)(2) and (e), federal actions “in response to emergencies which are typically commenced on the order of hours or days after the emergency” and actions “which are part of part of a continuing response to emergency or disaster” that are taken up to 6 months after beginning response activities, will be exempt from any conformity determinations (GPO, 2010).

The estimated pollutant emissions are compared to *de minimis*¹²⁴ levels. These values are the minimum thresholds for which a conformity determination must be performed (see Table 4.1.12-2). Lower *de minimis* thresholds for VOCs and NO_x could apply depending on the attainment status of a county.

¹²⁴ *de minimis*: USEPA states that “40 CFR 93 § 153 defines *de minimis* levels, that is, the minimum threshold for which a conformity determination must be performed, for various criteria pollutants in various areas.” (USEPA, 2016f)

Table 4.1.12-2: *De Minimis* Levels

Pollutant	Area Type	TPY
Ozone (VOC or NO _x)	Serious Nonattainment	50
	Severe Nonattainment	25
	Extreme Nonattainment	10
	Other areas outside an OTR	100
Ozone (NO _x)	Maintenance	100
Ozone (VOC)	Maintenance outside an OTR	100
CO, SO ₂ , NO ₂	All Nonattainment and Maintenance	100
PM ₁₀	Serious Nonattainment	70
	Moderate Nonattainment and Maintenance	100
PM _{2.5} (Direct Emissions) (SO ₂) (NO _x (unless determined not to be a significant precursor)) (VOC or ammonia (if determined to be significant precursors))	All Nonattainment and Maintenance	100
Lead	All Nonattainment and Maintenance	25

Source: (GPO, 2010)

If an action does not result in an emissions increase above the *de minimis* levels in Table 4.1.12-2, then a conformity determination is not required. If the applicability analysis shows that the total direct and indirect emissions are above the *de minimis* levels in Table 4.1.12-2, then the action must undergo a conformity determination. The federal agency must first show that the action would meet all SIP control requirements and that any new emissions would not cause a new violation of the NAAQS (USEPA 2010). To demonstrate conformity,¹²⁵ the agency would have to fulfill one or more of the following:

- Show any emissions increase is specifically identified and accounted for in the respective state's SIP;
- Receive acknowledgement from the state that any increase in emissions would not exceed the SIP emission budget;
- Receive acknowledgement from the state to revise the SIP and include emissions from the action;
- Show the emissions would be fully offset by implementing reductions from another source in the same area; and
- Conduct air quality modeling that demonstrates the emissions would not cause or contribute to new violations of the NAAQS, or increase the frequency or severity of any existing violations of the NAAQS (USEPA 2010).

State Implementation Plan Requirements

The Arkansas SIP is composed of many related actions to ensure ambient air concentrations of the six criteria pollutants comply with the NAAQS. Arkansas's SIP is a conglomeration of separate actions taken for each of the pollutants. All of Arkansas's SIP actions are codified

¹²⁵ Conformity: Compliance with the State Implementation Plan.

under 40 CFR Part 52 Subpart E. Information on Arkansas's SIP can be found on the ADEQ website (https://www.adeq.state.ar.us/air/planning/naaqs_sip/).

4.1.12.3. *Environmental Setting: Ambient Air Quality*

Nonattainment Areas

The USEPA classifies areas as attainment, nonattainment, maintenance, or unclassifiable for six criteria pollutants. When evaluating an area's air quality against regulatory thresholds (i.e., permitting and general conformity), maintenance areas are often combined with nonattainment, while unclassifiable areas are combined with attainment areas (USEPA, 2015s). Figure 4.1.12-1 and Table 4.1.12-3 present the nonattainment area in Arkansas as of January 30, 2015. The year(s) listed in the table for each pollutant indicate when USEPA promulgated an ambient air quality standard for that pollutant; note that, for PM_{2.5}, O₃, and SO₂, both standards listed are in effect. Unlike Table 4.1.12-3, Figure 4.1.12-1 does not differentiate between standards for the same pollutant. Additionally, given that particulate matter is the criteria pollutant of concern, PM₁₀, and PM_{2.5} merge in the figure to count as a single pollutant.

Table 4.1.12-3: Arkansas Nonattainment and Maintenance Areas by Pollutant Standard and County

County	Pollutant and Year USEPA Implemented Standard										
	CO	Lead		NO ₂	PM ₁₀	PM _{2.5}		O ₃		SO ₂	
County	1971	1978	2008	1971	1987	1997	2006	1997	2008	1971	2010
Crittenden								M	X-5		

Source: (USEPA, 2015l)

X-1 = Nonattainment Area (Extreme)
X-2 = Nonattainment Area (Severe)
X-3 = Nonattainment Area (Serious)
X-4 = Nonattainment Area (Moderate)
X-5 = Nonattainment Area (Marginal)
X-6 = Nonattainment Area (Unclassified)
M = Maintenance Area

Air Quality Monitoring and Reporting

The ADEQ measures air pollutants at 17 sites across the state as part of the National Air Monitoring Stations Network and the State and Local Air Monitoring Stations Network (ADEQ, 2015g). Annual Arkansas State Ambient Air Quality Reports are prepared, containing pollutant data summarized by region. ADEQ reports hourly readings of O₃ and PM_{2.5} monitoring data, as well as air quality indices for the Little Rock Metropolitan Area and the Springdale Metropolitan Area on the ADEQ website: (https://www.adeq.state.ar.us/techsvs/air_chem_lab/).

Throughout 2014, O₃ measurements exceeded the federal standard of 0.075 ppm one time in the Memphis, TN-MS-AR Metropolitan Statistical Area (MSA). In addition, PM_{2.5} measurements exceeded the federal standard one time in the Little Rock-North Little Rock-Conway, AR MSA and one time in the Memphis, TN-MS-AR MSA. No other criteria pollutants exceed the federal standard. (ADEQ, 2015g)

Air Quality Control Regions

USEPA classified all land in the United States as a Class I, Class II, or Class III federal Air Quality Control Region (AQCR) (42 U.S.C. § 7470). Class I areas include international parks, national wilderness areas which exceed 5,000 acres in size, national memorial parks which exceed 5,000 acres in size, and national parks which exceed 6,000 acres in size. Class I areas cannot be re-designated as Class II or Class III and are intended to maintain pristine air quality. Although USEPA developed the standards for a Class III AQCR, to date they have not actually classified any area as Class III. Therefore, any area that is not classified as a Class I area is, by default, automatically designated as a Class II AQCR (42 U.S.C. § 7472).

In a 1979 USEPA memorandum, the Assistant Administrator for Air, Noise, and Radiation (USEPA, 1979) advised USEPA Regional Offices to provide notice to the Federal Land Manager (FLM) of any facility subject to the Prevention of Significant Deterioration (PSD) permit requirements and within 100 kilometers¹²⁶ of a Class I area. “The EPA’s policy is that FLMs should be notified by the Regional Office about any project that is within 100 kilometers of a Class I area. For sources having the capability to affect air quality at greater distances, notification should also be considered for Class I areas beyond 100 kilometers” (Page, 2012). The 2005 USEPA guidelines for air quality modeling do not provide a precise modeling range for Class I areas.

¹²⁶ The memorandum and associated guidance use kilometers. 100 kilometers is equal to about 62 miles.

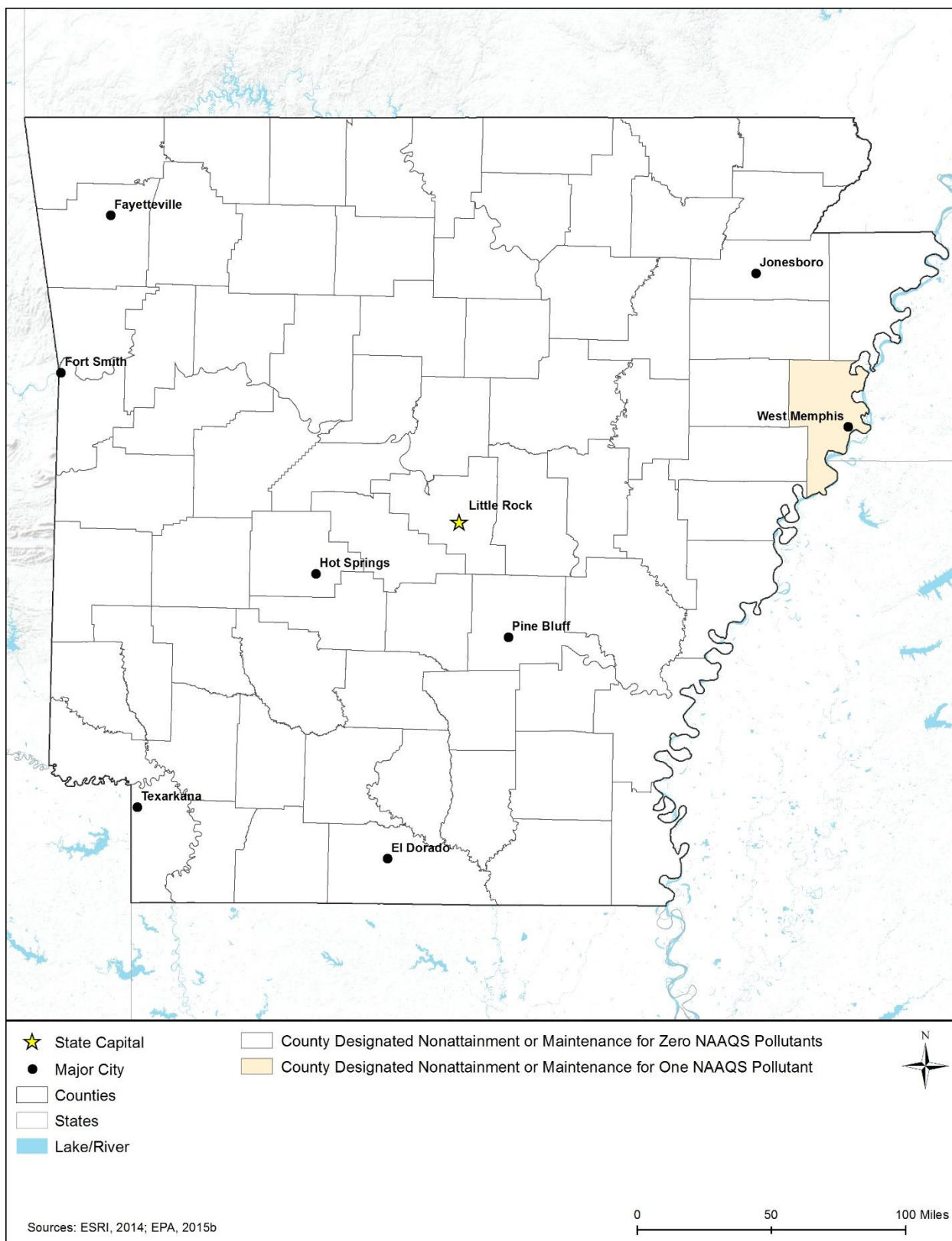


Figure 4.1.12-1: Nonattainment and Maintenance Counties in Arkansas

PSD applies to new major sources or major modifications at existing sources for pollutants where the source is in an attainment or unclassifiable area. An air quality analysis is required for sources subject to PSD requirements and generally consists of using a dispersion model to evaluate emission impacts to the area. “Historically, the EPA guidance for modeling air quality impacts under the PSD program has tended to focus more on the requirements for a Class II modeling analysis. Such guidance has provided that applicants need not model beyond the point of significant impact or the source or 50 kilometers¹²⁷ (the normal useful range of EPA-approved Gaussian plume models” (USEPA, 1992).

Arkansas contains two federal Class I areas; all other land within the state is classified as Class II (USEPA, 2012a). If an action is considered major source and consequently subject to PSD requirements, the air quality impact analysis need only to analyze the impacts to air quality within 100 kilometers from the source. Missouri has two Class I areas where the 100-kilometer buffer intersects a few Arkansas counties. Any PSD-applicable action within these counties would require FLMs notification from the appropriate Regional Office (USEPA, 2012a). Figure 4.1.12-2 provides a map of Arkansas highlighting all relevant Class I areas and all areas within the 100-kilometer radiuses. The numbers next to each of the highlighted Class I areas in Figure 4.1.12-2 correspond to the numbers and Class I areas listed in Table 4.1.12-4.

Table 4.1.12-4: Relevant Federal Class I Areas

# ^a	Area	Acreage	State
1	Upper Buffalo Wilderness	9,912	AR
2	Caney Creek Wilderness	4,344	AR
3	Hercules-Glades Wilderness	12,315	MO
4	Mingo Wilderness	8,000	MO

Source: (USEPA, 2012a)

^a The numbers correspond to the shaded regions in Figure 4.1.12-2.

¹²⁷ The memorandum and associated guidance use kilometers. 50 kilometers is equal to about 31 miles.

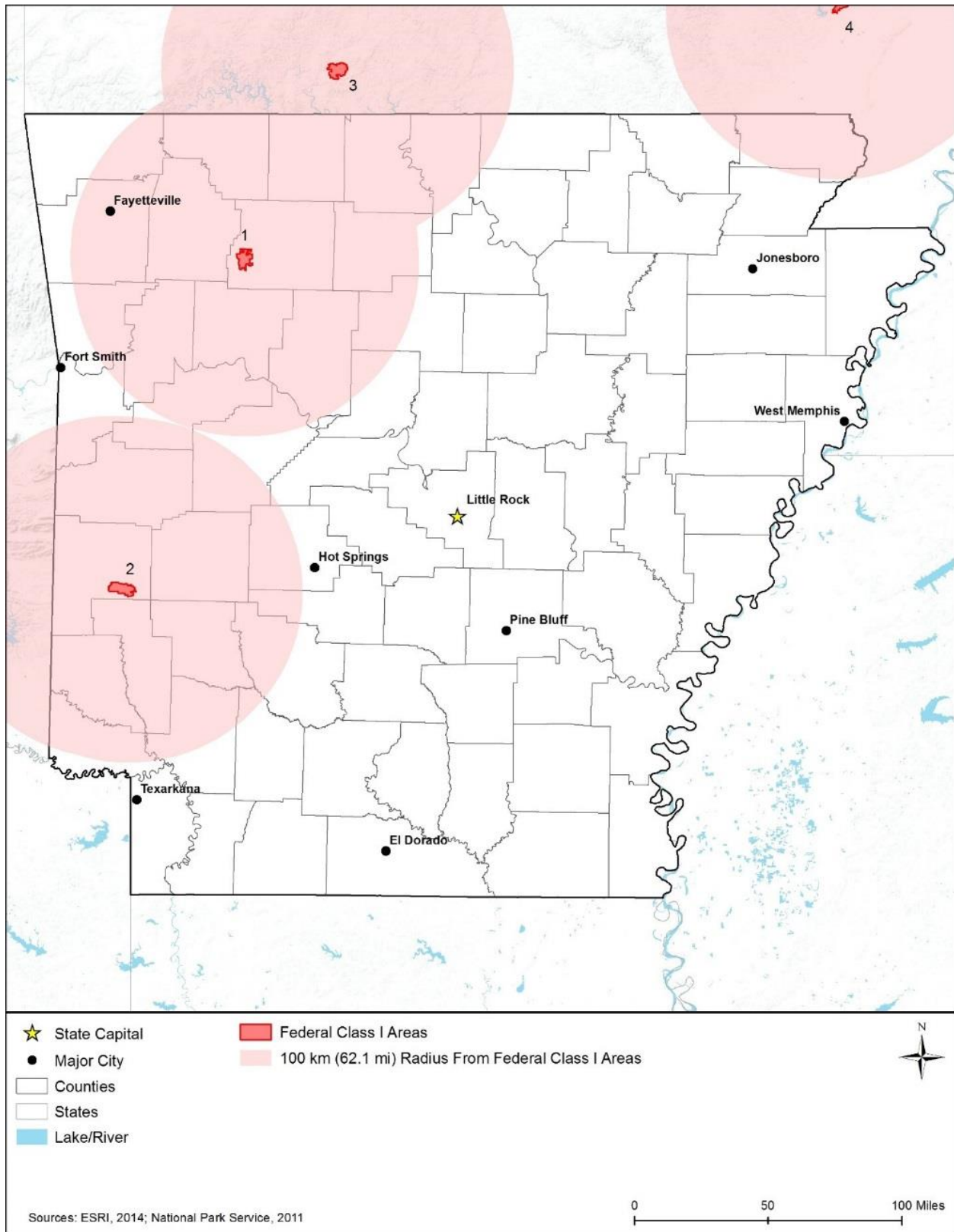


Figure 4.1.12-2: Federal Class I Areas with Implications for Arkansas

4.1.13. Noise and Vibration

This section presents a discussion of a basic understanding of environmental noise, background/ambient noise levels, noise standards, and guidelines.

4.1.13.1. Definition of the Resource

Noise is caused by pressure variations that the human ear can detect and is often defined as unwanted sound (USEPA, 2012b). Noise is one of the most common environmental issues that interferes with normal human activities and otherwise diminishes the quality of the human environment. Typical sources of noise that result in this type of interference in urban and suburban surroundings includes interstate and local roadway traffic, rail traffic, industrial activities, aircraft, and neighborhood sources like lawn mowers, leaf blowers, etc.

The effects of noise can be classified into three categories:

- Noise events that result in annoyance and nuisance;
- Interference with speech, sleep, and learning; and Physiological effects such as hearing loss and anxiety (USEPA, 2015m).
- Ground-borne vibrations, which in many instances can be caused by tools or equipment that generate noise, can also result from roadway traffic, rail traffic, and industrial activities as well as from some construction-related activities such as blasting, pile-driving, vibratory compaction, demolition, and drilling. Unlike noise, most ground-borne vibrations are not typically experienced every day by most people because the existing environment does not include a significant number of perceptible ground-borne vibration events.

Fundamentals of Noise and Vibration

For environmental noise analyses, a noise metric refers to the unit that quantitatively measures the effect of noise on the environment. The unit used to describe the intensity of sound is the decibel (dB). Audible sounds range from 0 dB (“threshold of hearing”) to about 140 dB (“threshold of pain”) (OSHA, 2016a). The vibration frequency characteristics of the sound, measured as sound wave cycles per second [Hertz (Hz)], determines the pitch of the sound (FTA, 2006). The normal audible frequency range is approximately 20 Hz to 20 kHz (FAA, 2015h). The A-weighted scale, denoted as dBA, approximates the range of human hearing by filtering out lower frequency noises, which are not as damaging as the higher frequencies. The dBA scale is used in most noise ordinances and standards (OSHA, 2016a).

Measurements and descriptions of noise (i.e., sounds) are based on various combinations of the following factors (FTA, 2006):

- The total sound energy radiated by a source, usually reported as a sound power level.
- The actual air pressure changes experienced at a particular location, usually measured as a sound pressure level (the frequency characteristics and sound pressure level combine to determine the loudness of a sound at a particular location).
- The duration of a sound.
- The changes in frequency characteristics or pressure levels through time.

Figure 4.1.13-1 presents the sound levels of typical events that occur on a daily basis in the environment. For example, conversational speech is measured at about 55 to 60 dBA, whereas a band playing loud music may be as high as 120 dBA (OSHA, 2013).



Source: (Sacramento County Airport System, 2015)

Prepared by: Booz Allen Hamilton

Leq: Equivalent Continuous Sound Level

Figure 4.1.13-1: Sound Levels of Typical Sounds

Because of the logarithmic unit of measurement, sound levels cannot be added or subtracted linearly. However, several methods of estimating sound levels can be useful in determining approximate sound levels. First, if two sounds of the same level are added, the sound level increases by approximately three dB (e.g., 60 dB + 60 dB = 63 dB). Secondly, the sum of two sounds of a different level is slightly higher than the louder level (e.g., 60 dB + 70 dB = 70.4 dB).

The changes in human response to changes in dB levels is categorized as follows (FTA, 2006):

- A 3-dB change in sound level is considered a barely noticeable difference;
- A 5-dB change in sound level will typically result in a noticeable community response; and
- A 10-dB change, which is generally considered a doubling of the sound level, almost certainly causes an adverse community response.

In general, ambient noise levels are higher during the day than at night and typically this difference is about 10 dB (USEPA, 1973). Ambient noise levels can differ considerably depending on whether the environment is urban, suburban, or rural.

Related to noise, vibration is a fluctuating motion described by displacement with respect to a reference point. Depending on the intensity, vibrations may create perceptible ground shaking and the displacement of nearby objects as well as rumbling sounds. Table 4.1.13-1 lists vibration source levels produced by typical construction machinery and activities at a distance of 25 feet in units of vibration decibels (VdB). The vibration thresholds for human perceptibility and potential building damage are 65 and 100 VdB, respectively (FTA, 2006).

Table 4.1.13-1: Vibration Source Levels for Select Construction Equipment (VdB)

Equipment ^a	VdB at 25 feet away
Pile Driver (impact type)	104-112
Pile Driver (sonic or vibratory type)	93-105
Vibratory Roller	94
Hoe Ram	87
Large Bulldozer	87
Caisson Drilling	87
Loaded Trucks	86
Jackhammer	79
Small Bulldozer	58

Source: (FTA, 2006)

VdB = vibration decibels

^a The types of equipment listed in this table are included for reference purposes only. It is possible that not all equipment types listed here would be used in the deployment and operation of the Proposed Action.

4.1.13.2. Specific Regulatory Considerations

As identified in Appendix C, Environmental Laws and Regulations, the Noise Control Act of 1972, along with its subsequent amendments (e.g., Quiet Communities Act of 1978 [42 U.S.C. Parts 4901–4918]), delegates authority to the states to regulate environmental noise and directs government agencies to comply with local community noise statutes and regulations. Although

no federal noise regulations exist, the USEPA has promulgated noise guidelines (USEPA, 1974). Similarly, most states have no quantitative noise-limit regulations.

Arkansas does have a statewide noise regulation that limits the noise from motor vehicles. Vehicles used as part of the Proposed Action would likely already meet the basic noise control regulations, such as mufflers, covered by Arkansas State Regulations (Chapter 37 Section 601). However, many cities and towns may have local noise ordinances to manage community noise levels. The noise limits specified in such ordinances are typically applied to define noise sources and specify a maximum permissible noise level. Large cities and towns, such as Little Rock and Fort Smith, are likely to have different regulations than rural or suburban communities largely due to the population density and difference in ambient noise levels. (FHWA, 2011)

4.1.13.3. Environmental Setting: Ambient Noise

The majority of national and state parks are likely to have lower than average ambient noise levels given their size and location in wilderness areas. The range and level of ambient noise in Arkansas varies widely based on the area and environment of the area. The population of Arkansas can choose to live and interact in areas that are large cities, rural communities, and national and state parks. Figure 4.1.13-1 illustrates noise values for typical community settings and events that are representative of what the population of Arkansas may experience on a day-to-day basis. These noise levels represent a wide range and are not specific to Arkansas. As such, this section describes the areas where the population of Arkansas can potentially be exposed to higher than average noise levels.

- **Urban Environments:** Urban areas are likely to have higher noise levels on a daily basis due to highway traffic (70 to 90 dBA), construction noise (90 to 120 dBA), and outdoor conversations (e.g., small/large groups of people) (60 to 90 dBA) (U.S. Department of Interior, 2008). The areas that are likely to have the highest ambient noise levels in the state are Little Rock and Fort Smith.
- **Airports:** Areas surrounding airports tend to be more sensitive to noise due to aircraft operations that occur throughout the day. A jet engine aircraft can produce between 130 to 160 dBA in its direct proximity (FAA, 2007). However, commercial aircraft are most likely to emit noise levels between 70 to 100 dBA depending of the type of aircraft and associated engine (FAA, 2012). This noise will be perceived differently based on the altitude of the aircraft and its distance to the point of measurement. Airport operations are primarily arrivals and departures of commercial aircraft but based on the type of airport can include touch-and-go operations that are typical of general aviation airports and military airfields. The location of most commercial airports are in the proximity of urban communities; therefore, aircraft operations (arrivals/departures) can result in noise exposure in the surrounding areas to be at higher levels with the potential for increased noise levels during peak operation times (early morning and evenings), when there is an increase in air traffic. The noise levels in areas surrounding commercial airports can have significantly higher ambient noise levels than in other areas. In Arkansas, Bill and Hillary Clinton National Airport (LIT) and Northwest Arkansas Regional Airport (XNA) have more than 100,000 annual operations combined (FAA, 2015i). These operations result in increased ambient

noise levels in the surrounding communities. See Section 4.1.7, Land Use, Recreation, and Airspace, and Figure 4.1.7-5 to Figure 4.1.7-7 for more information about airports in the state.

- **Highways:** Communities near major highways also experience higher than average noise levels when compared to areas that are not in close proximity to a highway. There are a number of major highways within the state that may contribute to higher ambient noise levels for residents living in those areas. The major highways in the state tend to have higher than average ambient noise levels on nearby receptors, ranging from 52 to 75 dBA (FHWA, 2015d). See Section 4.1.1, Infrastructure, and Figure 4.1.1-1 for more information about the major highways in the state.
- **Railways:** Like highways, railways tend to have higher than average ambient noise levels for residents living in close proximity (FTA, 2006). Railroad operations can produce noise ranging from 70 dBA for an idling locomotive to 115 dBA when the locomotive engineer rings the horn while approaching a crossing (FRA, 2015). Arkansas has multiple rail corridors with high levels of commercial and commuter rail traffic. These major rail corridors include lines that extend mainly from Little Rock to other regional cities. A number of other rail corridors join these major rail lines and connect with other cities (AHTD, 2007). See Section 4.1.1, Infrastructure, and Table 4.1.1-3 for more information about rail corridors in the state.
- **National and State Parks:** The majority of national and state parks are likely to have lower than average ambient noise levels given their size and location in wilderness areas. National and state parks, historic areas, and monuments are protected areas. These areas typically have lower noise levels, as low as 30 to 40 dBA (NPS, 2014c). Arkansas has seven National Parks and five NNLs (NPS, 2015b). Visitors to these areas expect lower ambient noise conditions than the surrounding urban areas. See Section 4.1.8, Visual Resources, and Figure 4.1.8-4 for more information about national and state parks for Arkansas.

4.1.13.4. Sensitive Noise and Vibration Receptors

Noise-and vibration-sensitive receptors include residences, schools, medical facilities, places of worship, libraries, churches, nursing homes, concert halls, playgrounds, and parks. Sensitive noise receptors are typically areas where the intrusion of noise and vibration can disrupt the use of the environment. A quiet urban area usually has a typical noise level in the daytime of 50 dBA, and 40 dBA during the evening. Noise and vibration levels in remote wilderness and rural nighttime areas are usually 30 dBA (Bureau of Land Management, 2014). Most cities and towns in Arkansas have at least one school, church, or park, in addition to likely having other noise- and vibration-sensitive receptors. There are most likely thousands of sensitive receptors in Arkansas.

4.1.14. Climate Change

4.1.14.1. Definition of the Resource

Climate change, according to the Intergovernmental Panel on Climate Change (IPCC), is defined as "...a change in the state of the climate that can be identified (e.g., using statistical tests) by

changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer. It refers to any change in climate over time, whether due to natural variability or human activity.” (IPCC, 2007)

Accelerated rates of climate change are linked to an increase in atmospheric concentrations of greenhouse gas (GHG) caused by emissions from human activities such as burning fossil fuels to generate electricity (USEPA, 2012c). The IPCC is now 95 percent certain that humans are the main cause of current global warming (IPCC, 2013). Human activities result in emissions of four main GHGs: carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), and halocarbons (a group of gases containing fluorine, chlorine, or bromine) (IPCC, 2007). The common unit of measurement for GHGs is metric tons of CO₂-equivalent (MT CO₂e),¹²⁸ which equalizes for the different global warming potential of each type of GHG. Where this document references emissions of CO₂ only, the units are in MMT CO₂. Where the document references emissions of multiple GHGs, the units are in MMT CO₂e.

The IPCC reports that “global concentrations of these four GHGs have increased significantly since 1750” with “atmospheric concentrations of CO₂ increased from 280 parts per million (ppm) of carbon in 1750 to 379 ppm of carbon in 2005” (IPCC, 2007). The atmospheric concentration of CH₄ and N₂O have increased from pre-industrial values of about 715 and 270 parts per billion (ppb) to 1774 and 319 ppb, respectively, in 2005 (IPCC, 2007). In addition, the IPCC reports that human activities are causing an increase in various hydrocarbons from near-zero pre-industrial concentrations (IPCC, 2007).

Both the GHG emissions effects of the Proposed Action and Alternatives, and the relationships of climate change effects to the Proposed Action and Alternatives, are considered in this PEIS (see Section 4.2.14, Environmental Consequences). Existing climate conditions in the project area are described first by state and sub-region, where appropriate, and then by future projected climate scenarios. The discussion focuses on the following climate change impacts: temperature, precipitation/drought, and severe weather events (USEPA, 2015d).

4.1.14.2. Specific Regulatory Considerations

The pertinent federal laws relevant to the protection and management of climate change are summarized in Appendix C, Environmental Laws and Regulations. The Council on Environmental Quality (CEQ) published draft National Environmental Policy Act (NEPA) guidance on the consideration of the effects of climate change and greenhouse gas in February of 2010. Revised draft guidance was published in December 2014 and in August 2016 (after publication of the Draft PEIS) CEQ published its final guidance. This guidance is applicable to all federal agency actions and is meant to facilitate compliance within the legal requirements of NEPA. The CEQ guidance describes how federal agency actions should evaluate GHG and climate change effects in their NEPA reviews, using GHG emissions as a proxy for assessing a proposed action’s potential effect on climate change. CEQ defines GHGs to include CO₂, CH₄,

¹²⁸ CO₂e refers to Carbon Dioxide Equivalent, “A metric measure used to compare the emissions from various greenhouse gases based upon their global warming potential (GWP). Carbon dioxide equivalents are commonly expressed as million metric tons of carbon dioxide equivalents (MMTCO₂e). The carbon dioxide equivalent for a gas is derived by multiplying the tons of the gas by the associated GWP. MMTCO₂e = (million metric tons of a gas) * (GWP of the gas)” (USEPA, 2015d).

N₂O, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride, which is in accordance with Section 19 (m) of *Executive Order 13693*. The final CEQ guidance suggests that agencies consider “(1) the potential effects of a proposed action on climate change as indicated by assessing GHG emissions (e.g. to include, where applicable, carbon sequestration); and (2) the effects of climate change on a proposed action and its environmental impacts.” The final guidance recommends that agencies quantify an action’s projected direct and indirect GHG emissions when data inputs are reasonably available to support calculations. The final guidance states that “agencies should be guided by the principle that the extent of the analysis should be commensurate with the quantity of the projected GHG emissions and take into account available data and GHG quantification tools that are suitable for and commensurate with the proposed agency action.” In addition, CEQ recommends agencies evaluate project emissions and changes in carbon sequestration and storage, when appropriate, in assessing a proposed action’s potential climate change impacts. The analysis should assess direct and indirect climate change effects of a proposed project including connected actions, the cumulative impacts of its proposed action, and reasonable alternatives. CEQ advises that climate change effects on the environmental consequences of a proposed action should be described based on available studies, observations, interpretive assessments, predictive modeling, scenarios, and other empirical evidence. The temporal bounds should be limited by the expected lifetime of the proposed project. Mitigation and adaptation measures should be considered in the analysis for effects that occur immediately and in the future.

At the state level, there has been no significant policy action. In 2007 Arkansas passed legislation (House Bill 2460) directing the Governor’s Commission on Global Warming to recommend goals and regulations to reduce GHG emissions to combat climate change. The final report was published in 2008 (Arkansas Governor’s Commission On Global Warming, 2008), but the recommendations were not adopted by the state legislature or incorporated into any regulations or executive orders.

4.1.14.3. Arkansas Greenhouse Gas Emissions

Estimates of Arkansas’s total GHG emissions vary. The Department of Energy’s (DOE) Energy Information Agency (EIA) collects and disseminates national-level emissions data on other GHGs such as methane (CH₄) and nitrous oxide (NO_x), but not at the state level (EIA, 2015a). The USEPA also collects and disseminates national-level GHG emissions data, but by economic sector, not by state (USEPA, 2014c). Individual states have developed their own GHG inventories, which are updated with different frequencies and trace GHGs in a variety of ways.

For the purposes of this PEIS, the EIA data on CO₂ emissions are used as the baseline metric to ensure consistency and comparability across the 50 states. However, if additional data sources on GHG emissions are available for a given state, including other GHGs such as CH₄, they are described and cited.

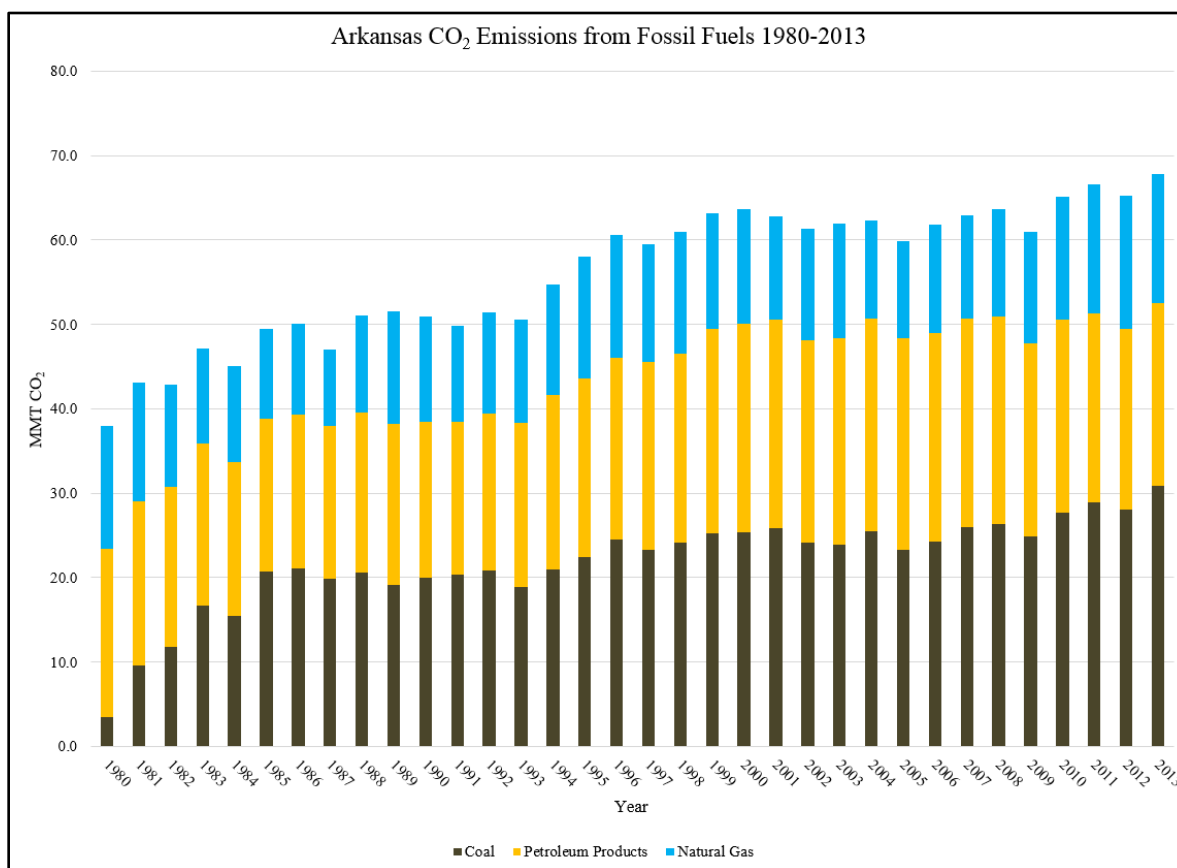
According to the EIA, Arkansas emitted a total of 69.0 million metric tons (MMT) of CO₂ in 2014 with the electric power sector as the highest emitter, accounting for 52 percent of total CO₂ emissions from fossil fuel and almost all of the emissions from coal. The next largest sector is

transportation, emitting almost 27 percent of total CO₂, almost all of which is from petroleum products Table 4.1.14-1(EIA, 2014). Annual emissions between 1980 and 2013 are presented in Figure 4.1.14-1. Between 1980 and 2013, Arkansas's CO₂ emissions from fossil fuels almost doubled, with only brief pauses in the rate of overall growth in the early 90s and early 2000s. Emissions increased in all areas, but the largest increase came from coal in the electric power sector (EIA, 2014). Arkansas was ranked 30th among the 50 states and the District of Columbia for total CO₂ emissions in 2013, and ranked 16th in per-capita CO₂ emissions (EIA, 2017d).

Table 4.1.14-1: Arkansas CO₂ Emissions from Fossil Fuels by Fuel Type and Sector, 2014

Fuel Type (MMT)		Source (MMT)	
Coal	32.0	Residential	2.4
Petroleum Products	22.4	Commercial	3.1
Natural Gas	14.6	Industrial	9.2
		Transportation	18.9
		Electric Power	35.5
TOTAL	69.0	TOTAL	69.0

Source: (EIA, 2014)



Source: (EIA, 2014)

Figure 4.1.14-1: Arkansas CO₂ Emissions from Fossil Fuels by Fuel Type 1980-2013

Arkansas commissioned the Center for Climate Strategies to prepare a report of Arkansas's GHG emissions in October 2008 (Center for Climate Strategies, 2008). The majority of Arkansas's GHG emissions are CO₂. These emissions are the result of fossil fuel combustion for producing energy, mostly petroleum products from transportation and coal-related emissions from electric power plants. Other GHGs emitted in Arkansas include CH₄, hydrofluorocarbons, NO_x, sulfur hexafluoride (SF₆) and perfluorocarbons (Center for Climate Strategies, 2008).

Total U.S. GHG emissions were 6,870 million metric tons CO₂e in 2014 (USEPA, 2014d). Arkansas's estimated gross emissions (not counting subtractions from carbon sequestration) in 2005 were 85.5 MMTCO₂e, and were projected to increase to 114.2 MMTCO₂e by 2025 (Center for Climate Strategies, 2008).

The transportation sector and high electricity consumption lead to Arkansas's gross GHG emission rising 30 percent between 1990 and 2003. In 2005, vehicles powered by gasoline and diesel contributed 57 percent and 28 percent respectfully. The remaining emissions are attributed to air travel, vehicles from natural gas, and liquefied petroleum gas (LPG). Transportation emissions have risen 1.8 percent annually and will likely increase 27 percent by 2025. (Center for Climate Strategies, 2008)

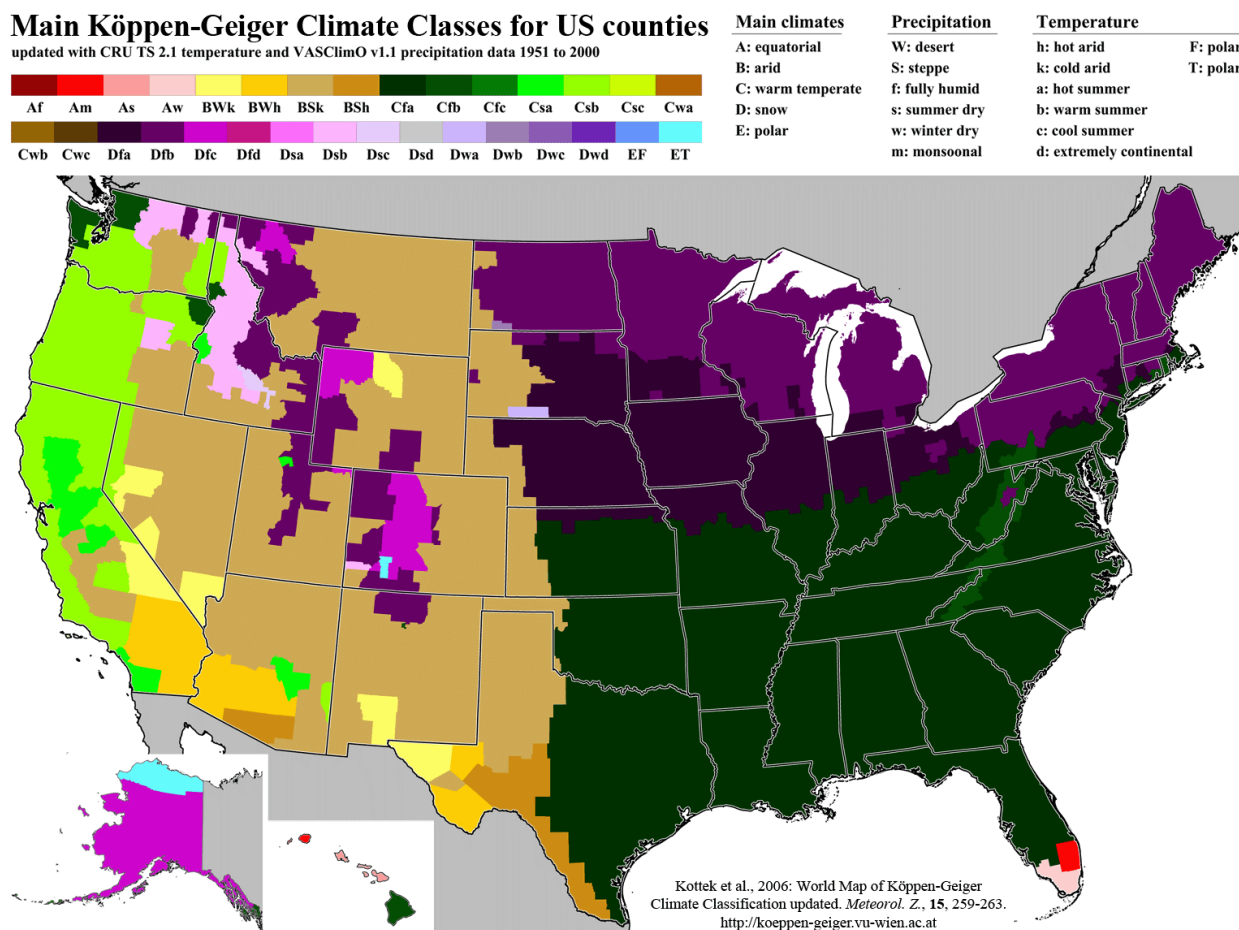
Arkansas has two petroleum refineries located in the southern part of the state with a combined capacity of approximately 90,000 barrels of crude oil per day. Arkansas also has three petroleum pipelines that pass through the state (EIA, 2016c).

Between 2005 and 2012 there was an increase in natural gas reserves, which resulted in an emissions increase from electric power generation. Arkansas is a large producer of natural gas but only consumes about one fourth of what the state produces. Production along with emissions has continued to rise in the past decade with an increase use of horizontal drilling and hydraulic fracturing (EIA, 2016c). The state has one nuclear power plant, which generates about one-fourth of total generation by Arkansas. The remaining electricity is produced from coal and hydroelectric power plants. The two bituminous coal mines in the state supply less than one percent of Arkansas's needs; the rest is transported by rail from Wyoming. Hydroelectric power plants supply two-thirds of the state's power generation, and Arkansas is currently developing its wind energy capacity (EIA, 2016c).

4.1.14.4. Environmental Setting: Existing Climate

The National Weather Service defines climate as "The composite or generally prevailing weather conditions of a region, throughout the year, averaged over a series of years." (NWS, 2009). The widely accepted division of the world into major climate categories is referred to as the Köppen-Geiger climate classification system. Climates within this system are classified based "upon general temperature profiles related to latitude" (NWS, 2009). The first letter in each climate classification details the climate group. The Köppen-Geiger system further divides climates into smaller sub-categories based on precipitation and temperature patterns. The secondary level of classification details the seasonal precipitation, degree of aridity, and presence or absence of ice. The tertiary levels distinguish different monthly temperature characteristics (NWS, 2006).

Across the United States, the five most common climate groups are (A), (B), (C), (D), and (E). The entirety of Arkansas falls into climate group C. Climates classified as (C) are generally warm, with humid summers and mild winters (NWS, 2009) (NWS, 2006). During summer months, thunderstorms are frequent. Arkansas has one sub-climate category, which is described in the following paragraphs (NWS, 2006).



Source: (Kottek, 2006)

Figure 4.1.14-2: Köppen-Geiger Climate Classes for U.S. Counties

Cfa – The Köppen-Geiger climate classification system classifies the entirety of Arkansas as Cfa. Cfa climates are generally warm, with humid summers and mild winters. In this climate classification zone, the secondary classification indicates year-round rainfall, but it is highly variable; thunderstorms are dominant during summer months. In this climate classification zone, the tertiary classification indicates mild, hot summers with average temperature of warm months over 72 °F. Average temperatures of the coldest months are under 64 °F. (NWS, 2006)

This section discusses the current state of Arkansas’s climate with regard to air temperature, precipitation, and extreme weather events (e.g., tropical storms, tropical cyclones, and hurricanes) in the state’s one climate region, Cfa.

Air Temperature

The climate of Arkansas is classified as humid and subtropical. Northern interior areas of the state, located at higher elevations, experience drier and cooler conditions, while southern areas of the state experience wetter and warmer conditions. In addition, “lower relative humidity in the northern part of the state makes the temperature extremes feel greater than they really are” (Borengasser, 2015). For example, Harrison, located in northern Arkansas, has an average July maximum temperature of 88.9 °F. In comparison, Crossett, located in southern Arkansas, has an average July temperature of 92.1 °F.

The highest temperature to occur was on August 10, 1936 with a record of 120 °F in Ozark, located in the Arkansas Valley (State Climate Extremes Committee, 2015). The lowest temperature to occur was on February 13, 1905 with a record of negative 29 °F in Gravette, located in northwestern Arkansas (State Climate Extremes Committee, 2015). Statewide, between 1895 and 2013, the average annual temperature in Arkansas has ranged between 58 and 63.6 °F (Office of the Arkansas State Climatologist, 2015). The 119-year average annual temperature is 60.5 °F. “The highest statewide summer average maximum temperature was 96.9 °F in 1954” (Office of the Arkansas State Climatologist, 2015). “The lowest statewide winter average temperature was 24.2 °F in 1918” (Office of the Arkansas State Climatologist, 2015).

Statewide, the coldest month in Arkansas is January with an average minimum temperature of 29.3 °F. July is the warmest month in Arkansas, with an average maximum temperature of 91.6 °F. Since 1973, there is a clear upward trend in temperature of 4.7 °F per century. “The trend is virtually identical for the summer, while the winter trend is for an increase of 8.5 °F” (Office of the Arkansas State Climatologist, 2015). Fall and spring temperatures have increased by approximately 3.2 and 3.1 °F respectively (Office of the Arkansas State Climatologist, 2015).

The following paragraph describe annual temperatures as they occur in the various climate classification zones:

Cfa – Little Rock, the capital of Arkansas, is centrally located. The average annual temperature in Little Rock is 62.7 °F; 42.8 °F during winter months; 81.5 °F during summer months; 62.2 °F during spring months; and 63.8 °F during autumn months (NOAA, 2015c).

Precipitation

Precipitation in Arkansas comes from “one or more sources: middle latitude cyclones (lows), with warm, cold, and other frontal situations, tropical lows from the Gulf of Mexico, thunderstorms, or orographic uplift caused by hills and mountains” (Office of the Arkansas State Climatologist, 2015). While middle latitude cyclones can occur during any month of the year, they are most common during the fall, winter, and spring. Thunderstorms also occur most commonly during warmer months of the year (Office of the Arkansas State Climatologist, 2015).

Annual precipitation statewide averages between 40 and 60 inches, “with higher amounts in the south or where there is significant orographic effect in the Ouachita Mountains” (Borengasser, 2015). “In 2009, a new state record was established at Leola (Grant County) of 100.05 inches,

surpassing the 98.55 inches for Newhope (Pike County) in 1957” (Borengasser, 2015). Statewide, the driest year in Arkansas was 1963. During this year, “large areas of northern Arkansas recorded precipitation amounts of only 20 to 30 inches” (Borengasser, 2015). In 2005, precipitation was also unusually light, with several stations recording record lows. For example, Little Rock recorded 28.26 inches of precipitation, 55 percent less than the normal annual average. Between 1895 and 2013, the average annual precipitation in Arkansas was approximately 49.56 inches. Since 1895, precipitation has increased by approximately 3.11 inches per century, or 1/3 inch per decade (Office of the Arkansas State Climatologist, 2015).

During autumn, winter, and spring months, precipitation most commonly results from low pressure and frontal passages. During summer months, convective showers dominate precipitation. “Heavy rainfall from stalled frontal passages or intense thunderstorms occasionally causes widespread flooding” (Borengasser, 2015). As tropical storms and hurricanes move inland, severe weather, tornadoes, and flooding occur. Snowfall in Arkansas averages approximately five inches per year. The highest amounts of snowfall typically occur in northern and western regions, with approximately 10 to 15 inches per year. The greatest 24-hour snowfall accumulation occurred on January 22, 1918 with a record of 25 inches (Borengasser, 2015) (Office of the Arkansas State Climatologist, 2015).

The following paragraph describe annual precipitation as it occurs in the various climate classification zones:

Cfa – Little Rock, the capital of Arkansas, is centrally located. The average annual precipitation accumulation in Little Rock is 49.75 inches; 12.18 inches during winter months; 9.51 inches during summer months; 14.69 inches during spring months; and 13.37 inches during autumn months (NOAA, 2015c).

Severe Weather Events

Although Arkansas is not a coastal state, hurricanes, and tropical storms, do affect the area, bringing heavy rainfall, flash flooding, high winds, and tornadoes. Records of Atlantic hurricanes and tropical storms in the United States began to be maintained in 1851. Based on more than 150 years of records, Arkansas is affected by a hurricane or tropical storm four or five times each decade on average. Storm centers move through the state with less frequency, on average three times per decade. These storms typically affect Arkansas during the month of September, although storms have occurred as early in the hurricane season as June and as late as October. Hurricanes and tropical storms that reach or affect Arkansas are usually on the decline to the point of not having hurricane strength winds. Exceptions to this pattern include hurricane Betsy in 1965 and hurricane Ike in 2008, both of which were full-strength hurricanes when they arrived in Arkansas. (NOAA, 2012)

Hurricanes and tropical storms that affect Arkansas generally make landfall along the eastern Texas coast or the coast of Louisiana. For example, Hurricane Rita made landfall on the Gulf coast at the Texas-Louisiana as a category three storm and continued inland, causing rainfall from 4 to 6 inches in Arkansas, and winds up to 53 miles per hour (NOAA, 2005). In 2008,

tropical storms Gustav and Ike caused extensive flooding that resulted in federal disaster declarations (FEMA, 2012).

Thunderstorms, tornadoes, and high winds occur in Arkansas during all seasons. Tornadoes are caused when warm and cold air masses collide, which in Arkansas is in the spring and the fall. Tornadoes in Arkansas generally track from the southwest to the northeast. On average, Arkansas expects about thirty-three tornadoes per year, although in 2014 only twenty were recorded (NOAA, 2015d). Between the period of 1950 through 2013, 1,714 tornadoes (26+ per year) have caused 386 fatalities and approximately \$1.8 billion in damages (Office of the Arkansas State Climatologist, 2015). Approximately 51 percent of tornadoes occur between March and May. Another peak in tornadoes occurs between November and January, with 26.5 percent of tornadoes occurring during this period. “In 2009, 45 tornadoes were tracked across the state” (Borengasser, 2015). Arkansas occasionally experiences extremely powerful tornadoes, for example an F4-rated tornado on April 27, 2014, which tracked 41 miles through Pulaski, Faulkner, and White Counties, killing 16 people. However, these large tornadoes are rare in Arkansas, with only two out of 654 total since 2000 rated higher than F3. The only known F5-rated tornado in Arkansas occurred on April 10, 1929 (NOAA, 2015d).

Tornadoes are often accompanied by violent thunderstorms and heavy rainfall events. For example, the tornado outbreaks in the first two weeks of May 2003 were caused by several waves of severe weather which crossed the southeast region, dropping six to eight inches of rain in a 24-hour period throughout Arkansas, causing widespread flash flooding that washed away bridges and damaged roads. Extreme rainfall events can occur at other times of year outside and independently from tornado season (NOAA, 2015d).

Arkansas is also vulnerable to snow and ice storms during the winter months. The largest storms typically occur during unusually harsh winters when arctic high pressure builds into Arkansas from the Plains States, bringing extended periods of at or below freezing temperatures near the ground, while warm moist air is pushed in from the south by a storm system (NOAA, 2015d). These winter storms do not occur every year, but when they do, they are often accompanied by heavy snow or rainfall that leads to widespread flooding, as well as ice storms, and even tornadoes (NOAA, 2013).

Flooding in Arkansas is also common, with events occurring most often due to heavy rainfall, thunderstorms, tropical storms, and hurricanes. The most common types of flooding to occur in Arkansas include flash flooding, riverine flooding, tropical systems and/or coastal flooding, and dam breaks and/or levee failures. Four of Arkansas’s most destructive floods occurred within a short 40-year period: 1915, 1927, 1937, and 1945. (NOAA, 2015b)

During the Great Flood of 1927, approximately 16,570,627 acres of land were inundated by floodwaters (roughly 26,000 square miles). Across seven states, 170 counties and 4,459,238 million people were affected. “For the first time in recorded history of Mississippi Valley floods,” there was a substantial loss of life with over 100 fatalities in Arkansas alone. This flooding event throughout the Mississippi River Valley signaled the need for prompt action and flood control measures from the federal Government. In total, this flooding event cost the

government approximately \$1 billion, which was one third of the federal budget at the time. (NOAA, 2015b)

More recently, the Albert Pike flash flooding event of June 2010 caused 20 fatalities, injured 24, and resulted in an estimated \$9 million in property losses. This flooding event is considered the “most catastrophic flash flood event to date in Arkansas in terms of lives lost and injuries.” During this event, storm totals in this basin reached 6 to 7 inches. (NOAA, 2015b)

4.1.15. Human Health and Safety

4.1.15.1. Definition of the Resource

The existing environment for health and safety is defined by occupational and environmental hazards likely to be encountered during the construction, operation, and maintenance of towers, antennas, cables, utilities, and other equipment and infrastructure at existing and potential FirstNet telecommunication sites. There are two human populations of interest within the existing environment of health and safety, (1) telecommunication occupational workers and (2) the public near telecommunication sites. Each of these populations could experience different degrees of exposure to hazards as a result of their relative access to FirstNet telecommunication sites and their function throughout the implementation of the FirstNet telecommunication network infrastructure.

The health and safety issues reviewed in this section include occupational safety for telecommunications workers, contaminated sites, and manmade or natural disaster sites. This section does not evaluate the health and safety risks associated with radio frequency emissions, addressed in Section 2.4, RF Emissions, or vehicle traffic and the transportation of hazardous materials and wastes, which are evaluated in Section 4.1.1, Infrastructure.

There are unique infectious diseases throughout the continental U.S. Because of the great variety of diseases, as well as the variables associated with contracting them, this PEIS will not be evaluating infectious diseases. For information on Infectious Diseases, please visit the Centers for Disease Control and Prevention website at www.CDC.gov.

4.1.15.2. Specific Regulatory Considerations

Federal organizations, such as the U.S. Department of Labor, Occupational Safety and Health Administration (OSHA), USEPA, the U.S. Department of Health and Human Services, and others protect human health and the environment. In Arkansas, the Arkansas Department of Labor, OSHA Consultation Division (AOSH), and the ADEQ regulate this resource area. Federal OSH regulations apply to workers through either OSHA, or stricter state-specific plans that must be approved by OSHA.

Federal laws relevant to protecting occupational and public health and safety are summarized in Appendix C, Environmental Laws and Regulations, and Section 1.8, Overview of Relevant Federal Laws and Executive Orders. Table 4.1.15-1 below summarizes the major Arkansas laws relevant to the state’s occupational health and safety, hazardous materials, and hazardous waste management programs.

Table 4.1.15-1: Relevant Arkansas Human Health and Safety Laws and Regulations

State Law and Regulation	Regulatory Agency	Applicability
Arkansas Code: Title 8, Chapter 7, Subchapter 10 (8-7-1001)	Arkansas Occupational Safety and Health (AOSH)	Regulates chemical hazards in the workplace and requires communication of the hazards to public employees where concentrations exceed 55 gallons or 500 pounds.
Arkansas Code: 11-5-307	AOSH	Requires written notice to the owner or operator of electrical lines for temporary work or operation in close proximity to energized overhead electrical line or conductor.
Arkansas Code: 11-7-301	ADEQ, Surface Mining and Reclamation Division	Identifies access requirements for active and abandoned mining operations, and reporting requirements for injuries and fatalities.
Arkansas Code: 11-8-101	AOSH	Requires recordkeeping and monitoring for general employee injuries and fatalities.

Sources: (JUSTIA, 2010b), (JUSTIA, 2010c), (JUSTIA, 2014d), (JUSTIA, 2015c)

4.1.15.3. Environmental Setting: Existing Telecommunication Sites

There are many inherent health and safety hazards at telecommunication sites.

Telecommunication site work is performed indoors, below ground level, on building roofs, over water bodies, and on communication towers. Tasks may also be performed at dangerous heights or confined spaces, while operating heavy equipment, on energized equipment near underground and overhead utilities, and while using hazardous materials, such as flammable gases and liquids. Because telecommunication workers are often required to perform work outside, heat and cold exposure, precipitation, and lightning strikes also present hazard and risks depending on the task, occupational competency, and work-site monitoring (OSHA, 2016b). A summary description of the health and safety hazards present in the telecommunication occupational work environment is listed below.

Working from height, overhead work, and slips, trips, or falls – At tower and building-mount sites, workers regularly climb structures using fixed ladders or step bolts to heights up to 2,000 feet above the ground's surface (OSHA, 2015). In addition to tower climbing hazards, telecommunication workers have restricted workspace on rooftops or work from bucket trucks parked on uneven ground. Cumulatively, these conditions present fall and injury hazards to telecommunication workers, and the general public who may be observing the work or transiting the area (International Finance Corporation, 2007).

Trenches and confined spaces – Installation of underground utilities, building foundations, and work in utility manholes¹²⁹ are examples of confined space work is necessary. Installation of telecommunication activities involves laying conduit and in small trenches (generally 6 to 12 inches in width). Confined space work can involve poor atmospheric conditions, requiring ventilation and rescue equipment. Additionally, when inside a confined space, worker

¹²⁹ Manholes may be used for telecommunications activities, especially in cities and urban areas, depending on the location of other utilities. In cities, power, water, and telecommunication lines are often co-located; if access is through a manhole in the street, that access will be used.

movement is restricted and may prevent a rapid escape or interfere with proper work posture and ergonomics. (OSHA, 2016c) (OSHA, 2016d)

Heavy equipment and machinery – New and replacement facility deployment and maintenance can involve the use of heavy equipment and machinery. During the lifecycle of a telecommunication site, heavy equipment such as bulldozers, backhoes, dump trucks, cement trucks, and cranes are used to prepare the ground, transport materials, and soil, and raise large sections of towers and antennas. Telecommunication workers may be exposed to the additional site traffic and often work near heavy equipment to direct the equipment drivers and to accomplish work objectives. Accessory machinery such as motorized pulley systems, hydraulic metal shears, and air driven tools present additional health and safety risks as telecommunication work sites. These pieces of machinery can potentially sever skin and bone, or cause other significant musculoskeletal injuries to the operator. (OSHA, 2016c) (OSHA, 2016d)

Energized equipment and existing utilities – Electrical shock from energized equipment and utilities is an elevated risk at telecommunication sites due to the amount of electrical energy required for powering communication equipment and broadcasting towers. Telecommunication cables are often co-located with underground and overhead utilities, which can further increase occupational risk during earth-breaking and aerial work. (International Finance Corporation, 2007)

Optical fiber safety – Optical fiber cable installation and repair presents additional risks to telecommunications workers, including potential eye or tissue damage, through ingestion, inhalation, or other contact with glass fiber shards. The shards are generated during termination and splicing activities, and can penetrate exposed skin (International Finance Corporation, 2007). Additionally, fusion splicing (to join optical fibers) in confined spaces or other environments with the potential for flammable gas accumulation presents risk of fire or explosion (Fiber Optic Association, 2010).

Noise – Sources of excess noise at telecommunication sites include heavy equipment operation, electrical power generators and other small engine equipment, air compressors, electrical and pneumatic power tools, and road vehicles, such as diesel engine work trucks. The cumulative noise environment has the potential to exceed the OSHA acceptable level of 85 dB per 8-hour time weighted average (see Section 4.1.13, Noise) (OSHA, 2002). Fugitive noise may emanate beyond the telecommunication work site and impact the public living in the vicinity, observing the work, or transiting through the area. (OSHA, 2016c) (OSHA, 2016d)

Hazardous materials and hazardous waste – Work at telecommunication sites may require the storage and use of hazardous materials such as fuel sources for backup power generators and compressed gases used for welding and metal cutting (new towers only). In some cases, telecommunication sites require treatments, such as pesticide application. Secondary hazardous materials, like exhaust fumes, may be a greater health risk than the primary hazardous material (i.e., diesel fuel). Furthermore, the use of hazardous materials creates down-stream potential to generate hazardous waste. While it is unlikely that any FirstNet activities would involve the generation or storage of hazardous waste, older existing telecommunication structures and sites could have hazardous materials present, such as lead-based (exterior and interior) paint at

outdoor structures or asbestos tiles and insulation in equipment sheds. The public, unless a telecommunication work site allows unrestricted access, are typically shielded from hazardous materials and hazardous wastes that are components of telecommunication site work. (OSHA, 2016c) (OSHA, 2016d)

Aquatic environments – Installation of telecommunication lines may include laying, burying, or boring lines under waterways and wetlands, such as lakes, rivers, ponds, or streams. Workers responsible for these activities operate heavy equipment from soft shorelines, boats, barges, and other unstable surfaces. There is potential for equipment and personnel falls, as well as drowning in waterbodies. Wet work conditions also increase risks of electric shock and hypothermia. (OSHA, 2016c) (OSHA, 2016d)

Outdoor elements – Weather conditions have the potential to quickly and drastically reduce safety, and increase hazards at telecommunication work sites. Excessive heat and cold conditions impact judgement, motor skills, hydration, and in extreme cases may lead to hyper- or hypothermia. Precipitation, such as rain, ice, and snow, create slippery climbing conditions and wet or muddy ground conditions. Lightning strikes are risks to telecommunication workers climbing towers or working on top of buildings. (OSHA, 2016c) (OSHA, 2016d)

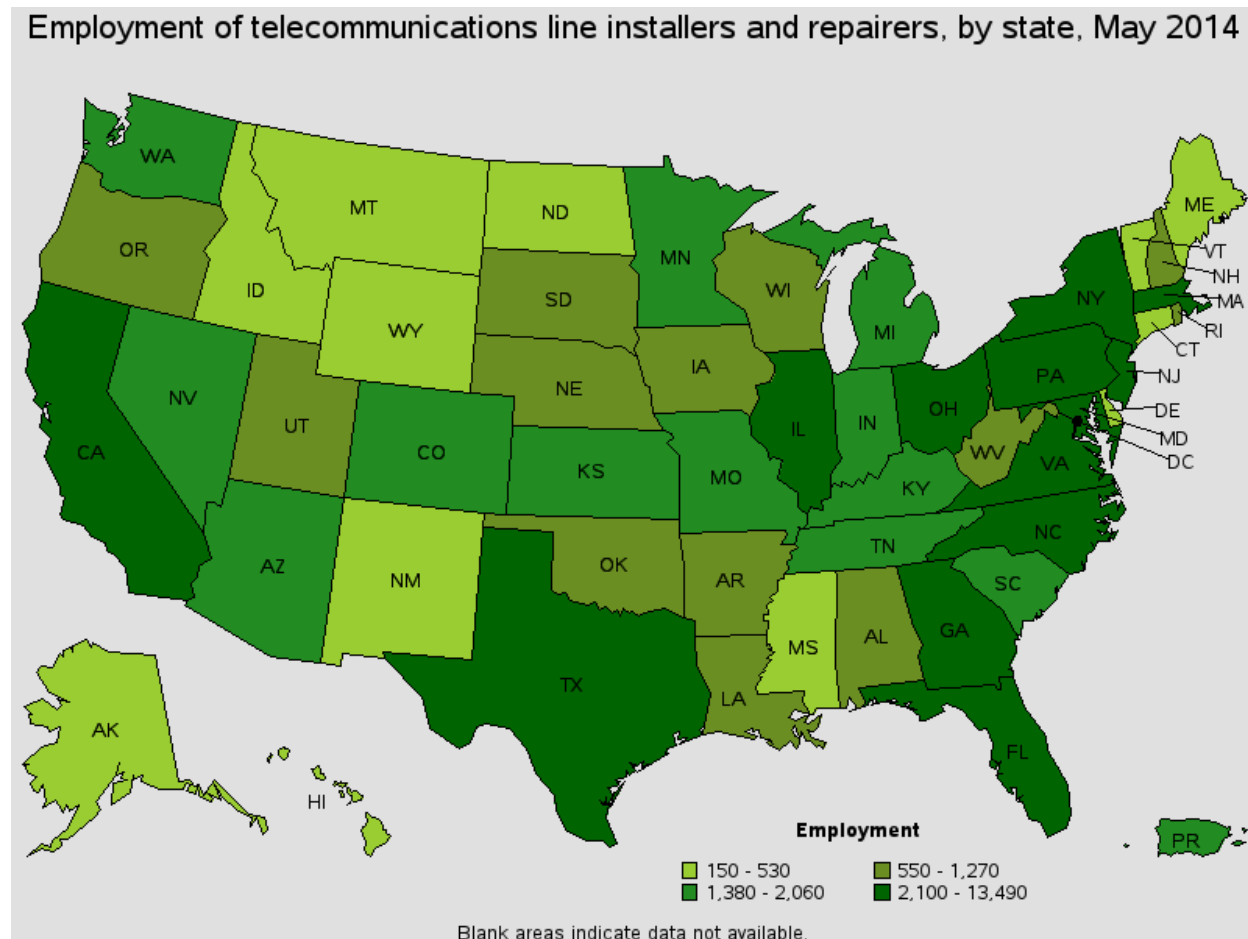
Telecommunication Worker Occupational Health and Safety

The BLS uses established industry and occupational codes to classify telecommunications workers. For industry classifications, BLS uses the North American Industry Classification System (NAICS) codes, which identify the telecommunications industry (NAICS code 517XX) as being within the information industry (NAICS code 51). For occupational classifications, BLS uses the Standard Occupational Classification (SOC) system to identify workers as belonging to 1 of 840 occupations. Telecommunications occupations are identified as telecommunication equipment installers and repairers, except line installers (SOC code 49-2022) or telecommunication line installers and repairers (SOC code 49-9052). Both occupations are reported under the installation, maintenance and repair occupations (SOC code 49-0000).

As of May 2014, there were 1,800 telecommunication equipment installers and repairers, and 810 telecommunication line installers and repairers working in Arkansas (BLS, 2015b). In 2013, the most recent year data are available, Arkansas had 1 case of nonfatal occupational injuries or illnesses in the telecommunications industry per 100 full-time workers (BLS, 2015c). By comparison, there were 1.9 nonfatal occupational injury cases nationwide in both 2012 and 2013 per 100 full-time workers in the telecommunications industry (BLS, 2013a).

Nationwide in 2013, there were 18 fatalities reported across the telecommunications industry (5 due to violence and other injuries by persons or animals; 3 due to transportation incidents; and 7 due to slips, trips, or falls), with an hours-based fatal injury rate of 7.9 per 100,000 full-time equivalent workers (BLS, 2013b). This represents 45 percent of the broader information industry fatalities (40 total), and less than 1 percent of occupational fatalities (4,585 total). Arkansas has not had any fatalities in the telecommunications industry or telecommunications occupations since 2003, when data are first available. In the broader installation, maintenance, and repair occupations (SOC code 49-0000), there were 76 total fatalities in Arkansas between

2003 and 2014, with the highest fatality years being 2008 and 2013, with 10 fatalities each. (BLS, 2015c)



Source: (BLS, 2015b)

Figure 4.1.15-1: Number of Telecommunication Line Installers and Repairers Employed per State, May 2014

Public Health and Safety

The public is unlikely to encounter occupational hazards at telecommunication sites due to limited access. Arkansas collects injury surveillance and fatality data among the public through the Arkansas Health Statistics Branch Query System (Arkansas Department of Health, 2011). The same data are reported with more specificity at the federal level through the Centers for Disease Control and Prevention Wide-ranging Online Data for Epidemiologic Research (WONDER). While the WONDER database cannot be searched for cases specific to telecommunication sites, many available injury categories are consistent with risks present at telecommunication sites. For example, between 1999 and 2013, there were 109 fatalities due to a fall from, out of, or through a building or structure; 24 fatalities due to exposure to electric transmission lines; and 30 fatalities due to being caught, crushed, jammed or pinched in or between objects (Centers for Disease Control and Prevention, 2015a). Among the public,

trespassers entering telecommunication sites would be at the greatest risk for exposure to health and safety hazards.

4.1.15.4. Contaminated Properties at or near Telecommunication Sites

Existing and surrounding land uses, including landfills or redeveloped brownfields, near telecommunication sites have the potential to impact human health and safety. Furthermore, undocumented environmental practices of telecommunication site occupants, including practices before current environmental laws, could result in environmental contamination, affecting the quality of soil, sediments, groundwater, surface water, and air.

The federal environmental remediation or cleanup programs that govern them typically classify contaminated property, such as sites administered through the Superfund Program¹³⁰ or listed on the National Priorities List (NPL), as well as the Resource Conservation and Recovery Act (RCRA) Corrective Action sites and Brownfields. These regulated cleanup sites are known to contain environmental contaminants at concentrations exceeding acceptable human health exposure thresholds. Contact with high concentrations of contaminated media can result in adverse health effects, such as dermatitis, pulmonary and cardiovascular events, organ disease, central nervous system disruption, birth defects, and cancer. It generally requires extended periods of exposure over a lifetime for the most severe health effects to occur.

In Arkansas, the ADEQ Hazardous Waste Division functions as a support agency to the USEPA to manage sites placed on the NPL (ADEQ, 2013a). As of October 2015, Arkansas had 30 RCRA Corrective Action sites,¹³¹ 173 brownfield sites, and 9 proposed or final Superfund/NPL sites (USEPA, 2015n). Based on an October 2015 search of USEPA Cleanups in My Community database, there are no Superfund sites and no RCRA Corrective Action sites (USEPA, 2015o) in Arkansas where contamination has been detected at an unsafe level, or a reasonable human exposure risk still exists.

Brownfield sites in Arkansas may enroll in the Arkansas Brownfield Program, administered by ADEQ (ADEQ, 2013a). One example of an Arkansas brownfield site is Heifer International, along the Arkansas River in downtown Little Rock, AR. The 28-acre site was historically used for rail yard storage, warehousing, and various vehicle maintenance and industrial operations for more than 100 years. Heifer International redeveloped the site as their world headquarters, constructing a Leadership in Energy & Environmental Design Platinum-rated facility and a 4.2-acre green parking lot, including a vegetated runoff collection system and pervious pavement. (USEPA, 2012d)

In addition to contaminated properties, certain industrial facilities are permitted to release toxic chemicals into the air, water, or land. One such program is the Toxics Release Inventory (TRI), administered by the USEPA under the Emergency Planning and Community Right to Know Act

¹³⁰ The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) enacted in 1980, commonly referred to as the Superfund Program, governs abandoned hazardous waste sites, and collects a tax on chemical and petroleum industries. CERCLA was amended by the Superfund Amendments and Reauthorization Act (SARA) in 1986; see Appendix C, Environmental Laws and Regulations (USEPA, 2011).

¹³¹ Data gathered using USEPA's Cleanups in My Community search on October 23, 2015, for all sites in Arkansas, where cleanup type equals 'RCRA Hazardous Waste – Corrective Action,' and excludes sites where cleanup phase equals 'Construction Complete' (i.e., no longer active). (USEPA, 2013c)

(EPCRA) of 1986. The Toxic Release Inventory database is a measure of the industrial nature of an area and the over-all chemical use, and can be used to track trends in releases over time. The “releases” do not necessarily equate to chemical exposure by humans or necessarily constitute quantifiable health risks because the releases include all wastes generated by a facility – the majority of which are disposed of via managed, regulated processes that minimize human exposure and related health risks (e.g., in properly permitted landfills or through recycling facilities). As of December 2015, Arkansas had 332 TRI reporting facilities. The identification of a TRI facility does not necessarily indicate that the facility is actively releasing to the environment; the majority of TRI reports involve permitted disposal facilities. According to the USEPA, in 2013, the most recent data available, Arkansas released 35.7 million pounds of toxic chemicals through onsite and offsite disposal, transfer, or other releases, largely from electric utilities and paper industries. This accounted for 0.87 percent of total nationwide TRI releases, ranking Arkansas 29 of 56 states and territories based on total releases per square mile. (USEPA, 2015p)

Another USEPA program is the NPDES, which regulates the quality of stormwater and sewer discharge from industrial and manufacturing facilities. Permitted discharge facilities are potential sources of toxic constituents that are harmful to human health or the environment. As of November 12, 2015, Arkansas had 185 major NPDES permitted facilities registered with the USEPA Integrated Compliance Information System. (USEPA, 2015q)

The National Institutes of Health, U.S. National Library of Medicine, provides an online mapping tool called TOXMAP, which allows users to “visually explore data from the USEPA’s TRI and Superfund Program” (National Institutes of Health, 2015). Figure 4.1.15-2 provides an overview of potentially hazardous sites in Arkansas.

Telecommunication Worker Occupational Health and Safety

Telecommunications sites may be on or near contaminated land, industrial discharge facilities, or sites presenting additional hazards. Occupational exposure to contaminated environmental media can occur during activities like soil excavating, trenching, other earthwork, and working over water bodies. Indoor air quality may also be impacted from vapor intrusion infiltrating indoors from contaminated soil or groundwater that are present beneath a building’s foundation. As of October 2015, USEPA does not have any regulated programs at telecommunications sites in Arkansas (USEPA, 2015r).

According to BLS data, Arkansas had four occupational fatalities in 2004 within the installation, maintenance, and repair occupation (SOC code 49-0000) from exposure to “harmful substances or environments,” although these were not specific to telecommunications (BLS, 2008). By comparison, the BLS reported three fatalities in 2011 and three fatalities in 2014 nationwide within the telecommunications industry (NAICS code 517), due to exposure to harmful substances or environments (BLS, 2015d). In 2014, BLS also reported four fatalities within the telecommunications line installers and repairers occupation (SOC code 49-9052), and no fatalities within the telecommunications equipment installers and repairers occupation (SOC code 49-2022) due to exposure to harmful substances or environments (BLS, 2014).

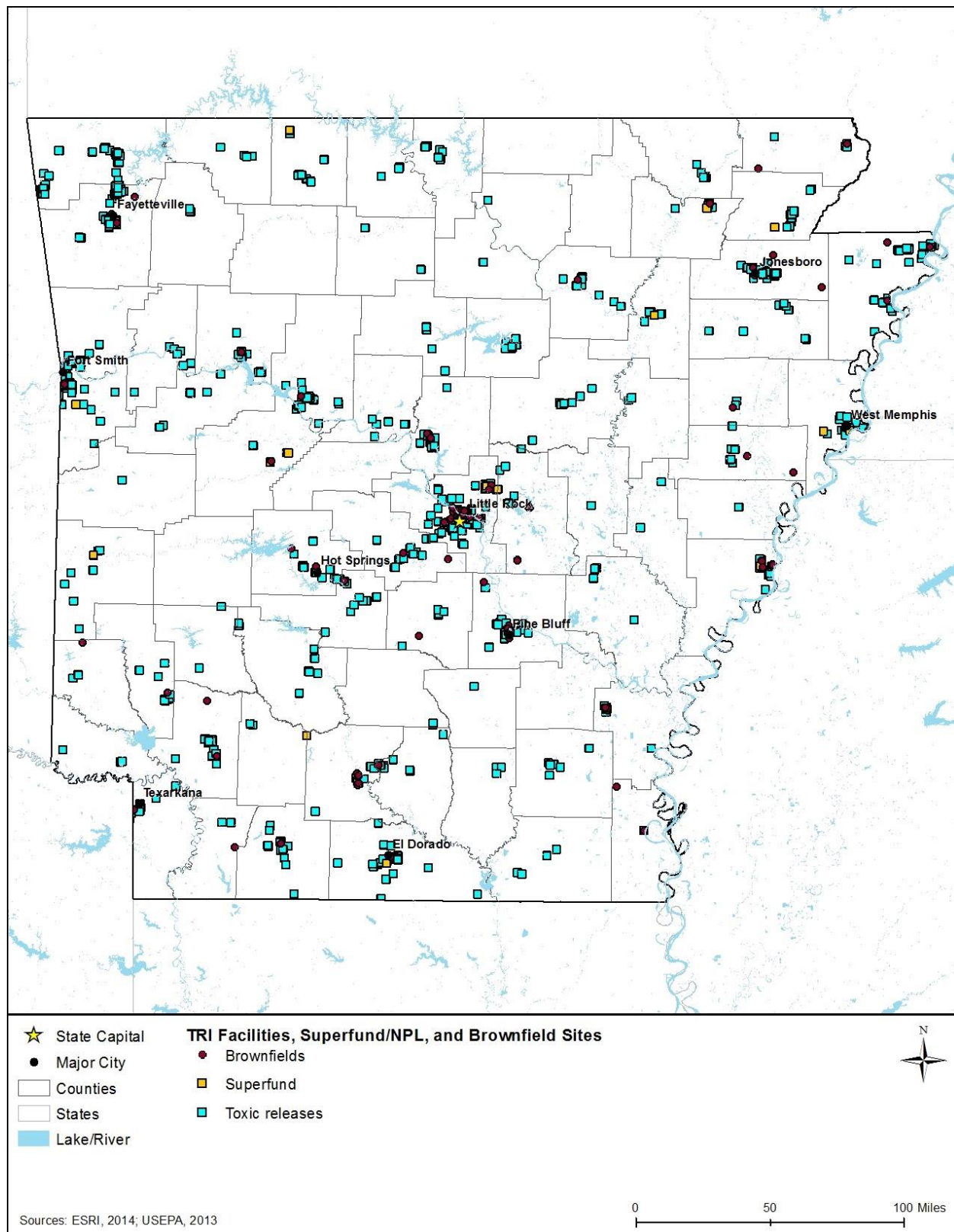


Figure 4.1.15-2: TOXMAP Superfund/NPL and TRI Facilities in Arkansas (2013)

Public Health and Safety

As described earlier, access to telecommunication sites is nearly always restricted to occupational workers. Although site access control is one of the major reasons telecommunication sites present an inherent low risk to non-occupational workers, the public could be potentially exposed to contaminants and other hazards in a variety of ways. One example would be if occupational workers disturb contaminated soil while digging, causing hazardous chemicals to mix with an underlying groundwater drinking water sources. If a contaminant enters a drinking water source, the surrounding community could inadvertently ingest or absorb the contaminant when using that source of water for drinking, cooking, bathing, and swimming. By trespassing on a restricted property, a trespasser may come in contact with contaminated soil or surface water, or by inhaling harmful vapors.

ADH partners with the federal Agency for Toxic Substances and Disease Registry (ATSDR) and USEPA as required by EPCRA to provide health assessments and consultations that identify and assess human exposure risks at contaminated sites. Public health assessments, consultations, and advisories developed by ADH are publicly available through the ATSDR Records Center (ATSDR, 2015). At the federal level, the Centers for Disease Control and Prevention, National Environmental Public Health Tracking Network, provides health, exposure, and hazard information, including known chemical contaminants, chronic diseases, and conditions based on geography. Data for injuries or fatalities due to reported acute toxic substance release incidents is not available for Arkansas (Centers for Disease Control and Prevention, 2015b).

4.1.15.5. Abandoned Mine Lands at or Near Telecommunications Sites

Another health and safety hazard in Arkansas includes surface and subterranean mines. In 2015, the Arkansas mining industry ranked 26th for non-fuel minerals (primarily bromine, sand and gravel, crushed stone, and portland cement), generating a value of \$991M (USGS, 2016a). In 2013, the most recent data available, Arkansas had two active coalmining operations (one underground and one surface) (EIA, 2013). Arkansas is also home to Crater of Diamonds State Park, in Murfreesboro, AR, which is the only publicly accessible diamond mine site in the world (State Parks of Arkansas, 2015n). Health and safety hazards at active mines and abandoned mine lands (AML) include falling into open shafts, cave-ins from unstable rock and decayed support, deadly gases and lack of oxygen inside the mine, unused explosives and toxic chemicals, horizontal and vertical openings, high walls, and open pits (Federal Mining Dialogue, 2015a).

The Arkansas Abandoned Mine Reclamation Program is administered by the ADEQ Surface Mining and Reclamation Division, Coal Program, which is responsible for managing health and safety hazards resulting from pre-1977 coal mining operations (ADEQ, 2015h). Health and safety hazards at open-pit and quarry sites (non-coal) are regulated by ADEQ's Non-Coal Program (ADEQ, 2015i). As of 2015, there were 5,000 acres of disturbed land as a result of mining activities in Arkansas (Federal Mining Dialogue, 2015b). Figure 4.1.15-4 shows the distribution of High Priority (Priority 1, 2 and adjacent Priority 3) AMLs in Arkansas, where Priority 1 and 2 sites pose a significant risk to human health and safety, and Priority 3 sites pose a risk to the environment. As of October 2015, Arkansas had 81 Priority 1 and 2 AMLs, with

115 unfunded problem areas (U.S. Department of Interior, Office of Surface Mining Reclamation and Enforcement, 2014).

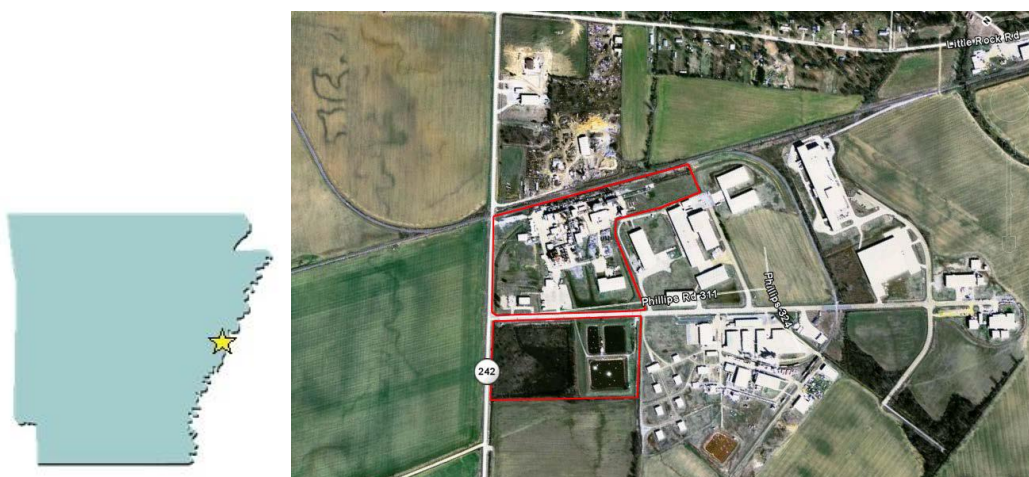
Telecommunication Worker Occupational Health and Safety

Telecommunications sites may be on or near AMLs or active surface mines, presenting occupational exposure risks from fire, toxic gases, and subsidence during FirstNet deployment, operation, and maintenance activities. Because the locations of many abandoned mines are unknown or hidden, these mines pose a risk to telecommunications workers because they may be encountered during deployment and maintenance operations.

Spotlight on Arkansas Superfund Sites: Cedar Chemical Company

Cedar Chemical Company is a 48-acre site in West Helena, AR (Phillips County). Between 1970 and 2002, the site was used to manufacture agricultural chemicals (primarily herbicides) including dinoseb, which is regulated by the USEPA in drinking water standards. After repeated environmental violations, Cedar Chemical filed for bankruptcy in 2002 and abandoned the property. The site was placed on the State Priority List soon after, and maintained by ADEQ until 2012 when the site was elevated to the NPL. Pesticides, volatile organic compounds, and heavy metals were found in the soils, surface water sediments, and groundwater at concentrations potentially posing an unacceptable risk to human health and safety. (ADEQ, 2013b)

Between 2001 and 2004, ADEQ sampled the groundwater from four nearby irrigation wells and found 1, 2-dichloroethane (ethylene dichloride) concentrations “significantly above ATSDR’s drinking water health comparison value.” 1, 2-Dichlorethane is released into the air during irrigation and is a known carcinogen, causing damage the nervous system, liver, kidneys, and lungs if breathed in at high levels. As a result, ADH conducted a public health consultation in partnership with ATSDR in 2005 to evaluate the potential health risk to the surrounding farming community. The ADH-ATSDR risk assessment evaluated groundwater samples from irrigation wells and found potential inhalation exposures to 1, 2-dichlorethane but lacked sufficient air sampling data to assess exposure pathways (ATDSR, 2005). A second health consultation evaluated additional air samples to evaluate field workers’ inhalation exposure risk, and found no apparent public health hazard to exposed individuals (ATSDR, 2006).

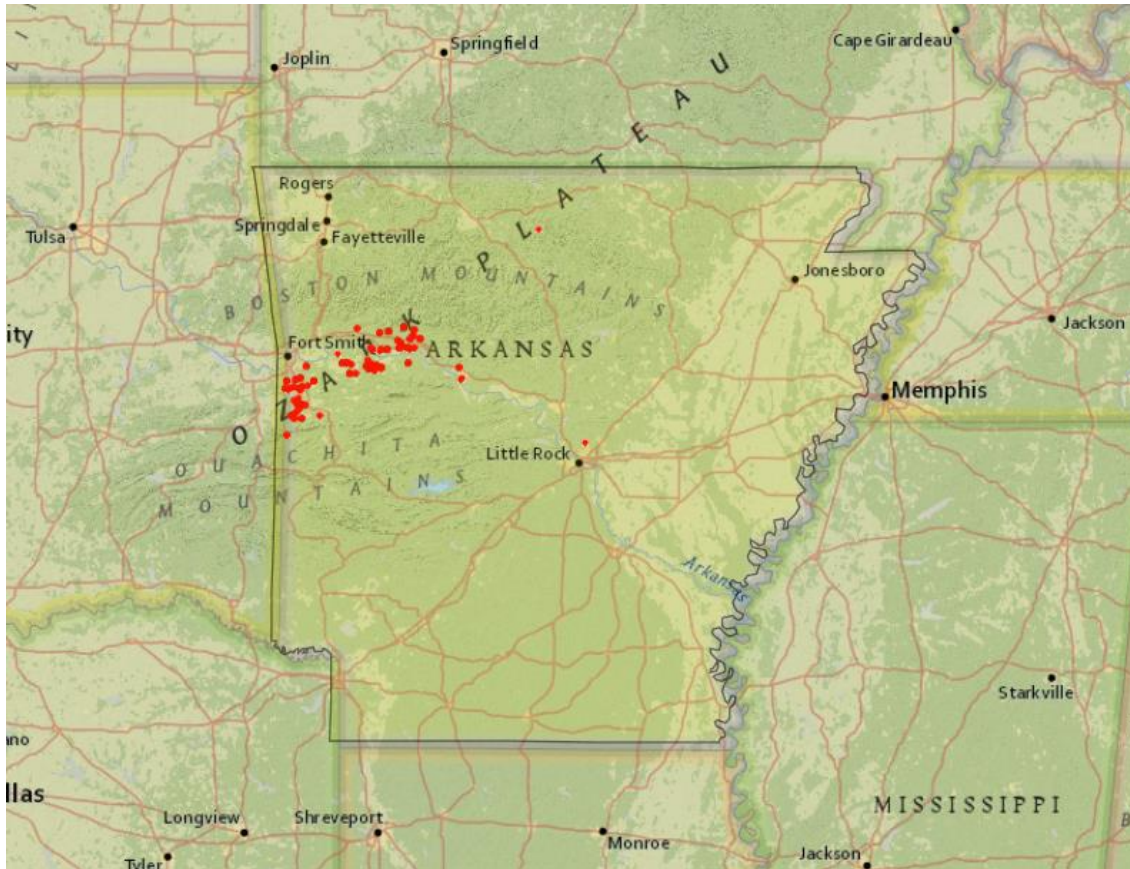


Source: (ADEQ, 2013b)

Figure 4.1.15-3: Aerial Image of Cedar Chemical Company

Public Health and Safety

Subterranean coalmines present additional health and safety risks to the public, by generating toxic combustible gases, which can penetrate the surface through ground fractures, potentially seeping into residential structures. Additionally, coalmine fires can consume enough sub-surface material, that risk of subsidence increases. As a result, AMLs and coalmine fires in particular, can result in evacuations of entire communities (U.S. Department of the Interior, Office of Surface Mining Reclamation and Enforcement, 2015).



Source: (U.S. Department of Interior, Office of Surface Mining Reclamation and Enforcement, 2015)

Figure 4.1.15-4: High Priority Abandoned Mine Lands in Arkansas (2015)

4.1.15.6. *Natural & Manmade Disaster Sites*

Natural and manmade disaster events can create health and safety risks, as well as present unique hazards, to telecommunication workers and the public. Telecommunications, including public safety communications, can be knocked out (temporarily or permanently) during disaster events. Examples of manmade disasters are train derailments, refinery fires, or other incident involving the release of hazardous constituents. A common example of a natural disaster is flooding. Floodwaters damage transportation infrastructure (roads, railways, etc.) and utility lines (sewer, water, electric power, broadband, natural gas lines, etc.). Hazardous chemicals and sanitary wastes often contaminate floodwaters, which can cause headaches, skin rashes, dizziness,

nausea, excitability, weakness, fatigue, and disease to exposed workers (OSHA, 2003). Another natural hazard common to Arkansas is lightning strikes. Between 1959 and 2014, Arkansas ranked 11th in the United States for the most lightning fatalities (125 total), but ranked 3rd for the population-weighted fatality rate at 0.98 fatalities per one million people (NOAA, 2015e).

Physical hazards may also be present at disaster sites, such as downed utility lines, debris blockage or road washout conditions, which increases exposure risks to telecommunication workers. Climbing and working from tower structures damaged by wind increases the risk of slips, trips, or falls. During natural and manmade disasters, access to the telecommunication sites can be obstructed by debris.

Telecommunication Worker Occupational Health and Safety

Telecommunication workers are often called upon to provide support to natural and manmade disaster response efforts because of the critical need to restore and maintain telecommunication capabilities. The need to enter disaster areas as part of the recovery effort exposes telecommunication workers to elevated risks because chemical, biological, and physical hazards might not have not been fully identified or assessed. Transportation infrastructure and utilities in the affected areas are often compromised and present unknown chemical and biologic hazards. Correspondingly, if telecommunication workers are injured during response and repair operations, their rescue and treatment might over-extend first responder staff and medical facilities that are delivering care to victims of the initial incident.

Currently, the AOSH and BLS do not report data specific to injuries or fatalities among telecommunication workers responding to natural or manmade disasters. However, the National Response Center (NRC), managed by the U.S. Coast Guard, compiles reports for oil spills, chemical releases, or other maritime security incidents and contains incident reports related to occupational health and safety. Of the 152 NRC-reported incidents for Arkansas in 2015 with known causes, only 18 were attributed to natural disaster (flooding and natural phenomenon), while the majority (134) were attributed to manmade disasters (equipment failure and operator error) (U.S. Coast Guard, 2015). For example, during the April 2014 Mayflower/Vilonia tornado, a utility substation was demolished and released 1,000 gallons of non- Polychlorinated Biphenyl mineral oil into a nearby ditch, potentially affecting water quality (U.S. Coast Guard, 2015). Such incidents present unique, hazardous challenges to telecommunication workers responding during natural and manmade disasters.

Public Health and Safety

Hazards present during natural and manmade disasters are often far-reaching, affecting large geographic areas and affecting all populations living within the area. Similar to telecommunication workers, the public faces risks during these types of disasters, such as compromised transportation infrastructure and utilities, potential for exposure to unknown chemical and biologic hazards, and inadequate medical support. In 2014, Arkansas had 23 weather-related fatalities (17 due to tornado, 4 due to wind, and 2 due to lightning) and 225 injuries. By comparison, 384 weather-related fatalities and 2,203 injuries were reported nationwide the same year (NWS, 2015a).

Spotlight on Arkansas Natural Disaster Sites: 2014 Mayflower/Vilonia Tornado

On April 27, 2014, an EF4 (166-200 mph winds) tornado decimated the cities of Mayflower, AR, and Vilonia, AR, in Faulkner County. The tornado was tracked for 41 miles for a period 56 minutes, causing 16 fatalities and 193 injuries. This made the tornado the deadliest in the United States for 2014, and the deadliest in Arkansas since 1968. (NWS, 2015b)

In addition to the wind, hail, and debris damage, extensive flash flooding occurred after rain accumulations topped 5 inches in 24 hours, resulting in washout conditions across many roads and bridges. Following the storm, 12 counties in Arkansas (including Faulkner County) were declared federal disaster areas. Statewide infrastructure damages were \$14M, excluding damages to private property. (NWS, 2015b)



Sources: left (NWS, 2015c); right (FEMA, 2014e)

Figure 4.1.15-5: Aerial View of Tornado Path Crossing Interstate 30 (left) and Utility Workers Restoring Grid Infrastructure (right)

4.2. ENVIRONMENTAL CONSEQUENCES

This section describes the potential environmental impacts, beneficial, or adverse, resulting from the Proposed Action and Alternatives. As this is a programmatic evaluation, site- and project-specific issues are not assessed.

The specific deployment activity and where the deployment will take place will be determined based on location-specific conditions and the results of site-specific environmental reviews.

At the programmatic level, the categories of impacts have been defined as *potentially significant*, *less than significant with mitigation measures incorporated*, *less than significant*, or *no impact*. Each resource area identifies the range of possible impacts on resources for the Proposed Action and Alternatives, include the No Action Alternative. The No Action Alternative provides a comparison to describe the effects of environmental resources of the existing conditions to the proposed Alternatives.

NEPA requires agencies to assess the potential direct and indirect impacts each alternative could have on the existing environment (as characterized earlier in this section). Direct impacts are those impacts that are caused by the Proposed Action and occur at the same time and place, such as soil disturbance. Indirect impacts are those impacts related to the Proposed Action but result from an intermediate step or process, such as changes in surface water quality because of soil erosion.

For each resource, the potential impact is assessed in terms of context of the action and the intensity of the potential impact, per CEQ regulations (40 CFR §1508.27). *Context* refers to the timing, duration, and where the impact could potentially occur (i.e., local vs. national; pristine vs. disturbed; common species vs. protected species). In terms of duration of potential impact, context is described as short or long term. *Intensity* refers to the magnitude or severity of the effect as either beneficial or adverse. Resource-specific significance rating criteria are provided at the beginning of each resource area section.

4.2.1. Infrastructure

4.2.1.1. Introduction

This section describes potential impacts to infrastructure in Arkansas associated with construction, deployment, and operation of the Proposed Action and Alternatives. Chapter 16, Best Management Practices (BMPs) and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

4.2.1.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on infrastructure were evaluated using the significance criteria presented in Table 4.2.1-1. As described in Section 4.2, Environmental Consequences, the categories of impacts are defined at the programmatic level as *potentially significant*, *less than significant with mitigation measures incorporated*, *less than significant*, or *no impact*. Characteristics of each impact type, including magnitude or intensity, geographic extent, and

duration or frequency, were used to determine the impact significance rating associated with each potential impact.

Given the nature of this programmatic evaluation, and because the Proposed Action could potentially cover a wide variety of actions that would take place in various landscapes, the potential impacts to infrastructure addressed in this section are presented as a range of possible impacts.

Table 4.2.1-1: Impact Significance Rating Criteria for Infrastructure at the Programmatic Level

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Transportation system capacity and safety	Magnitude or Intensity	Creation of substantial traffic congestion/delay and/or a substantial increase in transportation incidents (e.g., crashes, derailments).	Effect that is <i>potentially significant</i> , but with mitigation is <i>less than significant</i> .	Minimal change in traffic congestion/delay and/or transportation incidents (e.g., crashes, derailments).	<i>No effect</i> on traffic congestion or delay, or transportation incidents.
	Geographic Extent	Regional impacts observed throughout the state/territory.		Effects realized at one or multiple isolated locations.	NA
	Duration or Frequency	Permanent: Persisting indefinitely.		Short-term effects will be noticeable for up to the entire construction phase or a portion of the operational phase.	NA
Capacity of local health, public safety, and emergency response services	Magnitude or Intensity	Impacted individuals or communities cannot access health care and/or emergency services, or access is delayed, due to the project activities.	Effect is <i>potentially significant</i> , but with mitigation is <i>less than significant</i> .	Minor delays to access to care and emergency services that do not impact health outcomes.	<i>No impacts</i> on access to care or emergency services.
	Geographic Extent	Regional impacts observed (“regional” assumed to be at least a county or county-equivalent geographical extent, could extend to state).		Impacts only at a local/neighborhood level.	NA
	Duration or Frequency	Duration is constant during construction and deployment phase.		Rare event during construction and deployment phase.	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Modifies existing public safety response, physical infrastructure, telecommunication practices, or level of service in a manner that directly affects public safety communication capabilities and response times	Magnitude or Intensity	Substantial adverse changes in public safety response times and the ability to communicate effectively with and between public safety entities.	Effect that is <i>potentially significant</i> , but with mitigation is <i>less than significant</i> .	Minimal change in the ability to communicate with and between public safety entities.	No perceptible change in existing response times or the ability to communicate with and between public safety entities.
	Geographic Extent	Local/City, County/Region, or State/Territory.		Local/City, County/Region, or State/Territory.	Local/City, County/Region, or State/Territory.
	Duration or Frequency	Permanent or perpetual change in emergency response times and level of service.		Change in communication and/or the level of service is perceptible but reasonable to maintaining effectiveness and quality of service.	NA
Effects to commercial telecommunication systems, communications, or level of service	Magnitude or Intensity	Substantial adverse changes in level service and communications capabilities.	Effect that is <i>potentially significant</i> , but with mitigation is <i>less than significant</i> .	Minor changes in level of service and communications while transitioning to the new system.	No perceptible effect to level of service or communications while transitioning to the new system.
	Geographic Extent	Local/City, County/Region, or State/Territory.		Local/City, County/Region, or State/Territory.	Local/City, County/Region, or State/Territory.
	Duration or Frequency	Persistent, long-term, or permanent effects to communications and level of service.		Minimal effects to level of service or communications lasting no more than a short period (minutes to hours) during the construction and deployment phase.	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Effects to utilities, including electric power transmission facilities and water and sewer facilities	Magnitude or Intensity	Substantial disruptions in the delivery of electric power or to physical infrastructure that results in disruptions, including frequent power outages or drops in voltage in the electrical power supply system (“brownouts”). Disruption in water delivery or sewer capacity, or damage to or interference with physical plant facilities that impact delivery of water or sewer systems.	Effect that is <i>potentially significant</i> , but with mitigation is <i>less than significant</i> .	Minor disruptions to the delivery of electric power, water, and sewer services, or minor modifications to physical infrastructure that result in minor disruptions to delivery of power, water, and sewer services.	There would be no perceptible impacts to delivery of other utilities and no service disruptions.
	Geographic Extent	Local/City, County/Region, or State/Territory.		Local/City, County/Region, or State/Territory.	Local/City, County/Region, or State/Territory.
	Duration or Frequency	Effects to other utilities would be seen throughout the entire construction phase.		Effects to other utilities would be of short duration (minutes to hours) and would occur sporadically during the entire construction phase.	NA

NA = Not Applicable

4.2.1.3. Description of Environmental Concerns

Transportation System Capacity and Safety

The primary concerns for transportation system capacity and safety related to FirstNet activities would primarily occur during the construction phases of deployment. Depending on the exact site locations and placement of new assets in the field, temporary impacts on traffic congestion, railway use, airport operations, or use of other transportation corridors could occur if site locations were near or adjacent to roadways and other transportation corridors, requiring temporary closures (lane closures on roadways, for example). Coordination would be necessary with the relevant transportation authority (i.e., departments of transportation, airport authorities, and railway companies) to ensure proper coordination during deployment. Based on the impact significance criteria presented in Table 4.2.1-1, such impacts would be *less than significant* at the programmatic level due to the temporary nature of the deployment activities, even if impacts would be realized at one or more isolated locations. These impacts would be noticeable during the deployment phase, but would be short-term, with no anticipated impacts continuing into the operational phase, unless any large-scale maintenance would become necessary during operations.

Capacity of Local Health, Public Safety, and Emergency Response Services

The capacity of local health, public safety, and emergency response services would experience *less than significant* impacts at the programmatic level during deployment or operation phases. During deployment and system optimization, existing services would likely remain operational in a redundant manner ensuring continued operations and availability of services to the public. The only potential impact would be extremely rare, if emergency response services were using transportation infrastructure to respond to an emergency at the exact time that deployment activities were taking place. This type of impact would be isolated at the local or neighborhood level, and the likelihood of such an impact would be extremely low. Once operational, the new network would provide beneficial impacts to the capacity of local health, public safety, and emergency response services through enhanced communications infrastructure, thereby increasing capacity for and enhancing the ability of first responders to communicate during emergency response situations. Based on the impact significance criteria presented in Table 4.2.1-1, potential negative impacts would be *less than significant* at the programmatic level. Substantial beneficial impacts are likely to result from implementation.

Modifies Existing Public Safety Response Telecommunication Practices, Physical Infrastructure, or Level of Service in a manner that directly affects Public Safety Communication Capabilities and Response Times

The Proposed Action and Alternatives contemplated by FirstNet would not cause negative impacts to existing public safety response telecommunication practices, physical infrastructure, or level of service in a manner that directly affects public safety communication capabilities and response times. Based on the impact significance criteria presented in Table 4.2.1-1, any potential impacts would be *less than significant* at the programmatic level during deployment.

As described above, during deployment and system optimization, existing services would likely remain operational in a redundant manner ensuring continued operations and availability of services to the public. Once operational, state, and local public safety organizations would need to evaluate telecommunication practices and standard operating procedures (SOPs). FirstNet's mission is to complement such practices and SOPs in a positive manner; therefore, only beneficial or complementary impacts would be anticipated. Public safety communication capabilities and response times would be expected to also experience beneficial impacts through enhanced communications abilities. It is possible that FirstNet would be upgrading physical telecommunications infrastructure, thus the infrastructure would also experience a positive and beneficial impact. Disposal or reuse of old public safety communications infrastructure would also likely need to be considered once the specifics are known. Any negative impacts would be expected to be *less than significant* at the programmatic level given the short-term nature of the deployment activities.

Effects to Commercial Telecommunication Systems, Communications, or Level of Service

Commercial assets would be using a different spectrum for communications; as such, commercial telecommunication systems, communications, or level of service would experience *no impacts*. FirstNet has exclusive rights to use of the assigned spectrum, and only designated public safety organizations would be authorized to connect to FirstNet's network. Depending on the use patterns of FirstNet's spectrum, such spectrum use may be over-built or under-utilized.¹³² Anticipated impacts would be *less than significant* at the programmatic level due to the limited extent and temporary nature of deployment.

Effects to Utilities, including Electric Power Transmission Facilities, and Water and Sewer Facilities

The activities proposed by FirstNet would have *less than significant* impacts at the programmatic level on utilities, including electric power transmission facilities, and water and sewer facilities. Depending on the specific project contemplated, installation of new equipment could require connection with local electric sources, and use of site-specific local generators, on a temporary or permanent basis. Also, depending on the specific project contemplated, the draw or use of power from the transmission facilities may need to be examined; however, it is not anticipated that such use of power would have negative impacts, due to the local nature of the proposed activities and the widespread availability and use of the power grid in the United States.

4.2.1.4. Potential Impacts of the Preferred Alternative

The following section assesses potential impacts associated with implementation of the Preferred Alternative, including deployment, and operation activities.

¹³² Telecommunications equipment for specific spectrum use can be built where other equipment for other spectrum use already exists. If the new equipment and spectrum is not fully utilized, the geographic region may experience "over-build," where an abundance of under-utilized equipment may exist in that geographic location. This situation can be caused by a variety of factors including changes in current and future use patterns, changes in spectrum allocation, changes in laws and regulations, and other factors.

Deployment Impacts

As described in Section 2.1, Proposed Action Infrastructure, implementation of the Preferred Alternative could result in the deployment of various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure and the specific deployment requirements, some activities would result in potential impacts to infrastructure and others would not. In addition, and as explained in this section, the same type of Proposed Action Infrastructure could result in a range of *no impacts* to *less than significant* impacts depending on the deployment scenario or site-specific conditions.

Activities Likely to Have No Impacts at the Programmatic Level

Of the types of facilities or infrastructure deployment scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are likely to have *no impacts* to infrastructure under the conditions described below:

- **Wired Projects**
 - **Use of Existing Conduit – New Buried Fiber Optic Plant:** Disturbance associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas. It is anticipated that there would be *no impacts* to infrastructure resources since the activities that would be conducted at these small entry and exit points are not likely to produce perceptible changes or disruption of transportation, telecommunications, or utility services.
 - **Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable:** Lighting of dark fiber would have *no impacts* on infrastructure resources because there would be no ground disturbance and no interference with existing utility, transportation, or communication systems.
- **Satellites and Other Technologies**
 - **Satellite-Enabled Devices and Equipment:** It is anticipated that the use of portable devices that use satellite technology would not impact infrastructure resources because there would be no change to the built or natural environment from the use of portable equipment. Installation of satellite-enabled equipment would not be expected to have any impacts to infrastructure resources, given that construction activities would occur on existing structures, would not be expected to interfere with existing equipment, and transportation capacity and safety, and access to emergency services would not be impacted.
 - **Deployment of Satellites:** FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it may include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact infrastructure resources, it is anticipated that this activity would have *no impact* on infrastructure resources.

Activities with the Potential to Have Impacts at the Programmatic Level

Potential deployment-related impacts to infrastructure as a result of implementation of the Preferred Alternative would encompass a range of impacts that could occur as a result of direct

interface with existing infrastructure, most notably existing telecommunication infrastructure. The types of infrastructure deployment activities that could be part of the Preferred Alternative and result in potential impacts to infrastructure include the following:

- **Wired Projects**
 - **New Build – Buried Fiber Optic Plant:** Plowing (including vibratory plowing), trenching, or directional boring and the construction of points of presence (POPs),¹³³ huts, or other associated facilities or hand-holes to access fiber could result in potential impacts to infrastructure resources, depending on the specific assets connected on either end of the buried fiber. If a fiber optic plant is being used to tie into existing telecommunications assets, then localized impacts to telecommunications sites could occur during the deployment phase, however, it is anticipated that this tie-in would cause *less than significant* impacts at the programmatic level as the activity would be temporary and minor.
 - **New Build – Aerial Fiber Optic Plant:** Installation of a new aerial fiber optic plant could impact new telecommunications infrastructure through the installation of new, or replacement of existing, telecommunications poles.
 - **Collocation on Existing Aerial Fiber Optic Plant:** Similar to new build activities (above), collocation on existing aerial fiber optic plant could include installation of new or replacement towers requiring ground disturbance.
 - **New Build – Submarine Fiber Optic Plant:** The installation of cables in or near bodies of water would not impact infrastructure resources because there would be no local infrastructure to impact, other than harbor operations. However, impacts to infrastructure resources could potentially occur as result of the construction of landings and/or facilities on shores or the banks of waterbodies that accept the submarine cable, depending on the exact site location and proximity to existing infrastructure.
 - **Installation of Optical Transmission or Centralized Transmission Equipment:** Installation of transmission equipment such as small boxes or huts, or access roads, could potentially impact to infrastructure. Impacts could include disruption of service in transportation corridors, disruption of service to telecommunications infrastructure, or other temporary impacts.
- **Wireless Projects**
 - **New Wireless Communication Towers:** Installation of new wireless towers and associated structures (generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads might result in temporary or unintended impacts to current utility services during installation or interconnection activities. Generally, however, these deployment activities would be independent and would not be expected to interfere with other existing towers and structures. In addition, installation activities would have beneficial impacts due to expansion of infrastructure at a local level. Such activities could enhance public safety infrastructure, and other telecommunications as the site could potentially be available for subsequent collocation.

¹³³ Points of Presence are connections or access points between two different networks, or different components of one network.

- Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower, which would result in localized impacts to that tower and tower site such as minor disruptions in services. As a result of collocation of equipment, the potential addition of power units, structural hardening, and physical security measures could potentially have beneficial impacts on existing infrastructure assets, depending on the site specific plans.
- Deployable Technologies: Deployable technologies such as COWs, COLTs, and SOWs are composed of cellular base stations, sometimes with expandable antenna masts, and generators that connect to utility power cables. Connecting the generators to utility power cables has the potential to disrupt electric power utility systems or cause power outages; however, this is expected to be temporary and minor. Some staging or landing areas (depending on the type of technology) could require minor construction and maintenance within public road ROWs and utility corridors, heavy equipment movement, and minor excavation and paving near public roads, which have the potential to impact transportation capacity and safety as these activities could increase transportation congestion and delays. Implementation of deployable technologies could result in potential impacts to infrastructure resources in terms of infrastructure expansion, if deployment requires paving of previously unpaved surfaces or other new infrastructure build to accommodate the deployable technology. In addition, beneficial impacts could be realized, as deployable technologies are used when other infrastructure is impaired in some way; so deployable technologies could provide continuity of service during emergency events. Where deployable technologies would be implemented on existing paved surfaces and the acceptable load on those paved surfaces is not exceeded, or where aerial deployable technologies may be utilized but launched from existing paved surfaces, it is anticipated that there would be *no impacts* to infrastructure resources because there would be no disturbance of the natural or built environment.

In general, the abovementioned activities could potentially impact infrastructure resources in different ways, resulting in both potentially negative and potentially positive impacts. Potential negative impacts to infrastructure associated with deployment could include temporary disruption of various types of transportation corridors, temporary impacts on existing or new telecommunications sites, and more permanent impacts on utilities, if new infrastructure required tie-in to the electric grid. These impacts are expected to be *less than significant* at the programmatic level as the deployment activities will likely be of short duration (generally a few hours to a few months depending on the activity), would be regionally based around the on-going phase of deployment, and minor. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Positive impacts to infrastructure resources may result from the expansion of public safety and commercial telecommunications capacity and an improvement in public safety telecommunications coverage, system resiliency, response times, and system redundancy.

Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major infrastructure replacement as part of ongoing system maintenance would result in potential impacts similar to the abovementioned deployment impacts. It is anticipated that there would be *no impacts* to infrastructure associated with routine inspections of the Preferred Alternative, assuming that the same access roads used for deployment are also used for inspections. If usage of heavy equipment as part of routine maintenance or inspections occurs off of established access roads or corridors, or if further construction related activities are required along public road and utility ROWs, increased traffic congestion, current telecommunication system interruption, and utility interruptions could occur. These potential impacts would be expected to be minor and temporary as explained above.

Numerous beneficial impacts would be associated with operation of the NPSBN. The new system is intended to result in substantial improvements in public safety response times and the ability to communicate effectively with and between public safety entities, and would likely result in substantial improvements in level of service and communications capabilities. Operation of the NPSBN is intended to involve high-speed data capabilities, location information, images, and eventually streaming video, which would likely significantly improve communications and the ability of the public safety community to effectively engage and respond. The NPSBN is also intended to have a higher level of redundancy and resiliency than current commercial networks to support the public safety community effectively, even in events of extreme demand. This improvement in the level of resiliency and redundancy is intended to increase the reliability of systems, communications, and level of service, and also minimize disruptions and misinformation resulting from limited or disrupted service. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

4.2.1.5. *Alternatives Impact Assessment*

The following section assesses potential impacts to infrastructure associated with the Deployable Technologies Alternative and the No Action Alternative.¹³⁴

Deployable Technologies Alternative

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the

¹³⁴ As mentioned above and in Section 2.1.2 Proposed Action Infrastructure, the Preferred Alternative includes implementation of deployable technologies.

Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential impacts to infrastructure as a result of implementation of this alternative could be as described below.

Deployment Impacts

As explained above, implementation of deployable technologies could result in *less than significant* impacts at the programmatic level to infrastructure even if deployment requires expansion of infrastructure, such as paving of previously unpaved surfaces or other new infrastructure built to support deployment. This is primarily due to the small amount of paving or new infrastructure that might have to be constructed to accommodate the deployables. The site-specific location of deployment would need to be considered, and any local infrastructure assets (transportation, telecommunications, or utilities) would need to be considered, planned for, and managed accordingly to try and avoid any negative impacts to such resources. Site-specific analysis may be required depending on the site conditions, the type of deployment, or any other permits or permissions necessary to perform the work. Beneficial impacts could be realized, as deployable technologies are used when other infrastructure is impaired in some way; so deployable technologies could provide continuity of service during emergency events. Chapter 16, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As explained above, operation activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. As with the Preferred Alternative, it is anticipated that there would be *no impacts* to infrastructure resources associated with routine inspections of the Preferred Alternative, assuming that the same access roads used for deployment are also used for inspections. At the programmatic level, if usage of heavy equipment, as part of routine maintenance or inspection occurs off an established access road or utility ROW, or if additional maintenance-related construction activities occur within public road and utility ROWs, *less than significant* impacts at the programmatic level would likely still occur to transportation systems or utility services due to the limited amount of new infrastructure needed to accommodate the deployables. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed; therefore, there would be no associated deployment or installation of wired, wireless, deployable infrastructure or satellites and other technologies. Therefore, there would be *no impacts* to infrastructure at the programmatic level as a result of the No Action Alternative. Environmental conditions would

therefore be the same as those described in Section 4.1.1, Infrastructure. The state also would not realize positive, beneficial impacts to infrastructure resources described above.

4.2.2. Soils

4.2.2.1. Introduction

This section describes potential impacts to soil resources in Arkansas associated with deployment and operation of the Proposed Action and Alternatives. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

4.2.2.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on soil resources were evaluated using the significance criteria presented in Table 4.2.2-1. As described in Section 4.1.2, Environmental Consequences, the categories of impacts are defined, at the programmatic level, as *potentially significant*, *less than significant with mitigation measures incorporated*, *less than significant*, or *no impact*. Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

Given the nature of this programmatic evaluation, and because the Proposed Action could potentially cover a wide variety of actions that would take place in various landscapes, the potential impacts to soil resources addressed in this section are presented as a range of possible impacts.

Table 4.2.2-1: Impact Significance Rating Criteria for Soils at the Programmatic Level

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Soil erosion	Magnitude or Intensity	Severe, widespread, and observable erosion in comparison to baseline, high likelihood of encountering erosion-prone soils.	Effect that is <i>potentially significant</i> , but with mitigation is <i>less than significant</i> .	Perceptible erosion in comparison to baseline conditions; low likelihood of encountering erosion-prone soil types.	No perceptible change in baseline conditions.
	Geographic Extent	State or territory.		Region or county.	NA
	Duration or Frequency	Chronic or long-term erosion not likely to be reversed over several years.		Isolated, temporary, or short-term erosion that that is reversed over few months or less.	NA
Topsoil mixing	Magnitude or Intensity	Clear and widespread mixing of the topsoil and subsoil layers.	Effect that is <i>potentially significant</i> , but with mitigation is <i>less than significant</i> .	Minimal mixing of the topsoil and subsoil layers has occurred.	No perceptible evidence that the topsoil and subsoil layers have been mixed.
	Geographic Extent	State or territory.		Region or county.	NA
	Duration or Frequency	NA		NA	NA
Soil compaction and rutting	Magnitude or Intensity	Severe and widespread, observable compaction and rutting in comparison to baseline.	Effect that is <i>potentially significant</i> , but with mitigation is <i>less than significant</i> .	Perceptible compaction and rutting in comparison to baseline conditions.	No perceptible change in baseline conditions.
	Geographic Extent	State or territory.		Region or county.	NA
	Duration or Frequency	Chronic or long-term compaction and rutting not likely to be reversed over several years.		Isolated, temporary, or short term compaction and rutting that is reversed over a few months or less.	No perceptible change in baseline conditions.

NA = Not Applicable

4.2.2.3. Description of Environmental Concerns

Soil Erosion

Soil erosion is an environmental concern for nearly every construction activity that involves ground disturbance. Construction erosion typically only occurs in a small area of land with the actual removal of vegetative cover from construction equipment or by wind and water erosion. Of concern in Arkansas and other states with similar geography and weather patterns is the erosion of construction site soils to natural waterways, where the sediment could impair water and habitat quality, and potentially affect aquatic plants and animals (Natural Resources Conservation Service, 2000). Areas exist in Arkansas that have steep slopes (i.e., greater than 20 percent) or where the erosion potential is medium to high, including locations with Aqualfs, Aquents, Aquepts, Aquerts, Aquults, Fluvents, Udalfs, Udepts, Uderts, Udolls, and Udufts (see Section 4.1.2.4, Soil Suborders and Figure 4.1.2-2).

Based on the impact significance criteria presented in Table 4.2.2-1, building of some of FirstNet's network deployment sites could cause *potentially significant* erosion at locations with highly erodible soil and steep grades. For the majority of projects, impacts to soils would be expected to be *less than significant* at the programmatic level given the short-term and temporary duration of the construction activities.

To the extent practicable, FirstNet would attempt to minimize ground-disturbing construction in areas with high erosion potential due to steep slopes or soil type. Where construction is required in areas with a high erosion potential, FirstNet could implement BMPs and mitigation measures, where practicable and feasible, to avoid or minimize impacts, and minimize the periods when exposed soil is open to precipitation and wind (see Chapter 16).

Topsoil Mixing

The loss of topsoil (i.e., organic and mineral topsoil layers) by mixing is a potential impact at all ground disturbing construction sites, including actions requiring clearing, excavation, grading, trenching, backfilling, or site restoration/remediation work.

Based on impact significance criteria presented in Table 4.2.2-1, and due to the relatively small scale (less than 1 acre) of most FirstNet project sites, *less than significant* impacts from the minimal topsoil mixing is expected at the programmatic level. Additionally, implementation of BMPs and mitigation measures (Chapter 16) could further reduce potential impacts.

Soil Compaction and Rutting

Soil compaction and rutting at construction sites could involve heavy land clearing equipment such as bulldozers and backhoes, trenchers and directional drill rigs to install buried fiber, and cranes to install towers and aerial infrastructure. Soils with the highest potential for compaction or rutting were identified by using the STATSGO2 database (see Section 4.1.2.4, Soil Suborders). The most compaction susceptible soil suborders in Arkansas are Aqualfs, Aquepts, Aquerts, Aquults, and Udepts, which are hydric soils with poor drainage conditions. These soils

constitute approximately 32.48 percent of Arkansas's land area¹³⁵ (see Figure 4.1.2-2). The potential for compaction or rutting impact would be generally low at FirstNet network deployment sites where other soil types predominate.

Based on impact significance criteria presented in Table 4.2.2-1, the risk of soil compaction and rutting resulting from FirstNet deployment activities would be *less than significant* at the programmatic level, due to the extent of susceptible soils in the state.

4.2.2.4. Potential Impacts of the Preferred Alternative

The following section assesses potential impacts associated with implementation of the Preferred Alternative, including deployment and operation activities.

Deployment Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative could deploy various types of facilities or infrastructure. Depending on the physical nature and location of FirstNet facilities or infrastructure and the specific action, some activities would result in potential impacts to soil resources and others would not. In addition, and as explained in this section, the same type of Proposed Action infrastructure could result, at the programmatic level, in a range of *no impacts* to *less than significant* impacts depending on the deployment scenario or site-specific conditions.

Activities Likely to Have No Impacts at the Programmatic Level

Of the types of facilities or infrastructure deployment scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are likely to have *no impacts* to soil resources at the programmatic level under the conditions described below:

- **Wired Projects**
 - **Use of Existing Conduit – New Buried Fiber Optic Plant:** Installation of fiber optic cable in existing conduit through existing hand holes, pulling vaults, junction boxes, huts, and POP, structures, and would have *no impact* on soil resources at the programmatic level because it would not produce perceptible changes to soil resources.
 - **Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable:** Lighting of dark fiber would be conducted electronically through existing infrastructure, with *no impacts* to soil resources at the programmatic level. If physical access is required to light dark fiber, it would be through existing hand holes, pulling vaults, junction boxes, huts, and similar existing structures. Impacts to soil resources associated with the construction of new poles to accept aerial fiber or on shore to accept submarine cable are addressed below, and depend on the proximity of such infrastructure to the landing site.
 - **New Build – Submarine Fiber Optic Plant:** The installation of cables in or near bodies of water would have no on soil resources at the programmatic level because there would be no ground disturbance associated with this activity (see Section 4.2.4, Water Resources,

¹³⁵ This percentage was calculated by dividing the acres of soils that fall within the suborders listed above by the total soil land cover for the state.

for a discussion of potential impacts to water resources). Impacts to soil resources associated with the construction of landings or facilities on shore to accept submarine cable are addressed below.

- Installation of Optical Transmission or Centralized Transmission Equipment: If installation of transmission equipment would occur in existing boxes or huts and require no ground disturbance, there would be *no impacts* to soils at the programmatic level. The section below addresses potential impacts to soils if construction of new boxes, huts, or other equipment is required.
- Collocation on Existing Aerial Fiber Optic Plant: Collocation of new aerial fiber optic plant on existing utility poles and other structures would have *no impact* on soils at the programmatic level because there would be no ground disturbance for pole/structure installation, and heavy equipment use would be typically limited to bucket trucks operated from existing paved, gravel, or dirt roads. Impacts to soils associated with the construction of new poles to accept aerial fiber or on shore to accept submarine cable are addressed below.
- Wireless Projects
 - Collocation on Existing Wireless Tower, Structure, or Building: Collocation is the mounting or installing of new equipment on existing structures (such as antennas on an existing tower). This activity would have *no impact* on soil resources at the programmatic level because there would be no ground disturbance. Potential impacts to soil resources from structural hardening, addition of power units, or security measures are addressed below.
 - Deployable Technologies: Where technologies such as Cell on Wheels (COW), Cell on Light Trucks (COLT), or System on Wheels (SOW) are deployed on existing paved surfaces or dirt or gravel areas, there would be *no impacts* to soil resources at the programmatic level because there would be no ground disturbance. Potential impacts associated with paving of previously unpaved surfaces or other ground disturbing activities are addressed below.
- Satellites and Other Technologies
 - Satellite-Enabled Devices and Equipment: Deployment of temporary or portable equipment that use satellite technology, including COWs, COLTs, SOWs, satellite phones, and video cameras would have *no impact* on soil resources because those activities would not require ground disturbance.
 - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the nationwide public safety broadband network (NPSBN); however, it could include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact soil resources, it is anticipated that this activity would have *no impact* on soil resources at the programmatic level.

Activities with the Potential to Have Impacts at the Programmatic Level

Implementation of the Preferred Alternatives could include potential deployment-related impacts to soil resources resulting from ground disturbance activities, including soil erosion, topsoil

mixing, and soil compaction and rutting. The types of deployment activities that could be part of the Preferred Alternative and result in potential impacts to soil resources include the following:

- Wired Projects
 - New Build – Buried Fiber Optic Plant: New fiber optic cable installation usually requires trenching, plowing (including vibratory plowing), or directional boring, as well as construction of hand holes, pulling vaults, junction boxes, huts, and POP structures that require ground disturbance. Impacts from fiber optic plant installation and structure construction, as well as associated grading and restoration of the disturbed ground when construction is completed, could result in soil erosion, topsoil mixing, or soil compaction and rutting.
 - New Build – Aerial Fiber Optic Plant: Installation of new utility poles, and replacement/upgrading of existing poles and structures could potentially impact soil resources resulting from ground disturbance for pole/structure installation (soil erosion and topsoil mixing), and heavy equipment use from bucket trucks operating on existing gravel or dirt roads (soil compaction and rutting). Potential impacts to soils are anticipated to be small-scale and short-term.
 - Collocation on Existing Aerial Fiber Optic Plant: As stated above, collocation with no ground disturbance would result in *no impacts* to soil resources at the programmatic level. However, topsoil removal, soil excavation, and excavated material placement during the replacement of poles and structural hardening could result in soil erosion and topsoil mixing. Heavy equipment use associated with these activities as well as with installing new fiber on existing poles could result in soil compaction and rutting.
 - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: As stated above, lighting up of dark fiber in existing conduits or cables would have *no impact* on soil resources at the programmatic level, however, if installation of new huts or equipment were necessary, the activity could result in soil erosion and topsoil mixing during grading or excavation activities. This activity could also require the short-term use of heavy equipment for grading or other purposes, which could result in soil compaction and rutting.
 - New Build – Submarine Fiber Optic Plant: As stated above, the installation of cables in or near bodies of water would have *no impact* on soil resources at the programmatic level because there would be no soils to impact. However, installation of fiber optic plants in limited nearshore and inland bodies of water could potentially impact soil resources at and near the landings or facilities on shore to accept submarine cable. Soil erosion and topsoil mixing could potentially occur as result of grading, foundation excavation, or other ground disturbance activities. Perceptible soil compaction and rutting could potentially occur due to heavy equipment use during these activities depending on the duration of the construction activity.
 - Installation of Optical Transmission or Centralized Transmission Equipment: As stated above, if installation of transmission equipment would occur in existing boxes or huts and require no ground disturbance, there would be *no impacts* to soils at the programmatic level. However, installation of optical transmission equipment or centralized transmission equipment, including associated new utility poles, hand holes, pulling vault,

junction box, hut, and POP structure installation, would require ground disturbance that could potentially impact soil resources. Potential impacts to soils resulting from soil erosion, topsoil mixing, soil compaction, and rutting are anticipated to be small-scale and short-term.

- Wireless Projects
 - New Wireless Communication Towers: Installation of new wireless towers and associated structures, such as generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads, or access roads could result in impacts to soil resources. Land/vegetation clearing, excavation activities, landscape grading, and other ground disturbance activities during the installation of new wireless towers and associated structures or access roads could result in soil erosion or topsoil mixing, and heavy equipment use during these activities could result in soil compaction and rutting.
 - Collocation on Existing Wireless Tower, Structure, or Building: As stated above, collocation that would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower, which would not result in impacts to soils. However, if additional power units, structural hardening, and physical security measures required ground disturbance, such as grading, or excavation activities, impacts to soil resources could occur, including soil erosion and topsoil mixing, as well as soil compaction and rutting associated with heavy equipment use.
 - Deployable Technologies: As stated above, if deployment occurred on paved surfaces or previously disturbed land, there would be *no impact* on soil resources, however, implementation of deployable technologies could result in potential impacts to soil resources depending on the technology and location for deployment. Potential impacts may result if deployment of vehicles (i.e., SOWs, COWs, COLTs, or UAVs) occurs in unpaved areas, or if the implementation results in paving of previously unpaved surfaces. Some staging or landing areas (depending on the type of technology) may require land/vegetation clearing, excavation, and paving. These activities could result in soil erosion and topsoil mixing. Heavy equipment use associated with these activities may result in soil compaction and rutting. In addition, implementation of deployable technologies themselves could result in soil compaction and rutting if deployed in unpaved areas.

In general, the abovementioned activities could potentially involve land/vegetation clearing, topsoil removal, excavation, excavated material placement, trenching or directional boring, construction of access roads, and other impervious surfaces, landscape grading, and heavy equipment movement. Potential impacts to soil resources associated with deployment of this infrastructure could include soil erosion, topsoil mixing, or soil compaction and rutting. These impacts are expected to be *less than significant* at the programmatic level as the activity would likely be short term, localized to the deployment locations, and those locations would return to normal conditions as soon as revegetation occurs, often by the next growing season. It is expected that heavy equipment would utilize existing roadways and utility ROWs for deployment activities, where feasible. Chapter 16, BMPs and Mitigation Measures, provides a

listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As described earlier, operation activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned construction impacts. It is anticipated that there would be *no impacts* to soil resources associated with routine inspections of the Preferred Alternative, assuming that the same access roads used for deployment are also used for inspections because there would be no ground disturbance. If usage of heavy equipment as part of routine maintenance or inspections occurs off of established access roads or corridors, or if the acceptable load of the surface is exceeded, soil compaction and rutting impacts could result as explained above. The impacts are expected to be *less than significant* at the programmatic level due to the temporary nature and small scale of operations activities with the potential to create impacts. Chapter 16, BMPs and Mitigation Measures provides, a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

4.2.2.5. Alternatives Impact Assessment

The following section assesses potential impacts to soils associated with the Deployable Technologies Alternative and the No Action Alternative.

Deployable Technologies Alternative

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential impacts to soil resources as a result of implementation of this alternative could be as described below.

Deployment Impacts

As explained above, implementation of deployable technologies could result in *less than significant* impacts to soil resources at the programmatic level, regardless of whether the deployment occurs in unpaved areas, or if the implementation results in paving of previously unpaved surfaces. In addition, impacts to soils could occur on paved surfaces if the acceptable load of the surface is exceeded. Some staging or landing areas (depending on the type of technology) may require land/vegetation clearing, excavation, and paving. These activities could

result in soil erosion and topsoil mixing. Heavy equipment use associated with these activities may result in soil compaction and rutting. In addition, implementation of deployable technologies themselves could also result in soil compaction and rutting if deployed in unpaved areas. However, these potential impacts are expected to be *less than significant* at the programmatic level due to the small scale and short term nature of the deployment. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As explained above, operation activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. As with the Preferred Alternative, it is anticipated that there would be *no impacts* to soil resources associated with routine inspections of deployable assets, assuming that the same access roads used for deployment are also used for inspections because there would be no ground disturbance. If usage of heavy equipment as part of routine maintenance or inspections occurs off of established access roads or corridors, or if the acceptable load of the surface is exceeded, *less than significant* soil compaction and rutting impacts at the programmatic level could result as previously explained above. Finally, if deployable technologies are parked and operated with air conditioning for extended periods, the condensation water from the air conditioner could result in minimal soil erosion. However, it is anticipated that the potential soil erosion would result in *less than significant* impacts at the programmatic level as described above. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed. Therefore, there would be no associated construction or installation of wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be *no impacts* to soil resources at the programmatic level as a result of the No Action Alternative. Environmental conditions would therefore be the same as those described in Section 4.1.2, Soils.

4.2.3. Geology

4.2.3.1. Introduction

This section describes potential impacts to Arkansas geology resources associated with deployment and operation of the Proposed Action and Alternatives. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

4.2.3.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on geology resources were evaluated using the significance criteria presented in Table 4.2.3-1. As described in Section 4.2, Environmental Consequences, the categories of impacts are defined, at the programmatic level, as *potentially significant, less than significant with mitigation measures incorporated, less than significant, or no impact*. Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

Given the nature of this programmatic evaluation, and because the Proposed Action could potentially cover a wide variety of actions that would take place in various landscapes, the potential impacts to geological resources addressed in this section are presented as a range of possible impacts.

Table 4.2.3-1: Impact Significance Rating Criteria for Geology at the Programmatic Level

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Seismic Hazard	Magnitude or Intensity	High likelihood that a project activity could be located within a high-risk earthquake hazard zone or active fault.	Effect that is <i>potentially significant</i> , but with mitigation is <i>less than significant</i> .	Low likelihood that a project activity could be located within an earthquake hazard zone or active fault.	No likelihood of a project activity being located in an earthquake hazard zone or active fault.
	Geographic Extent	Hazard zones or active faults are highly prevalent within the state/territory.		Earthquake hazard zones or active faults occur within the state/territory, but may be avoidable.	Earthquake hazard zones or active faults do not occur within the state/territory.
	Duration or Frequency	NA		NA	NA
Volcanic Activity	Magnitude or Intensity	High likelihood that a project activity could be located near a volcano lava or mud flow area of influence.	Effect that is <i>potentially significant</i> , but with mitigation is <i>less than significant</i> .	Low likelihood that a project activity could be located near a volcanic ash area of influence.	No likelihood of a project activity located within a volcano hazard zone.
	Geographic Extent	Volcano lava flow areas of influence are highly prevalent within the state/territory.		Volcano ash areas of influence occur within the state/territory, but may be avoidable.	Volcano hazard zones do not occur within the state/territory.
	Duration or Frequency	NA		NA	NA
Landslide	Magnitude or Intensity	High likelihood that a project activity could be located within a landslide area.	Effect that is <i>potentially significant</i> , but with mitigation is <i>less than significant</i> .	Low likelihood that a project activity could be located within a landslide area.	No likelihood of a project activity located within a landslide hazard area.
	Geographic Extent	Landslide areas are highly prevalent within the state/territory.		Landslide areas occur within the state/territory, but may be avoidable.	Landslide hazard areas do not occur within the state/territory.
	Duration or Frequency	NA		NA	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Land Subsidence	Magnitude or Intensity	High likelihood that a project activity could be located within an area with a hazard for subsidence (e.g., karst terrain).	Effect that is <i>potentially significant</i> , but with mitigation is <i>less than significant</i> .	Low likelihood that a project activity could be located within an area with a hazard for subsidence.	Project activity located outside an area with a hazard for subsidence.
	Geographic Extent	Areas with a high hazard for subsidence (e.g., karst terrain) are highly prevalent within the state/territory.		Areas with a high hazard for subsidence occur within the state/territory, but may be avoidable.	Areas with a high hazard for subsidence do not occur within the state/territory.
	Duration or Frequency	NA		NA	NA
Potential Mineral and Fossil Fuel Resource Impacts	Magnitude or Intensity	Severe, widespread, observable impacts to mineral and/or fossil fuel resources.	Effect that is <i>potentially significant</i> , but with mitigation is <i>less than significant</i> .	Limited impacts to mineral and/or fossil resources.	No perceptible change in mineral and/or fossil fuel resources.
	Geographic Extent	Regions of mineral or fossil fuel extraction areas are highly prevalent within the state/territory.		Mineral or fossil fuel extraction areas occur within the state/territory, but may be avoidable.	Mineral or fossil fuel extraction areas do not occur within the state/territory.
	Duration or Frequency	Long-term or permanent degradation or depletion of mineral and fossil fuel resources.		Temporary degradation or depletion of mineral and fossil fuel resources.	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Potential Paleontological Resources Impacts	Magnitude or Intensity	Severe, widespread, observable impacts to paleontological resources.	Effect that is <i>potentially significant</i> , but with mitigation is <i>less than significant</i> .	Limited impacts to paleontological and/or fossil resources.	No perceptible change in paleontological resources.
	Geographic Extent	Areas with known paleontological resources are highly prevalent within the state/territory.		Areas with known paleontological resources occur within the state/territory, but may be avoidable.	Areas with known paleontological resources do not occur within the state/territory.
	Duration or Frequency	NA		NA	NA
Surface Geology, Bedrock, Topography, Physiography, and Geomorphology	Magnitude or Intensity	Substantial and measurable degradation or alteration of surface geology, bedrock, topography, physiographic characteristics, or geomorphological processes.	Effect that is <i>potentially significant</i> , but with mitigation is <i>less than significant</i> .	Minor degradation or alteration of surface geology, bedrock, topography that do not result in measurable changes in physiographic characteristics or geomorphological processes.	No degradation or alteration of surface geology, bedrock, topography, physiographic characteristics, or geomorphologic processes.
	Geographic Extent	State/territory.		State/territory.	NA
	Duration or Frequency	Permanent or long-term changes to characteristics and processes.		Temporary degradation or alteration of resources that is limited to the construction and deployment phase.	NA

NA = Not Applicable

4.2.3.3. *Description of Environmental Concerns*

Environmental concerns regarding geology can be viewed as two distinct types, those that would potentially provide impacts to the project, such as seismic hazards, and landslides, and those that would be impacts from the project, such as land subsidence and effects on mineral and fossil fuel resources, paleontological resources, surface geology, bedrock, topography, physiography, and geomorphology. These concerns and their impacts on geological resources are discussed below.

Seismic Hazard

A concern related to deployment is placement of equipment in highly active seismic zones. Equipment that is exposed to earthquake activity is subject to misalignment, alteration, or, in extreme cases, destruction; all of these activities could result in connectivity loss. As discussed in Section 4.1.3, Arkansas has a high risk for earthquake events. As shown in Figure 4.1.3-4, the center of the state radiating northeast, including West Memphis and Jonesboro has the most potential for earthquakes. In 2015, 64 earthquakes were recorded within Arkansas, the largest of which measured 2.6 on the Richter scale¹³⁶ (Arkansas Geological Survey, 2015e). Based on the impact significance criteria presented in Table 4.2.3-1, seismic impacts from deployment or operation of the Proposed Action would have *no impact* on seismic activity; however, seismic impacts to the Proposed Action could be *potentially significant* if FirstNet's deployment locations were within high-risk earthquake hazard zones. Given the potential for minor to moderate earthquakes in parts of Arkansas, some amount of infrastructure could be subject to earthquake hazards. Chapter 16, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Landslides

Similar to seismic hazards, another concern would be placement of equipment in areas that are highly susceptible to landslides. Equipment that is exposed to landslides is subject to misalignment, alteration, or, in extreme cases, destruction; all of these activities could result in connectivity loss.

As discussed in Section 4.1.3.8, Geological Hazards, the potential for landslides in Arkansas is moderate to high, particularly in western portions of the state within the Ouachita and Ozark Plateaus Provinces (Figure 4.1.3-6). Based on the impact significance criteria presented in Table 4.2.3-1, potential impacts to landslides from deployment or operation of the Proposed Action would have *less than significant* impacts at the programmatic level as it is likely that the project would attempt to avoid areas that are prone to landslides. However, landslide impacts to the Proposed Action could be *potentially significant* if FirstNet's deployment locations were within areas in which landslides are highly prevalent. To the extent practicable, FirstNet would avoid deployment in areas that are susceptible to landslide events. Where infrastructure is subject to

¹³⁶ The Richter scale is a numerical scale for expressing the magnitude of an earthquake based on seismograph oscillations. The more destructive earthquakes typically have magnitudes between about 5.5 and 8.9; the scale is logarithmic and a difference of one represents an approximate thirtyfold difference in magnitude. (USGS, 2014d)

landslide hazards, BMPs and mitigation measures, as discussed in Chapter 16, could help avoid or minimize the potential impacts. Chapter 16, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Land Subsidence

Equipment that is exposed to land subsidence, such as sinkholes created by karst topography or mine collapse, is subject to misalignment, alteration, or, in extreme cases, destruction. Significant long-term land subsidence, due to factors such as aquifer compaction, in coastal areas could lead to relative sea level rise¹³⁷ and inundation of equipment. All of these activities could result in connectivity loss.

As discussed in Section 4.1.3.8, Geological Hazards and shown in Figure 4.1.3-6, portions of Arkansas are prone to land subsidence due to karst topography. In Arkansas, karst topography is most common in northern portions of the state in areas that are underlain by limestone and dolostone, which are both subject to slow dissolution when infiltrated by groundwater. Sometimes, a thicker clay-rich overburden may coat the cavity, but a collapse or sinkhole of the overburden into the subsurface could occur. Based on the impact significance criteria presented in Table 4.2.3-1, potential impacts to soil subsidence from deployment or operation of the Proposed Action would have *less than significant* impacts at the programmatic level; however, subsidence impacts to the Proposed Action could be *potentially significant* to the Proposed Action if FirstNet's deployment locations were within areas at high risk to land subsidence due to karst topography or mining areas that could collapse. To the extent practicable, FirstNet would avoid deployment in known areas of karst and pseudokarst topography. However, given that karst and pseudokarst topography exists in many counties throughout the state, some amount of infrastructure may subject to subsidence hazards, in which case BMPs and mitigation measures would help avoid or minimize the potential impacts. Chapter 16, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Potential Mineral and Fossil Fuel Resource Impacts

Equipment deployment near mineral and fossil fuel resources is not likely to affect these resources. Rather the new construction is only likely to limit access to extraction of these resources. To the extent practicable, FirstNet would avoid construction in areas where these resources exist. Chapter 16, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

¹³⁷ Relative Sea Level Rise: "[Sea level rise that] includes the combined movement of both water and land. Even if sea level was constant, there could be changes in relative sea level. For example, a rising land surface would produce a relative fall in sea level, whereas a sinking land surface would produce a relative rise in sea level." (USGS, 2016c)

Potential Paleontological Resource Impacts

Equipment installation and construction activities that require ground disturbance could damage existing paleontological resources, which are both fragile and irreplaceable. Based on the impact significance criteria presented in Table 4.2.3-1, impacts to paleontological resources could be *potentially significant* if FirstNet's buildout/deployment locations were to cause impacts to paleontological resources during construction activities. As discussed in Section 4.1.3.7, fossils have been found in Arkansas. It is anticipated that potential impacts to specific areas known to contain paleontological resources would be avoided, minimized, or mitigated, and any potential impacts would be limited and localized. Site-specific analysis may be required depending on the site conditions, the type of deployment, or any other permits or permissions necessary to perform the work. Potential impacts to paleontological resources could be minimized by implementing BMPs and mitigation measures. Chapter 16, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Surface Geology, Bedrock, Topography, Physiography, and Geomorphology

Equipment installation and construction activities that degrade or alter surface geology, bedrock, or topography could cause measurable changes in physiographic characteristics of an area's geology, topography, physiography, or geomorphology. Based on the impact significance criteria presented in Table 4.2.3-1, impacts could be *potentially significant* if FirstNet's deployment were to cause substantial and measurable degradation or alteration of surface geology, bedrock, topography, physiographic characteristics, or geomorphological processes. Construction activities related to the Proposed Action and Alternatives are likely to be minor and *less than significant* at the programmatic level as the proposed activities are not likely to require removal of significant volumes of terrain and any rock ripping would likely occur in discrete locations and would be unlikely to result in large-scale changes to the geologic, topographic, or physiographic characteristics. When ground disturbance is required, BMPs and mitigation measures could be implemented to help avoid or minimize the potential impacts. Chapter 16, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Potential Impacts of the Preferred Alternative

The following section assesses potential impacts associated with implementation of the Preferred Alternative, including deployment and operation activities.

Deployment Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative could result in the deployment of various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure and the specific deployment requirements, some activities have the potential to be impacted by geologic hazards, some activities could result in potential impacts to geology, and other activities would have *no*

impacts. In addition, and as explained in this section, the same type of Proposed Action Infrastructure could result in a range of *no impacts* to *less than significant* impacts depending on the deployment scenario or site-specific conditions.

Activities Likely to Have No Impacts at the Programmatic Level

Of the types of facilities or infrastructure deployment scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are likely to have *no impacts* to geology under the conditions described below:

- **Wired Projects**
 - **Use of Existing Conduit – New Buried Fiber Optic Plant:** Disturbance associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas. There would be *no impacts* to geologic resources at the programmatic level since the activities that would be conducted at these small entry and exit points are not likely to produce perceptible changes. The section below addresses potential impacts if entry/exit points are installed in coastal locations that are susceptible to land subsidence.
 - **Collocation on Existing Aerial Fiber Optic Plant:** Collocation of new aerial fiber optic plant on existing utility poles and other structures would have *no impact* on geologic resources at the programmatic level because there would be no ground disturbance for pole/structure installation, and heavy equipment use would be typically limited to bucket trucks operated from existing paved, gravel, or dirt roads. Impacts to geologic resources associated with the construction of new poles to accept aerial fiber or on shore to accept submarine cable are addressed below.
 - **Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable:** Lighting up of dark fiber would have *no impacts* to geologic resources because there would be no ground disturbance at the programmatic level. Potential impacts associated with ground disturbing activities are discussed below.
 - **Installation of Optical Transmission or Centralized Transmission Equipment:** If installation of transmission equipment would occur in existing boxes or huts and require no ground disturbance, there would be *no impacts* to geologic resources at the programmatic level. The section below addresses potential impacts if the boxes/huts are installed in locations that are susceptible to specific geologic hazards (e.g., land subsidence, landslides, or earthquakes).
- **Wireless Projects**
 - **Collocation on Existing Wireless Tower, Structure, or Building:** Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower, which would result in *no impacts* to geologic resources at the programmatic level if no ground disturbance were associated with this activity. The potential addition of power units, structural hardening, and physical security measures would not impact geologic resources if this activity did not require ground disturbance. The section below addresses potential impacts if ground disturbing activities occur in locations that are susceptible to specific geologic hazards.

- Deployable Technologies: Where deployable technologies would be implemented on existing paved surfaces, there would be *no impacts* to/from geologic resources at the programmatic level because there would be no ground disturbance and mobile technologies could be moved to avoid geologic hazards. Potential impacts associated with site preparation for staging or landing areas is discussed below.
- Satellites and Other Technologies
 - Satellite-Enabled Devices and Equipment: In most cases, installation of permanent equipment on existing structures and the use of portable devices that use satellite technology would *not impact* geologic resources at the programmatic level because those activities would not require ground disturbance. The section below addresses potential impacts if ground disturbance activities occur in locations that are susceptible to specific geologic hazards.
 - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN, however it may include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact geologic resources, it is anticipated that this activity would have *no impact* on geologic resources.

Activities with the Potential to Have Impacts at the Programmatic Level

Potential deployment-related impacts to geologic resources, or resulting from geologic hazards due to implementation of the Preferred Alternative, would encompass a range of impacts that could occur as a result of ground disturbance activities, including loss of mineral and fuel resources and paleontological resources. The types of infrastructure development scenarios or deployment activities that could be part of the Preferred Alternative and result in potential impacts to geologic resources, or impacts from geologic hazards, include the following:

- Wired Projects
 - New Build – Buried Fiber Optic Plant: Plowing (including vibratory plowing), trenching, or directional boring and the construction of POP, huts, or other associated facilities or hand-holes to access fiber could result in potential impacts to geologic resources due to associated ground disturbance, such as impacts to fuel and mineral resources or paleontological resources. Where equipment is installed in locations that are susceptible to landslides, earthquakes, and other geologic hazards, it is possible that equipment could be affected by that hazard.
 - New Build – Aerial Fiber Optic Plant: Installation of new utility poles, and associated use of heavy equipment during construction, could result in potential impacts to geologic resources due to associated ground disturbance. Where equipment is installed in locations that are susceptible to landslides, earthquakes, and other geologic hazards, it is possible that equipment could be affected by that hazard.
 - Collocation on Existing Aerial Fiber Optic Plant: As stated above, if collocation does not require new utility poles or ground disturbance, there would be *no impacts* to geologic resources. However, replacement of utility poles and structural hardening, and associated use of heavy equipment during construction, could result in potential impacts to geologic

- resources due to associated ground disturbance. Where equipment is installed in locations that are susceptible to landslides, earthquakes, and other geologic hazards, it is possible that equipment could be affected by that hazard.
- Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: As stated above, although lighting up of dark fiber would have *no impacts* to geologic resources at the programmatic level, installation of new associated huts or equipment, if required, could result in ground disturbance during grading or excavation activities. Where equipment is installed in locations that are susceptible to specific geologic hazards, it is possible that equipment could be affected by that hazard.
 - Use of Existing Conduit – New Buried Fiber Optic Plant: As stated above, disturbance associated with the installation of fiber optic cable in existing conduit have *no impacts* to geologic resources at the programmatic level. However, if fiber were installed in locations susceptible to landslides, earthquakes, or other geologic hazards, it is possible that the equipment could be affected by that hazard.
 - New Build – Submarine Fiber Optic Plant: The installation of cables in limited nearshore and inland bodies of water is not expected to impact geologic resources including marine paleontological resources. However, where landings and/or facilities for submarine cable are installed at locations that are susceptible to landslides, earthquakes, and other geologic hazards, it is possible that equipment could be affected by that hazard.
 - Installation of Optical Transmission or Centralized Transmission Equipment: As stated above, if installation of equipment were to take place in existing facilities, there would be *no impact* to/from geologic resources. However, if installation of transmission equipment would occur in existing boxes or huts in areas that are susceptible to geologic hazards (e.g., land subsidence, landslides, or earthquakes), it is possible that they could be affected by that hazard.
 - Wireless Projects
 - New Wireless Communication Towers: Installation of new wireless towers and associated structures (generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads could result in impacts to geologic resources. Land/vegetation clearing, excavation activities, landscape grading, and other ground disturbance activities during the installation of new wireless towers and associated structures or access roads could result in erosion or disturbance of geologic resources. Where equipment is installed in locations that are susceptible to landslides, earthquakes, and other geologic hazards, it is possible that equipment could be affected by that hazard.
 - Collocation on Existing Wireless Tower, Structure, or Building: As stated above, collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower, which would not result in ground disturbance and therefore, would have *no impact* on geologic resources. However, if additional power units, structural hardening, and physical security measures required ground disturbance, such as grading, or excavation activities, impacts to geologic resources could occur due to ground disturbance. Where equipment is installed in locations that are

susceptible to landslides, earthquakes, and other geologic hazards, it is possible that equipment could be affected by that hazard.

- Deployable Technologies: As stated above, where deployable technologies would be implemented on existing paved surfaces, there would be *no impacts* to/from geologic resources because there would be no ground disturbance and mobile technologies could be moved to avoid geologic hazards. However, implementation of deployable technologies could result in potential impacts to geologic resources depending on the technology and location proposed for deployment. Potential impacts may result if deployment of vehicles (i.e., SOWs, COWs, COLTs, or UAVs) occurs in unpaved areas, or if the implementation results in paving of previously unpaved surfaces. Some staging or landing areas (depending on the type of technology) may require land/vegetation clearing, excavation, and paving.
- Satellites and Other Technologies
 - Satellite-Enabled Devices and Equipment: As stated above, the installation of permanent equipment on existing structures, adding equipment to satellites launched for other purposes, or the use of portable devices that use satellite technology would have *no impact* on geologic resources because those activities would not require ground disturbance. However, where equipment is permanently installed in locations that are susceptible to landslides, earthquakes, and other geologic hazards, it is possible that they could be affected by that hazard. The use of portable satellite-enabled devices would not impact geologic resources nor would it be affected by geologic hazards because there would be no ground disturbance nor any impact to the built or natural environment.

In general, the abovementioned activities could potentially involve ground disturbance resulting from land/vegetation clearing, topsoil removal, excavation, excavated material placement, trenching or directional boring, construction of access roads and other impervious surfaces, landscape grading, and heavy equipment movement. Potential impacts to geological resources associated with deployment could result in incidental removal of bedrock or mineral resources, or adverse impacts to installed equipment resulting from geologic hazards (e.g., minor earthquakes, landslides, and land subsidence). Specific FirstNet Proposed Actions are likely to be small scale; correspondingly, disturbance to geologic resources for those types of projects with the potential to impact geologic resources is also expected to be small scale. As a result, these potential impacts are expected to be *less than significant* at the programmatic level. For the same reason, impacts to deployment from geologic hazards are likely to be *less than significant* at the programmatic level as well. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned deployment impacts. It is anticipated that there

would be *no impacts* to geology associated with routine inspections of the Preferred Alternative, assuming that the same access roads used for deployment are also used for inspections because there would be no ground disturbance.

The operation of the Preferred Alternative could be affected by to geologic hazards including minor seismic activity, landslides, and land subsidence. However, potential impacts would be anticipated to be *less than significant* at the programmatic level as it is anticipated that deployment locations would avoid, as practicable and feasible, locations that are more likely to be affected by potential seismic activity, landslides, or land subsidence. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

4.2.3.4. Alternatives Impact Assessment

The following section assesses potential impacts to geology associated with the Deployable Technologies Alternative and the No Action Alternative.

Deployable Technologies Alternative

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential impacts to geology as a result of implementation of this alternative could be as described below.

Deployment Impacts

Implementation of deployable technologies on existing paved surfaces would not result in impacts to geologic resources (or from geologic hazards) as there would be no ground disturbance and mobile technologies could be moved to avoid geologic hazards. Potential impacts may result if deployment of vehicles (i.e., SOWs, COWs, COLTs, or UAVs) occurs in unpaved areas, or if the implementation results in paving of previously unpaved surfaces. Some staging or landing areas (depending on the type of technology) may require land/vegetation clearing, excavation, and paving. These impacts are expected to be *less than significant* at the programmatic level due to the minor amount of paving or new infrastructure needed to accommodate the deployables. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As explained above, operation activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. As with the Preferred Alternative, it is anticipated that there would be *no impacts* to geologic resources (or from geologic hazards) associated with routine inspections of the Preferred Alternative because there would be no ground disturbance.

The operation of the Deployable Technologies Alternative could be affected by to geologic hazards including seismic activity, landslides, and land subsidence. However, potential impacts would be anticipated to be *less than significant* at the programmatic level as the deployment would be temporary and likely would attempt to avoid locations that was subject to increased seismic activity, landslides, and land subsidence. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed; therefore, there would be no associated construction or installation of wired, wireless, deployable infrastructure, or satellites and other technologies. As a result, there would be *no impacts* to geologic resources (or from geologic hazards) at the programmatic level as a result of the No Action Alternative. Environmental conditions would therefore be the same as those described in Section 4.1.3, Geology.

4.2.4. Water Resources

4.2.4.1. Introduction

This section describes potential impacts to water resources in Arkansas associated with deployment and operation of the Proposed Action. Mitigation measures, as defined through permitting and/or consultation with the appropriate resource agency, would be implemented as part of deployment and operation of the Proposed Action to help avoid or reduce potential impacts to water resources. Implementation of BMPs, as practicable or feasible, could further reduce the potential for impacts. Both mitigation measures and BMPs are discussed in Chapter 16, BMPs and Mitigation Measures.

4.2.4.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on water resources were evaluated using the significance criteria presented in Table 4.2.4-1. As described in Section 4.2, Environmental Consequences, the categories of impacts are defined at the programmatic level as *potentially significant*, *less than significant with mitigation measures incorporated*, *less than significant*, or *no impact*. Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

Given the nature of this programmatic evaluation, and because the Proposed Action could potentially cover a wide variety of actions that would take place in various landscapes, the potential impacts to water resources addressed in this section are presented as a range of possible impacts.

Table 4.2.4-1: Impact Significance Rating Criteria for Water Resources at the Programmatic Level

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Water Quality (groundwater and surface water) - sedimentation, pollutants, nutrients, water temperature	Magnitude or Intensity	Groundwater contamination creating a drinking quality violation, or otherwise substantially degrade groundwater quality or aquifer; local construction sediment water quality violation, or otherwise substantially degrade water quality; water degradation poses a threat to the human environment, biodiversity, or ecological integrity; violation of various regulations including CWA, SDWA.	Effect that is <i>potentially significant</i> , but with BMPs and mitigation measures is <i>less than significant</i> at the programmatic level.	Potential impacts to water quality, but potential effects to water quality would be below regulatory limits and would naturally balance back to baseline conditions.	No changes to water quality; no change in sedimentation or water temperature, or the presence of water pollutants or nutrients.
	Geographic Extent/Context	Watershed level, and/or within multiple watersheds.		Watershed or subwatershed level.	NA
	Duration or Frequency	Chronic and long term changes not likely to be reversed over several years or seasons.		Impact is temporary, lasting no more than six months.	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Floodplain degradation ^a	Magnitude or Intensity	The use of floodplain fill, substantial increases in impervious surfaces, or placement of structures within a 500-year flood area that will impede or redirect flood flows or impact floodplain hydrology; high likelihood of encountering a 500-year floodplain within a state or territory.	Effect that is <i>potentially significant</i> , but with BMPs and mitigation measures is <i>less than significant</i> at the programmatic level.	Activities occur inside the 500-year floodplain, but do not use fill, do not substantially increase impervious surfaces, or place structures that will impede or redirect flood flows or impact floodplain hydrology, and do not occur during flood events. Low likelihood of encountering a 500-year floodplain within a state or territory.	Activities occur outside of floodplains and therefore do not increase fill or impervious surfaces, nor do they impact flood flows or hydrology within a floodplain.
	Geographic Extent	Watershed level, and/or within multiple watersheds.		Watershed or subwatershed level.	NA
	Duration or Frequency	Chronic and long term changes not likely to be reversed over several years or seasons.		Impact is temporary, lasting no more than one season or water year, or occurring only during an emergency.	NA
Drainage pattern alteration	Magnitude or Intensity	Alteration of the course of a stream of a river, including stream geomorphological conditions, or a substantial and measurable increase in the rate or amount of surface water or changes to the hydrologic regime.	Effect that is <i>potentially significant</i> , but with BMPs and mitigation measures is <i>less than significant</i> at the programmatic level.	Any alterations to the drainage pattern are minor and mimic natural processes or variations.	Activities do not impact drainage patterns.
	Geographic Extent	Watershed level, and/or within multiple watersheds.		Watershed or subwatershed level.	NA
	Duration or Frequency	Impact occurs in perennial streams, and is ongoing and permanent.		Impact is temporary, lasting no more than six months.	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Flow alteration	Magnitude or Intensity	Consumptive use of surface water flows or diversion of surface water flows such that there is a measurable reduction in discharge.	Effect that is <i>potentially significant</i> , but with BMPs and mitigation measures is <i>less than significant</i> at the programmatic level.	Minor or no consumptive use with negligible impact on discharge.	Activities do not impact discharge or stage of waterbody (stream height).
	Geographic Extent	Watershed level, and/or within multiple watersheds.		Watershed or subwatershed level.	NA
	Duration or Frequency	Impact occurs in perennial streams, and is ongoing and permanent.		Impact is temporary, not lasting more than six months.	NA
Changes in groundwater or aquifer characteristics	Magnitude or Intensity	Substantial and measurable changes in groundwater or aquifer characteristics, including volume, timing, duration, and frequency of groundwater flow, and other changes to the groundwater hydrologic regime.	Effect that is <i>potentially significant</i> , but with BMPs and mitigation measures is <i>less than significant</i> at the programmatic level.	Any potential impacts to groundwater or aquifers are temporary, lasting no more than a few days, with no residual impacts.	Activities do not impact groundwater or aquifers.
	Geographic Extent	Watershed level, and/or within multiple watersheds.		Watershed or subwatershed level.	NA
	Duration or Frequency	Impact is ongoing and permanent.		Impact is temporary, not lasting more than six months.	NA

^a Since public safety infrastructure is considered a critical facility, project activities should avoid the 500-year floodplain wherever practicable, per the Executive Orders on Floodplain Management (EO 11988 and EO 13690). (See <http://www.archives.gov/federal-register/codification/executive-order/11988.html> and <https://www.federalregister.gov/articles/2015/02/04/2015-02379/establishing-a-federal-flood-risk-management-standard-and-a-process-for-further-soliciting-and-considering-stakeholder-input>).

NA = Not Applicable

4.2.4.3. *Description of Environmental Concerns*

Potential Water Quality Impacts

Water quality impaired waterbodies are those waters that have been identified as not supporting their appropriate uses. Projects in watersheds of impaired waters may be subject to heightened permitting requirements. For example, the CWA requires states to assess and report on the quality of waters in their state. Section 303(d) of the CWA requires states to identify impaired waters. For these impaired waters, states must consider the development of a Total Maximum Daily Load (TMDL) or other strategy to reduce the input of the specific pollutant(s) restricting waterbody uses, in order to restore and protect such uses.

As shown in Table 4.1.4-2 various sources affect Arkansas's waterbodies, causing impairments (USEPA, 2015b). For example, mercury in segments of the Ouachita River have resulted in fish consumption advisories (ADEQ, 2014b). Additionally, more than half of assessed lakes, reservoirs, and ponds in Arkansas are impaired due to pollutants, such as excess nutrients (e.g., phosphorus) and sediments. Sediments and siltation are the cause for impairment in lakes located in the north and west-central Arkansas (ANRC, 2014a). Statewide, the primary designated use for Arkansas's impaired waterbodies is agricultural water supply (USEPA, 2015b). Generally, the water quality of Arkansas's aquifers is adequate for existing uses (ANRC, 2014a).

Deployment activities could contribute pollutants in a number of ways but the primary likely manner is increased sediment in surface waters. Vegetation removal on site exposes soils to rain and wind that could increase erosion. Impacts to water quality may occur from post-construction vegetation management, such as herbicides, that may leach into groundwater or move to surface waters through soil erosion or runoff, spray drift, or inadvertent direct overspray. Fuel, oil, and other lubricants from equipment could contaminate groundwater and surface waters if carried in runoff. Other water quality impacts could include changes in temperature, pH or dissolved oxygen levels, water odor, color, or taste, or addition of suspended solids.

Soil erosion or the introduction of suspended solids into waterways from implementation of the Preferred Alternative could contribute to degradation of water quality. If the Proposed Action and Alternatives would disturb more than 1 acre of soil, a state or USEPA NPDES Construction General Permit (CGP) would be required. As part of the permit application for the CGP, a stormwater pollution prevention plan (SWPPP) would need to be prepared containing BMPs that would be implemented to prevent, or minimize the potential for, sedimentation and erosion. Adherence to the CGP and the BMPs could help prevent sediment and suspended solids from entering the waterways and ensure that effects on water quality during construction would not be adverse.

Deployment activities associated with the Proposed Action have the potential to increase erosion and sedimentation around construction and staging areas. Grading activities associated with construction would potentially result in a temporary increase in the amount of suspended solids running off construction sites. If a storm event were to occur, construction site runoff could

result in sheet erosion of exposed soil. If not adequately controlled, water runoff from these areas would have the potential to degrade surface water quality. Implementing BMPs could reduce potential impacts to surface water quality.

Expected deployment activities would not violate applicable state, federal (e.g., CWA, SDWA), and local regulations, cause a threat to the human environment, biodiversity, or ecological integrity through water degradation, or cause a sediment water quality violation from local construction, or otherwise substantially degrade water quality. Therefore, based on the impact significance criteria presented in Table 4.2.4-1, water quality impacts would likely be *less than significant* at the programmatic level, and could be further reduced if BMPs and mitigation measures were to be incorporated where practicable and feasible.

During implementation of the Proposed Action and Alternatives, there is the potential to encounter shallow groundwater due to clearing and grading activities, shallow excavation, or relocation of utility lines. This is unlikely, as trenching is not expected to exceed a 48-inch depth. However, groundwater contamination may exist in areas directly within or near the project area. If trenching¹³⁸ or tower construction were to occur near or below the existing water table (depth to water), then dewatering would be anticipated at the location. Residual contaminated groundwater could be encountered during dewatering activities. Construction activities would need to comply with Arkansas dewatering requirements. Any groundwater extracted during dewatering activities, or subject to the terms of a dewatering permit, may be required to be treated prior to discharge or disposed of at a wastewater treatment facility.

Trenching would not likely introduce new contamination in the state's aquifers. The Proposed Action and Alternatives are unlikely to cause new drinking water violations, or otherwise substantially degrade groundwater quality. Based on the impact significance criteria presented in Table 4.2.4-1, there would likely be *less than significant* impacts at the programmatic level on groundwater quality. In areas where groundwater is close to the surface, then site-specific analysis may be required depending on the site conditions, the type of deployment, or any other permits or permissions necessary to perform the work. Furthermore, BMPs and mitigation measures could be implemented to further reduce potential impacts.

Floodplain Degradation

Floodplains are low-lying lands next to rivers and streams. When left in a natural state, floodplain systems store and dissipate floods without adverse impacts on human beings, buildings, roads and other infrastructure. The 500-year floodplain is the area of minimal flood hazard, where there is a 0.2-percent-annual-chance flood. Some projects may be outside of a floodplain, but still be in an area with known flooding history.

Based on the impact significance criteria presented in Table 4.2.4-1, floodplain degradation impacts would be *less than significant* at the programmatic level since the majority of FirstNet's likely deployment activities, on the watershed or subwatershed level, would use minimal fill, would not substantially increase impervious surfaces, structures would not impede or redirect

¹³⁸ Telecommunications activities involve laying conduit, with minimal trenching. Trenching activities would likely be at a minimal depth (less than 36 inches) and width (6 to 12 inches).

flood flows or impact floodplain hydrology, and would not occur during flood events with the exception of deployable technologies which may be deployed in response to an emergency. Additionally, any effects would be temporary, lasting no more than one season or water year,¹³⁹ or occur only during an emergency.

Examples of activities that would have *less than significant* impacts at the programmatic level include:

- Construction of any structure in the 500-year floodplain but is built above base flood elevation pursuant to floodplain management regulations.
- Land uses that include pervious surfaces such as gravel parking lots.
- Land uses that do not change the flow of water or drainage patterns.
- Limited clearing or grading activities.

Implementation of BMPs and mitigation measures could reduce the risk of additional impacts to floodplain degradation (see Chapter 16).

Drainage Pattern Alteration

Flooding and erosion from land disturbance could change drainage patterns. Stormwater runoff causes erosion while construction activities and land clearing could change drainage patterns. Clearing or grading activities, or the creation of walls or berms, could alter water flow in an area or cause changes to drainage patterns. Drainage could be directed to stormwater drains, storage, and retention areas designed to slow water and allow sediments to settle out. Improperly handled drainage could cause increased erosion, changes in stormwater runoff, flooding, and damage to water quality. Existing drainage patterns could be modified by channeling (straightening or restructuring natural watercourses); creation of impoundments (detention basins, retention basins, and dams); stormwater increases; or altered flow patterns.

According to the significance criteria in Table 4.2.4-1, any temporary (lasting less than six months) alterations to drainage patterns that are minor and mimic natural processes or variations within the watershed or subwatershed level would be considered *less than significant* at the programmatic level.

Example of projects that could have minor changes to the drainage patterns include:

- Land uses with pervious surfaces that create limited stormwater runoff.
- Where stormwater is contained on site and does not flow to or impact surface waterbodies offsite on other properties.
- Activities designed so that the amount of stormwater generated before construction is the same as afterwards.
- Activities designed using low impact development techniques for stormwater.

Since the proposed activities would not substantially alter drainage patterns in ways that alter the course of a stream or river; create a substantial and measurable increase in the rate and amount of surface water; or change the hydrologic regime; and any effects would be short-term; impacts to

¹³⁹ A water year is defined as “the 12-month period October 1, for any given year through September 30, of the following year. The water year is designated by the calendar year in which it ends and which includes 9 of the 12 months.” (USGS, 2013a)

drainage patterns would be *less than significant* at the programmatic level. BMPs, mitigation measures, and avoidance could be implemented to further reduce any impacts.

Flow Alteration

Flow alteration refers to the modification of flow characteristics, relative to natural conditions. Human activities may change the amount of water reaching a stream, divert flow through artificial channels, or alter the shape and location of streams. Surface water and groundwater withdrawals could alter flow by reducing water volumes in streams. Withdrawals may return to the surface/groundwater system at a point further downstream, be removed from the watershed through transpiration by crops, lawns or pastures, or be transferred to another watershed altogether (e.g., water transferred to a different watershed for drinking supply). Altered flow could increase flooding and introduce more erosion and potential for pollution. Alternatively, if water is diverted from its normal flow, the opposite may occur; wetlands and streams may not receive as much water as necessary to maintain the ecology and previous functions.

Activities that do not impact discharge or stage of waterbody (stream height) are not anticipated to have an impact on flow, according to Table 4.2.4-1. Projects that include minor consumptive use of surface water with *less than significant* impacts on discharge (do not direct large volumes of water into different locations) on a temporary basis (no more than six months) are likely to have *less than significant* impacts at the programmatic level on flow alteration, on a watershed or subwatershed level. Examples of projects likely to have *less than significant* impacts include:

- Construction of any structure in a 100-year or 500-year floodplain but is built above base flood elevation pursuant to floodplain management regulations.
- Land uses that are maintaining or increasing pervious surfaces.
- Land uses that do not change the flow of water or drainage patterns off site or into surface waterbodies that have not received that volume of stormwater previously.
- Minor clearing or grading activities.

Since the proposed activities would not likely alter flow characteristics or change the hydrologic regime, impacts would be *less than significant* impacts at the programmatic level to flow alteration. BMPs, mitigation measures, and avoidance could be implemented to further reduce any impacts.

Changes in Groundwater or Aquifer Characteristics

As described in Section 4.1.4.7, approximately 71 percent of Arkansas's water supply is from groundwater as a source of potable water. Groundwater is an important natural resource used by industrial, commercial, agricultural, and residential uses for manufacturing, irrigation, and drinking water purposes (ANRC, 2014a). Generally, the water quality of Arkansas's aquifers is suitable for drinking and daily water needs. Once a groundwater supply is exhausted or contaminated, it is very expensive, and sometimes impossible, to replace. Water supply demand from the deployment activities is unlikely to exceed safe and sustainable withdrawal capacity rate of the local supply or aquifer.

Storage of generator fuel over groundwater or an aquifer would unlikely to cause *significant* impacts to water quality due to the expected small volume of these materials. Activities that may cause changes in groundwater or aquifer characteristics include:

- Excavation, mining, or dredging during or after construction.
- Any liquid waste, including but not limited to wastewater, generation.
- Storage of petroleum or chemical products.

Private and public water supplies often use groundwater as a water source. To maintain a sustainable system, the amount of water withdrawn from these groundwater sources must be balanced with the amount of water returned to the groundwater source (groundwater recharge).

Deployment activities should be *less than significant* at the programmatic level since they would not substantially deplete supplies of potable groundwater, as any construction dewatering would be short-term. The siting of deployment activities should be considered to avoid areas that would extract groundwater from potable groundwater sources in the area. According to Table 4.2.4-1, *potentially significant* impacts to groundwater or aquifer characteristics would only occur if actions resulted in substantial and measurable changes in groundwater or aquifer characteristics, including volume, timing, duration, and frequency of groundwater flow, and other changes to the groundwater hydrologic regime on a watershed or within multiple watersheds that is ongoing and permanent. Chapter 16, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

4.2.4.4. Potential Impacts of the Preferred Alternative at the Programmatic Level

The following section assesses potential impacts associated with implementation of the Preferred Alternative, including construction/deployment and operation activities.

Potential Deployment Impacts

As described in Section 2.1.2, Proposed Action, implementation of the Preferred Alternative could result in the deployment of various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure and the specific deployment requirements, some activities could result in potential impacts to water resources and others would not. In addition, and as explained in this section, the various types of Preferred Alternative Infrastructure could result in a range of *no impacts* to *less than significant* impacts depending on the deployment scenario or site-specific conditions. The impact on the water resources that could be affected would depend on the watershed, duration (chronic or short-term), frequency (many years or a few months) the resource would be used, and the water resource's current use (sole source for drinking water, considered exceptional value for recreation, or provides critical habitat for a species).

Activities Likely to Have No Impacts at the Programmatic Level

Of the types of facilities or infrastructure deployment scenarios described in Section 2.1.2, Infrastructure, the following are likely to have *no impacts* to water resources at the programmatic under the conditions described below:

- **Wired Projects**
 - **Use of Existing Conduit – New Buried Fiber Optic Plant:** Disturbance associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas. It is anticipated that there would be *no impacts* to water resources at the programmatic level since the activities that would be conducted at these small entry and exit points are not likely to produce perceptible changes.
 - **Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable:** Lighting up of dark fiber would have *no impacts* on water resources at the programmatic level because there would be no ground disturbance.
- **Satellites and Other Technologies**
 - **Satellite-Enabled Devices and Equipment:** It is anticipated that the installation of permanent equipment on existing structures and the use of portable devices that use satellite technology would not impact water resources because those activities would not require ground disturbance, construction in floodplains, or use of motorized equipment near streams.
 - **Deployment of Satellites:** FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it could include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact water resources, it is anticipated that this activity would have *no impact* on water resources at the programmatic level.

Activities with the Potential to Have Impacts at the Programmatic Level

Potential construction/deployment-related impacts to water resources as a result of implementation of the Preferred Alternative would encompass a range of potential impacts that could occur as a result of ground disturbance activities, including in-stream construction work, resulting primarily in sediments entering streams, but also potentially to near-shore or inland waters, as well as the potential for other impacts to water quality and floodplains. The types of infrastructure development scenarios or deployment activities that could be part of the Preferred Alternative and result in potential impacts to water resources include the following:

- **Wired Projects**
 - **New Build – Buried Fiber Optic Plant:** Plowing (including vibratory plowing), trenching, or directional boring and the construction of POPs, huts, or other associated facilities or hand-holes to access fiber could result in potential impacts to water resources. Ground disturbance and heavy equipment use associated with plowing, trenching, or directional boring as well as land/vegetation clearing, excavation activities, and landscape grading associated with construction of POPs, huts, or other associated facilities or hand-holes to access fiber could result in stream sedimentation, construction of impervious surfaces and

- structures in floodplains, stream channel alteration, and accidental spills of fuels or lubricants to waterbodies. These projects could present a higher risk to water resources because of their relatively high degree of soil disturbance compared to the other types of projects. Implementing BMPs and mitigation measures could reduce impact intensity.
- New Build – Submarine Fiber Optic Plant: The installation of cables in limited nearshore and inland bodies of water could potentially impact water quality due to disruption of sediments on the floor of the waterbody. Impacts to water resources could also potentially occur as result of the construction of landings and/or facilities on shore to accept submarine cable. Sediments entering limited near-shore or inland waterbodies could potentially occur as result of grading, foundation excavation, or other ground disturbance activities. Construction of facilities in floodplains could potentially impact floodplain functionality and drainage patterns.
 - New Build – Aerial Fiber Optic Plant: Soil exposure from installation of new poles or construction of new roads, POPs, huts, or other facilities near waterbodies could result in ground disturbance, potentially resulting in sediment deposition and increased turbidity in nearby waterbodies. The use of heavy equipment during the installation of new poles and cables could result in potential soil disturbance and the resulting potential sedimentation impacts to streams, disturbance of riparian vegetation, leaching of PCPs, and accidental spills of fuels or lubricants to waterbodies.
 - Collocation on Existing Aerial Fiber Optic Plant: Ground disturbance during the replacement of poles and structural hardening could result in potential soil erosion and sedimentation impacts to streams, particularly where this work would be done in proximity to waterbodies. Collocation on Existing Aerial Fiber Optic Plant projects could present a lower risk to water resources because of their relatively low degree of soil disturbance compared to the other types of projects.
 - Installation of Optical Transmission or Centralized Transmission Equipment: If installation of transmission equipment required grading or other ground disturbance to install small boxes or huts, or access roads, there could potentially be direct and indirect impacts to water quality from a temporary increase in the amount of suspended solids running off construction sites. The amount of impact depends on the land area affected, installation technique, and location. Trenching would not be expected to occur near or below the existing water table (depth to water). If installation of transmission equipment would occur in existing boxes or huts and require no ground disturbance, there would be *no impacts* to water resources at the programmatic level.
 - Wireless Projects
 - New Wireless Communication Towers: Installation of new wireless towers and associated structures (generators, equipment sheds, fencing, security lighting, electrical feeds, and concrete foundations and pads) or access roads could result in potential direct and indirect impacts to water quality from a temporary increase in the amount of suspended solids running off construction sites. The amount of impact depends on the land area affected, installation technique, and location. Trenching would not be expected to occur near or below the existing water table (depth to water). Implementing BMPs could reduce impact intensity. If a new roadway were built, additional impervious

surface would not be expected to impact water resources or the overall amount of runoff and nonpoint pollution.

- Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower, which would not result in impacts to water resources because there would be no ground disturbance or in-water construction associated with this activity. The potential addition of power units, structural hardening, and physical security measures would not impact water resources if this activity would not require ground disturbance or in-water construction. However, if the on-site delivery of additional power units, structural hardening, and physical security measures required travel through streams or ground disturbance, such as grading or excavation activities near streams, potential impacts to water resources could occur including stream sedimentation and physical disturbance associated with heavy equipment use.
- Deployable Technologies
 - Implementation of land-based deployable technologies could result in potential impacts to water resources if deployment involves movement of equipment through streams, occurs in riparian or floodplain areas, occurs in unpaved areas, or if the implementation results in paving of previously unpaved surfaces. Some staging or landing areas (depending on the type of technology) may require land/vegetation clearing, excavation, and paving. These activities could result in direct and indirect impacts to water quality from a temporary increase in suspended solids running off construction sites or deployment in unpaved areas. The amount of impact depends on the land area affected, installation technique, and location. Implementing BMPs and mitigation measures could reduce impact intensity. The activities could also result in indirect impacts on water quality if fuels leak into surface or groundwater. Where deployable technologies would be implemented on existing paved surfaces, or where aerial and vehicular deployable technologies may be used on existing paved surfaces, it is anticipated that there would be *no impacts* to water resources at the programmatic level because there would be no ground disturbance.
 - Deployment of drones, balloons, blimps, or piloted aircraft could have indirect impacts on water quality if fuels spill or other chemicals seep into ground or surface waters. In general, the abovementioned activities could potentially involve land/vegetation clearing; excavation and trenching; installation of security/safety lighting and fencing; and deployment of aerial platforms. Potential impacts to water resources associated with deployment of this infrastructure could include water quality impacts, but are expected to be *less than significant* at the programmatic level to the small scale of individual activities. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

In general, the abovementioned activities could potentially involve land/vegetation clearing; excavation and trenching; construction of access roads; installation or restructuring of towers or poles; installation of security/safety lighting and fencing; and deployment of aerial platforms.

Potential impacts to water resources associated with deployment of this infrastructure would likely be *less than significant* at the programmatic level due to the limited geographic scale of individual activities and would likely return to baseline conditions once revegetation of disturbed areas is complete. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Potential Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned construction impacts. It is anticipated that there would be *no impacts* to water resources at the programmatic level associated with routine inspections of the Preferred Alternative, assuming that the same access roads used for deployment are also used for inspections, and assuming that all refueling and vehicle maintenance BMPs and mitigation measures are followed. If usage of heavy equipment as part of routine maintenance or inspections occurs off of established access roads or corridors and near waterbodies, the resulting ground disturbance could increase sedimentation in waterbodies, potentially impacting water quality. It is assumed that routine maintenance would not include operation of vehicles or equipment in waterbodies. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

4.2.4.5. Alternatives Impact Assessment

The following section assesses potential impacts to water resources associated with the Deployable Technologies Alternative and the No Action Alternative.

Deployable Technologies Alternative

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential impacts to water resources as a result of implementation of this alternative could be as described below.

Potential Deployment Impacts

As explained above, implementation of deployable technologies could result in *less than significant* impacts at the programmatic level to water resources if those activities occurred on paved surfaces. Some staging or launching/landing areas (depending on the type of technology) may require land/vegetation clearing, excavation, and paving, however, these activities would be isolated and short term, and would likely return to baseline conditions once revegetation was complete. Additionally, project activities could result in direct and indirect impacts to water quality from a temporary increase in the amount of suspended solids running off construction sites and from fuels leaking into surface or groundwater. However, spills from vehicles or machinery used during deployment tend to be associated with re-fueling operations, and as such, would likely be a few gallons or less in volume and would likely be easily contained or cleaned up, and therefore would have *less than significant* impacts at the programmatic level. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Potential Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Deployable Technologies Alternative would consist of routine maintenance and inspection of the deployable technologies. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned deployment impacts. The water resources impacts would depend on the watershed, duration (chronic or short-term) and frequency (many years or a few months) the resource would be used, and the water resource's current use (considered exceptional value for recreation, or provides critical habitat for a species).

It is anticipated that there would be *no impacts* at the programmatic level to water resources associated with routine inspections of the Deployable Technologies Alternative, assuming that the same access roads used for deployment are also used for inspections. If usage of heavy equipment as part of routine maintenance or inspections occurs off of established access roads or corridors and near waterbodies, the resulting ground disturbance could increase sedimentation in waterbodies, potentially impacting water quality. It is assumed that routine maintenance would not include operation of vehicles or equipment in waterbodies. Finally, if ground-based deployable technologies are parked and operated with air conditioning for extended periods, the condensation water from the air conditioner could result in soil erosion that could potentially impact waterbodies if the deployables are located adjacent to waterbodies, however, due to the limited and temporary nature of the deployable activities, it is anticipated that these potential impacts would be *less than significant* at the programmatic level. Site maintenance, including mowing or herbicides, may result in *less than significant* effects at the programmatic level to water quality, due to the small scale of expected FirstNet activities in any particular location. In addition, the presence of new access roads could increase the overall amount of impervious surface in the area, and increase runoff effects on water resources, as explained above. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that

FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed; therefore, there would be no associated construction or installation of wired, wireless, deployable infrastructure or satellites and other technologies. Therefore, there would be *no impacts* to water resources at the programmatic level as a result of the No Action Alternative. Environmental conditions would therefore be the same as those described in Section 4.1.4, Water Resources.

4.2.5. Wetlands

4.2.5.1. Introduction

This section describes potential impacts to wetlands in Arkansas associated with deployment and operation of the Proposed Action and Alternatives. Mitigation measures, as defined through permitting and/or consultation with the appropriate resource agency, would be implemented as part of deployment and operation of the Proposed Action to help avoid or reduce potential impacts to wetland resources. Implementation of BMPs, as practicable or feasible, could further reduce the potential for impacts. Both mitigation measures and BMPs are discussed in Chapter 16, BMPs and Mitigation Measures.

4.2.5.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on wetlands were evaluated using the significance criteria presented in Table 4.2.5-1. As described in Section 4.2, Environmental Consequences, the categories of impacts are defined at the programmatic level as *potentially significant, less than significant with mitigation measures incorporated, less than significant, or no impact*. Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

Given the nature of this programmatic evaluation, and because the Proposed Action could potentially cover a wide variety of actions that would take place in various landscapes, the potential impacts to wetlands addressed in this section are presented as a range of possible impacts.

Table 4.2.5-1: Impact Significance Rating Criteria for Wetlands at the Programmatic Level

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Direct wetland loss (fill or conversion to non-wetland)	Magnitude ^a or Intensity	Substantial loss of high-quality wetlands (e.g., those that provide critical habitat for sensitive or listed species, are rare or a high-quality example of a wetland type, are not fragmented, support a wide variety of species, etc.); violations of Section 404 of the CWA.	Effect that is <i>potentially significant</i> , but with mitigation is <i>less than significant</i> at the programmatic level.	Impacts to lower quality wetlands (e.g., not rare or unique, that have low productivity and species diversity, and those that are already impaired or impacted by human activity).	No direct loss of wetlands.
	Geographic Extent/Context	USGS watershed level, and/or within multiple watersheds.		USGS watershed or subwatershed level.	NA
	Duration or Frequency	Long-term or permanent loss, degradation, or conversion to non-wetland.		Periodic and/or temporary loss reversed over 1-2 growing seasons with or without active restoration.	NA
Other direct effects: vegetation clearing; ground disturbance; direct hydrologic changes (flooding or draining); direct soil changes; water quality degradation (spills or sedimentation)	Magnitude or Intensity	Substantial and measurable changes to hydrological regime of the wetland impacting salinity, pollutants, nutrients, biodiversity, ecological integrity, or water quality; introduction and establishment of invasive species to special value wetlands.	Effect that is <i>potentially significant</i> , but with mitigation is <i>less than significant</i> at the programmatic level.	Impacts to lower quality wetlands affecting the hydrological regime including salinity, pollutants, nutrients, biodiversity, ecological integrity, or water quality; introduction and establishment of invasive species to special value wetlands.	No direct impacts to wetlands affecting vegetation, hydrology, soils, or water quality.
	Geographic Extent	USGS watershed level, and/or within multiple watersheds.		USGS watershed or subwatershed level.	NA
	Duration or Frequency	Long-term or permanent alteration that is not restored within 2 growing seasons, or ever		Periodic and/or temporary loss reversed over 1-2 growing seasons with or without active restoration	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Indirect Effects: ^b Change in Function(s) ^c Change in Wetland Type	Magnitude or Intensity	Changes to the functions or type of special value wetlands (e.g., those that provide critical habitat for sensitive or listed species, are rare or a high-quality example of a wetland type, are not fragmented, support a wide variety of species, etc.).	Effect that is <i>potentially significant</i> , but with mitigation is <i>less than significant</i> at the programmatic level.	Impacts to lower quality wetlands (e.g., not rare or unique, that have low productivity and species diversity, and those that are already impaired or impacted by human activity).	No changes in wetland function or type.
	Geographic Extent	USGS watershed level, and/or within multiple watersheds.		USGS watershed or subwatershed level.	NA
	Duration or Frequency	Long-term or permanent change in function or type that is not restored within two growing seasons, or ever.		Periodic and/or temporary loss reversed over 1-2 growing seasons with or without active restoration.	NA

^a “Magnitude” is defined based on the type of wetland impacted, using USACE wetland categories. Category 1 are the highest quality, highest functioning wetlands.

^b Indirect Effects are those resulting from direct effects, but they occur elsewhere in space and/or time. Includes indirect hydrologic effects (wetting or drying) that in turn alters wetland function or type.

^c Wetland functions include hydrologic, ecological, geomorphic, and social functions typically assessed for wetlands as part of USACE compensatory mitigation planning. Typical functions assessed may include flood attenuation, bank stabilization, water quality, organic matter input/transport, nutrient processing, wildlife habitat, T/E species habitat, biodiversity, recreational/social value.

NA = Not Applicable

4.2.5.3. *Description of Environmental Concerns*

Potential Direct Wetland Loss (Fill or Conversion to Non-Wetland)

Construction-related impacts from several of the deployment activities have the potential for direct wetland impacts such as filling, draining, or conversion to a non-wetland. Examples include placement of fill in a wetland to construct a new tower, trenching through a wetland or directly connected waterway to install a cable or pipeline, and placement of a structure (tower, building) within the wetland.

Wetlands regulate the quality and quantity of surface and groundwater supplies, reduce flood hazards by serving as retention basins for surface runoff, and maintain water supplies after floodwaters subside. If wetlands were filled, the entire area may be at risk for increased flooding. There could be a loss of open space to be enjoyed by the community, and decreased wildlife populations may be observed due to displacement and increased noise, light, and other human disturbance. To the extent practicable or feasible, FirstNet and/or their partners would avoid filling wetlands or altering the hydrologic regime so that wetlands would not be lost or converted to non-wetlands. Loss of high and low-quality wetlands would be *less than significant* at the programmatic level given the amount of land disturbance associated with the project locations (generally less than an acre) and the short time-frame of deployment activities. Site-specific analysis may be required depending on the site conditions, the type of deployment, or any other permits or permissions necessary to perform the work. Potential wetlands impacts could be further reduced by implementing BMPs and mitigation measures. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

There are more than 2.13 million acres of palustrine, riverine, and lacustrine wetlands throughout Arkansas (USFWS, 2017b). Many of the state's wetlands can be found in the western portions of the state (see Figure 4.1.5-1).

Based on the impact significance criteria presented in Table 4.2.5-1, the deployment activities would most likely have *less than significant* direct impacts at the programmatic level on wetlands. Additionally, the deployment activities would be unlikely to violate applicable federal, state, and locally required regulations.

In addition to protections under the state's wetlands regulations, and national CWA, Arkansas considers certain wetland communities as areas of special value due to their global or regional scarcity, unusual local importance, or habitat they support. These include bogs and fens and wetlands associated with critical resource waters. The USACE must be notified before initiation of activities covered under Nationwide Permits in fens, bogs, groundwater seeps, dune depression wetlands, and wetlands adjacent to the Cache River (USACE, 2015a). See Section 4.1.5.4 for more information on these wetlands. If any of the proposed deployment activities were to occur in high quality wetlands, *potentially significant* impacts could occur. High quality wetlands occur throughout the state, and are not always included on state maps; therefore, site-

specific analysis may be required depending on the site conditions, the type of deployment, or any other permits or permissions necessary to perform the work to avoid *potentially significant* impacts to wetlands. Potential wetlands impacts could be further reduced by implementing BMPs and mitigation measures. Chapter 16, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Potential Other Direct Effects

Other direct impacts consist of altering the chemical, physical, or biological components of a wetland to the extent that changes to the wetland functions occur. However, other direct impacts would not result in a loss of total wetland acreage. Changes, for example, could include conversion of a forested wetland system to a non-forested state through chemical, mechanical, or hydrologic manipulation; altered hydrologic conditions (increases or decreases) such as storm water discharges or water withdrawals that alter the functions of the wetlands.

Construction-related deployment activities that result in long-term or permanent, substantial, and measurable changes to hydrological regime of the wetland (i.e., changes in salinity, pollutants, nutrients, biodiversity, ecological integrity, or water quality) could cause *potentially significant* impacts. In addition, introduction and establishment of invasive species to wetland communities of special value within a watershed or multiple watersheds could be *potentially significant*. Based on the impact significance criteria presented in Table 4.2.5-1, other direct effects to high- and low-quality wetlands would be *less than significant* at the programmatic level given the amount of land disturbance associated with the project locations (generally less than an acre) and the short time-frame of deployment activities and the application of federal, state, and locally required wetlands regulations. Site-specific analysis may be required depending on the site conditions, the type of deployment, or any other permits or permissions necessary to perform the work. Potential wetlands impacts could be further reduced by implementing BMPs and mitigation measures. Chapter 16, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Examples of activities that could have other direct effects to wetlands in Arkansas include:

- *Vegetation Clearing*: removing existing vegetation by clearing forest and herbaceous vegetation during construction activities, grading, seeding, and mulching. Clearing and grading may include increased soil erosion and a decrease in the available habitat for wildlife.
- *Ground Disturbance*: Increased amounts of storm water runoff in wetlands could alter water level response times, depths, and duration of water detention. Reduction of watershed infiltration capacity could cause wetland water depths to rise more rapidly following storm events.
- *Direct Hydrologic Changes (flooding or draining)*: Greater frequency and duration of flooding could destroy native plant communities, as could depriving them of their water supply. Hydrologic changes could make a wetland more vulnerable to pollution. Increased water depths or flooding frequency could distribute pollutants more widely through a

wetland. Sediment retention in wetlands is directly related to flow characteristics, including degree and pattern of channelization, flow velocities, and storm surges.

- *Direct Soil Changes:* Changes in soil chemistry could lead to degradation of wetlands that have a specific pH range and/or other parameter.
- *Water Quality Degradation (spills or sedimentation):* The loss of wetlands results in a depletion of water quality both in the wetland and downstream. Filtering of pollutants by wetlands is an important function and benefit. High levels of suspended solids (sedimentation) could reduce light penetration, dissolved oxygen, and overall wetland productivity. Toxic materials in runoff could interfere with the biological processes of wetland plants, resulting in impaired growth, mortality, and changes in plant communities.

Indirect Effects:¹⁴⁰ Change in Function(s)¹⁴¹ or Change in Wetland Type

Indirect Effects to wetlands could include change in wetland function or conversion of a resource to another type (i.e., wetland to an open body of water). The construction of curb and gutter systems diverts surface runoff and could cause flooding or wetlands to dry out, depending on the direction of diversion. Indirect Effects to high- and low-quality wetlands would be *less than significant* at the programmatic level given the amount of land disturbance associated with the project locations (generally less than an acre) and the short time-frame of deployment activities and the application of federal, state, and locally required wetlands regulations. Site-specific analysis may be required depending on the site conditions, the type of deployment, or any other permits or permissions necessary to perform the work. Potential wetlands impacts could be further reduced by implementing BMPs and mitigation measures. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Examples of functions related to wetlands in Arkansas that could potentially be impacted from construction-related deployment activities include:

- *Flood Attenuation:* Wetlands provide flood protection by holding excess runoff after storms, before slowly releasing it to surface waters. While wetlands may not prevent flooding, they could lower flood peaks by providing detention of storm flows. Correspondingly, disturbance of the wetlands (e.g., dredging or filling) could proportionately reduce water storage function.
- *Bank Stabilization:* By reducing the velocity and volume of flow, wetlands provide erosion control, floodwater retention, and reduce stream sedimentation.
- *Water Quality:* Water quality impacts on wetland soils could eventually threaten a wetland's existence. Where sediment inputs exceed rates of sediment export and soil consolidation, a wetland would gradually become filled.

¹⁴⁰ Indirect Effects are those resulting from direct effects, but they occur elsewhere in space and/or time. Includes indirect hydrologic effects (wetting or drying) that in turn alters wetland function or type

¹⁴¹ Wetland functions include hydrologic, ecological, geomorphic, and social functions typically assessed for wetlands as part of USACE compensatory mitigation planning. Typical functions assessed may include flood attenuation, bank stabilization, water quality, organic matter input/transport, nutrient processing, wildlife habitat, T/E species habitat, biodiversity, recreational/social value.

- *Nutrient Processing:* Wetland forests retain ammonia during seasonal flooding. Wetlands absorb metals in the soils and by plant uptake via the roots. They also allow metabolism of oxygen-demanding materials and reduce fecal coliform populations. These pollutants are often then buried by newer plant material, isolating them in the sediments.
- *Wildlife Habitat:* Impacts on wetland hydrology and water quality affect wetland vegetation. While flooding could harm some wetland plant species, it promotes others. Shifts in plant communities because of hydrologic changes could have impacts on the preferred food supply and animal cover.
- *Recreational Value:* Wetlands provide recreation opportunities for people, such as hiking, bird watching, and photography.
- *Groundwater Recharge:* Wetlands retain water, allowing time for surface waters to infiltrate into soils and replenish groundwater.

According to the significance criteria defined in Table 4.2.5-1, impacts to lower quality wetlands (e.g., not rare or unique, that have low productivity and species diversity, and those that are already impaired or impacted by human activity), would be considered *less than significant* at the programmatic level. Since the majority of wetlands in Arkansas are not considered of special value, deployment activities could have *less than significant* indirect impacts at the programmatic level on wetlands in the state.

In areas of the state with high quality wetlands, there could be *potentially significant* impacts at the project level that may require site-specific analysis depending on the site conditions, the type of deployment, or any other permits or permissions necessary to perform the work. If avoidance were not possible, potential wetlands impacts could be further reduced by implementing BMPs and mitigation measures. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

4.2.5.4. Potential Impacts of the Preferred Alternative at the Programmatic Level

The following section assesses potential impacts associated with implementation of the Preferred Alternative, including deployment and operation activities. Site-specific analysis may be required depending on the site conditions, the type of deployment, or any other permits or permissions necessary to perform the work.

Potential Deployment Impacts

As described in Section 2.1, Proposed Action Infrastructure, implementation of the Preferred Alternative could result in the deployment of various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure and the specific deployment requirements, some activities would result in potential impacts to wetlands and others would not. In addition, and as explained in this section, the same type of Preferred Alternative Infrastructure could result in a range of *no impacts* to *potentially significant* impacts at the programmatic level depending on the deployment scenario or site-specific conditions.

Activities Likely to Have No Impacts at the Programmatic Level

Of the types of facilities or infrastructure deployment scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are likely to have *no impacts* to wetlands at the programmatic level under the conditions described below:

- **Wired Projects**
 - **Use of Existing Conduit – New Buried Fiber Optic Plant:** Disturbance associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas. It is anticipated that there would be *no impacts* to wetlands at the programmatic level since the activities that would be conducted at these small entry and exit points are not likely to produce perceptible changes.
 - **Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable:** Lighting up of dark fiber would have *no impacts* to wetlands at the programmatic level because there would be no ground disturbance.
- **Satellites and Other Technologies**
 - **Satellite-Enabled Devices and Equipment:** It is anticipated that the installation of permanent equipment on existing structures, adding equipment to satellites being launches for other purposes, and the use of portable devices that use satellite technology is not likely to impact wetlands since there would be no ground disturbance.
 - **Deployment of Satellites:** FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it could include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would not impact wetlands, it is anticipated that this activity would have *no impact* on wetlands.

Activities with the Potential to Have Impacts at the Programmatic Level

Potential deployment-related impacts to wetlands because of implementation of the Preferred Alternative would encompass a range of impacts that could occur, including direct effects, other direct effects, and Indirect Effects on wetlands. The types of deployment activities that could be part of the Preferred Alternative and result in potential impacts to wetlands include the following:

- **Wired Projects**
 - **New Build – Buried Fiber Optic Plant:** Plowing (including vibratory plowing), trenching, or directional boring and the construction of POPs, huts, or other associated facilities or hand-holes to access fiber could result in potential impacts to wetlands. Land/vegetation clearing and excavation activities, associated with construction of POPs, huts, or other associated facilities could result in direct and indirect impacts to wetlands. The amount of impact depends on the land area affected, installation technique, proximity to wetlands, and type of wetland that could be affected (e.g., special value). Any ground disturbance could cause direct and indirect impacts wetlands, depending on the proximity to wetlands and type of wetlands that could be affected. Implementing BMPs and mitigation measures could reduce impact intensity.

- New Build – Submarine Fiber Optic Plant: The installation of cables in limited inland bodies of water would potentially impact wetlands found along shorelines. Additional project-specific environmental reviews would be required to assess potential impacts to wetland environments, including coastal and marine environments.
- New Build – Aerial Fiber Optic Plant: Potential impacts would be similar to Buried Fiber Optic Plant. Any ground disturbance could cause direct and indirect impacts to wetlands, depending on the proximity to wetlands and type of wetlands that could be affected.
- Collocation on Existing Aerial Fiber Optic Plant: Any ground disturbance could cause direct and indirect impacts to wetlands from increased suspended solids and runoff from activities, depending on the proximity to wetlands and type of wetlands that could be affected.
- Installation of Optical Transmission or Centralized Transmission Equipment: If installation of transmission equipment required grading or other ground disturbance to install small boxes or huts, or access roads, there could potentially be direct and indirect impacts to wetlands. The amount of impact from a temporary increase in the amount of suspended solids running off construction sites and into wetlands, depends on the land area affected, installation technique, and location. If trenching were to occur near wetlands, it could cause impacts on wetlands. Implementing BMPs and mitigation measures could reduce impact intensity.
- Wireless Projects
 - New Wireless Communication Towers: Installation of new wireless towers and associated structures (generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads could potentially cause direct and indirect impacts to wetlands. The activities could cause a temporary increase in the amount of suspended solids running off construction sites and into wetlands, depending on their proximity. The amount of impact depends on the land area affected, installation technique, and proximity to wetlands, and wetland type. If trenching were to occur near wetlands, it could cause impacts on wetlands. Implementing BMPs and mitigation measures could reduce impact intensity.
 - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower, which would not result in impacts to wetlands. However, if additional power units, structural hardening, and physical security measures required ground disturbance, such as grading, or excavation activities, impacts to wetlands could occur near wetlands, it could cause impacts on wetlands. Implementing BMPs and mitigation measures could reduce impact intensity.
- Deployable Technologies
 - Implementation of deployable technologies could result in potential impacts to wetlands if deployment occurs in unpaved areas, or if the implementation results in paving of previously unpaved surfaces. Some staging or landing areas (depending on the type of technology) may require land/vegetation clearing, excavation, and paving. The amount of impact depends on the land area affected, installation technique, and location.

Implementing BMPs and mitigation measures could reduce impact intensity. The activities could also result in other direct impacts on wetlands if fuels leak into nearby waterbodies or wetlands. Deployment of drones, balloons, or blimps, piloted aircraft could have other direct impacts on wetlands if fuels spill or other chemicals seep into nearby waterbodies or wetlands.

In general, the abovementioned activities could potentially involve land/vegetation clearing; excavation and trenching; construction of access roads; installation or restructuring of towers, poles, or underwater cables; installation of security/safety lighting and fencing; and deployment of aerial platforms. Depending on the deployment activity for this infrastructure, potential impacts to wetlands may occur. The amount of impact depends on the land area affected, installation technique, proximity to wetlands, and type of wetland that could be affected (e.g., special value). Any ground disturbance could cause direct and indirect impacts wetlands, depending on the proximity to wetlands and type of wetlands that could be affected. These impacts are expected to be *less than significant* at the programmatic level due to the small amount of land disturbance (generally less than one acre) and the short timeframe of deployment activities. Potential wetlands impacts could be further reduced by implementing BMPs and mitigation measures. Chapter 16, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Potential Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned potential deployment impacts. It is anticipated that there would be *no impacts* at the programmatic level to wetland resources associated with routine inspections of the Preferred Alternative, assuming that the same access roads used for deployment are also used for inspections, and assuming that all federal, state, and local requirements associated with refueling and vehicle maintenance are followed. If heavy equipment is used as part of routine maintenance or inspections off of established access roads or corridors, or if routine maintenance and application of herbicides is used to control vegetation, potential wetland impacts could be *less than significant* at the programmatic level as explained above. Chapter 16, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

4.2.5.5. Alternatives Impact Assessment

The following section assesses potential impacts to water resources associated with the Deployable Technologies Alternative and the No Action Alternative.

Deployable Technologies Alternative

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential impacts to wetlands as a result of implementation of this alternative could be as described below.

Potential Deployment Impacts

As explained above, implementation of deployable technologies could result in *less than significant* impacts at the programmatic level to wetlands. Some staging or launching/landing areas (depending on the type of technology) may require land/vegetation clearing, excavation, and paving. These activities could result in direct and indirect impacts to wetlands from a temporary increase in the amount of suspended solids running off construction sites to nearby surface waters. The amount of impact depends on the land area affected, installation technique, and proximity to wetlands, and wetland type; however, impacts are expected to be *less than significant* at the programmatic level due to the small-scale and temporary duration of expected FirstNet deployment activities in any one location. Potential wetlands impacts could be further reduced by implementing BMPs and mitigation measures. Chapter 16, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Potential Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Deployable Technologies Alternative would consist of routine maintenance and inspection of the deployable technologies. Any major infrastructure replacement as part of ongoing system maintenance could result in impacts similar to the abovementioned deployment impacts. The wetlands impacts would depend on the watershed, duration (chronic or short-term) and frequency (many years or a few months) the resource would be used, and the wetland's quality and function.

As explained above, operation activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. As with the Preferred Alternative, it is anticipated that there would be *no impacts* at the programmatic level to wetland resources associated with routine inspections of the Deployable Technologies Alternative, assuming the use of access roads and compliance with refueling and vehicle maintenance requirements, and *less than significant* potential impacts at the programmatic level associated with maintenance activities if heavy equipment is used as part of routine maintenance, if or

inspections occur off of established access roads or corridors, or if routine maintenance and application of herbicides is used to control vegetation. Potential wetlands impacts could be further reduced by implementing BMPs and mitigation measures. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed; therefore, there would be no associated construction or installation of wired, wireless, deployable infrastructure or satellites and other technologies. Therefore, there would be *no impacts* to wetlands at the programmatic level as a result of the No Action Alternative. Environmental conditions would therefore be the same as those described in Section 4.1.5, Wetlands.

4.2.6. Biological Resources

4.2.6.1. Introduction

This section describes potential impacts to terrestrial vegetation, wildlife, fisheries and aquatic habitat, and threatened and endangered species in Arkansas associated with deployment and operation of the Proposed Action and its alternatives. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

4.2.6.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on terrestrial vegetation, wildlife, fisheries, and aquatic habitats were evaluated using the significance criteria presented in Table 4.2.6-1. As described in Section 4.2, Environmental Consequences, the categories of impacts are defined as *potentially significant*, *less than significant with mitigation measures incorporated*, *less than significant*, or *no impact*. Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

Given the nature of this programmatic evaluation, and because the Proposed Action could potentially cover a wide variety of actions that would take place in various landscapes, the potential impacts to terrestrial vegetation, wildlife, and fisheries and aquatic habitat addressed in Sections 4.2.6.3, 4.2.6.4, and 4.2.6.5, respectively, are presented as a range of possible impacts.

Refer to Section 4.2.6.6 for impact assessment methodology and significance criteria associated with threatened and endangered species in Arkansas.

Table 4.2.6-1: Impact Significance Rating Criteria for Terrestrial Vegetation, Wildlife, Fisheries, and Aquatic Habitats at the Programmatic Level

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Direct Injury/ Mortality	Magnitude or Intensity	Population-level or sub-population injury/mortality effects observed for at least one species depending on the distribution and the management of said species. Events that may impact endemics, or concentrations during breeding or migratory periods. Violation of various regulations including: MBTA and Bald and Golden Eagle Protection Act (BGEPA).	Effect that is <i>potentially significant</i> , but with BMPs and mitigation measures is <i>less than significant</i> .	Individual mortality observed but not sufficient to affect population or sub-population survival.	No direct individual injury or mortality would be observed.
	Geographic Extent	Regional effects observed within Arkansas for at least one species. Anthropogenic ^a disturbances that lead to exclusion from nutritional or habitat resources, or direct injury or mortality of endemics or a significant portion of the population or sub-population located in a small area during a specific season.		Effects realized at one location when population is widely distributed, and not concentrated in affected area.	NA
	Duration or Frequency	Chronic and long-term effects not likely to be reversed over several years for at least one species.		Temporary, isolated, or short-term effects that are reversed within one to three years.	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Vegetation and Habitat Loss, Alteration, or Fragmentation	Magnitude or Intensity	Population-level or sub-population effects observed for at least one species or vegetation cover type, depending on the distribution and the management of the subject species. Impacts to terrestrial, aquatic, or riparian habitat or other sensitive natural community vital for feeding, spawning/breeding, foraging, migratory rest stops, refugia, or cover from weather or predators. Violation of various regulations including: MBTA and BGEPA.	Effect that is <i>potentially significant</i> , but with BMPs and mitigation measures is <i>less than significant</i> .	Habitat alteration in locations not designated as vital or critical for any period. Temporary losses to individual plants within cover types, or small habitat alterations take place in important habitat that is widely distributed and there are no cover type losses or cumulative effects from additional projects.	Sufficient habitat would remain functional to maintain viability of all species. No damage or loss of terrestrial, aquatic, or riparian habitat from project would occur.
	Geographic Extent	Regional effects observed within Arkansas for at least one species. Anthropogenic disturbances that lead to the loss or alteration of nutritional or habitat resources for endemics or a significant portion of the population or sub-population located in a small area during a specific season.		Effects realized at one location.	NA
	Duration or Frequency	Chronic and long-term effects not likely to be reversed over several years for at least one species.		Temporary, isolated, or short-term effects that are reversed within one to three years.	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Indirect Injury/Mortality	Magnitude or Intensity	Population-level or sub-population effects observed for at least one species depending on the distribution and the management of said species. Exclusion from resources necessary for the survival of one or more species and one or more life stages. Anthropogenic disturbances that lead to mortality, disorientation, the avoidance, or exclusion from nutritional or habitat resources for endemics or a significant portion of the population or sub-population located in a small area during a specific season. Violation of various regulations including: MBTA and BGEPA.	Effect that is <i>potentially significant</i> , but with BMPs and mitigation measures is <i>less than significant</i> .	Individual injury/mortality observed but not sufficient to affect population or sub-population survival. Partial exclusion from resources in locations not designated as vital or critical for any given species or life stage, or exclusion from resources that takes place in important habitat that is widely distributed. Anthropogenic disturbances are measurable but minimal as determined by individual behavior and propagation, and the potential for habituation or adaptability is high given time.	No stress or avoidance of feeding or important habitat areas. No reduced population resulting from habitat abandonment.
	Geographic Extent	Regional or site specific effects observed within Arkansas for at least one species. Behavioral reactions to anthropogenic disturbances depend on the context, the time of year age, previous experience, and activity. Anthropogenic disturbances that lead to startle responses of large groupings of individuals during haulouts, resulting in injury or mortality.		Effects realized at one location.	NA
	Duration or Frequency	Chronic and long-term effects not likely to be reversed over several years for at least one species.		Temporary, isolated, or short-term effects that are reversed within one to three years,	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Effects to Migration or Migratory Patterns	Magnitude or Intensity	Population-level or sub-population effects observed for at least one species depending on the distribution and the management of said species. Temporary or long-term loss of migratory pattern/path or rest stops due to anthropogenic activities. Violation of various regulations including: MBTA and BGEPA.	Effect that is <i>potentially significant</i> , but with BMPs and mitigation measures is <i>less than significant</i> .	Temporary loss of migratory rest stops due to anthropogenic activities take place in important habitat that is widely distributed and there are no cumulative effects from additional projects.	No alteration of migratory pathways, no stress or avoidance of migratory paths/patterns due to project.
	Geographic Extent	Regional effects observed within Arkansas for at least one species. Anthropogenic disturbances that lead to exclusion from nutritional or habitat resources during migration, or lead to changes of migratory routes for endemics or a significant portion of the population or sub-population located in a small area during a specific season.		Effects realized at one location when population is widely distributed, and not concentrated in affected area.	NA
	Duration or Frequency	Chronic and long-term effects not likely to be reversed over several years for at least one species.		Temporary, isolated, or short-term effects that are reversed within one to three years.	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Reproductive Effects	Magnitude or Intensity	Population or sub-population level effects in reproduction and productivity over several breeding/spawning seasons for at least one species depending on the distribution and the management of said species. Violation of various regulations including: MBTA and BGEPA.	Effect that is <i>potentially significant</i> , but with BMPs and mitigation measures is <i>less than significant</i> .	Effects to productivity are at the individual rather than population level. Effects are within annual variances and not sufficient to affect population or sub-population survival.	No reduced breeding or spawning success.
	Geographic Extent	Regional effects observed within Arkansas for at least one species. Anthropogenic disturbances that lead to exclusion from prey or habitat resources required for breeding/spawning or stress, abandonment, and loss of productivity for endemics or a significant portion of the population or sub-population located in a small area during the breeding/spawning season.		Effects realized at one location.	NA
	Duration or Frequency	Chronic and long-term effects not likely to be reversed over several breeding/spawning seasons for at least one species.		Temporary, isolated, or short-term effects that are reversed within one breeding season,	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Invasive Species Effects	Magnitude or Intensity	Extensive increase in invasive species populations over several seasons.	Effect that is <i>potentially significant</i> , but with BMPs and mitigation measures is <i>less than significant</i> .	Mortality observed in individual native species with no measurable increase in invasive species populations.	No loss of forage and cover due to the invasion of exotic or invasive plants introduced to project sites from machinery or human activity.
	Geographic Extent	Regional impacts observed throughout Arkansas.		Effects realized at one location.	NA
	Duration or Frequency	Chronic and long-term changes not likely to be reversed over several years or seasons.		Periodic, temporary, or short-term changes that are reversed over one or two seasons.	NA

^a Anthropogenic: “Made by people or resulting from human activities. Usually used in the context of emissions that are produced as a result of human activities.” (USEPA, 2016e)

NA = Not Applicable

4.2.6.3. Terrestrial Vegetation

Impacts to terrestrial vegetation occurring in Arkansas are discussed in this section.

Description of Environmental Concerns

Direct Injury/Mortality

Direct injury/mortality effects are physical injuries, extreme physiological stress, or death of an individual organism from interactions associated with the Proposed Action. The most common direct injuries are permanent or temporary loss or disturbance of individual plants. Based on the impact significance criteria presented in Table 4.2.6-1, direct injury or mortality impacts could be significant if population-level or sub-population effects were observed for at least one species depending on the distribution and the management of the subject species. Although unlikely, direct mortality/injury to plants could occur in construction zones from land clearing, excavation activities, or vehicle traffic; however, FirstNet deployment events are expected to be relatively small in scale and therefore would have *less than significant* impacts at the programmatic level. The implementation of BMPs and mitigation measures and avoidance measures could help to minimize or altogether avoid potential impacts to plant population survival. Chapter 16, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Vegetation and Habitat Loss, Alteration, or Fragmentation

Habitat impacts are primarily physical disturbances that result in alterations in the amount or quality of a habitat. As with all of the effects categories, the magnitude of the potential impact depends on the duration, location, and spatial scale of the system and associated activities. Habitat fragmentation is the loss or breaking down of continuous and connected habitat. Areas along Interstate 30 and Interstate 49 in Arkansas have experienced land use changes from urbanization, while eastern Arkansas has experienced extensive land use changes from agriculture (Natural Resources Conservation Service, 2006b). However, a large portion of the state remains relatively unfragmented, particularly in the Ouachita National Forest and Ozark Mountains regions.

Comments received on other regional Draft PEIS documents for the Proposed Action expressed concerns related to the potential impacts to vegetation from RF emissions. Some studies have indicated the potential for *adverse effects* to vegetation from RF emissions. As explained in Section 2.4, Radio Frequency Emissions, as well as Section 4.2.6.4, Wildlife, additional, targeted research needs to be conducted to more fully document the nature and effects of RF exposure, including the potential impacts to vegetation.

Construction of new infrastructure and long-term facility maintenance would result in the alteration of the type of vegetative communities in these localized areas, and in some instances the permanent loss of vegetation. In general, these impacts are expected to be *less than significant* at the programmatic level due to the short-term, localized nature of the deployment

activities. Further, some limited amount of infrastructure may be built in sensitive or rare regional vegetative communities, in which case BMPs and mitigation measures could be recommended and consultation with appropriate resource agencies, if required, could be undertaken to minimize or avoid potential impacts. Chapter 16, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Indirect Injury/Mortality

Indirect Effects are effects that are caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable (40 CFR 1508.8[b]). Indirect injury/mortality could include stress related to disturbance. The alteration of soils or hydrology within a localized area could result in stress or mortality of plants. Construction activities that remove large quantities of soil in the immediate vicinity of trees could cause undue stress to trees from root exposure, although this is unlikely to occur due to the small size of expected FirstNet activities. Indirect injury/mortality impacts vary depending on the species, time of year and duration of construction or deployment. Overall, these impacts are expected to be *less than significant* at the programmatic level due to the short-term and small-scale nature of deployment activities. Chapter 16, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Effects to Migration or Migratory Patterns

No effects to the long-term migration or migratory patterns for terrestrial vegetation (e.g., forest migration) are expected as a result of the Proposed Action given the small-scale of deployment activities.

Reproductive Effects

No reproductive effects to terrestrial vegetation are expected as a result of the Proposed Action given the small-scale of deployment activities.

Invasive Species Effects

When human activity results in a species entering an ecosystem new to it, the species is classified as introduced or, depending on its ability to spread rapidly and outcompete native species, invasive. The introduction of invasive species could have a dramatic effect on natural resources and biodiversity.

As described in Section 4.1.6.4, when non-native species are introduced into an ecosystem in which they did not evolve, their populations sometimes increase rapidly. There are 30 state-listed noxious weeds that are regulated in Arkansas as set forth under the provisions of the Federal Seed Act. Seven of the 30 noxious weeds are listed as prohibited in Arkansas due to the danger they present to natural ecosystems (USDA, 2015c). Even if natives are not completely eliminated by invasive species, the ecosystem often becomes much less diverse (USFWS, 2012g). For example, Japanese Blood Grass, also known as Cogongrass, is among the top ten

worst invasive weeds in the world and “can invade pastures, natural or planted forests, riparian areas, highway rights-of-way, urban areas and wetlands” (University of Arkansas, 2016).

The potential to introduce invasive plants within construction zones and during long-term site maintenance could occur from vehicles and equipment being transported from one region to another, or when conducting revegetation of a site after deployment activities are complete. Overall, these impacts are expected to be *less than significant* at the programmatic level due to the small scale and localized nature of likely FirstNet activities. BMPs could help to minimize or avoid the potential for introducing invasive plant species as well as minimize effects to vegetation as a result of the introduction of invasive species. Chapter 16, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Potential Impacts of the Preferred Alternative

The following section assesses potential impacts associated with implementation of the Preferred Alternative, including construction/deployment and operational activities.

Deployment Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative could result in the deployment of various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure and the specific deployment requirements, some activities would result in potential impacts to terrestrial vegetation resources and others would not. In addition, and as explained in this section, the same type of Proposed Action infrastructure could result in a range impacts, from *no impacts* to *less than significant* impacts, depending on the deployment scenario or site-specific conditions. The terrestrial vegetation that would be affected would depend on the ecoregion, the species’ phenology,¹⁴² and the nature as well as the extent of the habitats affected. Chapter 16, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Activities Likely to Have No Impacts at the Programmatic Level

Of the types of facilities or infrastructure deployment scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are expected to have *no impacts* to terrestrial vegetation under the conditions described below:

- **Wired Projects**
 - **Use of Existing Conduit – New Buried Fiber Optic Plant:** Disturbance associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas. Although terrestrial vegetation could be impacted, it is anticipated that effects to vegetation would be minimal

¹⁴² Phenology is the seasonal changes in plant and animal lifecycles, such as emergence of insects or migration of birds.

since the activities that would be conducted at these small entry and exit points are not likely to produce perceptible changes.

- Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up of dark fiber would have *no impacts* on terrestrial vegetation because there would be no ground disturbance.
- Satellites and Other Technologies
 - Satellite-Enabled Devices and Equipment: It is anticipated that the installation of permanent equipment on existing structures, attaching equipment to satellite launches for other purposes, and the use of portable devices that use satellite technology would not impact terrestrial vegetation because those activities would not require ground disturbance.
 - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it could include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact biological resources, it is anticipated that this activity would have *no impact* on terrestrial vegetation.

Activities with the Potential to Have Impacts at the Programmatic Level

Potential deployment-related impacts to terrestrial vegetation as a result of implementation of the Preferred Alternative would encompass a range of impacts that could occur, including direct injury/mortality; vegetation and habitat loss, alteration, or fragmentation; indirect injury/mortality; and invasive species effects. The types of infrastructure deployment activities that could be part of the Preferred Alternative and result in potential impacts to terrestrial vegetation include the following:

- Wired Projects
 - New Build – Buried Fiber Optic Plant: Plowing, trenching, or directional boring and the construction of POPs, huts, or other associated facilities or hand-holes to access fiber could result in potential impacts to terrestrial vegetation. Land/vegetation clearing and excavation activities, associated with construction of POPs, huts, or other associated facilities could result in direct or indirect injury to plants; the loss, alteration, or fragmentation of vegetative communities; and invasive species effects. BMPs and mitigation measures could help avoid or minimize potential impacts.
 - New Build – Aerial Fiber Optic Plant: The installation of new poles and hanging cable and associated security, safety, or public lighting components on public ROWs or private easements as well as the construction of access roads, POPs, huts, or facilities to house outside plant equipment could result in potential impacts to terrestrial vegetation. Impacts may vary depending on the number or individual poles installed, but could include direct or indirect injury to plants; the loss, alteration, or fragmentation of vegetative communities; and invasive species effects. BMPs and mitigation measures could help avoid or minimize potential impacts.
 - Collocation on Existing Aerial Fiber Optic Plant: Land clearing and excavation during replacement of poles and structural hardening could result in direct or indirect injury to

- plants; the loss, alteration, or fragmentation of vegetative communities; and invasive species effects.
- New Build – Submarine Fiber Optic Plant: The installation of cables in or near bodies of water would not impact terrestrial vegetation. However, impacts to terrestrial vegetation could potentially occur as a result of the construction of landings and/or facilities on shores or the banks of waterbodies that accept the submarine cables could potentially occur as a result of land clearing, excavation activities, and heavy equipment use. Effects could include direct or indirect injury to plants; the loss, alteration, or fragmentation of vegetative communities; and invasive species effects. BMPs and mitigation measures could help avoid or minimize potential impacts.
 - Installation of Optical Transmission or Centralized Transmission Equipment: If installation of transmission equipment required construction of access roads, trenching, and/or land clearing, such disturbance could result in direct or indirect injury to plants, the vegetation loss, and invasive species effects.
 - Wireless Projects
 - New Wireless Communication Towers: Installation of new wireless towers and associated structures (generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads), microwave facilities, or access roads could result in impacts to terrestrial vegetation. Land/vegetation clearing, excavation activities, landscape grading, and other disturbance activities during the installation of new wireless towers and associated structures or access roads could result in direct or indirect injury to plants; the loss, alteration, or fragmentation of vegetative communities; and invasive species effects.
 - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower, which would not result in impacts to terrestrial vegetation. However, if new power units, replacement towers, structural hardening, and physical security measures require land clearing or excavation activities, impacts would be similar to new wireless construction.
 - Deployable Technologies: Implementation of deployable technologies including COWs, COLTs, or SOWs could result in direct impacts to terrestrial vegetation if deployment occurs on vegetated areas, or the implementation results in paving of previously unpaved surfaces. Some staging or landing areas (depending on the type of technology) may require land/vegetation clearing, excavation, and paving. These activities could result in direct or indirect injury to plants; the loss, alteration, or fragmentation of vegetative communities; and invasive species effects. Deployment of drones, balloons, blimps, or piloted aircraft could potentially impact terrestrial vegetation if launching or recovery occurs on vegetated areas. Impacts would be similar to deployment of COWs, COLTs, and SOWs.

In general, the abovementioned activities could potentially involve land/vegetation clearing; topsoil removal; excavation and trenching; construction of access roads; installation or restructuring of towers, poles, or cables; heavy equipment movement; installation of

security/safety lighting and fencing; and deployment of aerial platforms. Potential impacts to terrestrial vegetation associated with deployment of this infrastructure, depending on their scale, could include direct or indirect injury/mortality to plants; the loss, alteration, or fragmentation of vegetative communities; and invasive species depending on the ecoregion, the species' phenology, and the nature and extent of the vegetation affected. Despite the variability, these potential impacts are expected to be *less than significant* at the programmatic level due to the small-scale and limited geographic scope of expected deployment activities. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operational activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned deployment impacts. The terrestrial vegetation that would be affected would depend on the ecoregion, the species' phenology, and the nature and extent of the habitats affected.

It is anticipated that there would *no impacts* to terrestrial vegetation associated with routine inspections of the Preferred Alternative, assuming that the same access roads used for deployment are also used for inspections because there would be no ground disturbance. Site maintenance, including mowing or herbicides, may result in *less than significant* effects at the programmatic level due to the small-scale of expected activities. These potential impacts could result from accidental spills from maintenance equipment or release of herbicides and because these areas would not be allowed to revert to a more natural state. If usage of heavy equipment or land clearing activities occurs off established roads or corridors as part of routine maintenance or inspections, direct or indirect injury/mortality to plants; the loss, alteration, or fragmentation of vegetative communities; and invasive species could occur to terrestrial vegetation, however impacts are expected to be *less than significant* at the programmatic level due to the small-scale of expected activities. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Alternatives Impact Assessment

The following section assesses potential impacts to terrestrial vegetation associated with the Deployable Technologies Alternative and the No Action Alternative.

Deployable Technologies Alternative

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred

Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential impacts to terrestrial vegetation as a result of implementation of this alternative could be as described below.

Deployment Impacts

As described above, implementation of deployable technologies could result in *less than significant* impacts at the programmatic level from land/vegetation clearing, excavation, and paving activities. These activities could result in direct or indirect injury to plants; the loss, alteration, or fragmentation of vegetative communities; and invasive species effects. Greater frequency and duration of deployments could change the magnitude of impacts. Nonetheless, impacts are expected to remain *less than significant* due to the relatively small scale of FirstNet activities at individual locations. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Operational Impacts

As described above, operational activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. The impacts could vary greatly among species, vegetative community, and geographic region, but are expected to remain *less than significant* at the programmatic level. As with the Preferred Alternative, it is anticipated that there would be *less than significant* impacts at the programmatic level to terrestrial vegetation associated with routine operations and maintenance due to the relatively small scale of likely FirstNet project sites. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed; therefore, there would be no associated construction or installation of wired, wireless, deployable infrastructure or satellites and other technologies. Therefore, there would be *no impacts* to terrestrial vegetation at the programmatic level as a result of the No Action Alternative. Environmental conditions would therefore be the same as those described in Section 4.1.6.3, Terrestrial Vegetation.

4.2.6.4. Wildlife

Impacts to amphibians and reptiles, terrestrial mammals, birds, and invertebrates occurring in Arkansas are discussed in this section. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Description of Environmental Concerns

Direct Injury/Mortality

Direct injury/mortality effects are physical injuries, extreme physiological stress, or death of an individual organism from interactions associated with the Proposed Action. The most common direct injuries are entanglement, vehicle or vessel strike, problems associated with accidental ingestion, and injuries incurred by sensitive animals from disturbance events.

Based on the impact significance criteria presented in Table 4.2.6-1, *less than significant* impacts at the programmatic level would be anticipated given that the majority of the proposed deployment activities are likely to be small-scale and would be dependent on the location and type of deployment activity as discussed below, which would be *less than significant with BMPs and mitigation measures incorporated*. Although anthropogenic disturbances may be minimal, yet measurable for some FirstNet projects, impacts to individual behavior of animals would be short-term and direct injury or mortality impacts at the population-level or sub-population effects would not likely be observed. Therefore, impacts are generally expected to be *less than significant* at the programmatic level (except for birds), as discussed further below. Chapter 16, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Terrestrial Mammals

Vehicle strikes are common sources of direct mortality or injury to both small and large mammals in Arkansas. Mammals are attracted to roads for a variety of reasons including use as a source of minerals, foraging, and migration (FHWA, 2009). In Arkansas, deer-vehicle collisions are a very visible negative consequence of an increasing human population combined with an abundant population of white-tailed deer (University of Arkansas, 2005). Individual injury or mortality as a result of vehicle strikes associated with the Proposed Action could occur.

Entanglement in fences or other barriers could be a source of mortality or injury to terrestrial mammals, though entanglements would likely be isolated, individual events.

For example, if tree-roosting bats and particularly maternity colonies are present at a site location, removal of trees during land clearing activities could result in direct injury/mortality if bats are utilizing them as roost trees or for rearing young. The scale of this impact would be expected to be small scale and would be dependent on the location and type of deployment activity, and the amount of tree removal. Site avoidance measures could be implemented to avoid disturbance to bats or other species.

Birds

Mortalities from collisions or electrocutions with manmade cables and wires are environmental concerns for avian species. Generally, collision events occur to “poor” fliers (e.g., ducks), heavy birds (e.g., swans and cranes), and birds that fly in flocks; while species susceptible to

electrocution are birds of prey, ravens, and thermal soarers, typically having large wing spans. (Gehring, Kerlinger, & Manville, 2011)

Avian mortalities or injuries could also result from vehicle strikes, although typically occur as isolated events.

Direct injury and mortality of birds could occur to ground-nesting birds when nests are either disturbed or destroyed during land clearing, excavation, and trenching, and other ground disturbing activities. Removal of trees during land clearing activities, could also result in direct injury/mortality to forest dwelling birds if they are utilizing them as roost trees for resting or shelter from predators and inclement weather, or as nest trees for rearing young. The scale of this impact would be associated with the amount of tree removal and the abundance of forest-dwelling birds roosting/nesting in the area. These impacts could be particularly pronounced in IBAs within the state as these areas provide them with essential habitat that supports various life stages (Hill, et al., 1997).

Direct mortality and injury to birds of Arkansas are not likely to be widespread or affect populations of species as a whole due to the small size of the likely FirstNet actions, however, DOI comments dated October 11, 2016¹⁴³ state that communication towers are “currently estimated to kill between four and five million birds per year”, although collisions with towers have the potential to impact a large number of birds unless BMPs and mitigation measures are incorporated, tower collisions are unlikely to cause population-level impacts. Of particular concern is avian mortality due to collisions with towers at night, when birds can be attracted to tower obstruction lights. Research has shown that birds are attracted to steady, non-flashing red lights and are much less attracted to flashing lights, which can reduce migratory bird collisions by as much as 70%. The FAA has issued requirements to eliminate steady-burning flashing obstruction lights and use only flashing obstruction lights. Additionally, on Jan. 6, 2017 the FCC issued a notice titled Opportunities to Reduce Bird Collisions with Communications Towers While Reducing Tower Lighting Costs (FCC, 2017). See Chapter 16, BMPs and Mitigation Measures, for BMPs and mitigation measures that FirstNet and/or their partners would require, as practicable or feasible, to further avoid or minimize potential impacts to birds from tower lighting. Site-specific analysis and/or consultation with FWS may be required depending on the site conditions, the type of deployment, or any other permits or permissions necessary to perform the work. If siting considerations and BMPs and mitigation measures are implemented (Chapter 16), potential impacts would be minimized. Additionally, potential impacts under MBTA and BGEPA could be addressed through BMPs and mitigation measures, as defined through consultation with USFWS.

Reptiles and Amphibians

In Arkansas, reptiles and amphibians occur in a wide variety of habitats from the upland hardwoods in the northwest to Mississippi Alluvial Plain in the southeast. Many of these species are widespread throughout the state (ADPT, 2015e) (AGFC, 2006a) (AGFC, 2011a). Direct mortality to amphibians or reptiles could occur in construction zones by excavation activities or

¹⁴³ See Appendix F, Draft PEIS Public Comments, for the full text of the Department of Interior comments.

by vehicle strikes; however, these effects are expected to be *less than significant* at the programmatic level because they would be temporary and isolated, affecting only individual animals.

Invertebrates

The terrestrial invertebrate populations of Arkansas are so widely distributed that injury/mortality events are not expected to affect populations of species as a whole.

Vegetation and Habitat Loss, Alteration, or Fragmentation

As described in Section 4.2.6.3, habitat loss could occur through exclusion, directly or indirectly, preventing an animal from accessing an optimal habitat (e.g., breeding, forage, or refuge), either by physically preventing use of a habitat or by causing an animal to avoid a habitat, either temporarily or long-term. It is expected that activities associated with the Proposed Action would cause exclusion effects only in very special circumstances, as in most cases an animal could fly, swim, or walk to a nearby area that would provide refuge.

In general, potential effects of vegetation and habitat loss, alteration, or fragmentation are expected to be *less than significant* at the programmatic level because of the small-scale nature and limited geographic scope of expected deployment activities. These potential impacts are described for Arkansas's wildlife species below. Chapter 16, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Terrestrial Mammals

Mammals occupy a wide range of habitats throughout Arkansas and may experience localized effects of habitat loss or fragmentation. Removal or loss of vegetation may impact large mammals (e.g., white-tailed deer) by decreasing the availability of forest for cover from predators or for foraging. Loss of cover may increase predation on both breeding adults as well as their young. The loss, alteration, or fragmentation of forested habitat would also impact some small mammals (e.g., bats, foxes) that utilize these areas for roosting, foraging, sheltering, and for rearing their young. Loss of habitat or exclusions from these areas could be avoided or minimized by BMPs and mitigation measures, as appropriate (see Chapter 16).

Birds

The direct removal of migratory bird nests is prohibited under the MBTA. The USFWS and the AGFC could provide regional guidance on the most critical time periods (e.g., breeding season) to avoid vegetation clearing. The removal and loss of vegetation could affect avian species directly by loss of nesting, foraging, stopover, and cover habitats.

Noise and vibration disturbance and human activity, as discussed previously, could directly restrict birds from using their preferred resources. Greater human activity of longer duration would increase the likelihood that birds would avoid the area, possibly being excluded from essential resources. These impacts could be particularly pronounced if birds temporarily avoid

IBAs within the state as these areas provide them with essential habitat that supports various life stages (Hill, et al., 1997). DOI comments dated October 11, 2016, state that communication towers are “currently estimated to kill between four and five million birds per year”, although collisions with towers have the potential to impact a large number of birds unless BMPs and mitigation measures are incorporated, tower collisions are unlikely to cause population-level impacts. Of particular concern is avian mortality due to collisions with towers at night, when birds can be attracted to tower obstruction lights. Research has shown that birds are attracted to steady, non-flashing red lights and are much less attracted to flashing lights, which can reduce migratory bird collisions by as much as 70%. The FAA has issued requirements to eliminate steady-burning flashing obstruction lights and use only flashing obstruction lights. Additionally, on Jan. 6, 2017 the FCC issued a notice titled *Opportunities to Reduce Bird Collisions with Communications Towers While Reducing Tower Lighting Costs*. (FAA, 2016b) (FCC, 2017) See Chapter 16, BMPs and Mitigation Measures, for BMPs and mitigation measures that FirstNet and/or their partners would require, as practicable and feasible, to further avoid or minimize potential impacts to birds from tower lighting.

The degree to which habitat exclusion affects birds depends on many factors. The impact to passerine¹⁴⁴ species from disturbance or displacement from construction activities is likely to be short-term with minor effects from exclusion. Exclusion from resources concentrated in a small migratory stop area during peak migration could have major impacts to species that migrate in large flocks and concentrate at stop overs. Exclusion from resources are expected to be *less than significant* at the programmatic level because of the small-scale nature of expected deployment. BMPs and mitigation measures, including nest avoidance during construction-related activities, would help to avoid or minimize the potential impacts to birds from exclusion of resources, as appropriate.

Reptiles and Amphibians

Important habitats for Arkansas’s amphibians and reptiles typically consist of wetlands and, in some cases, as with the timber rattlesnake the surrounding upland forest. Impacts are expected to be *less than significant* at the programmatic level given the short-term nature and limited geographic scope of individual activities. If proposed project sites were unable to avoid sensitive areas, BMPs and mitigation measures would be required to avoid or minimize potential impacts.

Filling or draining of wetland breeding habitat (see Section 4.2.4, Water Resources) and alterations to ground or surface water flow from development associated with the Proposed Action may also have effects to Arkansas’s amphibian and reptile populations; though BMPs and mitigation measures would help to avoid or minimize the potential impacts.¹⁴⁵

¹⁴⁴ Passerines are an order of “perching” birds that have four toes, three facing forward, and one backward, which allows the bird to easily cling to both horizontal and nearly vertical perches.

¹⁴⁵ See Chapter 16, Wetlands, for a discussion of BMPs for wetlands.

Invertebrates

Ground disturbance or land clearing activities as well as use of heavy equipment could result in direct injury or mortality to invertebrates. However, deployment activities are expected to be temporary and isolated, thereby limiting the potential for direct mortality and likely affecting only a small number of invertebrates. Habitat loss and degradation are the most common causes of invertebrate species' declines; however, habitat for many common invertebrates is generally assumed to be abundant and widely distributed across the state, therefore effects to invertebrates are expected to be *less than significant*. Impacts to sensitive invertebrate species are discussed below in Section 4.2.6.6, Threatened and Endangered Species and Species of Concern.

Indirect Injury/Mortality

Indirect injury/mortality impacts vary depending on the species, time of year and duration of deployment. Overall, impacts are expected to remain *less than significant* at the programmatic level (except for birds and bats due to potential exposure to RF emissions, see below) due to the short-term nature and limited geographic scope of expected activities, though BMPs and mitigation measures could further help to avoid or minimize the potential impacts. Chapter 16, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Terrestrial Mammals

Stress from repeated disturbances during critical time periods (e.g., roosting and mating) could reduce the overall fitness and productivity of young and adult terrestrial mammals. Indirect effects could occur to roosting bats from noise, vibration, light, or human disturbance causing them to leave their roosting locations or excluding them from their summer roosting/maternity colony roosts. For example, some bat species establish summer roosting or maternity colonies in the same general area that they return to year and after year. The majority of FirstNet deployment activities would be short-term in nature, and repeated disturbances would not occur, therefore impacts are expected to be *less than significant* at the programmatic level, except for bats (see below).

There are no published studies that document physiological or other adverse effects to bats from radio frequency (RF) exposure. However, because bats are similar ecologically and physiologically to birds, they have the potential to be affected by RF exposure in similar ways to birds (see the birds subsection below). One study demonstrated that foraging bats avoided areas exposed to varying levels of electromagnetic emissions compared with control sites, and attributed this behavior to the increased risk of overheating and echolocation interference caused by electromagnetic field exposure (Nicholls & Racey, 2009). As stated below, experts emphasize that targeted field research needs to be conducted to more fully document the nature and extent of effects of RF exposure on bats and other wildlife, and the implications of those effects on populations over the long term (Manville, 2015) (Manville, 2016a) (Appendix G). FirstNet recognizes that RF exposure has the potential to adversely impact bats, particularly bats that communally roost or breed and nurture young in areas with RF exposure, and concurs with

the need for further research. As such, and as a precaution, FirstNet would implement BMPs and mitigation measures that focus on siting towers away from known communal bat use areas to the extent practicable or feasible (described in Chapter 16, BMPs and Mitigation Measures) to help reduce bird mortalities associated with both RF emissions and tower collision. See Section 2.4, Radio Frequency Emissions, for additional information on potential RF exposure impacts.

Birds

Repeated disturbance, especially during the breeding and nesting season, could cause stress to individuals lowering fitness and productivity. These impacts could be particularly pronounced in IBAs within the state if birds temporarily avoid those areas, since they provide essential habitat for various life stages (Hill, et al., 1997). However, the majority of FirstNet deployment activities would be short-term in nature, and repeated disturbances would not occur. BMPs and mitigation measures could help to further avoid or minimize effects to birds that make use of migratory pathways.

Research indicates that RF exposure may adversely affect birds. A comment letter on the Draft Programmatic Environmental Impact Statement for the West region, presented by Dr. Albert Manville, former USFWS agency lead on avian-structural impacts, summarizes the state of scientific knowledge of the potential effects of RF exposure on wildlife, particularly migratory birds; the comment letter is presented in its entirety in Appendix G. RF exposure may result in adverse impacts on wildlife, although a distinct causal relationship between RF exposure and responses in wild animal populations has not been established. Further, important scientific questions regarding the mechanisms of impact, the exposure levels that trigger adverse effects, and the importance of confounding factors in the manifestation of effects, among other questions, remain unanswered (Manville, 2016b) (Appendix G).

Research conducted to date under controlled laboratory conditions has identified a wide range of physiological and behavioral changes in avian and mammalian subjects, including embryonic mortality in bird eggs, genetic abnormalities, cellular defects, tumor growth, and reproductive and other behavioral changes in adult birds and rodents (DiCarlo, White, Guo, & Litovitz, 2002) (Wyde, 2016) (Levitt & Lai, 2010) (Grigor'ev, 2003) (Panagopoulos & Margaritis, 2008).

Few studies of the effects of RF exposure on wild animal populations have been conducted due to the difficulty of performing controlled studies on wild subjects. Those that have been conducted are observational in nature (i.e., documenting of reproductive success and behavior in birds near RF-emitting facilities). These studies lack controls on exposure levels or other potentially confounding factors. Nevertheless, findings from these studies indicate reduced survivorship at all life stages; physiological problems related to locomotion and foraging success; and behavioral changes that resulted in delayed or unsuccessful mating in several species of nesting birds (Manville, 2016b) (Balmori, 2005) (Balmori, A., 2009) (Balmori & Hallberg, 2007) (Appendix G). Balmori (2005) documented effects as far as 1,000 feet from an RF source consisting of multiple cellular phone towers. Another study of wild birds conducted by Engels et al. (2014) documented that migratory birds are unable to use their magnetic

compass in the presence of urban electromagnetic noise,¹⁴⁶ which can disrupt migration or send birds off course, potentially resulting in reduced survivorship. (Engels, et al., 2014)

Experts emphasize that targeted field research needs to be conducted to more fully document the nature and extent of effects of RF exposure on birds and other wildlife and the implications of those effects on wildlife populations over the long term (Manville, 2015) (Manville, 2016b) (Appendix G). Such studies should be conducted over multiple generations and include controls to more clearly establish causal relationships, identify potential chronic effects, and determine threshold exposure levels. FirstNet recognizes that RF exposure may adversely impact wildlife, particularly birds that nest, roost, forage, or otherwise spend considerable time in areas with RF exposure, and concurs with the need for further research. As such, and as a precaution, FirstNet would implement BMPs and mitigation measures that focus on siting towers away from high bird use areas to the extent practicable or feasible (described in Chapter 16, BMPs and Mitigation Measures). See Section 2.4, Radio Frequency Emissions, for additional information on potential RF exposure impacts.

Reptiles and Amphibians

Changes in water quality, especially during the breeding seasons, could cause stress resulting in lower productivity. The majority of FirstNet deployment activities would be short-term in nature, and repeated disturbances would not occur.

Invertebrates

Invertebrates could experience chronic stress, either by changes in habitat composition or competition for resources, resulting in lower productivity. Due to the large number of invertebrates distributed throughout the state, and given the short-term nature of most of the deployment activities, this impact would likely be *less than significant* at the programmatic level.

Effects to Migration or Migratory Patterns

Migration is the regular movement of animals from one region to another and back again. Migratory patterns vary by species and sometimes within the same species. Overall, potential impacts are anticipated to be *less than significant* at the programmatic level due to the small-scale and localized nature of expected activities, which would be unlikely to result in long-term avoidance. Potential effects to migration patterns of Arkansas's amphibians and reptiles, terrestrial mammals, birds, and invertebrates are described below. Chapter 16, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts. See Section 2.4, Radio Frequency Emissions, for additional information on potential RF exposure impacts.

¹⁴⁶ Urban electromagnetic noise is a term used to describe an area with a concentration of cell phone towers and users, which by sheer volume and level of use, creates a zone of electromagnetic noise.

Terrestrial Mammals

Some large mammals will perform short seasonal migrations between foraging/breeding habitats and denning habitats. Some small mammals (e.g., bats) also have migratory routes that include spring and fall roosting areas between their summer maternity roosts and hibernacula.¹⁴⁷

Any clearance, drilling, and construction activities needed for network deployment, including noise and vibration associated with these activities, has the potential to divert mammals from these migratory routes. Impacts could vary depending on the species, time of year of construction/operation, and duration, but are generally expected to be *less than significant* at the programmatic level. BMPs and mitigation measures could help to further avoid or minimize the potential impacts.

Birds

Because many birds have extremely long migrations, protection efforts for critical sites along migratory routes must be coordinated over distances often involving many different countries. For example, as a group, shorebirds migrating throughout Arkansas undertake some of the longest-distance migrations of all animals. Arkansas's IBAs serve as important stopover and breeding habitat for migratory birds (NAS, 2015c). Many migratory routes are passed from one generation to the next. Additionally, there is some evidence in the scientific literature that RF emissions could affect bird migration. Engels et al. (2014) documented that migratory birds are unable to use their magnetic compass in the presence of urban electromagnetic noise, which can disrupt migration or send birds off course, potentially resulting in reduced survivorship. (Engels, et al., 2014) It is unlikely that the limited amount of infrastructure, the amount of RF emissions generated by Project infrastructure, and the temporary nature of the deployment activities would result in impacts to large populations of migratory birds, but more likely that individual birds could be impacted. Impacts could vary (e.g., mortality of individuals or abandonment of stopover sites by whole flocks) depending on the species, time of year of construction/operation, and duration, and impacts are expected to be *less than significant* at the programmatic level. BMPs and mitigation measures could help to further avoid or minimize effects to birds that make use of migratory pathways.

Reptiles and Amphibians

Several species of salamanders and frogs are known to seasonally migrate. For example, wood frogs use diverse vegetation types from grassy meadows to open forests. After they emerge from dormancy, wood frogs migrate up 900 feet to breeding pools, where they breed rapidly in early spring in permanent or ephemeral water (Homan, Atwood, Dunkle, & Karr, 2010). However, (Berven & Grudzien, 1990) found that a small percentage of juvenile wood frogs could migrate more than 1.5 miles from natal ponds, suggesting juveniles may be capable of migrating relatively long distances. Mortality and barriers to movement could occur as result of the Proposed Action (Calhoun & DeMaynadier, 2007).

¹⁴⁷ A location chosen by an animal for hibernation.

Species that use streams as dispersal or migratory corridors may be impacted if these waterways are restricted or altered, but impacts are expected to be *less than significant* at the programmatic level. BMPs and mitigation measures could help to further avoid or minimize the potential impacts.

Invertebrates

The proposed deployment activities would be expected to be short-term or temporary in nature; therefore, *no effects* to migratory patterns of Arkansas's invertebrates are expected as a result of the Proposed Action.

Reproductive Effects

Reproductive effects are considered those that either directly or indirectly reduce an animal's ability to produce offspring or reduce the rates of growth, maturation, and survival of offspring, which could affect the overall population of individuals. Overall, potential impacts are anticipated to be *less than significant* at the programmatic level due to the short-term and limited nature of expected activities. Chapter 16, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts. See Section 2.4, Radio Frequency Emissions, for additional information on potential RF exposure impacts.

Terrestrial Mammals

Restricted access to important winter hibernacula or summer maternity roosts for bats and dens for large mammals, such as the black bear, has the potential to negatively affect body condition and reproductive success of mammals in Arkansas.

For example, in addition to food and water, black bears require den sites in order to thrive, which provide shelter and security during the denning season (USFWS, 2014e). Disturbance from deployment and operations could also result in the abandonment of offspring leading to reduced survival. There are no published studies that document adverse effects to bats from RF exposure. As stated above, experts emphasize that targeted field research needs to be conducted to more fully document the nature and extent of effects of RF exposure on bats and other wildlife, and the implications of those effects on populations over the long term (Manville, 2015) (Manville, 2016a) (Appendix G). FirstNet recognizes that RF exposure has the potential to adversely impact bats, particularly bats that communally roost or breed and nurture young in areas with RF exposure, and concurs with the need for further research. As such, and as a precaution, FirstNet would implement BMPs and mitigation measures that focus on siting towers away from known communal bat use areas to the extent practicable or feasible (described in Chapter 16, BMPs and Mitigation Measures). See Section 2.4, Radio Frequency Emissions, for additional information on potential RF exposure impacts.

These activities are expected to be small scale and therefore impacts are expected to be *less than significant* at the programmatic level. Reproductive effects as a result of displacement and disturbance could be minimized through the use of BMPs and mitigation measures.

Birds

Impacts due to Proposed Action deployment and operations could include abandonment of the area and nests due to disturbance. Disturbance (visual, noise, and vibration) may displace birds into less suitable habitat and thus reduce survival and reproduction. These impacts could be particularly pronounced in IBAs within the state if birds temporarily avoid those areas, since they provide essential habitat for various life stages (Hill, et al., 1997). Research conducted to date under controlled laboratory conditions has identified a wide range of physiological and behavioral changes in avian subjects, including embryonic mortality in bird eggs and reproductive changes in adult birds (DiCarlo, White, Guo, & Litovitz, 2002) (Wyde, 2016) (Levitt & Lai, 2010) (Grigor'ev, 2003) (Panagopoulos & Margaritis, 2008). Laboratory studies conducted with domestic chicken embryos have shown that emissions at the same frequency and intensity as that used in cellular telephones have appeared to result in embryonic mortality (DiCarlo, White, Guo, & Litovitz, 2002) (Manville, 2007). These studies suggest that RF emissions at low levels (far below the existing exposure guidelines for humans) (see Section 2.4.2, RF Emissions and Humans) may be harmful to wild birds; however, given the controlled nature of the studies and potential exposure differences in the wild, it is unclear how this exposure would affect organisms in the wild.

As such, and as a precaution, FirstNet would implement BMPs and mitigation measures that focus on siting towers away from high bird use areas to the extent practicable or feasible (described in Chapter 16, BMPs and Mitigation Measures). See Section 2.4, Radio Frequency Emissions, for additional information on potential RF exposure impacts.

The majority of FirstNet deployment or operation activities are likely to be small-scale. Applicable BMPs and mitigation measures, as defined through consultation with USFWS for MBTA or BGEPA, if required, could help to avoid or minimize any potential impacts. Environmental consequences pertaining to federally listed species will be discussed in Section 4.2.6.6, Threatened and Endangered Species.

Reptiles and Amphibians

Reproductive effects to reptile nests may occur through direct loss or disturbance of nests. For example, the spiny softshell turtle (*Apalone spinifera*) will lay its eggs in exposed soil in late spring or summer (USGS, 2015a).

Reproductive effects to sub-populations of amphibians and reptiles may occur through the direct loss of vernal pools as breeding habitat if deployment activities occur near breeding pools, or alter water quality through sediment infiltration, or obstruction of natural water flow to pools, though BMPs would help to avoid or minimize the potential impacts.

Invertebrates

The majority of FirstNet deployment or operation activities are likely to be short-term in nature; therefore, no reproductive effects to invertebrates are expected as a result of the Proposed Action.

Invasive Species Effects

When human activity results in a species entering an ecosystem new to it, the species is classified as introduced or invasive. The introduction of invasive species could have a dramatic effect on natural resources.

FirstNet deployment or operation activities could result in short-term or temporary changes to specific project sites; although these sites are expected to return to their natural state in a year or two. Invasive species are not expected to be introduced to project sites as part of the deployment activities from machinery or construction workers. Therefore, potential impacts are expected to be *less than significant* at the programmatic level.

Potential invasive species effects to Arkansas's wildlife are described below.

Terrestrial Mammals

In Arkansas, feral hogs adversely impact several native mammals, including squirrels and deer. They feed on young mammals, destroy native vegetation resulting in erosion and water resource concerns, and could carry/transmit disease to livestock and humans (AGFC, 2013).

FirstNet deployment activities are not expected to introduce terrestrial mammal species to project sites as these activities are temporary and would not provide a mechanism for transport of invasive terrestrial mammals to project sites from other locations, therefore impacts would be *less than significant* at the programmatic level. BMPs and mitigation measures (see Chapter 16) would help to avoid or minimize the potential for introducing invasive plant species during implementation of the Proposed Action as well as minimize effects to terrestrial mammals as a result of the introduction of invasive species.

Birds

FirstNet deployment activities could result in short-term or temporary changes to specific project sites although these sites are expected to return to their natural state in a year or two. Invasive bird species are not expected to be introduced at project sites as part of the deployment activities from machinery or construction workers, therefore impacts are expected to be *less than significant* at the programmatic level. BMPs and mitigation measures (see Chapter 16) would help to avoid or minimize the potential for introducing invasive plant species during implementation of the Proposed Action as well as minimize effects to birds as a result of the introduction of invasive species.

Reptiles and Amphibians

Although FirstNet deployment activities could result in short-term or temporary changes to specific project sites, these sites are expected to return to their natural state in a year or two. Invasive reptile or amphibian species are not expected to be introduced at project sites as part of the deployment activities. Invasive reptile or amphibian species are not expected to be introduced at project sites from machinery or laborers, therefore impacts are expected to be *less than significant* at the programmatic level. BMPs and mitigation measures (see Chapter 16) would help to avoid or minimize the potential for introducing invasive plant species during

implementation of the Proposed Action as well as minimize effects to reptiles and amphibians as a result of the introduction of invasive species.

Invertebrates

Invertebrate populations are susceptible to invasive plant species that may change or alter the community composition of specific plants on which they depend. Effects from invasive plant species to invertebrates would be similar to those described for habitat loss and degradation.

Invasive insects could pose a threat to Arkansas's forest and agricultural resources. Species such as the gypsy moth, hemlock woolly adelgid, emerald ash borer, and Asian longhorn beetle are known to cause irreversible damage to native forests (AFC, 2015). The potential to introduce invasive invertebrates within construction zones and during long-term site maintenance could occur from vehicles and equipment being transported from one region to another, or when conducting revegetation of a site after deployment activities are complete. BMPs and mitigation measures would help to avoid or minimize the potential for introducing invasive terrestrial invertebrate species during implementation of the Proposed Action. Invasive species effects related to terrestrial invertebrates could be minimized with the implementation of BMPs and mitigation measures (Chapter 16). Furthermore, BMPs and mitigation measures (see Chapter 16) would also help to avoid or minimize the potential for introducing invasive plant species during implementation of the Proposed Action as well as minimize effects to invertebrates as a result of the introduction of invasive species.

Potential Impacts of the Preferred Alternative

The following section assesses potential impacts associated with implementation of the Preferred Alternative, including construction/deployment and operational activities.

Deployment Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative could result in the deployment of various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure and the specific deployment requirements, some activities would result in potential impacts to wildlife resources and others would not. In addition, and as described in this section, infrastructure developed under the Preferred Alternative could result in a range of impacts, from *no impacts* to *less than significant* impacts with BMPs and mitigation measures incorporated, depending on the deployment scenario or site-specific conditions. The wildlife that would be affected would depend on the ecoregion, the species' phenology and the nature and extent of the habitats affected. Chapter 16, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Activities Likely to Have No Impacts at the Programmatic Level

Of the types of facilities or infrastructure deployment scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are expected to have *no impacts* to wildlife resources under the conditions described below:

- **Wired Projects**
 - **Use of Existing Conduit – New Buried Fiber Optic Plant:** Disturbance associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas. Noise and vibration generated by equipment required to install fiber would be infrequent and of short duration, and unlikely to produce measurable changes in wildlife behavior. It is anticipated that effects to wildlife would be temporary and would not result in any perceptible change.
 - **Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable:** Lighting up of dark fiber would have *no impacts* to wildlife resources because there would be no ground disturbance.
- **Satellites and Other Technologies**
 - **Satellite-Enabled Devices and Equipment:** It is anticipated that the installation of permanent equipment on existing structures, attaching equipment to satellites launched for other purposes, and the use of portable devices that use satellite technology would not impact wildlife because those activities would not require ground disturbance.
 - **Deployment of Satellites:** FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it could include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact wildlife resources, it is anticipated that this activity would have *no impact* on wildlife resources.

Activities with the Potential to Have Impacts at the Programmatic Level

Potential deployment-related impacts to wildlife resources as a result of implementation of the Preferred Alternative would encompass a range of impacts that could occur, including direct injury/mortality; vegetation and habitat loss, alteration, or fragmentation; effects to migratory patterns; indirect injury/mortality; reproductive effects; and invasive species effects. The types of infrastructure deployment activities are anticipated to be *less than significant* at the programmatic level to wildlife resources:

- **Wired Projects**
 - **New Build – Buried Fiber Optic Plant:** Plowing, trenching, or directional boring and the construction of POPs, huts, or other associated facilities or hand-holes to access fiber could result in potential impacts to wildlife resources. Land/vegetation clearing and excavation activities, associated with construction of POPs, huts, or other associated facilities could result in direct injury/mortalities of wildlife that are not mobile enough to avoid construction activities (e.g., reptiles, small mammals, and young individuals), that utilize burrows (e.g., ground squirrels), or that are defending nest sites (such as ground-nesting birds). Disturbance, including noise and vibration, associated with the above

activities involving heavy equipment or land clearing could result in habitat loss, effects to migration patterns, indirect injury/mortality, reproductive effects, and invasive species effects. Implementation of BMPs and mitigation measures could help to avoid or minimize potential impacts.

- New Build – Aerial Fiber Optic Plant: The installation of new poles and hanging cable and associated security, safety, or public lighting components on public ROWs or private easements as well as the construction of access roads, POPs, huts, or facilities to house outside plant equipment could result in potential impacts to wildlife resources. Impacts may vary depending on the number or individual poles installed and the extent of ground disturbance, but could include direct injury/mortality of individuals as described above; habitat loss, alteration, or fragmentation; effects to migratory patterns; indirect injury/mortality; and invasive species effects.
- Collocation on Existing Aerial Fiber Optic Plant: Land clearing and excavation during replacement of poles and structural hardening could result in direct injury/mortality, habitat loss or alteration, effects to migratory patterns, indirect injury/mortality, and invasive species effects. Noise and vibration disturbance from heavy equipment use associated with these activities as well as with installing new fiber on existing poles could result in migratory effects and indirect injury/mortality.
- New Build – Submarine Fiber Optic Plant: The installation of cables in or near bodies of water and construction of landings and/or facilities on the shores or the banks of waterbodies that accept the submarine cables could potentially impact wildlife (see Section 4.2.4, Water Resources, for a discussion of potential impacts to water resources). Potential effects could include direct injury/mortality, habitat loss, alteration, or fragmentation depending on the site location. If activities occurred during critical periods, effects to migratory patterns as well as reproductive effects and indirect injury/mortality could occur.
- Installation of Optical Transmission or Centralized Transmission Equipment: If installation of transmission equipment required construction of access roads, trenching, and/or land clearing, such disturbance could result in direct injury/mortality of wildlife as described for other New Build activities. Habitat loss, alteration and fragmentation; effects to migration or migratory patterns, indirect injury/mortality, and invasive species effects could occur as a result of construction and resulting disturbance.
- Wireless Projects
 - New Wireless Communication Towers: Installation of new wireless towers and associated structures (e.g., generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads could result in impacts to wildlife resources. Land/vegetation clearing, excavation activities, landscape grading, and other disturbance activities during the installation of new wireless towers and associated structures or access roads could result in direct injury/mortality, habitat loss, alteration or fragmentation, and effects to migratory patterns. Security lighting and fencing could result in direct and indirect injury or mortality, effects to migratory patterns, as well as reproductive effects. For a discussion of RF emissions, refer to Section 2.4, Radio Frequency Emissions.

- Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower, which would not result in impacts to wildlife. However, if new power units, replacement towers, or structural hardening were required, impacts would be similar to new wireless construction. For a discussion of RF emissions, refer to Section 2.4, Radio Frequency Emissions.
- Deployable Technologies: Implementation of deployable technologies including COWs, COLTs, and SOWs could result in direct injury/mortalities to wildlife on roadways. If external generators are used, noise and vibration disturbance could potentially impact migratory patterns of wildlife. RF hazards could result in indirect injury or mortality as well as reproductive effects depending on duration and magnitude of operations. For a discussion of RF emissions, refer to Section 2.4, Radio Frequency Emissions.
- Deployment of drones, balloons, blimps, and piloted aircraft could potentially impact wildlife by direct or indirect injury/mortality from collision, entanglement, or ingestion and effects to migratory patterns and reproductive effects from disturbance and/or displacement due to noise and vibration. The magnitude of these effects depends on the timing and frequency of deployments. However, deployment activities are expected to be temporary and isolated, and likely affecting only a small number of wildlife.

In general, the abovementioned activities could potentially involve land/vegetation clearing; excavation and trenching; construction of access roads; installation or restructuring of towers or poles; installation of security/safety lighting and fencing; and deployment of aerial platforms. Potential impacts to wildlife resources associated with deployment of this infrastructure are anticipated to be *less than significant* at the programmatic level given the small scale of likely individual FirstNet projects, with the exception of impacts to birds and bats, which are expected to be *less than significant with BMPs and mitigation measures incorporated*. Some deployment activities could include direct injury/mortality, habitat loss, indirect injury/mortality, effects to migration, reproductive effects, and effects of invasive species depending on the project type, location, ecoregion, the species' phenology, and the nature and extent of the habitats affected. As stated above, these impacts would likely be limited to individual wildlife species and unlikely to cause population-level impacts, and are therefore expected to remain *less than significant* at the programmatic level. Proposed FirstNet actions at some individual sites may have a higher level of impacts due to location-specific conditions, and therefore those proposed activities would undergo site-specific environmental review. Site-specific analysis may be required depending on the site conditions, the type of deployment, or any other permits or permissions necessary to perform the work. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operational activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major infrastructure replacement as part of ongoing system maintenance would

result in impacts similar to the abovementioned deployment impacts. The wildlife that would be affected would depend on the ecoregion, the species' phenology, and the nature and extent of the habitats affected.

It is anticipated that there would be *less than significant* impacts to wildlife resources at the programmatic level associated with routine inspections of the Preferred Alternative. Site maintenance would be infrequent, including mowing or limited application of herbicides, may result in *less than significant* effects at the programmatic level to wildlife including direct injury/mortality to less mobile wildlife, or exposure to contaminants from accidental spills from maintenance equipment or release of pesticides. Potential spills of these materials would be expected to be in small quantities.

During operations, direct injury/mortality of wildlife could occur from collisions and/or entanglements with transmission lines, towers, and aerial platforms. In particular, collisions with new cell towers that may be installed as part of the Preferred Alternative could increase avian mortality. As stated above, these impacts would likely be limited to individual wildlife species. DOI comments dated October 11, 2016 stated that communication towers are "currently estimated to kill between four and five million birds per year", although collisions with towers have the potential to impact a large number of birds unless BMPs and mitigation measures are incorporated, tower collisions are unlikely to cause population-level impacts.

Wildlife resources could still be affected by the reduction in habitat quality associated with habitat fragmentation from the presence of access roads, transmission corridors, and support facilities. These features could also continue to disrupt movements of terrestrial wildlife, particularly during migrations between winter and summer ranges or in calving areas.

In addition, the presence of new access roads and transmission line ROWs may increase human use of the surrounding areas, which could increase disturbance to wildlife resulting in effects to migratory pathways, indirect injury/mortalities, reproductive effects, as well as the potential introduction and spread of invasive species as explained above. As stated above, these impacts would likely be limited to individuals and unlikely to cause population-level impacts, and therefore would likely be *less than significant* at the programmatic level given the short-term nature and limited geographic scope for individual activities. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Alternatives Impact Assessment

The following section assesses potential impacts to wildlife resources associated with the Deployable Technologies Alternative and the No Action Alternative.

Deployable Technologies Alternative

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred

Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential impacts to wildlife resources as a result of implementation of this alternative could be as described below.

Deployment Impacts

As described above, implementation of deployable technologies could result in *less than significant* impacts at the programmatic level from direct and indirect injury or mortality events, changes in migratory patterns, disturbance, or displacement. Greater frequency and duration of deployments could change the magnitude of impacts depending on species, life history, and region of the state. However, impacts are expected to remain *less than significant* at the programmatic level because deployment activities are expected to be temporary and localized, likely affecting only a small number of wildlife. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Operational Impacts

As described above, operational activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. As with the Preferred Alternative, it is anticipated that there would be *less than significant* impacts at the programmatic level because deployable activities are expected to be temporary and likely affecting only a small number of wildlife. Proposed FirstNet actions at some individual sites may have a higher level of impacts due to location-specific conditions, and therefore those proposed activities would undergo site-specific environmental review. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the nationwide, interoperable, public safety broadband network would not be deployed; therefore, there would be no associated construction or installation of wired, wireless, deployable infrastructure or satellites and other technologies. Therefore, there would be *no impacts* to wildlife resources at the programmatic level as a result of the No Action Alternative. Environmental conditions would therefore be the same as those described in Section 4.1.6.4, Terrestrial Wildlife.

4.2.6.5. Fisheries and Aquatic Habitats

Impacts to fisheries and aquatic habitats occurring in Arkansas are discussed in this section. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Description of Environmental Concerns

Direct Injury/Mortality

The most common direct injuries are entanglement, vessel strike, problems associated with accidental ingestion, and injuries incurred by sensitive animals from disturbance events (USEPA, 2012e).

Based on the impact significance criteria presented in Table 4.2.6-1, *less than significant* impacts would be anticipated at the programmatic level given that the majority of proposed deployment activities are likely to be small-scale and would be dependent on the location and type of deployment activity. Although anthropogenic disturbances may be measurable, but minimal, for some FirstNet projects, direct injury or mortality impacts at the population-level or sub-population level would not likely be observed. BMPs and mitigation measures could help to avoid or minimize potential impacts to fisheries and aquatic invertebrate population survival.

Vegetation and Habitat Loss, Alteration, or Fragmentation

As with all of the effects categories, the magnitude of the impact depends on the duration, location, and spatial scale of the system and associated activities. Habitat fragmentation is the breaking down of continuous and connected habitat, and impeding access to resources and mates.

Depending on the location, the construction of new infrastructure and long-term facility maintenance could result in the river and lake shoreline habitat alteration in localized areas; in some instances, the permanent loss of riparian vegetation could occur, which could lead to water quality impacts and in turn aquatic habitat alteration. Habitat loss is not likely to be widespread or affect populations of species as a whole; fish species would be expected to swim to a nearby location, depending on the nature of the deployment activity. Therefore, potential impacts are expected to be *less than significant* at the programmatic level. Additionally, deployment activities with the potential for impacts to vulnerable aquatic habitats could be addressed through BMPs and mitigation measures as defined through consultation with the appropriate resource agency.

Indirect Injury/Mortality

Erosion or sedimentation from land clearing and excavation activities near or within riparian areas, floodplains, wetlands, streams, and other aquatic habitats could have potential impacts on water quality. Exposure to contaminants from accidental spills from vehicles and equipment could also potentially affect water quality. These potential effects could result in changes to habitat, food sources, or prey resulting in indirect mortality/injury to fish and aquatic

invertebrates. Indirect injury/mortality impacts vary depending on the species, time of year, and duration of deployment. Nonetheless, these impacts are expected to be *less than significant* at the programmatic level due to the short-term nature and limited geographic scope of deployment activities. BMPs and mitigation measures to protect water resources (see Section 4.2.4, Water Resources) could help to minimize or avoid potential impacts.

Effects to Migration or Migratory Patterns

Migration is the regular movement of animals from one region to another and back again. Migratory patterns vary by species and sometimes within the same species. For example, restrictions or alterations to waterways could alter migration patterns, limit fish passage, or affect foraging and spawning site access. Impacts would vary depending on the species, time of year, and duration of deployment, but would be localized and small-scale, and therefore are expected to be *less than significant* at the programmatic level. BMPs and mitigation measures, as feasible and appropriate, could help to further avoid or minimize the potential impacts.

Reproductive Effects

Reproductive effects are those that either directly or indirectly reduce an animal's ability to produce offspring or reduce the rates of growth, maturation, and survival of offspring, which could affect the overall population of individuals. Restrictions to spawning/breeding areas for fish and aquatic invertebrates and the alteration of water quality through sediment infiltration, obstruction of natural water flow, or loss of submerged vegetation resulting from the deployment of various types of infrastructure, are not anticipated, and therefore impacts are expected to be *less than significant* at the programmatic level. BMPs and mitigation measures, as feasible and appropriate, could help to further avoid or minimize any potential impacts.

Invasive Species Effects

FirstNet deployment activities could result in *less than significant* impacts to aquatic populations at the programmatic level due to introduction of invasive species. The potential to introduce invasive plant (and plant seeds) and pest species (e.g., invasive insects) within construction zones could occur from vehicles and equipment being transported from one region to another, or when conducting revegetation of a site after deployment activities are complete. FirstNet deployment activities could result in short-term or temporary changes to specific project sites however, these sites are expected to return to their natural state in a year or two. Invasive species are not expected to be introduced to project sites as part of the deployment activities from machinery or construction workers. Overall, these potential impacts are expected to be *less than significant* at the programmatic level due to the small-scale, localized nature of deployment activities. BMPs and mitigation measures (see Chapter 16) would help to avoid or minimize the potential for introducing invasive species during implementation of the Proposed Action as well as minimize effects to fisheries and aquatic habitats as a result of the introduction of invasive species. Should invasive species be found on a site, BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented to minimize invasive species effects to fisheries and aquatic species.

Potential Impacts of the Preferred Alternative

The following section assesses potential impacts associated with implementation of the Preferred Alternative, including construction/deployment and operational activities.

Deployment Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative could result in the deployment of various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure and the specific deployment requirements, some activities would result in potential impacts to fisheries and aquatic habitats and others would not. In addition, and as explained in this section, the same type of Proposed Action infrastructure could result in a range of *no impacts* to *less than significant* impacts at the programmatic level depending on the deployment scenario or site-specific conditions. The fisheries and aquatic habitats that would be affected would depend on the ecoregion, the species' phenology, and the nature and extent of the habitats affected. Chapter 16, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Activities Likely to Have No Impacts at the Programmatic Level

Of the types of facilities or infrastructure deployment scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are expected to have *no impacts* to fisheries and aquatic habitats under the conditions described below:

- **Wired Projects**
 - Use of Existing Conduit – New Buried Fiber Optic Plant: Disturbance, including noise and vibration, associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas. It is anticipated that effects to fisheries and aquatic habitat would be temporary and would not result in any perceptible change.
 - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up of dark fiber would have *no impacts* to fisheries and aquatic habitats because there would be no ground disturbance.
- **Satellites and Other Technologies**
 - Satellite-Enabled Devices and Equipment: It is anticipated that the installation of permanent equipment on existing structures and the use of portable devices that use satellite technology would not impact fisheries and aquatic habitats because those activities would not require ground disturbance.
 - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it could include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact fisheries, it is anticipated that this activity would have *no impact* on the aquatic environment.

Activities with the Potential to Have Impacts at the Programmatic Level

Potential/deployment-related impacts to fisheries and aquatic habitats as a result of implementation of the Preferred Alternative would encompass a range of impacts that could occur, including direct injury/mortality; vegetation and habitat loss, alteration, or fragmentation; effects to migratory patterns; indirect injury/mortality; reproductive effects; and invasive species effects. The types of infrastructure deployment activities that could be part of the Preferred Alternative and result in potential impacts to fisheries and aquatic habitats include the following:

- **Wired Projects**
 - **New Build – Buried Fiber Optic Plant:** Plowing, trenching, or directional boring and the construction of POPs, huts, or other associated facilities or hand-holes to access fiber could result in potential impacts to fisheries and aquatic habitats. Land/vegetation clearing and excavation activities, associated with construction of POPs, huts, or other associated facilities, particularly if they occur adjacent to water resources that support fish, could result in habitat loss, alteration and fragmentation; indirect injury/mortality; and invasive species effects. BMPs and mitigation measures could help avoid or minimize potential impacts.
 - **New Build – Aerial Fiber Optic Plant:** The installation of new poles and hanging cable and associated security, safety, or public lighting components on public ROWs or private easements as well as the construction of access roads, POPs, huts, or facilities to house outside plant equipment could result in potential impacts to fisheries and aquatic habitats if activities occur near water resources that support fish. Impacts may vary depending on the number or individual poles installed or if access roads or stream crossings are needed, but could include habitat loss, alteration and fragmentation; indirect injury/mortality; and invasive species effects.
 - **Collocation on Existing Aerial Fiber Optic Plant:** Land clearing and excavation during replacement of poles and structural hardening could, if conducted near water resources that support fish, result in habitat loss, alteration, and fragmentation; cause indirect injury/mortality; and invasive species effects.
 - **New Build – Submarine Fiber Optic Plant:** The installation of cables in limited inland bodies of water and construction of landings and/or facilities on the shore to accept submarine cables could result in direct injury/mortalities of fisheries and aquatic invertebrates that are not mobile enough to avoid construction activities (e.g., mussels), that utilize burrows (e.g., crayfish), or that are defending nest sites. Disturbance, including noise and vibration, associated with the above activities could result in habitat loss, effects to migration patterns, indirect injury/mortality, reproductive effects, and invasive species effects. BMPs and mitigation measures could help avoid or minimize potential impacts.
 - **Installation of Optical Transmission or Centralized Transmission Equipment:** If installation of transmission equipment required construction of access roads, trenching, and/or land clearing, particularly near water resources that support fish, such disturbance could result in habitat loss, alteration and fragmentation; indirect injury/mortality, and invasive species effects.

- Wireless Projects
 - New Wireless Communication Towers: Installation of new wireless towers and associated structures (generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads could result in impacts to fisheries and aquatic habitats, if such actions were deployed near water resources. Land/vegetation clearing, excavation activities, landscape grading, and other disturbance activities during the installation of new wireless towers and associated structures or access roads, particularly if they occur near waterbodies, could result in habitat loss or indirect injury/mortality, and invasive species effects, although highly unlikely. Refer to Section 2.4, Radio Frequency Emissions, for more information on RF emissions.
 - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower, which would not result in impacts to fisheries and aquatic habitats. However, if new power units, replacement towers, structural hardening, or physical security measures required ground disturbance, impacts would be similar to new wireless construction. For a discussion of radio frequency emissions, refer to Section 2.4, Radio Frequency Emissions.
 - Deployable Technologies: Implementation of deployable technologies including COWs, COLTs, or SOWs could result in habitat loss, alteration and fragmentation; indirect injury/mortality, and invasive species effects if new access roads or other ground disturbing activities are necessary that generate erosion, sedimentation, or water quality impacts.
 - Deployment of drones, balloons, blimps, or piloted aircraft could potentially impact fisheries and aquatic habitat if deployment occurs within or adjacent to water resources. The magnitude of these effects depends on the timing and frequency of deployments, and could result in result in habitat loss, alteration, and fragmentation; indirect injury/mortality, and invasive species effects.

In general, the abovementioned activities could potentially involve land/vegetation clearing; excavation and trenching; construction of access roads; installation or restructuring of towers, poles, or underwater cables; installation of security/safety lighting and fencing; and deployment of aerial platforms. Potential impacts to fisheries and aquatic habitats associated with deployment of this infrastructure could include direct injury/mortality, habitat loss, indirect injury/mortality, effects to migration, reproductive effects, and effects of invasive species depending on the ecoregion, the species' phenology, and the nature and extent of the habitats affected. These impacts are anticipated to be *less than significant* at the programmatic level due to the small-scale deployment and localized nature of deployment activities that have the potential to impact aquatic habitats. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operational activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned deployment impacts. The fisheries and aquatic habitats that would be affected would depend on the ecoregion, the species' phenology, and the nature and extent of the habitats affected.

It is anticipated that, at the programmatic level, there would be *less than significant* impacts to fisheries and aquatic habitats associated with routine inspections of the Preferred Alternative. Site maintenance activities that may result in accidental spills from maintenance equipment or pesticide runoff near fish habitat are expected to have *less than significant* effects at the programmatic level to fisheries and aquatic habitats. Potential spills of these materials would be expected to be in small quantities.

Fisheries and aquatic habitat could still be affected by the reduction in habitat quality associated with habitat fragmentation from the presence of access roads, transmission corridors, and support facilities. These features could also continue to disrupt movements of fish passage. In addition, the presence of new access roads and transmission line ROWs near water resources that support fish may increase human use of the surrounding areas, which could increase disturbance to fisheries and aquatic habitats resulting in effects to migratory pathways, indirect injury/mortalities, reproductive effects, as well as the potential introduction and spread of invasive species as explained above. Fisheries and aquatic habitat may also be impacted if increased access leads to an increase in the legal or illegal take of biota. However, impacts are expected to be *less than significant* at the programmatic level due to the small scale of expected activities with the potential to affect fisheries and aquatic habitat. As a result of the small scale, only a limited number of individuals are anticipated to be impacted, furthermore, habitat impacts would also be minimal in scale. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Alternatives Impact Assessment

The following section assesses potential impacts to fisheries and aquatic habitats associated with the Deployable Technologies Alternative and the No Action Alternative.

Deployable Technologies Alternative

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies

implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential impacts to fisheries and aquatic habitats as a result of implementation of this alternative could be as described below.

Deployment Impacts

As explained above, implementation of deployable technologies could result in *less than significant* impacts at the programmatic level from habitat loss, alteration, and fragmentation; indirect injury/mortality, and invasive species effects. Greater frequency and duration of deployments could change the magnitude of impacts depending on species, life history, and region of the state. However, impacts are expected to remain *less than significant* at the programmatic level due to the limited nature of expected deployment activities. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Operational Impacts

Operational activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. As with the Preferred Alternative, the impacts could vary greatly among species and geographic region. Nonetheless, it is anticipated that there would be *less than significant* impacts at the programmatic level to fisheries and aquatic habitats associated with routine operations and maintenance due to the limited nature of expected deployment activities. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the nationwide, interoperable, public safety broadband network would not be deployed; therefore there would be no associated construction or installation of wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be *no impacts* to fisheries and aquatic habitats at the programmatic level as a result of the No Action Alternative. Environmental conditions would therefore be the same as those described in Section 4.1.6.5, Fisheries and Aquatic Habitats.

4.2.6.6. Threatened and Endangered Species

This section describes potential impacts to threatened and endangered species in Arkansas associated with deployment and operation of the Proposed Action and Alternatives. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on threatened and endangered species and their habitat were evaluated using the significance criteria presented in Table 4.2.6-2. The categories of impacts for threatened and endangered species and their habitats are defined as *may affect*, *likely to adversely affect*, *may affect, not likely to adversely affect*, and *no effect*.

These impact categories are comparable to those defined in the *Endangered Species Consultation Handbook* and are described in general terms below (FWS, 1998):

- *No effect* means that no listed resources would be exposed to the action and its environmental consequences.
- *May affect, not likely to adversely affect* means that all effects are beneficial, insignificant, or discountable. Beneficial effects have contemporaneous positive effects without any *adverse effects* to the species or habitat. Insignificant effects relate to the size of the impact and include those effects that are undetectable, not measurable, or cannot be evaluated. Discountable effects are those extremely unlikely to occur.
- *May affect, likely to adversely affect* means that listed resources are likely to be exposed to the action or its environmental consequences and would respond in a negative manner to the exposure.

Characteristics of each effect type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

Given the nature of this programmatic evaluation, and because the Proposed Action could potentially cover a wide variety of actions that would take place in various landscapes across the state, the potential impacts to threatened and endangered species addressed below are presented as a range of possible impacts.

Table 4.2.6-2: Impact Significance Rating Criteria for Threatened and Endangered Species at the Programmatic Level

Type of Effect	Effect Characteristics	Impact Level		
		May Affect, Likely to Adversely Affect	May Affect, Not Likely to Adversely Affect	No Effect
Injury/Mortality of a Listed Species	Magnitude or Intensity	As per the ESA, this impact threshold applies at the individual level so applies to any mortality of a listed species and any impact that has more than a negligible potential to result in unpermitted take of an individual of a listed species. Excludes permitted take.	Does not apply in the case of mortality (any mortality unless related to authorized take falls under <i>likely to adversely affect</i> category). Applies to a negligible injury that does not meet the threshold of take due to its low level of effect and/or ability to fully mitigate the effect. Includes permitted take.	No measurable effects on listed species.
	Geographic Extent	Any geographic extent of mortality or any extent of injury that could result in take of a listed species.	Any geographic extent that does not meet the threshold of take due to its low level of effect and/or ability to fully mitigate the effect. Typically applies to one or very few locations.	
	Duration or Frequency	Any duration or frequency that could result in take of a listed species.	Any duration or frequency that does not meet the threshold of take due to its low level of effect and/or ability to fully mitigate the effect. Typically applies to infrequent, temporary, and short-term effects.	
Reproductive Effects	Magnitude or Intensity	Any reduction in breeding success of a listed species.	Changes in breeding behavior (e.g., minor change in breeding timing or location) that are not expected to result in reduced reproductive success.	No measurable effects on listed species.
	Geographic Extent	Reduced breeding success of a listed species at any geographic extent.	Changes in breeding behavior at any geographic extent that are not expected to result in reduced reproductive success of listed species. Typically applies to one or very few locations.	
	Duration or Frequency	Any duration or frequency that could result in reduced breeding success of a listed species.	Infrequent, temporary, or short-term changes in breeding behavior that do not reduce breeding success of a listed species within a breeding season.	

Type of Effect	Effect Characteristics	Impact Level		
		May Affect, Likely to Adversely Affect	May Affect, Not Likely to Adversely Affect	No Effect
Behavioral Changes	Magnitude or Intensity	Disruption of normal behavior patterns (e.g., breeding, feeding, or sheltering) that could result in take of a listed species.	Minor behavioral changes that would not result in take of a listed species.	No measurable effects on listed species.
	Geographic Extent	Any geographic extent that could result in take of a listed species.	Changes in behavior at any geographic scale that are not expected to result in take of a listed species. Typically applies to one or very few locations.	
	Duration or Frequency	Any duration or frequency that could result in take of a listed species.	Infrequent, temporary, or short-term changes that are not expected to result in take of a listed species.	
Loss or Degradation of Designated Critical Habitat	Magnitude or Intensity	Effects to any of the essential features of designated critical habitat that would diminish the value of the habitat for the survival and recovery of the listed species for which the habitat was designated.	Effects to designated critical habitat that would not diminish the functions or values of the habitat for the species for which the habitat was designated.	No measurable effects on designated critical habitat.
	Geographic Extent	Effects to designated critical habitat at any geographic extent that would diminish the value of the habitat for listed species. Note that the <i>likely to adversely affect</i> threshold for geographic extent depends on the nature of the effect. Some effects could occur at a large scale but still not appreciably diminish the habitat function or value for a listed species. Other effects could occur at a very small geographic scale but have a large <i>adverse effect</i> on habitat value for a listed species.	Effects realized at any geographic extent that would not diminish the functions and values of the habitat for which the habitat was designated. Typically applies to one or few locations within a designated critical habitat.	
	Duration or Frequency	Any duration or frequency that could result in reduction in critical habitat function or value for a listed species.	Any duration or frequency that would not diminish the functions and values of the habitat for which the habitat was designated. Typically applies to Infrequent, temporary, or short-term changes.	

Description of Environmental Concerns

Injury/Mortality of a Listed Species

Direct injury/mortality effects are physical injuries, extreme physiological stress, or death of an individual organism from interactions associated with the Proposed Action. The most common direct injuries are entanglement, vehicle strike, problems associated with accidental ingestion, and injuries incurred by sensitive animals from disturbance events.

Based on the impact significance criteria presented in Table 4.2.6-2, any direct injury or mortality of a listed species at the individual-level, as well as any impact that has the potential to result in unpermitted take of an individual species at any geographic extent, duration, or frequency, *may affect and likely adversely affect* a listed species. Direct injury/mortality environmental concerns pertaining to federally listed terrestrial mammals, birds, reptiles and amphibians, fish, invertebrates, and plants with known occurrence in Arkansas are described below. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

Terrestrial Mammals

There are three endangered and one threatened mammal species federally listed and known to occur in Arkansas; they include the gray bat, Indiana bat, northern long-eared bat, and Ozark big-eared bat.

Direct mortality or injury to the federally listed Indiana bat or northern long-eared bat could occur if tree clearing activities occurred at roosting sites while bats were present (USFWS, 2012a) (USFWS, 2015h). Direct mortality or injury to the federally listed gray bat or Ozark big-eared bat could occur if caves were flooded or blocked off while bats were present (USFWS, 1997a) (USFWS, 2008). While projects would not likely directly affect winter hibernacula (e.g., caves), human disturbance in and around these sites when bats are present could lead to *adverse effects* to these species; when disturbed by noise, vibration, or light, bats awaken resulting in a loss of body fat needed to help them survive in the spring (USFWS, 1997a). Impacts would likely be isolated, individual events and therefore *may affect, but are not likely to adversely affect*, a listed species.

BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

Birds

There are three endangered and one threatened bird species that are federally listed and known to occur in Arkansas; they include the ivory-billed woodpecker, least tern, piping plover, and red-cockaded woodpecker. Depending on the project type and location, direct mortality or injury to these birds could occur from collisions or electrocutions with manmade cables and wires, vehicle strikes, or by disturbance or destruction of nests during ground disturbing activities. However,

these potential impacts *may affect, but are not likely to adversely affect*, listed species as FirstNet would attempt to avoid deployment activities in areas where they are known to nest. If proposed project sites were unable to avoid sensitive areas, BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

Fish

There are four endangered and three threatened fish species federally listed and known to occur in Arkansas; they include the Arkansas river shiner, cave crayfish, cave crayfish, leopard darter, Ozark cavefish, pallid sturgeon, and yellowcheek darter. Direct mortality or injury to this species are unlikely but could occur from entanglements resulting from the Proposed Action, but are unlikely as the majority of FirstNet deployment projects would not occur in the aquatic environment. Therefore, potential impacts *may affect, but are not likely to adversely affect*, listed species. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

Reptiles and Amphibians

One amphibian species is federally listed as endangered and known to occur in Arkansas, the Ozark hellbender. The majority of FirstNet deployment projects would not occur in an aquatic environment. Direct mortality or injury to this species is unlikely but could occur from entanglements resulting from the Proposed Action. Potential effects would likely be isolated, individual events, and FirstNet would attempt to avoid areas where the species may occur. Therefore potential impacts *may affect, but would not likely adversely affect*, the listed species. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

No federally listed reptiles are known to occur in Arkansas. Therefore, no injury or mortality effects to federally threatened and endangered reptiles are expected as a result of the Proposed Action.

Invertebrates

Twelve federally listed mussels, 10 of which are endangered and two of which are threatened, and one federally listed endangered terrestrial invertebrate species occur in Arkansas. The federally listed terrestrial invertebrate is the American burying beetle. Direct mortality or injury could occur to these species if land clearing or excavation activities associated with the Proposed Action occur in an area inhabited by one of these species. FirstNet would attempt, as practicable and feasible, to avoid areas where these species may occur.

The federally listed mussel species include the Arkansas fatmucket, Curtis pearlymussel, fat pocketbook, Neosho mucket, Ouachita rock pocketbook, pink mucket, rabbitsfoot, scaleshell

mussel, speckled pocketbook, spectaclecase, turgid blossom, and winged mapleleaf. The majority of FirstNet deployment projects would not occur in an aquatic environment. Direct mortality or injury to these species are unlikely but could occur from changes in water quality from ground disturbing activities resulting from the Proposed Action. Potential impacts *may affect, but are not likely to adversely affect*, the listed species. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

Plants

There are five federally listed plant species known to occur in Arkansas, three of which are endangered and two of which are threatened, as follows: the *Geocarpon minimum*, harperella, Missouri bladderpod, pondberry, and running buffalo clover. Direct mortality to federally listed plants could occur if land clearing or excavation activities associated with the Proposed Action occur in an area inhabited by one of these species. FirstNet would attempt, as practicable and feasible, to avoid areas where these species may occur; therefore, potential impacts *may affect, but are not likely to adversely affect*, listed species. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

Reproductive Effects

Reproductive effects are considered those that either directly or indirectly reduce the breeding success of a listed species by altering its breeding timing or location, or reducing the rates of growth, maturation, and survival of offspring, which could affect the breeding success. Potential effects to federally listed terrestrial mammals, birds, terrestrial reptiles, amphibians, fish, invertebrates, and plants with known occurrence in Arkansas are described below.

Terrestrial Mammals

Noise, vibration, light, and other human disturbances associated with the Proposed Action could affect federally listed terrestrial mammals within or near Project activities. Impacts would be directly related to the frequency, intensity, and duration of these activities; however, they are anticipated to be small-scale and localized. FirstNet would attempt to avoid these areas. Therefore, potential impacts *may affect, but are not likely to adversely affect*, listed species. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

Birds

Noise, vibration, light, or human disturbance within nesting areas could cause federally listed birds to relocate to abandon their nests or relocate to less desirable locations, or may result in stress to individuals reducing survival and reproduction. FirstNet would attempt to avoid these

areas. Therefore, potential impacts *may affect, but are not likely to adversely affect*, listed species. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

Reptiles and Amphibians

Changes in water quality, especially during the breeding seasons, resulting from ground disturbing activities could cause stress resulting in lower productivity. Land clearing activities, noise, vibration, and human disturbance during the critical time periods (e.g., mating, nesting) could lower fitness and productivity. FirstNet would attempt to avoid these areas. Therefore, potential impacts *may affect, but are not likely to adversely affect*, listed species. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

No federally listed reptiles are known to occur in Arkansas. Therefore, no reproductive effects to federally threatened and endangered reptiles are expected as a result of the Proposed Action.

Fish

Deployment activities resulting in increased disturbance (e.g., humans, noise, vibration), especially during spawning activity, and changes in water quality as a result of ground disturbing activities could cause stress resulting in lower productivity (see Section 4.2.4, Water Resources, for a discussion of potential impacts to water resources). Effects to reproduction of the federally listed fish species in Arkansas are unlikely as the majority of FirstNet deployment projects would not occur in an aquatic environment and FirstNet would attempt to avoid these areas. Therefore, potential impacts *may affect, but are not likely to adversely affect*, listed species. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

Invertebrates

Changes in water quality could cause stress resulting in lower productivity for federally listed mussels known to occur in Arkansas. In addition, introduction of invasive aquatic species could indirectly affect mussels as a result of fish populations that they rely on for their reproductive cycle being altered (Vaughn, 1997). Impacts to food sources utilized by the federally listed invertebrates could potentially affect these species (USFWS, 2014f). Potential impacts to federally listed invertebrate species *may affect, but are not likely to adversely affect*, those species, as FirstNet would attempt to avoid these areas. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

Plants

Potential impacts could occur from ground-disturbing activities to listed plant species as a result of the Proposed Action. However, FirstNet would attempt to avoid these areas. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

Behavioral Changes

Effects to normal behavior patterns that could lead to disruptions in breeding, feeding, or sheltering, resulting in take of a listed species would be considered *potentially significant*. Potential effects to federally listed terrestrial mammals, birds, reptiles and amphibians, fish, invertebrates, and plants with known occurrence in Arkansas are described below.

Mammals

Noise, vibration, light, and other human disturbances associated with the Proposed Action could affect breeding and foraging sites of the federally listed terrestrial mammals resulting in reduced survival and productivity. However, the localized nature of disturbances during deployment activities are not anticipated to stress federally listed terrestrial mammals. Ground disturbing activities could impact food sources for the federally listed terrestrial mammals in Arkansas. Further, increased human disturbance, noise, vibration, and vessel traffic could cause stress to these species causing them to abandon breeding locations or alter migration patterns. Terrestrial mammals have the capacity to divert from sound sources during feeding and migration. FirstNet would attempt, as practicable and feasible, to avoid areas where these species are known to occur; therefore, potential impacts *may affect, but would likely not adversely affect*, these species. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

Birds

Because many birds have extremely long migrations, protection efforts for critical sites along migratory routes must be coordinated over distances often involving many different countries. For example, piping plovers use sites throughout Arkansas as stopover habitat during their migration from the Northern Great Plains and Great Lakes Area to the coastal habitats in the south. Stopover sites consist of shorelines that occur throughout the state along reservoirs, lakes, ponds, rivers, and wetlands (USFWS, 2014a). Disturbance in stopover, foraging, or breeding areas (visual, noise, or vibration) or habitat loss/fragmentation could cause stress to individuals causing them to abandon areas for less desirable habitat and potentially reduce over fitness and productivity. Activities related to the Proposed Action, such as aerial deployment or construction activities could result in effects to federally listed birds. FirstNet would attempt, as practicable and feasible, to avoid areas where these species are known to occur; therefore, potential impacts *may affect, but would likely not adversely affect*, these species. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency,

would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

Reptiles and Amphibians

Habitat loss or alteration, particularly from fragmentation or invasive species, could affect nesting and foraging sites of the federally listed amphibian species, resulting in reduced survival and productivity; however, the localized nature of disturbances during deployment activities are not anticipated to stress federally listed reptiles or amphibians. FirstNet would attempt, as practicable and feasible, to avoid areas where these species are known to occur; therefore, potential impacts *may affect, but would likely not adversely affect*, these species. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

No federally listed reptiles are known to occur in Arkansas. Therefore, no behavioral effects to federally threatened and endangered reptiles are expected as a result of the Proposed Action.

Fish

Changes in water quality as a result of ground disturbance activities could impact food sources for the federally listed fish species in Arkansas. Further, increased human disturbance, noise, vibration, and vessel traffic could cause stress to these species causing them to abandon spawning locations or altering migration patterns. Behavioral changes to these listed species are unlikely as the majority of FirstNet deployment projects would not occur in aquatic environment. Therefore, potential impacts *may affect, but are not likely to adversely affect*, these species. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

Invertebrates

Changes in water quality, habitat loss or alternation, and introduction of aquatic invasive species could impact food sources for federally listed mussels resulting in lower productivity. Disturbances to food sources utilized by the federally listed terrestrial species, especially during the breeding season, could impact foraging behavior. FirstNet would attempt, as practicable and feasible, to avoid areas where these species are known to occur; therefore, potential impacts *may affect, but would likely not adversely affect*, these species. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

Plants

No behavioral effects to federally listed plants are expected as a result of the Proposed Action.

Loss or Degradation of Designated Critical Habitat

Effects to designated critical habitat and any of its essential features that could diminish the value of the habitat for the listed species or its survival and recovery would be considered an *adverse effect* and could be *potentially significant*. Depending on the species or habitat, the *adverse effect* threshold would vary for geographic extent. In some cases, large-scale impacts could occur that would not diminish the functions and values of the habitat, while in other cases, small-scale changes could lead to *potentially significant adverse effects*, such as impacts to designated critical habitat for a listed species that is only known to occur in one specific location geographically. Potential effects to federally listed birds, reptiles and amphibians, fish, invertebrates, and plants with designated critical habitat in Arkansas are described below.

Terrestrial Mammals

No designated critical habitat occurs for terrestrial mammals in Arkansas. Therefore, *no effect* to threatened and endangered species from the loss or degradation of designated critical habitat is expected as a result of the Proposed Action.

Birds

No designated critical habitat occurs for birds in Arkansas. Therefore, *no effect* to threatened and endangered species from the loss or degradation of designated critical habitat is expected as a result of the Proposed Action.

Reptiles and Amphibians

No designated critical habitat occurs for reptiles or amphibians in Arkansas. Therefore, *no effect* to threatened and endangered species from the loss or degradation of designated critical habitat is expected as a result of the Proposed Action.

Fish

Two federally protected fish species in Arkansas have designated critical habitat. Critical habitat for the leopard darter includes Mountain Fork River in Polk County. Critical habitat for the yellowcheek darter includes the Devil's Fork, Middle Fork, South Fork, and Archery Fork of the Little Red River in north-central Arkansas. Proposed FirstNet deployment activities near water would likely occur onshore with limited activities in the water and therefore would not likely disturb critical habitat. FirstNet would attempt, as practicable and feasible, to avoid areas where these species are known to occur; therefore, potential impacts *may affect, but would likely not adversely affect*, designated critical habitat. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

No critical habitat has been designated for the other federally listed fish species in Arkansas.

Invertebrates

Critical habitat has been designated for two of the federally listed invertebrate species in Arkansas. Critical habitat for the Neosho mucket includes a segment of the Illinois River beginning at the Muddy Fork and Illinois River confluence. Critical habitat for the rabbitsfoot exists in the Ouachita River, Saline River, Little River, Middle Fork Little Red River, White River, Black River, Spring River, Strawberry River, and Buffalo River Land clearing, excavation activities, and other ground disturbing activities in these regions of Arkansas could lead to habitat loss or degradation, which could affect these invertebrates depending on the duration, location, and spatial scale of the associated activities. FirstNet would attempt, as practicable and feasible, to avoid areas where these species are known to occur; therefore, potential impacts *may affect, but would likely not adversely affect*, designated critical habitat. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

No critical habitat has been designated for the other federally listed invertebrate species in Arkansas.

Plants

No designated critical habitat occurs for plants in Arkansas. Therefore, *no effect* to threatened and endangered species from the loss or degradation of designated critical habitat is expected as a result of the Proposed Action.

Potential Impacts of the Preferred Alternative

The following section assesses potential impacts associated with implementation of the Preferred Alternative, including deployment and operational activities.

Deployment Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative could result in the deployment of various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure and the specific deployment requirements, some activities would result in potential effects to threatened and endangered species and others would not. In addition, and as explained in this section, the same type of Proposed Action infrastructure could result in a range of *no effects to may affect, but not likely to adversely effect*, depending on the deployment scenario or site-specific conditions. Site-specific analysis may be required depending on the site conditions, the type of deployment, or any other permits or permissions necessary to perform the work. The threatened and endangered species that would be affected would depend on the ecoregion, the species' phenology, and the nature and extent of the habitats affected. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Activities Likely to Have No Effect at the Programmatic Level

Of the types of facilities or infrastructure deployment scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are expected to have *no effect* on threatened and endangered species or their habitat under the conditions described below:

- **Wired Projects**
 - Use of Existing Conduit – New Buried Fiber Optic Plant: Disturbance, including noise and vibration, associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas. Although threatened and endangered species and their habitat could be impacted, it is anticipated that effects to threatened and endangered species would be temporary, infrequent, and likely not conducted in locations designated as vital or critical for any period.
 - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up of dark fiber would have *no impacts* to threatened and endangered species or their habitat because there would be no ground disturbance and very limited human activity.
- **Satellites and Other Technologies**
 - Satellite-Enabled Devices and Equipment: It is anticipated that the installation of permanent equipment on existing structures, and the use of portable devices that use satellite technology would have *no effect* on threatened and endangered because those activities would not require ground disturbance.
 - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it could include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to affect protected species, it is anticipated that this activity would have *no effect* on protected species.

Activities with the Potential to Affect Listed Species at the Programmatic Level

Potential deployment-related effects to threatened and endangered species and their habitats as a result of implementation of the Preferred Alternative would encompass a range of effects that could occur, including direct injury/mortality, reproductive effects, behavioral changes, and loss/degradation of designated critical habitat. The types of infrastructure deployment activities that could be part of the Preferred Alternative and result in potential effects to threatened and endangered species include the following:

- **Wired Projects**
 - New Build – Buried Fiber Optic Plant: Plowing, trenching, or directional boring and the construction of POPs, huts, or other associated facilities or hand-holes to access fiber could result in potential impacts to threatened and endangered species. Land/vegetation clearing and excavation activities, associated with construction of POPs, huts, or other associated facilities could result in direct injury/mortalities of threatened and endangered species that are not mobile enough to avoid construction activities (e.g., reptiles, mollusks, small mammals, and young), that utilize burrows (e.g., ground squirrels), or

that are defending nest sites (e.g., ground-nesting birds). Disturbance, including noise and vibration, associated with the above activities could result in direct injury/mortality, reproductive effects, behavioral changes, and loss/degradation of designated critical habitat. BMPs and mitigation measures could help to avoid or minimize potential impacts.

- New Build – Aerial Fiber Optic Plant: The installation of new poles and hanging cable and associated security, safety, or public lighting components on public ROWs or private easements as well as the construction of access roads, POPs, huts, or facilities to house outside plant equipment could result in potential effects to threatened and endangered species and their habitat. Impacts may vary depending on the number or individual poles installed, but could include direct injury/mortality, reproductive effects, behavioral changes, and loss/degradation of designated critical habitat.
- Collocation on Existing Aerial Fiber Optic Plant: Land clearing and excavation during replacement of poles and structural hardening could result in direct injury/mortality, reproductive effects, behavioral changes, and loss/degradation of designated critical habitat to threatened and endangered species. Noise and vibration disturbance from heavy equipment use associated with these activities as well as with installing new fiber on existing poles could result in reproductive effects or behavior changes.
- New Build – Submarine Fiber Optic Plant: The installation of cables in limited inland bodies of water and construction of landings and/or facilities on the shore to accept submarine cables could potentially affect threatened and endangered species and their habitat, particularly aquatic species (see Section 4.2.4, Water Resources, for a discussion of potential impacts to water resources). Effects could include direct injury/mortality, reproductive effects, behavioral changes, and loss/degradation of designated critical habitat. If activities occurred during critical time periods, reproductive effects and behavioral changes could occur.
- Installation of Optical Transmission or Centralized Transmission Equipment: If installation of transmission equipment would occur in existing boxes or huts, there would be *no impacts* to threatened and endangered species or their habitats. If installation of transmission equipment required construction of access roads, trenching, and/or land clearing, such disturbance could result in direct injury/mortality of threatened and endangered species as described for other New Build activities. Reproductive effects, behavioral changes, and loss/degradation of designated critical habitat could also occur as a result of construction and resulting disturbance.
- Wireless Projects
 - New Wireless Communication Towers: Installation of new wireless towers and associated structures (generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads could result in impacts to threatened and endangered species and their habitat. Land/vegetation clearing, excavation activities, landscape grading, and other disturbance activities during the installation of new wireless towers and associated structures or access roads could result in direct injury/mortality, reproductive effects, behavioral changes, and loss/degradation of designated critical habitat. Security lighting and fencing could result

in direct injury/mortality, disruption of normal behavior patterns, as well as reproductive effects. For a discussion of radio frequency emissions, refer to Section 2.4, Radio Frequency Emissions.

- Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower. FirstNet activities would be infrequent, temporary, or short-term in nature and are unlikely to result in direct injury/mortality or behavioral changes to threatened and endangered species. However, if replacement towers, or structural hardening are required, effects would be similar to new wireless construction. Hazards related to security/safety lighting and fencing may produce direct injury/mortality, reproductive effects, and behavioral changes. For a discussion of radio frequency emissions, refer to Section 2.4, Radio Frequency Emissions.
- Deployable Technologies: Implementation of land-based deployable technologies including COWs, COLTs, or SOWs could result in direct injury/mortalities to threatened and endangered species on roadways. If external generators are used, noise and vibration disturbance could potentially result in reproductive effects or behavioral changes to threatened and endangered species. For a discussion of radio frequency emissions, refer to Section 2.4, Radio Frequency Emissions.
- Deployment of drones, balloons, blimps, or piloted aircraft could potentially impact threatened and endangered species by direct injury/mortality, reproductive effects, behavioral changes, and loss/degradation of designated critical habitat. The magnitude of these effects depends on the timing and frequency of deployments. For a discussion of radio frequency emissions, refer to Section 2.4, Radio Frequency Emissions.

In general, the abovementioned activities could potentially involve land/vegetation clearing; excavation and trenching; construction of access roads; installation or restructuring of towers, poles, or underwater cables; installation of security/safety lighting and fencing; and deployment of aerial platforms. Potential impacts to threatened and endangered species associated with deployment of this infrastructure could include direct injury/mortality, reproductive effects, behavioral changes, and loss/degradation of designated critical habitat depending on the species' phenology and the nature and extent of the habitats affected. FirstNet would attempt, as practicable and feasible, to avoid areas where these species are known to occur; therefore, potential impacts *may affect, but are not likely adversely affect* protected species. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operational activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned deployment impacts. For potential impacts to birds and bats from RF emissions, please see section 4.2.6.4. Wildlife.

It is anticipated that operational impacts *may affect, but are not likely to adversely affect* threatened and endangered species due to routine inspections of the Preferred Alternative, assuming that the same access roads used for deployment are also used for inspections. Site maintenance, including mowing or application of herbicides, *may affect, but are not likely to adversely affect* threatened and endangered species, as they would be conducted infrequently, and BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

During operations, direct injury/mortality of threatened and endangered species could occur from collisions and/or entanglements with transmission lines, towers, and aerial platforms. FirstNet would attempt, as practicable and feasible, to avoid areas where these species are known to occur. Therefore, listed species may be affected, but are not likely to be adversely affected. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

Threatened and endangered species may be affected, but are not likely to be adversely affected, by the reduction in habitat quality associated with habitat fragmentation from the presence of access roads, transmission corridors, and support facilities. These features could also continue to disrupt movements of some species, particularly during migrations between winter and summer ranges. FirstNet would attempt, as practicable and feasible, to avoid areas where these species are known to occur. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

Alternatives Impact Assessment

The following section assesses potential effects to threatened and endangered species associated with the Deployable Technologies Alternative and the No Action Alternative.

Deployable Technologies Alternative

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential effects to threatened and endangered species as a result of implementation of this alternative could be as described below.

Deployment Impacts

As explained above, implementation of deployable technologies *may affect, but is not likely to adversely affect*, threatened and endangered species through direct injury/mortality, reproductive effects, behavioral changes, and loss/degradation of designated critical habitat. Greater frequency and duration of deployments could change the magnitude of impacts depending on species, life history, and region of the state. FirstNet would attempt, as practicable and feasible, to avoid areas where these species are known to occur. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

Operational Impacts

As explained above, operational activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. As with the Preferred Alternative, it is anticipated that operational activities are not likely to adversely effect, threatened and endangered species, and their habitats as a result of routine operations, management, and monitoring. FirstNet would attempt, as practicable and feasible, to avoid areas where these species are known to occur. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the nationwide, interoperable, public safety broadband network would not be deployed; therefore there would be no associated construction or installation of wired, wireless, deployable infrastructure or satellites and other technologies. Therefore, there would be *no effects* to threatened and endangered species at the programmatic level as a result of the No Action Alternative. Environmental conditions would therefore be the same as those described in Section 4.1.6.6, Threatened and Endangered Species and Species of Concern.

4.2.7. Land Use, Recreation, and Airspace

4.2.7.1. Introduction

This section describes potential impacts to land use, recreation, and airspace resources in Arkansas associated with deployment and operation of the Proposed Action and Alternatives. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

4.2.7.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on land use, recreation, and airspace resources were evaluated using the significance criteria presented in Table 4.2.7-1. As described in Section 4.2,

Environmental Consequences, the categories of impacts are defined as *potentially significant, less than significant with mitigation measures incorporated, less than significant, or no impact*. Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

Given the nature of this programmatic evaluation, and because the Proposed Action could potentially cover a wide variety of actions that would take place in various landscapes, the potential impacts to land use, recreation, and airspace resources addressed in this section are presented as a range of possible impacts.

Table 4.2.7-1: Impact Significance Rating Criteria for Land Use, Recreation, and Airspace at the Programmatic Level

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Direct land use change	Magnitude or Intensity	Change in designated/permitted land use that conflicts with existing permitted uses, and/or would require a change in zoning. Conversion of prime or unique agricultural lands.	Effect that is <i>potentially significant</i> , but with mitigation is <i>less than significant</i> .	Minimal changes in existing land use, or change that is permitted by-right, through variance, or through special exception.	No changes to existing development, land use, land use plans, or policies. No conversion of prime or unique agricultural lands.
	Geographic Extent	Regional impacts observed throughout the state or territory.		Effects realized at one or multiple isolated locations.	NA
	Duration or Frequency	Permanent: Land use altered indefinitely.		Short-Term: Land use altered for as long as the entire construction phase or a portion of the operations phase.	NA
Indirect land use change	Magnitude or Intensity	New land use directly conflicts with surrounding land use pattern, and/or causes substantial restriction of land use options for surrounding land uses.	Effect that is <i>potentially significant</i> , but with mitigation is <i>less than significant</i> .	New land use differs from, but is not inconsistent with, surrounding land use pattern; minimal restriction of land use options for surrounding land uses.	No conflicts with adjacent existing or planned land uses.
	Geographic Extent	Regional impacts observed throughout the state or territory.		Effects realized at one or multiple isolated locations.	NA
	Duration or Frequency	Permanent: Land use altered indefinitely.		Short-Term: Land use altered for as long as the entire construction phase or a portion of the operations phase.	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Loss of access to public or private recreation land or activities	Magnitude or Intensity	Total loss of access to recreation land or activities.	Effect that is <i>potentially significant</i> , but with mitigation is <i>less than significant</i> .	Restricted access to recreation land or activities.	No disruption or loss of access to recreational lands or activities.
	Geographic Extent	Most or all recreational land/sites in a state or territory; recreational lands/sites that are of national significance.		Effects realized at one or multiple isolated locations; recreational lands that are not nationally significant, but that are significant within the state/territory.	NA
	Duration or Frequency	Persists during the life of the project.		Persists for as long as the entire construction phase or a portion of the operations phase.	NA
Loss of enjoyment of public or private recreation land (due to visual, noise, vibration, or other impacts that make recreational activity less desirable)	Magnitude or Intensity	Total loss of enjoyment of recreational activities; substantial reduction in the factors that contribute to the value of the recreational resource, resulting in avoidance of activity at one or more sites.	Effect that is <i>potentially significant</i> , but with mitigation is <i>less than significant</i> .	Small reductions in visitation or duration of recreational activity.	No loss of enjoyment of recreational activities or areas; no change to factors that contribute to the value of the resource.
	Geographic Extent	Most or all recreational land/sites in a state or territory; recreational lands/sites that are of national significance.		Effects realized at one or multiple isolated locations; recreational lands that are not nationally significant, but that are significant within the state/territory.	NA
	Duration or Frequency	Persists during or beyond the life of the project.		Persists for as long as the entire construction phase or a portion of the operations phase.	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Use of airspace	Magnitude or Intensity	Measurable, substantial change in flight patterns and/or use of airspace.	Effect that is <i>potentially significant</i> , but with mitigation is <i>less than significant</i> .	Alteration to airspace usage is minimal.	No alterations in airspace usage or flight patterns.
	Geographic Extent	Regional impacts observed throughout the state or territory.		Effects realized at one or multiple isolated locations.	NA
	Duration or Frequency	Permanent: Airspace altered indefinitely.		Short-Term: Airspace altered for as long as the entire construction phase or a portion of the operations phase.	NA

NA = Not Applicable

4.2.7.3. Description of Environmental Concerns

Direct Land Use Change

Changes in land use could be influenced by the deployment, operation, and maintenance of facilities or other infrastructure, and the acquisition of rights-of-way or easement, as required. The deployment, operation, and maintenance of structures, towers, roads, and other permanent features could conflict with existing development or land use. The installation of poles, towers, structures, or other aboveground facilities or assets could have short- or long-term effects to existing development or land use based on the characteristics of the structures or facilities, such as the location, type, or height. In addition, the acquisition of ROWs or easements and the construction of roads to access facilities and locations could influence changes in land use. The effects from these actions would depend on the geographic location; compatibility with existing land uses; and characteristics of the right-of-way, easement, or access road. These characteristics, such as the length, width, and location could change the existing land use to another category or result in the short- or long-term loss of the existing land use.

Based on the impact significance criteria presented in Table 4.2.7-1, *less than significant* impacts at the programmatic level would be anticipated given the size and nature of the majority of the proposed deployment activities. Direct land use changes would be minimized and isolated at specific locations and all required permits would be obtained; only short-term impacts during the construction phase would be expected.

Indirect Land Use Change

Changes in surrounding land use patterns and options for surrounding land uses could be influenced by the deployment, operation, and maintenance of facilities and the acquisition of ROWs or easement. The deployment, operation, and maintenance of structures, towers, roads, and other permanent features could conflict with surrounding land use patterns and options for surrounding land uses. The installation of poles, towers, structures, or other aboveground facilities or assets could have short- or long-term effects to surrounding land use patterns or options for surrounding land uses based on the characteristics of the structures or facilities, such as the location, type, or height. In addition, the acquisition of ROWs or easements and the construction of roads to access facilities and locations could influence changes in surrounding land uses. The effects from these actions would depend on the geographic location; compatibility with surrounding land uses; and characteristics of the ROW, easement, or access road. These characteristics, such as the length, width, and location could conflict with surrounding land use patterns or restrict options for surrounding land uses.

Based on the impact significance criteria presented in Table 4.2.7-1, *less than significant* impacts would be anticipated, as any new land use would be small-scale and short-term during the construction phase.

Loss of Access to Public or Private Recreation Land or Activities

The deployment, operation, and maintenance of facilities and the acquisition of ROW or easement could influence access to public or private recreation land or activities. Localized, short-term accessibility to recreation land or activities could be impacted by the deployment and maintenance of structures, towers, roads, and other permanent features. In the long-term, the deployment and installation of poles, towers, structures, or other aboveground facilities could alter the types and locations of recreation activities.

Based on the impact significance criteria presented in Table 4.2.7-1, *less than significant* impacts at the programmatic level would be anticipated as restricted access or a loss of access to recreation areas would not occur; only short-term impacts or small-scale limitations during the construction phase would be expected.

Loss of Enjoyment of Public or Private Recreation Land

The deployment of new towers, and the resulting built tower, could influence the enjoyment of public or private recreation land. Crews accessing the site during the deployment and maintenance of structures, towers, roads, and other permanent features could temporarily impact enjoyment of recreation land. The deployment of poles, towers, structures, or other aboveground facilities could affect the enjoyment of recreational land based on the characteristics of the structures or facilities, including permanent impacts to scenery, short-term noise and vibration impacts, and the presence of deployment or maintenance crews.

Based on the impact significance criteria presented in Table 4.2.7-1, *less than significant* impacts at the programmatic level would be anticipated as only small reductions, if any, in recreational visits or durations would occur due to the relatively small-scale nature of likely FirstNet activities. Only short-term impacts during the construction phase would be expected.

Use of Airspace

Primary concerns to airspace include the following: if aspects of the Proposed Action would result in violation of FAA regulations; undermine the safety of civilian, military, or commercial aviation; or infringe on flight activity and flight corridors. Potential impacts could include air routes or flight paths, available flight altitudes, disruption of normal flight patterns, and restrictions to flight activities. Construction of new towers or alternations to existing towers could obstruct navigable airspace depending on the tower location. Use of aerial technologies could result in SUA considerations.

Based on impact significance criteria presented in Table 4.2.7-1, airspace impacts are not likely to change or alter flight patterns or airspace usage. As drones, balloons, and piloted aircraft would likely only be deployed in an emergency and for a short period, FirstNet would be unlikely to have a significant impact on airspace resources.

4.2.7.4. Potential Impacts of the Preferred Alternative

The following section assesses potential impacts associated with implementation of the Preferred Alternative, including deployment and operation activities.

Deployment Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative could result in the deployment of various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure, and the specific deployment requirements, some activities would result in potential impacts to land use, recreation, and airspace resources and others would not. In addition, and as explained in this section, the same type of Proposed Action infrastructure could result in a range of *no impacts* to *less than significant* impacts at the programmatic level depending on the deployment scenario or site-specific conditions. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Activities Likely to Have No Impacts at the Programmatic Level

Of the types of facilities or infrastructure deployment scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are likely to have *no impacts* to land use, recreation, and airspace resources under the conditions described below:

- Wired Projects
 - New Build – Buried Fiber Optic Plant: Plowing (including vibratory plowing), trenching, or directional boring alongside the road in utility corridors or within public road ROWs.
 - Land Use: See *Activities with the Potential to Have Impacts* below.
 - Recreation: See *Activities with the Potential to Have Impacts* below.
 - Airspace: *No impacts* at the programmatic level to airspace would be anticipated since the activities would not affect flight patterns or cause obstructions that would require FAA and/or state review based on FAR 14 CFR, Part 77, *Safe, Efficient Use, and Preservation of the Navigable Airspace*. (See Section 4.1.7.7, Obstructions to Airspace Considerations)
 - Use of Existing Conduit – New Buried Fiber Optic Plant: Disturbance associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas.
 - Land Use: It is anticipated that there would be *no impacts* at the programmatic level to land use since the activities that would be conducted would not directly or indirectly result in changes to existing and surrounding land uses.
 - Recreation: See *Activities with the Potential to Have Impacts* below.
 - Airspace: Installation of new poles would have *no impact* at the programmatic level on airspace because utility poles are an average of 40 feet in height and do not intrude into useable airspace.
 - New Build – Aerial Fiber Optic Plant: Installing new poles and hanging cables on previously disturbed or new (undisturbed) ROWs or easements and the potential construction of access roads.
 - Land Use: See *Activities with the Potential to Have Impacts* below.
 - Recreation: See *Activities with the Potential to Have Impacts* below.

- Airspace: Installation of new poles would have *no impact* at the programmatic level on airspace because utility poles are an average of 40 feet in height and do not intrude into useable airspace
- Collocation on Existing Aerial Fiber Optic Plant: Installation of new fiber on existing poles would be limited to previously disturbed areas.
 - Land Use: It is anticipated that there would be *no impacts* at the programmatic level to land use since the activities that would be conducted would not directly or indirectly result in changes to existing and surrounding land uses.
 - Recreation: *No impacts* at the programmatic level to recreation would be anticipated since the activities that would be conducted would not cause disruption or loss of access to recreational lands or activities or the enjoyment of those lands or activities.
 - Airspace: *No impacts* at the programmatic level are anticipated to airspace from collocations.
- Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting of dark fiber and installation of new equipment in existing huts.
 - Land Use: It is anticipated that there would be *no impacts* at the programmatic level to land use since the activities would not directly or indirectly result in changes to existing and surrounding land uses.
 - Recreation: Use of existing dark fiber would *not impact* recreation at the programmatic level because it would not impede access to recreational resources.
 - Airspace: Lighting of dark fiber would have *no impacts* at the programmatic level to airspace.
- New Build – Submarine Fiber Optic Plant: Installing cables in limited inland bodies of water and the constructing landings and/or facilities on shore or the banks of waterbodies that accept submarine cable.
 - Land Use: See *Activities with the Potential to Have Impacts* below.
 - Recreation: See *Activities with the Potential to Have Impacts* below.
 - Airspace: The installation of cables in bodies of water and construction of landings/facilities would *not impact* at the programmatic level flight patterns or cause obstructions that would require FAA and/or state review based on FAR 14 CFR, Part 77, *Safe, Efficient Use, and Preservation of the Navigable Airspace*. (See Section 4.1.7.7 Obstructions to Airspace Considerations)
- Installation of Optical Transmission or Centralized Transmission Equipment: Installation of transmission equipment would occur in existing boxes or huts. The section below addresses potential impacts to land use, recreation resources, and airspace if deployment of new boxes, huts, or access roads is required.
 - Land Use: See *Activities with the Potential to Have Impacts* below.
 - Recreation: See *Activities with the Potential to Have Impacts* below.
 - Airspace: *No impacts* at the programmatic level to airspace would be anticipated since the activities would not affect flight patterns or cause obstructions that would require FAA and/or state review based on FAR 14 CFR, Part 77, *Safe, Efficient Use, and Preservation of the Navigable Airspace*.
- Wireless Projects

- Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower, structure, or building.
 - Land Use: There would be *no impacts* at the programmatic level to existing and surrounding land uses. The potential addition of power units, structural hardening, and physical security measures would not impact existing or surrounding land uses.
 - Airspace: See *Activities with the Potential to Have Impacts* below.
 - Recreation: See *Activities with the Potential to Have Impacts* below.
- Deployable Technologies
 - Deployable Technologies: These technologies would be used where permanent, fixed infrastructure cannot be deployed due to a variety of factors such as the need to supplement coverage or to avoid or mitigate permanent impacts to sensitive resources or receptors.
 - Land Use: It is anticipated that there would be *no impacts* at the programmatic level to existing or surrounding land uses because these technologies would be temporarily located in areas compatible with other land uses.
 - Recreation: *No impacts* at the programmatic level to recreation are anticipated as deployable technologies would not affect the use or enjoyment of recreational lands.
 - Airspace: See *Activities with the Potential to Have Impacts* below.
- Satellites and Other Technologies
 - Satellite-Enabled Devices and Equipment: Installation of permanent equipment on existing structures and the use of portable devices that use satellite technology.
 - Land Use: It is anticipated that there would be *no impacts* at the programmatic level to existing or surrounding land uses because these technologies would be temporarily located in areas compatible with other land uses.
 - Recreation: See *Activities with the Potential to Have Impacts* below.
 - Airspace: See *Activities with the Potential to Have Impacts* below.
 - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it could include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact land use, recreation, or airspace, it is anticipated that this activity would have *no impact* at the programmatic level on land use, recreation, or airspace.

Activities with the Potential to Have Impacts at the Programmatic Level

Potential deployment-related impacts to land use, recreation resources, or airspace as a result of implementation of the Preferred Alternative would encompass a range of impacts that could occur, including changes to existing and surrounding land uses. The types of infrastructure deployment activities that could be part of the Preferred Alternative and result in potential impacts to land use resources include the following:

- Wired Projects
 - New Build – Buried Fiber Optic Plant: Plowing (including vibratory plowing), trenching, or directional boring alongside the road in utility corridors or within public road ROWs.
 - Land Use: Construction activities could temporarily restrict existing and surrounding land uses at isolated locations.
 - Recreation: It is anticipated that plowing, trenching, or directional boring may cause temporary, localized restrictions to recreational land or activities, which may persist during the deployment phase. It is reasonable to anticipate that small reductions in visitation to localized areas may occur during the deployment phase.
 - Airspace: *No impacts* at the programmatic level are anticipated – see previous section.
 - New Build – Aerial Fiber Optic Plant: Installing new poles and hanging cables on previously disturbed or new (undisturbed) ROWs or easements and the potential construction of access roads.
 - Land Use: These activities could result in term potential impacts to land uses. Construction activities could temporarily restrict existing and surrounding land uses at isolated locations. New structures, poles, or access roads on previously undisturbed ROWs or easements could have long-term impacts to existing and surrounding land uses. The magnitude of the impact would depend on the specific location and the compatibility of the new structures with existing and surrounding land uses.
 - Recreation: Deployment activities may cause temporary, localized restricted access to recreation land or activities, which may persist for the duration of the deployment phase. Small reductions to visitation during the deployment phase may be anticipated.
 - Airspace: *No impacts* at the programmatic level are expected – see previous section.
 - New Build – Submarine Fiber Optic Plant: Installing cables in limited inland bodies of water and the constructing landings and/or facilities on shore to accept submarine cable.
 - Land Use: Construction activities could temporarily restrict existing and surrounding land uses at isolated locations. New landings and/or facilities on shore could have long-term impacts to existing and surrounding land uses. The magnitude of the impact would depend on the specific location and the compatibility of the new facilities with existing and surrounding land uses.
 - Recreation: Deployment may temporarily restrict recreation on or within limited inland bodies of water and the surrounding area during the deployment phase. Reductions in visitation may result during deployment.
 - Airspace: *No impacts* at the programmatic level are anticipated – see previous section.
 - Installation of Optical Transmission or Centralized Transmission Equipment: Installation of equipment including construction of new boxes, huts, or access roads.
 - Land Use: Construction activities could temporarily restrict existing and surrounding land uses at isolated locations. New boxes, huts, or access roads could have long-term impacts to existing and surrounding land uses. The magnitude of the impact

- would depend on the specific location and the compatibility of the new facilities with existing and surrounding land uses.
- Recreation: Deployment of installation equipment and the construction of boxes, huts, or access roads may restrict access to recreation land or activities. Reductions in visitation during deployment may occur.
 - Airspace: *No impacts* at the programmatic level are anticipated – see previous section.
- Wireless Projects
 - New Wireless Communication Towers: Installing new wireless towers, associated structures (generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads.
 - Land Use: Construction activities could temporarily restrict existing and surrounding land uses at isolated locations. New wireless towers, associated structures, or access roads could have long-term impacts to existing and surrounding land uses. The magnitude of the impact would depend on the specific location and the compatibility of the new facilities with existing and surrounding land uses.
 - Recreation: Deployment of new towers and associated structures could result in temporary, localized restricted access for recreation land or activities for the duration of the deployment phase. Reductions in visitation or duration of recreational activity may result from restricted access.
 - Airspace: Installation of new wireless towers could result in impacts to airspace if towers exceed 200 feet AGL or meets other criteria listed in Section 4.1.7.5 Obstruction to Airspace Considerations. An OE/AAA could be required for the FAA to determine if the proposed construction does affect navigable airways or flight patterns of an airport if the aerial fiber optic plant is located in proximity to one of Arkansas's airports.
 - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower.
 - Land Use: *No impacts* at the programmatic level are anticipated – see previous section.
 - Recreation: Installation of antennas or microwaves to existing towers may cause temporary, localized restricted access to recreation lands or activities during installation, which may cause small reductions in visitation for the duration of installation.
 - Airspace: Collocation of mounting or installing equipment (such as antennas or microwave dishes) on an existing tower, addition of power units, structural hardening, and physical security measures could result in impacts if located near airports or air navigation facilities.
 - Deployable Technologies
 - Deployable Technologies: These technologies would be used where permanent, fixed infrastructure cannot be deployed due to a variety of factors such as the need to

supplement coverage or to avoid or mitigate permanent impacts to sensitive resources or receptors.

- Land Use: *No impacts* at the programmatic level are anticipated – see previous section.
 - Recreation: *No impacts* at the programmatic level are anticipated – see previous section.
 - Airspace: Implementation of deployable aerial communications architecture could result in temporary or intermittent impacts to airspace. Deployment of tethered systems (such as balloons or blimps) could pose an obstruction hazard if deployed above 200 feet and near Arkansas airports. Potential impacts to airspace (such as SUAs and MTRs) may be possible depending on the planned use of drones, piloted aircraft, untethered balloons and blimps (e.g., frequency of deployment, altitudes, proximity to airports and airspaces classes/types, length of deployment, etc.). Coordination with the FAA would be required to determine the actual impact and the required certifications. It is expected that FirstNet would attempt to avoid changes to airspace and the flight profiles (boundaries, flight altitudes, operating hours, etc.).
- Satellites and Other Technologies
 - Satellite-Enabled Devices and Equipment: The installation of permanent equipment on existing structures and the use of portable devices that use satellite technology.
 - Land Use: *No impacts* at the programmatic level are anticipated – see previous section.
 - Recreation: It is anticipated the installation of equipment on existing structures may cause temporary, localized restricted access to recreation lands or activities during installation, which may cause small reductions in visitation for the duration of installation.
 - Airspace: It is anticipated that the installation of permanent equipment on existing structures and the use of portable devices that use satellite technology may impact airspace if equipment creates an obstruction.

In general, the abovementioned activities could potentially involve construction activities. Potential impacts to land uses associated with deployment of this infrastructure could include temporary restrictions to existing and surrounding land uses in isolated locations. Potential impacts to recreation land and activities could include temporary, localized restricted access and reductions in visitation or duration of recreational activities. Potential impacts to airspace could include obstructions. These potential impacts are expected to be *less than significant* at the programmatic level due to the temporary and small-scale nature of deployment activities. Additionally FirstNet (or its network partners), would prepare an OE/AAA for any proposed tower that might affect navigable airways or flight patterns of an airport. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned deployment impacts. It is anticipated that there would be *no impacts* at the programmatic level to land use, recreation resources, or airspace associated with routine inspections of the Preferred Alternative, assuming that the same access roads used for deployment are also used for temporary, short-term inspections because there would be no ground disturbance, no airspace activity, and no access restrictions to recreational lands. If routine maintenance or inspection activities would conflict with existing or surrounding land uses, impact recreation resources, or conflict with airspace, impacts could result as explained above.

Operation of the Deployable Technologies options of the Preferred Alternative could result in the temporary presence of deployable vehicles and equipment (including airborne equipment), potentially for up to two years in some cases. Operation activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. It is anticipated that there would be *no impacts* at the programmatic level to land use, recreation resources, or airspace associated with routine inspections, assuming that the same access roads used for deployment are also used for inspections.

The degree of change in the visual environment (see Section 4.2.8, Visual Resources)—and therefore the potential indirect impact on a landowner's ability to use or sell of their land as desired—would be highly dependent on the specific deployment location and length of deployment. Once deployment locations are known, the location would be subject to an environmental review to help ensure environmental concerns are identified. The use of deployable aerial communications architecture could temporarily add new air traffic or aerial navigation hazards. The magnitude of these effects would depend on the specific location of airborne resources along with the duration of their use. FirstNet would coordinate with the FAA to review required certifications. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

4.2.7.5. *Alternatives Impact Assessment*

The following section assesses potential impacts to land use, recreation resources, and airspace associated with the Deployable Technologies Alternative and the No Action Alternative.

Deployable Technologies Alternative

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land

clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential impacts to land use, recreation, and airspace resources as a result of implementation of this alternative could be as described below.

Deployment Impacts

As explained above, implementation of deployable technologies could result in *less than significant impacts* at the programmatic level to land use. While a single deployable technology may have an imperceptible impact, multiple technologies operating in close proximity for longer periods could impact existing and surrounding land uses. There could be impacts to recreation activities during the deployment of technologies if such deployment were to occur within or near designated recreation areas. Enjoyment of activities dependent upon the visibility of wildlife or scenic vistas may be affected, however, impacts would be *less than significant* at the programmatic level due to the temporary nature of likely deployment activities. If deployment does trigger any obstruction criterion or result in changes to flight patterns and airspace restrictions, FirstNet (or its partners) would consult with the FAA to determine how to proceed. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As explained above, operation activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. As with the Preferred Alternative, it is anticipated that there would be *no impacts* at the programmatic level to land use, recreation resources, or airspace associated with routine inspections of the Deployable Technologies Alternative, assuming that the same access roads used for deployment are also used for inspections. Operation of deployable technologies would result in land use, land ownership, airspace, and recreation (access and enjoyment) similar in type to those described for the Preferred Alternative. The frequency and extent of those potential impacts would be greater than for the Proposed Action because under this Alternative, deployable technologies would be the only options available. As a result, this alternative would require a larger number of terrestrial and airborne deployable vehicles and a larger number of deployment locations in—all of which would potentially affect a larger number of properties and/or areas of airspace. Overall, these potential impacts would be *less than significant* at the programmatic level due to the temporary nature of deployment activities. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed; therefore, there would be no associated construction or installation of wired, wireless, deployable infrastructure, or satellites and other technologies. As a result, there would be *no impacts* at the programmatic level to land use, recreation resources, or airspace. Environmental conditions would therefore be the same as those described in Section 4.1.7, Land Use, Recreation, and Airspace.

4.2.8. Visual Resources

4.2.8.1. Introduction

This section describes potential impacts to visual resources in Arkansas associated with deployment and operation of the Proposed Action and Alternatives. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

4.2.8.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on visual resources were evaluated using the significance criteria presented in Table 4.2.8-1. As described in Section 4.2, Environmental Consequences, the categories of impacts are defined as *potentially significant*, *less than significant with mitigation measures incorporated*, *less than significant*, or *no impact*. Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

Given the nature of this programmatic evaluation, and because the Proposed Action could potentially cover a wide variety of actions that would take place in various landscapes, the potential impacts to visual resources addressed in this section are presented as a range of possible impacts.

Table 4.2.8-1: Impact Significance Rating Criteria for Visual Resources at the Programmatic Level

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Adverse change in aesthetic character of scenic resources or viewsheds	Magnitude or Intensity	Fundamental and irreversibly negative change in aesthetic character.	Effect that is <i>potentially significant</i> , but with mitigation is <i>less than significant</i> .	Intermittently noticeable change in aesthetic character that is marginally negative.	No visible effects.
	Geographic Extent	Regional impacts observed throughout the state/territory.		Effects realized at one or multiple isolated locations.	No visible effects.
	Duration or Frequency	Permanent or persistent changes to aesthetic character lasting throughout or beyond the construction or deployment phase.		Persisting through the construction and deployment phase, but aesthetics of the area would be returned to original state following the construction and deployment phase.	Transient or no visible effects.
Nighttime lighting	Magnitude or Intensity	Lighting dramatically alters night-sky conditions.	Effect that is <i>potentially significant</i> , but with mitigation is <i>less than significant</i> .	Lighting alters night-sky conditions to a degree that is only intermittently noticeable.	Lighting does not noticeably alter night-sky conditions.
	Geographic Extent	Regional impacts observed throughout the state/territory.		Effects realized at one or multiple isolated locations.	No visible effects.
	Duration or Frequency	Permanent or persistent changes to night-sky conditions lasting throughout or beyond the construction or deployment phase.		Persisting through the construction and deployment phase, but lighting would be removed and night-sky conditions would be returned to original state following the construction and deployment phase.	Transient or no visible effects.

4.2.8.3. Description of Environmental Concerns

Adverse Change in Aesthetic Character of Scenic Resources or Viewsheds

A primary concern during and following construction of structures, towers, roads or other permanent features is the long-term disruption of scenery and viewsheds. In Arkansas, residents and visitors travel to many national monuments, historic sites, and state parks, to view its scenic viewsheds and for recreation. If lands considered visually significant or scenic were subject to vegetation loss or removal, short- or long-term effects to viewsheds or scenic resources could occur. Bare ground or interruption of a landscape due to vegetation removal could be considered an adverse change in the aesthetic character of scenic resources or viewsheds. New towers or structures constructed within scenic areas could disrupt the perceived aesthetic character or scenery of an area. If new towers were constructed to a height that required lighting, nighttime vistas could be affected in areas where the night skies do not have light disruptions or are within unpopulated areas.

Based on the impact significance criteria presented in Table 4.2.8-1, impacts to the aesthetic character of scenic resources or viewsheds would be considered *potentially significant* if landscapes were permanently removed or fragmented, or if damage to historic or cultural resources occurred. The majority of FirstNet deployment activities would not cause negative impacts to the aesthetic character to a noticeable degree. However, some projects, such as towers, facilities, or infrastructure could cause a negative impact on the aesthetic character of local viewsheds depending on their size and location. However, given the small scale of likely FirstNet activities, impacts are expected to be *less than significant* at the programmatic level.

Nighttime Lighting

If new towers or facilities were constructed to a height that required lighting, nighttime vistas could be affected in areas where the night skies do not have light disruptions or are within unpopulated areas. If nighttime lighting were necessary for the operation or function of a facility that caused regional impacts or permanent changes to night sky conditions, those effects could be considered *potentially significant* at the programmatic level.

Based on the impact significance criteria presented in Table 4.2.8-1, lighting that illuminates the night sky, diminishes night sky viewing over long distances, and persists over the long-term would be considered *potentially significant*. Although likely FirstNet actions are expected to be small-scale, certain discrete locations may experience *potentially significant* impacts to night skies, although potentially minimized to *less than significant at the programmatic level with implementation of BMPs and mitigation measures*, as defined in Chapter 16, BMPs and Mitigation Measures. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented.

4.2.8.4. Potential Impacts of the Preferred Alternative

The following section assesses potential impacts associated with implementation of the Preferred Alternative, including deployment and operation activities.

Deployment Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative could result in the deployment of various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure and the specific deployment requirements, some activities would result in potential impacts to visual resources and others would not. In addition, and as explained in this section, the same type of Proposed Action Infrastructure could result in a range of *no impacts* to *less than significant impacts with BMPs and mitigation measures incorporated*, depending on the deployment scenario or site-specific conditions. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Activities Likely to Have No Impacts at the Programmatic Level

Of the types of facilities or infrastructure development scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are likely to have *no impacts* to visual resources under the conditions described below:

- **Wired Projects**
 - Collocation on Existing Aerial Fiber Optic Plant: While the addition of new aerial fiber optic plant to an existing aerial fiber optic transmission system would likely be visible, the change associated with this option is so small as to be essentially imperceptible. This option would involve no new nighttime lighting and pole replacement would be limited.
 - Use of Existing Conduit – New Buried Fiber Optic Plant: Disturbance associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas. It is anticipated that there would be *no impacts* at the programmatic level to visual resources since the activities would be conducted at small entry and exit points and are not likely to produce perceptible changes, and would not require nighttime lighting.
 - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up of dark fiber would have *no impacts* at the programmatic level to visual resources because there would be no ground disturbance, would not require nighttime lighting, and would not produce any perceptible changes.
- **Satellites and Other Technologies**
 - Satellite-Enabled Devices and Equipment: It is anticipated that the installation of permanent equipment on existing structures and the use of portable devices that use satellite technology would *not impact* visual resources at the programmatic level since those activities would not require ground disturbance or vegetation removal.
 - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it may include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact visual resources, it is anticipated that this activity would have *no impact* at the programmatic level on visual resources.

Activities with the Potential to Have Impacts at the Programmatic Level

Potential deployment-related impacts to visual resources as a result of implementation of the Preferred Alternative would encompass a range of impacts that could occur as a result of ground disturbance, vegetation removal, or installation of permanent structures if development occurs in scenic areas. The types of deployment activities that could be part of the Preferred Alternative and result in potential impacts to visual resources include the following:

- **Wired Projects**
 - **New Build – Buried Fiber Optic Plant:** Plowing (including vibratory plowing), trenching, or directional boring and the construction of POPs, huts, or other associated facilities or hand-holes to access fiber could result in potential impacts to visual resources. The degree of impact would depend on the timing, location, and type of project. Installation of a hut or POP would be permanent, whereas ground disturbing activities would be short-term. In most cases, development in or next to existing roadways would not affect visual resources unless vegetation were removed or excavation occurred in scenic areas.
 - **New Build – Aerial Fiber Optic Plant:** Construction and installation of new or replacement poles and hanging cables could result in impacts to the aesthetic character of scenic resources or viewsheds depending on the location of the installation. In most cases, development in public ROWs would not affect visual resources unless vegetation were removed or construction occurred in scenic areas. If new lighting were necessary, impacts to night skies could occur. Construction of new roadways could result in linear disruptions to the landscape, surface disturbance, and vegetation removal; all of which could impact the aesthetic character of scenic resources or viewsheds, depending on the location of the installation.
 - **New Build – Submarine Fiber Optic Plant:** The installation of cables in limited inland bodies of water would not impact visual resources at the programmatic level. However, impacts to the aesthetic character of scenic resources or viewsheds could potentially occur as result of the construction of landings and/or facilities on shore to accept submarine cable.
 - **Installation of Optical Transmission or Centralized Transmission Equipment:** If installation of transmission equipment required grading, vegetation removal, or other ground disturbance to install small boxes or huts, or access roads, potential impacts at the programmatic level to visual resources could occur but effects would be temporary and localized.
- **Wireless Projects**
 - **New Wireless Communication Towers:** Installation of new wireless towers and associated structures (generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads could result in impacts to visual resources. Land/vegetation clearing, excavation activities, landscape grading, and other surface disturbing activities during the installation of new wireless towers and associated structures or access roads could result in the degradation of the aesthetic character of scenic resources or viewsheds. Impacts may be experienced by viewers if new towers were located in or near a national park unit or other sensitive area.

If new towers were constructed to a height that required aviation lighting, nighttime vistas could be impacted in areas where the night skies do not have light disruptions or are within unpopulated areas. If nighttime lighting were necessary for the operation or function of a facility, impacts to night sky conditions could occur.

- Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower and would not likely result in additional impacts to visual resources. However, if additional power units, structural hardening, or physical security measures required ground disturbance or removal of vegetation, impacts to the aesthetic character of scenic resources or viewsheds could occur.
- Deployable Technologies: Implementation of deployable technologies could result in potential impacts to visual resources if long-term deployment occurs in scenic areas, or if the implementation requires minor construction or staging or landing areas, results in vegetation removal, areas of surface disturbance, or additional nighttime lighting.

In general, the abovementioned activities could potentially involve land/vegetation clearing, and potential scenic intrusion of towers, poles, roads, infrastructure, and other structures. Potential impacts to visual resources associated with deployment could include interruptions of landscapes, degradation of the aesthetic character of scenic resources or viewsheds, and overall changes in valued scenic resources, particularly for permanent fixtures such as towers or facilities. These impacts are expected to be *less than significant* at the programmatic level due to the temporary and small-scale nature of deployment activities. As discussed above, potential impacts to night skies from lighting are expected to be *less than significant at the programmatic level with BMPs and mitigation measures incorporated*. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned construction impacts. It is anticipated that there would be *no impacts* at the programmatic level to visual resources associated with routine inspections of the Preferred Alternative, assuming that the same access roads used for deployment are also used for inspections. Nighttime lighting in isolated rural areas or if sited near a national park would be *less than significant* at the programmatic level with BMPs and mitigation measures incorporated during operations. Additionally, FirstNet would work closely with the NPS to address any concerns they might have if a tower needed to be placed in an area that might affect the nighttime sky at a NPS unit. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

4.2.8.5. Alternatives Impact Assessment

The following section assesses potential impacts to visual resources associated with the Deployable Technologies Alternative and the No Action Alternative.

Deployable Technologies Alternative

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential impacts to infrastructure as a result of implementation of this alternative could be as described below.

Deployment Impacts

As explained above, implementation of deployable technologies could result in *potential impacts* at the programmatic level to visual resources if long-term deployment occurs in scenic areas. If staging or landing areas (depending on the type of technology) require surface disturbance or vegetation clearing, or if these areas were within scenic landscapes or required new nighttime lighting, impacts could occur to the aesthetic character of scenic resources or viewsheds. These impacts are expected to be *less than significant* at the programmatic level as generally they would be limited to the deployment location and could often be screened or otherwise blocked from view. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As explained above, operation activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. As with the Preferred Alternative, it is anticipated that there would be *no impacts* at the programmatic level to visual resources associated with routine inspections of the Preferred Alternative, assuming that the same access roads used for deployment are also used for inspections. The potential visual impacts—including aesthetic conditions and nighttime lighting—of the operation of deployable technologies would be *less than significant* at the programmatic level given the limited geographic scope for individual activities. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed; therefore, there would be no associated construction or installation of wired, wireless, deployable infrastructure or satellites and other technologies. Therefore, there would be *no impacts* at the programmatic level to visual resources as a result of the No Action Alternative. Environmental conditions would therefore be the same as those described in Section 4.1.8, Visual Resources.

4.2.9. Socioeconomics

4.2.9.1. Introduction

This section describes potential impacts to socioeconomics in Arkansas associated with deployment and operation of the Proposed Action and Alternatives. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

4.2.9.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on socioeconomics were evaluated using the significance criteria presented in Table 4.2.9-1. As described in Section 4.2, Environmental Consequences, the categories of impacts are defined as *potentially significant*, *less than significant with mitigation measures incorporated*, *less than significant*, or *no impact*. Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact at the programmatic level associated with each potential impact. Site-specific analysis may be required depending on the site conditions, the type of deployment, or any other permits or permissions necessary to perform the work.

Given the nature of this programmatic evaluation, and because the Proposed Action could potentially cover a wide variety of actions that would take place in various landscapes, the potential impacts to socioeconomics addressed in this section are presented as a range of possible impacts.

Table 4.2.9-1: Impact Significance Rating Criteria for Socioeconomics at the Programmatic Level

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Impacts to real estate (could be positive or negative)	Magnitude or Intensity	Changes in property values and/or rental fees, constituting a significant market shift.	Effect that is <i>potentially significant</i> , but with mitigation is <i>less than significant</i> at the programmatic level.	Indiscernible impact to property values and/or rental fees.	<i>No impacts</i> to real estate in the form of changes to property values or rental fees.
	Geographic Extent	Regional impacts observed throughout the state/territory.		Effects realized at one or multiple isolated locations, as opposed to throughout the state or territory.	NA
	Duration or Frequency	Persists during the life of the project.		Persists for as long as the entire construction phase or a portion of the operations phase.	NA
Changes to spending, income, industries, and public revenues	Magnitude or Intensity	Economic change that constitutes a market shift.	Effect that is <i>potentially significant</i> , but with mitigation is <i>less than significant</i> at the programmatic level.	Indiscernible economic change.	No change to tax revenues, wages, major industries, or direct spending.
	Geographic Extent	Regional impacts observed throughout the state/territory.		Effects realized at one or multiple isolated cities/towns, as opposed to throughout the state or territory.	NA
	Duration or Frequency	Persists during or beyond the life of the project.		Persists for as long as the entire construction phase or a portion of the operations phase.	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Impacts to employment	Magnitude or Intensity	High level of job creation at the state or territory level.	Effect that is <i>potentially significant</i> , but with mitigation is <i>less than significant</i> at the programmatic level.	Low level of job creation at the state/territory level.	No job creation due to project activities at the state/territory level.
	Geographic Extent	Regional impacts observed throughout the state/territory.		Effects realized at one or multiple isolated cities/towns, as opposed to throughout the state or territory.	NA
	Duration or Frequency	Persists during the life of the project.		Persists for as long as the entire construction phase or a portion of the operations phase.	NA
Changes in population number or composition	Magnitude or Intensity	Substantial increases in population, or changes in population composition (age, race, gender).	Effect that is <i>potentially significant</i> , but with mitigation is <i>less than significant</i> at the programmatic level.	Minor increases in population or population composition.	No changes in population or population composition.
	Geographic Extent	Regional impacts observed throughout the state or territory.		Effects realized at one or multiple isolated locations, as opposed to throughout the state or territory.	NA
	Duration or Frequency	Persists during the life of the project.		Persists for as long as the entire construction phase or a portion of the operations phase.	NA

NA = Not Applicable

4.2.9.3. *Description of Environmental Concerns*

This section discusses at a high level the types of socioeconomic impacts that could result from deployment of the NPSBN. Socioeconomic impacts could be negative or positive. Subsections below address socioeconomic impacts in four general areas, following the breakdown of the significance rating criteria in the table above:

- Impacts to Real Estate;
- Economic Benefits or Adverse Impacts related to Changes in Spending, Income, Industries, and Public Revenue;
- Impacts to Employment; and
- Changes in Population Number or Composition.

In addition to the specific impacts noted below, the Proposed Action would likely have broad, beneficial impacts to all four areas in times of disaster, by improving the response of public safety personnel. Reduced damages and faster recovery would result. This would support property values; maintain corporate income, personal income, and government revenues; preserve jobs; and reduce disruptions to populations.

Impacts to Real Estate

Deployment of the NPSBN has the potential to improve property values in areas that have reduced property values due to below average public safety communication services. Improved services would reduce response times and improve responses. These effects would reduce the potential for economic losses and thus support investments in property and greater market value for property. Any increases in property values are most likely in areas that have low property values and below average public safety communication services. Increases are less likely in areas that already have higher property value. As discussed in Affected Environment, property values vary across Arkansas. Median values of owner-occupied housing units in the 2009–2013 period ranged from over \$148,000 in the Arkansas portion of the greater Fayetteville/Springdale/Rogers area, to below and around \$79,000 in the Pine Bluff area. These figures are general indicators only. Property values are probably both higher and lower in specific localities. Any property value effects of deployment of the NPSBN would occur at a localized level.

Some telecommunications infrastructure, such as wireless communications towers, may adversely affect property values, depending on infrastructure location and other characteristics. Researchers believe these negative impacts relate to perceptions of the aesthetics of towers, or fears over electromagnetic emissions. Economists and appraisers have studied this issue and use a statistical analysis methodology known as hedonic pricing, or hedonic modelling, to assess how different attributes of properties such as distance from a tower affect property value (Bond, Sims, & Dent, 2013). Essentially, analysts compare the value of multiple properties while statistically controlling for differences in property attributes, in order to isolate the effect of a specific attribute such as proximity of a communications tower.

A recent literature review examined such studies in the United States, Germany, and New Zealand (Bond, Sims, & Dent, 2013). These studies all focused on residential properties. One study identified a positive effect on price in one neighborhood due to the presence of a wireless communications tower. Most studies identified negative effects on price. Generally, these negative effects were small: an approximately two percent decrease in property price. In one case, the average reduction in price was 15 percent. In all cases, the effects declined rapidly with distance, with some cases showing no effect beyond 100 meters (328 feet) and one case showing effects up to about 300 meters (984 feet).

Based on review of the particulars of each study, the literature review authors hypothesize that many additional factors regarding communications towers, besides distance, may affect property value. These include the type, height, size, and appearance of communication towers; grouping of towers; the level of activity in the property market at the time properties are listed or sold; and the level of negative local media focus on potential health effects of communication towers at the time properties are listed or sold.

Economic Benefits or Adverse Impacts related to Changes in Spending, Income, Industries, and Public Revenue

Developing the NPSBN may increase economic activity as governments and contractors make expenditures to deploy, operate, and maintain telecommunications and broadband infrastructure. Funds for such expenditures would come primarily from federal, state, and local government sources or through private entities under a written agreement with such governmental entities. FirstNet has three primary sources of funding to carry out its mission: (1) up to \$7 billion in cash funded by proceeds of incentive auctions authorized by the Act; (2) network user or subscriber fees; and (3) fees from covered leasing agreements that allow FirstNet to permit a secondary user to access network capacity on a secondary basis for non-public safety services only. The use of NPSBN capacity on a secondary basis for non-public safety services, including commercial services, by parties entering into a covered leasing agreement with FirstNet may also increase economic activity and generation of income for such party.

Direct spending of federal, state, and private sector funds to deploy and operate the NPSBN would likely represent new income to businesses that provide goods and services for the network, resulting in a positive impact. This direct impact would lead to indirect impacts (as directly impacted businesses purchase supporting goods and services) and induced impacts (as the employees of all affected businesses spend the wages they have earned). Because most FirstNet infrastructure investments would be dispersed across the nation, the business income and wages generated in any particular state or community would generally be small relative to the overall state or community economy, but measurable. Based on the significance criteria above, the business income and wage impacts would be considered positive and *less than significant* at the programmatic level. It is also highly unlikely that these impacts would lead to significant market shifts or other significant changes to local/regional economic structure.

Spending and income generation related to developing the NPSBN would also result in changes to public revenues. Property taxes may change as property values increase or decrease due to the

installation of new infrastructure. General and selective sales taxes may change (most likely increase), reflecting expenditures during system development and maintenance. Public utility tax revenues may change. These taxes are a subcategory of selective sales taxes that includes taxes on providers of land and mobile telephone, telegraph, cable, and internet services (U.S. Census Bureau, 2006). These service providers may obtain new taxable revenues from operation of components of the public safety broadband network. In such cases, public utility tax revenues may increase, but they could also remain the same or decrease if providers are granted tax breaks in return for operating portions of the network. Individual and corporate income taxes may change as FirstNet infrastructure development and operation creates new taxable income for involved companies and workers.

FirstNet's partner(s) may be given the right to use excess NPSBN capacity commercially. This would result in additional economic activity and generation of income. In turn, this could have revenue implications for federal and state governments, through taxes on sales and on corporate income generated by commercial use of the network.

FirstNet may have an additional, non-revenue benefit to the public sector. The network is likely to create operational cost savings and increased productivity for public safety personnel.

Impacts to Employment

Private companies and government organizations that receive income from deploying and operating the NPSBN would use portions of that income to hire the employees they need to provide their support to the network. This generation of new employment could be a minor direct, beneficial impact of expenditures on FirstNet. Additional, indirect employment increases would occur as additional businesses hire workers to provide supporting goods and services. For instance, FirstNet's partner(s) and their subcontractors and vendors would need engineers and information technology professionals, project managers, construction workers, manufacturing workers, maintenance workers, and other technical and administrative staff. Further employment gains would occur as businesses throughout the economy benefit from consumer spending by wage-earners in direct and indirectly affected businesses.

For the most part, employment gains in any particular state or community would generally be measurable, but small relative to the overall state or community economy. This is because FirstNet infrastructure investments would be dispersed across the nation. Based on the significance criteria above, the employment impacts would be considered positive and *less than significant* at the programmatic level. However, even small employment gains are beneficial, and would be especially welcomed in areas that have high unemployment. As discussed in Affected Environment, unemployment rates (as shown by the unemployment rate map and selected economic indicators table) vary considerably across Arkansas. The average annual unemployment rate in 2014 was 6.1 percent, slightly lower than the national rate of 6.2 percent. The majority of counties with unemployment rates below the national average (that is, better employment performance) are located around the three largest population concentrations (i.e., the Little Rock area, the Arkansas portion of the Fayetteville/Springdale/Rogers area, and the Fort Smith area). Some additional counties with unemployment rates below the national average

are located in other parts of the state, and counties with unemployment rates above the national average are distributed throughout Arkansas.

Large companies that win major contracts for deploying and operating the NPSBN may have concentrations of employees in some specific locations; for instance, engineers and other system designers may be located in one or a few specific offices. While such employment concentrations could be important to specific communities, these and other employment impacts would still not be significant based on the criteria in Table 4.2.9-1 because they would not constitute a “high level of job creation at the state or territory level.”

Changes in Population Number or Composition

In general, changes in population numbers occur when employment increases or decreases to a degree that affects the decisions of workers on where they could find employment; that is, when workers and their families move to or leave an area because of employment opportunities or the lack thereof. As noted above, deployment and operation of the NPSBN is likely to generate new employment opportunities (directly and indirectly), but employment changes would not be large enough in any state to be considered significant. Therefore, it is highly unlikely that the NPSBN would lead to significant changes in population numbers according to the significance criteria table above. Further, it is unlikely that the NPSBN would lead to any measurable changes in population numbers in any geographic areas, with the possible exception of cities where companies that win major NPSBN contracts establish centers for NPSBN deployment and operation activities. Smaller numbers of employees in any area would not produce measurable population changes because population is always in flux due to births, deaths, and in-migration and out-migration for other reasons.

Population composition refers to age, gender, race, ethnicity, and other characteristics of the individuals making up a population. Given the low potential for changes to population numbers, it is highly unlikely that the NPSBN would lead to any changes in population composition.

4.2.9.4. Potential Impacts of the Preferred Alternative

The following section assesses potential impacts associated with implementation of the Preferred Alternative, including deployment and operation activities.

Deployment Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative could deploy various types of facilities or infrastructure. Almost all deployment activities would have socioeconomic impacts, because all represent economic activity that would result, for instance, in expenditures and generation of income. These effects are measurable by economists, even if very small, but their significance is determined by application of the criteria in Table 4.2.9-1. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Activities Likely to Have No Impacts at the Programmatic Level

- Satellites and Other Technologies
 - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it could include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact socioeconomics, it is anticipated that this activity would have *no impact* at the programmatic on socioeconomic resources.

Activities with the Potential to Have Impacts at the Programmatic Level

Potential impacts to socioeconomics for the Preferred Alternative would encompass a range of impacts that could result from deployment activities. The discussion below indicates which of the four types of socioeconomic impacts discussed above and listed again here apply to each type of deployment activity. For detail on the nature of these impacts, see the Description of Environmental Concerns section above.

- Impacts to Real Estate;
- Changes to Spending, Income, Industries, and Public Revenues;
- Impacts to Employment; and
- Changes in Population Number or Composition.

Positive impacts on property values would generally not result from one or a few particular activities, but instead would result from the totality of the new NPSBN infrastructure and operational systems that enable improved public safety services to currently underserved areas. Similarly, any change to population numbers in a few locations as discussed above would result from large contract awards and contractor decisions about employee locations, not from specific deployment activities. Therefore, these types of impacts are not included in the activity-focused discussions below.

- Wired Projects
 - Use of Existing Conduit – New Buried Fiber Optic Plant: Installation of fiber optic cable in existing conduit would have the following types of socioeconomic impacts:
 - Changes to Spending, Income, Industries, and Public Revenues – Materials and labor for these projects would represent new expenditures that would generate income, help support industries, and may generate public revenues. All such effects would be small in scale relative to the regional and state economy and of limited duration; their impacts would be *less than significant* at the programmatic level.
 - Impacts to Employment – Similarly, expenditures for these projects would generate temporarily a *less than significant* number of jobs regionally and statewide.
 - Collocation on Existing Aerial Fiber Optic Plant: Collocation of new aerial fiber optic plant on existing utility poles and other structures would have the following types of socioeconomic impacts:
 - Changes to Spending, Income, Industries, and Public Revenues – Materials and labor for these projects would represent new expenditures that would generate income, help support industries, and may generate public revenues. All such effects would be

- small in scale relative to the regional and state economy and of limited duration; their impacts would be *less than significant* at the programmatic level.
- Impacts to Employment – Similarly, expenditures for these projects would generate temporarily a *less than significant* number of jobs regionally and statewide.
 - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting of dark fiber would be conducted electronically through existing infrastructure, and would have the following types of socioeconomic impacts:
 - Changes to Spending, Income, Industries, and Public Revenues – Labor for these projects would represent new expenditures that would generate income, help support industries, and may generate public revenues. All such effects would be small in scale relative to the regional and state economy and of limited duration; their impacts would be *less than significant* at the programmatic level.
 - Impacts to Employment – Similarly, expenditures for these projects would generate temporarily a *less than significant* number of jobs regionally and statewide.
 - New Build – Submarine Fiber Optic Plant: The installation of cables in limited inland bodies of water, and associated onshore activities at existing or new facilities would have the following types of socioeconomic impacts:
 - Changes to Spending, Income, Industries, and Public Revenues – Materials and labor for these projects would represent new expenditures that would generate income, help support industries, and may generate public revenues. All such effects would be small in scale relative to the regional and state economy and of limited duration; their impacts would be *less than significant* at the programmatic level.
 - Impacts to Employment – Similarly, expenditures for these projects would generate temporarily a *less than significant* number of jobs regionally and statewide.
 - Installation of Optical Transmission or Centralized Transmission Equipment: Installation of transmission equipment through existing or new boxes or huts would have the following types of socioeconomic impacts:
 - Changes to Spending, Income, Industries, and Public Revenues – Materials and labor for these projects would represent new expenditures that would generate income, help support industries, and may generate public revenues. All such effects would be small in scale relative to the regional and state economy and of limited duration; their impacts would be *less than significant* at the programmatic level.
 - Impacts to Employment – Similarly, expenditures for these projects would generate temporarily a *less than significant* number of jobs regionally and statewide.
 - New Build – Buried Fiber Optic Plant: New fiber optic cable installation usually requires construction activities and would have the following types of socioeconomic impacts:
 - Changes to Spending, Income, Industries, and Public Revenues – Materials and labor for these projects would represent new expenditures that would generate income, help support industries, and may generate public revenues. All such effects would be small in scale relative to the regional and state economy and of limited duration; their impacts would be *less than significant* at the programmatic level.
 - Impacts to Employment – Similarly, expenditures for these projects would generate temporarily a *less than significant* number of jobs regionally and statewide.

- New Build – Aerial Fiber Optic Plant: Pole/structure installation would have the following types of socioeconomic impacts:
 - Changes to Spending, Income, Industries, and Public Revenues – Materials and labor for these projects would represent new expenditures that would generate income, help support industries, and may generate public revenues. All such effects would be small in scale relative to the regional and state economy and of limited duration; their impacts would be *less than significant* at the programmatic level.
 - Impacts to Employment – Similarly, expenditures for these projects would generate temporarily a *less than significant* number of jobs regionally and statewide.
- Wireless Projects
 - New Wireless Communication Towers: Installation of new wireless towers and associated structures, such as generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads, or access roads would have the following types of socioeconomic impacts:
 - Impacts to Real Estate – As discussed above, communication towers sometimes have adverse impacts on nearby property values (Bond, Sims, & Dent, 2013). Such impacts, if they occur, would be limited to a small area around each project and would generally be a small percentage reduction in property value; thus, the impacts would be *less than significant* at the programmatic level.
 - Changes to Spending, Income, Industries, and Public Revenues – Materials and labor for these projects would represent new expenditures that would generate income, help support industries, and may generate public revenues. All such effects would be small in scale relative to the regional and state economy and of limited duration; their impacts would be *less than significant* at the programmatic level.
 - Impacts to Employment – Similarly, expenditures for these projects would generate temporarily a *less than significant* number of jobs regionally and statewide.
 - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would include mounting or installing equipment (such as antennas) on an existing facility would have the following types of socioeconomic impacts. While communication towers sometimes have adverse impacts on nearby property values (Bond, Sims, & Dent, 2013), the impacts of existing wireless towers are presumably already factored into property values and would not be affected by the addition of new equipment.
 - Changes to Spending, Income, Industries, and Public Revenues – Materials and labor for these projects would represent new expenditures that would generate income, help support industries, and may generate public revenues. All such effects would be small in scale relative to the regional and state economy and of limited duration; their impacts would be *less than significant* at the programmatic level.
 - Impacts to Employment – Similarly, expenditures for these projects would generate temporarily a *less than significant* number of jobs regionally and statewide.
 - Deployable Technologies: COWs, COLTs, and SOWs and aerial deployable technologies require storage, staging, and (for aerial deployables) launch/landing areas. Development of such areas, or enlargement of existing areas to accommodate FirstNet equipment, would have the following types of socioeconomic impacts:

- Impacts to Real Estate – It is possible that development or enlargement of storage, staging, and launch/landing areas could have adverse impacts on nearby property values. This is because such facilities may have adverse aesthetic aspects (e.g., large areas of pavement and large numbers of parked vehicles), equipment maintenance activities at such facilities may generate noise and vibration, and operational activities may generate traffic. Such factors could affect nearby property values. These impacts, if they occur, would occur within a limited distance of each site, and would be limited to a relatively small number of sites within the region and state. Therefore, these impacts would be *less than significant* at the programmatic level.
- Changes to Spending, Income, Industries, and Public Revenues – Materials and labor for these projects would represent new expenditures that would generate income, help support industries, and may generate public revenues. All such effects would be small in scale relative to the regional and state economy and of limited duration; their impacts would be *less than significant* at the programmatic level.
- Impacts to Employment – Similarly, expenditures for these projects would generate temporarily a *less than significant* number of jobs regionally and statewide.
- Satellites and Other Technologies
 - Satellite-Enabled Devices and Equipment: It is anticipated that the deployment of such devices and equipment would be similar to collocation of wireless equipment on existing wireless towers, structures, or buildings, and would have the following types of socioeconomic impacts:
 - Changes to Spending, Income, Industries, and Public Revenues – Materials and labor for these projects would represent new expenditures that would generate income, help support industries, and may generate public revenues. All such effects would be small in scale relative to the regional and state economy and of limited duration; their impacts would be *less than significant* at the programmatic level.
 - Impacts to Employment – Similarly, expenditures for these projects would generate temporarily a *less than significant* number of jobs regionally and statewide.

In general, the abovementioned activities would have *less than significant* beneficial socioeconomic impacts at the programmatic level. The discussion above characterized the impacts of each type of activity. The socioeconomic impacts of all activities considered together would also be *less than significant* at the programmatic level. Even when considered together, the impacts would be very small relative to the total economic activity and property value of any region or the state. In addition, with the possible exception of property values, all deployment impacts would be limited to the construction phase. To the extent that certain activities could have adverse impacts to property values, those impacts are also expected to be *less than significant* at the programmatic level, as described above. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

Activities with the Potential to Have Impacts at the Programmatic Level

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Preferred Alternative would consist of primarily of routine maintenance and inspection of fixed infrastructure. As with deployment activities, all operational activities would have socioeconomic impacts, because all represent economic activity. Public or private sector employees would conduct all operational activities, and therefore support employment and involve payment of wages. Even if these economic effects are a very small for each operational activity and not significant across the entire state, they are measurable socioeconomic impacts.

Potential socioeconomic impacts would primarily be beneficial, and generally of these types:

- Changes to Spending, Income, Industries, and Public Revenues – Operational activities would require expenditures, which then generate business income and employee wages, and may result in new public sector revenues such as taxes on sales and income. All such effects would be small in scale relative to the regional and state economy; their impacts would be *less than significant* at the programmatic level.
- Impacts to Employment – Public and private sector organizations responsible for operating the NPSBN would sustain existing employees and/or hire new employees to carry out operational activities. They would generate a *less than significant* number of jobs regionally and statewide.

The potential negative impacts on property values mentioned above for deployment of new wireless communication towers and deployable technology storage, staging, and launch/landing areas may also apply in the operations phase. The ongoing presence of such facilities has aesthetic and other effects that may reduce nearby property values, relative to values in the absence of such facilities. These impacts, if they occur, would be *less than significant* at the programmatic level as they would occur within a limited distance of each site, and would be limited to a relatively small number of sites within the region and Arkansas. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

4.2.9.5. Alternatives Impact Assessment

The following section assesses potential impacts to socioeconomics associated with the Deployable Technologies Alternative and the No Action Alternative.

Deployable Technologies Alternative

Under the Deployable Technologies Alternative, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or

paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential impacts to socioeconomics resulting from implementation of this alternative could be as described below.

Deployment Impacts

As explained above, all deployment activities represent economic activity and thus have socioeconomic impacts. These impacts would primarily be beneficial, such as generation of business income and employee wages, and creation or sustainment of jobs. The impacts would be small for each activity and therefore *less than significant* at the programmatic level.

Deployable technologies such as COWs, COLTs, and SOWs, along with aerial deployable technologies, would require storage, staging, and launch/landing areas. Development or enlargement of these facilities could have adverse impacts on nearby property values. The potential for such impacts is higher under this alternative than the Preferred Alternative because it is likely that these facilities would be implemented in greater numbers and over a larger geographic extent. These potential impacts are anticipated to be *less than significant* at the programmatic level as described above. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

All operational activities represent economic activity and thus have socioeconomic impacts. These impacts would primarily be beneficial, because they are small individually, overall impacts would be *less than significant* at the programmatic level.

The ongoing presence of facilities for housing and maintaining deployable technologies may have adverse aesthetic aspects (e.g., large areas of pavement and large numbers of parked vehicles) or other aspects (e.g., noise, vibration, and traffic) that could negatively affect the value of surrounding properties. The potential for such impacts is higher under this alternative than the Preferred Alternative because it is likely that these facilities would be more numerous, present over a larger geographic extent, and used with greater frequency and duration. These impacts, if they occur, would be *less than significant* at the programmatic level as they would be limited to a relatively small number of sites within Arkansas. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed. Therefore, there would be no associated deployment or installation activities to deploy wired, wireless, deployable infrastructure or satellites and other technologies. Therefore, there would be *no impacts* to socioeconomics at the programmatic level as a result of the No Action Alternative.

Socioeconomic conditions would therefore be the same as those described in Section 4.1.9, Socioeconomics.

4.2.10. Environmental Justice

4.2.10.1. Introduction

This section describes potential impacts to environmental justice in Arkansas associated with deployment and operation of the Proposed Action and Alternatives. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

4.2.10.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on environmental justice were evaluated using the significance criteria presented in Table 4.2.10-1. As described in Section 4.2, Environmental Consequences, the categories of impacts are defined as *potentially significant*, *less than significant with mitigation measures incorporated*, *less than significant*, or *no impact*. Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact. Site-specific analysis may be required depending on the site conditions, the type of deployment, or any other permits or permissions necessary to perform the work.

Given the nature of this programmatic evaluation, and because the Proposed Action could potentially cover a wide variety of actions that would take place in various landscapes, the potential impacts to environmental justice addressed in this section are presented as a range of possible impacts.

Table 4.2.10-1: Impact Significance Rating Criteria for Environmental Justice at the Programmatic Level

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Effects associated with other resource areas (e. g., human health and safety, cultural resources, socioeconomics) that have a disproportionately high and adverse impact on low-income populations and minority populations	Magnitude or Intensity	Direct and disproportionately high and <i>adverse effects</i> on environmental justice communities (as defined by EO 12898) that cannot be fully mitigated.	Effect that is <i>potentially significant</i> , but with mitigation is <i>less than significant</i> at the programmatic level.	Direct effects on environmental justice communities (as defined by EO 12898) that are not disproportionately high and adverse, and therefore do not require mitigation.	No direct effects on environmental justice communities, as defined by EO 12898.
	Geographic Extent	Effects realized within counties at the Census Block Group level.		Effects realized within counties at the Census Block Group level, as opposed to throughout the state or territory.	Effects realized within counties at the Census Block Group level.
	Duration or Frequency	Persists during the life of the project.		Persists for as long as the entire construction phase or a portion of the operations phase.	NA

NA = Not Applicable

4.2.10.3. Description of Environmental Concerns

Effects associated with other Resource Areas that have a Disproportionately High and Adverse Impact on Low-Income Populations and Minority Populations

EO 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations* (Executive Office of the President, 1994), and guidance from CEQ, require federal agencies to evaluate potential human health and environmental effects on environmental justice populations. Specifically, “Such effects may include ecological, cultural, human health, economic, or social impacts on minority communities, low-income communities, or Indian tribes when those impacts are interrelated to impacts on the natural or physical environment” (CEQ, 1997). Thus, effects associated with other resource areas are of interest from an environmental justice perspective. This includes Human Health and Safety, Cultural Resources, Socioeconomics, Noise and Vibration, Aesthetics and Visual Resources, and other resources.

Potential concerns noted in the impact analyses for these resources include dust, noise, vibration, traffic, and other adverse impacts of construction activities. New wireless communication towers sometimes have adverse impacts on nearby property values (Bond, Sims, & Dent, 2013). See Socioeconomics Environmental Consequences for additional discussion. The presence and operation of large storage, staging, and launch/landing areas for deployable technologies could raise environmental justice concerns as described below. American Indian tribes are considered environmental justice populations (CEQ, 1997); thus, impacts on tribal cultural resources (for instance, due to construction) could be a concern from an environmental justice perspective.

Impacts are considered environmental justice impacts only if they are *both* “adverse” and “disproportionately high” in their incidence on environmental justice populations relative to the general population (CEQ, 1997). The focus in environmental justice impact assessments is always, by definition, on adverse effects. However, telecommunications projects, such as those proposed by FirstNet, could have beneficial effects. These effects may include better provision of police, fire, and emergency medical services; improvements in property values; and the generation of jobs and income. These impacts are considered in the Socioeconomics Environmental Consequences (Section 4.2.9).

Construction impacts are localized, and property value impacts of wireless telecommunications projects rarely extend beyond 300 meters (984 feet) of a communications tower (Bond, Sims, & Dent, 2013). In addition, impacts related to deployment are of short duration. The potential for significant environmental justice impacts from the FirstNet deployment activities would be limited. Most, but not all, of the FirstNet operational activities have very limited potential for impacts as these activities are limited in scale and short in their duration.

Site-specific analysis to evaluate environmental justice may be required depending on the site conditions, including the presence of low-income populations or minority populations, the type of deployment, or any other permits or permissions necessary to perform the work. Such analyses could tier-off the methodology and results of this PEIS. The areas shown in the environmental justice screening map of Affected Environment (Section 4.1.10.4, Environmental

Justice Screening Results, Figure 4.1.10-1) as having moderate potential or high potential for environmental justice populations would particularly warrant further screening. As discussed in Section 4.1.10.3, Environmental Setting: Minority and Low-Income Populations, the population of Arkansas has lower percentages of minorities than the region or the nation. The state's poverty rate is higher than that of the region and considerably higher than that of the nation. A high proportion of Arkansas has high potential for environmental justice populations. The distribution of these high potential areas is fairly even across the state, and occurs both within and outside of the 10 largest population concentrations. The distribution of areas with moderate potential for environmental justice populations is also fairly even across the state. Further analysis using the data developed for the screening analysis in Section 4.1.10.4, Environmental Justice Screening Results, may be useful. In addition, USEPA's EJSCREEN tool and USEPA's lists of environmental justice grant and cooperative agreement recipients may help identify local environmental justice populations (USEPA, 2015g; USEPA, 2016d).

Site-specific analysis may be required depending on the site conditions, the type of deployment, or any other permits or permissions necessary to perform the work. This site-specific analysis would also evaluate whether an actual environmental justice impact on those populations would be likely to occur. Analysts could use the evaluation presented below under "Activities with the Potential to Have Impacts at the Programmatic Level" as a starting point. Analysts should bear in mind that any such activities that are problematic based on the adverse impact criterion of environmental justice may also have beneficial impacts on those same environmental justice communities.

4.2.10.4. Potential Impacts of the Preferred Alternative

The following section assesses potential impacts associated with implementation of the Preferred Alternative, including deployment and operation activities.

Deployment Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative could deploy various types of facilities or infrastructure. Depending on the physical nature and location of FirstNet facilities or infrastructure and the specific action, some activities would result in potential impacts to environmental justice communities and others would not. In addition, and as explained in this section, the same type of proposed action infrastructure could result in a range of *no impacts* to *less than significant* impacts at the programmatic level depending on the deployment scenario or site-specific conditions. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Activities Likely to Have No Impacts at the Programmatic Level

Of the types of facilities or infrastructure deployment scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are likely to have *no impacts* to environmental justice under the conditions described below:

- **Wired Projects**
 - **Use of Existing Conduit – New Buried Fiber Optic Plant:** Installation of fiber optic cable in existing conduit would be through existing hand holes, pulling vaults, junction boxes, huts, and POP structures. Activities at these small entry points would be limited and temporary and thus are not likely to produce perceptible changes affecting any surrounding communities. Therefore, they would not affect environmental justice communities.
 - **Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable:** Lighting of dark fiber would be conducted electronically through existing infrastructure, and therefore would have *no impacts* to environmental justice. If physical access is required to light dark fiber, it would likely be through existing hand holes, pulling vaults, junction boxes, huts, and similar existing structures, with no resulting impacts on environmental justice communities.
- **Satellites and Other Technologies**
 - **Satellite-Enabled Devices and Equipment:** It is anticipated that the deployment of such devices and equipment would not involve new ground disturbance, impacts to environmental justice communities would not occur. Impacts associated with satellite-enabled devices requiring construction activities are addressed below.
 - **Deployment of Satellites:** FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it could include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact environmental justice, it is anticipated that this activity would have *no impact* on environmental justice.

Activities with the Potential to Have Impacts at the Programmatic Level

Potential deployment-related impacts to environmental justice for the Preferred Alternative would encompass a range of impacts that could occur as a result of disturbance to communities from construction activities, such as noise, vibration, dust, and traffic. The types of infrastructure deployment activities that could be part of the Preferred Alternative and result in potential impacts to environmental justice communities include the following:

- **Wired Projects**
 - **New Build – Buried Fiber Optic Plant:** New fiber optic cable installation usually requires construction activities such as trenching, plowing (including vibratory plowing), or directional boring, as well as construction of hand holes, pulling vaults, junction boxes, huts, and POP structures. These activities could temporarily generate noise, vibration, and dust, or disrupt traffic. If such impacts occur disproportionately to environmental justice communities, they would be considered environmental justice impacts.
 - **New Build – Aerial Fiber Optic Plant:** Pole/structure installation could temporarily generate noise, vibration, and dust, or disrupt traffic. If these effects occur disproportionately in environmental justice communities, they would be considered environmental justice impacts.

- New Build – Submarine Fiber Optic Plant: The installation of cables in limited inland bodies of water would not impact environmental justice because there would be no ground disturbance or other impacts associated with this activity that would adversely impact communities. Associated onshore activities occurring at existing facilities such as staging of equipment and materials, or connection of cables, would be small in scale and temporary; thus, they would not impact environmental justice communities. Construction of new landings and/or facilities onshore to accept submarine cable could temporarily generate noise, vibration, and dust, or disrupt traffic. If these effects occur disproportionately in environmental justice communities, they would be considered environmental justice impacts.
- Installation of Optical Transmission or Centralized Transmission Equipment: If installation of transmission equipment would occur in existing boxes or huts, there would be no adverse impacts on surrounding communities, and thus no potential for environmental justice impacts. Installation of optical transmission equipment or centralized transmission equipment requiring construction of new utility poles, hand holes, pulling vaults, junction boxes, huts, and POP structures could temporarily generate noise, vibration, and dust, or disrupt traffic. If these effects occur disproportionately in environmental justice communities, they would be considered environmental justice impacts.
- Wireless Projects
 - New Wireless Communication Towers: Installation of new wireless towers and associated structures, such as generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads, or access roads requires construction activities that could temporarily generate, vibration, and dust, or disrupt traffic. New communication towers sometimes have adverse impacts on nearby property values (Bond, Sims, & Dent, 2013). (See Socioeconomics Environmental Consequences for additional discussion.) If these effects occur disproportionately in environmental justice communities, they would be considered environmental justice impacts.
 - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would include mounting or installing equipment (such as antennas) on an existing facility. This activity would be small in scale, temporary, and highly unlikely to produce adverse human health or environmental impacts on the surrounding community. Thus, it would not impact environmental justice communities. If collocation requires construction for additional power units, structural hardening, and physical security measures, the construction activity could temporarily generate noise, vibration, and dust, and disrupt traffic. If these effects occur disproportionately in environmental justice communities, they would be considered environmental justice impacts.
 - Deployable Technologies: COWs, COLTs, and SOWs and aerial deployable technologies require storage, staging, and (for aerial deployables) launch and landing areas. To the extent such areas require new construction, noise, vibration, and dust could be temporarily generated, and traffic could be disrupted. If these effects occur disproportionately in environmental justice communities, they would be considered environmental justice impacts.

In general, the impacts from the abovementioned activities would be short-term and could potentially involve objectionable dust, noise, vibration, traffic, or other localized impacts due to construction activities. In some cases, these effects and aesthetic effects could potentially impact property values, particularly from new towers. These impacts are expected to be *less than significant* at the programmatic level, but are problematic from an environmental justice perspective if they occur disproportionately in environmental justice communities. Since environmental justice impacts occur at the site-specific level, analyses of individual proposed projects would help determine potential impacts to specific environmental justice communities, furthermore, site-specific analysis could evaluate site conditions and the impacts of the type of deployment, and could satisfy requirements associated with any other permits or permissions necessary to perform the work. BMPs and mitigation measures may be required to address potential impacts to environmental justice communities at the site-specific level. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Preferred Alternative would consist of primarily of routine maintenance and inspection of fixed infrastructure. It is anticipated that such activities would not result in environmental justice impacts, as the intensity of these activities would be low (low potential for objectionable effects such as noise, vibration, and dust) and their duration would be very short. Routine maintenance and inspection would not adversely affect property values, for the same reasons. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned deployment activities that involve construction.

Impacts are expected to be *less than significant* at the programmatic level given the short-term nature and limited geographic scope for individual activities. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

4.2.10.5. Alternatives Impact Assessment

The following section assesses potential impacts to environmental justice associated with the Deployable Technologies Alternative and the No Action Alternative.

Deployable Technologies Alternative

Under the Deployable Technologies Alternative, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part

of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential impacts to environmental justice communities resulting from implementation of this alternative could be as described below.

Deployment Impacts

As explained above, deployable technologies such as COWs, COLTs, and SOWs, along with aerial deployable technologies, could require storage, staging, and launch/landing areas. To the extent such areas require new construction, noise, vibration, and dust could be generated temporarily, and traffic could be disrupted. If these effects occur disproportionately in environmental justice communities, they would be considered environmental justice impacts. Impacts are expected to be *less than significant* at the programmatic level because they would be temporary in nature. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

The ongoing presence of facilities for housing and maintaining deployable technologies may have adverse aesthetic aspects (e.g., large areas of pavement and large numbers of parked vehicles) that could negatively affect the value of surrounding properties. In addition, equipment maintenance activities at such facilities may temporarily generate noise and vibration, and operational activities may generate traffic. These effects may be adverse in themselves, and may impact property values. If these effects occur disproportionately in environmental justice communities, they would be considered environmental justice impacts. Impacts are expected to be *less than significant* at the programmatic level as operations are expected to be temporary in nature. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed. Therefore, there would be no associated construction or installation activities to deploy wired, wireless, deployable infrastructure or satellites and other technologies. Therefore, there would be *no impacts* to environmental justice at the programmatic level as a result of the No Action Alternative. Environmental conditions would therefore be the same as those described in Section 4.1.10, Environmental Justice.

4.2.11. Cultural Resources

4.2.11.1. Introduction

This section describes potential impacts to cultural resources in Arkansas associated with deployment and operation of the Proposed Action and Alternatives. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

4.2.11.2. Impact Assessment Methodology and Significance Criteria

The potential impacts of the Proposed Action on cultural resources were evaluated using the significance criteria presented in Table 4.2.11-1. The categories of impacts are defined at the programmatic level as an *adverse effect*; *mitigated adverse effect*; *effect, but not adverse*; and *no effect*. These impact categories are comparable to those defined in 36 CFR § 800, Secretary of Interior's Standards and Guidelines for Archaeology and Historic Preservation (NPS 1983), and the United States (U.S.) National Park Service's *National Register Bulletin: How to Apply the National Register Criteria for Evaluation* (NPS 2002). Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

Given the nature of this programmatic evaluation, and because the Proposed Action could potentially cover a wide variety of actions that would take place in various landscapes, the potential impacts to cultural resources addressed in this section are presented as a range of possible impacts.

Table 4.2.11-1: Effect Significance Rating Criteria for Cultural Resources at the Programmatic Level

Type of Effect	Effect Characteristics	Effect Level			
		Adverse Effect	Mitigated Adverse Effect ^a	Effect, but not Adverse	No Effect
Physical damage to and/or destruction of historic properties ^b	Magnitude or Intensity	Effects to a contributing portion of a single or many historic properties.	<i>Adverse effect</i> that has been procedurally mitigated through Section 106 process.	Effects to a non-contributing portion of a single or many historic properties.	No direct effects to historic properties.
	Geographic Extent	Direct effects Area of Potential Effects (APE).		Direct effects APE.	Direct effects APE.
	Duration or Frequency	Permanent direct effects to a contributing portion of a single or many historic properties.		Permanent direct effects to a non-contributing portion of a single or many historic properties.	No direct effects to historic properties.
Indirect Effects to historic properties (i.e., visual, noise, vibration, atmospheric)	Magnitude or Intensity	Effects to a contributing portion of a single or many historic properties.	<i>Adverse effect</i> that has been procedurally mitigated through Section 106 process.	Effects to a contributing or non-contributing portion of a single or many historic properties.	No Indirect Effects to historic properties.
	Geographic Extent	Indirect Effects APE.		Indirect Effects APE.	Indirect Effects APE.
	Duration or Frequency	Long-term or permanent Indirect Effects to a single or many historic properties.		Infrequent, temporary, or short- or long-term or permanent Indirect Effects to a single or many historic properties.	No Indirect Effects to historic properties.
Loss of character defining attributes of historic properties	Magnitude or Intensity	Effects to a contributing portion of a single or many historic properties.	<i>Adverse effect</i> that has been procedurally mitigated through Section 106 process.	Effects to a non-contributing portion of a single or many historic properties.	No direct or Indirect Effects to historic properties.
	Geographic Extent	Direct and/or Indirect Effects APE.		Direct and/or Indirect Effects APE.	Direct and/or Indirect Effects APE.
	Duration or Frequency	Long-term or permanent loss of character defining attributes of a single or many historic properties.		Infrequent, temporary, or short-term changes to character defining attributes of a single or many historic properties.	No direct or Indirect Effects to historic properties.

Type of Effect	Effect Characteristics	Effect Level			
		Adverse Effect	Mitigated Adverse Effect ^a	Effect, but not Adverse	No Effect
Loss of access to historic properties	Magnitude or Intensity	Effects to a contributing portion of a single or many historic properties.	<i>Adverse effect</i> that has been procedurally mitigated through Section 106 process.	Effects to a non-contributing portion of a single or many historic properties.	No segregation or loss of access to historic properties.
	Geographic Extent	Any area surrounding historic properties that would cause segregation or loss of access to a single or many historic properties.		Any area surrounding historic properties that could cause segregation or loss of access to a single or many historic properties.	No segregation or loss of access to historic properties.
	Duration or Frequency	Long-term or permanent segregation or loss of access to a single or many historic properties.		Infrequent, temporary, or short-term changes in access to a single or many historic properties.	No segregation or loss of access to historic properties.

^a Whereas mitigation measures for other resources discussed in this PEIS may be developed to achieve an impact that is “*Less than significant with mitigation measures incorporated*,” historic properties are considered to be “non-renewable resources,” given their very nature. As such, any and all unavoidable *adverse effects* to historic properties, per Section 106 of the NHPA (as codified in 36 CFR Part 800.6), would require FirstNet to consult with the SHPO/THPO and other consulting parties, including American Indian Tribes and Native Hawaiian Organizations, to develop appropriate mitigation.

^b Per NHPA, a “historic property” is defined as any district, archaeological site, building, structure, or object that is either listed or eligible for listing in the NRHP. Cultural resources present within a project’s APE are not historic properties if they do not meet the eligibility requirements for listing in the NRHP. Sites of religious and/or cultural significance refer to areas of concern to American Indian Tribes and other consulting parties that, in consultation with the respective party (ies), may or may not be eligible for listing in the NRHP. These sites may also be considered TCPs. Therefore, by definition, these significance criteria only apply to cultural resources that are historic properties, significant sites of religious and/or cultural significance, or TCPs. For the purposes of brevity, the term historic property is used here to refer to either historic properties, significant sites of religious and/or cultural significance, or TCPs.

4.2.11.3. Description of Environmental Concerns

Physical Damage to and/or Destruction of Historic Properties

One of the primary environmental concerns during deployment activities is damage to or destruction of historic and cultural resources. Deployment involving ground disturbance has the potential to damage or destroy archaeological sites, and the attachment of communications equipment to historic building and structures has the potential to cause damage to features that are historically significant.

Based on the impact significance criteria presented in Table 4.2.11-1, direct deployment impacts could have an *adverse effect* if FirstNet's deployment locations were in areas with moderate to high probabilities for archaeological deposits, within historic districts, or at historic properties. To the extent practicable, FirstNet would attempt to minimize activities in areas with archaeological deposits or within historic districts. However, given archaeological sites and historic properties are present throughout Arkansas, some deployment activities may be in these areas, in which case BMPs (see Chapter 16) would help avoid or minimize the potential impacts.

Indirect Effects to Historic Properties (i.e., visual, noise, vibration, atmospheric)

The potential for Indirect Effects to historic properties would be present during deployment of the proposed facilities/infrastructure and during trenching, grading, and/or foundation excavation activities. Indirect Effects include the introduction of visual, noise, atmospheric, and/or vibration effects that diminish a property's historic integrity. The greatest likelihood of potentially *adverse effects* from Indirect Effects would be from the deployment of equipment in areas that would cause adverse visual effects to historic properties. To the extent practicable, FirstNet would attempt to minimize activities in areas within or adjacent to historic districts or properties.

Loss of Character Defining Attributes of Historic Properties

Deployment of FirstNet equipment has the potential to cause the loss of character defining attributes of historic properties; such attributes are the features of historic properties that define their NRHP eligibility. Examples of such effects would be the loss of integrity of archaeological sites through ground disturbing activities, and direct impacts to historic buildings from equipment deployment that adversely alter historic architectural features. *Adverse effects* such as these could be avoided or minimized through BMPs (see Chapter 16).

Loss of Access to Historic Properties

The deployment of equipment requiring a secure area has the potential to cause the loss of access to historic properties. The highest potential for this type of *adverse effect* would be from the deployment of equipment in secure areas that impact the access to sites of cultural importance to American Indians. It is anticipated that FirstNet would identify potential effects to such areas through the NHPA consultation process, and would minimize deployment activities that would cause such loss of access.

4.2.11.4. Potential Effects of the Preferred Alternative

The following section assesses potential effects associated with implementation of the Preferred Alternative, including deployment and operation activities.

Deployment Effects

As described in Section 2.1, Proposed Action, implementation of the Preferred Alternative could result in the deployment of various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure and the specific deployment requirements, some activities would result in potential impacts to cultural resources, while others would not. In addition, and as explained in this section, the same type of Proposed Action Infrastructure could result in a range of *no effects* to *effects, but not adverse*, depending on the deployment scenario or site-specific conditions. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Activities Likely to Have No Effects at the Programmatic Level

Of the types of facilities or infrastructure deployment scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are likely to have *no effects* to cultural resources under the conditions described below:

- **Wired Projects**
 - Use of Existing Conduit – New Buried Fiber Optic Plant: Disturbance associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas. It is anticipated that there would be *no effects* to cultural resources since the activities that would be conducted at these small entry and exit points are not likely to produce impacts.
 - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up of dark fiber would have *no impacts* to cultural. If required, and if done in existing huts with no ground disturbance, installation of new associated equipment would also have *no effects* to cultural resources because there would be no ground disturbance and no perceptible visual changes.
- **Satellites and Other Technologies**
 - Satellite-Enabled Devices and Equipment: It is anticipated that the installation of permanent equipment on existing structures and the use of portable devices that use satellite technology would not impact cultural resources because those activities would not require ground disturbance or create perceptible visual effects.
 - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it could include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact cultural resources, it is anticipated that this activity would have *no effects* on cultural resources.

Activities with the Potential to Have Effects at the Programmatic Level

Potential deployment-related impacts to cultural resources as a result of implementation of the Preferred Alternative would encompass a range of impacts that could occur as a result of ground disturbance activities, including destruction of cultural or historic artifacts. The types of infrastructure deployment activities that could be part of the Preferred Alternative and result in potential effects to cultural resources include the following:

- **Wired Projects**
 - **New Build – Buried Fiber Optic Plant:** Plowing (including vibratory plowing), trenching, or directional boring and the construction of POP, huts, or other associated facilities or hand-holes to access fiber could result in potential impacts to cultural resources. Soil disturbance and heavy equipment use associated with plowing, trenching, or directional boring as well as land/vegetation clearing, excavation activities, and landscape grading associated with construction of POPs, huts, or other associated facilities or hand-holes to access fiber could result in the disturbance of archaeological sites, and the associated structures could have visual effects on historic properties.
 - **New Build – Aerial Fiber Optic Plant:** Ground disturbance during the installation of new utility poles and the use of heavy equipment during the installation of new utility poles and hanging of cables could result in the disturbance of archaeological sites, and the associated structures could have visual effects on historic properties.
 - **New Build – Submarine Fiber Optic Plant:** The installation of cables in limited inland bodies of water could impact cultural resources, as coastal areas of Arkansas where sea level was lower during glacial periods (generally the Middle Archaic Period and earlier) have the potential to contain archaeological sites. Impacts to cultural resources could also potentially occur as a result of the construction of landings and/or facilities on shore to accept submarine cable, which could result in the disturbance of archaeological sites (archaeological deposits are frequently associated with bodies of water), and the associated structures could have visual effects on historic properties.
 - **Installation of Optical Transmission or Centralized Transmission Equipment:** If installation of transmission equipment would occur in existing boxes or huts and require no ground disturbance, there would be *no impacts* to cultural resources. If installation of transmission equipment required grading or other ground disturbance to install small boxes or huts, or access roads, there could potentially be impacts to cultural resources. Ground disturbance could impact archaeological sites, and the associated structures could have visual effects on historic properties.
 - **Collocation on Existing Aerial Fiber Optic Plant:** Soil excavation and excavated material placement during the replacement of poles and structural hardening could result in direct and indirect effects to cultural resources, although any effects to access would be short-term. Heavy equipment use associated with these activities as well as with installing new fiber on existing poles could result in direct and Indirect Effects to cultural resources.
- **Wireless Projects**
 - **New Wireless Communication Towers:** Deployment of new wireless towers and associated structures (generators, equipment sheds, fencing, security and aviation

lighting, electrical feeds, and concrete foundations and pads) or access roads could result in impacts to historic properties. Land/vegetation clearing, excavation activities, landscape grading, and other ground disturbance activities during the deployment of new wireless towers and associated structures or access roads, could result in the disturbance of archaeological sites. The deployment of new wireless communication towers and their associated structures could result in visual impacts to historic properties or the loss of access to historic properties.

- Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower could result in impacts to historic properties. Ground disturbance activities could result in the disturbance of archaeological sites, and the deployment of collocated equipment could result in visual impacts or physical damage to historic properties, especially in urban areas such as Arkansas City that have larger numbers of historic public buildings.
- Deployable Technologies: Implementation of deployable technologies could result in potential impacts to cultural resources if deployment occurs in unpaved areas, or if the implementation results in paving of previously unpaved surfaces. In addition, impacts to historic properties could occur if the deployment is long-term, or if the deployment involves aerial technologies with the potential for visual or other indirect impacts.

In general, the abovementioned activities could potentially involve ground disturbance, construction of access roads and other impervious surfaces, landscape grading, and heavy equipment movement. Potential impacts to cultural resources associated with deployment could include physical damage to or destruction of historic properties, indirect impacts including visual effects, the loss of access to historic properties, or the loss of character-defining features of historic properties. These activities could *affect, but not adversely affect*, cultural resources as the potential adverse effects would be temporary and limited to the area near individual Proposed Action deployment site. Additionally, some equipment proposed to be installed on or near properties that are listed or eligible for listing on the NRHP could potentially be removed. Additionally, as appropriate, FirstNet would engage in consultation as required under Section 106 of the NHPA. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential effects.

Operation Effects

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major communications infrastructure replacement as part of ongoing system maintenance would result in effects similar to the abovementioned deployment effects. It is anticipated that there would be *no effect* to cultural resources associated with routine inspections of the Preferred Alternative. If usage of heavy equipment as part of routine maintenance or inspections occurs off established access roads or corridors, or if the acceptable load of the surface is exceeded, ground disturbance impacts on archaeological sites could result as explained

above. These potential effects would be associated with ground disturbance or modifications of properties, however, due to the small scale of expected activities, these actions could affect but would not likely adversely affect, cultural resources. In the event that maintenance and inspection activities occur off existing roads, FirstNet would engage in consultation as required under Section 106 of the NHPA. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

4.2.11.5. Alternatives Effect Assessment

The following section assesses potential impacts to cultural resources associated with the Deployable Technologies Alternative and the No Action Alternative.

Deployable Technologies Alternative

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential impacts to cultural resources as a result of implementation of this alternative could be as described below.

Deployment Effects

As explained above, implementation of deployable technologies could result in effects to cultural resources if deployment occurs in unpaved areas, or if the implementation results in paving of previously unpaved surfaces. Some staging or landing areas (depending on the type of technology) may require land/vegetation clearing, excavation, and paving. These activities could result in impacts to archaeological sites. These activities could *affect, but not adversely affect*, cultural resources due to the limited amount of expected ground disturbing activities and the short-term nature of deployment activities. However, in the event that land/vegetation clearing is required, FirstNet would engage in consultation as required under Section 106 of the NHPA. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Effects

As explained above, operation activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. As with the deployment impacts, it is anticipated that there would be *effects, but no adverse effects* to historic properties

associated with implementation/running of the deployable technology. *No adverse effects* would be expected to either site access or viewsheds due to the temporary nature of expected activities. As with the Preferred Alternative, it is anticipated that there would be *no effects* to cultural resources associated with routine inspections of the Preferred Alternative, assuming that the same access roads used for deployment are also used for inspections. If usage of heavy equipment as part of routine maintenance or inspections occurs off established access roads or corridors, impacts to archaeological sites could occur, however, in the event that this is required, FirstNet would engage in consultation as required under Section 106 of the NHPA. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed; therefore, there would be no associated construction or installation of wired, wireless, deployable infrastructure or satellites and other technologies. Therefore, there would be *no effects* to cultural resources at the programmatic level as a result of the No Action Alternative. Environmental conditions would therefore be the same as those described in Section 4.1.11, Cultural Resources.

4.2.12. Air Quality

4.2.12.1. Introduction

This section describes potential impacts to Arkansas's air quality from deployment and operation of the Proposed Action and Alternatives. Mitigation measures, as defined through permitting and/or consultation with the appropriate resource agency, would be implemented as part of deployment and operation of the Proposed Action to help avoid or reduce potential impacts to air quality. Implementation of best management practices (BMPs), as practicable or feasible, could further reduce the potential for impacts. Both mitigation measures and BMPs are discussed in Chapter 16, BMPs and Mitigation Measures.

4.2.12.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on Arkansas's air quality were evaluated using the significance criteria presented in Table 4.2.12-1. As described in Section 4.2, Environmental Consequences, the categories of impacts are defined at the programmatic level as *potentially significant*, *less than significant with mitigation measures incorporated*, *less than significant*, or *no impact*. Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

Given the nature of this programmatic evaluation, and because the Proposed Action could potentially cover a wide variety of actions that would take place in various landscapes, the potential impacts to Arkansas's air quality addressed in this section are presented as a range of possible impacts.

Table 4.2.12-1: Impact Significance Rating Criteria for Air Quality at the Programmatic Level

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Increased air emissions	Magnitude or Intensity	Emissions would prevent progress toward meeting one or more NAAQS in nonattainment areas. Emissions in attainment or maintenance areas would cause an exceedance for any NAAQS. Emissions exceed one or more major source permitting thresholds. Projects do not conform to SIP.	Effect that is <i>potentially significant</i> , but with mitigation is <i>less than significant</i> at the programmatic level.	Negligible emissions would occur for any pollutant within an attainment area, but would not cause a NAAQS exceedance and would not trigger major source permitting.	Emission increases would be infrequent or absent, mostly immeasurable; projects conform to SIP.
	Geographic Extent/Context	NA		NA	NA
	Duration or Frequency	Permanent or long-term.		Short term.	Temporary.

NA = Not Applicable

4.2.12.3. Description of Environmental Concerns

The Proposed Action has the potential to generate air pollutant emissions. These emissions could be beyond what is typically generated in a given area and may alter ambient air quality. Deployment activities may involve the use of vehicles, heavy equipment, and other equipment that could emit exhaust and create fugitive dust in localized areas. During operations, routine maintenance and other use of generators at tower facilities may emit exhaust for specific durations (maintenance) or unpredictable timeframes (if power is lost to a site, for example). Impacts are likely to be *less than significant* at the programmatic level due to the mobile nature of the sources and the temporary and short-term duration of deployment activities. Although unlikely the emissions of criteria pollutants could impair the air quality of the region and potentially affect human health. Potential impacts to air quality from emissions may occur in areas where the current air quality exceeds, or has a history of exceeding, one or more NAAQS. Areas exist in Arkansas that are in maintenance or nonattainment for one or more criteria pollutants, particularly, ozone is a state-wide issue (see Section 4.1.12, Air Quality and Figure 4.1.12-1). The majority of the counties in Arkansas are designated as maintenance areas for ozone (Table 4.1.12-3); West Memphis County, located in the eastern edge of the state is designated nonattainment or maintenance for one NAAQS pollutant (Figure 4.1.12-1).

Based on the significance criteria presented in Table 4.2.12-1, air emission impacts would likely be *less than significant* at the programmatic level given the size and nature of the majority of the proposed deployment activities. The majority of FirstNet's deployment activities would not be located in sensitive areas nor would a large number of emission sources be deployed/operated long-term in the same area from fixed or mobile sources or construction activities. *Less than significant* emissions at the programmatic level could occur for any of the criteria pollutants within attainment areas in Arkansas; however, NAAQS exceedances are not anticipated. Given that nonattainment areas are present throughout Arkansas (Figure 4.1.12-1), and because infrastructure could be deployed in these areas, BMPs and mitigation measures (see Chapter 16, BMPs and Mitigation Measures) could help avoid or minimize potential air quality impacts. In addition, it is anticipated that any air pollution increase due to deployment would likely be short-term with pre-existing air quality levels generally achieved after some months (typically less than a year, and could be as short as a few hours or days for some activities such as pole construction).

4.2.12.4. Potential Impacts of the Preferred Alternative at the Programmatic Level

The following section assesses potential impacts associated with implementation of the Preferred Alternative, including construction, deployment, and operation activities.

Potential Deployment and Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementing the Preferred Alternative could result in deploying various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure and the specific deployment requirements, some activities would result in potential impacts to air quality and others would

not. The potential impacts could range from *no impacts* to *less than significant* impacts at the programmatic level depending on the deployment scenario or site-specific conditions. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Activities Likely to Have No Impacts at the Programmatic Level

Of the types of facilities or infrastructure deployment scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are likely to have *no impacts* to air quality at the programmatic level under the conditions described below:

- **Wired Projects**
 - **Use of Existing Conduit – New Buried Fiber Optic Plant:** Activities associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit. Gaining access to the conduit and installing the cable may result in minor disturbance at entry and exit points, however this activity would be temporary and infrequent, and is not expected to produce any perceptible changes in air emissions.
 - **Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable:** Lighting up dark fiber would require no construction and have no short- or long-term emissions to air quality because it would create no new sources of emissions.
- **Satellites and Other Technologies**
 - **Satellite Enabled Devices and Equipment:** The duration of construction activities associated with installing permanent equipment on existing structures would most likely be short-term. It is anticipated that insignificant concentrations of criteria pollutants would be emitted during installment of this equipment from the use of machinery. Deployment and operation of satellite-enabled devices and portable equipment are expected to have minimal to *no impact* at the programmatic level on ambient air quality concentrations.
 - **Deployment of Satellites:** FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it may include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact air quality, it is anticipated that this activity would have *no impact* on those resources at the programmatic level.

Activities with Potential Impacts at the Programmatic Level

Construction, deployment, and operation activities related to the Preferred Alternative could impact air quality by generating various quantities of criteria and air pollutant emissions. It is expected that such impacts would be *less than significant* at the programmatic level due to the shorter duration and localized nature of the activities. The types of infrastructure deployment scenarios or deployment activities that could be part of the Preferred Alternative and result in potential impacts to air quality include the following:

- **Wired Projects**
 - **New Build – Buried Fiber Optic Plant:** Plowing (including vibratory plowing), trenching, or directional boring and the construction of POPs, huts, or other associated facilities or hand-holes to access fiber as well as land/vegetation clearing, excavation activities, and landscape grading could result in fugitive dust and products of combustion from the use of vehicles and heavy equipment.
 - **New Build – Aerial Fiber Optic Plant:** The use of heavy equipment during the installation of new poles and hanging cables, as well as constructing access roads, POP huts, or other associated facilities to house plant equipment could result in products of combustion from the use of vehicles and machinery, as well as fugitive dust emissions from site preparation.
 - **Collocation on Existing Aerial Fiber Optic Plant:** Excavation equipment used during pole replacement, and other heavy equipment used for structural hardening or reinforcement, could result in products of combustion from the use of vehicles and heavy equipment, as well as fugitive dust from site preparation.
 - **New Build – Submarine Fiber Optic Plant:** The installation of cables in limited inland bodies of water could generate products of combustion from vessels used to lay the cable. In addition, the construction of landings and/or facilities on shore to accept submarine cable could result in products of combustion and fugitive dust from heavy equipment used for grading, foundation excavation, or other ground disturbing activities.
 - **Installation of Optical Transmission or Centralized Transmission Equipment:** Emissions associated with the installation of optical transmission or centralized transmission equipment would be limited to the short-term, temporary use of vehicle and construction equipment. Long-term impacts are unlikely, as the power requirements for optical networks are relatively low.
- **Wireless Projects**
 - **New Wireless Communication Towers:** Activities associated with installing new wireless towers and associated structures (e.g., generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads could result in products of combustion. Operating vehicles and other heavy equipment, running generators while conducting excavation activities, and landscape grading to install new wireless towers and associated structures or access roads could result in products of combustion and fugitive dust.
 - **Collocation on Existing Wireless Tower, Structure, or Building:** Vehicles and equipment used to mount or install equipment, such as antennas or microwave dishes, on an existing tower could impact air quality. If the delivery of additional power units, structural hardening, and physical security measures required grading or excavation, then exhaust and fugitive dust from heavy equipment used for these activities could also result in increased air emissions.
- **Deployable Technologies**
 - The type of deployable technology used would dictate the types of air pollutants generated. For example, mobile equipment deployed via heavy trucks could generate products of combustion from the internal combustion engines associated with the

vehicles and onboard generators. These units may also generate fugitive dust depending on the type of road traveled during deployment (i.e., paved versus unpaved roads). Aerial platforms (e.g., UASs or other aircraft) would generate pollutants during all phases of flight.

In general, the pollutants of concern from the abovementioned activities would be products of combustion from burning fossil fuels in internal combustion engines and fugitive dust from site preparation activities and vehicles traveling on unpaved road surfaces. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the construction impacts. These impacts are anticipated to be *less than significant* at the programmatic level due to the limited nature of the deployment. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Potential Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major communications infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned deployment impacts. It is anticipated that there would be *less than significant* impacts at the programmatic level to air quality associated with routine inspections of the Preferred Alternative due to the limited nature of the activity. If usage of heavy equipment as part of routine maintenance or inspections occurs off established access roads or corridors additional air quality impacts may occur, however, they would be *less than significant* at the programmatic level as they would still be limited in nature. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

4.2.12.5. Alternatives Impact Assessment

The following section assesses potential impacts to air quality associated with the Deployable Technologies Alternative and the No Action Alternative.

Deployable Technologies Alternative

Under the Deployable Technologies Alternative, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific equipment associated with the Deployable Technologies Alternative could include heavy trucks with onboard generators, aerial vehicles (e.g., UASs or other aircraft), and ground support vehicles and other equipment for aerial deployment. The stand-alone Deployable Technologies Alternative differs from the Preferred Alternative in the number of mobile and aerial vehicles likely to deploy, the distances traveled

from storage locations, and the duration of deployment. The potential impacts to air quality are as follows:

Potential Deployment and Operation Impacts to Air Quality

Implementing deployable technologies could result in products of combustion from mobile equipment deployed via heavy trucks using internal combustion engines associated with the vehicles and onboard generators. While a single deployable vehicle may have an insignificant impact, multiple vehicles operating for longer periods, in close proximity, may have a greater cumulative impact, although this is expected to be *less than significant* at the programmatic level based on the defined significance criteria, since activities would be temporary and short-term. These vehicles may also produce fugitive dust if traveling on unpaved roads. Some staging or landing areas (depending on the type of technology) may require excavation, site preparation, and paving. Heavy equipment used for these activities could emit products of combustion as a result of burning fossil fuels in internal combustion engines. The deployment and operation of aerial technology is anticipated to generate pollutants during all phases of flight, except for balloons. The products of combustion from ground support vehicles, as well as the duration of ground support operations and travel between storage and deployment locations would dictate the concentrations and associated impacts. Additionally, routine maintenance and inspections of the deployable technologies are anticipated to be *less than significant* at the programmatic level, given that these activities are of low-intensity and short duration. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, FirstNet would not deploy the NPSBN and there would be *no impact* to ambient air quality at the programmatic level. By not deploying the NPSBN, FirstNet would avoid generating emissions from construction, installation, or operation of wired, wireless, or deployable infrastructure or technologies; satellites; and other technologies.

4.2.13. Noise and Vibration

4.2.13.1. Introduction

This section describes potential noise and vibration impacts from construction, deployment, and operation of the Proposed Action and Alternatives in Arkansas. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

4.2.13.2. Impact Assessment Methodology and Significance Criteria

The noise and vibration impacts of the Proposed Action were evaluated using the significance criteria presented in Table 4.2.13-1. As described in Section 4.2, Environmental Consequences, the categories of impacts are defined at the programmatic level as *potentially significant*, *less than significant with mitigation measures incorporated*, *less than significant*, or *no impact*.

Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

Given the nature of this programmatic evaluation, and because the Proposed Action could potentially cover a wide variety of actions that would take place in various landscapes, the potential noise and vibration impacts to Arkansas addressed in this section are presented as a range of possible impacts.

Table 4.2.13-1: Impact Significance Rating Criteria for Noise and Vibration at the Programmatic Level

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Increased noise and vibration levels	Magnitude or Intensity	Noise levels would exceed typical noise levels from construction equipment and generators. Noise levels at noise sensitive receptors (such as residences, hotels/motels/inns, hospitals, and recreational areas) would exceed 55 dBA or specific state noise limits. Noise levels plus baseline noise levels would exceeds 10 dBA increase from baseline noise levels (i.e., louder). Project noise levels near noise receptors at National Parks would exceed 65 dBA. Vibration levels would exceed 65 VdB for human receptors and 100 VdB for buildings.	Effect that is <i>potentially significant</i> , but with mitigation is <i>less than significant</i> .	Noise and vibration levels resulting from project activities would exceed natural sounds, but would not exceed typical noise and vibration levels from construction equipment or generators.	Natural sounds would prevail. Noise and vibration generated by the action (whether it be construction or operation) would be infrequent or absent, mostly immeasurable.
	Geographic Extent/Context	County or local.		County or local.	County or local.
	Duration or Frequency	Permanent or long-term.		Short term.	Temporary.

4.2.13.3. Description of Environmental Concerns

Increased Noise and Vibration Levels

The Proposed Action has the potential to generate noise and vibration during construction and operation of various equipment used for deployment. These noise and vibration levels could be above what is typically generated in a given area and may alter the ambient acoustical environment. If significant, the noise and vibration could cause impacts on residential areas, or other facilities that are sensitive to noise and vibration, such as churches, hospitals, or schools. The construction activities for deploying some of the various equipment evaluated under the Proposed Action could cause short-term impacts to nearby populations. However, it is likely that there would be less long-term effects from operational use of the proposed equipment (see Section 4.1.13, Noise and Vibration).

Based on the significance criteria presented in Table 4.2.13-1, noise and vibration impacts would likely be *less than significant* at the programmatic level given the size and nature of the majority of the proposed deployment activities. The majority of FirstNet's deployment activities would not be located in sensitive areas nor would a large number of noise or vibration sources be deployed/operated long-term in the same area. Noise and vibration levels from deployment activities are not expected to exceed typical noise and vibration levels for short-term/temporary construction equipment or generators.

To the extent practicable, FirstNet would attempt to mitigate or minimize noise and vibration effects during construction or operation. BMPs and mitigation measures could help to limit impacts on nearby noise-sensitive receptors. However, given that much of the construction and operation of the Proposed Action would often occur in populated areas, FirstNet would not be able to completely avoid noise or vibration impacts.

4.2.13.4. Potential Impacts of the Preferred Alternative

The following section assesses potential impacts associated with implementation of the Preferred Alternative, including construction, deployment, and operation activities.

Deployment Impacts

As described in Section 2.1, Proposed Action Infrastructure, implementing the Preferred Alternative could result in deploying various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure and the specific deployment requirements, some activities would result in potential noise and vibration impacts and while others would not. In addition, the same type of Proposed Action Infrastructure could result in a range of *no impacts to less than significant impacts* depending on the deployment scenario or site-specific conditions. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Activities Likely to Have No Impacts at the Programmatic Level

Of the types of facilities or infrastructure deployment scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are likely to have no noise and vibration impacts under the conditions described below:

- **Wired Projects**
 - **Use of Existing Conduit – New Buried Fiber Optic Plant:** Disturbance associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas. Noise and vibration generated by equipment required to install fiber would be infrequent and of short duration, and is not expected to create perceptible impacts.
 - **Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable:** Lighting up dark fiber would require no construction and have no noise or vibration impacts.
- **Satellites and Other Technologies**
 - **Satellite Enabled Devices and Equipment:** The duration of construction activities associated with installing permanent equipment on existing structures would most likely be short-term. It is anticipated that insignificant levels of noise and vibration would be emitted during installment of this equipment. Noise and vibration caused by these construction and installation activities would be similar to other construction activities in the area, such as the installation of cell phone towers or other communication equipment. Deployment and operation of satellite-enabled devices and equipment are expected to have minimal to *no impact* on the noise and vibration environment.
 - **Deployment of Satellites:** FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it could include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact noise or vibration resources, it is anticipated that this activity would have *no impact* on those resources.

Activities with the Potential for Noise and Vibration Impacts at the Programmatic Level

Construction, deployment, and operation activities related to the Preferred Alternative could create noise and vibration impacts from either the construction or operation of the infrastructure. The types of infrastructure deployment scenarios or deployment activities that could be part of the Preferred Alternative and result in potential impacts to noise and vibration include the following:

- **Wired Projects**
 - **New Build – Buried Fiber Optic Plant:** Plowing (including vibratory plowing), trenching, or directional boring and the construction of POPs, huts, or other associated facilities or hand-holes to access fiber as well as land/vegetation clearing, excavation activities, and landscape grading could result in high noise and vibration levels from the use of heavy equipment and machinery.
 - **New Build – Aerial Fiber Optic Plant:** The use of heavy equipment during the installation of new poles and hanging cables, as well as constructing access roads, POP

- huts, or other associated facilities to house plant equipment would be short term and could result in increased noise and vibration levels from the use of vehicles and machinery.
- Collocation on Existing Aerial Fiber Optic Plant: Excavation equipment used during potential pole replacement, and other heavy equipment used for structural hardening or reinforcement, could result in temporary increases in noise and vibration levels from the use of heavy equipment and machinery.
 - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Installation of new associated huts or equipment, if required, could result in short-term and temporarily higher noise and vibration levels if the activity required the use of heavy equipment for grading or other purposes.
 - New Build – Submarine Fiber Optic Plant: The installation of cables in limited inland bodies of water could generate noise and vibration if vessels are used to lay the cable. In addition, the construction of landings and/or facilities on shore to accept submarine cable could result in short-term and temporarily increased noise and vibration levels to local residents and other noise and vibration sensitive receptors from heavy equipment used for grading, foundation excavation, or other ground disturbing activities.
 - Installation of Optical Transmission or Centralized Transmission Equipment: Noise and vibration associated with the installation of optical transmission or centralized transmission equipment would be limited to the short-term, temporary use of vehicle and construction equipment. Long-term impacts are unlikely, as the noise from optical networks is relatively low, and vibration impacts do not occur. Heavy equipment used to grade and construct access roads could generate increased levels of noise and vibration over baseline levels temporarily.
- Wireless Projects
 - New Wireless Communication Towers: Activities associated with installing new wireless towers and associated structures (e.g., generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads could result in localized construction noise and vibration. Operating vehicles, other heavy equipment, and generators would be used on a short-term basis and could increase noise and vibration levels.
 - Collocation on Existing Wireless Tower, Structure, or Building: Vehicles and equipment used to mount or install equipment, or to grade or excavate additional land on sites for installation of equipment, such as antennas or microwave dishes on an existing tower, could temporarily impact the local noise environment and create vibrations.
 - Deployable Technologies: The type of deployable technology used would dictate the types of noise and vibration generated. For example, mobile equipment deployed via heavy trucks could generate noise and vibration from the internal combustion engines associated with the vehicles and onboard generators. With the exception of balloons, aerial platforms (e.g., UASs or other aircraft) generate noise during all phases of flight, including takeoff, landing, and flight operations over necessary areas that could impact the local noise and vibration environment.

In general, noise and vibration from the abovementioned activities would be products of site preparation, installation, and construction activities, as well as additional construction vehicles traveling on nearby roads and localized generator use. These impacts are expected to be *less than significant* at the programmatic level due to the temporary duration of deployment activities. Additionally, pre-existing noise and vibration levels achieved after some months (typically less than a year but could be a few hours for linear activities such as pole construction). Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

Operation activities associated with the Preferred Alternative would be *less than significant* at the programmatic level and similar to several of the deployment activities related to routine maintenance and inspection of the facilities because of the temporary nature of the activities which would not create new permanent sources of noise or vibration. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned construction impacts. It is anticipated that potential noise or vibration impacts would be similar to or less than those described for the deployment activities. If usage of vehicles or heavy equipment as part of routine maintenance or inspections or onsite generator use occurs, potential noise and vibration impacts could result as explained above. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

4.2.13.5. Alternatives Impact Assessment

The following section assesses potential noise and vibration impacts associated with the Deployable Technologies Alternative and the No Action Alternative.

Deployable Technologies Alternative

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific equipment associated with the Deployable Technologies Alternative would be heavy trucks with onboard generators, aerial vehicles (e.g., UASs or other aircraft), and ground support vehicles and equipment for aerial deployment. The stand-alone Deployable Technologies Alternative differs from the Preferred Alternative in the number of mobile and aerial vehicles likely to deploy, the distances traveled from storage locations and the duration of deployment. The potential noise and vibration impacts are as follows:

Deployment Impacts

Implementing deployable technologies could result in noise and vibration from mobile equipment deployed via heavy trucks, including not only onboard generators, but also the vehicles themselves. While a single deployable vehicle may have an insignificant impact, multiple vehicles operating for longer periods, in close proximity, may increase localized noise and vibration levels. Several vehicles traveling together could also create short-term noise and vibration impacts on residences or other noise-sensitive receptors as they pass by. With the exception of balloons, the deployment of aerial technology is anticipated to generate noise and vibration during all phases of flight. Aerial technologies would have the highest level of noise and vibration impact if they are required to fly above residential areas, areas with a high concentration of noise- and vibration-sensitive receptors (i.e., schools or churches), or over national parks or other areas where there is an expectation of quiet and serenity on their way to their final destinations. Residences near deployment areas for aerial technologies (i.e., airports or smaller airfields) could also be affected during takeoff and landing operations. Additionally, routine maintenance and inspections of the deployable technologies are anticipated to be *less than significant* at the programmatic level, given that these activities are of low-intensity and short duration. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

Operation activities associated with the Deployable Technologies Alternative would be similar to several of the deployment activities related to routine maintenance and inspection of the facilities. Operation of generators could also generate noise in the area. However, deployable technologies could be deployed to areas with few existing facilities, so noise impacts could be minimal in those areas. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned construction impacts. It is anticipated that potential noise and vibration impacts would be the same as those described for the deployment activities. If usage of vehicles or heavy equipment as part of routine maintenance or inspections occurs, potential noise impacts could result as explained above.

Operational impacts from aerial technologies would include repeated flyovers by UAS vehicles while they are needed in the area. This could generate *less than significant*, short-term impacts on any residential areas or other noise- or vibration-sensitive receptors under the flight path of these vehicles. However, once these operations cease, noise and vibration levels would quickly return to baseline levels. Chapter 16, BMPs and Mitigation Measures provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, FirstNet would not deploy the NPSBN and there would be *no impact* to ambient noise and vibration at the programmatic level. By not deploying NPSBN, FirstNet would avoid generating noise from construction, installation, or operation of wired, wireless, deployable infrastructure or satellites and other technologies.

4.2.14. Climate Change

4.2.14.1. Introduction

This section describes potential impacts to climate and climate change-vulnerable resources in Arkansas associated with deployment and operation of the Proposed Action and Alternatives. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

4.2.14.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on climate and potential climate change impacts on the Proposed Action's installations and infrastructure were evaluated using the significance criteria presented in Table 4.2.14-1. As described in Section 4.2, Environmental Consequences, the categories of impacts are defined at the programmatic level as *potentially significant, less than significant with mitigation measures incorporated, less than significant, or no impact*. Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

Given the nature of this programmatic evaluation, and because the Proposed Action could potentially cover a wide variety of actions that would take place in various landscapes, the potential impacts to climate and climate change-vulnerable resources addressed in this section are presented as a range of possible impacts.

CEQ requires the consideration of climate change from two perspectives. The first is the potential for impacts on climate change through GHG emissions resulting from the Proposed Action or alternatives. The second is related to the implications and possible effects of climate change on the environmental consequences of the Proposed Action or alternatives. This extends to the impacts of climate change on facilities and infrastructure that would be part of the Proposed Action or alternatives (CEQ, 2014).

In addition to the consideration of climate change's effects on environmental consequences, it also includes the impact that climate change may have on the projects themselves (CEQ, 2014). Projects located in areas that are vulnerable to the effects of climate change (e.g., sea level rise) may be at risk. Analysis of these risks through the NEPA process could provide useful information to the project planning to ensure these projects are resilient to the impacts of climate change.

Table 4.2.14-1: Impact Significance Rating Criteria for Climate Change at the Programmatic Level

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Contribution to climate change through GHG emissions	Magnitude or Intensity	See discussion below in Section 4.2.14.5, Potential Impacts of the Preferred Alternative	Effect that is <i>potentially significant</i> , but with mitigation is <i>less than significant</i> .	Only slight change observed.	No increase in greenhouse gas emissions or related changes to the climate as a result of project activities.
	Geographic Extent			Global impacts observed.	NA
	Duration or Frequency			Changes occur on a longer time scale. Changes cannot be reversed in the short term.	NA
Effect of climate change on FirstNet installations and infrastructure	Magnitude or Intensity	Climate change effects (such as sea level rise or temperature change) negatively impact FirstNet infrastructure.	Effect that is <i>potentially significant</i> , but with mitigation is <i>less than significant</i> .	Only slight change observed.	No measurable impact of climate change on FirstNet installations or infrastructure.
	Geographic Extent	Local and regional impacts observed.		Local and regional impacts observed.	NA
	Duration or Frequency	Long-term changes. Changes cannot be reversed in a short term.		Changes occur on a longer time scale. Changes cannot be reversed in the short term.	NA

NA = Not Applicable

4.2.14.3. *Projected Future Climate*

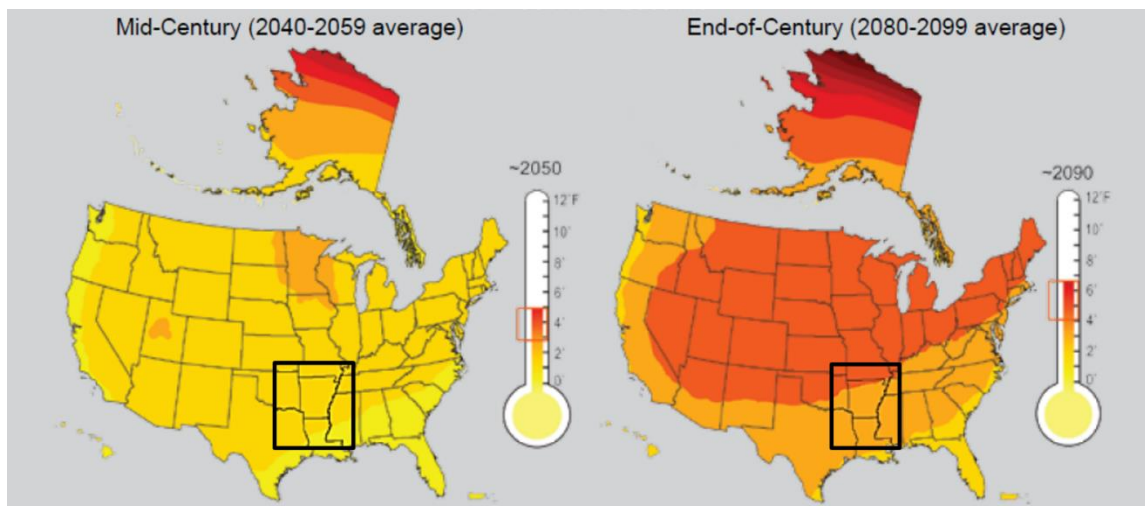
There have been increasing numbers of days above 95 °F and nights above 75 °F, and decreasing numbers of extremely cold days since 1970 in the Southeast. Temperatures across this section of the United States are expected to increase during this century. Major consequences of warming include significant increases in the number of hot days, defined as 95 °F or above, and decreases in freezing events. (USGCRP, 2014a)

Air Temperature

Figure 4.2.14-1 and Figure 4.2.14-2 illustrate the anticipated temperature changes for low and high GHG emission scenarios for Arkansas from a 1969 to 1971 baseline.

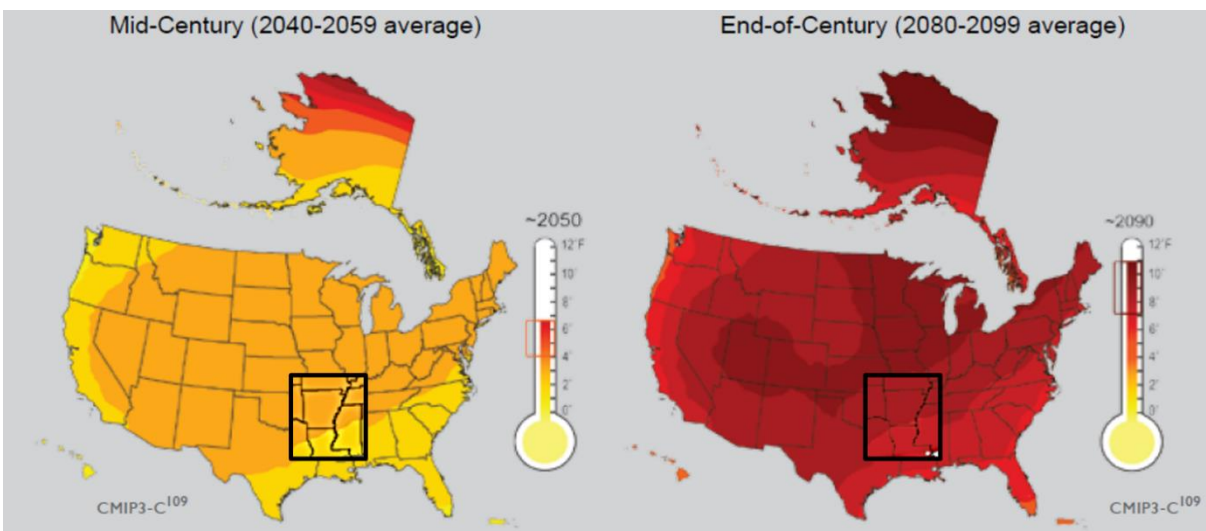
Cfa –Figure 4.2.14-1 shows that by mid-century (2040 to 2059), temperatures in the entire state under a low emissions scenario would increase by approximately 4 °F. By the end of the century (2080 to 2099) under a low emissions scenario in the majority of Arkansas temperatures would increase by approximately 5 °F and by 6 °F in the northwest corner. (USGCRP, 2009)

Figure 4.2.14-2 shows that under a high emissions scenario for the period (2040 to 2059), temperatures would increase by approximately 5 °F. Under a high emissions scenario for the period (2080 to 2099) in the Cfa region of Arkansas, temperatures would increase by approximately 9 °F in the majority of the state and by 8 °F in the southeastern corner. (USGCRP, 2009)



Source: (USGCRP, 2009)

Figure 4.2.14-1: Arkansas Low Emission Scenario Projected Temperature Change



Source: (USGCRP, 2009)

Figure 4.2.14-2: Arkansas High Emission Scenario Projected Temperature Change

Precipitation

Predicting future precipitation patterns in the Southeast are much less certain than projections for temperature. The Southeast is located in the transition zone between projected wetter conditions to the north and drier conditions to the southwest; therefore, many of the model projections show only small changes relative to natural variations. However, many models do project drier conditions in the far southwest portion of the region and wetter conditions in the far northeast portion of the region. (USGCRP, 2014b)

Total seasonal snowfall has generally decreased in southern and some western areas although snow is melting earlier in the year and more precipitation is falling as rain versus snow. Overall snow cover has decreased in the Northern Hemisphere, due in part to higher temperatures that shorten the time snow spends on the ground. (USGCRP, 2014b)

In the majority of Arkansas, there is an expected increase of about 10 percent in the number of consecutive dry days under a low emissions scenario by mid-century (2041 to 2070) as compared to the period (1971 – 2000). Under a high emissions scenario in the majority of the state there is a projected increase of about 20 percent in the number of consecutive dry days. An increase in consecutive dry days could lead to drought. (USGCRP, 2014b)

Figure 4.2.14-3 and Figure 4.2.14-4 show predicted seasonal precipitation change for an approximate 30-year period of 2071 to 2099 compared to a 1970 to 1999 approximate 30-year baseline.

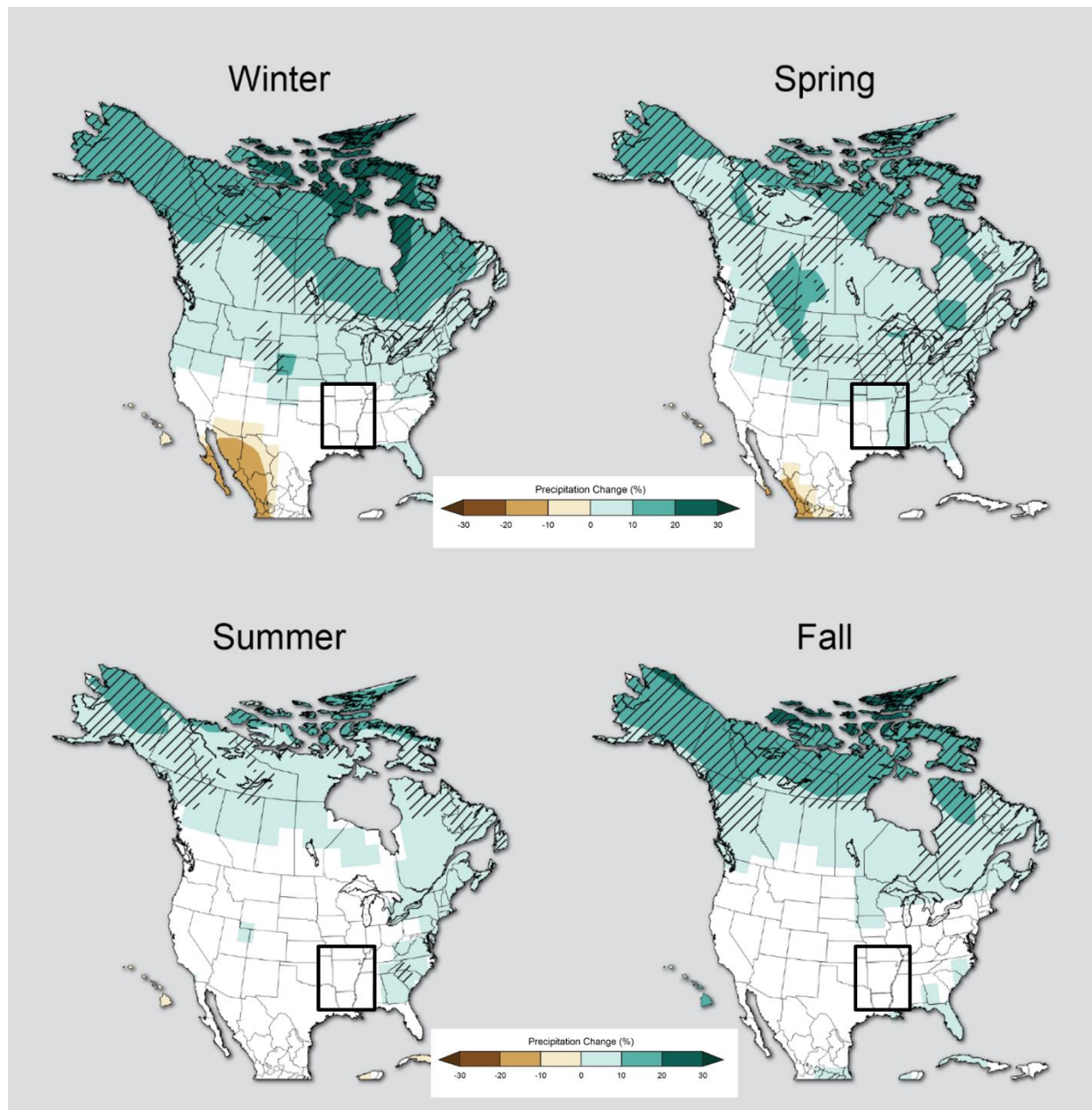
Figure 4.2.14-3 shows seasonal changes in a low emissions scenario, which assumes rapid reductions in emissions where rapid reductions means more than 70 percent cuts from current levels by 2050 (USGCRP, 2014b).

Figure 4.2.14-4 shows a high emissions scenario, which assumes continued increases in emissions, with associated large increases in warming and major precipitation changes. (Note:

white areas in the figures indicate that the changes are not projected to be larger than could be expected from natural variability.) (USGCRP, 2014b)

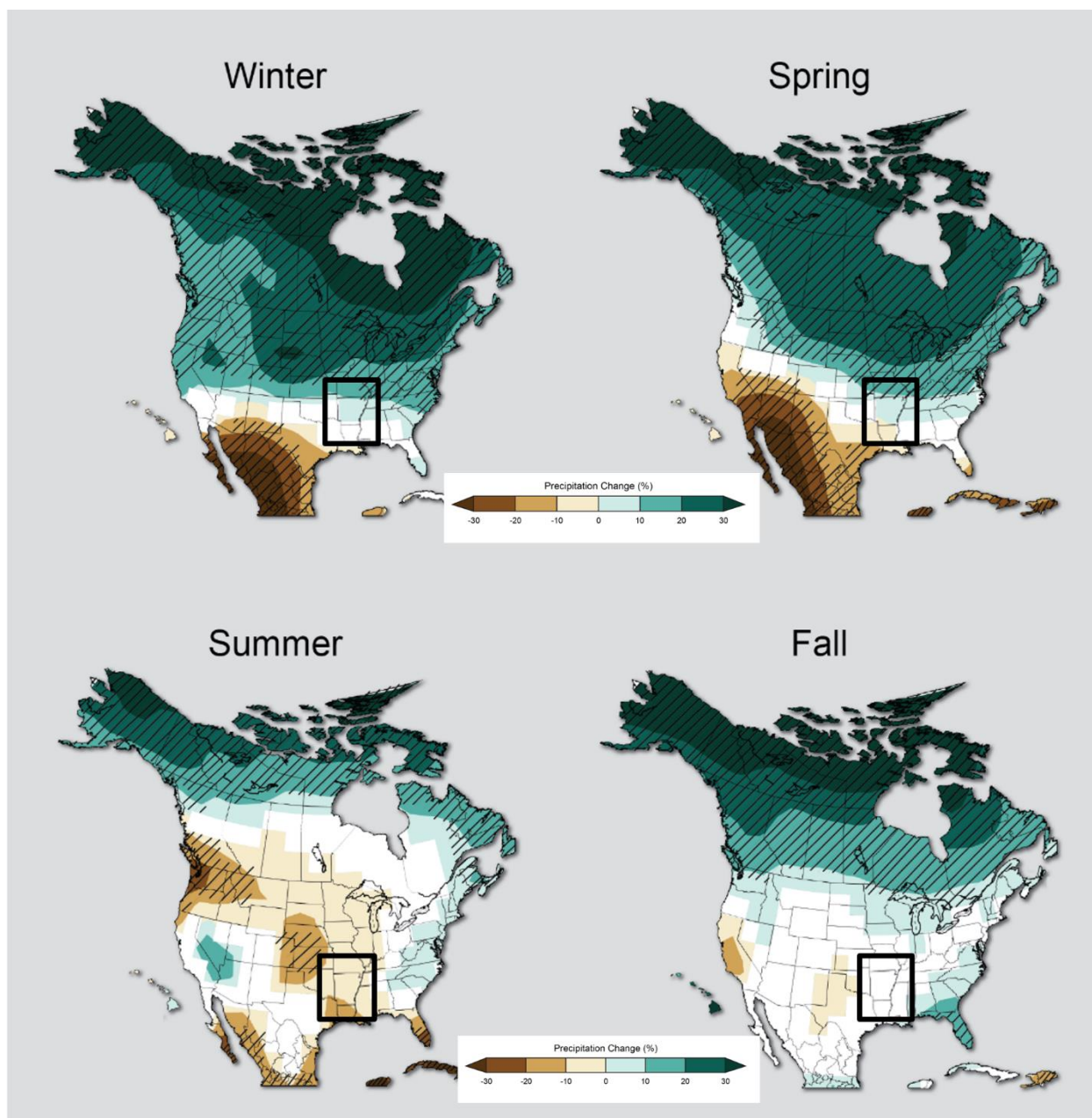
Cfa - Figure 4.2.14-3 shows that in a low emissions scenario in the 30-year period for 2071 to 2099, there are no expected changes to precipitation in winter, summer, or fall. In spring, precipitation would increase by 10 percent in some areas of the state while other portion of the state are not expected to have any fluctuations in precipitation other than fluctuations due to natural variability. (USGCRP, 2014b)

Figure 4.2.14-4 shows that if emissions continue to increase, winter and spring precipitation could increase as much as 10 percent over the period 2071 to 2099 in the majority of the state while some southern portions of the state are not expected to have any changes in precipitation. In summer, precipitation in this scenario could decrease as much as 10 percent in the southeastern corner of the state while the remainder of the state is not expected to have any changes to precipitation. No significant change to fall precipitation is anticipated over the same period. (USGCRP, 2014b)



Source: (USGCRP, 2014b)

Figure 4.2.14-3: Predicted Seasonal Precipitation Change for 2071 to 2099 Compared to 1970 to 1999 Baseline in a Low Emissions



Source: (USGCRP, 2014b)

Figure 4.2.14-4: Predicted Seasonal Precipitation Change for 2071 to 2099 Compared to 1970 to 1999 Baseline in a High Emissions Scenario

Severe Weather Events

It is difficult to forecast the impact of climate change on severe weather events such as winter storms and thunderstorms. Trends in thunderstorms are subject to greater uncertainties than trends in temperature and associated variables directly related to temperature such as sea level rise. Climate scientists are studying the influences of climate change on severe storms. Recent research has yielded insights into the connections between warming and factors that cause severe

storms. For example, atmospheric instability and increases in wind speed with altitude link warming with tornadoes and thunderstorms. Additionally, research has found a link between warming and conditions favorable for severe thunderstorms. However, more research is required to make definitive links between severe weather events and climate change. (USGCRP, 2014c)

4.2.14.4. Description of Environmental Concerns

Greenhouse Gas Emissions

Increases in GHG emissions have altered the global climate, leading to generalized temperature increases, weather disruption, increased droughts and heatwaves, and may have potentially catastrophic long-term consequences for the environment. Although GHGs are not yet regulated by the federal government, many states have set various objectives related to reducing GHG emissions, particularly CO₂ emissions from fossil fuels.

Based on the impact significance criteria presented in Table 4.2.14-1, climate change impacts as a result of GHG emissions could be significant and require a quantitative analysis if FirstNet's deployment of technology was responsible for increased emissions. The GHG emissions resulting from FirstNet activities fall into two categories: short-term and long-term. Short-term emissions could be associated with deployment activities (vehicles and other motorized construction equipment) and would have no long-term or permanent impact on GHG emissions or climate change. Long-term (both temporary and permanent) emission increases could result from operations, including the use of grid-provided electricity by FirstNet equipment such as transmitters and optical fiber, and from the temporary use of portable or onsite electric generators (a less efficient, more carbon-intensive source of electricity), during emergency situations when the electric grid was down, for example after a hurricane.

Climate Change

Climate change may increase project-related impacts by magnifying or otherwise altering impacts in other resources areas. For example, climate change may impact air quality, water resource availability, and recreation. These effects would vary from state to state depending on the resources in question and their relationship to climate change. These impacts will be considered fully in Chapter 18, Cumulative Impacts. No BMPs will be described for this aspect of the resource.

Forested areas of the Southeast, including Arkansas, may be at a higher risk of wildland fires, particularly during the periods of extended drought that are forecasted under warming scenarios. This may permanently change forest ecosystems (Mitchell, 2014). Wildland fires will also threaten lives and property and potentially impede first responders.

Climate change impacts on FirstNet installations and infrastructure will vary from state to state, depending on the placement and vulnerability of the installations and infrastructure, and the impacts that climate change is anticipated to have in that particular location.

Although Arkansas is a land-locked state out of the immediate path of hurricanes and other coastal severe weather, it is nevertheless at risk of flooding from these and other extreme

precipitation events. Climate change is projected to increase the frequency and severity of torrential downpours, which in turn may increase the potential for flash floods. (USGCRP, 2014c) Extended periods of extreme heat may impede the operation of the grid in the South (DOE, 2015) and overwhelm the capacity of onsite equipment needed to keep microwave and other transmitters cool.

Based on the impact significance criteria presented in Table 4.2.14-1: Impact Significance Rating Criteria for Climate, climate change effects on FirstNet installations and infrastructure would be significant if they negatively affected the operation of these facilities.

4.2.14.5. Potential Impacts of the Preferred Alternative

Greenhouse Gas Emissions

Given this assessment is programmatic and does not include any site-specific locations or deployment technology, it is impossible to determine the actual GHG emissions associated with any of the action alternatives. This information could only be captured once the site-specific information is determined. However, an assessment of potential impacts is provided in this section based on the potential emissions associated with the various activities that could occur as a result of the implementation of the Preferred Alternative, in Arkansas, including deployment and operation activities.

As described in Section 2.1, Proposed Action Infrastructure, implementation of the Preferred Alternative could result in the deployment and operation of various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure and the specific deployment requirements, some activities would result in potential impacts to GHG emissions, climate impacts in other resource areas, and FirstNet infrastructure and operations, and others would not. In addition, and as explained in this section, the same type of Proposed Action Infrastructure could result in a range of *no impacts to less than significant impacts* at the programmatic level with BMPs and mitigation measures incorporated depending on the deployment scenario or site-specific conditions.

Activities Likely to Have No Impacts at the Programmatic Level

Of the types of facilities or infrastructure deployment scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are likely to have *no impacts* to climate change under the conditions described below:

- **Wired Projects**
 - **Use of Existing Conduit – New Buried Fiber Optic Plant:** There would be no short-term emissions associated with construction, as construction would not take place. The equipment required to blow or pull fiber through existing conduit would be used temporarily and infrequently, resulting in no perceptible generation of GHG emissions.
 - **Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable:** Lighting up dark fiber would require no construction and have no short- or long-term emissions. This would create no perceptible change in GHG emissions.

- **Satellites and Other Technologies**
 - **Distribution of Satellite Enabled Devices and Equipment:** The installation of satellite-enabled equipment on existing structures, or the use of portable satellite-enabled devices would not create any perceptible changes in GHG emissions because they would not create any new emissions sources.
 - **Deployment of Satellites:** FirstNet does not anticipate launching satellites as part of the NPSBN; however, it could include equipment on satellites that are already being launched for other purposes. Therefore it is anticipated that there would be no GHG emissions or any climate change effects on the project because these activities.

Activities with the Potential to Have Impacts at the Programmatic Level

The deployment and use of energy-consuming equipment as a result of the implementation of the Preferred Alternative would result in GHG emissions whose significance would vary depending on their power requirements, duration and intensity of use, and number. The types of infrastructure deployment scenarios that could be part of the Preferred Alternative and result in *potential impacts* to GHG emissions and climate change include the following:

- **Wired Projects**
 - **New Build - Buried Fiber Optic Plant:** This activity would include plowing (including vibratory plowing), trenching, and directional boring, and could involve construction of POPs, huts, or other facilities to house outside plant equipment or hand holes to access fiber. These activities could generate GHG emissions.
 - **New Build Aerial Fiber Optic Plant:** These projects would require construction equipment for installing or replacing new poles and hanging cables as well as excavation and grading for new or modified right-of-ways or easements. It could also include construction of POPs, huts, or other facilities to house outside plant equipment. These activities could generate GHG emissions.
 - **Collocation on Existing Aerial Fiber Optic Plant:** These projects would require equipment for replacement of existing wiring and poles. GHG emissions associated with these projects would arise from use of machinery and vehicles to complete these activities.
 - **New Build – Submarine Fiber Optic Plant:** The deployment of small work boats with engines similar to recreational vehicle engines may be required to transport and lay small wired cable. The emissions from these small marine sources would contribute to GHGs.
 - **Installation of Optical Transmission or Centralized Transmission Equipment:** The construction of small boxes or huts or other structures would require construction equipment, which could generate GHG emissions
- **Wireless Projects**
 - **New Wireless Tower Construction:** Installation of new wireless towers and associated structures (generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads could result in short-term, temporary GHG emissions from vehicles and construction equipment. Long-term, permanent or temporary increases in GHG emissions would result from the electricity

- requirements of the towers (both grid-provided and back-up), and would depend on their size, number, and the frequency and duration of their use.
- Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on existing towers. There would be no short-term GHG emissions associated with construction, as it would not occur. Minor, short-term, temporary GHG emissions may result from any associated equipment used for installation, such as cranes or other equipment. Long-term, permanent or temporary increases in GHG emissions would result from the electricity requirements of the towers (both grid-provided and back-up), and would depend on their size, number, and the frequency and duration of their use.
 - Deployable Technologies
 - COWs, COLTs, SOWs: The long-term operations of these mobile systems have the potential to have GHG emission impacts if operated in large numbers over the long-term. However this would be highly dependent on their size, number, and the frequency and duration of their use.
 - Emissions associated with the deployment and maintenance of a complete network solution of this type may be *potentially significant* if large numbers of piloted or unpiloted aircraft were used for a sustained period of time (i.e., months to years). Emissions would depend on the type of platforms used, their energy consumption, and the duration of the network's operation.

Potential climate change impacts associated with deployment activities as a result of implementation of the Preferred Alternative include increased GHG emissions. These emissions would arise from the combustion of fuel used by equipment during construction and operation. The total potential level of GHG emissions would be *less than significant* at the programmatic level; although geographically large (all 50 states, 5 territories, and the District of Columbia) any one site would be limited in extent and emit minor levels of GHG emissions as explained in the analysis. Land use related emissions occurring as a result of soil disturbance and loss of vegetation are expected to be *less than significant* at the programmatic level due to the limited and localized nature of deployment activities. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Climate Change Impacts on FirstNet Deployable Infrastructure or Operations

At the programmatic level, climate change effects on the Preferred Alternative could be *potentially significant to less than significant with BMPs and mitigation measures incorporated* because climate change may potentially impact FirstNet installations or infrastructure during periods of extreme heat, severe storms, and other weather events. FirstNet installations should be evaluated in the design and planning phase through tiering to this analysis, in the context of their local geography and anticipated climate hazards to ensure they are properly hardened or there is sufficient redundancy to continue operations in a climate-affected environment. Mitigation measures could minimize or reduce the severity or magnitude of a potential impact resulting to the project, including adaptation, which refers to anticipating adverse effects of

climate change and taking appropriate action to prevent and minimize the damage climate change effects could cause.

Climate change's anticipated impact on extreme weather events such as hurricanes or heat waves may increase the severity of the emergencies to which first responders are responding in vulnerable areas, and thus the extent and duration of their dependence on FirstNet resources. FirstNet would likely prepare to sustain these operations in areas experiencing climate and weather extremes through the design and planning process for individual locations and operations.

4.2.14.6. Alternatives Impact Assessment

The following section assesses potential impacts to climate associated with the Deployable Technologies Alternative and the No Action Alternative.

Deployable Technologies Alternative

Under the Deployable Technologies Alternative, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration.

Deployment Impacts

As explained above, implementation of deployable technologies could involve use of fossil-fuel-powered vehicles, powered generators, and/or aerial platforms. There could be some emissions and soil and vegetation loss as a result of excavation and grading for staging and/or landing areas depending on the type of technology. GHG emissions are expected to be *less than significant* at the programmatic level based on the defined significance criteria, since activities would be temporary and short-term. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Operations Impacts

Implementing land-based deployable technologies (COW, COLT, and SOW) could result in emissions from mobile equipment on heavy trucks using internal combustion engines associated with the vehicles and onboard generators. While a single deployable vehicle may have a *less than significant* impact, multiple vehicles operating for longer periods, in close proximity, may have a cumulative impact, although this impact is expected to be *less than significant* at the programmatic level due to the temporary nature of the operation of deployables. Some staging or landing areas (depending on the type of technology) may require excavation, site preparation,

and paving. Heavy equipment used for these activities could produce emissions as a result of burning fossil fuels in internal combustion engines. The operation of aerial technology is anticipated to generate pollutants during all phases of flight, except for balloons. These activities are expected to be *less than significant* at the programmatic level due to the limited duration of deployment activities. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Additionally, routine maintenance and inspections of the deployable technologies are anticipated to be *less than significant* at the programmatic level, given that these activities are of low-intensity and short duration.

Climate Change Impacts on FirstNet Deployable Infrastructure or Operations

Climate change effects have the most noticeable impacts over a long period. Climate change effects such as temperature, precipitation changes, and extreme weather during operations would be expected but could have little to *no impact* at the programmatic level on the deployed technology due to the temporary nature of deployment. However, if these technologies are deployed continuously (at the required location) for an extended period, climate change effects on deployables could be similar to the Proposed Action, as explained above. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed; therefore, there would be no associated construction or installation of wired, wireless, deployable infrastructure, or satellites and other technologies. Therefore, there would be *no impacts* to GHG emissions or climate at the programmatic level as a result of the No Action Alternative. Environmental conditions would therefore be the same as those described in Section 4.1.14, Climate Change.

4.2.15. Human Health and Safety

4.2.15.1. Introduction

This section describes potential impacts to human health and safety in Arkansas associated with deployment of the Proposed Action and Alternatives. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

4.2.15.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on human health and safety were evaluated using the significance criteria presented in Table 4.2.15-1. As described in Section 4.2, Environmental Consequences, the categories of impacts are defined as *potentially significant*, *less than significant with mitigation measures incorporated*, *less than significant*, or *no impact*.

Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

Given the nature of this programmatic evaluation, and because the Proposed Action could potentially cover a wide variety of actions that would take place in various landscapes, the potential impacts to human health and safety addressed in this section are presented as a range of possible impacts.

Table 4.2.15-1: Impact Significance Rating Criteria for Human Health and Safety at the Programmatic Level

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Exposure to Worksite Occupational Hazards as a Result of Activities at Existing or New FirstNet Sites	Magnitude or Intensity	Exposure to concentrations of chemicals above occupational regulatory limits and time weighted averages. A net increase in the amount of hazardous or toxic materials or wastes generated, handled, stored, used, or disposed of, resulting in unacceptable risk, exceedance of available waste disposal capacity and probable regulatory violations. Exposure to recognized workplace safety hazards (physical and chemical). Violations of various regulations including: OSHA, RCRA, CERCLA, TSCA, EPCRA.	Effect is <i>potentially significant</i> , but with mitigation is <i>less than significant</i> at the programmatic level.	No exposure to chemicals above health-protective screening levels. Hazardous or toxic materials or wastes could be safely and adequately managed in accordance with all applicable regulations and policies, with limited exposures or risks. No exposure to unsafe working conditions or other workplace safety hazards.	No exposure to chemicals, unsafe working conditions, or other workplace safety hazards.
	Geographic Extent	Regional impacts observed (“regional” assumed to be at least a county or county-equivalent geographical extent, could extend to state/territory).		Impacts only at a local/neighborhood level, as opposed to throughout the state or territory.	NA
	Duration or Frequency	Occasional frequency during the life of the project.		Rare event.	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Exposure to Hazardous Materials, Hazardous Waste, and Mine Lands as a Result of FirstNet Site Selection and Site-Specific Land Disturbance Activities	Magnitude or Intensity	Exposure to concentrations of chemicals above regulatory limits, or USEPA chemical screening levels protective of the public. A net increase in the amount of hazardous or toxic materials or wastes generated, handled, stored, used, or disposed of, resulting in unacceptable risk, exceedance of available waste disposal capacity and probable regulatory violations. Site contamination conditions could preclude development of sites for the proposed use. Violations of various regulations including OSHA, RCRA, CERCLA, TSCA, EPCRA. Unstable ground and seismic shifting.	Effect is <i>potentially significant</i> , but with mitigation is <i>less than significant</i> at the programmatic level.	No exposure to chemicals above health-protective screening levels. Hazardous or toxic materials or wastes could be safely and adequately managed in accordance with all applicable regulations and policies, with limited exposures or risks. No exposure to unstable ground conditions or other workplace safety hazards.	No exposure to chemicals, unstable ground conditions, or other workplace safety hazards.
	Geographic Extent	Regional impacts observed (“regional” assumed to be at least a county or county-equivalent geographical extent, could extend to state/territory).		Impacts only at a local/neighborhood level, as opposed to throughout the state or territory.	NA
	Duration or Frequency	Occasional frequency during the life of the project.		Rare event.	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Exposure to Hazardous Materials, Hazardous Waste, and Occupational Hazards as a Result of Natural And Manmade Disasters	Magnitude or Intensity	Exposure to concentrations of chemicals above regulatory limits, or USEPA chemical screening levels protective of the public. Site contamination conditions could preclude development of sites for the proposed use. Physical and biologic hazards. Loss of medical, travel, and utility infrastructure.	Effect is <i>potentially significant</i> , but with mitigation is <i>less than significant</i> at the programmatic level.	No exposure to chemicals above health-protective screening levels. Hazardous or toxic materials or wastes could be safely and adequately managed in accordance with all applicable regulations and policies, with limited exposures or risks. No exposure to unsafe conditions. No loss of medical, travel, or utility infrastructure.	No exposure to chemicals, unsafe conditions, or other safety and exposure hazards.
	Geographic Extent	Regional impacts observed (“regional” assumed to be at least a county or county-equivalent geographical extent, could extend to state/territory).		Impacts only at a local/neighborhood level, as opposed to throughout the state or territory.	NA
	Duration or Frequency	Occasional frequency during the life of the project.		Rare event.	NA

NA = Not Applicable

4.2.15.3. *Description of Environmental Concerns*

Worksite Physical Hazards, Hazardous Materials, and Hazardous Waste

The human health and safety concern having the greatest likelihood to occur during FirstNet deployment activities is occupational injury to telecommunication workers. The nature of telecommunication work requires workers to execute job responsibilities that could sometimes be hazardous. Telecommunication work activities present physical and chemical hazards to workers. The physical hazards have the potential to cause acute injury, long-term disabilities, or in the most extreme incidents, death. Other occupational activities such as handling hazardous materials and hazardous waste often do not result in acute injuries, but may compound over multiple exposures, resulting in increased morbidity. Based on the impact significance criteria presented in Table 4.2.15-1, occupational injury impacts could be *potentially significant* if the FirstNet deployment locations require performing occupational activities that have the highest relative potential for physical injury and/or chemical exposure. Examples of activities that may present increased risk and higher potential for injury include working from heights (i.e., from towers and roof tops), ground-disturbing activities like trenching and excavating, confined space entry, operating heavy equipment, and the direct handling of hazardous materials and hazardous waste. Predominately, these hazards are limited to occupational workers, but may impact the general public if there are trespassers or if any physical or chemical hazard extends beyond the restricted access of proposed FirstNet work sites.

To protect occupational workers, the OSHA mandates that employers be required to protect their employees from occupational hazards that could result in injury. Depending on the source of the hazard and the site-specific work conditions, OSHA generally recommends the following hierarchy for protecting onsite workers. (OSHA, 2017)

- Engineering controls;
- Work practice controls;
- Administrative controls; and
- Personal protective equipment (PPE).

Engineering controls are often physical barriers that prevent access to a worksite, areas of a worksite, or from idle and operating equipment. Physical barriers take many forms like perimeter fences, trench boxes,¹⁴⁸ chain locks, bollards, storage containers (for storing equipment and chemicals), or signage and caution tape. Other forms of engineering controls could include machinery designed to manipulate the quality of the work environment, such as ventilation blowers. Whenever practical, engineering controls may result in the complete removal of the hazard from the work site, an example of which would be the transport and offsite disposal of hazardous waste or asbestos containing materials.

Work practice controls could be implemented as abiding by specific OSHA industry standards, such as the Confined Space Entry standard (29 CFR 1910.146) or thru the development of

¹⁴⁸ Trench boxes are framed metal structures inserted into open trenches to support trench faces, to protect workers from cave-ins and similar incidents (OSHA, 2016e).

employer specific workplace rules and operational practices (OSHA, 2017). To the extent practicable, FirstNet's partner(s) would likely implement and abide by work practice controls through employee safety training and by developing site-specific health and safety plans (HASP). The HASPs would identify all potential hazardous materials and hazardous wastes, potential physical hazards, and applicable mitigation steps. Other components of a HASP identifying appropriate PPE for each task and the location of nearby medical facilities. Safety Data Sheets (SDS) describing the physical and chemical properties of hazardous materials used during FirstNet deployment and maintenance activities, as well as the physical and health hazards, routes of exposure, and precautions for safe handling and use would be kept and maintained at all FirstNet project sites. In addition to HASPs and safety data sheets, SOPs would be developed and implemented by FirstNet partner(s) for critical and/or repetitive tasks that require attention to detail, specialized knowledge, or clear step-wise directions to prevent worker injury and to ensure proper execution.

Administrative controls are employer-initiated methods to reduce the potential for injury and physical fatigue. Administrative controls may take the form of limiting the number of hours an employee is allowed to work per day, requiring daily safety meetings before starting work, utilizing the buddy system for dangerous tasks and any other similar activity or process that is designed to identify and mitigate unnecessary exposure to hazards. When engineering controls, work practice controls, and administrative controls are not feasible or do not provide sufficient protection, employers must also provide appropriate PPE to their employees and ensure its proper use. PPE is the common term used to refer to the equipment worn by employees to minimize exposure to chemical and physical hazards. Examples of PPE include gloves, protective footwear, eye protection, protective hearing devices (earplugs, muffs), hard hats, fall protection, respirators, and full body suits. PPE is the last line of defense to prevent occupational injuries and exposure. (OSHA, 2017)

Arkansas does not have an OSHA-approved "state plan." Therefore, OSHA enforces private sector occupational safety and health programs in Arkansas, and public sector programs are enforced under the AOSH Compliance Program. The ADH monitors public health.

Hazardous Materials, Hazardous Waste, and Mine Lands

The presence of environmental contamination and mine lands at FirstNet deployment sites has the potential to negatively impact health and safety of workers and the general public. Past or present contaminated media, such as soil and groundwater, may be present and become disturbed as a result of site activities. Mines may cause unstable surface and subsurface conditions because of underground shaft collapses or seismic shifting. Based on the impact significance criteria presented in Table 4.2.15-1, human health impacts could be significant if FirstNet deployment sites are near contaminated properties or abandoned mine lands. Prior to the start of any FirstNet deployment project, potential site locations should be screened for known environmental contamination and/or mining activities using federal resources such as the USEPA Cleanups in My Community database and U.S. Department of Interior's Abandoned Mine Lands inventory, through the ADEQ, or through an equivalent commercial resource.

By screening sites for environmental contamination, mining activities, and reported environmental liabilities, the presence of historic contamination and unsafe ground conditions could be evaluated and may influence the site selection process. In general, the lower the density of environmental contamination or mining activities, the more favorable the site will be for FirstNet deployment projects. If sites containing known environmental contamination (or mine lands) are selected for proposed FirstNet deployment activities it may be necessary to implement additional controls (e.g., engineering, work practice, administrative, and/or PPE) to ensure workers, and the general public, are not unnecessarily exposed to the associated hazards. Additionally, for any proposed FirstNet deployment site, it is possible undocumented environmental contamination is present.

During FirstNet deployment activities, if any soil or groundwater is observed to be stained or emitting an unnatural odor, it may be an indication of environmental contamination. When such instances are encountered, it may be necessary to stop work until the anomaly is further assessed through record reviews or environmental sampling. Proposed FirstNet deployment would attempt to avoid known contaminated sites. However, in the event that FirstNet is unable to avoid a contaminated site, then site analysis and remediation would be required under RCRA, CERCLA, Superfund, and applicable Arkansas state laws in order to protect workers and the public from direct exposure or fugitive contamination.

Exposure assessments identify relevant site characteristics, temporal exposure parameters, and toxicity data to determine the likelihood of adverse health effects. More formally known as a human health risk assessment (HHRA), these studies provide mathematical justification for implementing controls at the site to protect human health. If the HHRA determines the potential for adverse health effects is too great ADEQ may require FirstNet to perform environmental clean-up actions at the site to lower the existing levels of contamination. HHRA's help determine which level of PPE (i.e., Level D, Level C, Level B, or Level A) is necessary for a work activity. HHRA's take into account all exposure pathways: absorption, ingestion, inhalation, and injection. Therefore, specific protective measures (e.g., controls and PPE) that disrupt the exposure pathways could be identified, prioritized, and implemented.

Natural and Manmade Disasters

The impacts of natural and manmade disasters are likely to present unique health and safety hazards, as well as exacerbate pre-existing hazards, such as degrading occupational work conditions and disturbing existing environmental contamination. The unique hazards presented by natural and manmade disasters may include, fire, weather incidents (e.g., floods, tornadoes, hurricanes, etc.), earthquakes, vandalism, large- or small-scale chemical releases, utility disruption, community evacuations, or any other event that abruptly and drastically denudes the availability or quality of transportation infrastructure, utility infrastructure, medical infrastructure, and sanitation infrastructure. Additionally, such natural and manmade disasters could directly impact public safety communication infrastructure assets through damage or destruction.

Based on the impact significance criteria presented in Table 4.2.15-1, human health impacts could be significant if FirstNet deployment sites are located in areas that are directly impacted by natural and manmade disasters that could lead to exposure to hazardous wastes, hazardous materials, and occupational hazards. FirstNet's emphasis on public safety-grade communications infrastructure may result in a *less than significant* beneficial impact at the programmatic level, as new infrastructure could be deployed with additional structural hardening, and existing infrastructure may also be hardened as appropriate and feasible, in an effort to reduce the possibility of infrastructure damage or destruction to some degree.

Potential mitigation measures for natural disasters is to be aware of current weather forecasts, forest fire activities, seismic activities, and other news worthy events that may indicate upcoming disaster conditions. Awareness provides time and opportunity to plan evacuation routes, to relocate critical equipment and parts, and to schedule appropriate work activities preceding and after the natural disaster. These mitigation steps reduce the presence of workers and dangerous work activities to reduce the potential for injury or death. Manmade disasters could be more difficult to anticipate due to the unexpected or accidental nature of the disaster. Though some manmade disasters are due to malicious intentions, many manmade disasters result from human error or equipment failure. The incidence of manmade disasters affecting FirstNet deployment sites would be difficult to predict and diminish because the source of such disasters is most likely to originate from sources independent of FirstNet activities. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

4.2.15.4. Potential Impacts of the Preferred Alternative

The following section assesses potential impacts associated with implementation of the Preferred Alternative, including deployment and maintenance activities.

Deployment Impacts

As described in Section 2.1, Proposed Action Infrastructure, implementation of the Preferred Alternative could result in the deployment of various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure and the specific deployment requirements, some activities would result in potential impacts to human health and safety and others would not. In addition, and as explained in this section, the same type of Proposed Action Infrastructure could result in a range of *no impacts* to *less than significant* with mitigation, depending on the deployment scenario or site-specific activities. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Activities Likely to Have No Impacts at the Programmatic Level

Of the types of facilities or infrastructure deployment scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are likely to have *no impacts* to human health and safety under the conditions described below:

- **Wired Projects**
 - **Use of Existing Conduit – New Buried Fiber Optic Plant:** the pulling or blowing of fiber optic cable would be performed through existing conduit. Use of mechanical equipment would be limited to pulley systems and blowers. Some locations with no existing power supply may require the use of electrical generators. Hazardous materials needed for this work would include fiber optical cable lubricants, mechanical oil/grease, and fuel for electrical generators although these materials are expected to be used infrequently and in small quantities. These activities are not likely to result in serious injury or chemical exposure, or surface disturbances since work would be limited to existing entry and exit points, would be temporary, and intermittent. It is anticipated that there would *be no impacts* at the programmatic level to human health and safety.
 - **Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable:** Lighting up of dark fiber would have *no impacts* at the programmatic level to human health and safety, because there would be no ground disturbance or heavy equipment used.
- **Satellites and Other Technologies**
 - **Deployment of Satellites:** FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it could include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact human health and safety resources, it is anticipated that this activity would have *no impact* at the programmatic level on human health and safety.

Activities with the Potential to Have Impacts at the Programmatic Level

Potential deployment-related impacts to human health and safety as a result of implementation of the Preferred Alternative would encompass a range of impacts that occur as a result of ground disturbance activities, construction activities, equipment upgrade activities, management of hazardous materials and/or hazardous waste, and site selection. The types of infrastructure development scenarios or deployment activities that could be part of the Preferred Alternative and result in potential impacts to human health and safety include the following:

- **Wired Projects**
 - **New Build – Buried Fiber Optic Plant:** Plowing (including vibratory plowing), trenching, or directional boring and the construction of POPs, huts, or other associated facilities or hand-holes to access fiber would require the use of heavy equipment and hazardous materials. The additional noise and activity at the site would require workers to demonstrate a high level of situational awareness. Failure to follow OSHA and industry controls could result in injuries. Excavation of soil at proposed sites known to contain environmental contamination has the potential to expose workers to harmful chemicals or releases that could impact the general public in the immediate vicinity. Additionally, some of this work would likely be performed along road right-of-ways, increasing the potential for vehicle traffic to collide with site workers or equipment. If a proposed deployment activity involves the operation of heavy equipment, managing hazardous

materials and hazardous waste management, or other site location challenges, there could be potential human health and safety impacts to consider.

- New Build – Aerial Fiber Optic Plant: Installation of new poles and fiber optic lines could require excavation activities, working from heights, use of hazardous materials, and site locations in right-of-ways. Hazards associated with the site work include injury from heavy equipment, fall hazards, chemical hazards, and the potential for vehicle traffic to collide with site workers or equipment. Excavation of soil at proposed sites known to contain environmental contamination has the potential to expose workers to harmful chemicals or releases that could impact the general public in the immediate vicinity. If a proposed deployment activity involves the operation of heavy equipment, hazardous materials and hazardous waste management, or other site location challenges, there could be potential human health and safety impacts to consider.
- Collocation on Existing Aerial Fiber Optic Plant: Installation of overhead fiber optic lines would require work from height. In some instances, new poles would be installed requiring excavation activities with heavy equipment. Hazards associated with the site work include injury from heavy equipment, fall hazards, chemical hazards, and the potential for vehicle traffic to collide with site workers or equipment. Excavation of soil at proposed sites known to contain environmental contamination has the potential to expose workers to harmful chemicals or releases that could impact the general public in the immediate vicinity. If a proposed deployment activity involves the operation of heavy equipment, hazardous materials and hazardous waste management, or other site location challenges, there could be potential human health and safety impacts to consider.
- New Build – Submarine Fiber Optic Plant: The installation of fiber optic cables in limited inland bodies of water requires workers to operate over aquatic and/or marine environments, which presents opportunities for drowning. When working over water exposure to sun, high or low temperatures, wind, and moisture could impact worker safety. Construction of landings and/or facilities on shores or banks of waterbodies to accept submarine cable would require site preparation, construction, and management of hazardous materials and hazardous waste. Excavation of soils or sediments at proposed sites known to contain environmental contamination may result in workers being exposed to harmful chemicals or releases that could impact the general public in the immediate vicinity. If a proposed deployment activity involves the operation of heavy equipment, hazardous materials and hazardous waste management, or other site location challenges, there could be potential human health and safety impacts to consider.
- Installation of Optical Transmission or Centralized Transmission Equipment: Installation of transmission equipment would require site preparation, construction activities, and management of hazardous materials and hazardous waste. Excavation of soils at proposed sites known to contain environmental contamination may result in workers being exposed to harmful chemicals or releases that could impact the general public in the immediate vicinity. If a proposed deployment activity involves the operation of heavy equipment, hazardous materials and hazardous waste management, or other site location challenges, there could be potential human health and safety impacts to consider.

- **Wireless Projects**
 - **New Wireless Communication Towers:** Installation of new wireless towers and associated structures (generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads would require site preparation, construction activities, and management of hazardous materials and hazardous waste. Communication towers would be erected, requiring workers to perform their duties from heights sufficient to result in serious injury or death in the event of falling. Working from heights may also result in additional overhead hazards and falling objects. Excavation of soils at proposed sites known to contain environmental contamination may result in workers being exposed to harmful chemicals or releases that could impact the general public in the immediate vicinity. If a proposed deployment activity involves the operation of heavy equipment, hazardous materials and hazardous waste management, or other site location challenges, there could be potential human health and safety impacts to consider. For a discussion of radio frequency emissions, refer to Section 2.4, Radio Frequency Emissions.
 - **Collocation on Existing Wireless Tower, Structure, or Building:** Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower. This would require workers to perform their duties from heights sufficient to result in serious injury or death in the event of falling. Working from heights may also result in additional overhead hazards and falling objects. Excavation of soils at proposed sites known to contain environmental contamination may result in workers being exposed to harmful chemicals or releases that could impact the general public in the immediate vicinity. If a proposed deployment activity involves the operation of heavy equipment, hazardous materials and hazardous waste management, or other site location challenges, there could be potential human health and safety impacts to consider. For a discussion of radio frequency emissions, refer to Section 2.4, Radio Frequency Emissions.
- **Deployable Technologies**
 - The use of deployable technologies could result in soil disturbance if land-based deployables are deployed on unpaved areas or if the implementation results in paving of previously unpaved surfaces. The use of heavy machinery presents the possibility for spills and soil and water contamination, and noise emissions could potentially impact human health; and vehicles and heavy equipment present the risk of workplace and road traffic accidents that could result in injury. Set-up of a cellular base station contained in a trailer with a large expandable antenna mast is not expected to result in impacts to human health and safety. However, due to the larger size of the deployable technology, site preparation or trailer stabilization may be required to ensure the self-contained unit is situated safely at the site. Additionally, the presence of a dedicated electrical generator would produce fumes and noise. The possibility of site work and the operation of a dedicated electrical generator have the potential for impacts to human health and safety. For a discussion of radio frequency emissions, refer to Section 2.4. Use of aerial vehicles would not involve telecommunication site work. Prior to deployment and when not in use, the aerial vehicles would likely require preventive maintenance. Workers

responsible for these activities may handle hazardous materials, not limited to fuel, solvents, and adhesives.

- Satellites and Other Technologies
 - Satellite-Enabled Devices and Equipment: The use of portable devices that utilize satellite technology would not impact human health and safety because there is no construction activities or use of hazardous materials. The installation of permanent equipment on existing structures may require workers to operate from heights or in sensitive environments. As a result, the potential for falling, overhead hazards, and falling objects is greater and there is a potential to impact human health and safety.

In general, the abovementioned FirstNet activities could potentially involve site preparation work, construction activities, work in potentially harmful environments (road ROW, work over water, environmental contamination, and mine lands), management of hazardous materials and hazardous waste, and weather exposure. Potential impacts to human health and safety associated with deployment of the Proposed Project could include injury from site preparation and operating heavy equipment, construction activities, falling/overhead hazards/falling objects, exposure to, and release of hazardous chemicals and hazardous waste. It is anticipated that potential health impacts associated with human exposure to environmental hazardous materials in air, water, or soil, the risk of road traffic, workplace accidents, and injuries, noise exposure, and risk of infectious disease transmission would be *less than significant* at the programmatic level due to the small-scale of likely FirstNet activities that would be temporary and of short duration. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned construction impacts. It is anticipated that there would be *less than significant* at the programmatic level impacts to human health and safety associated with routine inspections of the Preferred Alternative. Use of PPE or other mitigation measures could be necessary to adequately protect workers. If usage of heavy equipment were part of routine maintenance, the potential for impacts to human health and safety would also increase. It is anticipated that potential health impacts associated with human exposure to environmental hazardous materials in air, water, or soil, the risk of road traffic, workplace accidents, and injuries, noise exposure, and risk of infectious disease transmission would be *less than significant* at the programmatic level due to the small-scale of likely FirstNet activities that would be temporary and of short duration. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

4.2.15.5. Alternatives Impact Assessment

The following section assesses potential impacts to human health and safety associated with the Deployable Technologies Alternative and the No Action Alternative.

Deployable Technologies Alternative

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable land-based infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential impacts to human health and safety as a result of implementation of this alternative could be as described below.

Deployment Impacts

As explained above, implementation of deployable technologies could result in *less than significant* impacts at the programmatic level to human health and safety. The largest of the land-based deployable technologies may require site preparation work or stabilization work to ensure the self-contained trailers are stable. Heavy equipment may be necessary to complete the site preparation work. However, in general, the deployable technologies are small mobile units that could be transported as needed. While in operation, the units are parked and operate off electrical generators or existing electrical power sources. Connecting deployable technology to a power supply may present increased electrocution risk during the process of connecting power. If the power source were an electrical generator, then there would also likely be a need to manage fuel onsite. These activities could result in *less than significant* impacts at the programmatic level to human health and safety. It is anticipated that potential health impacts associated with human exposure to environmental hazardous materials in air, water, or soil, the risk of road traffic, workplace accidents, and injuries, noise exposure, and risk of infectious disease transmission would be *less than significant* at the programmatic level due to the small scale of likely FirstNet activities that would be temporary and of short duration. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As explained above, operation activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. As with the Preferred Alternative, it is anticipated that there would be *no impacts* to human health and safety associated with routine inspections. Use of PPE or other mitigation measures could be necessary

to adequately protect workers. If usage of heavy equipment is part of routine maintenance, the potential for impacts to human health and safety would also increase. These impacts would be *less than significant* at the programmatic level because of the small-scale of likely FirstNet activities; activities associated with routine maintenance, inspection, and deployment of deployable technologies would be temporary and often of limited duration. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed; therefore, there would be no associated construction or installation of wired, wireless, deployable infrastructure or satellites and other technologies. Therefore, there would be *no impacts* to human health and safety at the programmatic level as a result of the No Action Alternative. Environmental conditions would therefore be the same as those described in Section 4.1.15, Human Health and Safety.

AR APPENDIX A – COMMUNITIES OF CONCERN

Table A-1: S1 Ranked Terrestrial Communities of Concern in Arkansas

Vegetative Community Type	USEPA Ecoregion(s)	Description	Distribution
Arkansas Valley Prairie and Woodland	Arkansas Valley	A system of prairies and woodlands that is restricted to the Arkansas valley. Typically occurs on shale-derived soils.	Restricted to central Arkansas.
Caves, Mines & Karst Habitat	Arkansas Valley, Ozark Highlands, Ouachita Mountains, and Boston Mountains	Karst features and their associated habitats.	This community occurs in central and western Arkansas.
Central Interior Acidic Cliff and Talus	Arkansas Valley, Ozark Highlands, Ouachita Mountains, and Boston Mountains	Sparsely vegetated sandstone and shale outcrops. Typically small isolated systems within a larger community.	Occurs in the Interior Highlands of Arkansas.
Central Interior Calcareous Cliff and Talus	Ozark Highlands and Boston Mountains	Limestone and dolomite outcrops range from sparse to well vegetated. Typically isolated systems within a larger community.	Occurs in the northern portion of the interior highlands.
Central Interior Highlands and Appalachian Sinkhole and Depression Pond	Arkansas Valley, Ozark Highlands, and Boston Mountains	Isolated depressions in uplands. Vegetation is usually tree or shrub dominated with soils consisting of peat or muck. Surface water is present for much of the yearly and rarely becomes dry.	Occurs at high elevation in the Presidential Range.
Central Interior Highlands Calcareous Glade and Barrens	Ozark Highlands, Ouachita Mountains, and Boston Mountains	A system of stunted open woodlands typically found on steep slopes and valleys. A recurring fire regime keeps the open structure and prevents woody encroachment.	Found in the Interior Highlands of Arkansas.
Central Interior Highlands Dry Acidic Glade and Barrens	Arkansas Valley, Ozark Highlands, Ouachita Mountains, and Boston Mountains	A drought influenced system of grasses and open stunted oak woodlands. Drought and a recurring fire regime maintains the open structure.	Found in the Interior Highlands of Arkansas.
Cultivated Forest	All ecoregions	Pine plantations of various species that are used for commercial purposes throughout Arkansas. These communities are used by many species of conservation concern.	Found throughout the state.
Lower Mississippi Alluvial Plain Grand Prairie	Mississippi Alluvial Plain and Mississippi Valley Loess Plains	A system of wet and dry prairies occurring on river deposited sediments. Historically almost annual fires maintained this prairie community.	Limited to the Mississippi Plain region of Arkansas.
Lower Mississippi Flatwoods Woodland and Forest	Mississippi Alluvial Plain	Forested systems occurring on flat topography with poor drainage.	Limited to the Mississippi Plain region of Arkansas.

ACRONYMS

Acronym	Definition
AARC	Average Annual Rate Of Change (compound growth rate)
ACS	American Community Survey
ADEQ	Arkansas Department Of Environmental Quality
ADH	Arkansas Department Of Health
AGFC	Arkansas Game And Fish Commission
AGL	Above Ground Level
AHDT	Arkansas State Highway And Transportation Department
AIRFA	American Indian Religious Freedom Act
AML	Abandoned Mine Lands
ANHC	Arkansas Natural Heritage Commission
ANRC	Arkansas Natural Resources Commission
AOSH	Arkansas Occupational Safety And Health
APCECR	Arkansas Pollution Control & Ecology Commission Regulation
APE	Area of Potential Effects
APSC	Arkansas Public Service Commission
AQCR	Air Quality Control Region
AR	Arkansas
ARPA	Archaeological Resources Protection Act
ASL	Above Sea Level
ATADS	Air Traffic Activity Systems
ATC	Air Traffic Control
ATSDR	Agency For Toxic Substances And Disease Registry
AWIN	Arkansas Wireless Information Network
BGEPA	Bald And Golden Eagle Protection Act
BLM	Bureau of Land Management
BLS	Bureau of Labor Statistics
CAA	Clean Air Act
CEQ	Council on Environmental Quality
CFOI	Census of Fatal Occupational Injuries
CGP	Construction General Permit
CH ₄	Methane
CO	Carbon Monoxide
CO ₂	Carbon Dioxide
COLT	Cell On Light Trucks
COW	Cell On Wheels
CRS	Community Rating System
CWA	Clean Water Act
DOE	Department of Energy
EFH	Essential Fish Habitat
EIA	Energy Information Agency

Acronym	Definition
EMS	Emergency Medical Services
EPCRA	Community Right To Know Act
FAA	Federal Aviation Administration
FCC	Federal Communication Commission
FEMA	Federal Emergency Management Agency
FGDC	Federal Geographic Data Committee
FHWA	Federal Highway Administration
FLM	Federal Land Manager
FSDO	Flight Standards District Offices
GAP	Gap Analysis Program
GHG	Greenhouse Gas
HAP	Hazardous Air Pollutant
HASP	Health And Safety Plans
HHRA	Human Health Risk Assessment
IBA	Important Bird Areas
IFR	Instrument Flight Rules
IPCC	Intergovernmental Panel On Climate Change
LBS	Locations-Based Services
LCCS	Land Cover Classification System
LIT	Clinton National Airport
LPG	Liquefied Petroleum Gas
LRR	Land Resource Region
LTE	Long Term Evolution
MBTA	Migratory Bird Treaty Act
MHI	Median Household Income
MLRA	Major Land Resource Areas
MMT	Million Metric Tons
MSA	Metropolitan Statistical Area
MSL	Mean Sea Level
MYA	Million Years Ago
N ₂ O	Nitrous Oxide
NAAQS	National Ambient Air Quality Standards
NAGPRA	Native American Graves Protection and Repatriation Act
NAICS	North American Industry Classification System
NAS	National Airspace System
NAS	National Audubon Society
NEPA	National Environmental Policy Act
NFIP	National Flood Insurance Program
NHL	National Historic Landmarks
NHPA	National Historic Preservation Act
NIST	National Institute of Standards and Technology

Acronym	Definition
NM	Nautical Miles
NOTAM	Notices To Airmen
NO _x	Oxides of Nitrogen
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
NPS	National Park Service
NPSBN	Nationwide Public Safety Broadband Network
NRC	National Response Center
NRCS	Natural Resources Conservation Service
NRHP	National Register Of Historic Places
NSA	National Security Areas
NTFI	National Task Force On Interoperability
NWI	National Wetlands Inventory
NWP	Nationwide Permit
OE/AAA	Obstruction Evaluation And Airport Airspace Analysis
OSHA	Occupational Safety And Health Administration
PEIS	Programmatic Environmental Impact Statement
PEM	Palustrine Emergent Wetlands
PFO	Palustrine Forested Wetlands
PGA	Peak Ground Acceleration
POP	Points Of Presence
PPE	Personal Protective Equipment
PSCR	Public Safety Communications Research
PSD	Prevention Of Significant Deterioration
RCRA	Resource Conservation And Recovery Act
RF	Radio Frequency
SAIPE	Small Area Income and Poverty Estimates
SASP	State Aviation System Plan
SCIP	Statewide Communication Interoperability Plan
SDS	Safety Data Sheets
SDWA	Safe Drinking Water Act
SF ₆	Sulfur Hexafluoride
SGCN	Species Of Greatest Conservation Need
SIP	State Implementation Plan
SO ₂	Sulfur Dioxide
SOC	Standard Occupational Classification
SOP	Standard Operating Procedures
SOW	System On Wheels
SO _x	Oxides of Sulfur
SUA	Special Use Airspace
SWPPP	Stormwater Pollution Prevention Plan

Acronym	Definition
TMDL	Total Maximum Daily Load
TRI	Toxics Release Inventory
UA	Unmanned Aircraft
UAS	Unmanned Aircraft Systems
UHF	Ultra-High Frequency
USACE	U.S. Army Corps Of Engineers
USEPA	U.S. Environmental Protection Agency
USFS	U.S. Forest Service
USFWS	U.S. Fish And Wildlife Service
USGS	U.S. Geological Survey
VFR	Visual Flight Rules
VHF	Very High Frequency
VOC	Volatile Organic Compound
WONDER	Wide-Ranging Online Data For Epidemiologic Research
WWI	World War I
WWII	World War II
XNA	Northwest Arkansas Regional Airport

REFERENCES

The citations in this Final PEIS reflect the most recent information on the referenced site at the time the document was written.

- 40 CFR 230.3(t). (1993, August 25). *Clean Water Act-Guidelines for Specification of Disposal Sites for Dredged or Fill Material*. Retrieved April 6, 2015, from <http://www.ecfr.gov/cgi-bin/text-idx?SID=7977290449ab243f2865159951305a77&node=40:25.0.1.3.24&rgn=div5>
- AAD. (2016, May). *Arkansas Laws on Plants and Seeds*. Retrieved from http://www.aad.arkansas.gov/Webistes/aad/files/Content/5944144/Circular_8_-_Arkansas_Laws_on_Plants_and_Seeds.pdf
- ADEM. (2010, September 2). *All Hazard Mitigation Plan State of Arkansas*. Retrieved November 4, 2015
- ADEQ. (2010, May 27). *Regulation No. 18 Arkansas Air Pollution Control Code*. Retrieved October 26, 2015, from https://www.adeq.state.ar.us/regs/files/reg18_final_100618.pdf
- ADEQ. (2012, October 26). *Regulation No. 26 Regulations of the Arkansas Operating Air Permit Program*. Retrieved October 29, 2015, from https://www.adeq.state.ar.us/regs/files/reg26_final_121118.pdf
- ADEQ. (2013a). *Arkansas Superfund*. Retrieved October 23, 2015, from http://www2.adeq.state.ar.us/hazwaste/branch_tech/superfund.aspx
- ADEQ. (2013b, July). *Cedar Chemical Company: State Priority List Site, West Helena, Arkansas*. Retrieved October 23, 2015, from <http://www2.adeq.state.ar.us/downloads/hw/PriorityList/pdf/Cedar%20SPL%20Site%20Summary.pdf>
- ADEQ. (2014a, April). *2014 Statewide Solid Waste Management Plan*. Retrieved October 2015, from Arkansas Department of Environmental Quality: https://www.adeq.state.ar.us/sw/programs/pdfs/2014_statewide_sw_mgmt_plan_20140305.pdf
- ADEQ. (2014b). *2014 Integrated Water Quality Monitoring Assessment Report*. Retrieved October 30, 2015, from http://www2.adeq.state.ar.us/water/branch_planning/303d/pdfs/integrated_wqmar_20140401.pdf
- ADEQ. (2014c, August 22). *Regulation No. 19 Regulation of the Arkansas Plan of Implementation for Air Pollution Control*. Retrieved October 26, 2015, from https://www.adeq.state.ar.us/regs/files/reg19_final_140913.pdf
- ADEQ. (2015a, October). *Discharge Permits*. Retrieved October 2015, from Arkansas Department of Environmental Quality: http://www2.adeq.state.ar.us/water/branch_permits/individual_permits/discharge_permits.htm
- ADEQ. (2015b, October). *Permits Branch*. Retrieved October 2015, from Arkansas Department of Environmental Quality: http://www2.adeq.state.ar.us/water/branch_permits/
- ADEQ. (2015c, October). *Enforcement Branch*. Retrieved October 2015, from Arkansas Department of Environmental Quality: http://www2.adeq.state.ar.us/water/branch_enforcement/default.htm#Background

- ADEQ. (2015d, October). *Wastewater Licensing*. Retrieved October 2015, from Arkansas Department of Environmental Quality:
http://www2.adeq.state.ar.us/water/branch_enforcement/wwl/
- ADEQ. (2015e, October). *Solid Waste Management*. Retrieved from Arkansas Department of Environmental Quality: <https://www.adeq.state.ar.us/sw/>
- ADEQ. (2015f, October). *Permitted Solid Waste Facility Data*. Retrieved October 2015, from Arkansas Department of Environmental:
https://www.adeq.state.ar.us/sw/permits/facility_data.aspx#display
- ADEQ. (2015g, October 13). *State of Arkansas 2015 Five-Year Newtwork Assessment*. Retrieved October 26, 2015, from
https://www.adeq.state.ar.us/air/planning/pdfs/signed_ar_five_year_network_assessment.pdf
- ADEQ. (2015h). *Coal Program*. Retrieved October 23, 2015, from
<https://www.adeq.state.ar.us/mining/coal.aspx>
- ADEQ. (2015i). *Non-Coal Program*. Retrieved December 2, 2015, from
<https://www.adeq.state.ar.us/mining/noncoal.aspx>
- ADEQ. (2017a). *Laws & Regulations*. Retrieved from <https://www.adeq.state.ar.us/regs/>
- ADEQ. (2017b). *Instream 401 Certification and Short Term Activity Authorization*. Retrieved from <https://www.adeq.state.ar.us/water/planning/instream/>
- ADH. (2011). *Source Water Protection, Source Water Assessment Program Reports*. Retrieved October 2015, from Arkansas Department of Health:
<http://www.healthy.arkansas.gov/programsServices/environmentalHealth/Engineering/sourceWaterProtection/Pages/WaterSystemInformation.aspx>
- ADH. (2014, February). *Rules and Regulations Pertaining to Public Water Systems*. Retrieved October 2015, from Arkansas State Board of Health:
<http://www.healthy.arkansas.gov/aboutADH/RulesRegs/PublicWater.pdf>
- ADPT. (2015a). *Arkansas River (Little Rock To Miss. River)*. Retrieved November 3, 2015, from
<http://www.arkansas.com/outdoors/water-activities/lakes-rivers/river.aspx?id=35>
- ADPT. (2015b). *Lake Ouachita*. Retrieved November 3, 2015, from
<http://www.arkansas.com/outdoors/water-activities/lakes-rivers/lake.aspx?id=23>
- ADPT. (2015c). *Beaver Lake*. Retrieved November 3, 2015, from
<http://www.arkansas.com/outdoors/water-activities/lakes-rivers/lake.aspx?id=1>
- ADPT. (2015d). *Millwood Lake*. Retrieved November 3, 2015, from
<http://www.arkansas.com/outdoors/water-activities/lakes-rivers/lake.aspx?id=29>
- ADPT. (2015e). *Arkansas wildlife - at home in the wild*. Retrieved from
<http://www.arkansas.com/outdoors/birding/wildlife/>
- Advisory Council on Historic Preservation. (2004, August 5). *36 CFR Part 800 - Protection of Historic Properties*. Retrieved July 21, 2015, from Advisory Council on Historic Preservation: <http://www.achp.gov/regs-rev04.pdf>
- AFC. (2015). *Manage Your Forest*. Retrieved July 12, 2016, from Arkansas Forestry Commission:
[http://forestry.arkansas.gov/Services/ManageYourForests/Pages/EmeraldAshBorer\(EAB\).aspx](http://forestry.arkansas.gov/Services/ManageYourForests/Pages/EmeraldAshBorer(EAB).aspx)
- AGFC. (2005). *Designing a future for Arkansas wildlife*. Retrieved from
<http://www.wildlifearkansas.com/ecoregions.html>

- AGFC. (2006a). *Arkansas wildlife action plan*. Retrieved from <http://www.wildlifearkansas.com/strategy.html>
- AGFC. (2006b). *Arkansas fish*. Retrieved from http://www.agfc.com/resources/publications/ar_fish.pdf
- AGFC. (2006c). *Arkansas wildlife action plan - Section II. SCGN*. Retrieved July 5, 2016, from http://www.wildlifearkansas.com/materials/2006_updates/03SGCN.pdf
- AGFC. (2011a). *Species by group*. Retrieved from <http://www.agfc.com/species/Pages/SpeciesWildlifeList.aspx>
- AGFC. (2011b). *Fishing by species*. Retrieved from <http://www.agfc.com/fishing/Pages/FishingbySpecies.aspx>
- AGFC. (2011c). *Our Mission*. Retrieved October 26, 2015, from <http://www.agfc.com/aboutagfc/Pages/AboutMission.aspx>
- AGFC. (2011d). *Where to Hunt*. Retrieved October 26, 2015, from <http://www.agfc.com/hunting/Pages/HuntingWheretohunt.aspx>
- AGFC. (2011e). *Get Started Fishing - Catfishing*. Retrieved July 11, 2016, from <http://www.agfc.com/youth/Pages/YouthGetStartedFishingCatfish.aspx>
- AGFC. (2013). *Feral hogs in Arkansas*. Retrieved from <http://www.agfc.com/species/Documents/FeralHogs.pdf>
- AGFC. (2015a). *2015-16 Arkansas Waterfowl Hunting Guidebook*. Retrieved November 4, 2015, from <http://www.agfc.com/resources/GuidebookDocs/WaterfowlGuidebook.pdf>
- AGFC. (2015b). *Arkansas invasive species alert*. Retrieved from <http://www.agfc.com/resources/Publications/InvasiveSpeciesAlert.pdf>
- AGFC. (2016, June 16). *AGFC Code Book*. Retrieved July 5, 2016, from http://www.agfc.com/enforcement/Documents/agfc_code_of_regulations.pdf
- AGFC. (2017). *Code of Regulations*. Retrieved from <https://www.agfc.com/en/enforcement/code-regulations/>
- AGS. (2017). *Arkansas Geological Survey: Energy Oil*. Retrieved from <http://www.geology.ar.gov/energy/oil.htm>
- AGS. (2017). *Arkansas Geological Survey: Natural Gas*. Retrieved from http://www.geology.ar.gov/energy/natural_gas.htm
- AHTD. (2002, May). *AR State Rail Plan*. Retrieved October 23, 2015, from https://www.dot.state.al.us/tpmpweb/mp/_pdf/Rail/ALDOT_Rail_Summary.pdf
- AHTD. (2007). *Arkansas Statewide Long-Range Intermodal Transportation Plan 2007 Update*. Retrieved from Planning and Research Division: arkansashighways.com/stip/2007-2010/Final_2007_Statewide_LongRange_Plan.pdf
- AHTD. (2014). *2014 Fact Sheet*. Retrieved October 23, 2015, from http://www.arkansashighways.com/Trans_Plan_Policy/policy_legis/publications/fact_sheets/2014_fact_sheet.pdf
- AHTD. (2015, October). *About AHTD*. Retrieved October 23, 2015, from http://www.arkansashighways.com/about/about_ahtd.aspx
- AKSOS. (2014, June). *Arkansas*. Retrieved July 5, 2016, from Arkansas Secretary of State: <http://www.sos.arkansas.gov/rulesRegs/Arkansas%20Register/2014/june2014/209.02.14-003.pdf>
- Alvey, J. S. (2005). Middle Archaic Settlement Organization in the Upper Tombigbee Drainage: A View from the Uplands. *Southeastern Archaeology*, 24(2), 199-208. Retrieved October 2015, from <http://www.jstor.org/stable/40713358>

- American Trails. (2015a, August 14). *National Trails Training Partnership*. Retrieved September 15, 2015, from <http://www.americantrails.org/resources/feds/NatTrSysOverview.html>
- American Trails. (2015b). *Resources and Library: Arkansas Trail Resources*. Retrieved October 26, 2015, from <http://americantrails.org/resources/statetrails/ARstate.html>
- Amtrak. (2015a, October). *South Train Routes*. Retrieved October 23, 2015, from Amtrak: <http://www.amtrak.com/south-train-routes>
- Amtrak. (2015b, April 6). *Amtrak System Timetable*. Retrieved from Amtrak: <https://www.amtrak.com/ccurl/294/1015/Amtrak-System-Timetable-Winter-Spring-2016-rev,0.pdf>
- Anderson, D. (1995). Recent Advances in Paleoindian and Archaic Period Research in Southeastern United States. *Archaeology of Eastern North America*, 23, 145-176. Retrieved October 2015, from <http://www.jstor.org/stable/40914396>
- Anderson, D. G., Miller, S., Yerka, S. J., Gillam, C., Johanson, E. N., T, A. D., . . . Smallwood, A. M. (2010). *PIDBA (Paleoindian Database of the Americas) 2010: Current Status and Findings*. Retrieved October 2015, from <http://www.jstor.org/stable/40914542>
- Anderson, J. R., Hardy, E. E., Roach, J. T., & Witmer, R. E. (2001). *A Land Use And Land Cover Classification System For Use With Remote Sensor Data*. Retrieved from Appendix C Land Use Definitions: https://www.usbr.gov/lc/socal/reports/SMappend_C.pdf
- ANHC. (2014). *Rare species search engine: find Arkansas endangered species*. Retrieved from <http://www.naturalheritage.com/Research-and-Data/rare-species-search>
- ANRC. (1981). *Arkansas State Water Plan*. Retrieved October 229, 2015, from https://static.ark.org/eeuploads/anrc/lakes_of_arkansas_1981.pdf
- ANRC. (2014a, January). *Arkansas Water Plan Update: Water Availability Report*. Retrieved November 5, 2015, from http://www.arwaterplan.arkansas.gov/reports/water_availability_report_final%201.13.14.pdf
- ANRC. (2014b). *The Arkansas Annual Report*. Retrieved November 4, 2015, from <http://www.uaex.edu/environment-nature/water/quality/2014%20ANRC%20annual%20report%20for%20NPS%20Program.pdf>
- APA. (2013, August 20). *Freshwater Wetlands*. Retrieved March 20, 2015, from Agency Regulations: <http://www.apa.ny.gov/Documents/Flyers/FreshwaterWetlands.pdf>
- APCEC. (2014, February 28). *Regulation No. 2*. Retrieved November 5, 2015, from https://www.adeq.state.ar.us/regs/files/reg02_final_140324.pdf
- APSC. (2015a, October). *Electric Section*. Retrieved October 2015, from Arkansas Public Service Commission: <http://www.apscservices.info/electric.asp>
- APSC. (2015b, October). *Gas and Water Section*. Retrieved October 2015, from Arkansas Public Service Commission: http://www.apscservices.info/g_w.asp
- Arkansas Archeological Society. (2015). *Who We Are*. Retrieved October 2015, from Arkansas Archeological Society: http://www.arkarch.org/index.php?pages/socweb_whoare
- Arkansas Audubon Society. (2009a). *Bird Species*. Retrieved July 5, 2016, from http://www.arbirds.org/AAS_fieldlist09.pdf
- Arkansas Audubon Society. (2009b). *2009 field reference to Arkansas birds*. Retrieved from http://www.arbirds.org/AAS_fieldlist09.pdf

- Arkansas Building Authority. (2012, April 14). *Standards & Criteria Manual* . Retrieved from <http://aba.arkansas.gov/aboutUs/Pages/StandardsCriteriaManual.aspx>
- Arkansas Department of Aeronautics. (2015). *Arkansas Department of Aeronautics, Dept. of Aeronautics Mission Statement*. Retrieved August 2015, from Arkansas Department of Aeronautics: <http://www.fly.arkansas.gov/AboutUsDocs/MissionStatement.htm>
- Arkansas Department of Health. (2011). *Arkansas Health Statistics Branch Query System*. Retrieved October 23, 2015, from http://healthstats.adh.arkansas.gov/scripts/broker.exe?_service=default&_program=arcod e.main_welcome_live.sas
- Arkansas Department of Parks & Tourism. (2015a). *Making a State*. Retrieved September 16, 2015, from <http://www.arkansas.com/things-to-do/history-heritage/making-state/>
- Arkansas Department of Parks & Tourism. (2015b). *Arkansas Department of Parks and Tourism*. Retrieved October 2015, from <http://www.arkansas.gov/government/agency-detail/parks-and-tourism-arkansas-department-of>
- Arkansas Department of Parks & Tourism. (2015c). *Arkansas - The Natural State*. Retrieved October 27, 2015, from <http://www.arkansas.com>
- Arkansas Department of Parks & Tourism. (2015d). *Scenic Byways and Trails*. Retrieved October 26, 2015, from <http://www.arkansas.com/scenic-byways/>
- Arkansas Forestry Commission. (2015a). *Arkansas Forestry Commission*. Retrieved October 2015, from <http://forestry.arkansas.gov/Services/Pages/PoisonSprings.aspx>
- Arkansas Forestry Commission. (2015b). *Poison Springs State Forest*. Retrieved October 26, 2015, from <http://forestry.arkansas.gov/Services/Pages/PoisonSprings.aspx>
- Arkansas Geological Survey. (2010). *Liquefaction Susceptibility Map of Arkansas*. Retrieved November 2015, from http://www.geology.ar.gov/maps_pdf/geohazards/Liquefaction_Susceptibility_Map_Of_Arkansas.pdf
- Arkansas Geological Survey. (2015a). *Geology of the Ouachita Mountains*. Retrieved October 2015, from http://www.geology.ar.gov/education/geo_ouachita_mtns.htm
- Arkansas Geological Survey. (2015b). *Ouachita Mountains*. Retrieved October 2015, from http://www.geology.ar.gov/education/ouachita_mtns.htm
- Arkansas Geological Survey. (2015c). *General Geology -- Main*. Retrieved November 2015, from http://www.geology.ar.gov/geology/general_geology.htm
- Arkansas Geological Survey. (2015d). *Geology Resources*. Retrieved November 2015, from http://www.geology.ar.gov/education/geology_resources.htm
- Arkansas Geological Survey. (2015e). *Historic Earthquakes -- 2014*. Retrieved October 2015, from http://www.geology.ar.gov/geohazards/historic_earthquakes.htm
- Arkansas Geological Survey. (2015f). *Earthquakes - General Information*. Retrieved October 2015, from http://www.geology.ar.gov/geohazards/eq_geninfo.htm
- Arkansas Geological Survey. (2015g). *Landslides - Case Studies*. Retrieved October 2015, from http://www.geology.ar.gov/geohazards/landslides_casestudies.htm
- Arkansas Geological Survey. (2015h). *Landslides in Arkansas*. Retrieved October 2015, from <http://www.geology.ar.gov/geohazards/landslides.htm>
- Arkansas Geological Survey. (2015i). *Sinkholes*. Retrieved October 2015, from <http://www.geology.ar.gov/geohazards/sinkholes.htm>
- Arkansas Geological Survey. (2015j). *Groundwater Contamination*. Retrieved November 5, 2015, from http://www.geology.ar.gov/geohazards/groundwater_contamination.htm

- Arkansas Geological Survey. (2015k). *Land Subsidence -- Earthquake Induced*. Retrieved November 2015, from http://www.geology.ar.gov/geohazards/landsub_eq_induced.htm
- Arkansas Governor's Commission On Global Warming. (2008). *Arkansas Governor's Commission on Global Warming - Final Report*. Retrieved October 29, 2015, from <https://www.c2es.org/docUploads/Arkansas%20climate%20plan.pdf>
- Arkansas Historic Preservation Program. (2013). *A Foundation for the Future: The Arkansas State Historic Preservation Plan, 2013*. Little Rock: Arkansas Historic Preservation Program. Retrieved October 2015, from <file:///C:/Users/578179/Documents/FirstNet/Arkansas/AHPP-5YearPlan2013.pdf>
- Arkansas Historic Preservation Program. (2015a). *A Reference Guide to the Architectural Styles of Arkansas*. Little Rock: Arkansas Historic Preservation Program.
- Arkansas Historic Preservation Program. (2015b). *Home*. Retrieved October 2015, from Arkansas Historic Preservation Program: <http://www.arkansaspreservation.com/About-Us/about>
- Arkansas MAWPT. (2001a). *Wetlands in Arkansas*. Retrieved October 29, 2015, from <http://www.mawpt.org/wetlands/>
- Arkansas MAWPT. (2001b). *Alkali Wet Prairie*. Retrieved November 4, 2015, from http://www.mawpt.org/wetlands/classification/community_types.asp?communityType=Alkali+Wet+Prairie
- Arkansas MAWPT. (2001c). *Wetlands in Arkansas: Wetland Protection*. Retrieved October 29, 2015, from <http://www.mawpt.org/wetlands/protection.asp>
- Arkansas MAWPT. (2001d). *Non-Calcerous Perennial Seep*. Retrieved November 4, 2015, from http://www.mawpt.org/wetlands/classification/community_types.asp?communityType=Non%20Calcareous+Perennial+Seep
- Arkansas MAWPT. (2001e). *Sand Pond*. Retrieved November 4, 2015, from http://www.mawpt.org/wetlands/classification/community_types.asp?showDetail=1&communityType=Sand+Pond
- Arkansas Natural Heritage Commission. (2015a). *What is a Natural Area?* Retrieved October 26, 2015, from http://www.naturalheritage.com/Natural_Areas/about-natural-areas
- Arkansas Natural Heritage Commission. (2015b). *Visting a Natural Area*. Retrieved October 26, 2015, from <http://www.naturalheritage.com/Get-Involved/visit-a-natural-area>
- Arkansas Pollution Control and Ecology Commission. (2007, October 26). *Regulation No.2 Regulation Establishing Water Quality Standards for Surface Waters of the State of Arkansas*. Retrieved from http://www.sos.arkansas.gov/rulesRegs/Arkansas%20Register/2007/nov_2007/014.00.07-014.pdf
- Arkansas Secretary of State. (2015a, October). *Timeline: 1541-1699*. Retrieved October 2015, from <http://www.sos.arkansas.gov/educational/students/historyTimeline/Pages/1541-1699.aspx>
- Arkansas Secretary of State. (2015b, October). *Timeline: 1700s*. Retrieved October 2015, from <http://www.sos.arkansas.gov/educational/students/historyTimeline/Pages/1700s.aspx>
- Arkansas Secretary of State. (2015c, October). *Timeline: 1800s*. Retrieved October 2015, from <http://www.sos.arkansas.gov/educational/students/historyTimeline/Pages/1800s.aspx>
- Arkansas Secretary of State. (2015d, October). *Timeline: 1900-2000s*. Retrieved October 2015, from <http://www.sos.arkansas.gov/educational/students/historyTimeline/Pages/1900s.aspx>

- Arkansas Secretary of State. (2016). *Arkansas Game and Fish Commission Code Book*. Retrieved July 11, 2016, from http://www.sos.arkansas.gov/rulesRegs/Arkansas%20Register/2007/mar_apr_2007/002.00.07-002.pdf
- Arkansas State Parks History & Heritage. (2015a). *National Register & Landmarks*. Retrieved October 27, 2015, from <http://www.historystateparks.com/register-landmarks/>
- Arkansas State Parks History & Heritage. (2015b). *Arkansas State Parks History & Heritage*. Retrieved October 27, 2015, from <http://www.historystateparks.com/>
- Arkansas Waterways Commission. (2016a, June 6). *River Ports and Terminals*. Retrieved from <http://www.waterways.arkansas.gov/arkansas-river-ports>
- Arkansas Waterways Commission. (2016b, June 6). *Arkansas River Ports*. Retrieved from <http://waterways.arkansas.gov/ports/Pages/arkansasRiver.aspx>
- Arkansas Waterways Commission. (2016c, June 6). *Mississippi River Ports*. Retrieved from <http://www.waterways.arkansas.gov/arkansas-river-ports>
- Arkansas Wireless Information Network. (2014, June 1). *Arkansas Statewide Communication Interoperability Plan (SCIP) Implementation Report (2014)*. Retrieved May 9, 2016, from Arkansas.gov: www.awin.arkansas.gov/resources/Pages/default.aspx
- Arkansas Wireless Information Network. (2015a, September 2). *AWIN Leadership Team*. Retrieved September 2, 2015, from <http://www.awin.arkansas.gov/leadership/Pages/default.aspx>
- Arkansas Wireless Information Network. (2015b, September 2). *AWIN Bridging Assets*. Retrieved September 2, 2015, from <http://www.awin.arkansas.gov/systemInformation/Pages/default.aspx>
- Arkansas Wireless Information Network. (2015c, September 2). *AWIN Home Page*. Retrieved September 2, 2015, from <http://www.awin.arkansas.gov/Pages/default.aspx>
- ATSDR. (2005, August). *Health Consultation: Health Implications of Farm Workers Exposed to Groundwater Adjacent to Cedar Chemical Corporation, West Helena, AR*. Retrieved October 23, 2015, from <http://www.atsdr.cdc.gov/HAC/pha/Cedar%20Chemical%20Company/CedarChemicalHC080105.pdf>
- ATSDR. (2006, June 16). *Health Consultation: Follow-up Report on the Health Implications of Farm Workers Exposed to 1, 2-DCA Contaminated Groundwater Adjacent to Cedar Chemical Corporation*. Retrieved October 23, 2015, from <http://www.atsdr.cdc.gov/HAC/pha/Cedar%20Chemical%20Corporation/CedarChemicalCorpHC061606.pdf>
- ATSDR. (2015, August 13). *Public Health Assessments & Health Consultations (Arkansas)*. Retrieved October 23, 2015, from <http://www.atsdr.cdc.gov/HAC/PHA/HCPHA.asp?State=AR>
- Balmori, A. (2005). Possible Effects of Electromagnetic Fields from Phone Masts on a Population of White Stork (*Ciconia ciconia*). In *Electromagnetic Biology and Medicine* (pp. 24, 109-119).
- Balmori, A. (2009). Electromagnetic Pollution from Phone Masts: Effects on Wildlife. In *Pathophysiology: Electromagnetic Fields (EMF) Special Issue*, (pp. 16(2-3), 191-199).
- Balmori, A., & Hallberg, O. (2007). The Urban Decline of the House Sparrow (*Passer domesticus*): A Possible Link with Electromagnetic Radiation. *Electromagnetic Biology and Medicine*, 26: 141-151.

- Bense, J. A. (1996). *Overview of the Mississippian Stage in the Southeastern United States*. Retrieved October 2015, from <http://www.jstor.org/stable/27768367>
- Berven, K. A., & Grudzien, T. A. (1990). Dispersal in the Wood Frog (*Rana sylvatica*): Implications for Genetic Population Structure. *Evolution*, 2047-56. doi:<http://doi.org/10.2307/2409614>
- BLM. (1984). *Manual 8400 - Visual Resource Management*. Washington: Department of the Interior, Bureau of Land Management. Retrieved from <https://www.blm.gov/programs/recreation/recreation-programs/visual-resource-management>
- BLS. (2008). *Fatal occupational injuries in Arkansas*. Retrieved October 23, 2015, from Injuries, Illnesses, and Fatalities: <http://www.bls.gov/iif/oshwc/cfoi/tgs/2008/iiffi05.htm>
- BLS. (2013a, December 4). *Table 1. Incidence rates of nonfatal occupational injuries and illnesses by case type and ownership, selected industries, 2013*. Retrieved September 4, 2015, from <http://www.bls.gov/news.release/osh.t01.htm>
- BLS. (2013b). *Fatal occupational injuries to private sector wage and salary workers, government workers, and self-employed workers by industry, all United States, 2013*. Retrieved September 22, 2015, from <http://www.bls.gov/iif/oshwc/cfoi/cftb0279.pdf>
- BLS. (2014). *Table A-5. Fatal occupational injuries by occupation and event or exposure, all United States, 2014*. Retrieved September 29, 2015, from 2014 Census of Fatal Occupational Injuries (preliminary data): <http://www.bls.gov/iif/oshwc/cfoi/cftb0290.pdf>
- BLS. (2015a, May). *U.S. Bureau of Labor Statistics*. Retrieved from May 2015 State Occupational Employment and Wage Estimates Arkansas: http://www.bls.gov/oes/current/oes_ar.htm
- BLS. (2015b, March 25). *May 2014 State Occupational Employment and Wage Estimates Arkansas*. Retrieved October 23, 2015, from Occupational Employment Statistics: http://www.bls.gov/oes/current/oes_ar.htm#49-0000
- BLS. (2015c, April 22). *State Occupational Injuries, Illnesses, and Fatalities*. Retrieved October 8, 2015, from Injuries, Illnesses, and Fatalities: http://www.bls.gov/iif/state_archive.htm#AR
- BLS. (2015d, September 17). *Census of Fatal Occupational Injuries (CFOI) - Current and Revised Data*. Retrieved September 18, 2015, from Injuries, Illnesses, and Fatalities: <http://www.bls.gov/iif/oshcfoi1.htm>
- BLS. (2017, April 19). *Civilian Noninstitutional Population and Associated Rate and Ratio Measures for Model-Based Areas*. Retrieved April 2015, from <http://www.bls.gov/lau/rdsenp16.htm>
- Bond, S., Sims, S., & Dent, P. (Eds.). (2013). *Towers, Turbines, and Transmission Lines: Impacts on Property Value*. Chichester, West Sussex, United Kingdom: Wiley-Blackwell.
- Borengasser, M. J. (2015). *Arkansas Razorback Report*. Retrieved from Arkansas's Climate the Cocorah's State Climate Series: http://www.cocorahs.org/Media/docs/ClimateSum_AR.pdf
- Bureau of Land Management. (2014). *DRECP Noise and Vibration*. Retrieved 07 22, 2015, from http://www.blm.gov/style/medialib/blm/ca/pdf/pa/energy/drecp/draft_drecp.Par.37401.File.dat/III.21%20Noise%20and%20Vibration.pdf
- Calhoun, A. J., & DeMaynadier, P. G. (2007). *Science and Conservation of Vernal Pools in Northeastern North America: Ecology and Conservation of Seasonal Wetlands in*

- Northeastern North America*. CRC Press. Retrieved September 2015, from http://www.nae.usace.army.mil/Portals/74/docs/regulatory/VernalPools/Ch12_ScienceConservationofVernalPools.pdf
- CEC. (2011, April). *North American Terrestrial Ecoregions - Level III*. Retrieved from USEPA Ecoregions of North America: ftp://ftp.epa.gov/wed/ecoregions/pubs/NA_TerrestrialEcoregionsLevel3_Final-2june11_CEC.pdf
- Center for Climate Strategies. (2008). *Arkansas Greenhouse Gas Inventory & Reference Case Forecast, CCS*. Retrieved 4 25, 2016, from <http://www.climatestrategies.us/library/library/view/937>
- Centers for Disease Control and Prevention. (2015a, September 17). *CDC WONDER: Underlying Cause of Death, 1999-2013 Results*. Retrieved October 23, 2015, from <http://wonder.cdc.gov/controller/datarequest/D76>
- Centers for Disease Control and Prevention. (2015b, September 25). *National Environmental Public Health Tracking Network*. Retrieved October 23, 2015, from <http://ephtracking.cdc.gov/showHome.action>
- CEQ. (1997, December). *Environmental Justice: Guidance Under the National Environmental Policy Act*. Retrieved April 2015, from http://energy.gov/sites/prod/files/nepapub/nepa_documents/RedDont/G-CEQ-EJGuidance.pdf
- CEQ. (2014). *Draft NEPA Guidance on Consideration of the Effects of Climate Change and Greenhouse Gas Emissions*. Retrieved June 2014, from https://ceq.doe.gov/guidance/ceq_guidance_nepa-ghg-climate_final_guidance.html
- Chandler, A., & Doerr, E. (2008). *Richland Creek Road Landslide*. Retrieved October 2015, from <http://www.geology.ar.gov/pdf/Richland%20Creek%20Road%20landslide.pdf>
- Charpentier, V., Inizan, M. L., & Feblot-Augustins, J. (2002). Fluting in the Old World: The Neolithic Projectile Points of Arabia. *Lithic Technology*, 27(1), 39-46. Retrieved August 2015, from <http://www.jstor.org/stable/23273456>
- CIO Council. (2015). *Data Center Consolidation and Optimization*. Retrieved from <https://cio.gov/drivingvalue/data-center-consolidation/>
- City of Lincoln. (2015). *What are Saline Wetlands?* Retrieved July 2015, from <http://lincoln.ne.gov/city/parks/parksfacilities/wetlands/wetlandsinfo.htm>
- Cowardin, L. M., Carter, V., Golet, F. C., & LaRoe, E. T. (1979). *Classification of wetlands and deepwater habitats of the United States, FWS/OBS-79/31*. Retrieved April 4, 2015, from <http://www.fws.gov/wetlands/Documents/classwet/index.html>
- CSC. (2007, March). Retrieved from Telecommunications Facilities: An Illustrated Primer on the Siting of Facilities within Connecticut and Throughout the Nation: http://www.ct.gov/csc/lib/csc/csc_tower_3_07.pdf
- Department of Arkansas Heritage. (2016). *Arkansas Historic Preservation Program*. Retrieved from <http://www.arkansaspreservation.com/>
- Detroit Publishing Company. (1905a). New Union Station, Little Rock, Ark. *Library of Congress Prints & Photographs Online Collection*. Little Rock, Arkansas: Library of Congress. Retrieved January 2016, from <http://www.loc.gov/resource/det.4a23597/>
- Detroit Publishing Company. (1905b). Little Rock Public Library, Little Rock, Ark. *Library of Congress Prints & Photographs Online Collection*. Little Rock, Arkansas: Library of Congress. Retrieved January 2016, from <http://www.loc.gov/resource/det.4a23603/>

- Detroit Publishing Company. (1905c). Post office and [Pulaski] Court House, Little Rock, Ark. *Library of Congress Prints & Photographs Online Collection*. Little Rock, Arkansas: Library of Congress. Retrieved January 2016, from <http://www.loc.gov/resource/det.4a23607/>
- DiCarlo, A., White, F., Guo, P., & Litovitz, T. (2002). Chronic Electromagnetic Field Exposure decreases HSP70 Levels and Lowers Cytoprotection. In A. DiCarlo, F. White, P. Guo, & T. Litovitz, *Cellular Biochemistry* (pp. 447-454).
- DOE. (2015). *Climate Change and the U.S. Energy Sector: Regional Vulnerabilities and Resilience Solutions*. Washington, DC: Department of Energy. Retrieved December 15, 2015, from <http://energy.gov/epsa/downloads/climate-change-and-us-energy-sector-regional-vulnerabilities-and-resilience-solutions>
- DOT. (2015). *National Transportation Atlas Database*. Retrieved July 2015, from Bureau of Transportation Statistics National Transportation Atlas Database: http://www.rita.dot.gov/bts/sites/rita.dot.gov.bts/files/publications/national_transportation_atlas_database/index.html
- eBird. (2015a). *eBird range map--bald eagle*. Retrieved from http://ebird.org/ebird/map/baleag?bmo=1&emo=12&byr=2011&eyr=2015&__hstc=75100365.64b7254677ac8cc5c8f21aa17c0b9689.1442877327577.1442877327577.1442877327577.1&__hssc=75100365.4.1442877327577&__hsfp=3470679313#_ga=1.21938685.790432658.1442877326
- eBird. (2015b). *eBird range map--golden eagle*. Retrieved from http://ebird.org/ebird/map/goleag?bmo=1&emo=12&byr=2011&eyr=2015#_ga=1.21938685.790432658.1442877326
- Edinger, G. J., Evans, D. J., Gebauer, S., Howard, T. G., Hunt, D. M., & Olivero, A. M. (2014, March). *Ecological Communities of New York State*. Retrieved March 19, 2015, from A revised and expanded edition of Carol Reschke's Ecological Communities of New York State.: <http://www.dec.ny.gov/animals/97703.html>
- EIA. (2013). *Annual Coal Report 2013 - Table 21. Coal Productivity by State and Mine Type, 2013 and 2012*. Retrieved October 23, 2015, from <http://www.eia.gov/coal/annual/pdf/table21.pdf>
- EIA. (2014). *State CO2 Emissions*. Retrieved 4 25, 2016, from <http://www.eia.gov/environment/emissions/state/>
- EIA. (2015a, July). *Greenhouse Gas Emissions Overview*. Retrieved 07 28, 2015, from Emissions of Greenhouse Gases in the United States: http://www.eia.gov/environment/emissions/ghg_report/ghg_overview.cfm
- EIA. (2015b). *Frequently Asked Questions*. Retrieved from <http://www.eia.gov/tools/faqs/faq.cfm?id=45&t=8>
- EIA. (2016a, October). *Electricity*. Retrieved November 2015, from U.S. Energy Information Administration: <https://www.eia.gov/electricity/data/state>
- EIA. (2016b). *Arkansas State Energy Profile*. Retrieved November 2015, from U.S. Energy Information Administration: <http://www.eia.gov/state/print.cfm?sid=AR>
- EIA. (2016c, January 21). *Arkansas - State Profile and Energy Estimates*. Retrieved April 25, 2016, from <http://www.eia.gov/state/analysis.cfm?sid=AR>
- EIA. (2017a, February). *Electric Power Monthly with Data for December 2016*. Retrieved from https://www.eia.gov/electricity/monthly/current_year/february2017.pdf

- EIA. (2017b, October). *Arkansas Electricity Data Browser*. Retrieved October 2015, from U.S. Energy Information Administration:
<http://www.eia.gov/electricity/data/browser/#/topic/0?agg=2,0,1&fuel=vtvo&geo=000000000g&sec=g&linechart=ELEC.PRICE.NY-RES.A~ELEC.PRICE.NY-COM.A~ELEC.PRICE.NY-IND.A~ELEC.PRICE.NY-TRA.A~ELEC.PRICE.NY-OTH.A&columnchart=ELEC.GEN.ALL-AR-99.A&map=ELEC.GEN.ALL->
- EIA. (2017c, October). *Arkansas Profile Overview*. Retrieved October 2015, from U.S. Energy Information Administration: <http://www.eia.gov/state/?sid=AR#tabs-2>
- EIA. (2017d, January 17). *Energy-Related CO2 Emissions at the State Level, 2000-2014*. Retrieved February 11, 2016, from
<http://www.eia.gov/environment/emissions/state/analysis/>
- Engels, et. al. (2014, May 15). Anthropogenic Electromagnetic Noise Disrupts Magnetic Compass Orientation in a Migratory Bird. *Nature*. doi:10.1038/nature13290
- Engels, S., Schneider, N., Lefeldt, N., Hein, C., Zapka, M., Michalik, A., . . . Mouritsen, H. (2014, May 15). Anthropogenic electromagnetic noise disrupts magnetic compass orientation in a migratory bird. *Nature* 509. doi:10.1038/nature13290
- Executive Office of the President. (1994, February). *Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*. Retrieved April 2015, from 59 Federal Register 7629: <https://federalregister.gov/a/94-3685>
- FAA. (2007). *Hearing and Noise in Aviation*. Retrieved 07 22, 2015, from
<https://www.faa.gov/pilots/safety/pilotsafetybrochures/media/hearing.pdf>
- FAA. (2008). *Chapter 14 Airspace*. Retrieved June 2015, from Pilot's Handbook of Aeronautical Knowledge:
http://www.faa.gov/regulations_policies/handbooks_manuals/aviation/pilot_handbook/media/phak%20-%20chapter%2014.pdf
- FAA. (2012, April 05). *Advisory Circular AC 36-3H*. Retrieved July 22, 2015, from
http://www.faa.gov/documentLibrary/media/Advisory_Circular/AC36-3H%20Chg%201.pdf
- FAA. (2013 First Edition). *Integration of Civil Unmanned Aircraft Systems (UAS) in the National Airspace System (NAS) Roadmap*. Washington D.C.: U.S. Department of Transportation Federal Aviation Administration.
- FAA. (2014a, January). *Federal Aviation Administration, Air Traffic Organization*. Retrieved June 2015, from http://www.faa.gov/about/office_org/headquarters_offices/ato/
- FAA. (2014b, August 6). *FAA Air Traffic Organization Policy, JO 7400.9SZ, Airspace Designations and Reporting Points*. Retrieved September 2015, from FAA, Regulations & Policies, Orders & Notices:
http://www.faa.gov/regulations_policies/orders_notices/index.cfm/go/document.list?parentTopicID/10
- FAA. (2015a, June 25). *Airport Data and Contact Information*. Retrieved October 23, 2015, from http://www.faa.gov/airports/airport_safety/airportdata_5010/
- FAA. (2015b, March). *Flight Standards District Offices (FSDO)*. Retrieved June 2015, from https://www.faa.gov/about/office_org/field_offices/fsdo/?state=AR
- FAA. (2015c). *Aeronautical Information Manual*. Retrieved 2015 August, from
http://www.faa.gov/air_traffic/publications/media/aim.pdf

- FAA. (2015d). *Obstruction Evaluation / Airport Airspace Analysis (OE/AAA)*. Retrieved July 2015, from Federal Aviation Administration:
<https://oeaaa.faa.gov/oeaaa/external/portal.jsp>
- FAA. (2015e). *Air Traffic Organization Policy Order JO 7400.8X, Subject: Special Use Airspace*. Retrieved July 2015, from
http://www.faa.gov/documentlibrary/media/order/7400_8x_2015.pdf
- FAA. (2015f). *FAA TFR List*. Retrieved September 2015, from <http://tfr.faa.gov/tfr2/list.html>
- FAA. (2015g). *Air Traffic Organization Policy Order JO 7400, 8Y Special Use Airspace*. Retrieved July 2015, from
[http://www.faa.gov/documentLibrary/media/Order/7400.8Y_\(2016\).pdf](http://www.faa.gov/documentLibrary/media/Order/7400.8Y_(2016).pdf)
- FAA. (2015h, August). *FAA Pilot Safety Brochure - Hearing and Noise in Aviation*. Retrieved August 05, 2015, from FAA.gov:
<https://www.faa.gov/pilots/safety/pilotsafetybrochures/media/hearing.pdf>
- FAA. (2015i). *Air Traffic Activity Systems (ATADS) Database*. Retrieved 10 22, 2015, from
<http://aspm.faa.gov/opsnet/sys/Airport.asp>
- FAA. (2016a, April 27). *Volume 7 Investigation Chapter 5 Conduct a Complaint Investigation*. Retrieved from
http://fsims.faa.gov/wdocs/8900.1/v07%20investigation/chapter%2005/07_005_001.htm
- FAA. (2016b, October 8). *Advisory Circular AC 70/7460-1L CHG1*. Retrieved from
https://www.faa.gov/documentLibrary/media/Advisory_Circular/AC_70_7460-1L_Change_1_Obstruction_Marking_and_Lighting_10062016.pdf
- FAO. (2017). *Land Cover Classification System (LCCS) Definitions*. Retrieved from
<http://www.fao.org/docrep/003/x0596e/x0596e01e.htm>
- FCC. (2000, August 15). *Deployment of Advanced Telecommunications Capability: Second Report*. Retrieved Nov 16, 2015, from
https://transition.fcc.gov/Bureaus/Common_Carrier/Orders/2000/fcc00290.pdf
- FCC. (2012, March 13). *Final Programmatic Environmental Assessment for the Antenna Structure Registration Program*. Retrieved from
https://apps.fcc.gov/edocs_public/attachmatch/DOC-312921A1.pdf
- FCC. (2014a). *Internet Access Services: Status as of December 31, 2013*. Industry Analysis and Technology Division Wireline Competition Bureau. Federal Communications Commission.
- FCC. (2014b). *Local Telephone Competition: Status as of December 31, 2013*. Retrieved from
https://apps.fcc.gov/edocs_public/attachmatch/DOC-329975A1.pdf
- FCC. (2015, June 17). *Antenna Structure Registration*. Retrieved June 17, 2015, from Federal Communications Commission:
<http://wireless2.fcc.gov/UlsApp/AsrSearch/asrRegistrationSearch.jsp>
- FCC. (2016a, March). *National Broadband Plan Chapter 16 Public Safety*. Retrieved March 29, 2016, from Broadband.gov: <http://www.broadband.gov/plan/16-public-safety/>
- FCC. (2016b, February 1). *Tower and Antenna Siting*. Retrieved February 10, 2016, from
<https://www.fcc.gov/general/tower-and-antenna-siting>
- FCC. (2016c, June). *Detail - Microwave*. Retrieved from Application Search Help:
http://wireless2.fcc.gov/helpfiles/applicationSearch/ad_microwave.html
- FCC. (2016d, June 27). *Master PSAP Registry*. Retrieved from <https://www.fcc.gov/general/9-1-1-master-psap-registry>

- FCC. (2017, January 6). *Opportunities to Reduce Bird Collisions with Communications Towers While Reducing Tower Lighting Costs*. Retrieved from https://www.fcc.gov/sites/default/files/Light_Changes_Information_Update_Jan_2017.pdf
- Federal Mining Dialogue. (2015a, January 6). *Abandoned Mine Lands Portal - Staying Safe*. Retrieved September 29, 2015, from <http://www.abandonedmines.gov/ss.html>
- Federal Mining Dialogue. (2015b, May 7). *Abandoned Mine Lands Portal*. Retrieved October 23, 2015, from <http://www.abandonedmines.gov/>
- FEMA. (2000). *44 CFR Section 59.1 of the National Flood Insurance Program (NFIP) Regulations: Definitions of NFIP Terms*. Retrieved May 2015, from <http://www.fema.gov/media-library/assets/documents/12437?id=3064>
- FEMA. (2010, March). *Guidelines for Estimation of Percolation losses for NFIP Studies*. Retrieved August 6, 2015, from FEMA: http://www.fema.gov/media-library-data/20130726-1731-25045-9495/dl_perc.pdf
- FEMA. (2012, May 30). *Arkansas "Hurricane Season" History Demonstrates Need to Prepare Now*. Retrieved October 23, 2015, from FEMA: <https://www.fema.gov/news-release/2012/05/30/arkansas-hurricane-season-history-demonstrates-need-prepare-now>
- FEMA. (2013). *Unit 3: NFIP Flood Studies and Maps*. Retrieved May 2015, from http://www.fema.gov/media-library-data/20130726-1539-20490-0241/nfip_sg_unit_3.pdf
- FEMA. (2014a, May). *Chapter 8: Floodplain Natural Resources and Functions*. Retrieved May 2015, from <https://training.fema.gov/hiedu/docs/fmc/chapter%208%20-%20floodplain%20natural%20resources%20and%20functions.pdf>
- FEMA. (2014b, May). *Chapter 2: Types of Floods and Floodplains*. Retrieved May 2015, from <http://training.fema.gov/hiedu/docs/fmc/chapter%202%20-%20types%20of%20floods%20and%20floodplains.pdf>
- FEMA. (2014c, May). *The National Flood Insurance Program Community Status Book*. Retrieved November 4, 2015, from <http://www.fema.gov/cis/AR.pdf>
- FEMA. (2014d, May). *Community Rating System*. Retrieved October 27, 2015, from http://www.fema.gov/media-library-data/1398878892102-5cbcaa727a635327277d834491210fec/CRS_Communities_May_1_2014.pdf
- FEMA. (2014e, June 19). *Entergy and T&D Solutions Restore Electrical Power to Mayflower, Arkansas (photo)*. Retrieved October 23, 2015, from FEMA Media Library: <https://www.fema.gov/media-library/assets/images/96044>
- FEMA. (2015, April). *Floodplain Management Fact Sheet*. Retrieved May 2015, from <https://www.fema.gov/floodplain-management-fact-sheet>
- Fenneman, N. (1916). *Physiographic Subdivision of the United States*. Retrieved April 2015, from <http://www.pnas.org/content/3/1/17.full.pdf?ck=nck>
- FGDC. (2013, August). *Classification of Wetlands and Deepwater Habitats of the United States*. Retrieved April 17, 2015, from FGDC Subcommittee on Wetlands Data: <http://www.fgdc.gov/standards/projects/FGDC-standards-projects/wetlands/nvcs-2013>
- FHWA. (2009, October). *Advances in Wildlife Crossing Technologies*. Retrieved July 12, 2016, from Public Roads: <http://www.fhwa.dot.gov/publications/publicroads/09septoct/03.cfm>
- FHWA. (2011, July 14). *Highway Traffic and Construction Noise*. Retrieved 07 27, 2015, from [fhwa.dot.gov: http://www.fhwa.dot.gov/environment/noise/regulations_and_guidance/probresp.cfm#appendix](http://www.fhwa.dot.gov/environment/noise/regulations_and_guidance/probresp.cfm#appendix)

- FHWA. (2013, September 3). *National Scenic Byways Program - Intrinsic Qualities: Identification and Distinctions*. Retrieved May 2016, from http://www.fhwa.dot.gov/hep/scenic_byways/byway_quality/analysis/iq_identification.cfm
- FHWA. (2014, October 21). *Public Road Length*. Retrieved October 23, 2015, from <http://www.fhwa.dot.gov/policyinformation/statistics/2013/hm10.cfm>
- FHWA. (2015a, May 28). *Bridges by State and County 2014*. Retrieved October 23, 2015, from <http://www.fhwa.dot.gov/bridge/nbi/no10/county14.cfm#ar>
- FHWA. (2015b, September 22). *All Cargo Data reported for CY14*. Retrieved October 23, 2015, from http://www.faa.gov/airports/planning_capacity/passenger_allcargo_stats/passenger/media/cy14-cargo-airports.pdf
- FHWA. (2015c). *America's Byways: Arkansas*. Retrieved October 26, 2015, from <http://www.fhwa.dot.gov/byways/states/AR>
- FHWA. (2015d, May 28). *Highway Traffic Noise*. Retrieved July 22, 2015, from http://www.fhwa.dot.gov/environment/noise/regulations_and_guidance/faq_nois.cfm
- Fiber Optic Association. (2010). *Guide to Fiber Optics & Premises Cabling*. Retrieved September 21, 2015, from Safety in Fiber Optic Installations: <http://www.thefoa.org/tech/safety.htm>
- FindLaw. (2017). *Arkansas Code Title 15. Natural Resources and Economic Development § 15-20-304. Arkansas Natural Heritage Commission*. Retrieved from <http://codes.findlaw.com/ar/title-15-natural-resources-and-economic-development/ar-code-sect-15-20-304.html>
- FRA. (2015). *Federal Railroad Administration Horn Noise FAQ*. Retrieved 07 22, 2015, from <https://www.fra.dot.gov/Page/P0599>
- FTA. (2006). *Transit Noise and Vibration Impact Assessment*. FTA. Retrieved from <https://www.transit.dot.gov/regulations-and-guidance/environmental-programs/fta-noise-and-vibration-impact-assessment>
- FWS. (1998, March). *Endangered Species Consultation Handbook*. Retrieved from https://www.fws.gov/endangered/esa-library/pdf/esa_section7_handbook.pdf
- GAO. (2013). *Data Center Consolidation: Strengthened Oversight Needed to Achieve Billions of Dollars in Savings*. Retrieved from <http://www.gao.gov/products/GAO-13-627T>
- Gehring, J., Kerlinger, P., & Manville, A. M. (2011). "The Role of Tower Height and Guy Wires on Avian Collisions with Communication Towers." *The Journal of Wildlife Management*, 848-855. Retrieved from <http://onlinelibrary.wiley.com/doi/10.1002/jwmg.99/abstract>.
- Geological Survey of Georgia. (1911). *Geology of the Coastal Plain of Georgia*. Retrieved October 2015, from https://epd.georgia.gov/sites/epd.georgia.gov/files/related_files/site_page/B-26.pdf
- Giles, B., Bauder, J., & Alfonso-Durruty, M. P. (2010). Revisiting the Dead at Helena Crossing, Arkansas. *Southeastern Archaeology*, 29(2), 323-340. Retrieved October 2015, from <http://www.jstor.org/stable/41620245>
- Gillam, C. J. (1996, August). A View of Paleoindian Settlement From Crowley's Ridge. *Plains Anthropologist*, 41(157), 273-286. Retrieved October 2015, from <http://www.jstor.org/stable/25669409>

- GPO. (2010, April 5). *Title 40 Code of Federal Regulations Part 93.153*. Retrieved July 20, 2015, from http://www.ecfr.gov/cgi-bin/text-idx?SID=2028b268447f0bf79b396678569dac85&mc=true&node=se40.20.93_1153&rgn=div8
- GPO. (2011). *Title 7, Agriculture*. Retrieved from <https://www.gpo.gov/fdsys/pkg/USCODE-2011-title7/pdf/USCODE-2011-title7-chap104.pdf>
- GPO. (2015, June). *Electronic Code of Federal Regulations*. Retrieved June 2015, from U.S. Government Publishing Office: http://www.ecfr.gov/cgi-bin/text-idx?SID=6095c0db6bb5edb10c850334725dae34&mc=true&tpl=/ecfrbrowse/Title36/36tab_02.tpl
- Grigor'ev, I. (2003). *Biological Effects of Mobile Phone Electromagnetic Field on Chick Embryo (Risk Assessment using the Mortality Rate)*.
- Haag, W. G. (1961). The Archaic of the Lower Mississippi Valley. *American Antiquity*, 26(3), 317-323. Retrieved October 2015, from <http://www.jstor.org/stable/277398>
- Harris, E. C. (1979). The Laws of Archaeological Stratigraphy. *World Archaeology*, 11(1), 111-117. Retrieved July 2015, from <http://www.google.com/url?sa=t&rct=j&q=&esrc=s&frm=1&source=web&cd=1&ved=0CB4QFjAAahUKEwjz-8uDzoXHAhWMFpIKHXZnAWk&url=http%3A%2F%2Fusers.clas.ufl.edu%2Fdavidson%2FProseminar%2FWeek%252012%2520Time%2FHarris%25201979%2520laws%2520of%2520stratigraphy.pdf&ei=>
- Hill, D., Hockin, D., Price, D., Tucker, G., Morris, R., & Treweek, J. (1997). Bird Disturbance: Improving the Quality and Utility of Disturbance Research. *Journal of Applied Ecology*, 34(2): 275-288.
- Hilliard, J. E., & Mainfort, R. C. (2007). The Ira Spradley Field Site: A Late Woodland Cemetery in the Arkansas Ozarks. *Southeastern Archaeology*, 26(2), 269-291. Retrieved October 2015, from <http://www.jstor.org/stable/40713601>
- Historic American Buildings Survey. (1933). Historic American Buildings Survey Lester Jones, Photographer March 3, 1940 North Elevation (Front) - Archibald Yell House, Fayetteville, Washington County, AR. *Library of Congress Prints & Photographs Online Collection*. Fayetteville, Arkansas: Library of Congress. Retrieved January 2016, from <http://www.loc.gov/resource/hhh.ar0021.photos/?sp=1>
- Historic Preservation Alliance of Arkansas. (2015). *About Us*. Retrieved October 2015, from Preserve Arkansas: <http://preservearkansas.org/about/>
- Homan, R. N., Atwood, M. A., Dunkle, A. J., & Karr, S. B. (2010, January 5). Movement Orientation by Adult and Juvenile Wood Frogs (*Rana sylvatica*) and American Toads (*Bufo americanus*) Over Multiple Years. *Herpetological Conservation and Biology*, pp. 64-72. Retrieved from http://www.herpconbio.org/Volume_5/Issue_1/Homan_etal_2010.pdf
- Idaho State University. (2000). *Environmental Geology*. Retrieved March 20, 2016, from http://geology.isu.edu/wapi/EnvGeo/EG4_mass_wasting/EG_module_4.htm
- Institute of Maritime History. (2015, August). *Rainsford Island Archaeological Survey*. Retrieved August 2015, from <http://www.maritimelhistory.org/content/rainsford-island-archaeological-survey>
- International Finance Corporation. (2007, April 30). *Environmental, Health, and Safety Guidelines for Telecommunications*. Retrieved from

- <http://www.ifc.org/wps/wcm/connect/0985310048855454b254f26a6515bb18/Final+-+Telecommunications.pdf?MOD=AJPERES&id=1323152343828>
- IPCC. (2007). *Climate Change 2007: Synthesis Report*. Retrieved 2015, from Intergovernmental Panel on Climate Change: www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr.pdf
- IPCC. (2013). *Climate Change 2013: The Physical Science Basis*. Intergovernmental Panel on Climate Change. Retrieved from <https://www.ipcc.ch/report/ar5/wg1/>
- ITU-T. (2012). *Series L: Construction, Installation and Protection of Cables and Other Elements of Outside Plant*. International Telecommunication Union, Telecommunication Standardization Sector of ITU, Geneva.
- Jennings, T. A. (2008, July). San Patrice: An Example of Late Paleoindian Adaptive Versatility in South-Central North America. *Jennings, Thomas A*, 73(3), 539-559. Retrieved October 2015, from <http://www.jstor.org/stable/25470504>
- JUSTIA. (2010a). *2010 Arkansas Code Title 15 - Natural Resources and Economic Development Subtitle 2 - Land And Water Resources Generally*. Retrieved from Chapter 22 - Water Resources Subchapter 2 - Allocation and Use Generally § 15-22-205 - Powers of commission regarding waters.: <http://law.justia.com/codes/arkansas/2010/title-15/subtitle-2/chapter-22/subchapter-2/15-22-205>
- JUSTIA. (2010b). *2010 Arkansas Code Title 8 - Environmental Law Chapter 7 - Hazardous Substances*. Retrieved from <http://law.justia.com/codes/arkansas/2010/title-8/chapter-7/subchapter-10>
- JUSTIA. (2010c). *2010 Arkansas Code Title 11 - Labor and Industrial Relations Chapter 5 - Working Conditions Generally*. Retrieved from <http://law.justia.com/codes/arkansas/2010/title-11/chapter-5/subchapter-3/11-5-307>
- JUSTIA. (2014a). *2014 Arkansas Code Title 12 - Law Enforcement, Emergency Management, And Military Affairs*. Retrieved from <http://law.justia.com/codes/arkansas/2014/title-12>
- JUSTIA. (2014b). *2014 Arkansas Code Title 23 - Public Utilities and Regulated Industries*. Retrieved from <http://law.justia.com/codes/arkansas/2014/title-23>
- JUSTIA. (2014c). *2014 Arkansas Code Title 27 - Transportation*. Retrieved from <http://law.justia.com/codes/arkansas/2014/title-27>
- JUSTIA. (2014d). *2014 Arkansas Code Title 11 - Labor and Industrial Relations Chapter 7 - Regulation of Mines*. Retrieved from <http://law.justia.com/codes/arkansas/2014/title-11/chapter-7/subchapter-3/section-11-7-301>
- JUSTIA. (2015a). *2015 Arkansas Code Title 15 - Natural Resources and Economic Development Subtitle 2 - Land And Water Resources Generally Chapter 20 - General Provisions*. Retrieved from <http://law.justia.com/codes/arkansas/2015/title-15/subtitle-2/chapter-20/subchapter-7/section-15-20-707>
- JUSTIA. (2015b). *2015 Arkansas Code Title 13 - Libraries, Archives, And Cultural Resources Chapter 6 - Archeological Research*. Retrieved from <http://law.justia.com/codes/arkansas/2015/title-13/chapter-6/>
- JUSTIA. (2015c). *2015 Arkansas Code Title 11 - Labor and Industrial Relations Chapter 8 - Injury or Death of Employees Generally*. Retrieved from <http://law.justia.com/codes/arkansas/2015/title-11/chapter-8/>
- Kottke, M. (2006). *World Map of the Köppen-Geiger Climate Classification*. Offenbach, Germany and Vienna, Austria: Gebrüder Borntraeger.

- Lee, R. (1938). Type of house. Lake Dick Project, Arkansas. *Library of Congress Prints & Photographs Online Collection*. Lake Dick, Arkansas: Library of Congress. Retrieved January 2016, from <http://www.loc.gov/resource/fsa.8b20566/>
- Levitt, B., & Lai, H. (2010). Biological Effects from Exposure to Electromagnetic Radiation Emitted by Cell Tower Base Stations and Other Antenna Arrays. *Environ. Rev.* 18. doi:10.1139/A10-018
- LIT. (2014, December). *December 2014 Enplanements and Deplanements*. Retrieved October 23, 2015, from http://www.clintonairport.com/sites/default/files/december_2014_enplanements_deplanements.pdf
- LIT. (2015, October). *Leadership*. Retrieved October 23, 2015, from <http://www.clintonairport.com/airport-business/leadership>
- Manville, A. (2007, February 2). Comments of the U.S. Fish and Wildlife Service submitted electronically to the FCC on 47 CFR Parts 1 and 17, WT Docket No. 03-187, FCC 06-164, Notice of Proposed Rulemaking, “Effects of Communication Towers on Migratory Birds.”
- Manville, A. (2015, March 5). Recommendations For Additional Research and Funding to Assess Impacts of Non-ionizing Radiation to Birds and Other Wildlife. Emorandum to Dr. J. McGlade, Science Advisor to United Nations Environment Program, Key Research Needs Affecting Wildlife. 2.
- Manville, A. (2016a). Impacts to Birds and Bats Due to Collisions and Electrocutions from Some Tall Structures in the United States: Wires, Towers, Turbines and Solar Arrays — State of the Art in Addressing the Problems. In I. Angelici (Ed.), *Problematic Wildlife: a Cross-Disciplinary Approach* (pp. Chap 20, pp 415-442). Switzerland: Springer International Publishing. doi:10.1007/978-3-319-22246-2_20
- Manville, A. (2016b, July 14). A Briefing Memo: What We Know, Can Infer, and Don’t Yet Know About Impacts From Thermal and Non-thermal Non-ionizing Radiation to Birds and Other Wildlife — for Public Release. Peer-Reviewed Briefing Memo.
- Merriam Webster Dictionary. (2015a). *Airspace*. Retrieved June 2015, from Merriam Webster Dictionary: <http://www.merriam-webster.com/dictionary/airspace>
- Merriam Webster Dictionary. (2015b). *Sea Level*. Retrieved July 2015, from Merriam Webster Dictionary: <http://www.merriam-webster.com/dictionary/sea%20level>
- Missouri Department of Natural Resources. (2015). *Facts about the New Madrid Seismic Zone*. Retrieved October 2015, from <http://dnr.mo.gov/geology/geosrv/geores/techbulletin1.htm>
- Mitchell, R. (2014). Future climate and fire interactions in the South Eastern region of the United States. *Forest Ecology and Management*, 316-326.
- NAS. (2015a). *What is an Important Bird Area?* Retrieved from http://web4.audubon.org/bird/iba_intro.html
- NAS. (2015b). *Arkansas' Important Bird Areas*. Retrieved from <http://netapp.audubon.org/IBA/State/US-AR>
- NAS. (2015c). *Arkansas important bird areas*. Retrieved from <http://netapp.audubon.org/IBA/State/US-AR>
- NASA. (2013, July). Final Environmental Impact Statement: Sounding Rockets Program at Poker Flat Research Range. Wallops Island, VA. Retrieved July 1, 2016, from <http://netspublic.grc.nasa.gov/main/NASA%20SRP%20at%20PFRR%20FEIS%20Volume%20I.pdf>

- National Association of State Aviation Officials. (2015). *Resources NASAO National Association of State Aviation Officials*. Retrieved July 2015, from NASAO National Association of State Aviation Officials: <http://www.nasao.org/Resources.aspx>
- National Conference of State Legislators. (2015, February). *Federal and State Recognized Tribes*. Retrieved October 6, 2015, from <http://www.ncsl.org/research/state-tribal-institute/list-of-federal-and-state-recognized-tribes.aspx#fl>
- National Institutes of Health. (2015, June). *What is TOXMAP?* Retrieved from <http://toxmap.nlm.nih.gov/toxmap/faq/2009/08/what-is-toxmap.html>
- National League of Cities. (2007). *Sub-county, General-Purpose Governments by Population-Size Group and State*. (Census of Governments) Retrieved May 21, 2015, from <http://www.nlc.org/build-skills-and-networks/resources/cities-101/city-structures/number-of-municipal-governments-and-population-distribution>
- National Wild and Scenic River System. (2015a). *Big Piney Creek, Arkansas*. Retrieved November 4, 2015, from <http://www.rivers.gov/rivers/big-piney.php>
- National Wild and Scenic Rivers System. (2015b). *Buffalo River, Arkansas*. Retrieved November 4, 2015, from <http://www.rivers.gov/rivers/buffalo.php>
- National Wild and Scenic Rivers System. (2015c). *Cossatot River, Arkansas*. Retrieved November 4, 2015, from <http://www.rivers.gov/rivers/cossatot.php>
- National Wild and Scenic Rivers System. (2015d). *Hurricane Creek, Arkansas*. Retrieved November 4, 2015, from <http://www.rivers.gov/rivers/hurricane.php>
- National Wild and Scenic Rivers System. (2015e). *Little Missouri River, Arkansas*. Retrieved November 4, 2015, from <http://www.rivers.gov/rivers/little-missouri.php>
- National Wild and Scenic Rivers System. (2015f). *Mulberry River, Arkansas*. Retrieved November 4, 2015, from <http://www.rivers.gov/rivers/mulberry.php>
- National Wild and Scenic Rivers System. (2015g). *North Sylamore Creek*. Retrieved November 4, 2015, from <http://www.rivers.gov/rivers/north-sylamore.php>
- National Wild and Scenic Rivers System. (2015h). *Richland Creek, Arkansas*. Retrieved November 4, 2015, from <http://www.rivers.gov/rivers/richland.php>
- National Wild and Scenic Rivers System. (2015i). *Arkansas Wild and Scenic Rivers*. Retrieved October 26, 2015, from <https://www.rivers.gov/arkansas.php>
- National Wildlife Federation. (2015). *Ecoregions*. Retrieved from <http://www.nwf.org/Wildlife/Wildlife-Conservation/Ecoregions.aspx>
- Natural Resources Conservation Service. (1996a). *Soil Quality Resource Concerns: Soil Erosion*. Retrieved September 2015, from http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_051278.pdf
- Natural Resources Conservation Service. (1996b). *Soil Quality Resource Concerns: Compaction*. Retrieved September 2015, from http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_051594.pdf
- Natural Resources Conservation Service. (1999). *Soil Taxonomy A Basic System of Soil Classification for Making and Interpreting Soil Surveys*. Retrieved from http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_051232.pdf
- Natural Resources Conservation Service. (2000, March). *Soil Quality - Urban Technical Note No. 1*. Retrieved from Erosion and Sedimentation on Construction Sites: http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_053285.pdf

- Natural Resources Conservation Service. (2003). *Soil Compaction: Detection, Prevention, and Alleviation*. Retrieved September 2015, from http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_053258.pdf
- Natural Resources Conservation Service. (2006a). *Land Resource Regions and Major Land Resource Areas of the United States, the Caribbean, and the Pacific Basin*. Retrieved May 2015, from Major Land Resource Area: http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_051845.pdf
- Natural Resources Conservation Service. (2006b). *Arkansas land use*. Retrieved from http://www.nrcs.usda.gov/wps/portal/nrcs/detail/ar/programs/?cid=nrcs142p2_035025
- Natural Resources Conservation Service. (2009). *Protecting pollinators*. Retrieved from http://www.nrcs.usda.gov/wps/portal/nrcs/detail/mt/newsroom/photos/?cid=nrcs144p2_057907
- Natural Resources Conservation Service. (2015a). *What is Soil?* Retrieved June 2015, from Soil Education: http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/edu/?cid=nrcs142p2_054280
- Natural Resources Conservation Service. (2015b). *Twelve Orders of Soil Taxonomy*. Retrieved August 2015, from Soils: http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/ref/?cid=nrcs142p2_053588
- Natural Resources Conservation Service. (2015c). *Using Soil Taxonomy to Identify Hydric Soils*. Retrieved July 2015, from http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs143_010785.pdf
- Natural Resources Conservation Service. (2015d). *STATSGO2 Database*. Retrieved June 2015, from http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/survey/geo/?cid=nrcs142p2_053629
- Natural Resources Conservation Service. (2015e). *Hydric Soils -- Introduction*. Retrieved June 2015, from http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/use/hydric/?cid=nrcs142p2_053961
- Natural Resources Conservation Service. (2015f). *Erosion*. Retrieved September 2015, from <http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/landuse/crops/erosion/>
- Natural Resources Conservation Service. (2015g). *Cropland*. Retrieved October 27, 2015, from <http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/landuse/crops/>
- NCED. (2015). *State of Arkansas and All Easements*. Retrieved November 2, 2015, from http://conservationeasement.us/reports/easements?report_state=Arkansas&report_type=All
- New Hampshire Department of Environmental Services. (2014). *Geologic Mapping Program*. Retrieved August 2015, from <http://des.nh.gov/organization/commissioner/gsu/gmp/categories/overview.htm>
- NIST. (2015, March). *Nationwide Public Safety Broadband Network Deployment: Network Parameter Sensitivity Analysis*. U.S. Department of Commerce. National Institute of Standards and Technology (NIST), Wireless Networks Division, Communications Technology Laboratory. Retrieved from <http://nvlpubs.nist.gov/nistpubs/ir/2015/NIST.IR.8039.pdf>
- NOAA. (2005). *National Weather Service Forecast Office Little Rock, AR*. Retrieved October 23, 2015, from <http://www.srh.noaa.gov/lzk/?n=rita0905c.htm>

- NOAA. (2010, June 11). *Flood Pictures on June 11, 2010*. Retrieved November 5, 2015, from <http://www.srh.noaa.gov/lzk/?n=rain0610picsyr.htm>
- NOAA. (2012, August 29). *National Weather Service Forecast Office Little Rock, AR*. Retrieved October 23, 2015, from <http://www.srh.noaa.gov/lzk/?n=pns082912txt.htm>
- NOAA. (2013, May 15). *National Weather Service Forecast Office, Little Rock, AR*. Retrieved October 23, 2015, from <http://www.srh.noaa.gov/lzk/?n=pns111612txt.htm>
- NOAA. (2014, January 29). *What is a slough?* Retrieved July 17, 2015, from <http://oceanservice.noaa.gov/facts/slough.html>
- NOAA. (2015a). *Flood Related Hazards*. Retrieved July 2015, from <http://www.floodsafety.noaa.gov/hazards.shtml>
- NOAA. (2015b). *Flooding in Arkansas*. Retrieved November 5, 2015, from <http://www.nws.noaa.gov/floodsafety/states/ar-flood.shtml>
- NOAA. (2015c). *National Oceanic and Atmospheric Administration*. Retrieved from Data Tools: 1981 - 2010 Normals: <http://www.ncdc.noaa.gov/cdo-web/datatools/normals>
- NOAA. (2015d, March 4). *National Weather Service Forecast Office, Little Rock, AR*. Retrieved October 23, 2015, from <http://www.srh.noaa.gov/lzk/?n=swaw4txt.htm>
- NOAA. (2015e, April). *Lightning Fatalities by State, 1959-2014*. Retrieved October 23, 2015, from http://www.lightningsafety.noaa.gov/stats/59-14_State_Ltg_Fatalities.pdf
- NOAA. (2015f). *Essential fish habitat mapper*. Retrieved from <http://www.habitat.noaa.gov/protection/efh/efhmapper/index.html>
- NPS. (1995, July 12). *The Secretary of the Interior's Standards for the Treatment of Historic Properties and the Guidelines for the Treatment of Cultural Landscapes*. Retrieved September 4, 2015, from National Park Service: <http://www.nps.gov/tps/standards/four-treatments/landscape-guidelines/index.htm>
- NPS. (2000). *Geologic Glossary*. Retrieved August 2015, from <https://www.nature.nps.gov/geology/usgsnps/misc/glossaryDtoI.html#G>
- NPS. (2003, January 16). *History E-Library*. Retrieved September 10, 2015, from <http://www.nps.gov/parkhistory/hisnps/NPSHistory/nomenclature.html>
- NPS. (2010). *Official State Fossils*. Retrieved November 2015, from http://www.nature.nps.gov/geology/nationalfossilday/state_fossils.cfm#ar
- NPS. (2012a). *Arkansas*. Retrieved November 2, 2015, from <http://www.nature.nps.gov/nnl/state.cfm?State=AR>
- NPS. (2012b, July 17). *The National Trails System Act*. Retrieved April 12, 2015, from <http://www.nps.gov/nts/legislation.html>
- NPS. (2012c, June 28). *National Natural Landmarks Program: Roaring Branch Research Natural Area*. Retrieved October 26, 2015, from <http://www.nature.nps.gov/nnl/site.cfm?Site=ROBR-AR>
- NPS. (2013, December 10). *Geologic Hazards*. Retrieved September 1, 2015, from Geologic, Energy, and Mineral Resources: <http://www.nature.nps.gov/geology/hazards/>
- NPS. (2014a). *Earth Science Concepts -- Geology by Region*. Retrieved October 2015, from https://www.nature.nps.gov/geology/education/concepts/concepts_regional_geology.cfm
- NPS. (2014b, June 20). *Prohibition of Unmanned Aircraft in National Parks*. Retrieved June 2015, from <https://www.nps.gov/gaar/learn/news/prohibition-of-unmanned-aircraft-in-national-parks.htm>
- NPS. (2014c, June 16). *National Park Service Science of Sound*. Retrieved 07 22, 2015, from <http://www.nature.nps.gov/sound/science.cfm>

- NPS. (2015a). *Geology of the Coastal Plain*. Retrieved April 2015, from http://www.nps.gov/cue/geology/geo_coastalplain.htm
- NPS. (2015b, October 26). *Arkansas*. Retrieved October 26, 2015, from <http://www.nps.gov/state/ar/index.htm>
- NPS. (2015c). *Hot Springs National Park*. Retrieved October 2015, from <http://www.nps.gov/hosp/index.htm>
- NPS. (2015d, October 6). *National Register of Historic Places Program: Research*. Retrieved October 6, 2015, from <http://www.nps.gov/nr/research/>
- NPS. (2015e, April 27). *National Historic Landmarks Program*. Retrieved April 28, 2015, from <http://www.nps.gov/nhl/INDEX.htm>
- NPS. (2015f, April 5). *National Historic Landmarks in Arkansas*. Retrieved October 27, 2015, from <http://www.nps.gov/nhl/find/statelists/ar.htm>
- NPS. (2015g, October 27). *Hot Springs National Park: Environmental Factors*. Retrieved October 27, 2015, from <http://www.nps.gov/hosp/learn/nature/environmentalfactors.htm>
- NPS. (2015h). *Wilderness*. Retrieved September 2015, from <http://wilderness.nps.gov/faqnew.cfm>
- NPS. (2015i). *National Register of Historic Places Program: Fundamentals*. Retrieved September 23, 2015, from http://www.nps.gov/nr/national_register_fundamentals.htm
- NPS. (2015j). *Southeast Archaeological Center*. Retrieved October 2015, from <http://www.nps.gov/SEAC/hnc/outline/01-setting/index.htm>
- NPS. (2015k). *National Heritage Areas: A Map of All the National Heritage Areas*. Retrieved May 2015, from National Park Service: <http://www.nps.gov/maps/full.html?mapId=01a03739-ab0c-40eb-bc3d-6791d3bb67fa>
- NPS. (2015l, February 18). *National Historic Landmarks Program*. Retrieved May 2016, from <https://www.nps.gov/nhl/>
- NPS. (2016a, May). *Trail of Tears National Historic Trail*. Retrieved from <https://www.nps.gov/trte/index.htm>
- NPS. (2016b, June). *National Historic Landmarks Program*. Retrieved from <https://www.nps.gov/nhl/learn/intro.htm>
- NPS. (2017). *Trail of Tears*. Retrieved from A Journey of Injustice: www.nps.gov/trte/index.htm
- NTFI. (2005). *Why Can't We Talk? Working Together to Bridge the Communications Gap to Save Lives: A Guide for Public Officials*. U.S. Department of Justice, Office of Justice Programs, National Institute of Justice. National Task Force on Interoperability (NTFI). Retrieved from <https://www.ncjrs.gov/pdffiles1/nij/204348.pdf>
- NTIA. (2005, October). *Interference Protection Criteria Phase 1 - Compilation from Existing Sources*. Retrieved January 6, 2016, from NTIA Report 05-432: https://www.ntia.doc.gov/files/ntia/publications/ipc_phase_1_report.pdf
- NTIA. (2014). *Download Data*. Retrieved from National Broadband Map: <http://www.broadbandmap.gov/data-download>
- NWS. (2006). *National Weather Service: JetStream - Online School for Weather*. Retrieved from National Oceanic and Atmospheric Administration: http://www.srh.noaa.gov/jetstream/global/climate_max.htm
- NWS. (2009, June 25). *National Weather Service: JetStream - Online School for Weather*. Retrieved from National Oceanic and Atmospheric Administration: <http://w1.weather.gov/glossary/index.php?letter=c>

- NWS. (2015a, June 10). *Office of Climate, Water, and Weather Services*. Retrieved October 23, 2015, from 2014 Summary of Hazardous Weather Fatalities, Injuries, and Damage by State: <http://www.nws.noaa.gov/om/hazstats/state14.pdf>
- NWS. (2015b, April 27). *Tornadoes/Flooding on April 27-28, 2014*. Retrieved October 23, 2015, from April 2014 Storm Report: <http://www.srh.noaa.gov/lzk/?n=svr0414c.htm>
- NWS. (2015c, April 14). *Tornado continued northeast through Mayflower (Faulkner County) (photo)*. Retrieved October 23, 2015, from Tornadoes on April 27, 2014 (Aerial Photos): <http://www.srh.noaa.gov/lzk/?n=svr0414caerial.htm>
- Office of the Arkansas State Climatologist. (2015). *Climate of Arkansas*. Retrieved from <http://www.climate.ar.gov/Climate%20Intro.pdf>
- Olcott, P. G. (1995a). *Carbonate-Rock Aquifers, HA 730-M*. Retrieved May 5, 2015, from http://pubs.usgs.gov/ha/ha730/ch_m/M-text4.html
- Olcott, P. G. (1995b). *Sandstone Aquifers, HA-730-M*. Retrieved May 5, 2015, from http://pubs.usgs.gov/ha/ha730/ch_m/M-text5.html
- Oregon Department of Geology. (2015). *Earthquake Hazards in the Pacific Northwest*. Retrieved March 2015, from <http://www.oregongeology.org/sub/earthquakes/EQs.htm>
- OSHA. (2002). *Occupational Safety & Health Administration We Can Help*. Retrieved September 22, 2015, from Hearing Conservation: <https://www.osha.gov/Publications/OSHA3074/osha3074.html>
- OSHA. (2003). *Fact Sheets on Natural Disaster Recovery: Flood Cleanup*. Retrieved December 2013, from https://www.osha.gov/OshDoc/data_Hurricane_Facts/Bulletin2.pdf
- OSHA. (2013). *OSHA Technical Manual - Noise*. Retrieved from https://www.osha.gov/dts/osta/otm/new_noise/index.pdf
- OSHA. (2015). *Communication Towers*. Retrieved September 21, 2015, from <https://www.osha.gov/doc/topics/communicationtower/index.html>
- OSHA. (2016a). *OSHA Technical Manual: Noise*. Retrieved May 2016, from Section III: Chapter 5: https://www.osha.gov/dts/osta/otm/new_noise/
- OSHA. (2016b, March 28). *Regulations (Standards - 29 CFR)*. Retrieved from Occupational Safety & Health Administration: https://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=9867
- OSHA. (2016c, November 18). *Occupational Safety and Health Standards Special Industries*. Retrieved from https://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=9867
- OSHA. (2016d). *Restoring Communications Systems*. Retrieved February 16, 2016, from Infrastructure Repair and Restoration: <https://www.osha.gov/SLTC/etools/hurricane/communications.html>
- OSHA. (2016e, May 29). *Section V: Chapter 2, Excavations: Hazard Recognition in Trenching and Shoring*. Retrieved from https://www.osha.gov/dts/osta/otm/otm_v/otm_v_2.html
- OSHA. (2017). *Recommended Practices for Safety and Health Programs*. (S. L. OSHA Directorate of Technical Support and Emergency Management, & U. Salt Lake City, Editors) Retrieved September 22, 2015, from Safety & Health Management System Tools: <https://www.osha.gov/shpguidelines/index.html>
- P25.org. (2015, August 10). *Project 25 Systems (State Listing P25.org)*. Retrieved August 10, 2015, from

- http://www.project25.org/images/stories/ptig/docs/P25_Phase_1_FDMA_Systems_REV_2_update_June_2015.pdf
- Page, S. D. (2012, October 15). Timely Processing of Prevention of Significant Deterioration (PSD) Permits when EPA or a PSD-Delegated Air Agency Issues the Permit. Retrieved April 21, 2015, from <https://www.epa.gov/nsr/timely-processing-prevention-significant-deterioration-psd-permits-when-epa-or-psd-delegated-air>
- Panagopoulos, D., & Margaritis, L. (2008). Mobile Telephony Radiation Effects on Living Organisms. *H. Buress (Ed.), Mobile Telephones*, 107-149.
- ProximityOne. (2015). *State Population Projections, Outlook 2030*. Retrieved March 2015, from <https://proximityone.wordpress.com/2013/12/19/state-population-projections-2030/>
- PSCR. (2015). *Location-Based Services R&D Roadmap*. Retrieved from <http://nvlpubs.nist.gov/nistpubs/TechnicalNotes/NIST.TN.1883.pdf>
- Purdue University. (2015). *Hydrologic Soil Groups*. Retrieved June 2015, from <https://engineering.purdue.edu/mapserve/LTHIA7/documentation/hsg.html>
- Purdue University Consumer Horticulture. (2006). *What is Loam?* Retrieved May 19, 2016, from <https://hort.purdue.edu/ext/loam.html>
- RadioReference.com. (2015a, September 2). *State of Arkansas Radio Reference*. Retrieved September 2, 2015, from <http://www.radioreference.com/apps/db/?stid=5>
- RadioReference.com. (2015b, September 2). *AWIN Tower Map*. Retrieved September 2, 2015, from http://wiki.radioreference.com/index.php/AWIN_Tower_Map
- RadioReference.com. (2015c, September 2). *Arkansas Statewide Mutual Aid*. Retrieved September 2, 2015, from <http://www.radioreference.com/apps/db/?aid=2924>
- Ramsar Convention. (2014). *Wetlands of International Importance*. Retrieved June 2015, from <http://www.ramsar.org/about/wetlands-of-international-importance>
- Redmond, B. G., & Tankersley, K. B. (2015, November). Evidence of Early Paleoindian Bone Modification and Use at the Sheriden Cave Site (33WY252), Wyandot County, Ohio. *American Antiquity*, 70(3), 503-526. Retrieved November 2015, from <http://www.jstor.org/stable/40035311>
- Ritterbush, L. W. (2002). Drawn by the Bison: Late Prehistoric Native Migration into the Central Plains. *Great Plains Quarterly*, 22(4), 259-270. Retrieved November 2015, from <http://www.jstor.org/stable/23533248>
- Ritterbush, L. W., & Logan, B. (2000, August). Late Prehistoric Oneota Population Movement into the Central Plains. *Plains Anthropologist*, 45(173), 257-272. Retrieved November 2015, from <http://www.jstor.org/stable/25669669>
- Rogers, D. J., Olshansky, R., & Rogers, B. R. (2004). *Damage to Foundations From Expansive Soils*. Retrieved March 23, 2015, from http://web.mst.edu/~rogersda/expansive_soils/DAMAGE%20TO%20FOUNDATIONS%20FROM%20EXPANSIVE%20SOILS.pdf
- Rolingson, M. A., & Howard, M. J. (1997). Igneous Lithics of Central Arkansas: Identification, Sources, and Artifact Distribution. *Southeastern Archaeology*, 16(1), 33-50. Retrieved October 2015, from <http://www.jstor.org/stable/41890364>
- Rothschild, B. M., Turner, K. R., & DeLuca, M. A. (1988). *Symmetrical Erosive Peripheral Polyarthrititis in the Late Archaic Period of Alabama*. Retrieved October 2015, from <http://www.jstor.org/stable/1702683>
- Sabo III, G. (2013, February 13). *The Mississippi Period: Southeastern Chiefdoms A.D. 900 - 1541*. Retrieved January 13, 2016, from Indians of Arkansas:

- <http://arkarcheology.uark.edu/indiansofarkansas/index.html?pageName=The%20Mississippi%20Period>
- Sabo, G. I., & Hilliard, J. E. (2008). *Woodland Period Shell-Tempered Pottery in the Central Arkansas Ozarks*. Retrieved October 2015, from <http://www.jstor.org/stable/40713448>
- Sacramento County Airport System. (2015). *Sacramento County Airport System Noise Page*. Retrieved 6 10, 2015, from http://www.sacramento.aero/scas/environment/noise/noise_101/
- Sciulli, P. W., & Aument, B. W. (1987). *Paleodemography of the Duff Site [33LO111], Logan County, Ohio*. Retrieved November 2015, from <http://www.jstor.org/stable/20707979>
- Smithsonian Institution. (2016). *Glossary -- Courtesy of the Department of Paleobiology, National Museum of Natural History, Washington, DC*. Retrieved May 2016, from <http://paleobiology.si.edu/geotime/main/glossary.html>
- State Climate Extremes Committee. (2015). *State Climate Extremes Committee*. (N. O. Administration, Producer) Retrieved 2015, from National Climatic Data Center: <http://www.ncdc.noaa.gov/extremes/scec/records>
- State Parks of Arkansas. (2015a). *Lake Chicot State Park*. Retrieved October 2015, from <http://www.arkansasstateparks.com/lakechicot/>
- State Parks of Arkansas. (2015b). *White Oak Lake State Park*. Retrieved October 2015, from <http://www.arkansasstateparks.com/whiteoaklake/>
- State Parks of Arkansas. (2015c). *Moro Bay State Park*. Retrieved October 2015, from <http://www.arkansasstateparks.com/morobay/>
- State Parks of Arkansas. (2015d). *Logoly State Park*. Retrieved October 2015, from <http://www.arkansasstateparks.com/logoly/>
- State Parks of Arkansas. (2015e). *South Arkansas Arboretum*. Retrieved October 2015, from <http://www.arkansasstateparks.com/southarkansasarboretum/>
- State Parks of Arkansas. (2015f). *Arkansas Museum of Natural Resources*. Retrieved October 2015, from <http://www.arkansasstateparks.com/museumofnaturalresources/>
- State Parks of Arkansas. (2015g). *Poison Springs Battleground State Park*. Retrieved October 26, 2015, from <http://www.arkansasstateparks.com/poisonspring/>
- State Parks of Arkansas. (2015h). *Marks' Mills Battleground State Park*. Retrieved October 2015, from <http://www.arkansasstateparks.com/marksmills/>
- State Parks of Arkansas. (2015i). *Jenkins Ferry Battleground State Park*. Retrieved October 2015, from <http://www.arkansasstateparks.com/jenkinsferry/>
- State Parks of Arkansas. (2015j). *Delta Heritage Trail State Park*. Retrieved October 2015, from <http://www.arkansasstateparks.com/deltaheritagetrail/>
- State Parks of Arkansas. (2015k). *Trails*. Retrieved October 26, 2015, from <http://www.arkansasstateparks.com/things-to-do/trails/>
- State Parks of Arkansas. (2015l). *Park Finder*. Retrieved October 27, 2015, from <http://www.arkansasstateparks.com/park-finder/>
- State Parks of Arkansas. (2015m). *Devil's Den State Park*. Retrieved October 27, 2015, from <http://www.arkansasstateparks.com/devilsden/>
- State Parks of Arkansas. (2015n). *Crater of Diamonds State Park*. Retrieved October 23, 2015, from <http://www.craterofdiamondsstatepark.com/digging-for-diamonds/>
- The Nature Conservancy. (2015). *Arkansas: Places We Protect*. Retrieved October 14, 2015, from

- <http://www.nature.org/ourinitiatives/regions/northamerica/unitedstates/arkansas/placesweprotect/index.htm>
- The Nature Conservancy. (2016, June 5). *Arkansas Conservation Critical to Migratory Birds*. Retrieved from <http://www.nature.org/ourinitiatives/regions/northamerica/unitedstates/arkansas/explore/bird-migration-through-arkansas.xml>
- The Paleontology Portal. (2015). *Arkansas, US*. Retrieved November 6, 2015, from Time & Space: http://paleoportal.org/index.php?globalnav=time_space&sectionnav=state&name=Arkansas
- Thompson, W. (2015). *Surficial Geology Handbook for Southern Maine*. Retrieved July 2015, from http://www.maine.gov/dacf/mgs/explore/surficial/sghandbook/surficial_geology_handbook_for_southern_maine.pdf
- U.S. Bureau of Justice Statistics. (2011, July 26). *Census of State and Local Law Enforcement Agencies*. Retrieved from <http://www.bjs.gov/index.cfm?ty=pbdetail&iid=2216>
- U.S. Census Bureau. (2006). *Government Finance and Employment Classification Manual*. Retrieved July 2015, from http://www2.census.gov/govs/pubs/classification/2006_classification_manual.pdf
- U.S. Census Bureau. (2010). *2010 Census Summary File 1, Table GCT-PH1, Population, Housing Units, Area, and Density*. Retrieved June 2015, from http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=DEC_10_SF1_GCTPH1.US01PR&prodType=table
- U.S. Census Bureau. (2010). *2010 Census Urban and Rural Classification and Urban Area Criteria*. Retrieved October 2015, from Other Census Urban Area Information - Maps, Shapefiles & References.: <http://www.census.gov/geo/reference/ua/urban-rural-2010.html>
- U.S. Census Bureau. (2010). *State Area Measurements and Internal Point Coordinates*. Retrieved September 15, 2015, from <https://www.census.gov/geo/reference/state-area.html>
- U.S. Census Bureau. (2012a). *2010 Census Urban and Rural Classification and Urban Area Criteria*. Retrieved June 2015, from http://www2.census.gov/geo/docs/reference/ua/ua_st_list_all.xls
- U.S. Census Bureau. (2012b). *American Community Survey, 2013 1-Year Estimates, Table DP04, Selected housing characteristics*. (Obtained via Census Bureau online American FactFinder tool) Retrieved April 2015, from http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_12_1YR_DP04&prodType=table
- U.S. Census Bureau. (2012c). *2012 Census of Governments: Finance – Surveys of State and Local Government Finances, Table LGF001*. (Obtained via Census Bureau online American FactFinder tool) Retrieved June 2015, from http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=COG_2012_LGF001&prodType=table
- U.S. Census Bureau. (2012d). *American Community Survey, 2012 1-Year Estimates, Table B01003: Total Population*. (Obtained via Census Bureau online American FactFinder tool) Retrieved June 2015, from

- http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_12_1YR_B01003&prodType=table
- U.S. Census Bureau. (2013). *American Community Survey, 2013 1-year Estimates, Table DP03, Selected economic characteristics*. (Obtained via Census Bureau online American FactFinder tool) Retrieved June 2015, from http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_13_1YR_DP03&prodType=table
- U.S. Census Bureau. (2013a, September). *Individual State Descriptions: 2012*. Retrieved from <http://www2.census.gov/govs/cog/2012isd.pdf>
- U.S. Census Bureau. (2013b). *American Community Survey, 2009-2013 5-Year Summary File, Table B02001, Race*. Retrieved April 2015, from <http://dataferrett.census.gov/>
- U.S. Census Bureau. (2013c). *Small Area Income and Poverty Estimates (SAIPE), 2013*. Retrieved March 2015, from <http://www.census.gov/did/www/saipe/data/statecounty/data/2013.html>
- U.S. Census Bureau. (2013d). *American Community Survey, 2013 1-Year Estimates, Table DP02, Selected social characteristics*. Retrieved April 2015, from http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_13_1YR_DP02&prodType=table
- U.S. Census Bureau. (2013e). *American Community Survey, 2013 1-Year Estimates, Table S1902, Mean Income in the Past 12 Months (in 2013 Inflation-Adjusted Dollars)*. Retrieved April 2015, from http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_13_1YR_S1902&prodType=table
- U.S. Census Bureau. (2013f). *2009-2013 American Community Survey 5-Year Estimates, Table DP03: Selected economic characteristics*. (Obtained via Census Bureau online American FactFinder tool) Retrieved April, July 2015, from http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_13_5YR_DP03&prodType=table
- U.S. Census Bureau. (2013f). *American Community Survey and Puerto Rico Community Survey 2013 Subject Definitions*. Retrieved April 2015, from http://www2.census.gov/programs-surveys/acs/tech_docs/subject_definitions/2013_ACSSubjectDefinitions.pdf
- U.S. Census Bureau. (2013g). *American Community Survey, 2009-2013 5-year Estimates, Table DP04, Selected housing characteristics*. (Obtained via Census Bureau online American FactFinder tool) Retrieved April, July 2015, from http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_13_5YR_DP04&prodType=table
- U.S. Census Bureau. (2013h). *American Community Survey, 2013 1-Year Estimates, Table DP05, Demographic and Housing Estimates*. (Obtained via Census Bureau online American FactFinder tool) Retrieved August 31, 2015, from http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_13_1YR_DP05&prodType=table
- U.S. Census Bureau. (2013i). *American Community Survey, 2013 1-Year Estimates, Table S1701: Poverty Status in the Past 12 Months*. Retrieved August 31, 2015, from http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_13_1YR_S1701&prodType=table

- U.S. Census Bureau. (2015a). *Annual Estimates of the Resident Population: April 1, 2010 to July 1, 2014*. Washington, D.C.: US. Census Bureau, Population Division.
- U.S. Census Bureau. (2015b). *Population Estimates Program, 2010-2014 Data*. Retrieved March 2015, from <http://www.census.gov/popest/data/national/totals/2014/files/NST-EST2014-alldata.pdf>
- U.S. Census Bureau. (2015c). *Resident Population of the 50 States, the District of Columbia, and Puerto Rico: Census 2000*. Retrieved March 2015, from <https://www.census.gov/population/www/cen2000/maps/respop.html>
- U.S. Census Bureau. (2015d). *Census 2000 Summary File 1 (SF 1), Table P001, Total Population*. Retrieved July 2015, from <http://factfinder.census.gov/faces/nav/jsf/pages/searchresults.xhtml?refresh=t>
- U.S. Census Bureau. (2015e). *American Community Survey, 2009-2013 5-Year Estimates, Table DP05, Demographic and Housing Estimates*. (Obtained via Census Bureau online American FactFinder tool) Retrieved August 2015, from <http://factfinder.census.gov/faces/nav/jsf/pages/index.xhtml>
- U.S. Census Bureau. (2015f). *American Community Survey, 2009-2013 5-Year Summary File, Table B03002, Hispanic or Latino Origin by Race*. (Obtained via Census Bureau online DataFerrett tool) Retrieved April 2015, from <http://dataferrett.census.gov>
- U.S. Census Bureau. (2015g). *American Community Survey, 2009-2013 5-Year Summary File, Table B17021, Poverty Status of Individuals in the Past 12 Months by Living Arrangement*. (Obtained via Census Bureau online DataFerrett tool) Retrieved April 2015, from <http://dataferrett.census.gov>
- U.S. Census Bureau. (2015h). *American Community Survey, 2009-2013 5-Year Summary File, Table C17002, Ratio of Income to Poverty Level in the Past 12 Months*. (Obtained via Census Bureau online DataFerrett tool) Retrieved May 2015, from <http://dataferrett.census.gov>
- U.S. Census Bureau. (2016a, July 1). *Arkansas 2016 Population Estimates*. Retrieved from <https://www.census.gov/search-results.html?q=2016+Arkansas+estimated+population&page=1&stateGeo=none&searchtype=web&cssp=SERP&search.x=0&search.y=0>
- U.S. Census Bureau. (2016b). *American Community Survey (ACS)*. Retrieved March 2016, from <http://www.census.gov/programs-surveys/acs/>
- U.S. Coast Guard. (2015, September 26). *National Response Center (2015 Reports) Incident Investigation Reports*. Retrieved October 23, 2015, from <http://www.nrc.uscg.mil/IIR/IIRSearch.aspx>
- U.S. Department of Commerce. (2013, February 21). *Department of Commerce Environmental Justice Strategy*. Retrieved July 2015, from http://open.commerce.gov/sites/default/files/DOC_Environmental_Justice_Strategy.pdf
- U.S. Department of Interior. (2008). *Navajo Reservoir RMP/FEA Appendix E Noise*. Retrieved 07 22, 2015, from <https://www.usbr.gov/uc/envdocs/ea/navajo/appdx-E.pdf>
- U.S. Department of Interior, Office of Surface Mining Reclamation and Enforcement. (2014, June 30). *e-AMLIS Advanced Query*. Retrieved October 23, 2015, from <http://amlis.osmre.gov/QueryAdvanced.aspx>
- U.S. Department of Interior, Office of Surface Mining Reclamation and Enforcement. (2015, September 27). *e-AMLIS, Abandoned Mine Land Inventory System*. Retrieved October 23, 2015, from <http://amlis.osmre.gov/Map.aspx>

- U.S. Fire Administration. (2015, June 11). *National Fire Department Census*. Retrieved from <http://apps.usfa.fema.gov/census-download/main/download>
- University of Arkansas. (2005). Deer-Vehicle Collisions in Arkansas. *Journal of the Arkansas Academy of Science, Vol. 59, 2005*. Retrieved July 12, 2016, from <https://libinfo.uark.edu/aas/issues/2005v59/v59a31.pdf>
- University of Arkansas. (2015). *Watershed Prioritization for Managing Nonpoint Source Pollution in Arkansas*. Retrieved November 4, 2015, from <https://www.uaex.edu/publications/pdf/FSPPC116.pdf>
- University of Arkansas. (2016). *Cogongrass - General Information*. Retrieved July 12, 2016, from Potential Invaders: <http://www.arinvasives.org/potential-invaders-of-arkansas/cogongrass/>
- University of California Museum of Paleontology. (2011, May). *Geologic Time Scale*. Retrieved June 2016, from <http://www.ucmp.berkeley.edu/help/timeform.php>
- University of California, Hastings College of Law. (2010). *Environmental Justice for All: A Fifty State Survey of Legislation, Policies and Cases, Fourth Edition*. Retrieved August 2015, from <http://gov.uchastings.edu/public-law/docs/ejreport-fourthedition1.pdf>
- University of Minnesota. (2001). *Soils and Landscapes of Minnesota*. Retrieved July 2015, from <http://www.extension.umn.edu/agriculture/tillage/soils-and-landscapes-of-minnesota/>
- USACE. (1997, July 1). *Planning and Guidance Letter #97-09: Scenic and Aesthetic Considerations*. Retrieved October 15, 2015, from <http://planning.usace.army.mil/toolbox/library/MemosandLetters/pgl97-09.pdf>
- USACE. (2015a). *Final Nationwide Permit Regional Conditions in Arkansas*. Retrieved November 5, 2015, from <http://www.swl.usace.army.mil/Portals/50/docs/regulatory/ARRC.pdf>
- USACE. (2015b). *Arkansas Special Resource Waters*. Retrieved November 5, 2015, from <http://www.swl.usace.army.mil/Missions/Regulatory/ArkansasSpecialResourceWaters.aspx>
- USACE. (2015c, August). *Corps Lakes Gateway*. Retrieved October 15, 2015, from <http://www.swl.usace.army.mil/Missions/Recreation.aspx>
- USACE. (2017). *Little Rock District: Regulatory Program Overview*. Retrieved from <http://www.swl.usace.army.mil/Missions/Regulatory/>
- USDA. (2014). *Federal noxious weed list*. Retrieved from https://www.aphis.usda.gov/plant_health/plant_pest_info/weeds/downloads/weedlist.pdf
- USDA. (2015a). *Ecoregions of the United States*. Retrieved from <http://www.fs.fed.us/rm/ecoregions/products/map-ecoregions-united-states/>
- USDA. (2015b). *Emerald ash borer quarantine map*. Retrieved from https://www.aphis.usda.gov/plant_health/plant_pest_info/emerald_ash_b/downloads/eab_quarantine_map.pdf
- USDA. (2015c). *State Noxious-Weed Seed Requirements Recognized in the Administration of the Federal Seed Act*. Retrieved from <https://www.ams.usda.gov/sites/default/files/media/NWS%20List%20for%202015.pdf>
- USDA Economic Research Service. (2015, April 9). *Major Uses of Land in the United States, 2007*. Retrieved October 9, 2015, from <http://www.ers.usda.gov/data-products/major-land-uses/maps-and-state-rankings-of-major-land-uses.aspx>
- USDA, Census of Agriculture. (2012a). *2012 Census Volume 1, Chapter 1: State Level Data*. Retrieved October 2015, from

- https://www.agcensus.usda.gov/Publications/2012/Full_Report/Volume_1,_Chapter_1_State_Level/Arkansas/st05_1_001_001.pdf
- USDA, Census of Agriculture. (2012b). *2012 Census Publications*. Retrieved October 2015, from http://www.agcensus.usda.gov/Publications/2012/Online_Resources/Rankings_of_Market_Value/Arkansas/
- USEPA. (1973, July 27). *EPA.gov*. Retrieved 08 05, 2015, from National Service Center for Environmental Publications - Impact Characterization of Noise: <https://nepis.epa.gov/Exe/ZyPURL.cgi?Dockey=9101DPQN.TXT>
- USEPA. (1974). *Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety*. Washington, D.C.: EPA. Retrieved from <https://nepis.epa.gov/Exe/ZyPURL.cgi?Dockey=2000L3LN.TXT>
- USEPA. (1979, March 19). Notification to Federal Land Manager Under Section 165(d) of the Clean Air Act. Retrieved April 21, 2015, from <http://www.epa.gov/sites/production/files/2015-07/documents/fdlnmgr.pdf>
- USEPA. (1992, October 19). *Clarification of Prevention of Significant Deterioration (PSD) Guidance for Modeling Class I Area Impacts*, U.S. Environmental Protection Agency. (J. S. Seitz, Ed.) Retrieved April 21, 2015, from <http://www.epa.gov/sites/production/files/2015-07/documents/class1.pdf>
- USEPA. (1995). *America's wetlands: Our vital link between land and water*. Retrieved April 21, 2015, from U.S. Environmental Protection Agency, EPA843-K-95-001: <https://www.epa.gov/wetlands/why-are-wetlands-important>
- USEPA. (2004, April 15). *Inventory of U.S. Greenhouse Gas Emissions and Sinks: Glossary*. Retrieved July 16, 2015, from http://ofmpub.epa.gov/sor_internet/registry/termreg/searchandretrieve/glossariesandkeywordlists/search.do?details=&vocabName=Greenhouse%20Emissions%20Glossary&uid=1869718#formTop
- USEPA. (2010, March 24). *Revisions to the General Conformity Regulations*. Retrieved April 20, 2015, from <https://www.epa.gov/general-conformity/final-revisions-general-conformity-regulations>
- USEPA. (2011, December 12). *CERCLA Overview*. Retrieved from EPA Superfund: <http://www.epa.gov/superfund/policy/cercla.htm>
- USEPA. (2012a, May). *List of 156 Mandatory Class I Federal Areas*. Retrieved April 20, 2015, from Visibility: <http://www3.epa.gov/airquality/visibility/class1.html>
- USEPA. (2012b, July 16). *Noise Pollution*. Retrieved August 4, 2015, from <https://www.epa.gov/clean-air-act-overview/clean-air-act-title-iv-noise-pollution>
- USEPA. (2012c). *Climate Change Indicators in the United States 2012*. Retrieved October 2013, from Environmental Protection Agency: <https://www3.epa.gov/climatechange/pdfs/climateindicators-full-2012.pdf>
- USEPA. (2012d, October 16). *Heifer International - Green Building - Green Parking Lot*. Retrieved October 23, 2015, from Brownfields: <http://pubweb.epa.gov/region6/6sf/bfpages/bfheifer.htm>
- USEPA. (2012e, March 12). *Marine Debris Impacts*. Retrieved Nov 24, 2015, from http://water.epa.gov/type/oceb/marinedebris/md_impacts.cfm
- USEPA. (2013a, February 21). *EPA Terminology Services*. (U.S. Environmental Protection Agency) Retrieved July 28, 2015, from

- http://iaspub.epa.gov/sor_internet/registry/termreg/searchandretrieve/termsandacronyms/search.do
- USEPA. (2013b, August 13). General Conformity. Retrieved April 20, 2015, from <https://www.epa.gov/general-conformity>
- USEPA. (2013c). *Cleanups in my Community*. Retrieved October 2013, from <http://www2.epa.gov/cleanups/cleanups-my-community>
- USEPA. (2014a, October 21). *National Ambient Air Quality Standards (NAAQS)*. Retrieved April 20, 2015, from <http://www.epa.gov/air/criteria.html>
- USEPA. (2014b, October 28). Who Has to Obtain a Title V Permit. Retrieved April 20, 2015, from <https://www.epa.gov/title-v-operating-permits/who-has-obtain-title-v-permit>
- USEPA. (2014c). *U.S. Greenhouse Gas Inventory Report 1990-2013*. Retrieved July 28, 2015, from Greenhouse Gas Emissions: <https://www.epa.gov/ghgemissions/us-greenhouse-gas-inventory-report-1990-2014>
- USEPA. (2014d). *U.S. Greenhouse Gas Inventory Report 1990-2013*. Retrieved July 28, 2015, from Greenhouse Gas Emissions: <http://www.epa.gov/climatechange/ghgemissions/usinventoryreport.html#data>
- USEPA. (2015a, October). *Arkansas Drinking Water*. Retrieved October 2015, from United States Environmental Protection Agency: <http://water.epa.gov/drink/local/ar.cfm>
- USEPA. (2015b). *Watershed Assessment, Tracking & Environmental Results System*. Retrieved November 4, 2015, from http://ofmpub.epa.gov/waters10/attains_state.control?p_state=AR
- USEPA. (2015c, January). *Chesapeake Bay Glossary*. Retrieved July 15, 2015, from http://ofmpub.epa.gov/sor_internet/registry/termreg/searchandretrieve/glossariesandkeyw ordlists/search.do?details=&glossaryName=Chesapeake%20Bay%20Glossary
- USEPA. (2015d). *USEPA Terms Index*. Retrieved from <https://www3.epa.gov/climatechange/glossary.html>
- USEPA. (2015e). *Level III ecoregions of the continental United States*. Retrieved from http://www.epa.gov/wed/pages/ecoregions/level_iii_iv.htm
- USEPA. (2015f). *Environmental Justice*. Retrieved July 2015, from <http://www.epa.gov/compliance/environmentaljustice/index.html>
- USEPA. (2015g). *EJSCREEN: Environmental Justice Screening and Mapping Tool*. Retrieved July 2015, from <http://www2.epa.gov/ejscreen>
- USEPA. (2015h, July 17). *Technology Transfer Network - Basic Information*. Retrieved July 17, 2015, from http://cfpub.epa.gov/oarweb/mkb/basic_information.cfm
- USEPA. (2015i, January 30). *Designations*. Retrieved April 20, 2015, from <http://www.epa.gov/airquality/greenbook/define.html>
- USEPA. (2015j, October). *National Emission Standards for Hazardous Air Pollutants Compliance Monitoring*. Retrieved November 25, 2015, from <http://www2.epa.gov/compliance/national-emission-standards-hazardous-air-pollutants-compliance-monitoring>
- USEPA. (2015k, July 14). *Air Permit Programs*. Retrieved April 20, 2015, from Air Quality Planning and Standards: <http://www3.epa.gov/airquality/permjmp.html>
- USEPA. (2015l, April 21). *The Green Book Nonattainment Areas for Criteria Pollutants*. Retrieved April 20, 2015, from <https://www.epa.gov/green-book>
- USEPA. (2015m, October 27). *Title IV- Noise Pollution*. Retrieved November 2015, 2015, from <http://www2.epa.gov/clean-air-act-overview/title-iv-noise-pollution>

- USEPA. (2015n, October 14). *Cleanups in my Community*. Retrieved October 23, 2015, from http://ofmpub.epa.gov/apex/cimc/f?p=cimc:73:::71:P71_WELSEARCH:AR|State|AR|||true|true|true|true|true|-1|sites|N|basic
- USEPA. (2015o, October 14). *Cleanups in My Community List Results*. Retrieved October 23, 2015, from [http://ofmpub.epa.gov/apex/cimc/f?p=100:35:4367258045478:::35:P35_State_code,P35_ADV_QUERY:AR,\(\(SF_EI_HE_CODE='N'\)\)](http://ofmpub.epa.gov/apex/cimc/f?p=100:35:4367258045478:::35:P35_State_code,P35_ADV_QUERY:AR,((SF_EI_HE_CODE='N')))
- USEPA. (2015p, March). *2013 TRI Analysis: State - Arkansas*. Retrieved December 2, 2015, from http://iaspub.epa.gov/triexplorer/tri_factsheet.factsheet_forstate?&pstate=AR&pyear=2013&pDataSet=TRIQ1
- USEPA. (2015q, October 8). *Envirofacts - PCS-ICIS*. Retrieved October 23, 2015, from <http://www3.epa.gov/enviro/facts/pcs-icis/search.html>
- USEPA. (2015r, October 14). *Envirofacts Search Results*. Retrieved October 23, 2015, from http://iaspub.epa.gov/enviro/efsystemquery.multisystem?fac_search=primary_name&fac_value=&fac_search_type=Beginning+With&postal_code=&location_address=&add_search_type=Beginning+With&city_name=&county_name=&state_code=ar&TribalLand=0&TribeType=selectTribe
- USEPA. (2015s, December 28). *NAAQS Table*. Retrieved from Pollutants: <https://www.epa.gov/criteria-air-pollutants/naaqs-table>
- USEPA. (2016a, February 21). *Ecoregions of North America*. Retrieved from Western Ecology Division: https://archive.epa.gov/wed/ecoregions/web/html/na_eco.html
- USEPA. (2016b). *Environmental Justice*. Retrieved March 2016, from <http://www3.epa.gov/environmentaljustice/>
- USEPA. (2016c, May 18). *Hazardous Air Pollutants*. Retrieved May 25, 2016, from <https://www.epa.gov/haps>
- USEPA. (2016d). *Grants and Programs*. Retrieved March 2016, from <http://www3.epa.gov/environmentaljustice/grants/index.html>
- USEPA. (2016e, May 28). *Waste and Cleanup Risk Assessment Glossary*. Retrieved from Vocabulary Catalog: https://ofmpub.epa.gov/sor_internet/registry/termreg/searchandretrieve/glossariesandkeywordlists/search.do?details=&glossaryName=Waste%20and%20Cleanup%20Risk%20Assess
- USEPA. (2016f, May 19). *De Minimis Levels*. Retrieved from <https://www3.epa.gov/airquality/genconform/deminimis.html>
- USEPA. (2016g, January). *Overview of the Clean Air Act and Air Pollution*. Retrieved May 21, 2015, from <http://www.epa.gov/clean-air-act-overview>
- USFS. (1995, December). *Landscape Aesthetics: A Handbook for Scenery Management*. Retrieved from http://www.fs.fed.us/cdt/carrying_capacity/landscape_aesthetics_handbook_701_no_append.pdf
- USFS. (2009a, Sept 30). *Chapter 90 Communications Site Management*. Retrieved Nov 16, 2015, from Forest Service Handbook 2709.11 - Special Uses Handbook: http://www.fs.fed.us/specialuses/documents/Comm_Use_Policy_2709.11_90.doc
- USFS. (2009b). *Soil-Disturbance Field Guide*. Retrieved from <http://www.fs.fed.us/t-d/pubs/pdf/08191815.pdf>

- USFS. (2015a). *Red-cockaded woodpecker and shortleaf pine*. Retrieved from http://www.fs.usda.gov/detail/ouachita/home/?cid=fsm9_039691
- USFS. (2015b). *Ouachita National Forest: About the Forest*. Retrieved October 26, 2015, from <http://www.fs.usda.gov/main/ouachita/about-forest>
- USFS. (2015c). *Ozark-St. Francis National Forest*. Retrieved October 2015, from <http://www.fs.usda.gov/main/osfnf/home>
- USFS. (2015d). *Ozark-St. Francis National Forests: About the Forest*. Retrieved October 26, 2015, from <http://www.fs.usda.gov/main/osfnf/about-forest>
- USFS. (2015e, October 26). *Find a Forest or Grassland*. Retrieved October 26, 2015, from <http://www.fs.fed.us/>
- USFWS. (1985a). *Recovery plan for pink mucket*. Retrieved from <http://pbadupws.nrc.gov/docs/ML1218/ML12184A115.pdf>
- USFWS. (1985b). *Recovery plan for tuberculed-blossom pearly mussel, turgid-blossom pearly mussel, and yellow-blossom pearly mussel*. Retrieved from https://ecos.fws.gov/docs/recovery_plan/850125.pdf
- USFWS. (1986). *Recovery plan for Curtis pearly mussel*. Retrieved from https://ecos.fws.gov/docs/recovery_plan/860204.pdf
- USFWS. (1988a, September 28). *Endangered and Threatened Wildlife and Plants; Determination of Endangered Status for Ptilimnium nodosum*. Retrieved April 27, 2015, from http://ecos.fws.gov/docs/federal_register/fr1482.pdf
- USFWS. (1988b). *Recovery plan for Missouri bladderpod*. Retrieved from https://ecos.fws.gov/docs/recovery_plan/880407.pdf
- USFWS. (1989a). *Recovery plan for the fat pocketbook pearly mussel*. Retrieved from https://www.fws.gov/midwest/mussel/documents/fat_pocketbook_recovery_plan.pdf
- USFWS. (1989b). *Endangered status for the speckled pocketbook (Lampsilia streckeri)*. Retrieved from https://ecos.fws.gov/docs/federal_register/fr1524.pdf
- USFWS. (1990). *Recovery plan for the interior population of the least tern*. Retrieved from http://ecos.fws.gov/docs/recovery_plan/900919a.pdf
- USFWS. (1991a). *American burying beetle recovery plan*. Retrieved from <http://www.fws.gov/southdakotafieldoffice/ABBRcoveryPlan.pdf>
- USFWS. (1991b). *Determination of endangered status for the winged mapleleaf freshwater mussel*. Retrieved from http://ecos.fws.gov/docs/federal_register/fr1873.pdf
- USFWS. (1992). *Recovery plan for Arkansas fatmucket*. Retrieved from https://ecos.fws.gov/docs/recovery_plan/920210.pdf
- USFWS. (1993a). *Recovery plan for Geocarpon minimum*. Retrieved from http://www.fws.gov/ecos/ajax/docs/recovery_plan/930726.pdf
- USFWS. (1993b). *Recovery plan for pondberry*. Retrieved from http://ecos.fws.gov/docs/recovery_plan/930923a.pdf
- USFWS. (1996a). *Piping Plover Atlantic Coast Population Recovery Plan*. Retrieved from http://ecos.fws.gov/docs/recovery_plan/960502.pdf
- USFWS. (1996b). *Recovery plan for cave crayfish Cambarus aculabrum*. Retrieved from http://ecos.fws.gov/docs/recovery_plan/961030.pdf
- USFWS. (1997a). *Gray bat fact sheet*. Retrieved from <http://www.fws.gov/midwest/endangered/mammals/pdf/gray-bat.pdf>
- USFWS. (1997b). *Fact sheet for the Ozark big-eared bat*. Retrieved from http://www.fws.gov/midwest/endangered/mammals/obeb_fct.html

- USFWS. (1999, May 27). *Endangered and Threatened Wildlife and Plants; Proposed Establishment of Nonessential Experimental Population Status for Sixteen Freshwater Mussels*. Retrieved April 27, 2015, from <http://www.fws.gov/policy/library/1999/99fr28779.pdf>
- USFWS. (2001a). *Piping plover fact sheet*. Retrieved from <http://www.fws.gov/midwest/endangered/pipingplover/pipingpl.html>
- USFWS. (2001b). *Final designation of critical habitat for the Arkansas River shiner*. Retrieved from <https://www.gpo.gov/fdsys/pkg/FR-2001-04-04/pdf/01-8082.pdf#page=1>
- USFWS. (2003a). *Recovery plan for the red-cockaded woodpecker (Picoides borealis)*. Retrieved from http://ecos.fws.gov/docs/recovery_plan/030320_2.pdf
- USFWS. (2003b). *Reclassification of Lesquerella filiformis Missouri bladderpod from endangered to threatened*. Retrieved from https://ecos.fws.gov/docs/federal_register/fr4194.pdf
- USFWS. (2004a). *Indiana bat (Myotis sodalis)*. Retrieved from <http://www.fws.gov/northeast/pdf/indianabat.fs.pdf>
- USFWS. (2004b). *Recovery plan for Ouachita Rock pocketbook*. Retrieved from http://ecos.fws.gov/docs/recovery_plan/040602.pdf
- USFWS. (2006, December). *Indiana Bat (Myotis Sodalis)*. Retrieved from <https://www.fws.gov/midwest/endangered/mammals/inba/inbafctsht.html>
- USFWS. (2007a). *Five year review of fat pocketbook*. Retrieved from <http://www.fws.gov/southeast/5yearReviews/5yearreviews/7Mussels.pdf>
- USFWS. (2007b). *Five year review for green-blossom, turgid-blossom, and yellow-blossom pearly mussels*. Retrieved from https://ecos.fws.gov/docs/five_year_review/doc1961.pdf
- USFWS. (2008). *Five year review Ozark big-eared bat*. Retrieved from https://ecos.fws.gov/docs/five_year_review/doc1912.pdf
- USFWS. (2010a). *Recovery plan for the ivory-billed woodpecker*. Retrieved from https://ecos.fws.gov/docs/recovery_plan/100719.pdf
- USFWS. (2010b). *Recovery plan for the scaleshell mussel*. Retrieved from http://ecos.fws.gov/docs/recovery_plan/100407_v2.pdf
- USFWS. (2010c). *Five year review of the Curtis pearlymussel*. Retrieved from https://ecos.fws.gov/docs/five_year_review/doc3119.pdf
- USFWS. (2011a). *Five year review for Ozark cavefish*. Retrieved from <http://www.fws.gov/southeast/5yearReviews/5yearreviews/ozarkcavefish.pdf>
- USFWS. (2011b). *Five year review of running buffalo clover*. Retrieved from http://www.fws.gov/midwest/endangered/plants/pdf/RBC_5YrReview.pdf
- USFWS. (2012a). *Guidance on developing and implementing an Indiana bat conservation plan*. Retrieved from http://www.fws.gov/northeast/pafo/pdf/IBATconservationplanguidance_PAFO_040412.pdf
- USFWS. (2012b). *Five year review for cave crayfish Cambarus zophonastes*. Retrieved from https://ecos.fws.gov/docs/five_year_review/doc4024.pdf
- USFWS. (2012c). *Five year review of the leopard darter*. Retrieved from http://ecos.fws.gov/docs/five_year_review/doc4107.2.12%20with%20signautres.pdf
- USFWS. (2012d). *Critical habitat determination for the yellowcheek darter*. Retrieved from <https://www.gpo.gov/fdsys/pkg/FR-2012-10-16/pdf/2012-24468.pdf>

- USFWS. (2012e). *Proposed endangered status for the Neosho mucket, threatened status for the rabbitsfoot*. Retrieved from <https://www.gpo.gov/fdsys/pkg/FR-2015-04-30/pdf/2015-09200.pdf>
- USFWS. (2012f). *Determination of endangered status for the sheepsnose and spectaclecase mussels throughout their range: final rule*. Retrieved from <https://www.gpo.gov/fdsys/pkg/FR-2012-03-13/pdf/2012-5603.pdf>
- USFWS. (2012g). *Frequently asked questions about invasive species*. Retrieved from <http://www.fws.gov/invasives/faq.html>
- USFWS. (2012h, May). *Cache River Arkansas*. Retrieved November 2, 2015, from <https://www.doi.gov/sites/doi.gov/files/migrated/news/pressreleases/upload/Arkansas-Cache-River-Final.pdf>
- USFWS. (2013a). *Birds protected by the migratory bird treaty act*. Retrieved from <http://www.fws.gov/migratorybirds/regulationspolicies/mbta/mbtintro.html>
- USFWS. (2013b). *Interior least tern 5 year review*. Retrieved from http://ecos.fws.gov/docs/five_year_review/doc4294.pdf
- USFWS. (2013c). *Five year review for cave crayfish *Cambarus aculabrum**. Retrieved from http://ecos.fws.gov/docs/five_year_review/doc4153.pdf
- USFWS. (2013d). *Five year review of Arkansas fatmucket*. Retrieved from https://ecos.fws.gov/docs/five_year_review/doc4327.pdf
- USFWS. (2014a). *Arkansas threatened, endangered, and at-risk species*. Retrieved from http://www.washingtonccd.org/uploads/6/9/1/2/6912341/species_habitat_summary_for_nrcs_gis_tool_8-7-14.pdf
- USFWS. (2014b). *Candidate Species*. Retrieved from https://www.fws.gov/endangered/esa-library/pdf/candidate_species.pdf
- USFWS. (2014c). *Interior least tern fact sheet*. Retrieved from <https://www.fws.gov/MIDWEST/Endangered/birds/leasttern/pdf/InteriorLeastTernFactSheetMarch2014.pdf>
- USFWS. (2014d). *Threatened, Endangered, and At-Risk Species' Geographic Ranges*. Retrieved April 2015, from <http://www.fws.gov/arkansas-es/docs/Species%20Habitat%20Summary%20for%20NRCS%20GIS%20Tool%208-7-14.pdf>
- USFWS. (2014e, April 21). *Dale Bumpers white River - Black Bear*. Retrieved July 12, 2016, from National Wildlife Refuge - Arkansas: https://www.fws.gov/refuge/White_River/wildlife_and_habitat/index.html
- USFWS. (2014e). *Revised recovery plan for the pallid sturgeon*. Retrieved from <http://www.fws.gov/mountain-prairie/species/fish/pallidsturgeon/RecoveryPlan2014.pdf>
- USFWS. (2014f). *American burying beetle biology*. Retrieved from <http://www.fws.gov/southwest/es/oklahoma/Documents/ABB/American%20Burying%20Beetle%20Biology.pdf>
- USFWS. (2015a, January 26). *Wetlands Mapper Legend Categories*. Retrieved April 20, 2015, from National Wetland Inventory: <http://www.fws.gov/wetlands/Data/Mapper-Wetlands-Legend.html>
- USFWS. (2015aa). *Species profile for Neosho mucket *Lampsilis rafinesqueana**. Retrieved from http://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=F00F

- USFWS. (2015ab). *Federal register designation of critical habitat for Neosho mucket and rabbitsfoot, final rule*. Retrieved from <https://www.gpo.gov/fdsys/pkg/FR-2015-04-30/pdf/2015-09200.pdf>
- USFWS. (2015ac). *Fact sheet for pink mucket*. Retrieved from http://www.fws.gov/midwest/endangered/clams/pinkm_fc.html
- USFWS. (2015ad). *Species profile for pink mucket *Lampsilis abrupta**. Retrieved from <http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=F00G>
- USFWS. (2015ae). *Species profile for rabbitsfoot *Quadrula cylindrica* ssp. *cylindrica**. Retrieved from <http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=F03X>
- USFWS. (2015af). *Species profile for scaleshell mussel *Leptodea leptodon**. Retrieved from http://ecos.fws.gov/tess_public/profile/speciesProfile?spcode=F00W
- USFWS. (2015ag). *Species profile for speckled pocketbook (*Lampsilis streckeri*)*. Retrieved from http://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=F020
- USFWS. (2015ah). *Five year review of speckled pocketbook*. Retrieved from https://ecos.fws.gov/docs/five_year_review/doc4505.pdf
- USFWS. (2015ai). *Species profile for spectaclecase mussel *Cumberlandia monodonta**. Retrieved from <http://ecos.fws.gov/speciesProfile/profile/speciesProfile?spcode=F00X>
- USFWS. (2015aj). *Species profile for winged mapleleaf *Quadrula fragosa**. Retrieved from <http://ecos.fws.gov/speciesProfile/profile/speciesProfile?spcode=F00C>
- USFWS. (2015ak). *Species profile for *Geocarpon minimum**. Retrieved from http://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=Q1WK
- USFWS. (2015al). *Harperella (*Ptilimnium nodosum*)*. Retrieved from http://www.fws.gov/raleigh/species/es_harperella.html
- USFWS. (2015am). *Species profile for harperella *Ptilimnium nodosum**. Retrieved from <http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=Q2H9>
- USFWS. (2015an). *Species profile for Missouri bladderpod *Physaria filiformis**. Retrieved from http://ecos.fws.gov/tess_public/profile/speciesProfile?spcode=Q2CC
- USFWS. (2015ao). *Species profile for pondberry *Lindera melissifolia**. Retrieved from http://ecos.fws.gov/tess_public/profile/speciesProfile?spcode=Q2CO
- USFWS. (2015ap). *Running buffalo clover fact sheet*. Retrieved from <http://www.fws.gov/midwest/endangered/plants/runningb.html>
- USFWS. (2015aq). *Species profile for running buffalo clover *Trifolium stoloniferum**. Retrieved from http://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=Q2RE
- USFWS. (2015ar, April). *National Wildlife Refuge System*. Retrieved April 17, 2015, from <http://www.fws.gov/refuges/>
- USFWS. (2015as). *Arkansas*. Retrieved October 26, 2015, from <http://www.fws.gov/refuges/refugeLocatorMaps/Arkansas.html>
- USFWS. (2015at). *Holla Bend National Wildlife Refuge*. Retrieved October 26, 2015, from <http://www.fws.gov/refuges/profiles/index.cfm?id=43590>
- USFWS. (2015b, January 26). *Data Limitations, Exclusions and Precautions*. Retrieved May 11, 2015, from <http://www.fws.gov/wetlands/Data/Limitations.html>
- USFWS. (2015c). *Critical habitat map for Arkansas*. Retrieved from <http://ecos.fws.gov/ecp/report/table/critical-habitat.html>
- USFWS. (2015d). *Candidate species believed to or known to occur in Arkansas*. Retrieved from http://ecos.fws.gov/tess_public/reports/species-listed-by-state-report?state=AR&status=candidate

- USFWS. (2015e). *Species profile for gray bat (Myotis grisescens)*. Retrieved from <https://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=A04J>
- USFWS. (2015f). *Indiana bat (Myotis sodalis) fact sheet*. Retrieved from <http://www.fws.gov/midwest/endangered/mammals/inba/inbafactsht.html>
- USFWS. (2015g). *Species profile for Indiana bat (Myotis sodalis)*. Retrieved from <http://ecos.fws.gov/speciesProfile/profile/speciesProfile?spcode=A000>
- USFWS. (2015h). *Northern long-eared bat fact sheet*. Retrieved from <http://www.fws.gov/midwest/endangered/mammals/nleb/nlebFactSheet.html>
- USFWS. (2015i). *Species profile for northern long-eared bat*. Retrieved from <http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=A0JE>
- USFWS. (2015j). *Species profile for Ozark big-eared bat Corynorhinus plecotus townsendii ingens*. Retrieved from https://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=A075
- USFWS. (2015k). *Species profile for ivory-billed woodpecker (Campephilus principalis)*. Retrieved from http://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=B03Q
- USFWS. (2015l). *Species profile for least tern Sterna antillarum*. Retrieved from http://ecos.fws.gov/tess_public/profile/speciesProfile?spcode=B07N
- USFWS. (2015m). *Piping plover, Atlantic Coast population*. Retrieved from <http://www.fws.gov/northeast/pipingplover/overview.html>
- USFWS. (2015n). *Red-cockaded woodpecker recovery*. Retrieved from <http://www.fws.gov/rcwrecovery/rcw.html>
- USFWS. (2015o). *Species profile for red-cockaded woodpecker (Picoides borealis)*. Retrieved from <http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=B04F>
- USFWS. (2015p). *Species profile for Arkansas River shiner (Notropis girardi)*. Retrieved from http://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=E05X
- USFWS. (2015q). *Species profile for cave crayfish Cambarus aculabrum*. Retrieved from http://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=K02J
- USFWS. (2015r). *Species profile for cave crayfish Cambarus zophonastes*. Retrieved from http://ecos.fws.gov/tess_public/profile/speciesProfile?spcode=K02H
- USFWS. (2015s). *Species profile for leopard darter Percina pantherina*. Retrieved from http://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=E017
- USFWS. (2015t). *Species profile for Ozark cavefish Amblyopsis rosae*. Retrieved from https://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=E02J
- USFWS. (2015u). *Species profile for pallid sturgeon Scaphirhynchus albus*. Retrieved from http://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=E06X
- USFWS. (2015v). *Species profile for yellowcheek darter Etheostoma moorei*. Retrieved from https://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=E01E
- USFWS. (2015w). *Species profile for Ozark hellbender Cryptobranchus alleganiensis bishopi*. Retrieved from http://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=D032
- USFWS. (2015x). *Fact sheet for Ozark hellbender*. Retrieved from <http://www.fws.gov/midwest/endangered/amphibians/ozhe/ozheFactSheet.html>
- USFWS. (2015y). *Species profile for Arkansas fatmucket Lampsilis powellii*. Retrieved from http://ecos.fws.gov/tess_public/profile/speciesProfile?spcode=F02I

- USFWS. (2015z). *Species profile for fat pocketbook Potamilus capax*. Retrieved from http://ecos.fws.gov/tess_public/profile/speciesProfile?spcode=F00T
- USFWS. (2016). *Listed species believed to or known to occur in Arkansas*. Retrieved May 16, 2016, from ECOS: http://ecos.fws.gov/tess_public/reports/species-listed-by-state-report?state=AR&status=listed
- USFWS. (2017a, May 10). *Wetlands Mapper Legend Categories*. Retrieved from National Wetlands Inventory: <http://www.fws.gov/wetlands/Data/Mapper-Wetlands-Legend.html>
- USFWS. (2017b, May 19). *National Wetlands Inventory*. Retrieved May 15, 2015, from Wetlands Mapper: <https://www.fws.gov/wetlands/data/Mapper.html>
- USGCRP. (2009). *Global Climate Change Impacts in the United States*. New York: Cambridge University Press. Retrieved from <https://downloads.globalchange.gov/usimpacts/pdfs/climate-impacts-report.pdf>
- USGCRP. (2014a). *National Climate Assessment: Southeast*. Retrieved from U.S. Global Change Research Program: <http://nca2014.globalchange.gov/report/regions/southeast>
- USGCRP. (2014b). *U.S. Global Change Research Program: Precipitation Change*. Retrieved from National Climate Assessment: <http://nca2014.globalchange.gov/report/our-changing-climate/precipitation-change>
- USGCRP. (2014c). *National Climate Assessment: Changes in Storms*. Retrieved July September, 2015, from U.S. Global Change Research Program: <http://nca2014.globalchange.gov/report/our-changing-climate/changes-storms>
- USGS. (1981). *Coal Resource Classification System of the U.S. Geological Survey*. Retrieved October 2015, from <http://pubs.usgs.gov/circ/c891/glossary.htm>
- USGS. (1992). *The Great Ice Age*. Retrieved November 2015, from http://pubs.usgs.gov/gip/ice_age/ice_age.pdf
- USGS. (1995a). *Environmental and Hydrologic Setting of the Ozark Plateaus Study Unit, Arkansas, Kansas, Missouri, and Oklahoma*. Retrieved October 2015, from <http://pubs.usgs.gov/wri/wri944022/WRIR94-4022.pdf>
- USGS. (1995b). *Ground Water Atlas of the United States: Surficial Aquifer System*. Retrieved November 5, 2015, from http://pubs.usgs.gov/ha/ha730/ch_f/F-text2.html
- USGS. (1995c). *Ground Water Atlas of the United States: Mississippi Embayment System*. Retrieved November 5, 2015, from http://pubs.usgs.gov/ha/ha730/ch_f/F-text4.html
- USGS. (1995d). *Ground Water Atlas of the United States: Ozark Plateaus Aquifer System*. Retrieved November 5, 2015, from http://pubs.usgs.gov/ha/ha730/ch_f/F-text6.html
- USGS. (1995e). *Ground Water Atlas of the United States: Edwards-Trinity Aquifer System*. Retrieved November 5, 2015, from http://pubs.usgs.gov/ha/ha730/ch_e/E-text8.html
- USGS. (1995f). *Ground Water Atlas of the United States: Cretaceous Aquifers*. Retrieved November 5, 2015, from http://pubs.usgs.gov/ha/ha730/ch_f/F-text5.html
- USGS. (1999). *How Ground Water Occurs*. Retrieved February 12, 2013, from U.S. Geological Survey General Interest Publication: http://pubs.usgs.gov/gip/gw/how_a.html
- USGS. (2000). *Land Subsidence in the United States (Fact Sheet 165-00)*. Retrieved September 2013, from <http://water.usgs.gov/ogw/pubs/fs00165/SubsidenceFS.v7.PDF>
- USGS. (2001). *Elevations and Distances in the United States*. Retrieved from Online Edition: <http://pubs.usgs.gov/gip/Elevations-Distances/elvadist.html>
- USGS. (2003a). *A Tapestry of Time and Terrain: The Union of Two Maps, Geology and Topography*. Retrieved September 2013, from <http://pubs.usgs.gov/imap/i2720/>

- USGS. (2003b). *National Landslide Hazards Mitigation Strategy – A Framework for Loss Reduction*. Retrieved September 2013, from <http://pubs.usgs.gov/circ/c1244/c1244.pdf>
- USGS. (2005). *Atlas of Water Resources in the Black Hills Area, South Dakota*. Retrieved August 2015, from <http://pubs.usgs.gov/ha/ha747/>
- USGS. (2010). *What is "Peak Acceleration" or "Peak Ground Acceleration" (PGA)?* Retrieved April 2015, from <http://geohazards.usgs.gov/deaggint/2002/documentation/parm.php>
- USGS. (2012a). *Earthquake Glossary - Earthquake*. Retrieved July 2015, from <http://earthquake.usgs.gov/learn/glossary/?term=earthquake>
- USGS. (2012b). *Historic Earthquakes -- New Madrid 1811-1812 Earthquakes*. Retrieved October 2015, from <http://earthquake.usgs.gov/earthquakes/states/events/1811-1812.php>
- USGS. (2012d). *Earthquake Glossary -- Liquefaction*. Retrieved October 2015, from <http://earthquake.usgs.gov/learn/glossary/?term=liquefaction>
- USGS. (2013a, June 17). *Water Basics Glossary*. Retrieved February 2016, from http://water.usgs.gov/water-basics_glossary.html
- USGS. (2013b). *Glossary of Glacier Terminology*. Retrieved August 2015, from <http://pubs.usgs.gov/of/2004/1216/text.html#tz>
- USGS. (2013c). *Land Subsidence from Ground-water Pumping*. Retrieved September 2013, from <http://geochange.er.usgs.gov/sw/changes/anthropogenic/subside/>
- USGS. (2014a). *Geologic Provinces of the United States: Ouachita-Ozark Interior Highlands*. Retrieved October 2015, from <http://geomaps.wr.usgs.gov/parks/province/inthigh.html>
- USGS. (2014b). *Sedimentary Rocks*. Retrieved July 2015, from <http://geomaps.wr.usgs.gov/parks/rxmin/rock2.html>
- USGS. (2014c). *Historic Earthquakes*. Retrieved October 2015, from http://earthquake.usgs.gov/earthquakes/states/events/1811-1812.php#december_16
- USGS. (2014d). *Measuring the Size of an Earthquake*. Retrieved July 2015, from <http://earthquake.usgs.gov/learn/topics/measure.php>
- USGS. (2014e, November). *Water Resources of the United States*. Retrieved July 2015, from <http://www.usgs.gov/water/>
- USGS. (2014f). *National Atlas of the United States*. Retrieved October 2015, from http://nationalmap.gov/small_scale/printable/fedlands.html
- USGS. (2014g). *The National Map*. Retrieved September 2015, from http://nationalmap.gov/small_scale/printable/fedlands.html#va
- USGS. (2015a). *Spiny softshell (Apalone spinifera) -- fact sheet*. Retrieved from <http://nas.er.usgs.gov/queries/factsheet.aspx?SpeciesID=1274>
- USGS. (2015b). *Water Science Glossary of Terms*. Retrieved June 2015, from <http://water.usgs.gov/edu/dictionary.html#B>
- USGS. (2015c). *Paleontology*. Retrieved July 2015, from <http://www.usgs.gov/science/science.php?term=861>
- USGS. (2015d). *Groundwater Atlas of the United States - Arkansas, Louisiana, Mississippi*. Retrieved October 2015, from http://pubs.usgs.gov/ha/ha730/ch_f/F-text1.html
- USGS. (2015e). *Geologic Glossary*. Retrieved November 2015, from <http://geomaps.wr.usgs.gov/parks/misc/glossarya.html>
- USGS. (2015f). *Structural Geology*. Retrieved July 2015, from <http://www2.usgs.gov/science/science.php?thcode=2&code=1117>
- USGS. (2015g). *About U.S. Volcanoes*. Retrieved August 2015, from <http://volcanoes.usgs.gov/about/volcanoes/>

- USGS. (2016a). *Mineral Commodity Summaries*. Retrieved from <http://minerals.usgs.gov/minerals/pubs/mcs/>
- USGS. (2016c). *Physical Agents of Land Loss: Relative Sea Level*. Retrieved from An Overview of Coastal Land Loss: With Emphasis on the Southeastern United States: <http://pubs.usgs.gov/of/2003/of03-337/sealevel.html>
- USGS. (2016d). *2012-2013 Minerals Yearbook Arkansas*. Retrieved November 2015, from https://minerals.usgs.gov/minerals/pubs/state/2012_13/myb2-2012_13-ar.pdf
- USGS. (2017, February 21). *Gap Analysis Program (GAP), National Land Cover, Version 2*. Retrieved October 2015, from Land Cover Data and Modeling: <http://gapanalysis.usgs.gov/gaplandcover/data/>
- UVA Weldon Cooper Center. (2015). *University of Virginia Weldon Cooper Center for Public Service, National Population Projections, 2020-2040*. Projections for the 50 States and D.C., one-click download of all files, file USProjections_2020to2040_all_data_udpated_noshapefile.zip. Retrieved March 2015, from <http://www.coopercenter.org/demographics/national-population-projections>
- Vaughn, P. W. (1997). *Winged Mapleleaf Mussel Recovery Plan*. Retrieved from http://ecos.fws.gov/docs/recovery_plan/970625.pdf
- Waters, M. R., Stafford, T. W., Redmond, B. G., & Tankersley, K. B. (2009). *The Age of the Paleoindian Assemblage at Sheriden Cave, Ohio*. Retrieved November 2015, from <http://www.jstor.org/stable/25470540>
- Wilderness.net. (2015). *List Wilderness Areas by Location*. Retrieved October 26, 2015, from <http://www.wilderness.net/NWPS/stateView?state=AR>
- World Atlas. (2015, September 29). *Arkansas*. Retrieved October 27, 2015, from <http://www.worldatlas.com/webimage/countrys/namerica/usstates/ar.htm#page>
- World Wildlife Fund. (2015). *What is an ecoregion?* Retrieved from http://wwf.panda.org/about_our_earth/ecoregions/about/what_is_an_ecoregion/
- WSR. (2017). *National Wild and Scenic Rivers*. Retrieved from <https://www.rivers.gov/>
- Wyde, M. (2016, June 8). *National Toxicology Program Finds Cell Phone Radiation Causes Cancer*.

GIS REFERENCES

- BIA. (2003, December). Cultural Resources: Approximate Historic Boundaries of Tribes. (GIS Metadata) Retrieved August 2015, from <http://sagemap.wr.usgs.gov/ftp/regional/ind3.html> and <http://www.arcgis.com/home/item.html?id=2e915ef3df48422283e5b2c7d89dfcba>
- BLS. (2015). Socioeconomics: Unemployment. (GIS Metadata) Retrieved August 2015, from Local Area Unemployment Statistics, Employment status of the civilian noninstitutional population, 1976 to 2014 annual averages. State Data, Annual Average Series, Employment status of the civilian noninstitutional population, annual averages.: <http://www.bls.gov/lau/rdsnpl6.htm>
- Digital Aeronautical Flight Information File. (2015, June). Land Use, Recreation, and Airspace: MTR Airspace. (GIS Metadata) Retrieved June 2015, from National Geospatial-Intelligence Agency: [https://pki.geo.nga.mil/servlet/ShowHomepage?menu=Products and Services](https://pki.geo.nga.mil/servlet/ShowHomepage?menu=Products%20and%20Services)

- Digital Aeronautical Flight Information File. (2015, June). Land Use, Recreation, and Airspace: SUA Airspace. (GIS Metadata) Retrieved June 2015, from National Geospatial-Intelligence Agency: <https://pki.geo.nga.mil/servlet/ShowHomepage?menu=Products and Services>
- Environmental Systems Research Institute (ESRI). (2016). All Maps. (GIS Metadata) Retrieved August 2015, from http://www.arcgis.com/home/group.html?owner=esri&title=ESRI%20Data%20%26%20Maps&content=all&_ga=1.174384612.712313298.1421186728&q=rivers&t=group&start=1
- FAA. (2015, June). Infrastructure: Transportation. (GIS Metadata) Retrieved June 2015, from Airport hubs data. Data is updated every 8 weeks. Data downloaded by state: http://www.faa.gov/airports/airport_safety/airportdata_5010/
- FAA. (2015, June). Land Use, Recreation, and Airspace: Composite Airspace. (GIS Metadata) Retrieved June 2015, from Data is updated every 8 weeks: http://www.faa.gov/airports/airport_safety/airportdata_5010/
- FAA. (2015, June). Land Use, Recreation, and Airspace: Private Airspace. (GIS Metadata) Retrieved June 2015, from Data is updated every 8 weeks. : http://www.faa.gov/airports/airport_safety/airportdata_5010/
- FAA. (2015, June). Land Use, Recreation, and Airspace: Public Airspace. (GIS Metadata) Retrieved June 2015, from Data is updated every 8 weeks.: http://www.faa.gov/airports/airport_safety/airportdata_5010/
- FCC. (2014, June). Infrastructure: FCC Towers. (GIS Metadata) Retrieved August 2015, from Data was obtained through a more advanced search by BAH being in direct touch with Cavell, Mertz & Associates to obtain ALL the relevant data across the country.: <http://wireless2.fcc.gov/UlsApp/AsrSearch/asrAdvancedSearch.jsp>
- FCC. (2014, June). Infrastructure: FCC Wireless. (GIS Metadata) Retrieved August 2015, from David F. LaBranche, P.E. Geospatial Information Officer (GIO) OASD (EI&E) 571-372-6768 at Defense Installations Spatial Data Infrastructure (DISDI): <http://www.broadbandmap.gov/data-download>
- FCC. (2015). Infrastructure: FCC Fiber. (GIS Metadata) Retrieved August 2015, from <http://www.broadbandmap.gov/data-download>
- FHWA. (2015, September 14). Infrastructure: Transportation. (GIS Metadata) Retrieved September 14, 2015, from Byways and National Scenic Trails; Gary A. Jensen; Research Implementation Team Leader; FHWA; 1200 New Jersey Ave, SE Room E76-304: <http://www.fhwa.dot.gov/byways/> https://www.nps.gov/ncrc/programs/nts/nts_trails.html
- FHWA. (2015, August). Visual Resources: Natural Areas. (GIS Metadata) Retrieved August 2015, from National Scenic Byways Program. Data obtained by Gary A. Jensen, Research Implementation Team Leader, Office of Human Environment HEPH-30, Federal Highway Administration, 1200 New Jersey Avenue, SE Room E76-304, Washington, DC 20590, 202-366-2048, gary.je: <http://www.fhwa.dot.gov/byways/>
- National Atlas and Interagency Wild and Scenic Rivers Coordinating Council. (2009). Visual Resources: Natural Areas. (GIS Metadata) Retrieved September 2015, from NPS: <https://www.rivers.gov/mapping-gis.php>
- National Atlas and Interagency Wild and Scenic Rivers Coordinating Council. (2009). Water Resources: Surface Water / Watershed. (GIS Metadata) Retrieved September 2015, from

- National Wild and Scenic Rivers Program, NPS, Department of Interior:
<https://www.rivers.gov/mapping-gis.php>
- National Audubon Society. (2015). Biological Resources: Important Bird Areas. (GIS Metadata) Retrieved September 2015, from Web service, data is not saved locally:
http://gis.audubon.org/arcgisweb/rest/services/NAS/ImportantBirdAreas_Poly/MapServer
- National Conference of State Legislatures. (2010). Cultural Resources: Approximate Historic Boundaries of Tribes. (GIS Metadata) Retrieved August 2016, from
<http://www.ncsl.org/research/state-tribal-institute/list-of-federal-and-state-recognized-tribes.aspx#federal>
- National Heritage Areas Program Office. (2011). Visual Resources: Representative Sample of Some Historic and Cultural Resources that May be Visually Sensitive. (GIS Metadata) Retrieved August 2015, from Department of Interior, National Parks Service, National Heritage Areas Program Office: <https://www.nps.gov/heritageareas/>
- Native Languages of the Americas. (2015). Cultural Resources: Approximate Historic Boundaries of Tribes. (GIS Metadata) Retrieved August 2015, from <http://www.native-languages.org/states.htm>
- NPS. (2011). Air Quality: Class 1 Areas. (GIS Metadata) Retrieved August 2015, from
<http://science.nature.nps.gov/im/gis/index.cfm>
- NPS. (2015). Land Use, Recreation, and Airspace: Recreation. (GIS Metadata) Retrieved September 2015, from United States Park, NPS, Department of Interior:
<http://www.arcgis.com/home/item.html?id=578968f975774d3fab79fe56c8c90941>
- NPS. (2015, August). Visual Resources: Cultural Heritage. (GIS Metadata) Retrieved September 2015, from United States Park, NPS, Department of Interior [US Parks]:
<http://www.arcgis.com/home/item.html?id=578968f975774d3fab79fe56c8c90941>
- NPS. (2015, August). Visual Resources: Cultural Heritage. (GIS Metadata) Retrieved September 2015, from United States Park, NPS, Department of Interior [National Monuments and Icons]:
http://mapservices.nps.gov/arcgis/rest/services/cultural_resources/nhl_public/MapServer
- NPS. (2015, August). Visual Resources: Natural Areas. (GIS Metadata) Retrieved September 2015, from United States Park, National Parks Service, Department of Interior [National Scenic and Historic trails]: https://www.nps.gov/ncrc/programs/nts/nts_trails.html
- NPS. (2015, August). Visual Resources: Natural Areas. (GIS Metadata) Retrieved September 2015, from United States Park, NPS, Department of Interior [US Parks]:
<http://www.arcgis.com/home/item.html?id=578968f975774d3fab79fe56c8c90941>
- NRCS. (2006). Soils: Soil Suborders. (GIS Metadata) Retrieved April 2015, from Downloaded by state-level: <https://gdg.sc.egov.usda.gov/>
- NRHP. (2015). Cultural Resources: National Heritage. (GIS Metadata) Retrieved August 2015, from Stutts M. 2014. NRHP. National Register properties are located throughout the U.S. and their associated territories around the globe.:
<https://irma.nps.gov/DataStore/Reference/Profile/2210280>
- U.S. Census Bureau. (2015c). Environmental Justice. (GIS Metadata) Retrieved July 2015, from U.S. Environmental Protection Agency. "EJSCREEN Environmental Justice Mapping and Screening Tool: EJSCREEN Technical Documentation.":
<http://www2.epa.gov/ejscreen/technical-documentation-ejscreen>

- U.S. Census Bureau. (2015f, April). Socioeconomics: Population Distribution. (GIS Metadata) Retrieved August 2015, from American Community Survey and Puerto Rico Community Survey 2013 Subject Definitions. 2013_ACSSubjectDefinitions:
http://www2.census.gov/programs-surveys/acs/tech_docs/subject_definitions/2013_ACSSubjectDefinitions.pdf
- U.S. Census Bureau. (2015j). Socioeconomics: Median Household Income. (GIS Metadata) Retrieved August 2015, from American Community Survey, 2009-2013 5-Year Summary File, Table B02001, Race. Obtained via Census Bureau online DataFerrett tool.: <http://www.census.gov/geo/maps-data/data/tiger-data.html>
- U.S. Census Bureau. (Undated(a)). Environmental Justice. (GIS Metadata) Retrieved August 2015, from "2010 Census Urban and Rural Classification and Urban Area Criteria." Lists of 2010 Census Urban Areas: A national, state-sorted list of all 2010 urbanized areas and urban clusters for the U.S., Puerto Rico, and Island Areas:
<http://www.census.gov/geo/maps-data/data/tiger-data.html>
- U.S. Census Bureau. (Undated(a)). Socioeconomics: Median Household Income. (GIS Metadata) Retrieved August 2015, from "2010 Census Urban and Rural Classification and Urban Area Criteria." Lists of 2010 Census Urban Areas: A national, state-sorted list of all 2010 urbanized areas and urban clusters for the U.S., Puerto Rico, and Island Areas:
<http://www.census.gov/geo/maps-data/data/tiger-data.html>
- U.S. Census Bureau. (Undated(a)). Socioeconomics: Population Distribution. (GIS Metadata) Retrieved August 2015, from "2010 Census Urban and Rural Classification and Urban Area Criteria." Lists of 2010 Census Urban Areas: A national, state-sorted list of all 2010 urbanized areas and urban clusters for the U.S. first sorted by state FIPS code, then USACE code.: <http://www.census.gov/geo/maps-data/data/tiger-data.html>
- U.S. Census Bureau. (Undated(a)). Socioeconomics: Unemployment. (GIS Metadata) Retrieved August 2015, from "2010 Census Urban and Rural Classification and Urban Area Criteria." Lists of 2010 Census Urban Areas: A national, state-sorted list of all 2010 urbanized areas and urban clusters for the U.S. first sorted by state FIPS code then by USACE code.: <http://www.census.gov/geo/maps-data/data/tiger-data.html>
- U.S. DOT Bureau of Transportation Statistics National Transportation Atlas Database. (2015). Infrastructure: Transportation. (GIS Metadata) Retrieved August 2015, from Railroads, Major Highways data:
http://www.rita.dot.gov/bts/sites/rita.dot.gov/bts/files/publications/national_transportation_atlas_database/2015/polyline
- United States National Atlas. (2014). Land Use, Recreation, and Airspace: Recreation. (GIS Metadata) Retrieved September 2015, from http://nationalmap.gov/small_scale/
- United States National Atlas. (2014). Visual Resources: Natural Areas. (GIS Metadata) Retrieved September 2015, from http://nationalmap.gov/small_scale/
- USACE. (2015, March 17). Infrastructure: Transportation. (GIS Metadata) Retrieved August 2015, from Port Data. Has since been updated:
<http://www.navigationdatacenter.us/gis/gis1.htm>
- USEPA. (2013). Biological Resources: Ecoregions. (GIS Metadata) Retrieved August 2015, from Level III and IV ecoregions of the continental United States. National Health and Environmental Effects Research Laboratory, Corvallis, Oregon, Map scale 1:3,000,000:
http://www.epa.gov/wed/pages/ecoregions/level_iii_iv.htm

- USEPA. (2014). Water Resources: Impaired Water. (GIS Metadata) Retrieved August 2015, from <https://www.epa.gov/waterdata/waters-geospatial-data-downloads>
- USEPA. (2015). Human Health and Safety: TRI. (GIS Metadata) Retrieved September 2015, from Web service, data is not saved locally:
<https://map11.epa.gov/arcgis/rest/services/NEPAssist/NEPAVELayersPublic>
- USEPA. (2015b, April 21). Air Quality: Nonattainment Areas. (GIS Metadata) Retrieved August 2015, from The Green Book Nonattainment Areas for Criteria Pollutants:
https://www3.epa.gov/airquality/greenbook/gis_download.html
- USFWS. (2014). Wetlands. (GIS Metadata) Retrieved August 2015, from State level data layer:
<https://www.fws.gov/wetlands/Data/Data-Download.html>
- USFWS. (2015). Biological Resources: Critical Habitat. (GIS Metadata) Retrieved September 2015, from <https://www.fws.gov/gis/data/national/>
- USFWS. (2015, December 4). Land Use, Recreation, and Airspace: Recreation. (GIS Metadata) Retrieved September 2015, from National Wildlife Refuge Boundaries:
<http://www.arcgis.com/home/item.html?id=7b90f9c5e8044d189a5764758ce3775e>
- USFWS. (2015, December 14). Visual Resources: Natural Areas. (GIS Metadata) Retrieved September 2015, from USFWS National Wildlife Refuge System, Realty Division:
<http://www.arcgis.com/home/item.html?id=7b90f9c5e8044d189a5764758ce3775e>
- USGS. (1999 to 2001). Visual Resources: Land Cover. (GIS Metadata) Retrieved August 2015, from USGS GAP Analysis Land Cover, National Land Cover Dataset; Landsat 7 ETM+; Imagery provided for Spring, Summer and Fall dates between 1999 and 2001:
<http://gapanalysis.usgs.gov/gaplandcover/data/download/>
- USGS. (2003, October). Water Resources: Groundwater. (GIS Metadata) Retrieved August 2015, from <http://water.usgs.gov/ogw/aquifer/map.html>
- USGS. (2010). Geology: Surface Geology. (GIS Metadata) Retrieved April 2015, from <http://www.arcgis.com/home/item.html?id=2967ae2d1be14a8bf5888b4ac75a01f>
- USGS. (2012). Cultural Resources: Physiographic Provinces. (GIS Metadata) Retrieved April 2015, from Physiographic provinces and regions are made from the same dataset; downloaded by state-level:
http://services.arcgis.com/ZzrwjTRez6FJiOq4/arcgis/rest/services/US_PhysiographicProvinces/FeatureServer
- USGS. (2012). Geology: Landslide Incidence. (GIS Metadata) Retrieved May 2015, from Web service, data is not saved locally:
<https://www.arcgis.com/home/item.html?id=b3fa4e3c494040b491485dbb7d038c8a>
- USGS. (2013). Geology: Karst Subsidence. (GIS Metadata) Retrieved May 2015, from Two data layers within the same source show different varieties of Karst, and were published on different dates:
http://services.arcgis.com/hoKRg7d6zCP8hwp2/arcgis/rest/services/Appalachian_Karst_Features/FeatureServer
- USGS. (2014). Geology: Seismic Hazard. (GIS Metadata) Retrieved April 2015, from http://services.arcgis.com/VTyQ9soqVukalltT/arcgis/rest/services/USPGA_Seismic_Hazard/FeatureServer
- USGS, Protected Areas of the United States. (2012, 11 30). Land Use, Recreation, and Airspace: Land Ownership. (GIS Metadata) Retrieved August 2015, from Data was updated in 5/5/2016. Maps were completed in December 2015 prior to this update:
<http://gapanalysis.usgs.gov/padus/data/download/>

- USGS, Protected Areas of the United States. (2012, November 30). Land Use, Recreation, and Airspace: Recreation. (GIS Metadata) Retrieved September 2015, from Data was updated in 5/5/2016. Maps were completed in December 2015 prior to this update.:
<http://gapanalysis.usgs.gov/padus/data/download/>
- USGS, Protected Areas of the United States. (2012, November 30). Visual Resources: Cultural Heritage. (GIS Metadata) Retrieved September 2015, from Data was updated in 5/5/2016. Maps were completed in December 2015 prior to this update.:
<http://gapanalysis.usgs.gov/padus/data/download/>
- USGS, Protected Areas of the United States. (2012, November 30). Visual Resources: Natural Areas. (GIS Metadata) Retrieved September 2015, from Data was updated in 5/5/2016. Maps were completed in December 2015 prior to this update. :
<http://gapanalysis.usgs.gov/padus/data/download/>

